



# VT103

LSI-11 VIDEO TERMINAL  
USER'S GUIDE

digital



# VT103 LSI-11 VIDEO TERMINAL USER'S GUIDE

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# PREFACE

The VT103 LSI-11 Video Terminal is designed to be a basic building block in an LSI-11 based microcomputer system. The VT103 combines the features of the versatile DIGITAL VT100 alphanumeric terminal with a 4 X 4 LSI-11 backplane. All the support hardware needed to build a complete LSI-11 microcomputer system within the video terminal is available. The VT103 offers complete versatility so you can configure the terminal using any of the available LSI-11 options. These options are described in the Microcomputer Handbook Series manuals.

<i>Microcomputer Processors</i>	(EB-15115-78)
<i>Memories and Peripherals</i>	(EB-15114-78)

The user can select a VT103 with a factory-installed TU58 DECtape II. This is a dual minicartridge system for inexpensive mass storage of data and/or for program loading. Each TU58 cartridge provides 256K bytes of storage for data or programs. The VT103 is available in the following models.

Model	Description
VT103-AA	Video terminal with keyboard
VT103-BA	VT103-AA with TU58 DECtape II

The VT103 has three basic support blocks.

1. Video Terminal: This consists of a video monitor, terminal controller, detachable keyboard, and monitor cabinet.
2. LSI-11 support hardware: This consists of a VT103 backplane assembly and an H7835 power supply.
3. TU58 DECtape II (optional): This is a factory-installed cartridge tape option installed below the video monitor.

Chapter 1 provides operator information; Chapter 2 provides programmer information on the terminal; Chapter 3 defines the LSI-11 support hardware; Chapter 4, the TU58 DECtape II; Chapter 5 provides information on installation and specifications of the VT103, and Chapter 6 adds installation information for user-installable options.



# CHAPTER 1

## OPERATOR INFORMATION

### 1.1 INTRODUCTION

The VT103, shown in Figure 1-1, is a video terminal that features an internal LSI-11 backplane which allows you to configure an LSI-11 microcomputer system within your terminal. The TU58 DECTape II (which can be factory-installed in the terminal cabinet) provides computer program loading or mass storage of data on cassettes. You control the terminal, the computer, and the TU58 via a detachable keyboard that operates much like a typewriter. This chapter defines the operation of the keyboard.

Chapter 1 is divided into the following sections:

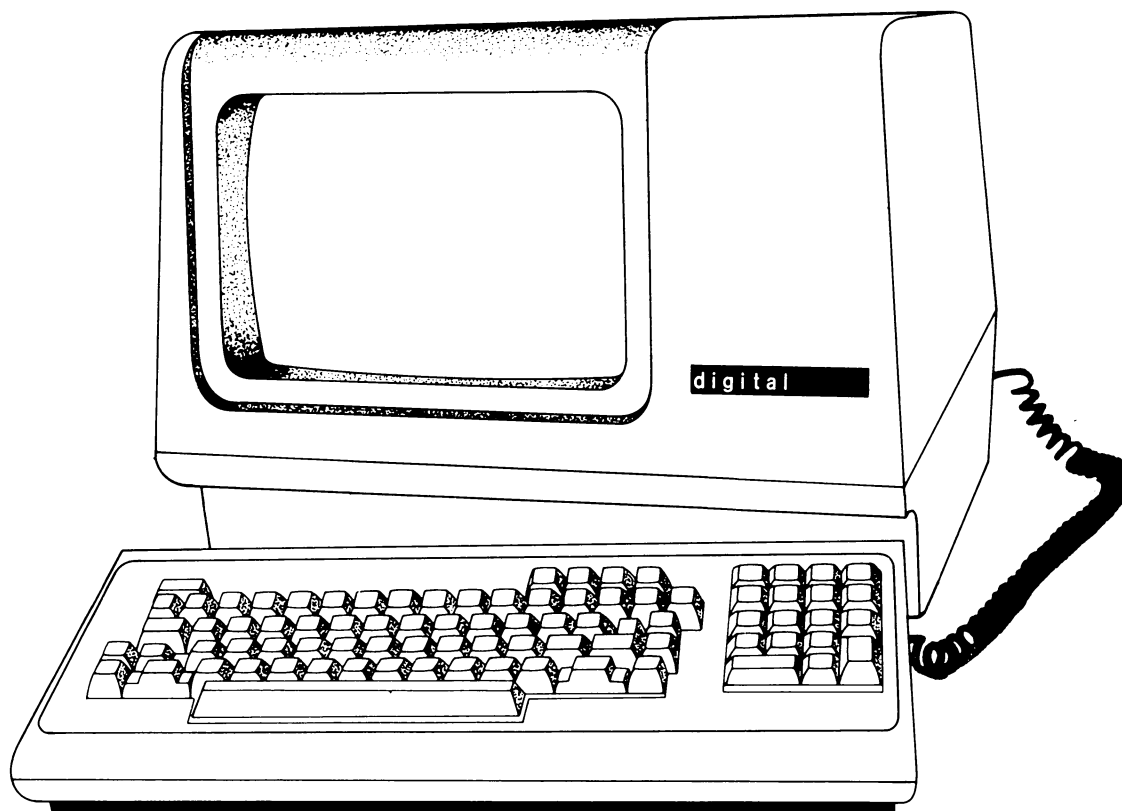
1. Introduction
2. Controls and indicators
3. Set-up mode (brief introduction to the terminal features)
4. Definitions (in detail) of each set-up feature
5. Power-up sequence (program loading)
6. Operator equipment care
7. Self-testing the VT103 terminal
8. What to do in event of a problem
9. Related hardware manuals.

### 1.2 CONTROLS AND INDICATORS

The controls and indicators of the VT103 are categorized as follows:

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

## 2 OPERATOR INFORMATION



MR-2890

Figure 1-1 VT103 LSI-11 Video Terminal

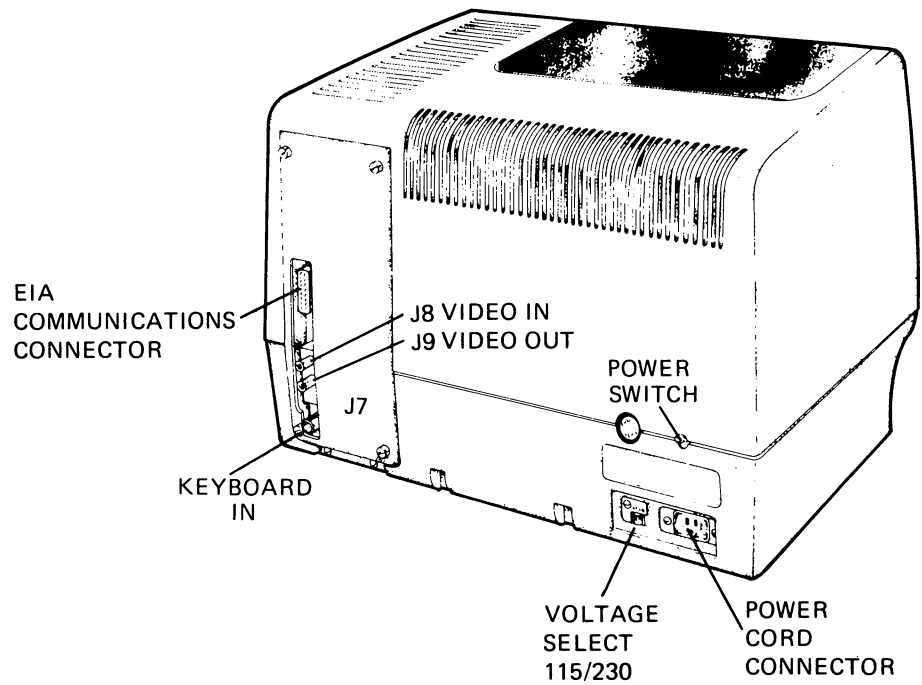
### 1.2.1 Monitor Controls

The VT103 is equipped with two monitor controls (shown in Figure 1-2) – a POWER ON/OFF switch and a POWER (voltage) 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	(typical U.S.)
230	180 – 256 Vac rms	(typical European)



MR-3519

Figure 1-2 VT103 LSI-11 Video Terminal (Rear View)

### 1.2.2 Keyboard Controls

The VT103 has a detachable keyboard equipped with two keypads. Its main keypad array is 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 function as follows:

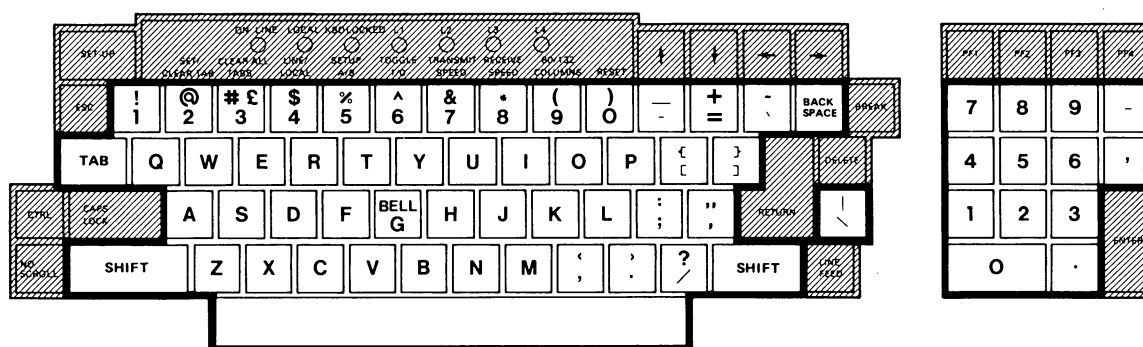
- Standard alphanumeric keys
- Special function keys
- Set-up mode keys.

The keyboard has keys that transmit codes and other keys which modify the codes transmitted. CTRL and SHIFT modify the codes transmitted by the other keys. Two code-transmitting keys, when typed together, transmit codes immediately in the order typed. If three keys are pressed, the code for the third key is transmitted when one of the first two keys is lifted.

If the auto repeat feature is selected, all keys will repeat automatically, except SET-UP, ESC, NO SCROLL, TAB, RETURN, and any key pressed with CTRL. Other keys repeat automatically when held down for more than one-half second.

## 4 OPERATOR INFORMATION

**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 entered into the internal LSI-11 microcomputer (host computer).

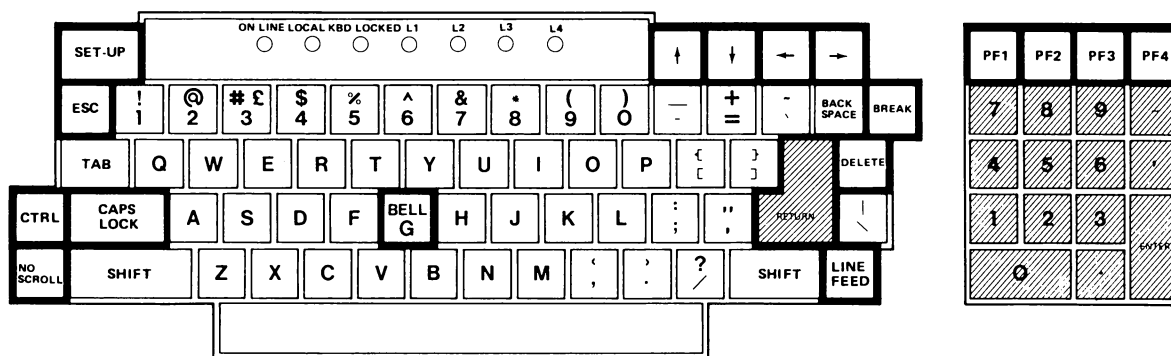


MR-3520

Figure 1-3 Standard Alphanumeric Keys

**Special Function Keys** – Figure 1-4 identifies the special function keys on the keyboard. Each of these keys provides 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.



MR-3521

Figure 1-4 Special Function Keys

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



When pressed in combination with the CTRL key, this key causes a bell code (007g) to be sent to the host computer.

**BREAK** Key

This key transmits a break signal.

**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 (177<sub>g</sub>) 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 (033<sub>g</sub>) 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 (012<sub>g</sub>).

**NO  
SCROLL** Key

When first pressed, this key stops transmission of data from the computer to the terminal. When pressed again, transmission resumes. The AUTO XON/XOFF feature controls the function of this key. Recognition of this key is dependent on the system software.

**RETURN** Key

This key transmits either a carriage return code (CR, 015<sub>g</sub>) or a carriage return (CR) and linefeed code (LF, 012<sub>g</sub>). This is a set-up selectable feature. (See Paragraph 1.3.2.)

### PF1 PF2 PF3 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 VT103 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

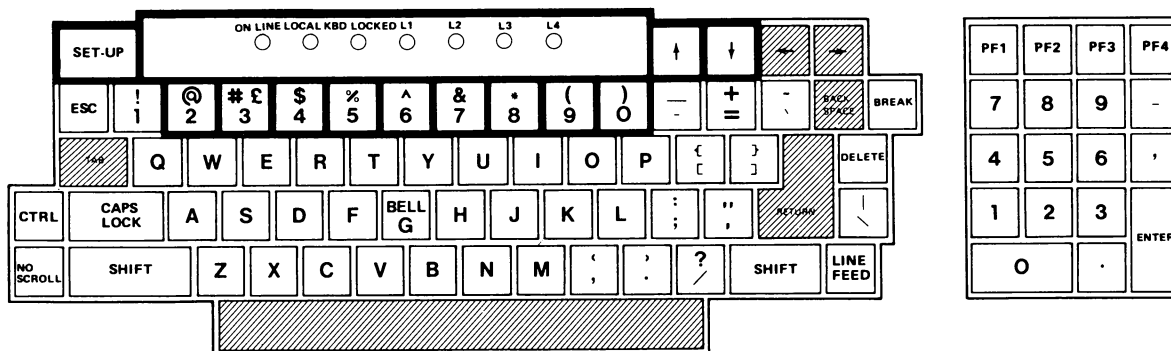
#### BRIGHTNESS – Set-up A

In set-up A, these keys increase or decrease the brightness of the video characters:  
↑ = increase; ↓ = decrease.

### @ 2 Key

#### SET/CLEAR TAB – Set-up A

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



MR-3522

Figure 1-5 Set-Up Mode Keys





Key

#### **CLEAR ALL TABS – Set-up A**

This key clears all horizontal tabs.



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.



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.



Key

#### **TOGGLE – Set-up B**

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



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. If the standard terminal port (STP) module is installed, setting the transmit speed establishes a common transmit and receive speed for a second serial line interface.



Key

#### **RECEIVE SPEED – Set-up B**

This key steps the terminal through the available receive baud rates of the terminal. If the STP module is installed, this selection is disabled; the receive speed follows the transmit speed selection.



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 screen in set-up A mode is 80 or 132.



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 in the paragraphs that follow.

**ON LINE Indicator**

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

**LOCAL Indicator**

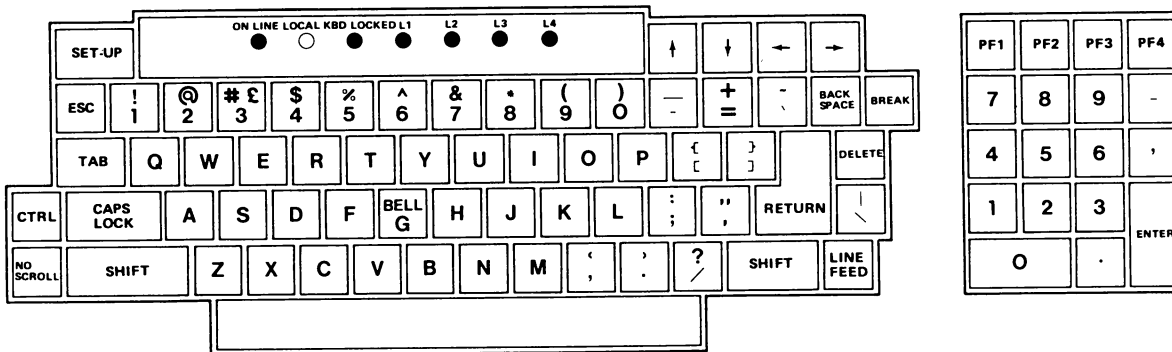
This indicator lights to show that the terminal is off-line and cannot communicate with the host device. In local mode, the keyboard remains active and all characters typed are placed on the screen.

**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. You can clear this condition by entering and exiting set-up mode.



MR-3523

Figure 1-6 Keyboard Indicators

## 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 VT103: a short tone (click), a long tone (bell), and a series of long tones.

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

- The SHIFT or CTRL keys do not generate any keyclick.
- The KBD LOCKED indicator is turned on; in which case, the characters typed are lost.
- 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.

- A bell code is received by the terminal.
- 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 VT103 has many selectable built-in features. These features provide compatibility with an LSI-11 computer within the VT103 (or another host computer), adapt the terminal to local power, or alter the terminal's operation for your comfort and efficiency.

The VT103 does not use switches, dials, or knobs 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.

- Set-up A – displays the location of the tab stops along a visual ruler numbering each character position on the line.
- 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, you verify the settings of the features in the installation category.

Features that affect computer compatibility must be set 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.













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		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	
<div style="border: 1px solid black; padding: 2px; display: inline-block;"># 3</div> (shifted)		X	

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 summarizes the set-up features, the set-up mode you must be in to change a given feature, and the key that changes 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	
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	X	
MARGIN BELL		X	
NEW LINE		X	
PARITY		X	

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

## 12 OPERATOR INFORMATION

**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 SENSE		X	
POWER		X	
RECEIVE SPEED		X	
SCREEN BACKGROUND		X	
SCREEN BRIGHTNESS	X	X	 or 
SCROLL		X	
TABS	X		 and 
TRANSMIT SPEED		X	
WRAPAROUND		X	
 (shifted)		X	

### 1.3.3 Set-Up A

To enter set-up A, press the SET-UP key. The display is similar to the one shown in 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.

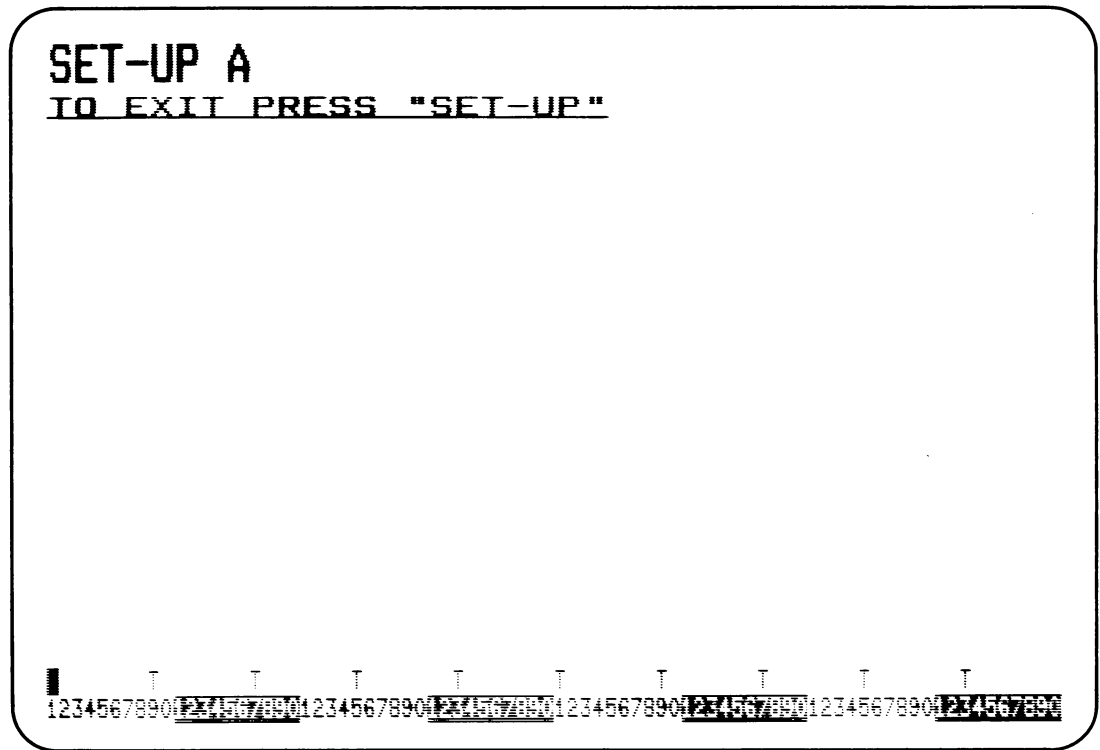
Press the 2 key on the main keyboard. A T is displayed in the desired tab stop location.

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

**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.



MR-1517

Figure 1-7 Set-Up A Mode Presentation

**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 longer in 132 character mode; however, the characters are more compressed.

