

RA82 Disk Drive User Guide



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Contents

About This Manual	xiii
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1 INTRODUCTION

1.1 GENERAL INFORMATION	1-1
1.2 DATA BACKUP	1-2
1.3 DRIVE DESCRIPTION	1-2
1.3.1 Physical and Logical Media Layout	1-4
1.3.2 Media Format	1-5
1.3.3 Internal Microprocessors	1-6
1.4 INTERNAL DRIVE DIAGNOSTICS	1-8
1.5 CONTROLLER AND DRIVE CONFIGURATIONS	1-8
1.6 RAX2 SPECIFICATIONS	1-9
1.7 ELECTROSTATIC DISCHARGE (ESD)	1-15
1.7.1 Electrostatic Protection	1-16
1.8 RELATED DOCUMENTATION	1-16
1.9 ORDERING DOCUMENTATION	1-18

2 OPERATING INSTRUCTIONS

2.1 CONTROL PANEL SWITCHES AND INDICATORS	2-1
2.1.1 RUN/STOP Switch and Indicator	2-2
2.1.2 FAULT Switch and Indicator	2-3
2.1.3 READY Plug and Indicator	2-5
2.1.4 WRITE PROTECT Switch and Indicator	2-5
2.1.5 Port Select Switches	2-6
2.2 REAR POWER CONTROLS	2-7
2.2.1 Power Controller Circuit Breaker	2-7
2.2.2 Bus/Off/On Switch (881 Power Controller)	2-7
2.2.3 Disk Drive Circuit Breakers	2-11
2.3 DRIVE OPERATION	2-11
2.3.1 Spin Up	2-11
2.3.2 Spin Down	2-11

IV Contents

2.3.3	Drive Power Removal	2-11
2.4	CUSTOMER CARE	2-12
2.4.1	Air Filter Removal	2-12
2.4.2	Cleaning	2-13
2.4.3	Air Filter Replacement	2-14

3 INSTALLING THE RA82 DISK DRIVE

3.1	INTRODUCTION	3-1
3.2	SITE PREPARATION AND PLANNING	3-1
3.2.1	Environmental Considerations	3-1
3.2.2	Cleanliness	3-1
3.2.3	Floor Loading	3-2
3.2.4	Heat Dissipation	3-2
3.2.5	Power and Safety Precautions	3-2
3.3	ADJUSTING THE LEVELER FEET	3-2
3.4	EXTENDING CABINET STABILIZER FOOT	3-4
3.5	FOUR-HIGH CABINET REAR DOOR REMOVAL	3-4
3.6	CABINET INTERLOCK (If Applicable)	3-6
3.7	EXTENDING AND RETRACTING THE DRIVE ON SLIDES	3-7
3.7.1	Extending the RA82 Disk Drive Using the Slides	3-7
3.7.2	Sliding the RA82 Disk Drive Back into the Cabinet	3-9
3.8	REMOVING RA82 INTERNAL SHIPPING BRACKETS AND PACKING MATERIAL	3-9
3.9	SDI CABLES (DESCRIPTION)	3-16
3.10	EXTERNAL SDI CABLING PROCEDURE (FOUR-HIGH CABINET)	3-19
3.11	SEQUENCE CABLES (DESCRIPTION)	3-19
3.12	PROGRAMMING THE UNIT ADDRESS PLUG	3-20
3.13	RA82 DRIVE DIAGNOSTIC CHECKOUT	3-20
3.13.1	The Diagnostic Terminal	3-21
3.13.2	Applying Power to the Drive	3-21
3.13.3	Verifying RA82 Disk Drive Operation	3-22
3.13.3.1	Using the Diagnostic Terminal to Verify the Drive	3-25

4 INSTALLATION OF RA82 DISK DRIVES IN THREE-HIGH CABINETS

4.1	INTRODUCTION	4-1
4.2	UNPACKING AND EXTERNAL INSPECTION (40-INCH CABINET)	4-1
4.2.1	Unpacking the System on a Shipping Pallet	4-3
4.2.2	Removing the Internal Shipping Brackets and Packing Material	4-3
4.2.3	Electrostatic Discharge (ESD) Brackets	4-4
4.3	OPENING AND REMOVING THE REAR DOOR	4-5
4.4	CABLING THE RA82 TOP DRIVE	4-5
4.4.1	Mounting the I/O Bulkhead Connectors	4-6
4.4.2	Installing External SDI Cables	4-6
4.4.3	Installing Internal SDI Cables	4-11
4.4.4	Installing the Drive Sequence Cable	4-12
4.4.5	Connecting the Disk Drive Power Cord	4-12
4.5	INSTALLING RA82 ADD-ON DRIVES	4-12
4.5.1	Removing the Rear Cabinet Door	4-12
4.5.2	Removing the Front Filter Panels	4-15
4.5.3	Extending the Cabinet Stabilizer Foot	4-15
4.6	PREPARING THE ADD-ON DRIVE FOR INSTALLATION	4-16
4.6.1	Removing Internal Shipping Brackets and Packing Material	4-17
4.7	INSTALLING CABINET SLIDES	4-17
4.7.1	Preparing the Slides for Cabinet Mounting	4-18
4.7.2	Attaching Slides to Cabinet	4-20
4.8	MOUNTING THE ADD-ON DRIVE ON THE SLIDES	4-20
4.8.1	Mounting the Drive with a Lifting Device	4-24
4.8.2	Mounting the Drive Without a Lifting Device	4-24
4.9	INSTALLING CABLE STANDOFFS AND U-NUTS	4-26
4.10	INSTALLING THE I/O BULKHEAD CONNECTORS	4-26
4.11	INSTALLING SDI CABLES	4-26
4.11.1	Installing the First Add-On Drive SDI Cables	4-27
4.11.2	Installing the Second Add-On Drive SDI Cables	4-30
4.12	INSTALLING SEQUENCE CABLES ON RA8X DISK DRIVES	4-30
4.12.1	Installing First Add-On Drive Sequence Cables	4-30
4.12.2	Installing the Second Add-On Drive Sequence Cables	4-33
4.13	INSTALLING THE SEQUENCE TERMINATOR PLUG	4-33
4.14	INSTALLING THE DISK DRIVE POWER CORDS	4-33
4.14.1	Installing the First Add-On Drive Power Cord	4-33
4.14.2	Installing the Second Add-On Drive Power Cord	4-34
4.15	REMOVING HDA SHIPPING BRACKETS	4-34
4.16	SECURING THE DRIVE TO THE ESD BRACKETS	4-34
4.17	PERFORMING DRIVE CHECK-OUT PROCEDURE	4-34

4.18	REMOVING A DRIVE	4-34
4.18.1	Removing Power	4-35
4.18.2	Removing Sequence Cables (From Mounted Drives)	4-35
4.18.3	Removing the Power Cord (From Mounted Drives)	4-35
5	INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET	
5.1	INTRODUCTION	5-1
5.2	REMOVING THE REAR DOOR	5-1
5.3	REMOVING THE FRONT FILLER PANEL	5-1
5.4	UNPACKING THE ADD-ON DRIVE FROM THE BOX	5-1
5.4.1	Add-On Hardware Mounting Kit Parts Checklist	5-4
5.5	PREPARING THE ADD-ON DRIVE FOR INSTALLATION	5-5
5.5.1	Removing Internal Shipping Brackets and Packing Material	5-6
5.6	REMOVING THE HDA	5-6
5.7	PREPARING THE SLIDES FOR CABINET MOUNTING	5-9
5.8	INSTALLING CABINET SLIDES	5-13
5.9	EXTENDING CABINET STABILIZER FOOT	5-18
5.10	CABINET INTERLOCK	5-18
5.10.1	Positioning Interlock Rod Actuator	5-18
5.11	MOUNTING THE ADD-ON DRIVE ON THE SLIDES	5-18
5.11.1	Mounting the Drive Using an Approved Lifting Device	5-20
5.11.2	Mounting the Drive Without an Approved Lifting Device	5-21
5.12	MOUNTING THE I/O BULKHEAD ON THE SDI INTERFACE BRACKET	5-23
5.13	INSTALLING CABLE STANDOFF AND U-NUT	5-23
5.14	INSTALLING SDI CABLES	5-24
5.14.1	Installing First Add-On Drive SDI Cables	5-25
5.14.2	Installing Second Add-On Drive SDI Cables	5-25
5.14.3	Installing Third Add-On Drive SDI Cables	5-29
5.15	INSTALLING SEQUENCE CABLES	5-29
5.15.1	Installing First Add-On Drive Sequence Cables	5-31
5.15.2	Installing Second Add-On Drive Sequence Cables	5-32
5.15.3	Installing Third Add-On Drive Sequence Cables	5-32
5.16	INSTALLING SEQUENCE TERMINATOR PLUG	5-32
5.17	INSTALLING DISK DRIVE POWER CORD	5-33
5.18	POWER CONTROLLERS	5-33
5.19	REPLACING THE HDA	5-33
5.20	SECURING THE DRIVE TO THE TWO ESD BRACKETS	5-36
5.21	CHECKING OUT THE DRIVE	5-36

6 INSTALLING RA82 ADD-ON DRIVES IN AN SA482

6.1	INTRODUCTION	6-1
6.2	UNPACKING THE ADD-ON DRIVE FROM THE BOX	6-1
6.2.1	Add-On Hardware Mounting Kit Parts Checklist	6-1
6.2.2	Add-On Hardware Mounting Kit Parts Checklist	6-2
6.3	PREPARING THE SA482	6-2
6.3.1	Removing the Rear Door	6-3
6.3.2	Removing the Front Door	6-4
6.3.3	Front Door Inlet Plate Removal	6-5
6.3.4	Extending the Cabinet Stabilizer Foot	6-5
6.4	PREPARING THE ADD-ON DRIVE FOR INSTALLATION	6-6
6.4.1	Removing Internal Shipping Brackets and Packing Material	6-7
6.5	PREPARING THE SLIDES FOR CABINET MOUNTING	6-15
6.6	INSTALLING CABINET SLIDES	6-18
6.7	MOUNTING THE ADD-ON DRIVE ON THE SLIDES	6-23
6.7.1	Installing an RA82 Using a Lifting Device	6-23
6.7.2	Installing an RA82 Without a Lifting Device	6-25
6.8	SECURE THE DRIVE TO THE TWO ESD BRACKETS	6-25
6.9	MOUNTING THE I/O BULKHEAD ON THE SDI INTERFACE BRACKET	6-27
6.10	INSTALLING CABLE STANDOFF AND U-NUT	6-28
6.11	INSTALLING SDI CABLES	6-29
6.11.1	First Add-On Drive SDI Cable	6-30
6.11.2	Second Add-On Drive SDI Cable	6-34
6.12	INSTALLING SEQUENCE CABLE	6-36
6.12.1	First Add-On Drive Sequence Cable	6-37
6.12.2	Second Add-On Drive Sequence Cable	6-37
6.13	INSTALLING SEQUENCE TERMINATOR PLUG	6-37
6.14	INSTALLING DISK DRIVE POWER CORD	6-38
6.14.1	Closing the Cabinet	6-39
6.15	POWER CONTROLLERS	6-39
6.16	IDA REMOVAL	6-39
6.17	IDA REPLACEMENT (RA82)	6-41
6.18	CHECKING OUT THE DRIVE	6-45

A RA82 ERROR CODES**B STATIC CONTROL MATERIALS****Index****Figures**

1-1	RA82 Disk Drive	1-2
1-2	Hinged Circuit Module Arrangement	1-3
1-3	HDA Head Arrangement	1-5
1-4	Physical and Logical Media Layout	1-6
1-5	Disk Geometry	1-7
1-6	RA82 Sector Format	1-8
1-7	Typical RA82 Disk Drive Subsystem Block Diagram	1-9
1-8	Single Port, Multi-Drive Configuration	1-10
1-9	Dual-Port Configuration	1-11
1-10	Connecting ESD Wrist Strap to Ground	1-17
2-1	Front Panel Controls and Indicators	2-1
2-2	Drive Unit Address Plug (Ready Cap)	2-5
2-3	Cam-Coded Switch Cover	2-6
2-4	Rear Cabinet Power Controls (Four-High)	2-8
2-5	Rear Cabinet Power Controls (Three-High)	2-9
2-6	Electrical Plug Configurations	2-10
2-7	HDA and Drive Details	2-12
2-8	Air Filter Removal	2-13
3-1	Power Connector Configurations	3-3
3-2	Leveler Feet Adjustment	3-4
3-3	Stabilizer Foot Extension	3-5
3-4	Removing the Rear Door	3-6
3-5	RA82 Actuator Assembly	3-7
3-6	Electrostatic Discharge Bracket Details	3-8
3-7	Extending the Chassis Slides	3-9
3-8	Connecting ESD Wrist Strap to Ground	3-10
3-9	Upper Chassis Assembly	3-11
3-10	Dumper (Gas Spring) Assembly	3-12
3-11	HDA Shipping Brackets	3-13
3-12	HDA Details	3-14
3-13	Cable Spring Assembly	3-15
3-14	Opening the Logic Access Cover	3-17
3-15	I/O Bulkhead Mounting	3-18
3-16	Drive Unit address Plug (Ready Cap)	3-21
3-17	Rear Cabinet Power Controls (60-Inch Cabinets)	3-23
3-18	Rear Cabinet Power Controls (40-Inch Cabinets)	3-24
3-19	Hinged Circuit Module Arrangement	3-26

3-20	Diagnostic Terminal Connections	3-27
3-21	Locking the Logic Access Cover	3-30
3-22	HDA Removal	3-31
4-1	Unpacking the 40-Inch Cabinet System	4-2
4-2	Ramp Construction (40-Inch Cabinet)	4-4
4-3	Leveler Adjustments	4-5
4-4	Electrostatic Discharge Bracket Details	4-6
4-5	Opening the Rear Door	4-7
4-6	Removing the Rear Door	4-8
4-7	I/O Bulkhead	4-9
4-8	SDI Cables for the Top Drive	4-10
4-9	Cable Wiring Diagram for the Top Drive	4-13
4-10	Rear Cabinet Power Controls (40-Inch Cabinet)	4-14
4-11	Power Cord Routing on Cab Floor	4-15
4-12	Front Panel Removal	4-16
4-13	Extending the Stabilizer Foot	4-17
4-14	Cabinet Upright Holes (40-Inch Cabinet)	4-18
4-15	Mounting Hole Table	4-19
4-16	Left-Hand Slide	4-21
4-17	Right-Hand Slide	4-22
4-18	Mounting the Slide Assembly	4-23
4-19	Mounting the Drive on Slides	4-25
4-20	Mounting U-Nut and Standoffs	4-27
4-21	Cable Routing - First Add-On Drive	4-28
4-22	Cable Wiring Diagram of a Two-Drive System (Generic)	4-29
4-23	Cable Routing - Second Add-On Drive	4-31
4-24	Cable Wiring Diagram of a Three- or Four-Drive System (Generic)	4-32
4-25	Removing Cable Ties (RA82)	4-36
5-1	Rear Door Removal	5-2
5-2	Front Filler Panel Removal	5-3
5-3	Connecting ESD Wrist Strap to Ground	5-7
5-4	Upper Chassis Assembly	5-8
5-5	Damper (Gas Spring) Assembly	5-9
5-6	HDA Connectors	5-10
5-7	Cable Spring Assembly	5-11
5-8	HDA Positioner Lock	5-12
5-9	Left-Hand Slide	5-14
5-10	Right-Hand Slide	5-15
5-11	Cabinet Upright Holes (60-Inch Cabinet)	5-16
5-12	Mounting the Slide Assembly	5-17
5-13	Stabilizer Foot Extension	5-19
5-14	Drive Actuator Assembly	5-20
5-15	Mounting the Drive on Slides	5-22
5-16	I/O Bulkhead Mounting	5-23
5-17	Mounting U-Nut and Standoffs	5-24
5-18	RA82 Cable Routing and Connections	5-26

5-19	Cable Wiring Diagram (First Add-On RA82)	5-27
5-20	Cable Wiring Diagram (Second Add-On RA82)	5-28
5-21	Cable Wiring Diagram (Third Add-On RA82)	5-30
5-22	Cable Wiring Diagram - External Drive (Generic)	5-31
5-23	Routing Power Cords on Cabinet Floor (Four-High)	5-34
5-24	Belt Alignment	5-35
5-25	Electrostatic Discharge Bracket Details	5-37
6-1	Removing the Rear Door	6-3
6-2	Disk Drive Access in SA482	6-4
6-3	Filler Plate Removal	6-5
6-4	Stabilizer Foot Extension	6-6
6-5	Connecting ESD Wrist Strap to Ground	6-7
6-6	Upper Chassis Assembly	6-8
6-7	Damper (Gas Spring) Assembly	6-9
6-8	HDA Shipping Brackets	6-10
6-9	HDA Details	6-11
6-10	Cable Spring Assembly	6-12
6-11	Opening the Logic Access Cover	6-14
6-12	RA82 Front Bezel Removal	6-15
6-13	Preparing Left-Hand Slide	6-17
6-14	Preparing Right-Hand Slide	6-18
6-15	Cabinet Upright Holes (60-Inch cabinet)	6-20
6-16	Mounting the Slide Assembly	6-22
6-17	Mounting the Drive on Slides	6-24
6-18	SA482 ESD Brackets	6-26
6-19	I/O Bulkhead Mounting	6-27
6-20	Mounting U-Nut and Standoffs	6-29
6-21	Cable Wiring Diagram (First Add-On RA82)	6-31
6-22	RA82 Cable Routing and Connections	6-33
6-23	Cable Wiring Diagram (Second Add-On RA82)	6-35
6-24	Cable Wiring Diagram - External Drive (Generic)	6-36
6-25	Routing the Power Cords on Cabinet Floor (Four-High)	6-38
6-26	HDA Positioner Lock	6-40
6-27	Belt Alignment	6-42

Tables

1-1	RA82 Specifications	1-12
1-2	RA82 Typical Measured Values, Table I	1-15
1-3	RA82 Typical Measured Values, Table II	1-15
1-4	Related Documentation	1-17
2-1	Indicator Conditions	2-2
2-2	RA82 Front Panel Fault Identification	2-4
3-1	SDI Cable Options	3-18
3-2	Drive Sequence Cable Options	3-20
4-1	Three-High Cabinet Specifications	4-1
5-1	RA82 Add-On Drive Checklist	5-4

5-2	RA82 Hardware Mounting Kit Checklist	5-5
5-3	RA82 Installation Holes	5-13
6-1	RA82 Add-On Drive Checklist	6-1
6-2	RA82 Hardware Mounting Kit Checklist	6-2
6-3	SA482 Installation Holes	6-19
A-1	RA82 LED Error Codes	A-1
B-1	Static Control Materials Part Number List	B-1

About This Manual

This manual contains a product description and operating information for the end user of the RA82 disk drive. Drive specifications are included in the introductory material of this manual.

Installation instructions in this manual are for use by DIGITAL field service engineers performing original installation of the RA82 disk drive.

INTRODUCTION

1.1 GENERAL INFORMATION

The RA82 is a movable-head disk drive with non-removable recording media. The RA82 is a member of the Digital Storage Architecture (DSA) family and can be connected to any controller that uses the Standard Disk Interconnect (SDI) cable and protocol.

Each RA82 has a data storage capacity of 623 megabytes in 16-bit word format (PDP-11 and VAX systems). Other features of the RA82 disk drive follow:

Performance

- 19.2 megabits per second transfer rate
- 24 milliseconds average seek time

Data integrity

- Protected (sealed) media
- Microprocessor-controlled servo
- SDI-invoked error recovery hardware

Hardware

- Simple modular construction
- Reduced field replaceable unit (FRU) set
- Rugged design
- Two internal microprocessors

Maintainability

- Improved and easy service access
- No scheduled preventive maintenance
- Extensive internal microcode diagnostics
- Access to RS232 diagnostic terminal port behind front cover

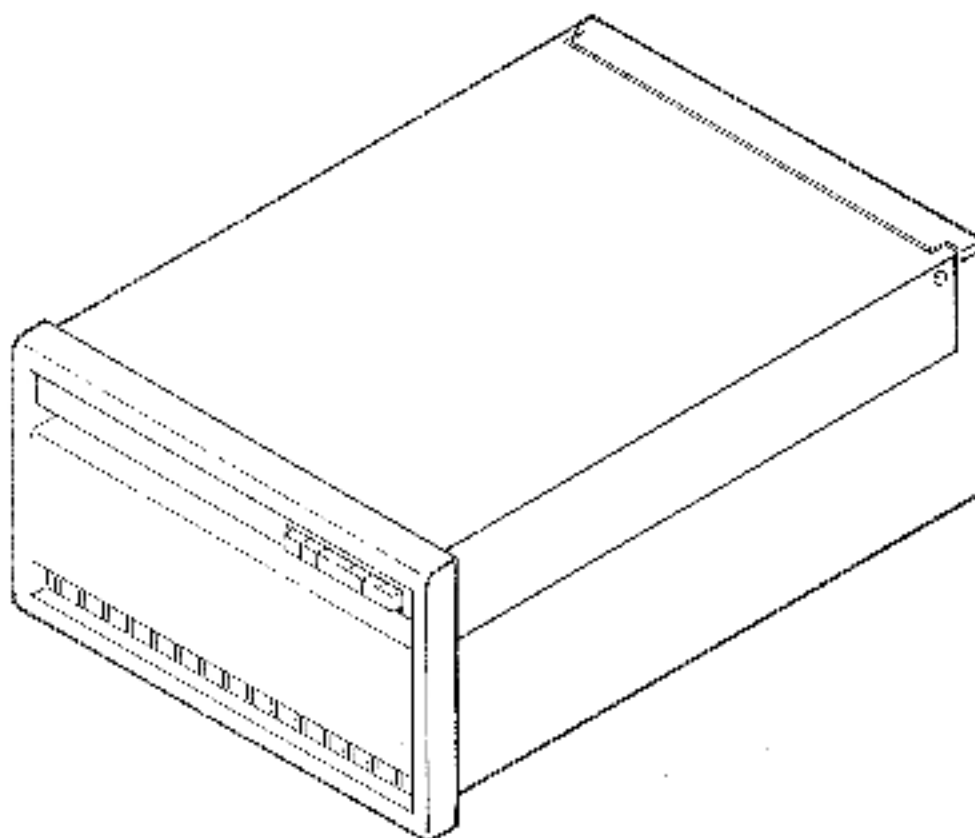
1.2 DATA BACKUP

Some method of backup must be used on fixed media drives to prevent loss of data in the event of a system failure. The following methods of backup are recommended for the RA82:

- **File Duplication** - normally involves copying the data on removable media such as magnetic tape.
- **Journaling** - recommended for files in a transaction processing application. Allows reconstruction of files up to the last checkpoint or backup.

1.3 DRIVE DESCRIPTION

The RA82 is a self-contained disk drive. Logic modules, dc power supply, and a cooling system are all within the drive cabinet. Figure 1-1 shows an RA82 disk drive.



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Figure 1-1 RA82 Disk Drive

The logic modules are made up of three removable circuit board assemblies (hybrid, servo, and read/write module) that can be folded out for ease of service (Figure 1-2).

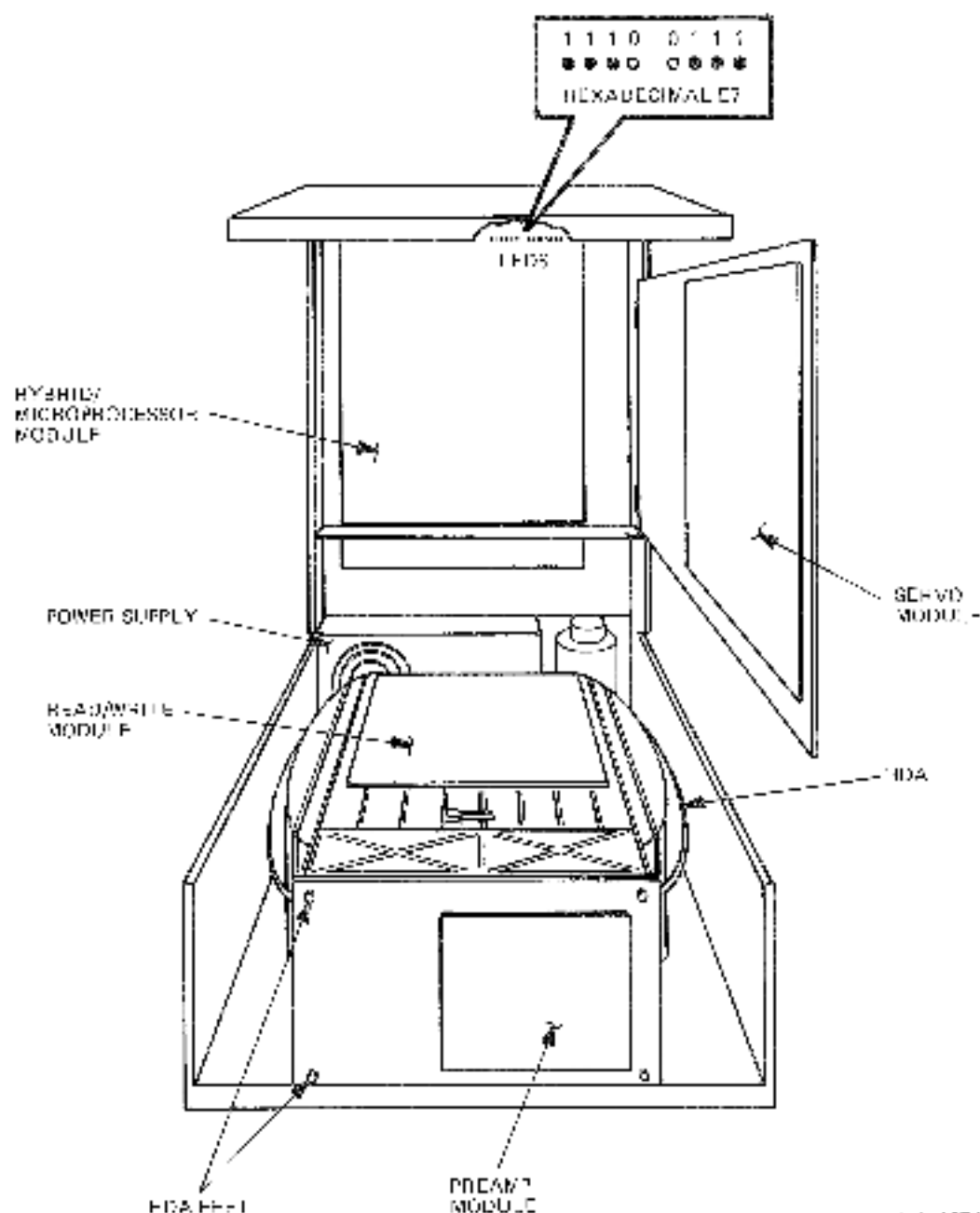


Figure 1-2 Hinged Circuit Module Arrangement

The dc power supply is located inside the back of the drive. The supply provides the dc operating power for the logic circuits. A cooling system which includes internal fans provides air circulation for the power supply and other drive components.

In addition, the RA82 houses the head disk assembly (HDA), a sealed unit inside the drive which contains and protects the recording media, and a rotary positioner, read/write heads, and a preamplifier module.

The drive also has slide rails designed to be fitted to a 19-inch wide RETMA equipment rack. This type of rack is housed inside a 60-inch high cabinet that holds up to four drives (mounted on slides) or a 40-inch high cabinet that holds up to three drives (one fix-mounted and two mounted on slides).

The drive recording media is made up of four disk platters. Each platter contains two recording surfaces, upper and lower, for a total of eight surfaces. Seven of the disk surfaces are for data storage only; the remaining surface is equally shared between data and dedicated servo information. Figure 1-3 shows these disk surfaces.

Additional servo information, called embedded servo, is written before each block of data on the data surfaces. Both types of servo information are created on the disks when the HDA is manufactured.

The heads are mounted on a rotary positioner which moves in an arc over the recording surfaces. The drive has sixteen heads (two per data surface): fifteen for reading and writing data and one for reading the dedicated servo. Figure 1-3 shows the head arrangement. To position the heads over the desired data location, the RASZ reads the servo information and moves the positioner accordingly.

Attached to the outside of the HDA are the read/write and preamplifier modules. The read/write module, located on top of the HDA, works with the preamplifier module to select read/write heads, generate write-drive current, amplify read signals, and monitor unsafe conditions in the HDA. (Refer to Figure 1-2 for module locations.)

1.3.1 Physical and Logical Media Layout

Each of the read/write heads accesses a group of concentric tracks. The tracks under the heads at any instant are grouped together into a logical cylinder. (In other words, a logical cylinder consists of all the tracks that can be read without moving the positioner.)

A track is divided into a number of sectors each of which contains a fixed number of bytes. A sector is the equivalent of a logical block. At the end of each sector is an error detection code (EDC) which is used by the controller for detecting errors, and an error correction code (ECC) which can reconstruct data bits that were lost or garbled. One sector of each track (the last sector in LBN and RCT space) is a spare which can be used to replace a weak or corrupted sector. Each of these spare sectors is assigned a replacement block number (RBN). A map of these replaced sectors is maintained on a designated part of the media called the replacement control table (RCT).

The controller converts each logical block number (LBN) into logical cylinders, groups, tracks, and physical sectors.

The physical structure of the media format is invisible to the user. The controller keeps track of where the data is physically stored. An LBN with bad or suspect data is flagged for replacement/relocation. The controller automatically replaces the flagged LBN with a spare sector. Thus, the host computer sees the disk subsystem as a collection of continuous logical blocks.

Figure 1-4 shows the physical and logical layout of the media. Figure 1-5 shows disk media geometry.

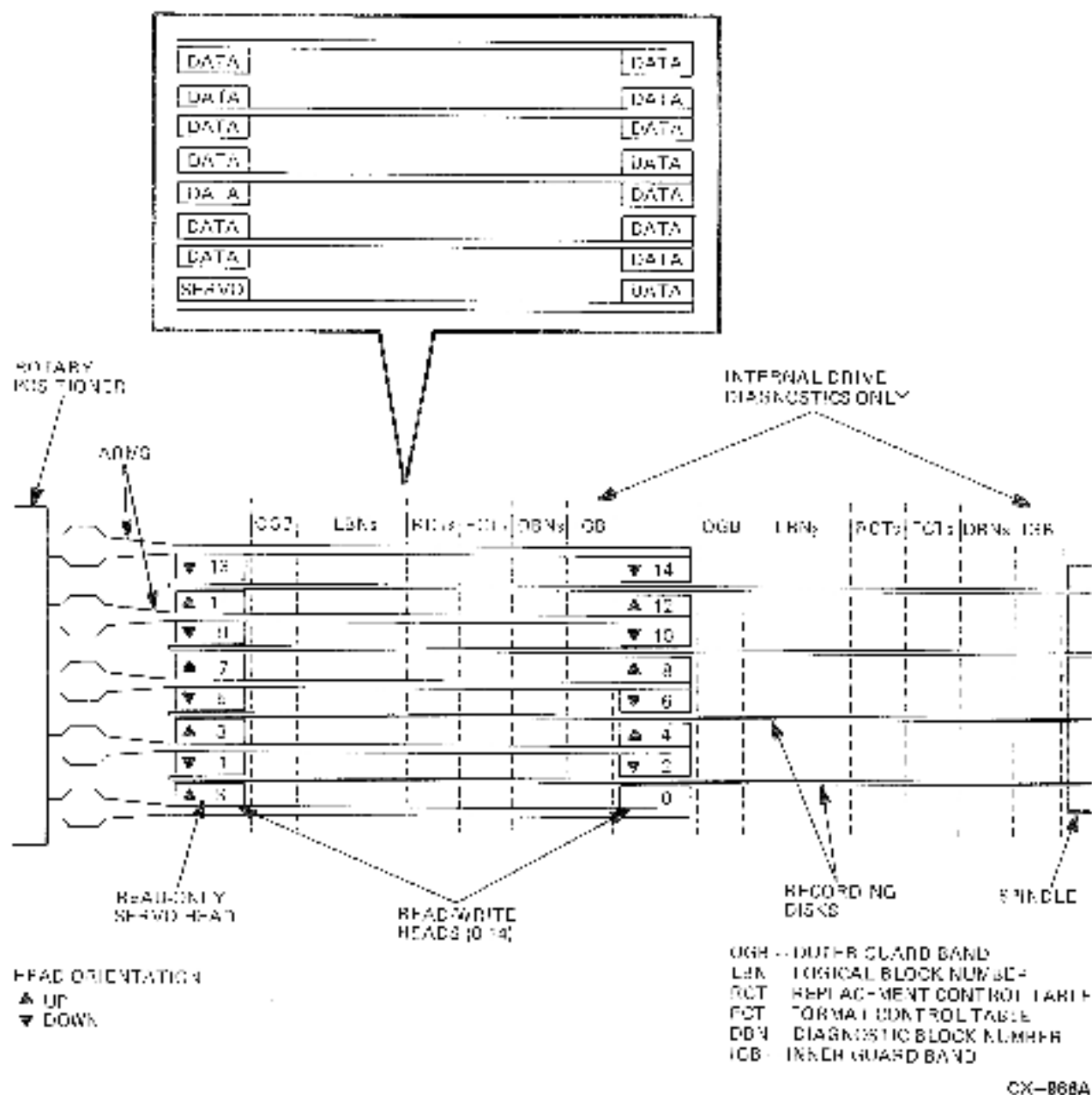


Figure 1-3 HDA Head Arrangement

1.3.2 Media Format

Each of the read/write heads can address 1435 cylinders (numbered 0 through 1434). There are 58 sectors (numbered 0 to 57) per track in 16-bit word format. Each sector includes information encoded in a header preceding the data to identify the type of block (LBN, RBN, XBN or DBN) and block number.

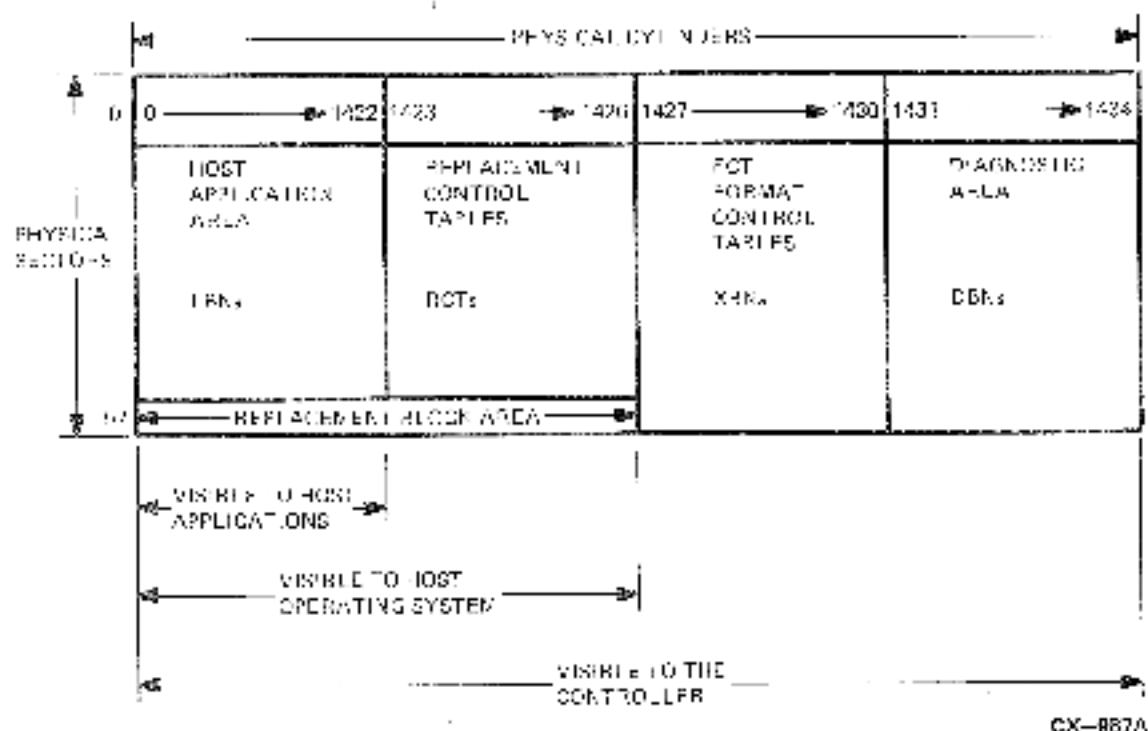


Figure 1-4 Physical and Logical Media Layout

Figure 1-6 shows the RA82 sector format details.

The RA82 employs a sector offset method to compensate for rotational latency during head switching.

1.3.3 Internal Microprocessors

The RA82 has a dual (master and slave) microprocessor control system. Except for the read and write operations, the microprocessors control and/or monitor all primary functions of the disk drive. The slave handles the mechanical functions of the drive (such as head loading, servo positioning, and motor control). The master manages and monitors overall drive functions and handles SDI communication. Both microprocessors share diagnostic responsibilities.

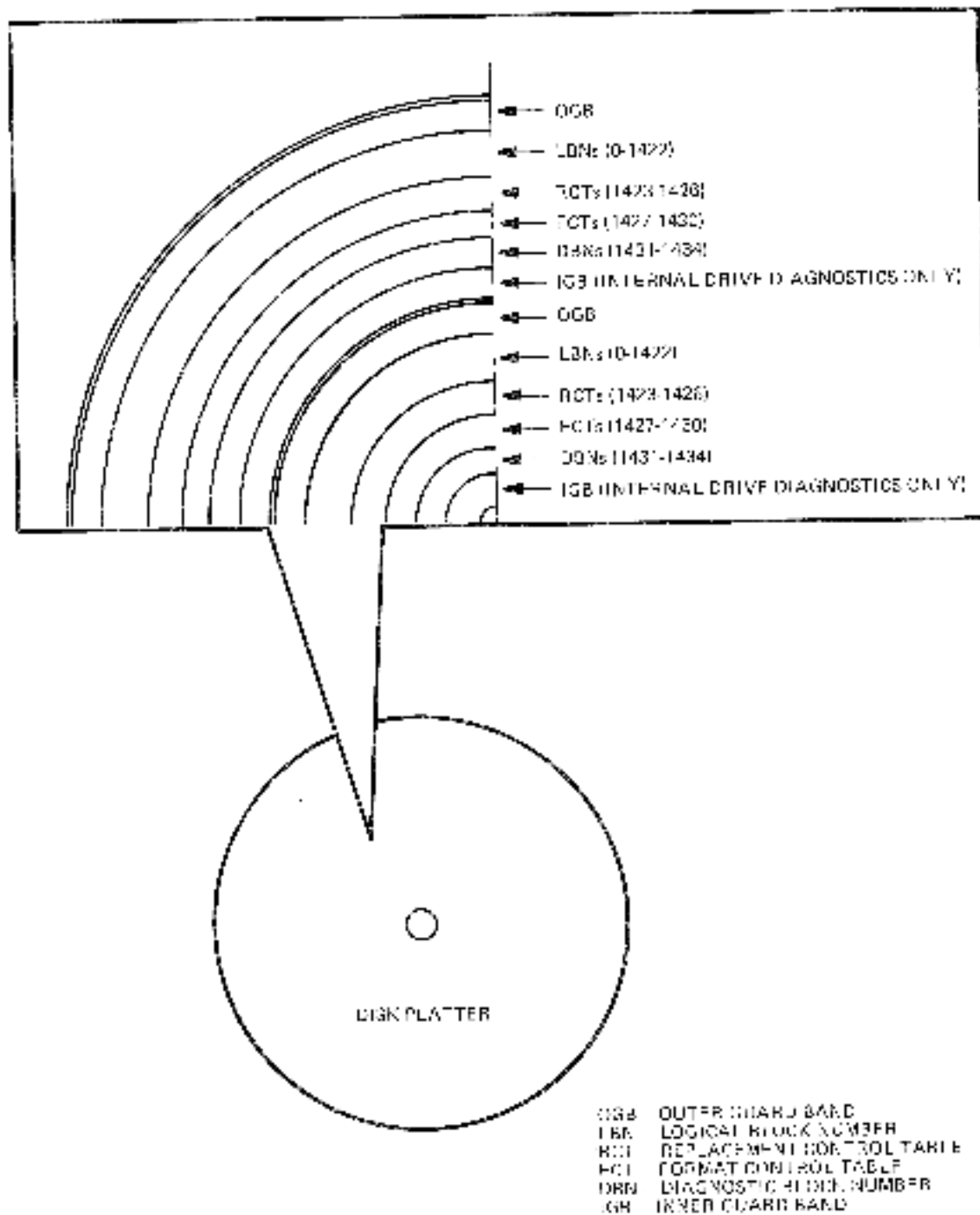


Figure 1-5 Disk Geometry

SECTOR POINTER	HEADER			DATA PREAMBLE	SYNCH	DATA FIELD	END	LOCK FLAG	DATA POST AMBLE	READ-TO- WRITE RECOVERY
1 WORD OF ZEROS	PREAMBLE 2 WORDS OF ZEROS	SYNCH CHAR 1 WORD	HEADER 2 WORDS 4 BITS (8 WORDS)	19 WORDS OF ZEROS	DATA SYNCH CHAR 1 WORD	256 WORDS (16-BIT FORMAT)	1 WORD	1 WORD	1 WORD OF ZEROS	UNRECOVERED DATA 37 WORDS

DISK FORMAT PROTECTED BY © DIGITAL EQUIPMENT CORPORATION, 1986

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Figure 1-6 RA82 Sector Format

1.4 INTERNAL DRIVE DIAGNOSTICS

Most RA82 self-diagnostics execute during drive power-up and spin-up. Internal LED indicators on the hybrid module (Figure 1-2) display the results of the self tests.

The remaining diagnostics are initiated and monitored by field service engineers using a diagnostic terminal. The drive performs these diagnostics in an offline mode or through SDI diagnostic requests from the controller in an online mode to the controller.

Refer to Chapter 3 for additional information on the internal drive diagnostics and to Appendix A for a list of LED error codes.

1.5 CONTROLLER AND DRIVE CONFIGURATIONS

An RA82 disk drive subsystem consists of an SDI controller (or two controllers in a dual-port configuration) and one or more disk drives. Figure 1-7 shows the relationship between the subsystem components.

Connections between the SDI controller and the RA82 disk drive are illustrated in Figure 1-8. The standard RA82 dual port feature permits a second controller to be connected to a single drive and provides shared access of the drive between the two controllers (Figure 1-9). In this arrangement, called static dual-porting, the controller accesses only one drive at a time. The controller accessing the drive must relinquish its ownership of the drive before the other controller can access it.

NOTE

A drive can be dual-ported between two controllers only if supported by system software. If each controller is connected to a different host computer, both operating systems must use the same word format and file structure as well as support the dual-port feature.

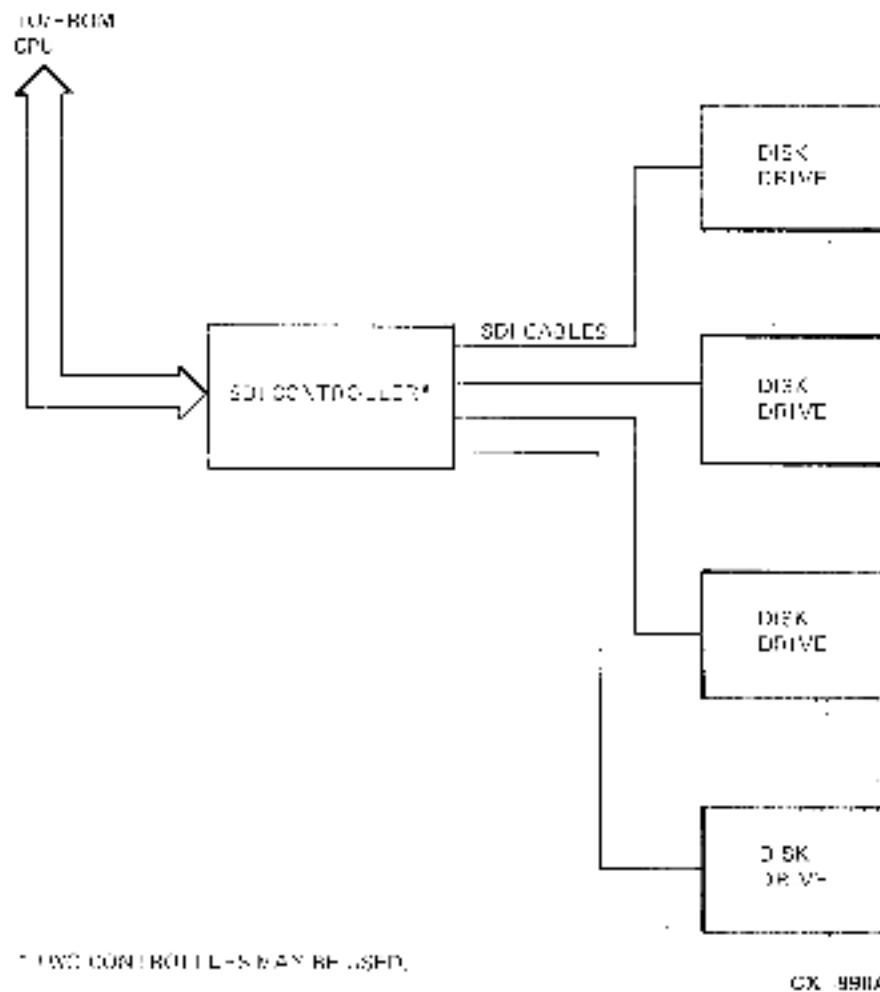


Figure 1-7 Typical RA82 Disk Drive Subsystem Block Diagram

1.6 RA82 SPECIFICATIONS

Table 1-1 contains the primary performance, power, environmental, and physical characteristics of the RA82 disk drive.

CAUTION

The term *operating* in Table 1-1 indicates values not to be exceeded while the drive is operational. The term *nonoperating* indicates values not to be exceeded when the drive is being stored. Exceeding these values may damage the drive.

Table 1-2 and Table 1-3 show typical measured values of the RA82.

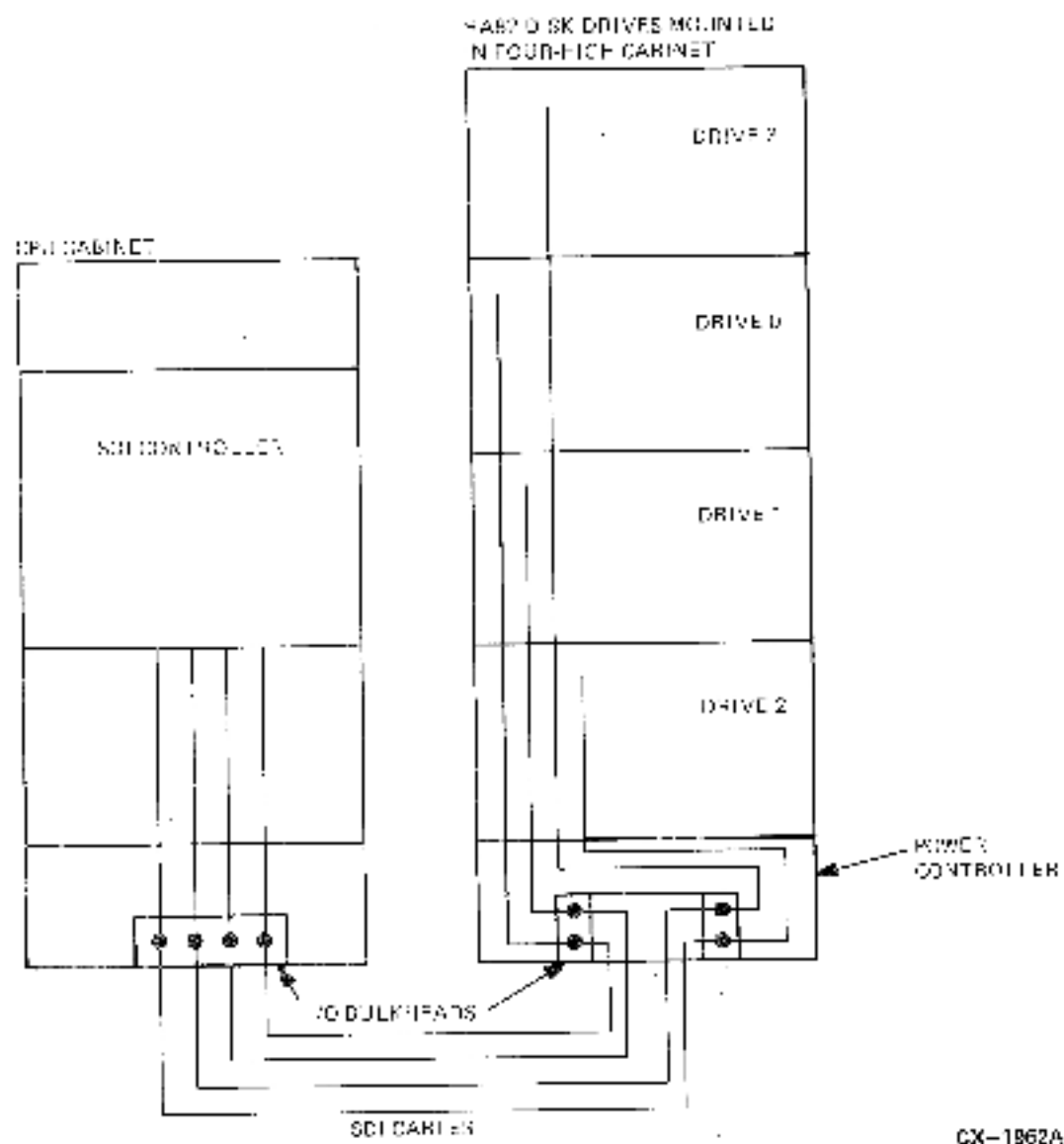


Figure 1-8 Single Port, Multi-Drive Configuration

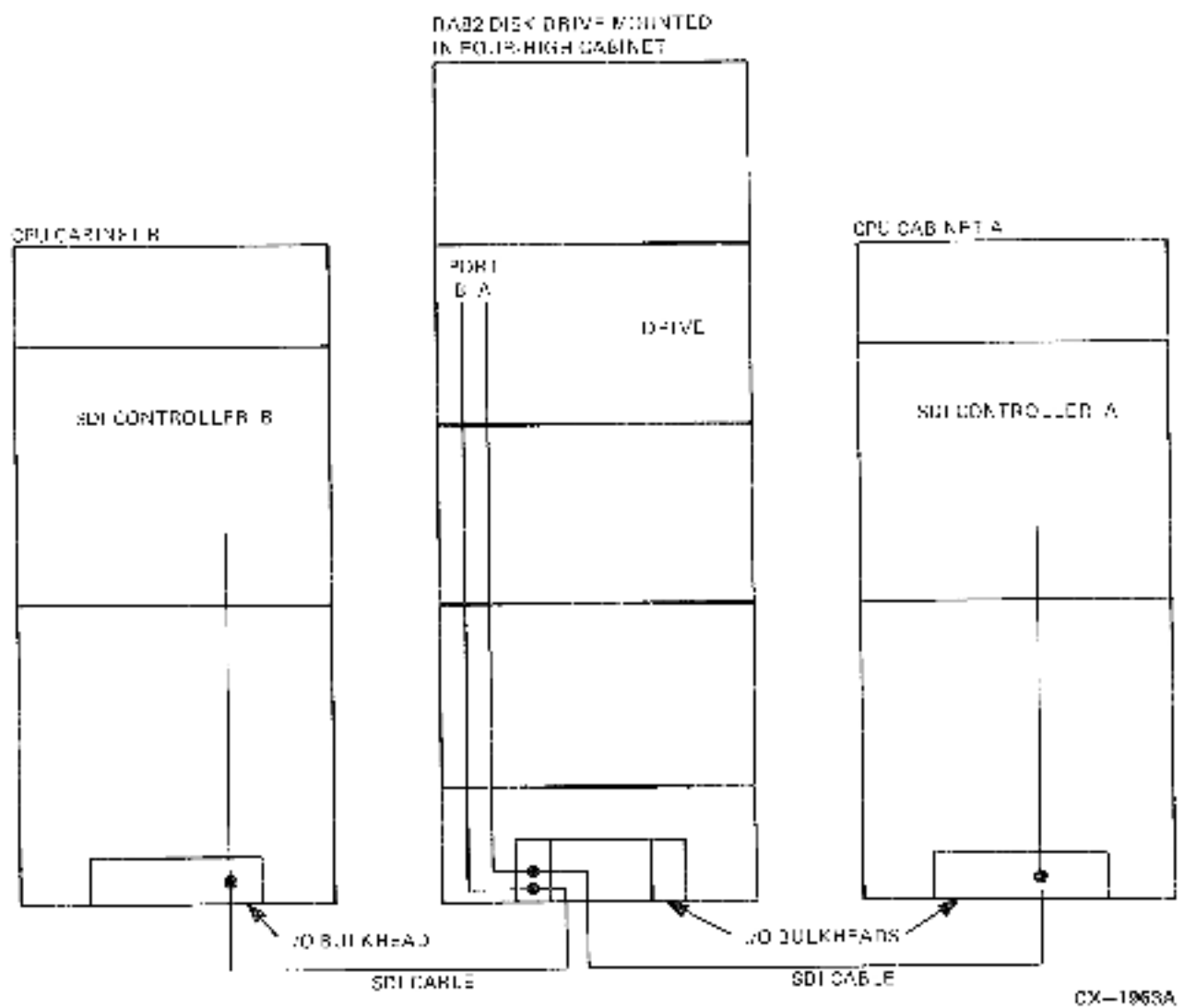


Figure 1-9 Dual-Port Configuration

Table 1-1 RA82 Specifications

Characteristics	Specifications
Data storage capacity (Host Applications Area) single drive	
16-bit word format	622.93 megabytes (formatted)
Media type	Winchester head disk assembly
Number of spindles	1
Number of disk platters/spindle	4
Disk surfaces/spindle	7 1/2 data, 1/2 servo (eighth disk surface is shared with servo data)
Number of heads/spindle	15 data, 1 servo
Heads per disk surface	2
Logical cylinders per head (Non-DSA formatted)	1438
Sectors per track 116-bit format	58
Tracks per logical group	1
Groups per logical cylinder	15
Performance characteristics	
Disk encoding method	2/3
Recording density	
Tracks per inch	1063
Bits per inch	12,800 bits per inch; 9,624 flux changes per inch at inner track
Bytes per track	40,000 (unformatted)
Transfer rate (bit rate)	19.2 megabits per second nominal/spindle
Bit cell period	52.08 nanoseconds nominal
Data rate	2.4 megabytes per second nominal (burst)/spindle
Read initialization time	
Write-to-read recovery	10 microseconds excluding data separator sync
Read-to-write recovery	1 microsecond
Data separator synchronization	10 microseconds
Rotational Latency	
Rotational speed	3600 r/min +2.5%, -3.5%
Average rotational latency	6.33 milliseconds
Maximum rotational latency	16.66 milliseconds
Head switch latency (time to switch heads on a given cylinder)	6 milliseconds maximum
Average seek	24 milliseconds
One cylinder seek	6 milliseconds maximum
Maximum seek	38 milliseconds maximum (1435 tracks)
Disk rotation start/stop times	

Table 1-1 (Cont.) RA92 Specifications

Characteristics	Specifications
Start time	50 seconds (to ready) maximum
Stop time	20 seconds maximum
Maximum start/stop frequency	6 minutes (3 minutes between cycles with the drive powered up and ready during one of the three-minute cycles)
Physical characteristics (drive only)	
Width (nominal)	44.5 centimeters (17.5 inches)
Depth (nominal)	67.3 centimeters (26.5 inches)
Height (nominal)	25.4 centimeters (10.4 inches)
Weight (approximate)	61.2 kilograms (135 pounds)
Environmental limits (maximum)	
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)
Nonoperating	-40 to +60 degrees C (-40 to +140 degrees F)
Relative humidity	
Operating	10% to 85% (noncondensing) 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)
Nonoperating	10% to 85% with no condensation
Altitude	
Operating	Sea level to 2438 meters (8000 feet) above sea level. Maximum allowable temperatures are reduced by a factor of 1.8 degrees F/1000 meters (1 degree C/1000 feet) for operation at higher altitude sites
Nonoperating	200 meters (1000 feet) below sea level to 9175 meters (30,000 feet) above sea level (actual or by means of cabin pressurization)
Environmental limits (recommended range)	

Table 1-1 (Cont.) RA82 Specifications

Characteristics	Specifications
The following environmental limits are the recommended range for optimum equipment performance and reliability:	
Temperature	18 to 24 degrees C (64.4 to 75.2 degrees F) with an average rate of change of 3 degrees C/hour maximum and a step change of 3 degrees C or less
Relative humidity	40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Air quality (maximum particle count)	Not to exceed 500,000 particles per cubic foot of air at a size of .5 micron or larger
Air volume (at inlet)	50 cubic feet per minute (.026 cubic meters per second)
RA82 disk drive ac voltage requirements, single phase	
NOTE: These are the only voltage/frequency configurations available	
120 volt, 60 Hz drives	90 to 128 volts ac, 60 $\pm$ 1 Hz
220/240 volt, 50 Hz drives	181 to 256 volts ac, 50 $\pm$ 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 to 240 volt ac drives	18 ampere peak surge for 4 seconds
Running current for 220 to 240 volt ac drives	3.5 amperes rms at 240 volts
Running power for 120 volt ac drives	936 watts
Running power for 220 to 240 volt ac drives	840 watts
Power factor	0.65 minimum
Line cord length (from cabinet)	259 cm (8.5 feet)
DC voltage tolerances	
+5 volts	+4.75 to +5.25 volts dc (+5 volts $\pm$ 5%)
-5.2 volts	-5.04 to -5.56 volts dc (-5.2 volts $\pm$ 5%)
+24 volts	+23.0 to +27.0 volts dc (+24 volts unregulated, 3% long term stability)
-24 volts	-23.0 to -27.0 volts dc (-24 volts unregulated, 3% long term stability)

Table 1-2 RA82 Typical Measured Values, Table I

Voltage	Inrush Current First Half Cycle (peak)	Surge Current (startup peak)	Surge Duration (startup)	Power On (I)	Heads Loaded (I)
184 V (50 Hz)	23 amps	10 amps	80 msec	1.5 amps	3.0 amps
240 V (50 Hz)	38 amps	15 amps	30 msec	1.6 amps	3.5 amps
256 V (50 Hz)	62 amps	18 amps	30 msec	1.9 amps	3.8 amps
90 V (60 Hz)	40 amps	15 amps	130 msec	3.2 amps	10 amps
120 V (60 Hz)	90 amps	35 amps	45 msec	3.3 amps	7 amps
128 V (60 Hz)	98 amps	40 amps	45 msec	3.6 amps	8 amps

Table 1-3 RA82 Typical Measured Values, Table II

Voltage	Watts (Heads loaded)	Watts (Powered On)	BTU/Hr. (Heads loaded)	BTU/Hr. (Powered On, HDA Stopped)
184 V (50 Hz)	490	277	1672	945
240 V (50 Hz)	560	308	1911	1051
256 V (50 Hz)	600	323	2047	1102
90 V (60 Hz)	500	286	1706	976
120 V (60 Hz)	560	310	1911	1058
128 V (60 Hz)	593	320	2023	1092

1.7 ELECTROSTATIC DISCHARGE (ESD)

Electrostatic discharge (ESD) is caused by the buildup and release of static electricity (the surface storage of an electrical charge on a person or an inanimate object). The effects of static electricity on equipment are subtle. Damage may be caused from the static on a person and also by the static field that is emanated from a person. Some components don't have to be touched to become damaged by static electricity. This is especially true of delicate oxide layers that, when damaged, can cause equipment to perform intermittently or fail.

1.7.1 Electrostatic Protection

The basic concept of complete static electricity protection for electronic components is the prevention of static buildup, where possible, and the quick, reliable removal of existing charge. If the charged object is a conductor, such as a conductive bag or person, complete discharge can be achieved by grounding.

CAUTION

For drive protection, a grounding (electrostatic discharge) wrist strap must be used when handling drive modules and components.

