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computer corporation

Plot Matrix Printer

User's Manual

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PREFACE

This document describes the operation of the DS180 matrix printer. This material is for informational purposes and is subject to change without notice. Datasouth assumes no responsibility for any errors which may appear in this manual.

INTRODUCTION

The DS180 matrix printer is a general purpose impact printer for use in a variety of computer output applications. Flexible communications and forms handling capabilities make the DS180 ideal for CRT slave printing, business systems output and remote computing terminals. The DS180 utilizes logic-seeking bidirectional printing at 180 cps to achieve extremely high throughput. Under microprocessor control, the printhead automatically takes the shortest path to the next printable character. The 94 ASCII character set is printed in a 9-high by 7-wide dot matrix. True lower case descenders and simultaneous underlining are possible because of the 9-wire printhead. The head is rated for a life of over 650 million characters. An adjustable head-to-platen gap accommodates forms up to 6 parts in thickness. Fanfold perforated forms from 3 to 15 inches may be fed through the front or bottom of the printer. The easy-to-change cartridge ribbon has an estimated life of nearly four million characters.

The programmable features of the DS180 may be configured from the control panel on the front of the printer or via the communications line. The LED indicators, digital display and custom keypad make format set-up quick and simple. A non-volatile memory retains the settings when power is turned off, eliminating the need to reconfigure the printer before its next use.

Baud rates from 110-9600 may be used over the RS232 or optional current loop serial interfaces. A 1000 character buffer and a choice of two handshaking protocols ensure optimum throughput. An 8-bit parallel interface is also provided.

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SECTION 1

GENERAL INFORMATION

1.1 UNPACKING AND INSTALLATION

The DS180 is shipped in a box-within-a-box package to prevent damage. The printer is unitized on a 18" x 26" sheet of particle board within the inner box. Unpack as follows:

- 1) Inspect outer box for obvious signs of damage. If any damage has occurred, notify the carrier and Datasouth for appropriate action to be taken.
- 2) Place shipping carton on the floor and open top flaps.
- 3) Remove loose items (cables, ribbons, manuals, etc.)
- 4) Remove inner box and open flaps.
- 5) Remove printer mounted on particle board.
- 6) Using a screwdriver, remove the carriage bolts attaching the printer to the board.
- 7) If necessary, wipe the outer surface with a clean, soft, lint-free cloth.
- 8) Save the carton and packing material, should the printer require shipment in the future.

Place the printer on the stand or work table where it will operate. The printer occupies a surface area 24" x 16". The printer should be located near the front edge of the table so that forms will have a clear path into the front-feed slot. If mounted on a stand or slotted work table, the bottom feed should be used.

It is recommended that at least 2 inches of clearance be provided on all sides of the printer for adequate ventilation. Do not block the exhaust louvers on the top rear of the cover.

1.2 CHECKOUT

Remove the smoked plexiglass access window and manually move the carriage from right to left to make sure the carriage mechanism and cable drive assembly are intact. A noticeable degree of resistance will occur due to the permanent magnet stepper motor, but the carriage should move smoothly without binding.

1.3 RIBBON INSTALLATION

- 1) Turn the power off.
- 2) Manually move the printhead to the middle of the carriage.

1.3 (cont'd)

- 3) Turn the blue knob on the cartridge to remove any slack in the ribbon.
- 4) Place the cartridge over the printhead with the exposed ribbon sliding down between the platen and printhead tip. Seat the cartridge on the brass mounting pins and spring clamps.
- 5) Manually move the carriage from left to right to verify that the ribbon is advancing in a constant counter-clockwise motion.

1.4 PRINthead ADJUSTMENT

The printhead-to-platen gap may be adjusted to accommodate various form thicknesses. The adjustment lever is located on the left side of the carriage on the outside of the side plate. Although the lever is actually under the top cover of the printer, it can be manipulated by removing the plexiglass access window and reaching under the top cover. The lever is spring loaded and may be set in one of nine (9) detents. Flex the lever toward the printer side plate so that it may be adjusted freely. Move the lever forward to move the printhead closer, and back to move the printhead away from the platen.

NOTE: If the printhead is moved manually for any reason, the RESET button should be pressed before printing is resumed. This will restore the carriage to the left margin and reset the printhead positioning logic.

1.5 LOADING FORMS

Forms may be fed from the front when the printer is on a desktop, or through the bottom when the printer is mounted on a stand.

Front-load -- Feed the leading edge of the form through the opening in the front of the cover. Be sure the paper feeds under the metal plate beneath the carriage system and up from behind the mylar tensioning bar below the platen. The paper should feed smoothly with some resistance due to the mylar tensioner. At this point the tractors should be adjusted for the particular form being used.

Bottom-load -- Feed the leading edge through the slot in the bottom of the printer cover. The form should pass behind the mylar tension bar and up to the tractors where the paper is engaged.

NOTE: To make loading forms easier, it is a good idea to move the carriage to the true left margin either manually or by electronic RESET.

1.6 ADJUSTING FORMS TRACTORS

Both the right and left tractors may be adjusted to accommodate various form widths. To release the tractor for repositioning, push up on the plastic tab on the side of the tractor. To lock the tractor in position, press down on the tab.

SECTION 2

OPERATING INFORMATION

2.1 POWER ON

The power switch is located on the left rear of the printer beside the line fuse and power cord. The carriage will reset to the left margin when the printer is powered on.

2.2 CONTROL PANEL AND INDICATORS

ON LINE Indicator -- LED glows steadily when the printer is on-line.

POWER Indicator -- LED glows steadily when power is on.

ERROR Indicator -- LED blinks when an error condition occurs.

PAPER Indicator -- LED blinks when paper-out condition occurs.

LINE Key -- Pressing this key places the printer on-line.

LOCAL Key -- Pressing this key places the printer in local or off-line condition. The local condition will raise a busy signal on the communications interface.

RESET Key -- Pressing this key restores the carriage to the left margin and resets the printhead positioning logic.

CONT Key -- Pressing this key will resume operation after an error or paper-out condition has been corrected.

ADV Key -- Pressing this key momentarily will generate a line feed. If the switch is depressed for more than .5 seconds, the paper will advance continuously until the key is released. This paper movement is registered electronically in the forms control program.

TOF Key -- Pressing this key generates a paper movement to the preset top of the next form. This key operates in the local or on-line condition. This paper movement is registered electronically in the forms control program.

FORM ↑ -- Pressing this key moves the form 1/48 inch up for precise form alignment. This paper movement does not register electronically in the forms control program. This key may be used while the printer is operating.

FORM ↓ -- Pressing this key moves the form 1/48 inch down for precise form alignment. This paper movement does not register electronically in the forms control program. This key may be used while the printer is operating.

SECTION 3

PROGRAMMING INFORMATION

3.1 SET-UP PANEL

The set-up panel is used to configure all programmable format parameters on the DS180 printer.

A set of default parameters is stored permanently in the printer as listed in Reference Appendix 1. The default condition may be reached by depressing and holding the CLEAR key while simultaneously pressing the RESET key.

The user may also program and store a specially configured format. The settings are retained in a non-volatile memory and will not be lost when power is turned off. The settings may be altered and stored at a later time should the application requirements change.

Upon power-on, the DS180 will resume operation with all user-programmable features (including forms status) configured as they were when the printer was last powered off. This is accomplished by transferring information from the non-volatile status memory into working storage.