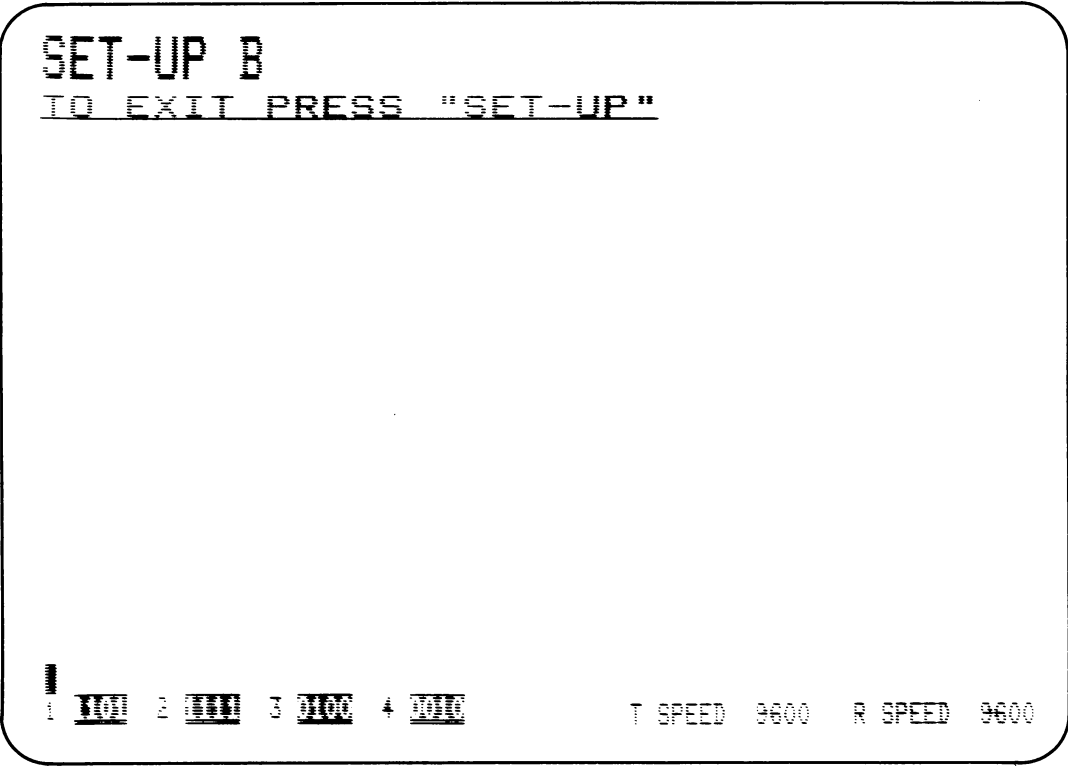
**NOTE**

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

**1.3.4 Set-Up B (Operational Features)**

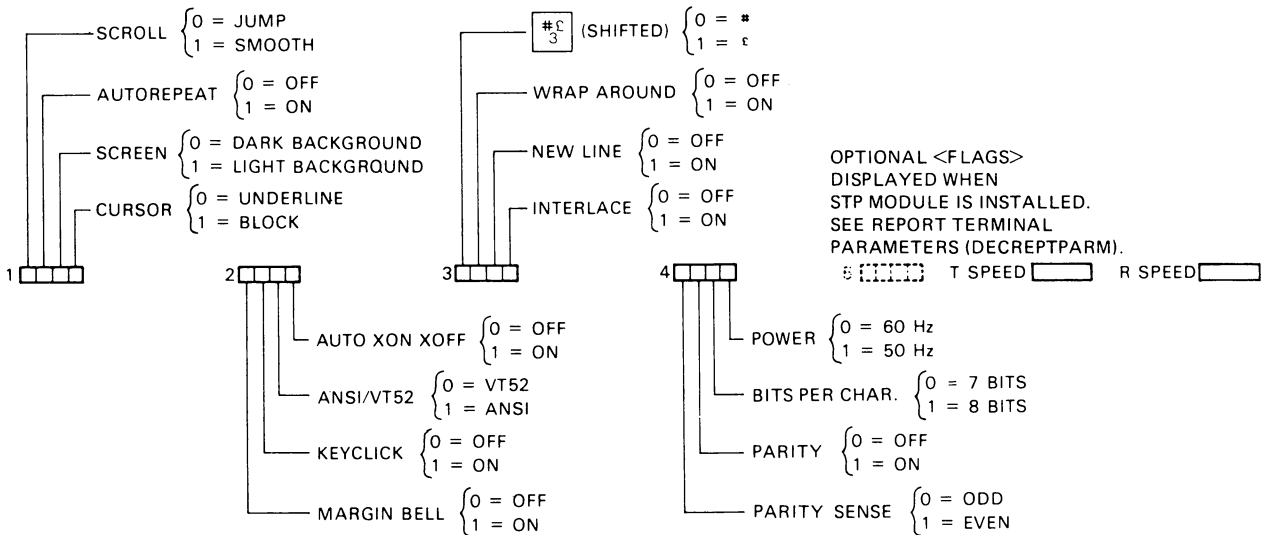
Set-up B mode is entered from set-up A mode. When in set-up A, press the 5 key on the main keyboard. The display is similar to the one shown in Figure 1-8. Figure 1-9 summarizes the set-up B presentation. This summary shows the operational features enabled. For additional information on a feature, refer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



MR-3524

Figure 1-8 Set-Up B Mode Presentation



MR-3414

Figure 1-9 Set-Up B Mode Summary



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

For example, if a graphics module is installed in the VT103, the following features are recommended.

Interlace disabled  
 AUTO XON/XOFF enabled  
 Smooth Scroll enabled  
 ANSI Mode enabled

**Changing the Transmit Speed** – While in set-up B, press the 7 key to cycle through the available transmit baud rates. Stop when the desired "T SPEED" is displayed on the screen. When the STP module is installed, setting the transmit speed also sets the receive speed on the second asynchronous serial interface. You establish a common transmit and receive speed for the terminal.

#### NOTE

**The terminal speed must match the host computer  
 (no STP Card) or modem (STP card installed).**

**Changing the Receive Speed** – While in set-up B, press the 8 key to cycle through the available receive baud rates. When the STP module is installed, the receive speed follows the transmit speed setting for the second asynchronous serial interface.

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 for this; 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 have 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. The screen clears and, after a brief wait, the terminal returns to set-up A mode.

### 1.3.8 Resetting the Terminal

The VT103 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. To reset the terminal, do the following.

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 state 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 VT103 terminal follows one of two programming standards – American National Standards Institute (ANSI) or DIGITAL VT52. In ANSI mode, the VT103 generates and responds to control functions per ANSI standards X3.41-1974 and X3.64-1977. In VT52 mode, the terminal responds to most control functions used by the VT52 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 VT103 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 occurs.

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 one of the following events occurs.

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 VT103 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.**

**When the STP module is installed, AUTO XON/XOFF support is enabled.**

#### **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. When the STP module is installed, use eight data bits.

#### **CHARACTERS PER LINE – (Set-up A)**

The VT103 can display either 80 or 132 characters per line. In the 80-character per line mode, the screen is 80 characters wide by 24 lines high.

In the 132-character per line mode, the screen is 132 characters wide by 14 lines high (24 lines if the VT103 is equipped with the advanced video option). In the 132-character per line mode, the displayed lines are physically the same width as in the 80-character per line mode, but the characters are more compact.

#### **NOTES**

1. **When changing from 80- to 132-character per line mode or vice versa, the current contents of the screen are lost.**
2. **The use of double-width characters reduces the number of characters per line by half.**

#### **CURSOR – (Set-up B)**

The VT103 offers a choice of two cursor displays to indicate the "active position" 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 (Paragraph 2.4.1).

#### **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 VT103, 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. When the STP module is installed, no parity is used.

**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 U.S., 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 VT103 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, and 19,200 baud.

When the STP module is installed, the receive speed follows the transmit speed selection for a second asynchronous serial line interface.

**RESET – (Set-up A or B)**

The reset feature initializes the system, clears any 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 VT103 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 VT103 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)**

The VT103 has the following transmit speeds: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, and 19,200 baud.

When the STP module is installed, setting the transmit speed also sets the receive speed for a second asynchronous serial line interface.

### **WRAPAROUND - (Set-up B)**

When the wraparound feature is enabled, characters entered in excess of 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 VT103 contains character sets for the U.S. 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.

#### **NOTE**

Ensure that the installation of the VT103 is complete before powering up the system. Refer to Chapter 5 for installation information.

## **1.5 POWER-UP SEQUENCE**

VT103 terminals are equipped with permanently resident terminal self-test programs. These programs verify the proper operation of the VT103 terminal and are run whenever the power-up sequence is initiated. This sequence is initiated by one of the following procedures.

- The terminal's ac power switch is turned on.
- The terminal is placed in set-up A mode, and the reset feature is selected (by pressing the reset key, 0 on the main keyboard).
- The terminal receives a reset control sequence from the processor module.

### **Self-Test Programs**

The self-test programs are designed to verify proper operation of the terminal hardware and may be used to isolate equipment malfunctions. If the test is successful, the cursor returns to its home (upper-left) position and LEDs L1–L4 are off.

Upon finding an error, the terminal attempts to display an error message on either the keyboard indicators or on the video screen.

### 1.6 OPERATOR EQUIPMENT CARE

The basic VT103 terminal (without tape unit) requires no periodic preventive maintenance. It may be desirable to occasionally clean the external surfaces of the cabinet with a damp cloth to maintain a suitable appearance. Avoid excessive amounts of water that may get inside the cabinet and damage the electronic components.

#### **CAUTION**

**Do not allow liquids to get inside the cabinet.**

**Do not block the openings on top of the cabinet.**

**Do not use cleaners with solvents.**

To clean the keys, rub with a dry or barely moist soft cloth. Do not remove the keycaps to clean them; damage may result to the key switch contacts if the keycaps are replaced incorrectly.

The VT103 terminal with TU58 DECTape II requires periodic cleaning of the tape drive components. The tape head and drive capstan require cleaning (usually once a week) to minimize tape cartridge and drive wear and to eliminate read/write errors due to oxide buildup. Refer to Chapter 4 for TU58 information.

### 1.7 SELF-TESTING THE VT103

A self-test program is built into the VT103 to test, automatically or on command, the condition of the video terminal. The self-test program checks the following items.

- Advanced video memory (if installed)
- Nonvolatile Memory (NVR)
- 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 cursor returns to its home (upper-left) position and 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 stop all operations immediately. 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. 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 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 Chapter 2 for programming 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. Paragraph 1.8 discusses how to locate the error source.

**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

### 1.8 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.

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
Terminal does not turn on when the power switch is on. No LINE/LOCAL light, no cursor.	<p>The ac 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>
No keyboard response; cursor is present, but no indicators are on.	Keyboard cable is not plugged into the monitor. Plug in keyboard cable.
No keyboard response and KBD LOCKED indicator is on.	<p>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 1.8.</p>
Garbled or error characters (⌘)	<p>Incorrect set-up feature selection. Check the set-up features. Features that may be in error are:</p> <p>ANSI/VT52 mode            AUTO XON/XOFF            Bits per character            Parity            Parity sense            Transmit speed</p> <p>Without the STP module, check both the transmit and receive baud rates. If the STP module has been removed, check to ensure contact is made with all the pins of the STP connector. Perform the self-test operation and note any error indications.</p>
Last character is garbled	Wraparound feature may be disabled: To correct, re-enable.
Double line feeds occur	New line feature may be enabled with the computer already performing this function. Disable the new line feature (set-up B).

**Table 1-4 Problem Checklist (Cont)**

Symptom	Possible Cause and Corrective Action
Losing data in graph mode (if graphic option is installed)	<p>Check the following features:</p> <p>AUTO XON/XOFF should be enabled</p> <p>INTERLACE should be disabled</p> <p>ANSI/VT52 mode may be erroneously selected for software being used</p>
Several successive 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>
System has difficulty loading the application program (if TU58 option is installed).	<p>Incorrectly formatted tape; wrong tape used; oxide build-up on tape head or drive capstan; old or worn tape; wrong tape drive specified.</p> <p>Check the cable from the TU58 to ensure it is right side up and secure in its connector.</p> <p>Verify tape using read with increased threshold.</p>
Losing Data	<p>AUTO XON/XOFF should be enabled at high baud rates. To determine if the CPU accepts XOFF:</p> <ol style="list-style-type: none"> <li>1. Print a listing on the terminal</li> <li>2. During the listing, press: CTRL S. The listing should stop.</li> <li>3. Press: CTRL Q</li> </ol> <p>The listing should resume.</p>

**1.9 RELATED HARDWARE MANUALS AND TAPE SUPPLIES**

The following hardware manuals are related to the VT103 and may be purchased from Digital Equipment Corporation.

<b>Title</b>	<b>Part Number</b>	<b>Notes</b>
Microcomputer Handbook Series:		
Microcomputer Processors	EB-15115-78	Hardcopy
Memories and Peripherals	EB-15114-78	Hardcopy
VT100 Series Technical Manual	EK-VT100-TM	Microfiche
VT100 Series Pocket Service Guide	EK-VT100-J1	Hardcopy
VT103 Illustrated Parts Breakdown	EK-VT103-IP	Available in hardcopy or microfiche
VT100 Illustrated Parts Breakdown	EK-VT100-IP	
VT100 Print Set (base terminal)	MP-00663	Hardcopy
VT103 Print Set (supplement)	MP-00731	Hardcopy
TU58 DECtape II User's Guide	EK-OTU58-UG	Hardcopy

**Tape Supplies**

The following tape supplies are available from DIGITAL.

<b>Description</b>	<b>Part Number</b>
Minitape Cartridges (formatted)	TU58-K
Cleaning Kit for Tape Drive	TUC01

**Ordering Information**

Purchase orders, correspondence, and invoicing inquiries concerning DIGITAL hardware manuals and tape supplies should be forwarded to:

Digital Equipment Corporation  
Supplies and Accessories Group  
Cotton Road  
Nashua, N.H. 03060

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 pre-paid 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.

For information concerning microfiche libraries, contact:

Digital Equipment Corporation  
Micropublishing Group 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

EIA standards RS-170, RS-232-C, RS-422, and RS-423 may be obtained by writing to:

Electronic Industry Association  
EIA Engineering Department  
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# CHAPTER 2

## PROGRAMMER INFORMATION

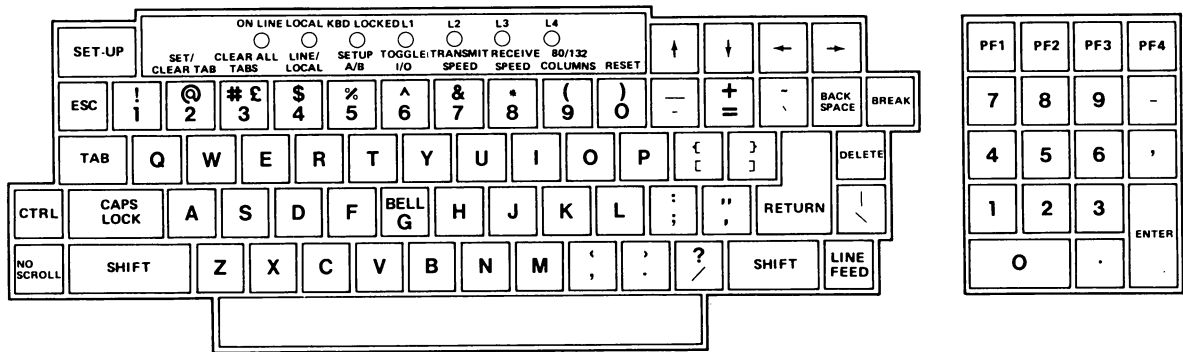
### 2.1 INTRODUCTION

The first block of the VT103 to be defined is the terminal, consisting of the video monitor and the keyboard. The VT103 terminal 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; data coming from the computer is displayed on the video screen.

This chapter discusses communication between the VT103 and the internal LSI-11 microcomputer (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 VT103 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.



MR-2577

Figure 2-1 VT103 Keyboard

### 2.2.1 LED Indicators

The keyboard has seven light-emitting diodes (LEDs), two of which 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, DECLL Load 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.)

**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
<b># 3</b> (shifted)	Yes	(SCS)	Yes



### 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 VT103 prints either uppercase or lowercase alphabetic characters. The codes required to print these are listed in Table 2-2. The VT103 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

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

### 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.

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.

### 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  $\pm 10$  percent. If either SHIFT key is down, the time is increased to 3.5 seconds  $\pm 10$  percent and data terminal ready (DTR) 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.

The CTRL and BREAK keys typed together cause the transmission of the answer-back 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. The code transmitted by the other keys if the CTRL key is held down 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

Table 2-5 Control Codes Generated (Cont)

Key Pressed with CTRL Key Down (Shifted or Unshifted)	Octal Code Transmitted	Function Mnemonic
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 is sent once, immediately. If the key is held down for more than one-half second, the code is 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 137<sub>8</sub> through 176<sub>8</sub> are replaced with characters shown in Table 2-7. See the SCS control function (Paragraph 2.4.1) to enable this mode.

**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)

**Notes**

- Codes 152g–156g, 161g, and 164g–170g are used to draw rectangular grids; each piece of this line drawing set is contiguous with others so that the lines formed are unbroken.
- Codes 157g–163g 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.

**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 or ANSI mode and keypad numeric or 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 2-8 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

**Table 2-9 ANSI Mode Auxiliary Keypad Codes (Cont)**

Key	Keypad Numeric Mode	Keypad Application Mode
,	,	ESC O I
.	.	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 VT103 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.

#### Control Characters

Control characters have values of 000<sub>8</sub> – 037<sub>8</sub>, and 177<sub>8</sub>. The control characters recognized by the VT103 are shown in Table 2-10. All other control codes cause no action to be taken.

**Table 2-10 Control Characters Received**

Control Character	Octal Code	Action Taken
NUL	000	Ignored on input (not stored in input buffer).
INIT	004	To TU58, not console – Initialize tape (if present).
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, Paragraph 1.4.)
VP	013	Interpreted as LF.
FF	014	Interpreted as LF.
CR	015	Move cursor to left margin on the current line.
SO	016	Select G1 character set, as designated by SCS.
SI	017	Select GO character set, as designated by SCS escape sequence.

Table 2-10 Control Characters Received (Cont)

Control Character	Octal Code	Action Taken
XON	021	Resume transmission to terminal.
XOFF	023	Stop transmitting to terminal all codes except XOFF and XON.  The TU58 uses XOFF and CONTINUE to control data transmission.
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).

Control characters (codes 0 to 37<sub>8</sub> 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<sub>8</sub>) occurs, the current control function stops and a new one begins.
2. If the character CAN (030<sub>8</sub>) or the character SUB (032<sub>8</sub>) occurs, the current control function stops.

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 VT103 is compatible with both the previous DIGITAL standard and the ANSI standards. Throughout this section of the manual references are made to "VT52 mode" or "ANSI mode." These two terms are used to indicate control functions used in the software. All new software should be designed with ANSI control functions. Future DIGITAL video terminals may not respond to VT52 control functions.

### 2.4.1 ANSI Mode Control Functions

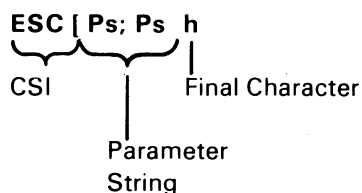
The following listing briefly defines the basic elements of the ANSI control functions. A more complete listing appears in Appendix B.

- Control Sequence Introducer (CSI) – A prefix to a control sequence. In the VT103, **ESC [** is the CSI.
- Parameter – (1) A string of 0 or more characters that represents a single value. Leading 0s are ignored. The characters have a range of 60<sub>8</sub> to 77<sub>8</sub>. (2) The value so represented.



- **Numeric parameter** – A parameter that represents a number, designated by **Pn**.
- **Selective parameter** – A parameter that selects a subfunction from a specified list, designated by **Ps**.
- **Parameter string** – A string of parameters each separated by a semicolon (73g).
- **Default value** – A value that is assumed when no explicit value, or a value of 0, is specified.
- **Final character** – A character that terminates a control sequence or escape sequence.

Example:



A control function is either a single character or a string of characters that affects the recording, processing, transmission, or representation of data. Control functions in the VT103 are classified in three ways, as follows.

1. **Control character** – A control character is a single character that initiates, modifies, or stops a control function. A control character may range from 0 to 37<sub>8</sub> and 177<sub>8</sub>.
2. **Escape sequence** – An escape sequence is a string of characters that begins with **ESC** (033<sub>8</sub>), has zero or more intermediate characters, and ends with the first occurrence of a final character.

Example: ESC # 6

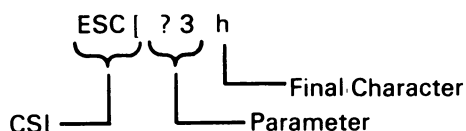
Escape Sequence Character	Octal Value
Escape	033
Intermediate character	040 to 057
Final character	060 to 176

Escape sequence for double-width line (DEC DWL).

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

3. **Control sequence** – A control sequence is a string of characters that begins with a control sequence introducer **ESC [** and ends with the first occurrence of a final character. A control sequence may have one or more intermediate characters, and it may have zero or more parameters. More than one parameter value is separated by a semicolon (073<sub>8</sub>).

Example:



Control Sequence Character	Octal Value
Control sequence introducer	033 133
Intermediate character	040 to 057
Parameter	060 to 077
Final character	100 to 176

Control sequence to set 132 column mode.

Control Sequence	Octal Representation of Same Sequence
ESC[?3h	033 133 077 063 150

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

In this section, control functions designated with 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 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 one-half 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 Off\***

**ESC 2**

Turn off graphics.

**DECGON Graphics On\***

**ESC 1**

Turn on graphics. All subsequent characters are interpreted as commands or data to a graphics module (if present). The terminal remains in this mode until the graphics off command (ESC 2) is received. This command is ignored if the module 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 hard-copy 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.

**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 [ Ps 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 presented in Table 2-11.

Table 2-11 Terminal Report Parameters

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>		Bits per second
<rspeed>	0	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.



**DECREQTPARM Request Terminal Parameters\*****ESC [ <sol> x**

The DECREPTPARM 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. DECREPTPARM 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 given in Table 2-11.

**DECSC Save Cursor\*****ESC 7**

This escape sequence causes the cursor position, graphic rendition, and character set to be saved. (See 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 value: (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 key-board, 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 status (using a DSR control sequence).
6	Command from host – Report active position (using a 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 VT103 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 (if installed).

**RM Reset Mode**

**ESC [ Ps ;Ps ; . . . ; Ps I** *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.] The last character of the sequence is a lowercase L.

**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 S1 and S0 (shift in and shift out) respectively.

<b>G0 Sets Sequence</b>	<b>G1 Sets Sequence</b>	<b>Meaning</b>
ESC(A	ESC)A	United Kingdom set
ESC(B	ESC)B	USASCII set
ESC(O	ESC)O	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 USASCII 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 137<sub>8</sub> to 176<sub>8</sub> 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 following characters transmitted to the video screen react according to the parameter(s) selected until the next occurrence of SGR. *Format Effector*

<b>Parameter</b>	<b>Parameter Meaning</b>
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 in Chapter 1, Paragraph 1.4.)

**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	LNLM	Line feed/new line mode

**2.4.2.2 DIGITAL Private Modes** – If the first character in the parameter string is ? (77g), the parameters, shown in Table 2-12, are interpreted as DIGITAL private parameters. Any other parameter values are ignored.

