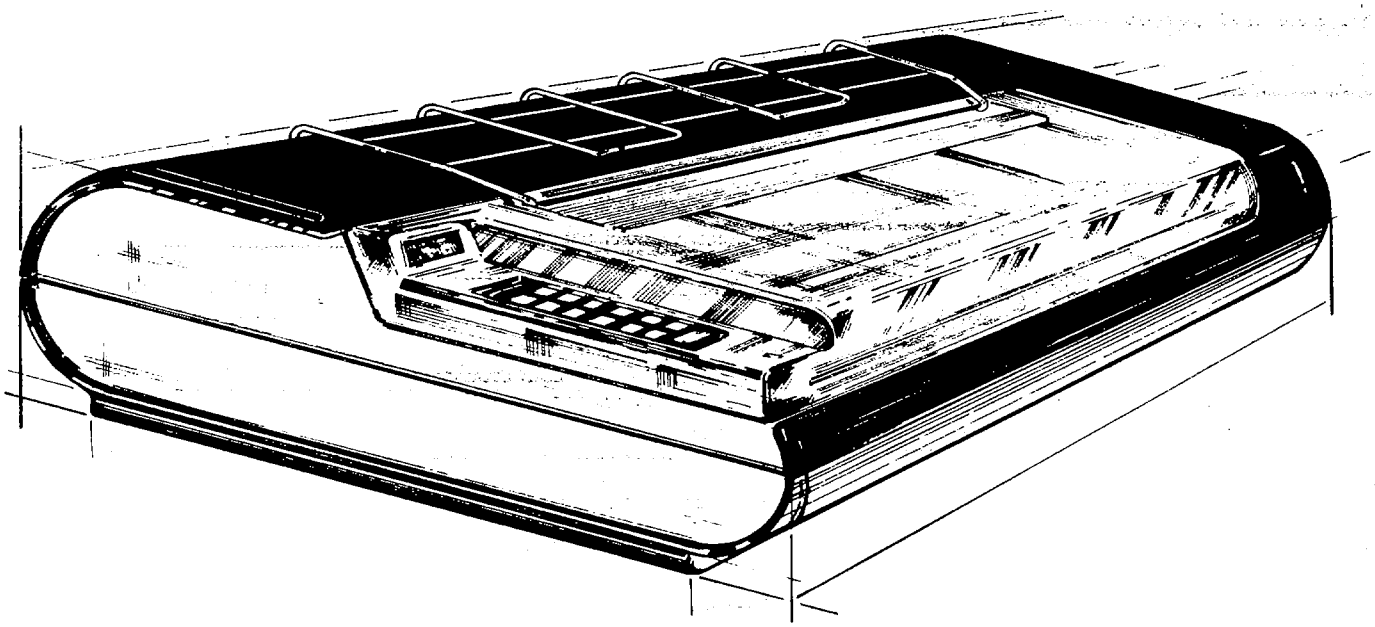
DOT MATRIX PRINTER MODELS
USER'S MANUAL



DataGeneral

Ordering No. 014-000732

TECHNICAL SPECIFICATIONS

GENERAL:

Style:	Tabletop design with parallel or serial interface and optional pedestal
Print Rate:	180 cps at 136 columns per line, single line feed (79.4 lines per minute), conditionally bidirectional, fast carriage turnaround (25 ms), high-speed space skip
Print Outputs:	All software selectable
Print Method:	Serial 9-wire, impact through ribbon
Character Style:	7x9-dot matrix
Character Size:	Height: 2.67 mm (0.105 in.) Width: 1.93 mm (0.076 in.) normal width characters
Character Sets:	U.S., U.K., Danish, French, German, Spanish, Swedish, Swiss, Kana/ASCII, Kana/Japanese, Multilingual; has 120 downloaded characters possible
Paper Forms:	Pin-feed, fan-fold, 1- to 6-part carbon or carbonless forms, maximum pack thickness of 0.64 mm (0.025 in.)
Forms Length:	41.91 cm (16.5 in.) maximum for input, output, and stacking considerations (99 lines at 6 lines per inch)
Forms Width:	10.2 to 38.1 cm (4 to 15 in.)
Forms Weight:	See details in Table 1-2
Hole Size:	4.0 mm (0.156 in.) nominal
Hole Spacing:	12.7-mm (0.500-in.) centers, 6.35-mm (0.25-in.) center to edge
Forms Crimps:	Tab type only
Forms Adjustment:	Electrical
Carriage Slew Speed:	88.9 cm/sec (35 in./sec) minimum
Paper Slew Speed:	25.4 cm/sec (10 in./sec) minimum
Column Capacity:	136-character columns at 10 cpi, 226-character columns at 16.7 cpi
Vertical Pitch:	6 lpi (0.167 +/- .01 in.) 8 lpi (0.125 +/- .01 in.)
Ribbon:	Fabric, Mobius loop
Carriage Drive:	DC servo motor with steel cable

MECHANICAL:

Height:	19.67 cm (7.7 in.)
Width:	70.3 cm (27.7 in.)
Depth:	46.2 cm (18.2 in.)
Weight:	22.7 kg (50 lb)

ELECTRICAL:

Controls/Indicators:	All front panel except power and configuration switches, and serial interface status indicators
Parallel Interface:	Compatible with 7- and 8-bit line printer interfaces which include STROBE, DEMAND, and READY signals
Serial Interface:	Plug-compatible with either 20-mA current loop; EIA RS-232-C or EIA RS-422-A interfaces; includes modem interface
Baud Rates:	50 to 19,200 baud, except 19,200 baud not possible with current loop operation, or EIA operation with hardware busy
Parity Type:	Even, odd, mark, none
Data Bits:	7 or 8
Graphics Mode:	67x69, 133x69, 67x137, 133x137 dpi
Voltage:	90 to 110 (nominal 100) Vac, 50/60 Hz 102 to 132 (nominal 120) Vac, 60 Hz 187 to 242 (nominal 220) Vac, 50 Hz 204 to 264 (nominal 240) Vac, 50 Hz
Phase:	Single
Input Current:	2.4 A, 100 Vac, 50 Hz 2.0 A, 120 Vac, 60 Hz 1.4 A, 220 Vac, 50 Hz 1.0 A, 240 Vac, 50 Hz
Power Cable:	2.3 m (7.5 ft)
External I/O Cables:	Parallel Interface: 9.1 m (30 ft) max Serial Interface: 20-mA current loop, 91 m (300 ft), 9600 baud 183 m (600 ft), 4800 baud 366 m (1200 ft), 2400 baud or less EIA RS-232-C, 15.2 m (50 ft) max, 19,200 baud or less EIA RS-422-A, 1500 m (4920 ft), 19,200 baud or less

ENVIRONMENTAL:

Temperature:	Operating:	10° to 38°C (50° to 100° F)
	Storage:	−10° to 50° C (14° to 122° F)
	Transit:	−40° to 65° C (−40° to 158° F)
Relative Humidity:	Operating:	20 to 80%
	Storage:	10 to 90%
	Transit:	5 to 95%
Altitude:	Operating:	−305 to 2438 m (−1000 to 8000 ft)
	Storage:	−305 to 7620 m (−1000 to 25,000 ft)
	Transit:	−305 to 7620 m (−1000 to 25,000 ft)

DOT MATRIX PRINTER
Models 6215 and 6216
USER'S MANUAL

Warning:

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

Data General

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FIRST EDITION
(First Printing March 1984)

Ordering No. 014-000732

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Rev. 00, March 1984

PREFACE

This manual contains product information about the Dot Matrix Printer Models 6215 and 6216. The manual is organized into chapters and appendixes as follows:

Chapter/
Appendix

1 *Product Overview — Provides a physical and functional description of the printer and identifies the standard and optional features.*

2 *Operation — Describes the printer controls and indicators and provides basic operating instructions for on-line and off-line use.*

3 *Programming — Describes the codes used to control the programmable features of the printer.*

4 *Installation and Maintenance — Contains information required to unpack, configure, connect, and maintain the printer.*

A *ASCII Character Codes*

B *International Character Sets*

Index

RELATED PUBLICATIONS

Service information is contained in the *Dot Matrix Printer Maintenance Service Guide*, part number 015-000126.

Installation information is contained in the *Dot Matrix Printer Installation Data Sheets*, part numbers 010-000653, 010-000683, and 010-000695.

CONTENTS

CHAPTER 1
PRODUCT OVERVIEW

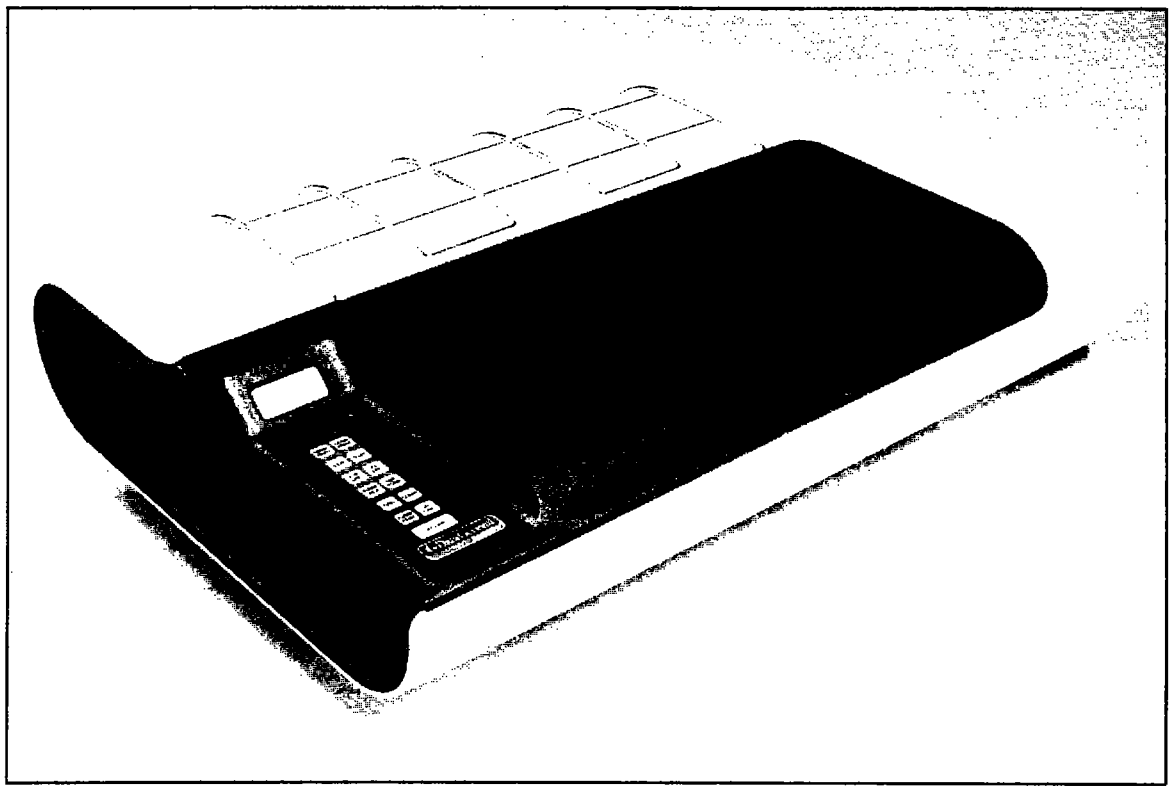


Figure 1-1. Dot Matrix Printer

INTRODUCTION

The Dot Matrix Printer, shown in Figure 1-1, is a compact, receive-only dot matrix impact printer with microprocessor control. It uses a 7x9-dot character cell, and contains character patterns for 11 languages It may also be programmed with up to 120 user-defined (downloaded) characters. Bit-image graphics and memo-quality print modes are software selectable. The printer is equipped to transmit Xon and Xoff sequences for data flow control.

The printer is a tabletop model (pedestal optional) with either a parallel or serial interface, contained within an outer plastic shell that has a hinged top access cover. The printer has a wide range of operating configurations which can be set up on-site.

Maximum throughput occurs with conditionally bidirectional printing, a fast carriage turnaround (25 ms), and high-speed space skip (twice print speed). The printer uses a 9-wire printhead on a print carriage driven by a steel cable and DC motor with integral encoder.

The paper entry slot is at the bottom front, with the paper exit at the top of the printer immediately behind the top access cover. A stepping motor with high resolution positions the paper vertically to minimize paper position settling time.

Top-of-forms position is set electronically, rather than manually, and a switch mounted in the paper path senses the presence or absence of paper. The printhead-to-platen spacing can be adjusted using the forms thickness lever on the left side of the printer mechanism, accessible when the top access cover is raised.

The front panel controls and indicators are on the printer left side. The power and interface connectors, power switch, fuse, and configuration switches are all accessible from the rear of the printer.

The ribbon cartridge is installed at the front of the printer and is accessible by lifting the top access cover. An interlock circuit takes the printer off-line and shuts down power to the printhead and motors when the top access cover is raised.

Typical printing examples are shown in Figure 1-2.

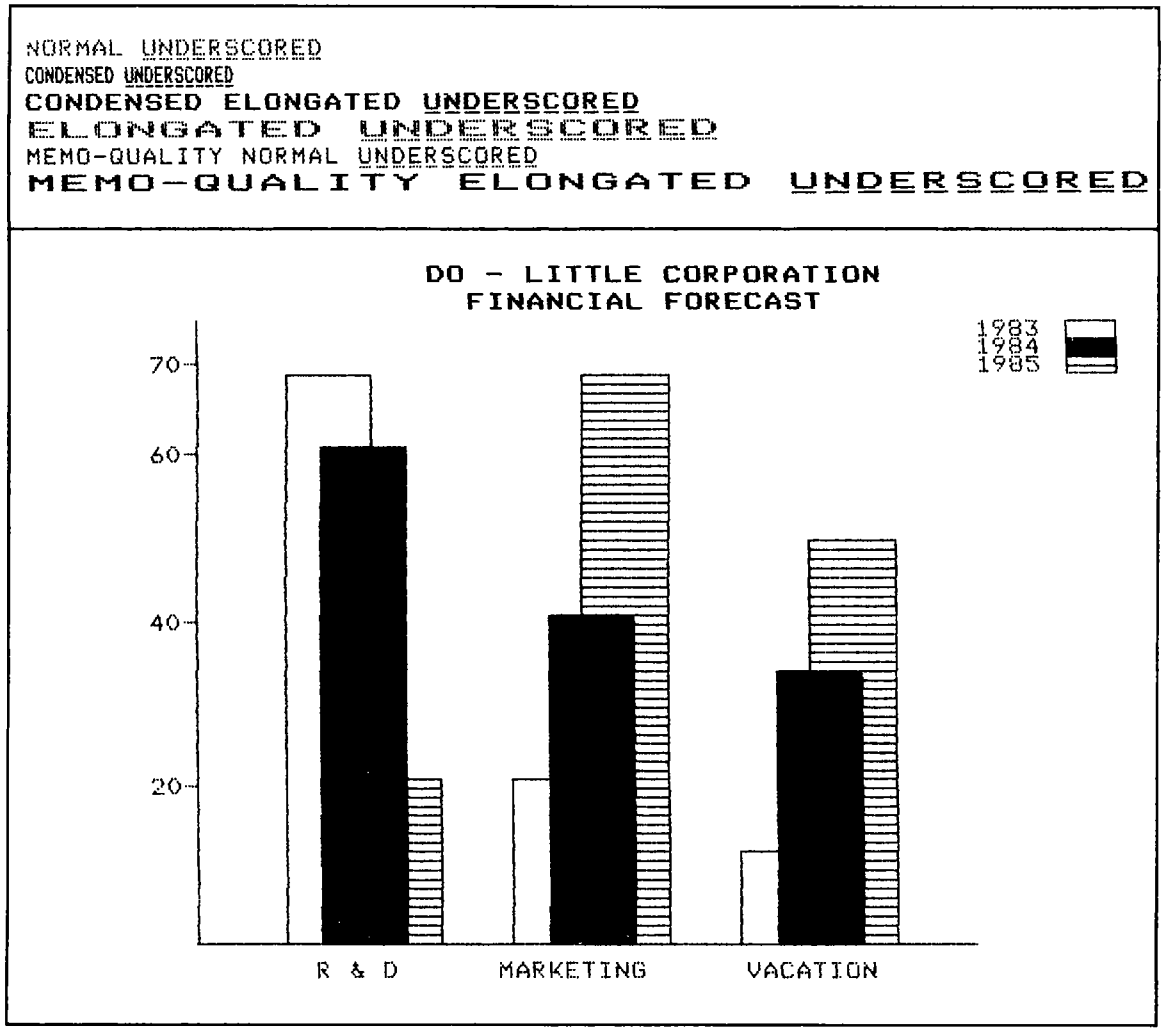


Figure 1-2. Printing Examples

PRINTER CONFIGURATIONS

The printer is available as a stand-alone unit with either a parallel or serial interface. The printer may be configured with a U.S. or international character set, and for use with standard U.S. or international voltages and frequencies. The various models of the printer are summarized in Table 1-1. Printer Model 6215-X can be used with many Data General serial controllers.

Table 1-1. Dot Matrix Printer Models

Model Number	Description
6215-X	Printer, Serial Interface
6216-X	Printer, Parallel Interface
1612	Ribbon, Fabric, Quantity of One
	X = Power Suffix None = 120 Vac, 60 Hz 1 = 100 Vac, 50/60 Hz 0,8,9 = 220 Vac, 50 Hz 2 = 220 Vac, 50 Hz, power cord not supplied 5,6,7 = 240 Vac, 50 Hz 4 = 240 Vac, 50 Hz, power cord not supplied 3 = not available

STANDARD FEATURES

Model 6215/6216 printers contain the following standard features:

- Automatic Print-Speed Adjustment
- User-Selectable/Definable Character Sets
- Graphics Mode
- Memo-Quality Printing
- Elongated Printing
- Condensed Printing
- Self-Test
- Underscoring and Tabbing
- Forms Control and Override
- Software Reset
- 8-Bit Character Codes

- Model ID/Status Request/Response (serial printers)
- ENQ/ACK Handshaking

These features are described in the following paragraphs.

Automatic Print-Speed Adjustment

The horizontal motor speed is adjusted automatically to the speed required for a throughput of 180 characters per second (cps) when printing 136 columns per line with a single line feed. No electrical adjustments are required.

The carriage moves at twice the regular print speed if the next nonblank print column is more than 0.55 inch away from the present print position. This feature also operates in the graphics mode.

User-Selectable/Definable Character Sets

The character sets internal in ROM are U.S., U.K., Danish, French, German, Spanish, Swedish, Swiss, Kana/ASCII, Kana/Japanese, and Multilingual. Any two may be selected as the main and alternate character sets by switches, or under software control via an escape sequence. All can be mixed on a line with no throughput loss. The internal character sets are illustrated in Figure 1-3.

A total of 120 characters can be downloaded into the printer memory by using an escape sequence and can be selected to be printed with any of the other characters with no loss of throughput. Memo-quality characters may be user-defined.

Graphics Mode

The graphics mode may be selected by two types of escape sequences. A spacing of 67 or 133 dots per inch (dpi) horizontally and 69 or 137 dpi vertically in any combination may be used. The throughput will vary depending on dot density. When more than 40 dot columns are blank, a slew speed of twice the normal print speed is used to get to the next nonblank print column. Trailing blanks are ignored. Printing in graphics mode is left to right only, and the carriage return speed is twice the normal print speed.

Memo-Quality Printing

Memo-quality printing is selected and deselected via an escape sequence. In this mode, the printer can fire printwires in adjacent print columns of the character cell, thereby doubling the horizontal print resolution.

Memo-quality printing may be used with either normal or normal elongated print, but not with condensed or condensed-elongated print.

Memo-quality character sets may be downloaded. If memo-quality printing is selected, for any character set or sets, printing will be at half the normal print speed. Memo-quality downloaded character sets can be printed at normal speed but not in memo-quality at normal speed.

Figure 1-3. Internal Character Sets

Elongated Printing

This print mode is selected and deselected via escape sequences. Elongated characters are twice the width of normal characters. This mode may be selected or deselected anywhere in a line, and it is not necessary to reissue the escape sequence after a line terminator is received. Elongated print may be selected in normal, condensed, or memo-quality modes.

Condensed Printing

Condensed printing allows 132 characters per line on 80-column paper or 226 characters per line on 136-column paper. Condensed mode is selected and deselected by escape sequences, or by ANSI escape sequences that do not require deselection, and can be selected or deselected anywhere in a line. This mode remains active until it is deselected, or until another mode is selected (ANSI).

Elongated printing can be selected in condensed mode to print condensed-elongated characters. If condensed and normal print are used on the same line, the line will be printed at the condensed speed. This will cause some drop in throughput.

Self-Test

The front panel TEST control activates and deactivates a print test pattern (Figure 1-4) in the off-line mode. This control is not monitored when the printer is on-line. Exit from self-test clears the print buffer while retaining print configuration data.

The serial interface printer configuration has its own self-test (Figure 1-5, shown in 6 lpi normal print mode), performed on-line by use of the baud rate select switches. This tests the serial board-to-main board interfaces. The printout will vary with lines per inch and condensed/normal selection. Refer to Chapter 4 for more information.

Underscoring and Tabbing

Underscoring allows characters or complete lines to be underlined as they are being printed. This avoids any drop in throughput by eliminating the need for a second pass to fill in the underscores.

Horizontal tabs may be set at all character positions. The tabs are set at character positions and will vary with changes in print mode.

Vertical tabbing allows quick movement to any line of the form. An escape sequence is used to clear existing tabs and define the new tab positions. If a vertical tab code is received and no more tabs are set in the current form, the printer will tab to the first tab in the next form. Vertical tabs may be set throughout the maximum form length of 112 lines. As with horizontal tabs, the positions are defined in terms of line position and will vary with changes in line pitch.

No action is taken for either type of tab if a tab command is issued and no tabs have been set.

