



Developer Note

Apple LaserWriter Select 310 Printer



Developer Note

Developer Press

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About This Note

The LaserWriter Select 310 printer is a new member of Apple's LaserWriter printer family. It is an economical printer that supports the Adobe™ PostScript™ Level 1 programming language. This developer note describes the features and capabilities of the printer, and it is intended for use by software and hardware developers.

To use this note, you need to understand the PostScript Level 1 programming language. You should also be familiar with the computer for which you intend to develop software.

You do not need to use this note if you are simply running packaged programs for your computer. However, it is useful if you are writing or modifying a program that is used with the LaserWriter Select 310 printer.

Your owner's guide provides instructions for connecting the printer to your computer, inserting paper, and performing other routine operating tasks. This note does not provide that type of information.

This preface describes the contents of the note, explains visual cues and conventions used in the note, and lists other books to which you can refer.

What This Note Contains

This note is made up of three chapters.

- Chapter 1, "LaserWriter Select 310 Hardware," describes the hardware features of the LaserWriter Select 310 printer, including the built-in communications ports and interfaces.
- Chapter 2, "LaserWriter Select 310 Software," provides an overview of software features, including the PostScript Programming Language, the PostScript interpreter, LaserWriter Select 310 driver, and page types. It also describes the software parameters and the PostScript Level 1 operators that enable you to set up and configure the LaserWriter Select 310 printer. Finally, it discusses changes made to the PostScript language that impact the LaserWriter Select 310 printer.
- Chapter 3, "Communication Channels," describes the software support for serial and parallel communication channels.

Conventions Used in This Note

The following visual cues are used throughout this note to identify different types of information:

Note

A note like this contains information that is interesting but not essential for an understanding of the main text. ◆

IMPORTANT

This type of note contains information that is essential for an understanding of the main text. ▲

▲ **WARNING**

A warning like this directs your attention to something that could damage hardware or software, or that could result in loss of data. ▲

A special font, *Courier*, is used for characters that you type or for lines of program code. It looks like this.

Other Reference Material

This developer note assumes that you are familiar with printer technology and know how to operate and program Apple LaserWriter printers. The following supplementary documents also provide useful information:

- The owner's guide shipped with every LaserWriter printer explains how to set up the printer in the standard configuration. The guide gives basic operating information on how to load toner cartridges, load the paper tray, and so forth. It also provides basic troubleshooting information.
- The *LaserWriter Reference*, published by Addison-Wesley, provides information that is not in this note about fonts and about communicating with LaserWriter printers over serial channels.
- The *PostScript Language Reference Manual*, published by Addison-Wesley, provides supplementary information on the PostScript language, including information about semantics and syntax. The edition referenced throughout this note is the first edition, unless otherwise indicated.
- The *PostScript Language Tutorial and Cookbook*, published by Addison-Wesley, provides a basic introduction to the PostScript programming language. It also includes sample PostScript programs that help you quickly understand how the PostScript programming language works.
- The *PostScript Language Program Design*, published by Addison-Wesley, is written for programmers who want to take advantage of the PostScript program language to design efficient PostScript programs and printer devices.

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LaserWriter Select 310 Hardware

LaserWriter Select 310 Hardware

The LaserWriter Select 310 printer is an economical laser printer that supports PostScript™ Level 1 functions. It executes page descriptions written in the PostScript language, and it produces printed pages at a rate of up to five pages per minute. The raster printing technology is xerographic, black and white, and write black at 300 dots (pixels) per inch. The printer is dedicated, and it operates with Macintosh computers using the RS-232 serial port or with DOS-based IBM personal computers using the Centronics parallel port. It is available in 110-volt and 220-volt versions.

This chapter describes:

- hardware features of the printer
- communication ports
- status lights
- memory capabilities
- basic operation
- page types
- paper handling capabilities of the printer

The LaserWriter Select 310 printer supports the entire PostScript language specified in the first edition of the *PostScript Language Reference Manual*. In addition, it has features, capabilities, and operating modes not present in other PostScript language printers. You may access these additional facilities by executing special PostScript operators that exist only in the LaserWriter Select 310 printer's PostScript interpreter.

Unlike other Apple LaserWriter printers, the LaserWriter Select 310 printer does not have a rotary selection switch to allow you to select different communication protocols.

In addition, the printer does not have EEROM (electronically erasable ROM). This means that any of the interpreter's default parameters that are changed using `statusdict` operators are not placed in nonvolatile storage and will not persist across power cycles. However, for parameters that are expected to change infrequently, a portion of RAM may be used to simulate EEROM.

Table 1-1 lists functional features of the LaserWriter Select 310 printer.

Table 1-1 LaserWriter Select 310 printer features

Features	Specifications
Printing speed	5 pages per minute
Warm-up time	90 seconds (worst case)
Imaging	300 dpi
Processor	Advanced Micro Devices Am29205, 16 MHz
Paper handling	<p>Standard</p> <p>Output: 150-page, face-down tray</p> <p>Inputs: Manual feed tray; 250-page feeder with 250-page universal cassette</p> <p>Optional</p> <p>Inputs: additional 250-page feeder; additional 500-page feeder; 250-page legal-size cassette, 30-page envelope-size cassette, 500-page B5-size cassette, 500-page letter-size cassette, 500-page A4-size cassette, 50-page/5-envelope multi-purpose tray</p> <p>For more information see sections "Page Types" and "Paper Handling" at the end of this chapter</p>
ROM	<p>1 MB</p> <p><1 MB used for PostScript firmware and fonts</p>
DRAM	<p>1.5 MB</p> <p>Expandable to 2.5 MB or 5.5 MB</p> <p>The printer requires a minimum of 2.5 MB to print legal-size image areas</p>
Interface ports	<p>RS-232 8-pin serial</p> <p>Centronics 36-pin parallel</p>
Communication rates	57,600 baud (RS-232)
Fonts	<p>13 PostScript Type I fonts on board</p> <p>TrueType fonts supported by downloading TrueType fonts in unhinted Type I</p>
PDL (Page Description Language)	PostScript Level 1, or compatible

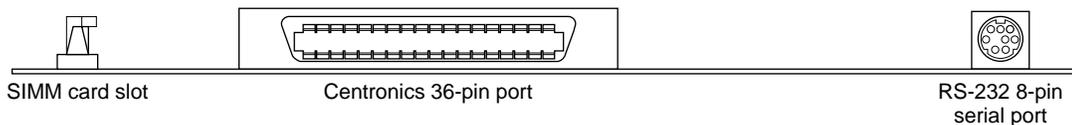
Communication Ports

The LaserWriter Select 310 printer supports two communication ports:

- RS-232 8-pin serial port
- Centronics 36-pin parallel port

Figure 1-1 shows the relative positions of these ports on the rear panel of the printer.

Figure 1-1 LaserWriter Select 310 printer side panel connectors



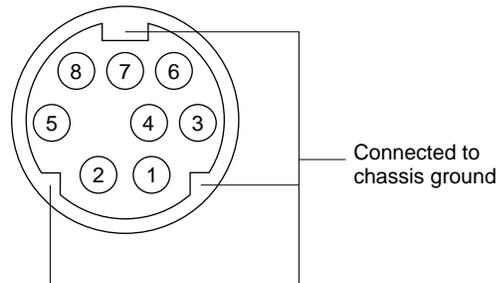
When the LaserWriter Select 310 printer is first powered on, the serial port with binary protocol enabled is the default communication port. If any character is received over the Centronics parallel port, the parallel port with binary protocol and a serial back channel automatically becomes the default port. If you want to change the communication port back to serial mode after a job has been sent over the parallel port, you should power down and then restart the printer. Similarly, if you wish to change printer drivers, you should power down and then restart.

IMPORTANT

It is better to operate the LaserWriter Select 310 printer in either a serial or a parallel communication environment than to transmit both serial and parallel data. Attempting to operate in both environments may cause unpredictable results. ▲

Serial Port for RS-232C Devices

The LaserWriter Select 310 printer supports the RS-232 protocol by means of an 8-pin mini-DIN connector. This connector provides the interface between the printer and Apple Macintosh computers. Figure 1-2 shows the connector pin designations and Table 1-2 lists the pin functions for this 8-pin connector. You can also connect the printer directly to a Macintosh computer using a Peripheral-8 (M0197) cable and communicate with the printer using the LaserWriter Select 310 printer driver, or a terminal emulation program such as MacTerminal.

Figure 1-2 An 8-pin serial port connector**Table 1-2** Signal descriptions for an 8-pin serial port

Pin number	Signal name	I/O	Description
1	DTR	I	Data terminal ready. Send data when this signal is asserted.
2	DSR	O	Data set ready.
3	/TXD	O	Transmit data (inverted)
5	/RXD	O	Receive data (inverted)
4, 6	GND	-	Ground
7, 8	Not used	-	These pins are not connected

Centronics Parallel Connector

The LaserWriter Select 310 printer provides a 36-pin connector for communication with a standard Centronics parallel interface. It is fully compatible with the IBM PC Centronics port.

The parallel channel is basically unidirectional and is used to input information from the host computer to the printer. The printer returns minimal status information to the host, such as /POUT and /FAULT, which flag paper errors. It also returns handshaking signals such as PBUSY and /PACK. If you require additional status information from the printer while you are printing to the parallel port, you can use a host computer running a terminal emulation at 9600 bauds to connect to the serial port of the printer.

LaserWriter Select 310 Hardware

Figure 1-3 shows the pin designations for the Centronics parallel connector and Table 1-3 lists the signal descriptions. Figure 1-4 shows the timing requirements for the Centronics interface.

Figure 1-3 A Centronics parallel connector

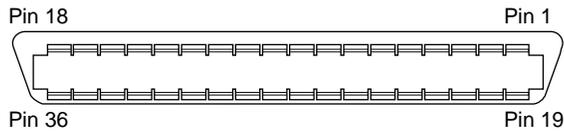


Table 1-3 Signal descriptions for a Centronics parallel port

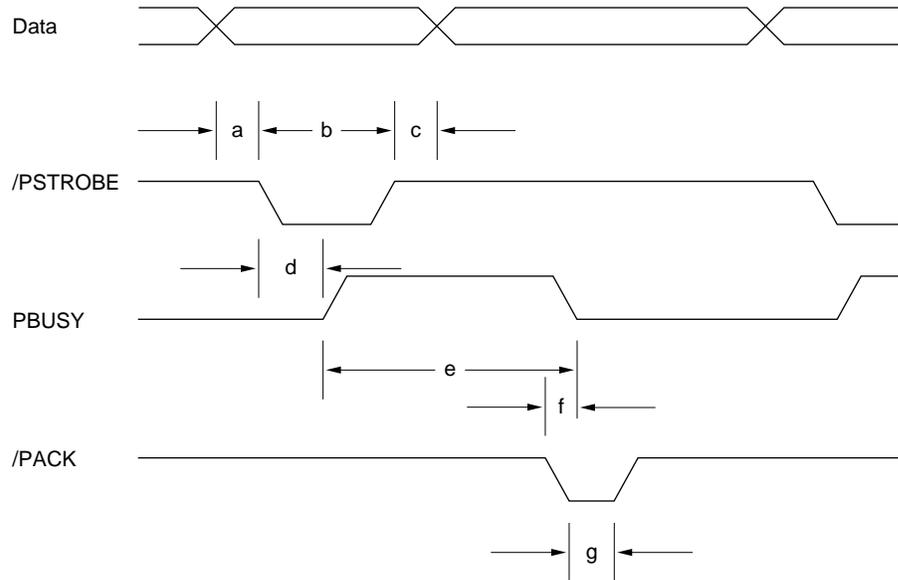
Pin number	Signal name	I/O	Description
1	/PSTROBE	I	Strobe for parallel input data
2	DATA 0	I	Data input bit 0
3	DATA 1	I	Data input bit 1
4	DATA 2	I	Data input bit 2
5	DATA 3	I	Data input bit 3
6	DATA 4	I	Data input bit 4
7	DATA 5	I	Data input bit 5
8	DATA 6	I	Data input bit 6
9	DATA 7	I	Data input bit 7
10	/PACK	O	Handshaking output signal; printer uses it to acknowledge receipt of parallel data
11	PBUSY	O	Busy output signal; indicates that a /PSTROBE signal has been received, but /PACK has not yet been given
12	POUT	O	Paper out; an output error signal; indicates the printer has run out of paper
13	Tied high	–	This select line is tied high so the LaserWriter Select 310 printer is always selected
14, 15, 16	Not connected	–	These lines are not connected
17	CHASSIS GROUND	–	Chassis ground
18	Not used	–	Not used