The following are required of all individuals who handle or work with this equipment:

- Proper grounding when handling modules, components, or static-sensitive devices. Establishing zero voltage potential between people and devices being handled.
- Transferring modules and components in static-protective containers (totes, boxes, and bags).
- Implementing and maintaining proper static control training certification.

NOTE

Read all instructions and installation procedures included with the static control materials and kits. If part numbers for static control materials and demonstration kits are needed, refer to Appendix B.

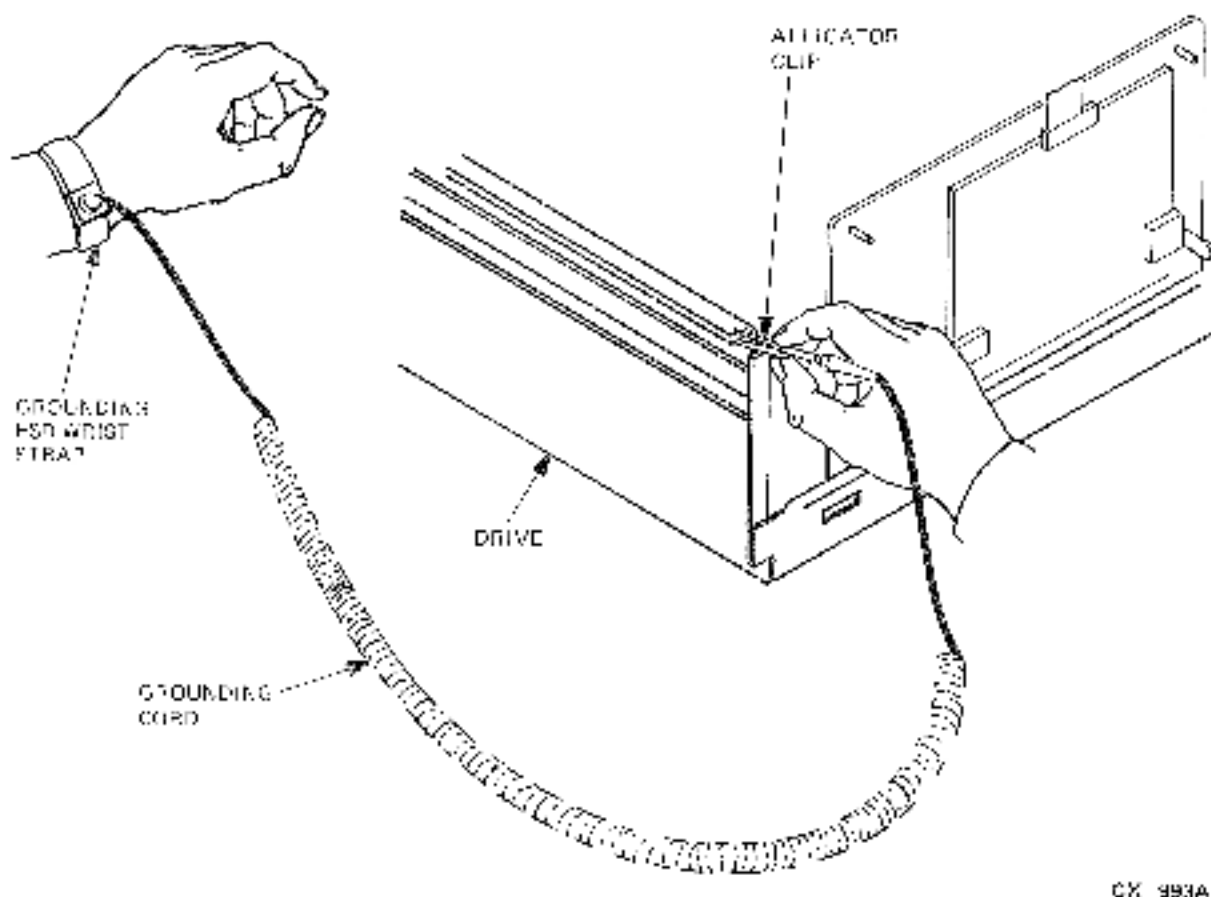
Figure 1-10 shows the electrostatic wrist strap in use. Notice the fastener on one end of the grounding cord and the alligator clip on the other. The grounding cord connects the wrist strap and the conductive work surface to ground.

When using an ESD wrist strap:

- Make sure the wrist strap fits snugly to assure conductivity.
- Never overextend the grounding cord. Use a longer grounding cord if necessary.
- Attach the alligator clip securely to a clean, unpainted, *grounded metal* surface such as the drive chassis.

1.8 RELATED DOCUMENTATION

Table 1-4 contains a list of related RA82 documentation.



CX 993A

Figure 1-10 Connecting ESD Wrist Strap to Ground**Table 1-4 Related Documentation**

Document Title	Part Number
<i>U3C Disk Controller User Guide</i>	AA-GMEAA-TE
<i>KDA50 Disk Controller User Guide</i>	EK-KDA5Q-UG
<i>KDB50 Disk Controller User Guide</i>	EK-KDB5Q-UG
<i>UDA50 Disk Controller User Guide</i>	EK-UDA5Q-UG
<i>DSA Hand Held Terminal User Guide</i>	EK-DSAHH-UG
<i>H9646 AH/AJ Cabinet System User Guide</i>	EE-H9646-UG
<i>H9642-JA/IB Installation Sheet</i>	EK-9642-IN
<i>881 Power Controller User Guide</i>	EK-881PC-UG

1.9 ORDERING DOCUMENTATION

Internal DIGITAL customers:

Publication and Circulation Services

10 Forbes Road

Northboro, Massachusetts 01532

(RCS Code: NR12, Mail Code: NR03/W3)

External DIGITAL customers:

Digital Equipment Corporation

P.O. Box CS2008

Nashua, New Hampshire 03061

or by calling toll-free: (800) 258-1710.

Outside the United States, customers should contact one of the following DIGITAL offices:

Europe:

Digital Equipment International BV

Mervue Industrial Estate

Galway, Ireland

Telephone [353]-(91)-54271

Digital Equipment Parts Centre BV

P.O. Box 6774

NL-6503 GG Nijmegen, Netherlands

Telephone [31]-(80)-529911

Far East and General G1A Area:

Accessories and Supplies Group

P.O. Box CS2008

Nashua, New Hampshire, USA 03061

Telephone (603) 844-5111

OPERATING INSTRUCTIONS

2.1 CONTROL PANEL SWITCHES AND INDICATORS

Each switch on the operator control panel has an indicator light that displays the drive conditions. The RA82 operator control panel has the following switches and indicators:

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

Figure 2-1 shows the arrangement of these controls on the front panel of the drive. Table 2-1 lists the conditions reflected by the state of the indicator lights. The following paragraphs describe these controls and indicators in more detail.

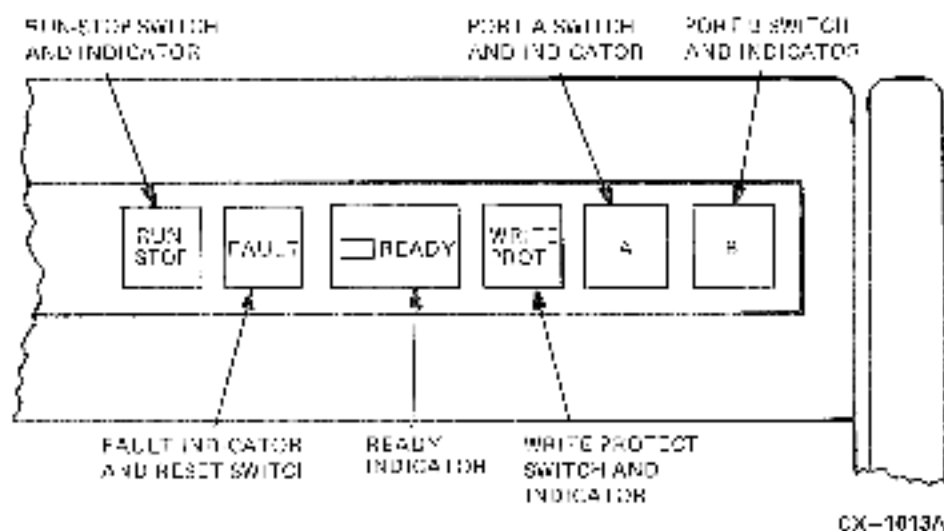


Figure 2-1 Front Panel Controls and Indicators

Table 2-1 Indicator Conditions

Indicator	Turned On	Turned Off
RUN/STOP	When disk is spinning	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 cannot process host requests or is not on cylinder (seeking)
WRITE/PROT	When drive is physically or logically write-protected	When drive is write-enabled
A	When drive is online to controller A	When drive is not online to controller A
B	When drive is online to controller B	When drive is not online to controller B

2.1.1 RUN/STOP Switch and Indicator

The RUN/STOP switch is a double-action push button. In the IN (RUN) position, the switch requests a drive spinup and permits initialization of the drive for operation. In the OUT (STOP) position, the heads are moved off the data cylinders and the spindle motor is stopped.

CAUTION

If the disk does not spin down after releasing the RUN/STOP switch, contact field service.

Regardless of the switch position, the RUN/STOP indicator light always reflects the state of the drive spindle. That is, the indicator light is on while the spindle is turning and off when it has stopped.

If the RUN/STOP switch is in the run position on powerup, spinup can be initiated either automatically by the controller or by manually toggling the RUN/STOP switch.

If the drive is online and operating when the switch is placed in the stop position, the drive completes all outstanding operations commanded by the controller before spinning down.

NOTE

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

2.1.2 FAULT Switch and Indicator

The FAULT light indicates a fault or error condition within the drive. The FAULT reset switch displays front panel fault codes and clears drive conditions.

NOTE

Some drive conditions cannot be cleared by pressing the FAULT switch.

When the disk drive detects an error, the FAULT light turns on. Some faults are corrected automatically, and the light goes off. If this does not occur, the light stays on and the FAULT button must be pushed. The drive stays in its current operating state until the condition is corrected.

The FAULT button is a momentary contact switch. When pushed the first time, it causes the drive to enter an offline state (relative to the controller) and to assume control of all front panel indicator lights in order to display a blinking front panel fault code (table 2-2). The drive stays offline as long as the fault code is displayed and the lights are blinking. When the FAULT switch is pushed a second time, the drive tries to clear the condition, enters the available operating state (assuming a port switch is pushed), and returns the front-panel indicators to their normal service.

Front panel fault codes show general fault conditions. Only the most recent or most severe fault codes can be read through the front panel. The LED hexadecimal error codes displayed on the hybrid module (figure 1-2) show specific error conditions. The error codes are stored in drive memory as the error conditions are cleared. The 16 most recent error codes are stored in the drive internal error site for use in troubleshooting the drive. Appendix A lists the hybrid LED error codes and associated drive conditions. Error condition hex codes are sent to the controller/host error log. Table 2-2 gives an explanation of the error condition hex codes that are logged in the controller/host error log.

The FAULT indicator is also used for a lamp test. When held in (after hardware test sequence is completed), all operator control panel lights should illuminate. When released, all lights return to the condition of the drive (last known state or fault code).

Table 2-2 RAB2 Front Panel Fault Identification

RUN/ STOP	FAULT	READY	WRITE PROT	A	B	Hex Code*	Error Condition
—	On	—	—	—	On	08	Spindle error
—	On	—	—	On	—	04	Hybrid fault
—	On	—	—	On	On	0C	NDF error
—	On	—	On	—	—	10	Master/slave error
—	On	—	On	—	On	18	Servo fine positioning error
—	On	—	On	On	—	14	Servo coarse positioning error
—	On	—	On	On	On	1C	Spindle motor interlock error
—	On	On	—	—	—	01	Servo or HDA overtemp error
—	On	On	—	—	On	09	Read/write unsafe error
—	On	On	—	On	—	05	Read/write command error
—	On	On	—	On	On	0D	Servo-HDA-R/W interlock error
—	On	On	On	—	—	11	Hybrid-servo interlock error
—	On	On	On	—	On	19	Hybrid-R/W interlock error
—	On	On	On	On	—	15	Hybrid-OCP interlock error
On	—	On	On	On	On	xx	DC low
On	On	—	—	—	—	20	Index error
On	On	—	—	—	On	28	Write and bad embedded servo
On	On	—	—	On	—	24	Drive disabled by DD bit
On	On	—	—	On	On	2C	Write and write protect
On	On	—	On	—	—	30	Servo diagnostics failed
On	On	—	On	—	On	38	Read/write diagnostics failed
On	On	—	On	On	—	34	Idle diagnostics failed
On	On	On	On	On	On	3D	Power-up diagnostics failed

* This hex code represents the code that appears in error log information for drive status byte 15. This hex code is not displayed by the front panel indicator lights.

xx The dc low condition prevents code transmission to the controller and, therefore, does not have a hexadecimal code representation for host diagnostic or error logging output.

2.1.3 READY Plug and Indicator

The numbered plastic cap over the READY indicator lamp serves as a unit address plug. It does not contain a switch. The plastic tabs on the rear of this cap provide a binary code which identifies one drive unit from another in multidrive arrangements. See Figure 2-2.

The binary or unit code corresponds to the drive number when plugged into the mating cam-coded switch located behind the READY indicator light. Drive selection is accomplished when the address on the drive select lines matches the code established by the switch cover (Figure 2-3).

The READY indicator lights following a successful (fault-free) spin-up sequence, indicating the drive is up to speed and ready to receive READ/WRITE or SEEK commands. The READY indicator only comes on when the RUN/STOP switch is in the RUN position and the RUN light is on. The READY indicator goes out during seek operations.

NOTE

If both port-select switches (A and B) are placed in the OUT position while the READY indicator is on, the READY indicator goes 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 goes on and off intermittently while this self test is being executed.

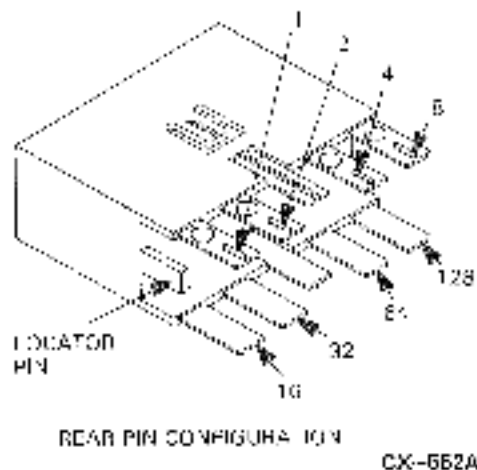
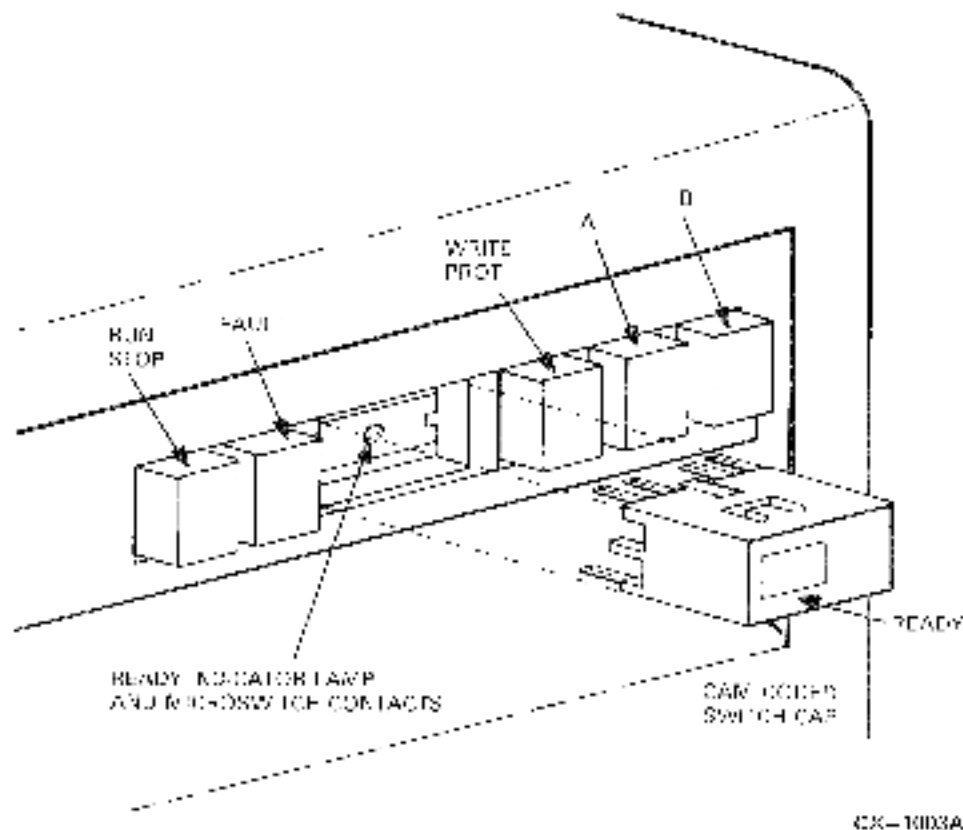


Figure 2-2 Drive Unit Address Plug (Ready Cap)

2.1.4 WRITE PROTECT Switch and indicator

The WRITE PROTECT 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. While in the write-protect mode, the drive firmware and logic blocks WRITE-DATA-OPERATION commands. Releasing the push button (OUT) enables the write circuits and turns off the WRITE PROT indicator light.



CX-1003A

Figure 2-3 Cam-Coded Switch Cover

2.1.5 Port Select Switches

The RA82 disk drive has two port select push button double-action switches (A and B) with built-in lights. When pushed, these switches light to indicate the port through which the drive is being accessed by the controller. If both port switches are pushed in, either port can be accessed by the controller, though not at the same time. The following three modes can then be selected with the A and B port-select switches:

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

NOTE

Pushing the port A or B switch does not put the chosen port on line, but only enables that port to the controller. The port is on line when (1) the port switch is in and (2) the controller accesses the port.

Also, both port select switches must be OUT to run internal drive diagnostics.

2.2 REAR POWER CONTROLS

Power control switches are located on the rear of the cabinet power controller and on the rear of the individual disk drives. To gain access to these controls, open the rear door of the cabinet.

The two basic controls on the power controller are the circuit breaker and the Bus/Off/On switch. Refer to Figure 2-4 for four-high (60-inch) cabinets and Figure 2-5 for three-high (40-inch) cabinets. The following paragraphs give the function of each.

NOTE

Always spin down the disk (spindle completely stopped) before switching off the disk drive or power controller circuit breaker. If the disk does not spin down after releasing the RUN/STOP switch, contact field service.

2.2.1 Power Controller Circuit Breaker

The power controller circuit breaker controls the ac power to all the ac circuits in the power controller and provides overload protection for the output receptacles. (The 881 power controller in the four-high cabinet has SWITCHED receptacles only.) The power controller circuit breaker must be in the ON position to draw power from any of its ac outlets.

2.2.2 Bus/Off/On Switch (881 Power Controller)

The 881 power controller rear panel contains a three-position Bus/Off/On switch (Figure 2-4.) This switch controls ac power to the nine ac outlets and selects remote operation. When the circuit breaker to the power controller is ON, the following conditions apply: the ac outlets are energized when the Bus/Off/On switch is in the ON position and not energized when the Bus/Off/On switch is in the OFF position.

The BUS position of the Bus/Off/On switch is intended for remote sensing of DIGITAL power control bus instructions. This position requires the use of a remote sensing cable shipped with the power controller. If you don't have this cable, or your application does not require the use of the DIGITAL power control bus, leave the switch in the ON position.

NOTE

Some power controllers (other than the 881), have a LOCAL/REMOTE switch. This switch only controls the power to ac outlets marked SWITCHED. The REMOTE position is intended for remote sensing of a keyswitch on a CPU cabinet. This feature enables the power controller to be turned on when the CPU is turned on and requires the use of a remote sensing cable.

For more detailed information on the 881 power controller, refer to the *881 Power Controller User Guide* (DIGITAL Order Number EK-881PC-UG). Refer to Figure 2-6 for plug designations and information.

NOTE

The three-high, 40-inch cabinet uses the 874 power controller.

2-5 OPERATING INSTRUCTIONS

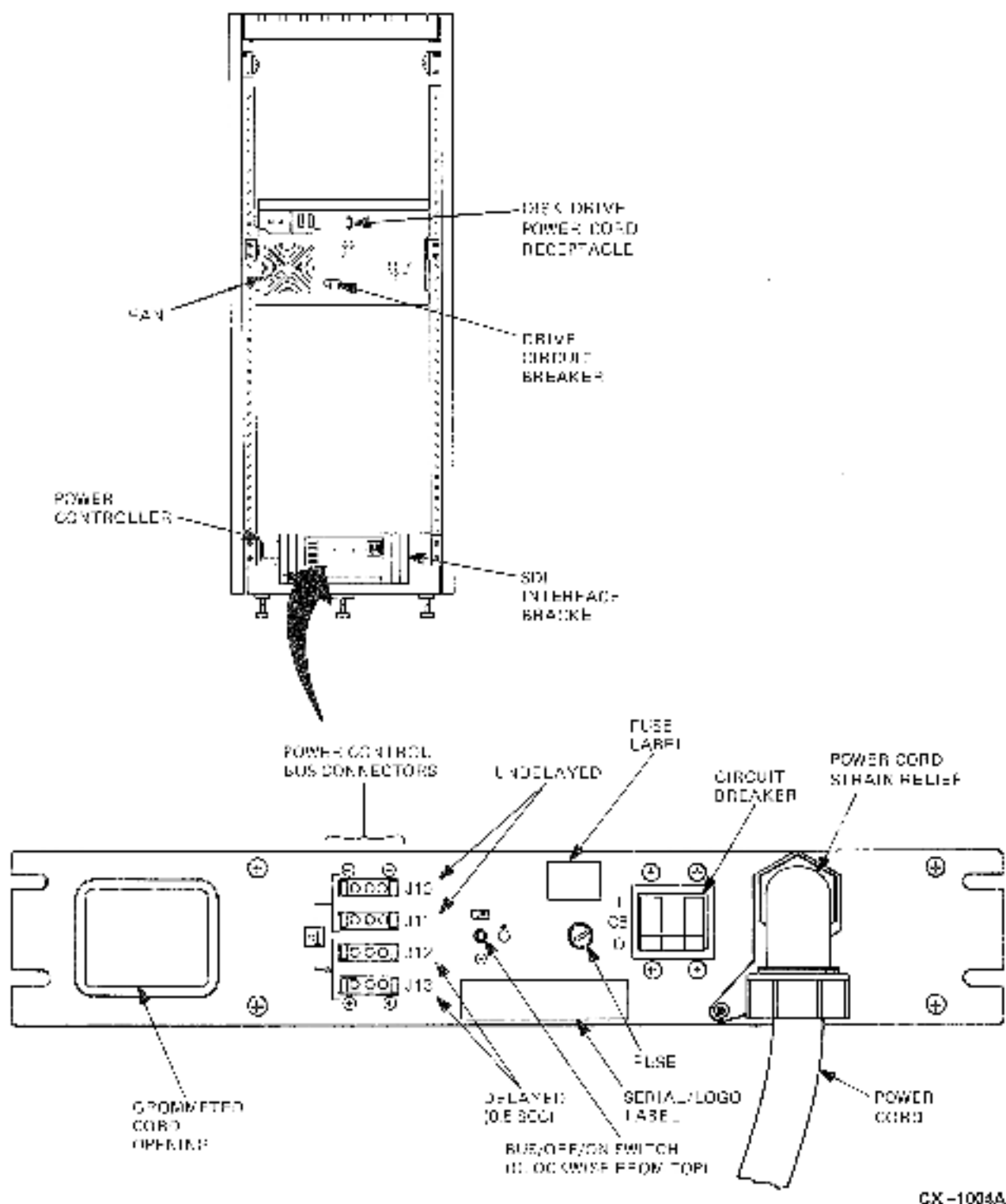


Figure 2-4 Rear Cabinet Power Controls (Four-High)

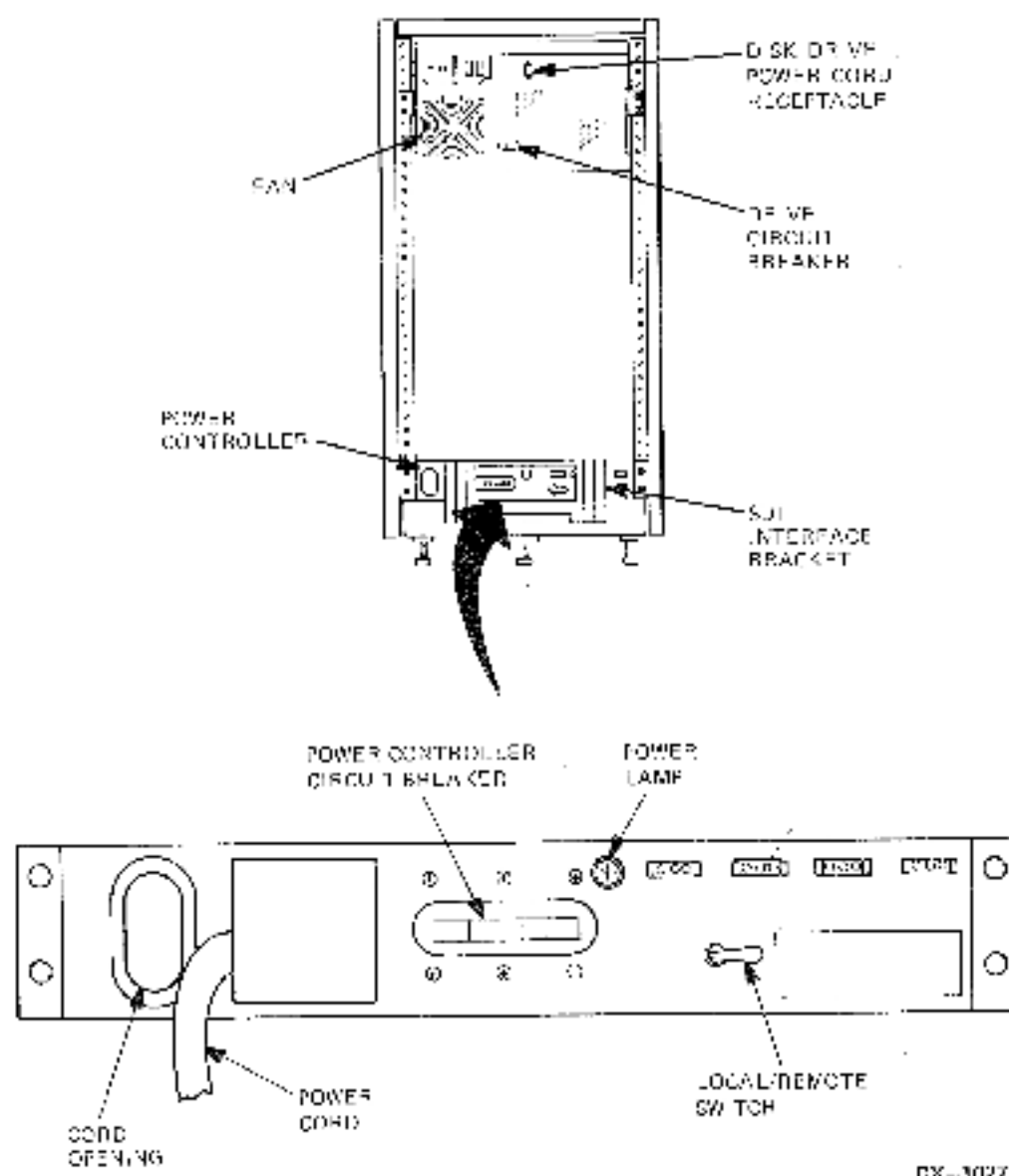


Figure 2-5 Rear Cabinet Power Controls (Three-High)

POWER CORDS GOING TO POWER CONTROLLER (FROM REAR OF ENCLOSURE)

120V 60 HZ POWER CORD DEC NO. A-PS-170008323	
240V 50 HZ POWER CORD DEC NO. A-PS-170008324	
120/240V 47-63 HZ NEMA POWER CORD DEC NO. A-PS-170042-15 OT A-PS-170044-11 USED WITH 351 POWER CONTROLLER	

PLUGS GOING TO WALL OUTLET (FROM CONTROLLER)

THREE-PHASE CABINET	170V 30 HZ 30A 3-PHASE		NEMA NO. 1-15P DEC NO. 12-11130
	270V 50 HZ 20A 3-PHASE USED WITH 4-4874R POWER CONTROLLER		NEMA NO. 1-15P DEC NO. 12-11130
FOUR-PHASE CABINET	120/208V AC 60 HZ 30A 3-PHASE WYE USED WITH 351A AND 351C POWER CONTROLLERS		3-WIRE NEMA NO. 1-15P
	220/240/208/415V AC 50 HZ 20A OR 15A 4-PHASE WYE USED WITH 351C POWER CONTROLLER		3-WIRE 4-POLE NEMA NO. 1-15P

CX-1872A

Figure 2-6 Electrical Plug Configurations

2.2.3 Disk Drive Circuit Breakers

A circuit breaker, located on the rear panel of each disk drive, controls the ac power to the drive dc power supply, the cooling fans, and the spindle motor. This circuit breaker and the power controller circuit breaker must be in the ON position before the drive will spin up. See Figure 2-4 for four-high (60-inch) cabinets and Figure 2-5 for three-high (40-inch) cabinets.

2.3 DRIVE OPERATION

This section contains operating instructions for the RA82 disk drive. Before operating, the drive must be properly installed and checked out by a qualified field service engineer.

NOTE

Make sure all drive and logic fans are working every time the drive is turned on. These cooling fans must be working to operate this equipment. Refer to Figure 2-4 for four-high cabinets or Figure 2-5 for three-high cabinets and Figure 2-7 for fan locations.

2.3.1 Spin Up

Push the RUN/STOP button (IN position) on the drive front panel to spin up the drive. The RUN indicator lights, and the READY indicator lights as soon as the drive completes the spin-up cycle and passes the initialization tests. If the initialization tests fail, the FAULT light on the operator control panel lights. See Section 2.1.2 to determine the cause of the problem.

CAUTION

To prevent HDD and head damage, never open or close the upper chassis assembly while the drive is operating.

For optimum drive performance, leave the RA82 disk drive on and spinning as much as possible. Do not power off the disk drive unless absolutely necessary.

2.3.2 Spin Down

Release the RUN/STOP switch (OUT position) on the drive front panel to spin down the drive. The READY and the RUN indicators go off when disk rotation stops.

If the disk does not spin down after releasing the RUN/STOP switch, contact field service.

CAUTION

For optimum drive performance, do not power off or spin down the RA82 disk drive unless absolutely necessary.

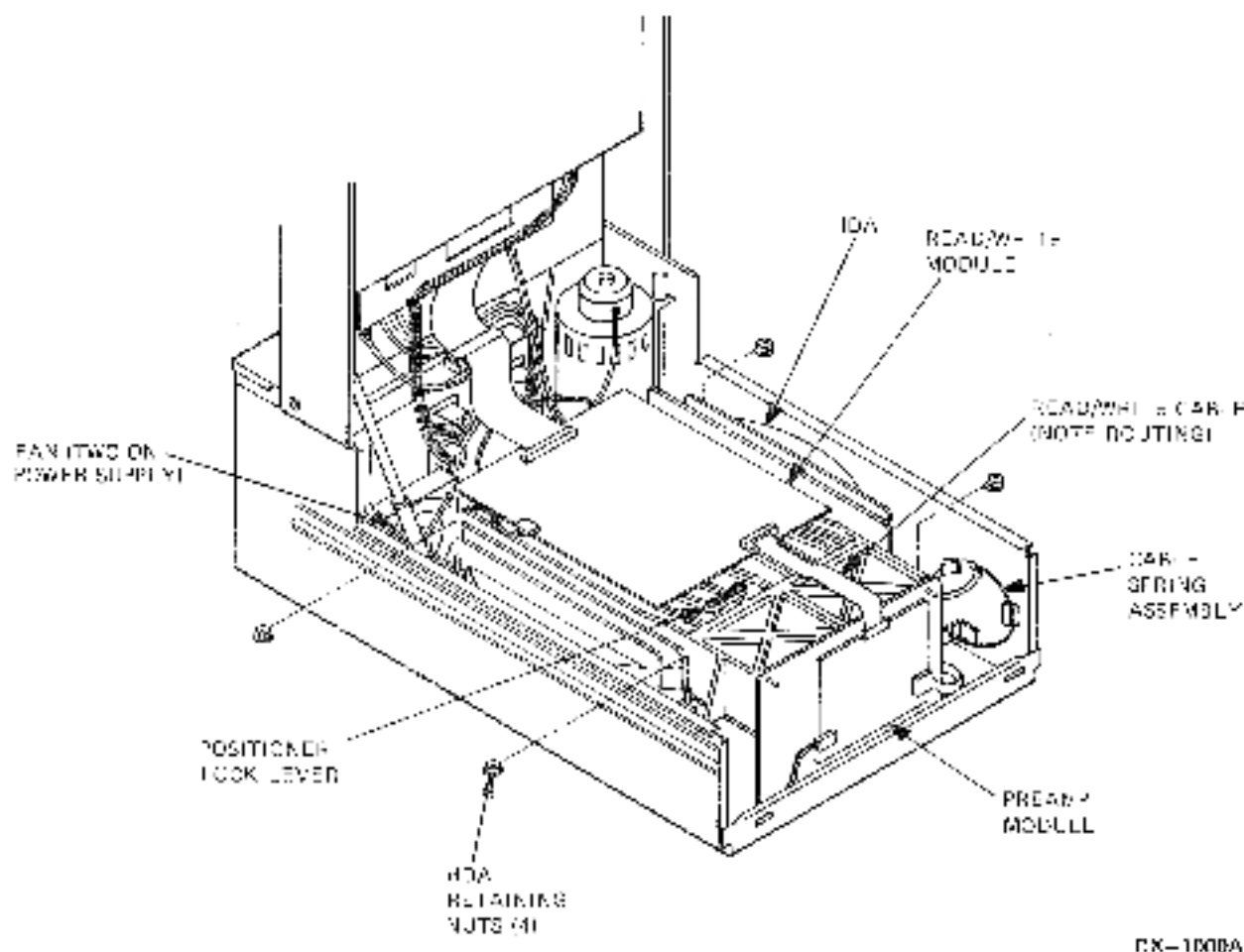


Figure 2-7 HDA and Drive Details

2.3.3 Drive Power Removal

Spin down the drive, as described above. When the RUN indicator is off, turn off the drive circuit breaker on the back panel (Figure 2-4 or Figure 2-5) and disconnect the cord to the power controller. This removes power to the drive.

CAUTION

Do not use the disk drive or power controller circuit breaker to stop the drive.

Always spin down the disk (spindle completely stopped) before switching off the disk drive or power controller circuit breaker. If the disk does not spin down after releasing the RUN/STOP switch, contact field service.

2.4 CUSTOMER CARE

Inspect the air filter in the chassis assembly monthly and clean, if necessary.

2.4.1 Air Filter Removal

Remove the air filter as follows:

1. While gently pushing the release latch under the operator control panel, pull down the access door on the front bezel of the drive to reveal the air filter. Refer to Figure 2-8.

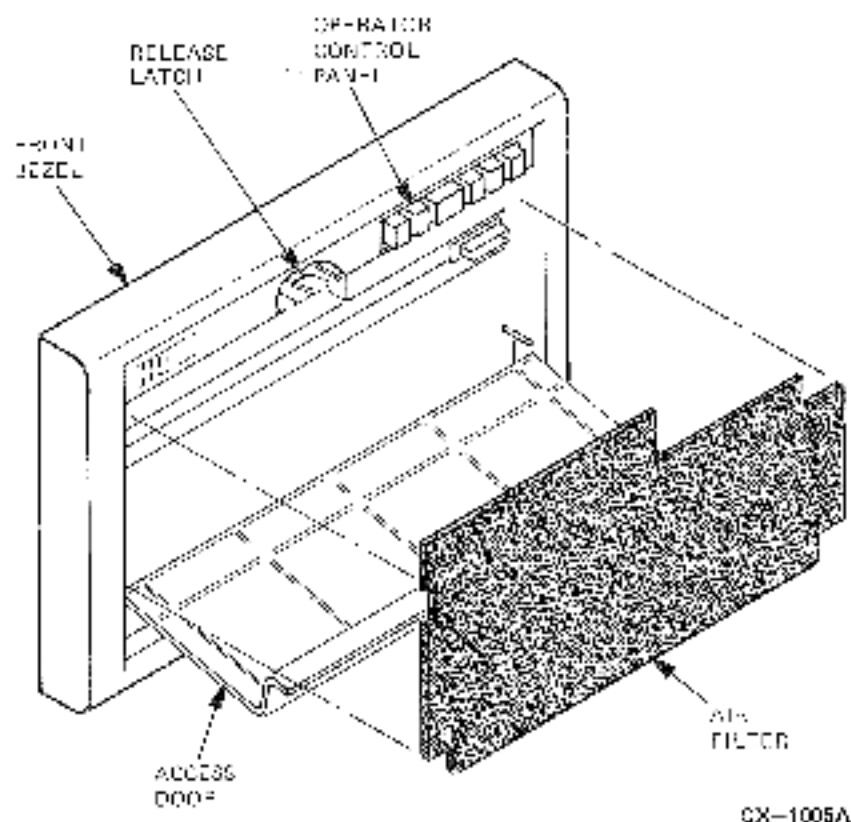


Figure 2-8 Air Filter Removal

CAUTION

To prevent damage to the hinge mechanism, do not lean on or place tools near the open access door.

2. Carefully pull the filter material outward until it is free of the bezel.

2.4.2 Cleaning

1. Gently wash the filter in warm water using a mild detergent.
2. Gently rinse with clear water.
3. Allow the filter to completely dry before reinstalling in the drive.

2.4.3 Air Filter Replacement

1. Slide the clean, dry filter into place inside the bezel.
2. Close the access door by swinging it up into the front bezel until the release latch snaps into place. Make sure the access door is secured in place by the release latch. Refer to Figure 2-8.

NOTE

Order a replacement filter under DIGITAL Part Number 74-29721-01.

INSTALLING THE RA82 DISK DRIVE

3.1 INTRODUCTION

This chapter provides installation procedures for the RA82 disk drive and includes notable features, specifications, and cable options. This chapter also includes an introduction to drive cabling.

If you have received a four-high cabinet filled with RA82s or if you have received a cabinet as part of a system configuration, then read this entire chapter for installation procedures.

If you are installing an RA82 as an add-on to an existing cabinet, refer to Chapter 4 for a three-high (48 inch) cabinets, and Chapter 5 for four-high (60 inch) cabinets.

If the system to be installed is an SA configuration, you have been directed here by the *Storage Array Configuration Guide*. Refer to Chapter 6 for installation instructions.

NOTE

Cabinet unpacking instructions are not covered in this document but can be found in the *H9646-A11/AJ Cabinet System User Guide* (DIGITAL Order Number EK-H9646-UG) included with every four-high cabinet.

3.2 SITE PREPARATION AND PLANNING

A certain amount of preparation and planning is necessary before installing the RA82 disk drive. The following paragraphs discuss some points to consider.

3.2.1 Environmental Considerations

The RA82 disk drive 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 1-1 for environmental specifications.

CAUTION

RA82 disk drives in any storage array must be thermally stabilized in the site environment a minimum of 24 hours before operation. Failure to thermally stabilize the RA82 disk drive could result in damage to the disk drive media or electronics upon powerup.

3.2.2 Cleanliness

The RA82 sealed HDA minimizes the risk of dust particles entering the area where the recording media is located. However, for maximum reliability and optimum performance, operate the equipment in the cleanest environment possible.

3.2.3 Floor Loading

The weight of one four-high cabinet filled with RAS2 disk drives is approximately 408 kilograms (899 pounds). The weight of each additional add-on RAS2 is approximately 61.2 kilograms (135 pounds).

The four-high cabinet does not place any abnormal stress on a raised computer room floor. However, consider the weight of existing equipment before installing additional cabinets.

3.2.4 Heat Dissipation

The heat dissipation of each RAS2 may reach approximately 644 watts (nominal) at 120 V, 60 Hz. Compute approximate cooling requirements for the complete system by multiplying this figure by the number of drives and adding the heat dissipation figures of the other system components. Adjust the total figure to allow for cooling system efficiency.

3.2.5 Power and Safety Precautions

The RAS2 does not present any unusual fire or safety hazards to other computer equipment. However, check the ac power wiring in the computer system to determine adequate capacity for future expansion.

WARNING

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

To prevent damage to equipment and possible personal injury, verify all power sources to make sure they are the exact voltage and frequency required for this equipment.

CAUTION

The RAS2 disk drive and power controller must be the same voltage and frequency. For example, a 120 V, 60 Hz drive must have a 120 V, 60 Hz power controller; a 240 V, 50 Hz drive must have a 240 V, 50 Hz power controller.

Figure 3-1 shows the ac plug configurations for the four-high cabinet and the 881 power controller.

3.3 ADJUSTING THE LEVELER FEET

Use the following procedure to adjust the leveler feet after the cabinet has been moved to its final location. See the *HV646-AH/AT Cabinet System User Guide* for more detailed instructions.

1. Turn the leveler hex nut downward until the leveler feet make solid contact with the floor (Figure 3-2).
2. Repeat for each of the four leveler feet until the drive cabinet is level and the load is removed from the casters.

CAUTION

Extend the leveler feet far enough to carry the load of the cabinet, allowing the casters to spin freely. If not, damage to the casters may result over an extended period of time.

POWER CORDS GOING TO POWER CONTROLLER (FROM REAR OF ENCLOSURE)

120V 60HZ POWER CORD D-C NO. 4 PS-170042-20	
240V 50-62 POWER CORD D-C NO. 4 PS-170042-24	
120/240V 47-63-67 10A/14 POWER CORD D-C NO. 4 PS-170042-16 OR A-PS-170042-13 USED WITH 801 POWER CONTROLLER	

PLUGS GOING TO WALL OUTLET (FROM CONTROLLER)

THREE PHASE
CABINET

120V 60HZ 30A 1-PHASE		NEMA NO. 15-30P D-C NO. 12-11183
270V 50-62 20A 1-PHASE USED WITH 4-48/48 POWER CONTROLLER		NEMA NO. 16-20P D-C NO. 12-11182

FOUR-PHASE
CABINET

120/208V AC 60-67 30A 3-PHASE WYE USED WITH 301 A AND 60-60 POWER CONTROLLERS		5-WIRE NEMA NO. 14-30P
220-240/330-415V AC 60-62 20A OR 15A 3-PHASE WYE USED WITH 481 A-1 POWER CONTROLLERS		5-WIRE, 4-POLE, 120-30P

CX-1072A

Figure 3-1 Power Connector Configurations

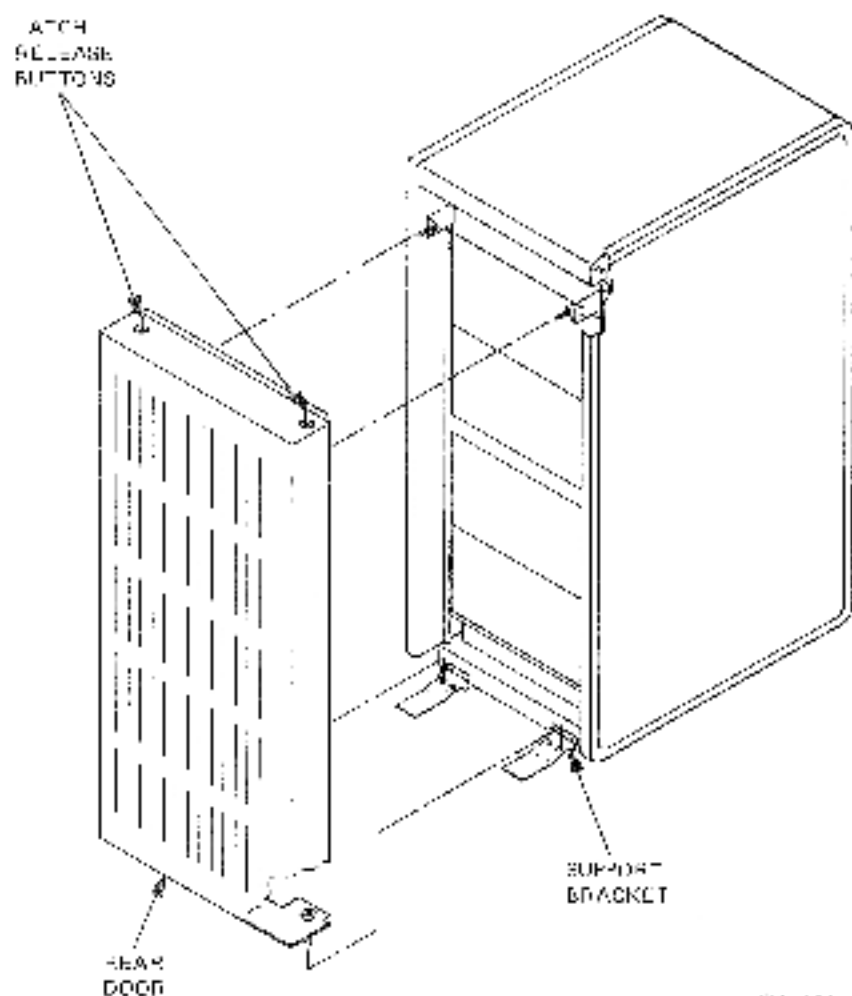


Figure 3-4 Removing the Rear Door

3.6 CABINET INTERLOCK (if Applicable)

The cabinet interlock and the drive actuator assemblies maintain cabinet stability and ensure operator safety. If the stabilizer foot is retracted, all drives are locked and cannot be extended on the slides. When the stabilizer foot is extended, the cabinet interlock mechanism allows only one drive at a time to be extended.

The drive actuator assembly works in conjunction with the cabinet interlock mechanism to maintain cabinet stability. Refer to Figure 3-5.

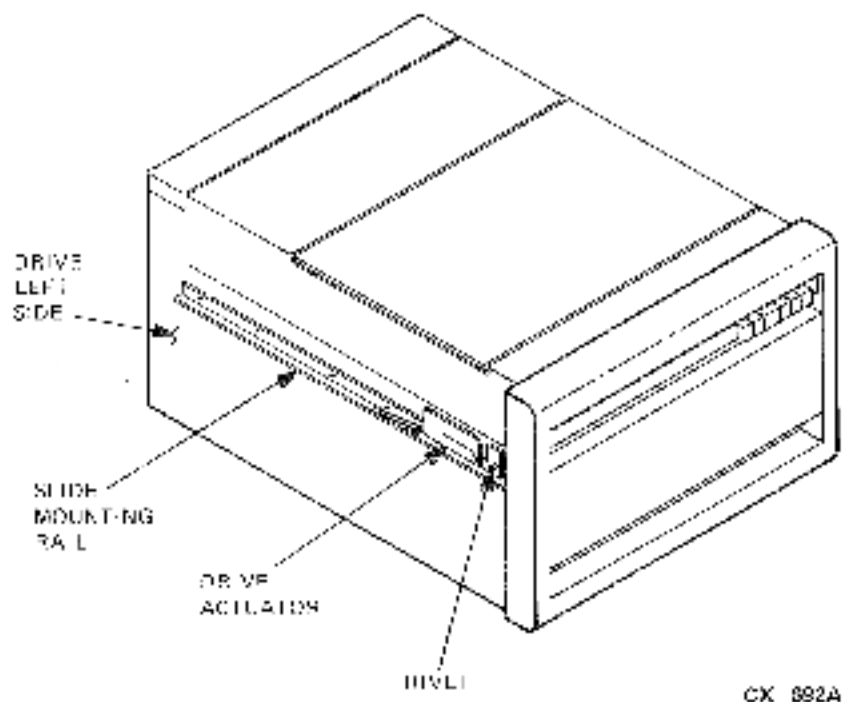


Figure 3-5 RA82 Actuator Assembly

3.7 EXTENDING AND RETRACTING THE DRIVE ON SLIDES

The following sections describe the procedure for extending and retracting disk drives on the cabinet slides.

CAUTION

To prevent damage to HDA or heads, never extend or retract the cabinet slides while a disk drive is operating. Spin down and completely stop the drive before moving it on the cabinet slides.

3.7.1 Extending the RA82 Disk Drive Using the Slides

Perform the following steps to extend the RA82 disk drive.

1. Pull out the cabinet stabilizer. Refer to Section 3.4.
2. Remove the back door of the cabinet. Refer to Section 3.5.
3. Remove the screws that hold the back of the disk drive to the electrostatic discharge (ESD) brackets. Refer to Figure 3-6.
4. Pull the drive out until the slides lock in place. Refer to Figure 3-7.

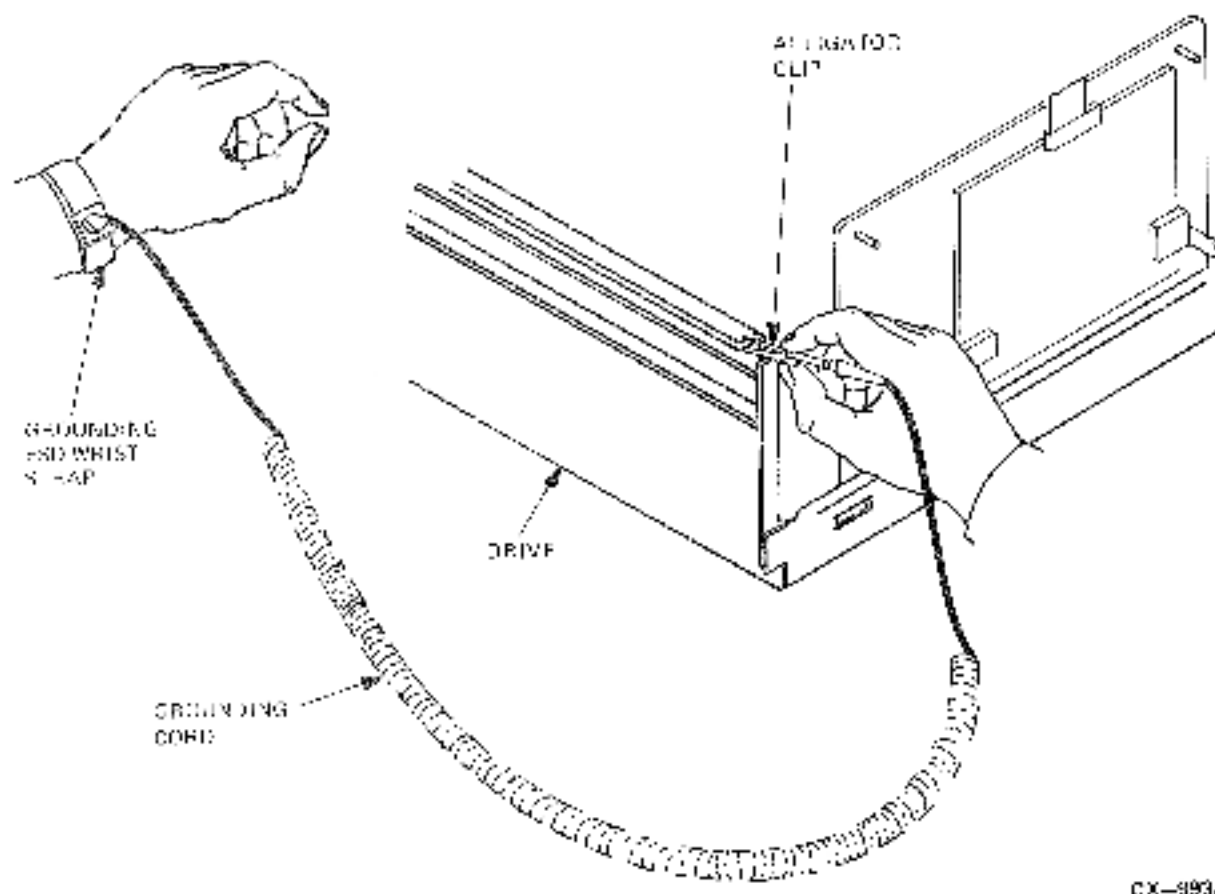


Figure 3-8 Connecting ESD Wrist Strap to Ground

2. Extend the drive out of the cabinet on its slides (Section 3.7).

For all drives:

1. Unlock the upper chassis assembly by turning the two cam latches under the front bezel 180 degrees counterclockwise with a 5/16-inch allen hex wrench. Refer to Figure 3-9.
2. Raise the upper chassis assembly until the damper (gas spring) lock slides in place and the cover is supported by the damper (Figure 3-10).

CAUTION

To prevent HDD and head damage, *never* open or close the upper chassis assembly while the drive is operating.

3. Locate the three red shipping brackets that fasten the HDD to its mountings. Refer to Figure 3-11.

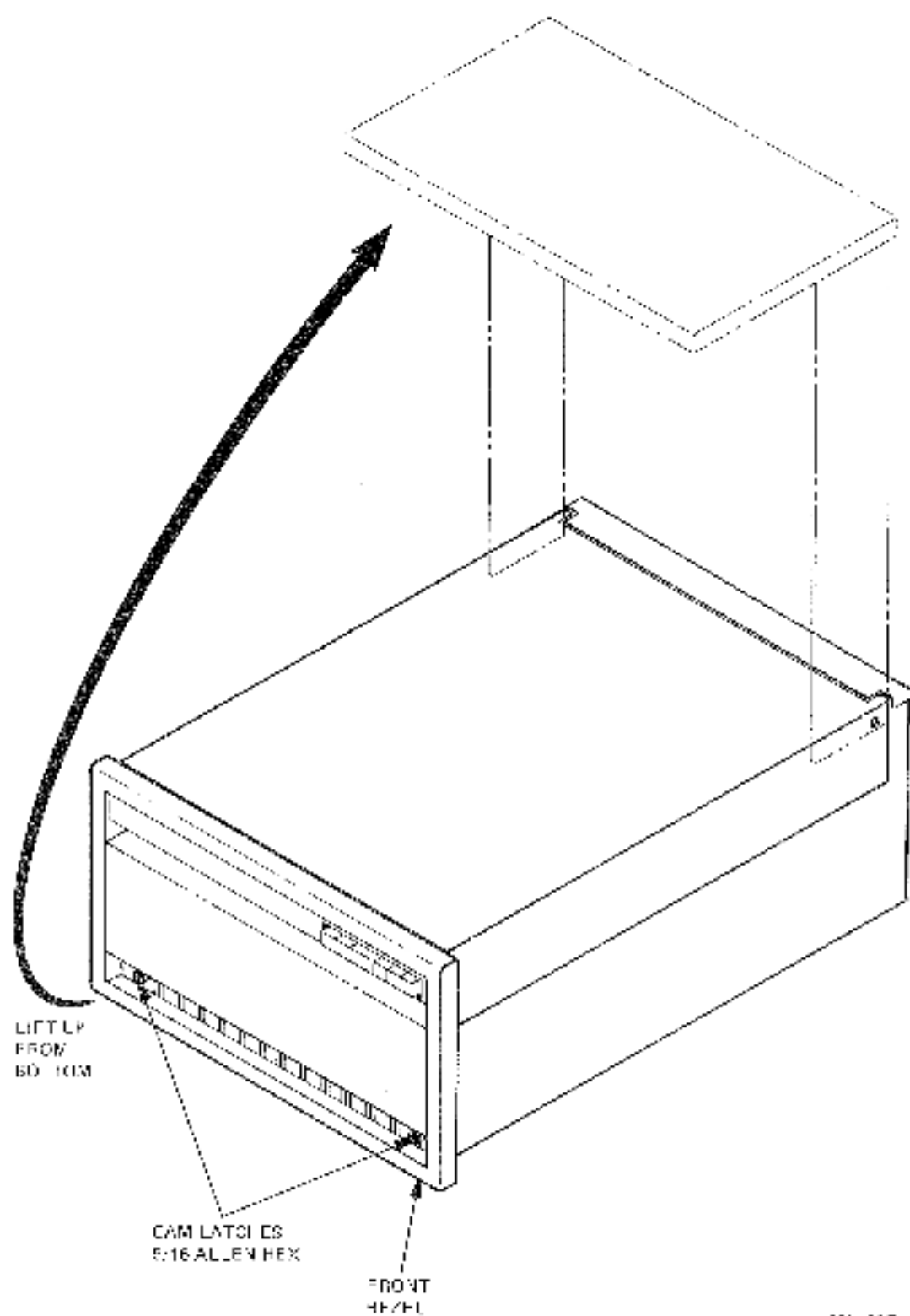


Figure 3-9 Upper Chassis Assembly

3-14 INSTALLING THE RAS2 DISK DRIVE

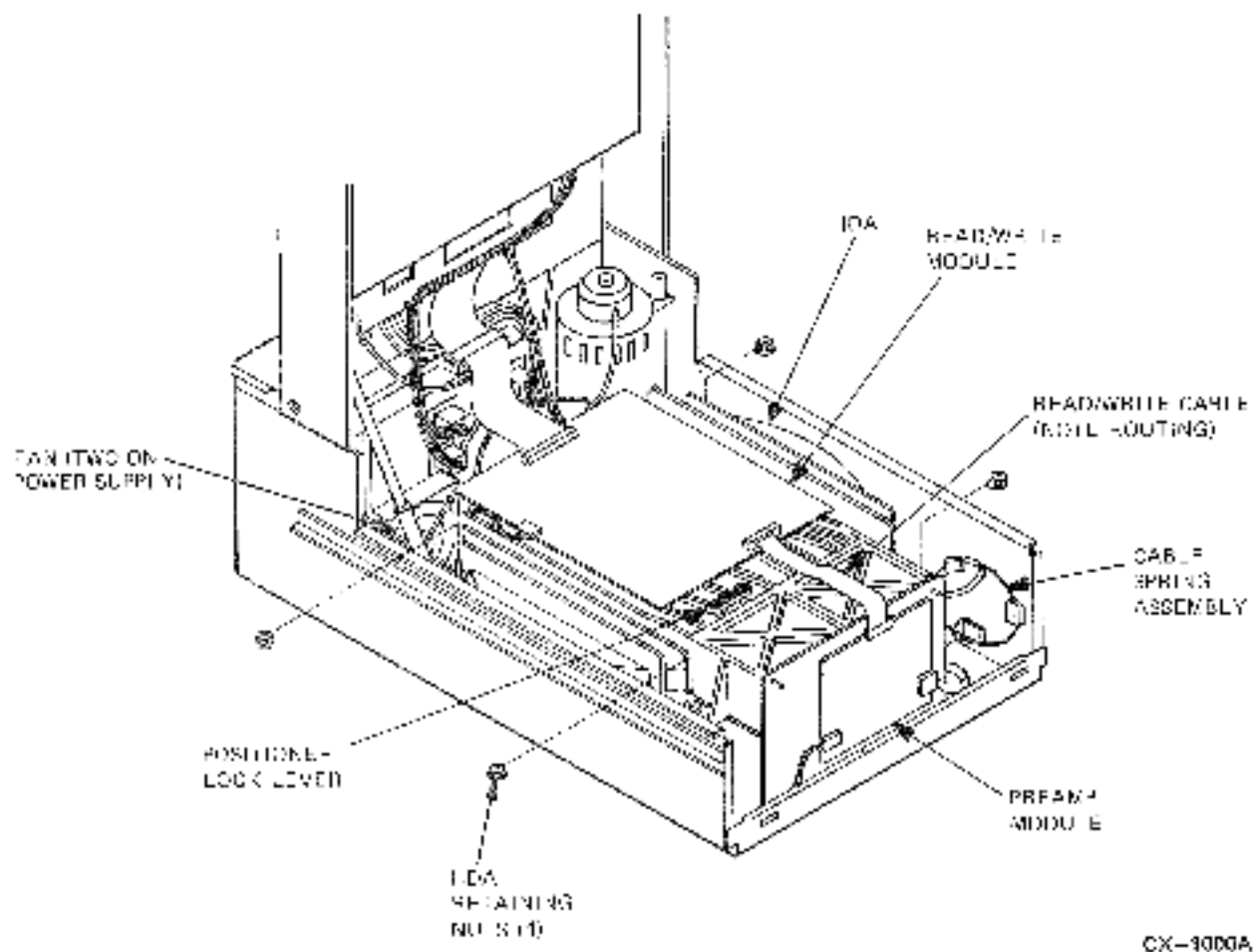


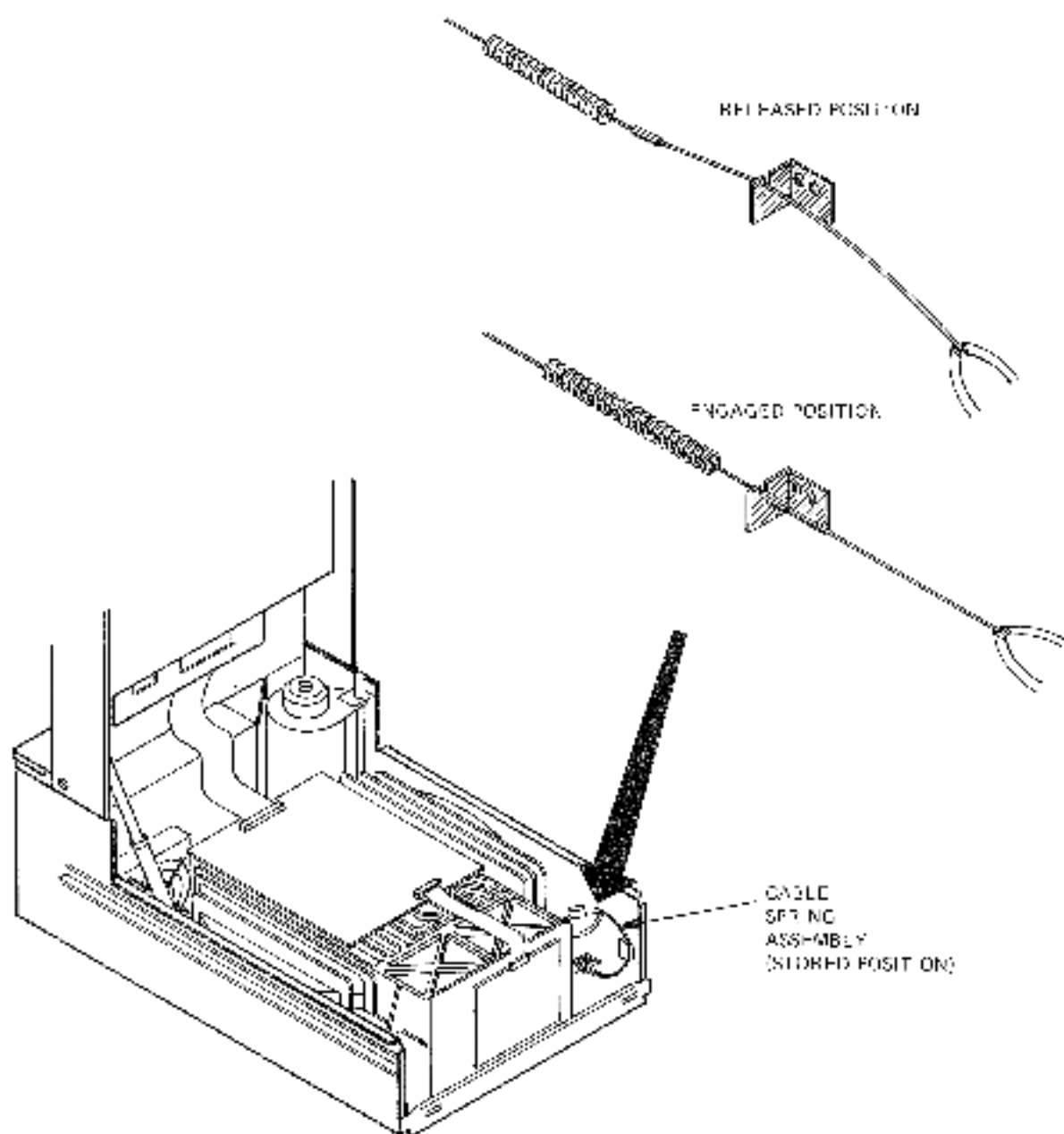
Figure 3-12 HDA Details

7. Loosely tighten all four HDA retaining nuts with a 7/16-inch nut driver. Refer to Figure 3-12.
8. Ensure the cable spring assembly is in the ENGAGED position as shown in Figure 3-13.

