MODEL 620 PRINTER/TERMINAL

SERIAL INTERFACE

90457-01 REV A April, 1982

DIABLO SYSTEMS INCORPORATED
A XEROX Company

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Warning: This equipment generates, uses and can radiate radio frequency energy and, if not installed in accordance with the instructions manual, may cause interference to radio communications.

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In equipment labeled Class B Compliant a shielded and grounded I/O cable is necessary to achieve compliance with the FCC Rules regarding radio emissions from computers. Please consult your authorized Diablo sales representative for further details regarding the cable.

PREFACE

The contents of this manual represent the unit as manufactured at the time of publication.

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WARRANTY

Diablo Model 620 Printers are warranted against defects in materials and workmanship for 90 days as outlined in the warranty statement included as a separate publication and packed with the unit. Any questions regarding the warranty not covered by this statement should be directed to your Diablo Sales Representative.

UL/CSA/VDE

UL recognized and listed under File No. E51242.
CSA certified as a component and printer under CSA File No. LR2196.
Complies with VDE regulations 0730 and 0871

Printed in The USA

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SECTION 1

GENERAL DESCRIPTION

1.1 GENERAL INFORMATION

The Model 620 Printer/Terminal has only one major printed circuit board (PCB). This PCB is called Serial & Control, and incorporates all interface, logic, systems driver and power regulator circuits. Only the power supply rectifier and control panel circuits are separate.

The Model 620 is capable of operating at data transfer rates of 110, 300 and 1200 baud. It communicates using the USA Standard Code for Information Interchange (ASCII), it conforms to EIA RS-232-C (CCITTV-24) interface standard, and it is compatible with the Bell 103A and other equivalent modems. An appropriate interface cable for interconnecting between the Model 620 and the modem is available from Diablo. See subsection 2.2.

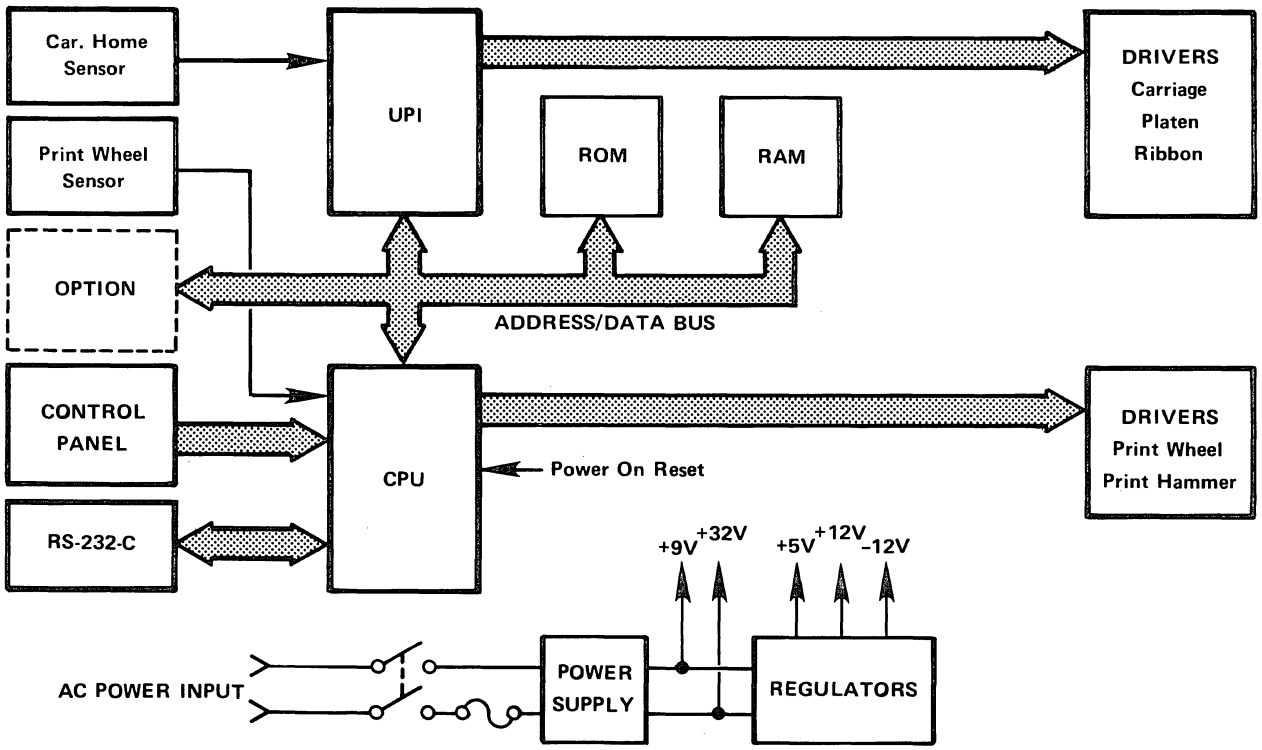
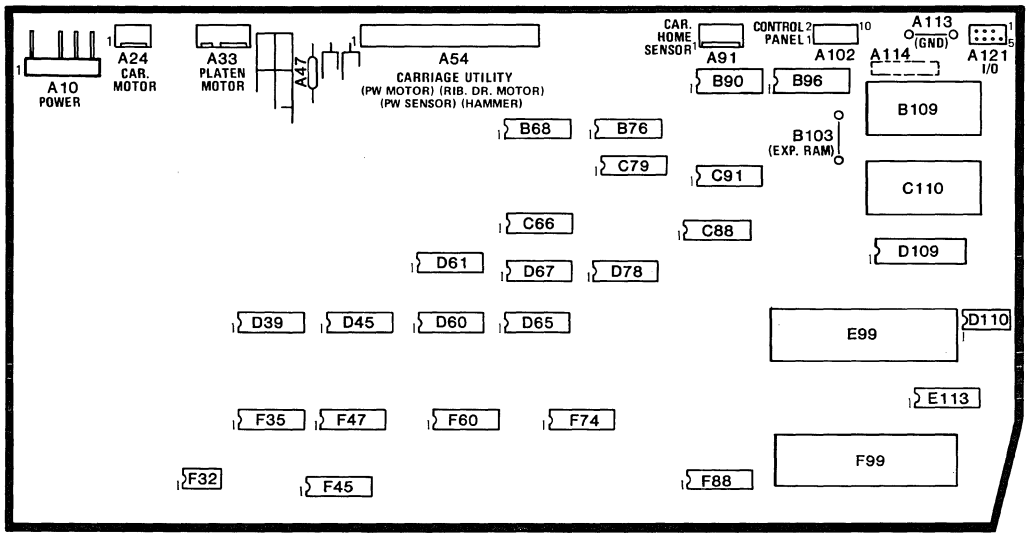


Figure 1-1 MODEL 620 BLOCK DIAGRAM

Figure 1-1 contains a block diagram depicting the Model 620. The interface section receives serial ASCII data via its RS-232-C connector, and directs the data into the microprocessor logic chain. The microprocessor processes the data into control signals which are then channeled to the several subsystem driver circuits. The drive circuits develop the power signals for their associated printer mechanisms (carriage motor, print wheel motor, platen or paper feed motor, and ribbon drive) to produce the printed result. The control panel interfaces directly to the Serial & Control PCB. It supports an 8-section DIP switch which permits selection of operating parameters (Page Size, Auto Line Feed, Self Test, Printer Ready/DC1/DC3, Parity On/Off-Odd/Even, and Baud Rate/Option), and four touch-action switches which are used to command Reset, Pause, Line Feed and Form Feed.



S/C PCB COMPONENT SIDE

Figure 1-2 MODEL 620 S & C CIRCUIT BOARD

Figure 1-2 shows the location of the major components and connectors on the S&C PCB.

1.2 SIGNAL CONVENTIONS

All signal designations used in this manual comply with the following conventions.

1. A signal name prefixed by a "-" symbol (as in -Rx DATA) identifies a signal whose active state is a low electrical level.

2. A signal name prefixed by a "+" symbol (as in +DTR) identifies a signal whose active state is a high electrical level.

3. Electrical levels are identified by "H" (HI) or "L" (LO). HI indicates an electrical level greater than 2.4 volts. LO indicates an electrical level less than 0.8 volts.

4. The "true" state of a signal is indicated by a logical "1", and the "false" state by a logical "0", regardless of electrical levels. For example, -Rx DATA = 1 = LO; and +DTR = 1 = HI.

SECTION 2

INTERFACE HARDWARE AND SIGNALS

2.1 GENERAL

The information in this section pertains to the signal interface only. Information regarding power supplies, grounding requirements, ventilation and physical space requirements is contained in Section 2 of the Model 620 Product Description manual, Publication No. 90452-XX.

2.2 RS-232-C SERIAL INTERFACE CABLE

An EIA RS-232-C compatible interface cable, P/N 152S2416X*, is available from Diablo for use with the Model 620. This cable is illustrated in Figure 2-1. Cable lengths available from Diablo are (*) 10' (X=0), 15' (X=1), 25' (X=2) and 50' (X=3). The cable is terminated on each end with a D-subminiature Cannon or Cinch DB-25P connector, and is shielded for VDE/FCC emission compliance.

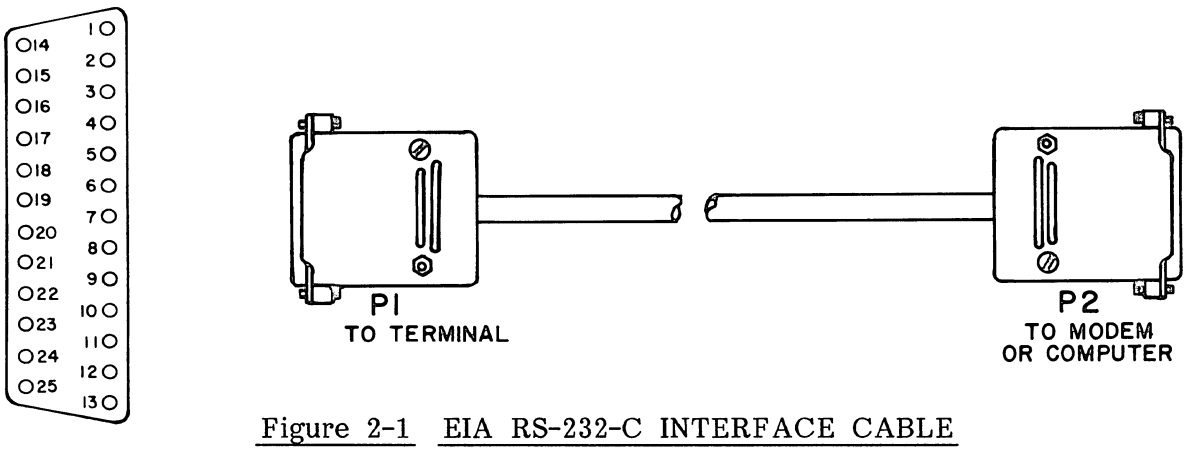


Figure 2-1 EIA RS-232-C INTERFACE CABLE

2.3 INPUT/OUTPUT LEVEL CONVERTER CIRCUITS

2.3.1 Input Level Converter

The Model 620's circuit board uses a type 75154 line receiver to convert the +/-12V modem signals into +5V and 0V for use by the TTL logic. These circuits are capable of handling the +/-3V to +/-25V maximum voltage swings allowed under EIA Standard RS-232-C. Input resistance is from 3K to 7K ohms, with 5K typical.