**Table 2-12 DIGITAL Private Modes**

Parameter	Mode Mnemonic	Mode Function	Reset	Set
0	–	Error (ignored)		
1	DECKM	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	DESCNM	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

**2.4.2.3 Other ANSI Mode States** – The modes, shown in Table 2-13, are specified in the ANSI X3.64-1977 standard and may be considered to be permanently set, permanently reset, or not applicable. Refer to that standard for further information concerning these modes.

**Table 2-13 Other ANSI Modes**

Mode Mnemonic	Mode Function	State
CRM	Control representation	Reset
EBM	Editing boundary	Reset
ERM	Erasure	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 VT103 ANSI control functions. The ANSI mode must be enabled to use the control functions outlined in the following paragraphs. Recognition of the control function is dependent on system software and in some cases the presence of terminal options. The following definitions apply.

- Pn refers to a parameter in the range of 060<sub>8</sub> to 071<sub>8</sub>.
- Ps refers to a selective parameter from a specified list. Ps has a range of 0 (060<sub>8</sub>) to 9 (071<sub>8</sub>).
- Multiple parameters are separated by a semicolon (073<sub>8</sub>).
- 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 semi-colon (073<sub>g</sub>). 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
U.S. (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 or 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 parameter value = 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
Graphics option	On	ESC 1	Off	ESC 2
Keypad mode	Application	ESC =	Numeric	ESC >

**Programmable LEDs**

ESC [ Ps;Ps;...Ps q

P<sub>s</sub> parameters are selected from the list that follows. Separate parameters with a semicolon (073g).

Parameter (P <sub>s</sub> )	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.

---

\*The last character of the sequence is a lowercase L.

## 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*)

### 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	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 <i>or</i> 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 2-14 provides a brief summary of the valid VT52 control functions.

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

**Graphics ON****ESC 1**

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

**Graphics OFF****ESC 2**

Turn off graphics.

**Table 2-14 VT52 Mode Control Functions**

<b>Control Function/Action</b>	<b>Escape Sequence</b>
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 >
Graphics option ON	ESC 1 (see note 3)
Graphics option 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 37<sub>8</sub>. Line and column numbers start at 1.
2. Response to ESC Z is ESC / Z.
3. Ignored if graphics option is not installed.

**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 VT103 are the same as those of the VT100, but they differ 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 037<sub>8</sub>. For example, 040<sub>8</sub> refers to the first line or column, 050<sub>8</sub> 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 023<sub>8</sub> (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 021<sub>8</sub> (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 buffer overflow condition occurs. To determine if the buffer will overflow, use the following formulas.

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

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

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:

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

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

#### NOTE

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

Example 2:

The VT103 is transmitting 7-bit characters (with parity) at 300 baud and is receiving at 1200 baud. The terminal sends an XOFF.

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

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

#### NOTE

**The host must respond within 0.1666 second to avoid a buffer overflow. If the buffer overflows, the VT103 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.

### 2.5.2 Reset and Self-Test

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

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).



You can test for CPU acceptance of XOFF as follows.

1. Print any listing to the terminal.
2. While the terminal is printing the listing, press: CTRL S  
The listing should stop.
3. Press: CTRL Q  
The listing should resume.

**NOTE**

**Perform this test any time you suspect the terminal is losing data. Also check the setting of the AUTO XON/OFF feature; it should be enabled for DIGITAL LSI-11 processors.**



# CHAPTER 3

## VT103 LSI-11

### SUPPORT HARDWARE

#### 3.1 GENERAL

The second block of the VT103 consists of the LSI-11 support hardware. This hardware can be subdivided into three basic subassemblies.

- A backplane assembly
- An upgraded power supply (H7835)
- A fan assembly

This chapter describes these subassemblies, briefly describes the system architecture, presents a typical system configuration, and introduces the LSI-11 bus. For in-depth information on the LSI-11 microcomputer, refer to the *Microcomputer Processors* handbook. For information on other options, refer to the *Memories and Peripherals* handbook.

#### 3.2 SYSTEM ARCHITECTURE

A complete and powerful microcomputer system can be configured using the VT103. By selecting an LSI-11 processor module, memory module, a serial line interface, I/O devices, and interconnection hardware, you can build a system to meet your application. The VT103 backplane provides communication paths between system components. A typical LSI-11 system may be configured as shown in Figure 3-1.

##### 3.2.1 VT103 Backplane Assembly

The VT103 backplane assembly, shown in Figure 3-2, consists of a multilayer printed circuit board with two H803s (2 × 4 connector blocks) stacked vertically in a 4 × 4 configuration. These connector blocks provide eight option slots. The backplane conforms to LSI-11 bus rules and specifications for a backplane of less than 25 cm (10 in) in length. All configuration rules and expansion rules for a backplane of this length are outlined in the *Microcomputer Processors* handbook.

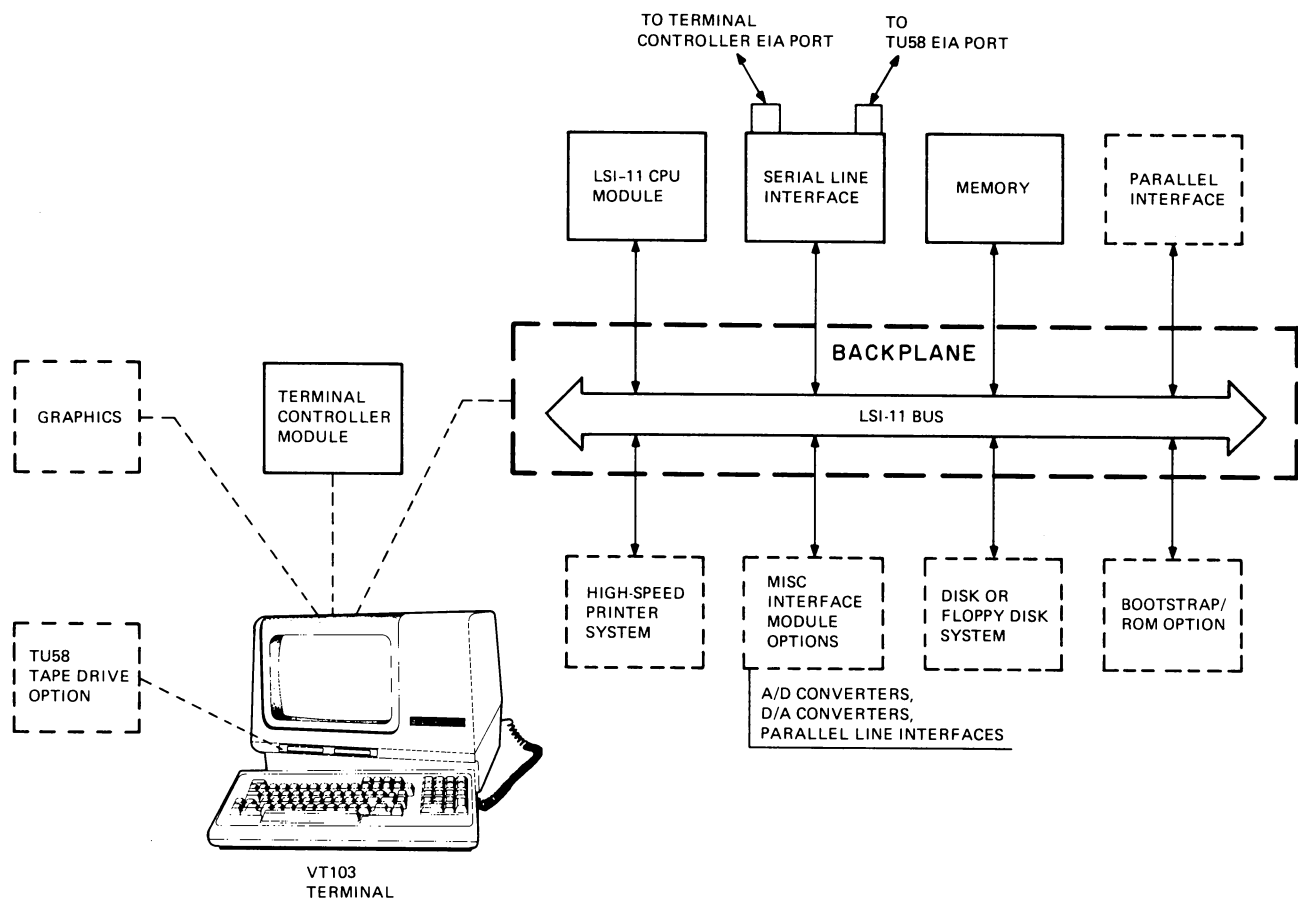


Figure 3-1 Typical LSI-11 System Configuration

Other components on the backplane include the following.

1. A 22-pin AMP connector for the terminal controller module
2. An 18-pin AMP connector for a graphics module
3. A 6-pin power supply plug for the TU58 tape drive included in VT103-BA systems
4. Jumper pins to enable the line time clock signal
5. An edge connector for the video terminal power harness
6. Fast-on tabs for user-supplied battery backup power

The other side of the backplane has no connectors or pins.

The VT103 backplane assembly attaches to a mounting frame, as shown in Figure 3-3. The frame has standoffs to support the H803 connector blocks and two AMP connectors.

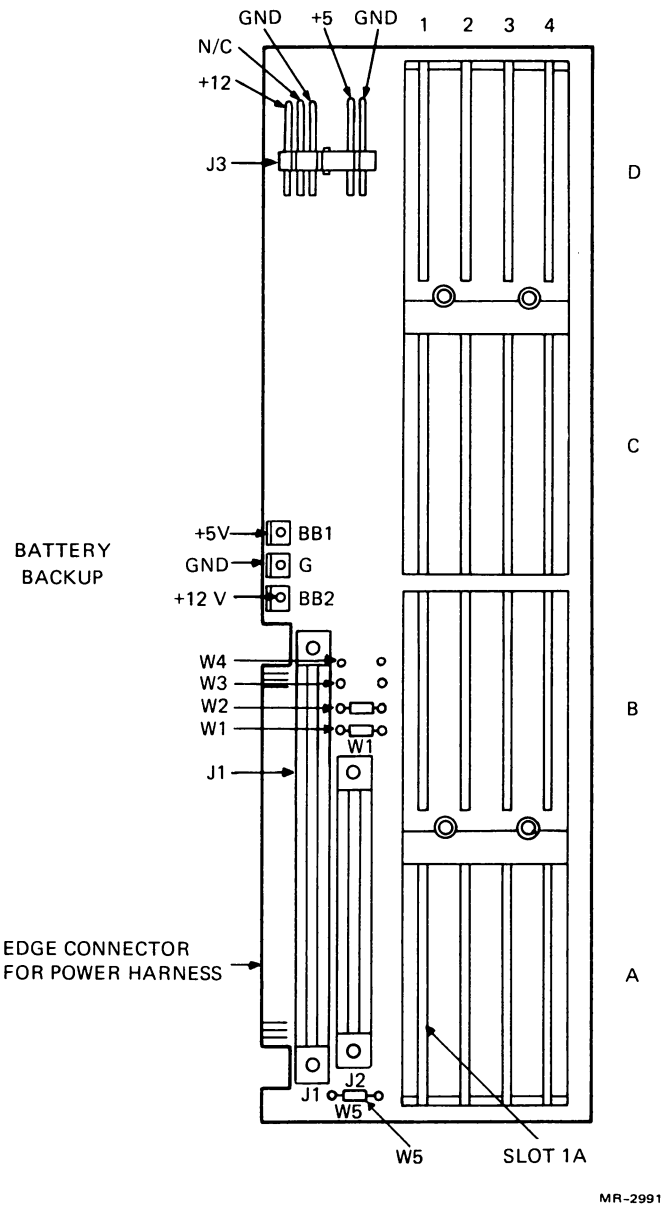


Figure 3-2 VT103 Backplane Assembly

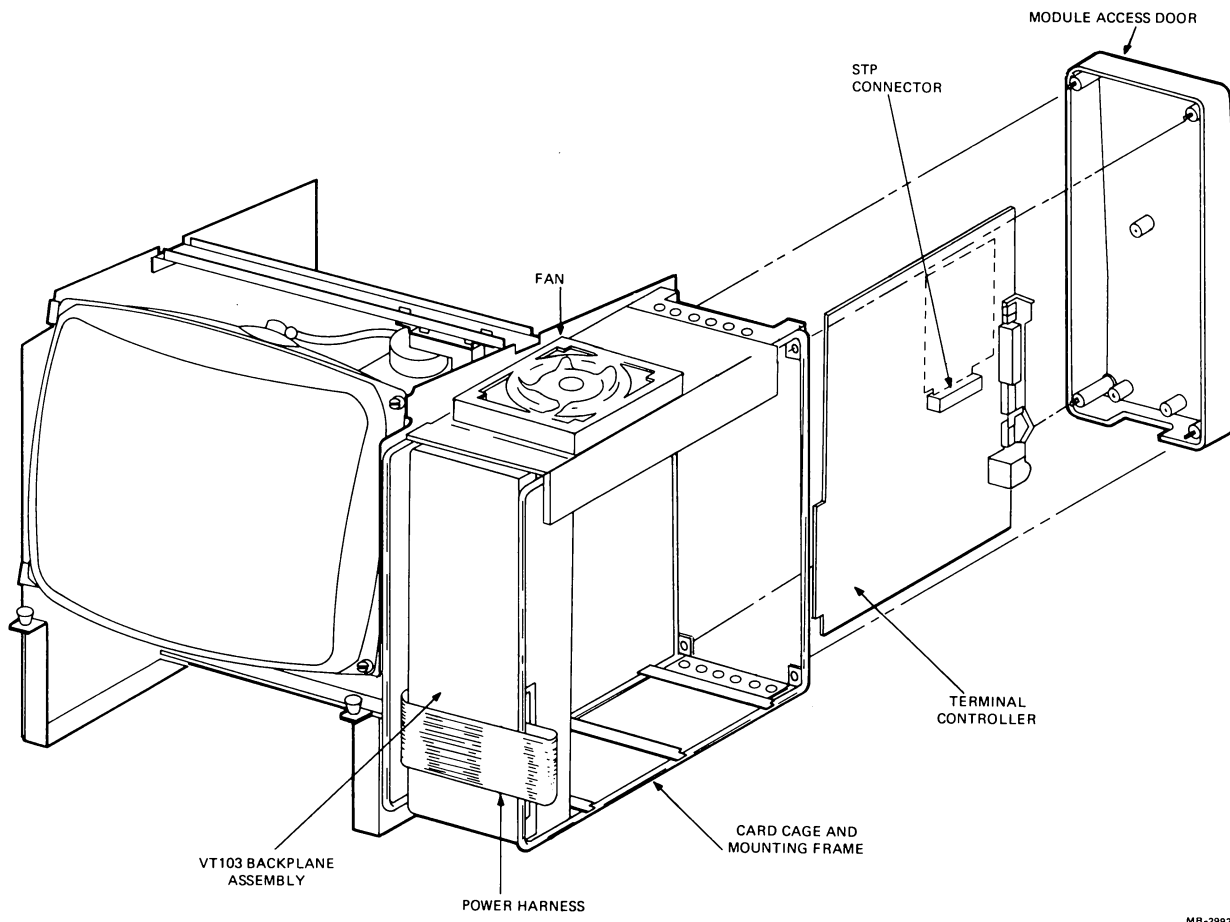


Figure 3-3 VT103 With Top and Bottom Covers Removed

### 3.2.2 Standard Terminal Port

The standard terminal port (STP) connector card provides internal connectors for communication line interfaces. You install this module in the STP connector on the terminal controller module, shown in Figure 3-3. (See Chapter 5.) This module intercepts the communications path between the terminal controller module and the EIA connector at the rear of the terminal. The STP module has two 10-pin connectors (J1 and J2) and one 40-pin connector (J3).

J1 connects to the console device interface, which must also contain a 10-pin connector. J2 connects a second serial port to the terminal controller module. The second port is then connected through the terminal controller unit to the EIA connector at the rear of the terminal. Two 10-pin cables are provided with the VT103 for connecting the STP module to console devices.

J3 is for connecting an interface that has a 40-pin connector on it using a BC08R-01 cable (not supplied). The communications cable, or cable to modem, is then attached to the EIA connector at the rear of the terminal.

**NOTE**

**When connecting an asynchronous serial line interface to the STP module, disconnect any baud rate selection on the MXV11 or DLV11-J. A DLV11-E or -F must be configured for common speed. You select a common baud rate using the transmit speed (T SPEED) in set-up B. (Refer to Chapter 5.)**

### 3.2.3 H7835 Power Supply

The H7835 power supply in the VT103 provides the following voltages at the specified current levels.

**H7835 Power Supply Less Power Used by VT103 Components**

Voltage	Current	Monitor	Basic Video	Adv Video	TU58
+5 V	16.0 A	0	2.5 A	1.1 A	0.75 A
+12 V	5.0 A	1.0 A	0.6 A	0	0.6 A (1.0 A spike on tape startup)
-12 V	0.5 A				
-23 V	0.01 A				

The power supply is switch selectable on the rear of the terminal to either 90–130 V rms, or 180–250 V rms, at a line frequency of 47–63 Hz.

The power supply is convection cooled and rated to function in a VT103 at 5°–40° C (41°–104° F). The complete terminal specifications are presented in Chapter 5.

**Power OK** – The power supply monitors both the ac power input and the dc power output. Two power OK signals to the VT103 backplane are:

BPOK H	AC power OK – negating this signal warns of impending loss of ac power; asserting this signal implies that ac power is restored.
BDCOK H	DC power OK – negating this signal warns of impending loss of dc power; asserting this signal implies that dc power is restored.

**LTC Interrupt** – Line time clock (LTC) interrupts can be enabled to the backplane by wirewrap jumper W4. This jumper is not factory installed in the VT103. LTC interrupts occur at the line frequency of the ac supply to the VT103.

### 3.2.4 VT103 Fan Assembly

The VT103 has a cooling fan for the logic assembly. This fan is mounted above the logic case on a metal plate that creates a plenum effect within the logic area in which the air is to travel. The fan draws air from beneath the terminal, cools the logic modules, and exhausts the air upward through the openings in the top of the terminal cabinet.

#### **CAUTION**

**Keep the ventilation slots clear so the terminal does not overheat.**

### 3.3 TU58 DECtape II (OPTIONAL)

The VT103 optionally supports a dual drive TU58 cartridge tape drive subsystem. The TU58 is installed below the monitor (both the drives and the controller module). The dual drives protrude below the monitor to provide convenient access to the operator. The TU58 cannot be upgraded in the field; it must be factory installed. Refer to Chapter 4 for additional information on the TU58.

### 3.4 THE LSI-11 BUS

The LSI-11 bus is a simple, fast, easy-to-use interface between LSI-11 modules. The bus has bidirectional bus data and control lines (except daisy-chained grant signals). All LSI-11 modules connected to this bus structure receive the same interface signal lines.

#### 3.4.1 Module Slot Assignments, Priority, and Configuration Considerations

Since the LSI-11 bus is used by the processor and all I/O devices, the priority of each is determined by the hardware structure of the backplane assembly. When more than one device requests control of the bus at the same time, the device electrically closest to the processor module has the highest priority.

Figure 3-4 shows the slot and row assignments of the VT103 backplane. Slot 1, rows A and B, has the highest priority and is reserved for the LSI-11 processor module you select. The option number indicates the daisy-chain bus grant wiring scheme with respect to the processor module. The bus grant signals propagate through the slot locations in the order shown until they reach the requesting device. Any unused slot must be jumpered to maintain the bus grant continuity; or we recommend that unused locations occur only in the highest numbered locations.

#### 3.4.2 Configuring LSI-11 Backplane Systems

Three characteristics of each module in an LSI-11 system must be known before configuring the system.

1. Power consumption
2. DC bus loading
3. AC bus loading

Power consumption is the amount of current drawn from the power supply for each voltage. The amount of current at +5 Vdc should be determined separately from the amount of current at +12 Vdc. Be sure to include the current drawn by the VT103 monitor, base video, advanced video (if installed), and TU58 (if installed). (See Paragraph 3.2.3.)



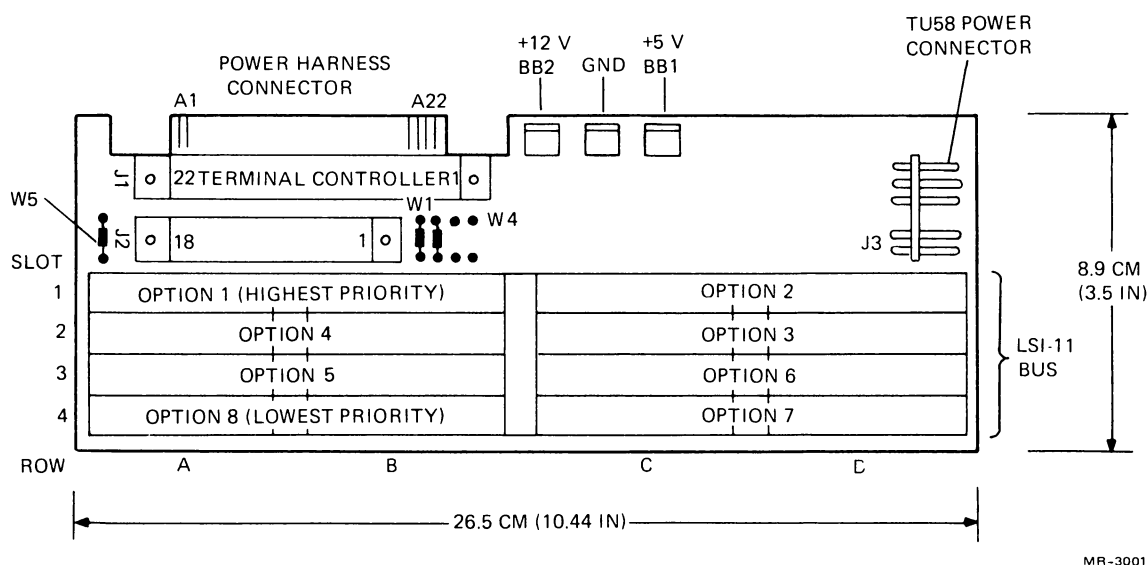


Figure 3-4 VT103 Backplane Module Utilization

DC bus loading is the leakage current a module presents to a bus signal line; one dc load is  $105 \mu\text{A}$ . Most modules present one dc load to the backplane.

