GT-600

VT-100 GRAPHICS ADD-ON BOARD

MANUAL No. 170-A50-03/1

Release Date : Mar. 2, 1984

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matrox
electronic systems

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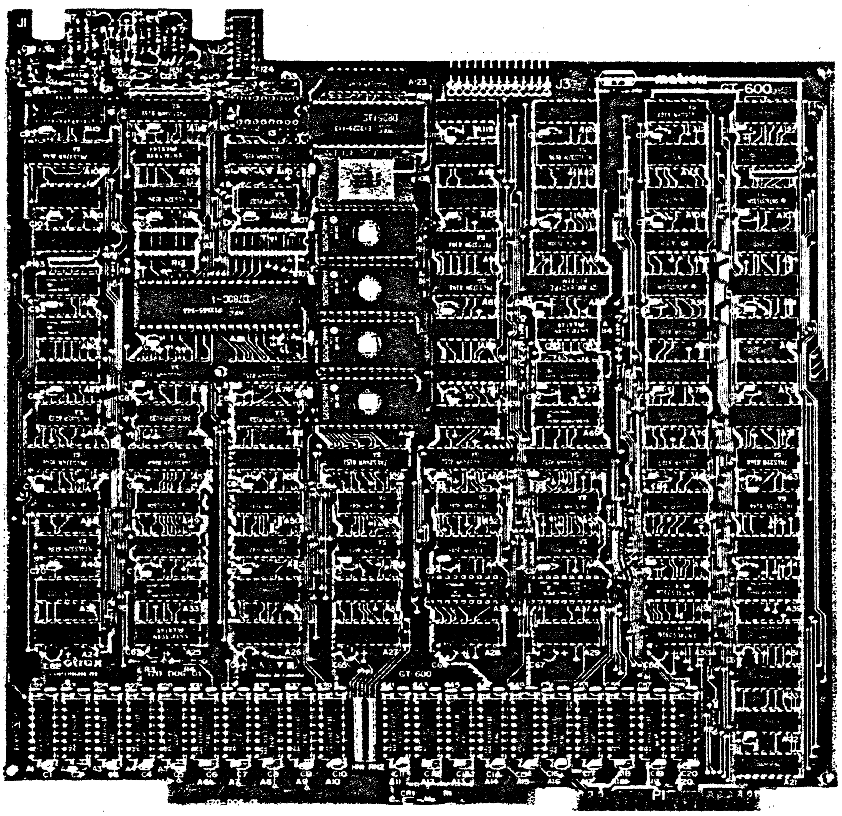
FEATURES

- PLOT-1Ø COMPATIBLE
- EXTERNAL MONITOR CAPABILITY
- PRINTER INTERFACE
- AUTO SCALING
- GRAPHICS TABLET INPUT
- SIMPLE INSTALLATION
- DRAW ARC AND DRAW ELLIPSI
- SOFTWARE SELECTABLE DISPLAY FORMAT
- FIVE OPERATING MODES
- ALL POWER SUPPLIED BY VT TERMINAL.



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1.Ø SPECIFICATIONS:

CONCEPT:

Plug-in graphics controller for DEC VT-1ØØ and VT-1Ø3 terminals.

FORMAT:

3 software selectable display formats within a 4K x 4K clipped working area.

DISPLAY MEMORY	DISPLAY
128Ø x 24Ø	1219 x 24Ø
64Ø x 48Ø	61Ø x 48Ø*
64Ø x 24Ø x 2	61Ø x 24Ø x 2
*REQUIRES LONG PERSISTANCE CRT	

COMPATIBILITY:

Compatible with Tektronix 4Ø1x series graphics terminals and PLOT-1Ø software.

OPERATING MODES:

Alpha Mode - maximum text format of 13Ø x 3Ø characters.
Graph Mode - draws vectors.
Point Plot Mode - also compatible with Special Point Plot Mode.
Incremental Plot Mode - long and short increments.
Crosshair Mode - crosshair moved by arrow keys.
Graphics Input Function - sends position and status information to host.

SOFTWARE SELECTABLE ATTRIBUTES:

- Resolution
- Scaling
- Pen Size
- Line Format
- Video Enable
- Pen Colour
- Incremental Plot Base Direction
- Character Offset

SPECIAL FUNCTIONS:

- Pan
- Scroll
- Zoom
- Erase Screen
- Draw Arc
- Draw Ellipse

1.Ø SPECIFICATION (Cont'd):

INSTALLATION:

Takes no more than 1 hour.
All parts supplied.

POWER REQUIREMENTS:

All power supplied by VT terminal.
+5V at 2A
12V at 5Ø mA

PRINTER INTERFACE:

Will interface with any C.ITOH M851ØP (parallel) Compatible Graphics Printer.

* * * * *

2.Ø FUNCTIONAL DESCRIPTION:

The MATROX GT-6ØØ is a plug-in graphics add-on board for the VT-1ØØ and VT-1Ø3 alphanumeric terminals manufactured by Digital Equipment Corporation (DEC). When installed, it allows these terminals to emulate the Tektronix 4Ølx series graphics terminals and provides compatibility with the powerful Plot-1Ø graphics package, also from Tektronix. In addition to its Tektronix compatible functions, the GT-6ØØ provides a number of useful supplementary functions which can be exploited by the user. Chapter 2 gives a brief overview of GT-6ØØ features and functions, while Chapter 5 contains detailed programming information.

The operation of the VT-1ØØ/GT-6ØØ graphics system can be best understood by considering the GT-6ØØ card as the terminal controller and the VT-1ØØ as a "peripheral" device. The GT-6ØØ is situated in series between the VT-1ØØ and the host. This means that all incoming ASCII will be received by the GT-6ØØ and processed. Input to the terminal will only reach the VT-1ØØ circuitry if it is transmitted there by the GT-6ØØ. See Fig. 2.1.

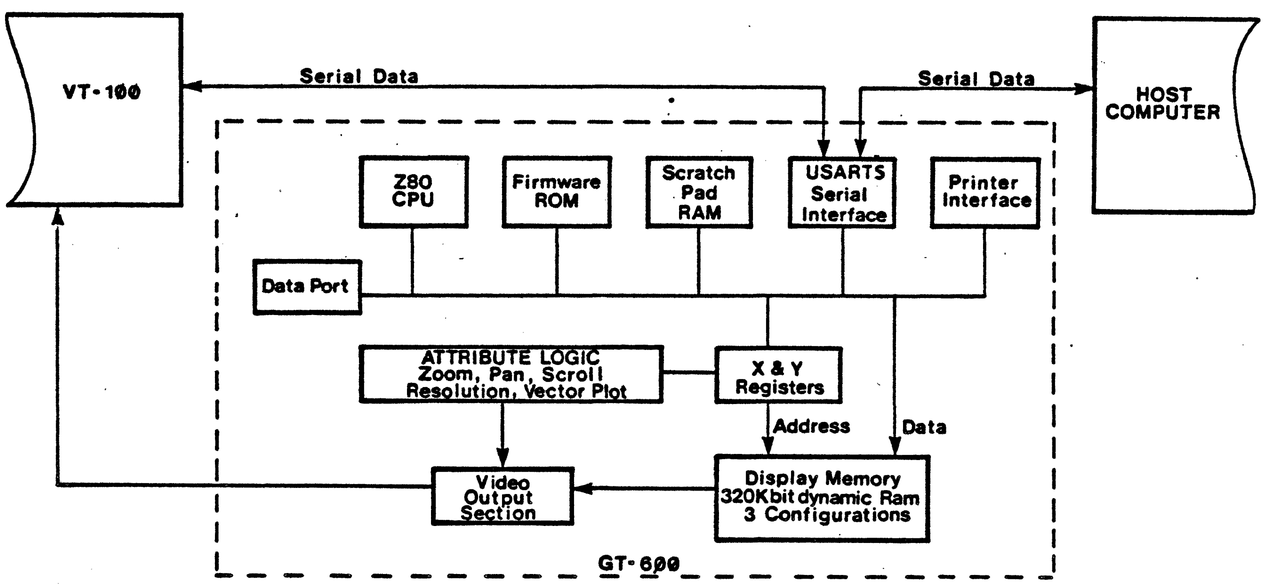


Figure 2.1 - GT-6ØØ BLOCK DIAGRAM

2.Ø FUNCTIONAL DESCRIPTION (cont'd):

The GT-6ØØ can perform several functions on the incoming data, depending on the actual ASCII code received and the GT-6ØØ operating mode. Certain control codes, called mode transition codes, can set the GT-6ØØ to any of the operating modes. After entering one of the graphics modes (Vector, Point Plot, or Incremental Plot), subsequent input is interpreted as X-Y coordinate data and is used in the generation of a point or vector display. The GT-6ØØ does not retransmit an ASCII code to the VT-1ØØ if it is being used as an X-Y coordinate. If the GT-6ØØ is in Transparent mode, however, all incoming ASCII data is passed to the VT-Terminal.

If the GT-6ØØ is in the Alpha Mode, the incoming ASCII data is considered to be alphanumeric text and causes the GT-6ØØ to perform its own character generation. This means text displayed in the Alpha Mode is written into the graphics RAM. The advantages of the Alpha Mode are that text may be written at any X-Y location on the 64Ø by 48Ø display memory plotting grid, permitting more precise labeling of graphs and pictures; and character attributes such as size and inclination can be easily controlled by software. The first feature is required if the terminal is being used with Tektronix Plot 1Ø software.

2.1 INSTALLATION:

The GT-6ØØ is supplied in a kit containing all of the supplementary material required for installation, and if the installation procedure in section 3.Ø is followed, the user should be able to convert his VT-1ØØ or VT-1Ø3 into a graphics terminal within 1 hour. Full instructions are given in Section #3.

2.2 OPERATING MODES:

The GT-6ØØ has six operating modes corresponding to those used by the Tektronix 4Ø1x series terminals:

- Transparent Mode passes all data to the VT-terminal.
- Alpha Mode is used when the host computer is to write alphanumeric characters to the display.
- Graph Mode is used to draw vectors to absolute addresses.
- Point Plot Mode is used to draw points at absolute addresses.
- Incremental Plot Mode is used to draw vectors to relative addresses.
- Crosshair Mode is used to provide a crosshair graphics cursor that can be controlled from the keyboard.

The host computer sends control characters to transfer control from one mode to another as current requirements demand.

2.2.1 ALPHA MODE:

Alpha Mode allows the host computer to write alphanumeric characters to the graphics display. When the GT-6ØØ is in this mode and the host computer sends an ASCII coded alphanumeric character, the character is displayed at the current cursor position. The host computer can move the Alpha cursor about the display by sending various control characters.

LOW ORDER HEX DIGIT OF ASCII CODE

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

Figure 2.2 - ALPHA MODE CHARACTER FONT

Alpha Mode provides the font of 96 characters shown in figure 2.2. These characters can be set by software to any size from a minimum of 7 pixels x 5 pixels to a maximum limited only by the size of the display. Spacing between characters and vertical offset between characters in the same row can also be set by software. The latter facility allows text to be written in an inclined line. The default configuration uses a character size of 7 pixels by 5 pixels, a horizontal spacing of 3 pixels, and no vertical offset. This provides the maximum text format which is 13Ø columns by 3Ø rows. For detailed programming information refer to Section 5.1.1.

2.2.2 GRAPH MODE:

When the GT-6ØØ is in Graph Mode, the host computer can draw a line (vector) from the current pen position to a point specified by a set of X and Y coordinates called a Vector Address. The Vector is drawn as soon as the GT-6ØØ receives the Vector Address from the host computer. Each subsequent Vector Address received causes a new vector to be drawn starting where the previous one stopped. Lines drawn in this manner can be assigned as displayed or non-displayed. Non-displayed lines, called dark vectors, are used to move the pen to the starting point of each new continuous line sequence. The type of line used in Graph mode can be selected as solid or dashed. If dashed lines are used, the user may set the exact duty cycle himself or he can choose one of several predetermined dashed line formats. Also see Section 5.1.2.

2.2.3 POINT PLOT MODE:

Point Plot mode is very similar to Graph Mode; however, instead of drawing lines between Vector Addresses, it draws a dot at each vector address. Also see Section 5.1.3.

2.2.4 INCREMENTAL PLOT MODE:

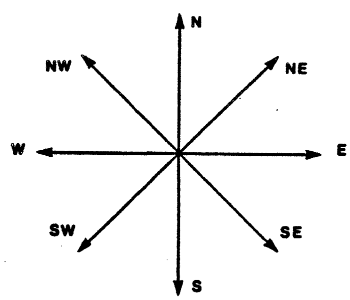


Figure 2.3 - INCREMENTAL PLOT DIRECTIONS

Incremental Plot Mode allows the host computer to draw short lines using relative addressing. These lines or vectors are drawn when the GT-6ØØ receives a command containing one of 8 direction codes (see figure 2.3). The vector is drawn from the current pen position in the direction indicated. The length of the vector depends on which of two sorts of commands is used. If a short command is used, the vector length is one pen point - the short command is compatible with the Tektronix 4Ø16 terminal's Incremental Plot Mode. If a long command is used, the vector can be up to 16 pen points in length - the long form is unique to the GT-6ØØ.

The pen can be raised and lowered (i.e. enabled and disabled) while the GT-6ØØ is in Incremental Plot Mode. This allows the pen to be moved from one point to another without drawing a line.

The attitude of figures drawn in Incremental Plot Mode can be set with a separate command in any one of four directions: upright, up side down, on the side to the right, or on the side to the left. Also see Section 5.1.4.

2.2.5 CROSSHAIR MODE:

The Crosshair Mode is used to provide user interaction with the graphics display. When the GT-6ØØ enters this mode a crosshair cursor is displayed either at the last crosshair position or the last pen position. The cursor can then be moved in any of four directions by pressing the corresponding arrow key on the VT-terminal keyboard. Crosshair mode is terminated in one of two ways - the user hits a keyboard key (other than the arrows) or the host sends an "inquire" command. In both cases the Graphics Input Function (see section 2.4) transmits the current cursor position to the host. The crosshair mode allows the user to select certain parts of the screen or to "draw" on the display.

2.3 GRAPHICS INPUT (GIN):

The GT-6ØØ has a Graphics Input Function which allows the host computer to obtain the current position of the alpha cursor, the graphics pen, or the crosshair cursor as applies in the current mode. This information is contained in a series of ASCII characters called a GIN transmission that is sent to the host computer upon request. In all modes the request is in the form of an ESC ENQ sequence from the host computer; however, in Crosshair Mode a GIN transmission can be initiated from the keyboard as well by entering any alphanumeric character. In which case, the character entered preceeds the GIN transmission on the serial line.

In all modes except Crosshair Mode, the GIN transmission contains a status byte as well as the above mentioned position data. The status byte tells the host computer whether the GT-6ØØ is in Alpha Mode or not and whether it is ready to accept another Vector Address or not.

The GIN transmission can also be assigned, by software, an optional termination consisting of a CR or a CR and an EOT character. A bypass condition which restricts command acceptance to a few necessary commands is initiated by entering Crosshair Mode or by making a GIN transmission. It prevents the echoed transmission from being interpreted as commands that would disrupt the display. If a CR character is included in the transmission, the bypass condition is ended and the GT-6ØØ will automatically enter Alpha Mode at the end of every GIN transmission.

The option of having an EOT character is mainly to provide compatability with Tektronix terminals which use this character to signal turn around of half duplex lines. Since the VT-terminal with the GT-6ØØ does not allow half duplex operations, the EOT character is of no great use in this terminal per se.

2.4 ATTRIBUTES AND SPECIAL FUNCTIONS:

The GT-6ØØ has a number of commands which can be used in any mode but Crosshair Mode to set the attributes and perform the special functions that are set out in the following two lists:

ATTRIBUTES	SPECIAL FUNCTIONS
Resolution	Horizontal Shift (PAN)
Scaling	Vertical Shift (SCROLL)
Pen Size	Zoom
Line Format	Screen Preset
Video Enable	Draw Arc
Bit Plane Write	Draw Ellipse
Character Offset	
Character Attitude	

Exception: Draw Arc and Draw Ellipse do not work in Alpha Mode.

When power comes up, the attributes and special functions default to a special configuration called the Tek Configuration. In this configuration attributes are set to be compatible with Plot-1Ø software, and with the exception of Draw Arc and Draw Ellipse, special functions can not be executed. If an attribute or special function command is sent while the GT-6ØØ is in the Tek Configuration, the command parameters will be stored but the commands will not be executed until an exit Tek Configuration command is sent. The Tek Configuration can be returned to at any time by sending a single command. Note that even though Draw Arc and Draw Ellipse can be executed while in the Tek Configuration they are not supported by Plot-1Ø.

Detailed descriptions of the attributes and special functions are given in section 5.3. of this manual.

* * * * *

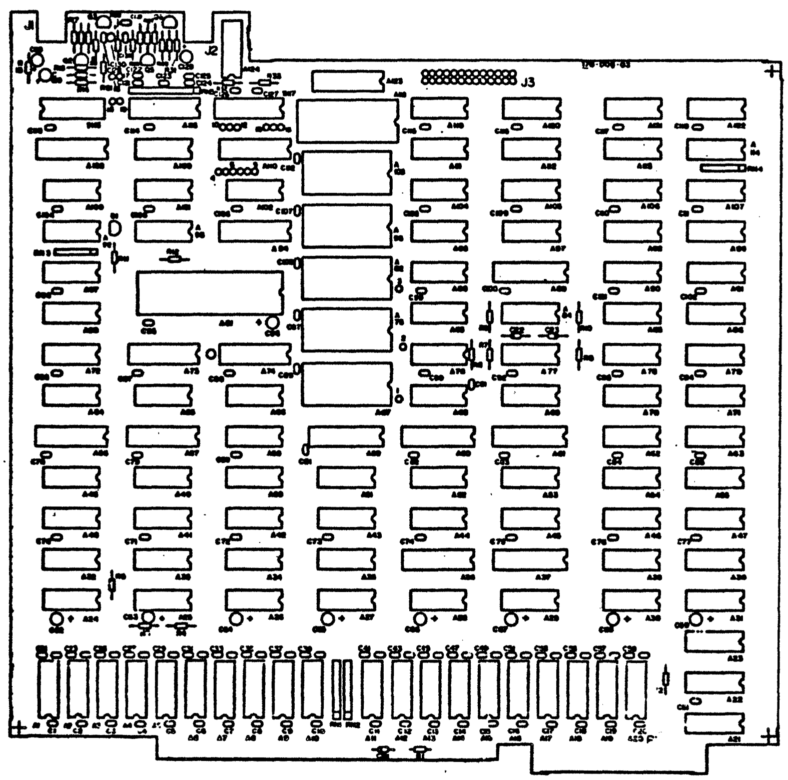
3.Ø INSTALLATION PROCEDURE:

The GT-6ØØ, as-shipped, contains the parts for installation on either the VT-1ØØ or the VT-1Ø3 terminal. One installation procedure is used for both terminals, with certain steps skipped depending on the terminal. You will need a Phillips screwdriver, a slot head screwdriver, a pair of pliers, and - for the GT-6ØØ/VT-1Ø3 - a soldering iron.

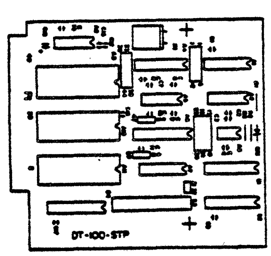
1. Complete the following check list, comparing the items on it with the contents of the package you have received from Matrox. If there are any shortages or shipping damage, please notify us immediately.

CHECK

a) GT-6ØØ PCB ✓



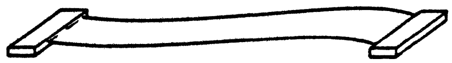
b) STP PCB ✓



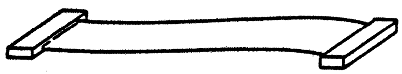
3.Ø INSTALLATION PROCEDURE (Cont'd)

CHECK

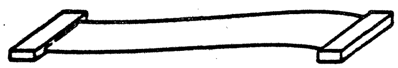
c) STP CABLE 18 CKTS ✓



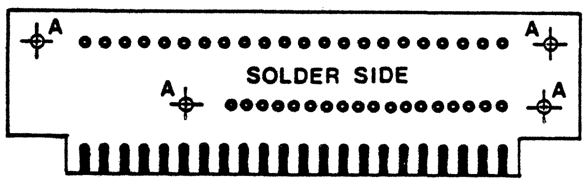
d) INTERFACE CABLE 18 CKTS ✓



e) GRAPHICS CABLE 18 CKTS ✓

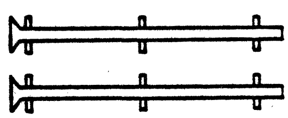


f) BACK PLANE PCB ✓



g) BACKPLANE HARDWARE
- 2 4/4Ø x 5/8 screws
- 4 Nylon washers
- 2 4/4Ø x 1/4" nuts

h) TWO plastic card Guides



i) STP HARDWARE
- 2 Plastic threaded spacers
- 4 4/4Ø x 1/4" screws

j) TWO pieces of insulated wire.

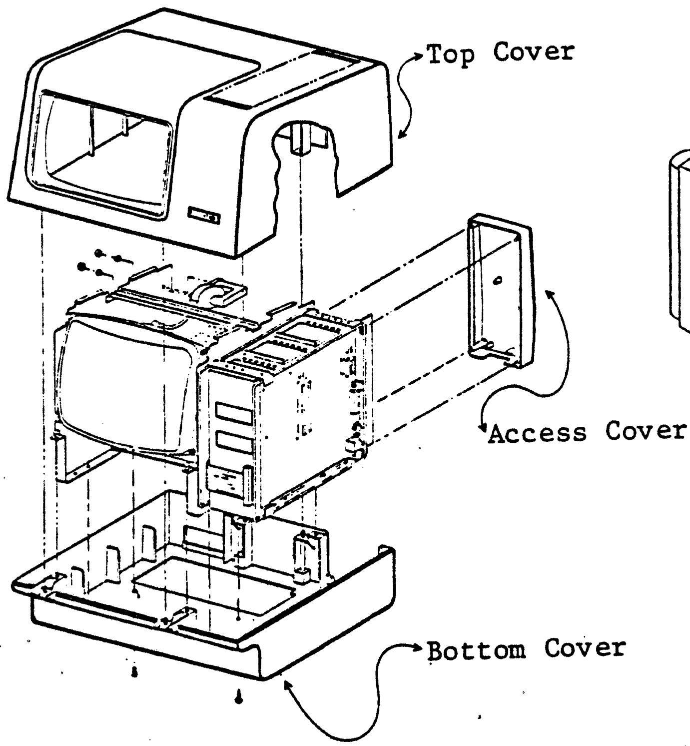
3.Ø INSTALLATION PROCEDURE (Cont'd):

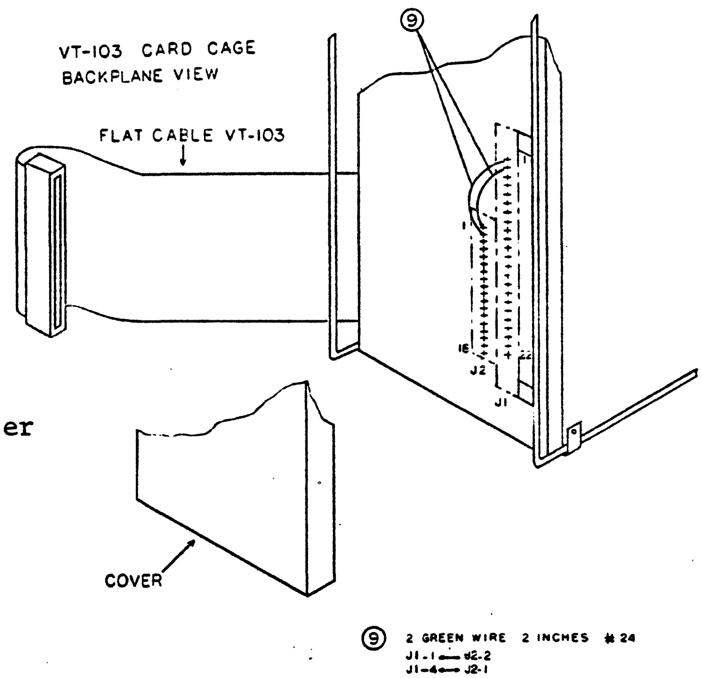
2. Disconnect power from the terminal.

3. Remove the access cover (four screws).

4. Remove the top cover (four pop connectors).

5. Remove the bottom cover (four pop connectors on chassis and four screws on bottom cover).





6. Remove terminal control board.

7. If the GT-6ØØ is being installed in a VT-1ØØ skip to step 14. If the GT-6ØØ kit is being installed in a VT-1Ø3 continue to step 8.

8. Disconnect the power connector from the backplane.

9. Remove the metal plate that covers the solder side of the backplane (4 screws).

1Ø. Remove the backplane noting that the ground strap has one washer below, and one above (8 screws).

11. On the solder side of the backplane, solder short wires from J1-Pin 1 to J2-Pin 2 and from J1-Pin 4 to J2-Pin 1 (J1 pin 1 is marked on the socket. J2, which is not marked, follows the orientation of J1).

12. Reinstall the backplane in the chassis and replace the metal plate.

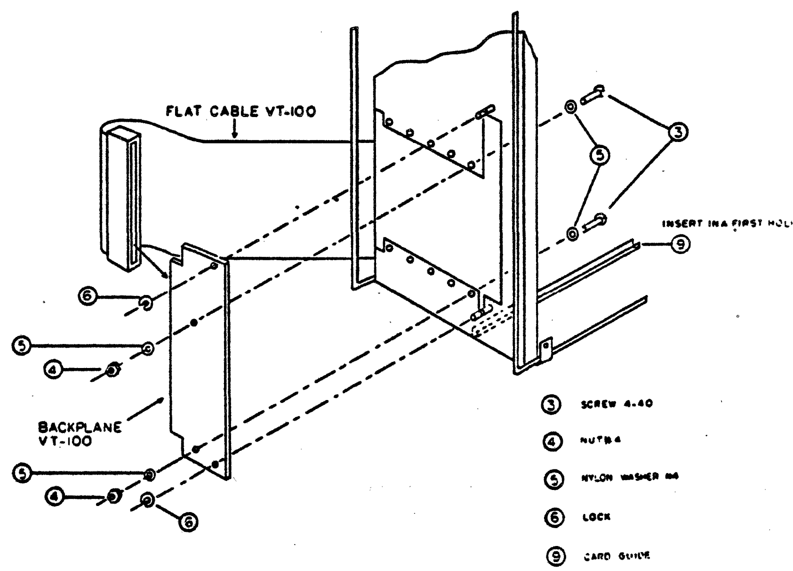
3.Ø INSTALLATION PROCEDURE (Cont'd):

13. Skip to step number 17.

14. Remove the power supply connector from the back of the card cage chassis. Be careful to save the two C-clips.

Note: On recent production runs of the VT-1ØØ (LEVEL AA), Digital equipment has made a modification to the chassis. The modification consists of the addition of a spring clip to the back of the card cage to hold the VT-1ØØ flat cable in place. When attaching the Matrox Backplane, remove the spring clip and use the hardware provided with your GT-6ØØ to fasten the backplane in place. Removal of the spring clip will expose the two holes to be used for this purpose. Note that since the VT-1ØØ(AA) chassis does not contain a cooling fan, the maximum operating room temperature advisable for the GT-6ØØ:VT-1ØØAA system is 3Ø degrees Centigrade (or 86 Farenheit).

15. Attach the backplane PCB to the card cage chassis as is shown in the following diagrams. Note that the C-clips that were used to hold the power supply cable are now used to hold the right side of the backplane in place.

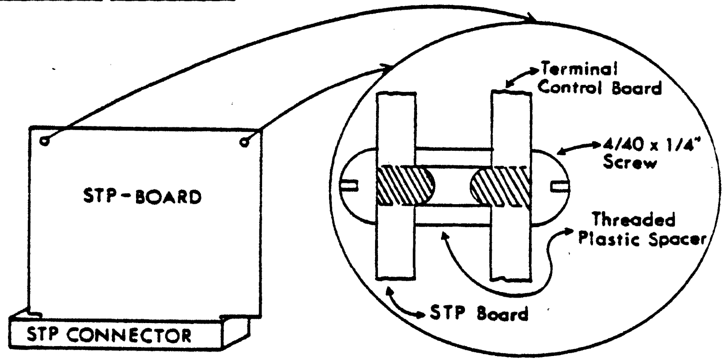


16. Install the two plastic card guides so that they are aligned with the 18 pin edge connector on the backplane.

17. Connect the power supply connector to the edge connector on the side of the backplane.

18. Install the two spacers directly beneath the area for the STP PCB and fasten them with the 4/4Ø x 1/4 screws supplied, then insert the STP PCB into the STP connector on the terminal control board and fasten it in place as shown on the following page:

3.0 INSTALLATION PROCEDURE (Cont'd)



19. When the GT-600 is shipped, its serial interface is strapped for parity disabled, two stop bits, and 8 bits per word. If this does not correspond to the format used by the host computer, see Section 6.0 and change the GT-600's serial interface straps accordingly.

20. Carefully observing pin assignments:

a) Insert one end of the short 18-pin cable assembly into S2 on the STP card, and insert the other end of the short cable into J2 on the VT terminal control board. Make sure that Pin 1 on the cable matches with Pin 1 on the socket in both cases.

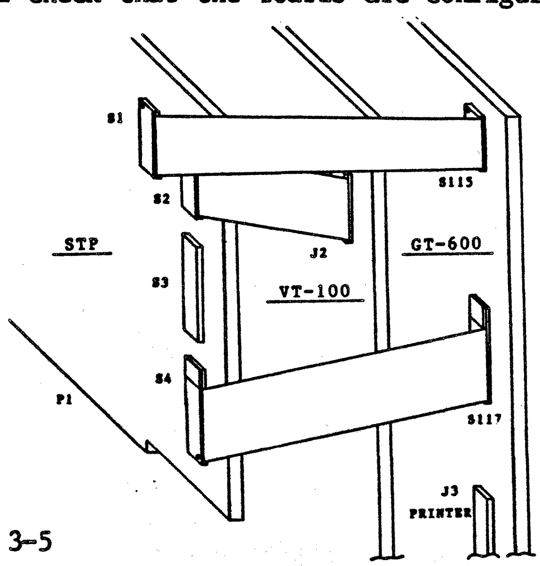
b) Insert the end of another 18-pin cable assembly into S1 on the STP board, making sure that Pin 1 of the cable goes to Pin 1 of the socket.

c) Insert one end of the last 18-pin cable assembly into S4 of the STP board. Note that the socket has 20 pins. The 18-pin assembly must be inserted so that pin 1 goes to pin 1 of the socket.

21. Insert the terminal control board into the 22-pin edge connector in the card cage, then slide the GT-600 PCB into the adjacent tracks.

22. Connect the free end of the cable that goes to S1 on the STP board to socket S115 on the GT-600 board, and connect the free end of the cable that goes to S4 on the STP board to socket S117 on the GT-600. In both cases Pin 1 of the cable must go to Pin 1 of the socket.

23. Look into the card cage and check that the boards are configured as shown in the following figure:



3.Ø INSTALLATION PROCEDURE (Cont'd)

24. Replace the access cover and turn on the terminal.

25. Enter SET-UP B mode (your VT-1ØØ/1Ø3 manual explains how to do this), and set up your VT-1ØØ/1Ø3 communication parameters as follows:

a) Notice there are four nibbles (groups of inverse binary digits) at the bottom left of the screen. The individual bits must be set as shown below (# = SET TO MATCH WITH THE STRAPS ON THE STP BOARD):

X = DON'T CARE 1 |X|X|X|X| 2 |X|X|1|1| 3 |X|X|X|1| 4 |#|#|#|Ø|

Full information on what these bits do, and how to change change them is contained in your VT-1ØØ/1Ø3 operator's manual.

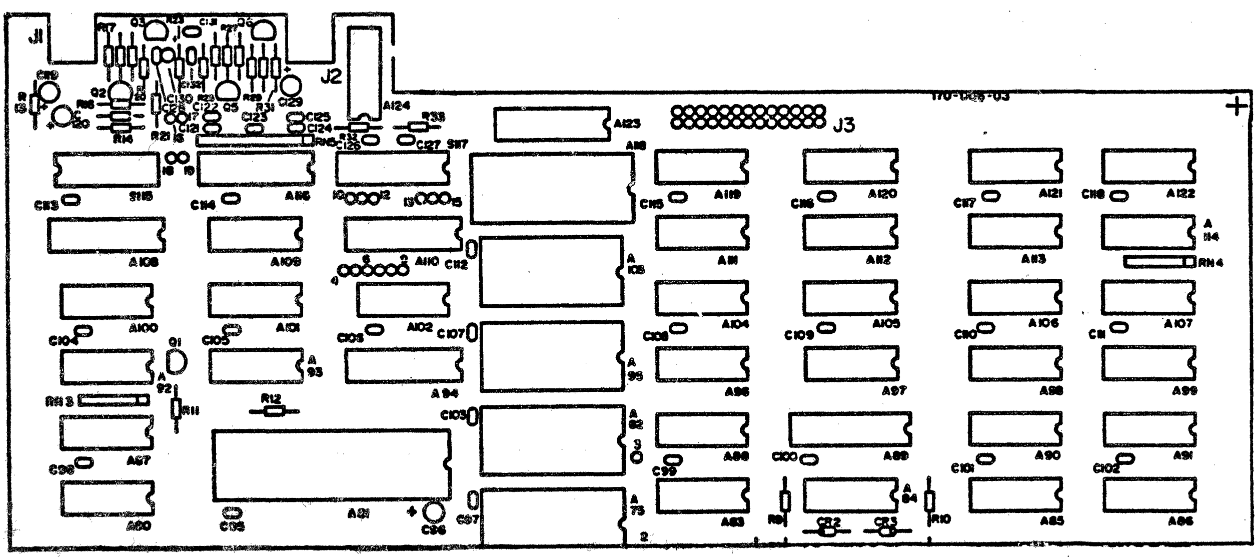
b) Note that the transmit and receive speeds are displayed at the bottom right of the screen. Both are be set to 96ØØ. If the Baud rate must be changed, you must change the baud rate of the host.

c) Remember that all communication parameters must match between the host computer, the VT-1ØØ/1Ø3 and the GT-6ØØ. If you experience problems with your graphics system, this is the first thing to check.