2.3.2 Output Level Converter

The Model 620's circuit board uses a type 75150 line driver to convert the TTL levels used within the logic circuits into +/-12V levels suitable for use on the RS-232-C interface. These circuits can withstand output short circuits to any low-impedance voltage within the RS-232-C range (+/-25V).

2.4 INTERFACE SIGNAL PIN ASSIGNMENTS

Table 2-1 lists the EIA RS-232-C interface connector pin assignments that are used by the Model 620. The direction of signal flow at the interface is indicated by arrows in the table.

Table 2-2 provides a pin-to-pin wiring list for the internal interface cable that connects from the EIA I/O connector on the rear panel to Interface Connector A121 on the circuit board.

TABLE 2-1
EIA INTERFACE CONNECTOR PIN ASSIGNMENTS

Signal Direction Terminal : Modem	Pin Number	CCITT	TelCo	Signal
→	2	103	BA	-Transmitted Data*
←	3	104	BB	-Received Data*
→	4	105	CA	+Request To Send
←	6	107	CC	+Data Set Ready*
- - - - - -	7	102	AB	Signal Ground
→	20	108	CD	+Data Terminal Ready

***Notes:** In those installations where the Model 620 is to be used with an input direct from the host system rather than thru a modem, the user must ensure the following conditions:

1. The +DATA SET READY input must be held HI during data input.
2. All status conditions required by the host system must be satisfied.
3. The transmitted data from the Model 620 must connect to the received data input of the host controller, and vice versa. In some cases, it may be necessary to alter the wiring at one end of the I/O cable to exchange the two wires connected to pins 2 and 3 of the I/O connector.

TABLE 2-2
CABLE WIRING BETWEEN I/O and CIRCUIT BOARD CONNECTORS

I/O Pin	PCB Pin	Signal
2	A121-7	-Tx
3	A121-2	-Rx
4	A121-6	+RTS
6	A121-3	+DSR
7	A121-1	GND
20	A121-8	+DTR

2.5 INTERFACE SIGNAL DEFINITIONS

-Tx - This is the serial ASCII-coded digital data being transmitted by the Model 620. This line is in the "mark" state (LO) between characters, rises for logic 0 and drops for logic 1.

-Rx - This is the serial ASCII-coded digital data being received by the Model 620. This line must be held in the "mark" state (LO) between characters. It should go HI for logic 0, and LO for logic 1.

+RTS - Held HI (+12V) whenever power is ON.

+DSR - Must be ON (HI) for Model 620 operation in Remote mode. If OFF (LO), no data can be received. (Also see "Notes" for Table 2-1)

GND - Ground reference for all other interface signals.

+DTR - This signal from the Model 620 controls connection and disconnection of the data communication equipment (the modem) to and from the communication channel. The operation of this signal conforms to EIA RS-232-C specifications.

SECTION 3

OPERATING CONSIDERATIONS

3.1 GENERAL

This section of the manual contains a detailed discussion of the operating features of the Model 620. The procedures for routine operator duties, such as changing ribbons and print wheels, are given in detail in the Model 620 Operators Guide and thus are not repeated here.

A few of the functions and operating parameters of the Model 620 are controlled by switches from the control panel area. However, as an RO (Receive-Only) terminal, most of its functions and operating parameters are controlled by Control (CTRL) Codes and Escape (ESC) sequences received via the interface. Many of the ESC sequences include 2- and 3-character CTRL codes. These CTRL Codes and ESC Sequences are summarized in the next two subsections.

3.2 CONTROL (CTRL) CODES

The Model 620 responds to a standard set of ASCII Control Codes. The standard ASCII Code Chart shown in subsection 4.2 lists the Control Characters and their corresponding ASCII Codes (although the operator normally need not be concerned with the actual codes for the Control Characters). The Control Characters, as they apply to the Model 620, are defined below. The keyboard (CTRL) codes given are those generated on a Logical-Bit-Paired keyboard.

ACK (CTRL F) (HEX 06) - This code is used in conjunction with ETX for the ETX/ACK alternative communication protocol. (See subsection 3.4.2)

BEL (CTRL G) (HEX 07) - Updates all summarized motion and suspends processing of further characters until all printer activity is complete.

BS (CTRL H or BACKSPACE) (HEX 08) - Backspaces the carriage one print position (HMI) in normal mode, or 1/60" in Graphics mode. Direction of movement reverses in the Backward Print mode. (see subsection 3.7)

CAN (CTRL X) (HEX 18) - This code is used in the sequence ESC CAN A or B to select or exit the high hammer energy mode.

CR (CTRL M or RETURN) (HEX 0D) - Causes a carriage return. If the Auto LF switch is ON, a line feed operation also occurs. (See subsection 3.5.1)

DC1 (CTRL Q) (HEX 11) - This code is used in conjunction with DC3 for communication protocol. (See subsection 3.4.1)

DC2 (CTRL R) (HEX 12) - Used in the sequence ESC SO DC2 to exit down-load mode.

DC3 (CTRL S) (HEX 13) - This code is used in conjunction with DC1 for communication protocol. (See subsection 3.4.1)

DC4 (CTRL T) (HEX 14) - This code is used to exit print wheel down-load mode.

DEL (CTRL DEL) (HEX 7F)- This character is used only to exit Test Mode in Remote Diagnostics. It can be used however as a buffer or "sluff" code the same as NUL.

ENQ (CTRL E) (HEX 05) - This code is used in the sequence ESC SUB ENQ to select Test Mode in Remote Diagnostics.

ESC (CTRL]) (HEX 1B) - This code is always received as the first character of a 2- or 3-character command sequence. (See subsection 3.3)

ETB (CTRL W) (HEX 17) - This code is used in the sequence ESC ETB A or B to select or exit the single strike ribbon mode.

ETX (CTRL C) (HEX 03) - This code is used in conjunction with ACK for the ETX/ACK alternative communication protocol. (See subsection 3.4.2)

FF (CTRL L) (HEX 0C) - This code initiates a form feed to the top of the next form (page), or to the top margin on the next form or page if one is set.

HT (CTRL I) (HEX 09) - This code is used in the sequence ESC HT n for absolute horizontal tab to column "n".

LF (CTRL LF) (HEX 0A)- (or CTRL J) This code initiates paper movement up 1 line. Movement changes to 1/48" per command in the Graphics Mode.

NAK (CTRL U) (HEX 15) - This code is transmitted whenever Down-Load mode is aborted, or when error conditions exist.

NUL (CTRL 1-8)(HEX 00)- This code is ignored by the Model 620. It can be used as a buffer or "sluff" code.

RS (CTRL ^) (HEX 1E) - This code is used in the sequence ESC RS n to set VMI.

SI (CTRL O) (HEX 0F) - This code is used to clear Program Mode.

SO (CTRL N) (HEX 0E) - This code is used in the sequences ESC SO M, ESC SO DC2 and in initiating Test Mode in Remote Diagnostics.

SP (CTRL SPACE) (HEX 20) - This code initiates carriage movement one print position (HMI) in the Normal mode.

STX (CTRL B) (HEX 02) - This code is used in Remote Diagnostics Test Mode.

SUB (CTRL Z) (HEX 1A) - This code is used as the second character in ESC sequences for remote diagnostics routines.

US (CTRL _) (HEX 1F) - This code is used in the sequence ESC US n to set HMI.

VT (CTRL K) (HEX 0B) - This code is used in the sequence ESC VT n for absolute vertical tab to line "n".

3.3 ESCAPE CODE SEQUENCES

The Escape (ESC) mode is entered by receiving the ESC control code over the communications interface. This code is always received as the first character of a 2- or 3-character "Escape Code Sequence". The ESC code conditions the Model 620 logic to receive the next one or two characters as command rather than print data. The Model 620 immediately executes the command and exits the Escape Mode. The following list summarizes the ESC code command sequences.

Characters (1)	(2)	(3)	Description of the Command
ESC	3		Graphics mode ON (clear with CR)
ESC	4		Graphics mode OFF
ESC	5		Forward Print mode ON
ESC	6		Backward Print mode ON (Forward OFF) (clear with CR)
ESC	9		Set Left Margin (at current position) ***
ESC	0		Set Right Margin (at current position) ***
ESC	a		Print Print Wheel Character HEX 80
ESC	b		Print Print Wheel Character HEX 81
ESC	c		Print Print Wheel Character HEX 82
ESC	d		Print Print Wheel Character HEX 83
ESC	C		Clear Top and Bottom Margins
ESC	CAN	A	High Hammer Energy Mode ON
ESC	CAN	B	High Hammer Energy Mode OFF
ESC	CR	P	Initiate Remote RESET
ESC	D		Perform Negative Half-Line Feed
ESC	ETB	A	Single Strike Ribbon Mode ON
ESC	ETB	B	Single Strike Ribbon Mode OFF
ESC	FF	(n)	Set Lines Per Page to (n) **
ESC	HT	(n)	Absolute HT to print column (n) **
ESC	L		Set Bottom Page Margin (at current position) ***
ESC	LF		Perform Negative Line Feed
ESC	P		Proportional Space ON (clear with CR) *
ESC	Q		Proportional Space OFF *
ESC	RS	(n)	Set VMI to (n-1) ****
ESC	S		Return HMI control to internal program
ESC	SO	DC2	Enable Print Wheel Conversion Table Download Mode (exit with DC4)
ESC	SO	M	Program Mode ON (clear with SI)
ESC	SUB	(one of the following)	Enter Remote Diagnostic Mode
ESC	SUB	I	Remote Initialization
ESC	SUB	R	Remote Error Reset
ESC	SUB	1	Remote Status 1 Request
ESC	SUB	SO	Remote RAM/ROM TEST
ESC	SUB	ENQ	Remote Test Mode
ESC	T		Set Top Page Margin (at current position) ***
ESC	U		Perform Half-Line Feed
ESC	US	(n)	Set HMI to (n-1) ****
ESC	VT	(n)	Absolute VT to print line (n) **
ESC	Y		Print Print Wheel Character HEX 20
ESC	Z		Print Print Wheel Character HEX 7F
ESC	/		Enable Auto Backward Printing
ESC	\		Disable Auto Backward Printing

(continued next page)

* = Model 620 automatically enters Proportional Space Printing Mode when a PS Print Wheel is installed. This command enables proportional space printing with a Non-PS print wheel.

