

VT105 GRAPHIC TERMINAL TECHNICAL MANUAL

First Edition, September 1979

Copyright © 1979 by Digital Equipment Corporation

The material in this manual is for informational purposes and is subject to change without notice.

Digital Equipment Corporation assumes no responsibility for any errors which may appear in this manual.

Printed in U.S.A.

This document was set on DIGITAL's DECset-8000 computerized typesetting system.

The following are trademarks of Digital Equipment Corporation, Maynard, Massachusetts:

DIGITAL	DECsystem-10	MASSBUS
DEC	DECSYSTEM-20	OMNIBUS
PDP	DIBOL	OS/8
DECUS	EDUSYSTEM	RSTS
UNIBUS	VAX	RSX
	VMS	IAS

CONTENTS

	Page
CHAPTER 1	OPERATOR INFORMATION
1.1	INTRODUCTION.....1-1
1.2	CONTROLS AND INDICATORS.....1-1
1.2.1	Monitor Controls.....1-4
1.2.2	Keyboard Controls.....1-4
1.2.3	Keyboard Indicators.....1-9
1.2.4	Audible Indicators (Tones).....1-9
1.3	SET-UP MODE.....1-11
1.3.1	Determining What a Set-Up Feature Does.....1-11
1.3.2	How to Change a Set-Up Feature.....1-12
1.3.3	Set-Up A.....1-14
1.3.4	Set-Up B (Operational Features).....1-16
1.3.5	Setting the Answerback Message.....1-18
1.3.6	Saving the Set-Up Features.....1-18
1.3.7	Recalling Set-Up Features.....1-19
1.3.8	Resetting the Terminal.....1-19
1.4	DEFINITION OF EACH SET-UP FEATURE.....1-19
1.5	SELF-TESTING THE VT105.....1-24
1.6	WHAT TO DO IN THE EVENT OF A PROBLEM.....1-25
1.7	RELATED HARDWARE MANUALS.....1-27
CHAPTER 2	PROGRAMMER INFORMATION
2.1	INTRODUCTION.....2-1
2.2	THE KEYBOARD.....2-1
2.2.1	LED Indicators.....2-1
2.2.2	SET-UP Key.....2-1
2.2.3	Keyboard Operation.....2-3
2.2.4	Alphabetic Keys.....2-3
2.2.5	Nonalphabetic Keys.....2-3
2.2.6	Function Keys.....2-4
2.2.7	NO SCROLL Key.....2-4
2.2.8	BREAK Key.....2-4
2.2.9	CTRL (Control) Key.....2-6
2.2.10	Cursor Control Keys.....2-7
2.2.11	Auto Repeating.....2-7
2.2.12	Special Graphic Characters.....2-7
2.2.13	Auxiliary Keypad.....2-7
2.3	TERMINAL CONTROL COMMANDS.....2-10
2.3.1	Control Characters.....2-10
2.4	CONTROL FUNCTIONS.....2-10
2.4.1	ANSI Mode Control Functions.....2-10
2.4.2	Modes.....2-23
2.4.2.1	ANSI Specified Modes.....2-23
2.4.2.2	DIGITAL Private Modes.....2-23
2.4.2.3	Other ANSI Mode States.....2-24
2.4.3	ANSI Control Function Summary.....2-24

CONTENTS (Cont)

	Page
2.4.4	VT52 Mode Control Functions.....2-28
2.5	COMMUNICATION PROTOCOL.....2-31
2.5.1	Full Duplex – XON/XOFF Response .....2-31
2.5.2	Reset and Self-Test .....2-32
2.5.3	NO SCROLL and CTRL S/CTRL Q .....2-33
 CHAPTER 3 GRAPH DRAWING	
3.1	INTRODUCTION.....3-1
3.2	ENTERING THE GRAPH DRAWING MODE.....3-1
3.3	DEFINITIONS AND LIMITATIONS .....3-1
3.4	SELECTING THE GRAPH DRAWING FIELD.....3-8
3.5	SELECTING DESIRED DISPLAY.....3-9
3.5.1	Loading Control Register 0 .....3-9
3.5.2	Enabling Graphs and Histograms (Shaded Graphs).....3-13
3.5.3	Enabling Strip Charts and Shade Lines (Baselines).....3-13
3.5.4	Loading Control Register 1.....3-13
3.5.5	Enabling Graph Markers, Vertical Lines, and Horizontal Lines.....3-13
3.6	FORMING GRAPH DRAWING DATA CHARACTERS.....3-13
3.6.1	Selecting Upper and Lower Data Characters.....3-17
3.6.2	Load Data Sequences .....3-17
3.6.3	Frequent Data Entry Errors.....3-17
3.7	LOADING THE SHADE LINE (BASELINE).....3-18
3.8	LOADING GRAPH MEMORIES.....3-18
3.9	HISTOGRAM DATA .....3-20
3.10	LOADING GRAPH MARKER MEMORY.....3-20
3.11	DISPLAYING VERTICAL LINES .....3-22
3.12	DISPLAYING HORIZONTAL LINES .....3-23
3.13	LOAD THE STARTING X-COORDINATE.....3-24
3.14	ENTERING STRIP CHART DATA .....3-25
3.14.1	Single Strip Chart Data.....3-25
3.14.2	Dual Strip Chart Data .....3-25
 CHAPTER 4 INSTALLATION, INTERFACE INFORMATION, AND SPECIFICATIONS	
4.1	UNPACKING .....4-1
4.2	SITE CONSIDERATIONS.....4-1
4.3	INSTALLATION.....4-1
4.4	INTERFACE INFORMATION.....4-4
4.4.1	EIA Interface and Electrical Characteristics.....4-4
4.4.2	Optional 20 mA Current Loop Interface.....4-4
4.5	EXTERNAL VIDEO CONNECTION.....4-6
4.5.1	Composite Video Output (J9).....4-8
4.5.2	Video Input (J8) .....4-8
4.6	TERMINAL CONTROLLER MODULE (54-13009).....4-10
4.7	WAVEFORM GENERATOR MODULE (M7071) .....4-11
4.7.1	Waveform Generator Checkout.....4-14

CONTENTS (Cont)

		Page
4.8	EXPANSION BACKPLANE (54-13384).....	4-14
4.9	DC POWER HARNESS (70-14978).....	4-14
4.10	CUSTOMER EQUIPMENT CARE.....	4-16
4.11	VT105 SPECIFICATIONS.....	4-16
CHAPTER 5	OPTIONS	
5.1	20 mA CURRENT LOOP OPTION – VT1XX-AA	5-1
5.1.1	20 mA Current Loop Option Installation.....	5-1
5.1.2	20 mA Current Loop Option Checkout.....	5-4
5.2	ADVANCED VIDEO OPTION – VT1XX-AB.....	5-4
5.2.1	Advanced Video Option Installation.....	5-5
5.2.2	Advanced Video Option Checkout	5-6
5.3	COMMUNICATION CABLES.....	5-8
CHAPTER 6	TECHNICAL DESCRIPTION	
6.1	INTRODUCTION.....	6-1
6.2	ENABLING GRAPHIC INFORMATION	6-1
6.2.1	Writing Data to the Waveform Generator (Block Diagram Discussion).....	6-2
6.2.2	Reading Data from the Waveform Generator (Block Diagram Discussion).....	6-4
6.3	DECODING THE INPUT.....	6-6
6.4	SELECTING MODE OF OPERATION.....	6-6
6.4.1	Rectangular Aspect Ratio.....	6-6
6.4.2	Square Aspect Ratio.....	6-7
6.4.3	Decoding Field Selection	6-8
6.5	PHASE LOCK LOOP TIMING.....	6-8
6.6	ESTABLISHING DESIRED DISPLAY.....	6-8
6.6.1	Loading Register 0.....	6-11
6.6.2	Loading Register 1.....	6-12
6.7	LOADING X-ADDRESS INFORMATION	6-13
6.8	LOADING GRAPH MEMORIES.....	6-13
6.9	GENERATING BASELINES (SHADE LINES) (Figure 6-14).....	6-13
6.10	ENABLING A HISTOGRAM (SHADING A GRAPH)	6-17
6.10.1	Shading the Graph Without a Baseline (ShadeLine) Enabled.....	6-17
6.10.2	Shading the Graph With a Baseline (Shade Line) Enabled.....	6-17
6.11	LOADING VERTICAL LINES.....	6-17
6.12	ADDING GRAPH MARKER.....	6-17
6.13	GENERATING HORIZONTAL LINES.....	6-19
6.14	GENERATING STRIP CHARTS (Figure 6-18).....	6-19
6.14.1	Single Strip Chart Operation.....	6-19
6.14.2	Dual Strip Chart Operation	6-23
6.15	COMBINING VIDEO OUT AND TIMING	6-23

CONTENTS (Cont)

APPENDIX A	VT105 INTERACTIVE GRAPHIC TEST PROCEDURE
APPENDIX B	GLOSSARY AND NOTATION
APPENDIX C	GRAPH DRAWING PROGRAMMER'S CARD
APPENDIX D	7-BIT ASCII CODE
APPENDIX E	FILL CHARACTER REQUIREMENTS
APPENDIX F	VT105 PHYSICAL/FUNCTIONAL BLOCK DIAGRAM

FIGURES

Figure No.	Title	Page
1-1	VT105 Graphic Terminal	1-2
1-2	VT105 Graphic Terminal (Rear View).....	1-3
1-3	Standard Alphanumeric Keys.....	1-5
1-4	Special Function Keys.....	1-5
1-5	Set-Up Mode Keys.....	1-8
1-6	Keyboard Indicators	1-10
1-7	Set-Up A Mode Presentation.....	1-15
1-8	Set-Up B Mode Presentation	1-16
1-9	Set-Up B Mode Summary.....	1-17
2-1	VT105 Keyboard.....	2-2
3-1	VT105 with Graph Display.....	3-2
3-2	Graph with Graph Markers.....	3-3
3-3	Histogram Display (Shaded Graph)	3-4
3-4	Example of a Grid Display	3-5
3-5	Strip Chart Display (Moves From Right to Left)	3-6
3-6	Rectangular Graph Drawing Field	3-7
3-7	Square Graph Drawing Field	3-7
3-8	Histogram without Shade Line (Baseline) Enabled.....	3-20
3-9	Graph with Shade Line (Baseline) Enabled	3-20
4-1	VT105 Terminal Dimensions.....	4-2
4-2	VT105 Rear View	4-3
4-3	20 mA Current Loop Connection	4-7
4-4	Composite Video Output.....	4-9
4-5	Graphic Interconnecting Cable Removal	4-10
4-6	Graphic Interconnecting Cable Installation	4-11
4-7	M7071 Waveform Generator Jumper and Connector Locations	4-12
4-8	Expansion Backplane Removal and Installation	4-15
5-1	20 mA Current Loop Option	5-2
5-2	Terminal Access Cover with 20 mA Option Installed	5-3

FIGURES (Cont)

Figure No.	Title	Page
5-3	VT105 Rear View	5-5
5-4	Advanced Video Option Installation	5-7
6-1	M7071 Waveform Generator Block Diagram	6-3
6-2	Decoding the Control Character	6-5
6-3	Rectangular Aspect Ratio Graph Drawing Field	6-7
6-4	Square Aspect Ratio Graph Drawing Field	6-7
6-5	Selecting Mode of Operation	6-8
6-6	Phase Lock Loop Timing	6-9
6-7	Loading the Registers	6-10
6-8	Register 0 (1st Data Character)	6-11
6-9	Register 0 (2nd Data Character)	6-11
6-10	Register 1 (1st Data Character)	6-12
6-11	Register 1 (2nd Data Character)	6-12
6-12	Loading Address Data	6-14
6-13	Graph Memory and Y-Address Monitor	6-15
6-14	Baseline (Shade Line) Registers and Comparators	6-16
6-15	Vertical Line and Graph Marker Memory	6-18
6-16	Graph Marker Y-Address Comparator	6-20
6-17	Horizontal Line Memory	6-21
6-18	Generating Strip Charts	6-22
6-19	Dual Strip Chart Timing Diagram	6-24
6-20	Combining Video Out	6-25

TABLES

Table No.	Title	Page
1-1	Categories of Set-Up Features	1-12
1-2	Set-Up Feature Change Summary	1-13
1-3	Nonfatal Displayed Error Codes	1-25
1-4	Problem Checklist	1-26
2-1	Set-Up Features and Terminal Modes	2-3
2-2	Alphabetic Key Codes	2-4
2-3	Nonalphabetic Key Codes	2-5
2-4	Function Key Codes	2-5
2-5	Control Codes Generated	2-6
2-6	Cursor Control Key Codes	2-7
2-7	Special Graphic Characters	2-8
2-8	VT52 Mode Auxiliary Keypad Codes	2-9
2-9	ANSI Mode Auxiliary Keypad Codes	2-9
2-10	Control Characters	2-11
2-11	VT52 Mode Control Functions	2-28
3-1	Comparison of Graph Drawing Formats	3-8
3-2	Load Enable Register 0 Command	3-9
3-3	Examples of Selecting Graphs or Histogram	3-11

TABLES (Cont)

Table No.	Title	Page
3-4	Examples of Selecting Shaded Graphs with Shade Lines (Baselines) and Strip Charts.....	3-11
3-5	Graph Drawing Characters	3-12
3-6	Load Enable Register 1 Command	3-14
3-7	Examples of Selecting Graph Markers, Horizontal Lines, and Vertical Lines	3-15
3-8	Graph Drawing Data Characters.....	3-16
3-9	Load Data Sequences	3-18
3-10	Loading Shade Line Position	3-19
3-11	Loading Graph Data	3-19
3-12	Load Graph Marker Memory.....	3-21
3-13	Load Vertical Line Coordinate	3-22
3-14	Load Horizontal Line Coordinates	3-23
3-15	Load Starting X Coordinate	3-24
4-1	EIA RS-232-C Connector Signals.....	4-5
4-2	Graphic Connector Pin Assignments for XE90	4-13
4-3	Expansion Backplane Pin Assignments for Graphics Connector (J2).....	4-13
5-1	Optional Communications Cables	5-8
6-1	Control Characters.....	6-6

CHAPTER 1

OPERATOR INFORMATION

1.1 INTRODUCTION

The VT105 Graphic Terminal is a video terminal that features alphanumeric and graphical display. When interfaced to a host computer, the VT105 (shown in Figure 1-1) can display as many as two graphs, two shaded graphs, or two strip charts, along with alphanumeric labels. Control of the terminal is via a detachable keyboard that operates much like a typewriter. This chapter defines the operation of the terminal. Chapter 1 is divided into five parts:

1. Controls and indicators
2. Set-up mode
3. Definition of each Set-up feature
4. Self-testing the VT105
5. What to do in the event of a problem.

Part 1 shows all the controls and indicators on the terminal and summarizes the function of each to provide a quick reference for these functions.

Part 2 defines the Set-up mode and briefly summarizes the terminal's features.

Part 3 describes each feature in detail. Refer to this section for further information on a feature mentioned in Part 2.

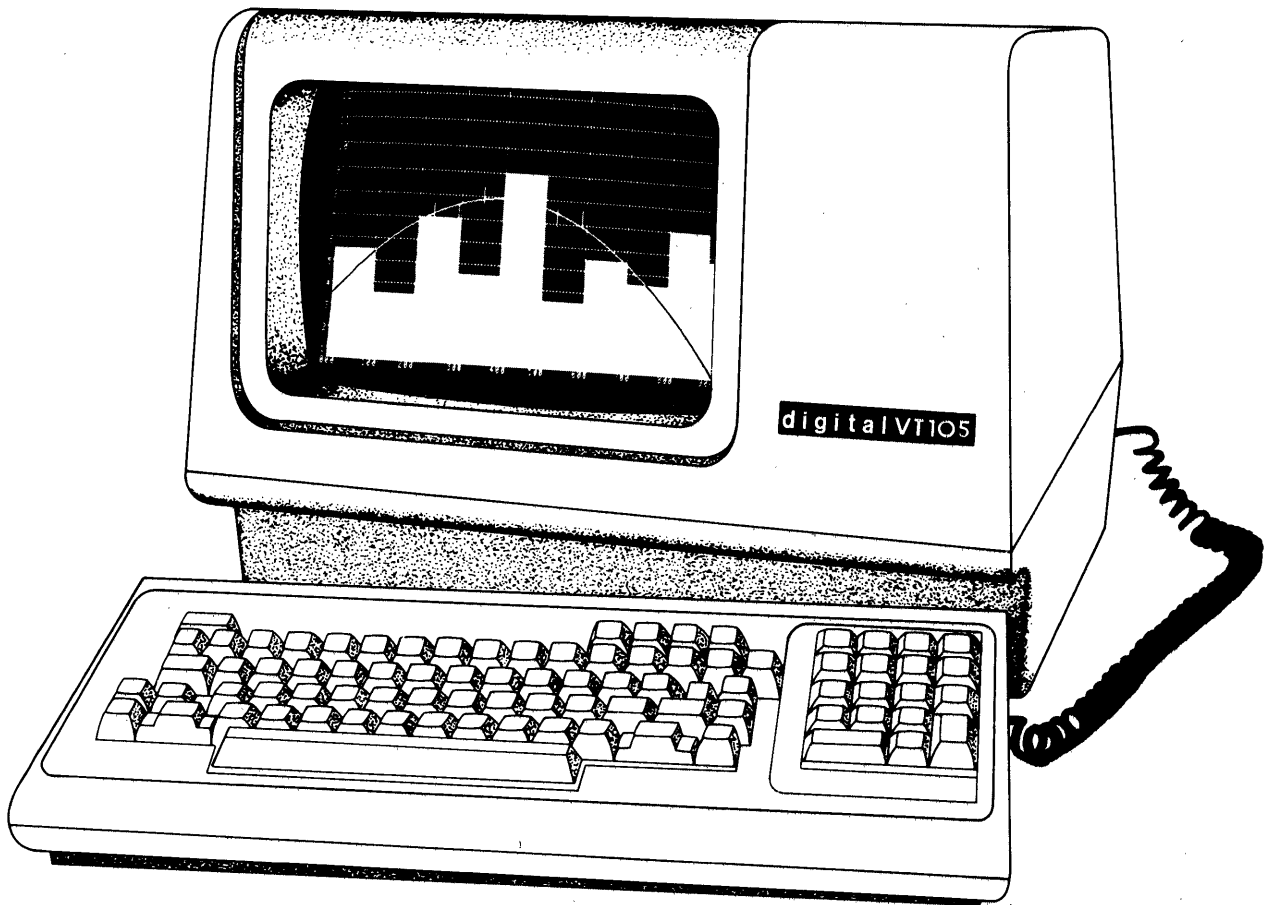
Part 4 provides information on self-testing the VT105. It outlines the steps required to start the built-in self-tests and how to interpret the results of the tests.

Part 5 provides a table of easily recognized failures with simple corrective actions. *Check this list before calling for service.*

1.2 CONTROLS AND INDICATORS

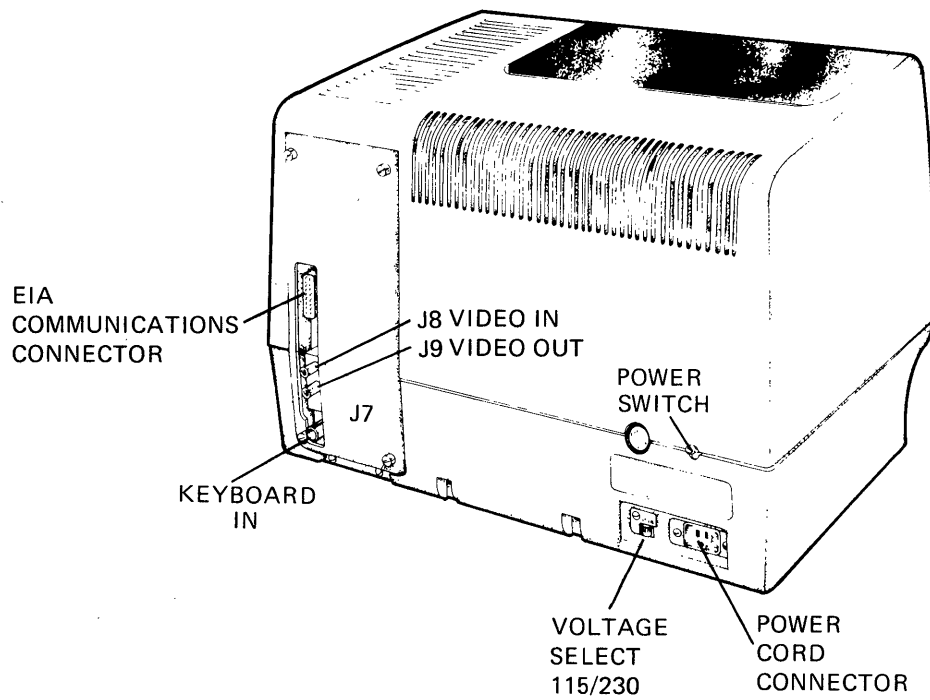
The controls and indicators of the VT105 are categorized as follows.

- Monitor Controls
- Keyboard Controls
- Keyboard Indicators
- Audible Indicators



MR-3518

Figure 1-1 VT105 Graphic Terminal



MR-3519

Figure 1-2 VT105 Graphic Terminal (Rear View)

1.2.1 Monitor Controls

The VT105 is equipped with two monitor controls (shown in Figure 1-2) – a POWER ON/OFF switch and a POWER SELECTOR switch. The POWER ON/OFF switch applies ac power to the terminal as follows.

Switch Position	AC Power
Up	On
Down	Off

The POWER SELECTOR switch is used to configure the terminal to the available ac input voltage as follows.

Switch Position	Voltage Range
115	90 – 128 Vac rms
230	180 – 256 Vac rms

1.2.2 Keyboard Controls

The VT105 has a detachable keyboard equipped with two keypads. Its main keypad array is arranged, and functions similar to a standard office typewriter. An auxiliary numeric keypad provides rapid data entry similar to an adding machine or calculator. Within this document, the keyboard keys are defined by functionality as follows.

- Standard alphanumeric keys
- Special function keys
- Set-up mode keys

Standard Alphanumeric Keys – Figure 1-3 identifies the keys on the keyboard that function as standard typewriter or calculator keys when the terminal is off-line in LOCAL mode. When the terminal is on-line, operation of these keys is dependent on the system software of the host computer.

Special Function Keys – Figure 1-4 identifies the special function keys on the keyboard. Each of these keys provide a unique operation to the terminal. The function of these keys is dependent on the system software and may or may not have meaning to your system.

When in Keypad Application mode, the shaded keys, shown in Figure 1-4, provide additional special functions that may be used by an application program.

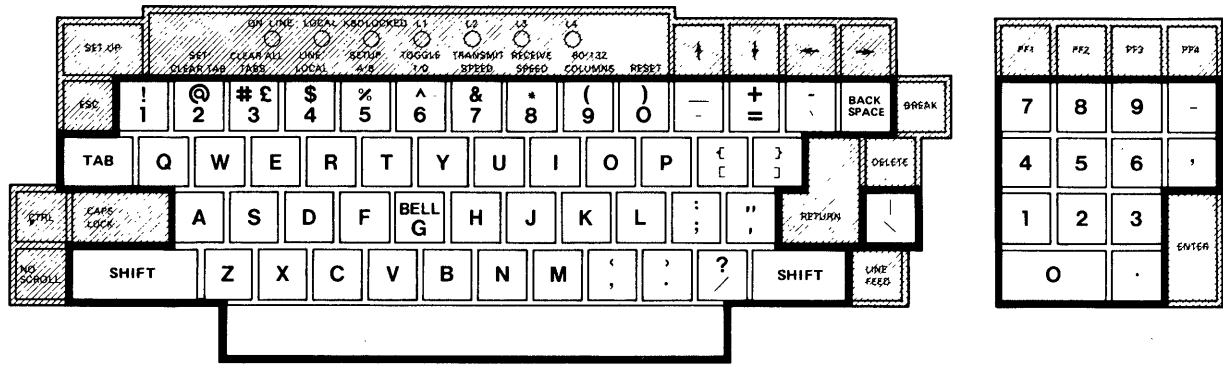
The general operation of the special function keys is provided in the following paragraphs.

BELL
G Key

When pressed in combination with the CTRL key, this key causes a bell code (007₈) to be sent to the host computer.

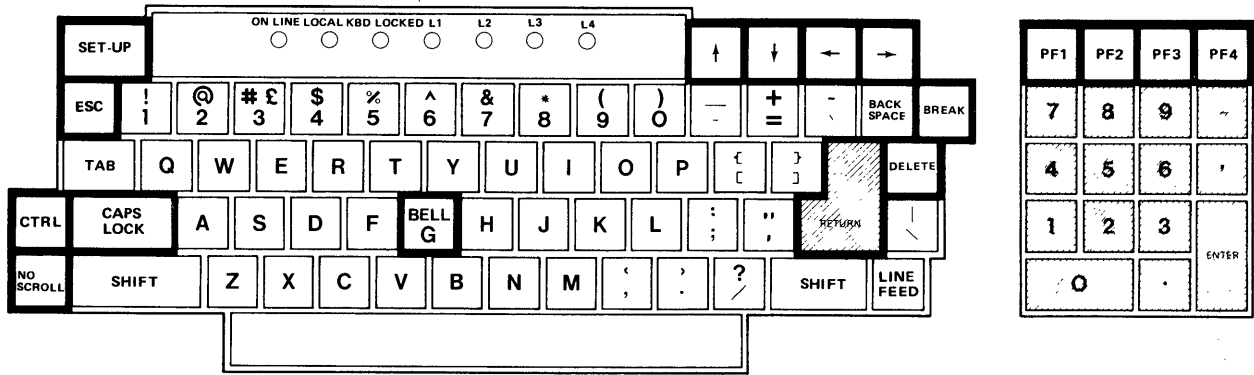
BREAK Key

This key causes the console to generate a timed break signal.



MR-3520

Figure 1-3 Standard Alphanumeric Keys



MR-3521

Figure 1-4 Special Function Keys

**CAPS
LOCK** Key

This key enables the transmission of uppercase alphabetic characters only. All numeric and special symbol keys remain in lowercase.

CTRL Key

When pressed in combination with another key, this key alters the code transmitted by the other keys on the main keyboard. These new codes may have a special meaning to the system.

DELETE Key

This key causes the terminal to transmit a delete character code (177₈) to the host computer. The deleted character may or may not be erased from the screen depending on the system software.

ENTER Key

This key operates the same as the RETURN key for rapid data entry on the numeric keypad.

When in Keypad Application mode, a control function is generated that may have a special meaning to the application program.

ESC Key

This key transmits an escape code (033₈) that normally has a special meaning to your system. In many applications, it treats the next keys pressed as a command.

LINEFEED Key

This key transmits a linefeed code (012₈).

**NO
SCROLL** Key

When first pressed, this key stops transmission of data from the computer to the terminal. When pressed again, transmission resumes. Recognition of this key is dependent on the system software. This key is affected by the AUTO-XON/XOFF (DC3, 023₈) and XON (DC1, 021₈).

RETURN Key

This key transmits either a carriage return code (CR, 015₈) or a carriage return (CR) and linefeed code (LF, 012₈). This is a SET-UP selectable feature. (See Paragraph 1.3.2.)

PF1-PF4 Keys

These keys are used to generate special function codes that may be used by the system software.

↑ ↓ → ← Keys

Each of these keys causes the VT105 to transmit a code that may have a special meaning to your system. In Set-up mode the ↑ and ↓ keys increase or decrease the brightness of the display. The ← and → keys move the cursor left and right.

Set-Up Mode Keys – Figure 1-5 identifies the keyboard keys that establish the configuration of the terminal in Set-up mode. The shaded keys are used to position the cursor while in this mode. The paragraph that follows briefly describes the function of each key. Refer to Paragraph 1.3 for more details of the Set-up procedure.

SET-UP Key

This key is used to enter and exit the Set-up mode. SET-UP A is displayed on the screen when this key is pressed.

↑ ↓ Keys

Set-up A

These keys increase or decrease the brightness of the video characters. ↑ = increase; ↓ = decrease.

**@
2** Key

SET/CLEAR – Set-up A

This key sets or clears individual horizontal tabs. Position the cursor over the tab stop position and press this key.

**# £
3** Key

CLEAR ALL TABS – Set-up A

This key clears all horizontal tabs.

**\$
4** Key

LINE/LOCAL – Set-up A or Set-up B

This key switches the terminal to communicate with your system (ON LINE) or stops the terminal from communicating with your system (LOCAL). Two indicators above this key switch from ON LINE to LOCAL or from LOCAL to ON LINE.

**%
5** Key

SET-UP A/B – Set-up A or Set-up B

This key switches the terminal from Set-up A to Set-up B or from Set-up B to Set-up A. The display indicates which mode the terminal is in.

**^
6** Key

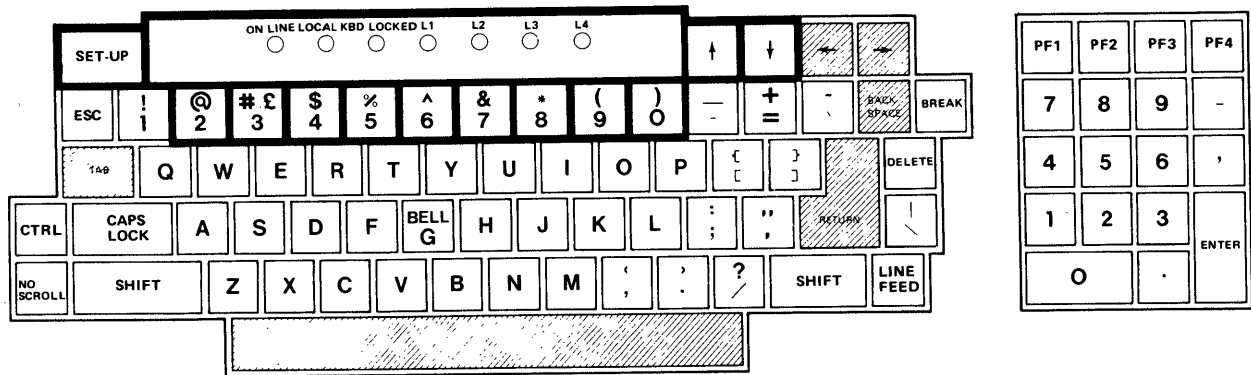
TOGGLE – Set-up B

This key turns the selected operational feature on or off. (Refer to Paragraph 1.3.4 for more details.)

**&
7** Key

TRANSMIT SPEED – Set-up B

This key steps the terminal through the transmit baud rate settings in ascending order. The display indicates the current transmit baud rate (T SPEED) setting.



MR-3522

Figure 1-5 Set-Up Mode Keys

8** Key

RECEIVE SPEED – Set-up B

This key steps the terminal through the receive baud rate settings in ascending order. The display indicates the current receive baud rate (R SPEED) setting.

**(
9** Key

80/132 COLUMNS – Set-up A

This key switches the display line size from 80 to 132 characters per line or from 132 to 80 characters per line. The number of characters displayed in the rule at the bottom of the screen in Set-up A mode is 80 or 132.

**)
0** Key

RESET – Set-up A or Set-up B

This key starts the reset sequence. This has the same result as turning the terminal power off and then on. Pressing this key exits set-up mode, performs a self-test, and places the cursor in the upper-left corner of the screen when the test is completed successfully. (If this does not happen, refer to Paragraph 1.6 to try to isolate the problem.)

1.2.3 Keyboard Indicators – Figure 1-6 shows the location of the keyboard indicators. The indicators are defined as follows.

ON LINE Indicator

This indicator lights to show that the terminal is on-line and ready to transmit or receive messages.

LOCAL Indicator

This indicator lights to show that the terminal is off-line and cannot communicate with the host device. In local mode, the keyboard remains active and all characters typed are placed on the screen.

NOTE

Power on is indicated by lighting either the ON LINE or LOCAL indicator.

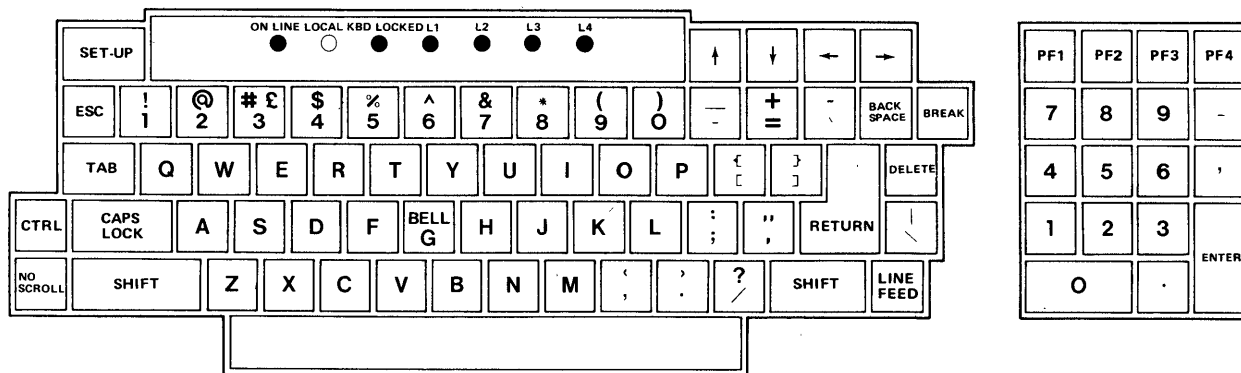
KEYBOARD LOCKED Indicator

This indicator lights when the keyboard has been turned off. The terminal is still able to receive data from the host computer. This condition can be cleared by entering and exiting Set-up mode.

L1–L4 Indicators

These indicators are turned on and off by the system software. L1–L4 are also used to show self-test errors.

1.2.4 Audible Indicators (Tones) – There are three audible alarms associated with the VT105: a short tone (click), a long tone (bell), and a series of long tones.



MR-3523

Figure 1-6 Keyboard Indicators

Short Tone (Click) – The short tone is sounded by the terminal whenever a key is pressed, with the following exceptions.

1. The SHIFT or CTRL keys do not generate any keyclick.
2. The KBD LOCKED indicator is turned on; in which case, the characters typed are lost.
3. The keyclick feature is turned off in Set-up B mode.

Long Tone (Bell) – The long tone is sounded by the terminal to indicate one of the following conditions.

1. A bell code is received by the terminal.
2. The margin bell feature is enabled, and the cursor is eight characters away from the right margin.

Series of Long Tones – The terminal sounds the long tone several times in rapid succession to indicate that the terminal's memory is having difficulty in reading or writing the Set-up features. (When this occurs, check the Set-up features and perform the Recall or Save operation again.)

1.3 SET-UP MODE

The VT105 has many selectable built-in features. These features provide compatibility with a host computer, adapt the terminal to local power, or alter the terminal's operation for user comfort and efficiency.

The VT105 does not use switches or jumpers to turn the features on or off. It uses a memory to electronically select and store the features. This is performed in the Set-up mode that is entered by pressing the SET-UP key. There are two Set-up displays:

1. Set-up A – displays the location of the tab stops along a visual ruler numbering each character position on the line.
2. Set-up B – summarizes the status of the other terminal features.

NOTE

Data on the video screen before entering Set-up mode is restored to the screen after exiting Set-up mode.

1.3.1 Determining What a Set-Up Feature Does

The Set-up features allow the terminal to be tailored to its operating environment. Table 1-1 lists each feature in one of the following general categories.

- Installation
- Computer compatibility
- Operator comfort

During initial installation, or when options are added or removed, or when the physical location of the terminal is changed, verify the settings of the features in the Installation category.

Table 1-1 Categories of Set-Up Features

Set-Up Feature	Installation	Computer Compatibility	Operator Comfort
ANSI/VT52 Mode		X	
ANSWERBACK Message		X	
AUTO REPEAT			X
AUTO XON XOFF		X	
BITS PER CHARACTER		X	
CHARACTERS PER LINE		X	
CURSOR			X
INTERLACE	X		
KEYCLICK			X
LINE/LOCAL		X	
MARGIN BELL			X
NEW LINE		X	
PARITY		X	
PARITY SENSE		X	
POWER	X		
RECEIVE SPEED		X	
SCREEN BACKGROUND			X
SCREEN BRIGHTNESS			X
SCROLL		X	X
TABS		X	
TRANSMIT SPEED		X	
WRAPAROUND		X	
# £ 3 (shifted)		X	

Features that affect computer compatibility must be set correctly so that the terminal can communicate with the host computer. An error in these settings may cause incorrect data to be sent to or received from the computer; or an error may prevent the terminal from communicating with the computer. The settings for these features must be obtained from the host computer programmer, operator, or system manager since there are many combinations of settings designed to work with particular computers and special software. These feature settings would normally change only when you need to communicate with a different computer or a unique software package.

1.3.2 How to Change a Set-Up Feature

Changing any or all of the Set-up features is a simple operation and is generally performed by following the same basic steps.

1. Enter Set-up mode by pressing the SET-UP key.
2. Select the appropriate Set-up mode by pressing the 5 key on the main keyboard each time you want to switch from Set-up A to Set-up B or from Set-up B to Set-up A.
3. Position the cursor above the feature switch or tab stop to be changed. To position the cursor, the "SPACE" bar, "←", "→", "TAB" and "RETURN" keys may be used. Some features do not use this step since a specific key is dedicated to changing the feature.

4. Change the feature setting by pressing either the 6 key on the main keyboard or the appropriate dedicated key. Each time the key is pressed the feature will change, generally to the opposite state.

Table 1-2 briefly summarizes the Set-up features, the Set-up mode you must be in to change a given feature, and the key used to change the feature setting.

Table 1-2 Set-Up Feature Change Summary

Set-Up Feature	Changed In		Key Used to Change Feature		
	Set-Up A Mode	Set-Up B Mode			
ANSWERBACK message		X	†		
ANSI/VT52 mode		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
AUTO REPEAT		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
AUTO XON/XOFF		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
BITS PER CHARACTER		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
BRIGHTNESS	X	X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>↑</td></tr></table> or <table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>↓</td></tr></table>	↑	↓
↑					
↓					
CHARACTERS PER LINE	X		<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>(</td></tr><tr><td>9</td></tr></table>	(9
(
9					
CURSOR		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
INTERLACE		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
KEYCLICK		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
LINE/LOCAL	X	X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>\$</td></tr><tr><td>4</td></tr></table>	\$	4
\$					
4					
MARGIN BELL		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					
NEW LINE		X	<table border="1" style="text-align: center; width: 30px; height: 30px;"><tr><td>^</td></tr><tr><td>6</td></tr></table>	^	6
^					
6					

†A special sequence is required for this feature. See Paragraph 1.3.5.

Table 1-2 Set-Up Feature Change Summary (Cont)

Set-Up Feature	Changed In		Key Used to Change Feature
	Set-Up A Mode	Set-Up B Mode	
PARITY		X	⌘ 6
PARITY SENSE		X	⌘ 6
POWER		X	⌘ 6
RECEIVE SPEED		X	* 8
SCREEN		X	⌘ 6
SCROLL		X	⌘ 6
TABS	X		@ 2 and # 3
TRANSMIT SPEED		X	\$ 7
WRAPAROUND		X	⌘ 6
⌘ 3 (shifted)		X	⌘ 6

1.3.3 Set-Up A

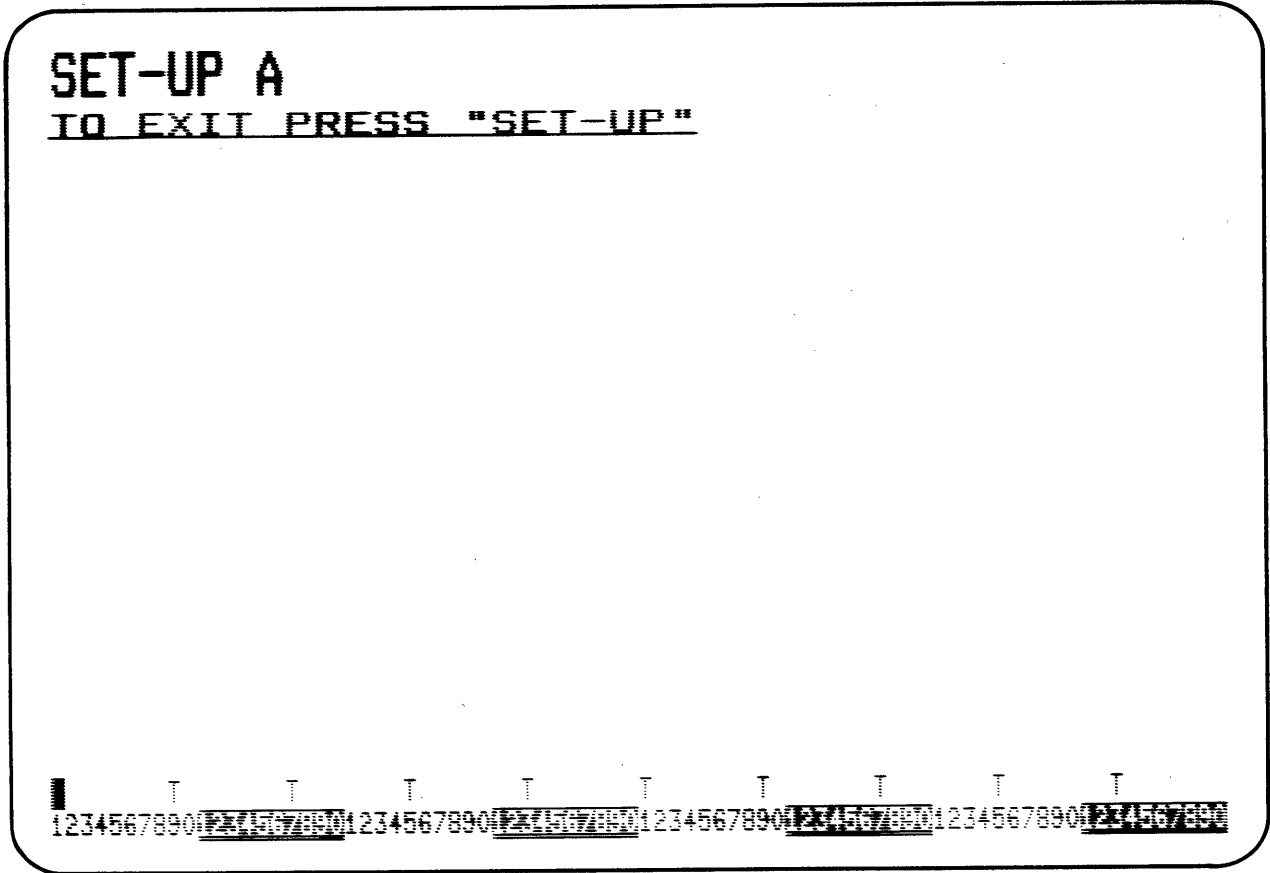
To enter Set-up A, press the SET-UP key. The display is similar to Figure 1-7. The bottom line of the display is a “ruler” that numbers each character position on a line. The location of each tab stop is shown by a “T” placed above the ruler. If the tab stops present are those desired, no action is necessary.

To exit Set-up A, press the SET-UP key.

Setting a Tab Stop – To set a tab stop, position the cursor above the desired location on the ruler. Use the SPACE BAR, →, and ← keys to move the cursor.

Press the 2 key on the main keyboard. A “T” is displayed in the desired tab stop location.

Erasing a Tab Stop – Position the cursor on the “T” displayed above the ruler. Press the 2 key. The “T” disappears.



MR-1517

Figure 1-7 Set-Up A Mode Presentation

Clear All Tab Stops – Press the 3 key. All “Ts” above the ruler disappear.

NOTE

Tab stops set or cleared are stored temporarily by exiting the Set-up mode. To set tab stops on a fixed basis, a Save operation must be performed. Refer to Paragraph 1.3.6.

ON LINE/LOCAL – While in Set-up A, pressing the 4 key toggles the terminal between ON LINE and LOCAL operation. Two indicators directly above this key reflect the current operation.

80/132 Characters per Line – While in Set-up A, the number of characters per line can be changed. Pressing the 9 key toggles the terminal between 80 and 132 characters per line.

The ruler on the screen reflects the current state of this feature. The line is not physically longer in 132 character mode; however, the characters are more compressed. For graph drawing in the VT105, 80 characters per line is required.

NOTE

The screen contents are lost when toggling between 80 and 132 characters per line.

1.3.4 Set-Up B (Operational Features)

Set-up B mode is entered from Set-up A mode. When in Set-up A, press the 5 key on the main keyboard. The display is similar to Figure 1-8. Figure 1-9 summarizes the Set-up B presentation. This summary shows the operational features enabled. For additional information on a feature, refer to Paragraph 1.4.

Changing an Operational Feature – Position the cursor above the location of the feature to be changed using the SPACE BAR, ←, or →.

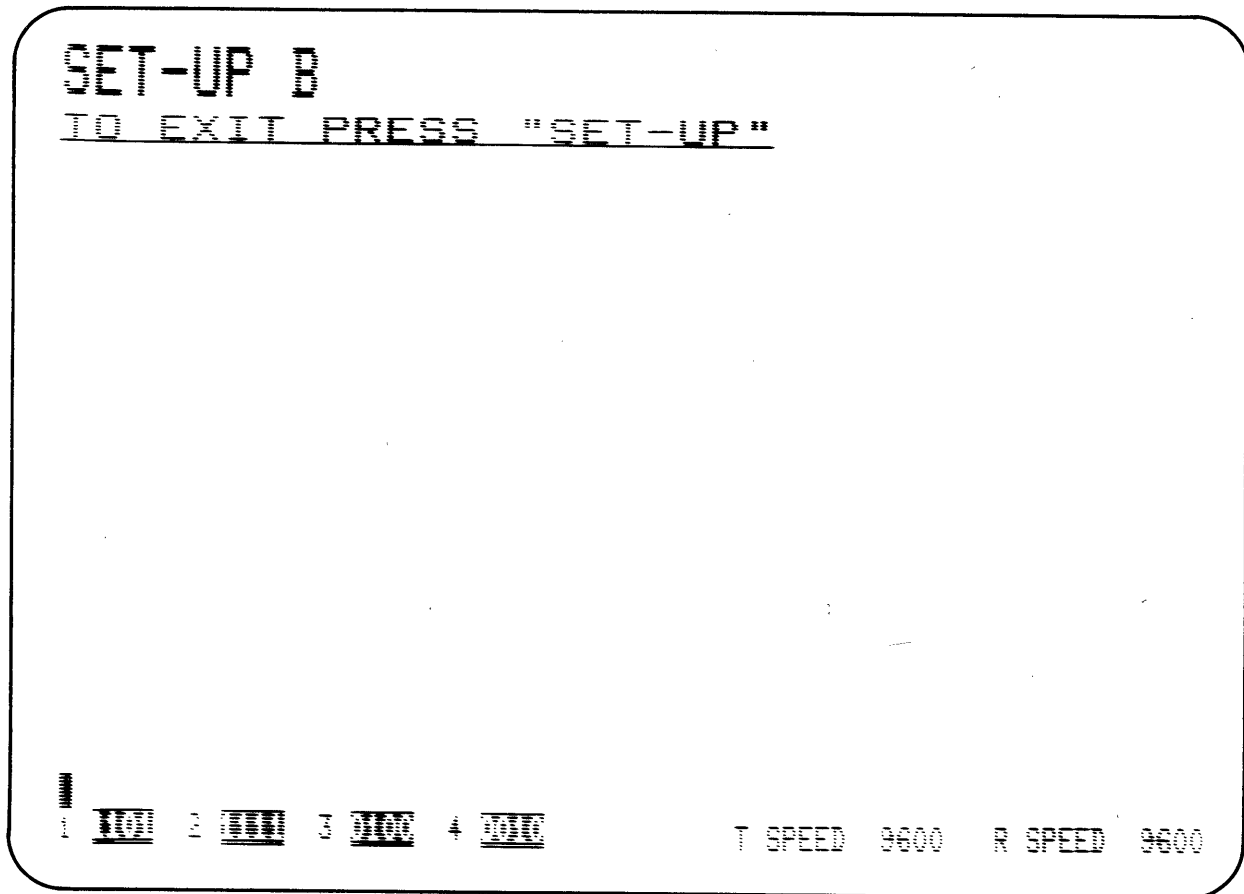
Press the 6 key on the main keyboard. This changes the displayed 0 to a 1 (or the 1 to a 0).

