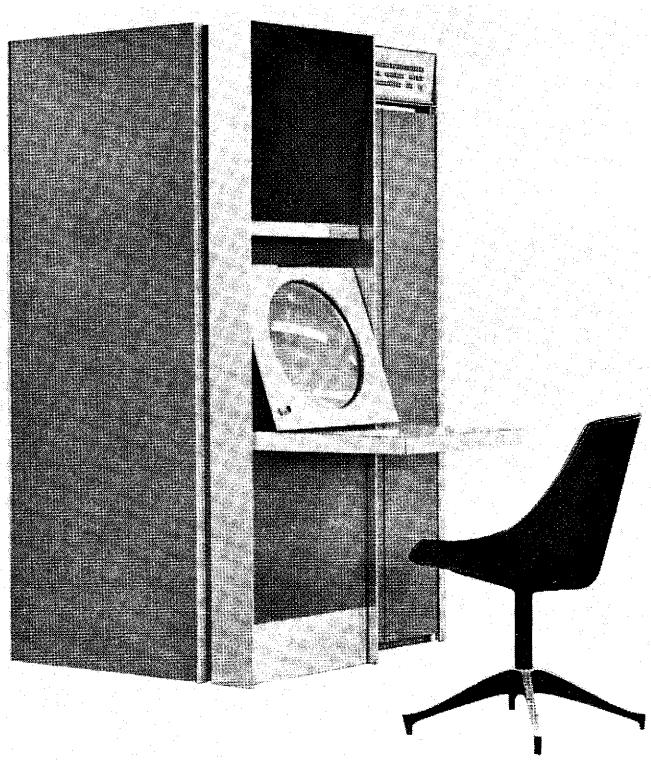
340 DISPLAY PROGRAMMING MANUAL



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DECUS NO. 7-13

340 DISPLAY
PROGRAMMING MANUAL

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PREFACE

This manual provides the first single reference of information required to program the 340 Display. Most of the information summarized in this manual can be found in one or more of the following Digital Equipment Corporation publications.

1. PDP-7 Reference Manual F-75P
2. PDP-7 Users Handbook F-75
3. Type 340 Precision Incremental CRT Display H-340
4. Technical Drawing - Shift-In First 64 Character Gen. Type 342 - #A342-0-9 (October 6, 1964).
5. Technical Manual - 342 Symbol Generator H-342
6. Technical Flier - Computer Options: 370 High Speed Light Pen F-03(370)
7. Technical Memo - Type 341 Interface and Type 347 Subroutine Options for the 340 Display (Bill Long, August 18, 1964).

Technical specifications not of general interest to the programmer have been omitted, but can be found in the appropriate DEC publications listed above. It is assumed that the reader is familiar with the PDP-7 computer.

CONTENTS

CHAPTER 1
PROGRAMMING THE 340 DISPLAY

1.1 INTRODUCTION

The 340 Display can be thought of as a special purpose computer which stores its instructions (data words) in the memory of the computer which controls it, and interacts with that computer through a series of instructions, interrupts, and data transfers. The display is an output device with respect to the controlling computer since:

a. The computer has a series of instructions which start, stop, and interrogate the registers of the display.

b. The computer can modify the data words which are interpreted by the display because the data words are stored in the computer's memory.

To program the 340 Display, it is necessary to learn the computer instructions that control the display as well as the data word formats which are interpreted by the display.

1.2 DISPLAY PARAMETERS

1.2.1 Coordinate System

Points may be plotted on a 9-3/8" square raster centered on the face of the display tube. There are 1024_{10} x positions and 1024_{10} y positions which may be specified, with respect to the following coordinate system.

a. The lower left corner is the point (0,0).

b. Up is +; down is −.

c. Right is +; left is −.

The electron beam does not scan the face of the tube; its position is determined by the contents of the x and y registers of the display. (If a data word specifies a point outside of the raster, an edge violation occurs and stops the display.)

1.2.2 Scale

The scale setting determines the number of positions each succeeding spot is moved before it is intensified. It effects both the size and appearance of lines or symbols drawn in the vector, vector

continue, increment, or character modes. At scale setting 11_2, each point can be clearly distinguished. At scale setting 00_2, lines and symbols appear to be continuous. The point spacing is illustrated in the following table.

Scale	Point Spacing	Intensify
00_2	● ● ● ● ● ● ● ● ●	Every
01_2	● ○ ● ○ ● ○ ● ○ ●	2nd
10_2	● ○ ○ ○ ● ○ ○ ○ ●	4th
11_2	● ○ ○ ○ ○ ○ ○ ○ ●	8th

1.2.3 Intensity

There are eight intensity levels available on the display, ranging from 000_2, which is barely visible, to 111_2, which is very bright. Note that scale and intensity settings are interrelated. For example, if characters are drawn (with the character generator) at the lowest scale setting, and too high an intensity is used, they will be badly blurred. On the other hand, if many characters are to be displayed simultaneously or if the light pen is to be used, it is best to use as high an intensity level as possible.

