

DISPLAY STATION PROGRAMMING

KEYBOARD

A PP transmits function code 7020_g to request data from the keyboard of the display station. The PP then activates the input channel and inputs one character from the keyboard. This character enters as the lower 6 bits of the word; the upper bits are cleared. There is no status report by the keyboard. Table 5-9 lists the keyboard character codes.

Table 5-9. Keyboard Character Codes

Character	Code	Character	Code
No data	00	0	33
A	01	1	34
B	02	2	35
C	03	3	36
D	04	4	37
E	05	5	40
F	06	6	41
G	07	7	42
H	10	8	43
I	11	9	44
J	12	+	45
K	13	-	46
L	14	*	47
M	15	/	50
N	16	(51
O	17)	52
P	20	Left blank key	53
Q	21	=	54
R	22	Right blank key	55
S	23	.	56
T	24	,	57
U	25	Carriage return	60
V	26	Backspace	61
W	27	Space	62
X	30		
Y	31		
Z	32		

DATA DISPLAY

Data is displayed within an 8- by 11-inch area of a cathode-ray tube (CRT). The display can be in character mode (alphanumeric) and/or dot mode (graphic). Two presentation areas (left and right) are displayed. Each is made up of 262 14-dot locations arranged in a 512-by-512 dot format. Each dot position is determined by the intersection of X

and Y coordinates. The lower left corner dot is octal address X=6000 and Y=7-00, and the upper right corner dot is octal address X=6777 and Y=7777.

Character Mode

In character mode, three sizes are provided. Large characters are arranged in a 32-by-32 dot format with 16 characters per line. Medium characters are arranged in a 16-by-16 dot format with 8 characters per line. Small characters are arranged in an 8-by-8 dot format with 4 characters per line. Table 5-10 lists the display character codes.

Table 5-10. Display Character Codes

Character	Code	Character	Code
Space	00	0	33
A	01	1	34
B	02	2	35
C	03	3	36
D	04	4	37
E	05	5	40
F	06	6	41
G	07	7	42
H	10	8	43
I	11	9	44
J	12	+	45
K	13	-	46
L	14	*	47
M	15	/	50
N	16	(51
O	17)	52
P	20	Space	53
Q	21	=	54
R	22	Space	55
S	23	.	56
T	24	,	57
U	25		
V	26		
W	27		
X	30		
Y	31		
Z	32		

Dot Mode

In dot mode, display dots are positioned by X and Y coordinates. The X coordinates position the dots horizontally. The Y coordinates position the dots vertically and unblank the CRT for each horizontal line. Horizontal lines are formed by a series of X coordinates. Vertical lines are formed by a series of X coordinate and a series of Y coordinates.

DEADSTART PROGRAMS FOR DISPLAY

DISPLAY CHARACTERS

1.	7510	Deactivate
2.	7710	Function
3.	7002	Large char. left screen
4.	7410	Activate
5.	1404	Load A with 4
6.	7310	Output (A) words from
7.	0011	Addr. 11
10.	0370	Loop or (0300 = HALT)
11.	6400	X coordinate
12.	7400	Y coordinate
13.	XXXX	Display char.
14.	XXXX	Display char.

DISPLAY KEYBOARD

1.	7510	Deactivate
2.	7710	Function
3.	7020	Keyboard input
4.	7410	Activate
5.	7010	Input to A
6.	0402	A = 0, Jump 2 places
7.	3422	A ≠ 0, Store in loc 22
10.	7510	Deactivate
11.	7710	Function
12.	7002	Large char. left screen
13.	7410	Activate
14.	1402	Load A with 2
15.	7310	Output from
16.	0020	Addr. 20
17.	0361	Loop
20.	6400	First coordinate

If program doesn't work, PP10 may be started running. In PP10 by using reconf. switches.

To halt, execute 0300 inst.

