RT103-BA-BB/CA-CB

USER'S GUIDE

EP-RTBAC-UG-001

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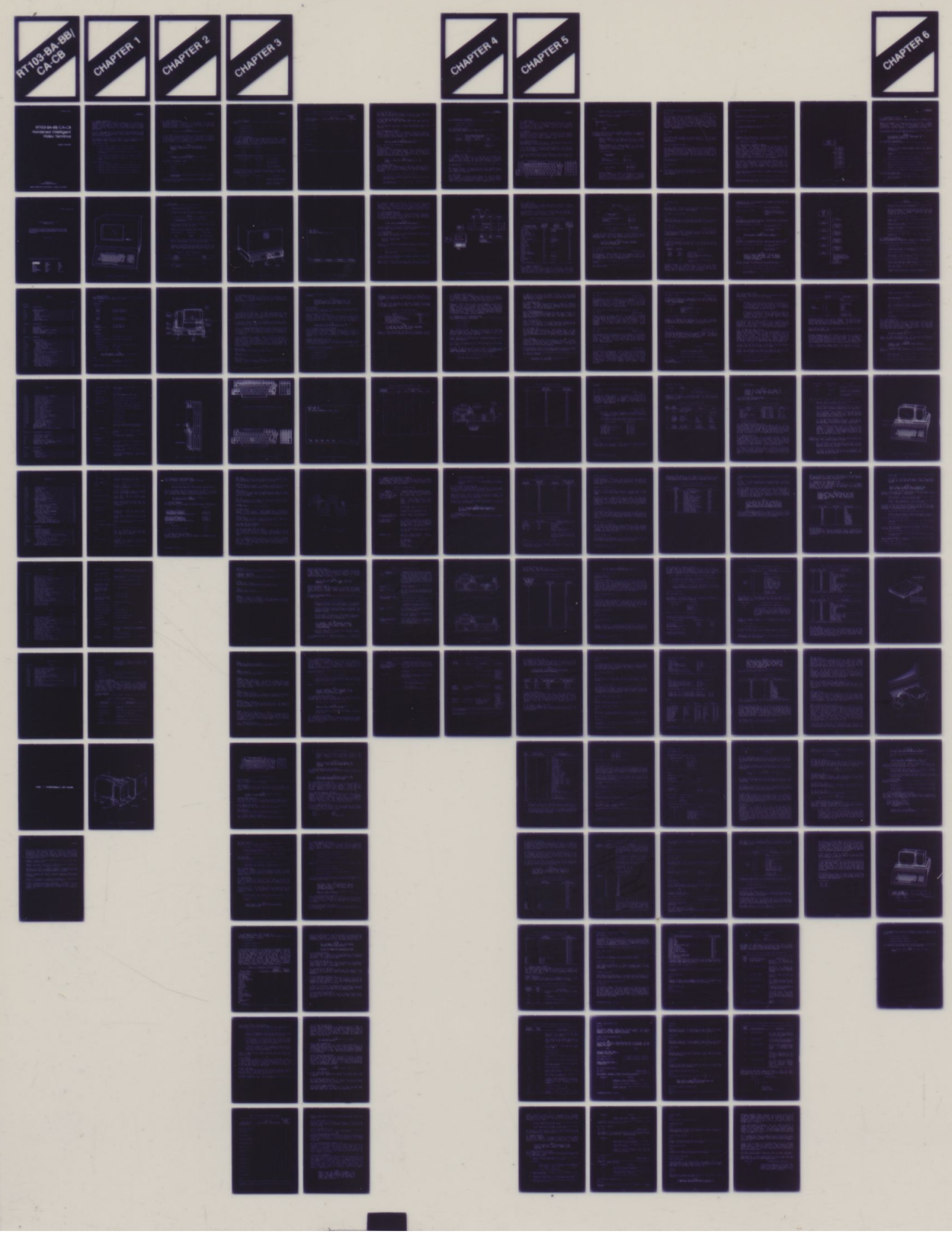

RT10-03-BA-BB/
CA-CB

EK-RTBAC-UG-001

RT103-BA-BB/CA-CB Hardened Intelligent Video Terminal

User's Guide

Prepared by
Computer Special Systems

Digital Equipment Corporation • Hudson, NH 03051

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CONTENTS

CONTENTS (Cont)

CONTENTS (Cont)

FIGURES

Tables

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PREFACE

This user's guide contains information pertinent to four hardened intelligent video terminal models. Because of their minor differences, the RT103-BA, -BB, -CA, and -CB terminals are discussed as one unit in this document. The manual is intended for use by both DIGITAL and customer personnel who are concerned with installation, operation, programming, configuration, and maintenance activities.

Chapter 1 contains a general introduction to the unit and lists equipment specifications.

Chapter 2 provides installation instructions and inspection, checkout, and customer acceptance conditions.

Chapter 3 is devoted to equipment operation describing controls and indicators and tabulating assignment of address space and vectors for the options contained within the terminal.

Chapter 4 contains information concerning terminal configuration and lists restrictions. Several typical configurations are given as examples.

Chapter 5 is dedicated to equipment programming. A tabulation is given for assignments of address space and vectors.

Chapter 6 contains maintenance information. A discussion is given of the recommended maintenance philosophy for the unit. This is coupled with preventive maintenance procedures and a list of typical diagnostic software to be used if the equipment malfunctions.

CHAPTER 1

CHAPTER 1
INTRODUCTION

1.1 GENERAL DESCRIPTION

The RT103-BA -BB/CA -CB (hereafter referred to as the RT103) is a hardened DIGITAL video terminal and keyboard for use in harsh industrial environments. Both the terminal and detachable membrane keyboard are enclosed in steel that provides a rugged building block for industrial control and factory data collection applications.

The unit (shown in Figure 1-1) contains two TU58 DECtape IIs that provide inexpensive mass storage of data. This dual minicartridge system is factory installed within the unit shell. Each cartridge has a 256K byte capacity.

The terminal may be down-line loaded from a host processor via an EIA RS-232-C serial line unit (SLU). When equipped with the proper DIGITAL option, loading can be performed via DECnet.

System features are:

- Integral power supply and 4 X 4 LSI-11 backplane
- Integral TU58 DECtape II dual minicartridge drive
- Sturdy, fan-cooled metal enclosure with filter-protected air intake
- Detachable, metal-enclosed alphanumeric membrane keyboard
- LSI-11 backplane-compatible modules can be used (DEC or other).

System differences are:

- RT103-BA = 120 Vac operation with LSI-11 BUS backplane
- RT103-BB = 240 Vac operation with LSI-11 BUS backplane
- RT103-CA = 120 Vac operation with Q22 BUS backplane
- RT103-CB = 240 Vac operation with Q22 BUS backplane.

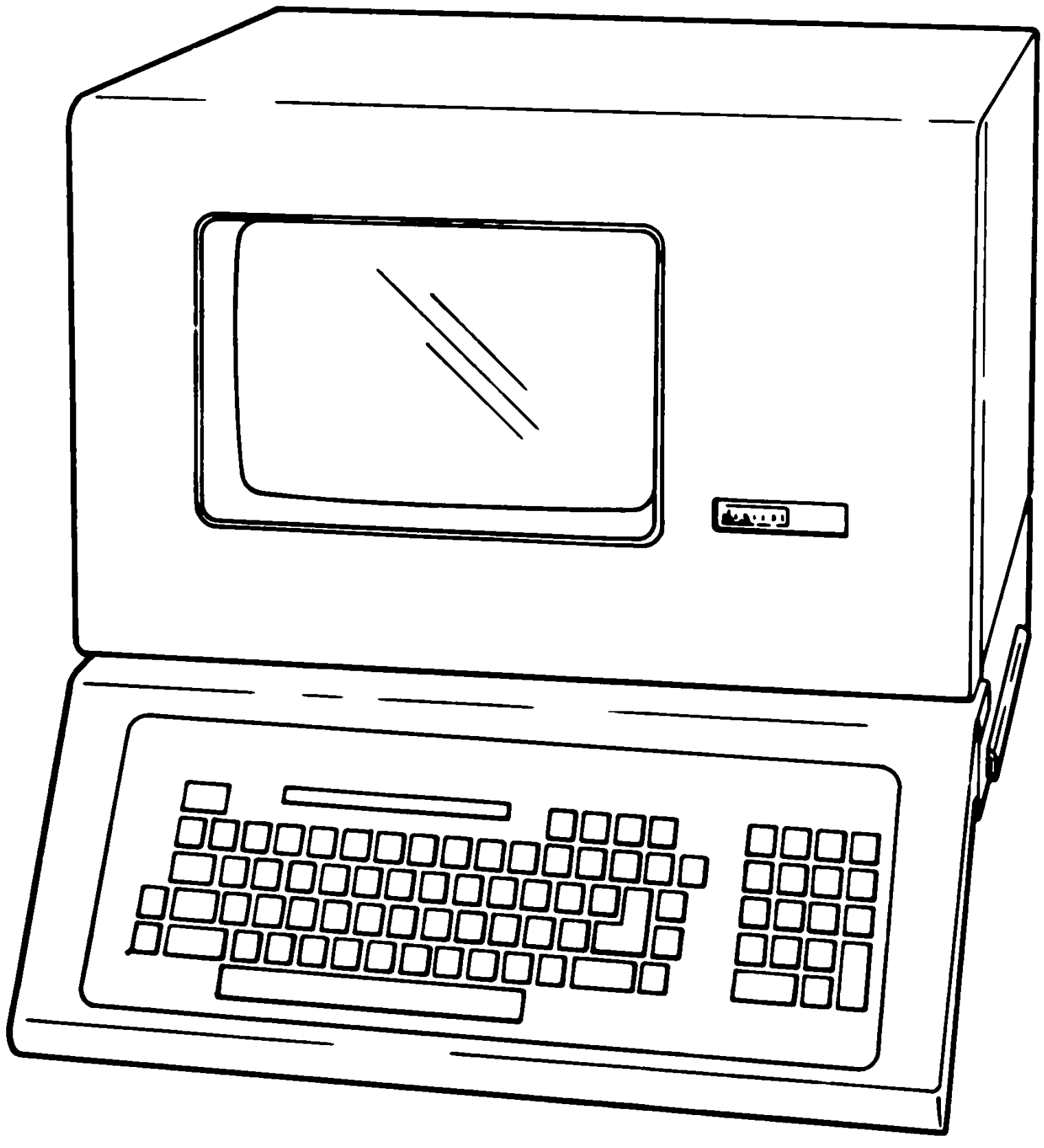

Figure 1-1 RT103 Front View

1.2 SPECIFICATIONS*

Specifications for the RT103 are given below. Unless otherwise noted, parameters given apply to all models.

1.2.1 Terminal

Dimensions

Monitor	
Height	41.25 cm (16.50 in)
Width	51.25 cm (20.50 in)
Depth	45.00 cm (18.00 in)
Keyboard	
Height	4.38 cm (1.75 in)
Width	51.25 cm (20.50 in)
Depth	21.25 cm (8.50 in)

Weight

Monitor	36.0 kg (80.0 lb)
Keyboard	2.7 kg (6.0 lb)
Shipping Weight	45.0 kg (100 lb)

Environment

Class A:
Operating

Temperature	5°C to 40°C (41°F to 104°F)
Relative Humidity	10% to 80% (noncondensing)

Nonoperating

Temperature	-40°C to +66°C (-40°F to +151°F)
Maximum Wet Bulb	28°C (82°F)
Minimum Dew Point	2°C (36°F)

NOTE
The TU58 medium is rated at 10% to 80% relative humidity nonoperating.

Power

Line Voltage	90 to 128 V rms single phase, 2 wire (RT103-BA/CA)

*Specifications are subject to change without notice.

Line Voltage (Cont)	180 to 256 V rms single phase, 2 wire (RT103-BB/CB)
Line Frequency	47 to 63 Hz
Current	4.0 A rms maximum at 115 V rms 2.0 A rms maximum at 240 V rms
Input Power	250 V A apparent, 300 W maximum
Current Limiting	4 A normal blow fuse (two)
Power Cord	Detachable, 3 prong, 1.9m (6.2 ft)
	120 Vac power cord (DEC 17-00083-09)
	240 Vac power cord (DEC 17-00083-10)
Power Supply	+ 5 V at 16.0 A
	+12 V at 5.0 A
	-12 V at 0.50 A
	-23 V at 0.01 A
	Convection cooled
	Power OK signals (BPOK and BDCOK) and line time clock signal to backplane.

1.2.2 Display

CRT	305 mm (12 inch) diagonal measure, P4 phosphor
Format	24 lines X 80 characters or 14 lines X 132 characters (selectable)
Alphanumerics	
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.

1.2.3 Keyboard

General	83-key, detachable membrane unit, enclosed in steel, 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	Eight light-emitting diodes (LED); four LEDs are dedicated to ON LINE, LOCAL, KBD LOCKED and CAPS; four LEDs are user programmable.
Audible Signals	
Key Click	Sounds when keys are typed (user selectable). Two volume levels (jumper selectable).
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.

1.2.4 Terminal Communication

Type	EIA (RS-232-C) or 20 mA current loop
Speeds	Full- or half-duplex 50, 75, 110 (two stop bits), 134.5, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, and 19,200 bits per second.
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.

1.2.5 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 sec per data bit; 24K bits/sec
Search Error Rate (Failure to Find Block After Eight Tries)	1 in 10^6 searches
Soft Data Error	1 in 10^7 bits read
Hard Error Data Rate (Unrecoverable Within Eight Tries)	1 in 10^9 bits read
Error Checking	Checksum with rotation
Average Access Time	9.3 sec
Maximum Access Time	28 sec
Read/Write Tape Speed	75 cm/s (30 in/s)
Search Tape Speed	105 cm/s (60 in/s)
Bit Density	315 bits/cm (800 bits/in)
Flux Reversal Density	945 fr/cm (2400 frpi)
Recording Method	Ratio encoding

1.2.6 Tape Media

Cartridge	DECtape II cartridge (part number TU58-K) with 42.7 m (140.0 ft) of 3.81 mm (0.150 in) tape.
Size	6.1 X 8.1 X 1.3 cm (2.4 X 3.2 X 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; four records from one block for a total of 512 byte blocks.
Environmental	
Nonoperating	
Temperature	0°C to 50°C (32°F to 122°F)
Relative Humidity	10% to 80%
Cartridge Life	5000 end-to-end tape passes (minimum)

1.3 PHYSICAL DESCRIPTION

The RT103 has been hardened for industrial use. The unit consists of a basic terminal (Figure 1-2) housed in a rugged steel enclosure. Cooling is provided by convection and two fans for adequate logic ventilation. The keyboard also has been ruggedized by encasement in steel and contains a membrane keyboard enclosure to both prevent entry of foreign matter that could deteriorate proper operation and to tolerate the rough usage expected in industrial applications.

Standard Equipment

The RT103 consists of the standard equipment listed in Table 1-1.