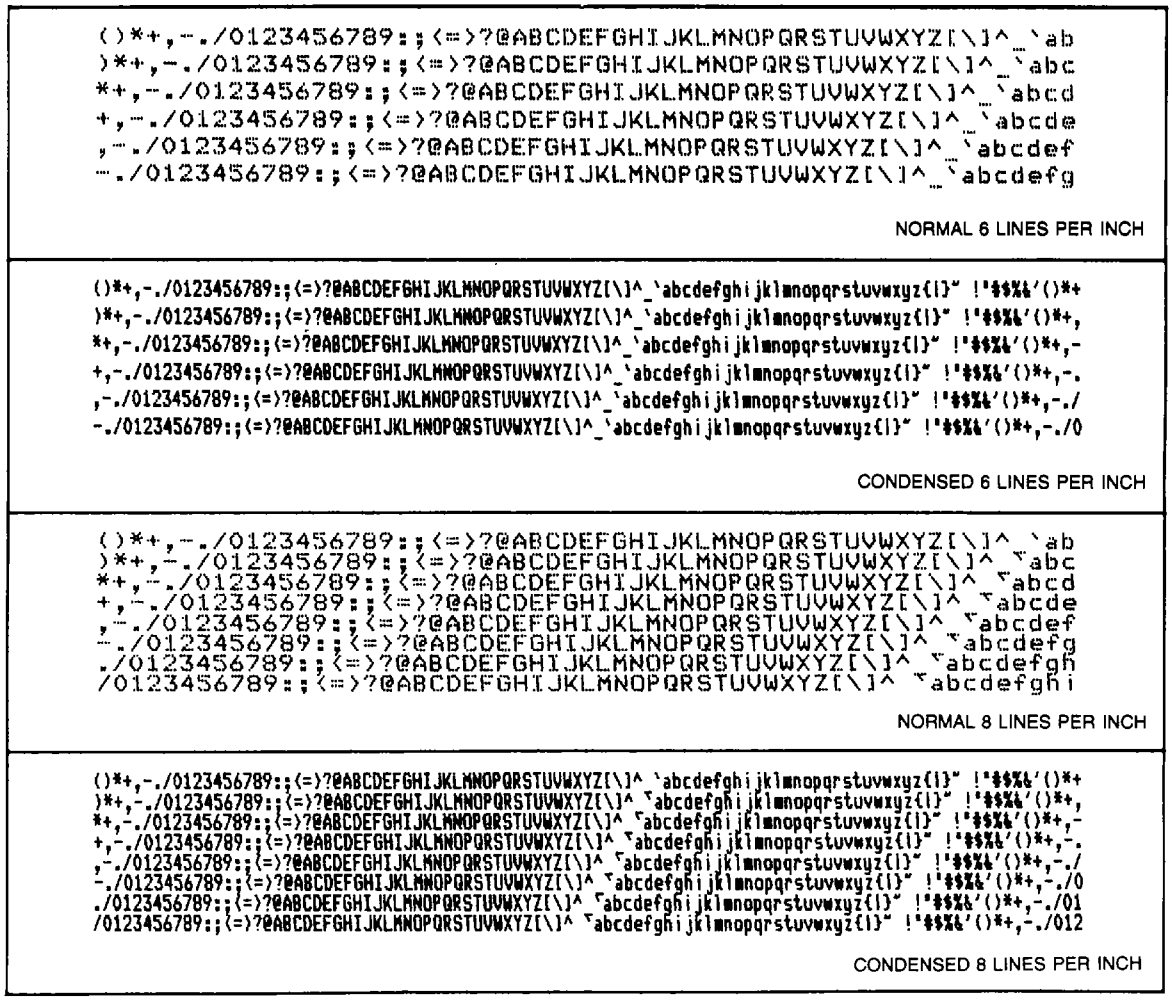


Figure 1-4. Off-Line, Self-Test Printout

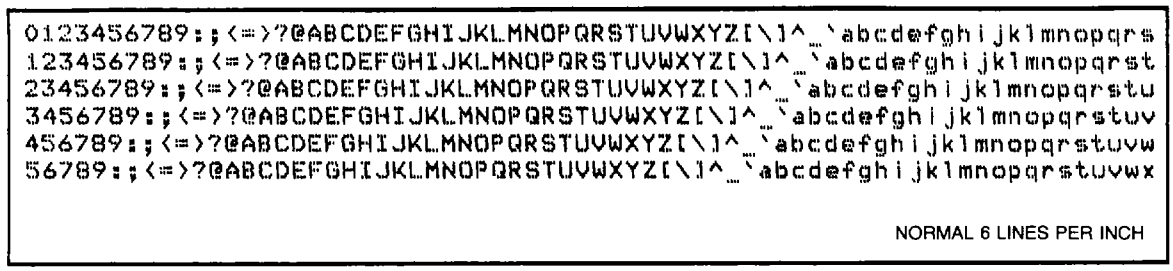


Figure 1-5. Serial Board Self-Test Printout

Forms Control and Override

Any form length up to 112 lines can be set with an escape sequence from the host computer. Lines per inch, top margin, and bottom margin skipover can be set with an escape sequence. Spacings of 6 and 8 lpi can be mixed in the same form.

When the printer's out-of-forms sensing switch is activated, it goes off-line and an out-of-forms error code is shown on the status display. When this occurs, depressing the ON LINE control (for forms override) causes one more line of data to be printed. This may be repeated until the form is completed. At this point, the operator may load a new paper supply, put the printer back on-line, and continue printing.

Hardware/Software Resets

Turning the power switch off and on generates a hardware reset.

Software reset is an escape sequence which reconfigures the printer to its switch settings for character sets, pitch, and form length; resets top of form to the current line; and returns the carriage to the left margin. Reset should follow a form feed to prevent incorrect setting of the top of form.

8-Bit Character Codes

This feature, used with an 8-bit interface, allows the most significant bit of the data word to select characters from the alternate character set without using SHIFT IN (SI) and SHIFT OUT (SO) control codes.

If the Multilingual character set is selected as the alternate character set, all European characters will be available without using escape sequences for selection.

If the most significant bit of the data word is a 1, the alternate character set is automatically selected. This feature operates on a character-by-character basis and will print characters from the active character set when bit 8 is not set.

Printers using a 7-bit interface can achieve the same result by using the SHIFT IN (SI) and SHIFT OUT (SO) codes.

Model ID/Status Reporting and Response

This feature enables Model 6215 serial printers to respond to a model ID request from the host system. The printer returns a model ID number, printer status information, and a software revision number.

ENQ/ACK Handshaking

This indicates that data sent to a serial model printer is actually being printed. When an ENQ control code is found in the line being printed, the printer will return an ACK control code to the host. Only one response will be given per line terminator, for one or more ENQs within a

line. ENQ codes must not be embedded within any escape code sequences, or an error will result. Responses to an ENQ will occur only if the line containing it is terminated.

OPTIONAL FEATURES

In addition to the standard features listed, optional features include a parallel or serial interface and a pedestal.

Parallel Interface

The parallel interface transfers 7 or 8 bits of information at a time, and tells the system when the printer is powered-up, on-line, and ready to accept characters. Data is accepted on a demand basis, as the maximum rate of data transfer is determined by the printer rather than the driving device. Refer to Chapter 4 for cable details.

Serial Interface

The serial interface supports EIA RS-232-C, EIA RS-422-A, and 20-mA current loop operation, the choice depending primarily on the cable length required, the configuration of the host computer, and use of a modem. Refer to Chapter 4 for cable details.

Pedestal

The pedestal provides a rigid mounting for the printer, allowing the printer to be floor mounted if desired. A paper basket is supplied with the pedestal.

FUNCTIONAL OPERATION

The printer accepts data and control characters from the host computer and stores these until the end of a line occurs or a line terminator is received, which causes the microprocessor to begin the printing process.

Printing

Each ASCII-coded character is converted into a series of dot patterns, and a 9-wire printhead produces the character in 7 dot columns (Figure 1-6) as it moves across the paper. Printing is bidirectional, so a character may be formed by starting with either its left or right column.

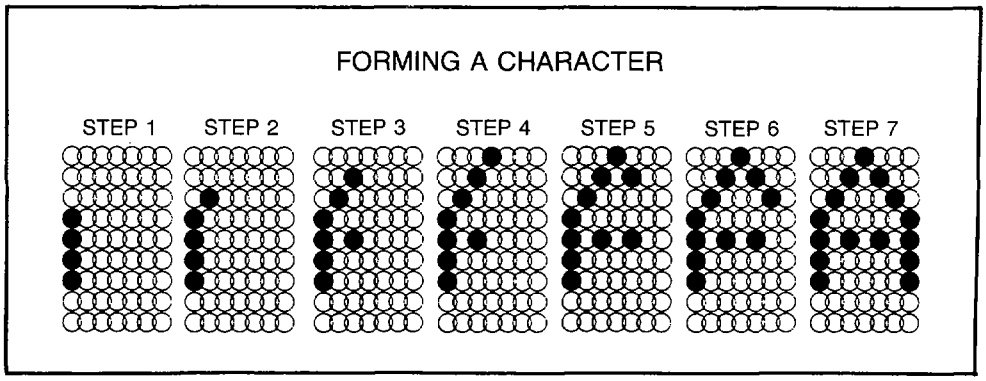


Figure 1-6. Print Character Generation Diagram

Modes of Operation

The printer has four basic modes of operation including:

- Initialization
- On-line
- Off-line
- Self-test

Initialization Mode

The printer automatically enters the initialization mode when turned on. In this mode, the printhead drive motor is set to operate at the proper speeds and direction, and the printhead is positioned at park. Configuration is set to either 80 or 136 normal print positions. If the characters in a line exceed the line length selected, a carriage return is inserted and the line is processed or an error code (E44) is reported. Also, ROM and RAM are tested and the status display is reset.

Initialization Off-Line Scan

After initialization, the program enters off-line scan to read the front panel controls. If the on-line initialization switch (a configuration control) is ON, the program goes to on-line scan. Otherwise, it remains in off-line scan until placed on-line.

Initialization On-Line Scan

This checks for errors and looks for data in the interface. If there is data, it is inserted in the buffer a character at a time, and when a terminator is received, the line is processed. This continues until the printer is taken off-line or until an error occurs.

On-Line Mode

After initialization, the printer may be placed on-line with the ON LINE control (unless the paper supply sensor or top access cover sensor indicates a problem). In this mode the host computer transmits print data which is stored in a buffer. When the printer has received a line of print, it begins printing in the most efficient direction, firing the appropriate printwires to form the desired characters.

Off-Line Mode

The printer may be placed in the off-line mode by pressing the OFF LINE control. This disables the communication interface and activates the OFF LINE indicator. All other front panel controls are active in the off-line mode.

Self-Test Mode

The self-test mode may be selected with the TEST control on the front panel (if off-line), or after pressing the OFF LINE control. The serial interface configuration has a self-test controlled by the baud rate switches when the printer is on-line as described in Chapter 4.

MECHANICAL / ELECTRICAL DESCRIPTION

All models of the printer are tabletop mounted, each in a plastic case with a top cover door for easy access to the paper feed system, ribbon cartridge, and printhead.

The printer mechanical assemblies (Figure 1-7) are:

- Printhead System
- Ribbon System
- Paper Feed System
- Controls and Indicators
- Power Supply
- Circuit Boards

Printhead System

The printer is equipped with a 9-wire printhead mounted on a shuttle mechanism. This assembly is driven along the print line by a DC servo motor and cable. Column position information is obtained from an encoder disk mounted on the shuttle servo motor shaft. Column 1 is automatically referenced from the printer left-side frame.

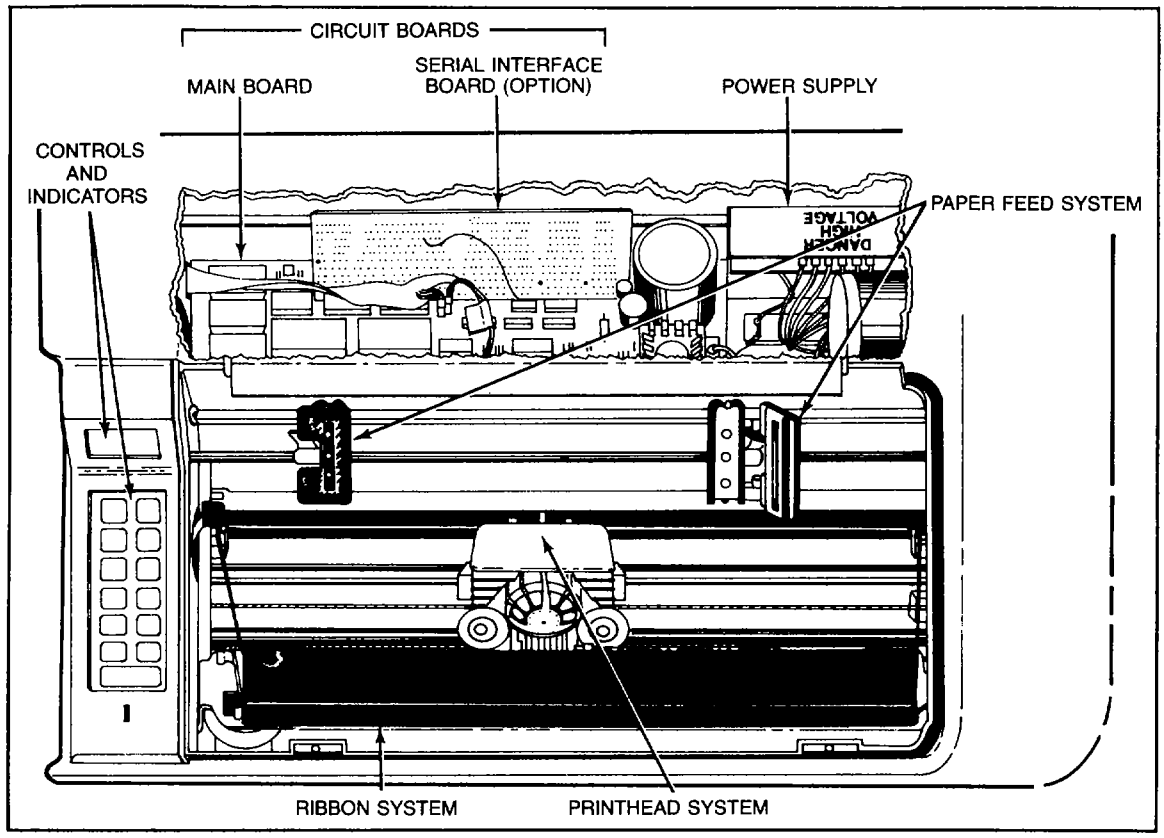


Figure 1-7. Printer Mechanical Assemblies

Ribbon System

The ribbon system consists of a ribbon cassette and a ribbon drive motor. Both components are mounted on the frame mechanism and do not move with the printhead. The ribbon cassette is operator replaceable as described in Chapter 2.

Paper Feed System

The paper feed system consists of a paper feed step motor, drive belt, and a tractor drive assembly. The two tractors, located at each side and above the print station, move the paper vertically past the printhead. A tensioning device, located below the print station, holds the paper (form) flat against the platen. The tractors may be adjusted for various form widths and margin requirements as described in Chapter 2 of this manual.

Controls and Indicators

All mechanical controls are underneath the hinged top access cover. The electrical controls and indicators (except the power switch and serial interface board indicators on the rear panel), are on the front panel located on the left side of the printer. For more information refer to Chapter 2 of this manual.

Power Supply

The printer power supply is identical for all models, and is configured for the various operating voltages with terminal block jumpers.

Circuit Boards

The circuit boards used in the printer include:

- Parallel Interface
  Communicates between a computer and the microprocessor over 7 or 8 data lines, 8 bits at a time.

- Serial Interface
  Communicates between a computer and the Main Board, assembling data 1 bit at a time in a 7- or 8-bit buffer until a received character is present. This board contains its own microprocessor.

- Display Board
  Contains printer operation indicators.

- Front Panel
  Contains printer operation controls.

- Main Board
  Contains the power supply, the control electronics, connectors to other assemblies, and the configuration switches.

The Main Board microprocessor controls the various printer subsystems with its internal program.

The Main Board memory stores the microprocessor program and variables, characters received from the computer, and special codes used to fire the print wires. The printer has two types of memory: read-only memory (ROM) and random-access memory (RAM).

The printer operating program is stored in ROM and cannot be altered by the microprocessor. Its contents are not lost when power is off.

Random-access memory (RAM) stores program data and incoming characters, including characters received but not yet printed and downloaded character-set dot patterns. These are lost when the printer is turned off.

FORMS REQUIREMENTS

The printer is capable of printing on forms with as many as 6 parts. Forms with more than 6 parts are not recommended for use in this printer.

The duplicate parts may be printed on either carbonless paper or single-use carbon paper. Other multipart forms may be used but should be tested under user operating conditions to verify paper handling and printout legibility.

The recommended storage environment for printer forms is 16° to 27° C (60° to 80° F) with a relative humidity range of 40 to 60%. Forms should be stored at least 72 hours in this environment before use.

The following tables should be used to obtain acceptable print quality and reliable forms movement in the printer.

Table 1-2 shows the recommended total forms thickness for forms of 1 to 6 parts, with and without carbon paper. For example, a 6-part form using carbonless paper would have a thickness of 0.48 mm (0.019 in.), while the same form with single-use carbon paper would be limited to the maximum form thickness of 0.64 mm (0.025 in.).

Table 1-3 gives the maximum paper weights per parts of forms, with a paper weight shown for each part. The weights per part are listed in order from the topmost part (on the printer, the read or operator side) to the printer platen side. For example, a 3-part form could have a maximum paper weight for part 1 of 20-pound paper, part 2 of 15-pound paper, and part 3 of 100-pound paper. Lower weight paper per part could be used, with a minimum weight of 10 pounds per part.

Table 1-2. Recommended Forms Thickness

Parts Per Form	Carbonless Paper		Carbon Paper 19 G/M*2 (8 lb.) Single Use	
	(mm)	(in.)	(mm)	(in.)
1	0.17	0.007	0.17	0.007
2	0.28	0.010	0.33	0.013
3	0.36	0.014	0.46	0.018
4	0.44	0.017	0.60	0.024
5	0.43	0.017	0.56	0.022
6	0.47	0.018	0.61	0.024

Table 1-3. Maximum Form Parts Paper Weights

Parts	Forms Weight G/M*2 (Lb) Per Part					
	1	2	3	4	5	6
1	163 (100)	¦	¦	¦	¦	¦
2	75 (20)	163 (100)	¦	¦	¦	¦
3	75 (20)	56 (15)	163 (100)	¦	¦	¦
4	56 (15)	56 (15)	56 (15)	163 (100)	¦	¦
5	56 (15)	56 (15)	56 (15)	56 (15)	75 (20)	¦
6	56 (15)	45 (12)	45 (12)	45 (12)	45 (12)	75 (20)

CHAPTER 2
OPERATION

GENERAL

This chapter describes the printer operating controls and indicators and provides basic operating procedures for paper loading, ribbon replacement, turning on the printer, on/off-line procedures, and self-test.

ELECTRICAL CONTROLS AND INDICATORS

All electrical controls and indicators (except the power and configuration switches on the rear panel) are located on the printer front (control) panel. When power is applied, the carriage is initialized to the home position and top of form is set at the current line of the form. The printer is configured to the modes defined by the rear-panel configuration switches described in Chapter 4.

Front Panel Controls

The front panel controls are shown in Figure 2-1 and are described in Table 2-1.

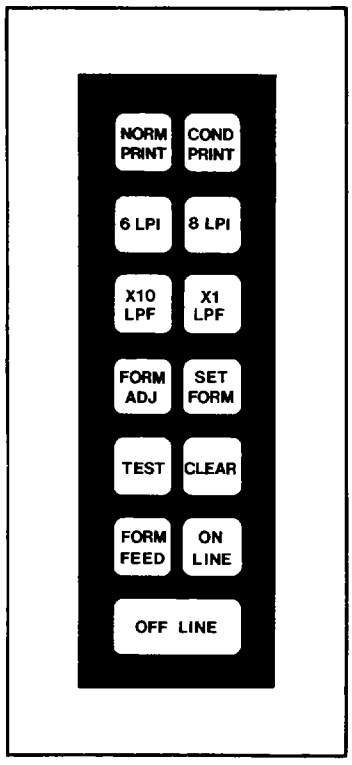


Figure 2-1. Front Panel Controls

Table 2-1. Front Panel Controls

Control	Function
ON LINE	Enables the communication interface and activates the ON LINE indicator, if no fault conditions exist. The printer will go off-line if a fault occurs. The printer can be set to be on-line at turn-on by the Initialize On-line/Off-line switch (see Chapter 4). The only other control active in this state is the OFF LINE control.
OFF LINE	Disables the communication interface and activates the OFF LINE indicator. All other front panel controls are active in off-line.
CLEAR	Clears the fault status if the condition causing the fault has been corrected. The printer then returns to a Ready state. Press ON LINE to resume printing.
FORM FEED	Advances the paper to the top of the next form at slew speed.
NORM PRINT	Selects normal character width (0.10 in.).
COND PRINT	Selects condensed character width (0.06 in.).
6 LPI	Selects 6 lpi vertical spacing.
8 LPI	Selects 8 lpi vertical spacing.
X10 LPF	Manually defines the tens digit of the lines per form and associated indicator. Momentary depression of this control causes the tens digit to increment by one. Continuous depression causes the tens digit to increment at a rate of about 2 per second.
X1 LPF	Manually defines the units digit of the lines per form and associated indicator. Its operation is similar to the X10 LPF control.
TEST	Activates and deactivates the printer self-test mode.
SET FORM	Defines current paper position as top of form.
FORM ADJ	Adjusts vertical paper position in 1/120 inch steps (4 steps per each switch actuation) with momentary depression. Continuous depression causes the paper to advance at about 1 inch per second.

Front Panel Indicators

These are shown in Figure 2-2 and are described in Tables 2-2 through 2-4. The printer operating condition, STAT and LINES/FM displays, and error codes are shown on the front panel indicators. These indicators consist of several legends for printer operating condition, and three 7-segment displays for status, lines per form, and error codes.

The operating condition legends are shown in Table 2-2. The three 7-segment STAT and LINES/FM displays of Table 2-2 are listed in Table 2-3, and the error codes of Table 2-3 are given in Table 2-4.

For Figure 2-2 (and Table 2-3) from left to right, the first (STAT) 7-segment display shows printer status using an alphanumeric code. This code defines the function of the other two (LINES/FM) display digits.

An 8 in STAT indicates data in the print buffer, and a 0 indicates the buffer is empty. In either case, the next two displays indicate form length.

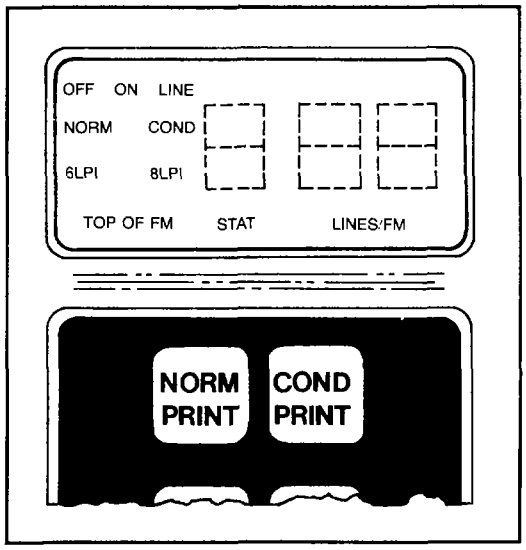


Figure 2-2. Front Panel Indicators

When a 5 is displayed in STAT, it indicates self-test mode; the other two digits show which test has been selected.

An E in STAT indicates that a fault has occurred; the other two digits indicate the type of fault (error codes, Table 2-4).

At power-on, all three 7-segment displays are activated. If the displays do not clear, this indicates that either the program is not running or the ROM test failed. After the ROM test is complete the displays should clear. At power-on, if the displays remain clear, it indicates the RAM test failed.

Table 2-2. Printer Operating Condition Legends

Legend	Indication
ON LINE	Printer on-line, ready to receive data.
OFF LINE	Communication interface disabled.
NORM	Configured to 10 cpi.
COND	Configured to 16.7 cpi.
6 LPI	Configured for line spacing of 6 lpi.
8 LPI	Configured for line spacing of 8 lpi.
TOP OF FM	TOP OF FM control activated. Remains displayed until next vertical motion.
STAT	The display above the legend shows printer condition (an 8, 0, 5, or E, Table 2-3).
LINES/FM	The two displays above the legend indicate (with an 8 or 0 in STAT), form length in lines (on forms of 100 to 112 lines the leading digit is not shown); or indicate (with an E in STAT) error codes (Table 2-4); or indicate (with a 5 in STAT) the type of self-test selected.

Table 2-3. STAT and LINES/FM Displays

STAT Display	STAT Display Meaning	LINES/FM Display Digits On
8	Data in print buffer	Form length
0	Print buffer empty	Form length
5	Self-test mode	Self-test number
E	Fault indication	Error codes (Table 2-4)

Table 2-4. Error Codes

Code	Meaning	Code	Meaning
00	Interrupt pending but unable to reset it	35-38	Undefined
		39	Serial buffer overflow
01	+12 volts fault	40-41	Undefined
02	Horizontal current fault	42	Invalid Escape sequence
03	Undefined	43	Invalid form setting
04	Not able to find left end of mechanism	44	Too many print characters in the line
05	Not getting forward IRQ interrupts	45	DLL checksum incorrect
06	Unable to set forward speed	46	Invalid codes on escape sequence
07	Not getting reverse IRQ interrupts	47	Invalid horizontal tab
08	Unable to set reverse speed	48	Invalid vertical tab
09	Not getting interrupt from PTM channel 3	49	Undefined
		50	Horizontal motor over-current
10	Not getting enough forward interrupts	51	Timing position interrupt before print complete
11	Not getting interrupt from PTM channel 1 vertical	52-59	Undefined
		60	Self-test running
12	Not getting interrupt from PTM channel 2 vertical	61	Signature analysis test of I/O decode
		62	Signature analysis test of ROM address space
13	Not getting interrupt from PTM channel 1 print	63	Signature analysis test of RAM address space
14	Not getting interrupt from PTM channel 2 print	64	Signature analysis test print one character
15-19	Undefined		
20	Serial board ROM failure	65	Signature analysis test line feed
21	Serial board CPU, RAM failure	66	Signature analysis test move horizontal motor
22	Serial board RAM failure		
23	Serial board UART failure	67	Signature analysis test initialization, print, line feed
24	Serial board reports no errors but FAULT line active	68	Power-up initialize
		69	Watchdog timer test
25	ACK signal not seen by interface (no NMI)	70	Out of forms
		71-72	Undefined
26	Serial board fault, error code received, invalid	73	Printer top access cover open
		74-76	Undefined
27-29	Undefined	77	Watchdog timer error
30	Fault from serial interface after power-up	78-99	Undefined
31-33	Undefined		
34	Serial communications error framing, parity/overrun		

NOTES:

Errors 01 through 30 are hardware errors that cannot be cleared with the CLEAR control. If these cannot be cleared by turning the power off and on, call Data General Service.

