7.1 INTRODUCTION

This chapter provides information needed by the Field Service engineer or customer to configure, test, troubleshoot, adjust, and repair the VT180 terminal. Internal ROM-based self-tests and the tests provided by the diagnostic diskette are described. Information about configuring the terminal controller modules, the AVO, and the VT18X control module is also provided.

Troubleshooting is described both for those situations where a failure is indicated by a diagnostic error message or LED error code and those situations where the system has failed to a level where it is unable to run the diagnostics.

7.2 TESTING THE VT180 USING ROM DIAGNOSTICS

The VT180 has internal ROM-based self-tests that help isolate failures to a field replaceable unit (FRU). These self-tests indicate failures by LED error codes and error characters or error messages displayed on the screen. Corrective action may then be taken as directed by the error indication.

The VT180 has the following self-tests.

1. Power-up test
2. CPU test
3. Dynamic RAM test
4. Communications UART test
5. Disk drive controller/disk drive test
6. Set-up display test
7. Video adjust pattern keyboard test

Each test prints an error message or code that helps isolate a failure to the defective module.

7.2.1 Error Messages and Codes

A self-test stops automatically when it encounters an error. The screen displays an error message or a random pattern of characters. An error condition may also light the LEDs on the keyboard (L1−L4) or on the VT18X control module. If the test is set to run continuously and one or more errors occur, the video screen may change from white to black and back to white about once every second. To clear this condition, press the SET-UP key and then the 0 key (reset).

Table 7-1 shows the error message characters that may appear on the screen and the FRU that should be checked or replaced.

Table 7-1 VT180 Displayed Error Messages

Error Message or Character Displayed	VT18X Control Module	Check or Replace				
		Terminal Controller	Advanced Video	Keyboard	Disk Unit	Diskette Media
ROM FAILURE	X					
CPU FAILURE	X					
RAM FAILURE						
8K bytes to 64K bytes	X					
0K bytes to 8K bytes	X					
RTC	X					
TERMINAL-PRINTER	X					
CONSOLE	X					
COMM PORT	X					
FLOPPY ERROR, INTERNAL REGISTER	X					
FLOPPY ERROR, RESTORE FAILURE, DRIVE [n]	X				X	
FLOPPY ERROR, STEP FAILURE, DRIVE [n]	X				X	
FLOPPY ERROR, INDEX PULSE FAILURE, DRIVE [n]					X (no diskette)	
FLOPPY ERROR, MOTOR SPEED FAILURE, DRIVE [n]	X				X	
FLOPPY ERROR, SEEK FAILURE, DRIVE [n]	X				X	X (unfor-matted)
FLOPPY ERROR, READ SECTOR FAILURE, DRIVE [n]	X				X	X
ROM DISK LOADER FAILURE OR DISKETTE BOOT FAILURE					X (no diskette loaded)	
1			X			
2		X(NVM)*				
3		X	X			
4				X		
5			X	X		
6		X		X		
7		X	X	X		
8		X				

n = Drive number: A, B, C, or D
*If you have replaced ROM, enter set-up and perform a save operation.

Table 7-1 VT180 Displayed Error Messages (Cont)

Error Message or Character Displayed	VT18X Control Module	Check or Replace				
		Terminal Controller	Advanced Video	Keyboard	Disk Unit	Diskette Media
9		X	X			
:		X				
;		X	X			
>		X		X		
=		X	X	X		
<		X		X		
?		X	X	X		
@		X				
A		X	X			
B		X				
C		X	X			
D		X		X		
E		X	X	X		
F		X		X		
G		X	X	X		
H		X				
I		X	X			
J		X				
K		X	X			
L		X		X		
M		X	X	X		
N		X		X		
O		X	X	X		

n = Drive number: A, B, C, or D
*If you have replaced ROM, enter set-up and perform a save operation.

7.2.2 Power-Up Test
The terminal automatically performs the following tests during power-up.

1. It writes a 1 and a 0 (in turn) in each bit location of RAM on the basic terminal controller module to verify that the RAM can store each bit.

2. It writes a 1 and a 0 (in turn) in each bit location of RAM on the advanced video option (AVO) to verify that the option RAM can store each bit. If the AVO is not present, the test does not check this part of the terminal.

3. It reads the contents of the nonvolatile RAM (NVR), computes a checksum, and then compares the checksum to the checksum stored in the NVR.

4. It reads the contents of each ROM chip, computes a checksum, and then compares the checksum to the checksum stored in each ROM chip.

5.   It turns on all keyboard LEDs, rings the keyboard bell, and looks for the end-of-scan character from the keyboard to determine if the keyboard is functional.

<div align="center">

CAUTION
Before turning the power to the disk drives on or off,
remove all diskettes.

</div>

Performing the Test

Any one of the following methods will start the power-up test. The terminal must be in ANSI mode. Check the SET-UP B features to see if you are in ANSI mode. To save the set-up features, press the shift and S key together (a shifted S).

1.   Turn the terminal power on.

2.   Press the SET-UP key and then the 0 (reset) key.

3.   Press SET-UP and 4, placing the VT180 in local mode. Type the following sequence to perform the power-up test once.

<ESC>[2;1y

4.   Place the terminal in local mode. Type the following sequence to perform the test continuously.

<ESC>[2;9y

<div align="center">

NOTE
The continuously running test stops if an error is
found or if power is turned off.

</div>

Any error found by the power-up test is printed on the video screen. Table 7-2 explains the error messages and codes displayed by either VT18X control module LEDs or keyboard LEDs.

<div align="center">

Table 7-2   LED Error Codes

</div>

					Field Replaceable Unit			
						VT18X		
Keyboard LEDs				Error Detected	Terminal Controller	Control Module	Disk Unit	Diskette Media
L1	L2	L3	L4					
O	O	O	X	ROM 1	X			
O	O	X	O	ROM 2	X			
O	O	X	X	ROM 3	X			
O	X	O	O	ROM 4	X			
O	X	O	X	Main data RAM	X			

X = On; O = Off

Table 7-2   LED Error Codes (Cont)

VT18X Control Module LEDs				Error Detected	Field Replaceable Unit			
					Terminal Controller	VT18X Control Module	Disk Unit	Diskette Media
4	3	2	1					
X	X	X	X	ROM FAILURE		X		
X	X	X	O	CPU FAILURE		X		
X	X	O	X	RAM FAILURE 8K byte to 64K byte			X	
X	X	O	O	RAM FAILURE 0K byte to 8K byte			X	
X	O	X	X	RTC		X		
X	O	X	O	TERMINAL-PRINTER		X		
X	O	O	X	CONSOLE		X		
X	O	O	O	COMM PORT		X		
O	X	X	X	FLOPPY ERROR, INTERNAL REGISTER		X		
O	X	X	O	FLOPPY ERROR, RESTORE FAILURE, DRIVE n		X	X	
O	X	O	X	FLOPPY ERROR, STEP FAILURE, DRIVE n		X	X	
O	X	O	O	FLOPPY ERROR, INDEX PULSE FAILURE, DRIVE n; MOTOR SPEED FAILURE, DRIVE n		X	X (no diskette in drive)	
O	O	X	X	FLOPPY ERROR, SEEK FAILURE, DRIVE n		X	X	X (unformatted diskette)
O	O	X	O	FLOPPY ERROR, READ SECTOR FAILURE, DRIVE n		X	X	X
O	O	O	X	ROM DISK LOADER FAILURE OR DISKETTE BOOT FAILURE			X (no diskette in drive)	
O	O	O	O	TEST PASSED				

X = On; O = Off

7.2.3 Keyboard Tests

The power-up test checks if a keyboard is present. A key may be tested by placing the terminal off-line and enabling keyclick. All keys typed should produce a click except NO SCROLL, CAPS LOCK, SHIFT, BREAK, and CTRL. Typing the keys should cause the corresponding characters to be displayed on the screen.

Typing <CTRL>G should cause the bell to sound. This checks both the bell circuitry and the CTRL key. Keys typed with CAPS LOCK and SHIFT verify the operation of those keys. After enabling XON/XOFF and placing the terminal on-line, the BREAK and NO SCROLL keys should produce a click when typed.

7.2.4 CPU, Dynamic RAM, Communication UART, and Disk Drive Controller Tests

These tests are run automatically when the system is turned on or optionally when the terminal is reset. These tests check the VT18X control module — its ROMs, CPU, RAMs, PUSARTs, and disk drive controller circuitry. The power-up test assumes that there are no diskettes loaded in the disk drives.

If these tests run successfully, the following menu message is printed on the video terminal.

VT180-XX Version n.n
Copyright 1982 Digital Equipment Corporation
PRESS A, B, C, D, S, or T

A = Start System (drive A)
B = Start System (drive B)
C = Start System (drive C)
D = Start System (drive D)
S = Execute Self-Test
T = Enter Terminal Mode

If an error occurs during any of these tests, a message is printed on the video terminal. See Table 7-1 for a list of error messages.

7.2.5 Set-Up Screen Test

In set-up the terminal exercises all of its display functions. The functions available in the VT180 include double-height, double-width characters (shown as SET-UP A); double-width, single-height characters (shown as TO EXIT PRESS "SET-UP"); and the reverse or underline attribute (selected by the cursor setting and displayed by the cursor and the tab ruler).

In addition to the basic VT180 functions, the functions available in the VT180 with advanced video option include 24 lines with 132 columns (test with the video adjust pattern, Paragraph 7.2.6), and more character attributes.

The following set-up features can be checked with the keyboard controls.

1. Intensity (up and down arrow keys)
2. 80/132 column
3. Tab setting and clearing
4. Transmit and receive speeds
5. Reset
6. Smooth/jump scroll
7. Auto-repeat
8. Reverse screen
9. Margin bell

10. Keyclick
11. United States/United Kingdom character set
12. Wraparound
13. On-line/off-line control

To perform the test, enter the two set-up displays and check that the details agree with those that follow.

SET-UP A is shown in Figure 2-9. The bottom ruler on the display shows the position of the tab stops that are set in the terminal.

SET-UP B, shown in Figure 2-10, displays the current setting for the terminal's features. Figure 2-12 is a summary of features found in SET-UP B.

CP/M application software requires that certain SET-UP B features be set to one mode rather than the other. The remaining features can be set according to the user's preference. The required feature settings are listed in Table 7-3.

Table 7-3   Required Settings for Features

Feature	Required Setting
ANSI/VT52	1 (ANSI) (see note below)
Auto XON/XOFF	1 (on) (must be left on)
Wraparound	0 (off)
New line	0 (off)
Power	0 or 1 (60 Hz or 50 Hz)

NOTE
You can use VT52 mode in the VT180, but you should not save the VT52 features. Upon power-up, the VT18X control module interrogates the terminal controller module to find its parameters. This is done using an ANSI control sequence.

To test the advanced video option, check that the words SET-UP A change from normal to reverse video in boldface, the words TO EXIT PRESS "SET-UP" are underlined, and the tab ruler has alternating normal and reverse video, even if the cursor selected is an underline.

7.2.6   Video Adjust Test
The video adjust test provides a screen full of Es for the display height, width, and linearity adjustments. The test pattern is internal to the terminal and is not sent to the host computer.

Performing the Test
Use the following procedure to display the test pattern.

1. Place the terminal in ANSI mode.
2. Place the terminal in local mode.
3. Type <ESC>#8 to display the pattern.
4. Check smooth scrolling by typing <LF>.

7.3 MODULE CONFIGURATIONS

This section describes the information needed to configure the jumpers and switches on the terminal controller module, the VT18X control module, and the advanced video option (AVO) for use in the VT180 terminal.

7.3.1 VT18X Control Module Configuration

The VT18X control module contains 14 jumpers and a 20-pin DIP switchpack (E22) that allows the user to select various operating features. The switchpack and jumper locations are shown in Figure 7-1. The communication switches configuration is described in Table 3-2 and the jumper configuration in Table 7-4.
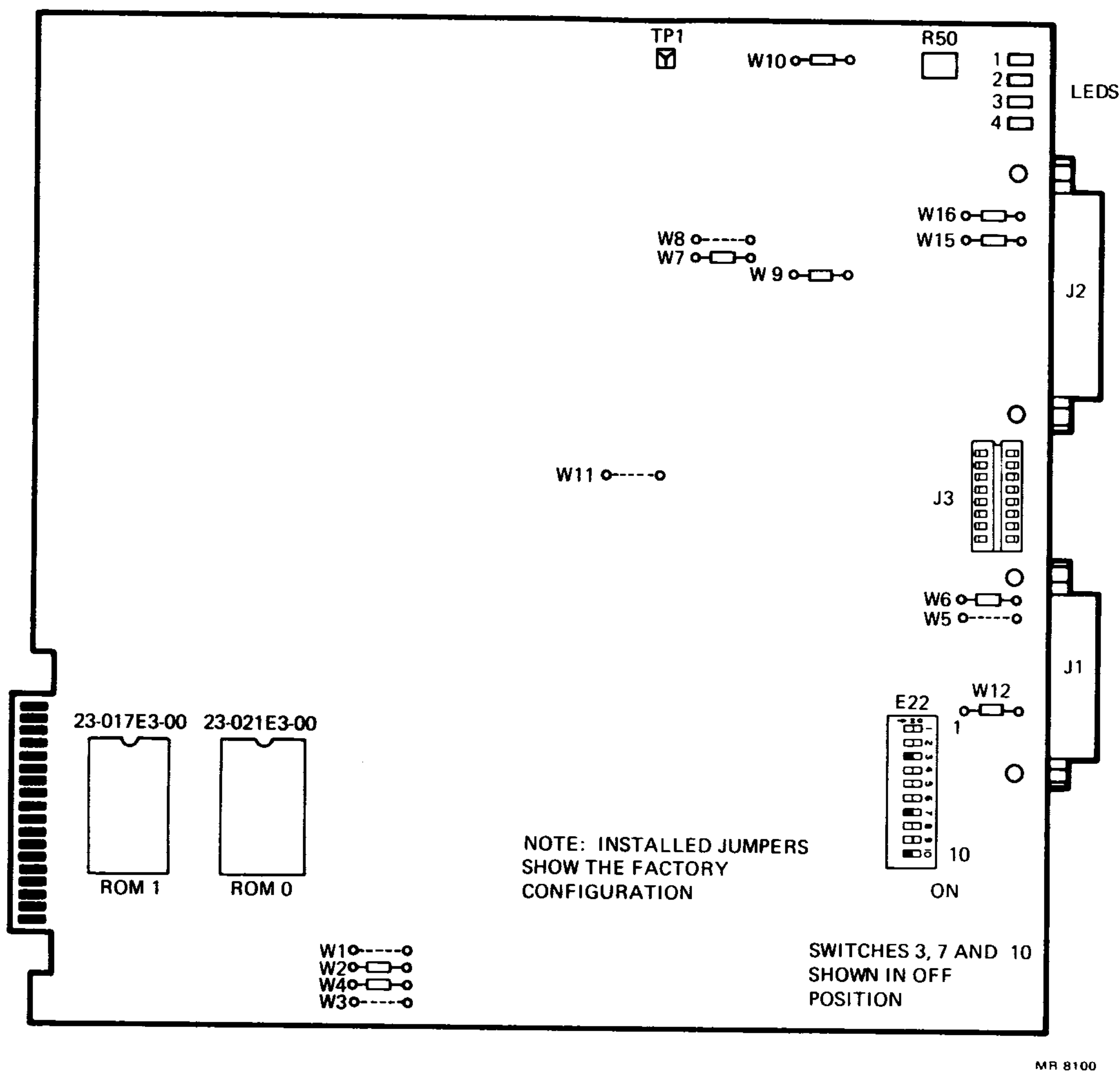
Figure 7-1   VT18X Control Module Jumpers, Switches, LEDs and ROM Locations

Table 7-4 CP/M Processor Factory Jumper Configuration

Jumper	Jumper State	Function
W1	Out	Connects +5 to pin 21 of 2716 ROM 1 (2K × 8).
W2	In	Connects address bit All to pin 21 of 2732 ROM 1 (4K × 8).
W3	Out	Connects +5 to pin 21 of 2716 ROM 0 (2K × 8).
W2	In	Connects address bit All to pin 21 of 2732 ROM 0 (4K × 8).
W5	Out	When installed, disk drive supplies ready (DREADY L) signal.
W6	In	Asserts DREADY L all the time.
W7	In	Selects double-density operation.
W8	Out	Selects single-density operation.
W9	In	Turns on the disk drive motor.
W10	In	Selects double-density data separator. When out, selects single-density data separator.
W11	Out	Installed only during manufacturing testing.
W15	In	Installed for normal operation, removed for FCC testing.
W16	In	Installed for normal operation, removed for FCC testing.

