
Introduction to LaserWriter Service

Version 2.0



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Introduction



Welcome

Welcome to the *Introduction to LaserWriter Service* course. This course is your first step to becoming an Apple®-certified LaserWriter® service technician. This course introduces you to Apple LaserWriter printers and to the skills and knowledge you need to service them.

About This Course

This course was designed with flexibility in mind. Mac®OS-based computers can access and use the files on the CD. Additionally, you can print out the course on paper (except for the QuickTime® animated sequences) and complete the modules away from the computer.

The course has been designed in a linear sequence. Each module in the course builds on the previous modules. The best order in which to complete the course, therefore, is to start with the first module and continue through to the end. (It's perfectly OK to browse around, though, and check back on topics already completed. The navigational features of Adobe™ Acrobat™ Reader make browsing and searching through the course manual quite easy.)

There are practice exercises throughout the course. Some involve hands-on activity. You will learn the most from this course by completing all the activities.

Introduction



Navigation Tips

The Adobe Acrobat Reader program provides many options for displaying, navigating, and searching documents. Consult the Acrobat Reader Help file for complete details and instructions. Here are the toolbar controls you will use most:

The *Introduction to LaserWriter Service* course manual contains both bookmarks and thumbnails. The toolbar buttons shown in Figure 1-1 allow you to switch between these three views:

- **Page Only:** Provides the widest viewing area possible.
- **Bookmarks and Page:** Bookmarks allow you to navigate quickly to a particular page. Click a bookmark name to go to the topic marked by that bookmark. Click the triangle to the left of a bookmark to show and hide subordinate bookmarks. Adjust the width of the bookmark pane by dragging the divider left or right.
- **Thumbnails and Page:** Thumbnails provide a visual indication of what each page contains without having to flip through each page. Viewing thumbnails can be useful for locating a particular graphic. Click a thumbnail to go to the page marked by that thumbnail. Adjust the width of the thumbnail pane by dragging the divider left or right.



Figure 1-1
The Page Only, Bookmarks and Page, and Thumbnails and Page buttons.

Introduction



Figure 1-2 shows the Previous Page, Next Page, and Hand Tool. The Previous Page and Next Page buttons provide a way of navigating from page to page that may be easier for you to use than the standard vertical scrollbar. The Hand Tool is a handy alternative to the standard horizontal and vertical scrollbars for scrolling within a single page.



Figure 1-2
Previous Page and Next Page buttons, and the Hand Tool.

Figure 1-3 shows the three buttons used to control how a page is scaled within the window.

- **Actual Size:** Click the Actual Size button to display the page at 100 %.
- **Fit Page:** Click the Fit Page button to scale the page to fit within the window.
- **Fit Width:** Click the Fit Width button to scale the page to fill the width of the window.



Figure 1-3
Actual Size, Fit Page, and Fit Width buttons.

Introduction



The Find button is shown in Figure 1-4. Click the Find button to search for part of a word, a complete word, or multiple words in a document.



Figure 1-4
Find button.

Printing Tips

You may wish to view the course manual on computer and print out just the practice exercises (which require paper and pencil). For your convenience, Appendix B is a collection of all the practice exercises found throughout the course manual. To print all the practice exercises, simply print Appendix B (pages 142-166).

Another option is to use the entire course manual in printed form. If so, print out pages 1-141, which includes everything except Appendix B. Note that the QuickTime movies will not be available since they cannot be printed on paper.

QuickTime Movies

The course manual includes QuickTime movies. The movies are embedded throughout the manual, making for a smooth integration with the rest of the course material. If you would like to play the movies separately, you will find them in a folder named MOVIES on the CD. Play the movies using the QuickTime MoviePlayer utility. The MoviePlayer utility is provided on the CD.

Introduction



Equipment and Materials

In order to complete this course and all of its activities, you will need the following equipment and materials:

- A LaserWriter printer that can be networked
- Owner's manual for the LaserWriter printer
- Toner cartridge, paper, and cables as specified by the owner's manual
- MacOS-based computer with CD-ROM drive, capable of running QuickTime 2.0 or greater and Adobe Acrobat Reader 2.1. The monitor should display at least 256 colors.
- Apple Service documentation, including *Service Source* CD, *Apple Service Guides*, and access to Service Source Online on the World Wide Web.

Begin the first module of the course—"Features"—on the next page.

Overview



Apple LaserWriter service technicians answer user questions, perform upgrades, and troubleshoot hardware- and software-related LaserWriter printer problems. To perform these tasks, you need to know the features and capabilities of Apple LaserWriter printers so you can efficiently service and support them.

Objectives

Upon completion of this module you should be able to:

- Locate and retrieve information regarding LaserWriter printers in Apple references
- Identify the ports found on LaserWriter printers
- Classify a given printer connection as network, direct serial, parallel, or SCSI
- Define common LaserWriter features
- Name common accessories and upgrades available for LaserWriter printers

Module Organization

This module has four sections:

- “Information Sources” provides a refresher on the availability and use of Apple service references.
- “Printer Connections” illustrates and defines the various methods available for connecting to and communicating with a LaserWriter.
- “Features” defines commonly found LaserWriter features.
- “Accessories and Upgrades” describes LaserWriter accessories and upgrades you may have to install and service.

Begin the first section of the module—“Information Sources”—on the next page.

Information Sources



Apple offers several sources of information to help you service and support LaserWriter printers:

- Owner's manuals
- Apple *Service Source* CD
- *Apple Service Guides* for LaserWriter Printers
- Apple Service Source Online World Wide Web site
- Tech Info Library, which can be accessed via either the World Wide Web or the *Service Source Companion* CD

Owner's Manuals

The LaserWriter owner's manuals include the following information:

- Step-by-step set-up instructions for the printer and its accessories
- Features that can be upgraded
- Basic troubleshooting procedures

Owner's manuals are the only reference that users receive; technicians can gauge users' LaserWriter knowledge by becoming familiar with the owner's manual.

Service Source CD

The *Service Source* CD is the most comprehensive service reference for Apple products. *Service Source* is organized by product, and contains detailed information and instructions for performing:

- take-apart
- troubleshooting
- upgrades
- adjustments

A wiring diagram for each printer is also provided.

Service Guides

The *Apple Service Guides* for LaserWriter Printers are condensed booklets of the most commonly referenced material in *Service Source*, including troubleshooting information and wiring diagrams. The small size of the *Apple Service Guides* make them easy to take on-site.

Information Sources



Service Source Online

Service Source Online is a password-protected World Wide Web site available only to Apple Authorized Service Providers. It is located at:

<http://service.info.apple.com/>

(See your current *Service Source* CD for the current password.)

Service Source Online contains late-breaking information on service issues. When a new product is released, the service manual for it will appear here first. And, you can access the Tech Info Library through Service Source Online.

Tech Info Library

The Tech Info Library offers a wealth of information. There are over 10,000 articles in the library on a wide variety of topics ranging from spec sheets to troubleshooting to compatibility. The Tech Info Library can be accessed in two ways. One way to access the Tech Info Library is through the Service Source Online World Wide Web site. This method offers access anywhere you have an Internet connection and a World Wide Web browser. Further, you can be sure the on-line version of the Tech Info Library has the most recent additions to the library. As an alternative, the *Service Source Companion* CD, which is part of the *Service Source* CD subscription, contains a version of the Tech Info Library. The Library is accessed with Adobe Acrobat Reader, features a very fast and accurate search engine, and eliminates the need for an Internet connection.

Note: Apple offers a limited version of the Tech Info Library to the general public on the World Wide Web. Be aware that it does not contain articles of a “service provider only” nature—often the articles you need most. So it is best to access the Tech Info Library through either Service Source Online or the Service Source Companion CD.

Continue with Practice Exercise 1 on the next page.

Practice Exercise 1

**Directions**

Use the indicated information resource to find an answer to each question.

Service Source CD

1. How many settings does the configuration switch have on a LaserWriter 16/600 PS?

2. What type of engine does the LaserWriter 12/640 PS printer use?

Service Guide

1. Which switches must be triggered on a LaserWriter II in order to perform the laser power output check?

2. On a LaserWriter Pro 630, when the self-diagnostic is invoked and no error is found, what pattern do the LEDs exhibit?

Practice Exercise 1



Service Source Online

1. Locate two topics in the Safety section. Record their titles.

2. Locate a "Service Notice" and a "Hot Issue." Record their titles.

Tech Info Library

(Access the library through either Service Source Online or the *Service Source Companion* CD.)

1. A customer is having problems with the fax card on a LaserWriter 16/600 PS. He is unable to set the date and time using the appropriate utility software. A message about needing a password is displayed. What is the problem?

Practice Exercise 1



2. A customer had a jam in the duplexing unit of her LaserWriter 12/640 PS. After she cleared the jammed paper, the jam light stayed on. What is the problem?

When you finish, compare your answers with those on pages 17-19.

Practice Exercise 1 (Answers)



Service Source CD

1. How many settings does the configuration switch have on a LaserWriter 16/600 PS?

There are 2 settings to this switch: in and out. One setting provides the default configuration. The other setting allows the user to custom-configure the printer through software.

(This answer was found in the LaserWriter 16/600 PS manual in the section named Basics under a subtitle named Configuration Switch.)

2. What type of engine does the LaserWriter 12/640 PS printer use?

The LaserWriter 12/640 PS uses the Fuji Xerox® P893 laser-xerographic engine.

(This answer was found in the LaserWriter 12/640 PS manual in the section named Specifications under the subtitle Engine.)

Service Guide

1. Which switches must be triggered on a LaserWriter II in order to perform the laser power output check?

The top cover interlock and the two drum sensitivity switches, SW301 and SW302.

(This answer was found in Volume I of the Service Guide for LaserWriter Printers. Page 55 contains the laser power output check procedure.)

Practice Exercise 1 (Answers)



2. On a LaserWriter Pro 630, when the self-diagnostic is invoked and no error is found, what pattern do the LEDs exhibit?

All LEDs come on.

(This answer was found in Volume II of the Service Guide for LaserWriter Printers. Pages 38-39 contain the printer diagnostic procedure.)

Service Source Online

1. Locate two topics in the Safety section. Record their titles.

Due to the changing nature of Service Source Online it is impossible to provide you with a definitive answer here. However, topics likely to be found in the Safety section are:

- *CRT safety*
- *Electrostatic discharge (ESD) prevention*
- *Safe handling of batteries*

2. Locate a “Service Notice” and a “Hot Issue.” Record their titles.

Again, due to the changing nature of Service Source Online it is impossible to provide you with a definitive answer. However, you’ll know when you have successfully completed this activity.

Practice Exercise 1 (Answers)



Tech Info Library

1. A customer is having problems with the fax card on a LaserWriter 16/600 PS. He is unable to set the date and time using the appropriate utility software. A message about needing a password is displayed. What is the problem?

The printer appears to have had its Adobe Postscript password set, which prevents changes (such as date and time on the fax card). A short Postscript program can be downloaded to the printer to reset passwords to their factory default.

The article describing this problem and its cure can be found with search strings such as:

LaserWriter and fax and password

fax and date

LaserWriter 16/600 and fax and date

2. A customer says that she had a jam in the duplexing unit of her LaserWriter 12/640 PS. After she cleared the jammed paper, the jam light still stayed on. What is the problem?

There may still be a paper fragment in the duplexing unit; there are some areas that are hard to see.

The article describing this problem and its cure can be found with search strings such as:

duplex and jam

LaserWriter 12/640 and light

When you are ready, begin the next section—"Printer Connections."

Printer Connections



You can connect LaserWriter printers to a variety of computers and networks. Different types of LaserWriters have different sets of ports, allowing for a particular set of connections. Recognizing these ports tells you a lot about a particular printer's connection capabilities.

A given port may be capable of processing printjobs in several different formats. Three common formats are:

- Postscript®
- HP Printer Control Language (PCL™)
- QuickDraw™

These formats are sometimes referred to as “page description languages.” You'll learn more about page description languages in the Theory of Operations chapter.

Ethernet

An Ethernet port provides a network connection, processing both Postscript and PCL printjobs. A single Ethernet cable can simultaneously carry a number of network protocols, including:

- AppleTalk® (called EtherTalk® when it is on an Ethernet network)
- Novell Netware IPX
- TCP/IP

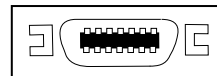


Figure 2-1
An AUI Ethernet port

Printer Connections



LocalTalk

A LocalTalk® port provides a network connection, processing Postscript printjobs. LocalTalk is an implementation of the AppleTalk network protocol. Computers on a LocalTalk network will have access to the printer.

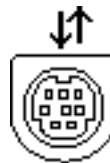


Figure 2-2
A LocalTalk port

Parallel

A parallel port provides a one-to-one direct connection, and can be used to connect a DOS®- or Windows-based computer to a LaserWriter. The port is capable of processing both Postscript and PCL printjobs. One feature of a parallel connection is its high speed.

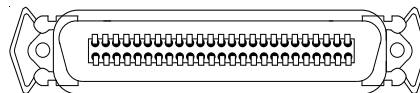


Figure 2-3
A parallel port

Printer Connections



Serial Direct

A serial direct port provides a one-to-one direct connection. Some LaserWriters have only a serial port. These printers process QuickDraw printjobs. Some LaserWriters include a direct serial port along with other ports, providing several connection and communication options. On those printers, the serial port can be used to process Postscript and PCL printjobs.

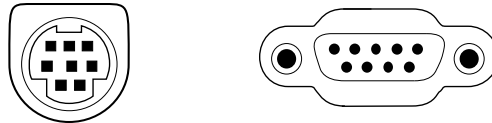


Figure 2-4
Two serial ports: mini-DIN 8 (left) and DB-9 (right)

SCSI

A SCSI port provides a one-to-one direct printer connection, processing QuickDraw printjobs. This SCSI connection follows standard SCSI rules for cable length, device ID, and termination. One feature of a SCSI connection is its high speed.

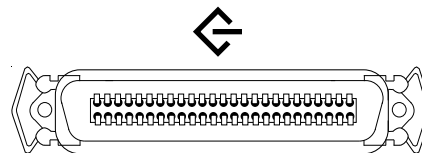


Figure 2-5
A 50-pin SCSI port

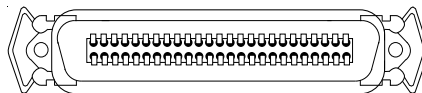


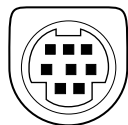
Practice Exercise 2

Directions

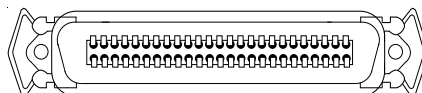
This exercise gives you an opportunity to identify the ports found on LaserWriter printers and the printjobs they are capable of processing. Pictured below are the icons associated with each type of port. Indicate the name of the port, whether it is networkable or direct connect, and the type of printjobs it can process.









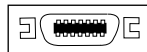


When you finish, compare your answers with those on page 24.

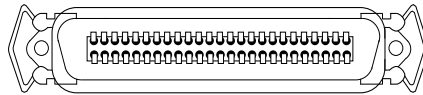
Practice Exercise 2 (Answers)



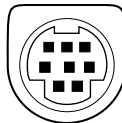
Compare your answers to Practice Exercise 2 with the answers below.



- Ethernet
- network
- processes Postscript, PCL printjobs



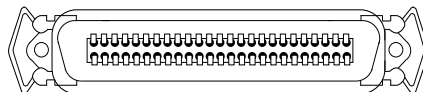
- Parallel
- direct
- processes Postscript, PCL printjobs



- Serial
- direct
- processes QuickDraw printjobs (some models)
- processes Postscript, PCL printjobs (some models)



- LocalTalk
- network
- processes Postscript printjobs



- SCSI
- direct
- processes QuickDraw printjobs

If you missed any items, review "Printer Connections" and correct any incorrect answers before you continue. When you are ready, begin the next section—"Printer Features."

Printer Features



This section presents the LaserWriter features that you need to know in order to set up, upgrade, and troubleshoot Apple LaserWriter printers. You should know the:

- features found on Apple LaserWriters
- functionality they offer

All Ports Active

Some LaserWriter printers have a feature known as “all ports active.” This feature allows connections to all ports at the same time (such as Ethernet, LocalTalk, parallel). The printer scans the ports continuously, awaiting a printjob. When a printjob arrives through any one of the ports it is processed. During this time, no other printjob is accepted—the printer is “busy.” When the printjob is finished, the printer once again scans its ports awaiting the next printjob.

Multiple Protocols Over Ethernet

Some LaserWriters with an Ethernet port have the ability to communicate using any of several protocols:

- AppleTalk (EtherTalk)
- Novell Netware
- TCP/IP

These protocols can all be active at the same time. When a printjob arrives, the LaserWriter can determine which protocol is being used and communicate appropriately.

Automatic Language Sensing

Automatic language sensing allows the printer to determine which page description language—PostScript or PCL—is required by a printjob.

Printer Features



Desktop Printing

Desktop printing software allows the computer to create printer icons (or “desktop printers”) on the desktop. In addition to the traditional print process, you can also print a document by simply dragging its icon onto a desktop printer icon. Desktop printers also give more control over printing, including setting printing priorities, choosing specific print times, and printing to multiple printers at the same time. Desktop printers are created by choosing a printer through the Chooser. There is always one desktop printer that serves as the default, though any desktop printer can be made the default. Desktop printing can be temporarily turned off or completely removed.

Hard Drive

Some LaserWriters have a hard drive attached. In some cases, a hard drive is mounted externally as a SCSI device on a separate SCSI bus provided by the printer. On other models, the hard drive may be mounted inside the printer. In both cases, the hard drive is used for the same things: font storage and faxing. Fonts can be downloaded with a printer utility to the printer’s hard drive for use with all subsequent printjobs. This frees up printer RAM for processing printjobs and speeds printing. When the printer also has PostScript fax capability, the hard drive is used for temporary storage of faxes when printer memory becomes full. All formatting and management of the hard drive is done with printer utility software. The LaserWriter’s hard drive does not show up on the desktop.

Fax Capability

Some LaserWriters have PostScript fax capability. With PostScript faxing, users can send and receive faxes with traditional fax machines, computers with fax cards, and with other PostScript fax-capable printers. A networked LaserWriter with a PostScript fax card is available to anyone on the network and therefore is a multi-user fax solution. Fax cards will typically come with utility software for configuring the card. Also note that fax cards sometimes require a specific version of LaserWriter printer driver software in order to work properly.

Printer Features

**GrayShare**

GrayShare® software is printer driver software that provides grayscale printing and printer sharing (PrinterShare). GrayShare is used by direct-connect, QuickDraw-based LaserWriters. The computer acts as the host, making the printer connected to it available on the network. Once the printer has been configured through the Chooser and shared on the network, it appears to network users as a shared printer. Printjobs sent to the printer are actually sent to the host computer. The computer then processes the printjob. While this technology allows a direct connect printer to be shared on a network, it also slows the host computer while it processes a printjob and sends it to the printer.

Duplex Printing

With a duplex printing unit, you can print on both sides of the paper (often called “duplex printing” or “two-sided printing”). The LaserWriter does the work of flipping the paper for printing on both sides of the page.

PhotoGrade

PhotoGrade enhances the look of printed images, such as scanned photographs, by providing more shades of gray and better printed clarity and contrast. The enhancement is achieved through a combination of smaller dots on the page and smaller halftone cells, thereby providing finer detail. PhotoGrade requires additional printer memory. Due to memory constraints, there are times when a printjob cannot be processed with PhotoGrade turned on. The solution is to add more physical RAM to the printer or turn off PhotoGrade. PhotoGrade configuration is managed through the printer utility software.

FinePrint

FinePrint™ provides smoother, less jagged printing of text characters. It is an option that is set to either on or off. FinePrint configuration is managed through the printer utility software.

Energy Star

Energy Star is a designation given by the U.S. Environmental Protection Agency to printers, monitors, and other devices that are designed for low-power consumption. LaserWriter printers that are Energy Star compliant will go into a low-power state when not in use. The printer may appear to be off or “asleep,” but it is monitoring its printer ports, awaiting a printjob. When a printjob arrives, the LaserWriter comes to life and begins printing.

Continue with Practice Exercise 3 on the next page.

Practice Exercise 3



Directions

This exercise gives you an opportunity to test your knowledge of LaserWriter features. Listed below are the LaserWriter features presented in this course. Match each feature with its description.

- | | | |
|-----------|----------------------------------|---|
| 1. _____ | GrayShare | A. Used by the printer for font storage and temporary fax storage |
| 2. _____ | Desktop Printing | B. Detects whether PostScript or PCL is being used |
| 3. _____ | Energy Star | C. Allows direct-connect, QuickDraw-based LaserWriters to be shared over a network |
| 4. _____ | All Ports Active | D. Provides even smoother text on LaserWriters |
| 5. _____ | Fax Capability | E. Allows LaserWriters to send and receive traditional and PostScript faxes; can be used by anyone on the network |
| 6. _____ | Hard Drive | F. Creates desktop printer icons; supports drag and drop printing and multiple printjobs |
| 7. _____ | Multiple Protocols over Ethernet | G. Allows printing on both sides of a page |
| 8. _____ | PhotoGrade | H. Allows a printjob to be sent to any port; the printer scans its ports continuously |
| 9. _____ | Automatic Language Sensing | I. Enhances images printed on LaserWriters |
| 10. _____ | Duplex Printing | J. Provides a standard for low-power consumption devices |
| 11. _____ | FinePrint | K. Allows communication by AppleTalk, Novell Netware, and TCP/IP simultaneously on a single Ethernet port |

Practice Exercise 3 (Answers)



Check your answers. If necessary, review the appropriate section of the module until you are confident you know all the terms and definitions.

- | | |
|--|---|
| 1. <u> C </u> GrayShare | A. Used by the printer for font storage and temporary fax storage |
| 2. <u> F </u> Desktop Printing | B. Detects whether PostScript or PCL is being used |
| 3. <u> J </u> Energy Star | C. Allows direct-connect, QuickDraw-based LaserWriters to be shared over a network |
| 4. <u> H </u> All Ports Active | D. Provides even smoother text on LaserWriters |
| 5. <u> E </u> Fax Capability | E. Allows LaserWriters to send and receive traditional and PostScript faxes; can be used by anyone on the network |
| 6. <u> A </u> Hard Drive | F. Creates desktop printer icons; supports drag and drop printing and multiple printjobs |
| 7. <u> K </u> Multiple Protocols over Ethernet | G. Allows printing on both sides of a page |
| 8. <u> I </u> PhotoGrade | H. Allows a printjob to be sent to any port; the printer scans its ports continuously |
| 9. <u> B </u> Automatic Language Sensing | I. Enhances images printed on LaserWriters |
| 10. <u> G </u> Duplex Printing | J. Provides a standard for low-power consumption devices |
| 11. <u> D </u> FinePrint | K. Allows communication by AppleTalk, Novell Netware, and TCP/IP simultaneously on a single Ethernet port |

When you are ready, begin the next section—"Accessories and Upgrades."

Accessories and Upgrades



One of the tasks you will perform as a service technician is the installation of LaserWriter accessories and upgrades. You must also be able to answer customer questions about these accessories and upgrades and be able to troubleshoot a system that includes them.

Paper Trays and Cassettes

There are a variety of paper trays and cassettes that can be added to LaserWriter printers. Some provide increased capacity; others allow for larger paper sizes such as legal-sized paper. Some hold 250 sheets; others hold as many as 500 sheets. Each comes with installation instructions. The new paper tray or cassette is controlled through printer software as a normal part of the printjob.