For graph drawing in the VT105, set the following features as indicated.

80 characters per line
Interlace disabled

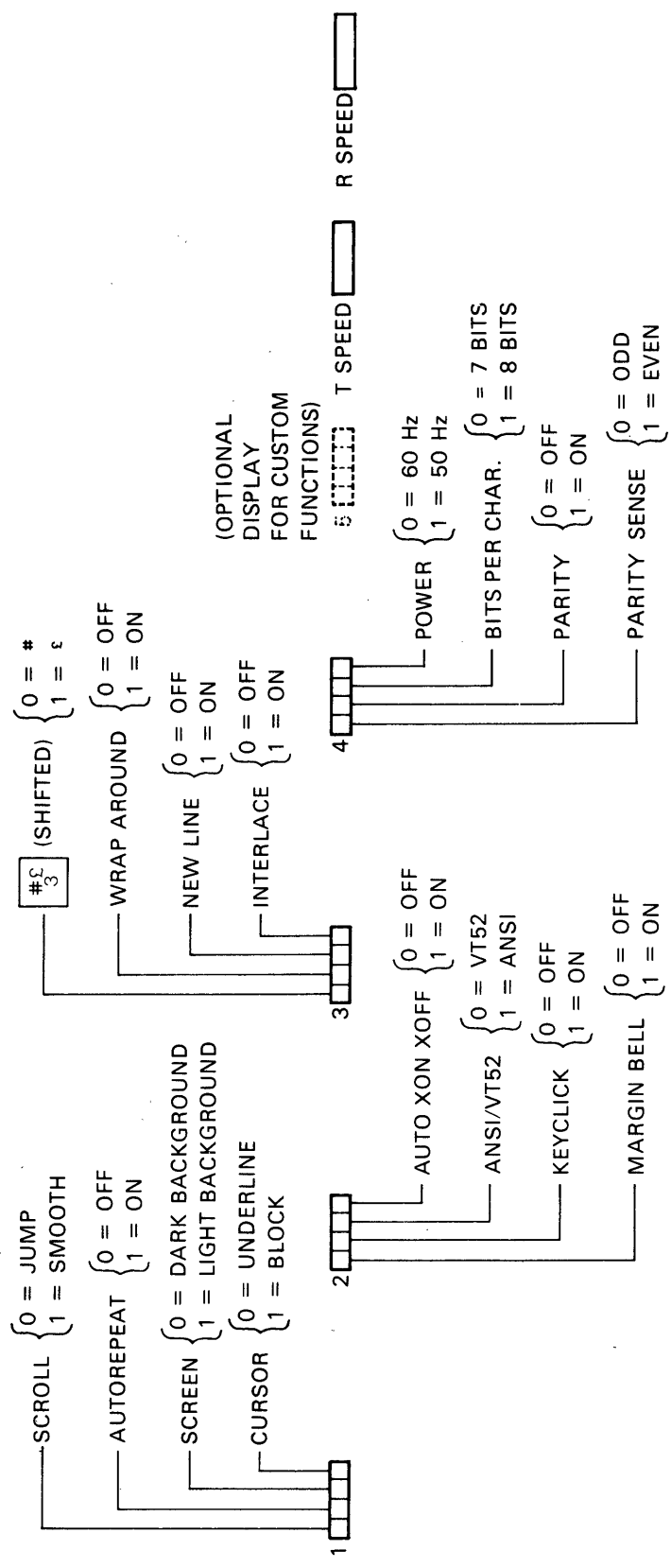
The following additional features are recommended.

AUTO XON/XOFF enabled
Smooth scroll
ANSI mode



MR-3524

Figure 1-8 Set-Up B Mode Presentation



MR-3525

Figure 1-9 Set-Up B Mode Summary

For previous DECgraphic software (i.e., PLOT 55), the VT52 mode should be used.

Changing the Transmit Speed – While in Set-up B, pressing the 7 key cycles through the available transmit baud rates. Stop when the desired T SPEED is displayed on the screen.

NOTE

The transmit and receive speed must match the host computer or modem connected to this terminal.

Changing the Receive Speed – While in Set-up B, pressing the 8 key cycles through the available receive baud rates. Stop when the desired R SPEED is displayed on the screen.

To exit Set-up B, press the SET-UP key.

1.3.5 Setting the Answerback Message

An answerback message can be typed into the terminal using the following steps.

1. Place the terminal in Set-up B mode.
2. Press the SHIFT and A keys simultaneously. The terminal responds by placing "A =" on the screen. (The SHIFT key is required. The CAPS LOCK key does not work here.)
3. Type the message delimiter character. This may be any character not used in the actual answerback message. The message delimiter character is not a part of the answerback message.
4. Type the answerback message. The message may be up to 20 characters, including space and control characters. Control characters are displayed as a character to indicate their presence in the message.

If a mistake is made when typing the answerback message, type the message delimiter character again and go back to step 2. This is the *only* way to correct errors in the answerback message.

5. Type the message delimiter character. Once the message delimiter character is typed, the answerback message disappears from the screen.

The answerback message is temporarily stored in the terminal and can be saved with the Save operation.

1.3.6 Saving the Set-Up Features

Set-up features may be changed and stored on either a temporary or a fixed basis. To temporarily store a feature, exit Set-up mode after changing the feature; the terminal now reacts according to the new setting. If a Recall operation is performed, or the terminal is reset, or the terminal power is turned off, all temporary feature settings are replaced by the features that have been stored on a fixed basis.

To store Set-up feature settings on a fixed basis, perform a Save operation as follows.

1. Place the terminal in either Set-up mode.
2. Press the SHIFT and S keys simultaneously. The screen clears and the message WAIT is displayed in the upper-left corner. After a brief wait, the terminal returns to Set-up A mode.

Set-up features stored temporarily are now stored on a fixed basis.

NOTE

The Save operation must be performed at the terminal keyboard. The computer cannot perform this operation, although it can temporarily modify these settings.

1.3.7 Recalling Set-Up Features

The temporarily stored Set-up feature settings may differ from the settings that are stored on a fixed basis. To return to the fixed settings, perform a Recall operation as follows.

1. Place the terminal in either Set-up mode.

NOTE

When a Recall operation is performed, the contents of the screen are destroyed.

2. Press the SHIFT and R keys simultaneously. After a brief wait, the terminal returns to Set-up A mode.

1.3.8 Resetting the Terminal

The VT105 may be reset from the keyboard without turning power off. When the terminal is reset, the terminal memory is cleared and the self-test program is run as if the terminal power switch had been turned OFF and then back ON. Reset the terminal using the following steps.

1. Place the terminal in either Set-up mode.
2. Press the 0 (zero) key on the main keyboard. The terminal resets, the power on self-test is run, and the terminal responds to the fixed Set-up features. The cursor is returned to the upper-left corner of the screen.

CAUTION

When a Reset operation is performed, the contents of the screen and graph memories are destroyed. Other options present may also be affected.

1.4 DEFINITION OF EACH SET-UP FEATURE

The following paragraphs describe each Set-up feature in detail (in alphabetical order) and states how each feature affects the terminal.

NOTE

Unless otherwise stated, entering Set-up mode and changing features does not result in the loss of data displayed on the screen.

ANSI/VT52 Mode – (Set-up B)

The VT105 terminal follows one of two programming standards: American National Standards Institute (ANSI) or DIGITAL VT52. In ANSI mode, the VT105 generates and responds to control functions per ANSI standards X3.41-1974 and X3.64-1977. In VT52 mode, the terminal responds to control functions that are compatible with previous DIGITAL software using the VT52 or VT55 DECscope. Both modes are outlined in the programmer's chapter of this manual.

ANSWERBACK Message – (Set-up B)

Answerback is a question and answer sequence that allows the host computer to ask the terminal to identify itself. The terminal responds by sending a message to the host. The answerback sequence takes place automatically without affecting the screen or requiring operator action. The answerback message may also be transmitted by typing CTRL BREAK; this does not occur in LOCAL operation. (See Paragraph 1.3.5 for setting this feature.)

AUTO REPEAT – (Set-up B)

The auto repeat feature allows a key to be automatically repeated at the rate of about 30 characters per second when the key is held down for more than one-half second. The auto repeat feature affects all keyboard keys except the following:

SET-UP	TAB
ESC	RETURN
NO SCROLL	ENTER
	CTRL and any key

AUTO XON/XOFF – (Set-up B)

The VT105 supports the synchronizing codes XON (DC1) and XOFF (DC3). The XOFF control sequence is used to stop the transmission of data from the computer to the terminal; the XON sequence is used to resume transmission. With the feature enabled, the terminal generates the XOFF code when one of the following events occur.

1. The internal buffer is nearly full.
2. The NO SCROLL key is pressed.
3. The terminal is placed in Set-up mode.
4. CTRL S is pressed.

The terminal resumes transmission when:

1. The internal buffer empties.
2. The NO SCROLL key is pressed again.
3. The terminal is taken out of Set-up mode.
4. CTRL Q is pressed.

If the host computer software does not support the XON/XOFF codes, data sent during buffer full conditions, or when the terminal is in Set-up mode, may be lost.

NOTE

The VT105 always stops transmission when an XOFF (DC3) code is received and resumes transmission when an XON (DC1) code is received regardless of the setting of the AUTO XON/XOFF feature.

BITS PER CHARACTER – (Set-up B)

This feature allows the terminal to transmit and receive either 7- or 8-bit characters. When set for 8-bit operation, bit 8 is set to a space (or 0) for characters transmitted and is ignored for all characters received.

CHARACTERS PER LINE – (Set-up A)

The VT105 is capable of displaying either 80 or 132 characters per line. In the 80 characters per line mode, the screen is 80 characters wide by 24 lines high.

In the 132 characters per line mode, the screen is 132 characters wide by 14 lines high (24 lines if the VT105 is equipped with the Advanced Video Option). In the 132 characters per line mode, the displayed lines are physically the same width as in the 80 characters per line mode, but the characters are more compact.

NOTES

1. **When changing from 80 to 132 characters per line mode or vice versa, the current contents of the screen are lost.**
2. **The 80 characters per line mode must be used for graph drawing in the VT105.**
3. **The use of double-width characters reduces the number of characters per line by half.**

CURSOR – (Set-up B)

The VT105 offers a choice of two cursor displays to indicate the “active positions” or where the next character will be placed on the screen. The cursor may be displayed as either a blinking underline (—) or a blinking block (■). The cursor selection may perform an additional function; see the SGR control function definition in Chapter 2.

INTERLACE – (Set-up B)

This feature is used for high resolution options. The interlace feature should be turned off if such an option is not installed to reduce screen flicker. For graph drawing in the VT105, this feature should be off (noninterlaced).

KEYCLICK TONE – (Set-up B)

The keyclick is a tone that is generated every time a key is pressed to provide audible feedback from the keyboard. The keyclick may be turned on or off. The keyclick volume is *not* adjustable.

LINE/LOCAL – (Set-up A or B)

The LINE/LOCAL feature places the terminal in either an ON-LINE or a LOCAL (off-line) condition. When the terminal is on-line, the keyboard ON-LINE indicator is ON. All characters typed on the keyboard are sent directly to the computer, and messages from the computer are displayed on the screen.

In the LOCAL condition, the keyboard LOCAL indicator is ON. The terminal is electrically disconnected from the computer; messages are not sent to or received from the computer; and characters typed on the keyboard are echoed on the screen directly.

MARGIN BELL – (Set-up B)

The margin bell sounds when the cursor is eight characters from the end of the current line to alert the operator while typing. This feature may be turned off. The bell tone volume is *not* adjustable.

NEW LINE – (Set-up B)

The new line feature enables the RETURN key on the terminal to function like the RETURN key on an electric typewriter. When the new line feature is enabled, pressing the RETURN key generates a carriage return (CR) and a line feed (LF). When a line feed code is received, the code is interpreted as a carriage return and line feed.

When the new line feature is disabled, the RETURN key generates only the CR code; an LF code causes the terminal to perform a line feed only.

NOTE

The application software may not recognize this new line feature.

PARITY – (Set-up B)

Parity, when enabled, checks for correct data transmission. If a transmission error occurs, the terminal indicates its presence by placing a checkerboard character (⌘) on the screen in place of the character with the error. The parity sense feature determines if the parity is even or odd. When parity is disabled, no parity bit is transmitted or received.

PARITY SENSE – (Set-up B)

The parity sense defines which of two methods of parity checking, odd or even, is being used by the terminal. If parity is enabled, the terminal's parity sense must be matched to the parity of the computer. If the parity sense does not match, most characters sent to the computer are rejected. If a parity incompatibility occurs, the checkerboard character (⌘) is shown on the screen in place of the received character.

NOTE

If parity is disabled, parity sense is disregarded.

POWER – (Set-up B)

During the initial installation, the terminal display must be set to the power line frequency 50 or 60 Hz. In the United States, this is set to 60 Hz.

RECALL – (Set-up A or B)

The fixed terminal memory may hold Set-up features that differ from those temporarily set in the terminal. To return to these fixed settings, use the Recall feature. Refer to Paragraph 1.3.7 to use this feature.

RECEIVE SPEED – (Set-up B)

The receive speed must be set to match the computer transmit speed. The VT105 is capable of receiving at any one of the following preselected speeds: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, 19,200 baud.

The receive speed is independent of the transmit speed; the terminal may receive data at one speed and transmit data at a different speed.

RESET – (Set-up A or B)

The reset feature initializes the system, clears the graph memories, and invokes the power-up sequence. The power-up sequence performs the self-tests and returns the terminal to its initialize state. Refer to Paragraph 1.3.8 to use this feature.

SAVE – (Set-up A or B)

The save feature is used to store Set-up features on a fixed basis. Refer to Paragraph 1.3.6 to use this feature.

SCREEN BACKGROUND – (Set-up B)

The screen background feature allows the operator to determine the background of the screen. In the normal screen mode, the display contains light characters on a dark background; in the reverse screen mode, the display contains dark characters on a light background.

SCREEN BRIGHTNESS – (Set-up A or B)

The VT105 electronically controls the brightness of characters displayed on the screen when using a dark background; or it controls the background screen brightness when the light background is selected. This feature allows the operator to select the desired level of brightness for maximum comfort under varied lighting conditions. This setting may be saved like any other feature in the terminal.

SCROLL – (Set-up B)

Scrolling is the upward or downward movement of existing lines on the screen to make room for new lines. It can be performed in two ways: jump scroll or smooth scroll. In jump scroll mode, new lines appear on the screen as fast as the computer sends them to the terminal. At the higher baud rates, the data is very difficult to read due to the rapid movement of the lines.

In smooth scroll mode, a limit is placed on the speed at which new lines of data may be sent to the terminal. The movement of lines occurs at a smooth steady rate allowing the data to be read as it appears on the screen.

NOTE

Smooth scroll mode allows a maximum of six lines of data per second to be added to the screen. The AUTO XON/XOFF feature must be enabled and supported by the host computer to ensure that data is not lost when smooth scroll mode is enabled.

TABS – (Set-up A)

The VT105 can tab to preselected points on a line. These tab stops may be individually changed, or totally cleared and then set. Refer to Paragraph 1.3.3 to set or clear tab stops.

TRANSMIT SPEED – (Set-up B)

Transmit speed must be set to match the computer receive speed. The VT105 is capable of transmitting at any one of the following preselected transmit speeds:

50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, and 19,200 baud.

Transmit speed is independent of receive speed; the terminal may transmit data at one speed and receive data at a different speed.

WRAPAROUND - (Set-up B)

When this feature is enabled, characters entered beyond 80 (or 132) per line (depending upon the line size selected) are placed on the next line. If the wraparound feature is not enabled, these characters are overwritten in the last character position of the current line.

NOTE

The use of double-width characters reduces the number of characters per line by half.



(shifted) – (Set-up B)

The VT105 contains character sets for the United States and the United Kingdom. The difference between the two character sets is one character, the # or £ symbol. When the standard U.S. character set is selected, the uppercase 3 key on the main keyboard displays the # character. The £ character is displayed when the U.K. character set is selected.

1.5 SELF-TESTING THE VT105

A self-test program is built into the VT105 to automatically, or on command, test the condition of the terminal. The self-test program checks the following items.

- Advanced video memory (if option is installed)
- Nonvolatile memory (NVR)
- Internal memory
- Keyboard

This test is performed automatically whenever the terminal is turned on. It also can be invoked by the operator.

1. Enter Set-up mode; press the SET-UP key.
2. Press the 0 (zero) key on the main keyboard to perform a reset operation.

If the test is successful, the program flashes several test patterns, prints WAIT in the upper-left corner, and after a few seconds returns the cursor to its home (upper-left) position. LEDs L1-L4 are off.

If the test fails, check the self-test error codes.

Self-Test Error Codes

There are two broad categories of errors: fatal and nonfatal.

Fatal errors cause the terminal to immediately stop all operations. No intelligible information is displayed on the screen; however, the screen may contain a random pattern of characters. In addition, an error code may be displayed on the programmable keyboard LEDs, L1-L4. No terminal function, including the lighting of LEDs, is guaranteed if a fatal error occurs.

Nonfatal errors do not halt the terminal processor. Instead, the terminal is forced to LOCAL mode and an error code character is displayed in the upper-left corner of the screen.

There are five types of nonfatal errors.

1. Advanced Video Option RAM data (AVO)
2. Nonvolatile RAM data checksum error (NVR)
3. Keyboard missing or malfunction (KBD)
4. Data loopback error (Data)
5. EIA modem control error (EIA)

NOTE

The loopback and EIA tests are not performed on power-up; they must be invoked separately with the proper control function. See the programmer's chapter for further information on these tests.

Table 1-3 shows the possible nonfatal error characters that may appear on the screen and the failure represented by each character. Refer to Paragraph 1.6 to possibly isolate the cause.

Interactive Graphic Test

An interactive graphic test is built into the waveform generator module to test the graph drawing features of the VT105. Test patterns are generated by "Key-in" instructions. Refer to Appendix A to perform this test.

**Table 1-3 Nonfatal Displayed
Error Codes**

Displayed Character	Fault Detected				
	AVO	NVR	KBD	Data	EIA
1	X				
2		X			
3	X	X			
4			X		
5	X		X		
6		X	X		
7	X	X	X		
8				X	
9	X			X	
:		X		X	
;	X	X		X	
<			X	X	
=	X		X	X	
>		X	X	X	
?	X	X	X	X	
@					X
A	X				X
B		X			X
C	X	X			X
D			X		X
E	X		X		X
F		X	X		X
G	X	X	X		X
H				X	X
I	X			X	X
J		X		X	X
K	X	X		X	X
L			X	X	X
M	X		X	X	X
N		X	X	X	X
O	X	X	X	X	X

1.6 WHAT TO DO IN THE EVENT OF A PROBLEM

If it appears that there is a problem in the terminal, initiate the power-up self-test program. This test will help to determine if the problem is within the terminal or in some other part of the computer system.

If a problem occurs while in graphic mode, refer to Appendix A to perform the Interactive Graphics Test. This test checks the waveform generator module within the terminal.

Table 1-4 describes the items an operator can check prior to making a service call.

Table 1-4 Problem Checklist

Symptom	Possible Cause and Corrective Action
<p>Terminal does not turn ON when the power switch is ON. LINE/LOCAL light does not light.</p>	<p>The power cord is not plugged into wall outlet. Plug in cord.</p> <p>Power is not coming from the wall outlet. Check outlet with a known working electrical device (such as a lamp). If no power, call your electrician.</p> <p>The ac power cord is not plugged into the terminal. Plug in cord.</p> <p>The ac line fuse is blown. Turn the terminal OFF and replace the fuse. (See Figure 1-2 for location.)</p>
<p>No keyboard response</p>	<p>Keyboard cable is not plugged into the monitor. Plug in keyboard cable.</p> <p>KBD LOCKED indicator ON; the computer has turned the keyboard off. The KBD LOCKED condition may be cleared by entering and exiting the Set-up mode. If this condition persists, check with the host computer programmers for a possible error.</p> <p>Perform the self-test operation and note any error indications. Refer to Paragraph 1.5.</p>
<p>Garbled or error characters (☘)</p>	<p>Incorrect Set-up feature selection. Check the Set-up features. Suggested features that may be in error are:</p> <p>ANSI/VT52 mode AUTO XON/XOFF Bits per character Parity Parity sense Receive speed Transmit speed</p> <p>Perform the self-test operation and note any error indications.</p>
<p>Last character is garbled</p>	<p>Wraparound feature may be disabled. Enable this feature.</p>
<p>Double line feeds occur</p>	<p>New line feature may be enabled with the computer already performing this function. Disable the new line feature (Set-up B).</p>

Table 1-4 Problem Checklist (Cont)

Symptom	Possible Cause and Corrective Action
Losing data in graph drawing mode	<p>Check the following features.</p> <p>AUTO XON/XOFF should be enabled</p> <p>INTERLACE should be disabled</p> <p>80 characters per line should be enabled</p> <p>ANSI/VT52 mode may be erroneously selected for software being used.</p>
Several successive long tones	<p>The terminal is having difficulty reading or writing the Set-up features in the nonvolatile memory.</p> <p>Check the feature settings and perform the Save operation. Perform the Self-Test operation.</p>

1.7 RELATED HARDWARE MANUALS

The following hardware manuals are related to the VT105 and may be purchased from Digital Equipment Corporation.

Title	Part Number	Availability
VT105 Graphics Terminal Technical Manual	EK-VT105-TM	Microfiche Library
VT100 Technical Manual	EK-VT100-TM	Microfiche
VT105 Illustrated Parts Breakdown	EK-VT105-IP	Hardcopy or microfiche
VT100 Illustrated Parts Breakdown	EK-VT100-IP	
VT100 Print Set (base terminal)	MP-00663	Hardcopy
VT105 Print Set (supplement)	MP-00642	Hardcopy
VT105 Maintenance Kit	(to be supplied)	

All purchase orders for hardware manuals should be forwarded to:

Digital Equipment Corporation
 Cotton Road
 Nashua, NH 03060
 Accessory and Supplies Group (P086)

Contact your local sales office or call DIGITAL Direct Catalog Sales toll-free 800-258-1710 from 8:30 a.m. to 5:00 p.m. eastern standard time (U.S. customers only). New Hampshire customers should dial (603) 884-6660. Terms and conditions include net 30 days and F.O.B. Digital plant. Freight charges will be prepaid by DIGITAL and added to the invoice. Minimum order is \$35.00. Minimum does not apply when full payment is submitted with an order. Checks and money orders should be made out to Digital Equipment Corporation.

All correspondence and invoicing inquiries should be directed to the above address.

For information concerning microfiche libraries, contact:

Digital Equipment Corporation
Communications Development and Publishing
Micropublishing (BU/D2)
Bedford, MA 01730

ANSI standards X3.41-1974 and X3.64-1977 may be obtained by writing to:

American National Standards Institute
Attn: Sales Department
1430 Broadway
New York, NY 10018

CHAPTER 2

PROGRAMMER INFORMATION

2.1 INTRODUCTION

The VT105 normally performs a two-part function. It is an input device to a computer; information entered through the keyboard is sent to the computer. It is simultaneously an output device for the computer; that is, data coming from the computer is displayed on the video screen.

This chapter discusses communication between the VT105 and the host. Included are the codes generated by the keyboard; the transmission protocol followed by the terminal; and the actions and reactions of the terminal to control codes and control functions in both ANSI and VT52 modes of operation.

2.2 THE KEYBOARD

The VT105 uses a keyboard with a key arrangement similar to an ordinary office typewriter, as shown in Figure 2-1. In addition to the standard typewriter keys, the keyboard has additional keys to generate control functions and cursor control commands. The keyboard also has indicators to show the current terminal status.

2.2.1 LED Indicators

The keyboard has seven light-emitting diodes (LEDs) of which two are committed to the complementary ON-LINE/LOCAL function. The power-on condition is shown by either of the two LEDs being on.

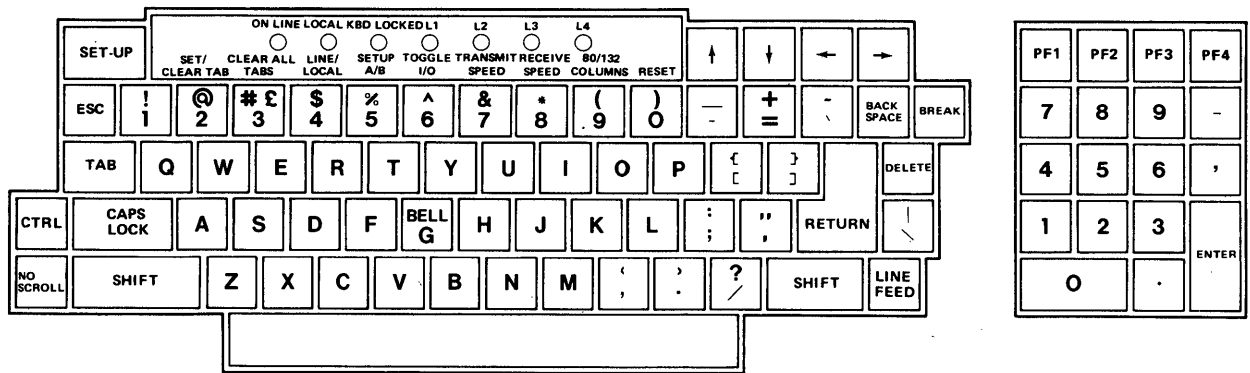
A third LED indicates a "keyboard locked" condition. When this LED is on, the keyboard is automatically "turned off" by the terminal due to a full buffer, or by the host through the transmission of an XOFF to the terminal.

The four remaining LEDs are programmable and can be assigned any meaning for specific applications. The code sequences to turn these LEDs on or off are discussed in Paragraph 2.4.1, Programmable LEDs.

2.2.2 SET-UP Key

The SET-UP key is at the upper-left corner of the main key array. Operations performed in Set-up mode can be stored in a nonvolatile memory (NVR) so that turning the terminal power off does not, by itself, alter the terminal configuration.

The procedures to change the Set-up features are provided in Chapter 1 of this manual. Those Set-up features which may be modified by the host are listed in Table 2-1 and described in detail in this chapter. (See Paragraph 2.4.)



MR-2577

Figure 2-1 VT105 Keyboard

Table 2-1 Set-Up Features and Terminal Modes

Set-Up Feature or Terminal Mode	Changeable from Host Computer	Control Function Mnemonic	Saved in Memory and Changeable in Set-Up		
Alternate keypad mode	Yes	(DECKPAM/DECKPNM)	No		
ANSI/VT52	Yes	(DECANM)	Yes		
Auto repeat	Yes	(DECARM)	Yes		
AUTO XON XOFF	No		Yes		
Bits per character	No		Yes		
Characters per line	Yes	(DECCOLM)	Yes		
Cursor	No		Yes		
Cursor key mode	Yes	(DECCKM)	No		
Graphic drawing mode	Yes	(DECGON/DECGOFF)	No		
Interlace	Yes	(DECINLM)	Yes		
New line	Yes	(LNM)	Yes		
Keyclick	No		Yes		
Margin bell	No		Yes		
Origin mode	Yes	(DECOM)	No		
Parity	No		Yes		
Parity sense	No		Yes		
Power	No		Yes		
Receive speed	No		Yes		
Screen background	Yes	(DECSCNM)	Yes		
Screen brightness	No		Yes		
Scroll	Yes	(DECSCLM)	Yes		
Tabs	Yes	(HTS/TBC)	Yes		
Transmit speed	No		Yes		
Wraparound	Yes	(DECAWM)	Yes		
<table border="1" style="display: inline-table; vertical-align: middle;"><tr><td># £</td></tr><tr><td>3</td></tr></table> (shifted)	# £	3	Yes	(SCS)	Yes
# £					
3					

2.2.3 Keyboard Operation

The keyboard transmits ASCII codes to the host. Some keys transmit one or more codes to the host immediately when typed. Other keys, such as CTRL and SHIFT, do not transmit codes when typed but modify the codes transmitted by other keys. If two code-transmitting keys are pressed together, two codes are transmitted in the order the keys are typed. The terminal does not wait for the keys to be lifted. If three keys are pressed simultaneously, the codes for the first two keys are transmitted immediately; the code for the third is transmitted when one of the first two keys is lifted.

2.2.4 Alphabetic Keys

The VT105 prints either upper or lowercase alphabetic characters. The codes required to print these are listed in Table 2-2. The VT105 transmits the lowercase code until either SHIFT key or the CAPS LOCK key is pressed. The CAPS LOCK key locks only the 26 alphabetic keys in the uppercase mode.

2.2.5 Nonalphabetic Keys

Each of the nonalphabetic keys generates two different codes. One code is generated without pressing the SHIFT key; the other is generated if either or both SHIFT keys are pressed. Table 2-3 shows the codes generated by these keys. The CAPS LOCK key does not affect these keys.

Table 2-2 Alphabetic Key Codes

Key	Uppercase Code (octal)	Lowercase Code (octal)
A	101	141
B	102	142
C	103	143
D	104	144
E	105	145
F	106	146
G	107	147
H	110	150
I	111	151
J	112	152
K	113	153
L	114	154
M	115	155
N	116	156
O	117	157
P	120	160
Q	121	161
R	122	162
S	123	163
T	124	164
U	125	165
V	126	166
W	127	167
X	130	170
Y	131	171
Z	132	172

2.2.6 Function Keys

There are several keys on the keyboard that transmit control codes. Control codes do not produce displayable characters but are codes for functions. If these codes are received by the terminal, it performs the function shown in Table 2-4.

2.2.7 NO SCROLL Key

The NO SCROLL key generates a single XOFF code to inhibit scrolling and freezes the screen. When pressed again, the same key generates XON. If the software recognizes XOFF, the host stops transmitting until the NO SCROLL key is pressed again. Disabling the XOFF/XON feature in Set-up B, disables the NO SCROLL key.

2.2.8 BREAK Key

Typing the BREAK key causes the transmission line to be forced to its zero or space state for 0.2333 seconds ± 10 percent. If either SHIFT key is down, the time is increased to 3.5 seconds ± 10 percent and Data Terminal Ready is disabled. After the 3.5 second interval, Data Terminal Ready is again asserted.

The SHIFT BREAK provides a long-break-disconnect function. Modems with EIA RS-232-C levels can be configured to use this long-break to cause both the local and remote data sets to disconnect. Modems that are connected via the 20 mA current loop may be configured to disconnect the remote data set only.

Table 2-3 Nonalphabetic Key Codes

Lowercase Character	Neither SHIFT Key Down (Octal)	Uppercase Character	Either or Both SHIFT Keys Down (Octal)
1	061	!	041
2	062	@	100
3	063	# or £	043
4	064	\$	044
5	065	%	045
6	066	^	136
7	067	&	046
8	070	*	052
9	071	(	050
0	060	)	051
-	055	_	137
=	075	+	053
[	133	{	173
:	073	:	072
,	047	“	042
,	054	>	074
.	056	<	076
/	057	?	077
\	134	|	174
`	140	~	176
]	135	}	175

Table 2-4 Function Key Codes

Key	Octal Code	Terminal Action
RETURN*	015	Carriage return
LINE FEED	012	Line feed
BACK SPACE	010	Backspace
TAB	011	Tab to next tab stop
SPACE BAR	040	Deposit a space on the screen, erasing that position
ESC	033	Escape – interpret the following character string from the host as a command, rather than displaying it.
Delete	177	Ignored

*The RETURN key can be redefined to issue 015g, 012g (carriage return and line feed). The new line feature in Set-up mode provides this capability.

The CTRL and BREAK keys typed together cause the transmission of the answerback message.

NOTE

The BREAK key does not function when the terminal is in LOCAL mode.

2.2.9 CTRL (Control) Key

The CTRL key is used with other keys on the keyboard to generate control codes. If the CTRL key is held down, the code transmitted by the other keys is shown in Table 2-5.

Table 2-5 Control Codes Generated

Key Pressed with CTRL Key Down (Shifted or Unshifted)	Octal Code Transmitted	Function Mnemonic
Space Bar	000	NUL
A	001	SOH
B	002	STX
C	003	ETX
D	004	EOT
E	005	ENQ
F	006	ACK
G	007	BELL
H	010	BS
I	011	HT
J	012	LF
K	013	VT
L	014	FF
M	015	CR
N	016	SO
O	017	SI
P	020	DLE
Q	021	DC1 or XON
R	022	DC2
S	023	DC3 or XOFF
T	024	DC4
U	025	NAK
V	026	SYN
W	027	ETB
X	030	CAN
Y	031	EM
Z	032	SUB
[	033	ESC
\	034	FS
]	035	GS
~	036	RS
?	037	US

2.2.10 Cursor Control Keys

The keyboard contains four keys labeled with arrows in each of four directions. These keys transmit control functions. If the host echoes these control functions back to the terminal, the cursor moves one character up, down, right, or left. Table 2-6 shows the escape sequence generated by each key.

NOTE

In Set-up mode, the left and right arrow keys move the cursor; the up and down keys increase or decrease the screen brightness.

Table 2-6 Cursor Control Key Codes

Cursor Key (arrow)	VT52 Mode	ANSI Mode and Cursor Key Mode Reset	ANSI Mode and Cursor Key Mode Set
Up	ESC A	ESC [A	ESC O A
Down	ESC B	ESC [B	ESC O B
Right	ESC C	ESC [C	ESC O C
Left	ESC D	ESC [D	ESC O D

2.2.11 Auto Repeating

All keys will auto repeat except: SET-UP, ESC, NO SCROLL, TAB, RETURN, and any key pressed with CTRL. Auto repeating may be disabled (SET-UP function). Auto repeating works as follows: when a key is typed, its code(s) is sent once, immediately. If the key is held down for more than 1/2 second, the code(s) are sent repeatedly at a rate of approximately 30 Hz until the key is released. (This rate is less if a low transmit baud rate is used.)

2.2.12 Special Graphic Characters

If the special graphic set is selected, the ASCII codes 137₈ through 176₈ are replaced with characters shown in Table 2-7. (See the SCS control function to enable this mode.)

2.2.13 Auxiliary Keypad

The keys on the auxiliary keypad normally transmit the codes for the numerals, decimal point, minus sign, and comma. The ENTER key transmits the same code as the RETURN key. The host cannot tell if these keys are typed on the auxiliary keypad or on the main keyboard. Therefore, software that requires numeric data entry may use either keypad.

If software must be able to distinguish between pressing a key on the auxiliary keypad and pressing the corresponding key on the main keyboard, the host can give the terminal a command to place it in keypad application mode. In this mode, all keys on the auxiliary keypad give control functions that may be used by the software as user-defined functions.

The codes sent by the auxiliary keypad for the four combinations of the VT52/ANSI mode and keypad numeric/application mode are shown in Tables 2-8 and 2-9. These keys are not affected by pressing the SHIFT, CAPS LOCK, or CONTROL keys.

NOTE

In ANSI mode, if the codes are echoed back to the terminal, or if the terminal is in LOCAL mode, the last character of the sequence is displayed on the screen; e.g., PF1 will display a "P."

Table 2-7 Special Graphic Characters

Octal Code	Graphic With US or UK Set	Graphic with "Special Graphics" Set
137	-	Blank
140	`	◆ Diamond
141	a	▩ Checkerboard (error indicator)
142	b	HT Horizontal tab
143	c	FF Form feed
144	d	CR Carriage return
145	e	LF Line feed
146	f	° Degree symbol
147	g	± Plus/minus
150	h	NL New line
151	i	VT Vertical tab
152	j	└ Lower-right corner
153	k	┐ Upper-right corner
154	l	┌ Upper-left corner
155	m	└ Lower-left corner
156	n	+ Crossing lines
157	o	- Horizontal line - Scan 1
160	p	- Horizontal line - Scan 3
161	q	- Horizontal line - Scan 5
162	r	- Horizontal line - Scan 7
163	s	- Horizontal line - Scan 9
164	t	┌ Left "T"
165	u	┐ Right "T"
166	v	└ Bottom "T"
167	w	┌ Top "T"
170	x	| Vertical bar
171	y	< Less than or equal to
172	z	> Greater than or equal to
173	{	π Pi
174	|	≠ Not equal to
175	}	£ UK pound sign
176	~	• Centered dot (bullet)

NOTE 1: Codes 152₈ - 156₈, 161₈, and 164₈ - 170₈ are used to draw rectangular grids; each piece of this line drawing set is contiguous with others so that the lines formed are unbroken.

NOTE 2: Codes 157₈ - 163₈ give better vertical resolution than dashes and underlines when drawing lines; using these segments 120 × 132 resolution may be obtained in 132 column mode with the Advanced Video Option installed.

Table 2-8 VT52 Mode Auxiliary Keypad Codes

Key	Keypad Numeric Mode	Keypad Application Mode
0	0	ESC ? p
1	1	ESC ? q
2	2	ESC ? r
3	3	ESC ? s
4	4	ESC ? t
5	5	ESC ? u
6	6	ESC ? v
7	7	ESC ? w
8	8	ESC ? x
9	9	ESC ? y
-	-	ESC ? m
,	,	ESC ? l
.	.	ESC ? n
ENTER	Same as RETURN key	ESC ? M
PF1	ESC P	ESC P
PF2	ESC Q	ESC Q
PF3	ESC R	ESC R
PF4	ESC S	ESC S

Table 2-9 ANSI Mode Auxiliary Keypad Codes

Key	Keypad Numeric Mode	Keypad Application Mode
0	0	ESC O p
1	1	ESC O q
2	2	ESC O r
3	3	ESC O s
4	4	ESC O t
5	5	ESC O u
6	6	ESC O v
7	7	ESC O w
8	8	ESC O x
9	9	ESC O y
-	-	ESC O m
,	,	ESC O l
.	.	ESC O n
ENTER	Same as RETURN key	ESC O M
PF1	ESC O P	ESC O P
PF2	ESC O Q	ESC O Q
PF3	ESC O R	ESC O R
PF4	ESC O S	ESC O S

2.3 TERMINAL CONTROL COMMANDS

The VT105 has many control commands that cause the terminal to take action other than displaying a character on the screen. The host can command the terminal to move the cursor, change modes, ring the bell, etc. The following paragraphs discuss the terminal control commands.

2.3.1 Control Characters

Control characters have values of 000_8 – 037_8 , and 177_8 . The control characters recognized by the VT105 are shown in Table 2-10. All other control codes cause no action to be taken.

Control characters (codes 0 to 37_8 inclusive) may be imbedded within a control function sequence. Imbedded control characters are executed as soon as they are encountered by the terminal. Then, the control function continues to be processed. The exceptions are as follows.

1. If the character ESC (033_8) occurs, the current control function is aborted and a new one commences.
2. If the character CAN (030_8) or the character SUB (032_8) occurs, the current control function is aborted.

The ability to imbed control characters within sequences allows the synchronization characters XON and XOFF to be interpreted without affecting the control function.

2.4 CONTROL FUNCTIONS

The VT105 is an upward and downward software compatible terminal; that is, previous DIGITAL video terminals have private standards for control functions. The American National Standards Institute (ANSI) has since standardized control functions within terminals in documents X3.41-1974 and X3.64-1971.

The VT105 is compatible with both the previous DIGITAL standard and the ANSI standards. Customers may use existing DIGITAL software designed around the VT52 or new VT100 or VT105 software. The VT105 has a VT52-compatible mode, in which, the terminal responds to control functions like a VT52 or VT55.

Throughout this section of the manual references are made to “VT52 mode” or “ANSI mode.” These two terms are used to indicate the software compatibility. All new software should be designed around the ANSI mode. Future DIGITAL video terminals may not be committed to VT52 compatibility.

2.4.1 ANSI Mode Control Functions

Definitions – The following listing briefly defines the basic elements of the ANSI control functions. A more complete listing appears in Appendix B.

1. Control Sequence Introducer (CSI) – A prefix to a control sequence. In the VT105, ESC [is the CSI.
2. Parameter –
 - a. A string of 0 or more decimal characters that represent a single value. Leading 0s are ignored. The characters have a range of 0 (60_8) to 9 (71_8).
 - b. The value so represented.
3. Numeric Parameter – A parameter that represents a number, designated by **Pn**.

Table 2-10 Control Characters

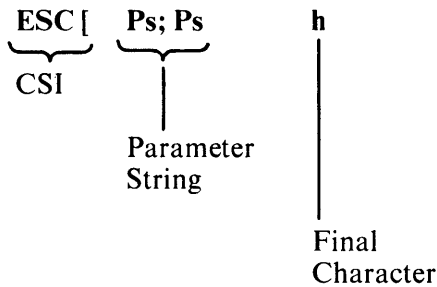
Control Character	Octal Code	Action Taken
NUL	000	Ignored on input (not stored in input buffer).
ENQ	005	Transmit answerback message.
BEL	007	Sound bell tone.
BS	010	Move the cursor to the left one character position. If cursor is at the left margin, no action occurs.
HT	011	Move the cursor to the next tab stop, or move cursor to the right margin if no further tab stops are present on the line.
LF	012	This code causes a line feed or a new line operation. (See new line mode.)
VT	013	Interpreted as LF.
FF	014	Interpreted as LF.
CR	015	Move cursor to left margin on the current line.
SO	016	Invoke G1 character set, as designated by SCS control function.
SI	017	Select GO character set, as selected by SCS control function.
XON	021	Resume transmission to terminal.
XOFF	023	Stop transmitting to terminal all codes except XOFF and XON.
CAN	030	If sent during an escape or control sequence, the sequence is immediately terminated and not executed. It also causes the error character to be displayed.
SUB	032	Interpreted as CAN.
ESC	033	Introduces an escape sequence.
DEL	177	Ignored on input (not stored in input buffer).

4. **Selective Parameter** – A parameter that selects a subfunction from a specified list, designated by **Ps**.
5. **Parameter String** – A string of parameters separated by a semicolon (73₈).
6. **Default Value** – A value that is assumed when no explicit value, or a value of 0, is specified.
7. **Final Character** – A character that terminates a control sequence or escape sequence.

Examples:

1. **General**

selective
parameter



2. **Escape Sequence for double-width line (DEC DWL).**

Escape Sequence	Octal Representation of Same Sequence
ESC # 6	033 043 066

3. **Control sequence to set 132 column mode.**

Control Sequence	Octal Representation of Same Sequence
ESC[?3h	033 133 037 063 150
CSI | Final character | Parameter	CSI | Parameter | Final Character

Refer to Appendix B for a more complete listing of definitions and notation used in this manual.

All of the following control functions are transmitted from the host computer to the terminal unless otherwise noted. All of the control functions are a subset of those specified in ANSI X 3.64 1977 and ANSI X 3.41 1974.

NOTE

Control functions designated by an asterisk have DIGITAL private parameters.

CPR Cursor Position Report – Terminal to Host

ESC [Pn; Pn R

default value: 1

The CPR control sequence reports the active position by means of the parameters. This sequence has two parameter values. The first specifies the line, and the second specifies the column. The default condition with no parameters present, or parameters of 0, is equivalent to a cursor at home position.

The numbering of lines depends on the state of the origin mode (DECOM).

This control sequence is solicited by a device status report (DSR) sent from the host.

CUB Cursor Backward – Host to Terminal and Terminal to Host

ESC [Pn D

default value: 1

The CUB control sequence moves the active position to the left. The distance moved is determined by the parameter. If the parameter value is zero or one, the active position is moved one position to the left. If the parameter value is n, the active position is moved n positions to the left. If an attempt is made to move the cursor to the left of the left margin, the cursor stops at the left margin. *Editor Function*

CUD Cursor Down – Host to Terminal and Terminal to Host

ESC [Pn B

default value: 1

The CUD control sequence moves the active position downward without altering the column position. The number of lines moved is determined by the parameter. If the parameter value is zero or one, the active position is moved one line downward. If the parameter value is n, the active position is moved n lines downward. If an attempt is made to move the cursor below the bottom margin, the cursor stops at the bottom margin. *Editor Function*

CUF Cursor Forward – Host to Terminal and Terminal to Host

ESC [Pn C

default value: 1

The CUF control sequence moves the active position to the right. The distance moved is determined by the parameter. A parameter value of zero or one moves the active position one position to the right. A parameter value of n moves the active position n positions to the right. If an attempt is made to move the cursor to the right of the right margin, the cursor stops at the right margin. *Editor Function*

CUP Cursor Position

ESC [Pn; Pn H

default value: 1

The CUP control sequence moves the active position to the position specified by the parameters. This sequence has two parameter values. The first specifies the line position, and the second specifies the column position. A parameter value of zero or one for the first or second parameter moves the active position to the first line or column in the display, respectively. The default condition, with no parameters present, is equivalent to a cursor to home action. This control sequence behaves identically with the HVP command. *Editor Function*

The numbering of lines depends on the state of the origin mode (DECOM).

CUU Cursor Up - Host to Terminal and Terminal to Host

ESC [Pn A

default value: 1

This control sequence moves the active position upward without altering the column position. The number of lines moved is determined by the parameter. A parameter value of zero or one moves the active position one line upward. A parameter value of n moves the active position n lines upward. If an attempt is made to move the cursor above the top margin, the cursor stops at the top margin. *Editor Function*

DA Device Attributes

ESC [Pn c

default value: 0

1. The host requests the terminal to send a device attributes (DA) control sequence to identify itself. The DA request is a control sequence with either no parameter or a parameter of 0.
2. The response to the request generated by the terminal is a DA control sequence with numeric parameters as follows:

Option Present	Sequence Sent
No options	ESC [?1;0c
Processor option (STP)	ESC [?1;1c
Advanced video option (AVO)	ESC [?1;2c
AVO and STP	ESC [?1;3c
Graphic waveform generator option (GPO)	ESC [?1;4c
GPO and STP	ESC [?1;5c
GPO and AVO	ESC [?1;6c
GPO, STP, and AVO	ESC [?1;7c

DECALN Screen Alignment Display*

ESC # 8

This command fills the entire screen area with uppercase Es for screen focus and alignment. This command is used by DIGITAL manufacturing and Field Service personnel.

DECANM ANSI/VT52 Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes only VT52-compatible control functions to be interpreted and executed. The set state causes only ANSI-compatible control functions to be interpreted and executed.

DECARM Auto Repeat Mode*

This is a private parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes no keyboard keys to auto-repeat. The set state causes certain keyboard keys to auto-repeat.

