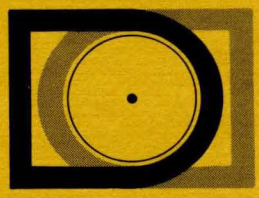

DATA DISC

6500 Series Graphic Display System

SYSTEM DESCRIPTION MANUAL

6500 Series Graphic Display System
SYSTEM DESCRIPTION MANUAL

DATA DISC INC./Display Division
1275 California Avenue • Palo Alto, California 94304 • (415) 326-7602 • TWX 910-373-1248

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SECTION I

GENERAL DESCRIPTION

1.1 GENERAL

The Data Disc 6500 Series Graphic Display System is a time-shared display system which:

a. Has 16 high resolution, 32 medium resolution or 32 standard resolution channels.

b. Displays up to 4335 alphanumeric characters or 262,144 graphic points on each channel. Display matrix for full resolution is 512 bits wide x 512 bits high. Each channel can be loaded to maximum display capacity without reducing the capacity of other channels.

c. Uses television monitors to provide daylight-viewable displays.

d. Operates with any computer as a "soft-copy" printer where ASCII-coded alphanumeric characters are transformed into displayed characters, and graphic instructions are transformed into bits along a scan line.

A typical Graphic Display System consists of a disc memory, and a time-shared video generator with video-distribution cards. A standard interface is provided with the basic system. Display terminals and keyboards are optional.

Other system features are:

a. A simple 16 command instruction set.

b. Displayed alphanumeric or graphic characters can be individually added or deleted.

c. Dark images can be displayed on a light background, or light images can be displayed on a dark background.

d. During writing on one channel, other channels are not disturbed.

e. ASCII-character codes are converted into either a 5 x 7 or a 7 x 10 (optional) picture-element matrix.

f. Superscript characters and subscript characters can be easily written.

g. Characters can be written at rates up to 5,100 characters per second (i.e., up to 1 page per second).

h. Graphic images can be superimposed. This enables composition of complex graphic displays from a series of images; e.g., grid lines, first curve, second curve, alphanumeric data, etc.

1.2 APPLICATION

The primary 6500 applications are to provide output display for computer keyboard input and provide a means of presenting data graphically in a time-shared computer system.

1.3 OPTIONAL FEATURES

In addition to the basic system:

a. Data Disc display terminals are also available with solid-state keyboards and keyboard serializers for use with computer systems where typewriter printout is not required. Keyboard outputs are 8-bit parallel ASCII with TTL logic levels.

b. Hard copy of the displayed picture can be obtained with any of several commercially available raster-type printers.

c. The channel outputs can be combined with analog video outputs to form, for example, a display which is a combination of computer-generated and camera-generated data. Analog video source may be a Data Disc analog video disc memory system or a video tape recorder.

d. A servo drive system can be supplied for applications where the 6500 output must be synchronized to an external signal source such a television station or a video tape recorder.

e. The 6500 channel outputs can be connected to the terminals via a switching network which enables switching of one or all channels to any number of terminals.

1.4 OPERATIONAL ENVIRONMENTS

The 6500 operates in the following environments:

a. Operating temperature: 50°F to 90°F. (Disc intake air.)

b. Non-operating temperature: -20°F to +130°F.

c. Operating humidity: 80% maximum without condensation.

d. Atmosphere: Corrosive atmospheres such as those found in steel mills and chemical plants are not considered normal.

e. Vibration: Floor vibration of 0.15 g maximum from 10 to 65 Hz. The disc package will not be damaged by 5 g's or less of shock in any axis.

1.5 PHYSICAL DIMENSIONS

a. Electronic Assemblies. All electronic assemblies are packaged for mounting in standard 19-inch equipment racks or cabinets. The basic 6500 Series Graphic Display System consists of a 5200 Series Parallel Disc Memory 10 1/2Hx 19Wx22D and a 6500 Controller/ Video Generator 10 1/2Hx19W x22D.

b. Display Terminals. See Section 7.

SECTION 2

SYSTEM OPERATION

2.1 GENERAL OPERATION

Line address, column address and channel address, function code, and text are transferred into the Graphic Display System via a 9-bit data bus. A 7-bit data-routing bus specifies the type of data on the data bus and routes the data to appropriate registers in the 6500. The line and column addresses specify the starting display position for subsequent writing and displaying of text or graphics. Addresses and the function code are transferred prior to the text or graphic instructions.

The text or graphic instructions are sent to the A/N generator or the graphic generator in the controller and the output of the generator, a 10 MBPS digital video signal is stored directly in the display memory on the particular track(s) assigned to the addressed channel.

2.2 FUNCTIONS

The 8-bit function code which has been transferred to the function-code register specifies how the text will be processed. Functions are:

a. Write light images on a dark background.

b. Write dark images on a light background.

c. Write data in the display memory.

d. Write graphics with various options.

e. Erase entire frame.

f. Write normal-size characters.*

g. Write double-height characters.*

h. Write double-height, double-width characters.*

i. Write with replacement. Data written at a location replaces previous data.

j. Write with addition. Only "1" bits are written.

*Characters may be A/N or graphic text.

2.3 PROCESSING OF ALPHANUMERIC TEXT

a. The ASCII data is transferred to the 6500 one byte at a time. As soon as one character has been processed, the 6500 will accept the next character from the computer at a rate of approximately 190 microseconds between transfers.

b. The ASCII text is used as addresses for an MOS read-only memory to generate the dot patterns for raster characters.

c. The display raster is composed of interlaced scan lines. Because of the interlace, adjacent scan lines are separated in time by 16.7 milliseconds (the period of a disc revolution). A displayed character is composed of picture elements on adjacent scan lines. Therefore, a portion of the displayed character is generated 16.7 milliseconds

later. The Video Generator allows both scan lines to be written simultaneously.

d. A character can be written at any column position and can be positioned vertically to any element position. This vertical positioning allows the formation of superscripts and subscripts.

e. In writing, previous picture elements at a character position are automatically erased.

f. After writing on a row, a new element address must be transferred to the 6500.

g. The element-address register is changed by transferring the explicit row address over the data bus.

h. The element-address refers to the bottom element of a character location; i.e., the bottom position of a row.

i. After writing on a row, the column address, the channel address and the function code can be changed. By changing the channel address during a frame period, data can be written on many different monitors.

j. The column address can be changed by transferring an explicit address over the data bus.

2.3.1 Writing One Row per Frame Period. The maximum rate of transfer is one row of characters per revolution. The data is simultaneously written into both fields.

2.4 PROCESSING GRAPHIC DATA

The processing of graphic data by the 6500 can take one of two modes, graphic text or graphic line drawing.