Envelope Feeders

For customers printing lots of envelopes, an envelope feeder is an attractive accessory. As with optional paper trays and cassettes, envelope feeders come with installation instructions. Use of this accessory is controlled through printer software as a normal part of the printjob.

Memory

A memory upgrade provides the ability to process more complex printjobs. An upgrade can also speed up a printjob, allowing the entire job to be stored in printer memory rather than be processed in pieces. Memory upgrades sometimes are necessary to use all of a printer's features. For example, PhotoGrade printing with a duplex printing unit may require more memory than the LaserWriter has available. A memory upgrade allows both PhotoGrade and duplex printing to be used together.

LaserWriter memory upgrades are installed much like memory upgrades on Macintosh computers. For each LaserWriter, *Service Source* has information on available upgrades, the type of memory required, and how and where to install the upgrade.

PostScript Fax Card

A PostScript fax card provides the ability to send and receive traditional fax transmissions as well as PostScript faxes. Network users who have access to the printer have the ability to use the fax, making it a multi-user fax solution. Installation instructions can be found in *Service Source*.

Accessories and Upgrades



Hard Drive

Hard drives are used primarily for long-term font storage. They are also used by fax cards as temporary storage should available printer RAM run low. Some LaserWriters allow a hard drive to be installed internally. Others require the hard drive to be external. And some allow a combination. Installation instructions for internal hard drives can be found in *Service Source*.

When configuring hard drives for use with a LaserWriter, there are several things to know. First, some LaserWriter models require the hard drive to be specially formatted for use with the printer. This is accomplished through the use of the printer utility software. Second, the hard drive is used exclusively and privately by the LaserWriter—it will not show up on the Finder desktop. Lastly, external hard drives are connected to the LaserWriter according to traditional SCSI conventions. This is a separate SCSI chain, not associated with the computer's SCSI chain. Remember the rules regarding unique SCSI ID numbering, cable length, and termination. Make sure also that each external hard drive provides its own SCSI termination power.

Duplex Printing Unit

A duplex printing unit provides the automatic ability to print on both sides of a page. The duplex unit does the work of flipping the page over after the first side has been printed and feeding the paper back for printing on the second side. The duplex unit comes with installation instructions. *Service Source* provides troubleshooting information. Duplex printing options are controlled through software as a normal part of the printjob.

Continue with Practice Exercise 4 on the next page.

Practice Exercise 4

**Directions**

This exercise gives you an opportunity to test your knowledge of LaserWriter accessories and upgrades. The section “Accessories and Upgrades” presented six accessories and upgrades. Indicate as many of them as you can remember.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

When you finish, compare your answers with those on page 33.

Practice Exercise 4 (Answers)



Check your answers. If necessary, review the appropriate section of the module until you are confident you can recall the names of all the accessories and upgrades.

1. *Paper trays and cassettes*
2. *Envelope feeders*
3. *Memory*
4. *PostScript fax card*
5. *Hard drive*
6. *Duplex printing unit*

When you are ready, begin the next module—"Setup."

Overview



This module guides you through the process of setting up a LaserWriter printer. The information and skills you learn will help you troubleshoot problems caused by improper set up.

Note: This module deals with networkable LaserWriters. For information and guidance on setting up direct-connect LaserWriter models, see Appendix A.

Objectives

At the conclusion of this module, you will be able to:

- Set up a LaserWriter printer and print a startup test page
- Answer questions about setting up Apple LaserWriter printers

Module Organization

This module has two sections:

- “Prepare the LaserWriter Printer” lists the four major steps for setting up any Apple LaserWriter printer.
- “Network Setup” lists the procedures for connecting a LaserWriter printer to a LocalTalk network. You will practice the setup procedures using the printer owner’s manual, and then complete a written exercise.

Overview



Additional Equipment and Materials

To perform the hands-on practice exercises in this module, you must provide the following equipment and materials:

- Network LaserWriter printer
- Owner's manual for the LaserWriter printer
- Toner cartridge, paper, and cables as specified by the owner's manual
- MacOS-based computer

Do not begin the module until you have the materials in this list.

Begin the first section of the module—"Prepare the LaserWriter"—on the next page.

Prepare the LaserWriter



You must complete four major steps to set up any LaserWriter (the steps are the same for all LaserWriter printers):

- I. Prepare the LaserWriter printer.
- II. Connect the LaserWriter printer.
- III. Install the software.
- IV. Test the connection.

Prepare The Printer

To prepare a LaserWriter printer for setup, perform the procedures below. You must complete the first three in order. You may not need to complete some of the procedures if a LaserWriter printer was moved and set up in a new location.

1. Find a location that meets the space and environmental conditions in the owner's manual.
2. Remove the LaserWriter printer and all other items from the shipping carton.
3. Remove the retainers and cushioning materials from the LaserWriter printer.
4. Install the I/O board (if the I/O board ships separately). Remember to follow ESD safety rules.
5. Install the toner cartridge. Remove the toner tape if the cartridge is new.
6. Load the paper cassette tray with paper and install the tray in the LaserWriter printer.

Some LaserWriter printers may require that you complete one or both of the following additional procedures:

- Install the cleaning pad in the fuser assembly.
- Install the optional paper feeder.

Continue with the next section—"Network Setup"—on the next page.

Network Setup



Connect the LaserWriter

The second and third major steps (“Prepare the LaserWriter” and “Connect the LaserWriter”) differ for each printer and depend on how the LaserWriter printer communicates with the computer. In this module, we use a LocalTalk connection as our example.

As you learned in a previous module, network LaserWriter printers can connect to different types of networks and use different communication protocols. In this section, you will learn to connect a LaserWriter to a LocalTalk network and install the appropriate software. If you do not have access to an existing LocalTalk network, you can network the LaserWriter to a single Macintosh.

To connect the LaserWriter to a LocalTalk network, complete the following procedures:

1. Make sure the computer and the LaserWriter are switched off before connecting them to the network.
2. Connect a LocalTalk connector box to each device. The LaserWriter has one LocalTalk connection, but the computer has two. Use the computer’s printer port if possible.
3. Connect each connector box by using LocalTalk cables.

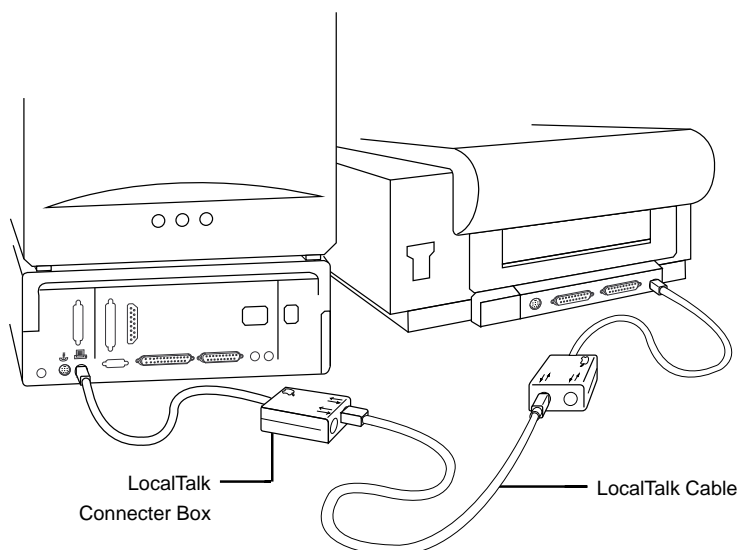


Figure 3-1
The computer-to-LaserWriter LocalTalk connection

Network Setup



4. Set the switches on the back of the LaserWriter to AppleTalk (as required by some LaserWriters). Note that some LaserWriters use a rotary dial, some use DIP switches, and some use a thumbwheel.
5. Connect the power cable to the printer and to the electrical outlet.
6. Switch on the LaserWriter printer.

A startup test page, similar to the one shown in Figure 3-2, prints automatically every time a network laser printer is switched on. (The option to print out a startup test page can be turned off through printer utility software; be aware of this when troubleshooting.)

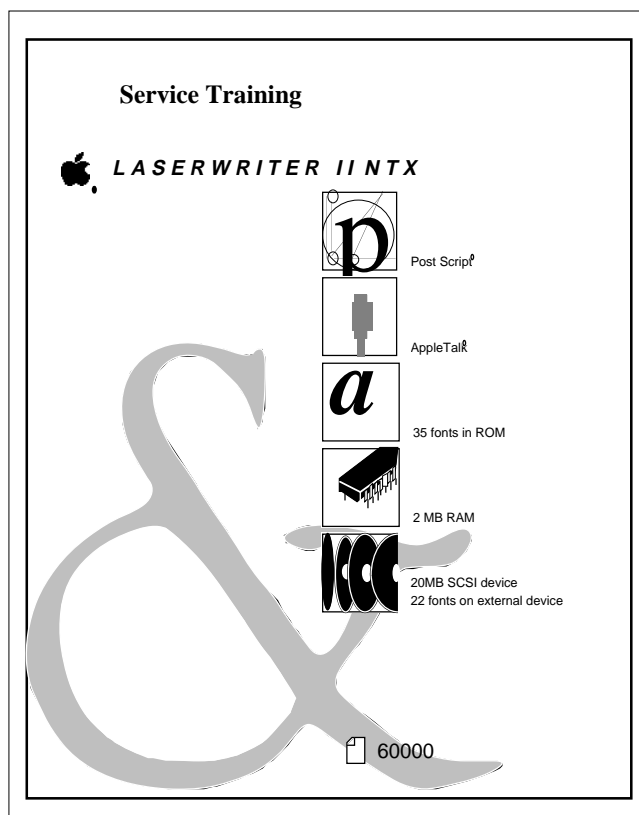


Figure 3-2
A networked LaserWriter startup test page

Network Setup



Install Software

To install the software that network LaserWriter printers require, complete the following procedures:

1. Switch on the computer.
2. Use the Installer utility software that came with the printer to install the network printer driver and fonts.
3. Now you need to tell the computer which port AppleTalk protocols should be routed through. Some MacOS computers use Apple's original networking architecture, now referred to as "Classic AppleTalk." Other MacOS computers use a newer networking architecture known as "Open Transport." Each architecture uses a different set of control panels to manage the computer's network connections.

If the computer uses Open Transport: Open the AppleTalk control panel and select the port (printer port or modem port) through which to route AppleTalk. Continue with step 4.

If the computer uses Classic AppleTalk: Open the Network control panel and select LocalTalk(via the built-in printer port) as the connection method. Continue with step 4.

4. Open the Chooser and complete these steps to select a printer:
 - a. Click the AppleTalk Active button if it is not already selected. (The button may state "Active on Restart." If so, you will need to restart the computer for AppleTalk to be active.)
 - b. Select the LaserWriter icon for your LaserWriter printer.
 - c. Click the name of the printer you wish to use from the list of LaserWriter printer names that appear.
 - d. Click the button named "Create" (or "Setup") to allow the system to select the proper PostScript Printer Description (PPD) file for the LaserWriter to which you are connecting.
 - e. Close the Chooser.

Network Setup



5. Use the LaserWriter printer utility software to name the LaserWriter printer. If more than one LaserWriter printer is connected to the network, give each printer a different name.

Test the Connection

1. Open a window in the Finder. This action provides you with something to print.
2. Choose **Print Window...** from the File menu.

When the necessary software is installed and a normal-looking page prints, the LaserWriter printer is set up and ready to use.

Continue with Practice Exercise 1 on the next page.

Practice Exercise 1



Directions

In this exercise, you will practice setting up a LaserWriter and MacOS-based computer on a LocalTalk network. Before you begin, gather the following equipment and materials:

- MacOS-based computer
- Network LaserWriter
- LaserWriter toner cartridge
- Paper
- LaserWriter owner's manual
- All necessary cables (as specified in the owner's manual)
- LaserWriter Installer disks (as specified by the owner's manual)

To complete this exercise, do the following:

1. Locate the owner's manual. The owner's manual lists step-by-step procedures for setting up a LaserWriter printer on a network. For each of the following steps, read and perform the procedures in the owner's manual.
2. Prepare the LaserWriter printer.
3. Connect the LaserWriter printer. If you have a LocalTalk network, connect the LaserWriter to the network. If you do not have a LocalTalk network, network a single computer to the LaserWriter printer.
4. Install the software.
5. Print a window. From the Finder desktop, open any window and choose **Print Window...** from the File menu. Be sure you first select the proper printer driver and printer name in the Chooser.

When you have printed a page, you have completed this exercise. If you have problems, refer to the Troubleshooting section of the owner's manual.

Continue with Exercise 2 on the next page

Practice Exercise 2



Directions

Assume you are setting up a single MacOS-based computer and a networked LaserWriter using LocalTalk. Check each statement that describes how to set up the computer and LaserWriter printer.

- _____ Select a location for the LaserWriter printer and remove all hardware, software, and materials from the shipping carton.
- _____ Remove retainers and cushioning materials from the LaserWriter printer.
- _____ Install the toner cartridge and remove toner tape.
- _____ Load paper into the paper tray and install the tray into the LaserWriter printer.
- _____ Connect a parallel cable from the computer to the LaserWriter printer.
- _____ Connect a LocalTalk connector box to the computer and the LaserWriter, and use a LocalTalk cable to connect the boxes.
- _____ Connect the power cord.
- _____ Switch on the LaserWriter printer to generate a startup test page.
- _____ Set the SCSI ID number to 7. Switch on the LaserWriter to generate a startup test page.
- _____ Install the thirteen standard PostScript fonts.
- _____ Install the appropriate LaserWriter printer driver.
- _____ Install the appropriate QuickDraw printer driver.
- _____ Open the Chooser and select the network LaserWriter icon.
- _____ Open the Chooser and select the appropriate QuickDraw printer.

Compare your answers with those on page 43.

Practice Exercise 2 (Answers)



Compare your answers to Practice Exercise 2 with the answers below.

- ☒ Select a location for the LaserWriter printer and remove all hardware, software, and materials from the shipping carton.
- ☒ Remove retainers and cushioning materials from the LaserWriter printer.
- ☒ Install the toner cartridge and remove toner tape.
- ☒ Load paper into the paper tray and install the tray into the LaserWriter printer.
- ☐ Connect a parallel cable from the computer to the LaserWriter printer.
- ☒ Connect a LocalTalk connector box to the computer and the LaserWriter, and use a LocalTalk cable to connect the boxes.
- ☒ Connect the power cord.
- ☒ Switch on the LaserWriter printer to generate a startup test page.
- ☐ Set the SCSI ID number to 7. Switch on the LaserWriter to generate a startup test page.
- ☐ Install the thirteen standard PostScript fonts.
- ☒ Install the appropriate LaserWriter printer driver.
- ☐ Install the appropriate QuickDraw printer driver.
- ☒ Open the Chooser and select the network LaserWriter icon.
- ☐ Open the Chooser and select the appropriate QuickDraw printer.

If you missed any items, please review this section before you continue and correct any incorrect answers.

When you are ready, begin the next module—"Theory of Operation"—on the next page.

Overview



This module presents a Macintosh-to-LaserWriter system; provides an overview of page creation, data transfer, and print generation; and describes normal printer functions and common symptoms of faulty operation. A Macintosh-to-LaserWriter system includes these major components:

- MacOS-based computer
- Application software (such as a word-processing program)
- Apple LaserWriter (any model)
- Printer software (in the System Folder)
- Data transfer technology (between the computer and the LaserWriter—including all cards, cables, and connectors)

All Apple LaserWriters use the printing technology described in this module. When you understand how a computer-to-LaserWriter system functions and can identify common causes of faulty operation, you will have learned much of the functional information you need to troubleshoot and repair faulty systems.

Note: Information on direct-connect serial LaserWriters and direct-connect SCSI LaserWriters can be found in Appendix A.

Objectives

After completing this module, you should be able to:

1. Define basic page description language terms and functions, and indicate possible causes of faulty LaserWriter operation.
2. Identify the terms and functions of the computer-to-LaserWriter data transfer technologies and indicate possible causes of faulty operation.
3. Identify the major conditions necessary for the LaserWriter to come to a ready state.

Overview



4. Identify the sequence and function of the major stages of the laser printer print cycle, and indicate possible causes of faulty operation at each stage.
5. Identify possible causes of faulty laser printer operation when you have a problem or symptom description.

Module Organization

This module has four sections with practice exercises after each section:

- “Overview” outlines this module and presents the components of a computer-to-LaserWriter system.
- “Page Creation and Conversion” presents a functional overview of the page description languages that computers and Apple LaserWriters use to display and print text and graphic information, as well as the common symptoms and causes of faulty page creation and conversion.
- “Data Transfer Technology” introduces the types of data transfer technology that exchange information between the computer and the LaserWriter, with emphasis on AppleTalk. The section also presents the common symptoms and causes of faulty data transfer.
- “Print Generation” presents the ready states, a functional description of the print cycle stages, and the common symptoms and causes of faulty operation at each stage.

Begin the next section—“Page Creation and Conversion”—on the following page.

Page Creation and Conversion



The printing process begins with the creation of a page (or pages) that contain text and/or graphic information. The information appears on the computer screen and is stored in RAM. When you print, the information is sent to the printer driver where it is converted as necessary into the proper page description language and transferred to printer RAM. This section begins by defining key page creation terms, followed by a description of the page description languages that convert and transfer the pages to the printer.

The following terms are used in describing the page creation process:

Bitmapped images display on the computer screen as a collection of black dots and white spaces. Bitmapping refers to a method of storing information in computer memory. RAM stores bitmap fonts and graphics as dots and spaces in a corresponding location (or bit) in memory, as Figure 4-1 shows.

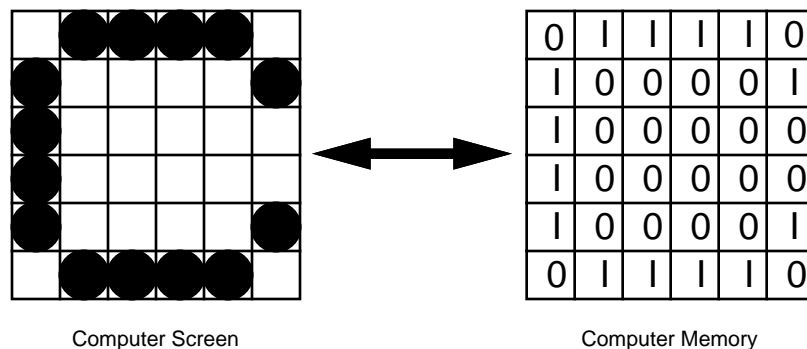


Figure 4-1
A bitmap of the letter 'C' on-screen and in computer memory

Page Creation and Conversion



QuickDraw performs all MacOS graphic and text operations. QuickDraw is a set of routines (coded instructions that perform a series of operations) in the MacOS. Applications access QuickDraw to create graphics and text that output to the computer screen or other devices, such as printers. Graphics and text appear on the screen as bitmap images.

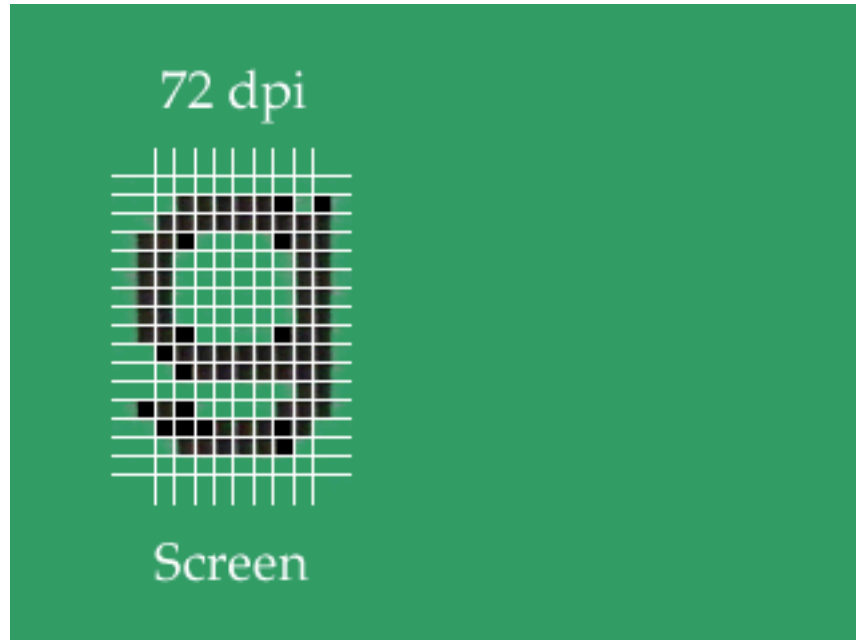
Resolution describes the sharpness of an image in dots per inch (dpi). QuickDraw assumes a display system has a resolution of 72 dpi. The dots per inch correspond to a printer's point ($1/72$ inch) which is a standard of the printing industry.

The computer screen has a relatively low resolution when compared to laser printers. LaserWriters have a resolution of 300, 600, or 800 dpi, depending on the printer model. Phototypesetters print at even higher resolutions (1,000 dpi and higher). A page printed by a LaserWriter or phototypesetter appears much sharper than the image on the screen because it has more and smaller dots.

Screen fonts are bitmapped fonts. QuickDraw uses screen fonts to display text on the computer screen. Fonts are a set of characters in one size and style. Font sizes are expressed in points, such as 12 points. Style refers to the shape and weight of a font. **Times bold** and *Times italic* are two styles of the Times font family. A font family is a complete set of characters for one font, including all styles and sizes.

LaserWriter printer drivers are system software files that take a printjob from the computer. On a MacOS-based computer, LaserWriter printer drivers translate a printjob from QuickDraw commands into commands recognized by the page description language the printer is expecting. LaserWriter printer drivers also initiate and control communication between the computer and the LaserWriter during printing.

Page Creation and Conversion

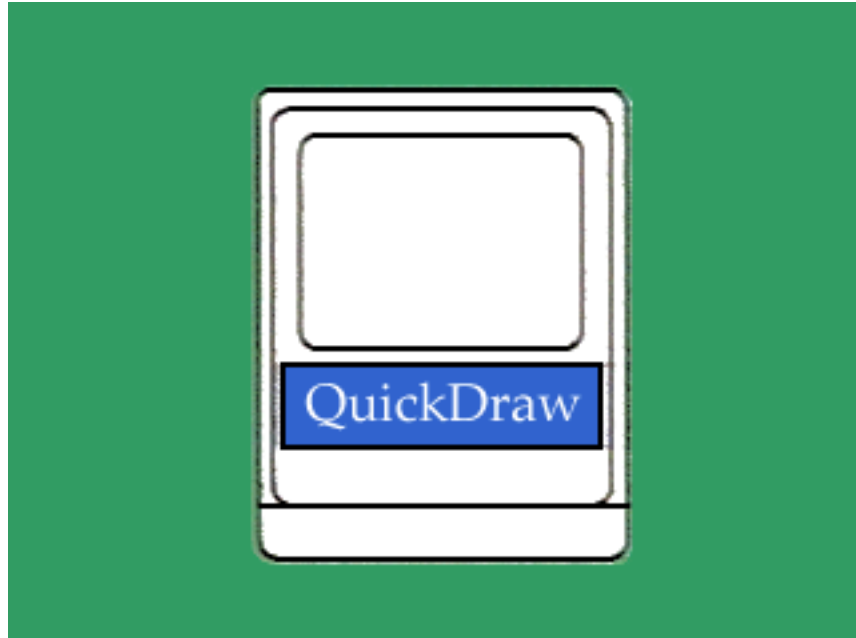


Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the process of converting a 72 dpi bitmap into the 300, 600, or 800 dpi image used by a LaserWriter.

