

RA60 Disk Drive User Guide

Prepared by Educational Services
of
Digital Equipment Corporation

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CONTENTS

	Page
CHAPTER 1 INTRODUCTION	
1.1 RA60 DISK DRIVE DESCRIPTION	1-1
1.2 RA60 DISK DRIVE FEATURES	1-1
1.3 RA60 OPTIONS	1-1
1.4 RA60 SPECIFICATIONS	1-4
1.5 RA60 RELATED DOCUMENTATION	1-7
CHAPTER 2 INSTALLATION	
2.1 INTRODUCTION	2-1
2.2 SITE PREPARATION AND PLANNING	2-1
2.2.1 Cleanliness	2-1
2.2.2 Floor Loading	2-1
2.2.3 Heat Dissipation	2-1
2.2.4 Temperature and Humidity	2-1
2.3 EQUIPMENT UNPACKING AND EXTERNAL INSPECTION	2-1
2.4 RA60 INSTALLATION CHECKLIST	2-4
2.5 JOINING CABINETS	2-4
2.6 INSTALLING LEVELER FEET	2-10
2.7 INSTALLING SDI CABLES	2-14
2.7.1 Installing the External SDI Cables	2-14
2.7.2 Internal SDI Cable Installations	2-15
2.8 RA60 SAFETY LABELS	2-16
2.8.1 Safety Label Information	2-16
2.9 SETTING THE VOLTAGE AND FREQUENCY	2-17
2.10 REMOVING THE HEAD LOCKING PIN	2-19
2.11 PROGRAMMING THE UNIT ADDRESS PLUG	2-20
2.12 REMOVING THE RETAINING BRACKET SCREW	2-21
2.13 PLUGGING IN THE POWER CABLE	2-21
2.14 INSTALLING ADD-ON DRIVES	2-22
2.14.1 Removing the Front Filler Panel	2-22
2.14.2 Installing the Slide Assembly	2-23
2.14.3 Mounting the RA60 Drive on the Slides	2-25
2.14.4 Extending the Drive on the Slide	2-26
2.14.5 Setting the Drive AC Voltage and Frequency	2-28
2.14.6 Removing the Head Locking Pin	2-28
2.14.7 Programming the Drive Unit Address Plug	2-28
2.15 RA60 CHECKOUT PROCEDURE	2-28
2.15.1 Applying Power	2-28
2.15.2 Drive Checkout Procedure	2-28
2.15.3 Internal Diagnostics	2-28
2.15.4 Subsystem Diagnostics	2-29

	Page
CHAPTER 3 OPERATING INSTRUCTIONS	
3.1 INTRODUCTION	3-1
3.2 OPERATOR CONTROLS AND INDICATORS	3-1
3.2.1 RUN/STOP Switch and Indicator	3-2
3.2.2 FAULT Switch and Indicator	3-2
3.2.3 UNIT/READY Plug and Indicator	3-4
3.2.4 WRITE PROTECT Switch and Indicator	3-4
3.2.5 A and B Port Select Switches	3-4
3.3 POWER ON AND POWER OFF	3-5
3.4 DISK PACK LOADING AND UNLOADING	3-5
3.4.1 Loading the Disk Pack	3-6
3.4.2 Unloading the Disk Pack	3-8
 FIGURES	
1-1 RUA60 Disk Subsystem Cabinet	1-2
2-1 Unpacking the Disk Subsystem	2-2
2-2 Ramp Construction	2-3
2-3 Side Panels and Joiner Panels	2-5
2-4 Opening the Back Door	2-5
2-5 Back Door and End Panel Lock Removal	2-6
2-6 Side Panel and Bottom Key Button Removal	2-7
2-7 Joining the Cabinets	2-8
2-8 Bottom Trim Panel Removal	2-9
2-9 Installing the Front Locking Bracket	2-10
2-10 Installing the Back Locking Brackets	2-11
2-11 Shipping Bracket Removal	2-11
2-12 Leveler Feet Installation	2-12
2-13 Leveler Feet Adjustments	2-13
2-14 External SDI Cable Installation	2-14
2-15 Internal SDI Cable Installation	2-15
2-16 RA60 Safety Labels	2-16
2-17 Removing the Rear Cover and Shield	2-17
2-18A 120V/60 Hz Voltage/Frequency Configuration	2-18
2-18B 240V/50 Hz Voltage/Frequency Configuration	2-18
2-19 Head Locking Pin Removal	2-19
2-20 Drive Ready Switch and Unit Address Plug	2-20
2-21 Removing the Retaining Bracket Screws	2-21
2-22 Power Controller Plugs and Receptacle	2-22
2-23 Removing Cabinet Filler Panels	2-23
2-24 Mounting Chassis Slide to Front Upright	2-24
2-25 Mounting Chassis Slide to Back Upright	2-24
2-26 Extending Cabinet Stabilizer Foot	2-25
2-27 Mounting the Chassis Slides	2-26
2-28 Extending the Drive	2-27
3-1 Front Panel Controls and Indicators	3-1
3-2 Drive Circuit Breakers	3-5
3-3 Gaining Access to the Disk Spindle	3-6
3-4 RA60-P Disk Pack Storage Canister	3-7

TABLES

1-1	RA60 Options	1-3
1-2	RA60 Disk Drive Performance Specifications	1-4
1-3	RA60 Physical Specifications	1-5
1-4	RA60 Environmental Limits Specifications	1-6
1-5	RA60 AC Power Specifications	1-6
3-1	Indicator Conditions	3-2
3-2	Fault Identification Codes	3-3

CHAPTER 1 INTRODUCTION

1.1 RA60 DISK DRIVE DESCRIPTION

The RA60 Disk Drive is a removable-media drive with a storage capacity of 205 million bytes of 16-bit word data or 208 million bytes of 18-bit word data. The drive operates on the Standard Disk Interface (SDI) and may be used on any SDI disk controller.

The disk drive is sold with slides and is rack mountable. Up to three disk drives may be mounted into each cabinet, as shown in Figure 1-1.

The RA60 uses a disk pack that comes factory preformatted in either 16- or 18-bit word lengths. Their part numbers are RA60-P and RA60-PE, respectively.

Note

The RA60 disk pack formatting information is protected under the copyright laws.

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1.2 RA60 DISK DRIVE FEATURES

The RA60 has the following features:

- A corrected data error rate of 1 bit in 10^{11}
- High data transmission speeds to over 15 megabits per second
- A universal power supply for 120/240 volt, 50/60 Hz operation
- Drive resident self-diagnostics on power up
- An EIA port for field service handheld terminals
- Remote error diagnosis capability
- Front panel generic fault code display

1.3 RA60 OPTIONS

An RA60 may be purchased separately as an add-on, rack mountable drive with slides and cables. It may also be purchased as a disk subsystem in combination with an SDI disk controller. The options currently available are listed in Table 1-1.



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Figure 1-1 RUA60 Disk Subsystem Cabinet

Table 1-1 RA60 Options

Options	Description
Add-on Drives	
RA60-AA	One add-on RA60 Disk Drive (50/60Hz 120/240V) with an RA60P disk pack formatted for 16 bit words.
RA60-AE	One add-on RA60 Disk Drive (50/60Hz 120/240V) with an RA60PE disk pack formatted for 18 bit words.
Cabinet Mounted Drives	
RA60-CA	One cabinet mounted RA60-AA Disk Drive (60Hz, 120V, 16 bit format)
RA60-CD	One cabinet mounted RA60-AA Disk Drive (50Hz, 240V, 16 bit format)
RA60-CE	One cabinet mounted RA60-AE Disk Drive (60HZ, 120V, 18 bit format)
RA60-CJ	One cabinet mounted RA60-AE Disk Drive (50Hz, 240V, 18 bit format)
UDA50 Disk Subsystems	
RUA60-CA	One RA60-CA and a UDA50 Disk Controller (16 bit format)
RUA60-CD	One RA60-CD and a UDA50 Disk Controller (16 bit format)
RUA60-EA	One RA60-EA and a UDA50 Disk Controller (18 bit format)
RUA60-ED	One RA60-ED and a UDA50 Disk Controller (18 bit format)
Add-on drives with add-on UDA50	
RUA60-AA	One RA60-AA add-on drive plus a UDA50 Disk Controller
RUA60-AE	One RA60-AE add-on drive plus a UDA50 Disk Controller

1.4 RA60 SPECIFICATIONS

The RA60 specifications are broken down into four categories: performance, physical, environmental, and AC power. These specifications are listed in Tables 1-2, 1-3, 1-4, and 1-5, respectively.

Table 1-2 RA60 Disk Drive Performance Specifications

Characteristics	Specifications
Data storage capacity	
in 16 bit word format	205 megabytes
in 18 bit word format	208 megabytes
Head switch latency	
Minimum	10 ms
Maximum	14 ms
Seek latency	
One cylinder seek latency	6.67 ms
Maximum seek latency	70.00 ms
Average seek latency	41.67 ms
Rotational latency	
Disk speed	3600 RPM \pm 5%
Maximum latency	16.66 ms
Average latency	8.33 ms
Maximum start time	35 sec
Data transfer rate	
Bit rate	15.84 megabits/sec \pm 5%
Bit cell period	63.13 nsec \pm 5%
Unrecoverable data error rate	1 in 10**12 bits
Recoverable data error rate	1 in 10**7 bits
Corrected data error rate	1 in 10**11 bits
Recoverable seek error rate	1 misseek in 10**6

Table 1-3 RA60 Physical Specifications

Characteristics		Specifications (RA60 Drive Only)
Height		26.52 centimeters 10.44 inches
Width		48.26 centimeters 19 inches
Depth		85.09 centimeters 33.75 inches
Weight (drive only)		68.95 kilograms 152 pounds
Height		106.30 centimeters 41.80 inches
Width		54.20 centimeters 21.30 inches
Depth		14.20 centimeters 36.00 inches
Weight (cabinet only)		90.70 kilograms 200 pounds
Shipping weight one drive in cabinet		176.42 kilograms 389 pounds
Minimum door entrance width required for shipping crate		76.2 centimeters 30 inches
Minimum service clearance required		
Front		91.4 centimeters 36 inches
Rear		91.4 centimeters 36 inches
Left side		No side access needed
Right side		No side access needed

Table 1-4 RA60 Environmental Limits Specification

Characteristic	Specification
Operating ranges:	
Temperature	16°C (50°F) to 40°C (104°F)
Temperature rate of change	20°C/hour (36°F/hour)
Relative humidity	8% to 80% with a maximum wet bulb temperature of 26°C (78°F) and a minimum dew point of 2°C (36°F)
Altitude	2438 meters 8000 feet
Air quality requirement	Less than 5 million particles of 0.5 micron per cubic foot of air
Nonoperating ranges: shipping and storage	
Temperature	-40°C (-40°F) to +66°C (+150°F)
Relative humidity	8% to 80% with no condensation
Altitude	9175 meters 30,000 feet

Table 1-5 RA60 AC Power Specifications

Characteristic	Specification
Voltage/Current	
RA60-CA/CE	Nominal: 120 volts ac/7.5 amperes
RA60-CD/CJ	Nominal: 240 volts ac/3.75 amperes
Voltage range/Frequency range	
RA60-CA/CE	90-128 volts ac/60 \pm 1 hz
RA60-CD/CJ	180-256 volts ac/50 \pm 1 hz

Table 1-5 RA60 AC Power Specifications Cont'd

Characteristic	Specification
Input power	
RA60-CA/CE	600 watts typical/800 watts worst case
RA60-CD/CJ	600 watts typical/800 watts worst case
Power factor	Greater than 0.75
Maximum start current	190 amps RMS at 120 VAC for ½ ac cycle 95 amps RMS at 240 VAC for ½ ac cycle

1.5 RA60 RELATED DOCUMENTATION

Digital customers may order the following list of RA60 related manuals from the Accessories and Supplies Group.

- *RA60 USER GUIDE* (EK-ORA60-UG)
- *RA60 SERVICE MANUAL* (EK-ORA60-SV)
- *RA60 FIELD MAINTENANCE PRINT SET* (MP-01421)
- *RA60 ILLUSTRATED PARTS BREAKDOWN* (EK-ORA60-IP)
- *RA60 MAINTENANCE GUIDE* (AA-M880A-TC)
- *MAINTENANCE GUIDE LOOSELEAF BINDER* (AV-L980A-TK)
- *UDA50 MAINTENANCE DOCUMENTATION KIT* (QP904-GZ)*

* 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.

Within the United States, DIGITAL customers may order the above manuals from the Accessories and Supplies Group over a 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 & Supplies Group
Cotton Road
Nashua, New Hampshire 03060
Tel: 603-884-5111

Central Region

Accessories & Supplies Group
1050 E. Remington Road
Schaumburg, Illinois 60195
Tel: 312-640-5612

Western Region

Accessories & Supplies Group
Moffett Park Warehouse
632 East Caribbean Drive
Sunnyvale, California 94086
Tel: 408-734-9125

Outside the United States, consult local DIGITAL offices.

Internal Digital Equipment Corporation customers can order the *RA60 User Guide*, the *RA60 Service Manual*, the *RA60 Field Maintenance Print Set*, and the *RA60 Illustrated Parts Breakdown* directly from Printing and Circulation Services, 444 Whitney Street, Northboro, Massachusetts 01532.

The *RA60 Maintenance Guide*, the *Maintenance Guide Looseleaf Binder*, and the *UDA50 Maintenance Documentation Kit*, can be ordered from the Software Distribution Center, Order Administration/Processing, 20 Forbes Road, Northboro, Massachusetts 01532.

CHAPTER 2 INSTALLATION

2.1 INTRODUCTION

This chapter describes the procedures necessary for RA60 installations. It includes safety precautions, site preparation and planning, joining disk cabinets, cabling, and checkout.

Warning

Hazardous voltages are present inside this equipment. Installation and service should be performed by a qualified and trained service person. Bodily injury or equipment damage may result from incorrect servicing.

2.2 SITE PREPARATION AND PLANNING

Some site preparation and planning is necessary before installing an RA60 disk subsystem. The paragraphs that follow discuss some of the things to consider.

2.2.1 Cleanliness

Cleanliness is always an important consideration when working with disk drives. The close tolerances between the read/write heads and the media make disk drives very sensitive to dust or other particulates. The RA60 is designed to operate in an office or light industrial environment. The air particulates should not exceed 5 million particles of 0.05 micron per cubic foot of air.

2.2.2 Floor Loading

The weight of one RA60 in a cabinet is 159.64 kg (352 lbs). The weight of each additional disk drive is approximately 68.95 kg (152 lbs). This 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.