Table 1-3 Signal descriptions for a Centronics parallel port (continued)

Pin number	Signal name	I/O	Description
19-30	SIGNAL GROUND	-	Signal ground
31	Not connected	-	This line is not connected
32	/FAULT	O	Fault signal; asserted if there is a printer problem
33-36	Not connected	-	These lines are not connected

NOTE Inputs and outputs are referenced to the printer. An input (I) signal is sent from the host computer to the printer, and an output (O) signal is sent from the printer to the host.

Figure 1-4 Timing for a Centronics interface



Timing specification	Min. value	Typical value	Max. value
a. Data setup time before PSTROBE on	0.5µsec		
b. PSTROBE on pulse width	1.0µsec		500µsec
c. Data hold time after PSTROBE off	0.5µsec		
d. PSTROBE on to PBUSY on	0.0µsec		1.0µsec
e. Duration of PBUSY on (printer on line)	10.0µsec		
f. PBUSY off to /PACK on	0.0µsec	2.5µsec	
g. /PACK on pulse width	1.5µsec		10.0µsec

Status Lights

The LaserWriter Select 310 printer has three colored lights on the left side of the printer. These lights indicate what the printer is doing. Figure 1-5 shows a view of the status light symbols, and Table 1-4 describes the functions of the lights.

Figure 1-5 Status lights

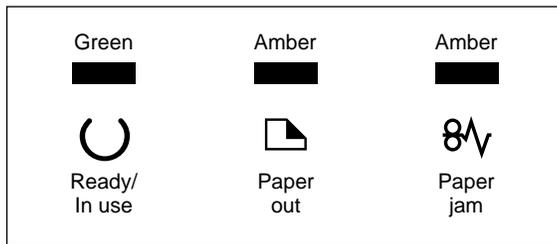


Table 1-4 Status light messages

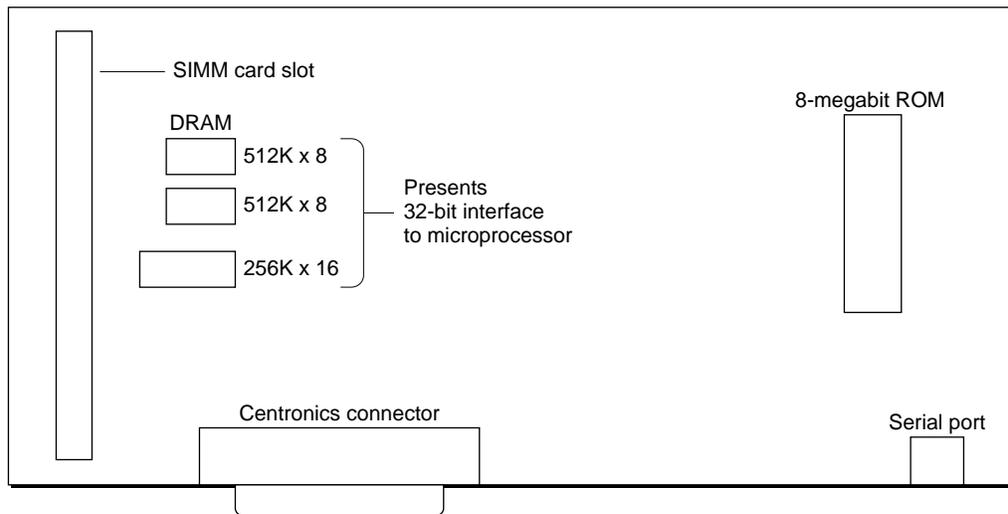
Light	Light's state	Printer's state
Ready /in use Green	On	The printer is ready to use.
	Off	The printer cannot print because there is an error condition, or the printer cover is open.
	Flashing	The printer is warming up or is processing data for the next print job.
Paper out Amber	On	Paper tray is empty or has been removed from the printer.
	Off	There is an adequate supply of paper in the paper tray.
	Flashing	The printer is in manual-feed mode and is ready for the next sheet of paper.
Paper jam Amber	On	There is a paper jam.
	Off	Paper is feeding correctly through the printer.
	Flashing	The printer requires service.

NOTE If both the Paper out and Paper jam lights flash or stay on, the printer requires service.

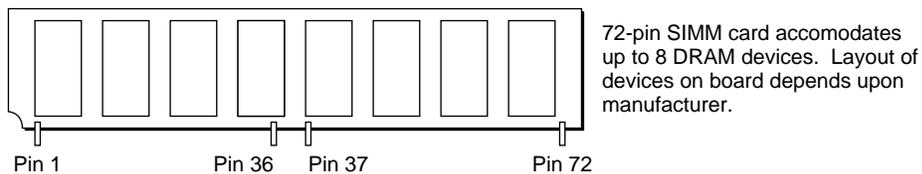
Memory Capabilities

The standard configuration of the LaserWriter Select 310 printer comes with 1MB of ROM and 1.5 MB of DRAM. Figure 1-6 shows the positioning of the DRAM and ROM on the printer's main circuit board.

Figure 1-6 The ROM and DRAM locations on a printed circuit board



Detail of SIMM card



72-pin SIMM card accommodates up to 8 DRAM devices. Layout of devices on board depends upon manufacturer.

8 256K x 4 DRAMs provide 1 MB of storage.
8 1 megabit x 4 DRAMs provide 4 MBs of storage.

Note: You must use 32-bit wide SIMMs.

ROM Capability

The LaserWriter Select 310 printer has a single ROM installed on the board. It is an 8-megabit, 42-pin masked ROM, and it stores the diagnostic software, fonts, and PostScript interpreter required by the printer. Currently you cannot expand ROM capacity.

DRAM Expansion

The LaserWriter Select 310 printer comes with 1.5 MB of DRAM installed on the printer's main circuit board. As shown in Figure 1-6, there are three DRAM devices: two 512K x 8 bit devices, and one 256K x 16 bit device. These three DRAMs present a 16-bit interface to the microprocessor installed on the printed circuit board.

You can expand DRAM capability by adding a 72-pin SIMM (single in-line memory module), which plugs into the SIMM connector on the circuit board. The LaserWriter Select 310 printer supports SIMM cards with capacities of 1 MB and 4 MB. You must use a 32-bit wide SIMM card in this configuration.

Basic Operation

This section provides an overview of the LaserWriter Select 310 printer's operating modes. Since much of the printer's behavior may be changed by changing the parameter settings, as described in Chapter 2, this section assumes that all options that may be adjusted are set to their standard values.

The main function of the LaserWriter Select 310 printer is to execute the PostScript language programs sent to it from a computer. During normal operation, the printer cycles endlessly through the following sequence of steps:

1. It sets up a clean initial execution environment (virtual memory) for the PostScript language program. In effect, it is setting up a job.
2. It executes the job by interpreting the standard input files, which are received on either the serial port or on the Centronics parallel port.
3. When the printer encounters an end-of-file character or when an error occurs, it cleans up after the job and restores the virtual memory to its initial state in preparation for the next job.

The main object of this process is to produce printed pages. However, a program may change some permanent parameters in the printer itself, or it may perform some computation that causes results to be sent back to the host computer, rather than causing hard copy to be printed.

There are two basic modes of operation: batch and interactive.

Batch Mode

Batch mode is the normal way of operating the LaserWriter Select 310 printer. In this mode it operates as a printing device for a computer.

A batch-mode job consists of executing a single file containing a PostScript language program. When an end-of-file character is reached, or the PostScript language terminates, the job is finished. In this mode, the only data transmitted from the LaserWriter Select 310 printer to the host is generated by the PostScript language printer operator or by errors. The printer provides no echoing, editing, or other user amenities.

Interactive Mode

You can use the LaserWriter Select 310 printer as a personal computer, and control it directly by means of a terminal or other input device. This way of using the printer is known in this context as interactive mode. It allows you to experiment with the PostScript language.

In interactive mode, a job consists of a long dialogue, in which you issue a PostScript language statement, and the server executes the statement and prompts for the next one. The state of the PostScript interpreter's virtual memory persists until you explicitly end the job. While you are entering a statement, the printer echoes characters and provides you with limited means for making corrections.

Page Types

The imageable area of a page (the area in which printed matter may appear) is referred to as the page size. Page size constrained by

- the physical size of the paper
- the margins required by the printing engine
- the amount of memory available for the full-page frame buffer

Table 1-5 lists the range of paper sizes supported by the LaserWriter Select 310 printer.

Table 1-5 Available page types

Name	Paper size in inches	Page size in inches	Description
a4	8.27 x 11.69	7.84 x 11.42	Standard page type for European A4-size paper
a4small	8.27 x 11.69	7.47 x 10.85	Smaller version of a4
a5	5.87 x 8.27	5.44 x 7.84	Standard page type for European A5-size paper
b5	7.17 x 10.12	6.97 x 9.72	Standard page type for Japanese B5-size paper
c5	6.38 x 9.02	5.98 x 8.62	Standard page type for the C5-size envelope
com10	4.13 x 9.5	3.73 x 9.1	Standard page type for the COM10-size envelope
dl	4.33 x 8.66	3.93 x 8.26	Standard page type for the DL-size envelope
executivepage	7.25 x 10.5	6.85 x 10.1	Standard page type for Executive-size paper
legal	8.5 x 14	8.1 x 13.67	Standard page type for legal-size paper
letter	8.5 x 11	8.1 x 10.67	Standard page type for letter-size paper
lettersmall	8.5 x 11	7.68 x 10.16	Smaller version of letter size
monarch	3.87 x 7.5	3.47 x 7.1	Standard page type for the Monarch-size envelope

NOTE The margins required in all cases are 0.2 inches on each side, and at the top and bottom.

