

LBP-CX SERIES

VIDEO INTERFACE

REVISION 3

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The content of this manual may be revised as a result of product modification. These revisions are detailed in Service Information Bulletins.

1. OVERVIEW

This manual gives the specifications for the LBP-CX printer interface. There are two types of LBP-CX printers. One has a scan line density of 240 lines per inch. The other has a 300 line per inch scanning density. Specifications for the 240 line per inch printer will be given first, with the specifications for the 300 line per inch model given in parentheses.

1.1 Interface Characteristics

The LBP-CX interface is called a "video signal interface." The LBP-CX interface receives digital bits in the form of serial signals which correspond to either black or white dots. The LBP-CX modulates a laser beam to create an image based upon the signals received by the LBP-CX interface.

A controller transmits commands through the LBP-CX video interface to the printer. The printer responds with status signals. While the commands and status signals are being exchanged, the picture information is being processed by the controller. Finally, the controller sends the video signals through the LBP-CX interface to the printer.

The controller may be designed as an independent module or as part of the user's system.

1.2 Interface Functions

The printer receives printing information in the form of bit serial signals which pass through the VIDEO signal line. The vertical and horizontal synchronous signals necessary to form the image are processed in the printer using the raster scanning method. The synchronous signal for the vertical axis is sent from the controller to the printer through the $\overline{\text{VSYNC}}$ signal. The synchronous signal for the horizontal axis is output by the printer through the $\overline{\text{BD}}$ pulse line and is used by the controller.

Control commands from the controller to the printer and status messages from the printer to the controller pass through the bidirectional STATUS/COMMAND signal line.

The interface is made up of 12 types of signals: 5 printer output signals, 5 printer input signals, and 2 bidirectional signals.

2. SIGNALS

Signal name	Abbreviation	Type
\overline{BD}	\overline{BD}	Output signal (pulse)
PRINTER POWER READY	PPRDY	Output signal (level)
\overline{READY}	\overline{RDY}	Output signal (level)
$\overline{VSYNC REQUEST}$	\overline{VSREQ}	Output signal (level)
$\overline{STATUS BUSY}$	\overline{SBSY}	Output signal (level)
$\overline{STATUS/COMMAND}$	\overline{SC}	☆Input/Output signal (level)
$\overline{SERIAL CLOCK}$	\overline{SCLK}	☆Clock signal (pulse)
$\overline{COMMAND BUSY}$	\overline{CBSY}	Input signal (level)
\overline{PRINT}	\overline{PRNT}	Input signal (level)
$\overline{VERTICAL SYNC}$	\overline{VSYNC}	Input signal (pulse)
CONTROLLER POWER READY	CPRDY	Input signal (level)
\overline{VIDEO}	\overline{VDO}	Input signal (level)

☆bidirectional signal

Table 2-1 Signals

2.1 PPRDY (PRINTER POWER READY Output Signal)

PPRDY indicates that the printer has been turned on, the CPU in the printer has been initialized, and transmission between the controller and the interface can begin. If PPRDY stays HIGH 2.5s the controller regards it as TRUE, and commences printer initialization.

This signal goes LOW (FALSE) when power is shut off. After being LOW 0.25s PPRDY is regarded as FALSE. All data in the printer memory is lost when power is shut off. See Fig. 2-1 for timing characteristics.

2.2 CPRDY (CONTROLLER POWER READY Input Signal)

CPRDY indicates that the controller has been turned on and is ready to send to and receive signals from the printer. If CPRDY stays HIGH 2.5s the printer regards it as TRUE, allowing commands to be sent from the controller to the printer.

After staying LOW 0.25s CPRDY is regarded by the printer as FALSE. When power is resupplied the controller keeps CPRDY LOW for 0.5s before letting it so TRUE again. The power-up sequence then restarts. See Fig. 2-2 for timing characteristics.

The printer ignores all other interface signals from the controller once CPRDY goes FALSE. The printer cancels all signals received up until that time. The printer unconditionally sets $\overline{\text{SBSY}}$ FALSE. If there is paper in the printer it is expelled. The printer returns to the state existing immediately after power is turned on.

2.3 $\overline{\text{RDY}}$ ($\overline{\text{READY}}$ Output Signal)

In conjunction with $\overline{\text{PRNT}}$, $\overline{\text{RDY}}$ indicates that printing can begin (or continue). $\overline{\text{RDY}}$ comes TRUE given the following conditions:

- a) PPRDY is TRUE.
- b) Fixing assembly temperature is at a specified temperature.
- c) The cartridge is inserted properly.
- d) There is paper in the cassette (when the cassette is being used).
- e) There is no jam.
- f) There is no data retransmission request.
- g) The printer is not in a pause state.
- h) In cassette mode, the paper feed sensor does not detect paper (with the printer stopped).

$\overline{\text{RDY}}$ goes FALSE at any of the following conditions:

- a) The PPRDY signal goes FALSE.
- b) The temperature of the fixing assembly strays from the prescribed range.
- c) The cartridge is pulled out.
- d) There is no paper in the cassette (when the cassette is being used).
- e) A jam occurs.
- f) A data retransmission request is made.
- g) The scanner has not reached the correct speed within 10s.
- h) Scanner rotation speed deviates from the specified speed.
- i) The scanner is rotating normally, but the $\overline{\text{BD}}$ signal cycle becomes irregular.
- j) A pause state exists.
- k) In cassette mode, the paper feed sensor detects paper when the printer is stopped.

$\overline{\text{PRNT}}$ is ignored if $\overline{\text{RDY}}$ is FALSE, and a $\overline{\text{VSREQ}}$ signal is not returned. If $\overline{\text{VSREQ}}$ is TRUE it goes FALSE.

If printing is underway when $\overline{\text{RDY}}$ goes FALSE because the paper supply runs out, $\overline{\text{BD}}$ is preserved and printing continues after paper is supplied.

$\overline{\text{RDY}}$ becomes TRUE again after the problem has been eliminated. This includes the following cases:

- a) If $\overline{\text{RDY}}$ goes FALSE because of a data retransmission request, $\overline{\text{RDY}}$ comes TRUE after the retransmission request release command is received. (See the section on Retransmission Request Release (EC14) in the chapter on Commands for further information.)
- b) If $\overline{\text{RDY}}$ goes FALSE because the cartridge has been removed, $\overline{\text{RDY}}$ comes TRUE once the cartridge is replaced.
- c) If $\overline{\text{RDY}}$ goes FALSE because the paper supply runs out, $\overline{\text{RDY}}$ comes TRUE after paper is added, the cassette is replaced, or if paper feed is switched to manual mode.
- d) If $\overline{\text{RDY}}$ goes FALSE because the printer is in a pause state, $\overline{\text{RDY}}$ comes TRUE again after the problem has been eliminated and the wait time has passed.
- e) If $\overline{\text{RDY}}$ goes FALSE because the paper-feed sensor detects paper when the printer is stopped in cassette mode, $\overline{\text{RDY}}$ comes TRUE again after the paper-feed sensor detects paper delivery.
- f) For all other causes of a FALSE signal, $\overline{\text{RDY}}$ comes TRUE again after the problem has been eliminated, power has been switched back on, and the wait time has passed.

2.4 $\overline{\text{PRNT}}$ ($\overline{\text{PRINT}}$ Input Signal)

$\overline{\text{PRNT}}$ indicates that printing is about to begin or that printing is already underway. The printer ignores $\overline{\text{PRNT}}$ until $\overline{\text{RDY}}$ is TRUE.

If $\overline{\text{RDY}}$ comes TRUE and the drum is not rotating, the drum begins rotating, the scanner starts rotating, the laser is ready to light, the paper is advanced, and, within 10s after the $\overline{\text{PRNT}}$ comes TRUE, $\overline{\text{VSREQ}}$ becomes TRUE.

If the drum is rotating at the paper speed for printing while $\overline{\text{RDY}}$ is TRUE, the drum and scanner continue rotating, the laser stays on, paper is fed, and, within 3.7s after a $\overline{\text{PRNT}}$ sensing (see Fig. 2-4), $\overline{\text{VSREQ}}$ becomes TRUE.