2.2.3 Heat Dissipation

The heat dissipation of each RA60 is approximately 2730 Btu/hour. To calculate the total heat dissipation of each drive cabinet, multiply the above Btu/hour by the number of drives it contains.

2.2.4 Temperature and Humidity

The operating temperature range for the RA60 is between 10°C (50°F) and 40°C (104°F). The relative humidity range is between 10% and 90% with a wet bulb temperature of 28°C (82°F).

2.3 EQUIPMENT UNPACKING AND EXTERNAL INSPECTION

Before unpacking a carton, inspect it for external damage. Report any damage to the DIGITAL Field Service or Sales Office and the local carrier. If no external damage exists, the disk drive may be unpacked using the following procedure.

1. Remove the external packing material shown in Figure 2-1.

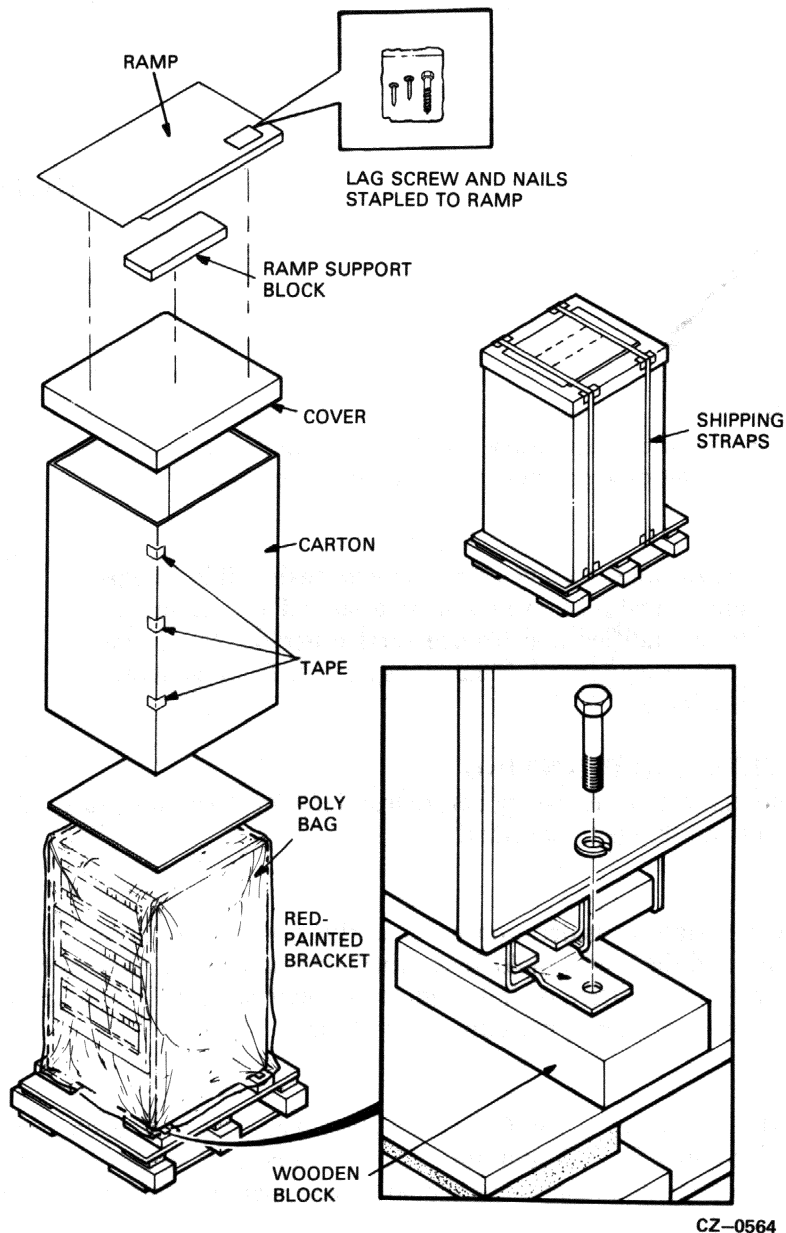
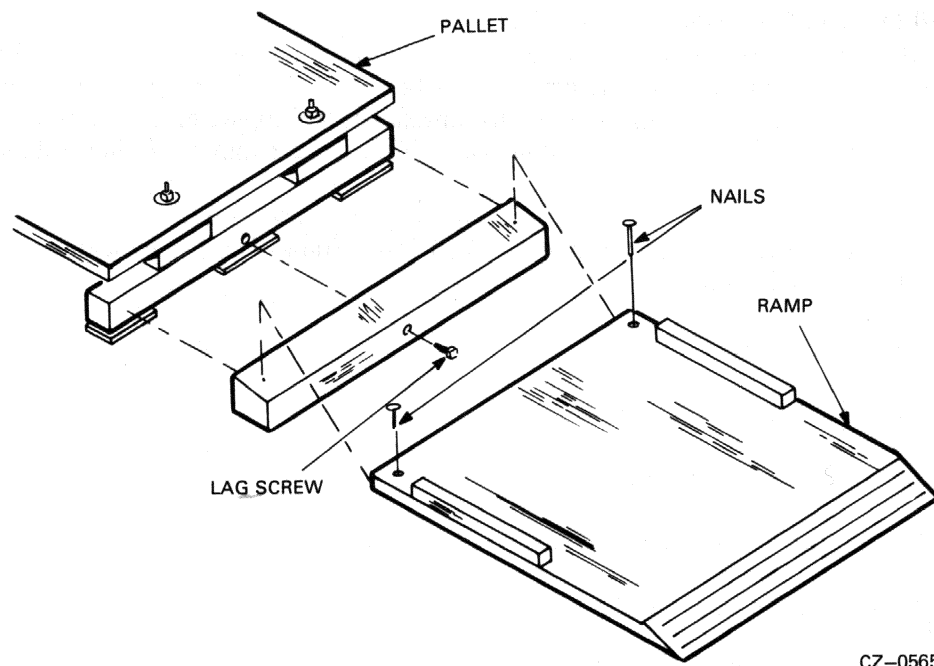


Figure 2-1 Unpacking the Disk Subsystem

2. Remove the four shipping bolts that fasten the drive cabinet to the pallet. See insert in Figure 2-1.
3. Build the ramp to roll the disk cabinet off the pallet. Use the lag screw and nails in the plastic bag stapled to the ramp. Figure 2-2 shows how the ramp is assembled.

Warning

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



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Figure 2-2 Ramp Construction

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

2.4 RA60 INSTALLATION CHECKLIST

The installation procedure for the RA60 requires the installation of leveler feet and SDI cables. The head locking pin must be removed and the drives must be set up for the right voltage and frequency ranges. Also, the drive unit address plug must be programmed, and a shipping retainer bracket must be released. If cabinets are to be joined, this should be done first. If only one cabinet is being installed, go to Paragraph 2.6.

Use the following checklist to perform the RA60 installation. The list indicates the paragraph number where each procedure is described.

- Joining Cabinets (2.5) _____
- Installing the Leveler Feet (2.6) _____
- Installing the SDI Cable (2.7) _____
- Setting the Voltage and Frequency(2.9) _____
- Removing the Locking Pin (2.10) _____
- Programming the Unit Address Plug (2.11) _____
- Removing the Retaining Bracket Screw (2.12) _____
- Plugging in the Power Cable (2.13) _____
- Installing Add-on Drives (2.14) _____
- Performing Drive Checkout Procedures (2.15) _____

2.5 JOINING CABINETS

The H9642 AP/AR (120/240 volt) cabinet will hold up to three disk drives. It comes equipped with two side 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 and no side panels. This expansion cabinet may be joined to the first cabinet by removing one of the side panels on the first cabinet and placing it on the outer side of the expansion cabinet. Figure 2-3 shows the side panel and joiner panel locations.

Use the following procedure to join disk cabinets.

1. Open the back door on the cabinet with the side panels by turning the hex lock counterclockwise. Refer to Figure 2-4.

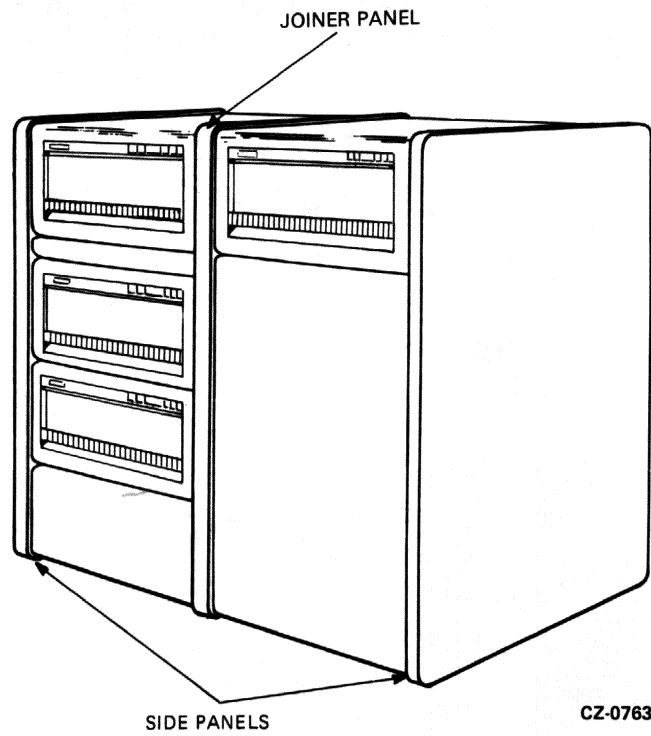


Figure 2-3 Side Panels and Joiner Panels

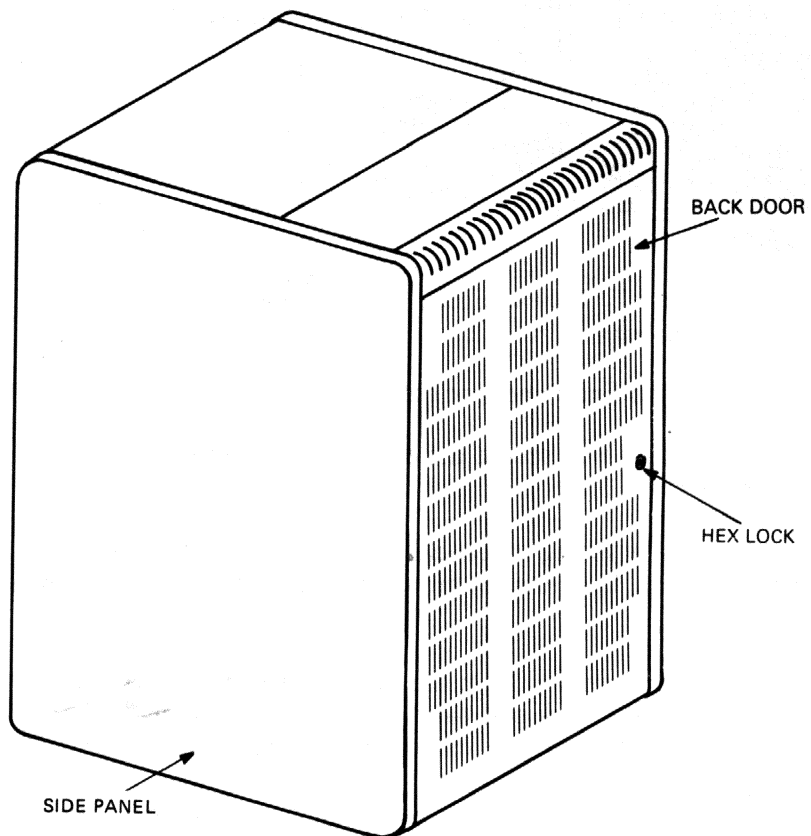


Figure 2-4 Opening the Back Door

2. Remove the back cabinet door by unscrewing the ground wire from the door and then pulling down on the top door latch. The door should now be free to lift off of the bottom end panel lock. Refer to Figure 2-5.

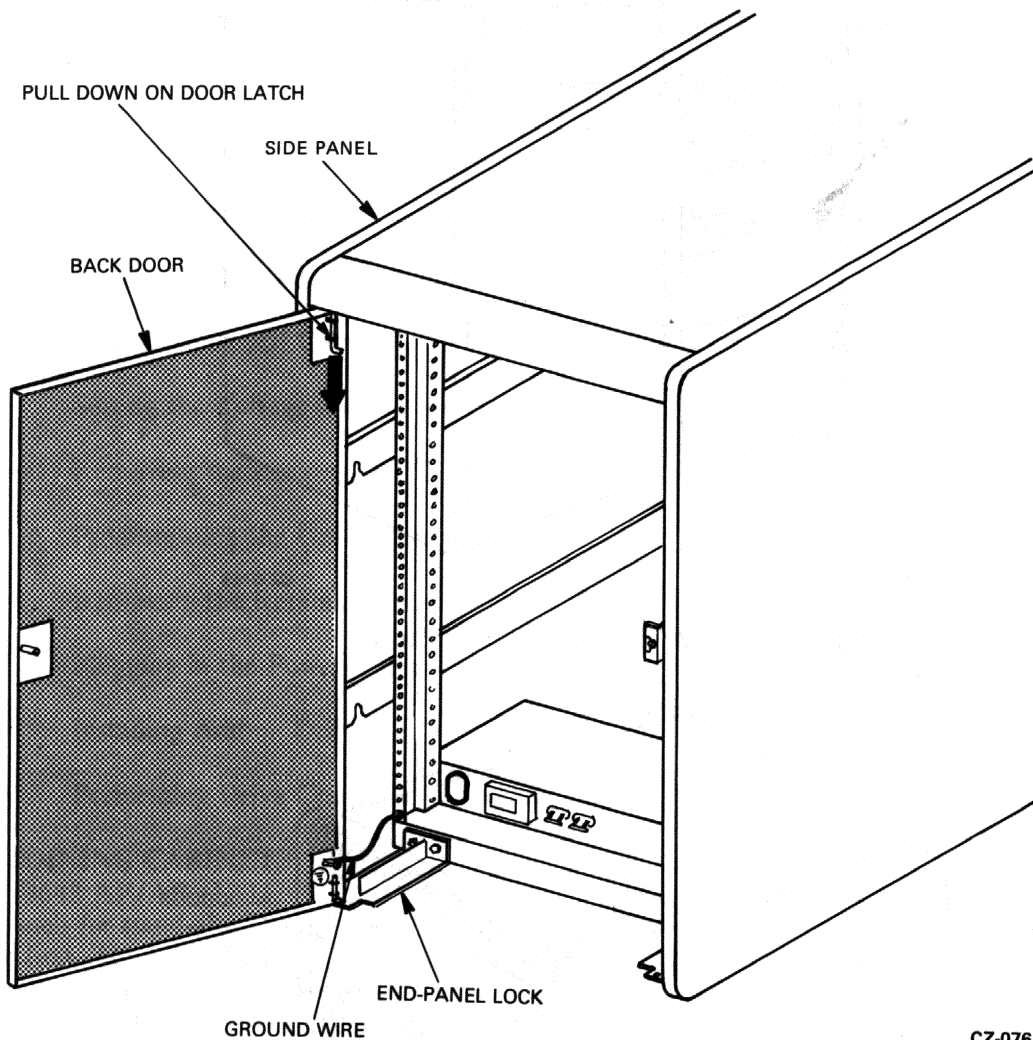


Figure 2-5 Back Door and End Panel Lock Removal

3. Loosen the two hex screws that secure the end panel lock to the base of the disk cabinet. Then lift the end panel lock off. Refer to Figure 2-5.
4. Remove the side panel by lifting it vertically to disengage it from the four key buttons on the side of the cabinet frame. Unscrew the ground wire attached to the side panel. Refer to Figure 2-6.
5. Install the side panel just removed from the first cabinet on the open side of the expansion cabinet. Begin by removing the back end panel lock from the expansion cabinet. Next, attach the ground wire just removed from the first cabinet to the exposed side frame of the expansion cabinet. Attach the other end of the ground wire to the side panel being installed. Then lower the side panel over the keyhole buttons on the cabinet. Secure the side panel by replacing the end panel lock. Refer to Figure 2-6.