NOTE

An interlock switch prevents the spindle motor from operating while the cable spring assembly tension is released. The cable spring assembly must be in the ENGAGED position for spinup.

9. Remove the positioner lock seal and place the positioner lock lever on the HDA in the UNLOCK position (Figure 3-11).



CX-1001A

Figure 3-13 Cable Spring Assembly

10. Unlock the logic access cover by manually turning the two captive fastener assembly screws several turns counterclockwise. Release and tighten these screws by hand only. Refer to Figure 3-14.
11. Fold out the logic access cover.

3-16 INSTALLING THE RA82 DISK DRIVE

12. Check all modules, cables, and connections. Make sure all cable connectors are firmly seated in the mating connectors.

NOTE

Visually inspect all modules and components for obvious damage. *Do not operate equipment if components are damaged. Report all damage to the DIGITAL field service or sales office and to the delivery agent.*

13. Return the logic access cover to its original closed position. Lock the two captive fastener assembly screws by manually turning them clockwise. Make sure the logic access cover is securely locked in place. Refer to Figure 3-14.
14. Position the read/write cable between the ribs on the IDA to ensure that the cable is not pinched when the cover is closed. Refer to Figure 3-12.

CAUTION

Do not pinch cables when lowering the upper chassis assembly. Check cable locations and reroute cables, if necessary, before lowering.

15. Gently lift up on the upper chassis assembly to take the weight off of the gas spring. Unlock the gas spring by pulling the locking knob out while still supporting the weight of the upper chassis assembly. Refer to Figure 3-10.
16. Slowly lower the upper chassis assembly until resistance from the gas spring is felt. When resistance is sufficient to ensure the gas spring will allow the logic to close slowly, release your hold on the upper chassis assembly. Lock in place by turning the two cam latches under the front bezel 180 degrees clockwise with a 5/16-inch allen hex wrench. Refer to Figure 3-9.

CAUTION

DO NOT permit the upper chassis to free fall and DO NOT force the upper chassis assembly against the gas spring pressure.

For drives mounted in a cabinet:

1. Slide the drive back into the cabinet. Refer to Section 3.7.
2. Repeat the above procedures for all drives in the cabinet.

3.9 SDI CABLES (DESCRIPTION)

A four-high cabinet subsystem consists of an SDI (Standard Disk Interconnect) disk controller and four RA82 disk drives. Like all RA-series disk drives, the RA82 is connected directly to the disk controller via an external SDI cable. If the RA drive is operated in dual port mode, then two SDI cables are used: one to each disk controller.

These external SDI cables plug into the I/O bulkhead assembly at the rear base of the cabinet. External SDI cables must be installed for each drive in the cabinet between the I/O bulkhead in the CPU or controller cabinet and, in the four-high cabinet, the SDI interface bracket (Figure 3-15). The controller connector should already be installed. If not, refer to the installation procedure in the appropriate disk drive controller user guide.

NOTE

In the four-high cabinet, external SDI cables are connected to the *inside* of the SDI interface bracket. The internal SDI cables exit from the *back* of the drive and connect to the *outside* of the SDI interface bracket (Figure 3-15).

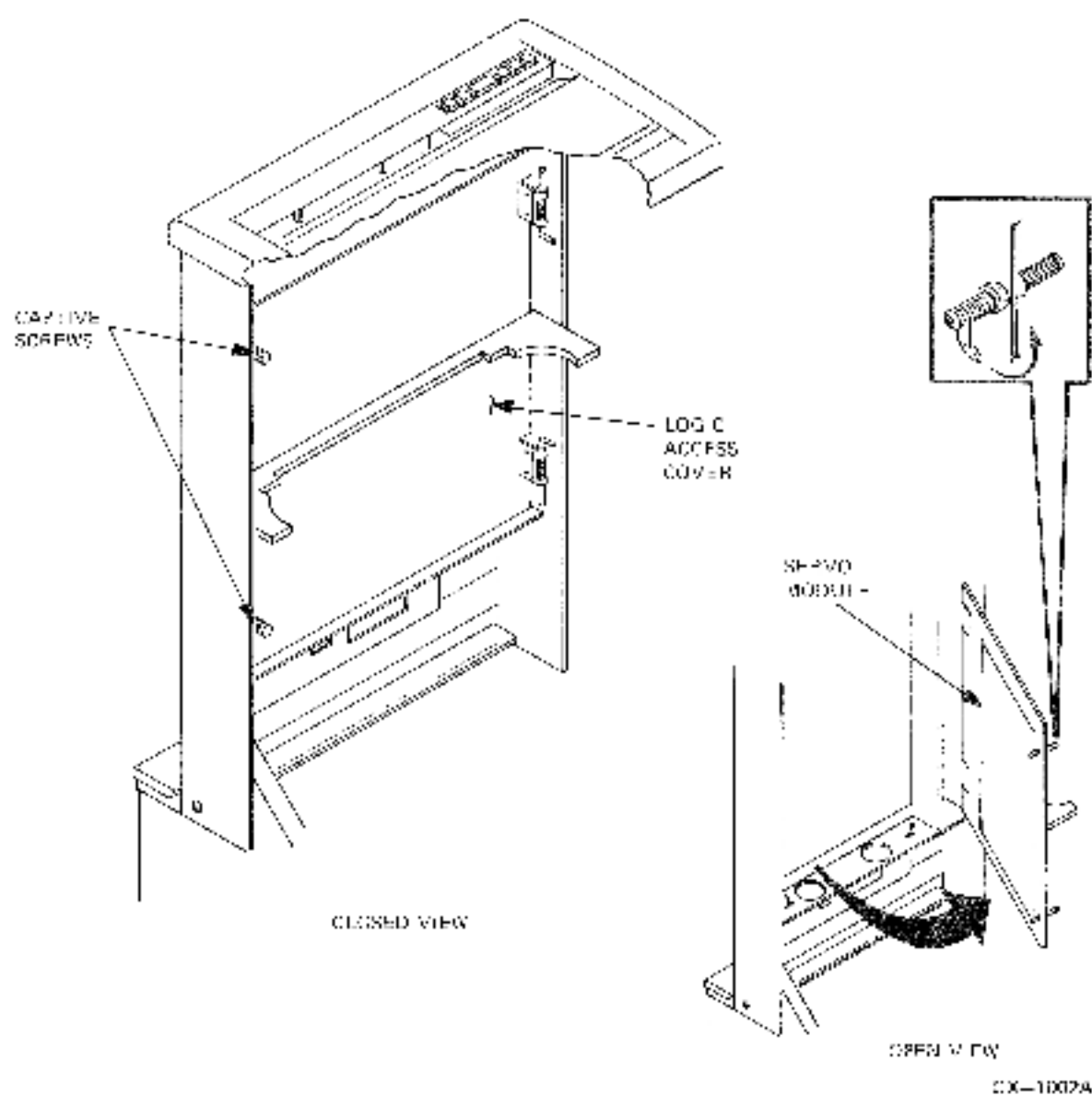


Figure 3-14 Opening the Logic Access Cover

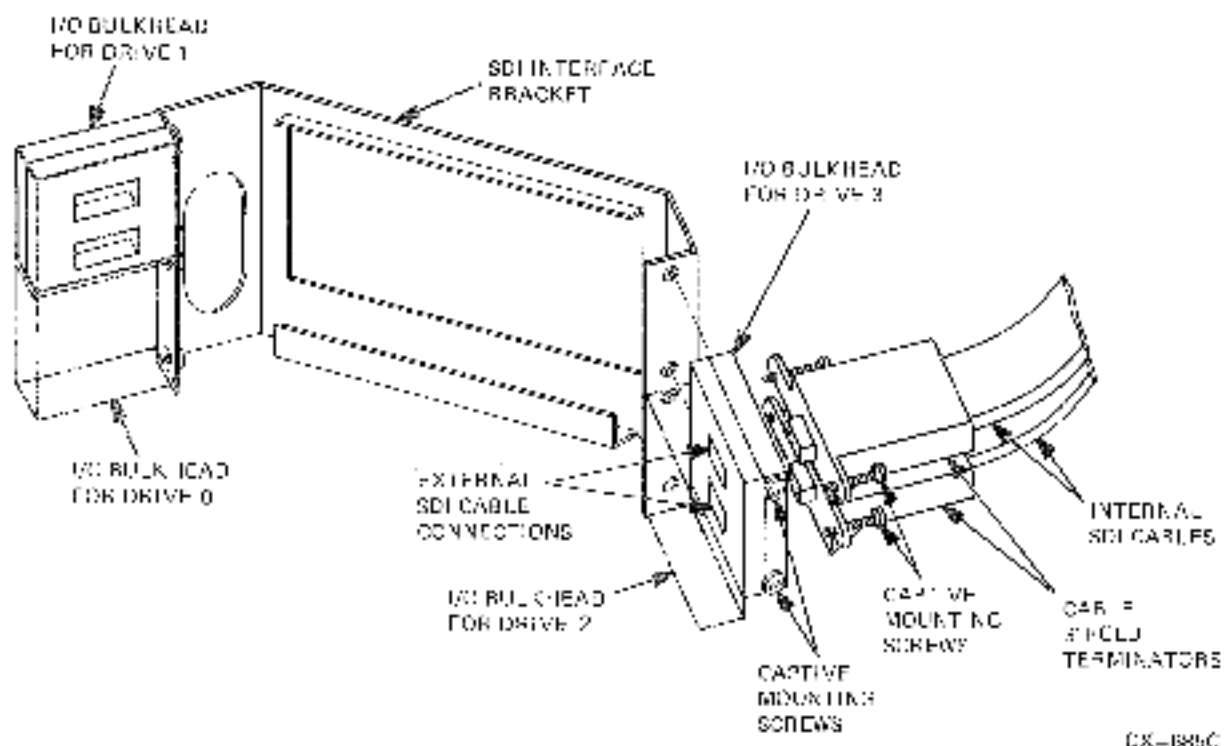


Figure 3-15 I/O Bulkhead Mounting

Each drive is shipped with a 12-foot SDI cable for external connection to the drive controller. A second 12-foot SDI cable is required for dual-port operation. In situations requiring more distance between the drive cabinet and the disk controller, other SDI cable lengths are available as shown in Table 3-1.

Table 3-1 SDI Cable Options

Part No.	Description
BC26V-5D	Six foot four inch SDI cable
BC26V-12	Twelve foot SDI cable
BC26V-25	Twenty-five foot SDI cable
BC26V-50	Fifty foot SDI cable
BC26V-80	Eighty foot SDI cable

Use the following procedure to install the external SDI cables to the drive cabinet. For internal SDI cabling information, add-on drive information, and associated cabling, refer to Chapter 4 for three high cabinets and Chapter 5 for four high cabinets.

3.10 EXTERNAL SDI CABLING PROCEDURE (FOUR-HIGH CABINET)

Refer to Figure 3-15 during the following installation procedure.

1. Remove the rear door of the cabinet (Section 3.5).
2. Plug the external SDI cable from the disk controller into the port A connector on the I/O bulkhead. Note the orientation key on the SDI cable.

NOTE

To orient the connections properly for external and internal cables, turn the I/O bulkheads on the left side of the SDI interface bracket 180 degrees from those on the right side. This should be apparent when the screw holes are aligned.

3. If a second disk controller is used, mount its SDI cable into the port B connector on the I/O bulkhead. Note the orientation key on the SDI cable.

CAUTION

Ensure no pins are bent during assembly.

4. Tighten the two captive screws on the SDI cable shield terminators to the I/O bulkhead. *Do not over tighten (10 inch-pound maximum).*
5. Repeat the above cabling procedure for all drives in the cabinet.
6. Reinstall the rear door of the cabinet (Section 3.5).

3.11 SEQUENCE CABLES (DESCRIPTION)

Drive sequence cables are installed to guarantee only one RA62 disk drive at a time starts a spin-up cycle. Sequence cables are used on drives with nonremovable media such as the RAXX-series disk drives (RA80, RA81, and RA82).

The drive sequence cables inside the cabinet connect the drives in a series chain. These cables may also be external to the disk cabinet to connect the series chain in one cabinet with another in a second cabinet. When a large distance exists between drive cabinets, longer lengths of drive sequence cables may be required. Refer to Table 3-2 for a list of these optional lengths.

CAUTION

Sequence cables *must* be installed or disk/data corruption or damage may result during or after a system power failure.

Table 3-2 Drive Sequence Cable Options

Part No.	Description
70-19690-06	Six foot drive sequence cable
70-19690-08	Eight foot drive sequence cable
70-19690-12	Twelve foot drive sequence cable
70-19690-25	Twenty-five foot drive sequence cable
70-19690-50	Fifty foot drive sequence cable
70-19690-80	Eighty foot drive sequence cable

For detailed four-high cabinet sequence cabling information, refer to Chapter 5.

3.12 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 between 0 and 254 (decimal) must be programmed into this plug.

A new switch cover is set as unit 0. To set a drive unit number other than 0, remove the READY switch cap from the control panel and cut off the tabs that add up to the required number. Add the tabs according to the binary values shown in Figure 3-16. For example, if unit number 7 is required for a specific drive, cut tabs 1, 2, and 4 off the switch cap. If unit number 113 is required, remove tabs 64, 32, 16, and 1. Leave all tabs on if unit number 0 is required.

NOTE

Do not use the same unit number for two drives on the same controller.

After selecting the drive unit number, place the gummed label with the corresponding number in the recessed area on the front of the switch cap. Then replace the switch cap on the operator control panel. For more information on the READY plug and indicator, see Section 2.1.3.

3.13 RA82 DRIVE DIAGNOSTIC CHECKOUT

The following paragraphs describe how to run the RA82 drive-resident diagnostics using the diagnostic terminal and how to verify the proper operation of each RA82 disk drive after installation.

NOTE

RA82 disk drive checkout must be performed by trained field service personnel only.

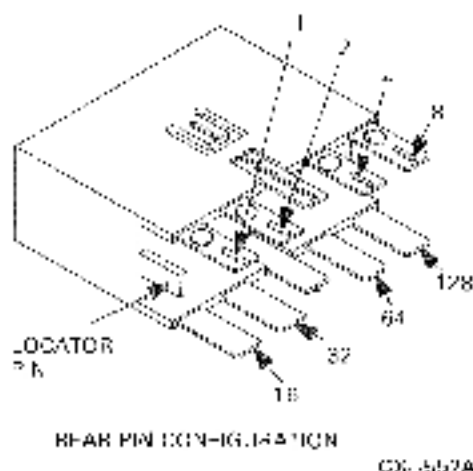


Figure 3-16 Drive Unit address Plug (Ready Cap)

3.13.1 The Diagnostic Terminal

A field service hand-held diagnostic terminal used to communicate with the RA82 is stocked with every spares kit. The diagnostic terminal uses a standard ASCII keyboard and an RS232 interface. The RS232 connector for the diagnostic terminal is located inside of the front bezel filter door.

Instructions on how to use the hand-held terminal are in the *DSA Hand Held Terminal User Guide* (DIGITAL Order Number EK-DSAHH-UG). Any EIA-compatible terminal (with null modem cable) set at 300 baud can be used to communicate with the drive to run the diagnostic tests.

3.13.2 Applying Power to the Drive

Use the following procedure to apply power to the RA82 disk drive.

CAUTION

RA82 disk drives in any storage array must be thermally stabilized a minimum of 24 hours in the site environment before operation. Failure to thermally stabilize the RA82 could result in damage to the disk drive media or electronics upon powerup.

1. Verify the ac circuit breakers on the power control unit and each disk drive are in the OFF position. Refer to Figure 3-17 for four high (60 inch) cabinets or Figure 3-18 for three high (40 inch) cabinets.
2. Plug the disk drive power cord between the drive and the power controller into the receptacle on the power control unit at the bottom of the cabinet.

WARNING

The power cord between the drive and the power controller (disk drive power cord) in the four-high cabinet is the same for both 120 V, 60 Hz and 240 V, 50 Hz. To prevent damage to equipment and possible personal injury, verify both the disk drive and the power controller in the four-high cabinet are the same voltage and

3-22 INSTALLING THE RA82 DISK DRIVE

frequency. A 120 V, 60 Hz drive *must* have a 120 V, 60 Hz power controller; a 240 V, 50 Hz drive *must* have a 240 V, 50 Hz power controller.

3. Switch the air circuit breaker on the power control unit to the ON position. Refer to Figure 3-17 for four high (60 inch) cabinets or Figure 3-18 for three high (40 inch) cabinets.

3.13.3 Verifying RA82 Disk Drive Operation

Use the following procedure to verify disk drive operation.

CAUTION

For drive protection, use a grounded (electrostatic discharge) wrist strap during the following procedures (Figure 3-8). Also, read Section 1.7 for information on ESD protection.

1. Unlock the upper disk drive chassis assembly by turning the two cam latches under the front bezel 180 degrees counterclockwise with a 3/16-inch allen hex wrench. Refer to Figure 3-9.
2. Raise the upper chassis assembly until the damper lock slides in place and the chassis is supported by the damper (Figure 3-10).
3. Unlock the logic access cover by manually turning the two captive fastener assembly screws several turns counterclockwise. (Release and tighten these screws by hand only.) Refer to Figure 3-14.
4. Fold out the logic access cover (Figure 3-14).
5. Check that all module and cable connectors are firmly seated. Also, visually inspect all modules and components for obvious damage. *Do not* operate equipment if components are damaged.
6. Switch the air circuit breaker on the back of the disk drive to the ON (up) position. This activates the internal disk drive diagnostics (hardware test sequence) and all front panel indicator lights. When the drive successfully passes the diagnostics, the front panel lights will go off (3 or 4 seconds).

CAUTION

Make sure the drive and logic fans are working every time the drive is turned on. These cooling fans must be working to operate this equipment. Refer to Figure 3-17 for four high (60 inch) cabinets or Figure 3-18 for three high (40 inch) cabinets, and Figure 3-12 for fan locations.

If an error occurs, press and release the FAULT switch/indicator on the operator control panel to display the drive condition fault codes indicated by fault lights on the front panel. See Section 2.1.2 for additional information on the FAULT switch and indicator.

7. As a front panel lamp test, depress and hold the FAULT switch of the RA82 OCP after the hardware test sequence. All front panel lights should light.

NOTE

If both port select switches (A and B) are placed in the OUT position while the READY indicator is on, the READY indicator goes 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 goes on and off intermittently while this self test is being executed.

Both port select switches must be OUT to run internal drive diagnostics.

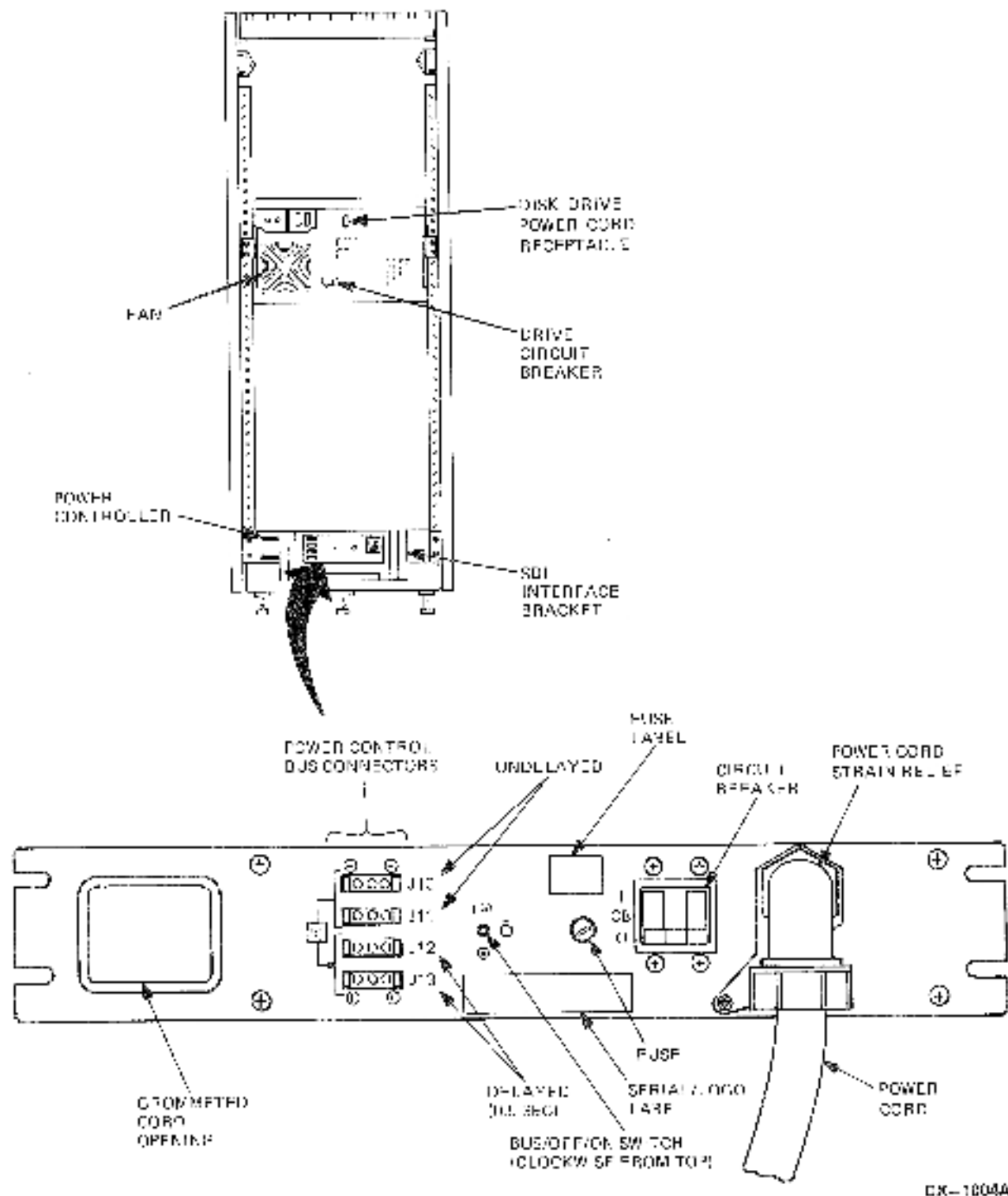


Figure 3-17 Rear Cabinet Power Controls (60-Inch Cabinets)

3-26 INSTALLING THE RA82 DISK DRIVE

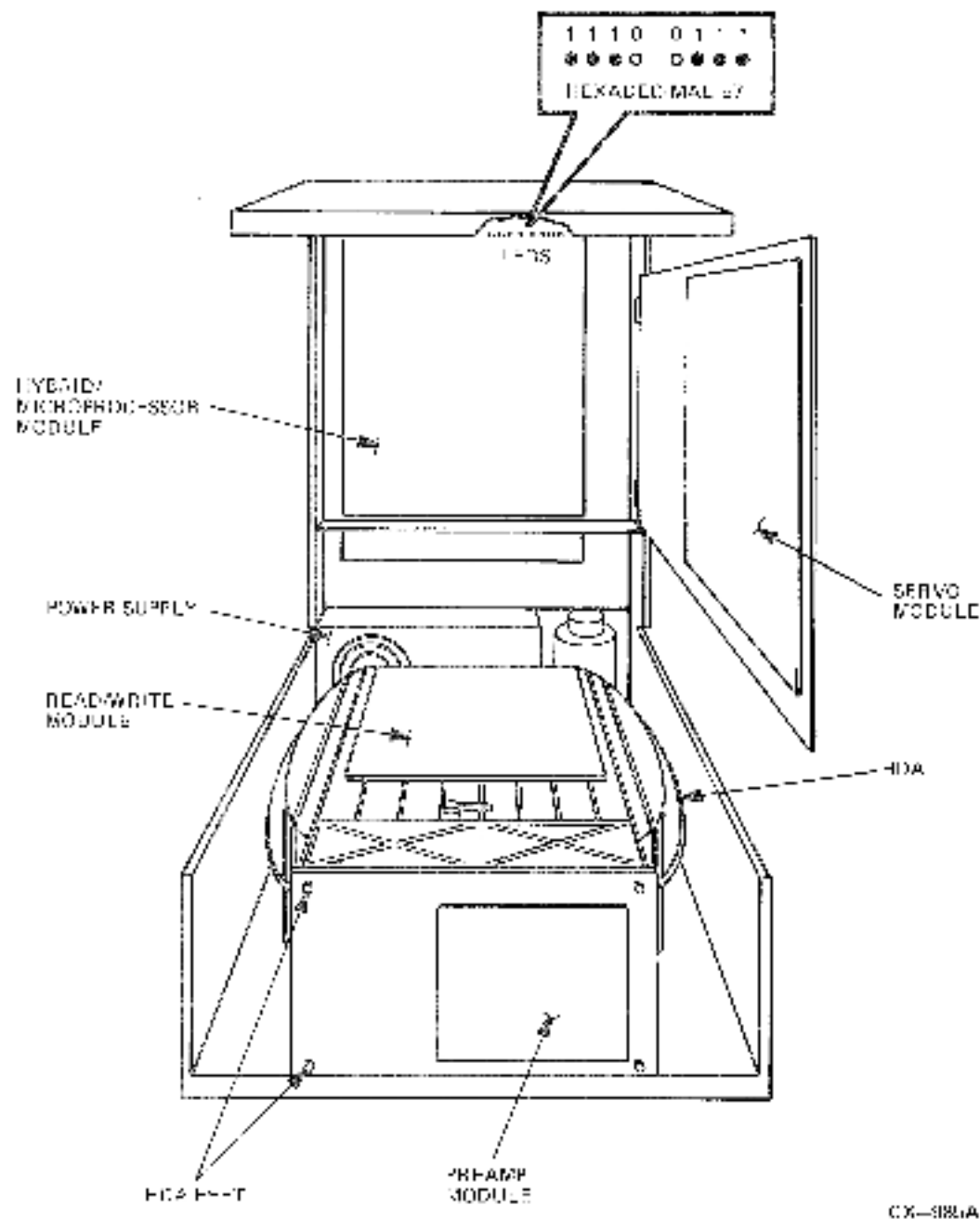
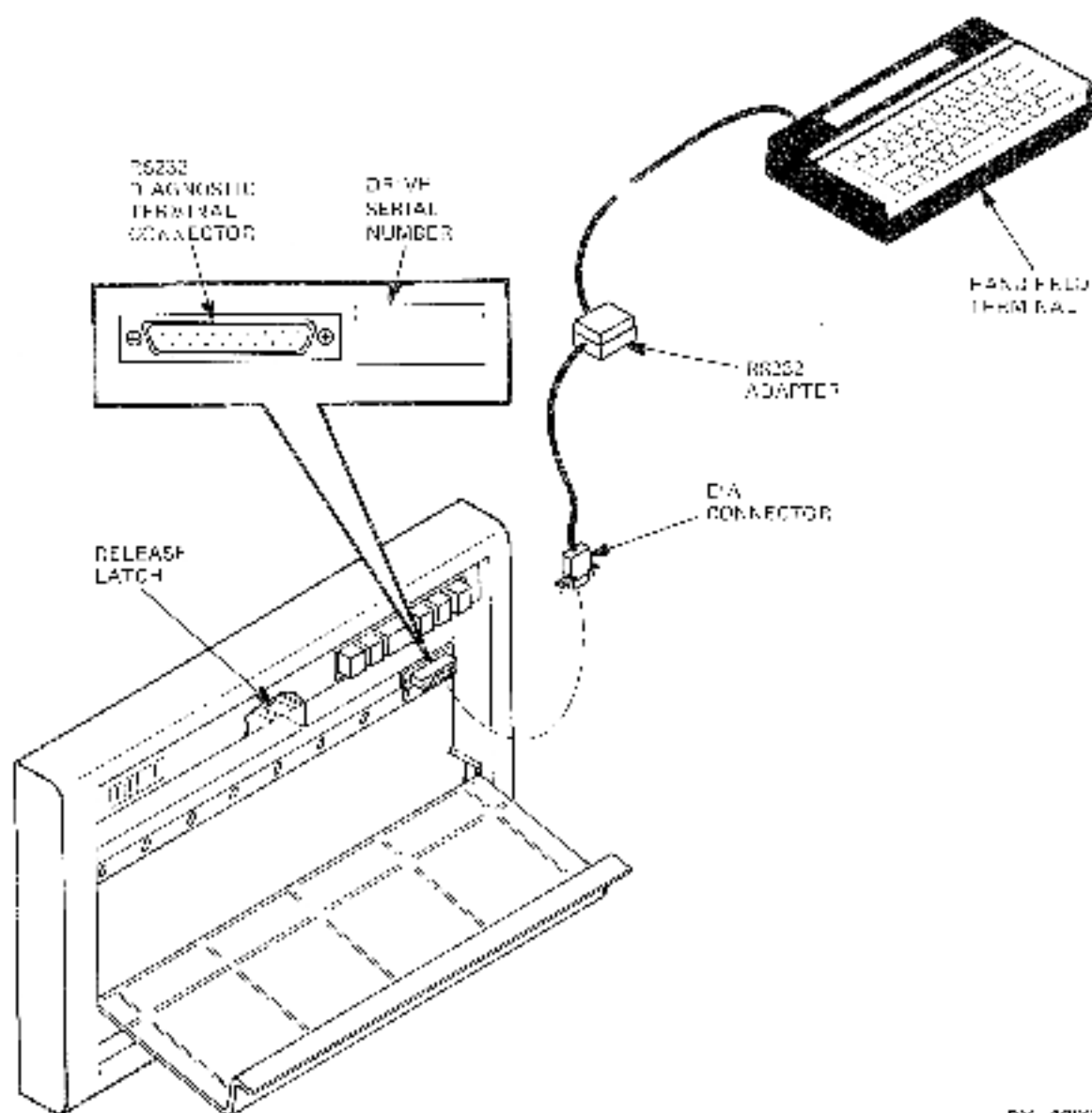


Figure 3-15 Hinged Circuit Module Arrangement



CX-10161A

Figure 3-20 Diagnostic Terminal Connections

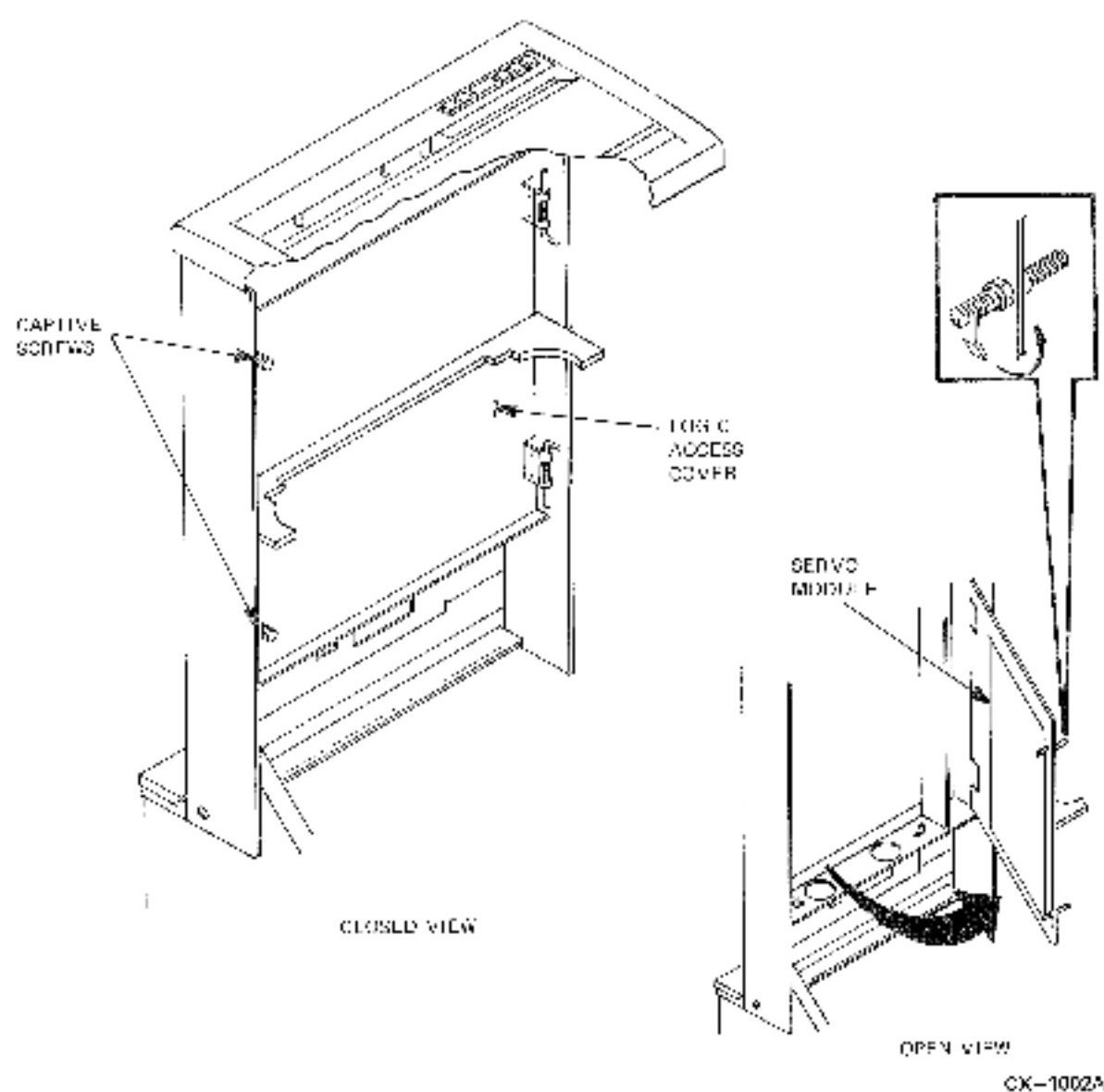


Figure 3-21 Locking the Logic Access Cover

INSTALLATION OF RA82 DISK DRIVES IN THREE-HIGH CABINETS

4.1 INTRODUCTION

This chapter describes the installation of the RA82 disk drive in the 40-inch (three-high) cabinet system. For a list of basic three-high cabinet specifications, refer to Table 4-1.

Table 4-1 Three-High Cabinet Specifications

Characteristic	Specification
Overall height	41.8 inches (106 cm)
Depth	36 inches (91.4 cm)
Width	21.3 in (54.2 cm)
Weight (empty)	52 lbs (23.5 kg)
Mounting width	19 inches (48.3 cm)
Mounting	STD EIA/RETMA
Cooling	Front to rear
Frame construction	All steel, riveted
Power cord length	14 feet

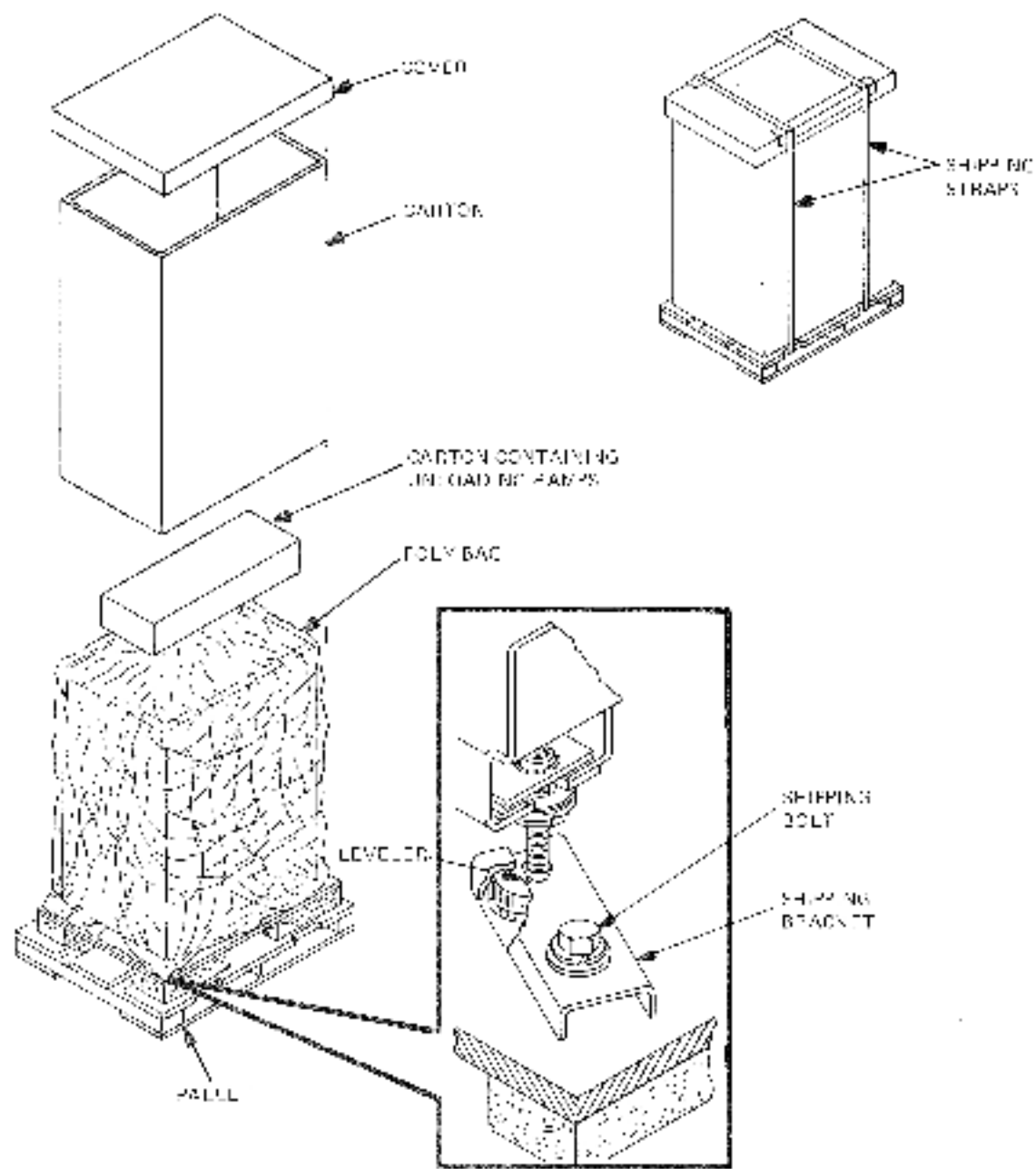
NOTE

For specific information and instructions on drives other than the RA82, refer to the appropriate disk drive user guide and the *119642-1A/1B Installation Sheet*. Order Number EK-9642K-IN.

4.2 UNPACKING AND EXTERNAL INSPECTION (40-INCH CABINET)

When delivered, the three-high cabinet containing the RA82 disk drives is packed in a cardboard container attached to a shipping skid or pallet. Refer to Figure 4-1.

4-2 INSTALLATION OF RA22 DISK DRIVES IN THREE-HIGH CABINETS



CX-393D

Figure 4-1 Unpacking the 40-inch Cabinet System

4.2.1 Unpacking the System on a Shipping Pallet

Use the following procedure to unpack and remove the equipment from the pallet. Use Figure 4-1 as a guide.

1. Cut the shipping straps with diagonal cutters.
2. Lift and remove the cover.
3. Remove the two unloading ramps packed in the box on top of the disk cabinet.
4. Remove the shipping carton and all associated packing materials.
5. Check the cabinet and associated equipment for any external shipping damage. Report any damage to the DIGITAL field service or sales office and to the local carrier.

NOTE

Keep all packing material and receipts in case a damage claim is filed.

6. Remove the four shipping bolts that fasten the drive cabinet to the pallet. Refer to the insert in Figure 4-1.
7. Slide the four shipping brackets off the cabinet leveler feet.
8. Extend the loading ramps to their full length by connecting the two sections of each ramp with the steel dowel (taped in the ramp). Refer to Figure 4-2.
9. Matching the arrows, attach the two unloading ramps to the pallet by fitting the tab of each ramp board into the pre-drilled holes on the rear of the pallet deck (Figure 4-2).
10. Screw the cabinet leveler feet all the way up into the chassis by turning the lock nut down until it makes contact with the leveler hex nut, and then turning the hex nut up until it raises the leveler foot. The cabinet should now rest on the casters so that the leveler feet will not touch the ramps (Figure 4-3).

CAUTION

Fully retract the leveler feet to prevent contact with the floor when the cabinet is unloaded from the skid.

WARNING

Take extreme care during the following procedures. At least two people (preferably three) must assist in the process of deskidding or taking the cabinet off the pallet.

The cabinet is top-heavy. Restrain it when you roll it from pallet onto the ramp. When rolling it down the ramp, guide it and retard its motion.

11. Carefully roll the drive cabinet down the ramps.
12. Wheel the cabinet to its final location.
13. Adjust the leveler feet downward until they make solid contact with the floor. Adjust the four leveler feet until the drive cabinet is level and stable. See Figure 4-3.

4.2.2 Removing the Internal Shipping Brackets and Packing Material

Remove the packing materials and shipping brackets inside the chassis of each disk drive using the procedures described in Section 3.8.

4-4 INSTALLATION OF RAB2 DISK DRIVES IN THREE-HIGH CABINETS

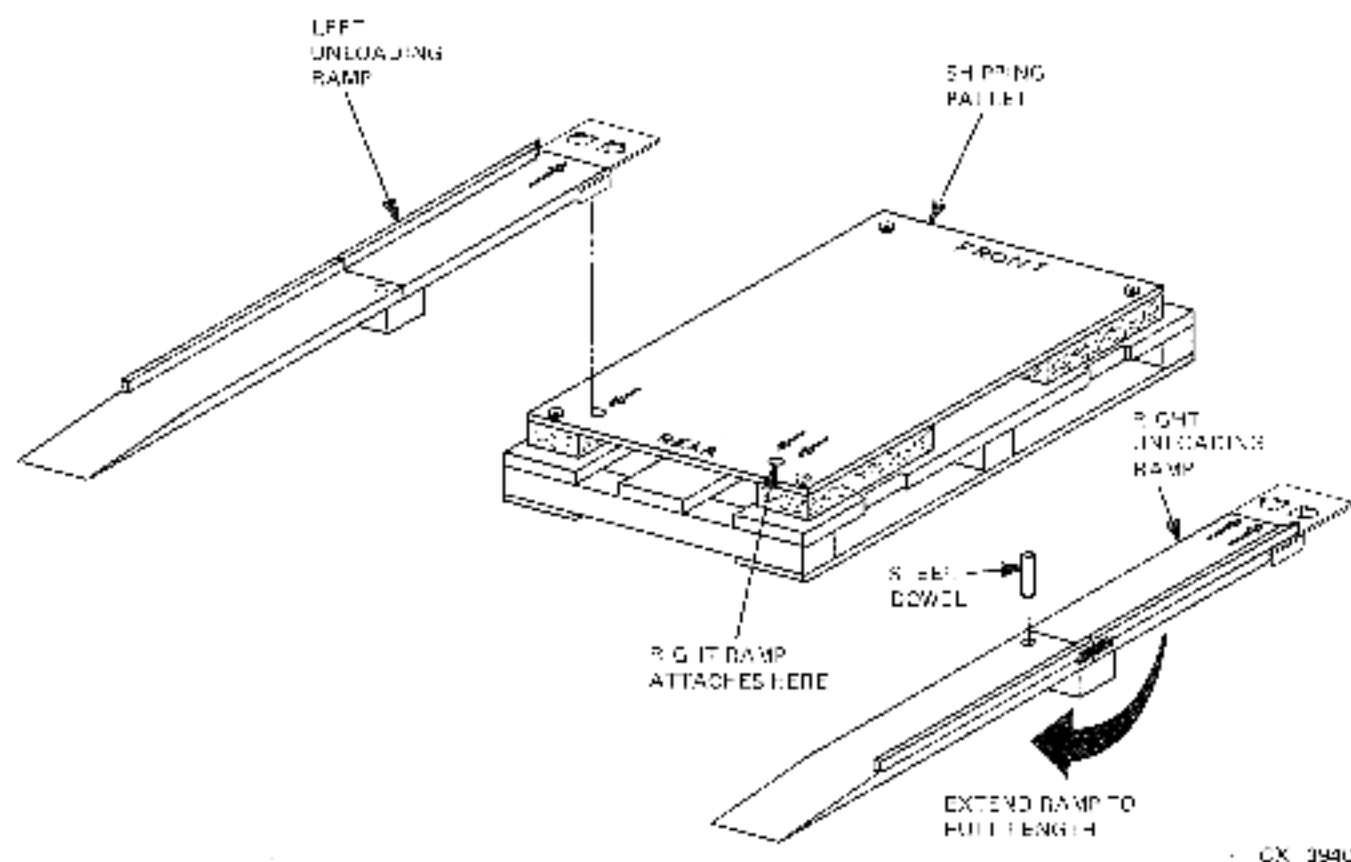


Figure 4-2 Ramp Construction (40-inch Cabinet)

4.2.3 Electrostatic Discharge (ESD) Brackets

The electrostatic discharge (ESD) brackets ground the disk drive to the cabinet.

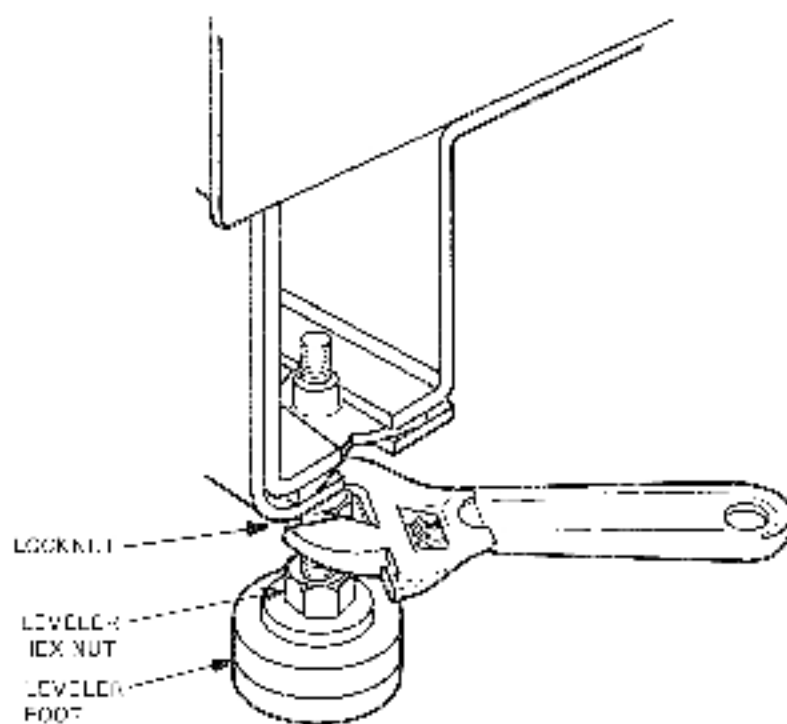
CAUTION

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

Use the following procedure and Figure 4-4 to secure the drives to the ESD brackets:

1. Locate the ESD bracket holes on the rear of the drive.
2. Push the drive forward just enough to remove the bottom corner 1/4-inch hex screws and washers on the power supply.
3. Use the screws and washers just removed to secure the drive to the two ESD brackets.

The screws holding the ESD brackets must be removed to slide the drive forward. These brackets must be reconnected each time the drive is pushed back into the cabinet.



CX 395C

Figure 4-3 Leveler Adjustments

4.3 OPENING AND REMOVING THE REAR DOOR

Refer to Figure 4-5 and Figure 4-6 when performing these procedures.

Open the rear door:

1. Turn the hex lock counterclockwise.
2. Pull open the rear door.

Remove the rear door:

1. Open the rear door as described above.
2. Remove the ground wire attached to the bottom inside of the door.
3. Pull down on the latch in the top corner and lift the door off the lower bracket.

4.4 CABLING THE RA82 TOP DRIVE

Before proceeding with the cabling, open and remove the rear door of the cabinet as described in Section 4.3.

4-8 INSTALLATION OF RA82 DISK DRIVES IN THREE-HIGH CABINETS

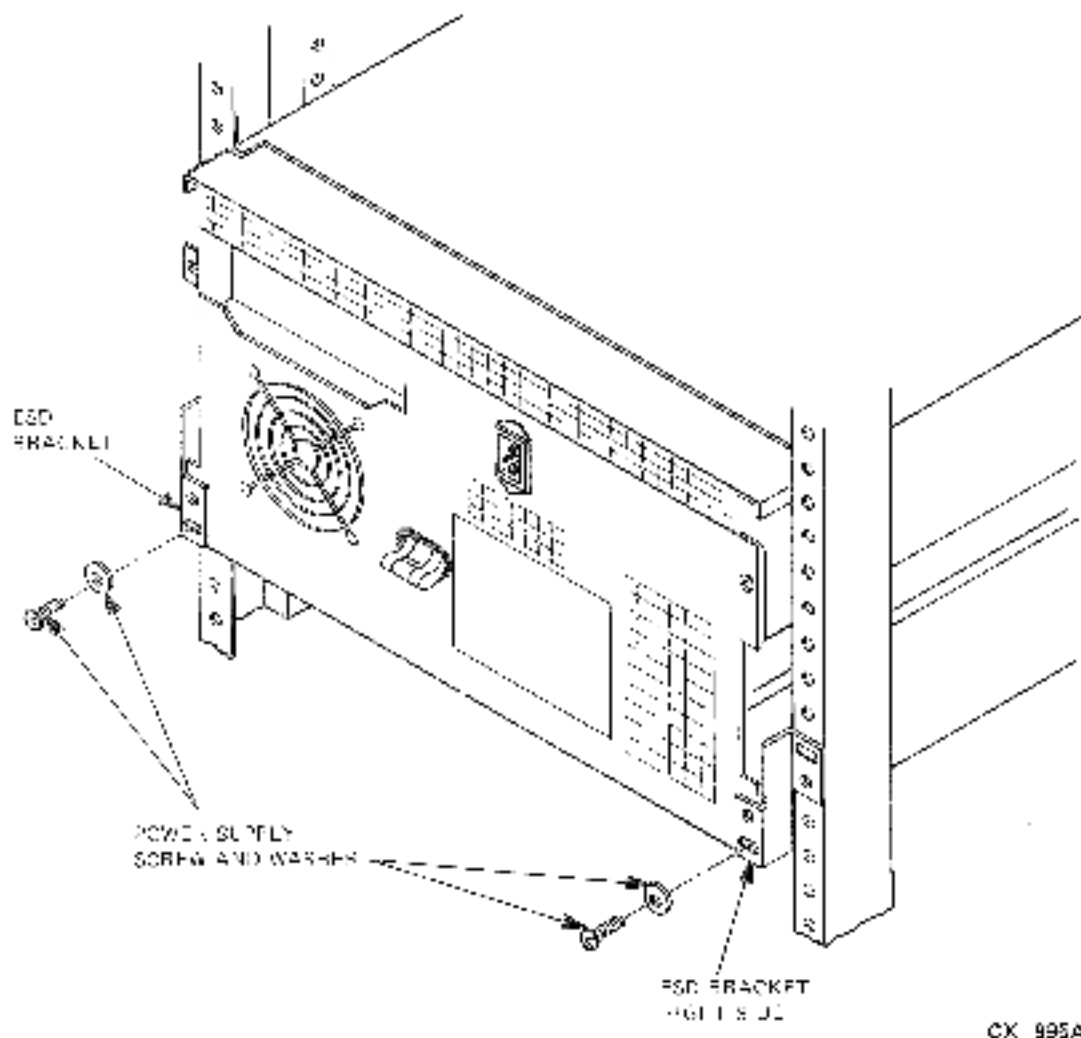


Figure 4-4 Electrostatic Discharge Bracket Details

4.4.1 Mounting the I/O Bulkhead Connectors

An I/O bulkhead connector must be installed on the SDI interface bracket at the back of the drive cabinet for each add-on drive. Screw this assembly to the SDI interface bracket as shown in Figure 4-7.

4.4.2 Installing External SDI Cables

The external SDI cables coming from the central processing unit (CPU) are connected to the I/O bulkhead assembly. Refer to Figure 4-7 and Figure 4-8 for cabling of the top drive.