** = See subsection 4.4, Table 4-2 for ASCII character values for setting Absolute Tabs and Lines Per Page.

*** = Left and Right MARGIN positions must be arrived at using SPACE or BACKSPACE commands FROM Carriage Home (RESET) position. Top and Bottom MARGIN postions must be arrived at using LINE FEED commands FROM the manually set Top Of Form position.

**** = See subsection 4.4, Table 4-1 for ASCII values in setting HMI and VMI.

3.4 COMMUNICATION PROTOCOLS

The print buffer in the Model 620 has a capacity of 512 bytes. The communications protocols prevent print buffer overflow when print data is being received faster than the printer can print.

3.4.1 DC1/DC3 Protocol (XON/XOFF)

This protocol is switch selectable opposite Printer Ready. With DC1/DC3 protocol selected, a DC3 control code character is transmitted by the Model 620 when the PAUSE switch is pressed or when printing is attempted under any of the following conditions:

1. Print buffer nearly full (within 64 bytes)
2. Printer in check (POWER light flashing)

Once a DC3 has been transmitted, the Model 620 will transmit a DC1 character when 1) the print buffer is nearly empty (within 64 bytes), or 2) when either the PAUSE or the printer check condition has been cleared by pressing the RESET switch.

3.4.2 ETX/ACK Protocol

The Model 620 will respond to the ETX/ACK protocol at all times. In this mode, the host system maintains the printer's print buffer. When it sends a string of print data, it includes an ETX control character at the end. When the ETX character is retrieved from the buffer by the printer logic, the Model 620 transmits an ACK character back to the host system to indicate it is ready to accept more data.

3.4.3 PRINTER READY PROTOCOL

This protocol is switch selectable opposite DC1/DC3. Printer Ready protocol uses a dedicated interface line (Data Terminal Ready - I/O Pin 20) instead of special control characters. When Printer Ready protocol is selected, the output on Pin 20 (now representing +PRINTER READY) goes LO when printing is attempted under any of the following conditions:

1. Print buffer becomes nearly full (within 64 bytes)
2. Printer in check (POWER light flashing)

The +PRINTER READY signal returns HI when 1) the print buffer becomes nearly empty (within 64 bytes), or 2) the Printer-in-Check condition has been cleared by pressing the RESET switch.

When the Control Panel DIP switch #5 is set for DC1/DC3, the Data Terminal Ready interface line (Pin 20) is held HI as long as correct power is applied to the unit.

3.5 OPERATOR CONTROL PANEL

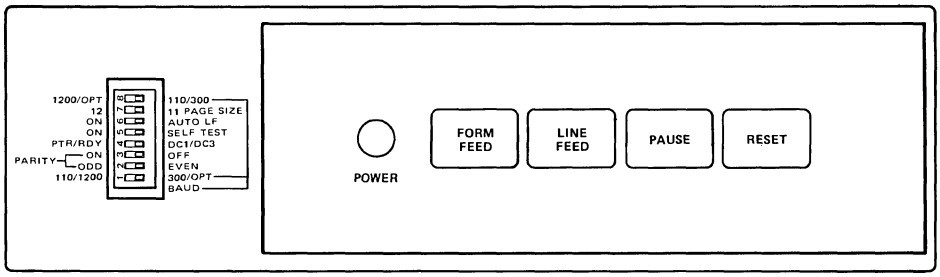


Figure 3-1 OPERATOR CONTROL PANEL

The layout of the Operator Control Panel is illustrated in Figure 3-1. The eight slide switches are used to select some of the basic and seldom changed operating parameters. The four command switches allow the operator to intervene in printer operation.

3.5.1 Slide Switches

These switches are located to the left of the Command switches and are under the front access cover when it is installed. Their purpose is for tailoring the Model 620 operating modes to more nearly suit the user's application. Once set they are ordinarily left alone unless the operating situation changes.

SWITCH #8 1200/OPT-110/300 - This switch is used in conjunction with Switch #1 to select either the baud rate at which the Model 620 will receive and transmit data, or an optional operating mode.

SWITCH #7 12-11 PAGE SIZE - This switch enables setting of page size, used in the Top Of Form/Form Feed functions, to either the US standard 11" or the European standard of approximately 12" page length.

SWITCH #6 ON-AUTO LF - When on, this switch enables the Model 620 to automatically advance the paper one line with each carriage return. This relieves the host system of the need to send a line feed command with each carriage return command.

SWITCH #5 ON-SELF TEST - Normally this switch will be used only by your Service Technician. If this switch is ON when the Model 620 is turned on, the unit will enter its self test mode and begin sequencing thru its self test program. The PAUSE and RESET Command Switches may be used to interrupt and restart the self test sequence. To exit the mode, the SELF TEST switch must be moved to OFF and the power to the Model 620 turned off momentarily.

SWITCH #4 PTR RDY-DC1/DC3 - In addition to the ETX/ACK communications protocol which is always enabled, this switch allows selection between Printer Ready and DC1/DC3 communications protocols.

SWITCH #3 PARITY ON/OFF - When on, this switch enables parity checking and parity information transmission.

SWITCH #2 PARITY ODD-EVEN - This switch is used in conjunction with PARITY ON-OFF to determine the nature of parity information handling. If Parity is OFF, this switch determines if the transmitted parity bit is always a space (odd) or a mark (even).

SWITCH #1 110/1200-300/OPT - With Switch #8 in the "110/300" position, this switch selects 110 or 300 Baud as the speed at which the Model 620 will receive or transmit data. With Switch #8 in the "1200/OPT" position, this switch selects either 1200 Baud as the operating speed or an optional operating mode.

3.5.2 Command Switches

These membrane type "touch" switches are always available to the operator for use in controlling printer operation.

FORM FEED - Pressing this switch causes the Model 620 to advance the paper or form to the next top-of-form position. A form feed code is not transmitted.

LINE FEED - Pressing this switch causes the Model 620 to advance the paper or form one line. Holding the pressure on the switch longer than about 1/2 second will cause the line feed operation to repeat. A line feed code is not transmitted.

PAUSE - Pressing this switch will cause the Model 620 to stop printing without loss of data, drives Printer Ready signal LO, and causes the DC3 signal to be transmitted. The POWER indicator will go out. Printing is resumed, and the POWER indicator will come back on, when the RESET switch is pressed.

RESET - This switch has three functions, depending on the Model 620's situation at the time it was pressed: a) It will clear an "error" indication and b) return the Model 620 to operation; or c) return the Model 620 to operation following a PAUSE command (Printer Ready signal HI, transmit DC1 signal).

3.5.3 The Power Indicator

The POWER indicator glows whenever power is turned on to the Model 620. The indicator will commence flashing on and off whenever any of the following conditions are present: a) A parity error was detected with PARITY switch on; b) The print buffer (memory) has overflowed; or c) The status signal "Data Set Ready" is false. The indicator goes out during a PAUSE activity.

3.6 PRINTING FORMAT

Printing format is dependent on three main factors; horizontal character spacing, vertical line spacing, and number of lines per page. Each of these factors can be independently controlled. Any point on a page can be defined in terms of a "horizontal position" and a "vertical position". The number of lines per page can easily be changed when necessary.

3.6.1 Definition of Terms

Figure 3-2 and the text following describe some of the points associated with a simple page layout.

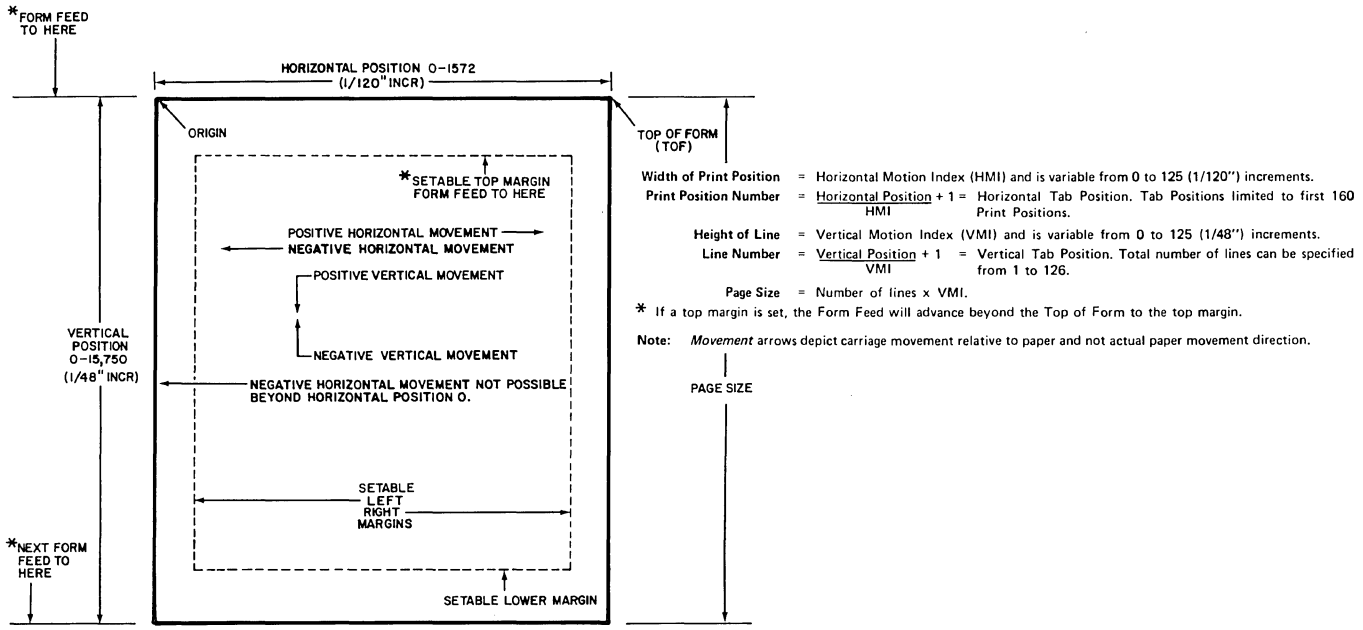


Figure 3-2 PAGE LAYOUT AND PRINTING FORMAT

ORIGIN: The position of the print head following a Form Feed (with no top margin set) and an Absolute Horizontal Tab to position 0. The first print position on the first line of a page.