1.2.4 Mode

The mode register is a 3-bit register whose contents determine the way in which the next data word will be interpreted. The eight different data word formats (modes) are discussed in detail in chapter 2.

1.2.5 Light Pen

The light pen is an input device which generates a signal (flag) that can be sensed and interpreted by the computer. Light pen interruptions stop the display, leaving the contents of all display registers intact, and signal the computer that an interruption has occurred. When this happens, the programmer can examine the contents of the display registers to determine the location (on the display) of the point of light that was sensed by the light pen or determine the memory location of the data word specifying that point. The light pen will detect light in the range 4300 to 5600 angstroms.

1.2.6 Timing

The display requires 3 μsec for information transfer, 35 μsec per point for random positioning, and 0.5 μsec per point for intensification. In vector, vector continue, increment, and character modes the display only requires 1.5 μsec per point for positioning.

1.3 STEPS IN GENERATING A DISPLAY

A computer instruction (700606_8) clears the display registers, loads the display address counter (DAC) with the starting address of a block of data words in storage, and starts the display.

The display interprets the contents of the first word in the block of storage as a control word (parameter mode) and sets the indicated registers. Each time the display completes an operation, it breaks the computer program for one cycle while it fetches the next word specified by the DAC and loads it into the display buffer register (BR). The DAC is automatically indexed by one, so that it points to the next word in the block.

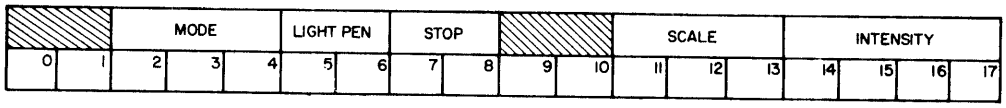
The series of operations terminates when a word with the stop bit set is received, signaling the computer that the display operation is finished.

Note that once the display has been started, it operates asynchronously with the computer and requires no special program attention until it has completed its display. At that time, the program determines whether or not to repeat the display.

CHAPTER 2
DATA WORD FORMATS

The contents of a 3-bit mode register determines how each data word is interpreted. The display mode register is set by initialization of the display, by being specified in a data word, or automatically by an escape from certain data word formats. Note that the contents of the mode register determines how the next data word will be interpreted. There are eight possible data word formats.

2.1 PARAMETER MODE (000_2)



Parameter mode is the control mode for the display. A parameter word can be used to change the mode, scale, intensity, light pen and/or interrupt parameters of the display. A word is interpreted by the display as a parameter word under the following conditions:

a. It is the first data word addressed by the display.

b. The mode register was set equal to 000_2 by the data word previously interpreted by the display.

c. It follows a data word that was in character mode and the escape character is decoded.

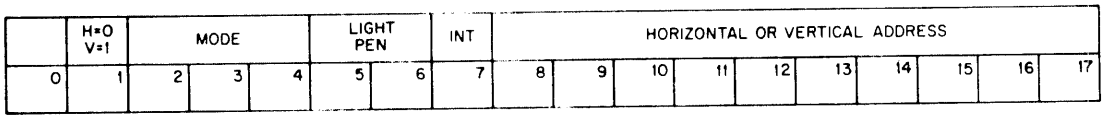
d. It follows a data word that was in vector or increment mode and the escape bit is equal to 1.

e. It follows a data word that was in vector continue mode. When the display is in parameter mode, the bit positions are interpreted as follows.

Bit(s)	Interpretation
0,1	Not used.
2,3,4	Specify the mode of the next word.

Bit(s)	Interpretation
5	Permits the light pen circuit to be set (according to bit 6) when it is a 1, and prevents the circuit from being changed when it is 0.
6	Turns the light pen on when it is a 1, or off when it is 0, provided bit 5 is a 1.
7	Stops the display if equal to 1. It is used to signal the computer that it is the last data word to be displayed.
8	Generates an interrupt signal when it is a 1 if bit 7 is a 1. (If the computer interrupt logic is turned on, then bit 8 = 1 stops the computer and transfers control to memory location 1).
9,10	Not used.
11	Allows the scale register to be set (by bits 12, 13) when it is a 1, and prevents changing the register when it is a 0.
12,13	Determines one of four possible scale settings if bit 11 is a 1.
14	Allows the intensity register to be set (by bits 15, 16, 17) when it is a 1, and prevents changing the register when it is a 0.
15,16,17	Determines one of eight possible intensity settings if bit 14 is a 1.

2.2 POINT MODE (001_2)

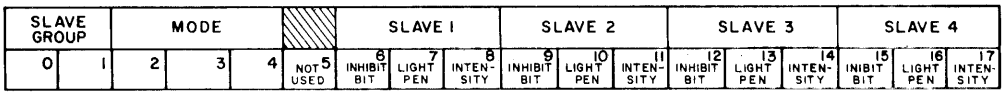


Point mode is used to specify an x or a y coordinate location on the display. It can change the mode, light pen, and intensify parameters. A data word is interpreted by the display as point mode if the mode register was set equal to 001_2 by the previously interpreted word. When the display is in point mode, the bit positions are interpreted as follows:

Bit(s)	Interpretation
0	Not used.
1	Determines the axis of the coordinate address: horizontal coordinate words are 0 and vertical coordinate words are 1.
2,3,4	Specify the mode of the next word.