Table 1-1 RT103 Standard Equipment

Identifier	Description
RT103-BA/BB or	Video terminal with 18-bit LSI-11 BUS backplane
RT103-CA/CB	Video terminal with Q22 BUS backplane
TU58 DECtape II	Dual minicartridge drive
TU58	Diagnostic tape cartridge (installed in drive 0)
TU58-K	Blank cartridge (installed in drive 1)
70-17935	Membrane keyboard

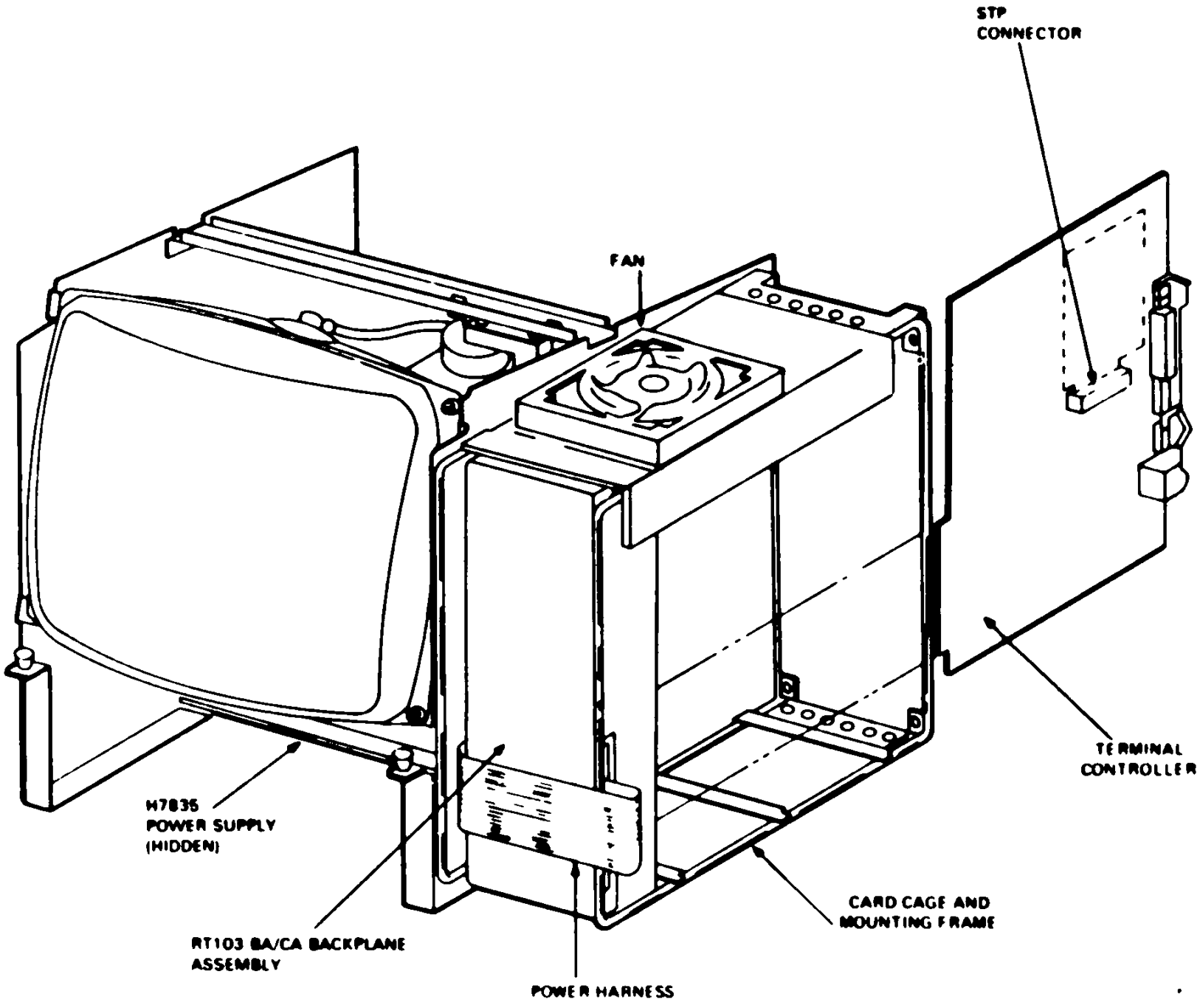

Figure 1-2 RT103 with Case Removed

CHAPTER 2

CHAPTER 2
INSTALLATION

2.1 SITE CONSIDERATIONS

The RT103 should be installed in an environment that meets the specifications given in Chapter 1 of this manual. The terminal should have access to power within the length of the power cord provided, and should be located within the limits of data cable length specified for reliable operation.

CAUTION
Power cord extensions should not be used.

If the terminal is to be operated as a benchtop unit, the keyboard can be either horizontally mounted to the terminal or may be detached and operated within 0.6 meters (2.0 feet) of the unit. If the terminal is to be operated as a workstation, the keyboard can be attached to the terminal in a vertical position and the keyboard cable coiled within the terminal.

NOTE
When operated in a detached position, all mounting holes should be filled with 8-32 screws to prevent dust from entering the keyboard.

2.2 UNPACKING

WARNING
Because of its weight, two people are required to unpack and move the RT103.

The RT103 is packaged within a reinforced corrugated carton containing the following items.

1. RT103 video monitor
2. Keyboard
3. Power cord
4. SET-UP label
5. RT103-BA-BB/CA-CB Hardened Intelligent Video Terminal User's Guide

Instructions are printed on the carton for unpacking the unit. Save carton and all packing materials in case return of equipment to factory is required.

2.3 INSTALLATION

To install the RT103 perform the following steps.

1. Remove the RT103 from the shipping carton and place it in the desired work area.

2. Inspect the equipment for physical damage. If no damage is found, place the terminal in the desired work area.

NOTES

1. Insure power cord has not been connected.

2. Be careful not to damage fan cable running to the terminal.

3. Open the rear cover (two captive Phillips screws in the upper corners of the rear cover). Lift it out of its retainer slot, and set it aside.

4. Verify that the internal power selector switch (see Figure 2-1) shows the correct wall outlet voltage.

Switch Position	RT103 Model	Voltage Range
120	BA/CA	90 to 128 Vac rms
240	BB/CB	180 to 256 Vac rms

5. Verify that the internal power switch, located on the rear of the monitor, is in the ON (up) position, and that the internal power cord is seated properly.

6. See that the backplane has a 2-conductor cable wired to jumper (W4) from the line time clock (LTC) switch. The backplane jumpers and wirewrap pins are shown in Figure 2-2. Their conditions are listed in Table 2-1.

Table 2-1 Jumper Configuration

Jumper Designation	Jumper State
W1,W2,W5	I*
W3	R†

*I = installed.
†R = removed.

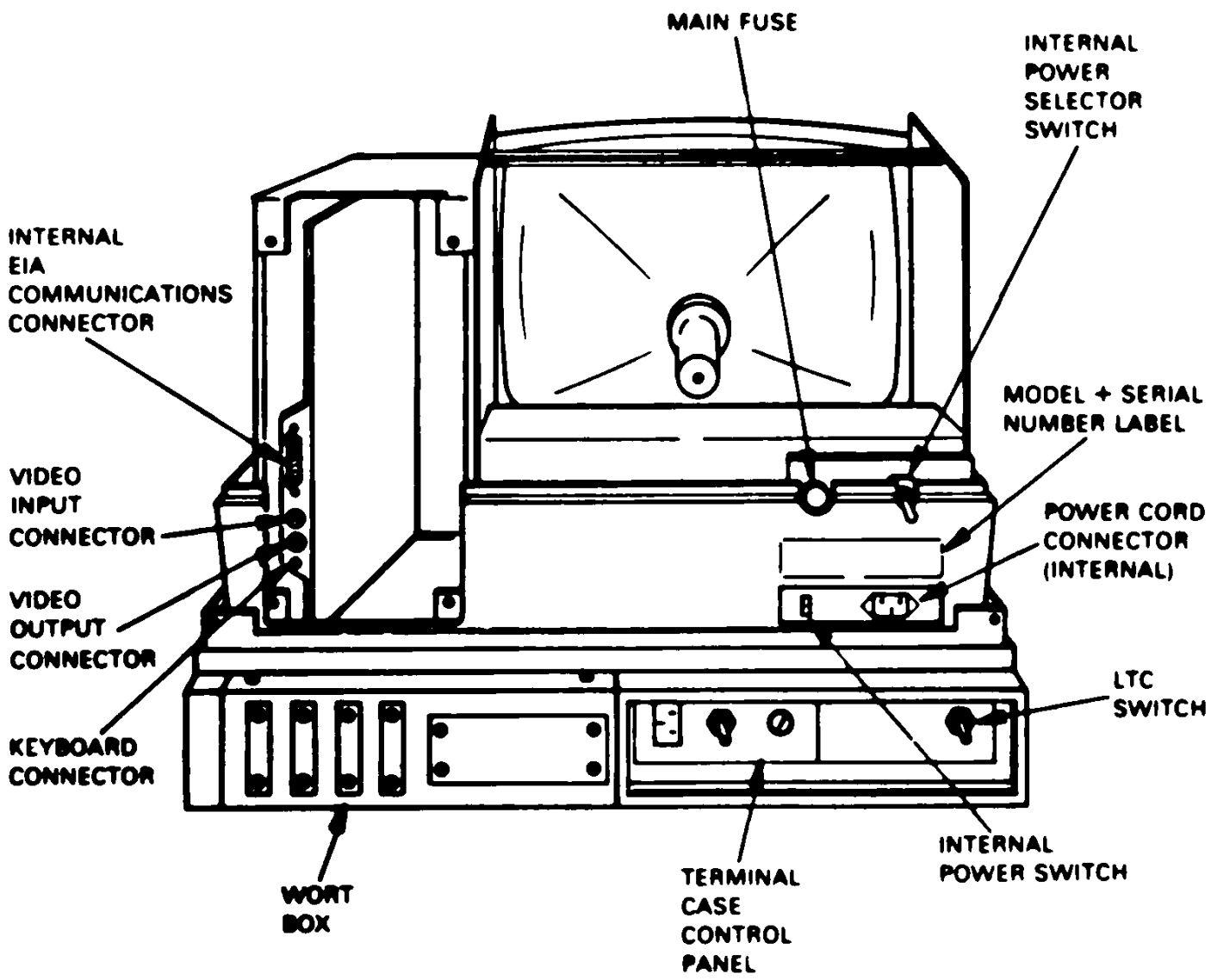

Figure 2-1 RT103 Rear View with Cover Removed

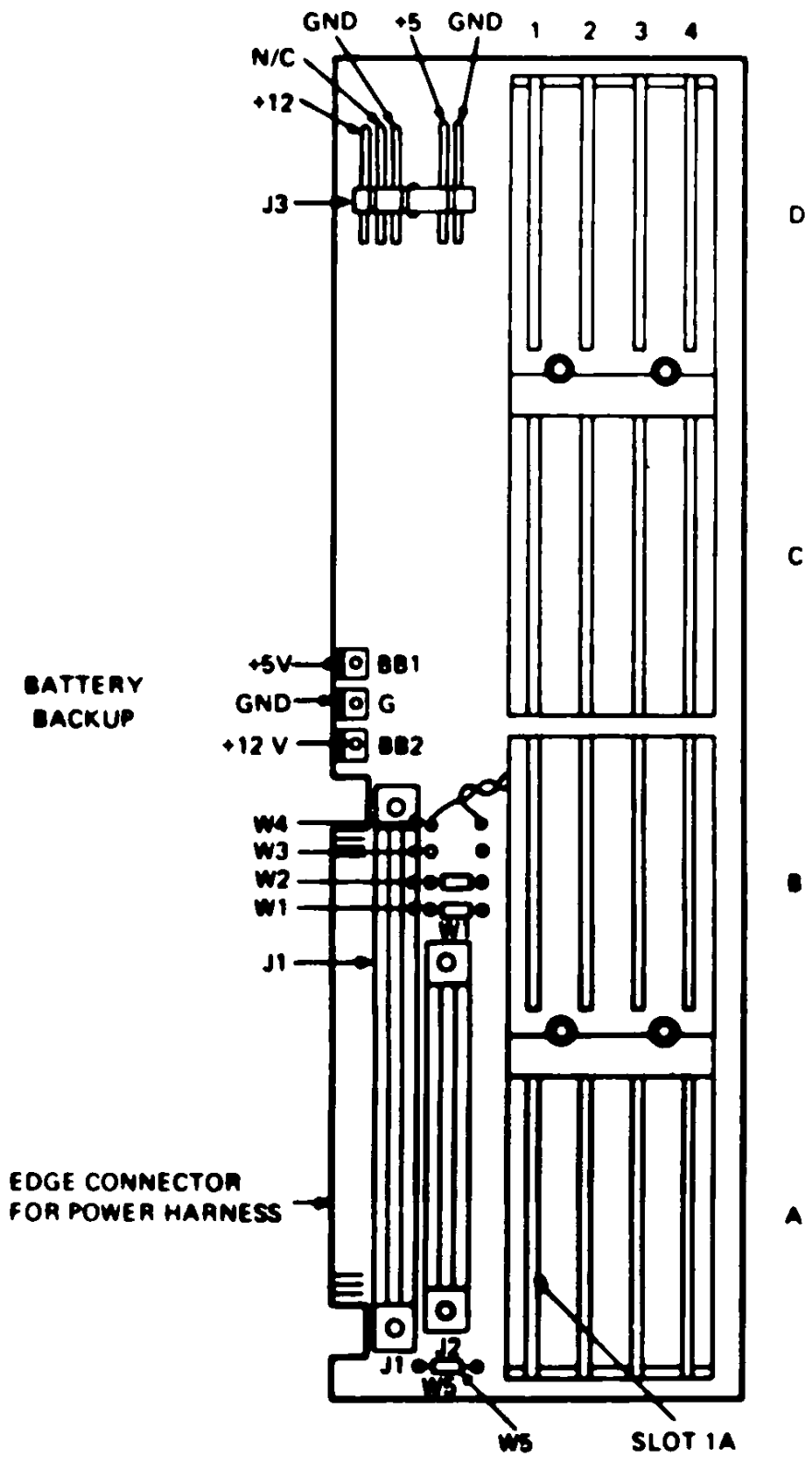

Figure 2-2 RT103 Backplane Assembly

2.4 CHECKOUT AND CUSTOMER ACCEPTANCE

These procedures verify RT103 proper operation and serve as a basis for customer acceptance. Proceed as follows.

1. Turn the terminal power on.

2. Within 10 seconds a short beep is heard from the keyboard and the cursor appears on the screen at home position.

The tone indicates that basic self-testing has completed. If the test is successful, LEDs L1 through L4 will be off. If the test fails, certain indications are provided as described in Section 3.6. Self-test error codes are given in Tables 3-3 and 3-4.

NOTE

The RT103 has been tested and checked out at the factory prior to shipment.

2.5 RELATED DOCUMENTS

The following documents contain information that is pertinent to the RT103 and may be purchased from Digital Equipment Corporation.

Title	Document No
Microcomputer Handbook Series:	
Microcomputer Processors	EB-15115-78
Memories and Peripherals	EB-15114-78
Microcomputer Interface Handbook 1980	EB-20175-20
VT103 Unit Assembly IPB	EK-VT103-IP*
VT103 Print Set (supplement)	MP-00731
TU58 DECtape-II Users Guide	EK-OTU58-UG
VT103 LSI-11 Users Guide and Addendum	EK-VT103-UG

Tape Supplies

Description	Part No
Minitape Cartridges (formatted)	TU58-K
Cleaning Kit for Tape Drive	TUC01

2.6 CUSTOMER ORDERING INFORMATION

Purchase orders, invoices, and correspondence concerning DIGITAL hardware manuals and tape supplies should be forwarded to your local sales office.

*Available in microfiche.

CHAPTER 3

CHAPTER 3
OPERATION

3.1 RT103 OPERATION

There are two types of controls and two types of indicators on the RT103.

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

3.1.1 Monitor Controls

The RT103 is equipped with four monitor controls (shown in Figure 3-1): an internal and external POWER ON/OFF switch, a POWER (voltage) SELECTOR switch, and a line time clock (LTC) switch. The POWER SELECTOR is located internally and the LTC switch is located externally on the unit. The POWER ON/OFF switches apply 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	RT103 Model	Voltage Range
120	BA/CA	90 - 128 Vac rms (typical U.S.)
240	BB/CB	180 - 256 Vac rms (typical European)

The LTC switch controls the operation of an LTC. It is mounted on the rear of the terminal, and when on allows LTC interrupts to the processor at the line frequency of the ac supply. The switch should be used as follows.