6. Remove the two lower key buttons from the open side of first drive cabinet by removing the screws in the center of the key buttons. Refer to Figure 2-6.

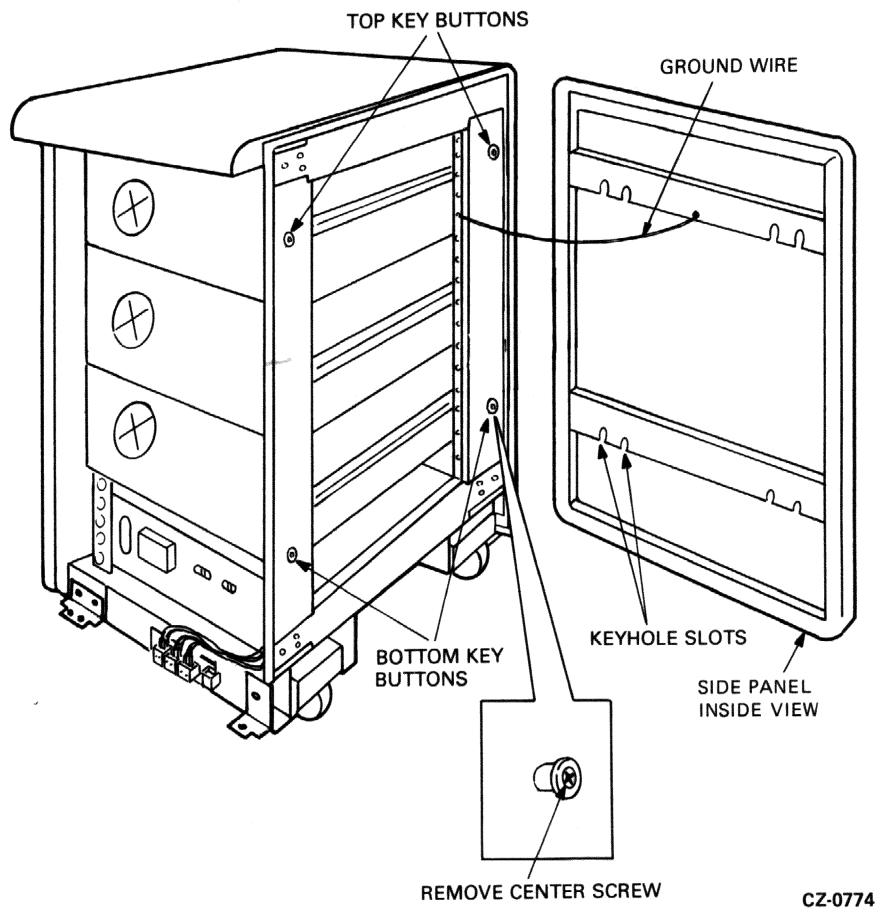
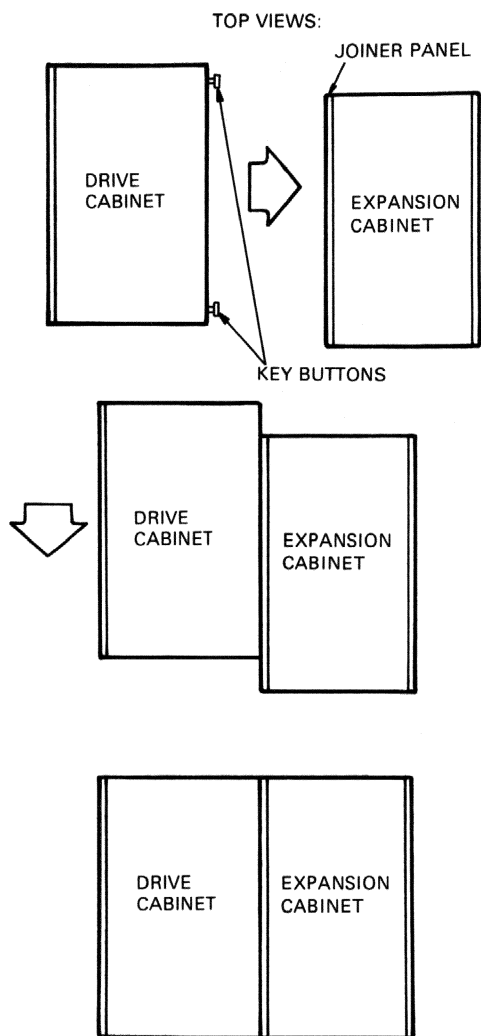


Figure 2-6 Side Panel and Bottom Key Button Removal

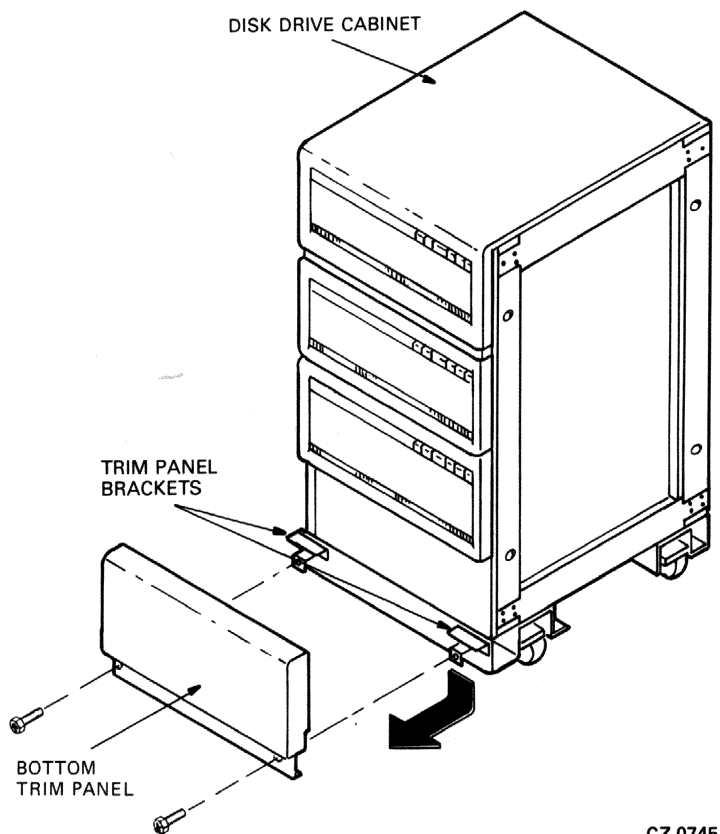
7. Join the two cabinets together as shown in Figure 2-7. Engage the top two key buttons on the first drive cabinet into the keyhole slots on the expansion cabinet joiner panel. Adjust the cabinets until their fronts are flush.



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Figure 2-7 Joining the Cabinets

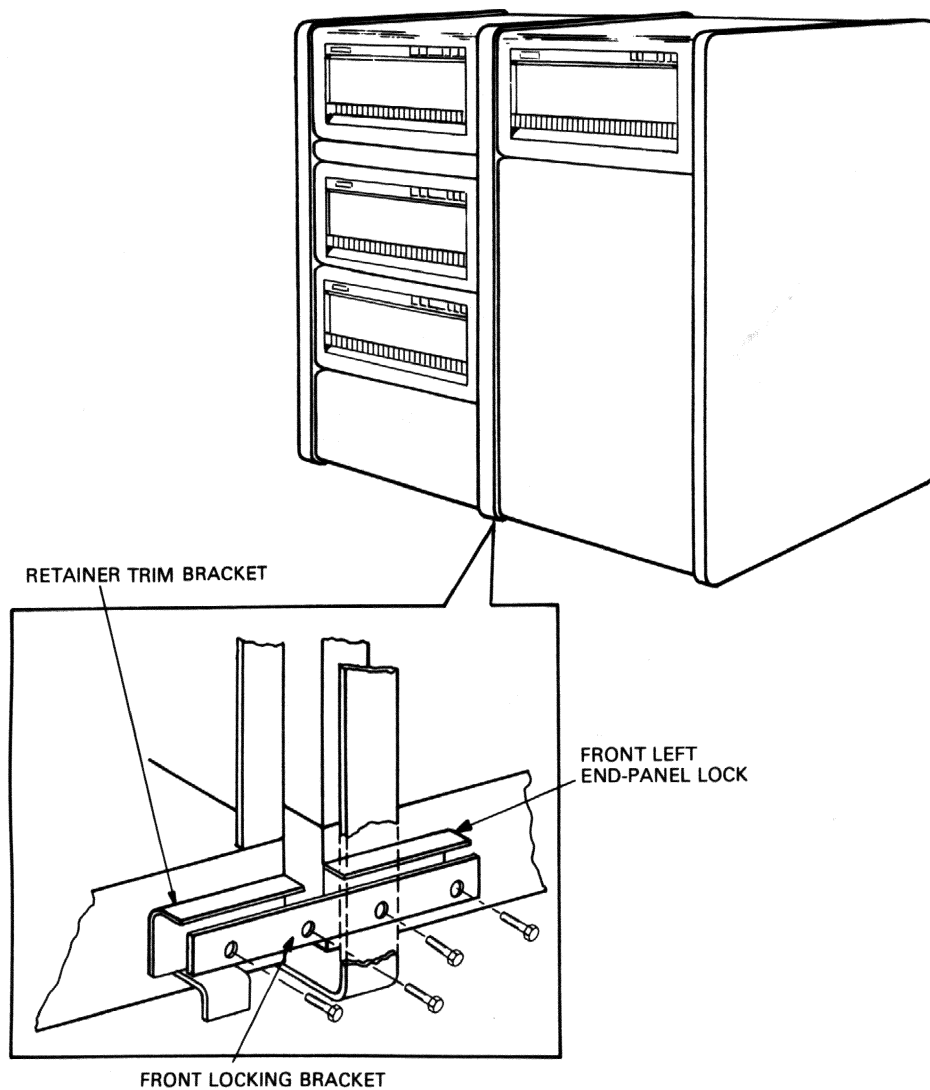
8. Remove the bottom trim panels from the front of the cabinets by removing the two screws at the base of each. Refer to Figure 2-8.



CZ-0745

Figure 2-8 Bottom Trim Panel Removal

9. Remove the screws that hold the two retainer trim brackets at the point where the two cabinets are joined. Refer to Figure 2-9.
10. Place the front locking bracket over the retainer trim brackets. Then bolt the two cabinets together with the existing hardware.
11. Replace the two bottom trim panels previously removed from the front of the cabinets.



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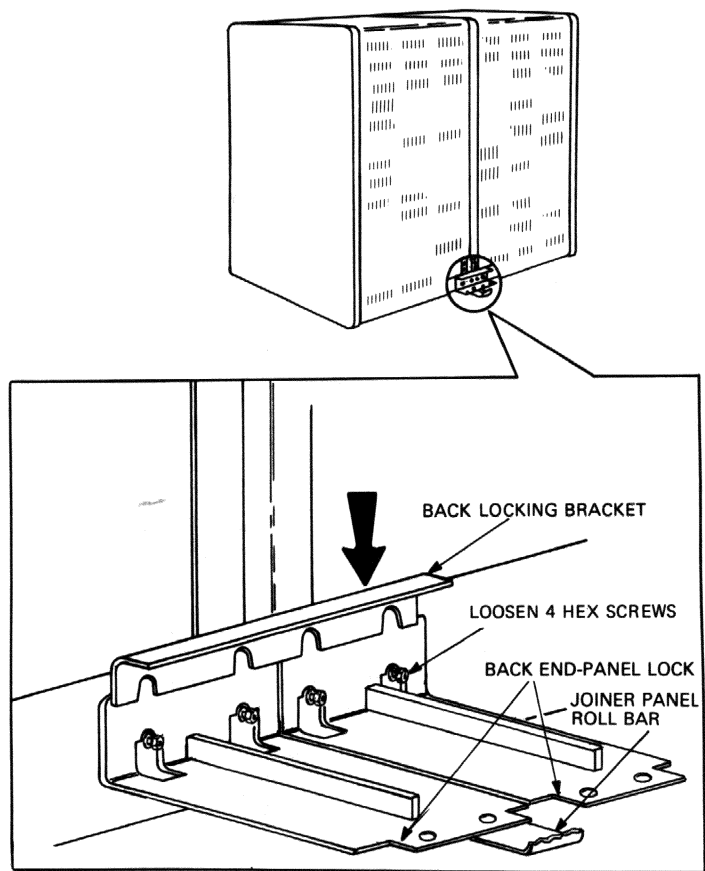
Figure 2-9 Installing the Front Locking Bracket

12. Open the back doors of the cabinets and loosen the screws that hold the two back end panel locks at the point where the two cabinets are joined. Slide the locking bracket over the end panel locks and tighten the four screws. Refer to Figure 2-10.
13. Replace the back door and any end panel locks removed in this procedure.