HORIZONTAL MOTION INDEX (HMI): The distance that the carriage moves after printing a character (or when spacing). This distance is in multiples of 1/120 inch. Minimum HMI is 0, maximum is 125.

VERTICAL MOTION INDEX (VMI): The distance moved by the paper (platen) for each line feed, etc. This distance is in multiples of 1/48 inch. Minimum VMI is 0, maximum is 125. When VMI=0, no paper movement occurs.

HORIZONTAL POSITION: The horizontal distance (in 1/120 inch increments) between the print head and the origin. Minimum horizontal position = 0, maximum = 1572.

VERTICAL POSITION: The vertical distance (in 1/48 inch increments) between the current print line and the first line on the page (the origin). Minimum vertical position = 0, maximum = 15,750.

PRINT POSITION: The horizontal area capable of being occupied by a single printed character. This can be likened to a print "column" on a line printer, except that it is variable: The number of print positions per line is dependent upon the HMI. The minimum number of print positions per line is 13 (when HMI=125): the maximum number is 1573 (when HMI=1). The leftmost print position is position 1.

$$\text{Print Position No.} = \frac{\text{Horizontal Position}}{\text{HMI}} + 1$$

LINE: The vertical distance capable of being occupied by a row of printed characters. The height from one line to the next is equal to VMI. Line number may be calculated as follows:

$$\text{Line No.} = \frac{\text{Vertical Position}}{\text{VMI}} + 1$$

LINES PER PAGE: The actual number of print lines per page of paper. Lines per page can be set to any number from 1 thru 126.

3.6.2 Standard Printing Formats

The Model 620 can produce a printed output in any one of three standard formats (10, 12 and 15 pitch), and proportional space. These formats are summarized in Table 3-1.

TABLE 3-1
STANDARD & PS PRINTING FORMATS

PITCH	Horizontal Spacing			Vertical Spacing			
	Char/in	Char/Line (Max)	HMI	Lines/in	Lines/pg 11"	Lines/pg 12"	VMI
10	10	132	12	6	66	72	8
12	12	158	10	6	66	72	8
15	15	197	8	6	66	72	8
PS	-	-	12	6	66	72	8

The correct print format is established for the printer from information encoded on the printwheel installed. Proportional Space printing is discussed in the next subsection.

3.6.3 Proportional Space Printing

The Proportional Space mode is selected by the Model 620 when the proper encoding sequence is detected from information encoded on a PS printwheel. If the unit is in the Remote HMI mode, the PS data is ignored. When Proportional Space is enabled, HMI is set to 12 pitch.

The sequence ESC P may be used to initiate proportional space mode remotely, while ESC Q will cause the Model 620 to exit proportional space mode. Once either of these ESC sequences has been received, the Model 620 will ignore print wheel pitch data until the sequence ESC S is received. HMI may be changed at any time by executing ESC US (n).

Proportional space printing is accomplished by move, print, move. This differs from normal printing which is print before move. The size of the moves are equal to the sum of the PS values of two adjacent characters, plus offset. The size of space is 10/120". The size of backspace is determined by the last printed character (or space if that character was last).

Entering and exiting proportional space mode via the Escape sequences does not change HMI. Normal processing of all control codes and escape sequences continues in proportional space mode. NOTE: HMI is used only for tabbing and word space (space and backspace).

3.6.4 Optional Printing Formats

Any of the three format factors (character spacing, line spacing and lines per page) can be altered, along with hammer energy and ribbon advance, by utilizing special escape (ESC) sequences. The Remote Reset (ESC CR P) sequence cancels all optional format factors, and returns the unit to its own selected format.

Execution of any of these sequences does not immediately alter horizontal or vertical position. It does however change subsequent operations by redefining the variable format factors. It is recommended that a Form Feed and an Absolute Tab to location 0 be performed prior to changing any format factors.

3.6.4.1 Variable HMI

The standard HMI can be altered by executing the 3-character sequence ESC US (ASCII character), where the binary value of the ASCII character is one greater than the number of increments (1/120") the carriage will move after printing a character or when spacing. See subsection 4.4, Table 4-1 to determine the appropriate ASCII character to be used.

HMI = (ASCII character -1) x 1/120"

NUL and DEL characters cannot be used, so minimum HMI is 0, and maximum is 125 increments.

This places the terminal in the remote HMI mode. HMI is returned to the standard format by executing the 2-character sequence ESC S. This places the unit in the local HMI mode.

NOTE: Print Wheel designated PITCH is ignored in Remote HMI mode.

3.6.4.2 Variable VMI

The standard VMI can be altered by executing the 3-character sequence ESC RS (ASCII character), where the binary value of the ASCII character is one greater than the number of increments (1/48") the paper will move for each line feed, negative line feed, etc. Minimum VMI is 0, maximum is 125. See subsection 4.4, Table 4-1 to determine the appropriate ASCII character to be used.

VMI = (ASCII character -1) x 1/48"

3.6.4.3 Lines Per Page

The number of lines per page can be altered by executing the 3-character sequence ESC FF (ASCII character), where the binary value of the ASCII character is equal to the number of lines per page desired. Minimum number of lines per page is 1, maximum is 126. See subsection 4.4, Table 4-2 to determine the appropriate ASCII character to be used.

3.6.4.4 Hammer Energy/Ribbon Advance

Hammer Energy - The sequence ESC CAN A enables shifting hammer energy levels 1-3 to levels 2-4 when needed to compensate for lower than normal hammer energy due to below normal line voltage levels. Level 4 is unchanged. This mode is exited with the sequence ESC CAN B.

Ribbon Advance - The sequence ESC ETB A enables a ribbon advance mode to support the use of single strike ribbons. This mode is exited with the sequence ESC ETB B. Single strike ribbons are often used where a very dense printout is required, as with direct application to offset printing.

3.7 FORWARD/BACKWARD PRINTING

3.7.1 Auto Backward Printing

The Model 620 defaults to Auto Backward Printing Mode when initialized. Auto Backward Printing is disabled by the sequence ESC \, and reenabled by the sequence ESC /. Forced backward printing is enabled by the sequence ESC 6 which overrides Auto backward printing. When enabled, Auto Backward Printing will print a line of text in the reverse direction only when all the following requirements are met:

1. Printing is at least one line behind print-queued data.
2. The line in question contains less then 256 characters following the first printable character.
3. If the end of the line is the shortest distance for carriage motion.
4. No ESC sequences or control characters are embedded within the line of text.

When all of the above contitions are satisfied the Model 620 will automatically go into Auto Backward Printing mode.

3.7.2 Programmed Backward Printing

To take advantage of the Model 620's backward printing capability, the system utilizes both a Forward and a Backward Print Mode. The Backward Printing Mode is enabled in the Model 620 when the sequence ESC 6 is received, and disabled when the sequence ESC 5 or a CR is received. Disabling Backward Printing Mode re-establishes the Forward Print Mode.

During Forward Print, each character printed also causes incremental carriage movement to the right. (Note exception during GRAPHICS mode.) During backward print this motion is reversed, moving the carriage to the left. The action of the Space and Backspace codes are also reversed in Backward Print. Note, however, that tabbing operations, carriage return, and all paper movement functions are not affected by being in the Backward Print Mode.

3.8 MARGIN CONTROL

3.8.1 Horizontal Margins

Both the left and right margins can be adjusted by positioning the carriage to the desired print position, and then sending an ESC 9 (for left margin) or ESC 0 (for right margin). Altering the left margin causes the carriage to return to the new margin position following a carriage return (CR). The carriage can be moved to the left beyond the new left margin position by any of the following methods (new left margin must be at a position greater then 1):

1. Absolute Horizontal Tab
2. Backspacing
3. Spacing in Backward Print Mode

A power-on or Remote RESET operation will automatically clear the left margin to horizontal position 0 and the right margin to horizontal position 1572.

3.8.2 Vertical Margins

Both top and bottom page margins can be adjusted by positioning the print head on the desired line, and then sending an ESC T (for top margin) or ESC L (for bottom margin). The bottom margin must be set below the top margin, and both must be within the page size boundaries.

Whenever a bottom page margin is crossed with a line feed, auto line feed or half line feed, the paper will be automatically advanced to the top margin on the next page. The Form Feed command is not needed for this activity. The area between the bottom margin of one page and the top of form of the next page can be accessed using vertical tabs (absolute or normal), and thru negative line feeds.

3.9 TABBING

The Model 620 utilizes "Absolute Tabbing" only. The "Absolute Tab" is unique in that it does not require prior setting of tab stops, and allows automatic positioning of the carriage or paper to any of the first 126 positions horizontally or vertically.

This method of tabbing provides horizontal and vertical positioning to standard print positions or lines. This makes it possible, thru utilization of variable indexing, to print data out in any format desired, without prior editing. For example, data that was originally formatted for 10 characters per inch, 6 lines per inch, can be printed out at 15 characters per inch, 4 lines per inch (or any other format), and all tabular material will remain in the same relative position as when it was first formatted.

Absolute tabbing is initiated by an ESC HT (for horizontal) or ESC VT (for vertical) sequence. Since tabbing provides positioning only to normal print positions and lines, finer positioning requires the use of spacing and line feeding in GRAPHICS mode. All tabbing functions are unchanged in GRAPHICS. When returning to normal print mode or during graphics mode, when a tab is encountered the present position is assumed to be a column position. This will remain until a carriage return or subsequent graphics move occurs.

