HP 2608A LINE PRINTER

TECHNICAL REFERENCE MANUAL

CHANGE TO:

HP 2608 Line Printer
### Technical Reference Manual

Change Description:

The HP 2608A Printer is shipped from the factory with the Service Request Function disabled. All references in the manual to the Service Request Function should be ignored unless this function has been implemented after shipment (refer to the HP-IB Strapping Diagram on page 45).

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INTRODUCTION

The purpose of this manual is to provide programming and technical reference information for the HP 2608A Line Printer.

The HP 2608A may be equipped for operation with either the Parallel Differential Interface or the Hewlett-Packard Interface Bus *(HP-IB).* The following illustrations show the interface connectors on the printer.
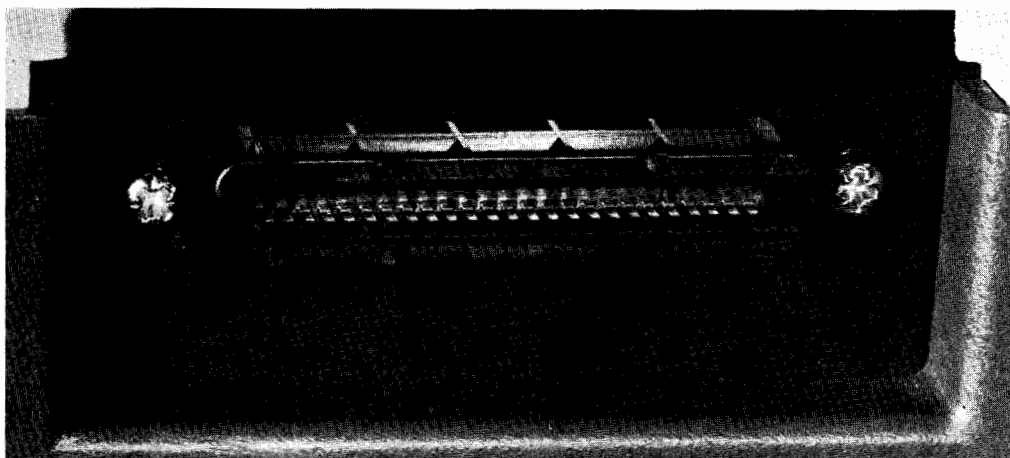
PARALLEL DIFFERENTIAL INTERFACE CONNECTOR
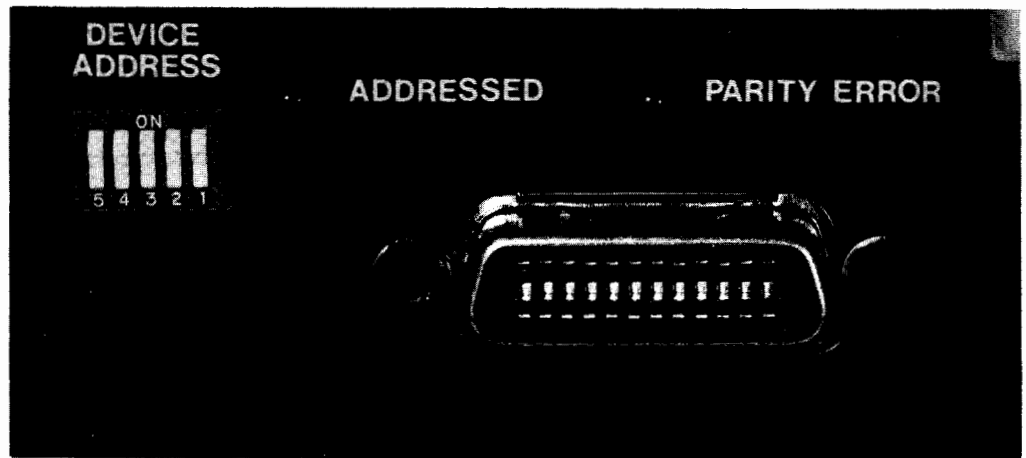
HP-IB CONNECTOR

The following sections of this manual contain detailed programming and reference information.

NOTE

In presenting the explanation of command structures for both the Parallel Differential Interface and HP-IB:
X = Don't Care
P = Odd Parity *(HP-IB only)*

Information describing the printer's power requirements, default status, paper loading, maintenance, etc. is contained in the Operator's Manual *(P/N 02608-90901)*.

NOTE

The HP 2608A Printer is shipped from the factory with the Service Request Function disabled. All references in the manual to the Service Request Function should be ignored unless this function has been implemented after shipment (refer to the HP-IB Strapping Diagram on page 45.)

PARALLEL DIFFERENTIAL INTERFACE
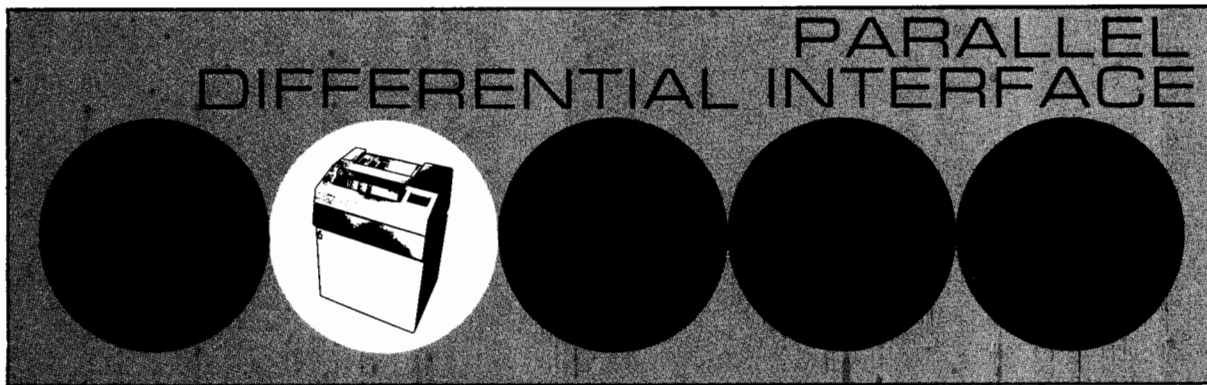
PROGRAMMING INFORMATION

The HP 2608A Printer with a parallel differential interface will operate with the 26099A Interface in the HP 21XX family of computers. It will also operate with other equipment which adheres to the same specifications.

Command and associated data bytes are transmitted from the controlling device to the printer in a single word. Bit 15 is the most significant bit and bit 0 is the least significant bit. The 26099A Interface routes the bytes to the printer and performs the transfer handshake.

16-BIT COMMAND WORD

```
15            12        7                    0
 _____
|          | X  X  X  X |                        |
 ‾‾‾‾‾‾‾‾‾‾‾‾            ‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾
   Command Byte              Data Byte
```
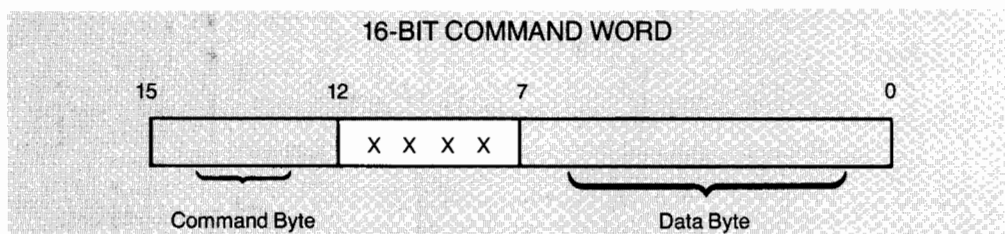
COMMAND CODES

When the printer is off-line, all commands except On-Line and Status Read are ignored except when a fault condition exists, in which case the On-Line Command is also ignored.

CONTROL CODE FUNCTIONS

All control codes except Backspace *(BS),* Shift Out *(SO),* and Shift In *(SI)*, when received in either Standard Alphanumeric Print Mode or Double Size Character Print Mode by the printer, are printed as symbols but not executed. In Transparency Mode all control codes are printed as symbols but not executed. In the Graphics Mode, all data including control codes is printed as graphics data.

BACKSPACE

The Backspace control code, when received in a character mode by the printer, is used to overstrike the preceding character with the following character. If the backspace code is used prior to the first character of a line, the first character of the line will be lost. A single character overstrike is performed by using the Backspace control code; successive BS codes are interpreted as a single code. Overstrike of a full line of print is performed by issuing a print command with zero line slew and then the overstrike line of data followed by a print command which specifies paper motion.

SHIFT OUT

The Shift Out control code, when received by the printer in a character mode, will cause succeeding characters to be printed from the currently designated secondary character set. Shift Out is not terminated by a print operation and does not occupy a print buffer location. It is terminated by Shift In *(SI)*, Reset or Master Clear.

SHIFT IN

The Shift In control code, when received by the printer in a character mode, will return character printing to the designated primary character set. Shift In does not occupy print buffer locations.

SPECIAL PROGRAMMING CONSIDERATIONS

The HP 2608A has been designed with *"double buffering"* capability which allows the printer to receive one line while printing another. The printer acknowledges receipt of data or a command by setting the interface flag. The printer indicates its readiness to accept data or commands through its DEMAND *(Busy/$\overline{Busy}$)* signal. For example: the DEMAND line is active, therefore a series of data bytes are sent to the printer, each acknowledged by the interface flag setting. Finally, a print command is sent to the printer. When the interface flag sets, it acknowledges receipt of the print command but does not imply that all data received has been printed. In the event of a power failure while the machine is operating, data will be lost.

If the data stream between print commands exceeds buffer capacity, excess characters will be lost. Buffer capacity for the HP 2608A is:

* Standard Print Mode = 132 characters (132 bytes)
* Double Size Print Mode = 66 characters (66 bytes)
* Graphics Print Mode = 924 dot positions (115.5 bytes)

Prudent monitoring of the power fail bit in the I/O status word *(see Table 2-4)* will advise the user of the state of programmable features which are changed or affected by power failures or reset conditions.

At power-on or reset, the power fail bit is set and remains set until cleared by the Master Clear command.

● Example
If the power fail bit is found set after it has been cleared, all programmable operating features *(print mode, VFC definition, 6/8 LPI selection)* will have been cleared to the power on state including Top Of Form definition. The current status of these features should then be redefined.

The HP 2608A will always set the interface flag when put on-line or when a power failure recovery or reset occurs. This will cause an interrupt if the controller's interrupt system is enabled. For example: the printer has been taken off-line to replace the paper. When the operator places the printer back on-line, the interface flag will set, notifying the system of the printer's availability.

DATA COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	0/1	CHARACTER CODE						

0 = Primary Set
1 = Secondary
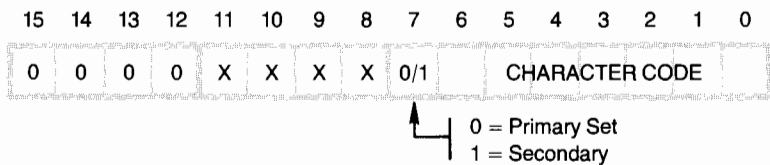
The Data Command transfers all print character data directly into the printer's buffer. In Standard and Double Size print modes, bit seven may be used to select a designated character set. *(Refer also to the Character Set Change Command below.)* If you wish to use the control codes Shift In *(selects Primary Set)* and Shift Out *(selects Secondary Set)*, bit seven should be zero.

If the printer is operating in the Transparency mode, all control codes are printed but not executed *(refer to the Print Mode Command explanation in this section)*.

When the printer is operating in the Graphics mode, bits zero through seven are print information.
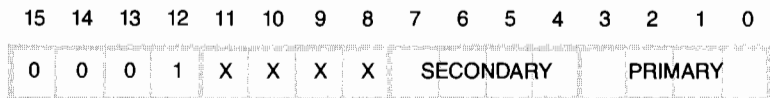
Character code data is contained in Appendix C.

CHARACTER SET CHANGE COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	X	X	X	X	SECONDARY				PRIMARY			

The Character Set Change Command is used to select primary and secondary sets with character set codes specified in bits zero through seven as shown. If the character set selected is not present in the printer, the printer defaults to USASCII.

TABLE 2-1

CHARACTER SET ASSIGNMENTS

	BINARY CODE		BINARY CODE
USASCII	0 0 0 0	GERMAN	1 0 0 1
ARABIC	0 0 0 1	SWEDISH/FINNISH	1 0 1 0
CYRILLIC	0 0 1 0	DANISH/NORWEGIAN	1 0 1 1
KATAKANA	0 0 1 1	SPANISH	1 1 0 0
DRAW	0 1 0 0	BRITISH	1 1 0 1
APL	0 1 1 1	JAPANESE ASCII	1 1 1 0
FRENCH	1 0 0 0	ROMAN EXTENSION SET	1 1 1 1

VFC SET/RESET COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	0	X	X	X	X	0/1	NO. OF LINES						

0 = 6 LPI
1 = 8 LPI

(ODD)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	CHANNELS 16 — 9							

(EVEN)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	CHANNELS 8 — 1							
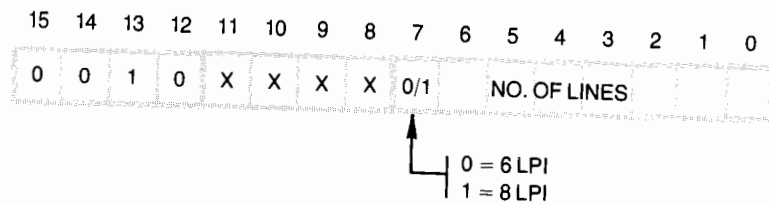
The VFC Set/Reset Command defines the vertical forms control format through user specifications from an external data source or by default to the HP standard format *(see Table 2-2.)* Bit seven selects either 6 LPI (0) or 8 LPI (1). Bits zero through six specify the form length in lines *(127 decimal maximum)*. If the form length is zero, the HP standard vertical format is used *(same as power on or reset)*. If the form length is other than zero, two data byte transfers are required for every line of form length *(see Table 2-3.)*

Format specification bytes are transferred as data where the bytes of odd numbered transfers *(bytes 1, 3, 5, etc.)* define successive values of channels nine through sixteen, and even transfers define channels one through eight. This command will be aborted if any secondary command byte other than 0_8 is received before all specified bytes have been transferred. If this occurs, the HP standard vertical format will default with the vertical line spacing set to the spacing specified by the 6/8 LPI default switch on the control panel. The new command is then executed.

