

RA81 Disk Drive User Guide

digital

RA81 Disk Drive User Guide

Prepared by Educational Services
of
Digital Equipment Corporation

Copyright © 1982 by Digital Equipment Corporation

All Rights Reserved

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

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

Printed in U.S.A.

This document was set on DIGITAL's computerized type-setting system.

• **Class A Computing Devices:**

Notice: This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such radio frequency interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user at his own expense may be required to take measures to correct the interference.

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

DEC	DECnet	OMNIBUS
DECUS	DECsystem-10	OS/8
DIGITAL	DECSYSTEM-20	PDT
Digital Logo	DECwriter	RSTS
PDP	DIBOL	RSX
UNIBUS	EduSystem	VMS
VAX	IAS	VT
	MASSBUS	

CONTENTS

	Page	
CHAPTER 1	INTRODUCTION	
1.1	PURPOSE AND SCOPE	1-1
1.2	GENERAL INFORMATION	1-1
1.3	DRIVE DESCRIPTION	1-2
1.3.1	Head Disk Assembly	1-2
1.3.2	Internal Drive Diagnostics	1-2
1.3.3	Multi-Drive and Dual-Port Capability	1-5
1.3.4	Recording Features	1-7
1.3.5	Media Format	1-7
1.4	RELATED DOCUMENTATION	1-8
1.5	RA81 SPECIFICATIONS	1-9
1.6	RA81 OPTIONS	1-12
CHAPTER 2	INSTALLATION	
2.1	SITE PREPARATION AND PLANNING	2-1
2.1.1	Environmental Considerations	2-1
2.1.2	Cleanliness	2-1
2.1.3	Floor Loading	2-1
2.1.4	Heat Dissipation	2-1
2.1.5	Power and Safety Precautions	2-1
2.1.6	AC Power Wiring	2-2
2.2	EQUIPMENT UNPACKING AND EXTERNAL INSPECTION	2-2
2.2.1	Unpacking the System on a Shipping Pallet	2-2
2.2.2	Installing the Cabinet Levelers	2-4
2.2.3	Removing Internal Shipping Brackets and Packing Material	2-6
2.3	RA81 INSTALLATION	2-10
2.3.1	Connecting Cabinets	2-10
2.3.2	External SDI Cabling Procedure	2-17
2.3.3	Programming the Drive Unit Address Plug	2-19
2.4	RA81 ADD-ON INSTALLATION	2-20
2.4.1	Remove the Front Trim Panel	2-20
2.4.2	Install the Slide Assembly	2-21
2.4.3	Remove the Internal Shipping Brackets and Packing Material	2-25
2.4.4	Mount the RA81 on the Slides	2-25
2.4.5	Program the Drive Unit Address Plug	2-30
2.4.6	Connect the Electrostatic Discharge Bracket	2-30
2.4.7	Install the Internal SDI Cables	2-31
2.4.8	Mount the I/O Bulkhead	2-33
2.4.9	Install the Drive Sequence Cables	2-33

	Page
CHAPTER 2	INSTALLATION (Cont)
2.4.10	Connect AC Power 2-36
2.4.11	Route and Clamp the Cables 2-36
2.5	RA81 DRIVE DIAGNOSTIC CHECKOUT 2-38
2.5.1	The Diagnostic Terminal 2-38
2.5.2	Applying Power to the Drive 2-39
2.5.3	Checkout 2-39
CHAPTER 3	OPERATING INSTRUCTIONS
3.1	CONTROL PANEL SWITCHES AND INDICATORS 3-1
3.1.1	RUN/STOP Switch and Indicator 3-2
3.1.2	FAULT Switch and Indicator 3-3
3.1.3	UNIT/READY 3-5
3.1.4	WRITE PROT 3-5
3.1.5	A and B Port Select Switches 3-6
3.2	CIRCUIT BREAKERS 3-6
3.3	DRIVE OPERATION 3-6
3.3.1	Spin-Up 3-6
3.3.2	Spin-Down 3-6
3.3.3	Removing RA81 Power 3-6
3.4	CUSTOMER CARE 3-6
3.4.1	Air-Filter 3-6
3.4.2	Cleaning 3-7
3.4.3	Replacement 3-7
APPENDIX A	DIAGNOSTIC TERMINAL INSTRUCTIONS
A.1	INTRODUCTION A-1
A.2	SHIFT KEYS A-2
A.3	CONTROL CHARACTERS A-2
A.4	CONTINUE (CONT) AND CLEAR (CLR) KEYS A-2
A.5	X-ON, X-OFF KEYS A-2
A.6	DELETE KEY A-2
A.7	DISPLAY SCROLL SWITCH A-2
A.8	BREAK KEY A-3
A.9	CR KEY (CARRIAGE RETURN) A-3
A.10	ESCAPE KEY A-3
FIGURES	
1-1	The RA81 Disk Drive 1-3
1-2	Basic RA81 Disk-Subsystem Block Diagram 1-4
1-3	Hinged Circuit-Module Arrangement 1-5
1-4	Single-Port, Multi-Drive Configuration 1-6
1-5	Dual-Port Configuration 1-6
1-6	HDA Head Arrangement 1-7
1-7	RA81 Sector Format 1-7
2-1	RA81 Electrical Plugs and Receptacles 2-2
2-2	Unpacking a System on a Shipping Pallet 2-3
2-3	Building the Ramp 2-4
2-4	Shipping Bracket Removal 2-5
2-5	Cabinet Leveler Installation 2-5
2-6	Leveler Adjustment 2-6

FIGURES (Cont)

2-7	Raising the Drive Logic Chassis Assembly	2-7
2-8	Foam Pad Removal	2-7
2-9	HDA Details	2-8
2-10	Belt Tension Lever	2-9
2-11	Belt tension Lever and Interlock Switch	2-10
2-12	End Panels and Joiner Panels	2-11
2-13	Opening the Back Door	2-11
2-14	Back Door and End-Panel Lock Removal	2-12
2-15	End-Panel and Bottom Key-Button Removal	2-13
2-16	Connecting the Cabinets	2-14
2-17	Removing the Trim Panel Brackets	2-15
2-18	Installing the Front Locking Bracket	2-16
2-19	Installing the Back Locking Brackets	2-17
2-20	SDI Cable Shield Terminator Installation	2-18
2-21	Single Drive External SDI Cables	2-19
2-22	Drive Unit Address Plug	2-19
2-23	Removing Cabinet Trim Panels	2-20
2-24	Chassis Slide Bracket Installation	2-21
2-25	Mounting Chassis Slide to Front Upright	2-22
2-26	Mounting Chassis Slide to Back Upright	2-22
2-27	Mounting the Electrostatic Discharge Bracket	2-23
2-28	Installation of Cable Retainer Springs	2-24
2-29	Installation of Drive Detent Latch	2-24
2-30	Installation of Drive Mounting Rails	2-25
2-31	Removal of HDA Cable Connections	2-26
2-32	HDA Positioner Lock	2-27
2-33	Extending Cabinet Stabilizer	2-28
2-34	Extending the Chassis Slides	2-28
2-35	Wing Pivot Assembly	2-29
2-36	Electrostatic Discharge Bracket Details	2-30
2-37	Cabling for a Two-Drive System	2-31
2-38	Cabling for a Three- and Four-Drive System	2-32
2-39	Connecting SDI Cable Shield Terminators	2-33
2-40	Mounting the I/O Bulkhead Assembly	2-34
2-41	Drive Sequence Cable Installation	2-35
2-42	Power Controller AC Receptacles	2-36
2-43	Connecting Cable Clamps to Uprights	2-37
2-44	Cable Routing and Clamping	2-38
2-45	Diagnostic Terminal Connections	2-40
3-1	Front-Panel Controls and Indicators	3-1
3-2	Cam-Coded Switch Cover	3-5
3-3	Air Filter Removal	3-7
A-1	Field Service Diagnostic Terminal	A-1

TABLES

1-1	Related Documentation	1-8
1-2	RA81 Specifications	1-9
1-3	RA81 Options	1-13
3-1	Indicator Conditions	3-2
3-2	Drive Front-Panel Fault Identification Codes	3-3

CHAPTER 1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual describes the RA81 Disk Drive and tells how to install, checkout, and operate the equipment.

This manual is written primarily for the RA81 user except for Chapter 2 which is only for qualified field service personnel.

1.2 GENERAL INFORMATION

The RA81 is a random-access, moving-head disk drive with non-removable media using a head/disk assembly (HDA). The HDA, a key feature of this drive, protects data and improves hardware dependability. The RA81 has a data storage capacity of 456 megabytes in 16-bit word format. The RA81 connects to the controller via the Standard Disk Interconnect (SDI) bus and may be used with any controller implementing this bus. Additional disk drives can be connected to a controller to increase the data storage capacity. The RA81 can also be connected in a dual-port arrangement permitting time-shared access by two controllers.

Performance Features

- 17.4 megabit per second peak transfer rate
- 28 ms average positioning rate
- 8.3 ms average rotational latency

Data Integrity

- Protected media
- Microprocessor-controlled servo
- Automatic error correction

Hardware Features

- Simple modular construction
- Rugged design
- Extensive microcode diagnostics

NOTE

Like other fixed-media devices, some method of backup should be used to prevent loss of data in the event of a failure. The following methods are recommended.

File Duplication—Important files should be duplicated often. Usually, this will involve copying the data on a removable medium such as magnetic tape.

Journaling—The use of journaling is recommended in transaction processing applications. This method allows reconstruction of files up to the last checkpoint or backup.

1.3 DRIVE DESCRIPTION

The RA81 is a self-contained disk drive with a built-in cooling system and dc power supply. See Figure 1-1. The drive has optional slide rails and is designed to be inserted into a 19-inch wide RETMA equipment rack. Up to three drives (one fixed mounted and two mounted on slides) can be included in a single cabinet. An RA81 Disk Drive subsystem is made up of an SDI controller (two controllers with the dual-port configuration) and one or more disk drives. Figure 1-2 shows the relationship between the subsystem components.

All RA81 disk logic is included within the drive. Three of the primary circuit modules (servo, microprocessor, and personality) are located directly under the logic access cover on top of the cabinet. These three modules are mounted on hinges for ease of service. See Figure 1-3.

DC operating power for the logic circuits is provided by the drive power supply located inside the back of the drive. Internal fans provide the necessary cooling for the power supply and for other drive components. The RA81 Disk Drive conforms to UL, CSA, FCC, and VDE standards.

1.3.1 Head Disk Assembly

The sealed HDA contains the recording media (four platters), rotary positioner, read/write heads, and preamplifiers. Seven of the platter surfaces are used for recording data. The eighth has dedicated servo information used for positioning the read/write heads. The rotary positioner in the HDA is controlled by a slave microprocessor closed-loop servo system. The RA81 uses both dedicated and embedded servo for head positioning. This dual arrangement allows for coarse cylinder positioning from the dedicated servo surface and fine cylinder positioning from embedded servo bursts which are read preceding each block of data. The dedicated servo surface and the embedded servo data are written on the disk at the time the HDA is manufactured.

1.3.2 Internal Drive Diagnostics

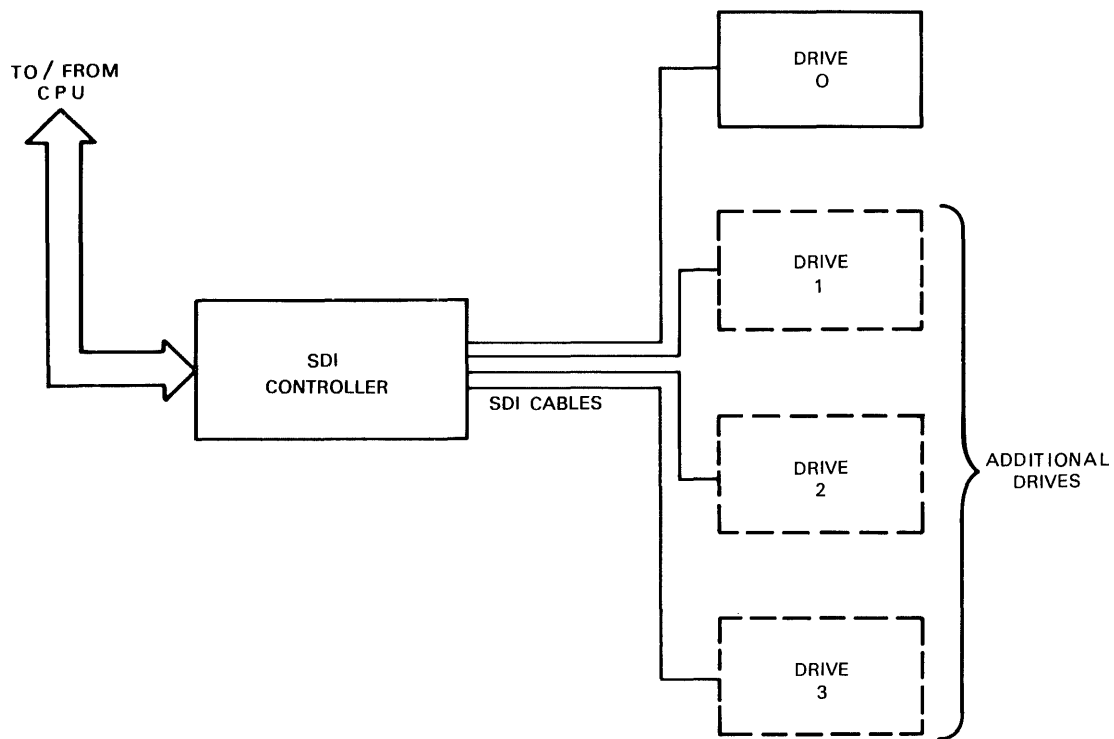
Two groups of internal diagnostics are used in the RA81 to permit error detection and fault isolation. The first group of diagnostics is run automatically during the power-up sequence to validate initial operations. Error codes for this test are displayed by indicators on the operator control panel. The second set of diagnostics is initiated and monitored through a diagnostic terminal as a maintenance function in the off-line mode. These microcode diagnostics are for field service use only and are not part of the normal operating functions.

The RA81 has a dual microprocessor (master and slave) control system. The master is located on the microprocessor module and the slave is located on the servo module. One microprocessor handles real-time functions, such as servo control, while the other controls status checking. Both microprocessors share the diagnostic responsibilities.



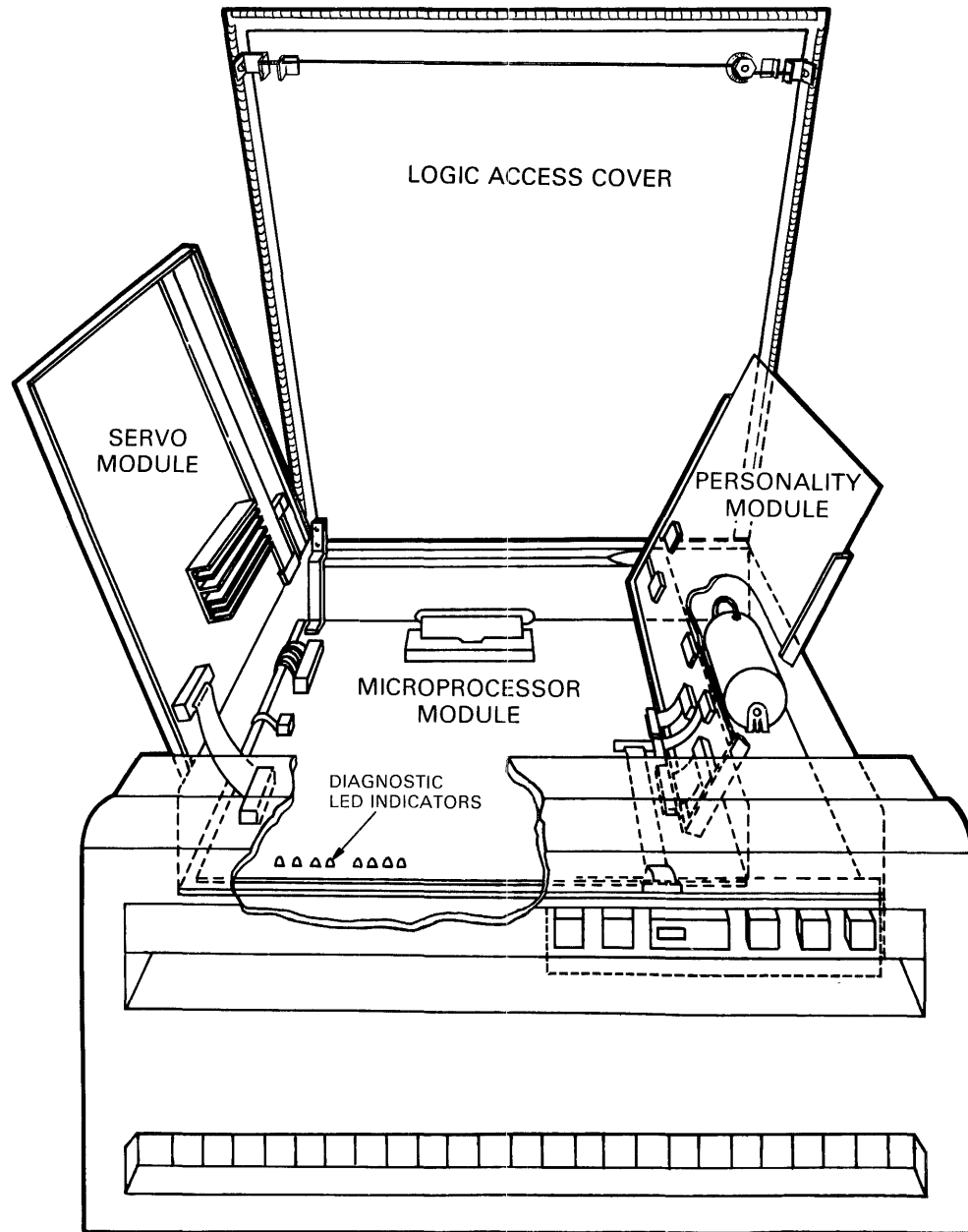
CZ-0775

Figure 1-1 The RA81 Disk Drive



CZ-0730

Figure 1-2 Basic RA81 Disk-Subsystem Block Diagram



CZ-0731

Figure 1-3 Hinged Circuit-Module Arrangement

Except for the read and write operations, the dual microprocessors control and/or monitor all of the primary functions of the disk drive. This includes operation of the front-panel switches and indicators, drive safety monitors, retry conditions, error and status storage, as well as the basic drive control loop.

1.3.3 Multi-Drive and Dual-Port Capability

Multiple disk drives (the number depends on the type of controller used) can be operated from a single controller for added storage capacity (Figure 1-4). Also, a dual-port feature permits a second controller to be connected to permit time-shared access of the subsystem between the two controllers. See Figure 1-5.

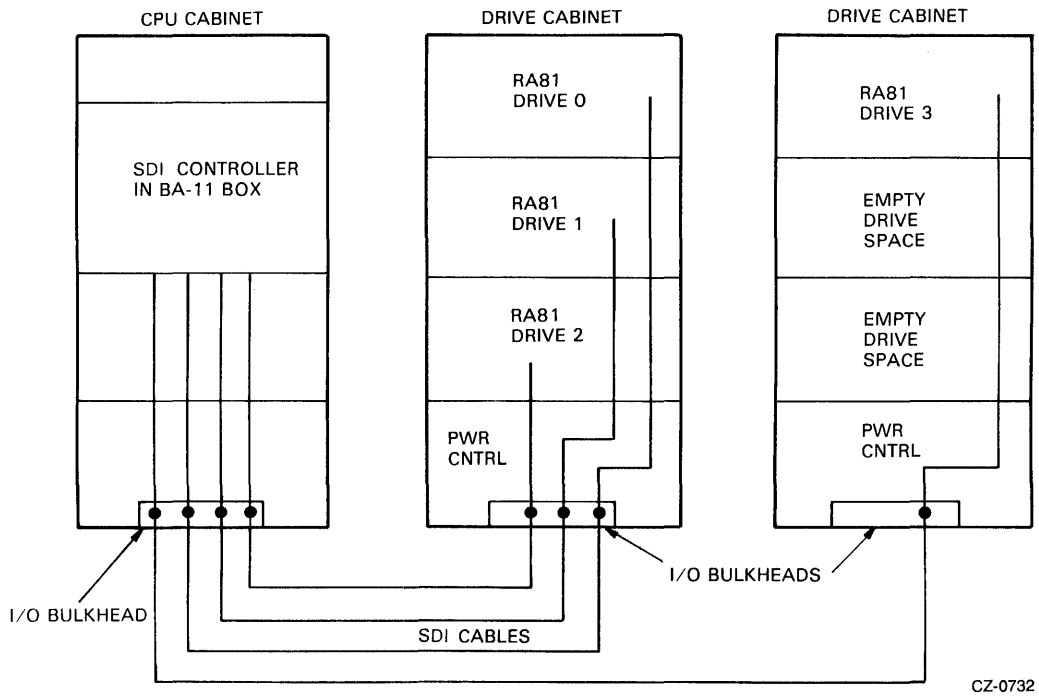


Figure 1-4 Single-Port, Multi-Drive Configuration

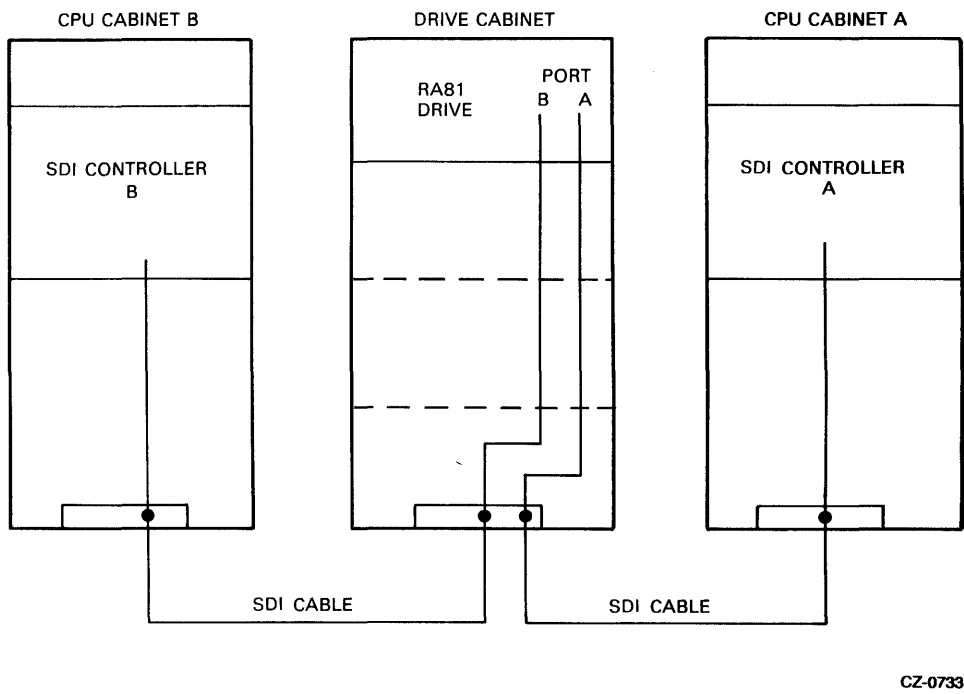


Figure 1-5 Dual-Port Configuration

1.3.4 Recording Features

Four disk platters comprise the recording media. Seven of the disk surfaces are for data storage; the eighth contains encoded servo information. The HDA also has 14 read/write heads and one read-only servo head. The read/write head addresses are called groups and are numbered from 0 to 13 (decimal). Figure 1-6 shows the head arrangement. Two read/write heads are provided for each of the seven data surfaces and a single read-only head reads the servo information on the eighth disk surface. The heads are positioned over the desired data location by a servo-controlled rotary positioner which moves the head arms in an arc over the recording surface.