Paper Handling

The LaserWriter Select 310 printer offers a variety of paper handling features, as shown in Figure 1-7. It has three paper feeders and six types of cassettes:

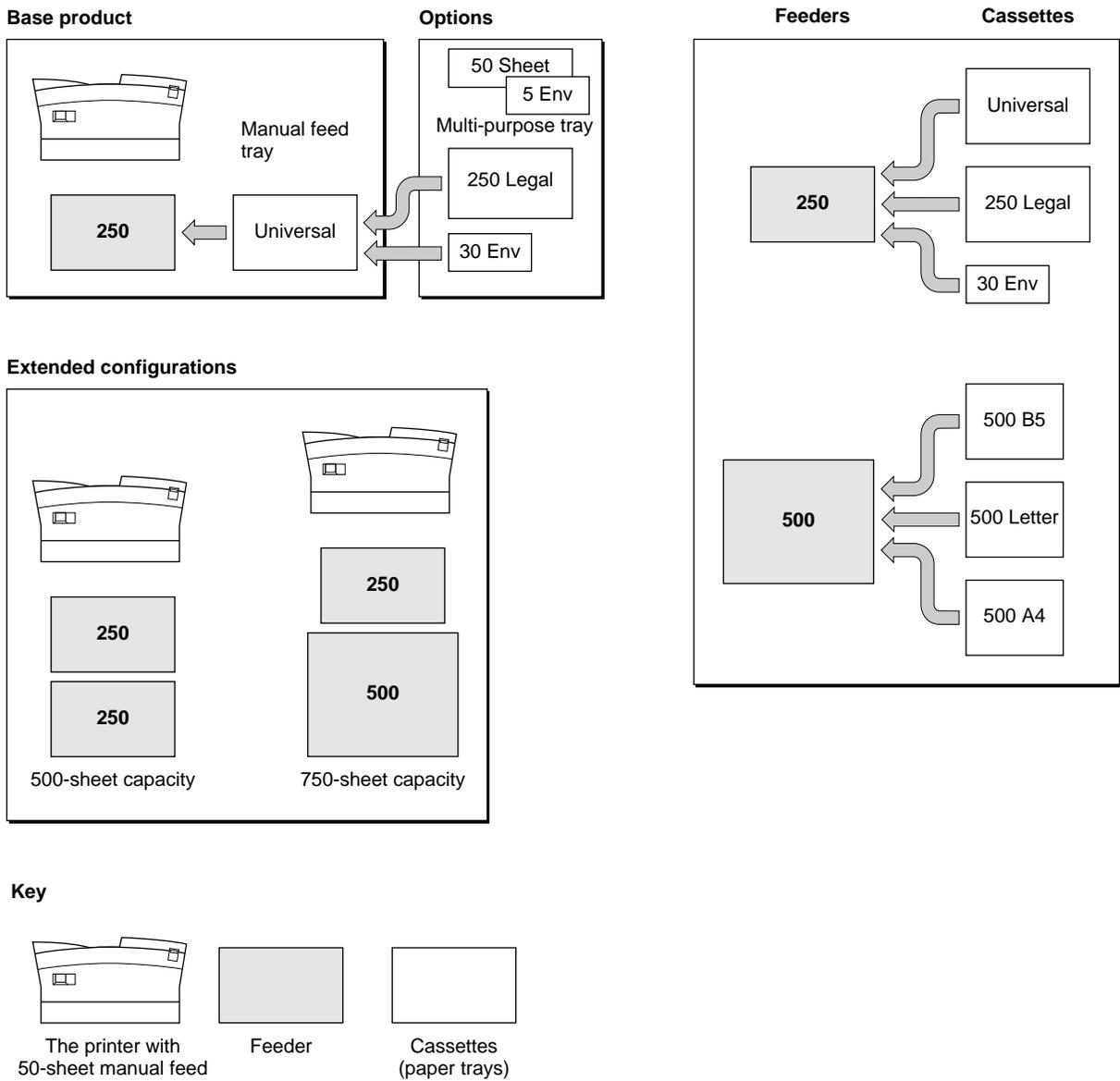
- The manual feeder is an integral part of the printer. To use it, you pull down a small flap on the front of the printer. You may use this feeder to feed single sheets manually, or you may attach an optional multi-purpose tray that accommodates up to 50 sheets of varying sizes, or five envelopes.
- The 250-page feeder pulls out like a drawer from the front of the printer. It accommodates a cassette which holds three paper sizes: letter, legal, and envelope.
- The 500-page optional feeder is a separate unit. It is installed under the LaserWriter Select 310 printer. It accommodates a cassette which holds three paper sizes: A4, B5, and letter.

The basic printer comes with:

- the 50-sheet feeder
- the 250-sheet feeder
- a universal cassette 250-sheet cassette that holds U.S. letter-size paper, A4-size paper, A5-size paper, B5-size paper, and executive-size paper.

As shown in Figure 1-7, if you use the basic printer with additional optional feeders, you can extend the printer's paper-feeding capabilities to 500 or 750 sheets. You can also use the manual feed tray in any of these configurations.

Figure 1-7 Paper handling options



LaserWriter Select 310 Software

LaserWriter Select 310 Software

This chapter describes the LaserWriter Select 310 software.

- It provides an overview of software features, including the Adobe PostScript Programming Language, the PostScript interpreter, the LaserWriter Select 310 driver, and page types.
- It defines the software parameters that enable you to set up and configure the LaserWriter Select 310 printer. They include, system parameters, page device parameters, user parameters, device parameters, communication parameters, engine device, extensions to PostScript Level 1, and the printer error parameter.
- It also explains how to set these parameters.
- It describes changes made to the PostScript language that impact the LaserWriter Select 310 printer including the use of packed arrays, use of immediately evaluated names, changes in the operation of the font cache, new general sampling and halftone techniques, and a different method of handling end-of-line recognition.

Software Overview

This section gives you an overview of the LaserWriter Select 310 software features, including:

- the Adobe PostScript Programming Language
- the PostScript interpreter
- the LaserWriter Select 310 driver
- page types
- product strings

Adobe PostScript Programming Language

The LaserWriter Select 310 printer executes descriptions written in the PostScript language. The version of the PostScript language used has features and capabilities that might not be present in other PostScript output devices. This developer note describes the supplementary PostScript language features of the LaserWriter Select 310 printer. You should use the note in conjunction with the *PostScript Language Reference Manual*, first edition, published by Addison-Wesley.

PostScript Interpreter

You may access the special features of the LaserWriter Select 310 printer by executing special PostScript operators that exist only in the printer's interpreter, PostScript interpreter version 52.5.

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The special operators are intended for use by interactive users, by programmers of host software that carries out user requests, or by users who may want to configure the LaserWriter Select 310 printer in non-standard ways. Normally page descriptions should not refer to the special operators, since doing so impairs portability.

LaserWriter Select 310 Driver

The LaserWriter Select 310 driver and Print Manager provide a general printer interface to the printer. The interface should meet the needs of most Macintosh applications.

The driver:

- provides full support for PostScript Language Level 1
- supports standard and optional cassettes, multiple bins, a multipurpose paper tray, and an envelope feeder
- enables the printer to report paper size in the standard and optional cassettes to the user
- presents printer jam status if reported back by the printer
- supports print density adjustment
- supports Type 1 and TrueType fonts

Page Types

The page types for the LaserWriter Select 310 printer are the same as those described in Chapter 4 of the *LaserWriter Reference*.

At the beginning of each job, the server selects the default paper tray, as assigned by the `defaultpapertray` operator. If the default is the main cassette, the server can detect its size and install the appropriate image region. If the default is the multipurpose tray, the server uses the image region most recently installed by means of the `setdefaultmultipurposepapertraysize` operator.

When the multipurpose tray is selected in this way, or by using the `setpapertray` operator, it is treated like the main cassette. Several sheets of paper may be stacked in it, and it feeds continuously until it is empty, at which time a light comes on to indicate that the paper has run out. If a job requires a particular paper size, it should invoke one of the paper tray selection operators listed in Table 2-1 on page 18 before it generates an image. The paper tray selection stays in effect for the duration of the job. The server restores the default paper tray selection when that job is finished. Table 1-5, in Chapter 1, defines the different paper sizes.

Table 2-1 Paper tray selection operators

Operator	Description
a4tray	Selects the paper tray containing A4-size paper and sets the page type to either a4 or a4small, depending on the value of pagetype. This operator raises the PostScript language error rangecheck if there is no paper tray containing A4-size paper.
a5tray	Selects the paper tray containing A5-size paper and sets the page type to a5. This operator raises the PostScript language error rangecheck if there is no paper tray containing A5-size paper.
b5tray	Selects the paper tray containing B5-size paper and sets the page type to b5. This operator raises the PostScript language error rangecheck if there is no paper tray containing B5-size paper.
c5tray	Selects the paper tray containing C5-size paper and set the page type to c5. This operator raises the PostScript language error rangecheck if there is no paper tray containing C5-size paper.
com10tray	Selects the paper tray containing COM10-size envelopes and sets the page type to com10. This operator raises the PostScript language error rangecheck if there is no paper tray containing COM10-size envelopes.
dltray	Selects the paper tray containing DL-size envelopes and sets the page type to dl. This operator raises the PostScript language error rangecheck if there is no paper tray containing DL-size envelopes.
executivetray	Selects the paper tray containing Executive-size paper and sets the page type to executivesize. This operator raises the PostScript language error rangecheck if no paper tray contains Executive-size paper.
legaltray	Selects the paper tray containing legal-size paper and sets the page type to legal. This operator raises the PostScript language error rangecheck if there is no paper tray containing legal-size paper.
lettertray	Selects the paper tray containing letter-size paper and sets the page type to either letter or lettersmall, depending on the value of pagetype. This operator raises the PostScript language error rangecheck if there is no paper tray containing letter-size paper.
monarchtray	Selects the paper tray containing Monarch-size paper and sets the page type to monarch. This operator raises the PostScript language error rangecheck if no paper tray contains Monarch-size envelopes.

Product Strings

Table 2-2 lists values assigned to the product strings associated with the LaserWriter Select 310 printer.

Table 2-2 Product string values

String name	Type	Value
product	string	LaserWriter Select 310
productA	string	LaserWriter Select 310
version	string	52.5

Software Parameters

This section defines the software parameters that enable you to set up and configure the LaserWriter Select 310 printer. These parameters fall into two broad categories:

- communication device parameters
- compatibility operators

Communication Device Parameters

The LaserWriter Select 310 printer has two communication ports: an RS-232 serial port and a Centronics 36-pin parallel port. The section “Setting Communication Parameters,” later in this chapter, defines communication channel parameters. Chapter 3, “Communication Channels,” provides detailed information on this subject.

The LaserWriter Select 310 printer does not need to change parameters for the parallel communication channel, nor is it equipped to do this.

Compatibility Operators

The PostScript language has undergone a number of significant extensions. The language is designed to be a universal standard for device-independent page descriptions, but each PostScript language implementation supports features and capabilities particular to that implementation. Appendix D, “Compatibility Strategies,” in the *PostScript Language Reference Manual*, second edition, presents guidelines for taking advantage of language extensions, while maintaining compatibility with PostScript interpreters.

Level 1 implementations provide a collection of device control and system parameter configuration operators and procedures, most of which are defined in the dictionary `statusdict`. The contents of `statusdict` are product dependent, although an attempt has been made to maintain a consistent specification for common features. It is the dictionary for product-specific operators and other definitions.

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The compatibility operators present in the LaserWriter Select 310 printer appear in three dictionaries: `statusdict`, and `userdict`. Table 2-3 lists these operators by dictionary group.