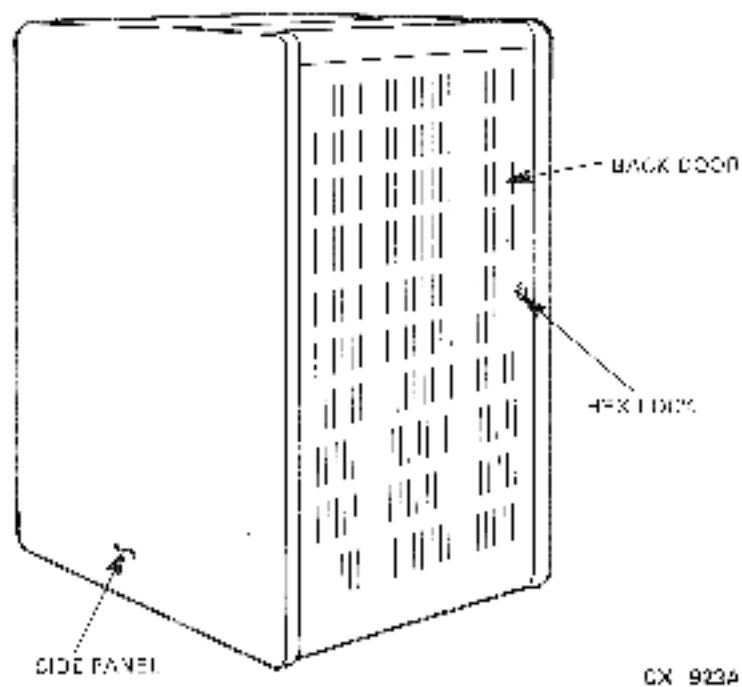


Figure 4-5 Opening the Rear Door

4-8 INSTALLATION OF RA82 DISK DRIVES IN THREE HIGH CABINETS

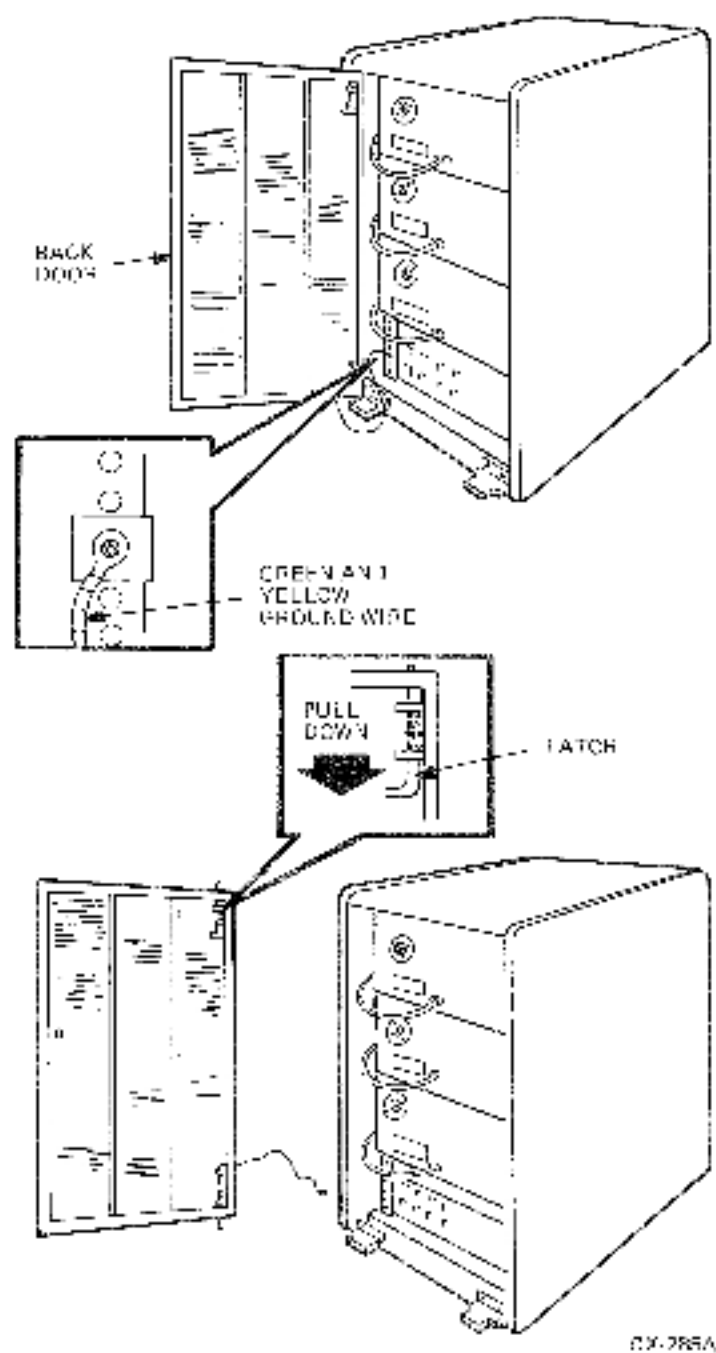


Figure 4-6 Removing the Rear Door

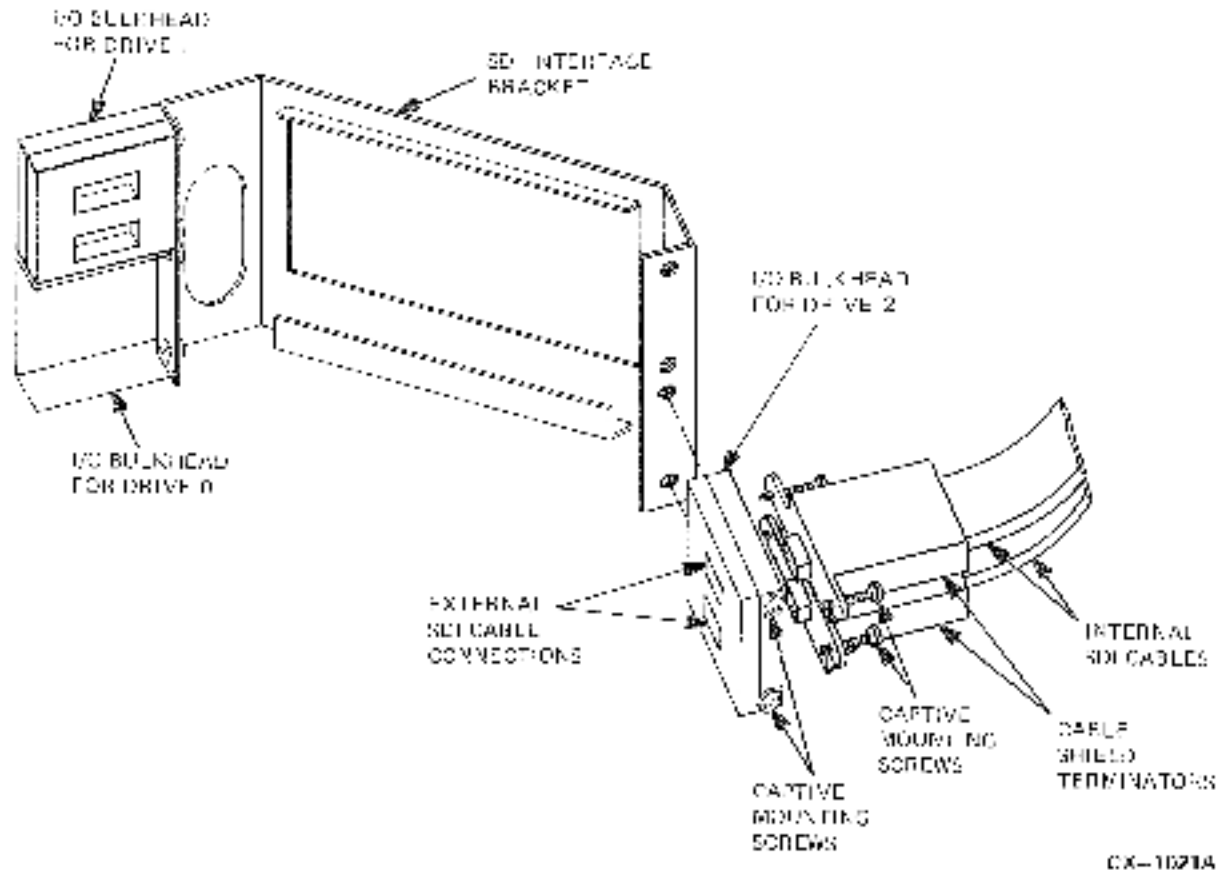
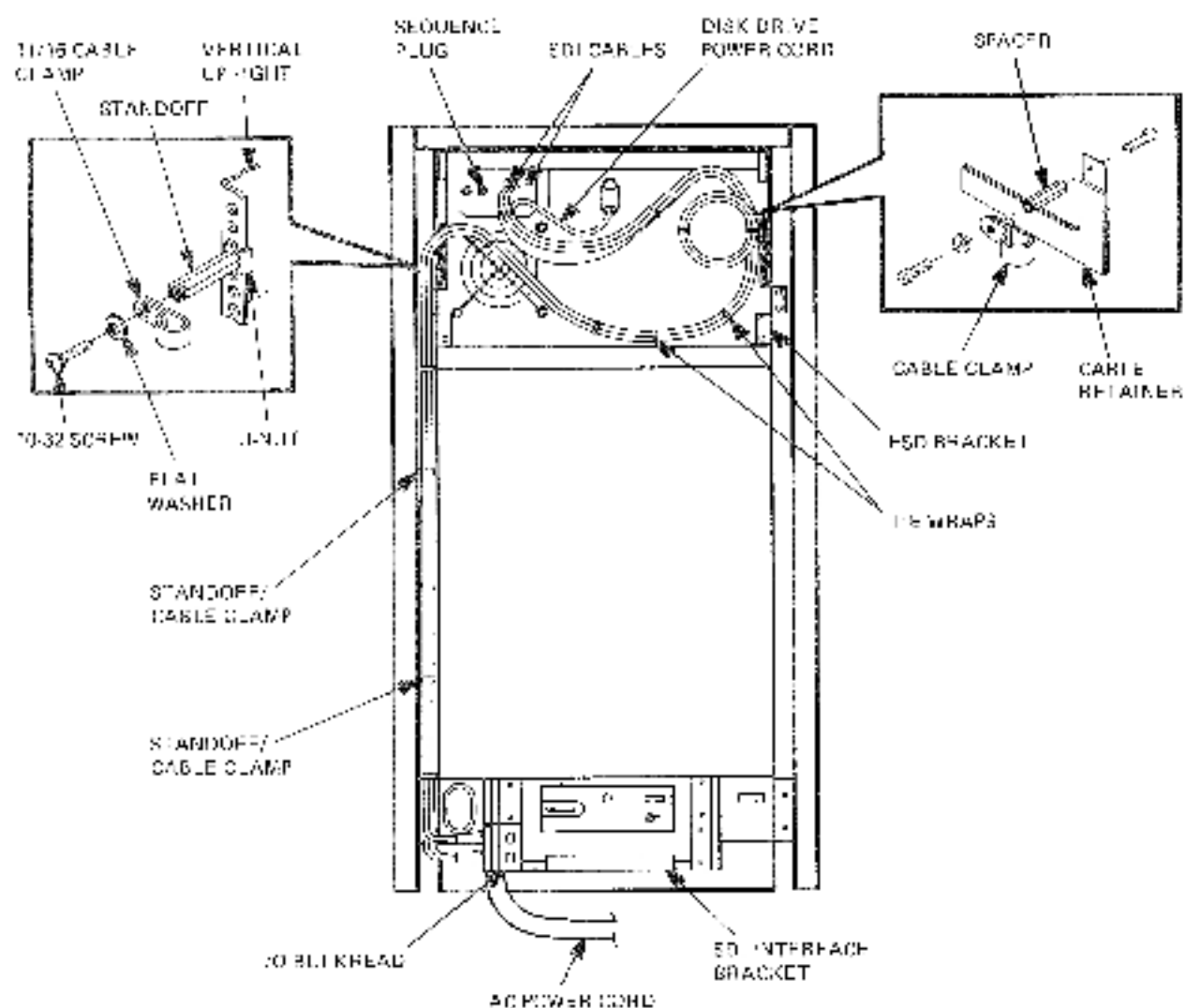


Figure 4-7 I/O Bulkhead

4-10 INSTALLATION OF RA02 DISK DRIVES IN THREE-HIGH CABINETS



EX-1022A

Figure 4-6 SDI Cables for the Top Drive

The external SDI cables must be installed between the I/O bulkhead in the CPU or controller cabinet and all drive I/O bulkhead connectors in the drive cabinet. The controller connector should already be installed. If not, refer to the appropriate controller user guide for instructions on installing the SDI cables at the controller. Use the following procedure to install the external SDI cables to the drive cabinet.

1. Unscrew the two screws holding the I/O bulkhead connector to the SDI interface bracket.
2. Remove the I/O bulkhead connector.
3. Plug the external SDI cable from the disk controller into port A connector on the I/O bulkhead. Note the orientation key on the SDI cable. Refer to Figure 4-7 and Figure 4-8.
4. If a second disk controller is used, mount its SDI cable into port B of the I/O bulkhead connector. Note the orientation key on the SDI cable.

CAUTION

Ensure that no pins are bent during assembly.

5. Tighten the two captive screws on the SDI cable shield terminators to the I/O bulkhead connector. *Do not overtighten (10 in/lb maximum.)*
6. Reconnect the I/O bulkhead connector to the SDI interface bracket.
7. Tighten the two captive screws on the I/O bulkhead connector. *Do not overtighten (10 in/lb maximum).*
8. Repeat the above cabling procedure for all drives in the cabinet.

NOTE

If more than one drive is mounted in the cabinet, additional cables must be installed. Refer to Section 4.5 for instructions.

4.4.3 Installing Internal SDI Cables

The two internal SDI cables that exit from the back of the drive connect to the I/O bulkhead connector (Figure 4-7). Use the following procedure to install the internal SDI cables to the top drive:

1. Locate the port A SDI cable where it exits at the back of the disk drive. Plug the end of the port A connector into the port A position on the I/O bulkhead connector. Note the orientation key on the SDI cable.

CAUTION

Ensure that no pins are bent during assembly.

2. Tighten the two captive screws on the SDI cable shield terminator to the I/O bulkhead connector. *Do not overtighten (10 in/lb maximum.)*
3. Repeat steps 1 and 2 for the port B internal SDI cable.
4. Secure the SDI cables as indicated in Figure 4-8.

4-11 INSTALLATION OF RA82 DISK DRIVES IN THREE-HIGH CABINETS

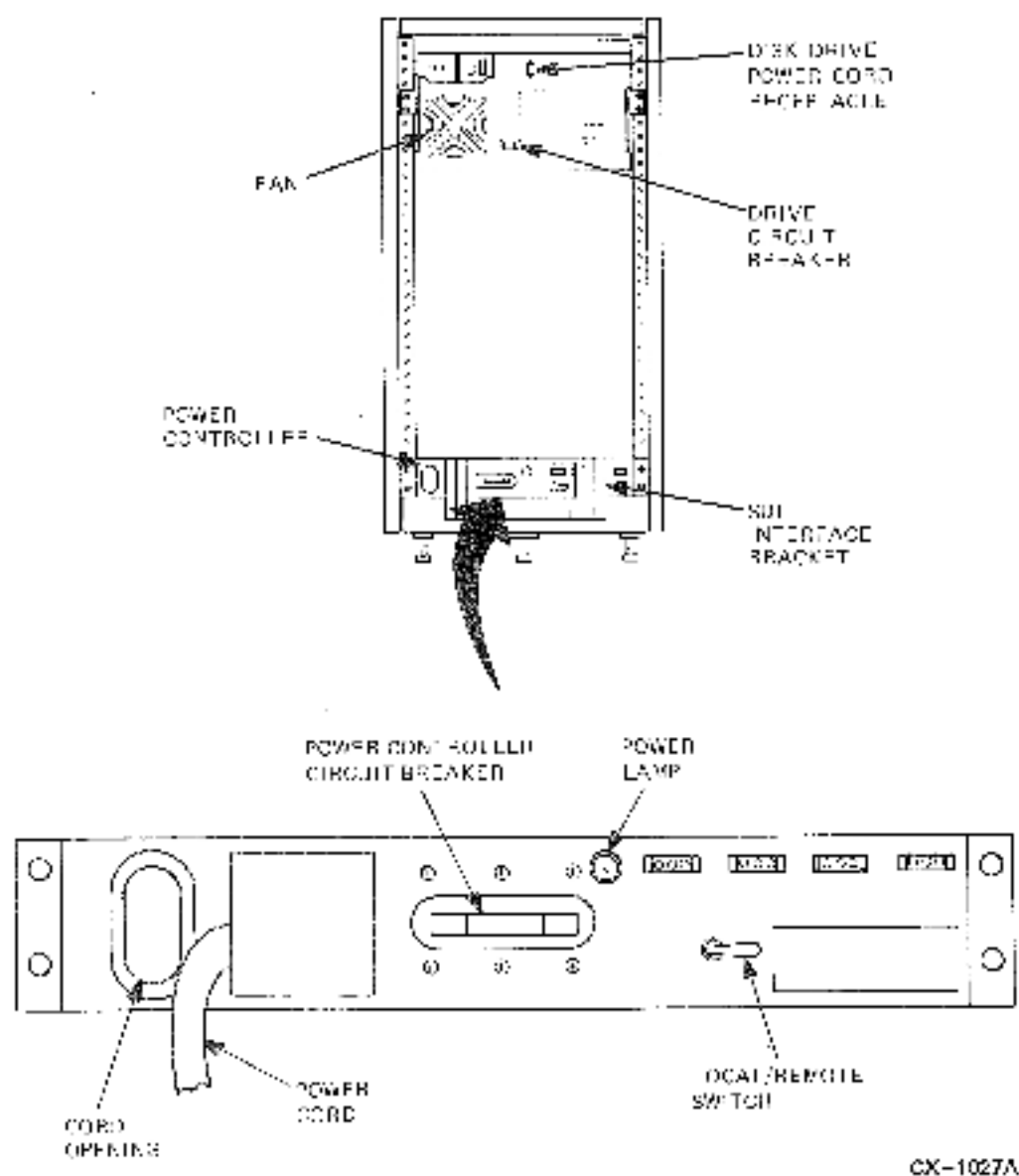


Figure 4-10 Rear Cabinet Power Controls (40-Inch Cabinet)

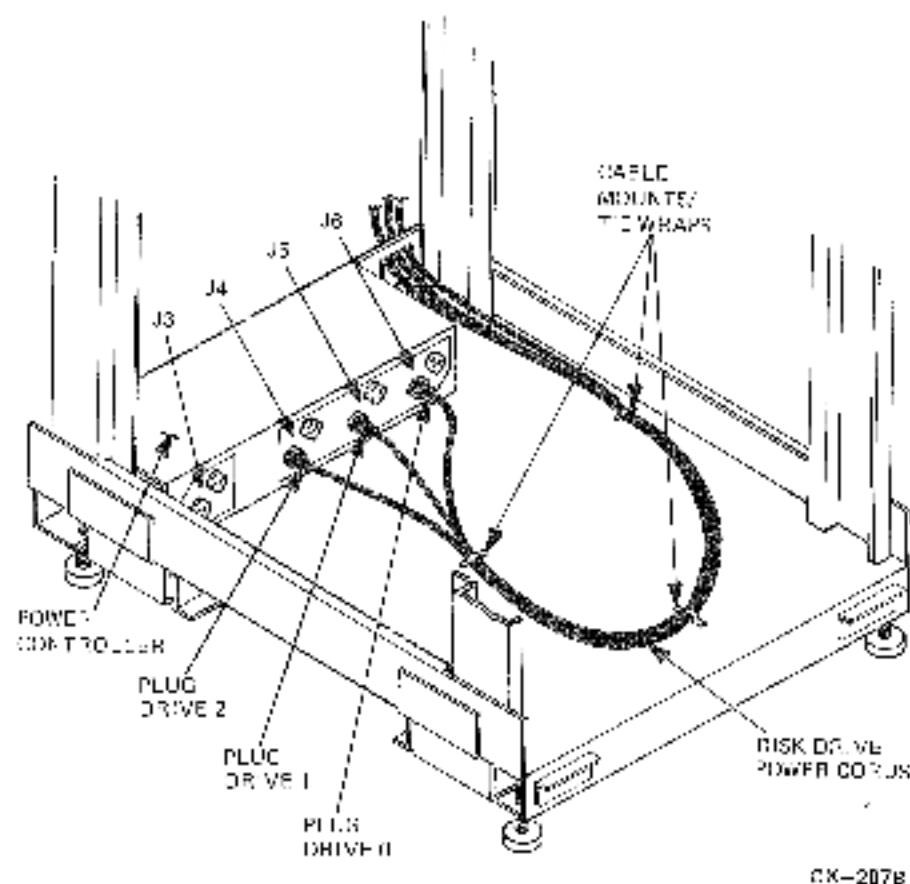


Figure 4-11 Power Cord Routing on Cab Floor

4.5.2 Removing the Front Filter Panels

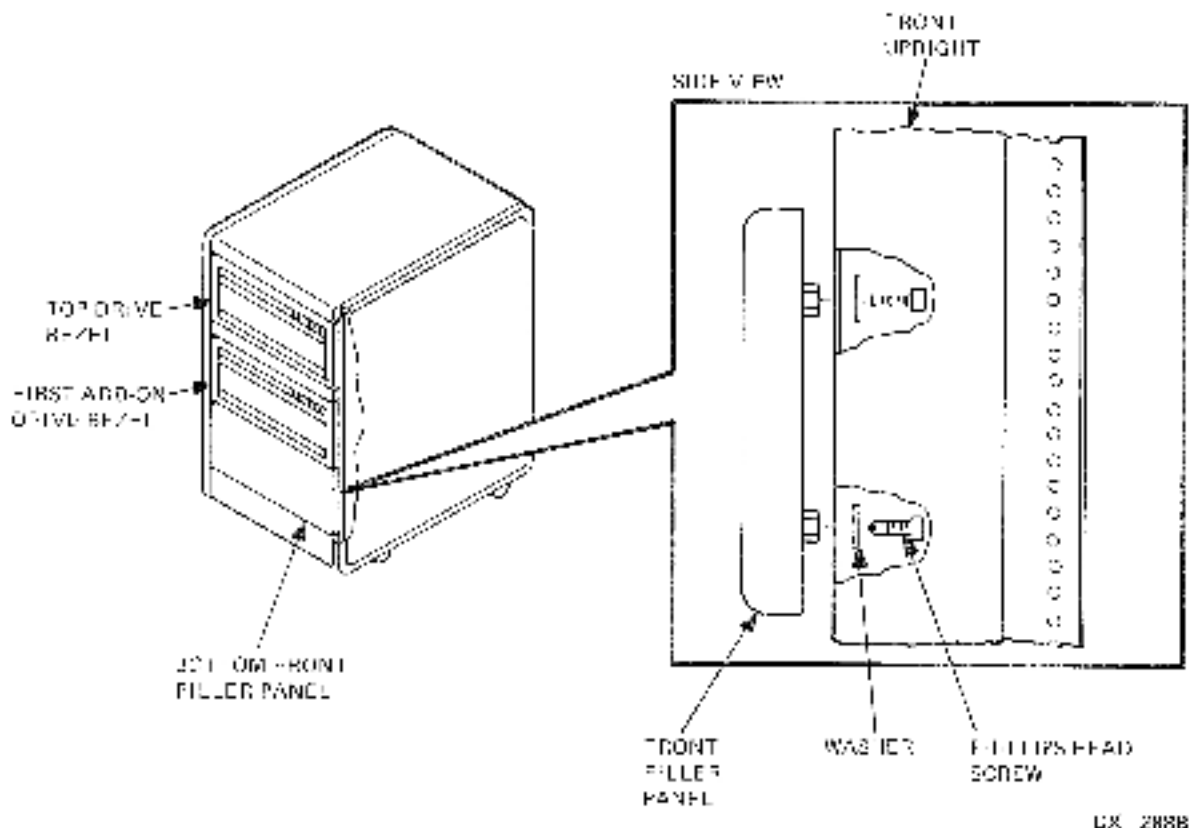
Remove the middle panel from the front of the drive cabinet if this is the first add-on drive to be installed. Remove the bottom panel from the front of the drive cabinet if this is the second add-on drive. The front cabinet panels are held to the cabinet uprights by four nuts and washers. Refer to Figure 4-12.

4.5.3 Extending the Cabinet Stabilizer Foot

Extend the stabilizer foot forward from the center bottom of the drive cabinet and lower the foot so that it makes firm contact with the floor. This step is very important. It prevents the drive cabinet from tipping forward when the new drive is added. Refer to Figure 4-13.

WARNING

Always extend the cabinet stabilizer foot forward before sliding a drive out of the cabinet for any reason. Failure to do so could cause equipment damage or bodily injury.



LX 2888

Figure 4-12 Front Panel Removal

4.6 PREPARING THE ADD-ON DRIVE FOR INSTALLATION

The first and second add-on drives in a 40-inch (three-high) cabinet must be mounted on a slide assembly. The top drive in a 40-inch cabinet is not mounted on slides.

Use the following procedures to prepare the add-on drive for installation.

WARNING

Since the drive weighs at least 61.2 Kg (135 pounds), you must use an approved field service lifting device rated at 200 pounds (DIGITAL Part Number PC-10074-AC) to place the drive onto the chassis slides.

If an approved lifting device is not available, at least three persons are required to lift and install the disk drive. (Refer to Section 4.8.2 for the appropriate procedure.)

The head disk assembly (HDA) may be removed from the drive to reduce the total weight by approximately 35 pounds. Refer to Section 5.6 for instructions on HDA removal.

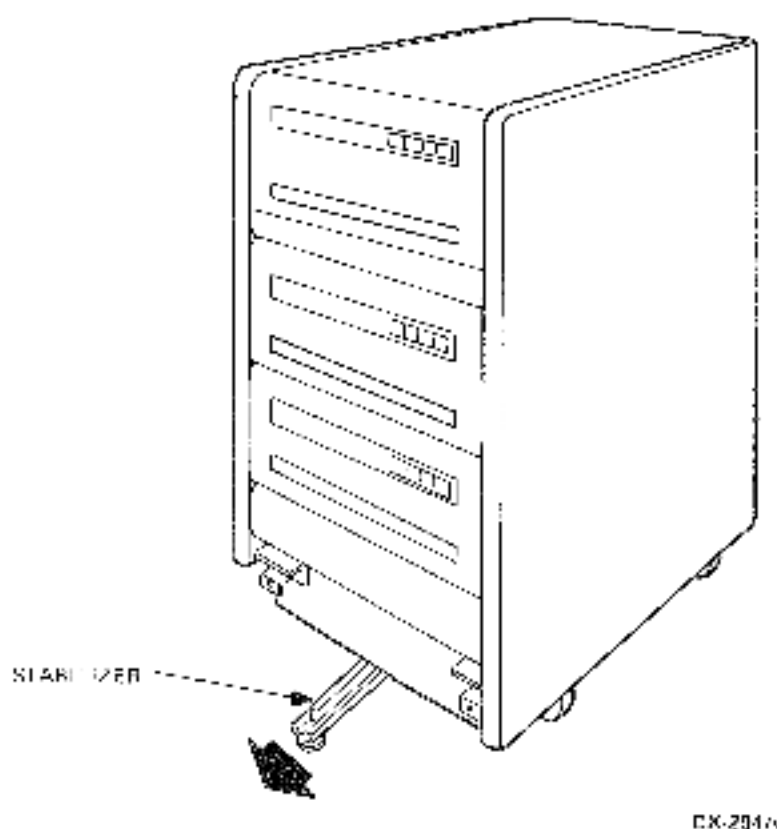


Figure 4-13 Extending the Stabilizer Foot

4.6.1 Removing Internal Shipping Brackets and Packing Material

Packing materials and shipping brackets are inside the chassis of each disk drive. To remove them, follow the procedures described in Section 3.8.

4.7 INSTALLING CABINET SLIDES

Drives must be mounted on a slide assembly. Refer to Figure 4-14 and Figure 4-15 for the proper installation hole locations in the 40-inch (three-high) cabinet.

Note that in the 40-inch cabinet the first hole in the rear uprights above the power controller is hole number 7. On the front of the 40-inch cabinet, if the lower front panel is still in place, the next hole in the cabinet uprights above the front panel is hole number 25.

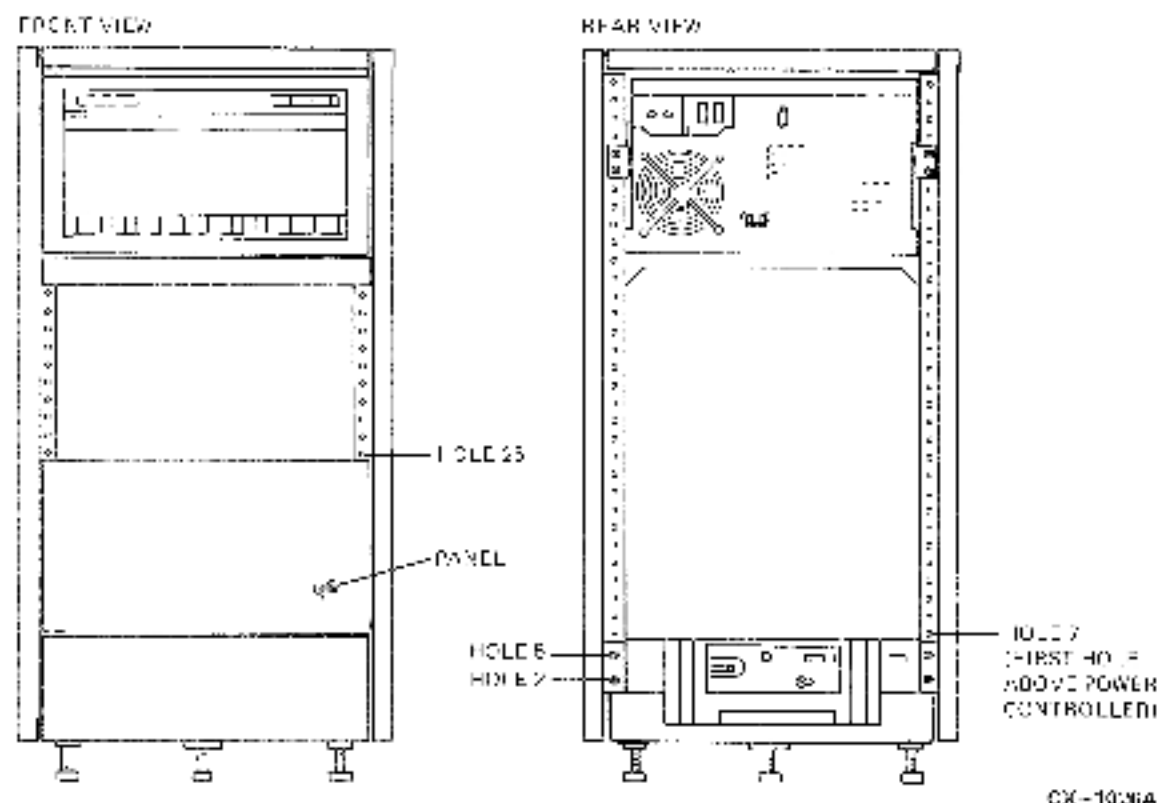


Figure 4-14 Cabinet Upright Holes (40-inch Cabinet)

4.7.1 Preparing the Slides for Cabinet Mounting

Use the following procedure to prepare the cabinet slide assemblies for installation. Assemble the left-hand slide assembly first.

1. Locate the left-hand slide that has part number 1213686-00-REV-X-1 engraved on it. The revision level of the slide is given here as "X" because it changes occasionally. The letter L indicates this is the left-hand slide.
2. Locate the plastic bag containing four slide brackets.
3. Locate the plastic bag containing the 8-32 X 5/16 screws.
4. Lay the left-hand slide on its back and push the lower half of the slide to the left to gain access to the rear mounting holes (Figure 4-16).
5. Use two 8-32 screws to mount the rear slide bracket to the slide as shown in Figure 4-16. Don't tighten the screws all the way since some leeway is needed later when the slides are mounted into the cabinet.
6. Use two more 8-32 screws to mount the front slide bracket to the left-hand slide. The screws must be inserted into the mounting holes through the movable oval opening on the slide. Tighten the two screws.

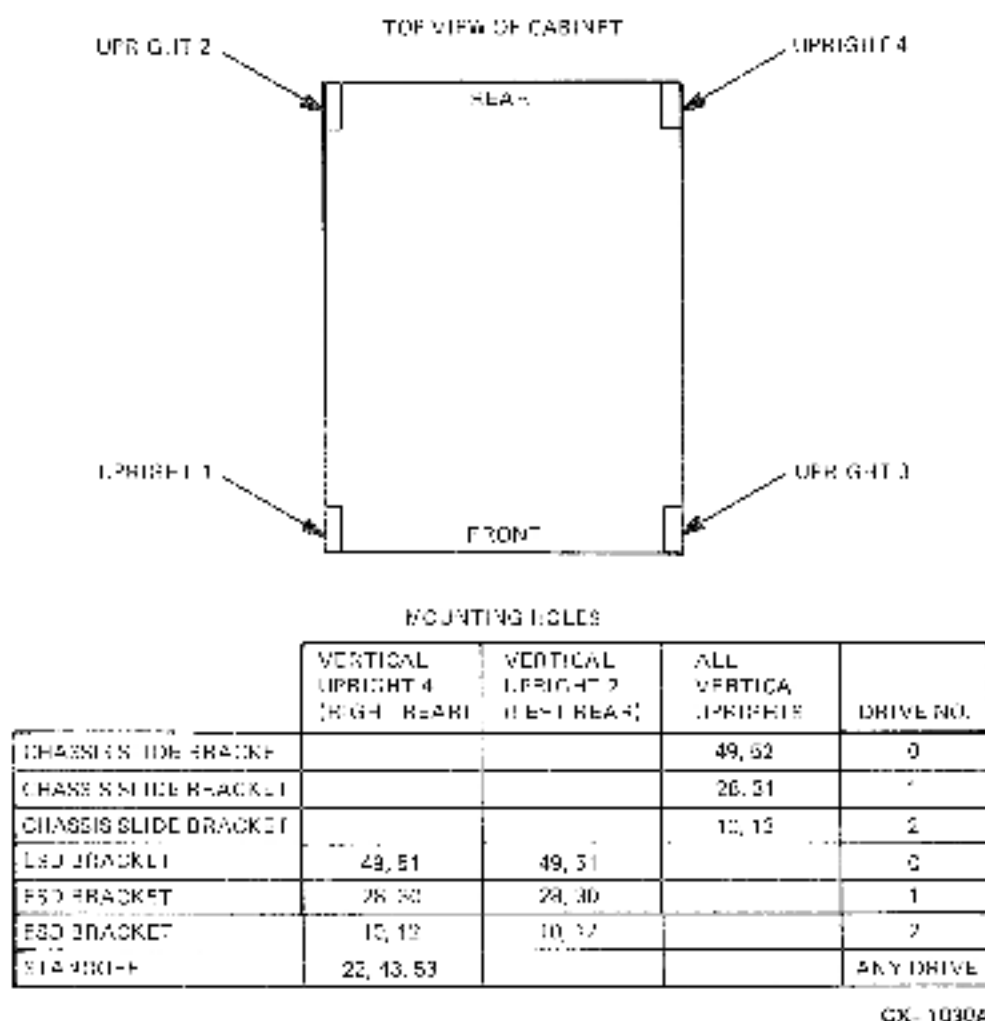


Figure 4-15 Mounting Hole Table

7. Press the two front leaves of the L-shaped cable retainer together and force the retainer into the rear of the left-hand slide assembly as shown in Figure 4-16.

NOTE

A cable retainer must be used on each left-hand slide assembly for drives installed in positions 0, 1, and 2.

8. Locate the drive right-hand slide that has part number 1213686-00-REV-X-R engraved on it. The revision level of the slide is given as "X" because it changes occasionally. The letter R indicates this is the right-hand slide.
9. Lay the right-hand slide on its back and push the lower half of the slide to the right to gain access to the rear mounting holes (Figure 4-17).

4-20 INSTALLATION OF RAS2 DISK DRIVES IN THREE-HIGH CABINETS

10. Use two 8-32 screws to mount the rear slide bracket to the slide. Don't tighten the screws all the way since some leeway is needed when the slides are later mounted into the cabinet.
11. Use two more 8-32 screws to mount the front slide bracket to the right-hand slide. Insert the screws into the slide mounting holes by aligning the oval opening over them. Tighten the two screws.

Both slides are now prepared for installation into the drive cabinet.

4.7.2 Attaching Slides to Cabinet

Use the following procedures to install the slides and associated hardware in the cabinet.

1. Go to the rear of the drive cabinet. Counting from the bottom, locate and mark the mounting holes in both rear cabinet uprights. Refer to Figure 4-14.
2. Go to the front of the drive cabinet. Counting from the bottom, locate and mark the mounting holes on both front cabinet uprights. Refer to Figure 4-14.
3. Locate the plastic bag containing the 10-32 X 1/2 screws.
4. Locate the plastic bag containing the four nut bars.
5. Locate the plastic bag containing two electrostatic discharge (ESD) brackets.
6. At the front of the cabinet, mount the right-hand slide assembly to the front-right cabinet upright using two 10-32 screws and one nut bar as shown in Figure 4-18.
7. Use the same procedure to mount the left-hand slide assembly to the front-left cabinet upright.
8. Go to the rear of the cabinet. Insert one 10-32 screw through the left-hand cabinet upright, the top hole of the right-hand slide bracket, and the top hole of the nut bar (to hold the slide in place).
9. Use two more 10-32 screws to mount the ESD bracket to the upright as shown in Figure 4-18.
10. Use the same procedure to mount the left-hand slide assembly and ESD bracket to the rear right-hand cabinet upright.
11. Once both slides are mounted, go to the rear of the cabinet and tighten the screws holding the slides to the slide brackets. These brackets were left loose for adjustment. Do this for both slides.

4.8 MOUNTING THE ADD-ON DRIVE ON THE SLIDES

Use the following procedure to mount the RAS2 add-on drive on the slides. Refer to figure 4-19.

WARNING

The cabinet stabilizer foot must be fully extended and locked (Figure 4-13).

The RAS2 disk drive weighs at least 61.2 Kg (135 pounds). DIGITAL recommends that you use an approved field service lifting device rated at 200 pounds (DIGITAL Part Number PC-18074-AC) to place the drive on the chassis slides.

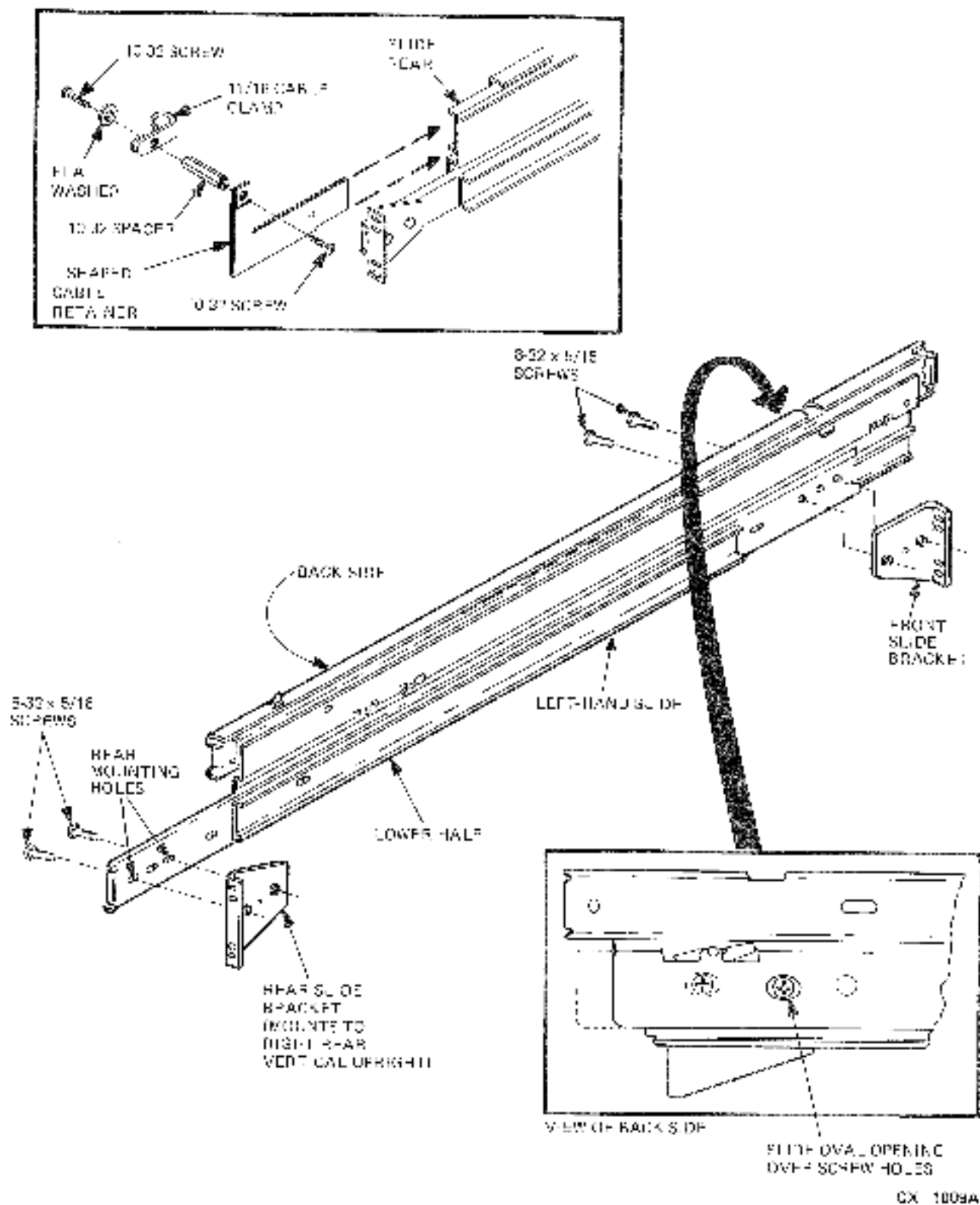
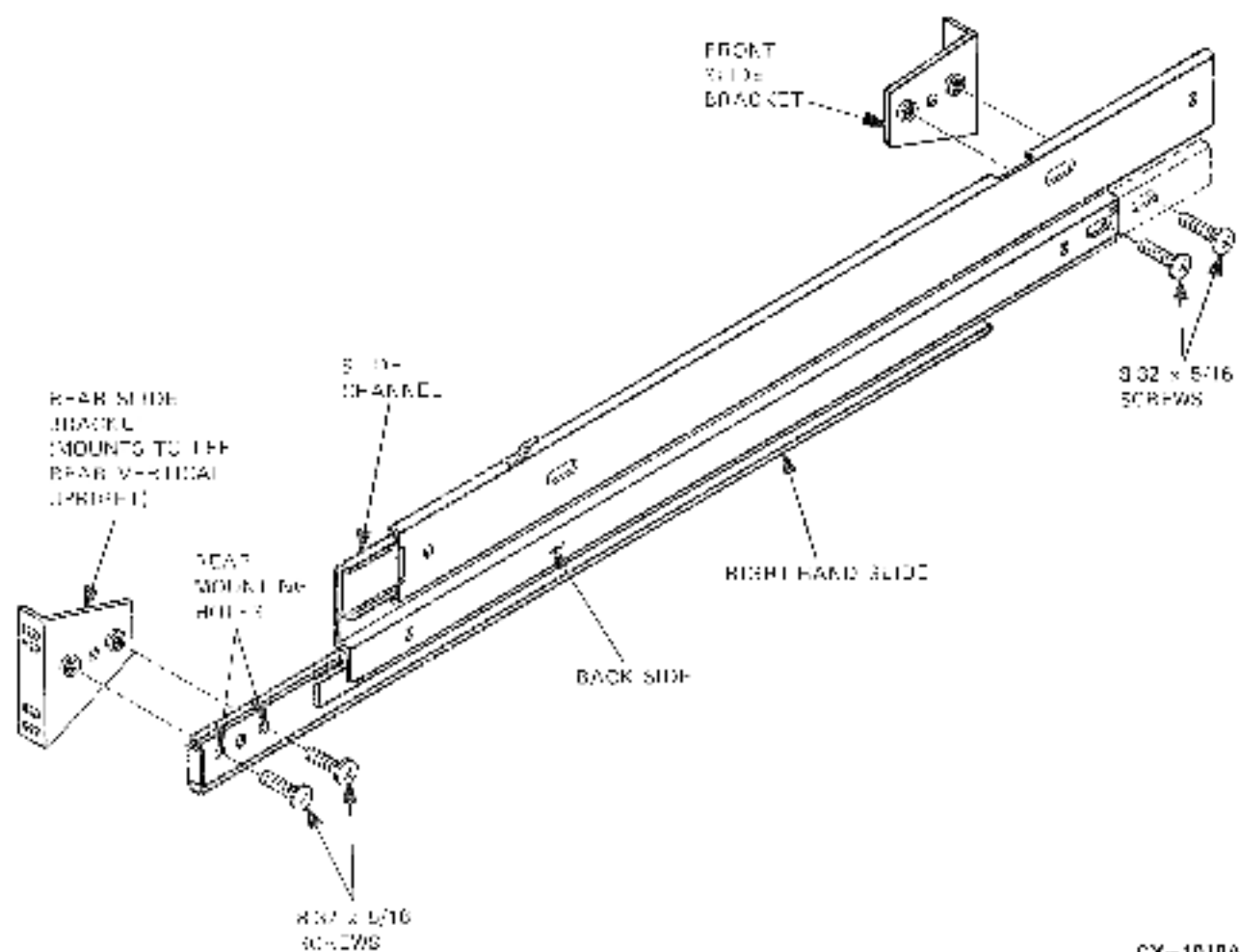


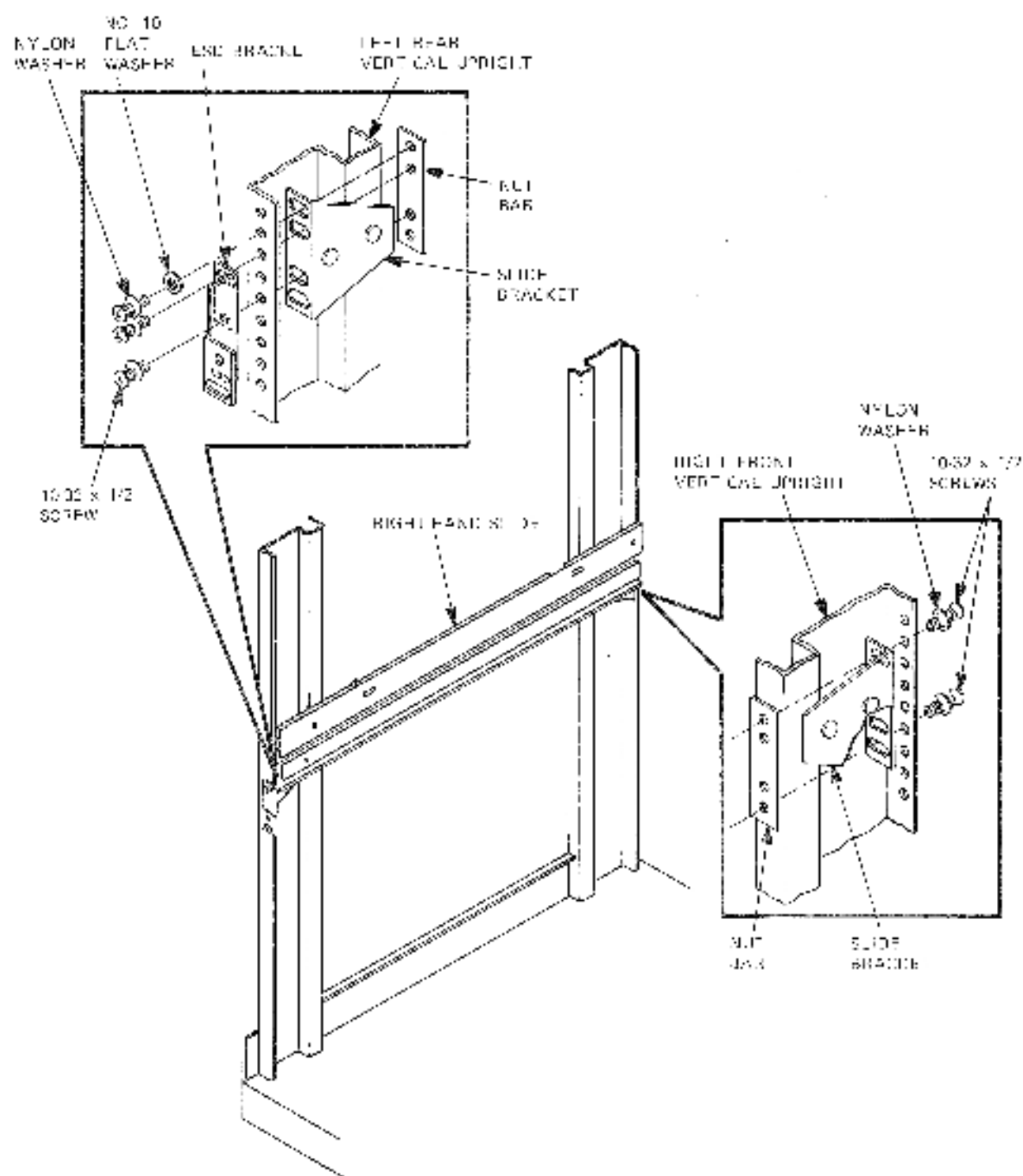
Figure 4-15 Left-Hand Slide

4-22 INSTALLATION OF RA82 DISK DRIVES IN THREE-HIGH CABINETS



CX-1010A

Figure 4-17 Right-Hand Slide



DA 1012B

Figure 4-18 Mounting the Slide Assembly

2. Place one person on each side of the unit.
3. Place one person at the front of the unit.
4. The two persons at the sides of the unit grasp the front and rear of the unit and, using the leg muscles, lift the unit together.
5. The person at the front of the unit removes the skid or other packaging material from the immediate area.
6. The person at the front of the unit guides the lifters and assures that the slides are locked and that the unit is resting on the slides correctly.
7. While the two are holding the RA82 in position, the third person starts two mounting screws on each side of the unit (the one closest to the front and the one closest to the rear).
8. Secure the remaining mounting hardware as required and continue with normal installation procedures.

4.9 INSTALLING CABLE STANDOFFS AND U-NUTS

Cable standoffs and U-nuts are used with cable clamps in the three-high cabinet to hold the cables away from the rear vertical uprights. The number of cable standoffs to install depends upon the number of drives in the cabinet. Refer to Figure 4-15 for the proper three-high RA82 cabinet installation notes.

Use the following procedure to mount each cable standoff and U-nut. Refer to Figure 4-20.

1. Locate the plastic bags containing the cable standoffs.
2. Locate the plastic bag containing the U-nuts.
3. Slide each U-nut over the hole of the rear vertical upright designated in Figure 4-15. The threaded portion of the U-nut should face the inside of the cabinet.
4. Screw the standoff into the U-nut.

4.10 INSTALLING THE I/O BULKHEAD CONNECTORS

Locate the I/O bulkhead connector that came with the add-on disk drive. Based on drive position, each I/O bulkhead must be mounted in a designated location on the SDI interface bracket. Using the two captive screws, mount the I/O bulkhead to the SDI interface bracket at the rear base of the drive cabinet as shown in Figure 4-7.

4.11 INSTALLING SDI CABLES

Two six-foot SDI cables and one twelve-foot SDI cable are shipped with each add-on drive. The two six-foot SDI cables are the internal cabinet cables that connect the drive to the I/O bulkhead assembly. The twelve-foot SDI cable is the external cable that attaches the drive cabinet to the disk controller in another cabinet.

When installing the SDI cables, you have to choose which of the following SDI cable installation procedures fits your need. The first one describes how to install the SDI cables for the first RA8X series add-on (middle cabinet position). The second one describes how to install the SDI cables for the second RA8X series add-on (bottom cabinet position).

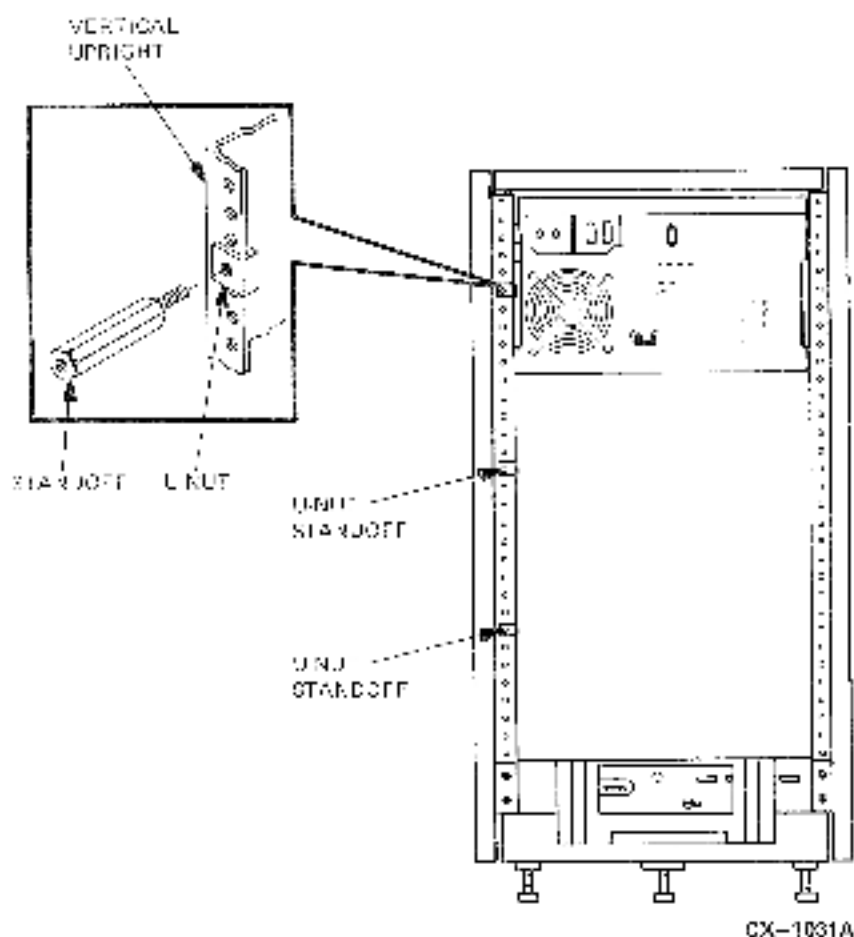


Figure 4-20 Mounting U-Nut and Standoffs

4.11.1 Installing the First Add-On Drive SDI Cables

Use the following procedure to install the SDI cables for the first add-on drive. Refer to Figure 4-21. See Figure 4-22 for electrical wiring diagrams of a two-drive system.

1. Install the bottom end of the SDI cables with the I/O bulkhead on the SDI interface bracket at the base of the cabinet.
2. Clamp the SDI cables to the cable retainers on the end of the drive slides and the cable standoffs.
3. Starting at the I/O bulkhead, tie wrap the SDI cables as shown in Figure 4-21. Leave enough slack in the SDI cables so the drive can slide out the front of the cabinet.

4.11.2 Installing the Second Add-On Drive SDI Cables

Use the following procedure to install the SDI cables for the second add-on drive. Refer to Figure 4-23. See Figure 4-24 for cable wiring diagrams of a three- and four-drive system.

1. Install the bottom end of the SDI cables from the second add-on drive into the I/O bulkhead assembly at the base of the cabinet. Based on drive position, each I/O bulkhead must be mounted in a designated location on the SDI interface bracket. Using the two captive screws, mount the I/O bulkhead to the SDI interface bracket at the rear base of the drive cabinet as shown in Figure 4-7.
2. Clamp the SDI cables to the cable retainers on the end of the drive slides and the cable standoffs.
3. Tie wrap the SDI cables as shown in Figure 4-23.
4. Extend the cabinet stabilizer foot and pull the drive out of the cabinet to check if there is enough slack left in the SDI cables. Check that no cables are being pinched. If necessary, adjust the cable loop.

This completes the SDI cable installation for the second add-on drive. The sequence cables are added next.

4.12 INSTALLING SEQUENCE CABLES ON RASX DISK DRIVES

Sequence cables permit only one drive to start up at a time. All RASX series disk drives need drive sequence cables. RAM0 disk drives do not use drive sequence cables because they do not require as much start-up current. The following drive sequence cable procedures assume that only RASXs are used in the cabinet.

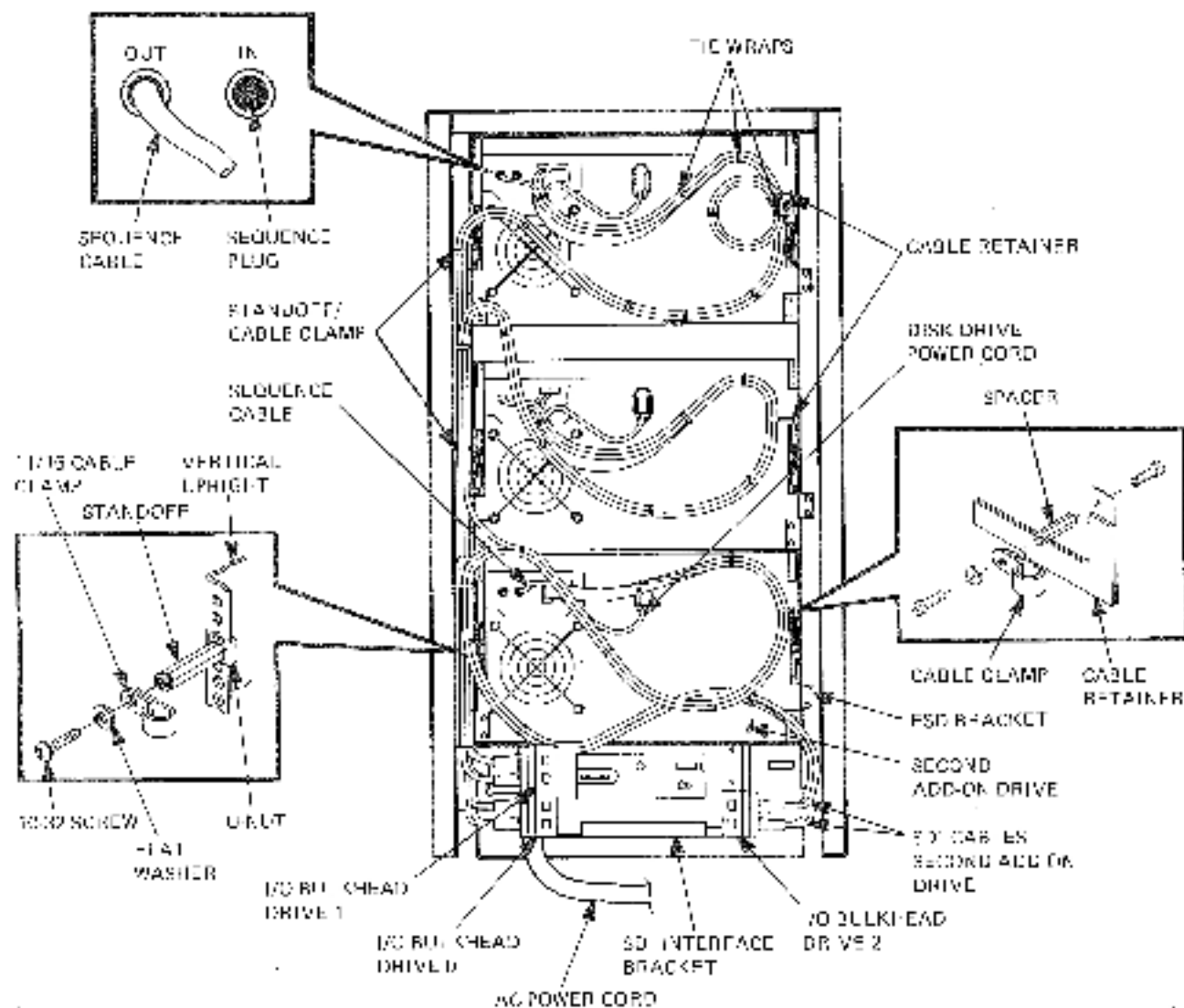
CAUTION

Sequence cables must be installed or disk/data corruption or damage may result during or after a system power failure.

4.12.1 Installing First Add-On Drive Sequence Cables

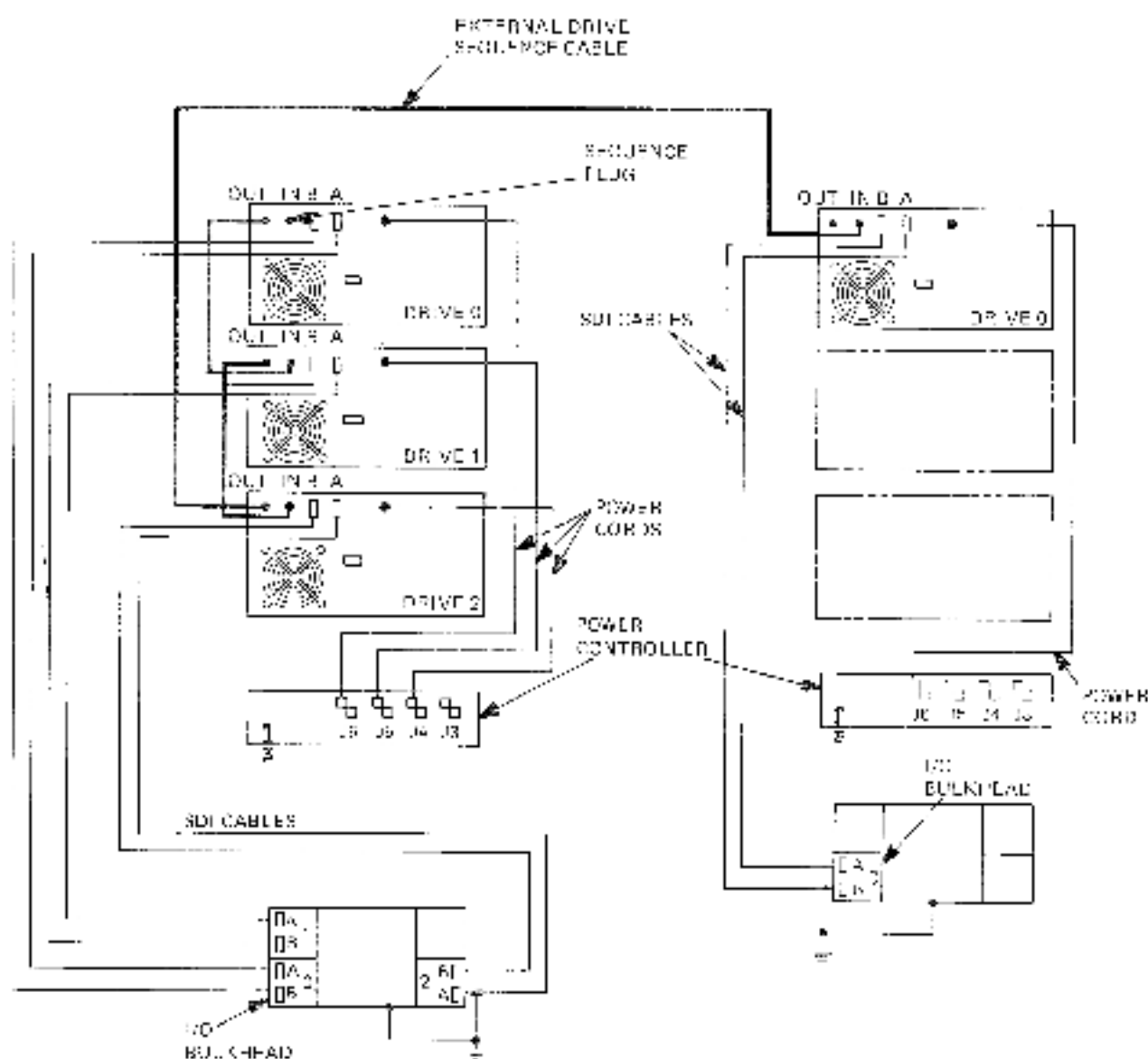
Use the following procedure to install the drive sequence cables on the first RASX series add-on drive. Refer to Figure 4-24. See Figure 4-22 for electrical wiring diagrams of a two-drive system.