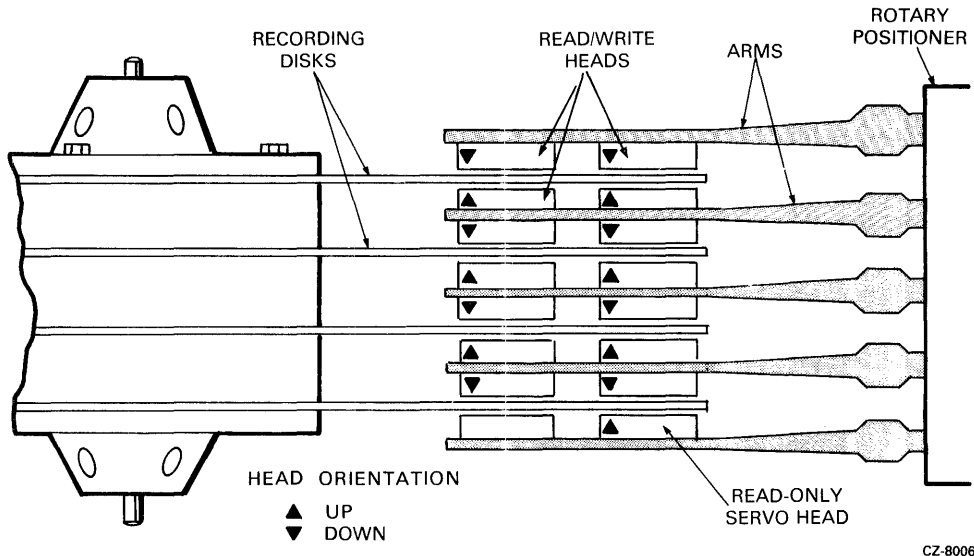


Figure 1-6 HDA Head Arrangement

1.3.5 Media Format

Each of the read/write heads can address 1258 cylinders which are numbered 0 through 1257. A cylinder is made up of the vertical alignment of corresponding tracks on each disk surface. Each track, in turn, is divided into fixed-length sectors. There are 52 sectors (numbered 0 through 51) recorded in 16-bit word format. Each sector includes cylinder and sector information which is encoded in a header preceding the data. Figure 1-7 shows the details of the sector format.

SECTOR PULSE	HEADER			DATA PREAMBLE	SYNC.	DATA FIELD	EDC	ECC + FILL	DATA POSTAMBLE	READ-TO-WRITE RECOVERY
1 WORD OF ZEROS	PREAMBLE 12 WORDS OF ZEROS	SYNC. CHAR 1 WORD	HEADER 2 WORDS 4 TIMES (8 WORDS)	19 WORDS OF ZEROS	DATA SYNC. CHAR 1 WORD	256 WORDS (16-BIT FORMAT)	1 WORD	11 WORDS	1 WORD OF ZEROS	UNDEFINED DATA 37 WORDS

CZ-0734

Figure 1-7 RA81 Sector Format

The RA81 uses a sector offset method to reduce rotational latency. With this method, the controller determines the rotational position of the disk by reading from the header the sector address as well as the head (group) and cylinder address. The sectors are reassigned to optimize the data transfer rate when it becomes necessary to perform a seek during a data transfer.

1.4 RELATED DOCUMENTATION

Table 1-1 lists documents that will add to the information in this user guide. Digital customers may order the following RA81 related manuals from the Accessories and Supplies Group.

Outside the United States, consult local Digital offices. Internal Digital Equipment Corporation customers should order the *RA81 Disk Drive Service Manual* directly from Printing and Circulation Services, 444 Whitney Street, Northboro, MA. 01532. The *RA81 Maintenance Guide* should be ordered from the Software Distribution Center, 20 Forbes Road (NR4), Northboro, MA. 01532.

Table 1-1 Related Documentation

Document Title	Part Number
<i>RA81 Disk Drive Service Manual</i>	EK-ORA81-SV
<i>RA81 Disk Drive Maintenance Guide</i>	AA-M879A-TC
<i>RA81 Disk Drive Illustrated Parts Breakdown</i>	EK-ORA81-IP
<i>UDA50 Disk Controller User Guide</i>	EK-UDA50-UG
<i>MSCP Basic Disk Functions Manual</i>	AA-L619A-TK
<i>Storage System UNIBUS Port Description</i>	AA-L621A-TK
<i>Storage System Diagnostic and Utilities Protocol</i>	AA-L620A-TK
<i>Maintenance Guide Looseleaf Binder</i>	AV-L980A-TK
<i>UDA50 Maintenance Documentation Kit</i>	QP904-GZ *
<i>RA81 Field Maintenance Print Set</i>	MP-01359

* This kit consists of a small looseleaf binder, the *UDA50 Maintenance Guide*, and the current maintenance guides for disks that operate on the UDA50 controller.

Digital customers in the United States may order the above manuals and accessories from the Accessories and Supplies Group over toll free number 800-258-1710. Orders by mail should be addressed to one of the following primary distribution centers.

Northeast/Mid-Atlantic Region
Accessories and Supplies Group
Cotton Road
Nashua, New Hampshire 03060
Tel: (603) 884-5111

Central Region
Accessories and Supplies Group
1050 E. Remington Road
Schaumburg, Illinois 60195
Tel: (312) 640-5612

Western Region
Accessories and Supplies Group
Moffett Park Warehouse
632 E. Caribbean Drive
Sunnyvale, Calif. 94086
Tel: (408) 734-9125

1.5 RA81 SPECIFICATIONS

Table 1-2 gives the primary performance, power, environmental, and physical characteristics of the RA81 Disk Drive.

NOTE

The term *operating*, under the specification section of the table, indicates those values that must not be exceeded while the drive is operational. The term *non-operating* indicates those values that must not be exceeded when the drive is being stored or in a non-operating condition. Exceeding these values can damage the drive when power is applied. Adhering to these values ensures that the drive operates correctly when power is applied.

Table 1-2 RA81 Specifications

Characteristic	Specification
Data storage capacity (Single drive) 16-bit word format	456 MB
Media type	Winchester double density
Head disk assembly(HDA)	
Number of disks	4
Disk surfaces	7 data, 1 servo
Number of heads (groups)	14 data, 1 servo
Heads per disk surface	2
Cylinders per head	1258 (numbered 0 through 1257)
Sectors per track 16-bit word format	52
Servo system	Dedicated and embedded
Performance characteristics	
Disk encoding method	3/2
Linear bit density	11,400 bpi, 8550 flux changes per inch at inner group
Bytes per track (unformatted)	36,352
Transfer rate	17.4 megabits per second
Bit cell period	57 ns (nominal)
Read initialization time	
Write-to-read recovery	10 microseconds (ex- cluding data separator sync)

Table 1-2 RA81 Specifications (Cont)

Characteristic	Specification
Read-to write recovery	1 microsecond
Data separator synchronization	10 microseconds
Rotational latency	
Rotational speed	3600 rpm, +2.5%, -3.5%
Average rotational latency	8.33 ms
Maximum rotational latency	16.66 ms
Head switch latency (switch on a given cylinder)	6 ms maximum
Average seek	28 ms maximum
One cylinder	7 ms maximum
Maximum seek	50 ms (1258 cylinders)
Disk rotation start/stop times	
Start time	20 seconds maximum
Stop time	20 seconds maximum
Maximum start/stop frequency	6 (3 minutes between cycles with drive powered up and ready during one of the 3-minute cycles)
Physical characteristics (Drive only)	
Width (nominal)	44.5 centimeters (17.50 in.)
Depth (nominal)	67.3 centimeters (26.50 in.)
Height (nominal)	26.4 centimeters (10.38 in.)
Weight (approx.)	67.1 kilograms (148 pounds)
Environmental limits	
Temperature	
Operating	10 to 40 degrees C (50 to 104 degrees F) with a temperature gradient of 20 degrees C/hour (36 degrees F/hour)
Non-operating	-40 to +60 degrees C (-40 to +140 degrees F)
Relative humidity	
Operating	10% to 85% (non-condensing) with a maximum wet bulb temperature of 28 degrees C (82 degrees F) and a minimum dew point of 2 degrees C (36 degrees F)

Table 1-2 RA81 Specifications (Cont)

Characteristic	Specification
Shipping and storage	10% to 85% with no condensation
Heat dissipation	644 watts (nominal)
Altitude Operating	Sea level to 2400 meters (8000 feet) above sea level. Note: Maximum allowable temperatures are reduced by a factor of 1.8 degrees C/1000 meters (1 degree F/1000 feet) for operation at higher altitude sites
Non-operating and shipping	300 meters (1000 feet) below sea level to 9000 meters (30000 feet) above sea level (actual or by means of cabin pressurization)
Power Voltage requirements (Single phase)	
120 volt, 60 Hz drives	90-128 volts ac, 60 plus or minus 1 Hz
220-240 volt, 50 drives	184-256 volts ac, 50 plus or minus 1 Hz
Current requirements	
Starting current for 120 volt ac drives	35 ampere peak surge for 4 seconds
Running current for 120 volt ac drives	7.8 amperes rms at 120 volts
Starting current for 220-240 volt ac drives	18 ampere peak surge for 4 seconds
Running current for 220-240 volt ac drives	3.5 amperes rms at 240 volts
Power requirements Starting power for 120 volt ac drives	4200 watts at 120 volts

Table 1-2 RA81 Specifications (Cont)

Characteristic	Specification
Running power for 120 volt ac drives	644 watts at 120 volts
Starting power for 220-240 volt ac drives	4320 watts at 240 volts
Running power for 220-240 volt ac drives	496 watts at 240 volts
Power factor	0.9
Line cord length (from cabinet)	259 cm (8.5 feet)
Plug type	
120 volts,60 Hz	Hubbel No.2611 NEMA No.L5-30P DEC No.12-11193 (See Figure 2-1)
240 volts, 50Hz	Hubbel No.2321 NEMA No.L6-20P DEC No.12-11192 (See Figure 2-1)

1.6 RA81 OPTIONS

Table 1-3 lists the RA81 options.

All RA81 options in Table 1-3 include a 12-foot, shielded, inter-cabinet cable. If a longer cable is required because of the dual-access feature, order cable BC06V-12 (12 feet), BC06V-25 (25 feet), BC06V-50 (50 feet),or BC06V-80 (80 feet).

Table 1-3 RA81 Options

Option	Description
RA81-AA	456 MB drive,120 VAC, 60 Hz, no cabinet
RA81-AD	456 MB drive,240 VAC, 50 Hz, no cabinet
RA81-CA	RA81-AA, H9642-AP cabinet, 60 Hz
RA81-CD	RA81-AD, H9642-AR cabinet, 50 Hz
RA81-EA	(3) RA81-AA, H9642-AP cabinet, 60 Hz
RA81-ED	(3) RA81-AD, H9642-AR cabinet, 50 Hz
RUA81-AA	RA81-AA, UDA50, no cabinet
RUA81-AD	RA81-AD, UDA50, no cabinet
RUA81-CA	RA81-CA, UDA50, cabinet
RUA81-CD	RA81-CD, UDA50, cabinet
RUA81-EA	RA81-EA, UDA50, cabinet
RUA81-ED	RA81-ED, UDA50, cabinet
RUA81-JA	RA81-CA, (2) UDA50, cabinet
RUA81-JD	RA81-CD, (2) UDA50, cabinet

CHAPTER 2 INSTALLATION

2.1 SITE PREPARATION AND PLANNING

A certain amount of preparation and planning is necessary before installing the RA81 Disk Drive. The paragraphs that follow discuss some of the points that should be considered.

2.1.1 Environmental Considerations

The RA81 is designed to operate in a business or light industrial environment. Temperature, humidity, and altitude limits must be considered before the drive is installed. Refer to Table 1-2 for figures on environmental characteristics.

2.1.2 Cleanliness

Because the RA81 has a sealed HDA, dust particles should not be able to enter the area where the recording media is located. However, it is still desirable that the equipment be operated in the cleanest environment possible.

2.1.3 Floor Loading

The weight of one RA81 cabinet and disk drive is approximately 148.8 Kg (328 lb) with each additional drive weighing approximately 67.1 Kg (148 lbs). A completely loaded RA81 cabinet (approximately 283 Kg or 624 lbs) should not place any abnormal stress on a raised computer room floor. However, the weight of existing equipment should be considered before installing additional drives.

2.1.4 Heat Dissipation

The heat dissipation of each RA81 may reach approximately 2200 Btu/hour. The approximate cooling requirements for the complete system can be computed by multiplying this figure by the number of drives, adding the heat dissipation figures of the other system components, and then adjusting the total figure to allow for cooling system efficiency and any other factors.

2.1.5 Power and Safety Precautions

WARNING

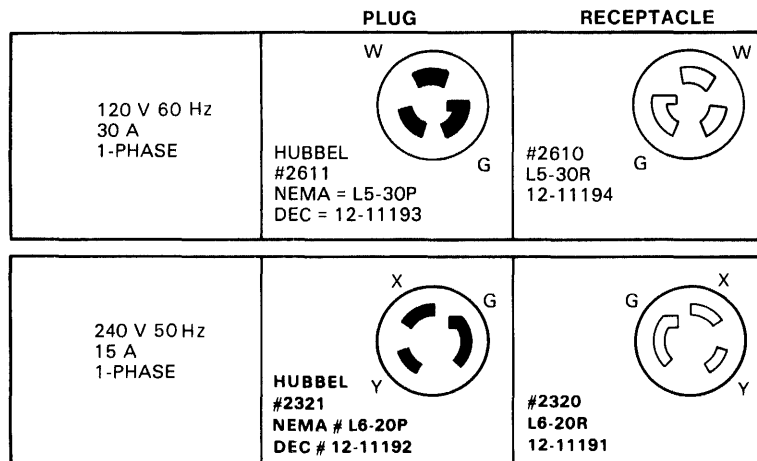
Hazardous voltages are present inside this equipment. Installation and servicing should be performed by a qualified and trained service person. Bodily injury or equipment damage may result from incorrect servicing. Refer to the *RA81 Service Manual* for proper instructions.

The RA81 will not cause any unusual fire or safety hazards to other computer equipment. The ac power wiring in the computer system should be carefully checked, however, to be sure there is adequate capacity for future expansion. The circuit breaker on the back of the power controller regulates the power to every drive within the cabinet.

2.1.6 AC Power Wiring

The wiring used by Digital Equipment Corporation conforms to UL and other standards listed in Paragraph 1.3. This means the wire used as equipment ground is green and yellow. The ground wire carries no load current (except in an emergency), but does carry leakage current. All equipment is shipped with a grounding connection on its frame. The ac return line (also called the identified conductor, neutral, common, and cold lead) is blue. The ac return line must not be used to ground equipment since its purpose is to conduct current.

The ac input line (brown wire) is also called the hot wire. Its purpose is to supply current to the system. The ac plugs and receptacles used on the RA81 are shown in Figure 2-1.



NOTE: PIN CONFIGURATIONS OF PLUGS EXITING
POWER CONTROLLER IN CABINET.

CZ-0740

Figure 2-1 RA81 Electrical Plugs and Receptacles

2.2 EQUIPMENT UNPACKING AND EXTERNAL INSPECTION

When delivered, the RA81 equipment is packed in a cardboard container attached to a shipping skid or pallet. Refer to Figure 2-2.

Before unpacking the equipment, check for external shipping damage. Report any damage to the DIGITAL Field Service or Sales Office and to the local carrier. Keep all packing material and receipts when a damage claim is filed.

2.2.1 Unpacking the System on a Shipping Pallet

To unpack the equipment and remove it from the pallet, proceed as follows using Figure 2-2 as a guide.

1. Remove all packing materials.
2. Remove the four shipping bolts that fasten the drive cabinet to the pallet. Refer to the inset in Figure 2-2.

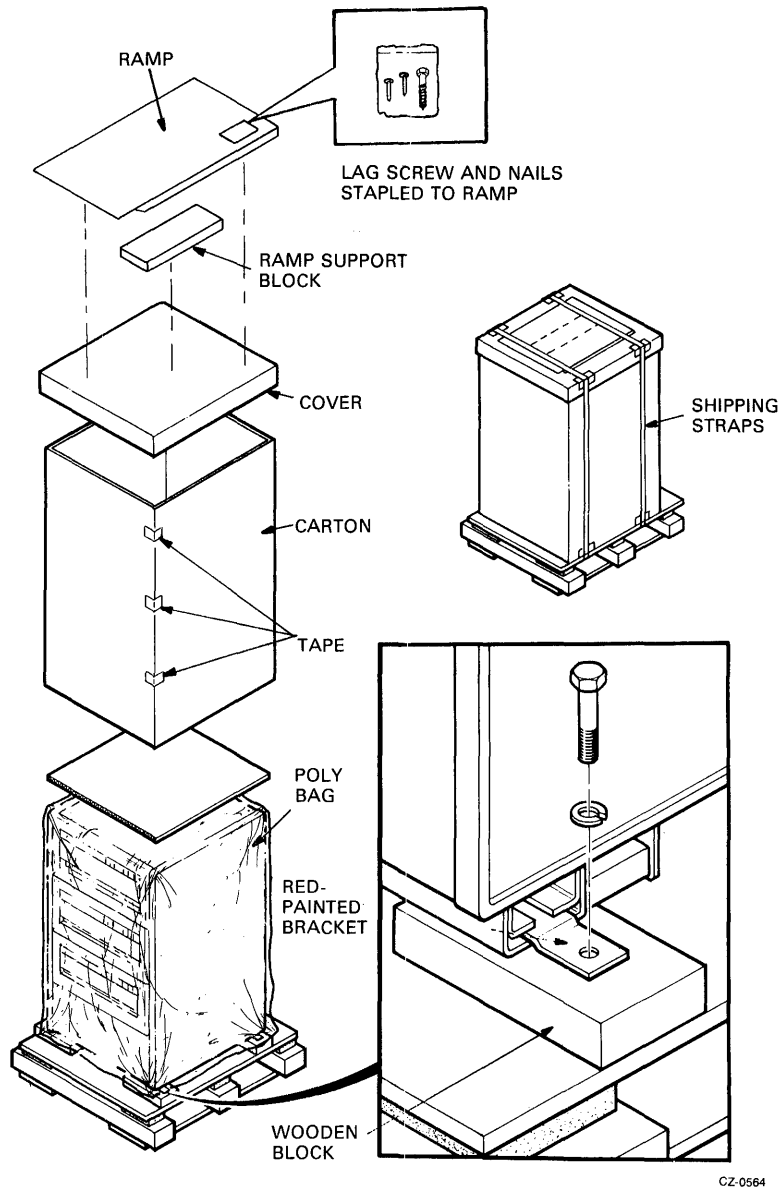
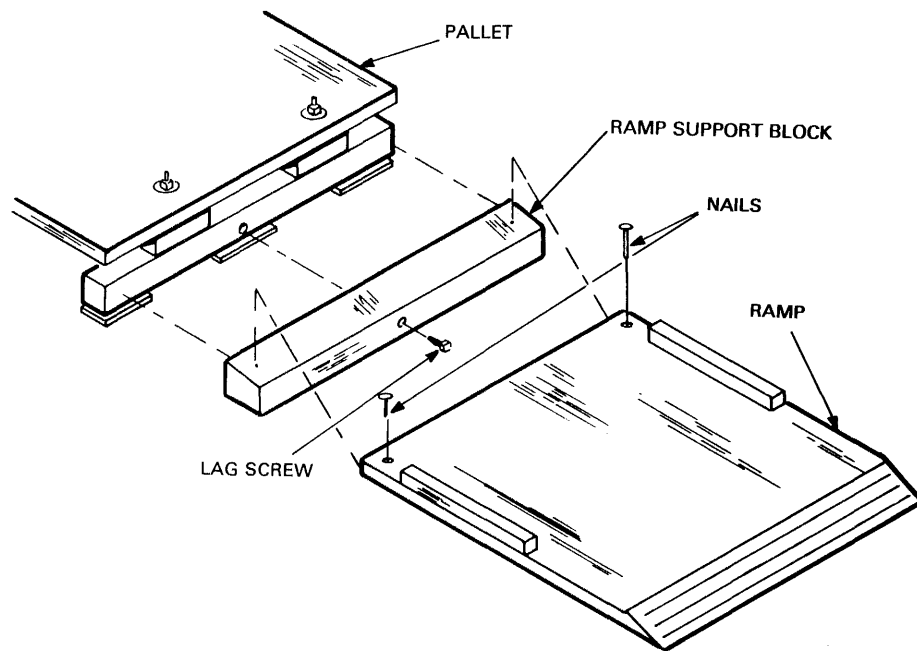


Figure 2-2 Unpacking a System on a Shipping Pallet

3. Build the ramp (Figure 2-3) to aid in rolling the disk drive off the pallet.
 1. Remove the plastic package containing the lag screw and nails from the bottom of the ramp.
 2. Connect the ramp support block to the front of the shipping pallet with the lag screw.
 3. Nail the ramp to the top of its support block using the two nails provided.



CZ-0735

Figure 2-3 Building the Ramp

WARNING

At least two persons will be needed to perform the next step of this procedure because of the weight of the cabinet.

4. Remove the four wooden blocks under the drive cabinet.
5. Carefully roll the drive cabinet down the ramp.

2.2.2 Installing the Cabinet Levelers

Use the following procedure to install the cabinet levelers.

1. Wheel the equipment cabinet to the correct location before installing the levelers.
2. Unbolt and remove the four red shipping brackets and leveler nuts as shown in Figure 2-4.
3. Assemble the four levelers as shown in Figure 2-5. Screw each leveler through the nut until it may be positioned into place without raising the cabinet. See inset in Figure 2-5.