Upon conclusion of the transfer, the DS180 performs a cyclic redundancy test on the status memory. If no error is found, operation will commence with the line number in the LED display. If a status memory fault is detected, the ERROR light will begin blinking and the error code 6508 will be displayed. When this occurs, the operator may continue operation by depressing the CONT key. Default values will be loaded into the DS180 in lieu of the previous user-programmed status. This error condition will occur only when there is a hardware malfunction on the DS180 logic board.

The Set-Up panel consists of eight (8) keys, a 4-digit display, and an indicator light. Refer to Figure 1.

SET-UP Indicator -- Blinks when printer is in set-up mode.

Digital Readout -- Displays enunciator codes and values of features being programmed.

ENTER Key -- Pressing this key places the printer in set-up mode.

EXIT Key -- Pressing this key exits set-up mode.

DSP ↑ Key -- Pressing this key moves digital readout up.

DSP ↓ Key -- Pressing this key moves digital readout down.

SET Key -- Pressing this key stores the numeric value of a parameter on certain features. It is also used to set the "on" or "enabled" condition on features 28-40.

CLEAR Key -- Pressing this key sets an "OFF" or "Disabled" condition on certain features.

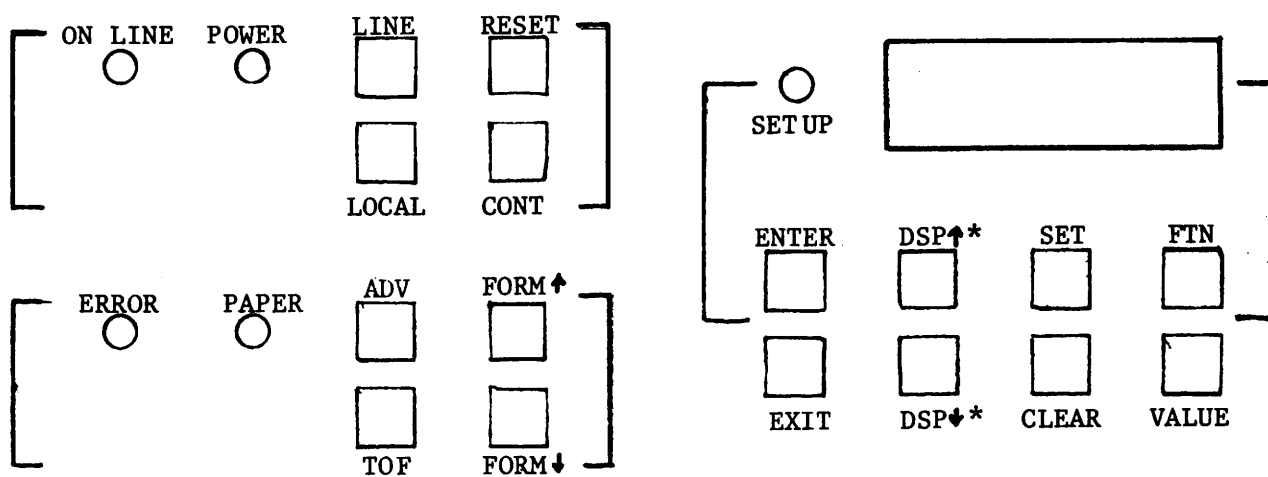


FIGURE 1

*NOTE: The display UP-DWN Keys will auto-repeat if held depressed for 0.5 sec

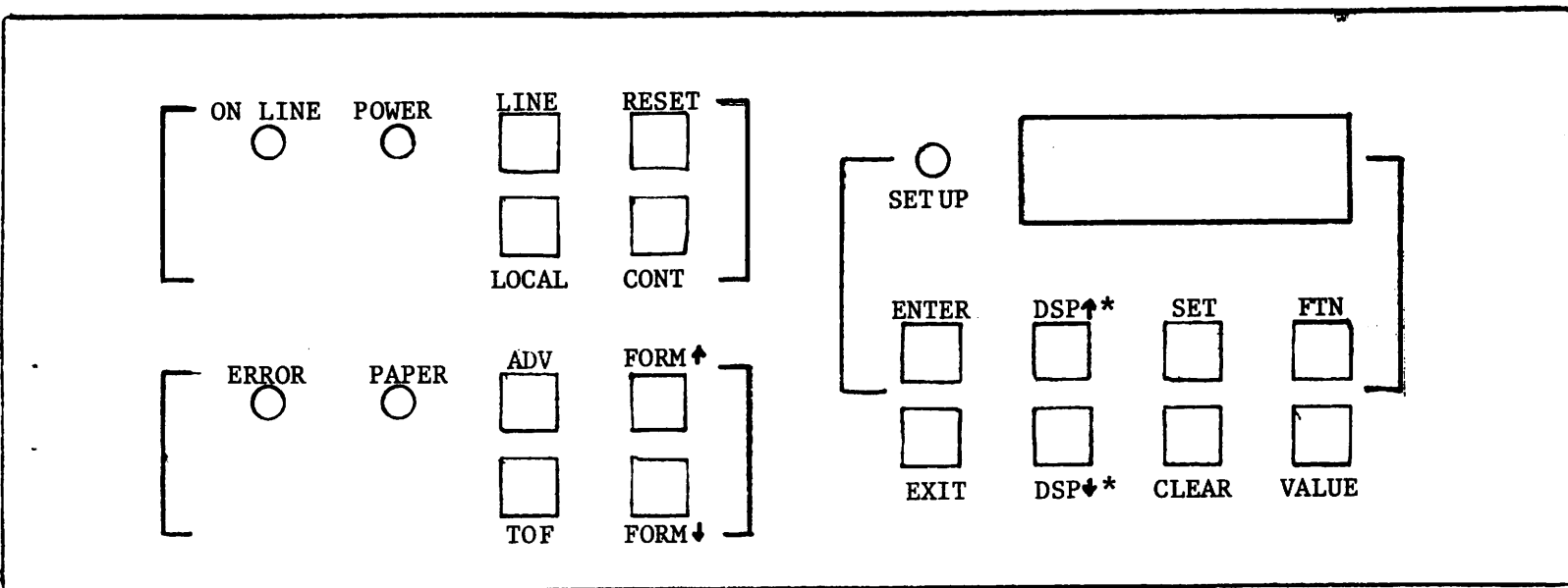


FIGURE 1

*NOTE: The display UP-DWN Keys will auto-repeat if held depressed for 0.5 sec

3.1 (cont'd)

FTN Key -- Pressing this key will display the enunciator code for the feature being programmed at the time.

VALUE Key -- Pressing this key will display the value of the parameter being configured at the time.

The following example shows how to program the baud rate:

- 1) Press the LOCAL button to place the printer in off-line condition.
- 2) Press the ENTER key to enter set-up mode. The Set-Up indicator light will begin blinking, indicating you are in set-up mode. A 2-digit enunciator will appear in columns 3 and 4 of the LED display, indicating the feature being programmed at the time. Upon entering set-up mode, 01 will be the enunciator. Referring to the programmer's reference list, the user knows that 01 represents the baud rate feature.
- 3) To determine the baud rate value currently set in the printer, press the VALUE key and a number will appear in the LED panel indicating a baud rate from 110-9600.
- 4) To increment to a higher baud rate, press and release the DSP↑ key. This will move the display to the next higher rate. Press again to move to the next rate and continue until you have reached the desired setting. When the display has reached 9600, pressing the DSP↑ will wrap around to 110, the lowest baud rate setting, and will continue to cycle through the available rates. To decrement the display value and reverse the cycle, press the DSP↓ key.
- 5) When the desired value is in the display, press the SET key and the value will be stored in the non-volatile memory. The user may then exit set-up mode by pressing EXIT, or move on to the next programmable feature by pressing FTN.
- 6) Pressing FTN will return the LED display to the 2-digit enunciator, indicating the feature being programmed. In our example, pressing FTN returns the display to 01. To move to the next feature, press the DSP↑ key and the display will read 02, indicating that you are now programming Form Length. To check the form length value presently in the machine, press the VALUE key and the LED panel will display a number from 1-132. To go to a longer form length, press the DSP↑. When the desired value is displayed, press the SET key to store it in the non-volatile memory. You may exit set-up mode by pressing the EXIT key, or proceed to the next programmable feature by pressing the FTN key and incrementing the display to 03.