2.4.1 Graphic Text Mode

a. In this mode the 8-bit byte is written on the display channel exactly as transferred.

b. The data is written at the element and line position selected.

c. The least significant bit is written first on the line moving from bottom to top of the screen.

d. In writing a graphic byte with addition, only "1" bits are added to an 8-bit line segment. Polarity of the "1"s can be dark or light. Single picture elements and individual curves can be added. Component images of a display can be combined in the 6500 rather than in the external computer. For example, characters can be written into the 6500 followed by grid lines, and then by curves.

e. In writing a graphic byte with replacement, both "1" bits and "0" bits are added to an 8-bit line segment. This erases previous picture elements on that same segment.

f. The 6500 is designed to allow different 8-bit bytes to be written in both fields simultaneously. This allows an 8-bit segment covering all 512 lines to be written in one revolution.

g. Since the system processes only one 8-bit row at a time, the line-address register is automatically stepped to the next line.

h. Other address and function registers may be changed before transferring to another line.

2.4.2 Line Drawing Mode

a. In this mode the element registers and line registers are used for Y_1 and X_1 locations.

b. Two additional registers containing Y_2 and X_2 information are included.

c. Writing with both addition and replacement (see 2.4.1 Graphic Text Mode) is possible in the line-drawing mode.

d. This mode allows the transfer of an X_1, X_2, Y_1, and Y_2 from the computer and a definable rectangle will automatically be drawn on the display. This can be used for selective erasing of areas.

e. When X_1 and X_2 are the same, a vertical line will be drawn between Y_1 and Y_2.

f. When Y_1 and Y_2 are the same, a horizontal line will be drawn between X_1 and X_2.

g. When Y_1 and Y_2 and X_1 and X_2 are defined and the end points mode is selected, the outline of a rectangle will be drawn.

h. The Y_1 register can be loaded and saved, in which case the computer will output only Y_2's. This will draw vertical lines from a baseline of Y_1. The X registers are automatically advanced one increment after each update. This allows the computer to do block transfers of only the new Y_2 position.

i. Data may be plotted with connecting lines.

j. Section 8 details typical programs illustrating graphic capability.

SECTION 3

SYSTEM PERFORMANCE

3.1 TRANSFER RATES FROM THE EXTERNAL COMPUTER

In writing alphanumerics, performance during a frame period can range from writing a single character to writing an entire page of 4335 characters. The 6500 Series Graphic Display System uses a vertical raster format which results in the transfer of one row of characters per revolution, with the disc memory revolving at 60 revolutions per second. The maximum data transfer is 60 x 85 or 5,100 characters per second.

Similarly, in writing graphics, performance for one frame period can range from writing a single point to writing an entire page. A page can be a combination of alphanumeric text and lines of graphic text.

3.2 LIMITATIONS IN PROCESSING KEYBOARD-GENERATED TEXT

If several keyboard-generated requests to write characters occur on the same row and column, but on different channels, only one of these request can be handled during a field period (1/60 second). The other "character-write requests" are delayed and then processed during subsequent frames. If further key strokes occur during this delay, additional "character-write requests" must be held in the computer. All these delay characters are then written in a subsequent field period. In this way, no key strokes are missed and all keyboard entries are processed, but with a possible delay between the key stroke and the appearance of the characters on the screen; i.e., with 12 terminals all on the same location, the last terminal delay would be 200 milliseconds.

Typically, where characters are being entered on many rows, delays are not noticeable; i.e., the display lags the key strokes by not more than five or six frame periods (240 milliseconds). For example, with entries distributed over 12 rows of characters and with five key strokes per second on each of 32 terminals, the writing of displayed characters is delayed only five frames at most -- 200 milliseconds -- and is not noticeable.

In the worst case, all characters are entered on all displays on the same row and delays become noticeable. For example, with simultaneous entries all on the same row on each of 32 terminals, the displayed characters lag the keyboard entry by 1/2 second. Normally, such events are sufficiently rare to be tolerable.

SECTION 4

CONTROLLER INTERFACE

4.1 GENERAL

The 6500 Series Graphic Display System Controller has all inputs except for MAC (Master Clear) terminated in one 7400 Series TTL load. MAC is terminated in one TTL load plus a 1.1K pull-up resistor to +5V dc.

Output signals DAK and BSY are driven by 7440 gates.

All returns are bused together and are at ground potential within the controller. All signals are TTL levels with a logic "1" set at zero volts.

4.2 BASIC INTERFACE LINES

The following 20 lines are necessary and sufficient for operation of the 6500. The timing is provided in Figure 4-1.

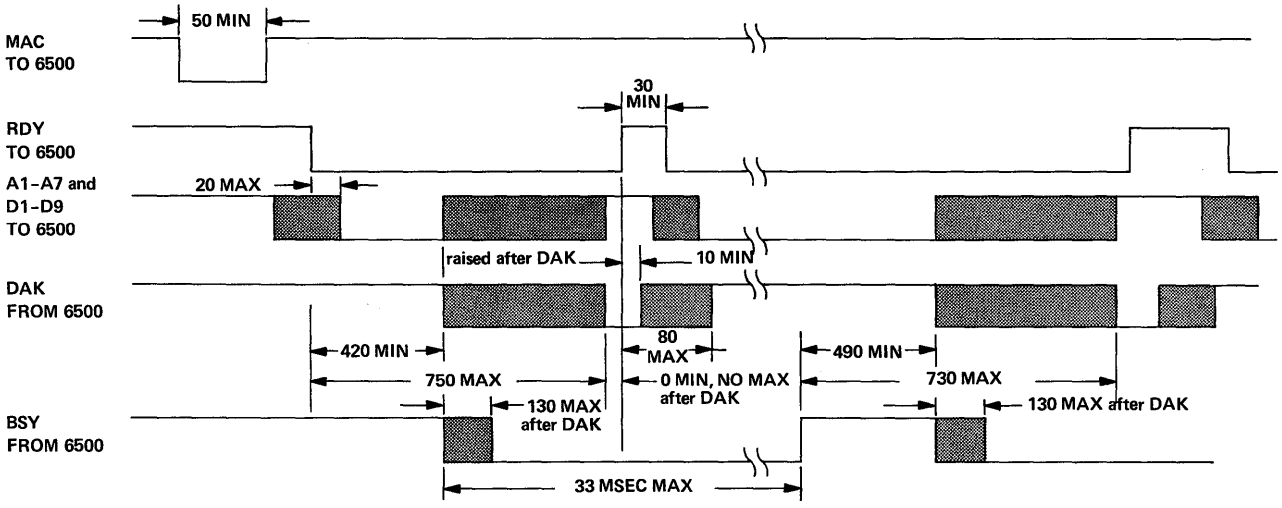
4.2.1 Lines to the 6500 from the Interface Unit:

a. D1 through D9. Nine data lines. Data can be a function code, a line address, column address, channel address, ASCII text, graphic text, X_1, X_2, X_1 and X_2, Y_1, Y_2, or Y_1 and Y_2. Bit assignments are shown in the Table 4-1.

All data within given fields is right justified with the LSB being D1 and having a binary weighted value of 0.

ASCII code is right justified in all fields to place bit 1 in position D1.

In Graphic Text mode the LSB is the first bit written along a scan line moving from the bottom to the top of the screen.