AC loading is the capacitance a module presents to a bus signal line; one ac load equals  $9.35 \text{ pF}$ . The ac load varies for each LSI-11 module.

The power consumption, dc load, and ac load of each option to be installed in the backplane can be found in the *Memories and Peripherals* handbook. The ac loading of the VT103 backplane is 4.5 ac loads. The following rules apply for the LSI-11 backplane.

1. The LSI-11 bus can support up to 20 dc loads.
2. The bus can support up to 20 ac loads before a terminator module is required.
3. If a terminator module is added to the bus, the bus can support a maximum of 35 ac loads.
4. The VT103 supports all LSI-11 bus modules and expansion boxes as specified in the *Microcomputer Processors* handbook.

### 3.5 TYPICAL LSI-11 CONFIGURATIONS

Both the video terminal and the TU58 DECTape II in the VT103 require a serial line interface to communicate on the LSI-11 bus. Two typical configurations are illustrated. Each provides 10-pin connectors for cables to the STP module and the TU58.

Figure 3-5 shows an LSI-11 processor, an MSV11-DD 32K word memory module, and a DLV11-J 4-channel serial line interface. One channel is connected to the TU58 and one channel is connected to the terminal console via the STP module.

Figure 3-6 illustrates another possible configuration: an LSI-11 processor with an MXV11-A multipurpose memory module. The MXV11-A has two serial line channels.

#### NOTE

Refer to the *Microcomputer Processors handbook* and the *Memories and Peripherals handbook* to determine the modules that meet your application.

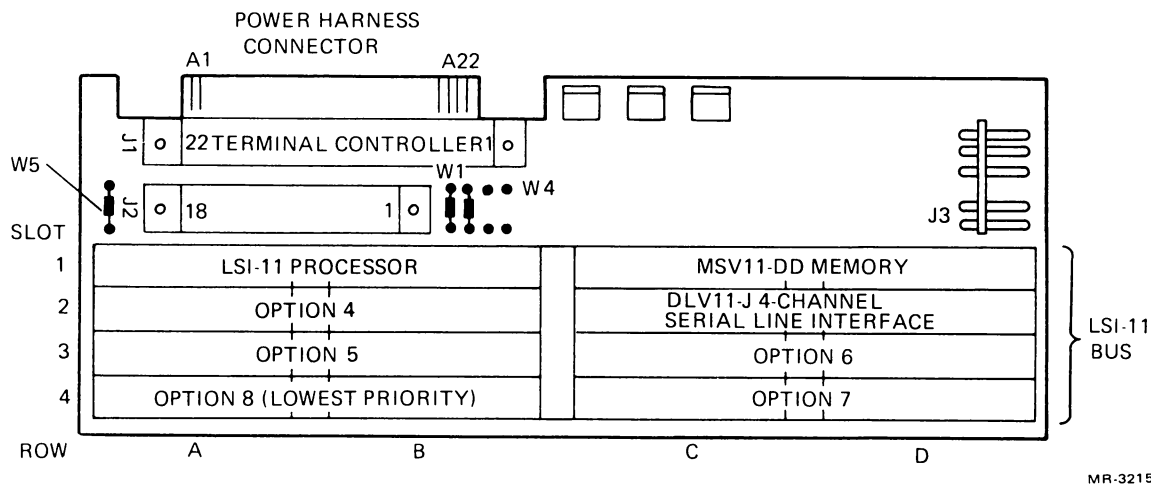


Figure 3-5 Example 1: Configuring the LSI-11 Bus

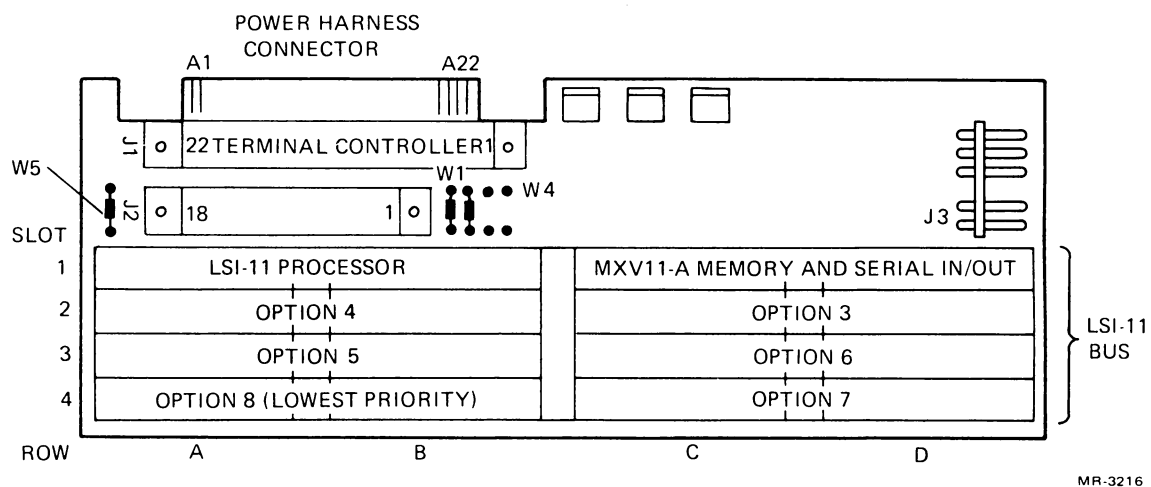


Figure 3-6 Example 2: Configuring the LSI-11 Bus

# CHAPTER 4

## TU58 TAPE DRIVE

### 4.1 GENERAL INFORMATION

The VT103-BA terminal has a factory-installed TU58 DECtape II tape cartridge drive mounted within the video monitor. The dual tape drives are accessible from the front of the video monitor directly below the video display, as shown in Figure 4-1.

The tapes used by the system are preformatted, miniature, reel-to-reel cartridges that hold 256K bytes of data in 512-byte blocks. Each tape has two tracks which hold 256 blocks of data.

#### NOTE

**The TU58 programming message packets are defined in Appendix A.**

TU45-K cartridges are preformatted. The VT103 cannot format these tapes, but the preformatted tapes are available from DIGITAL. Refer to Chapter 1 for ordering information.

#### 4.1.1 Tape Cartridge Storage and Care

The following general rules apply for handling tape cartridges for maximum error-free operation.

1. Keep tapes away from magnetism, dust, heat, and direct sunlight.
2. Never touch the surface of the tape.
3. Remove tape cartridges from the drive when not in use.
4. Always store the tape cartridges inside containers when not in use.

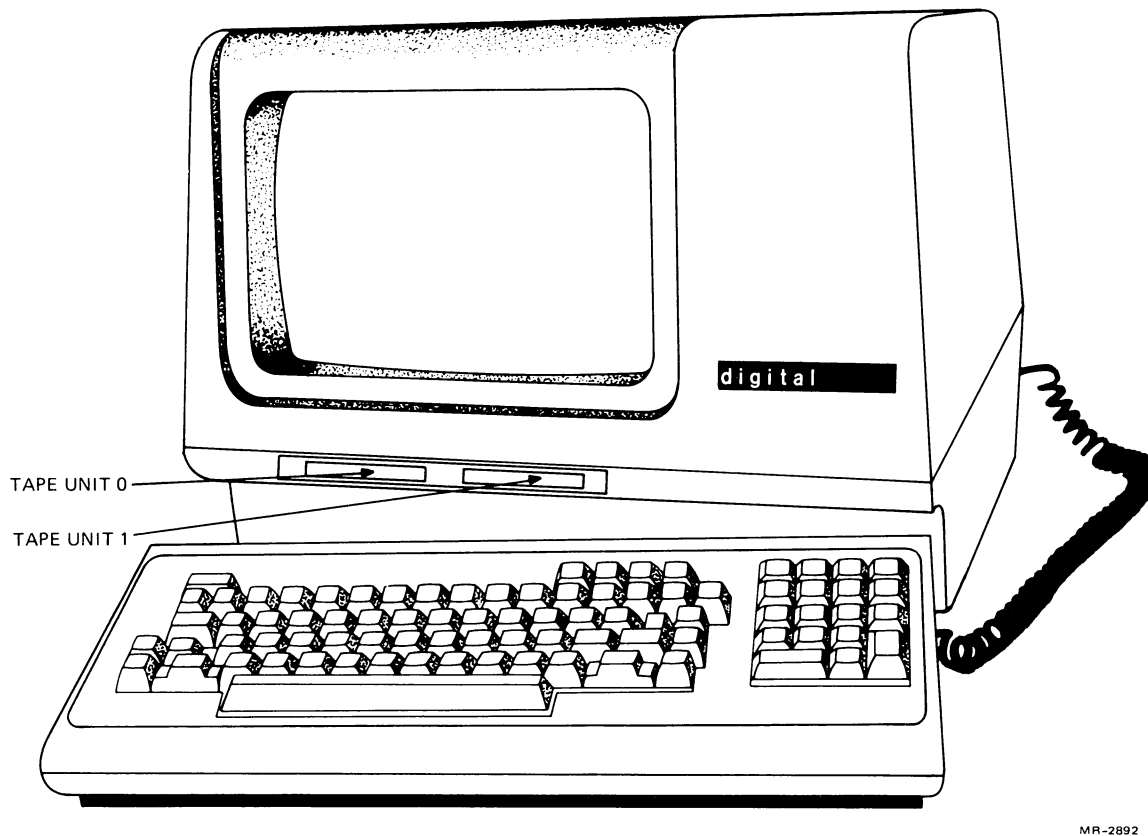


Figure 4-1 VT103 With TU58 DEtape II

5. If the tape is exposed to extremes of temperature, rewind the tape in both directions before using. Temperature extremes are less than 0° C (32° F) or greater than 50° C (122° F).

**CAUTION**

**System and program tapes should always be copied to ensure against data loss if a tape cartridge should malfunction.**

**4.1.2 Write Protect Tab**

Each cartridge has a movable write protect tab. This tab may be placed in one of two positions, as illustrated in Figure 4-2.

Write Protect – Move tab toward drive roller. This inhibits writing onto the tape cartridge.

Record (Write Permitted) – Move tab away from drive roller. The system may now write on the tape.

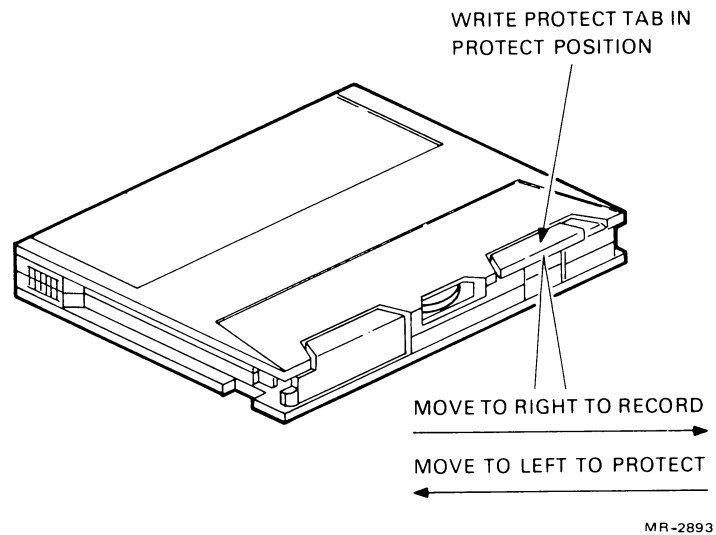


Figure 4-2 Write Protect Tab

The write protect tab may be completely removed from the tape cartridge to eliminate accidentally having the tab in the wrong position and any possibility of overwriting data on the tape cartridge. To remove the write protect tab:

1. Move the tab into the write protect position.
2. Lift the tab and remove it from the cartridge. Save this tab for possible reinstallation on the tape cartridge.

To reinstall the write protect tab:

1. Place the tab into the tab slot over the write protect position.
2. Press down firmly until the tab clicks into place.

#### 4.1.3 Tape Cartridge Installation and Removal

To load a tape cartridge into the VT103:

1. Hold the cartridge with the label side up.
2. Push the cartridge into the tape drive opening, as shown in Figure 4-3.

The tape drive opening is covered by a protective door that swings upward whenever a tape is inserted.

To remove a tape cartridge:

1. Wait for tape motion to stop.

#### CAUTION

If a tape is removed when the tape is in motion, a tape error message is generated by the tape controller and data may be lost.

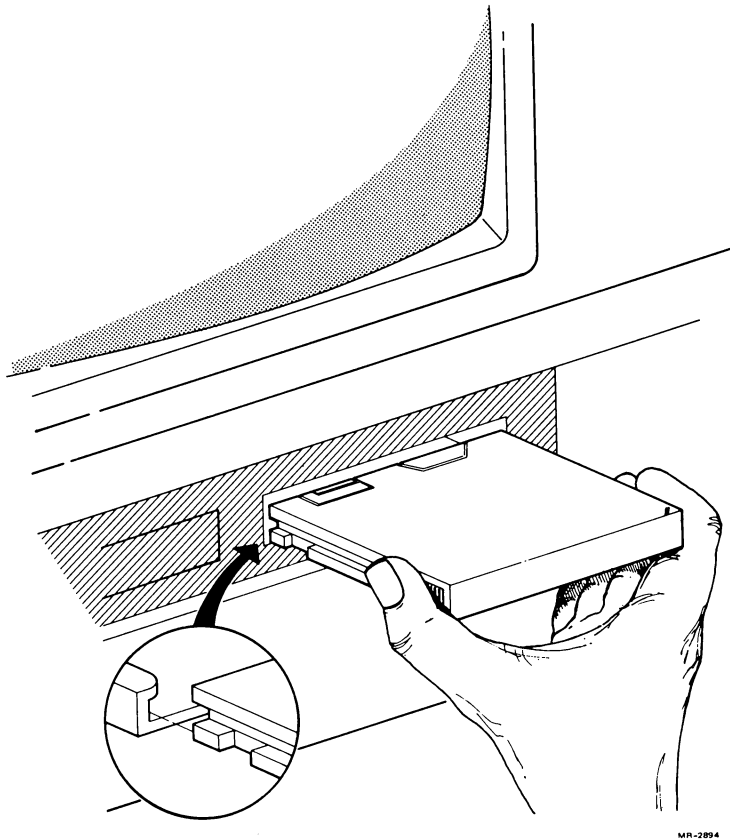


Figure 4-3 Loading a Cartridge

2. Pull the cartridge directly out of the tape drive opening.

**WARNING**

Remove both tapes before disassembling the VT103 cabinet. If left in the tape drive, you may damage the cabinet when disassembling the VT103.

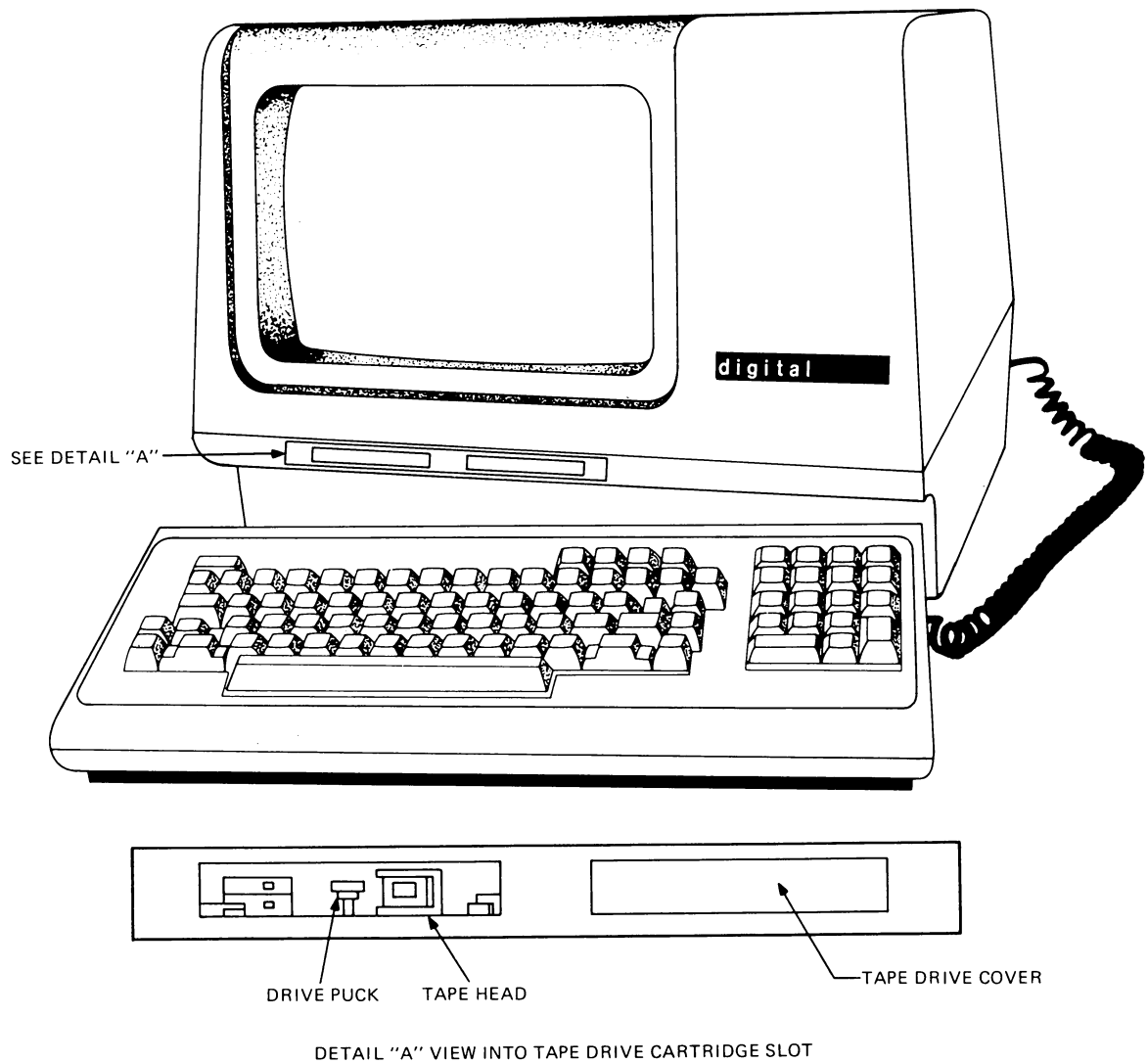
#### 4.1.4 Tape Drive Cleaning

Weekly cleaning of the tape drive components minimizes tape and head wear and reduces the possibility of tape damage and data errors.

1. Clean the tape drive head, shown in Figure 4-4, using a cotton-tipped wooden applicator moistened with head cleaning fluid (DEC part number TUC01).
2. Clean the entire surface of the drive capstan by rotating it with the cotton-tipped applicator moistened with head cleaning fluid.

## 4.2 TU58 COMMUNICATION SELECTION

The TU58 and the video terminal communicate via a user-supplied serial line interface on the LSI-11 bus. You may select a variety of transmission rates and standards to be compatible with the serial line interface you select.



MR-3005

Figure 4-4 Tape Drive Cleaning

The TU58 controller module operates on full duplex, asynchronous 4-wire lines. The transmission and receive rates may be independently set with jumpers from 150 to 38.4K baud. The TU58, when shipped with the VT103, is factory-configured with both transmit and receive baud rates set to 38.4K baud.

The TU58 controller module offers a choice of Electronic Industry Association (EIA) standards: RS-422 (balanced signals) or RS-423 (unbalanced signals). The TU58 is factory-configured for RS-423; this is compatible with devices complying with RS-232-C standard, such as the video terminal in the VT103.

#### 4.2.1 Selecting Baud Rate

Table 4-1 lists the pins on the TU58 controller module and their function. The transmit and receive baud rates may be independently set, or they can operate at the same rate. Connect the pin with the desired baud rate to XMIT or RCV pins or both. Figure 4-5 shows the pin locations, and Figure 4-6 shows the factory-wired configuration.