1. Install a sequence cable between the OUT connector on the back of the top drive and the IN connector on the back of the first add-on drive.
2. Tie wrap the sequence cables to the SDI cables as shown in Figure 4-24 leaving enough slack in the cables so the drive can be slid out the front of the cabinet.
3. Extend the cabinet stabilizer foot and then pull the add-on drive out of the cabinet to check if you left enough slack in the sequence cables. Check that no cables are being pinched. Adjust cables if necessary.
4. Use as many tie wraps as needed to dress the cables properly.



CX-1023A

Figure 4-23 Cable Routing - Second Add-On Drive



NOTE 1: ALL PORT A CONNECTIONS GO TO SDI CONTROLLER R/A. ALL PORT 1 CONNECTIONS GO TO SDI CONTROLLER R/B.
NOTE 2: HEAVY LINE INDICATES GND - SIGNALING CABLE

CX-1025A

Figure 4-24 Cable Wiring Diagram of a Three- or Four-Drive System (Generic)

4.12.2 Installing the Second Add-On Drive Sequence Cables

Use the following procedure to install the sequence cables onto the second RA8X series add-on drive. This procedure assumes that the top and middle drives are RA8X series drives. Refer to Figure 4-23. See Figure 4-24 for electrical wiring diagrams of a three- and four-drive system.

1. Install a sequence cable between the OUT connector on the back of the top drive and the IN connector on the back of the first add-on drive.
2. Install a second sequence cable between the OUT connector on the back of the first add-on drive and the IN connector on the back of the second add-on drive.
3. Tie wrap these sequence cables to the SDI cables as shown in Figure 4-23 leaving enough slack so the drives can be slid out the front of the cabinet.
4. Extend the cabinet stabilizer foot and pull the add-on drives out of the cabinet to check if there is enough slack in the sequence cables. Check that no cables are being pinched. Adjust cables if necessary.
5. Use as many tie wraps as needed to dress the cables properly.

4.13 INSTALLING THE SEQUENCE TERMINATOR PLUG

Check to see if there is a drive sequence terminator plug at the IN connector of the first drive. If not, use the terminator plug (Part Number 70-19692-01) that comes in the add-on RA8X series drive hardware kit.

4.14 INSTALLING THE DISK DRIVE POWER CORDS

The installation of the disk drive power cord varies depending on whether you are installing the first or second add-on drive. In general, disk drive power cords are routed with the SDI cables down the rear cabinet upright to the power controller. The power cords are then routed through the grommeted opening in the power controller.

4.14.1 Installing the First Add-On Drive Power Cord

Use the following procedure to install the disk drive power cord for the first RA82 add-on drive. Refer to Figure 4-21. See Figure 4-22 for electrical wiring diagrams of a two-drive system.

1. Plug the disk drive power cord into the rear of the top drive in the cabinet.
2. Plug the disk drive power cord into the rear of the first add-on drive.
3. Secure the power cords as shown in Figure 4-21.
4. Extend the cabinet stabilizer foot and then test whether enough slack has been left in the power cord on the add-on drive by sliding the drive all the way forward. Leave enough slack so there isn't any tension on the power cord when the drive is extended. Loosen the power cord at the standoff cable clamp if necessary.
5. Insert the plug ends of the power cords through the grommeted opening in the power controller panel at the base of the cabinet.
6. Route the power cords over the base of the cabinet as shown in Figure 4-11.
7. Plug the shortest power cord into power controller receptacle J6.
8. Plug the power cord from the add-on drive into power controller receptacle J5.

4.34 INSTALLATION OF RAX2 DISK DRIVES IN THREE-HIGH CABINETS

9. After the power cords are routed properly on the base of the cabinet, secure them in place with tie wraps. Slide the tie wraps with their rough side up through the plastic cable mounts on the floor of the cabinet. Tighten the tie wraps around the power cords. Cut off the excess tie wrap material.

4.14.2 Installing the Second Add-On Drive Power Cord

Use the following procedure to install the disk drive power cord on the second add-on drive. Refer to Figure 4-23. See Figure 4-24 for cable wiring diagrams of a three- and four-drive system.

1. Plug the disk drive power cords into the rear of the drives.
2. Secure the power cords as shown in Figure 4-23.
3. Extend the cabinet stabilizer foot, then slide the bottom disk drive all the way out of the cabinet to test whether there is enough slack in the power cord. Check to make sure that no cables are being pinched. Adjust the power cord loops, if necessary.
4. Insert all three power cords through the grounded opening in the power controller panel.
5. Route the power cords over the base of the cabinet as shown in Figure 4-11.
6. Plug the shortest power cord into power controller receptacle J6.
7. Plug the power cord from the first add-on drive into power controller receptacle J5.
8. Plug the power cord from the second add-on drive into power controller receptacle J4.
9. After the power cords are routed properly on the base of the cabinet, tie wrap them in place. Slide the tie wraps with their rough side up through the plastic cable mounts on the floor of the cabinet. Tighten the tie wraps around the power cords. Cut off excess tie wrap material.

4.15 REMOVING HDA SHIPPING BRACKETS

If you removed the HDA for installation, refer to Section 5.19 for the replacement procedure.

Remove the shipping brackets from the HDA now if this was not done when you mounted the add-on drive onto the slides. Use the procedure described in Section 3.8.

4.16 SECURING THE DRIVE TO THE ESD BRACKETS

Secure the drive to the ESD brackets as described in Section 4.2.3.

4.17 PERFORMING DRIVE CHECK-OUT PROCEDURE

After installing the add-on drive, perform the drive check-out procedure described in Section 3.13.

4.18 REMOVING A DRIVE

This section describes how to remove an RAX2 disk drive from a three-high cabinet.

4.18.1 Removing Power

Before reconfiguring a cabinet, remove the power from the system by tripping the circuit breaker on the power controller. The power controller is located on the bottom of the cabinet. The circuit breakers are located at the rear of the power controller.

4.18.2 Removing Sequence Cables (From Mounted Drives)

The sequence cables are the small, round gray cables. As the sequence cables travel down the rear of the cabinet, they are held in place by a number of tie wraps. Cut away all the tie wraps that hold the sequence cables in place. (Don't cut the cable clamps that hold the SSI cables.) Then unplug the sequence cables from the rear of the drive(s). Refer to Figure 4-25.

4.18.3 Removing the Power Cord (From Mounted Drives)

Use the following procedure to remove the disk drive power cord from the top drive or drives.

1. Cut away the three tie wraps that hold the power cord to the inside floor of the cabinet (Figure 4-11).
2. Remove and save the two cable clamps that hold the power cord to the rear cabinet upright. Leave the two standoffs attached in the cabinet.
3. Unplug the power cords from the power controller in the base of the cabinet.
4. Unplug the power cord from the back of the top disk drive only if it is an RA8X series drive.
5. Remove the power cord from the first add-on drive (middle cabinet position) only if it is an RA8X series drive and you are installing the second add-on drive (in the bottom cabinet position).
6. Pull the power cords out from the grommeted opening in the power controller panel and save them for later reinstallation.

5-2 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET

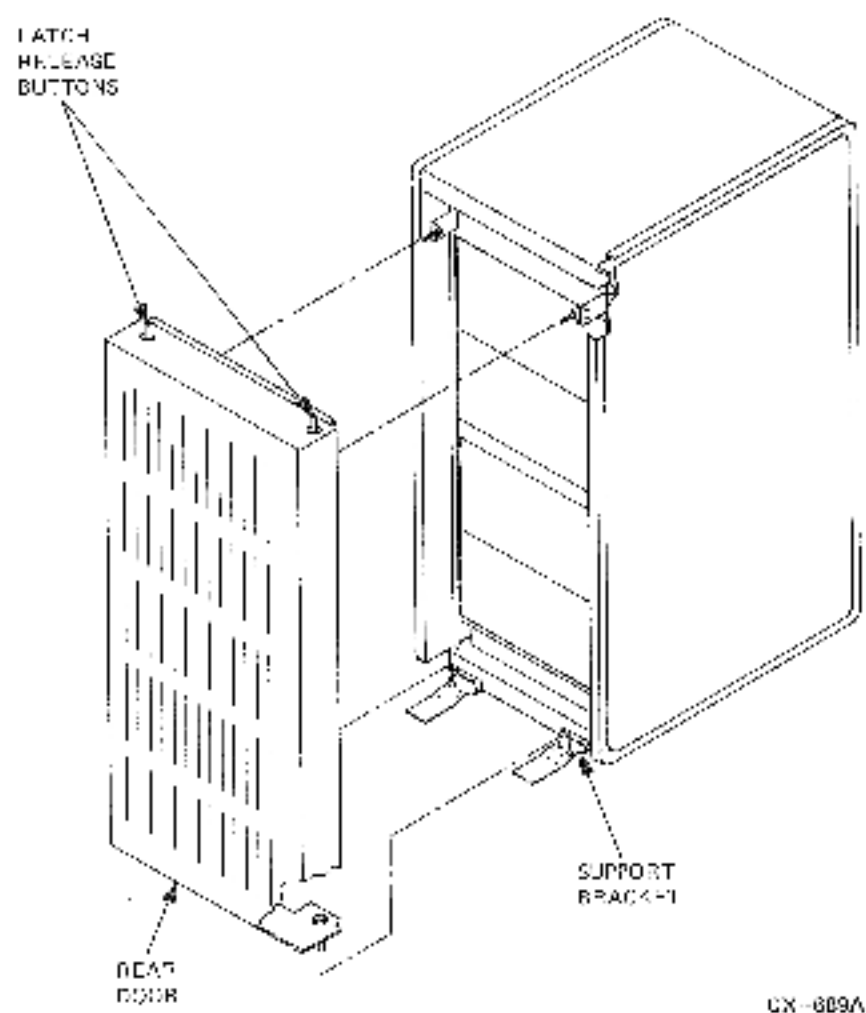


Figure 5-1 Rear Door Removal

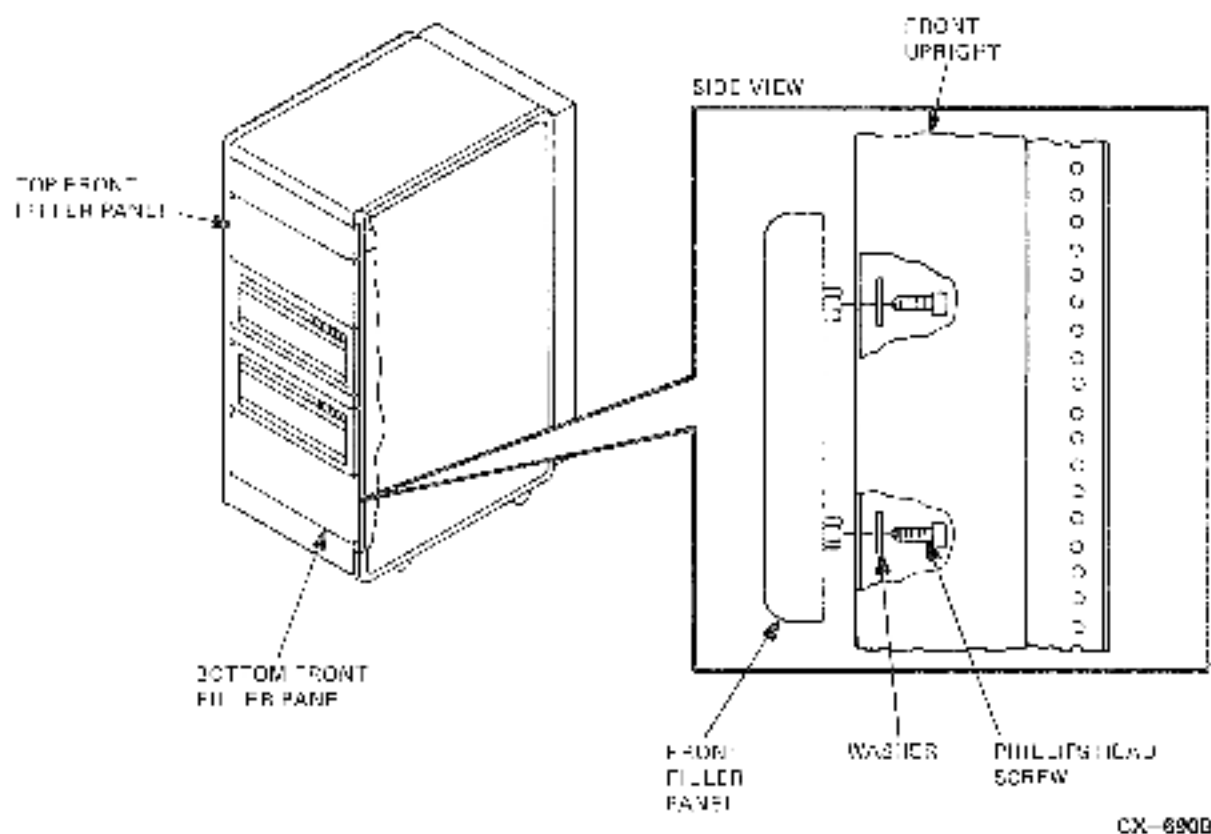


Figure 5-2 Front Filler Panel Removal

The head disk assembly (HDA) may be removed from the drive to reduce the total weight by approximately 35 pounds. Refer to Section 5.6 for instructions on HDA removal.

5.5.1 Removing Internal Shipping Brackets and Packing Material

Packing material and shipping brackets are inside the chassis of each disk drive. Use the procedure described in Section 3.3 to remove the brackets and material to prepare the drive for installation.

If you do not need to remove the HDA, follow the procedures beginning in Section 5.7 to install the slides and mount the disk drive into the cabinet.

5.6 REMOVING THE HDA

Use the following procedure to remove the head disk assembly (HDA) from the RA82 disk drive.

CAUTION

For drive protection, use a grounding (electrostatic discharge) wrist strap during the following procedures (Figure 5-3). For information on ESD protection, read Section 1.7.

1. Unlock the upper chassis assembly by turning the two cam latches under the front bezel 180 degrees counterclockwise with a 3/16-inch allen hex wrench. Refer to Figure 5-4.
2. Raise the upper chassis assembly until the damper (gas spring) lock slides in place and supports the upper chassis assembly (Figure 5-5).
3. Unplug connector P502 from the read/write module (Figure 5-6).
4. Unplug connectors P602 and P603 from the HDA preamplifier module (Figure 5-6).
5. Place the cable spring assembly in the RELEASED position (Figure 5-7).
6. Place the positioner lock in the LOCK position (Figure 5-8). The lever must be lifted slightly to clear the surface of the read/write module.
7. Remove the four HDA retaining nuts and washers (Figure 5-6).

CAUTION

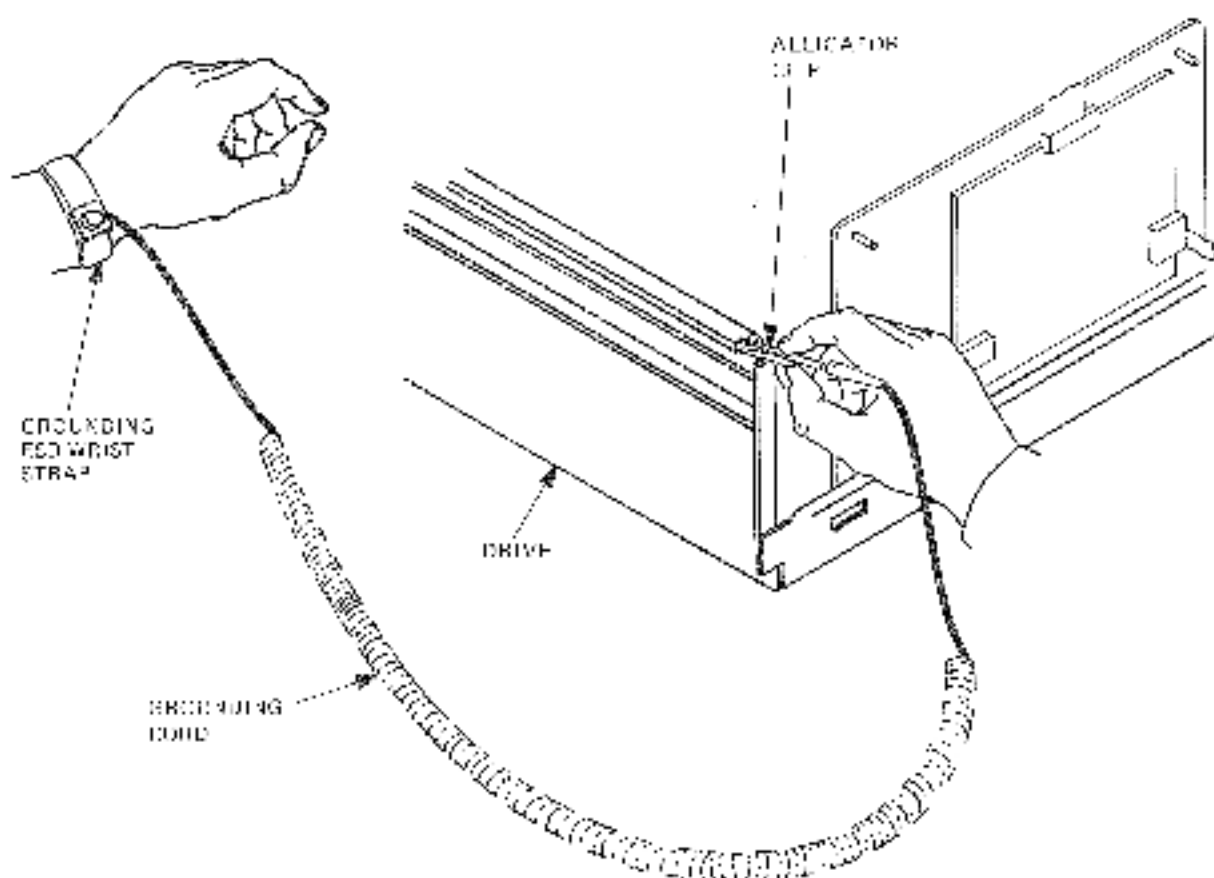
The HDA could be damaged if the positioner is not locked.

8. Remove the HDA from the drive by lifting it from diagonally opposite corners (Figure 5-8). The HDA weighs approximately 35 pounds.
9. 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 (Figure 5-8).

CAUTION

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

If the HDA is to be moved or packed for shipment, use an HDA Spindle Pulley Lock (DIGITAL Order Number 74-31667-011) to lock the spindle pulley in place. Any movement of the spindle could damage the heads.



CX 98GA

Figure 5-3 Connecting ESD Wrist Strap to Ground

10. Gently lift up on the upper chassis assembly to take the weight off of the gas spring. Unlock the gas spring by pulling the locking knob out while still supporting the weight of the upper chassis assembly. Refer to Figure 5-5.
11. Slowly lower the upper chassis assembly until resistance from the gas spring is felt. When resistance is sufficient to ensure the gas spring will allow the logic to close slowly, release your hold on the upper chassis assembly. Lock in place by turning the two cam latches under the front bezel 180 degrees clockwise with a 5/16-inch allen hex wrench. Refer to Figure 5-4.

CAUTION

DO NOT permit the upper chassis to free fall and **DO NOT** force the upper chassis assembly against the gas spring pressure.

CAUTION

Do not pinch cables when lowering the upper chassis assembly. Check cable locations and reroute cables, if necessary, before lowering.

5-8 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET

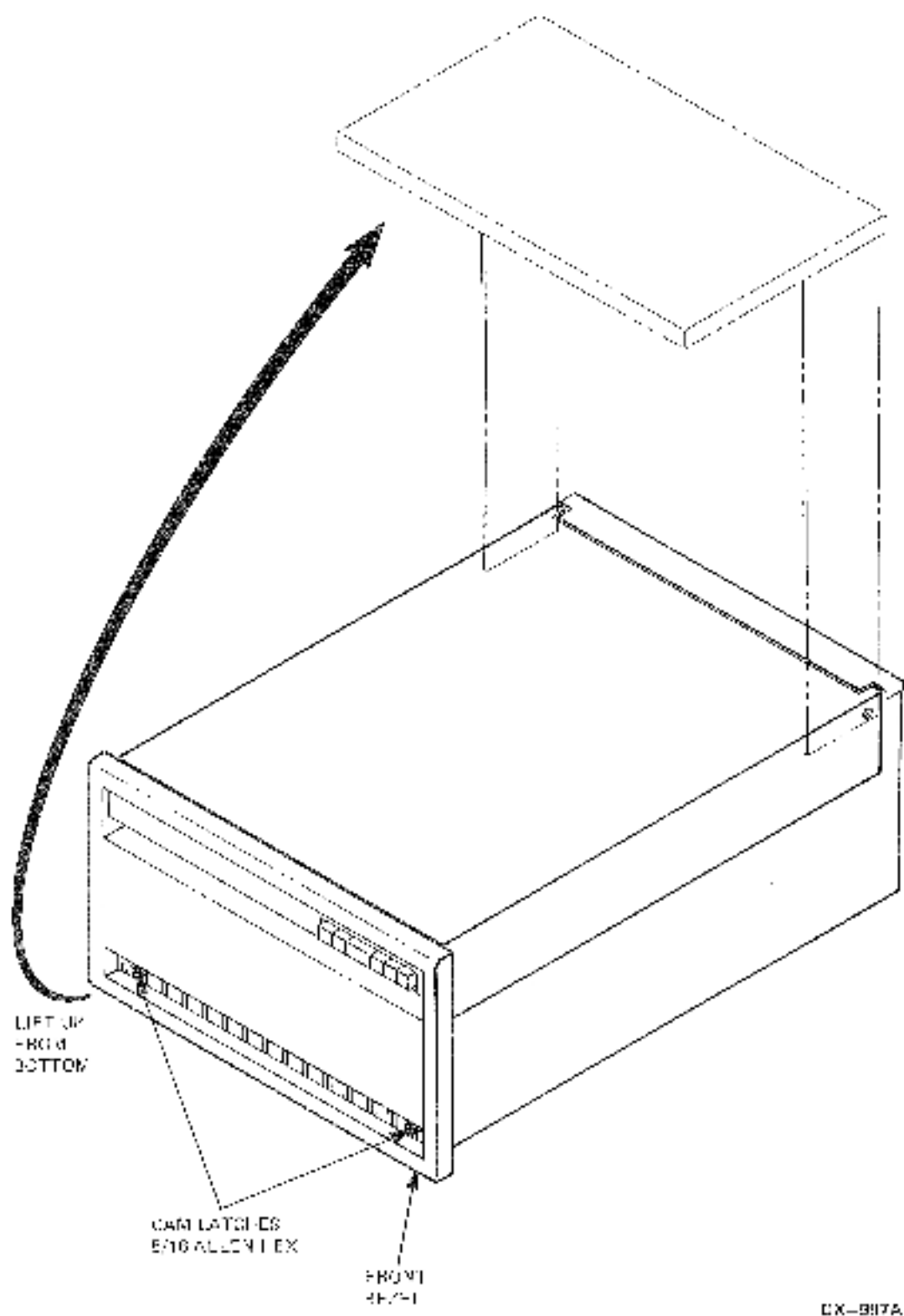
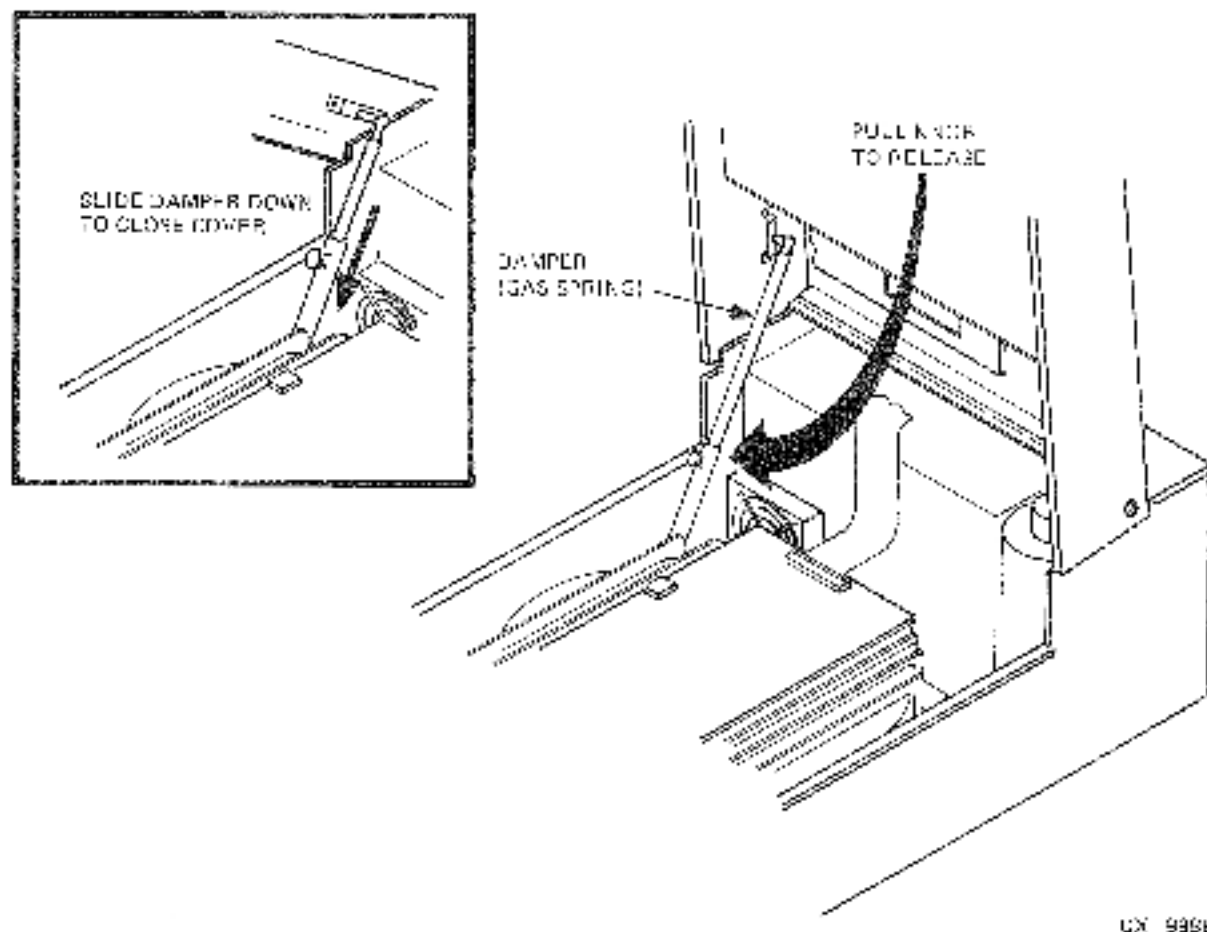


Figure 5-4 Upper Chassis Assembly



CX 9996

Figure 5-5 Damper (Gas Spring) Assembly

5.7 PREPARING THE SLIDES FOR CABINET MOUNTING

Use the following procedure to prepare the cabinet slide assemblies for installation. Assemble the left-hand slide assembly first.

1. Locate the left-hand slide that has part number 1213686-00 REV X-1, engraved on it. The revision level of the slide is given here as "X" because it changes occasionally. The letter 1, indicates this is the left-hand slide.
2. Locate the plastic bag containing four slide brackets.
3. Locate the plastic bag containing the 8-32 X 5/16 screws.
4. Lay the left-hand slide on its back and push the lower half of the slide to the left to gain access to the rear mounting holes (Figure 5-9).

5-10 INSTALLING RAB2 ADD-ON DRIVES IN FOUR-HIGH CABINET

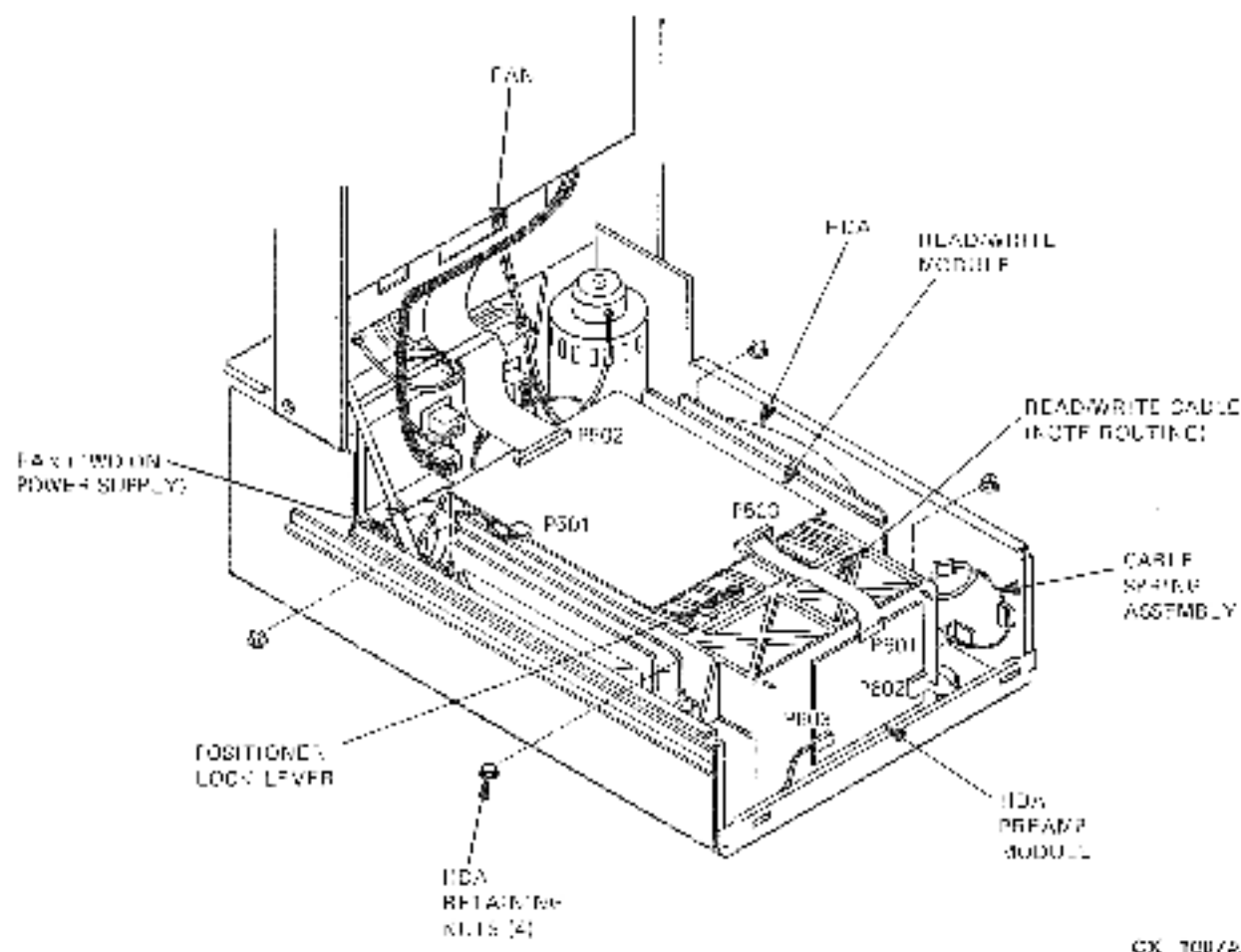
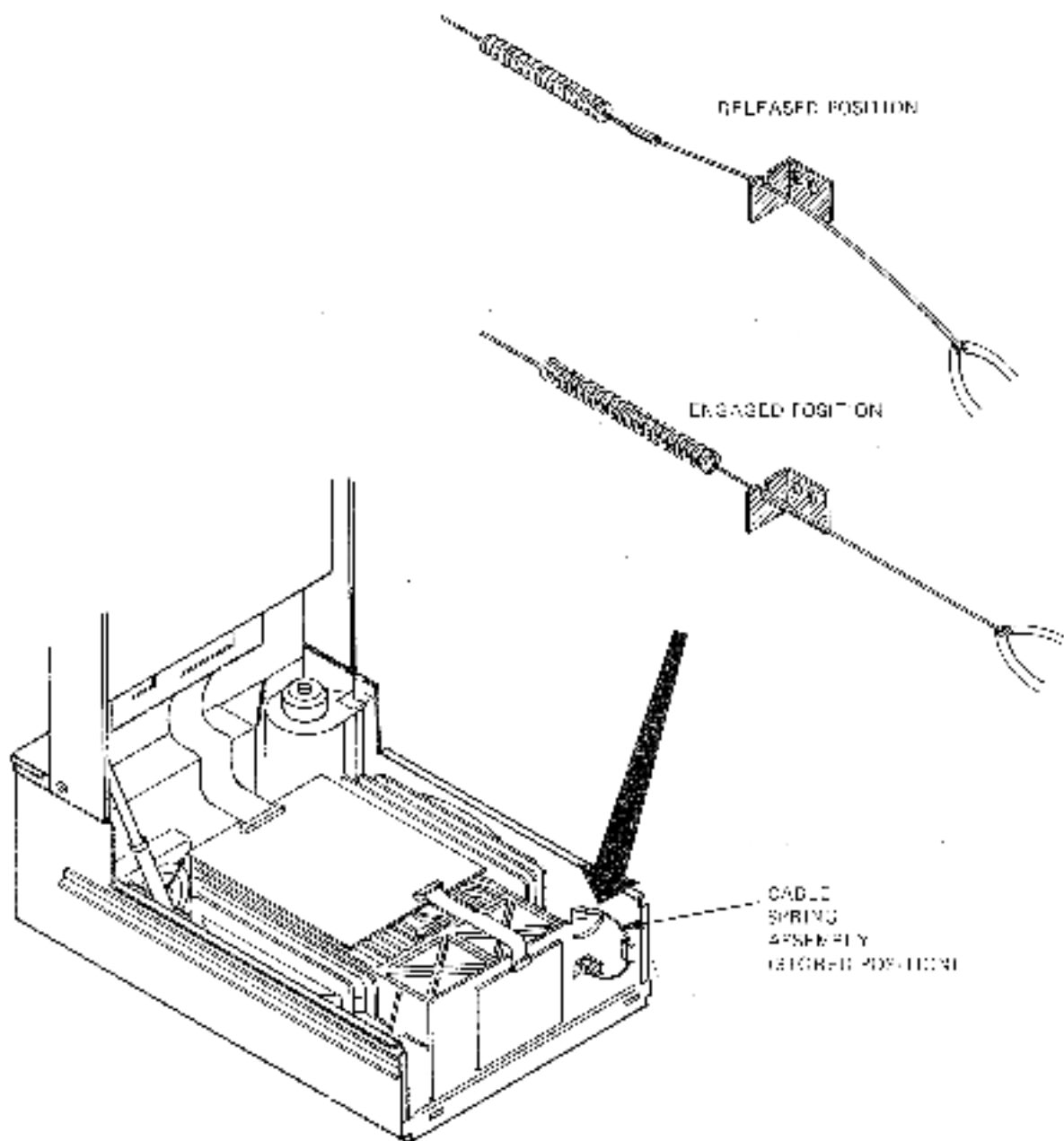


Figure 5-5 HDA Connectors

5. Use two 8-32 screws to mount the rear slide bracket to the slide as shown in Figure 5-9. Don't tighten the screws all the way since some leeway is needed later when the slides are mounted into the cabinet.
6. Use two more 8-32 screws to mount the front slide bracket to the left-hand slide. The screws must be inserted into the mounting holes through the movable oval opening on the slide. Tighten the two screws.
7. Press the two front leaves of the L-shaped cable retainer together and force the retainer into the rear of the left-hand slide assembly as shown in Figure 5-9.

NOTE

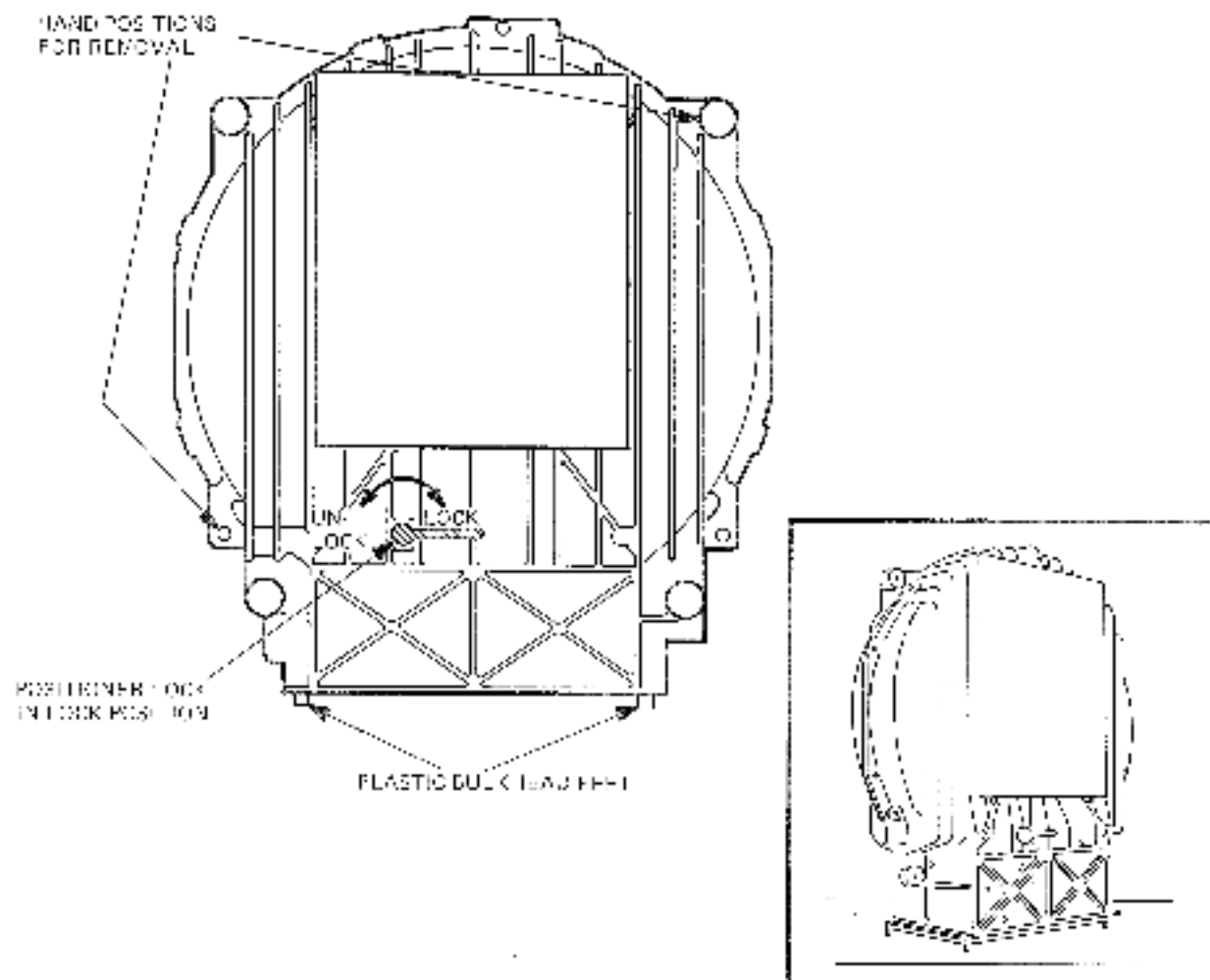
A cable retainer must be used on each left-hand slide assembly for drives installed in positions 0, 1, and 2.



CX-1001A

Figure 5-7 Cable Spring Assembly

5-12 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET



CX 1008A

Figure 5-8 NDA Positioner Lock

8. Locate the drive right-hand slide that has part number 1210686-00-RLV-X-R engraved on it. The revision level of the slide is given as "X" because it changes occasionally. The letter R indicates this is the right-hand slide.
9. Lay the right-hand slide on its back and push the lower half of the slide to the right to gain access to the rear mounting holes (Figure 5-10).
10. Use two 8-32 screws to mount the rear slide bracket to the slide. Don't tighten the screws all the way since some leeway is needed when the slides are later mounted into the cabinet.

11. Use two more 8-32 screws to mount the front slide bracket to the right-hand slide. Insert the screws into the slide mounting holes by aligning the oval opening over them. Tighten the two screws.

Both slides are now prepared for installation into the drive cabinet.

5.8 INSTALLING CABINET SLIDES

Use the following procedures to install the slides and associated hardware in the cabinet. Refer to Table 5-3 for the proper four-high RA82 cabinet installation holes.

Table 5-3 RA82 Installation Holes

Drive Position	FRONT Slide Holes	REAR Slide Holes	ESD Brackets	RIGHT REAR* Clamp/Standoff	LEFT REAR* Clamp/Standoff
Drive 3	66, 70	70	67, 69	Not used	71
Drive 0	48, 52	52	49, 51	53	48
Drive 1	27, 31	31	28, 30	43	27
Drive 2	9, 17	13	10, 12	22	9

* **RIGHT REAR** refers to the right rear vertical upright as viewed from the front of the cabinet. **LEFT REAR** refers to the left rear vertical upright as viewed from the front of the cabinet.

1. Go to the rear of the drive cabinet. Counting from the bottom, locate and mark the mounting holes in both rear cabinet uprights. Refer to Figure 5-11.
2. Go to the front of the drive cabinet. Counting from the bottom, locate and mark the mounting holes on both front cabinet uprights. Refer to Figure 5-11.
3. Locate the plastic bag containing the 10-32 X 1/2 screws.
4. Locate the plastic bag containing the four nut bars.
5. Locate the plastic bag containing two electrostatic discharge (ESD) brackets.
6. At the front of the cabinet, mount the right-hand slide assembly to the front right cabinet upright using two 10-32 screws and one nut bar as shown in Figure 5-12.
7. Use the same procedure to mount the left-hand slide assembly to the front left cabinet upright.
8. Go to the rear of the cabinet. Insert one 10-32 screw through the left-hand cabinet upright, the top hole of the right-hand slide bracket, and the top hole of the nut bar (to hold the slide in place).
9. Use two more 10-32 screws to mount the ESD bracket to the upright as shown in Figure 5-12.
10. Use the same procedure to mount the left-hand slide assembly and ESD bracket to the rear right-hand cabinet upright.

5-14 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET

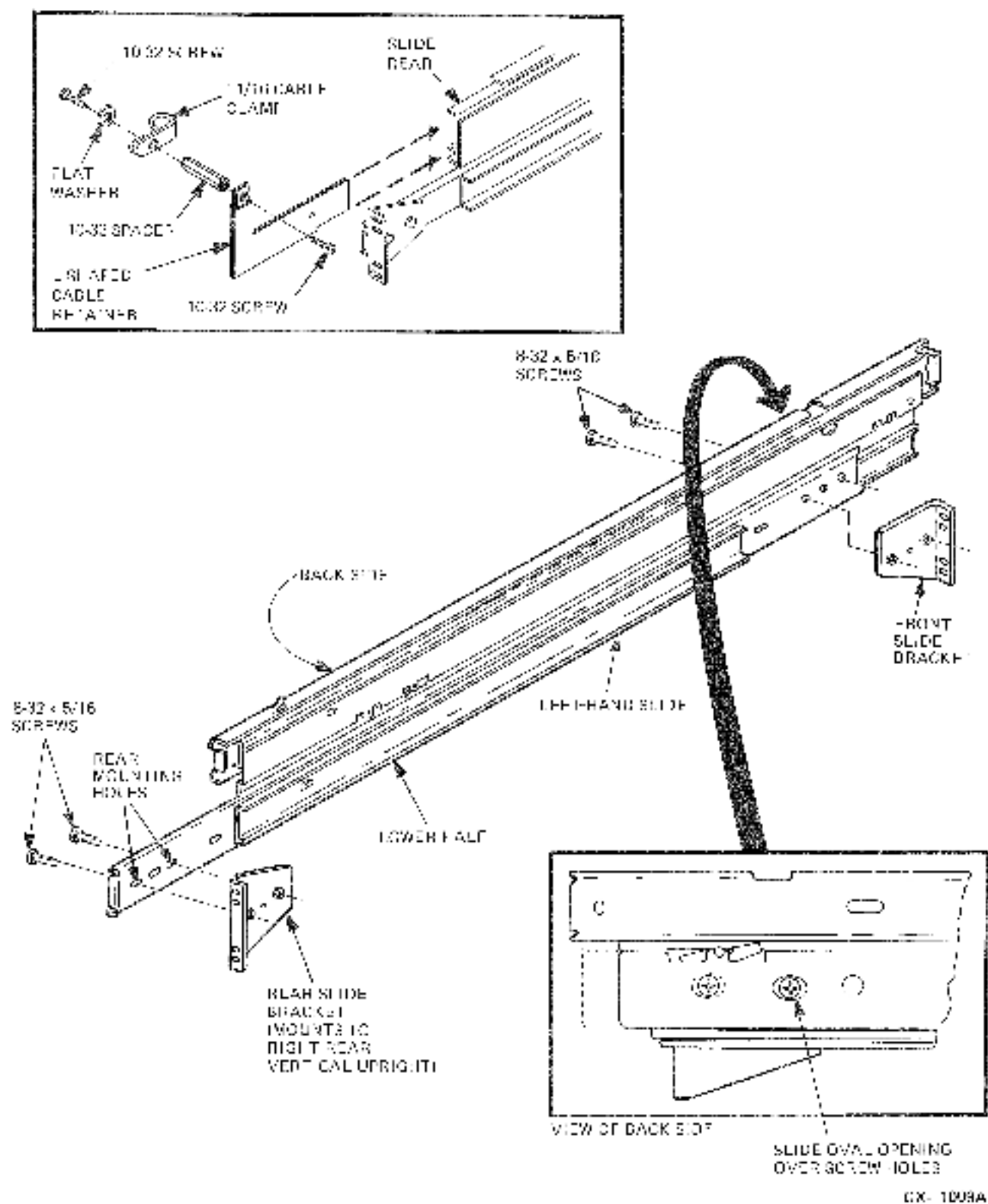


Figure 5-9 Left-Hand Slide

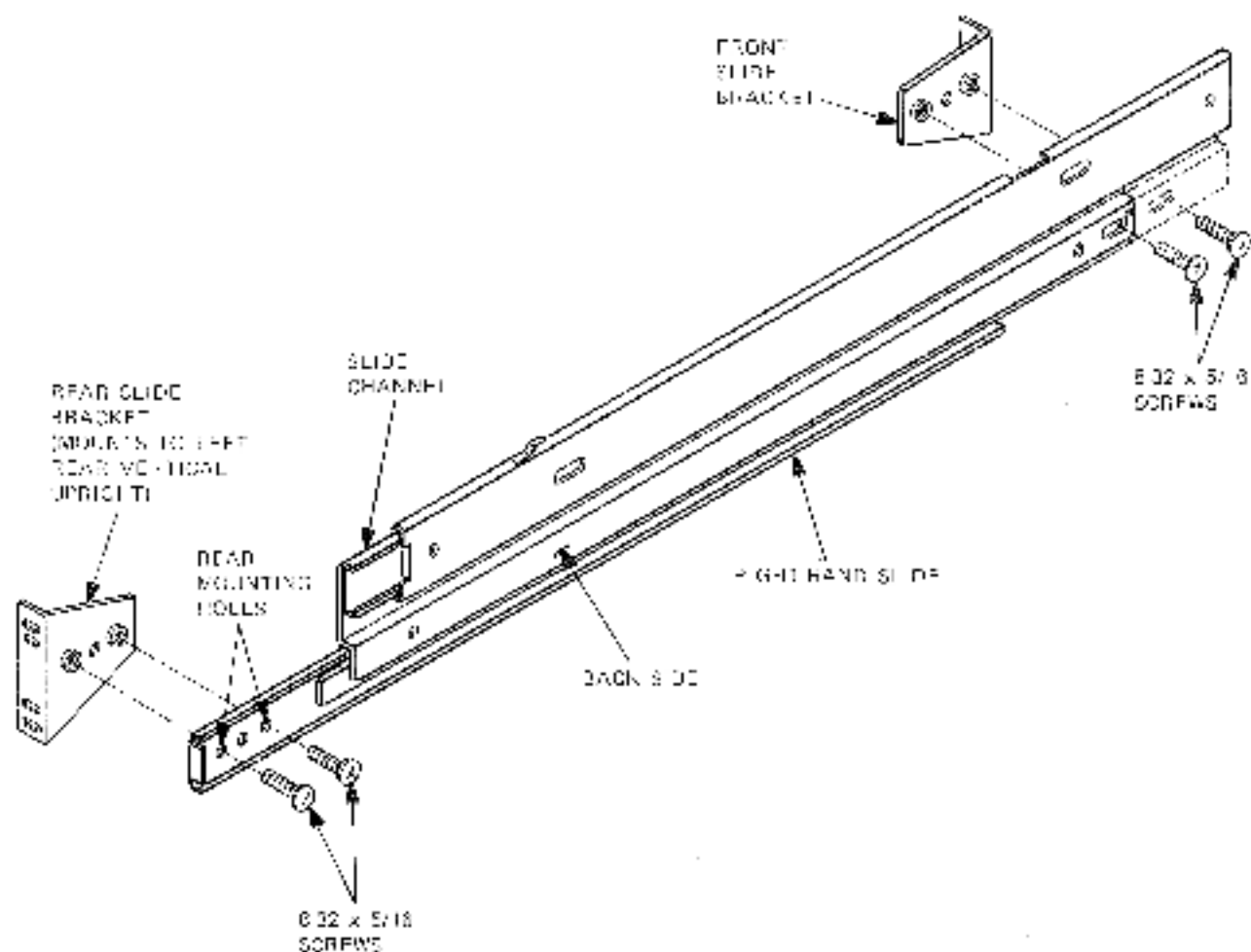
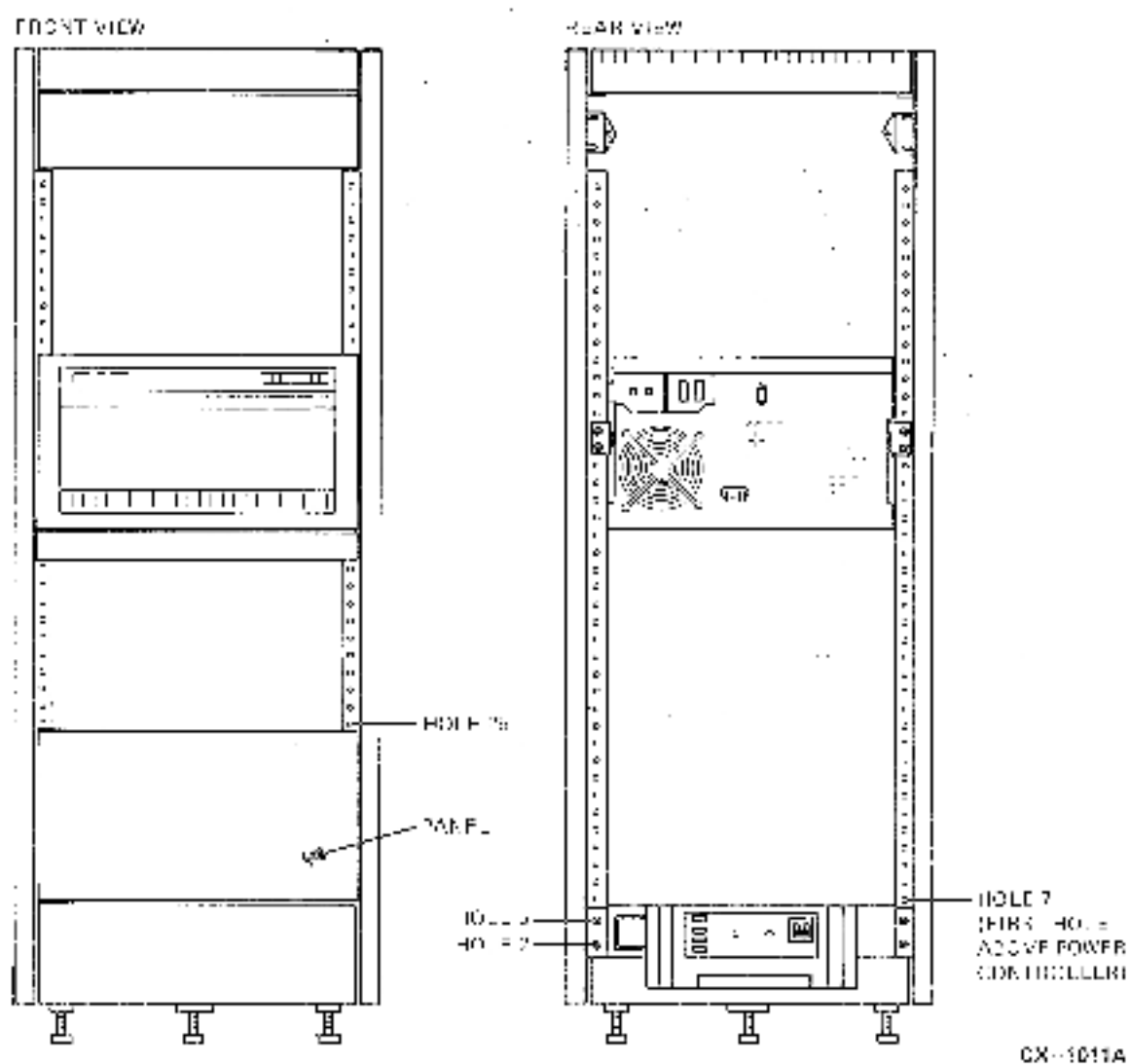


Figure 5-10 Right-Hand Slide

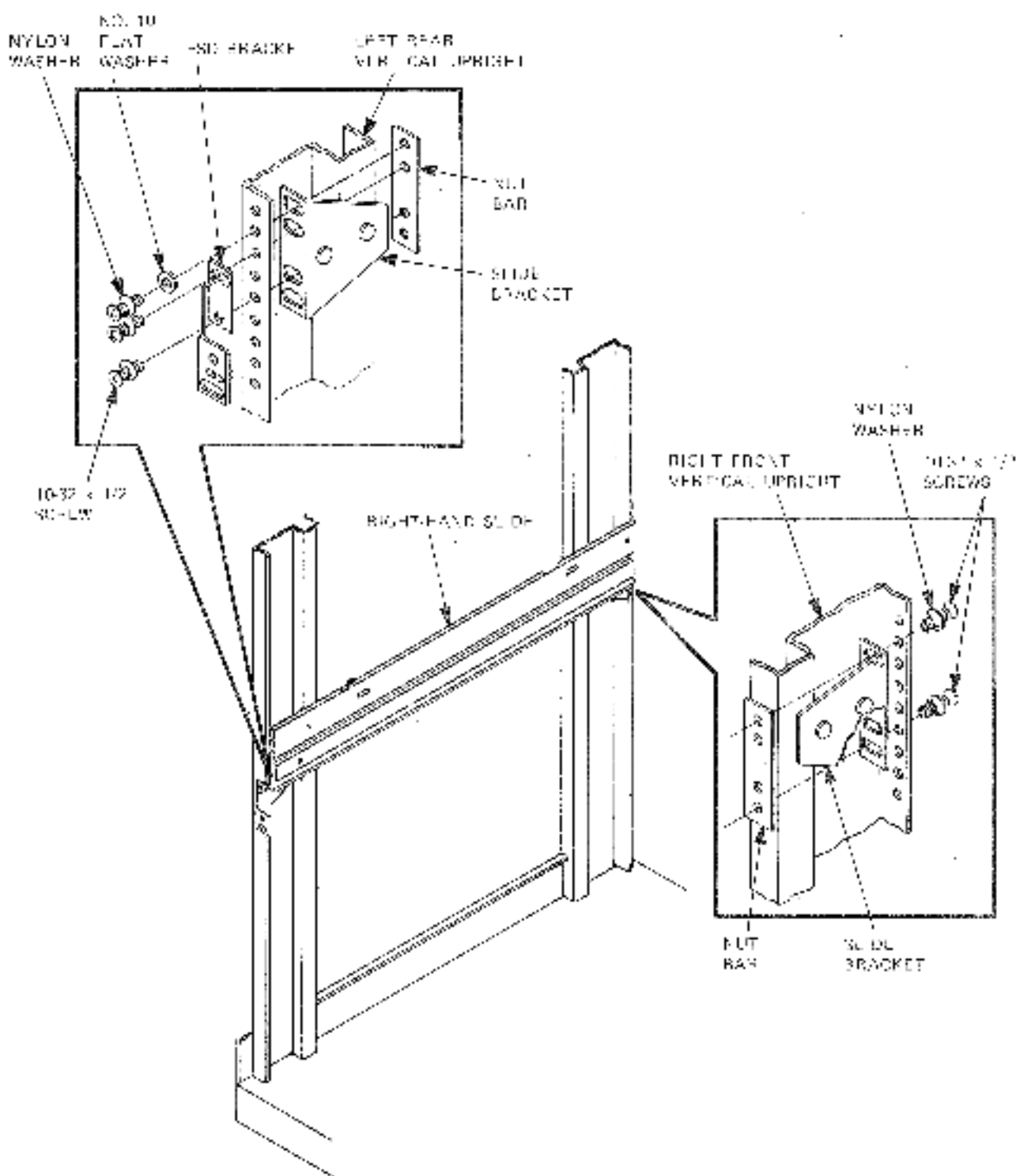
11. Once both slides are mounted, go to the rear of the cabinet and tighten the screws holding the slides to the slide brackets. These brackets were left loose for adjustment. Do this for both slides.

5-16 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET



CX-1011A

Figure 5-11 Cabinet Upright Holes (60-Inch Cabinet)



CX-1012B

Figure 5-12 Mounting the Slide Assembly

5.9 EXTENDING CABINET STABILIZER FOOT

The cabinet stabilizer foot is part of an interlock mechanism that prevents the drive cabinet from tipping forward when a drive is extended on its slides or when a new drive is installed into the cabinet. Extend the stabilizer foot forward from the center bottom of the drive cabinet and lower it until it makes firm contact with the floor. Refer to Figure 5-13.

WARNING

Always extend the cabinet stabilizer foot completely forward before placing a drive on the slides or sliding a drive out of the cabinet. Failure to do so could cause equipment damage or bodily injury.

Also, do not push stabilizer foot in while drive is extended. Damage to cabinet interlock mechanism could result.

5.10 CABINET INTERLOCK

The cabinet interlock maintains cabinet stability and ensures operator safety. If the stabilizer foot is retracted, all drives are locked and cannot be extended on the slides. When the stabilizer foot is extended, the cabinet interlock mechanism is released to allow only one drive at a time to be extended.

5.10.1 Positioning Interlock Rod Actuator

Before the drive is installed, position the interlock rod actuator contained within the front-left upright of the cabinet to prevent damage to the interlock mechanism during drive installation. Do this by manually rotating the interlock rod actuator 90 degrees clockwise until the output portion of the rod actuator faces frontwards, ready to engage the drive actuator (Figure 5-14) of the drive.

NOTE

The rod actuator does not rotate unless the stabilizer foot is extended.

5.11 MOUNTING THE ADD-ON DRIVE ON THE SLIDES

Use the following procedure to mount the RA82 add-on drive on the slides. Refer to Figure 5-15.

WARNING

The cabinet stabilizer foot must be fully extended and locked (Section 5.9).

The RA82 disk drive weighs at least 61.2 Kg (135 pounds). DIGITAL recommends that you use an approved field service lifting device rated at 240 pounds (DIGITAL Part Number FC-10074-AC) to place the drive onto the chassis slides.