To insure an 8.1 page per minute (6.9 page per minute for legal size paper) throughput, the controller must output $\overline{\text{VSYNC}}$ within 10ms after $\overline{\text{VSREQ}}$ becomes TRUE, and must set $\overline{\text{PRNT}}$ for the next page TRUE within 3.5s (4.6s for legal size paper) after $\overline{\text{VSREQ}}$ goes TRUE. (See Fig. 2-3.)

If paper feed is unnecessary (i.e., printing is completed), the controller sets $\overline{\text{PRNT}}$ FALSE within 3.5s (4.6s for legal size paper) after $\overline{\text{VSYNC}}$ temporarily comes TRUE. It is important for internal printer operation, however, that $\overline{\text{PRNT}}$ not go FALSE while $\overline{\text{VSYNC}}$ is TRUE. Also, to insure that paper is supplied, $\overline{\text{PRNT}}$ is kept TRUE until $\overline{\text{VSYNC}}$ goes FALSE. If any of the above conditions is violated, unneeded paper may be fed or $\overline{\text{VSREQ}}$ may not go TRUE.

If $\overline{\text{PRNT}}$ continues to be FALSE longer than 5.3s from 3.5s (4.6s for legal size paper) after $\overline{\text{VSYNC}}$ comes TRUE, the drum stops rotating within 10s, the scanner stops, and the laser goes out. If, however, the EC4 command is ON (See section 4.1.), the drum continues rotating.

If $\overline{\text{PRNT}}$ becomes TRUE within 8.2s after the printer receives a TRUE $\overline{\text{VSYNC}}$ signal, and $\overline{\text{PRNT}}$ continues to be TRUE until the end of the next TRUE $\overline{\text{VSYNC}}$ signal, the drum will continue rotating.

If $\overline{\text{RDY}}$ is TRUE and the drum is at last rotation, then when $\overline{\text{PRNT}}$ becomes TRUE the drum starts initial rotation, the printer supplies paper, and, within 10s after $\overline{\text{PRNT}}$ comes TRUE, $\overline{\text{VSREQ}}$ comes TRUE.

2.5 $\overline{\text{VSREQ}}$ ($\overline{\text{VSYNC}}$ REQUEST Output Signal)

$\overline{\text{VSREQ}}$ indicates that the printer is ready for the $\overline{\text{VSYNC}}$ signal. $\overline{\text{VSREQ}}$ comes TRUE given the following conditions:

- a) $\overline{\text{RDY}}$ is TRUE.
- b) $\overline{\text{PRNT}}$ is TRUE.
- c) Initial rotation is completed.
- d) Paper has been delivered.
- e) The scanner has reached the correct speed.
- f) The $\overline{\text{BD}}$ signal cycle is normal.

When the above conditions are met and the drum is rotating normally $\overline{\text{VSREQ}}$ comes TRUE within 3.7s after $\overline{\text{PRNT}}$ becomes TRUE. If the drum is at last rotation or stopped $\overline{\text{VSREQ}}$ comes TRUE within 10s. See Fig. 2-4 for timing characteristics.

$\overline{\text{VSREQ}}$ goes FALSE within 5ms after the printer receives a TRUE $\overline{\text{VSYNC}}$ signal. See Fig. 2-3 for timing characteristics.

The time from which $\overline{\text{VSREQ}}$ is received until a TRUE $\overline{\text{VSYNC}}$ signal is output is changeable. If 8.1 page per minute throughput is to be maintained, however, $\overline{\text{VSYNC}}$ must be output within 10ms after receiving a TRUE $\overline{\text{VSREQ}}$ signal.

5ms or more after receiving a TRUE $\overline{\text{VSYNC}}$ signal, the controller can check that $\overline{\text{VSYNC}}$ was received by the printer by checking that $\overline{\text{VSREQ}}$ is FALSE.

2.6 $\overline{\text{VSYNC}}$ (Input Signal)

$\overline{\text{VSYNC}}$ is both the synchronous signal for the vertical axis of the printed image and the signal for coordinating image transfer. The printer monitors $\overline{\text{VSYNC}}$ while $\overline{\text{VSREQ}}$ is TRUE. The printer controls paper feeding to ensure proper image transfer based upon the $\overline{\text{VSYNC}}$ signal. The controller sends $\overline{\text{VDO}}$ synchronously with $\overline{\text{VSYNC}}$.

212ms after transmitting a TRUE $\overline{\text{VSYNC}}$ signal the controller outputs $\overline{\text{VDO}}$. This timing allows a leading edge (blank area) that is typically 5mm.

Because of the way the printer works, it is not possible to set $\overline{\text{VDO}}$ TRUE less than 212ms after transmitting a TRUE $\overline{\text{VSYNC}}$. See Fig. 2-5 for timing requirements. The printer ignores any $\overline{\text{VSYNC}}$ signal if $\overline{\text{VSREQ}}$ is FALSE.

2.7 $\overline{\text{BD}}$ (Output Signal)

$\overline{\text{BD}}$ is the synchronous signal for the horizontal axis, and indicates the place at which the laser beam begins horizontal scanning. This signal is guaranteed to be correct from the time a TRUE $\overline{\text{VSREQ}}$ signal is received to 6.52s after receiving a TRUE $\overline{\text{VSYNC}}$ signal.

The controller sends a horizontal scanning $\overline{\text{VDO}}$ signal synchronized with $\overline{\text{BD}}$ t seconds after reception of a TRUE $\overline{\text{BD}}$ signal. (See the Table below for t values). See Fig. 2-6 for timing characteristics.

The given value of t is used for each different size of paper listed in the table below. The left margin is typically 8 mm.

Paper size (horizontal x vertical axis)	t
Letter (215.9mm x 279.4mm)	135.5 μs *(108.4 μs)
A4 (210.0mm x 297.0mm)	182.2 μs *(145.8 μs)
B5 (182.0mm x 257.0mm)	404.0 μs *(323.2 μs)

(* 240 lines per inch. Values in parentheses indicate 300 lines per inch.)

Table 2-2 $\overline{\text{BD}}$ time values

Note: Confirm that the controller outputs one scanning line $\overline{\text{VDO}}$ in sync with the falling edge of $\overline{\text{BD}}$. If $\overline{\text{VDO}}$ is not in sync with the falling edge of $\overline{\text{BD}}$ (e.g., in sync with the rising edge of $\overline{\text{BD}}$), poor image quality will result.

In case of possible delays in t, the following points must be kept in mind during controller design. To insure good image quality the variation in t for the horizontal axis must be kept under 105ns (67ns). Also, to correct for variations in different printers, and to be able to print properly, the controller must be able to adjust the value of t at least $\pm 16\mu\text{s}$ (13 μs).

2.8 $\overline{\text{VDO}}$ ($\overline{\text{VIDEO}}$ Input Signal)

The controller outputs $\overline{\text{VDO}}$ to indicate that there is an image to be printed. If $\overline{\text{VDO}}$ is TRUE the printer prints a black image. If $\overline{\text{VDO}}$ is FALSE the printer prints a white image.

The controller must synchronize $\overline{\text{VDO}}$ with $\overline{\text{VSYNC}}$ for the vertical scanning direction, and synchronize $\overline{\text{VDO}}$ with $\overline{\text{BD}}$ for the horizontal scanning direction. See Figs. 2-5 and 2-6 for timing characteristics.

An "image output clock" outputs serial signals corresponding to each dot of an image at the following frequencies:

240 dots/inch: 1,192,840 Hz
300 dots/inch: 1,863,813 Hz

Thus the time it takes to print one dot is as follows:

240 dots/inch: 838.3ns
300 dots/inch: 536.5ns

The controller must output a specific $\overline{\text{VDO}}$ signal for each different paper size. $\overline{\text{VDO}}$ must not be TRUE in areas of the paper which are not supposed to be printed on.

2.9 $\overline{\text{SBSY}}$ ($\overline{\text{STATUS BUSY}}$ Output Signal)

$\overline{\text{SBSY}}$ takes control of the $\overline{\text{SC}}$ and $\overline{\text{SCLK}}$ lines when the printer sends a status message. After the printer sends the status message, $\overline{\text{SBSY}}$ continues to be TRUE until the printer is ready for the next command. After the printer confirms that $\overline{\text{CBSY}}$ is FALSE it sets $\overline{\text{SBSY}}$ TRUE. See Fig. 2-7 for timing characteristics.