All keys will auto-repeat except: SET-UP, ESC, NO SCROLL, TAB, RETURN, and any key pressed with CTRL key down. Auto repeating works as follows: when a key is typed, its code is sent once, immediately. If the key is held down for more than 1/2 second, its code is sent repeatedly at a rate of approximately 30 Hz until the key is released. This rate is lower at low transmit baud rates.

DECAWM Autowrap Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes any displayable characters received when the cursor is at the right margin to replace any previous characters there. The set state causes these characters to advance to the start of the next line, performing scroll up if required and permitted.

DECCKM Cursor Keys Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. This mode is only effective when the keypad application mode (DECKPAM) and the ANSI/VT52 mode (DECANM) is set. If the cursor key mode is reset, the four cursor function keys send ANSI cursor control commands. If cursor key mode is set, the four cursor function keys send application functions.

DECCOLM Column Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes a maximum of 80 columns on the screen. The set state causes a maximum of 132 columns on the screen.

NOTE

The use of double-width characters reduces the number of characters per line by half.

DECDHL Double Height Line*

Top Half: ESC # 3

Bottom Half: ESC # 4

These escape sequences cause the line containing the active position to become the top or bottom half of a double-height, double-width line. The sequences must be used in pairs on adjacent lines and the same character output must be sent to both lines to form full double-height characters. If the line was single-width single-height, all characters to the right of the center of the screen are lost. The cursor remains over the same character position unless it would be to the right of the right margin, in which case, it is moved to the right margin.

DECDWL Double-Width Line*

ESC # 6

This escape sequence causes the line that contains the active position to become double-width single-height. If the line was single-width single-height, all characters to the right of the center of the screen are lost. The cursor remains over the same character position unless it would be to the right of the right margin, in which case, it is moved to the right margin.

DECGOFF Graphics Waveform Generator Off*

ESC 2

Turn off the graphics waveform generator.

DECGON Graphics Waveform Generator On*

ESC 1

Turn ON the graphics waveform generator. All subsequent characters are interpreted as commands or data to the graphics waveform generator option. The terminal remains in this mode until the graphics waveform generator off command (ESC 2) is received. This command is ignored if the option is not installed.

DECHCP Hard Copy*

ESC # 7

This escape sequence signals the hardcopy unit to obtain control of the terminal while it copies the video screen. Data to update the screen ceases until the hardcopy output is obtained, after which, the normal operation resumes. This command is ignored if no hard copy option is installed.

DECID Identify Terminal*

ESC Z

This function causes the same response as the ANSI device attributes (DA) command. The DA function is preferred over the DECID function for new software.

DECINLM Interlace Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state (noninterlace) causes the video processor to display 240 scan lines per frame. The set state (interlace) causes the video processor to display 480 scan lines per frame. There is no difference in character resolution.

NOTE

Noninterlace mode (reset state) must be used in the VT105 for graph drawing.

DECKPAM Keypad Application Mode*

ESC =

Enable the auxiliary keypad keys to transmit escape sequences as defined in Tables 2-8 and 2-9.

DECKPNM Keypad Numeric Mode*

ESC >

Return to the numeric keypad mode. The auxiliary keypad keys send ASCII codes corresponding to the characters engraved on the keys.

DECLL Load LEDs*

ESC [P s q

default value: 0

Light the four programmable LEDs on the keyboard according to the parameter(s).

Parameter	Meaning
0	Clear LEDs L1 through L4
1	Light LED L1
2	Light LED L2
3	Light LED L3
4	Light LED L4

LED numbers are indicated on the keyboard.

DECOM Origin Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes the origin to be at the upper-left character position on the screen. Line numbers are independent of current margin settings. The cursor may be positioned outside the margins with a cursor position (CUP) command or a horizontal and vertical position (HVP) command.

The set state causes the origin to be at the upper-left character position within the margins. Line numbers are relative to the current margin settings. The cursor is not allowed to be positioned outside the margins.

The cursor is moved to the new home position when this mode is set or reset.

Lines and columns are numbered consecutively with the origin being line 1, column 1.

DECRC Restore Cursor*

ESC 8

This escape sequence causes the previously saved cursor position, graphic rendition, and character set to be restored.

DECRETPARM Report Terminal Parameters*

**ESC [<sol>; <par>; <nbits>; <xspeed>;
<rspeed>; <clkmul>; <flags>x**

The parameters for this control sequence are explained in the next paragraph, DECREQTPARM.

DECREQTPARM Request Terminal Parameters*

ESC [<sol> x

The DECRETPARM control sequence is sent by the terminal controller to notify the host of the status of selected terminal parameters. The status sequence may be sent when requested by the host or at the terminal's discretion. DECRETPARM is sent upon receipt of a DECREQTPARM. On power-up or reset, the terminal is inhibited from sending unsolicited reports.

The meanings of the sequence parameters are as follows.

Parameter	Value	Meaning
<sol>	0 or none	This message is a request (DECREQTPARM) and the terminal is allowed to send unsolicited reports. Unsolicited reports are sent when the terminal exits the Set-up mode.
	1	This message is a request; the terminal may only report in response to a request.
	2	This message is a report (DECREPTPARM).
	3	This message is a report and the terminal is only reporting on request.
<par>	1	No parity set
	4	Parity is set and odd
	5	Parity is set and even
<nbits>	1	8 bits per character
	2	7 bits per character
<xspeed> <rspeed>	0	Bits per second 50
	8	75
	16	110
	24	134.5
	32	150
	40	200
	48	300
	56	600
	64	1200
	72	1800
	80	2000
	88	2400
	96	3600
	104	4800
	112	9600
	120	19200
<clkmul>	1	The bit rate multiplier is 16.
<flags>	0-15	This value communicates the four switch values in block 5 of Set-up B, which are only visible to the user when a processor option (STP) is installed. These bits may be assigned for an STP device. The four bits are a decimal-encoded binary number.

DECSC Save Cursor*

ESC 7

This escape sequence causes the cursor position, graphic rendition, and character set to be saved. (See Restore Cursor DECRC.)

DECSCLM Scrolling Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes scrolls to “jump” instantaneously. The set state causes scrolls to be “smooth” at a maximum rate of six lines per second.

DECSCNM Screen Mode*

This parameter is applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes the screen to be black with white characters. The set state causes the screen to be white with black characters.

DECSTBM Set Top and Bottom Margins*

ESC [Pn; Pn r

default values: (see below)

This control sequence sets the top and bottom margins to define the scrolling region. The first parameter is the line number of the first line in the scrolling region; the second parameter is the line number of the bottom line in the scrolling region. Default is the entire screen (no margins). The minimum size of the scrolling region allowed is two lines; that is, the top margin must be less than the bottom margin. The cursor is placed in the home position. (See origin mode DECOM.)

DECSWL Single-Width Line*

ESC # 5

This escape sequence causes the line that contains the active position to become single-width single-height. The cursor remains in the same character position. This is the default condition for all new lines on the screen.

DECTST Invoke Confidence Test*

ESC [2 ; Ps y

Ps is the parameter indicating the test to be done. Ps is computed by taking the value indicated for each desired test and adding them together. If Ps is 0 no test is performed but the terminal is reset.

Test	Value
Power up self-test (ROM checksum, RAM, NVR keyboard, and AVO if installed)	1
Data loop back test	2 (loop-back connector required)
EIA modem control test	4 (loop-back connector required)
Repeat selected test(s) indefinitely until failure or power off.	8

DSR Device Status Report

ESC [Ps n *default value: 0*

This control sequence requests and reports the general status of the terminal according to the following parameter(s).

Parameter	Parameter Meaning
0	Response from terminal – Ready; no malfunctions detected (default).
3	Response from terminal – Malfunction; retry.
5	Command from host – Report active position (using a CPR control sequence).
6	Command from host – Report active position (using CPR control sequence).

A parameter value of 0 or 3 is always sent in response to a DSR request with a parameter value of 5.

ED Erase In Display

ESC [Ps J *default value: 0*

Erase some or all of the characters in the display according to the parameter. Any complete line erased by this sequence returns that line to single-width mode. *Editor Function*

Parameter	Parameter Meaning
0	Erase from the active position to the end of the screen, inclusive (default).
1	Erase from start of the screen to the active position, inclusive.
2	Erase all of the display – all lines are erased, changed to single-width, and the cursor does not move.

EL Erase In Line

ESC [Ps K *default value: 0*

Erase some or all characters in the active line according to the parameter. *Editor Function*

Parameter	Parameter Meaning
0	Erase from the active position to the end of the line, inclusive (default).
1	Erase from the start of the screen to the active position, inclusive.
2	Erase all of the line, inclusive.

HTS Horizontal Tabulation Set

ESC H

Set one horizontal tab stop at the active position. *Format Effector*.

HVP Horizontal and Vertical Position

ESC [Pn ; Pn f

default value: 1

Move the active position as specified by the parameters. This control sequence has two parameter values: the first specifies the line position and the second specifies the column. A parameter value of either zero or one causes the active position to move to the first line or column in the display, respectively. The default condition with no parameters present moves the active position to the home position. This command reacts identically with its editor function counterpart, CUP. The numbering of lines and columns depends on the reset or set state of the origin mode (DECOM). *Format Effector*

IND Index

ESC D

This escape sequence causes the active position to move downward one line without changing the column position. If the active position is at the bottom margin, a scroll up is performed. *Format Effector*

LNM Line Feed/New Line Mode

This is a parameter applicable to set mode (SM) and reset mode (RM) control sequences. The reset state causes the interpretation of the line feed (LF), defined in ANSI Standard X3.64-1977, to imply only vertical movement of the active position and causes the return key (CR) to send the single code CR. The set state causes the LF to imply movement to the first position of the following line and causes the return key to send the two codes (CR and LF). This is the new line (NL) Set-up feature.

This mode does not affect the index (IND), or next line (NEL), format effectors.

NEL Next Line

ESC E

This escape sequence causes the active position to move to the first position on the next line downward. If the active position is at the bottom margin, a scroll up is performed. *Format Effector*

RI Reverse Index

ESC M

Move the active position to the same horizontal position on the preceding line. If the active position is at the top margin, scroll down is performed. *Format Effector*

RIS Reset To Initial State

ESC c

Reset the VT105 to its initial state as powered on. This also causes the execution of the power-up self-test and signal INIT H to be asserted briefly to clear graph memories.

RM Reset Mode

ESC [Ps ; Ps ; . . . ; Ps l *default value: none*

Reset one or more modes as specified by each selective parameter in the parameter string. Each mode to be reset is specified by a separate parameter. [See Set Mode (SM) control sequence.]

SCS Select Character Set

The appropriate G0 and G1 character sets are designated from one of the five possible character sets. The G0 and G1 sets are invoked by the codes SI and SO (shift in and shift out) respectively.

G0 Sets

G1 Sets

Sequence	Sequence	Meaning
ESC(A	ESC)A	United Kingdom set
ESC(B	ESC)B	ASCII set
ESC(0	ESC)0	Special graphics character set
ESC(1	ESC)1	Alternate character ROM standard character set
ESC(2	ESC)2	Alternate character ROM special graphics set

The United Kingdom and ASCII sets conform to the "ISO international register of character sets to be used with escape sequences." The other sets are DIGITAL private character sets. Special graphics means that the graphic characters for the codes 137₈ to 176₈ are replaced with other characters. The specified character set is used until another SCS is received.

SGR Select Graphic Rendition (Character Attributes)

ESC [Ps ; . . . ; Ps m *default value: 0*

Invoke the character attributes specified by the parameter(s). All subsequent characters transmitted to the video screen react according to the parameter(s) selected until the next occurrence of SGR. *Format Effector*

Parameter	Parameter Meaning
0	Attributes off
1	Bold or increased intensity
4	Underscore
5	Blink
7	Negative (reverse) image

All other parameter values are ignored.

Without the Advanced Video Option, only one type of character attribute is possible as determined by the cursor selection. Specify either the blinking underline or the blinking block cursor to activate the character attribute. (See cursor selection in Chapter 1.)

SM Set Mode

ESC [Ps; . . . ; Ps h

default value: none

This control sequence causes one or more modes to be set as specified by each parameter in the parameter string. Each mode to be set is specified by a separate parameter. A mode is considered set until it is reset by a reset mode (RM) control sequence. (See Paragraph 2.4.2 to select the parameters for the modes.)

TBC Tabulation Clear

ESC [Ps g

default value: 0

Parameter	Parameter Meaning
0	Clear the horizontal tab stop at the active position (the default case).
3	Clear all horizontal tab stops

Any other parameter values are ignored. *Format Effector*

2.4.2 Modes

The following is a list of modes that may be changed with set mode (SM) and reset mode (RM) control sequences.

2.4.2.1 ANSI Specified Modes

Parameter	Mode Mnemonic	Mode Function
0	-	Error (ignored)
20	LNM	Line feed/new line mode

2.4.2.2 DIGITAL Private Modes – If the first character in the parameter string is ? (77₈), the parameters are interpreted as DIGITAL private parameters according to the following:

Parameter	Mode Mnemonic	Mode Function	Reset	Set
0	-	Error (ignored)		
1	DECCKM	Cursor key	ANSI functions	Application functions
2	DECANM	ANSI/VT52	VT52 mode	ANSI mode
3	DECCOLM	Column	80	132
4	DECSCLM	Scrolling	Jump	Smooth
5	DECSCNM	Screen Background	Black	White
6	DECOM	Origin	Screen reference	Margin reference
7	DECAWM	Auto wrap	Disabled	Enabled
8	DECARM	Auto repeating	Disabled	Enabled
9	DECINLM	Interlace	Noninterlace	Interlace

Any other parameter values are ignored.

2.4.2.3 Other ANSI Mode States – The following modes, specified in the ANSI X3.64-1977 standard, may be considered to be permanently set, permanently reset, or not applicable, as noted. Refer to that standard for further information concerning these modes.

Mode Mnemonic	Mode Function	State
CRM	Control representation	Reset
EBM	Editing boundary	Reset
ERM	Erase	Set
FEAM	Format effector action	Reset
FETM	Format effector transfer	Reset
GATM	Guarded area transfer	NA
HEM	Horizontal editing	NA
IRM	Insertion-replacement	Reset
KAM	Keyboard action	Reset
MATM	Multiple area transfer	NA
PUM	Positioning unit	Reset
SATM	Selected area transfer	NA
SRTM	Status reporting transfer	Reset
TSM	Tabulation stop	Reset
TTM	Transfer termination	NA
VEM	Vertical editing	NA

2.4.3 ANSI Control Function Summary

The following is a summary of the VT105 ANSI control functions. The ANSI mode must be enabled to use the control functions outlined in the following paragraphs. Recognition of the escape sequences is dependent on system software and in some cases the presence of terminal options. The following definitions apply.

1. Pn refers to a numeric parameter in the range of 0 (060g) to 9 (071g).
2. Ps refers to a selective parameter from a specified list. Ps has a range of 0 (060g) to 9 (071g).
3. Multiple parameters are separated by a semicolon (073g).
4. If a parameter is omitted or specified to be 0, the default parameter value is used. (For the cursor movement commands, the default parameter value is 1.)

Character Attributes

ESC [Ps;Ps;Ps;...; Ps m

Ps refers to a selective parameter. Multiple parameters are separated by a semicolon (073g). The parameters are executed in order and have the following meanings:

Parameter (Ps)	Attribute
0 or None	All Attributes Off
1	Bold on
4	Underscore on
5	Blink on
7	Reverse video on

Any other parameter values are ignored.

Character Sets (G0 and G1 Designators)

The G0 and G1 character sets are designated as follows.

Character set	G0 designator	G1 designator
United Kingdom (UK)	ESC (A	ESC) A
United States (ASCII)	ESC (B	ESC) B
Special graphics characters and line drawing set	ESC (0	ESC) 0
Alternate character ROM	ESC (1	ESC) 1
Alternate character ROM special graphic characters	ESC (2	ESC) 2

Cursor Movement Commands

Cursor up	ESC [Pn A
Cursor down	ESC [Pn B
Cursor forward (right)	ESC [Pn C
Cursor backward (left)	ESC [Pn D
Direct cursor addressing	ESC [Pl; Pc H <i>or</i> ESC [Pl; Pc f
Index	ESC D
Reverse index	ESC M
Save cursor and attributes	ESC 7
Restore cursor and attributes	ESC 8

Pl = line number; Pc = column number; default character = 1.

Erase

From cursor to end of line	ESC [K <i>or</i> ESC [0 K
From beginning of line to cursor	ESC [1 K
Entire line containing cursor	ESC [2 K
From cursor to end of screen	ESC [J <i>or</i> ESC [0 J
From beginning of screen to cursor	ESC [1 J
Entire screen	ESC [2 J

Line Size (Double-Height and Double-Width) Commands

Change this line to double-height top half	ESC # 3
Change this line to double-height bottom half	ESC # 4
Change this line to single-width single-height	ESC # 5
Change this line to double-width single-height	ESC # 6

Modes

Mode Name	To Set		To Reset	
	Mode	Sequence	Mode	Sequence*
Line feed/new line	New line	ESC [20h	Line feed	ESC [20l
Cursor key mode	Application	ESC [?1h	Cursor	ESC [?1l
ANSI/VT52 mode	ANSI	N/A	VT52	ESC [?2l
Column mode	132 Col	ESC [?3h	80 Col	ESC [?3l
Scrolling mode	Smooth	ESC [?4h	Jump	ESC [?4l
Screen mode	Reverse	ESC [?5h	Normal	ESC [?5l
Origin mode	Relative	ESC [?6h	Absolute	ESC [?6l
Wraparound	On	ESC [?7h	Off	ESC [?7l
Auto repeat	On	ESC [?8h	Off	ESC [?8l
Interlace	On	ESC [?9h	Off	ESC [?9l
Waveform Generator	On	ESC 1	Off	ESC 2
Keypad mode	Application	ESC =	Numeric	ESC >

Programmable LEDs

ESC [Ps;Ps;...Ps q

Ps refers to a selective parameter. Multiple parameters are separated by semicolons (073g) and executed in order, as follows.

Parameter (Ps)	LED Selected
0 or None	All LEDs Off
1	LED L1 On
2	LED L2 On
3	LED L3 On
4	LED L4 On

Any other parameter values are ignored.

Reports

Cursor Position Report

Invoked by: ESC [6 n

Response is: ESC [Pl ; Pc R
Pl = line number and Pc = column number.

Status Report

Invoked by: ESC [5 n

Response is: ESC [0 n (terminal ok)
ESC [3 n (terminal not ok)

*Last character in sequence is a lowercase L.

What Are You? (Identify Report)

Invoked by: ESC [c

or

ESC [0 c

Response is: ESC [? 1 ; Ps c

Ps is the “option present” parameter with the following meaning:

Ps	Meaning
0	Base VT100, no options
1	Processor option (STP)
2	Advanced video option (AVO)
3	AVO and STP
4	Graphic Waveform Generator Option (GPO)
5	GPO and STP
6	GPO and AVO
7	GPO, STP, and AVO

The identify report is alternately invoked by ESC Z sequence; however, this is not recommended for new software. The response is the same.

Reset

Reset causes the power-up reset routine to be executed.

ESC c

Scrolling Region

ESC [Pt ; Pb r

Pt is the number of the top line of the rolling region; Pb is the number of the bottom line of the scrolling region and must be greater than Pt.

Tab Stops

Set tab at current column

ESC H

Clear tab at current column

ESC [g *or* ESC [0 g

Clear all tabs

ESC [3 g

Tests

Fill Screen with “Es”

ESC # 8

Invoke Test(s)

ESC [2 ; Ps y

Ps is the parameter indicating the test to be done and is a decimal number computed by taking the “value” indicated for each desired test and adding them together.

Test	Value
Power-up self-test (ROM checksum, RAM, NVR, keyboard, and AVO if installed)	1
Data loop-back test	2 (Loop-back connector required)
EIA modem control test	4 (Loop-back connector required)
Repeat selected test(s) indefinitely until failure or power off.	8

2.4.4 VT52 Mode Control Functions

The VT52 mode must be enabled to use the following control functions. Table 2-11 provides a brief summary of the valid VT52 control functions.

Table 2-11 VT52 Mode Control Functions

Control Function/Action	Escape Sequence
Cursor Up	ESC A
Cursor Down	ESC B
Cursor Right	ESC C
Cursor Left	ESC D
Select Special Graphics character set	ESC F
Select ASCII character set	ESC G
Cursor to home	ESC H
Reverse line feed	ESC I
Erase to end of screen	ESC J
Erase to end of line	ESC K
Direct cursor address	ESC Ylc (see note 1)
Identify	ESC Z (see note 2)
Enter alternate keypad mode	ESC =
Exit alternate keypad mode	ESC >
Waveform generator ON	ESC 1 (see note 3)
Waveform generator OFF	ESC 2 (see note 3)
Enter ANSI mode	ESC <

NOTES:

1. Line and column numbers for the direct cursor address are single character codes with octal values of the desired number plus 37₈. Line and column numbers start at 1.
2. Response to ESC Z is ESC / Z.
3. Ignored if waveform generator option is not installed.

The following paragraphs explain the VT52 mode control functions in detail.

Waveform Generator ON

ESC 1

Turn on the waveform generator. All subsequent characters are interpreted as commands to the graphics waveform generator option until ESC 2 is received. This sequence is ignored if this option is not installed.

Waveform Generator OFF

ESC 2

Turn off the waveform generator.

Cursor Up

ESC A

Move the active position upward one position without altering the horizontal position. If an attempt is made to move the cursor above the top margin, the cursor stops at the top margin.

Cursor Down

ESC B

Move the active position down one position without altering the horizontal position. If an attempt is made to move the cursor below the bottom margin, the cursor stops at the bottom margin.

Cursor Right

ESC C

Move the active position to the right. If an attempt is made to move the cursor to the right of the right margin, the cursor stops at the right margin.

Cursor Left

ESC D

Move the active position one position to the left. If an attempt is made to move the cursor to the left of the left margin, the cursor stops at the left margin.

Enter Special Graphic Character Mode

ESC F

This command causes the special graphics character set to be used.

NOTE

The special graphics characters in the VT105 are different from those in the VT52.

Exit Special Graphic Character Mode

ESC G

This function returns the terminal to the standard ASCII character set.

Cursor to Home

ESC H

Move the cursor to the home position.

Reverse Line Feed

ESC I

Move the active position up one position without altering the column position. If the active position is at the top margin, a scroll down is performed.

Erase to End of Screen

ESC J

Erase all characters from the active position to the end of the screen. The active position is not changed.

Erase to End of Line

ESC K

Erase all characters from the active position to the end of the current line. The active position is not changed.

Direct Cursor Addressing

ESC Y line column

Move the cursor to the specified line and column. The line and column numbers are sent as ASCII codes whose values are the number plus 037₈; for example, 040₈ refers to the first line or column, 050₈ refers to the eighth line or column, etc.

Identify

ESC Z

This function causes the terminal to send an identifier escape sequence to the host as follows:

ESC / Z

NOTE

Information regarding options must be obtained in ANSI mode, using the device attributes (DA) control sequence.

Enter Alternate Keypad Mode

ESC =

The auxiliary keypad keys send unique identifiable escape sequences for use by applications programs.

Exit Alternate Keypad Mode

ESC >

The auxiliary keypad keys send the ASCII codes for the functions or characters engraved on the key.

Enter ANSI Mode

ESC <

Entering this mode allows the terminal to recognize ANSI-compatible control functions. (Refer to Paragraph 2.4.1.) The VT52 control functions in this section will not be recognized.

2.5 COMMUNICATION PROTOCOL

2.5.1 Full Duplex – XON/XOFF Response

This terminal can operate at transmission speeds up to 19,200 baud. However, the terminal may not be able to keep up with incoming data. The terminal stores incoming characters in a 64-character buffer and processes them on a first-in/first-out basis. When the contents of the buffer reaches 32 characters, the terminal transmits 023₈ (XOFF or DC3). On this signal, the host should suspend its transmission to the terminal. If the host stops transmitting, the terminal soon depletes the buffer. When 16 characters remain in the buffer, the terminal transmits 021₈ (XON or DC1) to signal the host to resume transmission.

The terminal always recognizes received XOFF and XON. Receipt of XOFF inhibits transmission of any codes except XOFF and XON. From three to seven keystrokes on the keyboard will be stored in a keyboard buffer. (Some keys transmit two or three codes, e.g., cursor controls). If the keyboard buffer overflows, keyclicks stop and the KBD LOCKED LED turns on. Transmission resumes upon receipt of XON.

Also, entering Set-up mode causes the terminal to temporarily stop taking characters from the buffer. An XOFF is sent if the buffer becomes nearly full.

Entering and exiting SET-UP clears the keyboard locked condition.

Calculating “Buffer Overflow” – If the host fails to respond to an XOFF from the terminal, the buffer continues to fill. When the 64-character capacity of the buffer is exceeded, a condition occurs called “buffer overflow.” To determine if the buffer will overflow, use the following formulas.

No. of characters to overflow = $32 - [3 \times (\text{receive speed}/\text{transmit speed})]$

Time to respond to XOFF = $\text{No. of characters to overflow} \times (\text{bits per character} + \text{parity bit} + 2)/\text{receive speed}$

Example 1:

The terminal is transmitting 8-bit characters with no parity at 1200 baud and receiving at 1200 baud. The terminal sends an XOFF. The formula applies as follows.

No. of characters to overflow = $32 - [3 \times (1200/1200)] = 29$ characters

Time to respond to XOFF = $29 \times (8+0+2)/1200 = 0.2416$ second

Conclusion: The host must respond to the XOFF within 0.2416 second to avoid a buffer overflow.

Example 2:

The VT105 is transmitting 7-bit characters (with parity) at 300 baud and is receiving at 1200 baud. The terminal sends an XOFF.

No. of characters to overflow = $32 - [3 \times (1200/300)] = 20$ characters

Time to respond to XOFF = $20 \times (7+1+2)/1200 = 0.1666$ second

Conclusion: The host must respond within 0.1666 second to avoid a buffer overflow. If the buffer overflows, the VT105 will begin to discard incoming characters and the error character (⌘) will be displayed.

Software that does not support the AUTO XON/XOFF feature can still use this terminal if the following conditions are met.

1. The software never sends an ESC code to the terminal.
2. The baud rate is limited to 4800 or less.
3. The software does not use smooth scrolling or split screen features.

Alternatively, if the AUTO XON/XOFF feature cannot be used, fill characters may be used after certain characters or character strings are sent to the terminal. Refer to Appendix E for fill characters required for specific control functions.

2.5.2 Reset and Self-Test

Reset and self-test routines initialize the terminal and erase the input buffer. If characters are received and placed in the buffer, after either of these commands the characters are destroyed.

To compensate for this, the host may act in one of two ways.

1. Immediately after sending the commands to perform either the reset or self-test functions, the host may act as if it had received XOFF from the terminal, thus sending no more characters until it receives XON. The terminal transmits XON after it completes the specified operation if the AUTO XOFF/XON feature is enabled.
2. When the first method cannot be implemented, a delay of 10 seconds or more may be used to allow the terminal time to complete the function. Future options may require a change in the time delay. This method, however, does not guarantee against the loss of data when an invoked function has detected an error.

The XOFF/XON synchronization scheme has an advantage over requiring the host to insert delays or filler characters in its data stream. Requiring a minimum of software support, XON/XOFF ensures that every character or command sent to the terminal is processed in correct order. It frees interface programs from all timing considerations and results in a more reliable operation.

2.5.3 NO SCROLL and CTRL S/CTRL Q

There are two other means of transmitting XOFF and XON – the NO SCROLL key, and CTRL S/CTRL Q. If the AUTO XON/XOFF feature is enabled, the terminal coordinates these operations so that the desired effect occurs. For example: If the buffer-filling condition causes an XOFF to be sent and the operator types the NO SCROLL key, a second XOFF is not sent. However, instead of sending an XON when the buffer empties, the terminal waits until the operator types the NO SCROLL key again before sending XON. Use of CTRL S and CTRL Q is synchronized with the NO SCROLL key.

If the AUTO XON/XOFF feature is disabled, the buffer-filling condition does not send an XOFF, the NO SCROLL key is disabled, and CTRL S and CTRL Q are transmitted as typed.

If the user transmits an XOFF to the host (by CTRL S or NO SCROLL), the host should not send any characters until the user transmits XON (by typing CTRL Q or the NO SCROLL key again).

CHAPTER 3 GRAPH DRAWING

3.1 INTRODUCTION

The graph drawing features of the VT105 terminal are provided by the waveform generator module, M7071. It gives the terminal the capability of plotting graphs, histograms, strip charts, graph markers, and vertical and horizontal lines.

This chapter describes how to:

- Select the graph drawing mode
- Establish the graph area
- Establish desired display
- Load graph data
- Generate shade lines, cursors, and grid
- Enter strip chart data

NOTE

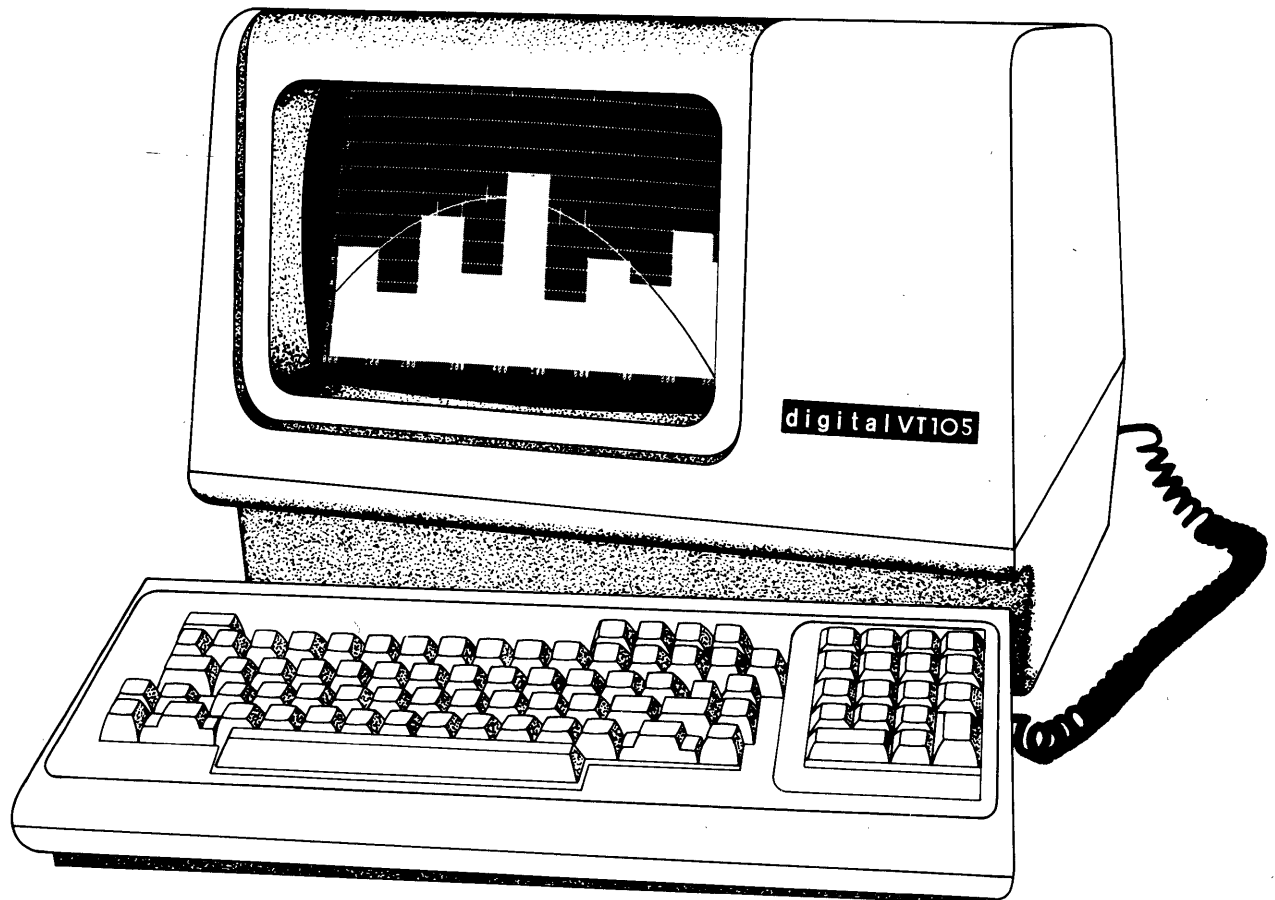
Should any of the features described in this chapter fail to perform properly, an interactive graphics test is provided in Appendix A to check the performance of the M7071 module in LOCAL mode.

3.2 ENTERING THE GRAPH DRAWING MODE

Receiving an escape (033g) followed by the number 1 (061g) or typing **ESC 1** in LOCAL mode switches the terminal to its graph drawing mode. The terminal will remain in this mode until **ESC 2** is received by the terminal whether typed OFF LINE or sent by the host.

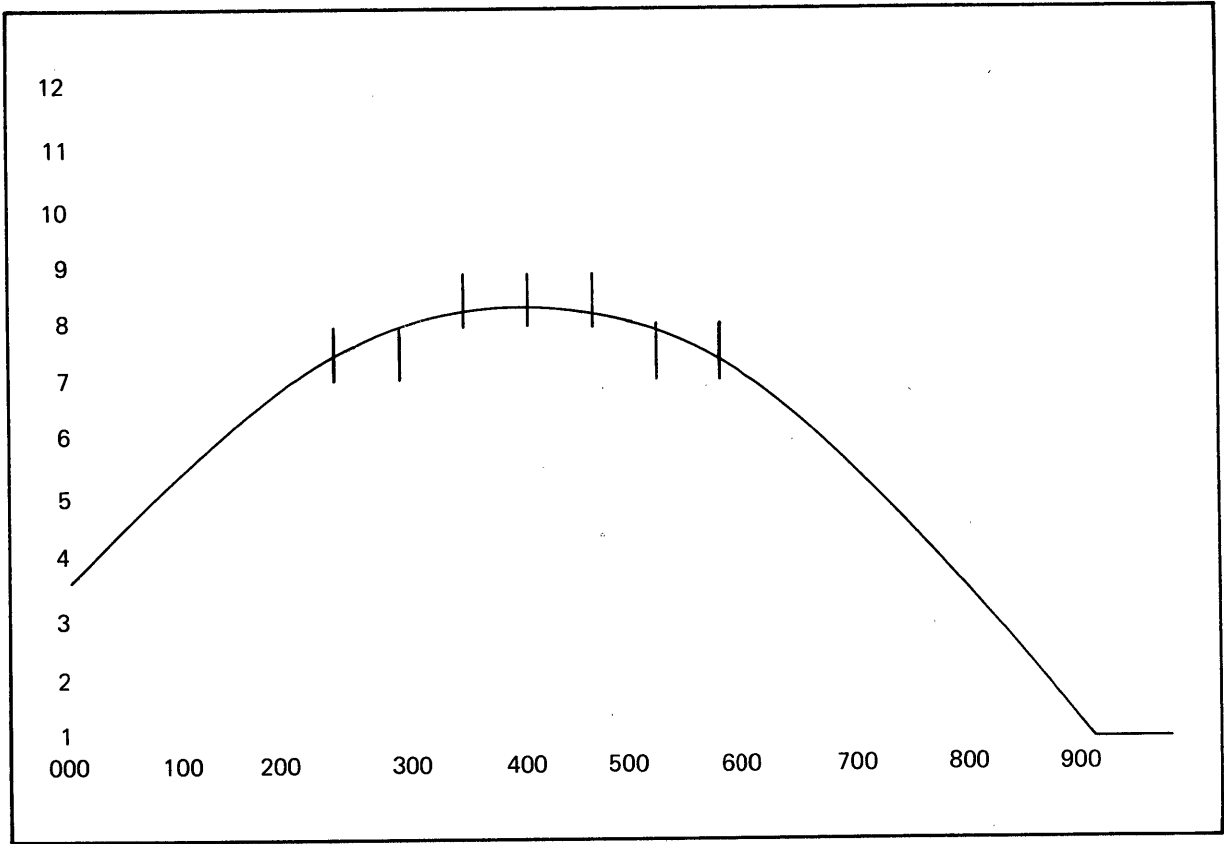
3.3 DEFINITIONS AND LIMITATIONS

- GRAPH:** A graph is a series of points representing the variation in value of two variables: X and Y (Figure 3-1). For each horizontal value (x), there can be only one Y value; example, a sine wave.
- GRAPH MARKER:** A graph marker is a short vertical line that may be programmed to mark any point of the graph. Each marker represents a specific value of X and appears at intervals of $Y = 240/16$. As many as 512 markers can be placed on each graph or histogram for a total of 1024 markers. See Figure 3-2.



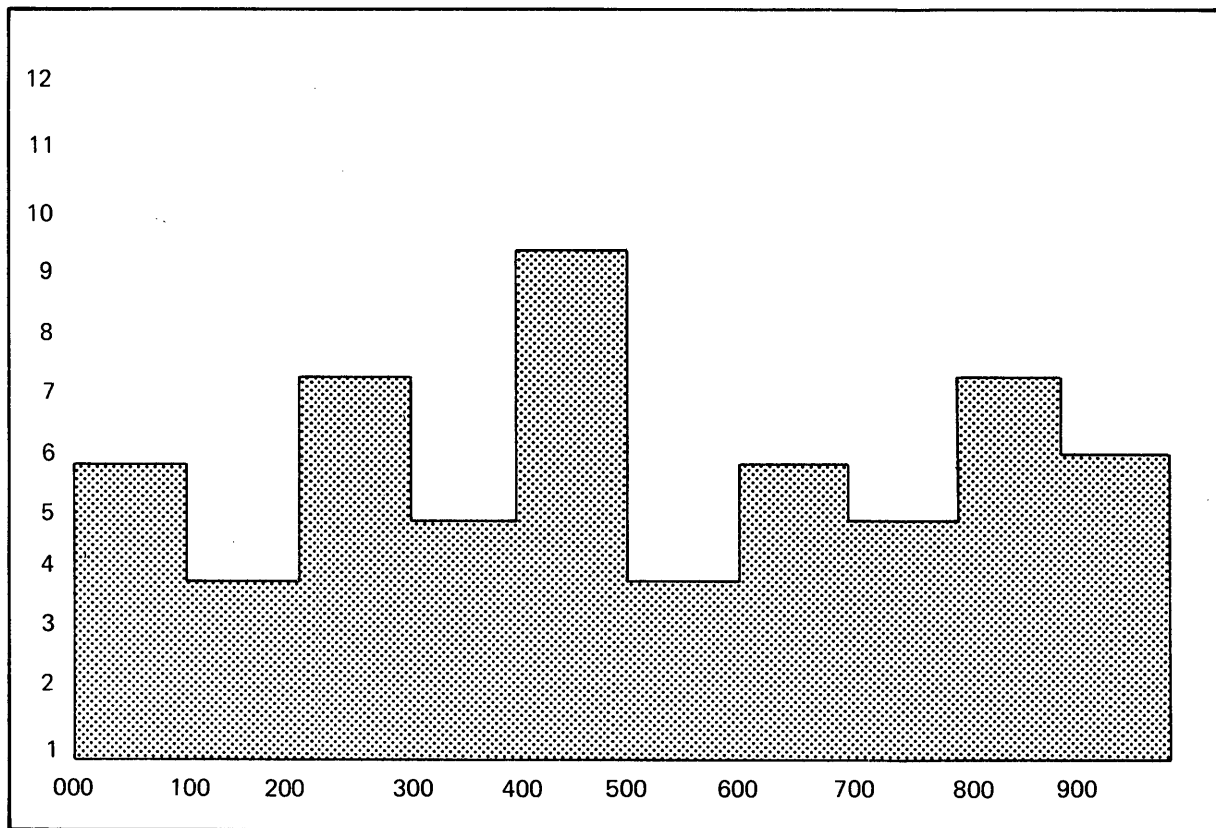
MR-3518

Figure 3-1 VT105 with Graph Display



MR-2572

Figure 3-2 Graph with Graph Markers



MR-2573

Figure 3-3 Histogram Display (Shaded Graph)

**HISTOGRAM:
(SHADED GRAPH)**

A histogram in the VT105 is a graphic display that has the area between the graph line and the bottom of the graph drawing field intensified. Two histograms can overlap and still be discernible. A bar graph is an example of a histogram, as shown in Figure 3-3.

**SHADE LINE:
(BASELINE)**

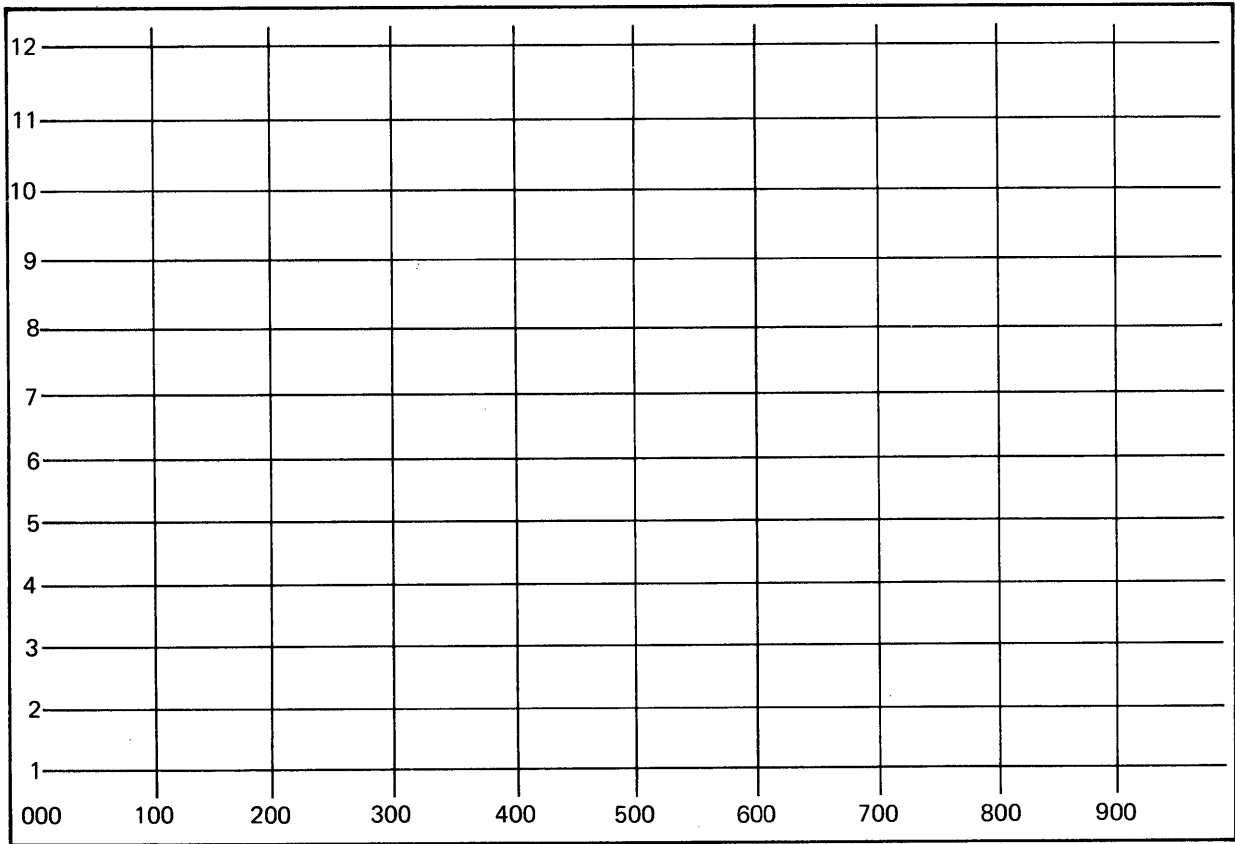
A shade line (baseline) is the line referenced for shading a graph. One shade line can be displayed for each of the two graphs. If no shade line is established, the graph can be shaded to the bottom of the graph drawing area. (See Histogram.)

**HORIZONTAL LINES/
VERTICAL LINES:**

Horizontal lines and/or vertical lines may be displayed in the graph area to represent set values of X or Y. As many as 512 vertical or 240 horizontal lines may be individually displayed on the screen. For example, a grid is displayed using specific values for horizontal and vertical lines, as shown in Figure 3-4.

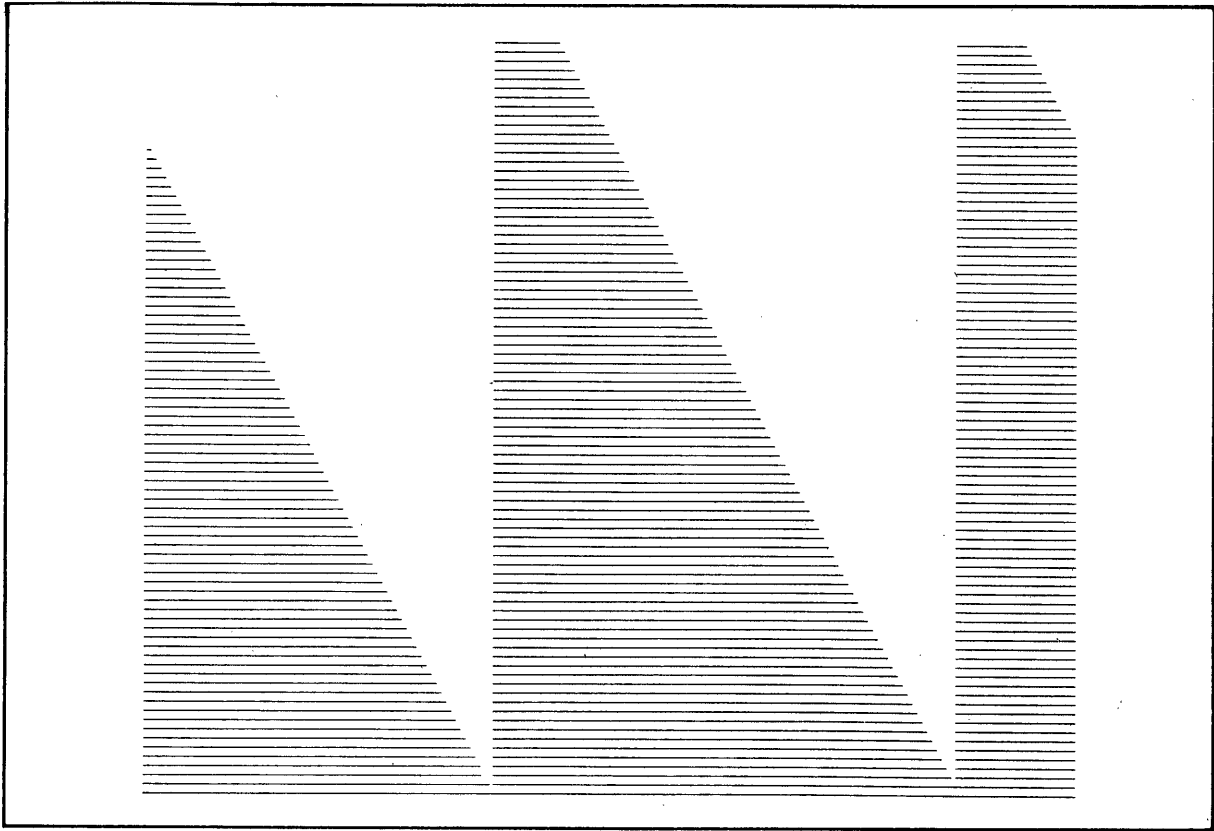
STRIP CHART:

A strip chart is a graph or histogram that permits new data to be added to its right side while shifting previous data to the left, as in Figure 3-5. Vertical and horizontal lines, if present, move from right to left as the strip chart moves, and wrap around the screen as they leave the left edge.