TABLE 2-2

VFC STANDARD FORMAT

LINE POSITIONS OF LOGICAL ONE*

CHANNEL	FUNCTIONS	6 LPI**	8 LPI**
1	Slew to top of next form	0	0
2	Slew to bottom of form	59	79
3	Single space	0, 1, 2, ... 59	0, 1, 2, ... 79
4	Slew to next double space line	0, 2, 4, ... 58	0, 2, 4, ... 78
5	Slew to triple space line	0, 3, 6, ... 57	0, 3, 6, ... 78
6	Slew to half form line	0, 30	0, 40
7	Slew to next quarter form line	0, 15, 30, 45	0, 20, 40, 60
8	Slew to next tenth line	0, 10, 20, ... 50	0, 10, 20, ... 70
9	Slew to bottom of form	59	79
10	Slew to one line previous to bottom of form	58	78
11	Slew to one line previous to top of next form	65	87
12	Slew to top of next form	0	0
13	Slew to next seventh line	0, 7, 14, ... 56	0, 7, 14, ... 77
14	Slew to next sixth line	0, 6, 12, ... 54	0, 6, 12, ... 78
15	Slew to next fifth line	0, 5, 10, ... 55	0, 5, 10, ... 75
16	Slew to next fourth line	0, 4, 8, ... 56	0, 4, 8, ... 76

* Logical one is analagous to the hole in a paper tape or destination point for that channel.

** Assumes ten-inch printed form area on eleven-inch page. At 6 LPI, 60 printed lines possible. At 8 LPI, 80 printed lines possible.

TABLE 2-3
VFC CONFIGURATION

| Data Bit # | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Channel # | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

Line #

1	Byte 1	Byte 2
2	Byte 3	Byte 4
3	Byte 5	Byte 6
4		
5		
6		
7		
8		
9		
10		
n-1		
n	Byte 2n-1	Byte 2n

for n ≤ 127

EQUIVALENT PAPER TAPE

| Channel # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	1	X	X	X	X	X	X	X	X	X	X	X	0/1

0 = Off-line
1 = On-line

The On/Off-Line Command allows a controlling device to put the printer on-line or off-line remotely. However, if a fault condition exists, a remotely directed on-line command will not be recognized. The operator must correct the fault.

If the printer is on-line, a remotely directed off-line command will not be executed until all previously accepted commands have been executed.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	0/1

0 = Enable Printing
1 = Disable Printing
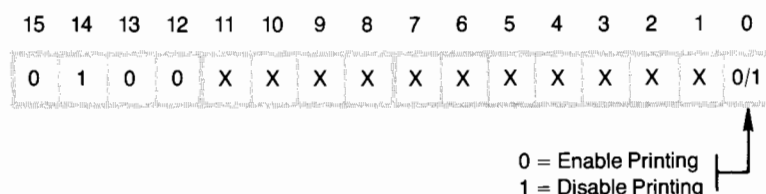
The Self Test Command allows remote initiation of the internal diagnostic routine. When the routine has been completed, test results are indicated by bit six *(Ready bit)* of the I/O Status and by bit seven of Self Test Status as shown in Table 2-4. If a detectable problem exists within the printer, the number of the subtest which failed is indicated in Bits zero to six of Self Test Status as shown in Table 2-4.

SUBTEST NAME	SUBTEST NUMBER
Processor Direct Control and Interrupt	001
Input Bus	010
Output Bus	011
RAM	100
Character Generation	101
Servo	110

Next, a one page self test printout is completed. Only character sets which are installed in the printer are printed out. Refer to the HP 2608A Operator's Manual *(P/N 02608-90901)* for additional self test information.

Bit zero of the data byte is used to enable or disable printing during self test. With printing enabled, self test requires approximately 20 seconds and will produce one full page of output. The non-printing version of self test executes in less than three seconds.

Upon successful completion of the self test routine, the operating status of the printer prior to self test is re-instituted.

A self test failure may also be identified from the operator control panel. When the TEST FAIL indicator is lit, depress and hold down the SELF TEST switch. With the switch held down, a binary number will be displayed by the other three indicators of the Fault Conditions group of indicators. For example, if self test has failed and the PLATEN/RIBBON and PAPER OUT Fault indicators light, the printer has failed the Output Bus subtest *(011)*.

POWER
ON

ON
LINE

FORM
FEED

LINE
FEED

8LPI

OFF
LINE

6LPI

POWER ON CONDITIONS

8LPI

SECONDARY
LANGUAGE

8 4 2 1 8 4 2 1

0

6LPI

PRIMARY
LANGUAGE

FAULT CONDITIONS

PRINT
MECH

PAPER
OUT

PLATEN
RIBBON

TEST
FAIL

FORMS ADJUST

RESET

UP

DOWN
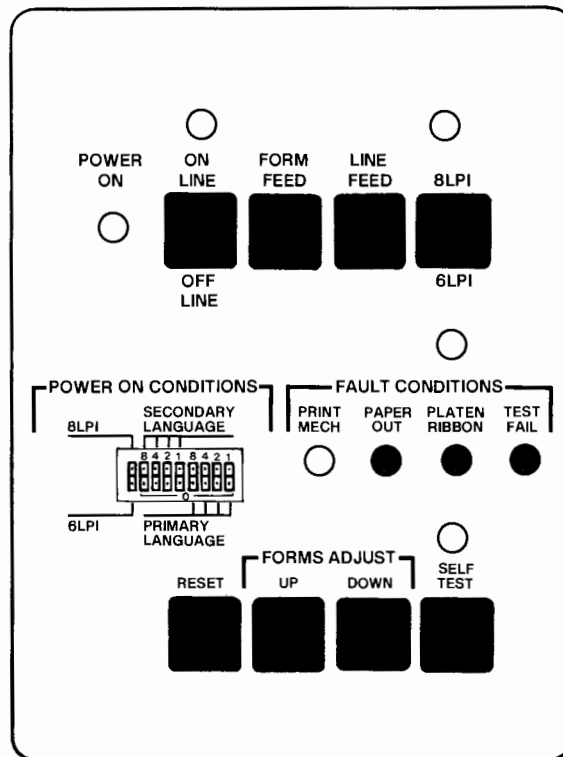
SELF
TEST

**Output Bus Test Failure
(Test No. 011)**

**MASTER
CLEAR
COMMAND**

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	1	X	X	X	X	X	X	X	X	X	X	X	X

The Master Clear Command returns the printer to power-on status except:

• Printer remains on-line
• Power Fail bit is cleared in I/O status byte (see Table 2-4).
• Fault conditions are not cleared.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	256 TEST DATA BYTES							

The Ping Command is used to send 256 test data bytes to the printer. Data bytes are stored in the printer as they are received. When transferred *(see Pong command)* back to the controlling device, these data bytes verify data channels between the printer and the controlling device.

The command byte for test byte data transfers associated with Ping must be zero. If any other command is received, transfers are aborted and the new command is executed. The Pong command should follow Ping. Attempting to execute other commands between Ping and Pong will destroy the integrity of test data and future print data.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	1

The Pong Command is used to return the 256 test data bytes sent to the printer by the Ping Command. If any other command is received, transfers are aborted and the new command is executed. To preserve data integrity the Pong Command should always follow Ping.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	1	X	X	X	X	X	X	X	X	MARGIN OFFSET			

The Left Margin Command defines the number of blank columns that will appear as the left margin. This number can be no greater than 15. The Left Margin Command reduces the effective line length. For example: if there are 4 columns in the left margin, the effective line length is reduced to 128 characters for standard size printing, 62 characters for double size printing, and 111.5 bytes (892 dots) for graphics.

PRINT COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	X	X	X	X	0				SLEW			

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	X	X	X	X	1	X	X	X	CHANNEL NO.-1			

The Print Command terminates print data transfers and initiates a buffer print. Bit seven specifies either line slewing or VFC channel selection. When bit seven is zero, bits zero through six select the number of lines to be slewed. The maximum number of lines which can be slewed is 127. Bits zero through three are used to select the VFC channel number when bit seven is set.

The Print Command with zero lines slewed allows one line of data to be overstruck with another line. The overstrike line will be held in the print buffer and will be merged with the next line.

• Example-Line Slew

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

When print mode is:

- Standard, slew = 4 standard print lines
- Double Size, slew = 4 double size print lines (8 standard print lines)
- Graphics, slew = 4 dot rows

• Example — Channel Selection

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0

The above command will select VFC channel five. Because there is not a channel zero, subtract one from the channel number to determine the channel number assignment. VFC standard format is presented in Table 2-2.

Line positions defined by the VFC are positions defined in terms of 6 or 8 LPI in standard alphanumerics print mode. When in Double Size print mode, these positions remain in the same physical locations on the page as in the standard print mode.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	X	X	X	X	0		NO. OF STATUS BYTES					

OR

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	X	X	X	X	1	X	X	X		LANGUAGE CODE		

The Status Read Command allows the user to read various status bytes from the printer or the dot matrix character patterns of a selected character set from the printer. If any other command is received during status read, status read is aborted and the new command is executed.

NOTE

Whenever a programmed status read is not being performed, I/O status is constantly available on the output data bus and may be read via execution of the LIA instruction for 21XX series computers, or an equivalent instruction for other systems. I/O status is defined as Status Byte No. 1₈ in Table 2-4.

When bit seven of the data byte is zero, as many status bytes will be output as specified by bits zero through six. Status bytes are defined in Table 2-4.

When bit seven of the data byte is one, a character dot matrix pattern read will be performed with bits zero through three specifying the character set to be output. The character set language code will be contained in the least significant four bits of the first data byte returned. Character set language codes are identified in Table 2-1.

If a read request is made for a character set which is not contained in the printer, the default will be to USASCII.

Each character set output consists of the one language code byte plus 1152 pattern bytes *(9 dot rows by 128 characters)* in ascending ASCII order.

After transmission of the last byte, the printer must receive a handshake strobe from the controlling device before acknowledging receipt of the last byte before the printer will update status to its interface board.

The HP 2608A has been designed so that status information is not returned until any operation in progress has been completed, thus ensuring that returned status information is accurate.

The intent of the Status Read Command is to inform the user of the printer's current configuration and to monitor changes to the configuration — such as character set changes. Excessive status read requests — for example, a request at the end of every line — will greatly reduce the operating speed and throughput capability of the printer.

TABLE 2-4

STATUS BYTES

STATUS BYTE NO.	STATUS TYPE	DATA FORMATS							
		7	6	5	4	3	2	1	0
1_8	I/O	On Line	Ready/ Not Ready*	VFC Ch. 9**	VFC Ch. 12**	VFC Initialized	6/8 LPI	Reserved	Power Fail or Reset
2_8	Operator Status	On Line	Print Mech. Error	Self Test Fail	Paper Error	Reserved	6/8 LPI	Platen-Ribbon Error	Reserved
3_8	Print Mode				Transparency		Mode Number		
4_8	Primary/Secondary		Secondary Character Set Code				Primary Character Set Code		
5_8	Self Test	Pass/Fail				Subtest Number			
6_8	6 LPI Dot Row Count				6 LPI Dot Row Count				
7_8	6 LPI Form Position					6 LPI Form Line Number			
10_8	6 LPI Form Length				6 LPI Form Length in Lines				
11_8	8 LPI Dot Row Count				8 LPI Dot Row Count				
12_8	8 LPI Form Position					8 LPI Form Line Number			
13_8	8 LPI Form Length				8 LPI Form Length in Lines				
14_8	Firmware			Firmware Identification Code for Diagnostic Purposes					
15_8	Margin				No. of Columns in Left Margin				
20_8	Power On Pri./Sec.			Power On Primary/Secondary Character Set Switches					

* Signifies a machine error or fault.
See Operator Status (2_8) for detail.

** Because of printer buffering characteristics, these status bits reflect current paper position, which is not necessarily the same as the paper position which will result after all buffered commands are executed..

Any bit definition in this table that uses the backslash ("\") to separate the description refers to a 0/1 setting of the bit. Any other description refers to the given definition when that bit is set = 1.

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15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	1	X	X	X	X	X	X	X	0/1	MODE			

0000 = Standard
0001 = Double Size
0010 = Graphics

0 = Transparency Disable
1 = Transparency Enable

The Print Mode Command is used to set the printer to one of three print modes. Bits zero through three of the data byte are set as shown above. The printer will remain in the mode established by this command until:

- A new mode is requested.
- A Master Clear command is received.
- A power failure occurs.
- The operator resets the printer with the RESET switch on the control panel.

The printer will default to the standard alphanumerics print mode at power-on or reset and upon receipt of the Master Clear Command.

When the Transparency bit is set, all ASCII control codes will be printed but not executed, and primary or secondary character set selection is performed exclusively by using bit seven of the data byte *(refer to Data Command)*.

When the printer receives control codes in either the standard alphanumeric or double size print mode (Transparency = 0), they are printed but not executed except for Backspace *(BS)*, Shift Out *(SO)*, and Shift In *(SI)*.

Transparency is meaningless when the printer is placed in the Graphics print mode.

If the Double Size print mode is selected, printing is performed at twice normal print size and paper motion is either three or four lines per inch compared to six or eight lines per inch. If Graphics print mode is selected, printing is performed a dot row at a time. VFC definition remains unchanged when either Graphics or Double Size print is selected. Unlike the paper position which relates to slewing instructions, VFC channel positions are related to fixed positions on the paper. Thus, a select to Channel 5, for example, will cause motion to that position independent of the Double Size print mode *(also refer to Print Command)*.