26. Go on to the Familiarization Procedure in Section Four.

3.1 HIGH PERSISTANCE MONITOR INSTALLATION

To take advantage of the extended vertical resolution provided by the 61Ø x 48Ø display format, an interface has been included on the GT-6ØØ which will enable the use of an external high persistance monitor. The recommended phosphor is P39. To use this function, two BNC connectors (J1, J2) have been provided which can be user-installed as described on the next page. Note, however, that installation of these two connectors will not permit the use of the rear cover on the VT unit; so the following procedure should only be implemented if the rear cover can be left off.



3.1 HIGH PERSISTANCE MONITOR INSTALLATION (cont'd)

1) Install J1 on the leftmost upper corner of the board, the center terminal from J1 is to be soldered to the terminal on the component side of the board and the ground terminal goes to the solder side.

2) Install J2 in the space immediately to the right of J1 following the same connection procedure as J1.

3) Re-insert the board as explained in section 3.Ø

4) Following installation, connect a cable (any co-axial cable will do), from "Video Out" (J9 on your VT monitor) to J1 on your GT-6ØØ board; and connect another cable from J2 on your GT-6ØØ board to video input on your high persistance monitor. This will allow high-resolution graphics to be displayed on the remote monitor. Note that the VT-terminals' own character set can not be displayed on the auxilliary monitor.

3.2 PRINTER INSTALLATION

Use the following procedure to connect a dot matrix printer to the GT 6ØØ-VT combination. Note: The software, as-shipped, has been configured to support any printer that is directly compatible with the C. ITOH 851ØP. Installation of a different type of printer will require a change in firmware. Please contact MATROX if this is necessary.

1) The printer port on the GT 6ØØ, J3 (26-Pin), mates with a 26-Pin right angle connector with .1ØØ IN. spacing (2.54 mm) such as 3M #3399 (not included).

2) The printer input mates with a 36-Pin connector with .1ØØ IN. spacing (2.54 mm) such as AMP 552742-1 (not included).

3) Connect a 26-conductor ribbon cable between the connectors, carefully observing pin orientation (Pin-1 to Pin-1).

4) Insert the 26-Pin edge connector onto J3 of the GT-6ØØ making sure that Pin 1 of J3 goes to Pin 1 of the receptacle.

5) Insert the 36-Pin connector into the printer, again making certain that corresponding pins match.

6) Re-install the Gt-6ØØ board according to the procedure in section 3.Ø. The printer is now ready for use.

* * * * *

4.Ø FAMILIARIZATION PROCEDURE:

The following is a brief procedure to familiarize the user with the basic operation of the GT-6ØØ. Note that for ease of reading, characters are separated by a semicolon then a space, as follows: 7; c; >;. The semicolon and space are intended only for clarity and must not be entered as code. **O** denotes the letter, while **Ø** denotes the number. **Bold** type is used for upper case, symbol, and control characters in the command. Regular (not-bold) lower case type is used for lower case command characters.

1. After installation assure that the terminal is operational by observing that the 'on-line' indicator is illuminated. To program it for local operation press **SETUP**; **RESET**; **PF3** (within 5 seconds). Wait at least 5 seconds and press **PF3** again. The function keys are now enabled and the terminal is in local mode.

2. Hit **PF1**. This will pass control to the GT-6ØØ.

3. Erase the screen and enter Alpha Mode by entering **ESC**; **CTRL L** . Note that there will now be two cursors on the screen. The underline cursor is the GT-6ØØ cursor.

4. Type in some text. The text will be written by the underline cursor, indicating that the GT-6ØØ is entering text instead of the VT-Terminal.

5. Erase the screen by entering **ESC**; **CTRL L** , then go to Graphics mode by entering **CTRL]**. At this point the underline cursor will disappear.

6. Draw a diagonal line across the screen by entering the following sequence of characters: **space bar**; **`**; **space bar**; **@**; **7**; c; **>**; O.

7. Erase the screen by entering **ESC**; **CTRL L**.

8. Go to the Point Plot Mode and draw a dot in each corner of the screen by entering the following sequence of characters: **CTRL **; **space bar**; **`**; **space bar**; **@**; **space bar**; **`**; **>**; O; **7**; **c**; **>**; O; 7; c; **space bar**; **@** .

9. Move the pen to the center of the screen by entering **CTRL]**; **+**; r; **Ø**; **@** .

1Ø. Go to Incremental Plot Mode and draw a small rectangle by entering **CTRL ^**; **P**; **Ø**; **O**; **B**; **Ø**; **O**; **H**; **Ø**; **O**; **A**; **Ø**; **O**; **D** .

11. Turn to section 5.3 and try the examples that are given with the explanations of the attribute and special function commands. Repeat some of the above steps after attributes have been changed to see how the display is affected. NOTE that you must exit from the the TEK configuration for these special functions to operate (section 5.3.2).

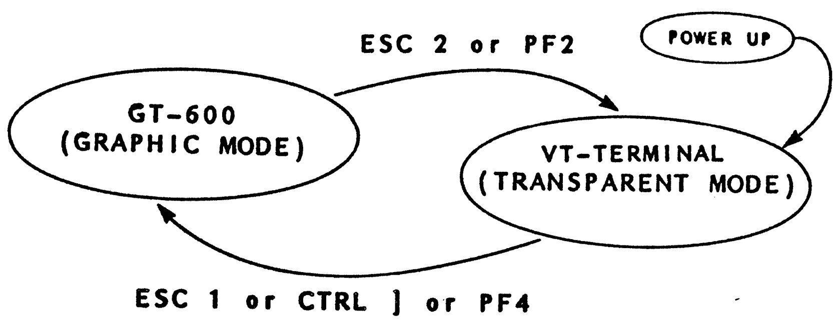
12. Return to Transparent Mode by pressing the **PF2** key. The GT-6ØØ cursor will disappear. Typing some characters will cause the text to be written by the other cursor, indicating that the VT-Terminal is now entering text instead of the GT-6ØØ.

13. Crosshair Mode and the GIN function can only be used while the terminal is on-line. Before trying these functions see Sections 3.Ø-Parts 19 & 25, Section 5.Ø-Page 5-1, and Sections 5.1.5 to 5.2.4.

* * * * *

.Ø PROGRAMMING:

The GT-6ØØ is controlled by ASCII characters received from the host computer when on line, or from the keyboard when the terminal is in local mode. This section explains which characters must be sent and in what manner to command the many and varied functions provided by the GT-6ØØ.



When power comes up in the VT-1ØØ or VT-1Ø3, it starts operating in its normal alphanumeric mode and ignores the existence of the GT-6ØØ (Transparent Mode). Control is passed to the GT-6ØØ by sending **ESC 1** or **CTRL]**. To return to the regular VT-Terminal mode, send an escape character followed by a 2.

A standard set of codes operates to allow transition from one mode to another, regardless of the current mode. These codes are explained in detail in Section 5.1.

Function Keys

The function keys (**PF1-PF4**) can be enabled to rapidly change between modes by performing the following two steps:

Step 1: Press **SET-UP**, then **RESET**, (or power-up).

Step 2: While the two cursors are simultaneously visible, strike **PF3** key. If this is not done the function keys are passed on to the host as on a normal VT terminal.

When enabled, the PF keys function as follows:

PF1: Clears screen; Enters Alpha Mode. Equivalent to **ESC 1**; **ESC**; **CTRL L.** (Valid only in Local)

PF2: Enters Transparent Mode. Equivalent to **ESC 2.** (Valid only in Local)

PF3: Toggles between Local & On-Line. (Always valid)

PF4: Leaves Transparent Mode. Equivalent to **ESC 1.** (Valid only in Local)

5.Ø PROGRAMMING (cont'd):

In order to accommodate those users who wish to retain the PF keys' function unique to their own programs, the GT-6ØØ will only enable these keys within five seconds after either power-up or the sequence SET-UP; RESET.

Once control has been passed to the GT-6ØØ it will respond to five categories of commands: mode changing commands, mode dependent commands, graphics input (GIN) commands, attribute commands, and special function commands. The mode change commands are used to move control between the GT-6ØØ's five operating modes and the mode dependent commands are those commands that are unique to each mode. The graphics input commands are used to send pen or cursor position data to the host computer. The attribute commands are used to set display parameters such as resolution and pen size, and the special function commands are used to perform special operations such as zoom and scroll.

Table 5.1 provides an overview of all the commands used by the GT-6ØØ. Note that mode changing commands are generally CoNTRoL characters, attribute setting commands are ESCaped non-control characters and command arguments are a sequence of non-control characters. A complete description of the GT-6ØØ's commands is found in the rest of the section.

A table of ASCII characters has been included in Appendix B of this manual. It can be referred to to identify the control character abbreviations that are used in the command descriptions.

MODE CHANGE COMMANDS	
TO ALPHA MODE SEE SECTION 5.1.1	
US (CTRL ?)	Moves control to Alpha Mode from all other modes except Crosshair Mode, and terminates the bypass condition if it is in effect.
CR (CRTL M)	Moves control to Alpha Mode from all other modes and terminates the bypass condition if it is in effect.
ESC FF (CTRL L)	Moves control to Alpha Mode from all other modes, clears the screen, moves the cursor to its home position, and terminates the bypass condition if it is in effect.
SI (CTRL O)	Valid only when bypass condition exists. It clears the bypass condition and moves control to Alpha Mode.
TO GRAPH MODE	
GS (CTRL])	Moves control to Graph Mode from all other modes, and terminates the bypass condition if it is in effect.
TO POINT PLOT MODE	
FS (CTRL\)	Moves control to Point Plot Mode from all other modes, and terminates the bypass condition if it is in effect.
ESC FS (CTRL\)	Moves control to a different form of the Point Plot Mode that accepts vector addresses in the format used by the 4Ø16's Special Point Plot Mode. Intensity variations are not implemented.
TO INCREMENTAL PLOT MODE SEE SECTION 5.1.4	
RS (CTRL^)	Moves control to the Incremental Plot Mode from any other mode and terminates the bypass condition if it is in effect.
TO CROSSHAIR MODE SEE SECTION 5.1.5	
ESC SUB (CTRL Z)	Moves control to Crosshair Mode from any other mode. Crosshair is displayed at the last used crosshair position or at the center of the screen if it is the first time Crosshair Mode is being entered.
ESC / f	If the ESC SUB sequence is preceded by an ESC / f sequence the crosshair will be displayed at the current pen position. Note that this feature is not supported by Plot 1Ø.

TABLE 5-1. COMMANDS

MODE DEPENDENT COMMANDS	
ALPHA MODE SEE SECTION 5.1.1.	
CARRIAGE RETURN CR (CTRL M)	Moves the cursor to the start of the next lower line. If the cursor is already in the bottom line, it is moved to the start of the top line in the alternate margin.
LINE FEED LF (CTRL J)	Moves the cursor down one line in the same column. If the cursor is already in the bottom line it is moved to the top line in the same column. Terminates bypass condition.
HORIZONTAL TAB HT(CTRL I)	Moves the cursor one space to the right. If the cursor is in the last column it will wrap around to the first column.
VERTICAL TAB VT(CTRL K)	Moves the cursor up one line in the same column. If the cursor is in the top line, it will wrap around to the bottom line.
BACK SPACE BS (CTRL H)	Moves the cursor one space to the left. If the cursor is in the first column, it is wrapped around to the last column
ESC FF (CTRL L)	When the GT-6ØØ is in Alpha Mode and receives an ESC FF sequence it erases the screen and moves the cursor to its home position. Note that this is also a mode change command.

TABLE 5-1. COMMANDS (CONTINUED)

MODE DEPENDENT COMMANDS (CONTINUED)

GRAPH MODE
SEE SECTION 5.1.2

VECTOR ADDRESS

A four or five character sequence containing a 2Ø bit X-Y coordinate address as shown below. A vector is executed when this address is received.

SENDING SEQUENCE	BYTE NAME	7 BIT ASCII CHARACTER						
		TAG BIT		ADDRESS BIT				
		6	5	4	3	2	1	Ø
1	HIGH ORDER Y (HIY)	Ø	1	5 MSB OF Y COORDINATES				
2	EXTRA BYTE (OPTIONAL)	1	1	SEE SECTION 5.1.2				
3	LOW ORDER Y (LOY)	1	1	5 LSB OF Y COORDINATE				
4	HIGH ORDER X (HIX)	Ø	1	5 MSB OF X COORDINATE				
5	LOW ORDER X (LOX)	1	Ø	5 LSB OF X COORDINATE				

BEL (CTRL G)

If a BEL character is sent between GS and the first vector address the first vector will be displayed. Otherwise it will be dark (not displayed).

POINT PLOT MODE
SEE SECTION 5.1.3

VECTOR ADDRESS

When the GT-6ØØ receives a vector address in the Graph Mode format while it is in Point Plot Mode, it draws a dot at that address

TABLE 5.1 COMMANDS (CONTINUED)

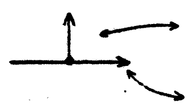
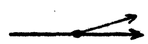
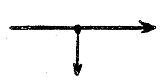
MODE DEPENDENT COMMANDS (CONTINUED)	
POINT PLOT MODE (CONT'D)	
SPECIAL POINT PLOT	When the GT-600 is in the special point plot compatible Mode and receives a vector address in the special point plot format (see 4016 manual) it draws a dot at that address. Intensity not implemented
INCREMENTAL PLOT MODE SEE SECTION 5.14	
SP (SPACE)	PEN UP (DRAWING DISABLED)
P	PEN DOWN (DRAWING)
SHORT COMMAND	When the GT-600 receives a single direction character it moves the pen one pen point in the direction indicated
LONG COMMAND	When the GT-600 receives an ASCII 0 followed by a line length character followed by a direction character, it will move the pen the indicated number of pen points in the indicated direction
D	Direction Character  PEN DIRECTION BASE DIRECTION
E	Direction Character  Pen moves as indicated with respect to Base Direction
A	Direction Character
I	Direction Character 
H	Direction Character 

TABLE 5-1 COMMANDS (CONTINUED)

MODE DEPENDENT COMMANDS (CONTINUED)	
INCREMENTAL PLOT MODE (CONTINUED)	
J	Direction Character 
B	Direction Character
F	Direction Character 
C	Used like direction character but draws dot at current pen position.
@	Line length Character - 1 pen point
A	Line length Character - 2 pen points
B	Line length Character - 3 pen points
C	Line length Character - 4 pen points
D	Line length Character - 5 pen points
E	Line length Character - 6 pen points
F	Line length Character - 7 pen points
G	Line length Character - 8 pen points
H	Line length Character - 9 pen points
I	Line length Character - 1Ø pen points

TABLE 5-1. COMMANDS (CONTINUED)

MODE DEPENDENT COMMANDS (CONTINUED)	
INCREMENTAL PLOT MODE (CONTINUED)	
J	Line length Character - 11 pen points
K	Line length Character - 12 pen points
L	Line length Character - 13 pen points
M	Line length Character - 14 pen points
N	Line length Character - 15 pen points
O	Line length character - 16 pen points
CROSSHAIR MODE SEE SECTION 5.1.5	
ARROW KEYS	Pressing the keyboard arrow keys causes the crosshair cursor to move in the direction indicated by the arrow.
ANY NON CONTROL CHARACTER	Pressing the key for any character other than a control character will cause the address of the cursor to be sent to the host computer preceded by the character pressed.
	GIN COMMANDS (SEE SECTIONS 5.2.1 AND 5.2.2)
ESC ENQ (CTRL E)	When the GT-6ØØ receives an ESC ENQ sequence from the host computer it executes a GIN transmission to the host computer. The information in this transmission varies with the current mode as follows.
	ALPHA MODE: status byte followed by address of lower left corner of alpha cursor, followed CR and EOT if they are included.

TABLE 5-1. COMMANDS (CONTINUED)

GIN COMMANDS (CONTINUED)		
ESC ENQ (CTRL E) (CONTINUED)	GRAPH MODE	Status byte followed by address of the current pen position followed by CR and/or EOT if they have been programmed to be included.
	POINT PLOT MODE	same as Graph Mode
	INCREMENTAL PLOT MODE	same as Graph Mode
	CROSSHAIR MODE	Address of crosshair followed by CR and EOT if included. No status byte and GIN can be initiated from keyboard in this mode.
Miscellaneous Commands		
ESC CAN (CTRL 8)	Causes GT-6ØØ to enter a bypass condition without doing a GIN transmission.	
BEL (CTRL G)	Clears bypass condition, but does not ring bell on VT terminal. Also used in Graph Mode (see Graph Mode dependent commands	
ESC ETB (CTRL W) (TEK Standard)	Causes a hard copy of the display to be made if an energized hard copy unit is connected and terminates the bypass condition if it is active. SEE SECTION 5.3.18.	
ESC 3	Starts/Stops printer. Used to print ASCII data sent to the VT-1ØØ (-1Ø3) when in Transparent Mode. Makes graphics hard copy when not in Transparent Mode. SEE SECTION 5.3.18.	
ESC / Ø d	Sets subsequent pixels on. See section 5.3.17.	
ESC / 1 d	Sets subsequent pixels off. See section 5.3.17.	
ESC / 2 d	Complements subsequent pixels. See section 5.3.17.	

TABLE 5-1. COMMANDS (CONTINUED)

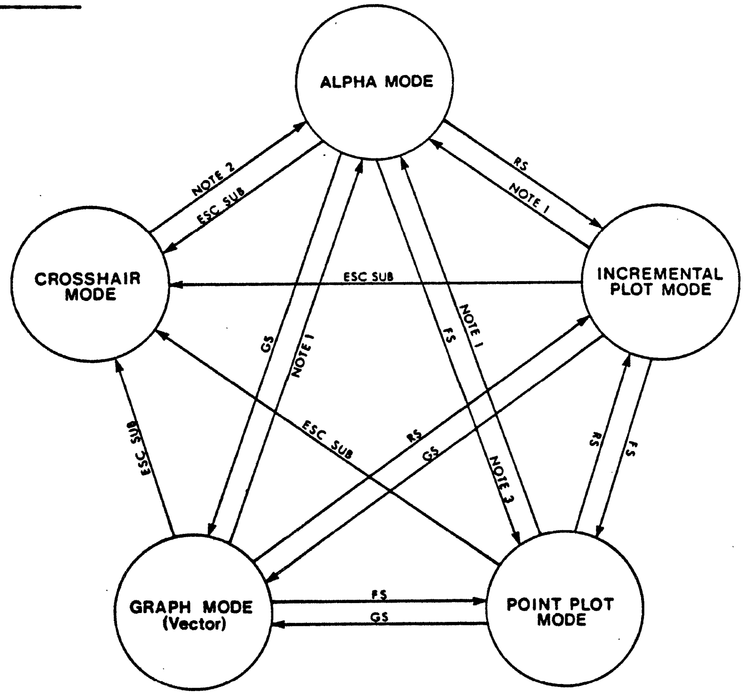
ATTRIBUTE AND SPECIAL FUNCTION COMMANDS

COMMAND		DISTINGUISHING CHARACTER	ARGUMENT Hi Y	Lo Y	Hi X	Lo X	DEFAULT
EXIT TEK CONFIGURATION		T				ANYTHING BUT @	EMULATOR CONFIGURATION
RETURN TO TEK CONFIGURATION		T				@	
FORMAT RESOLUTION	1280 x 240 x 1	M				@	1280 x 240 x 1
	640 x 480 x 1	M				A	
	640 x 240 x 2 OR'D	M				B	
	640 x 240 x 2 GREY SCALE	M				C	
SCALING	ON	U				@	ON
	OFF	U				ANYTHING BUT @	
PEN ASPECT RATIO		W	Y	Y	X	X	$\frac{Y}{X} = \frac{1}{1}$
SET PEN SIZE		S		DON'T CARE	SIZE	SIZE	1
LINE FORMAT		D	ON	ON	OFF	OFF	SOLID LINES
HORIZONTAL IMAGE SHIFT		P	RIGHT	RIGHT	LEFT	LEFT	0
VERTICAL IMAGE SHIFT		Q	UP	UP	DOWN	DOWN	0
ZOOM		Z		Y-ZOOM		X-ZOOM	ZOOM BY ONE
ELLIPSE AND ARC ASPECT RATIO		R	B	B	A	A	$\frac{B}{A} = \frac{1}{1}$
DRAW ELLIPSE *		CTRL Y	SIZE	SIZE		@	
DRAW ARC *		CTRL X	SIZE	SIZE		DIRECTION	
PEN COLOUR	BIT PLANE 0 - DARK BIT PLANE 1 - DARK	F				@	BIT PLANE 0 WRITES LIGHT BIT PLANE 1 WRITES DARK
	BIT PLANE 0 - LIGHT BIT PLANE 1 - DARK	F				A	
	BIT PLANE 0 - DARK BIT PLANE 1 - LIGHT	F				B	
	BIT PLANE 0 - LIGHT BIT PLANE 1 - LIGHT	F				C	
ERASE	BIT PLANE 0	E				A	
	BIT PLANE 1	E				B	
	BIT PLANE 0 and 1	E				C	
VIDEO DISABLE	ENABLE VIDEO 0 ENABLE VIDEO 1	V				@	ENABLE VIDEO 0 DISABLE VIDEO 1
	ENABLE VIDEO 0 DISABLE VIDEO 1	V				A	
	DISABLE VIDEO 0 ENABLE VIDEO 1	V				B	
	DISABLE VIDEO 0 DISABLE VIDEO 1	V				C	
STATUS TERMINATION	NO EXTRA TERMINATION	[				@	CR
	CR	[				A	
	CR EOT	[				B	
ALPHANUMERIC OFFSET		O	VERTICAL	VERTICAL	HORIZONTAL	HORIZONTAL	VERT. = 0 PIXELS HORIZ. = 0 PIXELS
INCREMENTAL PLOT ATTITUDE	A	B				@	@
	>	B				F	
	<	B				B	
	V	B				D	

- Nothing is sent in blank spaces. - Don't Care indicates any character with the correct tag bits
* Note that Draw Arc and Draw Ellipse use Control Characters and not escape sequences.

Table 5.1 - COMMANDS

5.1 OPERATING MODES:



NOTE 1: US, CR, ESC FF
NOTE 2: CR, ESC FF, ESC SUB, ESC ETB
NOTE 3: ESC FF (SPECIAL FORM)

Figure 5.1 - MODE CHANGE COMMANDS.

Figure 5.1 schematically shows the GT-6ØØ's operating modes and the commands used to move between them. Subsections 5.1.1 through 5.1.5 describe these modes in detail.

5.1.1 ALPHA MODE:

The GT-6ØØ will enter Alpha Mode from any other mode when it receives a CR character, or an ESC FF sequence; and a US character will cause the GT-6ØØ to enter Alpha Mode from any other mode except GIN Mode. The Alpha Mode is automatically entered when control is first passed from the VT-1ØØ to the GT-6ØØ. When the GT-6ØØ is in Alpha Mode and receives an ASCII character that is neither a control character nor part of an escape sequence, that character is displayed at the current Alpha cursor position.

The text format and character size depend on the size of the pen point and the character offset which can be set using the commands described in sections 5.3.5 and 5.3.14 respectively; however the GT-6ØØ defaults to a text format of 16Ø columns by 3Ø rows of characters 8 scan lines high.

Alpha Mode provides two margins: Margin 1 at the left of the screen and Margin 2 in the middle of the screen. Initially text is entered along Margin 1, then as each subsequent page of text is entered the GT-6ØØ alternates between Margin 1 and Margin 2.

The cursor home position is always in Margin 1.

5.1.1 ALPHA MODE (Cont'd)

The Alpha Mode cursor is an inverted character cell: a rectangle 8 pen points by 8 pen points. The actual size of the cursor in pixels depends on the pen size however, the default pen size provides a cursor that is 8 X-axis pixels by 8 Y-axis pixels. The cursor's home position is in the upper left hand corner of the display.

The following is a list of Alpha Mode Commands used to move the cursor:

Carriage Return (CTRL M): When the GT-6ØØ receives a CR character, it moves the cursor to the start of the next lower line. If the cursor is already in the bottom line, it is moved to the start of the top line in the alternate margin.

Line Feed (CTRL J): When the GT-6ØØ receives a LF character, it moves the cursor down one line in the same column. If the cursor is already in the bottom line it is moved to the top line in the same column.

Horizontal Tab (CRTL I): When the GT-6ØØ receives an HT character, it moves the cursor one space to the right. If the cursor is in the last column it will wrap around to the first column.

Vertical Tab (CTRL K): When the GT-6ØØ receives a VT character, it moves the cursor up one line in the same column. If the cursor is in the top line, it will wrap around to the bottom line.

Back Space (CTRL H): When the GT-6ØØ receives a BS character, it moves the cursor one space to the left. If the cursor is in the first column, it is wrapped around to the last column.

ESC CTRL L (FF): When the GT-6ØØ receives an ESC FF sequence it erases the screen and moves the cursor to the home position. If the GT-6ØØ receives an ESC FF sequence when it is in some other mode it will enter to Alpha Mode then execute the command.

5.1.2 GRAPH MODE:

The Graph Mode is entered whenever the GT-6ØØ receives a GS control character (Ctrl]). When the GT-6ØØ first enters Graph Mode, the current pen position is the position set by the last set of X and Y coordinates that was received in any mode. When the GT-6ØØ is in Graph Mode and receives a set of X and Y coordinates in the Vector Address format, it draws a vector from the current pen position to the position defined by the received coordinates. The first vector drawn after the receipt of a GS character is dark (not displayed) unless its vector address is preceded by a BEL(ctrl G) character; however, all following vectors are displayed. Whenever a dark vector (a move) is required the GS command can be issued. Also, the lines used to draw vectors can be set as solid or dashed using the attribute command described in subsection 5.3.6.

5.1.2 GRAPH MODE (Cont'd):

SENDING SEQUENCE	BYTE NAME	7 BIT ASCII CHARACTER						
		TAG BITS		ADDRESS BITS				
		6	5	4	3	2	1	Ø
1	HIGH ORDER Y (HIY)	Ø	1	5 MSB OF Y COORDINATE				
2	LOW ORDER Y (LOY)	1	1	5 LSB OF Y COORDINATE				
3	HIGH ORDER X (HIX)	Ø	1	5 MSB OF X COORDINATE				
4	LOW ORDER X (LOX)	1	Ø	5 LSB OF X COORDINATE				
1A	EXTRA BYTE* (LOXY)	1	1	Ø	Y2	Y1	X2	X1

Table 5.2 - VECTOR ADDRESS FORMAT

The X and Y coordinates used to generate a vector are normally sent in the Vector Address format set out in table 5.2. This format provides 1Ø-bit X and Y coordinates and is used by most of the Tektronix 4Ø1x series terminals. *The 4Ø16 terminal, however, uses 12 bit coordinates which require an extra byte to be sent in the Vector Address. This byte, called the Extra Byte, is sent between the High Order Y Byte and the Low Order Y Byte and provides the two least significant bits of the X and Y coordinates. The GT-6ØØ will accept vector addresses that include the Extra Byte but will ignore all addresses that are out of its range.

Vector address components (HiX, LowX, HiY, LowY) that do not change their value in successive vectors, do not necessarily have to be included in each vector address. Vector addresses that contain less than four ASCII characters are called Short Form Addresses and their form is governed by the following rules:

1. If LOW X changes, then LOW X needs to be specified in the new address.

2. If HIGH X changes, then LOW Y, HIGH X, and LOW X must be spcified in the new address; HIGH Y does not have to be respecified unless it changes.

3. If LOW Y changes, then LOW Y and LOW X must be specified in the new address; HIGH Y and HIGH X do not have to be respecified unless they change.

4. If HIGH Y changes, then HIGH Y and LOW X must be specified in the new address; LOW Y and HIGH X do not have to be respecified unless they change.

Figure 5.2 provides a more graphic view of the short form rules.

5.1.2 GRAPH MODE (Cont'd):

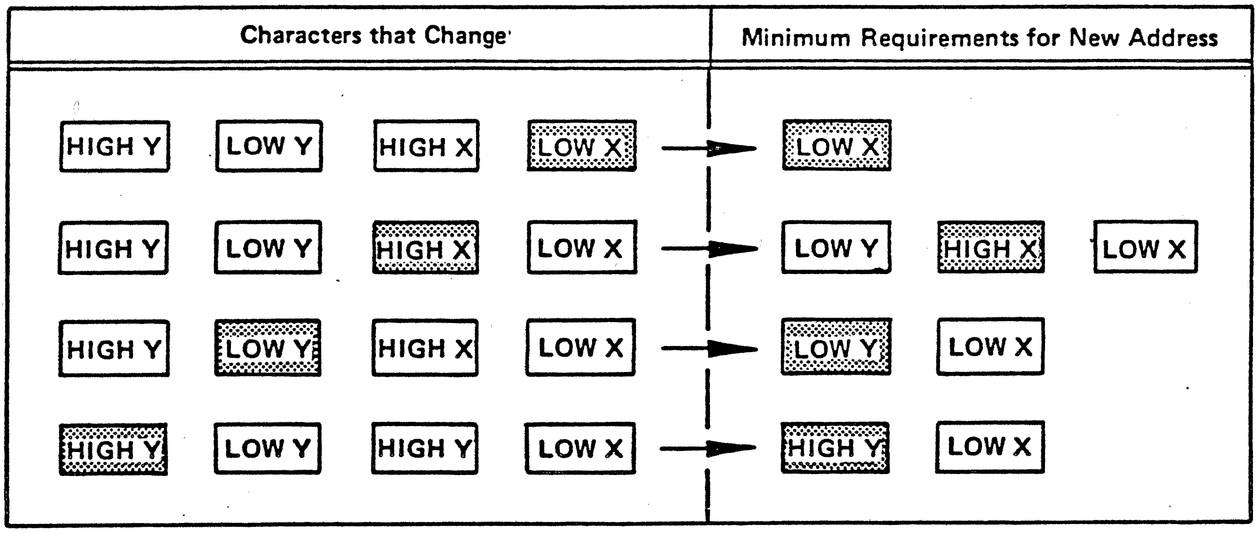


Figure 5.2 - SHORT FORM RULES

Example: A horizontal line is to be drawn left to right access the bottom of the display. The first vector address would be Y=Ø X=Ø, which would be sent as the sequence: SP; \`; SP; @ . The next vector address would be Y=Ø X=1, which in long form would be sent as: SP; \`; SP; A; however, since the SP; \`; SP; part of the sequence was already sent in the previous vector address the short form vector address A; is all that needs to be sent. Note that semicolons and blanks in the above are for clarity only and are not meant to be entered as code.

5.1.2 GRAPH MODE (Cont'd):

Figure 5.3 is a representation of the display memory showing how the display is configured with respect to the X and Y axes. It also shows the areas of the display memory that are not displayed when the display is in the default pan position. Note that position Ø, Ø is at the bottom left corner of the screen. See section 5.3.4 for an explanation of how the display format is affected by scaling.

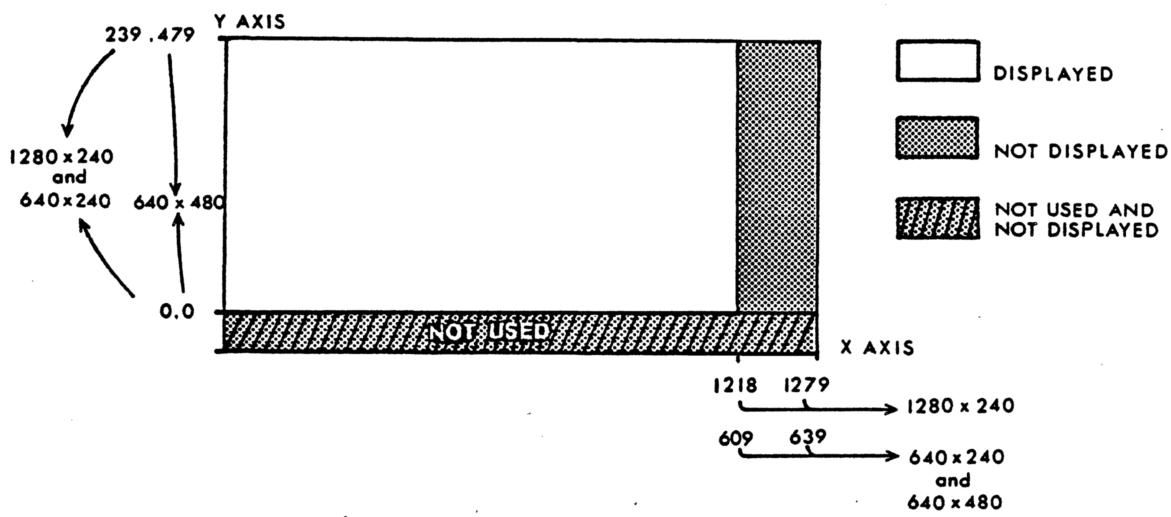


FIGURE 5.3 DISPLAY MEMORY (PAN IN DEFAULT POSITION)

5.1.3 POINT PLOT MODE:

The GT-6ØØ enters the Point Plot Mode when it receives an **FS** character from the host computer. This mode is exactly the same as the Graph Mode except that only the end points of vectors are displayed. When the GT-6ØØ receives an **ESC FS** sequence it enters a variation of the Point Plot Mode that accepts vector addresses in the format used by the Tektronix 4Ø16 terminal's Special Point Plot Mode. For compatibility, the intensity byte is accepted but not used.

5.1.4 INCREMENTAL PLOT MODE:

The Incremental Plot Mode uses both long and short commands to draw lines in specified directions from the current pen position. These lines are one pen point in length if the short command is used and up to 16 pen points in length if the long commands are used. The pen can also be raised and lowered in this mode.

The GT-6ØØ enters the Incremental Plot Mode when it receives an RS character (**ctrl** ~) from the host computer. Since there is no default for pen up or down upon entering this mode, a **P** should follow the RS character from the host computer if the pen is to be down (drawing) or a **SP** character should follow the RS character if the pen is to be initially up (not drawing). The **SP** and **P** characters can be used to raise or lower the pen at any time as images are drawn in this mode.

The short commands consist of one character which defines a direction as shown in table 5.3. When one of these commands is sent the pen moves one pen point in the direction indicated, drawing one dot if the pen is down. One exception is the "C" command which does not move the pen but causes a dot to be drawn at the current pen position. Note that, excepting the "C" command, all the short commands are compatible with those used by the Tektronix 4Ø16's Enhanced Graphics Module.

The long commands consist of an ASCII ZERO followed by a line length character and a direction character. The ASCII Ø marks the command as long, the length character indicates how long a line is to be drawn and its format is shown in figure 5.5. The direction character is exactly the same as those used by short commands (table 5.3).