After viewing the movie, continue on the following page.

Page Creation and Conversion

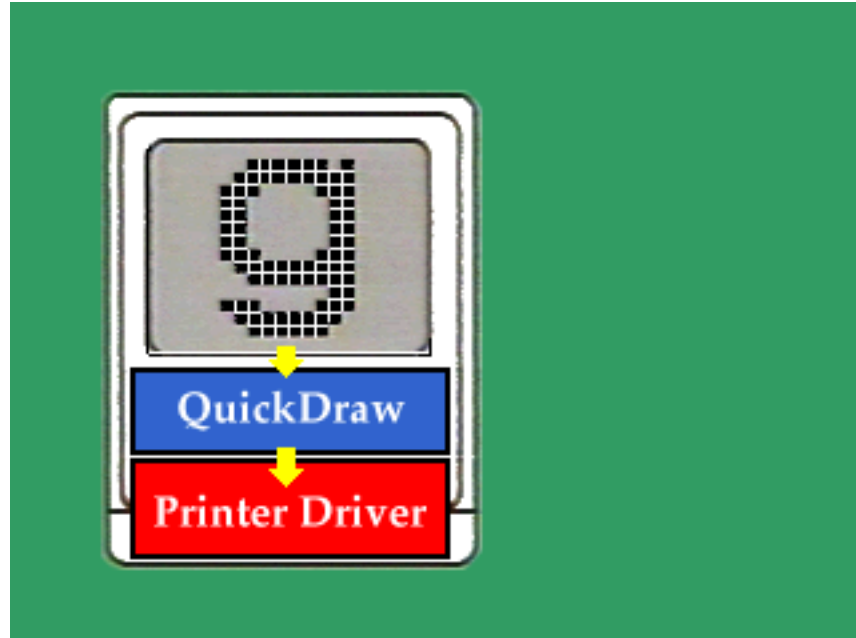


Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie provides an overview of QuickDraw and its importance to the MacOS.

After viewing the movie, continue on the following page.

Page Creation and Conversion

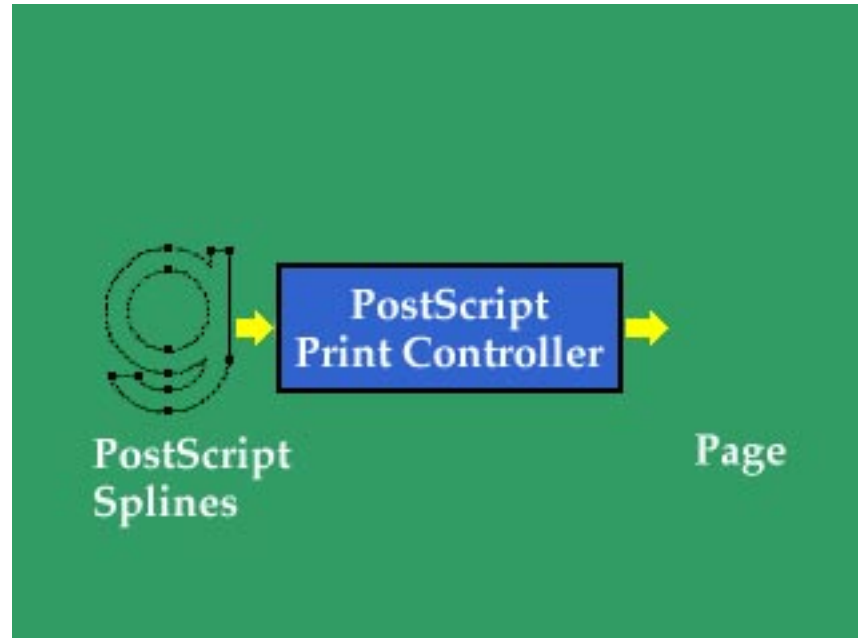


Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the process of converting a QuickDraw-based image (on screen) into a PostScript description. Additionally, the movie illustrates the conversion of the PostScript data into a bitmap for use by the printer.

After viewing the movie, continue on the following page.

Page Creation and Conversion



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates how PostScript uses splines to define text characters, and the advantage of PostScript fonts over bitmap fonts.

After viewing the movie, continue on the following page.

Page Creation and Conversion



QuickDraw performs all MacOS graphic and text operations. Once information is created and stored in RAM, the information is converted to the PostScript page description language by the PostScript printer driver and transferred to printer RAM. This section of the module describes the PostScript page description language.

QuickDraw

QuickDraw is used by a number of Apple LaserWriters to form the printed image. It is discussed in more detail in Appendix A.

Printer Control Language (PCL)

The Printer Control Language (PCL) was developed by Hewlett-Packard. It is used by IBM PC and compatible computers as a protocol for communicating with and controlling a printer. PCL uses escape-character sequences (or “escape codes”) in the data stream to control the printer’s actions. There are several versions of PCL, such as PCL4 and PCL5. For specific compatibility and troubleshooting information related to PCL, check the Tech Info Library.

PostScript

PostScript is an industry-standard page description language that processes both text and graphics. PostScript uses outline font technology to describe text for printed pages. Outline font technology defines each character using mathematical formulas that specify the formation of font sizes and styles (and also of graphics). After the size and style of each letter is defined, the controller fills in the outline with dots at the specific resolution of the print device. Figure 4-2 shows the difference between a bitmap font and the PostScript outline font technology.

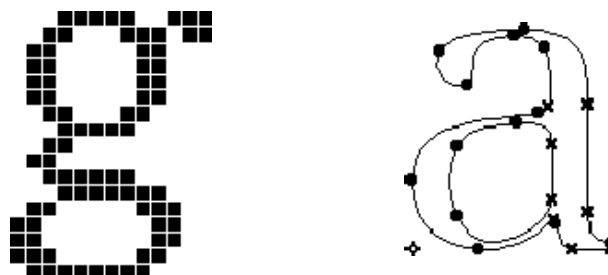


Figure 4-2
QuickDraw bitmap vs. PostScript fonts

Page Creation and Conversion



Again, the LaserWriter driver manages the page conversion process. Figure 4-3 shows the icon for the printer driver used by networked PostScript Apple LaserWriters.



Figure 4-3
Apple's PostScript LaserWriter printer driver icon

The PostScript LaserWriter driver converts the pages of text and graphic bitmap images in computer RAM to a series of PostScript instructions. The printer will receive and process these PostScript instructions to recreate the pages in its printer buffer.

QuickDraw uses bitmap fonts in the System Folder, whereas PostScript uses PostScript fonts found in several places: printer RAM and ROM, a hard drive attached to the printer, and the System Folder. PostScript LaserWriters permanently store several PostScript font families in ROM. Fonts that are not in the LaserWriter's ROM must be loaded into printer RAM before you print a document. Fortunately, the search for fonts is done automatically; no user intervention is required.

The process of copying nonresident fonts from a computer to printer RAM is called font downloading. Font downloading typically happens automatically. The computer and the LaserWriter communicate, determining what PostScript or TrueType® fonts are available and whether they are in printer RAM, printer ROM, a hard drive attached to the printer, or the System Folder. If a needed PostScript font is not available, the print controller downloads and creates a bitmap version of the font. Bitmap font creation slows the printing process and generates characters that are less well defined.

Page Creation and Conversion



If a limited amount of printer RAM is available, the printer may download the font temporarily until the file prints, and then purge the font from printer RAM. If enough RAM is available, the printer may store the font in RAM until the printer is switched off. If the LaserWriter has an option to connect a hard drive, you can permanently store downloaded fonts so that they are always available to the LaserWriter, just as if they were in printer ROM. The fonts are stored on the hard drive until they are removed by the user, even if the printer is switched off.

When TrueType is used with computers printing to PostScript printers, you need only one instance of the font installed in the System file for each family of fonts. TrueType fonts eliminate the need for a separate set of bitmapped fonts for each size and style of font. TrueType does not replace PostScript fonts. It is simply another font technology. TrueType is similar to PostScript font technology in that it uses mathematical descriptions of text characters rather than bitmaps. However, TrueType handles both screen display and printed output. PostScript requires separate font files: a bitmap font for screen display (hence the term “screen font”) and a PostScript font for printing.

With bitmap, TrueType, and PostScript versions of fonts to work with, it may seem confusing. Here is the order in which the MacOS looks for fonts when displaying text on screen:

- bitmap version of the same point size
- TrueType version
- bitmap version of a different size, scaled as necessary

Here is the order in which the MacOS looks for fonts when printing to a PostScript LaserWriter:

- printer’s RAM (for PostScript fonts)
- printer’s ROM (for PostScript fonts)
- printer’s hard drive (for PostScript fonts)
- PostScript font files stored within the System Folder (Extensions folder or Fonts folder)
- TrueType version of font
- bitmap version of font

Page Creation and Conversion



Faulty Page Creation and Conversion

Improper installation of printer driver files and fonts usually results in the inability to print, poor print quality, and/or poor printer performance. You may hear these symptoms from your customers when they try to print to LaserWriters that have just been set up. The likely causes of each of these common symptoms are listed below.

Common Symptoms and Likely Causes

Printer does not show up in Chooser

- Printer driver is not installed.
- Wrong printer driver is installed.
- Printer not selected in Chooser.

The print quality is poor

- Neither PostScript nor TrueType versions of a font are available; only the bitmap version is available.

Poor printing performance

- PostScript fonts are not available to support screen fonts. (Downloading of bitmap versions slows performance.)
- Attempting to print large files with insufficient printer RAM.

This list emphasizes the need to install the correct combination of LaserWriter driver and fonts to ensure high-quality output and efficient printer system operation.

Continue with Practice Exercise 1 on the following page.

Practice Exercise 1



Directions

Complete Practice Exercises 1 and 2, and then check your answers against the answer pages.

Match the terms that describe QuickDraw and the PostScript printing process.

| <u>Terms</u> | <u>Definitions</u> |
|----------------------------|--|
| 1. ____ Resolution | A. Provides the software interface between the computer and the LaserWriter |
| 2. ____ Screen font | B. Comprises a complete set of characters for one font, including all styles and sizes |
| 3. ____ Font | C. Specifies the sharpness of an image, in dots per inch (dpi) |
| 4. ____ Font family | D. Displays text on the computer screen |
| 5. ____ Font style | E. Comprises a set of characters in one size and style |
| 6. ____ Font size | F. Appears as a collection of black dots and white spaces |
| 7. ____ Bitmapped | G. Describes graphics and text in mathematical formulas instead of bitmap fonts |
| 8. ____ LaserWriter driver | H. Is a font characteristic expressed in points of the page |
| 9. ____ QuickDraw | I. Is the area of printer RAM that stores a bitmapped image |
| 10. ____ PostScript | J. Includes the characteristics (other than size) that uniquely define the fonts of a single font family |
| 11. ____ Page buffer | K. Performs all MacOS graphic and text operations |

When you finish, continue with Practice Exercise 2 on the next page.

Practice Exercise 2

**Directions**

Read each customer printing problem and list the possible causes of faulty operation.

1. You receive a call from a customer who states that his PostScript LaserWriter takes an exceptionally long time to print. What page-creation-and-conversion problems can cause slow printing?

2. A customer tells you that after unpacking and setting up her new PostScript LaserWriter she cannot print. What page-creation-and-conversion problems can cause the printer not to print?

3. A customer complains that the print quality of fonts with his new PostScript LaserWriter is inferior to the printer demonstration he received in your store. What page-creation-and-conversion problems can cause poor print quality?

When you are ready, compare your answers to Practice Exercises 1 and 2 with those provided on pages 58-59.

Practice Exercise 1 (Answers)



Compare your answers to Practice Exercise 1 with the answers below.

1. **C** Resolution
2. **D or F** Screen font
3. **E** Font
4. **B** Font family
5. **J** Font style
6. **H** Font size
7. **F or D** Bitmapped font
8. **A** LaserWriter driver
9. **K** QuickDraw
10. **G** PostScript
11. **I** Page buffer

If you missed any items, please review the appropriate section of the module and correct any incorrect answers.

Practice Exercise 2 (Answers)



Compare your answers to Practice Exercise 2 with the answers below.

1. You receive a call from a customer who states that his PostScript LaserWriter takes an exceptionally long time to print. What page-creation-and-conversion problems can cause slow printing?
 - *There are no PostScript or TrueType fonts installed for the fonts used in the documents. Only bitmap (screen) fonts are installed, requiring lengthy downloads to the printer of bitmap fonts.*
 - *The customer is printing large files with a minimum amount of printer RAM.*
2. A customer tells you that after unpacking and setting up her new PostScript LaserWriter she cannot print. What page-creation-and-conversion problems can cause the printer not to print?
 - *The customer is using the wrong printer driver or an old version that does not support all the features of her new printer.*
3. A customer complains that the print quality of fonts with his new PostScript LaserWriter is inferior to the printer demonstration he received in your store. What page-creation-and-conversion problems can cause poor print quality?
 - *PostScript or Truetype fonts are not available to support the screen fonts for the document being printed.*
 - *Text smoothing features such as FinePrint are turned off.*

If you missed any items, please review the appropriate section of the module and correct any incorrect answers.

When you are ready, continue with the next section of the module—"Data Transfer Technology."

Data Transfer Technology



This section introduces the types of data transfer technology that LaserWriters use to communicate with computers, and identifies common symptoms and causes of faulty data transfer. The focus of the section will be on AppleTalk, Apple's communication and networking protocol.

Apple LaserWriters use many types of data transfer technology to communicate, including:

- AppleTalk (including LocalTalk and EtherTalk)
- IPX (Novell Netware)
- TCP/IP (Unix)
- Parallel
- Serial
- SCSI

IPX, TCP/IP, and Parallel

Information on configuration and troubleshooting of IPX, TCP/IP, and parallel connections can be found in several places. LaserWriter owner's manuals are an excellent source of information on setting up and configuring a printer with a particular communication protocol. The Tech Info Library, reviewed in the Features module of this course, offers many informative articles regarding troubleshooting and compatibility.

Serial and SCSI

Serial and SCSI, which are direct one-to-one connections, are discussed in Appendix A.

AppleTalk

The AppleTalk network protocol is often used to transfer data between a MacOS-based computer and a LaserWriter. As you will recall from the previous section, the printer driver converts the pages in computer RAM into PostScript's mathematical formulas. Once converted to PostScript, the data is transferred to the print controller on the printer I/O PCB. There the data is converted into bitmap pages. The bitmap pages are stored in the page buffer until they print.

Data Transfer Technology



Network communication protocols are the rules that control interaction between devices on a network. AppleTalk is the name of Apple's network communication protocol. Protocols determine how devices on a network transfer data in an orderly manner. An AppleTalk network is a collection of devices that exchange information using AppleTalk over some medium. Two common implementations of the AppleTalk protocol are LocalTalk and EtherTalk.

LocalTalk is an inexpensive implementation of AppleTalk that is suitable for moderate data transfer rates. LocalTalk is built into every Macintosh. A LocalTalk-based network consists of cables, connectors, and cable extenders. LocalTalk shielded twisted-pair cable from Apple supports a maximum of 32 devices and can span up to 1000 feet. LocalTalk requires each device to have a connector. Devices on LocalTalk-based networks are typically daisy-chained to each other with connector cables. Star configurations utilizing a network hub are also used. Refer to the appropriate owner's guide for more information about LocalTalk cabling requirements.

EtherTalk permits the AppleTalk protocol to run on high-speed Ethernet networks, providing a relatively fast data transfer rate. The cabling itself may be thick coaxial, thin coaxial, or even twisted pair. An EtherTalk network is often part of an internet (two or more networks connected together) that includes one or more LocalTalk networks and can potentially include millions of users. Some Macintosh computers have EtherTalk built in. Others require the installation of an EtherTalk card.

Networks can have different sizes, shapes, and types of devices. One function of communication protocols is to define unique network device addresses. By assigning a unique address to each device, users can transfer data between devices. In addition to network addresses, the AppleTalk communication protocol adds an additional layer whose aim is to make things more human-friendly. AppleTalk's Name Binding Protocol matches (or "binds") a device name to its unique network address. When you open the Chooser and select the network LaserWriter printer icon, a list of all the names of the LaserWriters on the network appears. To print to a specific LaserWriter you simply select the name of that printer. The AppleTalk protocol translates the name into the LaserWriter's unique network address.

Data Transfer Technology



LaserWriter printer utility software allows you to name each LaserWriter on a network. If a printer is not named, the network uses a default naming scheme. The model name (for example, LaserWriter 12/640 PS) is assigned to the first printer. Other printers of the same model are then assigned a number, beginning with 1 (for example, LaserWriter 12/640 PS 1, LaserWriter 12/640 PS 2, etc.) in the order in which each is switched on.

In order for the network to “see” a LaserWriter and list its printer name in the Chooser, the following conditions must exist:

1. The correct printer driver must be installed in the System Folder.
2. The printer driver icon must be highlighted in the Chooser.
3. AppleTalk must be active. Even if the correct driver is installed and selected, the printer name will not appear in the Chooser unless AppleTalk is active.
4. The correct zone must be selected if the network is divided into zones.
5. The correct cables must be connected from a computer and LaserWriter to the network.
6. The LaserWriter must be switched on. The printer name will not appear in the Chooser until after the self-test executes and the printer has come to a ready state. The printer name will then appear in the Chooser.

Data Transfer Technology



Faulty AppleTalk Operation

The two common symptoms of faulty AppleTalk communication and their likely causes are:

Common Symptoms

Laser printer name not listed in the Chooser or the user can't print to the printer

Likely Causes

One or more of the following conditions exists:

- The correct printer driver is not installed.
- The driver icon is not highlighted.
- AppleTalk is not active.
- The computer port through which AppleTalk has been told to communicate (printer port for LocalTalk; Ethernet port for EtherTalk) is not the same port to which the network cable is attached.
- The correct zone is not selected (if the network is divided into zones).
- The user's computer and the LaserWriter are not correctly connected to the network.
- The LaserWriter is off.

If none of the above conditions exists and the LaserWriter name still does not appear in the Chooser, the problem is most likely a user's computer, a user's computer system software, or the network software (if the user is on a multiuser network).

Continue with Practice Exercise 3 on the next page.

Practice Exercise 3



Directions

Complete Practice Exercises 3 and 4, and then check your answers against the answer pages.

The following list contains statements about Macintosh-to-LaserWriter data transfer with AppleTalk technology. Use the key to indicate whether a term or statement relates to LocalTalk, EtherTalk or both. Try to respond to each item from memory.

L = LocalTalk

E = EtherTalk

LE = LocalTalk and EtherTalk

1. _____ Requires that AppleTalk must be active for communication to take place
2. _____ Provides a relatively fast data transfer rate
3. _____ Is an inexpensive AppleTalk implementation with moderate data transfer rates
4. _____ Is built into every Macintosh computer
5. _____ Utilizes AppleTalk's Name Binding Protocol to match device names with device addresses
6. _____ May require the installation of a card in the computer
7. _____ Using Apple cabling and connectors, supports a maximum of 32 devices and can span up to 1000 feet
8. _____ Requires that each LaserWriter have a unique name
9. _____ Supports up to 40 active nodes with a single cable length of 200 meters, and can potentially support millions of users with an internet network

When you are ready, continue with Practice Exercise 4 on the next page.

Practice Exercise 4

**Directions**

Indicate the likely causes of each customer data transfer problem.

1. A customer states that she has just purchased an Apple LaserWriter with a built-in Ethernet port as a replacement for her LocalTalk-based LaserWriter. She tells you that she is unable to make the connection and print. What are some data transfer problems she might be having?

2. You are helping a customer determine why the name of a new LaserWriter just added to the LocalTalk network does not appear in the Chooser. She indicates that the correct driver is installed and selected in the Chooser, and that the printer has a name. What data transfer problems can cause this problem?

3. A customer calls to ask for help with configuring a LaserWriter. He would like to connect it to his Windows-based computer via the parallel connector. Where can you find configuration and compatibility information to help this customer?

When you are ready, compare your answers to Practice Exercises 3 and 4 with the answers on pages 66-68.

Practice Exercise 3 (Answers)



Compare your answers to Practice Exercise 3 with the answers below.
Use the following key:

L = LocalTalk

E = EtherTalk

LE = LocalTalk and EtherTalk

1. LE Requires that AppleTalk must be active for communication to take place
2. E Provides a relatively fast data transfer rate
3. L Is an inexpensive AppleTalk implementation with moderate data transfer rates
4. L Is built into every Macintosh computer
5. LE Utilizes AppleTalk's Name Binding Protocol to match device names with device addresses
6. E May require the installation of a card in the computer
7. L Using Apple cabling and connectors, supports a maximum of 32 devices and can span up to 1000 feet
8. LE Requires that each LaserWriter have a unique name
9. E Supports up to 40 active nodes with a single cable length of 200 meters, and can potentially support millions of users with an internet network

If you missed any items, please review the appropriate section of the module and correct any incorrect answers.

Practice Exercise 4 (Answers)



Compare your answers to practice Exercise 4 with the answers below. If you miss any items, review the appropriate section of the module and correct any incorrect answers.

1. A customer states that she has just purchased an Apple LaserWriter with a built-in Ethernet port as a replacement for her LocalTalk-based LaserWriter. She tells you that she is unable to make the connection and print. What are some data transfer problems she might be having?
 - *The customer may not have switched her AppleTalk connection from the printer port (LocalTalk) to the Ethernet port (EtherTalk).*
 - *The customer may not have a computer with built-in Ethernet, meaning she will need to purchase an Ethernet card in order to make an EtherTalk connection to her new printer.*

2. You are helping a customer determine why the name of a new LaserWriter just added to the LocalTalk network does not appear in the Chooser. She indicates that the correct driver is installed and selected in the Chooser, and that the printer has a name. What data transfer problems can cause this problem?
 - *The correct zone (if the customer's network has zones) may not be selected.*
 - *The customer's computer and/or the new LaserWriter may not be connected correctly.*
 - *AppleTalk is not active.*
 - *The printer may not be switched on.*
 - *The addition of the LaserWriter to the LocalTalk network may have exceeded the limits for number of devices or total length of the network.*

Practice Exercise 4 (Answers)



3. A customer calls to ask for help with configuring a LaserWriter. He would like to connect it to his Windows-based computer via the parallel connector and send printjobs using Printer Control Language (PCL). Where can you find configuration and compatibility information to help this customer?

The owner's manual for the LaserWriter may be the best source of clear, simple-to-read instructions for making this type of connection (assuming that this type of connection is possible with his LaserWriter model). More detailed information and possible compatibility issues may be found in the Tech Info Library.

When you are ready, continue with the next section of the module—"Print Generation."

Print Generation



This section presents the print generation cycle of the printing process—specifically, how a LaserWriter generates a printed page and the functions of the I/O PCB and print engine.

I/O PCB Overview

The I/O PCB provides the interface between the computer or network and the printer. A QuickDraw-based LaserWriter I/O PCB communicates with the Macintosh via the SCSI connector or the serial port. A PostScript-capable LaserWriter I/O PCB communicates with devices using protocols such as AppleTalk, Novell Netware IPX, TCP/IP, and parallel communication.