7.3.2 Terminal Controller Module ROMs

The four ROMs used on the terminal controller module for the VT100 are the same as those required for the VT180. Figure 3-6 shows the Digital part numbers of the ROMs and their location on the module.

7.3.3 Advanced Video Option Configuration

Except for a VT180 with a word processing option installed, the VT180 uses no ROMs or jumpers on the advanced video option. A terminal with a word processing option (VT100-WA, -WB) has one ROM installed in the ROM A position on the advanced video option. The configuration of the advanced video option when used for word processing is described in Paragraph 3.4.13.

7.4 DISKETTE DIAGNOSTICS

The VT18X diskette resident diagnostics check the VT18X control module more thoroughly than the self-tests provided by the ROM-based diagnostics. The diskette resident diagnostics have two tests that chain individual diagnostics so that they may be run more easily by end users. The individual diagnostics are intended mainly for field service use.

7.4.1 Diagnostic Operation
When the diagnostic diskette is booted from the Main System menu, it displays the following head and menu.

Diskette Diagnostic Menu

VT180 DISKETTE DIAGNOSTICS VERSION 1.0
DIGITAL EQUIPMENT CORP. 12-31-81

Select one of the following:

1   Basic Test
2   Extended Test
3   Individual Tests

Type <E> to exit to Main System Menu.

CAUTION
**If version 2.1 appears on your Main System menu,
the disk drive motors will run continuously as long as
the menu appears on the screen, allowing you to boot
a diskette from any disk drive. If you intend to leave
your terminal on for an extended length of time,
overnight for example, press T to enter terminal
mode. The disk drive motors will then shut off auto-
matically and extend their life.**

The user diagnostics are selected by typing a 1 or a 2. Typing a 3 will display a menu of the individual diagnostics. Typing E causes the ROM-based Main System menu to be displayed.

7.4.1.1 Basic Test Operation – The basic test is a diskette diagnostic that checks the disk drives more thoroughly than the ROM diagnostics. The basic test requires two formatted diskettes to be run. Data on these diskettes is NOT preserved. The procedure for formatting diskettes is described in Paragraph 4.10.3.

When the basic test is selected from the Diskette Diagnostic menu, it enters the following dialog.

1   Basic Test

Number of disk drives? (2 or 4)
2
Remove system disk and install FORMATTED disks in A&B drives.
WARNING: Contents of diskettes will be destroyed.
Type <P> to proceed with test.
Type <E> to Exit to Diskette Diagnostic Menu.
P

During the test, the screen will display the following messages.

FLOPPY DISK DIAGNOSTIC TESTS, rev (1.1)

Drive N selected
End of part M

The N will be the drive currently under test and the M will be a number that increments from one to thirteen.

The test will run until an error is detected or until drives A and B have been tested. If the number of disk drives was four, the message that follows appears when drives A and B complete the test without any errors. The message is displayed only if the number of disk drives selected is four.

    Install FORMATTED diskettes in <C and D> drives.

    Type <P> to proceed with test.
    <u>P</u>

When the testing of all disk drives is complete, the following message is displayed on the CRT.

    IMPORTANT: Restore the DIAGNOSTIC System Diskette.

    Type <P> to proceed with test.
    <u>P</u>

The diagnostic diskette must be placed in drive A before pressing P. The basic test is complete at this point. When P is typed, the Diskette Diagnostic menu is displayed again.

If an error is detected in the basic test, the test halts and an error message is displayed. Refer to Paragraph 7.4.5 and Table 7-5 for information on error messages and their possible causes.

<div align="center">

Table 7-5   Diskette Error Messages

</div>

Diskette Error Messages	Possible Cause
No index pulse, no diskette, or drive	No diskette, disk drive not connected, door open, I/O cable disconnected
Disk rotation too slow	Bad RX180 disk drive unit
No track 0	VT18X control module bad or A, B,C, or D drive bad
Track register wrong value	VT18X control module bad
Step in error, controller module bad	VT18X control module bad
Direction output low	VT18X control module bad
Direction output high	VT18X control module bad
Step in error,?	Disk drive unit, VT18X control module, or cable bad
Timing wrong for single track move	Disk too fast or too slow, RX180 disk drive
Seek not completed in time (with no verify)	VT18X control module bad

Table 7-5 Diskette Error Messages (Cont)

Diskette Error Messages	Possible Cause
Step error	Disk drive unit, or cable bad
Timing wrong for multitrack move (too fast or too slow)	Disk drive unit bad
No seek error	VT18X control module bad
Seek error (no verify)	VT18X control module bad
Seek error (with verify)	Disk drive unit, using unformatted diskette, or diskette not write-protected
CRC error on header	Diskette or VT18X control module bad
No CRC error on header	Diskette or VT18X control module bad
No CRC error on data,?	VT18X control module bad
CRC error on data,?	Diskette, RX180 disk drive, or VT18X control module bad
Seek not completed in time (with verify)	Diskette bad, RX180 disk drive, using unformatted diskette in disk drive, or VT18X control module bad
Track 0 bit set?	RX180 disk drive or VT18X control module bad
Step out error	VT18X control module bad
Write gate high on write	VT18X control module bad
Write gate low on read	VT18X control module bad
Timing wrong for motor shut off	VT18X control module bad
Motor select bit high	VT18X control module bad
One shot too fast (too slow)	VT18X control module bad
Motor bit high	VT18X control module bad
No record not found	VT18X control module bad
No lost data	VT18X control module bad
Record not found error	Diskette, RX180 disk drive, or VT18X control module bad
Write fault	VT18X control module bad
Write-protected	Tried to format with metal tape on diskette
Bad data	Diskette, RX180 disk drive, or VT18X control module

Table 7-5   Diskette Error Messages(Cont)

Diskette Error Messages	Possible Cause
Ready set	VT18X control module bad
Busy set	Tried to select a nonexistent disk drive
Lost data	VT18X control module bad
RAM Test Error Messages	
Error Message	VT18X control module bad
CPU FAILURE	
RAM FAILURE BIT ?	
RAM FAILURE BIT 0	
RAM FAILURE BIT 1	
RAM FAILURE BIT 2	
RAM FAILURE BIT 3	
RAM FAILURE BIT 4	
RAM FAILURE BIT 5	
RAM FAILURE BIT 6	
RAM FAILURE BIT 7	
ADDRESS FAILURE	
Communications Test Error Messages	
Error Message	VT18X control module bad
INCORRECT VECTOR	
UNSOLICITED INTERRUPT	
RTC FAILURE	
CONSOLE FAILURE	
COMM FAILURE	
PRINTER FAILURE	
GENERAL PURPOSE FAILURE	
PRINTER GENERAL PURPOSE FAILURE	

7.4.1.2 Extended Test Operation – The extended test starts exactly as the basic test does. The only apparent change is the test header. The dialog follows.

   2 Extended Test

   Number of disk drives? (2 or 4)
   <u>2</u>

   Remove system disk and install FORMATTED disks in A and B drives.

   WARNING: Contents of diskettes will be destroyed.

   Type <P> to proceed with test.
   Type <E> to Exit to Diskette Diagnostic Menu.
   <u>P</u>

During the diskette test, the screen will display the following messages.

   FLOPPY DISK DIAGNOSTIC TESTS, rev (1.0)

   Drive N selected
   End of part M

The N will be the drive currently under test and the M will be a number that increments from one to thirteen.

The test will run until an error is detected or until drives A and B have been tested. If the number of disk drives was four, the following message appears when drives A and B complete the test without any errors. This message is only displayed if the number of disk drives selected was four.

   Install FORMATTED diskettes in <C and D> drives.

   Type <P> to proceed with test.
   <u>P</u>

When testing of all disk drives is complete, a message is displayed on the screen.

   IMPORTANT: Restore the Diagnostic System Diskette.

   Type <P> to proceed with test.
   <u>P</u>

The extended test goes on to test the RAM and communications ports. If these tests run without errors, the Diskette Diagnostic menu is displayed again. If an error is detected in any of the tests, the test halts and displays an error message. Refer to Paragraph 7.4.5 and Table 7-5 for information on error messages.

During the RAM test the following message blinks on the screen.

   2 RAM Test

7.4.1.3 Individual Diagnostics – To test a printer or to test a specific communications port, use the individual tests. Select these tests by typing 3 after the diagnostic menu. The following Individual Test menu is displayed on the video screen.

Individual Test Menu

1 Floppy Test
2 RAM Test
3 Basic Comm. Test (No Loop-Back Plug)
4 Comm. Test – Printer Port With Loop-Back Plug
5 Comm. Test – General Purpose Port with Loop-Back Plug
6 Comm. Test – Comm. Port with Loop-Back Plug
7 Printer Confidence Test on General Purpose Port
8 Printer Confidence Test on Printer Port
9 Synchronous Comm. Test

Type <E> to Exit to Diskette Diagnostic Menu.

Type the number of the test desired and follow the instructions printed on the video screen for the specific test. The terminal echos the number of the test selected and prints:

Type <P> to proceed with test.

The following conditions can be used to run the selected test.

1.   Type P to run the test once.

2.   Type ,nP to run the test n number of times, where n = 1 to 9.

3.   Type -P to run the test continuously. To stop a continuously running test, reset the terminal by pressing SET-UP 0. Boot the diagnostic diskette again to get the menu.

When the selected test starts, it displays the test name followed by any required dialog.

NOTES

1.   **An external loopback connector (Digital part number 12-15336) must be attached to the terminal to run test 4, 5, or 6. These tests detect failures in the EIA line drivers and receivers, which are not checked on power-up or during self-test. The transmit and receive baud rates for the terminal must be identical.**

2.   **The printer confidence tests (7 and 8) send a line of text that you type to the printer. The printer must be set up for these parameters.**

> **BAUD RATE:1200***
> **BIT/CHARACTER:8**
> **PARITY:NONE**
> **STOP BITS:1**

---

*A later revision ROM allows the baud rate to be either 300 or 1200. This is established using the P SETUP command. Refer to Chapter 5 to use this command.

3. The synchronous communications test (test 9) requires that the terminal's transmit and receive speeds be identical and be at 2400 baud or less. The communications port is tested in loopback mode; however, no loopback connector is required for this test. Enter SET-UP B and change the baud rate if you desire to run this test.

If the test runs without detecting any errors, the following message is displayed each time the test is successful.

TEST PASSED

When the test has run the specified number of times, the Individual Test menu will be displayed again.

7.4.1.4 Individual Test Example Dialog – The following dialog provides a simple example of selecting an individual test and running it with a repeat count of three. The test used in the example is the basic communications test. The example assumes that the system diagnostic diskette has been booted.

Diskette Diagnostic Menu

VT18X DISKETTE DIAGNOSTICS Version 1.0
DIGITAL EQUIPMENT CORP. 12-32-81

Select one of the following:

1   Basic Test
2   Extended Test
3   Individual Tests

Type <E> to exit to Main System Menu.
<u>3</u>

Individual Test Menu

1   Floppy Test
2   RAM Test
3   Basic Comm. Test (No Loop-Back Plug)
4   Comm. Test – Printer Port With Loop-Back Plug
5   Comm. Test – General Purpose Port with Loop-Back Plug
6   Comm. Test – Comm. Port with Loop-Back Plug
7   Printer Confidence Test on General Purpose Port
8   Printer Confidence Test on Printer Port
9   Synchronous Comm. Test

Type <E> to Exit to Diskette Diagnostic Menu.
<u>3</u>

Type <P> to proceed with test.
<u>,3P</u>

3 Basic Comm Test (No Loop-Back Plug)
TEST PASSED
TEST PASSED
TEST PASSED

Individual Test Menu

1 Floppy Test
2 RAM Test
3 Basic Comm. Test (No Loop-Back Plug)
4 Comm. Test – Printer Port With Loop-Back Plug
5 Comm. Test – General Purpose Port with Loop-Back Plug
6 Comm. Test – Comm. Port with Loop-Back Plug
7 Printer Confidence Test on General Purpose Port
8 Printer Confidence Test on Printer Port
9 Synchronous Comm. Test

Type <E> to Exit to Diskette Diagnostic Menu.

This example showed the dialog needed to run the basic communications test with a repeat count of three. It assumed that no errors were detected while running the test.

7.4.2 Floppy Test

The floppy test performs an extensive checkout of the disk drive controller and the selected disk drives. The floppy test is run in both the basic and extended tests. It also may be run individually with a greater number of operator options.

This paragraph explains operation of the floppy disk test when selected individually. It also gives a basic description of what the test does.

7.4.2.1 Floppy Test Operation – When the floppy test is selected from the Individual Test menu, it enters the following dialog.

1 Floppy Test

The screen is cleared and the following dialog is displayed.

FLOPPY DISK DIAGNOSTIC TESTS, rev (x.0)

Select drive(s) to be tested. <A,B,C,D>

Press RETURN to continue
<u>N</u>

The N is the user's response. This response can be any combination of A, B, C, or D repeated any number of times. For example, AABBCCAADD would test drive A twice followed by drives B and C twice each, drive A would then be tested twice again followed by two tests on drive D. The test requires about 4 minutes per drive, so the example would take about 40 minutes.

After the drives are entered and RETURN is pressed, the screen is cleared again and the following dialog is displayed.

FLOPPY DISK DIAGNOSTIC TESTS, rev (x.0)

Insert formatted disks into drives

WARNING, CONTENTS OF DISKS ARE DESTROYED!

Press RETURN to continue

This test requires formatted diskettes for each drive that is to be tested. These diskettes must be in good condition and have no data that must be saved. Any data that is on these diskettes will be destroyed.

When formatted diskettes have been installed in the drives to be tested, press RETURN.

The screen will be cleared again, and the following message will be displayed.

FLOPPY DISK DIAGNOSTIC TESTS, rev (1.0)

Drive N selected
End of part M

The N is the drive currently under test and the M is a number that increments from one to thirteen.

When all of the selected drives have been tested and no errors have been detected, the test exits to the Individual Test menu.

If an error is detected during the diskette test, the test will wait on the error and display an error message. (Refer to Paragraph 7.4.5 and Table 7-5 for more information on error messages.)

7.4.2.2 Floppy Test Description – The floppy test has an initialization section and 13 tests.

The initialization section presents the drive selection dialog and the message to insert formatted diskettes into the selected disk drives. If no selection was made and RETURN was typed, the initialization section selects drive A as a default. It then displays the selected drive.

Test one uses the index pulse from the selected drive to check motor speed over a four second period. There should be 20 index pulses in 4 seconds. If the number of pulses is not 20, the motor speed is either too fast or too slow.

Test two checks the restore command. It issues a restore command to the selected drive and waits 1.5 seconds for a track 0 bit to be set. If the bit does not set, another drive is tested to determine if the problem is in the controller or a drive. The track register is tested to be sure that it has been reset.

Test three checks part of the diagnostic read register and the general control register. The test also checks restore timing and head load timing.

Test four checks the step in command to see that the head moves away from track 0 and that the track register is incremented.

Test five verifies head speed using the restore command. The track register is also checked to ensure that it was reset.

Test six checks head motion and the track register using step in and step out commands.

Test seven checks the proper step command and track register performance.

Test eight puts the head at track 40 and then times a restore command. It also checks the track register.

Test nine does seek testing. First, sequential seeks are done from track 0 to track 40 with no verify. After each seek, the control and status register is tested for seek or CRC errors. When the last track is found, it seeks to tracks 10, 30, 20, 25, 5, 35, and 15 to move the head in a random fashion. The test is then repeated with a verify after each seek.