TABLE 1-2 I/O INTERFACE-CABLE PIN ASSIGNMENTS (CONTD)

CABLE B BEAC BLOCK CABLE PART PIN (WHITE)	COLOR CODE	PIN	(CHAN 10) SIGNAL I/O CABLE CONN A	DIRECTION	CHAN SIGNAL
1	90	A	Keyboard 20	Output ↓ Output Input ↓ Input Output Input	20 X
2	91	B	21		21 X
3	92	C	22		22 X
4	93	D	23		23 X
5	94	E	24		24 X
6	95	F	Keyboard 25		25 X
7	96	H	Key down		26 X
8	97	J	Key up		27 X
9	98	K	Unblank left screen		28 X
10	99	L	Unblank right screen		20 Y
11	900	M	Symbol size small		21 Y
12	910	N	Symbol size medium		22 Y
13	930	R	Symbol Analog +Y		23 Y
14	940	S	Symbol Analog -Y		24 Y
15	950	T	Symbol Analog +X		26 Y
16	960	U	Symbol Analog -X	27 Y	
17	970	V	Dead start	28 Y	
18	980	W	Screen select	NOT USED	
19		P	NOT USED	NOT USED	

* OPEN PIN LOCATIONS ON BEAC BLOCK ARE NOT COUNTED

KEYBOARD CHARACTER-CODE DATA

Figure 1-6 shows the layout of the keyboard used on the display station. The numbers in the lower righthand corner of each key imply provide a means of referencing the location of a particular key, and they do not actually appear on the keycaps. Table 1-3 lists each key on the keyboard and gives the symbol and the octal code associated with each key.

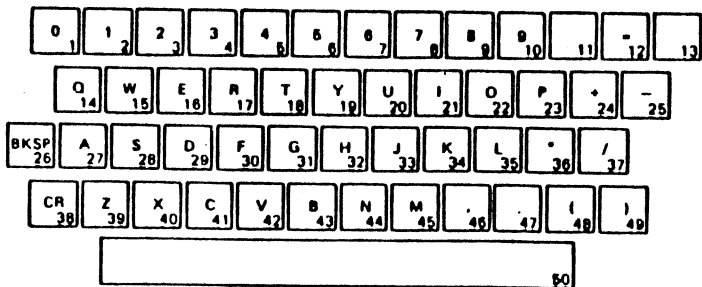


Figure 1-6. Keyboard Layout

I/O INTERFACE INFORMATION I-4

This portion of the text contains information regarding the input/output interface of the display station. Table 1-2 lists the pin assignments and some of the other characteristics of the I/O cables (internally two cables, labeled A and B, comprise the interface). From the table, note that the I/O interface consists of 23 digital-signal input lines, 9 digital-signal output lines, and 4 analog-signal input lines. The digital input signal lines use the following dc voltage levels: logic 1 = +0.2 v and logic 0 = +1.2 v. The analog signals use 0.2-volt incremental steps between +0.2 volts and +2.0 to control deflection. Each increment occurs over a 0.1 microsecond time period to ensure that all symbols and characters are produced smoothly and uniformly. With the exception of the Key-up and Key-down signals, the digital output signal lines use the following dc voltage levels: a logic 1 level is greater than 0 volts but less than 1.3 volts, and a logic 0 is greater than 3.3 volts but less than 5.0 volts. For the Key-up signal, a grounded line indicates that no key is down and a signal greater than 3.0 volts indicates that a key is down. The Key-down signal is just the inverse of the Key-up signal: a grounded line indicates a key is down while a signal of greater than 3.0 volts indicates that no key is pressed.

TABLE 1-2 I/O INTERFACE-CABLE PIN ASSIGNMENTS

CABLE A BEAC BLOCK CABLE PART PIN (WHITE)	COLOR CODE	PIN	(CHAN 10) SIGNAL I/O CABLE CONN B	DIRECTION	CHAN SIGNAL
1	90	A	20 X Deflection	Input ↓ Input	20 X
2	91	B	21 X		21 X
3	92	C	22 X		22 X
4	93	D	23 X		23 X
5	94	E	24 X		24 X
6	95	F	25 X		26 X
7	96	H	26 X		27 X
8	97	J	27 X		28 X
9	98	K	28 X		20 Y
10	99	L	20 Y		21 Y
11	900	M	21 Y		22 Y
12	910	N	22 Y		23 Y
13	920	P	23 Y		24 Y
14	930	R	24 Y		26 Y
15	940	S	25 Y		27 Y
16	950	T	26 Y	28 Y	
17	960	U	27 Y	NOT USED	
18	970	V	28 Y Deflection	NOT USED	
19		W	NOT USED	NOT USED	

* OPEN PIN LOCATIONS ON BEAC BLOCK ARE NOT COUNTED
6294001B

DISPLAY STATION PROGRAMMING

KEYBOARD

A PP must transmit a one-word function code (7020, octal) to request data from the keyboard of the display station. The code prepares the display controller for an input operation. The PP then activates the input channel and receives one character from the keyboard. This character enters as the lower six bits of the word. The upper bits clear. There is no status report by the keyboard. Table 5-10 lists the keyboard character codes.