The head disk assembly (HDA) may be removed from the drive to reduce the total weight by approximately 35 pounds. Refer to Section 5.6 for instructions on HDA removal.

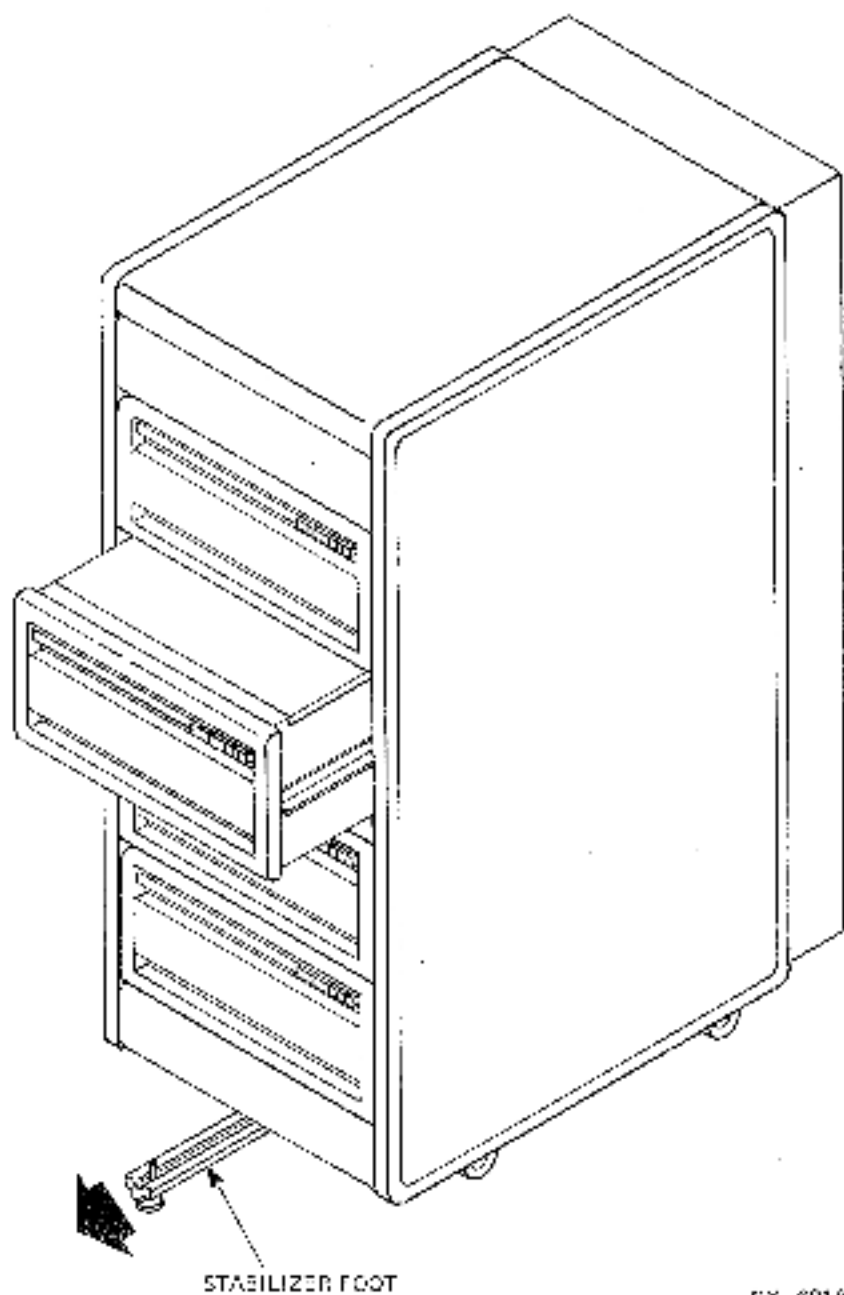
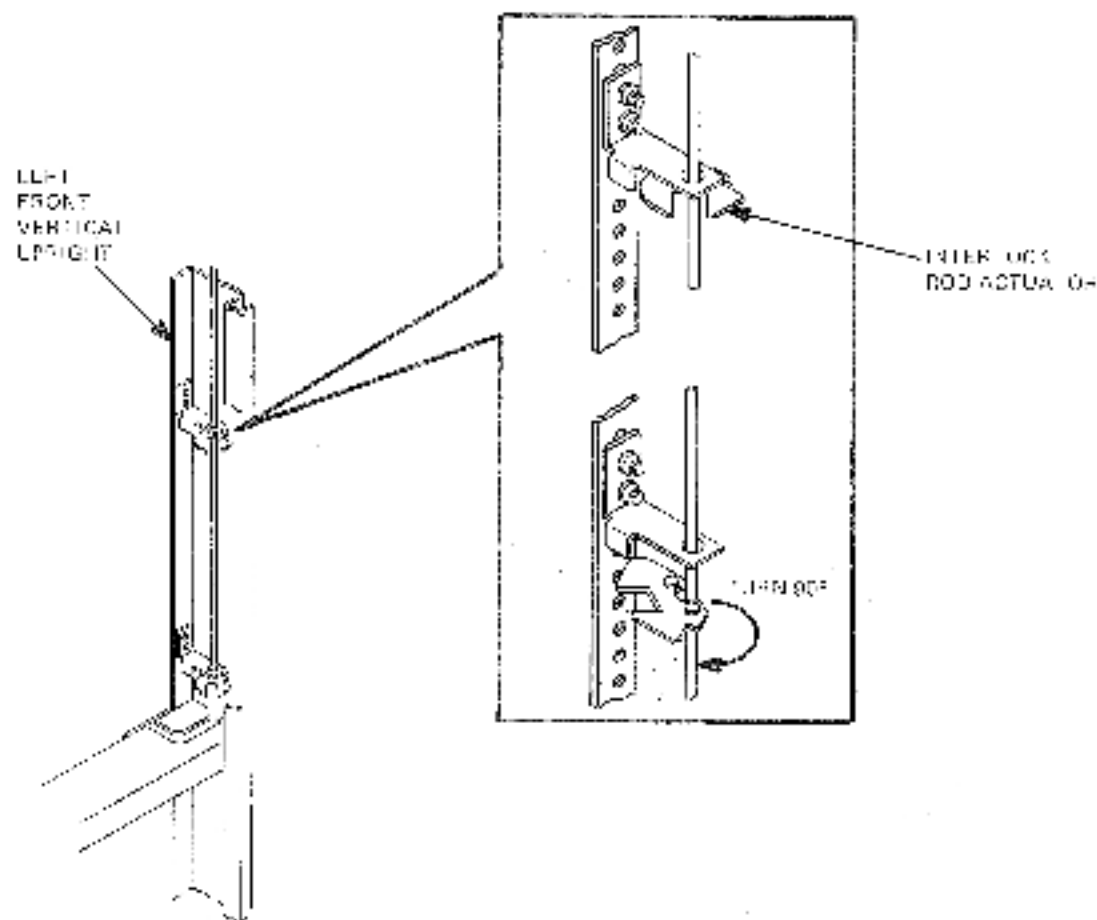


Figure 5-13 Stabilizer Foot Extension



CX-082A

Figure 5-14 Interlock Rod Actuator

5.11.1 Mounting the Drive Using an Approved Lifting Device

Use the following procedure to install an RA82 drive using an approved lifting device. If no lifting device is available refer to Section 5.11.2 for the proper procedure.

1. Pull the right and left slides out of the cabinet until they lock in place. Lift lock arm A on both arms and pull both slides out of the cabinet until they are fully extended forward. Refer to Figure 5-15.
2. Lift the drive with the lifting device.
3. Lower the drive onto the extended slides so the drive front bezel is about one inch forward of the front end of the slide.

WARNING

Make sure the drive mounting rails and slides engage properly. If not, the drive could fall between the slides.

4. Push the drive toward the rear of the slide assembly until it engages the top slide stops. Refer to Figure 5-15.
5. Insert the 8-32 x 5/16 mounting screws through the openings on each slide to secure the drive to the slide assemblies. Only the front screw holes in the drive will be visible.
6. Release the slide lock arm B on both slides and push the drive back slowly until the next drive mounting hole lines up with the keyhole opening in the slides. Refer to Figure 5-15.
7. Insert 8-32 x 5/16 screws into the keyhole openings on each slide to complete the mounting procedure of the drive to the slides.
8. Release slide lock arm A on both arms to push the drive the rest of the way into the cabinet. Refer to Figure 5-15.

NOTE

If the drive does not slide into the cabinet freely, loosen the front screws on the slide brackets and make the necessary adjustments before retightening them. Ensure the slide brackets are mounted in the proper cabinet upright holes and that there is enough vertical and horizontal play to allow the drives to move freely.

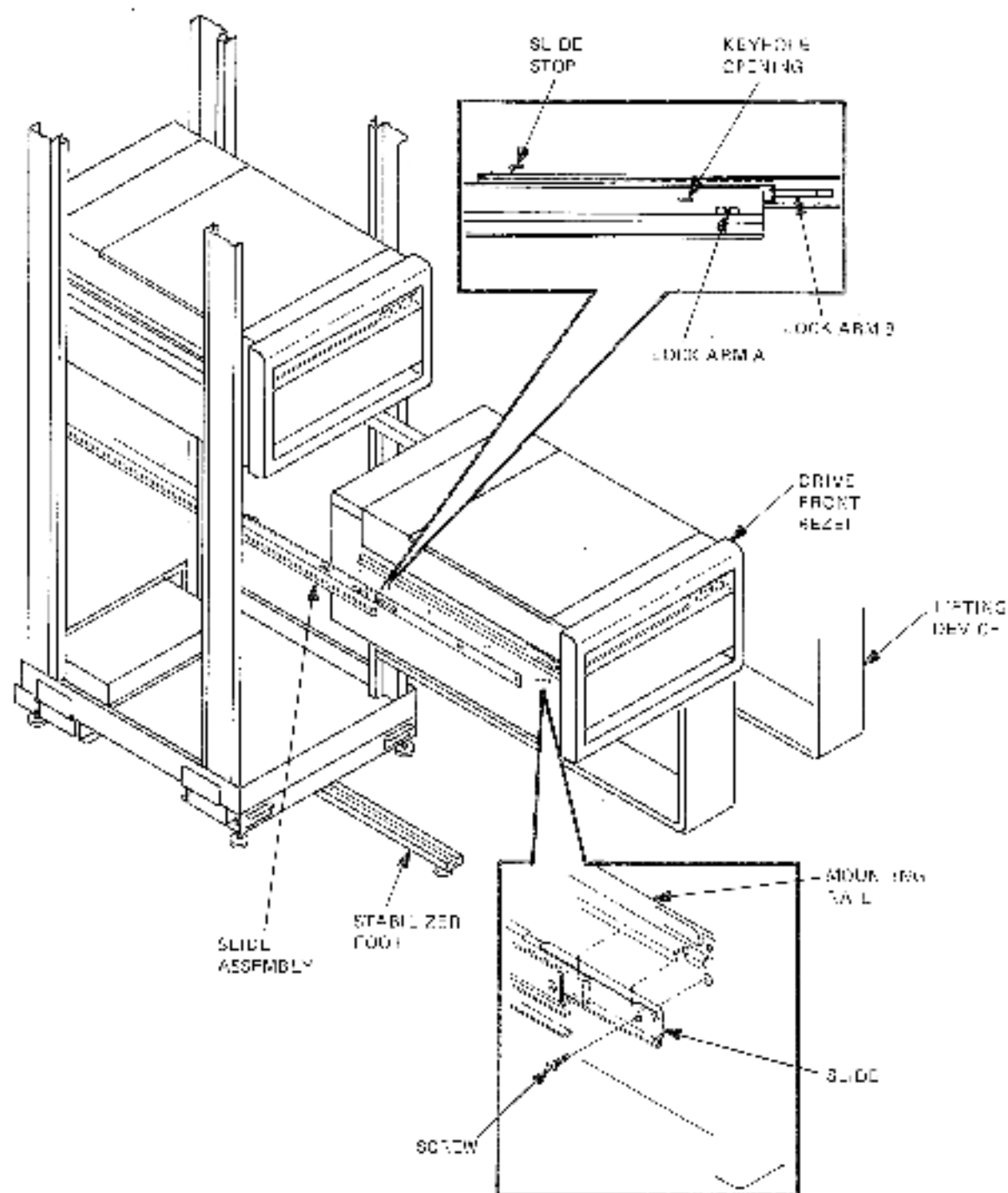
5.11.2 Mounting the Drive Without an Approved Lifting Device

If you do not have an approved lifting device available use the following procedure to install an RAS2 disk drive. The following procedure requires three people.

WARNING

The slides must be fully extended and locked, and the cabinet stabilizer foot must be fully extended and locked before this procedure is attempted.

1. Make certain the work area is clear of obstructions, cables, etc.
2. Place one person on each side of the unit.
3. Place one person at the front of the unit.
4. The two persons at the sides of the unit grasp the front and rear of the unit and using the leg muscles lift the unit together.
5. The person at the front of the unit removes the skid or other packaging material from the immediate area.
6. The person at the front of the unit guides the lifters and assures that the slides are locked and that the unit is resting on the slides correctly.
7. While the two are holding the RAS2 in position, the third person starts two mounting screws on each side of the unit (the one closest to the front and the one closest to the rear).
8. Secure the remaining mounting hardware as required and continue with normal installation procedures.



CX 921A

Figure 5-15 Mounting the Drive on Slides

5.12 MOUNTING THE I/O BULKHEAD ON THE SDI INTERFACE BRACKET

Locate the I/O bulkhead shipped with the add-on disk drive (attached to the end of the SDI cable). Based on drive position, each I/O bulkhead must be mounted in a designated location on the SDI interface bracket. Using the two captive screws, mount the I/O bulkhead to the SDI interface bracket at the rear base of the drive cabinet as shown in Figure 5-16.

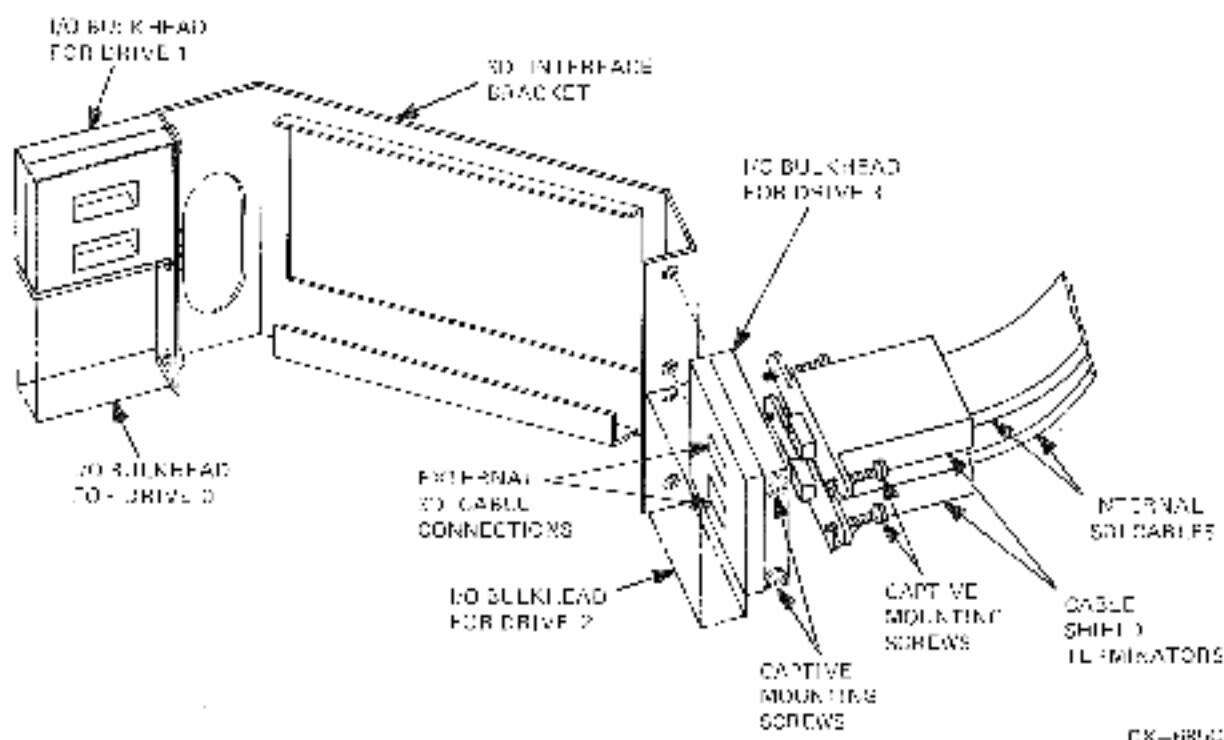


Figure 5-16 I/O Bulkhead Mounting

5.13 INSTALLING CABLE STANDOFF AND U-NUT

Cable standoffs and U-nuts are used with cable clamps in the four-high cabinet to hold the cables away from the rear vertical uprights. The number of cable standoffs to install depends upon the number of drives in the cabinet. Refer to Table 5-3 for the proper four-high RA82 cabinet installation holes.

Use the following procedure to mount each cable standoff and U-nut. Refer to Figure 5-17.

1. Locate the plastic bags containing the cable standoffs.
2. Locate the plastic bag containing the U-nuts.
3. Slide each U-nut over the hole of the rear vertical upright designated in Table 5-3. The threaded portion of the U-nut should face the inside of the cabinet.
4. Screw the standoff into the U-nut.

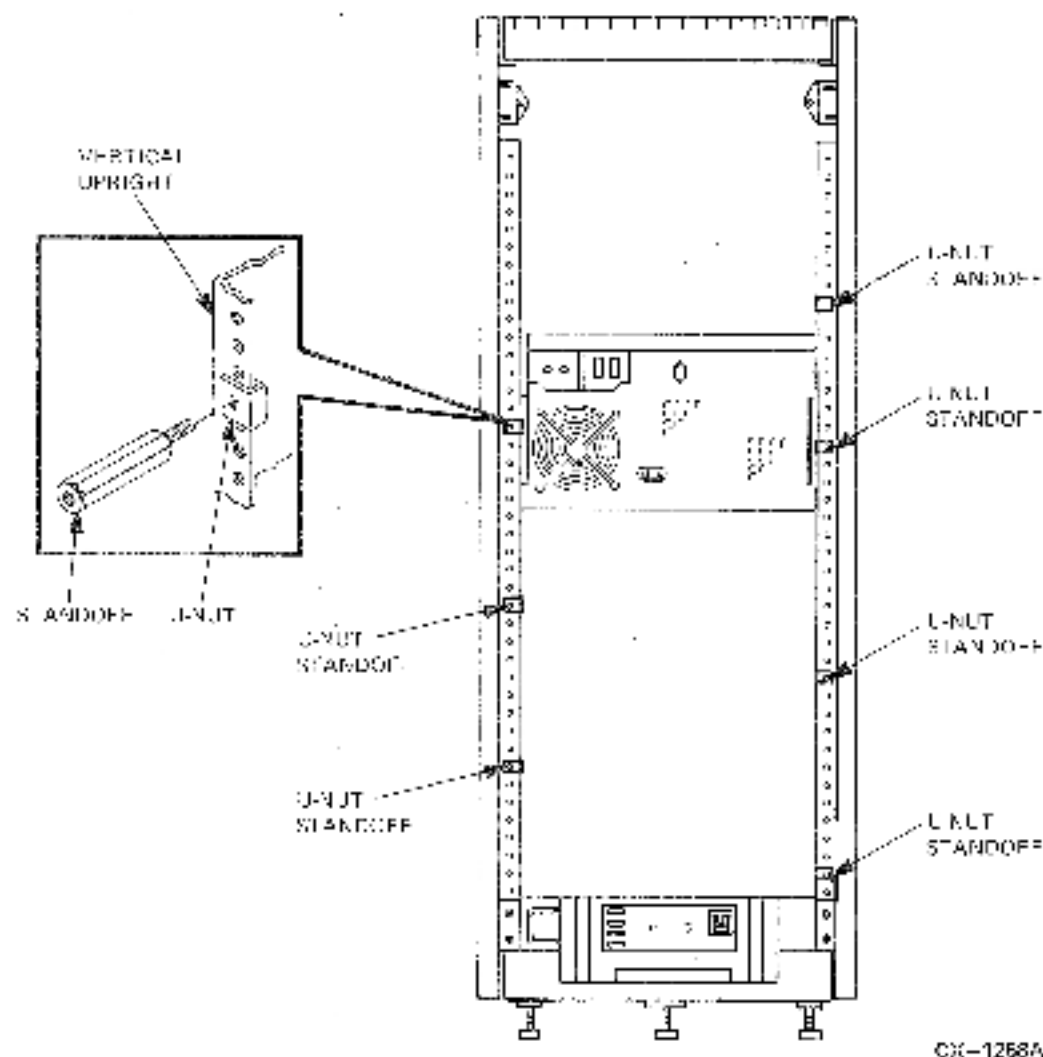


Figure 5-17 Mounting U-Nut and Standoffs

5.14 INSTALLING SDI CABLES

The 12-foot SMD cable shipped with all add on drives is the internal cabinet cable that connects the drive to the I/O bulkhead. The external SMD cable attaches the drive cabinet to the disk controller in another cabinet.

When installing the SDI cables, you must choose which of the SDI cable installation procedures in the following paragraphs fits your needs. The first one describes how to install the SDI cables for the first add-on (lower-middle cabinet position). The second one describes how to install the SDI cables for the second add-on (bottom cabinet position). The third procedure describes how to install the SDI cables for the third add-on (top cabinet position).

External SDI cables from the central processing unit (CPU) or controller cabinet are connected to the *inside* of the I/O bulkhead (opposite side of the SDI interface bracket from the internal SDI cables). Refer to Figure 5-16.

Refer to Table 5-3 for the proper four-high RAS2 cabinet installation holes.

5.14.1 Installing First Add-On Drive SDI Cables

Use the following procedure to install the SDI cables for the first add-on drive. Refer to Figure 5-18 to tie-wrap and route cables. Figure 5-19 shows the wiring diagram for two drives.

1. Install the bottom end of the SDI cable (end with I/O bulkhead) onto the SDI interface bracket at the base of the cabinet. Using the two captive screws, mount the I/O bulkhead in the internal SDI cable position designated for Drive 1 (Figure 5-16). Make sure drive port cable A plugs into the A connector and the port cable B plugs into the B connector of the I/O bulkhead.

NOTE

Mount the I/O bulkheads on the left side of the SDI interface bracket by turning them 180 degrees from those on the right side. This should be apparent when the screw holes are aligned.

2. Clamp the SDI cables to the cable retainers on the end of the drive slides and the cable standoffs (Figure 5-18).
3. Starting at the I/O bulkhead, tie-wrap the SDI cables to the vertical upright. Leave enough slack in the SDI cables so the drive can slide out the front of the cabinet to its fully extended position. Use as many tie wraps as needed to dress the cables properly.
4. Extend the cabinet stabilizer foot and then pull the add-on drive out of the cabinet to see if you left enough slack in the SDI cables. There shouldn't be any tension placed on the cables. Adjust the SDI cable loops now, if necessary, so the cables are not be pinched when the drive slides in and out.

This completes the SDI cable installation for the first add-on drive. Go to Section 5.15 to add the sequence cables.

5.14.2 Installing Second Add-On Drive SDI Cables

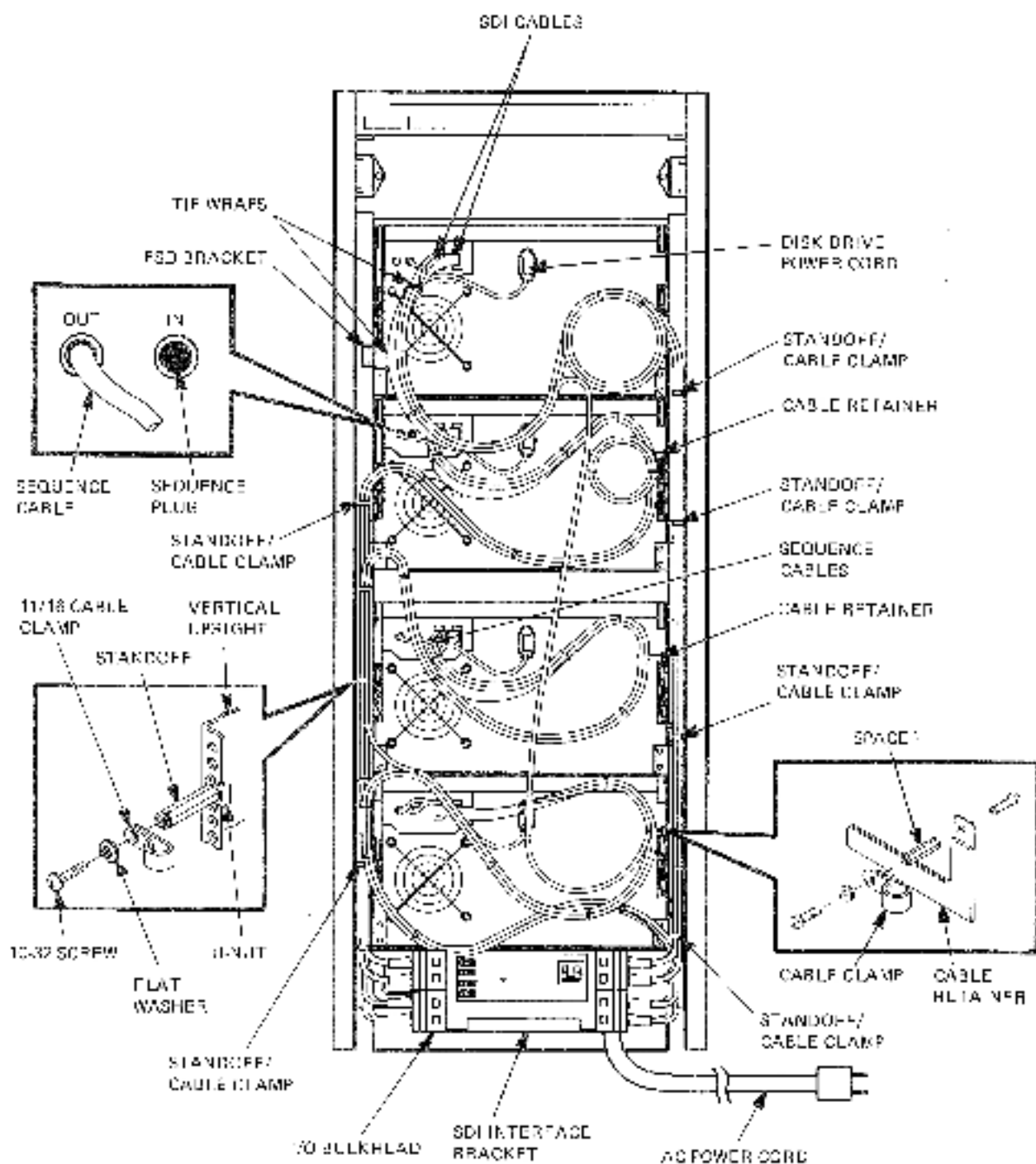
Use the following procedure to install the SDI cables for the second add-on drive. Refer to Figure 5-20. Refer to Figure 5-18 to tie-wrap and route the cables.

1. Install the bottom end of the SDI cable (end with I/O bulkhead) from the second add-on drive into the SDI interface bracket at the base of the cabinet. Using the two captive screws, mount the I/O bulkhead in the internal SDI cable position designated for Drive 2 (Figure 5-16). Make sure drive port cable A plugs into the A connector and the port cable B plugs into the B connector of the I/O bulkhead.

NOTE

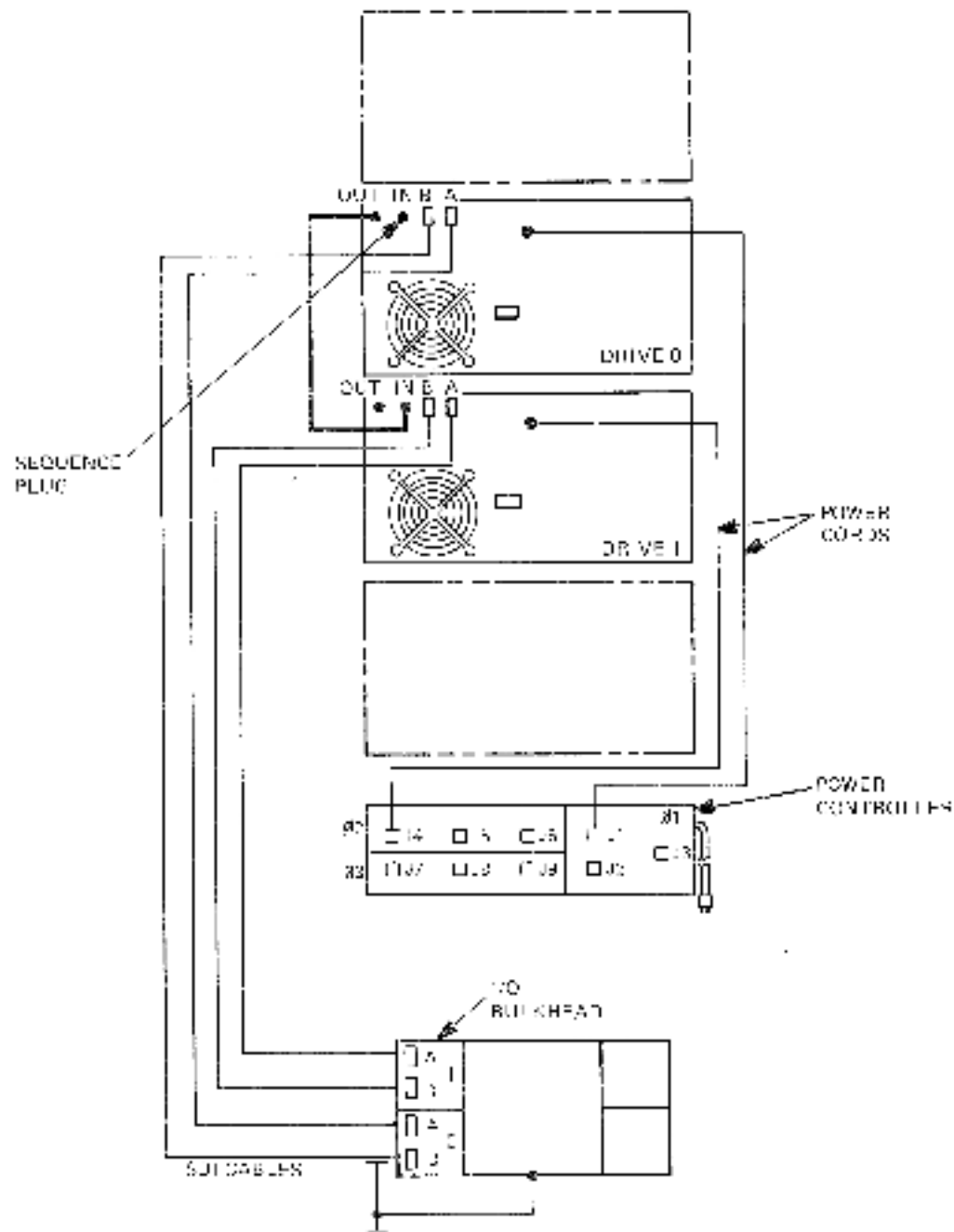
Mount the I/O bulkheads on the left side of the SDI interface bracket by turning them 180 degrees from those on the right side. This should be apparent when the screw holes are aligned.

2. Clamp the SDI cables to the cable retainers on the end of the drive slides and the cable standoffs (Figure 5-18).



CX-1018D

Figure 5-18 RA82 Cable Routing and Connections

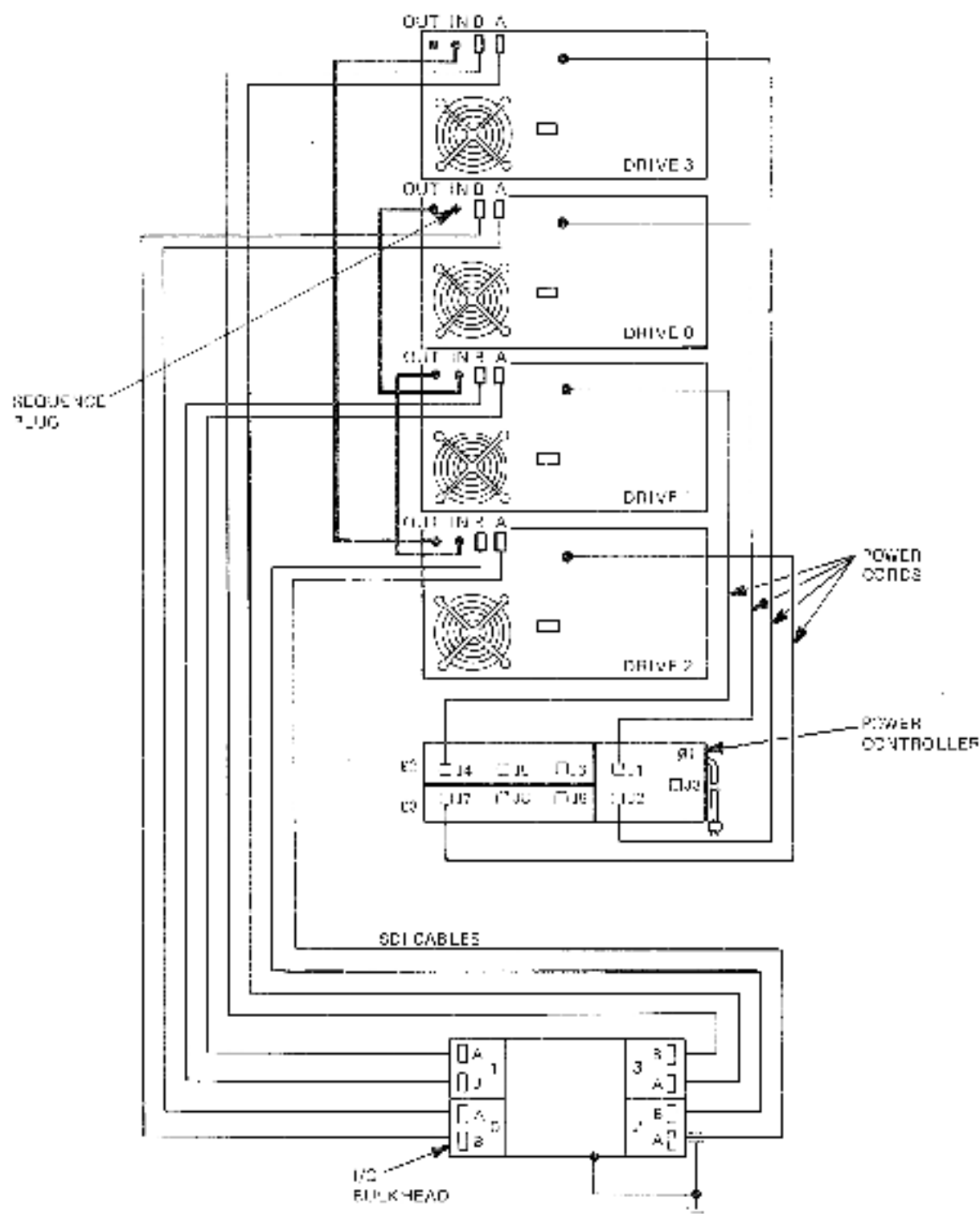


NOTE 1. ALL PORT A CONNECTIONS GO TO SUT CONTROL ROLLER A. ALL PORT B CONNECTIONS GO TO SUT CONTROL ROLLER B.
NOTE 2. HEAVY LINE INDICATES DRIVE SEQUENCE CABLE.

UX-00146

Figure 5-19 Cable Wiring Diagram (First Add-On RA82)

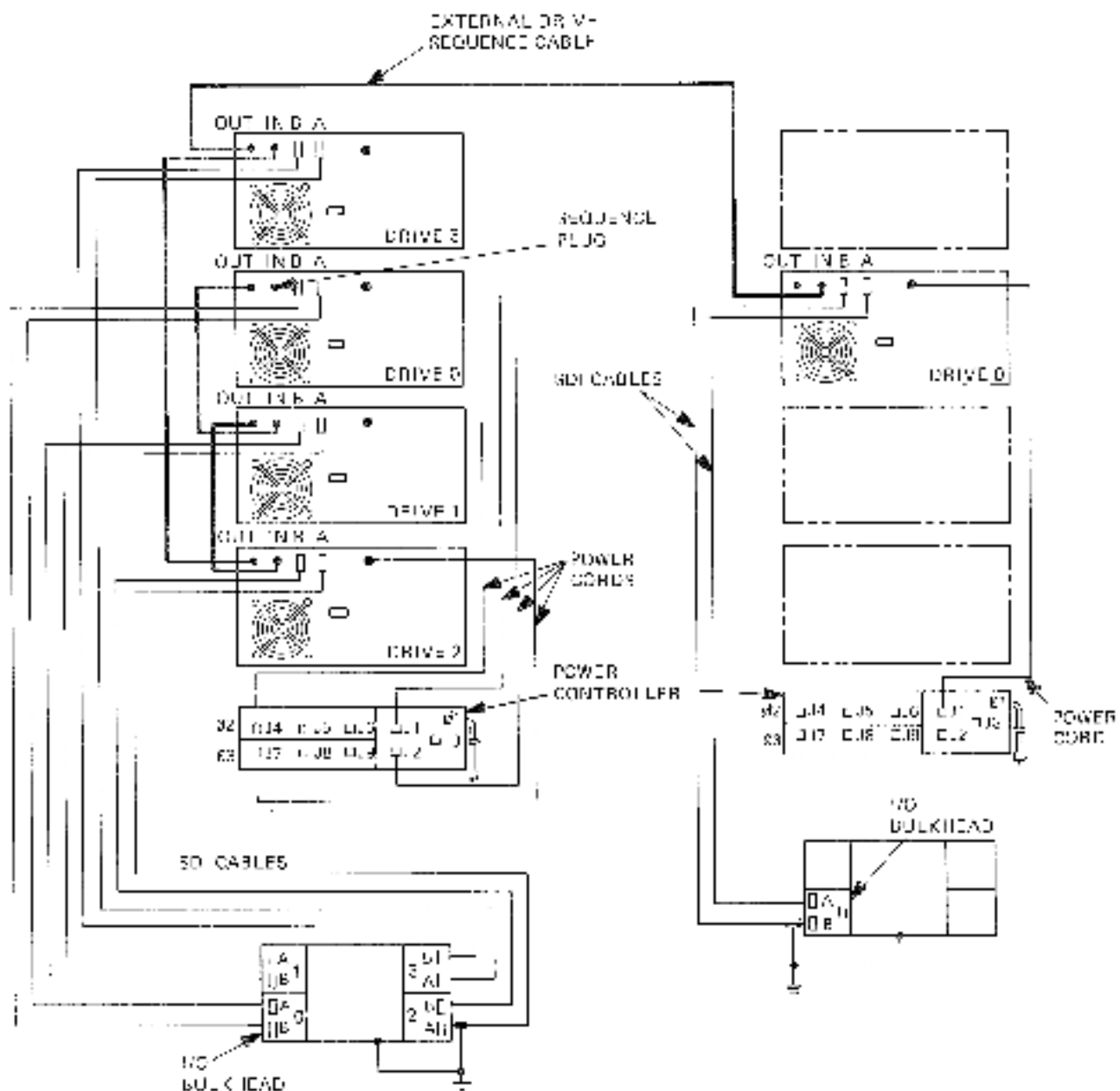
5-30 INSTALLING RA62 ADD-ON DRIVES IN FOUR-HIGH CABINET



NOTE 1: ALL PORT A CONNECTIONS GO TO SCSI CONTROLLER A, ALL PORT B CONNECTIONS GO TO SCSI CONTROLLER B.
 NOTE 2: HEAVY LINE INDICATES DRIVE SEQUENCE CABLE.

CX-10168

Figure 5-21 Cable Wiring Diagram (Third Add-On RA62)



NOTE 1: ALL PORT A CONNECTIONS GO TO SBI CONTROLLER A. ALL PORT B CONNECTIONS GO TO SBI CONTROLLER B.
NOTE 2: HEAVY LINE INDICATES DRIVE SEQUENCE CABLE.

OX-10378

Figure 5-22 Cable Wiring Diagram - External Drive (Generic)

5.15.1 Installing First Add-On Drive Sequence Cables

Use the following procedure and Figure 5-19 to install the drive sequence cables on the first RA82 add-on drive (Drive 1). This procedure assumes the original drive (Drive 0) is also an RA82.

1. Install a sequence plug in the in connector.

5-32 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET

2. Install a sequence cable between the OUT connector on the back of the original drive and the IN connector on the back of the first add-on drive.
3. Tie wrap the sequence cables to the SSI cables, leaving enough slack in the cables so the drive can slide out the front of the cabinet.
4. Extend the cabinet stabilizer foot and then pull the add-on drive out of the cabinet to check if you left enough slack in the sequence cables.
5. Use as many tie wraps as needed to dress the cables properly.
6. Be sure cables are not pinched when drive is moved in and out.

5.15.2 Installing Second Add-On Drive Sequence Cables

Use the following procedure and Figure 5-20 to install the sequence cables onto the second RA82 add-on drive (Drive 2). This procedure assumes the drives already mounted are RA82 drives.

1. Install a second sequence cable between the IN connector on the back of second add-on drive and connect it to the OUT connector on the first add-on drive.
2. Tie wrap the sequence cables to the SSI cables, leaving enough slack in the cables so the drive can slide out the front of the cabinet.
3. Extend the cabinet stabilizer foot, then pull the add-on drive out of the cabinet to check if you left enough slack in the sequence cables.
4. Use as many tie wraps as needed to dress the cables properly.
5. Be sure cables are not pinched when drive is moved in and out.

5.15.3 Installing Third Add-On Drive Sequence Cables

Use the following procedure and Figure 5-21 to install the sequence cables onto the third RA82 add-on drive (Drive 3). This procedure assumes the drives already mounted are RA82 drives.

1. Install a third sequence cable from the IN connector on the third add-on drive to the OUT connector on the second add-on drive.
2. Tie wrap the sequence cables to the SSI cables, leaving enough slack in the cables so the drive can slide out the front of the cabinet.
3. Extend the cabinet stabilizer foot and then pull the add-on drive out of the cabinet to check if you left enough slack in the sequence cables.
4. Use as many tie wraps as needed to dress the cables properly.
5. Be sure cables are not pinched when drive is moved in and out.

Refer to Table 5-3 for tie wrap hole locations.

5.16 INSTALLING SEQUENCE TERMINATOR PLUG

Check to see if there is a drive sequence terminator plug at the IN connector on Drive 0 (second down from the top). One should be there already. If it is not, use the terminator plug (Part Number 70-19692-01) that comes in the add-on RA8X drive hardware kit. Refer to the insert on Figure 5-18.

The sequence terminator plug position would change if this cabinet were externally connected to other drives (Figure 5-22).

5.17 INSTALLING DISK DRIVE POWER CORD

The installation of the disk drive power cord varies depending on whether you are installing the first, second, or third add-on drive. In general, however, power cords are routed with the SDI cables. This is shown in the fully-loaded cabinet configuration of Figure 5-15.

Route and plug the disk drive power cords from each drive into the receptacles designated in Figure 5-23. The disk drive power requirements must be equally distributed between the three phases of the power controller (Section 5.18). Secure the power cords over the base of the cabinet with cable mounts and tie wraps as shown.

5.18 POWER CONTROLLERS

The 881 power controller was developed for the 10646-A1/A1 series cabinets.

A general purpose, three phase power controller controls and distributes ac power to various ac devices packaged in an operating system. In addition, both versions (A and B) are fully filtered, contain nine outlets, and are packaged in a 3.4-inch enclosure. For detailed information and instructions on how to operate the 881 power controller, refer to the *881 Power Controller User Guide* included with this cabinet. See Section 2.2 for information on power control switches.

CAUTION

The nine outlets on the 881 power controller are divided into three outlets per phase. To prevent load imbalance, equally distribute the power to the drives between all three phases of the power controller. Refer to the appropriate cable wiring diagram in this chapter for proper power controller connections.

5.19 REPLACING THE HDA

If you removed the HDA before installing the add-on RA82 drive on the slides, use the following procedure to replace the HDA. Refer to the appropriate disk drive user guide if the drive is an RA80 or RA81.

CAUTION

For drive protection, use a grounding (electrostatic discharge) wrist strap during the following procedures (Figure 5-3). Also, read Section 1.7 for information on ESD protection.

1. Check that the cable spring assembly is in the **RELEASED** position (towards the rear). Refer to Figure 5-7.
2. Position the motor/brake assembly towards front of drive (swing slightly out on pivot rod) to take tension off drive belt.
3. Center the drive belt on the belt ramp bracket on the lower chassis as illustrated in Figure 5-24.

CAUTION

Damage to the HDA or drive belt may result if the drive belt is not aligned correctly.

4. Lift the HDA by grasping it from diagonally opposite corners (Figure 5-8). The HDA weighs approximately 35 pounds.
5. Lower the HDA over the four mounting bolts.

5-34 INSTALLING RA82 ADD-ON DRIVES IN FOUR-HIGH CABINET

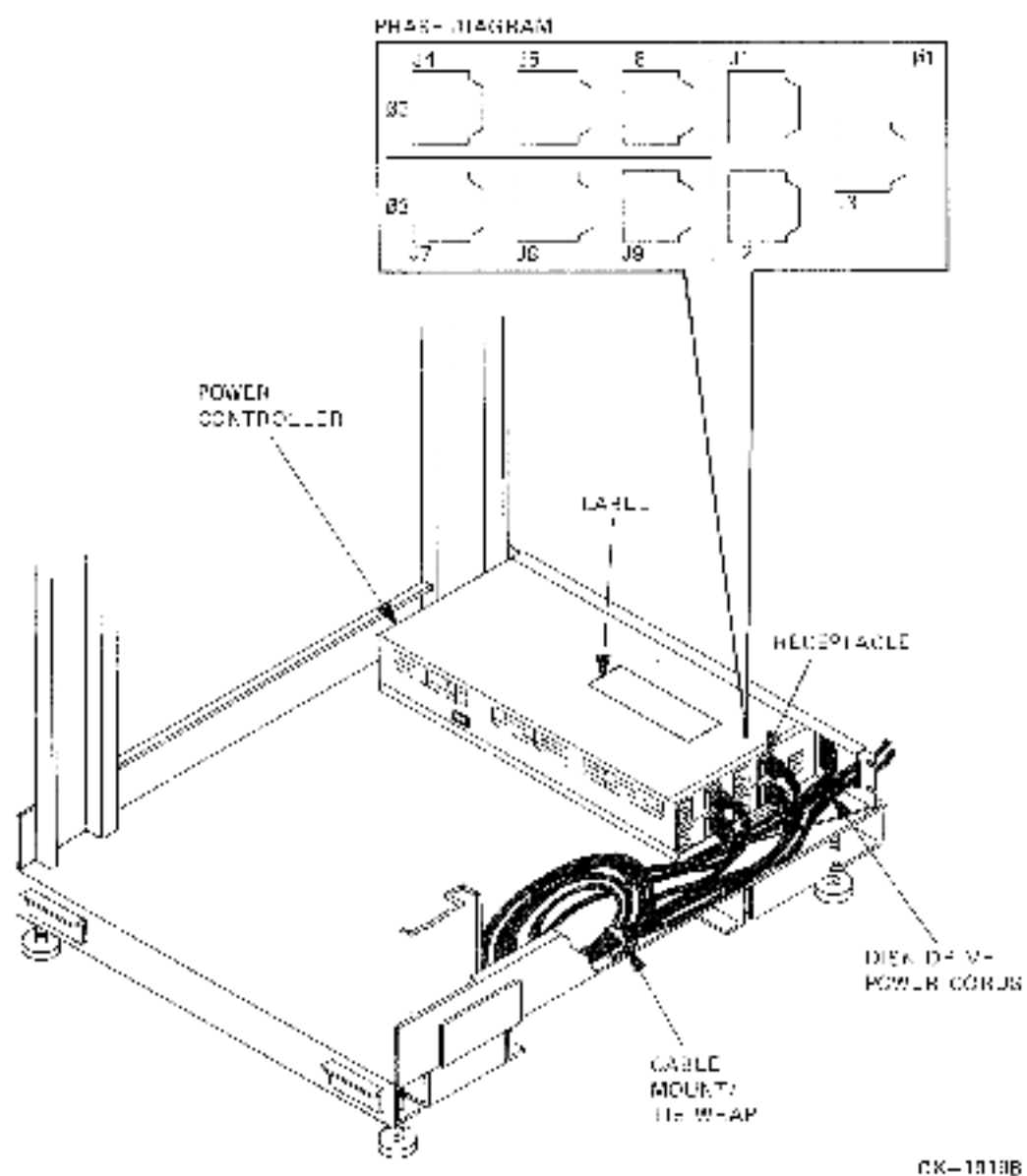
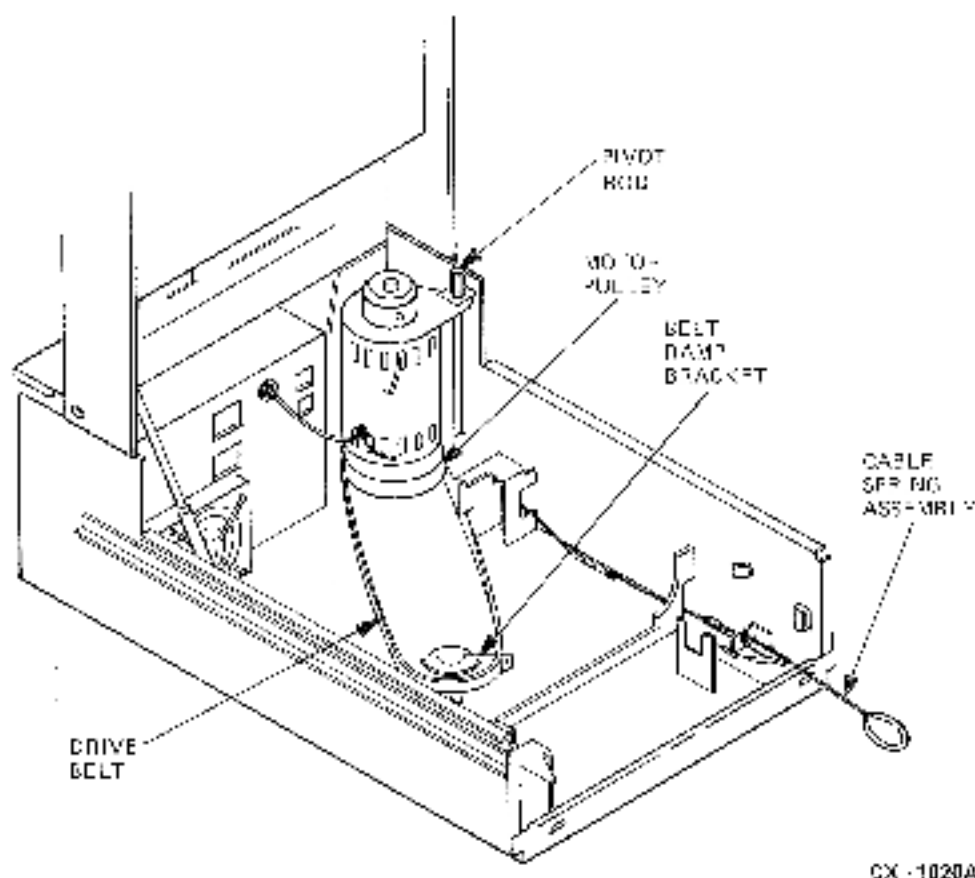


Figure 5-23 Routing Power Cords on Cabinet Floor (Four-High)



CX-1020A

Figure 5-24 Belt Alignment

6. Replace the four nuts and washers holding the HDA to its mounting bolts, and finally tighten the four nuts to the mounting bolts with a 7/16-inch nut driver. Refer to Figure 5-6.
7. Connect P502 from the read/write module (Figure 5-6).
8. Connect P602 and P603 from the HDA preamplifier module (Figure 5-6).
9. Lock the positioner in the UNLOCK position (Figure 5-8). The lever must be lifted slightly to clear the surface of the read/write module.
10. Place the cable spring assembly in the ENGAGED position (Figure 5-7).
11. Position the read/write cable between the ribs on HDA housing to assure that the cable does not get pinched when the cover is closed. See Figure 5-6.

INSTALLING RA82 ADD-ON DRIVES IN AN SA482

6.1 INTRODUCTION

This chapter describes how to install RA82 disk drives into an SA482 cabinet.

6.2 UNPACKING THE ADD-ON DRIVE FROM THE BOX

Open the add-on drive box and check the contents listed in the following sections.

6.2.1 Add-On Hardware Mounting Kit Parts Checklist

Inside the plastic bag(s) of the add-on hardware kit, you should find the following parts. Use this check list to make sure they are all present.

Table 6-1 RA82 Add-On Drive Checklist

Quant	Part Description	Part Number	Rev
1	RA82 disk drive	70-21577-01 (60 Hz) or 70-21577-02 (50 Hz)	
1	RA82 hardware mounting kit (checklist below)	70-20194-02 ¹	
1	Clamping slide set (containing left and right slides)	12-13686-00	K
1	Power cord, disk drive, 9 feet	17-00083-23 (125 volts) or 17-00083-24 (250 volts)	L
1	Power cord, disk drive, 9 feet, 15A	17-00442-10	A
1	Cable, SII, 12 feet (internal)	BC26V-12	

¹ The 70-20194-02 hardware kit is used to mount RA82 disk drives into three- and four-high cabinets, including SA cabinets.

6.2.2 Add-On Hardware Mounting Kit Parts Checklist

Inside the plastic bag(s) of the add-on hardware kit, you should find the following parts. Use Table 6-2 to make sure they are all present.

Table 6-2 RA82 Hardware Mounting Kit Checklist

Quan	Description	Part Number	Min Rev
1	Retainer, cable spring	74-25326-01	A
4	Brackets, chassis slide	74-19261-00	
1	Cable, drive sequence, 8-foot	70-19690-08	
2	Brackets, ESD (not used on SA cabinets)	74-28330-01	A
1	Plug	70-19692-01	
4	Bar, nut	74-25168-01	CR
16	Screws, Sems Pan Phillip, 8/32 x 5/16-inch	90-10174-01	C
13	Screws, Sems Truss Phillip, 10/32 x 1/2-inch	90-09700-00	A
3	Clump, cable, screw mounted, 11/16-inch	90-07088-00	CR
25	Ties, cable, 1 3/4-inch	90-07032-00	D
5	Washers, Dai SST	90-06664-00	CR
5	Retainer, U-nut, 10-32	90-07786-00	F
3	Standoff, male/female, hex 10-32	90-00001-22	A
1	Spacer, threaded, hex 10-32	90-07662-00	
10	Washer, shoulder nylon (not used on SA)	12-19700-02	
2	Standoff, 6-32 (SA cabinets only)	90-00001-06	
1	Cover, control panel (SA cabinets only)	74-34388-01	
2	Bracket, ESD (SA cabinets only)	74-36477-01	
4	Screw, 10-32 A25 (SA cabinets only)	12-21368-02	

6.3 PREPARING THE SA482

In order to add an RA82 disk drive to the SA482 cabinet, the SA482 must be spun down and power removed.

1. Release the **A** and the **B** part buttons on the operator control panel to the **OUT** position on each drive in the SA482.

2. Spin down the SA482 by releasing the **RUN/STOP** button on the operator control panel on the front of each disk drive to the **OUT** position.

6.3.1 Removing the Rear Door

Press down on each of the two latch release buttons. Then lift and remove the door from the bottom two support brackets. Refer to Figure 6-1.

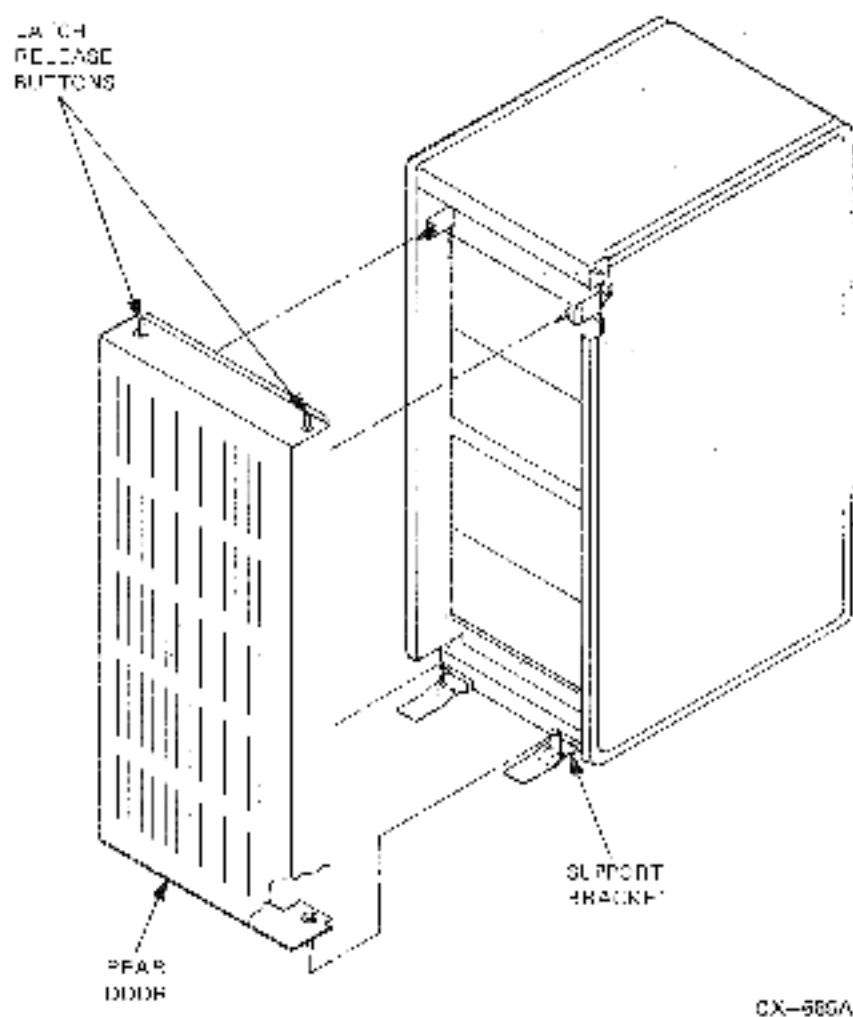


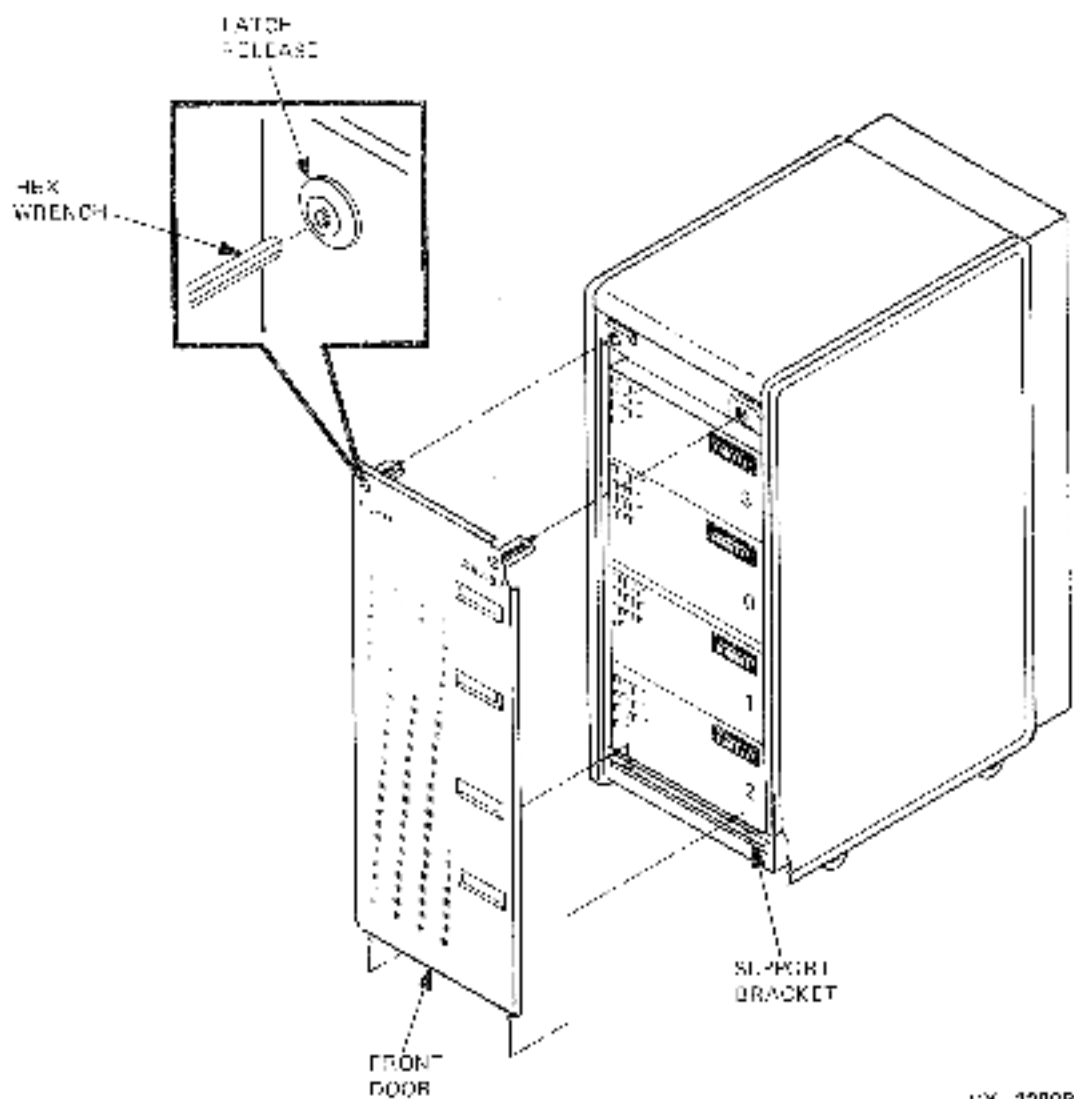
Figure 6-1 Removing the Rear Door

CAUTION

Before proceeding, turn **OFF** the ac circuit breaker for each drive and for the cabinet.