The above example depicts the appropriate procedure for programming the first 26 features which all require a numeric value. These are referred to as "value" features.

Features beginning at 28 require an "on/off" or "enable/disable" condition setting. These are referred to as "Discrete" features. The programming procedure is basically the same except that no numeric value is required. In-

3.1 (cont'd)

stead, an "ON" or "ENABLE" condition is selected by pressing the SET key. A "1" displayed in the digital readout indicates an "ON" condition. An "OFF" or "DISABLE" condition is selected by pressing the CLEAR key. A "0" displayed in the digital readout indicates an "OFF" condition.

EXAMPLE: To enable the X-on, X-off handshake feature, do the following:

- 1) Press the LOCAL button to place printer in off-line condition.
- 2) Press the ENTER key to enter set-up mode. The SET-UP indicator light will begin blinking, indicating you are in set-up mode.

The 2-digit enunciator will appear in columns 3 and 4 of the LED display. Upon entry into set-up mode, 01 will be the enunciator.

- 3) Refer to the programmer's reference list to find the enunciator code for the X-on, X-off feature. The code is 30.
- 4) To increment the digital display to 30, press the DSP ↑ key until the display reads 30.

NOTE: If the user inadvertently advances beyond the desired number, the digital display may be decremented by pressing the DSP ↓ key.

- 5) When the desired enunciator code, 30, is in the display, the feature may be enabled or disabled. If a "0" appears in the first column of the digital display, an "OFF" condition is stored in the memory. To enable an "ON" condition, press the "SET" key. A "1" will appear in the first column of the digital display indicating that the "ON" condition is now stored in the memory.
- 6) To exit set-up mode, press the EXIT key; or, if you wish to program additional features, press the DSP ↑ key which will advance the display to 31.

3.2 CONTROL COMMANDS

The DS180 utilizes many ANSI standard CONTROL COMMANDS to activate various features. When a recognizable CONTROL CODE (ASCII codes 000g - 037g) is received, the DS180 will respond with the appropriate operation as listed in Appendix 3.

SECTION 4

VALUE FEATURES

4.1 BAUD RATES

Baud rates from 110-9600 may be selected on the DS180. The baud rate must be programmed from the control panel on the DS180. Baud rates cannot be programmed via the communications line. The set-up enunciator code for baud rate is 01.

4.2 FORM LENGTH

The form length on the DS180 may be set from 1-132 lines. The enunciator code for the form length feature is 02.

Procedure:

- 1) To set the form length to 66 lines, enter set-up mode and advance the display to 02 (the enunciator code for the form length feature).
- 2) Press the VALUE key and then advance the display to 66 (the desired value for form length).
- 3) Press the SET key to enter the value in the non-volatile memory.
- 4) Press the EXIT key to exit set-up mode.

NOTE: Changing form length clears top and bottom margins and sets the top of form at the current line.

4.3 TOP OF FORM

The Top of Form may be set by entering set-up mode and pressing the TOF key. The top of form will be set at the current line.

NOTE: The digital readout will always display the current line number when the printer is not in set-up mode.

4.4 TOP AND BOTTOM FORM MARGINS

Form margins may be set so that output is formatted in pages and is not printed over perforations. The enunciator code for the top margin (first line of print) is 03.

The enunciator code for the bottom margin (last line of print) is 04. When the printer reaches the bottom margin of a page and receives a vertical paper movement command (i.e., Line Feed, Form Feed, Vertical Tab) the paper will automatically slew to the top margin of the next page.

Procedure:

- 1) To set the top margin at line 5 and the bottom margin at line 60, enter

4.4 (cont'd)

- 1) set-up mode and advance the display to 03 (the enunciator code for the top margin).
- 2) Press the VALUE key and then advance the display to 05 (the desired value for the top margin).
- 3) Press the set key to enter the value in the non-volatile memory.
- 4) Press the FTN key to return to feature mode.
- 5) Advance the display to 04 (the enunciator code for the bottom margin).
- 6) Press the VALUE key and advance the display to 60 (the desired value for the bottom margin).
- 7) Press the SET key to enter the value in the non-volatile memory.
- 8) Press the EXIT key to enter SET-UP mode.

NOTE: If an attempt is made to set the bottom margin greater than the form length, the ERROR light will begin blinking indicating an illegal command. The error code 0200 will be displayed. To correct the error condition, press the CONT key and the display will return to the value which was previously entered illegally. The value can then be altered to a legal entry.

The bottom margin must be greater than the top margin. If an attempt is made to program the top margin below the bottom margin, the ERROR light will blink indicating an illegal command. The error code 0300 will be displayed. If an attempt is made to set the bottom margin above the top margin, the error code 0400 will be displayed. To correct the error condition, press the CONT key and the display will return to the value which was previously entered illegally. The value can then be altered to a legal entry.

4.5 LEFT AND RIGHT MARGINS

The left margin (first printable column) may be set in any column from 1-132. The enunciator code for left margin is 05.

The right margin (last printable column) may be set in any column from 1-132. The enunciator code for right margin is 06.

Procedure:

- 1) To set the left margin at column 10, and the right margin at column 80, enter set-up mode and advance the display to 05 (the enunciator code for the left margin).
- 2) Press the VALUE key and then advance the display to 10 (the desired value for the left margin).
- 3) Press the SET key to enter the value in the non-volatile memory.

4.5 (cont'd)

- 4) Press the FTN key to return to feature mode.
- 5) Advance the display to 06 (the enunciator code for the right margin).
- 6) Press the VALUE key and advance the display to 80 (the desired value for the right margin).
- 7) Press the set key to enter the value in the non-volatile memory.
- 8) Press the EXIT key to exit set-up mode.

NOTE: The left margin must be less than the right margin. If an attempt is made to program the left margin to the right of the right margin, the ERROR light will blink indicating an illegal command. The error code 0500 will be displayed. If an attempt is made to program the right margin to the left of the left margin, the error code 0600 will be displayed. To correct the error condition, press the CONT key and the display will return to the value which was previously entered illegally. The value can then be altered to a legal entry.

4.6 HORIZONTAL TABS

Up to 15 horizontal tabs may be set in the DS180. When a horizontal tab code is received from the communications line, the printhead advances to the next horizontal tab stop.

NOTE

The procedure for setting horizontal tabs has been revised. The updated procedure is included in Appendix 6, page 1.

4.7 VERTICAL TABS

Up to 15 vertical tabs may be set in the DS180. When a vertical tab code is received from the communications line, the form will advance to the next vertical tab stop.

NOTE

The procedure for setting vertical tabs has been revised. The updated procedure is included in Appendix 6, page 1.

SECTION 5

DISCRETE FEATURES

Features with codes 28-41 are those with discrete "on/off" or "enable/disable" condition settings. These are the type of features which might be controlled by dip-switches or jumpers on other printers and terminals. When the enunciator code for one of these features is displayed in the digital readout, a third digit will appear in column one of the display indicating the present condition setting of the feature. A "0" in the first column indicates that the feature is "off" or "disabled". A "1" in the first column indicates that the feature is "on" or "enabled". An "off" condition may be entered by pressing the CLEAR key. An "on" condition may be entered by pressing the SET key.