If $\overline{\text{SCLK}}$ misfires (something other than 8 pulses), the controller resends the command. If $\overline{\text{SBSY}}$ is TRUE longer than the specified time, the controller sets $\overline{\text{CPRDY}}$ FALSE and reinitializes the printer interface.

2.10 $\overline{\text{CBSY}}$ ($\overline{\text{COMMAND BUSY}}$ Input Signal)

$\overline{\text{CBSY}}$ takes control of the $\overline{\text{SC}}$ and $\overline{\text{SCLK}}$ lines when the controller sends a command. After the controller sends a command, $\overline{\text{CBSY}}$ continues to be TRUE until the controller is ready for the next status message. After the controller confirms that $\overline{\text{SBSY}}$ is FALSE it sets $\overline{\text{CBSY}}$ TRUE. See Fig. 2-7 for timing characteristics.

If $\overline{\text{SCLK}}$ misfires while $\overline{\text{CBSY}}$ is TRUE, a PARITY ERROR STATUS is returned from the printer. In this case the controller resends the command.

2.11 \overline{SC} (STATUS/COMMAND Message Line)

\overline{SC} is the line used to send 8-bit bidirectional commands from the controller to the printer, and to transmit status messages from the printer to the controller. Both the controller and the printer use the \overline{SCLK} clock to read status messages and commands. \overline{SBSY} and \overline{CBSY} are also used to control bidirectional transmission.

In response to a one-byte command from the controller, the printer must always return a one-byte status message. There are two types of commands: status request commands and execution commands. In response to a status request command, the printer response with appropriate information regarding its status. In response to an execution command, the printer returns a STATUS 0 if the command is correct and recognized by the printer. If the command has a parity error, or the command is not recognized by the printer, a message indicating a COMMAND ERROR STATUS is returned. For details concerning the contents of the status bytes and commands see 3. "Statuses" and 4. "Commands."

2.12 \overline{SCLK} (INPUT/OUTPUT CLOCK)

\overline{SCLK} is the clock pulse by which the printer reads a command or the controller reads a status message. \overline{SCLK} is used in conjunction with \overline{SBSY} and \overline{CBSY} . See Fig. 2-7 for timing characteristics.

The controller outputs commands using \overline{SCLK} so that the printer can read them. The controller also outputs each bit of data on the falling edge of \overline{SCLK} . The printer reads each bit of an 8-bit command on the rising edge of the \overline{SCLK} clock pulse.

The controller must specify whether the \overline{SCLK} mode used when the controller reads a status message is the "printer output mode" or the "controller output mode." After CPRDY and PPRDY become TRUE, an execution command which specifies the \overline{SCLK} mode must be carried out.

If the mode specification for \overline{SCLK} is not received by the printer it will not set \overline{SBSY} TRUE. Therefore, in order for the controller to confirm that the \overline{SCLK} mode specification command was correctly received by the printer, the controller must monitor that \overline{SBSY} becomes TRUE within 200ms after \overline{CBSY} goes FALSE. If no confirmation is given, the controller must retransmit the \overline{SCLK} mode specification command.

The printer outputs each bit of an 8-bit status message on the falling edge of the \overline{SCLK} clock pulse. The controller reads each bit of data on the rising edge of the \overline{SCLK} clock pulse.

3. STATUSES

A status message is an 8 bit serial signal. The bits are named in the order in which they are output: 1st bit, 2nd bit, 3rd bit, 4th bit, 5th bit, 6th bit, 7th bit, and 8th bit. The 8th bit is a parity bit. An odd parity definition is used.

3.1 COMMAND ERROR STATUS

1st Bit	1
2nd Bit	Error information <small>0=Illegal command 1=Command parity error</small>
3rd Bit	—
4th Bit	—
5th Bit	—
6th Bit	—
7th Bit	—
8th Bit	Parity bit (odd)

Table 3-1 Command error status

The 1st bit of the status message is the "Command Error Bit." If the printer recognizes an error in the command sent by the controller, it sets the 1st bit to "1."

When the Command Error Bit is "1" the status word contents become the COMMAND ERROR STATUS. When the Command Error Bit is "0" the remaining content of the status byte is the response to a status information request made by the controller.

If a COMMAND ERROR STATUS is returned the printer does not execute the command. In the case of a parity error the controller must resend the command.

3.2 STATUS 0 (Standard Status)

1st Bit	0
2nd Bit	Print request
3rd Bit	Paper Delivery
4th Bit	Data retransmission request
5th Bit	Wait
6th Bit	Pause
7th Bit	Call
8th Bit	Parity bit (odd)

Table 3-2 Status 0

a) Print Request

When the following conditions are met, the 2nd bit is set to "1":

- 1) The drum and scanner are rotating normally.
- 2) The laser is ready to light.
- 3) $\overline{\text{PRNT}}$ is in a sense state (See Fig. 2-4).

If these conditions are met, then when the printer receives a TRUE $\overline{\text{PRNT}}$ signal from the controller it sets $\overline{\text{VSREQ}}$ TRUE within 3.7s.

When any of the following conditions occur, the 2nd bit is set to "0":

- 1) The drum is not rotating normally.
- 2) The printer is in the interval between the first time $\overline{\text{PRNT}}$ is recognized as TRUE and the next time $\overline{\text{PRNT}}$ is sensed (see Fig. 2-4). This occurs even if the drum is rotating normally.

b) Paper Delivery

A "1" in the 3rd bit indicates that the printer's main motor is turning and there is paper moving through the printer. A "0" indicates that the main motor is not running, or that there is no paper on the feeder.

c) Data Retransmission Request

A "1" in the 4th bit indicates that because of a jam or misprint the data must be resent. This indicates a print error. A "0" indicates that there is no retransmission request, or the request has been canceled.

d) Wait

A "1" in the 5th bit indicates that the heated roller in the fixing assembly is not yet hot enough. The temperature is being raised until the specified temperature is reached. A "0" indicates that the temperature has reached the specified level, the heated roller in the fixing assembly is out of order, or the printer is at a pause.

e) Pause

A "1" in the 6th bit indicates that a pause command has been received. The fixing assembly, main motor, scanner, and laser are all off. A "0" means there is no pause in effect. If the drum is not rotating when the printer receives a Pause command, the 6th bit is immediately set to "1". If drum is rotating, this bit is set to "1" after the command to stop the drum has been received and the drum has stopped.

f) Call

A "1" in the 7th bit indicates that something has happened that requires an operator or service call. The printer immediately sets the Call bit to 1 when a malfunction is diagnosed. A "0" means a service call is unnecessary. Among the conditions which will cause the Call bit to be set to "1," only a Paper Out condition can be rectified without turning the printer off and then on again. (When the paper runs out simply add more. The Call bit will reset to "0.") For all other malfunctions the printer must be turned off to reset the Call bit.

3.3 STATUS 1 (Operator-call Information)

1st Bit	0
2nd Bit	No cartridge
3rd Bit	-
4th Bit	Paper out
5th Bit	Jam
6th Bit	—
7th Bit	Test printing underway
8th Bit	Parity bit (odd)

Table 3-3 Status 1

The printer sets the Call bit of STATUS 0 to "1" after the printer sets STATUS 1. The controller reads STATUS 1 for details of a Call (given in STATUS 0). If a No Paper signal is canceled and the 4th bit of STATUS 1 is "0," the Call bit of STATUS 0 is reset to "0."

a) No Cartridge

A "1" in the 2nd bit indicates that the cartridge is not inserted, or the cartridge is inserted improperly. A "0" means the cartridge is correctly inserted.

b) Paper Out

A "1" in the 4th bit indicates that the printer is in the cassette feed mode but there is no paper inside the cassette, or that there is no cassette. A "0" means that there is paper in the cassette, or that the printer is in manual feed mode.

c) Jam

A "1" in the 5th bit indicates a paper jam. If there is paper in the printer before the printer is turned on, however, the printer cannot sense the jam. A "0" indicates there is no jam.

When a jam is sensed by the printer, it immediately places itself in a pause condition. The jam condition will remain until the power is cut off.