2.6 INSTALLING LEVELER FEET

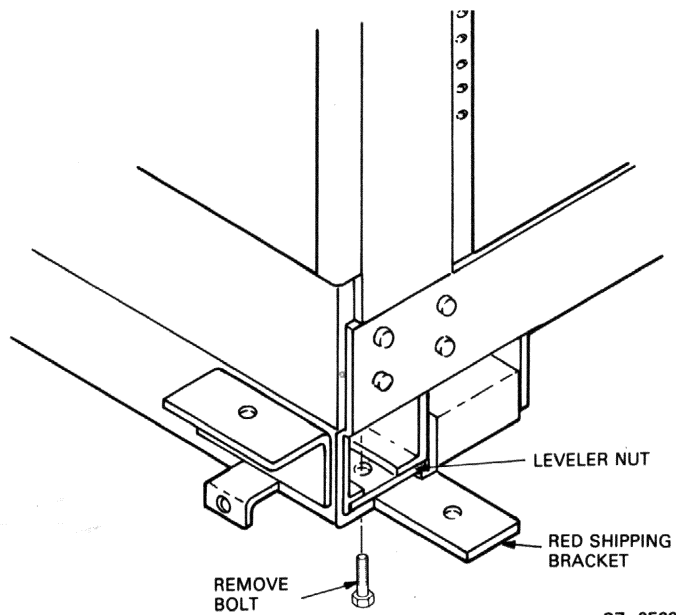
Use the following procedure to install the leveler feet.

1. Remove the four red shipping brackets and leveler nuts shown in Figure 2-11.



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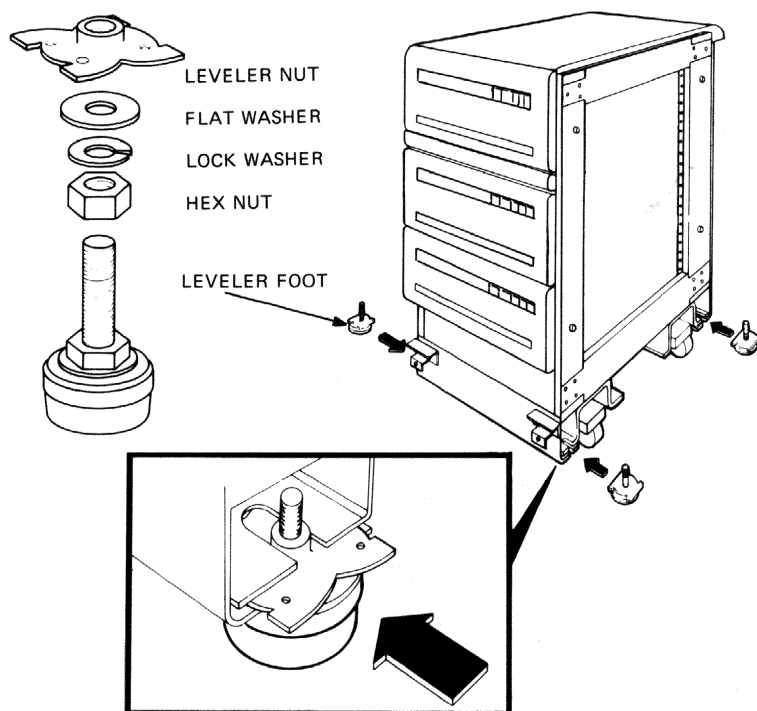
Figure 2-10 Installing the Back Locking Brackets



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Figure 2-11 Shipping Bracket Removal

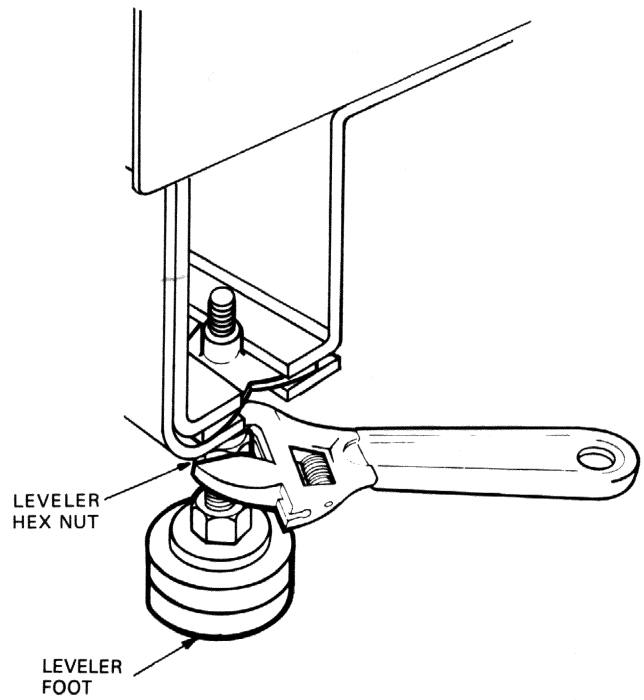
2. Assemble the four leveler feet as shown in Figure 2-12. Screw a leveler foot far enough into the leveler nut so that it may be slid into place without raising the drive cabinet.



CZ-0606

Figure 2-12 Leveler Feet Installation

3. Slide the leveler nut into the slots in the cabinet as shown in Figure 2-13. Wheel the disk cabinet to its final location before making the final leveler feet adjustments.
4. Screw the leveler feet down until they make firm contact with the floor. Adjust the feet until the drive cabinet is level.



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Figure 2-13 Leveler Feet Adjustments

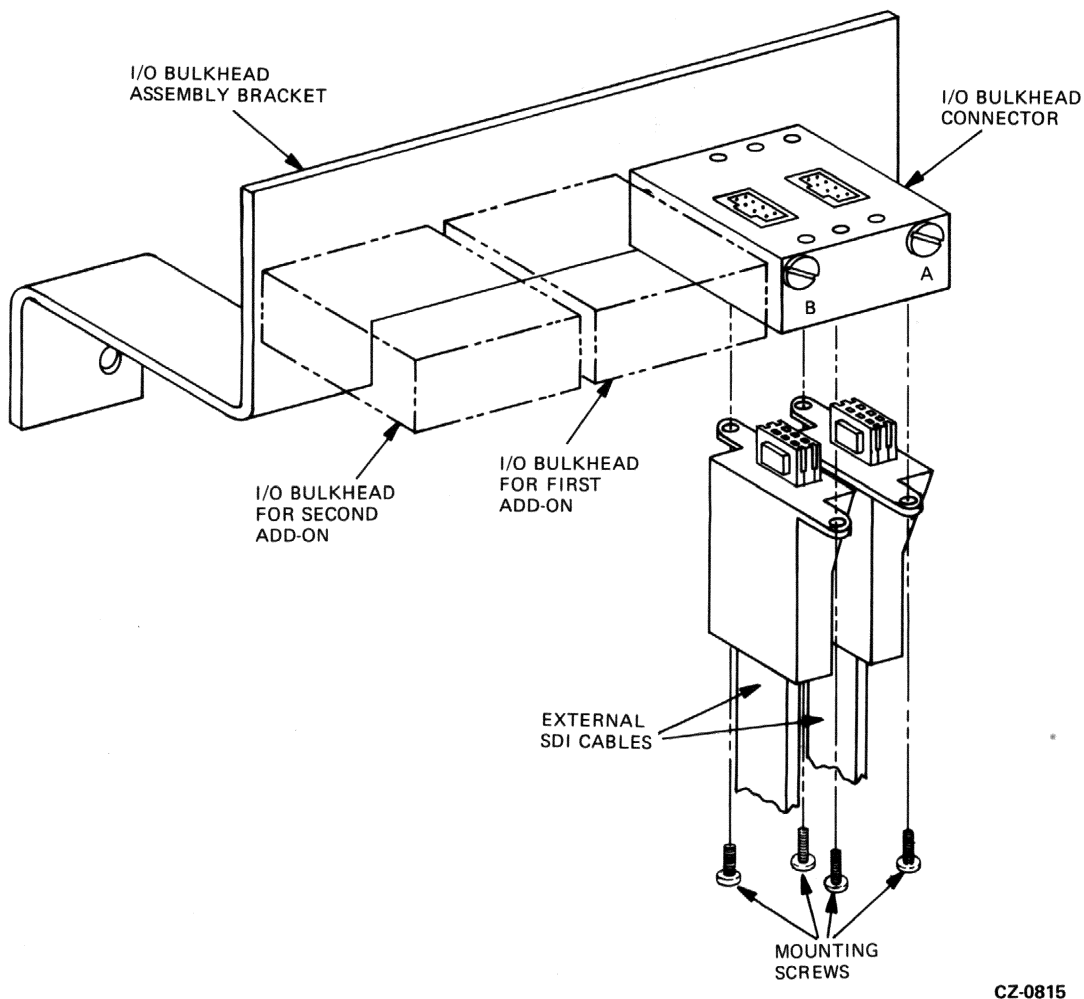
2.7 INSTALLING SDI CABLES

Both the internal and external SDI cables are mounted in the I/O bulkhead. Internal SDI cables connect to the top of the bulkhead and external SDI cables connect to the bottom.

2.7.1 Installing the External SDI Cables

The external SDI cables coming from the central processing unit (CPU) are connected to the bottom of the I/O bulkhead. Refer to Figure 2-14. Use the following procedure to install the external SDI cables:

1. Loosen the two screws holding the I/O bulkhead connector to the bracket.
2. Plug the external SDI cable from the disk controller into the Port A connector on the bottom of the I/O bulkhead. Note the orientation key on the SDI cable.
3. Install the two screws that hold the SDI cable shield terminator in place. Refer to Figure 2-14.



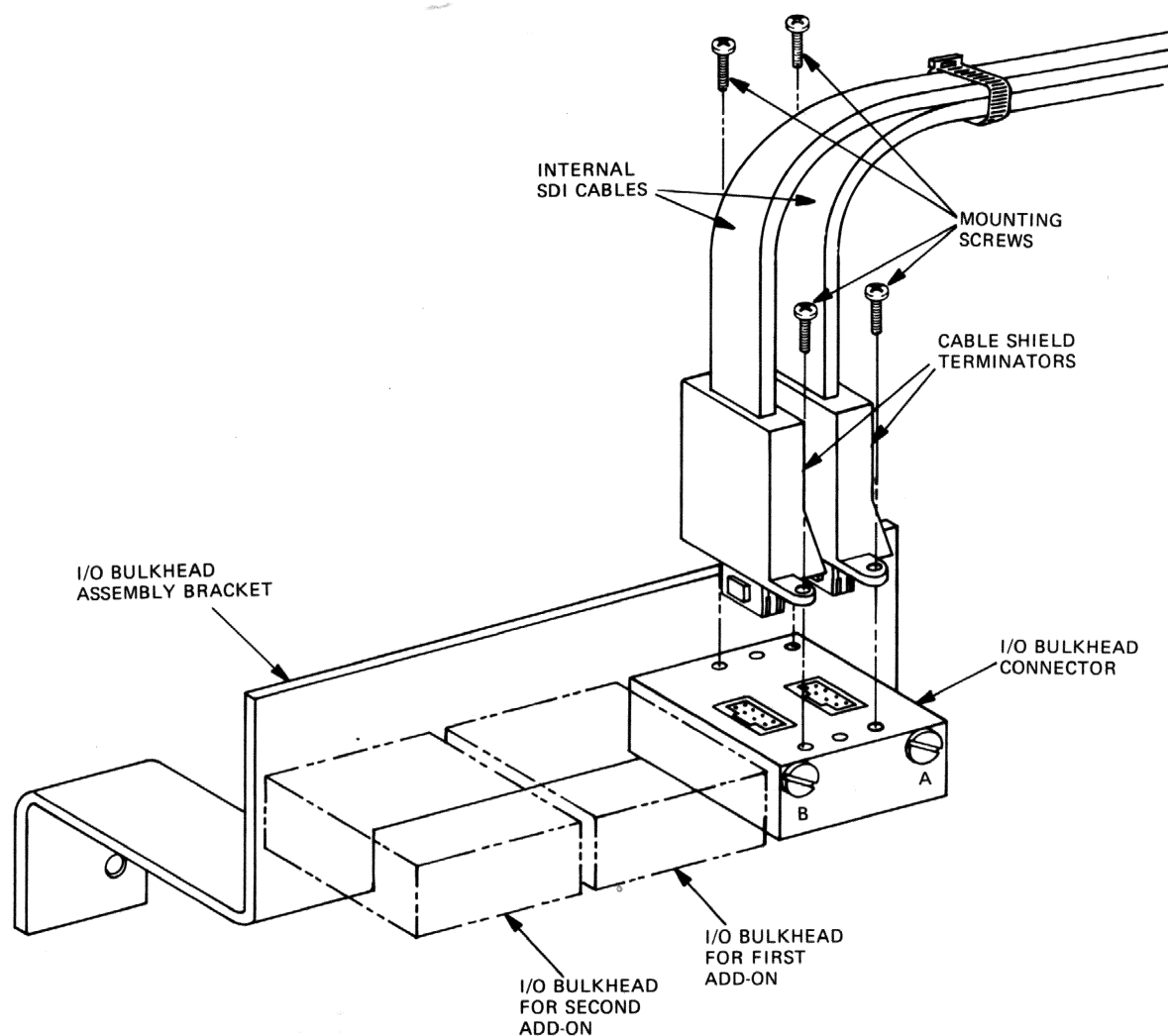
CZ-0815

Figure 2-14 External SDI Cable Installation

4. Clamp the external SDI cable to the cable entry retainers below the I/O bulkhead with either a hose clamp or tie wrap.
5. If a second disk controller is used, mount its SDI cable into the Port B connector on the bottom of the I/O bulkhead. Note the orientation key.
6. Repeat Steps 2, 3, and 4 for the Port B SDI cable.
7. Reconnect the I/O bulkhead connector to the bracket.

2.7.2 Internal SDI Cable Installation

The two internal SDI cables that exit from the back of the drive connect to the top of the I/O bulkhead. Refer to Figure 2-15. Use the following procedure to install the internal SDI cables:



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Figure 2-15 Internal SDI Cable Installation

1. Locate the Port A SDI cable where it exits the back of the disk drive. Plug the end of the Port A connector on the top of the I/O bulkhead. Note the orientation key on the SDI cable.
2. Install the two screws that hold the SDI cable shield terminator in place. Refer to Figure 2-15.
3. Repeat Steps 1 and 2 for the Port B SDI cable.

2.8 RA60 SAFETY LABELS

There are three safety labels on the back of the RA60. Be sure to read these safety labels before installing an RA60. Refer to Figure 2-16 for their locations.