(ALL TIMES IN NANOSECONDS UNLESS OTHERWISE NOTED.)

Figure 4-1. Controller Timing

b. A1 through A7. Seven data-routing lines. These lines are decoded and identify the data being transferred. Refer to Table 4-1.

c. RDY - Data Ready. A line which is set to "1" when data and routing information is put on line to the 6500. This line should be set to "0" following DAK.

d. MAC - Master Clear. A line which is set to "1" to clear all registers within the 6500 Controller. Performs the same function as RESET button on front panel.

e. ADR - Device Address. A line which may be used by the computer interface to select one of several I/O devices when a data bus addressing system is used or when more than one 6500 is on-line.

4.2.2 Lines from the 6500 to the Interface Unit:

a. DAK - Data Acknowledged. A line which is set to "1" to acknowledge transfer of data to the 6500. The line is set to "0" between 10 and 80 nsec after RDY is reset.

b. BSY - Video Generator Busy. When BSY line is active, new data cannot be entered into the 6500. BSY can be active for up to 33 milliseconds. When the BSY line is active, DAK will not be generated.

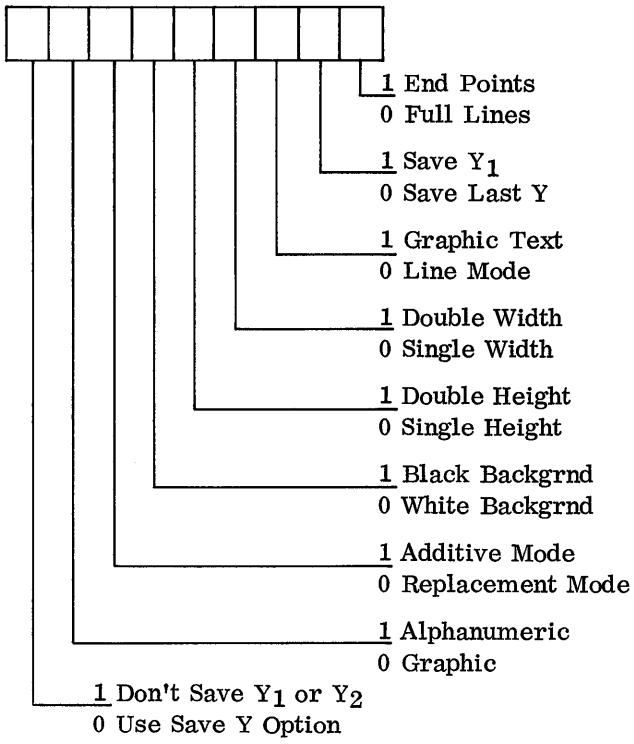
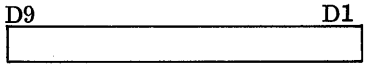
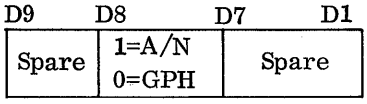
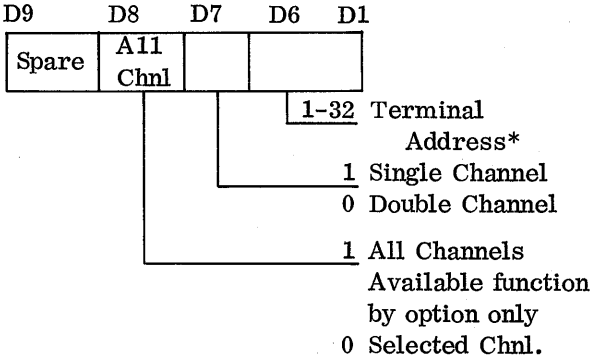
4.2.3 Special Considerations for the Standard (256x256) Display System.

a. The LSB of the Y register is hardwired to 0.

b. The Control Register is hardwired for double height characters.

c. The Track Address Register is hardwired for single track operation.

Table 4-1. Instruction Set Formats

Mnemonic	Type of Data/ Type of Transfer	Routing Lines	Data & Description
		A7 A6 A5 A4 A3 A2 A1	D9 D8 D7 D6 D5 D4 D3 D2 D1
LCR	Load Control Reg.	0 0 0 0 0 0 1	
XFR	Transfer Data	0 0 0 0 0 0 0	 ASCII Code and Graphic Text is right justified. Transfer Y_1 Value with Y_1 = 9 bits
LAG	Load A/N Graphics control bit	0 0 0 0 0 1 1	 Changes modes between Alpha-numeric and Graphic.
LTA	Load Terminal Address	0 0 1 0 0 1 0	

*Use 00_8 and all even addresses for high resolution (double channel) terminals.

Table 4-1. Instruction Set Formats (continued)

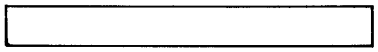
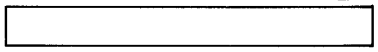
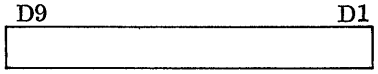
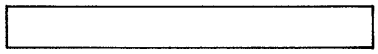
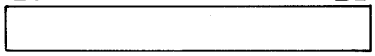
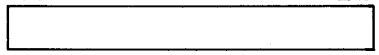
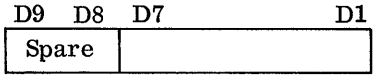
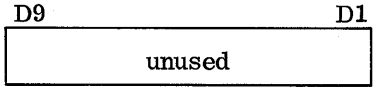
Mnemonic	Type of Data Type of Transfer	Routing Lines	Data and Description
LX1	Load X_1	0 0 0 1 0 1 0	D9 D1  A/N=Loads start column (horizontal position) GRAPHIC = Loads X_1
LX2	Load X_2	0 0 0 1 1 0 0	D9 D1  Graphics only stop point for horizontal lines
LBX	Load both X's	0 0 0 1 1 1 0	D9 D1  A/N: not to be used. GRAPHIC: used to draw vertical lines
LY1	Load Y_1	0 0 0 0 0 1 0	D9 D1  A/N: Row position address (vertical position) GRAPHIC: Start point on vertical plane
LY2	Load Y_2	0 0 0 0 1 0 0	D9 D1  A/N: not used GRAPHICS: stop point on vertical plane
LBY	Load both Y's	0 0 0 0 1 1 0	D9 D1  A/N: not used GRAPHIC: Allows horizontal lines to be drawn
ANC	A/N Character	0 0 0 0 1 0 1	D9 D8 D7 D1  Allows insertion of a A/N character in the middle of a line plot
ERS	Erase	0 0 1 0 1 0 0	D9 D1  Erase the previously selected terminal

Table 4-1. Instruction Set Formats (continued)