Bit(s)	Interpretation
5	Permits the light pen circuit to be set (according to bit 6) when it is a 1, and prevents the circuit from being changed when it is 0.
6	Turns the light pen on when it is a 1, or off when it is a 0, provided bit 5 is a 1.
7	Intensify bit, causing a spot of light to appear at the specified coordinate when it is a 1, and preventing the spot from occurring when it is a 0.
8-17	A 10-bit positive display address, with zero specifying the leftmost or bottom coordinate (0000_8 - 1777_8).

2.3 SLAVE MODE (010_2)

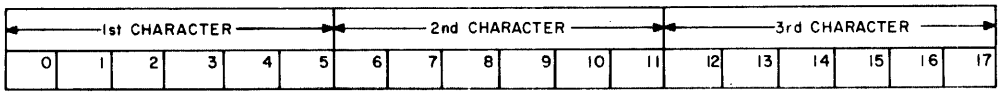


Slave mode is the control mode for up to 16 slave displays. A single slave word is used to turn on or off the intensify and/or light pen circuits of up to four displays in one of the four slave groups. The slave word also sets the mode of the next data word. A data word is interpreted by the display as slave mode if the mode register was set equal to 010_2 by the previously interpreted word. When the display is in slave mode, the bit positions are interpreted as follows:

Bit(s)	Interpretation
0,1	Select one of the four groups of up to four slave displays. If the display has only one group, these bits are not used.
2,3,4	Specify the mode of the next word.
5	Not used.
	Bits 6-17 are divided into four identical 3-bit bytes, one for each of the four slave displays in the group.
6,9,12,15	Permits the light pen and intensify circuits to be set (by the other two bits in the byte) when equal to 1, and prevents these circuits from being changed when equal to 0.
7,10,13,16	Turns the light pen on when equal to 1, or off when equal to 0, for the corresponding slave display when the first bit in that byte is equal to 1.

Bit(s)	Interpretation
8,11,14,17	Allows the picture on the 340 Display to appear on the corresponding slave when equal to 1, or prevents the picture from appearing on the corresponding slave when equal to 0, providing the first bit in the byte is a 1.

2.4 CHARACTER MODE (011_2)



In character mode the display interprets each word as containing three alphanumeric characters. Each character is specified by a 6-bit modified ASCII code. The display remains in the character mode until an escape code is encountered, when the display returns to parameter mode. A data word is interpreted by the display as character mode if the mode register was set equal to 011_2 by the previously interpreted word or if the previous data word was in character mode and did not contain the escape character. Bits 0-5 are interpreted as the first character. Bits 6-11 are interpreted as the second character and bits 12-17 are interpreted as the third character. In the basic set of 64 characters, there are special characters having the following function.

Line feed (33_8) moves the beginning location down 12 units.

Carriage return (34_8) moves the beginning location to the left edge of the raster.

Shift in (35_8) is used to specify the first set of 64 characters when two sets are available. If two sets of characters are not available, it is used to return horizontal characters.

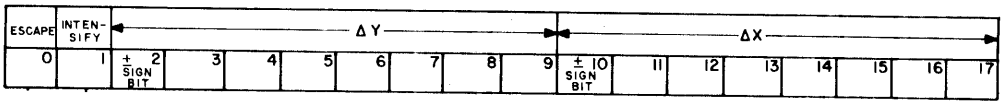
Shift out (36_8) is used to specify the second set of 64 characters when two sets are available. If two sets of characters are not available, it is used to specify vertical characters. Note that the display normally assumes characters are horizontal.

Space (40_8) moves the beginning location 7 units to the right.

Escape (37_8) returns the display to the parameter mode.

When the display is in character mode, it stays in character mode plotting characters from sequential data words, until it interprets the escape character. This is the only controlled way to leave the character mode. Table 2 illustrates in detail the basic set of 64 characters, their octal codes, and data about the character size and maximum number of characters that can be simultaneously plotted.

2.5 VECTOR MODE (100_2)

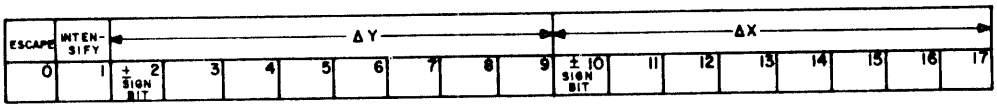


In vector mode the display interprets each word as containing vector size and direction, intensify, and escape information. The display remains in vector mode until the escape bit is set, at which time it returns to parameter mode. If the edge of the raster is violated, a flag is set which causes a computer interrupt. A data word is interpreted by the display as vector mode if the mode register was set equal to 100_2 by the previously interpreted word or if the previous word was in vector mode with the escape bit equal to 0. When the display is in vector mode, the bit positions are interpreted as follows:

Bit(s)	Interpretation
0	Escape bit. When set equal to 1, it returns the display to parameter mode.
1	When equal to 1, the vector is visible. If equal to 0, the vector is hidden.
2	Sign bit for the y component of the vector: 0 is plus or up; 1 is minus or down.
3-9	Specifies the size of the vector component along the y axis.
10	Sign bit for the x component of the vector: 0 is plus or right; 1 is minus or left.
11-17	Specifies the size of the vector component along the x axis.