TABLE 5-10. KEYBOARD CHARACTER CODES

Character	Code
No data	00
A	01
B	02
C	03
D	04
E	05
F	06
G	07
H	10
I	11
J	12
K	13
L	14
M	15
N	16
O	17
P	20
Q	21
R	22
S	23
T	24
U	25
V	26
W	27
X	30
Y	31
Z	32
0	33
1	34
2	35
3	36
4	37
5	40
6	41

TABLE 5-10. KEYBOARD CHARACTER CODES (Contd)

Character	Code
.	42
8	43
9	44
-	45
'	46
;	47
/	50
!	51
]	52
Left blank key	53
*	54
Right blank key	55
.	56
.	57
Carriage return	60
Backspace	61
Space	62

DATA DISPLAY

Data is displayed within an 8-inch by 8-inch area of a cathode-ray tube (CRT). The display can be alphanumeric (character mode) or graphic (dot mode). There are 262,144 dot locations arranged in a 512 by 512 format. Each dot position is determined by the intersection of X and Y coordinates. The lower left corner dot is octal address X=6000 and Y=7000, and the upper right corner dot is octal address X=6777 and Y=7777.

Character Mode

In character mode, large, medium, and small characters are provided. Large characters are arranged in a 32-by-32 dot format with 16 characters per line. Medium characters are arranged in a 16-by-16 dot format with 32 characters per line. Small characters are arranged in an 8-by-8 dot format with 64 characters per line. Table 5-11 lists the character codes.

Dot Mode

In dot mode, display dots are positioned by the X and Y coordinates. The X coordinates position the dots horizontally. The Y coordinates position the dots vertically and unblank the CRT for each dot. Horizontal lines are formed by a series of X and Y coordinates. Vertical lines are formed by a single X coordinate and a series of Y coordinates.

TABLE 5-11. DISPLAY CHARACTER CODES

Character	Code
Space	00
A	01
B	02
C	03
D	04
E	05
F	06
G	07
H	10
I	11
J	12
K	13
L	14
M	15
N	16
O	17
P	20
Q	21
R	22
S	23
T	24
U	25
V	26
W	27
X	30
Y	31
Z	32
0	33
1	34
2	35
3	36
4	37
5	40
6	41
7	42
8	43
9	44
.	45
'	46
;	47
/	50
!	51
]	52
Space	53
*	54
Space	55
.	56
.	57

Codes

A single function word is transmitted to select the presentation, mode, and character size (character mode only). Figure 5-11 illustrates the function word format. The word following the function word specifies the starting coordinates for the display (for either mode). Figure 5-12 illustrates coordinate data word. In character mode, the following words are display character codes. Figure 5-13 illustrates the character word.

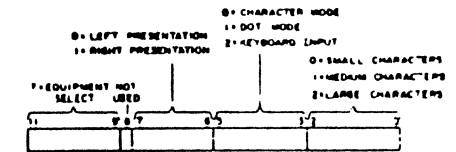
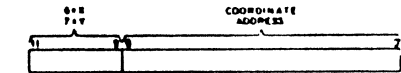


Figure 5-11. Display Station Output Function Code



NOTE:
IN DOT MODE, EACH Y COORDINATE TRANSMITTED FORCES A DOT DISPLAY.

Figure 5-12. Coordinate Data Word

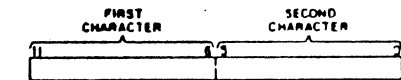


Figure 5-13. Character Data Word

When the display operation has started, the controller regulates character spacing on the line. A new coordinate data word must be sent to start each line. If new coordinates are not specified, data is written on the line specified by the active coordinate word, and information already on that line is overwritten. Character sizes can be mixed by sending a new function word and coordinate word for each size change. Spacing on a line can be varied by sending a coordinate word for the character which is to be spaced differently.