Table 2-3 Compatibility operators

Compatibility operators	Compatibility operators
statusdict	
a4tray	printrname
b5tray	product
buildtime	ramsize
byteorder	revision
checkpassword	sccbatch
currentcacheparams	sccinteractive
currentpacking	setcacheparams
darkness	setdarkness
defaultmultipurposetraysize	setdefaulttimeouts
defaultpapertray	setdefaultpapertray
defaulttimeouts	setdefaultmultipurposepagesize
dostartpage	setdostartpage
idlefonts	setidlefonts
jobname	setjobtimeout
jobtimeout	setmargins
legaltray	setpacketbackchannel
lettertray	setpacking
manualfeed	setpagestackorder
manualfeedtimeout	setpagetype
margins	setpapertray
packedarray	setpassword
packetbackchannel	setprintrname
pagecount	setscbatch
pagestackorder	setscinteractive
pagetype	setsoftwareiomode
papersize	softwareiomode
papertray	waittimeout
printererror	
userdict	
a4	d1
a4small	executive page
a5	legal
b5	letter
c5	lettersmall
com10	monarch

Setting Compatibility Operators

The LaserWriter Select 310 printer has an extensive collection of parameters that control its behavior. This section describes how to set the following types of parameters:

- system parameters
- page device parameters
- user parameters
- device parameters
- communication parameters
- engine device parameters
- parameters that are extensions to PostScript Level 1
- the printer error parameter

Table 2-4 lists the parameters by type, in the order described. Although certain parameters are described as persistent, the LaserWriter Select 310 printer does not have nonvolatile memory (EEROM), so the values of these parameters do not persist when the printer is turned off and then on again. However, they do persist between jobs if they are executed outside the server loop.

Table 2-4 LaserWriter Select 310 Parameters

Type	Name	Persistent/volatile
System parameters	checkpassword	Persistent
	defaulttimeouts	Persistent
	idlefonts	Persistent
	pagecount	Persistent
	printername	Persistent
	product	Volatile
	productA	Volatile
	ramsize	Persistent
	revision	Volatile
	setdefaulttimeouts	Persistent
	setidlefonts	Persistent
	setpassword	Persistent
	setprintername	Persistent

continued

Table 2-4 LaserWriter Select 310 Parameters (continued)

Type	Name	Persistent/volatile
Page device parameters	defaultmultipurposetraysize	Persistent
	defaultpapertray	Persistent
	dostartpage	Persistent
	manualfeed	Volatile
	manualfeedtimeout	Volatile
	margins	Persistent
	pagestackorder	Persistent
	papersize	Volatile
	papertray	Volatile
	setdefaultmultipurposetraysize	Persistent
	setdefaultpapertray	Persistent
	setdostartpage	Persistent
	setmargins	Persistent
	setpagestackorder	Persistent
setpagetype	Persistent	
setpapertray	Volatile	
User parameters	jobname	Volatile
	jobtimeout	Volatile
	setjobtimeout	Volatile
	waittimeout	Volatile
Device parameters	setsoftwareiomode	Persistent
	softwareiomode	Persistent
Communication parameters	packetbackchannel	Persistent
	sccbatach	Persistent
	setpacketbackchannel	Persistent
	setsccbatach	Persistent
Engine device parameters	darkness	Persistent
	setdarkness	Persistent
Extensions to PostScript Level 1	currentcacheparams	Volatile
	currentpacking	Volatile
	packedarray	Volatile
	setcacheparams	Volatile
	setpacking	Volatile
Error	printererror	Volatile

Setting System Parameters

This section describes the compatibility operators that set Level 1 system parameters.

checkpassword

Syntax `int checkpassword bool`

Definition This operator checks the validity of the current password. It returns `true` if `int` is equal to the current system administrator password. Otherwise, after delaying for one second, it returns `false`.

Standard value: 0

Error None

defaulttimeouts

Syntax `- defaulttimeouts job manualfeed wait`

Definition This operator returns the following values:

- default job
- manual feed
- wait timeout values

Standard value: 0 60 40

Error `stackoverflow`

idlefonts

Syntax `- idlefonts mark font sxsy rot chars`

Definition This operator pushes a *mark* followed by the integers that control idle time scan conversion (see `setidlefonts`). An empty list of integers, that is one with just a *mark* on the top of the operand stack, specifies that the standard set of characters is to be scan converted.

Standard value: *mark*

Error `stackoverflow`

pagecount

Syntax `- pagecount int`

Definition This operator returns the value of the system parameter `PageCount`. That is, it returns the number of pages that have been printed by the LaserWriter Select 310 printer.

There is no way to reset this value.

Error `stackoverflow`

printername

Syntax	<i>string printername substring</i>
Definition	This operator stores the value of the system parameter <code>PrinterName</code> in <i>string</i> and returns a string object designating the <i>substring</i> actually used. Standard value: (LaserWriter Select 310)
Errors	invalidaccess, rangecheck, stackunderflow, typecheck

product

Syntax	- <i>product string</i>
Definition	This operator is a <i>string</i> object which is the name of the laser printer product (LaserWriter-Select 310). If a program needs to know what type of printer it is running on, it should check this string. Standard value: (LaserWriter-Select 310)
Error	stackoverflow

productA

Syntax	- <i>productA string</i>
Definition	This operator is a <i>string</i> object which is used when the printer needs a default name to install in <code>printer name</code> . This happens when the printer is turned on for the first time after installation. It will happen each time the printer is turned on until a new name is stored using <code>setprintername</code> . Standard value: (LaserWriter-Select 310)
Error	stackoverflow

ramsize

Syntax	- <i>ramsize int</i>
Definition	This operator returns the number of bytes of RAM in the printer.
Error	stackoverflow

revision

Syntax	- <i>revision int</i>
Definition	This operator is an integer which designates the current revision level of the machine-dependent portion of the PostScript interpreter. Standard value: 0
Error	stackoverflow

setdefaulttimeouts

Syntax	<i>job manualfeed wait setdefaulttimeouts -</i>
Definition	This operator establishes the default values for the three timeouts. It returns the following: <ul style="list-style-type: none"> ■ system parameter <i>jobtimeout</i> for <i>job</i> ■ system parameter <i>waittimeout</i> for <i>wait</i> ■ <i>manualfeedtimeout</i> for <i>manualfeed</i>
Errors	<i>invalidaccess, rangecheck, stackunderflow, typecheck</i>

setidlefonts

Syntax	<i>mark font s_xs_y rot nchars ... setidlefonts -</i>
Definition	This operator expects the operand stack to contain up to 150 integers in the range 0 through 255. The integers are delimited by a <i>mark</i> immediately below them. Operator <i>setidlefonts</i> removes the <i>mark</i> and the integers and remembers them permanently. The integers are interpreted in groups of five that specify characters that are to be scan converted while the LaserWriter Select 310 printer is idle. If the last set of integers in the list is not a multiple of five at idle time, that group is ignored. An empty list of integers, that is one with just a <i>mark</i> on top of the operand stack, specifies that the standard set of characters is to be scan converted.
Errors	<i>invalidaccess, limitcheck, rangecheck, typecheck, unmatchedmark</i>

setpassword

Syntax	<i>old new setpassword bool</i>
Definition	This operator sets the system administrator password, controlling the ability to escape from the server <i>save/restore</i> context and to make persistent changes to system parameters or to the VM (virtual memory). The operator requires two integer operands: the <i>old</i> password and the <i>new</i> password. If <i>old</i> is the correct old password, <i>setpassword</i> changes the password to <i>new</i> and returns <i>true</i> . Otherwise, after a delay of one second, it returns <i>false</i> . Standard value: 0
Error	<i>typecheck</i>

setprintrname

Syntax *string* setprintrname -

Definition This operator establishes the string to be the printer's name.

To maintain compatibility with the Personal LaserWriter NT which includes AppleTalk, the string should be no longer than 31 characters. It should consist entirely of printing characters, and should not contain the characters : or @.

Errors *invalidaccess, limitcheck, stackunderflow, typecheck*

Setting Page Device Parameters

This section describes compatibility operators that set Level 1 page device parameters.

defaultmultipurposetraysize

Syntax - defaultmultipurposetraysize *name bool*

Definition This operator returns the *name* and *bool* parameters used with `setdefaultmultipurposetraysize` to set the default multipurpose tray size.

Standard value: `/letter true`

Error *stackoverflow*

defaultpapertray

Syntax *tray* defaultpapertray -

Definition This operator returns the default paper tray number set by `setdefaultpapertray`.

Standard value: 0

Error *stackoverflow*

dostartpage

Syntax - dostartpage *bool*

Definition This operator returns the Boolean set during the most recent execution of `dostartpage`.

Standard value: `false`

Error *stackoverflow*

manualfeed

Syntax - manualfeed *bool*

Definition If `manualfeed` is `true` at the time of a `showpage` or `copypage`, then that page will be fed manually. Otherwise, the page will not be fed manually.

Standard value: `false`

Error `stackoverflow`

manualfeedtimeout

Syntax - manualfeedtimeout *int*

Definition This operator is the manual feed timeout currently in effect, that is, the number of seconds the LaserWriter Select 310 printer will wait for a page to be inserted into the manual feed slot. This timeout applies only when the printer is in manual feed mode and `manualfeed` is `true`.

At the beginning of a job, the server initializes `manualfeedtimeout` to the default manual feed timeout returned by `defaulttimeouts`. However, a PostScript language program may change it to any non-negative integer value by using `def`, `put`, or `store`.

Standard value: `60`

Error `stackoverflow`

margins

Syntax - margins *top left*

Definition This operator returns the *x* and *y* components of the page `deviceMargins` parameter as *left* and *top*, respectively.

Standard value: `0`

Error `stackoverflow`

pagestackorder

Syntax - pagestackorder *bool*

Definition This operator returns the last value set by `setpagestackorder`. It should be `true` if the pages are to be stacked face down in the output tray and `false` if the pages are to be stacked face up.

Standard value: `true`

Error `stackoverflow`

papersize

Syntax - papersize *name bool*

Definition This operator returns the name of the operator that selects a tray containing paper of the current size. For example, if the current paper size is letter, this operator returns the value /lettertray. The value of *bool* is true if the page feeds short edge first, false if the page feeds long edge first.

Standard value: The operator appropriate for the tray specified by papertray.

Error stackoverflow

papertray

Syntax - papertray *integer*

Definition This operator returns the paper tray number most recently set by the setpapertray operator.

Standard value: The value of the defaultpapertray operator.

Error stackoverflow

setdefaultmultipurposepapertraysize

Syntax *name bool* setdefaultmultipurposepapertraysize -

Definition This operator tells the interpreter what paper size is installed in the multipurpose tray. Because the printer engine cannot sense this information, operators that need to know paper size refer to the value stored by this operator.

This operator must be executed outside the server loop.

The *name* operand is the name of one of the standard device setup procedures: /letter, /legal, /a4, /b5, /executive page, /a5, /com10, /monarch, /c5, or /dl.

The procedures /lettersmall and /a4small are not allowed.

The value of the pagetype operator controls whether or not the page is small.

The *bool* parameter is included for compatibility with other PostScript printers. It specifies whether the paper is to be fed long edge first or short edge first. For all paper sizes on the LaserWriter Select 310 printer, the value of *bool* must be true, which means the short edge is fed first.