Both types of I/O PCBs contain cable connectors, ROM, RAM, and a microprocessor. The features found on LaserWriters were covered in the Features module of this course.

Print Engine Overview

The LaserWriter print engine has four systems—the power distribution system, the control system, the image/formation system, and the pickup/feed system. The four print engine systems interact during each stage of the print cycle. Figure 4-4 on page 71 shows the relationship of the four LaserWriter print engine systems.

The **power distribution system** receives power through the AC power cord receptacle and provides power to the other three systems. Power flows directly to some systems, while others receive power indirectly through the DC controller PCB. The power distribution system provides AC and DC current, as well as high voltage.

The **control system** manages the print engine. The DC controller PCB—which monitors all functions of the LaserWriter—receives a command to print from the I/O PCB and issues control signals to the modules and parts in all other systems during the print cycle. The control system communicates print engine status to the user via the display panel LEDs on the front of the laser printer. Always remember to check the DC controller PCB as part of your troubleshooting procedures because it controls the entire engine. A module may seem faulty but in reality may not have received the command or voltage it needs.

Print Generation



The **image formation system** uses a laser beam to transfer bitmap images waiting to print in the page buffer, bit by bit, to a photosensitive drum. Charged particles or toner jumps to the image on the drum and transfers to the page as the drum moves. After passing the photo-sensitive drum, the printed page moves through the fuser assembly where the toner melts onto the paper.

The **pickup/feed system**, or paper pickup/feed system, moves sheets of paper through the print engine. Starting at the paper cassette, each sheet lifts, aligns, and moves past the photosensitive drum, where the image transfers to the paper. Finally, the pickup/feed system delivers the printed page to the paper delivery tray.

Print Generation

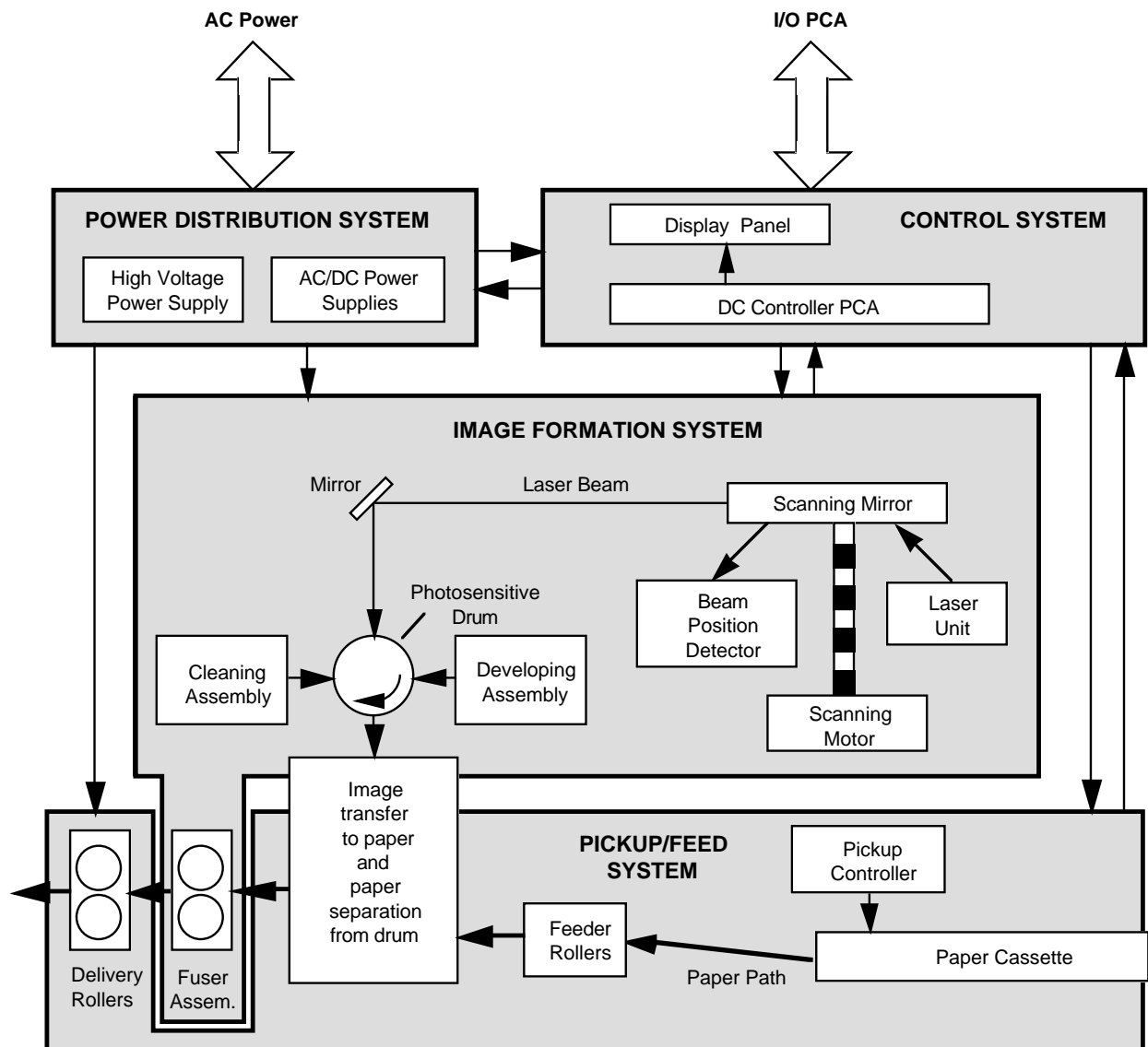
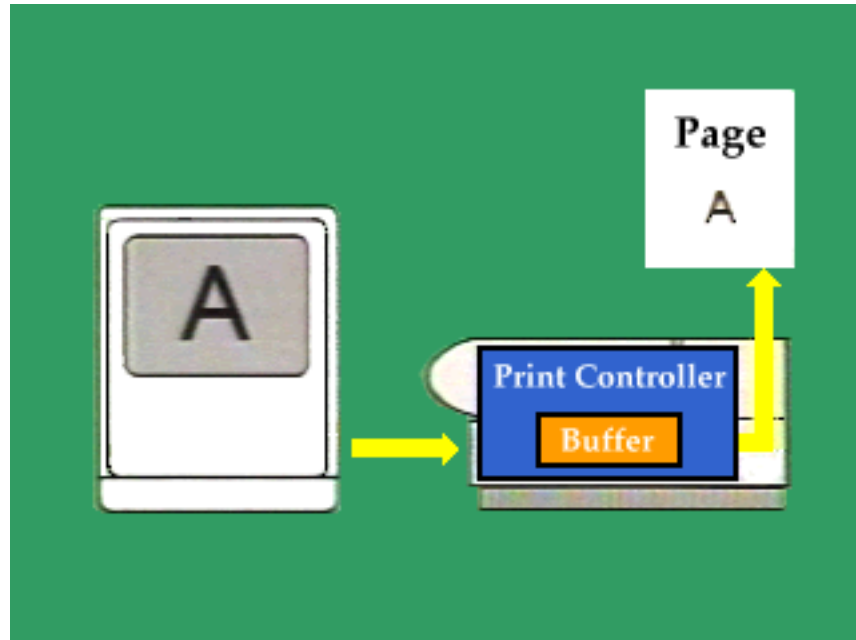


Figure 4-4
The four LaserWriter print engine systems

Print Generation



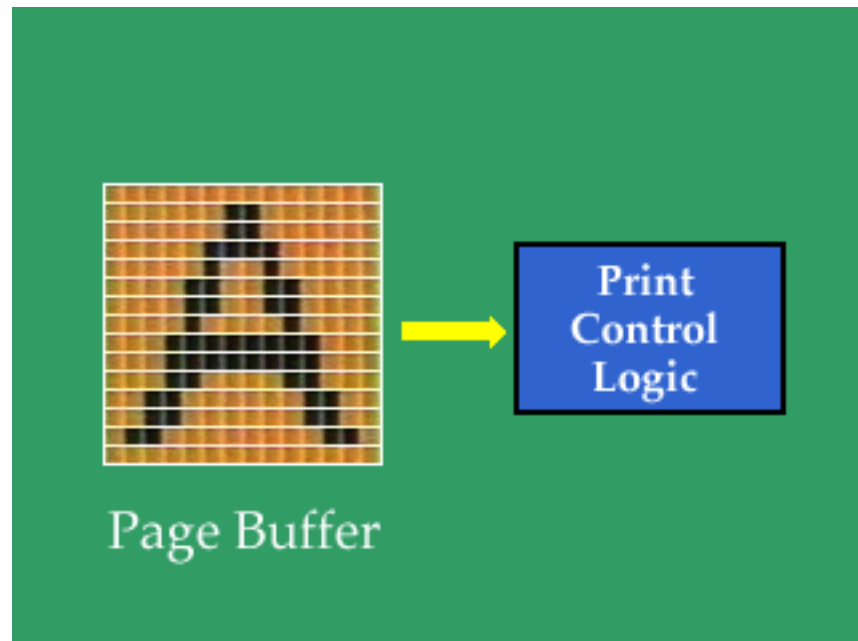
Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates and describes the LaserWriter page buffer.

Page Buffer

When the information for an entire page has been sent from the computer to the LaserWriter, it is constructed into a bitmap image to be printed. In the print engine, a bitmap image is composed of millions of possible dot positions on the actual page to be printed. Each dot position has a dedicated place in memory, which will store only one thing: whether there is a dot or not at that position on the page. This dedicated page in memory is known as the page buffer. The page buffer consumes most of a LaserWriter's RAM.

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates and describes the relationship between the page buffer, the print logic, and the firing of the laser unit.

From Page Buffer to Laser Pulses

The image formed on the photoconductive drum is based on the bitmap image in the page buffer. Formation of the image on the drum is accomplished with the aid of an extremely fine laser. The print control logic activates the laser to either turn it on when a dot is required, or off when a dot is not required. To create a dot, a pulse of laser light is emitted. During printing, turning on and off may happen several million times per printed page.

Print Generation



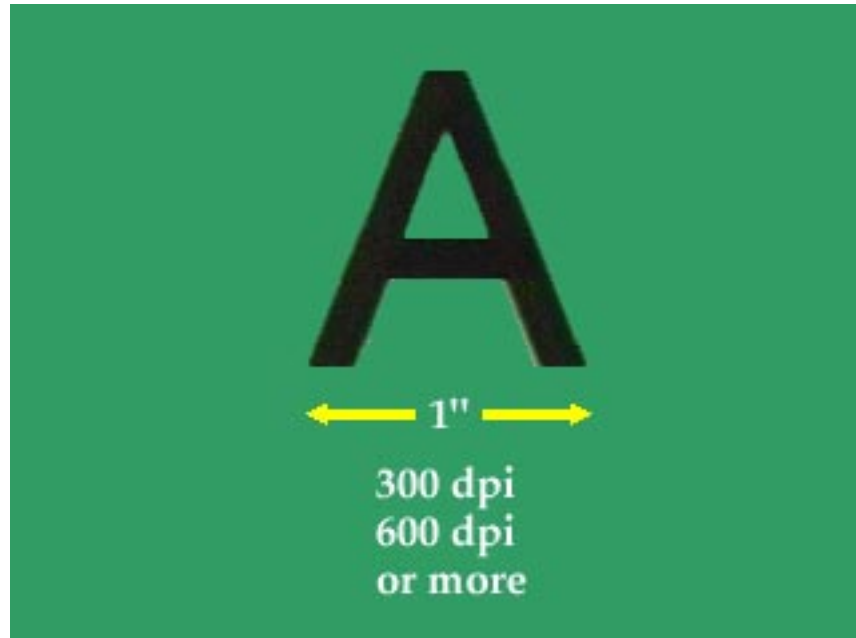
Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the path taken by the laser beam from the laser unit to the photosensitive drum.

From Laser Unit to Drum

The pulsed laser light is aligned by several lenses into a beam. The beam strikes a multi-sided scanning mirror that is rotating at a constant speed. The beam reflects off the face of the rotating mirror through a curved lens. From there, it travels to the photosensitive drum.

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates and describes several factors that affect print quality and that are related to the laser beam and the dots it creates.

Factors Affecting Quality

The quality of the dot matrix image the laser creates is dependent on several things. Mostly, it depends on the dot density, or the number of dots per inch (dpi). Apple LaserWriters lay down 300, 600, or 800 dpi, depending upon the model. With Apple's PhotoGrade technology the numbers are even higher. The size of the dots is another factor. The quality of the toner is also a factor. The consistency of each dot is another factor. LaserWriters (and laser printers in general) produce dots of a very consistent size and shape.

Print Generation



Ready States

Ready states are the conditions that must exist before a print cycle initiates. A ready state means the LaserWriter can begin a print cycle. There are as many as nine key ready states. Some ready state conditions do not apply to all LaserWriters. Knowing the ready states will help you more quickly and accurately isolate the cause of a faulty LaserWriter.

One of the DC controller sensors constantly monitors each ready state. When the sensor confirms the existence of all ready states, it initiates a print cycle after receiving a command from the I/O PCB. When troubleshooting, try to determine whether the DC controller or the sensor is faulty before you try to isolate the problem to another module or part.

The nine ready states are:

1. Access door(s) closed.
2. Correct paper cassette and paper installed—A sensor determines if the paper cassette is installed. Another sensor determines if the paper cassette is the correct size for the page setup parameters set by the user. A third sensor determines if the paper cassette contains paper. If the sensors are faulty, the printer cannot come to a ready state.
3. Toner cartridge installed.
4. No paper jam—Paper jams occur when: 1) a sheet of paper sticks in the paper path when the laser printer is switched on, or 2) a sheet of paper does not reach or clear the delivery sensor (the final sensor before the page exits the printer) within the required time, or 3) there is a faulty sensor or sensor actuator.
5. Main motor rotates properly—The main motor rotates briefly and the fuser rollers (part of the fuser assembly) turn after power-up. Listen for the sound of the main motor and watch for the turning fuser rollers immediately after switching on the printer.

Print Generation



6. Scanning motor scans at proper speed—The scanning motor turns the scanning mirror, which rotates at a very precise speed. The mirror reflects the laser scan beam from the laser assembly onto the photosensitive drum inside the toner cartridge. If the scanning motor does not turn the mirror at the correct speed, an accurate image will not scan onto the photosensitive drum. You can determine if the scanning motor is functioning by listening for a high-pitched whine (higher pitched than the main motor) during warmup or during the first print cycle. Note that some LaserWriters check the scanning motor before generating a startup page, while others check it as part of generating the startup page.
7. Laser beam temperature is normal —The laser beam produces images on the photosensitive drum. The DC controller checks the laser beam temperature before a print cycle initiates. On some LaserWriter models, it is possible to verify proper operating temperature. Refer to Apple *Service Source* and the wiring diagram for laser voltage levels.
8. Fuser roller temperature is acceptable—The fuser assembly fuses the toner image onto the paper and houses two pressure rollers. One of the fuser rollers contains a heater bulb that heats the toner and paper. Cool fuser rollers will not fuse the toner. Conversely, if the roller is too hot, the paper and roller can be damaged or the paper may move to the delivery tray without an image.

You can determine if the fuser heater bulb lights by looking through the door or tray openings near the fuser assembly when you switch on the printer or during the print cycle. If the bulb lights, you know it has power and has not burned out.
9. Fan rotates (some LaserWriter models)—The fan must rotate on some LaserWriter models. If the fan wire breaks or an object stops the fan from turning, the printer will not come to a ready state.

Review the ready states until you can recall them from memory.

Continue with Practice Exercise 5 on the next page.

Practice Exercise 5

**Directions**

Identify which statements describe a ready state.

1. ____ Driver files are properly installed in printer RAM.
2. ____ Registration assembly solenoid functions.
3. ____ Fuser roller temperature is acceptable.
4. ____ Access door(s) is/are closed.
5. ____ Toner cartridge is at least 10 percent full of toner.
6. ____ Toner cartridge is installed.
7. ____ Paper cassette has at least 20 sheets of paper.
8. ____ Printer does not sense a paper jam.
9. ____ Fan functions (some models).
10. ____ User test page prints.
11. ____ Cassette and paper are installed.
12. ____ Main motor rotates properly.
13. ____ Pickup roller rotates at correct intervals.
14. ____ Scanning motor scans at the proper speed.
15. ____ Laser beam temperature is normal.

When you finish, compare your answers with those on page 79.

Practice Exercise 5 (Answers)



Compare your answers to Practice Exercise 5 with the answers below.

1. ____ Driver files are properly installed in printer RAM.
2. ____ Registration assembly solenoid functions.
3. X Fuser roller temperature is acceptable.
4. X Access door(s) is/are closed.
5. ____ Toner cartridge is at least 10 percent full of toner.
6. X Toner cartridge is installed.
7. ____ Paper cassette has at least 20 sheets of paper.
8. X Printer does not sense a paper jam.
9. X Fan functions (some models).
10. ____ User test page prints.
11. X Cassette and paper are installed.
12. X Main motor rotates properly.
13. ____ Pickup roller rotates at correct intervals.
14. X Scanning motor scans at the proper speed.
15. X Laser beam temperature is normal.

If you missed any items, review the appropriate section of the module and correct any incorrect answers.

When you are ready, continue with the next part—"Print Generation."

Print Generation



Print Cycle

The print cycle has six steps, as Figure 4-5 illustrates: drum charging, image formation, development, transfer, fusing, and drum cleaning.

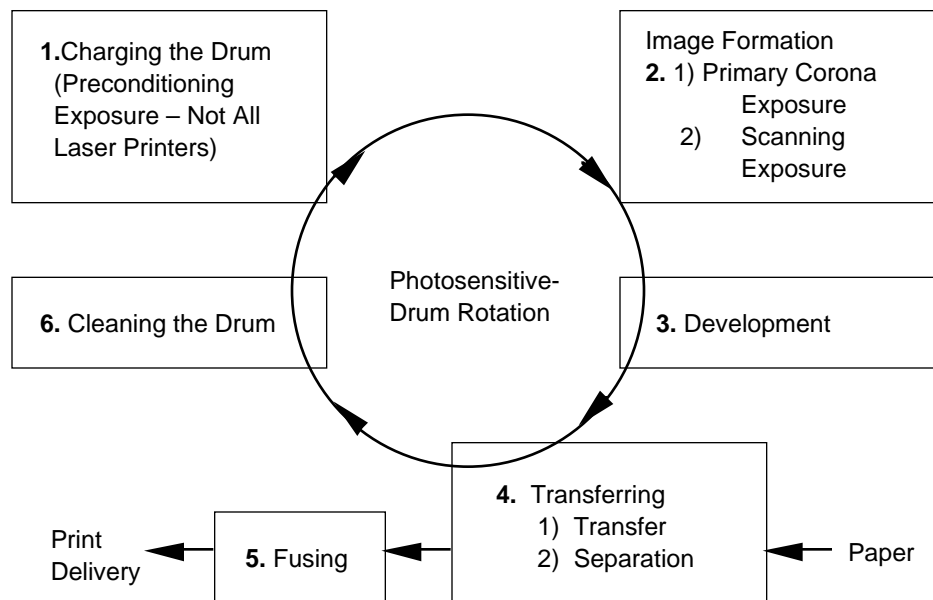
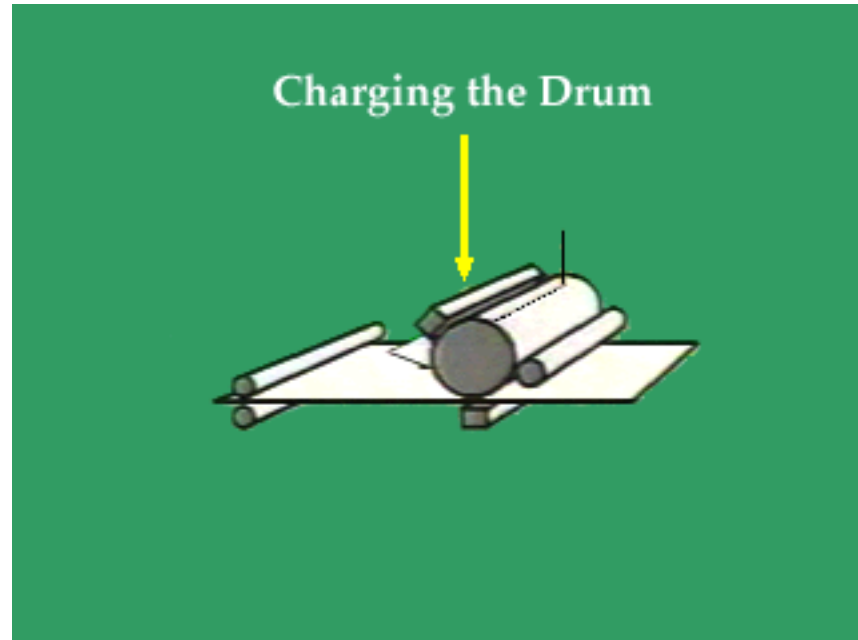


Figure 4-5
The LaserWriter print cycle

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the first step in the 6-step print cycle, drum charging.

Drum Charging

The first step exposes the photosensitive drum—located in the toner cartridge—to light so the drum is ready to receive charges during Step 2. The light passes through the preconditioning exposure shutter on the toner cartridge. Note: Some LaserWriters do not require this step. Refer to Figure 4-6 on the next page for the location of the drum and toner cartridge.

Print Generation

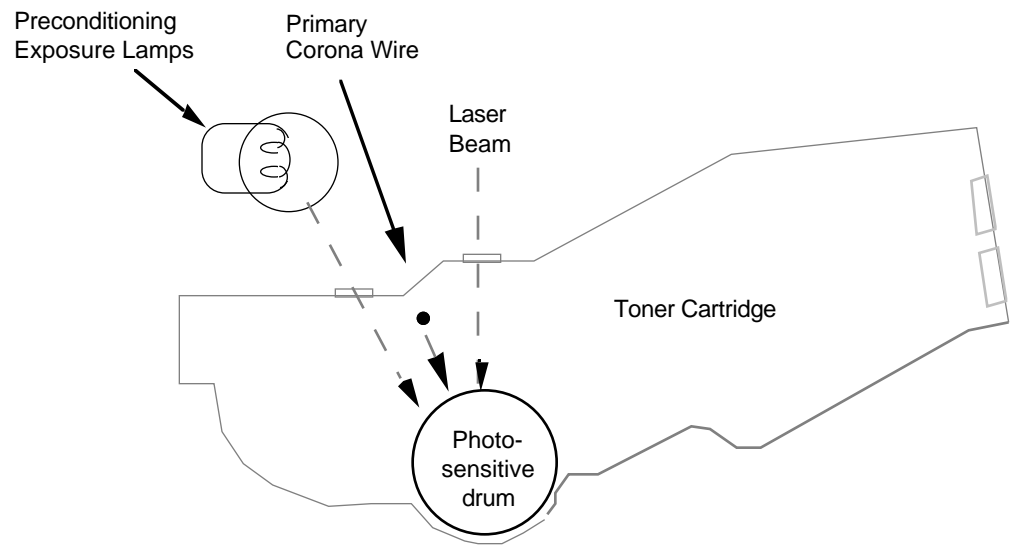
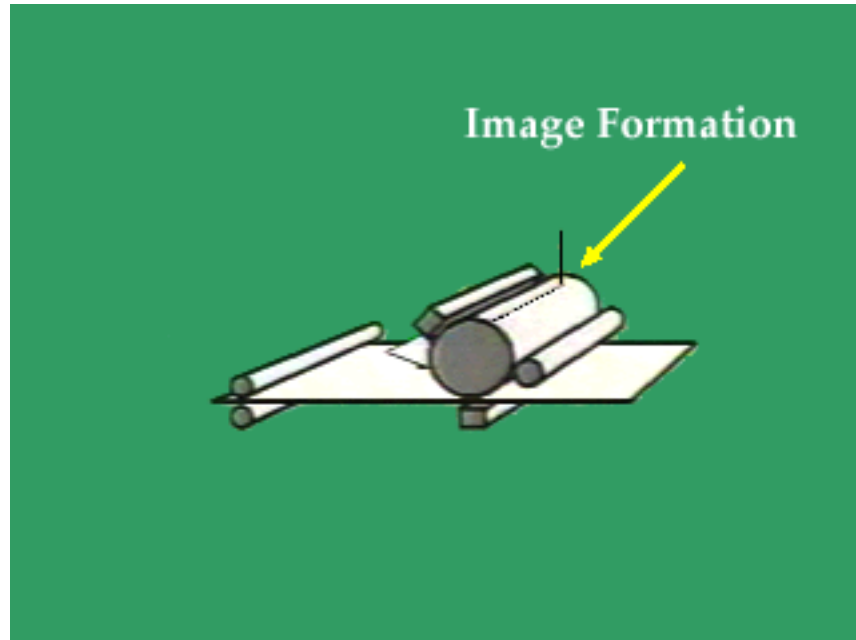


Figure 4-6
LaserWriter toner cartridge and photosensitive drum

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it.