EXAMPLE: To enable the X-on, X-off synchronization protocol (feature code 30), do the following:

- 1) Enter set-up mode by pressing the SET-UP key. The SET-UP light will begin blinking indicating the DS180 is in SET-UP mode.
- 2) Press the DSP $\uparrow$ key to advance the display to 30 (the enunciator code for the X-on, X-off feature).
- 3) The number 30 will be displayed in columns 3 and 4, indicating the feature being programmed.
- 4) A "0" will appear in column 1 indicating that the feature is disabled.
- 5) Press the SET key to enable the feature. A "1" will appear in column 1 of the display indicating that the feature is enabled and the setting is in the non-volatile memory.
- 6) Exit set-up mode by pressing the EXIT key.

5.0.1 6/8 LINES PER INCH

The vertical pitch on the DS180 can be set at either 6 or 8 lines per inch. The enunciator code for this feature is 39.

To program the vertical pitch, enter SET-UP mode and advance the display to 39. A "0" will appear in column 1 if the pitch is currently set at 6 lines, and a "1" will appear in column 1 if the pitch is at 8 lines.

To set the pitch at 6 lpi, press the CLEAR key. To set the pitch at 8 lpi, press the SET key.

5.0.2 PRINT INHIBIT

In certain applications, the user may wish to selectively enable or disable the printing of data received by DS180. This capability may be selected by enabling feature 28. When enabled, a CONTROL S received by the DS180 via the communications line will inhibit the printing of received data. A

5.0.2 (cont'd)

CONTROL Q received via the communications line signals the DS180 to resume printing received data.

To disable the print inhibit capability, enter set-up mode, advance to feature 28, and press the CLEAR key. A "0" will be displayed in column 1.

To enable the print inhibit capability, press the SET key. A "1" will be displayed in column 1.

5.0.3 EXPANDED CHARACTER PRINTING

The DS180 is capable of printing expanded characters at 5 characters per inch. The expanded characters may be used to highlight certain portions of the text such as titles or headings. The feature code for expanded print is 29.

This feature determines the capability to select between character sizes and not the actual selection of the character size itself. The selection of normal or expanded print is determined by a CONTROL code. A CONTROL N (shift-out) selects expanded print when feature 29 is enabled. A CONTROL O (shift-in) selects normal print when feature 29 is enabled. If feature 29 is disabled, expanded print cannot be selected.

NOTE: Only one passage of expanded print can be selected in a given line. At the end of a line, the print will automatically revert to normal size.

5.0.4 X-ON, X-OFF SYNCHRONIZATION PROTOCOL

X-on, X-off is a synchronization protocol between the printer and computer. This feature allows the printer to control the data transmission from the computer through software CONTROL codes to maximize throughput without overflowing the print buffer.

The X-on, X-off control may also be programmed to stop transmission when an error or paper-out condition has occurred.

The feature code for X-on, X-off is 30. When this feature is enabled, a CONTROL S, or X-off command, will automatically be transmitted to the computer when buffer overflow is imminent. When the buffer has emptied, a CONTROL Q, or X-on command, will be transmitted to the computer.

If feature 30 is disabled, the X-on, X-off synchronization is inactive.

5.0.5 DTR SYNCHRONIZATION PROTOCOL

Data Terminal Ready (DTR) restraint mode is a synchronization protocol between the printer and computer. This feature allows the printer to control the data transmission from the computer by monitoring the status of the DTR line on the RS232 interface. This enables the DS180 to maximize throughput without overflowing the print buffer.

The feature code for DTR synchronization is 31. When this feature is enabled, the DTR line will automatically go "busy" if the print buffer approaches capacity. When the buffer has emptied, the DTR line will go "idle".

5.0.5 (cont'd)

If the DTR feature is enabled and a paper-out condition is detected, the DTR line will go "busy" to stop transmission from the computer.

5.0.6 PARITY

The DS180 may be configured for even or odd parity, or no parity. To enable parity, feature code 32 should be set to the "on" condition.

To select even parity, feature code 33 should be set to the "off" condition. To select odd parity, feature code 33 should be set to the "on" condition.

5.0.7 AUTO NEW LINE

The DS180 may be configured to automatically execute a carriage return and line feed when the printhead reaches the right margin.

To enable this capability, feature code 34 should be set to the "on" position.

5.0.8 PRINT ON RECEIPT OF CARRIAGE RETURN

The DS180 normally begins printing data upon receipt of a paper movement command (i.e., line feed, form feed, vertical tab). In some cases, the user may wish to initiate printing without advancing the paper.

When feature code 35 is set to the "on" position, the DS180 will begin printing upon receipt of a carriage-return command and does not require receipt of a paper-movement command.

5.0.9 AUTOMATIC LINE FEED

The DS180 may be configured to automatically perform a line feed upon receipt of a carriage-return command.

To enable auto line feed, feature code 36 should be set to the "on" position.

5.1.0 AUTOMATIC CARRIAGE RETURN

The DS180 may be configured to automatically perform a carriage return upon receipt of a paper-movement command (i.e., line feed, form feed, vertical tab).

To enable auto carriage return, feature code 37 should be set to the "on" position.

5.1.1 FORM FEED DEFEAT

The DS180 normally performs a form feed upon receipt of a CONTROL L command from the communications line. In some cases, the user may wish to defeat this capability.

To enable the form feed defeat, feature code 38 should be set to the "on" position.

5.1.1 (cont'd)

NOTE: The form feed defeat is sensitive only to the CONTROL L command received from the communications line. The TOF key on the front panel will still generate a form feed.

SECTION 6

INTERFACE CONFIGURATIONS

6.1 RS232 INTERFACE

The DS180 features an EIA RS-232-C interface with the following pin configuration:

PIN	1	Chassis Ground
	2	Serial Data Out
	3	Serial Data In
	7	Signal Ground
	8	Carrier Detect
	20	Data Terminal Ready

6.2 20 mA CURRENT LOOP INTERFACE

The DS180 features a 20 mA Photo-isolated current loop interface with the following configuration:

PIN	17	Current Loop TX+
	23	Current Loop RCV+
	24	Current Loop TX-
	25	Current Loop RCV-

Both the RS232 and current loop interfaces are accessed through the 25-pin D-connector on the rear panel of the DS180.

6.3 PARALLEL INTERFACE

The DS180 features a TTL level 8-bit parallel interface with the following pin configuration:

PIN	1	Data Strobe	PIN	19	---
	2	Data Bit 1		20	---
	3	Data Bit 2		21	---
	4	Data Bit 3		22	---
	5	Data Bit 4		23	---
	6	Data Bit 5		24	---
	7	Data Bit 6		25	Twisted Pair Ground
	8	Data Bit 7		26	---
	9	---		27	---
	10	Acknowledge		28	---
	11	Busy		29	---
	12	Paper Out or Print Off		30	---
	13	---		31	---
	14	Ground		32	---
	15	---		33	Ground
	16	Ground		34	---
	17	Chassis Ground		35	---
	18	+5V		36	---

The parallel interface is accessed through the 36-pin female connector on the rear panel of the DS180.

Burst Mode

The parallel interface may be configured by the user to operate in continuous or burst mode. The default setting is continuous mode.

When operating in continuous mode, the printer will accept data any time there is room in the line buffer. This results in higher throughput since the printer is presented with data at the fastest possible rate.