Switch Position	Condition	Used When
Up	On	Running system software handlers such as RSX11-M
Down	Off	Running diagnostics or Power-up boot XXDP

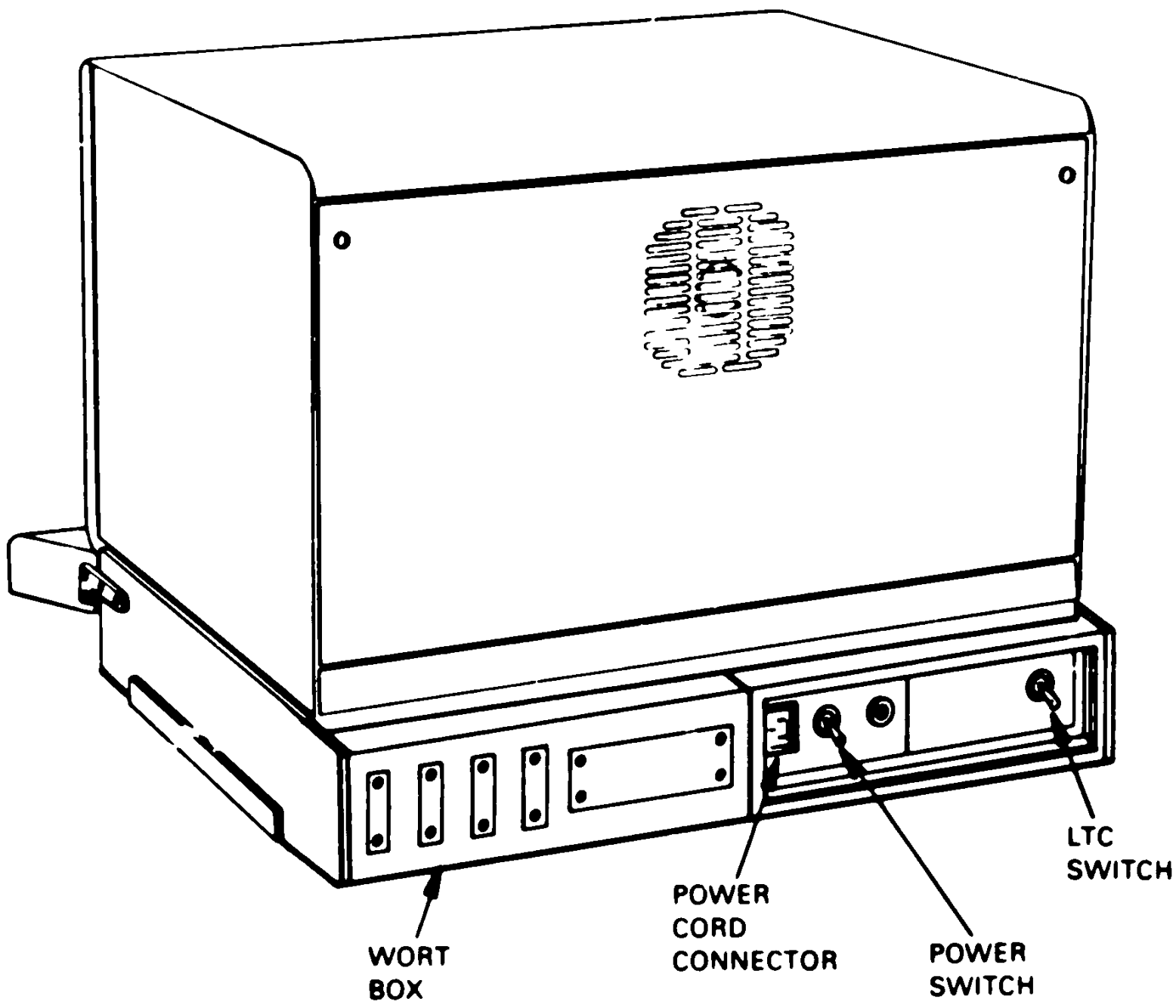

Figure 3-1 RT103 Rear View

3.1.2 Keyboard Controls

The RT103 has a detachable, membrane keyboard equipped with two key areas. The main key area is similar to a standard office typewriter. An auxiliary numeric key area provides rapid data entry similar to an adding machine or calculator. The keyboard keys function as follows.

- Standard alphanumeric keys
- Special function keys
- SET-UP mode keys

The keyboard contains keys that transmit codes and keys that 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 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 1/2 second.

3.1.2.1 Standard Alphanumeric Keys - Figure 3-2 identifies the keys on the keyboard that function as standard typewriter keys and 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).

3.1.2.2 Special Function Keys - Figure 3-3 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. When in keypad application mode, the shaded keys (shown in Figure 3-3) provide additional special functions that may be used by an application program. The general operation of the special function keys is provided in the following paragraphs.

BELL G Key
When pressed in combination with the CTRL key, this key causes a bell code (007_8) to be sent to the host computer.

BREAK Key
This key transmits a break signal.

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

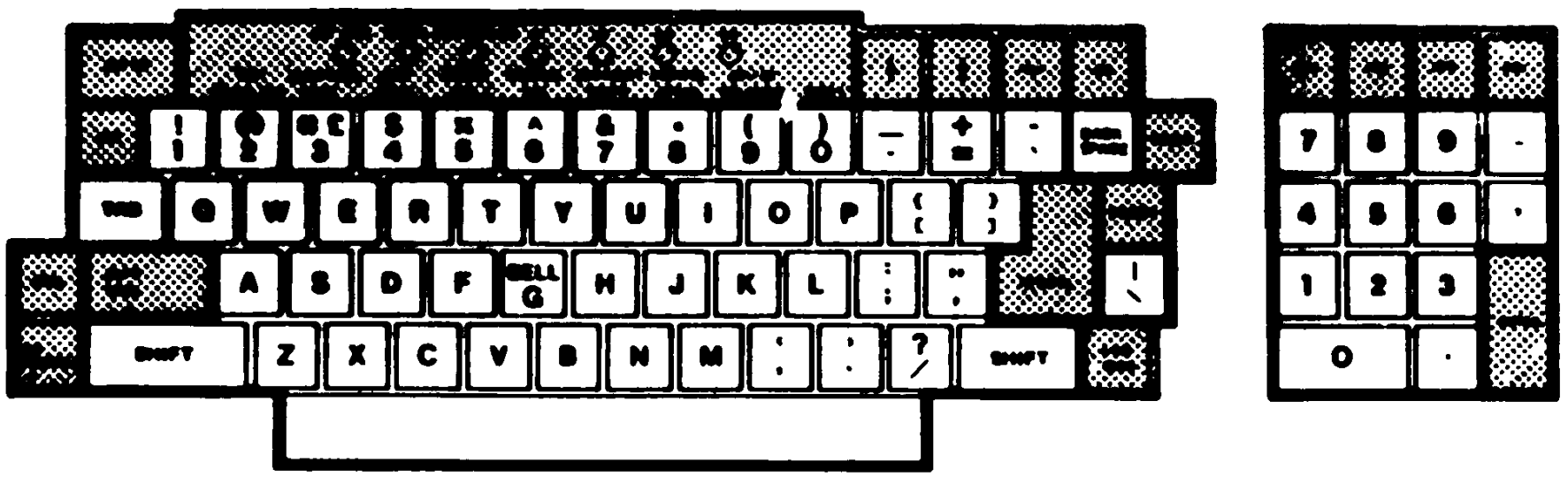

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Figure 3-2 Standard Alphanumeric Keys

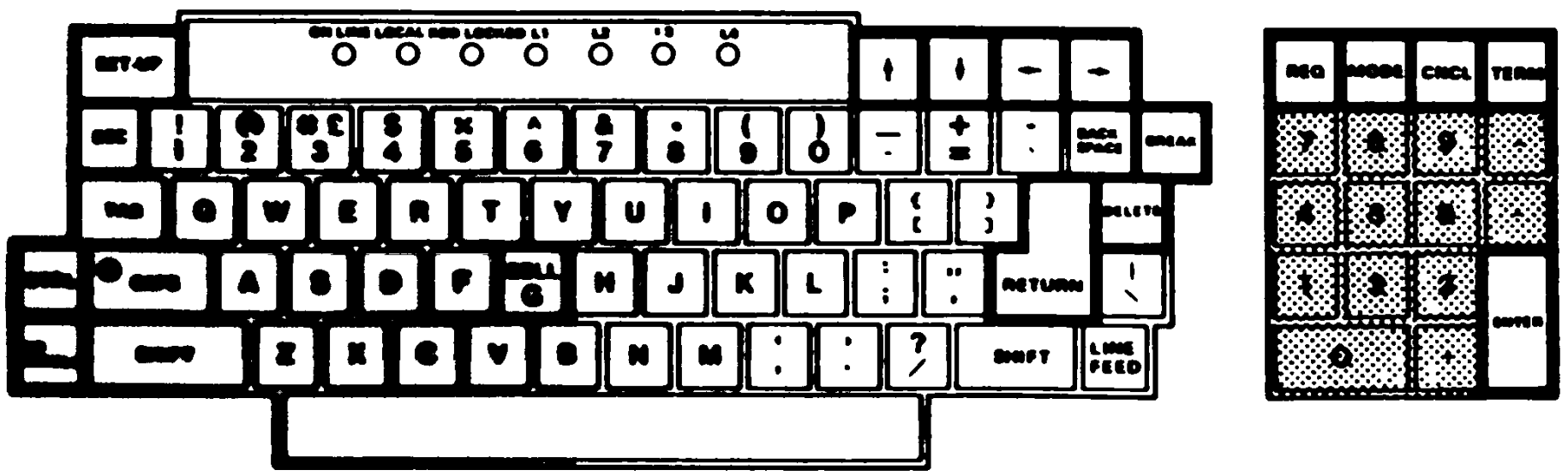

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Figure 3-3 Special Function Keys

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_8) 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_8) 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_8).

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_8) or a carriage return (CR) and linefeed code (LF, 012_8). This is a SET-UP selectable feature. (See Section 3.2.1)

REQ, MODE, CNCL and TERM Keys
These keys are used to generate special function codes that may be used by the system software.

Arrow Keys (Up, Down, Right and Left)
Each of these keys cause the RT103 to transmit a code that may have a special meaning to your system. In SET-UP mode the up and down arrow keys increase or decrease the brightness of the display. The left and right arrow keys move the cursor left or right.

3.1.2.3 **SET-UP Mode Keys** - Figure 3-4 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 paragraphs that follow briefly describe the function of each key. Refer to Section 3.2 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.

Arrow Keys (Up and Down)
Brightness - SET-UP A
In SET-UP A, these keys increase or decrease the brightness of the video characters: up = increase; down = 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.

#£
3 Key
Clear All Tabs - SET-UP A
This key clears all horizontal tabs.

$
4 Key
Line/Local - SET-UP A or SET-UP B
This key switches the terminal to communicate with your system (on-line) or stops the terminal from communicating with your system (local). Two indicators above this key switch from ON LINE to LOCAL or from LOCAL to ON LINE.

Figure 3-4 SET-UP Mode Keys

%
5 Key
SET-UP A/B - SET-UP A or SET-UP B
This key switches the terminal from SET-UP A to SET-UP B to SET-UP A. The display indicates which mode the terminal is in.

^
6 Key
Toggle - SET-UP B
This key turns the selected operational feature on or off. (Refer to Section 3.2.4 for more details.)

&
7 Key
Transmit Speed - SET-UP B
This key steps the terminal through the transmit baud rate settings in ascending order. The display indicates the current transmit baud rate (T SPEED) setting. 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.

*
8 Key
Receive Speed - SET-UP B
This key steps the terminal through the available receive baud rates. If the STP module is installed, this selection is disabled and the receive speed follows the transmit speed selection.

(
9 Key
80/132 Columns SET-UP A
This key switches the display line size from 80 to 132 characters per line or from 132 to 80 characters per line. The number of characters displayed in the rule at the bottom of the screen in SET-UP A mode is 80 or 132.

)
0 Key
Reset - SET-UP A or SET-UP B
This key starts the reset sequence. This has the same result as turning the terminal power off and then on. Pressing this key exits SET-UP mode, performs a self-test, and places the cursor in the upper left corner of the screen when the test is completed successfully. (If this does not happen, refer to Section 3.6 to isolate the problem.)

3.1.3 Keyboard Indicators
Figure 3-5 shows the location of the keyboard indicators. The indicators are defined in the paragraphs that follow.

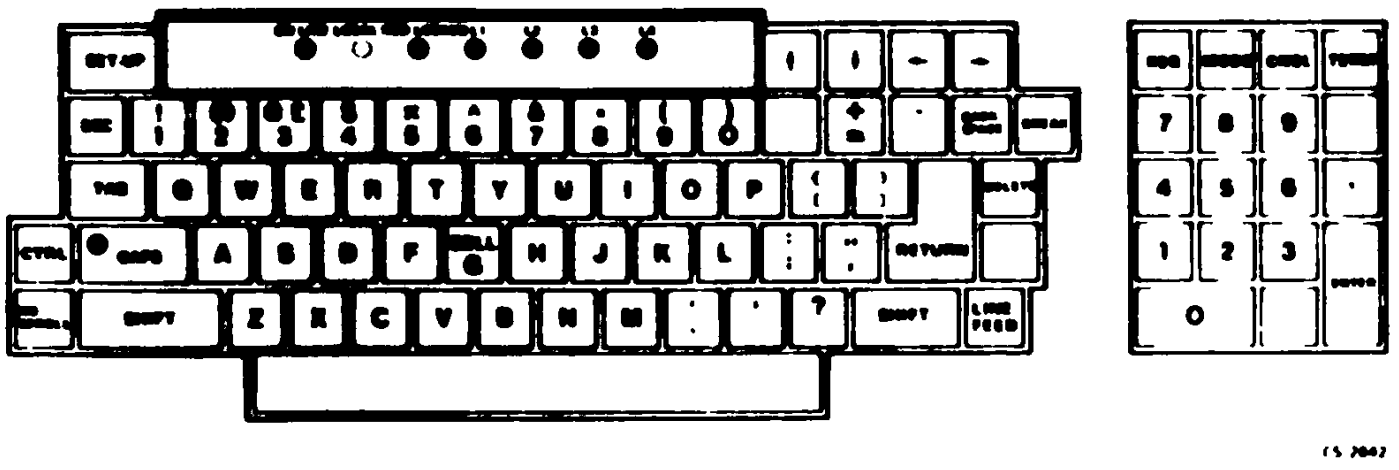


Figure 3-5 Keyboard Indicators

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

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

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

KEYBOARD LOCKED Indicator
This indicator lights when the keyboard has been turned off. The terminal is still able to receive data from the host computer. This condition is cleared by entering and exiting SET-UP mode.

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

CAPS Indicator
This indicator is turned on whenever the CAPS key is locked down. It is cleared by pressing and releasing the CAPS key.

3.1.4 Audible Indicators (Tones)
There are three audible alarms associated with the RT103: 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.

3.2 SET-UP MODE

The RT103 has many selectable built-in features. These features provide compatibility with an LSI-11 computer within the RT103 (or another host computer), adapt the terminal to local power, or alter the terminal's operation for operator comfort and efficiency.

The RT103 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 shows the location of 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.

3.2.1 Determining What a SET-UP Feature Does

A SET-UP feature allows the terminal to be tailored to its operating environment. Table 3-1 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 the physical location of the terminal is changed), 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 to communicate with a different computer or a unique software package.

Table 3-1 Categories of SET-UP Features

SET-UP Feature	Installation	Computer Compatibility	Operator Comfort
ANSI/VT52 Mode		X	
Answerback Message		X	
Auto Repeat			X
AUTO XON/XOFF		X	
Bits Per Character		X	
Characters Per Line		X	
Cursor			X
Interlace	X		
Keyclick			X
Line/Local		X	
Margin Bell			X
New Line		X	
Parity		X	
Parity Sense		X	
Power	X		
Receive Speed		X	
Screen Background			X
Screen Brightness			X
Scroll		X	X
Tabs		X	
Transmit Speed		X	
Wraparound		X	
#£ 3 (shifted)		X	

3.2.2 How to Change a SET-UP Feature

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

1. Enter SET-UP mode by pressing the SET-UP key.

2. Select the appropriate SET-UP mode by pressing the 5 key on the main keyboard each time you want to switch from SET-UP A to SET-UP B or from SET-UP B to SET-UP A.

3. Position the cursor above the feature switch or tab stop to be changed. To position the cursor, use the space bar, left and right cursor keys, tab, and return keys. (Some features do not require 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 3-2 summarizes the SET-UP features, shows the SET-UP mode used to change a given feature and the key that changes the feature setting.

3.2.3 SET-UP A

To enter SET-UP A, press the SET-UP key. The display is similar to the one shown in Figure 3-6. 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 shown 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 left and right arrow keys to move the cursor. Press the 2 key on the main keyboard. A T is displayed in the desired tab stop location.

Clearing a Tab Stop - Position the cursor on the T displayed above the ruler. Press the 2 key. The T disappears.

Table 3-2 SET-UP Feature Change Summary

SET-UP Feature	Changed in SET-UP A Mode	Changed in SET-UP B Mode	Key Used to Change Feature
ANSI/VT52 Mode		X	^6
Answerback Message*		X	*
Auto Repeat		X	^6
AUTO XON/XOFF		X	^6
Bits Per Character		X	^6
Characters Per Line	X		(9
Cursor		X	^6
Interlace		X	^6
Keyclick		X	^6
Line/Local	X	X	$4
Margin Bell		X	^6
New Line		X	^6
Parity		X	^6
Parity Sense		X	^6
Power		X	^6

*A special sequence is required for this feature. See Section 3.3.2.