Selection of the Graphics print mode causes all information to be interpreted as dot data rather than as printable characters. All eight bits in each byte are used as printable data. A binary one implies a print dot. A zero implies a blank. For example, when transmitted in the Graphics mode, data bytes 152_8, 200_8, and 277_8 result in the following dot pattern.

DOT POSITION   1   8   16   24   924

0 1 1 0 1 0 1 0 1 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 1
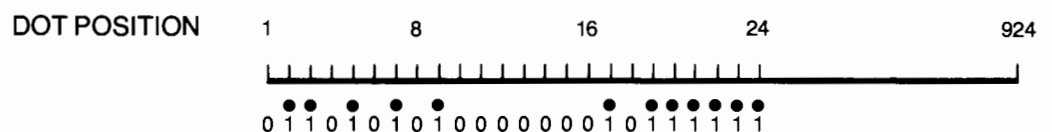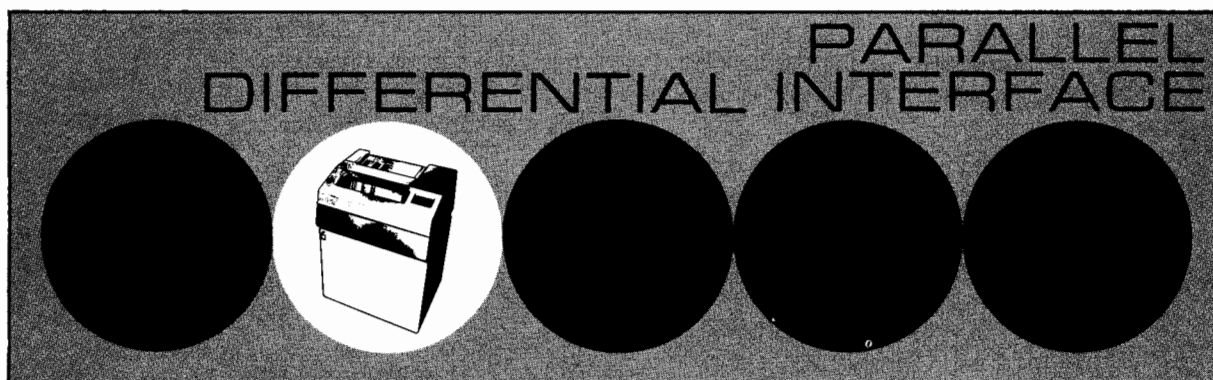
REFERENCE INFORMATION

The interface board in the printer provides the means for the interchange of commands and data between the controlling device and the HP 2608A. The board has two operating modes: Receive and Transmit. In both modes the interchange is controlled by an asynchronous handshake between the STROBE and DEMAND lines.

FUNCTIONAL DESCRIPTION

The Receive mode is the primary operating mode of the printer. All commands and character print data are handled in this mode. The operation of the handshake lines and the buses is described in the following paragraphs:

RECEIVE MODE

STROBE
The Strobe signal, when originated by the data source, is used in the Receive mode to tell the interface board in the printer that the information on the command bus and the input data bus is valid.

DEMAND
The Demand signal, when originated in the printer, is used in the Receive mode to handshake the data transfer from the data source and indicates that the printer is ready for more data transfers.

COMMAND BUS
All command bytes from the data source are transferred via the Command Bus *(four lines)* lines. Demand must be true *(printer not busy)* before any command will be recognized *(with the exception of the On-Line and Status Read commands)*.

INPUT DATA BUS
The Input Data Bus *(eight lines)* is used only in the Receive mode. The data on the bus must be valid when the data source generates a true Strobe. Data must remain valid until the Demand handshake.

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TRANSMIT MODE

When the printer receives a command which requires a response, it enters the Transmit mode. The handshake lines reverse their functions in the Transmit mode.

STROBE
In the Transmit mode, the Strobe signal from the data source is used to handshake the transfer into the data source and to tell the printer to transfer more data.

DEMAND
In the Transmit mode, the Demand signal tells the data source that data on the printer's Output Data Bus is valid.

OUTPUT DATA BUS
The Output Data Bus *(eight lines)* returns printer status and character set data to the data source. Table 2-4 defines the status word. When the printer is not in the Transmit mode the bus contains the printer's current I/O.

INTERFACE CONNECTOR

The interface cable connector is a AMP "Champ" 50 position receptacle. The interconnection diagram on the following page illustrates connection of the cable to the adapter board, the adapter board to the differential interface board, and the differential interface board to the backplane connector.

TIMING

RECEIVE MODE
The four bit command byte on the Command Bus and the eight bit data byte on the Input Bus must be settled and valid before the Strobe is transmitted. Demand completes the transfer handshake after the command and data bytes have been accepted by the printer. Receive mode timing is illustrated below.

RECEIVE MODE TIMING

	*MIN	MAX
A =	50 ns	—
B =	50 ns	—
*C =	900 ns	—
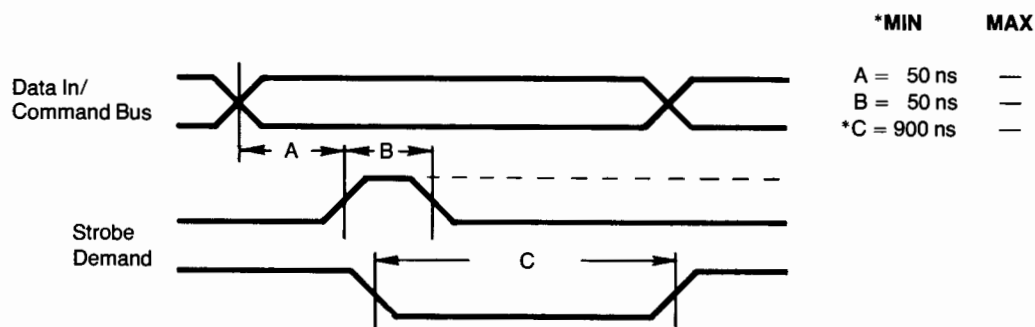
*Timing required at the printer's I/O connector.

ADAPTER INTERCONNECTS TO I/O BOARD

PIN	INPUT LINES	
8	B07	5
33	$\overline{B07}$	6
7	B06	7
32	$\overline{B06}$	8
6	B05	16
31	$\overline{B05}$	15
5	B04	4
30	$\overline{B04}$	3
4	B03	9
29	$\overline{B03}$	10
3	B02	11
28	$\overline{B02}$	12
2	B01	13
27	$\overline{B01}$	14
1	B00	1
26	$\overline{B00}$	2
17	CB3	23
42	$\overline{CB3}$	24
18	CB2	21
43	$\overline{CB2}$	18
19	CB1	19
44	$\overline{CB1}$	17
20	CB0	20
45	$\overline{CB0}$	22
41	$\overline{BI7}$	25
16	BI7	27
40	$\overline{BI6}$	31
15	BI6	33
39	$\overline{BI5}$	32
14	BI5	30
38	$\overline{BI4}$	26
13	BI4	28
37	$\overline{BI3}$	35
12	BI3	34
36	$\overline{BI2}$	36
11	BI2	37
35	$\overline{BI1}$	40
10	BI1	38
34	$\overline{BI0}$	29
9	BI0	39
21	STROBE	47
46	$\overline{STROBE}$	45
22	DEMAND	44
47	$\overline{DEMAND}$	46
24	+5VDC	50
25,50	GND	49

I/O BOARD TO BACKPLANE

	BACKPLANE OUTPUT LINES
47	IDB7
45	IDB6
43	IDB5
41	IDB4
39	IDB3
37	IDB2
35	IDB1
33	IDB0
51	$\overline{I/ODR}$
49	$\overline{I/OCR}$
52	$\overline{I/ODW}$
50	$\overline{I/OCW}$
48	ODB7
46	ODB6
44	ODB5
42	ODB4
40	ODB3
38	ODB2
36	ODB1
34	ODB0
60	$\overline{OS/REG}$
25	$\overline{POR}$
54	$\overline{I/O CYCLE STEAL}$
56	$\overline{I/O RAM WRT}$
58	$\overline{I/O ADD CLK}$
55	CL 02
53	CL 01
57	$\overline{FETCH}$
17	
18	+5V
19	
20	+5V
11	
12	GND
13	
14	
15	
16	
53	$\overline{STAT W}$
88	$\overline{I/O RAM ADDRESS}$

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	(CPU)
CB3	CB2	CB1	CB0		NO. LINES			ODB7 IDB7	ODB6 IDB6	ODB5 IDB5	ODB4 IDB4	ODB3 IDB3	ODB2 IDB2	ODB1 IDB1	ODB0 IDB0	(PRINTER)

COMMAND BYTE   DON'T CARE

DATA BYTE
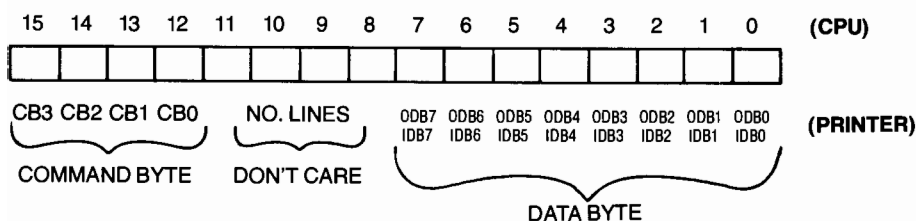
INTERCONNECTION DIAGRAM PARALLEL DIFFERENTIAL INTERFACE

CABLE CONNECTOR TO ADAPTER INTERCONNECTS

PIN	SIGNAL NAME	
21	Strobe	
46	$\overline{\text{Strobe}}$	
22	Demand	
47	$\overline{\text{Demand}}$	
9	Input Data	0
34	$\overline{\text{Input Data}}$	$\overline{0}$
12	Input Data	1
35	$\overline{\text{Input Data}}$	$\overline{1}$
11	Input Data	2
36	$\overline{\text{Input Data}}$	$\overline{2}$
12	Input Data	3
37	$\overline{\text{Input Data}}$	$\overline{3}$
13	Input Data	4
38	$\overline{\text{Input Data}}$	$\overline{4}$
14	Input Data	5
39	$\overline{\text{Input Data}}$	$\overline{5}$
15	Input Data	
40	$\overline{\text{Input Data}}$	$\overline{6}$
16	Input Data	7
41	$\overline{\text{Input Data}}$	$\overline{7}$
18	Command Bit	2
43	$\overline{\text{Command Bit}}$	$\overline{2}$
17	Command Bit	3
42	$\overline{\text{Command Bit}}$	$\overline{3}$
19	Command Bit	1
44	$\overline{\text{Command Bit}}$	$\overline{1}$
24	Command Bit	0
45	$\overline{\text{Command Bit}}$	$\overline{0}$
8	Output Data	7
33	$\overline{\text{Output Data}}$	$\overline{7}$
25	Ground	
24	+5 VDC	
48,49	$\overline{\text{N.C.}}$	
23	$\overline{\text{N.C.}}$	
7	$\overline{\text{Output Data}}$	6
32	$\overline{\text{Output Data}}$	$\overline{6}$
5	Output Data	4
30	$\overline{\text{Output Data}}$	$\overline{4}$
6	Output Data	5
31	$\overline{\text{Output Data}}$	$\overline{5}$
50	Ground	
4	Output Data	3
29	$\overline{\text{Output Data}}$	$\overline{3}$
3	Output Data	2
28	$\overline{\text{Output Data}}$	$\overline{2}$
2	Output Data	1
27	$\overline{\text{Output Data}}$	$\overline{1}$
1	Output Data	0
26	$\overline{\text{Output Data}}$	$\overline{0}$

TRANSMIT MODE

Data on the eight bit Output Bus is valid when Demand is transmitted from the printer. The Strobe completes the handshake after the data source accepts the data. Transmit mode timing is illustrated below.

TRANSMIT MODE TIMING

	*MIN	MAX
D =	800 ns	—
E =	50 ns	—
F =	800 ns	—
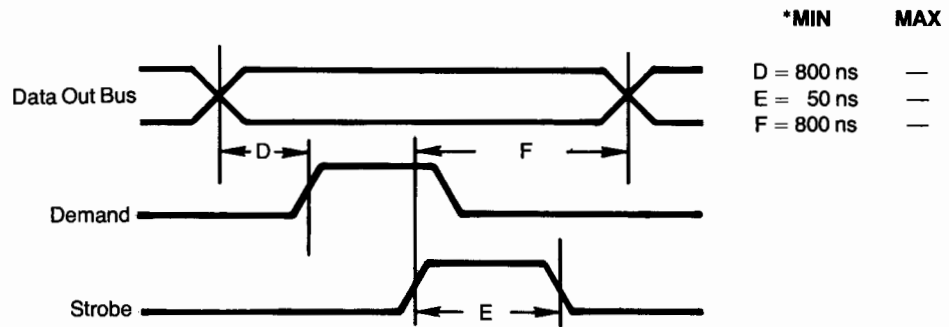
Timing required at the printer's I/O connector.