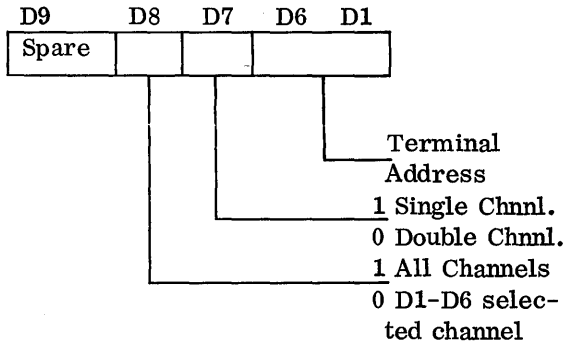
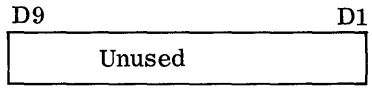
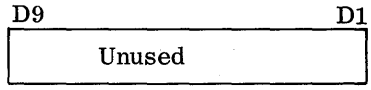
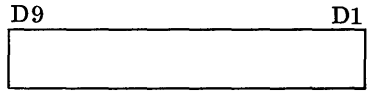
Mnemonic	Type of Data Type of Transfer	Routing Lines	Data and Description
LTE	Load Terminal Address & Erase	0 0 1 0 1 1 0	
CLS	Clear System	0 1 1 1 1 1 1	 Resets all control registers.
NOD	No Operation, Display	0 1 1 1 0 0 0	
BXF	Block Transfer (optional)	0 0 0 0 1 1 1	 Data specifies number of characters packed two bytes to a word in the following sequential words to be transferred.

Table 4-2. 6500 Series I/O Connector J06

Pin	Name	Function	Pin	Name	Function
A B	D1 return	Data to 6500, LSB	a b	A3 return	Data routing to 6500
C D	D2 return	Data to 6500	c d	A4 return	Data routing to 6500
E F	D3 return	Data to 6500	f g	A5 return	Data routing to 6500
H J	D4 return	Data to 6500	h i	A6 return	Data routing to 6500
K L	D5 return	Data to 6500	j k	A7 return	Data routing to 6500
M N	D6 return	Data to 6500	m n	ADR return	Device Address to 6500
P R	D7 return	Data to 6500	AJ AK	RDY return	Data Ready to 6500
S T	D8 return	Data to 6500	AL AM	MAC return	Master Clear to 6500
U V	D9 return	Data to 6500, MSB	BJ BK	DAK return	Data Acknowledge from 6500
W X	A1 return	Data routing to 6500	BL BM	BSY return	Video Generator Busy from 6500
Y Z	A2 return	Data routing to 6500			

Mating connectors and pins are supplied

104 Pin Connector J06

	Connector	Pin
Data Disc P/N	088-222	088-250
Manufacturer	Winchester	Winchester
Mfr. P/N	MRAC 104 PJTC6H	101-1024P

SECTION 5

VIDEO INTERFACE

5.1 GENERAL

Each channel of the 6500 Series Graphic Display System has both a composite video output for direct connection to a display terminal and (optional) a digital video output for connection through a switching network.

5.2 COMPOSITE VIDEO OUTPUTS

a. Greater than one volt peak-to-peak signal into 75 ohm load.

b. Three level video (synchronized black and white).

c. Drive up to 2500 feet of RG-11 75 ohm coaxial cable.

d. Longer lengths can be driven with addition of cable equalizers which can be supplied by Data Disc.

Table 5-1. 6500 Series Video Output Connector, J09

High Resolution System Pin	Medium or Standard Resolution System Pin	Terminal Address	High Resolution System Pin	Medium or Standard Resolution System Pin	Terminal Address
A	A	00	U	U	20
-	B	01	-	V	21
C	C	02	W	W	22
-	D	03	-	X	23
E	E	04	Y	Y	24
-	F	05	-	Z	25
H	H	06	AA	AA	26
-	J	07	-	BB	27
K	K	10	CC	CC	30
-	L	11	-	DD	31
M	M	12	EE	EE	32
-	N	13	-	FF	33
P	P	14	HH	HH	34
-	R	15	-	JJ	35
S	S	16	KK	KK	36
-	T	17	-	LL	37

Mating connectors and pins are supplied.

34 Pin Connector J09

	Connector	Pin
Data Disc P/N	081-206	081-256
Manufacturer	Burndy	Burndy
Mfr. P/N	MS34PM-824S	RM16M-23

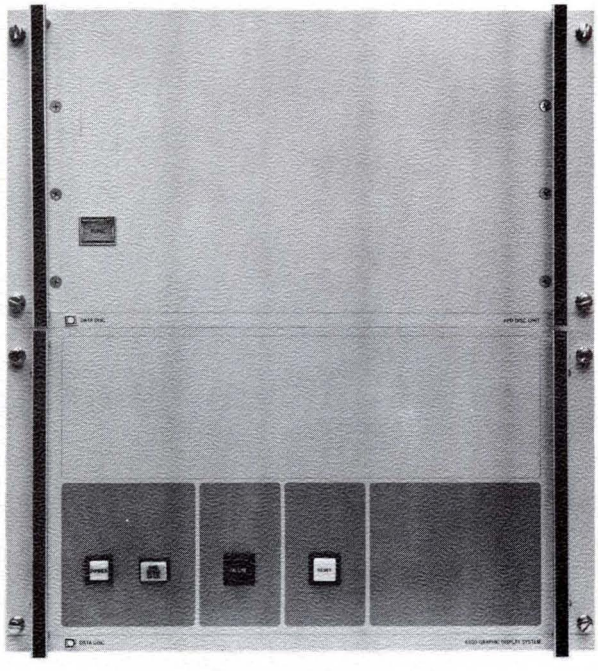
SECTION 6

PHYSICAL DESCRIPTION

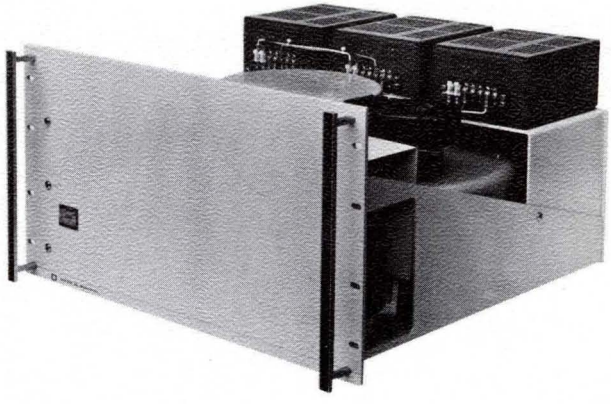
The basic 6500 Series Graphic Display System consists of two 10-1/2 inch rack-mounting units. One unit is a 5200 Series Parallel Disc Memory and the other unit is the 6500 Controller/Video Generator. These units are interconnected by twisted-pair cables, which are provided.

The images to be displayed on the system's TV monitors are stored in digital format on the 5200 Series Parallel Disc Memory. The 6500 Controller/Video Generator contains system power supplies, disc control logic, alphanumeric generator, graphic generator, video distribution amplifiers and a standard TTL interface card. A computer interface card built to customer specifications can be mounted in place of the standard interface card.