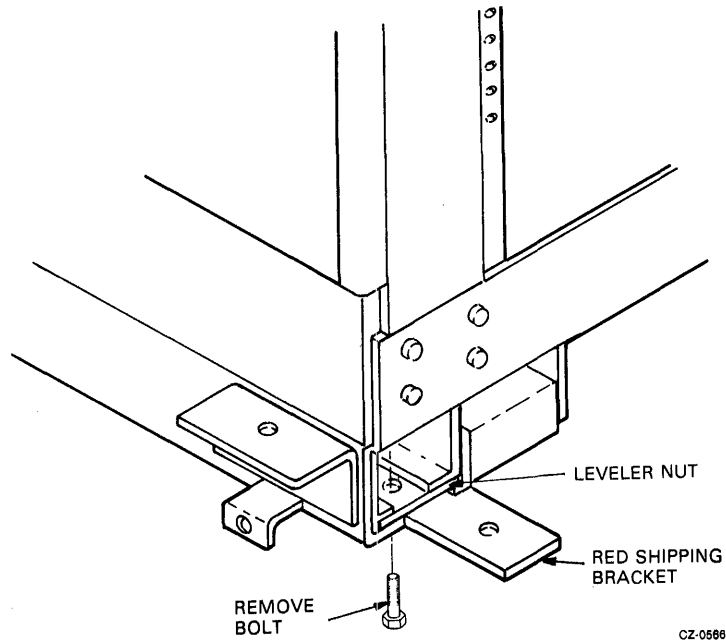


Figure 2-4 Shipping Bracket Removal

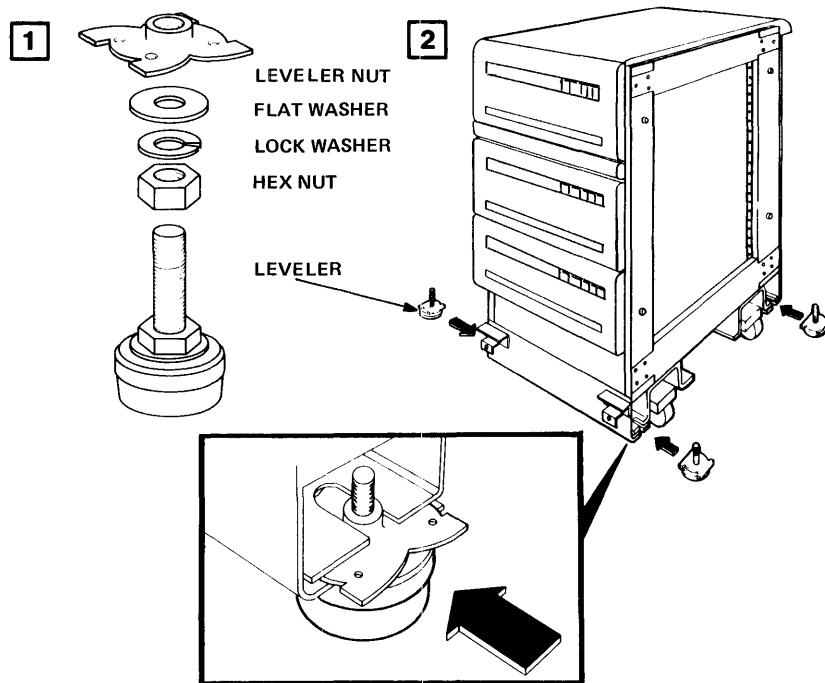
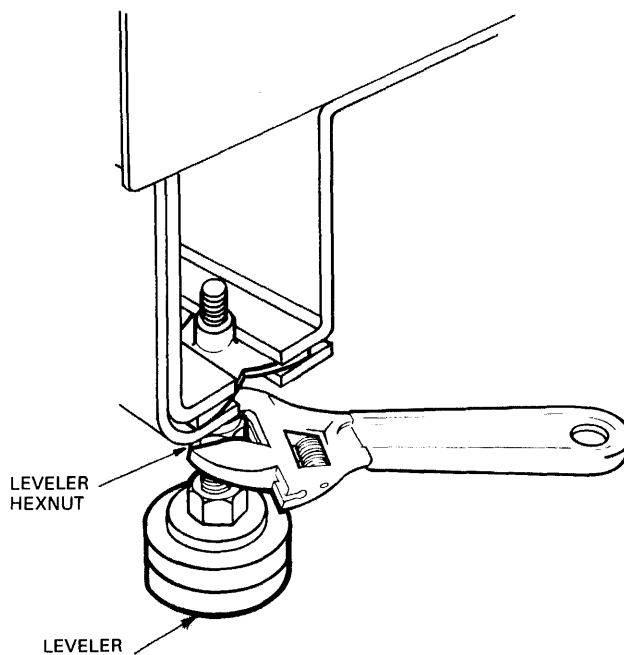


Figure 2-5 Cabinet Leveler Installation

4. Slide the leveler into the slots in the cabinet as shown. Screw the leveler down until solid contact is made with the floor. See Figure 2-6.
5. Adjust until the cabinet is level.



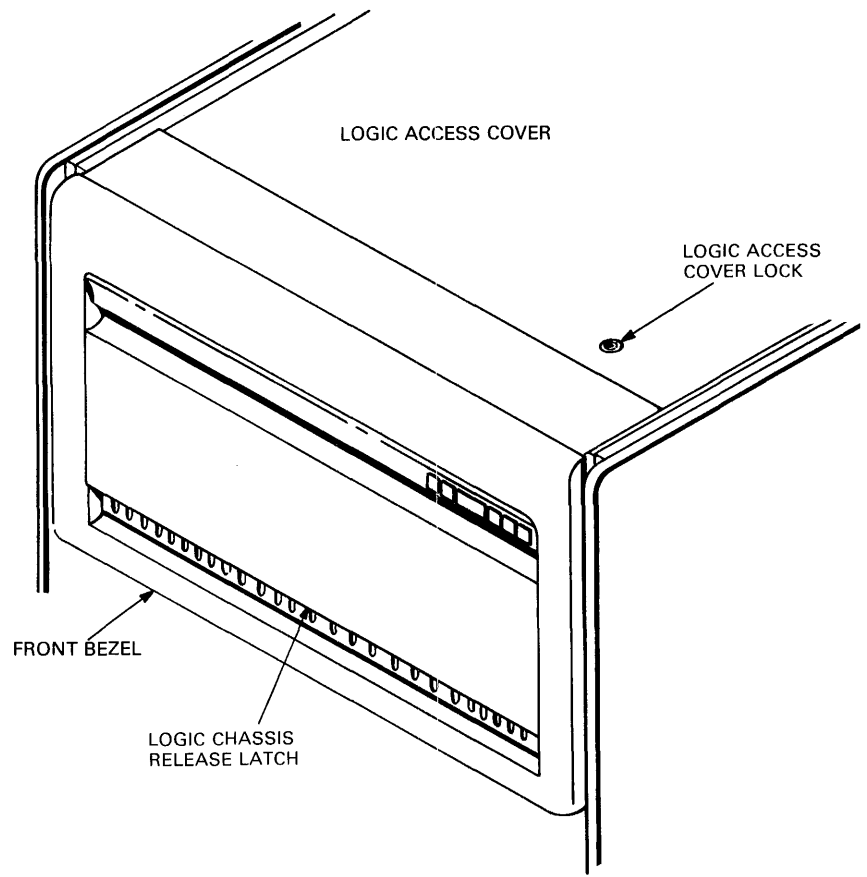
CZ-0737

Figure 2-6 Leveler Adjustment

2.2.3 Removing Internal Shipping Brackets and Packing Material

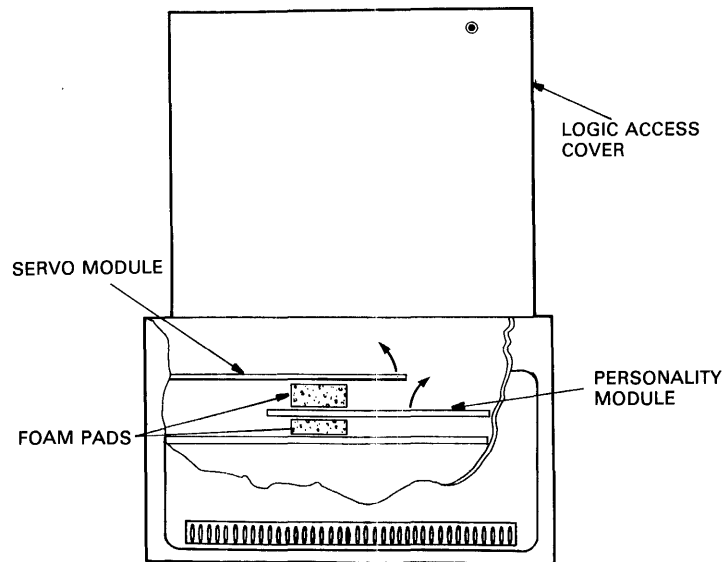
Packing material and shipping brackets are inside the cabinet of each disk drive. Use the following procedure to remove this material and to prepare the drive for operation.

1. Raise the logic access cover by turning the lock 90 degrees counterclockwise. Refer to Figure 2-7.
2. Fold out the servo and personality modules. Remove the foam shipping pads between the modules (Figure 2-8).
3. Return the modules to their original position and lock the logic access cover back in place.
4. Raise the drive logic chassis assembly by pushing in on the latch behind the center slot in the front bezel (Figure 2-7). Use a screwdriver blade to trip the latch.



CZ-0739

Figure 2-7 Raising the Drive Logic Chassis Assembly



CZ-0738

Figure 2-8 Foam Pad Removal

5. Remove the four red shipping brackets that fasten the HDA to its mountings. See Figure 2-9. The bracket next to the spindle motor requires special attention and should be removed last. To remove the other three shipping brackets, loosen the three HDA mounting nuts. Also, completely remove the 5/16-inch hex-head bolts that hold the shipping brackets in place. Slide the three shipping brackets out from under the HDA mounting nuts.
6. Remove the shipping bracket next to the spindle motor by loosening the remaining HDA mounting nut and detaching the bolt and jam nuts. See Figure 2-9. Slide the shipping bracket out from under the HDA mounting nut.

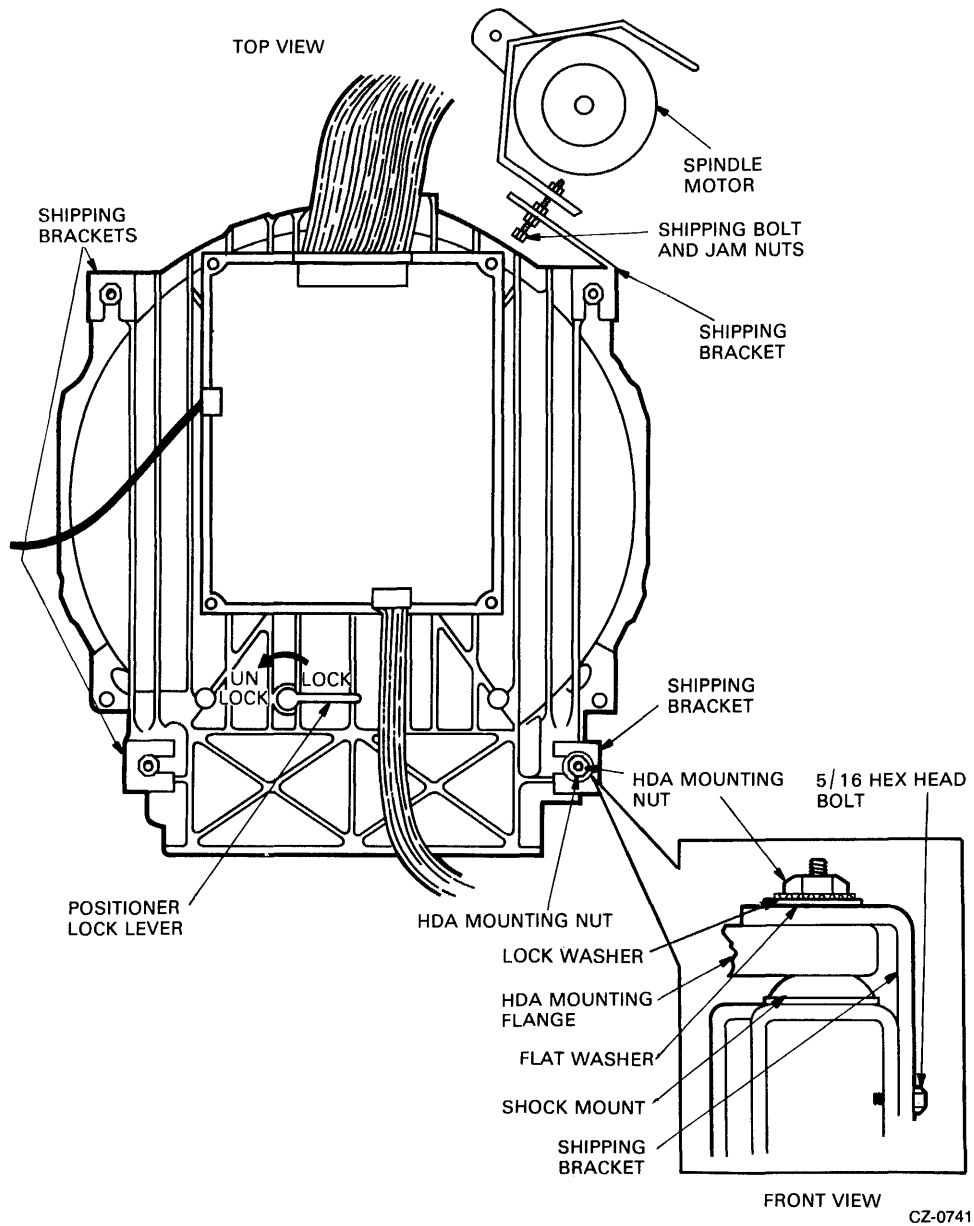
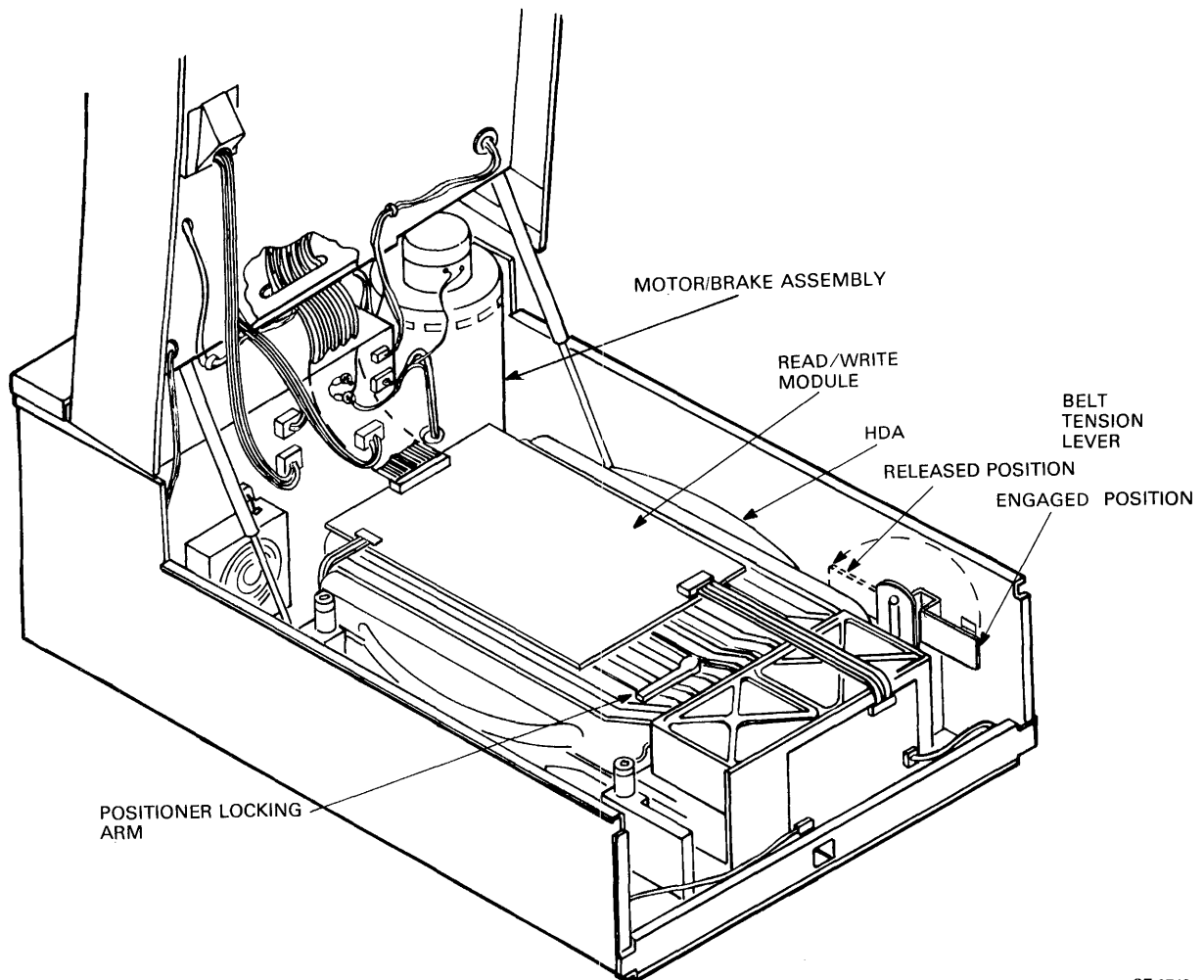


Figure 2-9 HDA Details

NOTE

Save all shipping brackets and hardware for future use when moving equipment.

7. Tighten all four HDA mounting nuts.
8. Ensure that the belt-tension lever is in the engaged position as shown in Figure 2-10.
9. Place the positioner lock lever on the HDA in the UNLOCK position (Figure 2-9).



CZ-0742

Figure 2-10 Belt Tension Lever

NOTE

An interlock switch prevents the spindle motor from operating while the belt tension is released. See Figure 2-11. The belt-tension lever must be in the engaged position for spin-up.

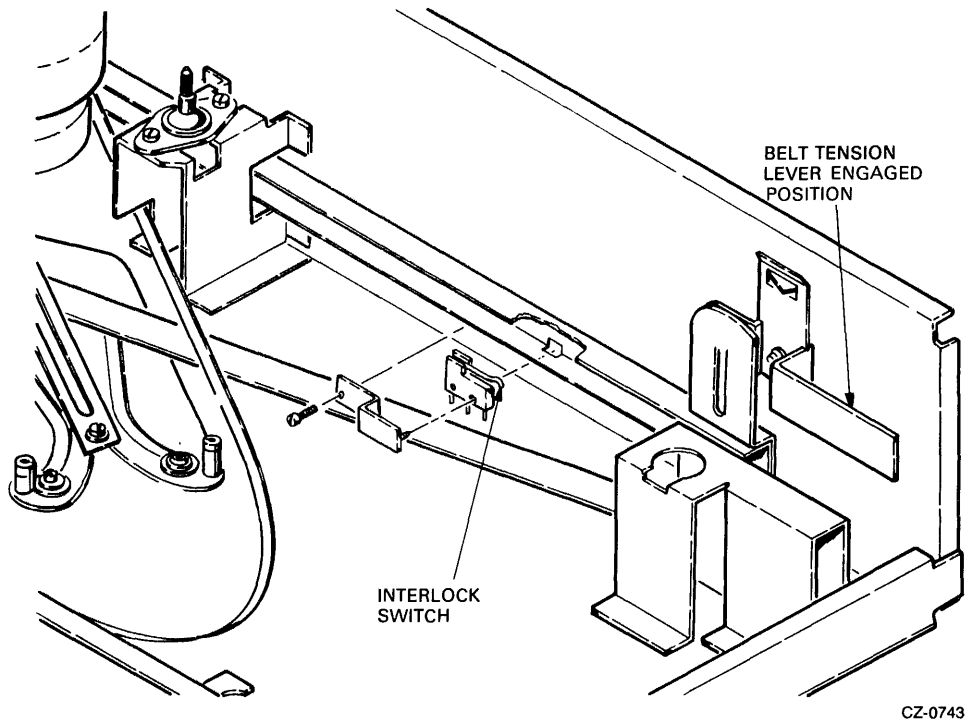


Figure 2-11 Belt Tension Lever and Interlock Switch

10. Lower the logic chassis assembly until it latches.

2.3 RA81 INSTALLATION

An RA81 Disk Subsystem consists of an SDI disk controller and at least one RA81 Disk Drive. To install the subsystem, it is necessary to connect the disk drive cabinet to the Central Processing Unit (CPU) cabinet, install the SDI cables, and program the unit address plug. If the system has more than three RA81s, it is necessary to join two drive cabinets together.

2.3.1 Connecting Cabinets

The H9642 AP/AR (120/240 volt) cabinet will hold up to three disk drives. It comes equipped with two end panels for stand-alone use. If more than three drives are required, a second drive cabinet may be joined to the first. The H9642 BP/BR (120/240 volt) expansion cabinet comes with a joiner panel but no end panels. The two cabinets may be joined by removing one of the end panels of the first cabinet and placing it on the the outside edge of the expansion cabinet. Figure 2-12 shows the end and joiner panel locations.

Use the following procedure to join disk cabinets.

1. Open the back door on the cabinet with the end panels by turning the hex lock counterclockwise. Refer to Figure 2-13.

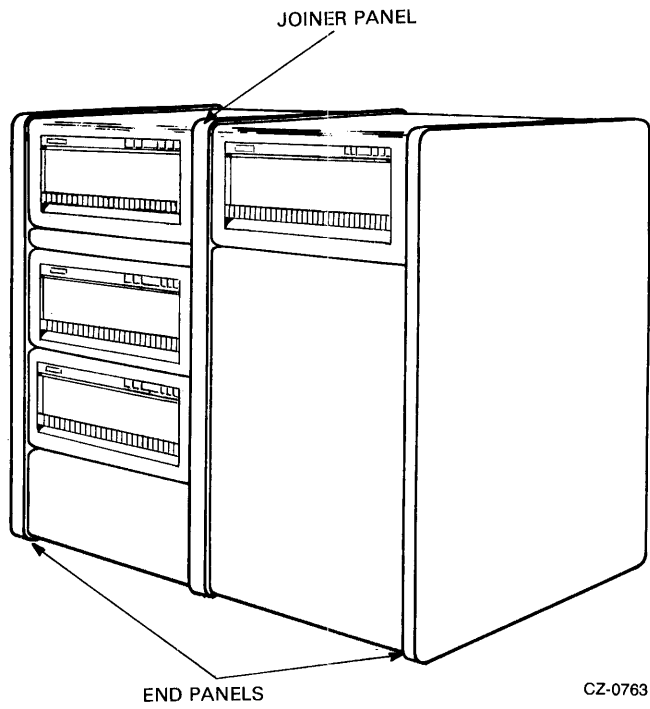


Figure 2-12 End Panels and Joiner Panels

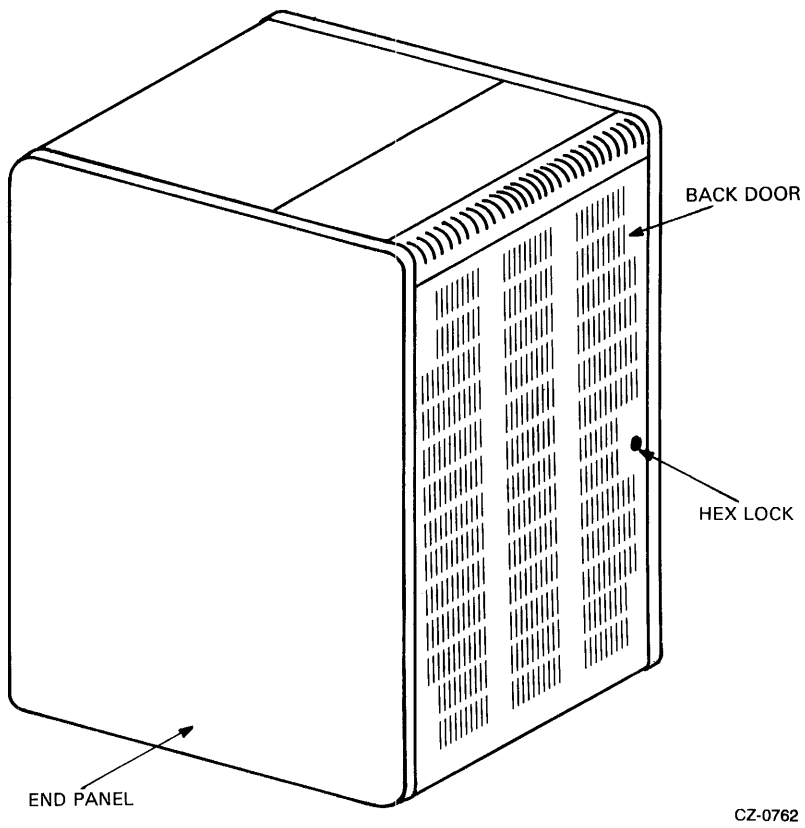
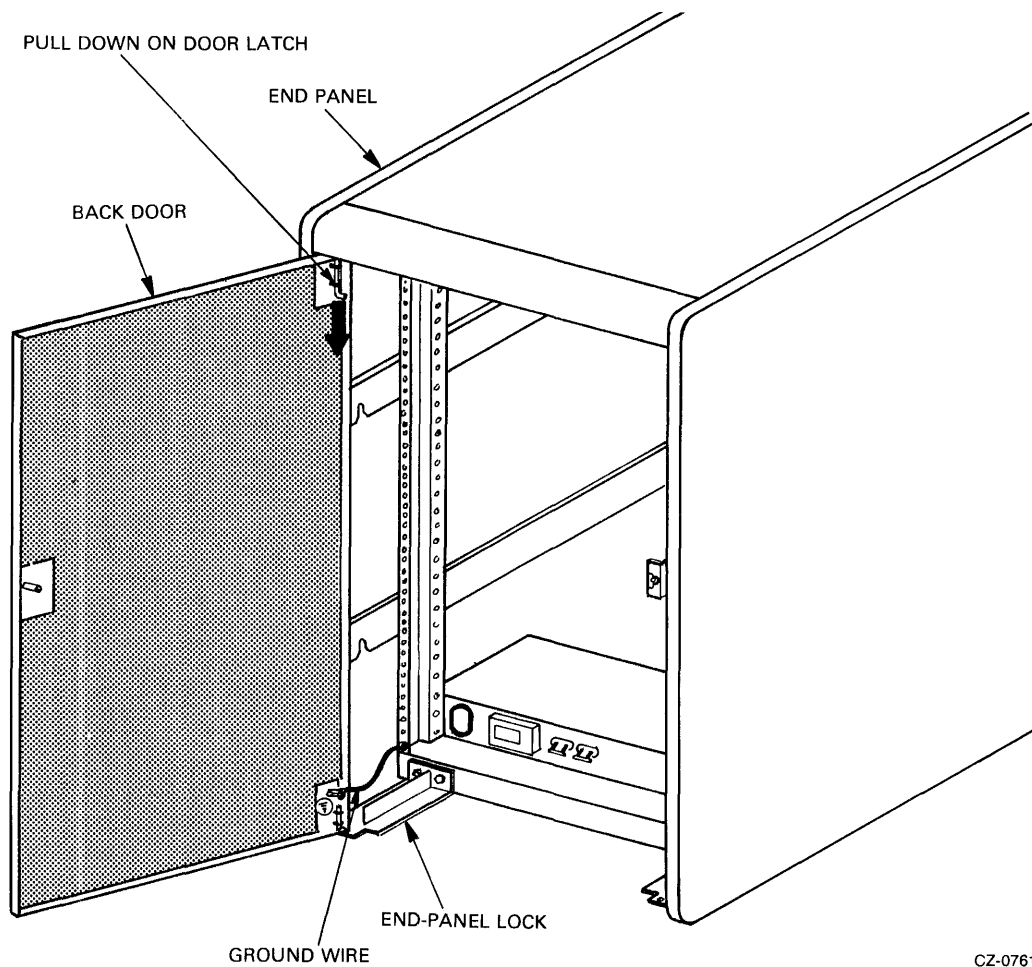


Figure 2-13 Opening the Back Door

2. Remove the back cabinet door by unscrewing the ground wire and pulling down on the top door latch. See Figure 2-14.



CZ-0761

Figure 2-14 Back Door and End-Panel Lock Removal

3. Lift the door off the bottom end panel lock.
4. Loosen the two hex screws and remove the end panel lock from the base of the cabinet.
5. Lift the end panel vertically to disengage it from the four key buttons on the side of the cabinet frame. Refer to Figure 2-15.
6. Unscrew the ground wire attached to the end panel.
7. Remove the back end-panel lock from the expansion cabinet.
8. Attach the ground wire just removed from the first cabinet to the exposed side frame of the expansion cabinet.
9. Attach the other end of the ground wire to the end panel just removed from the first cabinet.