If you are completing this material onscreen, view the movie now. If you are completing this material in printed form, you will be unable to view the movie.

This movie illustrates the second step in the 6-step print cycle, image formation.

Image Formation

The second step produces a pattern of electrical charges on the photosensitive drum that is identical to the print image. Image formation has several stages. First, the photosensitive drum passes under the primary corona wire (see Figure 4-6 on the previous page), which applies a uniform layer of negative charges over the drum surface.

Print Generation

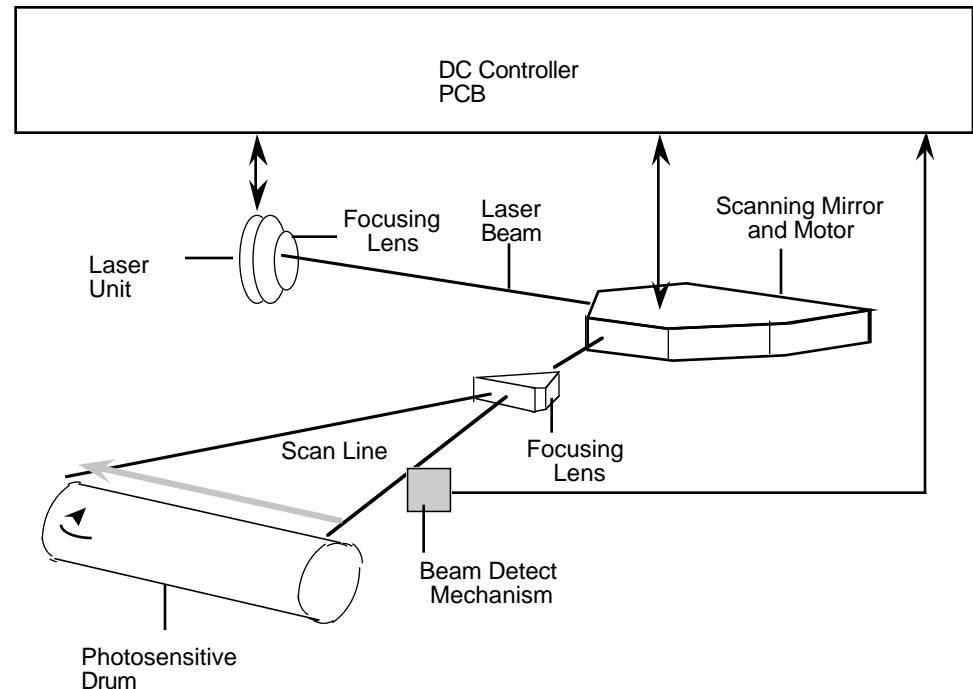


Figure 4-7
The laser scanning process and parts

Next, the DC controller receives a print command from the I/O PCB and sends a command to the laser/scanner assembly. The laser/scanner assembly consists of the laser unit, scanning mirror, scanning motor, and focusing lenses. (In some LaserWriters these may be separate parts, but they still function together as described here.) Refer to Figure 4-7 for an illustration of the laser scanning process.

The laser/scanner assembly generates the laser beam that hits the photosensitive drum. The modulated laser beam first passes through a focusing lens and strikes a multifaced scanning mirror on the scanning motor, which rotates at a constant speed. The beam passes through additional lenses that reflect the beam onto the photosensitive drum. The laser beam exposes the drum surface, neutralizes the charges, and creates an invisible pattern.

Print Generation



During image formation, the photosensitive drum rotates at a constant speed that matches the speed of the beam. In the time it takes for the beam to return to its original position, the drum surface shifts down enough to accept the next scan line. When the beam reaches a new line, the beam detect mechanism (see Figure 4-7) sends a light beam signal back to the DC controller. This signal alerts the DC controller that the beam is at the home position. Another modulated beam then scans the drum. As each successive beam scans the drum, an image accumulates on the drum in the form of tiny dots that match the bitmapped image in the page buffer.

Print Generation



Charging and Image Formation: Faulty Operation

The charging and image formation steps of the print cycle have several common symptoms of faulty operation. The symptoms and likely cause(s) are:

Symptom

Printer does not print; power is on but no paper is picked up.

A page has parts of the previously printed page, or appears gray or cloudy.

The image does not appear on the photosensitive drum after the print cycle begins. (You can verify that an image does not appear on the drum by opening the printer in the middle of a print cycle. Then open the drum shutter on the toner cartridge and look for an image.)

Likely Causes

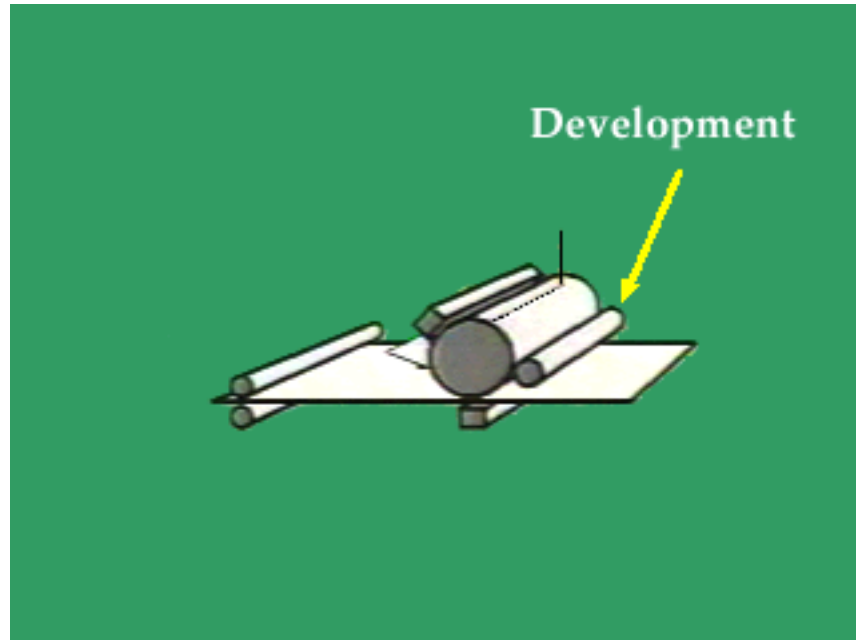
The laser unit and/or scanner motor is inoperable. These parts must function to specification for the printer to come to a ready state and initiate a print cycle.

The preconditioning exposure lamps may not be functioning properly. If the lamps are inoperable, the photosensitive drum does not erase completely between print cycles.

Any one of the following conditions cause this symptom:

- The beam detect mechanism from the laser/scanner assembly to the DC controller is damaged.
- The DC controller malfunctioned and did not send the required commands to the laser/scanner assembly.
- The toner cartridge is damaged, or the cartridge flange that opens the laser shutter is broken.
- The laser/scanner assembly is damaged.

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the third step in the 6-step print cycle, development.

Development

In the third step, the image on the photosensitive-drum surface develops into a visible image of toner particles. This process starts inside the toner cartridge with the developing cylinder (see Figure 4-8) that contains negatively charged toner powder. The toner particles jump from the cylinder to the exposed areas on the photosensitive drum that have a high positive potential. On some LaserWriters, the difference in potential between the development cylinder and photosensitive drum is controlled by a print density adjustment, which allows you to create slightly lighter or darker images. The print density on some LaserWriter models is adjusted with a dial, while other models use buttons, sliders, or software.

Print Generation

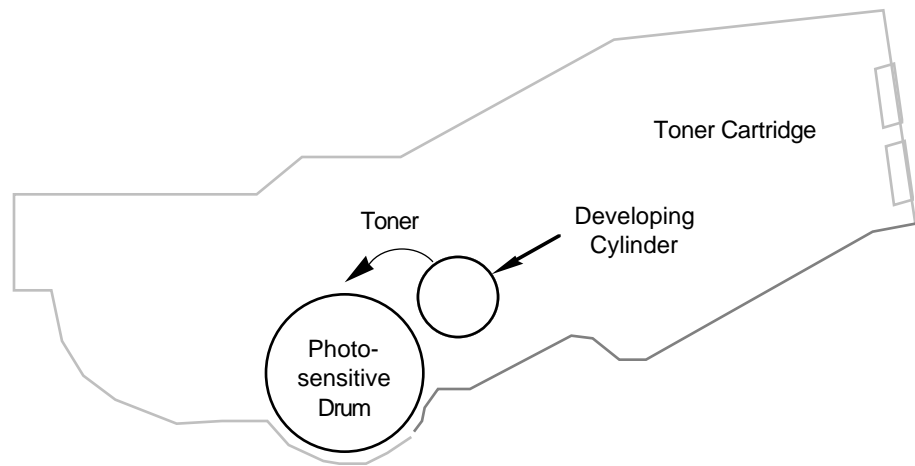


Figure 4-8
LaserWriter toner cartridge and developing cylinder

Development: Faulty Operation

The one common symptom of faulty operation at the development step of the print cycle and its likely causes are:

Common Symptom

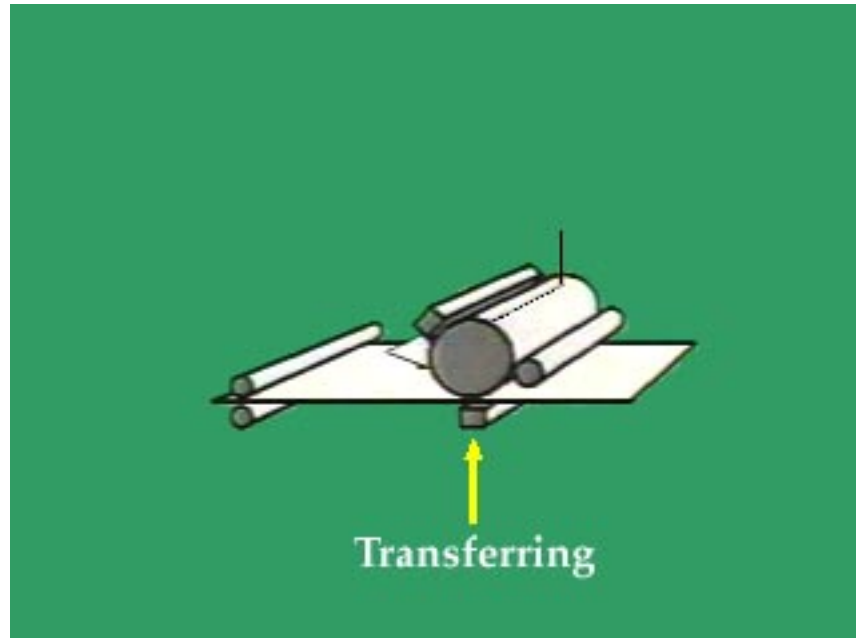
The latent image is created in Steps 1 and 2—Drum Charging and Image Formation (refer to Figure 4-5)—but is not developed. (To verify that an image did not develop, open the printer in the middle of a print cycle. Open the drum shutter and check for an undeveloped image on the drum.)

Likely Cause(s)

One or more of the following conditions may exist:

- The toner cartridge is faulty or the toner tape needs to be removed.
- The high-voltage power supply is faulty.
- The DC controller PCB malfunctioned and did not signal the high-voltage power supply to provide the correct voltage to the toner cartridge.

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the fourth step in the 6-step print cycle, transfer.

Transfer

During this fourth step of the LaserWriter print cycle (refer to Figure 4-9), the toner image on the drum surface transfers onto the paper in two stages. The paper passes between the photosensitive drum and the transfer roller assembly (or transfer corona wire on some LaserWriters), where the back of the paper receives a positive charge. The charge attracts the negatively charged toner particles to the paper, as illustrated in Figure 4-9.

Print Generation



Next, the stiffness of the paper and the negative voltage produced by a static-charge eliminator causes the paper to separate from the drum. By weakening the attractive force between the paper and the drum, the eliminator prevents thin paper from wrapping around the drum.

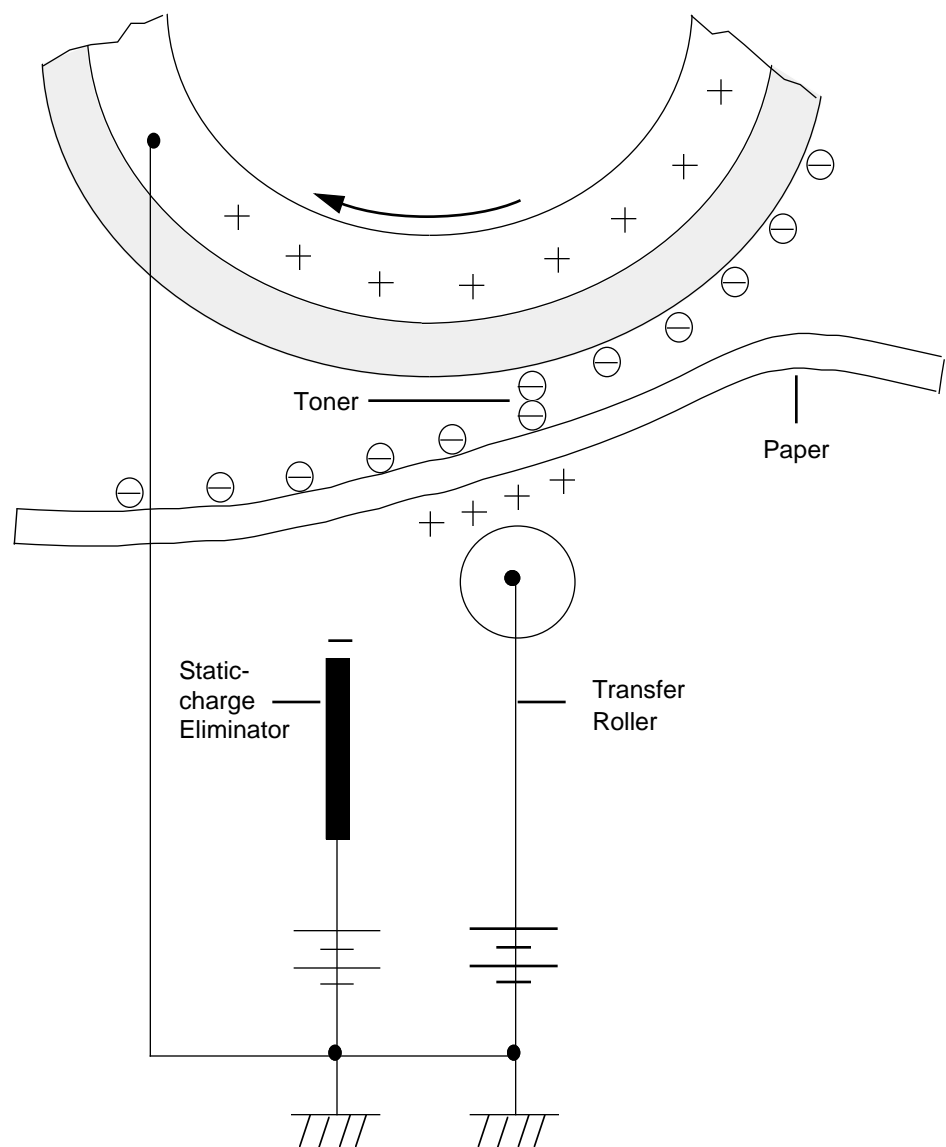


Figure 4-9
The transfer roller and static charge eliminator

Print Generation



Transfer: Faulty Operation

The one common symptom of faulty operation at the transfer step of the print cycle and its likely causes are:

Common Symptom

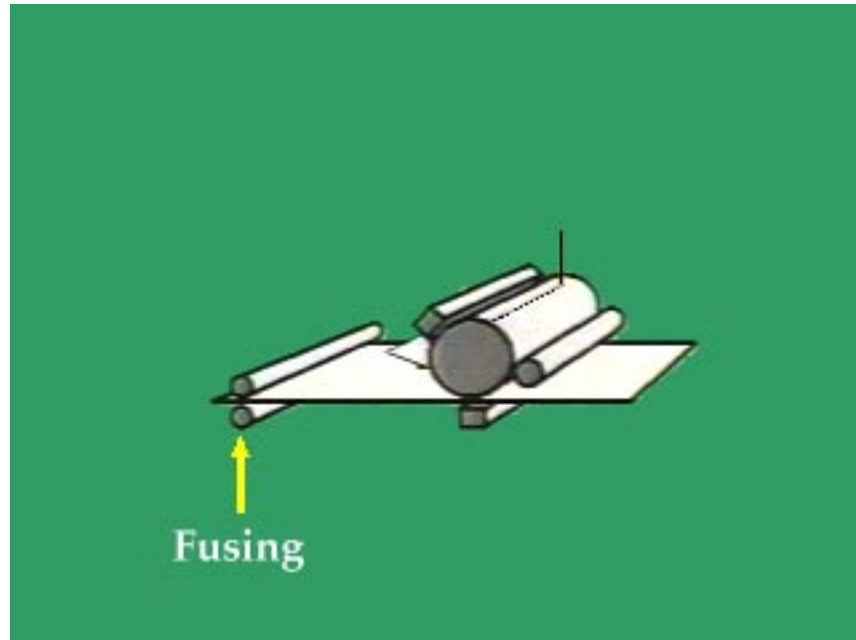
The image developed in Step 3—Development (refer to Figure 4-5)—does not transfer to the paper.

Likely Cause(s)

One or more of the following conditions exist:

- The transfer roller (or transfer corona wire on some laser printers) is damaged.
- The DC controller PCB did not provide the signal to the high-voltage power supply, which provides the voltage to the corona wire.
- The high-voltage power supply failed.

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the fifth step in the 6-step print cycle, fusing.

Fusing

The fifth step permanently fuses the image to the paper. After transfer, the toner remains on the paper only because of electrostatic attraction and a slight physical adhesion. A light touch smears the image.

The fuser assembly contains two rollers: the fusing roller and lower roller shown in Figure 4-10. The fusing roller contains a heater bulb that heats the toner and paper. The heat and pressure from both rollers fuses the toner particles onto the paper, creating a permanent image. The nonstick resin on the fusing roller keeps the paper from sticking to the roller.

Print Generation

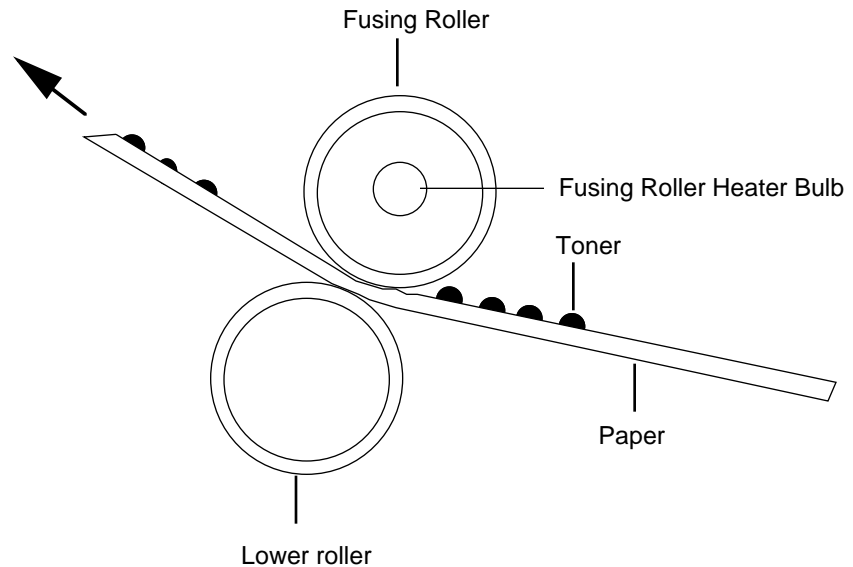


Figure 4-10
The Fuser Assembly

Fusing: Faulty Operation

Common symptoms of faulty operation at the fusing step of the print cycle and their likely causes are:

Common Symptom

The image transfers in step 4—Transfer (refer to Figure 4-5)—but fails to fuse to the paper.

Likely Cause(s)

- If the upper or lower fuser rollers are worn, the proper amount of pressure to bond the toner to the paper is not applied. For the printer to come to a ready state, an operating fuser bulb is required.
- The rollers may be in their shipping position, a position in which they are slightly separated from each other. Only certain LaserWriter models have a “shipping position” for their fuser rollers.
- The paper surface may be so smooth that the toner does not bond to the paper properly; the toner particles easily flake off.

Print Generation



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie illustrates the sixth step in the 6-step print cycle, cleaning the drum.

Cleaning the Drum

During this last step of the print cycle, the photosensitive drum is cleaned. Residual toner from the image is cleaned off the drum by the cleaning blade so that new images are clear and distinct. Figure 4-11 shows the location of the cleaning blade.

Print Generation



Cleaning: Faulty Operation

The one common symptom of faulty operation at this step of the print cycle and its likely cause(s) are:

Common Symptom

Pages have random black dots, spots, stripes, or parts of the previous page.

Likely Cause(s)

- The cleaning blade is malfunctioning.
- The photosensitive drum is damaged and cannot be cleaned.

In both cases, replace the toner cartridge.