TV monitors, keyboards, keyboard multiplexers, graphic input tablets, light pens, track balls, hard copy printers, precision servo drive and other items are options.



5200 Series Parallel Disc Memory and 6500 Graphic Display System ready for rack mounting.



5200 Series Parallel Disc Memory which stores the digital video images for the TV monitors.

SECTION 7

DISPLAY TERMINALS

7.1 GENERAL

Terminals are available as monitor-only terminals, monitor and keyboard terminals, or monitor, keyboard, and keyboard serializer terminals. Monitor-only terminals operate from 110-volt, 60 Hz, 1.5 amp power. Other terminals operate from 110-volt, 60 Hz, 2.0 amp power. Monitor-only terminals have the same capability to display as any other monitor or monitor/keyboard combination.

7.2 MONITOR, Data Disc Model 6512

a. 558-line raster. Compatible with 525-line TV monitors.

b. Solid-state except for CRT.

c. Typical display area - 9 inches high by 6-1/2 inches wide.

d. CRT tube phosphor - P-39, a long-persistence green phosphor.

e. Resolution - greater than 500 lines over the entire display area.

f. Video bandwidth - ±3db to 10 MHz.

g. Width - adjustable to attain a 1:1 screen aspect ratio as used with graphics.

h. Linearity - ±3 percent.

i. Composite video input to a UHF connector.

7.3 KEYBOARD, Data Disc Model 6511 (See Figure 7-1)

a. 67 keys - standard ASCII characters plus 15 control keys.

b. Solid-state.

c. 8-bit parallel ASCII-coded output at TTL logic levels.

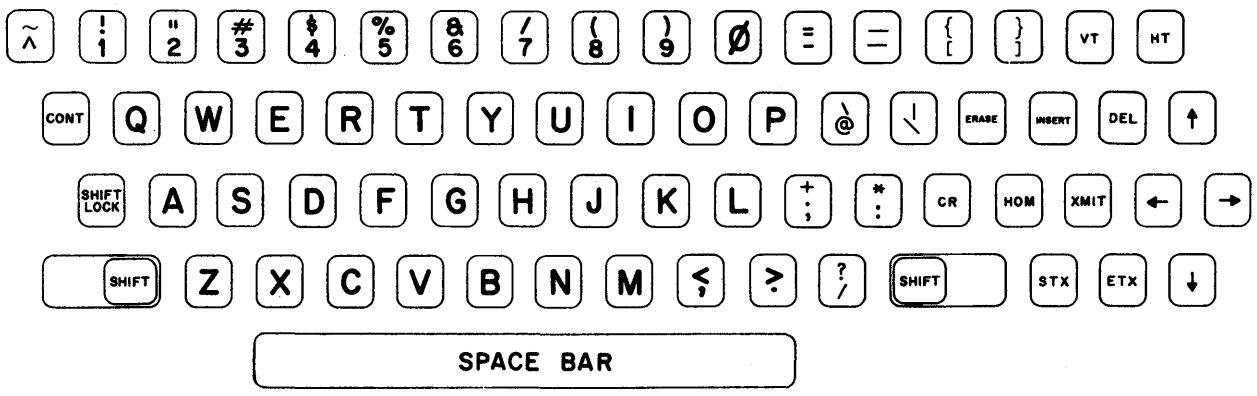


Figure 7-1. Keyboard

d. Two-key rollover.

e. Two-level, alternate action shift-lock key. With shift-lock key depressed, keyboard is in the upper case mode.

f. Key-cap legends on the 15 control keys can be changed to meet customer requirements.

g. Coding of the 15 control keys is shown in Table 7-1. Coding can be changed to meet customer requirements. Since control keys input to the customer's computer their functions are completely programmable.

7.4 KEYBOARD SERIALIZER

a. Accepts 8-bit parallel output from keyboard and converts to serial outputs.

b. Format matches teletype format so that keyboard can be used in place of TTY keyboard.

TABLE 7-1. KEYBOARD CONTROL KEY CODING

Legend	Code	Legend	Code
	Bit 7654321		Bit 7654321
VT	0001011	HOM	0010010
HT	0001001	XMIT	0010101
CONT	FUNCTION	←	0011010
ERASE	0000110	→	0011000
INSERT	0010111	STX	0010011
DEL	0000101	ETX	0000100
↑	0000011	↓	0001010
CR	0001101		

SECTION 8

SYSTEM PROGRAMMING

8.1 GENERAL

A main consideration in programming the Graphic Display System is to treat the display channel as if it were an electronic line printer with all rows and columns independently addressable.

The recommended data transfers are of the block-transfer type; i.e., the same as if the computer were transferring data to a standard line printer.

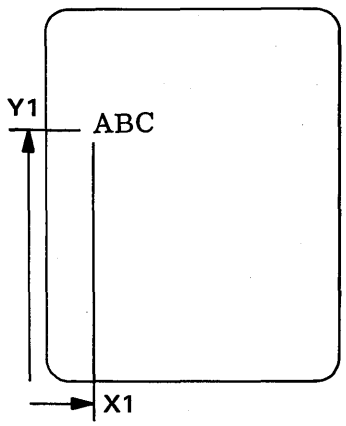
Always load X before Y. Additional information helpful to programming will be found in Section 2, System Operation and in Appendix A.

8.2 ALPHANUMERIC MODE

The number of characters which may be displayed on each channel depends on 1) Channel capacity and 2) character size. Figure 8-1 below provides maximum characters per channel for the different combinations possible.

		Character Size			
Display	Resolution	2W2H	2W1H	1W2H	1W1H
Standard	256x256	1050	----	----	----
Medium	256x512	1050	2142	----	----
High	512x512	1050	2142	2125	4335

Figure 8-1. Displayable characters per channel.



Write ABC on light background in double height, double width

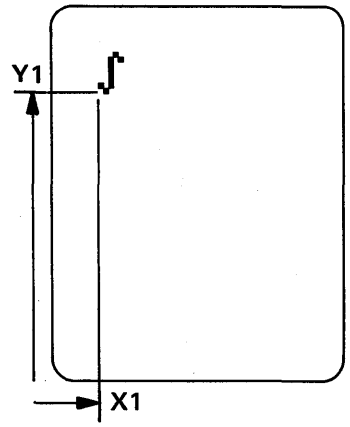
Word	Mnemonic and Typical Field	Function
1	LCR 232	Selects operating mode
2	LTA 000	Select terminal 0
3	LX1 000	Sets horizontal start position
4	LY1 770	Sets vertical start position (Note 1)
5 6 7	XFR A XFR B XFR C	Outputs the double width A/N characters to be written on one line. Up to 42 maximum.

(Note 1) The Y location for A/N characters can be loaded by LY1, LY2 or LBY. Since the Y location of the A/N character is determined by the last Y value transferred to the 6500.

Figure 8-2 Alphanumeric Mode

8.3 GRAPHIC TEXT MODE

The graphic text mode is used for creating special characters or symbols.