ASCII CHARACTER	COMMAND DESCRIPTION
SP	PEN UP (DRAWING DISABLED)
P	PEN DOWN (DRAWING ENABLED)
D	PEN MOVES NORTH (N)
E	PEN MOVES NORTH EAST (NE)
A	PEN MOVES EAST (E)
I	PEN MOVES SOUTH EAST (SE)
H	PEN MOVES SOUTH (S)
J	PEN MOVES (SOUTH WEST (SW)
B	PEN MOVES WEST (W)
F	PEN MOVES NORTH WEST (NW)
C	A DOT IS DRAWN AT THE CURRENT PEN POSITION

Table 5.3 - SHORT FORM COMMAND

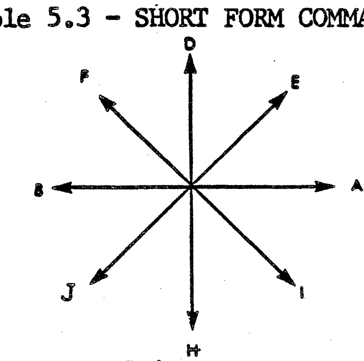


Figure 5.4 - DIRECTION

Base direction is set by the Incremental Plot Base Direction Command (see section 5.3.15.

.1.4 INCREMENTAL PLOT MODE (Cont'd)

7	6	5	4	3	2	1	Ø	BITS
	1	Ø	Ø	X	X	X	X	

LINE LENGTH IN PEN POINTS	1	2	3	4	5	6	7	8	9	1Ø	11	12	13	14	15	16
ASCII CHAR.	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O

ADDED BY SERIAL INTERFACE

Figure 5.5 - LONG COMMAND LINE LENGTH CHARACTER FORMAT

Example: To draw the letter 'A' on the screen (at 5x7 pen points), one would enter the following ASCII characters. (Note that the space and semicolon are for ease of reading only and are not to be entered as code.) :

1) (CTRL ~); SP; Ø; H; H; (moves pen to lowest character row)
2) SP; Ø; B; A; (moves pen right to character column)
3) P; Ø; E; D; (pen draws vertical line up 6 points)
4) P; E; (pen moves diagonally to top of character)
5) P; Ø; B; A; (pen draws horizontal line of 3 points)
6) P; I; (pen moves to top of opposite vertical line)
7) P; Ø; D; H; (pen draws vertical line down 5 points)
8) SP; Ø; B; D; (pen moves up to start of horizontal line)
9) SP; B; (pen moves left to start of horizontal line)
1Ø) P; Ø; B; B; (pen draws horizontal line right to left)

5.1.5 CROSSHAIR MODE:

When the GT-6ØØ receives an **ESC SUB** sequence from the host computer it enters the Crosshair Mode and displays a crosshair cursor. The cursor appears at the center of the screen if Crosshair Mode has not been previously entered, or at the last crosshair cursor position if there was a previous Crosshair Mode. If **ESC SUB** is preceded by an **ESC / f** sequence the GT-6ØØ will enter Crosshair Mode with the cursor at the current pen position (note this feature is not supported by PLOT-1Ø). The position of the cursor can be changed by using the arrow keys on the VT-Terminal keyboard. Each time an arrow key is pressed, the cursor will move one pen point in the direction indicated on the key. If the key is kept depressed the cursor will continue to move in the selected direction at an ever increasing rate.

The host computer can obtain the cursor position at any time by using the Graphics Input Function, which is explained in section 5.2

5.2 GRAPHICS INPUT (GIN):

The GT-6ØØ has a graphics input (GIN) function which allows it, upon request, to send a data string called a GIN transmission to the host computer. This transmission informs the host computer of the current cursor or pen position, as the case may be, and in all modes but Crosshair Mode, it also supplies the GT-6ØØ's status. The GIN transmission may also contain an optional termination.

5.2.1 GIN TRANSMISSION INITIATION:

A GIN transmission will be sent to the host computer whenever the GT-6ØØ receives an ESC ENQ sequence from the host computer. When the GT-6ØØ is in Crosshair Mode, a GIN transmission can also be initiated by entering any non-control character via the keyboard. In this latter case the GIN transmission begins with the character entered. An ESC ENQ should never be entered from the keyboard as it may cause problems at the host computer. Note - When reading these characters, the host computer must echo them.

5.2.2 GIN TRANSMISSION FORMAT:

The GIN transmission format is as follows:

1st	2nd	2nd A	3rd	4th	5th	6th	7th	SENDING ORDER
STATUS BYTE	HIGH X	X-Y EXT. (If required)	LOW X	HIGH Y	LOW Y	CR	EOT	
Not Sent When in Crosshair Mode	GIN Address					Optional		

Whether or not the CR and EOT characters are sent depends on the user's requirements (see sections 5.2.3 and 5.2.4).

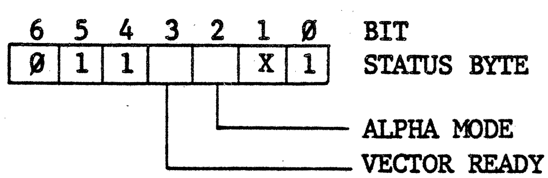
Extended Address - If the coordinate to be returned requires more than 1Ø bits, an extra byte (LOW XY) will automatically be added to the transmission and the 2 least significant X and Y bits will be sent in a byte tagged 11 coming after the high order X byte.

SENDING ORDER	BYTE NAME	7 BIT ASCII CHARACTER: TAG BITS 6	TAG BITS 5	ADDRESS BITS 4 3 2 1 Ø
1	HIGH ORDER X	Ø	1	5 MSB OF X COORDINATE
1A	LOW X Y	1	1	Ø Y EXT. X EXT.
2	LOW ORDER X	Ø	1	5 LSB OF X COORDINATE
3	HIGH ORDER Y	Ø	1	5 MSB OF Y COORDINATE
4	LOW ORDER Y	Ø	1	5 LSB OF Y COORDINATE
BIT 7 IS ADDED TO EACH BYTE BY THE SERIAL INTERFACE. THE X AND Y EXTENSIONS ARE THE TWO LSB's OF 12 BIT X AND Y COORDINATES				

Table 5.4 - GIN ADDRESS FORMAT

Note that the GIN address coordinates are not sent in the same order as the Vector Address coordinates. Also note that the tag bits are different.

Table 5.4 shows the format used by the four ASCII characters that form the GIN address. The format used by the Status Byte is as follows:



5.2.2 GIN TRANSMISSION FORMAT (Cont'd):

BIT 2: ALPHA MODE. When this bit is one, it indicates that the GT-6ØØ is in Alpha Mode. When this bit is zero, it indicates that the GT-6ØØ is not in Alpha Mode.

BIT 3: VECTOR READY. When this bit is zero, it indicates that the GT-6ØØ is ready to accept another vector address. When this bit is one, it indicates that the GT-6ØØ is not ready to accept another vector address. This bit reflects the current XON/XOFF status.

In Alpha mode the GIN address is the address of the lower left corner of the alpha cursor. In Graph mode, Point Plot Mode, and Incremental Plot Mode the GIN address is the address of the last pen position.

5.2.3 THE BYPASS CONDITION:

Whenever an **ESC ENQ** is received or Crosshair Mode is entered, the GT-6ØØ goes into a bypass condition which restricts the commands that will be accepted to those used to initiate a GIN or terminate the bypass condition. The bypass condition is necessary to prevent the echoed GIN transmission from being interpreted as alphanumeric characters or graphics data that would produce an erroneous display. Once a GIN transmission has been completed, however, the bypass condition must be terminated to reenable normal operation. This can be accomplished by embedding a **CR** character within the conclusion of the GIN transmission, or by sending one of the following program commands after each GIN transmission: **BEL, CR, ESC ETB, ESC FF, LF, US, SI,** or **GS** vector address. Note that besides terminating the bypass condition, most of the above program commands have other effects on the display or operating mode. These effects must be considered when deciding how to terminate the bypass condition.

The attribute command described in section 5.3.13 can be used during system initialization to embed something other than the default **CR** character in the GIN transmission. If this is not done, the GT-6ØØ will automatically terminate the bypass condition and enter Alpha Mode at the conclusion of each GIN transmission.

In some cases it may be desirable to enter the bypass condition without sending a GIN transmission. This can be accomplished by sending the GT-6ØØ an **ESC CAN (CTRL X)** sequence.

5.2.4 EOT, END OF TRANSMISSION:

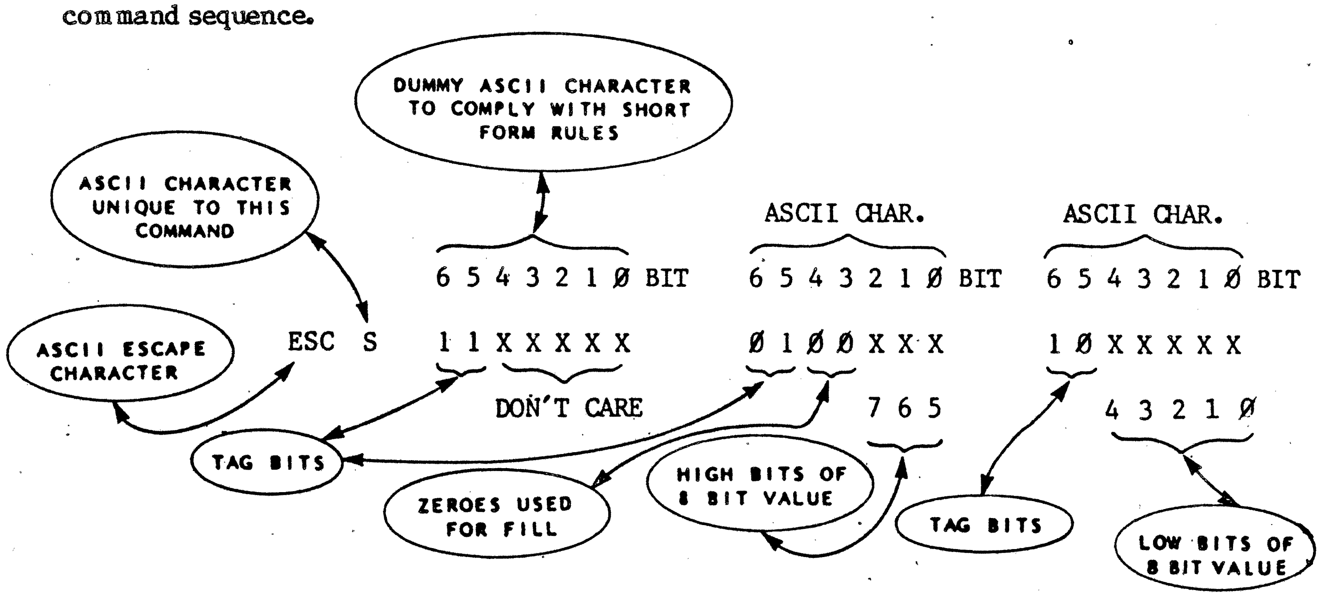
The VT-Terminals do not support half duplex serial lines; however, in order to be compatible with the Tektronix 4Ølx terminals the GT-6ØØ provides for an EOT character to be included at the end of the GIN transmission (see section 5.3.13).

5.3 ATTRIBUTE AND SPECIAL FUNCTIONS:

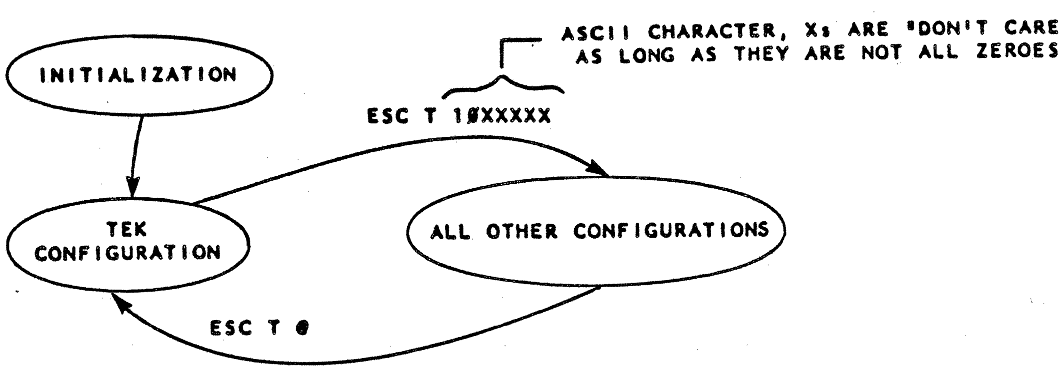
5.3.1 COMMAND FORMAT:

With the exception of draw arc and draw ellipse, escape sequences are used for all attribute and special function commands. First an **ESC** character is sent then an ASCII character unique to the command is sent, followed by the arguments. Arguments are contained within a group of up to five ASCII characters, using the same format used to send graphics position coordinates (see section 5.1.2). Each argument character has two tag bits followed by up to five bits of data; if all five bits are not required the remaining bits are sent as zeros. When an 8 bit value is sent as part of an argument, the three most significant bits (high bits) are sent in one character and the five least significant bits (low bits) are sent in the next character. It will be noted that where arguments are small requiring only one or two ASCII characters, dummy characters are sometimes added to the string to conform to the short form rules given in section 5.1.2

The following example shows the anatomy of a typical attribute or special function command sequence.



5.3.2 TEK CONFIGURATION (DEFAULT CONFIGURATION):



Upon initialization all of the GT-6ØØ's attributes and special functions are configured to emulate the Tektronix 4Ølx series graphics terminals. This emulator configuration,

5.3.2 TEK CONFIGURATION (DEFAULT CONFIGURATION) (Cont'd):

called the Tek Configuration can be exited by issuing an **ESC T A**, and it can be returned to at any time by sending a return command (**ESC T @**). If changes to attributes are attempted while in Tek Configuration, the changed parameters will be stored but will not take effect until the modification enable command is received.

The modification enabling command is as follows:

ESC T 1ØXXXXX

XXXXX — DON'T CARE, EXCEPT NOT ALL ZEROES

The return to Tek Configuration command is as follows: **ESC T @**. Any configuration that is in effect when the Tek Configuration is returned to, will be restored when the modification enable command is sent. The attribute and special function conditions used in the Tek Configuration are given in the default column of Table 5.1 on Page 5-1Ø.

GT-6ØØ Tek Configuration/Tek 4Ø14(6) Differences

In most ways the GT-6ØØ/VT-1ØØ(3) emulates the TekTronix 4Ø14/4Ø16 terminal, but there are certain differences that the user should be aware of so that application programs will give the expected results.

1) Character Size Commands: **ESC 8**, **ESC 9**, **ESC ;**, and **ESC :**, are accepted in order to be compatible with PLOT-1Ø, but they all set the character size to ONE. The GT-6ØØ will not support such tiny characters because the maximum display resolution available is 61Ø X 48Ø. The pen width, however, can be adjusted to a smaller size via a strap. See Section 6.Ø for details.

2) Incremental Plotting Commands: These are accepted as-is, but since the pixel increments in the GT-6ØØ are affected by the resolution the line width will appear greater than it would on a TekTronix terminal. The size in both axes will vary depending on the selected resolution.

5.3.3 DISPLAY FORMAT RESOLUTION:

The GT-6ØØ can generate three different display formats, and one of those formats has two bit planes that can be OR'd together or used to provide a two bit code for each pixel. When the latter option is selected, the VT-terminal automatically interprets the codes as greyscale information and displays them as such. If an external RGB-Monitor is used the two bits can be used to select different colors. OR'ing the two bit planes is an effective way of combining alphanumeric text and graphics figures. When this method is used, information on one bit plane can be erased or modified without affecting the other bit plane. Table 5.5 gives the different display format options and the escape sequences used to select them. Note that not all of the display memory is displayed. The size of the displayed area varies depending on the format.

Note that the 61Ø by 48Ø display format will require that the VT terminal be programmed for interlaced scan. Refer to your VT manual to find out how to set up your terminal in this way.

5.3.3 DISPLAY FORMAT RESOLUTION (Cont'd):

DISPLAY FORMAT		DISPLAY MEMORY FORMAT				
X-AXIS	Y-AXIS	X-AXIS	Y-AXIS	DEPTH	DISPLAY ASPECT	COMMAND
1219	24Ø	128Ø	24Ø	1	BLACK AND WHITE	ESC M @
61Ø	48Ø	64Ø	48Ø	1	BLACK AND WHITE	ESC M A
61Ø	24Ø	64Ø	24Ø	2	OR'D	ESC M B
61Ø	24Ø	64Ø	24Ø	2	GREY SCALE	ESC M C

Table 5.5 - RESOLUTION COMMANDS

Since the vertical and horizontal resolutions of the GT-6ØØ are not equal, displaying circles using the Ellipse function will appear to be expanded toward the vertical axis unless the aspect ratio (Section 5.3.16.1) is adjusted to take this into account. The following tables gives the command to be used for the selected resolution. Note that the semicolon and blank are for ease of reading only and are not to be entered as code:

DISPLAY RESOLUTION	COMMAND
1219 X 24Ø	ESC R; Sp; c; Sp; J
61Ø X 48Ø	ESC R; Sp; c; Sp; E
61Ø X 24Ø	ESC R; Sp; f; Sp; E

Note that the 61Ø x 48Ø display resolution requires an interlaced raster on a CRT with a long persistence phosphor. Since the standard CRTs on most of the VT-Terminals do not meet these requirements, an external monitor will likely be required if a flicker-free image is desired. See section 3.1 for details on use of an external monitor.

The default display resolution is 1219 x 24Ø. However if the resolution is changed, the new resolution will be kept when the GT-6ØØ is returned to its Tek Configuration (see 5.3.2)

5.3.4 SCALING:

The scaling attribute allows Plot-1Ø software to work with any of the three display format resolutions provided by the GT-6ØØ. When scaling is enabled, the GT-6ØØ looks like the 1Ø24 x 74Ø display used by the Tektronix 4Ø1x series terminals, and display addresses or distance parameters sent by the host computer are automatically scaled to be compatible with the current display format resolution whether it be 1219 x 24Ø, 61Ø x 48Ø, or 61Ø x 24Ø. When scaling is not enabled, the user must assure that display addresses and distance parameters correspond to the current display format.

Figure 5.5 shows how the TEK 1Ø24 x 74Ø format is scaled to each of the GT-6ØØ's formats. Note that the TEK format is not scaled into all of the display memory and that the area into which it is scaled, is not completely displayed. The non-displayed area can, however, be moved into the display window by using the pan function (section 5.3.7). Figure 5.5 shows an ellipsoid drawn on the display memory. The shaded portion represents the part of the ellipsoid that is displayed. Note that point Ø, Ø is in the lower left corner.

5.3.4 SCALING: (Cont'd)

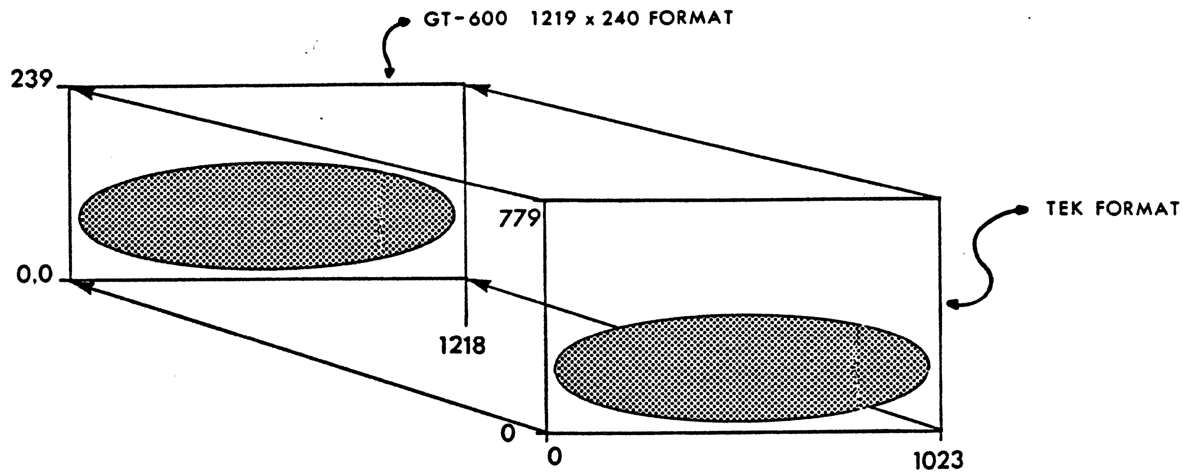


FIGURE 5.5A SCALING TO 1219x24Ø FORMAT

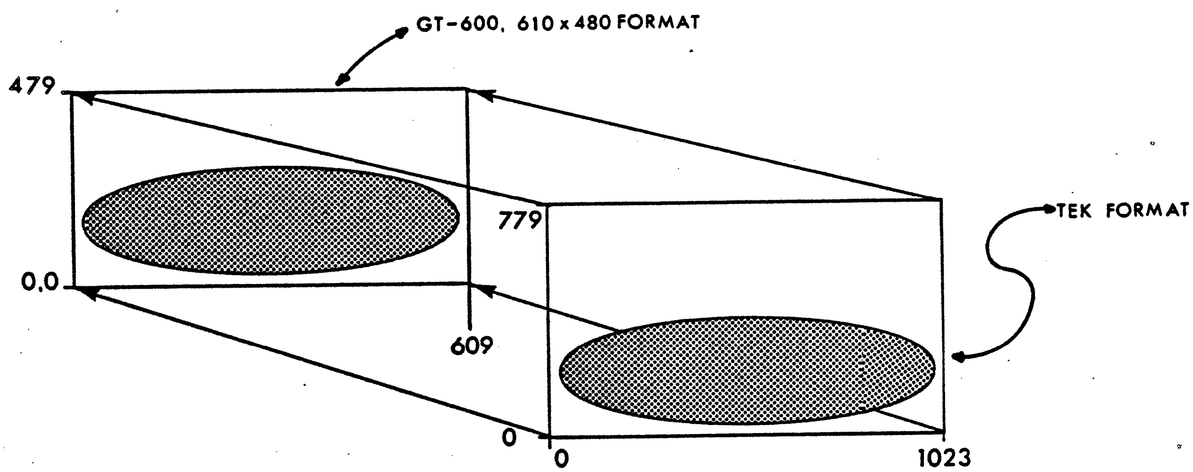


FIGURE 5.5B SCALING TO 61Øx48Ø FORMAT

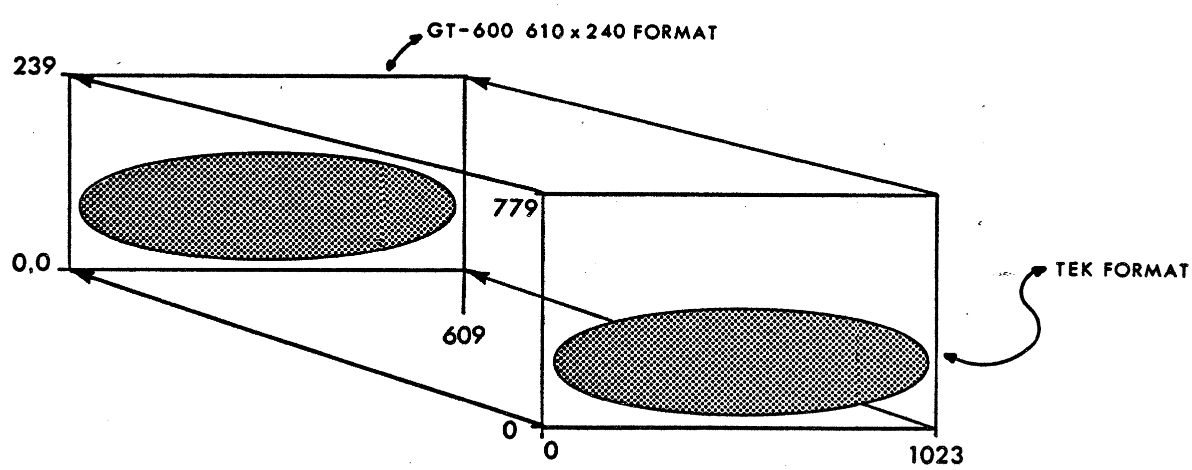


FIGURE 5.5C SCALING TO 61Øx24Ø FORMAT

5.3.4 SCALING: (Cont'd)

To enable scaling send **ESC U @.** To disable scaling send **ESC U A.** The default condition is scaling on.

5.3.5 PEN SIZE:

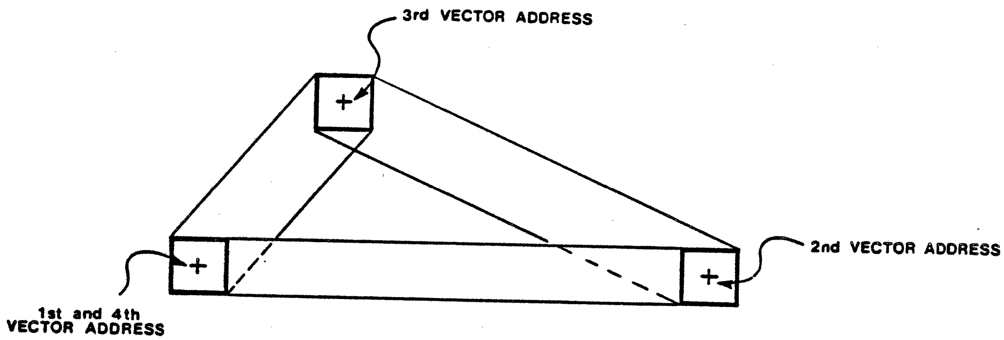


Figure 5.6 - PEN SIZE Vs LINE WIDTH

The pen point is an imaginary rectangle that determines the width of lines in the display in the same way that a real pen nib or paint brush determines the width of lines on a piece of paper. Figure 5.6 illustrates this by showing a triangle made with three vectors. Note that since the pen point is rectangular, line width varies with the vector angle.

Since alphanumeric characters are defined in pen points (see section 5.3.14) the pen point size has a direct effect on character size. This attribute can be used to vary character size from 5 pixels by 7 pixels up to sizes that fill the entire screen.

The shape and size of the graphics pen's point can be set by a two command sequence. One command sets the pens aspect ratio, the other sets the size. The aspect ratio is the ratio of the pen Y-axis dimension over the pen X-axis dimension where one of the two values must be one. It is set by sending a command in the following format:

ESC W Ø1ØØXXX 11XXXXX Ø1ØØXXX 1ØXXXXX

- Ø1ØØXXX — HIGH Y BITS
- 11XXXXX — LOW Y BITS
- Ø1ØØXXX — HIGH X BITS
- 1ØXXXXX — LOW X BITS

5.3.5 PEN SIZE (Cont'd):

The X and Y values of the aspect ratio are converted to 8 bit binary numbers that are inserted into the command argument in the positions labeled X bits and Y bits respectively.

The pen size is changed by sending a command in the following format:

```
ESC S   11XXXXX  0100XXX  10XXXXX
          |         |        |
          |         |        |_______LOW SIZE MULTIPLIER BITS
          |         |________________HIGH SIZE MULTIPLIER BITS
          |__________________________DON'T CARE
```

The 8 bit value that is sent in the positions labeled SIZE MULTIPLIER will be multiplied by the X and the Y values sent in the aspect ratio command, to determine the actual dimensions, in pixels, of the pen.

For example, if a pen with dimensions of 3 X-axis pixels by 9 Y-axis pixels was required, the following two commands would be sent: **ESC W SP c SP A** (Aspect ratio set as 3/1) **ESC S ` SP C** (Multiplier is set to 3).

To return to the default pen size in non-Tek mode, issue **ESC T B.**

The Tek Configuration uses a pen with dimension of 1 X-axis pixel by 1 Y-axis pixel.

5.3.6 LINE FORMAT:

Graphics lines can be selected as solid or dashed, and the user can set the dash and interval lengths himself or he can choose one of several predetermined line formats as set out in table 5.6. Note that the predetermined line formats and the commands used to select them are in most respects compatible with those used by the Tektronix 4Ø16 terminals. The defocussed and write-thru versions provided by Tektronix, however, are not provided by us, although the Tektronix defocused and write-through line format commands will work with our normal line formats. Tektronix also provides a dot-dash line format that we have not implemented. Instead we have substituted a short space dashed line.

5.3.6 LINE FORMAT (Cont'd):

NAME	SAMPLE	ON PERIOD	OFF PERIOD	COMMANDS
DOTTED	------	4 PEN POINTS	5 PEN POINTS	ESC a ESC i ESC q
SHORT SPACE DASHED	- - - - - -	5 PEN POINTS	1Ø PEN POINTS	ESC b ESC j ESC r
SHORT DASHED	— — — —	1Ø PEN POINTS	5 PEN POINTS	ESC c ESC k ESC s
LONG DASHED	—— ——	2Ø PEN POINTS	5 PEN POINTS	ESC d ESC l ESC t
SOLID	————			ESC ` ESC e ESC f ESC g ESC h ESC m ESC n ESC o ESC p ESC u ESC v ESC w

Table 5.6 - PREDETERMINE DASHED LINE FORMAT

If the line formats in table 5.6 will not fill the user's requirements he can set the on and off times himself. The off and on times can be up to 255 pixels in length and are set by two unsigned 8 bit binary values that are contained within the command as shown on the following page:

5.3.6 LINE FORMAT (Cont'd):

ESC D Ø1ØØØXXX 11XXXXX Ø1ØØXXX 1ØXXXXX

- LOW OFF BITS
- HIGH OFF BITS
- LOW ON BITS
- HIGH ON BITS

If the dashes were to be 1Ø pixels long and intervals were to be 5 pixel long the command would be sent as follows: **ESC D SP j SP E.**

5.3.7 HORIZONTAL IMAGE SHIFT (PAN):

The GT-6ØØ provides a command which allows the text or graphics image to be shifted left or right across the display CRT. Each time the command is sent, the image will be shifted to the left or the right by the number of pixels set out in the command argument. Panning the image is accomplished by repeatedly sending the command, which has the following format:

ESC P Ø1XXXXX 11XXXXX Ø1XXXXX 1ØXXXXX

- LOW SHIFT RIGHT BITS
- HIGH SHIFT RIGHT BITS
- LOW SHIFT LEFT BITS
- HIGH SHIFT LEFT BITS

If a shift to the left is required, the 1Ø bit binary value of the shift, defined in pixels, is sent in the argument positions labeled shift left bits and zeros are sent in the positions labeled shift right bits. If a shift to the right is required, the shift value is sent in the positions labeled shift right bits and the value sent in shift left bits is "Don't Care". If a shift of 1Ø pixels to the right was required the command would be as follows: **ESC P SP ` SP J.** When the scaling attribute is active, shift values are interpreted as being for a 1Ø24 x 74Ø format and are scaled to the GT-6ØØ resolution format that is currently in use. Note that the GT-6ØØ can be returned to its starting position from any pan by simply issuing a 'PAN Ø Pixels' command: **ESC P SP ` SP @.**

5.3.7 HORIZONTAL IMAGE SHIFT (PAN) (Cont'd):

Note: The configuration of the bit planes in the GT6ØØ has a direct effect on the minimum number of pixels that can be panned. The following list indicates the minimum pixel value for each display memory format shown.

128Ø x 24Ø - 2 Pixels

64Ø x 48Ø - 1 Pixel

64Ø x 24Ø x 2 - 1 Pixel

5.3.8 VERTICAL IMAGE SHIFT (SCROLL):

The vertical image shift command is similar to the horizontal image shift command and provides for vertical scrolling of the image on the CRT. The number of pixels in each shift is set out in the command argument as follows:

```
ESC Q   Ø1XXXXX  11XXXXX  Ø1XXXXX  1ØXXXXX
           |        |        |        |
           |        |        |        +------- LOW SHIFT DOWN BITS
           |        |        +---------------- HIGH SHIFT DOWN BITS
           |        +------------------------- LOW SHIFT UP BITS
           +---------------------------------- HIGH SHIFT UP BITS
```

If the image is to be shifted down, the 1Ø bit binary shift value, in pixels, is sent in the positions labeled Shift Down Bits and zeroes are sent in the positions labled Shift Up Bits. If the image is to be shifted up, the value of the shift is sent in positions labeled Shift Up Bits and any value can be sent in the positions labeled Shift Down Bits. When the scaling attribute is active, the shift values are assumed to be for a 1Ø24 x 74Ø display format and are scaled to the particular format that the GT-6ØØ is currently using. Note that the GT-6ØØ can be returned to its starting position from any scroll by simply issuing a 'scroll Ø pixels' command: **ESC Q SP ` SP @.**

Note: The configuration of the bit planes in the GT-6ØØ has a direct effect on the minimum number of pixels that can be scrolled. The following list indicates the minimum pixel value for each display memory format shown.

128Ø x 24Ø - 1 Pixel

64Ø x 48Ø - 2 Pixels

64Ø x 24Ø x 2 - 1 Pixel

5.3.9 ZOOM:

The GT-600 has a zoom function which allows a section of the display image (the Zoom Window) to be expanded to replace the image it was taken from. The Zoom Window can be expanded by independent X and Y axis zoom factors of 2 through 8, and there is also a default zoom factor of 1. The size of the Zoom Window depends on the zoom factor and the resolution format in use, and can be calculated as follows:

$$\text{ZOOM WINDOW} = \frac{\text{X AXIS OF DISPLAY FORMAT}}{\text{X ZOOM FACTOR}} \text{ By } \frac{\text{Y AXIS OF DISPLAY FORMAT}}{\text{Y ZOOM FACTOR}}$$

It should be noted, however, that if the X and Y zoom factors are different, the image will be distorted during the zoom: this fact can be put to good use in some situations; however, in most cases the user will want to use non-distorting zooms, and can refer to table 5.7 for the appropriate Zoom Window sizes.

Note: Due to the configuration of the Display memory; all zooms should be performed with a vertical display resolution of 240. Any other vertical resolution selected may result in unexpected results during a zoom.

	ZOOM FACTOR (X AND Y AXIS)						
RESOLUTION	2	3	4	5	6	7	8
1219 X 240	610 X 120	406 X 80	305 X 60	244 X 48	203 X 40	174 X 34	152 X 30
610 X 240	305 X 120	203 X 80	152 X 60	122 X 48	102 X 40	87 X 34	76 X 30

Table 5.7 - ZOOM WINDOW SIZES FOR NON-DISTORTING ZOOMS

5.3.9 ZOOM (Cont'd):

The Zoom Window is always located in the upper left hand corner of the screen, and as a result, the horizontal and vertical shift functions must be used to position the area of interest in that corner before the actual zoom is made. Zoom factors corresponding to a Zoom Window size that will contain the area of interest are then selected and the zoom is made by sending a command in the following formats:

```
ESC Z   11ØXXXX  1ØØXXXX
            |        |
            |        |________4 BIT BINARY VALUE OF X ZOOM
            |_________________4 BIT BINARY VALUE OF Y ZOOM
```

For example, a zoom of 4 on the X axis and 5 on the Y axis would be made by sending the following command: **ESC Z e D.** Note that during a zoom an erase command will erase only that area that is currently being displayed.