PROGRAMMING EXAMPLE

The following programming example (figure 5-14) requests an input of one line of data from the display station and displays this data on the CRT as it is being typed.

PROGRAMMING TIMING CONSIDERATION

When performing an output operation at a 2N speed, the computer must wait at the end of the output for a channel empty condition to prevent a loss of coordinates or data. A full jump at the end of the output ensures the channel empty and acceptance by the display controller of the last word of the output before disconnecting from the channel.

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 The Display Controller (DSC) facilitates communication between a PP and the CC545 Display Console. It resides on two paks, one of which includes an internal I/O channel.

The controller is designed to control one CC545 single-tube display station. It controller generates displays in either Dot Mode (for graphic displays), or Character mode (for alphanumeric displays). Alpha-numeric characters are generated by a pre-programmed read-only memory in three possible character sizes.

The controller supports all CYBER 170 12-bit function codes (except CYBER 170 Channel Pass-on and Dual Station features). It also supports the CYBER 170 Display Code character set.

The controller also accepts 16-bit data which it decodes and displays as two ASCII characters. All unused characters are displayed as blanks. In Keyboard Input mode the controller translates the input character into ASCII code if ASCII mode is selected.

INTERFACE DEFINITION (DSC 2.0,3.0)

DISPLAY CONTROLLER TO PP

The Display Controller option, if installed, is permanently wired to I/O channel 10. (If the option is not installed, a regular 12 or 16-bit channel can be substituted in the channel 10 location.) Inter-PP communication is available over this channel. The channel/PP signals and protocol are identical to the other 12-bit IOU channels.

DISPLAY CONTROLLER TO CONSOLE

The display controller connects to the display station via two CYBER 170 I/O Cables, 65 feet long, each with 19 coaxial wires. All signals to and from the console are TTL levels (0V for Logic 0 and +3V for Logic 1), except for the X and Y analog signals used to generate characters. These are differential signals with excursions from +0.2V to +2.0V:

X coordinate (X0-X8)	9 bits	Cable A, Pins A-K
Y coordinate (Y0-Y8)	9 bits	Cable A, Pins L-V
Astigmatism	1 bit	Cable A, Pin W
Character size (Small, Medium)	2 bits	Cable B, Pins M,N
X Analog (+,-)	2 bits	Cable B, Pins T,U

Y Analog (+,-)	2 bits	Cable B, Pins R,S
Unblank left screen	1 bit	Cable B, Pin K
Unblank right screen	1 bit	Cable B, Pin L
Left or Right Screen Select	1 bit	Cable B, Pin W

CONSOLE TO DISPLAY CONTROLLER

Keyboard Character Code	6 bits	Cable B, Pins A->F
Keyboard Up	1 bit	Cable B, Pin J
Keyboard Down	1 bit	Cable B, Pin H
Console Dead Start	1 bit	Cable B, Pin V

The software displays data for both left and right screens; both left and right unblank signals are transmitted to the CC545, where a switch determines which presentation will be displayed.

CHARACTERISTICS

12-BIT OPERATION

One 12-bit function word from the PP is translated into a function register to specify operation of the controller as follows:

<u>Function</u>	<u>Code</u>	<u>Description</u>
Equipment Select	7XXX	Connects display controller - without this, any other functions will not receive an inactive response from the controller.
Screen Select	X0XX X1XX X4XX	Display on left screen. Display on right screen. Display on both screens simultaneously.
Mode	XX0X XX1X XX2X	Character mode Dot mode Keyboard input request
Character size	XX00 XXX1 XXX2	Small (64 character per line) Medium (32 character per line) Large (16 character per line)

Keyboard Input Mode

The Keydown signal latches the 6-bit code from the console into a holding register, causing the holding register to go Full. Activate from the PP, with the holding register Full, loads the character data and Channel Full into the Channel Register. If the Holding Register is Full, a 00B code is loaded. The character is transmitted in the lower 6 bits of the channel word, with the upper bits set to zero.