Table 3-2 SET-UP Feature Change Summary (Cont)

SET-UP Feature	Changed in SET-UP A Mode	Changed in SET-UP B Mode	Key Used to Change Feature
Receive Speed		X	* 8
Screen Background		X	^ 6
Screen Brightness	X	X	↑ or ↓
Scroll		X	^ 6
Tabs	X		@ 2 and # 3
Transmit Speed		X	& 7
Wraparound		X	^ 6
# 3	(shifted)	X	^ 6

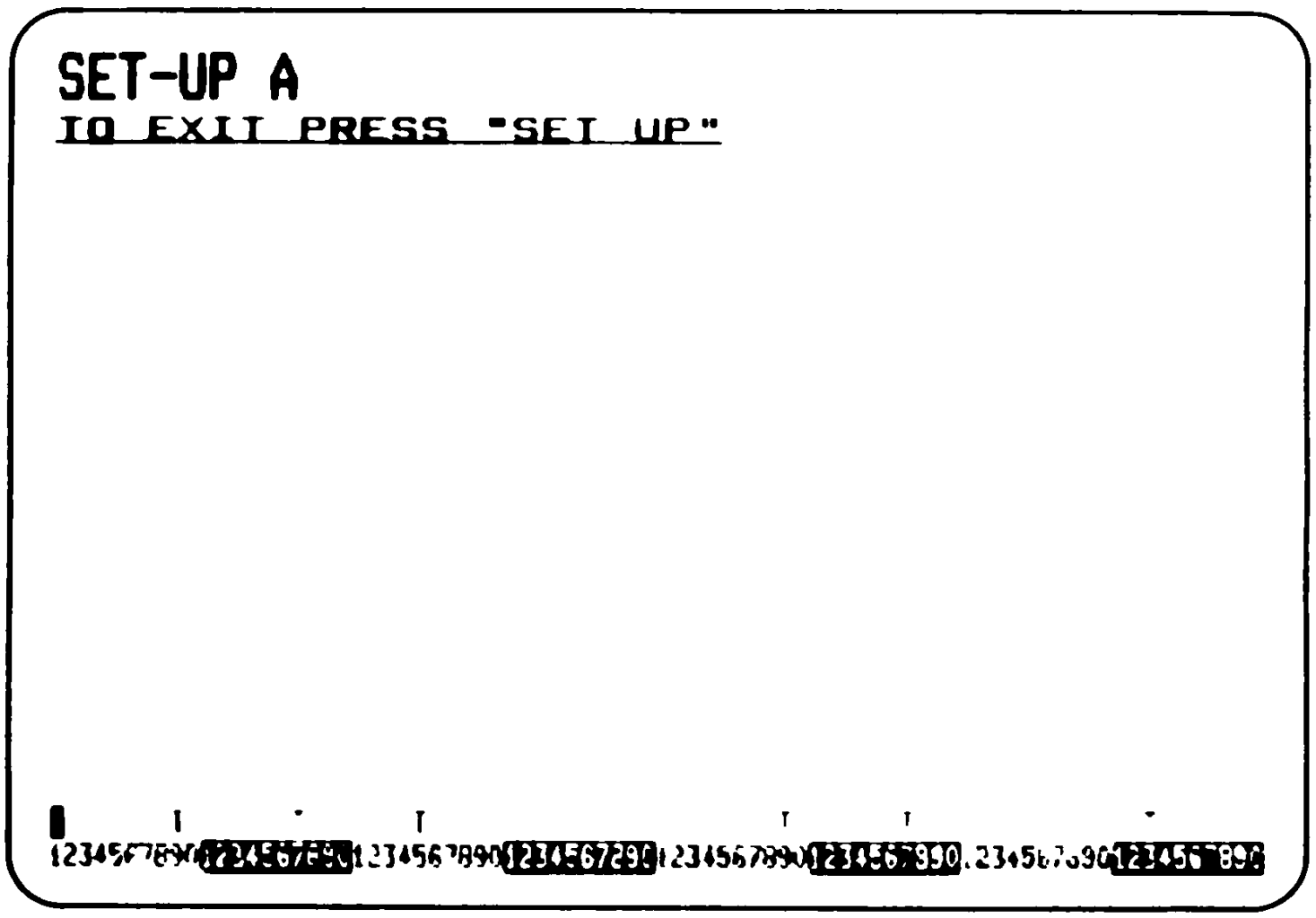


Figure 3-6 SET-UP A Mode Presentation

Clearing 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 Section 3.2.6.

ON LINE/LOCAL
While in SET-UP A, pressing the 4 key toggles the terminal between on-line and local operation. Two indicators directly above this key reflect the current operation.

Characters Per Line (80/132)
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.

3.2.4 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 3-7. Figure 3-8 summarizes the SET-UP B presentation. This summary shows the operational features enabled. For additional information on a feature, refer to Section 3.3.

Changing an Operational Feature
Position the cursor above the location of the feature to be changed using the SPACE bar and left and right arrow keys. Press the 6 key on the main keyboard. This changes the displayed "0" to "1" (or the "1" to "0").

For example, if a graphics module is installed in the RT103, the following features are recommended.

- Interlace disabled
- AUTO XON/XOFF enabled
- Smooth scroll enabled
- ANSI mode enabled

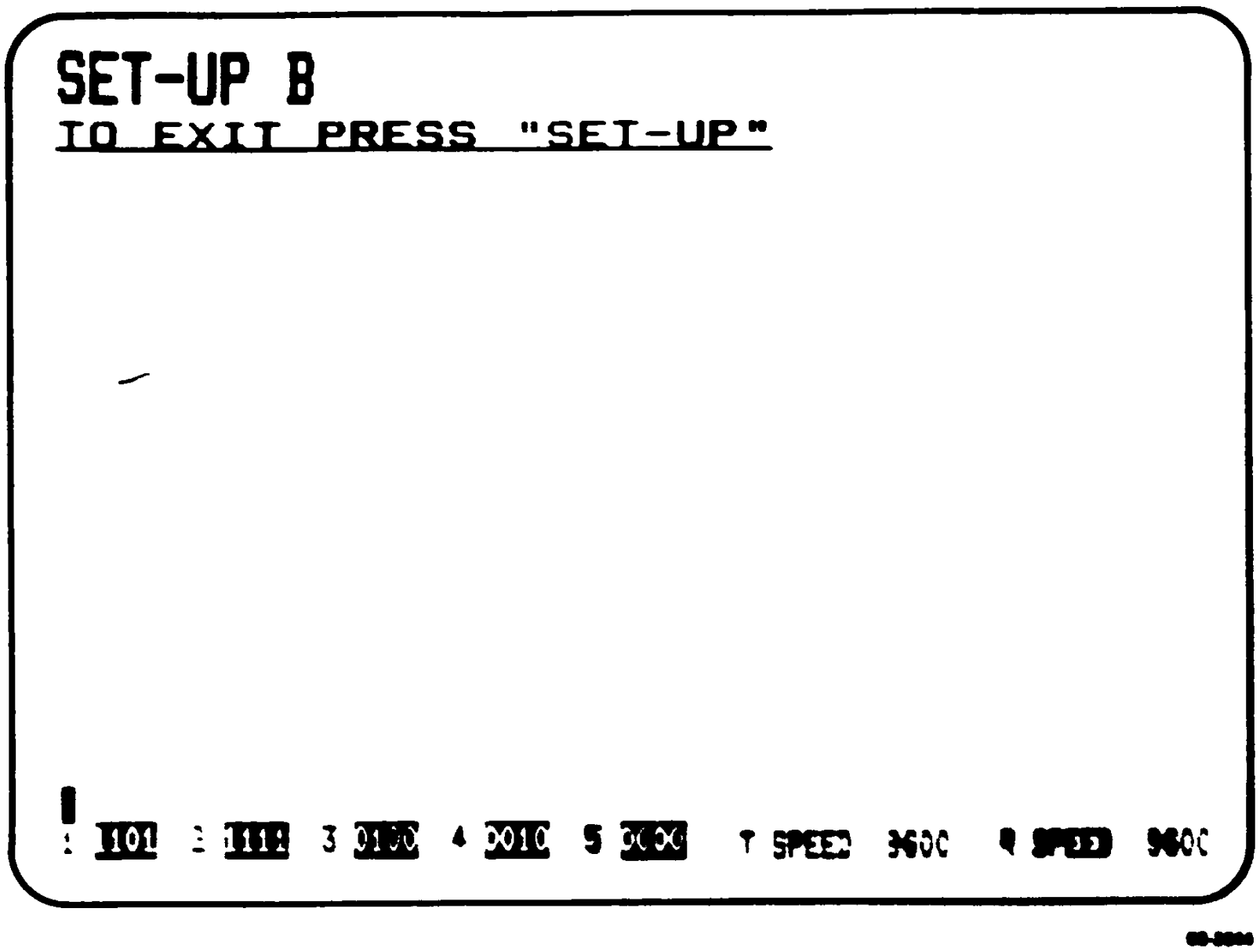


Figure 3-7 SET-UP B Mode Presentation

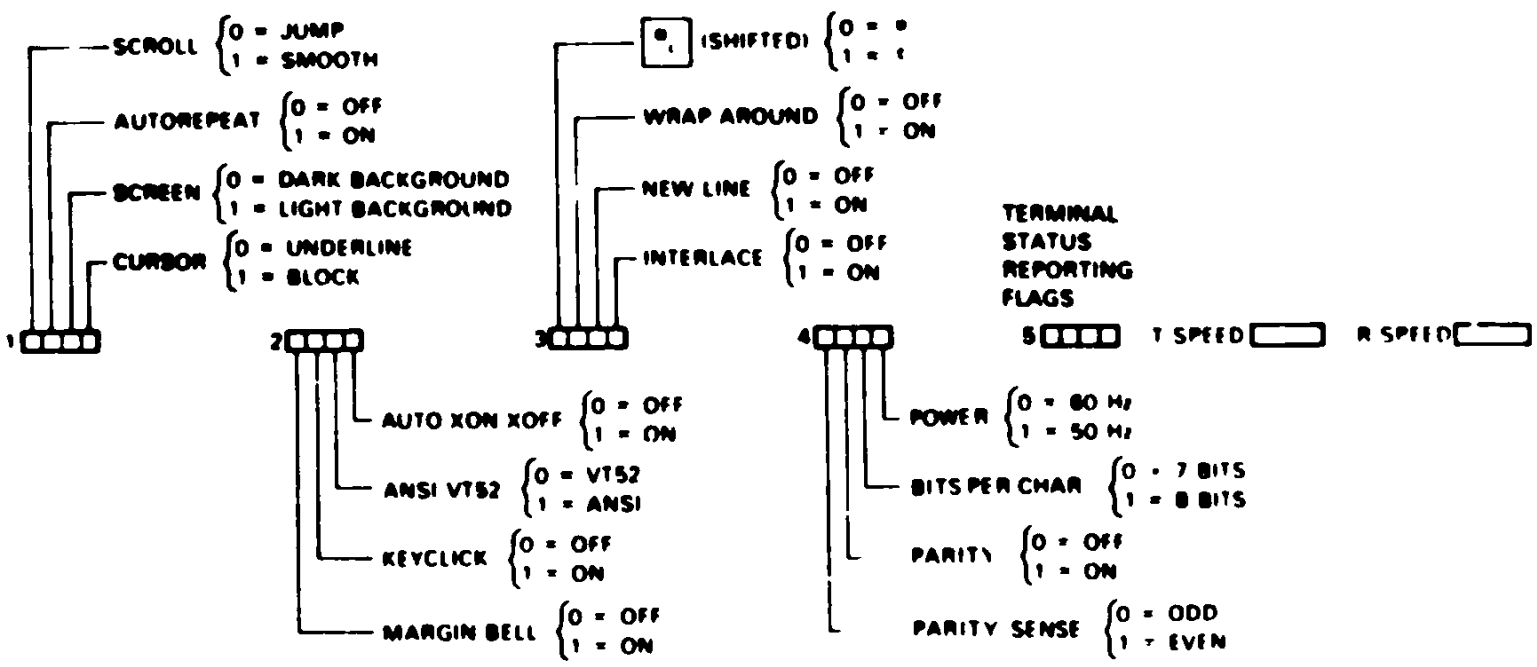


Figure 3-8 SET-UP Mode Summary

Changing the Tranmit 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. A common transmit and receive speed is established 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.

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 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.

NOTE
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 described in the following section.

3.2.5 Saving 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.

3.2.6 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 is 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.

3.2.7 Resetting the Terminal

The RT103 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, perform 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 setup 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.

3.3 DEFINITION OF EACH SET-UP FEATURE

The following sections 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.

3.3.1 ANSI/VT52 Mode (SET-UP B)

The RT103 terminal follows one of two programming standards - American National Standards Institute (ANSI) or DIGITAL VT52. In ANSI mode, the RT103 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 Chapter 5 of this guide.

3.3.2 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 Section 3.2.4 for setting this feature.)

3.3.3 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 1/2 second. The auto repeat feature affects all keyboard keys except the following.

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

3.3.4 AUTO XON/XOFF (SET-UP B)

The RT103 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 RT103 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.

3.3.5 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 8 data bits.

3.3.6 Characters Per Line (SET-UP A)

The RT103 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 RT103 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 by half the number of characters per line.**

3.3.7 Cursor (SET-UP B)

The RT103 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(■).

3.3.8 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 RT103, this feature should be off (noninterlaced).

3.3.9 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.

3.3.10 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 lit. 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 lit. 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.

3.3.11 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.

3.3.12 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 an LF 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, and the LF code causes the terminal to perform a line feed only.

NOTE

The application software may not recognize this new line feature.

3.3.13 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.

3.3.14 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.

3.3.15 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.

3.3.16 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.

3.3.17 Receive Speed (SET-UP B)

The RT103 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.

3.3.18 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.

3.3.19 Save (SET-UP A or B)

The save feature is used to store SET-UP features on a fixed basis. Refer to Section 3.2.5 to use this feature.

3.3.20 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.

3.3.21 Screen Brightness (SET-UP A or B)

The RT103 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.

3.3.22 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.

3.3.23 Tabs (SET-UP A)

The RT103 can tab to preselected points on a line. These tab stops may be individually changed, or totally cleared and then set. Refer to Section 3.2.3 to set or clear tab stops.

3.3.24 Transmit Speed (SET-UP B)

The RT103 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.

3.3.25 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 by half the number of characters per line.

3.3.26 Character Sets (SET-UP B)

#£

3 Key (Shifted)

The RT103 contains character sets for the U.S. and the United Kingdom (U.K.). The difference between the two character sets is one character: the # or the £ 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 RT103 is complete before powering up the system.

3.4 POWER-UP SEQUENCE

RT103 terminals are equipped with permanently resident terminal self-test programs. These programs verify the proper operation of the 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.

The self-test programs are designed to verify proper operation of the terminal hardware and may be used to isolate equipment malfunctions. Upon finding an error, the terminal attempts to display an error message on either the keyboard indicators or on the video screen. If the test is successful, the cursor returns to its home (upper left) position and LEDs L1 through L4 are off.

3.5 OPERATOR EQUIPMENT CARE

The basic terminal 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 the cabinet.

To clean the keys, rub with a dry or barely moist soft cloth. The terminal cabinet filter should be cleaned by vacuuming as often as the environment requires (daily, weekly, monthly).

3.6 SELF-TESTING

A self-test program is built into the RT103 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 by performing the following.

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 through L4 are off. If the test fails an error has occurred.

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 through 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. The nonfatal error types are listed in Table 3-3.

Table 3-3 Nonfatal Error Types

Error	Mnemonic
Advanced Video RAM Data	AVO
Nonvolatile RAM Data Checksum	NVR
Keyboard Missing or Malfunction	KBD
Data Loopback Error	DATA
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.

Table 3-4 shows the possible nonfatal error characters that may appear on the screen and the failure represented by each character. Section 3.7 discusses how to locate the error source.

Table 3-4 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

3.7 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 3-5 describes the items an operator can check prior to making a service call.

Table 3-5 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.	The ac power cord is not plugged into wall outlet. Plug in cord. 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. The ac power cord is not plugged into the terminal. Plug in cord. The ac line fuse is blown. Turn the terminal off and replace the fuse.
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.	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. Perform the self-test operation and note any error indications; refer to Section 3-6.
Garbled or error characters (:!!:).	Incorrect SET-UP feature selection. Check the SET-UP features. Features that may be in error are: ANSI/VT52 mode AUTO XON/XOFF Bits per character Parity Parity sense Transmit speed

Table 3-5 Problem Checklist (Cont)

Symptom	Possible Cause and Corrective Action
(Cont)	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.
Last character is garbled.	Wraparound feature may be disabled: to correct, reenable.
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).
Losing data in graph mode (if graphic option is installed).	Check the following features. AUTO XON/XOFF should be enabled. INTERLACE should be disabled. ANSI/VT52 mode may be erroneously selected for software being used.
Several successive tones.	The terminal is having difficulty reading or writing the SET-UP features in the nonvolatile memory. Check the feature settings and perform the save operation. Perform the self-test operation.
System has difficulty loading application program.	Incorrectly formatted tape; wrong tape used; oxide build-up on tape head or drive capstan; old or worn tape; wrong tape drive specified.