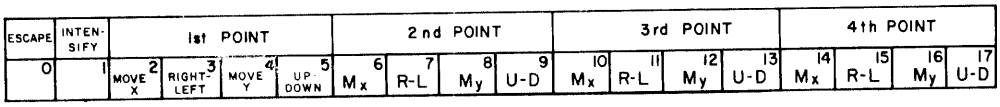
Note that the display plots the result of the x and y components specified. This vector will be straight only for horizontal, vertical, or 45° lines, but will appear straight at all angles if the smallest scale setting is used. Table 3 can be used to estimate the approximate line length for different vector components and scale settings.

2.6 VECTOR CONTINUE MODE (101_2)



In vector continue mode the display interprets the word as containing vector direction, and intensify information. The vector is drawn from the starting point to the edge of the raster. When the vector violates the edge of the raster, the display returns to parameter mode. A data word is interpreted by the display as vector continue mode if the mode register was set equal to 101_2 by the previously interpreted word. The bit positions are interpreted in the same way as in vector mode.

2.7 INCREMENT MODE (110_2)

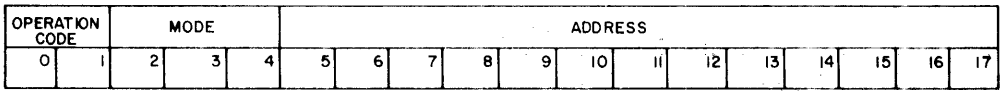


When in increment mode, the display interprets each succeeding word as containing information to plot four successive spots; each adjacent to the preceding one. A spot can be placed into any one of the eight adjacent locations at each movement. A data word is interpreted by the display as increment mode if the mode register was set equal to 110_2 by the previously-interpreted word or if the previous word was in increment mode and the escape bit was not equal to 1. The display remains in increment mode until the escape bit is set equal to 1 or it moves a spot past the edge of the raster. The bit positions are interpreted as follows:

Bit(s)	Interpretation
0	Escape bit. When set equal to 1, it returns the display to parameter mode.
1	When equal to 1, the point is visible. If equal to 0, the vector is hidden.
	Bits 2-17 consist of four 4-bit bytes, which specify if and when the spot is to be moved from its previous location.
2,6,10,14	If equal to 1, permits movement left or right according to bits 3, 7, 11, 15. If equal to 0, does not permit movement left or right.

Bit(s)	Interpretation
3,7,11,15	If equal to 1, move point left. If equal to 0, move point right.
4,8,12,16	If equal to 1, permits movement up or down according to bits 5, 9, 13, 17. If equal to 0, does not permit movement up or down.
5,9,13,17	If equal to 1, move point down. If equal to 0, move point up.

2.8 SUBROUTINE MODE (111_2)



When in this mode, the display interprets the next word as a jump instruction to some location in memory. The subroutine word sets the mode of the next word to be interpreted and allows the display of data from nonconsecutive memory locations. There are three possible jump instructions which are described below. A data word is interpreted by the display as subroutine mode if the mode register was set equal to 111_2 by the previously interpreted word.

Bit(s)	Interpretation
0,1	Specifies one of three possible jump instructions which will be discussed in detail below.
2,3,4	Specifies the mode of the next word to be displayed.
5-17	Specifies an address in the computer memory. The use of this address depends on the specific jump instruction.

The three possible jump instructions are as follows:

DJP - DISPLAY JUMP (10_2)--This is a non-return jump. The address specified in bits 5-17 replaces the previous contents of the DAC and the display goes to that address for its next data word. This instruction can be used to repeat a display without interrupting the computer. (Specify as the last data word in the display a DJP subroutine word specifying parameter mode and the address of the first word in the table.)

DJS - DISPLAY JUMP AND SAVE (11_2)--The contents of the DAC is incremented by one and stored in the address save register (ASR). A flip-flop called save is set equal to 1 to indicate entrance to a subroutine. The address specified in the subroutine data word becomes the new contents of the DAC and contains the next data word to be interpreted. In the subsequent display operation, an escape from vector, vector continue, increment, or character mode automatically restores the DAC from the ASR (assuming the save register is still a 1). Thus, for single level subroutines, the DJS instruction provides a return jump. In multilevel subroutine calls the return address saved in the ASR must be transferred to memory before any other jumps are made. This is accomplished with the DDS instruction which precedes the other instructions in the subroutine and requires that the DJS instruction specify the subroutine mode.

DDS - DISPLAY DEPOSIT SAVE REGISTER (01_2)--The DDS instruction is used to store the return jump when multilevel subroutines are used. In the address specified by the DDS instruction, a word of the following form will automatically be stored: DJP - PARAMETER MODE - C(ASR). Hence the address specified should be the last address in a block of data words having multiple subroutine calls.