Errors invalidaccess, rangecheck, stackunderflow, typecheck

setdefaultpapertray

Syntax	<i>tray</i> setdefaultpapertray -
Definition	When the server begins a job, it establishes the default paper tray as the tray from which it will feed paper, and it sets up an imageable area corresponding to the size of paper in that tray. The tray operand is an integer that must be set to one of the following values: <ul style="list-style-type: none"> 0 for the main cassette (cassette 250) 1 for the multipurpose tray 2 for the optional cassette (cassette250/500)
Errors	invalidaccess, rangecheck, stackunderflow, typecheck

setdostartpage

Syntax	<i>bool</i> setdostartpage -
Definition	Since the LaserWriter Select 310 printer has no start page, executing this operator with a value of true has no effect, and is ignored. The operator is present to maintain compatibility with the Personal LaserWriter NT.
Errors	invalidaccess, stackunderflow, typecheck

setmargins

Syntax	<i>top left</i> setmargins -
Definition	This operator adjusts the printer's margins, thus changing the alignment of the imageable area on the physical page. The <i>top</i> and <i>left</i> operands are integers that specify distances in device space. (The unit size is one device pixel or 1/300 inch.) A positive <i>top</i> widens the top margin, and a negative <i>top</i> narrows it, relative to the standard margin width. Similarly a positive <i>left</i> widens the left margin, and a negative <i>left</i> narrows it. <p>You should use <i>setmargins</i> only at installation time to correct any existing physical alignment errors. There are limits to the range of adjustment possible. The printer hardware imposes margins that cause the image to be clipped if it is moved too close to the edge of the paper.</p> <p><i>Note 1.</i> The margins imposed by the hardware are not symmetrical with respect to the center of the paper.</p> <p><i>Note 2.</i> This operator in no way affects the dimensions of the imageable area.</p> <p>Standard value: 0</p>
Errors	invalidaccess, rangecheck, stackunderflow, typecheck

setpagestackorder

- Syntax** *bool* setpagestackorder -
- Definition** This operator sets value returned by `pagestackorder`. A value of `true` indicates that the output is going to the face-down tray. A value of `false` indicates that the output is directed to the face-up tray. Since the LaserWriter Select 310 printer has only a face-down tray, `true` is the only correct value for this parameter.
- Errors** `rangecheck`, `invalidaccess`, `stackunderflow`, `typecheck`

setpagetype

- Syntax** *int* setpagetype -
- Definition** This operator specifies the default page type to be used subsequently when any paper tray is installed. The following values may be used:
- 0 selects the standard page image area (letter, a4, etc.)
- n a non-zero value selects note sizes
- Errors** `invalidaccess`, `stackunderflow`, `typecheck`

setpapertray

- Syntax** *integer* setpapertray -
- Definition** This operator sets the paper tray from which paper will be fed, and it sets the image area according to the size of paper in the tray and the value of the `pagetype` operator. The integer argument must be:
- 0 for the main cassette (cassette 250)
- 1 for the multipurpose tray
- 2 for the optional cassette (cassette250/500)
- Because this operator installs a new image area, it should be invoked before any marks are placed on the current page. If this operator is executed while an outstanding printer error exists, the interpreter waits until the error has been cleared before completing the execution of this operator.
- Errors** `rangecheck`, `stackunderflow`, `typecheck`

Setting User Parameters

This section describes the compatibility operators that set Level 1 user parameters.

jobname

Syntax – *jobname string*

Definition This operator is a string with the same value as the user parameter `JobName`. It specifies the name of the current job. If a PostScript language program defines `jobname`, status responses generated during the remainder of the job in progress will include a job field that reports the text of this string. The string should not contain the characters `;` or `]`, since they would disrupt the syntax of the status messages.

Standard value: `null`

Error `stackoverflow`

jobtimeout

Syntax – *jobtimeout int*

Definition This operator returns the number of seconds remaining before the job timeout will occur. It does this by returning the value of the user parameter `JobTimeout`. If the returned value is `0`, the job will never time out.

Standard value: `0`

Error `stackoverflow`

setjobtimeout

Syntax *int setjobtimeout -*

Definition This operator sets the timeout for the current job to the value *int*, a non-negative integer specifying a time interval in seconds. If the current job continues for *int* seconds without either completing or executing `setjobtimeout` again, the PostScript interpreter executes a `timeout` error. The value `0` disables the job timeout altogether.

At the beginning of a job, the server initially sets the job timeout to the default job timeout returned by `defaulttimeouts`. However, in interactive mode, the initial job timeout is always `0`.

Error `rangecheck, stackunderflow, typecheck`

waittimeout

Syntax - waittimeout *int***Definition** This operator is the wait timeout currently in effect, that is, it is the number of seconds the LaserWriter Select 310 printer will wait to receive additional characters from the host before it aborts the current job by executing a timeout. At the beginning of a job, the server initializes waittimeout to the default wait time returned by defaulttimeout. However, a PostScript language program may change it to any non-negative integer value. In interactive mode, the wait timeout is always 0.

Standard value: 40

Error stackoverflow

Setting Device Parameters

This section describes the compatibility operators that set Level 1 device parameters.

setsoftwareiomode

Syntax *int* setsoftwareiomode -**Definition** This operator sets the binary protocol mode of the communications channel according to the value of *int*:

0	binary protocol off
100	binary protocol on

Binary protocol is standard in the LaserWriter Select 310 printer, and it should be used by any driver that sends binary data to the printer.

A driver that does not use the binary protocol and does not filter the back channel data when softwareiomode is 100 will see receive control characters as quoted characters. In particular, Control-Ds will be seen as Control-A/ASCII-D.

The softwareiomode operator does not need to be set outside the server loop in order to be compatible with other printer implementations of softwareiomode. However changes to it do not take effect until the job that makes the changes is completed.

Standard value: 100

Errors rangecheck, stackunderflow, typecheck

softwareiomode

Syntax *int* setsoftwareiomode -

Definition This operator sets the binary protocol mode of the communications channel according to the value of *int*:

 0 binary protocol off
 100 binary protocol on

Binary protocol is standard in the LaserWriter Select 310 printer, and it should be used by any driver that sends binary data to the printer.

A driver that does not use the binary protocol and does not filter the back channel data when `softwareiomode` is 100 will see receive control characters as quoted characters. In particular, Control-Ds will be seen as Control-A/ASCII-D.

The `softwareiomode` operator does not need to be set outside the server loop in order to be compatible with other printer implementations of `softwareiomode`. However changes to it do not take effect until the job that makes the changes is completed.

Standard value: 100

Errors `rangecheck`, `stackunderflow`, `typecheck`

Setting Communication Parameters

The following compatibility operators set Level 1 serial communication parameters. Serial communication channel (SCC) operator encoding is described in Chapter 3, "Communication Channels," in the section "SCC Operator Encoding."

packetbackchannel

Syntax `packetbackchannel` *bool*

Definition This operator returns the current back channel packet protocol setting.

Standard value: `false`

Error `stackoverflow`

sccbatch

Syntax *channel sccbatch baud options***Definition** This operator returns the baud rate and options for the specified serial channel. Channel 9 only is available with this printer.*baud* and *options* affect the following device parameters:

- *Baud*, *StopBits*, and *FlowControl*
- *DataBits* and *Parity*
- *CheckParity*

See “*setsccbatch*” for further information.

The values for data bits and parity are determined by the bit positions. See the section “SCC Operator Encoding” in Chapter 3.

Baud, stop bits, and flow control are determined respectively by the corresponding settings for *Baud*, *StopBits*, and *FlowControl* device parameters.

Standard value: 57600 68

This value represents an 8-pin serial channel with a baud rate of 57600, space parity, DTR flow control, 8 data bits, and one stop bit. (See Table 3-6.)

Errors *rangecheck*, *stackoverflow*, *stackunderflow*, *typecheck***setpacketbackchannel**

Syntax *bool setpacketbackchannel -***Definition** This operator sets the serial communications back channel packet DTR protocol to be on if *bool* is *true*, or off if *bool* is *false*. The packet protocol is used exclusively by the Apple LaserWriter driver and should be set by it only.**Errors** *invalidaccess*, *stackunderflow*, *typecheck*

setscbatch

Syntax *channel baud options setscbatch -*

Definition This operator sets the communication parameters as specified by three integers:

- *channel*, which designates the serial channel. Channel 9 only is available
- *baud* rate, which determines the rate of data transfer
- *options*, which encodes parity, flow control, the number of data bits, and the number of stop bits to be used in serial communication mode

The new baud rate and options do not take effect until the end of the current job. You may not set the serial channel's baud rate to 0. A 0 setting will cause a rangecheck error to occur.

Example: `9 19200 2 setscbatch` sets the 8-pin serial channel to 19200 baud with even parity.

Refer to the section "SCC Operator Encoding," in Chapter 3, for detailed information on this subject.

Errors *invalidaccess, rangecheck, stackunderflow, typecheck*

Setting Engine Device Parameters

This section describes the compatibility operators that set Level 1 engine device parameters.

darkness

Syntax *- darkness real*

Definition This operator returns the darkness value set by `setdarkness`.

Standard value: .75

Error *stackoverflow*

setdarkness

Syntax *real* setdarkness -

Definition This operator sets the printer's laser density according to the value specified by *real*, where a value of 0 is the least dense and a value of 1 is the most dense. This causes the printer's output to be either lighter or darker, depending on whether the darkness value is lowered or increased from the current value.

The printer itself has only five darkness settings: 0, .25, .5, .75, and 1. If the value of *real* is set between 0 and 1 but is not one of these values, darkness will be set to the setting closest to *real*. If the value of *real* is outside the range of 0 through 1, a rangecheck error will occur.

Errors invalidaccess, rangecheck, stackunderflow, typecheck

Setting Extensions to PostScript Level 1

The LaserWriter Select 310 printer uses a variety of parameters that are not generally used with PostScript Level 1 language. These operators extend the capabilities of the PostScript Level 1 language supported by the printer.

currentcacheparams

Syntax - currentcacheparams *mark lower upper*

Definition This operator pushes a mark object followed by the current cache parameters onto the operand stack. The number of cache parameters returned is variable. See setcacheparams.

Standard value: mark 1250 12500

Error stackoverflow

currentpacking

Syntax - currentpacking *bool*

Definition This operator returns the array packing mode currently in effect.

Standard value: false

Error stackoverflow

packedarray

Syntax *any₀...any_{n-1} packedarray packedarray*

Definition This operator creates a packed array object of length *n*. The array object contains the objects *any₀* through *any_{n-1}* as elements. The packed array operator first removes the non-negative integer *n* from the operand stack, creates a packed array containing those objects as elements, and finally pushes the resulting packed array object onto the operand stack.

The resulting object has a type of *packedarraytype*, a literal attribute, and read-only access. In all other respects, its behavior is identical to that of an ordinary array object.

Error *rangecheck, stackunderflow, typecheck, VMerror*

setcacheparams

Syntax *mark lower upper setcacheparams -*

Definition This operator sets cache parameters as specified by the integer objects above the topmost mark on the stack, and then removes all operands and the mark object as if by *cleartomark*.