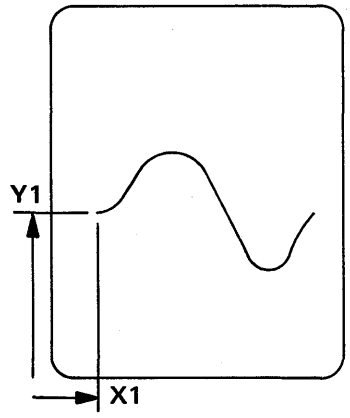


Write integral sign ∫ on light background in double height and double width.

Figure 8-3. Graphic Text Mode

Word	Mnemonic and Typical Field	Function
1	LCR 434	Selects operating mode
2	LTA 002	Select terminal 2
3	LX1 000	Sets horizontal start position (X1)
4	LX2 001	If X2 = X1 (mod 2) write one field. If X2 = X1 + 1 (mod 2) write both fields with same data.
5	LY1 770	Sets vertical start position.
6	XFR 01000000	Outputs Graphic Text to be written on each line. Up to 512 bytes maximum.
7	XFR 10000000	
8	XFR 01111110	
9	XFR 00000001	
10	XFR 00000010	

8.4 LINE DRAWING MODE (Save last Y)

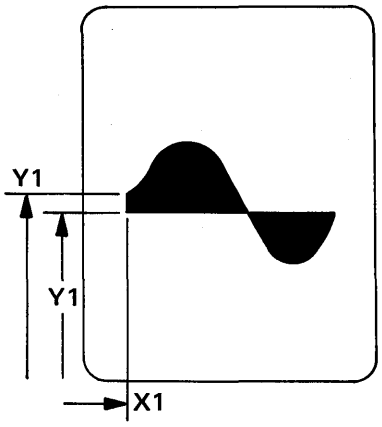


Plot continuous function on light background. Standard resolution. Requires 16.7 msec.

Word	Mnemonic and Typical Field	Function
1	LCR 000	Select operating mode
2	LTA 004	Select terminal 4
3	LX1 000	Sets horizontal start position (X1)
4	LX2 001	If X2 = X1 (mod 2) write one field. If X2 = X1 + 1 (mod 2) write both fields with same data.
5	XFR 400	Set start position vertically (Y1)
6	XFR 402	Set stop position vertically (Y2)
7	XFR 404	Updates stop position for line drawing. 256 points maximum.
⋮	⋮ ⋮	
261	XFR 400	

Figure 8-4. Line Drawing Mode (Save Last Y)

8.5 LINE DRAWING MODE (Save Y1)

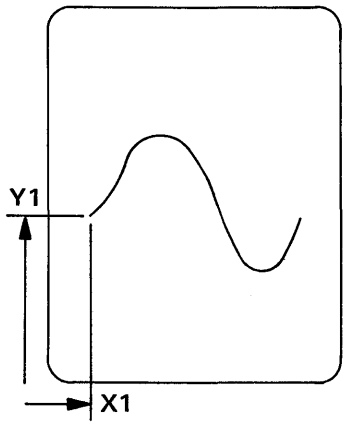


Plot histogram-type continuous function on light background. Standard resolution. Requires 16.7 msec.

Word	Mnemonic and Typical Field	Function
1	LCR 002	Select operating mode
2	LTA 006	Select terminal 6
3	LX1 000	Set horizontal start position (X1)
4	LX2 001	If X2 = X1 (mod 2) write one field. If X2 = X1 + 1 (mod 2) write both fields with same data.
5	XFR 400	Set start position vertically (Y1)
6	XFR 440	Set stop position vertically (Y2)
7 ⋮ 261	XFR 445 ⋮ XFR 400	Update stop position for line drawing. 256 points maximum.

Figure 8-5. Line Drawing Mode (Save Y1)

8.6 LINE DRAWING MODE (Save neither Y)

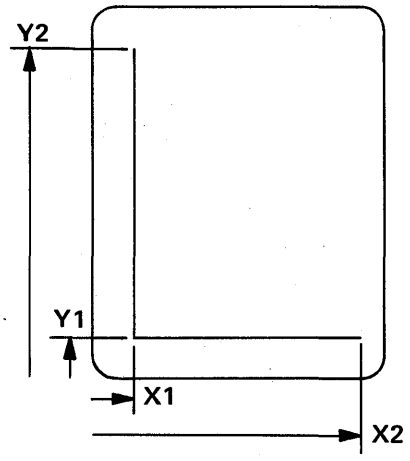


Plot continuous function on light background. High resolution. Requires 33.3 msec.

Word	Mnemonic and Typical Field	Function
1	LCR 500	Selects operating mode
2	LTA 010	Select terminal 10
3	LBX 000	Sets horizontal start position (X1=X2=0) To write one field only.
4	XFR 400	Set start position vertically (Y1)
5 ⋮ 260	XFR 402 ⋮ XFR 400	Set Y position vertically (Y2) Update stop positions for line drawing. 256 points maximum per field.
261	LBX 001	Sets horizontal start position (X1=X2=1) to write second field.
262	LOOP or EXIT	Test 1st time thru list and jump to word 5 to write second field.

Figure 8-6 Line Drawing Mode (Save neither Y)

8.7 LINE DRAWING MODE (coordinates)

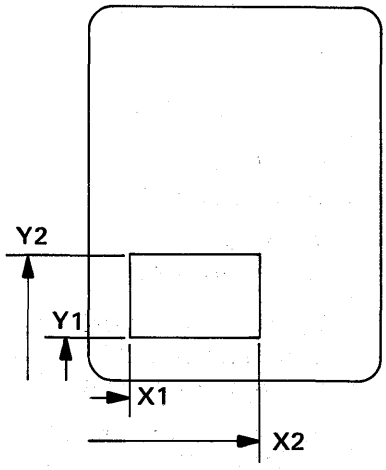


Draw coordinates on light background

Word	Mnemonic and Typical Field	Function
1	LCR 500	Selects operating mode
2	LTA 016	Select terminal 16
3	LX1 100	Sets horizontal start position (X1)
4	LX2 700	Sets horizontal stop position (X2)
5	LBY 100	Draws horizontal line @Y=100
6	LBX 100	Sets X1=X2=100
7	XFR 100	Sets vertical start position (Y1)
8	XFR 700	Sets vertical stop position (Y2) and draws vertical line at X = 100.

Figure 8-7. Line Drawing Mode (Coordinates)

8.8 BOX DRAWING MODE (outline)



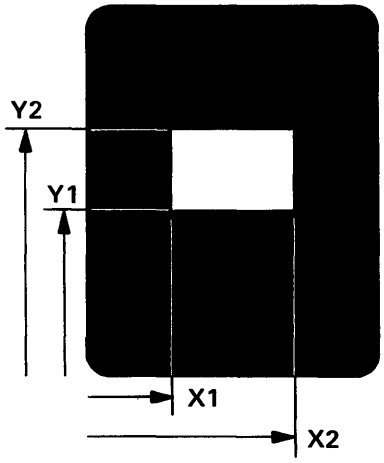
Draw outline box on light background

Use additive mode so as not to erase points within box.