Burst mode differs from continuous mode in that characters are accepted by the printer only during nonprinting intervals. Although not as efficient as continuous mode, this mode of operation is provided for compatibility with older model printers.

SECTION 7

SPECIAL FEATURES

7.1 PAPER OUT DETECTION

A photo sensor is embedded in the platen below the print line. When a paper-out condition occurs, a stop transmission command will be sent to the computer via the synchronization protocol currently programmed into the DS180. In addition, the paper-out indicator on the front panel will blink and an audio alarm will sound. When the forms have been reloaded and aligned in the printer, press the CONT key to resume printing. Since the content of the buffer is retained and then printed when operation is resumed, no data is lost during a paper-out condition.

The paper-out detection may be overridden by enabling Feature 40.

7.2 SELF-TEST

A preprogrammed print routine may be activated to verify proper operation of the DS180. A rotating pattern of the 94 ASCII characters will be printed during the test. To initiate the feature, enter Set-up mode and advance the display to Feature 50. Then press the SET key and the printer will generate 94 lines and stop. The self-test may be terminated earlier by pressing the CLEAR key.

7.3 LINE/LOCAL POWER-UP

A special feature has been added which provides the capability to power-up in "on-line" or "local" condition depending on user preference. When feature 42 is enabled, the DS180 will power-up in the "on-line" condition. When feature 42 is disabled, the DS180 will power-up in the "local" condition.

This setting also governs the status of the machine if the RESET key is depressed.

In addition, a down-line programming enhancement has been added to the DS180. A description of its operation is provided in Appendix 6.

Appendix 6 should be read in its entirety since several operational features have been changed. Annotations should then be made on the appropriate pages in this manual.

APPENDIX 1

VALUE MODE FEATURES

<u>CODE</u>	<u>FEATURE</u>	<u>DEFAULT STATUS</u>
01	Baud Rate	1200
02	Form Length	66
03	Top Margin	1
04	Bottom Margin	66
05	Left Margin	1
06	Right Margin	132
07	Horizontal Tabs	00
08	Vertical Tabs	00
09	Horizontal Pitch	10

APPENDIX 2

DISCRETE MODE FEATURE

<u>CODE</u>	<u>FEATURE</u>	<u>DEFAULT STATUS</u>
28	Print Inhibit	Off
29	Expanded Print	None
30	X-on, X-off Synchronization	Off
31	DTR Synchronization	Off
32	Parity Enable	Off
33	Parity Odd	Even
34	Auto New Line	Off
35	Print on Receipt of Carriage Return	Off
36	Auto Line Feed on Receipt of Carriage Return	Off
37	Auto Carriage Return on Receipt of Line Feed	Off
38	Form Feed Defeat	Off
39	8 Line Per Inch	6
40	Paper-Out Detection Override	Off
41	Burst-Mode Enable (Parallel Interface)	Off
42	Power-up On-line	Off
43	Serial Interface Disable	Off
44	Automatic Print Disable	Off
45	Top-of-form set	Off
46	Escape Sequence Disable	Off
47	Display Mode	Off
48	Alternate Character Set	Off
49	Graphics Mode Enable	Off

APPENDIX 3

CONTROL COMMANDS

CTRL G	Bell
CTRL H	Back Space
CTRL I	Horizontal Tab
CTRL J	Line Feed
CTRL K	Vertical Tab
CTRL L	Form Feed
CTRL M	Carriage Return
CTRL N	Shift-out of Double Wide
CTRL O	Shift-in to Double Wide
CTRL Q	X-on
CTRL S	X-off

APPENDIX 4

Error Codes

0200	Bottom margin greater than form length
0300	Top Margin below the bottom margin
0400	Bottom margin above the top margin
0500	Left margin to right of right margin
0600	Right margin to left of left margin
6508	Status Memory Fault

APPENDIX 5.1

DS180 PARALLEL INTERFACE CHARACTERISTICSScope

The intent of this technical note is to describe the operational characteristics of the DS180 parallel interface. Included is a discussion of the timing, protocol and compatibility with the Centronics convention.

Protocol

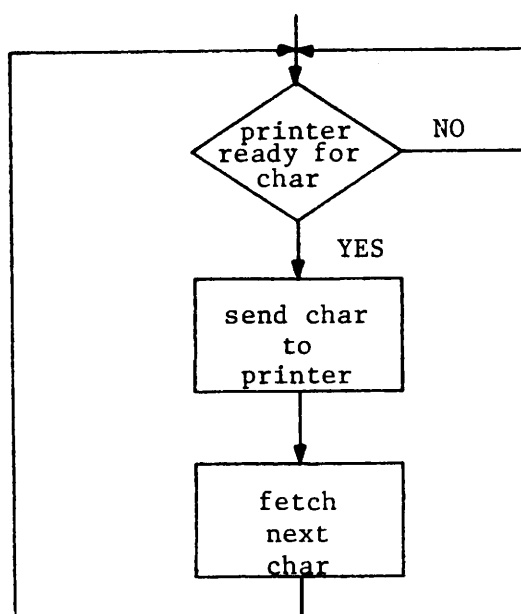
The parallel interface provides the user with a simple, high speed interface for communications with a CPU or host system. Operating with parallel data in lieu of serial offers several advantages. Among them are:

- 1) elimination of serial encoders and decoders
- 2) no requirement for a BAUD rate clock
- 3) inherent synchronization (i.e., no loss of data due to buffer overflow)

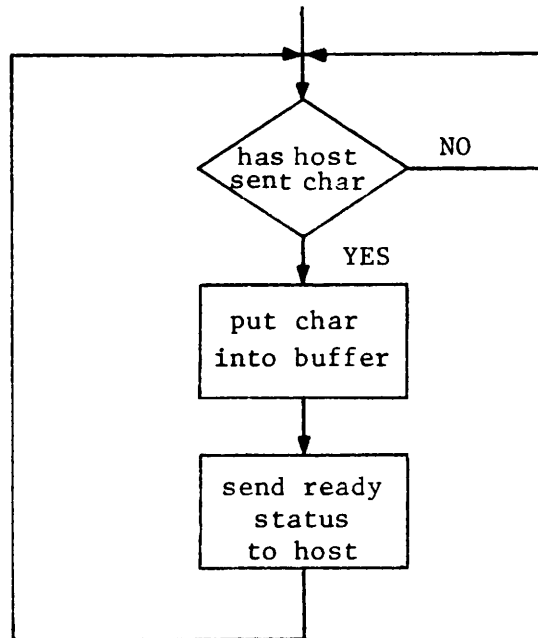
For proper operation, the printer and host must exchange information on a character-by-character basis. The host initiates the action by presenting to the printer a 7-bit parallel data word, or character. After a brief setting time, a data strobe is issued by the host. The printer takes the character from its interface circuitry and puts it in a line buffer. Then a ready signal is sent to the host indicating that another character may be sent.

The protocol may be summarized by the following flowcharts:

AT THE HOST END:



AT THE PRINTER END:



Reporting the Ready Status

As already mentioned, the printer must signal to the host when it is ready to receive another character. This is an extremely important task, and most compatibility problems center around this function. Garbled data, or the loss of it, will occur if the host does not honor the ready status, or if the printer does not transmit it.

Two signals on the interface are associated with the printer-ready status. They are referred to as BUSY and ACKNOWLEDGE and are described below:

ACKNOWLEDGE: This signal is a pulse (normally negative going) which is sent to the host when the printer is ready to accept a new character. It is often referred to as the handshake signal since it is the signal that the host is expected to await before sending more data. The electrical characteristics and timing of this pulse are described later.