**Table 4-1 TU58 Controller Module Pin Assignments****Wirewrap Pins**

WW1	150 Baud	
WW2	300 Baud	
WW3	600 Baud	
WW4	1200 Baud	
WW5	2400 Baud	
WW6	4800 Baud	
WW7	9600 Baud	
WW8	19200 Baud	
WW9	38400 Baud	
WW10	UART Receive Clock	
WW11	UART Transmit Clock	
WW12	Auxiliary A	
WW13	Auxiliary B	
WW14	Factory Test Point	
WW15	Ground	} Connect together for auto-boot on power-up.
WW16	Boot	
WW17	RS-423 Driver	
WW18	RS-423 Common (Ground)	
WW19	Transmit Line +	
WW20	Transmit Line -	
WW21	RS-422 Driver +	
WW22	RS-422 Driver -	
WW23	Receiver Series Resistor (Jump for RS-422)	
WW24		

**Serial Interface Connector**

J2-1	Auxiliary B	J2-7	Transmit Line-
J2-2	Ground	J2-8	Transmit Line +
J2-3	Receive Line +	J2-9	Ground
J2-4	Receive Line -	J2-10	Auxiliary A
J2-6	Ground		

**Power Input Connector**

J1-1	+12 V	J1-5	+5 V
J1-3	Ground	J1-6	Ground

**Drive Cable**

J3,4-1	Cart L	J3,4-9	LED
J3,4-2	No Connection	J3,4-10	Head Shield Ground
J3,4-3	Permit L	J3,4-11	Erase Return
J3,4-4	Signal Ground	J3,4-12	Erase 1
J3,4-5	Motor +	J3,4-13	Erase 0
J3,4-6	Motor-	J3,4-14	Head Return
J3,4-7	+12 V	J3,4-15	Head 0
J3,4-8	Tachometer	J3,4-16	Head 1



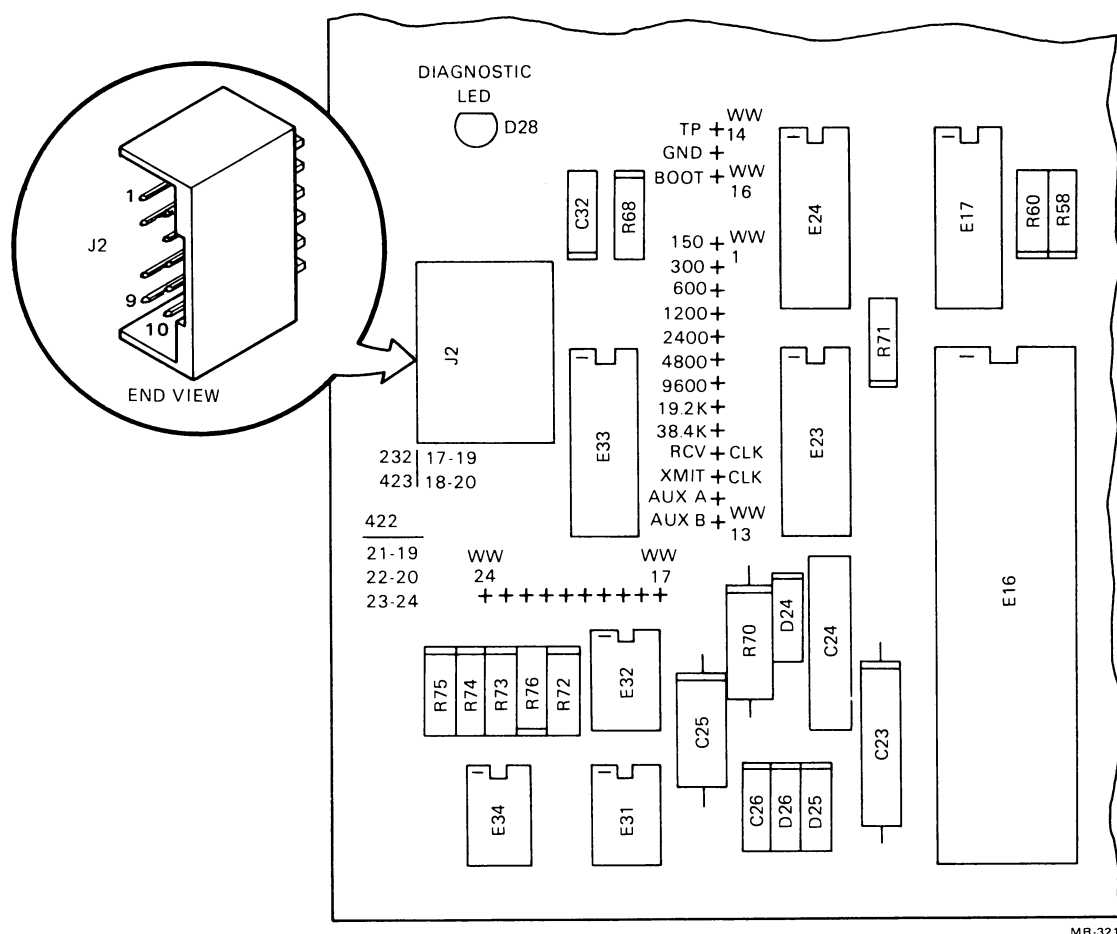


Figure 4-5 TU58 Controller Module Jumper Pin Locations

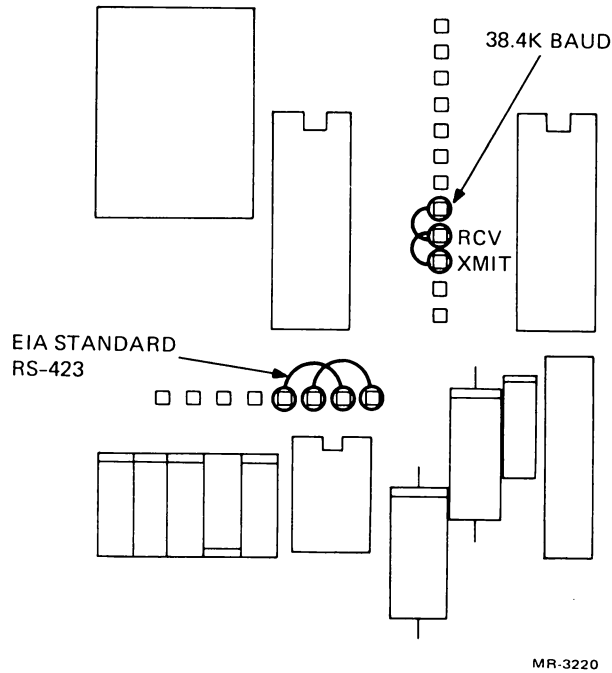


Figure 4-6 TU58 Factory Wiring

#### 4.2.2 Selecting Transmission Standard

The transmission standard is selected by connecting sets of pins together. The module is shipped prewired for RS-423. To change this selection, connect the pins indicated.

EIA Standard	Connections
RS-422	pin 21 to pin 19, pin 22 to pin 20, and pin 23 to pin 24.
RS-423	pin 17 to pin 19, and pin 18 to pin 20.

The jumper pins are standard 0.635 mm (0.025 in) wirewrap (WW) posts that may be connected using 30 AWG wire and a hand tool. You may use other techniques, such as slip-on connectors, DEC H821 Grip Clips, 915 patchcords, 917 daisy-chain, or soldering.

# CHAPTER 5 INSTALLATION, INTERFACE INFORMATION, AND SPECIFICATIONS

## 5.1 UNPACKING

The VT103 is packaged within a reinforced carton containing the following items.

- VT103 video monitor
- Detached Keyboard
- Power Cord
- Standard Terminal Port (STP) module
- STP module cables (2)
- Module Support Guides (4)
- Screws, spacers, washers, and nuts (2 each)
- SET-UP Label
- User Guide

Instructions are printed on the carton for unpacking the unit.

## 5.2 SITE CONSIDERATIONS

The VT103 consists of a video monitor and detachable keyboard that may be placed on a desk or table top. The dimensions of the VT103 are shown in Figure 5-1.

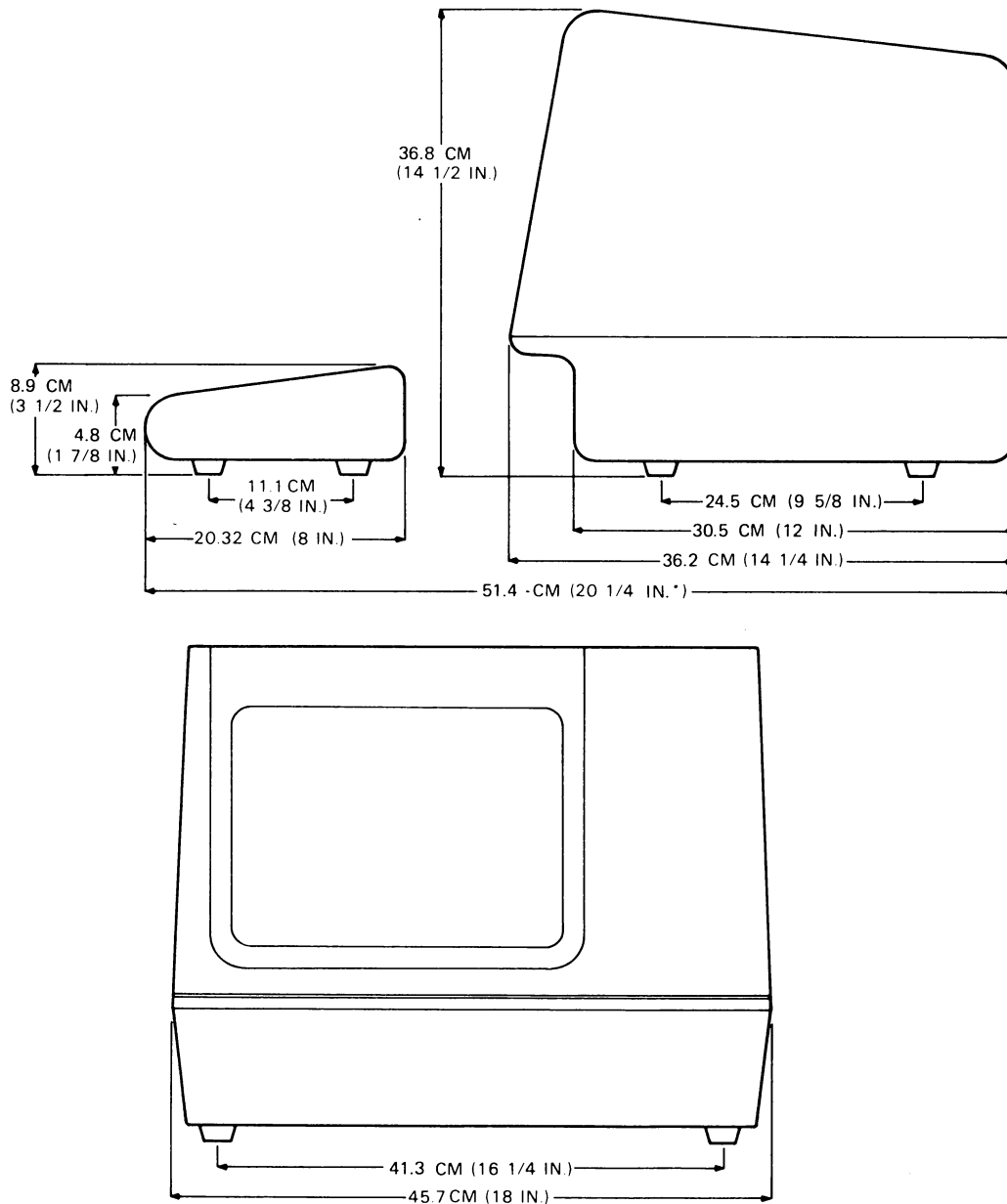
Specifications for operating environment are provided in Paragraph 5.6.

## 5.3 INSTALLATION

To install the VT103 perform the following steps.

1. Remove the VT103 from the shipping carton and place it in the desired work area.
2. 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



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

MR-3526

Figure 5-1 VT103 Terminal Dimensions

- Verify that the power switch is OFF.

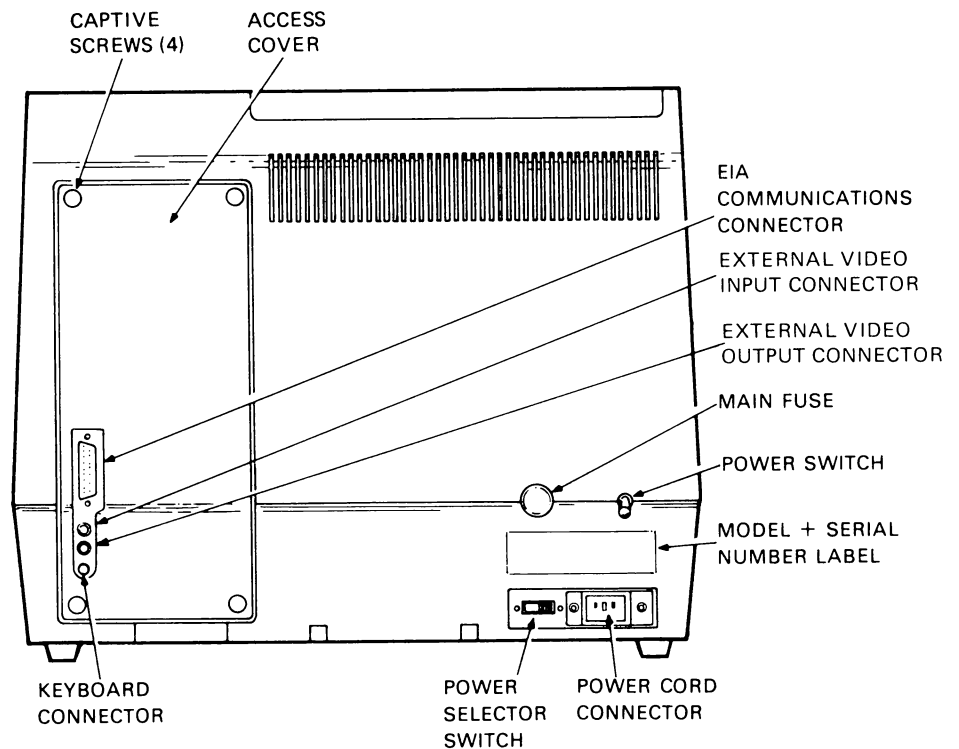
**Position      AC Power**

Up              ON  
Down          OFF

4. Remove the module access cover from the rear of the terminal by removing the four captive screws, shown in Figure 5-2.
5. The VT103 backplane has a jumper (W4) for enabling a line time clock (LTC). Check to be sure your system needs this LTC clock before installing W4. The backplane jumpers and wirewrap pins are shown in Figure 5-3 (I = installed, R = removed).

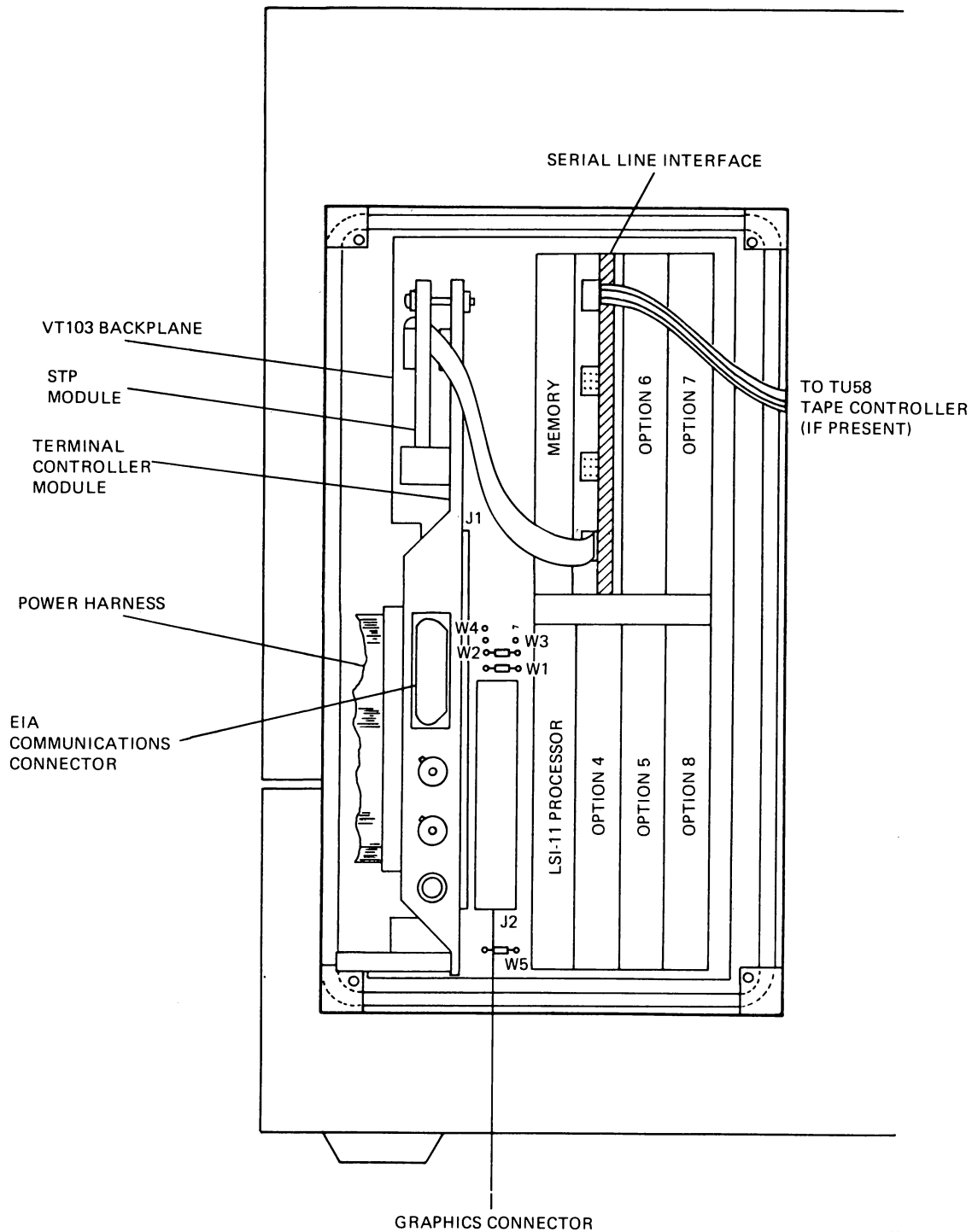
Jumper Designation	Jumper State	Function Implemented
W1,W2,W5	I	Factory configured; do not change.
W3	R	Factory configured; do not change.
W4	R	If installed, enables LTC by connecting pin 14 to the backplane.

The VT103 signal and power pin assignments are listed in Table 5-1.



MR-2891

Figure 5-2 VT103 Rear View



MR-2993

Figure 5-3 VT103 Backplane

**Table 5-1 VT103 Backplane Signal and Power Pin Assignments at Edge Connector**

Pin (Side 1 and 2)	Signal/Power
1	BV4 HORIZ DRIVE H
2	GND
3	DIRECT DRIVE VIDEO
4	BV4 VERT DRIVE L
5	Unused
6	Unused
7	+12 V
8	GND
9	-12 V
10	-23 V
11	BDCOK
12	BPOK
13	GND
14	LTC
15	GND
16	GND
17	GND
18	GND
19	+5 V
20	+5 V
21	+5 V
22	+5 V

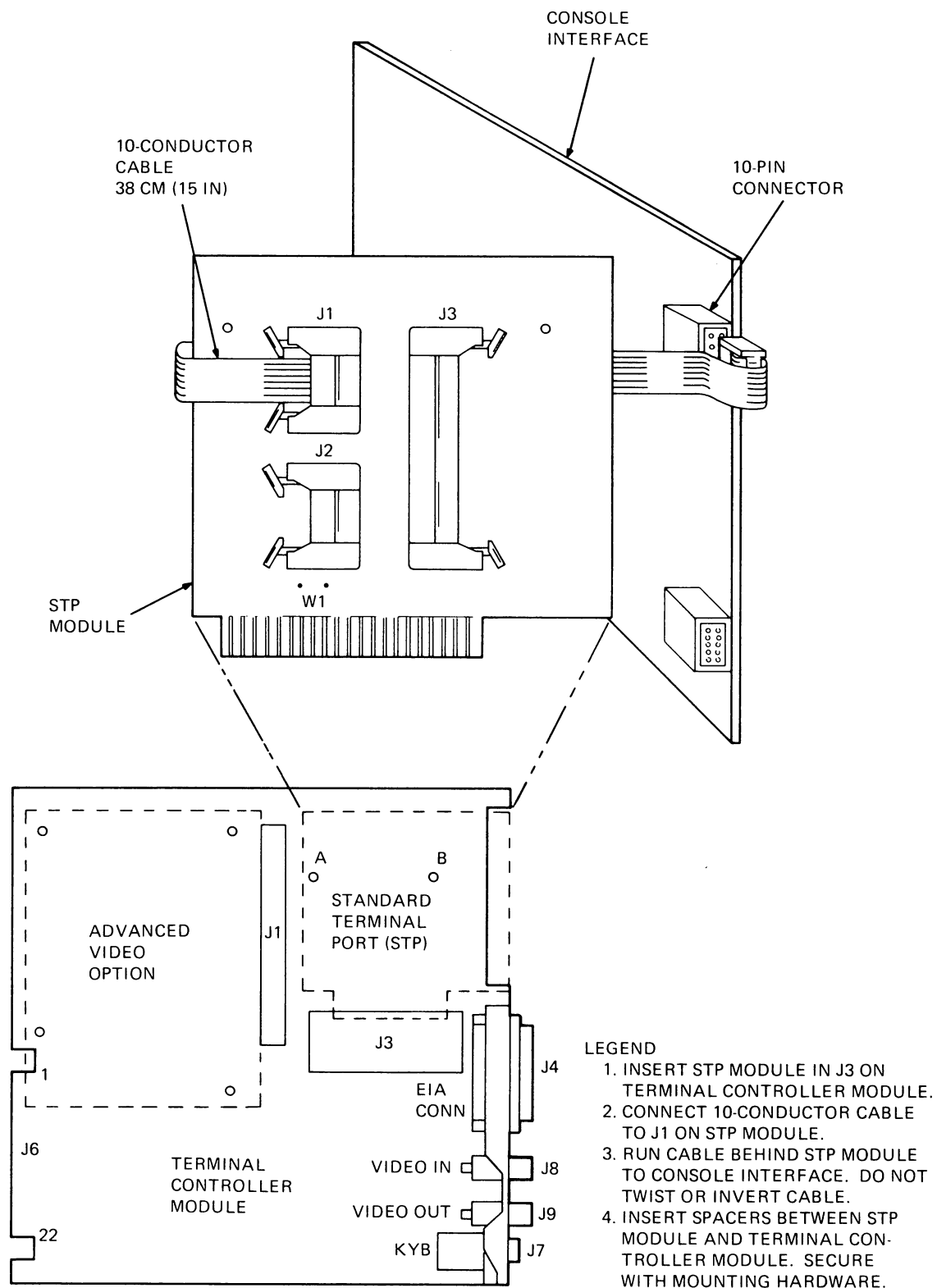
6. The standard terminal port (STP), included with the VT103, has three EIA connectors.

Two 10-pin connectors are for installing cables to serial line interfaces, such as a DLV11-J 4-channel serial line interface or an MXV11-A multipurpose memory and serial in/out module.

One connector is a 40-pin Berg connector for installing a cable to serial line units that also have a Berg connector, such as a DLV11-E/F asynchronous line interface or DUV11 synchronous line interface.

Install the STP module as follows.

- a. Remove the terminal controller module from J1 of the VT103 backplane.
- b. Plug the STP module into J3 on the terminal controller module, as shown in Figure 5-4.
- c. Two 38 cm (15 in) 10-conductor cables are supplied with the VT103. Plug one of these cables into J1 on the STP module. Run this cable around the back of the STP module, as shown in Figure 5-4.



MR-3415

Figure 5-4 Standard Terminal Port (STP) Installation



- d. Connect the other end of this cable to your console serial line interface.

Example:

1. Connect the cable to channel 3 (J3) on a DLV11-J, or
2. Connect the cable to channel 1 (J2) on an MXV11.

Install the connector right side up with no twists in the cable.