Errors 31 through 99 can be cleared with the CLEAR control.

Errors 42 through 48 are software errors and can be inhibited by configuration switch MB1-7 (see Chapter 4).

Rear Panel Controls and Indicators

Refer to Figure 2-3 and Table 2-5. The configuration controls (switches) and indicators are described in the following paragraphs.

The serial interface board uses three indicators (visible through the printer rear panel) to display serial interface status.

The top (center) indicator shows the state of the DSR (Data Set Ready) signal input to the UART. When on, it indicates that DSR is active.

The left indicator is used as a READY display. When on, it indicates that no critical faults have been detected by the processor.

The right indicator displays STATUS and gives a further indication as to the type of error detected. The error codes will also appear on the front panel indicators when a serial fault is detected.

When no critical faults have occurred, the right indicator will indicate noncritical serial board fault, or the status of DCD if no fault exists. The indicator will flash if DCD is inactive, or when the interface self-test is transferring characters to the main board.

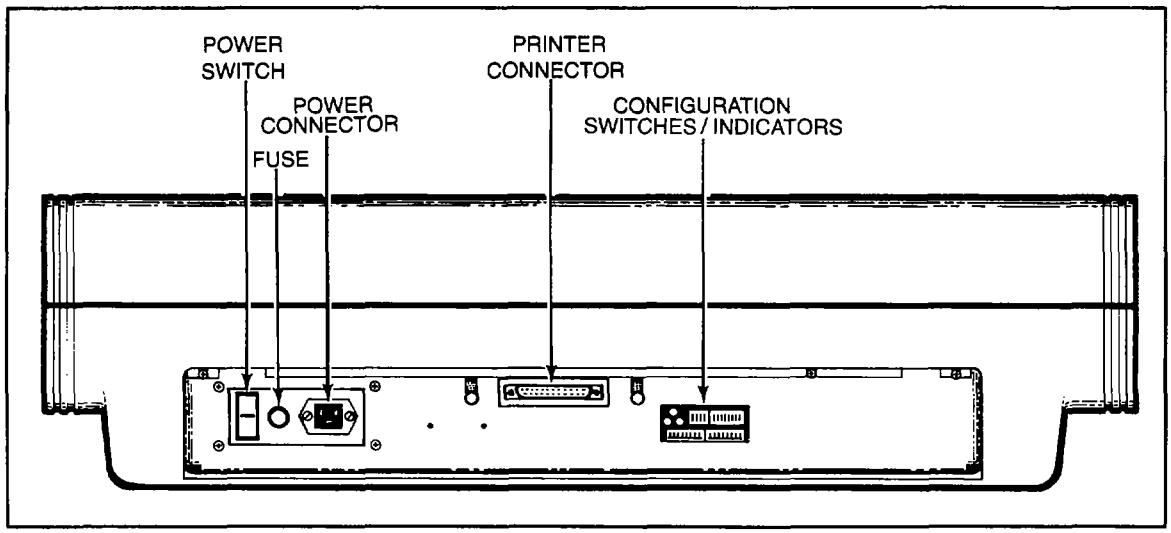


Figure 2-3. Printer Rear Panel

Table 2-5. Serial Interface Board Status Indicators

Indicator			Display Meaning
READY	DSR	STATUS	
	ON		DSR (data set ready) is active
OFF		OFF	System failure, processor not executing code or ROM checksum failure
OFF		ON	Interface loopback error at power-up
OFF		ON	Fatal serial error (NOTE 1)
OFF		FLASH	RAM error detected
ON		OFF	Nonfatal serial error (NOTE 2)
ON		ON	No errors detected
ON		FLASH	DCD inactive and no errors, or serial board self-test is running (NOTE 3)

NOTES:

1. *This error will occur only after power-on and will report a different error code (on the control panel) from the interface loopback error. The error may be cleared by pressing the CLEAR and ON LINE controls, to allow data previously buffered to be printed. If the error was an overflow, most likely it will continue to fail. If errors continue, turn the power off and then back on.*

2. *Displayed when a communication error occurs that has a character substituted for the errant character. Reset the printer by turning power off and then back on. If the error recurs, check configuration switch settings against the host system's configuration.*

   This error display may also be cleared by going off-line and then back on-line. This allows data previously buffered to be printed. No error code is displayed on the front panel for this type of error.

3. *The nonfatal serial error (Note 2) takes precedence over a DCD inactive error, but loss of DCD will disable the UART receiver.*

Sensors

Paper Out

Signals the printer processor that the printer is out of paper. The printer goes off-line until paper is loaded and the ON LINE control is pressed.

Top Access Cover Open

Signals the printer processor that the top access cover is open. At the completion of the current print line the printer will go off-line and power will be removed from the motors. Printing can be resumed by closing the top access cover and pressing ON LINE. Attempts to go on-line with the top access cover open will sound a bell alarm and requires clearing the fault prior to going back on-line.

MECHANICAL CONTROLS

The mechanical controls are for loading and aligning forms and loading and adjusting the printer ribbon. The mechanical controls include the tractor locks and tractor pressure plate, the ribbon advance knob, and the forms thickness lever. Refer to Figure 2-4.

PRINTER OPERATING PROCEDURES

This section covers paper loading, ribbon replacement, power-up, on/off-line operation, and self-test.

Paper Loading Procedure

The printer uses standard pin-feed, fan-fold paper forms. These forms have from 1 to 6 parts and may be from 4 to 15 inches wide. The space between the printhead and the platen can be adjusted for forms of different thicknesses to ensure good print contrast. Different form widths can be used by resetting the right and left paper tractors.

The label on the printer just below and to the left of the left side paper tractor (Figure 2-5), has tractor setting guides for 80-, 132-, and 136-column paper. Set the left paper tractor so the left edge of the paper to be used matches the proper line on the label. This will center the printing between paper margins on standard 80- or 132-column paper.

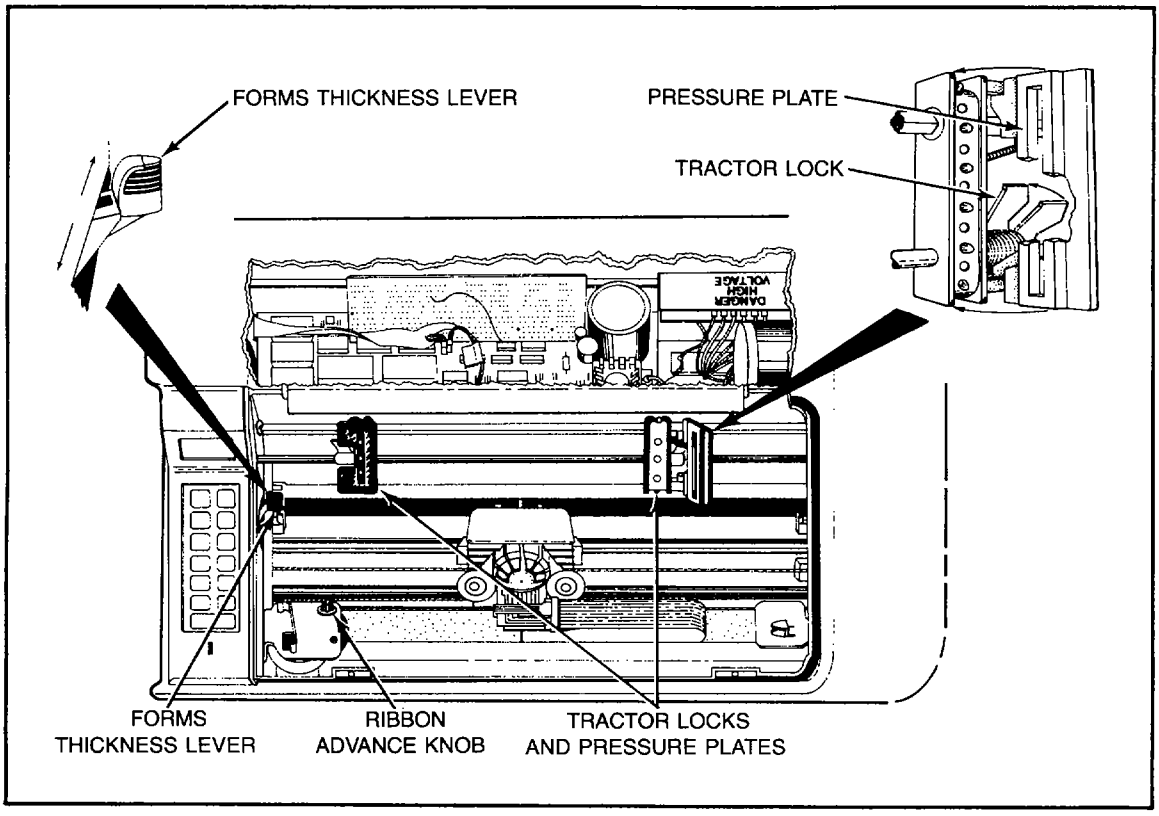


Figure 2-4. Printer Mechanical Controls

Refer to Figure 2-5 and load the paper into the printer as follows:

1. Open the top access cover. Adjust the paper tractors, if needed, by loosening the levers that lock them in place. Move the tractors as needed and retighten the levers. The left tractor can be set to align the form to a home reference mark for the printhead home position, if desired.

2. Set a box of pin-feed paper under the printer (Figure 2-6). Pull the forms thickness lever forward to the widest platen spacing position to allow room to slide the paper into place. Open the tractor gates and feed the paper through the front slot in the bottom of the printer, under the paper tensioner and onto the tractor pins.

   NOTE: *Align corresponding holes on either side of the paper to make the top of the paper horizontal, or the paper may jam or tear in the tractors.*

There should be a slight horizontal tension on the paper, but too great a tension may cause the paper to tear. To increase horizontal tension, move the right tractor slightly to the right; to decrease tension, move the right tractor slightly to the left.

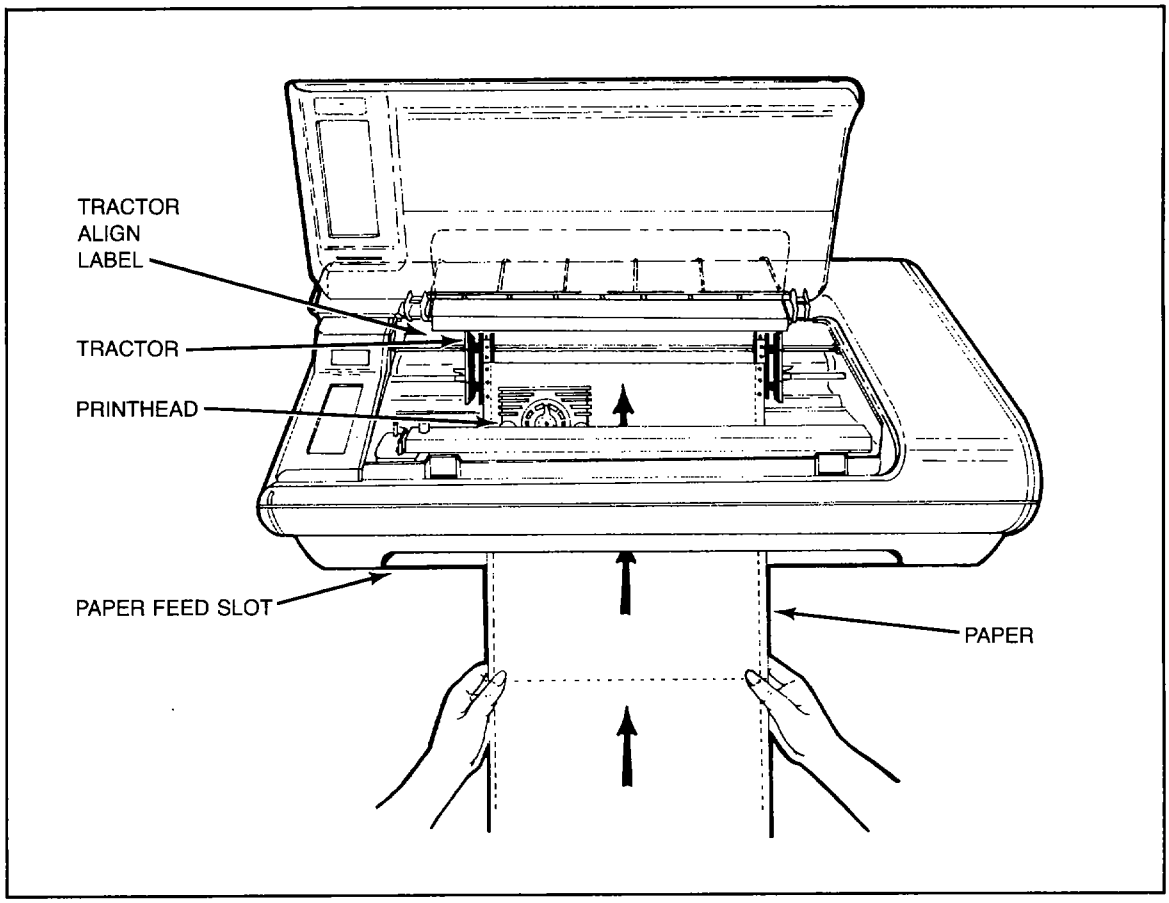


Figure 2-5. Loading Printer Paper

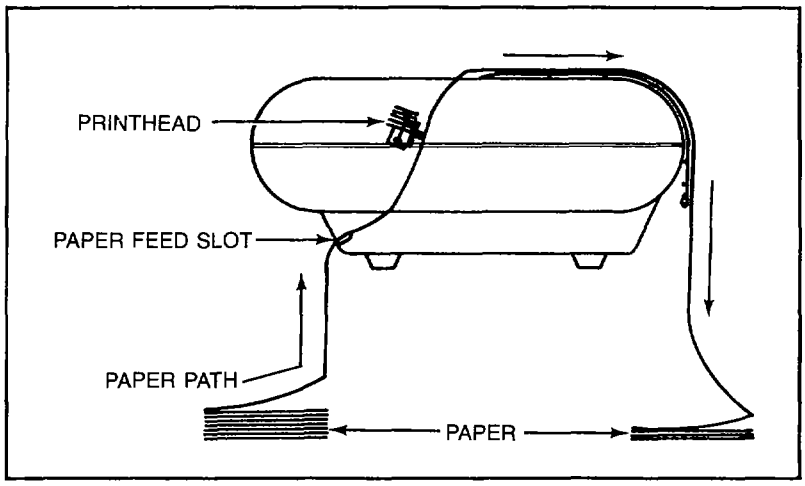


Figure 2-6. Printer Paper Path

3. Close the tractor gates and move the forms thickness lever to accommodate the form thickness used. For best results, adjust the forms thickness lever for the observed desired printing contrast.

4. Feed the paper through the large slot on the top access cover as it is closed.

Ribbon Cartridge Replacement Procedure

The printer uses a continuous feed cartridge type ribbon with the ends connected together so that both the upper and lower halves are used. Install a new cartridge as follows (Figure 2-7) when printing becomes too light:

1. Take the printer off-line and open the top access cover.

2. Note the position of the forms thickness lever and move it to the front (widest) position. Release the ribbon from the printhead and from around the left and right ribbon guides.

3. Unlatch the cartridge by moving the left-side spring catch to the left. Lift the left end upwards and to the left to remove the cartridge from its mounting.

4. To replace the cartridge, pull out a length of ribbon from the right end of the new cartridge. Position the cartridge on the printer with the ribbon tension knob up and to the left. Insert the cartridge right end slot onto the printer right side mounting bracket, then lower the cartridge left side into place over the ribbon drive gear shaft. Latch the cartridge into place with the spring catch.

5. Thread the ribbon around the left and right ribbon guides and through the printhead guides. Rotate the ribbon tension knob (on the cartridge top) COUNTERCLOCKWISE to remove any slack in the ribbon.

CAUTION: *The knob on the ribbon cartridge should not be turned clockwise as it may jam the ribbon.*

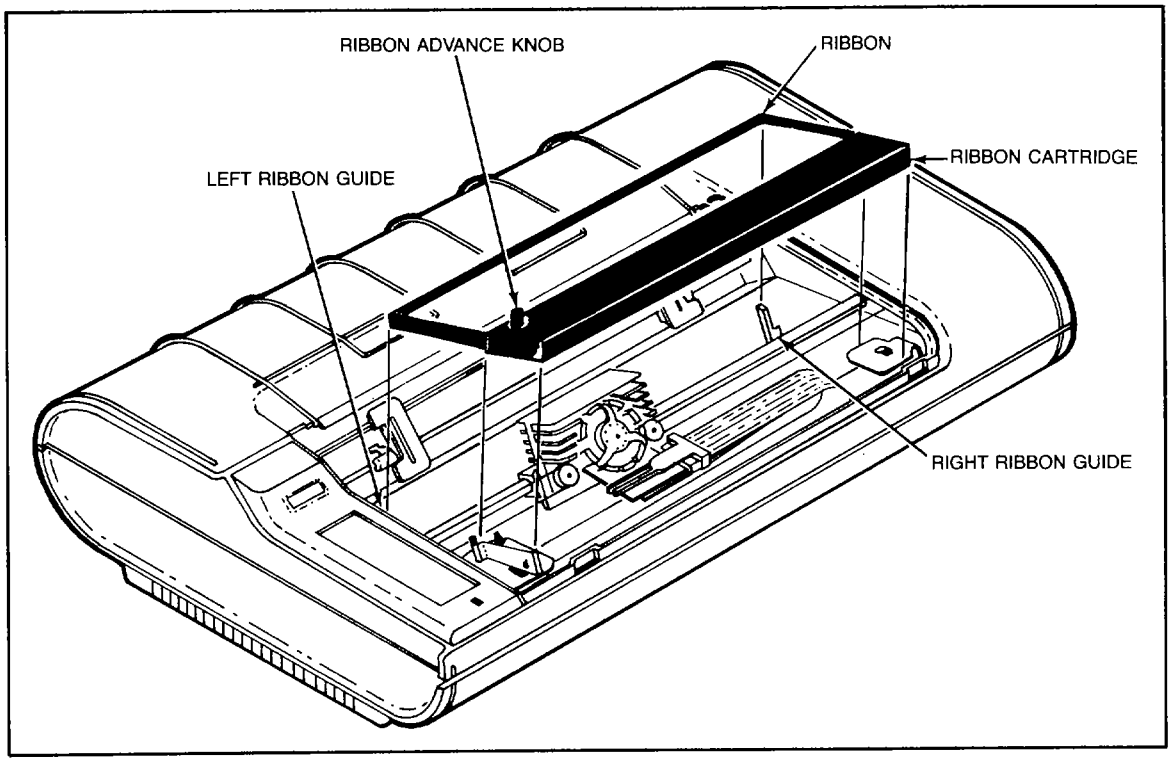


Figure 2-7. Ribbon Replacement

6. Reset the forms thickness lever to the desired position. Close the top access cover.

Power-On Procedure

Use the following procedure (preset or check the configuration switch settings as given in Chapter 4) before turning on the printer power.

1. Set power switch (lower-right rear side of printer) to on. The printhead should stop at the rest position.

2. Press the 6 LPI or 8 LPI control on the front panel to the desired vertical line spacing (6 or 8 lpi). Either can be preset on the configuration switches.

3. Press the X1 LPF or X10 LPF control on the front panel to the number of lines per form of paper being used.

4. Press FORM ADJ to move the paper to the top of the desired form, then press the SET FORM control to set the current paper position as the top of form.

   NOTE: *To position paper backward in the printer, swing open the tractor gates and reposition the paper feed holes over the sprocket pins. Close the tractor gates.*

5. Press the NORM PRINT or COND PRINT control on the front panel for the desired character spacing (10 cpi is standard (NORM PRINT), 16.7 cpi is condensed (COND PRINT).

6. Press the ON LINE control on the front panel and verify that the ON LINE display is visible.

NOTE: *If the printer is out of paper or is otherwise not ready for printing, the printer will not go on-line. Check the status display on the front panel and refer to Tables 2-3 and 2-4 to determine the nature of the problem. Clear the fault, press CLEAR and ON LINE to resume printing. If a fault occurs when on-line, the printer will go off-line.*

Off-Line Operating Procedures

To place the printer in the off-line mode, press the OFF LINE control on the front panel. The indicator should show OFF LINE.

All other front panel controls are active in the off-line mode. In the on-line mode, only the OFF LINE control is enabled.

Self-Test Procedure

Use the following procedure to activate the printer self-test feature:

1. Check the paper width configuration switch to be sure the paper to be used is wide enough. Set the power switch to the on position.

2. Press OFF LINE on the front panel and select the print characteristics to be tested, such as NORM PRINT at 6 or 8 lpi, or COND PRINT at 6 or 8 lpi.

3. Press TEST on the front panel. A print test pattern is printed (see Chapter 1) until TEST is pressed again, which clears the print buffer and reconfigures the printer.

4. Press ON LINE. The printer is now ready for normal operation.

NOTE: *The serial interface printer (Model 6215) has an additional self-test, performed on-line and controlled by the baud rate switches. This self-test is an 80-character rotating pattern. Refer to Chapters 1 and 4 for more information.*

CHAPTER 3
PROGRAMMING

INTRODUCTION

This chapter provides an overview of printer operation from the programmer's point of view and provides reference data required to program various printer features.

The printer receives information from a computer or communications line, represented by 7- or 8-bit ASCII codes. The 128 characters in the standard ASCII set consist of 96 uppercase and lowercase alphanumeric and punctuation characters, as well as 32 control codes. If the printer receives a valid control code, it performs the specific function defined by the code. If, however, the printer receives one of the control codes it does not use, it ignores that code.

The printer responds to three types of information:

1. Character Codes — For a character to be printed.
2. Control Codes — Codes which control special functions.
3. Escape Sequences — Codes beginning with ESC, DCS, CSI, or ST which control certain functions.

The printer may be set to any print configuration under software control. Print configuration is defined as:

- Form length, top margin, bottom margin
- Lines per inch
- Character width
- Tabs
- Character sets

HOST/PRINTER COMMUNICATIONS

The printer functions as a receive-only terminal connected to a host computer system either directly or via a communications network. For the serial interface printer Model 6215, character transmissions occur at a selectable baud rate of 110, 150, 300, 600, 1200, 2400, 4800, 9600, or 19,200 baud.

The printer has a 2800-byte buffer. Characters enter the buffer from either a parallel or serial interface and both types of interfaces can signal the computer or communications system when the buffer is full.

The parallel interface controls a special hardware signal which tells the computer system when there is room in the buffer for a character. As a result, the programmer need not worry about overflowing the buffer when programming the printer.

The serial interface has two methods of preventing the buffer from overflowing: It can signal the host to stop transmitting data by sending a hardware signal (for local connections), or by sending special control characters (full duplex).

Host-to-printer communications (control codes and print characters) for the printers occur as 7- or 8-bit data codes.

CONTROL CODES

The nonprintable control codes recognized by the printer are as follows. The values listed after the codes are in ⟨hexadecimal⟩.

ENQ
⟨05⟩
This code requests an ACK response.

ACK
⟨06⟩
Response to an ENQ to signify that the line containing it has been printed.

BELL
⟨07⟩
Sounds an audible tone.

HORIZONTAL TAB
⟨09⟩
The printhead moves to the next horizontal tab. If no tabs have been set, the code is ignored.

NEWLINE
⟨0A⟩
Terminates the present line and advances the paper one line. The printer then determines the most efficient direction of print for the next line. If no more lines are in the buffer, the printhead returns to park.

VERTICAL TAB
⟨0B⟩
Terminates the present line and advances paper to the next vertical tab. Subsequent actions are the same as those taken following paper advance with NEWLINE. If no tabs are set, the code is ignored.