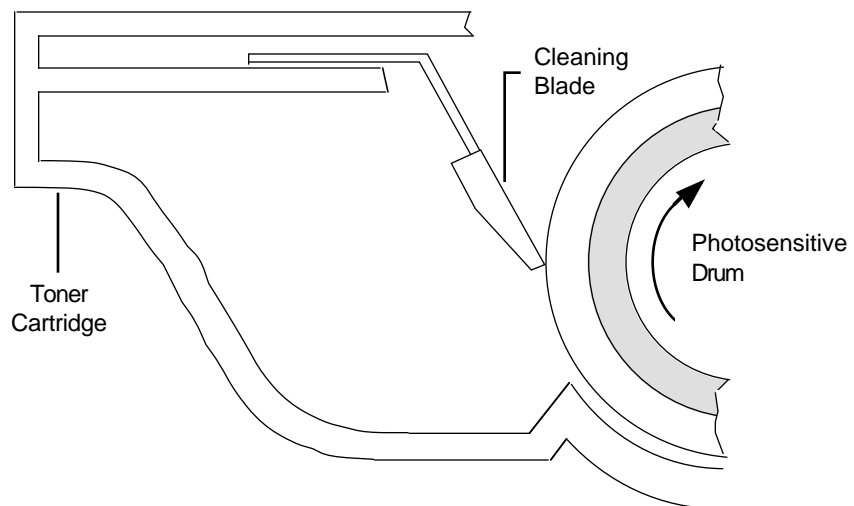


Figure 4-11
The toner cartridge drum-cleaning blade

Practice Exercise 6

**Directions**

The list below contains the six LaserWriter print cycle steps. Number the steps in the order in which they occur. Try to complete this exercise from memory.

- _____ Transfer
- _____ Cleaning the drum
- _____ Image formation
- _____ Fusing
- _____ Development
- _____ Charging the drum

When you are ready, continue with Practice Exercise 7 on the next page.

Practice Exercise 7



Directions

Match a LaserWriter print cycle step to each of the statements below. There is one answer for every statement; items can be used more than once.

- A. Transfer
 - B. Cleaning the drum
 - C. Image formation
 - D. Fusing
 - E. Development
 - F. Charging the drum
-
- 1. _____ Produces an image of electrical charges on the photosensitive drum.
 - 2. _____ Changes the image on the photosensitive drum to a visible image using toner.
 - 3. _____ Removes residual toner from the photosensitive drum.
 - 4. _____ Exposes the photosensitive drum to the preconditioning exposure lamps.
 - 5. _____ Positively charged paper attracts the negatively charged toner from the photosensitive drum.
 - 6. _____ Toner particles permanently adhere to the paper.
 - 7. _____ Primary corona applies a uniform layer of negative charges over the surface of the photosensitive drum.
 - 8. _____ The beam detect mechanism tells the DC controller to begin the next scan line.
 - 9. _____ Paper separates from the photosensitive drum.
 - 10. _____ Scanning mirror reflects the laser beam through focusing lenses.

When you finish, compare your answers for Exercises 6 and 7 with those on pages 98-99.

Practice Exercise 6 (Answers)



Compare your answers to Practice Exercise 6 with the answers below.

- 4 Transfer
- 6 Cleaning the drum
- 2 Image formation
- 5 Fusing
- 3 Development
- 1 Charging the drum

If you missed any items, please review the appropriate section of the module and correct any incorrect answers before you continue.

Practice Exercise 7 (Answers)



Compare your answers to Practice Exercise 7 with the answers below.

- A. Transfer
 - B. Cleaning the drum
 - C. Image formation
 - D. Fusing
 - E. Development
 - F. Charging the drum
-
- 1. C Produces an image of electrical charges on the photosensitive drum.
 - 2. E Changes the image on the photosensitive drum to a visible image using toner.
 - 3. B Removes residual toner from the photosensitive drum.
 - 4. F Exposes the photosensitive drum to the preconditioning exposure lamps.
 - 5. A Positively charged paper attracts the negatively charged toner from the photosensitive drum.
 - 6. D Toner particles permanently adhere to the paper.
 - 7. C Primary corona applies a uniform layer of negative charges over the surface of the photosensitive drum.
 - 8. C The beam detect mechanism tells the DC controller to begin the next scan line.
 - 9. A Paper separates from the photosensitive drum.
 - 10. C Scanning mirror reflects the laser beam through focusing lenses.

If you missed any items, please review the appropriate section of the module and correct any incorrect answers.

When you are ready, begin Practice Exercise 8 on the next page.

Practice Exercise 8

**Directions**

Complete Practice Exercises 8 and 9, and then check your answers against the answer pages.

Indicate the likely causes of each print generation symptom.

1. You are repairing a LaserWriter that generates blank pages. While troubleshooting the printer, you find that an image was created but not developed on the photosensitive drum. What are the likely print generation causes of this problem?

2. The LaserWriter you are repairing correctly develops the image on the photosensitive drum but does not transfer the image to the paper. What are the likely print generation causes of this problem?

3. The LaserWriter you are repairing correctly transfers the image to the paper, but the image easily smears or rubs off. What is/are the likely print generation cause(s) of this problem?

When you are ready, continue with Practice Exercise 9 on the next page.

Practice Exercise 9

**Directions**

Indicate the likely cause(s) of each page creation and print generation problem.

1. A customer just replaced her non-PostScript laser printer with a new PostScript LaserWriter. During your discussion you learn that she ran the Installer program to properly install the printer software, that she correctly connected her Macintosh to the printer by using LocalTalk cables and connectors, and that the printer is switched on. She also states that AppleTalk is active in the Chooser, and that her network is not divided into zones. She doesn't see the printer name in the Chooser. What is/are the likely cause(s) of this problem?

2. A customer says his new LaserWriter printer is printing much slower than it should. The files he is trying to print are one-page letters without graphics. The cables are correct, and the appropriate driver is installed and highlighted. What is/are the likely cause(s) of this problem?

3. The LaserWriter you are repairing does not print. While troubleshooting you do not find an image on the photosensitive drum. What is/are the likely cause(s) of this problem?

When you are ready, compare your answers to Practice Exercises 8 and 9 with those on pages 102-103.

Practice Exercise 8 (Answers)



Compare your answers to Practice Exercise 8 with the answers below.

1. You are repairing a LaserWriter that generates blank pages. While troubleshooting the printer, you find that an image was created but not developed on the photosensitive drum. What are the likely print generation causes of this problem?
 - *The toner cartridge is faulty or the toner tape is still in the cartridge.*
 - *The high-voltage power supply, which provides the voltage to the toner cartridge, is faulty.*
 - *The DC controller malfunctioned and did not provide the signal to the high-voltage power supply.*
2. The LaserWriter you are repairing correctly develops the image on the photosensitive drum, but does not transfer the image to the paper. What are the likely print generation causes of this problem?
 - *The transfer roller (or transfer corona wire on some LaserWriters), which attracts the toner to the paper, is damaged.*
 - *The DC controller did not provide the signal to the high-voltage power supply, which provides the voltage to the corona wire.*
 - *The high-voltage power supply failed.*
3. The LaserWriter you are repairing correctly transfers the image to the paper, but the image easily smears or rubs off. What is/are the likely print generation cause(s) of this problem?
 - *The fuser rollers are worn. (Remember that a faulty fuser bulb prevents the printer from coming to a ready state, so the problem could not be the bulb.)*
 - *The fuser rollers are in their shipping position, a position in which they are separated from each other very slightly.*

If you missed any items, please review the appropriate section of the module and correct any incorrect answers.

Practice Exercise 9 (Answers)



Compare your answers to Practice Exercise 9 with the answers below.

1. A customer just replaced her non-PostScript laser printer with a new PostScript LaserWriter. During your discussion you learn that she ran the Installer program to properly install the printer software, that she correctly connected her Macintosh to the printer by using LocalTalk cables and connectors, and that the printer is switched on. She also states that AppleTalk is active in the Chooser, and that her network is not divided into zones. She doesn't see the printer name in the Chooser. What is/are the likely cause(s) of this problem?
 - *The newly installed LaserWriter driver is not selected in the Chooser.*
2. A customer says his new LaserWriter printer is printing much slower than it should. The files he is trying to print are one-page letters without graphics. The cables are correct, and the appropriate driver is installed and highlighted. What is/are the likely cause(s) of this problem?
 - *TrueType or PostScript fonts are not available for the fonts he wants to print, forcing the printer to download and process bitmap fonts from the computer.*
3. The LaserWriter you are repairing does not print. While troubleshooting you do not find an image on the photosensitive drum. What is/are the likely cause(s) of this problem?
 - *The beam detect mechanism (often a fiber-optic cable) from the laser/scanner assembly to the DC controller is damaged.*
 - *The DC controller malfunctioned and did not send the required commands to the laser/scanner assembly.*
 - *The toner cartridge is damaged.*
 - *The laser shutter did not open, thereby preventing the laser from striking the drum. (Remember, if the laser and/or scanning motor are faulty, the print cycle does not initiate.)*

If you missed any items, please review the appropriate section of the module and correct any incorrect answers.

When you are ready, begin the next module—"Troubleshooting Basics."

Overview



This final module presents a general process for troubleshooting all Apple LaserWriters. In previous modules, you learned about LaserWriter features, setup procedures, and theory of operation. This module teaches you to use this information to troubleshoot and resolve LaserWriter problems. This module does not teach you to take apart LaserWriters or replace modules and parts, but does introduce you to the entire troubleshooting and repair process.

Objectives

1. Identify and describe the major steps of the LaserWriter troubleshooting process.
2. Recall key questions to ask customers and quick checks to perform when first troubleshooting a faulty LaserWriter.
3. Given a problem description, classify the problem as either hardware-, software-, or network-related.
4. Given a LaserWriter problem description, indicate which troubleshooting resource(s) are likely to be most helpful.

Module Organization

This module has four sections:

- “Overview” introduces this module.
- “General Troubleshooting” reviews the seven general troubleshooting steps common to troubleshooting all Apple products and presents the LaserWriter troubleshooting process.
- “Fault Isolation” provides hands-on techniques for isolating and resolving LaserWriter problems.
- “Troubleshooting Strategy” provides information and practice on selecting and combining the troubleshooting resources, and forming a troubleshooting strategy.

Begin the first section—“General Troubleshooting”—on the next page.

General Troubleshooting



Troubleshooting Apple LaserWriters is like troubleshooting any Apple product. First we will review the general troubleshooting process. You may already be familiar with the general troubleshooting process, but it is important to remind yourself of the major steps to ensure you apply them when troubleshooting LaserWriters.

You should follow the seven major steps in the list below when troubleshooting any Apple product. The actions within each step are listed in the order in which you should perform each action. As you gain troubleshooting experience, you may decide to complete the actions in a sequence that reflects your experience. Take a few minutes to thoroughly review each step.

1. Complete initial administrative tasks (as they apply to your service center):

- Determine Apple warranty coverage.
- Begin the AppleOrder Service Repair Order (SRO).
- Back up the customer's data.

2. Identify and isolate the problem:

- Determine the deviation from normal operation. By telephone or in person, ask the customer questions, listen carefully, and take notes.
- Isolate the cause of the problem. By telephone or in person, re-create intermittent problems.
- Try quick fixes as appropriate. Check cables, adjust controls, ensure proper installation, and check for visually damaged or dirty parts.
- Systematically search for the problem using the troubleshooting resources:
 - Be familiar with and use self-tests, diagnostic software, *Service Source*, *Apple Service Guides*, the Tech Info Library, owner's guides, your log of common problems, customer records, software update manuals, and Apple Technical Support.
- Identify a suspect module or part.

General Troubleshooting



3. Resolve the problem:
 - Replace modules.
 - Make adjustments.
 - Instruct the user.
 - Perform preventive maintenance.
 - Reassemble.
4. Test the system—run diagnostics overnight and perform basic functions.
5. Complete paperwork (as appropriate for your service center):
 - Complete the AppleOrder SRO form.
 - Update your own log of common problems.
 - Update the customer's file.
 - Inform Apple service support personnel about bugs you discover.
6. Pack and ship defective modules if necessary (and as appropriate for your service center):
 - Refer to the service programs information in *Service Source* for shipping-and-packaging guidelines.
 - Use exact or duplicate Apple packaging.
 - Ship the repair paperwork with the defective module.
7. Inform the user.
 - Explain the cause of the problem to the user.
 - Test the system in front of the user.
 - Instruct and caution the user, if appropriate.
 - Follow up on the problem.

Troubleshooting Apple LaserWriters is like troubleshooting other Apple products in that you should carefully complete each of these seven troubleshooting steps. The remaining sections of this module focus on step 2, identifying and isolating the problem.

Continue with the next section—"Fault Isolation."

Fault Isolation



The troubleshooting process often begins when a customer states that his or her LaserWriter is not functioning properly. When talking with a customer, your goal is to identify the deviation from normal operation and to take steps to quickly resolve the problem. Several variables can impact your successful achievement of this goal. First, the customer often provides a vague description of the problem. Second, the customer may not be familiar with the LaserWriter or the computer, and is only able to provide limited information. Third, you may spend a large amount of time on the problem if you do not troubleshoot efficiently.

Deviation From Normal Operation

Begin the troubleshooting process by identifying, as clearly as possible, the actual deviation from normal operation. Often a customer will call and say that his or her LaserWriter simply does not work. A vague symptom like this provides little useful information with which to begin troubleshooting. “Does not work” may mean anything—the printer does not power up, pages do not print, or the pages have smudge marks. You must ask, and keep asking, clarifying questions until the customer identifies a specific deviation from normal operation. Until you know the deviation from normal operation, you cannot begin to isolate the cause.

Naturally, you want to be sure that the customer’s description of the problem is indeed accurate. The best way to verify the deviation from normal operation is to set up the LaserWriter and try to re-create the problem. Make sure that you have all the customer’s equipment. If a problem is caused by a bad cable but you don’t have the customer’s cable, you will not be able to re-create the problem. If you cannot re-create the problem, contact the customer and repeat customer actions until you see the symptom. Continue to discuss the problem with the customer as needed. With an accurate problem description, you are ready to take actions to further isolate and resolve the problem.

Fault Isolation



Along with a problem description from the customer, there are some key questions you can ask of the customer. Ask questions about:

- The operating condition and environment under which the problem occurs (model of computer and LaserWriter; whether the printer is networked; LaserWriter driver version; system software and version; application software and version).
- Exactly what the customer is doing when the problem occurs.
- What has been changed or added to the system if the problem only appeared recently.
- What the customer has done to fix the problem, and the results.
- Whether the problem is continuous or intermittent. Does it occur only during dry seasons of the year when static is most prevalent?
- Whether the LaserWriter can print a user test page. (Remember that some LaserWriters do not print a test page, and that the test page option can be turned off on any LaserWriter through printer utility software.)

Quick Checks

Before diving headlong into a lengthy troubleshooting process, make some quick checks of simple things that might be the cause of the problem. Quick checks can save hours of needless troubleshooting and frustration. Apple's troubleshooting resources typically include suggestions on the things to check when performing a "quick check." Here is a partial list of quick checks, which gives you an idea of the kinds of things to look for when performing quick checks on a LaserWriter:

- Check the power source and power connection. Everything plugged in? Got power?
- Check all cables and cable connections. Everything plugged in?
- Confirm that the toner cartridge is installed and has toner. Has the toner cartridge sealing tape been removed?
- Confirm that the paper cassette is installed and has paper.
- Confirm that all access doors are closed.

Fault Isolation



- Check the status lights.
- Check the print density adjustment (where applicable).
- Check the switch settings, if applicable. (The network and communication settings of some LaserWriters are set by switches accessible by the customer, while on others they are set through software.)
- Confirm whether the printer produces a user test page. (You may already have asked the customer about this. Now is the time to confirm it. Additionally, it gives you the chance to see, hear, and smell(!) what the printer does when powering up. This is valuable information.) Remember that for many LaserWriters, printing a user test page is an option that can be turned off. You may have to enable the user test page option using Apple printer utility software before trying to print a user test page.

When you are ready, begin Exercise 1 on the following page.

Practice Exercise 1

**Directions**

This exercise tests your recall of important elements in the first phase of LaserWriter troubleshooting, information gathering.

From memory, write down four key questions that you can ask a customer about his or her faulty LaserWriter.

1. _____

2. _____

3. _____

4. _____

Continue on the next page.

Practice Exercise 1



From memory, write down four LaserWriter troubleshooting “quick checks.”

1. _____
2. _____
3. _____
4. _____

Compare your answers with those on page 112.

Practice Exercise 1 (Answers)



Compare your answers to Practice Exercise 1 with the answers below.

From memory, write down four key questions that you can ask a customer about their faulty LaserWriter.

- *The operating condition and environment under which the problem occurs (model of computer and LaserWriter; whether printer is networked; LaserWriter driver version; system software and version; application software and version).*
- *Exactly what the customer is doing when the problem occurs.*
- *What has been changed or added to the system if the problem only appeared recently.*
- *What the customer has done to fix the problem, and the results.*
- *Whether the problem is continuous or intermittent.*
- *Whether the LaserWriter can print a user test page.*

From memory, write down four LaserWriter troubleshooting “quick checks.”

- *Check the power source and power connection.*
- *Check all cables and cable connections. Everything plugged in?*
- *Confirm that the toner cartridge is installed and has toner. Has the toner cartridge sealing tape been removed?*
- *Confirm that the paper cassette is installed and has paper.*
- *Confirm that all access doors are closed.*
- *Check the status lights.*
- *Check the print density adjustment.*
- *Check the switch settings, if applicable.*
- *Confirm whether the printer produces a user test page.*

If you could not recall enough items to complete the exercise, review the appropriate section of the module and update incorrect or missing items before you continue.

When you are ready, continue with the next section on the following page.

Fault Isolation



If a quick check hasn't quickly led you to the solution, the next step in isolating the problem is to determine whether it is related to the:

- Hardware environment
- Software environment
- Network environment

Categorizing the problem helps narrow down the possible causes and helps you troubleshoot more efficiently.

Problem Identification (Hardware)

The source of the problem is most likely the LaserWriter itself if any of the following conditions exists:

- The printer is unable to print a user or service test page. (Information on how to generate a service test page for each LaserWriter is contained in *Service Source*.)
- The printer shows obvious, physical signs of damage.
- The printer emits unusual noises or smells.
- The printer indicates a paper jam or paper-out condition.
- The print quality of the test print is not acceptable.
- The printer has no power.

Problem Identification (Software)

If any of the following conditions exist, the source of the problem is most likely the software used to communicate and print with the LaserWriter.

- The printer successfully prints both a user test page and a service test page, but does not print when connected to a computer (provided the computer and network hardware components are known-good).
- The user is attempting to print using pre-release, public domain, or untested software (applications, fonts, printer drivers).
- The same problem occurs when the software is used with other known-good LaserWriter printers.

Fault Isolation



Problem Identification (Network)

If any of the following conditions exist, the source of the problem is most likely the network used to connect the computer and LaserWriter:

- Two or more users on the network experience the same printing problems.
- The printer successfully prints both a user test page and a service test page, and the computer and software are known-good.
- The printer suddenly exhibits “poor performance” symptoms (for example, the printer takes longer to print than it used to).
- The printer or other network devices have been moved from one location to another.

Practice Exercise 2



Directions

The following list contains problem descriptions. Classify each problem as hardware-, software-, or network-related using the key below.

H = Hardware

S = Software

N = Network

1. ____ The printer has no power.
2. ____ Two or more users on the network are experiencing the same problem.
3. ____ The printer shows obvious, physical signs of damage.
4. ____ The same problem occurs when the software is used with other known-good LaserWriter printers.
5. ____ The printer successfully prints both a user test page and a service test page, and the computer and software are known-good.
6. ____ The printer is unable to print a user test page or a service test page.
7. ____ The printer or other network devices have been moved from one location to another.
8. ____ The user is attempting to print with a pre-release version of a printer driver.
9. ____ The printer successfully prints both a user test page and a service test page, but does not print when connected to a computer. The computer and the network hardware components are known-good.
10. ____ The print quality of the user test print is not acceptable.

Compare your answers with those on page 116.

Practice Exercise 2 (Answers)



Compare your answers to Practice Exercise 2 with the answers below.

H = Hardware

S = Software

N = Network

1. H The printer has no power.
2. N Two or more users on the network are experiencing the same problem.
3. H The printer shows obvious, physical signs of damage.
4. S The same problem occurs when the software is used with other known-good LaserWriter printers.
5. N The printer successfully prints both a user test page and a service test page, and the computer and software are known-good.
6. H The printer is unable to print a user test page or a service test page.
7. N The printer or other network devices have been moved from one location to another.
8. S The user is attempting to print with a pre-release version of a printer driver.
9. S The printer successfully prints both a user test page and a service test page, but does not print when connected to a computer. The computer and the network hardware components are known-good.
10. H The print quality of the user test print is not acceptable.

If you missed any items, review the appropriate section of the module and correct any incorrect answers. When you are ready, continue with the next section on the following page.

Troubleshooting Strategy



Troubleshooting may be the most difficult aspect of providing LaserWriter service. It requires equal parts experience, logic, and knowledge. This section deals with troubleshooting strategy as it applies to Apple LaserWriters. You'll be presented with some thoughts on choosing the best troubleshooting resources and forming a troubleshooting strategy. And, you will be given a chance to form troubleshooting strategies yourself.

One of the challenges of troubleshooting LaserWriters is knowing which resources to use and when to use them. The "Features" module of this course reviewed resources available to the service technician for LaserWriter troubleshooting. In addition to the Apple resources reviewed in that module, there are a few more. A more complete list might include:

- Your experience
- Theory of operations (from this course)
- *Service Source* CD
- Service Source Online
- *Apple Service Guides* (ASGs)
- Tech Info Library
- Wiring diagrams (found in *Service Source* and ASGs)
- Owner's manuals

Some technicians rely on just one or two of these resources (the "expert" who only goes by experience and hunches, never looking at a manual; the "electronics whiz" who uses only a multimeter and the wiring diagram; the "rookie" who follows the manual from A-Z). Other technicians will skip around from one resource to another without a real plan. But the best technicians know how to use all the resources, and are able to pick the ones most likely to contain helpful information for a given troubleshooting problem.

Troubleshooting Strategy



After gathering information from the customer, begin to form a troubleshooting strategy. Try quick checks. Draw on your experience, however little or great it may be. Have you seen this problem before? Into what category does this problem fall: hardware, software, or network? Which resource(s) will have the information to help you with the type of problem you suspect it to be? These are the questions to consider when forming a troubleshooting strategy. Let's walk through a LaserWriter troubleshoot to see how a strategy is formed, what that strategy is, and which resources are used.

Continue with the Walk-Through on the next page.

Troubleshooting Strategy



Customer information: The customer, who has an on-site maintenance agreement with your organization, tells you that the LaserWriter 16/600 PS printer has suddenly stopped working. When the printer is turned on the jam light comes on steady. It is not an intermittent failure. The customer, who is fairly knowledgeable and capable, has opened up the access doors and searched for paper jams. There don't appear to be any.

Your thoughts/strategy: *"The customer has already performed a quick check by searching for loose paper fragments that might legitimately be causing the jam light to come on. Do I have enough information to classify this as hardware-, software-, or network-related? Yes. It sure seems to be a hardware-related problem. Because of the contract with the customer, I must go on-site."*

First step: Once on-site, you confirm the problem by re-creating it. Then you try the same quick check (checking for loose paper inside the printer) that the customer allegedly tried. Why "allegedly"? Because the customer may not have checked all areas or may have done something incorrectly. So to be sure, you perform the quick check yourself. It still appears to be a hardware-related problem.

Your thoughts/strategy: *"Because I'm on-site, and because this appears to be a hardware-related problem, I'll use the Apple Service Guide as a starting reference."*

Next step: The *Apple Service Guide* contains a troubleshooting flowchart that you follow. Eventually you are led to Table 15, "Paper-Jam LED is On After Printer Warmup."