Test ten checks the controller write logic. Errors are forced to ensure that the proper errors are detected. Forced errors are: record not found, lost data, seek error, and CRC error on the header. During the lost data test, the write gate is tested to be sure it goes low.

Test eleven writes data to tracks 0, 20, 40, 4, 36, 8, 32, 12, 28, 16, and 24. The data is left for the read sector test. If errors are encountered, an appropriate error message is displayed.

Test twelve checks the controller read logic. Errors are forced to ensure that the proper errors are detected. Forced errors are: record not found, lost data, and CRC error on the data field. During the lost data test, the write gate is tested to be sure it stays high.

Test thirteen reads and verifies the data written in test eleven. If an error is detected, an appropriate error message is displayed.

Refer to Paragraph 7.4.5 and Table 7-5 for information on errors.

7.4.3 RAM Test

The RAM test performs an extensive check on the VT18X control module RAM and the refresh circuitry of the Z80 CPU. The RAM test takes from 10 to 12 minutes to complete. It is run as a part of the extended test, although it may be run individually. When the RAM test starts, it displays the following header.

2   RAM Test

The RAM test has subtests that check the following aspects of RAM performance.

1. Z80 refresh register
2. RAM refresh
3. Addressing
4. Data integrity
5. Code execution
6. Gallop pattern
7. Alpha radiation

There are no operator dialogs needed within the RAM test. The possible error messages from this test follow.

CPU FAILURE
ADDRESS FAILURE
RAM FAILURE BIT 0
RAM FAILURE BIT 1
RAM FAILURE BIT 2
RAM FAILURE BIT 3
RAM FAILURE BIT 4
RAM FAILURE BIT 5

RAM FAILURE BIT 6
RAM FAILURE BIT 7
RAM FAILURE BIT ?

The question mark after the last message means that the test could not determine which bit failed.

7.4.4 Communications Tests

The communications tests include:

1. A basic communications test
2. A synchronous communications test
3. A printer confidence test on the general purpose port
4. A printer confidence test on the printer port
5. A loopback plug test on the printer port
6. A loopback plug test on the general purpose port
7. A loopback plug test on the communications port.

The basic communications test runs when the extended test is selected from the Diskette Diagnostic menu. The synchronous communications test, the loopback connector tests, and the printer confidence tests must be selected individually from the Individual Test menu. The basic communications test can also be selected individually from the Individual Test menu.

7.4.4.1 Basic Communications Test

7.4.4.1 Basic Communications Test – This test checks the operation of all the VT18X control module's PUSARTs in asynchronous mode. The test uses the loopback multiplexer on the control board to loop back the PUSART outputs. The test also checks the real time clock and interrupts.

The basic communications test is run as part of the extended test and can also be run individually.

When the basic communications test is selected from the Individual Test menu, it displays the following header.

 3 Basic Comm. Test (No Loop-Back Plug)

7.4.4.2 Synchronous Communications Test

7.4.4.2 Synchronous Communications Test – This test checks the operation of the communications port PUSART in synchronous mode.

To run this test, the transmit and receive speeds set in SET-UP B must be 2400 or lower. The speeds must also be equal. This is because the baud rate clock from the terminal controller module is used for the communications port PUSART. The actual transmission frequency is 16 times the frequency selected in SET-UP B. The limitations of the PUSART do not allow higher speeds to be used.

The communications port is operated in loopback mode during the test. Its output is looped back to its input. This is done with the loopback multiplexer on the VT18X control module. The external loopback connector is not used for this test.

When this test is selected from the Individual Test menu, it displays the following message.

 9 Synchronous Comm. Test

If the transmit and receive speeds from SET-UP B exceed 2400, the following error message is displayed.

  CANNOT RUN TEST BECAUSE SELECTED BAUD RATE
  EXCEEDS 2400 BAUD. CHANGE BAUD RATE USING
  SETUP IF YOU DESIRE TO RUN THE TEST.

The test then returns to the Individual Test menu.

If the test detects a failure, the following error message is displayed.

COMM FAILURE

7.4.4.3 Loopback Plug Tests – This test is designed to detect failures in the EIA drivers and receivers that were not checked by tests using the loopback multiplexer. The tests use an external loopback connector to loop an individual PUSART's output back to its input through the EIA drivers and receivers.

When a loopback test is selected from the Individual Test menu, one of the following messages is displayed.

    4   Comm. Test – Printer Port with Loop-Back Plug
DEPRESS Y WHEN CONNECTOR IS ON

    5   Comm. Test – General Purpose Port with Loop-Back Plug
DEPRESS Y WHEN CONNECTOR IS ON

    6   Comm. Test – Comm. Port with Loop-Back Plug
DEPRESS Y WHEN CONNECTOR IS ON

The external loopback connector must be connected to the selected port before typing the Y. To connect the loopback connector, the cable access cover must be removed and any cable connected to the selected port must be disconnected. Remember to replace any cables disconnected when the test is complete.

The Y will be echoed on the line following the message.

The error messages possible from these tests follow.

PRINTER FAILURE

GENERAL PURPOSE FAILURE

COMM FAILURE

If there were no failures indicated in self-test, the extended test, or the basic communications test diagnostics, one of these messages indicates a failure in the EIA drivers or receivers.

7.4.4.4 Printer Confidence Tests – These tests are used to send a line of text to a printer or printing terminal connected to the printer port or the general purpose port. They are included as confidence tests for the printer and general purpose ports. They are not intended to be printer tests.

When one of these tests is selected from the Individual Test menu, it displays the following header and message.

    7   Printer Confidence Test on General Purpose Port

    8   Printer Confidence Test on Printer Port

INPUT ONE LINE OF TEXT FOLLOWED BY AN <ESC>

The text is echoed on the line following the message.

When the test detects an ESC at the end of the text, it starts transmitting the text to the printer. The text can be up to 124 characters, including returns. Each return counts as two characters of the 124.

NOTE
This test always uses the following parameters to transmit data.

BAUD RATE: 1200
BITS/CHARACTER: 8
PARITY: NONE
STOP BITS:

The printer must be set up for these parameters to run this test.

When the <ESC> is detected at the end of the text, the following message is displayed.

    Starting Transmission

If the printer confidence tests are selected with a repeat count, the starting transmission message is only output once. The text only has to be entered once.

7.4.5 Diskette-Based Diagnostic Error Messages
When an error has been detected by a diagnostic test, the test will display an error message followed by these messages.

    WAITING ON ERROR, TYPE <P> TO PROCEED, <L> TO LOOP
    X̲

The X is the echoed response to the message. If loop is selected as the response to the message, the following message is displayed after 100 loops.

    PERCENTAGE OF ERROR ##%

This message is updated each time 100 loops have been done.

If P is typed, testing proceeds from the point at which the error was detected.

Table 7-5 lists the error messages that can be displayed by the diskette-based diagnostics.

7.5 TROUBLESHOOTING
All terminals in the VT180 series are based on the VT100 video terminal, with the VT18X personal office computing option added to the terminal. Therefore, when troubleshooting the VT180, you should attempt to isolate the problem first to the VT100 and then to the VT18X control module or RX180 disk drive unit(s). If a screen display or LED indication is obtained, the troubleshooting procedure generally involves running the ROM-based self-tests to isolate the failure to a FRU and then running the more extensive tests provided by the diskette-based diagnostics.

CAUTION
Before turning the power to the disk drives on or off, remove all diskettes.

7.5.1 Troubleshooting the Basic VT180

The VT180 internal self-tests help isolate failures in the VT180 caused by a field-replaceable unit (FRU). Paragraph 7.2 describes the tests and how to run them. Table 7-1 lists the displayed error messages and Table 7-2 lists the keyboard and VT18X control module LED error codes the tests provide, the failures they indicate, and the FRU that should be replaced.

The ROM-based diagnostics will be complete after approximately 15 seconds, and the following will be displayed on the video screen. (This printout is subject to change.)

VT18X VERSION 2.1 28-JUN-82

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PRESS A, B, C, D, S, or T

A = Start System (drive A)
B = Start System (drive B)
C = Start System (drive C)
D = Start System (drive D)

S = Execute Self-Test

T = Enter Terminal Mode

At this time you may insert a diskette into a drive and start the diskette; or you may enter VT100 terminal mode, not using the diskette; or you may start the self-test again.

To boot a diskette, type the letter of the drive that has the diskette installed. For example, to boot a diskette in drive A, type A.

If you want the VT180 to communicate with an external system, type T to enter VT100 terminal mode. If you want to run the internal extended self-test, place the formatted diskettes in drives A and B and type S.

7.5.2 Troubleshooting the VT180 with the Diagnostic Diskette

The diagnostic diskette includes the following programs.

1. CPU test
2. Dynamic RAM test
3. Communications UART test
4. Floppy controller/drive test

The CPU test verifies that the CPU processor on the VT18X control module is operating correctly.

The dynamic RAM test checks the RAMs on the VT18X control module for short or open circuits.

The communications UART test uses various data patterns and baud rates. Data is looped internally from the transmit of one UART to the receive of another.

The floppy controller/drive test checks many of the functions the ROM diagnostic does but is more extensive. These tests include register tests, timing and seek tests, sector read and write tests, and data tests.

7.5.2.1 Starting the Diagnostic Diskette – Turn the system on by pressing the 1/0 switch on the top of the disk drive unit (or upper disk drive unit if there are two) to 1. The following message appears on the terminal.

VT18X Version 2.1

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PRESS A, B, C, D, S, or T

Place the diagnostic diskette into drive A (the left drive of the top disk drive unit) and type A.

7.5.2.2 Diagnostic Error Messages – The diagnostic test will print an error message on the video screen. Upon detection of an error, the diagnostic will wait in error mode and will require you to type either a command to proceed (P) or a command to loop (L) on the error detected. The error message will appear as follows.

ROM DISK LOADER FAILURE

WAITING ON ERROR

If P is typed, the waiting on error message disappears and the diagnostic proceeds to the next test. If L is typed, the waiting on error message disappears and the following message takes its place.

LOOPING ON ERROR

XXX% OF FAILURE

The percent of failure is updated every 100 loops.

7.5.3 Troubleshooting the VT180 with no Printout
If the terminal has a problem and no start-up printout occurs, perform the following procedure.

1. Turn the power off by setting the 1/0 switch on the top (or only) disk drive unit to the off (0) position.

NOTE
If two disk drive units are installed, the 1/0 switch on the bottom disk drive unit should always remain set to 1.

2. The 1/0 switch on the back of the video terminal should be set to 1.

3. Check the voltage selector switches on the back of the disk drive unit(s) and the video terminal; they should match the system's power — 115 Vac or 230 Vac (Figure 3-25).

4. Check the ac power cables for correct configuration (Figures 3-26 and 3-27). These cables should be connected as follows.

    a. The wall receptacle to the top (or only) disk drive unit.
    b. The top disk drive unit to the bottom disk drive unit.
    c. The bottom (or only) disk drive unit to the terminal.

5.   Check the I/O cable for correct configuration (Figures 3-26 and 3-27).

   a.   A BC26K I/O cable connects from the disk drive port on the back of the video terminal to the left connector (as seen from the back) on the bottom (or only) disk drive unit.

NOTE
In a system with two disk drive units, the BC26K I/O cable must connect from the terminal to the RX180-AD, the bottom disk drive unit (drives C and D). Drive A of the RX180-AB, the top disk drive unit, has a resistor pack for terminating the I/O bus; therefore, drive A must always be last on the I/O bus.

   b.   A BC26Z 20 cm (8 inch) disk-to-disk I/O cable (17-00298) connects the bottom disk drive unit to the left connector (as seen from the back) on the top disk drive unit.

6.   Check that the keyboard cord is plugged into the keyboard connector at the back of the terminal.

7.   Turn the 1/0 switch on the top (or only) disk drive unit to 1 (on). The system performs its power-up test. (Refer to the power-up test description in Paragraph 7.2.2 for more information about the power-up test.)

Problems that occur with the VT180 can be isolated to the VT100 terminal controller, the keyboard, the monitor, the VT18X control module, the VT180 paddle board, the RX180 disk drive unit(s), or any option added to the VT180.

Table 7-6 lists the more common VT180 failures and the indications linked with these failures. In using the table, select the indication that matches the failure and note the following.

1.   Table 7-6 assumes that only one field-replaceable unit (FRU) has failed.
2.   Do not ignore the chance of a component failure after the module has been replaced.
3.   Turn off power before disconnecting or replacing any of the FRUs.

The indication displayed may represent a multiple failure, and as a result, the indication may change as FRUs are replaced. Always troubleshoot according to the current indication.

Table 7-6   Basic VT180 Troubleshooting Procedure

Indication	Probable Cause	Corrective Action
No response when the power switch is set to the on position. The CRT filament is not lit and 1/0 switches on the disk drive units are not on. The LEDs on the terminal are not on.	Not plugged in; no power at the wall socket.	Plug in the VT180; use a different wall socket if possible.
	Main power fuse.	Replace the fuse. (if the fuse blows again there may be a shorting problem. Use the appropriate troubleshooting methods.)
	Disk drive fuse.	Replace the fuse.

Table 7-6 Basic VT180 Troubleshooting Procedure (Cont)

Indication	Probable Cause	Corrective Action
	Power supply.	Replace the power supply.
	AC line cord.	Check for an open or short and replce the line cord.
The disk drive 1/0 switch light is off. The terminal is on.	The power cable is incorrectly installed.	Check for the correct daisy-chain of power through each disk drive unit to the terminal.
	The disk drive unit or power supply.	Replace the disk drive unit.
On a system with two disk drive units, the bottom left drive select light comes on when power is turned on. The diskette may have read errors.	The two disk drive units are installed in reverse order.	See Chapter 3 for installing two disk drive units.
Disk drive A fails; drive B functions correctly.	EMI static from the video terminal or disk drive failure.	Place the disk drive unit on the side of the terminal and test drive A again. If drive A still fails, replace the entire disk drive unit.
Disk drive B fails; drive A functions correctly.	The disk drive.	Replace the disk drive unit.
The disk drive select LED is on, but the terminal has no power. The CRT filament is not on.	The power cable from the disk drive unit to the terminal is unplugged or the switch is off.	Check for the correct daisy-chain of power through each disk drive unit to the terminal. Check the setting of 1/0 switches on each disk drive unit and on the back of the terminal.
	The power harness is not firmly attached to the expansion backplane.	Check the power harness.
	The dc power harness.	Replace the harness.
	Expansion backplane.	Replace the backplane.
	Terminal power supply.	Replace the terminal power supply.
No audible tone is heard when the terminal is turned on. The keyboard LEDs are lit.	Keyboard.	Replace the keyboard.
	Keyboard cable.	Replace the keyboard cable.
	Terminal controller.	Replace the terminal controller.

Table 7-6   Basic VT180 Troubleshooting Procedure (Cont)

Indication	Probable Cause	Corrective Action
	Speaker.	Replace the speaker.
	Keyboard cable.	Replace the keyboard cable.
A flashing 4 appears on the screen, but no audible alarm sounds when the terminal is turned on and no keyboard light comes on.	The keyboard is disconnected.	Connect the keyboard.
	Power cables.	Check the power cables.
	Keyboard cable.	Replace the keyboard cable.
	Keyboard.	Replace the keyboard.
	Terminal controller.	Replace the terminal controller.
An audible tone has sounded on the keyboard ON-LINE light is on, but the start-up message does not appear on the screen 30 seconds after the terminal is powered up.	The screen brightness is too low.	Adjust monitor brightness.
The start-up message appears when the system is powered up or reset, but the diagnostic diskette does not run when the drive is specified. The terminal displays ROM DISK LOADER FAILURE or DISKETTE BOOT FAILURE.	There is no diskette in the specified drive.	Install the diagnostic diskette in drive A.
	The drive door is not closed.	Close the door.
	An unformatted or wrong diskette is installed.	Change the diskette and try again.
The wrong character appears on the screen when typed in local mode.	Set-up features may be set incorrectly.	Enter SET-UP A and press 0 (reset). Then check SET-UP B features. The required feature settings are listed below.