The number of cache parameters is variable. If more operands are supplied to *setcacheparams* than are needed, the topmost ones are used and the remainder ignored. If fewer are supplied than are needed, *setcacheparams* implicitly inserts default values between the mark and the first operand supplied.

The *upper* operand specifies the maximum number of bytes that may be occupied by the pixel array of a single cached character. The *lower* operand specifies the threshold at which characters are stored in compressed form rather than as full pixel arrays. If a character's pixel array requires more bytes than specified by *lower* bytes to represent it, it is compressed in the cache and reconstituted from the compressed representation each time it is needed.

Setting *lower* to zero forces all characters to be compressed, permitting more characters to be stored in the cache, but increasing the amount of work required to print them. Setting *lower* to a greater value than *upper* disables compression.

Errors *rangecheck, unmatchedmark*

setpacking

Syntax `bool setpacking -`

Definition This operator determines the type of executable arrays subsequently created by the PostScript interpreter's scanner. It sets the array packing mode to the specified boolean value. The value `true` selects packed arrays. The value `false` selects ordinary arrays.

The packing mode affects only the creation of procedures by the scanner when it encounters program text bracketed by `{ }`, during interpretation of an executable file or string object; or during execution of the token operator.

It does not affect the creation of literal arrays by the `[]` operators, or by the array operator.

The array packing mode persists until it is overridden by another execution of `setpacking` or is undone by `restore`.

Example:

```
systemdict/setpacking known
  {/savepacking currentpacking def
   true setpacking
  } if
```

... arbitrary procedure definitions ...

```
systemdict/setpacking known [savepacking setpacking]
if
```

Errors `stackunderflow, typecheck`

Printer Error Parameter

The LaserWriter Select 310 printer has one parameter that allows you find out what has caused an error condition, and how many times the printer has attempted to complete a specific job.

printererror

Syntax *status tries printererror -*

Definition This procedure is called during execution of `showpage` or `copypage` if the printer mechanism reports an error such as out of paper, no paper tray, paper jam, cover open, and so on.

status is an integer that encodes details of the error condition. It is device dependent and is not documented in this developer note.

tries is the number of times `printererror` has previously been called during the same `showpage` or `copypage`. If `printererror` returns, the printed operation is retried. If it aborts, by executing `stop`, the printing operation is abandoned.

Standard procedure: `printererror` interprets *status* and generates a PrinterError status message. It then returns, allowing printer errors to be retried indefinitely.

Error `stackoverflow`

PostScript Language Changes

Several additions have been made to the PostScript language, which is used by the LaserWriter Select 310 printer, and by certain other PostScript printers. The additions are upwardly compatible and do not affect the function of any existing PostScript language programs.

Note

PostScript language programs that are intended to be compatible with all PostScript printers should not use the new features. The program can determine whether or not the new features are present, and it can invoke them conditionally. ♦

The new features described in the following sections include:

- packed arrays, which provide a means of cutting down on the amount of virtual memory allocated for the storage of executable arrays
- immediately evaluated name, a new kind of name token, that causes names in procedures to become tightly bound to their values
- a different kind of operation for the font cache
- a new general sampling and halftoning technique that allows a larger class of sampled images to be transferred from a binary source image to the raster output device
- a different method of handling end-of-line recognition

This section also lists the new operators used in the LaserWriter Select 310 printer.

Packed Arrays

PostScript language procedures are represented as executable arrays, which were previously stored in the same fashion as literal data arrays. This type of representation offers maximum flexibility but is very costly in terms of space, requiring 8 bytes per element. Large PostScript Language programs, such as the built-in server program, and downloaded preambles, consume considerable amounts of virtual memory.

Programs do not require the ability to be treated as data, but only the ability to be executed. The packed array fulfils this requirement. Programs represented as packed arrays are typically 50% to 70% smaller than programs represented as ordinary arrays.

Packed Arrays Versus Ordinary Arrays

The packed array object has a `type` different from an ordinary array, using `packedarraytype` instead of `arraytype`. However, in most respects it behaves in the same way. You can

- extract elements using `get`
- extract subarrays using `getinterval`
- enumerate the array using `forall`

Individual elements extracted from a packed array are ordinary PostScript language objects. A sub-array of a packed array is also a packed array.

Packed arrays are different from ordinary arrays in the following ways:

- packed arrays are always read only; you cannot use `put` or `putinterval` to store into one
- packed arrays are created differently; (see the section below, “Creating Packed Arrays”)
- accessing arbitrary elements of a packed array can be quite a slow process; however, accessing elements sequentially, as the PostScript interpreter and the `forall` operator do, is almost as efficient as accessing an ordinary array
- the `copy` operator cannot copy into a packed array, since the array is read only. However, it can copy the value of a packed array to an ordinary array that is at least as long as the packed array

Creating Packed Arrays

Packed arrays may be created in two ways. The first and more common way is for the PostScript interpreter’s input scanner to create packed arrays automatically for all executable arrays that it reads. This means that whenever the scanner encounters a `{` while reading a file or string, it accumulates all tokens up to the matching `}` and turns them into a packed array instead of an ordinary array.

The choice of array type is controlled by a mode setting, manipulated by the new operators, `setpacking` and `currentpacking`. (See “Setting Extensions to PostScript Level 1,” earlier in this chapter.) If the array packing mode is `true`, PostScript language procedures encountered subsequently by the scanner are created as packed arrays. If the mode is `false`, procedures are created as ordinary arrays. The default value is `false` to preserve compatibility with existing programs.

The second way to create a packed array is to build it explicitly by invoking the `packedarray` operator with a list of operands to be incorporated into a new packed array.

Immediately Evaluated Names

The PostScript language syntax has been extended to include a new kind of name token, the immediately evaluated name. When the scanner encounters the token `//name`, (a name preceded by two slashes with no intervening spaces), it immediately looks up the name in the context of the current dictionary stack and substitutes the corresponding value for the name. If the name is not found, an `undefined` error occurs.

The substitution occurs immediately, regardless of whether or not the token appears inside an executable array delimited by `{ . . . }`.

Note

This process is a substitution and not an execution. This means the name's value is not executed but is substituted for the name itself, just as if the load operator had been applied to the name. ♦

This substitution is related to the action performed by the `bind` operator. See the *PostScript Language Reference Manual* for further information. However, while `bind` substitutes only for those names with values that are operators, each occurrence of the `//name` syntax is replaced by the value associated with `name`, regardless of the value's type. The following examples illustrate this.

```
/a 3 def
/b {(test) print} def
//a =>3
//b => {(test) print}
{ //a //b a /b }=> {3 {(test) print} a /b
```

Using immediately evaluated names serves a similar purpose to using the `bind` operator. That is, it causes names in procedures to be tightly bound to their values.

▲ WARNING

Indiscriminate use of immediately evaluated names may change the semantics of a program. ▲

Specifically, when the interpreter encounters a procedure object directly, it simply pushes it onto the operand stack. When it encounters an object indirectly, by looking up an executable name, it executes the procedure. Therefore, execution of the program fragments `{ . . . b . . . }` and `{ . . . //b . . . }` may have different effects if the name of `b` is a procedure. See Section 3.6 of the *PostScript Language Reference Manual*, second edition, for further information.

The immediately evaluated name facility is present in all versions of the PostScript interpreter since version 25.0. Earlier versions of the interpreter will scan `//name` as two distinct tokens: `/` as a literal name with no text at all, and `/name` as a literal name with the text name.

Changes in Font Cache Operation

Operation of the font cache has changed in the LaserWriter Select 310 printer. Formerly, there was a single limit on the number of bytes occupied by a character in the cache. Any character larger than the space allocated would not be cached. Now there are two cache thresholds, a lower and an upper threshold. The following cache conditions apply:

- if the character is larger than the space allocated by the upper threshold, as determined by the bounding box specified to `setcachedevice`, the character will not be cached
- if the character is larger than the lower threshold, it will be compressed and cached
- if the character is not larger than the lower threshold, it will be stored as a full pixel array

The two thresholds are manipulated by the new operators `setcacheparams` and `currentcacheparams`. These operators are described in detail earlier in this chapter, in the section “Setting Extensions to PostScript Level 1.” The old operators, `cachestatus` and `setcachelimit`, remain valid, although they will rarely be used.

Compressed characters consume much less space in the font cache than the full pixel arrays, by factors of up to 40. However, more computation is required to reconstitute them when they are needed. Reconstituting a compressed character is still considerably faster than re-executing the original character description.

In systems such as the LaserWriter Select 310 printer which prints at 300 pixels per inch (dpi) or less, the default lower threshold is set so that characters up to about 20 points are stored as full pixel arrays, while larger ones are stored in compressed form. This means that ordinary body text may be cached using the time-efficient full pixel array representation, but large characters will be cached using space-efficient compressed representation.

Device Resolution Images

A large class of sampled images is now transferred directly from a binary source image to the raster output device rather than using the more general sampling and halftoning technique. The conditions for the image operator’s fast case are now as follows:

- The image is one bit per sample.
- Image and device resolutions are the same. This means that the combination of the image matrix and the current transformation matrix is such that one unit in image space corresponds to one unit in device space.
- The image coordinate systems x and y axes are either parallel to or perpendicular to the corresponding axes of the device space. This expands the fast case to include rotations of 0, 90, 180 and 270 degrees, as well as their x and y reflections, to provide a total of eight different image orientations, instead of the two previously allowed.

If an image that meets the above conditions on the LaserWriter Select 310 printer is printed on an earlier PostScript printer, it may be treated as a general image. In this case, the earlier printer may process the image more slowly than the LaserWriter Select 310 printer, but the results will still be correct, preserving the device independence of the PostScript language page descriptions.

End-of-Line Recognition

In PostScript interpreter versions 40.0 and later, the scanner and the `readline` operator recognize all three external forms of end of line (LF alone, CR alone, and CR LF pair) and treat them uniformly. The PostScript interpreter does not translate data read or written by any other means.

In the LaserWriter Select 310 printer, end-of-line (EOL) translation occurs at two levels: in the PostScript interpreter and in the serial communication channel. This section deals only with the EOL conventions at the level of the PostScript interpreter. The translation performed by the communication handler is described in Chapter 3, "Communication Channels."

The LaserWriter 310 Select printer supports translation by the communication channel to maintain compatibility with diverse host operating systems and communications environments. For instance, always sending CR LF for EOL permits use with operating systems that treat CR alone or LF alone as EOL characters, provided they strip out the redundant character. In addition, the CR LF convention is essential for use with directly connected terminals.

The new rules for end-of-line recognition at the level of the PostScript interpreter have the following consequences.

1. Any of the three forms of EOL appearing in a string are treated as a single newline (LF) character. For example:

```
(any text<CR>some more text)
(any text<LF>some more text)
(any text<CR><LF>some more text)
```

The above examples produce identical string objects, each of which has a single newline (LF) character separating `text` and `some`.

2. Any three forms of EOL appearing immediate after `\` in a string are treated as a continuation. This means that both the `\` and the EOL are discarded:

```
(any text\<<CR>some more text)
(any text\<<LF>some more text)
(any text\<<CR><LF>some more text)
```

The above examples produce identical string objects.