HP21XX SYSTEMS OPERATION

Interfacing functions required by the printer's interface board are performed through the 26099A Interface with the HP 21XX family of computers.
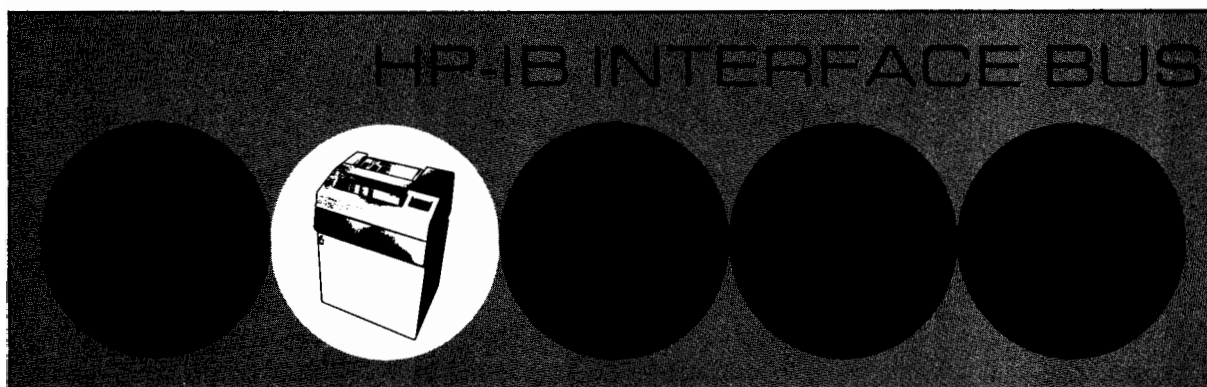
PROGRAMMING INFORMATION

The HP 2608A can be configured to operate with the Hewlett-Packard Interface Bus *(HP-IB)* which is an implementation of IEEE Standard 488. A knowledge of this standard is helpful when working with HP-IB. When so configured, the printer operates with other HP equipment possessing the same HP-IB capability.

The bus consists of 16 lines, eight of which are used for data transmission and eight for communication timing and control. Data transmission lines are designated DIO 1 through 8; communication lines are designated DAV, NRFD, and NDAC; and, control lines are designated IFC, ATN, SRQ, REN, and EOI.

Data is transmitted on the data lines as a series of eight-bit bytes by means of an interlocked handshake technique.

In the command mode, ATN must be active. Bit eight of the DIO lines in the command mode may be used for command parity (odd).

COMMANDS

LISTEN COMMAND
Bit one through seven of the DIO lines specify a listen command and address if they take the form 01ddddd where ddddd is the binary equivalent of the device's fundamental address.

TALK COMMAND
Bits one through seven of the DIO lines specify a talk command and address if they take the form 10ddddd where ddddd is the binary equivalent of the device's fundamental address.

UNIVERSAL COMMANDS
The HP 2608A responds to the following Universal Commands: Identify *(IDY);* Interface Clear *(IFC);* Parallel Poll Unconfigure *(PPU);* Serial Poll Disable *(SPD);* and, Serial Poll Enable *(SPE).*

The HP 2608A responds to the addressed command: Parallel Poll Configure (PPC). Associated with this command are two secondary commands: Parallel Poll Enable (PPE) and Parallel Poll Disable (PPD).

UNADDRESS COMMANDS

Two Unaddress Commands, Unlisten (UNL) and Untalk (UNT), cause all devices on the bus to go from either the ATL (Addressed to Listen) state or the ATT (Addressed to Talk) state to the unaddressed state. The HP 2608A responds accordingly.

SECONDARY COMMANDS

Secondary Commands are usually unique to each device on the bus. All secondary commands require that the device be addressed to talk (ATT) or addressed to listen (ATL). All listen addressed commands require at least one associated data byte. None of the talk addressed secondary commands require any associated data byte.

CONTROL CODE FUNCTIONS

When received in a character mode (Standard Alphanumeric Mode or Double Size Character Mode) by the printer, all ASCII control codes except Backspace (BS), Shift Out (SO), Shift In (SI), and, with optional interface configuration, Carriage Return (CR), Line Feed (LF), and Form Feed (FF) are printed as symbols but not executed. In the graphics mode, all control codes are printed as graphics data. When in transparency mode, all control codes are printed as symbols.

BACKSPACE

The Backspace control code, when received in a character mode by the printer, is used to overstrike the preceding character with the following character. If the backspace code is used prior to the first character of a line, the first character of the line will be lost. A single character overstrike is performed by using the Backspace control code; successive BS codes are interpreted as a single code. Overstrike of a full line of print is performed by issuing a print command with zero line slew and then the overstrike line of data followed by a print and slew desired number of lines.

SHIFT OUT

The Shift Out control code, when received by the printer in a character mode, will cause succeeding characters to be printed from the currently designated secondary character set. Shift Out is not terminated by a print operation and does not occupy a print buffer location. It is terminated by a Shift In, Reset, Master Clear or Device Clear.

SHIFT IN

The Shift In control code, when received by the printer in a character mode, will return character printing to the designated primary character set. Shift In does not occupy print buffer locations.

The interface board logic can also be configured to respond to the Carriage Return (CR), Line Feed (LF), and Form Feed (FF) control codes when in the character mode (refer to the Strapping Diagram on page 45). In the Graphics Mode, these optionally configured control functions are overridden and the codes are printed as their binary equivalents when the print data line is terminated by the print command. In the character mode these control codes cause the following response:

CARRIAGE RETURN

The Carriage Return code, when received by the printer in a character mode,

will cause a print operation with zero line slew. A print data line terminated by CR is buffered pending receipt of either a line of overprint characters, or a line feed *(LF)* which causes the data line to be printed.

LINE FEED
The Line Feed code, when received by the printer in a character mode, will cause a print operation with a single line slew.

FORM FEED
The Form Feed code, when received by the printer in a character mode, will cause a print operation and a VFC channel one selected *(Top Of Form)*.

SPECIAL PROGRAMMING CONSIDERATIONS

The HP 2608A is shipped from the factory with the Service Request function disabled. All subsequent references in this manual to the Service Request function should be ignored unless this function has been implemented after shipment (refer to the HP-IB Strapping Diagram on page 45).

The HP 2608A has been designed with *"double buffering"* capability which allows the printer to receive one line while printing another. If a power failure occurs while the machine is operating, data will be lost. The printer acknowledges receipt of data or a command through the completion of the standard bus handshake procedure. The printer indicates its readiness to accept data or commands through both its request for service and its affirmative response to parallel poll. An example would be: the printer responds affirmatively to a parallel poll; therefore a series of data bytes are sent to the printer, each acknowledged by the standard bus handshake. Finally a print command is sent to the printer, which is also acknowledged by a standard bus handshake. When the printer again responds affirmatively to a parallel poll, it indicates its readiness to accept more data or another command; it does not imply that all data received has been printed.

If the data stream exceeds buffer capacity, characters will be lost. Buffer capacity for the HP 2608A is:

- Standard Print = 132 characters *(132 bytes)*
- Double Size Print Mode = 66 characters *(66 bytes)*
- Graphics Print Mode = 924 dot positions *(115.5 bytes)*

Prudent monitoring of the power fail bit in the I/O status word will advise the user of the state of programmable features which are changed or affected by power failures or reset conditions.

At power-on or reset, the power fail bit is set and remains set until cleared by the Master Clear command or the Device Clear command.

- **Example**
If the power fail is found set after it has been cleared, all non-default status operating modes *(print mode, VFC definition, 6/8 LPI selection)* will have been cleared to the power on state including Top Of Form definition. The current status of these features should then be redefined.

The HP 2608A will always request service and respond affirmatively to a parallel poll when put on-line or when a power failure recovery or reset occurs. It will continue to request service and respond affirmatively to a parallel poll until the printer is identified or another command is given. For example: the printer has been taken off-line to replace paper. When the operator places the printer back on-line, the printer will request service, notifying the system of the printer's availability.

DATA COMMAND (Listen)

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	0	0	0

	8	7	6	5	4	3	2	1
Data Byte	0/1		CHARACTER CODE					

0 = Primary Set
1 = Secondary Set
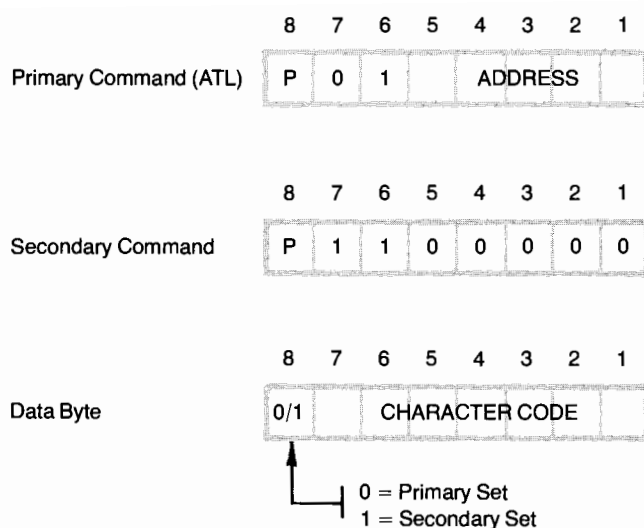
The Data Command transfers all print character data directly to the printer's buffer. In Standard and Double Size print modes, bit eight of the Data Byte may be used to select a designated character set *(refer also to the Character Set Change Command below)*. If you wish to use the control codes Shift In *(selects Primary Set)* and Shift Out *(selects Secondary Set)*, bit eight of the Data Byte should be zero.

If the printer is operating in the Transparency mode, all control codes are printed but not executed *(refer to the Print Mode Command explanation in this section)*.

When the printer is operating in the Graphics mode, all eight bits of the Data Byte are print information.

Character code data is contained in Appendix C.

CHARACTER SET CHANGE COMMAND (Listen)

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	0	0	1

	8	7	6	5	4	3	2	1
Data Byte		SECONDARY			PRIMARY			
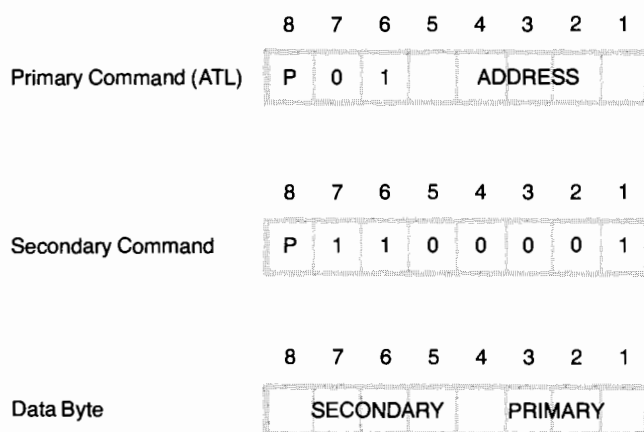
The Character Set Change Command is used to select primary and secondary sets with character set codes specified in the data byte as shown. If the character set selected is not present in the printer, the printer defaults to USASCII.

TABLE 3-1

CHARACTER SET ASSIGNMENTS

	BINARY CODE		BINARY CODE
USACII	0 0 0 0	GERMAN	1 0 0 1
ARABIC	0 0 0 1	SWEDISH/FINNISH	1 0 1 0
CYRILLIC	0 0 1 0	DANISH/NORWEGIAN	1 0 1 1
KATAKANA	0 0 1 1	SPANISH	1 1 0 0
DRAW	0 1 0 0	BRITISH	1 1 0 1
APL	0 1 1 1	JAPANESE ASCII	1 1 1 0
FRENCH	1 0 0 0	ROMAN EXTENSION SET	1 1 1 1

VFC SET/RESET COMMAND (Listen)

Primary Command (ATL)

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary

8	7	6	5	4	3	2	1
P	1	1	0	0	0	1	0

Data Byte

8	7	6	5	4	3	2	1
0/1		NO. OF LINES					

0 = 6 LPI
1 = 8 LPI

Data Byte (odd)

8	7	6	5	4	3	2	1
		CHANNEL 16 — 9					

Data Byte (even)

8	7	6	5	4	3	2	1
		CHANNEL 8 — 1					
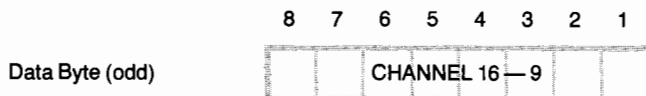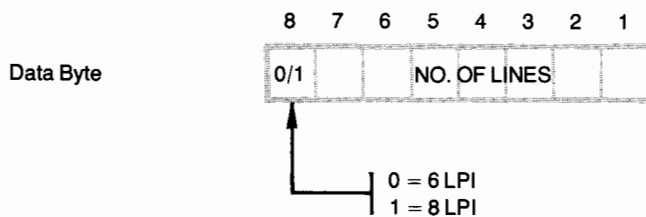
The VFC Set/Reset Command defines the vertical forms control format through user specifications from an external data source or by default to the HP standard format *(see Table 3-2)*. Bit eight selects either 6 LPI (0) or 8 LPI (1). Bits one through seven define the number of lines per form *(127 decimal maximum)*. If the form length is zero, the HP standard vertical format is used *(the printer is set at power on status)*. If the form length is other than zero, two data byte transfers are required for every line of form length *(see Table 3-3)*.

Format specification bytes are transferred as data where the bytes of odd numbered transfers *(bytes 1, 3, 5, etc.)* define successive values of channels nine through sixteen, and even transfers define channels one through eight. This command will be aborted before all specified bytes have been transferred if any intervening secondary command byte is received. If this occurs, the HP standard vertical format will default with the vertical line spacing set to the spacing specified by the 6/8 LPI default switch on the control panel. The new command is then executed.

TABLE 3-2

VFC STANDARD FORMAT

Line Positions of Logical One*

CHANNEL	FUNCTIONS	6 LPI**	8 LPI**
1	Slew to top of next form	0	0
2	Slew to bottom of form	59	79
3	Single space	0, 1, 2, ... 59	0, 1, 2, ... 79
4	Slew to next double space line	0, 2, 4, ... 58	0, 2, 4, ... 78
5	Slew to triple space line	0, 3, 6, ... 57	0, 3, 6, ... 78
6	Slew to half form line	0, 30	0, 40
7	Slew to next quarter form line	0, 15, 30, 45	0, 20, 40, 60
8	Slew to next tenth line	0, 10, 20, ... 50	0, 10, 12, ... 70
9	Slew to bottom of form	59	79
10	Slew to one line previous to bottom of form	58	78
11	Slew to one line previous to top of next form	65	87
12	Slew to top of next form	0	0
13	Slew to next seventh line	0, 7, 14, ... 56	0, 7, 14, ... 77
14	Slew to next sixth line	0, 6, 12, ... 54	0, 6, 12, ... 78
15	Slew to next fifth line	0, 5, 10, ... 55	0, 5, 10, ... 75
16	Slew to next fourth line	0, 4, 8, ... 56	0, 4, 8, ... 76

* Logical one is analagous to the hole in a paper tape or destination point for that channel.