Feature	Setting
ANSI/VT52	1
AUTO XON XOFF	1
Wraparound	0
New Line	0
Power	0 to 1

(The power matches the power line frequency, 60 Hz or 50 Hz.)

| | The ROMs on the terminal controller may need to be changed. | Check the ROM part numbers and replace them if necessary. |

Table 7-6 Basic VT180 Troubleshooting Procedure (Cont)

Indication	Probable Cause	Corrective Action
The wrong character appears on the screen when typed in on-line mode. The terminal is functional in local mode.	Set-up features may be set incorrectly.	Enter SET-UP B and then check SET-UP B features.
	Transmit or receive speed.	Set the speed to match the computer.
	Alternate character set or alternate keypad mode or cursor key mode is selected.	Clear the condition with power-up or reset.
	Terminal controller ROMs.	Check and replace the terminal controller ROMs if necessary.
	The bits per character feature is set incorrectly.	Set the feature to match the computer.
	The parity feature is set incorrectly to match the computer.	Set the parity and/or parity sense feature.
	Communications switches on the VT18X control module may be set incorrectly.	Check the settings of the communications switches. (See Chapter 3.)
	Communications facility problem.	Check the communications facility.
A horizontal or vertical line appears on the screen.	Monitor connectors.	Check and reconnect the monitor.
	Monitor board.	Replace the monitor board.
	CRT and yoke	Replace the CRT and yoke assembly.
The screen display is distorted. The characters are narrow on the left or right side of the screen.	The monitor is maladjusted.	Adjust the monitor.
	Monitor board.	Replace the monitor board.
	Flyback transformer.	Replace the flyback transformer.
	CRT and yoke assembly.	Replace the CRT and yoke assembly.
	Terminal controller.	Replace the terminal controller.

Table 7-6   Basic VT180 Troubleshooting Procedure (Cont)

Indication	Probable Cause	Corrective Action
The display bows in or out.	The yoke pincushion is maladjusted.	Replace the CRT and the yoke assembly.
The display is jumpy	The interlace feature is on.	Turn the feature off.
	The power feature is set incorrectly.	Set the feature to the correct line frequency.
	Terminal controller.	Replace the terminal controller.
	Power supply.	Replace the power supply.
	Monitor board.	Replace the monitor board.
	Flyback transformer.	Replace the flyback transformer.
	Keyboard.	Replace the keyboard.
	Controller.	Replace the controller.
The messages received are incomplete.	XON/XOFF feature is set incorrectly.	Set the feature.
	Terminal controller.	Replace the terminal controller.
All characters are displayed as a white area (black with reverse screen).	An alternate character set is selected and not available.	Clear the condition with power-up or reset.
Only the top or bottom half of the characters are displayed on the screen.	Incorrect use of the double-height escape sequence.	Check the escape sequence.
The set-up features do not work correctly (multiple alarms may sound on power-up or recall).	The save operation was not performed.	Perform the save operation.
	Terminal controller	Replace the terminal controller.
The terminal does not respond to the escape sequences.	The ANSI/VT52 feature is set incorrectly.	Set this feature to ANSI.

7.5.4   Troubleshooting the Options

Troubleshoot any terminal option module by removing it and then checking the basic terminal. If the problem occurs when the module is reinstalled, replace the module.
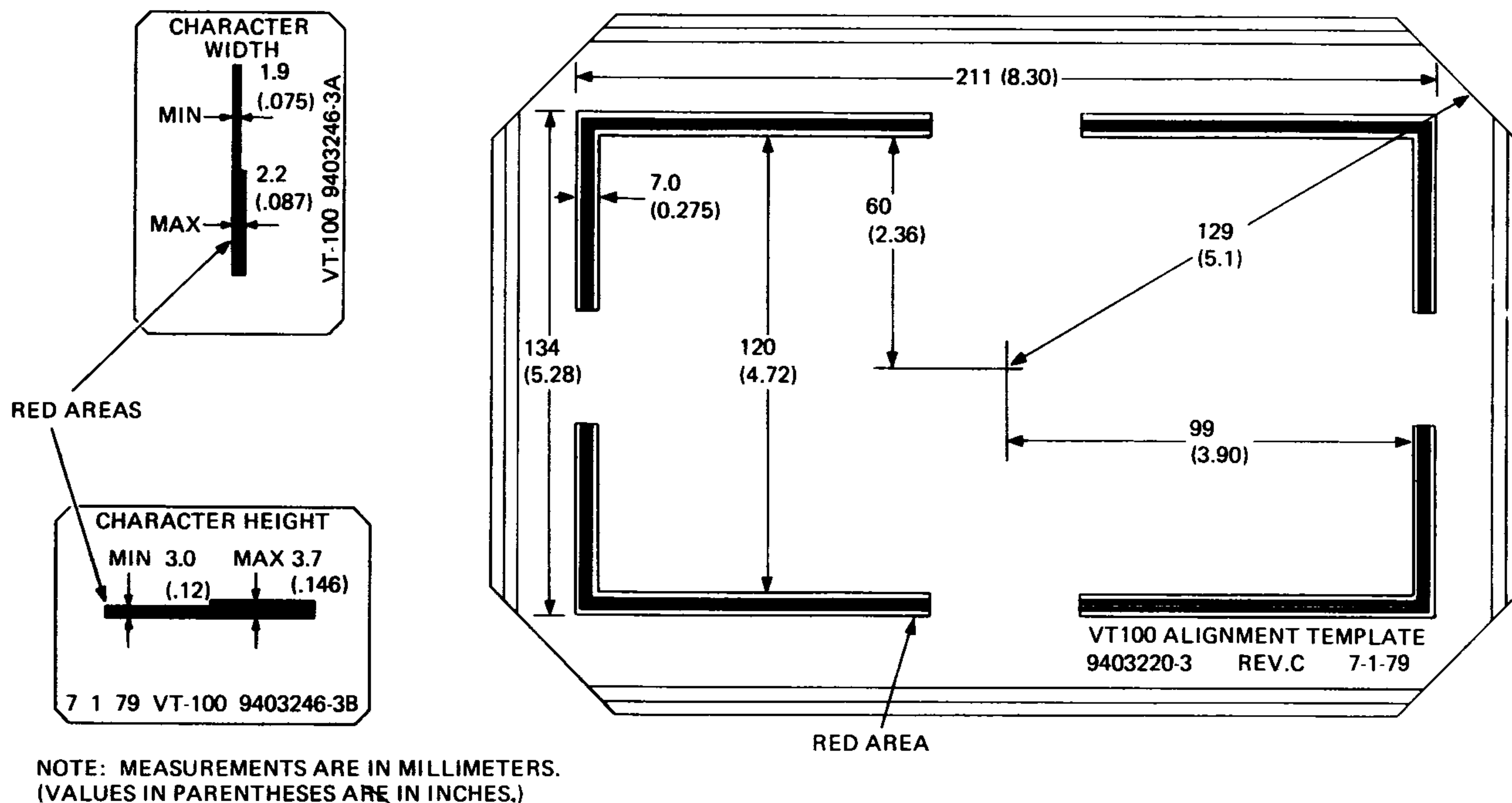
7.6 VIDEO ALIGNMENT

This section describes how to align the video monitor made by Elston. (For early model terminals, refer to the *VT100 Series Pocket Service Guide*.) Each adjustment should be checked because an adjustment may affect others that follow it. However, if a check shows the correct indication, do not perform that adjustment; instead, go on to the next procedure.

All adjustments must be made under the following conditions.

1. Normal video (dark background)
2. 80 characters per line
3. ANSI mode
4. Local mode
5. Not in either set-up mode
6. CRT alignment template attached to the screen
7. Top cover removed
8. When all of these conditions are met, type <ESC>#8 to fill the screen with a test pattern consisting of all Es.

7.6.1 Alignment Template

Figure 7-2 shows the alignment dimensions used in this procedure. If the mylar adjustment templates (94-03220-03 and 94-03270-03) are not available, use the dimensions in Figure 7-2 to help you make a template from a sheet of paper. Paragraph 7.6.1.1 describes this procedure. A correctly made paper template serves the purpose of the mylar template.

Figure 7-2 Video Alignment Template Dimensions

7.6.1.1 Making a Paper Template – You need a pen, a ruler, a triangle (or anything that can help you draw a right angle), scissors, and a 20 by 28 cm (8 by 11 inch) sheet of paper.

1. Mark a dot in the center of the sheet of paper.

2. Referring to Figure 7-2, make a rectangle on your paper that measures to the inside of the red area. Draw a rectangle using the triangle, as shown in Figure 7-3.
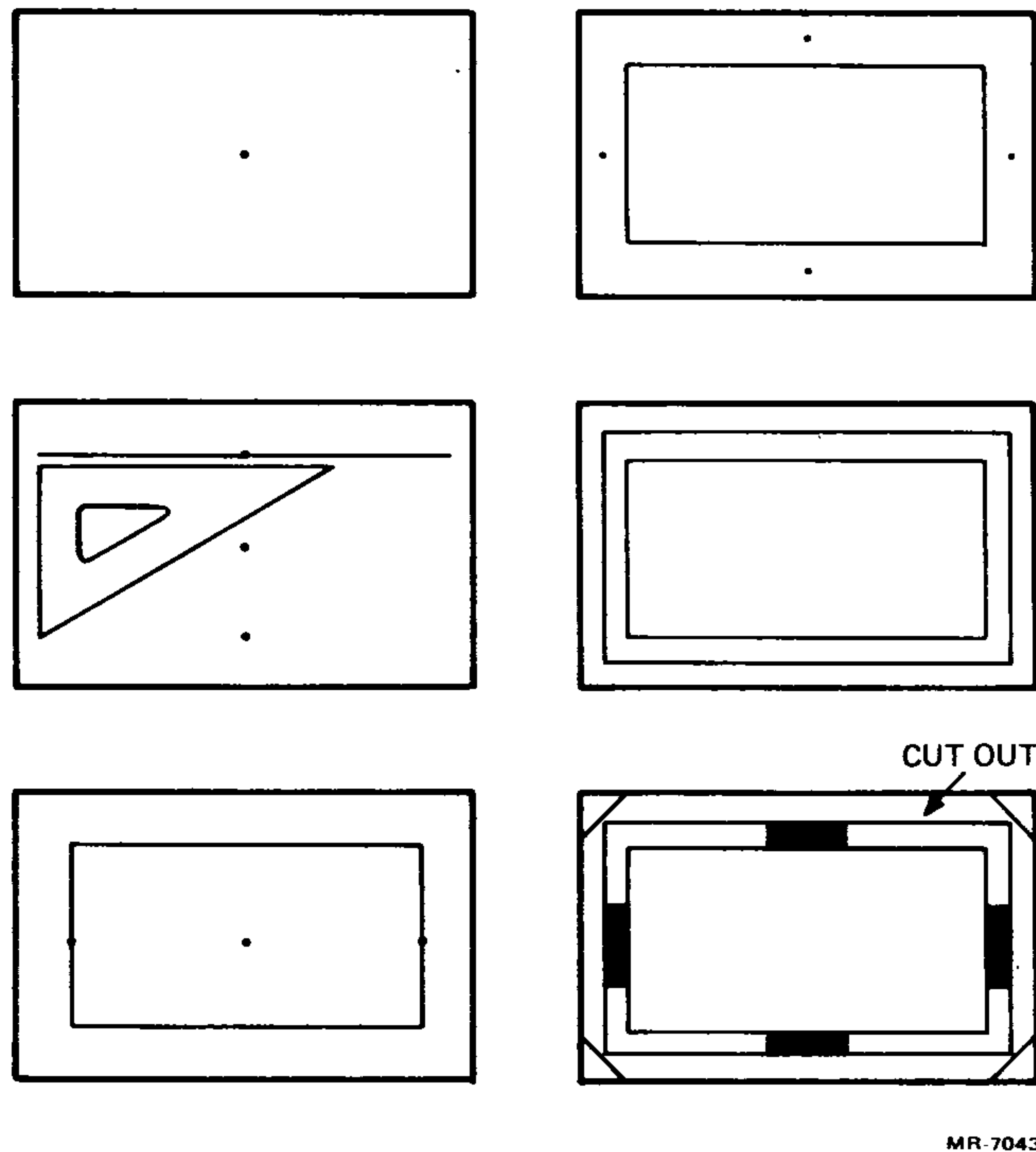

CUT OUT

MR-7043

Figure 7-3   Making a Paper Alignment Template

3. On the alignment template the width of the red area is 7 mm (.275 inch). Place a dot 7 mm outside each of the four sides of the rectangle.

4. Draw a line through each dot to form another rectangle around the previous one.

5. Between the two rectangles, mark an area in the center of each side to leave for support (the black areas in Figure 7-3). With scissors cut out the corners between the two rectangles.

6. Measure 12.9 cm (5.1 inches) from the center of the paper to each corner and cut the corners off. This allows you to center the paper template on the CRT.

7.6.1.2 Attaching the Template – The CRT alignment template (94-03220-03) must remain on the screen during all adjustment procedures. However, if you are using a paper template, you may have to remove it for brightness and linearity adjustments. Attach the template to the CRT using the following procedure.

1. Using the bezel around the screen as a guide, mark the four edges of the screen with water-soluble ink from a soft-tip pen.

2. Remove the terminal's top cover. (Refer to Chapter 3, Paragraph 3.4.3.)

3. Tape the CRT alignment template to the screen with all four corners of the template the same distance from the marks you made in step 1.

7.6.2 Monitor Adjustments

The Elston monitor can be identified by the position of the flyback transformer, which is found on the monitor sideplate opposite the monitor board. Also, the yoke assembly does not have a connector card.

All adjustments must be made under the conditions listed in Paragraph 7.6.

7.6.2.1 Brightness Adjustment – Perform the following steps to adjust the screen's brightness.

1. Increase the brightness to the maximum level with the ↑ key in either SET-UP A or B.

2. Adjust R109 (Figure 7-4) until the display raster is visible; then turn R109 in the opposite direction until the raster disappears.