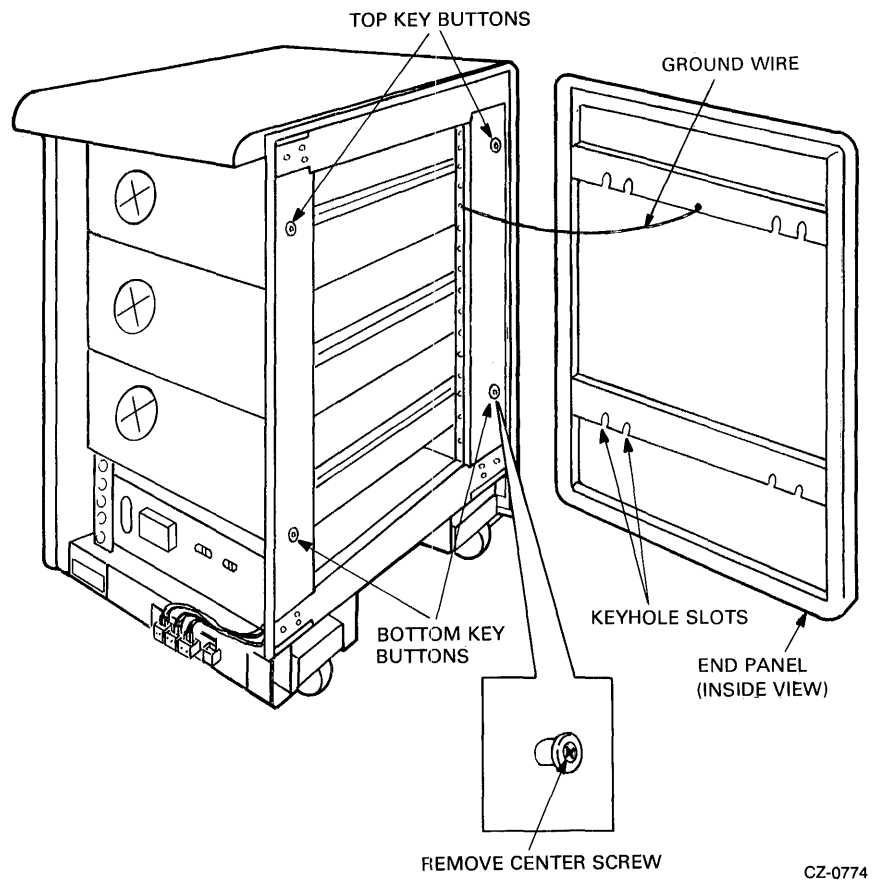


Figure 2-15 End-Panel Bottom Key-Button Removal

10. Lower the end panel over the keyhole buttons on the expansion cabinet.
11. Secure the end panel by replacing the back end-panel lock.
12. Remove the screws in the center of the two lower key buttons from the first drive cabinet.
13. Engage the top two key buttons on the first drive cabinet (Figure 2-16) into the keyhole slots on the expansion cabinet joiner panel.

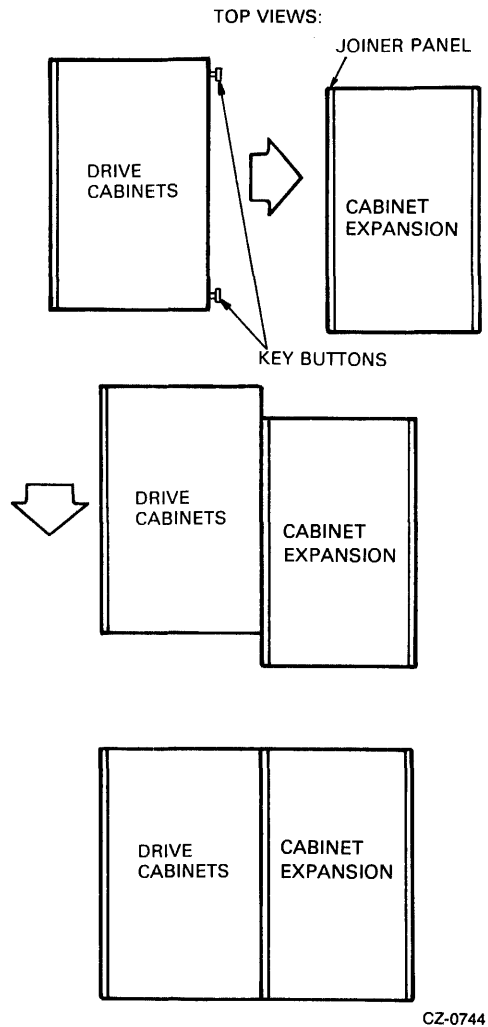
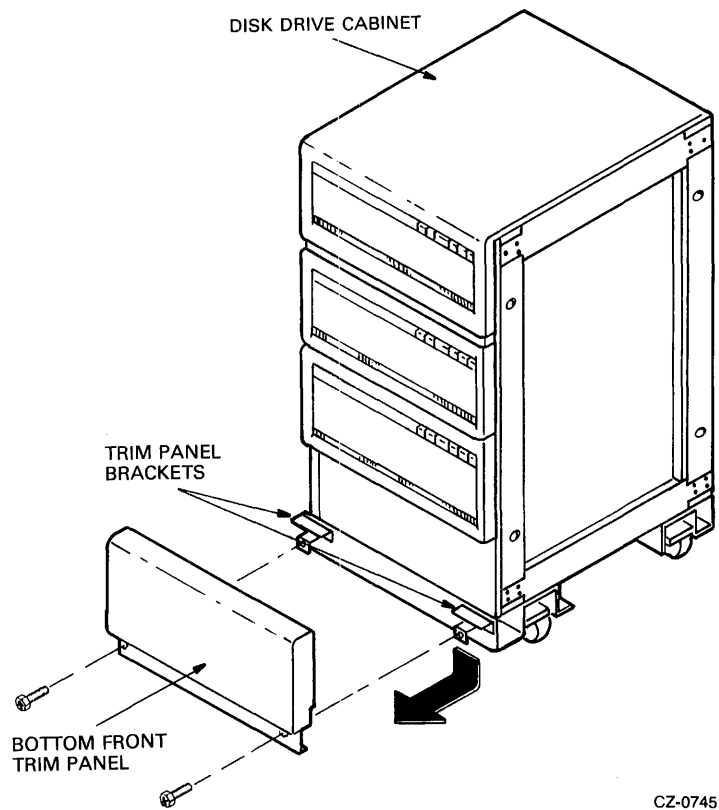


Figure 2-16 Connecting the Cabinets

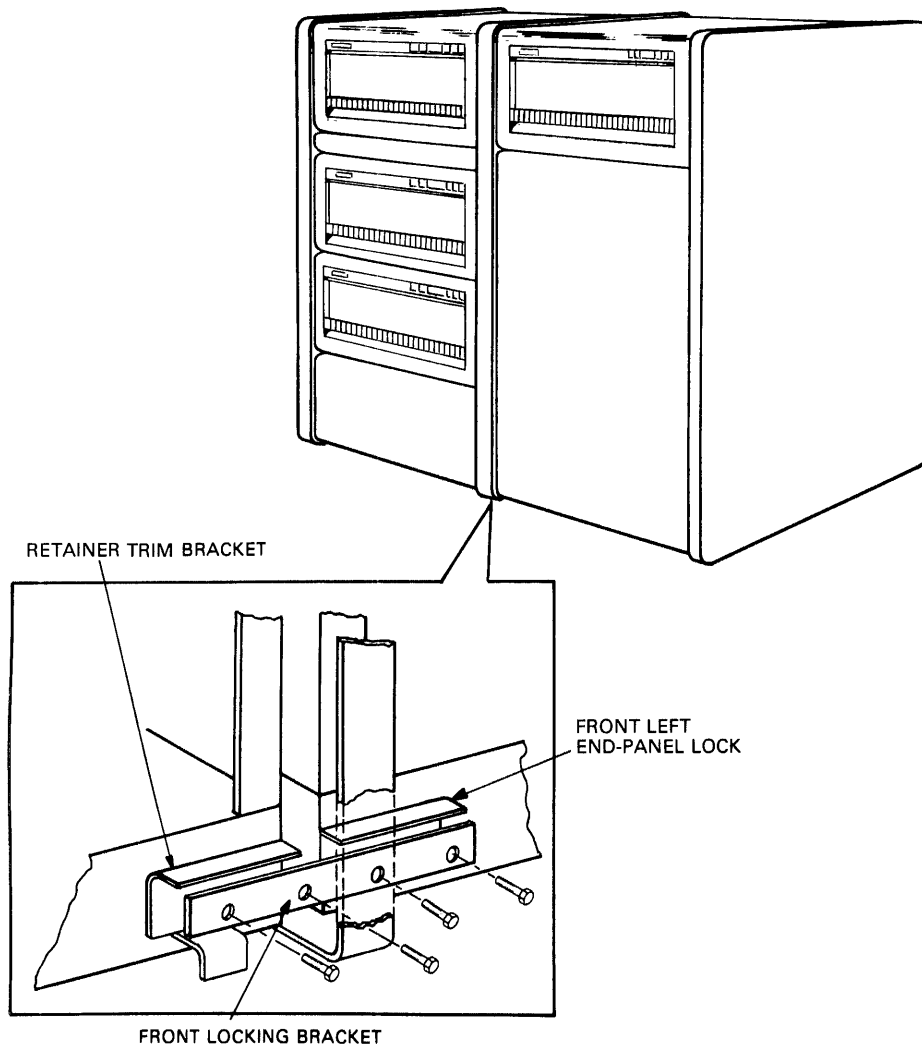
14. Adjust the cabinets until their fronts are flush.
15. Remove the bottom trim panels from the front of the cabinets by removing the two screws at their base. Refer to Figure 2-17.



CZ-0745

Figure 2-17 Removing the Trim Panel Brackets

16. Remove the two screws that hold the two retainer trim brackets nearest the side where the two cabinets are joined. Refer to Figure 2-18.
17. Place the front locking bracket over the retainer trim brackets.
18. Bolt the two cabinets together with the four bolts, as shown.
19. Replace the two bottom trim panels.
20. Open the back door of the cabinets.
21. Loosen the screws that hold the two back end-panel locks nearest the side where the two cabinets are joined.



CZ-0760

Figure 2-18 Installing the Front Locking Bracket

22. Slide the back locking bracket over the end panel locks and tighten the four screws. Refer to Figure 2-19.
23. Replace the back door and any end panel locks removed in this procedure.
24. Lower the levelers until the cabinets are raised off their casters.
25. Adjust the levelers.

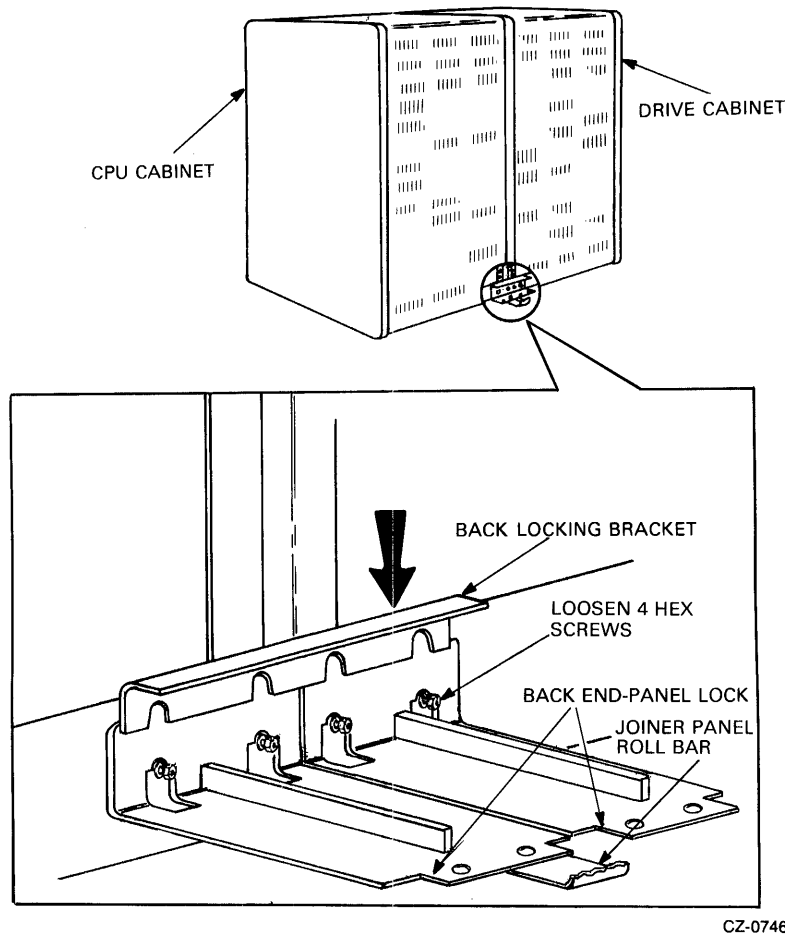


Figure 2-19 Installing the Back Locking Brackets

2.3.2 External SDI Cabling Procedure

Both internal and external SDI cables are mounted in the I/O bulkhead assembly. Internal SDI cables connect to the top of the bulkhead and external cables connect to the bottom. Refer to Figures 2-20 and 2-21. The procedure for connecting the internal SDI cables is discussed in Paragraph 2.4.7.

The external SDI cables must be installed between the central processing unit (CPU) cabinet, I/O bulkhead connector, and the drive cabinet I/O bulkhead connector. The CPU I/O bulkhead connector should have already been installed. If not, refer to the installation procedure in the appropriate disk drive controller user guide. When the CPU cabinet I/O bulkhead connector has been installed, follow the instructions in the appropriate disk controller user guide to install the SDI cables at the CPU cabinet. Use the following procedure to install the external SDI cables.

1. Plug the external SDI cable into the Port A receptacle on the bulkhead. External SDI cables enter from the bottom.
2. Install the two screws that hold the SDI cable shield terminator in place and tighten them. Refer to Figure 2-20.

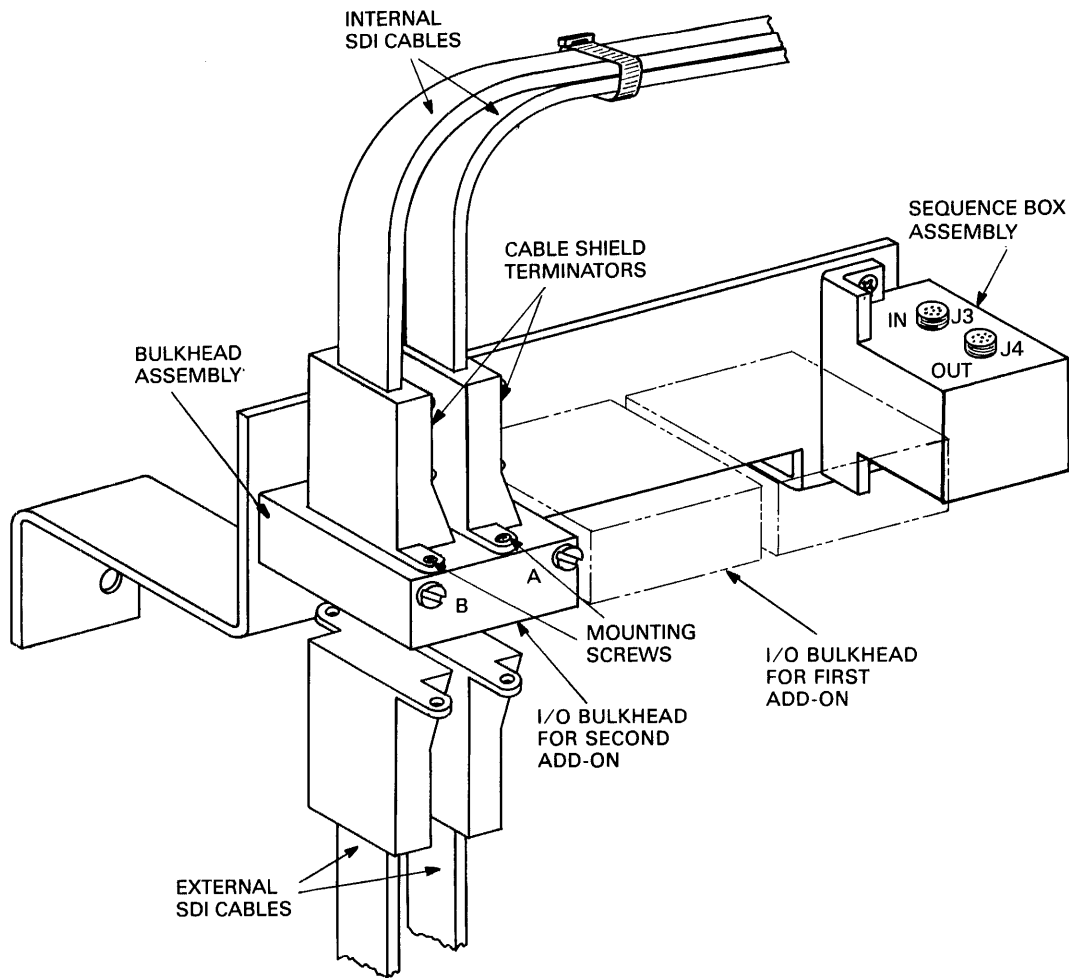


Figure 2-20 SDI Cable Shield Terminator Installation

3. Clamp the external SDI cables to the cable entry retainers below the I/O bulkheads with either a hose clamp or tie wrap. Refer to Figure 2-21.
4. If more than one drive is mounted in the cabinet, more SDI cables must be installed. Refer to the RA81 add-on installation procedure (Paragraph 2.4) for instructions.

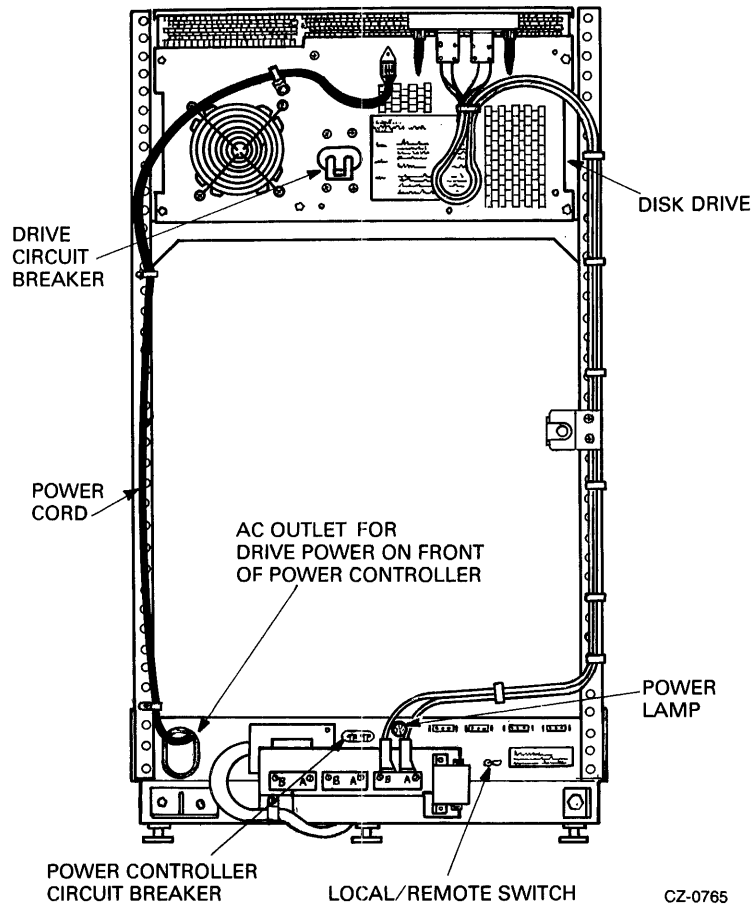


Figure 2-21 Single Drive External SDI Cables

2.3.3 Programming the Drive Unit Address Plug

The READY cover on the operator control panel is also the drive unit address plug. The drive unit numbers between 0 and 251 must be programmed into this plug. The plug comes as "Unit 0". To set up a drive unit number other than zero, remove the READY switch cover from the control panel and cut off the tabs that add up to the required number. Figure 2-22 shows the binary value represented by each tab.