5.3.1Ø BIT PLANE SELECT

The GT-6ØØ has a command which determines whether the pen writes ones or zeros to the display memory and provides for writing or erasing different data on the separate bit planes when the two bit plane configuration is used. This is necessary, since the two bits per pixel in the two bit configuration can be decoded to produce grey scale or OR'd images. The command format is as follows:

ESC F 10000XX

PEN	BIT PLANE Ø	Ø	1	Ø	1
LOGIC	BIT PLANE 1	Ø	Ø	1	1
ASCII CHARACTER		@	A	B	C

All display data following an **ESC F A**, for example, would be written into only bit plane Ø and all display data following an **ESC F B** would be written into only bit plane 1.

5.3.11 ERASE

The erase command allows the display to be preset to zero. If The two bit plane configuration is in use, each bit plane can be individually preset. The command format is as follows:

ESC E 1ØØØØXX

PRESET BIT PLANE	Ø	1	Ø & 1
ASCII CHARACTER	A	B	C

To erase bit plane Ø, for example, send **ESC E A.**

5.3.12 DISABLE VIDEO:

The GT-6ØØ has a video output for each of the two possible bit planes. These video outputs can be selectively disabled by using the following command format:

ESC V 1ØØØØXX

VIDEO OUTPUT # Ø	ENABLED	DISABLED	ENABLED	DISABLED
VIDEO OUTPUT # 1	ENABLED	ENABLED	DISABLED	DISABLED
ASCII CHARACTER	@	A	B	C

For example, to enable both video outputs the following command would be sent: **ESC V @.** Note that when only one bit plane is used, it is video output Ø that is active. The Tek Configuration (default configuration) enables video output Ø and disables video output 1.

5.3.13 STATUS TERMINATION:

The GT-6ØØ has a command which allows the GIN transmission to the host computer (see section 5.2) to be terminated with nothing, a carriage return character, or a carriage return followed by a end of transmission (EOT) character. On the 4Ølx series terminals a similar function is provided by a hardware switch. The command format is as follows:

ESC [1ØØØØXX

	NO TERM.	CR	CR EOT
ASCII CHAR.	@	A	B

5.3.13 STATUS TERMINATION (Cont'd):

For example, if no extra termination was required the following command would be sent: **ESC [@.** The default termination is one carriage return (CR).

5.3.14 CHARACTER OFFSET:

When the GT-6ØØ is in Alpha mode (see section 5.1.1) alphanumeric characters can be written as part of the graphic display. These characters are formed in a 5 pen points by 7 pen point matrix and are contained in character cells 8 pen points by 8 pen points (see figure 5.7).

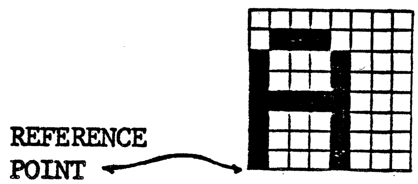
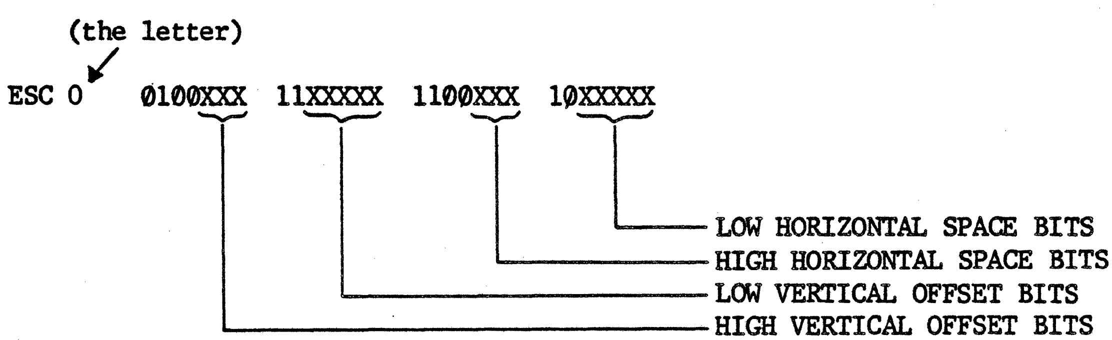


Figure 5.8 - CHARACTER CELL WITH CHARACTER

The GT-6ØØ has a command which allows the spacing and vertical offset of characters in the same row of text to be adjusted. The vertical offset portion of the command facilitates the use of inclined text as illustrated in the following example:

UP UP UP DOWN DOWN DOWN

The horizontal spacing between character cells can be anything from + 127 to -128 pen points and vertical offset can be anything from +127 to -128 pen points. The reference point is the lower left pen point in the character cell as indicated in figure 5.6. Note that negative spacing allows text to be written from right to left and allows overstrike characters.



The number of pen points required horizontally between characters is sent in twos complement form in the positions labeled Horizontal Space Bits. The size of the vertical offset, in pen points between adjacent characters, is sent in twos complement form in the positions labeled Vertical Offset Bits.

.3.14 CHARACTER OFFSET (Cont'd):

If a horizontal space of 3 pen points between character cells (6 between characters) was required and a vertical offset of plus 2 pen points was required, the following command would be sent: **ESC 0 ? ~ SP C.** The default spacing is zero (3 pen points between characters) and the default vertical offset is also zero.

5.3.15 INCREMENTAL PLOT BASE DIRECTION

The base direction for the Incremental Plot Mode can be set in 4 different attitudes with respect to the screen. North can be the top of the screen, the right of the screen, the bottom of the screen, or the left of the screen. Although the process is invisible to the user, the alphanumeric characters used in Alpha Mode are actually drawn in Incremental Plot Mode. As a result, this command can be used to set the attitude of characters as shown below.

ESC B 1ØØØXXX

CHAR. ATTITUDE	A	◁	∀	▷
ASCII	@	B	D	F

If a line of upside down characters was to be written, for example, that line would be preceded by the following command: **ESC B D.**

5.3.16 ARCS AND ELLIPSES:

The GT-6ØØ responds to three commands which can be used to draw arcs and ellipses with various sizes and aspect ratios. There is a command to draw an arc of a specific size, there is a command to draw an ellipse of a specific size, and there is a command to set the aspect ratio for both arcs and ellipses.

Note that a change in resolution will also change the apparent aspect ratio. For details on this, refer to section 5.3.3

5.3.16.1 ASPECT RATIO:

The arc and ellipse aspect ratio is the ratio of the arc or ellipses Y axis dimension over its X axis dimension. The Y axis dimension is referred to here as B and the X axis dimension is referred to here as A - thus the aspect ratio is B/A. The following command format is used to set the aspect ratio:

ESC R Ø1ØØXXX 11XXXXX Ø1ØØXXX 1ØXXXXX

- 1ØXXXXX — A LOW BITS
- Ø1ØØXXX (second) — A HIGH BITS
- 11XXXXX — B LOW BITS
- Ø1ØØXXX (first) — B HIGH BITS

The 8 bit binary value of B is sent in the positions labeled B Bits and the 8 bit binary value of A is sent in the positions labeled A Bits. There is a constraint that neither A nor B can be equal to zero. The defaulted value is 1:1.

Once the aspect ratio command is sent, that aspect ratio is good for all arcs and ellipses that are drawn until a new aspect ratio is set.

5.3.16.2 DRAW ELLIPSE:

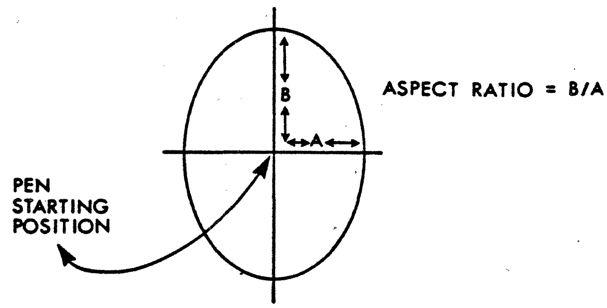


Figure 5.8 - ELLIPSE

The following command format is used to draw an ellipse:

```
EM   Ø1XXXXX   11XXXXX   1ØXXXXX      (EM = (ctrl Y))

     Ø1XXXXX  - HIGH SIZE BITS
     11XXXXX  - LOW SIZE BITS
     1ØXXXXX  - DON'T CARE
```

The 1Ø bit binary value that is sent in the positions labeled Size Bits, is the ellipse's Y dimension in pixels. The pen position at the time the command is sent will be the center point of the completed ellipse.

If an ellipse, 3ØØ X-axis pixels by 2ØØ Y-axis pixels, was to be drawn centered on a specific coordinate, a non-displayed vector would be made to that coordinate, then the following two commands would be sent: **ESC R SP b SP C** (aspect ratio set B/A = 2/3) **CTRL Y & h @** (draws ellipse with Y size of 2ØØ).

Note: Arcs and ellipses can not be drawn in Alpha Mode.

5.3.16.3 DRAW ARC:

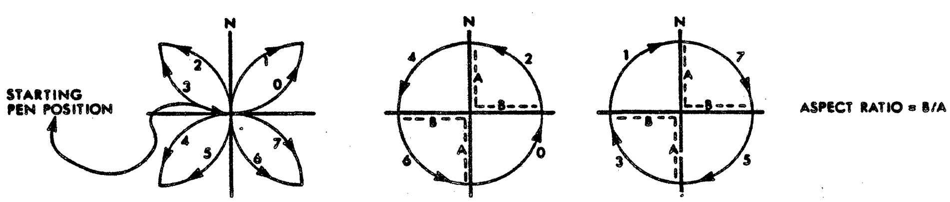
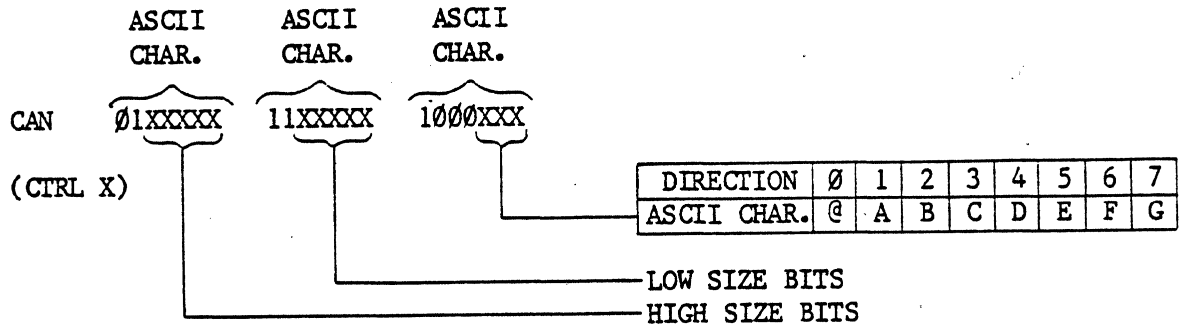


Figure 5.9 - ARC DIRECTION AND ASPECT RATIO

When a draw arc command is sent, 9Ø° of an arc is drawn starting at the current pen position. The direction and size of the arc are determined by the command argument. The aspect ratio of the arc is set by the separate aspect ratio command explained in subsection 5.3.16.1. Figure 5.9 shows how arc direction is coded. The command format is as follows:

'.3.16.3 DRAW ARC(Cont'd)



DIRECTION	Ø	1	2	3	4	5	6	7
ASCII CHAR.	@	A	B	C	D	E	F	G

The 1Ø bit binary value sent in the positions labelled Size Bits, is the arc's Y-axis dimension in pixels. The direction the arc is drawn in, is set by the three direction bits.

If an arc with an X-axis of 5Ø pixels and a Y-axis of 8Ø pixels was required to be drawn from the current pen position, moving right and turning down, the following two commands would be sent: **ESC R SP** e **SP** H (set aspect ratio B/A = 5/8), **CTRL X " p G** (set size, set direction, perform draw). Note that if a series of arcs or ellipses use the same aspect ratio, it need only be set once for the whole series.

5.3.17 DATA LEVEL:

Data can be entered in all modes except Alpha mode in one of three ways, selected by the following sequence:

ESC / n d Where n = Ø dots turned on (default)
1 dots turned off
2 dots complemented

For Example:

Entering **ESC; /; Ø; d** and then drawing a vector will cause the vector to be displayed on the screen as a white line. If the line being plotted passes through another line, the point of intersection will be written to in a normal fashion.

Entering **ESC; /; 1; d** and then drawing a vector will cause the line to be plotted but not displayed. If the line being plotted passes through a line already displayed, the point of intersection will be erased from the screen. Hence, to erase an image from the screen, simply redraw it after entering **ESC; /; 1; d.**

Entering **ESC; /; 2; d** and then drawing a vector will cause the plotted line to be displayed in the same way as with **ESC; /; Ø; d.** The difference is, however, that any intersecting displayed lines will be unplotted (erased) at the point of intersection as with **ESC; /; 1; d.**

The following final points should be noted about the above commands:

1) **ESC / Ø d** is equivalent to **ESC F C.**
2) **ESC / 1 d** is equivalent to **ESC F @.**
3) **ESC / 2 d** should be used only with the default pen size of 1 X-axis pixel by 1 Y-axis pixel.
4) The above commands remain active until changed by entering another **ESC / n d** sequence.

5.3.18 PRINTER CONTROLS:

The following commands will cause hard copy to be made on a printer. To install a dot matrix printer on your graphics system, see Section 3.2.

ESC CTRL W: The TEK copy command. Sends the entire GT-6ØØ display file to the printer. Once initiated, it cannot be stopped until the copy is complete. The display file is unaltered by **ESC CTRL W**, and it cannot be altered until the copy is finished.

ESC 3: The Echo-Print command. When the graphics system is in Transparent Mode, this command will print everything that appears on the screen, as it is entered. Repeatedly entering **ESC 3** will toggle this function on and off.

When not in Transparent Mode, this command operates in exactly the same way as **ESC CTRL W.**

* * * * *

6.Ø STRAPS:

The STP board has a series of numbered wire wrap pins which are strapped together in different ways to implement various serial interface formats as shown below:

PARITY ENABLED	46-45 IN, 46-47 OUT
PARITY DISABLED	46-45 OUT, 46-47 IN (AS-SHIPPED)
EVEN PARITY	26-25 IN, 26-27 OUT
ODD PARITY	26-25 OUT, 26-27 IN (AS-SHIPPED)
8 BIT WORD	14-13 IN, 14-15 OUT (AS SHIPPED)
7 BIT WORD	14-13 OUT, 14-15 IN
1 STOP BIT	2Ø-21 IN, 2Ø-19 OUT
2 STOP BITS	2Ø-21 OUT, 2Ø-19 IN (AS-SHIPPED)

The following straps are on the GT-6ØØ board, and can be located by referring to the schematic sheets in the back of this manual. Note: In the list below, <CR> means **carriage return,** and <LF> means **line feed.**

BIT PLANE #1 OUTPUT BIT PLANE #2 OUTPUT	17-16 IN (AS-SHIPPED) (JUMPERED, NOT WIRE-WRAPPED) 19-18 IN (AS-SHIPPED)
<CR> with auto <LF>	4-5 OUT, 5-6 IN.
<CR> without <LF>	4-5 IN, 5-6 OUT. (AS-SHIPPED)
RESERVED	8-7 OUT, 8-9 IN (AS-SHIPPED)
RESERVED	11-1Ø IN, 11-12 OUT (AS-SHIPPED)
TEK PEN WIDTH 1	13-14 OUT, 14-15 IN (152 CHAR/LINE).
TEK PEN WIDTH 2	13-14 IN, 14-15 OUT (76 CHAR/LINE) (AS-SHIPPED).

* * * * *

.Ø CONNECTORS:

7.1 GT-6ØØ SLOT CONNECTOR (P1):

This is an 18 pin edge connector which connects the GT-6ØØ to the backplane. It provides GT-6ØØ with power, vertical drive, and horizontal drive.

PIN	SIGNAL	PIN	SIGNAL
1	V DRIVE L (INPUT)	2	H DRIVE H (INPUT)
3	+12V	4	GND
5	-12V	6	NOT CONNECTED
7	NOT CONNECTED	8	NOT CONNECTED
9	GND	1Ø	GND
11	GND	12	GND
13	GND	14	+5V
15	+5V	16	+5V
17	+5V	18	+5V

TABLE 7-1 P1 PIN-OUT

7.2 PRINTER INTERFACE (J3):

PIN	FUNCTION	PIN	FUNCTION
1	DATA STR/	2–	
3	DØ	4	
5	D1	6	
7	D2	8	
9	D3	1Ø	
11	D4	12	GND.
13	D5	14	
15	D6	16	
17	D7	18	
19	N.C.	2Ø	
21	BUSY (INPUT)	22	
23	N.C.	24–	
25	N.C.	26	N.C.

TABLE 7.2 - PRINTER INTERFACE.

7.3 GRAPHICS CONNECTOR (S115):

S115 is an 18 pin DIP socket which is connected by a ribbon cable to the STP board's graphics connector (S1).

PIN	SIGNAL	PIN	SIGNAL
1	DOØ7H	1Ø	HSCKH
2	DOØ6H	11	GRAPHICS FLAG L (OUTPUT)
3	DOØ5H	12	GRAPHIC 2 IN (OUTPUT)
4	DOØ4H	13	INIT H
5	DOØ3H	14	HORIZ BLANK
6	DOØ2H	15	GRAPHICS WRL
7	DOØ1H	16	VERT BLANK L
8	DOØØH	17	GRAPHIC 1 IN (OUTPUT)
9	GND	18	GND

TABLE 7-3. S115 PIN-OUT

7.4 DATA CONNECTOR (S117)

S117 is a 2Ø pin DIP socket which is connected to S4 on the STP board. It connects the GT-6ØØ into the serial interface used between the VT terminal and the host computer, and also serves as the graphics input from the bit pad.

PIN	SIGNAL	PIN	SIGNAL
1	Bus Data 1	11	GND
2	Bus Data 3	12	GND
3	Bus Data 5	13	CPU Interrupt
4	Bus Data 7	14	WR/
5	Bus Address Ø	15	STP CS/
6	Bus Address 4	16	Bus Address 3
7	RD/	17	Bus Data 6
8	CLK	18	Bus Data 4
9	GND	19	Bus DAta 2
1Ø	GND	2Ø	Bus Data Ø

TABLE 7.4. S117 PIN-OUT

7.5 VIDEO CONNECTORS (J1, J2):

J1 and J2 are two female BNC connectors which allow the GT-6ØØ to provide a composite video signal for use by an external monitor. The video output of the VT-1ØØ is fed into the GT-6ØØ via J1. The sync signals are stripped off this signal and mixed with the GT-6ØØ's TTL video to provide a composite video signal at J2. These connectors are not installed when the board is shipped because they interfere with the closing of the VT terminals' rear cover. If they are required follow the procedure in section 3.1.

J1: VT-1ØØ VIDEO IN.

J2: GT-6ØØ VIDEO OUT.

.6 STP BOARD CONNECTORS:

7.6.1 STP CONNECTOR (P1):

P1 is a 4Ø pin edge connector that is inserted into the terminal controller board's STP Connector.

PIN	SIGNAL	PIN	SIGNAL
1	TXD/ (A1Ø)	21, 22	
2	RXD/ (A1Ø)		
3, 4		23, 24	
5	RXD/ (A11)	25, 26	-12V
6	TXD/ (A11)		
7, 8		27, 28	TXC, RXC (A1Ø)
9, 1Ø		29, 3Ø	TXC, RXC (A11)
11, 12		31, 32	+12V
13, 14		33, 34	GND
15, 16		35, 36	
17, 18		37, 38	RESET ALL USARTS
19, 2Ø		39, 4Ø	+5V

TABLE 7.5 - P1 PIN OUT.

7.6.2 DATA CONNECTOR TO GT-6ØØ (S1):

S1 is a 2Ø-pin DIP socket that interconnects with S115 on the GT-6ØØ PCB.

PIN	SIGNAL	PIN	SIGNAL
1	DOØ7H	1Ø	HSCKH
2	DOØ6H	11	GRAPHICS FLAG L (OUTPUT)
3	DOØ5H	12	GRAPHIC 2 IN (OUTPUT)
4	DOØ4H	13	INIT H
5	DOØ3H	14	HORIZ BLANK
6	DOØ2H	15	GRAPHICS WRL
7	DOØ1H	16	VERT BLANK L
8	DOØØH	17	GRAPHIC 1 IN (OUTPUT)
9	GND	18	GND

TABLE 7.6-S1 PIN OUT.

7.6.3 CONNECTOR TO TERMINAL CONTROLLER BOARD (S2):

S2 is an 18-pin D.I.P. socket that transfers parallel data between the VT board (J2) and the GT-6ØØ.

PIN	SIGNAL	PIN	SIGNAL
1	DATA 7	1Ø	HSCLKH
2	DATA 6	11	GRAPHICS FLAG L
3	DATA 5	12	GRAPHIC 2 IN
4	DATA 4	13	INIT H
5	DATA 3	14	HORIZONTAL BLANKING
6	DATA 2	15	GRAPHICS WRITE/
7	DATA 1	16	VERTICAL BLANKING
8	DATA Ø	17	GRAPHIC 1 IN
9	GND	18	GND

TABLE 7.7 - S2 PINOUT

7.6.4 USART CONNECTOR (S4):

S4 is a 2Ø-pin DIP socket which connects to S117 on the GT-6ØØ board. It gives the GT-6ØØ access to the USARTs which are linked into the VT-Host Computer serial lines.

PIN	SIGNAL	PIN	SIGNAL
1	Bus Data 1	11	GND
2	Bus Data 3	12	GND
3	Bus Data 5	13	CPU Interrupt
4	Bus Data 7	14	WR/
5	Bus Address Ø	15	STP CS/
6	Bus Address 4	16	Bus Address 3
7	RD/	17	Bus Data 6
8	CLK	18	Bus Data 4
9	GND	19	Bus DAta 2
1Ø	GND	2Ø	Bus Data Ø

TABLE 7.8 - S4 PINOUT

The following chart lists the USARTS on the STP board, and describes their functions. The USARTS are located on the schematic of the STP board in the back of this book, and are listed from left to right.

USART A1Ø (AM 8251)
Serial Communication Interface
USART A11 (AM 8251)

8.Ø CIRCUIT DESCRIPTION:

The block diagram in figure 8-1 gives a general view of the entire GT-6ØØ circuit. Note that it is essentially a video controller managed by a on-board CPU which runs a ROM resident monitor program. The video image is stored in a dual port display memory which is accessed directly by the CPU or by refresh circuits which scan through it, refreshing the image on the CRT. Other circuits, controlled by the CPU, effect operation of the refresh circuits and the timing generator to produce the scroll, pan and zoom functions. Note that all data is sent and received to and from the host computer and the VT terminal in serial fomat via the two USARTs on the STP board.

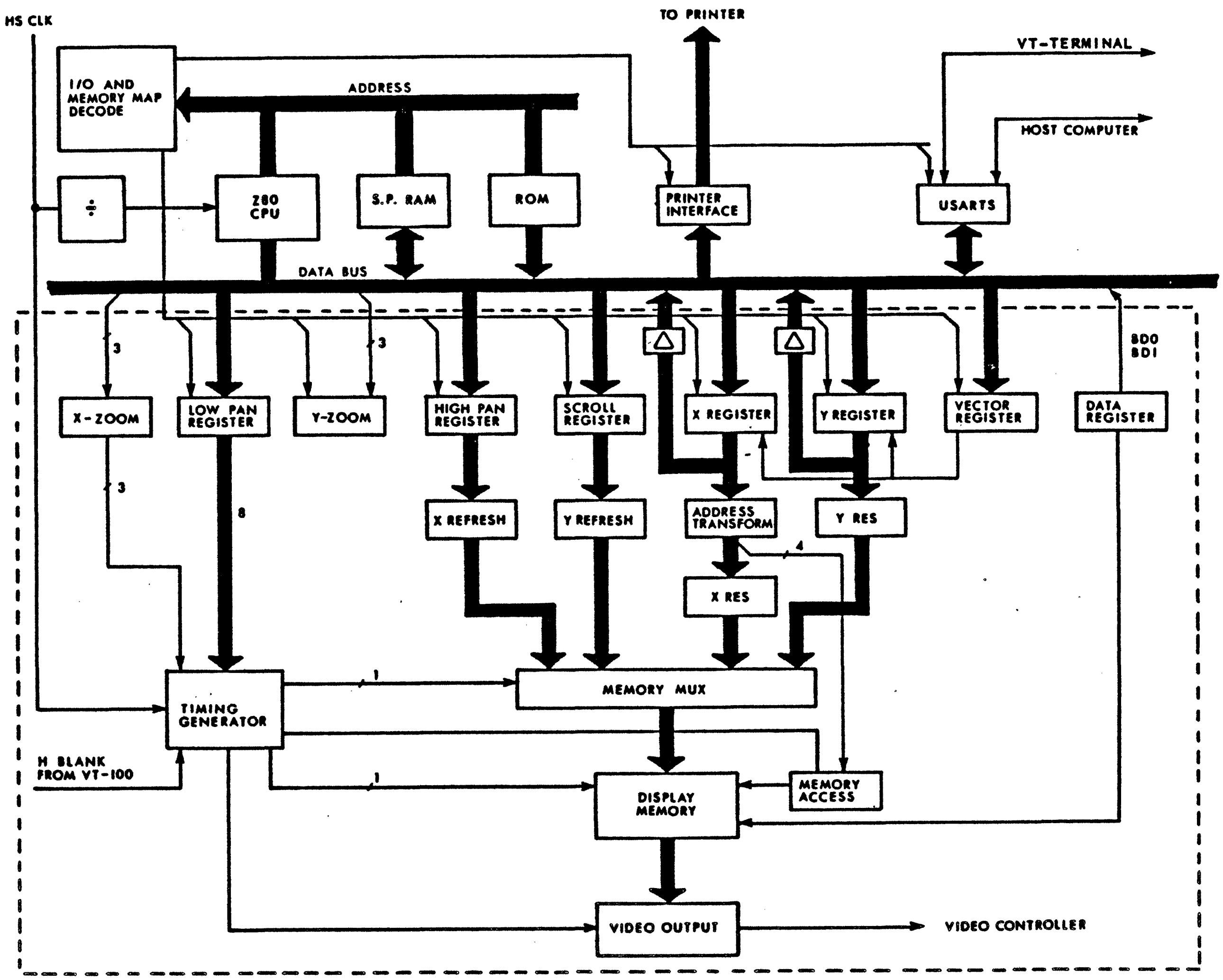


FIGURE 8-1. GT-6ØØ BLOCK DIAGRAM

The GT-6ØØ's microcomputer is fairly simple and there should be no problem understanding its operation. The video controller is, however, more complicated and subsections 8.1 through 8.6 go into its operation in more detail. Gates in I.C.s containing more than one gate are identified by their output pin. For example, A25-5 would refer to the gate in A25 that has its output at pin 5 of that chip. While reading this circuit description, the reader is invited to refer to the schematics in Appendix D and the list of internal registers in Appendix B.

8.1 TIMING:

Figure 8.2 contains a simplified block diagram of the GT-6ØØ's principal timing section. It uses the 24.Ø734 MHz HS-CLK from the VT terminal (VT-1ØØ or VT-1Ø3) to produce various timing signals including the Dot Clk, BCLE/ and diverse strobes for the Display Memory. It also implements the X-zoom function, the low pan function, and controls the CPU's wait line.

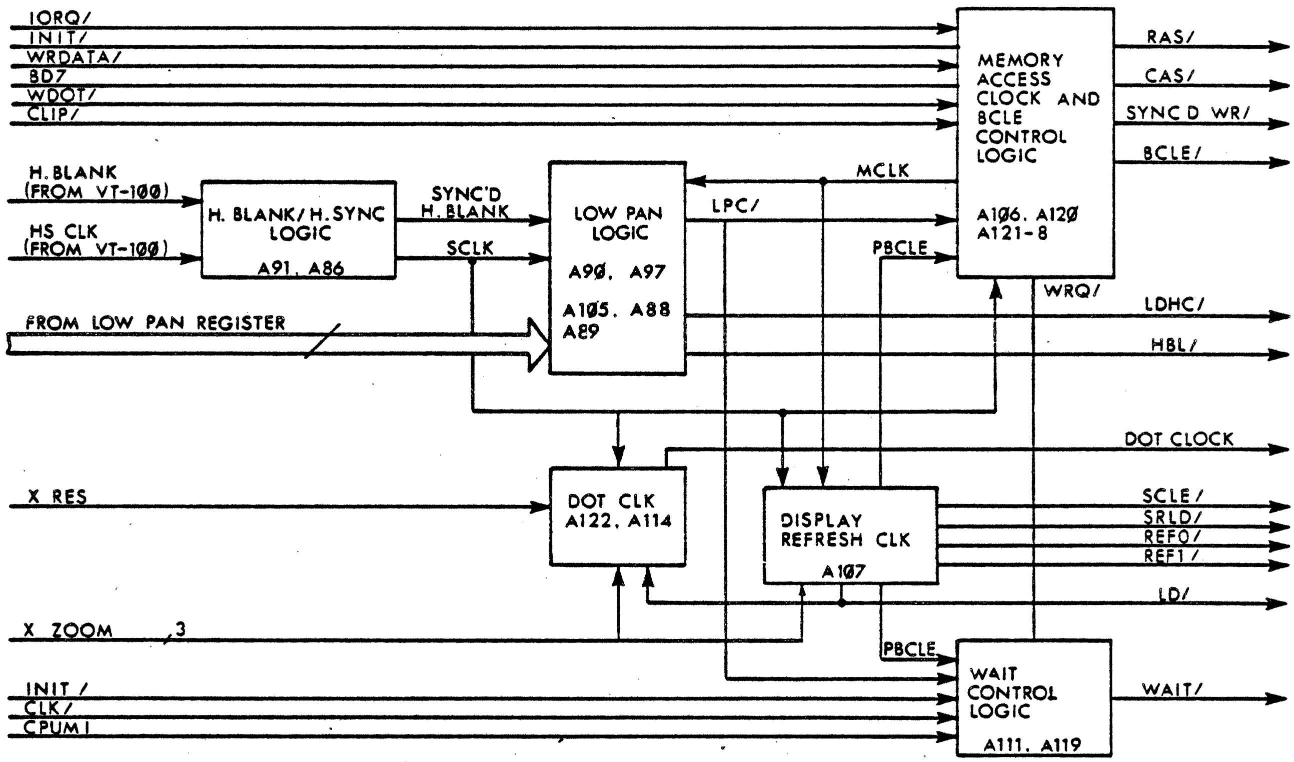


Figure 8.2 - THE MAIN TIMING SECTION

The basic timing signal within the main timing section is the SCLK, which is derived in the H. Blank/HSCLK Logic (figure 8.2) by dividing the HSCLK in half and synchronizing the result with the horizontal blanking pulse. The SCLK is used to clock the Low Pan Logic, the Dot Clock, the Display Refresh Clock, and the Memory Access Clock.

The primary function of the Dot Clock is to strobe out individual pixels of video data to the display. The frequency of the Dot Clock is controlled by bits BDØ-BD2 from the Zoom Register (X-zoom) and by the x-resolution line. This allows pixels to be clocked out at different rates for different X-axis resolutions. For example, the 128Ø x 24Ø format requires a faster dot clock than the 64Ø x 24Ø format.

The Display Refresh Clock has two basic functions: it generates PBCLE/ which is used by the BCLE Control Logic to produce BCLE/, and it generates a series of signals used to control the display refresh process. Because the rate at which the display is refreshed varies with the X-axis resolution, the frequencies of these latter signals - SCLE/, LD/, SRLD/, REFØ/ and REF1/ - are controlled, like the Dot Clk, by the X-zoom bits from the Zoom Register. Figure 8.3 shows display Refresh Clock timing for an X-zoom of one, and figure 8.4 shows the same signals when an X-zoom factor of two is being used.

8.1 TIMING (Cont'd):

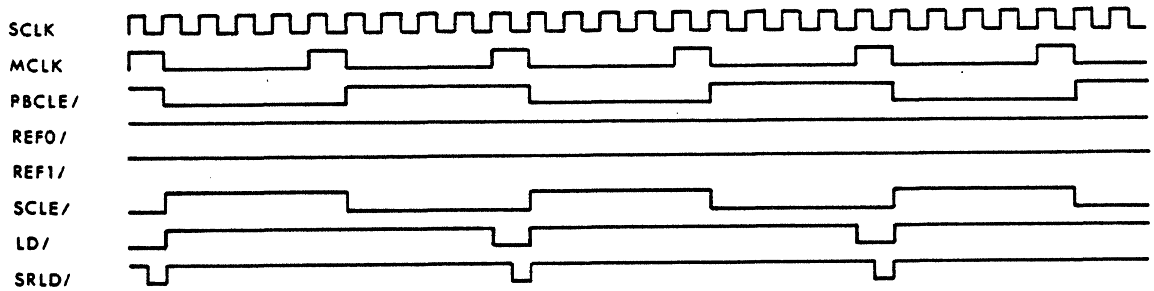


Figure 8.3 - DISPLAY REFRESH CLOCK TIMING : X-ZOOM TIMES ONE

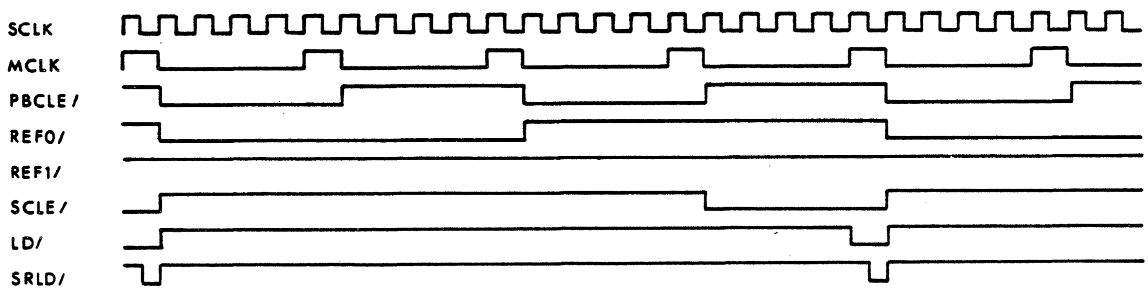


Figure 8.4 - DISPLAY REFRESH CLOCK TIMING: X-ZOOM TIMES TWO

The SCLE/ signal clocks the Display Refresh Counters (see section 8.3) as they are scanning through the Display Memory, addressing data which is sent out to refresh the display image. This data is shifted out to the display through three registers (A39, A47, A46) which are loaded from the Display Memory at the appropriate times by SRLD/. The LD/ signal has been provided for use by the GT-6ØØ. REFØ/ and REF1/ are used to ensure that refreshing of parts of the Display Memory is not displayed when X-zooms of greater than one are used, and their function is explained in section 8.3

The Memory Access Clock and BCLE Control Logic generate, MCLK, BCLE/, RAS/, and CAS/ as shown in figure 8.5. Figure 8.6 shows how SYNC'D WR/ is produced for a normal CPU access of the Display Memory, and figure 8.7 shows how SYNC'D WR/ is generated when the CPU accesses the Display Memory via the vector generator.