Your thoughts/strategy: *"Before digging in, I'll browse over the various checks and solutions in the table to get an overall idea of what the Service Guide's line of reasoning is. Here's where I apply my theory of operations knowledge. In case the troubleshooting table doesn't lead me to the solution, I'll have something to fall back on. I notice that the table includes a number of voltage checks, so I'll get out my multimeter and the wiring diagram in the Service Guide."*

Troubleshooting Strategy



Next step: As you work your way through the table, you arrive at a step that asks for a voltage reading on connector J208 of the DC controller board. Based on the results of the voltage reading, you are instructed to either replace an assembly or continue down the troubleshooting table.

Your thoughts/strategy: *“Let me look at the wiring diagram to see just what I’m being asked to test. What is the Service Guide ultimately asking me to check? Connector J208 on the DC controller board goes to the Delivery/Interlock sensor. I’ll bet that my voltage check is trying to determine whether the problem is with the sensor or with the board that communicates with the sensor (DC controller board).”*

Final outcome: You take the voltage reading and do not get acceptable results. Based on that, the table in the Service Guide instructs you to replace the delivery/interlock sensor. The printer now works.

Final analysis: This scenario illustrates two important points.

- Keep parts swapping to a minimum. In this example there was only one swap needed to solve the problem. LaserWriters have so many parts and are so prone to additional damage during the take-apart/reassembly process that it is wise to spend a bit more time testing and thinking, and less time swapping parts in and out.
- Use the right resources. The resources used this time included:
 - A bit of technician experience (to ask the right questions and perform the appropriate quick checks)
 - *Apple Service Guide* (because this was an on-site hardware-related problem)
 - The wiring diagram (to perform the voltage check and to see which assemblies are involved)
 - Theory of operations knowledge (to understand what’s happening and serve as the basis for additional troubleshooting steps should the *Service Guide* and wiring diagram not lead to the solution)

Troubleshooting Strategy



In this example, the solution was arrived at through the use of Apple resources. However, there will be LaserWriter troubleshoots for which a particular Apple resource may not seem helpful. In those cases, you must increase your reliance on experience and theory of operations knowledge to help form a strategy, while still referring back to the Apple resources along the way.

When you are ready, begin Exercise 3 on the following page.

Practice Exercise 3



Directions

Now it's your turn to troubleshoot. Read the customer information below. With that information, classify the problem as hardware-, software-, or network-related. Next, choose the resources that you think will be most helpful. Lastly, plan a strategy for the troubleshoot.

Customer Information: The customer reports a problem with his LaserWriter. Everything worked fine when it was first installed. Now, however, he has intermittent problems. Sometimes he gets error messages stating that the paper size is wrong. Other times the printer just sits and sits and sits but never prints out (known as "timing out"). Sometimes he just gets PostScript error messages returned. He has already tried re-installing the software, but the problem still occurs.

He is using version 8.4 of the LaserWriter printer driver software. The printer is on a network with other LaserWriter printers of the same type. The problem occurs with the other printers, too, but only from his computer. All the network devices (printers, file servers, mail servers) consistently show up in his Chooser.

This problem appears to be related to:

_____ Hardware _____ Software _____ Network

The resources that are most likely to help solve this problem are:

| | |
|--------------------------------|-----------------------------------|
| _____ Your experience | _____ <i>Apple Service Guides</i> |
| _____ Theory of operations | _____ Tech Info Library |
| _____ <i>Service Source</i> CD | _____ Wiring diagram |
| _____ Service Source Online | _____ Owner's manual |

Practice Exercise 3



Your strategy/plan for this troubleshoot:

Compare your answers with those provided on pages 124-125.

Practice Exercise 3 (Answers)



Compare your answers to those given below.

Customer Information: The customer reports a problem with his LaserWriter. Everything worked fine when it was first installed. Now, however, he has intermittent problems. Sometimes he gets error messages stating that the paper size is wrong. Other times the printer just sits and sits and sits but never prints out (known as “timing out”). Sometimes he just gets PostScript error messages returned. He has already tried re-installing the software, but the problem still occurs.

He is using version 8.4 of the LaserWriter printer driver software. The printer is on a network with other LaserWriter printers of the same type. The problem occurs with the other printers, too. It only occurs from his computer. All the network devices (printers, file servers, mail servers) consistently show up in his Chooser.

This problem appears to be related to:

_____ Hardware X Software _____ Network

The resources that are most likely to help solve this problem are:

| | |
|------------------------------|--------------------------------|
| <u> X </u> Your experience | _____ Apple Service Guides |
| _____ Theory of operations | <u> X </u> Tech Info Library |
| _____ Service Source CD | _____ Wiring diagram |
| _____ Service Source Online | _____ Owner’s manual |

How this troubleshoot worked out:

Based on the information you were able to get from the customer, it appears the network is OK. Further, the problem occurs only from his computer, leading you to believe the source of the problem is with his computer (software).

Practice Exercise 3 (Answers)



You suspect that the system software might be the problem, but the customer has already re-installed with no luck. This problem sounds like a specific, problem/cure situation. The Tech Info Library is just the place to find information of that type. You search the library using the search string "LaserWriter and 8.4 and paper size." The search returns an article that solves the problem! Corrupt printer preferences files appear to be the culprit. The final solution is to delete the preferences files and let the printer driver build new ones from scratch during the next printjob.

Continue with Practice Exercise 4 on the next page.

Practice Exercise 4



Directions

Read the customer information below. With that information, classify the problem as hardware-, software-, or network-related. Next, choose the resources that you think will be most helpful. Lastly, plan a strategy for the troubleshoot. Record your answers in the space provided or on a separate piece of paper.

Customer Information: The customer has brought a LaserWriter IINT into your shop. She says that the print quality is poor. You print out a user test page while she's there, and find that the image is light and cloudy across the whole page. The customer reports that the problem just occurred; it has not been a gradual decline.

This problem appears to be related to:

_____ Hardware _____ Software _____ Network

The resources that are most likely to help solve this problem are:

| | |
|--------------------------------|-----------------------------------|
| _____ Your experience | _____ <i>Apple Service Guides</i> |
| _____ Theory of operations | _____ Tech Info Library |
| _____ <i>Service Source</i> CD | _____ Wiring diagram |
| _____ Service Source Online | _____ Owner's manual |

Practice Exercise 4



Your strategy/plan for this troubleshoot:

Compare your answers with those provided on pages 128-129.

Practice Exercise 4 (Answers)



Compare your answers with those given below.

Customer Information: The customer has brought a LaserWriter IINT into your shop. She says that the print quality is poor. You print out a user test page while she's there, and find that the image is light and cloudy across the whole page. The customer reports that the problem just occurred; it has not been a gradual decline.

This problem appears to be related to:

☒ Hardware ☐ Software ☐ Network

The resources that are most likely to help solve this problem are:

| | |
|--|--|
| <input checked="" type="checkbox"/> Your experience | <input type="checkbox"/> Apple Service Guides |
| <input checked="" type="checkbox"/> Theory of operations | <input type="checkbox"/> Tech Info Library |
| <input checked="" type="checkbox"/> Service Source CD | <input checked="" type="checkbox"/> Wiring diagram |
| <input type="checkbox"/> Service Source Online | <input type="checkbox"/> Owner's manual |

How this troubleshoot worked out:

Because the customer brought in the printer and it exhibited the problem in a stand-alone environment, it is easy to conclude that this is a hardware-related problem. You try a couple of quick checks: printing with good laser-quality printer paper and a known-good toner cartridge. These actions do not help. Because you're in the shop, and because this is a hardware repair, you choose the Service Source CD as a troubleshooting resource.

The symptom chart in Service Source asks some yes/no questions. As you progress through the chart, you're asked to check the print density dial, the paper and toner cartridge, and the transfer corona wire. All are

Practice Exercise 4 (Answers)



OK. Next, you're asked to open up the printer and take some voltage readings. Time to get out the wiring diagram, multimeter, and theory of operations knowledge!

You perform voltage checks at J213 pins 1 and 6, and J213 pins 2 and 6. The wiring diagram shows that to be the connection between the DC controller and drum sensitivity switches. Those checks come out OK. Next, you are asked to check voltage at J601 pins 1 and 7, pins 6 and 7, and at pins 4 and 7. The wiring diagram shows those to be connections between the DC controller and the high voltage power supply. Your theory of operations knowledge tells you that you're checking the components involved with the transfer stage of the print cycle. If the Service Source flowchart doesn't work out, your backup plan will be to check other components involved in the image transfer stage of the print cycle.

One of the voltage readings on the high voltage power supply is abnormal, leading you to swap it out. The printer now functions normally.

Had you gotten to the end of the flowchart with no solution, what might have been next? Well, the DC controller was a part of all the voltage checks; that might have been the problem. You could try stopping a printjob when it is halfway through the printer, and inspecting the photosensitive drum to be sure the image is there (which confirms that everything up to the image transfer stage is working properly). Or you could conduct another check of the transfer corona wire for dirt or a poor electrical connection. In essence, you will want to retrace your steps while also expanding your inspection of the components involved in the image transfer stage of the print cycle.

When you have completed this exercise, you have finished the Introduction to LaserWriter Service course. Congratulations!

Appendix A



Overview

There are several LaserWriter printers that cannot be networked. Most do not use the PostScript page description language to produce printed pages. These LaserWriters are referred to as “direct-connect” and/or “QuickDraw-based” printers. This appendix presents information unique to these LaserWriters. In it, you’ll find information about how to set up these LaserWriters, their printer drivers, and how they communicate with the computer to which they’re attached.

Remember that these printers have much in common with all other LaserWriters. Only their connection method, their printer drivers, and the page description language differ.

Connections



Direct-connect LaserWriters connect to a single computer and cannot directly be shared by users on a network (though some direct-connect LaserWriters can be shared on the network via GrayShare software). Direct-connect LaserWriters connect to a computer using one of two connections: serial or SCSI.

Some direct-connect LaserWriters have a serial connection to the computer, to either the printer port or modem port. A common mini-DIN 8 serial cable is used to connect the devices, as Figure A-1 shows.

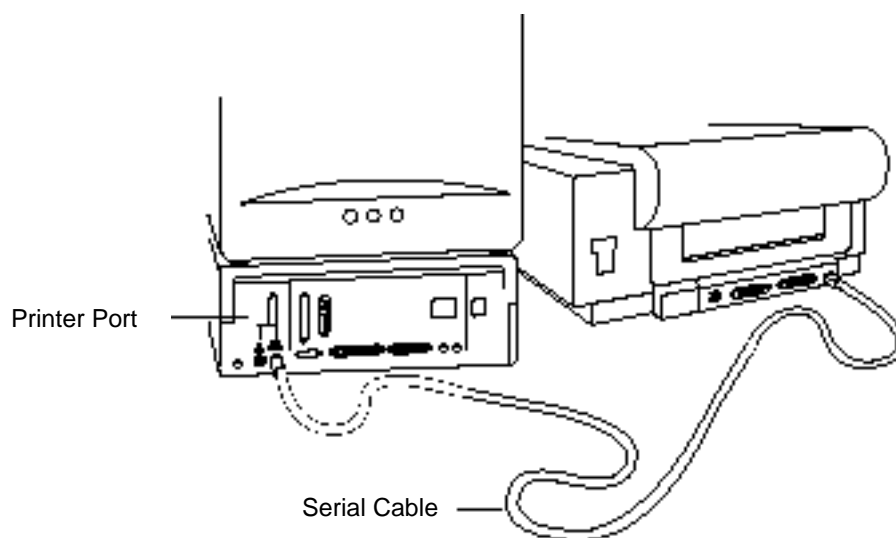


Figure A-1
A direct-connect LaserWriter connected to a MacOS-based computer's printer port

Connections



Note: Some network LaserWriters can also connect to a computer serial port. These printers offer the user a choice of connection types and allow simultaneous printer access to direct and network users.

Other Apple direct LaserWriter printers connect to a computer SCSI port, as Figure A-2 shows. As with any Apple SCSI device, you must use correct SCSI termination, cabling, and ID numbers.

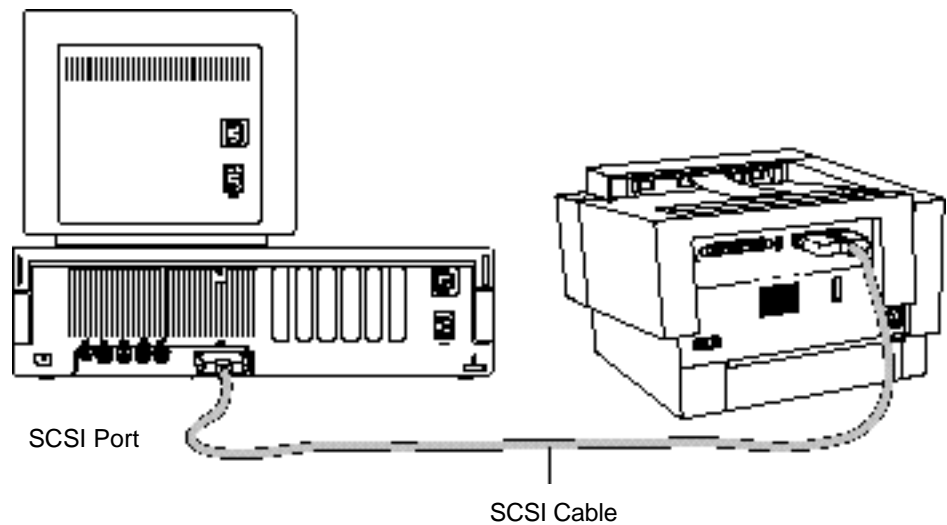


Figure A-2
A direct-connect LaserWriter connected to a MacOS-based computer's SCSI port

Apple direct-connect LaserWriter printers typically use the QuickDraw page description language. QuickDraw-based laser printers cannot operate in emulation mode (that is, they cannot use a page description language such as Hewlett-Packard's PCL) because they were designed to operate only with MacOS-based computers.

Unlike most other direct-connect LaserWriters, the LaserWriter Select 310 uses PostScript rather than QuickDraw. It has both a serial and a parallel port; either port can accept PostScript printjobs from the host computer.

Serial Setup



Direct-connect serial LaserWriter printers connect to the MacOS computer's printer port. If the printer port is already in use, you can use the modem port. To connect the LaserWriter printer to the printer port, complete the following procedures:

1. Make sure the LaserWriter printer and computer are switched off before you connect them.
2. Connect one end of a serial cable to the serial port on the LaserWriter.
3. Connect the other end of the serial cable to the printer port or modem port on the computer.
4. Connect the power cable to the printer and to the electrical outlet.
5. Switch on the LaserWriter.

Direct-connect serial LaserWriters do not generate a user test page. They only generate a service test page. (See *Service Source* for the procedure to generate a service test page with each LaserWriter model.)

To install the software that direct-connect serial LaserWriters require, complete the following procedures:

1. Switch on the LaserWriter printer and the computer.
2. Use the Installer utility software that came with the printer to install the direct-connect serial LaserWriter printer driver in the System Folder.
3. Restart the computer.
4. Open the Chooser—select the direct-connect serial LaserWriter printer driver icon. No printer name will appear. Instead, a pair of icons depicting the printer port and the modem port will appear. Click one of the icons to select the port through which the printer is connected (usually the printer port).
5. Close the Chooser.
6. From the desktop, choose **Print Window...** from the File menu. Click **Print** (or **OK**) in the dialog box to print the window. When the window prints successfully, you know the printer is ready to use.

SCSI Setup



Direct-connect SCSI LaserWriters connect to the computer in the same way as other SCSI devices. To connect the printer to the computer SCSI port, follow these procedures:

1. Make sure the computer and the LaserWriter printer are switched off.
2. Install the I/O board (if the printer ships without the I/O board). Remember to follow ESD safety rules.
3. Connect the SCSI cable to the computer.
4. Connect the SCSI cable to the LaserWriter, as Figure A-3 shows.

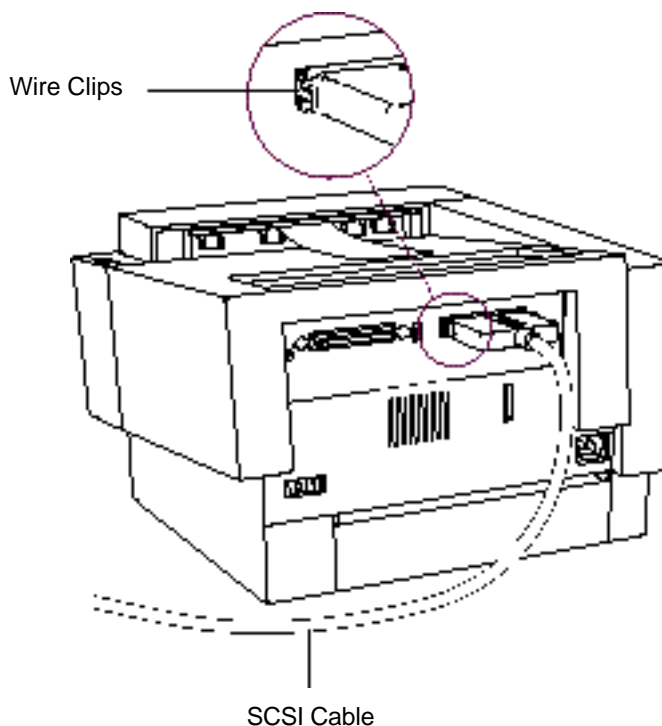


Figure A-3
The cable connection to a direct-connect SCSI LaserWriter.

SCSI Setup



Follow these guidelines when connecting a direct-connect SCSI LaserWriter to the SCSI port:

- Follow proper SCSI termination procedures.
 - Select the SCSI identification (ID) number you wish to assign to the LaserWriter printer and record the number for later reference.
 - Set the LaserWriter SCSI ID number to seven (7). The LaserWriter ID number must be 7 for the LaserWriter to print a startup test page. Since the computer's SCSI ID number is always 7, once you generate the startup test page, you must reset the LaserWriter SCSI ID number to the one you previously selected.
5. Connect the power cable.
 6. Switch on the LaserWriter to generate a startup test page.

Warning: SCSI startup test pages print continuously. To stop printing, remove the paper cassette, allow the last page to exit the printer, switch the printer off, and reset the SCSI ID to its assigned number, which must be something other than 7.

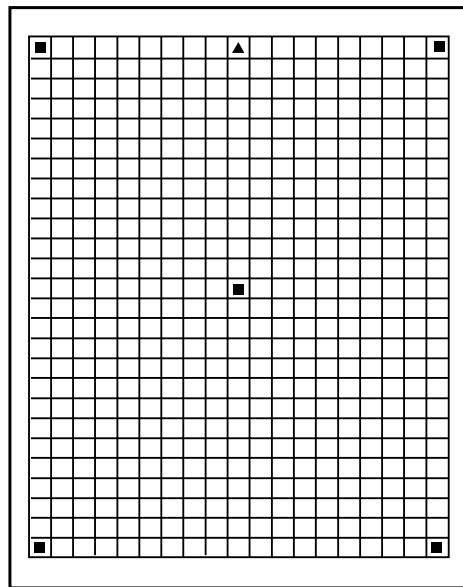


Figure A-4
A sample startup test page (taken from a Personal LaserWriter SC).

SCSI Setup



To install the software required by direct-connect SCSI LaserWriters, complete the following procedures:

1. Switch on the LaserWriter printer and the computer.
2. Use the Installer utility software that came with the printer to install the direct, SCSI LaserWriter printer driver in the System Folder.
4. Open the Chooser—select the direct-connect SCSI LaserWriter printer driver icon. Note that, unlike networked LaserWriters, no printer name will appear in the Chooser window.
6. Close the Chooser.
7. Choose **Print Window...** from the File menu. Click **Print** (or **OK**) in the dialog box to print the window. When the window prints successfully, you know the printer is ready to use.

QuickDraw Imaging



Printer Drivers

Like all other LaserWriters, the printer driver for direct-connect LaserWriters is responsible for managing communication between the computer and the printer. Direct-connect QuickDraw-based LaserWriters do not use the same printer driver as networked PostScript-based LaserWriters, as shown in Figure A-5.



Figure A-5
Sample printer driver icons for direct-connect LaserWriters

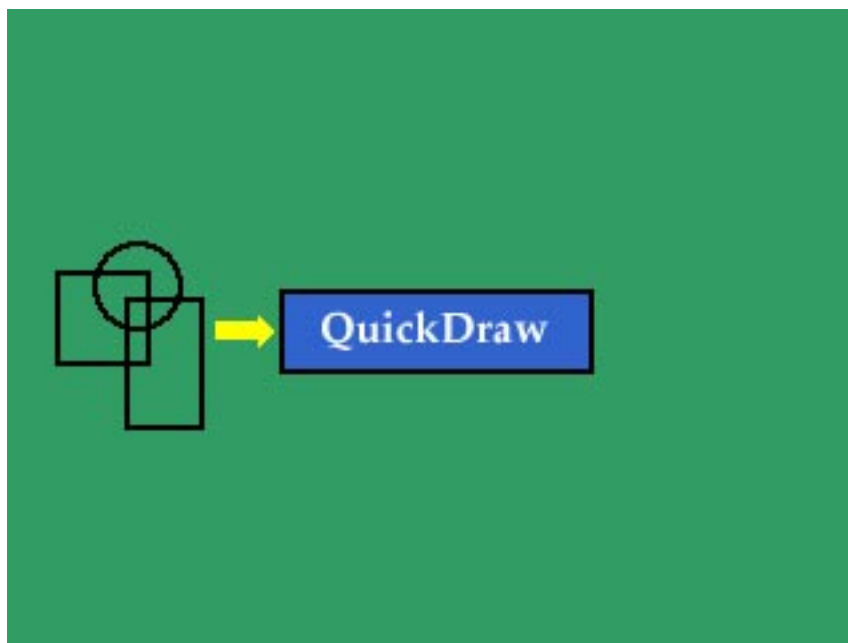
Data Transfer

QuickDraw-based LaserWriters communicate with the host computer by using serial and/or SCSI technology. QuickDraw converts the pages in computer RAM into 300 dpi bitmap pages. The data is then transferred page by page to the print controller on the printer I/O PCB. The pages are stored in the page buffer until they print. The QuickDraw printer driver manages the data transfer process.

Serial technology is a relatively slow data transfer technology. A serial interface sends one bit of data at a time on one line from the computer to the printer.

SCSI (Small Computer System Interface) technology is faster than serial technology. SCSI technology provides a parallel interface that moves 8 bits of data at a time, 1 bit on each of eight lines. As with all SCSI devices, LaserWriters that use a SCSI connection to the computer must have unique identification numbers and proper termination.

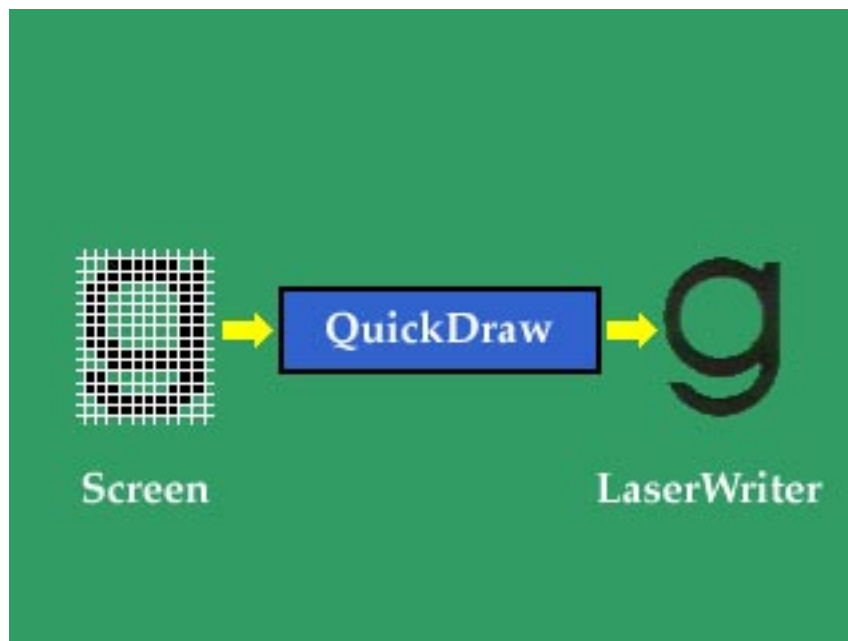
QuickDraw Imaging



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie explains that QuickDraw translates a screen object from a 72 dpi image to a 300 dpi image.