When the PP sends a Disconnect, this function (and only this function) is cleared from the function holding register.

16-BIT ASCII MODE OPERATION

One 16-bit function word from the PP is translated into a function register to specify controller operation as follows:

Function	Code	Description
Equipment Select	7XXX	Connects display controller - without this, any other function will not receive an inactive response from the controller.
Screen Select	X0XX	Display on left screen
	X1XX	Display on right screen
	X4XX	Display both screens
Mode	XX0X	Character Mode
	XX04	ASCII Character Mode Enable
	XX1X	Dot mode
	XX2X	Keyboard input to 6 bit Display Code character
Character size	XX24	Keyboard input to 8 bit ASCII character.
	XXX0	Small (64 character per line)
	XXX1	Medium (32 character per line)
	XXX2	Large (16 character per line)

Character Mode

With the controller in ASCII character mode, it responds to channel data in one of three ways:

- (1) 14XXXX or 15XXXX data code: right-most 9 bits of word specify X coordinate of CRT beam (000 through 777).
- (2) 16XXXX or 17XXXX data code: right-most 9 bits of word specify Y coordinate of CRT beam (000 through 777).
- (3) Any other data code: is interpreted as two 8-bit character codes with the first character in the left-most 8 bits and the second character in the right-most 8 bits. See Table 5-2 for the ASCII character set supported in this controller.

TABLE 5-2. ASCII DISPLAY IN THE CONSOLE

ASCII Char.	Char Display at Console	ASCII Char.	Char Display at Console
A	a	X	x
B	b	Y	y
C	c	Z	z
D	d		
E	e	1	1
F	f	2	2
G	g	3	3
H	h	4	4
I	i	5	5
J	j	6	6
K	k	7	7
L	l	8	8
M	m	9	9
N	n	0	0
O	o	+	+
P	p	-	-
Q	q	=	=
R	r	/	/
S	s	((
T	t))
U	u	=	=
V	v	.	.
W	w	.	.

Except for five Keyboard Input characters described below, all ASCII characters not listed above will be displayed as blanks.

Dot Mode

In Dot Mode, the controller responds to 14XXXX or 15XXXX (X position) and 16XXX or 17XXXX (Y position) data codes only. A 16XXX or 17XXXX code unblanks the display for 400 nanoseconds to paint a dot on the CRT screen.

Keyboard Input Mode

For the Function XX2X, the 6-bit display code from the console is latched directly into the holding register. For the Function XX24, the 6-bit display code translates into 8-bit ASCII before latching into the holding register. The resulting character is transmitted to the PP in the right-most 6 or 8 bits of the channel word.

Character Mode

With the controller in character mode, its response to channel data is one of the following:

- (1) 6XXX data code: low order 9 bits specify X coordinate of CRT beam (000 through 777).
- (2) 7XXX data code: low order 9 bits specify Y coordinate of CRT beam (000 through 777).
- (3) any other data code: is interpreted as two 6-bit characters with first character in bits 52-57 and second character in bits 58-63.

In character mode, the character generation logic uses the ROM contents to produce Character Generation Codes and to control the unblank signal following each character.

TABLE 5-1. CHARACTER GENERATION CODES

V1	V2	H1	H2	B	
0	0	0	0	1	Toggle blank/unblank state
1	0	0	0	0	Move beam vertically 1 increment
0	1	0	0	0	Move beam vertically 2 increments
1	1	0	0	0	Reverse vertical direction
0	0	1	0	0	Move beam horizontally 1 increment
0	0	0	1	0	Move beam horizontally 2 increments
0	0	1	1	0	Reverse horizontal direction

Character size determines how many characters can be displayed on the screen. Each screen is a 512 x 512 matrix. Screen formats for the three character sizes are:

Character Size	Characters/Line x Lines/Screen
Small 8 x 8	64 x 64
Medium 16 x 16	32 x 32
Large 32 x 32	16 x 16

In character mode the X coordinate automatically increments for every character by 8 for small characters, 16 for medium and 32 for large characters.