3.9.1 Absolute Horizontal Tab

Using Absolute Horizontal Tab, the carriage can be positioned directly to any of the first 126 print positions without the need for prior setting of tab stops. This is accomplished by executing the sequence ESC HT (ASCII character) where the binary value of the ASCII character selected indicates the print position desired. See subsection 4.4, Table 4-2 for the appropriate ASCII character to be used.

Note that this method of tabbing also makes possible tabbing to the left. For example, with the carriage positioned at print position 100, and ESC HT 1 sequence will move the carriage directly to print position 49, the binary value of the ASCII code for digit 1. The leftmost print position is considered to be binary location 1. Any ASCII character other than NUL and DEL can be used, making possible direct tabbing to any of the first 126 columns. The horizontal position at the completion of an Absolute Tab operation is computed as follows:

$$\text{Horizontal Position} = (\text{ASCII character} - 1) \times \text{HMI}$$

3.9.2 Absolute Vertical Tab

Using Absolute Vertical Tab, the form can be moved directly to any one of the either 66 or 76 lines per page from any other line. It is not possible to tab beyond the end of the page however, even though the maximum value is 126. Absolute Vertical Tab is initiated by executing the sequence ESC VT (ASCII character) where the binary value of the ASCII character selected determines the number of the line to be reached. The top line of the form is assigned the binary value of 1, and each successive line down the page is called out by the next higher binary value. The actual amount of paper (platen) movement is determined by (a) form position before VT execution, (b) the ASCII character used, and (c) the Vertical Motion Index (VMI). Ultimate position is determined by the formula:

$$\text{Vertical Position} = (\text{ASCII character} - 1) \times \text{VMI}.$$

See subsection 4.4, Table 4-2 for the appropriate ASCII character to be used.

3.10 LINE FEED

A Line Feed switch command from the control panel or a (LF) code received over the communications link will cause the paper or form to move up one line (one VMI). An ESC LF sequence commands a negative line feed, causing the paper or form to move down one line. See also subsection 3.13 GRAPHICS.

3.11 HALF LINE FEED

A Half-Line Feed command sequence ESC U causes the paper or form to move up 1/2 line (1/2 VMI). A Negative Half-Line Feed command sequence ESC D causes the paper or form to move down 1/2 line. These two commands are unchanged in GRAPHICS Mode. If VMI is set to some odd number, the total paper movement will be one increment (1/48") less than 1/2 line.

3.12 FORM FEED

A Form Feed switch command from the control panel or a (FF) code received over the communications link will cause the paper or form to move up either to the first line or the top margin of the next page if one has been set.

3.13 GRAPHICS

An ESC 3 sequence received over the communications link will put the Model 620 into GRAPHICS Mode. A carriage return (CR) or ESC 4 sequence will return the unit to its normal mode. While in the Graphics mode, carriage movement is completely divorced from printing: i.e. printing a character does not automatically move the carriage. The carriage can be moved only by executing a tab, space, carriage return, or backspace operation. The tab commands operate the same as they do in Normal mode. Space and Backspace commands, however, move the carriage only 1/60" regardless of the selected HMI.

Similarly, Line Feed and Negative Line Feed commands move the paper only 1/48" instead of the selected VMI. Vertical Tab, Form Feed, Half-Line and Negative Half-Line operations remain unchanged in Graphics Mode.

3.14 RESET/INTITIALIZATION

When power is applied, or when the remote reset command sequence ESC CR P is received and executed, the Model 620 defaults its parameters according to its configuration as follows:

Normal Print Mode (not Graphics)
Auto Backward Printing
Carriage to Print Position 0
Vertical Position cleared to 0 (paper does not move)
VMI set to 8 (6 lines per inch)
Lines per page set to 66 or 72 based on switch selection
Left margin set to position 0
Right margin set to position 1572
Top margin set to position 0 (line 1)
Bottom margin set to position 528 or 576 based on selected page size
Send and print buffers cleared

3.15 PROGRAM MODE

Program mode provides user control of spoke position, hammer energy, and ribbon advance, thus allowing the use of special print wheels without modification to the terminal. In

Program Mode, two characters are sent to the Model 620 for each character that is to be printed. The first of these characters selects the print wheel spoke, while the second character establishes the hammer energy and proportional space value that is to be used.

Spacing is controlled by HMI plus offset. If the Model 620 is in proportional space mode, spacing is controlled by the P.S. value (move 1/2 PS value, print, move 1/2 PS value) plus offset.

Program Mode is initiated by the sequence ESC SO M, and turned off by either receipt of the control character SI or cycling power off and on.

3.15.1 Spoke Position Data

The first character received is tested to determine if it is a control character or a spoke position character.

Spoke Position Character = Spoke Position + 32

If it is a control character, the normal processing of control characters will occur. If it is not a control character, it is assumed to be a spoke position character, and the next character will not be tested for control character status. Note that only 94 spoke position chartacters can be distinguished from control characters. Spokes 1, 2, 87, 95, 97 and 99 can be accessed by the ESC sequences shown in Figure 4-2.

3.15.2 Hammer Energy/Ribbon Advance Data

The second character in the sequence is the Hammer Energy/PS Value character. The proper ribbon advance is determined by the PS value. The second character contains 4 bits (0-3) for PS value and 3 bits (4-6) for hammer energy. This provides 16 different PS values and 5 different hammer energy levels (0-4). The hammer energy level definitions are as follows:

Level 0	=	Do not fire hammer	
Level 1	=	Lowest hammer energy	(see also subsection 3.6.4.4)
Level 2	=	Low hammer energy	
Level 3	=	High hammer energy	
Level 4	=	Highest hammer energy	

This feature allows the user to tailor print quality and ribbon economy as desired. The general criteria for selecting the amount of hammer energy and ribbon advance is to use the lowest hammer energy and the minimum ribbon advance that will produce a level of print quality suitable for the intended application. The use of excessive hammer energies will unnecessarily shorten the useful life of the affected print wheels.

The Print Wheel Data Book (Diablo Publication No. 90044-XX) provides users with specific information on each covered print wheel. This includes spoke addresses both by spoke and HEX code, recommended hammer energy and PS value.

3.16 PRINT WHEEL TABLE DOWN-LOAD FEATURE

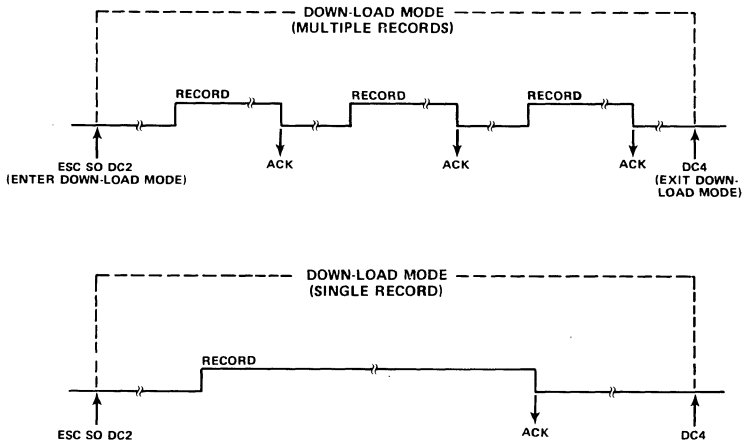
3.16.1 General

The Down-Load feature of the Model 620 provides a means by which the host system can write a temporary print wheel "lookup table" into the read-write (RAM) memory of the Model 620. This temporary table can be tailored by the host system to specifically support

any print wheel available for the Model 620 and not already supported by its resident firmware. It should include the following print wheel data for each of the 100 printable character positions:

- Hammer energy for the character
- Proportional space units for the character
- Spoke position of the character
- Ribbon advance units for the character
- Whether or not it is a printable spoke position on this print wheel

Each time one of the 100 potentially-printable ASCII characters is received over the interface in the normal printing mode, the Model 620's microprocessor refers to a particular location in the selected lookup table to obtain the proper print data for that character. The descriptions given here prescribe the format and protocol necessary for down-loading a print wheel table into the firmware to temporarily replace the imbedded print wheel tables. However, host system design to assemble the table and implement actual down-loading will vary with the system and with user preferences.

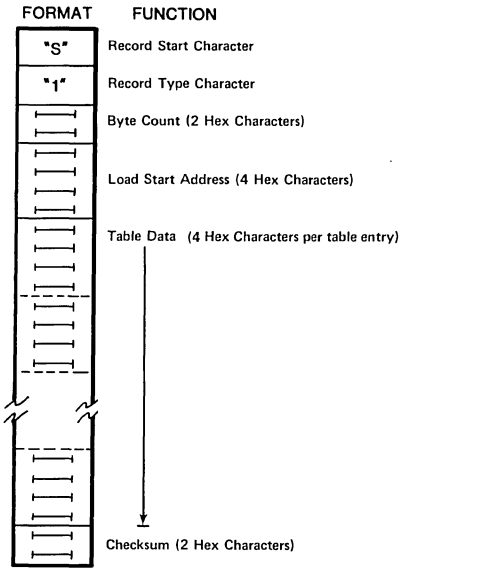


NOTE: The total amount of Table Data stored by either a Single-Record Down-Load or Multiple-Record Down-Load is 200 bytes (2 bytes for each of the 100 possible spoke positions).

Figure 3-3 DOWN-LOAD VARIATIONS

The diagrams in Figure 3-3 represent two variations of the down-load procedure: down-loading the table by a single record, and down-loading by multiple records. The required record format is described in the following subsection. Subject to user preference, the complete print wheel table can be down-loaded within a single record, or the table can be loaded in segments by a series of records. Smaller records are more easily debugged if errors in data format occur, but otherwise the multiple-record method has no significant advantage over single-record down-loading.

The down-load mode is entered with the sequence ESC SO DC2, and can be exited with the single control character DC4. Once the down-load procedure has been completed successfully, the down-loaded table is automatically selected for print wheel support. Reselection of one of the resident tables can be made by reentering down-load mode and sending an invalid record, or defaulted to by sending a remote RESET command or cycling power.



Notes:
1. ⊢⊣ = One Hex Character
2. The "Hex" characters designated in this diagram are ASCII characters, from the host, representing Hexadecimal values.