FORMFEED
⟨0C⟩
Terminates the present line and advances paper to the top of the next form. Subsequent actions are the same as those taken following paper advance with NEWLINE.

CARRIAGE RETURN
⟨0D⟩
Terminates the present line without advancing the paper. Subsequent actions are the same as those taken following paper advance with NEWLINE.

SHIFT OUT
⟨0E⟩
Selects the alternate character set (G1).

SHIFT IN
⟨0F⟩
Selects the primary character set (G0).

ESCAPE (ESC)
⟨1B⟩
Denotes the beginning of a command sequence.

SPACE
⟨20⟩
Blank, no printing.

DELETE
⟨7F⟩
Ignored, no action taken.

DCS
⟨90⟩
A Device Control Sequence in ANSI, equivalent to: an ESC P ⟨1B 50⟩ escape sequence, used only by an 8-bit interface.

CSI
⟨9B⟩
A Control Sequence Introducer in ANSI, equivalent to: an ESC [⟨1B 5B⟩ escape sequence, used only by an 8-bit interface.

ST
⟨9C⟩
A String Terminator in ANSI, equivalent to: an ESC \ ⟨1B 5C⟩ escape sequence, used only by an 8-bit interface.

ESCAPE COMMAND SEQUENCES

These DASHER-compatible and ANSI command formats followed by one or more bytes will select or deselect features of the printer. The escape command sequences are shown with ASCII and hex values.

In the escape command tables the following definitions apply:

- The dollar sign $ denotes a binary value or a series of binary values.
- The n$ symbol denotes a 1-digit hex value or a series of hex values.
- The word "number" with no dollar sign denotes a decimal number.
- The $number symbol means unsigned binary bytes.

DASHER-Compatible Escape Command Sequences

These escape command sequences are listed in Table 3-1 and are described following this table.

Table 3-1. DASHER-Compatible Escape Command Sequences

Command	Function
ESC Y $SCSA $data $cksm ⟨1B 59 $SCSA $data $cksm⟩	Download Character Set
ESC N $numbers ⟨1B 4E $address⟩	Select Downloaded Character Set
ESC O ⟨1B 4F⟩	Deselect Downloaded Character Set
ESC) ⟨1B 3E⟩	Select Condensed Print
ESC ? ⟨1B 3F⟩	Deselect Condensed Print
ESC (⟨1B 3C⟩	Select Elongated Print
ESC = ⟨1B 3D⟩	Deselect Elongated Print
ESC c ⟨1B 63⟩	Master Reset
ESC E Null ⟨1B 45 00⟩	Clear Horizontal Tabs
ESC 2 ⟨1B 32⟩	Clear Horizontal Tab at Current Print Position
ESC E values NUL ⟨1B⟩ 45 $numbers 00⟩	Set Horizontal Tabs
ESC 1 ⟨1B 31⟩	Set Horizontal Tab at Current Print Position
ESC F Null ⟨1B 46 00⟩	Clear Vertical Tabs
ESC 6 ⟨1B 36⟩	Clear Vertical Tab at Current Line
ESC F values NUL ⟨1B 46 $numbers 00⟩	Set Vertical Tabs
ESC 5 ⟨1B 35⟩	Set Vertical Tab at Current Line
ESC a ⟨1B 61⟩	Select Underscore
ESC b ⟨1B 62⟩	Deselect Underscore

The DASHER-compatible escape command sequences are described as follows, in the order listed in Table 3-1.

DOWNLOAD CHARACTER SET
ESC Y $SCSA $data SCKSM
⟨1B 59 $SCSA $data $CKSM⟩
Requires an 8-bit interface. The printer has sufficient memory to download a 128-code character set with the blank regarded as a printable character. The starting address is 400H and codes from 1H-08H, 0FH-1AH, 1CH-7FH can be printed. Control codes from 09H-ODH and 1BH will not print. There are 120 individual characters that can be defined.

SELECT DOWNLOADED CHARACTER SET
ESC N Snumbers
⟨1B 4E $address⟩
Selects the downloaded character set for printing.

DESELECT DOWNLOADED CHARACTER SET
ESC O
⟨1B 4F⟩
Deselects the downloaded character set. Subsequent printing uses the standard character set.

SELECT CONDENSED PRINT
ESC ⟩
⟨1B 3E⟩
Condensed print gives 132 characters per line on 80-column paper or 226 characters per line on 136-column paper. Condensed print may be selected any place in a line and remains active until deselected. If condensed and normal print are both used on the same line, the line will be printed at the condensed speed, causing some loss in throughput.

DESELECT CONDENSED PRINT
ESC ?
⟨1B 3F⟩
Turns off condensed print mode.

SELECT ELONGATED PRINT
ESC ⟨
⟨1B 3C⟩
Elongated characters are twice the normal character width. This mode can be used with both regular and condensed print. Elongated print can be selected anywhere in a line, and remains active until deselected.

DESELECT ELONGATED PRINT
ESC =
⟨1B 3D⟩
Turns off elongated mode.

MASTER RESET
ESC c
⟨1B 63⟩
Resets all software features and reconfigures the printer to the configuration switch settings.

CLEAR HORIZONTAL TABS
ESC E Null
⟨1B 45 00⟩
Clears all horizontal tabs.

CLEAR HORIZONTAL TAB AT CURRENT PRINT POSITION
ESC 2
⟨1B 32⟩
Clears horizontal tab (if set) at the current print position.

SET HORIZONTAL TABS
ESC E values NUL
⟨1B 45 $numbers 00⟩
Clears existing horizontal tabs and sets new tabs at the specified column (character) positions. Horizontal tab positions will change as character pitch changes. Horizontal tabs can only be set to column 127 on 7-bit interfaces, unless ANSI mode is used.

The values (in unsigned binary bytes) specify the character positions where tabs are to be set. No delimiter is needed between settings and any number of tabs may be set as long as they are at valid character positions. By default, ESC E NUL clears the tabs.

SET HORIZONTAL TAB AT CURRENT PRINT POSITION
ESC 1
⟨1B 31⟩
Sets a tab at the current print position.

CLEAR VERTICAL TABS
ESC F Nul
⟨1B 46 00⟩
Clears all vertical tabs.

CLEAR VERTICAL TAB AT CURRENT LINE
ESC 6
⟨1B 36⟩
Clears a vertical tab (if set) at the current line.

SET VERTICAL TABS
ESC F values NUL
⟨1B 46 $numbers 00⟩
Clears existing vertical tabs and sets new tabs at the line positions (line numbers) specified by the values in unsigned binary bytes. A change in line density (lines per inch) will change the line number to which a vertical tab command will advance the paper.

The printer will operate with vertical tabs as the only line terminator. If a tab code is received and no more tabs are set in the current form, the printer will tab to the first tab in the new form. Any number of tabs may be set, but 112 lines are the maximum allowed in a form. By default ESC F NUL clears the tabs.

SET VERTICAL TAB AT CURRENT LINE
ESC 5
⟨1B 35⟩
Sets a vertical tab at the current line.

SELECT UNDERSCORE
ESC a
⟨1B 61⟩
Permits underlining of characters including spaces. The underscore is printed at the same time as the character.

NOTE: *Since underscoring runs printwire 9 at 100% duty cycle, it is advisable not to use underscoring more than 50% of the time on an average, or to leave underscore mode active for more than 10 pages of continuous print.*

DESELET UNDERSCORE
ESC b
⟨1B 62⟩
Turns off underscore mode.

ANSI-Compatible Escape Command Sequences

These escape command sequences are listed in Table 3-2 and are described following this table.

Table 3-2. ANSI-Compatible Escape Command Sequences

Command	Function
ESC) [code] ⟨1B 29 code⟩	Select Alternate Character Set
ESC ([code] ⟨1B 28 code⟩	Select Standard Character Set
ESC [value w ⟨1B 5B $number 77⟩	Select Character Pitch
ESC [0 w ⟨1B 5B 30 77⟩	Elongated Print at 5 cpi
ESC [2 w ⟨1B 5B 32 77⟩	Condensed-Elongated Print at 8.3 cpi
ESC [3 w ⟨1B 5B 33 77⟩	Memo-Quality Normal Print at 10 cpi
ESC [4 w ⟨1B 5B 34 77⟩	Normal Print at 10 cpi
ESC [6 w ⟨1B 5B 36 77⟩	Condensed Print at 16.7 cpi
ESC [8 w ⟨1B 5B 38 77⟩	Memo-Quality Elongated Print at 5 cpi
ESC [numbers r ⟨1B 5B N1; N2; N3; 72⟩	Select Forms Change
ESC [1 z ⟨1B 5B 31 7A⟩	Select 6 lpi
ESC [2 z ⟨1B 5B 32 7A⟩	Select 8 lpi
CSI x ⟨1B 5B 78⟩ or ⟨9B 78⟩	Model ID Request (Serial Printers)

Table 3-2. ANSI-Compatible Escape Command Sequences (continued)

Command	Function
CSI Model ID; status; software rev; no keyboard x ⟨1B 5B 36 35 3B 30 3(0-7) 3B 3(0-9) 3B 30 30 78⟩ or ⟨9B 36 35 3B 30 3(0-7) 3B 3(0-9) 3B 30 30 78⟩	Model ID Response (Serial Printers)
DCS code device data ST ⟨1B 50⟩ code device data ⟨1B 5C⟩ or ⟨90⟩ code device data ⟨9C⟩	Nibble Mode
DCS F A byte-count address data checksum ST ⟨1B 50 46 41⟩ byte-count address data checksum ⟨1B 5C⟩ or ⟨90 46 41⟩ byte-count address data checksum ⟨9C⟩	Download Nibble Mode Character Set
DCS I A data ST ⟨1B 50 49 41⟩ data ⟨1B 5C⟩ or ⟨90 49 41⟩ data ⟨9C⟩	Select Nibble Mode Graphics
ESC [3 g ⟨1B 5B 33 67⟩	Clear Horizontal Tabs
ESC [0 g ⟨1B 5B 30 67⟩	Clear Horizontal Tab at Current Print Position
ESC [numbers u ⟨1B 5B N1;...;Nx 75⟩	Set Horizontal Tabs
ESC H ⟨1B 48⟩	Set Horizontal Tab at Current Print Position
ESC [4 g ⟨1B 5B 34 67⟩	Clear Vertical Tabs
ESC [1 g ⟨1B 5B 31 67⟩	Clear Vertical Tab at Current Line
ESC [numbers v ⟨1B 5B N1;..;Nx 76⟩	Set Vertical Tabs
ESC J ⟨1B 4A⟩	Set Vertical Tab at Current Line
ESC [⟨ 3 h ⟨1B 5B 3C 33 68⟩	Set ANSI Terminal Command

Table 3-2. ANSI-Compatible Escape Command Sequences (continued)

Command	Function
⟨036⟩ F @ ⟨1E 46 40⟩	Set ANSI From DG Mode Terminal Command
ESC [2 h ⟨1B 5B 3C 32 68⟩	Reset ANSI to DG Mode Terminal Command
ESC [4 m ⟨1B 5B 34 6D⟩	Select Underscore
ESC [0 m ⟨1B 5B 30 6D⟩	Deselect Underscore

The ANSI-compatible escape command sequences are described as follows, in the order listed in Table 3-2.

SELECT ALTERNATE CHARACTER SET
ESC) [code]
⟨1B 29 code⟩
Selects an alternate character set. Table 3-3 specifies the character set code.

SELECT STANDARD CHARACTER SET
ESC ([code]
⟨1B 28 code⟩
Selects a standard or main character set. Refer to Table 3-3 for the code corresponding to the character sets available. Standard and alternate sets can be printed bidirectionally on a single line without causing a drop in throughput. One code selects the configuration switches.

Table 3-3. Character Set Selection Code

Code Hex	Code Dec	Character Set
42	B	U.S.
41	A	U.K.
32	2	Danish
52	R	French
4B	K	German
31	1	Spanish
48	H	Swedish
33	3	Swiss
4A	J	*Kana/ASCII
49	I	Kana/Japanese
34	4	Multilingual
30	0	Configuration switches
20 30	SP 0	Downloaded character set

** Same as U.S. except for the yen sign in place of the backslash.*

SELECT CHARACTER PITCH
ESC [value w
⟨1B 5B $number 77⟩
There are six command sequences which select the horizontal pitch (number of characters per inch) for the printer's six print styles. Samples of these print styles are shown in Figure 3-1. A new width selection does not require a deselection of the one previously selected. The value in the command is a decimal number 0, 2, 3, 4, 6, or 8. The $number is a hex 30, 32, 33, 34, 36, or 38; equivalent to decimal 0, 2, 3, 4, 6, or 8.

The six selection numbers and their corresponding print styles are:

- 0 - Elongated print at 5 cpi
- 2 - Condensed-elongated print at 8.3 cpi
- 3 - Memo-quality normal print at 10 cpi
- 4 - Normal print at 10 cpi
- 6 - Condensed print at 16.7 cpi
- 8 - Memo-quality elongated print at 5 cpi

SELECT FORMS CHANGE
ESC [numbers r
⟨1B 5B N1; N2; N3 72⟩
The form length, top margin, and bottom margin can be set from the host computer by this escape sequence. The numbers used are line numbers sent as ASCII decimal numbers delimited by semicolons. The printer must be at the Top of Form when this escape sequence is issued. If any parameters are invalid, an error is reported. Parameters may be omitted if there is no need to change them, if their position in the sequence is marked by semicolons.

N1 is form length, with a maximum value of 112.

N2 is the top margin where printing is to begin, and has a minimum value of 1 causing the first line to print at the Top of Form position. N2 must be equal to or less than the currently set form length.

N3 is the bottom margin, the line number for the last line of print. It must be greater than or equal to the top margin but less than or equal to the form length.

The following example changes just the bottom margin to line 63:

```
ESC [ ;;63 r
⟨1B 5B 3B 3B 36 33 72⟩
```

The default form length is determined by the 6/8 LPI and the 11/12-inch form configuration switches. The default top margin is 1 and the default bottom margin is either the last line in the form (no bottom margin skip) or 1 inch (6 or 8 lines) less than the form length.

The next example shows a typical forms setting escape sequence for a form length of 66, a top margin of 4, and a bottom margin of 63:

```
FF ESC [ 66; 4; 63 r
⟨0C 1B 5B 36 36 3B 34 3B 36 33 72⟩
```

ELONGATED (5 CPI)

```
  ! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
```

NORMAL (10 CPI)

```
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~
```

CONDENSED-ELONGATED (8.3 CPI)

```
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~
```

CONDENSED (16.7 CPI)

```
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~
```

MEMO-QUALITY ELONGATED (5 CPI)

```
  ! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
```

MEMO-QUALITY NORMAL (10 CPI)

```
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~
```

Figure 3-1. Character Pitch Print Samples

SELECT SIX LINES PER INCH
ESC [1 z
⟨1B 5B 31 7A⟩
Selects 6 lpi vertical spacing.

SELECT EIGHT LINES PER INCH
ESC [2 z
⟨1B 5B 32 7A⟩
Selects 8 lpi vertical spacing.

MODEL ID REQUEST (Serial Printer Only)
CSI x
⟨1B 5B 78⟩
or
⟨9B 78⟩
Requests that the printer send its model identification and status information. This command sequence can only be used with the serial interface printer.

MODEL ID RESPONSE (Serial Printer Only)
CSI Model ID ; status ; software rev ; no keyboard x
⟨1B 5B 36 35 3B 30 3(0-7) 3B 3(0-9) 3B 30 30 78⟩
or
⟨9B 36 35 3B 30 3(0-7) 3B 3(0-9) 3B 30 30 78⟩
The Model ID for this printer is 65 and is sent as 2 ASCII digits. The semicolon is the delimiter.

The status word consists of 2 bytes as follows:

The first status byte (always ⟨30⟩ for the serial printer) is:
Bit 7 = 0 (the most significant bit)
Bit 6 = 0
Bit 5 = 1
Bit 4 = 1
Bit 3 = 0
Bit 2 = 0 (Reserved)
Bit 1 = 0 (Reserved)
Bit 0 = 0 (Black ribbon)
= 1 (Color ribbon)

The second status byte is:
Bit 7 = 0 (the most significant bit)
Bit 6 = 0
Bit 5 = 1
Bit 4 = 1
Bit 3 = 0
Bit 2 = 0 (No printer error)
= 1 (Error condition exists)
Bit 1 = 0 (7-bit interface mode)
= 1 (8-bit interface mode)
Bit 0 = 0 (Printer off-line)
= 1 (Printer on-line)

The software rev is an ASCII decimal number from 0 through 9. The last 2 zeros (⟨30⟩ ⟨30⟩) indicate no keyboard on this device. The x (⟨78⟩) terminates the escape sequence.

Status example:

A printer off-line, on an 8-bit interface, with an error detected, would have the first status word ⟨30⟩, and the second status word 001100110 equal to ⟨36⟩. The status codes returned would be ⟨30⟩ ⟨36⟩.

NIBBLE MODE
DCS code device data ST
⟨1B 50⟩ code device data ⟨1B 5C⟩
or
⟨90⟩ code device data ⟨9C⟩
Allows features (functions) which normally require an 8-bit interface to be used on 7-bit interfaces. It is also used for sequences having binary-coded decimal data, and for firmware features. The ENQ ⟨05⟩ will not be responded to by an ACK ⟨06⟩ when the printer is in the nibble mode, but will be treated as nibble data.

In the format DCS code device data, DCS begins a Device Control Sequence, and code is a 7-bit command byte which selects the function. Device is the symbol for the printer in use, which is A for the Model 6215/6216 printer. All subsequent data are nibble-mode with only the 4 low-order data bits 0 through 3 of each byte valid. The upper half of the byte is sent first, followed by the lower half to make up an 8-bit byte in the printer. The first of a pair of received nibbles becomes the most significant nibble when the nibble pair is concatenated.

All data transferred in the nibble mode must be printable data, that is, no codes from 0 to 20 hex. All values that would fall in the range ⟨00⟩ to ⟨20⟩ are translated to ⟨30⟩ through ⟨3F⟩. The first nibble value is always 0011 (⟨30⟩) for data information and the second nibble ranges from 0000 through 1111 (⟨00⟩ through ⟨0F⟩). Thus each 8-bit data byte will range in value from ⟨30⟩ + ⟨00⟩ = ⟨30⟩, through ⟨30⟩ + ⟨0F⟩ = ⟨3F⟩.

The sequence is ended or aborted by the ST, string terminator sequence, ESC \ ⟨1B 5C⟩ or ⟨9C⟩.

DOWNLOAD NIBBLE MODE CHARACTER SET
DCS F A byte-count address data checksum ST
⟨1B 50 46 41⟩ byte-count address data checksum ⟨1B 5C⟩
or
⟨90 46 41⟩ byte-count address data checksum ⟨9C⟩
A character set can be loaded into RAM using this escape sequence.

This set can be selected with another escape sequence and can be printed bidirectionally. It may be used with other sets with no loss of throughput.

The dot patterns are specified for the 7x9-dot character cell defined by wire 1 (top row) through wire 9 (bottom) and column 1 (leftmost) through column 7 (rightmost).

The dot patterns must not require the same wire to be fired on successive dot columns unless the characters are printed in memo-quality mode. If memo-quality print has not been selected when the user-defined characters are selected, the printer will perform an exclusive-or operation for each printwire using data for present and previous positions. This avoids firing any wire twice in a row.

On large character sets the average number of dots per character should not exceed 13 and the average number of dots per character on any dot row should not exceed 2.8.

The format of the escape command sequence is:

DCS F A byte-count address data checksum ST
⟨1B 50 46 41⟩ byte-count address data checksum ⟨1B 5C⟩
or
⟨90 46 41⟩ byte-count address data checksum ⟨9C⟩

where:

DCS is a Device Control Sequence ⟨1B 50⟩ or ⟨90⟩

F is the feature function code ⟨46⟩

A is the Model 6215/6216 printer code ⟨41⟩

byte-count is a 4-nibble value defining the number of data nibbles

address is a 4-nibble value 0000H to 03F0H (the starting address of the character set)

data (D, 1 = wire fired, 0 = not fired) is in nibble form:

Wire 9 columns 1-4 0011 DDDD
Wire 9 columns 5-8 0011 DDDD
Column 1 wires 1-4 0011 DDDD
Column 1 wires 5-8 0011 DDDD
Column 2 wires 1-4 0011 DDDD
Column 2 wires 5-8 0011 DDDD
Column 3 wires 1-4 0011 DDDD
Column 3 wires 5-8 0011 DDDD
Column 4 wires 1-4 0011 DDDD
Column 4 wires 5-8 0011 DDDD
Column 5 wires 1-4 0011 DDDD
Column 5 wires 5-8 0011 DDDD
Column 6 wires 1-4 0011 DDDD
Column 6 wires 5-8 0011 DDDD
Column 7 wires 1-4 0011 DDDD
Column 7 wires 5-8 0011 DDDD

checksum is 2 nibble values that form an 8-bit checksum, modulo 256

ST is a String Terminator ⟨1B 5C⟩ or ⟨9C⟩

SELECT NIBBLE MODE GRAPHICS
DCS I A data ST
⟨1B 50 49 41⟩ data ⟨1B 5C⟩
or
⟨90 50 49 41⟩ data ⟨9C⟩
In the graphics mode, "command bytes" embedded in the data stream control the printhead motion (conventional ASCII control codes are not used). Once graphics mode is selected, it remains active until explicitly deselected. Table 3-4 defines the commands recognized in graphics mode.

Table 3-4. Graphics Mode Commands

Data at Interface	Command Byte (Bit 6 = Logic 1)
0100 1010	Full Line Feed
0100 1100	Form Feed
0100 1101	Carriage Return
0100 1001	Double Density Graphics Select
0100 1011	1/16 of Full Line Feed
0100 0111	5/16 of Full Line Feed
0101 DDDD	Blank Columns-High
0101 DDDD	Blank Columns-Middle
0101 DDDD	Blank Columns-Low
0011 DDDD	Wires 1 to 4
0011 DDDD	Wires 5 to 8

D = valid data 1 (wire fired) or 0 (not fired)

Only printable data are defined in nibble pairs, with the first nibble specifying the wire firing pattern for the upper wires (wires 1 through 4) and the second specifying wires 5 through 8. Bit 6 of any character containing a data nibble must be set to 0.

A data compression scheme allows skipping over blank print columns. The number of blank print columns is specified in 3 nibbles. The characters containing the nibbles have bits 4 and 6 coded as 1's and bit 5 coded as 0, to denote the "blank column" command.

A double density function can be used to print 133 dpi in the horizontal plane. A double density line feed increases the vertical density to 133 dpi, and causes the paper to move about 1/2 dot position.

Refer to the section USING GRAPHICS in this chapter for an example using this command.

CLEAR HORIZONTAL TABS
ESC [3 g
⟨1B 5B 33 67⟩
Clears all horizontal tabs.

CLEAR HORIZONTAL TAB AT CURRENT PRINT POSITION
ESC [0 g
⟨1B 5B 30 67⟩
Clears horizontal tab (if set) at the current print position.

SET HORIZONTAL TABS
ESC [numbers u
⟨1B 5B N1;...;Nx 75⟩
This command sets tabs only but does not clear previously set tabs. A maximum of 16 tabs may be set with one command sequence, and they are sent as ASCII decimal numbers delimited by semicolons.

SET HORIZONTAL TAB AT CURRENT PRINT POSITION
ESC H
⟨1B 48⟩
Sets a single tab at the current print position.

CLEAR VERTICAL TABS
ESC [4 g
⟨1B 5B 34 67⟩
Clears all vertical tabs.

CLEAR VERTICAL TAB AT CURRENT LINE
ESC [1 g
⟨1B 5B 31 67⟩
Clears a vertical tab (if set) at the current printhead line.

SET VERTICAL TABS
ESC [numbers v
⟨1B 5B N1;...;Nx 76⟩
This command sets tabs only but does not clear previously set tabs. A maximum of 16 tabs may be set with one command sequence, and they are sent as ASCII decimal numbers delimited by semicolons.

SET VERTICAL TAB AT CURRENT LINE
ESC J
⟨1B 4A⟩
Sets a vertical tab at the current line.