The controller waits until the Paper Delivery bit becomes "0", then checks the number of retransmitted pages using the Data Retransmission Request command.

Remove any jammed paper before turning the printer back on.

d) Test Printing Underway

A "1" means that a test print is being made. A "0" means that a test print is not being made.

A test print is made by pressing the Test switch located on the left panel of the printer. Test prints continue to be output as long as the switch is pressed. During test printing, \overline{RDY} becomes FALSE and the READY indicator flashes.

Test printing is enabled only when the drum is not rotating and \overline{RDY} becomes TRUE. In other statuses, pressing the test switch does not do anything.

3.4 STATUS 2 (Service-call Information)

1st Bit	0
2nd Bit	Fixing assembly malfunction
3rd Bit	BD malfunction
4th Bit	Scanner malfunction
5th Bit	Laser temperature control circuit malfunction
6th Bit	Main motor malfunction
7th Bit	—
8th Bit	Parity bit (odd)

Table 3-4 Status 2

The controller examines STATUS 2 for details when the Call bit of STATUS 0 has been set. The printer sets STATUS 2 before setting the Call bit (the 7th bit of STATUS 0).

As soon as the printer detects a malfunction it immediately sets STATUS 2. The printer then goes into a pause state until turned off.

Until the printer is turned off the controller can confirm that the Paper Delivery bit of STATUS 0 is "0." The controller may also read page numbers of data to be resent by using the Data Retransmission Request command.

a) Fixing Assembly Malfunction

A "1" in the 2nd bit indicates a fixing assembly malfunction. Either the fixing assembly is not heating properly or the printer cannot detect it (being heated), possibly because of the heater, thermistor, or thermal fuse being disconnected. The printer reports a fixing assembly malfunction by setting the 2nd bit of STATUS 2 to "1."

The printer detects a fixing assembly malfunction. If there is no paper in the printer it immediately goes into a pause state. If the printer is partway through printing a page, it finishes printing, delivers the page, then goes into a pause state. If the paper is in but printing has yet to begin, the printer ejects the paper, then goes into a pause state.

A "0" means no fixing assembly malfunction.

b) BD Malfunction

A "1" the 3rd bit indicates that the laser does not light, laser output is insufficient, or BD is not output because of a malfunction in the laser system. A "0" means that BD can be output.

c) Scanner Malfunction

A "1" in the 4th bit indicates that the scanner is not rotating properly. A "0" means that scanner rotation is all right.

d) Laser Temperature Control Circuit

A "1" means that laser temperature is not correct. A "0" means that laser temperature is correct.

e) Main Motor Malfunction

A "1" means that timing signals to drive the main motor are not being output. A "0" means that timing signals are being output correctly.

3.5 STATUS 4 (Number of Pages to be Retransmitted)

1st Bit	0
2nd Bit	Bit 5
3rd Bit	Bit 4
4th Bit	Bit 3
5th Bit	Bit 2
6th Bit	Bit 1
7th Bit	Bit 0
8th Bit	Parity bit (odd)

Table 3-5 Status 4

When a data retransmission request is specified in STATUS 0, STATUS 4 indicates the number of pages which the controller is requesting. The number of pages to be retransmitted is derived in the following manner. Processing is traced back to the time before the Paper Delivery bit of STATUS 0 became "0." At this point a TRUE VSREQ signal is confirmed and the page corresponding to the output of a TRUE VSYNC signal is calculated.

The number of pages is presented in binary form. Bit 5 (the 2nd bit) is most significant bit (MSB), and bit 0 (the 7th bit) is the least significant bit (LSB).

The number of pages is kept until a Retransmission Request Release command (EC14) is received.

3.6 STATUS 5 (Paper Size)

1st Bit	0
2nd Bit	Bit 5
3rd Bit	Bit 4
4th Bit	Bit 3
5th Bit	Bit 2
6th Bit	Bit 1
7th Bit	Bit 0
8th Bit	Parity bit (odd)

Table 3-6 Status 5

The codes and their corresponding paper sizes are shown below in Table 3-7. The codes are presented in hexadecimal form, where bit 5 is the MSB and bit 0 is the LSB.

When a cassette loaded with paper is mounted in the printer, the printer sets the STATUS 1 (no paper) bit to "0".

Code	Paper size	Dimensions of paper	
		Paper-feed direction	Cross-feed direction
01	A4	297 (mm)	210 (mm)
04	Letter	279	216
09	B5	257	182
0C	Legal	356	216
00	No cassette	—	—

Note: Paper (all sizes) should always be fed into the printer lengthwise.

Table 3-7

4. COMMANDS

1st Bit	Bit 7
2nd Bit	Bit 6
3rd Bit	Bit 5
4th Bit	Bit 4
5th Bit	Bit 3
6th Bit	Bit 2
7th Bit	Bit 1
8th Bit	Bit 0 (odd parity bit)

Table 4-1 The command byte

Commands are made up of 8-bit serial signals. The bits are named in the order in which they are output: 1st bit, 2nd bit, 3rd bit, 4th bit, 5th bit, 6th bit, 7th bit, and 8th bit. The 8th bit of a command is a parity bit; an odd parity definition is used.

There are two types of commands: status request commands and execution commands. In response to a status request command the printer returns status information.

All commands are executed within 10ms from the time SBSY becomes TRUE except EC6 and EC7. EC6 and EC7 are dependent on paper feed and so may take longer to execute.

Each bit of a command is named corresponding to the Table 4-1. Bit 7 is the MSB. Bit 0 is the LSB. The command codes can be presented, and are explained below, in hexadecimal form. If there are no errors, a STATUS 0 signal is returned in response to execution commands.

Commands not given in the following table are not yet defined for the LBP-CX and are thus illegal commands. In response to these types of commands, the printer will return a STATUS 0 with a "1" in the 1st bit and a "0" in the 2nd bit, indicating a COMMAND ERROR STATUS.

Command name abbreviation	Command code	Type	Function	Corresponding status
SR0	01	Status request	STATUS 0 request	STATUS 0
SR1	02	Status request	STATUS 1 request	STATUS 1
SR2	04	Status request	STATUS 2 request	STATUS 2
SR4	08	Status request	STATUS 4 request	STATUS 4
SR5	0B	Status request	STATUS 5 request	STATUS 5
EC0	40	Execution	Specifies $\overline{\text{SCLK}}$ controller output mode	STATUS 0
EC1	43	Execution	Specifies SCLK printer output mode	STATUS 0
EC2	45	Execution	Pause	STATUS 0
EC3	46	Execution	Pause release	STATUS 0
EC4	49	Execution	Start drum rotation	STATUS 0
EC5	4A	Execution	Stop drum rotation	STATUS 0
EC6	4C	Execution	Cassette feed	STATUS 0
EC7	4F	Execution	Manual feed	STATUS 0
EC14	5D	Execution	Retransmission request release	STATUS 0

Table 4-2 Commands

4.1 Status Request Commands

As shown in Table 4-2, the controller makes a status request by outputting an SR command.

4.2 Execution Commands

1) EC0, EC1

EC0 specifies that SCLK is a signal from the controller to the printer. EC1 specifies that $\overline{\text{SCLK}}$ is a signal from the printer to the controller. When CPRDY and PPRDY are true and other commands are in queue, the controller must output either EC0 or EC1.

2) EC2, EC3

EC2 is a Pause command. EC3 cancels the Pause command. The pause can be canceled only by an EC3 command or by turning the printer off.

3) EC4, EC5

EC4 commands the printer to start the drum rotating. Upon receiving this command the printer begins drum and scanner rotation and lights the laser. If the drum and scanner are already rotating at the proper speed, the printer continues drum and scanner rotation and sets the laser ready to light.

The controller can keep the drum rotating without regard to PRNT by using this command. Because of this the controller can increase throughput. Running the drum, scanner, and laser for a long time without printing, however, reduces cartridge life.

If VSREQ response time is no problem, the controller can control the printer using only PRNT, without using this command.

EC5 stops the drum. As soon as the printer executes EC5 the drum starts last rotation. If, however, normal drum rotation is necessary to carry out a PRNT command, the PRNT command takes priority.