#### NOTE

**When connecting asynchronous serial line interfaces to the STP module, disconnect the baud rate selection for those channels on their line interface module. The console baud rate is automatically provided by the terminal controller at approximately 15K baud. The baud for the second communication interface can be selected, using the transmit speed (T SPEED) in set-up B.**

- e. **OPTIONAL** – If you have a second serial line unit with a 10-pin connector, run a cable from this unit behind the STP module and connect to J2 on the STP module, as shown in Figure 5-5. Connect the communications cable from the second unit to the EIA connector on the rear of the terminal.

**OPTIONAL** – If you have a second serial line unit (synchronous or asynchronous) with a 40-pin connector, connect one end of a BC08R-01 cable (not supplied) to J3 on the STP module with the connector right side up, as shown in Figure 5-6. Do not twist the cable. Connect the other end of this cable to the serial line unit installing the connector upside down. Connect the communications cable (or modem cable) to the EIA connector on the rear of the terminal. Asynchronous serial line interfaces (DLV11-E/-F) must be configured for common speed.

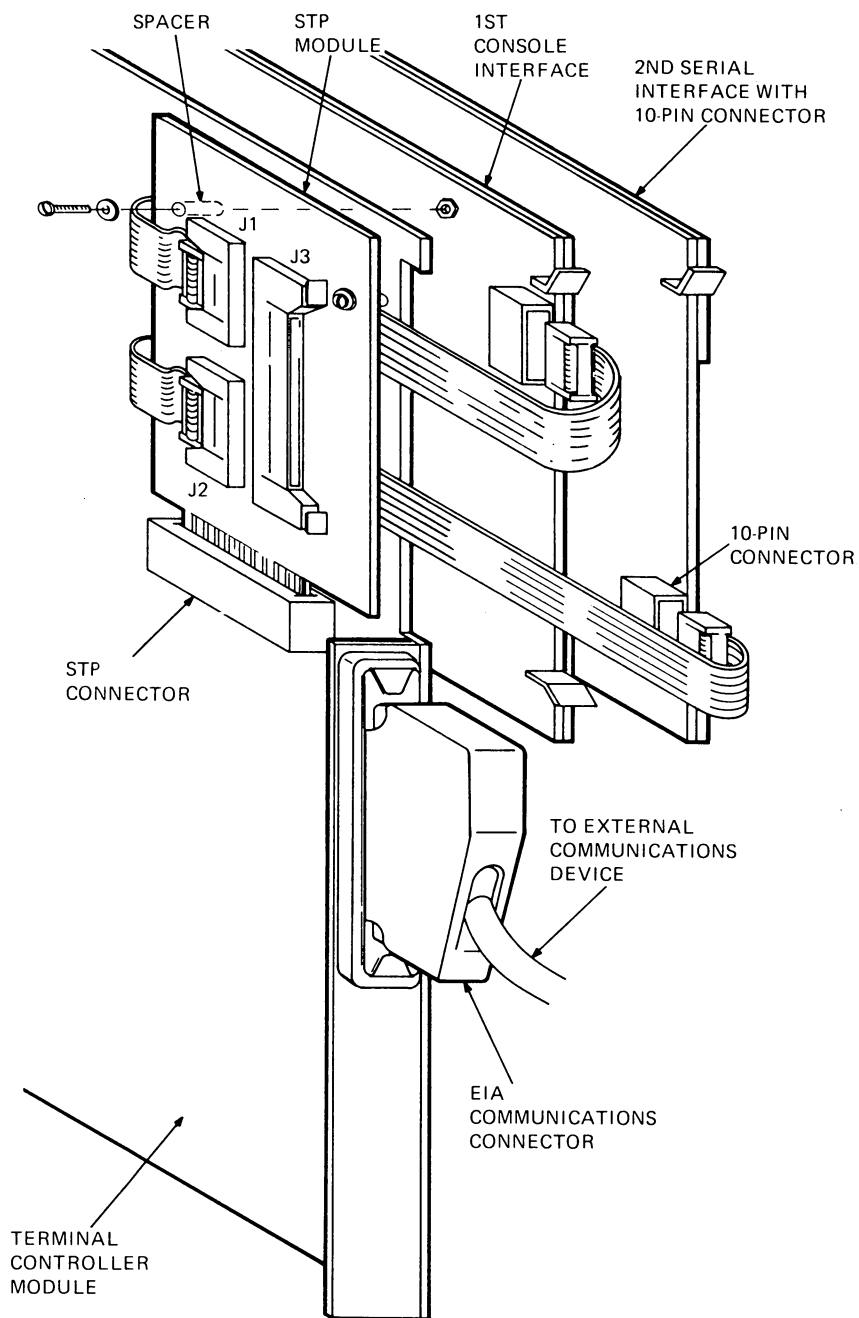
#### NOTE

**When using a second serial line unit with the STP module, EIA pin 24 (CLOCK EXT L) and pin 25 (FORCE BUSY) are not available for use.**

- f. Insert spacers at locations A and B between the terminal controller module and the STP module and fasten the modules together using the supplied hardware.

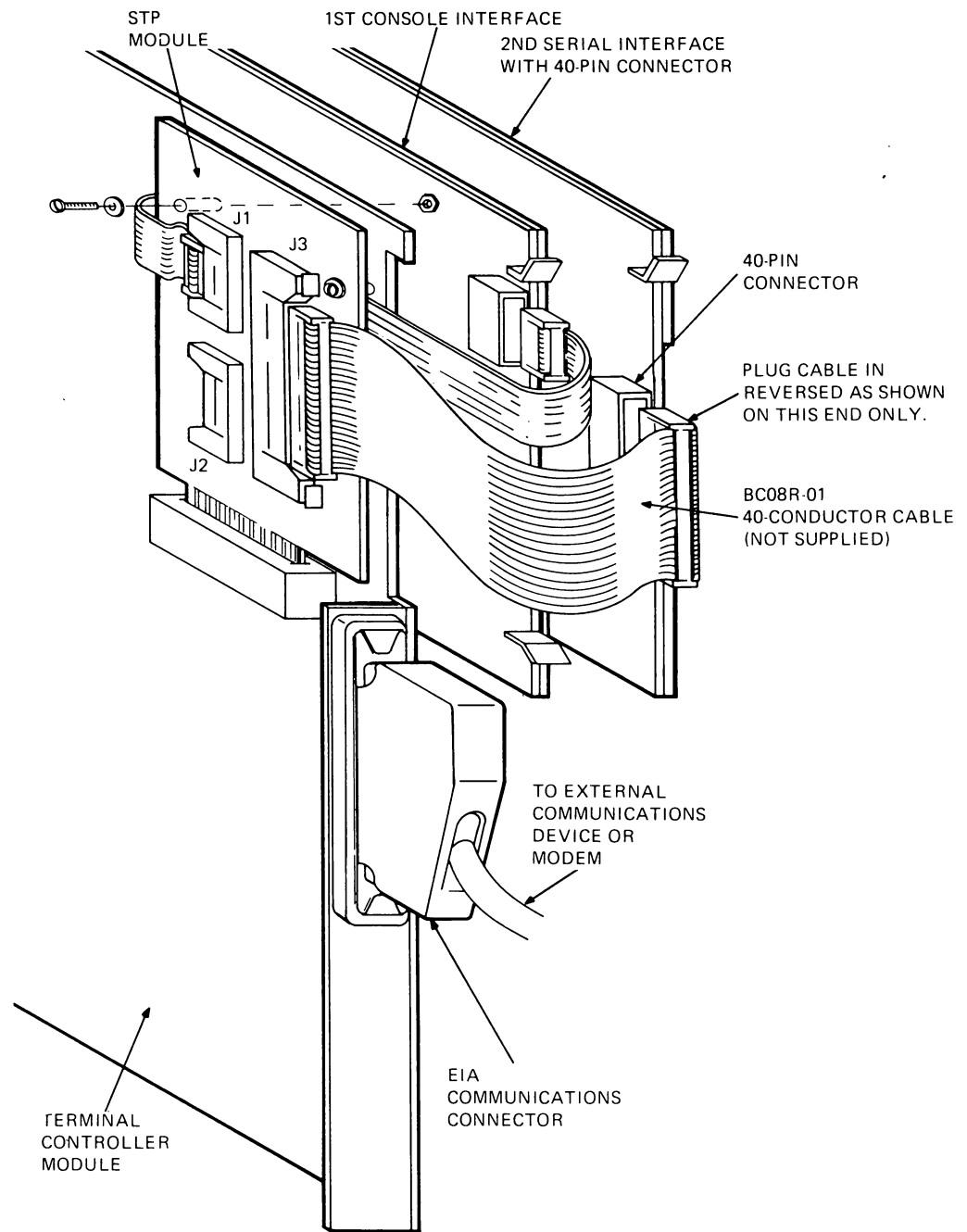
#### NOTE

**Refer to Chapter 6 for installation of the advanced video module if you are installing that option on the terminal controller at this time.**



MR-3417

Figure 5-5 Connecting a Second Serial Interface on the STP Module Using the 10-Pin Connector



MR-3418

Figure 5-6 Connecting a Second Serial Interface on the STP Module Using the 40-Pin Connector

- g. Install the terminal controller in J1 of the VT103 backplane.

## NOTES

1. At this time, you may configure any other LSI-11 modules within the VT103 backplane. Refer to the *Memories and Peripherals* handbook for available options and installation procedures.
2. For more than two serial interfaces or for other peripheral devices, run their cables out the bottom rear of the VT103 cabinet between the rear cover and the lower base of the VT103.
3. A jumper (W1) on the STP module is available for the user to connect the signal INIT L from the terminal controller module to pin 1 of J1. INIT L may be used to initialize the micro-computer system. Note however, that pin 1 has +12 V supplied by the serial interface which must be disconnected from the serial line interface module if W1 is installed.
4. If the STP module is removed from the terminal controller module, ensure that the pins in the STP connector come together to reconnect all communications lines.

## CAUTION

If you install any options other than those built by DIGITAL, ensure that each option complies with DEC Standard 119 on Product Safety.

7. Install module support guides to hold dual-height modules securely in the VT103 backplane. Quad-height modules do not need these support guides. To install the guide correctly:
  - a. Hold the guide by the plastic connector with both ends pointing away from you and to the left.
  - b. Insert the bottom end in the hole in the bottom bracket of the card cage assembly, near the module to be secured.
  - c. Bend the module support guide slightly and insert its other end in the hole in the top bracket of the card cage assembly.
  - d. Apply a slight pressure to the plastic connector and secure it to the module.

## NOTE

When installed correctly, the module support guide should line up with the edge of the module, as shown in Figure 5-7. If installed upside down, the plastic connector cannot be attached to the module.

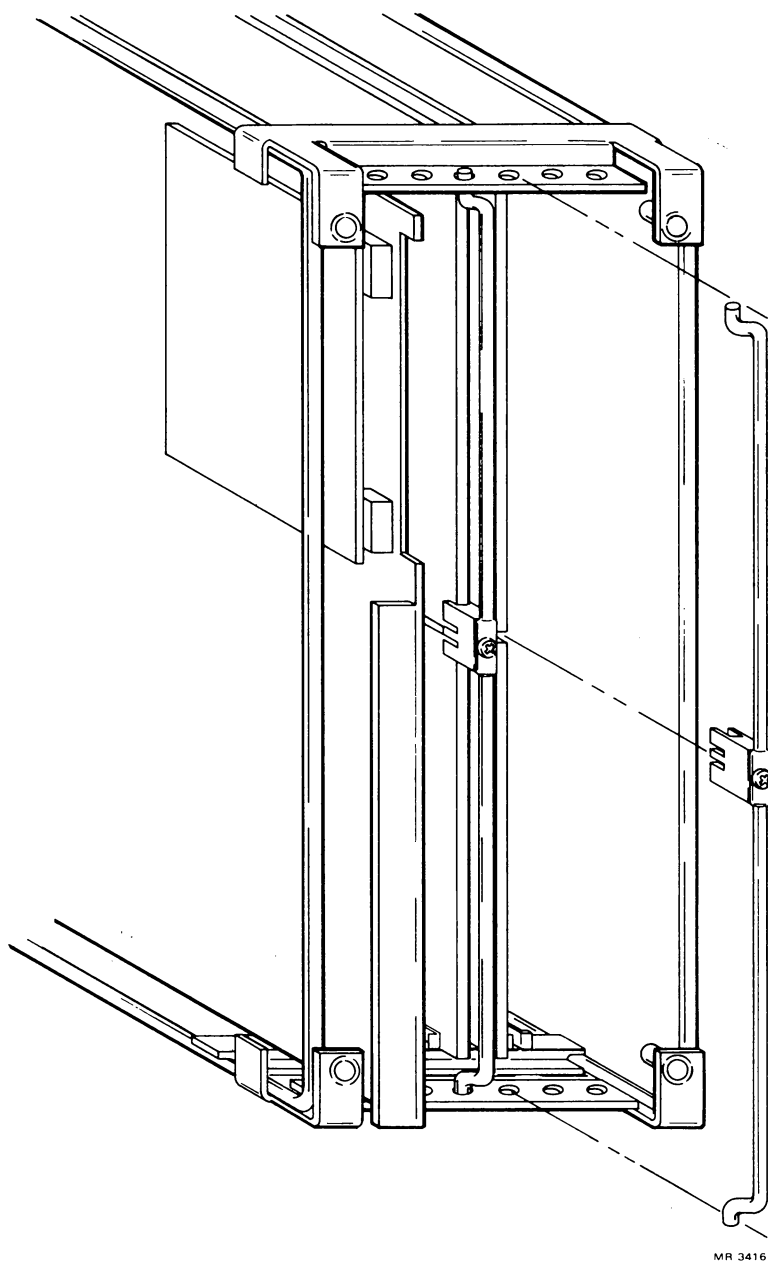


Figure 5-7 Module Support Guide Installation

8. Replace the module access cover.
9. 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 5-2).
10. 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.
11. 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.
12. Set the desired set-up features as outlined in Chapter 1.
13. Once the installation procedure is complete, record the set-up features selected on the set-up label and attach the label to the underside of the keyboard.

## 5.4 INTERFACE INFORMATION

### EIA Interface and Electrical Characteristics

The video terminal operates on full duplex, asynchronous communication lines. The terminal controller board interfaces to the line with a 25-pin connector mounted on the back of the terminal that meets EIA specification RS-232-C. Table 5-2 summarizes the EIA connector signals.

**Table 5-2 EIA RS-232-C Connector Signals**

Pin Number	Description	Signal Without STP Module	Signal With STP Module
1	Protective ground	Do not use	Note 1
2	Transmitted data	Mark state when not sending	Note 1
3	Received data		Note 1
4	Request to send	Asserted at all times	Note 2
5	Clear to send	Ignored by terminal controller unit (TCU)	Note 2
6	Data set ready	Ignored by TCU	Note 2
7	Signal ground	Terminal chassis ground (common return)	Note 2
8	Carrier detect	Ignored by TCU	Note 2

**Table 5-2 EIA RS-232-C Connector Signals (Cont)**

Pin Number	Description	Signal Without STP Module	Signal With STP Module
9	(not used)		
10	(not used)		
11	Speed select (secondary request to send)	Asserted	Note 2
12	Speed indicator (secondary carrier detect)	Ignored by TCU	Note 2
13	(not used)		
14	(not used)		
15	Transmit clock	Ignored by TCU	Note 2
16	(not used)		
17	Receive clock	Ignored by TCU	Note 2
18	(not used)		
19	Speed select (same as pin 11)	Asserted	Note 2
20	Data terminal ready	Asserted at all times except when: <ul style="list-style-type: none"> <li>terminal is not powered up</li> <li>terminal is in local mode</li> <li>during the 3.5s interval following a SHIFT-BREAK</li> </ul>	Note 2
21	(not used)		
22	Ring indicator	Ignored by TCU	Note 2
23	Speed select (same as pin 11)	Asserted	Note 2
24	(not used)		
25	(not used)		

**NOTES**

1. Signal is available at J2 and J3 of the STP module.
2. Signal is available at J3 of the STP module.

**Output Voltages** – On all signals from the terminal, the MARK or unasserted state is –6.0 V to –12.0 V; the SPACE or asserted state is +6.0 V to +12.0 V.

**Input Voltages** – On signals to the terminal, –25.0 V to +0.75 V or an open circuit is interpreted as a MARK, ON, or unasserted state, and +25.0 V to +2.25 V is interpreted as a SPACE, OFF, or asserted state. Voltages greater in magnitude than  $\pm 25$  V are not allowed. These levels are compatible with EIA STD RS-232-C and CCITT Recommendation V.28.

## 5.5 EXTERNAL VIDEO CONNECTION

The VT103 is capable of easily interfacing to external video devices. The video devices may act either as a slave to the VT103 when connected to the composite video output or provide synchronized video data to the VT103. 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.

### 5.5.1 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 VT103 screen *except* the video that comes from J8. The output has the following nominal characteristics. (Also, see Figure 5-8.)

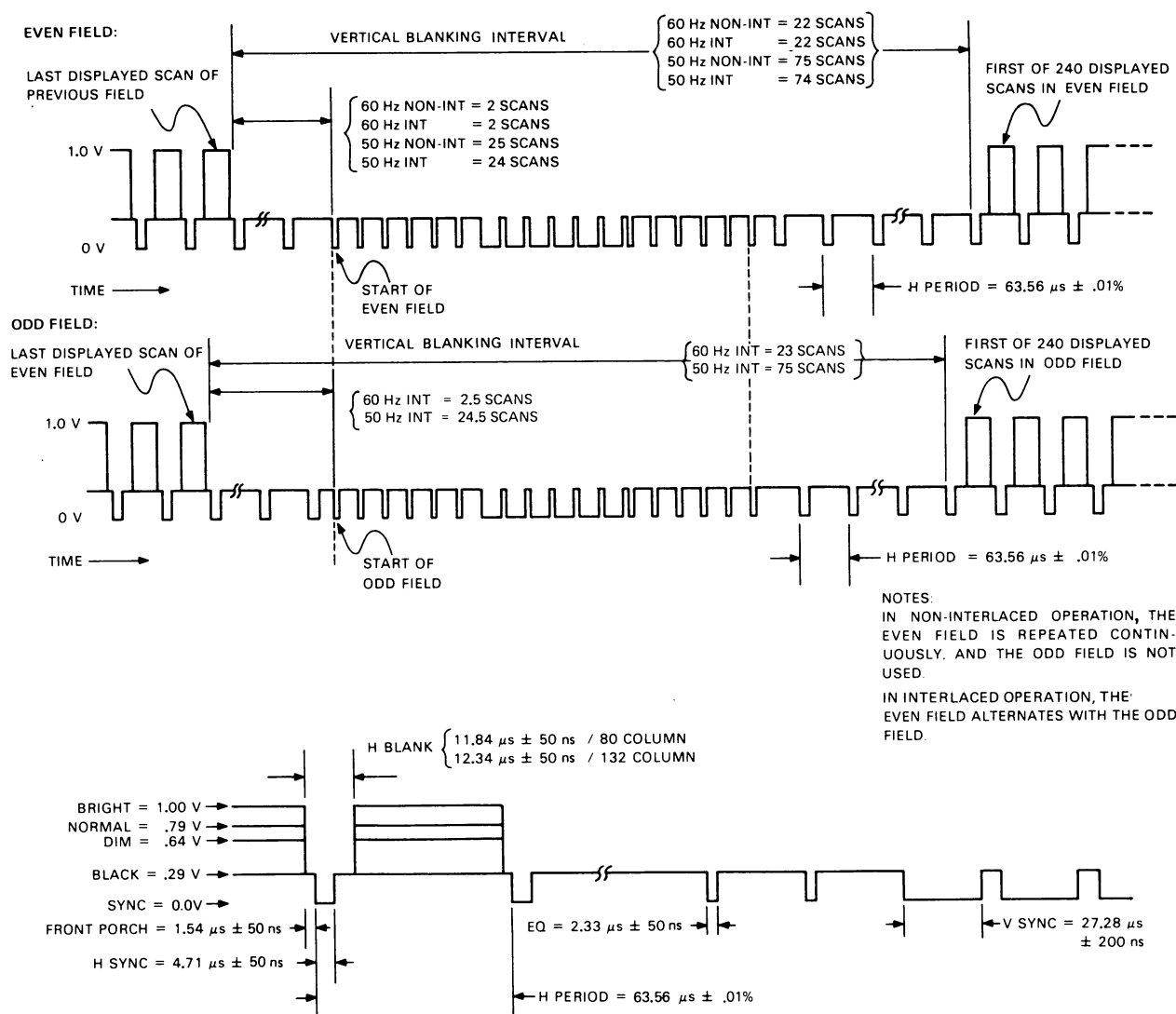
1. Output impedance = 75 ohms, dc-coupled
2. Sync level = 0 V
3. Black level = approximately 0.3 V with a 75 ohms load
4. White level = approximately 1.0 V with a 75 ohm load
5. The composite sync waveform conforms to EIA RS170 standards. The vertical interval is composed of six equalizing pulses, six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

Equalizing pulse width =  $2.33\mu\text{s} \pm 50$  ns  
 Vertical sync width =  $27.28\mu\text{s} \pm 200$  ns  
 Horizontal sync width =  $4.71\mu\text{s} \pm 50$  ns  
 Horizontal blank time =  $11.84\mu\text{s} \pm 50$  ns(80 column mode)  
                                       =  $12.34\mu\text{s} \pm 50$  ns(132 column mode)  
 Front porch =  $1.54\mu\text{s} \pm 50$  ns  
 Horizontal period =  $63.56\mu\text{s} \pm 50$  ns

#### NOTE

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





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Figure 5-8 Composite Video Output

### 5.5.2 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:

1. Input impedance = 75 ohms, dc-coupled
2. Black level = 0 V
3. White level = 1.0 V
4. Maximum continuous input =  $\pm 2.0 \text{ V}$ .

#### NOTE

The external video source must be synchronized to the VT103 by referencing the composite sync on the composite video output.