** Assumes ten-inch printed form area on eleven-inch page. At 6 LPI, 60 lines possible. At 8 LPI, 80 lines possible.

TABLE 3-3

VFC CONFIGURATION

Data Bit #	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
Channel #	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Line #

1			Byte 1			Byte 2	
2			Byte 3			Byte 4	
3			Byte 5			Byte 6	
4		
5		
6		
7		
8		
9		
10		
n-1		
n		Byte 2n-1		Byte 2n

for n ≤ 127

EQUIVALENT PAPER TAPE

Channel #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

ON/OFF-LINE COMMAND *(Listen)*
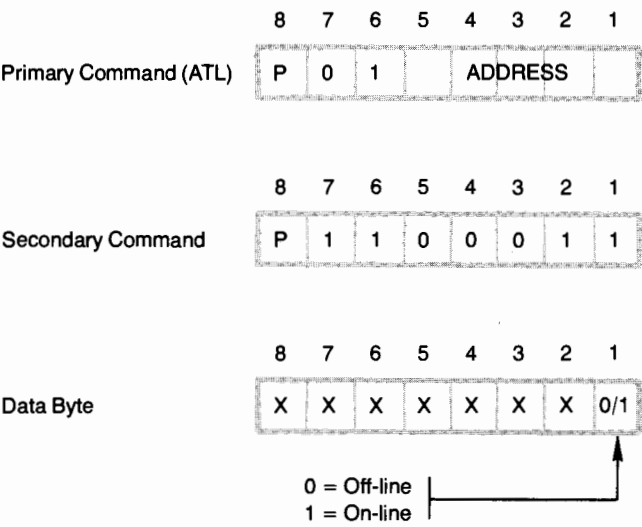
	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	0	1	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	0/1

0 = Off-line
1 = On-line

The On/Off-Line Command allows a controlling device to put the printer on-line or off-line remotely. However, if a fault condition exists, a remotely directed on-line command will not be recognized. The operator must first correct the fault.

If the printer is on-line, a remotely directed off-line command will not be executed until all previously accepted commands have been executed.

SELF TEST COMMAND *(Listen)*
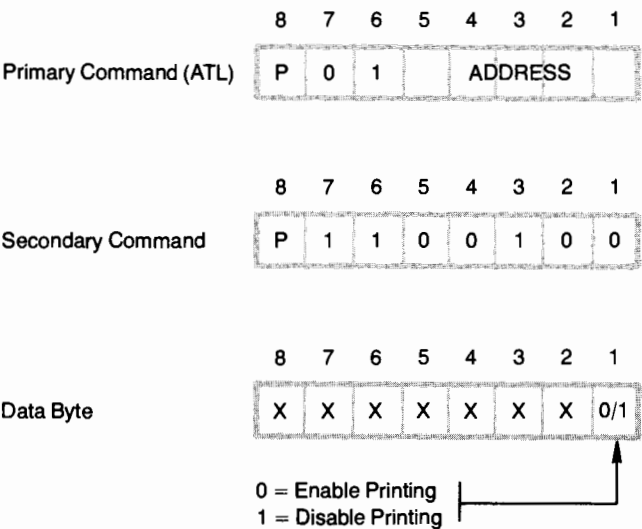
	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	1	0	0

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	0/1

0 = Enable Printing
1 = Disable Printing

The Self Test Command allows remote initiation of the internal diagnostic routine. When the routine has been completed, test results are indicated by bit seven *(Ready bit)* of the I/O status and by bit eight of Self Test status as shown in Table 3-4. If a detectable problem exists within the printer, the number of the subtest failure is indicated in bits one to seven of Self Test Status as shown in Table 3-4.

Bit one of the data byte is used to enable or disable printing during self test. With printing enabled, self test requires approximately 20 seconds and will produce one full page of output. The non-printing version of self test executes in less than three seconds.

Upon successful completion of the self test routine, the operating status of the printer prior to self test is re-instituted.

A self test failure may also be identified from the operator control panel. When the TEST FAIL indicator is lit, depress and hold down the SELF TEST switch. With the switch held down, a binary number will be displayed by the other three indicators of the Fault Condition group of indicators. For example, if self test has failed and the PLATEN/RIB-BON and PAPER OUT indicators light, the printer has failed the Output Bus subtest *(011)*.

SUBTEST NAME	SUBTEST NUMBER
Processor Direct Control and Interrupt	001
Input Bus	010
Output Bus	011
RAM	100
Character Generator	101
Servo	110

Next, a one-page self test printout is completed. Only character sets which are installed in the printer are printed out. Refer to the HP 2608A Operator's Manual *(P/N 02608-90901)* for additional self test information.

**BINARY DISPLAY INDICATION
FOR A SELF TEST FAILURE**

**Output Bus Test Failure
*(Test No. 011)***
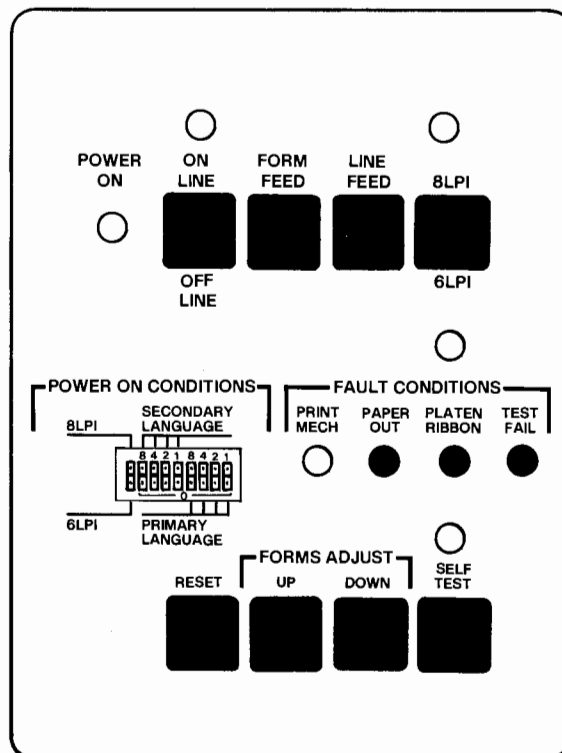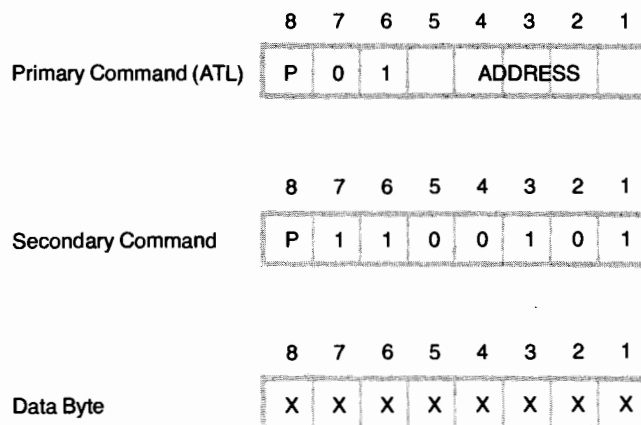
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MASTER CLEAR COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	1	0	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	X

The Master Clear Command returns the printer to power-on status except:

- Printer remains on-line.
- Power Fail bit is cleared in I/O status byte *(see Table 3-4)*.
- Fault conditions are not cleared.

LEFT MARGIN COMMAND *(Listen)*
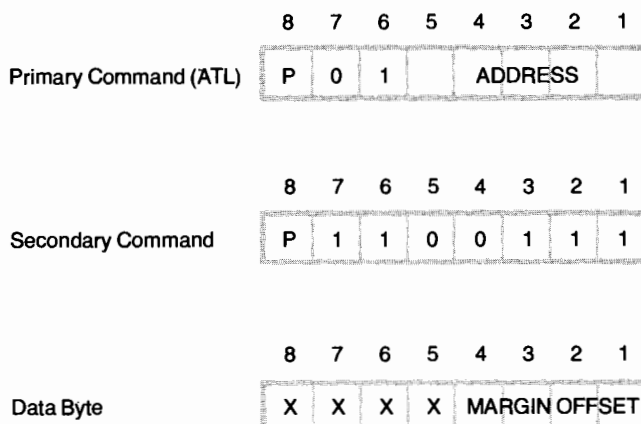
	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	1	1	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	MARGIN OFFSET			

The Left Margin Command defines the number of blank columns that will appear as the left margin. This number can be no greater than 15. The Left Margin Command reduces the effective page length. For example: if there are 4 columns in the left margin, the effective line length is reduced to 128 characters for standard size printing, 62 characters for double size printing, and 111.5 bytes (892 dots) for graphics..

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	1	0	0	0

	8	7	6	5	4	3	2	1
Data Byte	0				SLEW			

OR

	8	7	6	5	4	3	2	1
Data Byte	1	X	X	X	CHANNEL NO.-1			

The Print Command terminates print data transfers and initiates a buffer print. Bit eight of the data byte specifies either line slewing or VFC channel selection. When bit eight is clear, bits one through seven select the number of lines to be slewed. The maximum number of lines which can be slewed is 127. Bits one through four are used to select the VFC channel number when bit eight is set.

The Print Command with zero lines slewed allows one line of data to be overstruck with another line. The overstrike line will be held in the print buffer and will be merged with the next line.

● **Example — Line Slew**

8	7	6	5	4	3	2	1
0	0	0	0	0	1	0	0

When print mode is:

  ● Standard, slew = 4 standard print lines
  ● Double Size, slew = 4 double size lines (8 standard print lines)
  ● Graphics, slew = 4 dot rows

● **Example — Channel Selection**

8	7	6	5	4	3	2	1
1	0	0	0	0	1	0	0

The above command will select VFC channel five. Because there is not a channel zero, subtract one from the channel number to determine the channel number assignment. VFC standard format is presented in Table 3-2.

Line positions defined by the VFC are positions defined in terms of 6 or 8 LPI in standard alphanumerics print mode. When in Double Size print mode, these positions remain in the same physical locations on the page as in standard print mode.

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	1	0	1	0

	8	7	6	5	4	3	2	1
Data Byte	0		NO. STATUS BYTES					

OR

	8	7	6	5	4	3	2	1
Data Byte	1	X	X	X	LANGUAGE CODE			

	8	7	6	5	4	3	2	1
Primary Command (ATT)	P	1	0		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	1	0	1	0

The Status Read Command allows the user to read various status bytes from the printer or the dot matrix character patterns of a selected character set from the printers. If any other command is received during status read, status read is aborted and the new command is executed.

When bit eight of the data byte is zero, as many status bytes will be output as specified by bits one through seven. Status bytes are defined in Table 3-4.

When bit eight of the data byte is one, a dot matrix pattern read will be performed with bits one through four specifying the character set to be read. The character set language code will be read. The character set language code will be contained in the least significant four bits of the first data byte returned. Character set language codes are identified in Table 3-1.

If a read request is made for a character set which is not contained in the printer, the default will be to USASCII.

Each character set read will contain one language code byte plus 1152 pattern bytes *(9 dot rows by 128 characters)*.

The HP 2608A has been designed so that status information is not returned until any operation in progress has been completed, thus ensuring that returned status information is accurate.

The intent of the Status Read Command is to inform the user of the printer's current configuration and to monitor changes to the configuration — such as character set changes. Excessive status read requests — for example, a request at the end of every line — will greatly reduce the operating speed and throughput capability of the printer.

TABLE 3-4

STATUS BYTES

STATUS BYTE NO.	STATUS TYPE	DATA FORMATS							
		8	7	6	5	4	3	2	1
1₈	I/O	On Line	Ready/Not Ready*	VFC Ch. 9**	VFC Ch. 12**	VFC Initialized	6/8 LPI	Reserved	Power Fail or Reset
2₈	Operator Status	On Line	Print Mech. Error	Self Test Fail	Paper Error	Reserved	6/8 LPI	Platen-Ribbon Error	Reserved
3₈	Print Mode				Transparency	Mode Number			
4₈	Primary/Secondary			Secondary Character Set Code			Primary Character Set Code		
5₈	Self Test	Pass/Fail				Subtest Number			
6₈	6 LPI Dot Row Count			6 LPI Dot Row Count					
7₈	6 LPI Form Position			6 LPI Form Line Number					
10₈	6 LPI Form Length				6 LPI Form Length in Lines				
11₈	8 LPI Dot Row Count				8 LPI Dot Row Count				
12₈	8 LPI Form Position				8 LPI Form Line Number				
13₈	8 LPI Form Length				8 LPI Form Length in Lines				
14₈	Firmware			Firmware Identification Code for Diagnostic Purposes					
15₈	Margin				No. of Columns in Left Margin				
20₈	Power On Pri./Sec.			Power On Primary/Secondary Character Set Switches					

* Signifies a machine error or fault.
 See Operator Status (2₈) for detail.

** Because of printer buffering characteristics, these status bits reflect current paper position, which is not necessarily the same as the paper position which will result after all buffered commands are executed..

Any bit definition in this table that uses the backslash ("/") to separate the description refers to a 0/1 setting of the bit. Any other description refers to the given definition when that bit is set = 1.

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	1	0	1	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	0/1		MODE		

0000 = Standard
0001 = Double Size
0010 = Graphics

0 = Transparency Disable
1 = Transparency Enable

The Print Mode Command is used to set the printer into one of three print modes. Bits one through four of the data byte are set as shown above. The printer will remain in the mode established by this command until:

- A new mode is requested.
- A Master Clear command is received.
- A power failure occurs.
- The operator resets the printer with the RESET Switch on the control panel.