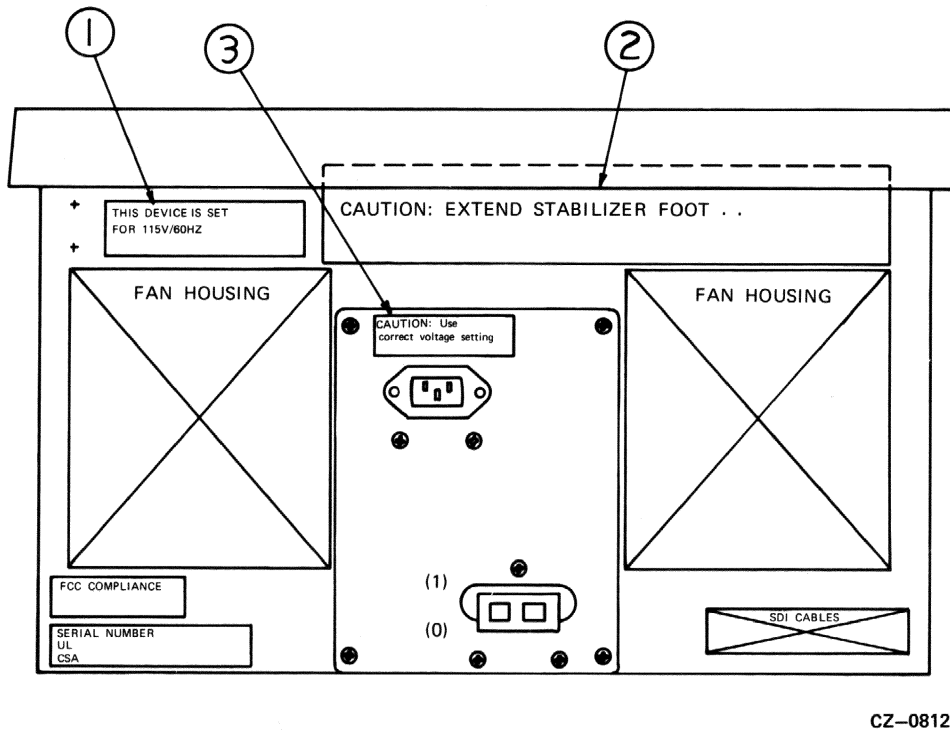


Figure 2-16 RA60 Safety Labels

2.8.1 Safety Label Information

Each of the safety labels located on the back of the RA60 is printed in four languages.

1. Label #1 gives voltage and frequency settings for the drive.
2. Label #2 is a CAUTION reminder to extend the stabilizer foot before pulling the drive out to the full service position.
3. Label #3 is a CAUTION reminder to use the correct voltage and frequency settings. Refer to Paragraph 2.9.

2.9 SETTING THE VOLTAGE AND FREQUENCY

The RA60 contains a universal power supply that may be used for 120/240 volt ac and 50/60 Hz operations. Use the following procedure to set the voltage and frequency to the correct range.

1. Remove the rear cover and shield from the disk drive. Refer to Figure 2-17.

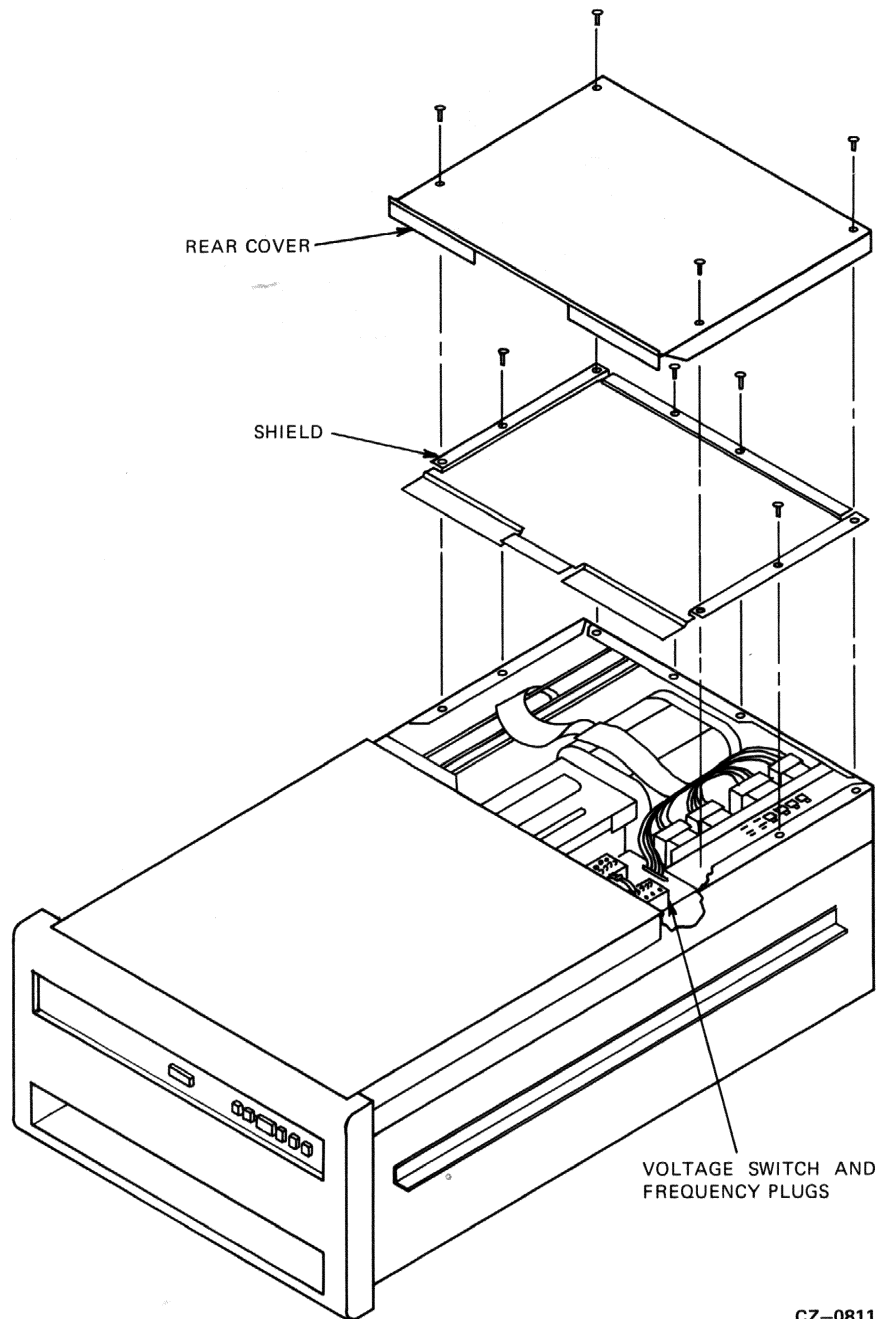


Figure 2-17 Removing the Rear Cover and Shield

2. Locate the voltage switch and frequency plugs located on top of the transformer assembly. See Figures 2-18A and 2-18B.

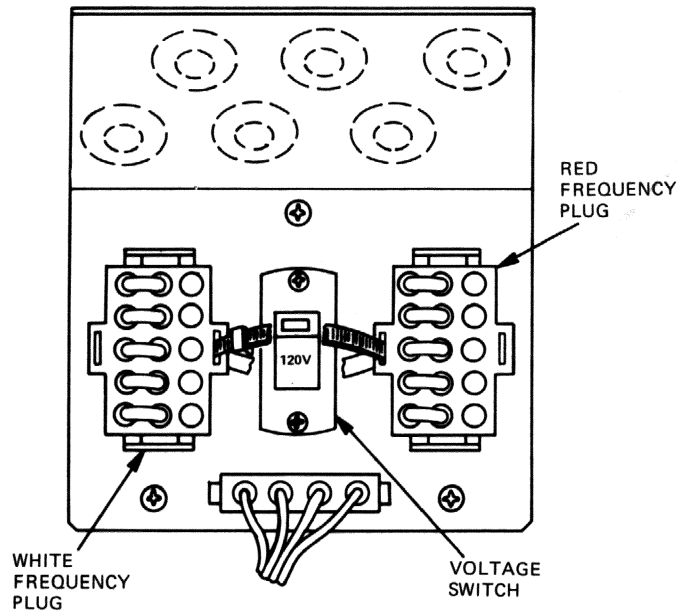
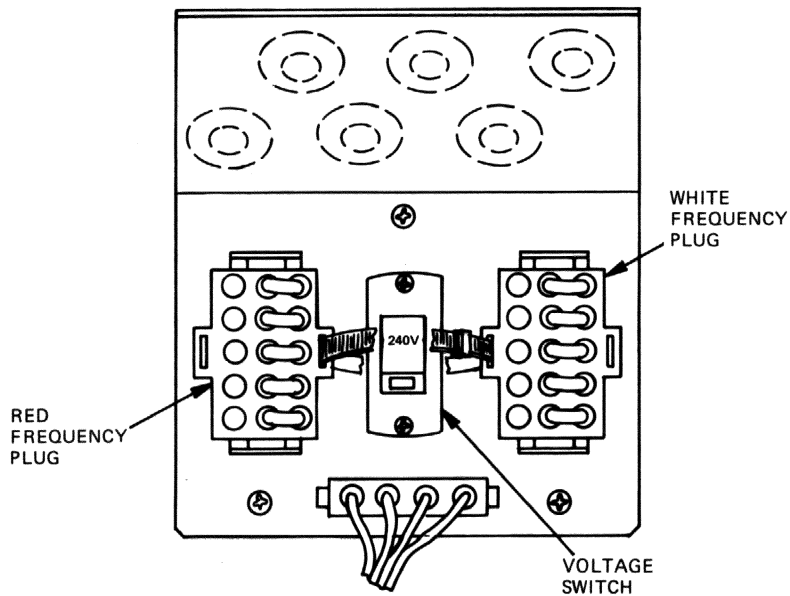


Figure 2-18A 120V/60 Hz Voltage/Frequency Configuration



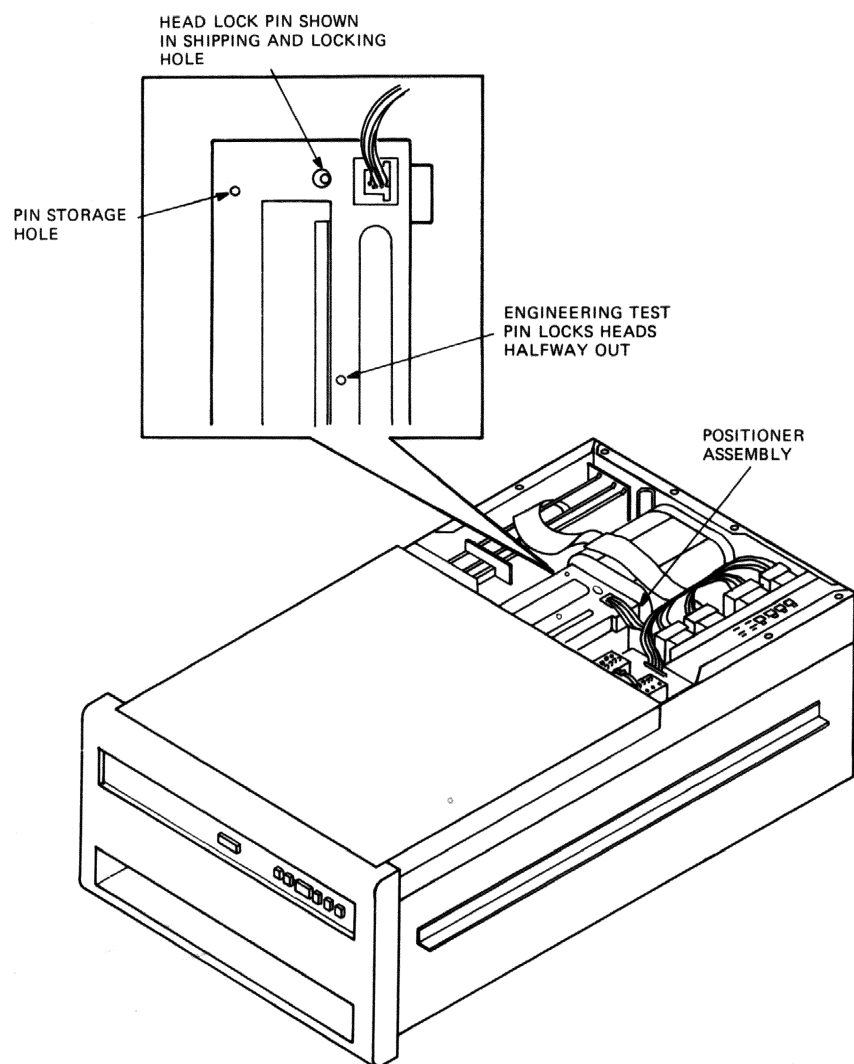
CZ-0814

Figure 2-18B 240V/50Hz Voltage/Frequency Configuration

3. Place the voltage switch into the needed 120- or 240-volt position. The 120-volt position will handle an ac voltage range of 90 to 128 volts. The 240-volt position will handle an ac voltage range of 180 to 254 volts.
4. Select either 50- or 60-cycle drive operation by installing the red and white frequency plugs in one of the configurations shown in Figure 2-18A or Figure 2-18B.
5. Leave the rear cover and shield off the drive to remove the head locking pin described in the next paragraph.

2.10 REMOVING THE HEAD LOCKING PIN

The head locking pin is used to lock the head assembly in place during shipment. It must be removed before the read/write heads can move. Assuming that the rear cover and shield have been removed to perform the voltage settings above, pull the head locking pin out of its locking hole on the positioner assembly and put it in the storage hole. Refer to Figure 2-19. Replace the rear cover and shield when this operation is completed.



CZ-0821

Figure 2-19 Head Locking Pin Removal

2.11 PROGRAMMING THE UNIT ADDRESS PLUG

The READY switch cap on the operator control panel is also the drive unit address plug. A drive unit number from 0 to 254 can be programmed into this plug. To set the drive unit number, remove the READY switch cap from the control panel and cut off the tabs that add up to the required number. Figure 2-20 shows the binary value represented by each tab.

If you wish to set a specific drive to a unit number of 7, for example, cut tabs 1, 2, and 4 off the switch cap.

After the drive unit number has been selected, place the gummed label with the corresponding number in the recessed area of the READY switch cap and replace the cap on the drive.