Figure 3-4 DOWN-LOAD RECORD FORMAT

3.16.2 Down-Load Data Record Format

The table is down-loaded using a hexadecimal blocked record structure as depicted in Figure 3-4. This format is similar to other common down-load structures. A "record" consists of a record start character, a record type character, a byte count, a load address, the table data, and a checksum. Each of these elements is described in detail and demonstrated by the printout of an actual down-load structure.

If no error in data format is detected while receiving the record, the Model 620 will transmit an ACK character immediately following receipt of the end of the record. An error in data format is detected if the unit receives any character other than the hex characters 0 thru 9 and A thru F, or if the checksum does not compare correctly against the data received. If an error in data format is detected, the Model 620 immediately transmits a NAK character, exits down-load mode, and defaults table selection to resident print wheel tables. Note that the "hex characters" referred to throughout this description are represented by standard 7-bit ASCII characters 0-9 and A-F from the host system. These characters are translated internally by the Model 620 into standard 4-bit hexadecimal characters.

3.16.2.1 Record Start Character

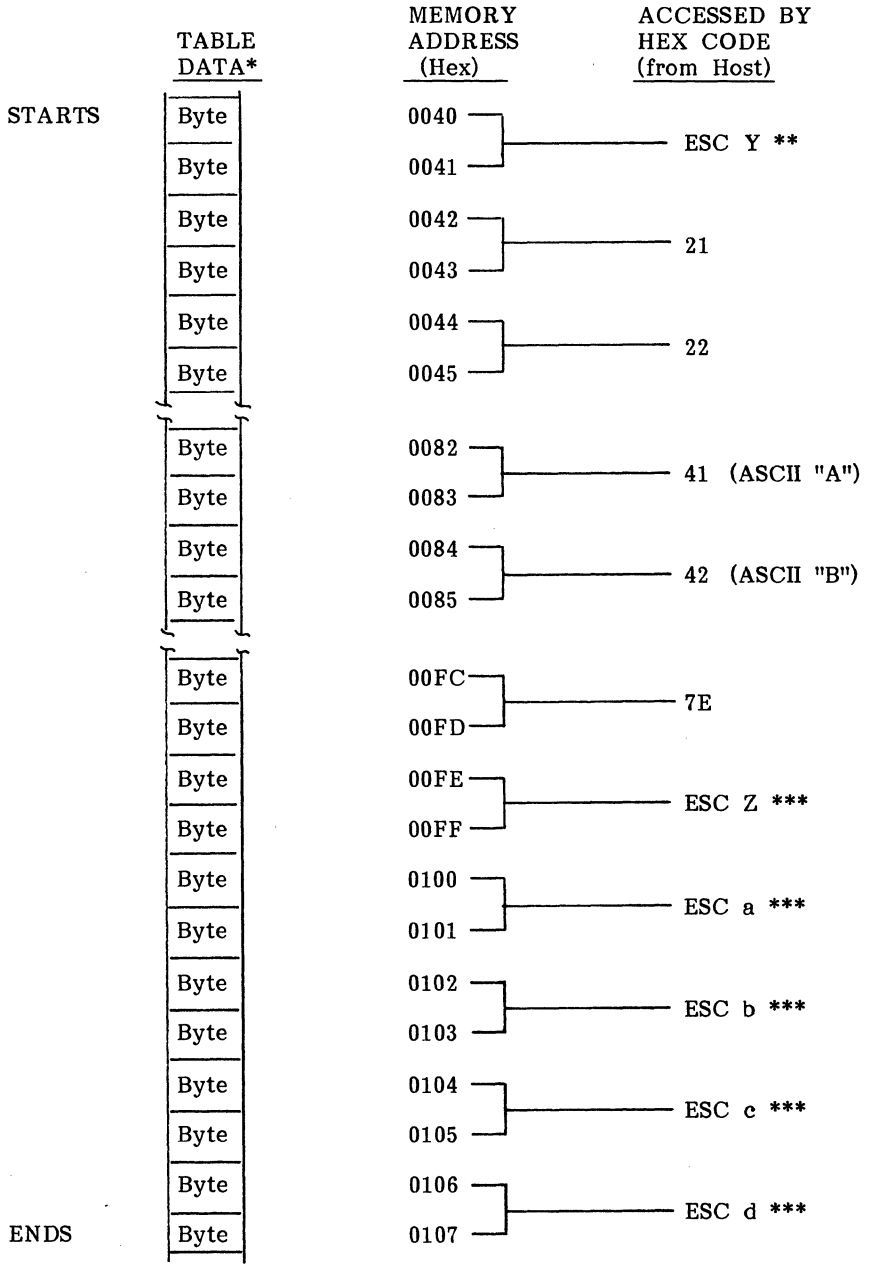
The record start character is an ASCII "S". Any data encountered before the "S" will be ignored. This allows carriage returns and line feeds, or other characters, to be embedded before, after or between data records. These embedded characters will not affect the down-load process, but do allow appropriate formatting of the printout if a hard-copy reference of the down-load records is outputted thru the printer (see subsection 3.16.4).

3.16.2.2 Record Type Character

The record type character must be an ASCII "1". In other similar down-load structures, the record type character may also be a "0" ("header record") or a "9" ("end-of-file record"). In the Model 620, a record identified as type 0 or 9 will simply be ignored. Any character other than a 0, 1 or 9 is detected as a down-load error which causes the unit to transmit a NAK character and exit the down-load mode. Print Wheel Table selection then defaults to the resident tables.

3.16.2.3 Byte Count

The byte count consists of two hex characters that specify the number of data bytes to follow, including the address and checksum. Because the byte count is based on a system of two 4-bit hex characters per byte, the record will contain twice as many hex characters as the number specified by the byte count.



NOTES:

* Each table entry is stored in memory as four 4-bit hex characters, comprising two 8-bit bytes as depicted above.

** Table data for character under ASCII hex code 20 is accessed by ESC Y over the interface during normal print mode.

*** Table data for characters under ASCII hex codes 7F, 80, 81, 82 and 83 are accessed by ESC Z, ESC a, ESC b, ESC c and ESC d respectively over the interface during normal print mode.

Figure 3-5 DOWN-LOAD TABLE MEMORY MAP

3.16.2.4 Load Address

The load address consists of four hex characters (two bytes) that specify the starting location in memory where the table data in this record is to be loaded. The most significant address byte (the two most significant hex characters) must be sent first. The diagram in Figure 3-5 defines the print wheel table memory layout.

The block of memory addresses allocated for the print wheel table extends from 0040 hex thru 0107 hex. If a Load Address outside this range is specified, it is interpreted as an error in data format and causes the Model 620 to abort the Down-Load mode. The data in each table entry occupies two byte locations of storage, and the data is loaded in ascending order of hex value of the corresponding ASCII characters.

The load address specified in the record must be equal to two times the hex value of the first ASCII character whose print data will be loaded in the table by this record. For example, if this is the second record of a multiple-record down-load and the first table entry to be loaded by this record is for the ASCII character "B" (hex 42), the Load Address for this record is 084 (hex). The two bytes of table data associated with printing the "B" will actually occupy locations 0084 and 0085, followed by the two bytes of data associated with the ASCII character "C" (hex 43) in memory locations 0086 and 0087, and so on for all subsequent characters in ASCII hex order. The Load Address for a single-record down-load, and for the first record of a multiple-record down-load, is always 0040 hex; corresponding to two times the lowest hex code (20) that represents a printable character in the Model 620. Note that the table data in some locations is the data accessed by ESC codes conforming to ISO standards.

3.16.2.5 Table Data

Each print wheel table entry requires two bytes of data (four hex characters). The four hex characters comprising these two bytes are recognized in the following order:

First hex character	-	represents	-	First byte, high 4 bits
Second hex character		-		First byte, low 4 bits
Third hex character		-		Second byte, high 4 bits
Fourth hex character		-		Second byte, low 4 bits

The format of the two bytes is defined below.

	BIT							
	7	6	5	4	3	2	1	0
1st Byte -	P	H	H	H	ps	ps	ps	ps
2nd Byte -	R	S	S	S	S	S	S	S

Where:
- P = 1 if this is a printable position on this print wheel; 0* if this is a nonprinting position
- H = hammer energy 1 to 4 (0 = no hammer fire)
- ps = proportional space value 0 to 15
- R = 0 at all times (no ribbon lift action required)
- S = absolute electrical spoke position 0 thru 99 (Spokes 1 to 100). (Electrical spoke positions greater than 99 will select spoke 0 and inhibit hammer fire.)

* = CAUTION: Failure to assign nonprinting status (P=0) when needed may result in print wheel damage by allowing the hammer to fire against the print wheel flag.

Diablo publishes a Print Wheel Data Book (Publication No. 90445-XX) which contains the print wheel data that must be inserted by the host system when assembling a down-load print wheel table.

All of the 100 locations in the table must be loaded. For any nonprinting print wheel positions, the "P" bit shown in the table data format (the highest bit in the first byte) must be a "0". The states of all other bits associated with that position are then irrelevant except for the "ps" bits (low 4 bits of the first byte). If this nonprinting position should ever be addressed in normal printing mode, the Model 620 will default to a space mode in which the value specified by the "ps" bits for this character determines the amount of carriage movement that occurs.

Any down-loaded table that will be used in a telecommunications environment must conform to the internationally accepted ASCII/ISO conventions regarding the specific hex code assigned to each ASCII character (see Figure 4-1).

3.16.2.6 Checksum

The checksum consists of one data byte (two hex characters) produced by the host system. It is the negation (i.e. the "2's" complement) of the modulo 256 sum of all data bytes, starting with the byte count. When all of the data bytes starting with the byte count are added together as received by the unit, and the checksum is then added, the result should be zero. No end-around carry is used when the check is calculated.

If the check calculation results in a nonzero sum, it is detected as an error in data format, a NAK is transmitted by the Model 620, and the down-load mode is aborted. In this situation, print wheel selection defaults to the embedded tables.

3.16.3 Down-Load Procedure

Described below is the general sequence of events that comprises a proper down-load procedure. The diagrams in Figure 3-3 will aid the reader in understanding the procedure described here.