The printer will default to the standard alphanumerics print mode at power-on or reset and upon receipt of the Master Clear command.

When the Transparency bit is set, all ASCII control codes will be printed but not executed, and primary or secondary character set selection is performed exclusively by using bit eight of the data byte *(refer to Data Command)*.

When control codes are received in either the standard alphanumeric or double size print mode *(Transparency = 0)*, they are printed but not executed except for Backspace *(BS)*, Shift Out *(SO)*, Shift In *(SI)*, and with optional strapping, Form Feed *(FF)*, Line Feed *(LF)*, and Carriage Return *(CR)*.

When the print mode is Graphics, transparency is meaningless.

If the Double Size print mode is selected, printing is performed at twice normal print size and paper motion is either three or four lines per inch compared to six or eight lines per inch. If Graphics print mode is selected, printing is performed a dot row at a time. VFC definition remains unchanged when either Graphics or Double Size print is selected. Unlike the paper position, which relates to slewing instructions, VFC channel positions are related to fixed positions on the paper. Thus, a channel select to channel three, for example, will cause motion to that position independent of the Double Size print mode *(also refer to Print Command)*.

0 1 1 0 1 0 1 0 1 0 0 0 0 0 0 0 1 0 1 1 1 1 1 1

Primary Command (ATL)

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	0	0	0	0

Data Byte

8	7	6	5	4	3	2	1
X	X	X	X	X	X	X	X
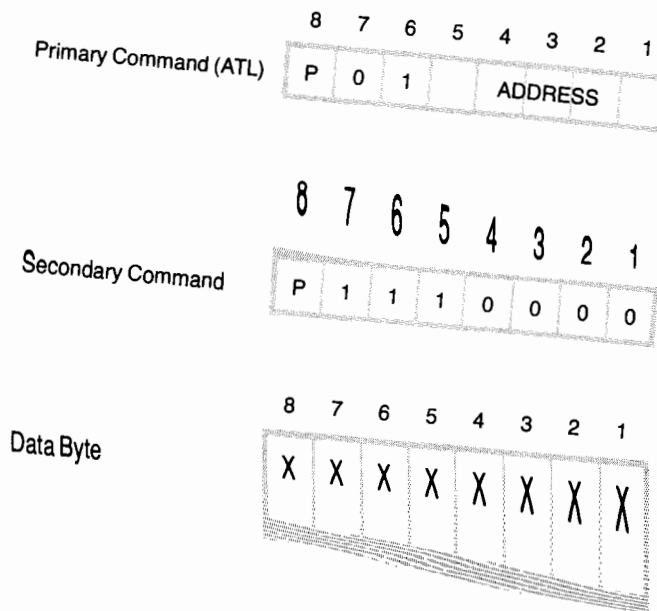
The Device Clear Command is a specific HP-IB listen command and functions identically to the Master Clear Command described previously in this section.

Primary Command (ATT)

8	7	6	5	4	3	2	1
P	1	0		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	0	0	0	0
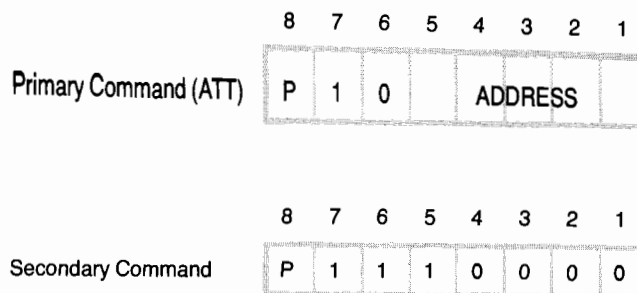
The Device Specified Jump Command (DSJ) is a specific HP-IB system talk command which is used to determine the general status of the printer. When DSJ is used, a single status byte is returned.

The DSJ command will be accepted by the printer in both on-line and off-line states. The DSJ Command must be used with the same constraints as all other commands, i.e. when the printer is on-line, the DSJ Command should only be sent if the printer is indicating its readiness (through a service request or affiramtive response to a parallel poll) to receive

data or commands. In both the on-line and off-line states, the DSJ Command should never be sent during another operation, such as Status Read because the operation in progress will be aborted. General status returned includes the following:

0_8 = READY
Printer is on-line with no attention required and ready to receive a new command or data if the last parallel poll response was affirmative.

1_8 = ATTENTION REQUIRED
Printer has undergone power failure, manual reset, or has been off-line. I/O Status *(byte no. 1_8)* should be read to determine cause and correction required. Attention required status indication is cleared by the Status Read command.

2_8 = PARITY ERROR
Bus command parity error has been detected. Parity error indication is cleared by the DSJ command.

3_8 = ATTENTION REQUIRED AND PARITY ERROR
Both conditions have occurred.

When the I/O status *(byte no. 1_8)* is read back after the ATTENTION REQUIRED bit is set in the DSJ status byte, the interpretation of the status byte is as follows:

BIT 7 = If true, printer is on-line.
  If false, printer is off-line because of:
    a. Power failure, reset or fault condition.
    b. Programmatically commanded off-line.
    c. Control panel switch commanded off-line.
BIT 6 = If true, a printer fault condition exists.
  Operator Status *(byte no. 2_8)* indicates fault *(refer to Table 3-3)*.
BIT 5 = No significance to DSJ ATTENTION REQUIRED bit.
BIT 4 = No significance to DSJ ATTENTION REQUIRED bit.
BIT 3 = If true, the programmable VFC has been reloaded from standard VFC ROM in the printer. Can be caused by power failure, reset, VFC reset, or changing 6/8 LPI when printer is off-line.
BIT 2 = 0 = 6 LPI; 1 = 8 LPI.
BIT 1 = No significance to DSJ ATTENTION REQUIRED bit.
BIT 0 = If true, a power failure or manual reset has occurred.

PING
COMMAND
(Listen)

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	1	1	1	1	0

	8	7	6	5	4	3	2	1
			256 TEST DATA BYTES					
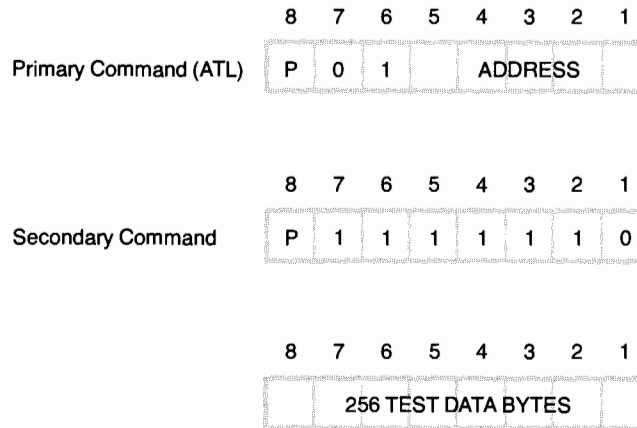
The Ping Command is a specific HP-IB system listen command which is used to send 256 test data bytes to the printer. Data bytes are stored as they are received. When transferred back to the controlling device by the Pong Command, these data bytes verify data channels to and from the printer.

If any command is received before the 256 bytes are transferred, transfers are aborted and the new command is executed. The Pong Command should always follow Ping. Attempting to execute other commands between Ping and Pong except the DSJ command, which can be used after Ping is completed but before Pong is transmitted, will destroy the integrity of test data and future print data.

PONG
COMMAND
(Talk)

	8	7	6	5	4	3	2	1
Primary Command (ATT)	P	1	0		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	1	1	1	1	0

	8	7	6	5	4	3	2	1
Data Byte			256 TEST DATA BYTES					
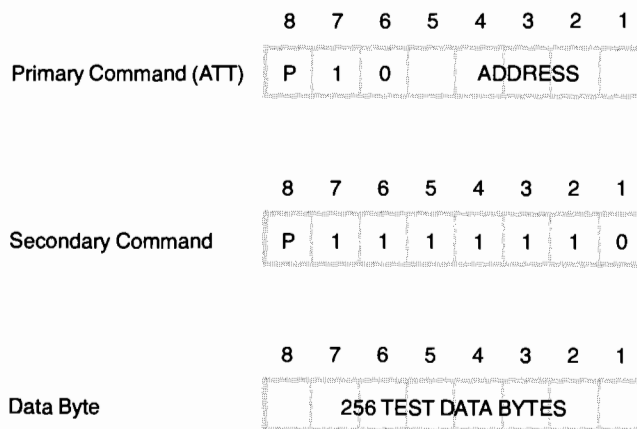
The Pong Command is a specific HP-IB system talk command which is used to return the 256 test data bytes sent to the printer by the Ping Command. To preserve data integrity the Pong Command should always follow Ping.

	8	7	6	5	4	3	2	1
Primary Command (ATL)	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	1	1	1	1	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	0/1
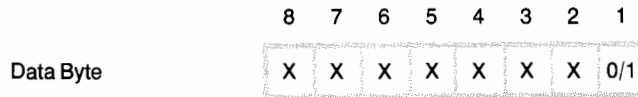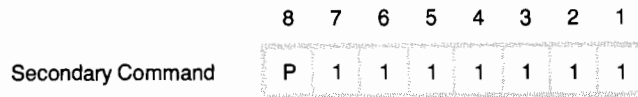
0 = Enable Printing
1 = Disable Printing

Initiate Self Test Command is a specific HP-IB system listen command and functions identically to the Self Test Command described previously in this section.

	8	7	6	5	4	3	2	1
Primary Command (ATT)	P	1	0		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	1	1	1	1	1

The Read Self Test Command is a specific HP-IB system talk command which returns one data byte, the self test status byte 5_8 *(refer to Table 3-4)*.
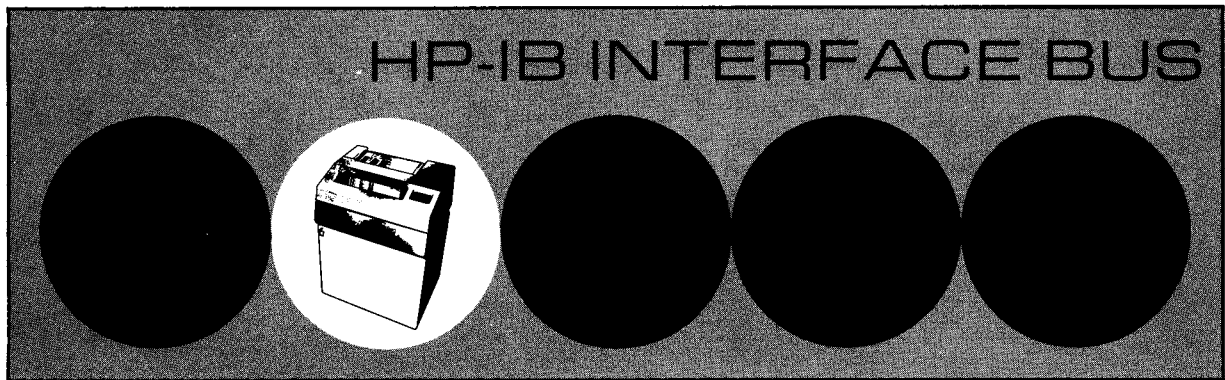
REFERENCE INFORMATION

PRINTER FUNCTIONS

The Listen mode is the primary operating mode of the printer. Most commands and all character print data are handled by the printer in this mode.

COMMANDS (ATTENTION true)
The printer decodes functional commands from the five modifier bits of the secondary listen address which is transmitted from the data source. The commands are held until an associated data byte has been received.

DATA (ATTENTION not true)
In Listen mode, once the associated data byte has been accepted, the new command is held until the printer has completed the previous command

The printer enters the Talk mode after the HP-IB controller has sent the printer a talk addressed command, such as Read Self Test or Pong.

COMMANDS
The printer decodes functional commands from the five modifier bits of the secondary talk address. The commands are held until the printer has completed the previous command.

DATA
In Talk mode, data is transferred from the printer to the listener(s). The last data byte is flagged via the EOI Message line.

HP-IB FUNCTIONS

The HP-IB interface board in the printer uses the Acceptor Handshake *(AH)*, Source Handshake *(SH)*, Listener *(LE)*, Talker *(T)*, Service Request *(SR)*, and Parallel Poll *(PP)* interface functions. The controller *(C)* function can not be implemented and the interface does not use the Device Clear *(DC)*, Device Trigger *(DT)*, and Remote-Local *(RL)*, functions.

LISTENER FUNCTION

This is the primary operating mode of the interface and is used to receive print character data and printer commands except DSJ, Read Self Test and Pong. Printer functional commands are decoded from the modifier bits of the secondary listen address. The EOI message line is not logically used by the interface board logic in the listen mode.

TALKER FUNCTION

This mode is used to transmit data back onto the bus. Printer functional commands are decoded from the modifier bits of the secondary talk address. The EOI message is tagged to the last byte of every transmission in the talk mode.

PARALLEL POLL FUNCTION

The HP 2608A provides the additional feature of automatically configuring its address set in the device address switches *(if the address is in the range of zero through seven).* At power on, this feature allows automatic configuring of DIO lines in accordance with the printer's device address, a positive response sense, and assumes the Parallel Poll Standby State *(ready to respond to any parallel poll conducted by the computer).* When the device address is other than zero through seven at power on, the parallel poll function assumes the Parallel Poll Idle State, which requires that the Parallel Poll function be configured by the computer before a response can be made to any parallel poll. After power on, the interface logic can be reconfigured at anytime by the computer.

SERVICE REQUEST FUNCTION

The interface logic will request service via the SRQ signal and respond accordingly to serial poll. This function has the same meaning as the affirmative response to a parallel poll.