MR-2574

Figure 3-4 Example of a Grid Display



MR-3515

Figure 3-5 Strip Chart Display (Moves From Right to Left)

DUAL STRIP CHART:

Dual strip chart is a feature that allows both Graph 0 and Graph 1 to pass across the screen.

RECTANGULAR GRAPH DRAWING FIELD:

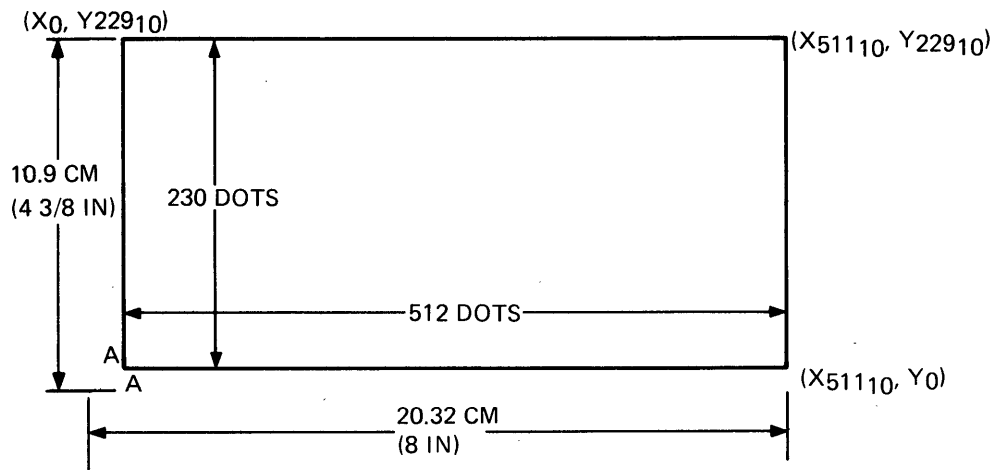
The rectangular graph drawing field is one of two aspect ratios selectable within the VT105. It has a 20 × 10.9 cm (8 × 4 3/8 in) graph drawing field compatible with previous DIGITAL graph drawing terminals (e.g., VT55). See Figure 3-6.

SQUARE GRAPH DRAWING FIELD:

The square graph drawing field is a selectable aspect ratio with a 16.5 × 11.5 cm (6.5 × 4.6 in) graph drawing field. It compresses the X-axis length and provides a greater area outside the field for alphanumeric labels, grid identifiers, or notes. See Figure 3-7.

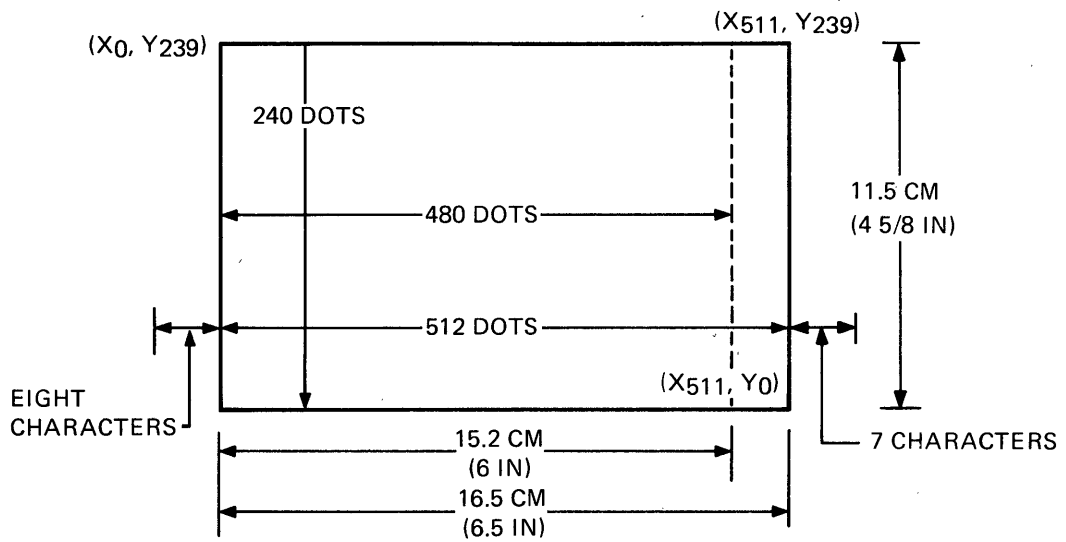
GRAPH RESOLUTION:

Up to 512 horizontal and 230 vertical points may be displayed per graph in the rectangular graph drawing field; 512 × 240 points, in the square graph drawing field.



MR-1132

Figure 3-6 Rectangular Graph Drawing Field



MR-1133

Figure 3-7 Square Graph Drawing Field

3.4 SELECTING THE GRAPH DRAWING FIELD

The VT105 has two selectable graph drawing fields or formats. Both formats display up to two 512-point graphs having single valued functions of X. Either or both graphs can be displayed as a histogram or a strip chart. Graphs and histograms can overlap and still be discernible, allowing the use of the entire field for both graphs, both histograms, or a graph and a histogram displayed together. Both formats display individually programmable horizontal and vertical lines over the entire graph field allowing a grid to represent any desired value. Graph markers can be displayed in either format. Table 3-1 compares the formats and how each is selected.

Example:

Character Sequence	Octal Code Sequence	Field
I space !	111 040 041	Enable square format
I space space	111 040 040	Enable rectangular format

Table 3-1 Comparison of Graph Drawing Formats

Feature	Rectangular Format	Square Format
Graph Field (maximum)	20 × 10.9 cm (8 × 4.3 in)	16.5 × 11.56 cm (6.5 × 4.625 in)
Graph Resolution (maximum)	512 × 230 points	512 × 240 points
Features		
Graphs	2	2
Shaded Graphs	2	2
Movable Shade lines	1 per graph	1 per graph
Strip Charts	2	2
Vertical Lines	512	512
Horizontal Lines	230	240
Graph Markers	512 per graph	512 per graph
Space provided in left margin for:	1 character (column 1)	8 characters (columns 1-8)
Character lines below graph field:	1 line (line 24)	none
Selected on Initialize	Yes	No
Program selectable by:	I space space	I space !
Display using previous DECgraphic software (i.e., VT55)	Display unchanged	Both height and width are changed

3.5 SELECTING DESIRED DISPLAY

Enabling graphs, histograms, strip charts, and shade lines (baselines) is accomplished by loading control register 0 in the VT105; enabling graph markers, vertical lines, and horizontal lines is accomplished by loading control register 1. The registers are loaded by sending a two or three character sequence from the keyboard or host computer. The number of characters depends on the type of graph or shade line (baseline) desired. The control bits are encoded as 7-bit ASCII characters that are sent to the terminal.

3.5.1 Loading Control Register 0

To determine the required bits to set in register 0, refer to Table 3-2. A seven digit binary code transmits the desired display. The bits are set as desired, for example: Bit 2 is set to enable Graph 1; bit 0 is set to enable the display. The binary code created is 0100101 (045₈). For examples of loading register 0, see Table 3-3 and Table 3-4.

Table 3-5 can be used to convert the binary codes created for register 0 to the program requirements.

Example:

Function	Octal Code	Character	Binary Code
Enable Graph 1	045	%	0100101

Table 3-2 Load Enable Register 0 Command

Rectangular or Square Format

1st character: A (10₁₈)

2nd character: variable (see below)

3rd character: variable (see below)

Explanation:

The second character is formed by setting bits where the bits have the following functions:

2nd Character (Register 0)

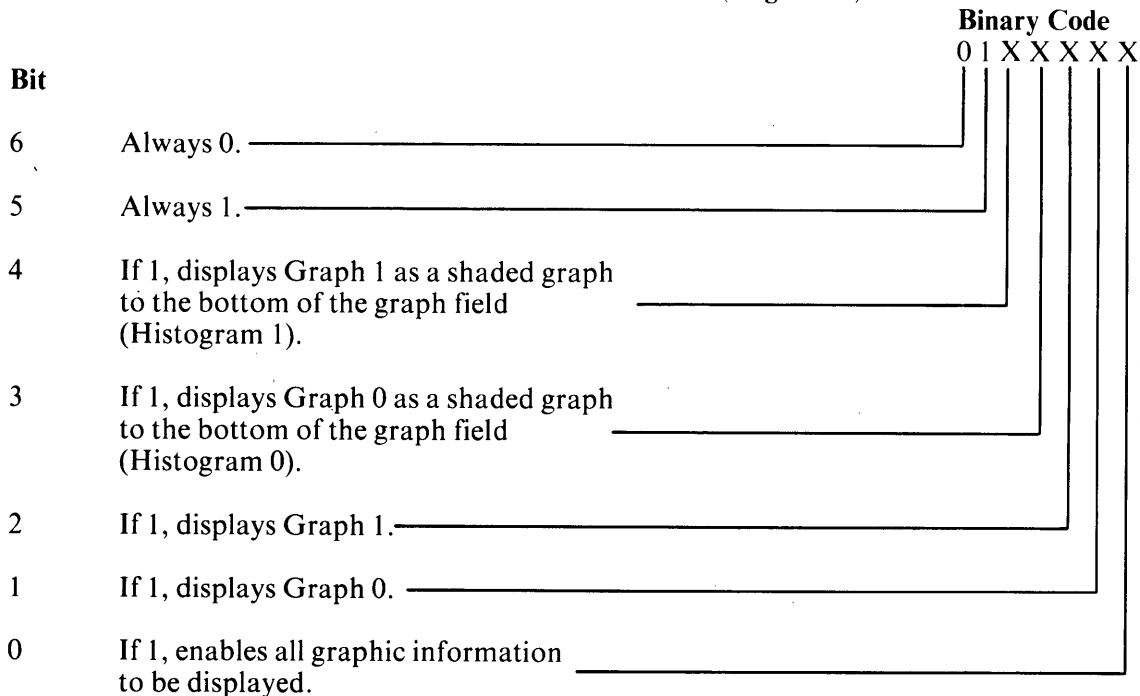
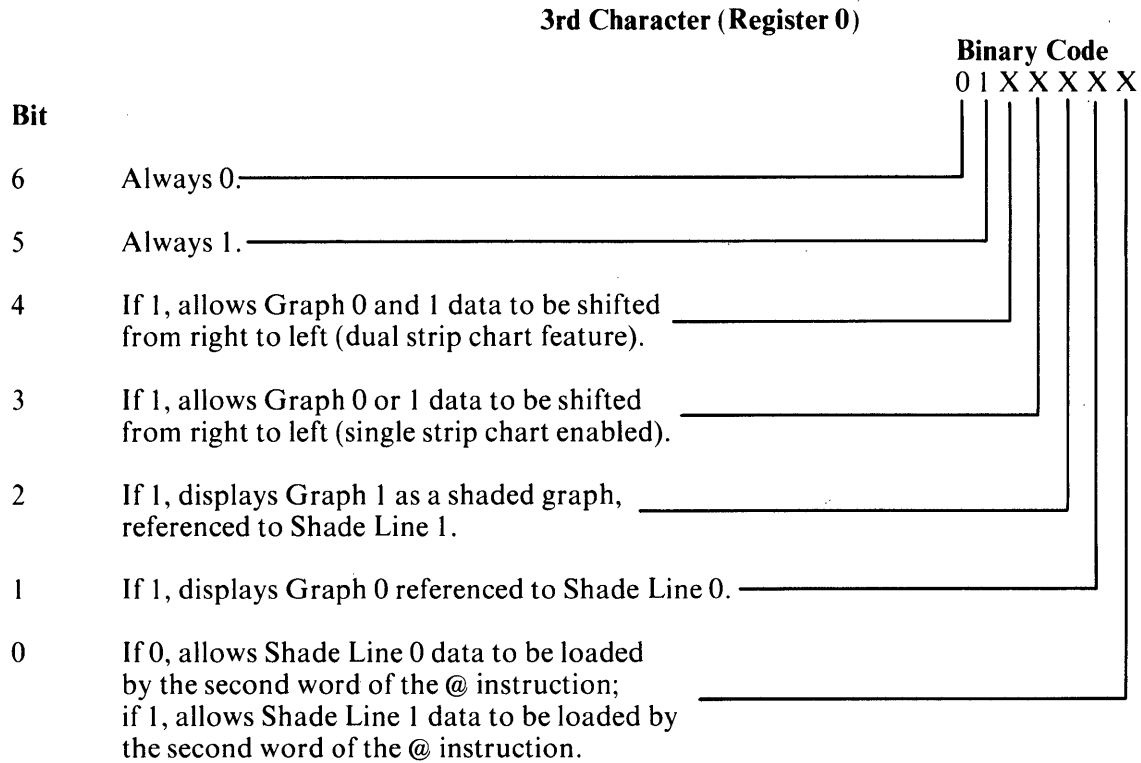


Table 3-2 Load Enable Register 0 Command (Cont)

NOTES

1. Enabling Graph 0 and Histogram 0 (or Graph 1 and Histogram 1) at the same time intensifies the graph envelope.
2. Enabling Shade Line 0 (or Shade Line 1) automatically shades Graph 0 (or Graph 1); Histogram 0 (bit 3) and Histogram 1 (bit 4) do not need to be enabled when shade lines are used.



NOTE

Bit 3 enables the single strip chart feature; either Graph 0 or Graph 1 data, but not both, can be incremented from right to left.

Bit 4 enables the dual strip chart feature. With Graph 0 enabled, Graph 0 data is entered, but the data does not shift at this time. Graph 1 is enabled and Graph 1 data is entered, then both Graph 0 and Graph 1 will shift their data one increment to the left.

Table 3-3 Examples of Selecting Graphs or Histogram

Function Enabled	Character Sequence*	Octal Code Sequence	Binary Code of 2nd Character	Decimal Value
Graph 0	A#	101 043	0100011	35
Graph 1	A%	101 045	0100101	37
Graphs 0 and 1	A'	101 047	0100111	39
Histogram 0	A)	101 051	0101001	41
Histogram 1	A1	101 061	0110001	49
Histograms 0 and 1	A9	101 071	0111001	57
Graph 0 and Histogram 1	A3	101 063	0110011	51
Graph 1 and Histogram 0	A-	101 055	0101101	45
Disable graphs and histograms	A space	101 040	0100000	32

*A third character is used to enable (or disable) shaded graphs (referenced to a shade line) and to enable strip charts. See Table 3-4.

Table 3-4 Examples of Selecting Shaded Graphs with Shade Lines (Baselines) and Strip Charts

Function Enabled	Third Character	Octal Code	Binary Code	Decimal Value
Load Shade Line 0*	“	042	0100010	34
Load Shade Line 1*	%	045	0100101	37
Enable Shaded Graphs with Shade Line 0 and 1	&	046	0100110	38
Enable single strip chart	(	050	0101000	40
Enable strip chart with shaded Graph 0 and Shade Line 0	)	052	0101010	42
Dual strip chart	0	060	0110000	48
Dual strip chart with shaded graphs and shade lines	6	066	0110110	54

*Loading or moving the shade line (baseline) in the VT105 does not affect Graph 0 or Graph 1 data. See Paragraph 3.7 for loading shade line position.

Table 3-5 Graph Drawing Characters

Character	Octal Code	Binary Code	Decimal Value
SPACE	040	0100 000	32
!	041	0100 001	33
”	042	0100 010	34
#	043	0100 011	35
\$	044	0100 100	36
%	045	0100 101	37
&	046	0100 110	38
' (apostrophe)	047	0100 111	39
(	050	0101 000	40
)	051	0101 001	41
*	052	0101 010	42
+	053	0101 011	43
, (comma)	054	0101 100	44
- (minus)	055	0101 101	45
	056	0101 110	46
/	057	0101 111	47
0	060	0110 000	48
1	061	0110 001	49
2	062	0110 010	50
3	063	0110 011	51
4	064	0110 100	52
5	065	0110 101	53
6	066	0110 110	54
7	067	0110 111	55
8	070	0111 000	56
9	071	0111 001	57
:	072	0111 010	58
;	073	0111 011	59
<	074	0111 100	60
=	075	0111 101	61
>	076	0111 110	62
?	077	0111 111	63

3.5.2 Enabling Graphs and Histograms (Shaded Graphs)

The second character in a sequence for loading register 0 selects the graph or histogram to be displayed. The letter A (101₈) allows register 0 to be loaded.

3.5.3 Enabling Strip Charts and Shade Lines (Baselines)

The third character in the load register 0 sequence enables shaded graphs and strip charts. Some of the common functions enabled by the third character are listed in Table 3-4.

3.5.4 Loading Control Register 1

The characters required to enable graph markers and grid lines are formed by setting the appropriate bits in the diagrams in Table 3-6, then finding the character for the code created in Table 3-5.

3.5.5 Enabling Graph Markers, Vertical Lines, and Horizontal Lines

Turning graph markers and grid lines ON and OFF is accomplished by loading register 1. The character sequence is the same in either graph drawing format, except a third character establishes the desired format. The exclamation mark, !(041₈), enables the square format; a SPACE (040₈) enables the rectangular format. The rectangular format is enabled also on initializing the terminal.

Table 3-7 shows examples of enabling graph markers, horizontal lines, and vertical lines.

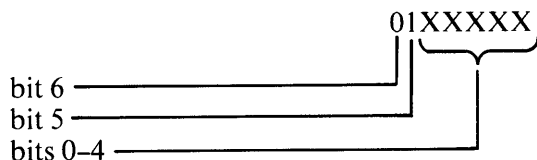
3.6 FORMING GRAPH DRAWING DATA CHARACTERS

In order to represent a horizontal or vertical address of a point on a 240 × 512 point graph, at least 9 binary bit positions are required.

Examples: $239_{10} = 011101111_2$
 $511_{10} = 111111111_2$

Keys typed from the keyboard, or transmitted from the host computer, normally only contain 7 digits (7-bit ASCII characters). Therefore, two keys must be typed, or two codes transmitted, to fully describe an X or a Y value. The first key (character) transmits the lower five bits of the binary data value; the second key transmits the remaining bits, or upper data value.

The graph drawing data characters can be standardized to the 32 characters listed in Table 3-8 if bits 5 and 6 of each character are always 1 and 0, respectively, as in the following format:



The data value is then transmitted in two parts as in the diagram below:

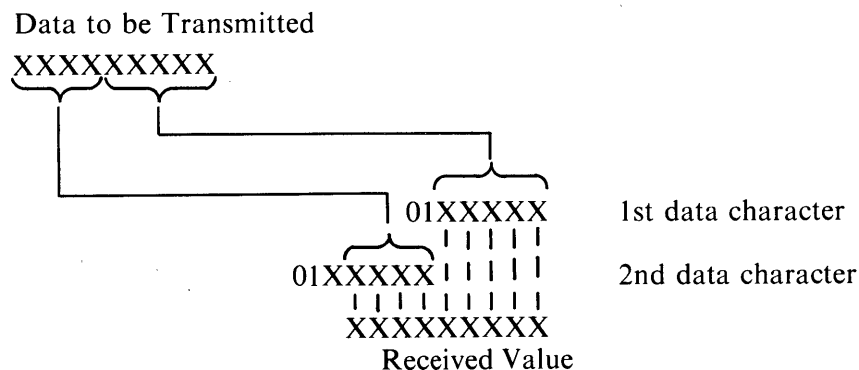
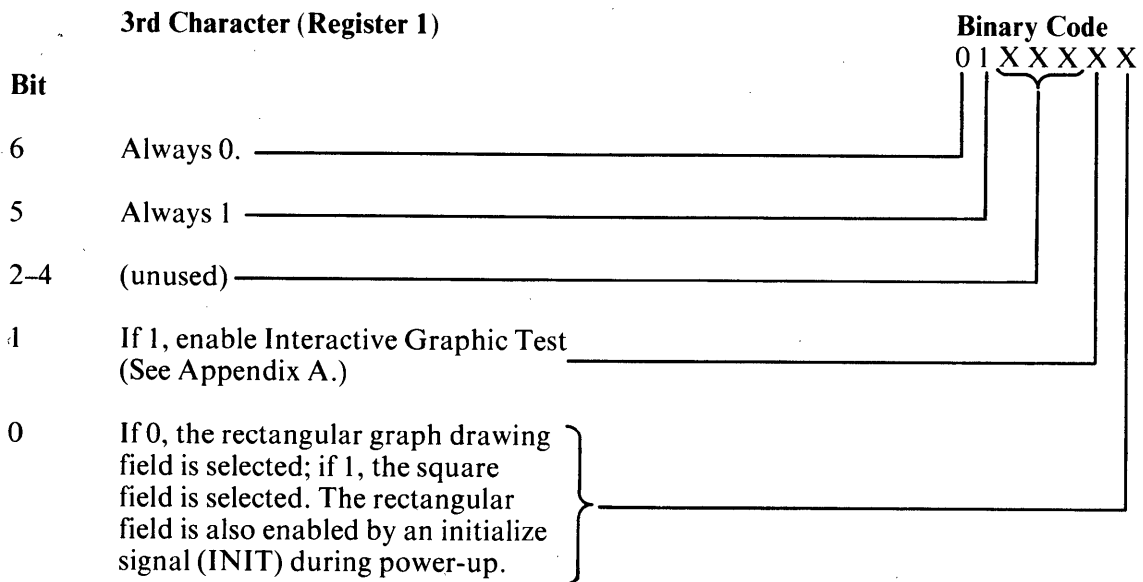
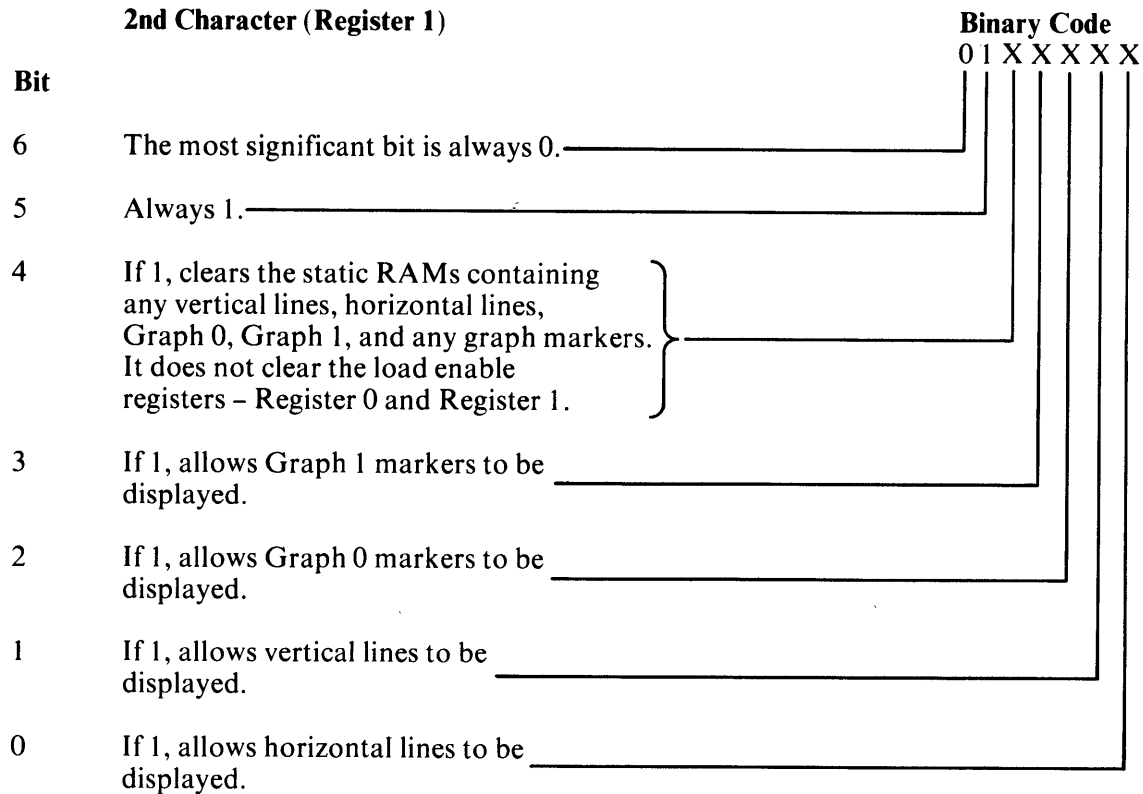


Table 3-6 Load Enable Register 1 Command

1st character: I (111₈) 73₁₀
 2nd character: variable (see below)
 3rd character: variable (see below)



**Table 3-7 Examples of Selecting Graph Markers,
Horizontal Lines, and Vertical Lines**

NOTE

Remember to bit map all options correctly when sending out a command. Setting a desired feature may reset other features if all options are not considered.

Function Enabled	Character Sequence	Octal Sequence*		Binary Code of 2nd Char.	Decimal Value
		1st	2nd		
Clear graph drawing memories	I0	111	060	0110000	48
Enable horizontal and vertical lines	I#	111	043	0100011	35
Enable horizontal lines only	I!	111	041	0100001	33
Enable vertical lines only	I"	111	042	0100010	34
Enable Graph 0 markers	I\$	111	044	0101100	36
Enable Graph 1 markers	I(	111	050	0101000	40
Enable Graph 0 and 1 markers	I,	111	054	0101100	44
Enable grid and Graph 0 markers	I'	111	047	0100111	39
Enable grid and Graph 1 markers	I+	111	053	0101011	43
Enable grid and Graph 0 and 1 markers	I/	111	057	0101111	47
Disable lines and graph markers	I space	111	040	0100000	32

*A third character is required to establish the square format, to change formats, or to set up the Interactive Graphics Test.

To load coordinates for the function enabled by register 1, refer to the following paragraphs.

Function	Paragraph
Load graph markers	3.10
Load vertical lines	3.11
Load horizontal lines	3.12

Table 3-8 Graph Drawing Data Characters

Decimal Lower data 1st data	Data Value Upper data 2nd data	Binary Code	Octal Code	Data Character
	Load shade line (base- line) and graph data; erase other lines.			
0	0	0100000	040	SPACE
1	32	0100001	041	!
2	64	0100010	042	"
3	96	0100011	043	#
4	128	0100100	044	\$
5	160	0100101	045	%
6	192	0100110	046	&
7	224	0100111	047	' (apostrophe)
8	256	0101000	050	(
9	288	0101001	051)
10	320	0101010	052	*
11	352	0101011	053	+
12	384	0101100	054	, (comma)
13	416	0101101	055	- (minus)
14	448	0101110	056	.
15	480	0101111	057	/
	<u>Load Horizontal, vertical lines, and markers *</u>			
16	0	0110000	060	0
17	32	0110001	061	1
18	64	0110010	062	2
19	96	0110011	063	3
20	128	0110100	064	4
21	160	0110101	065	5
22	192	0110110	066	6
23	224	0110111	067	7
24	256	0111000	070	8
25	288	0111001	071	9
26	320	0111010	072	:
27	352	0111011	073	;
28	384	0111100	074	<
29	416	0111101	075	=
30	448	0111110	076	>
31	480	0111111	077	?

*Upper data values below this line are used for loading graph markers and horizontal or vertical lines; they require bit 4=1. To erase these lines, or load shade lines (baselines), graph data or starting X-coordinate, use values above this line.

3.6.1 Selecting Upper and Lower Data Characters

The value of the lower data ranges from 0 to 31_{10} ; the upper data value increases in increments of 32 decimal units. Together they can describe any value of the graph drawing field. To find the characters or code to transmit a desired location, perform the following.

1. Select the upper data value closest, but not exceeding, the desired value in Table 3-8. This is the second data character which is transmitted last.

Example:

Value To be Transmitted	Nearest Upper Data Value	Second Data Character	Binary Code	Octal Code
200_{10}	192_{10}	&	0100110_2	046_8

NOTE

If a horizontal line, vertical line, or graph marker is to be loaded, use values in the lower half of the upper data column; i.e., 192_{10} is 066_8 or the character 6.

2. Find the remainder of the value to be transmitted in the lower data value column. This will be the first data character transmitted.

Example:

Remaining Value	Lower Data Value	First Data Character	Binary Code	Octal Code
8	8	(	0101000_2	050_8

3.6.2 Load Data Sequences

The data to be transmitted is initially preceded by a "load character," as described in Table 3-9. In the above example, loading a shade line at line 200_{10} is transmitted by @(& or equivalent program. Storing a horizontal line at line 200_{10} is transmitted by D(6 or equivalent program.

For multiple data entries, the load character does not need to be repeated. This allows data for a graph to be loaded into memory without repeating the character B or J. Exceptions to this procedure are loading a shade line and loading the starting X-coordinate.

3.6.3 Frequent Data Entry Errors

Largest Data Character Transmitted First - The low-order bits of the data value (lower data value in Table 3-8) must be transmitted first; if reversed, the point will typically exceed the range limits of the graph drawing field and not be displayed, or, it may appear near the edge of the field.

Example:

Desired Shade line	Data Transmitted	Characters Should be	Characters Reversed	New Values
40	$8 + 32$	@(!	@!(	$1+256$
70	$6 + 64$	@&"	@&"	$2+192$

Table 3-9 Load Data Sequences

Function	Load Character	Character Sequence	Range
Load shade line (baseline)	@	@ 1st data 2nd data	0-239
Load Graph 0 data	B	B 1st data 2nd data	0-239
Load Graph 1 data	J	J 1st data 2nd data	0-239
Load Graph 0 marker	C	C 1st data 2nd data	0-511
Load Graph 1 marker	K	K 1st data 2nd data	0-511
Load horizontal line	D	D 1st data 2nd data	0-239
Load vertical line	L	L 1st data 2nd data	0-511
Load starting X-coordinate	H	H 1st data 2nd data	0-511

Zero Valued Characters Not Transmitted – When transmitting data with two characters, if the upper data value is equal to the point or line desired, a SPACE (040₈) (equal to zero) must be the first data character. If missed, the line or point will be much less than desired.

Example:

Shade line Desired	Data Required	Characters Should be	Characters In error	Wrong Value
160	0+160	@ SPACE %	@%	5

3.7 LOADING THE SHADE LINE (BASELINE)

A movable shade line can be displayed for both Graph 0 and Graph 1. One shade line can be entered for Graph 0, and one for Graph 1, on any of the 230 (or 240, square format) horizontal lines available. To transmit positions within this range, a load character and two data characters are used, as shown in Table 3-10. Positions can be created by following Paragraph 3.6 for forming graph drawing data characters.

3.8 LOADING GRAPH MEMORIES

The M7071 has two graph memories – Graph 0 and Graph 1. Each graph may plot up to 512-horizontal points. Each horizontal point may have only one value using up to 230 vertical points with the rectangular format (or 240 vertical points with the square format). The graph will begin entering data at X = 0 (040₈) unless a starting X-address is specified. (See Paragraph 2.13.)

The data to be entered is initially preceded by the letter B (102₈) for Graph 0, or J (112₈) for Graph 1. Each pair of data characters describes a Y-data point.

A Y-value is entered for each value of X, using two data characters, as described in Paragraph 3.6. As the X-address is incremented from 0 to 511, the values of Y can sequentially be loaded into memory. The X-register will automatically increment after each pair of Y-data characters are stored in memory, except when dual strip charts are enabled. (See Paragraph 3.14.) The letters B or J do not need to be repeated for each pair of Y-data characters. Table 3-8 may be used to determine the Y-data characters.

NOTE

For each value of Y, the lower data value must be transmitted first, then the upper data value.

The formation of graph data characters is illustrated in Table 3-11.

Table 3-10 Loading Shade Line Position

	Previous VT55 Format	New VT105 Format Load Shade Line
1st Character:	@ NOP	@ (100 ₈) 64 ₁₀
2nd Character:	none	01XXXXX
3rd character:	none	01XXXXX

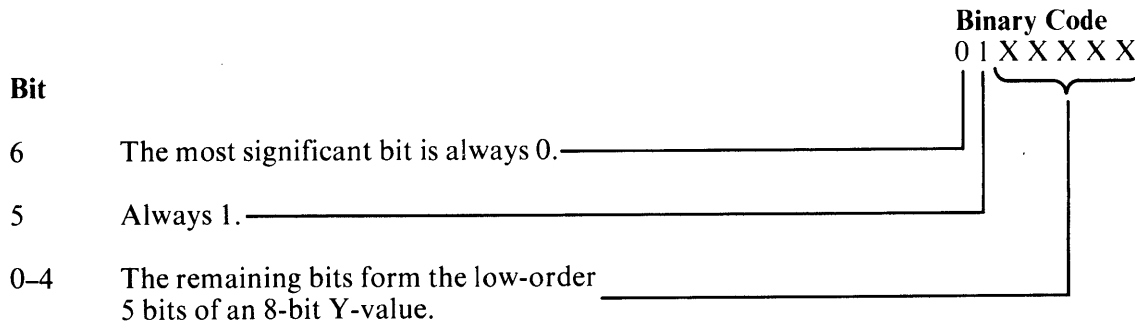
NOTE

Shade Line 0 or Shade Line 1 is loaded depending on which shade line is selected by loading register 0. See Paragraph 3.5.3.

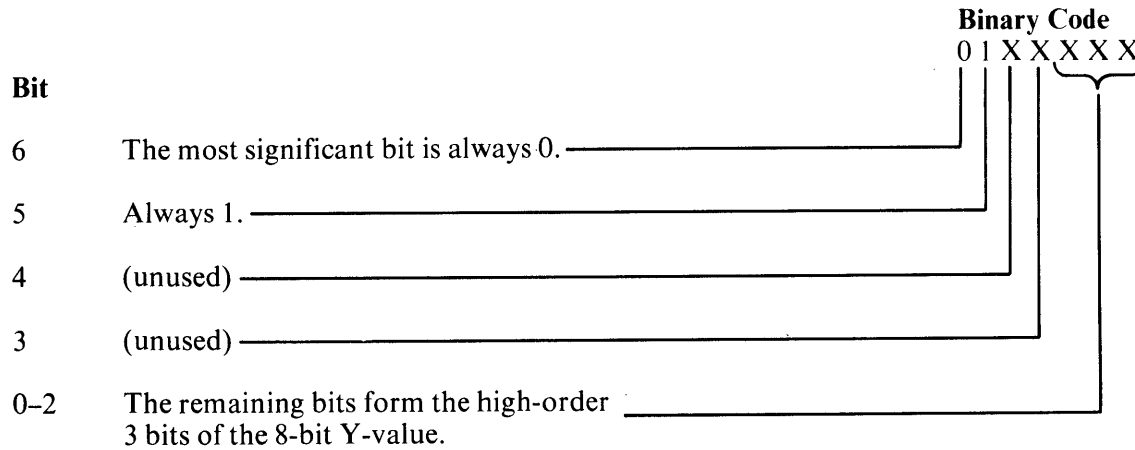
Table 3-11 Loading Graph Data

	Graph 0	Graph 1
1st character:	B (102 ₈)	J (112 ₈)
2nd character:	variable (see below)	variable
3rd character:	variable (see below)	variable

Explanation of Second Character:

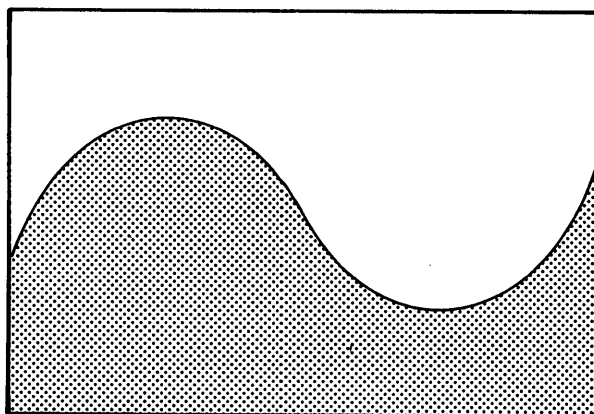


Explanation of Third Character:



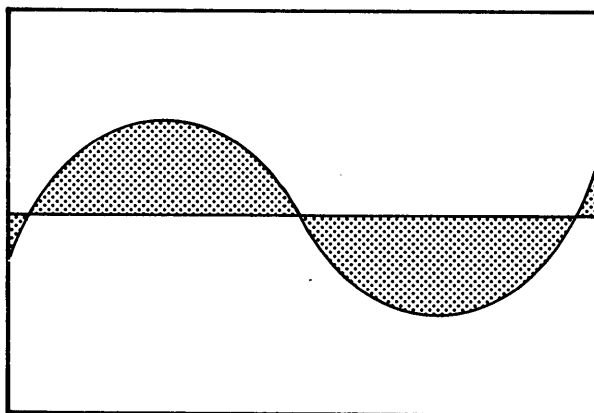
3.9 HISTOGRAM DATA

Data for a histogram (shaded graph) is entered by loading the appropriate graph memory (Paragraph 3.8). Histogram 0 and/or Histogram 1 is enabled by loading register 1 (Paragraph 3.5). Enabling a histogram will shade points between the graph envelope and the bottom of the graph field. Shading occurs from the graph data to graph line 0 (Figure 3-8). With a shade line (baseline) enabled, the graph is shaded above and below this line, as in Figure 3-9.



MR-3516

Figure 3-8 Histogram without Shade Line (Baseline) Enabled



MR-3517

Figure 3-9 Graph with Shade Line (Baseline) Enabled

3.10 LOADING GRAPH MARKER MEMORY

A graph marker is a short vertical line which marks the graph line at a desired value of X. A graph marker can be programmed for any point on Graph 0 and on Graph 1. As many as 512 graph markers can be placed on each graph.

Loading graph marker memory is accomplished by sending pairs of data characters following the letter C (103₈) for Graph 0, or K (113₈) for Graph 1. Each pair of data characters represents the lower data value and the upper data value of an X-address, as illustrated in Table 3-12. Note that bit 4 of the third character determines whether the graph marker will be loaded or erased.

Example:

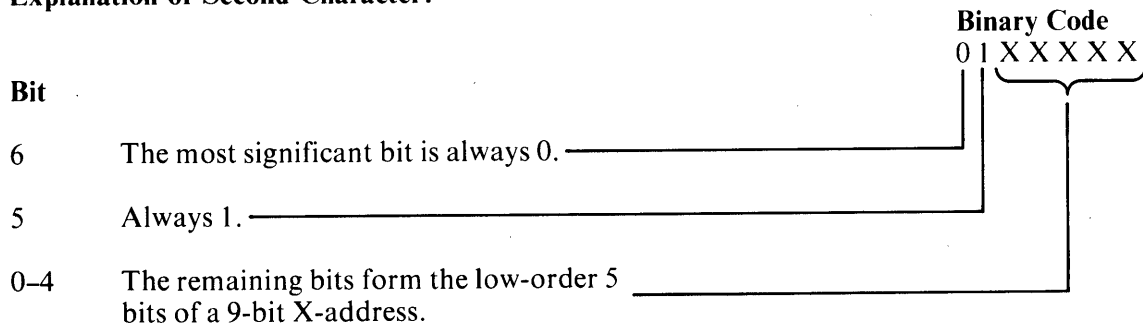
Function	Binary Code	Octal Code	Character Sequence
Load graph 0 marker at location 100	1000110	106	CS3
	0100100	044	
	0110011	063	
Erase graph 0 marker at location 100	1000110	106	CS#
	0100100	044	
	0100011	043	

Table 3-8 may be used to determine the characters required to load or erase a specific graph marker. Once stored in memory, graph markers are enabled and disabled by loading register 1. (See Paragraph 3.5.4.)

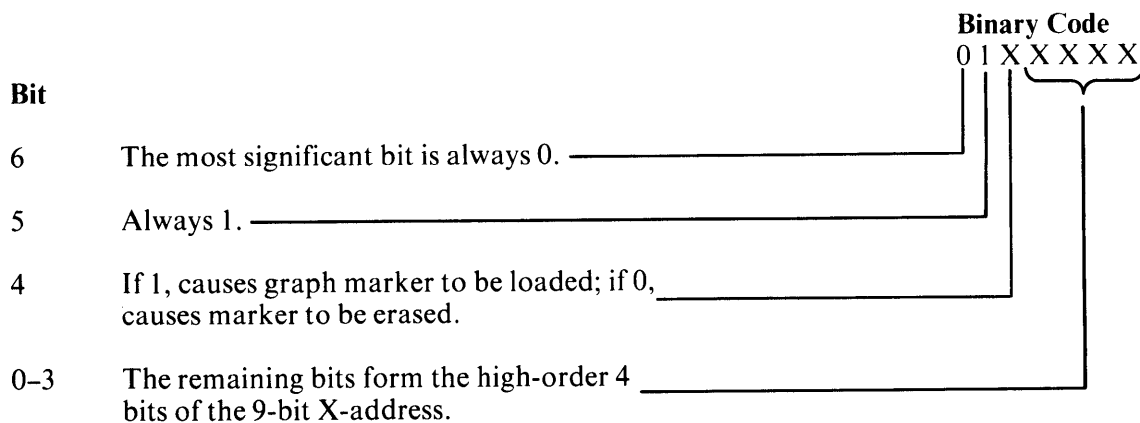
Table 3-12 Load Graph Marker Memory

	Graph 0 Marker	Graph 1 Marker
1st character:	C (103 ₈)	K (113 ₈)
2nd character:	variable	variable
3rd character:	variable	variable

Explanation of Second Character:



Explanation of Third Character:



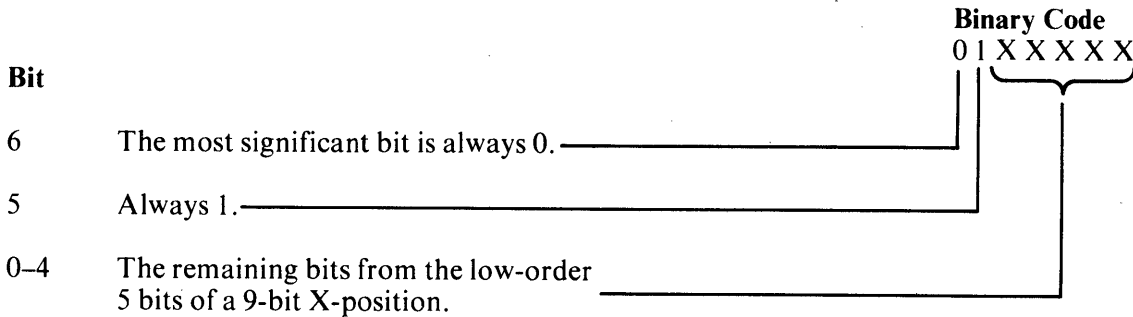
3.11 DISPLAYING VERTICAL LINES

Vertical lines may be programmed for any of the 512 points along the X-axis. Vertical lines are loaded following the letter L (114₈). The second and third characters form an X-data value, as illustrated in Table 3-13. Note that bit 4 of the third character must equal a 1 for the line to be loaded; a 0 in bit 4 will erase that line. Table 3-8 may be used to determine the characters required to load or erase a specific line. Vertical lines are enabled and disabled by loading register 1. (See Paragraph 3.5.4.)

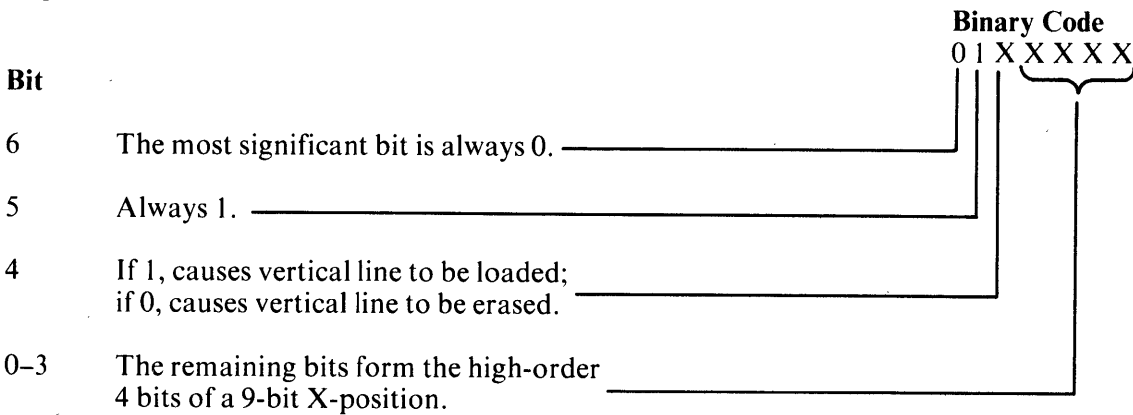
Table 3-13 Load Vertical Line Coordinate

1st character: L (114₈)
 2nd character: variable (see below)
 3rd character: variable (see below)

Explanation of Second Character:



Explanation of Third Character:



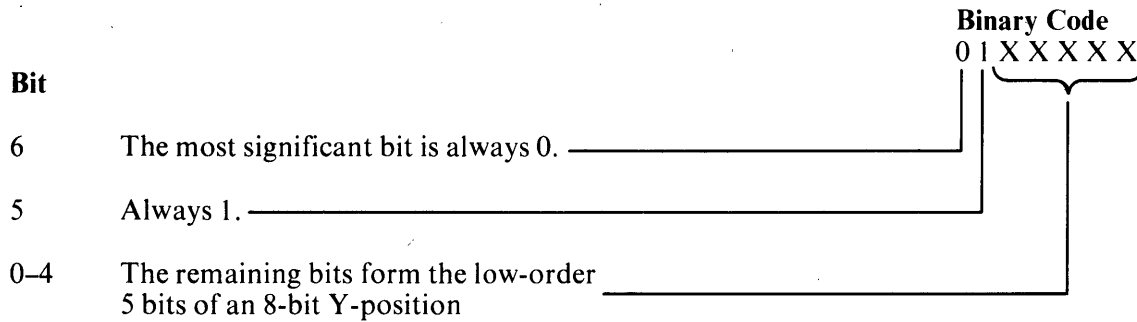
3.12 DISPLAYING HORIZONTAL LINES

A horizontal line is loaded into memory by two data characters following the letter D (104₈). The second and third characters form a Y-data value, as illustrated in Table 3-14. Up to 230 horizontal lines may be displayed in the rectangular format; 240, in the square format. Note that bit 4 in the third character must equal a 1 to load a horizontal line; bit 4=0 will erase the line. Table 3-8 can be used to determine the characters required to load or erase a specific horizontal line. Horizontal lines are enabled and disabled by loading register 1. (See Paragraph 3.5.4.)