4) EC6, EC7

EC6 is for cassette feed, and cancels manual paper feed. EC7 is for manual paper feed, and cancels cassette feed. Cassette feed is default mode.

If the printer receives EC6 or EC7 while the drum is rotating due to a PRNT command, the paper feed mode is switched from manual to cassette (or vice versa) when the printer begins the last rotation after PRNT goes FALSE. At all other times, the paper feed mode is switched at the instant the printer receives EC6 or EC7.

5) EC14

EC14 cancels a data retransmission request. This command sets the Data Retransmission Request bit of the STATUS 0 word to "0".

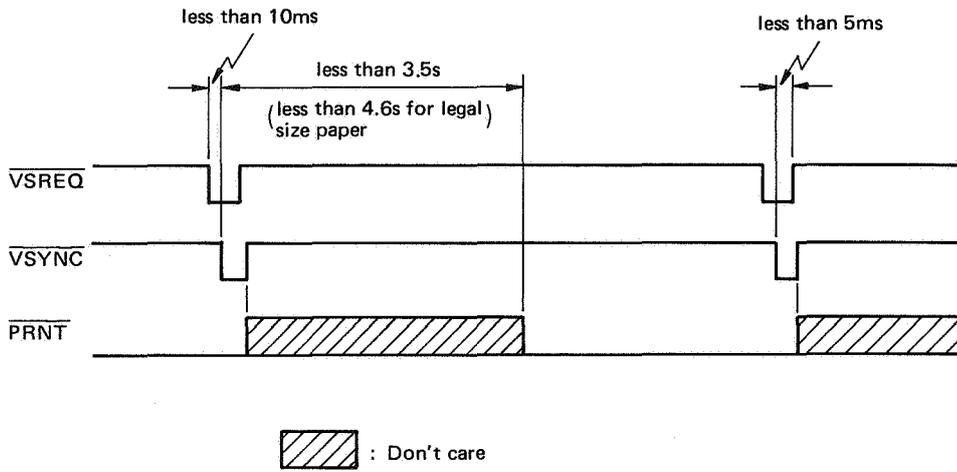
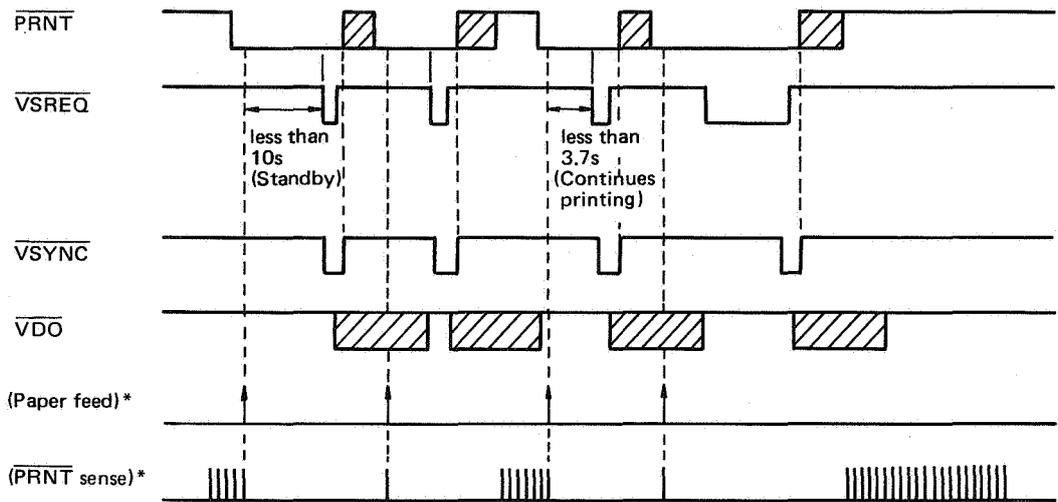


Fig. 2-3



(* () indicates the timing of internal printer operation.)

Fig. 2-4

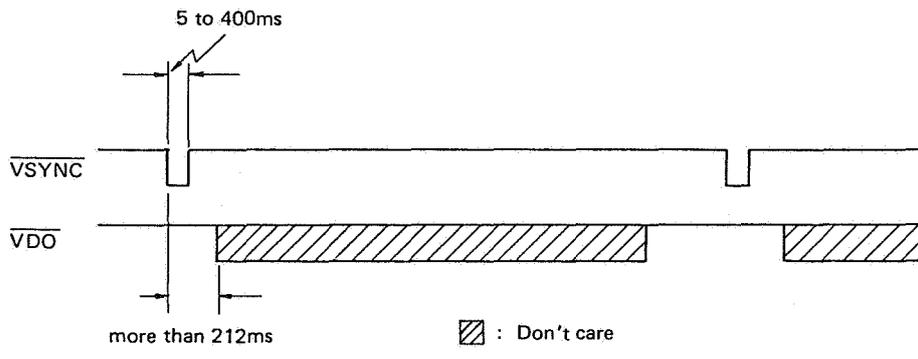
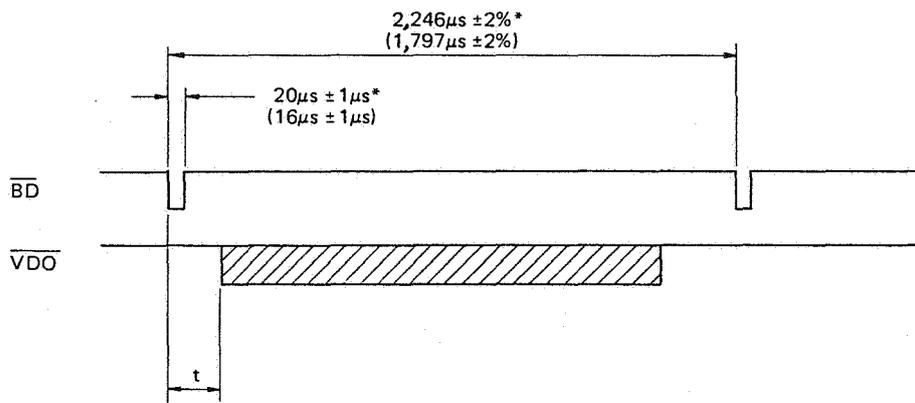


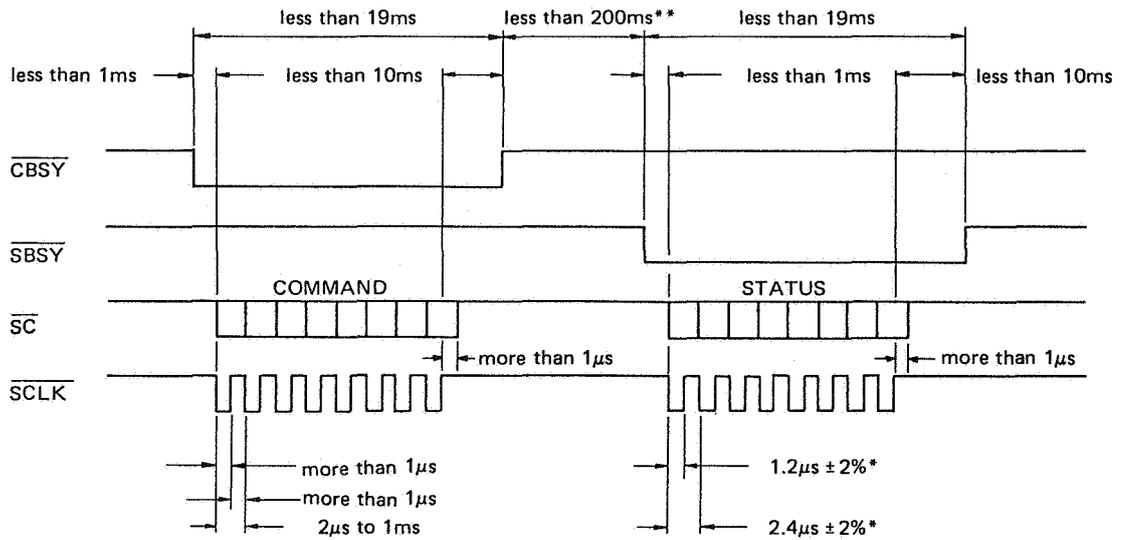
Fig. 2-5



* 240 lines per inch. Values in parentheses indicate 300 lines per inch.