6.3.2 Removing the Front Door

Obtain access to the drive elements in the SA482 by loosening the two hex latch releases (Figure 6-2) located at the top of the SA482 front door and lifting the panel up and out. Replacement of the door panel is the reverse procedure of removal.



LX 12898

Figure 6-2 Disk Drive Access in SA482

6.3.3 Front Door Filler Plate Removal

Carefully remove the appropriate front door filler plate from inside the front door. This filler plate is held in place by two screws accessible from the inside of the front door. Refer to Figure 6-3.

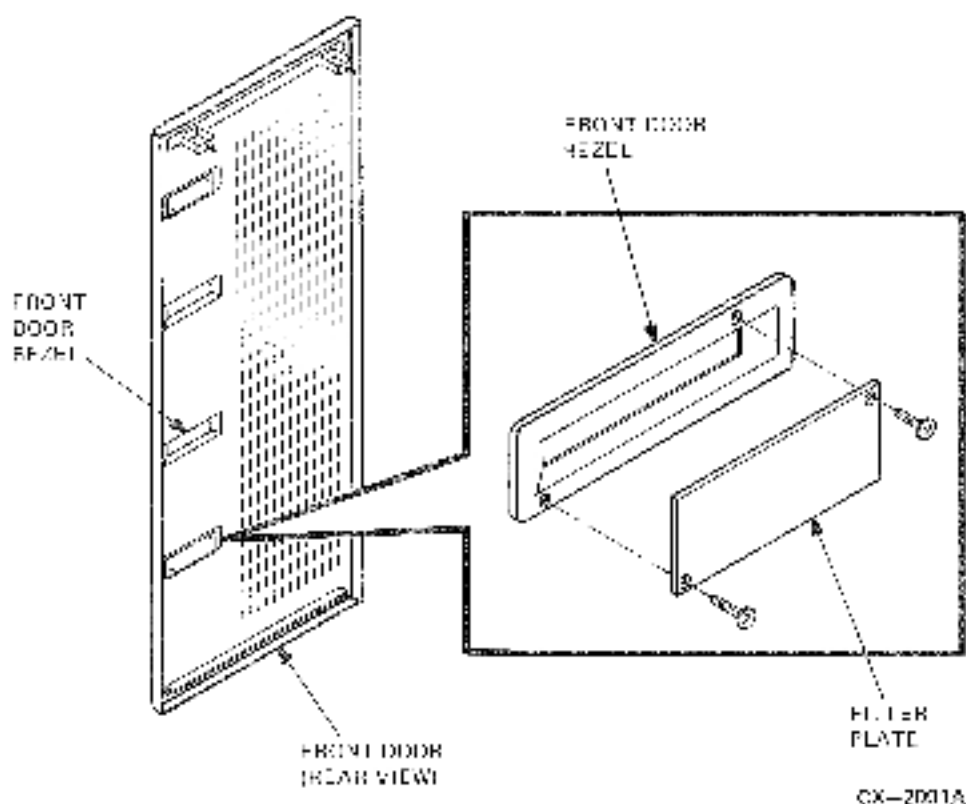


Figure 6-3 Filler Plate Removal

6.3.4 Extending the Cabinet Stabilizer Foot

The cabinet stabilizer foot prevents the drive cabinet from tipping forward when a drive is extended on its slides or when a new drive is installed in the cabinet. Extend the foot forward from the center bottom of the drive cabinet and lower it until it makes firm contact with the floor. Refer to Figure 6-4.

WARNING

Always extend the cabinet stabilizer foot completely forward before placing a drive on the slides or sliding a drive out of the cabinet.

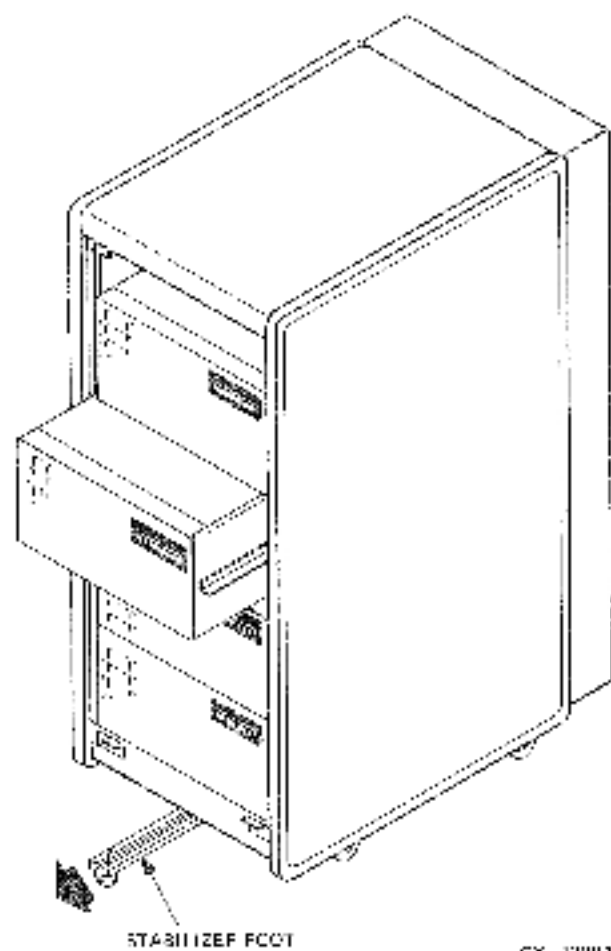


Figure 6-4 Stabilizer Foot Extension

CAUTION

Do not push the stabilizer foot in while the drive is extended.

6.4 PREPARING THE ADD-ON DRIVE FOR INSTALLATION

Each RA82 disk drive in the SA482 cabinet must be mounted on a slide assembly. Use the procedures in the following sections to prepare the add-on drive for installation.

NOTE

Since the drive weighs at least 61.2 Kg (135 pounds), DIGITAL recommends that an approved field service lifting device rated at 200 pounds (DIGITAL Part Number KL-10374-AC) be used to place the drive on the chassis slides.

If an approved lifting device is not available, at least three persons are required to lift and install the disk drive. Refer to Section 6.7.2 for the proper procedure.

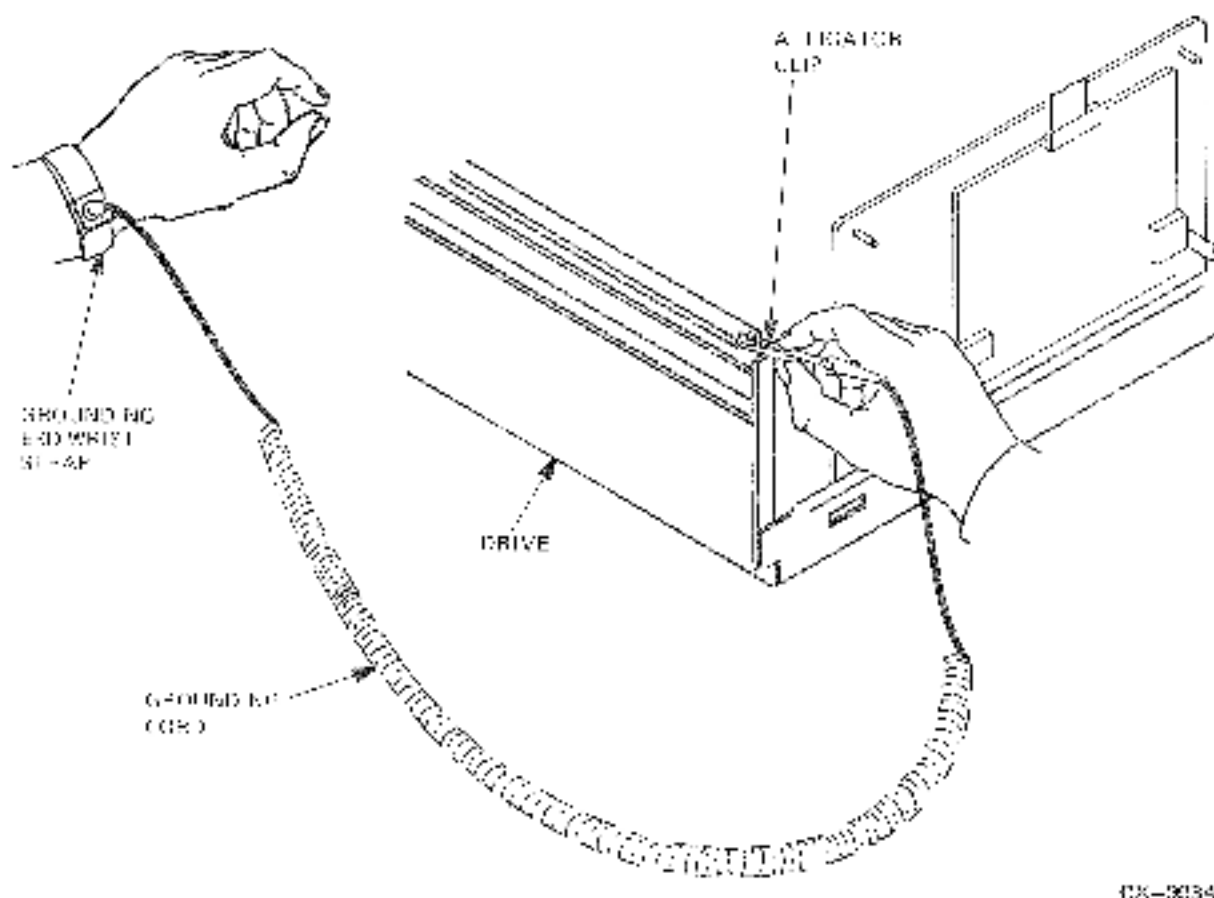
The hard disk assembly (HDA) may be removed from the drive to reduce the total weight by approximately 35 pounds. Refer to Section 6.16 for instructions on HDA removal.

6.4.1 Removing Internal Shipping Brackets and Packing Material

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

CAUTION

Use a grounding (electrostatic discharge) wrist strap during the following procedures for drive protection (Figure 6-5). Also, read Section 1.7 for information on ESD protection.



01X-20134

Figure 6-5 Connecting ESD Wrist Strap to Ground

1. Unlock the upper chassis assembly by turning the two cam latches under the front bezel 180 degrees counterclockwise with a 5/16-inch allen hex wrench. Refer to Figure 6-6.
2. Raise the upper chassis assembly until the damper (gas spring) lock slides in place and the cover is supported by the damper (Figure 6-7).

CAUTION

To prevent HDD and head damage, *never* open or close the upper chassis assembly while the drive is operating.

6-8 INSTALLING RA32 ADD-ON DRIVES IN AN SA482

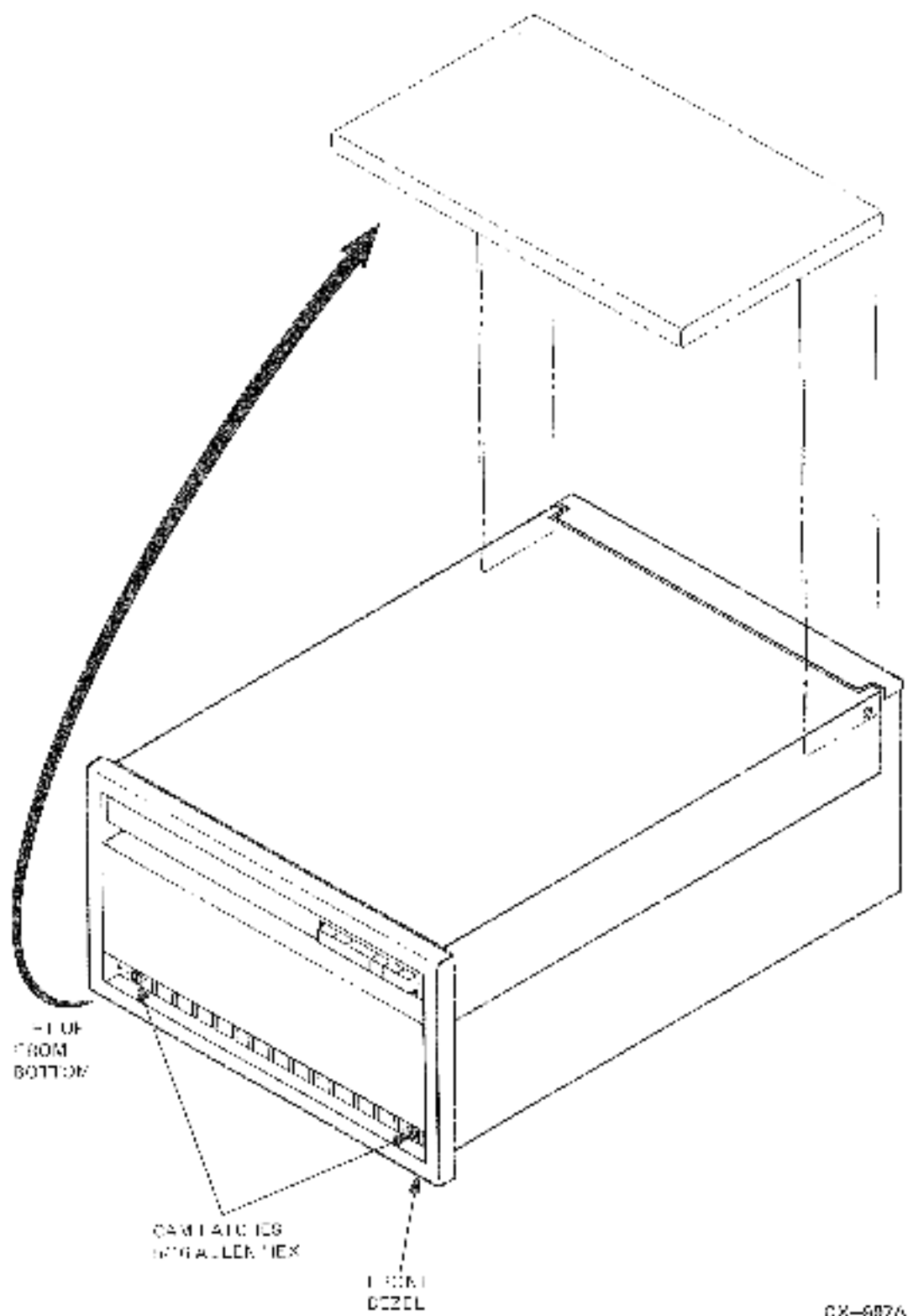
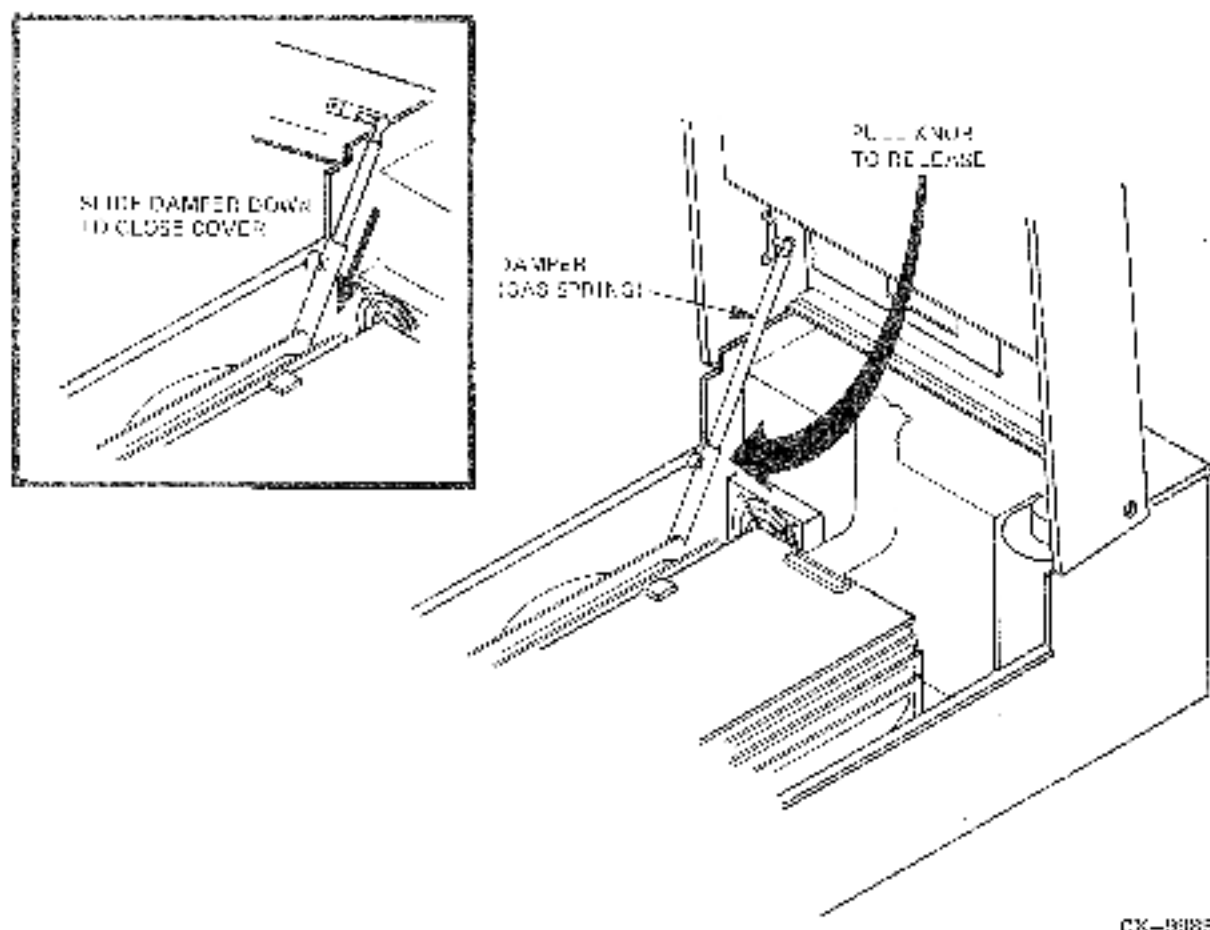


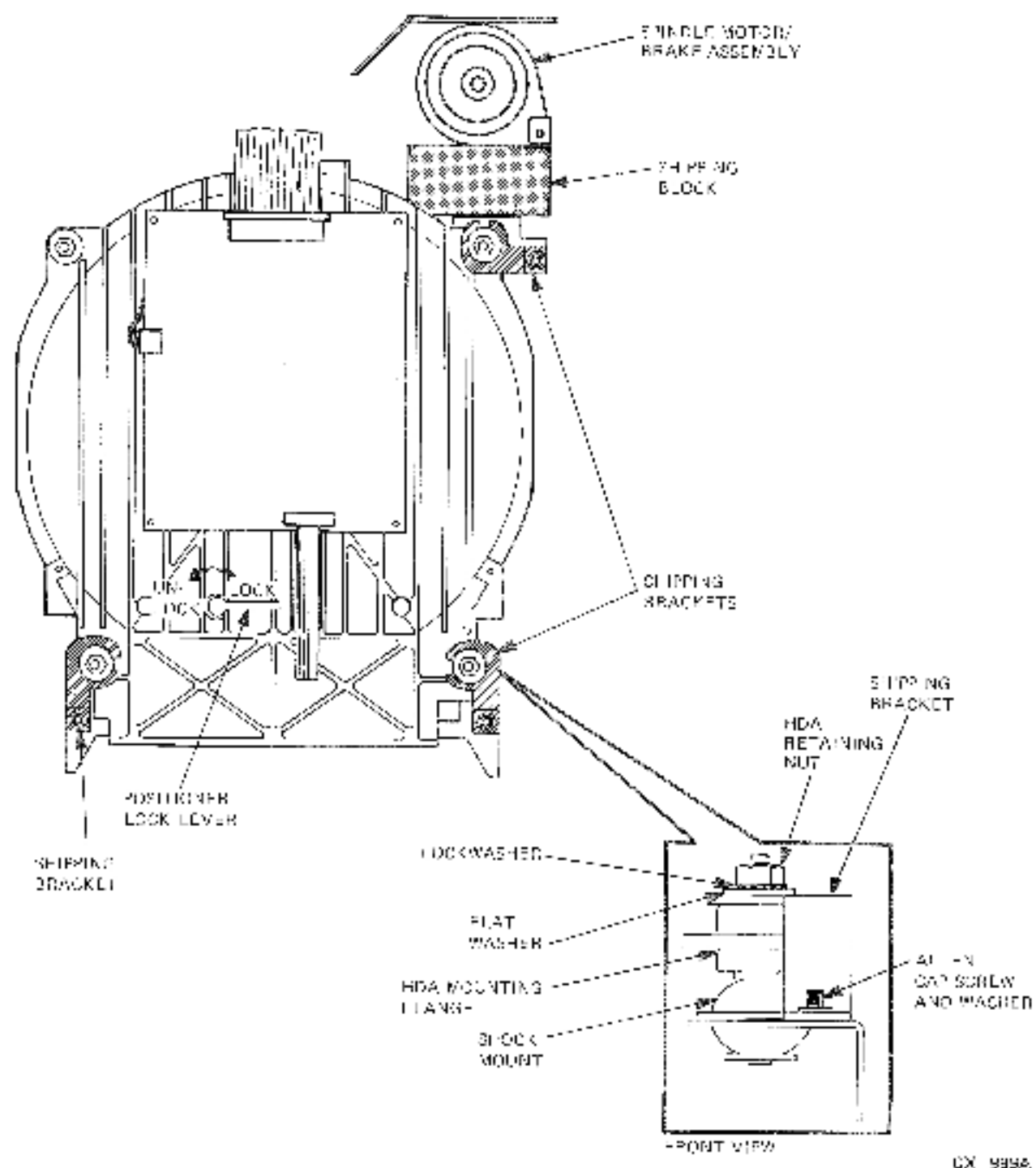
Figure 6-6 Upper Chassis Assembly



CK-10085

Figure 6-7 Damper (Gas Spring) Assembly

3. Locate the three red shipping brackets that fasten the HDA to its mountings. Refer to Figure 6-8.
4. Remove the three red shipping brackets by unscrewing the 7/16-inch hex retaining nuts and removing the number 10 (5/32 A/F) allen cap screws and cap screw washers from the sides of the brackets.



CX 999A

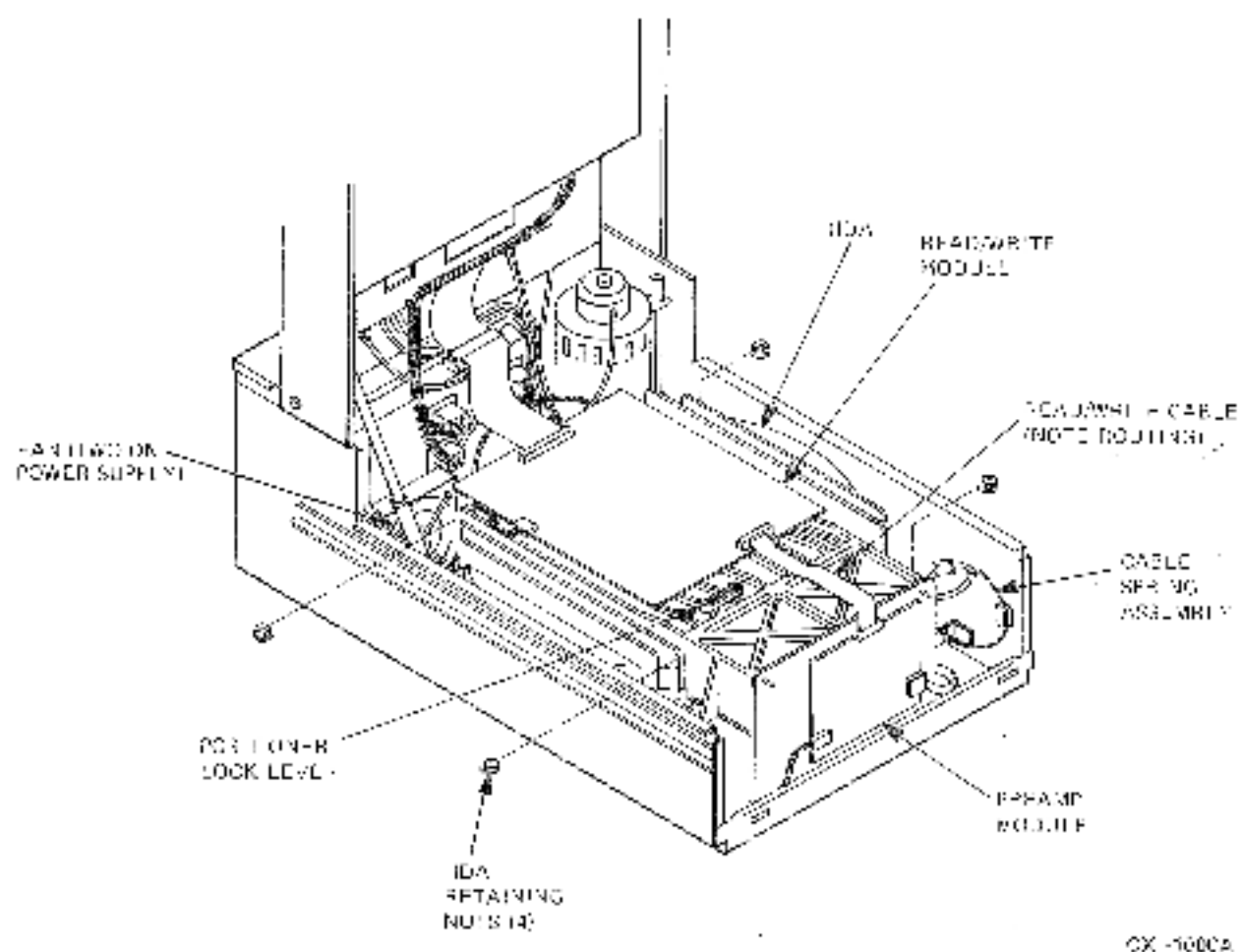
Figure 6-8 HDA Shipping Brackets

5. Slide the shipping brackets out from under the HDA retaining nuts, and remove the cap screw and cap screw washers. Refer to Figure 6-8. The HDA retaining nuts are used to hold down the HDA after the shipping brackets are removed.

NOTE

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

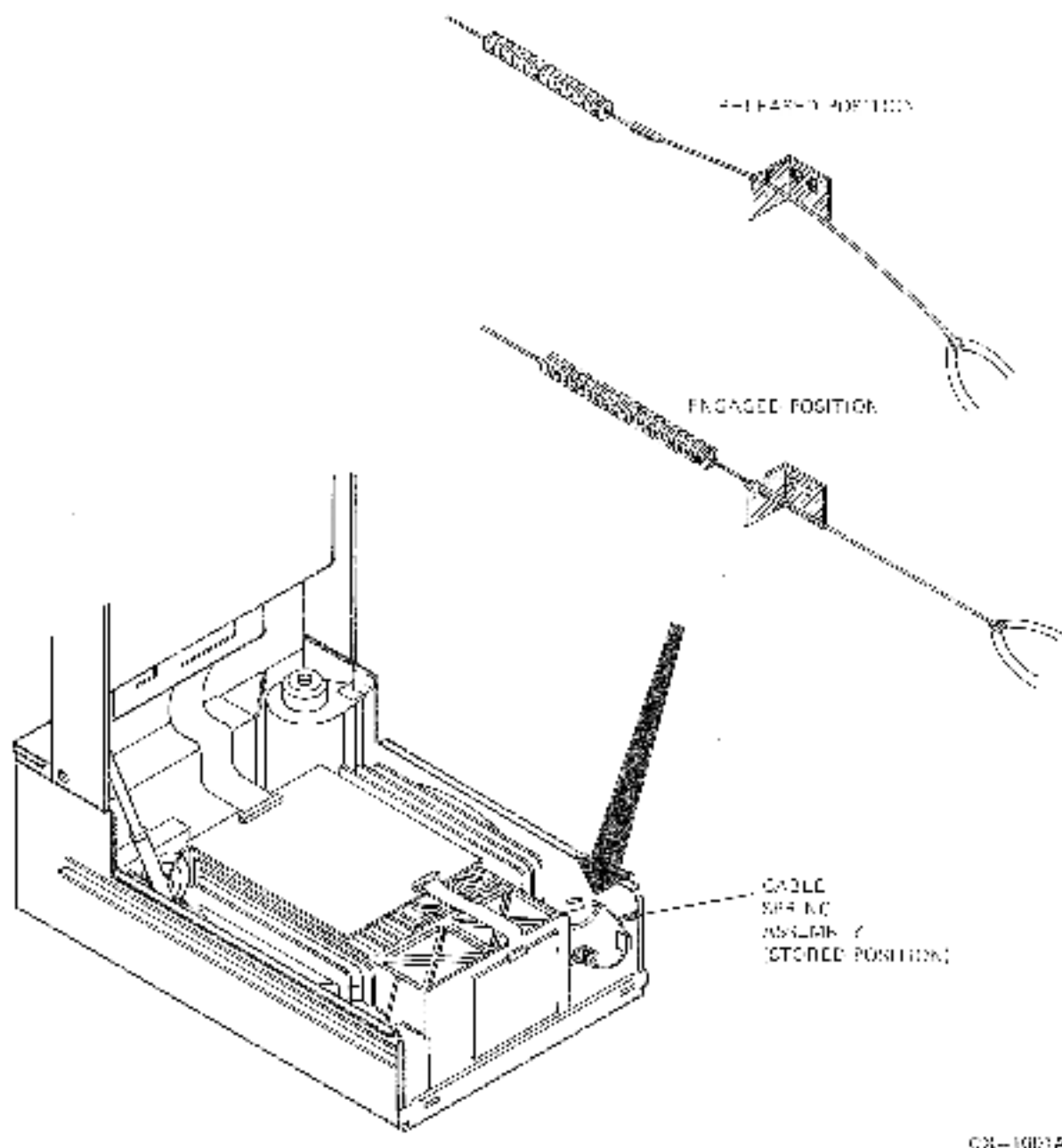
6. Remove the foam shipping block from between the spindle motor and the right rear HDA bracket. Refer to Figure 6-8.
7. Firmly tighten all four HDA retaining nuts with a 7/16 inch nut driver. Refer to Figure 6-9.



CX-1000A

Figure 6-9 HDA Details

8. Ensure the cable spring assembly is in the **ENGAGED** position as shown in Figure 6-10.



COL-1057A

Figure 6-10 Cable Spring Assembly

NOTE

An interlock switch prevents the spindle motor from operating while the cable spring assembly tension is released. The cable spring assembly must be in the ENGAGED position for setup.

9. Remove positioner lock seal and place the positioner lock lever on the BDA in the UNLOCK position (Figure 6-8).

10. Unlock the logic access cover by manually turning the two captive fastener assembly screws several turns counterclockwise. Release and tighten these screws by hand only. Refer to Figure 6-11.
11. Fold out the logic access cover.
12. Check all modules, cables, and connections. Make sure all cable connectors are firmly seated in the mating connectors.

NOTE

Visually inspect all modules and components for obvious damage. **DO NOT** operate equipment if components are damaged. Report all damage to the DIGITAL field service or sales office and to the delivery agent.

13. Return the logic access cover to its original closed position. Lock the two captive fastener assembly screws by manually turning them clockwise. Make sure the logic access cover is securely locked in place. Refer to Figure 6-11.
14. Position the read/write cable between ribs on the HDA to assure that the cable does not get pinched when the cover is closed. Refer to Figure 6-9.

CAUTION

Do not pinch cables when lowering the upper chassis assembly. Check cable locations and reroute cables, if necessary, before lowering.

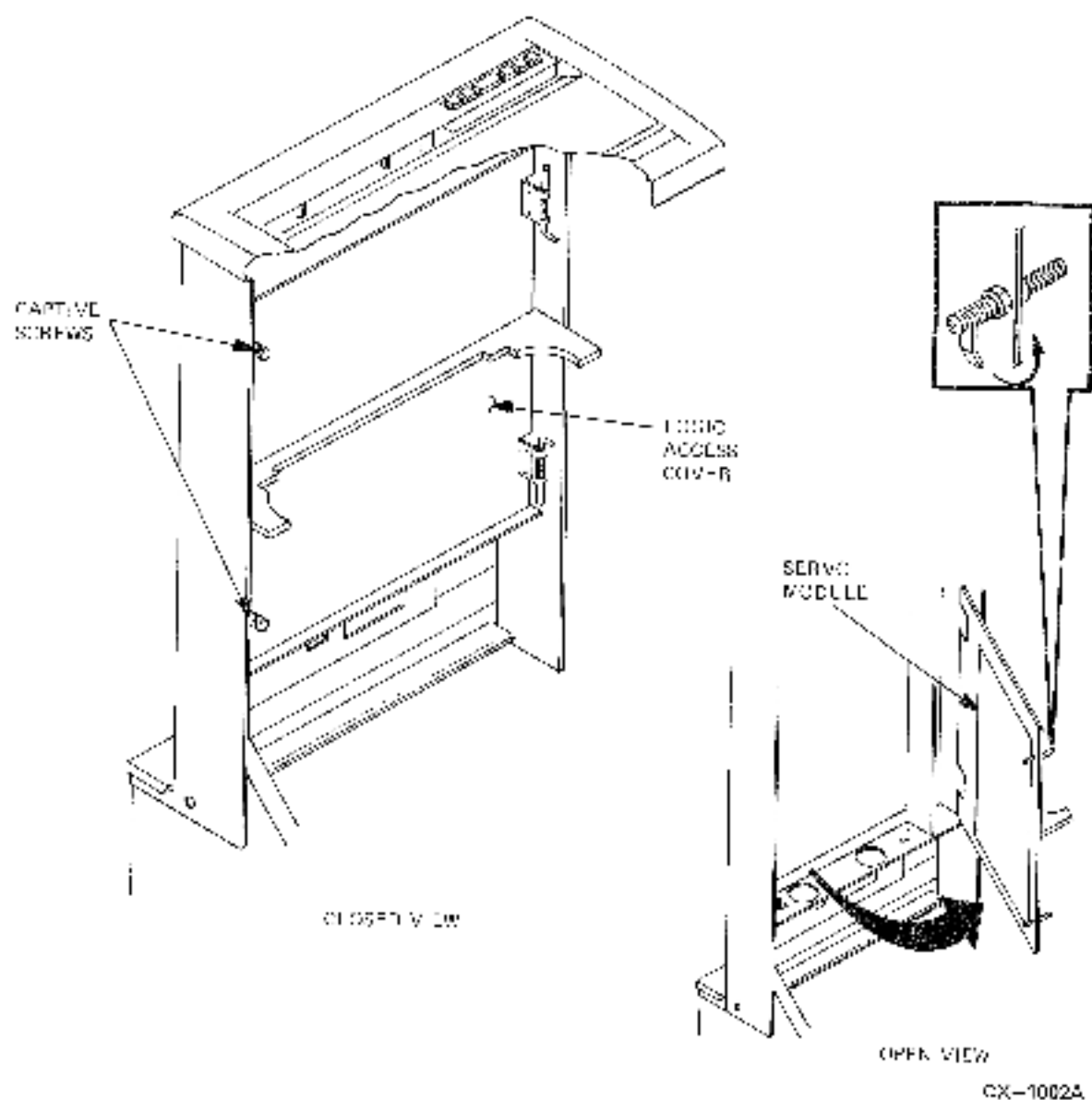
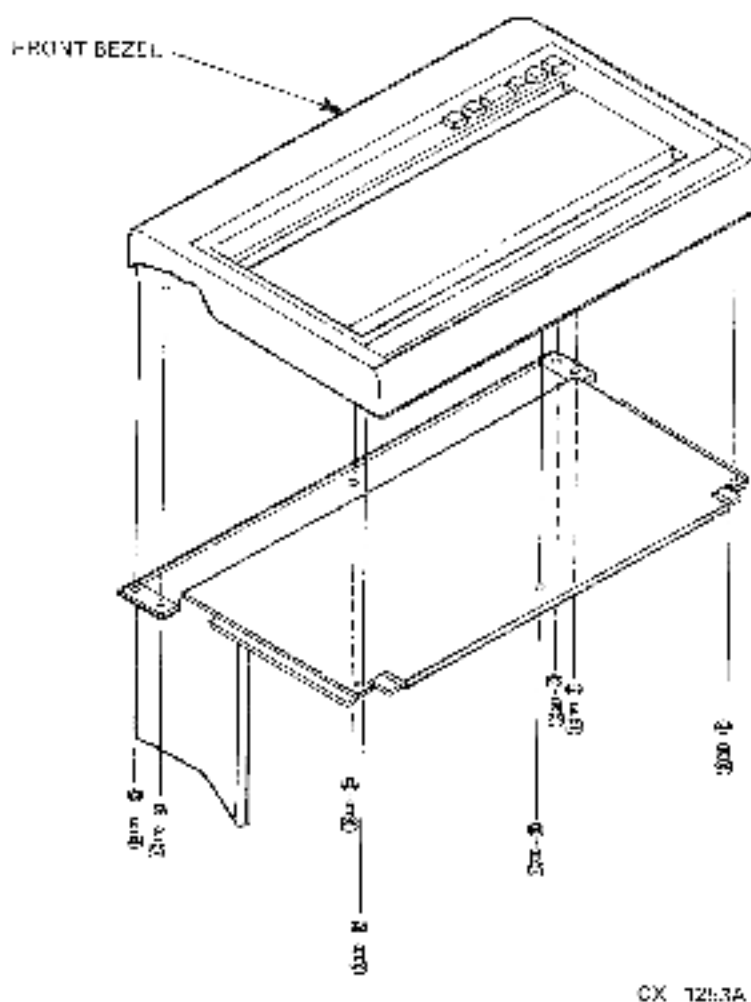


Figure 6-11 Opening the Logic Access Cover

15. Remove and discard the eight screws that hold the bezel in place. Refer to Figure 6-12 for screw location.



CX 1253A

Figure 6-12 RA82 Front Bezel Removal

16. Remove and discard the bezel and filter foam.
17. Gently lift up on the upper chassis assembly to take the weight off the gas spring. Unlock the gas spring by pulling the locking knob out while still supporting the weight of the upper chassis assembly. Refer to Figure 6-7.
18. Slowly lower the upper chassis assembly until resistance from the gas spring is felt. When resistance is sufficient to ensure the gas spring will allow the logic to close slowly, release your hold on the upper chassis assembly. Lock in place by turning the two cam latches under the front bezel 180 degrees clockwise with a 5/16-inch allen hex wrench. Refer to Figure 6-6.

CAUTION

DO NOT permit the upper chassis to free fall and **DO NOT** force the upper chassis assembly against the gas spring pressure.

If you do not need to remove the FDD, follow the procedures beginning in Section 6.5 to install the slides and mount the disk drive into the cabinet.

6.5 PREPARING THE SLIDES FOR CABINET MOUNTING

Use the following procedure to prepare the cabinet slide assemblies for installation. Assemble the left-hand slide assembly first.

1. Locate the left-hand slide that has part number 1213686-00-REV-X-L engraved on it. The revision level of the slide was given as X because it changes occasionally. The letter L indicates this is the left-hand slide.
2. Locate the plastic bag containing four slide brackets.
3. Locate the plastic bag containing the 8-32 X 5/16 screws.
4. Lay the left hand slide on its back and push the lower half of the slide to the left to gain access to the rear mounting holes. (Figure 6-13).
5. Use two 8-32 screws to mount the rear slide bracket to the slide as shown in Figure 6-13. Don't tighten the screws all the way since some leeway is needed later when the slides are mounted into the cabinet.
6. Use two more 8-32 screws to mount the front slide bracket to the left-hand slide. The screws must be inserted into the mounting holes through the oval opening on the slide. Tighten the two screws.
7. Press the two front ends of the L-shaped cable retainer together and force the retainer into the rear end of the left-hand slide assembly as shown in Figure 6-13.
8. Locate the drive right hand slide that has part number 1213686-00-REV-X-R engraved on it. The revision level of the slide was given as X because it changes occasionally. The letter R indicates this is the right-hand slide.
9. Lay the right-hand slide on its back and push the lower half of the slide to the right to gain access to the rear mounting holes (Figure 6-14).
10. Use two 8-32 screws to mount the rear slide bracket to the slide. Don't tighten the screws all the way since some leeway is needed when the slides are later mounted into the cabinet.
11. Use two more 8-32 screws to mount the front slide bracket to the right-hand slide. Insert the screws into the slide mounting holes by aligning the oval opening over them. Tighten the two screws.

Both slides are now prepared for installation into the drive cabinet.

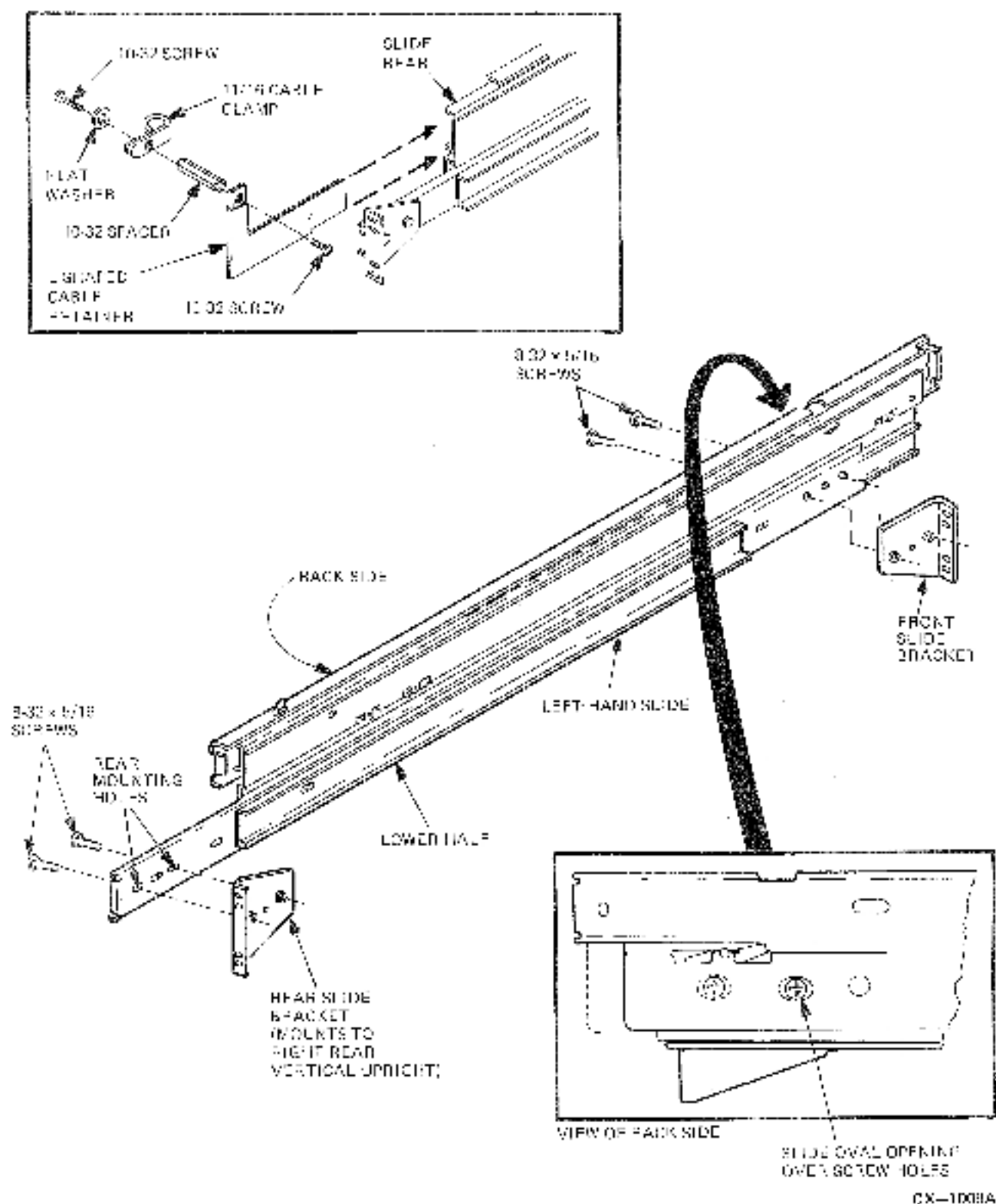
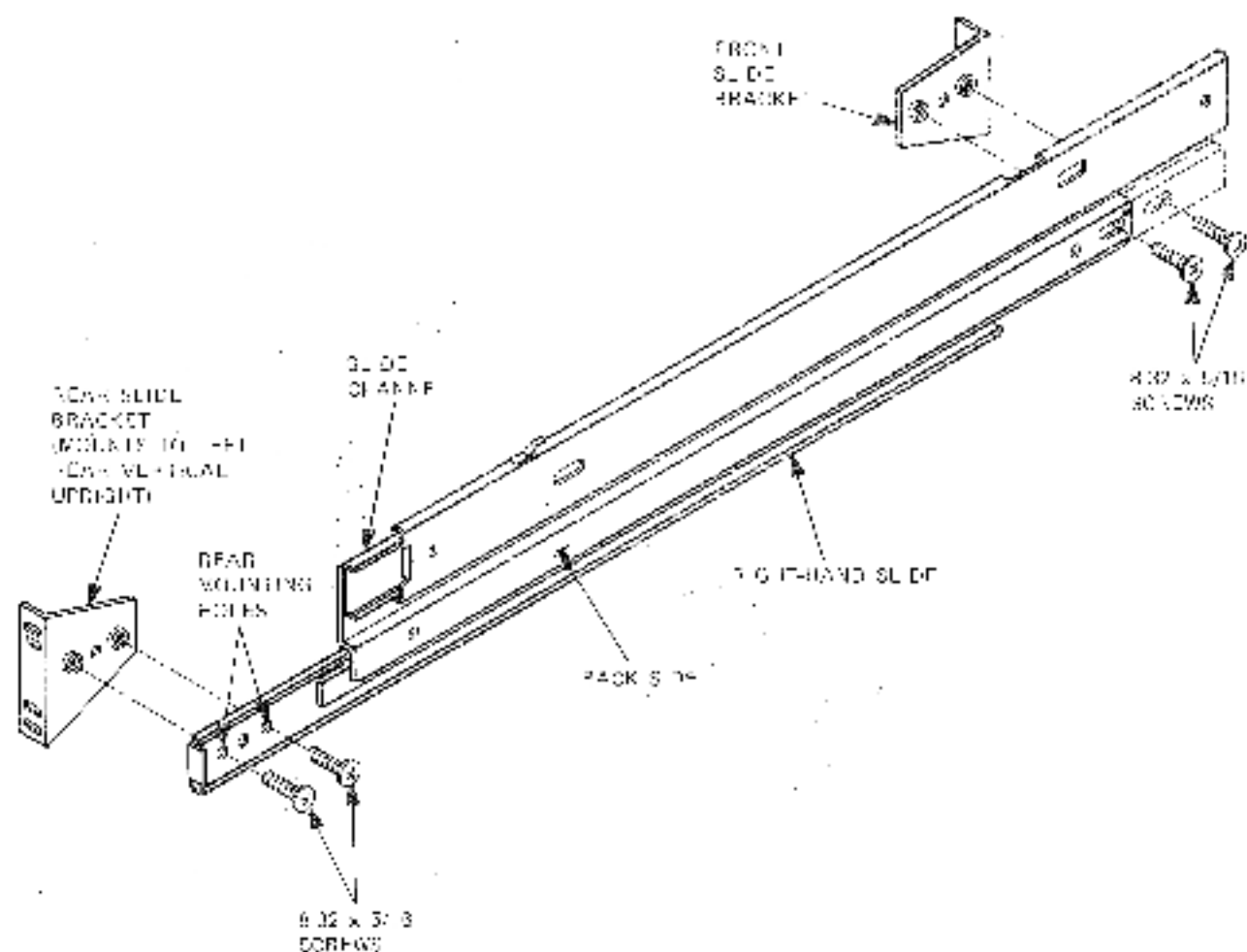


Figure 6-13 Preparing Left-Hand Slide



CA-1010A

Figure 6-14 Preparing Right-Hand Slide

6.6 INSTALLING CABINET SLIDES

Use the following procedures to install the slides and associated hardware in the cabinet. Refer to Table 6-3 for the proper SA482 cabinet installation holes.

Table 6-3 SA482 Installation Holes

Drive Position	FRONT Slide Holes	REAR Slide Holes	RIGHT REAR* Clamp/Standoff	LEFT REAR* Clamp/Standoff
Drive 3	66, 70	70, 69, 67	Not used	71
Drive 0	48, 52	52, 51, 49	53	48
Drive 1	27, 31	31, 30, 28	43	27
Drive 2	9, 13	13, 12, 10	22	9

* **RIGHT REAR** refers to the right rear vertical upright as viewed from the front of the cabinet. **LEFT REAR** refers to the left rear vertical upright as viewed from the front of the cabinet.

1. Go to the rear of the drive cabinet. Counting from the bottom, locate and mark the mounting holes in both rear cabinet uprights. Refer to Figure 6-15.
2. Go to the front of the drive cabinet. Counting from the bottom, locate and mark the mounting holes on both front cabinet uprights.

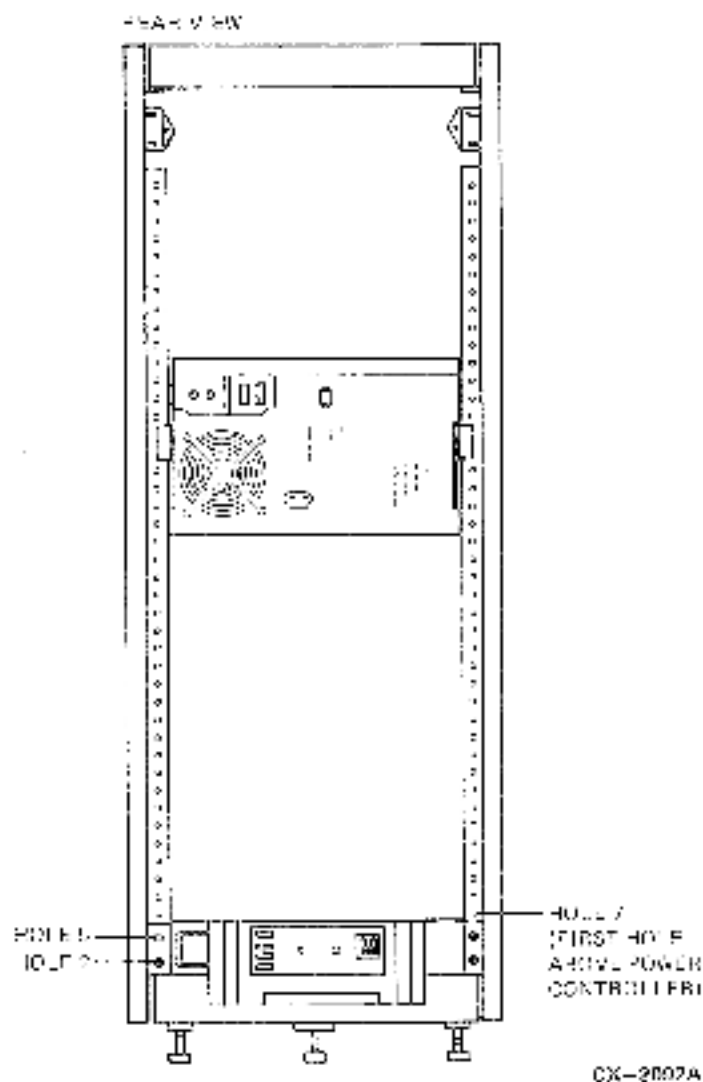
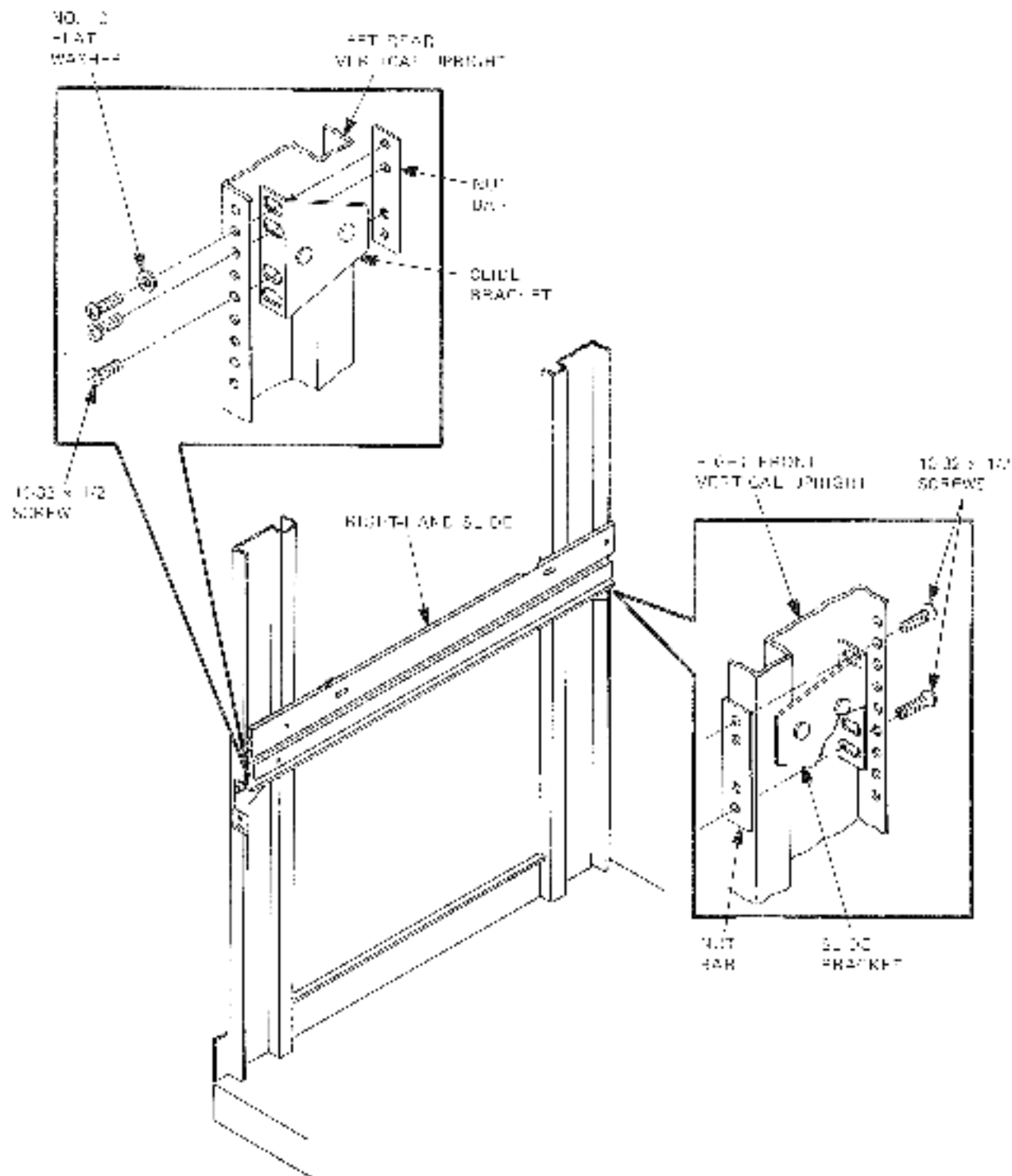


Figure 6-15 Cabinet Upright Holes (50-inch cabinet)

3. Locate the plastic bag containing the 10-32 X 1/2 screws.
4. Locate the plastic bag containing the four nut bars.
5. Locate the plastic bag containing two electrostatic discharge (ESD) brackets.
6. At the front of the cabinet, mount the right-hand slide assembly to the front right cabinet upright using two 10-32 screws and one nut bar as shown in Figure 6-16. Refer to Table 6-3.
7. Secure the back of the slide assembly to the rear frame with 10-32 SEMs screws (Part Number 90-09700-00). Refer to Table 6-3 for appropriate hole locations.

8. Once both slides are mounted, go to the rear of the cabinet and tighten the screws holding the slides to the slide brackets. Do this for both slides (these brackets were left loose for adjustments).



CX-2083A

Figure 6-16 Mounting the Slide Assembly

WARNING

Always extend the cabinet stabilizer foot completely forward before placing a drive on the slides or sliding a drive out of the cabinet.

Also, do not push the stabilizer foot in while the drive is extended or damage to the cabinet interlock mechanism could result.

6.7 MOUNTING THE ADD-ON DRIVE ON THE SLIDES

Use the following procedures to mount the add-on drive on the slides. Refer to Figure 6-17.

CAUTION

The cabinet stabilizer foot must be fully extended and locked (Figure 6-4).

6.7.1 Installing an RA82 Using a Lifting Device

Use the following procedure if you are using an approved lifting device (DIGITAL Part Number FC-10074 AC) to install the RA82 disk drive.

1. Be certain that you have removed the front bezel of the disk drive.
2. Pull the right and left slides out of the cabinet until they lock in place. Then lift up the lock arm A on both arms and pull both slides out of the cabinet until they are fully extended forward. Refer to Figure 6-17.
3. Lift the drive with the lifting device.

NOTE

Since the drive weighs at least 61.2 Kg (135 pounds), DIGITAL recommends that an approved field service lifting device rated at 260 pounds (DIGITAL Part Number FC-10074-AC) be used to place the drive onto the chassis slides.

If an approved lifting device is not available, at least three persons are required to lift and install the disk drive. Refer to Section 6.7.2 for the proper procedure.