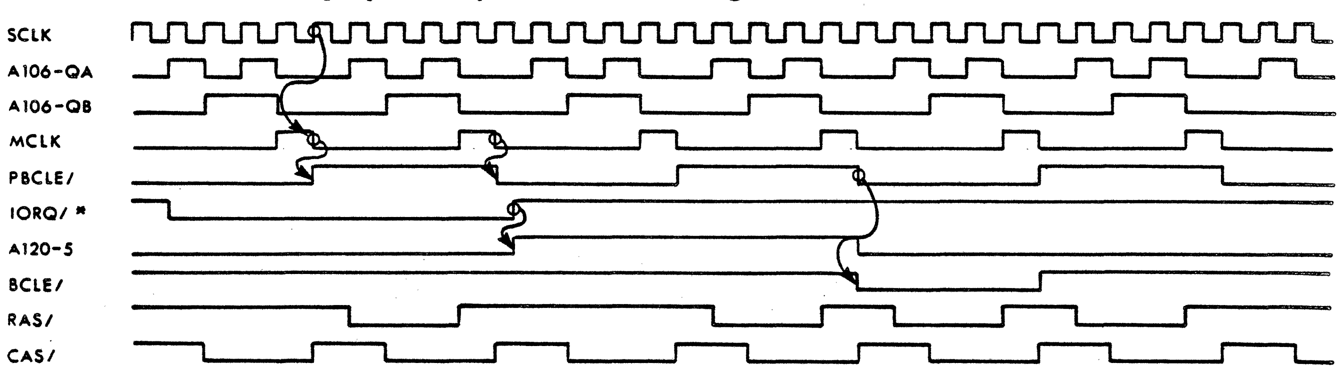


Figure 8.5 - MEMORY ACCESS TIMING

8.1 TIMING (Cont'd):

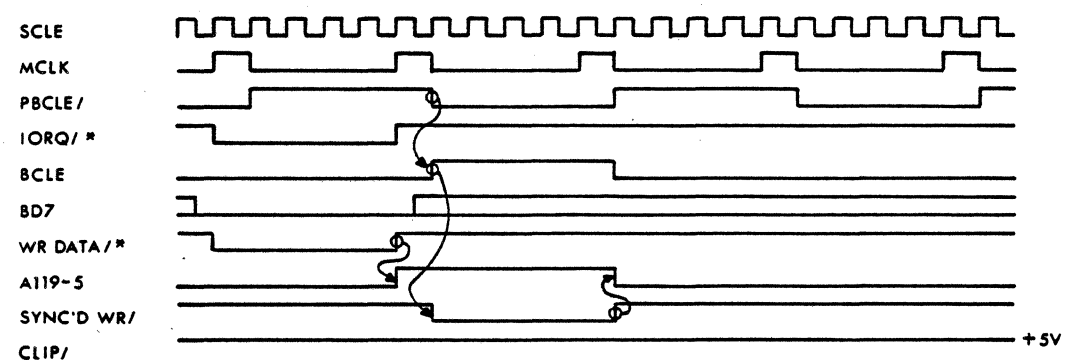


Figure 8.6 - SYNC'D WR/ GENERATION FOR NORMAL WRITE

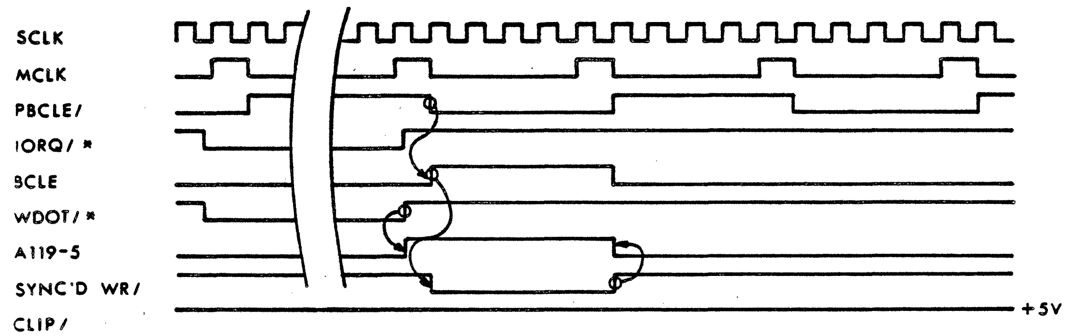


Figure 8.7 - SYNC'D WR/ GENERATION FOR WRITE FROM VECTOR REGISTER

The Display Memory Write signal, SYNC'D WR/, is BCLE gated by the signal from A119-5. BCLE is allowed to generate SYNC'D WR/ whenever CLIP/ is high and either WDOT/ is low or BD7 and WRDATA/ are low. WDOT/ comes from the Vector Register and signals that the current contents of the Data Register are to be written to the X-Y address resulting from the current Vector Register operation. WRDATA/ is generated when the CPU writes to the Data Register. If the 8th bit (BD7) of the data byte is low, the data will also be written to the Display Memory location defined by the current contents of the X and Y Registers. CLIP/ comes from the Clip Logic (A24) and goes low whenever an X or Y address is outside the boundaries of the displayed format but within the boundaries of the non-displayed working area (4Ø96 x 4Ø96). When CLIP/ goes low, it prevents non-displayed lines from wrapping around the display.

Note that BCLE/ is generated every time that the CPU issues an I/O Request (IORQ/). This means that the Display Memory is accessed even when the CPU is accessing locations other than the Data Register or the Vector Register. Since only a Data Register or Vector Register write can produce SYNC'D WR/, accessing other I/O locations will result in a Display memory read. The contents of the location addressed by the current contents of the X-Y Registers is read into the Data Register. This fact is of little use when the CPU is accessing the board's various control registers, but it does provide a preread function when the X or Y Register is accessed. In other words, the CPU does not have to wait for the Display Memory to be accessed when it reads the Data Register, because the correct data was loaded into the Data Register during the last X or Y Register access.

8.1 TIMING (Cont'd)

Figure 8.8 shows the timing for the Low Pan Logic. This circuit, controlled by the Low Pan Register, can shift the display horizontally by advancing the start of display refresh into the horizontal blanking period. The part of the display that is addressed by the Display Refresh Counters during horizontal blanking will not be seen in its normal position at the left of the display but will wrap around and be displayed on the right. The start of refresh can be moved up to 79 SCLK periods into the horizontal blanking and can be set with a precision of one SCLK period. Since 79 SCLK periods only covers a fraction of the display, the low pan function must be used in conjunction with the High Pan Register when longer pans are made.

The Low Pan Logic consists of a decade counter (A9Ø), a binary counter (A97), an RS flip flop (A98-13, A98-1Ø), a logic comparator (A89), and two D flip flops (A1Ø5). During each horizontal scan the two counters are started by the SYNC'D H.BLANK signal coming from the H.BLANK/HS CLK Logic (figure 8.2). They count 6Ø SCLK periods then turn over generating a carry out which causes A1Ø5-5, on the next MCLK pulse, to produce LPC/ which in turn stops all of the other counters in the Main Timing Section. The two low pan counters continue to count, and when their count is the exact inverse of the value in the Low Pan Register, the comparator generates E OUT. The flip flop A1Ø5-9 LDHC/ then resets flip flop A1Ø5-6 on the next SCLE pulse, and all of the Main Timing Section's counters are started again and display refresh is started even though horizontal blanking may be in effect. Meanwhile the two low pan counters continue to count up to 155 when they are stopped by A85-6.

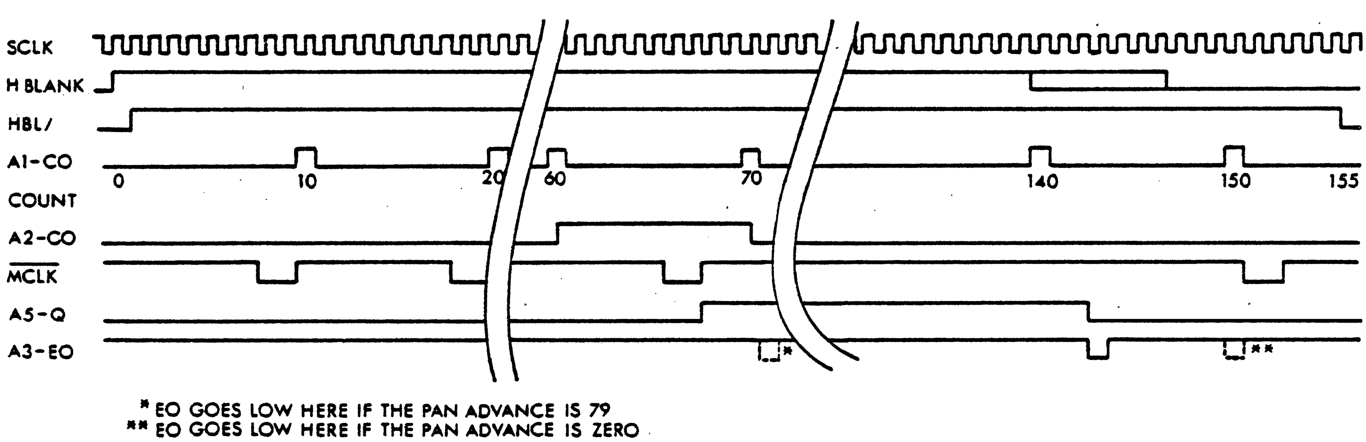


Figure 8.8 - LOW PAN LOGIC TIMING

Since all timing is stopped for a portion of the horizontal blanking, the Display Memory can not be accessed at that time. For this reason LPC resets A119-9 in the Wait Control Logic at the same time that it stops the memory access timing, and any IORQ/ during the off-period will cause the CPU wait line to go low. The Wait Control Logic also generates WAIT/ during CPU M1 cycles. This is required because the firmware PROM is not fast enough to allow the CPU to do fetches at its full speed.

8.2 DISPLAY MEMORY ACCESS:

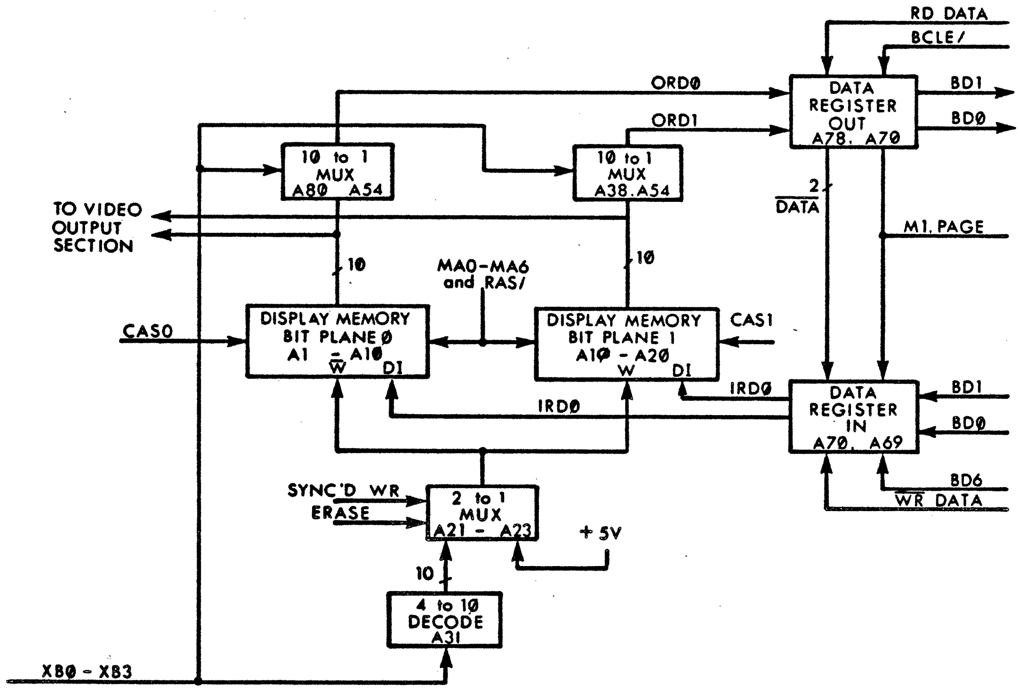


FIGURE 8-9 DISPLAY MEMORY

Figure 8-9 contains a block diagram of the Display Memory and most of its associated access logic. The memory is divided into two sections of 1Ø RAM's each: one section for bit plane Ø and one section for bit plane 1. When a memory access occurs, the bit plane to be accessed is selected by CASØ and CAS1. (see section 8.4), the RAM to be accessed is selected by XBØ-XB3, and the individual location within that RAM is selected by MAØ-MA6.

During display refresh MAØ-MA6 are supplied by the display refresh counters (see section 8.3) and data is read from memory 2Ø bits at a time in page mode (one bit from each RAM). These 2Ø bits are loaded into the Video Output Section and shifted out to the display in a manner corresponding to the board's programmed resolution (see section 8.6).

The Display Memory is also accessed everytime the CPU does an I/O access to any register. If the access is a write operation to the Data Register or the Vector Register, with their respective write enable bits set, the contents of the Data Register are written into the location addressed by the current contents of the X and Y registers, during the first complete PBCLE high period following the completion of the I/O access (see figure 8-5). If any other I/O access is performed the contents of the location addressed by the current contents of the X and Y registers, are read into output section of the Data Register during the first complete PBCLE high period following the I/O access. In the first case the RAM to be written to is selected by A31 which decodes XBØ-XB3 and pulls the appropriate write line low. In the latter case 2Ø bits are read out of memory, as in display refresh, and XBØ-XB3 select the data for the Data Registers via A3Ø, A38, and A54. In either case access is made to one or both bits planes depending on CASØ and CAS1 which are controlled by the programmed resolution.

8.2 DISPLAY MEMORY ACCESS (Cont'd):

A21-A23 are two to one multiplexers which are used to pull all the memory write lines low during a preset operation. They also allow SYNC'D WR to enable write operations.

8.3 DISPLAY REFRESH:

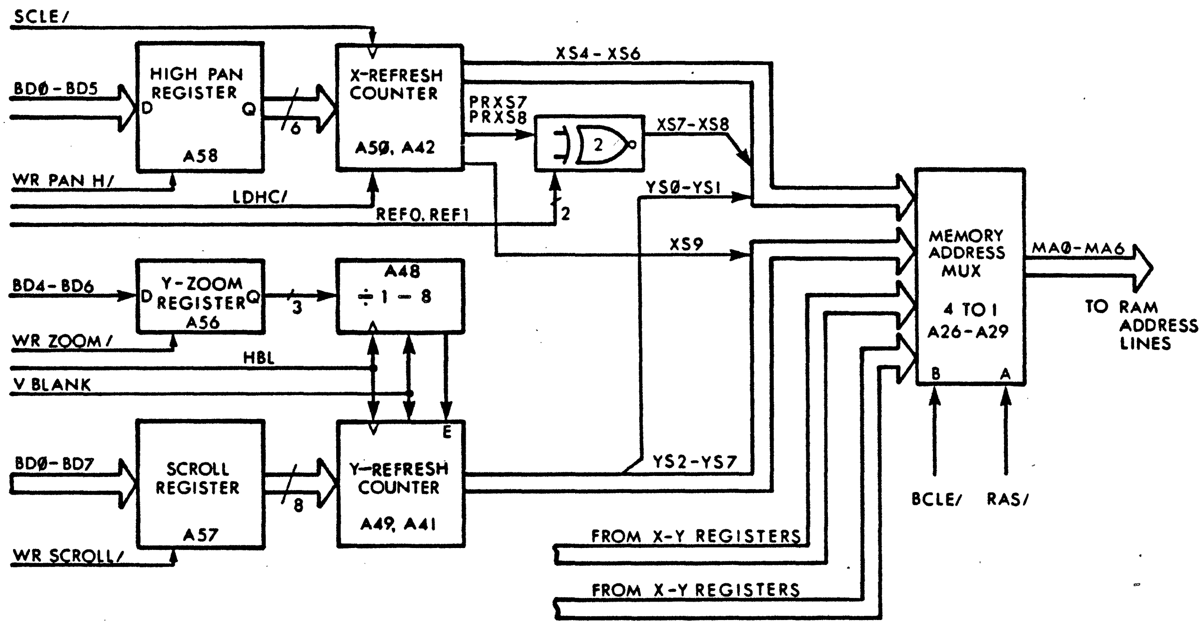


FIGURE 8-1Ø REFRESH GENERATOR

Figure 8-1Ø contains a block diagram of the GT-6ØØ's refresh generator. The X and Y refresh counters generate addresses which, as part of the on going refresh process, are passed to the display memory via the Memory Address Multiplexers when BCLE/is high. Each of these addresses is passed in two parts; first a RAM row address is passed to the RAM during RAS/ high, then a RAM column address is passed to the RAM during RAS/low (do not confused RAM row and column addresses with display row and column addresses). Table 8-1 shows how the Memory Address Multiplexers present addresses from different sources to the display memory (MAØ-MA6) at different times.

MUX CONTROL		ADDRESS SOURCE							
BCLE/	RAS/								
Ø	Ø	XB4	XB5	XB6	XB7	XB8	YBØ	YB1	RAM COLUMN ADDRESS (X-Y REGISTERS)
Ø	1	YB2	YB3	YB4	YB5	XB9	YB6	YB7	RAM ROW ADDRESS (X-Y REGISTERS)
1	Ø	XS4	XS5	XS6	XS7	XS8	YSØ	YS1	RAM COLUMN ADDRESS (REFRESH)
1	1	YS2	YS3	YS4	YS5	YS9	YS6	YS7	RAM ROW ADDRESS (REFRESH)
		MAØ	MA1	MA2	MA3	MA4	MA5	MA6	DISPLAY MEMORY ADDRESS LINES

TABLE 8-1. MEMORY MUX OPERATION

8.3 DISPLAY REFRESH (Cont'd):

As the Refresh Counters are refreshing the display, they are also refreshing the dynamic RAM Display Memory which must have all of its ROW addresses strobed every 2 mS at least. Because of this, bits YSØ, YS1, and XS4 through XS8 from the least significant part of the Refresh Address are used for the RAM row address. When X-zoom times one is in effect, all of these bits will turn over within the above mentioned time limit; however, when greater X-zoom factors are used, the SCLE/ frequency is reduced, only part of the Display Memory is accessed for display refresh, and the X-Refresh Counter outputs that become XS7 and XS8 (PRXS7, PRXS8) do not always turn over (PRXS8 does not turn over during zoom by 2; PRXS7 and PRXS8 do not turn over during zoom by 4). The XOR gates A32-4 and A32-11 are placed between PRXS7 and XS7, and PRX58 and XS8 to assure that the part of Display Memory not accessed for display refresh, is also refreshed. The second inputs to these gates are driven by REFØ and REF1 (see section 8.1). Figure 8-11 shows how REFØ and REF1 work to change the state of XS7 and XS8 so that ROW addresses not normally accessed during X-zoom by 4, can be strobed during periods when data read out of RAM will not be sent to the screen. Operation for X-zoom by 2 is similar except that REF1 remains high (see figure 8-4).

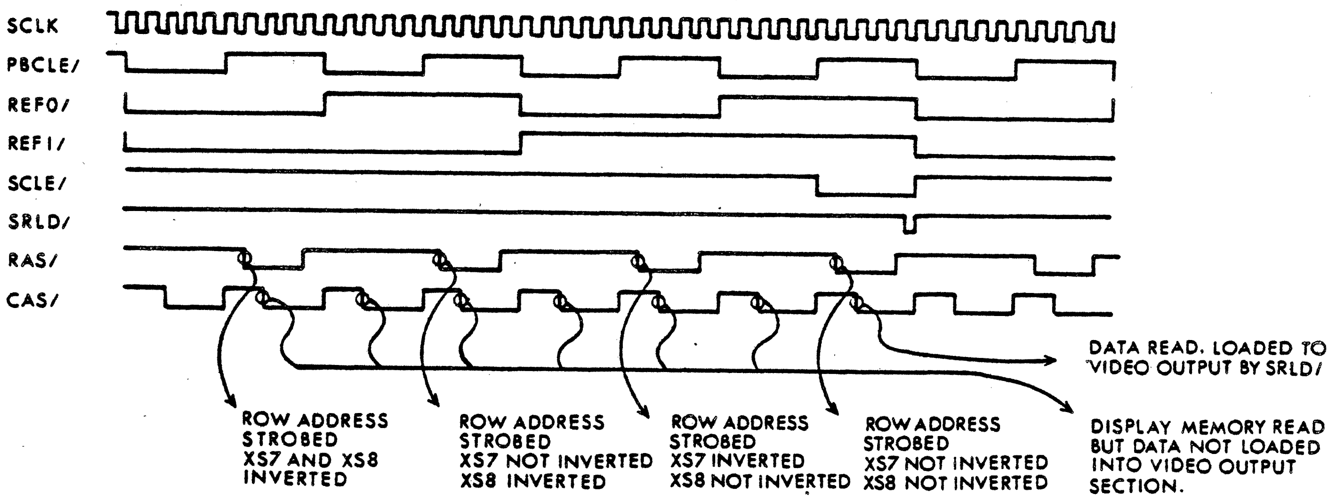


FIGURE 8-11. RAM REFRESH FOR X-ZOOM BY 4

The X-Refresh Counter's starting address is loaded from the High Pan Register during or at the end of each horizontal blanking period by LDHC/ from the Low Pan Logic (see section 8.1), then the counter is clocked by SCLE/ until the end of the horizontal scan. The starting address determines which part of the display Memories X-axis (to within 1Ø pixels) will be addressed at the start of each horizontal video scan, so by changing the value in the High Pan Register, the display can be rotated left or right in jumps of 1Ø pixels. Finer precision can be obtained by using the Low Pan Register.

The Y-Refresh Counter is loaded with the contents of the Scroll Register at the start of each vertical scan by BLANK and is then clocked at the horizontal scan frequency (HBL) divided by a value (1-8) determined by the contents of the Y-zoom Register. When the Y-zoom factor is one, the Y-Refresh counter is clocked on each HBL pulse. Thus the Y Refresh address changes with each scan line, and pixels are only one scan line high. As the Y-zoom factor is increased, the number of horizontal scans between Y-Refresh Address increments is increased, resulting in more scan lines per pixel.

8.3 DISPLAY REFRESH (Cont'd):

As mentioned above, the Y-Refresh starting address is loaded from the Scroll Register at the start of each vertical scan. As a result the Scroll Register establishes the vertical relation between the text and the display.

8.4 CAS/ CONTROL AND ERASE LOGIC:

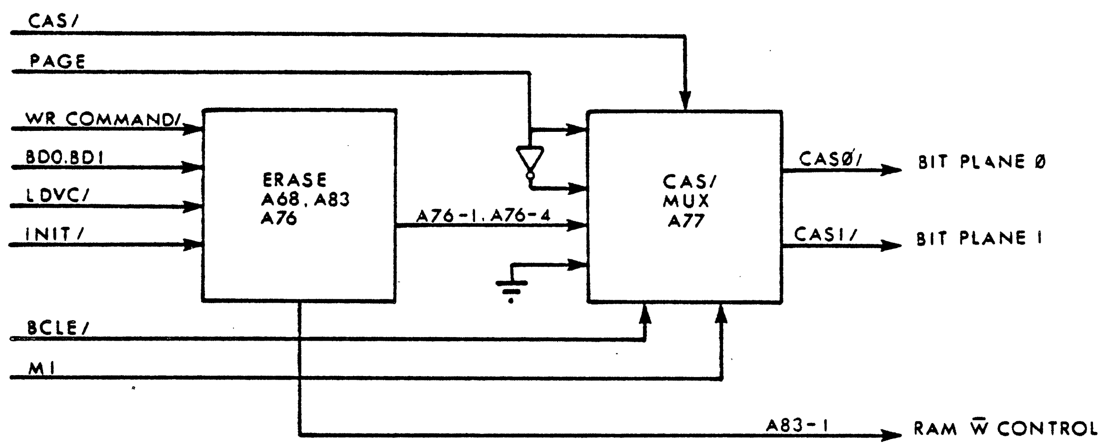


FIGURE 8-12. CAS/ CONTROL AND ERASE LOGIC

The CAS/ multiplexer (see figure 8-12) determines whether bit plane Ø, bit plane 1, or both bit planes will be accessed during any given Display Memory access. It is enabled by CAS/ from the timing section and is controlled by BCLE/ and M1 which determine which of several inputs will be used to generate CASØ/ and CAS1/. BCLE/ comes from the timing section (section 8.1) and indicates whether an access is from the CPU or the Refresh Generator (Ø=CPU, 1=REFRESH); M1 comes from the Control Register and indicates whether the current display format is one or two bit planes deep (Ø = 1 plane, 1 = 2 planes). Table 8-2 shows the relationship between BCLE/, M1, and the signals that they select to become CASO/ and CAS1/. Page comes from the Y-Resolution PROM (see section 8-5) and indicates whether the X and Y registers are addressing bit plane 1 or 2 or both. A76-1 and A76-4 are both normally low unless an erase is being done to a single bit plane.

The Erase Logic allows the CPU to erase bit plane Ø, bit plane 1, or both. The two flip flops A68-5 and A68-9 are loaded with BDØ and BD1 respectively when a write is made to the Command Register. At the start of the next vertical scan the inverse of these bits are presented via A76-1 and A76-4 to the CAS Multiplexer where they become CASØ and CAS/. At the same time A83-6 goes high and causes A21-A23 to pull all the RAM W/ lines low. The normal refresh access cycle then writes the data from the Data Register into one or both bit planes. The firmware assures that the data is zero at the time of an erase. At the end of the vertical scan the Erase Logic is reset.

CONTROL		OUTPUT	
BCLE/	M1	CASØ/	CAS1/
Ø	Ø	PAGE	PAGE/
Ø	1	GND	GND
1	Ø	A76-1	A76-1
1	1	A76-1	A76-4

TABLE 8-2. CAS/ MUX CONTROL

8.5 THE X AND Y REGISTERS:

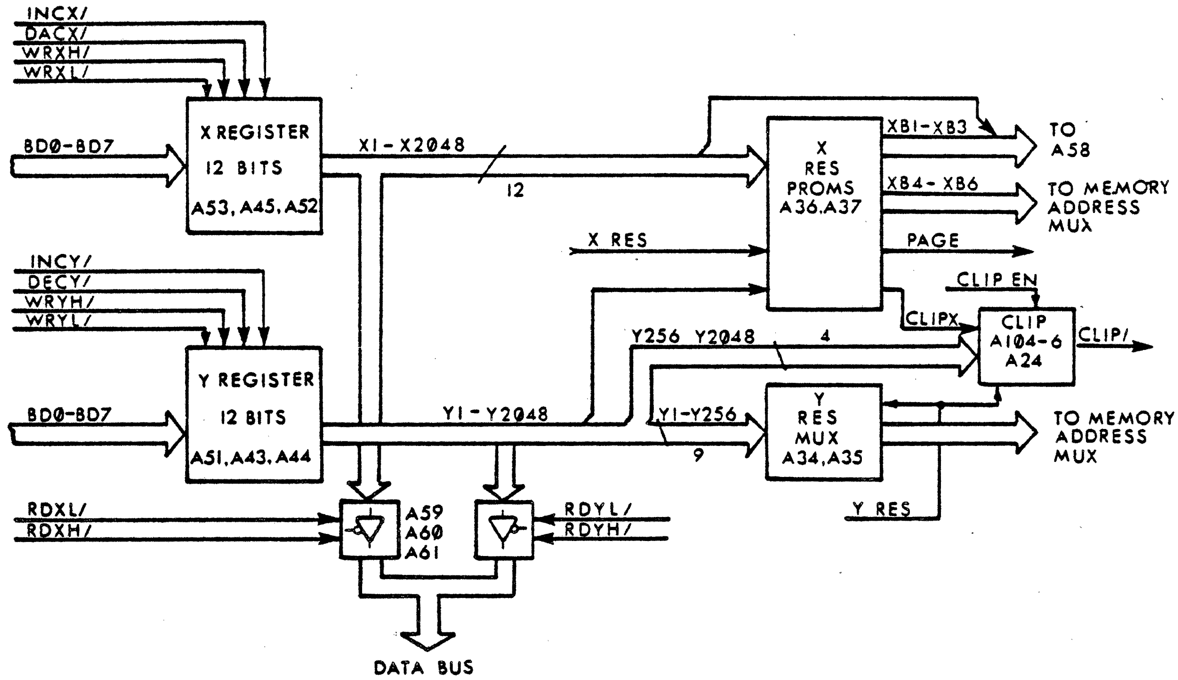


FIGURE 8-13. X AND Y REGISTERS

Figure 8-13 contains a block diagram of the X and Y Registers along with some of their supporting logic. The X and Y Registers, which are used by the CPU to address pixel location within the Display Memory, are composed of 74LS193 up-down counters, and hold 12 bits each. They are loaded and read from the Data Bus and can be incremented and decremented by the following signals from the Vector Register: INC X/, INC Y/, DEC X/, and DEC Y/.

The Display memory can be arranged in three different ways depending on the Resolution Mode (see figure 8-14). The two X-Resolution PROMs (A36 and A37) and the two Y-Resolution multiplexers (A34 and A35) translate addresses from the X and Y Registers to conform to the particular Display Memory arrangement in use. The only change seen by the X and Y Registers is that a different part of the 4Ø48 x 4Ø48 working area is clipped. Clipping is taken care of by A24-8 which generates CLIP/ when the X or Y Register contains an address outside of the physical memory but within the 4Ø48 x 4Ø48 working area. CLIP/ inhibits access to the Display Memory.

8.5 THE X AND Y REGISTERS (Cont'd):

Note that the 4 least significant bits from the X-Resolution PROMs (XBØ-XB3) go directly to the RAM access logic (see figure 8-9) where they select individual pixel locations within the pixel blocks that are addressed by XB4-XB9 through the Memory Address Multiplexers. The PAGE signal generated by the X-Resolution PROMs indicates which half of the Display Memory (which bit plane) contains the location to be accessed.

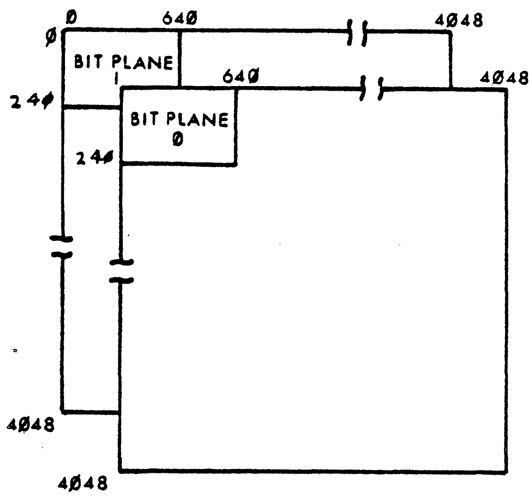


FIGURE 8-14. 64Ø x 24Ø

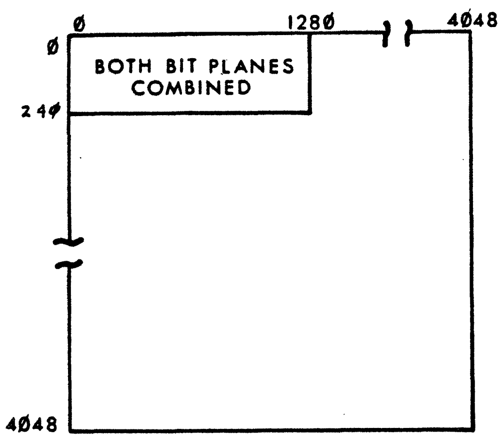


FIGURE 8-14B. 128Ø x 24Ø

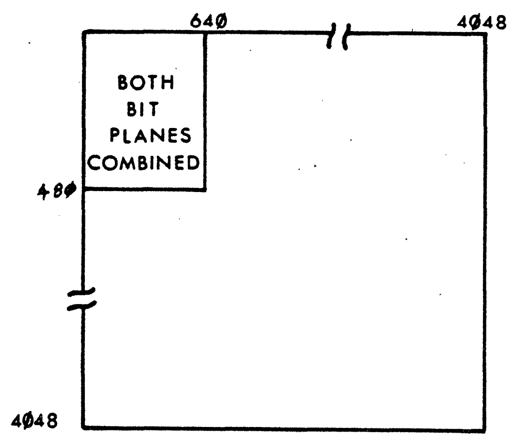


FIGURE 8-14C. 64Ø x 48Ø

FIGURE 8-14 DISPLAY MEMORY ORGANIZATION VS, RESOLUTION MODE

8.6 VIDEO OUTPUT:

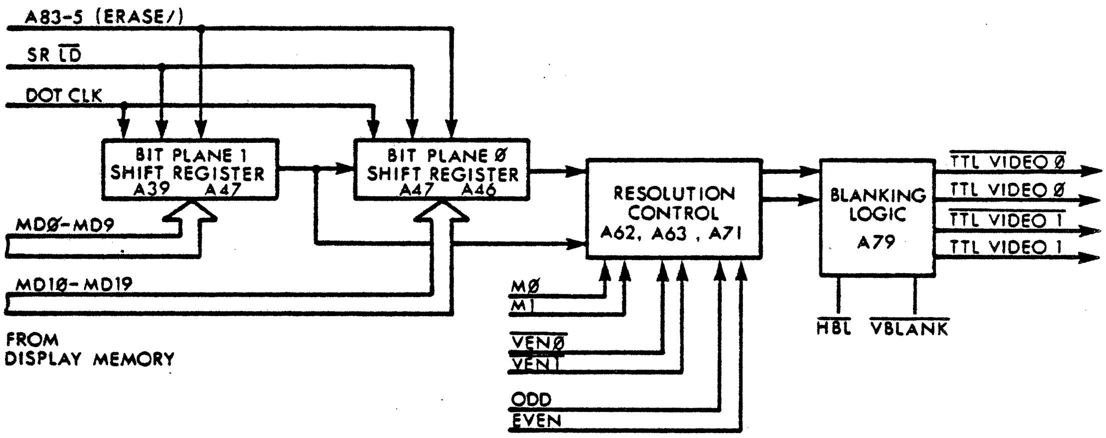


FIGURE 8-15 VIDEO OUTPUT

Figure 8-15 contains a block diagram of the Video Output section. Every time the Display Memory is accessed to refresh the display, 1Ø bits of consecutive video data are latched into each of the two shift registers: 1Ø bits from Bit Plane Ø and 1Ø bits from Bit Plane 1. This data is then shifted out in serial form to the Resolution Control Logic, where it is channeled to TTL VIDEO Ø and TTL VIDEO 1 in a manner determined by the resolution bits, MØ and M1, in the Control Register. When a 64Ø x 256 resolution with grey scale is used, the two 1Ø bit blocks are shifted out in parallel to TTL VIDEO Ø and TTL VIDEO 1. When the same resolution is used in the OR'd mode, the two 1Ø bit blocks are OR'd and the result is output at both TTL VIDEO Ø and TTL VIDEO 1. When the 128Ø x 256 resolution is used, the Dot Clk frequency is doubled and the two 1Ø bit blocks are shifted out, one after other, on TTL VIDEO Ø. When the 64Ø x 516 resolution is used, an interlaced display is used and each display refresh address is used in two consecutive scan lines. On even scan lines, data from Bit Plane Ø is allowed out to TTL VIDEO Ø; and on odd scan lines, data from Bit Plane 1 is allowed out to TTL VIDEO Ø. Note that the Control Register also uses the Resolution Control Logic to disable video via VENØ/ and VEN1/.