3. Return the brightness to its usual intensity with the ↓ key in either SET-UP A or B.
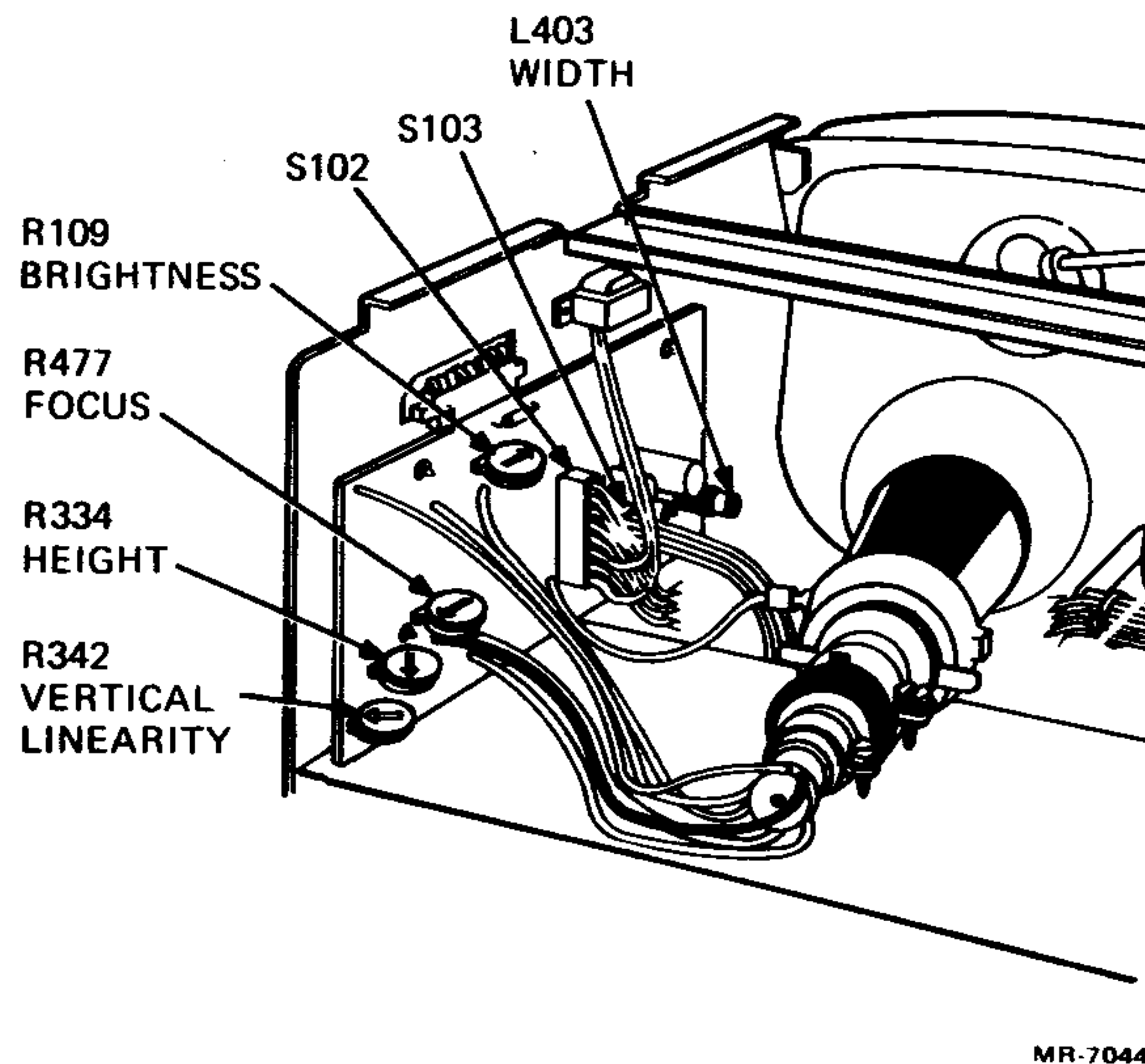
Figure 7-4 Digital/Elston Video Monitor Board Adjustments

7.6.2.2 Yoke Adjustment – Perform the following steps to adjust the yoke.

1. Check that all four sides of the screen display are parallel to the red area of the alignment template.

2. If not parallel, loosen the yoke collar clamp screw (Figure 7-5) and turn the yoke until the four sides of the screen display are parallel to the red area of the alignment template.

3. Check that the yoke is pushed all the way forward toward the face of the CRT. Tighten the yoke collar clamp screw while holding the yoke in place.

CRT ANODE CAP

FLYBACK
TRANSFORMER

VIDEO
MONITOR
BOARD

FOCUS
RINGS

YOKE
CLAMP
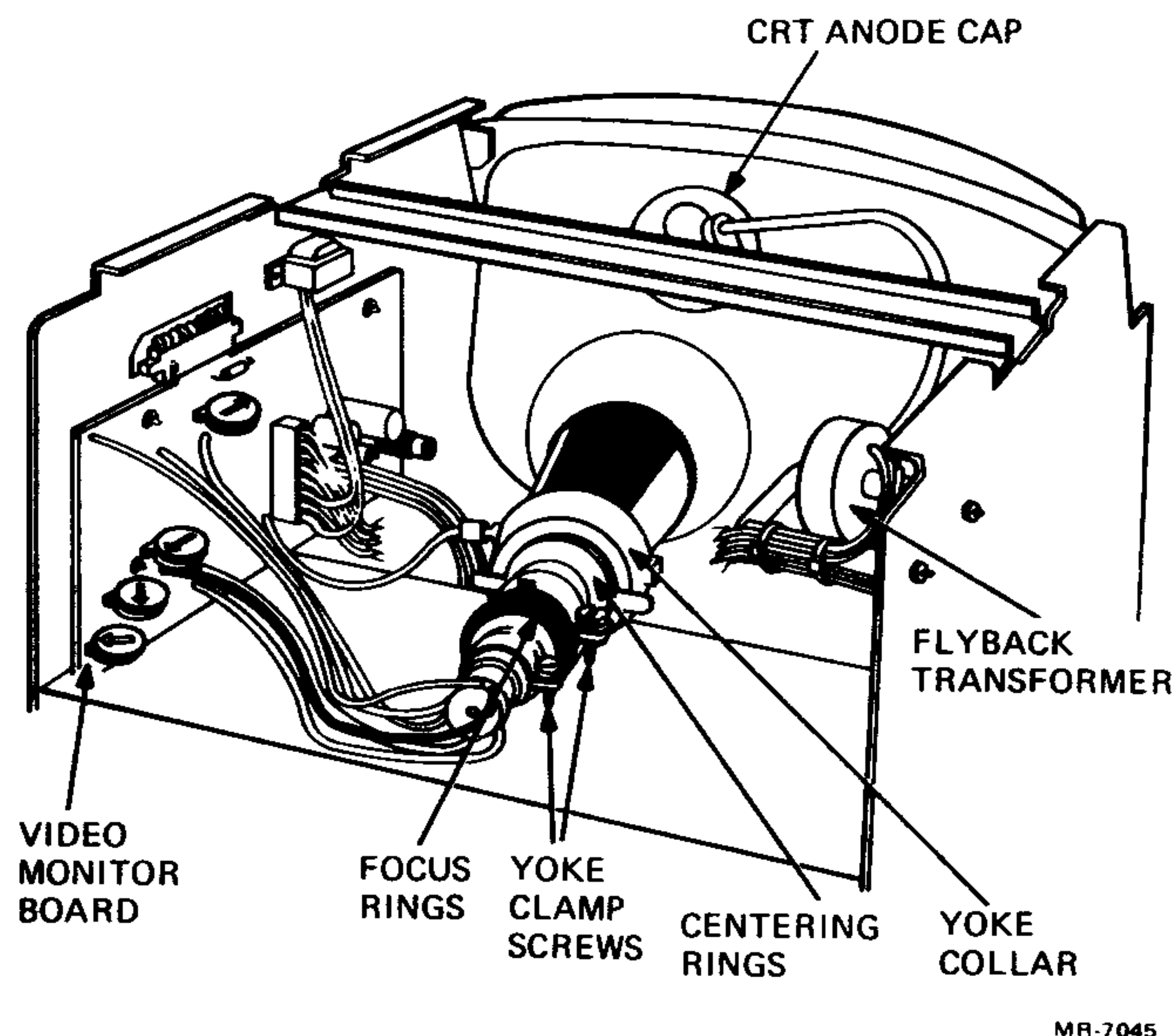SCREWS

CENTERING
RINGS

YOKE
COLLAR

MR-7045

Figure 7-5   Digital/Elston Monitor CRT Adjustments

7.6.2.3   Vertical Height Adjustment – Perform the following steps to adjust the vertical height of the display.

1.   Check that the top and bottom lines of the display are covered by the red area of the alignment template.

2.   Adjust the vertical height control R334.

7.6.2.4   Horizontal Width Adjustment – Perform the following steps to adjust the horizontal width of the display.

1.   Check that the first and last columns of the display are covered by the red area of the adjustment template.

2.   Adjust the horizontal width coil L403 with a monitor alignment tool (29-23190).

7.6.2.5   Center Adjustment – Perform the following steps to adjust the display to the center of the video screen.

1.   Check that the screen display is in the center of the red area on the alignment template.

2.   If necessary, move the display to the center by rotating the front rings found on the neck of the CRT (Figure 7-5).

7.6.2.6   Vertical Linearity Adjustment – Perform the following steps to adjust the vertical linearity.

1.   Use the character height template (94-03270-03) to check that the heights of the characters, found at the four corners and the center of the display, are between the minimum and maximum sections of the template.

2.   Adjust the vertical linearity using R342.

3.   Check and adjust the vertical height (Paragraph 7.6.2.3).

7.6.2.7 Focus Adjustment – Perform the following steps to adjust the focus.

1.   Increase the brightness to the maximum level with the ↑ key in set-up. Decrease the brightness eight steps by pressing the ↓ key eight times.

2.   Look at the characters at the four corners and in the center of the screen. The discrete dots in the vertical segment of the E should be visible in each character.

NOTE
Some users may want the focus slightly different for their needs. If the focus is adjusted correctly, go to step 5.

3.   Adjust R477 (Figure 7-4) for the best character display.

4.   Adjust the focus rings, found farthest from the yoke, for the best focus at all four corners (Figure 7-5). Adjust R477 again if necessary.

5.   Remove the CRT alignment template, clean the marks from the screen, and replace the terminal's top cover if no more adjustments are needed.

7.7 MODULE AND MECHANICAL ASSEMBLY REMOVAL AND INSTALLATION
This section describes the removal and replacement procedures for modules and mechanical assemblies of the VT180 series of terminals. Unless otherwise stated, each procedure applies to all terminals in the series. Figure 7-6 shows the sequence in which the procedures are to be performed.

7.7.1 Cable Access Cover (Wort Cover) and Module Access Cover (Rear Shield)
Perform the following steps to remove the cable access cover (wort cover) and module access cover (rear shield).

1.   Turn the power off by setting the 1/0 switch on the top (or only) disk drive unit to 0 (off). Disconnect the ac power cord from the wall receptacle.

2.   Remove the cable access cover (wort cover) from the back of the video terminal by removing the four 6-32 by 5/16 inch screws.

3.   Unplug the keyboard cable attached to the back of the module access cover (rear shield). (See Figure 3-20.)

4.   Disconnect the BC26K disk drive cable from the disk drive port on the module access cover.

5.   Disconnect the communications cable (if installed) from the communications port.

6.   Disconnect the printer cable (if installed) from the printer connector.

7.   Disconnect any other cables (video-in, video-out, general-purpose serial cables) attached to the module access cover.

```
                          ┌──────────────┐
                          │   ACCESS     │
                          │   COVERS     │
                          │ (PARA 7.7.1) │
                          └──────┬───────┘
            ┌────────────────────┼────────────────────┐
    ┌───────┴───────┐    ┌───────┴───────┐    ┌────────┴────────┐
    │    RX180      │    │    VT18X      │    │    TERMINAL     │
    │  DISK DRIVE   │    │   CONTROL     │    │   CONTROLLER    │
    │    UNIT       │    │   MODULE      │    │    MODULE       │
    │ (PARA 7.7.2)  │    │ (PARA 7.7.3)  │    │  (PARA 7.7.4)   │
    └───────┬───────┘    └───────┬───────┘    └────────┬────────┘
    ┌───────┴───────┐    ┌───────┴───────┐    ┌────────┴────────┐
    │    TOP        │    │   VT180       │    │   ADVANCED      │
    │   COVER       │    │  PADDLE BD    │    │    VIDEO        │
    │ (PARA 7.7.13) │    │ (PARA 7.7.5)  │    │    OPTION       │
    └───────┬───────┘    └───────────────┘    │  (PARA 7.7.6)   │
            │                                  └────────┬────────┘
            │                                  ┌────────┴────────┐
            │                                  │     ROM         │
            │                                  │  (PARA 7.7.7)   │
            │                                  └─────────────────┘
    ┌───────┴────────────────────┬─────────────────────┐
┌───┴────────┐         ┌─────────┴────────┐    ┌────────┴────────┐
│  BOTTOM    │         │  VIDEO MONITOR   │    │  CRT DISCHARGE  │
│  COVER     │         │     BOARD        │    │  AND ANODE CAP  │
│(PARA 7.7.16)│        │  (PARA 7.7.14)   │    │  (PARA 7.7.21)  │
└───┬────────┘         └──────────────────┘    └────────┬────────┘
┌───┴────────┐                        ┌─────────────────┴─────────┐
│  POWER     │                ┌───────┴────────┐       ┌──────────┴───────┐
│  SUPPLY    │                │  FLYBACK       │       │  CRT- YOKE       │
│(PARA 7.7.17)│               │ TRANSFORMER    │       │  ASSEMBLY        │
└───┬────────┘                │ (PARA 7.7.15)  │       │  (PARA 7.7.22)   │
┌───┴────────┐                └────────────────┘       └──────────────────┘
│  RF SHIELD │
│(PARA 7.7.18)│                                  ┌──────────────────┐
└───┬────────┘                                  │  KEYBOARD        │
┌───┴────────┐                                  │  TOP COVER       │
│   DC       │                                  │  (PARA 7.7.8)    │
│POWER HARNESS│                                 └────────┬─────────┘
│(PARA 7.7.19)│                                 ┌────────┴─────────┐
└───┬────────┘                                  │  KEYBOARD        │
┌───┴────────┐                                  │  (PARA 7.7.9)    │
│ EXPANSION  │                                  └────────┬─────────┘
│ BACKPLANE  │                                  ┌────────┴─────────┐
│(PARA 7.7.20)│                                 │  KEYBOARD        │
└────────────┘                                  │  CABLE           │
                                                │  (PARA 7.7.10)   │
                                                └────────┬─────────┘
                                                ┌────────┴─────────┐
                                                │  SPEAKER         │
                                                │  (PARA 7.7.11)   │
                                                └────────┬─────────┘
                                                ┌────────┴─────────┐
                                                │  KEYCAPS         │
                                                │  (PARA 7.7.12)   │
                                                └──────────────────┘
```

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Figure 7-6   Removal Procedure Sequence

8.   Remove the hex standoff from each corner of the module access cover (Figure 3-20). Remove the 6-32 by 5/16 inch screw from the center of the module access cover. This screw grounds the VT18X control module to the chassis.

9.   Remove the module access cover.

To install the module access cover and cable access cover, perform steps 1 through 8 in reverse.

7.7.2 Disk Drive Unit(s)
Perform the following steps to remove one or two RX180 disk drive units.

CAUTION
**Remove all diskettes from the disk drive unit(s)
before turning the power on or off.**

1. Set the 1/0 switch on the top (or only) disk drive unit to 0 (off).

2. Disconnect the ac line cord from the wall receptacle and from the back of the top (or only) disk drive unit.

3. Remove the ac line cord that connects the terminal to the back of the bottom (or only) disk drive unit.

4. Remove the cable access cover (Paragraph 7.7.1).

5. Disconnect the BC26K disk drive cable from the disk drive port on the module access cover and from the back of the bottom (or only) disk drive unit.

NOTE
**If two disk drive units are installed, continue with
step 6; if one is installed, go to step 8.**

6. Disconnect the BC26Z cable that connects one disk drive unit to the other.

7. Disconnect the ac line cord that connects one disk drive unit to the other.

8. Lift the top disk drive unit (RX180-AB) off the bottom disk drive unit (RX180-AD).

NOTE
**When installing two disk drive units, the RX180-AB
must be placed on top and cabled so that it is the last
disk drive unit on the I/O bus.**

Install the disk drive unit(s) by performing steps 1 through 8 in reverse. See Figures 3-26 and 3-27 for correct cable installation.

NOTE
**When placing the disk drive unit(s) on top of the
video terminal, do not cover the ventilation openings
on the terminal.**

**The authorized spare disk drive unit is the RX180-
AB (drives A and B) part number 30-19308-01. To
convert this unit to the RX180-AD (drives C and D),
refer to special procedures in Paragraph 3.4.12.2.**

CAUTION
**When replacing a disk drive unit in the field, always
set the ac voltage selector on the back of the disk
drive unit for the line voltage of the system — 115
Vac or 230 Vac. If set incorrectly, you may damage
the power supply.**

7.7.3 VT18X Control Module
Perform the following steps to remove the VT18X control module.

1. Remove the cable access cover and module access cover (Paragraph 7.7.1).

2. Pull the VT18X control module out from J2 of the backplane and partially out of the card cage (Figure 3-18).

CAUTION
The ribbon cable connectors in step 3 damage easily. Gently lift each end of the connector with a small flat screwdriver.

3. Disconnect the ribbon cable attached to the IC connector on this module. (This cable comes from the VT180 paddle board in the STP connector.)

4. Remove the VT18X control module from the card cage.

To install this module, perform steps 1 through 4 in reverse.