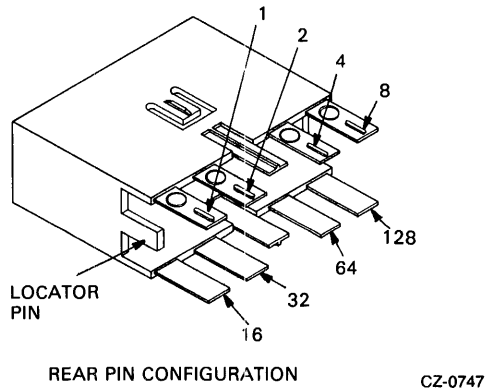


Figure 2-22 Drive Unit Address Plug

For example, if unit number 7 is required for a specific drive, tabs 1, 2, and 4 would have to be cut off the switch cap. If unit number 113 is required, tabs 64, 32, 16, and 1 must be removed. Leave all tabs on if unit number 0 is required.

After the drive unit number has been selected, place the gummed label with the corresponding number in the recessed area on the front of the switch cover. Replace the switch cover on the operator control panel.

2.4 RA81 ADD-ON INSTALLATION

Use the following procedure to install additional drives in a cabinet.

CAUTION

Do not try to complete the add-on installation without the help of a second person because of the weight of the drives.

2.4.1 Remove the Front Trim Panel

The first add-on drive should be placed in the center bay of the RA81 cabinet and the second in the bottom bay. Remove the trim panel at the proper location by unscrewing the four 10-32 hex nuts that hold the panel to the cabinet frame. These nuts can be reached through the back of the cabinet. Refer to Figure 2-23.

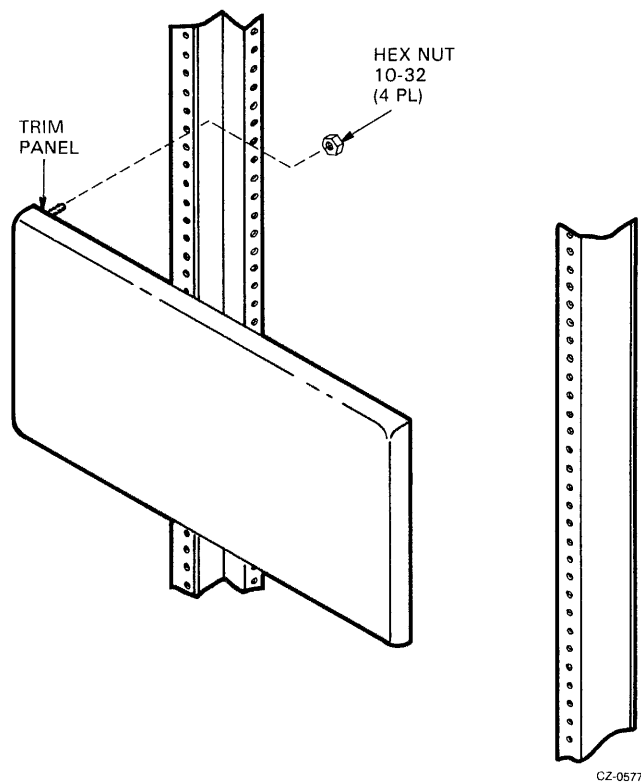
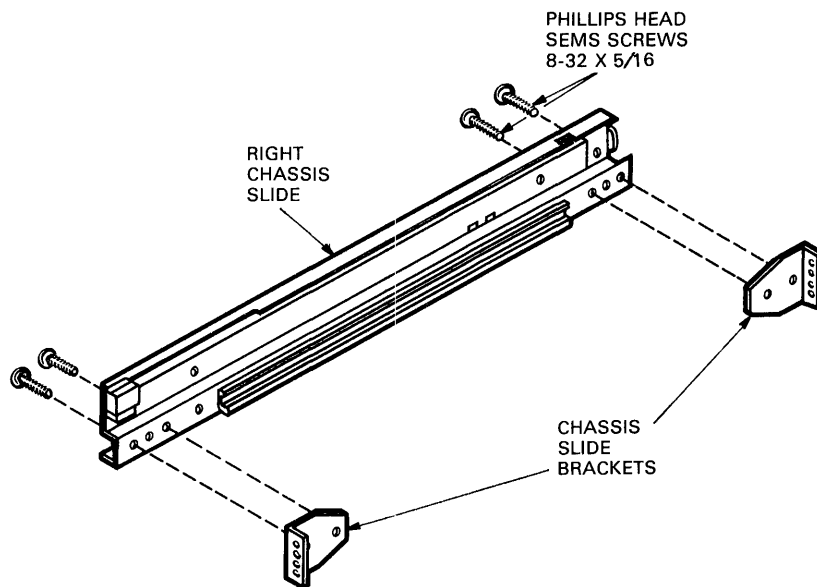


Figure 2-23 Removing Cabinet Trim Panel

2.4.2 Install the Slide Assembly

Each RA81 add-on drive must be mounted in the cabinet on a slide assembly. Use the following procedure to install the slides in the drive cabinet.

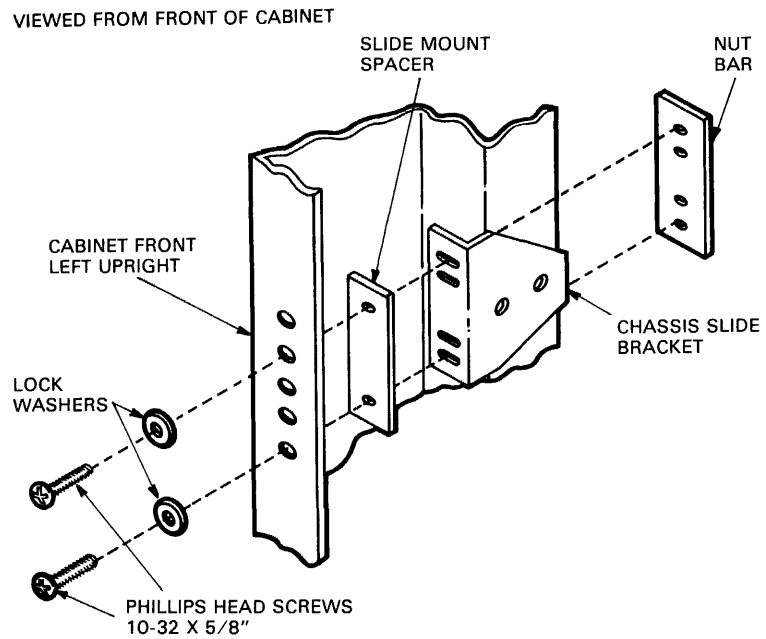
1. Screw a chassis slide bracket on to each end of the left and right chassis slides. Use two 8-32 x 5/16 inch phillips head sems screws (screws with star washers attached) to mount each. Refer to Figure 2-24.
2. Set aside the following hardware:
 - Four phillips head screws – 10-32 x 5/8 inch
 - Four lock washers – 0.380 inch O.D. x 0.200 inch I.D.
 - Two slide mount spacers (two holes)
 - Four phillips head sems screws – 10-32 x 1/2 inch
 - Four nut bars (four holes)
3. Mount the chassis slides to the front vertical upright as shown in Figure 2-25. If this is a first add-on drive (center bay), use mounting holes 27 and 31, counting from the bottom. Notice that this installation to the front vertical upright needs both a slide mount spacer and a nut bar.



NOTE
1. REPEAT FOR LEFT CHASSIS SLIDE.

CZ-0578

Figure 2-24 Chassis Slide Bracket Installation

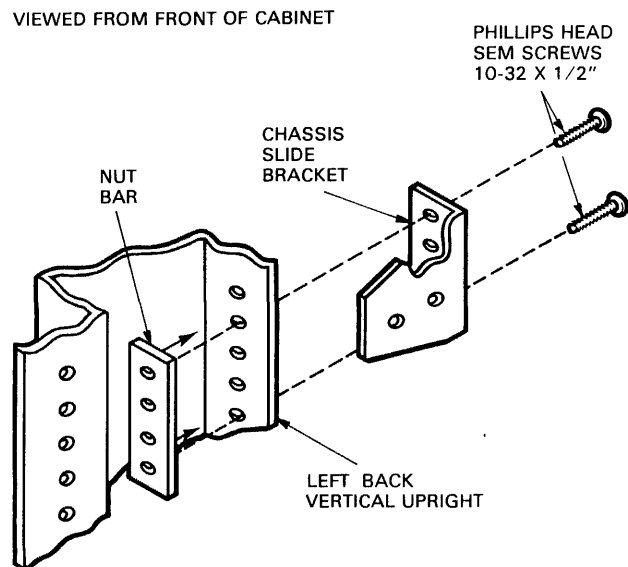


NOTE
1. REPEAT FOR FRONT RIGHT UPRIGHT.

CZ-0579

Figure 2-25 Mounting Chassis Slide to Front Upright

4. Mount the chassis slides to the back vertical uprights as shown in Figure 2-26. Note that only a nut bar is used here with sem screws. Use the same mounting holes as specified in Step 3 above.



NOTE
1. REPEAT FOR RIGHT BACK VERTICAL UPRIGHT.

CZ-0749

Figure 2-26 Mounting Chassis Slide to Back Upright

5. Mount the electrostatic discharge bracket over the chassis slide bracket on the back left vertical upright. Pass the two sem screws through the two center holes of the chassis slide bracket and fasten them to the nut bar inside. Refer to Figure 2-27. If this is the first add-on drive (center bay), use mounting holes 28 and 30. If this is the second add-on drive (bottom bay), use mounting holes 10 and 12.

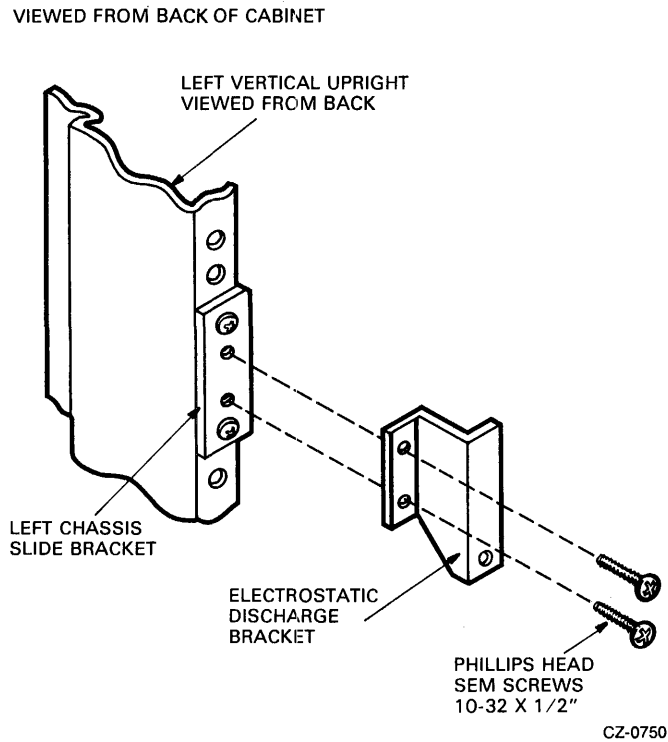
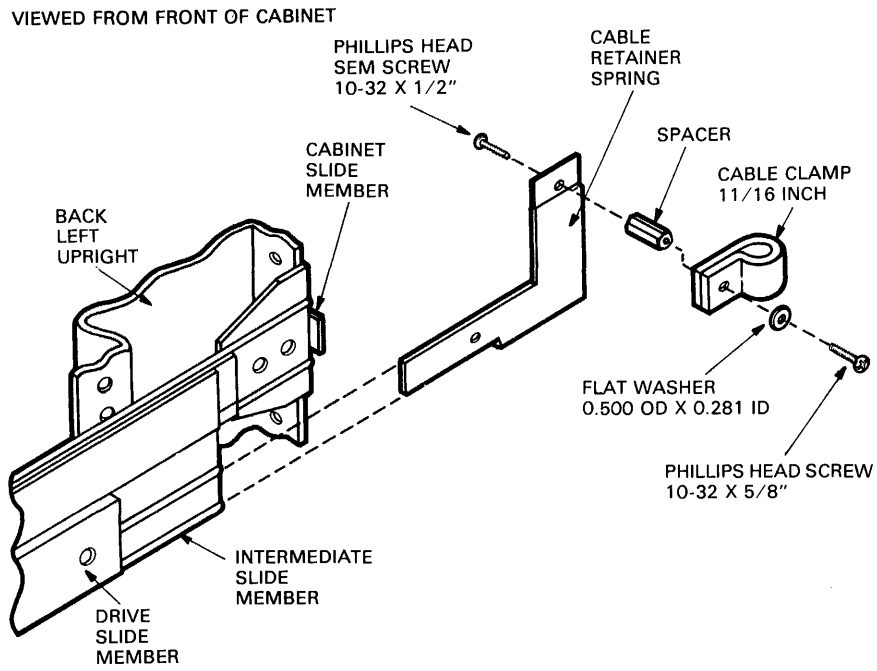


Figure 2-27 Mounting the Electrostatic Discharge Bracket

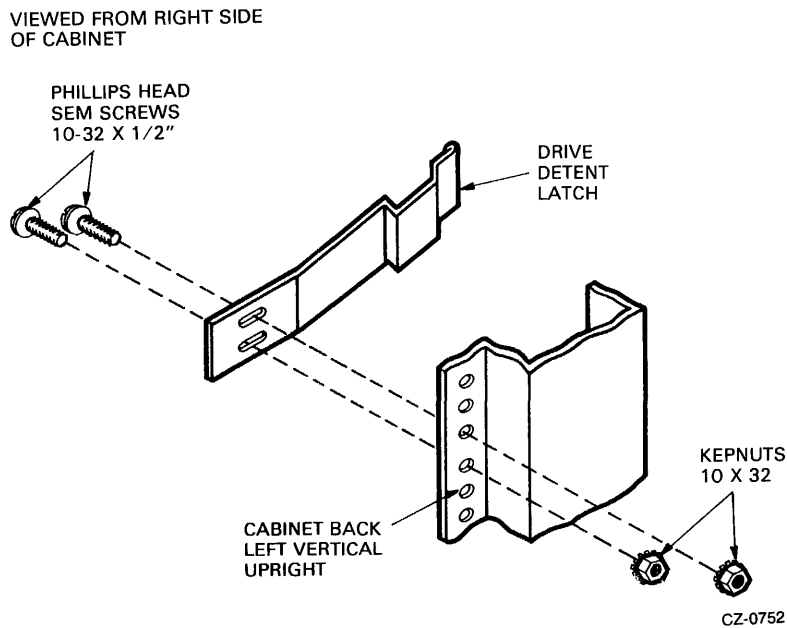
6. Insert the two cable retainer springs in to the back of the left and right chassis slides as shown in Figure 2-28. Push the cable retainer springs until they latch into place.
7. Mount an 11/16-inch cable clamp on to each cable retainer spring, as shown. Each cable clamp should be mounted on inside (drive side) of the cable retainer spring.
8. Install the drive detent latch on the left vertical upright (back view). See Figure 2-29. Ensure that the drive detent latch will not move freely but is loose enough that it can be adjusted later. If this is a first add-on drive (center bay), use mounting holes 36 and 37. If this is a second add-on drive (bottom bay), use mounting holes 18 and 19.



NOTE
1. REPEAT FOR CHASSIS SLIDE ON RIGHT SIDE.

CZ-0751

Figure 2-28 Installation of Cable Retainer Springs



CZ-0752

Figure 2-29 Installation of Drive Detent Latch

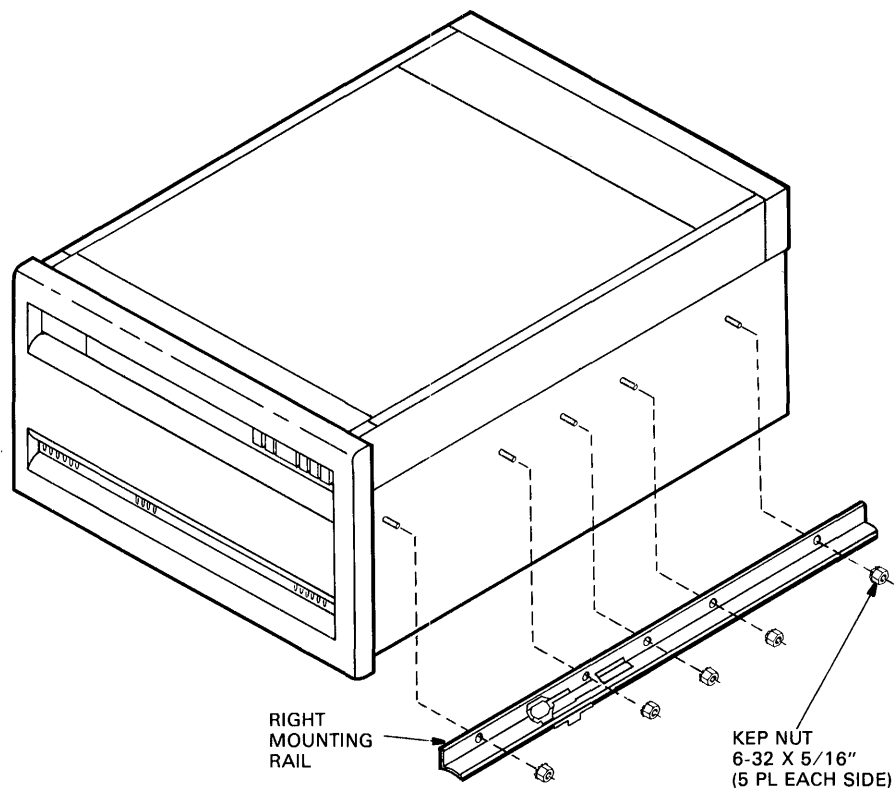
2.4.3 Remove the Internal Shipping Brackets and Packing Material

Remove the shipping brackets and packing material from inside the drive using the procedure described previously in Paragraph 2.2.3.

2.4.4 Mount the RA81 on the Slides

Use the following procedure to mount the drive on its slides.

1. Install the left and right mounting rails onto the sides of the disk drive as shown in Figure 2-30 using ten 6-32 keps nuts.



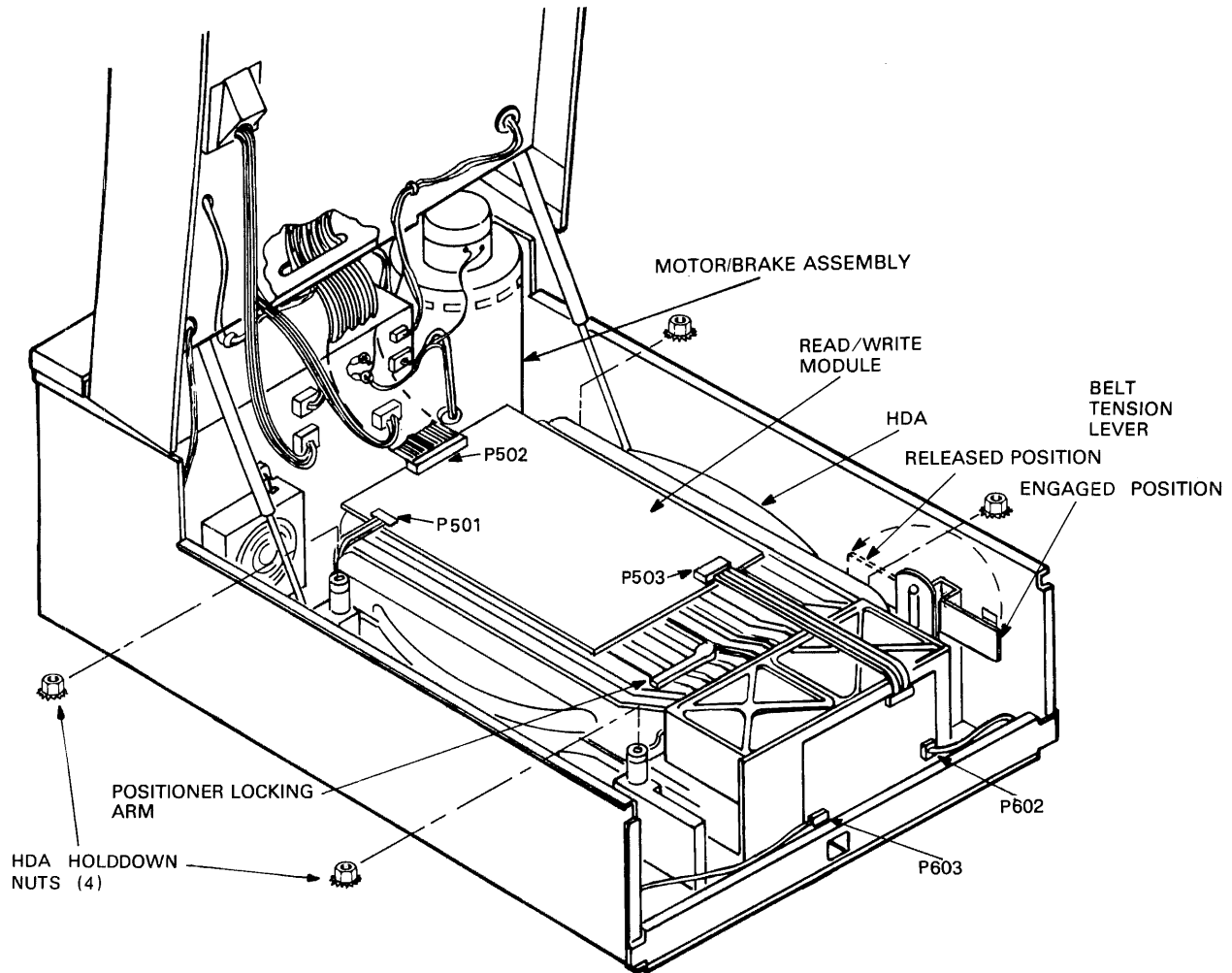
NOTES

1. REPEAT FOR LEFT MOUNTING RAIL.

CZ-0584

Figure 2-30 Installation of Drive Mounting Rails

2. Remove the HDA to reduce the weight of the drive using the following procedure. Refer to Figures 2-31 and 2-32.
 1. Raise the drive logic chassis. Refer to Paragraph 2.2.3, Step 4.
 2. Unplug connector P502 from the read/write module. See Figure 2-31.
 3. Unplug connectors P602 and P603 from the preamplifier module. Refer to Figure 2-31.
 4. Place the belt tension lever in the release position. Refer to Figure 2-31



CZ-0770

Figure 2-31 Removal of HDA Cable Connections

5. Remove the four HDA retaining nuts.
6. Place the positioner lock in the LOCK position. Refer to Figure 2-32.

CAUTION

The HDA could be damaged if the previous step is not performed.

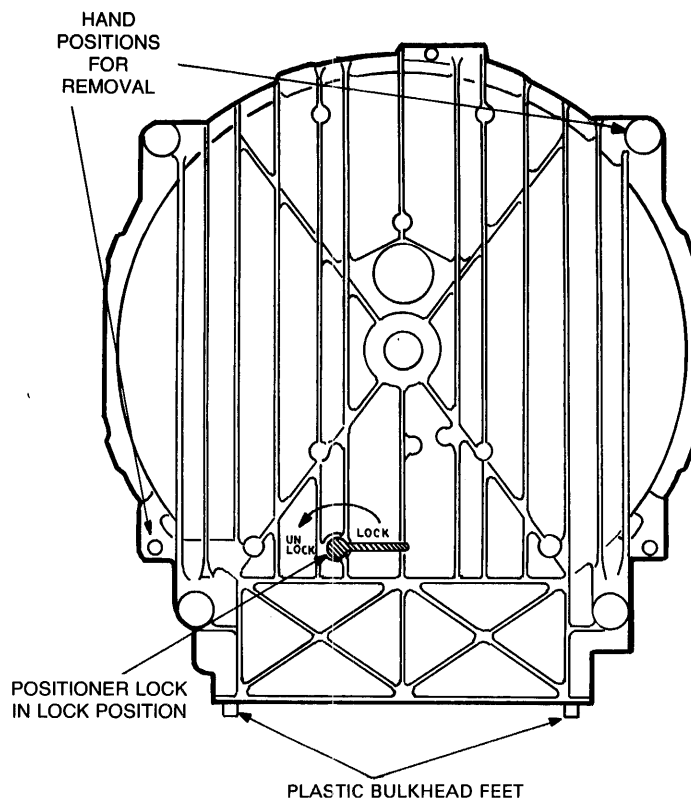
7. Remove the HDA from the drive by lifting from diagonally opposite corners. Refer to Figure 2-32.
8. Place the HDA on a level surface in the vertical position only. Feet are provided on the front cover of the HDA for this purpose.