* * * * *

9.Ø MAINTENANCE AND WARRANTY:

MATROX products are warranted against defects in materials and workmanship for a period of 18Ø days from date of delivery. We will repair or replace products which prove to be defective during the warranty period, provided they are returned to MATROX ELECTRONIC SYSTEMS, Ltd. No other warranty is expressed or implied. We are not liable for consequential damages.

Our U.S. customers are requested to return their products to our U.S. branch at the following address: MATROX INTERNATIONAL CORPORATION; Trimex Building, Mooers, N.Y. 12958.

1Ø.Ø ORDERING INFORMATION:

The GT-6ØØ can be ordered directly from MATROX ELECTRONIC SYSTEMS, Ltd. or from our worldwide network of distributors.

* * * * *

APPENDIX A PLOT-1Ø:

Reference is made throughout this manual to the Tektronix Plot-1Ø graphics package. Most people reading this manual will already be familiar with Plot-1Ø; however, some may not be, and this appendix has been added for their benefit. It is a brief overview intended only to give an idea of how Plot-1Ø works. Those readers requiring a more thorough description should contact their local Tektronix representative.

Plot-1Ø is a comprehensive set of functionally modular subroutines which drive the Tektronix 4Ø1Øx series of terminals and the GT-6ØØ when it is in its Tek Configuration. The user's program, written in Fortran, simply calls these subroutines and provides any required parameters to generate a graphics display which can include alphanumeric labels or text.

The Plot-1Ø system has four basic elements: the Virtual Display, the Virtual Window, the Screen (real display), and the Screen Window as illustrated in figures A-1 through A-4. The Virtual Display is an imaginary two-dimensional surface with X and Y dimensions limited only by the range of a single precision floating point number. The Virtual Display is the canvas used by the user's program, which can draw graphics anywhere on its surface. The Virtual Window is a rectangular section of the Virtual Display and outlines the part of the Virtual Display that will be displayed on the terminal CRT. The user sets its position and size to encompass all or part of the image that the program will draw. The Screen is the terminal CRT screen or the real display. The Screen Window is a rectangular section of the Screen, and its position and size are set by the user to include all or part of the Screen. Each time the user's program is run, the part of the Virtual Display that is outlined by the Virtual Window is displayed in that part of the Screen outlined by th Screen Window. The size and proportions set for the Virtual and Screen Windows do not have to be the same, since all scaling and adjustments are done automatically by PLOT-1Ø.

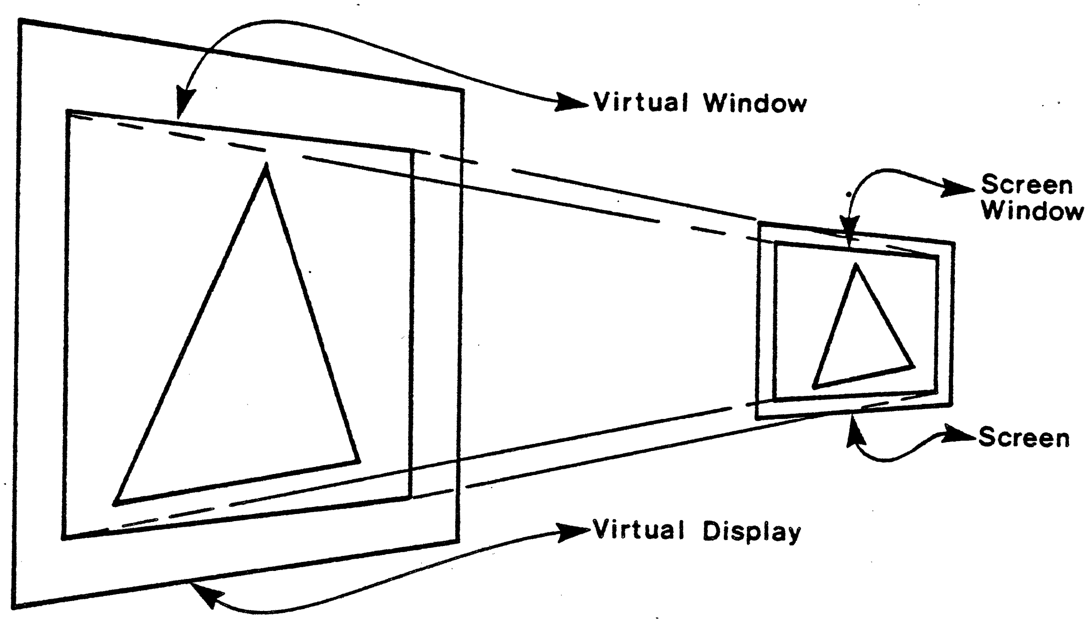


Figure A-1 - PLOT-1Ø VIRTUAL DISPLAY SYSTEM

APPENDIX A - PLOT-1Ø (Cont'd):

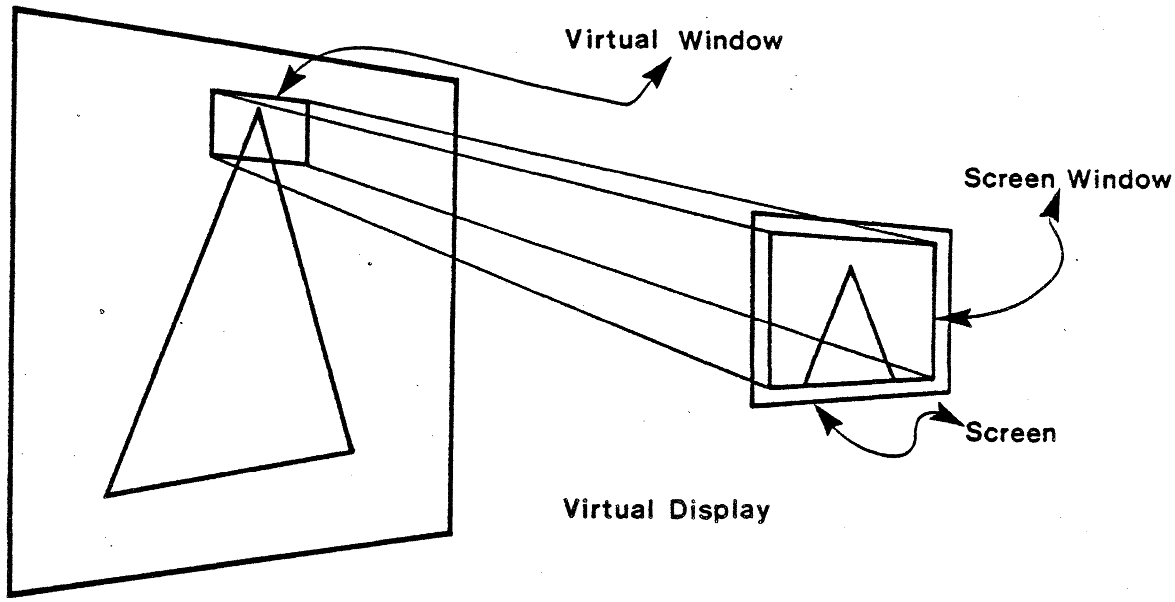


Figure A-2 - DISPLAYING A DETAIL OF A LARGER IMAGE

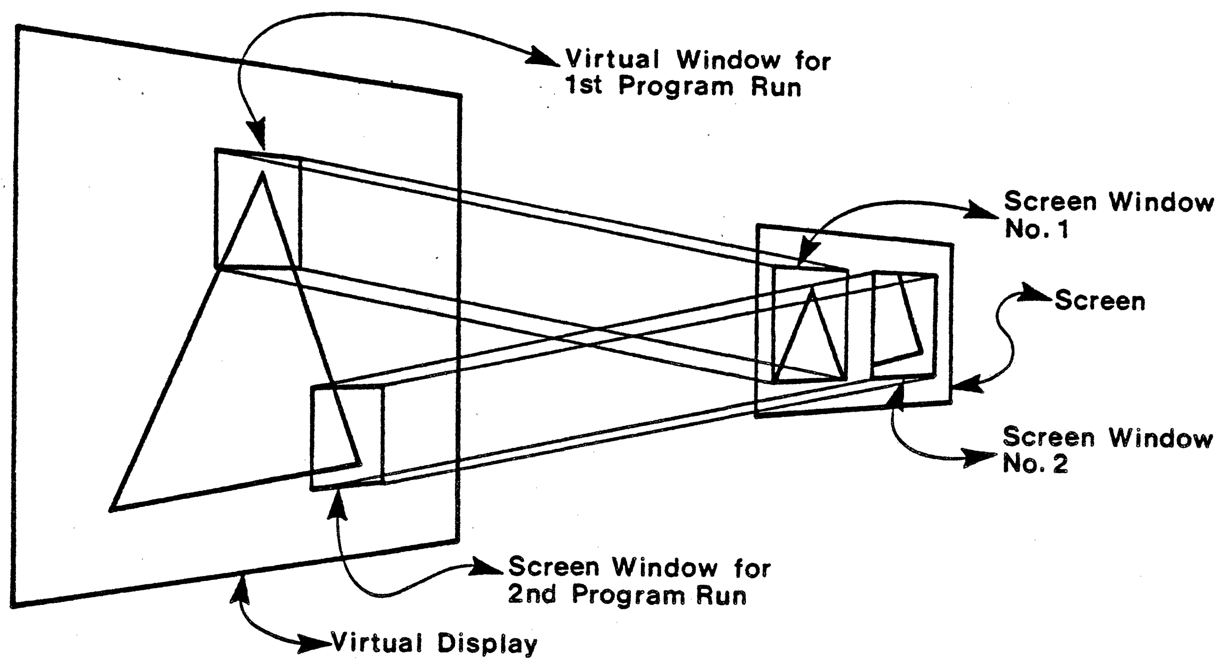


Figure A-3 - COMPARING TWO DETAILS OF LARGER IMAGE

APPENDIX A - PLOT-1Ø (Cont'd):

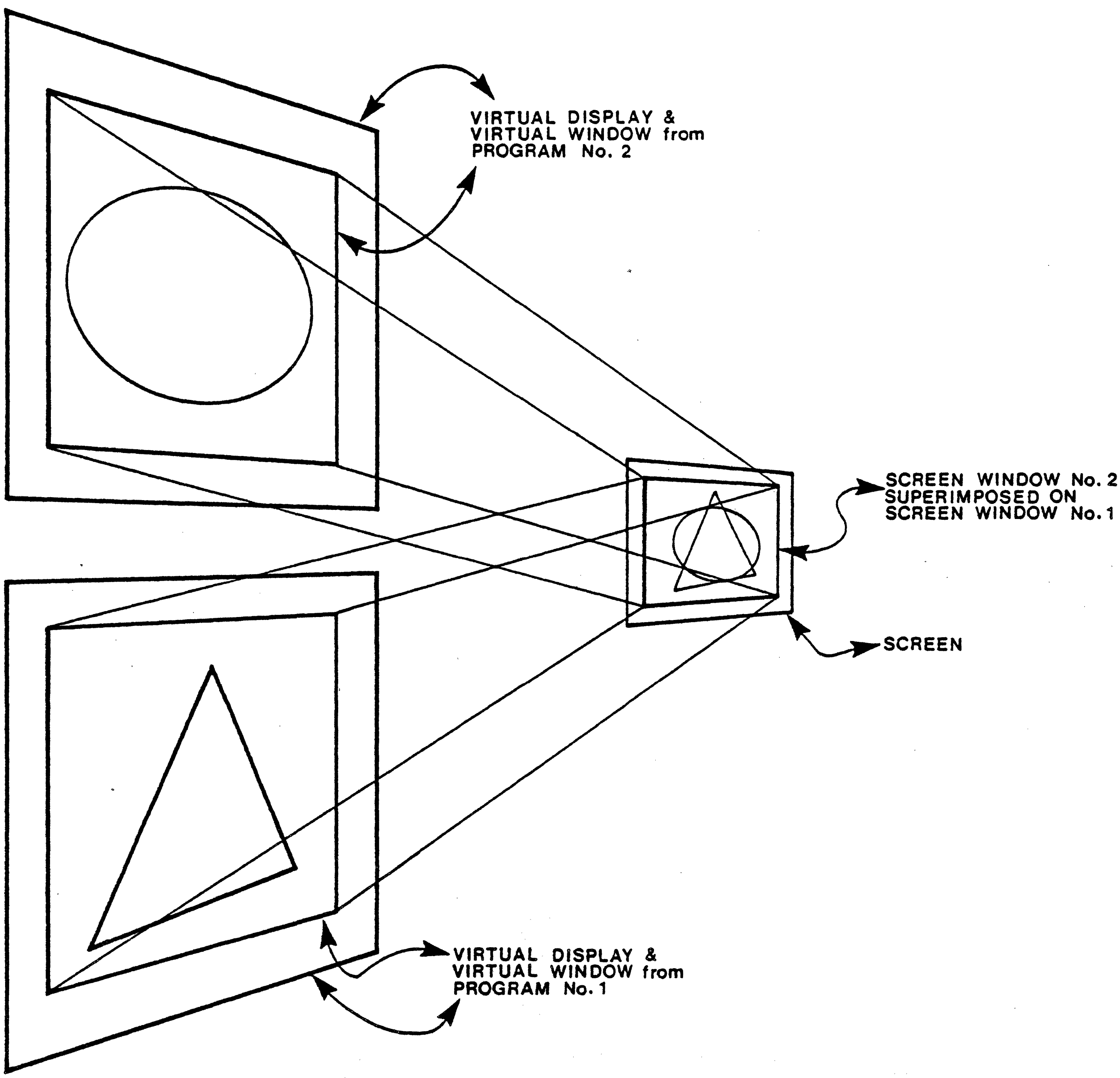


Figure A-4 - SUPERIMPOSING TWO DIFFERENT IMAGES

APPENDIX A - PLOT-1Ø (Cont'd):

The PLOT-1Ø system releases the user from the constraints imposed by the size and resolution of the terminal's graphics display. Since the Virtual Display is very large, the user can write programs that draw large graphics images with a high degree of detail. When a program is run the windows can be adjusted so that the whole image will be shown with some loss of detail due to scaling (figure A.1) or so that a small section of the image will be shown with all its detail (figure A.2). Different sections of the over all image can be compared in detail by simply running the program more than one time with different Virtual and Screen window positions set for each run (figure A-3). Images produced by different programs can be superimposed by simply assigning them the same screen window and not erasing it between programs (figure A-4).

The PLOT-1Ø package contains all the subroutines necessary to manage the system, manipulate the display, and draw complicated graphics figures in a simple straight forward manner. The user can call subroutines to initialize the system, to erase the display, to terminate a program, to ring a bell, or to generate hard copy. There are subroutines to set the size and position of the windows, there are subroutines to display and manipulate alphanumeric characters, and of course there are subroutines draw graphics figures.

The graphics subroutines include both vector and point plot functions which can be executed using either absolute or relative addressing. The vector function draws a line between two points; the point plot function draws a dot at a point. When absolute addressing is used, each point in the display has a unique address; when relative addressing is used, addresses are defined with respect to the current pen starting position. Relative addressing is useful when more then one copy of the same figure must be drawn at different positions, because the same call routine may be used each time by simply changing the pen starting position for each figure. Another advantage of relative addressing is that figures drawn in this way may be easily scaled and rotated. The lines used for vectors can be selected solid, dashed, or dark (not displayed).

PLOT-1Ø also provides a graphics cursor which the operator can move about the Virtual Display by using the keyboard "Arrow" keys. Once the cursor is in position striking a keyboard character will cause the cursor address along with the struck character to be sent to the host computer. The user's program can then react to the cursor in some predetermined fashion.

Up until now we have talked about creating graphics figures on the Virtual Display and using the windowing system to display all or part of the figure on the Screen. This is the method most often used; however, there is an alternative. PLOT-1Ø provides a parallel set of alphanumeric, vector, point plot, and graphics cursor subroutines that can be used to work directly on the screen. The user is responsible for staying on the screen when these direct functions are used.

PLOT-1Ø is the industry standard for graphics software, and when it is combined with the GT-6ØØ provides a very effective graphics tool.

* * * * *

APPENDIX B. INTERNAL REGISTERS:

The user does not need to know about these registers to operate the GT-6ØØ, however, information about them has been included as technical information.

B.1. USART #1 DATA REGISTER (GT-6ØØ TO HOST):

READ/WRITE

7	6	5	4	3	2	1	Ø

I/O LOCATION = ØØH

REFER TO INTEL DATA SHEETS FOR 8251A USART

B.2. USART #1 CONTROL REGISTER (GT-6ØØ TO HOST):

READ/WRITE

7	6	5	4	3	2	1	Ø

I/O LOCATION = Ø1H

REFER TO INTEL DATA SHEETS FOR 8251A USART

B.3. USART #2 DATA REGISTER (GT-6ØØ TO VT TERMINAL):

READ/WRITE

7	6	5	4	3	2	1	Ø

I/O LOCATION = Ø8H

REFER TO INTEL DATA SHEETS FOR 8251A USART

B.4. USART #2 CONTROL REGISTER (GT-6ØØ TO VT TERMINAL):

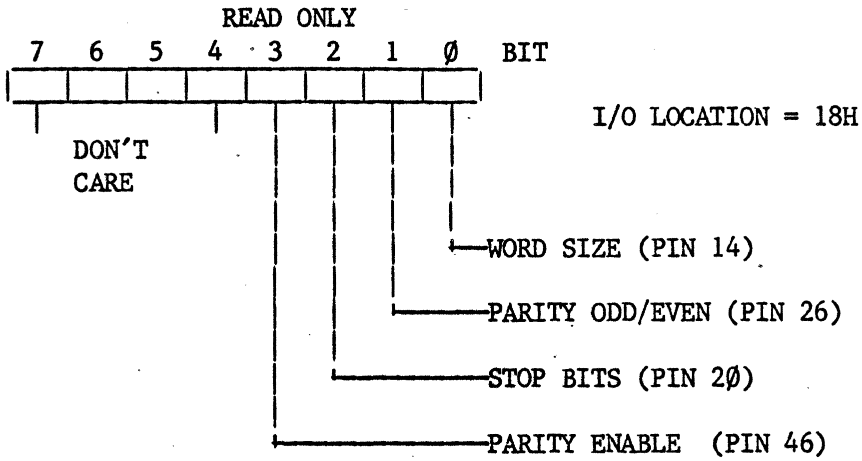
READ/WRITE

7	6	5	4	3	2	1	Ø

I/O LOCATION = Ø9H

REFER TO INTEL DATA SHEETS FOR 8251A USART

B.5. STP STRAP REGISTER:



These pins can be found in section 6.Ø and on the STP schematic in the back of this manual.

BIT Ø: WORD SIZE. When a one is written to this bit, word size is set to 7 bits. When this bit is set to zero, word size is set to 8 bits.

BIT 1: PARITY ODD/EVEN. When this bit is set to one, odd parity checking is used. When this bit is set to zero, even parity checking is used.

BIT 2: STOP BITS. When this bit is one, one stop bit is used. When this bit is zero, two stop bits are used.

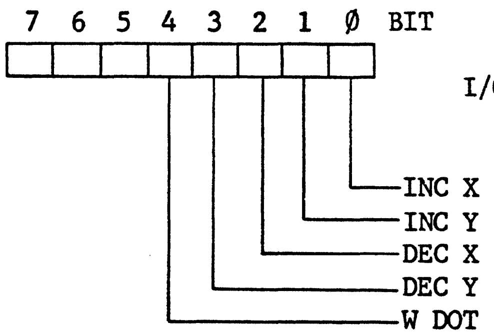
Bit 3: PARITY ENABLE. When this bit is set to one, parity checking is enabled. When this bit is zero, parity checking is disabled.

BITS 4-7: DON'T CARE.

Note that bits 4-7 are used to program the third USART on the STP Board, A12. This USART has no function at the present time, but may be implemented in the future as an extra serial port to the GT-6ØØ.

3.6. VECTOR REGISTER:

WRITE ONLY



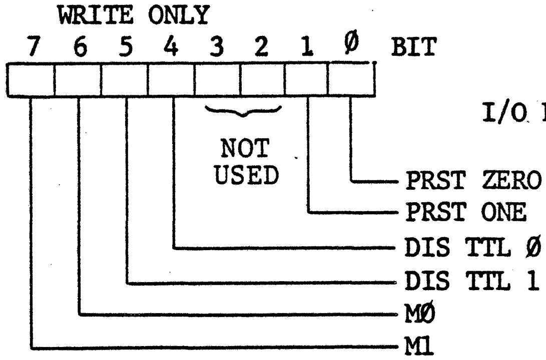
I/O LOCATION = 6ØH

BIT Ø:	INCX.	If a one is written to this bit the X-Register will be incremented. If a zero is written to this bit, it will have no effect.
BIT 1:	INCY.	If a one is written to this bit the Y-Register will be incremented. If a zero is written to this bit, it will have no effect.
BIT 2:	DEC X.	If a one is written to this bit the X-Register will be decremented. If a zero is written to this bit, it will have no effect.
BIT 3:	DEC Y.	If a one is written to this bit the Y-Regiter will be decremented. If a zero is written to this bit, it will have no effect.
BIT 4:	W DOT.	If a zero is written to this bit, the contents of the Data Register will be written into the pixel location addressed by the modified X and Y coordinates. If a one is written to this bit the contents of the display memory will not be changed when this register is accessed.

B.7. COMMAND REGISTER:

WRITE ONLY

I/O LOCATION = 61H



BITS Ø AND 1: PRST ZERO AND PRST ONE. When a one is written to one of these bits the corresponding bit plane (Ø or 1) is preset to the value in the Data Register.

BITS 4 AND 5: DIS ZERO AND DIS ONE. When a zero is written to one of these bits, the corresponding TTL video output is enabled. When a one is written to one of these bits, the TTL video from the corresponding bit plane (Ø or 1) is disabled. Both bits are zero after initialization.

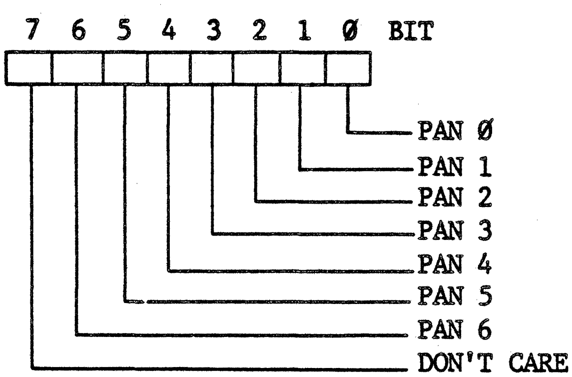
BITS 6 AND 7: MØ AND M1. These two bits determine the display resolution as indicated in the following table.

MØ	Ø	1	Ø	1
M1	Ø	Ø	1	1
FORMAT	1219 x 24Ø	61Ø x 48Ø	61Ø x 24Ø	61Ø x 24Ø
APPLICATION	BLACK AND WHITE	BLACK AND WHITE	OR'ED	GREY SCALE
PLANE	Ø	Ø	Ø AND 1	Ø AND 1

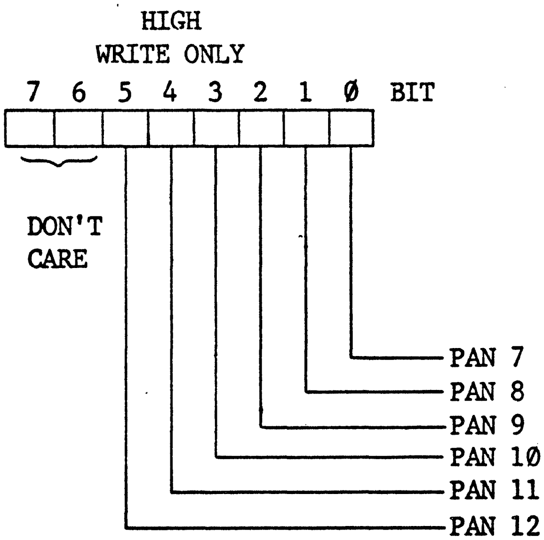
B.8. PAN REGISTERS:

LOW
WRITE ONLY

I/O LOCATION = 64H



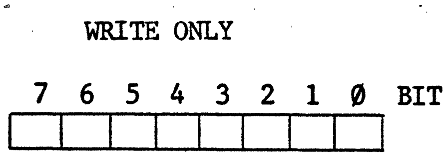
.8. PAN REGISTERS (Cont'd):



I/O LOCATION = 65H

The number written into the Low Pan Register indicates the number of SCLK periods that the image is shifted to the left. It can be any BCD number from 0 to 79. The binary number written into the High Pan Register indicates the number of 10-pixel sections that the image is shifted to the left. When a pan is done, the Low Pan Register is sequentially incremented until it is equal to the number of SCLK periods in 10 pixels (this value will vary with X-zoom factor in use), then the High Pan Register is incremented during vertical blanking. This process is continually repeated at a rate which will give the required pan speed.

B.9. SCROLL REGISTER:



I/O LOCATION = 66H

The vertical coordinate of the pixel row at the top of the display must be loaded into this register. Normally it would be 00H. When the Y resolution is 240 pixels any Y coordinate can be used; however, when the Y resolution is 480 pixels only even coordinates can be used. Scroll is accomplished by repeatedly incrementing this register. When the Y resolution is 240, the display can be incrementd with a maximum resolution of one pixel; when the Y resolution is 480 the display can be scrolled with a maximum resolution of two pixels. Note, however, that the size of the pixels changes with Y-zoom factor.

B.1Ø. ZOOM REGISTER:

WRITE ONLY

7 6 5 4 3 2 1 Ø BIT

I/O LOCATION = 67H

Bits Ø, 1, 2:

ZOOM FACTOR	1	2	3	4	5	6	7	8
X-ZOOM Ø	1	Ø	1	Ø	1	Ø	1	Ø
X-ZOOM 1	1	1	Ø	Ø	1	1	Ø	Ø
X-ZOOM 2	1	1	1	1	Ø	Ø	Ø	Ø

Bit 3: DON'T CARE

Bits 4, 5, 6:

ZOOM FACTOR	1	2	3	4	5	6	7	8
Y-ZOOM Ø	1	Ø	1	Ø	1	Ø	1	Ø
Y-ZOOM 1	1	1	Ø	Ø	1	1	Ø	Ø
Y-ZOOM 2	1	1	1	1	Ø	Ø	Ø	Ø

Bit 7: DON'T CARE

Zooms are accomplished by setting the X and Y zoom factors in this register and setting the position of the zoom area with the Scroll and Pan Registers.

B.11. DATA REGISTER:

READ/WRITE

7 6 5 4 3 2 1 Ø BIT

I/O LOCATION = AØH

- Bit Ø: DATA Ø (READ/WRITE)
- Bit 1: DATA 1 (READ/WRITE)
- Bit 5: ODD PARITY (READ ONLY)
- Bit 6: AUTO COMP./STOP BITS (SEE BELOW)
- Bit 7: PAR. EN (READ ONLY)

BITS Ø AND 1 — DATA Ø AND 1. These two bits are a data port to the display Memory.

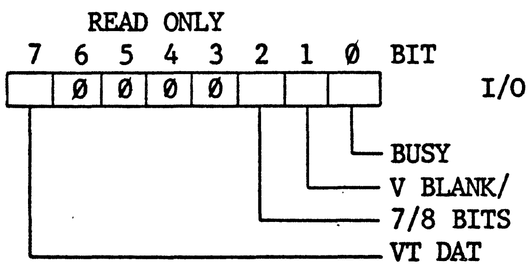
BIT 5 — ODD PARITY. When the CPU reads a one at this bit, it programs the USART for odd parity. When the CPU reads a zero at this bit, it programs the USART for even parity. The state of this bit is set by a strap. For strap designations refer to Section 6.Ø.

BIT 6 — AUTO COMP./STOP BITS. When the CPU writes a one to this bit, the pixel location addressed by the current contents of the X and Y registers will be complemented. When the CPU reads a one at this bit, it programs the USART for one stop bit. When the CPU reads a zero at this bit, it programs the USART for 2 stop bits. The read value is set by a strap. For strap designations refer to section 6.Ø.

B.11. DATA REGISTER (cont'd):

BIT 7 PAR EN. When the CPU reads a one at this location, it programs the USART to enable parity. When the CPU reads a zero at this location it programs the USART to disable parity. The value of this bit is set by a strap. For strap designations refer to Secton 6.0.

B.12. STATUS REGISTER:



I/O LOCATION = A1H

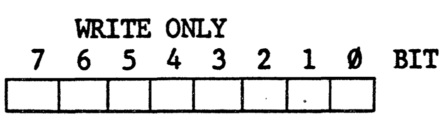
BIT 0: BUSY. This bit is one when the optional printer is busy. This bit is zero when the printer is ready to accept data from the VT-600.

BIT 1: V BLANK/. This bit is zero during the vertical blanking period.

BIT 2: 7/8 BITS. When the CPU reads a one at this bit, it programs the USART to use 7 bit words. When the CPU reads a zero at this bit, it programs the USART to use 8 bit words. The bit's state is set by a strap. For strap designations refer to Section 6.0.

BIT 7: VT DAT. This bit goes to one when data from the VT-100 or the host computer is placed in the GT-600's Data Input Register. This bit goes low when the GT-600 reads its Data Input Register.

B.13. PRINTER REGISTER:

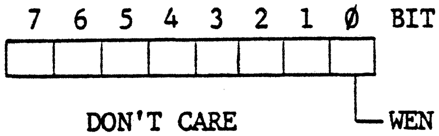


I/O LOCATION = A1H

Data to be sent to an external printer is loaded into this register.

B.14. WRITE CONTROL REGISTER

WRITE ONLY

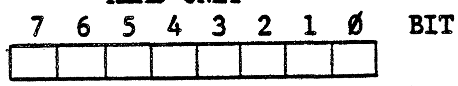


I/O LOCATION = A3H

BIT Ø: WEN. The CPU writes a one to this bit to enable writing to the Display Memory. It writes a zero to this bit to disable writing to the Display Memory.

B.15. DATA INPUT REGISTER:

READ ONLY

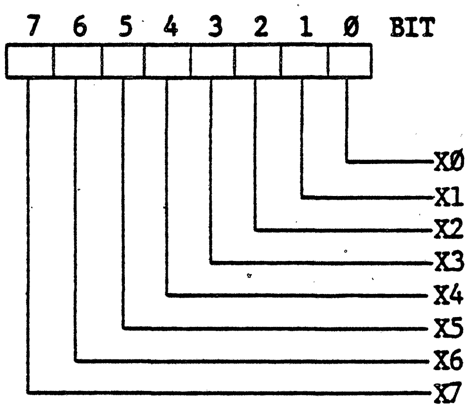


I/O LOCATION = A3H

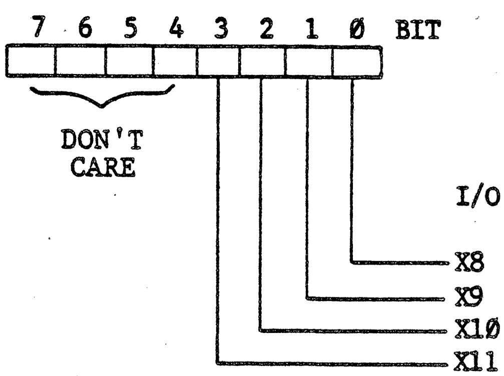
The VT-1ØØ passes data to the GT-6ØØ via this location.

B.16. X-REGISTERS:

READ/WRITE



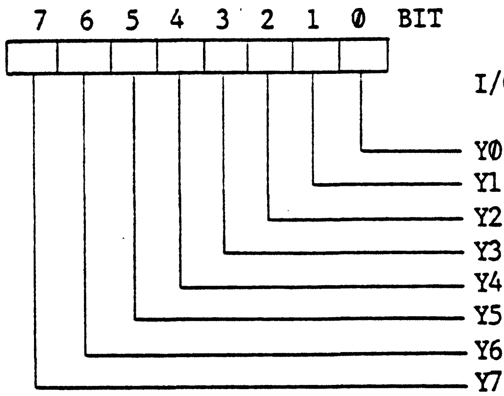
I/O LOCATION = A4H



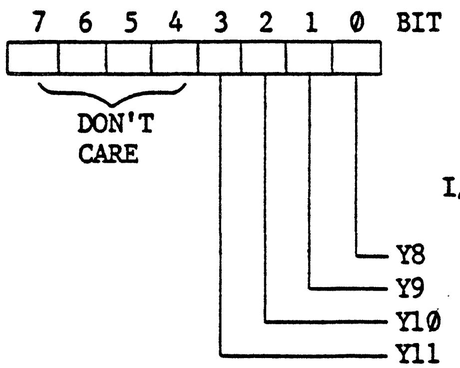
I/O LOCATION = A5H

The horizontal coordinate of the pixel location to be accessed is written to these registers which can also be read. The contents of these registers can also be modified via the Vector register.

B.17. Y-REGISTERS: (READ/WRITE)



I/O LOCATION = A6H



I/O LOCATION = A7H

The vertical coordinate of the pixel location to be accessed is written to these registers which can also be read. The contents of these registers can also be modified via the vector register.