7.7.4 Terminal Controller Module
Perform the following steps to remove the terminal controller module.

1. Remove the cable access cover and module access cover (Paragraph 7.7.1).

2. Pull the VT18X control module (Figure 3-18) partially out of the card cage and disconnect the ribbon cable from the IC connector on the module.

3. Remove the chassis ground screw from the paddle board and pull the terminal controller module partially out of the card cage. Disconnect the ground wire (if present) from the metal bracket at the EIA connector.

4. Remove the terminal controller module from the card cage.

5. Remove the VT180 paddle board from the STP connector on the terminal controller module (Paragraph 7.7.5).

6. If you are installing a new terminal controller module, remove the advanced video option (if present) from the old module and place it on the new module (Paragraph 7.7.6).

To install the terminal controller module, perform steps 1 through 6 in reverse. Be sure to connect the cables and any ground wires.

NOTE
Check the terminal controller module and the advanced video option for their correct ROM configuration. (See Chapter 3.) Refer to Paragraph 3.4.13 for ROM removal and installation procedures.

Remember to reconfigure the terminal to the customer's original set-up selections, which should be listed on the set-up label under the keyboard.

7.7.5 VT180 Paddle Board
Perform the following steps to remove the VT180 paddle board.

1. Remove the cable access cover and the module access cover (Paragraph 7.7.1).

2. Remove the VT18X control module (Paragraph 7.7.3).

3. Remove the terminal controller module (Paragraph 7.7.4).

4. Remove the screw and washer holding the VT180 paddle board to the terminal controller module (Figure 3-9).

5. Gently pull the paddle board out of the STP connector on the terminal controller module.

6. Using a small flat screw driver, remove the 16-pin flat cable from the VT180 paddle board.

To install the paddle board, perform steps 1 through 6 in reverse.

NOTE
If you remove the VT180 paddle board from the terminal controller module, check that all pairs of contacts in the STP connector come together to make electrical contact.

7.7.6 Advanced Video Option (AVO)
Perform the following steps to remove the advanced video option (AVO).

1. Remove the cable access cover and module access cover (Paragraph 7.7.1).

2. Remove the terminal controller module (Paragraph 7.7.4).

3. Hold the advanced video option by its edges and lift it straight up and off the terminal controller module (Figure 3-5).

To install the advanced video option (AVO), perform steps 1 through 3 in reverse.

NOTE
Check the AVO for the presence of ROMs and jumpers installed (or switches set). Refer to Chapter 3 for correct configuration.

7.7.7 Terminal Controller Module ROMs
If a ROM is defective or if the terminal is a variation with special ROMs, refer to Paragraphs 3.4.13 for the ROM removal and installation procedure.

7.7.8 Keyboard Top Cover
Perform the following steps to remove the keyboard top cover.

1. Set the 1/0 switch on the top (or only) disk drive unit to 0 (off).

2. Unplug the keyboard from the video terminal.

3. With a flat screwdriver, loosen the captive screws on the bottom of the keyboard that hold the keyboard together (Figure 7-7).

4. Remove the top cover by lifting it straight up.

To install the keyboard top cover, perform steps 1 through 4 in reverse.
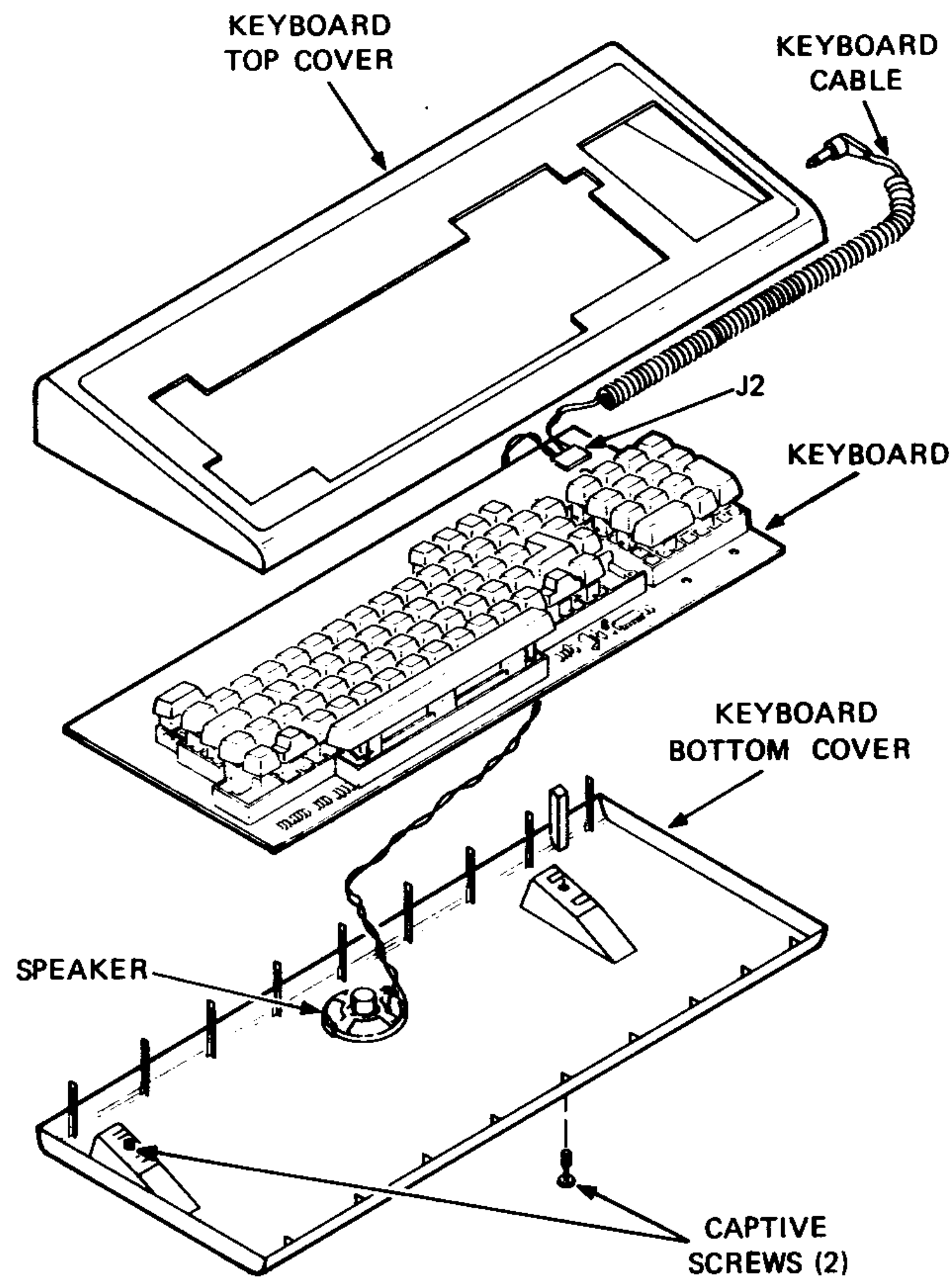
Figure 7-7 Keyboard Disassembly

7.7.9 Keyboard
Perform the following steps to remove the keyboard.

1. Remove the keyboard top cover (Paragraph 7.7.8).
2. Disconnect keyboard cable J2 from the keyboard.
3. Remove the keyboard.

To install the keyboard, perform steps 1 through 3 in reverse.

7.7.10 Keyboard Cable
Perform the following steps to remove the keyboard cable.

1. Remove the keyboard top cover (Paragraph 7.7.8).
2. Remove the keyboard (Paragraph 7.7.9).

3. Disconnect the keyboard cable from the speaker.
4. Remove the keyboard cable.

To install the keyboard cable, perform steps 1 through 4 in reverse.

7.7.11 Keyboard Speaker
Perform the following steps to remove the keyboard speaker.

1. Remove the keyboard top cover (Paragraph 7.7.8).
2. Remove the keyboard (Paragraph 7.7.9).
3. Remove the keyboard cable (Paragraph 7.7.10).
4. Remove the speaker by moving it toward the front edge of the keyboard cover.

To install the keyboard speaker, perform steps 1 through 4 in reverse.

7.7.12 Keycaps
The tools needed to remove and install keycaps are a keycap puller and a pair of needlenose pliers. Perform the following steps to remove keycaps. Reverse the procedure to install them.

1. Remove power from the terminal by turning it off.

2. Starting at the upper left corner of the keyboard, insert the keycap puller between the first keycap to be replaced and the adjacent keycap (Figure 7-8).
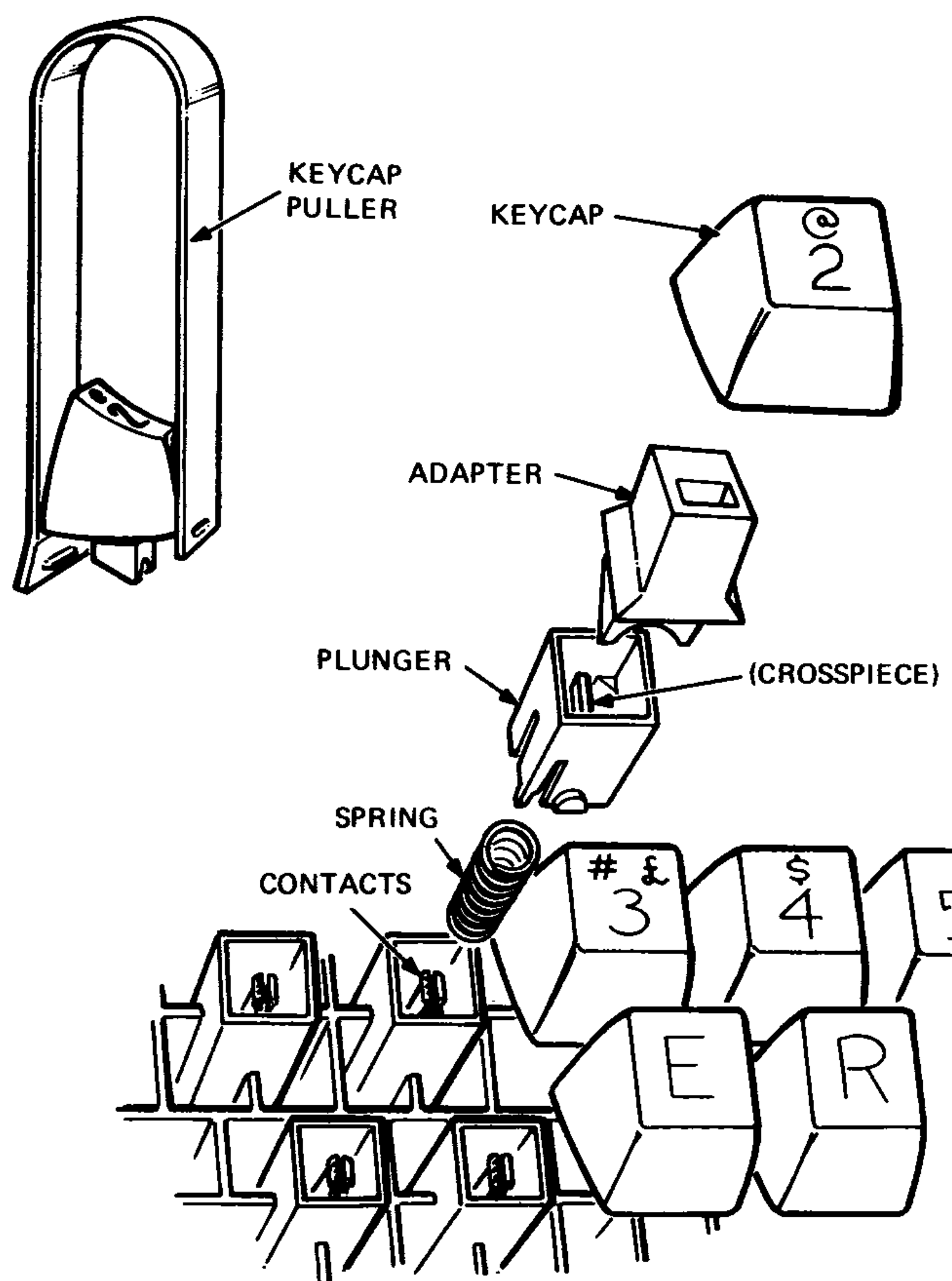
Figure 7-8   Keycap Removal

3. Compress the puller around the keycap and slowly pull it straight up.

4. If the adapter does not come off with the keycap, carefully remove the adapter with needlenose pliers. Reinstall the adapter in the keycap, making sure the pointed end faces the front of the keycap.

NOTE
In some keyboards the adapter and the keycap are one part.

5. In the event that the plunger comes off, take care to prevent the spring from flying out. Referring to Figure 7-8, replace the plunger and spring as follows.

CAUTION
You must follow this procedure carefully to prevent damage to key contacts.

a. Slide the spring into the plunger. Place the spring and plunger into the slot and over the key contacts. Make sure the crosspiece of the plunger is vertical, not horizontal.

b. Slowly push the plunger down until the crosspiece touches the contacts. Release the plunger and check that the contacts are separated.

6. Find a correct replacement keycap. Gently press the keycap straight down onto the plunger until it is completely installed.

7. Repeat this procedure for each keycap to be replaced.

8. Store all spare keycaps in a safe location for later use.

Test After Installation
Perform the following steps to check that the keycaps are correctly installed.

1. Place the terminal off-line.

2. Press each replacement keycap (both lowercase and uppercase) and make sure the correct character(s) are displayed on the screen.

7.7.13 Top Cover
Perform the following steps to remove and install the top cover.

1. Remove the cable access cover and the module access cover (Paragraph 7.7.1).

2. Remove the ac power cord from the terminal and, if installed on top of the terminal, remove the disk drive unit(s) from the terminal.

3. With a small scriber or a pointed tool, release the four front pop fasteners found under the front and rear edge of the terminal (Figure 3-10).

4. Remove the top cover by lifting it straight up.

5. Check if the VT180 logo has been installed. If not, position the top cover face down on a soft surface to remove and replace the VT100 logo. To remove the logo, use a pair of needlenose pliers and a flat blade screwdriver to pry up the retaining rings from the back of the VT100 logo and install the VT180 logo. See Figure 3-19.

6. To install the top cover, seat the top cover on the bottom cover and push the pop fasteners up into the top cover until they lock into place.

7. Attach the ac power cord from the wall receptacle to the top (or only) disk drive unit. Daisy-chain the power with a power cord to the second disk drive unit (if installed), then to the terminal (Figures 3-26 and 3-27).

8. Install the module access cover and the cable access cover (Paragraph 7.7.1).

7.7.14 Video Monitor Board (Digital or Elston)
Perform the following steps to remove the video monitor board (Digital or Elston).

1. Remove the top cover (Paragraph 7.7.13).
2. Remove the circular connector from the base of the CRT (Figure 7-9).
3. Disconnect the white wire connecting the video monitor board to the yoke ground lug.
4. Disconnect the 8-pin connector from the video monitor board.
5. Disconnect the 4-pin connector from the video monitor board.
6. Disconnect the video input connector from the top edge of the video monitor board.
7. Release the four standoffs and remove the video monitor board.