Word	Mnemonic and Typical Field	Function
1	LCR 503	Selects operating mode
2	LTA 014	Select terminal 14
3	LX1 000	Sets horizontal start position (X1)
4	LX2 450	Sets horizontal stop position (X2)
5	XFR 000	Sets vertical start position (Y1)
6	XFR 200	Sets vertical stop position (Y2)

Figure 8-8 Box Drawing Mode (Outline)

8.9 BOX DRAWING MODE (solid)



Draw solid box on dark background

Selective Erasure if dark box drawn on dark background

Word	Mnemonic and Typical Field	Function
1	LCR 442	Selects operating mode
2	LTA 012	Select terminal 12
3	LX1 100	Sets horizontal start position (X1)
4	LX2 500	Sets horizontal stop position (X2)
5	XFR 400	Sets vertical start position (Y1)
6	XFR 600	Sets vertical stop position (Y2)

Note: Neither Y need be saved because only two Ys are transferred to the two Y registers. Also if second box is to be drawn on same terminal, Y registers must not be saved because box would be drawn with new X's and old Y's as soon as new X's were loaded.

Figure 8-9 Box Drawing Mode (Solid)

SECTION 9

DISC MEMORY

The 6500 Series Graphic Display System disc memory is mechanically identical to the Data Disc 5200 Series Memory. The standard 5200 Series Memories are very reliable, have long life, and require minimum maintenance. (Detailed description of these memories is available.) The 6500 disc memory's electrical characteristics differ only slightly from the standard 5200 units.

Data Disc's 5200 Series Memory contains a shock-mounted aluminum casting on which are mounted the read/write heads, a 12-inch plated disc, drive motor, spindle, and a read/write amplifier for each track. The disc rotates at 3600 rpm, or 60 rps. Thus one disc revolution equals a field period, and two revolutions equal a frame period. The display data for one field of a channel is stored on one track. Therefore, memory for one high resolution channel is stored on two tracks. Each track contains 172,980 bit cells, 131,072 (512 x 256) of which contain display data. Data rate is 10.4×10^6 bits per second. Memory for a medium resolution channel (256 x 512) occupies just one disc track, and data rate is 5.2×10^6 bits per second.

Memory for a standard resolution channel (256 x 256) occupies one disc track which contains 86,490 bit cells, 65,536 (256 x 256) of which can contain display data. Data rate from each track is 2.6×10^6 bits per second.

Each track read/write amplifier connects to the video distribution unit by three signal lines; i.e., read data, write data, and write enable. Additional disc signals are the bit clock and the track origin (pulse/revolution) clock.

The disc memory contains power supplies which power all of its internal electronics plus parts of the video distribution-unit electronics.

SECTION 10

VIDEO DISTRIBUTION CARD

A video distribution card contains the line driver, sync mixer, write selection, and read selection for 4 high resolution channels or 8 medium/standard resolution channels. Up to 4 video distribution cards may be contained within the 6500 Series Controller.

APPENDIX A

DISPLAY FORMATS

A.1 RASTER FORMAT (Standard TV Compatible)

A.1.1 Raster or frame rate of 30 per second.

A.1.2 Field rate of 60 per second.

A.1.3 2 to 1 interlace.

A.1.4 558 total scan lines.

A.1.5 512 visible scan lines.

A.1.6 46 scan lines to accommodate horizontal retrace and nonlinearities at the start of the vertical sweep.

A.1.7 512 visible elements per scan line for medium and high resolution. 256 visible elements per scan line for standard resolution.

A.1.8 Scan proceeds from bottom to top and from left to right.

A.1.9 Picture element rate or data rate to the TV monitors for high resolution is 10.4×10^6 elements per second; for medium resolution is 5.2×10^6 elements per second, and for standard resolution is 2.6×10^6 elements per second.

A.2 CHARACTER FORMATS

A.2.1 5x7 Dot Matrix

a. 64 character ASCII set; i.e. no lower case alphanumeric characters.
b. Space between characters; 20% of the character width.
c. Space between rows: typically 45% of character height.

A.3 PAGE FORMATS

A.3.1 Normal size characters (1W1H)

a. 85 characters per row
b. 51 rows per frame
c. 4335 characters per frame

A.3.2 Double height characters (1W2H)

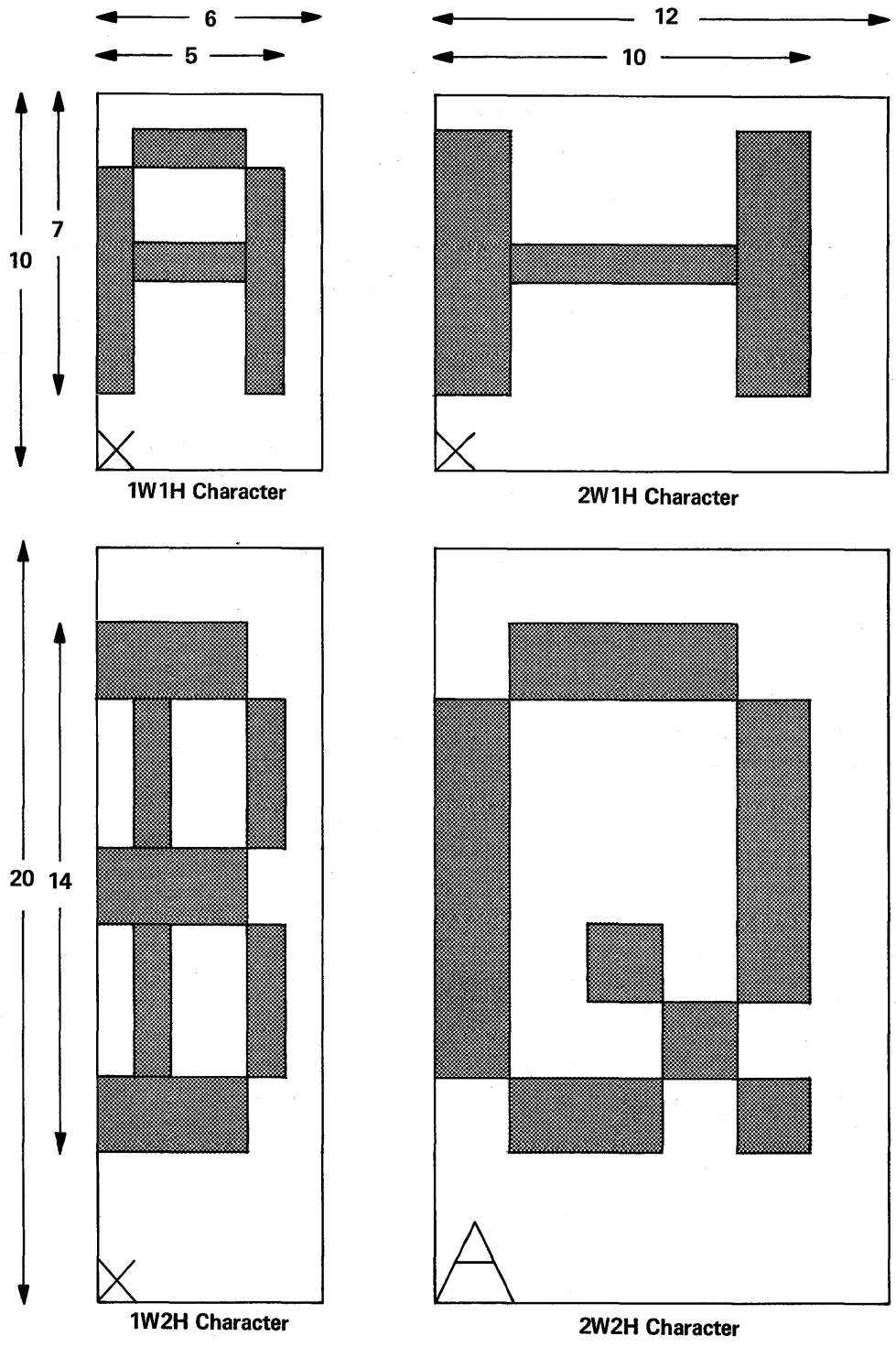
a. 85 characters per row
b. 25 rows per frame
c. 2125 characters per frame