An example illustrating the use of subroutine mode:

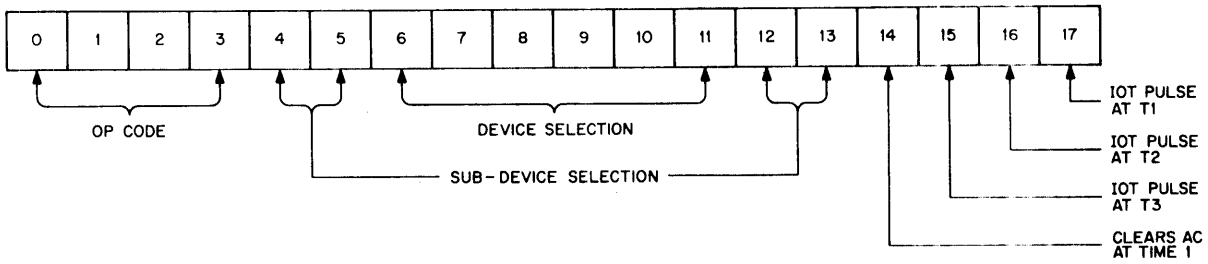
```
/THE FOLLOWING SEQUENCE OF INSTRUCTIONS IS USED TO DISPLAY THE WORD
/"JUMP" BY EXECUTING SUBROUTINE CALLS TO DISPLAY EACH LETTER

BEGN,   DJS     DO      /JUMPS TO SUBROUTINE DO
          :
          :
DO,     DDS     END     /STORES "DJP - PARAMETER MODE - (BEGN 1)" IN END.
        DJS     J       /JUMP TO SUBROUTINE TO DISPLAY LETTER J
        16xxxx          /PARAMETER WORD SPECIFYING SUBROUTINE MODE
        DJS     U       /JUMP TO SUBROUTINE TO DISPLAY LETTER U
        16xxxx          /PARAMETER WORD SPECIFYING SUBROUTINE MODE
        DJS     M       /JUMP TO SUBROUTINE TO DISPLAY LETTER M
        16xxxx          /PARAMETER WORD SPECIFYING SUBROUTINE MODE
        DJS     P       /JUMP TO SUBROUTINE TO DISPLAY LETTER P
        16xxxx          /PARAMETER WORD SPECIFYING SUBROUTINE MODE
END,    0               /RETURNS CONTROL TO BEGN 1
```

All the 340 Display data word formats are summarized in table 1. Appendix A lists suggested mnemonics which can simplify the detailed information in the data words. (This set can be easily added to the permanent symbol table of the symbolic assembler.)

CHAPTER 3

PDP-7 COMPUTER INSTRUCTIONS USED TO CONTROL THE DISPLAY

Information is transferred between the PDP-7 and peripheral equipment by the input/output control. This interface sets up the information path between the computer and device (in this case, the display), controls the transfer, and monitors the state of availability of each device. Input/output is controlled by a single IOT instruction which is microprogrammed to indicate the specific device and operation to be performed. The IOT instruction bit assignments are as follows:



The following table indicates the bit assignments (in octal) used to program the 340 Display.

	7005xx	70060x	7007xx	7010xx
1	Skip on vertical edge	Skip on stop	Skip on light pen	Skip on horizontal edge
2	C(DAC) V C(AC)→ C(AC)5-17	O → C(DAC)	C(x,y) V C(AC)→ C(AC)0-17	C(ASR) V C(AC)→ C(AC)5-17 C(SAVE) → C(AC)0
4	Resume display after light pen hit	C(AC)8-17 V C(DAC)→ C(DAC) Start display	Clear all display flags	Read sequence register and individual light pens → AC0-7

The above table is used to form the following set of instructions. Note that instructions which involve the transfer of data from one register to another are microprogrammed to clear the register to which the data is being transferred before the transfer takes place.

Mnemonic Symbol	Octal Code	Operation Executed
IDVE	700501	Skip on vertical edge violation. If the display has violated the vertical edge of the raster, the next instruction will be skipped.
IDSI	700601	Skip on stop interrupt. If the stop flip-flop has been set equal to 1, the next instruction will be skipped.
IDSP	700701	Skip on light pen flag. An interrupt caused by any light pen will set a common flag. If this light pen flag is set, the next instruction will be skipped.
IDHE	701001	Skip on horizontal edge. If the display has violated the horixontal edge of the raster, the next instruction will be skipped.
IDRS	700504	Continue after L.P. interrupt. Clears the light pen flag and resumes the display without affecting other display registers.
IDRA	700512	Read display address. Clears the AC and then transfers the C(DAC) to AC bits 5-17.
IDLA	700606	Load address and select. Clears the DAC, then transfers the C(AC)5-17 to the DAC and starts the display.
IDRD	700614	Resume display. Restarts the display after a stop code interrupt. Does not affect the contents of the display registers.
IDCF	700704	Clear flags. Clears all display flags and interrupts.
IDRC	700712	Read coordinates. Clears the AC. The contents of the 9 high order bits of the x register go into AC bits 0-8. The contents of the 9 high order bits of the y register go into AC bits 9-17. The lower order bit of both the x and y registers is lost.
IDSC	701012	Subroutine check. Clears the AC. The contents of the ASR go into AC bits 5-17 and the contents of the save flip-flop goes into AC bit position 0.
IDRP	701014	Read light pens. Clears the AC. Reads the status of the slave light pens and the sequence register. The contents of the slave display light pens are read into AC bit positions 4, 5, 6, and 7, indicating which pens caused the interrupt. The contents of the sequence register is read into AC bits 0-3. If the light pen hit occurred while the display was in increment mode, then bit 0, 1, 2, or 3 will be a 1, indicating which point was sensed by the light pen. If the light pen hit occurred while the display was in character mode, then bit 1, 2, or 3 will be a 1, indicating which character was sensed by the light pen. (Note that the specific bit assignments may vary for different computer I/O facilities.)