1. At power-up, remote reset (ESC CR P), or initialize (ESC SUB 1), the down-load table memory locations are initialized to all zeros, and one of the resident default print wheel tables is used, as selected by information encoded on the print wheel installed.

2. The host sends the sequence ESC SO DC2 to put the Model 620 into the down-load mode.

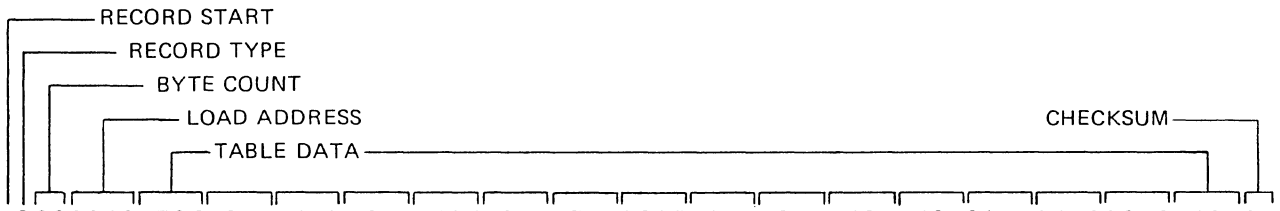
3. The host sends the properly formatted record(s) containing the table data. If this is being done as a single-record down-load, the entire table will be loaded by one record. If it is being done as a multiple-record down-load, subsequent records must be sent to load the remaining portions of the table data.

   - After each correctly-received record, the Model 620 sends an ACK character back to the host, and then awaits the "S" character at the start of the next record, or the DC4 character that terminates the down-load mode. Any other characters received during this waiting period are simply ignored by the Model 620.

   - Any error in data format detected while a record is being received, or as a result of the checksum calculation, will cause the Model 620 to transmit a NAK character and immediately abort the down-load mode.

4. After the ACK from the last record has been received, the host sends a DC4 character to take the Model 620 out of the down-load mode. The Model 620 will now use the down-loaded print wheel data for all ASCII-to-spoke translation

3.16.4 Sample Down-Load Structure

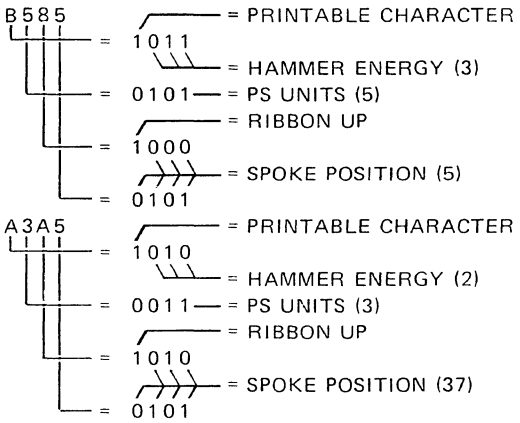



```
S1230040B585A3A5A4A1C6DCC587C8CFC7CD9297A3CCA3CAB58FA58B93CE94A393D0A49F05
S1230060C5D6A5D2B5D3B5D4B5D5B5D7B5D8B5D9C5DAB5DBA39DA39BC6D1A589C6C9A591F1
S1230080C8CBC792C688B7A4C7A0C690C696C7A8C79AB399B595C7AEB694C8A6C798C79E57
S11E00A0C68AC7B4C79CC58EB693C7A2C68CC8AAC7B2C7ACB686058005800513
S12300BB800580958D93A9B5BBB5C4B5BEB5BCB5BAB4ADC5C1B5BDA3AFB3B1B5C5A3ABC8E3
S12300DBB0B5B9B5B8C5C3C5C8A4B7B4B3B4B5B5BFB5C0B7B6B5C6B5C2B5C793A7058005AE
S10800FB800580058072
```

FIRST RECORD:

S = Record Start
1 = Record Type
23 = Byte Count = $23_{16} = 35_{10}$
0040 = Load Address (Hex)

TABLE DATA: (First two entries)



05 = CHECKSUM

Figure 3-6 SAMPLE DOWN-LOAD STRUCTURE

Figure 3-6 shows a printout of the group of records comprising an actual print wheel down-load structure. Following the printout, each element of the first record is separated and defined. As stated earlier, this printout serves only as a hard-copy reference of the assembled down-load elements - it does not actually occur as part of the down-load process.

In the example shown, seven separate records are used to down-load the table data for a particular print wheel. The number and length of the records in this example have no general significance; it is simply the way the down-load was structured by this particular host system.

3.17 SELF TEST/REMOTE DIAGNOSTIC FEATURES

The Model 620 provides several features to enable the operator and service personnel to analyze apparent malfunctions quickly and accurately. The two major features are:

1. Internal Self Test
2. Remote Diagnostics

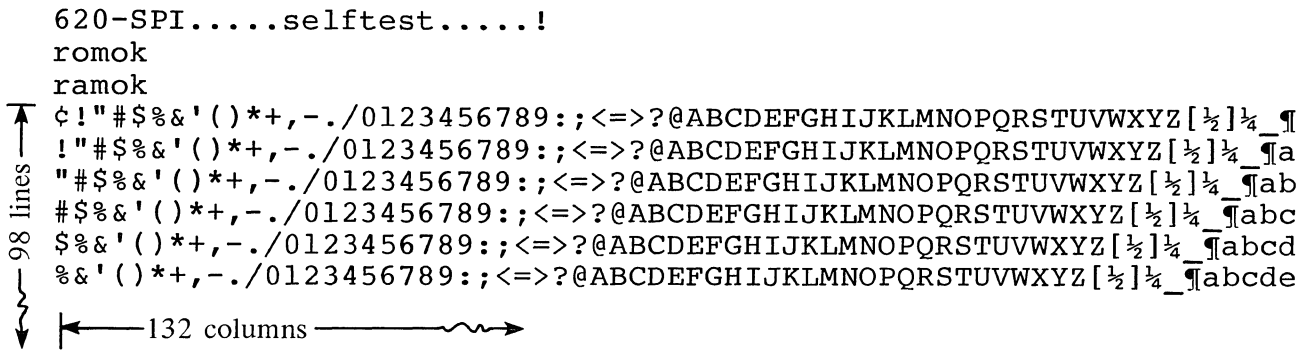


Figure 3-7 SAMPLE SELF TEST PRINTOUT

3.17.1 Self Test Feature

The Model 620 Self Test feature provides an automatic indication of proper operation. The self test is invoked by selecting the self test function on the switch block to the left of the Operator Control Panel under the top access cover. When this feature is selected, the Model 620 will automatically execute the Self Test routine, testing ROM, RAM, and the printing capability. The elements of the Self Test are shown in Figure 3-7 and explained below. Self Test may be interrupted and restarted using the Control Panel PAUSE and RESET switches, and will continue until power is turned off.

1. Sign-On
   The first part of the test prints the sign on message: "Model 620-SPI . . Self Test" indicating basic printer function.

2. ROM Test
   A CRC-16 algorithm is used to ensure correct ROM data. The calculation is a bit serial polynomial division starting with the most significant bit of the last byte. Completed data is used to enable blank ROM locations to be ignored. The result is zero if the ROM is coded correctly. Status of the ROM condition is printed - either "romok" or "rombad". A ROMBAD condition prevents execution of the Swirl Test.

3. RAM Test
   RAM is tested non-destructively. Each individual bit is set and cleared to ensure the rear/write capability. Status of the RAM condition is printed - either "ramok" or "rambad". A RAMBAD condition ends the Self Test.

4. Swirl Test
The Model 620 begins to print out 98 lines of an incremented pattern of the full ASCII character set on the print wheel, called Swirl Text. This gives a visable indication of printing capability.

3.17.2 Remote Diagnostic Feature

The Model 620 Remote diagnostic feature allows execution of certain diagnostic routines remotely from a host system. Diagnostic routines are activated using a three character ESC sequence. The diagnostic function commands are as follows:

Sequence	Result
ESC SUB I	Remote Initialize
ESC SUB R	Remote Error Reset
ESC SUB 1	Status 1 Request
ESC SUB SO	Ram/Rom Test
ESC SUB ENQ	Enter Test Mode

3.17.2.1 ESC SUB I - Remote Initialize

This command will cause the Model 620 to unconditionally execute an initialize sequence regardless of any error conditions that may exist within the printer. Unlike the corresponding sequence ESC CR P, this command is executed immediately when received over the interface. The Model 620 will default to the same conditions specified by ESC CR P. This command should be preceded by a non-printing character to cause the Model 620 to abort any multiple character sequence in progress. Once this command has been sent sufficient time must be allowed for all reset motion to cease before sending any more commands.

3.17.2.2 ESC SUB R - Remote Error Reset

This command causes the Model 620 to reset any error conditions. If the printer is in check it will execute a restore. Due to internal program latency, the minimum time necessary to reset all errors is 250 msec. This command is essentially the same as pressing the RESET switch on the control panel.