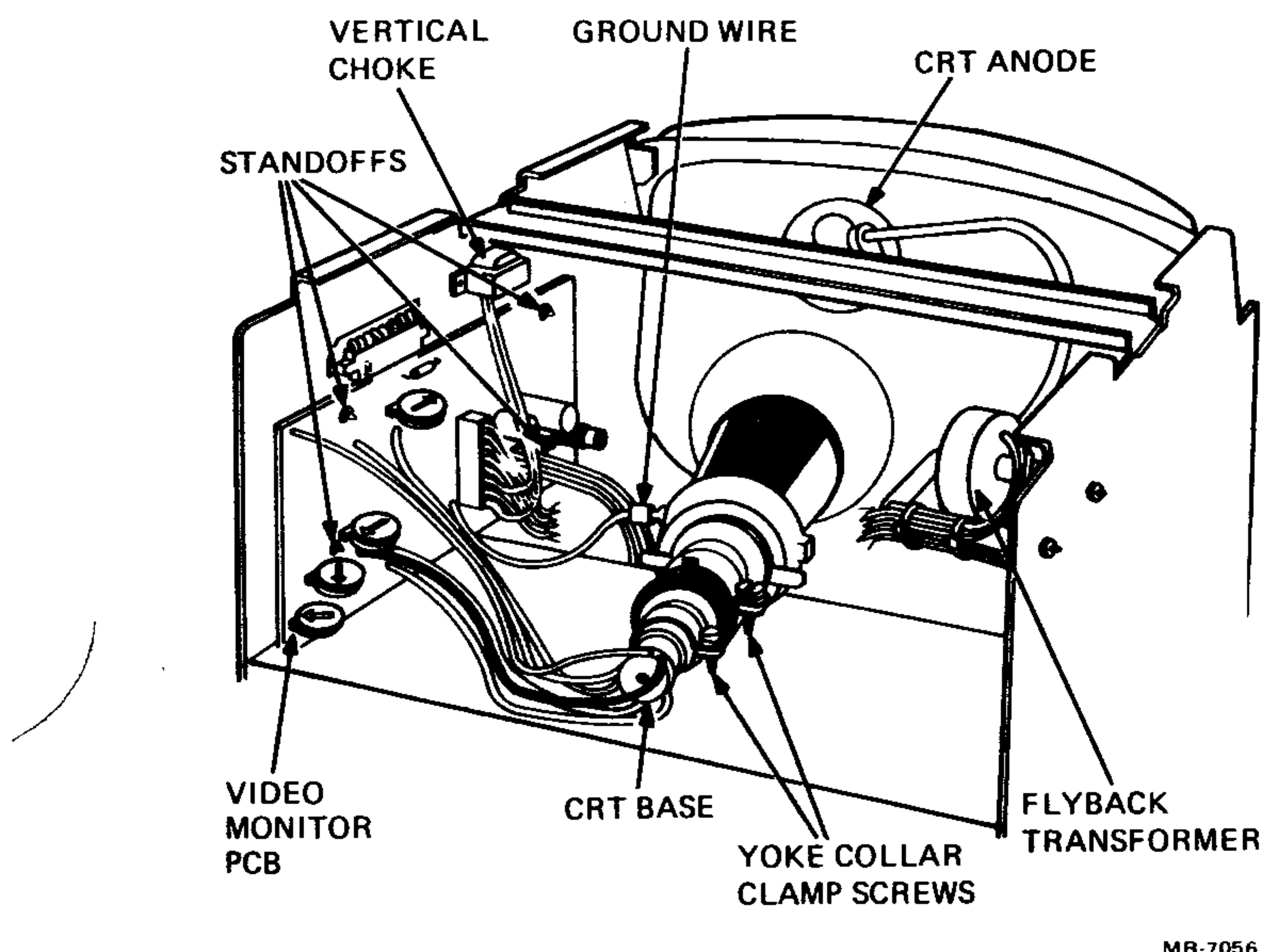To install the video monitor board, perform steps 1 through 7 in reverse.

Figure 7-9   Video Monitor Board Removal

CAUTION
Be sure to align the 8-pin connector correctly when connecting the cable. The video monitor board may be damaged if the connector is not installed correctly.

7.7.15 Flyback Transformer (Digital or Elston)
Perform the following steps to remove the flyback transformer (Digital or Elston) (Figure 7-9).

WARNING
The CRT anode may hold high voltage. Refer to Paragraph 7.7.21.1 for the anode discharge procedure.

1.   Remove the top cover (Paragraph 7.7.13).

2.   Disconnect the 8-pin connector from the video monitor board.

3.   Remove the screw and washer fastening the vertical choke to the monitor chassis. Remove the vertical choke.

4.   Discharge the high voltage at the CRT anode. Refer to Paragraph 7.7.22.1 for this procedure.

5.   Disconnect the CRT anode wire from the CRT. Refer to Paragraph 7.7.22.2 for this procedure.

6.   Using a ¼ inch nutdriver, remove the two nuts mounting the flyback transformer to the monitor chassis.

To install the flyback transformer, perform steps 1 through 6 in reverse.

CAUTION
Be sure to align the 8-pin connector correctly when connecting the cable. The video monitor board may be damaged if the connector is not installed correctly.

7.7.16 Bottom Cover Removal and Installation
The removal and installation procedure for the bottom cover is described in Paragraphs 3.4.3 and 3.4.8.

7.7.17 Power Supply
Perform the following steps to remove the power supply.

1.   Remove the top cover (Paragraph 7.7.13).

2.   Remove the bottom cover (Paragraph 7.7.16).

3.   Find the three pop fasteners on the side of the chassis. Release these pop fasteners by pulling their plungers out (Figure 7-10).

CHASSIS

POP
FASTENERS
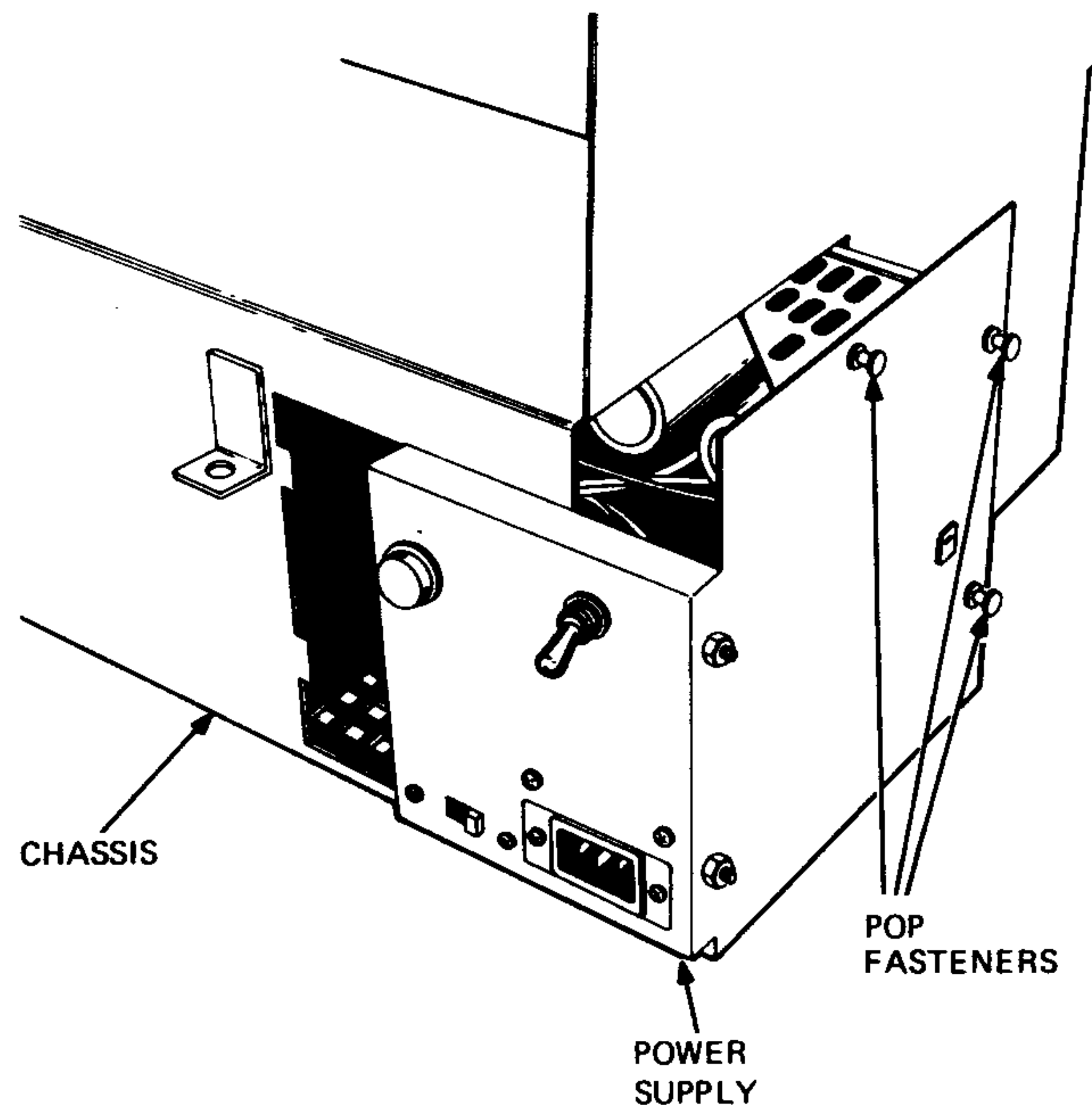
POWER
SUPPLY

MR-7057
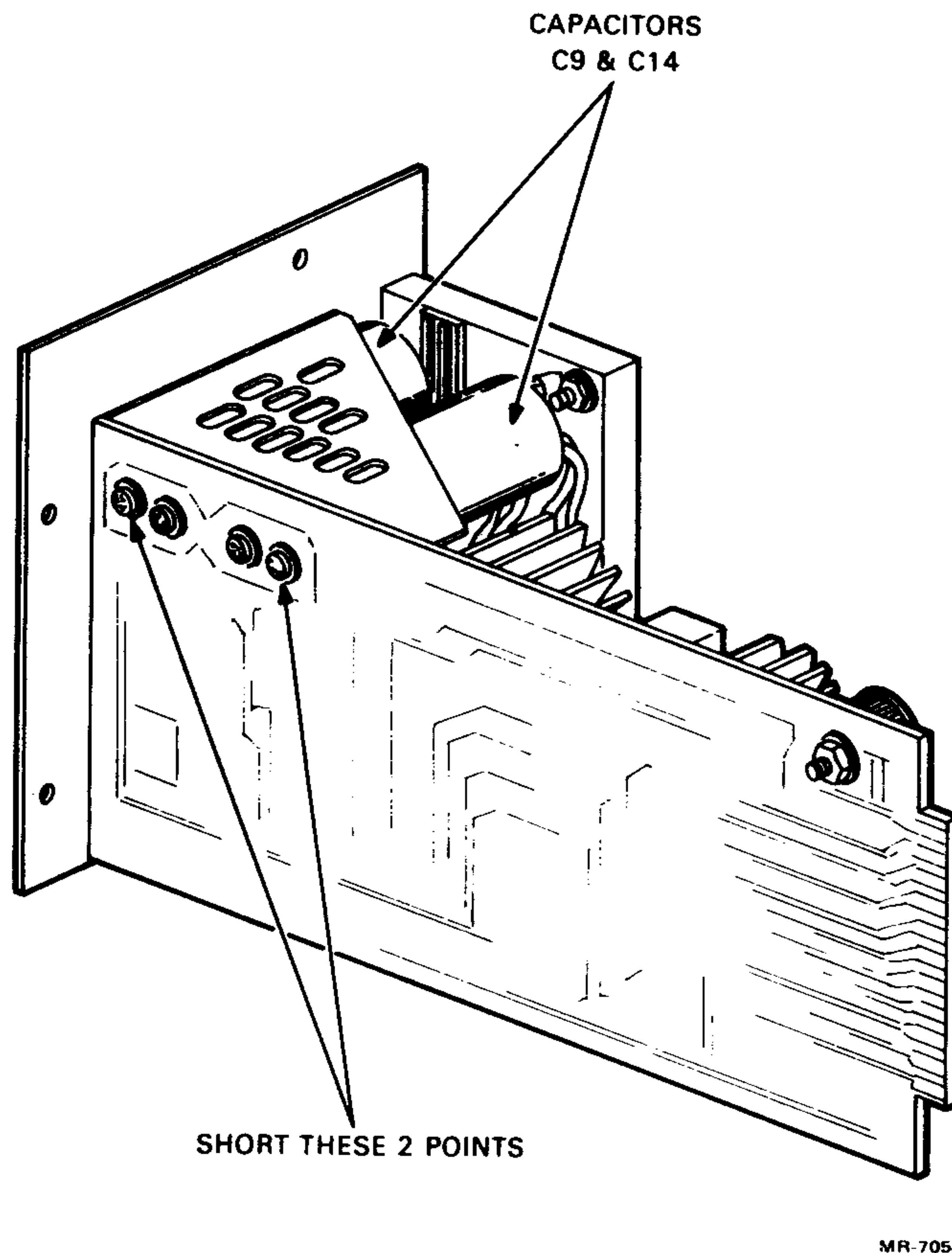
Figure 7-10   Power Supply Removal

WARNING
Capacitors C9, C14, and the circuits in the same area hold 300 Vdc. To discharge the capacitors, leave the power supply plugged into the terminal for a minimum of four minutes after the power cord is removed.

After the power supply is out of the terminal, make sure the capacitors are completely discharged. Short the capacitors with an insulated wire as shown in Figure 7-11.

4.   Hold the power supply by its end plate and pull it straight out.

To install the power supply, perform steps 1 through 4 in reverse. Note that there is a grounding tab on the back of the chassis that fits into a small slot in the end of the power supply's switch plate.

CAPACITORS
C9 & C14

SHORT THESE 2 POINTS

MR-7058

Figure 7-11   Discharging the Power Supply Capacitors

7.7.18   RF Shield Removal

Perform the following steps to remove the RF (radio frequency) shield.

1.   Remove the cable access cover and module access cover (Paragraph 7.7.1).
2.   Remove the disk drive unit(s) from the terminal (Paragraph 7.7.2).
3.   Remove the VT18X control module (Paragraph 7.7.3).
4.   Remove the terminal controller module (Paragraph 7.7.4).
5.   Remove the top cover (Paragraph 7.7.13).
6.   Remove the bottom cover (Paragraph 7.7.16).
7.   Set the chassis on end with the card cage up.
8.   Remove four ¼ inch hex-head screws from the top and bottom of the RF shield (Figure 7-12).
9.   Carefully remove the RF shield from around the card cage. Take care not to damage the shield.

To install the RF shield, use a scriber to line up the screw holes and install the (four) screws.