3. Any of the three forms of EOL appearing outside a string are treated as a single white-space character. Since the language treats multiple white-space characters in the same way as a single white-space character, the treatment of EOL is interesting only when a PostScript language token is followed by data to be read explicitly by one of the file operators:

```
currentfile read<cr>x
currentfile read<LF>x
currentfile read<CR><LF>x
```

The above examples produce identical results. The `read` operator reads the character `x` from the current input files and leaves its character code (an integer) on the stack.

4. The `readline` operator treats any of the three forms of EOL as the termination condition.

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5. Data read by `read` and `readstring` undergoes no EOL translation. Whatever characters were received from the channel are read by the PostScript interpreter. However, the channel itself may be performing some EOL translation. For example, the serial and parallel channels on the LaserWriter Select 310 printer may affect the input data, as described in Table 3-3, in Chapter 3, “Communication Channels.”
6. Data written by `write` and `writestring` undergoes no EOL translation. Whatever characters were provided by the PostScript interpreter are sent to the channel. The newline character, represented by `\n` in a PostScript language string object, is sent as LF.

New Operators

The following operators have been added to support LaserWriter Select 310 printer functions. These operators are described in an earlier section of this chapter, “Setting Extensions to PostScript Level 1.”

- `currentcacheparams`
- `currentpacking`
- `packed array`
- `setcacheparams`
- `setpacking`

TrueType Fonts

The LaserWriter Select 310 printer is a Class C device, and does not support the TrueType format. However, the printer does follow the Adobe Systems, Incorporated, Type 1 font format specification, which is described in “*Adobe Type 1 Font Format*,” published by Addison-Wesley.

Communication Channels

Communication Channels

The LaserWriter Select 310 printer has two communication ports that support two communication channels. One port is the RS-232 serial port used for serial communication. The other is the Centronics parallel port used to connect the LaserWriter Select 310 printer to an IBM-PC compatible computer. The section “Communication Ports,” in Chapter 1, describes the physical characteristics of the connectors. This chapter deals with the software support for the serial and parallel communication channels.

Serial Communication

When the LaserWriter Select 310 printer is in serial mode, it uses the RS-232 port to send data and receive data encoded in ASCII. Certain characters serve special purposes. For example, Control-D marks the end of the file, and Return indicates end of line. The server performs a job by reading and executing a PostScript program from the serial port. When it reads the end-of-file character and the program terminates, the server sends an end-of-file character, ends the job, and starts a new one.

Three parameters control the details of serial communication. They are channel, baud rate, and options. These parameters may be changed by invoking the `statusdict` operator `setscbatch`. Serial communication is asynchronous, start-stop, and uses 7 or 8 bits per character. The 8-pin serial connector is designated as a channel in the PostScript interpreter by the integer 9. Table 3-1 summarizes the default settings for the LaserWriter Select 310 printer serial communication channel.

Table 3-1 Default settings for the serial communication channel parameters

Parameter	Default settings	Other settings
Data bits	8	7
Parity	None	None
Stop bits	One	–
Flow control	DTR	XON/XOFF
Baud rate	57600	Any baud rate that divides into 115200 with a quotient of two or more
Protocol	Binary	Simple

Baud Rates

The baud rate is given as an integer, such as 1200 or 9600. The baud-rate parameter may be any positive integer less than 100000. However, the hardware can only achieve certain baud rates, and other values are rounded to the nearest achievable rate. Below 57600 baud, the achievable rates are 9600, 10473, 11520, 12800, 14400, 16457, 19200, 23040, 28800, and 38400. Any baud rate that divides into 115200 with a quotient of two or more is legal. The Macintosh host computer supports a 57600 baud rate. Host systems other than the Macintosh are most likely to support a 19200 baud rate.

Parity Settings

The parity settings for the serial channel may be odd, even, space, or mark. Table 3-2 indicates how the parity setting and number of data bits work together.

Table 3-2 Data and parity choices for the LaserWriter Select 310 printer

Data bits	Parity	Description
Standard	Space	8 bits are sent. The 8th bit transmitted is zero, and the 8th bit received is ignored.
Standard	Odd or even	8 bits are sent. The 8th bit is used for parity.
Standard	Mark	8 bits are sent and received. The parity bit is not stripped. Since the PostScript interpreter expects ASCII data (high bit zero), a host sending mark parity data will not be understood, and you should select 7-bit mode in which the parity bit is stripped.
7 bits	Space	7 data bits are sent. A zero is added.
7 bits	Odd or even	7 data bits are sent. A parity bit is added to the 7 data bits in either odd or even parity, depending on the parity setting.
7 bits	Mark	7 data bits are sent. A one is added.
8 bits	Space	8 bits are sent.
8 bits	Odd or even	8 bits are sent. A parity bit is added to the 8 bits in either odd or even parity, depending on the parity setting.
8 bits	Mark	8 bits are sent.

NOTE Parity is checked on received characters only when the parity setting is even or odd. If a parity error is detected the PostScript interpreter generates an `ioerror`.

Flow Control

The LaserWriter Select 310 printer uses one of two conventions for controlling the flow of characters to and from the host computer. These conventions are DTR and XON/XOFF. If the host fails to conform to the selected flow control protocol, unexpected occurrences of `ioerror` may result.

DTR Flow Control

DTR flow control uses the Data Terminal Ready control signal. Normally, the printer leaves this signal turned on. However, when it needs to stop the flow of characters from the host, it turns DTR off. The host must then immediately stop sending characters until the printer turns DTR back on again. Similarly, another signal, Data Set Read (DSR) may be used by the host to control the flow of data sent to it from the printer. Packet DTR is an implementation of DTR flow control specifically set and used by the Apple LaserWriter driver. It uses the DSR signal to control the flow of data sent to the host in packets of three characters at a time.

XON/XOFF Flow Control

XON/XOFF flow control uses two special characters, XON and XOFF, that may be sent either to the printer or to the host to control the flow of characters. When the LaserWriter Select 310 printer sends an XOFF character to the host, the host must immediately stop sending characters to the printer. When the printer sends XON to the host, the host may start sending characters again.

SCC Operator Encoding

The serial communications parameters are set by `setscbatch`, a 1-byte options argument that holds four SCC encoded parameters: stop bits, data bits, flow control, and parity. The argument is an integer parameter with values in the range 0–255. The bits are assigned to different fields, as shown in Table 3-3, with the most significant bit representing the field stop bits, and so on. Table 3-3 lists the proper field value for each setting. You may determine the value of the options integer by simply selecting one decimal value for each field and adding those decimal integers together.

Table 3-3 SCC compatibility operators options byte values

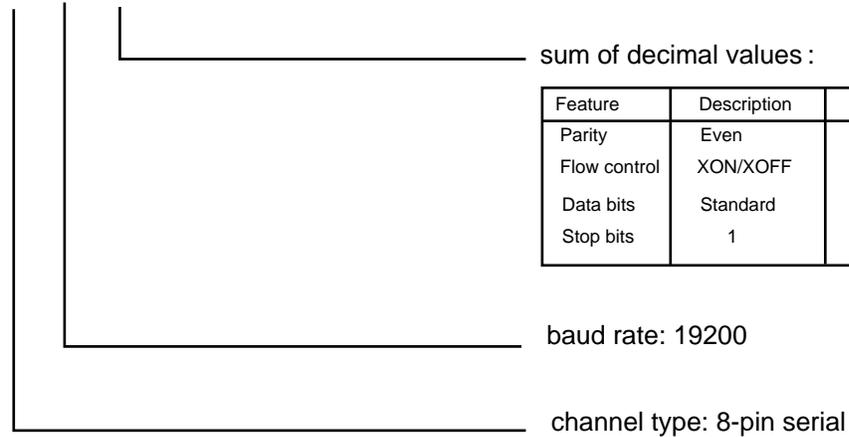
Bit position	Field	Setting	Decimal value	Field value
Bit 7	Stop bits	1 stop bit	0	0
		2 stop bits	128	1
Bits 6 and 5	Number of data bits	Standard	0	0
		7 bits	32	1
		8 bits	64	2
		Undefined	96	3
Bits 4–2	Flow control	XON/XOFF	0	0
		DTR	4	1
		Undefined	8, 12, 16, 29, 24, 28	2, 3, 4, 5, 6, 7
Bits 1 and 0	Parity	Space	0	0
		Odd	1	1
		Even	2	2
		Mark	3	3

Figure 3-1 shows an example of SCC operator encoding for an 8-pin serial port, using standard data bits with even parity, one stop bit, and XON/XOFF flow control.

In PostScript Level 1, the data bits and parity bit interact in a nonorthogonal way, to produce a table of possible choices for data and parity, as shown in Table 3-2. The choices include many commonly required methods of sending data. The Standard data bits setting provides compatibility with earlier versions of the PostScript Level 1.

Figure 3-1 SCC operator encoding**Example**

9 19200 2 setsccbatch



Communication Protocols

The LaserWriter Select 310 printer supports both simple and binary communication protocols for serial and parallel channels. Several character codes in both protocols are reserved for communication functions and are not passed through the PostScript interpreter. The default protocol is binary. The section “Setting Device Parameters,” “setsoftwareiomode,” in Chapter 2, describes how to change the default protocol from binary to simple.

Simple Communication Protocol

Table 3-4 lists the character codes reserved for communication functions in the simple communication protocol. The ASCII character codes are given in decimal.

Table 3-4 Reserved characters in simple communication protocol

Character	ASCII code	Function
Control-C	3	Interrupt. Causes execution of the PostScript language <code>interrupt</code> error. See the <i>PostScript Language Reference Manual</i> , Chapter 6, for further information on <code>interrupt</code> .
Control-D	4	End of file.
Control-S	19	Stop output (XOFF). Functional only if XON/XOFF flow control is in use.

continued

Communication Channels

Table 3-4 Reserved characters in simple communication protocol (continued)

Character	ASCII code	Function
Control-Q	17	Start output (XON). Function only if XON/XOFF flow control is in use.
Control-T	20	Status query. Causes the server to produce a one-line message that describes what the server is doing.
Return	13	End of line. Translated to the PostScript language <code>newline</code> character.
Line-feed	10	End of line. This is the PostScript language <code>newline</code> character. If a return and a line-feed are received in sequence, only one <code>newline</code> character is passed to the PostScript interpreter. When a <code>newline</code> character is written to the standard output file, it is translated to the two-character sequence: return and line-feed.

The serial and parallel communication handlers perform the special processing of the return and line-feed characters, as described in Table 3-4. This processing is independent of the return and line-feed handling performed by the PostScript interpreter itself. Unlike the processing done at the level of the PostScript interpreter, this processing is done regardless of how the data is to be treated by the interpreter.

With the simple protocol, there is no way to ‘quote’ the reserved characters, that is to pass them through to the PostScript interpreter. Nor is there any way to transmit characters in the ‘high ASCII’ range (128–255) when using parity settings 0, 1, and 2, which cause the high-order bit of each character to be ignored or used for parity. Therefore, with this protocol, the communication link is not fully transparent. This causes no difficulty in normal use, however, since the standard PostScript language character set consists entirely of printable characters. The language itself provides means for encoding arbitrary characters in strings (the ‘`\nnn`’ escape sequence).

When the server encounters an end-of-file character and the job terminates, the server sends an end-of-file character back to the host. This character marks the end of the data (if any) written to the standard output file while the job was being executed. This enables the application program running on the host computer to synchronize with the server, if this is desired, and to correlate a given output batch with the job that generated it.