BUSY: The BUSY line is provided to indicate to the host when the printer is performing an operation such as printing or moving paper. While the host may use this signal to determine the printer's ready status (in general), it should not be thought of as a handshake signal. An attempt to coordinate data transfer using BUSY will result in loss of data with many printers (including early models of the DS180). This is due to the fact that BUSY is not activated until a complete line has been received and stored in the line buffer. Thus, data loss will occur unless the printer input interface is fast enough to accept and store data at a rate equal to sending device (host).

Centronics Compatibility

The DS180 parallel interface was designed around the Centronics standard since most systems in use today are compatible with the Centronics specification. Unfortunately, there exist many interpretations as to what the Centronics specification actually is. The following variations have been observed:

IGNORING HANDSHAKE: Many designers take advantage of the hard-wired input circuitry of some printers by sending data without regard to the ACKNOWLEDGE or BUSY signals until a complete line has been sent. Although this is strictly against the specification, it works fine as long as the printer can accept data as fast as the host can send it.

Printers which utilize microprocessors (with software driven data acquisition) cannot accept data at an arbitrary rate and will lose data unless the host honors the handshake signal.

HANDSHAKE ON BUSY: A look at the Centronics specification will show that BUSY is not raised on a character-by-character basis. Thus, a system designed to look at BUSY (for a ready condition) after transmission of each character, will cause loss of data unless the printer has a fast front-end.

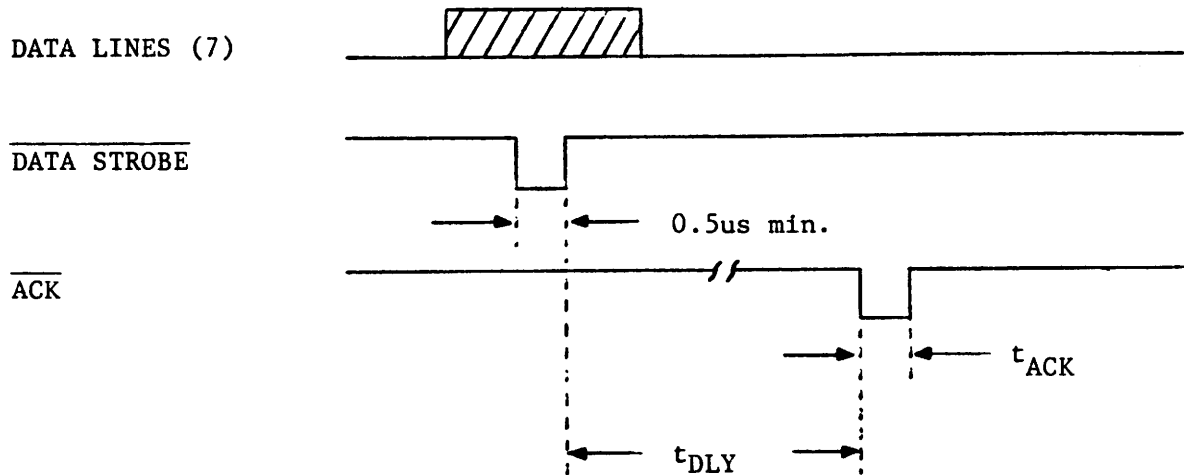
POLLING ACKNOWLEDGE: A few designers have attempted to handshake by polling the ACKNOWLEDGE pulse with a software routine at the host end. This will not work because the ACK pulse is too fast. The ACK pulse should be used to set a latch whose output can be "READ" by the host, then reset.

DS180 Upwards Compatibility

Being microprocessor controlled, the DS180 cannot accept data at a rate equal to printers with a hard-wired front-end. This makes it imperative that the host honor the ready status sent by the printer. Since many systems want to handshake using BUSY, new DS180 models have been modified to manipulate the BUSY signal on a character-by-character basis. The ACKNOWLEDGE signal is also issued just as before. This modification enables the DS180 to operate with more systems without sacrificing compatibility with others complying with the strict Centronics specifications.

Timing

Figures 1a and 1b show the timing diagram for DS180 models designed to meet the original Centronics specification. Figure 2 shows the timing diagram for the modified DS180.

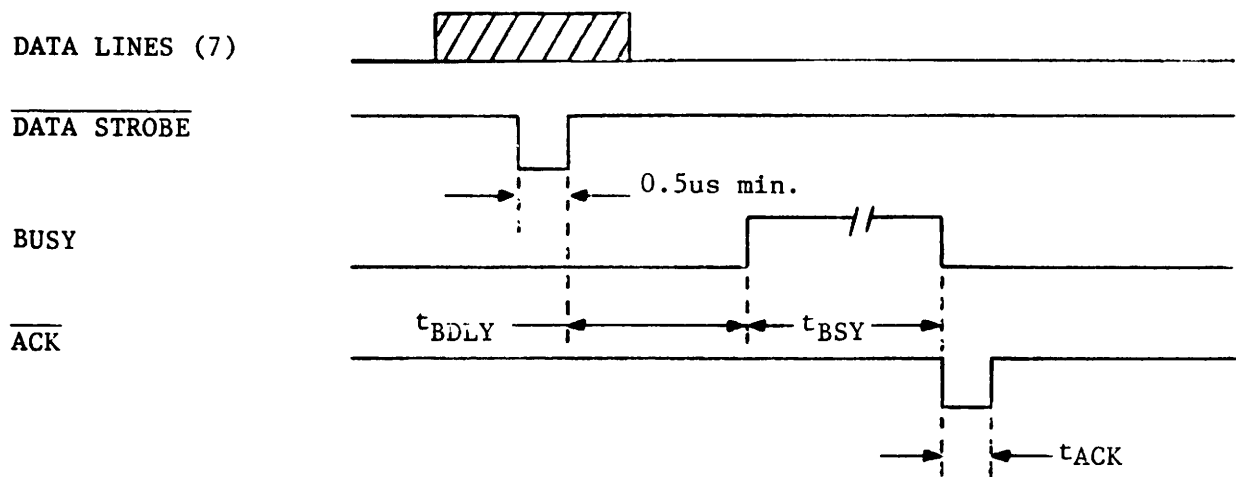


t_{DLY} : min. = $50\mu\text{s}$
max. = 1.0ms

t_{ACK} : min. = $4\mu\text{s}$
max. = $50\mu\text{s}^*$

*The $50\mu\text{s}$ occurrence is seldom seen, but can happen if MPU gets an interrupt at the instant it commands the ACK line low.