CHAPTER 4
SUMMARY

The 340 Display can operate upon data words in any one of 8 modes. The programmer is free to specify the mode of each data word subject to the following considerations.

The first data word is always interpreted by the display as a parameter word. The parameter mode is the control mode for the display.

In initializing a display, the programmer must specify the following information:

a. Mode of the next data word
b. Light pen (on or off)
c. Scale setting (4 possible)
d. Intensity setting (8 possible)
e. y coordinate position
f. x coordinate position
g. Visible (intensified) or hidden point plotting.

This is usually accomplished by the following sequence of 3 data words.

Parameter mode--sets mode of next word; sets light pen, scale and intensity registers.

Point mode--sets mode of next word, y coordinate position, may set light pen.

Point mode--sets mode of next word, x coordinate position, may be intensified, may set light pen.

⋮ continuation of data words.

The last word in the data table is usually a parameter word 003000. This signals the computer that the display is complete and will cause an interrupt if the computer interrupt logic is on. Alternately, the last word in the table may be a subroutine word which reinitializes the display or jumps to some other data word table.

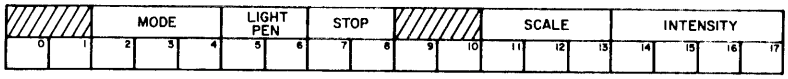
The sequence of data words is subject to the following constraints:

Mode of Present Data Word	Mode of Next Data Word May Be
Parameter (000)	Any
Point (001)	Any
Slave (010)	Any
Character (011)	Character mode or Parameter mode
Vector (100)	Vector or Parameter
Vector continue (101)	Parameter only
Increment (110)	Increment or Parameter
Subroutine (111)	Any

CHAPTER 5
TABLES

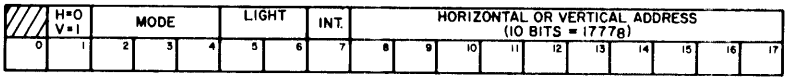
TABLE 1 340 DATA WORD FORMAT

PARAMETER MODE (000)

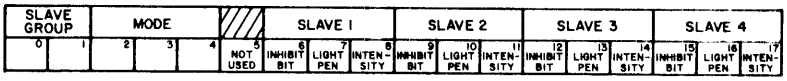


SCALE	PT. SPACING	
00	● ● ● ● ● ● ● ●	EVERY
01	● ○ ● ○ ● ○ ● ○	2nd
10	● ○ ○ ○ ● ○ ○ ○	4th
11	● ○ ○ ○ ○ ○ ○ ○	8th

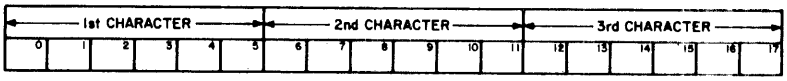
POINT MODE (001)



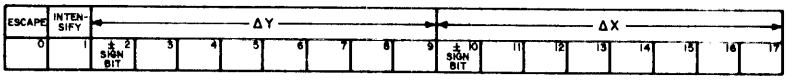
SLAVE MODE (010)



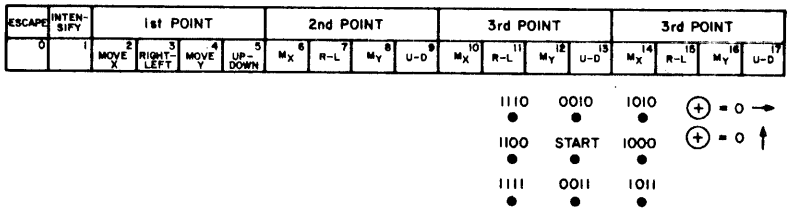
CHARACTER MODE (011)



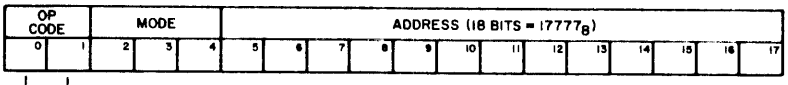
VECTOR MODE (100)
VECTOR CONTINUE (100)



INCREMENT MODE (110)



SUBROUTINE MODE (111)