3.17.2.3 ESC SUB 1 - Status 1 Request

This command causes the Model 620 to transmit Status Word 1 over the interface. The bit definitions for this word are as follows:

0 - unassigned = LO
1 - 10 Pitch = HI, other = LO
2 - unassigned = LO
3 - unassigned = LO
4 - unassigned = LO
5 - Printer Idle = HI (print buffer empty and all printer motion complete)
6 - unassigned = LO
7 - UART Parity bit (not detected in remote diagnostics)

3.17.2.4 ESC SUB SO - RAM/ROM Test

This command causes the Model 620 to execute a self test sequence. The test executed consists of the RAM test and the ROM CRC test portions only of the basic self test

routine. No indication of test pass or fail is printed out. At the end of the test a status byte is transmitted to the host system. Note that this command should not be sent while the Model 620 is busy. The bit definitions are as follows:

0 - 8041 RAM Bad = HI
1 - 8041 ROM Bad = HI
2 - 6803 RAM Bad = HI
3 - 6803 ROM Bad, upper half 4K = HI
4 - 6803 ROM Bad, lower half 4K = HI
5 - unassigned = LO
6 - unassigned = LO
7 - UART Parity bit (not detected in remote diagnostics)

3.17.2.5 ESC SUB ENQ - Enter Test Mode

This command causes the Model 620 to enter test mode. Upon receipt of this command the printing motion will stop when individual data bytes clear the print buffer. An SO character is then sent indicating start of test mode, where individual data bytes define the following:

@, data byte	6803 RAM data will be read after receipt of the second byte. This second byte defines the data address within the RAM, according to its ASCII code. The Model 620 then transmits two data bytes: 1) STX; and 2) data byte representing the contents of the RAM location addressed (location 22_{16} contains the information read from the print wheel itself. See the table below.)
A	Perform RAM/ROM check exactly as above with the sequence ESC SUB SO.
B	Print 1 line of swirl text, 132 characters. An ACK character will be transmitted following the printing of the 132nd character.
C	Print swirl text continuously.
D	Stop printing swirl text immediatly. Printing is stopped and the line will be terminated with CR and LF. An ACK character will be transmitted.
DEL	Exit test mode, re-initialize printer with same effect as power-on reset. (allow sufficient time for all restore motion to cease)

Data Byte 22(HEX) - Bit Significance

0	1	2	
0	0	0	= (not used)
0	0	1	= P.S.
0	1	0	= (not used)
0	1	1	= (not used)
1	0	0	= 15-Pitch
1	0	1	= 12-Pitch
1	1	0	= (not used)
1	1	1	= 10-Pitch

3	
0	= Rib Adv = Car Adv
1	= Rib Adv = Car Adv +1 Car step

4	5	6	7	
0	0	0	0	= U.S./U.K. English
0	0	0	1	= Ger.,Swiss,French
0	0	1	0	= Swedish-Finnish
0	0	1	1	= French-Italian
0	1	0	0	= Dutch
0	1	0	1	= Norwegian-Danish
0	1	1	0	= Spanish
0	1	1	1	= Portuguese
1	0	0	0	= South African
1	0	0	1	= Multi-National
1	0	1	0	= French Canadian

SECTION 4

OPERATING REFERENCES

4.1 GENERAL INFORMATION

This Section contains the charts and tables which support Section 3 OPERATING CONSIDERATIONS. Note that these charts and tables are general in nature and do not necessarily reflect the character set on the print wheel in use. Cross reference information is to be found in the Diablo Print Wheel Data Book, Publication No. 90044-XX.

4.2 ASCII CODING SYSTEM

The ASCII Coding System is based on the Americal National Standard Code for Information Interchange, Standard No. X3.4-1977 of the Americal National Standards Institute, Inc.

Bits 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
b_4 b_3 b_2 b_1	COLUMN→ / ↓ROW	0	1	2	3	4	5	6	7
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 (A)	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11 (B)	VT	ESC	+	;	K	[	k	{
1 1 0 0	12 (C)	FF	FS	,	<	L	\	l	|
1 1 0 1	13 (D)	CR	GS	-	=	M	]	m	}
1 1 1 0	14 (E)	SO	RS	.	>	N	^	n	~
1 1 1 1	15 (F)	SI	US	/	?	O	_	o	DEL

Figure 4-1 STANDARD ASCII CODE CHART

4.3 PRINT WHEEL CODE CHART (Typical)

Model 620 firmware features embedded print wheel look-up tables for the 98-character print wheels currently available. New print wheel releases and/or custom designs of up to 100 printable characters can be accommodated using the down-load feature. The chart in Figure 4-2 provides a general sample of data for the U.S. English print wheel supported by Model 620 firmware. Note that the print character codes HEX 20, 7F, 80, 81, 82 and 83 are non-printing in Model 620. The print characters depicted for these codes may be addressed using the sequences ESC Y, ESC Z, ESC a, ESC b, ESC c and ESC d respectively to provide a complete set of 100 codes for print wheel addressing in the down-load mode.

Spoke	HEX	Char.	Spoke	HEX	Char.	Spoke	HEX	Char.
1	ESC c	undef.*	34	2B	+	67	4D	M
2	ESC d	undef.*	35	55	U	68	22	"
3	5F	_	36	3D	=	69	58	X
4	7A	z	37	43	C	70	28	(
5	71	q	38	2D	-	71	5A	Z
6	6A	j	39	47	G	72	31	1
7	78	x	40	53	S	73	26	&
8	6B	k	41	52	R	74	39	9
9	76	v	42	2F	/	75	38	8
10	62	b	43	4F	O	76	37	7
11	70	p	44	3A	:	77	36	6
12	6C	l	45	48	H	78	35	5
13	6D	m	46	24	$	79	30	0
14	66	f	47	54	T	80	34	4
15	64	d	48	25	%	81	33	3
16	69	i	49	4A	J	82	32	2
17	6E	n	50	45	E	83	7B	±
18	61	a	51	56	V	84	40	@
19	65	e	52	41	A	85	7D	²
20	74	t	53	50	P	86	60	¶
21	68	h	54	27	'	87	ESC Z	³
22	6F	o	55	4E	N	88	5E	¼
23	72	r	56	49	I	89	5B	[
24	73	s	57	44	D	90	3E	>
25	67	g	58	3F	?	91	5C	½
26	63	c	59	46	F	92	3C	<
27	75	u	60	2A	*	93	23	#
28	79	y	61	4B	K	94	5D	]
29	77	w	62	21	!	95	ESC a	®
30	2E	.	63	51	Q	96	7E	°
31	57	W	64	4C	L	97	ESC Y	¢
32	2C	,	65	42	B	98	7C	§
33	59	Y	66	29	)	99	ESC b	µ
						100	3B	;

* = Flag positions on 98-Character print wheel

Figure 4-2 100-CHARACTER PRINT WHEEL - COMPOSITE

4.4 DECIMAL VALUE TABLES

TABLE 4-1
ASCII VALUES FOR ESC SEQUENCES
Set HMI and VMI

HMI/VMI	ASCII Character
0	CTRL A (SOH)
1	CTRL B (STX)
2	CTRL C (ETX)
3	CTRL D (EOT)
4	CTRL E (ENQ)
5	CTRL F (ACK)
6	CTRL G (BEL)
7	CTRL H BACKSPACE
8	CTRL I TAB
9	CTRL J LINEFEED
10	CTRL K (VT)
11	CTRL L (FF)
12	CTRL M RETURN
13	CTRL N (SO)
14	CTRL O (SI)
15	CTRL P (DLE)
16	CTRL Q (DC1)
17	CTRL R (DC2)
18	CTRL S (DC3)
19	CTRL T (DC4)
20	CTRL U (NAK)
21	CTRL V (SYN)
22	CTRL W (ETB)
23	CTRL X (CAN)
24	CTRL Y (EM)
25	CTRL Z (SUB)

HMI/VMI	ASCII Character
26	CTRL [ESC
27	CTRL \ (FS)
*28	CTRL] (GS)
**29	CTRL ^ (RS)
30	CTRL – (US)
31	SPACE
32	!
33	"
34	#
35	$
36	%
37	&
38	'
39	(
40	)
41	*
42	+
43	,
44	-
45	.
46	/
47	0
48	1
49	2
50	3

HMI/VMI	ASCII Character
51	4
52	5
53	6
54	7
55	8
56	9
57	:
58	;
59	<
60	=
61	>
62	?
63	@
64	A
65	B
66	C
67	D
68	E
69	F
70	G
71	H
72	I
73	J
74	K
75	L

HMI/VMI	ASCII Character
76	M
77	N
78	O
79	P
80	Q
81	R
82	S
83	T
84	U
85	V
86	W
87	X
88	Y
89	Z
90	[
91	\
92	]
93	^
94	_
95	`
96	a
97	b
98	c
99	d
100	e

HMI/VMI	ASCII Character
101	f
102	g
103	h
104	i
105	j
106	k
107	l
108	m
109	n
110	o
111	p
112	q
113	r
114	s
115	t
116	u
117	v
118	w
119	x
120	y
121	z
122	{
123	|
124	}
125	~

*Diablo Typewriter Paired keyboard uses ` (accent grave)
**Diablo Typewriter Paired keyboard uses = (equals symbol)

TABLE 4-2
ASCII VALUES FOR ESC SEQUENCES
Set Absolute Tab (H & V) and Lines/Page

Lines or Position	ASCII Character	Lines or Position	ASCII Character	Lines or Position	ASCII Character	Lines or Position	ASCII Character	Lines or Position	ASCII Character
	CTRL A		CTRL Z						
1	(SOH)	26	(SUB)	51	3	76	L	101	e
	CTRL B		CTRL [						
2	(STX)	27	ESC	52	4	77	M	102	f
	CTRL C		CTRL \						
3	(ETX)	28	(FS)	53	5	78	N	103	g
	CTRL D		CTRL]						
4	(EOT)	*29	(GS)	54	6	79	O	104	h
	CTRL E		CTRL ^						
5	(ENQ)	**30	(RS)	55	7	80	P	105	i
	CTRL F		CTRL –						
6	(ACK)	31	(US)	56	8	81	Q	106	j
	CTRL G								
7	(BEL)	32	SPACE	57	9	82	R	107	k
	CTRL H								
8	BACKSPACE	33	!	58	:	83	S	108	l
	CTRL I								
9	TAB	34	"	59	;	84	T	109	m
	CTRL J								
10	LINEFEED	35	#	60	<	85	U	110	n
	CTRL K								
11	(VT)	36	$	61	=	86	V	111	o
	CTRL L								
12	(FF)	37	%	62	>	87	W	112	p
	CTRL M								
13	RETURN	38	&	63	?	88	X	113	q
	CTRL N								
14	(SO)	39	'	64	@	89	Y	114	r
	CTRL O								
15	(SI)	40	(	65	A	90	Z	115	s
	CTRL P								
16	(DLE)	41	)	66	B	91	[	116	t
	CTRL Q								
17	(DC1)	42	*	67	C	92	\	117	u
	CTRL R								
18	(DC2)	43	+	68	D	93	]	118	v
	CTRL S								
19	(DC3)	44	,	69	E	94	^	119	w
	CTRL T								
20	(DC4)	45	-	70	F	95	_	120	x
	CTRL U								
21	(NAK)	46	.	71	G	96	`	121	y
	CTRL V								
22	(SYN)	47	/	72	H	97	a	122	z
	CTRL W								
23	(ETB)	48	0	73	I	98	b	123	{
	CTRL X								
24	(CAN)	49	1	74	J	99	c	124	¦
	CTRL Y								
25	(EM)	50	2	75	K	100	d	125	}
								126	~

*Diablo Typewriter Paired keyboard uses ` (accent grave)
**Diablo Typewriter Paired keyboard uses = (equals symbol)

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