Table 3-5 Problem Checklist (Cont)

Symptom	Possible Cause and Corrective Action
System has difficulty loading application program (Cont).	Check the cable from the TU58 to ensure it is right side up and secure in its connector. Verify tape using read with increased threshold.
Losing Data.	AUTO XON/XOFF should be enabled at high baud rates. To determine if the CPU accepts XOFF: 1. Print a listing on the terminal. 2. During the listing, press: CTRL S. The listing should stop. 3. Press: CTRL Q The listing should resume.

CHAPTER 4

4.1 CONFIGURATION CONSTRAINTS

There are two major constraints in configuring the RT103.

1. Power supply limitations
2. Module slot availability

4.1.1 H7835 Power Supply

The H7835 power supply in the RT103 provides the voltages at the specified current level given in Table 4-1.

Table 4-1 H7835 Power Supply Outputs Less Power Used by RT103 Components

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

4.1.2 Module Slot Usage

In the RT103, four quad slots are available for configuration. Any combination of modules up to quad size may be used (see examples in this section). The power requirements of the option modules selected together with the power consumed by supplied components should not exceed the capacity of the power supply.

No more than 1M byte of memory should be used as a result of these two constraints.

Because the RT103 is a totally confined unit that is shipped as an FCC compliant device, no expansion that would require running extra cables outside the cabinet should be attempted. To do so would negate FCC compliance.

4.2 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. A typical configuration is shown in Figure 4-1.

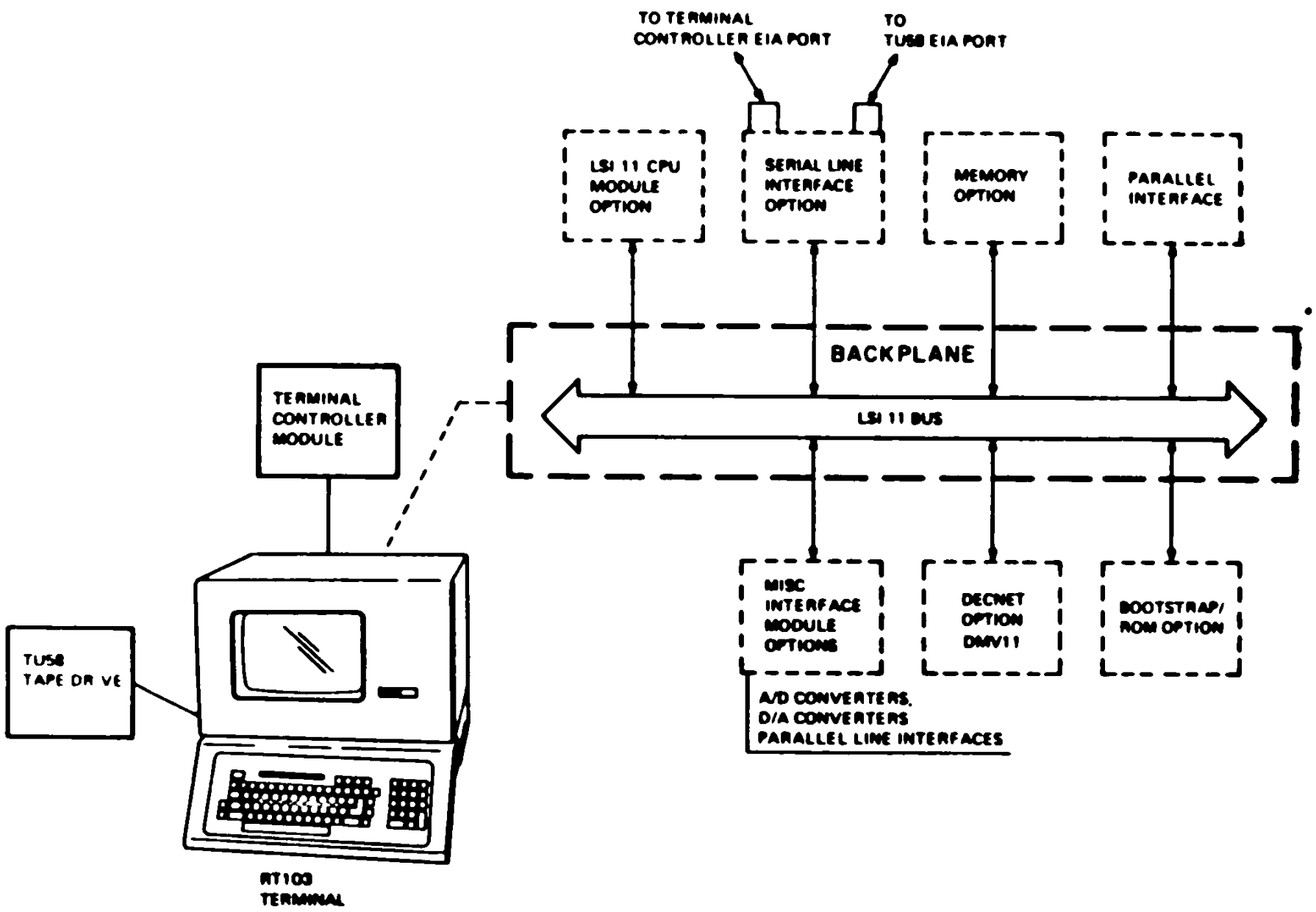


Figure 4-1 Typical RT103 System Configuration

4.3 ASSIGNING MODULE PRIORITY

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 4-2 shows the slot and row assignments of the RT103 backplane. Slot 1, rows A and B, has the highest priority and is reserved for the LSI-11 processor module selected. 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. It is recommended that unused locations occur only in the highest numbered locations.

4.4 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 V should be determined separately from the amount of current at +12 V. Be sure to include the current drawn by the monitor, base video, advanced video (if installed), and TU58.

DC bus loading is the leakage current a module presents to a bus signal line; one dc load is 105 μA. Most modules present one dc load to the backplane.

AC loading is the capacitance a module presents to a bus signal line; 1 ac load equals 9.35 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 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.

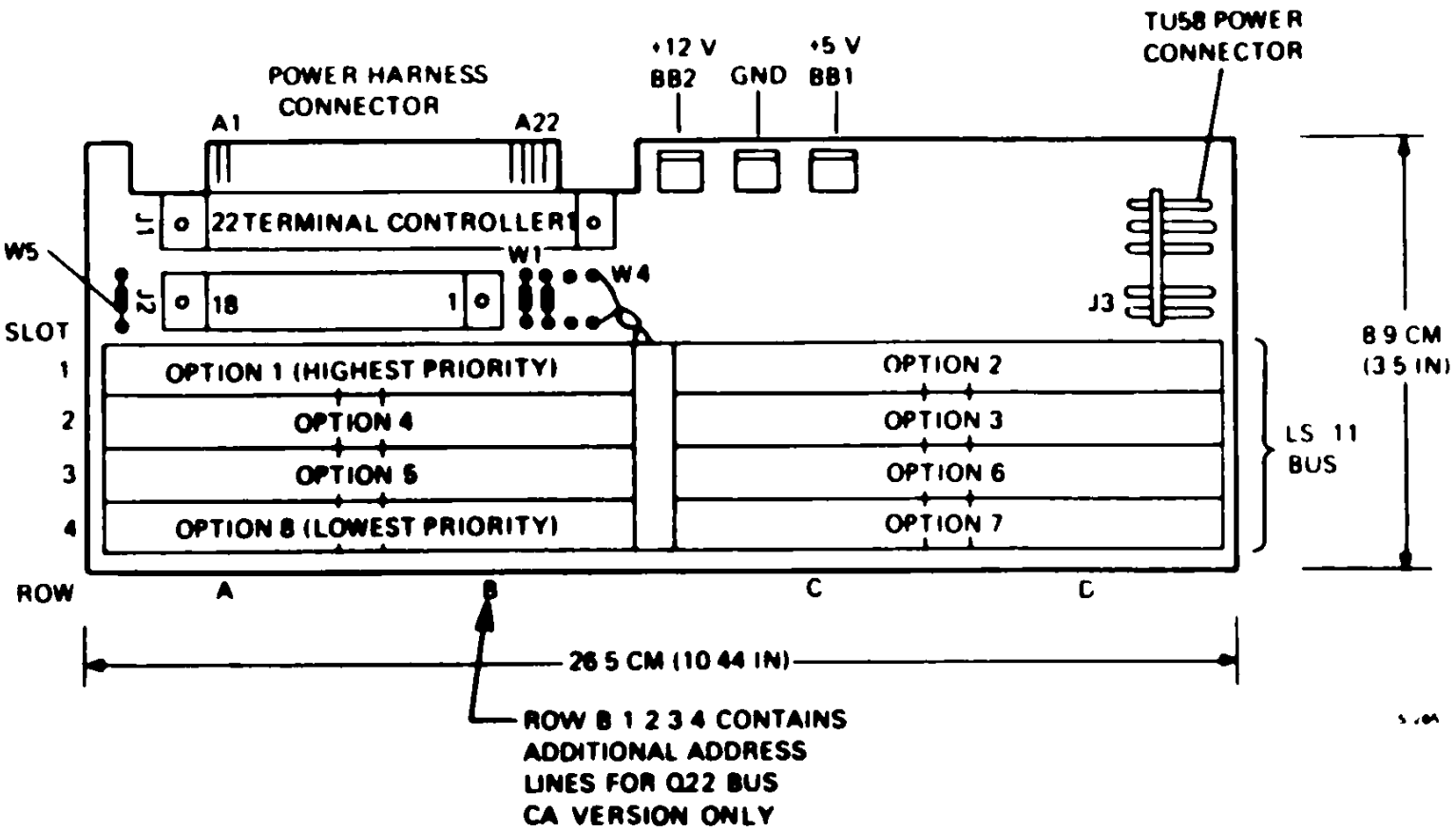


Figure 4-2 RT103 Backplane Module Utilization

3. If a terminator module is added to the bus, the bus can support a maximum of 35 ac loads.

4. The RT103 supports all LSI-11 BUS modules and expansion boxes as specified in the Microcomputer Processors Handbook.

4.5 TYPICAL LSI-11 CONFIGURATIONS

Both the video terminal and the TU58 DECtape II in the RT103 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 4-3 shows an LSI-11 processor, an MSV11-DD 32K byte 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 4-4 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.

4.6 COMMUNICATION CABLES

Optional communication cables for use with the RT103 are listed in Table 4-2. Contact your local DIGITAL Sales Office for ordering information.

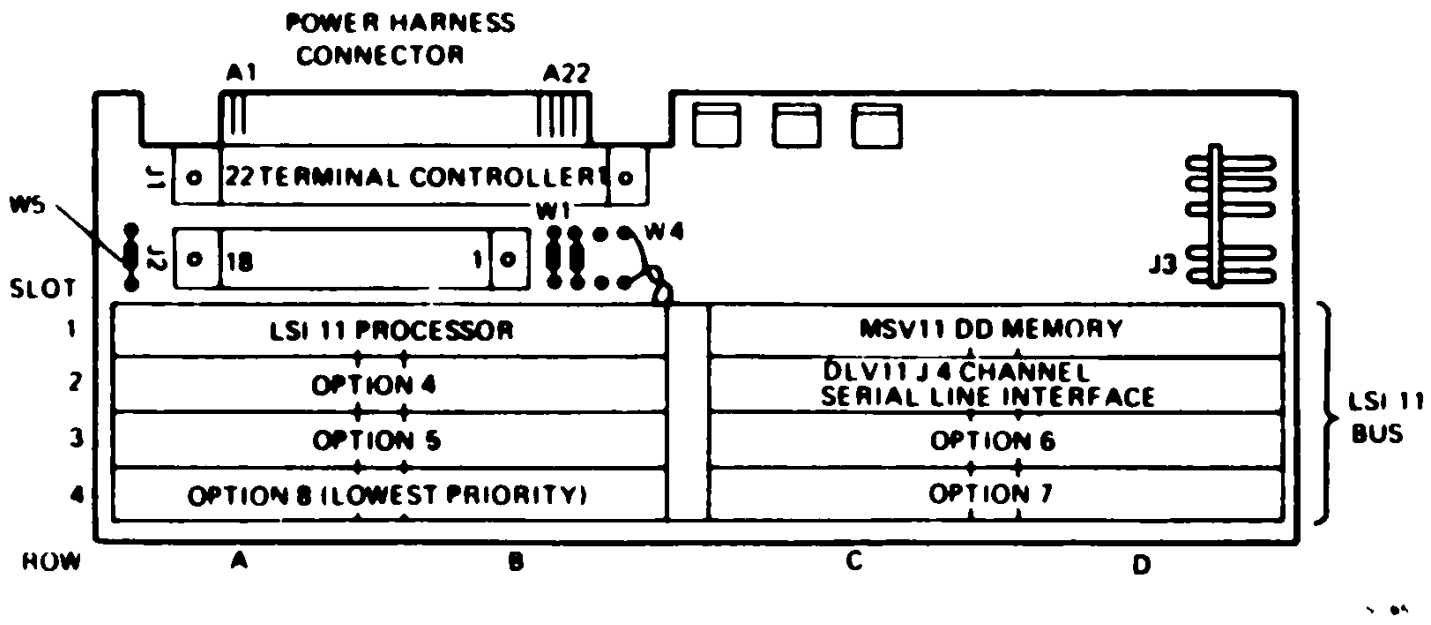


Figure 4-3 Configuration (Example 1)

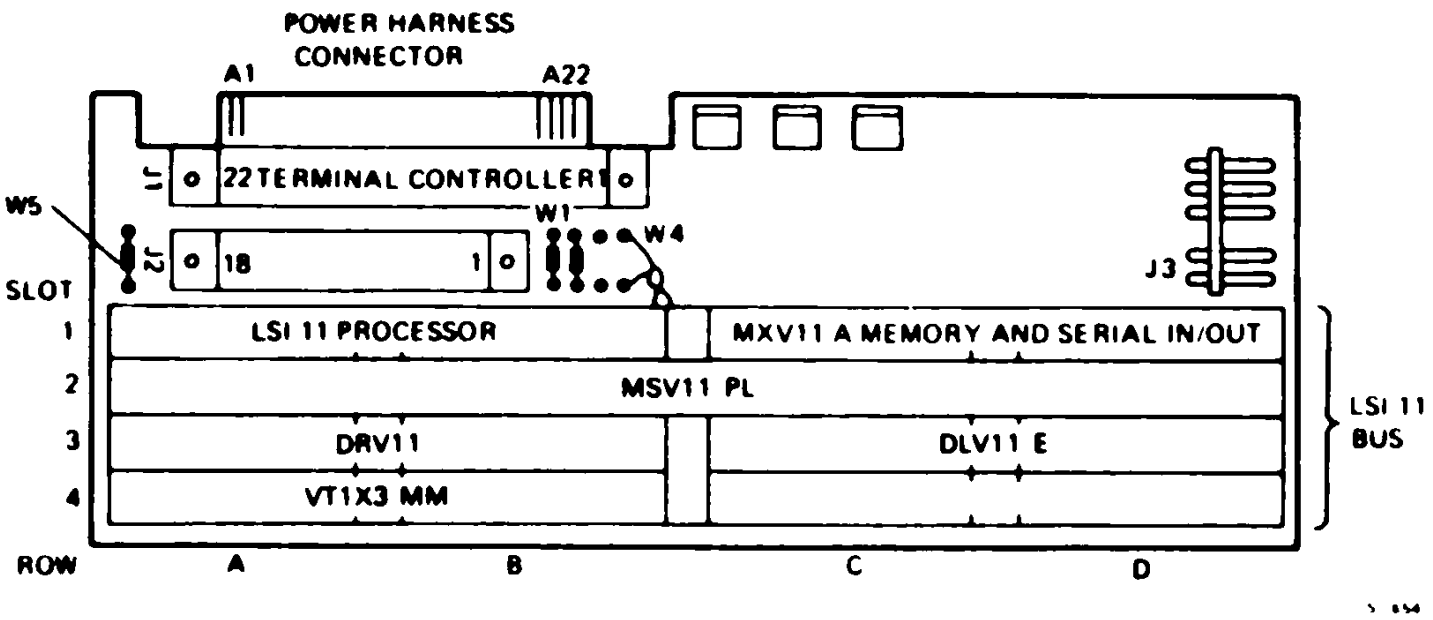


Figure 4-4 Configuration (Example 2)

Table 4-2 Communications Cables

Cable Part No	Length	Connectors	Purpose
		Supplied	
70-11411-1C	0.38 m (15 in)	Two 10-pin connectors	Connects STP module to serial line interface.
70-11411-02	0.38 m (15 in)	Two 10-pin connectors	Connects TU58 to serial line interface.
		Optional	
BC03M-01 BC03M-25 BC03M-A0 BC03M-XX*	0.3 m (1 ft) 7.6 m (25 ft) 30.5 m (100 ft) variable	Two RS-232-C female Cinch connectors	Null modem; connects terminal to a line unit.
BC05C-1F	0.3 m (1 ft)	Two 25-pin connectors	Connects DLV11-E to RS-232-C connector.
BC05D-10† BC05D-25†	3 m (10 ft) 7.6 m (25 ft)	RS-232-C male Cinch connector to female Cinch connector	Connects terminal to a modem.
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 DP01-A acoustic coupler, pin 23 of this cable must be disconnected.