A.3.3 Double width characters (2W1H)

a. 42 characters per row
b. 51 rows per frame
c. 2142 characters per frame

A.3.4 Double size characters (2W2H)

a. 42 characters per row
b. 25 rows per frame
c. 1050 characters per frame



X = Addressable point for placement on 512 x 512 matrix.
A = Addressable point for placement on 256 x 256 matrix.

Figure A. 1 5 x 7 Character Format

APPENDIX B

DEFINITIONS

B. 1 PAGE

Refers to that set of information from which a frame originates. In the case of an alphanumeric frame, a page consists of ASCII code characters. In the case of drawings (graphics), a page will consist of binary transformations of the drawing into raster lines which will be suitable for display at a terminal with no further transformation except that which is necessary to synchronize the individual raster lines.

B. 2 CURSOR

A visible mark on the frame which is uniquely distinguishable and can be moved under program control to a subset of raster points.

B. 3 FRAME (OR PICTURE)

Refers to a raster scan display and is the precise number of displayable bits in the raster.

B. 4 ALPHANUMERIC CHARACTER

An 8-bit word constituting an ASCII code.

B. 5 GRAPHIC CHARACTER

An 8-bit word which is transformed directly into eight picture elements along a scan line.

B. 6 SCAN LINE

A vertical string of 512 picture elements traced by the scanning electron beam.

B. 7 ROW

The set of elements from one field -- or two fields -- which compose the row of displayed alphanumeric characters.

B. 8 COLUMN

A vertical strip -- six scan lines wide for 5 x 7 character size -- extending from left to right of the picture.

B. 9 GRAPHICS

Refers to displays that are not generated by the character generator. These displays have the picture elements supplied by the computer of the graphics generator.

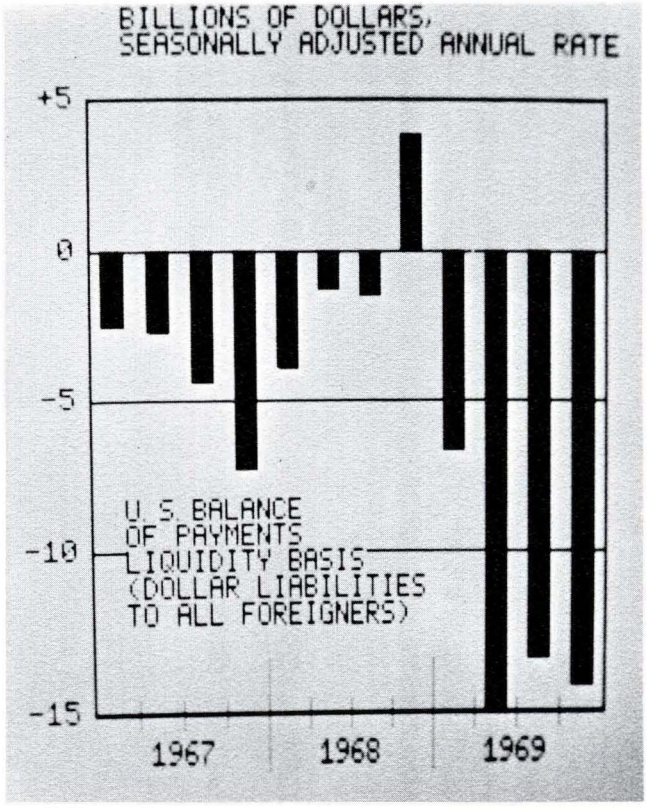
B. 10 PICTURE ELEMENT

The area of the display swept by the display beam during a clock period.

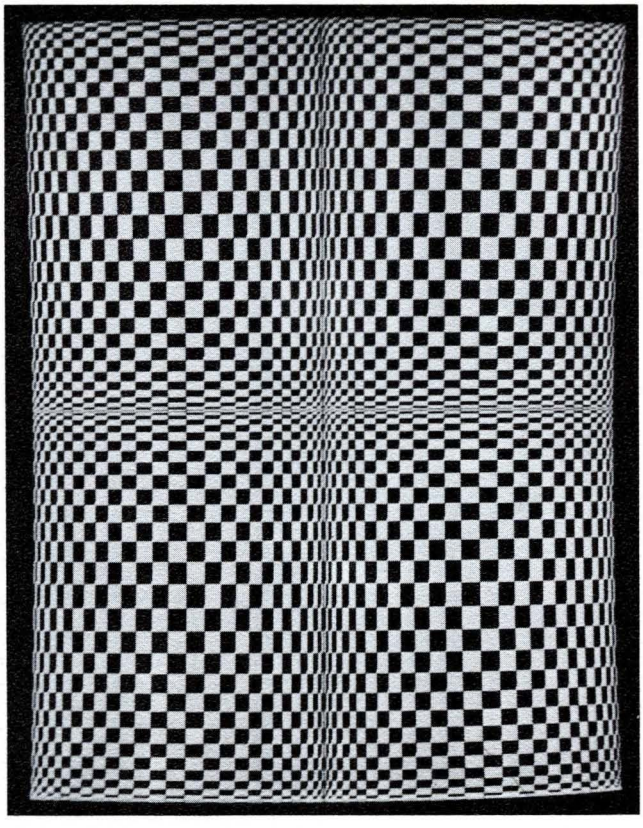
B. 11 TEXT

A portion of a page.

Display real time EKG waveforms for computerized patient monitoring on attractive CRT displays.



Present data graphically instead of as computer printout.



Computer generated art.

Graphics and alphanumerics can be presented as light figures on dark background also.

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