RF SHIELD

PUSH IN ON
DC POWER
HARNESS

HEX-HEAD
SCREW (4)

LINE UP HOLES
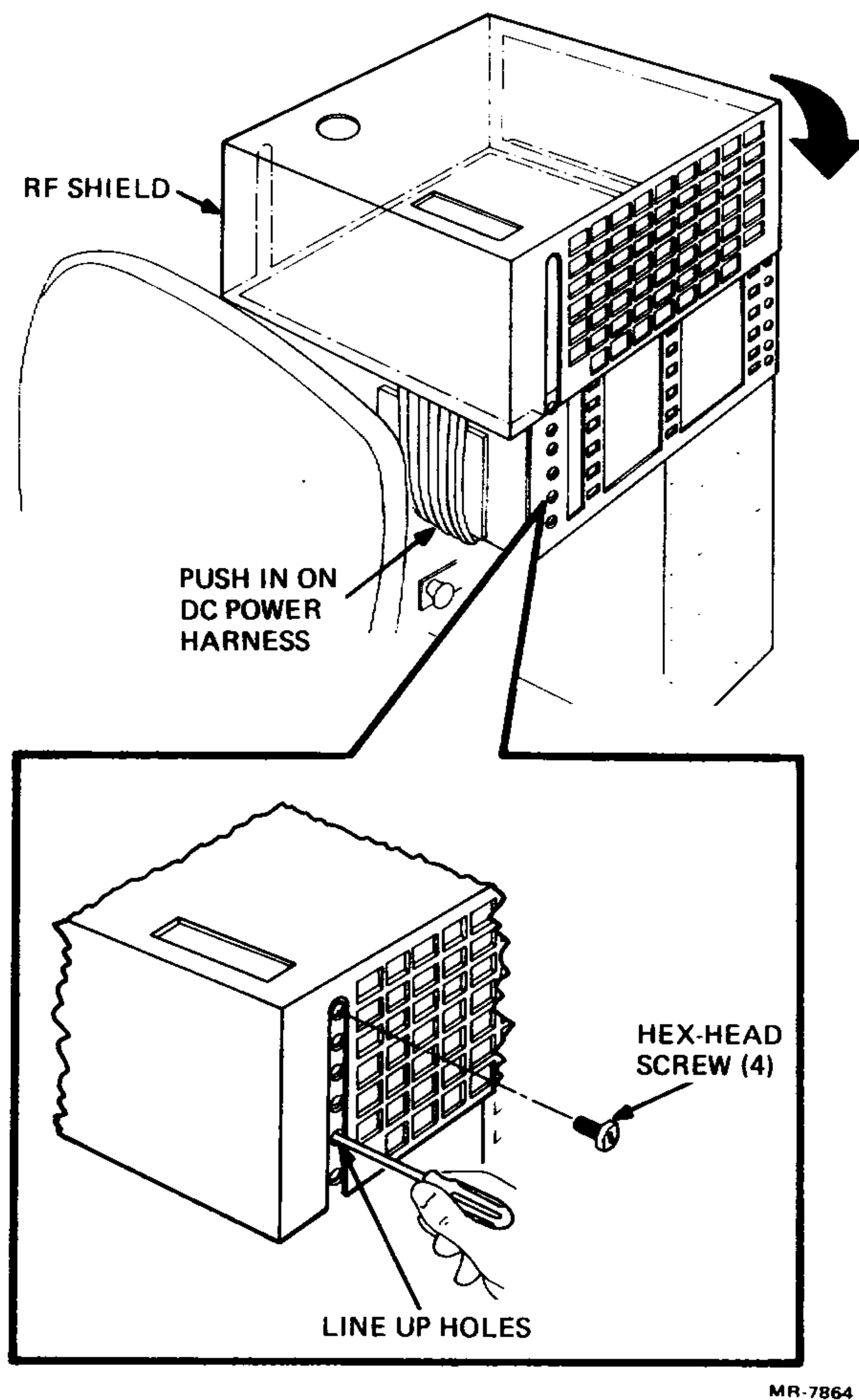
MR-7864

Figure 7-12   RF Shield Removal and Installation

7.7.19   DC Power Harness
Perform the following steps to remove the dc power harness.

1.   Remove the cable access cover and module access cover (Paragraph 7.7.1).

2.   Remove the disk drive unit(s) from the terminal (Paragraph 7.7.2).

3.   Remove the VT18X control module (Paragraph 7.7.3).

4.   Remove the terminal controller module (Paragraph 7.7.4).

5.   Remove the top cover (Paragraph 7.7.13).

6.   Remove the bottom cover (Paragraph 7.7.16).

7.   Remove the RF shield (Paragraph 7.7.18).

8.   Remove the power supply (Paragraph 7.7.17).

9. Disconnect the dc power harness from the expansion backplane.

10. Disconnect the 10-pin edge connector J101 from the video monitor board.

11. Remove the card cage by releasing the two pop fasteners that hold the top of the card cage to the chassis. (Remove two Phillips screws on late model terminals.) Tilt the card cage out slightly, then lift the card cage out of the bottom holding clips (chassis slots on late model terminals).

12. Disconnect the ground wire from the 10-pin connector to the monitor chassis.

13. Remove the two E-ring fasteners (spread the spring clips on late model terminals), holding the 18-pin edge connector to the chassis. Remove the connector.

14. Remove the dc power harness.

To install the dc power harness, perform steps 1 through 14 in reverse.

7.7.20 Expansion Backplane Removal
Perform the following steps to remove the expansion backplane.

1. Remove the cable access cover and module access cover (Paragraph 7.7.1).

2. Remove the disk drive unit(s) from the terminal (Paragraph 7.7.2).

3. Remove the VT18X control module (Paragraph 7.7.3).

4. Remove the terminal controller module (Paragraph 7.7.4).

5. Remove the top cover (Paragraph 7.7.13).

6. Remove the bottom cover (Paragraph 7.7.16).

7. Remove the RF shield (Paragraph 7.7.18).

8. Disconnect the dc power harness from the expansion backplane.

9. Remove the four 4-40 by ½ inch screws, spacers, and kep nuts fastening the expansion backplane to the card cage (Figure 3-14).

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

7.7.21 CRT Discharge and Anode Cap

7.7.21.1 CRT Anode Discharge – To discharge the CRT anode, use either of the following methods.

- Connect the plug end of a VOM lead to chassis ground. Discharge the anode by touching the probe to the CRT anode (Figure 7-13).

- Gently place the end of a screwdriver with an insulated handle under the plastic anode cap on top of the CRT while shorting the other end of the screwdriver to an unpainted part of the CRT chassis.
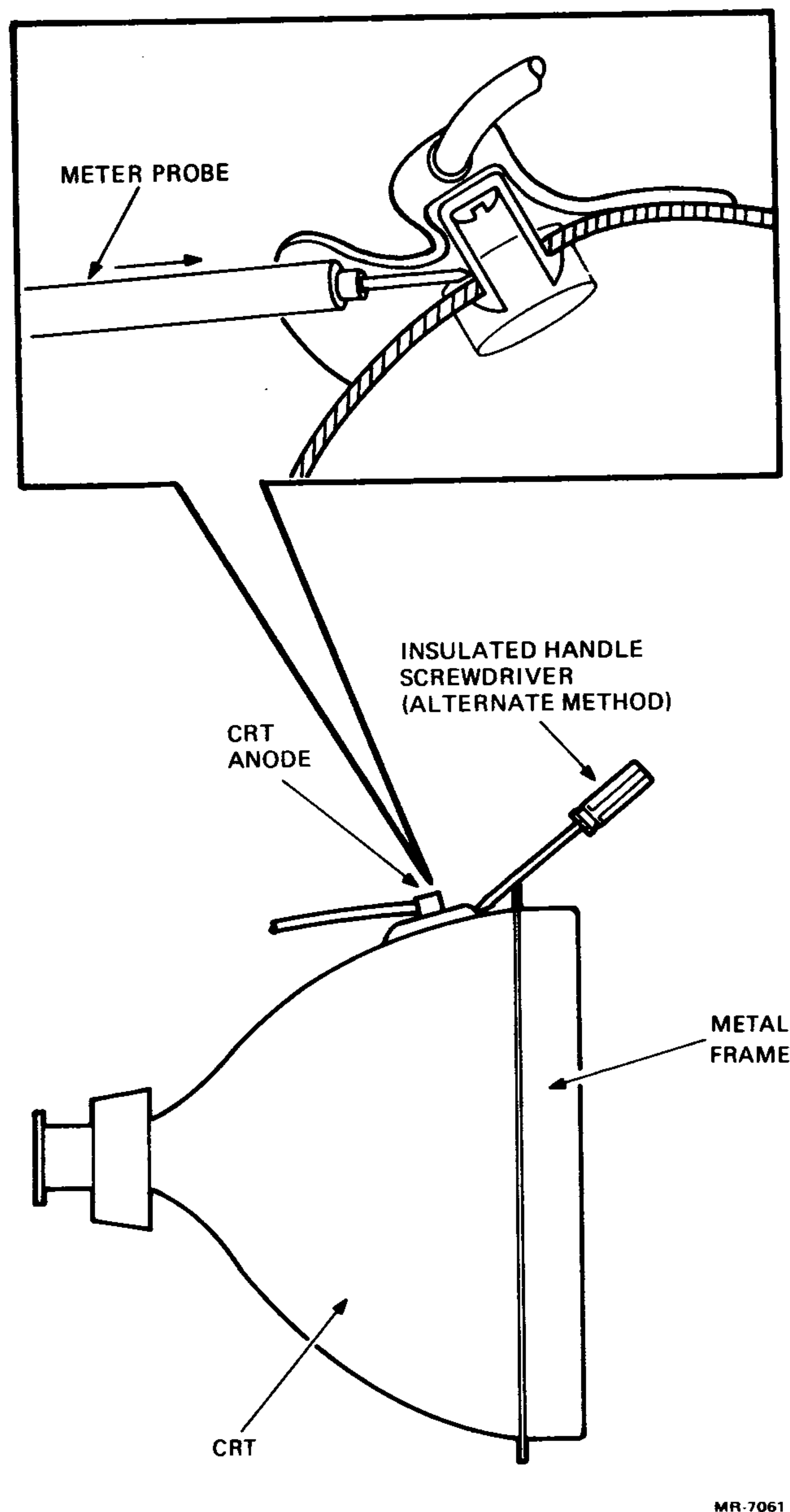
Figure 7-13   Discharging the CRT Anode

7.7.21.2 Anode Cap Removal and Installation – Perform the following steps to disconnect the CRT anode cap from the CRT.

1.   Note the position of the anode wire.

2.   The connector holds itself in place with spring barbs in the anode socket of the tube. Push against one barb, allowing it to clear the edge of the anode socket (Figure 7-14).

3.   Push up in the opposite direction to release the other barb.

A. PUSH IN THE DIRECTION OF THE ARROW

B. WHEN ONE BARB IS FREE PUSH IN THE OPPOSITE DIRECTION (SEE ARROWS) TO REMOVE ANODE CAP

CRT ANODE CAP

MR-7062

Figure 7-14   Removing the Anode Cap

7.7.22 CRT and Yoke Assembly

Elston terminals can be repaired with a new CRT and yoke assembly without having to replace the complete chassis assembly. When replacing the CRT and yoke on early model terminals, replace the flyback, choke, and monitor board with Elston parts at the same time. Perform the following steps to remove the CRT and yoke assembly.

WARNING
High voltage is present at the CRT anode. Refer to
Paragraph 7.7.21.1 to discharge the anode.

1. Remove power from the terminal by setting the 1/0 switch on the top (or only) disk drive unit to 0 (off). Remove the ac power cord from the back of the video terminal.

2. If placed on top, remove the disk drive unit(s) from the video terminal (Paragraph 7.7.2). Remove the top cover of the terminal (Paragraph 7.7.13).

3. Discharge the CRT anode (Paragraph 7.7.21.1).

4. Disconnect the CRT high-voltage anode wire (Paragraph 7.7.21.2).

5. Disconnect the circular connector from the CRT base (Figure 7-9).

6. Disconnect the white wire connecting the video monitor board to the yoke ground connector.

7. Disconnect the 4-pin yoke connector from the monitor board.

8. While supporting the assembly from the bottom rear of the CRT, remove the top two screws and then the bottom two screws from the CRT frame.

9. Remove the CRT and yoke assembly.

WARNING
Handle the tube by the sides next to its face, never by
its neck. Do not rest the tube on its neck.

To install the CRT and yoke assembly, perform steps 1 through 8 in reverse.

NOTE
Refer to Paragraph 7.7.23 for storing and discard-
ing the CRT.

7.7.23 Field Handling of CRTs

You must use the following procedures when replacing, handling, storing, or discarding a CRT in the field.

7.7.23.1 Replacing a CRT – Note the following when replacing a CRT.

1. Only Digital service personnel should be in the area during replacement.

2. Any service person replacing a CRT must wear goggles (or safety glasses with side guards) and gloves. The part numbers for these items are:

   29-16141 (goggles)
   29-16146 (gloves).

3. Before servicing the CRT or its connected circuits, you must discharge the anode (Paragraph 7.7.21.1).

7.7.23.2 Handling the CRT – Use the following precautions when handling a CRT.

CAUTION

- **Handle the CRT by the sides adjacent to the tube face. Never handle the CRT by its neck.**

- **Do not allow the neck to bump anything.**

- **Never rest a CRT on its neck.**

- **Never scratch the glass of the CRT. Take special care when working around the CRT with any tool.**

- **Never touch the glass of a CRT with a hot soldering tool.**

7.7.23.3 Storing a CRT – All CRTs must be either stored in a closed container or correctly mounted in the product. Never store a CRT without a protective enclosure.

7.7.23.4 Discarding a CRT – If your region has a procedure for discarding CRTs, use that procedure. If not, perform the following steps to discard a CRT. Destroy any CRT that cannot be returned for repair.

WARNING
Use extreme caution when performing this procedure.

1. Place the CRT into the container in which the replacement was received.

2. Close and seal the container, leaving only the end of the CRT's neck exposed (Figure 7-15).

3. With a pair of pliers or wire cutters, carefully break the CRT evacuation point. The evacuation point is found in the center of the CRT neck's end. If the procedure is done correctly, you will hear a sudden rush of air. This means the CRT no longer has a vacuum and can no longer implode.
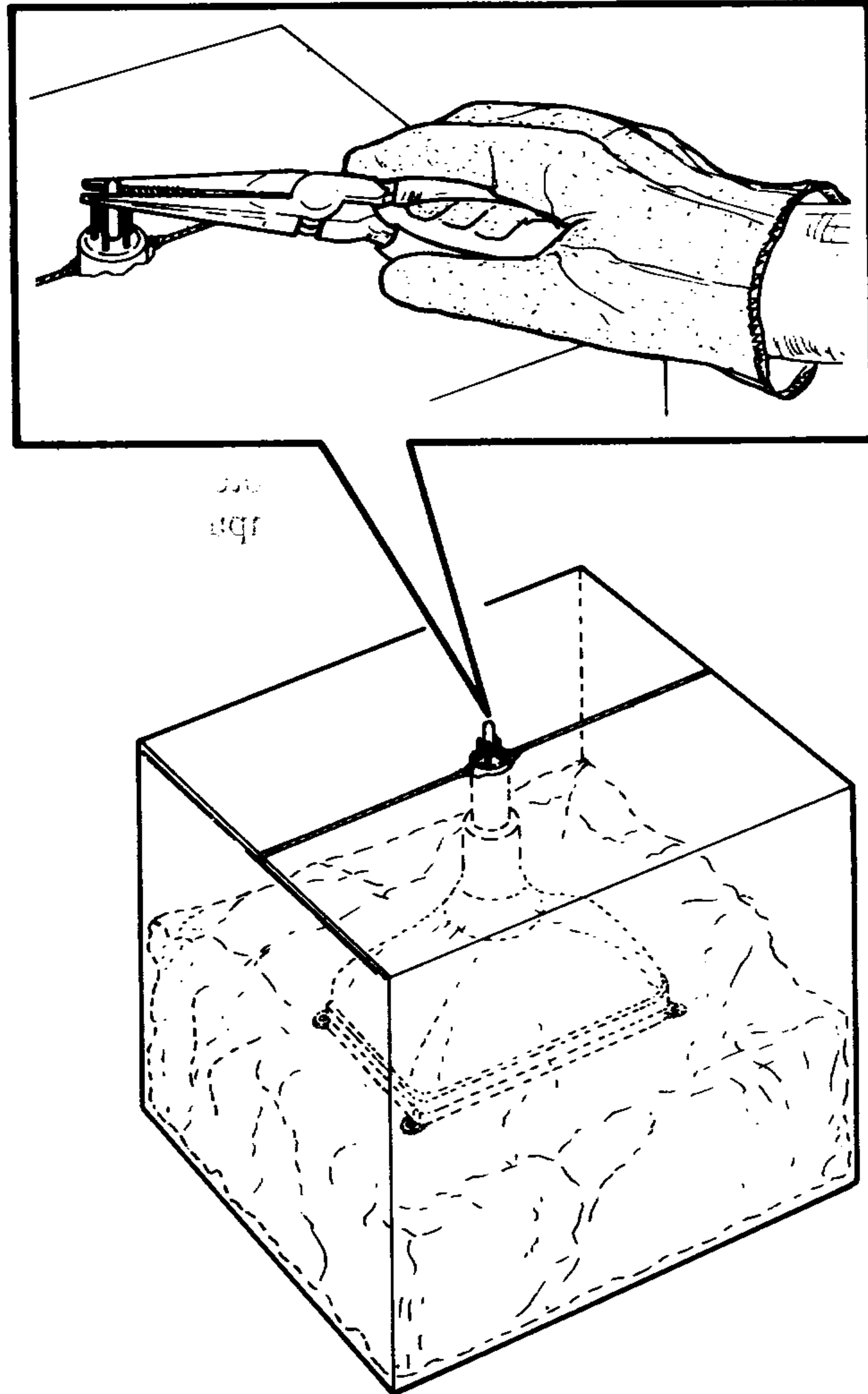
MR-7063

Figure 7-15 Disposing of the CRT