B.18. REGISTER LOCATER:

REGISTER	CHIP NUMBER	REGISTER	CHIP NUMBER
VECTOR	A51,A53	COMMAND	A55,A68
PAN LOW	A88,A96	PAN HIGH	A58
SCROLL	A57	ZOOM	A56
DATA WRITE	A69	STATUS	A110
PRINTER	A123	WRITE CONTROL	A72
DATA READ	A70	X-LOW	A45,A53
X-HIGH	A52	Y-LOW	A43,A51
Y-HIGH	A44	USART #1	A10 (ON STP BOARD)
USART #2	A11 (ON STP BOARD)		

* * * * *

APPENDIX C. ASCII CODE TABLE:

BITS b4	b3	b2	b1	b7 Ø b6 Ø b5 Ø	b7 Ø b6 Ø b5 1	b7 Ø b6 1 b5 Ø	b7 Ø b6 1 b5 1	b7 1 b6 Ø b5 Ø	b7 1 b6 Ø b5 1	b7 1 b6 1 b5 Ø	b7 1 b6 1 b5 1
				CONTROL		HIGH X & Y GRAPHIC INPUT		LOW X		LOW Y	
Ø	Ø	Ø	Ø	NUL Ø	DLE 16	SP 32	Ø 48	@ 64	P 8Ø	\ 96	p 112
Ø	Ø	Ø	1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	a 97	q 113
Ø	Ø	1	Ø	STX 2	DC2 18	" 34	2 5Ø	B 66	R 82	b 98	r 114
Ø	Ø	1	1	ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
Ø	1	Ø	Ø	EOT 4	DC4 2Ø	$ 36	4 52	D 68	T 84	d 1ØØ	t 116
Ø	1	Ø	1	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 1Ø1	u 117
Ø	1	1	Ø	ACK 6	SYN 22	& 38	6 54	F 7Ø	V 86	f 1Ø2	v 118
Ø	1	1	1	BEL 7 BELL	ETB 23	' 39	7 55	G 71	W 87	g 1Ø3	w 119
1	Ø	Ø	Ø	BS 8 BACK SPACE	CAN 24	(4Ø	8 56	H 72	X 88	h 1Ø4	x 12Ø
1	Ø	Ø	1	HT 9	EM 25	) 41	9 57	I 73	Y 89	i 1Ø5	y 121
1	Ø	1	Ø	LF 1Ø LINE FEED	SUB 26	* 42	: 58	J 74	Z 9Ø	j 1Ø6	z 122
1	Ø	1	1	VT 11	ESC 27	+ 43	; 59	K 75	[91	k 1Ø7	{ 123
1	1	Ø	Ø	FF 12	FS 28	, 44	< 6Ø	L 76	\ 92	l 1Ø8	¦ 124
1	1	Ø	1	CR 13 RETURN	GS 29	- 45	= 61	M 77	] 93	m 1Ø9	} 125
1	1	1	Ø	SO 14	RS 3Ø	. 46	> 62	N 78	^ 94	n 11Ø	~ 126
1	1	1	1	SI 15	US 31	/ 47	? 63	O 79	_ 95	o 111	RUBOUT (DEL) 127

APPENDIX D. PRINTER INFORMATION.

The following sheets have been drawn from the C. Itoh M85ØØP technical manual to give the user information pertaining to printer requirements.

3. PARALLEL INTERFACE: M8500P

3-1. Data Input Method:	8-bit Parallel (DATA 1 - 8) (Bit 8 reserved for Japanese characters and graphics mode)
3-2. Control Signals:	$\overline{\text{ACK}}$, BUSY, SELECT, PE, $\overline{\text{DATA.STB}}$, $\overline{\text{INPUT-PRIME}}$, $\overline{\text{FAULT}}$, INPUT. BUSY
3-3. Data Input Codes:	ASCII, JIS 8 or 7-Bit, UK, GE, SW Codes, Character Generator Based Graphic Symbol Codes, Bit Image Graphic 8-Bit Codes
3-4. Data Buffer:	1.5K (Data receivable during printing, until the buffer becomes full)

3-5. Connectors:

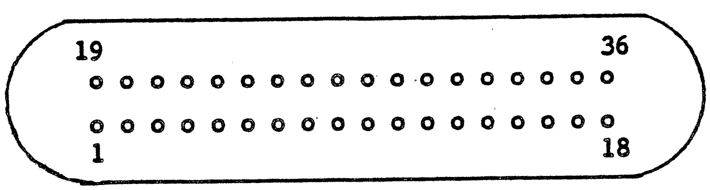
Printer: Japan AMP 552742-1 Connector or the equivalent
DDK 57L-40360-27C Connector or the equivalent

Cable: Japan AMP 552470-1 Connector or the equivalent
DDK 57-40360-1 Connector or the equivalent

APPENDIX D. PRINTER INFORMATION (cont'd).

3-6. Connector Pin Assignment Table

PIN NO.	SIGNAL NAME		PIN NO.	SIGNAL NAME	
1	$\overline{\text{DATA STB}}$		19	TWISTED PAIR GND	PIN 1
2	DATA	1	2Ø		2
3		2	21		3
4		3	22		4
5		4	23		5
6		5	24		6
7		6	25		7
8		7	26		8
9	DATA	8	27		9
1Ø	$\overline{\text{ACK}}$		28		1Ø
11	INPUT-BUSY		29		11
12	PE		3Ø	TWISTED PAIR GND	31
13	SELECT		31	$\overline{\text{INPUT - PRIME}}$	
14	OV		32	$\overline{\text{FAULT}}$	
15	NC		33	OV	
16	OV		34	NC	
17	CHASSIS GND		35	NC	
18	+ 5V DC		36	INPUT-BUSY	



NOTE: Pin 11 can be used for BUSY signal on the CPU PC board (jumper selectable).

Jumper No. J3: INPUT BUSY
J5: BUSY

Figure 17 Connector Pin Assignments

.PPENDIX D. PRINTER INFORMATION (cont'd).

3-7. Explanation of Control Signals

SIGNAL	FUNCTION
DATA 1-8	* 8-bit parallel input data signal (bit 8 reserved for Japanese characters); also used in graphics mode * Logic 1 represents HIGH level * Minimum data pulse width is 3 microseconds
DATA·STROBE or DATA·STB	* This is a synchronizing signal for reading-in the above data signal. * This signal is normally HIGH. The above data signal is clocked-in when DATA·STB is made LOW by the host computer. * Minimum pulse width is 1 microsecond
INPUT·PRIME	* This input signal brings the electronic controls of the printer to the initial state; however, this signal will not affect SELECT/DESELECT or the pre-set VFU conditions. * Upon receipt of this signal, all data stored in the DATA BUFFER will be printed; the printer will then return to the initial state. * This signal is normally HIGH. INPUT·PRIME is activated when the signal is LOW. * Minimum pulse width is 1 microsecond
ACKNOWLEDGE ACK	* The printer transmits this signal to the host computer after it has received and processed input data and performed any function commands. This signal indicates that the printer is ready to receive additional data or function codes. * The printer will not transmit this signal when a DC1 code is entered during PE status, nor in the case where a DC3 code is received under a SELECT state. * Nominal pulse width is 7 microseconds * This signal is normally HIGH. ACK is activated when the signal is LOW.

APPENDIX D. PRINTER INFORMATION (cont'd).

3-7. Explanation of Control Signals - Cont.

SIGNAL	FUNCTION
BUSY	* This is an output signal from the printer. When the signal is HIGH, no input codes or data except DC1 may enter the printer. * This signal will be HIGH (BUSY) under any of the following conditions: 1. The DATA BUFFER is full. 2. The printer is in the DESELECT state. 3. The printer is in the FAULT state. 4. An INPUT·PRIME code is received. (The BUSY status in this case will be cancelled after a specified period of time.)
SELECT	* This is an output signal from the printer, indicating whether the printer is in a SELECT or DESELECT state. * The signal is HIGH under SELECT and LOW under DESELECT. * SELECT state occurs under any of the following conditions: 1. The SEL switch is depressed under a DESELECT state. (However, if the SEL switch is depressed during a PE state, the printer will temporarily assume the SELECT state and print one line of data before returning to the DESELECT state. This override function enables the printing of the last few lines of a report, even under a PE state. 2. The DC1 code is received under a DESELECT state 3. The power switch is turned-on while the selector switch is closed. * DESELECT state will occur under any of the following conditions: 1. The SEL switch is depressed under a SELECT state. 2. A DC3 code is received. 3. The printer is in the PE state. 4. The power switch is turned-on while the selector switch is open. 5. The printer is in a FAULT state.

APPENDIX D. PRINTER INFORMATION (cont'd).

3-7. Explanation of Control Signals - Cont.

SIGNAL	FUNCTION
PAPER EMPTY (PE)	* This is an output signal from the printer indicating that the paper end is near (approx. 25mm from the paper's edge). PE status is also created when no paper is present. * This signal is activated by a micro switch located below the platen. * This signal is HIGH when activated.
$\overline{\text{FAULT}}$	* This is an output signal from the printer indicating printer FAULT state. * The signal is LOW during a FAULT state. * FAULT state occurs under any of the following conditions: 1. Under a PE state. (However, if the SEL switch is depressed during a FAULT state, the FAULT signal will temporarily become HIGH, enabling the printing of one line before returning to LOW.) 2. Under a DESELECT state. 3. An error or malfunction has occurred in the printer. (e.g., no timing pulses are generated) 4. Cover Open is detected.
INPUT BUSY	* This output signal is similar to the BUSY signal. When HIGH, INPUT·BUSY indicates that the printer is not ready to receive data. * INPUT·BUSY becomes HIGH whenever $\overline{\text{DATA·STB}}$ or BUSY is activated. * INPUT·BUSY becomes LOW when $\overline{\text{ACK}}$ is activated, either simultaneously with $\overline{\text{ACK}}$ or immediately after (depending on jumper-see Figure 18).
+5V DC	* This is not a signal. This is a +5V DC power source to an outside device. * The maximum output amperage is 5ØmA.

APPENDIX D. PRINTER INFORMATION (cont'd).

3-8. Timing Charts

(1) When data are being received

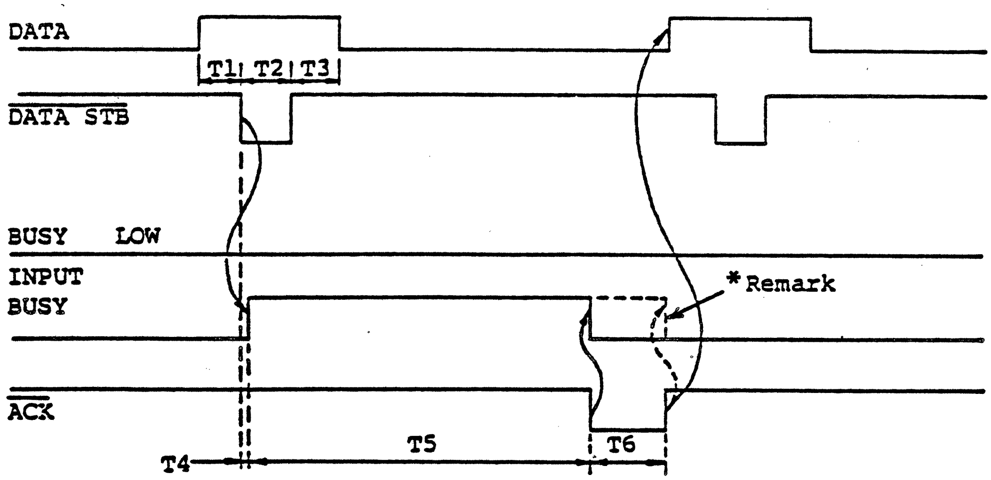


Figure 18 Timing Chart A

T1 ~ T3 = MIN 1 μs
T4 = MAX 1ØØ ns
T5 = Ø.1 ~ Ø.5 ms
T6 = 6 ~ 8 μs

*Remark - Jumper Selectable

The full line indicates the standard timing sequence (J2 connected).
The dotted line indicates the optional timing sequence (J1 connected).

(2) When the DATA BUFFER is full

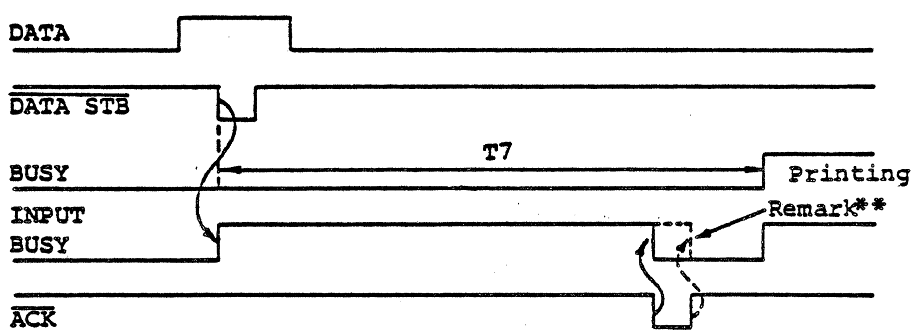


Figure 19 Timing Chart B

T7 = Ø.2m ~ 1.Øms

**Remark

BUSY is transmitted at Pin 11 when J5 is connected. INPUT BUSY is transmitted at Pin 11 when J3 is connected. J3 is the standard connection.

APPENDIX D. PRINTER INFORMATION (cont'd).

(3) When PE is detected in SELECT status

(a) When buffer is empty

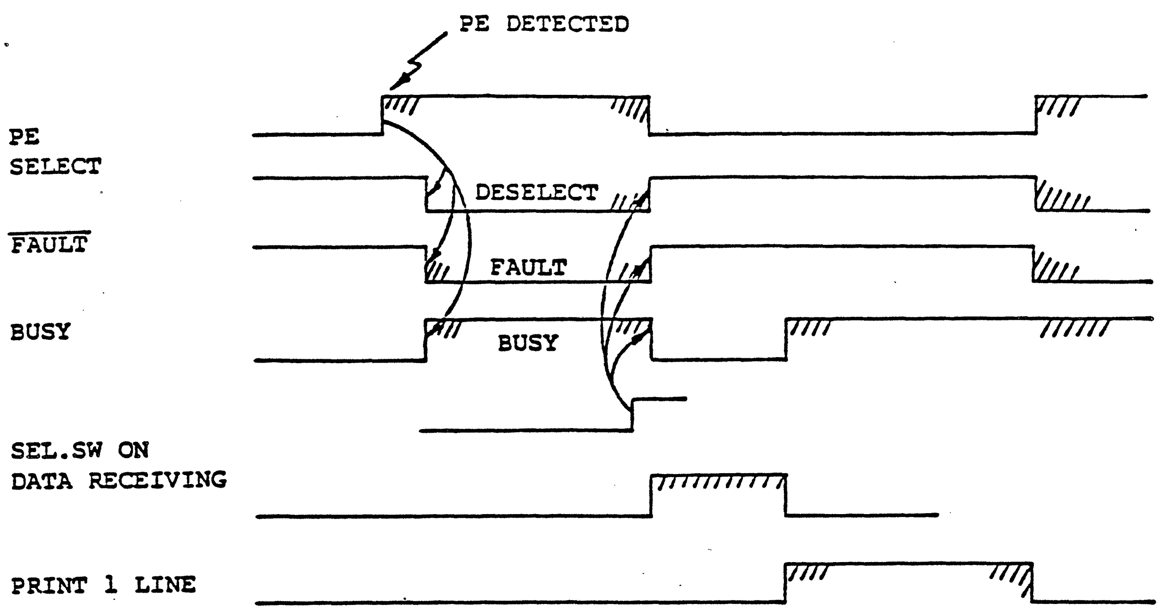


Figure 20 Timing Chart C

(b) When data remain in buffer

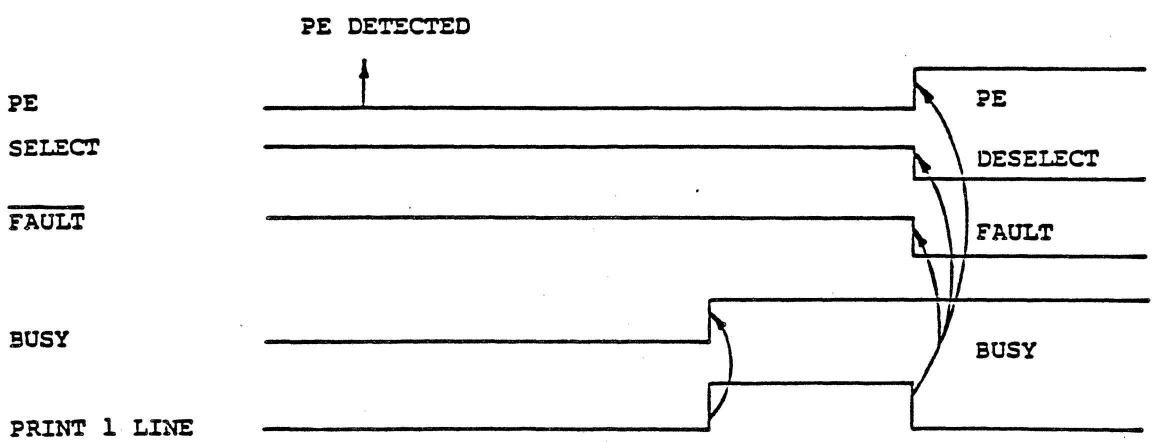


Figure 21 Timing Chart D

PPENDIX E GLOSSARY

The following glossary defines some of the terms used by MATROX, and should prove helpful when reading schematics or register bit names.

AB	Address Bus
ADDR	ADDRess
AEN	Address ENable
A. GND	Analog GrouND
ALTMAP	ALTernate Map
AR	Address Register
BAEN	Bus Address ENable
BB	Blink Background
BDAL	Bus Data Address Line (Ø-F)
BCLE	Bus CycLe Enable
BD	Bus Data
BDIN	Bus Data INput
BDMGI	Bus DMa Grant Input
BDMGO	Bus DMa Grant Output
BDOUT	Bus INITialization
BF	Blink Foreground
BIAKO	Bus Interrupt Acknowledged Output
BIAKI	Bus Interrupt Acknowledged Input
BIRQ4	Bus Interrupt ReQuest level 4
BRPLY	Bus RePLY
BSYNC	Bus SYNCronization
BUSPIR	BUS DIRection
CAS	Column Address Strobe
CBLAK	Composite BLAnKing
CBLANK	Composite BLANKing

APPENDIX E

GLOSSARY

CCLK	Cell CLocK/Continous CLocK
CG	Character Generator
C.G.M.	Character Generator Memory
C.H.P.	Character Height PROM
CLK	CLocK
CMD	CoMmanD
CMP	CoMParator
CO	Carry Out/Column Ø
COMP	COMPosite
CPU	CPU access to look-up table
CRT	Cathode Ray Tube
CRTC	Cathode Ray Tube Controller
CSYNC	Composite SYNC (HOR + VERT)
CUDISP	CUrsor DISPlay
DAC	Digital-Analog Converter
DAL	Data Address Line
DB	Data Bus
DCLK	Dot CLocK
DEC	DECoder
DECX	DECrement X
DECY	DECrement Y
D. GND	Digital GrouND
DIN	Data INput
DISPEN	DISPlay ENable
DISPTMG	DISPlay TiMinG

PPENDIX E

GLOSSARY

DOUT	Data OUTput
DOUTOR DIN	Data OUT or Data IN
DW	Data Write
EN	ENable (buffer for look-up table) (Ø-2)
EXH	EXtended Height
EXHE	EXtended Height
FDS	Frame Data Strobe
FGR	Frame GRab
HRS	Holding Register Storage
HSYNC	Horizontal SYNChronization
IAKI	Interrupt Acknowledged Input
INCX	INCrement X
INCY	INCrement Y
INIT	INITialize (Reset).
INTREQ	INTerrupt REQuest
INTRPLY	INTerrupt RePLY
LAD	Latched ADresses (Ø-a)
LD	LoaD clock
LPSTB	Light Pen STroBe
LSB	Least Signifigant Bit
MA	Refresh Memory Address
MACLK	Memory Access CLocK
MPU	MicroProcessor Unit
MPX	MultiPleXer
MSB	Most Signifigant Bit
MWR	Memory WRite

APPENDIX E

GLOSSARY

OFGN	OFfset and GaiN
P->S	Parallel-Serial Converter
PLL	Phase Lock Loop
PRMEM	PReset MEMory
RA	Raster Address/RAM Address
RAS	Row Address Strobe
R/C	Row/Column
REF	REFerence
RES	RESolution
RM	Refresh Memory
RS	Register Select
R Status	Read STATUS
SCLK	System CLocK
SD	Serial Data
SEL	SELect
SH/LD	SHift/LoaD
SYN RD	ReaD SYNchronize
SYN WR	WRite SYNchronize
TEXT	TEXTure
T.P.	Test Point (Ø-11)
ULN	UnderLiNe
VB	Video Bus (Ø-7)
VCO	Voltage Controlled Oscillator
VDO	ViDeO

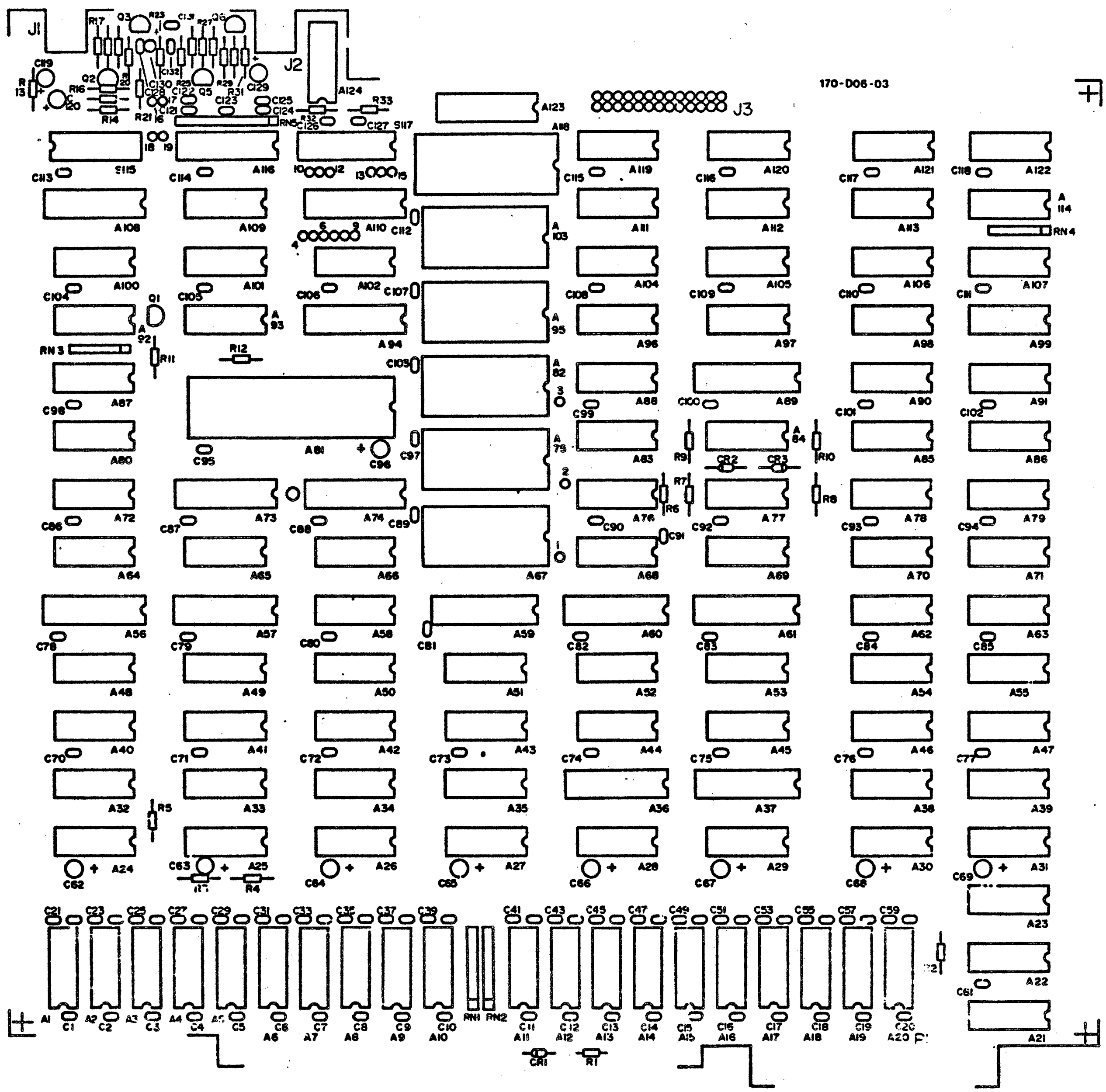
PPENDIX E

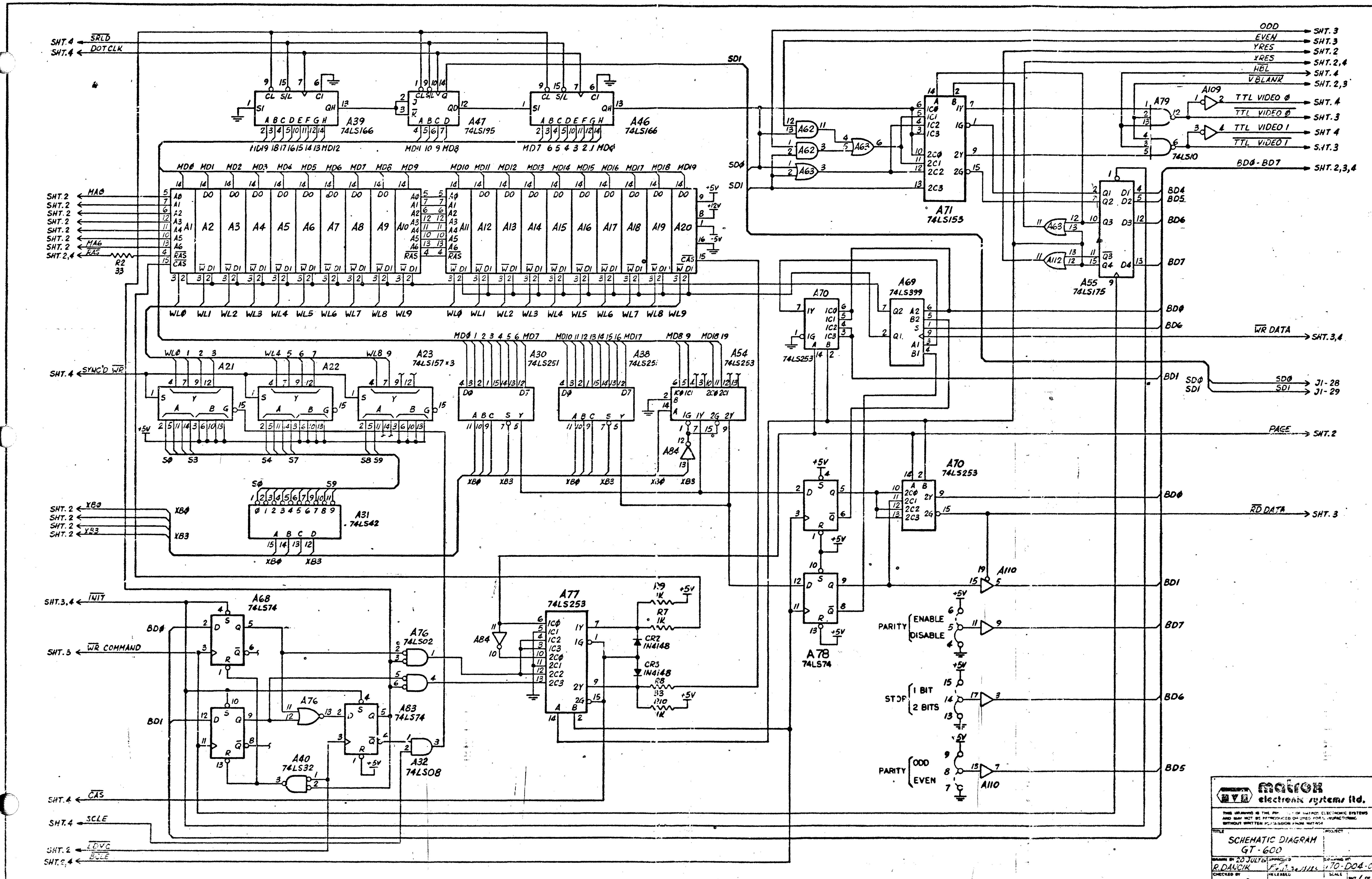
GLOSSARY

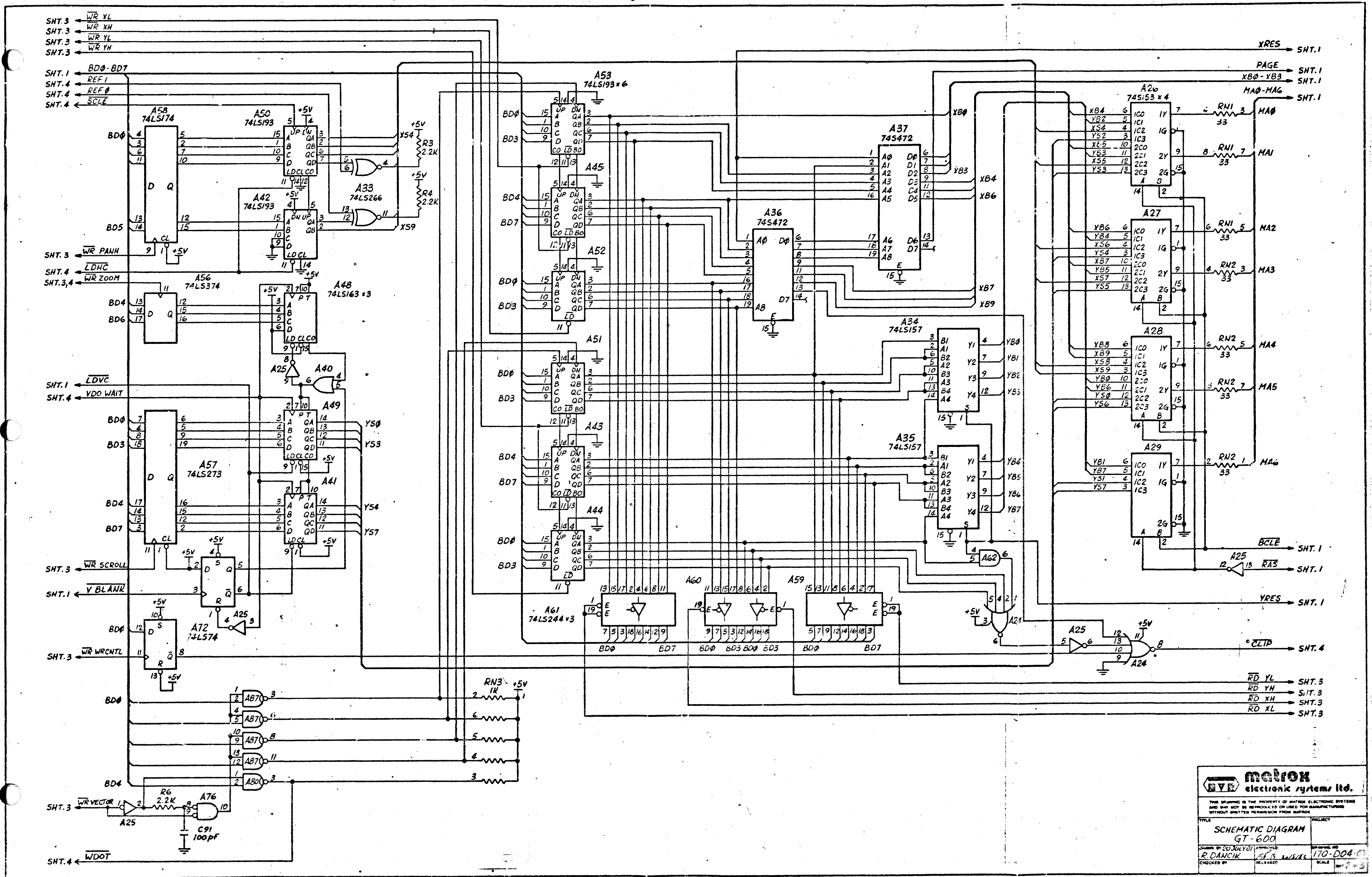
VEN	Video ENable
VFRAM	start of new FRAMe
VFU	Vertical Format Unit
V. RESET	Vertical Reset
VSYNC	Vertical SYNChronization
WCRTC	Write to CRTC
W DATA H	Write DATA High
W DATA L	Write DATA Low
WDOT	Write DOT
WEN	Write ENable
WR	WRite (look-up table)
WRS	WRiteStrobe
WRT	WRite Texture
XON	Transmit ON (ready for more data)
XOFF	Transmit OFF (buffer almost full, stop sending)

* * * * *

APPENDIX F. SCHEMATICS




matrox electronic systems ltd.
SCHEMATIC DIAGRAM
GT-600
R. DANCIK
70-D04-03
SHT 1 OF 5