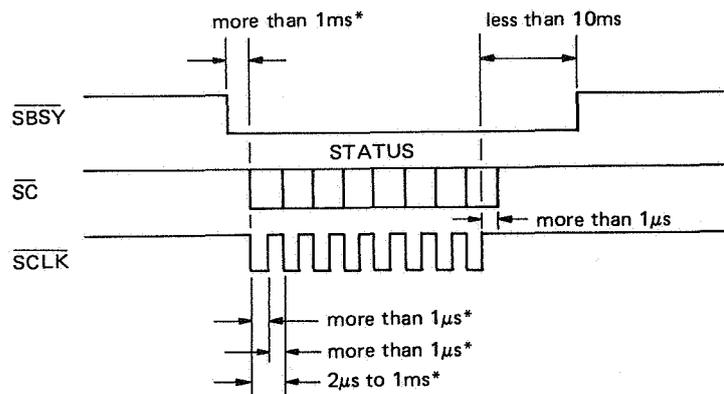
▨ : Don't care

Fig. 2-6



* The value when $\overline{\text{SCLK}}$ (for STATUS information) is output from the printer.

** The printer performs self-diagnosis and sends a status message using the $\overline{\text{SC}}$ line.



* The value when $\overline{\text{SCLK}}$ (for STATUS information) is output from the controller.

** The timing for command information is the same as that shown in the diagram at the top of this page.

Fig. 2-7

5. INTERFACE CIRCUITRY

5.1 Interface Signals

- 1) $\overline{\text{CBSY}}$, $\overline{\text{PRNT}}$, $\overline{\text{VSYNC}}$, $\overline{\text{SC}}$, $\overline{\text{SCLK}}$
Input signals

H(FALSE): 2 to 5V
L(TRUE) : 0 to 0.45V

- 2) $\overline{\text{VDO}}$, VDO
Input signals

H $\overline{\text{VDO}}$ - LVDO (FALSE): 1 to 5V
H VDO- L $\overline{\text{VDO}}$ (TRUE) : 1 to 5V

- 3) CPRDY
Input signal

H(TRUE) : 2 to 5V
L(FALSE) : 0 to 0.45V

- 4) $\overline{\text{RDY}}$, $\overline{\text{VSREQ}}$, $\overline{\text{SBSY}}$, $\overline{\text{SC}}$, $\overline{\text{SCLK}}$
Output signals

H(FALSE) : 2.5 to 5V
L(TRUE) : 0 to 0.4V

- 5) $\overline{\text{BD}}$, BD
Output signals

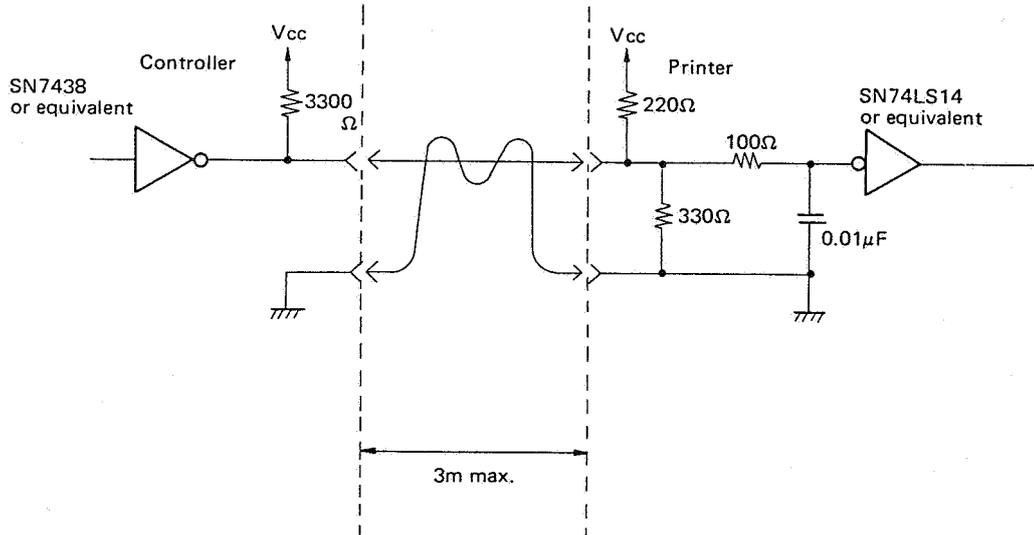
H($\overline{\text{BD}}$ =FALSE, BD=TRUE): 2 to 5V
L($\overline{\text{BD}}$ =TRUE, BD=FALSE): 0 to 0.5V