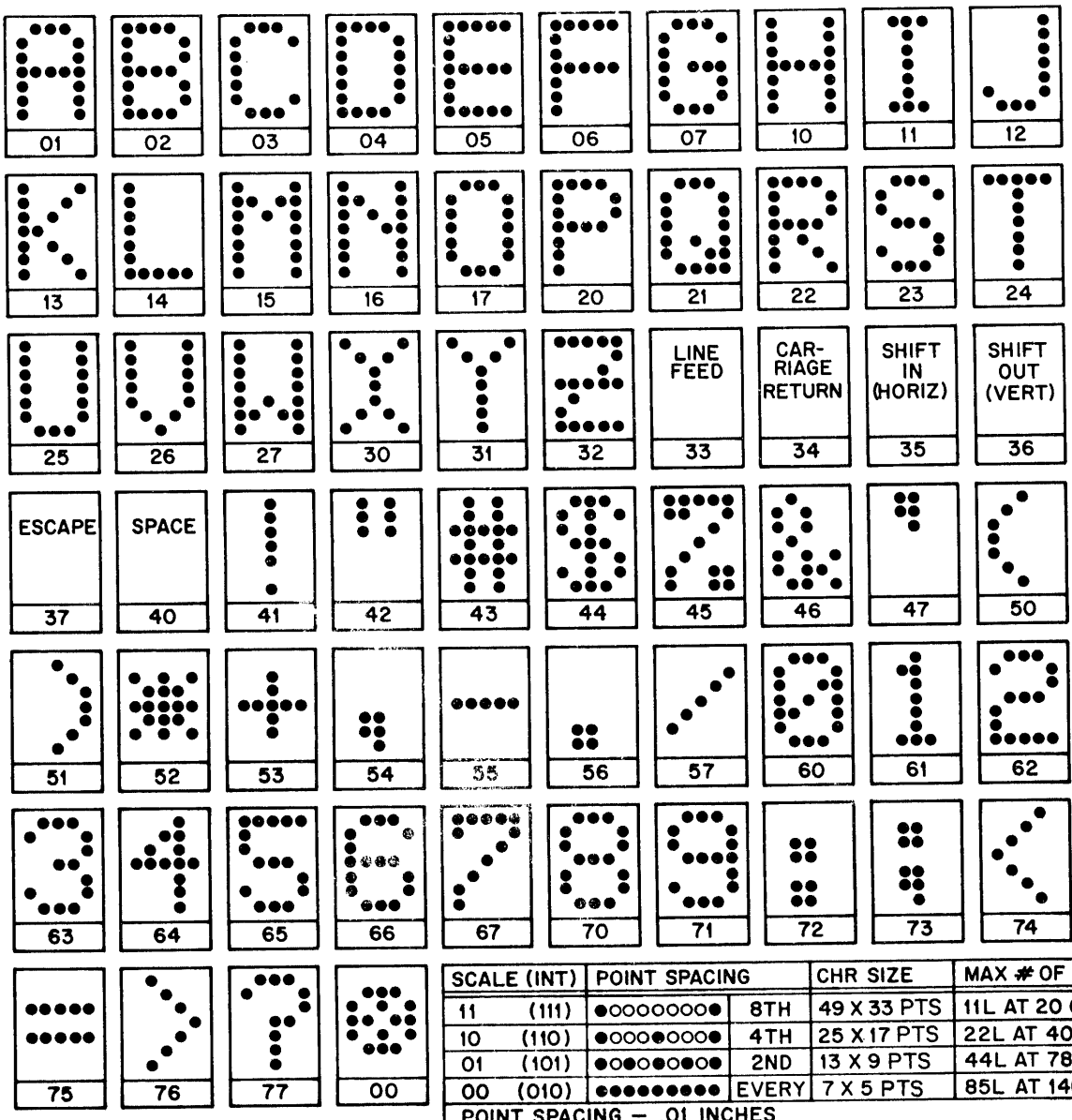


01 DDS – DISPLAY DEPOSIT SAVE REGISTER: THE RETURN JUMP INSTRUCTION FOR MULTILEVEL SUBROUTINES

10 DJP – DISPLAY JUMP: NON-RETURN JUMP TO A SUBROUTINE

11 DJS – DISPLAY JUMP AND SAVE: SAVES RETURN ADDRESS AND JUMPS BACK WHEN DISPLAY SEES ESCAPE BIT

TABLE 2 342 CHARACTER GENERATOR - FIRST 64 CHARACTERS



SCALE (INT)	POINT SPACING		CHR SIZE	MAX # OF CHARACTERS
11 (111)	●○○○○○○○●	8TH	49 X 33 PTS	11L AT 20 C/L = 220
10 (110)	●○○○●○○○●	4TH	25 X 17 PTS	22L AT 40 C/L = 880
01 (101)	●○●○●○●○●	2ND	13 X 9 PTS	44L AT 78 C/L = 3344
00 (010)	●●●●●●●●●	EVERY	7 X 5 PTS	85L AT 146 C/L = 12.410

POINT SPACING — .01 INCHES
C/L = CHARACTER PER LINE L = LINE

SPACE MOVES THE BEGINNING LOCATION 7 UNITS TO THE RIGHT

CARRIAGE RETURN MOVES THE BEGINNING LOCATION THE LEFT EDGE OF THE RASTER

LINE FEED MOVES THE BEGINNING LOCATION DOWN 12 UNITS

AFTER EACH CHARACTER IS DRAWN, THE BEGINNING LOCATION IS MOVED 2 UNITS PAST THE LOWER RIGHT CORNER TO CORRECTLY SPACE THE NEXT CHARACTER

TABLE 3 POINT SIZE, SPACING, AND APPROXIMATE LINE LENGTH IN VECTOR AND VECTOR CONTINUE MODE.