## 5.6 VT103 SPECIFICATIONS

### Dimensions

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

### Weight

Monitor	15 kg (33 lbs)
Keyboard	2.0 kg (4.5 lbs)
Shipping Weight	20.5 kg (45 lbs)

### Environment (VT103 without TU58)

Class B: Operating	Temperature: 5° to 40° C (41° 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)

### Environment (VT103 with TU58)

Class A: Operating	Temperature: 15° to 32° C (59° to 90° F) Relative Humidity: 20% to 80%
Non-Operating	Temperature: -34° to +60° C (-29° to +110° F) Relative Humidity: 5% to 95%

#### NOTE

The TU58 medium is rated at 10% to 80% relative humidity non-operating.

### 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	4.0 A RMS maximum at 115 V RMS 2.0 A RMS maximum at 230 V RMS
Input Power	250 VA apparent, 300W maximum
Current Limiting	4 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)
Power Supply Output	+5 Vdc at 16.0 A +12 Vdc at 5.0 A -12 Vdc at 0.50 A -23 Vdc at 0.01 A Convection cooled Power OK signals (BPOK and BDCOK) and line time clock signal to backplane
<b>Display</b>	
CRT	305 mm (12 in) diagonal measure, P4 phosphor
Format	24 lines X 80 characters or 14 lines X 132 characters (selectable)
<b>Alphanumerics</b>	
Character	7 X 9 dot matrix with descenders for lowercase
Character Size	3.35 mm X 2.0 mm (0.132 in X 0.078 in) in 80 column mode 3.35 mm X 1.3 mm (0.132 in X 0.051 in) in 132 column mode
Character Set	96 character displayable ASCII subset (uppercase and lowercase, numeric and punctuation)
Cursor Type	Keyboard selectable, blinking block character or blinking underline.
<b>Keyboard</b>	
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.

**Terminal 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, and 19,200
Code	ASCII
Character Format	Asynchronous 7- or 8-bit characters; keyboard selectable. (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.

**Tape Drive**

Drive	Single motor, head integrally cast into a molded chassis
Drives per Controller	Two; only one may operate at a time.
Data Transfer Rate Read/Write on Tape	41.7 $\mu$ s per data bit; 24K bps
Data Reliability:	
Search Error Rate (Failure to Find Block after 8 Tries)	1 in $10^6$ searches
Soft Data Error	1 in $10^7$ bits read

Hard Error Data Rate (Unrecoverable within 8 tries)	1 in $10^9$ bits read
Error Checking	Checksum with rotation
Average Access Time	9.3 s
Maximum Access Time	28 s
Read/Write Tape Speed	75 cm/s (30 ips)
Search Tape Speed	105 cm/s (60 ips)
Bit Density	315 bits/cm (800 bpi)
Flux Reversal Density	945 fr/cm (2400 frpi)
Recording Method	Ratio encoding

#### **Tape Media Specifications**

Cartridge	DECtape II cartridge (Part Number: TU58-K) with 42.7 m (140 ft) of 3.81 mm (0.150 in) tape  Size: 6.1 × 8.1 × 1.3 cm 2.4 × 3.2 × 0.5 in
Capacity per Cartridge	262K bytes, formatted in 512 blocks of 512 bytes each
Track Format	Two tracks, each containing 1024 individually numbered records; 4 records form 1 block for a total of 512 byte blocks.
Environmental:	
Non-Operating	Temperature: 0° C (32° F) to 50° C (122° F) Relative Humidity: 10% to 80%
Cartridge Life	5000 end-to-end tape passes (minimum)



# CHAPTER 6

## OPTIONS

### 6.1 INTRODUCTION

You may enhance your VT103 by adding available DIGITAL options. The controller board has space provided for an advanced video option. Other LSI-11 bus options are described in the *Memories and Peripherals* handbook.

Contact the nearest DIGITAL Sales Office for further information.

### 6.2 ADVANCED VIDEO OPTION – VT1XX-AB

The advanced video option enhances the basic VT103 by adding the features described below.

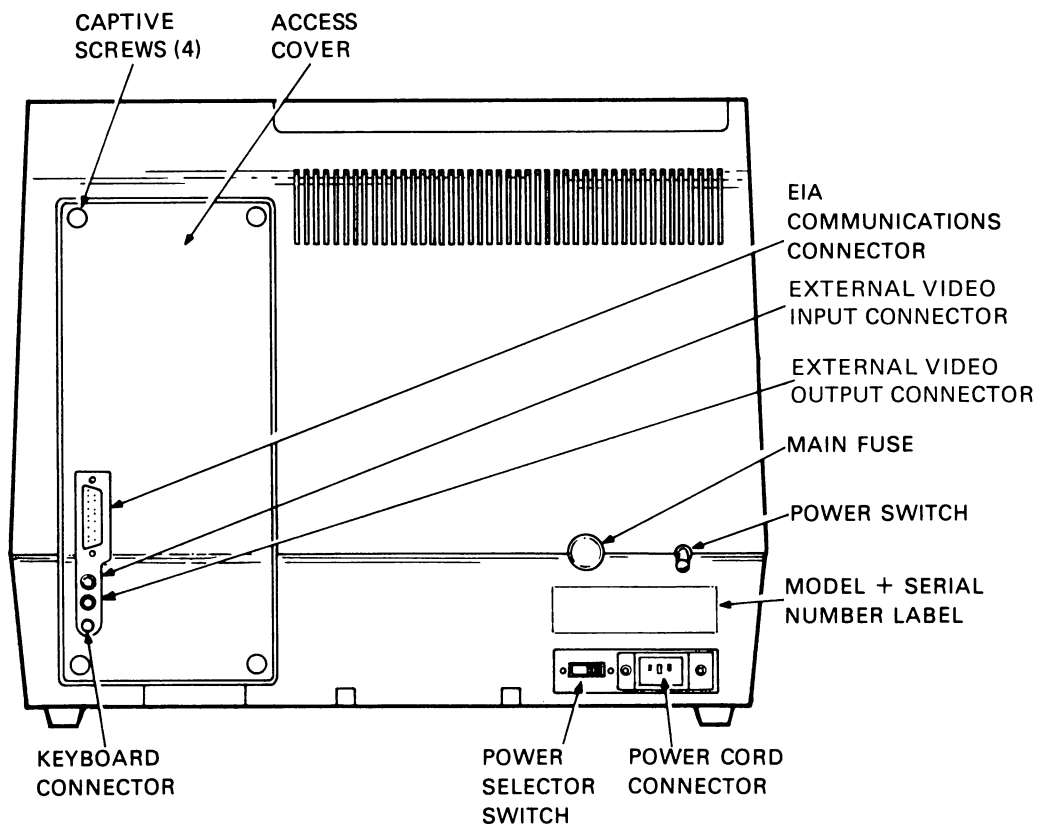
- Ten additional lines of 132 column display are added to the VT103 by providing additional display memory. The screen can now display a total of 24 lines in either 80- or 132-column format.
- Additional character attributes – the VT103 is now capable of highlighting any character(s) on the screen in any of the following ways.
  - Bold
  - Blink
  - Underline
  - Reverse
  - Any combination of the above
- Additional character generator ROM provides the memory required to access a second character generator providing special graphics characters. (See Chapter 2.)

#### 6.2.1 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 6-1).
6. Remove the access cover.
7. Remove other cables if present.
8. Remove the terminal controller board from the leftmost slot in the backplane. Gently but firmly pull the board straight out.
9. Place the terminal controller board on a flat surface with the component side up.

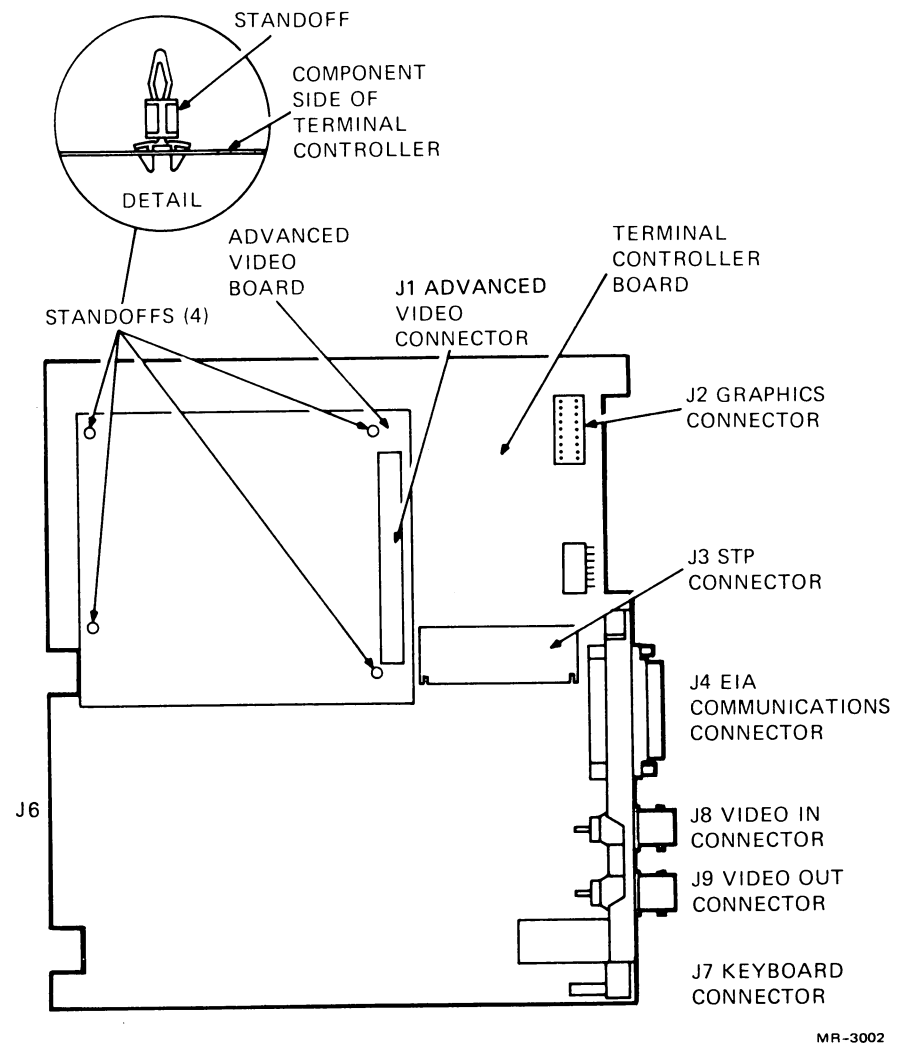


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Figure 6-1 VT103 Rear View



10. Locate the four mounting holes drilled in the terminal controller board shown in Figure 6-2. Mount a standoff in each hole.
11. 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.
12. Reinstall the terminal controller board into the leftmost slot (J1) in the backplane.



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Figure 6-2 Advanced Video Option Installation

13. Reinstall all internal cables removed.
14. Reinstall the access cover.
15. Reinstall the EIA cable to the EIA communications connector.

### 6.2.2 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 X 132 columns.

## 6.3 GRAPHICS CONNECTOR

The VT103 backplane provides a connector for a graphics option. Connector J2 on the backplane provides power to the graphics module. The pin assignments for J2 are listed in Table 6-1.

**Table 6-1 Graphics Connector Pin Assignments for J2 on VT103 Backplane**

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

## 6.4 COMMUNICATION CABLES

Optional communication cables for use with the VT103 are listed in Table 6-2. Contact your local DIGITAL Sales Office for ordering information.

**Table 6-2 Optional Communications Cables**

<b>Cable Part No.</b>	<b>Length</b>	<b>Connectors</b>	<b>Purpose</b>
70-11411-1C	0.38 m (15 in)	Two 10-pin connectors	Connects STP module to serial line interface
BC03M-01	0.3 m (1 ft)	Two RS-232 female Cinch connectors	Null modem; connects terminal to a line unit
BC03M-25	7.6 m (25 ft)		
BC03M-A0	30.5 m (100 ft)		
BC03M-XX*	variable		
BC05D-10**	3 m (10 ft)	RS-232 male Cinch connector to female Cinch connector	Connects terminal to a modem
BC05D-25**	7.6 m (25 ft)		
BC08R-01	0.3 m (1 ft)	Two 40-pin Berg connectors	Connects STP connector to DLV11-E/F or DUV11

\* 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.



# APPENDIX A

## TU58 MESSAGE PACKETS

### A.1 RADIAL SERIAL PROTOCOL (RSP)

The TU58 command strings adhere to Radial Serial Protocol specifications. This is a byte-oriented high-level message protocol used to transfer error-free data between a processor and a peripheral device. This protocol provides an envelope used by the processor and the TU58 to transfer data and commands. The envelope contains the numeric code for the operation to be performed, as well as the location and size of the data files to be transferred, if applicable.

### A.2 MESSAGE PACKETS

All communications between the tape drive controller and the processor module are broken up into message packets. These are groups of bytes arranged in a fixed order. The type of message packet determines the position of the bytes within the packet and the meaning of each individual byte. There are three general categories of message packets: command packets, data packets, and single byte command packets.

A command packet identifies the type of transaction to be performed. There is a start command packet to indicate the operation: write, read, diagnose, get status, set status, and position tape. There is also an end command packet to indicate the status of the operation just performed, whether it is successful or unsuccessful.

A data packet describes the number of bytes of data to be written or read. Data is transferred in 1 to 128 bytes within each data packet.

A single byte command packet controls the transmission or receiving of the data. This is accomplished with single command instructions such as: INIT (initialize), CONTINUE, and XOFF (stop transmitting).

A data transfer operation uses three or more message packets. The first packet is the command packet sent from the processor to the tape drive controller to indicate the type of transaction to be performed; i.e., read, write, etc. Next, the data

is transferred in 128-byte packets. After all data is transferred, the tape controller sends an end command packet to the processor to indicate if the operation was successful. Any error detected is indicated by the end packet.

**NOTE**  
**If the tape drive controller encounters a failure before all data is transferred, the end packet is sent as soon as the failure occurs. During the data transfer, the single command packets control the transfer operation to prevent buffers from overflowing and losing data.**

**A.2.1 Command Message Packet**

The command (control) message packet must be transmitted by the processor to specify the type of transaction to be implemented by the tape drive controller. Table A-1 indicates the byte structure of the command message packet. Each byte is discussed in the following paragraphs.

**Table A-1 Command Message Packet Structure**

	Byte No.	Byte Name
	0	Flag
	1	Message byte count
Message Byte Count	2	Instruction (op code)
	3	Instruction modifier
	4	Unit
	5	Switches byte (maint only)
	6	Not used – Always Zero
	7	Not used
	8	Data byte count – low
	9	Data byte count – high
	10	Block number – low
	11	Block number – high
	12	Checksum – low
	13	Checksum – high

**Flag Byte (Byte 0)** – Each packet begins with a flag byte that identifies the type of message packet to be transmitted. Is it a command packet or a data packet? The flag byte for a message packet is as follows.

Octal Code	Message Packet Identifier
002	The message packet is a command packet.
010	Bootstrap mode – This mode simplifies bootstrap operation. A flag indicating bootstrap (octal 10) followed by a byte containing the drive number causes the TU58 to read block 0 and return 512 bytes with no radial serial packaging.

**Message Byte Count (Byte 1)** – The message byte count is the number of message characters in the packet excluding the following.

1. Flag byte (byte 0)
2. Checksum (bytes 12 and 13)

The message byte count for all command message packets is as follows: the octal code is 012, the byte count is 10 (decimal).

**Instruction Byte (Op Code) (Byte 2)** – The instruction byte (or operational code) informs the tape drive controller of the transaction to be performed.

#### NOTE

Certain codes in the instruction set are reserved for future expansion. These commands have unpredictable results and should not be used. Using instructions (op codes) not listed in this section results in the return of an end command packet with a “bad instruction” success code.

The instructions that can be performed by the tape drive controller are listed in Table A-2.

Table A-2 Instruction Set

Octal Code	Op Code	Instruction
000	0	NOP
001	1	INIT
002	2	READ
003	3	WRITE
004	4	(Reserved)
005	5	POSITION
006	6	(Reserved)
007	7	DIAGNOSE
010	8	GET STATUS
011	9	SET STATUS
012	10	(Reserved)
013	11	(Reserved)
100	64	END MESSAGE PACKET

Refer to Paragraph A.3 for detailed information on each instruction in the instruction set.

**Instruction Modifier (Byte 3)** – The instruction modifier byte is used to alter the execution of the instruction specified by byte 2 of the command message packet. Refer to the modified op codes in Paragraph A.3 for additional information on instructions that may be changed.

**Special Address Mode** – Setting the most significant bit of the modifier selects special address mode. In this mode, all tape positioning operations are addressed by 128 byte blocks (0–127) instead of 512 byte blocks (0–511). Writing all zeros in a write-only instruction fills out a 128-byte boundary in this mode.

**Unit Number (Byte 4)** – The unit number specifies which of the two tape drives is to be used during the transaction.

Octal Code	Tape Drive Selected
000	Drive 0
001	Drive 1

**Switches Byte (Byte 5)** – Setting bit 4 of this byte to 1 in a READ command inhibits retries on data errors. Instead, any incorrect data is sent to the host followed by an end packet. The success code in the end packet indicates a data check error (357).

Since data is transmitted in 128 byte packets, a multiple packet read progresses normally until a read error occurs. A bad data packet transmitted is followed by an end packet, and the operation terminates.

#### NOTE

**Bytes 6 and 7 are not used. Set these bytes to zero.**

**Data Byte Count (Bytes 8 and 9)** – The data byte count indicates the number of data bytes to be transferred by a read or write instruction. The data byte count is ignored when using other instructions.

**Block Number (Bytes 10 and 11)** – The block number bytes indicate the data block number to be used by all instructions which require tape positioning. The block number bytes are ignored by instructions not requiring tape positioning.

**Checksum (Bytes 12 and 13)** – The last two bytes of the command message packet contain a 16-bit checksum used in detecting bit errors in the reception of the message packet. The checksum is formed by summing successive byte pairs, taken as 16-bit words, using an end-around carry from bit 15 to bit 0. The 16-bit words are created using successive byte pairs of the command packet from byte 0 through byte 11, inclusive.

#### A.2.2 End Packets

The end packet is a special case of the command message packet category. It is sent to the processor by the tape drive controller. The end packet is sent after the completion of an operation; or it is sent on the detection of an error condition. When an error condition is detected, the tape controller sends an end packet before the current packet is completely transferred by the processor. The reception of the premature end packet (with a command flag instead of a data flag) informs the processor that the tape drive controller has detected an error condition. Table A-3 illustrates the format and byte positions of the end packet. A detailed description of each byte is provided in the following paragraphs.

**Flag Byte (Byte 0)** – Each packet begins with a flag byte that identifies the type of message packet to be transmitted. The flag byte (002<sub>8</sub>) for all command message packets identifies this packet as a command packet.



**Table A-3 End Packet**

	Byte No.	Byte Name
	0	Flag
	1	Message byte count
Message Byte Count	2	Instruction (op code)
	3	Success code
	4	Unit number
	5	Not used
	6	Not used – Always Zero
	7	Not used
	8	Data byte count L
	9	Data byte count H
	10	Summary status L
	11	Summary status H
	12	Checksum L
	13	Checksum H

**Message Byte Count (Byte 1)** – The message byte count is the number of message characters in the packet excluding the following.

1. flag byte (byte 0)
2. checksum (bytes 12 and 13)

The message byte count used (012<sub>8</sub>) will be 10 (decimal) for all end message packets.

**Instruction Byte (Op Code) (Byte 2)** – The instruction byte (or operational code) informs the LSI-11 processor of the transaction that was performed. The instruction for an end packet is 100<sub>8</sub>. The TU58 transmits the end packet.

**Success Code (Byte 3)** – The success code byte is transmitted by the tape drive controller to the processor to indicate the status of the transaction just completed or the cause of an interrupted operation. The success codes that can be transmitted by the tape drive controller are listed in Table A-4.

**Unit Number (Byte 4)** – The unit number specifies which of the two tape drives was used during the transaction.

Octal Code	Selected Tape Drive
000	Drive 0
001	Drive 1

#### NOTE

Bytes 5, 6, and 7 are not used.

**Data Byte Count (Bytes 8 and 9)** – The data byte count indicates the number of data bytes transferred by the read or write operation. In a good transaction, this byte should be the same as the data byte count of the command packet which initiated the transfer. This byte is ignored by other commands.

Table A-4 End Packet Success Codes and Definition

Octal Code	Success Indication	Definition
000	Normal success	Operation is complete as defined by the instruction byte (byte 2).
001	Success with retries	Operation is complete as defined by the instruction byte (byte 2) but success was obtained only after repeated attempts.
311	Bad block number	The data block specified in bytes 10 and 11 is not possible.
320	Bad instruction	The instruction in byte 2 of the command message packet cannot be performed by the tape drive.
337	Motor stopped	Tape motion has stopped due to a tape drive logic problem or a bad tape cartridge.
340	Seek error	The tape drive data block cannot be found. Controller is unable to locate the data block specified by bytes 10 and 11 of the command message packet.
357	Data check error	Message checksums do not match.
365	Write protected	The tape cartridge located in the tape drive specified by byte 4 of the command message is write protected.
367	No cartridge	No tape cartridge is installed in the tape drive specified in byte 4 of the command packet.
370	Bad unit number	The unit number specified by byte 4 of the command message packet is incorrect; for example, a nonexistent drive unit.
376	Partial operation	Operation defined in the instruction byte (byte 2) has not been completed due to reaching the end of the tape cartridge.
377	Failed self-test	The tape drive controller failed to pass the internal self-test, initiated during the power-up sequence, during a master reset instruction or INIT instruction.

**Summary Status (Bytes 10 and 11)** – These two bytes can be monitored for error conditions. When no errors occur, both bytes equal zero. Byte 10 is reserved for future expansion. Byte 11 has the following error bit assignments.

Byte 11	Error Condition
Bit 0	Reserved
1	
2	
3	
4	Logic error
5	Motion error
6	Transfer error
7	Special condition error

**Checksum (Bytes 12 and 13)** – The last two bytes of the end packet contain a 16-bit checksum used in detecting bit errors in the end command message packet. The checksum is formed by summing successive byte pairs, taken as 16-bit words, using an end-around carry from bit 15 to bit 0. The 16-bit words are created using successive pairs of the end packet from byte 0 through byte 11, inclusive.