CAUTION

Do not place the HDA in a horizontal position (on the pulley). The speed and temperature transducers mounted on the bottom of the HDA could be damaged.

If the HDA is going to be moved to another location, tape the HDA spindle pulley in place to prevent movement of the spindle. Any movement of the spindle could damage the heads.

It is important to use a good nylon reinforced packing tape. Masking tape should never be used as it is not strong enough.



CZ-8021

Figure 2-32 HDA Positioner Lock.

3. Extend the cabinet stabilizer as shown in Figure 2-33.
4. Extend each chassis slide all the way forward until it locks. See Figure 2-34.

WARNING

A second person is needed to place the drive on the chassis slides because of the weight of the disk drive.

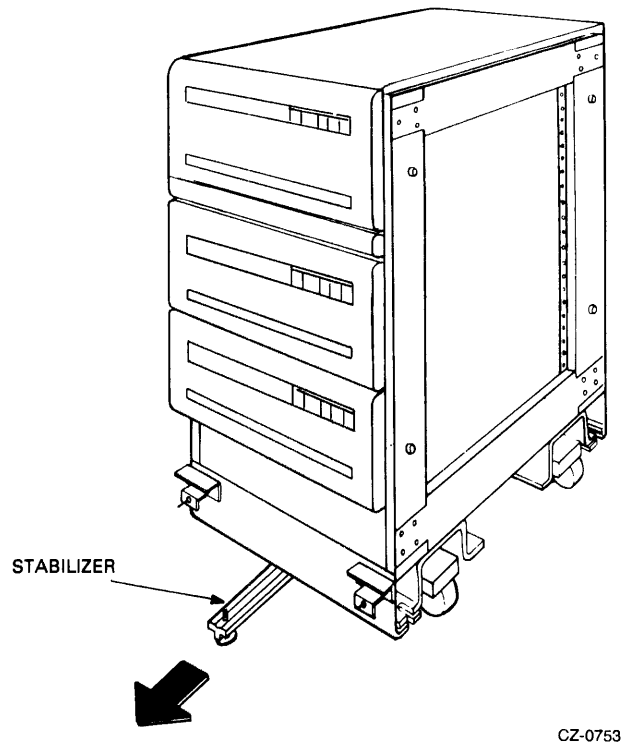


Figure 2-33 Extending Cabinet Stabilizer

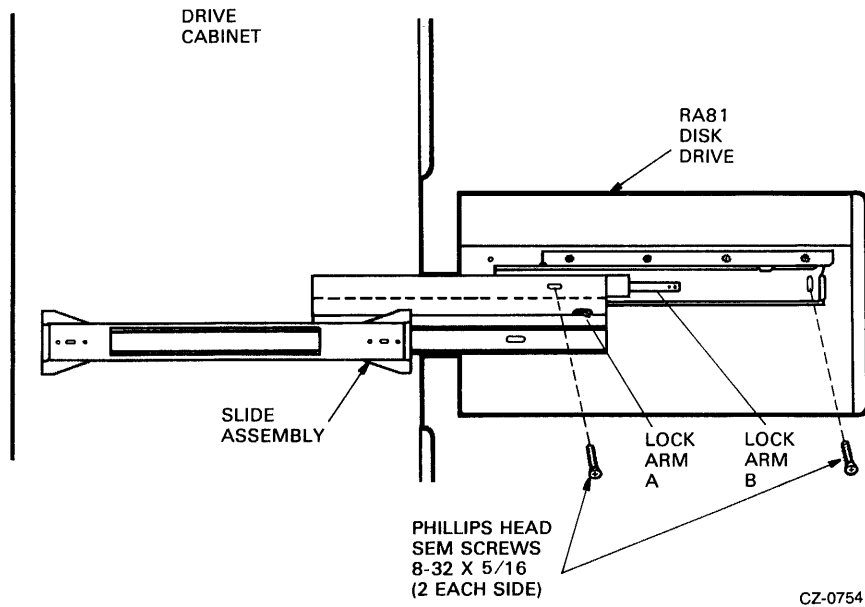
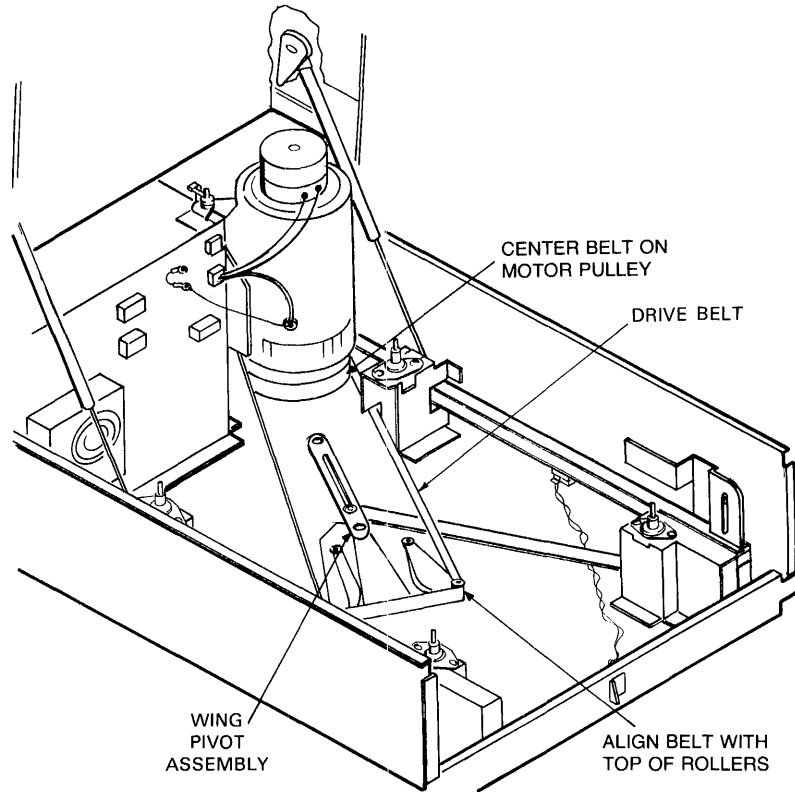


Figure 2-34 Extending the Chassis Slides

5. With the help of a second person, lift the drive and place it on top of the chassis slides as shown in Figure 2-34. Push the drive toward the back of the cabinet until its mounting rails touch the stop.

6. Fasten the drive to the chassis slides using four 8-32 x 5/16 inch phillips head sem screws, as shown.
7. Extend the drive forward on the slides.
8. Replace the HDA using the following procedure.
 1. Ensure that the drive belt is centered on the motor pulley. The other end of the belt should be even with the top of the nylon rollers on the wing pivot assembly. See Figure 2-35.



CZ-0767

Figure 2-35 Wing Pivot Assembly

CAUTION

Damage to the HDA, drive belt, or nylon rollers could result if the drive belt is not aligned correctly.

2. Lift the HDA by grasping two diagonally opposite corners, then lower the HDA over the four mounting bolts.
3. Replace the four nuts and washers on the HDA.
4. Connect P602 and P603 to the read preamplifier module on the front of the HDA.
5. Connect P502 to the read/write module.
6. Place the belt tension lever in the engaged position. See Figure 2-10.

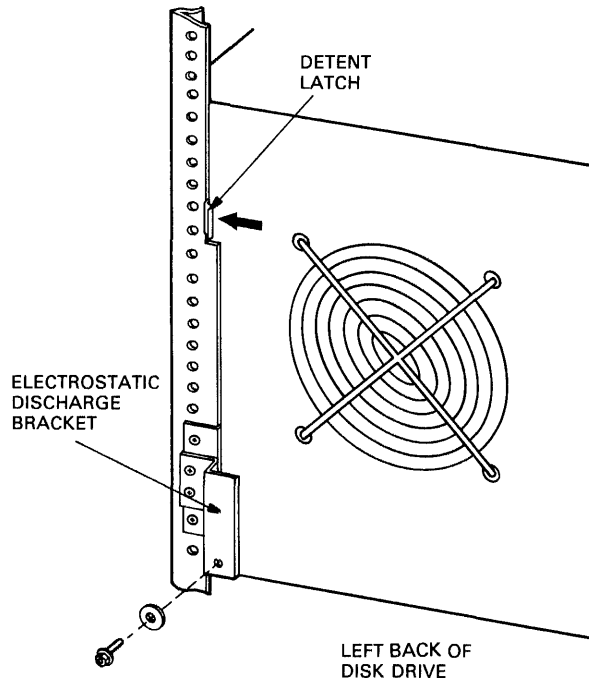
7. Turn the HDA positioner lock counterclockwise to the unlocked position.
9. Slide the drive back into the cabinet.
10. Adjust the drive detent latch so that it prevents the drive from sliding forward and tighten the latch screws.

2.4.5 Program the Drive Unit Address Plug

Program the drive unit address plug using the procedure described previously in Paragraph 2.3.3.

2.4.6 Connect the Electrostatic Discharge Bracket

The electrostatic discharge bracket grounds the disk drive to the cabinet. To complete this ground path, the bottom left screw on the drive power supply should be removed. This same screw should then be inserted through the electrostatic discharge bracket and screwed back into place as shown in Figure 2-36.



NOTE

1. REMOVE POWER SUPPLY SCREW TO SLIDE DRIVE FORWARD. REPLACE SCREW THROUGH BRACKET EACH TIME THE DRIVE IS SLID BACK INTO CABINET.

CZ-0755

Figure 2-36 Electrostatic Discharge Bracket Details

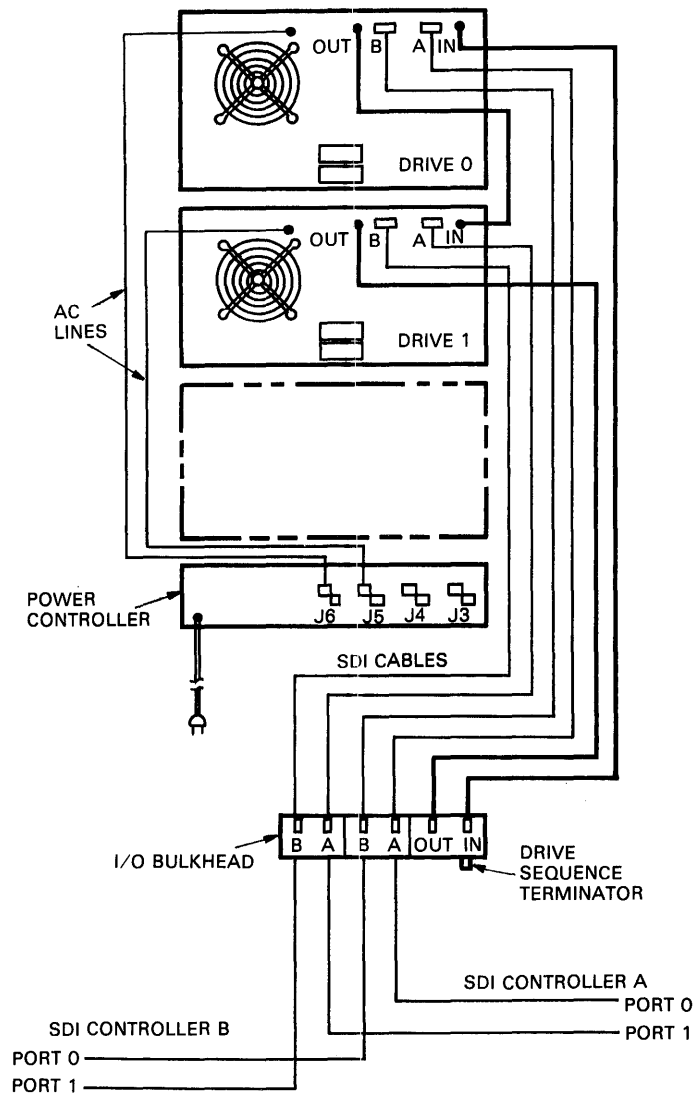
CAUTION

This ground connection must always be made before the drive is operated.

To slide the drive forward, remove the screw that holds the electrostatic discharge bracket to the power supply and push on the drive detent latch. Remember to reconnect the electrostatic discharge bracket each time the drive is pushed back into the cabinet.

2.4.7 Install the Internal SDI Cables

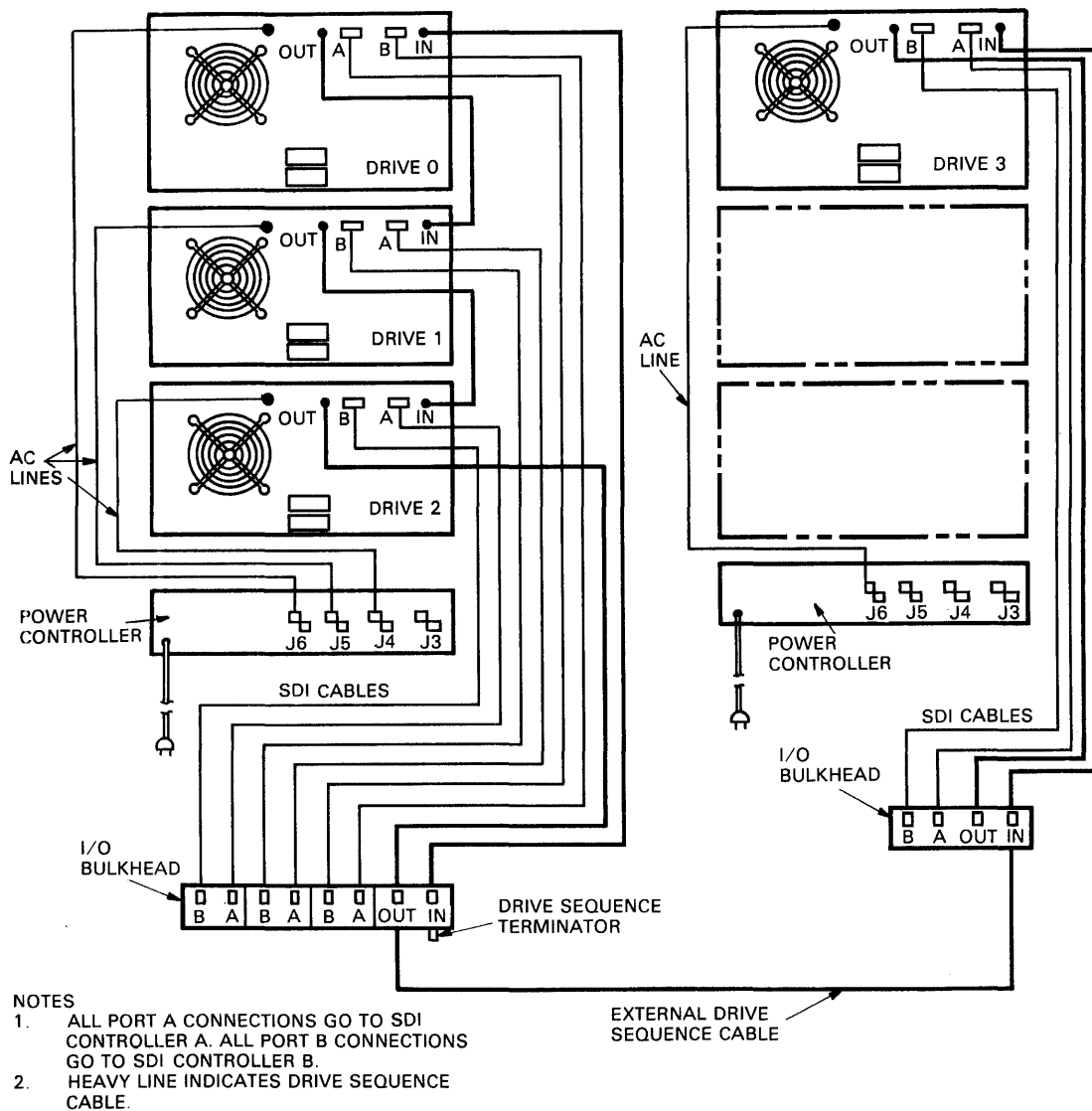
The two internal SDI cables that exit from the back of the add-on drive must be connected to the top of the I/O bulkhead assembly. The external SDI cable that connects the drive cabinet to the disk controller must be mounted on the bottom of the I/O bulkhead assembly. If two disk controllers are used (dual-port operation), a second external SDI cable must be installed. The SDI cables must be connected to the I/O bulkhead before the bulkhead is connected to the drive cabinet. Figures 2-37 and 2-38 show the electrical wiring for add-on disk drives. Use the following procedure to install the SDI cables.



- NOTES
 1. HEAVY LINE INDICATES THE DRIVE SEQUENCE CABLE.

CZ-0758

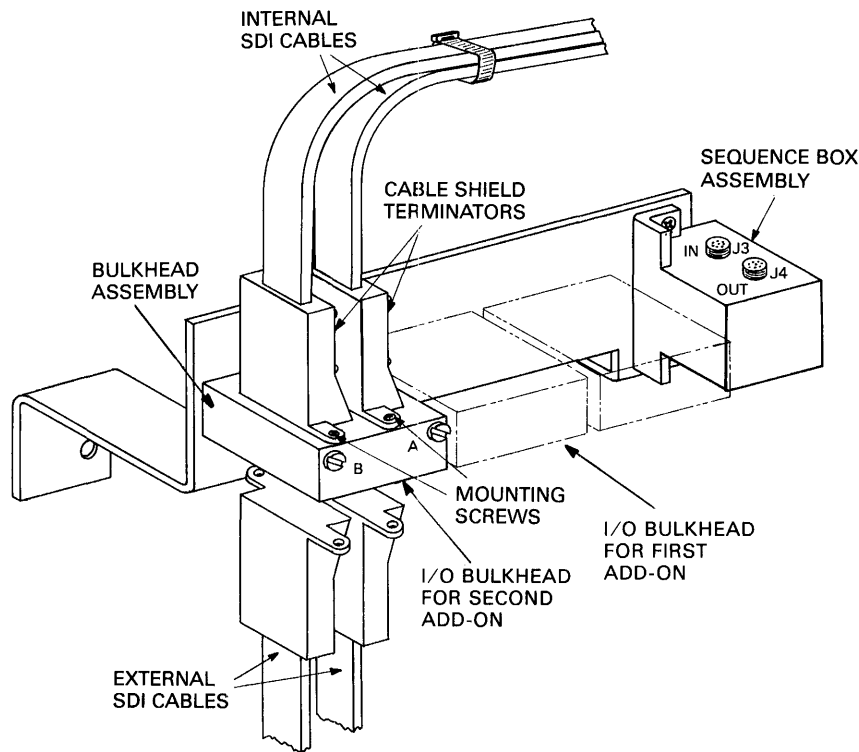
Figure 2-37 Cabling for a Two-Drive System



CZ-0759

Figure 2-38 Cabling for a Three- and Four-Drive System

1. Locate the Port A SDI cable where it exits the back of the disk drive. Find the end of the cable and plug the connector into Port A on the top of the I/O bulkhead assembly. Note the orientation key.
2. Screw the Port A SDI cable shield terminator into the I/O bulkhead assembly. Early versions of the disk drive will need separate screws to mount the shield terminator. Later versions will have captive hardware. Refer to Figure 2-39.
3. Repeat Steps 1 and 2 for the Port B SDI cable.
4. Plug the SDI cable from the first disk controller into the Port A connector on the bottom of the I/O bulkhead assembly. Note the orientation key.



CZ-0764

Figure 2-39 Connecting SDI Cable Shield Terminators

5. Screw the shield terminator of this cable into the I/O bulkhead assembly as in Step 2.
6. If a second disk controller is used, mount its SDI cable into Port B on the I/O bulkhead assembly.

2.4.8 Mount the I/O Bulkhead

An I/O bulkhead assembly must be installed on the back base of the drive cabinet for each add-on drive. Screw the I/O bulkhead assembly on to the back of the cabinet as shown in Figure 2-40. Mount the I/O bulkhead assembly in the drive 1 location for the first add-on drive. Mount the I/O bulkhead assembly in the drive 2 location for the second add-on drive.

2.4.9 Install the Drive Sequence Cables

Figures 2-37 and 2-38 show the electrical wiring diagrams for add-on drives. Use them as a reference when installing drive sequence cables, as follows.

1. Unplug the drive sequence cable from the output connector on drive 0 (top drive) done by raising the back cover and removing it from the cable clamp. Refer to Figure 2-41.
2. Plug the drive sequence cable described in Step 1 into the output connector on drive 1 for one add-on, or into the output connector on drive 2 for two add-ons.
3. Install the new 8-foot cable between the output connector of drive 0 and the input connector on drive 1. If a second add-on drive has been installed, connect another 8-foot drive sequence cable between the output connector of drive 1 and the input connector of drive 2.