TERMINAL COMMANDS

SET ANSI
ESC [⟨ 3 h
⟨1B 5B 3C 33 68⟩

SET ANSI FROM DG MODE
⟨036⟩ F @
⟨1E 46 40⟩

RESET ANSI TO DG MODE
ESC [2 h
⟨1B 5B 3C 32 68⟩

These codes are recognized by some DG terminals as commands to set the mode of the terminal to ANSI or DG. They are accepted by the printer but do not initiate any printer action.

SELECT UNDERSCORE
ESC [4 m
⟨1B 5B 34 6D⟩
Permits underlining of characters and spaces. The underscore is printed at the same time as the character.

> **NOTE:** *Since underscoring runs printwire 9 at 100% duty cycle, it is advisable not to use underscoring more than 50% of the time on an average, or to leave underscore mode active for more than 10 pages of continuous print.*

DESELECT UNDERSCORE
ESC [0 m
⟨1B 5B 30 6D⟩
Turns off underscore mode.

8-Bit Graphics Escape Command Sequences

These escape command sequences are listed in Table 3-5 and are described following this table. Graphics print samples are shown in Figure 3-2.

Table 3-5. 8-Bit Graphics Escape Command Sequences

Command	Function
ESC % 4 N1 N2 Data LF ⟨1B 25 34 BC Data 0A⟩	Select 8-Bit Graphics: H-Dens 67 DPI, V-Dens 69 BPI
ESC % 6 N1 N2 Data LF ⟨1B 25 36 BC Data 0A⟩	Select 8-Bit Graphics: H-Dens 133 DPI, V-Dens 69 BPI
ESC % 3 N1 N2 Data CR ⟨1B 25 33 BC Data 0D⟩ or ESC % 4 N1 N2 Data LF ⟨1B 25 34 BC Data 0A⟩	Select 8-Bit Graphics: H-Dens 67 DPI, V-Dens 133 BPI
ESC % 5 N1 N2 Data CR ⟨1B 25 35 BC Data 0D⟩ or ESC % 6 N1 N2 Data LF ⟨1B 25 36 BC Data 0A⟩	Select 8-Bit Graphics: H-Dens 133 DPI, V-Dens 137 BPI

There are four different escape sequences to specify horizontal and vertical dot density. All of the escape sequences begin with ESC %, followed by a decimal number, a 2-byte (16-bit) byte count, and the graphics data to be printed left to right on a first-in first-out basis.

In Table 3-5, the BC stands for byte count, a 16-bit unsigned binary number equal to the total number of data bytes that are to follow. The N1 is the least significant byte and N2 is the most significant byte. The byte count should be equal to the number of data bytes being sent. The least significant byte is to be sent first. A line terminator should follow the data stream to select the position for the next line. Line feed (LF) and carriage return (CR) must be used in the proper sequence to obtain 133 DPI vertical density.

Graphics data is printed 8 dots at a time in the vertical plane. The most significant bit (MSB) of the data word controls the firing of the top print wire and the least significant bit (LSB) the bottom print wire.

DEFINING/LOADING/SELECTING A CHARACTER SET

The printer allows character set definition for up to 120 7x9-dot matrix characters. Once each character has been defined, the set is loaded into memory with an escape sequence. Additional escape sequences allow selecting the character set. When the printer is turned off, a downloaded character set must be reloaded.

The character shown in Figure 3-3 will be used as an example for defining and loading (in nibble mode) one character that could be part of a character set. Also, the ANSI selection commands of Table 3-2 will be listed. When the downloaded character set is selected and a value of ⟨21⟩ is received at the interface, the downloaded dot pattern of Figure 3-3 will be printed instead of the standard "!" character.

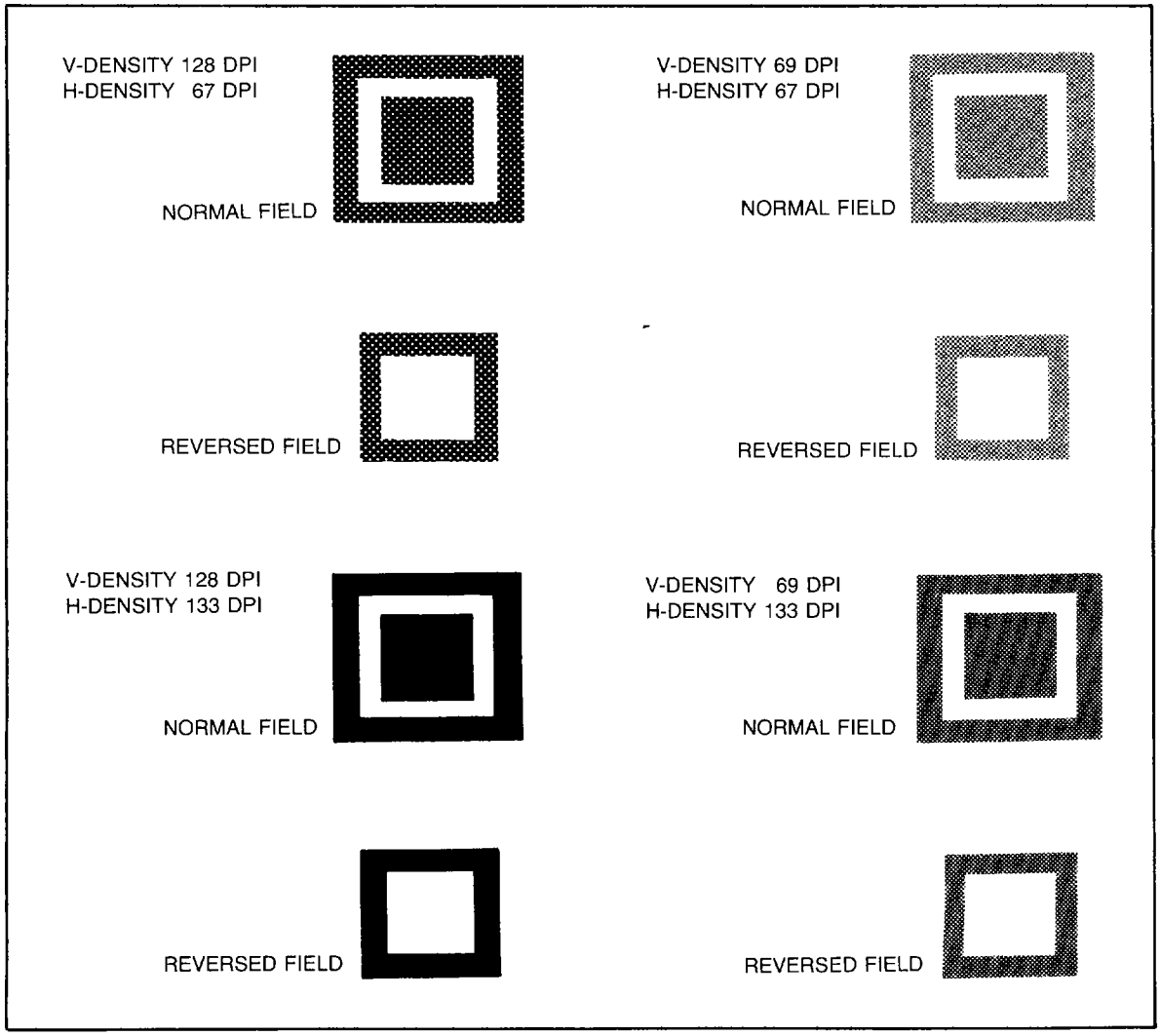


Figure 3-2. Graphics Print Samples

Defining a Character Set

Any printing character (including 1-8H, 0F-1A, and 1C-7F) may be defined except control codes. Each dot pattern in a character set is defined using a 7x9-dot matrix as shown in Figure 3-3. How characters are actually printed is given in the following paragraphs.

The 7x9 print matrix is filled in with the dots for the character to be defined, as in Figure 3-3. Notice there are 8 columns called out but only 7 are shown. Column 8 is always blank. The dots to be printed are selected using the printhead firing codes. These codes are in two nibbles: the first nibble is always binary 0011 and the second nibble (DDDD) selects the wires to fire. A "1" in the firing code indicates that the corresponding wire will be fired when that column is printed. A "0" in the firing code indicates that the wire will not be fired. Print wires may not be consecutively fired (i.e., the same bit may not be a "1" in two successive firing codes) unless in memo-quality mode.

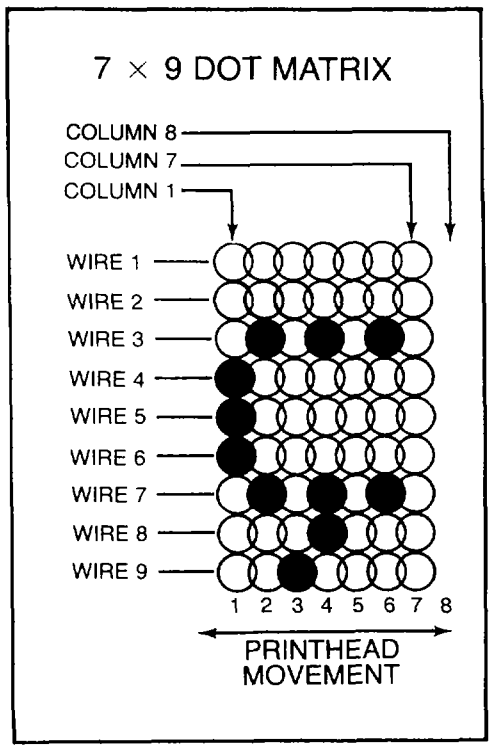


Figure 3-3. Download Character Example

For Figure 3-3, the printhead firing codes (second nibble) are as follows:

Wire 9 columns 1-4 0011 0010
Wire 9 columns 5-8 0011 0000
Column 1 wires 1-4 0011 0001
Column 1 wires 5-8 0011 1100
Column 2 wires 1-4 0011 0010
Column 2 wires 5-8 0011 0010
Column 3 wires 1-4 0011 0000
Column 3 wires 5-8 0011 0000
Column 4 wires 1-4 0011 0010
Column 4 wires 5-8 0011 0011
Column 5 wires 1-4 0011 0000
Column 5 wires 5-8 0011 0000
Column 6 wires 1-4 0011 0010
Column 6 wires 5-8 0011 0010
Column 7 wires 1-4 0011 0000
Column 7 wires 5-8 0011 0000

Once the firing codes for a character are determined, they must be put into a format to allow them to be loaded into the printer.

Loading A Character Set

The format of the escape command sequence to load a character set is:

DCS F A byte-count address data checksum ST
⟨1B 50 46 41⟩ byte-count address data checksum ⟨1B 5C⟩
or
⟨90 46 41⟩ byte-count address data checksum ⟨9C⟩

where:

DCS is a Device Control Sequence ⟨1B 50⟩ or ⟨90⟩

F is the feature function code ⟨46⟩

A is the Model 6215/6216 printer code ⟨41⟩

byte-count is a 4-nibble value defining the number of data nibbles

address is a 4-nibble value 0000H to 03F0H (the starting address of the character set)

data (dot-pattern) is in nibble form

checksum is 2 nibble values that form an 8-bit checksum, modulo 256

ST is a String Terminator ⟨1B 5C⟩ or ⟨9C⟩

In order to understand the format used in downloading a character set, it is useful to visualize the printer memory as ⟨400⟩ 8-bit wide words.

Figure 3-4 shows the character set organization in memory. The downloaded character set begins at word ⟨00⟩ and extends to word ⟨3FF⟩. Each character requires 8 words of storage; so the ⟨400⟩ words in the character set storage area can store 128 characters.

The location of the downloaded dot pattern in the character set storage area determines which ASCII code will print that dot pattern. ASCII code ⟨00⟩ prints the first dot pattern in the character set storage area. This pattern occupies the 8 words from ⟨00⟩ to ⟨01⟩. Likewise, ASCII code ⟨01⟩ will print the dot pattern beginning at word ⟨08⟩ and ending with word ⟨0F⟩. This suggests a formula for determining which locations should contain the dot pattern printed by any ASCII code:

address (starting) = ⟨00⟩ + [⟨ASCII code⟩ x ⟨08⟩]

The address in the formula is the address containing the first word in the ASCII code's dot pattern. The other 7 words in the dot pattern follow in the next 7 addresses. Using the formula, the addresses for the last dot pattern (corresponding to ASCII code ⟨7F⟩ can be found:

address = ⟨00⟩ + [⟨7F⟩ x ⟨08⟩] = ⟨3F8⟩

So the last dot pattern resides in words ⟨3F8⟩ - ⟨3FF⟩. This is the very top of the character set storage area.

When downloading a dot pattern into memory, define which ASCII code prints that pattern by specifying the correct starting address for the load.

Character sets do not need to be downloaded one dot pattern at a time. With this escape command sequence, any number of dot patterns (up to 128) may be loaded into memory. The only restriction is that the printer will load the dot patterns sequentially into memory beginning at the specified starting address.

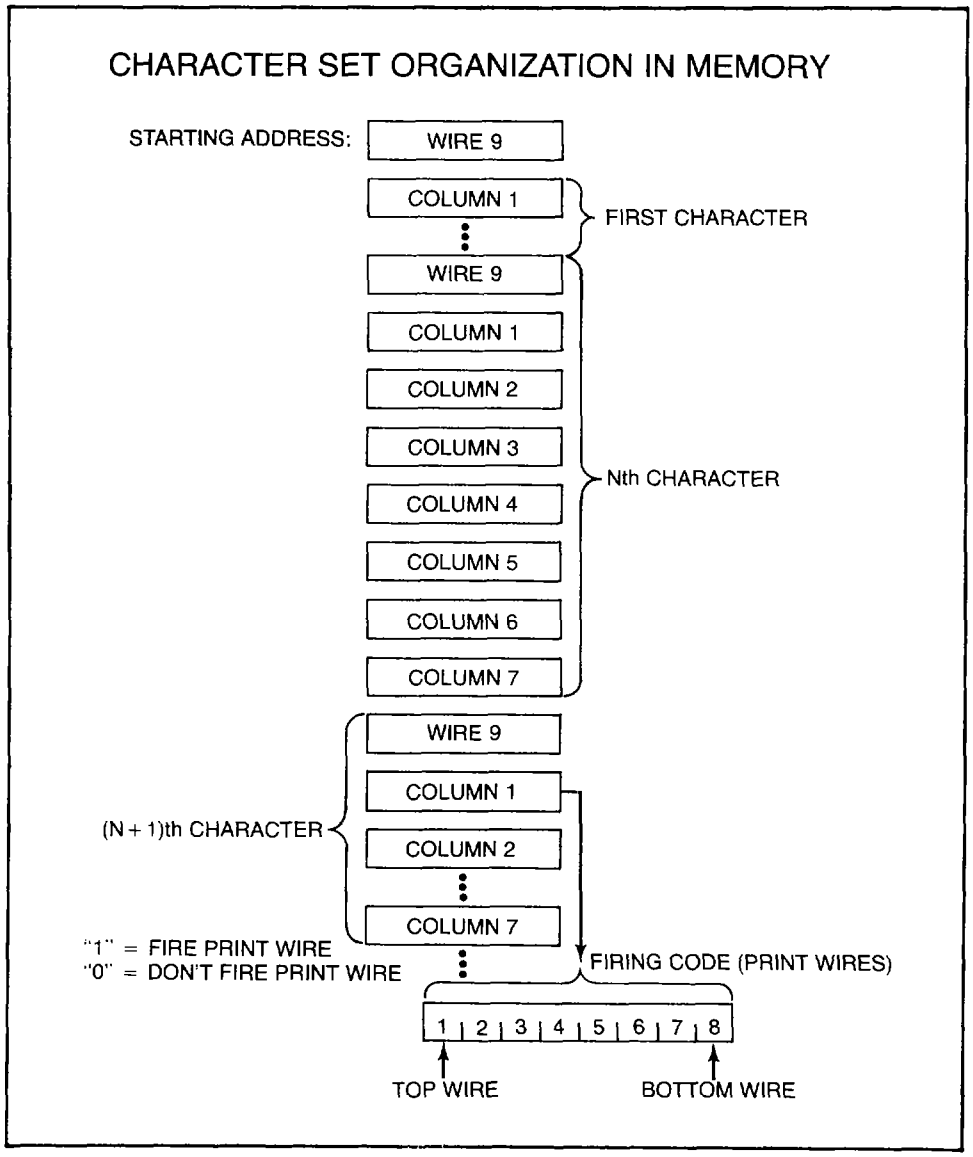


Figure 3-4. Character Set Organization in Memory

The communication interface receiving the download character set escape command sequence may receive only 7 bits at a time. Therefore, dot patterns are loaded sequentially into memory 1 nibble at a time. The dot patterns consist of firing codes contained in 8-bit bytes, which must be broken into two 4-bit nibbles before transmitting them to the printer. When sending a byte to the printer in 2 nibbles, the left nibble is always transmitted before the right.

In addition to the nibbles split from bytes in the dot patterns (data), the escape command sequence also sends the following information:

- Byte-count — Defines how many dot patterns are to be loaded in this escape command sequence by specifying the number of bytes contained in the dot patterns, as follows:

  byte-count = dot patterns x 8 bytes/pattern

- Address — Defines which ASCII codes print the dot patterns downloaded in this escape sequence by specifying the address in the character set storage area where the first of the consecutive dot patterns begins. The (starting) address is:

  starting address = [⟨ASCII code⟩ x ⟨08⟩]

- Checksum — A number used by the printer at the end of a load sequence to determine if any data errors occurred during the load. The 1-byte checksum is obtained by summing all the data nibbles ignoring any carry. This sum does not include the byte-count or the starting address, just the bytes containing the firing codes.

The entries for the escape command sequence DCS ⟨1B 50⟩ or ⟨90⟩, used to load a printer with a character (set) are outlined in the following steps. These entries are for loading the character of Figure 3-3 to replace the character "!".

1. In the escape sequence, F is the function code and A is the Model 6215/6216 printer code.

2. The byte-count is determined from the number of characters to be defined (1, in this example), multiplied by the number of words required for each character (8):

   byte-count = characters x 8 words each
   = 1 x 8 = 8 = ⟨08⟩
   = 0000 0000 0000 1000 nibbles

   Divide this into 4 nibbles, left nibble first: ⟨30⟩⟨30⟩⟨30⟩⟨38⟩

3. The starting address for the character to be replaced (the ASCII code for "!" is ⟨21⟩:

   address = ⟨21⟩ x ⟨08⟩ = ⟨108⟩
   = 0000 0001 0000 1000 nibbles

   Divide this into 4 nibbles, left nibble first: ⟨30⟩⟨31⟩⟨30⟩⟨38⟩

4. The firing codes are obtained from the data of Figure 3-3:

Wire 9 columns 1-4 0011 0010
Wire 9 columns 5-8 0011 0000
Column 1 wires 1-4 0011 0001
Column 1 wires 5-8 0011 1100
Column 2 wires 1-4 0011 0010
Column 2 wires 5-8 0011 0010
Column 3 wires 1-4 0011 0000
Column 3 wires 5-8 0011 0000
Column 4 wires 1-4 0011 0010
Column 4 wires 5-8 0011 0011
Column 5 wires 1-4 0011 0000
Column 5 wires 5-8 0011 0000
Column 6 wires 1-4 0011 0010
Column 6 wires 5-8 0011 0010
Column 7 wires 1-4 0011 0000
Column 7 wires 5-8 0011 0000

5. Determine the checksum from the data bytes. From step 3, list only the two 4-bit firing codes for wire 9 and firing codes for each column's wires 1-4 and 5-8. The sum of these nibbles forms the checksum, as follows:

Wires		Firing Code (Binary)	Firing Code Sum (Binary)
9		0010 →	0010 + 0000 = 0010
		0000 →	
Column 1	1-4	0001 →	0001 + 0010 = 0011
	5-8	1100 →	
			1100 + 0011 = 1111
Column 2	1-4	0010 →	0010 + 1111 = 0001
	5-8	0010 →	0010 + 0001 = 0011
Column 3	1-4	0000	0000 + 0011 = 0011
	5-8	0000	0000 + 0011 = 0011
Column 4	1-4	0010	0010 + 0011 = 0101
	5-8	0011	0011 + 0101 = 1000
Column 5	1-4	0000	0000 + 1000 = 1000
	5-8	0000	0000 + 1000 = 1000
Column 6	1-4	0010	0010 + 1000 = 1010
	5-8	0010	0010 + 1010 = 1100
Column 7	1-4	0000	0000 + 1100 = 1100
	5-8	0000	0000 + 1100 = 1100
Sum			= 1100
Sum (8-bits) 0000 1100			= ⟨00⟩ + ⟨0C⟩ = ⟨0C⟩
Sent out as 2 nibbles: ⟨0C⟩			= ⟨30⟩⟨3C⟩
			= X011 0000 X011 1100

Therefore, the download sequence for the defined character of Figure 3-3 is:

ESC P F A byte-count address
⟨1B⟩ ⟨50⟩ ⟨46⟩ ⟨41⟩ ⟨30⟩⟨30⟩⟨30⟩⟨38⟩ ⟨30⟩⟨31⟩⟨30⟩⟨38⟩

data
⟨31⟩⟨30⟩⟨31⟩⟨3C⟩⟨32⟩⟨32⟩⟨30⟩⟨30⟩⟨32⟩⟨33⟩⟨30⟩⟨30⟩⟨32⟩⟨32⟩⟨30⟩⟨30⟩

checksum ST
⟨30⟩⟨3B⟩ ⟨1B⟩⟨5C⟩

These entries are diagrammed in Table 3-6 which shows the completed ANSI escape command sequence for loading the character of Figure 3-3 into the printer.

Table 3-6. ANSI Escape Command Sequence Loading

Entry	Hex Value	Data at Interface
ESC	1B	0001 1011
P nibble mode	50	0101 0000
F function code	46	0100 0110
A device code	41	0100 0001
0 byte-count	30	0011 0000
0 high order	30	0011 0000
0 then low	30	0011 0000
8 count = 0008	38	0011 1000
0 starting address	30	0011 0000
1	31	0011 0001
0	30	0011 0000
8 address = 0108	38	0011 1000
wire 9 col 1 to 4	31	0011 0010
wire 9 col 5 to 7	30	0011 0000
col 1 wires 1 to 4	31	0011 0001
col 1 wires 5 to 8	3C	0011 1100
col 2 wires 1 to 4	32	0011 0010
col 2 wires 5 to 8	32	0011 0010
col 3 wires 1 to 4	30	0011 0000
col 3 wires 5 to 8	30	0011 0000
col 4 wires 1 to 4	32	0011 0010
col 4 wires 5 to 8	33	0011 0011
col 5 wires 1 to 4	30	0011 0000
col 5 wires 5 to 8	30	0011 0000
col 6 wires 1 to 4	32	0011 0010
col 6 wires 5 to 8	32	0011 0010
col 7 wires 1 to 4	30	0011 0000
col 7 wires 5 to 8	30	0011 0000
checksum	30	0011 0000
	3C	0011 1100
ESC	1B	0001 1011
\	5C	0101 1110

Selecting the Character Set

The ANSI escape comand sequences for this are given in Table 3-7. Use one of these escape command sequences to select the character set as the alternate or standard character set.

Table 3-7. Character Set Select

Escape Sequence	Function
ESC) [SP 0] ⟨1B 29 20 30⟩	Select Alternate Character Set
ESC ([SP 0] ⟨1B 28 20 30⟩	Select Standard Character Set

USING GRAPHICS

Graphics is a standard feature on all of these printers. In this mode, 8 of the printhead's 9 firing wires (the top 8) are under direct user control. The wires print in vertical columns and each column is printed separately. The printer prints from left to right, up to 907 columns per line.

The relationship between an 8-bit code and the printhead wires which are fired is shown in Figure 3-5 and Table 3-4. The numeral 1 in a bit position fires the corresponding printhead wire.

Enter the graphics mode by issuing a line terminator, i.e., Newline ⟨0A⟩, Vertical Tab ⟨0B⟩, Form Feed ⟨0C⟩, or Carriage Return ⟨0D⟩, followed by DCS I A data ST from Table 3-2.

After entering the graphics mode, issue the series of nibble codes which define the columns to print. These columns will not be printed until after the current line is terminated. To terminate a line, use command bytes.