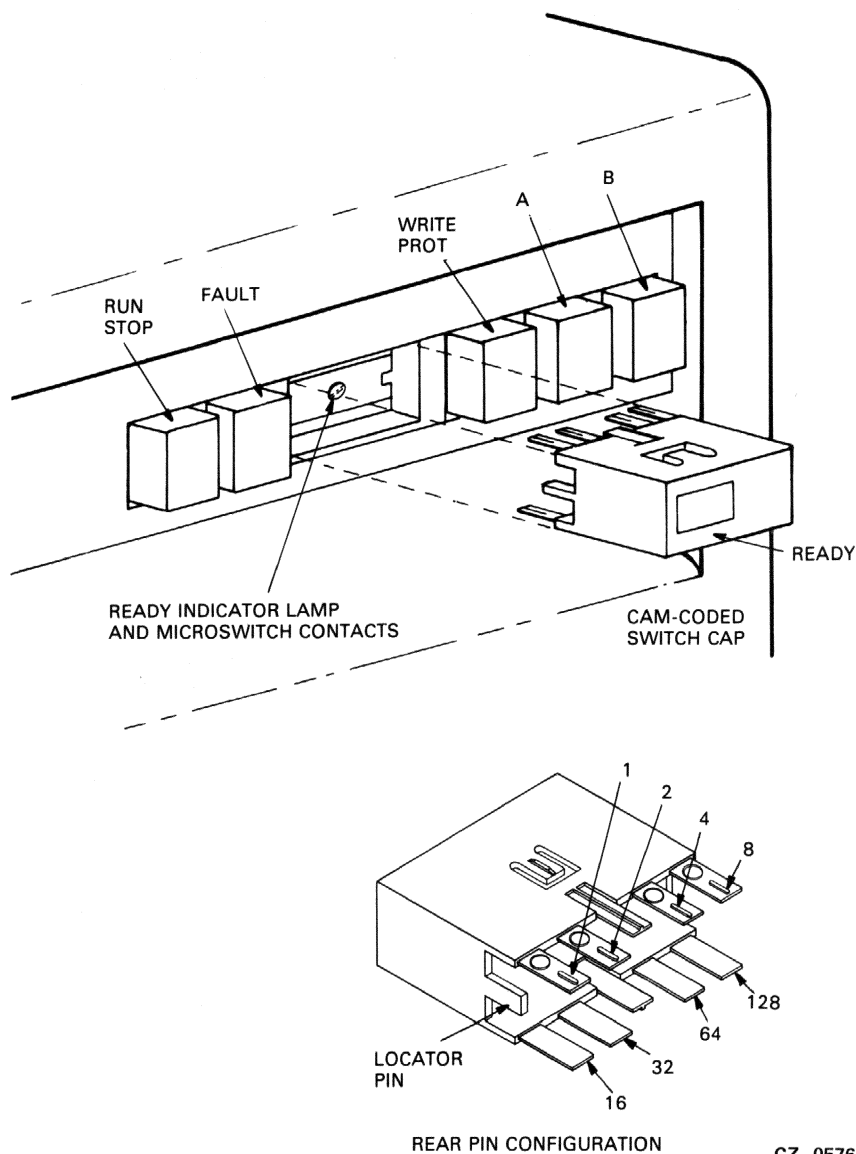
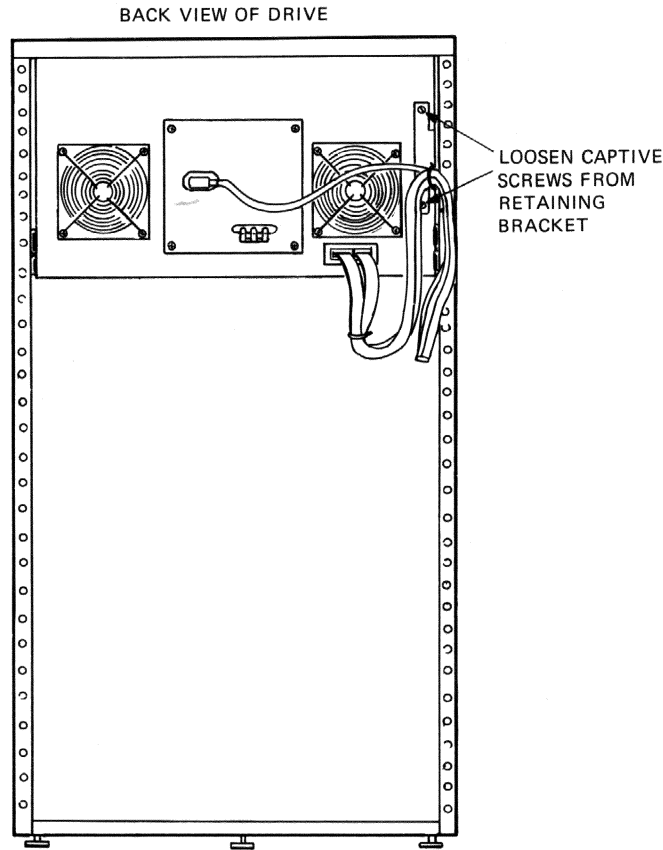


Figure 2-20 Drive Ready Switch and Unit Address Plug

2.12 REMOVING THE RETAINING BRACKET SCREW

A retaining bracket will be found on the back of all disk drives shipped in a cabinet. This retaining bracket serves to keep the drives from sliding out of the cabinets during shipment. Once at the customer site, the screws securing the drive to this retaining bracket must be removed as follows.

1. Open the back door of the disk cabinet by turning the hex lock clockwise.
2. Loosen the retaining bracket captive screws shown in Figure 2-21.

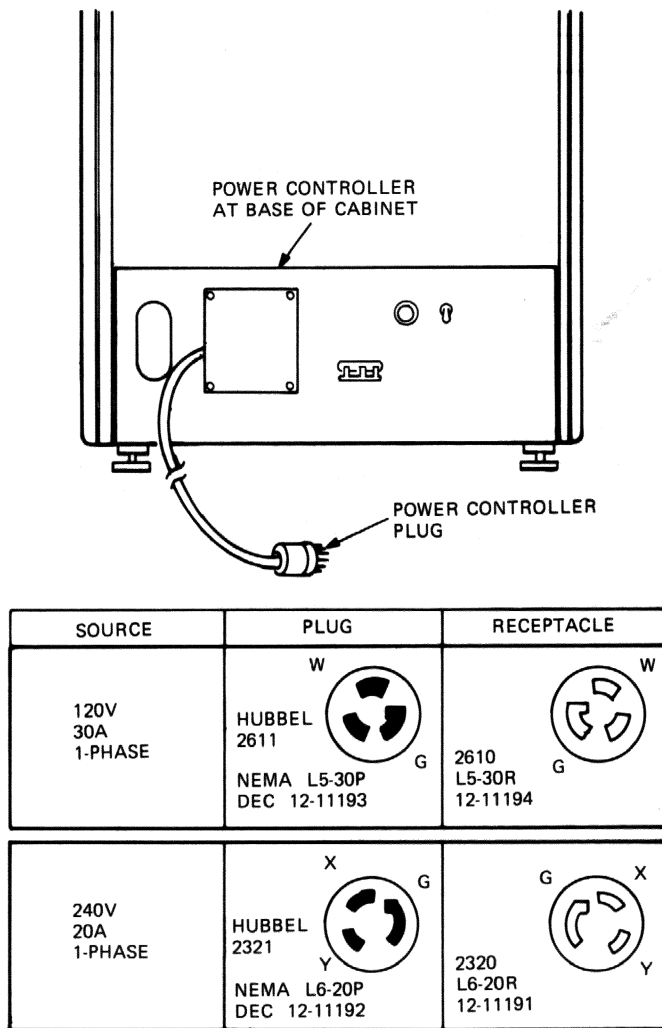


CZ-0824

Figure 2-21 Removing the Retaining Bracket Screws

2.13 PLUGGING IN THE POWER CABLE

The power cables from each disk drive are already plugged into the power controller at the base of the drive cabinet. Only the ac power cord from the power controller needs to be plugged into an external power source. Figure 2-22 shows the power plugs and receptacle types that are used in this power controller. Access to the power cord is gained through the back door of the disk cabinet. Do not switch on the circuit breaker on the power controller until you reach the drive checkout procedure.



CZ-0823

Figure 2-22 Power Controller Plugs and Receptacles

2.14 INSTALLING ADD-ON DRIVES

In its minimum configuration, the RA60 subsystem comes with only one disk drive in a cabinet. Use the following procedure to install a second or third drive in a cabinet.

Caution

Because of the weight of the disk drives, do not try to complete the add-on installation without the help of a lifting device.

2.14.1 Removing the Front Filler Panel

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

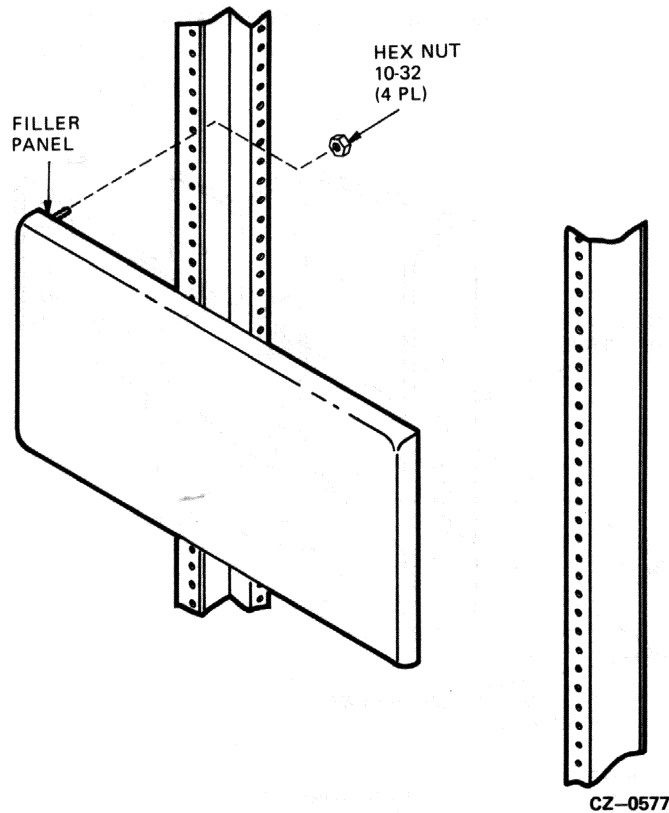
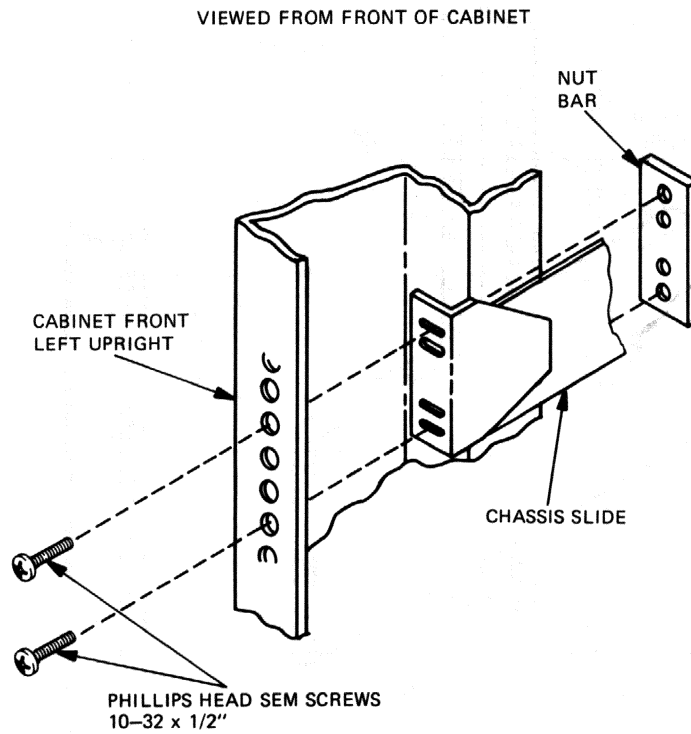


Figure 2-23 Removing Cabinet Filler Panels

2.14.2 Installing the Slide Assembly

Each RA60 add-on must be mounted in the drive cabinet on a slide assembly. Use the following procedure to install the slides on the drive cabinet.

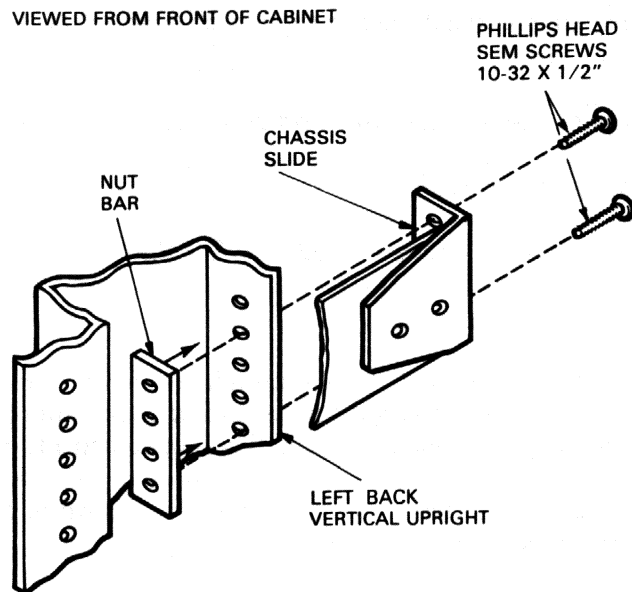
1. Find the left and right chassis slides. (Slide brackets are already attached.)
2. Set aside the following hardware:
 - Eight Phillips head sems screws - 10-32 \times 1/2 inch
 - Four nut bars
3. Mount the chassis slides to the front vertical upright as shown in Figure 2-24. If this is a first add-on drive (middle drive), use mounting holes 26 and 29, counting from the bottom. If this is a second add-on drive (bottom drive), use mounting holes 8 and 11, counting from the bottom.
4. Mount the chassis slides to the back vertical uprights as shown in Figure 2-25. Use the same mounting holes as specified in Step 3 above.



NOTE:
1. REPEAT FOR FRONT RIGHT UPRIGHT.

CZ-0822

Figure 2-24 Mounting Chassis Slide to Front Upright



NOTE
1. REPEAT FOR RIGHT BACK VERTICAL UPRIGHT.