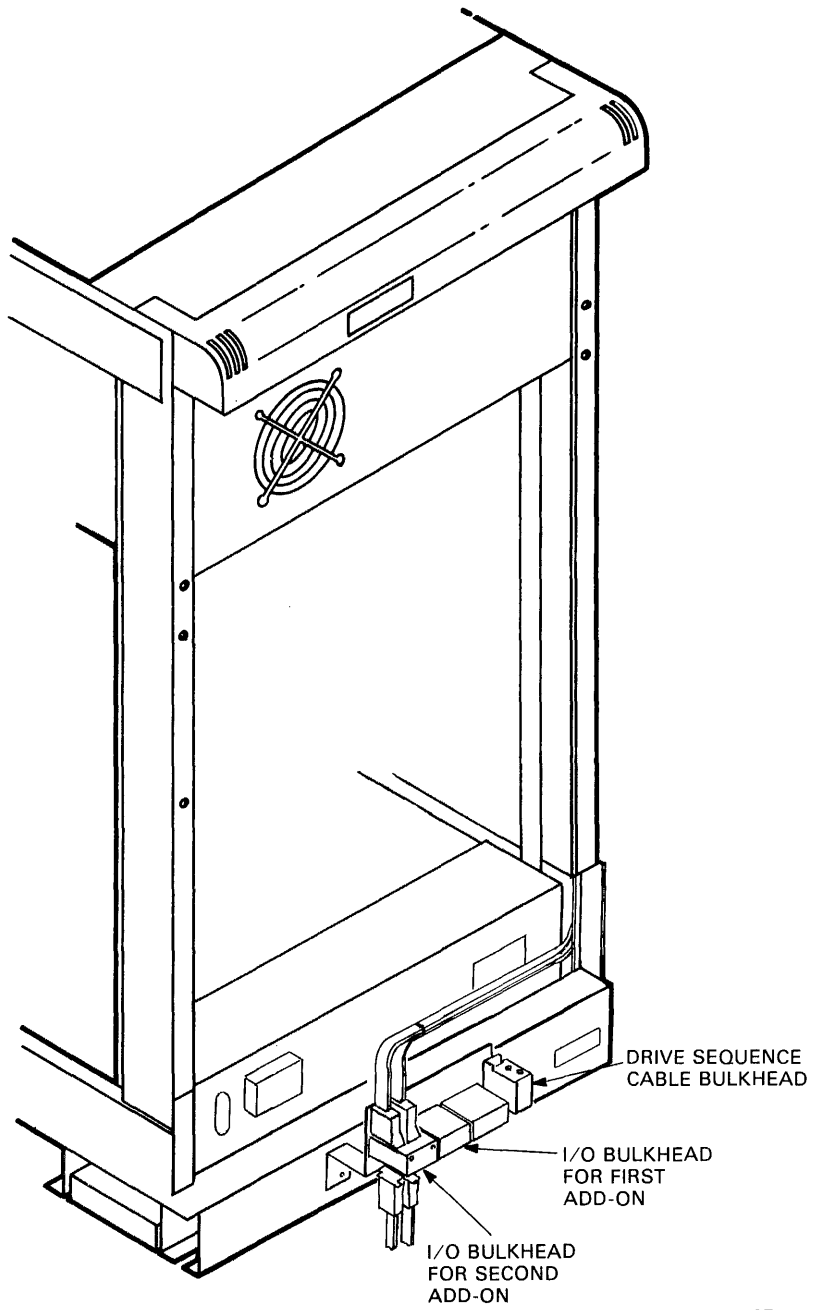
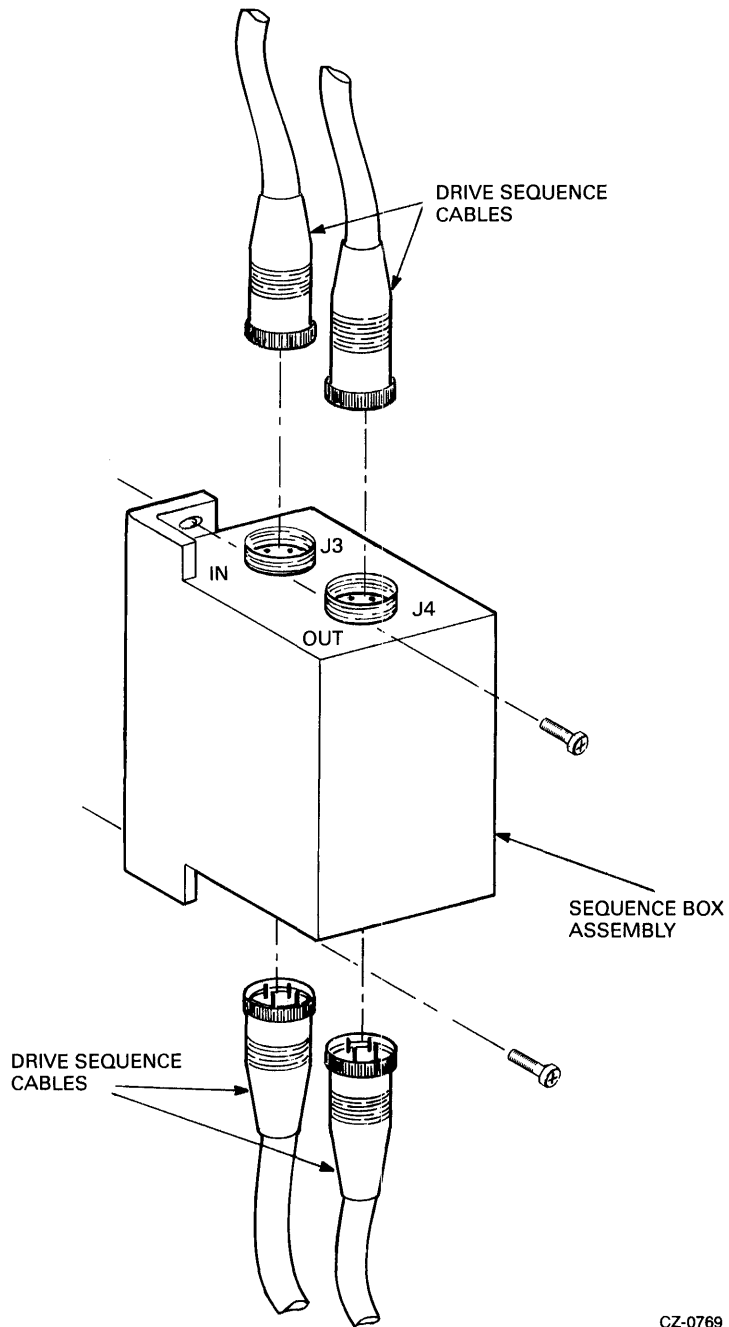


Figure 2-40 Mounting the I/O Bulkhead Assembly

CZ-0772



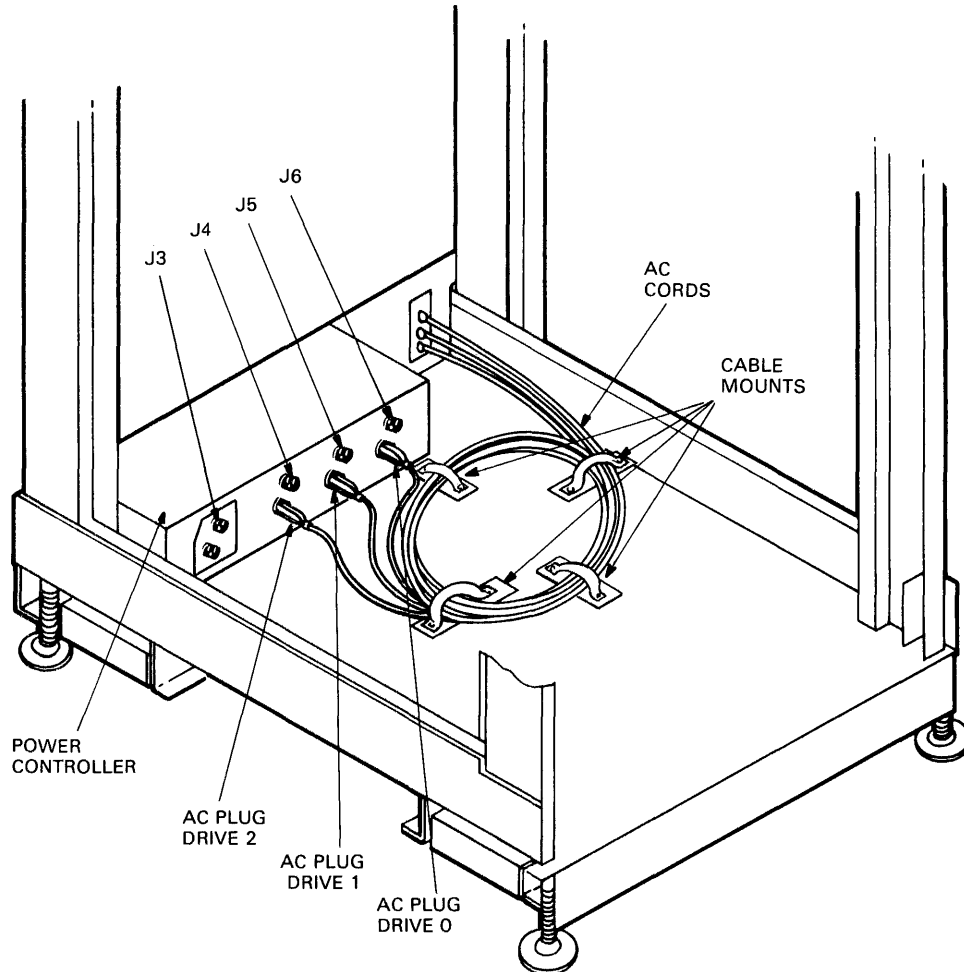
CZ-0769

Figure 2-41 Drive Sequence Cable Installation

4. Tie-wrap the drive sequence cable to the existing SDI cable clamps.
5. Add a cable between the drive sequence bulkheads on each drive cabinet when a second cabinet is used. Refer to Figures 2-38 and 2-41.

2.4.10 Connect AC Power

Plug the ac power cord from each add-on into the ac receptacle on the power controller at the base of the cabinet. Refer to Figure 2-42.



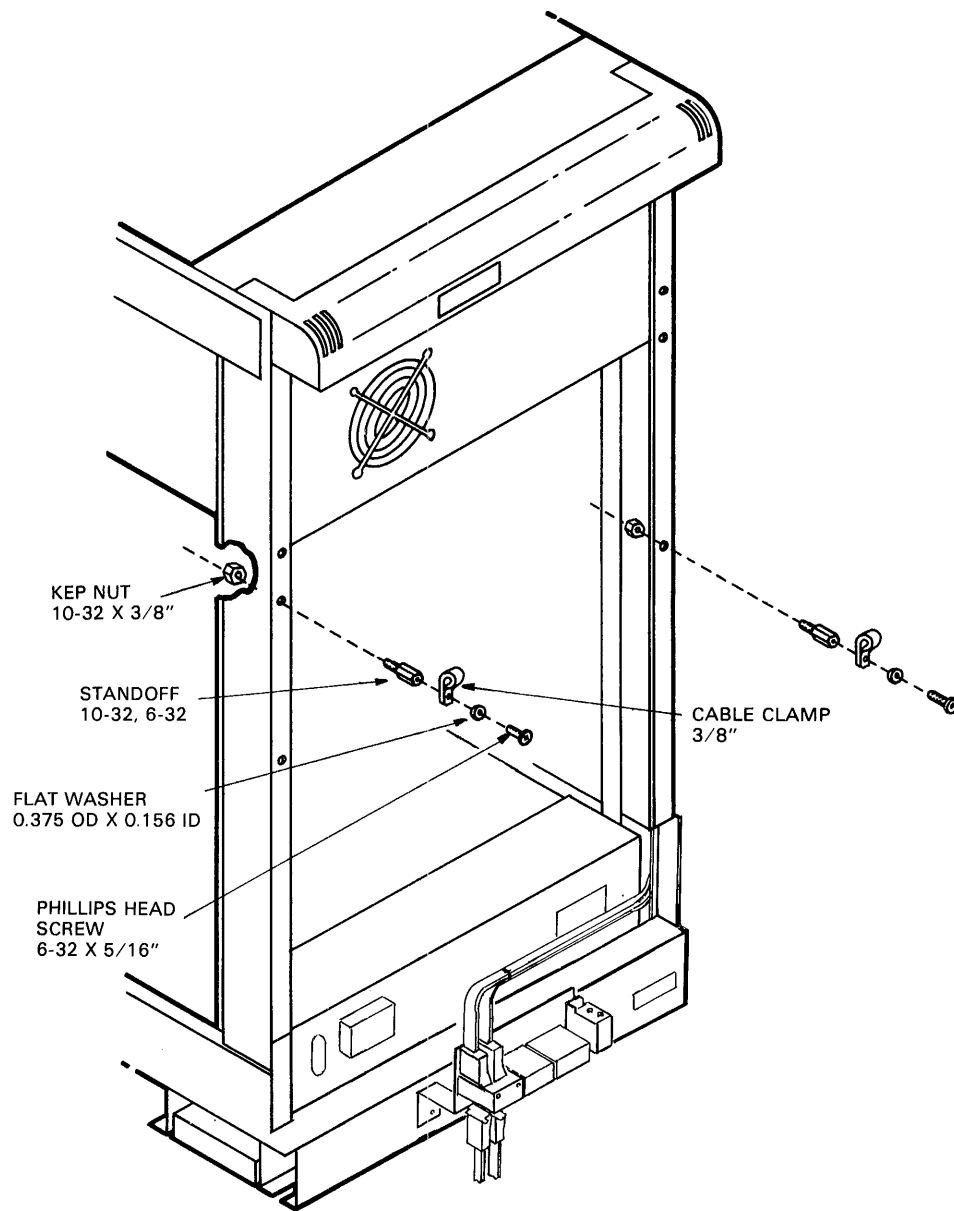
CZ-0757

Figure 2-42 Power Controller AC Receptacles

2.4.11 Route and Clamp the Cables

The cables from the add-on drives must now be routed and clamped to allow the drive to be extended on the slide rails. Route and clamp the cables as follows.

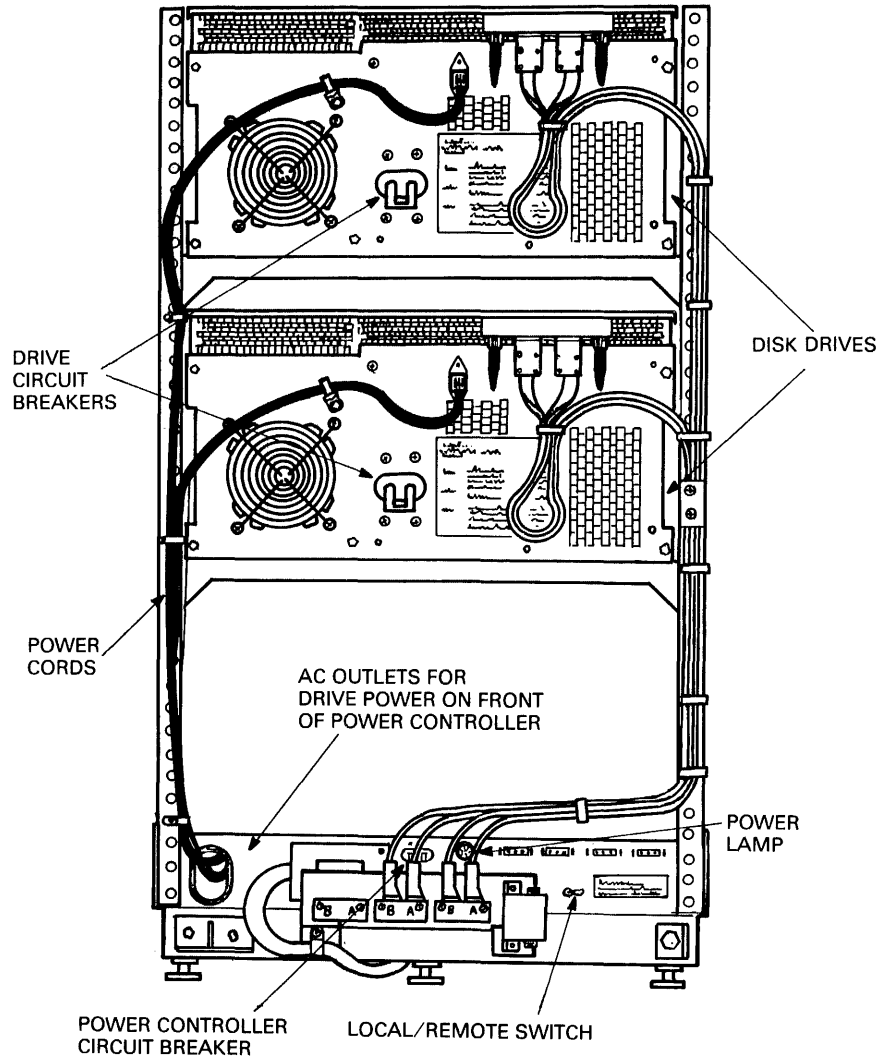
1. Mount the spacers and cable clamps into the back vertical uprights as shown in Figure 2-43. If this is the first add-on drive (center bay), mount the cable clamps in hole 44 of the left and right vertical uprights. If this is the second add-on drive (bottom bay), mount the cable clamps in mounting hole 23 of the left and right vertical uprights.



CZ-0771

Figure 2-43 Connecting Cable Clamps to Uprights

2. Use the 15 cable ties provided with each add-on to route and tie the cables where indicated in Figure 2-44. Three cable ties are used on the ac power cord and seven ties are used on the SDI and drive sequence cables.
3. Tie wrap the cables to the clamp mounted previously on the back of the chassis slides.
4. Form a service loop approximately eight inches in diameter in the cables as shown in Figure 2-44. Fasten the output of the service loop with the cable clamps installed on the vertical uprights in Step 1 above.
5. Tie wrap the cables at the bottom of the cabinet to the cable clamp at mounting hole 14.



CZ-0766

Figure 2-44 Cable Routing and Clamping

2.5 RA81 DRIVE DIAGNOSTIC CHECKOUT

The paragraphs that follow describe how to run the drive-resident diagnostics using the diagnostic terminal. Use this procedure to verify the proper operation of each RA81 Disk Drive after installation.

NOTE

Checkout procedures should be used only by trained maintenance personnel.

2.5.1 The Diagnostic Terminal

A field service diagnostic terminal used to communicate with the RA81 is stocked with every spares kit. The diagnostic terminal utilizes a standard ASCII keyboard and an RS232 interface. Any EIA-compatible terminal set at 300 baud can be used to communicate with the drive to run the diagnostic tests. See Appendix A for instructions on how to use this terminal.

2.5.2 Applying Power to the Drive

Use the following procedure to apply power to the drive.

1. Verify that the ac circuit breakers on the power control unit and each disk drive are in the OFF position. Refer to Figure 2-44.
2. Plug the ac power cord from the drive into the ac power receptacle on the power control unit at the bottom of the cabinet if this is an add-on drive.
3. The LOCAL/REMOTE switch on the power controller must be in the LOCAL position to ensure drive operation since no power sequencing cable is used.
4. Plug the control unit ac power cord into an external ac power source.
5. Place the ac circuit breaker on the power control unit in the ON position.

2.5.3 Checkout

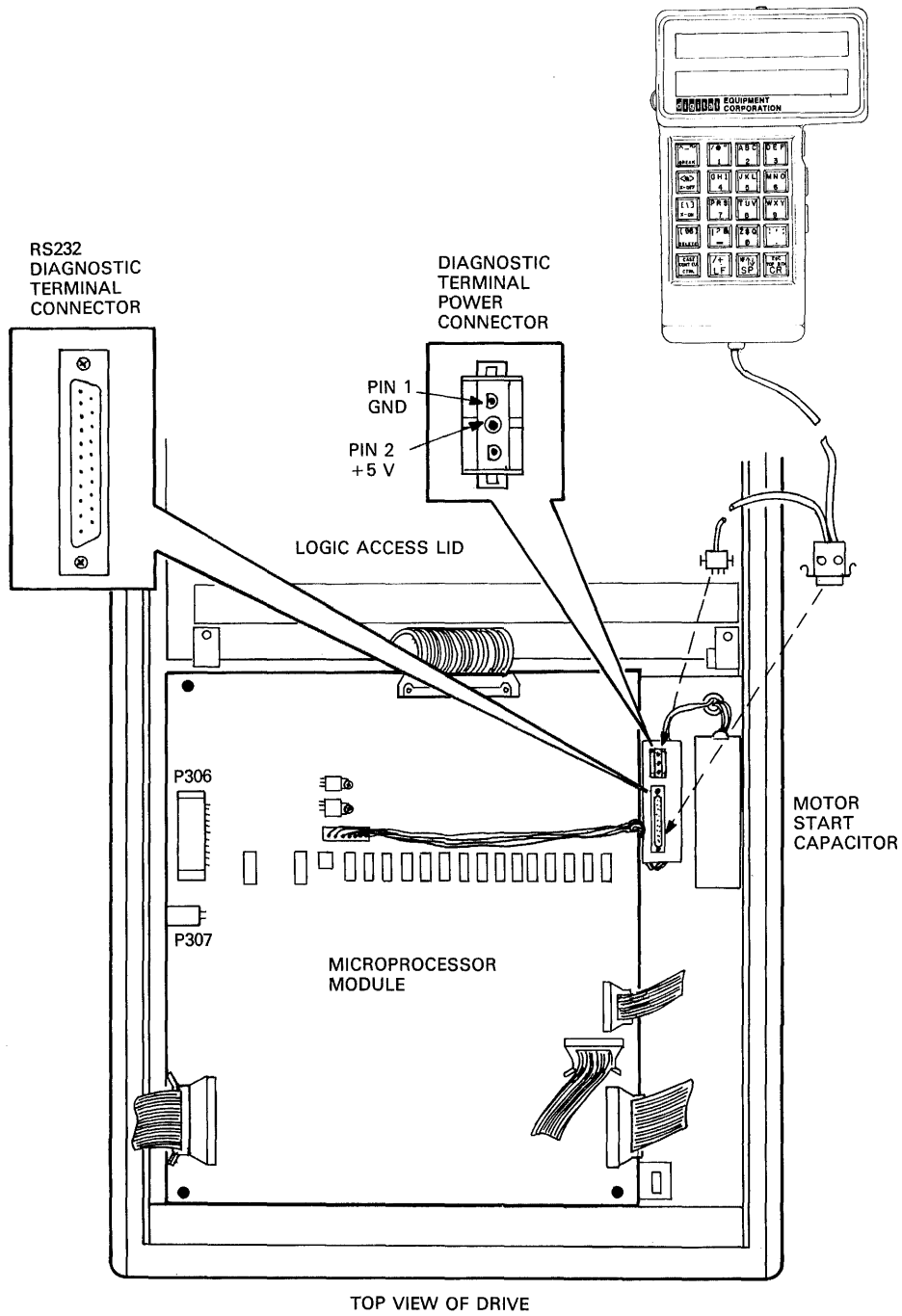
Use the following procedure to verify drive operation.

1. Ensure the drive is in the off-line state by placing both port select switches (A and B) in the OUT position.
2. Place the RUN/STOP switch in the OUT position.
3. Open the logic access cover and raise the servo and personality modules.
4. Make sure that all cable connectors are firmly seated in the mating connectors.
5. Place the ac circuit breaker on the back of the drive in the ON position. Internal drive diagnostics (hardcore test sequence) run automatically when the drive circuit breaker is turned on. All front-panel lights turn on while the drive runs these diagnostics. If the drive successfully passes the hardcore test sequence, the front-panel indicators go off in 3-4 seconds. If an error code is displayed on the front-panel indicators, refer to the fault isolation procedures in the *RA81 Service Manual*.

NOTE

Do not have the diagnostic terminal connected to the drive at this time. Doing so could cause the hardcore tests to fail.

6. The drive idle loop tests start automatically about 30 seconds following the end of the hardcore test sequence. Allow about 30 seconds for the execution of these tests. Observe the microprocessor LEDs for a display of a hexadecimal E7 after a successful completion. Errors are indicated by a fault code in the front-panel lights. Refer to the fault isolation procedures in the *RA81 Service Manual*.
7. Connect the diagnostic terminal to the RS232 port connector in the drive. Refer to Figure 2-45.



CZ-0773

Figure 2-45 Diagnostic Terminal Connections

8. Key in a CTRL C (⌘C) on the terminal keyboard to place the drive in the diagnostic monitor mode. A diagnostic prompt (RA81>) is then displayed by the terminal.

NOTE

The drive idle loop test sequence is repeated continuously until a CTRL C (⌘C) is input. The test will complete the current sequence before displaying the RA81> prompt.

9. Depress the continue (CONT) key on the terminal. This disables the automatic X-On, X-Off feature of the terminal allowing the testing to be continuous.
10. Run the entire drive sequence test with the drive spun down by typing RUN DIAG on the terminal. As the sequence is executed, the following messages are displayed by the terminal:

```
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
      --      --      --
      --      --      --
      --      --      --
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
RA81>
```

The microprocessor LEDs increment and then settle on a hexadecimal E7 while the sequence is being executed. The display of the prompt indicates successful completion of the test sequence.

The following terminal display means that one of the tests has failed. When a test fails, refer to the fault isolation procedures in the *RA81 Disk Drive Service Manual*.

```
%RA81-TEST:DIAG SUBTEST:xx ERROR:xx UNITxxx
%RA81-FRU-xxxx,xxxx,xxxx
```

11. After passing the above test, spin up the drive by pushing the RUN/STOP switch to the IN position. The drive should respond with the following message:

```
FRONT PANEL FUNCTION IN PROGRESS
```

A diagnostic sequence is automatically executed during spin-up.

The microprocessor LEDs remain off while the drive spins up. When it is up to speed, the LEDs display the E7 code and the terminal displays the following:

```

%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
      --      --      --
      --      --      --
      --      --      --
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
RA81>

```

The terminal displays the most likely FRU to replace if an error condition is noted during the above sequence. The diagnostic takes about 45 seconds to complete. Do not proceed to the next step until the prompt is displayed.