In addition to the primary HP-IB functions described above, an IDENTIFY function is provided. The HP 2608A transmits two 8-bit device identification bytes upon request from the controller. To initiate the transfer of these two bytes, the controller first issues a universal untalk *(address 31)* followed by the printer's assigned address in the modifier bits of the secondary address. The second byte will be tagged with the EOI message. The identifying bit structure of the HP 2608A is: first byte 40_8; second byte 1_8.

The interface cable connector is an Amphenol 57 series, 24 position receptacle. The interconnection diagram on the following page illustrates connection of the cable to the adapter board, the adapter board to the HP-IB interface board, and the HP-IB interface board to the backplane connector.

PHYSICAL DESCRIPTION

CABLE CONNECTOR TO ADAPTER INTERCONNECTS

PIN	SIGNAL NAME
1	Data Input Output 1
2	Data Input Output 2
3	Data Input Output 3
4	Data Input Output 4
5	End Or Identify
6	Data Valid
7	Not Ready For Data
8	Not Data Accepted
9	Interface Clear
10	Service Request
11	Attention
12	Shield
13	Data Input Output 5
14	Data Input Output 6
15	Data Input Output 7
16	Data Input Output 8
17	Remote Enable
18	Ground
19	Ground
20	Ground
21	Ground
22	Ground
23	Ground
24	Ground

HP-IB
INTERCONNECTION
DIAGRAM

INPUT LINES

BUS PIN		I/O PCA PIN
	ADR 5	27
	ADR 4	31
	ADR 3	32
	ADR 2	33
	ADR 1	34
7	NRFD	30
8	NDAC	29
11	ATN	19
9	IFC	26
17	REN	20
10	SRQ	22
6	DAV	3
5	EOI	4
16	DIO 8	21
15	DIO 7	23
14	DIO 6	24
13	DIO 5	25
4	DIO 4	12
3	DIO 3	15
2	DIO 2	16
1	DIO 1	17
	DS 1	2
18	GND	6
19	GND	7
20	GND	8
21,24	GND	9
22	GND	10
23	GND	11
	+5VDC	13
	+5VDC	14
12	SHIELD	
	DS 2	1

BACKPLANE OUTPUT LINES

88	$\overline{\text{I/O RAM ADD}}$
49	$\overline{\text{IOCR}}$
51	$\overline{\text{IODR}}$
47	IDB 7
45	IDB 6
43	IDB 5
41	IDB 4
39	IDB 3
37	IDB 2
35	IDB 1
33	IDB 0
21	+12VDC
22	
17	+5VDC
18	
19	
20	
11	GND
12	
13	
14	
48	ODB 7
46	ODB 6
44	ODB 5
42	ODB 4
40	ODB 3
38	ODB 2
36	ODB 1
34	ODB 0
52	$\overline{\text{I/ODW}}$
50	I/ODW
60	$\overline{\text{OS/REG}}$
54	$\overline{\text{I/O CYCLE STEAL}}$
56	$\overline{\text{I/O RAM WRT}}$
58	$\overline{\text{I/O ADD CLK}}$
25	$\overline{\text{POR}}$
57	$\overline{\text{FETCH}}$
55	CL 02
53	$\overline{\text{CL 01}}$
68	$\overline{\text{STAT W}}$

A five switch module located on the adapter board is used to establish any legal address $(0-30_{10})$ for the printer. This is a single address used for both the Listen and Talk functions. The switches are marked 5, 4, 3, 2, 1, with 1 assigned the least significant address bit position. The address bits are set $(1 = high)$ when toggled to the on position. Switch settings for address selection are shown in the following table.

Address 0

Address 1

Address 2

Address 3

Address 4

Address 5
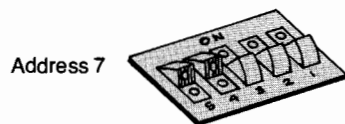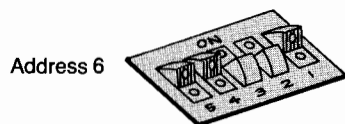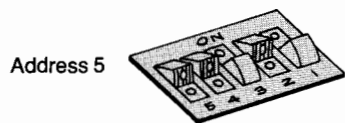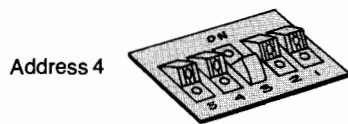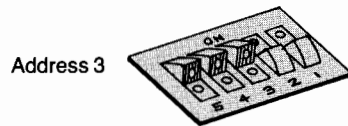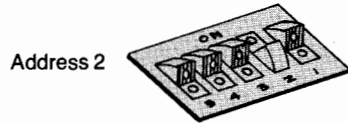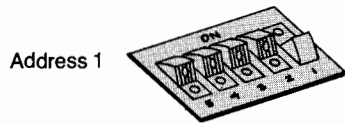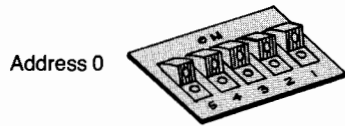
Address 6

Address 7

HP-IB ADDRESS SWITCH SETTINGS

Straps must be installed on the printer's interface board to: disable the logic from checking and reporting parity errors on bus commands, and to enable the logic to recognize control ' codes for Carriage Return, Line Feed, Form Feed, and to enable Service Request.

SYSTEM HANDSHAKE OPERATION

HP-IB operating characteristics provide protocol compatibility for specific HP components and systems. The printer's functional commands are received in the Listen mode and are decoded from the secondary address modifiers *(command bytes)* to perform system data operation. Listen mode timing is illustrated below.

LISTEN

EXTERNAL BUS SIGNALS

RFD

DAC

DAV

INTERNAL DEVICE SIGNALS

Receive Ready

Receive Handshake

Device ready for data

Data on HP-IB

Device accepts data

Data no longer valid
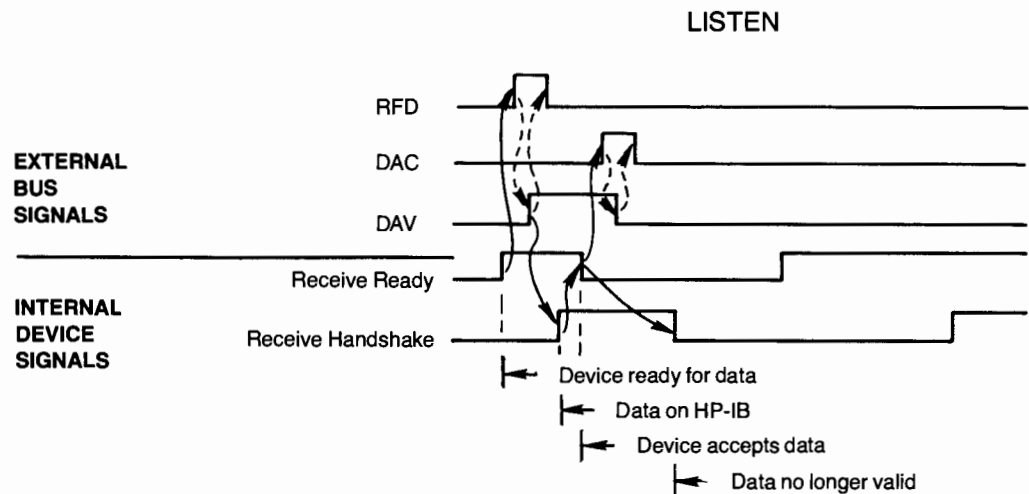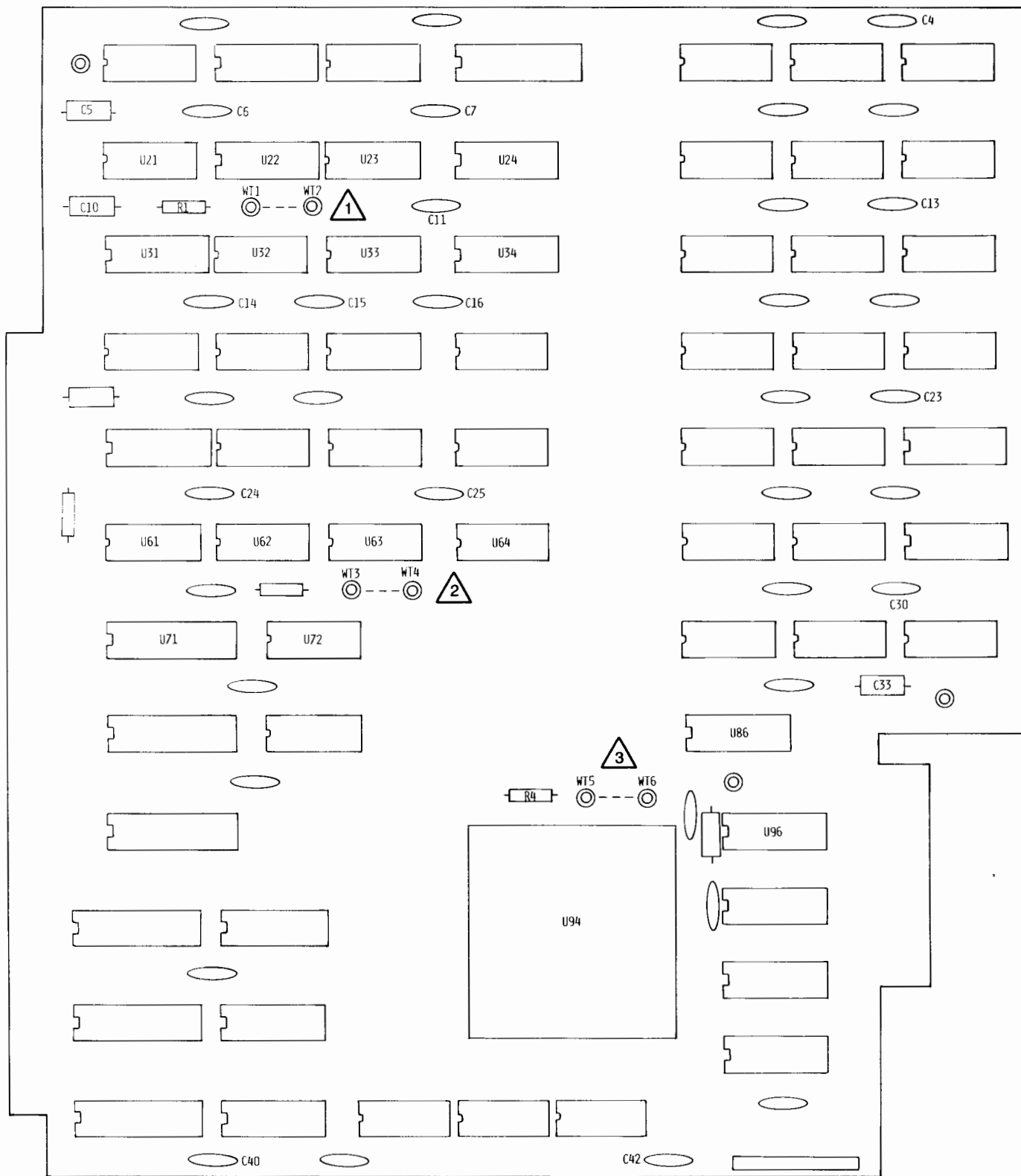
**STRAPPING DIAGRAM FOR OPTIONAL
HP-IB INTERFACE BOARD CONFIGURATION**

⚠️1 When strap WT1-WT2 is installed,
command parity checking is disabled.

⚠️2 When strap WT3-WT4 is installed,
CR, LF and FF are executed.

⚠️3 When strap WT5-WT6 is installed,
Service Request (SRQ) is enabled.

An affirmative parallel poll response from the printer tells the system controller that the printer is either ready to transmit or ready to receive commands/data. An affirmative response is repeated for repeated parallel polls. The printer responds affirmatively to a parallel poll when it is off-line only if it has received a listen command for a status read, on-line, or the DSJ talk command. After status has been transmitted, the affirmative response is taken away. The service request performs the same function as the parallel poll.

The printer will accept data in a burst mode at the transfer rate of approximately 500K bytes/sec. The EOI message has no significance in the Listen mode.

In Talk mode, the printer has data ready for transmission when it requests service or responds affirmatively to a parallel poll. All transmissions from the printer include the EOI message with the last byte of the transfer. Talk mode timing is illustrated below.

TALK

EXTERNAL BUS SIGNALS: RFD, DAC, DAV

INTERNAL DEVICE SIGNALS: Transmit Ready, Transmit Handshake

Device Data Good

Data no longer needed on HP-IB
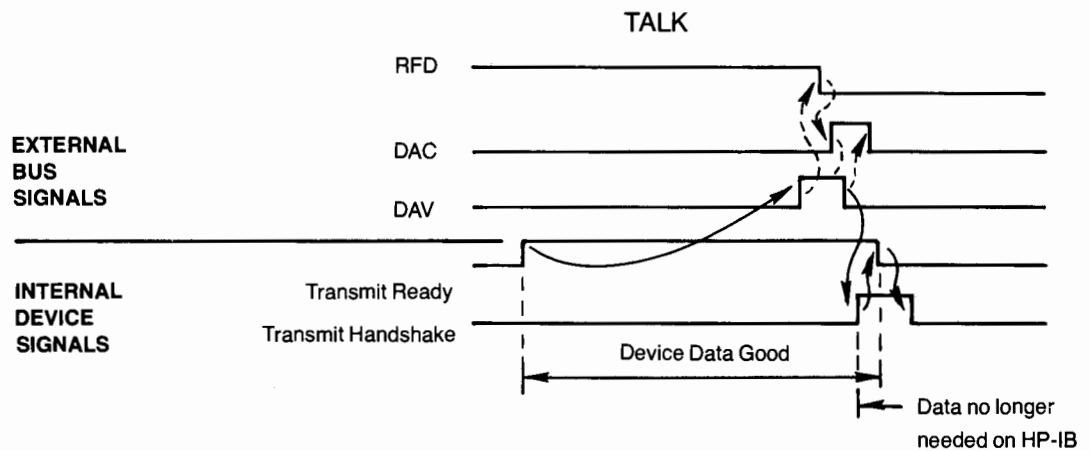
NOTE: The HP 2608A is a slow settling time device.