CZ-0749

Figure 2-25 Mounting Chassis Slide to Back Upright

2.14.3 Mounting the RA60 Drive on the Slides

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

1. Extend the stabilizer foot as shown in Figure 2-26.

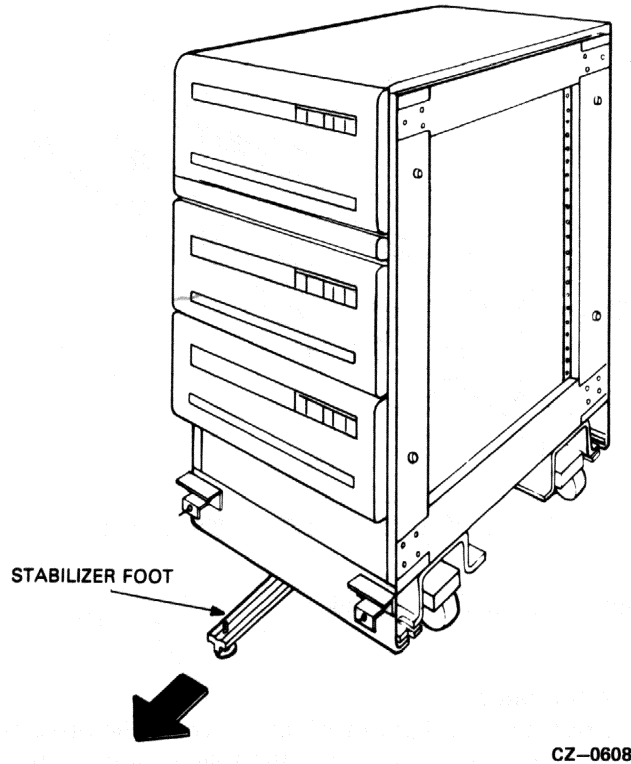


Figure 2-26 Extending Cabinet Stabilizer Foot

Caution

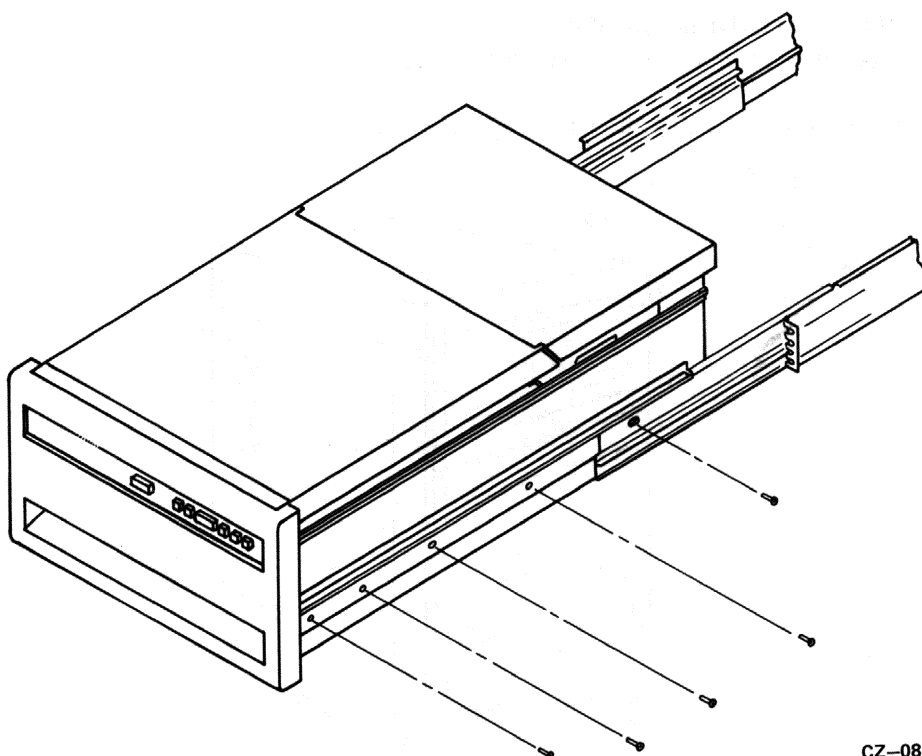
Failure to pull out the stabilizer foot may cause the drive cabinet to tip over when the disk drive is fully extended to its service position.

2. Extend each chassis slide all the way forward until it locks (Figure 2-27).

Warning

Because of the weight of the disk drive, a lifting device will be needed to place the drive on the chassis slides.

3. With the help of a lifting device, place the drive on top of the chassis slides as shown in Figure 2-27. Push the drive toward the back of the slides until the mounting rails touch the stop.
4. Fasten the drive to the chassis slides using five 8-32 \times 1/4 inch Phillips pan head screws, as shown in Figure 2-27.



CZ-0817

Figure 2-27 Mounting the Chassis Slides

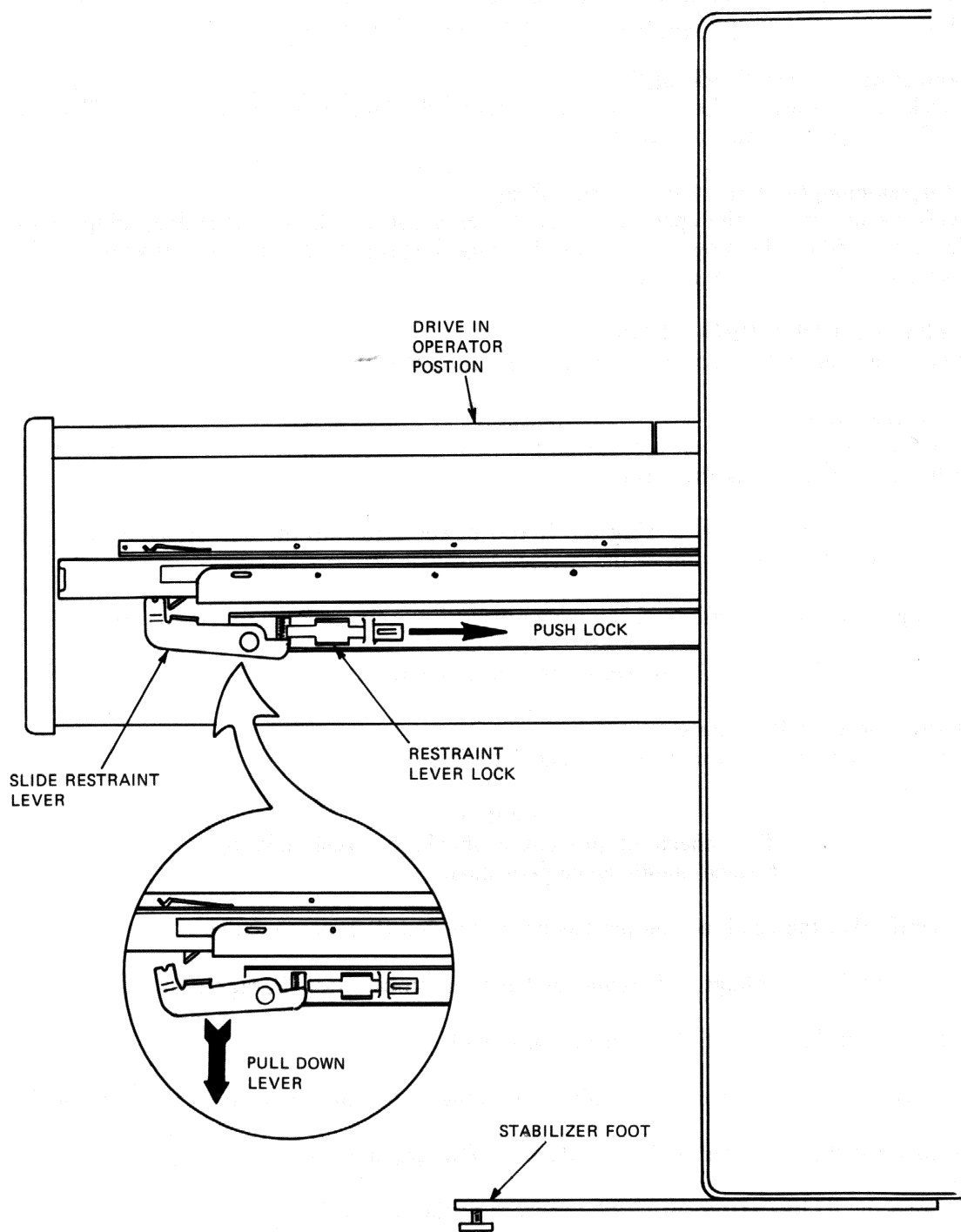
2.14.4 Extending the Drive on the Slide

The slides on the RA60 have a restraint mechanism which prevents the drive from being fully extended inadvertently. To slide the drive all the way forward use the following procedure.

1. Extend the stabilizer foot as show in Figure 2-26.
2. Extend the drive until restraint mechanism engages. Refer to Figure 2-28.
3. Insert a flat-bladed screwdriver under the restraint lever lock, and push the lock toward the back of the slide. Refer to Figure 2-28.
4. Push down on the restraint lever and extend the drive to the service position. Refer to Figure 2-28.
5. After completing service on the drive, be sure to re-engage (lock) the slide restraint mechanism.

Caution

Make certain that the restraint locks are fully engaged so the drive cannot be pulled to the full service position inadvertently.



CZ-0813

Figure 2-28 Extending the Drive

2.14.5 Setting the Drive AC Voltage and Frequency

The RA60 Disk Drive contains a universal power supply that may be used for 120/240 volt ac and 50/60 Hz operations. The only requirement is that you preset the voltage and frequency to the desired range. Refer to Paragraph 2.9, and to Figures 2-17, 2-18A, and 2-18B to perform this procedure.

2.14.6 Removing the Head Locking Pin

The head locking pin is used to lock the head assembly in place during shipment. Refer to Paragraph 2.10 and Figure 2-19 to perform this procedure.

2.14.7 Programming the Drive Unit Address Plug

The READY switch cap on the operator control panel is also the drive unit address plug. A drive unit number from 0 to 254 can be programmed into this plug. To properly program the drive unit address plug, refer to Paragraph 2.11 and Figure 2-20.

2.15 RA60 CHECKOUT PROCEDURE

Use the following checkout procedure after installing each RA60.

2.15.1 Applying Power

1. Verify that the ac circuit breaker on the power control unit is off. Also verify that the circuit breaker on each disk drive is off.
2. If this is an add-on drive, plug the RA60 power cord into the ac power outlet on the power control unit at the bottom of the cabinet.
3. Plug the ac power cord from the power control unit into an external ac receptacle.
4. Switch on the ac circuit breaker on the power control unit.

2.15.2 Drive Checkout Procedure

The following procedure is used to check out each RA60.

Caution

This checkout procedure should be used only by trained maintenance personnel.

1. Verify that the head locking pin has been removed (Paragraph 2.10).
2. Verify that the voltage and frequency has been properly set (Paragraph 2.9).
3. Switch on the ac circuit breaker on the RA60.
4. Open the front cover on the RA60 by pushing in the latch release on the front of the drive.
5. Load the disk pack on the RA60. Refer to Paragraph 3.4.1.
6. Press the RUN/STOP switch on the front of the RA60.

2.15.3 Internal Diagnostics

Run the six internal diagnostics to check out the status, recalibrate, and seek capability of the RA60. Refer to Chapter 3 in either the *RA60 Service Manual* or the *RA60 Maintenance Guide* for instructions on running these diagnostics.

2.15.4 Subsystem Diagnostics

Run the following diagnostics when the RA60 is connected to a PDP-11 system.

CZUDCC0 (UDA and Disk Drive Diagnostic)

Run the following diagnostics when the RA60 is connected to a VAX system.

ZZ-EVLRA (UDA50 Disk Subsystem Diagnostic)

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CHAPTER 3 OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This chapter explains the RA60 operator control panel and tells how to remove and replace disk packs, power on, and spin up the disk.

3.2 OPERATOR CONTROLS AND INDICATORS

The RA60 operator control panel is located on the front of the disk drive. It consists of five switches and one logic plug (UNIT/READY). See Figure 3-1. Covering these controls are six indicator caps labeled as follows:

- RUN/STOP
- FAULT
- UNIT/READY
- WRITE PROTECT
- A Port
- B Port

Under each indicator cap is a light that can be on or off regardless of the switch position. Table 3-1 lists the conditions that affect the indicator lights. The function of each switch is explained in the following paragraphs.

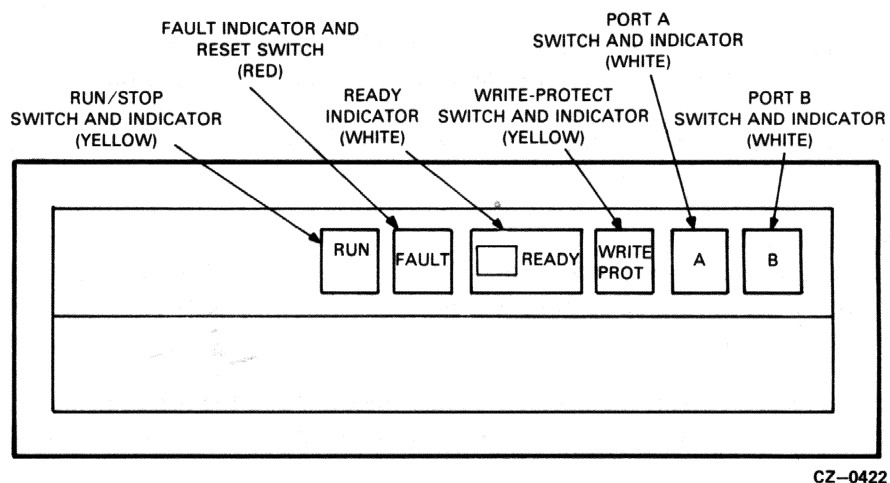


Figure 3-1 Front-Panel Controls and Indicators

Table 3-1 Indicator Conditions

Indicator	On	Off
RUN/STOP	When disk is turning	When disk has stopped
FAULT	When drive detects a 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.
WRITE PROTECT	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.

3.2.1 RUN/STOP Switch and Indicator

The RUN/STOP switch is a double-action push button. When placed in the RUN position (button in), the switch requests that the disk spin up and load the heads. When placed in the STOP position (button out), the heads are unloaded off the disk and the spindle motor is stopped. The RUN/STOP light always reflects the physical state of the disk spindle. When the light is on, it indicates that the disk spindle is spinning. When the light is off, it indicates that the disk spindle 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.

If the RUN/STOP switch is in the IN position when power is applied to the drive, it will have to be reset by releasing it and pushing it in again to start the spin-up sequence.