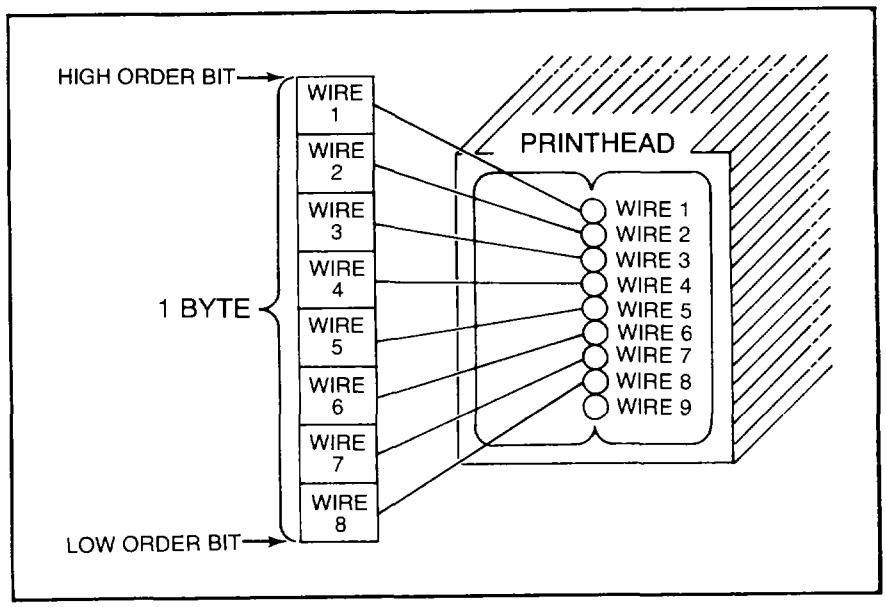


Figure 3-5. Printhead Firing Code

Various combinations of horizontal and vertical dot spacings per inch may be used, with throughput depending on dot density. When more than 40 columns are blank, a slew speed of twice the normal print speed is used to position to the next nonblank print column. Trailing blanks will be ignored.

An example will show how to draw a 16x16 dot matrix square at the left margin. Refer to Figure 3-6. Determine the codes needed and the order in which to send them, as given in the following chart.

The sequence used to draw the square of Figure 3-6 is:

Hex Code	Description
⟨XX⟩	Issue a Newline ⟨0A⟩ or Vertical Tab ⟨0B⟩ or Form Feed ⟨0C⟩ or Carriage Return ⟨0D⟩
⟨1B⟩ ⟨50⟩ ⟨49⟩ ⟨41⟩	Enter graphics mode. Command is ESC P I A
	Prints column 1, first line, in 2 parts:
⟨3F⟩	Data to fire wires 1-4, 0011 1111 = ⟨30⟩ + ⟨3F⟩ = ⟨3F⟩
⟨3F⟩	Data to fire wires 5-8, 0011 1111 = ⟨30⟩ + ⟨3F⟩ = ⟨3F⟩
	Sent 14 times, prints columns 2-15, first line, 2 parts:
⟨38⟩	Data to fire wire 1, 0011 1000 = ⟨30⟩ + ⟨08⟩ = ⟨38⟩
⟨30⟩	Data to fire no wires 5-8, 0011 0000 = ⟨30⟩ + ⟨00⟩ = ⟨30⟩
⟨3F⟩	Prints column 16, part 1 of first line (fires wires 1-4)
⟨3F⟩	Prints column 16, part 2 of first line (fires wires 5-8)
⟨4A⟩	Command byte, line feed
	Prints column 1, second line, in 2 parts:
⟨3F⟩	Data to fire wires 1-4, 0011 1111 = ⟨30⟩ + ⟨3F⟩ = ⟨3F⟩
⟨3F⟩	Data to fire wires 5-8, 0011 1111 = ⟨30⟩ + ⟨3F⟩ = ⟨3F⟩
	Sent 14 times, prints columns 2-15, second line, 2 parts
⟨30⟩	Data to fire no wires 1-4, 0011 0000 = ⟨30⟩ + ⟨00⟩ = ⟨30⟩
⟨31⟩	Data to fire wire 8, 0011 0001 = ⟨30⟩ + ⟨01⟩ = ⟨31⟩
⟨3F⟩	Prints column 16, part 1 of second line (fires wires 1-4)
⟨3F⟩	Prints column 16, part 2 of second line (fires wires 5-8)
⟨4A⟩	Command byte, line feed
⟨1B⟩ ⟨5C⟩	Exit graphics mode. Command is ESC \

PROGRAMMING RULES SUMMARY

The number of normal width characters plus twice the number of elongated characters within a line must not exceed 136.

Issue these escape command sequences anywhere within a line:

1. Underscore on or off.
2. Elongated character(s) select or deselect.
3. Compressed print select or deselect.
4. Alternate character set download or select or deselect.
5. Set and clear tabs at current position. Do not change pitch or line density when using these commands.

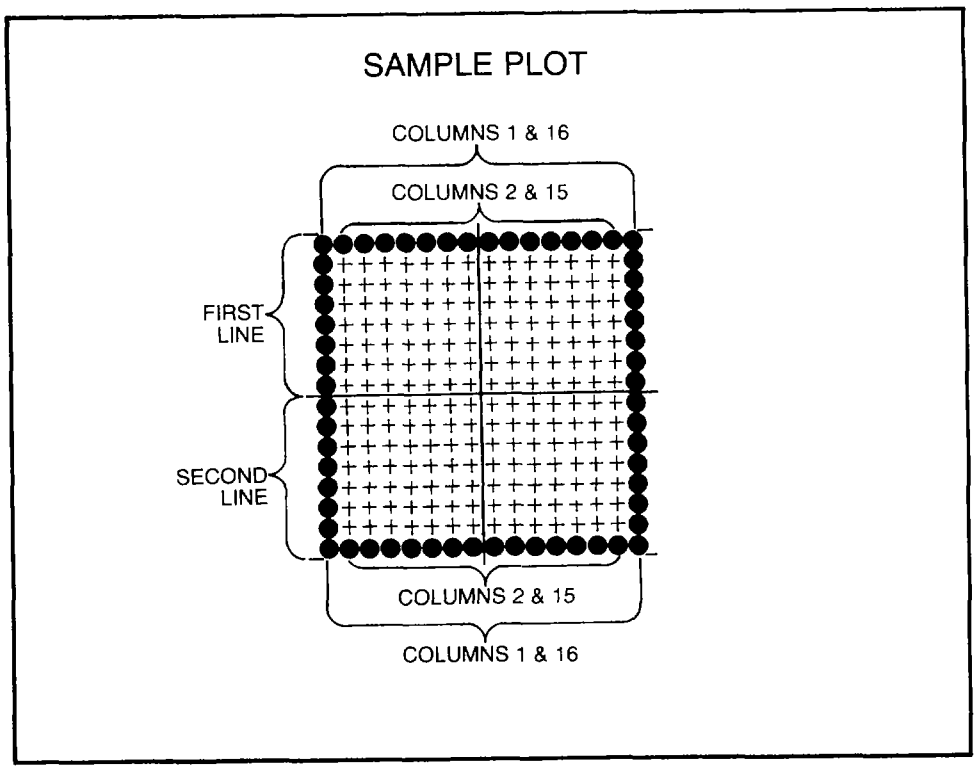


Figure 3-6. Graphics Example

Issue these escape command sequences only after a line terminator (Newline, Vertical Tab, or Carriage Return):

1. Horizontal multiple tabs set or clear.
2. Vertical tab set or clear.
3. Graphics mode enter.
4. Character set download.

Issue these escape command sequences only after a Form Feed terminator (they alter the top of form position to the present position):

1. Forms control
2. Master reset

PRINTER DEMONSTRATION PROGRAM

The following text file material, when spaced and entered as shown into a computer file and sent to a Model 6215 or 6216 printer, will demonstrate (Figure 3-7) some of the printer's capabilities. The demonstration program also could be written in BASIC in a similar manner, to produce similar results.

NOTE: *In the text material to be entered, the symbol ⟨33⟩ means an escape code must be entered instead of the ⟨33⟩.*

```
⟨33⟩c
⟨33⟩[4w⟨33⟩[1z⟨33⟩(B
    These print samples show some capabilities of the
    Model 6215/6216 Dot Matrix Printer. This is
    normal printing spaced 10 CPI horizontally and 6
    LPI vertically. It has a pleasing appearance. The
    U.S. ASCII character set looks like this:
    !"#$%&'()* +,-./0123456789:;⟨=⟩?@ABCDEFGHIJKLMNO
    PQRSTUVWXYZ[\] ^_`abcdefghijklmnopqrstuvwxyz{|} ~
    ⟨33⟩[2z
    To put more lines in less space, use a vertical
    line spacing of 8 LPI, as shown here in normal
    print. Other print styles also may be used.
    ⟨33⟩[1z
    ⟨33⟩[3w
    This is memo-quality normal print spaced
    at 10 CPI horizontally and 6 LPI vertically.
    It prints darker than normal printing.
    ⟨33⟩[0w
Elongated characters are twice
the width of normal characters.
The character set is as follows:
  !"#$%&'()* +,-./01234567
89:;⟨=⟩?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\] ^_`abcdefg
hijklmnopqrstuvwxyz{|} ~

    ⟨33⟩[8w
Memo-quality elongated
printing at 5 characters
per inch looks this way.
A unique type of print.
    ⟨33⟩[6w
        Condensed printing at 16.7 characters per inch
        allows more characters per line. The condensed
        printing character set prints out as follows:
        !"#$%&'()* +,-./0123456789:;⟨=⟩?@ABCDEFGHIJKLMNO
        PQRSTUVWXYZ[\] ^_`abcdefghijklmnopqrstuvwxyz{|} ~
    ⟨33⟩[2w
    The condensed elongated character set
    (with underscore turned on)
    is shown below:

    ⟨33⟩[4m!"#$%&'()* +,-./0123456789:;⟨=⟩?@ABCDEFGHIJKLMNO⟨33⟩[0m
    ⟨33⟩[4mPQRSTUVWXYZ[\] ^_`abcdefghijklmnopqrstuvwxyz{|} ~⟨33⟩[0m
      ⟨33⟩[4w
        These are a few samples of the printer's capabilities.
```

```
These print samples show some capabilities of the
Model  6215/6216  Dot Matrix Printer.  This is
normal printing spaced 10 CPI horizontally and 6
LPI vertically. It has a pleasing appearance. The
U.S. ASCII character set looks like this:
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

To put more lines in less space, use a vertical
line spacing of 8 LPI, as shown here in normal
print.  Other print styles also may be used.


This is memo-quality normal print spaced
at 10 CPI horizontally and 6 LPI vertically.
It prints darker than normal printing.

E l o n g a t e d   c h a r a c t e r s   a r e   t w i c e
t h e   w i d t h   o f   n o r m a l   c h a r a c t e r s .
T h e   c h a r a c t e r   s e t   i s   a s   f o l l o w s :
  ! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7
8 9 : ; < = > ? @ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g
h i j k l m n o p q r s t u v w x y z { | } ~


M e m o - q u a l i t y   e l o n g a t e d
p r i n t i n g   a t   5   c h a r a c t e r s
p e r   i n c h   l o o k s   t h i s   w a y .
A   u n i q u e   t y p e   o f   p r i n t .

Condensed printing at 16.7 characters per inch
allows more characters per line.  The condensed
printing character set prints out as follows:
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

The condensed elongated character set
(with underscore turned on)
is shown below:

 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

 These are a few samples of the printer's capabilities.
```

Figure 3-7. Printing Capabilities Demonstration

CHAPTER 4
INSTALLATION AND MAINTENANCE

INTRODUCTION

This chapter describes the procedures for installing and maintaining the printer. These procedures include site requirements, unpacking, connecting power, instructions for cabling, configuration, testing, and operator maintenance.

SITE SELECTION

Before unpacking the printer, select the printer location. Basically, the printer location is restricted by the location of the ac power receptacle and the length of the interface cable between the printer and the computer system (which varies according to interface type, etc.).

Other considerations include the temperature of the proposed site (must be within the range of 50° to 95° F) and the quality of the surrounding air (which should be relatively dust free).

Figure 4-1 provides outline dimensional information required for site selection planning.

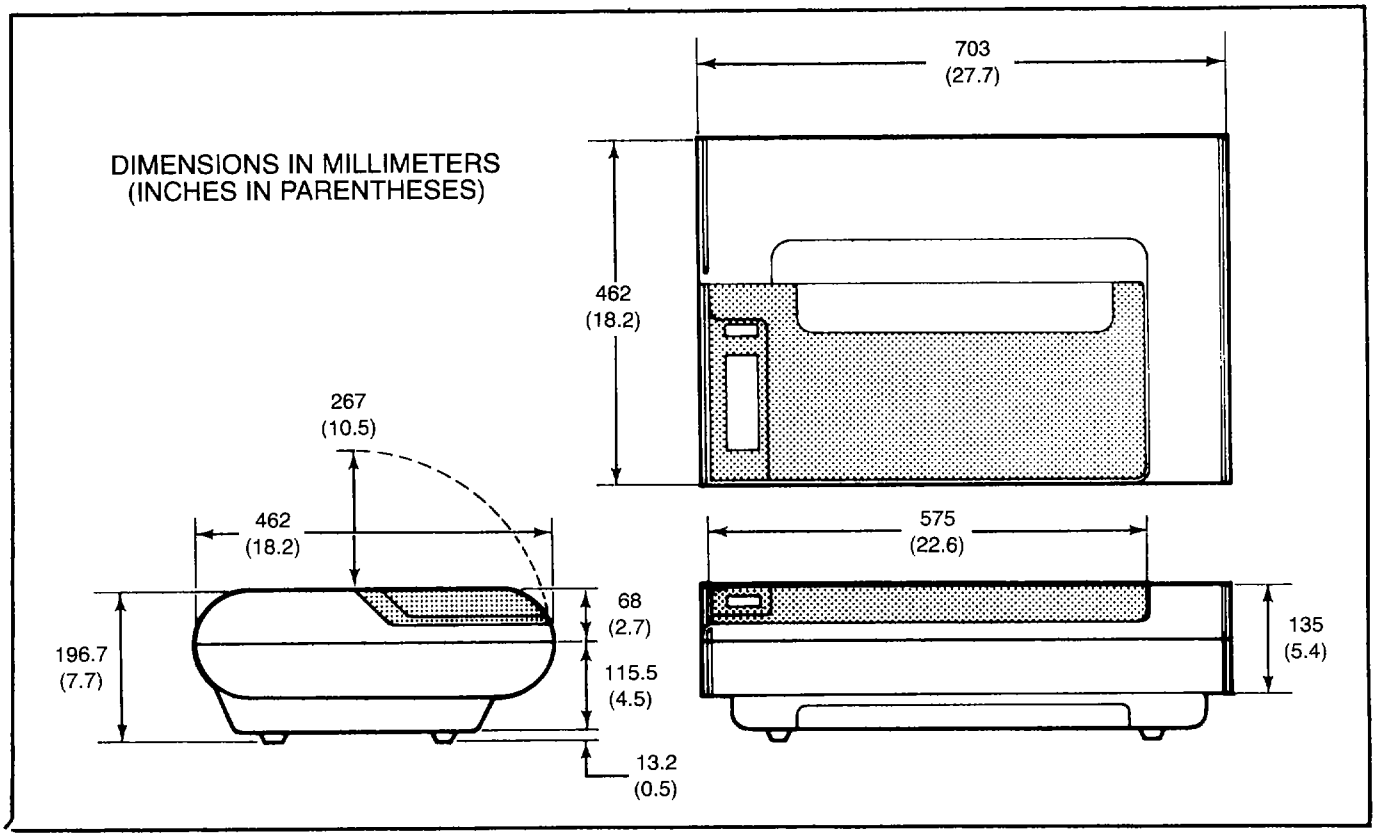


Figure 4-1. Printer Outline Dimensions

UNPACKING AND MOUNTING

The printer (and optional pedestal assembly) are shipped in cardboard containers packed in polyethylene sheeting and padded with polyurethane foam (refer to Figure 4-2). Before unpacking, move the container(s) to a clear area in the immediate vicinity of the installation site.

1. Open shipping container(s) and remove contents. Save boxes and packing material for possible future use if storage space permits.

2. Remove all wrapping material from the printer and place the printer on a level work surface such as a table top or the (optional) pedestal assembly.

3. Level the printer by rotating the four adjustment glides under the (optional) pedestal legs as required.

4. Consult the Universal Pedestal Installation Data Sheets, part number 010-001047, for print pedestal assembly.

POWER INSTALLATION

Use these procedures to connect the printer to the ac power receptacle:

> **CAUTION:** *Before connecting the printer power plug to the ac power receptacle, perform the following checks. Failure to do so could result in equipment damage.*

1. Verify that the ac power available matches the printer nameplate power requirements.

2. Be sure the correct fuse size has been installed:
   100/120 Vac requires a 3-A 250-V fuse.
   220/240 Vac requires a 1.6-A 250-V METRIC fuse.

3. REMOVE ALL PACKING OR OTHER OBSTRUCTION IN THE PRINTHEAD PATH.

4. Connect the printer power plug to the ac receptacle and set the power switch to the on position.

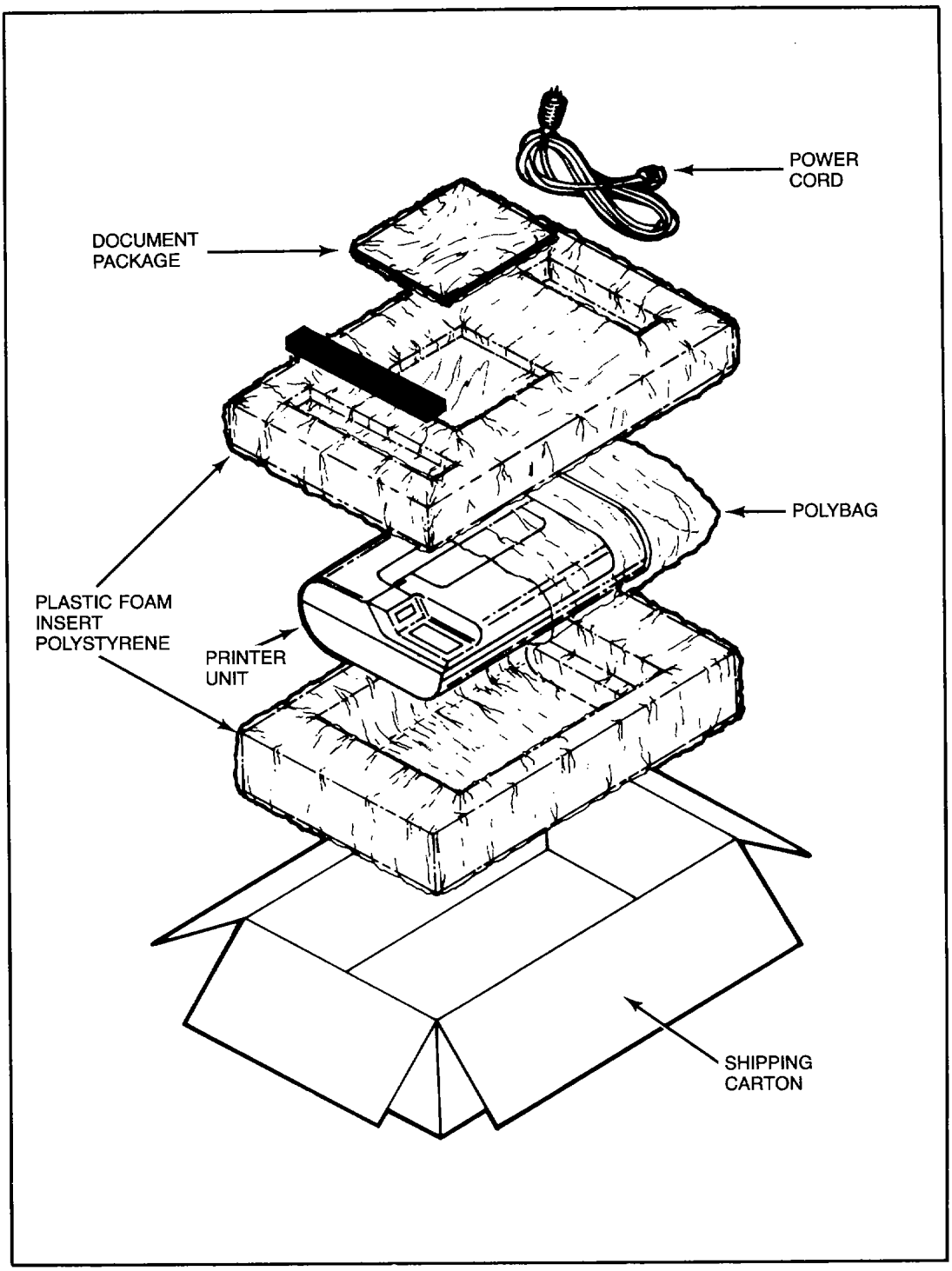


Figure 4-2. Printer Packaging Diagram

PRINTER CONFIGURATION PROCEDURES

The matrix printer is available with either a serial or parallel interface. Both printer types must be configured for their proper operational characteristics by means of switches MB1 and MB2 on the rear of the printer, and, for serial interface types, through switches SB1 and SB2 on the serial interface board above switches MB1 and MB2. Configuration switches MB1 and MB2 should be verified for proper setting during initial installation. The configuration of these switches is described in the following paragraphs.

Both Models, Power-Up Configuration

Two switch arrays, MB1 and MB2, define the configuration of the printer at power-up. Each array contains eight switches. The configuration specified by the 11/12 inch, 6/8 lpi, Bottom Margin Skipover, and Character Set Selections can be redefined under software control.

The switches are shown in Figure 4-3, and the descriptions are given in Table 4-1. For switches MB1 and MB2, an ON setting corresponds to the switch being in the down position.

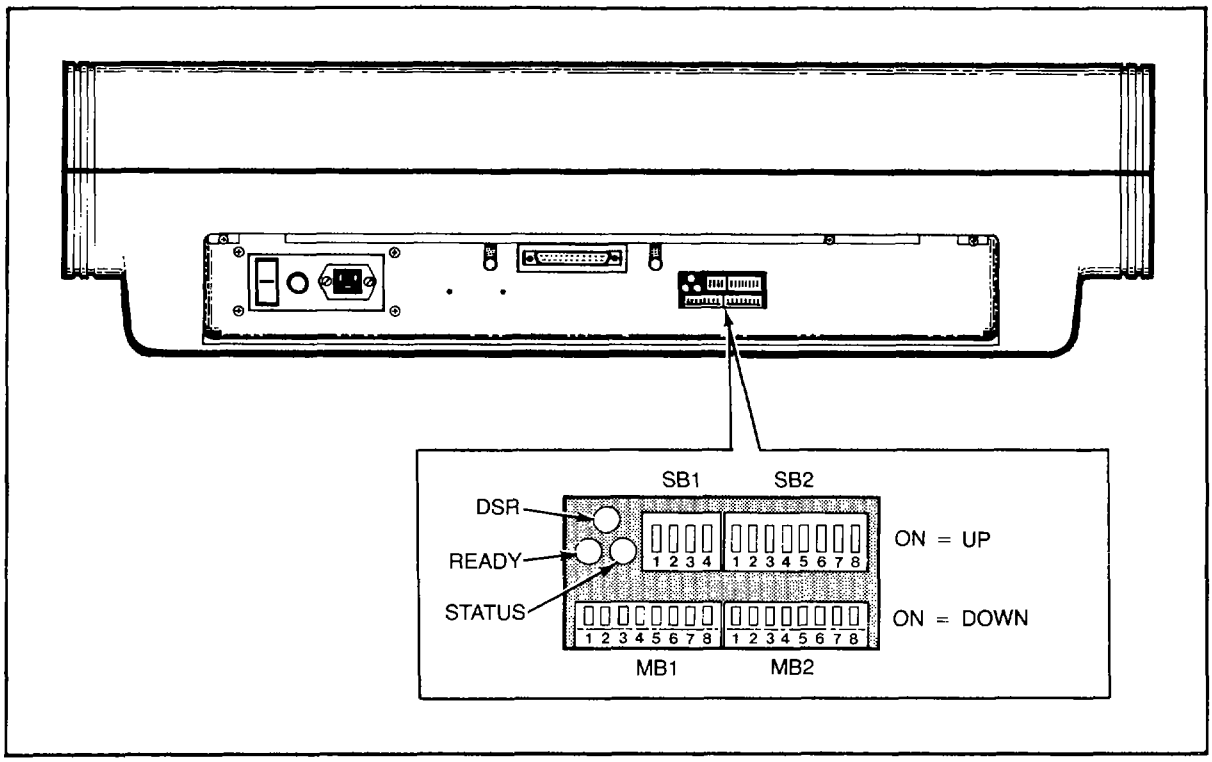


Figure 4-3. Configuration Switches and Indicators

Table 4-1. Configuration Switches MB1 and MB2

Switch	Function
MB1-1	OFF to ON forces printer into the signature analysis mode.
MB1-2	Initialize on-line/off-line. At power-up,the printer will initialize in the on-line mode (ON) or off-line mode (OFF).
MB1-3	6/8 lpi. Sets default line spacing to 8 lpi (ON) or 6 lpi (OFF).
MB1-4	11/12-inch form length. Sets default form length 12 inches (ON) or 11 inches (OFF).
MB1-5	Allows (OFF) or inhibits (ON) the reporting of errors for exceeding the line length selected by the 80/136 switch, or for sending an illegal escape sequence. When inhibited, will overprint the extra characters starting at the leftmost print position.
MB1-6	80/136 characters per line. Specifies number of characters per line to be printed as 80 (ON) or 136 (OFF).
MB1-7	Bottom margin skipover. When ON, will select a bottom margin 1 inch from the end of form, or deselects (OFF) bottom margin skipover at the end of each form.
MB1-8	7/8-bit interface. Selects 8-bit communication (ON) or 7-bit communication (OFF). If 7 data bits are selected, the most significant data bit received from the interface is ignored. With the serial interface printer, always configure this switch for 8 data bits (ON).
MB2-1 thru MB2-8	Main/alternate character set (font) select. The following chart defines which set will be the default alternate set (switches MB2-1, 2, 3, and 4), and which will be the default main set (switches MB2-5, 6, 7, and 8).