CHAPTER 5

CHAPTER 5
PROGRAMMING

5.1 INTRODUCTION

The RT103 consists of a video monitor, a keyboard, and a Q-BUS backplane. The 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.

5.2 KEYBOARD

The RT103 has a keyboard arrangement similar to an ordinary office typewriter, as shown in Figure 5-1. In addition to the standard typewriter keys, the keyboard has keys to generate control functions and cursor control commands. The keyboard also has indicators to show the current terminal status.

5.2.1 LED Indicators

The keyboard has seven 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 that turn these LEDs on or off are discussed in Section 5.4.1, DECLL Load LEDs.

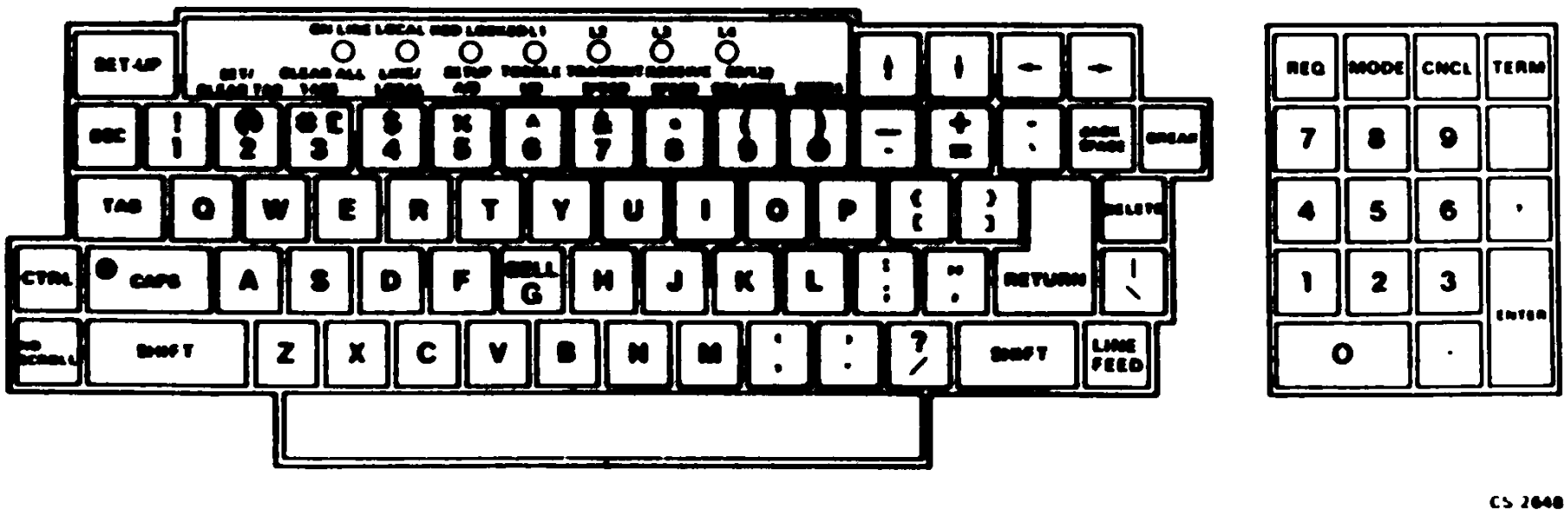


Figure 5-1 RT103 Keyboard

5.2.2 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 an 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 Section 3.2.2 of this manual. SET-UP features that may be modified by the nost are listed in Table 5-1 and described in detail in this chapter. (See Section 5.4).

Table 5-1 SET-UP Features and Terminal Modes

SET-UP Features and Terminal Modes	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
#£ 3 Key (shifted)	Yes	(SCS)	Yes

5.2.3 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.

5.2.4 Alphabetic Keys

The RT103 generates either uppercase or lowercase alphabetic characters. The codes required to display these are listed in Table 5-2. The RT103 transmits the lowercase code until either SHIFT key or the CAPS key is pressed. The CAPS key locks only the 26 alphabetic keys in the uppercase mode.

5.2.5 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 5-3 shows the codes generated by these keys. The CAPS key does not affect these keys.

5.2.6 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 5-4.

5.2.7 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 XON/XOFF feature in SET-UP B disables the NO SCROLL key.

5.2.8 BREAK Key

Typing the BREAK key causes the transmission line to be forced to its zero or space state for 0.2333 seconds ±10 percent. If either SHIFT key is down, the time is increased to 3.5 seconds ±10 percent and data terminal ready (DTR) is disabled. After the 3.5 second interval, DTR 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 answerback message.

NOTE

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

Table 5-2 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 5-3 Nonalphabetic Key Codes

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

Table 5-4 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 tap 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 015_8, 012_8 (carriage return and line feed). The new line feature in SET-UP mode provides this capability.

5.2.9 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 5-5.

Table 5-5 Control Codes Generated

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

5.2.10 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 5-6 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 5-6 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

5.2.11 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 1/2 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.)

5.2.12 Special Graphic Characters

If the special graphic set is selected, the ASCII codes 137_8 through 176_8 are replaced with characters shown in Table 5-7. See the Select Character Set (SCS) control function (Section 5.4.1) to enable this mode.

Table 5-7 Special Graphic Characters

Octal Code	Graphic with U.S. or U.K. 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	}	£	U.K. pound sign
176	~	·	Centered dot (bullet)

Notes:

1. Codes 152_8-156_8, 161_8, and 164_8-170_8 are used to draw rectangular grids; each piece of this line drawing set is contiguous with others so that the lines formed are unbroken.

2. Codes 157_8-163_8 give better vertical resolution than dashes and underlines when drawing lines. Using these segments, 120 X 132 resolution may be obtained in 132-column mode with the advanced video option installed.

5.2.13 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 5-8 and 5-9. These keys are not affected by pressing the SHIFT, CAPS, 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., REQ will display a "P".

Table 5-8 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
REQ	ESC P	ESC P
MODE	ESC Q	ESC Q
CNCL	ESC R	ESC R
TERM	ESC S	ESC S

Table 5-9 ANSI Mode Auxiliary Keypad Codes

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

5.3 TERMINAL CONTROL COMMANDS

The RT103 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_8-037_8, and 177_8. The control characters recognized by the RT103 are shown in Table 5-10. All other control codes cause no action to be taken.

Table 5-10 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.

Table 5-10 Control Characters Received (Cont)

Control Character	Octal Code	Action Taken
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, Section 3.3.)
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 G0 character set, as designated by SCS escape sequence.
XON	021	Resume transmission to terminal.
XOFF	023	Stop transmitting to terminal all codes except XON and XOFF. 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_8 inclusive) may be imbedded within a control function sequence. Imbedded control characters are executed as soon as they are encountered by the terminal. Then the control function continues to be processed. The exceptions are as follows.

1. If the character ESC (033_8) occurs, the current control function stops and a new one begins.

2. If the character CAN (030_8) or the character SUB (032_8) 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.

5.4 CONTROL FUNCTIONS

The RT103 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.

NOTE

All new software should be designed with ANSI control functions. Future DIGITAL video terminals may not respond to VT52 control functions.

5.4.1 ANSI Mode Control Functions

The following list briefly defines the basic elements of ANSI control functions. A more complete listing appears in Appendix B of the VT103 User's Guide.

- 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. 0s are ignored. The characters have a range of 60_8 to 77_8.

  2. The value so represented.

- Numeric parameter - A parameter that represents a number, designated by Pn.

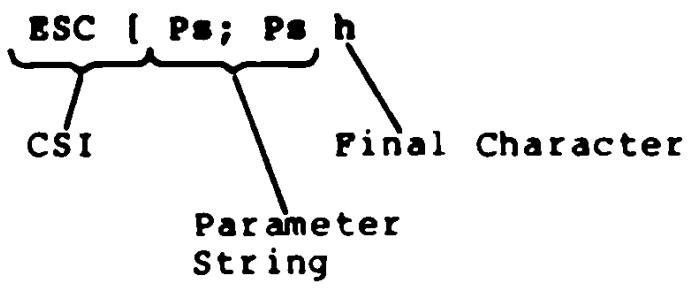
- Selective parameter - A parameter that selects a subfunction from a specified list, designated by Ps.

- Parameter string - A string of parameters each separated by a semicolon (73_8).

- 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 RT103 are classified in three ways.

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_8 and 177_8.

2. **Escape sequence** - An escape sequence is a string of characters that begins with ESC (033_8), has zero or more intermediate characters, and ends with the first occurrence of a final character.

   Example: ESC # 6

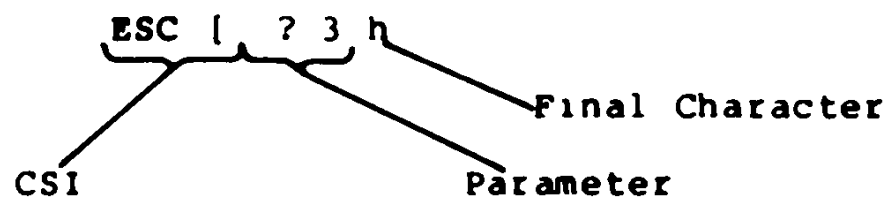
Escape Sequence Character	Octal Code
Escape	033
Intermediate character	040 to 057
Final character	060 to 176

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

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

3. **Control sequence** - A control sequence is a string of characters that begins with a CSI of 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_8).

Example:



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

All the following control functions (listed alphabetically) 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 (proprietary) 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 horizontal and vertical position (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.

*DIGITAL privileged commands.

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 SM and 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 SM and 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 SM and RM control sequences. This mode is only effective when the keypad application mode (DECKPAM) and the ANSI/VT52 mode (DECANM) are 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 SM and 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.

---

*DIGITAL privileged commands.

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

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.

*DIGITAL privileged commands.

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 DA command. The DA function is preferred over the DECID function for new software.

DECINLM Interlace Mode*

This parameter is applicable to SM and 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 5-8 and 5-9.

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).

*DIGITAL privileged commands.

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 SM and 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.

DECREPTPARM Report Terminal Parameters*

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

The parameters for this control sequence are presented in Table 5-11.

*DIGITAL privileged commands.

Table 5-11 Terminal Report Parameters

Parameter	Value	Meaning
<sol>	0 or more	This message is a request (DECREQTPARM) and the terminal is allowed to send unsolicited reports. Unsolicited reports are sent when the terminal exits the setup 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 5-11.

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 SM and RM control sequences. The reset state causes scrolls to "jump" instantaneously. The set state causes scrolls to be "smooth" at a maximum rate of 6 lines per second.

DECSCNM Screen Mode*

This parameter is applicable to SM and 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

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 DECOM).

*DIGITAL privileged commands.

DECSWL Single-Width Line*

ESC # 5

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

DECTST Invoke Confidence Test*

ESC [2; Ps y

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

Test	Value
Power-up self-test (ROM checksum, RAM, NVR, keyboard, and AVO is installed)	1
Data loopback test	2 (loopback connector required)
EIA modem control test	4 (loopback 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	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).

*DIGITAL privileged commands.

Parameter	Meaning
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	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	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; Pnf 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 SM and RM control sequences. The reset state causes the interpretation of the 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 RT103 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 | 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 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 SI and SO (shift in and shift out), respectively.

G0 Sets Sequence	G1 Sets Sequence	Meaning
ESC(A	ESC)A	United Kingdom set
ESC(B	ESC)B	USASCII set
ESC(0	ESC)0	Special graphics character set
ESC(1	ESC)1	Alternate character ROM standard character set
ESC(2	ESC)2	Alternate character ROM special graphics set

The United Kingdom and 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_8 to 176_8 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 parameters(s) selected until the next occurrence of SGR. Format Effector

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

All other parameter values are ignored.

Without the advanced video option, only one type of character attribute is possible as determined by the cursor selection. Specify either the blinking underline or the blinking block cursor to activate the character attribute. (See Section 3.3.7.)

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 RM control sequence. (See Section 5.4.2 to select the parameters for the modes.)

TBC Tabulation Clear

ESC [Ps g default value: 0

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

5.4.2 Modes

The following is a list of modes that may be changed with SM and RM control sequences.

ANSI Specified Modes

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

DIGITAL Private Modes - If the first character in the parameter string is ? (77_8), the parameters (shown in Table 5-12) are interpreted as DIGITAL private parameters. Any other parameter values are ignored.

Table 5-12 DIGITAL Private Modes

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

Other ANSI Mode States - The modes, shown in Table 5-13, 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 5-13 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	N/A
HEM	Horizontal editing	N/A
IRM	Insertion-replacement	Reset
KAM	Keyboard action	Reset
MATM	Multiple ai a transfer	N/A
PUM	Positioning unit	Reset
SATM	Selected area transfer	N/A
SRTM	Status reporting transfer	Reset
TSM	Tabulation stop	Reset
TTM	Transfer termination	N/A
VEM	Vertical editing	N/A

5.4.3 ANSI Control Function Summary

The following is a summary of the RT103 ANSI control functions. The ANSI mode must be enabled to use the control functions outlined in the following paragrapns. 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_8 to 071_8.
- Ps refers to a selective parameter from a specified list. Ps has a range of 0 (060_8) to 9 (071_8).
- Multiple parameters are separated by a semicolon (073_8).
- If a parameter is omitted or specified to be 0, the default parameter value is used. (For the cursor movement commands, the default parameter value is 1.)

Character Attributes

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

Ps refers to a selective parameter. Multiple parameters are separated by a semicolon (073_8). The parameters are executed in order and have the following meanings.

Parameters (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 (U.K.)	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 [PnA
Cursor down	ESC [PnB
Cursor forward (right)	ESC [PnC
Cursor backward (left)	ESC [PnD
Direct cursor addressing	ESC [Pl; PcH or ESC[Pl;Pcf
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 or ESC [0K
From beginning of line to cursor	ESC [1K
Entire line containing cursor	ESC [2K
From cursor to end of screen	ESC [J or ESC [0J
From beginning of screen to cursor	ESC [1J
Entire screen	ESC [2J

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

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

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

Programmable LEDs

ESC [Ps;Ps;...Ps q

Ps parameters are selected from the list that follows. Separate parameters with a semicolon (073_8).

Parameters (Ps)	LED Selected
0 or none	All LEDs off
1	LED L1 on
2	LED L2 on
3	LED L3 on
4	LED L4 on

Any other parameter values are ignored.

Reports

Cursor Position Report

Invoked by: ESC [6n
Response is: ESC [Pl; Pc R

Pl = line number and Pc = column number.

Status Report

Invoked by: ESC [5n
Response is: ESC [0n (terminal OK)
ESC [3n (terminal not OK)

What Are You? (Identify Report)

Invoked by: ESC [c
or
ESC [0c
Response is: ESC [1;Psc

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

Parameters (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; Pbr

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	ESC H
Clear tab at current column	ESC [g or ESC [0g
Clear all tabs	ESC [3 g

Tests

Fill screen with "Es"	ESC #8
Invoke test(s)	ESC [2; Psy

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 loopback test	2 (loopback connector required)
EIA modem control test	4 (loopback connector required)
Repeat selected test(s) (indefinitely until failure or power off).	8

5.4.4 VT52 Mode Control Functions

The VT52 mode must be enabled to use the following control functions. Table 5-14 provides a brief summary of the valid VT52 control functions.

Table 5-14 VT52 Mode Control Functions

Control Function/Action	Escape Sequence
Cursor up	ESC A
Cursor down	ESC B
Cursor right	ESC C
Cursor left	ESC D
Select special graphics character set	ESC F
Select ASCII character set	ESC G
Cursor to home	ESC H
Reverse line feed	ESC I
Erase to end of screen	ESC J
Erase to end of line	ESC K
Direct cursor addressing	ESC Ylc*
Identify	ESC Z†
Enter alternate keypad mode	ESC =
Exit alternate keypad mode	ESC >
Enter ANSI mode	ESC <

*Line and column numbers for the direct cursor address are single character codes with octal values of the desired number plus 37_8. Line and column numbers start at 1.