3.2.2 FAULT Switch and Indicator

The FAULT switch and indicator performs a dual function. When the FAULT light is off, the FAULT switch can be pushed to perform a lamp test. When the FAULT light is on, it indicates that an error condition exists within the RA60.

When the disk drive detects an error, the FAULT light comes on, and the drive stays in its current operating state until the condition is corrected. Some faults may be corrected automatically upon receipt of a DRIVE CLEAR command. The FAULT light will go off when this occurs. If the fault condition is not corrected automatically, the FAULT 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. In this state, the drive assumes control of all front-panel indicator lights which blink to display a binary code indicating the type of fault. Table 3-2 shows the hex fault codes that can be displayed by the front-panel indicators.

The blinking fault code will remain displayed until an attempt is made to clear the fault by pushing the FAULT switch a second time. When the FAULT switch is pushed the second time, the drive tries to clear the fault condition. If successful, the FAULT light will go off and the drive will return to the available state. If unsuccessful, the FAULT light will remain on until the drive is repaired.

Table 3-2 Fault Identification Codes

Description of Error	RUN STOP	FAULT	READY	WRT PROT	A	B	HEX Code
Microcode error (not sent to front panel)	*	off	off	off	off	off	00
Heads home switch fault	*	off	off	off	off	on	01
Front panel fault	*	off	off	off	on	off	02
Long spin-up time fault	*	off	off	off	on	on	03
Bad servo samples fault	*	off	off	on	off	on	05
Bad velocity fault	*	off	off	on	on	off	06
Linear mode fault	*	off	off	on	on	on	07
Retry on seek fault	*	off	on	off	off	off	08
Lost servo samples fault	*	off	on	off	off	on	09
Heads home switch would not open	*	off	on	off	on	off	0A

* The run/stop switch may be on or off depending on the state of the drive.

Table 3-2 Fault Identification Codes (Cont.)

Description of Error	RUN STOP	FAULT	READY	WRT PROT	A	B	HEX Code
Master processor fault	*	on	off	off	off	off	10
SDI fault	*	on	off	off	off	on	11
Invalid SDI level 1 command	*	on	off	off	on	on	13
Master processor fault	on	on	on	on	on	on	3F

* The run/stop switch may be on or off depending on the state of the drive.

3.2.3 UNIT/READY Plug and Indicator

The plastic cap labeled **READY** is both an indicator cap and a removable unit address plug. The **READY** light will come on after the **RUN/STOP** switch is pushed in and the drive has completed a successful spin-up sequence. The drive is ready to accept read and write commands whenever the **READY** light is on. The **READY** light will go off when the drive is performing seek operations.

The plastic **READY** cap is cam-coded to distinguish one drive from another in multi-drive arrangements. This unit address plug determines the logical number that this drive presents to the host. Only numbers between 0 and 251 may be programmed into this unit address plug to satisfy the requirements of the Mass Storage Control Protocol. The procedure for programming the unit address plug may be found in Paragraph 2.11 and Figure 2-20 of this user guide.

3.2.4 WRITE PROTECT Switch and Indicator

The **WRITE PROTECT** switch is a double-action push button with a built-in indicator light. Push in the **WRITE PROTECT** switch to place the drive in write protect mode and turn on the **WRITE PROTECT** light. In this mode, the write circuits of the disk drive are disabled.

Release the **WRITE PROTECT** switch (**OUT** position) to enable the write circuits and turn off the **WRITE PROTECT** light.

3.2.5 A and B Port Select Switches

The RA60 has two port select switches. These double-action switches (**A** and **B**) have built-in lights that indicate which drive port is presently on-line to the controller. Push in the **A** port switch to make the drive available to a controller through port **A**. Push in the **B** port switch to make the drive available to a controller through port **B**. When both port switches are pushed in, the drive will operate in the dual-port programmable mode where either controller may access the drive when it is not busy. When both switches are out, the drive is not available through either port.

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 **A** port light will be on. If the switches are then reset for access to controller **B**, the **A** light will stay on until the drive is actually on-line to controller **B**.

3.3 POWER ON AND POWER OFF

Power to the disk drive is controlled by two circuit breakers. One circuit breaker is on the power controller at the base of the cabinet, and it controls power to all drives in that cabinet. The other circuit breaker is on the back of each disk drive. These two circuit breakers should normally be left in the ON position after drive installation. If both of these circuit breakers are on, the drive will spin-up whenever the RUN/STOP switch is pushed. Refer to Figure 3-2.

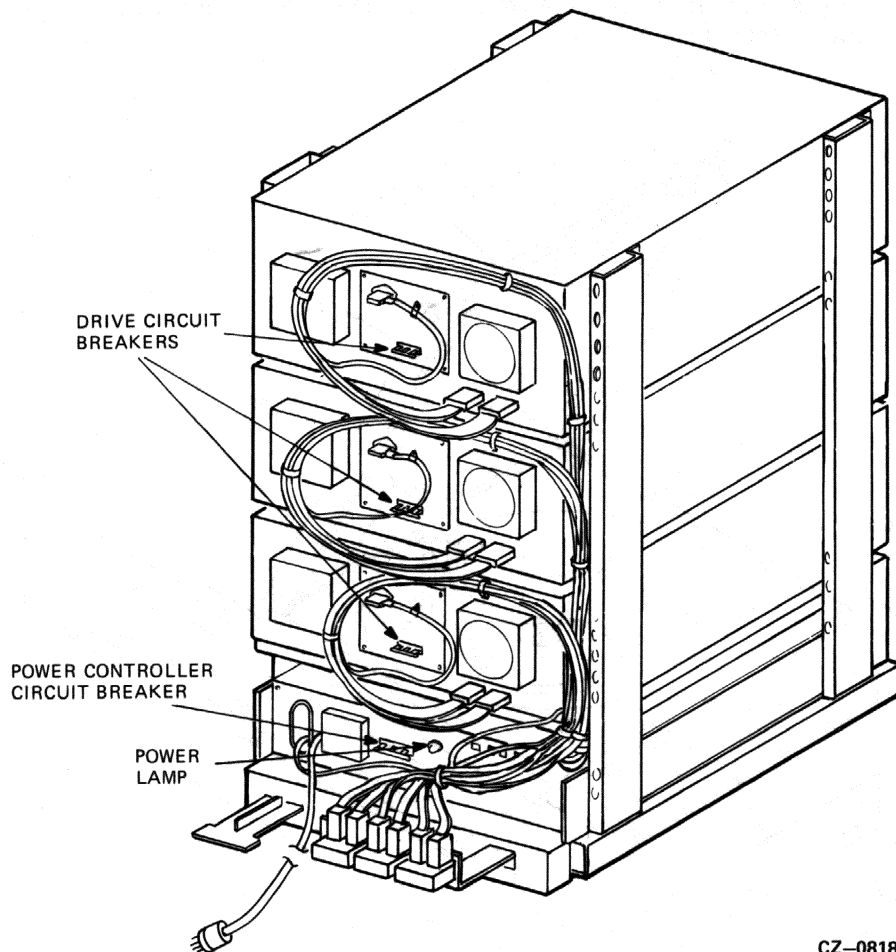


Figure 3-2 Drive Circuit Breakers

If the RUN/STOP switch is in the IN position when power is applied, it will have to be reset by releasing it and pushing it in again to start the spin-up sequence.

To remove power from a drive, open the back door of the disk cabinet by turning the hex lock clockwise. Switch off the circuit breaker on the back of the selected drive. If you wish to remove power to all disk drives, switch off the power controller circuit breaker.

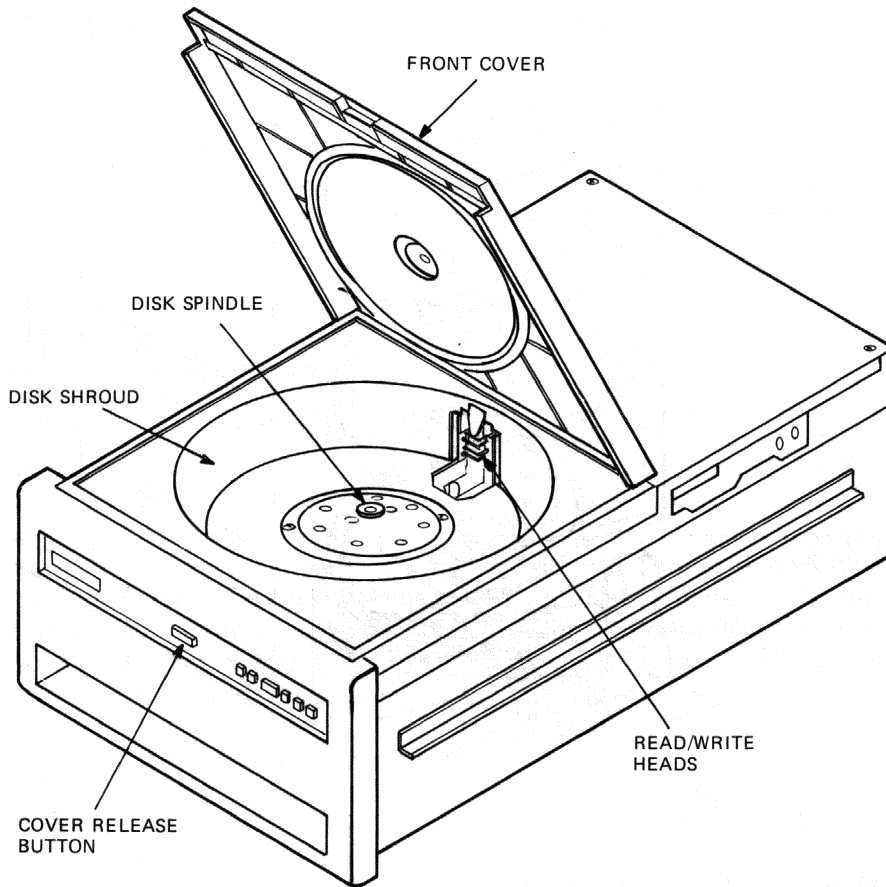
3.4 DISK PACK LOADING AND UNLOADING

The RA60 must be loaded with an RA60 disk pack and then be brought to the ready state before information can be stored or read. The procedures for loading and unloading the disk pack are as follows.

3.4.1 Loading the Disk Pack

Use the following procedure to load the disk pack.

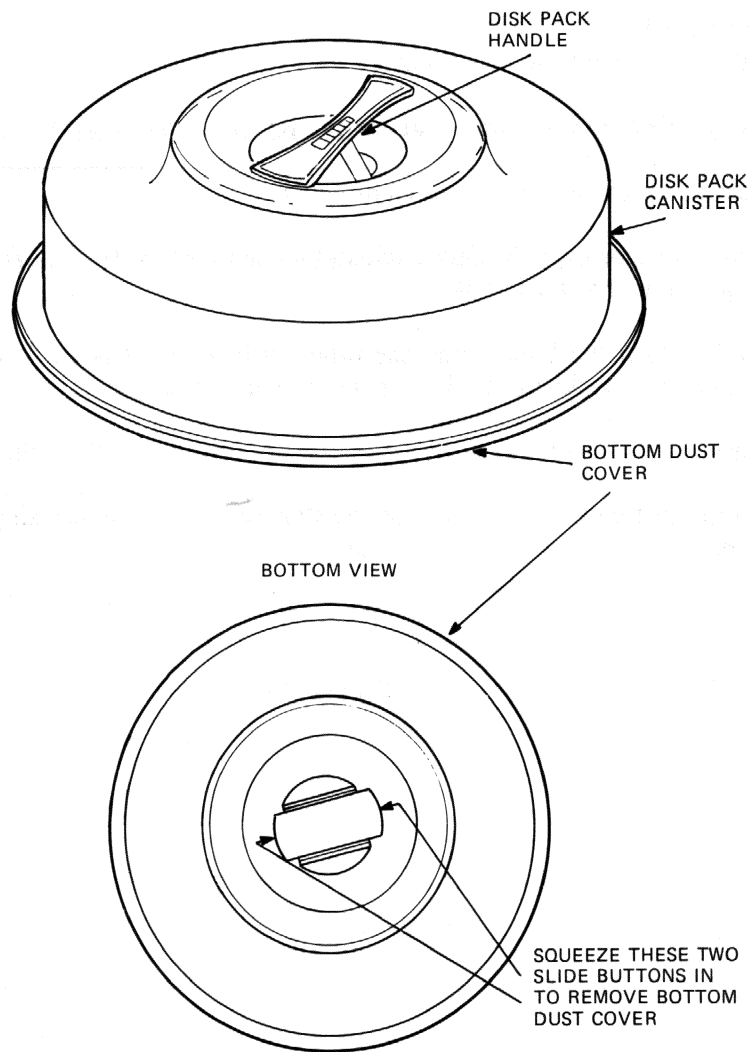
1. Apply power by turning on the drive circuit breaker located at the back of drive.
2. Make sure that the RUN light is off (RUN/STOP switch is not pushed in).
3. Push the release button to raise the front cover. Drive power must be on to operate the cover release button. Refer to Figure 3-3.



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Figure 3-3 Gaining Access to the Disk Spindle

4. Look into the disk well to make sure that the read/write heads are retracted from the disk shroud area. Failure to make sure that the heads are fully retracted could cause damage to the heads and/or the disk pack.
5. Remove the bottom dust cover from the disk pack canister by squeezing together the two slide buttons on its underside. Avoid placing fingerprints on the exposed disks inside the canister. Refer to Figure 3-4.



CZ-0819

Figure 3-4 RA60-P Disk Pack Storage Canister

6. Lifting the canister by its handle, set the pack onto the disk spindle.
7. Using one hand to turn the handle while holding the disk pack cover stationary with the other, rotate the pack handle clockwise until it stops turning. Give one last, firm twist to the handle and lift the storage canister off the pack.
8. Close the front cover of the disk drive.
9. Push in the RUN/STOP switch and wait for the READY light to come on. The disk drive is then ready to accept read and write commands.

3.4.2 Unloading the Disk Pack

Use the following procedure to unload the disk pack.

1. Release the RUN/STOP switch and wait for the RUN light to go off.
2. Push in the release button and raise the front cover.
3. Place the storage canister over the disk pack so that the post protruding from the center of the disk pack contacts the canister handle.
4. Using one hand to turn the handle and the other to hold the disk pack stationary, rotate the canister handle counterclockwise until the pack is free of the spindle.
5. Using the canister handle, lift the pack out of the disk drive and close the front cover.
6. Install the bottom dust cover on the base of the storage canister by pressing it on gently until it locks into place.

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