Alternate Set / Main Set	MB2-1 / MB2-5	MB2-2 / MB2-6	MB2-3 / MB2-7	MB2-4 / MB2-8
U.S.	ON	ON	ON	ON
U.K.	ON	ON	ON	OFF
French	ON	ON	OFF	ON
German	ON	ON	OFF	OFF
Swedish	ON	OFF	ON	ON
Spanish	ON	OFF	ON	OFF
Danish	ON	OFF	OFF	ON
Swiss	OFF	ON	ON	ON
*Kana/ASCII	OFF	ON	ON	OFF
Kana/Japanese	OFF	ON	OFF	ON
Multilingual	OFF	OFF	OFF	OFF

* U.S. ASCII with yen sign substituted for backslash (\)

Serial Interface Configuration

The serial interface is configured for the host communication mode by two switch arrays SB1 and SB2 (Figure 4-3) mounted over the MB1 and MB2 switches. Switches SB1 and SB2 are ON in the up position. The configuration switch settings are given in the following paragraphs.

Baud Rate Selection/Serial Board Self-Test

Transmission rates from 50 to 19,200 bits per second may be selected using switches SB2-1 through SB2-4 (refer to Table 4-2). These switches are also used to select the serial interface self-test mode, which sends an 80-character rotating test pattern to the printer logic.

Set the printer ON LINE for this test after setting the switches. Press OFF LINE to stop the test, then reset the switches for the desired baud rate. Going on-line again will continue self-test printing until the buffer empties.

Table 4-2. Baud Rate Selection, Serial Board Self-Test

Baud Rate Selected	Switch			
	SB2-1	SB2-2	SB2-3	SB2-4
19,200	OFF	OFF	OFF	OFF
9600	OFF	OFF	OFF	ON
7200	OFF	OFF	ON	OFF
4800	OFF	OFF	ON	ON
3600	OFF	ON	OFF	OFF
2400	OFF	ON	OFF	ON
1800	OFF	ON	ON	OFF
1200	OFF	ON	ON	ON
600	ON	OFF	OFF	OFF
300	ON	OFF	OFF	ON
150	ON	OFF	ON	OFF
135	ON	OFF	ON	ON
110	ON	ON	OFF	OFF
75	ON	ON	OFF	ON
50	ON	ON	ON	OFF
Self-Test	ON	ON	ON	ON

Parity Selection

Switches SB2-5 and SB2-6 are used to select parity type. Switch settings are given in Table 4-3.

Table 4-3. Parity Selection

Parity Type Selected	Switch	
	SB2-5	SB2-6
Even	OFF	OFF
Mark	OFF	ON
Odd	ON	OFF
None	ON	ON

7/8 Data Bits

Switch SB2-7 selects a data format of 8 data bits (ON) or 7 data bits (OFF). For the serial interface printer, the data format selected must have the same data format selected on the main board configuration switch MB1-8 (ON for 8-bit format and OFF for 7-bit format).

Auto Disconnect

Switch SB2-8 configures the printer for auto disconnect mode (ON) or nonauto disconnect mode (OFF). Refer to the Modem Communications Configuration paragraph in this chapter.

Communication Error Handling

Switches SB1-1 and SB1-2 (Table 4-4) define the manner in which communication errors will be handled. These include overrun, framing, and parity errors.

Table 4-4. Communication Error Handling

Effect	Switch SB1-1	Switch SB1-2
Drop error character	ON	ON
Substitute blank for error character	ON	OFF
Substitute question mark for error character	OFF	ON
Treat all communication errors as "fatal" (see NOTE)	OFF	OFF

NOTE:
Fatal errors cause the printer to halt before printing the line containing the error, go off-line, and display the appropriate error code. To resume printing, press CLEAR and ON LINE. The printer then substitutes a question mark for the error character.

If the printer is configured for software busy, it recovers from framing errors by signaling BUSY until the host stops sending data. It then signals NOT BUSY, and the host resumes transmission.

If there is a buffer overflow (due to the host failing to recognize the BUSY signal, for example), it will generate a fatal error and any further data will be lost. A plus sign will be substituted for the last character received before the fault occurred.

In the event of a buffer overflow error, check the hardware/software busy configuration of the interface against that of the host system.

The printer will continue printing if the operator takes it off-line and back on-line after the plus sign is printed; however, some data is likely to have been lost.

If the printer is configured for hardware busy, it recovers from framing errors by waiting for the data to resynchronize. Meanwhile, data is lost.

Modem Communications Configuration

Switches SB1-3 and SB1-4 configure the printer for modem communications as listed for DTR control and DTR enable.

DTR control

Switch SB1-3 determines how DTR responds to changes of DSR and the printer being off-line.

If SB1-3 is OFF, the printer will not terminate a call unless DSR is lost.

If this switch is ON, DTR will be dropped if the printer stays off-line for more than 30 seconds, or if the interface receives no data for 30 seconds while it is not busy (with DSR active). In this mode, if the printer powers up off-line DTR will be held inactive until the printer is put on-line.

When dropped, DTR remains inactive until DSR goes inactive and the printer is on-line. This feature minimizes telephone connect time and terminates calls to wrong numbers. The printer will always drop DTR if DSR is lost unless DTR is held active by the DTR Enable switch. DTR will stay inactive long enough to terminate the call and until DSR has been inactive.

Loss of carrier detect (DCD) will result in the UART receiver being disabled. Also, the printer will not accept data if DSR is inactive, nor will it transmit data unless DSR, DTR, and CTS are all active.

DTR enable

Switch SB1-4 in the OFF position gives control to SB2-8. When SB1-4 is ON, it forces DTR active. This switch must be OFF if the printer is configured for hardware busy. These relationships are shown in Table 4-5.

Table 4-5. Modem Communications Configuration

Communication Type	SB1-3	SB1-4	SB2-8
Hardware busy	OFF	OFF	OFF
Software busy without modem	ON	ON	OFF
Software busy with normal modem operation only	ON	OFF	OFF
Software busy with normal modem operation, plus calls will disconnect if printer goes off-line for 30 seconds or receives no data for 30 seconds (auto disconnect)	ON	OFF	ON

INTERFACE CABLING

The matrix printer must be connected to a controller in the computer system or to a communication system via the appropriate parallel or serial interface cable as described in the Installation Data Sheets, part numbers 010-000653, 010-000683, and 010-000695. Upon completion of interface cabling, the printer is ready for the operational test.

Parallel Interface Cabling

Binary information presented to the Data Input lines of the parallel interface is synchronously clocked to the input buffer by the Data Strobe signal. The Demand Output signals the controlling device that the next data byte may be sent.

The printer parallel connector (a 50-pin shielded shell connector) pin assignments are listed in Table 4-6, and the signals at the printer connector are listed and described in Table 4-7.

Table 4-6. Parallel Connector Pin Assignments

Signal	Pin	Gnd Pin
Strobe	38	37
Data 8	30	14
Data 7	36	35
Data 6	43	42
Data 5	34	18
Data 4	41	40
Data 3	1	2
Data 2	20	4
Data 1	19	3
Demand	23	7
Ready	22	6
On-Line	21	5
Chassis Ground	16	

Table 4-7. Parallel Interface Signals

Signal	Type	Description
Strobe	Input	A negative pulse to clock data from controlling device to data buffer
Data 8	Input	Most significant bit
Data 7-2	Input	
Data 1	Input	Least significant bit
Demand	Output	An active high signal that requests data from the controlling device; demand goes low as each character is received, and remains low when the data buffer is full
Ready	Output	An active high signal that indicates the printer is on
On-Line	Output	Same as the Ready signal

Serial Interface Cabling

The serial interface accepts serial data at rates up to 19,200 baud. The interface will operate in either an EIA RS-232-C or RS-422-A mode, or a 20-mA current loop mode. Full modem control signals are provided. An on-board microprocessor and EPROM perform various self-test and error diagnostic functions to improve maintainability and to facilitate repair.

The choice of communication lines depends primarily on the cable length required, configuration of the host system and whether or not a modem is being used.

The current loop configuration permits connection directly to a computer system over a maximum cable length of 300 feet (91 meters) at 9600 baud or up to 1200 feet (366 meters) at 2400 baud and below.

The EIA configuration can be used when a short cable less than 50 feet (15.2 meters) is needed, or if the printer is being attached to a Bell 103-, 113-, or 212-compatible modem.

The serial interface board connector pin assignments are shown in Table 4-8 and the signals at the printer connector are listed in Table 4-9.

Table 4-8. Serial Connector Pin Assignments

Pin	Signal	Pin	Signal
1	CH GND	14	−ACT1
2	TXD	15	+ACT1
3	RCD	16	−ACT2
4	RTS	17	+ACT2
5	CTS	18	TXD−
6	DSR	19	TEST (Note 2)
7	SIG GND	20	DTR or BUSY
8	DCD	21	RCD−
9	RC +	22	Unused
10	RC −	23	RCD+
11	TX +	24	TXD +
12	TX −	25	(Note 1)
13	(Note 1)		

NOTES:

1. *Pins 13 and 25 select operation type (RS-232-C, internal loopback, 20-mA current loop, or RS-422-A) through internal cable connections. These pins are either grounded to pin 7 or left open (within the connector) as follows:*

Pin 13	Pin 25	Operation Selected
Open	Open	RS-232-C, EIA w/modem
Gnd	Open	Internal loopback
Open	Gnd	20-mA Current loop
Gnd	Gnd	RS-422-A

2. *TEST, pin 19, may be grounded for external loopback testing BEFORE power is applied.*

Table 4-9. Serial Interface Signals

Signal	Description
TXD	Transmitted Data from the printer, used for software busy (EIA level), ACK, and MODEL ID.
RCD	Received Data at the printer (EIA level).
RTS	Request To Send (EIA level). A signal from printer to modem that data is ready to send.
CTS	Clear To Send (EIA level). A signal from modem to printer to send data.
DSR	Data Set Ready (EIA level). A signal from the modem indicating that it is ready.
DCD	Data Carrier Detect (EIA level). A signal from the modem indicating a received carrier signal.
DTR	Data Terminal Ready (EIA level). A signal from the printer indicating that it is ready. The operation of this signal depends on the type of modem operation selected.
BUSY	Busy complement, or DEMAND (EIA level). This signal is used in the hardware-busy mode to indicate the printer is ready to receive data.
RCD+, RCD−	Current loop receivers, plus and minus. The current loop responds to signal levels from 12 mA (ON) to 45 mA (ON).
TXD+ TXD−	Current loop transmitters, plus and minus. The passive transmitter can interrupt current loops up to 45 mA.
RC + RC −	RS-422-A receivers, + and −.
TX + TX −	RS-422-A transmitter, + and −.
TEST	External loopback on power-up select.
+ACT1 −ACT1 +ACT2 −ACT2	Current loop sources of nominal 20 mA which can be jumpered in the cable to provide an active current loop interface.

PAPER LOADING/RIBBON REPLACEMENT

Refer to the paper loading and ribbon replacement procedures in Chapter 2.

OPERATIONAL TEST

Perform the operational procedures described in Chapter 2 for power-up, off-line/on-line, and self-test.

OPERATOR MAINTENANCE PROCEDURES

Operator maintenance for the printer consists of two categories, including:

- Preventive maintenance
- Troubleshooting

Preventive Maintenance

Preventive maintenance consists of periodic inspection and cleaning to keep the printer operating at peak performance.

> **WARNING:** *DISCONNECT AC POWER FROM THE PRINTER BEFORE PERFORMING THESE PROCEDURES.*

1. Periodically inspect the printer for dust and lint. When accumulations occur, vacuum all interior surfaces gently.
2. Using a lint-free cloth, wipe dirt from the printer carriage shafts.
3. Clean the exterior of the printer with mild detergent and water. Avoid using a dry cloth on the plastic window as scratches may occur. Do not use excessive amounts of water or allow water to enter the inside of the printer cover.
4. Connect ac power, then perform the Power-On Procedure.

Printer Troubleshooting Procedures

Perform the troubleshooting procedures in Table 4-10 before calling for service. If the procedures fail to correct the problem, call the nearest Data General Field Service office.

Table 4-10. Printer Troubleshooting Procedures

Symptom	Troubleshooting Procedure
Printer inoperative, no printer status indicators are on.	Make sure the printer is connected and the power switch is on. Check the line fuse and replace if faulty. Check the ac outlet (see if another appliance operates on the circuit).
Printer inoperative, some printer status indicators are on.	Check the ON LINE display indicator. If not on, press the ON LINE control.
ON LINE indicator is on but printer does not operate.	Check the FORMS and OFF LINE display. If on, printer is out of paper (see paper loading procedures). If not, check the STATUS indicators at the rear of the printer (see Chapter 2).
Paper is skewed.	Paper tractors misadjusted (see Chapter 2).
Poor print quality.	Change the forms thickness adjustment. If still poor quality, replace the ribbon cartridge (see Chapter 2).
Paper tears.	Printhead spacing (to platen) is too tight, or spacing between paper tractors is improperly set.

APPENDIX A
ASCII CHARACTER CODES

Name or Mnemonic	Action Taken by Printer	ASCII Code Hex	Dec
NUL	NONE	00	000
SOH	NONE	01	001
STX	NONE	02	002
ETX	RESERVED	03	003
EOT	RESERVED	04	004
ENQ	ACK RETURNED	05	005
ACK	ENQ RESPONSE	06	006
BEL	AUDIBLE TONE	07	007
BS	NONE	08	008
HT	HORIZONTAL TAB	09	009
NL	NEWLINE	0A	010
VT	VERTICAL TAB	0B	011
FF	FORM FEED	0C	012
CR	CARRIAGE RETURN	0D	013
SO	SHIFT OUT	0E	014
SI	SHIFT IN	0F	015
DLE	NONE	10	016
DC1	SOFTWARE BUSY	11	017
DC2	NONE	12	018
DC3	SOFTWARE BUSY	13	019
DC4	NONE	14	010
NAK	NONE	15	021
SYN	NONE	16	022
ETB	NONE	17	023
CAN	NONE	18	024
EM	NONE	19	025
SUB	NONE	1A	026
ESC	COMMAND SEQUENCE	1B	027
FS	NONE	1C	028
GS	NONE	1D	029
RS	NONE	1E	030
US	NONE	1F	031
SP	SPACE	20	032
EXCLAMATION	PRINT !	21	033
QUOTATION	PRINT "	22	034
NUMBER SIGN	PRINT #	23	035
DOLLAR SIGN	PRINT $	24	036
PERCENT SIGN	PRINT %	25	037
AMPERSAND	PRINT &	26	038
APOSTROPHE	PRINT '	27	039
OPEN PARENTHESIS	PRINT (	28	040
CLOSE PARENTHESIS	PRINT)	29	041
ASTERISK	PRINT *	2A	042
PLUS SIGN	PRINT +	2B	043
COMMA	PRINT ,	2C	044
HYPHEN (MINUS SIGN)	PRINT -	2D	045
PERIOD (DECIMAL POINT)	PRINT .	2E	046
SLASH	PRINT /	2F	047
ZERO	PRINT 0	30	048
ONE	PRINT 1	31	049
TWO	PRINT 2	32	050
THREE	PRINT 3	33	051
FOUR	PRINT 4	34	052

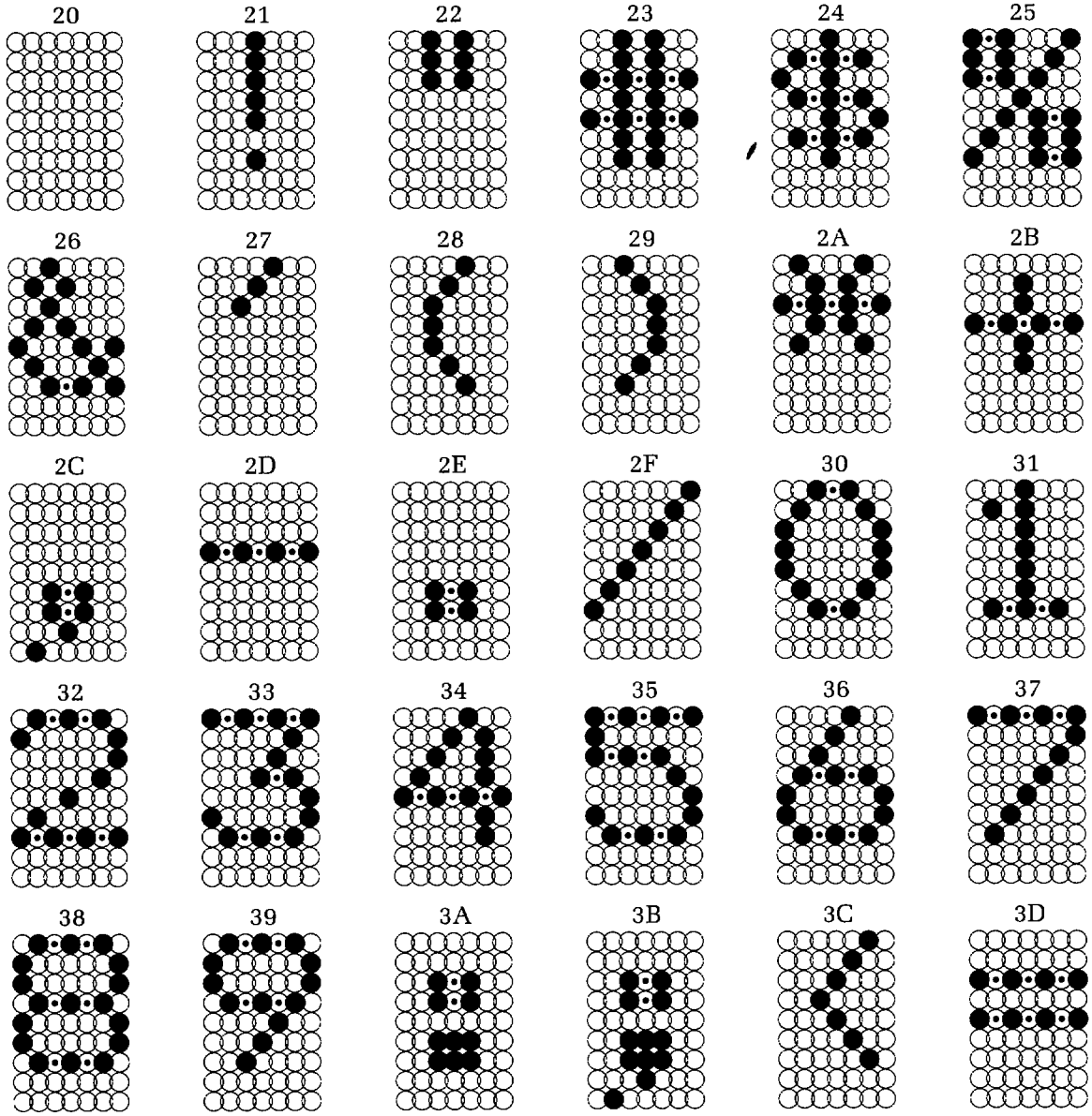
Name or Mnemonic	Action Taken by Printer	ASCII Code Hex	Dec
FIVE	PRINT 5	35	053
SIX	PRINT 6	36	054
SEVEN	PRINT 7	37	055
EIGHT	PRINT 8	38	056
NINE	PRINT 9	39	057
COLON	PRINT :	3A	058
SEMICOLON	PRINT ;	3B	059
LESS THAN	PRINT <	3C	060
EQUAL SIGN	PRINT =	3D	061
GREATER THAN	PRINT >	3E	062
QUESTION MARK	PRINT ?	3F	063
COMMERCIAL AT	PRINT @	40	064
A	PRINT A	41	065
B	PRINT B	42	066
C	PRINT C	43	067
D	PRINT D	44	068
E	PRINT E	45	069
F	PRINT F	46	070
G	PRINT G	47	071
H	PRINT H	48	072
I	PRINT I	49	073
J	PRINT J	4A	074
K	PRINT K	4B	075
L	PRINT L	4C	076
M	PRINT M	4D	077
N	PRINT N	4E	078
O	PRINT O	4F	079
P	PRINT P	50	080
Q	PRINT Q	51	081
R	PRINT R	52	082
S	PRINT S	53	083
T	PRINT T	54	084
U	PRINT U	55	085
V	PRINT V	56	086
W	PRINT W	57	087
X	PRINT X	58	088
Y	PRINT Y	59	089
Z	PRINT Z	5A	090
OPENING BRACKET	PRINT [	5B	091
BACK SLASH	PRINT \	5C	092
CLOSE BRACKET	PRINT]	5D	093
CIRCUMFLEX	PRINT ^	5E	094
UNDERLINE	PRINT _	5F	095
ACCENT GRAVE	PRINT `	60	096
a	PRINT a	61	097
b	PRINT b	62	098
c	PRINT c	63	099
d	PRINT d	64	100
e	PRINT e	65	101
f	PRINT f	66	102
g	PRINT g	67	103
h	PRINT h	68	104
i	PRINT i	69	105
j	PRINT j	6A	106
k	PRINT k	6B	107
l	PRINT l	6C	108
m	PRINT m	6D	109
n	PRINT n	6E	110
o	PRINT o	6F	111
p	PRINT p	70	112
q	PRINT q	71	113
r	PRINT r	72	114

Name or Mnemonic	Action Taken by Printer	ASCII Code Hex	Dec
s	PRINT s	73	115
t	PRINT t	74	116
u	PRINT u	75	117
v	PRINT v	76	118
w	PRINT w	77	119
x	PRINT x	78	120
y	PRINT y	79	121
z	PRINT z	7A	122
OPEN BAROQ. PARENTHESIS	PRINT {	7B	123
VERTICAL MARK	PRINT |	7C	124
CLOSE BAROQ. PARENTHESIS	PRINT }	7D	125
TILDE	PRINT ~	7E	126
DELETE	NONE	7F	127

APPENDIX B
INTERNATIONAL CHARACTER SETS

NOTES: *Values shown are hex values*
● *indicates normal print*
●⊙*indicates memo-quality print*

U.S.