### A.2.3 Data Message Packets

The data message packet is transmitted between the processor and tape drive controller in either direction depending on the type of instruction being executed (i.e., read or write). One data message packet transfers between 1 and 128 data bytes. For data transfers larger than 128 bytes, the transaction is broken up into multiple data packets and is sent 128 bytes at a time.

During a read instruction, the tape drive controller does not wait for a CONTINUE flag between message packets, as shown in Figure A-1. The processor is assumed to have enough buffer capacity to accept the entire transaction.

During a write command, the processor must receive the CONTINUE command from the tape drive controller before sending the next message packet, as shown in Figure A-2. This condition occurs because the tape drive controller has 128 bytes of buffer space, and it must finish all data processing before accepting an additional message packet.

The data message packet format is shown in Table A-5, and a description of each byte is provided in the following paragraphs.

**Flag Byte (Byte 0)** – Each packet begins with a flag byte that identifies the type of message packet to be transmitted. The flag byte is the same for all data message packets.

Octal Code	Message Packet Identifier
001	This flag informs the receiver that data, rather than a command, is arriving. The receiver loads the incoming bytes into a buffer area in memory and should not wait for an instruction to execute.

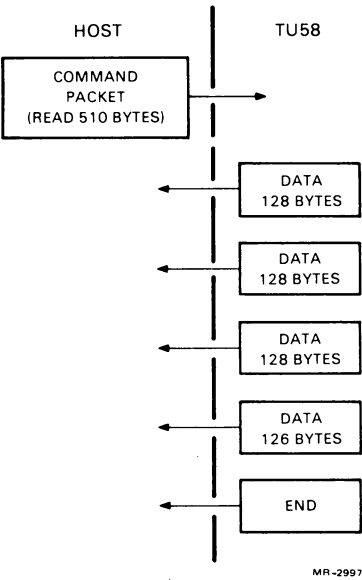


Figure A-1 Read Command Packet Exchange

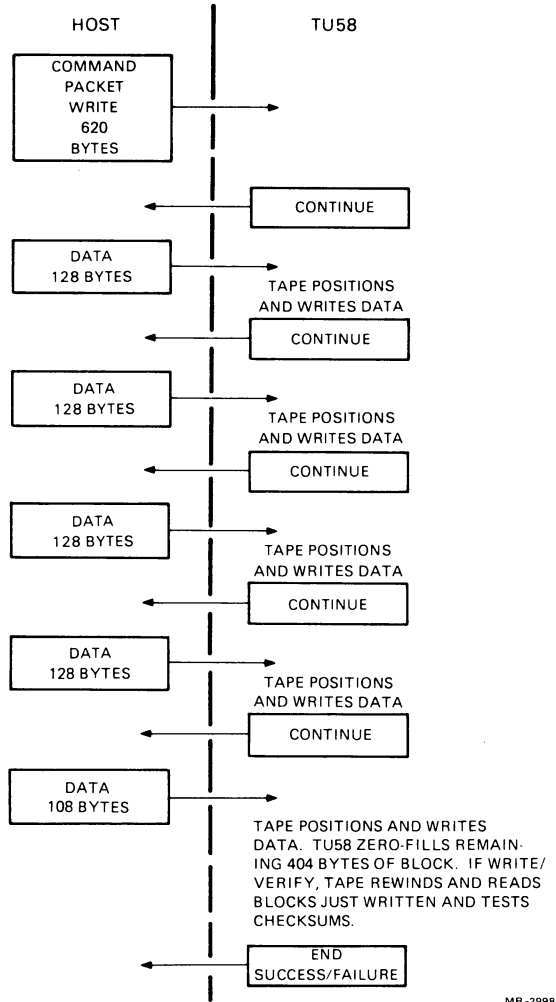


Figure A-2 Write Command Packet Exchange

Table A-5 Data Packets

	Byte No.	Byte Name
	0	Flag
	1	Byte count = M
Data Bytes Transferred	{ 2 3 • • • M M + 1	First data byte
		Next data byte
		(data)
		(data)
		(data)
		(data)
	M + 1	Last data byte
	M + 2	Checksum L
	M + 3	Checksum H

**Byte Count (Byte 1)** – This is the number of data bytes (M) to be transferred by this data message. Between 1 and 128 data bytes may be transferred within one data message. For data transfers larger than 128 bytes, the transaction must be broken up into multiple data packets and sent 128 bytes at a time.

**Data Bytes (Bytes 2 through M+1)** – This is the data space for a single record on the tape. Up to 128 bytes may be written into this space for one data message.

**Checksum (Bytes M+2 and M+3)** – The last two bytes of the data message packet are a 16-bit checksum used in detecting bit errors in the reception of the data packet. The checksum is formed by summing successive byte pairs, taken as 16-bit words, using an end-around carry from bit 15 to bit 0. The 16-bit words are created using successive byte pairs of the data packet from byte 0 through M+1 (the end of the transmitted data) inclusive.

#### A.2.4 Single Byte Commands

The tape drive controller reacts to a set of three single-byte control commands as follows.

Octal Code	Command Name	Function
004	INIT	Initialize tape and perform self-test.
020	CONTINUE	Ready to receive command or continue data transmission.
023	XOFF	Stop transmission and wait for CONTINUE.

**INIT** – This control command is used in several instances.

1. When the TU58 is powered up, it performs an internal checkout and initialization procedure.
2. Upon completion of the power-up sequence, the TU58 returns INIT commands continuously to the host to indicate that the power-up sequence has been completed.
3. The host acknowledges the TU58 by sending a BREAK and two NULL characters. When transfer is complete the host removes the BREAK then sends two INITs. The TU58 responds with CONTINUE, and it enters an idle state to wait for further instructions from the host.
4. If a communication breakdown occurs due to any problem, the host may restore order by sending a BREAK and two INIT commands. The TU58 reinitializes itself, returns a CONTINUE command, and waits for further instruction.
5. If the TU58 makes a protocol error or receives an invalid command, it reinitializes itself and sends 261 INIT commands to the host. The host does not interpret the INIT until it receives a complete message packet; in this case, it is expecting a data message that contains 261 bytes and discovers the error when it expects an end packet and does not receive one.

**CONTINUE** – This control command is used by the TU58 to control the flow of data; thus, it averts buffer overflows and the possibility of data loss. This command is used as follows.

1. After a message is sent by the host to the TU58, the host must wait until the TU58 sends CONTINUE before any more messages can be sent. The TU58 enters an idle state and waits for further instruction.
2. If the host is unable to receive all of a message from the TU58, it may send XOFF to stop transmitting. The TU58 stops and waits for the host to send CONTINUE before completing the data transfer.

**XOFF** – The tape drive controller supports the XOFF command. When the tape controller receives an XOFF command, it stops transmitting immediately and waits until the reception of the CONTINUE command before resuming data transmission.

### A.3 INSTRUCTION SET (OP CODE)

The instruction set described in this paragraph is a detailed description of the instruction byte, byte 2, of the command message (Paragraph A.2.1). The instruction byte or operational code (op code) informs the tape drive controller of the transaction to be performed. The instruction set is repeated in Table A-6.

#### NOTE

**Certain codes in the instruction set are marked "Reserved." These codes are for future expansion. Using these codes may have unpredictable results, and they return an end command packet with a "bad instruction" success code.**

**Table A-6 Instruction Set**

Octal Code	Op Code	Instruction
000	0	NOP
001	1	INIT
002	2	READ
003	3	WRITE
004	4	(Reserved)
005	5	POSITION
006	6	(Reserved)
007	7	DIAGNOSE
010	8	GET STATUS
011	9	SET STATUS
012	10	(Reserved)
013	11	(Reserved)

**NOP – Op Code 0**

The NOP instruction performs no tape operation but causes the tape drive controller to return an end packet. There is no modifier to the NOP instruction. The NOP command message packet is shown in Table A-7.

**Table A-7 NOP Instruction Message Packet**

Byte No.	Octal Code	Byte Name
0	002	Flag (Command)
1	012	Message byte count
2	000	Instruction (op code)
3	000	Instruction modifier
4	00X*	Unit number
5	000	(not used)
6	000	(not used)
7	000	(not used)
8	000	Byte count L (no data involved)
9	000	Byte count H
10	000	Block number L (no tape positioning)
11	000	Block number H
12	01X*	Checksum L
13	012	Checksum H

\*X = A variable number from 0 to 7 (octal)

The tape drive returns the end command packet shown in Table A-8.

**INIT – Op Code 1**

The INIT instruction performs no tape motion but causes the tape drive controller to reset itself. The command packet is the same as for the NOP instruction (Table A-7); except the instruction byte (byte 2), op code = 001, and the low order checksum byte (byte 12) changes, accordingly. The tape drive controller returns the same end packet as described for the NOP instruction. There is no modifier to the INIT instruction.

**Table A-8 NOP Instruction End Packet**

Byte No.	Octal Code	Byte Name
0	002	Flag
1	012	Message byte count
2	100	Instruction (op code)
3	000	Instruction modifier
4	00X*	Unit number
5	000	(not used)
6	000	(not used)
7	000	(not used)
8	000	Data byte count L (no data involved)
9	000	Data byte count H
10	000	Summary status L
11	XXX*	Summary status H
12	OXX*	Checksum L
13	XXX*	Checksum H

\*X = A variable number from 0 to 7 (octal)

### **READ – Op Code 2**

The READ instruction causes the tape drive controller to position the tape in the drive selected by the unit number byte (command byte 4) to the block designated by the block number byte (command bytes 10 and 11). The tape drive controller reads the data starting at the first block and continues reading until the byte count (command bytes 8 and 9) is satisfied. After the data has been sent, the tape drive controller sends an end packet.

Byte 3 of the end packet indicates the success of the read operation. Was the read operation successful on the first try, successful with retries, or did it fail? In the event of a failure, the end packet is sent at the time of failure without filling up the data count. An end packet can be recognized by the processor by the flag byte (byte 0) containing a command flag byte (octal 002) instead of a data flag (octal 001).

### **READ WITH INCREASED THRESHOLD – Modified Op Code 2**

There is one modifier to the read command. A modifier of octal 001 in byte 3 of a read command packet causes the tape drive controller to read the tape with an increased threshold in the data recovery circuit. This command is used to verify data integrity.

### **WRITE – Op Code 3**

The WRITE instruction causes the tape drive controller to position the tape in the tape drive selected by the unit number byte (command byte 4) to the block specified by the block number byte (command bytes 10 and 11). The tape drive controller writes data into one or more blocks until the byte count (command bytes 8 and 9) is satisfied. The controller will automatically fill any remaining bytes in a 512-byte block with zeros.

### **WRITE AND VERIFY – Modified Op Code 3**

There is one modifier to the WRITE command. A modifier of octal 001 in byte 3 of a common packet causes the tape drive controller to write and verify all of the data contained in the data packet. First, all of the data is written. Then, to verify the data, the tape drive controller returns to the newly written data and performs a



read operation. The checksum of each record is then tested. If the checksums of each are correct, the tape drive controller sends an end packet with the success code 000 for writing successfully on the first try; or octal 001 if retries were necessary to read the data. Failure to read the data correctly results in a success code of (octal 372) to indicate an unsuccessful operation with a hard read error.

During the write operation, the tape drive controller may only buffer 128 bytes of data per write command packet. Therefore, it is necessary for the processor to send a data packet and wait for the write operation to be completed before sending the next data packet. This is accomplished using the CONTINUE flag. The CONTINUE flag is a single byte command of octal 020 from the tape drive controller to the processor.

**NOTE**

**Op code 4 is reserved for future use.**

**POSITION – Op Code 5**

The POSITION command causes the tape drive controller to position the tape on the selected drive (indicated by command byte 4) to the block designated by command bytes 10 and 11. After reaching the selected block, the tape controller sends an end packet to the processor. There is no modifier to the POSITION instruction.

**NOTE**

**Op Code 6 is reserved for future use.**

**DIAGNOSE – Op Code 7**

The DIAGNOSE command causes the tape drive controller to run its internal diagnostic program. Upon completion, the tape drive controller sends an end packet with the appropriate success code. There is no modifier to the DIAGNOSE instruction.

**GET STATUS – Op Code 8**

The GET STATUS instruction is treated as a NOP instruction. The tape drive controller returns an end packet containing the current tape drive controller status.

**SET STATUS – Op Code 9**

The SET STATUS instruction is treated as a NOP instruction. The tape drive controller returns an end packet.

**NOTE**

**Op Codes 10 and 11 are reserved for future use.**

## **A.4 GENERAL PROGRAMMING CONSIDERATIONS**

Some device-related functions required during operation are not dealt with directly by the TU58 or the radial serial protocol commands. Software suggestions and considerations related to these device-related functions are listed below.

1. A short routine should be included in the tape drive device handler to provide a complete wind-rewind procedure for new or environmentally stressed tape cartridges. To accomplish this, use the POSITION command to move the tape to a data tape block at each end of the tape cartridge. This procedure brings the tape cartridge to the proper tape tension and also prevents sticking (which causes data errors).

2. The tape drive device handler should check the success code (byte 3 of the end packet) for the presence of soft errors (temporary data loss) and notify the operator. This will enable action to be taken before hard errors (permanent data loss) occur. For example, if the number of retries on a particular cartridge reaches some specified value, a message like TAPE MAINTENANCE REQUIRED could be displayed to prompt the operator to copy the tape or clean the tape drive components.
3. A short routine should be included in the tape drive device handler to allow the operator to easily create backup copies of a tape cartridge to prevent data loss due to cartridge malfunction.
4. File structured data should be organized with the use of a file directory contained in the first few data blocks of the tape cartridge. The file directory need only contain the number of the first block of the file and the file's byte count. If the file is larger than the 512-byte block, the data is held in additional sequential blocks. During read or write operations, the TU58 uses as many byte blocks as needed to fulfill the specified byte count.
5. When positioning files on the tape, the time performance of the instruction suffers if a multi-block file crosses the rewind boundary since a full rewind occurs. If possible, do not structure files on the tape to cross the following rewind boundaries.

**Rewind Boundary  
Block Numbers**

127 – 128  
255 – 256  
383 – 384

# 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 represents 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 VT103 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; that is, 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; that is, 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 60<sub>8</sub> to 176<sub>8</sub> inclusive.
2. The final character in a control sequence is from 100<sub>8</sub> to 176<sub>8</sub> 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.

**Home** – The character position at the origin; for example, 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 40<sub>8</sub> to 57<sub>8</sub> inclusive.

**Numeric Parameter** – A string of characters that represents a number  $P_n$ .  $P_n$  has a range of 0 ( $60_g$ ) to 9 ( $71_g$ ).

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

**Parameter String** – A string of characters that represents 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 sub-functions, designated by  $P_s$ . Each  $P_s$  character has a range of 0 to 9 ( $60_g$ – $71_g$ ); each character is separated by a semicolon.

**VT52 Mode** – A mode in which the terminal recognizes and responds only to control functions used in early DIGITAL video terminals; for example, VT52.

## B.2 CONTROL FUNCTION NOTATION

The abbreviations or notation used for defining the control functions for the VT103 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[IP<sub>n</sub>;P<sub>n</sub>...P<sub>n</sub>F**

where:

1. **ESC[** is the control sequence introducer ( $033\ 133_g$ ) for a 7-bit character environment.
2. **P** is a parameter character within the range of  $060$  to  $077_g$ . Zero or more parameter characters may be included in a control sequence. Parameter characters are separated by a semicolon ( $073_g$ ).
  - a. **P<sub>n</sub>** is a numeric parameter within the range of 0 through 9 ( $060_g$ – $071_g$ ).
  - b. **P<sub>s</sub>** is a selective parameter from a specified list.
3. **I** is an intermediate character within the range of  $040$ – $057_g$ . Zero or more intermediate characters may be included in a control sequence.
4. **F** is a final character within the range of  $100$ – $176_g$ .

### 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 VT103, is: **ESC I . . . I F**

where:

1. **ESC** is the introducer control character ( $33_g$ ) 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  $40_8$  to  $57_8$  in both 7- and 8-bit character formats.
3. **F** is the final character. "**F**" characters have a range of  $60_8$  to  $176_8$  using 7 bits;  $200_8$  to  $237_8$  using 8 bits.

**NOTE**

The occurrence of control characters ( $0_8$  to  $37_8$ ) 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 stops and the new control function begins.
2. If the character **CAN** ( $30_8$ ) or the character **SUB** ( $32_8$ ) occurs, the current control function stops.

# APPENDIX C

## 7-BIT ASCII CODE

Table C-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	
035	GS	075	=	135	]	175	}
036	RS	076	>	136	^	176	~
037	US	077	?	137	_	177	DEL





# APPENDIX D

## SUMMARY OF

## VT103 CONTROL FUNCTIONS

Table D-1 summarizes ANSI mode control functions; Table D-2 summarizes VT52 mode control function.

**Table D-1 ANSI Mode Control Functions**

---

### Cursor Movement Commands

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

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

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

---

†PI = line number; Pc = column number.

**Table D-1 ANSI Mode Control Functions (Cont)****Character Attributes****ESC [ Ps;Ps;Ps...;Ps m**

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

Parameter (Ps)	Meaning
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.

**Erasing**

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

**Programmable LEDs****ESC [ Ps;Ps...Ps q**

**Ps** are selective parameters separated by semicolons (073g) and executed in order, as follows.

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

Any other parameter values are ignored.

**Character Sets (G0 and G1 Designators)**

The G0 and G1 characters sets are designated as follows.

Character set	G0 designator	G1 designator
United Kingdom (UK)	<b>ESC ( A</b>	<b>ESC ) A</b>
United States (USASCII)	<b>ESC ( B</b>	<b>ESC ) B</b>
Special graphics characters and line drawing set	<b>ESC ( 0</b>	<b>ESC ) 0</b>
Alternate character ROM	<b>ESC ( 1</b>	<b>ESC ) 1</b>
Alternate character ROM for special graphics characters	<b>ESC ( 2</b>	<b>ESC ) 2</b>

**Table D-1 ANSI Mode Control Functions (Cont)****Scrolling Region****ESC [ Pt;Pb r**

Pt is the number of the top line of the scrolling 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	<b>ESC H</b>
Clear tab at current column	<b>ESC [ g or ESC [ g</b>
Clear all tabs	<b>ESC [ 3 g</b>

**Modes**

Mode Name	To Set		To Reset	
	Mode	Sequence	Mode	Sequence *
Line feed/new line	New line	<b>ESC [20h</b>	Line feed	<b>ESC [20I</b>
Cursor key mode	Application	<b>ESC [71h</b>	Cursor	<b>ESC [71I</b>
ANSI/VT52 mode	ANSI	<i>N/A</i>	VT52	<b>ESC [72I</b>
Column mode	132 Col	<b>ESC [73h</b>	80 Col	<b>ESC [73I</b>
Scrolling mode	Smooth	<b>ESC [74h</b>	Jump	<b>ESC [74I</b>
Screen mode	Reverse	<b>ESC [75h</b>	Normal	<b>ESC [75I</b>
Origin mode	Relative	<b>ESC [76h</b>	Absolute	<b>ESC [76I</b>
Wraparound	On	<b>ESC [77h</b>	Off	<b>ESC [77I</b>
Auto repeat	On	<b>ESC [78h</b>	Off	<b>ESC [78I</b>
Interlace	On	<b>ESC [79h</b>	Off	<b>ESC [79I</b>
Keypad mode	Application	<b>ESC =</b>	Numeric	<b>ESC &gt;</b>

**Reports****Cursor Position Report**

Invoked by	<b>ESC [ 6 n</b>
Response is	<b>ESC [ PI ; Pc R†</b>

**Status Report**

Invoked by	<b>ESC [ 5 n</b>
Response is	<b>ESC [ 0 n</b> (terminal OK) <b>ESC [ 3 n</b> (terminal not OK)

**What Are You**

Invoked by	<b>ESC [ c</b> <i>or</i> <b>ESC [ 0 c</b>
Response is	<b>ESC [ ?1 ; Ps c</b>

\* The last character of the sequence is a lowercase L (154g).

†PI = line number; Pc = column number.

## 130 SUMMARY OF VT103 CONTROL FUNCTIONS

**Table D-1 ANSI Mode Control Functions (Cont)**

---

**Ps** is the "option present" parameter with the following meaning.

<b>Ps</b>	<b>Meaning</b>
0	Base VT103, no options
1	Processor option (STP)
2	Advanced video option (AVO)
3	AVO and STP
4	Graphics processor option (GPO)
5	GPO and STP
6	GPO and AVO
7	GPO, STP, and AVO

Alternately invoked by ESC Z (not recommended). Response is the same.

### **Reset**

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

### **ESC c**

#### **Confidence 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.

<b>Test</b>	<b>Value</b>
Power-up self test (ROM checksum, RAM, NVR, keyboard and AVO if installed)	1
Data loop back	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

---

**Table D-2 VT52 Mode Control Functions**

Cursor up	<b>ESC A</b>	
Cursor down	<b>ESC B</b>	
Cursor right	<b>ESC C</b>	
Cursor left	<b>ESC D</b>	
Select special graphics character set	<b>ESC F</b>	
Select ASCII character set	<b>ESC G</b>	
Cursor to home	<b>ESC H</b>	
Reverse line feed	<b>ESC I</b>	
Erase to end of screen	<b>ESC J</b>	
Erase to end of line	<b>ESC K</b>	
Direct cursor address	<b>ESC YI c</b>	(see Note 1)
Identify	<b>ESC Z</b>	(see Note 2)
Enter alternate keypad mode		
<b>ESC =</b>		
<b>Exit alternate keypad mode</b>	<b>ESC &gt;</b>	
Enter ANSI mode	<b>ESC &lt;</b>	

**NOTES**

1. Line and column numbers for direct cursor address are single character codes whose values are the desired number plus 378. Line and column numbers start at 1.
2. Response to ESC Z is ESC / Z



# VT103

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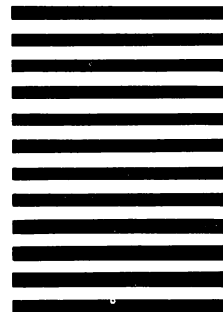
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