HORIZONTAL LINE LENGTH					
NUMBER OF POINTS IN LINE	ΔX IN VECTOR WORD	SCALE SETTING			
		00	01	10	11
1_{10}	1_8	.04"*	.05"*	.06"*	.09"*
2_{10}	2_8	.05"	.06"	.09"	.17"
4_{10}	4_8	.06"	.09"	.17"	.31"
8_{10}	10_8	.09"	.17"	.31"	.60"
16_{10}	20_8	.17"	.31"	.60"	1.18"
32_{10}	40_8	.31"	.60"	1.18"	2.35"
64_{10}	100_8	.60"	1.18"	2.35"	4.68"
127_{10}	177_8	1.32"	2.46"	4.76"	9.38"

*This applies to increment mode if the previous point is intensified.

Point size =.03" at high intensities, .015" at low intensities point spacing =.0091"

APPENDIX 1
MNEMONICS

The following mnemonics have been developed for use on a PDP-7 computer equipped with the following display hardware:

340 Display (light pen, character generator, subroutine option)

343 Slave Display (light pen)

To specify the mode of the next word in the display table:

Mode	Symbol	Octal Code
Parameter	PAR	000000
Point	PT	020000
Slave	SLV	040000
Character	CHR	060000
Vector	VCT	100000
Vector continue	VCTC	120000
Increment	INCR	140000
Subroutine	SUBR	160000
Parameter Mode Words		
Scale settings	S0	100
	S1	120
	S2	140
	S3	160
Intensity settings	IN0	10
	IN1	11
	IN2	12
	IN3	13
	IN4	14
	IN5	15
	IN6	16
	IN7	17
STOP	STP	3000
Light pen on	LPON	14000
Light pen off	LPOFF	10000
Point Mode Words		
Vertical word	V	200000
Horizontal word	H	000000
Intensify point	IP	2000

Slave Mode Words

Slave 1 on	S1ON	5000
Slave 1 off	S1OFF	4000
Light pen 1 on	LP1ON	2000
Slave 2 on	S2ON	500
Slave 2 off	S2OFF	400
Light pen 2 on	LP2ON	200
Slave 3 on	S3ON	50
Slave 3 off	S3OFF	40
Light pen 3 on	LP3ON	20
Slave 4 on	S4ON	5
Slave 4 off	S4OFF	4
Light pen 4 on	LP4ON	2

Character Mode Words

Consider the addition of a subroutine to the Editor program which would convert characters typed on the TT into the character generator code and assemble them three-per-word in a display table.

With such a subroutine the text typed by the user would appear on the display in exactly the same way as it was typed.

Vector and Vector Continue Words

Escape*	ESCP	400000
Intensify*	INSFY	200000
Up	UP	000000
Down	DN	100000
Left	LT	200
Right	RT	000000

The following mnemonics apply to the number of points moved in the component byte:

YP# = number of y points
XP# = number of x points

YP1	400
YP2	1000
YP4	2000
YP8	4000
YP16	10000
YP32	20000
YP64	40000
XP1	1
XP2	2
XP4	4
XP8	10
XP16	20
XP32	40
XP64	100

Increment Mode Words

Move first point right	P1R	100000
left	P1L	140000
up	P1U	020000
down	P1D	030000
up & left	P1UL	160000
up & right	P1UR	120000
down & left	P1DL	170000
down & right	P1DR	130000
Move second point right	P2R	4000
left	P2L	6000
up	P2U	1000
down	P2D	1400
up & left	P2UL	7000
up & right	P2UR	5000
down & left	P2DL	7100
down & right	P2DR	5100
Move third point right	P3R	200
left	P3L	300
up	P3U	040
down	P3D	060
up & left	P3UL	340
up & right	P3UR	240
down & left	P3DL	360
down & right	P3DR	260
Move fourth point right	P4R	10
left	P4L	14
up	P4U	02
down	P4D	03
up & left	P4UL	16
up & right	P4UR	12
down & left	P4DL	17
down & right	P4DR	13
Escape*	ESCP	400000
Intensify*	INSFY	200000

Subroutine Mode Words

Display deposit save register	DDS	200000
Display jump	DJP	400000
Display jump and save	DJS	600000

The octal codes can be used directly by the programmer to form in octal the specific word format he requires. This can be done without adding the mnemonics to the Assembler Permanent Symbol Table.

*The codes are the same for vector, vector continue, and increment modes. Note that intensification in point mode has a different code.

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PRINTED IN U.S.A.