- 6) PPRDY
Output signal

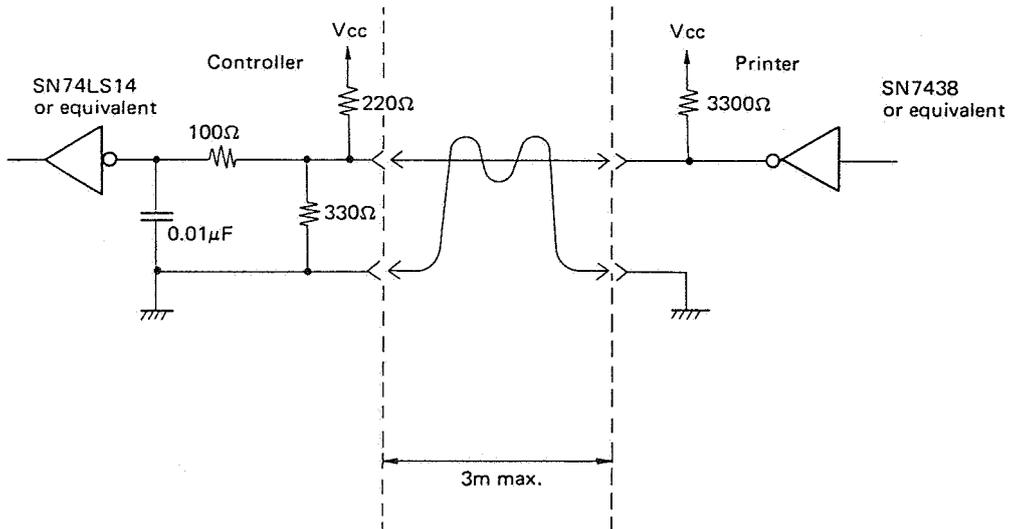
H(TRUE) : 2.5 to 5V
L(FALSE): 0 to 0.4V

5.2 Interface Circuits

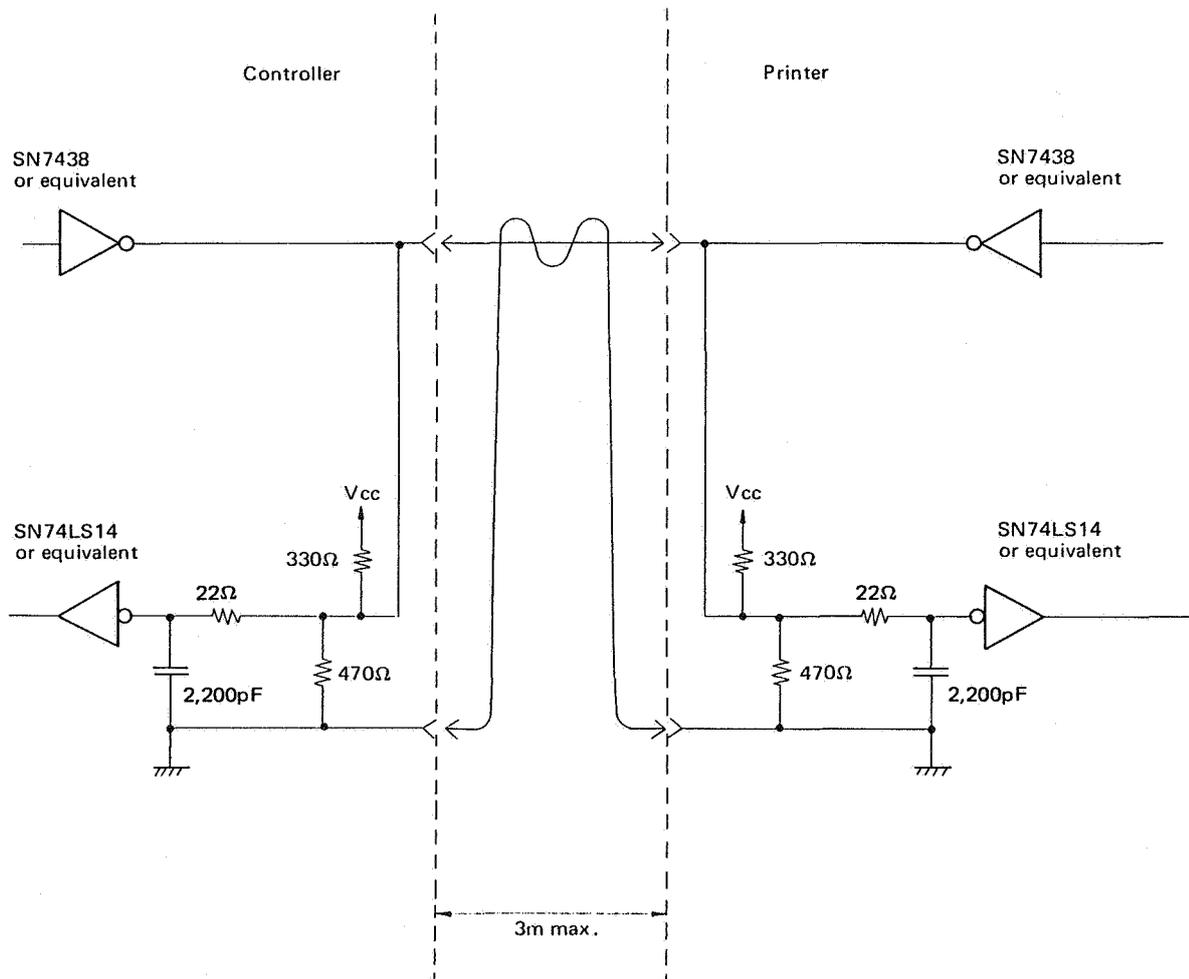
1) $\overline{\text{CBSY}}$, $\overline{\text{PRNT}}$, $\overline{\text{VSYNC}}$



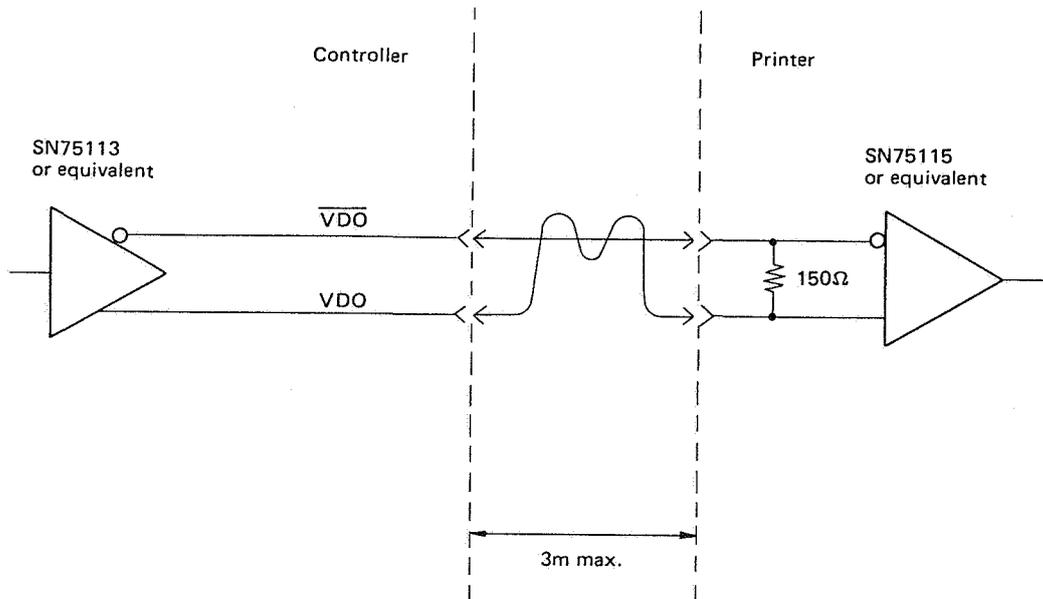
2) $\overline{\text{RDY}}$, $\overline{\text{VSREQ}}$, $\overline{\text{SBSY}}$



