## LaserWriter IIf and IIg: Raw, Normal, and Binary Protocols

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Article Created: 19 June 1992
Article Last Reviewed:
Article Last Updated:


TOPIC -----------------------------------------------------------

In reference to the LaserWriter IIf and IIg, what are the differences
among the normal, raw, and binary protocols?


DISCUSSION -------------------------------------------------------

Definitions
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• Raw: Lets all data pass through unfiltered.  Control characters such as
  End-of-file (CTRL-D) and status queries (CTRL-T) are passed through and
  not acted upon.

• Normal: Data passing through is filtered.  Control characters perform
  their intended function.  Status queries (CTRL-T) will have a status
  returned; End-of-file (CTRL-D) characters will end print job.

• Binary: We took the following from pages 15 to 17 of the "LaserWriter IIf
  and LaserWriter IIg Printers Developer Note" (APDA R0230LL/A):

  Binary serial protocol

  LaserWriter printers support an alternate protocol for the serial
  communication channels. While this protocol allows all character codes to
  be transmitted as data, it also allows certain characters to be used for
  specifying control functions, which may be handled asynchronously by the
  communications driver. Those control functions include requesting status,
  aborting a job, marking ends of jobs, and controlling flow for the serial
  channels.

  Because this protocol can transmit any character code, it can be used for
  sending PostScript language jobs that contain binary images or for
  sending commands with any sequence of control characters to emulators.

  Because this protocol can be used for sending both PostScript language
  programs and emulation jobs, it provides a way of switching between the
  PostScript interpreter and the emulators without flushing the input

buffers. The manner of switching between PostScript language programs and emulations is described in Chapter 3 of the "LaserWriter Reference".

To select the binary serial protocol, set the operating mode switch to position 6, or use the LaserWriter Utility to set one of the changeable parameter sets to use binary protocol.

The binary serial protocol requires the host computer to insert a quoting character at certain places in the data stream and to modify the character codes for certain characters. (This procedure is described later in this section.) That means that the host computer must filter the data before sending it to the printer. The filtering may be done by an application program or within the operating system of the host computer.

When the binary serial protocol is enabled, it operates on communications in both directions. Therefore, the host computer must also filter any data it receives from the printer.

There are eight control characters that are treated as control functions rather than as data when they are received by the communications driver. The control characters are defined in Table 2-1.

Table 2-1  Control characters in the binary serial protocol

| Hex value | ASCII name | ASCII function | 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 these characters as data, they must be quoted, as follows. To quote a character, the program replaces the character with the two-character sequence consisting of CTL-A followed by the result of the exclusive-OR (XOR) of the character to be transmitted with $40 (the dollar sign indicates hexadecimal). For example, to send a byte with the value $14, a program must send the 2-byte sequence $01$54. This method of quoting guarantees that whenever any of the eight special characters is received, the control function is intended, regardless of whether the preceding character is a CTL-A. Because of that character independence, the generation and processing of asynchronous control characters can take place at a lower level than the generation and consumption of the data stream. In particular, on the host computer, the CTL-A quoting convention can be implemented by a user program while XON/XOFF processing is performed independently by the operating system.

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

After a CTL-A is received, the next character received that is not one of
the eight special characters must be the result of XORing one of the
special characters with S40. The reception of any other character
constitutes an error in the input data. Between the CTL-A and the XORed
character, any number of special characters may appear, except for the
special characters that are handled synchronously—CTL-A and CTL-D.
Reception of CTL-A or CTL-D between a CTL-A and the XORed character
constitutes an error.

When one of the special characters arrives unquoted and it specifies no
control function for the channel, the character is discarded. For
example, if XON or XOFF is received and XON/XOFF flow control is not in
use, the XON or XOFF character is discarded. The characters CTL-E and
CTL-\ currently do not specify any control functions. They are included
among the characters that must be quoted in case new control functions
are added in the future.

The binary serial protocol is different from the simple serial protocol
in that there is no mapping between end-of-line conventions with the
binary protocol. Whatever end-of-line character (<CR>, <LF>, or <CR><LF>)
is sent by the host is received by the interpreter or emulator in the
printer. The PostScript interpreter handles different end-of-line
characters in a uniform way, but a program that reads data (by means of a
read or readstring operator) receives whatever characters were sent by
the host. Likewise, whatever output is generated by a PostScript program
(by means of a print or = operator) is sent unchanged.

  Note: The standard end-of-line character in the PostScript language,
  corresponding to '\n' in a PostScript language string, is <LF>.
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Keywords:   <None>

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19960215 11:05:19.00

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