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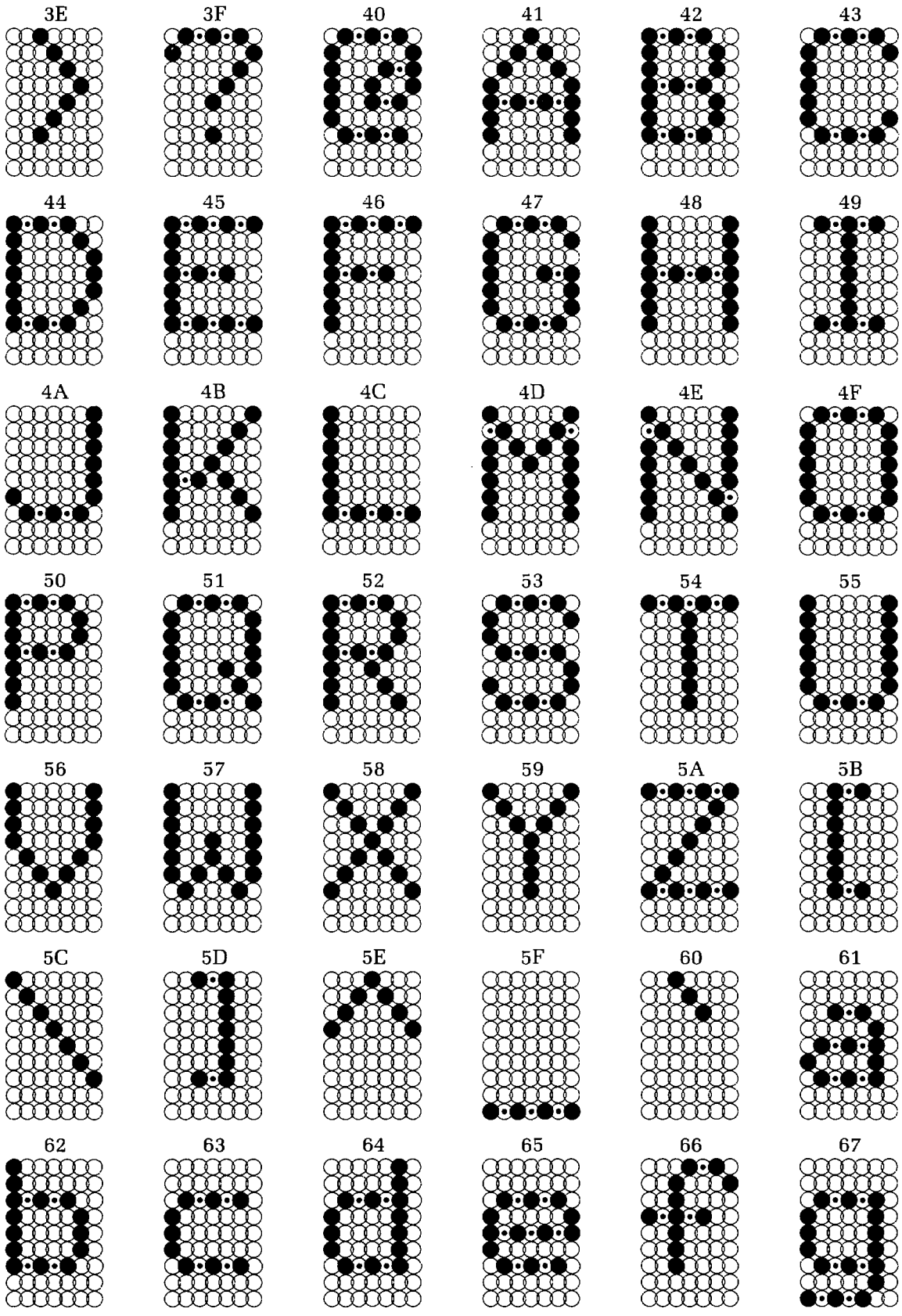
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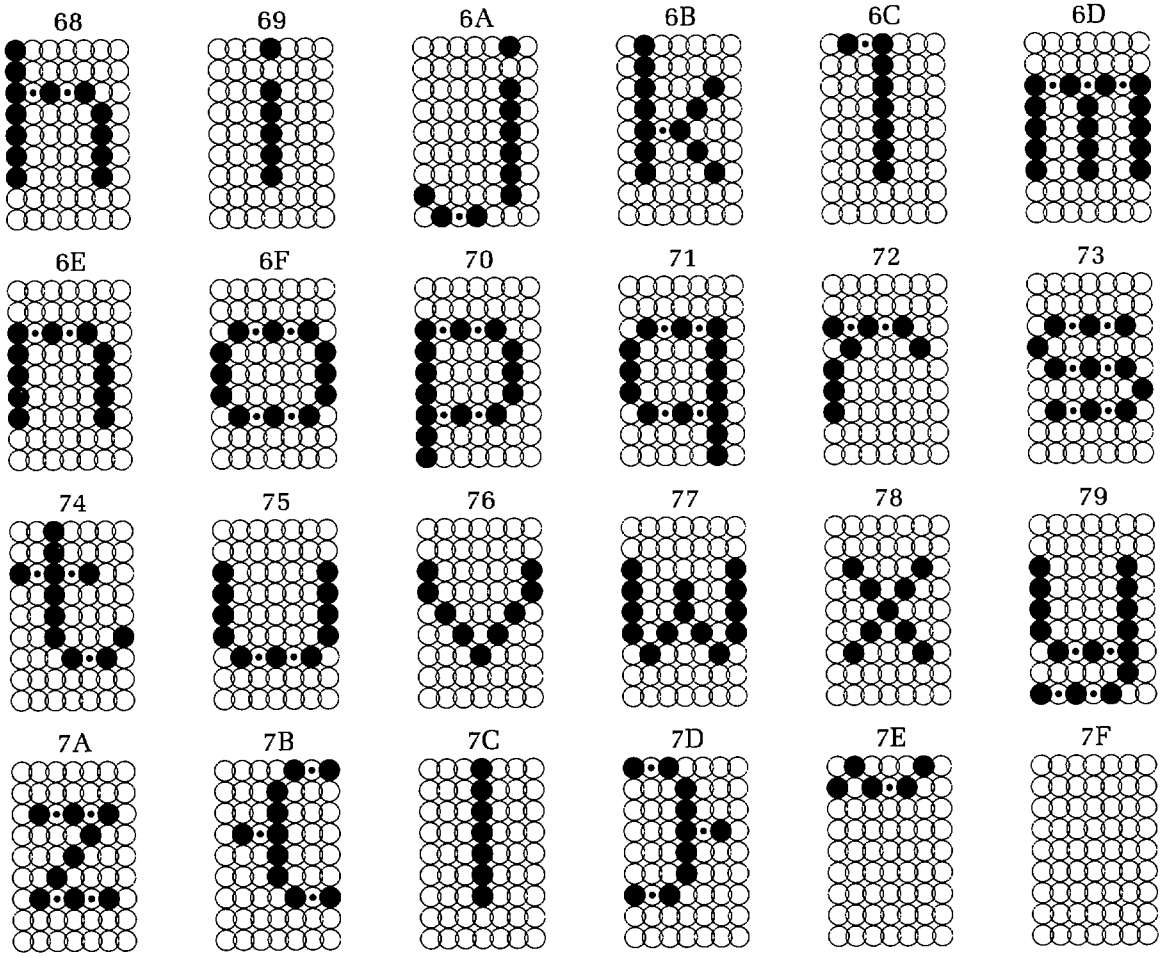

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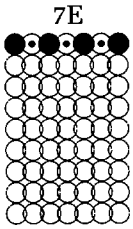

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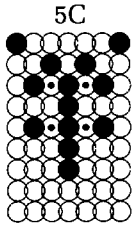

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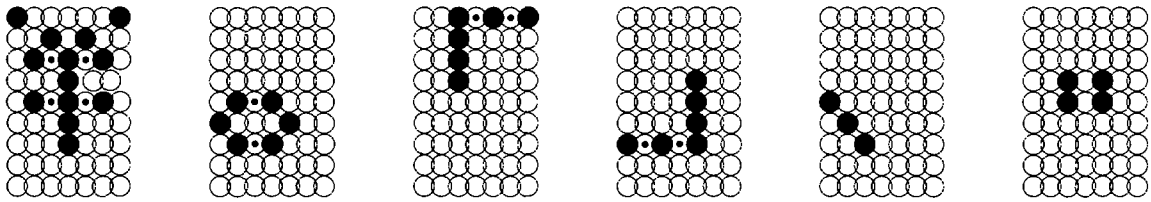

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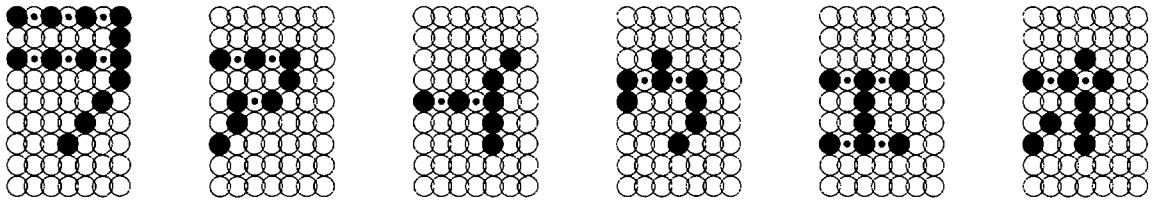

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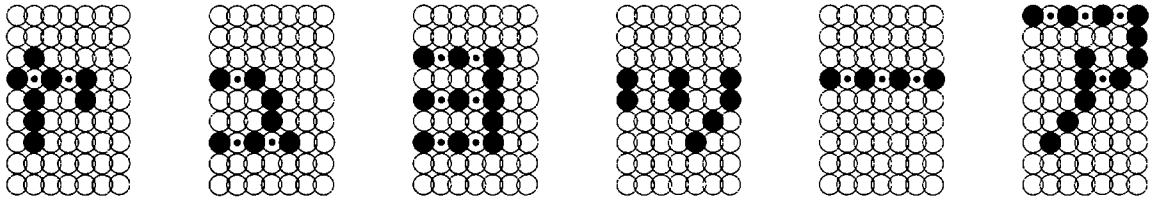

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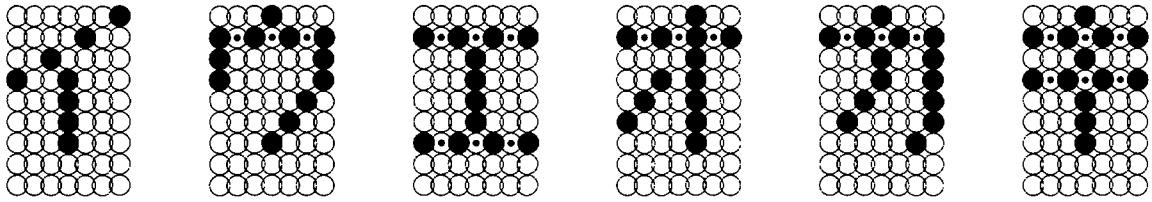

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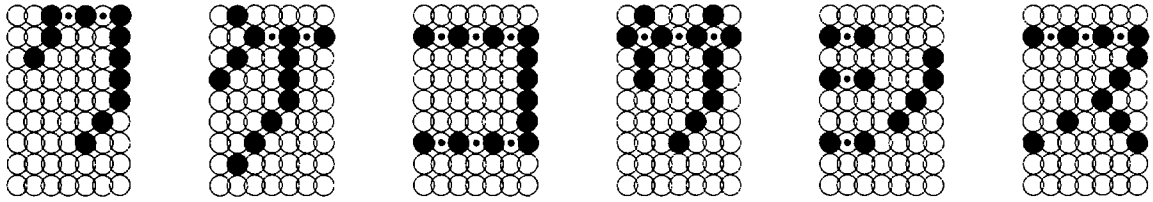

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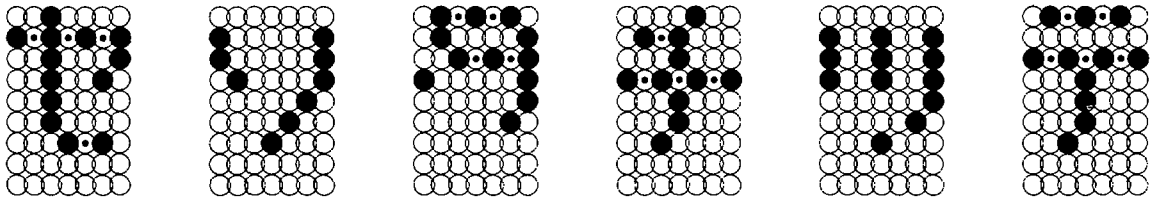

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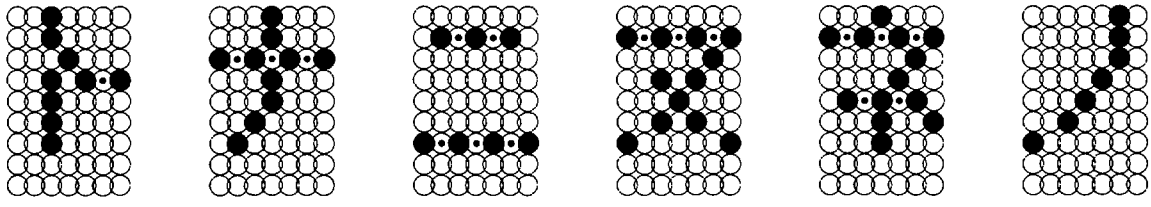

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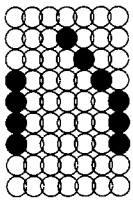

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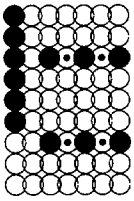

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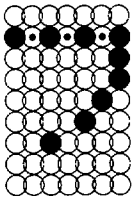

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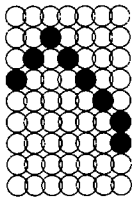

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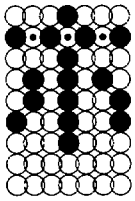

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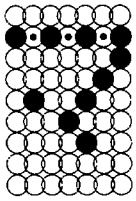

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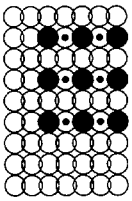

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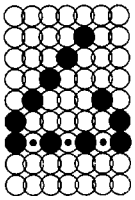

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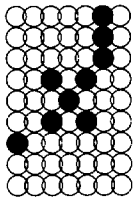

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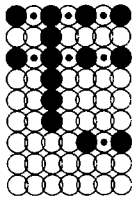

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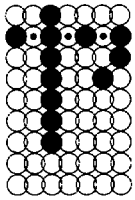

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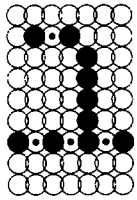

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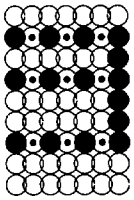

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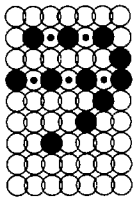

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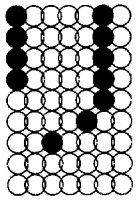

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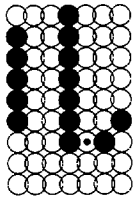

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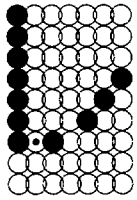

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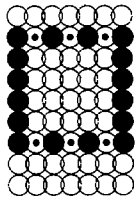

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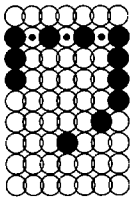

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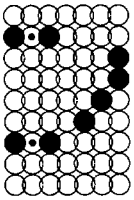

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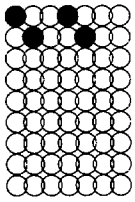

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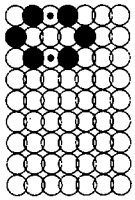

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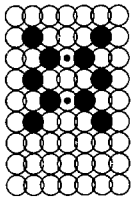

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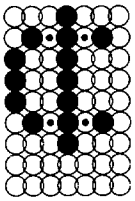

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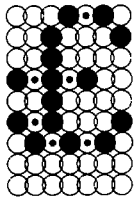

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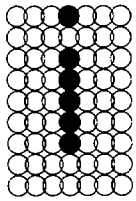

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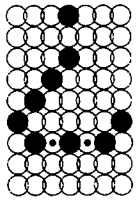

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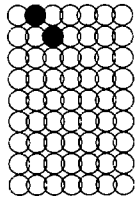

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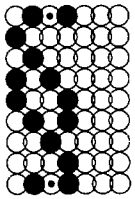

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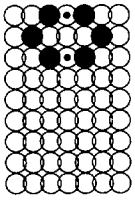

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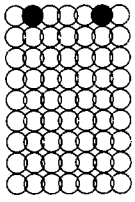

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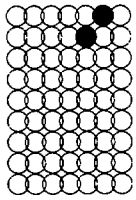

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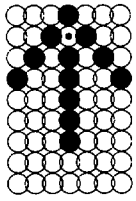

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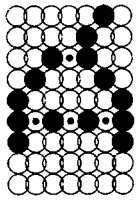

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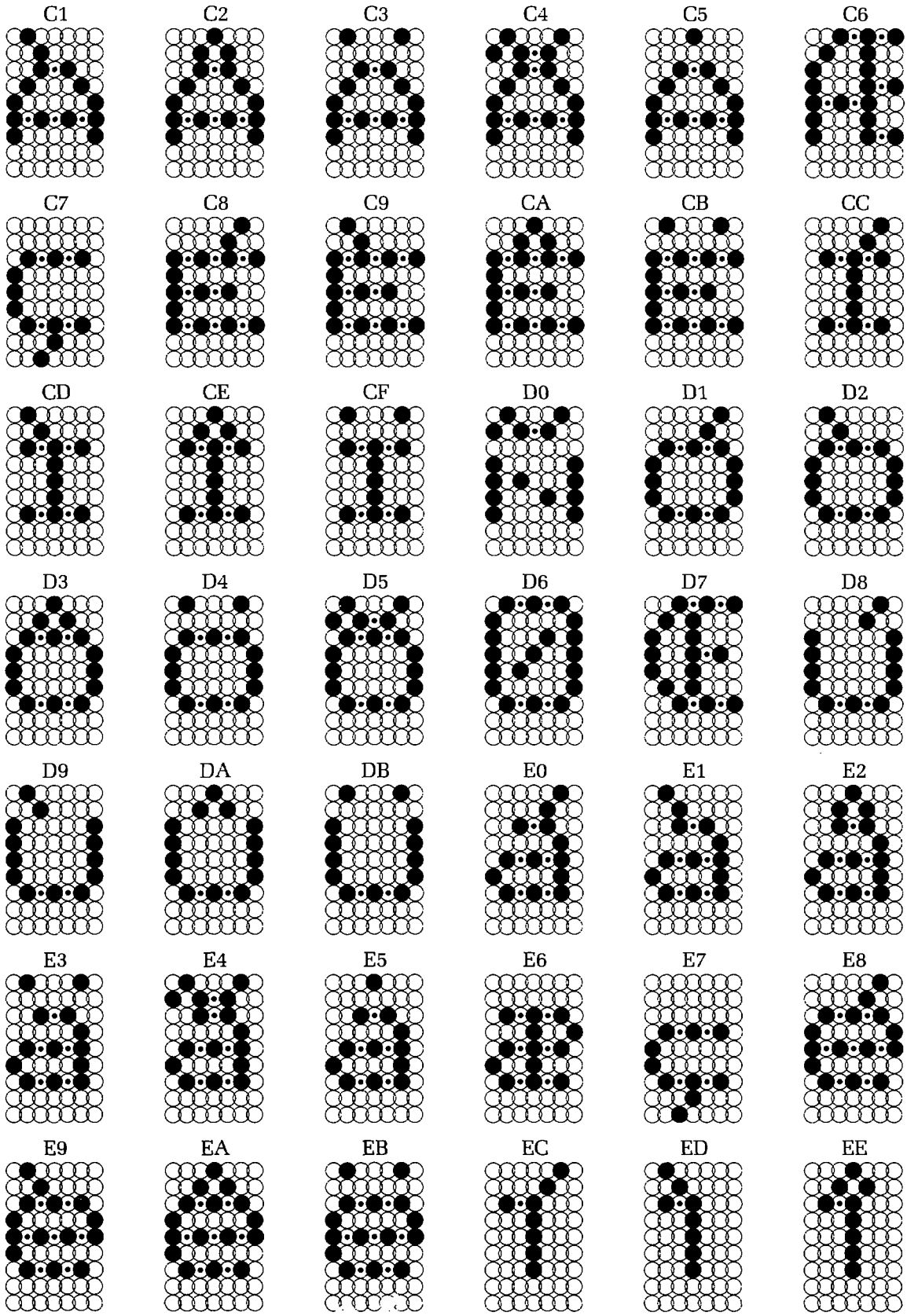

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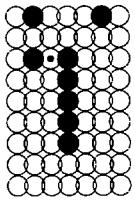

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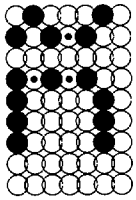

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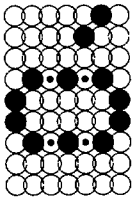

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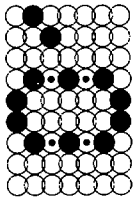

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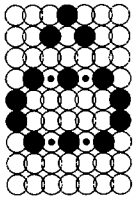

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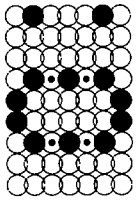

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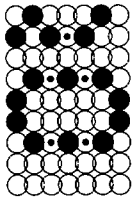

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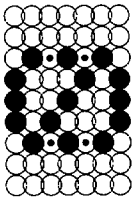

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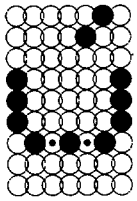

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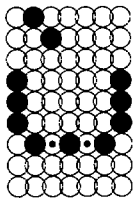

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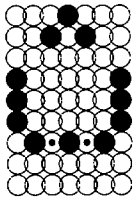

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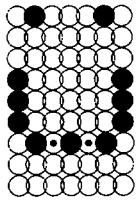

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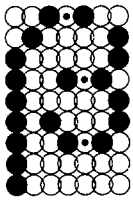

INDEX

Updating Instructions

Please make the following changes to your manual:

- On the Notice page, change "Rev. 00, March 1984" to "Rev. 01, October 1985."
- On page 2-3, the 3rd paragraph should read:

  At power-on, the alarm sounds and all three 7-segment displays are activated. If the displays do not clear, either the program is not running or (with alarm sounds) the ROM test failed. After the ROM test is complete, the displays should clear. At power-on, if the displays remain clear and the alarm sounds, the RAM test failed.

- On page 2-4, make these changes to Table 2-4 (Error Codes):

  – Change Code 03 "Undefined" to "Carriage motor circuit fault."
  – Change Code 15-19 "Undefined" to 15-17 "Undefined".
  – Add Code 18, "Ribbon motor fault during speed setting."
  – Add Code 19, "Carriage stall during speed setting."
  – Change Code 50 "Horizontal motor overcurrent" to "Carriage motor circuit fault."
  – Change Code 52-59 "Undefined" to 54-59 "Undefined."
  – Add Code 52, "Ribbon motor fault during printing."
  – Add Code 53, "Carriage stall during printing."

- On page 4-6, the 7/8 Data Bits paragraph should read:

  Switch SB2-7 selects a data format of 8 data bits (ON) or 7 data bits (OFF). For the serial printer, the data format selected must match the system controller data bits, and switch MB1-8 must be set to 8 data bits regardless of the setting of SB2-7.

- On page 4-7, the Modem Communications Configuration paragraph should read:

  Switches SB1-3, SB2-8, and SB1-4 configure the printer for modem communications as listed for DTR control and DTR enable.

- On page 4-7, the first two paragraphs under DTR control should read:

  Switch SB2-8 determines how DTR responds to changes of DSR, the printer being off-line, and data flow.
  If SB2-8 is OFF, the printer will not terminate a call unless DSR is lost.

- On page 4-8, the DTR enable paragraph should read:

  Switch SB1-4 in the OFF position gives control to SB2-8. When SB1-4 is ON, it forces DTR active. This switch must be OFF if the printer is configured for hardware busy (SB1-3 OFF). These relationships are shown in Table 4-5.

DataGeneral
Data General Corporation, Westboro, Massachusetts 01581

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