†Response to ESC Z is ESC / Z.

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

Graphics Option 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 Option OFF

ESC 2

Turn off graphics.

Cursor Up

ESC A

Move the active position upward one location 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.

Select Special Graphics Character Set

ESC F

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

NOTE

The special graphics characters in the RT103 are the same as those of the RT100, 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_8. For example, 040_8 refers to the first line or column, 050_8 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 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 Section 5.4.1.) The VT52 control functions in this section will not be recognized.

5.5 COMMUNICATION PROTOCOL

5.5.1 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_8 (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_8 (XON or DC1) to signal the host to resume transmission.

The terminal always recognizes received XON and XOFF. Receipt of XOFF inhibits transmission of any codes except XON and XOFF. 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.

Number of characters to overflow = 32 - [3 X (receive speed/transmit speed)]

Time to respond to XOFF = Number of characters to overflow X (bits per character + parity bit + 2)/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:

Number of characters to overflow = 32 - [3 X (1200/1200) = 29 characters

Time to responds to XOFF = 29 X (8+0+2)/1200 = 0.2416 second

NOTE

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

Example 2:

The RT103 is transmitting 7-bit characters (with parity) at 300 baud and is receiving at 1200 baud. The terminal sends an XOFF.

Number of characters to overflow = 32 - [3 X (1200/300)] = 20 characters

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

NOTE

The host must respond within 0.1666 second to avoid a buffer overflow. If the buffer overflows, the RT103 will begin to discard incoming characters and the error characters (:) 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.

5.5.2 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 specif ed operation if the AUTO XON/XOFF 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 XON/XOFF 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.

5.5.3 NO SCROLL and CTRL S/CTRL Q

There are two other means of transmitting XON and XOFF - 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.

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/XOFF feature; it should be enabled for DIGITAL LSI-11 processors.

5.6 ADDRESS AND VECTOR ASSIGNMENTS

Table 5-15 shows the address and vector assignments for options associated with the RT103.

Table 5-15 Address and Vector Assignments

Option	Address Space	Vector
MSV11-PC (RAM)	000000 -> 177777	N/A
DRV11	767770 -> 767774	370 + 374
MXV11 (ROM)	773000 -> 773776	N/A
MXV11(SLU 1, Console)	777560 -> 777566	60 + 64
MXV11(SLU 0, TU58)	776500 -> 776506	300 + 304
DLV11-E	777500 -> 777506	340 + 344

5.7 TU58 MESSAGE PACKETS

5.7.1 Radial Serial Protocol (RSP)

The TU58 command strings adhere to RSP 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.

5.7.2 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 message packets, data message packets, and single byte command message 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 transmission or receipt 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.

5.7.2.1 Command Message Packets - 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 5-16 indicates the byte structure of the command message packet. Each byte is discussed in the following paragraphs.

Table 5-16 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 Number
	5	Switches (Maint Only)
	6	Not Used (Always Zero)
	7	Not Used (Always Zero)
	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 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 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 (Op Code) (Byte 2) - The instruction byte [or operational code (Op 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 unpredicatable 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 5-17.

Table 5-17 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 Section 5.8 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 Section 5.8 for additional information on instructions that may be changed. 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 (Maintenance Only) (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 that 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.

End Packet
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 5-18 illustrates the format and byte positions of the end packet. A detailed description of each byte is provided in the following paragraphs.

Flag (Byte 0) - Each packet begins with a flag byte that identifies the type of message packet to be transmitted. The flag byte (001_8) for all command message packets identifies this packet as a command packet.

Table 5-18 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 (Low)
	9	Data Byte Count (High)
	10	Summary Status (Low)
	11	Summary Status (High)
	12	Checksum (Low)
	13	Checksum (High)

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_8) will be 10 (decimal) for all end message packets.

Instruction (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_8. 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 5-19.

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

Octal Code	Tape Drive Selected
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 that initiated the transfer. This byte is ignored by other commands.

Table 5-19 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.

Table 5-19 End Packet Success Codes and Definition (Cont)

Octal Code	Success Indication	Definition
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 power-up sequence, master reset instruction, or INIT instruction.

Summary Status (Low/High) (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 (Low/High) (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.

5.7.2.2 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 5-2. The processor is assumed to have enough buffer capacity to accept the entire transaction. This is not true during transmit. See Figure 5-3.

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 5-3. This condition occurs because the tape drive controller has 128 bytes of buffer space, and it must finish all the data processing before accepting an additional message packet.

The data message packet format is shown in Table 5-20 and a description of each byte is provided in the following paragraphs.

Flag (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.

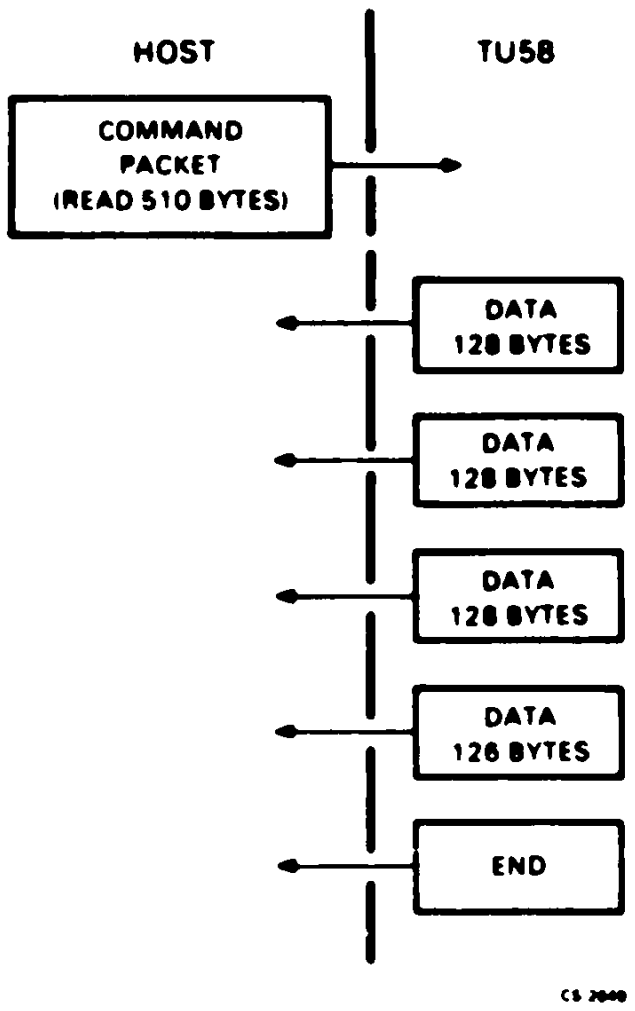


Figure 5-2 Read Command Packet Exchange

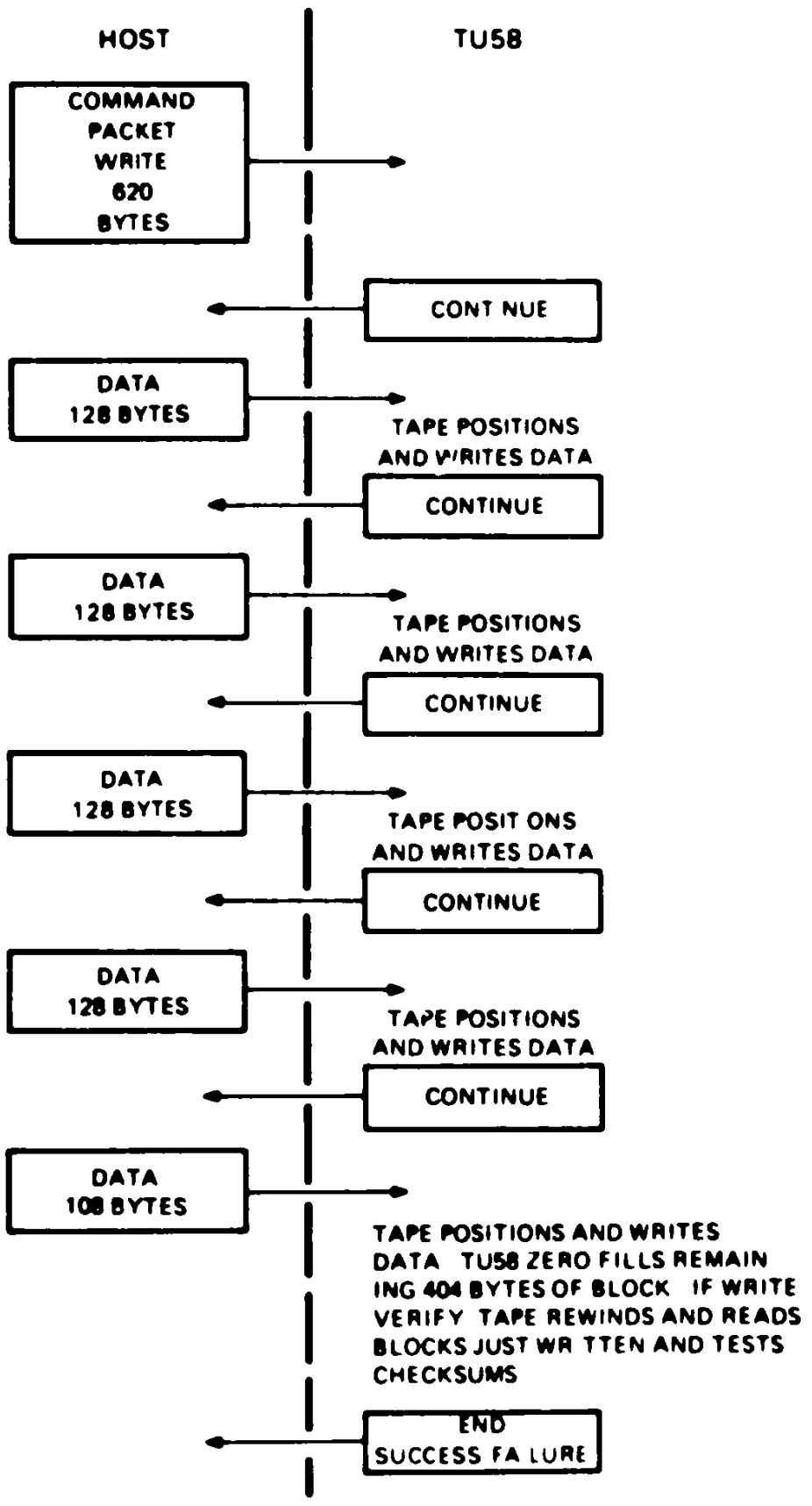


Figure 5-3 Write Command Packet Exchange

Table 5-20 Data Packets

	Byte No	Byte Name
	0	Flag
	1	Message Byte Count
Data Bytes Transferred	2	First Data Byte
	3	Next Data Byte
	•	(Data)
	•	(Data)
	•	(Data)
	M	(Data)
	M + 1	Last Data Byte
	M + 2	Checksum (Low)
	M + 3	Checksum (High)

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 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 (Low/High) (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.

5.7.2.3 Single Byte Command Packet - 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.
021	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 and 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.

5.8 INSTRUCTION SET (OPERATIONAL CODE)

The instruction set described in this section is a detailed description of the instruction byte (byte 2) of the command message. The instruction byte or Op code informs the tape drive controller of the transaction to be performed. The instruction set is repeated in Table 5-21.

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 5-21 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 instruction message packet is shown in Table 5-22. The tape drive returns the end packet shown in Table 5-23.

Table 5-22 NOP Instruction Message Packet

Byte No	Octal Code	Byte Name
0	002	Flag
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	Data Byte Count (Low) (no data involved)
9	000	Data Byte Count (High)
10	000	Block Number (Low) (no tape positioning)
11	000	Block Number (High)
12	01X*	Checksum (Low)
13	012	Checksum (High)

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

Table 5-23 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 (Low) (no data involved)
9	000	Data Byte Count (High)
10	000	Summary Status (Low)
11	XXX*	Summary Status (High)
12	0XX*	Checksum (Low)
13	XXX*	Checksum (High)

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

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 5-22), except the Op code instruction byte (byte 2) = 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.

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 checksum of each is 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 are 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.

5.9 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 that 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) occurs. 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.

Block Numbers

127 - 128
255 - 256
383 - 384

CHAPTER 6

6.1 MAINTENANCE PHILOSOPHY

For RT103 system failures within 90 days of shipment, the equipment may be returned to DIGITAL as described in Section 6-4.

Regular maintenance procedures should be performed. Filters should be cleaned at a frequency determined by the equipment environment. For example, in clean environments filters can be cleaned once a month, whereas in environments containing metal dust, filters should be cleaned as frequently as once a day.

If a failure occurs in the membrane keyboard, the entire keyboard assembly should be replaced (see Section 6.1.1).

WARNING

All maintenance (except weekly preventive maintenance) should be performed by a qualified technician only.

6.1.1 Keyboard Replacement

To remove the keyboard assembly from the monitor assembly:

1. Turn power off.
2. Remove the four mounting screws holding the keyboard assembly to the monitor assembly (two on each side of the keyboard).
3. Remove the bottom cover plate from the keyboard assembly.
4. Remove the cable clamp from the keyboard cord.
5. Remove the plug from the keyboard circuit board.
6. Remove the two fast-on tabs from the speaker.
7. Remove the grommet from the keyboard assembly.
8. Carefully feed keyboard cable through the slotted hole.
9. Reverse the procedure with a new keyboard assembly.

6.1.2 Monitor Replacement

To remove the monitor from the RT103 metal shell:

1. Turn the power off and remove the power cord from the power receptacle.

WARNING
Do not allow the cover to drop.

2. Open the rear cover by removing the two Phillips screws located at the top rear of the shell.

3. Remove top cover by turning counterclockwise the two Phillips fasteners located behind the rear cover that was opened in step 2. These are located in the lower corners of the rear opening. Slide the top cover forward and off the unit.

4. Remove the power cord from the monitor.

5. Remove the keyboard plug from the terminal control module jack.

6. Remove the EIA RS-232-C communication connector from the terminal control module.

7. Remove the four 10-32 Phillips mounting screws from the bottom of the shell.

8. Remove the defective monitor.

9. Reverse the procedure with a new monitor (refer to Figure 2-1).

6.2 PREVENTIVE MAINTENANCE

The RT103 preventive maintenance consists of two procedures normally performed by the operator (customer) on a weekly basis.

6.2.1 Weekly Preventive Maintenance Procedure

1. Turn power off.

2. Inspect and vacuum (if necessary) the slide-out filter on the bottom right of the terminal.

3. Replace cleaned filter.

4. Apply power to the terminal and check for air flow at fan exhaust on rear of terminal.

6.2.2 Quarterly Preventive Maintenance Procedure

1. Perform the procedure in Section 6.2 except replace with a new filter (DEC part number 7424924).

2. Turn the power off and remove the line cord from electrical outlet.

3. Open the rear cover using the two Phillips screws, and inspect rear fan and grid. Clean if necessary.

4. Remove top cover by releasing two internal 1/4-turn lock screws, and slide cover forward.

NOTE
TU58 tape drives are located directly below the video monitor.

5. Remove any cassettes from drive 0 or drive 1.

6. Clean the head and motorpuck of the TU58 tape drives. Use a long-handled cotton applicator moistened with head cleaning fluid (DEC part number TUC01).

7. Replace removed cassette.

8. Replace covers, apply power to terminal, and check air flow.

9. Perform the field checkout procedure in Section 2.4 of this manual.

6.2.3 TU58 Tape Care

The RT103 terminal has a factory-installed TU58 DECtape II tape cartridge drive mounted within the video monitor. The dual tape drive is accessible from the front of the video monitor directly below the video display, as shown in Figure 6-1. 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 that hold 256 blocks of data.

NOTE
The TU58 programming message packets are defined in Section 5.7.

TU58-K cartridges are preformatted. The RT103 cannot format these tapes, but the preformatted tapes are available from DIGITAL. Refer to Chapter 2 for ordering information.

WARNING
Access to tape cartridges is by removal of terminal cover. Always turn power off before removing cover.

6.2.3.1 Cartridge Storage and Care - The following general rules apply to handling tape cartridges for maximum error-free operation.