Figure 1a: Normal Parallel Data Input Timing
(Centronics Convention for characters that do not cause Busy)



TBDLY: min = $50\mu\text{s}$
 max = $150\mu\text{s}$

TACK: min = $4\mu\text{s}$
 max = $50\mu\text{s}$

TBSY: min = 30ms
 max = 4 sec

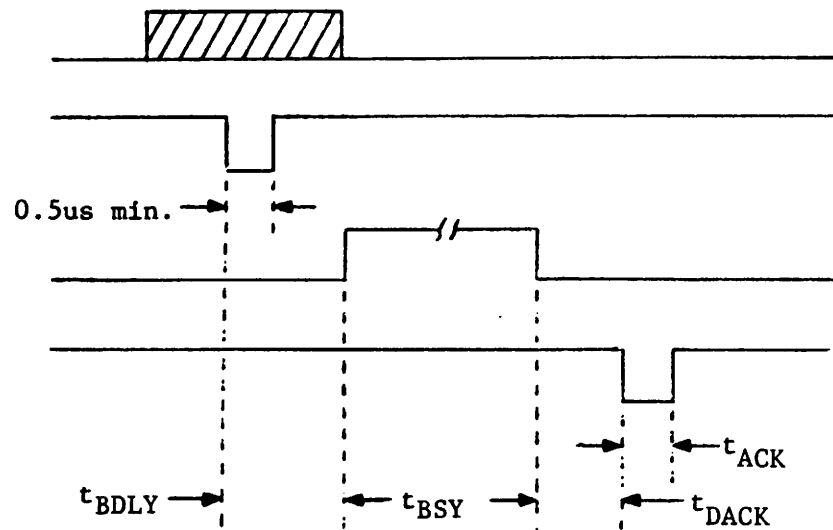
Figure 1b: Timing for character that cause busy
 (Centronics Convention)

DATA LINES (7)

DATA STROBE

BUSY

ACK



t_{BDLY} : min. = 250ns
max. = 400ns

t_{BSY} : min. = 100us
max. = 4 sec

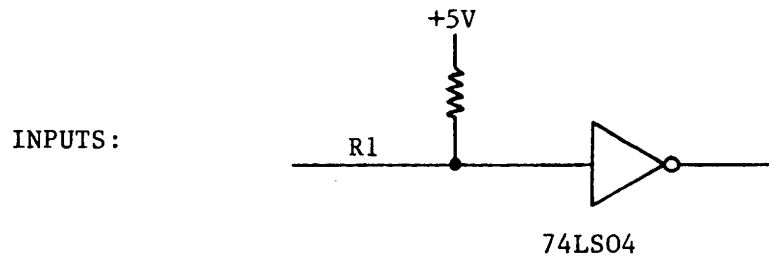
t_{ACK} : min. = 4us
max. = 50us

t_{DACK} : min. = 4us
max. = 50us

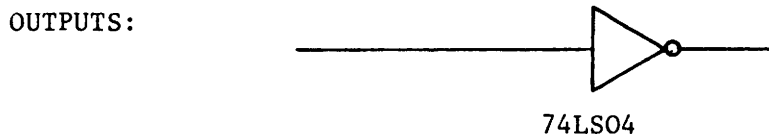
Figure 2: Parallel Data Timing for Modified DS180
(upwards Centronic Compatible)

Electrical Characteristics

The DS180 parallel interface is a TTL type with the following receiver and driver configuration:



NOTE: $R_1 = 1000 \text{ ohm}$ (for Data Lines)
 $R_1 = 470 \text{ ohm}$ (for Data Strobe)



Interface Connections

The DS180 parallel interface utilizes the standard 36-PIN connector found on Centronics printers. The pin connections are given in Table I.

PIN #	SIGNAL
1	$\overline{\text{DATA STROBE}}$
2	DATA 1
3	DATA 2
4	DATA 3
5	DATA 4
6	DATA 5
7	DATA 6
8	DATA 7
10	$\overline{\text{ACK}}$
11	BUSY
12	GND
14	GND
16	GND
18	+5
19	GND
20	GND
21	GND
22	GND
23	GND
24	GND
25	GND
26	GND
27	GND
28	GND
29	GND
30	GND

Table I: Parallel Interface Pin Connections

APPENDIX 6

To allow remote control of certain user programmable functions, a down-line load enhancement has been added to the DS180 firmware. This is accomplished through the use of Escape sequences patterned after the convention set forth by ANSI (American National Standards Institute). The DS180 Escape sequences are compatible with the ANSI specification provided that each sequence is formatted exactly as indicated. That is to say, no guarantee is given that all default modes will be compatible with another machine using the ANSI convention.

A complete list of the DS180 Escape sequences is provided in Table I. Certain default modes are indicated below.

Escape Default Modes

1. No control codes are allowed in an Escape sequence. The sequence is aborted if a control code is detected before the sequence is completed.
2. A numeric argument is set to a value of 1 if a zero is sent, or if it exceeds a value of 132.
3. A maximum of 15 vertical and horizontal tabs is allowed. An attempt to set additional tabs will be rejected and the bell will sound once. Thus, it may be desirable to first clear all tabs before a sequence is sent to set additional ones.

Other Enhancements

1. SETTING HORIZONTAL AND VERTICAL TABS

For operator convenience, a new method has been established to set or clear tabs. In lieu of separate function codes for each tab value, a single function code is used. For horizontal tabs the code is 07, and for vertical tabs it is 08. Function codes 09 through 26 are reserved for future expansion.

To set, clear, or view the tab status, the operator must first advance the display to the proper code. Now, depressing the VALUE key will cause the display to indicate up to a 4-digit number. The left-most digit will show a "1" if a tab is set, or a "0" if no tab is set. The right-most three digits indicate the column (or line) corresponding to the tab status. For example, the display will show a value of 1106 if a tab is set in column (or line) 106. A value of 0106 will be seen if no tab is set at column 106. The DISPLAY up-down keys are used to cycle the column (or line) number as before.

2. ERROR CODES

Previous DS180 models employ certain error codes to indicate when an attempt is made to set a feature to an illegal value (see Appendix 4). In the new firmware these error codes have been eliminated. Instead, the bell sounds when an illegal entry is attempted.

3. NEW FEATURE CODES

Three new feature codes have been added to the enhanced firmware. They are described below.

a) FTN 43: SERIAL INTERFACE DISABLE

When set, FTN 43 causes the DS180 to ignore any data sent to it over the serial interface (RS-232 or current loop). This feature should be set if the parallel interface is used, and the current loop option is installed. This prevents the possibility of erroneous characters entering the FIFO buffer. The default status of FTN 43 is "0", meaning the serial interface is enabled.

b) FTN 44: AUTOMATIC PRINT DISABLE

In previous DS180 models, no printing will occur until a paper motion command is detected. Thus, any characters that may have accumulated in the print buffer will remain there indefinitely unless a paper motion command is sent. In some applications this may be undesirable. For example, many operating systems send a message at the end of a command sequence which is not terminated with carriage-return line-feed. To see what was sent, the operator would have to send some form of paper motion command.

The enhanced version uses FTN 44 to allow the user to enable (or disable) an automatic print feature. The default status is a "0", meaning that the automatic print feature is enabled.

When FTN 44 is cleared, the DS180 will automatically print any characters which have accumulated in the print buffer after a 1-second delay period. Note that the 1-second timer is reset upon the receipt of each new character. Thus, the auto-print feature will not activate a print cycle unless there is more than 1-second between two characters. Further, the logical position of the printer is not disturbed (i.e., no paper motion occurs and any characters sent later will be printed in their proper column).

c) FTN 45: TOP-OF-FORM SET

In addition to allowing top-of-form position to be set with the TOF key in SETUP mode, the enhanced version allows TOF to be established by depressing the 'SET' key when not in SETUP mode.

This feature may be defeated by setting FTN 45. The default value of the feature is "0", meaning that TOF may be set via the 'SET' key.

d) FTN 46: ESCAPE SEQUENCE DISABLE

Escape sequence sensitivity may be disabled by setting feature 46. This may be required should the DS180 be used on a system which uses Escape sequences for purposes other than printer control. The default status is "0", meaning Escape sequences are enabled.

e) FTN 47: DISPLAY MODE

The display mode, when enabled, allows control codes to be printed rather than executed. This is useful in isolating communications problems. Display mode is enabled by setting FTN 47.

f) FTN 48: ALTERNATE CHARACTER SET

If an alternate character set is installed as an option on the DS180, the alternate set may be selected by setting FTN 48.

g) FTN 49: GRAPHICS MODE

If the graphics option is installed on the DS180, FTN 49 determines the capability to select between graphics or character mode. The actual entry into graphics printing is controlled by the codes described in Appendix 6, page 4.

h) FTN 9: COMPRESSED PRINT

When equipped with the compressed print option, the DS180 offers a choice of 10, 12 or 16.5 characters per inch for the horizontal pitch. In addition, in expanded print mode the DS180 offers 5, 6 or 8.25 characters per inch.