APPENDIX A. PARALLEL DIFFERENTIAL INTERFACE COMMAND SUMMARY

DATA COMMAND
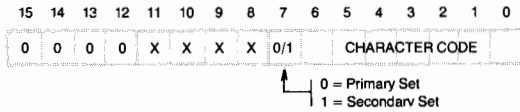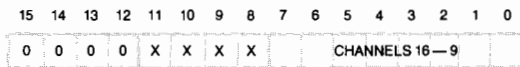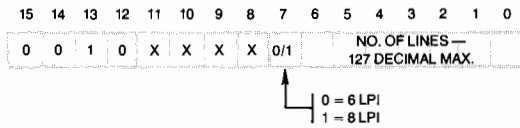
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	0/1			CHARACTER CODE				

0 = Primary Set
1 = Secondary Set

CHARACTER SET CHANGE COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	X	X	X	X	SECONDARY				PRIMARY			

VFC SET/RESET COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	0	X	X	X	X	0/1		NO. OF LINES — 127 DECIMAL MAX.					

0 = 6 LPI
1 = 8 LPI

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	CHANNELS 16 — 9							

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	CHANNELS 8 — 1							

ON/OFF-LINE COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	1	1	X	X	X	X	X	X	X	X	X	X	X	0/1

0 = Off-line
1 = On-line

SELF TEST COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	0/1

0 = Enable Printing
1 = Disable Printing

MASTER CLEAR COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	1	X	X	X	X	X	X	X	X	X	X	X	X

PING COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	X	X	X	X	256 TEST DATA BYTES							
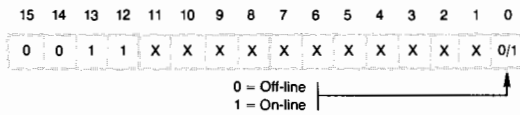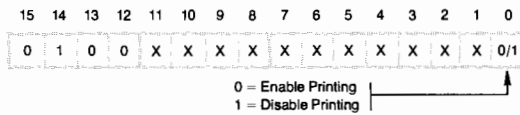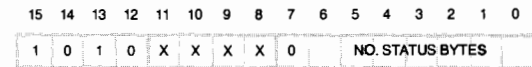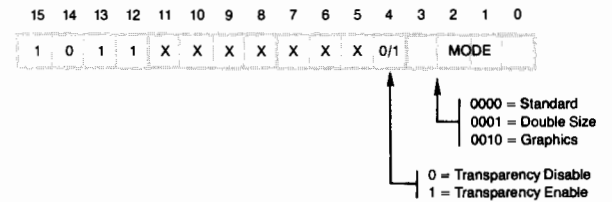
X = Don't Care

Bit 15 = MSB
Bit 0 = LSB

PONG COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	1

LEFT MARGIN COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	1	1	X	X	X	X	X	X	X	X	MARGIN OFFSET			

PRINT COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	X	X	X	X	0			SLEW				

OR

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	X	X	X	X	1	X	X	X	CHANNEL NO. -1			

STATUS READ COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	X	X	X	X	0		NO. STATUS BYTES					

OR

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	X	X	X	X	1	X	X	X	LANGUAGE CODE			

PRINT MODE COMMAND

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	1	X	X	X	X	X	X	X	0/1	MODE			

0000 = Standard
0001 = Double Size
0010 = Graphics

0 = Transparency Disable
1 = Transparency Enable

APPENDIX B. HP-IB COMMAND SUMMARY

DATA COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	0	0	0

	8	7	6	5	4	3	2	1
Data Byte(s)	0/1		CHARACTER CODE					

0 = Primary Set
1 = Secondary Set

CHARACTER SET CHANGE COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	0	0	1

	8	7	6	5	4	3	2	1
Data Byte	SECONDARY				PRIMARY			

VFC SET/RESET COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary	P	1	1	0	0	0	1	0

	8	7	6	5	4	3	2	1
Data Byte	0/1		NO. OF LINES — 127 DECIMAL MAX.					

0 = 6 LPI
1 = 8 LPI

	8	7	6	5	4	3	2	1
Data Byte (even)		CHANNEL 16 — 9						

	8	7	6	5	4	3	2	1
Data Byte (odd)		CHANNEL 8 — 1						

ON/OFF-LINE COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	0	1	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	0/1

0 = Off-line
1 = On-line

SELF TEST COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	1	0	0

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	0/1

0 = Enable Printing
1 = Disable Printing

MASTER CLEAR COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	1	0	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	X	X	X	X

LEFT MARGIN COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	0	1	1	1

	8	7	6	5	4	3	2	1
Data Byte	X	X	X	X	MARGIN OFFSET			

PRINT COMMAND *(Listen)*

	8	7	6	5	4	3	2	1
Primary Command	P	0	1		ADDRESS			

	8	7	6	5	4	3	2	1
Secondary Command	P	1	1	0	1	0	0	0

	8	7	6	5	4	3	2	1
Data Byte	0		SLEW					

OR

	8	7	6	5	4	3	2	1
Data Byte	1	X	X	X	CHANNEL NO. -1			

P = Parity
X = Don't Care

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APPENDIX B. HP-IB COMMAND SUMMARY (CONTINUED)

STATUS READ COMMAND *(Listen)*

Primary Command

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	0	1	0	1	0

Data Byte

8	7	6	5	4	3	2	1
0		NO. STATUS BYTES					

OR

Data Byte

8	7	6	5	4	3	2	1
1	X	X	X	LANGUAGE CODE			

(Talk)

Primary Command

8	7	6	5	4	3	2	1
P	1	0		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	0	1	0	1	0

PRINT MODE COMMAND *(Listen)*

Primary Command

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	0	1	0	1	1

Data Byte

8	7	6	5	4	3	2	1
X	X	X	0/1	MODE			

0000 = Standard
0001 = Double Size
0010 = Graphics

0 = Transparency Disable
1 = Transparency Enable

DEVICE CLEAR COMMAND *(Listen)*

Primary Command

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	0	0	0	0

Data Byte

8	7	6	5	4	3	2	1
X	X	X	X	X	X	X	X

P = Parity
X = Don't Care

DEVICE SPECIFIED JUMP COMMAND *(Talk)*

Primary Command

8	7	6	5	4	3	2	1
P	1	0		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	0	0	0	0

PING COMMAND *(Listen)*

Primary Command

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	1	1	1	0

Data Byte

8	7	6	5	4	3	2	1
256 TEST DATA BYTES							

PONG COMMAND *(Talk)*

Primary Command

8	7	6	5	4	3	2	1
P	1	0		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	1	1	1	0

INITIATE SELF TEST COMMAND *(Listen)*

Primary Command

8	7	6	5	4	3	2	1
P	0	1		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	1	1	1	1

Data Byte

8	7	6	5	4	3	2	1
X	X	X	X	X	X	X	0/1

0 = Enable Printing
1 = Disable Printing

READ SELF TEST COMMAND *(Talk)*

Primary Command

8	7	6	5	4	3	2	1
P	1	0		ADDRESS			

Secondary Command

8	7	6	5	4	3	2	1
P	1	1	1	1	1	1	1

APPENDIX C.
ASCII TABLES

				000-037B	040-077B	100-137B	140-177B

$b_7 b_6 b_5$				$^0 0_0$	$^0 0_1$	$^0 1_0$	$^0 1_1$	$^1 0_0$	$^1 0_1$	$^1 1_0$	$^1 1_1$
BITS			**COLUMN**	0	1	2	3	4	5	6	7
b_4	b_3	b_2	b_1	**ROW**							
0	0	0	0	0	NUL	DLE	SP	0	@	P	\	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	¦
1	1	0	1	13	CR	GS	—	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	_	o	DEL

32 CONTROL CODES

Example: The representation for the character "K" (column 4, row 11) is.

	b_7 b_6 b_5 b_4 b_3 b_2 b_1
BINARY	1 0 0 1 0 1 1
OCTAL	1 1 3

HP 2608A USASCII CHARACTER SET

The left and right byte columns show the octal patterns in a 16 bit word when the character occupies bits 8 to 14 *(left byte)* or 0 to 6 *(right byte)* and the rest of the bits are zero. To find the pattern of two characters in the same word, add the two values. For example, "AB" produces the octal pattern 040502. *(The parity bits are zero in this chart.)*

The octal values 0 through 37 and 177 are control codes. The octal values 40 through 176 are character codes.

Decimal Value	Left Byte	Right Byte	Mnemonic	Graphic	Meaning
0	000000	000000	NUL		Null
1	000400	000001	SOH		Start of Heading
2	001000	000002	STX		Start of Text
3	001400	000003	ETX		End of Text
4	002000	000004	EOT		End of Transmission
5	002400	000005	ENQ		Enquiry
6	003000	000006	ACK		Acknowledge
7	003400	000007	BEL		Bell, Attention Signal
8	004000	000010	BS		Backspace (1)
9	004400	000011	HT		Horizontal Tabulation
10	005000	000012	LF		Line Feed (2)
11	005400	000013	VT		Vertical Tabulation
12	006000	000014	FF		Form Feed (2)
13	006400	000015	CR		Carriage Return (2)
14	007000	000016	SO		Shift Out (1) } Alternate
15	007400	000017	SI		Shift In (1) } Character Set
16	010000	000020	DLE		Data Link Escape
17	010400	000021	DC1		Device Control 1
18	011000	000022	DC2		Device Control 2
19	011400	000023	DC3		Device Control 3
20	012000	000024	DC4		Device Control 4
21	012400	000025	NAK		Negative Acknowledge
22	013000	000026	SYN		Synchronous Idle
23	013400	000027	ETB		End of Transmission Block
24	014000	000030	CAN		Cancel
25	014400	000031	EM		End of Medium
26	015000	000032	SUB		Substitute
27	015400	000033	ESC		Escape
28	016000	000034	FS		File Separator
29	016400	000035	GS		Group Separator
30	017000	000036	RS		Record Separator
31	017400	000037	US		Unit Separator
127	077400	000177	DEL		Delete

Decimal Value	Left Byte	Right Byte	Character	Meaning
32	020000	000040		Space, Blank
33	020400	000041	!	Exclamation Point
34	021000	000042	"	Quotation Mark
35	021400	000043	#	Number Sign, Pound Sign
36	022000	000044	$	Dollar Sign
37	022400	000045	%	Percent
38	023000	000046	&	Ampersand, And Sign
39	023400	000047	'	Apostrophe, Acute Accent
40	024000	000050	(	Left (opening) Parenthesis
41	024400	000051	)	Right (closing) Parenthesis
42	025000	000052	*	Asterisk, Star
43	025400	000053	+	Plus
44	026000	000054	,	Comma, Cedilla
45	026400	000055	-	Hyphen, Minus, Dash
46	027000	000056	.	Period, Decimal Point
47	027400	000057	/	Slash, Slant
48	030000	000060	0	
49	030400	000061	1	
50	031000	000062	2	
51	031400	000063	3	
52	032000	000064	4	Digits, Numbers
53	032400	000065	5	
54	033000	000066	6	
55	033400	000067	7	
56	034000	000070	8	
57	034400	000071	9	
58	035000	000072	:	Colon
59	035400	000073	;	Semicolon
60	036000	000074	<	Less Than
61	036400	000075	=	Equals
62	037000	000076	>	Greater Than
63	037400	000077	?	Question Mark

HP 2608A USASCII CHARACTER SET (CONTINUED)

Decimal Value	Octal Values Left Byte	Octal Values Right Byte	Character	Meaning
64	040000	000100	@	Commercial At
65	040400	000101	A	
66	041000	000102	B	
67	041400	000103	C	
68	042000	000104	D	
69	042400	000105	E	
70	043000	000106	F	
71	043400	000107	G	
72	044000	000110	H	
73	044400	000111	I	
74	045000	000112	J	
75	045400	000113	K	
76	046000	000114	L	
77	046400	000115	M	Upper Case Alphabet, Capital Letters
78	047000	000116	N	
79	047400	000117	O	
80	050000	000120	P	
81	050400	000121	Q	
82	051000	000122	R	
83	051400	000123	S	
84	052000	000124	T	
85	052400	000125	U	
86	053000	000126	V	
87	053400	000127	W	
88	054000	000130	X	
89	054400	000131	Y	
90	055000	000132	Z	
91	055400	000133	[	Left (opening) Bracket
92	056000	000134	\	Backslash, Reverse Slant
93	056400	000135	]	Right (closing) Bracket
94	057000	000136	^	Caret
95	057400	000137	_	Underline

Decimal Value	Octal Values Left Byte	Octal Values Right Byte	Character	Meaning
96	060000	000140	`	Grave Accent[5]
97	060400	000141	a	
98	061000	000142	b	
99	061400	000143	c	
100	062000	000144	d	
101	062400	000145	e	
102	063000	000146	f	
103	063400	000147	g	
104	064000	000150	h	
105	064400	000151	i	
106	065000	000152	j	
107	065400	000153	k	
108	066000	000154	l	
109	066400	000155	m	Lower Case Letters
110	067000	000156	n	
111	067400	000157	o	
112	070000	000160	p	
113	070400	000161	q	
114	071000	000162	r	
115	071400	000163	s	
116	072000	000164	t	
117	072400	000165	u	
118	073000	000166	v	
119	073400	000167	w	
120	074000	000170	x	
121	074400	000171	y	
122	075000	000172	z	
123	075400	000173	{	Left (opening) Brace
124	076000	000174	|	Vertical Line
125	076400	000175	}	Right (closing) Brace
126	077000	000176	~	Tilde, Overline

Notes: 1. Executed by the HP 2608A. All other control codes are printed.

2. May be executed with HP-IB (option 046) when optionally configured.