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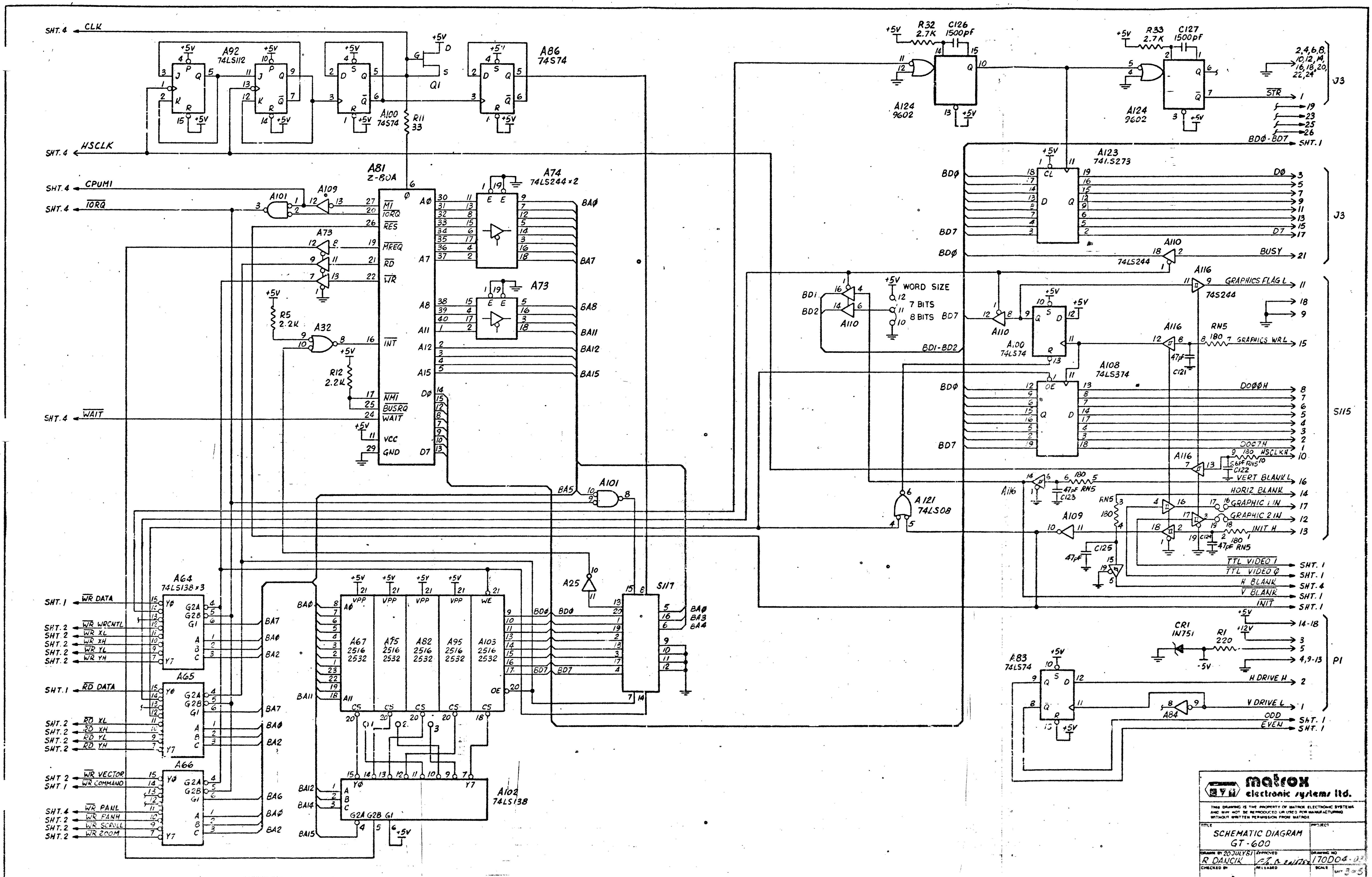
SCHEMATIC DIAGRAM
GT-600
R. DANCIK
20 JULY 81
170-D04
A58 74LS174
A50 74LS193
A42 74LS193
A33 74LS266
A56 74LS374
A48 74LS163 x3
A57 74LS273
A72 74LS74
A53 74LS193 x 6
A37 74S472
A36 74S472
A26 74S153 x 4
A34 74LS157
A35 74LS157
A61 74LS244 x3
RN3 1K
R6 2.2K
C91 100pF
R3 2.2K
R4 2.2K
WR XL
WR XH
WR YL
WR YH
BDØ-BD7
REF I
REF Ø
SCLE
WR PANH
LDHC
WR ZOOM
LDVC
VDO WAIT
WR SCROLL
V BLANK
WR WRCNTL
WR VECTOR
WDOT
XRES
PAGE
XBØ-XB3
MAØ-MA6
BCLE
RAS
YRES
CLIP
RD YL
RD YH
RD XH
RD XL



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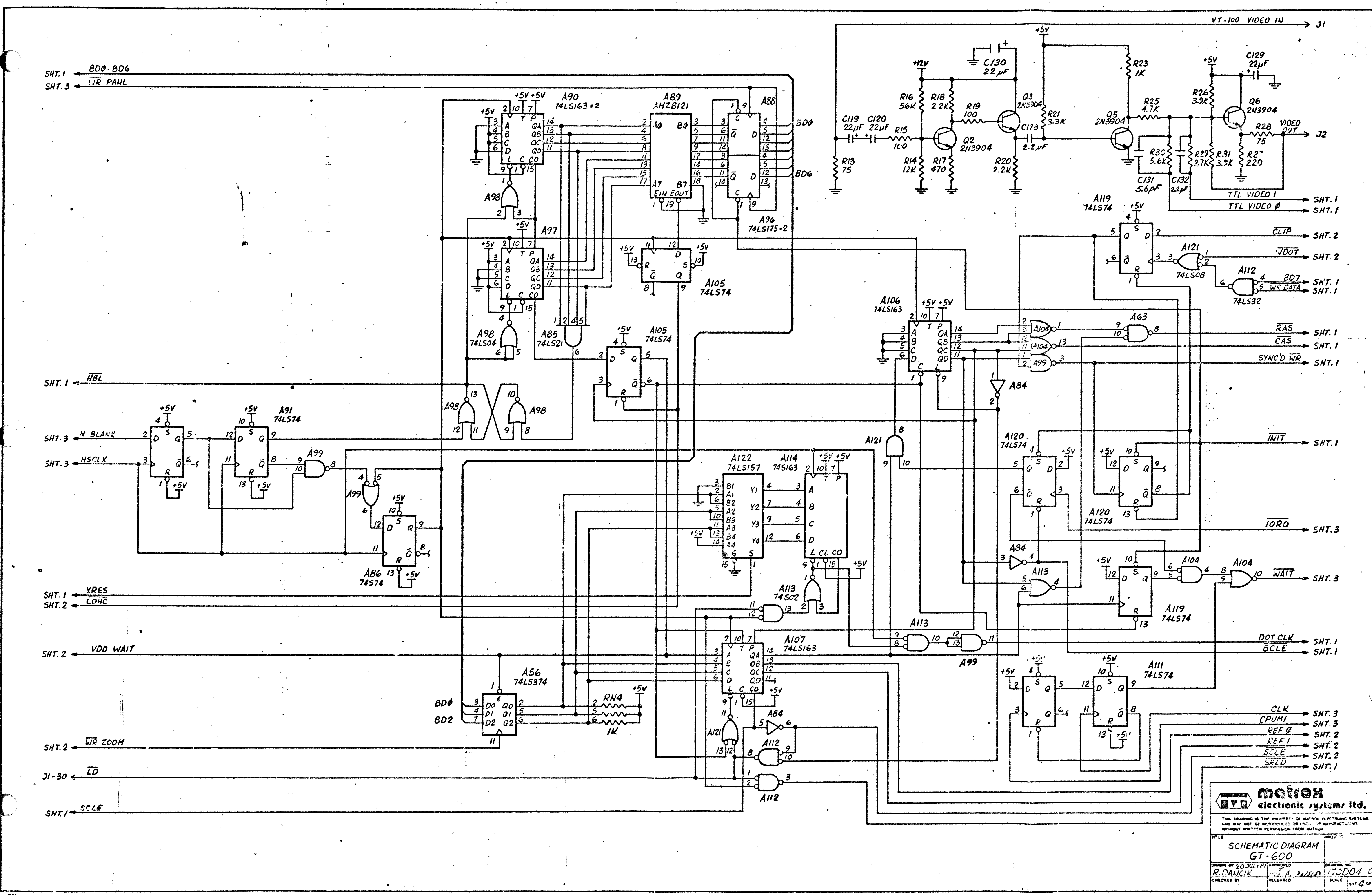
DRAWING NO: 170D04-0

SHT 3 OF 5



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GT-600

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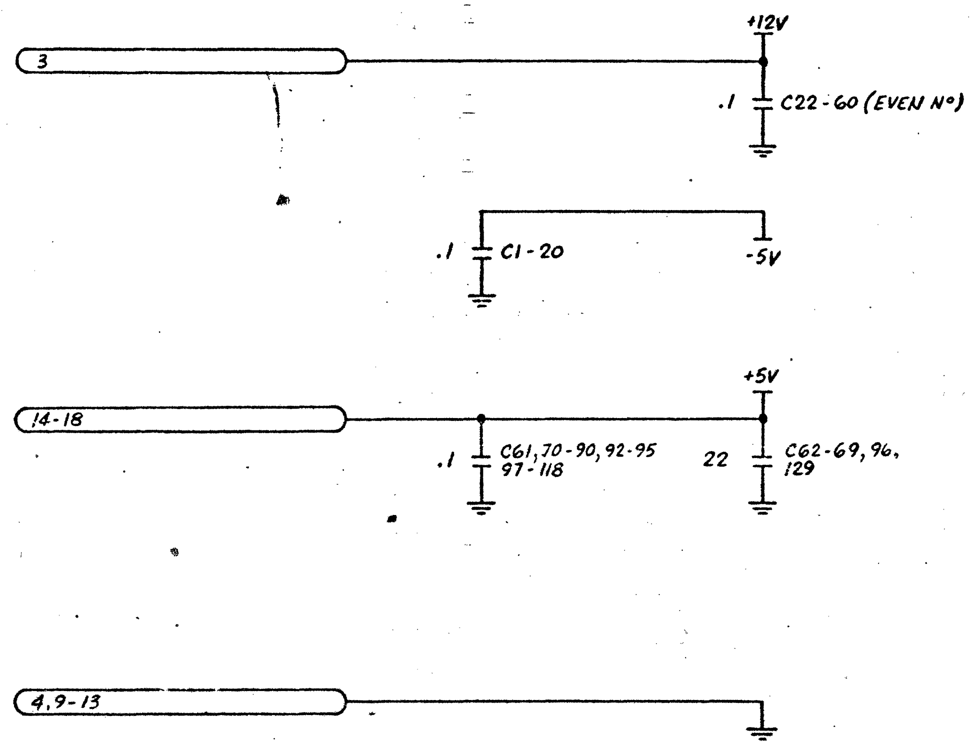
DRAWING NO. 170D04-03
SHT 4 of 5



PARTS #	IC REFERENCE	+5V	-5V	+12V	-12V	GND
74LS00	A99	14				7
74S02	A104, 113	14				7
74LS02	A76, 98	14				7
74LS04	A25, 84, 109	14				7
74LS08	A32, 62, 121	14				7
74LS10	A79	14				7
74LS21	A85	14				7
7425	A24	14				7
74LS32	A40, 63, 101, 112	14				7
74LS38	A80, 87	14				7
74LS42	A31	16				8
74S74	A91, 100, 86	14				7
74LS74	A68, 72, 78, 83, 105, 111, 119, 120	14				7
74LS112	A92	16				8
74LS138	A64, 65, 66, 102	16				8
74S153	A26, 27, 28, 29	16				8
74LS157	A21-23, 34, 35, 122	16				8
74LS163	A41, 48, 49, 90, 97, 106, 107	16				8
74S163	A114	16				8
74LS166	A39, 46	16				8
74LS174	A58	16				8
74LS175	A55, 88, 96	16				8
74LS193	A42-45, 50-53	16				8
74LS195	A47	16				8
74LS244	A59-61, 73, 74, 110 A116	20				10
						10
74LS251	A30, 38	16				
74LS253	A54, 70, 77	16				8
74LS266	A33	14				7
74LS273	A57, 123	20				10
74LS374	A56, 108	20				10
74LS399	A69	16				8
74S472	A36, 37	20				10
Z-80A	A81	11				29
TMS2532	A67, 75, 82, 95	24				12
4116-200	A1-20	9	1	8		16
AMZ-8121	A89	20				10
8251A	A118	26				4
9602	A124	16				8
4016-300	A103	24				12
74LS153	A71	16				8

PARTS #	IC REFERENCE	SPARES
74LS10	A79	1
74LS04	A109	2
74LS08	A32	2
74LS21	A85	1
74LS32	A40	2
74LS32	A101	2
74LS38	A80	3
74LS244	A73	1
74LS266	A33	2
74LS08	A62	1

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   - ALL RESISTANCES ARE IN OHMS, 1/4, 10%.
   - ALL CAPACITORS ARE MICROFARAD.

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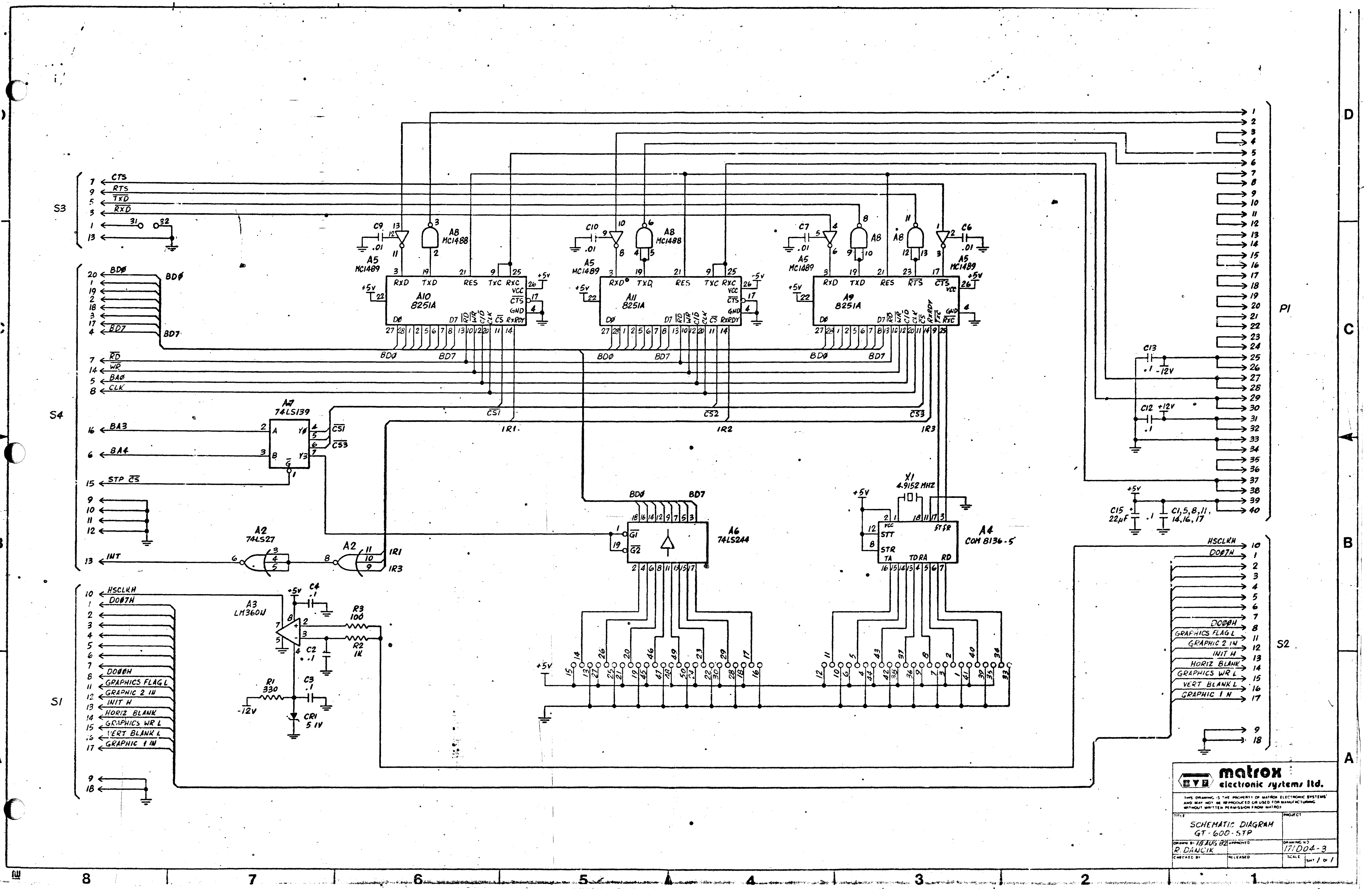
SCALE	SHT 5 OF 5



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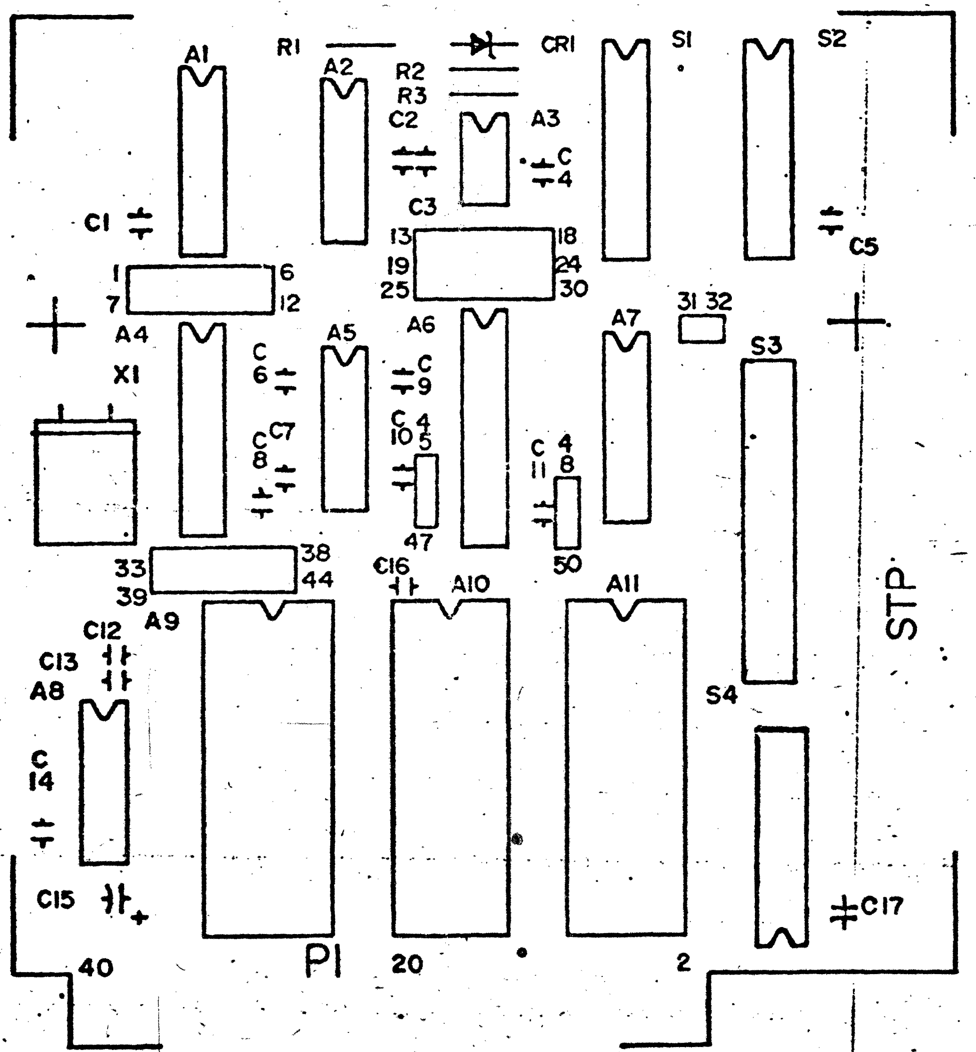
SHT 1 OF 1



SILKSCREEN

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DRAWING NO: 171-C05-3	CHECKED BY: TT 30 SEPT 1982
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GT-600A

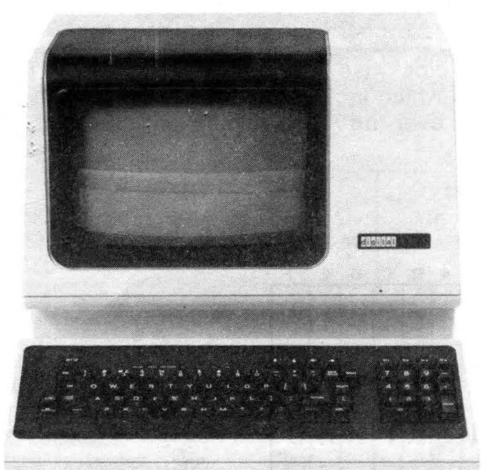
GRAPHICS UPGRADE BOARD FOR VT-100 TERMINAL

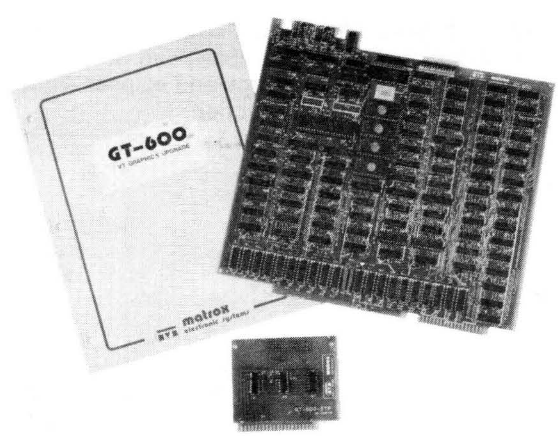
- **Tektronix 4016 emulation**
- **PLOT-10 software compatibility**
- **Programmable resolution: 640 x 480, 1280 x 240, 640 x 240 x 2**
- **Pan, Zoom, and Scroll**
- **Printer interface (C.ITOH 8510A)**
- **VT-100, VT-103 compatible**
- **Vector generation for lines and circles**
- **Simple installation**
- **Low cost**

The Matrox GT-600 is a low cost/high performance plug in graphics board that upgrades the popular DEC VT-100 (VT-103) alphanumeric terminal to a graphics terminal. The on-board Z-80A CPU, resident firmware, and high speed vector generation make the GT-600/VT-100 combination an extremely powerful graphics terminal at a very low cost.

The powerful set of commands includes a subset emulation of the Tektronix 4010 series of graphic terminals. Existing Plot-10* based software is immediately transportable to the upgraded terminal without any change. In addition to executing all of the Tektronix 4010, 4014, 4016 commands, the GT-600 has many other enhancements. Included are generation of arcs and ellipses, a 96 ASCII character set with an inclined character baseline, software selection of pen size, pen aspect ratio, dashed line format, and high speed whole screen or selective area erase. Hardware functions include: pan (X direction) and scroll (Y direction) on a per pixel basis, independent X, Y zoom (from 1 to 8), and hardware erase.

Matrox's unique user defined resolution feature allows the software selection of four possible display configurations which are: 1280 x 240 x 1, 640 x 480 x 1, 640 x 240 x 2 (logical OR), and 64 x 240 x 2 (4 level grey scale). Automatic scaling from 1024 x 1024 input format can be selected for all configurations.





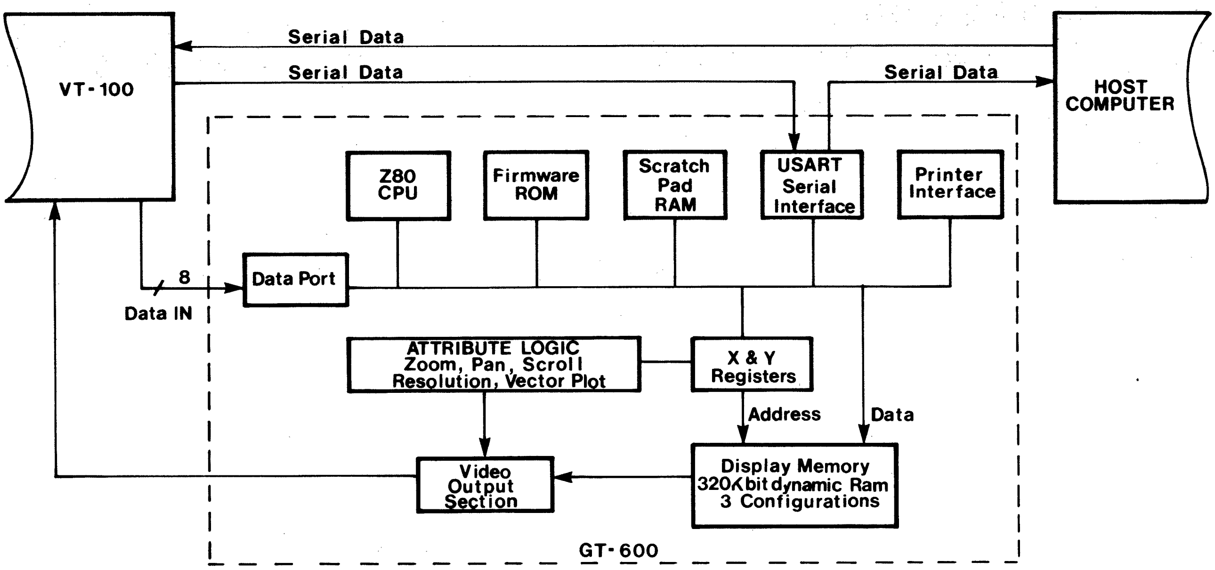


Figure 1. GT-600 block diagram

FUNCTIONAL DESCRIPTION

The Matrox GT-600 is a plug-in graphics add-on board for the VT-100 and VT-103 alphanumeric terminals manufactured by Digital Equipment Corp. (DEC). When installed, it allows these terminals to emulate the Tektronix 401x (4010, 4014, 4016) series of graphic terminals and provides compatibility with the powerful PLOT-10 graphics package, also from Tektronix. In addition to its Tektronix compatible functions, the GT-600 provides a number of useful supplementary functions which can be exploited by the user.

DISPLAY

The GT-600 features a unique user-definable resolution capability which allows the operator to select one of three available display configurations: 1280 x 240, 640 x 480, or 640 x 240 x 2. The third resolution option (640 x 240 x 2) is stored as two independent 640 x 240 bit planes. The two planes can be selected to be logically ORed together, (overlay), or used as intensity control bits to produce a 4 level grey scale image. The GT-600 also supports an automatic scaling feature which allows the user to run PLOT-10 software with any of the three format resolutions provided. When scaling is enabled, the GT-600 looks like the 1024 x 740 display used by the Tektronix 401x series terminals. Addresses and distance parameters sent by the host computer are automatically scaled to be compatible with the current display format resolution whether it be 1280 x 240, 640 x 480, or 640 x 240.

Every point on the display can be individually addressed and points can be drawn by simply defining the X and Y coordinates of the desired location (Point Plot Mode). Furthermore, strings of dots can be plotted on the GT-600 using relative address commands (Incremental Point Plot Mode). This mode enables the user to draw a line, up to 16 dots in length, from the present cursor position in any one of eight directions. Absolute vectors are drawn from the cursor position to a point whose X-Y coordinates are defined by the user. Line formats used to draw vectors are user selectable as solid, dashed, or dotted with the exact duty cycle defined in a special instruction.

The GT-600 allows the user to draw arcs and ellipses to the display using three simple commands. Arcs can be drawn in 90° segments with the arc's radius and direction (clockwise/counter-clockwise) information imbedded in the Draw Arc instruction. Similiarly ellipses can be drawn with a single instruction which includes the dimensions of the ellipse. The aspect ratio for both arcs and ellipses (ratio of the Y axis dimension over the X axis dimension) can be defined by the user in a separate instruction.

LOW ORDER HEX DIGIT OF ASCII CODE

HIGH ORDER HEX DIGIT OF ASCII CODE

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

Figure 2. Alpha Mode character set

A crosshair graphics cursor is supported on board the GT-600 for efficient user-display interaction. The graphics cursor is positioned with the keyboard's cursor arrow keys which enable left, right, up, and down movement. Keeping any one of these keys depressed will cause the cursor to move continuously in the corresponding direction at an ever increasing rate.

ALPHANUMERICS

The GT-600's Alpha Mode allows for maximum flexibility in applying alphanumeric labels to the graphics display. The GT-600 supports a font of 96 upper/lower case alphanumeric characters (Figure 2) that are normally displayed light on a dark background. Up to 160 characters can be displayed per line on a maximum of 30 lines per page. Furthermore, the GT-600 supports two independent margins to allow two full pages of textual data to be displayed simultaneously (80 x 30 characters per page). The displayed characters are formed in a 5 x 7 "pen point" matrix within a 8 x 8 pen point character cell.

Several software commands are recognized by the GT-600 to set the alphanumeric display format. A variable baseline feature allows the user to display characters on a slope. The offset between characters can be up to 128 pen points up or down. Horizontal spacing between characters is also user selectable. Inserting a negative value for inter-character spacing allows the user to enter alphanumeric characters backwards (i.e. from right to left). The attitude of the displayed characters can be set to normal (rightside-up), upside-down, or oriented to the right or left.

CONTROLS

The GT-600 allows the user to set the size of the display "pen". Through this feature the operator can vary the width of the displayed lines: useful in creating bar graphs. By increasing the pen size, the user can also increase the size of the displayed alphanumeric characters.

A group of commands enable the user to manipulate the position of the display. Seperate commands are used to shift the display either vertically (scroll) or horizontally (pan) by an operator defined number of pixels. The GT-600 can also zoom in one any segment of the display (Zoom Window). This Zoom Window can be expanded by independent X and Y factors of 2 through 8.

VIDEO INTERFACE

The GT-600 can be used to drive an external monitor as well as the VT-100 display. Using sync signals generated within the VT terminal, the GT-600 provides a 1Vp-p composite video signal.

PRINTER INTERFACE

A parallel printer port is provided on the GT-600 to drive an external hard copy device. The standard GT-600 firmware supports a C.ITOH model 8510A Prowriter (drivers for other printers are available on special request).

INSTALLATION

The GT-600 is supplied with all the supplementary material required for installation. Once installed the GT-600 interfaces with the VT-terminal (VT-100 or VT-103) and the host computer as illustrated in figure 1. When the VT-terminal is operating in its normal manner, the GT-600 is transparent and has no effect on the system. However, once control has been given to the GT-600, serial data from the host computer is automatically forwarded to it via the 8-bit parallel port on the VT-terminal's Graphics Connector. The GT-600 sends data to the host computer through it's serial interface which is tied into the serial line coming from the VT-terminal. Serial data coming from the VT-terminal, however, passes through this interface on its way to the host computer without affecting the GT-600's operation.

PROGRAMMING

Upon initialization, all of the GT-600's attributes and special functions are configured to emulate the Tektronix 401X series graphics terminals. This emulator configuration, called the Tek Configuration, is special because it can not be changed until a modification enabling command is sent, and it can be returned to any time by sending a return command. If changes to attributes are attempted while in the Tek Configuration, the changed parameters will be stored but will not take effect until the modification enable command is received.

FORMAT RESOLUTION	1240 X 240
SCALING	On
PEN ASPECT RATIO	Y/X = 1/1
PEN SIZE	1
LINE FORMAT	Solid lines
HORIZONTAL IMAGE SHIFT	0
VERTICAL IMAGE SHIFT	0
ZOOM	Zoom by one
ELLIPSE & ARC ASPECT RATIO	Y/X = 1/1
PEN COLOR	Bit plane 0 = light/bit plane 1 = dark
VIDEO DISABLE	Video 0 = enable/video 1 = disable
STATUS TERMINATION	CR
ALPHANUMERIC OFFSET	Vertical = 0/horizontal = 0
ATTITUDE	Normal

Table 1. Tek Configuration

A series of numbered wire-wrap pins are also included to implement various serial interface formats. The user can select to use either 7 or 8-bit data words and 1 or 2 stop bits. The user can also select either even, odd, or no parity.

SPECIFICATIONS

OPERATING MODES

TRANSPARENT MODE

- In this mode the GT-600 becomes inactive and the VT-100 behaves exactly as it would without the add-on board

ALPHA MODE

- Full ASCII character set
- User selectable character size: (8 x 8 to 255 x 255)
- Variable slope character baseline
- Inverse vidéo alpha cursor
- Selectable character shape (tall/thin, short/wide)

POINT PLOT MODE

- Absolute addressing of points

INCREMENTAL POINT PLOT MODE

- Relative addressing in any one of 8 directions
- "Long" form allows condensing of up to 16 moves in the same direction for compact representations of user defined fonts, etc.

VECTOR MODE

- Absolute addressing of vectors
- User selectable line formats (solid, dashed, dotted)
- Can intermix commands for arcs and ellipses
- Variable line width (1 - 255)

COMMAND SET

DRAW

- Absolute vector
- Incremental vector
- Point plot
- Arc (size, quadrant)
- Ellipse (size)
- Text

ALPHA CURSOR

- Move right space
- Backspace
- Linefeed
- Vertical tab
- Carriage return

HARDCOPY

- Output to parallel port

STATUS INQUIRY

- Graphic cursor position
- Current pen position
- Current alpha position

SET ATTRIBUTES

- Pen size
- Pen color
- Pen aspect ratio
- Ellipse aspect ratio
- Dash line format
- Character baseline slope
- Character orientation

GRAPHIC INPUT CROSSHAIR CURSOR

- Load start location
- Move crosshair cursor

SET SPECIAL FUNCTIONS

- Pan
- Scroll
- Zoom
- Preset (clear) screen
- Video enable

SELECT

- Resolution
- Scaling
- Tektronix emulator mode
- Point Plot Mode
- Incremental Point Plot Mode
- Vector Mode
- Crosshair Cursor Mode
- Graphics Input Mode
- Graphic Input Mode termination string

VIDEO SPECIFICATIONS

RESOLUTION

- 1280 x 240 x 1 bit
- 640 x 480 x 1 bit
- 640 x 240 x 2 bit (logical OR)
- 640 x 240 x 2 bit (grey scale)

VIDEO OUTPUT

- RS-170 composite video (75 ohm)
- Separate output for external monitor

HARDWARE FUNCTION GENERATOR

- Clear screen (16.6 ms)
- X, Y zoom (from 1 to 8)
- X, Y pan and scroll (single pixel and up)

PHYSICAL SPECIFICATIONS

POWER REQUIREMENTS

- +5V @ 2A
- +12V @ 500mA
- +12V @ 100mA

ENVIRONMENTAL REQUIREMENTS

- Operating Temperature: 10° to 40° C
- Relative Humidity: 10 to 90% (non-condensing)

ORDERING INFORMATION

The GT-600A is ordered as a complete kit and contains:

- one video and processor board that plugs into the VT terminal Graphics Board connector
- a serial interface card (4.5" x 1.275") that plugs into the terminal control board
- a backplane
- all mounting hardware
- technical manual

- the GT-600A is compatible with the VT-100, VT-103, VT-125, and VT-132.

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PRODUCT FAILURE REPORT

If you are returning one of our products for repair, you must fill out this form and return it with the defective unit. The information so provided is necessary for us to provide a high standard of service.

COMPANY NAME AND ADDRESS: ______________________________

____

NAME OF UNIT: ______________________________

MODEL NO.(on silkscreen): ______________ SERIAL NO.(on label): ______________

DATE UNIT RECEIVED: __________ DATE UNIT FAILED: __________ OR DEAD ON ARRIVAL [ ].

MEMORY BASE ADDRESS USED: ______________ I/O BASE ADDRESS USED: ______________

PLEASE DESCRIBE THE SYSTEM THAT THE UNIT IS USED IN (CPU,BUS,MEMORY,ETC.): __________

____

____

____

UNIT CONFIGURATION (50 or 60 Hz, attributes used, display resolution selected, etc.): ______________________________

____

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____

____

FAULT IS CONSTANT [ ] FAULT IS INTERMITTENT [ ]

PLEASE DESCRIBE THE FAULT: ______________________________

____

____

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THE FOLLOWING SPACE IS FOR FACTORY USE ONLY

CORRECTIVE STEPS TAKEN: ______________________________

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