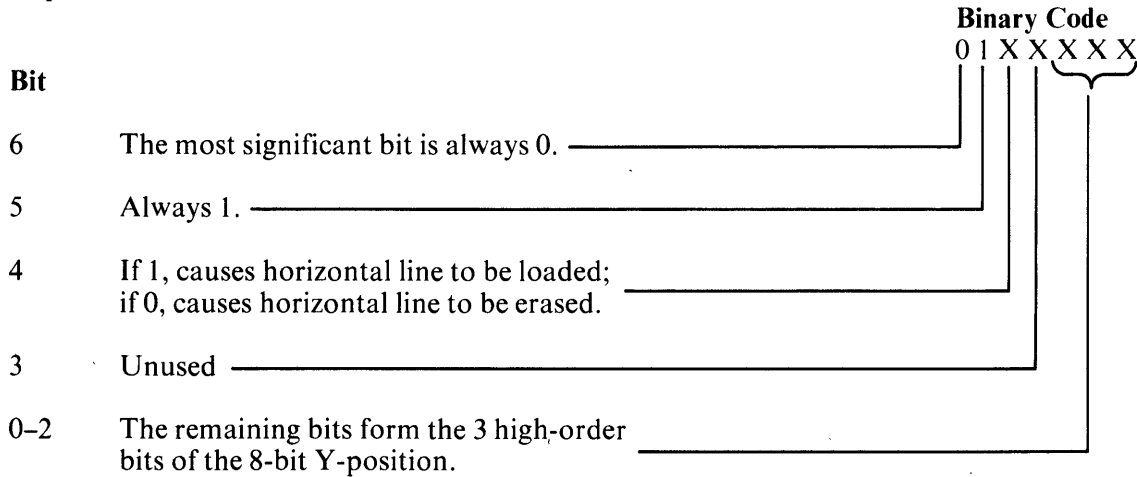
Table 3-14 Load Horizontal Line Coordinates

1st character: D (104₈)
 2nd character: variable (see below)
 3rd character: variable (see below)

Explanation of Second Character:



Explanation of Third Character:



3.13 LOAD THE STARTING X-COORDINATE

A starting X-coordinate may be loaded by two data characters following the letter H (110₈), as illustrated in Table 3-15. Any value of X, from 0 to 511, may be used. The data characters required for the desired X starting address can be determined from Table 3-8.

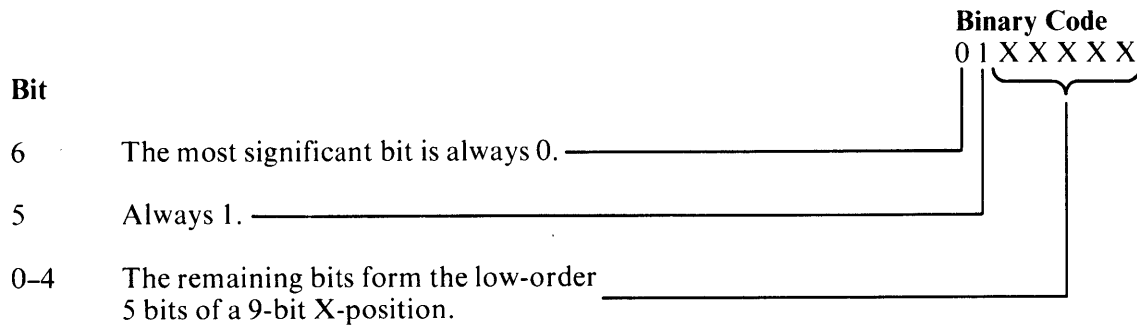
NOTE

The lower data value of X must be transmitted first, then the upper data value.

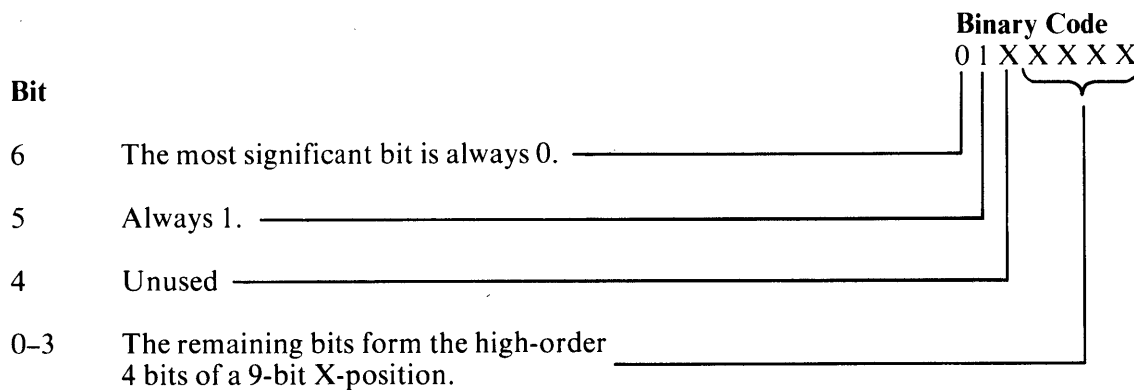
Table 3-15 Load Starting X Coordinate

1st character: H (110₈)
 2nd character: variable (see below)
 3rd character: variable (see below)

Explanation of Second Character



Explanation of Third Character



3.14 ENTERING STRIP CHART DATA

3.14.1 Single Strip Chart Data

Data for a single strip chart is entered by loading either Graph 0 or Graph 1 memory.

1. Enable the desired graph and single strip chart feature by loading register 0. (See Table 3-2.)

Example:

Enable Graph 0, Single Strip Chart, and Shade Line 0. Enter:

Character Sequence	Octal Sequence	Decimal Sequence
A#*	101 ₈ 043 ₈ 052 ₈	65 ₁₀ 35 ₁₀ 42 ₁₀

2. If desirable, load the starting X-coordinate at the right margin. Enter:

H??	110 ₈ 077 ₈ 077 ₈	72 ₁₀ 63 ₁₀ 63 ₁₀
-----	----------------------------------------------------	----------------------------------------------------

3. Now, enter data into Graph 0 memory; type B plus any sequence of two data characters. If started at the right margin, this will cause the graph to move from right to left; if not, the graph will fill the screen first, then move data from right to left with each new data word.

B(data)(data)	102 ₈ (data)(data)	66 ₁₀ (data)(data)
---------------	-------------------------------	-------------------------------

3.14.2 Dual Strip Chart Data

To set up the dual strip chart feature:

1. Enable both graphs and the dual strip chart feature; set bit 4 of the 3rd character in register 0. (See Table 3-2.)

Example:

Load Graph 0 and 1, dual strip chart, and Shade Line 0 and 1. Enter:

Character Sequence	Octal Sequence	Decimal Sequence
A'6	101 ₈ 047 ₈ 066 ₈	65 ₁₀ 39 ₁₀ 54 ₁₀

2. Load the starting X-coordinate at the right margin. Enter:

Character Sequence	Octal Sequence	Decimal Sequence
A'6	101 ₈ 047 ₈ 066 ₈	65 ₁₀ 39 ₁₀ 54 ₁₀
H??	110 ₈ 077 ₈ 077 ₈	72 ₁₀ 63 ₁₀ 63 ₁₀

3. Enter Graph 0 data; enter a B and two data characters. (The data is entered, but the graph will not move at this time.)

B(data)(data)	102 ₈ (data)(data)	66 ₁₀ (data)(data)
---------------	-------------------------------	-------------------------------

4. Enter Graph 1 data; enter a J plus two data characters. The graph will now display and shift both Graph 0 and Graph 1 data points one increment to the left.

J(data)(data)

112g(data)(data)

74₁₀(data)(data)

NOTES

1. Load starting X-coordinate, desired graph markers, and vertical lines before enabling either single- or dual-strip chart mode. The exact position of these points may vary once a strip chart is enabled.
2. Any graph markers and vertical lines enabled will wrap around as the strip chart moves.
3. When the strip chart mode is disabled, any displayed graphics shifts. The X-coordinate that moved during strip chart mode returns to its normal location.
4. When in dual-strip chart mode, the last available graph position (X=511) is not displayed. The switching action between Graph 0 and Graph 1 in that position is eliminated from the display.
5. A graph drawing programmer's card is included in Appendix C.

CHAPTER 4 INSTALLATION, INTERFACE INFORMATION, AND SPECIFICATIONS

4.1 UNPACKING

The VT105 is packaged within a reinforced carton containing the following items.

- Video Monitor
- Detached Keyboard
- Power Cord
- Set-Up Label
- User Guide

Instructions are printed on the carton for unpacking the unit.

4.2 SITE CONSIDERATIONS

The VT105 consists of a video monitor and detachable keyboard that may be placed on a desk or table top. The dimensions of the VT105 are shown in Figure 4-1.

Specifications for operating environment are provided in Paragraph 4.8.

4.3 INSTALLATION

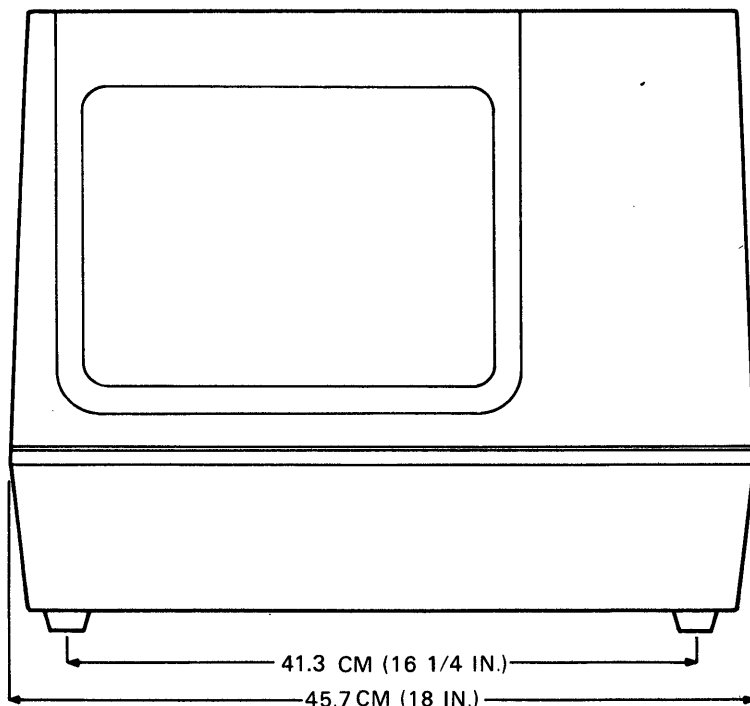
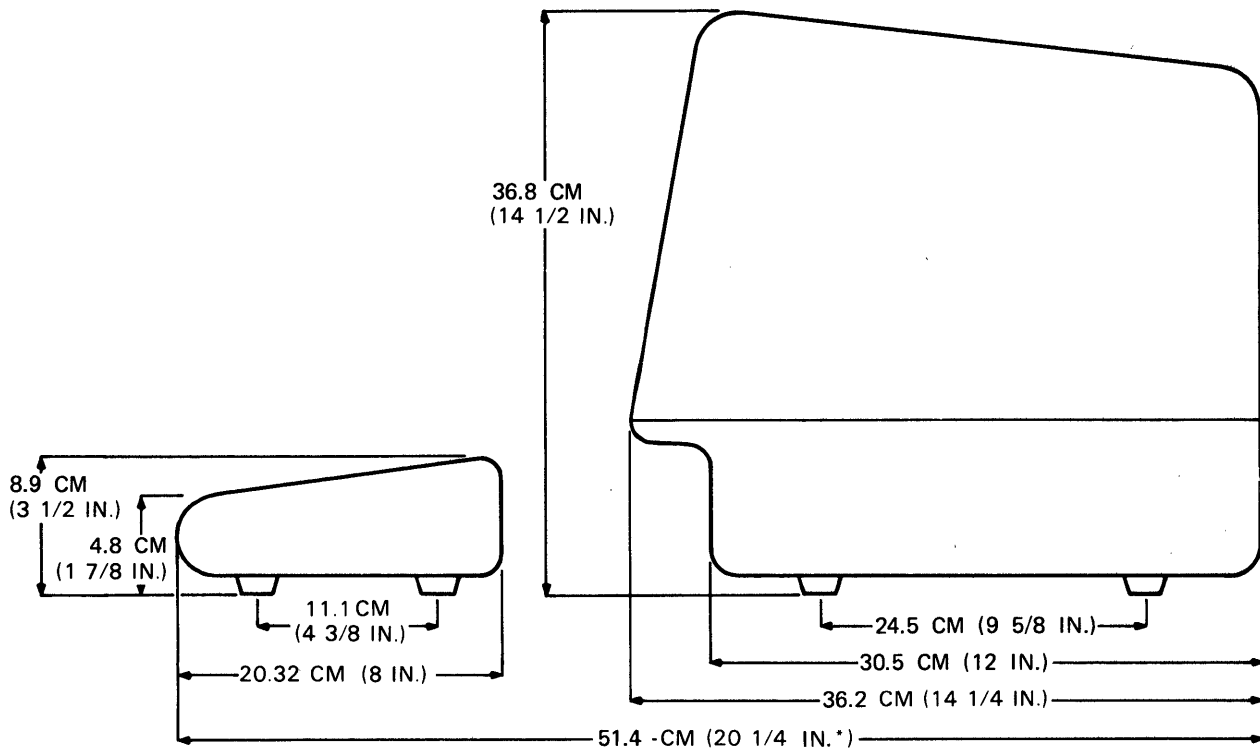
To install the VT105 perform the following steps.

1. Remove the VT105 from the shipping carton and place it in the desired work area.
2. Place the keyboard in front of the terminal and plug the keyboard coiled cord into the keyboard receptacle located on the rear of the terminal (Figure 4-2).
3. Verify that the power selector switch shows the correct wall outlet voltage (115 V is standard in the U.S.).

Switch Position	Voltage Range
115	90-128 Vac RMS
230	180-256 Vac RMS

4. Verify that the power switch is OFF.

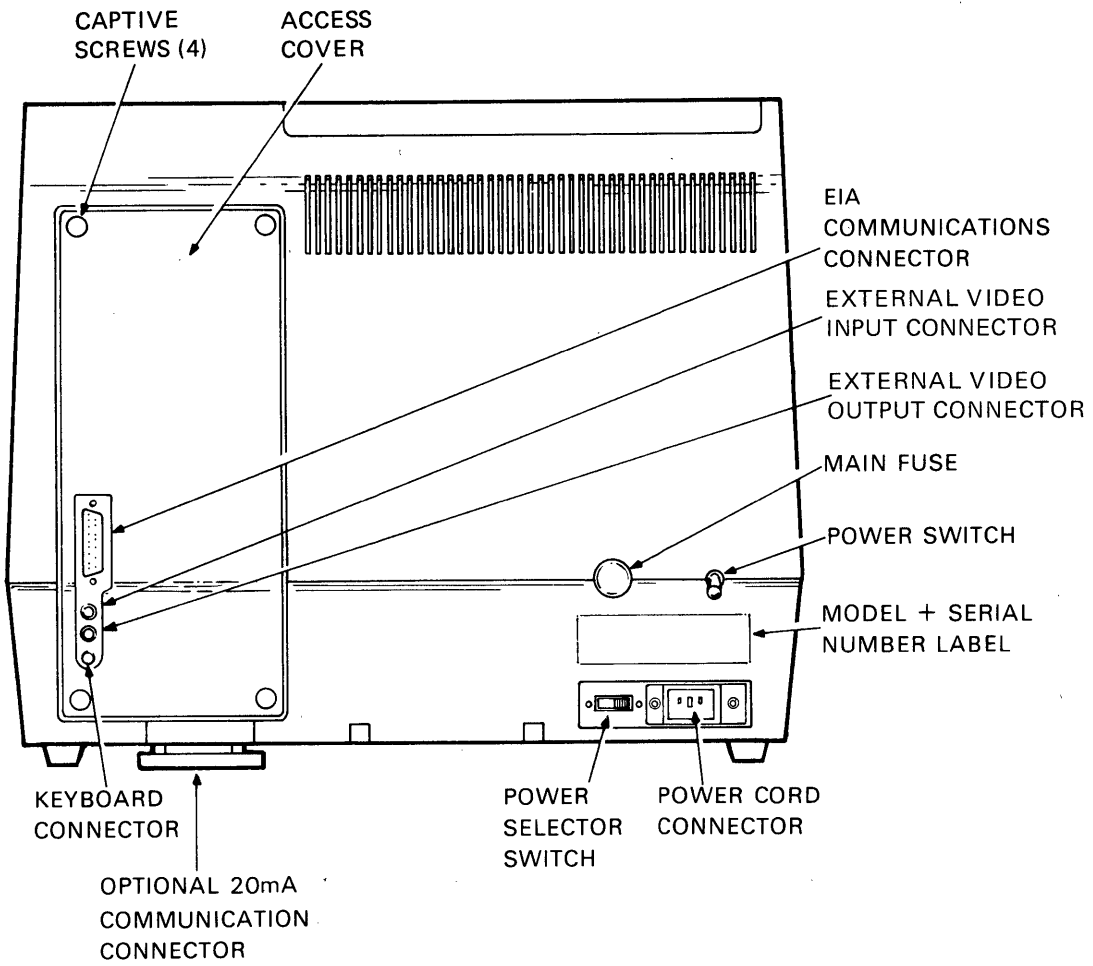
Position	AC Power
Up	ON
Down	OFF



*MEASUREMENT TAKEN WITH THE KEYBOARD PLACED FLUSH TO FRONT OF TERMINAL UNDER UNDERCUT.

MR-3526

Figure 4-1 VT105 Terminal Dimensions



MR-3527

Figure 4-2 VT105 Rear View

5. Connect the communications cable to the appropriate communications receptacle. Refer to Paragraph 4.4 for interface information.
6. Connect the power cord to the power cord receptacle on the rear of the terminal and plug the other end of the power cord into a nearby wall outlet.
7. Turn the power switch on. The terminal automatically performs the power-up self-test and either the ON LINE or LOCAL light located on the keyboard is turned on. After approximately one minute, the cursor is visible in the upper-left corner of the screen. If any other indication is shown, refer to Chapter 1 to isolate the problem.
8. Set the desired Set-up features as outlined in Chapter 1.
9. Once the installation setup procedure is complete, record the Set-up features selected on the Set-up label and attach the label to the underside of the keyboard.

4.4 INTERFACE INFORMATION

4.4.1 EIA Interface and Electrical Characteristics

The basic terminal operates on full duplex, asynchronous communication lines. The terminal interfaces to the line with a 25-pin connector mounted on the back of the terminal that meets EIA specification RS-232-C. Table 4-1 summarizes the EIA connector signals.

Output Voltages – On all signals designated “from VT105,” the mark or unasserted state is -6.0 V to -12.0 V ; the space or asserted state is $+6.0\text{ V}$ to $+12.0\text{ V}$.

Input Voltages – On signals designated “to VT105,” a voltage between -25.0 V to $+0.75\text{ V}$ or an open circuit is interpreted as a mark, ON, or unasserted state; a voltage between $+2.25\text{ V}$ to $+25.0\text{ V}$ is interpreted as a space, OFF, or asserted state. Voltages greater in magnitude than $\pm 25\text{ V}$ are not allowed. These levels are compatible with EIA STD RS-232-C and CCITT Recommendation V.28.

4.4.2 Optional 20 mA Current Loop Interface

In most current loop applications, the VT105 is connected in a passive configuration – that is, current is supplied to the VT105. In this mode, the transmitter and receiver are both passive, both optically isolated, and the transmitter goes to the mark state when power is turned off.

Conversion from active to passive (or vice versa) requires moving a slide switch.

In active mode, either the transmitter or the receiver or both may be connected so that the VT105 is the source of the 20 mA of current. In active mode, isolation is not present, and the transmitter goes to the space state when power is turned off.

Figure 4-3 shows the 20 mA current loop interface connector mounted to the access cover and the individual pin assignment.

Table 4-1 EIA RS-232-C Connector Signals

Pin Number	Description	Source/ Destination	Remarks
1	Protective ground	Ground	Do not use
2	Transmitted data	From VT105	Mark state when not sending.
3	Received data	To VT105	
4	Request to send	From VT105	Asserted at all times
5	Clear to send	To VT105	Ignored
6	Data set ready	To VT105	Ignored
7	Signal ground	Ground	Terminal chassis ground (common return)
8	Carrier detect	To VT105	Ignored
9	(not used)		
10	(not used)		
11	Speed Select (secondary request to send)	From VT105	Asserted
12	Speed indicator (secondary carrier detect)	To VT105	Ignored
13	(not used)		
14	(not used)		
15	Transmit clock	To VT105	Ignored
16	(not used)		
17	Receive clock	To VT105	Ignored
18	(not used)		
19	Speed select (Same as pin 11)	From VT105	Asserted

Table 4-1 EIA Connector Signals (Cont)

Pin Number	Description	Source/ Destination	Remarks
20	Data terminal ready	From VT105	Asserted at all times except: 1. terminal is not powered up. 2. terminal is in LOCAL mode. 3. during the 3.5s interval following a SHIFT-BREAK
21	(not used)		
22	Ring indicator	To VT105	Ignored
23	Speed select (Same as pin 11)	From VT105	Asserted
24	(not used)		
25	(not used)		

20 mA Electrical Characteristics – The electrical characteristics of the 20 mA current loop interface are shown below:

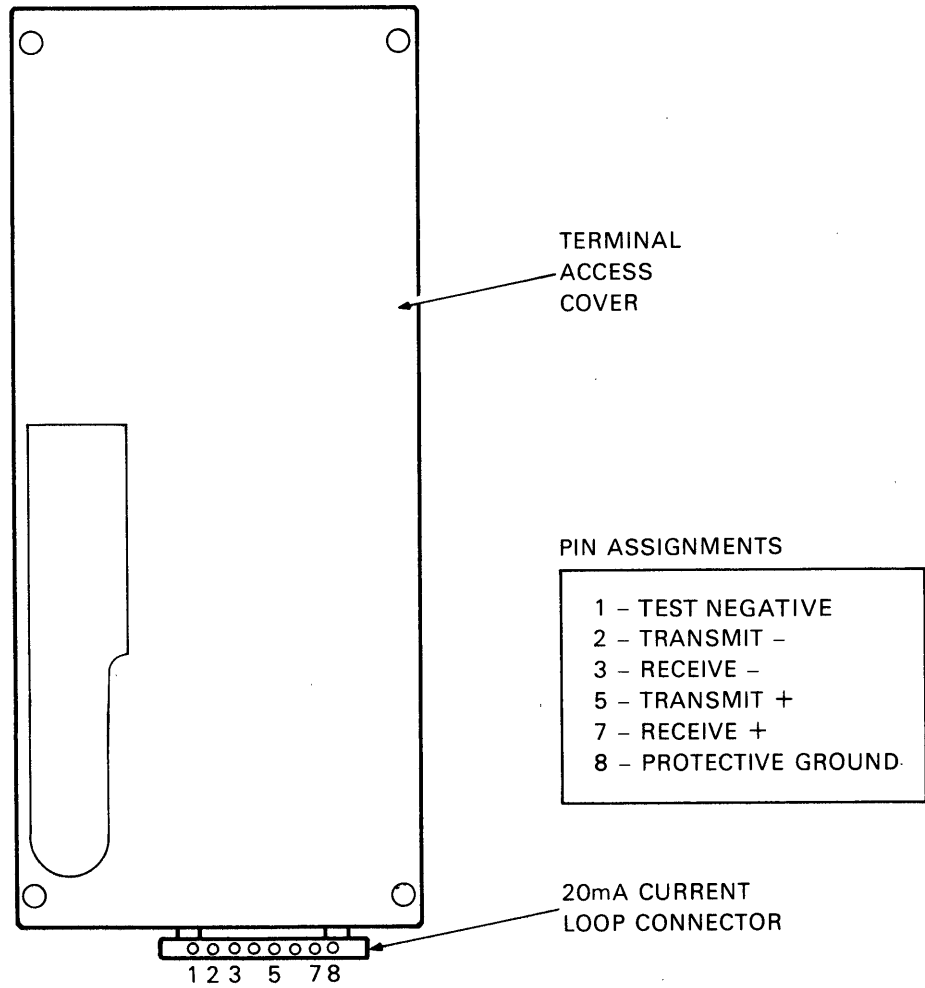
	Min	Max
Transmitter		
Open circuit voltage	5.0 V	50 V
Voltage drop marking	–	4.0 V
Spacing current	–	2.0 mA
Marking current	20 mA	50 mA

Receiver		
Voltage drop marking	–	2.5 V
Spacing current	–	3.0 mA
Marking current	15 mA	50 mA

In addition to the above specifications for passive operation, active mode places the transmitter or receiver in series with a source of 17 V \pm 5 percent and 660 ohms.

4.5 EXTERNAL VIDEO CONNECTION

The VT105 may be easily interfaced to external video devices. The video devices may act either as a slave to the VT105 when connected to the composite video output or provide synchronized video data to the VT105. The external video connectors are the two female BNC connectors located on the back of the terminal just below the EIA connector. The upper connector, J8, is the video input; the lower-connector, J9, is the video output.



MR-3528

Figure 4-3 20 mA Current Loop Connection

4.5.1 Composite Video Output (J9)

The composite video output provides RS170-like output (see note) generated by combining the video signal with a composite sync signal. This output contains all video data appearing on the VT105 screen *except* that video which comes from J8. The output has the following nominal characteristics. See Figure 4-4.)

1. Output impedance = 75 ohm, dc-coupled
2. Sync level = 0 V
3. Black level = approximately 0.3 V with a 75 ohm load
4. White level = approximately 1.0 V with a 75 ohm load
5. The composite sync waveform conforms to EIA RS170 standards. The vertical interval is composed of six equalizing pulses, six vertical sync pulses, and six more equalizing pulses. The timing is as follows.

Equalizing pulse width	= 2.33 μ s \pm 50 ns
Vertical sync width	= 27.28 μ s \pm 200 ns
Horizontal sync width	= 4.71 μ s \pm 50 ns
Horizontal blank time	= 11.84 μ s \pm 50 ns (80 column mode) = 12.34 μ s \pm 50 ns (132 column mode)
Front Porch	= 1.54 μ s \pm 50 ns
Horizontal period	= 63.56 μ s \pm 50 ns

NOTE

The use of decoupling is not in strict agreement with RS170. To agree with RS170 the output load requires a 10 μ F capacitor in series with the output. This presents no problem with most monitors as they are ac-coupled.

4.5.2 Video Input (J8)

An analog signal applied to the video input is ORed with the internal video signal. The beam intensity at any point on the screen corresponds to the intensity of the signal that would make the beam brighter. A video signal on this input affects only the internal screen and does not appear on the composite video output, J9. This input has the following nominal characteristics.

Input impedance	= 75 ohms, dc-coupled
Black level	= 0 V
White level	= 1.0 V
Maximum continuous input	= \pm 2.0 V

NOTE

The external video source must be synchronized to the VT105 by referencing the composite sync on the composite video output.

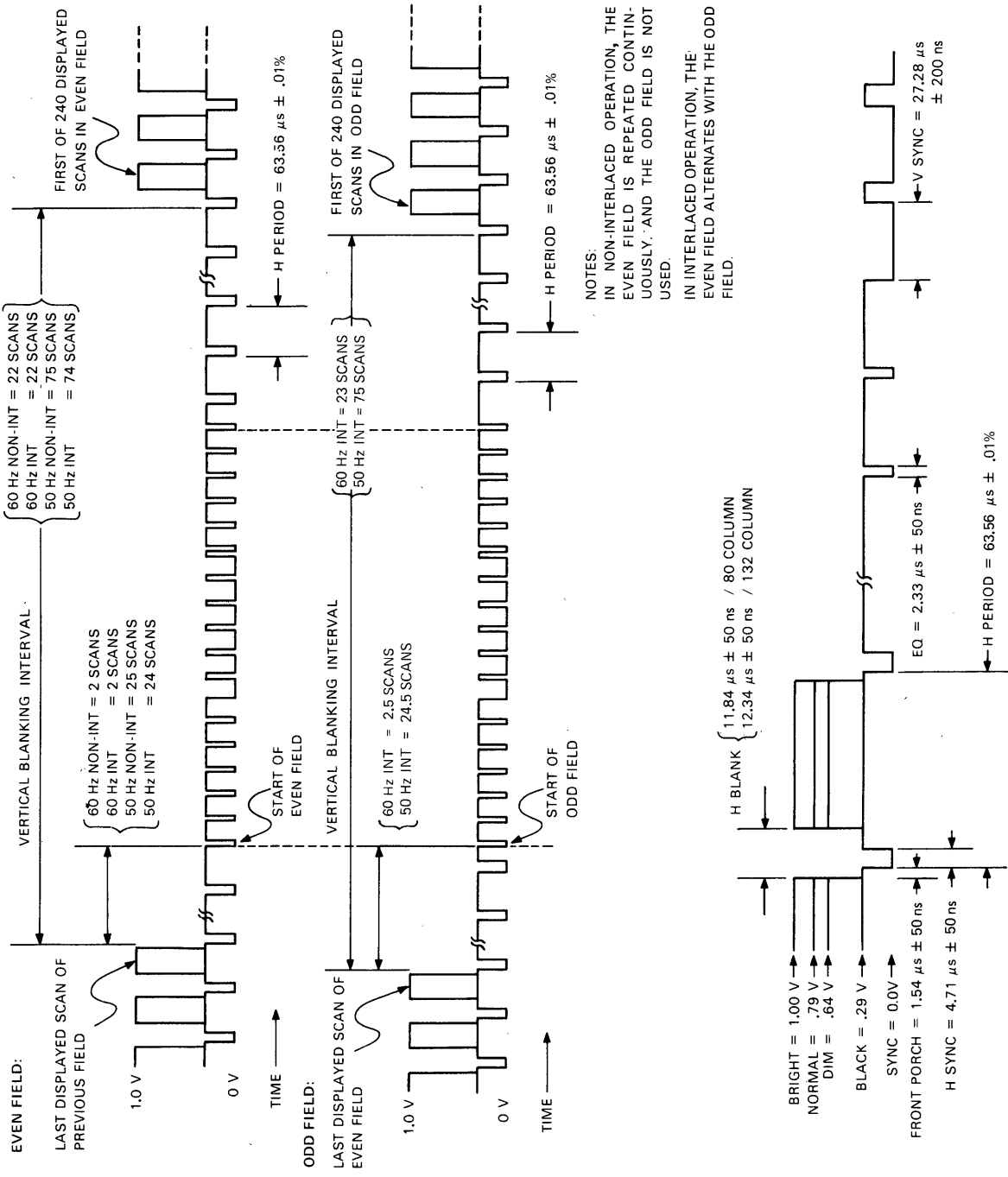


Figure 4-4 Composite Video Output

4.6 TERMINAL CONTROLLER MODULE (54-13009)

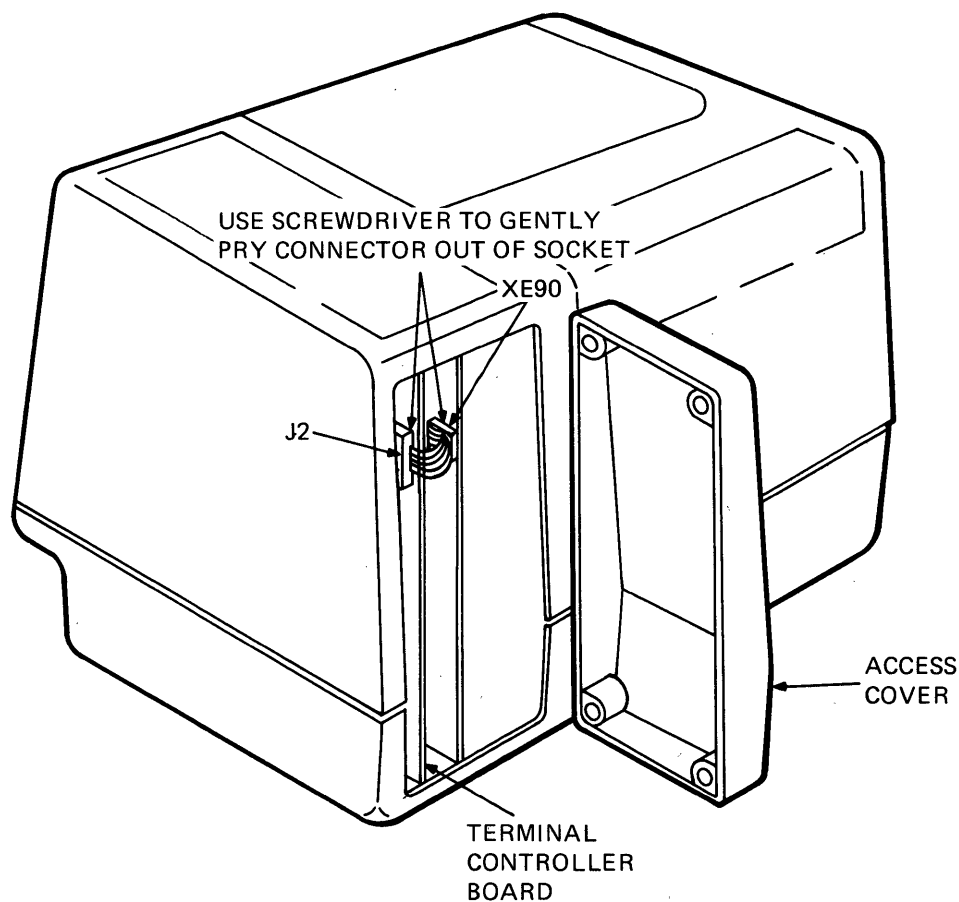
The following procedure describes the removal and installation of the terminal controller module.

1. Remove the access cover from the rear of the terminal.
2. Disconnect the graphic interconnecting cable (P/N 70-08612) from J2 of the terminal controller. Refer to Figure 4-5.

CAUTION

The graphic interconnecting cable connectors are easily damaged. To prevent damage, use a small screwdriver to alternately lift each end of the connector until it is released from the module.

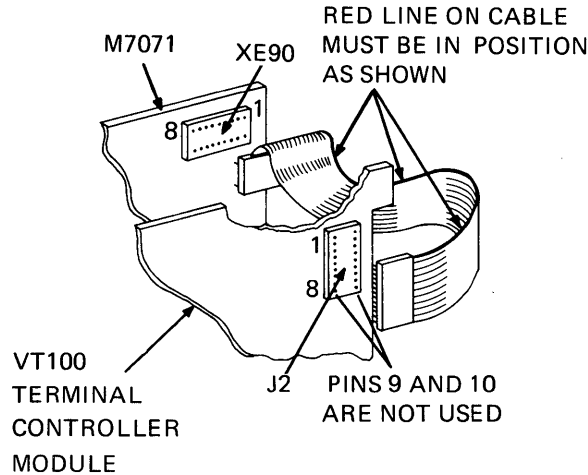
Refer to Figure 4-6 for correct orientation when re-connecting this cable. Use the upper 16 pins of the 18-pin connector, J2; pins 9 and 10 are left open. Pin 1 of J2 connects to pin 1 of XE90.



MR-2575

Figure 4-5 Graphic Interconnecting Cable Removal

3. Remove the terminal controller module by pulling it straight out.
4. To install the terminal controller module, perform steps 1, 2, and 3 in reverse.



MR-2576

Figure 4-6 Graphic Interconnecting Cable Installation

4.7 WAVEFORM GENERATOR MODULE (M7071)

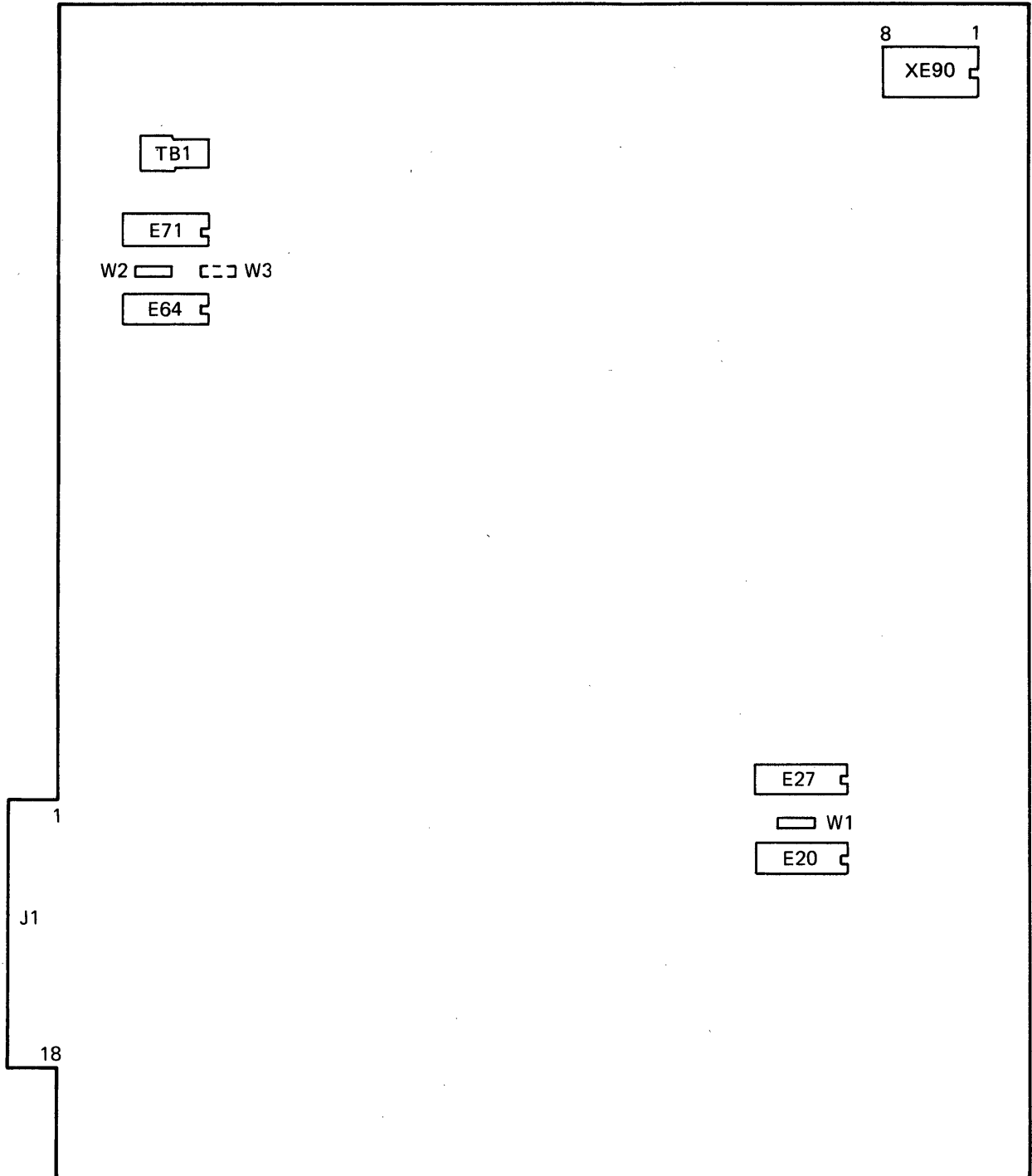
The waveform generator module provides the graph drawing capabilities of the VT105. This module, shown in Figure 4-7, has 3 jumpers. They are factory configured as follows.

Jumper	Position	Function
W1	IN	Enable timing (always in).
W2	IN	Enable control characters
W3	OUT	for unit 0.*

The following procedure describes the removal and installation of the waveform generator module.

1. Remove the access cover from the rear of the terminal.
2. Disconnect the graphic interconnecting cable from XE90 on the waveform generator module. (See CAUTION in Paragraph 4.6.) Table 4-2 shows the pin assignments for this connector.
3. Remove the waveform generator by gently but firmly pulling the module straight out of J2 on the backplane. Table 4-3 shows the expansion backplane pin assignments for J2.
4. To install the waveform generator module, perform steps 1, 2, and 3 in reverse.

*In this configuration only, the module is supportable by operational software and diagnostics.



MR-3510

Figure 4-7 M7071 Waveform Generator
Jumper and Connector Locations

Table 4-2 Graphic Connector Pin Assignments for XE90

Pin	Signal	Pin	Signal
Pin 1	DO 07 H	Pin 9	GRAPHICS FLAG L
Pin 2	DO 06 H	Pin 10	GRAPHICS 2 IN L
Pin 3	DO 05 H	Pin 11	RESET H
Pin 4	DO 04 H	Pin 12	HORIZ BLK H
Pin 5	DO 03 H	Pin 13	GRAPHICS WR L
Pin 6	DO 02 H	Pin 14	VERT BLK L
Pin 7	DO 01 H	Pin 15	GRAPHICS 1 IN L
Pin 8	DO 00 H	Pin 16	GND

Table 4-3 Expansion Backplane Pin Assignments for Graphics Connector (J2)

Pin	Signal/Voltage
Pin 1	Spare
Pin 2	Spare
Pin 3	+12 Vdc
Pin 4	GND
Pin 5	-12 Vdc
Pin 6	-23 Vdc
Pin 7	LBA5 H
Pin 8	Spare
Pins 9-13	GND
Pins 14-18	+5 Vdc

4.7.1 Waveform Generator Checkout

The M7071 module has an interactive test feature to display known test patterns on the video screen by typing keys on the keyboard. Refer to Appendix A to run this test procedure in entirety.

4.8 EXPANSION BACKPLANE (54-13384)

The following procedures describe the removal and installation of the expansion backplane.

CAUTION
Power must be off.

1. Remove the terminal access cover.
2. Remove the top cover.
3. Remove the bottom cover.
4. Remove the graphic interconnecting cable from one of the modules shown in Figure 4-8, detail B. (See CAUTION in Paragraph 4.6.)
5. Remove the terminal controller module from its 22-pin connector (J6) on the backplane.
6. Remove the waveform generator module from its 18-pin connector (J2) on the backplane.
7. Disconnect the 22-pin dc power harness from the edge of the expansion backplane board.
8. Using a nutdriver and Phillips head screwdriver, remove the screws and nuts that hold the expansion backplane to the chassis.

NOTE

Do not lose the two standoff spacers that mount between the chassis and the expansion backplane.

9. To install the expansion backplane, perform steps 1-8 in reverse.

4.9 DC POWER HARNESS (70-14978)

The following procedure describes the removal and installation of the dc power harness.

CAUTION
Power must be off.

1. Remove the terminal access cover.
2. Remove the top cover.
3. Remove the bottom cover.
4. Remove the terminal controller module (Paragraph 4.6).
5. Remove the waveform generator module (Paragraph 4.7).
6. Disconnect the 10-pin edge connector (J101) from the video monitor board. (The ground wire is tied to the chassis.)

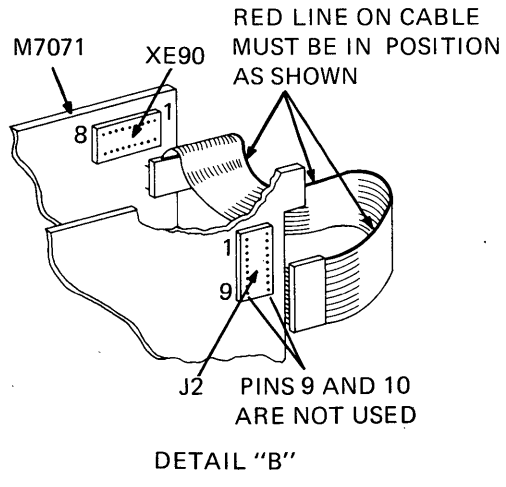
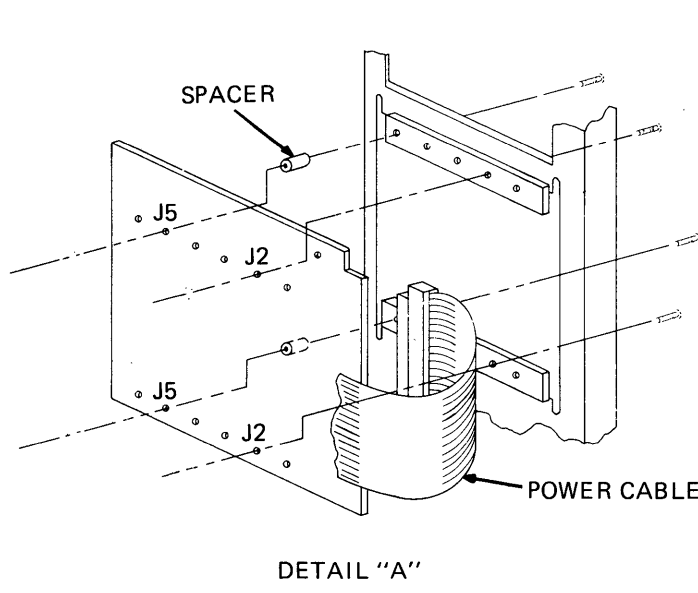
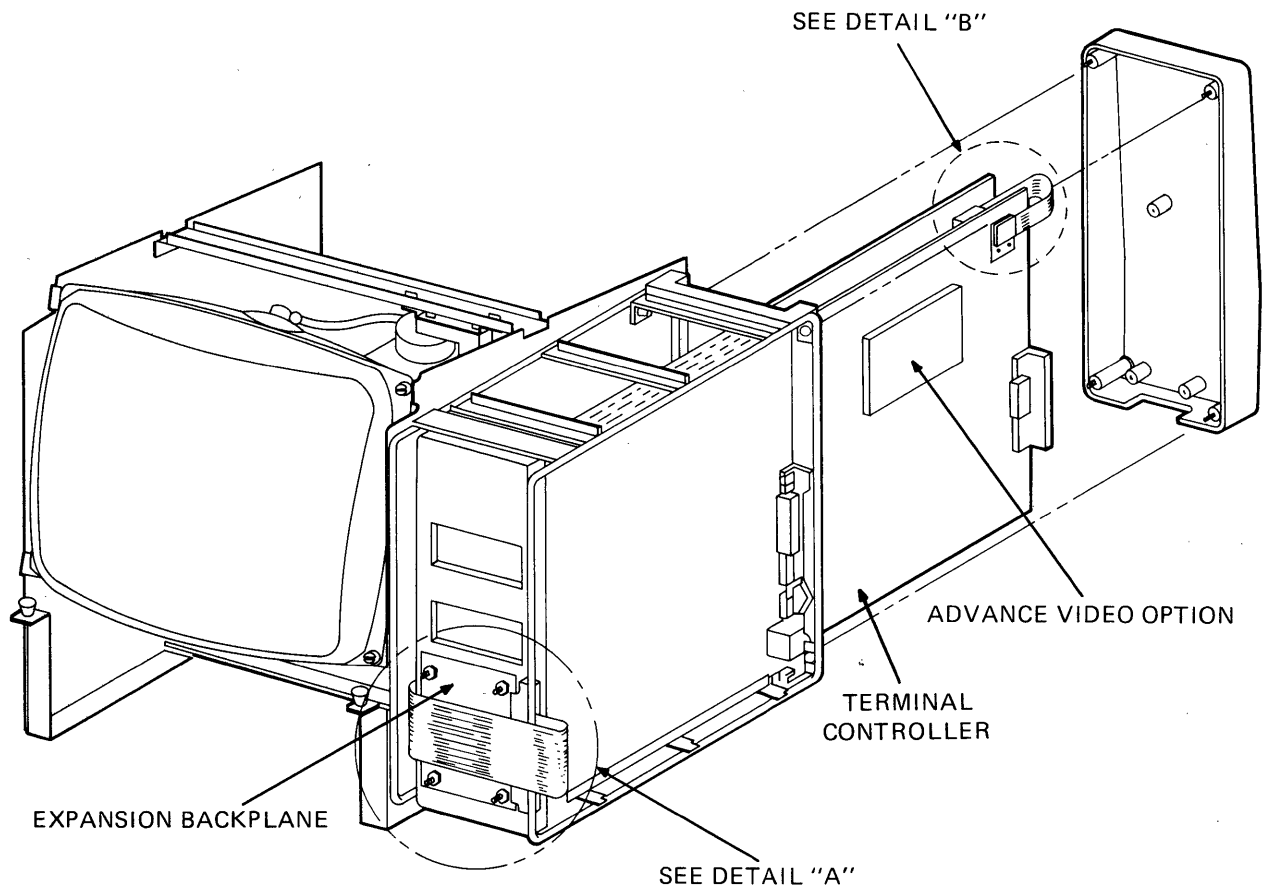


Figure 4-8 Expansion Backplane Removal and Installation

MR-3509

7. Disconnect the 22-pin edge connector from the expansion backplane. (Note how this cable wraps around the card cage assembly for reinstallation; refer to Figure 4-8.)
8. Release the two pop fasteners holding the top of the card cage to the chassis and tilt the card cage top out.
9. Remove the two fasteners holding the 18-pin edge connector to the chassis and remove the connector.
10. Remove the dc power harness from the terminal.
11. To install the dc power harness, perform steps 1–10 in reverse.