12. Type RUN DIAG to initiate the entire drive sequence test with the drive spun up. The terminal should display messages similar to those when the drive was spun down. If an error is indicated during this test, the terminal will display the most likely FRU to replace. The microprocessor LEDs increment and then settle on a hexadecimal E7 while the sequence is being executed (about 7 minutes).
13. When the RA81> prompt is displayed, respond by typing in SET DIAG LOOP=HALT to place the drive in a continuous loop mode, halting only on an error.
14. As soon as the drive returns with the RA81> prompt, respond by typing RUN DIAG. The entire drive sequence diagnostics are once again initiated. Run this test sequence for 25 minutes. If any errors occur during this time, the terminal will indicate the most likely failing FRU. Refer to the *RA81 Service Manual* for the list of FRUs.
15. After the above test has run for 25 minutes without an error, key in CTRL C (↑C) to terminate the loop mode and the test.
16. As soon as the drive returns an RA81> prompt, type EXIT to exit the diagnostic monitor mode.

NOTE

CTRL Z (↑Z) can also be used to exit the monitor mode. One or both of the port select switches can be pushed in to accomplish the same.

17. Push in the desired port select button to place the drive in an available state.
18. Run the main system diagnostics.
19. Upon completion of all tests on each drive, disconnect the diagnostic terminal, fold the servo and personality modules back into their proper positions, and then close and secure the logic access cover on the drive.

CHAPTER 3 OPERATING INSTRUCTIONS

3.1 CONTROL PANEL SWITCHES AND INDICATORS

Each switch on the operator control panel has an indicator light displaying the drive conditions. The RA81 panel has the following:

- RUN/STOP
- FAULT
- UNIT/READY
- WRITE PROT
- A port
- B port

Figure 3-1 shows the arrangement of these controls on the front panel of the drive, and Table 3-1 lists the conditions that control the indicator lights. The paragraphs that follow describe the functions of the switches and indicators in more detail.

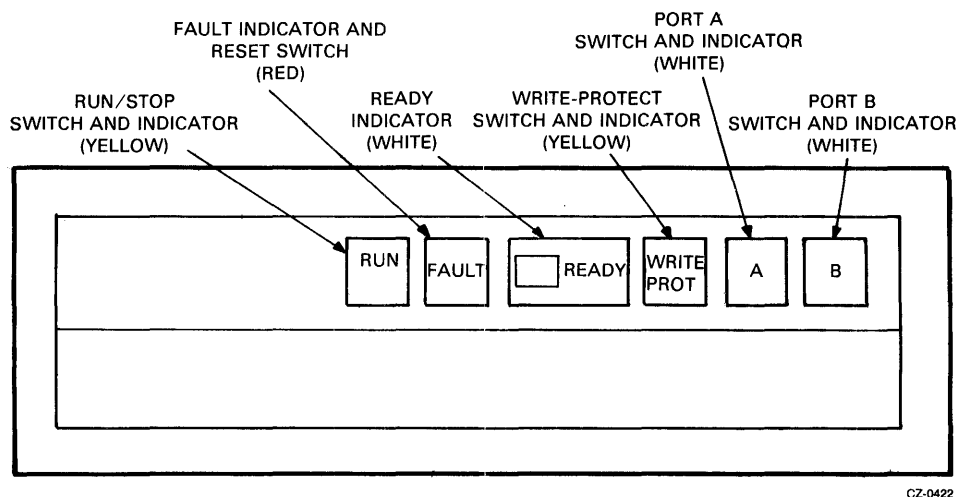


Figure 3-1 Front-Panel Controls and Indicators

Table 3-1 Indicator Conditions

Indicator	Turned On	Turned Off
RUN/STOP	When disk is turning	When disk has stopped
FAULT	When drive detects a serious fault	When no faults are detected
READY	When drive is on-cylinder and ready to process host request.(RUN light must be on)	When drive can not process host requests or is not on cylinder. (See note below)
WRITE PROT	When drive is physically or logically write protected	When drive is write enabled
A	When drive is on-line to controller A	When drive is not on-line to controller A
B	When drive is on-line to controller B	When drive is not on-line to controller B

NOTE

If both port select switches (A and B) are placed in the OUT position while the READY indicator is on, the READY indicator will go off. The drive automatically goes into an internal idle loop test sequence any time both port switches are out. During this time, the drive is not ready and the indicator will go off while this self test is being executed.

3.1.1 RUN/STOP Switch and Indicator

The RUN/STOP switch is a double-action push button. In the RUN (button in) position, the switch requests a drive spin-up and permits initialization of the drive for operation. In the STOP (button out) position, the heads are moved off of the data bands and the spindle motor is stopped.

If the drive is on-line and operating when the switch is placed in the STOP position, the drive will complete all outstanding write operations commanded by the controller before spinning down.

The RUN/STOP indicator light always reflects the state of the drive spindle. The indicator is on while the spindle is turning and off when the spindle has stopped.

If the RUN/STOP switch is in the RUN position on power up, spin-up will occur by the controller or by manually toggling the RUN/STOP switch.

NOTE

A minimum three-minute delay is recommended between each start and restart to prevent opening the thermal circuit breaker associated with the spindle motor.

3.1.2 FAULT Switch and Indicator

The FAULT light indicates an error condition within the drive, and the FAULT reset switch is used to correct errors.

When the disk drive detects an error, the FAULT light is turned on. The drive stays in its current operating state until the condition is corrected. Some faults are corrected automatically and the light will go off. If the fault condition is not corrected automatically, the light will stay on and the FAULT button will have to be pushed. If a fault occurs during a spin-up try, the spin-up will be aborted.

The FAULT button is a momentary contact switch. When pushed the first time, the switch causes the drive to enter an off-line state (relative to the controller) and to assume control of all front-panel indicator lights in order to display a blinking error code. Refer to Table 3-2 for identification of faults and indicator light combinations. The drive stays off-line as long as the fault code is being displayed. When the FAULT switch is pushed the second time, the drive tries to clear the error condition, stores the error code, enters the available operating state, and returns the front-panel indicators to their normal service. Up to 16 error codes can be stored for later use in troubleshooting the drive.

Table 3-2 Drive Front-Panel Fault Identification Codes

FAULT CONDITION	RUN/ STOP	FAULT	RDY	WRITE PROT	A	B
Spin error		on				on
Microprocessor fault		on			on	
SDI error		on			on	on
Master/slave error		on		on		
Servo fine positioning error		on		on		on
Servo coarse positioning error		on		on	on	
Spindle motor interlock error		on		on	on	on
Servo or HDA overtemp error		on	on			

Table 3-2 Drive Front-Panel Fault Identification Codes (Cont)

FAULT CONDITION	RUN/ STOP	FAULT	RDY	WRITE PROT	A	B
R/W unsafe error		on	on			on
R/W command error		on	on		on	
Servo/HDA interlock error		on	on		on	on
Servo/microprocessor interlock error		on	on	on		
Read/write microprocessor interlock error		on	on	on		on
Control panel/ microprocessor interlock error		on	on	on	on	
Personality/ microprocessor interlock error		on	on	on	on	on
Index error	on	on				
Write and bad embedded data	on	on				on
Drive disabled by DD bit	on	on			on	
Write enable and write protect asserted error	on	on			on	on
Servo diagnostic test error	on	on		on		
R/W diagnostic test error	on	on		on		on
Diagnostic idle loop test error	on	on		on	on	
DC low	on		on	on	on	on
Microprocessor hardcore test error	on	on	on	on	on	on

3.1.3 UNIT/READY

The READY indicator is preceded by a successful (fault-free) spin-up sequence and indicates that the drive is in a read/write ready condition. The READY indicator will only come on when the RUN/STOP switch is in the RUN position and the RUN light is on. The READY indicator goes off during seek operations.

The numbered switch cover over the READY indicator light is also a logic plug which distinguishes one drive from another in multi-drive arrangements. The switch cover has a unique cam-coded configuration that corresponds to the drive unit number. Refer to Paragraph 2.3.3 for details on how to program the logic plug. The cam-coded switch sets up a unit code corresponding to the drive number when plugged into the mating cam-encoded switch located behind the READY indicator light. Refer to Figure 3-2. Drive selection is accomplished when the address on the drive select lines matches the code established by the switch cover.

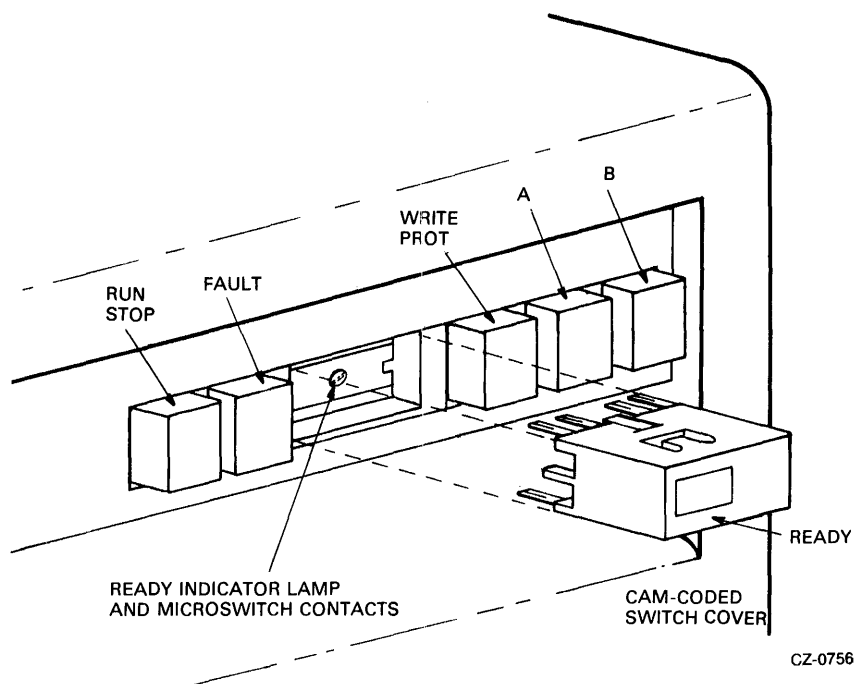


Figure 3-2 Cam-Coded Switch Cover

3.1.4 WRITE PROT

The WRITE PROT switch is a double-action push button with a built-in indicator light. Pushing in on this switch places the drive in the write protect mode and turns on the indicator light. The write circuits of the drive are disabled in this mode.

Releasing the push button enables the write circuits and turns off the WRITE PROT indicator light. When the disk is not read/write ready, it is always write protected.

3.1.5 A and B Port Select Switches

The RA81 Disk Drive has two port select push button switches. These double-action switches (A and B) have built-in lights that indicate the port through which the drive is being accessed. If the drive is equipped with dual-port abilities, any one of three modes can be selected with the A and B switches.

- Port A operation only
- Port B operation only
- Port A/B (programmable) operation

When the Port A button is pushed in and the Port B button is out, only Port A can be accessed by the controller. During the opposite condition, only Port B can be accessed. However, when both push buttons are in at the same time, either Port A or Port B can be accessed by the controller. When either or both buttons are out, the drive is off-line to the port or ports indicated.

The drive will indicate that it is on-line to controller A by lighting the A switch, on-line to controller B by lighting the B switch, or not on-line to either controller by leaving both lights off. During normal operation, the indicator lights will never be on at the same time. The on/off conditions of the port indicator lights do not always follow changes in switch positions immediately. For example, if the drive is on-line to controller A, the indicator light for A will be on. If the switches are then reset for access by controller B, the A indicator will stay on until the drive is actually on-line to controller B. Then and only then will the indicator lights change state.

3.2 CIRCUIT BREAKERS

Each disk drive has a circuit breaker on the back panel as well as a breaker on the back of the power controller in the bottom of the cabinet. Access to these breakers is through the back door of the cabinet. The breakers on the drive control the application of ac power to the drive dc power supply, the cooling fans, and the spindle motor. This breaker must be on before the drive will operate.

The power controller breaker regulates the application of ac power to all assemblies within the RA81 cabinet and must be turned on before the drive breaker can be effective.

3.3 DRIVE OPERATION

3.3.1 Spin-Up

Push in the RUN/STOP button on the drive front panel to spin-up the drive. The RUN indicator will light immediately and the READY indicator will come on as soon as the drive has completed the spin-up cycle.

3.3.2 Spin-Down

Release the RUN/STOP button (out position) on the drive front panel to stop the drive. The READY indicator will go off immediately and the RUN indicator will go off as soon as disk rotation stops.

3.3.3 Removing RA81 Power

Do a spin-down as described above. After the RUN indicator has gone off, turn the drive breaker on the back panel off and disconnect the cord going to the power controller. This will remove all power to the drive.

3.4 CUSTOMER CARE

The air filter in the logic chassis assembly should be inspected and cleaned every six months.

3.4.1 Air-Filter Removal

To remove the air filter, proceed as follows:

1. Pull down the access door on the front bezel of the drive. Refer to Figure 3-3.

NOTE

The hinge mechanism can be damaged if tools are placed on the open access door or if it is leaned on.

2. Take hold of the filter material and pull outward until it is free of the bezel.

3.4.2 Cleaning

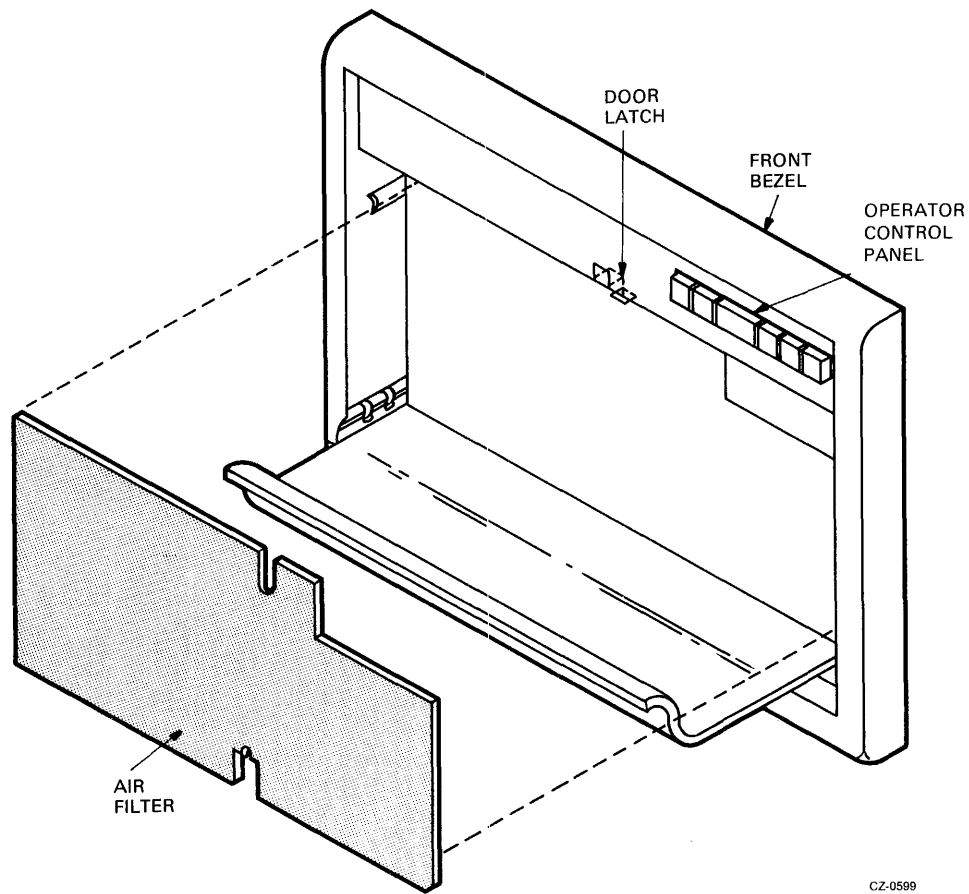
1. Wash the foam air filter in warm water using a mild detergent.
2. Rinse the filter material with clear water and then allow to dry.

3.4.3 Replacement

1. Slide the filter into place inside the bezel.
2. Close the access door.

NOTE

Replace the filter by ordering DIGITAL part no. 7422816-00.



CZ-0599

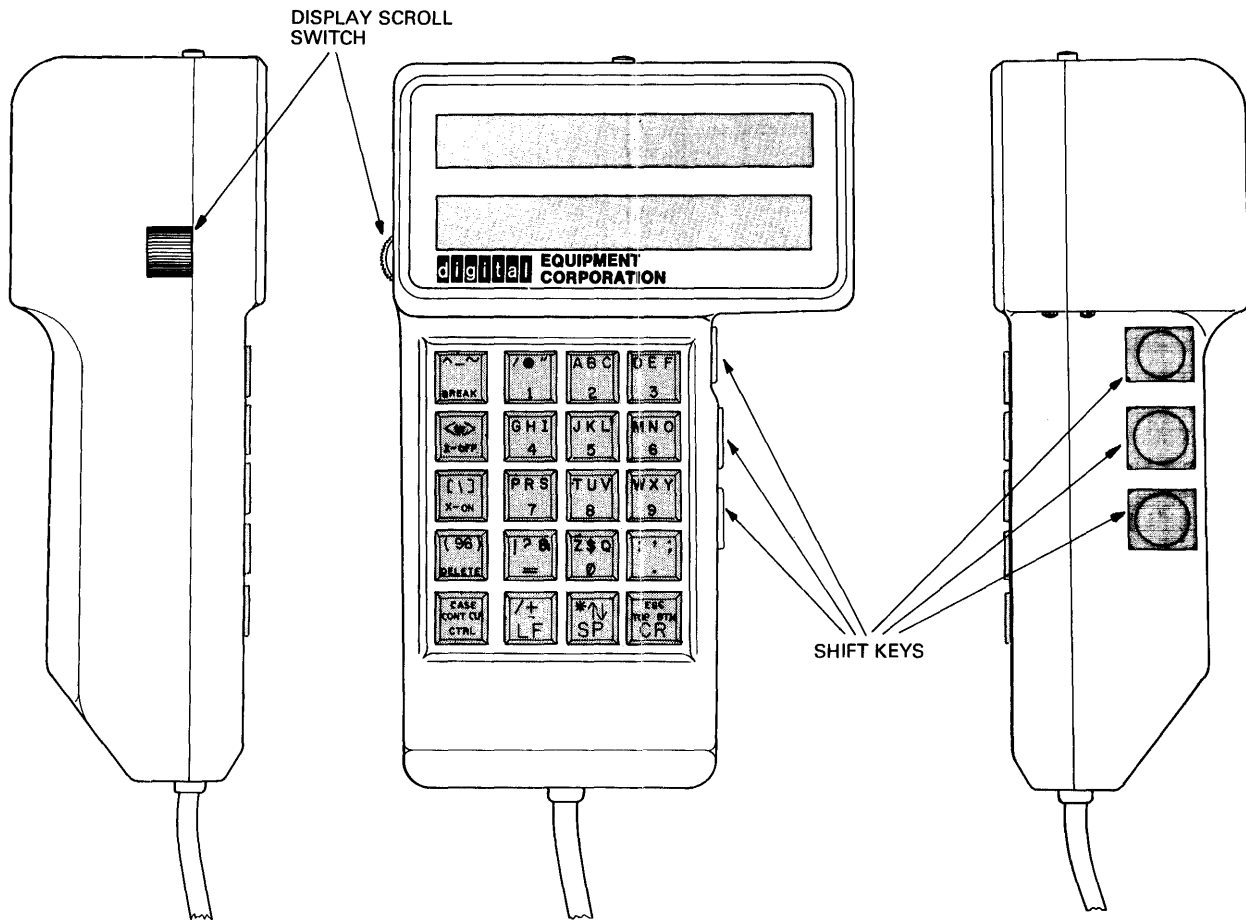
Figure 3-3 Air-Filter Removal

APPENDIX A DIAGNOSTIC TERMINAL INSTRUCTIONS

This appendix provides instructions on how to use the field service diagnostic terminal.

A.1 INTRODUCTION

Refer to Figure A-1. The terminal contains a two-level LED display and a keyboard. The display holds a maximum of 32 characters at a time while an internal buffer stores 2K characters for the display. The keyboard contains a standard ASCII set of alphanumeric characters. The larger character on each keybutton is the default character displayed when the button is pushed.



CZ-0768

Figure A-1 Field Service Diagnostic Terminal

A.2 SHIFT KEYS

To obtain one of the other three possible characters shown on any keybutton, one of the three shift keys on the right side of the terminal must be used. When the upper shift key on the terminal is pushed simultaneous with a keyboard button, the left-most character is displayed.

As an example, push the middle shift key and the number 5 key. The letter K is displayed. Pushing the lower shift key and the 0 key, results in the letter Q being displayed.

A.3 CONTROL CHARACTERS

A control character (e.g., |C) is obtained by using the CTRL key, the shift keys, and the appropriate letter key. Push the CTRL key. Push one of the shift keys simultaneous with the appropriate letter key.

Example: A |Z is desired. The following steps should be used.

1. Push CTRL key
2. Push the upper shift key on the right-hand side of the drive
3. Simultaneous with step 2, push the number 0 key.

A.4 CONTINUE (CONT) AND CLEAR (CLR) KEYS

The X-On, X-Off feature is enabled when power is applied to the terminal. The CONT key disables the automatic X-On, X-Off feature, while the CLR key re-enables the feature. Keeping this feature in automatic allows the display buffer to fill and then to automatically transmit a signal (X-Off) to the microprocessor. This signal stops all transmission of data to the display buffer until the buffer is unloaded. At this time, the terminal automatically sends an X-On signal to re-enable transmission.

A.5 X-ON, X-OFF KEYS

These keys manually control the display buffer of the terminal. If the display buffer is full, an automatic X-Off signal has stopped all transmission to the buffer. The X-On key is used to reload the buffer with new information even though the buffer has not been read.

The X-Off key may be used to stop the loading of the buffer even though the buffer is not full. For example, the automatic X-On, X-Off feature is disabled by the CONT key and the diagnostics are inputting test messages to the terminal. These messages are being sent at a faster rate than can be read by the human eye. Pushing the X-Off key stops the diagnostic testing (and the messages). This enables the user to read the display and manually scroll through the buffer.

A.6 DELETE KEY

The delete key is used to correct mistakes in keyboard entries. Once a mistake is discovered, the delete may be pushed causing a backslash (\) to be displayed with the last character input. The new character may now be keyed in. For example, if RUN DIAF was keyed in, the delete key could be used as follows.

```
RUN DIAF\F\G
```

The command RUN DIAG is now input correctly.

A.7 DISPLAY SCROLL SWITCH

The display scroll switch is located on the left side of the terminal. Its function is to back up or advance the display within the 2K display buffer. Long messages cannot be read all at once on a 32 character display. The display scroll switch is moved in the upward direction to scroll the display forward through the buffer. The display scroll switch is moved downward to scroll the display backward through the buffer.

A.8 BREAK KEY

The break key transmits a break character when pushed. Its purpose is the same as a VT100 break key. It is not used in RA81 diagnostic operation.

A.9 CR KEY (CARRIAGE RETURN)

This key is pushed after typing a command string. Its effect is that of an enter key on a computer.

A.10 ESCAPE KEY

This key transmits an escape character when pushed. Its purpose is the same as a VT100 escape key. It is not used in RA81 diagnostic operation.

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

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

What features are most useful? _____

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

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

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

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

Name _____	Street _____
Title _____	City _____
Company _____	State/Country _____
Department _____	Zip _____

Additional copies of this document are available from:

Digital Equipment Corporation
444 Whitney Street
Northboro, Ma 01532
Attention: Communications Services (NR2/M15)
Customer Services Section

Order No. EK-ORA81-UG-001

Fold Here-----

----- DO NOT TEAR - FOLD HERE AND TAPE -----

digital



No Postage
Necessary
if Mailed in the
United States

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 33 MAYNARD, MA.

POSTAGE WILL BE PAID BY ADDRESSEE

**Digital Equipment Corporation
Educational Services/Quality Assurance
12 Crosby Drive, BU/E08
Bedford, MA 01730**