QuickDraw Imaging



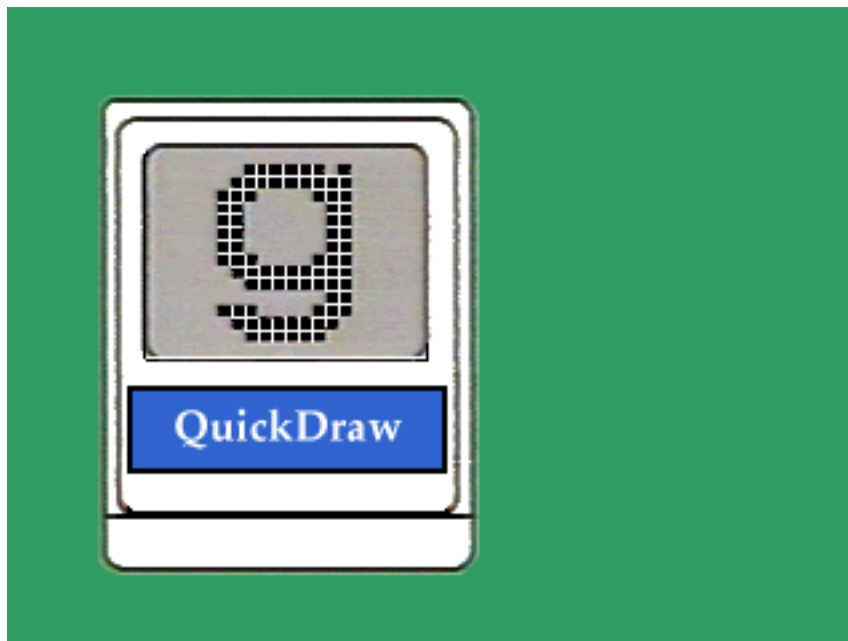
Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie explains how 4x fonts are used when printing text.

4x Fonts

When printing text for which no TrueType font is available, the QuickDraw-based LaserWriter printer driver searches for a point size that is 4 times larger (hence the term “4x”) than the point size used in the document. This provides the smoothest bitmap, since 300 dpi is nearly a perfect 4x multiple of 72 dpi. So if a document contains Times 12 point text and no TrueType font is available, the driver searches for a Times 48 point bitmap font. If the 4x point size is not available, the driver looks for a 2x size, then a size 1/2 of the original, then the next size larger, and finally either the next size smaller or the actual point size.

QuickDraw Imaging

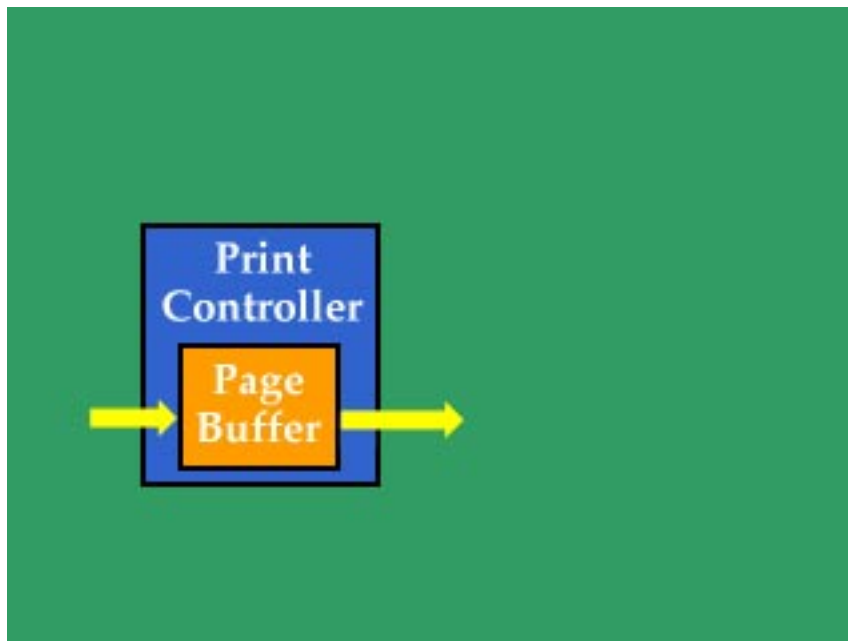


Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie describes the transmission of the image from the computer to a QuickDraw-based LaserWriter's page buffer.

The printer driver sends the bitmap image to the page buffer in the printer. Because the image is already described as a 300 dpi bitmap, little processing is required on the part of the printer controller.

QuickDraw Imaging



Note: The graphic above is a QuickTime movie. To view the movie, simply click on it. If you are completing this material onscreen, view the movie now.

This movie describes the function of the printer controller in a QuickDraw-based LaserWriter.

In a QuickDraw-based LaserWriter, the printer controller fundamentally does 2 things:

- Gathers data into the page buffer
- Manages the flow of data from the page buffer to the print engine

Appendix B



Overview

Appendix B is a collection of all the practice exercises found throughout the course.

As mentioned in the course introduction, one way to use the course manual is to view it on the computer, printing only the practice exercises (which require paper and pencil). Collecting all the exercises into a single place makes it easy to print them out.

The pages in Appendix B are exact duplicates of the pages found throughout the course manual. Even the page numbers are the same as the originals, making for easy reference back to the section of the course manual from which the pages were copied.

Practice Exercise 1

**Directions**

Use the indicated information resource to find an answer to each question.

Service Source CD

1. How many settings does the configuration switch have on a LaserWriter 16/600 PS?

2. What type of engine does the LaserWriter 12/640 PS printer use?

Service Guide

1. Which switches must be triggered on a LaserWriter II in order to perform the laser power output check?

2. On a LaserWriter Pro 630, when the self-diagnostic is invoked and no error is found, what pattern do the LEDs exhibit?

Practice Exercise 1



Service Source Online

1. Locate two topics in the Safety section. Record their titles.

2. Locate a "Service Notice" and a "Hot Issue." Record their titles.

Tech Info Library

(Access the library through either Service Source Online or the *Service Source Companion* CD.)

1. A customer is having problems with the fax card on a LaserWriter 16/600 PS. He is unable to set the date and time using the appropriate utility software. A message about needing a password is displayed. What is the problem?

Practice Exercise 1



2. A customer had a jam in the duplexing unit of her LaserWriter 12/640 PS. After she cleared the jammed paper, the jam light stayed on. What is the problem?

When you finish, compare your answers with those on pages 17-19.

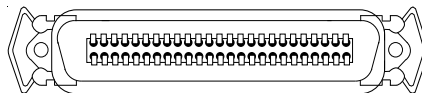


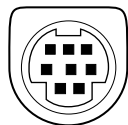
Practice Exercise 2

Directions

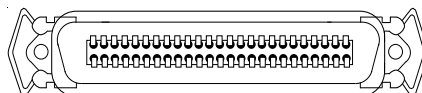
This exercise gives you an opportunity to identify the ports found on LaserWriter printers and the printjobs they are capable of processing. Pictured below are the icons associated with each type of port. Indicate the name of the port, whether it is networkable or direct connect, and the type of printjobs it can process.











When you finish, compare your answers with those on page 24.

Practice Exercise 3



Directions

This exercise gives you an opportunity to test your knowledge of LaserWriter features. Listed below are the LaserWriter features presented in this course. Match each feature with its description.

- | | | |
|-----------|----------------------------------|---|
| 1. _____ | GrayShare | A. Used by the printer for font storage and temporary fax storage |
| 2. _____ | Desktop Printing | B. Detects whether PostScript or PCL is being used |
| 3. _____ | Energy Star | C. Allows direct-connect, QuickDraw-based LaserWriters to be shared over a network |
| 4. _____ | All Ports Active | D. Provides even smoother text on LaserWriters |
| 5. _____ | Fax Capability | E. Allows LaserWriters to send and receive traditional and PostScript faxes; can be used by anyone on the network |
| 6. _____ | Hard Drive | F. Creates desktop printer icons; supports drag and drop printing and multiple printjobs |
| 7. _____ | Multiple Protocols over Ethernet | G. Allows printing on both sides of a page |
| 8. _____ | PhotoGrade | H. Allows a printjob to be sent to any port; the printer scans its ports continuously |
| 9. _____ | Automatic Language Sensing | I. Enhances images printed on LaserWriters |
| 10. _____ | Duplex Printing | J. Provides a standard for low-power consumption devices |
| 11. _____ | FinePrint | K. Allows communication by AppleTalk, Novell Netware, and TCP/IP simultaneously on a single Ethernet port |

Practice Exercise 4



Directions

This exercise gives you an opportunity to test your knowledge of LaserWriter accessories and upgrades. The section “Accessories and Upgrades” presented six accessories and upgrades. Indicate as many of them as you can remember.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

When you finish, compare your answers with those on page 33.

Practice Exercise 1



Directions

In this exercise, you will practice setting up a LaserWriter and MacOS-based computer on a LocalTalk network. Before you begin, gather the following equipment and materials:

- MacOS-based computer
- Network LaserWriter
- LaserWriter toner cartridge
- Paper
- LaserWriter owner's manual
- All necessary cables (as specified in the owner's manual)
- LaserWriter Installer disks (as specified by the owner's manual)

To complete this exercise, do the following:

1. Locate the owner's manual. The owner's manual lists step-by-step procedures for setting up a LaserWriter printer on a network. For each of the following steps, read and perform the procedures in the owner's manual.
2. Prepare the LaserWriter printer.
3. Connect the LaserWriter printer. If you have a LocalTalk network, connect the LaserWriter to the network. If you do not have a LocalTalk network, network a single computer to the LaserWriter printer.
4. Install the software.
5. Print a window. From the Finder desktop, open any window and choose **Print Window...** from the File menu. Be sure you first select the proper printer driver and printer name in the Chooser.

When you have printed a page, you have completed this exercise. If you have problems, refer to the Troubleshooting section of the owner's manual.

Continue with Exercise 2 on the next page

Practice Exercise 2



Directions

Assume you are setting up a single MacOS-based computer and a networked LaserWriter using LocalTalk. Check each statement that describes how to set up the computer and LaserWriter printer.

- _____ Select a location for the LaserWriter printer and remove all hardware, software, and materials from the shipping carton.
- _____ Remove retainers and cushioning materials from the LaserWriter printer.
- _____ Install the toner cartridge and remove toner tape.
- _____ Load paper into the paper tray and install the tray into the LaserWriter printer.
- _____ Connect a parallel cable from the computer to the LaserWriter printer.
- _____ Connect a LocalTalk connector box to the computer and the LaserWriter, and use a LocalTalk cable to connect the boxes.
- _____ Connect the power cord.
- _____ Switch on the LaserWriter printer to generate a startup test page.
- _____ Set the SCSI ID number to 7. Switch on the LaserWriter to generate a startup test page.
- _____ Install the thirteen standard PostScript fonts.
- _____ Install the appropriate LaserWriter printer driver.
- _____ Install the appropriate QuickDraw printer driver.
- _____ Open the Chooser and select the network LaserWriter icon.
- _____ Open the Chooser and select the appropriate QuickDraw printer.

Compare your answers with those on page 43.

Practice Exercise 1



Directions

Complete Practice Exercises 1 and 2, and then check your answers against the answer pages.

Match the terms that describe QuickDraw and the PostScript printing process.

| <u>Terms</u> | <u>Definitions</u> |
|-----------------------------|--|
| 1. _____ Resolution | A. Provides the software interface between the computer and the LaserWriter |
| 2. _____ Screen font | B. Comprises a complete set of characters for one font, including all styles and sizes |
| 3. _____ Font | C. Specifies the sharpness of an image, in dots per inch (dpi) |
| 4. _____ Font family | D. Displays text on the computer screen |
| 5. _____ Font style | E. Comprises a set of characters in one size and style |
| 6. _____ Font size | F. Appears as a collection of black dots and white spaces |
| 7. _____ Bitmapped | G. Describes graphics and text in mathematical formulas instead of bitmap fonts |
| 8. _____ LaserWriter driver | H. Is a font characteristic expressed in points of the page |
| 9. _____ QuickDraw | I. Is the area of printer RAM that stores a bitmapped image |
| 10. _____ PostScript | J. Includes the characteristics (other than size) that uniquely define the fonts of a single font family |
| 11. _____ Page buffer | K. Performs all MacOS graphic and text operations |

When you finish, continue with Practice Exercise 2 on the next page.

Practice Exercise 2

**Directions**

Read each customer printing problem and list the possible causes of faulty operation.

1. You receive a call from a customer who states that his PostScript LaserWriter takes an exceptionally long time to print. What page-creation-and-conversion problems can cause slow printing?

2. A customer tells you that after unpacking and setting up her new PostScript LaserWriter she cannot print. What page-creation-and-conversion problems can cause the printer not to print?

3. A customer complains that the print quality of fonts with his new PostScript LaserWriter is inferior to the printer demonstration he received in your store. What page-creation-and-conversion problems can cause poor print quality?

When you are ready, compare your answers to Practice Exercises 1 and 2 with those provided on pages 58-59.

Practice Exercise 3



Directions

Complete Practice Exercises 3 and 4, and then check your answers against the answer pages.

The following list contains statements about Macintosh-to-LaserWriter data transfer with AppleTalk technology. Use the key to indicate whether a term or statement relates to LocalTalk, EtherTalk or both. Try to respond to each item from memory.

L = LocalTalk

E = EtherTalk

LE = LocalTalk and EtherTalk

1. _____ Requires that AppleTalk must be active for communication to take place
2. _____ Provides a relatively fast data transfer rate
3. _____ Is an inexpensive AppleTalk implementation with moderate data transfer rates
4. _____ Is built into every Macintosh computer
5. _____ Utilizes AppleTalk's Name Binding Protocol to match device names with device addresses
6. _____ May require the installation of a card in the computer
7. _____ Using Apple cabling and connectors, supports a maximum of 32 devices and can span up to 1000 feet
8. _____ Requires that each LaserWriter have a unique name
9. _____ Supports up to 40 active nodes with a single cable length of 200 meters, and can potentially support millions of users with an internet network

When you are ready, continue with Practice Exercise 4 on the next page.

Practice Exercise 4

**Directions**

Indicate the likely causes of each customer data transfer problem.

1. A customer states that she has just purchased an Apple LaserWriter with a built-in Ethernet port as a replacement for her LocalTalk-based LaserWriter. She tells you that she is unable to make the connection and print. What are some data transfer problems she might be having?

2. You are helping a customer determine why the name of a new LaserWriter just added to the LocalTalk network does not appear in the Chooser. She indicates that the correct driver is installed and selected in the Chooser, and that the printer has a name. What data transfer problems can cause this problem?

3. A customer calls to ask for help with configuring a LaserWriter. He would like to connect it to his Windows-based computer via the parallel connector. Where can you find configuration and compatibility information to help this customer?

When you are ready, compare your answers to Practice Exercises 3 and 4 with the answers on pages 66-68.

Practice Exercise 5

**Directions**

Identify which statements describe a ready state.

1. ____ Driver files are properly installed in printer RAM.
2. ____ Registration assembly solenoid functions.
3. ____ Fuser roller temperature is acceptable.
4. ____ Access door(s) is/are closed.
5. ____ Toner cartridge is at least 10 percent full of toner.
6. ____ Toner cartridge is installed.
7. ____ Paper cassette has at least 20 sheets of paper.
8. ____ Printer does not sense a paper jam.
9. ____ Fan functions (some models).
10. ____ User test page prints.
11. ____ Cassette and paper are installed.
12. ____ Main motor rotates properly.
13. ____ Pickup roller rotates at correct intervals.
14. ____ Scanning motor scans at the proper speed.
15. ____ Laser beam temperature is normal.

When you finish, compare your answers with those on page 79.

Practice Exercise 6

**Directions**

The list below contains the six LaserWriter print cycle steps. Number the steps in the order in which they occur. Try to complete this exercise from memory.

- _____ Transfer
- _____ Cleaning the drum
- _____ Image formation
- _____ Fusing
- _____ Development
- _____ Charging the drum

When you are ready, continue with Practice Exercise 7 on the next page.

Practice Exercise 7

**Directions**

Match a LaserWriter print cycle step to each of the statements below. There is one answer for every statement; items can be used more than once.

- A. Transfer
 - B. Cleaning the drum
 - C. Image formation
 - D. Fusing
 - E. Development
 - F. Charging the drum
-
- 1. ____ Produces an image of electrical charges on the photosensitive drum.
 - 2. ____ Changes the image on the photosensitive drum to a visible image using toner.
 - 3. ____ Removes residual toner from the photosensitive drum.
 - 4. ____ Exposes the photosensitive drum to the preconditioning exposure lamps.
 - 5. ____ Positively charged paper attracts the negatively charged toner from the photosensitive drum.
 - 6. ____ Toner particles permanently adhere to the paper.
 - 7. ____ Primary corona applies a uniform layer of negative charges over the surface of the photosensitive drum.
 - 8. ____ The beam detect mechanism tells the DC controller to begin the next scan line.
 - 9. ____ Paper separates from the photosensitive drum.
 - 10. ____ Scanning mirror reflects the laser beam through focusing lenses.

When you finish, compare your answers for Exercises 6 and 7 with those on pages 98-99.

Practice Exercise 8

**Directions**

Complete Practice Exercises 8 and 9, and then check your answers against the answer pages.

Indicate the likely causes of each print generation symptom.

1. You are repairing a LaserWriter that generates blank pages. While troubleshooting the printer, you find that an image was created but not developed on the photosensitive drum. What are the likely print generation causes of this problem?

2. The LaserWriter you are repairing correctly develops the image on the photosensitive drum but does not transfer the image to the paper. What are the likely print generation causes of this problem?

3. The LaserWriter you are repairing correctly transfers the image to the paper, but the image easily smears or rubs off. What is/are the likely print generation cause(s) of this problem?

When you are ready, continue with Practice Exercise 9 on the next page.

Practice Exercise 9

**Directions**

Indicate the likely cause(s) of each page creation and print generation problem.

1. A customer just replaced her non-PostScript laser printer with a new PostScript LaserWriter. During your discussion you learn that she ran the Installer program to properly install the printer software, that she correctly connected her Macintosh to the printer by using LocalTalk cables and connectors, and that the printer is switched on. She also states that AppleTalk is active in the Chooser, and that her network is not divided into zones. She doesn't see the printer name in the Chooser. What is/are the likely cause(s) of this problem?

2. A customer says his new LaserWriter printer is printing much slower than it should. The files he is trying to print are one-page letters without graphics. The cables are correct, and the appropriate driver is installed and highlighted. What is/are the likely cause(s) of this problem?

3. The LaserWriter you are repairing does not print. While troubleshooting you do not find an image on the photosensitive drum. What is/are the likely cause(s) of this problem?

When you are ready, compare your answers to Practice Exercises 8 and 9 with those on pages 102-103.

Practice Exercise 1

**Directions**

This exercise tests your recall of important elements in the first phase of LaserWriter troubleshooting, information gathering.

From memory, write down four key questions that you can ask a customer about his or her faulty LaserWriter.

1. _____

2. _____

3. _____

4. _____

Continue on the next page.

Practice Exercise 1



From memory, write down four LaserWriter troubleshooting “quick checks.”

1. _____
2. _____
3. _____
4. _____

Compare your answers with those on page 112.

Practice Exercise 2



Directions

The following list contains problem descriptions. Classify each problem as hardware-, software-, or network-related using the key below.

H = Hardware

S = Software

N = Network

1. ____ The printer has no power.
2. ____ Two or more users on the network are experiencing the same problem.
3. ____ The printer shows obvious, physical signs of damage.
4. ____ The same problem occurs when the software is used with other known-good LaserWriter printers.
5. ____ The printer successfully prints both a user test page and a service test page, and the computer and software are known-good.
6. ____ The printer is unable to print a user test page or a service test page.
7. ____ The printer or other network devices have been moved from one location to another.
8. ____ The user is attempting to print with a pre-release version of a printer driver.
9. ____ The printer successfully prints both a user test page and a service test page, but does not print when connected to a computer. The computer and the network hardware components are known-good.
10. ____ The print quality of the user test print is not acceptable.

Compare your answers with those on page 116.

Practice Exercise 3



Directions

Now it's your turn to troubleshoot. Read the customer information below. With that information, classify the problem as hardware-, software-, or network-related. Next, choose the resources that you think will be most helpful. Lastly, plan a strategy for the troubleshoot.

Customer Information: The customer reports a problem with his LaserWriter. Everything worked fine when it was first installed. Now, however, he has intermittent problems. Sometimes he gets error messages stating that the paper size is wrong. Other times the printer just sits and sits and sits but never prints out (known as "timing out"). Sometimes he just gets PostScript error messages returned. He has already tried re-installing the software, but the problem still occurs.

He is using version 8.4 of the LaserWriter printer driver software. The printer is on a network with other LaserWriter printers of the same type. The problem occurs with the other printers, too, but only from his computer. All the network devices (printers, file servers, mail servers) consistently show up in his Chooser.

This problem appears to be related to:

_____ Hardware _____ Software _____ Network

The resources that are most likely to help solve this problem are:

| | |
|--------------------------------|-----------------------------------|
| _____ Your experience | _____ <i>Apple Service Guides</i> |
| _____ Theory of operations | _____ Tech Info Library |
| _____ <i>Service Source</i> CD | _____ Wiring diagram |
| _____ Service Source Online | _____ Owner's manual |

Practice Exercise 3



Your strategy/plan for this troubleshoot:

Compare your answers with those provided on pages 124-125.

Practice Exercise 4



Directions

Read the customer information below. With that information, classify the problem as hardware-, software-, or network-related. Next, choose the resources that you think will be most helpful. Lastly, plan a strategy for the troubleshoot. Record your answers in the space provided or on a separate piece of paper.

Customer Information: The customer has brought a LaserWriter IINT into your shop. She says that the print quality is poor. You print out a user test page while she's there, and find that the image is light and cloudy across the whole page. The customer reports that the problem just occurred; it has not been a gradual decline.

This problem appears to be related to:

_____ Hardware _____ Software _____ Network

The resources that are most likely to help solve this problem are:

| | |
|--------------------------------|-----------------------------------|
| _____ Your experience | _____ <i>Apple Service Guides</i> |
| _____ Theory of operations | _____ Tech Info Library |
| _____ <i>Service Source</i> CD | _____ Wiring diagram |
| _____ Service Source Online | _____ Owner's manual |

Practice Exercise 4



Your strategy/plan for this troubleshoot:

Compare your answers with those provided on pages 128-129.