4.10 CUSTOMER EQUIPMENT CARE

The keyboard keys are the only moving parts of the terminal and require no preventive maintenance by the owner. Rubbing the keys with a dry or barely moist cloth should suffice to clean them. Do not remove the keycaps to clean them more thoroughly; damage may result to the switch contacts if they are replaced incorrectly.

The terminal cabinet surfaces may be cleaned with soap and water or any mild detergent. Cleaners with solvents should not be used. Avoid using excessive water to clean the terminal.

Keep the ventilation slots clear so as not to cause the terminal to overheat.

4.11 VT105 SPECIFICATIONS

Dimensions

Monitor	Height: 36.83 cm (14.5 inch) Width: 45.72 cm (18 inch) Depth: 36.20 cm (14.25 inch)
Keyboard	Height: 8.89 cm (3.5 inch) Width: 45.72 cm (18 inch) Depth: 20.32 cm (8 inch) Minimum table depth: 51.4 cm (20.25 inch)

Weight

Monitor	13.6 kg (30 lbs)
Keyboard	2.0 kg (4.5 lbs)
Shipping Weight	19 kg (42 lbs)

Environment

Operating	Temperature: 10° to 40° C (50° to 104° F) Relative humidity: 10% to 90% Maximum wet bulb: 28° C (82° F) Minimum dew point: 2° C (36° F) Altitude: 2.4 Km (8,000 ft)
-----------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Non-Operating Temperature: -40° to 66° C (40° to 151° F)
Relative humidity: 0 to 95%
Altitude: 9.1 km (30,000 ft)

Power

Line Voltage 90-128 V RMS single phase, 2 wire
180-256 V RMS single phase, 2 wire
(switch-selectable)

Line Frequency 47-63 Hz

Current 3.0 A RMS maximum at 115 V RMS
1.5 A RMS maximum at 230 V RMS

Input Power 250 VA apparent, 150 W maximum

Current limiting 3 A normal blow fuse

Power cord detachable, 3 prong, 1.9 m (6 ft)
120 Vac power cord (DEC 17-00083-09)
240 Vac power cord (DEC 17-00083-10)

Display

CRT 305 mm (12 in) diagonal measure, P4 phosphor

Format 24 lines × 80 characters or 14 lines × 132 characters (selectable)

Graph Drawing

No. of fields Two, noninterlaced graph drawing fields.

Rectangular field 20.3 × 10.94 cm (8 × 4.375 in) horiz ×
vertical

Square field 16.5 × 11.56 cm (6.5 × 4.625 in) horiz ×
vertical

Graph resolution rectangular format: 230 dots × 512 dots
square format: 240 dots × 512 dots

No. of graphs,
shaded graphs,
or stripcharts Two single-valued functions of X, individ-
ually controlled.

Strip charts Single or dual strip charts; right data entry; right-to-left movement.

Shade lines Two movable shade lines; one per graph.

Graph markers 512 per graph; total of 1024, individually controlled.

Vertical lines	512; individually controlled.
Horizontal lines	230 (or 240) individually controlled in rectangular (or square) format.
Special features	Individual blanking and unblanking of separate graphs; overlapping areas of shaded graphs are discernible.
Test feature	Operator controlled by "key-in" instructions. Test patterns are displayed.

Alphanumerics

Character	7 × 9 dot matrix with descenders for lowercase
Character size	3.35 mm × 2.0 mm (0.132 inch × 0.078 inch) in 80 column mode 3.35 mm × 1.3 mm (0.132 inch × 0.051 inch) in 132 column mode
Character Set	96 character displayable ASCII subset (upper and lowercase, numeric and punctuation).
Cursor type	Keyboard selectable, blinking block character or blinking underline.

Keyboard

General	83-key detachable unit with a 1.9 m (6 ft) coiled cord attached.
Key Layout	65-key arrangement and sculpturing similar to standard typewriter keyboard with an 18-key auxiliary keypad.
Auxiliary Keyboard	18-key numeric pad with period, comma, minus, enter, and four general purpose function keys.
Visual Indicators	Seven LEDs; three LEDs are dedicated to ON LINE, LOCAL and KBD LOCKED; four LEDs are user programmable.
Audible Signals	Key-click: sounds when keys are typed. Bell: sounds upon receipt of BEL code; and sounds eight characters from right margin. Multiple bell: sounds upon detection of error in Set-up save or recall operation.

Communication

Type	EIA
Speeds	Full duplex: 50, 75, 110 (two stop bits), 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, 19,200
Code	ASCII
Character Format	Asynchronous 7- or 8-bit characters; keyboard selectable. (Note: if 8-bit characters are selected, the 8th bit is always a space.)
Parity	Even, odd, or none; keyboard selectable.
Synchronization	Keyboard selectable via automatic generation of XON and XOFF control codes.

CHAPTER 5 OPTIONS

The VT105 has available options that are designed to enhance the basic terminal and allow its use in a wide range of applications. The options currently available are:

VT1XX-AA	20 mA Current Loop Option
VT1XX-AB	Advanced Video Option

Contact the nearest DIGITAL Sales Office for further information and how to order the options.

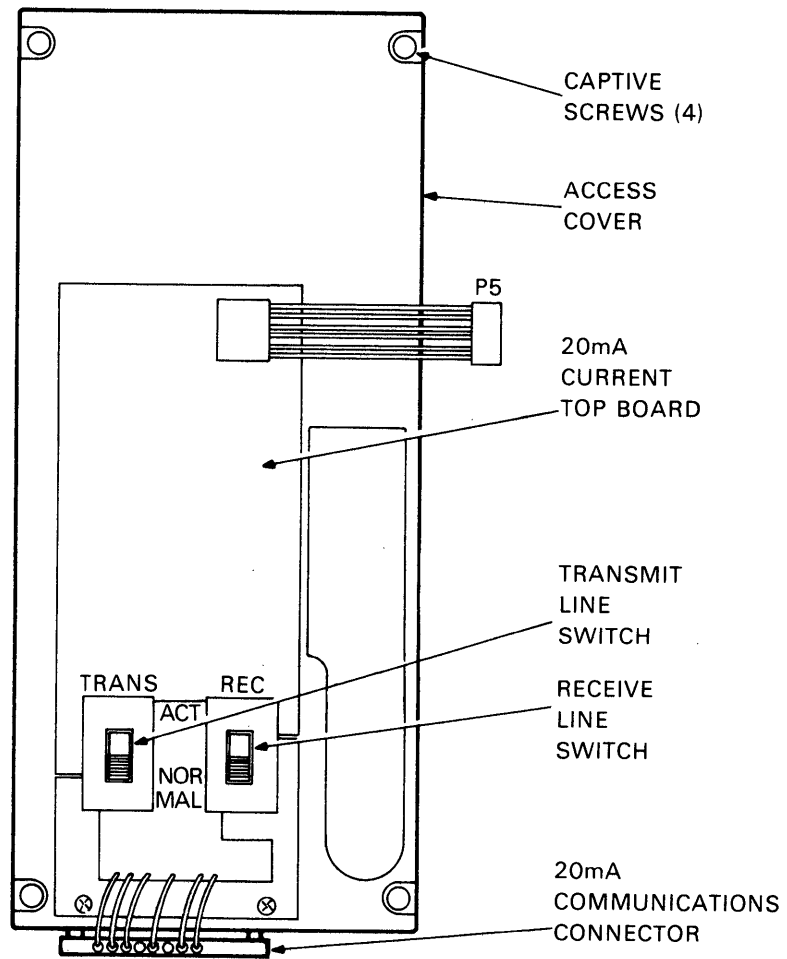
5.1 20 mA CURRENT LOOP OPTION - VT1XX-AA

The 20 mA Current Loop option allows the VT105 to connect directly to the host computer over a short distance without using a modem. The specifications for the 20 mA Current Loop option are located in Chapter 4.

5.1.1 20 mA Current Loop Option Installation

Use the following procedure to install the 20 mA Current Loop option:

1. Remove power from the terminal by disconnecting the ac plug.
2. Unplug the keyboard.
3. Unplug any connectors from the composite video input/output jacks.
4. Disconnect the communications cable.
5. With a blade-type screwdriver loosen the four captive screws holding the access cover; then remove the cover.
6. Set the TRANS switch to the NORMAL position (Figure 5-1). (If the terminal must provide current on the receiver line, set the switch to the ACT position.)
7. Set the REC switch to the NORMAL position (Figure 5-1). (If the terminal must provide current on the receive line, set the switch to the ACT position.)
8. Connect P5 to J5 on the terminal controller board (Figure 5-2).
9. Perform the 20 mA Current Loop option checkout.



MR-3530

Figure 5-1 20 mA Current Loop Option

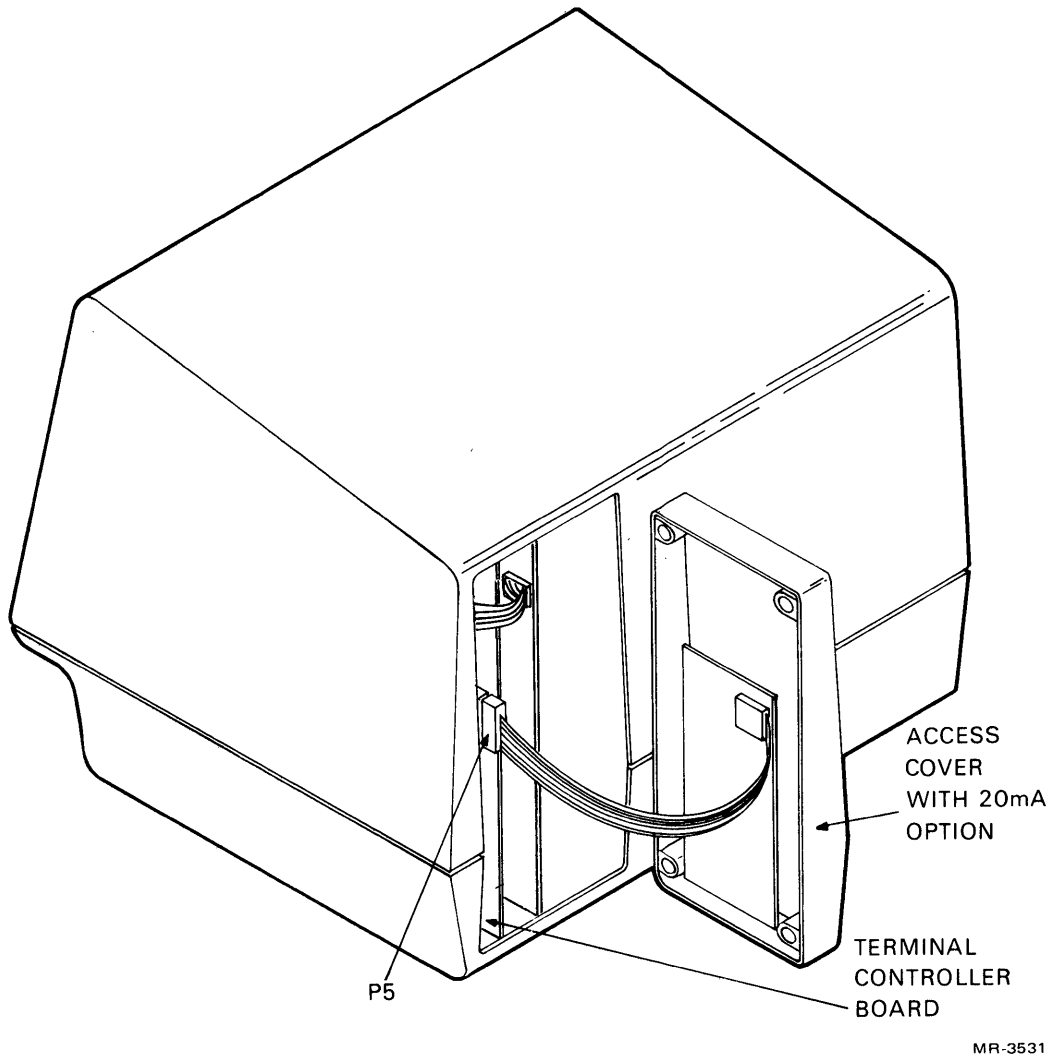


Figure 5-2 Terminal Access Cover with 20 mA Option Installed

5.1.2 20 mA Current Loop Option Checkout

The VT105 contains an internal test called the data loopback test. In the data loopback test the VT105 transmit and receive lines are connected to each other via a special external connector. A predefined set of characters are then transmitted. The terminal receives the characters and compares them to the characters transmitted. If the characters do not match, an error is then flagged.

Use the following procedure to check out the operation of the 20 mA current loop option.

1. Disconnect the terminal from the communications line.
2. Remove the terminal access cover containing the 20 mA current loopback board (Figure 5-2); place both of the switches in the NORMAL position. Reinstall the access cover.
3. Connect the 20 mA loopback connector (PN 70-15503-00) to the Mate-N-Lok connector mounted to the bottom of the access cover.
4. Place the terminal in ANSI mode (Set-up B).
5. Type the following sequence to perform the data loopback test:

ESC [2;2y

When the test is performed, the screen clears and the message WAIT is displayed in the upper-left corner of the screen. The entire test takes approximately 6 seconds to run.

NOTE

The data loopback test can be repeated indefinitely by typing: ESC[2;10y.

This test ends only when an error is detected or the terminal power is turned off.

6. A loop back error is shown by "8" being displayed in the upper-left corner of the screen. If an error occurs, check the 20 mA board connectors and switch settings, then repeat step 5. If the error persists, contact your service organization.
7. Once the test is complete, return the 20 mA current loop board switches to the original positions, remove the loopback connector, replace the access cover, and reconnect the terminal to the communications line.

5.2 ADVANCED VIDEO OPTION - VT1XX-AB

The Advanced Video Option enhances the basic VT105 by adding the following features.

1. Ten additional lines of 132 column display – this capability is added to the VT105 by providing additional display memory. The screen can now display a total of 24 lines in either 80- or 132-column format.
2. Additional character attributes – the VT105 is now capable of highlighting any character(s) on the screen in any of the following ways:

Bold

Blink

Underline

Reverse

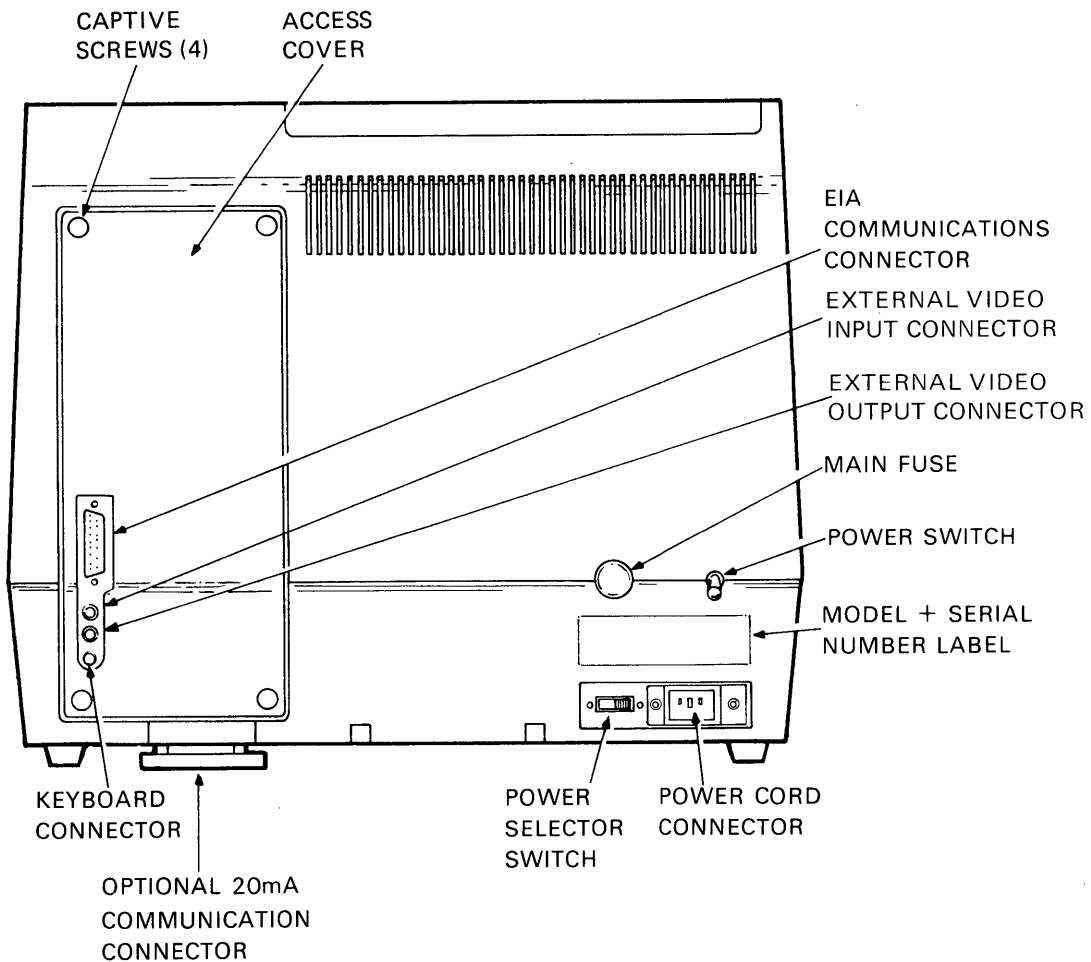
Any combination of the above

3. Additional character generator ROM provides memory required to access a second character generator ROM providing special graphics characters. (See Chapter 2.)

5.2.1 Advanced Video Option Installation

Use the following procedure to install the Advanced Video Option.

1. Remove power from the terminal by disconnecting the ac plug.
2. Unplug the keyboard.
3. Unplug any connectors from the composite video input/output jacks.
4. Disconnect the communications cable.
5. With a blade-type screwdriver, loosen the four captive screws holding the access cover (Figure 5-3).



MR-3527

Figure 5-3 VT105 Rear View

6. If the 20 mA current loop option is installed, gently pull the access cover away from the terminal about 5 cm (2 in); then reach in and disconnect J5 from the terminal controller board. The terminal controller board is located in the leftmost slot in the card cage (viewed from the rear).
7. Remove the access cover.
8. Remove graphic cable from J2 on the terminal controller board; remove other cables if present.
9. Remove the terminal controller board by gently but firmly pulling the board straight out.
10. Place the terminal controller board on a flat surface with the component side up.
11. Locate the four mounting holes drilled in the terminal controller board shown in Figure 5-4. Mount a standoff in each hole.
12. Grasp the advanced video board by the edges and carefully align the connector pins with the connector on the terminal controller board. Gently but firmly mount the Advanced Video board onto the terminal controller board.
13. Reinstall the terminal controller board. The terminal controller board must be inserted into the leftmost slot in the card cage.
14. Reinstall all cables.
15. Reinstall the access cover.

5.2.2 Advanced Video Option Checkout

Use the following procedure to check out the operation of the Advanced Video option.

1. Turn the terminal power on and verify that no error is detected during the power-up self-test.
2. Press the SET-UP key. The words "SET-UP A" should blink in boldface, the words "TO EXIT PRESS SET-UP" should be underlined, and the ruler should contain alternating normal and reverse video fields.
3. Place the terminal in the 132 column mode and then in the LOCAL mode.
4. Exit SET-UP and type the following sequence:

ESC < ESC # 8

The screen should now display 24 lines × 132 columns.
5. Ensure waveform generator is operational. Perform the Interactive Graphics test in Appendix A.

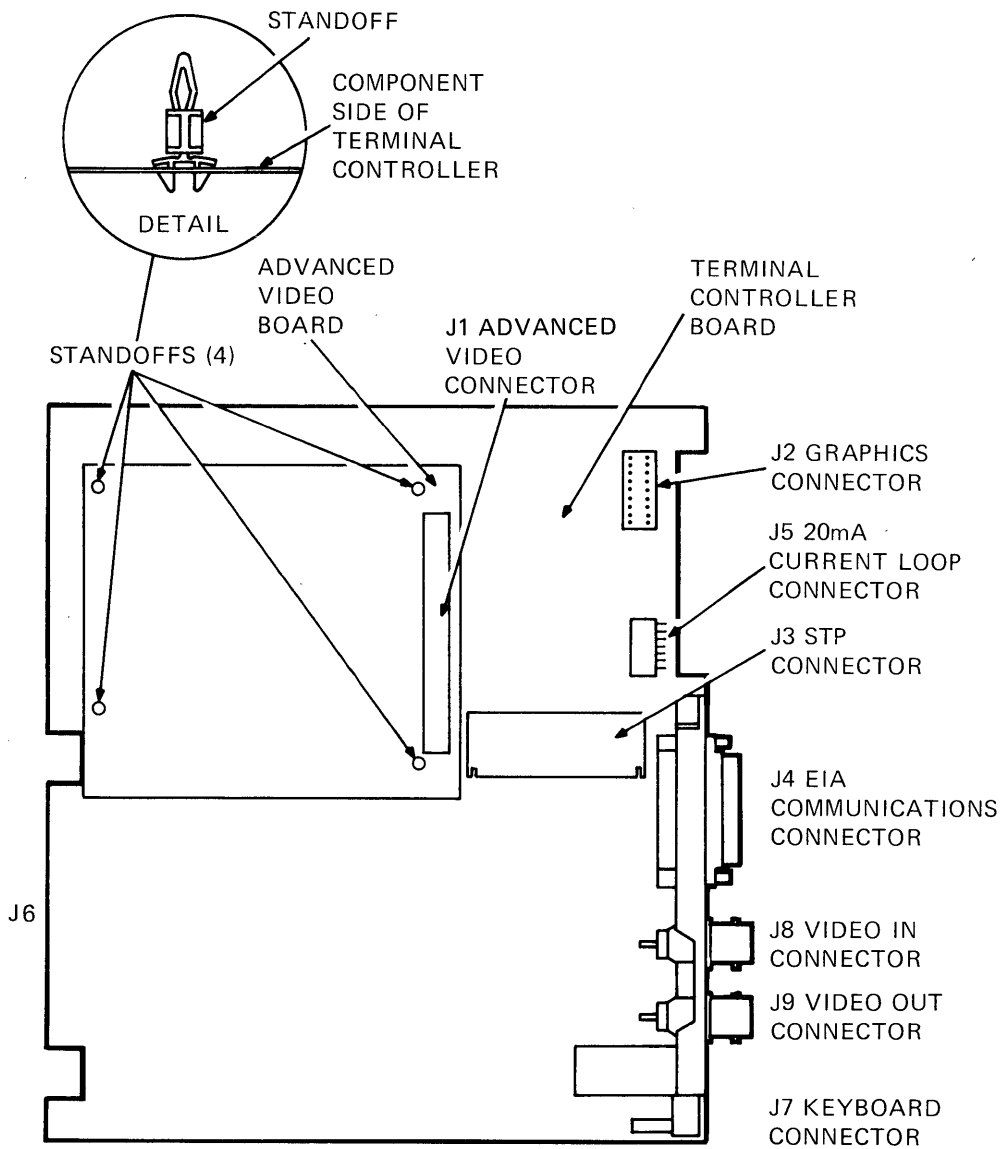


Figure 5-4 Advanced Video Option Installation

5.3 COMMUNICATION CABLES

Optional communication cables for use with the VT105 are listed in Table 5-1. Contact your local DIGITAL sales office for ordering information.

Table 5-1 Optional Communications Cables

Cable Part No.	Length	Connectors	Purpose
BC03M-01 BC03M-25 BC03M-A0 BC03M-XX*	0.3 m (1 ft) 7.6 m (25 ft) 30.5 m (100 ft) variable	2 - RS-232 female Cinch connectors	Null modem; connects terminal to a line unit.
BC05D-10** BC05D-25**	3 m (10 ft) 7.6 m (25 ft) to female Cinch connector	RS-232 male Cinch connector	Connects terminal to a modem
BC05F-9 BC05F-15† BC05F-XX*	2.7 m (9 ft) 4.5 m (15 ft) variable	2 - Mate-N-Lok male connectors	Connects terminal with a 20 mA option installed to a line unit.

* The -XX indicates that other lengths are available but do not come preassembled.

**When using a DF01-A acoustic coupler, pin 23 of this cable must be disconnected.

† A BC05F-15 cable is shipped with the VT1XX-AA 20 mA current loop option.

CHAPTER 6 TECHNICAL DESCRIPTION

6.1 INTRODUCTION

This chapter describes the VT105 waveform generator module, M7071. The M7071 complements the VT100 alphanumeric terminal by adding graph drawing capabilities. Together they comprise the VT105 Alphanumeric and Graphic Terminal. This chapter describes:

- the graph module in a block diagram format
- decoding the input
- establishing mode of operation
- phase lock loop timing
- rectangular aspect ratio graph drawing field
- square aspect ratio graph drawing field
- loading the registers
- loading graph memories
- generating baselines
- loading vertical and horizontal lines
- generating strip charts
- combining video out .

NOTE

Refer to the VT100 Series Mini-Maintenance Manual for troubleshooting, video alignment, and replacement procedures for the VT105.

6.2 ENABLING GRAPHIC INFORMATION

On initializing the VT105, the M7071 forces the GRAPHICS FLAG low so the VT100 terminal controller module recognizes that the graphics option is installed.

To enter the graph drawing mode, an escape sequence ESC 1 is needed. The terminal will remain in this mode until ESC 2 is received. When in this mode, graphics data is passed to the M7071 on parallel data lines. When data is passed, the GRAPHICS FLAG goes high and stays high until the data is stored in the static random access memories (RAMs); this signal is sensed by the VT100 terminal controller, and it does not pass another character to the M7071 until this signal goes low.

The M7071 also uses the following signals from the VT100.

- | | |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| DO 00 H – DO 06 H: | This is the parallel 7-bit graphic information in the form of a character to the M7071. |
| DO 07 H: | This signal is used by the VT105 for hard copy. |
| RESET H: | On power up, the M7071 uses this signal to initialize its registers. Pressing the RESET key during Set-up mode also generates this signal. |
| HORIZ BLK H: | This signal defines the horizontal blank time of 11.4 μ s. The horizontal active time is 52.1 μ s; the total period is then 63.5 μ s. |

- VERT BLK L: The vertical blank time is 1.016 ms. The vertical active time is 15.24 ms for a total period of 16.256 ms.
- WR GRAPHICS L: This is a pulse passed to the M7071 to strobe the parallel data (DO 00 H – DO 06 H) into the input latch.
- GRAPHICS 1 IN L: These signals are the video output from the M7071.
and
GRAPHICS 2 IN L:

The following paragraphs provide a brief discussion of the waveform generator block diagram, Figure 6-1.

6.2.1 Writing Data to the Waveform Generator (Block Diagram Discussion)

Data in the form of 7-bit ASCII characters is received by the data input latch. The first character must be a control character to give instructions to the waveform generator module as to where to place the next data information. Is the next data to be loaded into the registers or into the graph memories? Is it horizontal line data or vertical line data? The control character is loaded into a binary-to-decimal decoder that enables 1 of 10 load modes. (See Paragraph 6.3 for information on decoding the input character.)

One of these modes is load enable register 0; another is load enable register 1. These two registers store the information as to the type of graph desired (line graph, shaded graph, or strip chart) and the desired graph features (horizontal lines, vertical lines, and graph markers). Both of these registers use either one or two data characters to enable the desired graph features. The First Data flip-flop keeps track of these two data characters. Two data characters form a data word.

The second data character following a load enable register 1 command enables the mode select logic. Data bit 0 of this character determines the aspect ratio of the graph to be displayed on the video screen. When this bit is "1", the square aspect ratio is enabled. This aspect ratio is a new feature of the VT105 and uses all 240 scan lines on the terminal. When this bit is a "0", the rectangular aspect ratio is selected. This aspect ratio is compatible with previous DECgraphic video terminals (i.e., VT55) and uses only 230 scan lines of the terminal for the graph display. This later aspect ratio is also enabled during the power-up sequence of the terminal (by RESET H).

The outputs of the mode select logic go to a phase-lock-loop to establish the two timing signals necessary to set up the rectangular and square aspect ratios. These are 10.4 MHz and 12.4 MHz, respectively. The phase-lock-loop has a phase detector to monitor the horizontal blank signal from the VT100 and divides the frequency of this signal by a set number for each aspect ratio.

Another function of the decoder is to select the memory into which the data is to be loaded. This may be Graph 0 memory, Graph 1 memory, vertical line and graph marker memory, or horizontal line memory. Data to these memories must always be in the form of two data characters (one data word). A 5-bit data register holds the first character while waiting for the second. Then they are both parallel loaded through a 2-line to 1-line multiplexer, becoming RAM DATA to the inputs of each of the memories. The memory enabled to "write" at this time is determined by the decoder. The load enable signal from the decoder is synchronized by the First Data flip-flop and the Load X-Data multi-vibrator. One of the following signals is enabled to the memories:

- WR GRAPH 0 L
- WR GRAPH 1 L
- WR DATA L
- WR HORIZ L

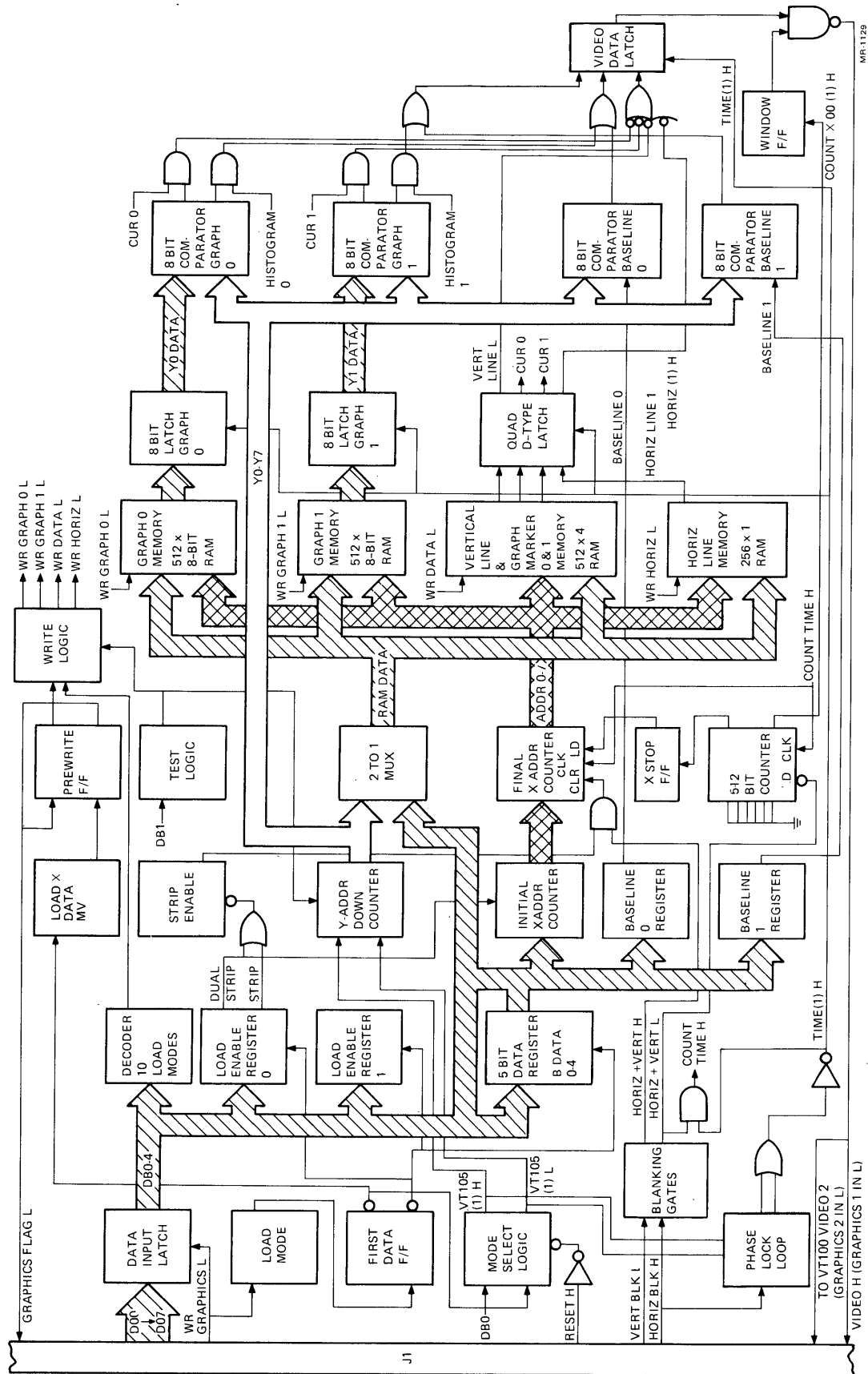


Figure 6-1 M7071 Waveform Generator Block Diagram

The data is then written into the appropriate memory, as shown in Figure 6-1.

Data for the shade lines (base lines) is loaded into Baseline 0 register and/or Baseline 1 register.

Data for the starting X-address is loaded into the initial X-address counter. The final X-address counter is loaded to this starting X-address at the end of the current scan (by the 512-bit counter). Data for successive X-address positions in memory only require one control character. The final X-address counter increments the position in memory for placing the new data.

When a strip chart is enabled (from Register 0), the clear input to the final X-address counter is disabled. This counter does not reset to zero, but rather it follows the initial X-address counter. New data increments the X-address and is added to the end of the graph. This new data is the last data to be read from memory. Previous data is read one position earlier causing a shift in the video graph to the left.

6.2.2 Reading Data from the Waveform Generator (Block Diagram Discussion)

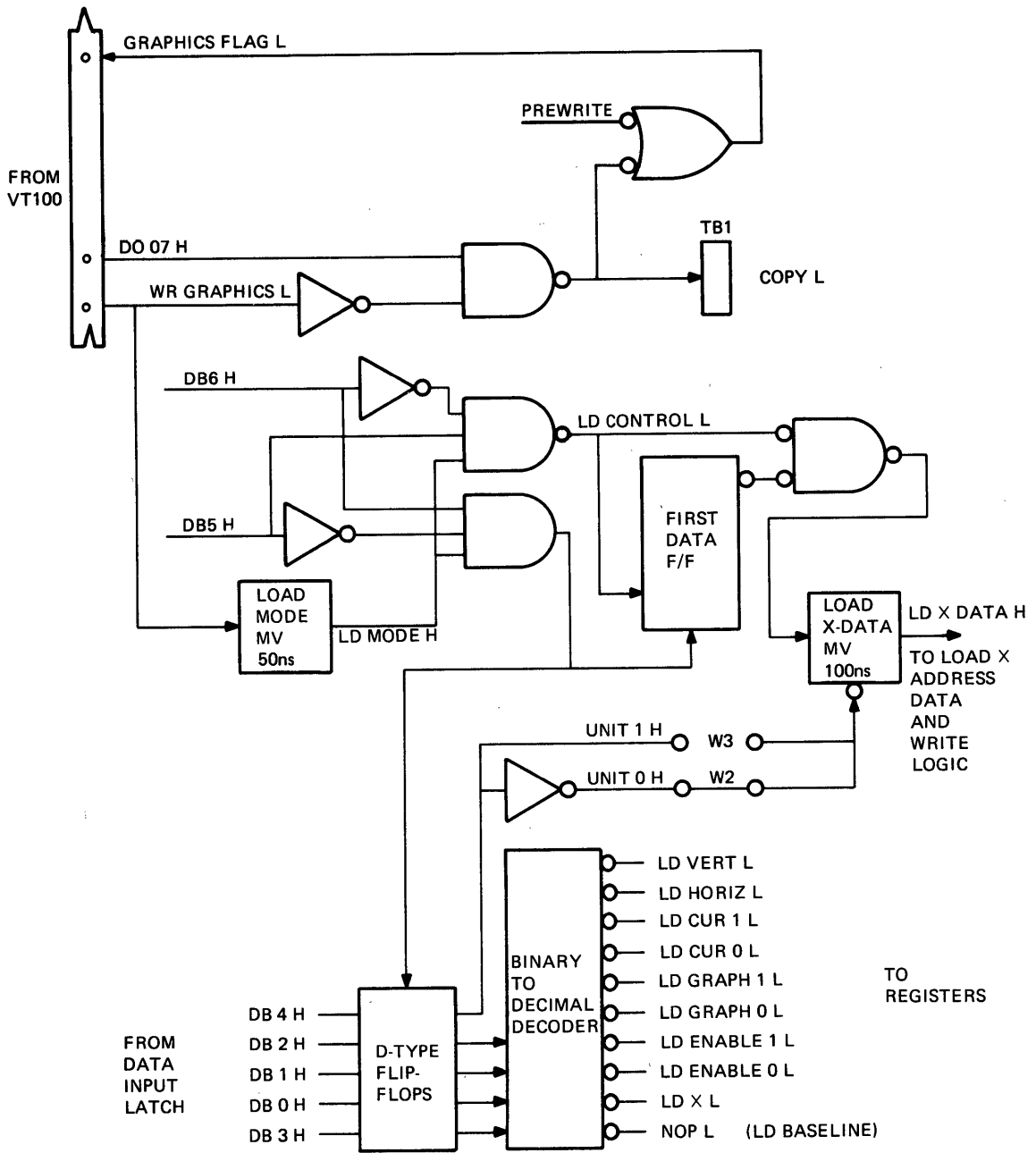
As long as the terminal is in the graph mode, the *enabled* graph data is read continuously from the waveform generator module. The Y-address downcounter is initially preset to one of two values: 240 lines for the square aspect ratio, or 230 lines for the rectangular aspect ratio. The output of this counter is enabled through the 2-to-1 multiplexer, becoming RAM DATA to strobe the row address of the memories. As each scan proceeds across each row, the X-address counter strobcs the column address of the memories.

The output of each memory is strobed into a corresponding D-type data latch. This provides buffering, as well as an input source for rewriting the data back into memory so it is not lost. The data from each memory is sent to a respective 8-bit comparator where the data is compared to the Y-address (Y0-Y7).

If both inputs are high at the same time, a high output is sent to the video data latch to intensify that position on the screen. If a histogram is enabled, all points below the graph position are also intensified. If a cursor (graph marker) is enabled, 16 points are intensified on the screen creating a short vertical line on the graph at a specific graph point. If a shade line (base line) is enabled at a specific Y-address: (1) all X-address positions on that line are intensified on the screen; and (2) all positions between the graph data and the shade line are also intensified. If a vertical line is enabled at a specific X-address, that X-address is intensified on each scan creating a vertical line on the screen.

All data is presented to the video data latch. At alternate times Histogram 0 and Histogram 1 data are gated out. This allows two shaded graphs to be displayed on the screen and still be discernible in overlapping areas. Graph markers, horizontal lines, and vertical lines are clocked to the output every TIME (1) H pulse. This timing comes from the phase-lock-loop previously mentioned.

The blanking gates keep track of both horizontal and vertical blank times from the VT100 and create the signal HORIZ + VERT H. This signal is used to clear the X-address counter and a 512-bit counter. Every COUNT X 00 (1) H from this counter clock the window flip-flop at the proper time to gate the video to the VT100 terminal controller. These signals are VIDEO H (GRAPHICS 1 IN L in the VT100) and VIDEO 2 (GRAPHICS 2 IN L).



MR-1131

Figure 6-2 Decoding the Control Character

6.3 DECODING THE INPUT

When the data received is one of the control characters listed in Table 6-1, bits 0-3 of the character are used to determine which control signal to enable. Only one set of control characters is used for one M7071; the extended character set is primarily used for a second M7071 installed in the same terminal to enable up to four graphs or stripcharts. These bits are sent to a binary-to-decimal decoder, Figure 6-2, that enables only one of the outputs at a time.

The extended character set is reserved for future expansion. Current software does not support the extended character set. Discussion in this chapter is limited to unit 0 to avoid confusion.

Data bit 4 is used to load X-data and select Graph 1.

Two ASCII characters are necessary to transmit a complete data word. Data bits 5 and 6 monitor these data bits. The first flip-flop keeps track of the first and second data characters.

Data bit 7 (DO 07 H) forces the GRAPHICS FLAG high to halt further transmission from the VT100 terminal controller while the video screen is being copied by a hard copy unit. The signal COPY L is sent to the hard copy unit on TB1. The hard copy unit must detect and hold this signal low while it copies the screen.

Table 6-1 Control Characters

Unit 0		Enable Signal	Unit 1	
Character	Octal Code		Extended Character	Octal Code
@	100	Load Baseline	P	120
A	101	LD ENABLE 0 L	Q	121
B	102	LD GRAPH 0 L	R	122
C	103	LD CURSOR 0 L	S	123
D	104	LD HORIZ L	T	124
H	110	LD X L	X	130
I	111	LD ENABLE 1 L	Y	131
J	112	LD GRAPH 1 L	Z	132
K	113	LD CURSOR 1 L	[	133
L	114	LD VERT L	\	134

6.4 SELECTING MODE OF OPERATION

There are two formats or modes for setting up the display: the rectangular format and the square format. The rectangular format uses a 10.4 MHz signal to display graphic data on the video screen in an area 230 dots high by 512 dots wide, as shown in Figure 6-3. The square format increases the rate of transmission to 12.4 MHz. The same graphic information is displayed in a more compact area, as shown in Figure 6-4.

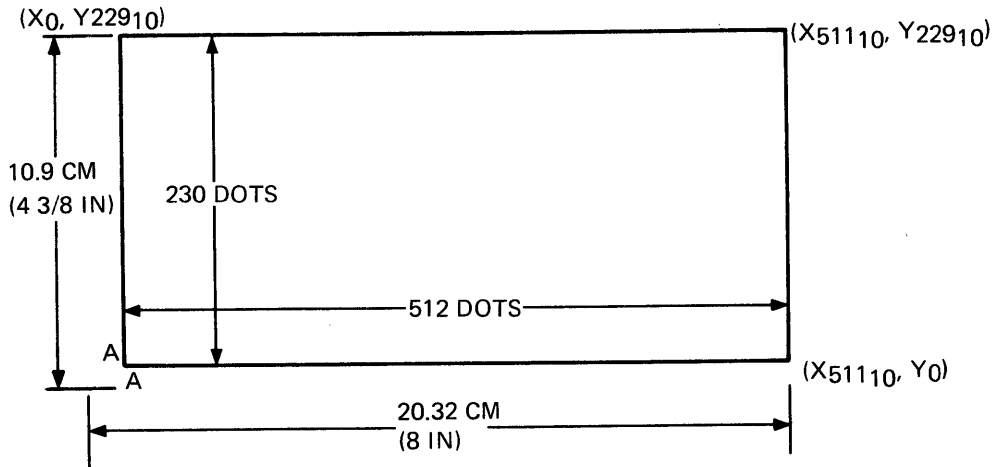
6.4.1 Rectangular Aspect Ratio

In the rectangular aspect ratio graph drawing field, shown in Figure 6-3, space is provided in the left margin for one character. Under the graph field, there is space for one line of characters. To set up the left margin, a delay is needed before starting the graph. Two signals (1.2 μ s and 320 ns) are added together to create a 1.52 μ s delay after horizontal blank time. This time allows space for one character in the left margin before starting the first X-address of the graph.

The horizontal line counter is initially loaded to 230 scan lines. Twenty-three lines of characters, each having a 10 line scan cell, can be printed within the graph drawing field. A 24th character line can be printed under the graph field.

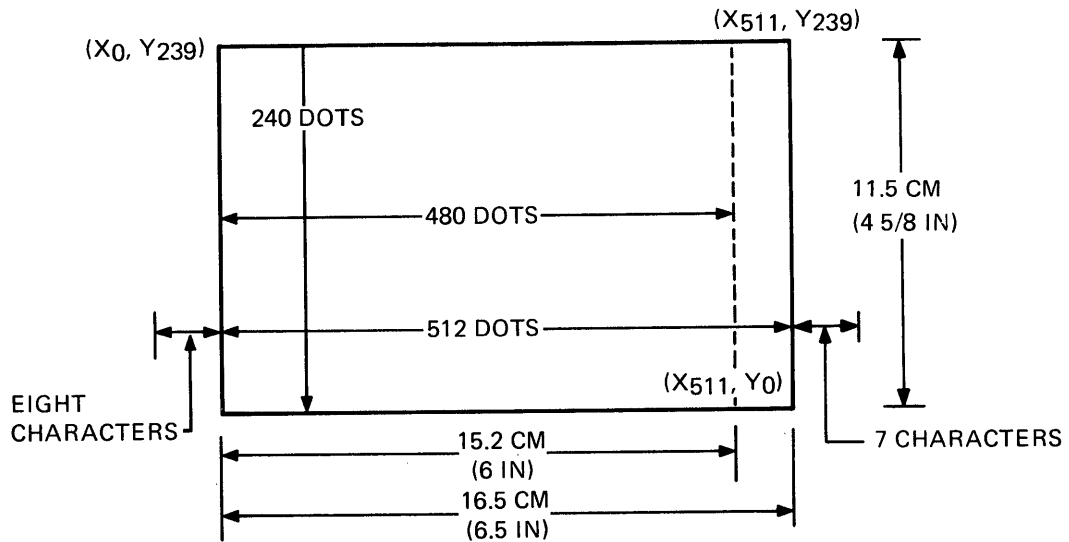
6.4.2 Square Aspect Ratio

In the square aspect ratio graph drawing field, shown in Figure 6-4, additional delay must be achieved before starting the first X-address. A 640 ns pulse is used to clock a counter loaded to divide by 8. A 5.12 μ s delay is achieved before starting the graph centering the graph field on the screen.