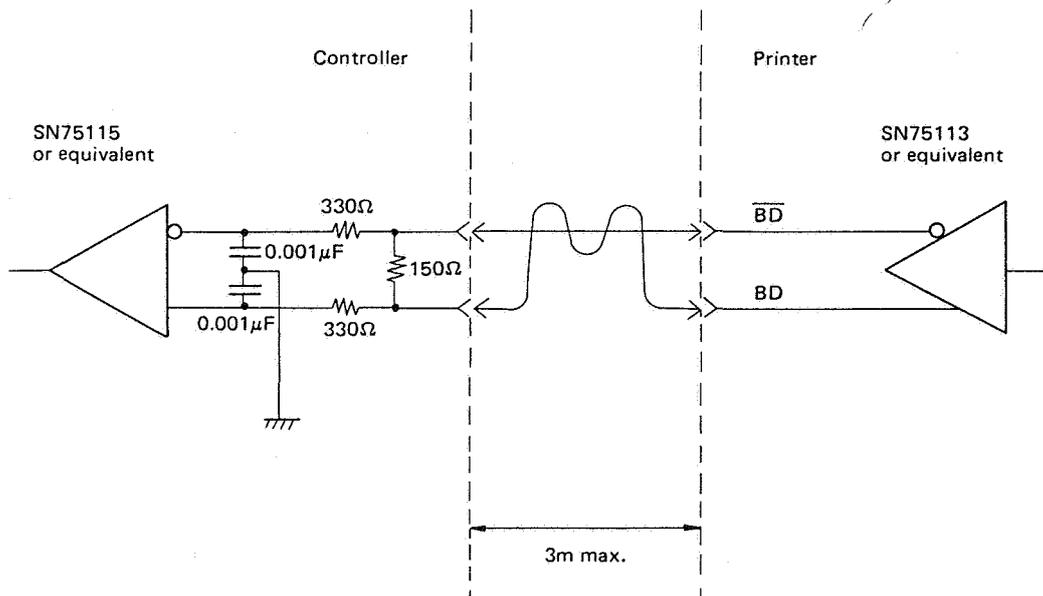
3) \overline{SC} , \overline{SCLR}



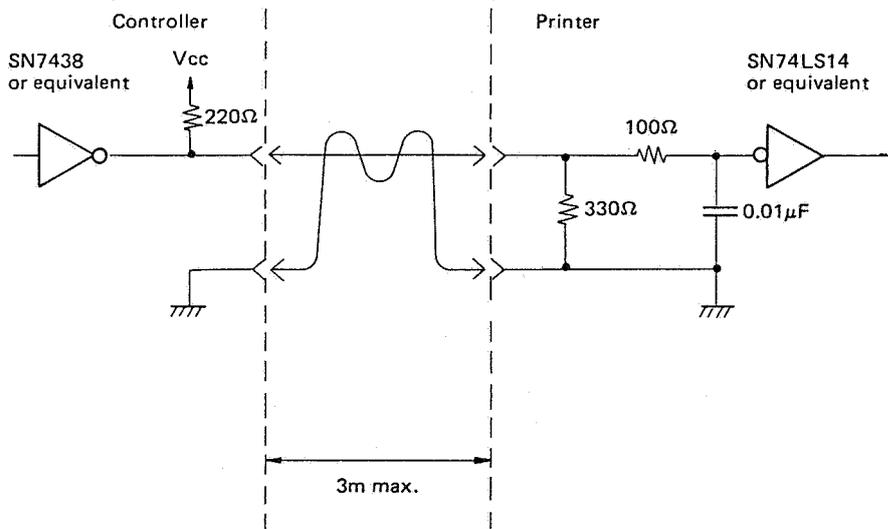
4) \overline{VDO} , VDO



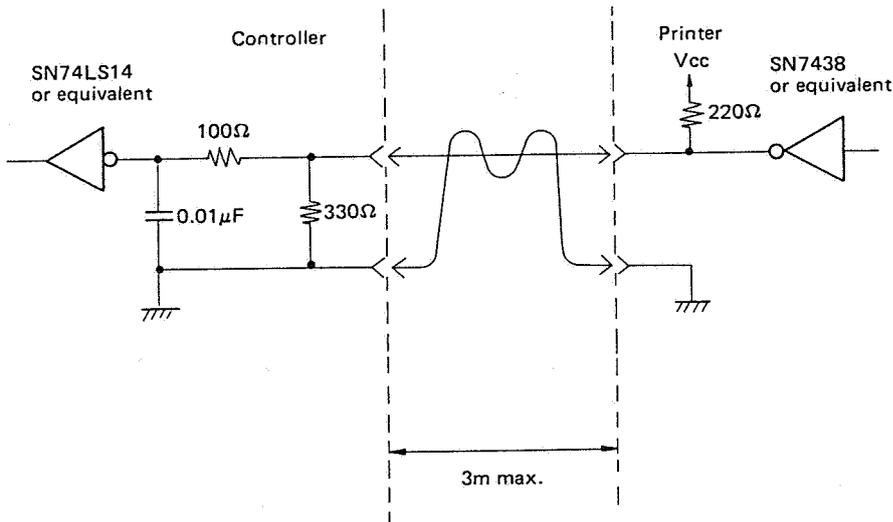
5) \overline{BD} , BD



6) CPRDY



7) PPRDY

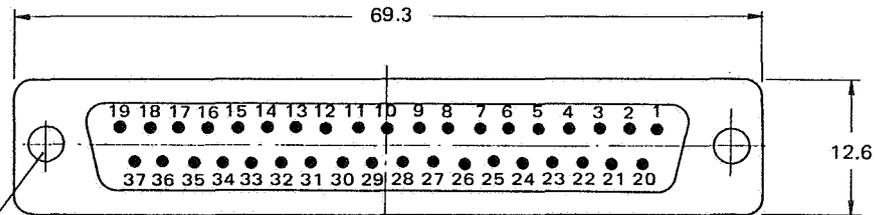


6. INTERFACE CONNECTION

6.1 Connector Type

Printer side: DC-37S (See the Fig. below.)

Cable side: DC-37P
(37 pin, CANNON or equivalent)



Printer-side connector

This nut is No. 4-40NC-2B.
For fastening the connector, please use a screw
which matches the nut.

6.2 Connector Signal Table

Signal name	Pin number		Signal name
Reserved for extension	1	20	Reserved for extension
\overline{BD}	2	21	BD
PPRDY	3	22	RET (GND)
\overline{RDY}	4	23	RET (GND)
\overline{VSREQ}	5	24	RET (GND)
\overline{SBSY}	6	25	RET (GND)
\overline{SC}	7	26	RET (GND)
\overline{SCLK}	8	27	RET (GND)
\overline{CBSY}	9	28	RET (GND)
\overline{PRNT}	10	29	RET (GND)
\overline{VSYNC}	11	30	RET (GND)
CPRDY	12	31	RET (GND)
\overline{VDO}	13	32	VDO
Reserved for extension	14	33	Reserved for extension
Reserved for extension	15	34	Reserved for extension
Reserved for extension	16	35	Reserved for extension
Reserved for extension	17	36	Reserved for extension
Reserved for extension	18	37	Reserved for extension
Reserved for extension	19		

(For lines between opposing pins, use twisted pair lines.)

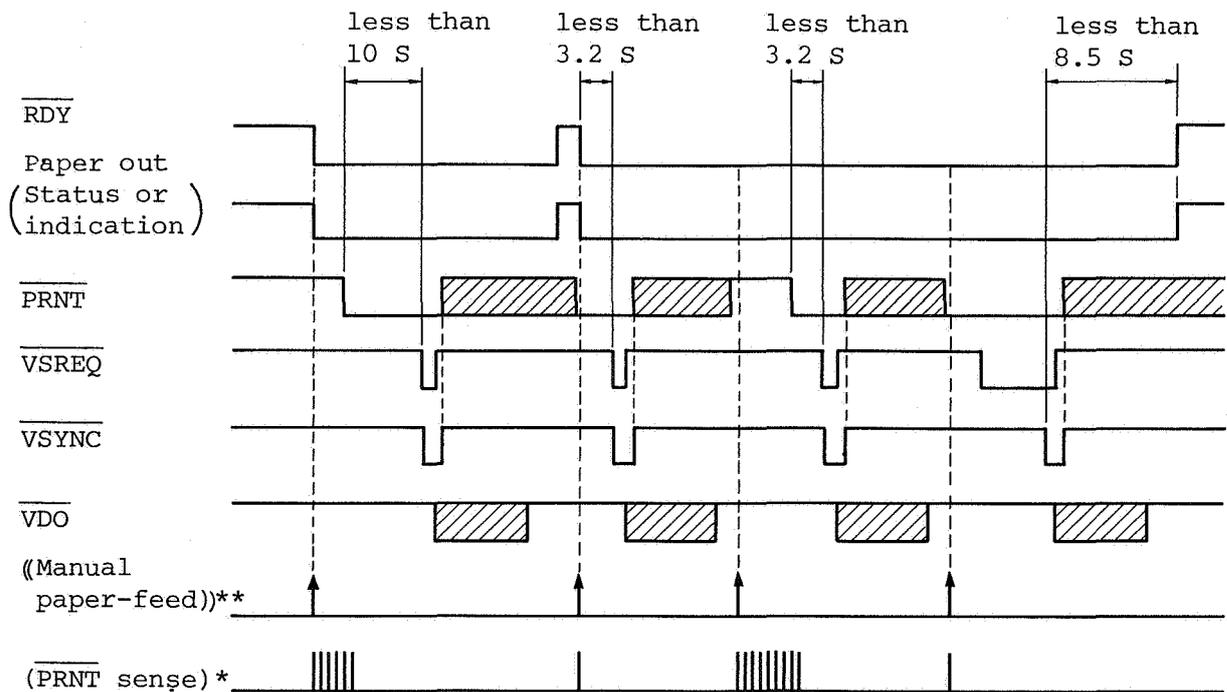
7. MANUAL PAPER FEED

The function and timing of the interface when the printer is set to manual paper feed through EC7 differs from that using cassette feed. A general description of manual paper feed is given here for easy understanding of the differences.

7-1 Characteristics of manual paper feed

In cassette feed, the printer can control paper pickup timing by itself. The printer begins printing when a TRUE $\overline{\text{PRNT}}$ signal is received, and completes printing within a specified time. In manual feed, however, the printer does not begin printing until a paper is manually fed even though TRUE $\overline{\text{PRNT}}$ signal has been received.

The printer keeps outputting a PAPER OUT status ($\overline{\text{RDY}}$ is FALSE.) to inform the controller that printing is impossible until paper is manually fed. If the next paper is not (manually) fed within 8.5 seconds after $\overline{\text{VSYNC}}$ comes TRUE, a PAPER OUT status is output and $\overline{\text{RDY}}$ goes FALSE. Signal timing using manual feed is shown in Fig. 7-1 below.



* () indicates the internal printer operation timing.

** () indicates manual paper-feed timing.

▨ : Don't care

Fig. 7-1 Manual paper feeding timing

7-2 Control conditions using manual feed

(1) General condition

The first paper after mode switch to manual feed should be fed after confirming that the PAPER OUT indicator lights. When making prints continuously using manual feed, the next sheet of paper should be inserted after a delay of 1.5 seconds or more after the previous sheet has been completely drawn into the printer.

(2) Conditions for insuring 5.1 pages/minute throughput

(a) Paper should be fed into the printer between 1.5 seconds and time t_1 (below) after the previous sheet has been drawn into the printer.

Paper Size (Length)	t_1
Legal (14")	2 seconds
Letter (11")	3.5 seconds
A4 (297mm)	3 seconds
B5 (257mm)	4 seconds

(b) PRNT must be set TRUE within 10ms after RDY becomes TRUE. (Paper is manually fed.)

Canon