1. Keep tapes away from magnetic material, dust, heat, and direct sunlight.

2. Never touch the surface of the tape.

3. Remove tape cartridges from the drive when not in use.

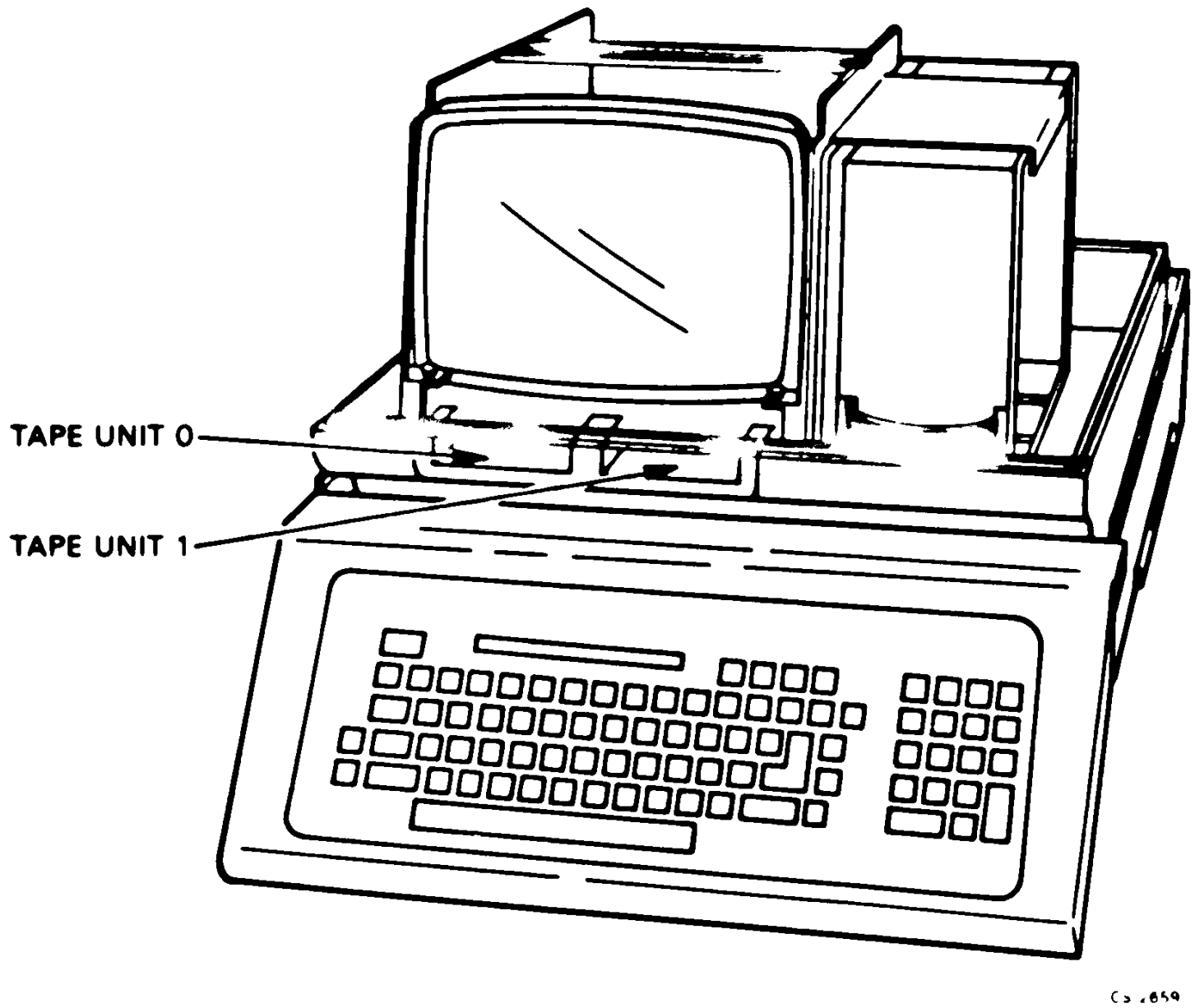


Figure 6-1 RT103 with TU58 DECtape II

4. Always store the tape cartridges inside containers when not in use.

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
Extra copies of system and program tapes should always be made to ensure against data loss if a tape cartridge should malfunction.

6.2.3.2 Write Protect Tab Operation - Each cartridge has a movable write protect tab. This tab may be placed in one of two positions, as illustrated in Figure 6-2.

1. Write protect - move tab toward drive roller. This inhibits writing onto the tape cartridge.

2. Record (write permitted) - move tab away from drive roller. The system may now write on the tape.

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.

6.2.3.3 Tape Cartridge Installation and Removal - To load a tape cartridge into the RT103:

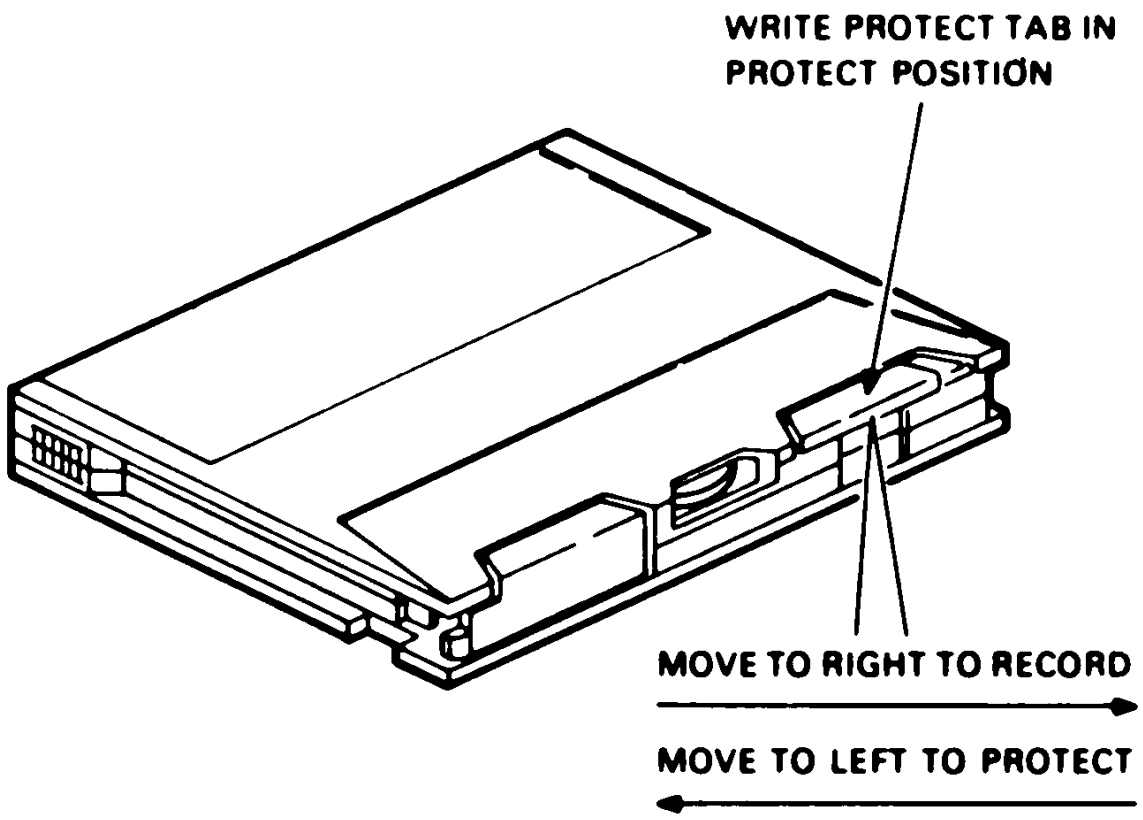
1. Hold the cartridge with the label side up.

2. Push the cartridge into the tape drive opening, as shown in Figure 6-3.

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.



CS 2646

Figure 6-2 Write Protect Tab

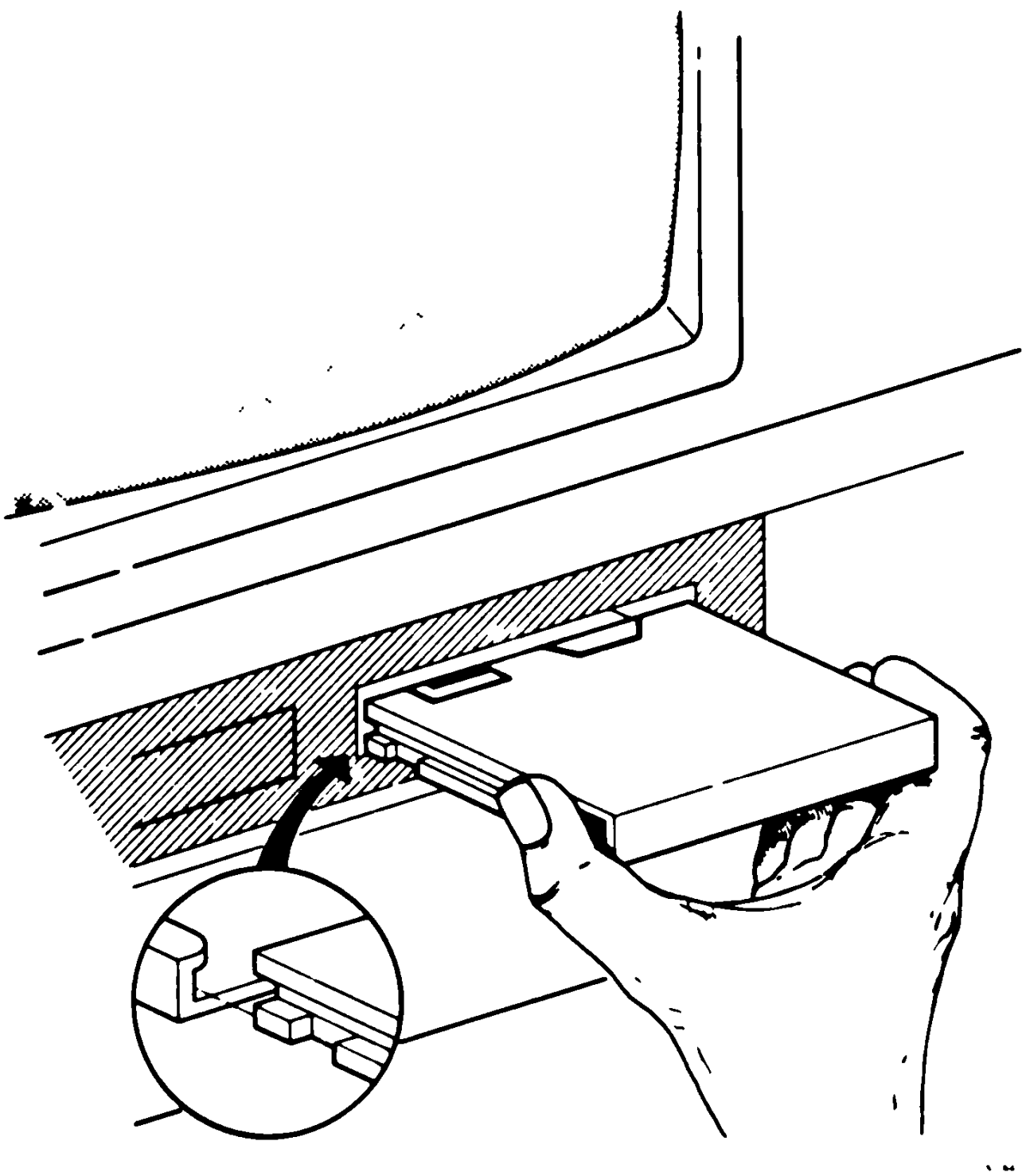


Figure 6-3 Loading a Cartridge

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.

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

CAUTION
To prevent damage to cartridges, remove them before completely disassembling the terminal.

6.2.3.4 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 6-4, 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.

6.3 PACKING EQUIPMENT

Should it become necessary to return the equipment to the factory, proceed as follows.

1. Secure the RT103 corrugated carton saved when unpacked (Section 2.2).

2. Repack the equipment reversing the instructions provided on the carton.

6.4 RETURNING EQUIPMENT TO MANUFACTURER

Whenever it becomes necessary to return the RT103 to DIGITAL, call your local sales representative and obtain a Return Authorization (RA) number. This number must be placed on the outside of the carton and the carton shipped to:

Digital Equipment Corporation
55 Northeastern Boulevard
Nashua, New Hampshire 03062
Attn: Customer Returns Center
RA Number:

NOTE
Address could change without notice. Check address when obtaining RA number.

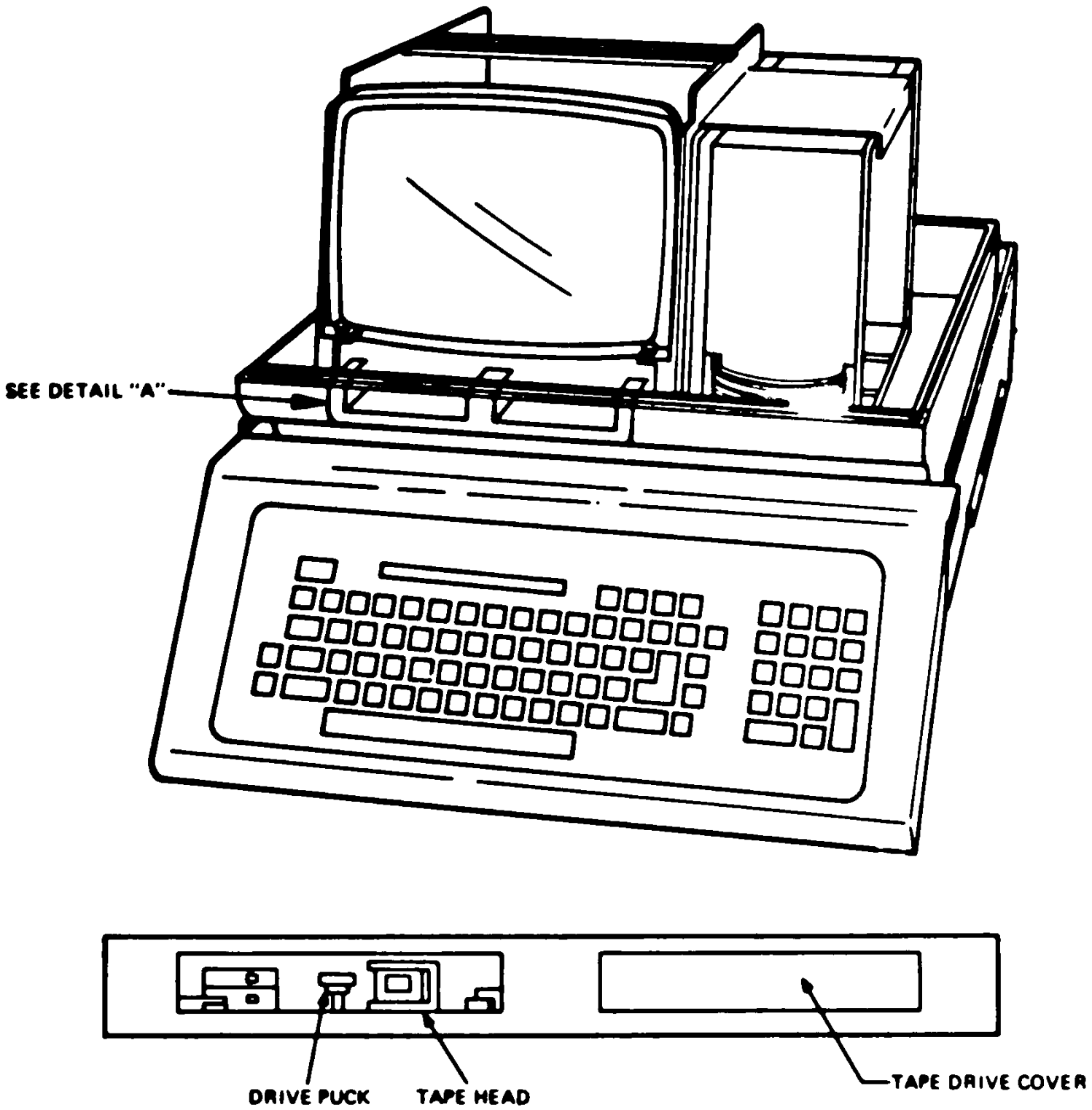


Figure 6-4 Tape Drive Cleaning

If the equipment is still under warranty (within 90 days of date of shipment), the following information should be added to the above:

- DIGITAL serial number(s)
- Computer Special Systems
- Original DIGITAL (DEC) order number.

All items must be shipped prepaid and the RA number must appear on the outside of the box and on all related paperwork.

NOTE

The average repair cycle is four to eight weeks.