MR-1132

Figure 6-3 Rectangular Aspect Ratio Graph Drawing Field



MR-1133

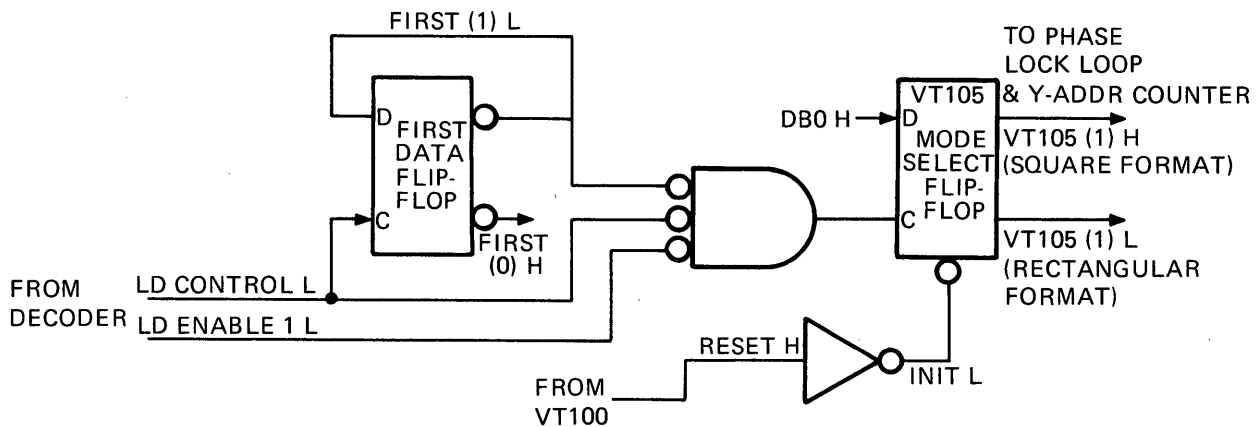
Figure 6-4 Square Aspect Ratio Graph Drawing Field

The square aspect ratio uses the full vertical screen area of 240 scan lines; 24 lines of alphanumeric data can be placed on the graph field. Up to eight characters may be placed on the screen to the left of the graph field; up to seven may be placed to the right of the graph field.

6.4.3 Decoding Field Selection

Selecting the field is accomplished by data bit 0 (DB 0) in the second data character following a Load Enable Register 1 instruction. The first flip-flop, shown in Figure 6-5, keeps track of the first and second data characters. The second data character enables FIRST (1) L which clocks DB 0 into the VT105 mode select flip-flop. If DB 0 is high, the square field is enabled. If DB 0 is low, the rectangular field is selected.

The signal RESET H (INIT L) from the VT100 terminal controller clears the mode select flip-flop and also enables the rectangular field.



MR-1134

Figure 6-5 Selecting Mode of Operation

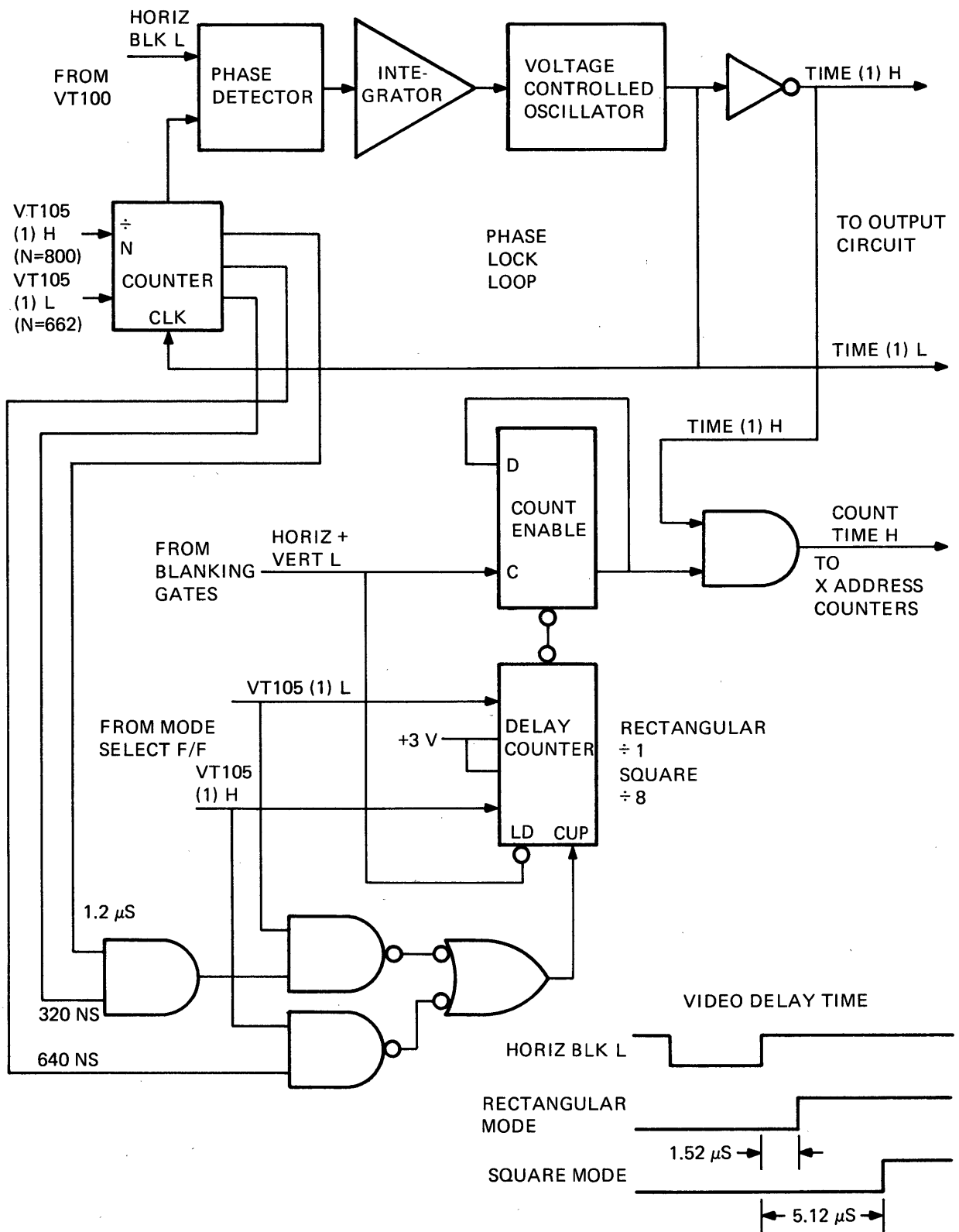
6.5 PHASE LOCK LOOP TIMING

A 10.4 MHz signal and a 12.4 MHz signal are needed to achieve the rectangular and square aspect ratio, respectively. A phase lock loop (shown in Figure 6-6) is used to generate and maintain these frequencies. The HORIZ BLK L signal from the VT100 terminal controller is used at one input to a phase detector. The phase detector monitors the output of the voltage controlled oscillator (VCO) to detect any frequency drift. The output frequency is divided by the number N in a counter to approximate the HORIZ BLK L input. The value for N is 662 for the rectangular aspect ratio and 800 for the square aspect ratio.

Should the frequency drift, the difference between the leading edge of the inputs to the phase detector is presented as a voltage change to the VCO and either raises or lowers the output frequency to compensate for the drift.

6.6 ESTABLISHING DESIRED DISPLAY

Selecting the desired graph, shading the graph, single or dual strip chart operation, and adding vertical and horizontal lines is initially stored in registers, shown in Figure 6-7. The signals LD ENABLE 0 L and LD ENABLE 1 L from the decoder enable register 0 and register 1, respectively. The first data flip-flop monitors the characters to enable the proper register to store the type of graph desired.



MR-1135

Figure 6-6 Phase Lock Loop Timing

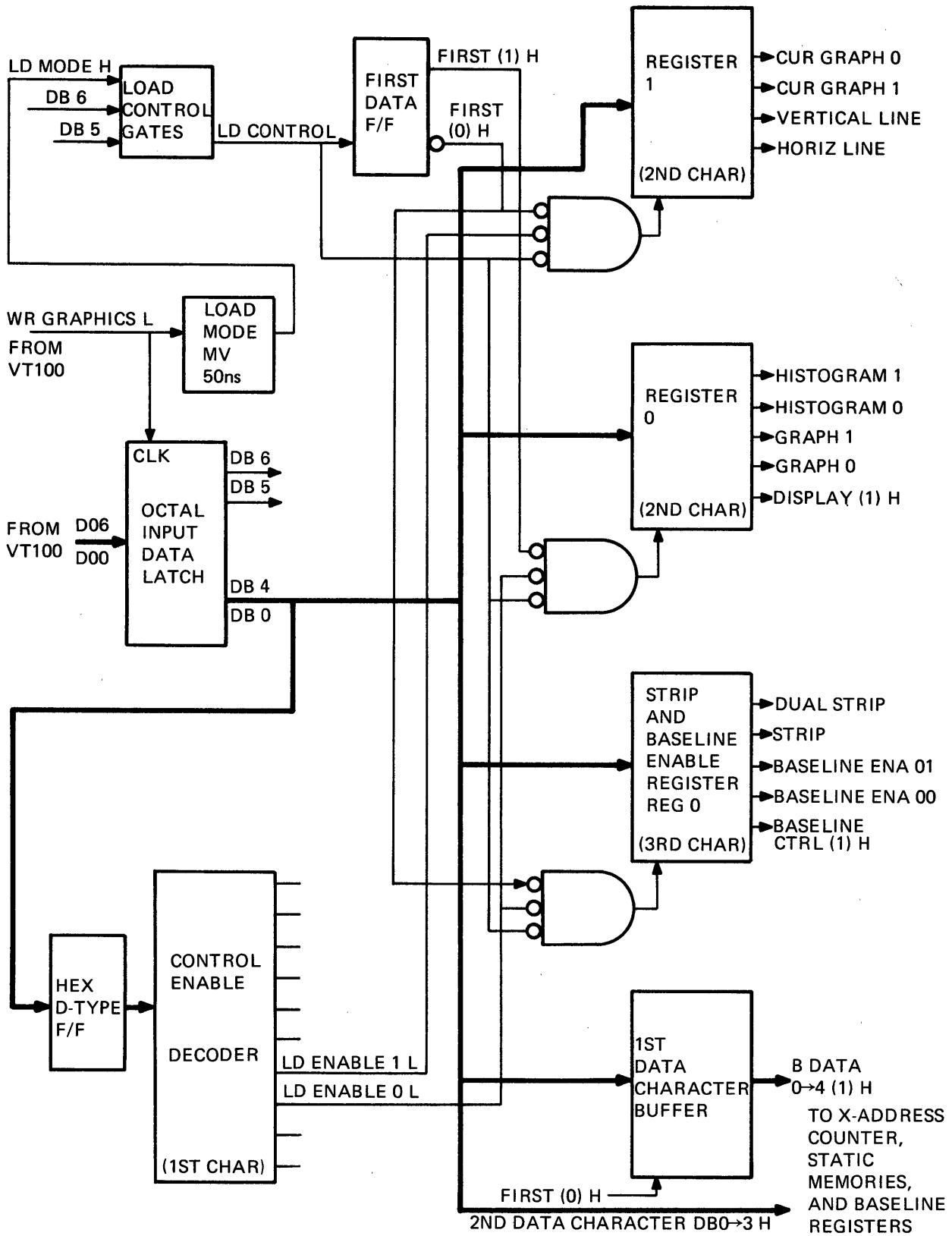
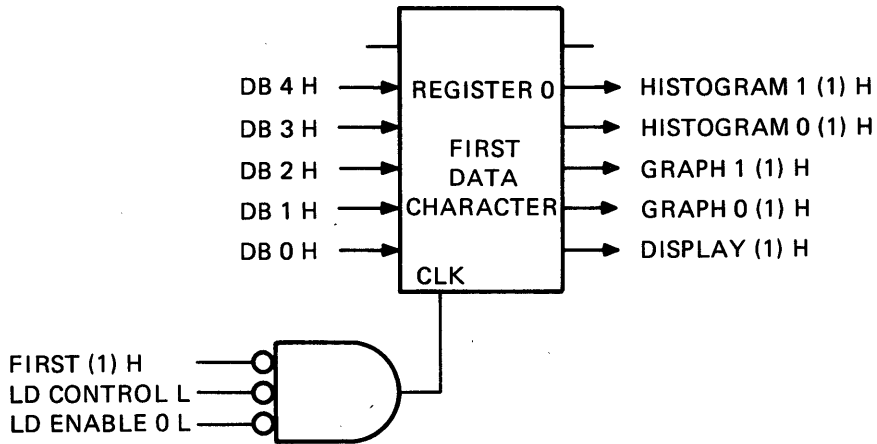


Figure 6-7 Loading the Registers

MR-1136

6.6.1 Loading Register 0

The letter A, when typed on the keyboard or coded in a program, enables register 0. One or two data characters may follow this letter. The first data character is clocked into a D-type flip-flop to determine the graphs or histograms desired. (See Figure 6-8.) DB 0 H must be set to display the graphic features enabled in register 0 and register 1; if 0, the graphic display is turned off.

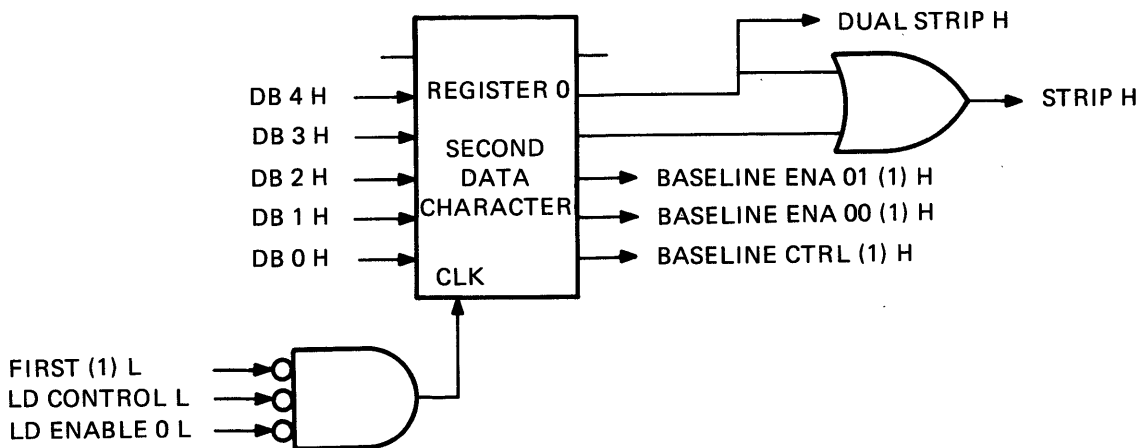


MR-1137

Figure 6-8 Register 0 (1st Data Character)

A second data character may be used to set up baselines (shade lines) or strip charts. (See Figure 6-9.) The state of the signal BASELINE CTRL determines whether Baseline 0 or Baseline 1 is to be loaded. If low, Baseline 0 may be loaded; if high, Baseline 1 may be loaded. See Paragraph 6.9 for more details on baselines.

DB 3 H enables the signal STRIP H to allow Graph 0 or Graph 1 to be a strip chart. DB 4 H enables STRIP H and DUAL STRIP H. Both signals are required to display both Graph 0 and Graph 1 as strip charts. Refer to Paragraph 6.14 for more information on strip charts.

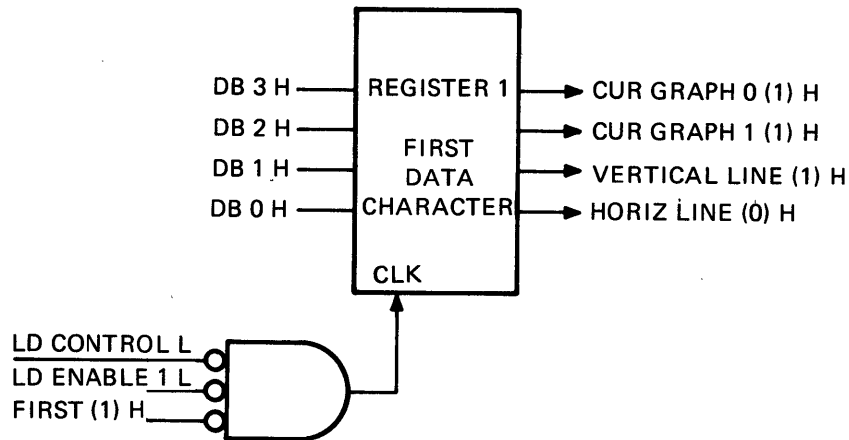


MR-1138

Figure 6-9 Register 0 (2nd Data Character)

6.6.2 Loading Register 1

The letter I produces the signal LD ENABLE 1 L to enable register 1. One or two data characters may follow this letter. The first data character enables horizontal lines, vertical lines, and graph markers, as shown in Figure 6-10.

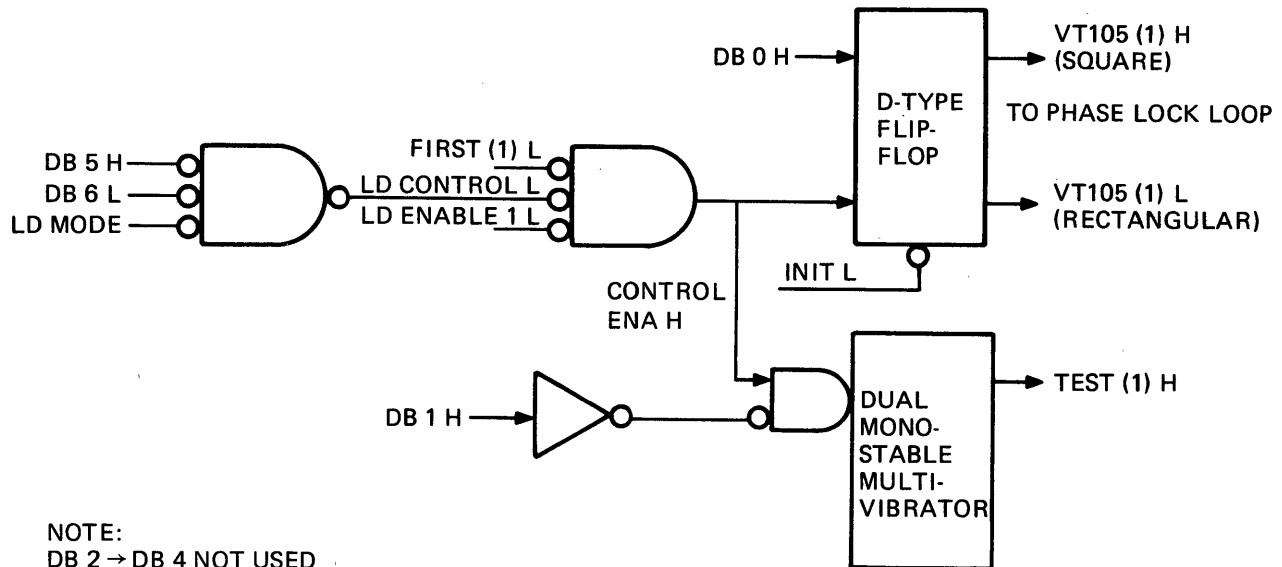


MR-1139

Figure 6-10 Register 1 (1st Data Character)

A second data character following the letter I enables the desired field and the Interactive Graphics Test. (See Figure 6-11.) The square field is established when data bit 0 is a one; the rectangular field is selected when DB 0 = 0. The rectangular field is also selected during the initial power-up sequence of the terminal by the signal RESET H (INIT L) from the VT100 terminal controller.

The interactive test is used to check the M7071 in LOCAL mode of operation. See Appendix A.



NOTE:
DB 2 → DB 4 NOT USED

MR-1140

Figure 6-11 Register 1 (2nd Data Character)

6.7 LOADING X-ADDRESS INFORMATION

In order to load the horizontal address of a dot or a line, two data characters must be transmitted. The first character contains the lower five bits of the binary X-address and is stored in a register while waiting for the second character with the upper bits. When both characters are received, the signal LD X DATA H loads the initial X-address counter, shown in Figure 6-12. When the current scan is complete, this data is loaded into the final synchronous X-address counter and presented to the random access memories.

During a write data program, the signal LD X DATA L clocks the pre-write flip-flop which triggers the write monostable multivibrator. The write multivibrator enables one of four write pulses to the RAM memories, either WR GRAPH 0 L, WR GRAPH 1 L, WR HORIZ H, or WRITE DATA L. This latter pulse is the write input signal to the vertical line and graph marker static RAMs. If either of the graph write pulses or WRITE DATA L is present, the initial X-address counter is incremented to be ready for the next data point.

When the pre-write flip-flop is cleared, GRAPHICS FLAG L is sent to the VT100 terminal controller, confirming that the data has been stored in the static RAMs, and they are ready to receive a new data word.

6.8 LOADING GRAPH MEMORIES

The characters B and J produce the signals LD GRAPH 0 L and LD GRAPH 1 L from the decoder. When enabled by the write multivibrator, these signals become WR GRAPH 0 L and WR GRAPH 1 L that determine into which memory to write the data.

The second and third characters of a load graph instruction form an 8-bit Y-value. This data passes through a two-line to one-line multiplexer becoming RAM DATA 0-7 (1) H, as shown in Figure 6-13. The data is then written into memory in the address, XADD 0-7, from the X-address counter.

Each RAM memory has $256_{10} \times 4$ bits of space available. Four of these are connected together to provide 512×8 bits of memory for each graph. The signal X ADDR 8 L enables the upper memory addresses, location 256 to 511.

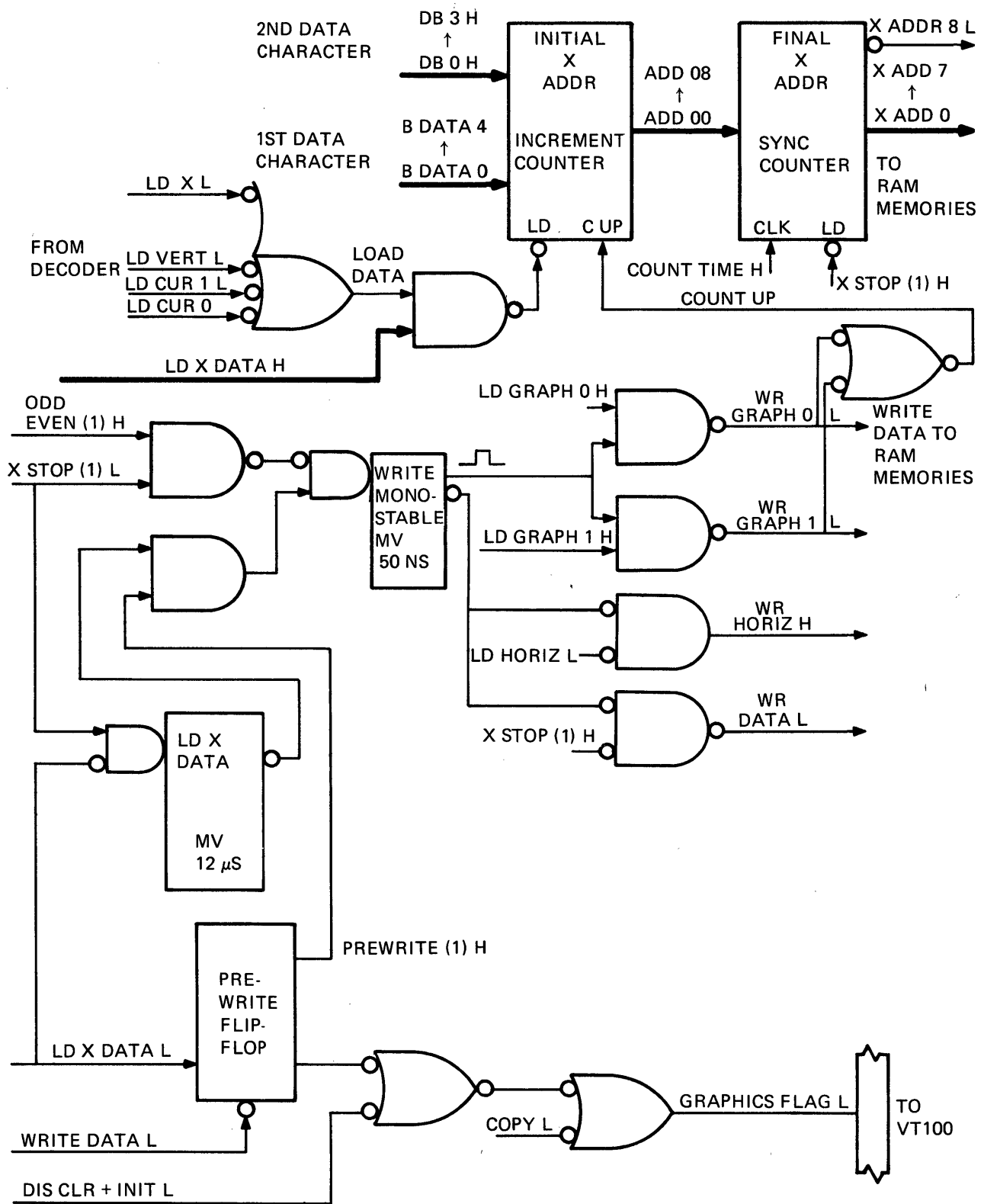
The M7071 uses a down-counter for a Y-address monitor. For the rectangular field, the down counter is initially loaded with address 230_{10} each time the scan reaches the bottom of the screen. The scan then starts at the top left corner of the screen. After each row of X-address information is processed, the Y-address monitor is counted down one increment. (For the square field, the down counter is initially loaded with address 240_{10} .)

In order to read memory, only the X-address must be available. The position of the graph data is compared with the current Y-address of the scan. If they are equal and the graph is enabled, the position on the screen is intensified.

6.9 GENERATING BASELINES (SHADE LINES) (Figure 6-14)

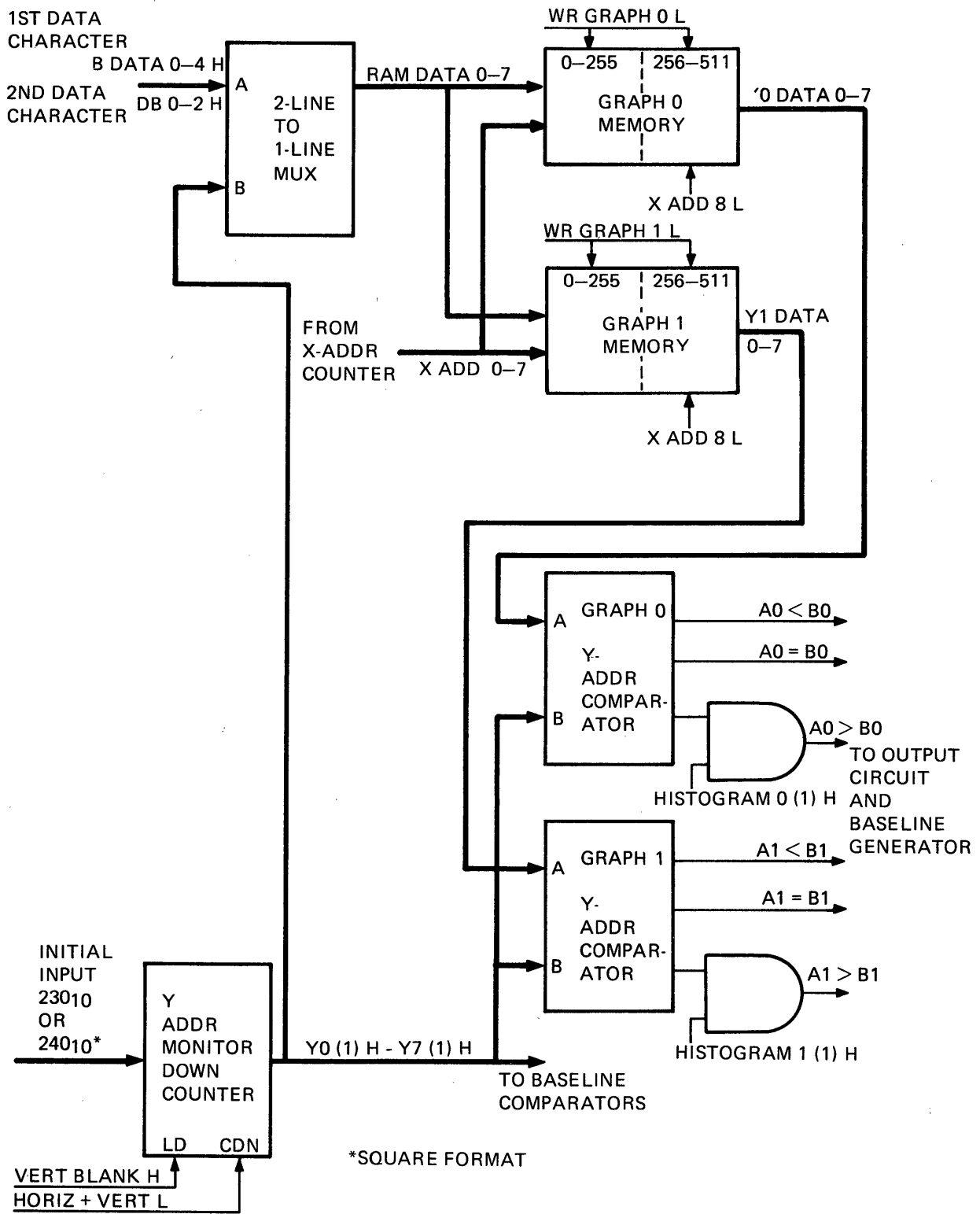
Data bit 0 in the 2nd data character following a load register 0 creates a signal called BASELINE CTRL (1) H. If high, this signal loads a baseline for Graph 1; if low, it loads a baseline for Graph 0. (See Paragraph 6.6.1 for loading register 0.)

The position of the baseline is determined by two data characters following the character @ (NOP). As the scan proceeds from top to bottom, its Y-address is compared with the position of each baseline. When they are equal, the baseline is intensified on the screen.



MR-1141

Figure 6-12 Loading Address Data



MR-1142

Figure 6-13 Graph Memory and Y-Address Monitor

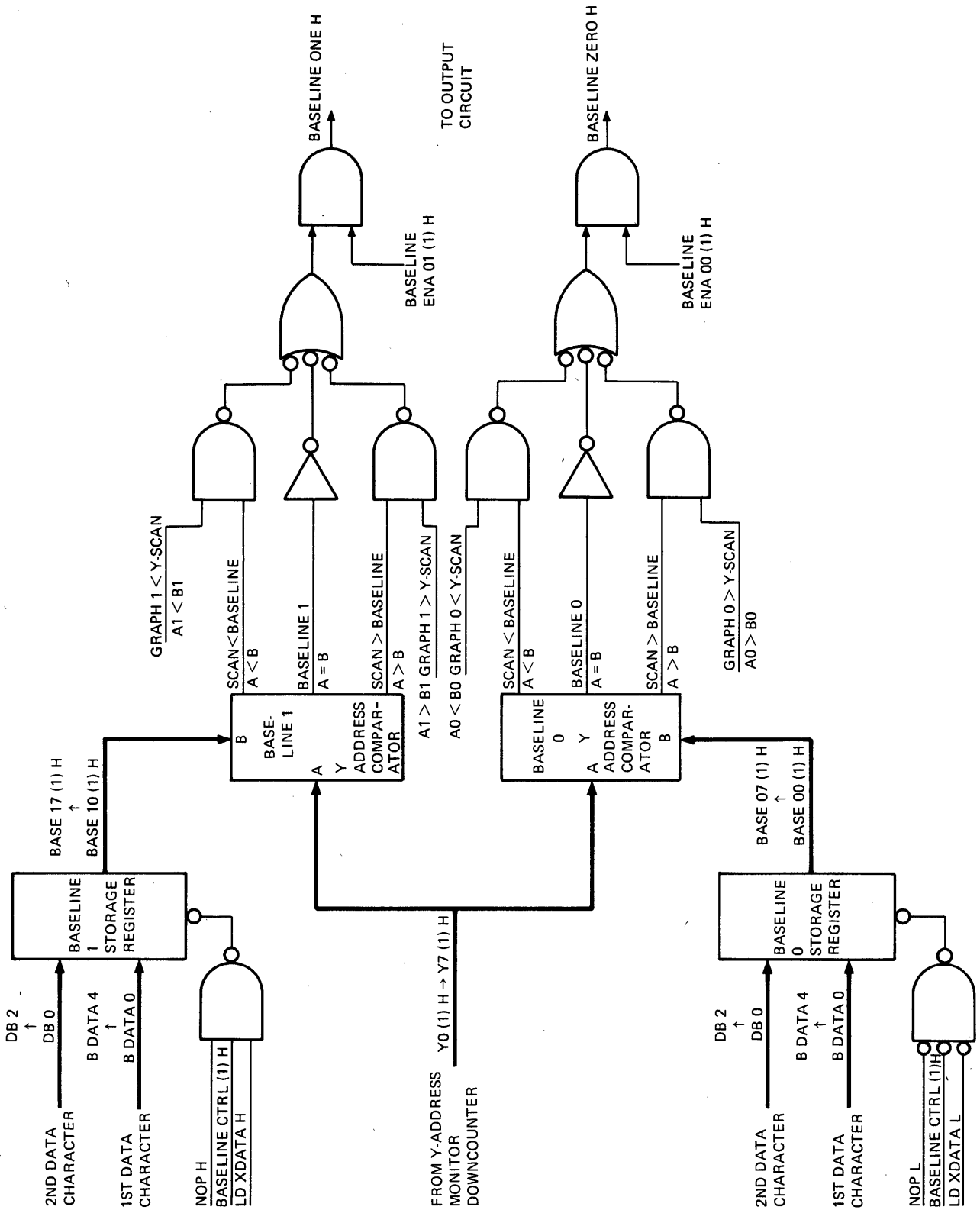


Figure 6-14 Baseline (Shade Line) Registers and Comparators

6.10 ENABLING A HISTOGRAM (SHADING A GRAPH)

6.10.1 Shading the Graph Without a Baseline (Shade Line) Enabled

Enabling a histogram intensifies points below a graph to the bottom of the graph drawing field. Data bits 3 or 4 in register 0 enable HISTOGRAM 0 (1) H and HISTOGRAM 1 (1) H, respectively. These signals, shown in Figure 6-13, enable all points below the graph determined by the Y-address comparator.

6.10.2 Shading the Graph With a Baseline (Shade Line) Enabled

When its baseline is enabled, a graph is shaded between the graph line and its baseline. To do this, two sets of comparators are used. One comparator, shown in Figure 6-13, monitors the position of the graph with respect to the current scan; the other, shown in Figure 6-14, compares the position of the baseline with that of the current scan. Together, they determine the points to be intensified. The baseline can be moved up or down, and the intensified area changes accordingly.

Bits 3 and 4 in register 0 enable Histogram 0 and Histogram 1, respectively. These bits should not be enabled if the baseline is enabled for that particular graph. Shading the histogram to line 0 eliminates the visual effect of shading only those areas between the graph and the movable baseline.

6.11 LOADING VERTICAL LINES

Vertical lines are loaded with two data characters following the letter L. Bit 4 of the second data character (B DATA 9 (1) H) along with LD VERT H from the decoder provide the data input (DI3) to the vertical line and graph marker memory. The other bits of the two data characters transmit the X-address in memory where the vertical line is to be stored. (See Figure 6-15.) If B DATA 9 (1) H is high, the vertical line is loaded; if low, the line is erased at that address.

The memory is continuously read by the X-address counter. The data in the current address is monitored by a D-type latch and is enabled only if VERTICAL LINE (1) H is present in register 1. This causes VERT LINE L to be sent to the output circuit. Every other point at a particular X-address is intensified to create a vertical line. Up to 512 vertical lines can be enabled on the graph field.

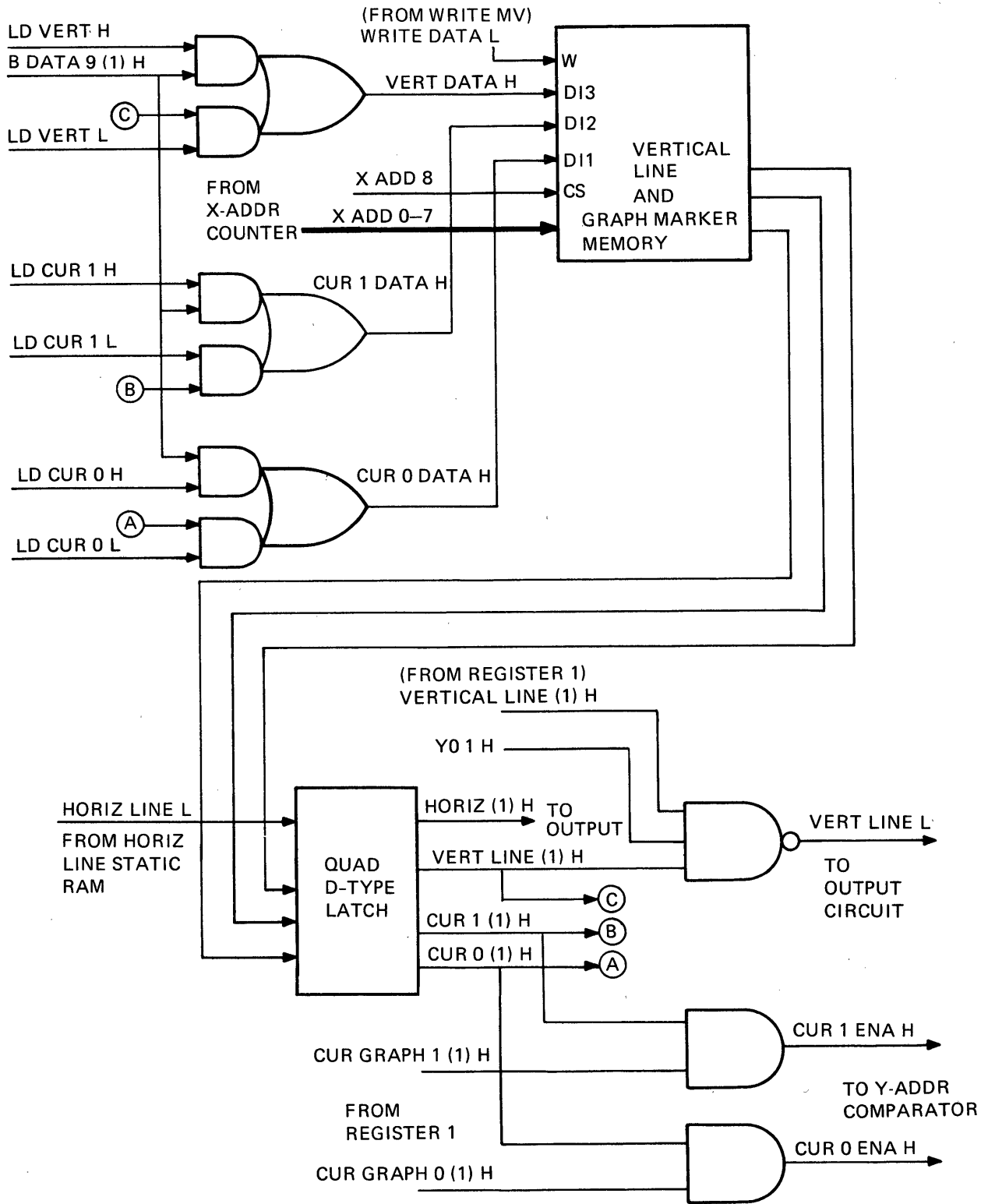
As the vertical line is read from the static RAM, its position is fed back (item C in Figure 6-15) and rewritten into the RAM so as not to lose the data.

When the strip chart feature is enabled, vertical lines follow the graph address in a wraparound fashion; that is, vertical lines move from right to left with the strip chart graph. When the current address exceeds address 511₁₀, the vertical line data is taken again from the beginning, address 0, 1, 2 . . . , etc.

6.12 ADDING GRAPH MARKER

The graph marker in the VT105 is a short vertical line that straddles the graph. For each graph marker, 16 additional dots on the screen are enhanced above and/or below the graph point. The number of dots above or below the graph point is hardware-dependent according to the current graph position. If the graph is at the top of the screen, the 16 dots will all be below that of the graph point; if at the bottom, they will all be above the graph point.

Loading a graph marker is accomplished by two data characters following the letters C or K. These letters are decoded as LD CUR 0 H and LD CUR 1 H, shown in Figure 6-15. When bit 4 of the second data character (B DATA 9 (1) H) is a one and WRITE DATA L is present, a graph marker is loaded in the address formed by the two data characters. If bit 4 is a zero, the graph marker is erased.



MR-1144

Figure 6-15 Vertical Line and Graph Marker Memory

When the graph marker is enabled and read from memory, an equal condition is forced from the lower four bits of the Y-address comparator. (See Figure 6-16.) The upper 4-bit comparator holds this equal condition until one of its bits changes. This does not happen until the Y-address has decremented 16 lines. The graph data point may be on any one of these 16 lines causing the graph marker to vary in number of dots above and below the graph point.

As the X-address is incremented, the output of the vertical line and graph marker memory is monitored by a D-type latch. As with the vertical line data, the graph marker data is also fed back into memory (items A and B in Figure 6-15) and wraps around when in strip chart mode.

6.13 GENERATING HORIZONTAL LINES

A horizontal line is loaded with the character D. The two data characters following the D represent an 8-bit Y-position of a horizontal line. Data bit 4 in the second data character enables the signal DIS CLR + INIT H that allows the A inputs to the two-line to one-line multiplexer (shown in Figure 6-17) to be gated out. The data, or address of the line, is then presented to the 256 × 1 static RAM memory. Data bit 4 (B DATA 9 (1) H) is also the data to be written into memory. If it is a one, a horizontal line is stored; if zero, a line is erased at that address.

A down-counter is used for tracking the Y-address when reading data from memory. To read from memory, only the Y-address is needed. A complement of the data in memory is the output. From register 1, HORIZ LINE (1) L enables all points at that Y-address creating a horizontal line. The signal 320 NS allows only every other dot to be displayed to decrease its intensity.

6.14 GENERATING STRIP CHARTS (Figure 6 - 18)

Strip charts are enabled by the second data character following a load enable register 0 instruction, as shown in Figure 6-9. Data bit 3 (DB 3 H) of this register enables the single strip chart feature; either Graph 0 or Graph 1 can be incremented from right to left across the screen.

Data bit 4 (DB 4 H) of this register enables the dual strip chart feature; both Graph 0 and Graph 1 data can be incremented from right to left across the screen. This must be done in the following sequence.

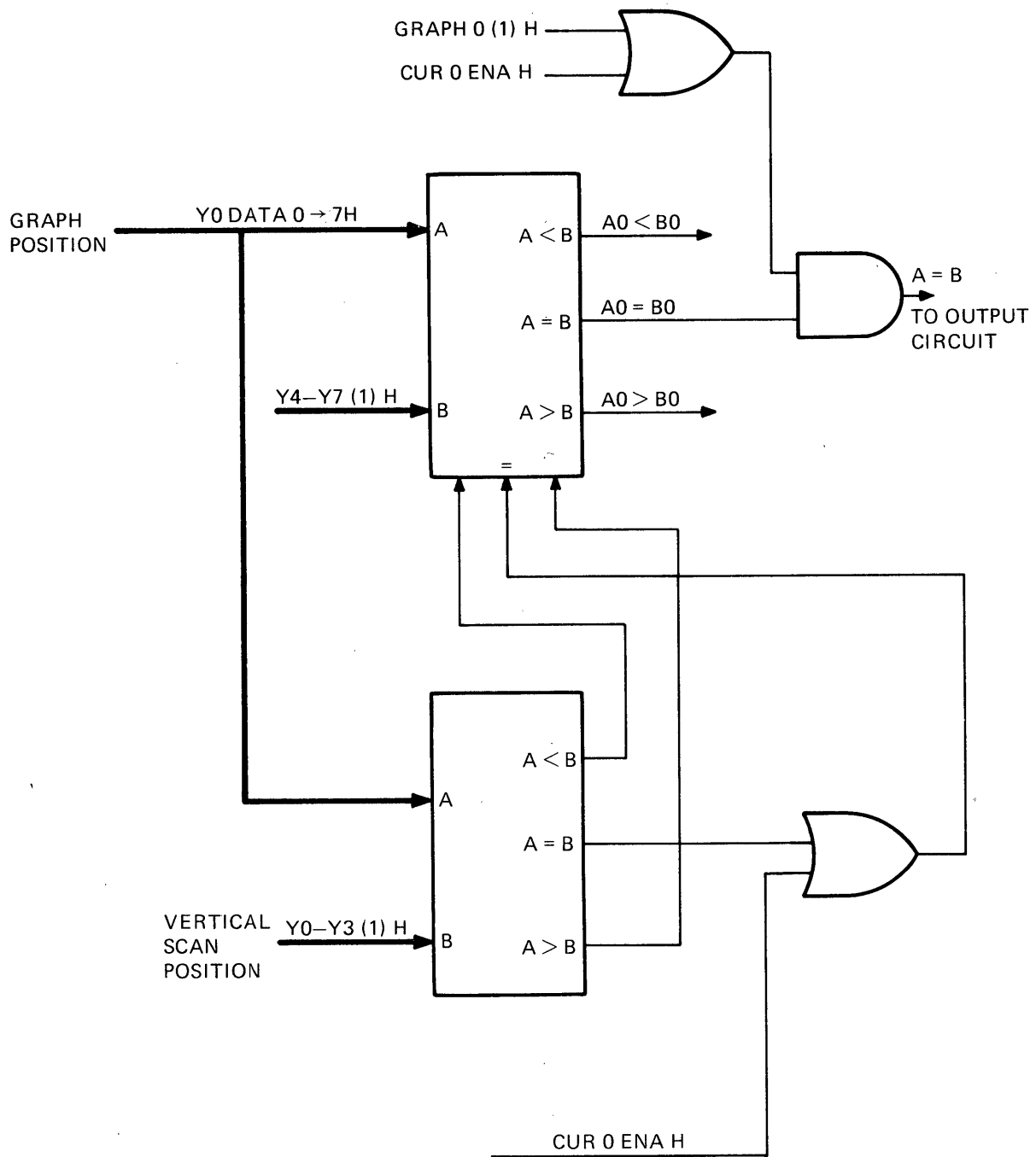
Data Entry	Character(s) Transmitted
Enable Graph 0	B
Enter Graph 0 data	two data characters
Enable Graph 1	J
Enter Graph 1 data	two data characters

6.14.1 Single Strip Chart Operation

Two X-address counters are used to create the strip chart motion. Without the strip chart feature enabled, the final X-address counter is cleared to zero at horizontal blank time (by HORIZ + VERT H). With a strip chart enabled, this clear signal is disabled allowing the final X-address counter to follow the initial X-address counter counting in a wraparound manner.