To select the horizontal pitch:

- 1) Enter set up mode.
- 2) Advance the display to feature 09.
- 3) Press the "value" key.
- 4) Advance the display to the desired value, i.e. 10, 12 or 16.
- 5) Press the "set" key to store the feature.
- 6) Exit set-up mode.

NOTE:

The DS180 cannot be operated faster than 4800 baud when 12 characters per inch is selected.

4. GRAPHICS

The DS180 printer offers an optional dot-addressable raster graphics feature. This allows the user to print computer-generated charts, graphs, maps and other pictorial images which help present data in a concise and readable form.

Under program control, 6 individual print wires can be addressed to print high density output at a resolution of 75 dots per inch horizontally and 72 dots per inch vertically.

To use the graphics on the DS180, FTN 49 must be set. Graphics mode can then be entered by sending CONTROL FS (File separator, 1CH) to the DS180.

Graphics printing may then be received on a byte-by-byte basis with up to 6 wires being fired on each cycle of the print head. A graphics byte must have bit 7 set (Logical 1). The remaining 6 bits control the respective print wires. When the bit is set, the corresponding wire will fire.

The print wires used are 2 through 7 with number 1 being the top wire and number 9 being the bottom wire. The LSB of the graphics byte corresponds to the bottom wire of the 6 graphics print wires. (See figure 1, page 5)

The graphics line is terminated by receipt of the ASCII numeral 6. This code advances the paper by 6 dot increments.

A horizontal indent may be programmed by sending the sequence ;NNN where NNN equals an ASCII decimal number. The indent will be NNN horizontal dot positions from the left margin. Example: 3BH 30H 32H 35H (;025) causes an indent of 25 dot positions. This sequence may be sent immediately after the FS code or after the line terminating code 6. The indent command sequence must immediately precede a printable graphic byte (i.e. 40H through 7FH).

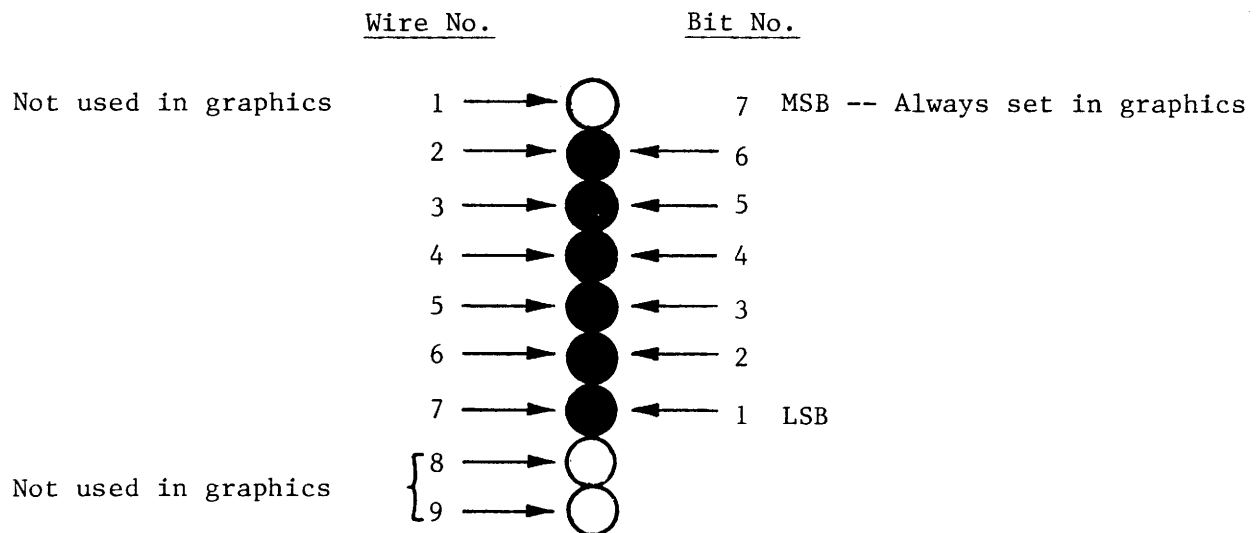
There is no wrap-around feature in the graphics mode. Therefore, any graphics bytes beyond the programmed print width are truncated. The forms control alignment is maintained when the DS180 is in the graphics mode. Top of form, perforation skipover and vertical tabs will be executed as programmed.

The graphics option includes a 990 character print buffer which can accommodate a complete printing record up to 13.2 inches in width (i.e. 75 dot per inch x 13.2 inches = 990).

The graphics mode is exited by sending Control code GS or any non-graphics character to the DS180.

The diagram below identifies the print wires used in the graphics mode.

Figure 1



DEC (ANSI) COMPATIBLE
ESCAPE SEQUENCES

<u>Sequence</u>	<u>Function</u>
ESC [n '	Set active column to column n (next print position). NOTE: ' is ASCII code 60H
ESC [n a	Advance active column by n columns
ESC E	Set active column to left column and perform line feed
ESC D	Line Feed
ESC [n d	Set active line to line n
ESC [n e	Advance active line by n lines
ESC [20 h	Enable carriage return on receipt of LF, FF or VT
ESC [20 l	Disable carriage return on receipt of LF, FF or VT
ESC [n s	Set left margin to column n
ESC [; n s	Set right margin to column n
ESC [n ₁ ; n ₂ s	Set left margin to column n ₁ and set right margin to column n ₂
ESC l	Set horizontal tab stop at active column
ESC [g	Clear horizontal tab stop at active column
ESC 2	Clear all horizontal tab stops
ESC [n u	Set horizontal tab stop at column n
ESC [n ₁ ; n ₂ u	Set horizontal tab stop at column n ₁ and at column n ₂
ESC [n ₁ ; n ₂ ; . . . n _x u	Set horizontal tab stops at columns n ₁ , n ₂ , . . . n _x (x ≤ 15)
ESC [1 z	Set vertical pitch to 6 lpi
ESC [2 z	Set vertical pitch to 8 lpi
ESC [n t	Set form length to n lines
ESC [n r	Set top margin to line n
ESC [; n r	Set bottom margin to line n
ESC [n ₁ ; n ₂ r	Set top margin to line n ₁ and set bottom margin to line n ₂

TABLE 1

<u>Sequence</u>	<u>Function</u>
ESC 3	Set vertical tab stop at active line
ESC [1 g	Clear vertical tab stop at active line
ESC 4	Clear all vertical tab stops
ESC [n v	Set vertical tab stop at line n
ESC [n ₁ ; n ₂ v	Set vertical tab stops at line n ₁ and at line n ₂
ESC [n ₁ ; n ₂ ; . . . n _x v	Set vertical tab stops at lines n ₁ , n ₂ , . . . n _x (x ≤ 15)
ESC [w	10 CPI
ESC [1 w	10 CPI
* ESC [2 w	12 CPI
* ESC [4 w	16.5 CPI
* ESC \$ 3	Display Mode On
* ESC \$ 4	Display Mode Off
* ESC \$ 5	Select APL character set
* ESC \$ 6	Select ASCII character set

* Optional Features