Binary Communication Protocol

As an alternate to the simple protocol, the LaserWriter Select 310 printer supports binary protocol for both the serial and parallel channels. Binary protocol allows all character codes to be transmitted as data, but also allows certain characters to be used for specifying control functions, which may be handled asynchronously by the communications driver. These functions include status requests, aborting of jobs, end-of-job markers, and flow control for the serial channel.

Communication Channels

Since any character code can be transmitted as data with this protocol, it can be used for sending PostScript language jobs that contain binary images. Binary protocol is set by default when the LaserWriter Select 310 printer is powered on. It may also be selected by setting `softwareiomode` to 100.

This protocol requires that a quoting character be inserted at certain places in the data stream and that the character codes for certain characters be altered. Therefore, the host computer must filter binary data before sending it to the printer. When the protocol is enabled, it is used for transmission in both directions. The host should therefore filter any data it receives from the printer. Filtering may be done by an application program or within the operating system of the host. In the case of the LaserWriter Select 310 printer, the Apple LaserWriter driver does this filtering. Table 3-5 lists the control characters for the binary serial protocol.

Table 3-5 Control characters in binary serial protocol

Hex value	ASCII name	ASCII keyboard	Control function
01	SOH	CTL-A	Quote data byte
03	ETX	CTL-C	Abort job and flush to end of file
04	EOT	CTL-D	End-of-job marker
05	ENQ	CTL-E	None
11	DC1	CTL-Q	XON in XON/XOFF flow control
13	DC3	CTL-S	XOFF in XON/XOFF flow control
14	DC4	CTL-T	Request printer status
1C	FS	CTL-\	None

To transmit the control characters as data, the characters must be quoted. This means that the character being sent is replaced by a two-character sequence consisting of control character CTL-A, which indicates a quoted data byte, followed by the character itself XORed with 40 hex. For example, if the host wants to send a request for printer status (hex value 14), it sends 01 hex-54.

This method of quoting means that whenever one of the eight special characters is received, the control function is intended, regardless of whether or not the preceding character is CTL-A. Asynchronous control characters may therefore be generated and processed at a lower level than the data stream may be generated and consumed. On a host machine, the user program may implement the CTL-A quoting convention, while the operating system is independently performing XON/XOFF processing.

Note

All byte values other than those of the eight special characters are transmitted by simply sending the value. ♦

Communication Channels

After CTL-A is received, the next character received that is not one of the special characters must be the result of XORing one of the special characters with 40 hex. If any other character is received, it is considered to be an input error. Any number of special characters may appear between CTL-A and the XORed character, with the exception of special characters CTRL-D and CTRL-A, which are handled asynchronously. If either of these characters is received between CTL-A and the XORed character, it is considered to be an error condition.

If a special character arrives unquoted and it specifies no control function for the channel, the character is simply discarded. For example, if XON or XOFF is received and XON/XOFF flow control is not in use, it is discarded.

IMPORTANT

CTL-E and CTL-\ currently specify no control functions and should not be sent to the LaserWriter Select 310 printer. They are included in the list of quoted characters in case new control functions are added in the future. ▲

In contrast to simple protocol, with binary protocol there is no mapping between end-of-line conventions. The end-of-line characters (<CR>, <LF>, or <CR><LF>) sent by the host are exactly what is received by the interpreter in the printer. The PostScript scanner handles the different end-of-line conventions in a uniform way, but a program that reads data from the channel directly (via `read` or `readstring`) receives whatever characters are sent by the host. Similarly, output is generated by a PostScript program (via `print` or `=`) is sent unchanged.

Note

In this connection, the standard end-of-line in the PostScript language (`\n` in a PostScript language string) is <LF>. ◆

Communicating with an IBM PC

You may connect the LaserWriter Select 310 printer to an IBM PC through either the Centronics 36-pin parallel connector or the RS-232 serial port. The physical characteristics of the connectors are described in Chapter 1, in the sections “Centronics Parallel Connector” and “Serial Port for RS-232C Devices.” This section describes the software support for the interface.

Parallel Interface

To set up the parallel port for communication between the LaserWriter Select 310 and the IBM PC, issue the following command:

```
MODE LPT1: , , P
```

This command allows the Centronics busy signal to be active for extended periods of time.

Communication Channels

Unlike the serial port, the Centronics parallel input allows no parameters. It always accepts 8-bit data with no parity, and it reserves the same set of characters for communication functions that the serial port reserves, with the exception of XON/XOFF characters, which are passed through the PostScript interpreter, since flow control is maintained by means of the /BUSY signal.

The Centronics parallel interface is essentially an input-only channel. This means it basically transfers information from the host to the printer. However, the PostScript interpreter always deals with both the input and output sides of an I/O channel. When operating in Centronics parallel input mode, the printer sets up the 8-pin serial port for the PostScript language print operator. The output from this port may be ignored for simple one-way communication. However, important information may be output via this port. Printer errors are always reported, since the Paper Error signal on the Centronics interface cannot be relied upon to report all printer errors. Table 3-6 summarizes the settings for the serial communications port when it is used as the output port during parallel communication.

Table 3-6 Settings for the serial output channel during parallel communication

Parameter	Settings
Data bits	8
Parity	None
Stop bits	1
Flow control	DTR
Baud rate	9600
Protocol	Binary

Serial Interface

You may also use the serial port as an alternative means of communicating with the IBM PC, using either DTR or XON/XOFF flow control. DTR flow control is preferred, since this is the default serial flow control for the LaserWriter Select 310 printer.

DTR Flow Control for PC Communication

To set up the LaserWriter Select 310 printer for serial interface with the IBM PC over the serial port using DTR flow control, issue the following MS-DOS commands to your computer:

```
MODE COM1:19200,N,8,1,P
MODE LPT1:=COM1:
```

XON/XOFF Flow Control for PC Communication

To set up the LaserWriter Select 310 printer for serial interface with the IBM PC over the serial port using XON/XOFF flow control at 19200 baud, issue the following MS-DOS commands to your computer:

```
MODE COM1:19200,N,8,1
MODE LPT1:=COM1:
```

These commands alone are not sufficient to handle XON/XOFF flow control. Some applications may handle this protocol themselves. Otherwise, you should install a different MS-DOS printer driver to avoid communication problems when printing large documents.

Note

You must issue these commands to your IBM PC whenever the computer is turned on. Alternatively, you may place them in the AUTOEXEC.BAT file on your MS-DOS disk. ♦

The LaserWriter Select 310 printer comes from the factory with its serial port configured for option 68: 8-bit data, no parity, DTR flow control, with 57600 baud. If you need to set up the printer for XON/XOFF communication at 19200 baud, send the following routine to the printer from the host, using either the parallel port, or the serial port at 57600 baud.

```
serverdict begin 0 exitserver
statusdict begin
9sccbatch 0 eq exch 19200 eq and not
{9 19200 0 setsccbatch} if
end stop
```

This routine tests the current values of the `sccbatch` parameters (see Chapter 2), and if they are not set for 19200 baud and option 0, it sets these values using `setsccbatch`.

Note

These changes are not permanently stored, since the LaserWriter Select 310 printer has no EEROM. They will not persist across power cycles. You should send this sequence each time the printer is turned on or whenever the serial communication parameters have been changed. ♦

Communication Dynamics

Data transmitted by the LaserWriter Select 310 printer, whether it is generated by executing the PostScript language program or by some other spontaneous event such as an error, is logically asynchronous with respect to the data received. This means that the host computer must be prepared to consume data received from the LaserWriter Select 310 printer while waiting to send more data to the printer. If the host computer is not set up to do this, the printer and the host may each wait for the other to consume data, and a deadlock will occur.

Communication Channels

Typically, characters written to the standard output file by PostScript operators, such as `print`, are not sent immediately. They are buffered until a flush is executed. A flush occurs automatically

- at the end of a job
- in interactive mode, whenever the user is prompted to make an entry

If a PostScript language program writes data that is needed immediately by the host, for example a reply to an environmental query, it is important to flush after writing the data. Otherwise, a deadlock may occur.

Status Queries and Spontaneous Messages

The LaserWriter Select 310 printer provides a status query facility that enables the host or user to determine what the printer is doing. The printer responds to a status query asynchronously with respect to normal job execution. That is, it sends a response immediately, regardless of what has gone on before, or how much input data has been buffered. This facility primarily enables spoolers (printer control programs) to track the activities of the LaserWriter Select 310 printers under their control.

If the printer receives a CTL-T character from the active input channel, it replies with a one-line status message over the active port's output channel. The message is bracketed by the text sequences `%%[` and `]%%`, to enable the host software to extract the message from the ordinary data generated by the job being executed.

The status message has standardized syntax that is intended to be machine readable. It consists of one or more key, value pairs separated by semicolons. For example:

```
%%[job: Jane's report; status: busy; source: serial 9]%%
```

The possible keys, values, and meanings are as follows:

<code>job</code>	The name of the job is stored as <code>jobname</code> entry in <code>statusdict</code> . (See Chapter 2.) This field is omitted if the current job has not defined <code>jobname</code> .
<code>status</code>	Indicates what the printer is currently doing: <ul style="list-style-type: none"> ■ <code>idle</code> indicates there is no job in progress ■ <code>busy</code> means the printer is executing the user's PostScript language program ■ <code>waiting</code> means that the I/O is waiting in the middle of a job ■ <code>printing</code> indicates that the printer is printing, and that paper is in motion ■ <code>PrinterError: reason</code> means that there is a printer error such as a paper jam or printer out of paper. ■ <code>initializing</code> indicates the printer is starting up
<code>source</code>	<code>serial 9</code> or <code>Centronics</code> indicates the source of the job that the server is currently executing. This field is omitted if the server is idle.

Communication Channels

All messages generated spontaneously by the server (as opposed to those messages produced when the PostScript language program executes `print`) conform to the same syntax as status messages. They are sent as ordinary data through the communication channel, in sequence with any other characters written to the standard output file. Consequently, they are always bracketed with `%%[and]%%` for either serial or parallel channels:

```
%%[Error:error; OffendingCommand: operator ]%%
```

An error has been detected by the PostScript interpreter and the standard error handle (`handleerror`) has been invoked.

`error` is the name of the error operator originally invoked `operator` is the operator or other PostScript object being executed at the time of the error

Refer to the *PostScript Language Reference Manual* for further information on error handling.

```
%%[PrinterError:reason]%%
```

A problem has been reported by the printer mechanism. The type of problem is indicated by `reason`: no paper, no paper tray, paper jam, cover open, etc.

A printer error can only occur during execution of `showpage` or `copypage`, that is when the printer is actually trying to print a page. After generating this message, the server usually waits for the condition to be corrected and then continues printing automatically.

The server's behavior when it encounters a printer error is controlled by the `printererror` procedure described in Chapter 3.

```
%%[Flushing: rest of job (to end-of-file) will be ignored ]%%
```

Because of a previous error or abort condition, for example `stop` or CTL-C interrupt, the remainder of the current job is being discarded. The server reads and discards characters from the standard input file until it receives an end-of-file indication.

```
%%[exit server: permanent state may be changed ]%%
```

The PostScript language program has successfully exited from the server's normal `save/restore` context, and may now make permanent changes to the system parameters or to the virtual memory. See Chapter 3.