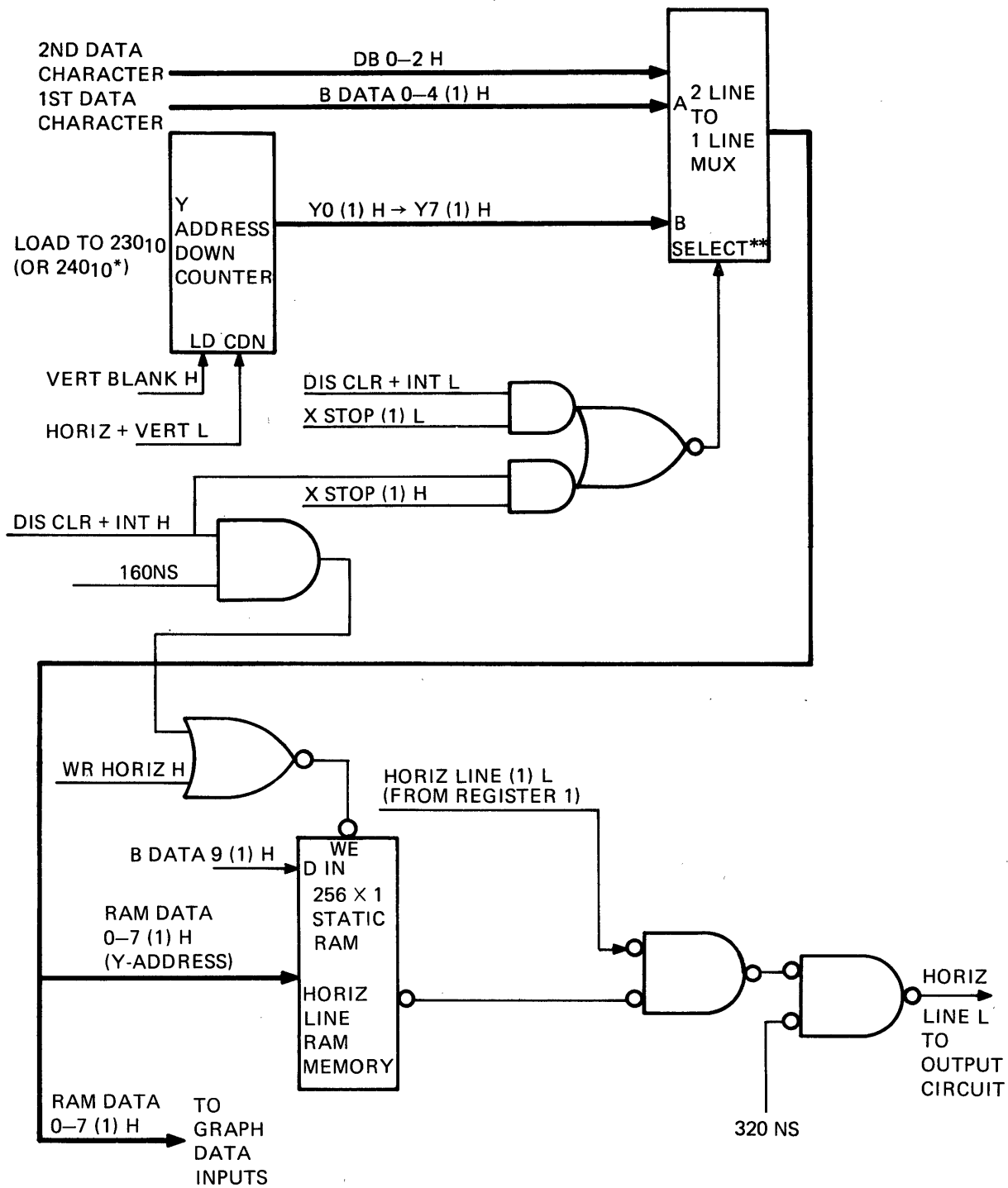
Data is loaded into the graph as usual for addresses up to 511. At address 512, an overflow occurs in the initial X-address counter. OVERFLOW (1) H clocks the strip enable flip-flop disabling the clear signal to the final X-address counter.

A 512-bit counter monitors the horizontal scan position and enables the load signal for the final X-address counter only after completing the current line. New data increments the X-address and is added to the end of the graph. This new data is then the last data to be read from memory. Previous data is read one position earlier causing a shift in the video graph to the left.



MR-1145

Figure 6-16 Graph Marker Y-Address Comparator

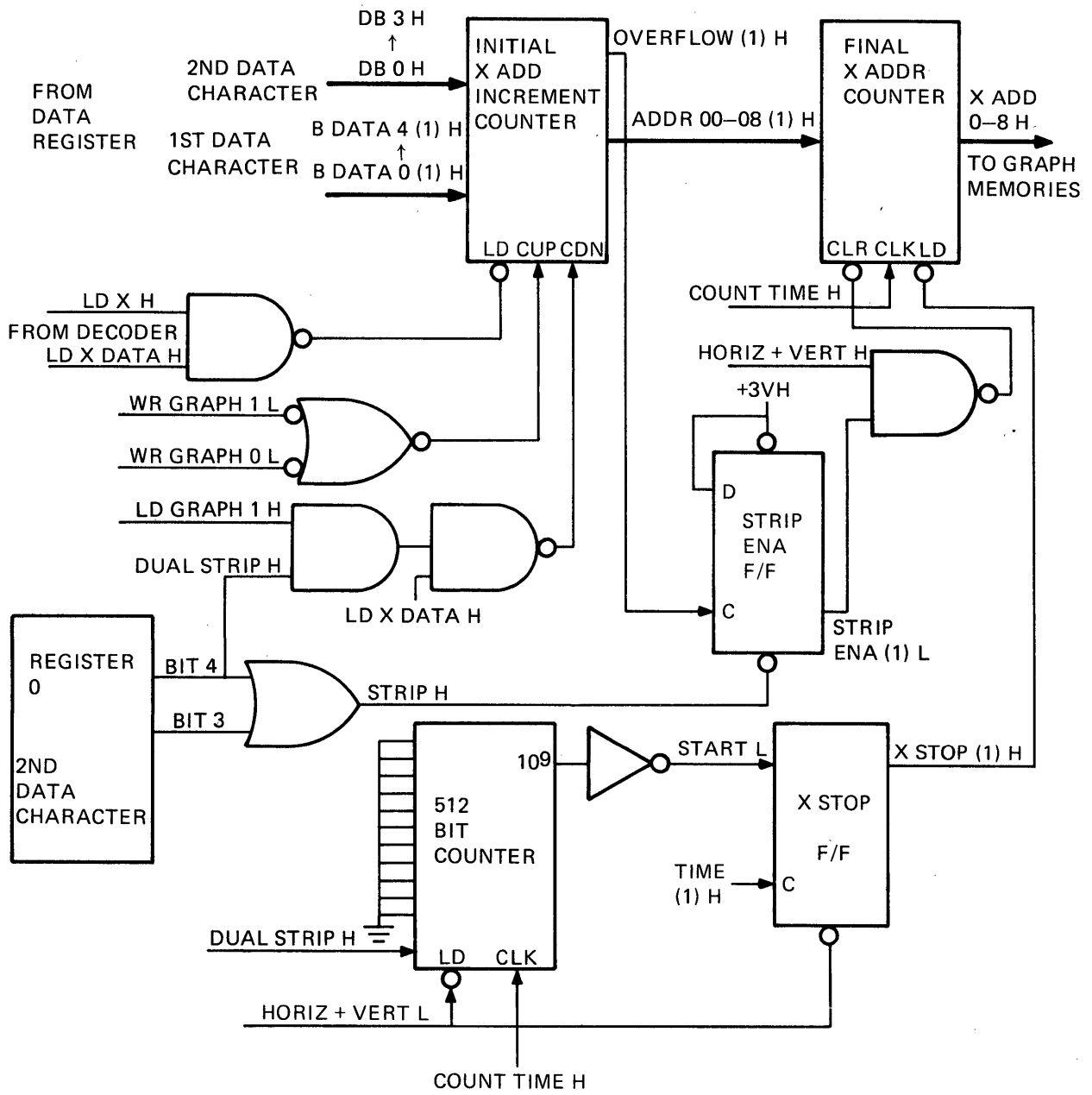


* SQUARE FORMAT

** LOW: OUTPUT = A; HIGH: OUTPUT = B

MR-1146

Figure 6-17 Horizontal Line Memory



MR-1147

Figure 6-18 Generating Strip Charts

When the strip chart is disabled, the final X-address counter is cleared at horizontal (or vertical) blank time regardless of its current count. This causes the displayed video graph to reposition itself as the counter is reset to zero.

6.14.2 Dual Strip Chart Operation

For dual strip chart operation, data bit 4 in register 0 must be set, creating the signal DUAL STRIP H. Data for both Graph 0 and Graph 1 must be placed at the same X-address and shifted simultaneously. Refer to the timing diagram (Figure 6-19) and the following sequence of events.

1. An instruction to load Graph 0 is received. WR GRAPH 0 L is placed on the count-up input to the initial X-address counter. The data is written into Graph 0. After 50 ns, WR GRAPH 0 times out, and the counter increments one address.
2. When the command to load Graph 1 is received, the Initial X-address counter counts down one address.
3. WR GRAPH 1 L is placed on the count-up input to the initial X-address counter. Data is written into Graph 1. After 50 ns, the initial X-address counter increments one address.

When the initial X-address counter is incremented, this new address is loaded into the final X-address counter at the end of the current graph line (as X STOP (1) H goes low). The last data word entered in each graph is the last X-address read.

Incrementing the initial X-address counter, by adding a new data word to each graph, causes the final X-address counter to access that data last in both memories. This causes both graphs on the screen to shift simultaneously one unit to the left for each new set of data words.

The 512-bit counter that monitors the graph drawing field is initially loaded to a "1" in dual strip chart mode. A count of 512 is reached one count time earlier, eliminating the last bit position on the graph. This removes the switching motion that would be visible on the screen while alternately plotting data on Graph 0 and Graph 1.

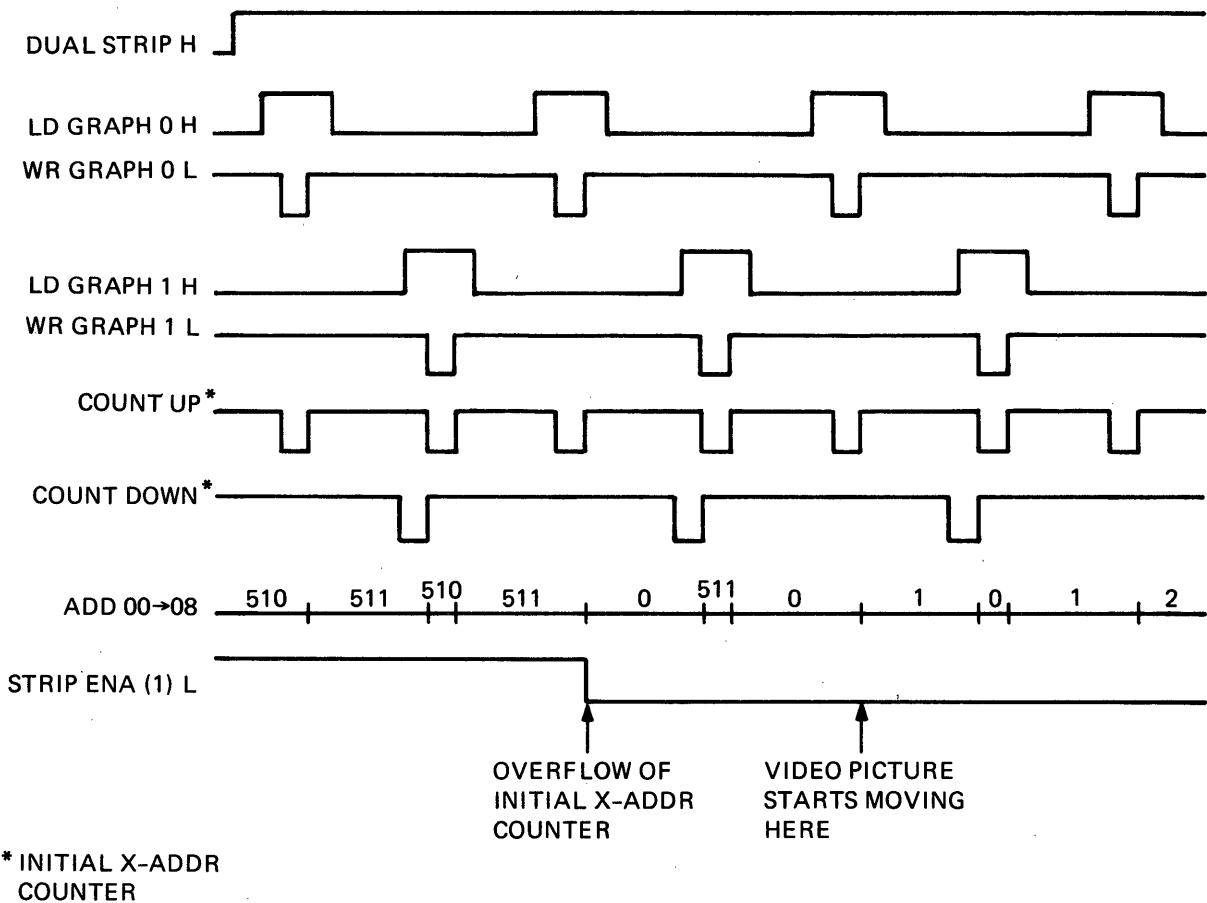
6.15 COMBINING VIDEO OUT AND TIMING

All data signals generated within the M7071 are combined to form one video output to the VT100 terminal controller. (See Figure 6-20.)

The timing signals are developed by the phase lock loop using HORIZ BLK L from the VT100 terminal controller. (See Paragraph 6.5.)

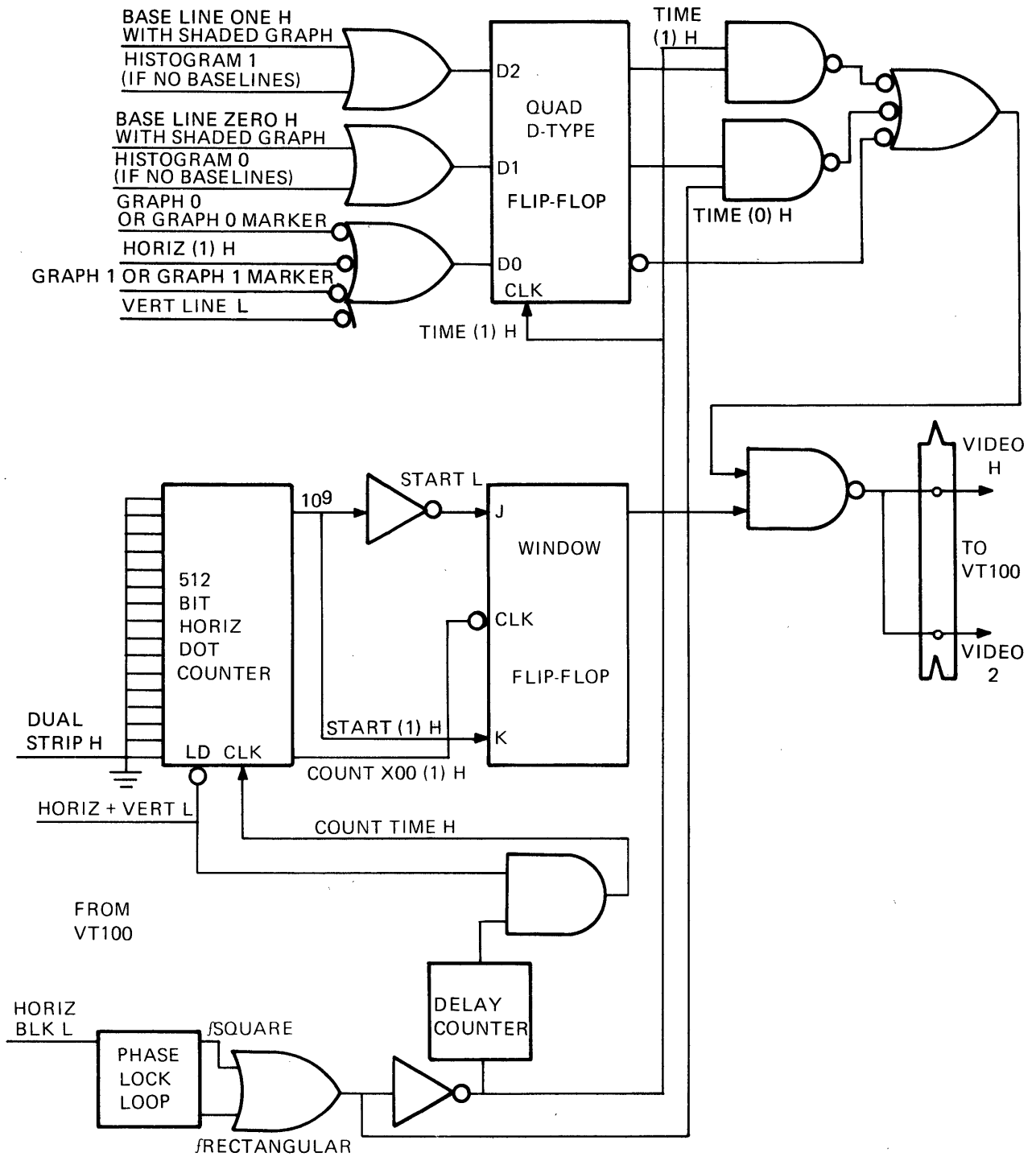
Graph 0 and Graph 1 data, horizontal lines, vertical lines, and Graph 0 and Graph 1 markers are presented to the video output every TIME (1) H. At COUNT TIME H the 512-bit horizontal counter clocks the window flip-flop to gate the data out.

Histogram 0 or Histogram 1 data is alternately enabled to the video output with TIME (0) H and TIME (1) H. This allows both shaded graphs to be discernible in areas on the screen where they overlap.



MR-1148

Figure 6-19 Dual Strip Chart Timing Diagram



MR-1149

Figure 6-20 Combining Video Out

APPENDIX A

VT105 INTERACTIVE GRAPHIC TEST PROCEDURE

A.1 INTRODUCTION

The interactive test feature of the VT105 is a series of test patterns that can be displayed by the user or Field Service engineer. One or all the patterns may be selected to be displayed; they are not dependent on each other.

The tests described in this procedure are run in the rectangular format.

NOTES

1. The tests may also be run in the square format; however, the test patterns are slightly different.
2. Do not type the SPACE BAR unless the word SPACE is spelled out.
3. Remember to use the SHIFT key for uppercase symbols; the CAPS LOCK key is only used for uppercase letters.
4. If at any time the wrong character is entered, initialize the registers and memories by typing the following sequence.

A SPACE SPACE
I 0
I SPACE “

Then reenter the test data.

A.2 SET-UP INTERACTIVE GRAPHIC TEST

Function	Type
Enter VT105 LOCAL mode.	
Set terminal to auto-repeat mode (Set-up B).	
Enter graphic mode:	ESC 1
Enable rectangular format:	I SPACE SPACE
Enable test:	I SPACE ”

A.3 TESTING PROCEDURE

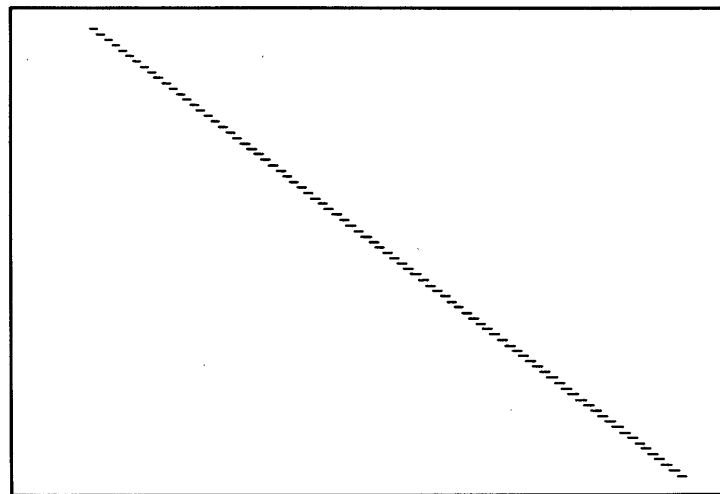
Enable the rectangular format of the interactive test.

A.3.1 Test Graph 0, Histogram 0, and Graph 0 Markers

Function	Type	Figure Reference
Enable Graph 0	A#	A-1
Enable Histogram 0	A)	A-2
Enable Graph 0 markers	I\$	A-3
Disable Graph 0 markers	I SPACE	
Disable Histogram 0 and Graph 0	A SPACE	

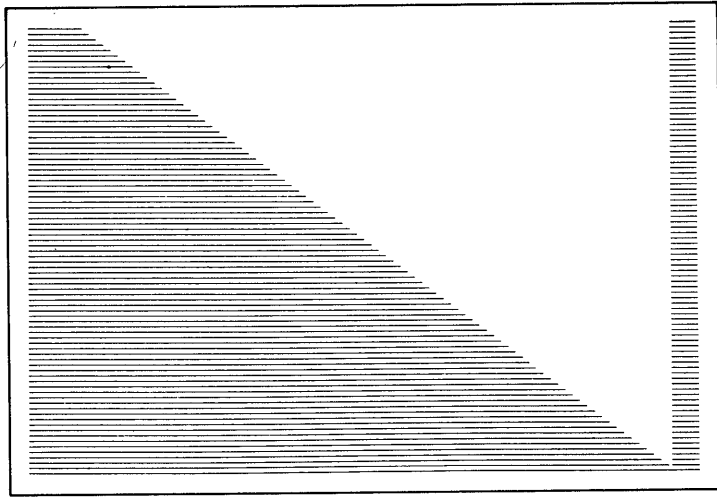
A.3.2 Test Graph 1, Histogram 1, and Graph 1 Markers

Function	Type	Figure
Enable Graph 1	A%	A-1
Enable Histogram 1	A|	A-2
Enable Graph 1 markers	I(	A-3
Disable Graph 1 markers	I SPACE	
Disable Histogram 1 and Graph 1	A SPACE	



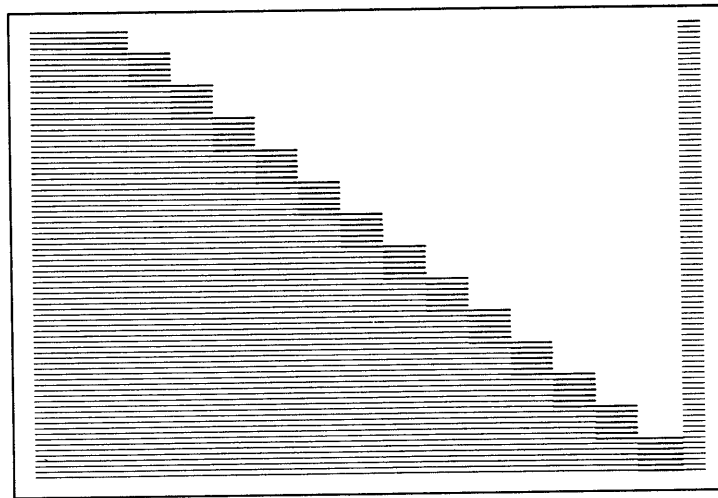
MR-3634

Figure A-1 Graph Test Pattern



MR-3535

Figure A-2 Histogram Test Pattern



MR-3536

Figure A-3 Graph Marker Test Pattern

A.3.3 Test Horizontal Lines

Function	Type	Figure
Enable display	A!	
Enable horizontal lines	I!	A-4
Disable horizontal lines	I SPACE	

A.3.4 Test Vertical Lines

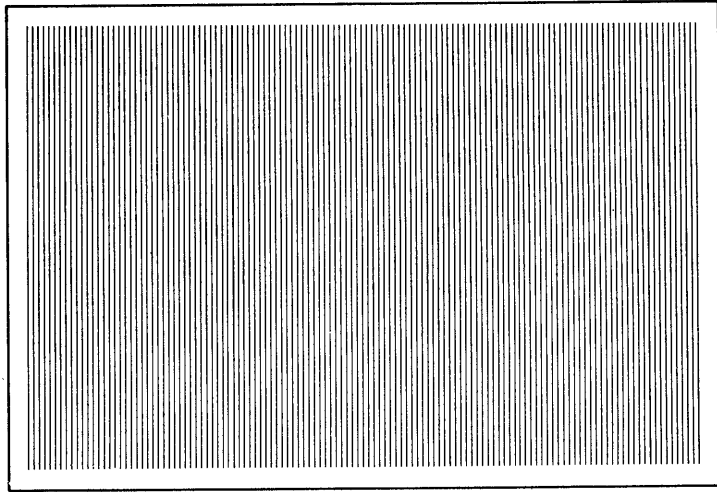
Function	Type	Figure
Enable display	A!	
Enable vertical lines	I"	A-5
Disable vertical lines	I SPACE	

A.3.5 Test Shade Line 0 (Baseline 0)

Function	Type	Figure
Enable Graph 0 and Shade Line 0	A#"	A-6
Load Shade Line:	@11	
49	22	
82	33	
115	44	
148	55	
181	66	
214	SPACE SPACE	
0		
Disable Graph 0 and Shade Line 0	A SPACE SPACE	

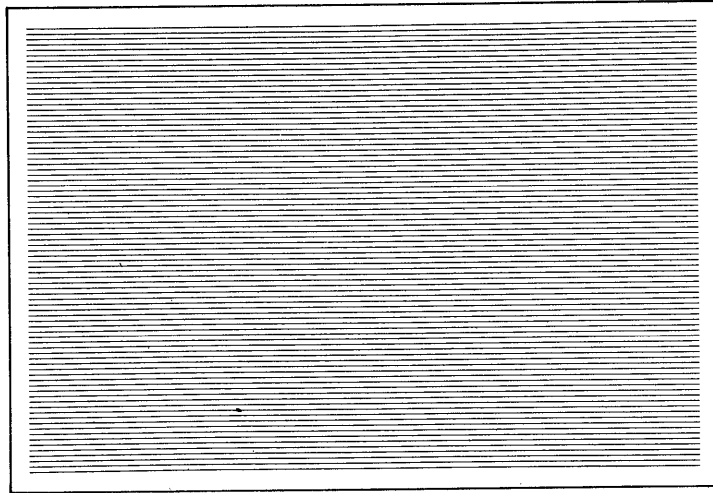
A.3.6 Test Shade Line 1 (Baseline 1)

Function	Type	Figure
Enable Graph 1 and Shade Line 1	A%%	A-6
Load shade lines	@11	
	22	
	33	
	44	
	55	
	66	
	SPACE SPACE	
Disable Graph 1 and Shade Line 1	A SPACE SPACE	



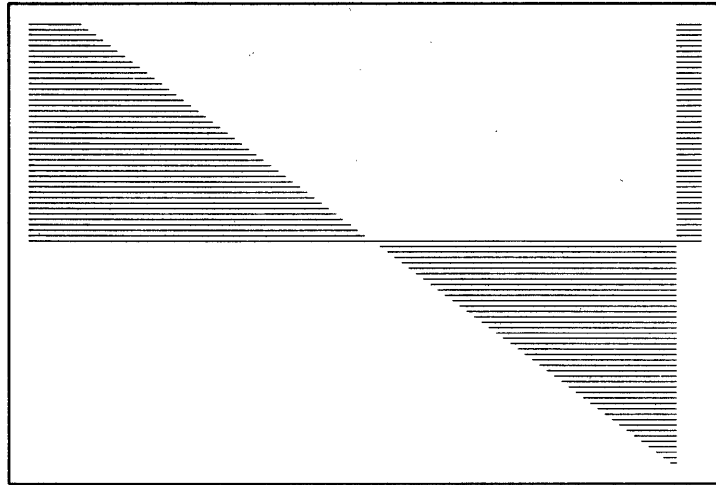
MR-3537

Figure A-4 Horizontal Line Test Pattern
(will look like vertical lines)



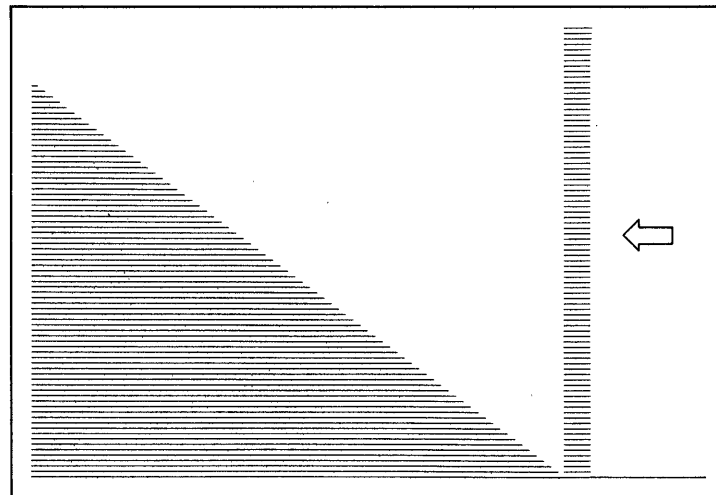
MR-3538

Figure A-5 Vertical Line Test Pattern
(will look like horizontal lines)



MR-3539

Figure A-6 Shade Line (Baseline) Test Pattern
(shade line will shift upward)



MR-3540

Figure A-7 Strip Chart Test Pattern
(Graph should shift right to left)

A.3.7 Test Strip Chart 0

Function	Type	Figure
Enable test	I SPACE"	
Enable Graph 0, Histogram 0, and Strip chart 0	A+(	A-2
Load X at right margin	H??	
Enable Load Graph 0	B	A-7

Any sequence of two numbers will cause graph to move; i.e., the SPACE BAR enters a 0 as in Figure A-7, 11 enters data at line 49, 22 enters data at line 82, etc. Hold number key down if in auto-repeat mode.

Disable Graph 0, Histogram 0 and Strip chart 0	A SPACE SPACE	
------------------------------------------------------	---------------	--

A.3.8 Test Strip Chart 1

Function	Type	Figure
Enable test	I SPACE"	
Enable Graph 1, Histogram 1 and Strip chart 1	A5(	A-2
Load X at right margin	H??	
Enable Load Graph 1	J	A-7

Any sequence of two numbers will cause graph to move.

Disable Graph 1, Histogram 1 and Strip chart 1	A SPACE SPACE	
------------------------------------------------------	---------------	--

A.3.9 Exit Graphic Test

Type the following sequences to exit the Interactive Graphic test and return the terminal to alphanumeric operation.

Function	Type
Exit test; initialize memories	I 0 SPACE
Clear Register 0	A SPACE SPACE
Clear Register 1	I SPACE SPACE
Exit graphic mode	ESC 2

APPENDIX B GLOSSARY AND NOTATION

B.1 GLOSSARY

Active Position – The character position on the visual display that is to display the next graphic character.

ANSI Mode – A mode in which the terminal recognizes and responds only to control functions in accordance with ANSI specifications.

Aspect Ratio – The width to height ratio of the image on a video picture tube.

Character – A sequence of 7 or 8 bits that represent a control or graphic entity. In serial-by-bit transmission, the character is transferred from low-order bit to high-order bit.

Character Position – That portion of a visual display which is displaying or is capable of displaying a graphic symbol.

Control – The term “control” refers to a “control function” (that includes a control character, an escape sequence, a control sequence, or control string).

Control Character – A single character whose occurrence in a particular context initiates, modifies, or stops a control function. The value of a control character is in the range of 0 through 37 and 177 octal in a 7-bit environment.

Control Function – An action that affects the recording, processing, transmission, or interpretation of data. This term refers to either a control character, an escape sequence, a control sequence, or a control string.

Control Sequence – A string of characters that begins with a control sequence introducer (CSI) and ends with the first occurrence of a final character (100 – 176 octal). A control sequence may contain zero or more parameter characters (060 – 077 octal) and/or intermediate characters (040 – 057 octal).

Control Sequence Introducer (CSI) – A prefix to a control sequence that provides supplementary control functions. The CSI for the VT105 is ESC[(033 133 octal).

Control String – A string of characters that is used to perform a control function and has an opening and closing control character. These characters are not presently used, are not printed, and are not displayed by the terminal.

Cursor – A visual representation of the active position for the next character, i.e., blinking reverse-video or blinking underline.

Cursor Control – An editor function that moves the active position of the cursor.

Default – A value that is assumed when no explicit value is specified.

Display – The active area of the screen, i.e., the area inside the scrolling region, or the entire screen, depending on the Origin mode.

Editor Function – A control that affects the layout or positioning of previously entered or received information. This information is to be interpreted and executed without remaining in the data stream. (See format effector.)

Escape Character (ESC) – A control character that provides supplementary characters (code extension).

Escape Sequence – A string of characters that begins with ESC (033 octal) and ends with the first occurrence of a final character (060 – 176 octal). An escape sequence may have zero or more intermediate characters (040 – 057) preceding the final character.

Final Character – A character whose bit combination terminates a control function. (See example below.)

1. The final character in an escape sequence is from 60₈ to 176₈ inclusive.
2. The final character in a control sequence is from 100₈ to 176₈ inclusive.

Format Effector – A control that affects the layout or positioning of information on the screen. It may remain in the data stream after processing. (See editor function.)

Graphic Character – A character, other than a control character, with a visual representation.

Graph Marker – A short vertical line programmed to mark a point on a graph.

Histogram – A graphic display that is shaded between the graph data and the bottom of the graph drawing field.

Home – The character position at the origin. See origin mode (DECOM); i.e., upper-left corner.

Interactive Graphic Device – A display that allows the user to interact directly with the system for creating, manipulating, and designing graphs using a display console or other device.

Intermediate Character – A character whose bit combination precedes a final character in an escape or control sequence. This character “I” in notation (Paragraph B.2) is from 40₈ to 57₈ inclusive.

Numeric Parameter – A string of characters that represents a number P_n. P_n has a range of 0 (60₈) to 9 (71₈).

Parameter – (1) A string of one or more characters that represent a single value; (2) The value so represented.

Parameter String – A string of characters that represent one or more parameter values.

Pixel – A single picture element in a graphic display.

Selective Parameter – A string of bit combinations from a specified list of subfunctions, designated by Ps. Each Ps character has a range of 0 to 9 (60₈ – 71₈); each character is separated by a semicolon.

Shade Line – The line referenced for shading a graph.

Strip Chart – A graph that moves previous data as new data is added.

VT52 Mode – A mode in which the terminal recognizes and responds only to control functions for VT52 (VT55) DECscope terminals.

B.2 CONTROL FUNCTION NOTATION

The abbreviations or notation used for defining the control functions for the VT105 are in accordance with ANSI standard X3.41 – 1974 and DEC STD 138 which define control function terminology.

B.2.1 Control Sequence Notation

A control sequence is defined by the notation:

ESC[IPn;Pn...PnF

where:

1. ESC[is the control sequence introducer (033 133₈) for a 7-bit character environment.
2. P is a parameter character within the range of 060 to 077₈. Zero or more parameter characters may be included in a control sequence. Parameter characters are separated by a semicolon (073₈).
 - a. Pn is numeric parameter within the range of 0 through 9 (060₈ – 071₈).
 - b. Ps is a selective parameter from a specified list.
3. I is an intermediate character within the range of 040 – 057₈. Zero or more intermediate characters may be included in a control sequence.
4. F is a final character within the range of 100 – 176₈.

B.2.2 Escape Sequence Notation

The format of an escape sequence, as defined in American National Standard X 3.41 – 1974 and used in the VT105, is:

ESC I . . . I F

where:

1. ESC is the introducer control character (33₈) that is named Escape.
2. I . . . I are the intermediate bit combinations that may or may not be present. “I” characters have a range of 40₈ to 57₈ in both 7- and 8-bit character formats.

3. F is the final character. "F" characters have a range of 60₈ to 176₈ using 7 bits; 200₈ to 237₈ using 8 bits.

NOTE

The occurrence of control characters (0₈ to 37₈) within a control or escape sequence is technically an error condition. Recovery is possible by executing the function specified by the control character and then executing the control or escape sequence. The exceptions are:

1. **If the character ESC occurs, the current control function is aborted, and the new control function commences.**
2. **If the character CAN (30₈) or the character SUB (32₈) occurs, the current control function is aborted.**

APPENDIX C GRAPH DRAWING PROGRAMMER'S CARD

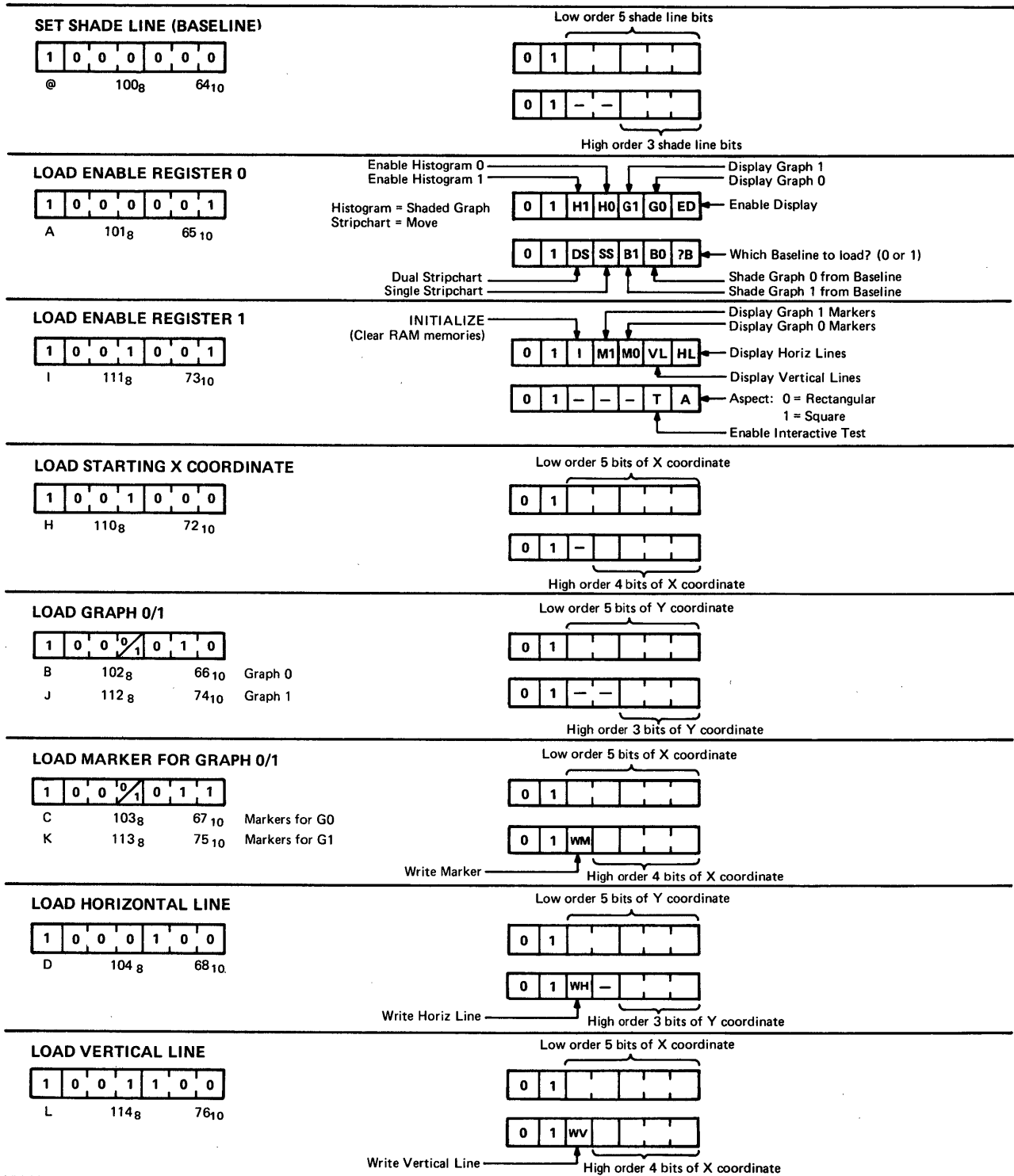


Figure C-1 Graph Drawing Programmer's Card

APPENDIX D 7-BIT ASCII CODE

Table D-1 7-Bit ASCII Code/Character Chart

Octal Code	Char	Octal Code	Char	Octal Code	Char	Octal Code	Char
000	NUL	040	SP	100	@	140	`
001	SOH	041	!	101	A	141	a
002	STX	042	“	102	B	142	b
003	ETX	043	#	103	C	143	c
004	EOT	044	\$	104	D	144	d
005	ENQ	045	%	105	E	145	e
006	ACK	046	&	106	F	146	f
007	BEL	047	,	107	G	147	g
010	BS	050	(	110	H	150	h
011	HT	051	)	111	I	151	i
012	LF	052	*	112	J	152	j
013	VT	053	+	113	K	153	k
014	FF	054	,	114	L	154	l
015	CR	055	-	115	M	155	m
016	SO	056	.	116	N	156	n
017	SI	057	/	117	O	157	o
020	DLE	060	0	120	P	160	p
021	DC1	061	1	121	Q	161	q
022	DC2	062	2	122	R	162	r
023	DC3	063	3	123	S	163	s
024	DC4	064	4	124	T	164	t
025	NAK	065	5	125	U	165	u
026	SYN	066	6	126	V	166	v
027	ETB	067	7	127	W	167	w
030	CAN	070	8	130	X	170	x
031	EM	071	9	131	Y	171	y
032	SUB	072	:	132	Z	172	z
033	ESC	073	;	133	[	173	(
034	FS	074	<	134	\	174	l
035	GS	075	=	135	]	175)
036	RS	076	>	136	^	176	~
037	US	077	?	137	_	177	DEL

APPENDIX E FILL CHARACTER REQUIREMENTS

E.1 RECEIVE SPEED VS. FILL CHARACTERS

NOTE

The VT105 always stops transmission when an XOFF code (023g is received and resumes transmission when an XON code (021g) is received regardless of the setting of the AUTO XON/XOFF feature

This appendix is only for systems with a host central processor that cannot use synchronization control codes XON and XOFF.

Fill characters are required to help keep the terminal synchronized with the host computer when the XON/XOFF control codes are not used. Table E-1 shows the fill character requirements for every receive speed at which the terminal is capable of operating. No entry in a column indicates that fill characters are not required in that specific case.

Table E-1 Fill Character Requirements

Control Function	Receive Baud Rate															
	19,200	9600	4800	3600	2400	2000	1800	1200	600	300	200	150	134.5	110	75	50
NEL, IND, LF, RI (Smooth scroll feature selected)	384	192	96	72	48	40	36	24	12	6	4	3	3	2	2	1
DECALN	243	122	61	46	30	25	23	15	8	4	3	2	2	1	1	1
DECCOLM	243	122	61	46	30	25	23	15	8	4	3	2	2	1	1	1
ED	90	45	23	17	11	9	8	6	3	1	1	1	1	1		
NEL, IND, LF, RI (Jump scroll feature selected)	60	30	15	11	7	6	6	4	2	1	1					
EL	4	2	1	1												
DECINLM	2	1	1													
ALL OTHERS except DECTST and RIS	2	1														

APPENDIX F

VT105 PHYSICAL/FUNCTIONAL BLOCK DIAGRAM

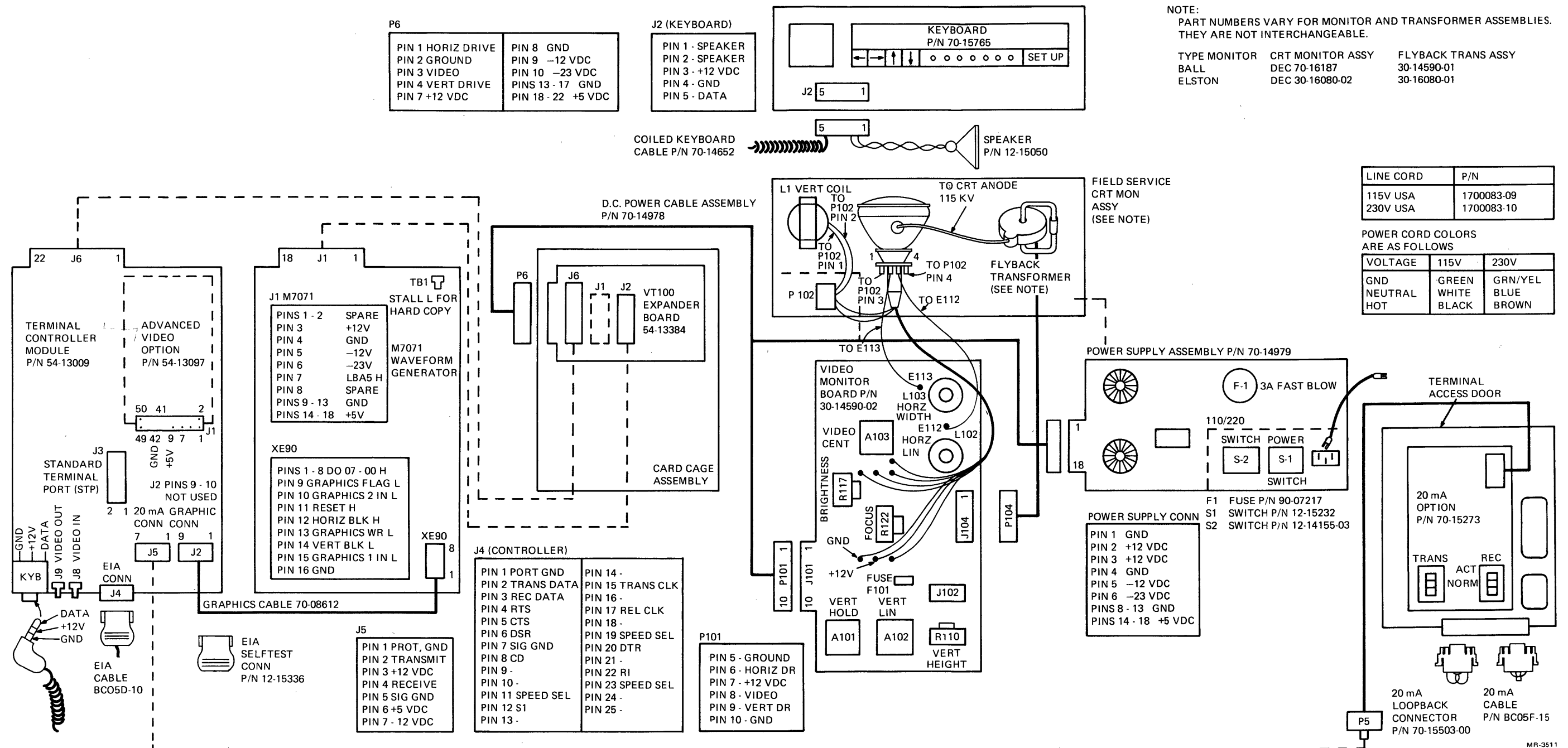


Figure F-1 VT105 Physical/Functional Block Diagram

Reader's Comments

**T105 Graphic Terminal
Technical Manual
EK-VT105-TM-001**

Our comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our publications.

What is your general reaction to this manual? In your judgment is it complete, accurate, well organized, well written, etc.? Is it easy to use? _____

What features are most useful? _____

What faults or errors have you found in the manual? _____

Does this manual satisfy the need you think it was intended to satisfy? _____

Does it satisfy *your* needs? _____ Why? _____

Please send me the current copy of the *Technical Documentation Catalog*, which contains information on the remainder of DIGITAL's technical documentation.

Name _____ Street _____

Title _____ City _____

Company _____ State/Country _____

Department _____ Zip _____

Additional copies of this document are available from:

Digital Equipment Corporation
444 Whitney Street
Northboro, MA 01532
Attention: Printing and Circulating Service (NR2/M15)
Customer Services Section

Order No. EK-VT105-TM

Fold Here

Do Not Tear -- Fold Here and Staple

digital



No Postage
Necessary
if Mailed in the
United States

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 33 MAYNARD, MA.
POSTAGE WILL BE PAID BY ADDRESSEE

**Digital Equipment Corporation
Educational Services Development and Publishing
200 Forest Street (MR1-2/T17)
Marlboro, MA 01752**