Dot Mode

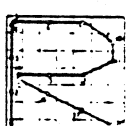
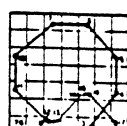
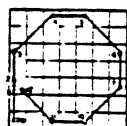
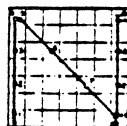
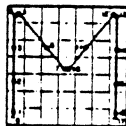
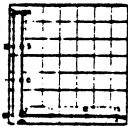
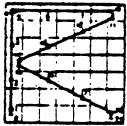
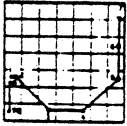
In Dot Mode, the controller responds to 6XXX (X position) and 7XXX (Y position) data codes only. A 7XXX code unblanks the display for 400 nanoseconds to paint a dot on the CRT screen.

The following ASCII codes are generated for special characters from the console:

Keyboard Character in Console (Octal)	Corresponding ASCII Code (Hex)
53 Left blank	19 Reset
55 Right blank	15 Skip
60 Carriage Return	0D Carriage Return
61 Backspace	08 Backspace
62 Space	20 Space

In Dot mode, the controller waits 3.3 microseconds following a 7XXX (12-bit mode) and 16XXXX or 17XXXX (16-bit mode) data code (Y coordinate) to allow the beam to settle; it then unblanks the beam for 400 nanoseconds to generate a dot. Total time between a Y coordinate output at the PP, and an Empty response from the controller is 5.8 microseconds.

In Character mode, each character requires 2.4 microseconds to be formed on the screen. In addition, each character time is preceded by a 1.2 microsecond delay to allow for beam settling. Total time between a Full output from the PP, and an Empty reply from the controller is 7.3 microseconds.



J 12

T						
76	X					
00						
01	X	X				
02	X	X	X			
03	X	X	X	X		
04	X	X	X	X	X	
05	X	X	X	X	X	X
06	X	X	X	X	X	X
07	X	X	X	X	X	X
08						
09						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

K 13

T						
76						X
00						
01	X					
02	X					
03	X	X				
04	X	X	X			
05	X	X	X	X		
06	X	X	X	X	X	
07	X	X	X	X	X	X
08						
09						
10						
11	X	X				
12	X	X	X			
13	X	X	X	X		
14	X	X	X	X	X	
15	X	X	X	X	X	X
16	X	X	X	X	X	X
17	X	X	X	X	X	X
18						
19						
20						
21						X
22						
23						
24						
25						

L 14

T						
76						
00						
01	X					
02	X	X				
03	X	X	X			
04	X	X	X	X		
05	X	X	X	X	X	
06	X	X	X	X	X	X
07	X	X	X	X	X	X
08						
09						
10						
11	X	X				
12	X	X	X			
13	X	X	X	X		
14	X	X	X	X	X	
15	X	X	X	X	X	X
16	X	X	X	X	X	X
17	X	X	X	X	X	X
18						
19						
20						
21						
22						
23						
24						
25						

M 15

T						
76						X
00						
01	X					
02	X	X				
03	X	X	X			
04	X	X	X	X		
05	X	X	X	X	X	
06	X	X	X	X	X	X
07	X	X	X	X	X	X
08						
09						
10	X	X				
11	X	X	X			
12	X	X	X	X		
13	X	X	X	X	X	
14	X	X	X	X	X	X
15	X	X	X	X	X	X
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

N 16

T						
76						X
00						
01	X					
02	X	X				
03	X	X	X			
04	X	X	X	X		
05	X	X	X	X	X	
06	X	X	X	X	X	X
07	X	X	X	X	X	X
08						
09						
10	X	X				
11	X	X	X			
12	X	X	X	X		
13	X	X	X	X	X	
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01	X					
02	X	X				
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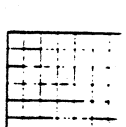
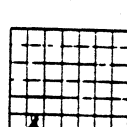
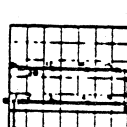
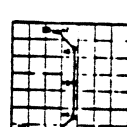
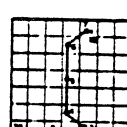
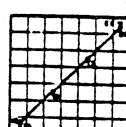
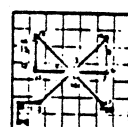
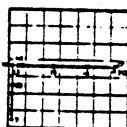
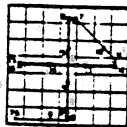
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