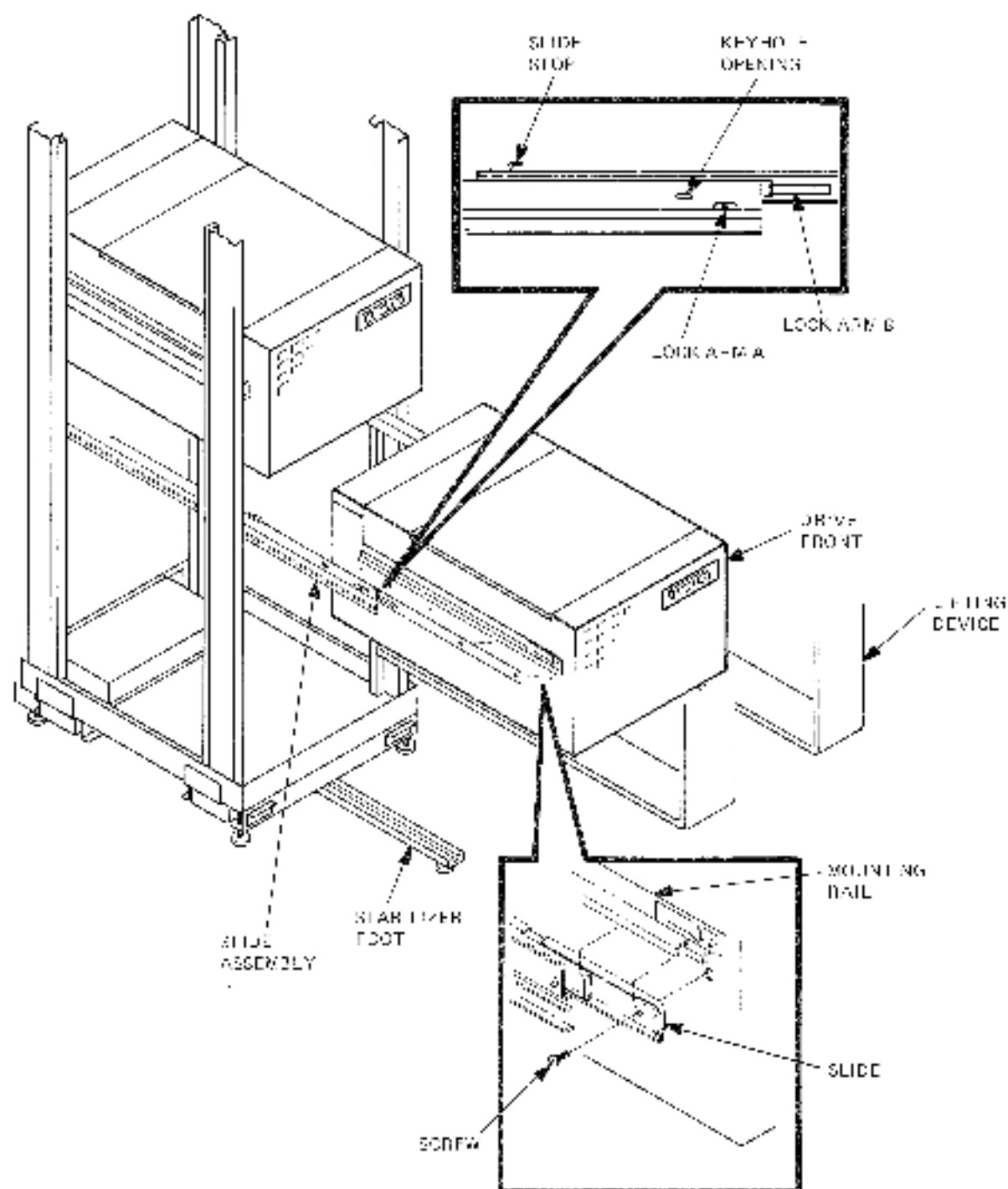
The head disk assembly (HDA) may be removed from the drive to reduce the total weight by approximately 35 pounds. Refer to Section 6.16 for instructions on HDA removal.

4. Lower the drive onto the extended slides so the drive front bezel is about one inch forward of the front end of the slide.

CAUTION

Make sure the drive mounting rails and slides engage properly. If not, the drive could fall between the slides.

5. Push the drive towards the rear of the slide assembly until it engages the top slide stops. Refer to Figure 6-17.
6. Insert the 8-32 x 5/16 mounting screws through the openings on each slide to secure the drive to the slide assemblies. Only the front screw holes in the drive will be visible. The slides must be unlocked and moved to expose the rear screw holes. Refer to Figure 6-17.



CX-2115A

Figure 6-17 Mounting the Drive on Slides

7. Release the slide lock arm B on both slides and push the drive back slowly until the next drive mounting hole lines up with the keyhole opening in the slides. Refer to Figure 6-17.
8. Insert 8-32 X 5/16 screws into the keyhole openings on each slide to complete the mounting procedure of the drive to the slides.

NOTE

If you have removed the HDA to install the drive into the cabinet, replace the HDA into the drive at this time (Section 6.17).

6.7.2 Installing an RA82 Without a Lifting Device

Use the following procedure to install an RA82 disk drive without an approved lifting device. The following procedure requires three people to complete.

WARNING

Fully extend and lock the slides and the cabinet stabilizer foot before attempting this procedure.

1. Make certain the work area is clear of obstructions, cables, etc.
2. Place one person on each side of the unit.
3. Place one person at the front of the unit.
4. The two persons at the sides of the unit grasp the front and rear of the unit and using the leg muscles lift the unit together.
5. The person at the front of the unit removes the skid or other packaging material from the immediate area.
6. The person at the front of the unit guides the lifters and assures that the slides are locked and that the unit is resting on the slides correctly.
7. While the two are holding the RA82 in position, the third person starts two mounting screws on each side of the unit (the one closest to the front and the one closest to the rear).
8. Secure the remaining mounting hardware as required and continue with normal installation procedures.

6.8 SECURE THE DRIVE TO THE TWO ESD BRACKETS

Use the following procedure to attach the drive to the ESD brackets included in the add-on hardware kit.

1. Remove the bottom left and the top right OCP mounting screws. Refer to Figure 6-18 for locations.
2. Install the 6-32 x 1.375 standoffs (Part Number 90-00001-06) in place of the two screws removed in step 1.

NOTE

Install the standoffs finger tight. Do not use a wrench.

3. Install the control panel cover (Part Number 74-34388-01), using the two screws removed in step 1. The textured surface of the cover should be to the front.

4. Attach the ESD brackets (Part Number 74-34389-01) behind the vertical flanges on the logic housing using 8-32 screws (Part Number 90-10174-01) (two brackets, one to each side, two screws per bracket). *Do not tighten these screws.* See Figure 6-18.

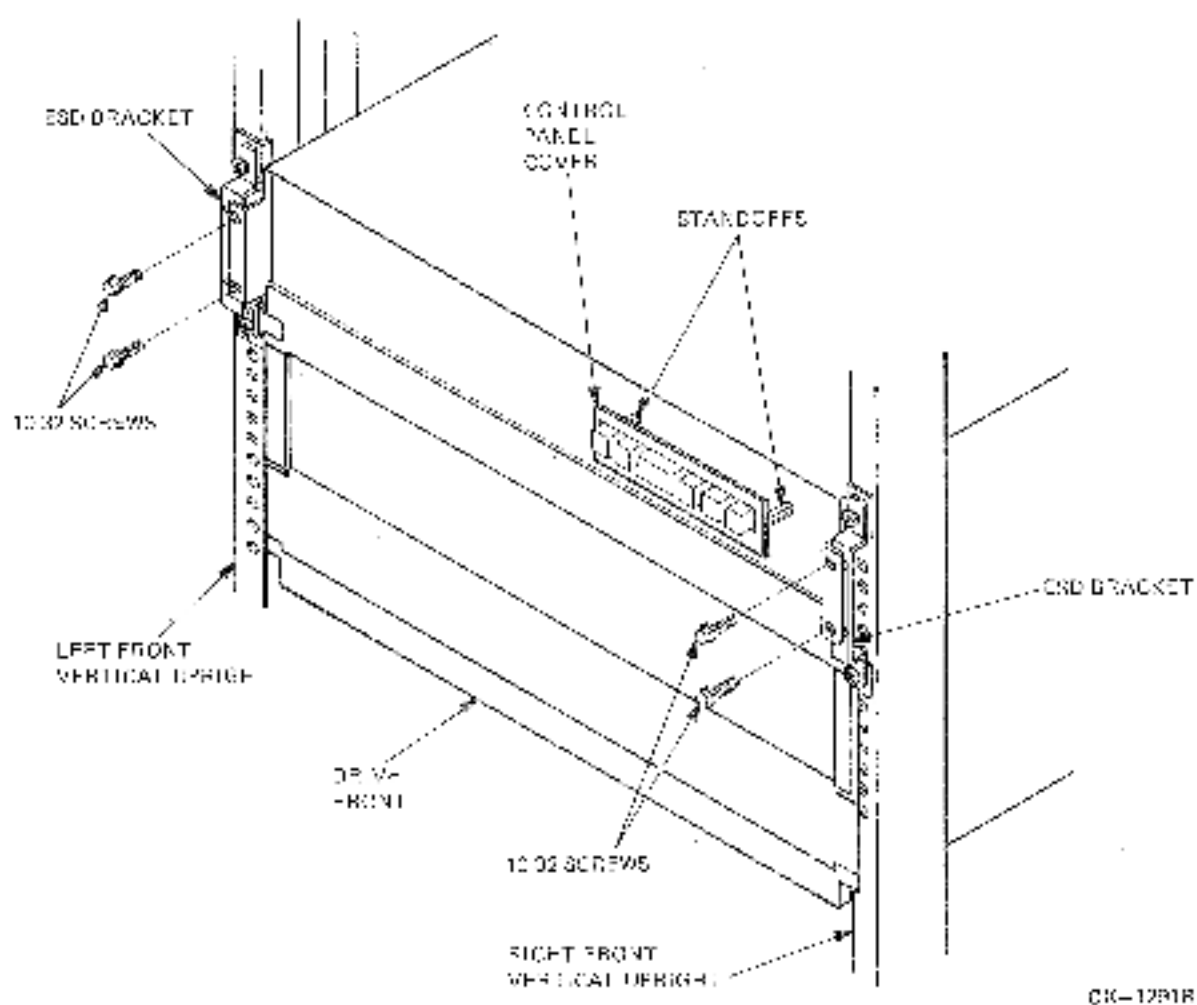


Figure 6-18 SA482 ESD Brackets

NOTE

The ESD brackets also serve as drive retainer brackets.

5. Release the slide latches and push the drive through all the way back into the cabinet. The lower holes on each ESD bracket will line up with a hole on the cabinet upright. Install a U-nut (Part Number 90-07786-00) in each of these holes. The threaded side of the U-nut goes to the inside of the upright. Refer to Table 6-3.

6. Release slide lock arm on both arms to push the drive the rest of the way into the cabinet. Refer to Figure 6-17. Attach the BSD brackets to the uprights using the 10-32 Tumb screws (Part Number 900970H-K0), one to each side. Tighten the BSD bracket screws left loose earlier. Refer to Figure 6-18.

NOTE

If the drive does not slide into the cabinet freely, loosen the front screws on the slide brackets and make the necessary adjustments before tightening them again. Also ensure the slide brackets are mounted in the proper cabinet upright holes and that there is enough vertical and horizontal play to allow the drives to move freely.

7. Retract the stabilizing foot.

6.9 MOUNTING THE I/O BULKHEAD ON THE SDI INTERFACE BRACKET

Locate the I/O bulkhead that came with the add-on disk drive (it should be attached to the end of the SDI cable). Based on drive position, each I/O bulkhead must be mounted in a designated location on the SDI interface bracket. Using the two captive screws, mount the I/O bulkhead to the SDI interface bracket at the rear base of the drive cabinet as shown in Figure 6-19.

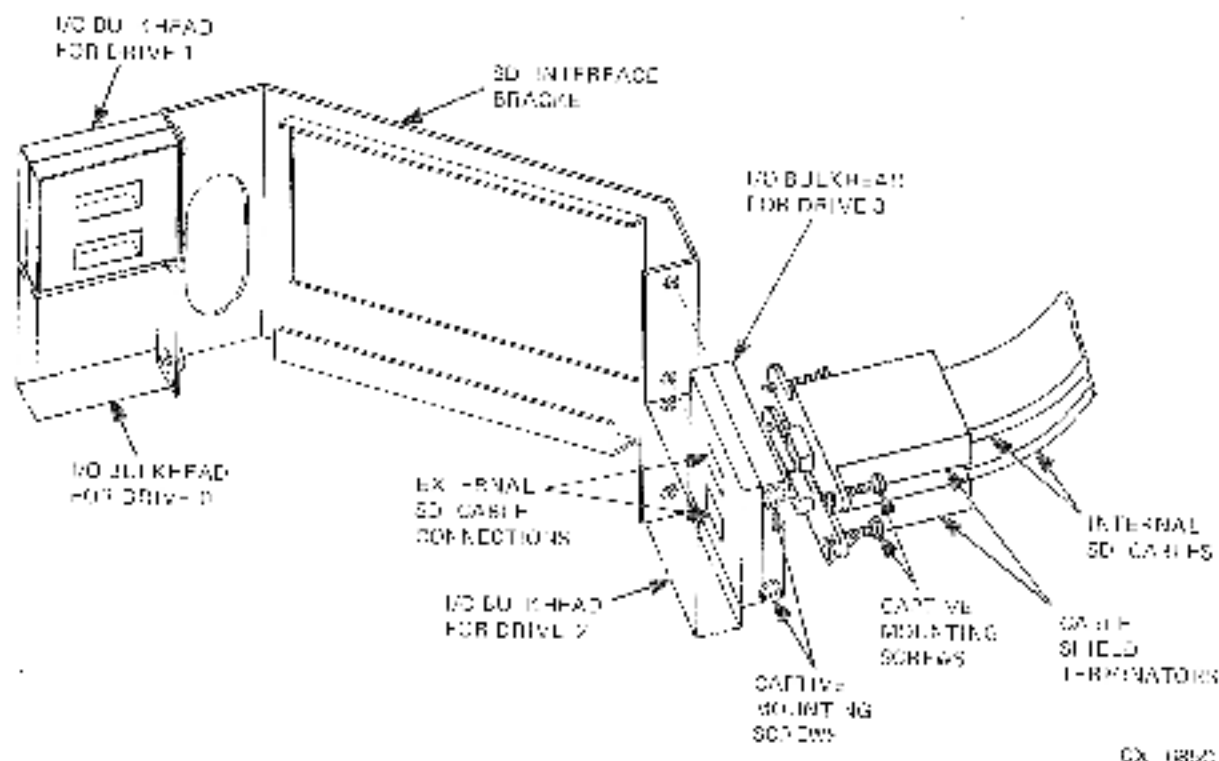


Figure 6-19 I/O Bulkhead Mounting

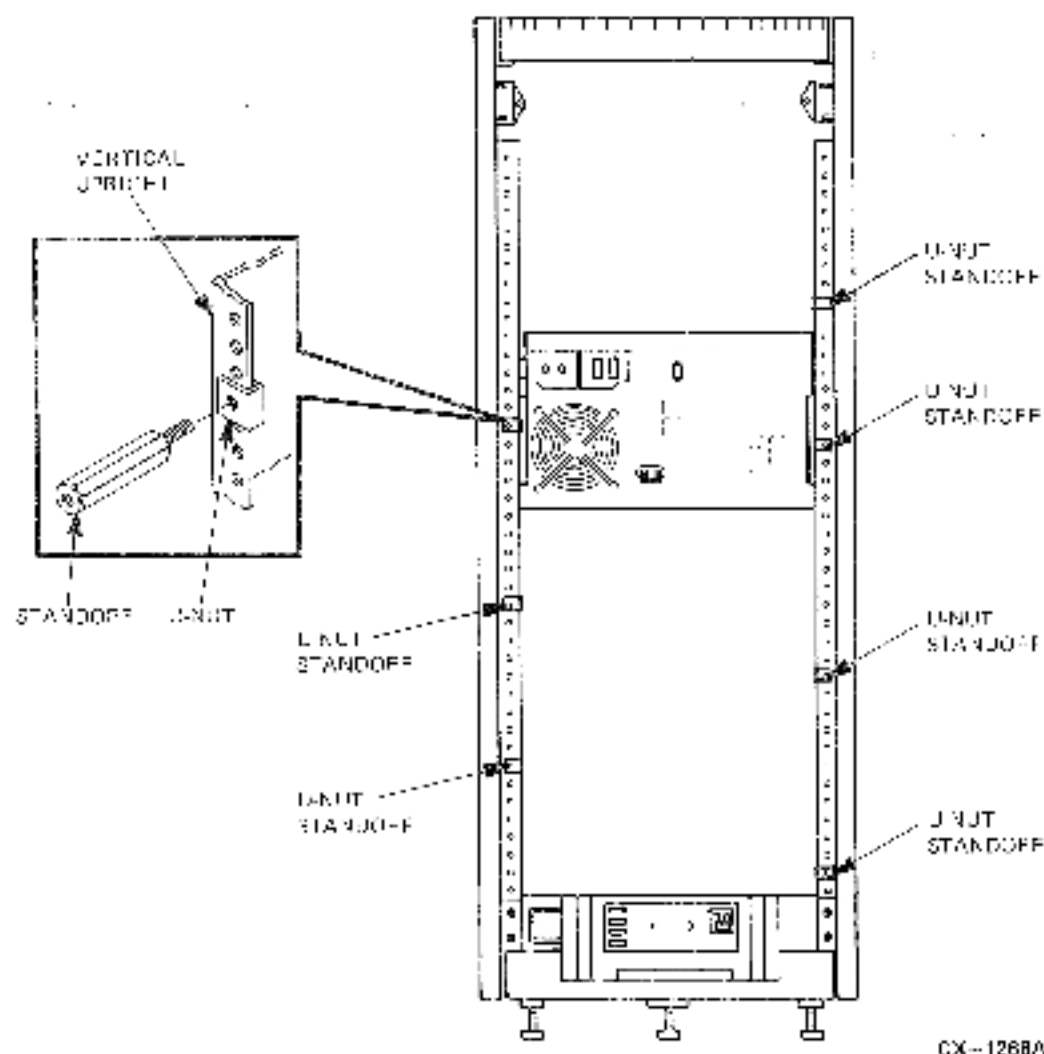
6.10 INSTALLING CABLE STANDOFF AND U-NUT

Cable standoffs and U-nuts are utilized with cable clamps in the four-high cabinet to hold the cables away from the rear vertical uprights. The number of cable standoffs to install depends upon the number of drives in the cabinet.

Use the following procedure to mount each cable standoff and U-nut. Refer to Figure 6-20.

1. Locate the plastic bags containing the cable standoffs.
2. Locate the plastic bag containing the U-nuts.
3. Slide each U-nut over the hole of the rear vertical upright designated in Table 6-3. The threaded portion of the U-nut should face the inside of the cabinet.
4. Screw the standoff into the U-nut.

The STI cables are installed next.



CX-1268A

Figure 6-20 Mounting U-Nut and Standoffs

6.11 INSTALLING SDI CABLES

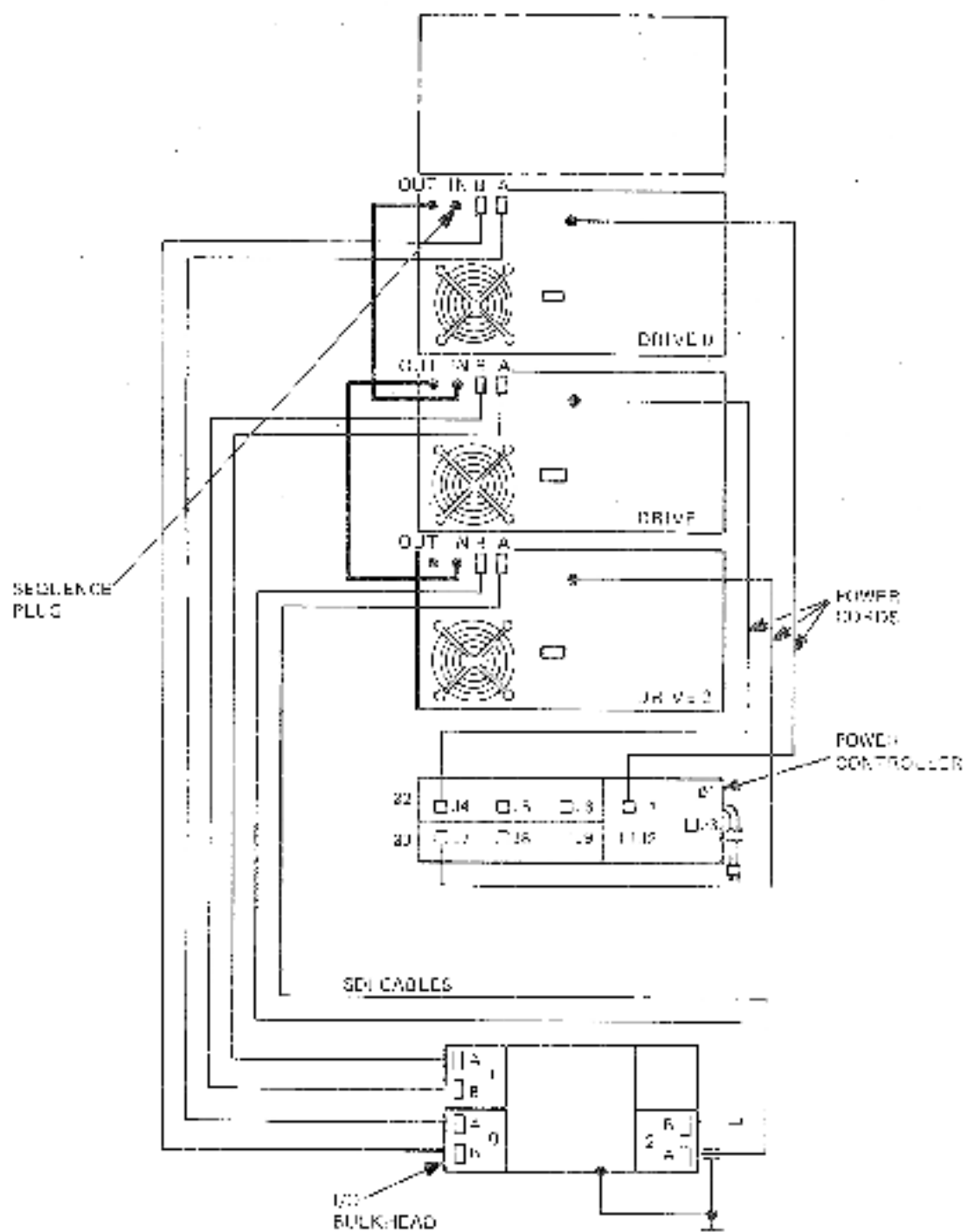
The 12-foot SDI cable shipped with all add-on drives is the internal cabinet cable that connects the drive to the I/O bulkhead. The external SDI cable attaches the drive cabinet to the disk controller in another cabinet.

When installing the SDI cables, you must choose which of the SDI cable installation procedures in the following paragraphs fits your needs. The first one describes how to install the SDI cables for the first add-on (bottom cabinet position). The second procedure describes how to install the SDI cables for the second add-on (top cabinet position).

External SDI cables from the central processing unit (CPU) or controller cabinet are connected to the *inside* of the I/O bulkhead (opposite side of the SDI interface bracket from the internal SDI cables). Refer to Figure 6-19.

6.11.1 First Add-On Drive SDI Cable

Use the following procedure to install the SDI cables for the first add-on drive. Refer to Figure 6-21. Refer to Figure 6-22 to tie-wrap and route the cables.



NOTE 1: ALL PORT A CONNECTIONS GO TO SDI CONTROLLER A. ALL PORT B CONNECTIONS GO TO SDI CONTROLLER B.
 NOTE 2: HEAVY LINE INDICATES DRIVES SEQUENCE CABLE.

CS-1055

Figure 6-21 Cable Wiring Diagram (First Add-On RA82)

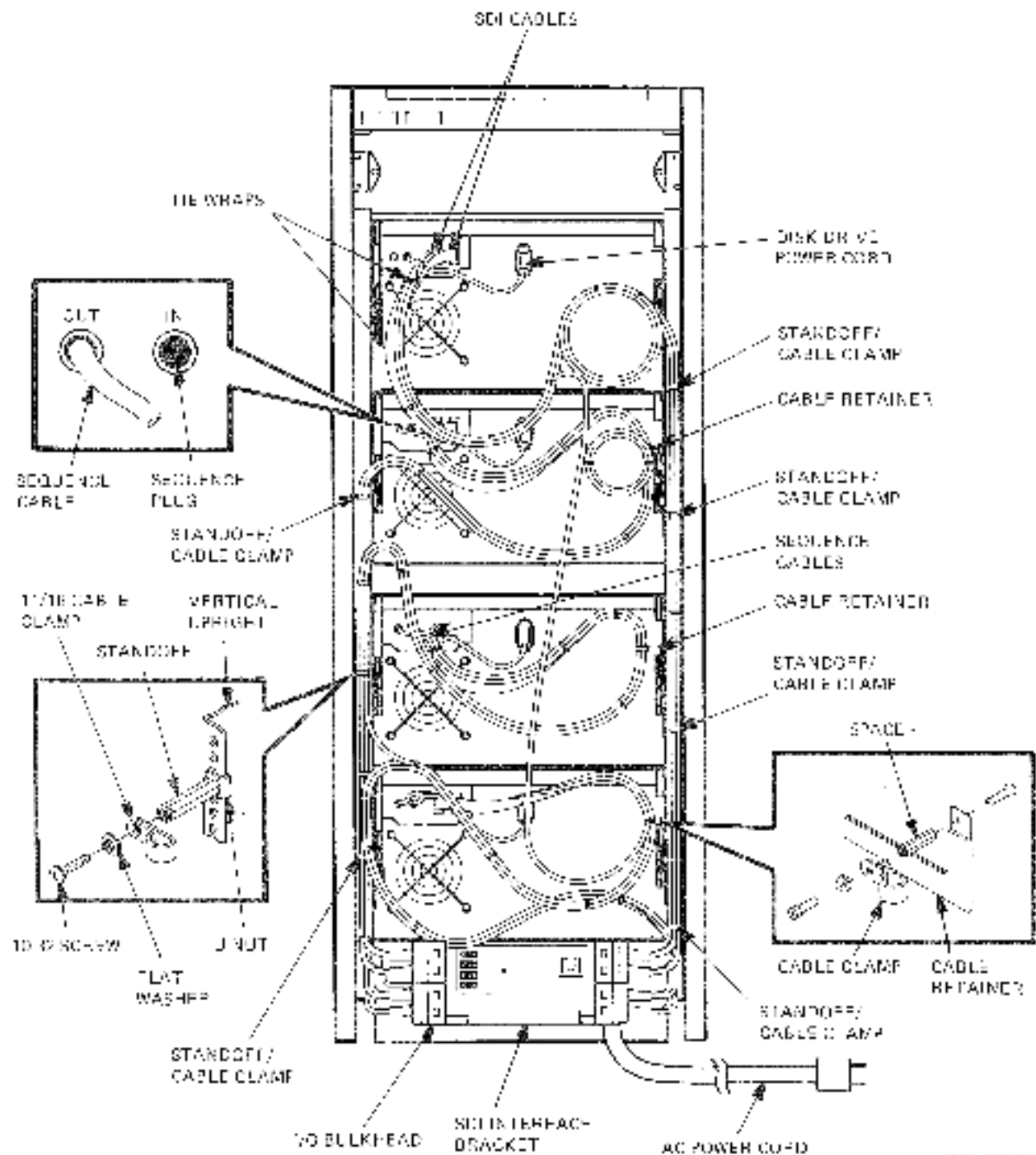
1. Install the bottom end of the SDI cable (end with I/O bulkhead) from the first add-on drive into the SDI interface bracket at the base of the cabinet. Using the two captive screws, mount the I/O bulkhead in the internal SDI cable position designated for Drive 2 (Figure 6-19). Make sure drive port cable A plugs into the A connector and the port cable B plugs into the B connector of the I/O bulkhead.

NOTE

Mount the I/O bulkheads on the left side of the SDI interface bracket by turning them 180 degrees from those on the right side. This should be apparent when the screw holes are aligned.

2. Clamp the SDI cables to the cable retainers on the end of the drive slides and the cable standoffs (Figure 6-22).
3. Starting at the I/O bulkhead, tie-wrap the SDI cables to the vertical upright. Leave enough slack in the SDI cables so the drive can slide out the front of the cabinet to its fully extended position. Use as many tie wraps as needed to dress the cables properly.
4. Extend the cabinet stabilizer foot and then pull the drive out of the cabinet to check if there is enough slack in the SDI cables. If not, adjust the cable loop size.

This completes the SDI cable installation for the first add-on drive. The sequence cables are added next.



CX-2094A

Figure 6-22 RA82 Cable Routing and Connections

6.11.2 Second Add-On Drive SDI Cable

Use the following procedure to install the SDI cables for the second add-on drive. Refer to Figure 6-23. Refer to Figure 6-22 to tie-wrap and route the cables.

1. Install the bottom end of the SDI cable (end with I/O bulkhead) from the second add-on drive into the SDI interface bracket at the base of the cabinet. Using the two captive screws, mount the I/O bulkhead in the internal SDI cable position designated for Drive 3 (Figure 6-19). Make sure the drive port cable A plugs into the A connector and the B port cable plugs into the B connector of the I/O bulkhead.

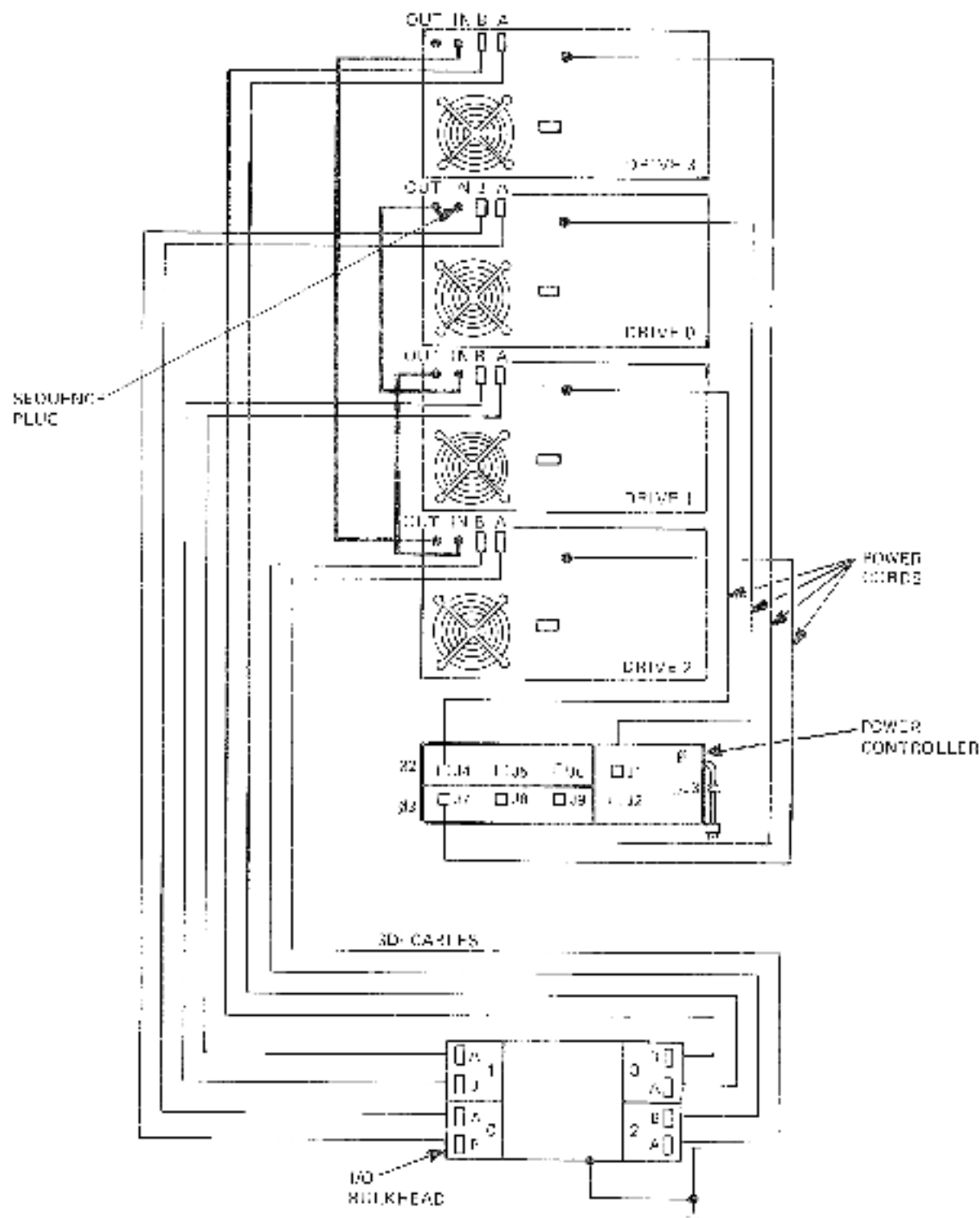
NOTE

Mount the I/O bulkheads on the left side of the SDI interface bracket by turning them 180 degrees from those on the right side. This should be apparent when the screw holes are aligned.

2. Clamp the SDI cables to the cable retainers on the end of the drive slides and the cable standoffs (Figure 6-22).
3. Starting at the I/O bulkhead, tie-wrap the SDI cables to the vertical upright. Leave enough slack in the SDI cables so the drive can slide out the front of the cabinet to its fully extended position. Use as many tie wraps as needed to dress the cables properly.
4. Extend the cabinet stabilizer foot and then pull the drive out of the cabinet to check if there is enough slack in the SDI cables. If not, adjust the cable loop size.

Figure 6-24 shows the wiring diagram for external drives.

This completes the SDI cable installation for the second add-on drive. The sequence cables are added next (Section 6.12).

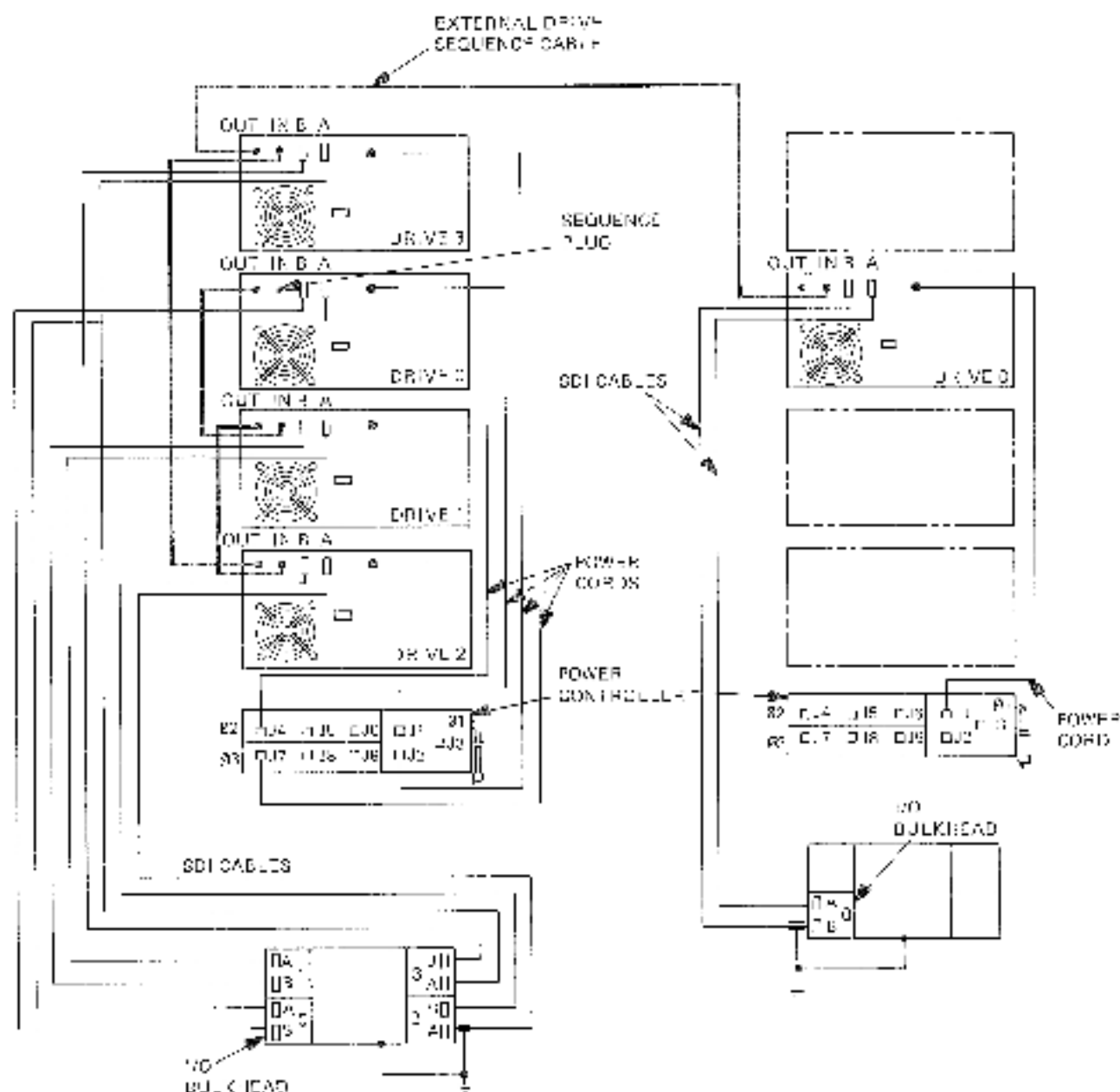


NOTE 1: ALL PORT A CONNECTIONS GO TO SDI CONTROLLER A. ALL PORT B CONNECTIONS GO TO SDI CONTROLLER B.

NOTE 2: HEAVY LINE INDICATES DRIVE SEQUENCE CABLE.

CX-1016B

Figure 6-23 Cable Wiring Diagram (Second Add-On RA82)



NOTE 1: ALL PORT A CONNECTIONS GO TO SDI CONTROLLER A. ALL PORT B CONNECTIONS GO TO SDI CONTROLLER B.
 NOTE 2: HEAVY LINE INDICATES DRIVE SEQUENCE CABLE.

CX-1017B

Figure 6-24 Cable Wiring Diagram - External Drive (Generic)

6.12 INSTALLING SEQUENCE CABLE

All RARX disk drives need drive sequence cables. Sequence cables permit only one drive to start at a time. The following drive sequence cable procedures assume only RA82s are used in the cabinet. Refer to Figure 6-22 to tie-wrap and route the cables.

CAUTION

Sequence cables **MUST** be installed. If not, disk/data corruption or damage may result during or after a system power failure.

6.12.1 First Add-On Drive Sequence Cable

Use the following procedure and Figure 6-21 to install the sequence cables onto the first RA82 add-on drive (Drive 2). This procedure assumes the drives already mounted are RA82 drives.

1. Install a sequence cable between the IN connector on the back of first add-on drive (Drive 2) and connect it to the OUT connector on Drive 1.
2. Tie wrap the sequence cables to the SDI cables, leaving enough slack in the cables so the drive can slide out the front of the cabinet.
3. Extend the cabinet stabilizer foot, then pull the add-on drive out of the cabinet to check if you left enough slack in the sequence cables.
4. Use as many tie wraps as needed to dress the cables properly.
5. Be sure cables are not pinched when drive is moved in and out.

6.12.2 Second Add-On Drive Sequence Cable

Use the following procedure and Figure 6-23 to install the sequence cables onto the second RA82 add-on drive (Drive 3). This procedure assumes the drives already mounted are RA82 drives.

1. Install a sequence cable from the IN connector on the second add-on drive (Drive 3) to the OUT connector on the first add-on drive (Drive 2).
2. Tie wrap the sequence cables to the SDI cables, leaving enough slack in the cables so the drive can slide out the front of the cabinet.
3. Extend the cabinet stabilizer foot and then pull the add-on drive out of the cabinet to check if you left enough slack in the sequence cables.
4. Use as many tie wraps as needed to dress the cables properly.
5. Be sure cables are not pinched when drive is moved in and out.

6.13 INSTALLING SEQUENCE TERMINATOR PLUG

Check to see if there is a drive sequence terminator plug at the IN connector of Drive 0. If it is not, use the terminator plug (Part Number 70-19692-01) that comes in the add-on RA8X drive hardware kit. Refer to the insert on Figure 6-22.

6.14 INSTALLING DISK DRIVE POWER CORD

The installation of the disk drive power cord varies depending on whether you are installing the first or second add-on drive. In general, however, power cords are routed with the SDI cables. This is shown in the fully-loaded cabinet configuration of Figure 6-22.

Route and plug the disk drive power cords from each drive into the receptacles designated in Figure 6-25. The disk drive power requirements must be equally distributed between the three phases of the power controller (see Section 6.15). Secure the power cords over the base of the cabinet with cable mounts and tie wraps as shown.

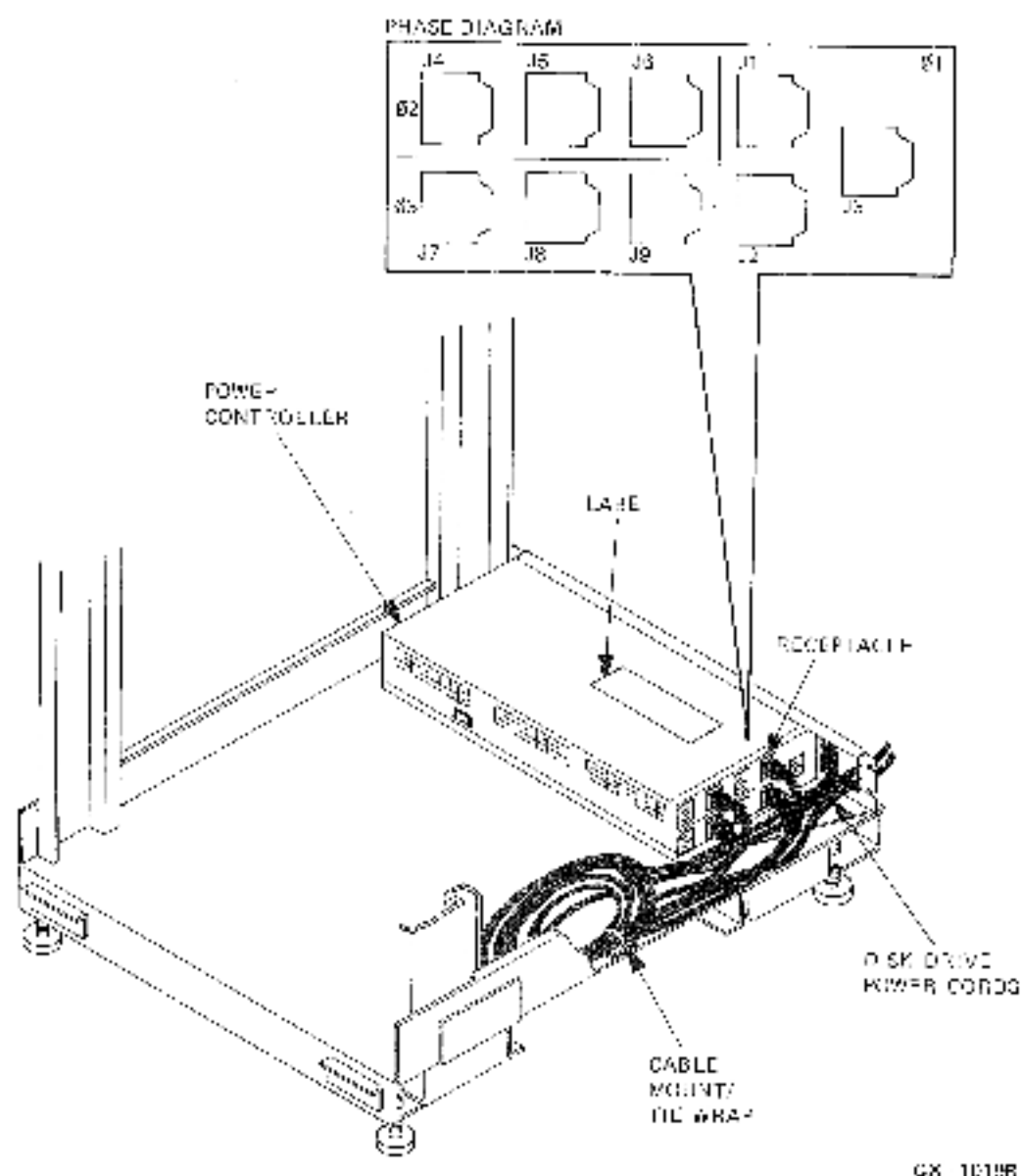


Figure 6-25 Routing the Power Cords on Cabinet Floor (Four-High)

6.14.1 Closing the Cabinet

After installing the add-on drive(s) and connecting all cables and power cords, turn the circuit breaker for the cabinet to the ON position. Next turn the power ON to the drives.

Replace the rear bustle door (Figure 6-1).

Replace the front panel assembly (Figure 6-2).

Refer to Chapter 2 of this manual and spin up the drives.

6.15 POWER CONTROLLERS

The 881 power controller was developed for the B9646-AH/AJ series cabinets. It is a general-purpose, three-phase power controller that controls and distributes ac power to various ac devices packaged in an operating system. In addition, both versions (A and B) are fully filtered, contain nine outlets, and are packaged in a 3.4-inch enclosure. For detailed information and instructions on how to operate the 881 power controller, refer to the *881 Power Controller User Guide* included with this cabinet.

CAUTION

The nine outlets on the 881 power controller are divided into three outlets per phase. To prevent load imbalance, distribute power to the drives equally between all three phases of the power controller. Refer to the appropriate cable wiring diagram in this chapter for proper power controller connections.

6.16 HDA REMOVAL

Use the following procedure to remove the head disk assembly (HDA) from the RA82 disk drive.

CAUTION

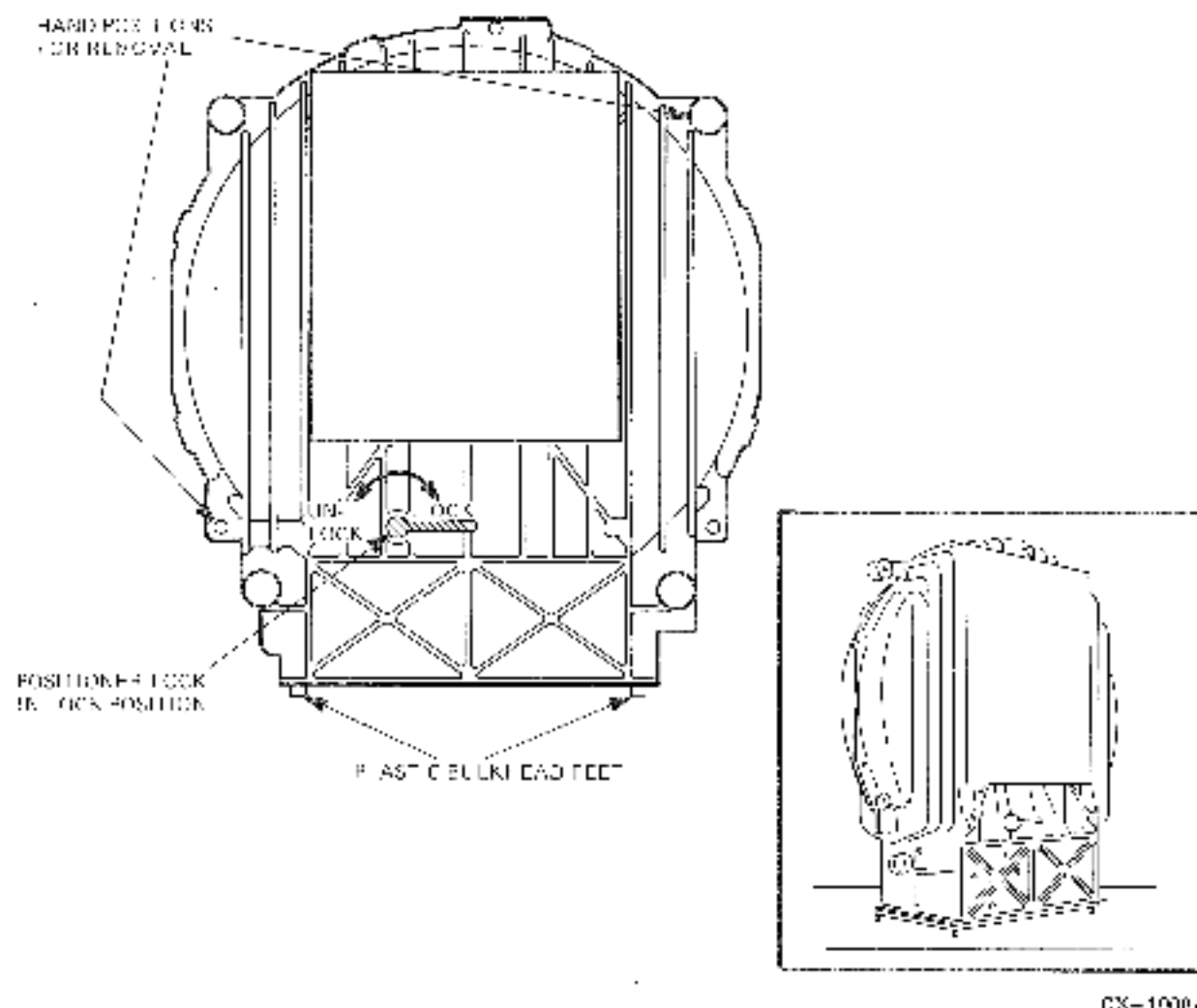
For drive protection, use a grounding (electrostatic discharge) wrist strap during the following procedures (Figure 6-5).

Procedures for access, removal, and replacement of the RA82 HDA are different from those of the RA80 or RA81. Refer to the appropriate user guide for the drive you are working with.

1. Unlock the upper chassis assembly by turning the two cam latches under the front bezel 180 degrees counterclockwise with a 3/16-inch allen hex wrench (Figure 6-6).
2. Raise the upper chassis assembly until the damper (gas spring) lock slides in place and supports the upper chassis assembly (Figure 6-7).
3. Unplug connector P502 from the read/write module (Figure 6-9).
4. Unplug connectors P602 and P603 from the HDA preamplifier module (Figure 6-9).
5. Place the cable spring assembly in the RELEASED position (Figure 6-10).
6. Remove the four HDA retaining nuts and washers (Figure 6-9).
7. Place the positioner lock in the LOCK position (Figure 6-26). The lever must be lifted slightly to clear the surface of the read/write module.

CAUTION

The HDA could be damaged if the positioner is not locked.



CX-1008A

Figure 6-26 HDA Positioner Lock

8. Remove the HDA from the drive by lifting it from diagonally opposite corners (Figure 6-26). The HDA weighs approximately 35 pounds.
9. 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 (Figure 6-26).

CAUTION

DO NOT place the HDA in a horizontal position (on the pulley) or the speed and temperature transducers mounted on the bottom of the HDA could be damaged.

If the HDA is to be moved or packed for shipment, use an HDA spindle pulley lock (DIGITAL Order Number 74-31467-01) to lock the spindle pulley in place. Any movement of the spindle could damage the heads.

10. Gently lift up on the upper chassis assembly to take the weight off of the gas spring. Unlock the gas spring by pulling the locking knob out while still supporting the weight of the upper chassis assembly. Refer to Figure 6-7.

11. Slowly lower the upper chassis assembly until resistance from the gas spring is felt. When resistance is sufficient to ensure the gas spring will allow the logic to close slowly, release your hold on the upper chassis assembly. Lock in place by turning the two cam latches under the front bezel 180 degrees clockwise with a 5/16-inch allen hex wrench. Refer to Figure 6-6.

CAUTION

***DO NOT** permit the upper chassis to free fall and **DO NOT** force the upper chassis assembly against the gas spring pressure.*

Do not pinch cables when lowering the upper chassis assembly. Check cable locations and reroute cables, if necessary, before lowering.

You may now return to Section 6.5 to continue with the add-on procedure.

6.17 HDA REPLACEMENT (RA82)

If you removed the HDA before installing the add-on drive onto the slides, use the following procedure to replace the HDA. Refer to the appropriate disk drive user guide if the drive is an RA80 or RA81.

CAUTION

For drive protection, use a grounding (electrostatic discharge) wrist strap during the following procedures (Figure 6-5).

1. Check that the cable spring assembly is in the RELEASED position (towards the rear). Refer to Figure 6-10.
2. Position the motor/brake assembly towards front of drive (swing slightly out on pivot rod) to take tension off drive belt.
3. Center the drive belt on the belt ramp bracket on the lower chassis as illustrated in Figure 6-27.

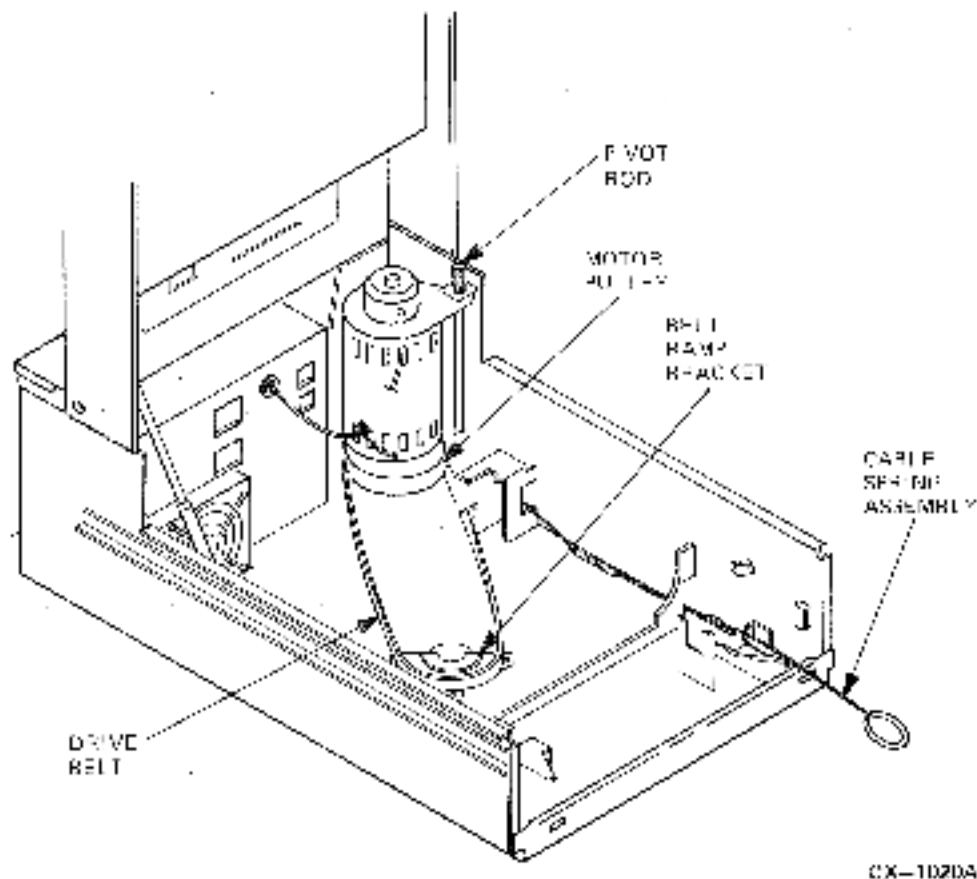


Figure 5-27 Belt Alignment

CAUTION

Damage to the HDA or drive belt may result if the drive belt is not aligned correctly.

4. Lift the HDA by grasping it from diagonally opposite corners (Figure 6-26). The HDA weighs approximately 35 pounds.
5. Lower the HDA over the four mounting bolts (Figure 6-9).
6. Replace the four nuts and washers holding the HDA to its mounting bolts, and firmly tighten the four nuts to the mounting bolts with a 7/16 inch nut driver (Figure 6-9).
7. Connect P502 from the read/write module (Figure 6-9).
8. Connect P602 and P603 from the HDA preamplifier module (Figure 6-9).
9. Place the positioner lock in the **UNLOCK** position (Figure 6-26). The lever must be lifted slightly to clear the surface of the read/write module.
10. Place the cable spring assembly in the **ENGAGED** position (Figure 6-10).

11. Position read/write cable between ribs on HDA housing to assure that cable does not get pinched when cover is closed (Figure 6-9).
12. Gently lift up on the upper chassis assembly to take the weight off the gas spring. Unlock the gas spring by pulling the locking knob out while still supporting the weight of the upper chassis assembly (Figure 6-7).
13. Slowly lower the upper chassis assembly until resistance from the gas spring is felt. When resistance is sufficient to ensure the gas spring will allow the logic to close slowly, release your hold on the upper chassis assembly. Lock in place by turning the two cam latches under the front bezel 180 degrees clockwise with a 5/16-inch allen hex wrench. Refer to Figure 6-6.

CAUTION

DO NOT permit the upper chassis to *free fall* and ***DO NOT*** force the upper chassis assembly against the gas spring pressure.

6.18 CHECKING OUT THE DRIVE

After installing the add-on drive, check out the drive using the procedure described in Chapter 3.

RA82 ERROR CODES

Table A-1 RA82 LED Error Codes

LED Error Code	Error Name
01	Spin-up error, spindle motor transducer timeout
02	Spin-up error, 0-1000 r/min too slow
03	Spin-up error, spindle not accelerating
04	Spin-up error, too long to get up to speed
05	Spin up is inhibited, GRANT not present or SIP present
06	Microcode fault
07	Level-2 SDI command frame sequence error
08	Level-2 SDI command checksum error
09	SDI-command framing error
0A	SDI-command opcode parity error
0B	Invalid level-2 SDI command opcode
0C	Invalid level-2 SDI command length
0D	Attempt command while drive status error byte is nonzero
0E	Invalid group select error
0F	SDI write enable command while drive is hardware write protected
10	Slave sent invalid error code
11	Transfer command while no R/W ready
12	Transfer command while "drive error"
13	Failed to achieve fine track after seek

Table A-1 (Cont.) RA82 LED Error Codes

LED Error Code	Error Name
14	Format attempted while format disabled
15	Illegal attempt to change 512/576 byte mode
17	Unable to find first track after guard band
18	AGC calibration timeout error
19	Seek or recalibration error during adaptive bias compensation
1A	Seek command contained an invalid cylinder address
1B	AGC calibration out of range
1C	Unit select number changed while on-line
1D	Controller timeout
1E	R/W sector overrun error
23	Spindle motor interlock error
24	Descent on wrong track after seek
25	Servo fault
26	Spindle speed less than 3420 r/min (3600 less 5 percent)
27	HDA temperature is too high
28	Servo temperature is too high
29	Invalid start recovery level specified
2A	Invalid subunit number specified
2B	Invalid test number specified in diagnose command
2C	Seek or recalibrate command received while spindle not ready
2E	Controller flags prohibit manual spin up
2F	Run command received while RUN/STOP switch in stop position
30	Write current and no write gate
31	Read gate and write gate
32	Read or write while drive faulted
33	Write and burst error
35	Write and write unsafe

Table A-1 (Cont.) RA62 LED Error Codes

LED Error Code	Error Name
36	R/W head short
37	Write gate and no write current
38	Read and multi-chip select error
39	Write and off track
3A	Write and write protect
3B	R/W-HDA-servo-hybrid interlock error
3C	Hybrid-servo interlock error
3D	Hybrid read/write interlock error
3E	Hybrid-OCP interlock error
40	Invalid R/W memory region specified
41	Response timeout error
42	Seek command received when drive not online
43	Level-1 SDF command while no R/W ready
46	R/W safety interrupt with no "cause" bits set
47	Incorrect TT bit during disconnect command
48	Invalid write memory offset or byte count
49	invalid command during topology mode
4A	Drive disabled by LD bit
4B	Index pulse error
4D	Write and bad embedded
4E	Write or format command received while drive write-protected
4F	SDF transmission/transfer error
50	Slave diagnostic timeout
51	Sector/byte counter "count" error
54	Head select register test error
57	Faulty hybrid dimer
58	Missing index or sector pulse fault

Table A-1 (Cont.) RA82 LED Error Codes

LED Error Code	Error Name
60	R/W test, head select error
61	R/W test, data setup error
62	Read test, overall failure
63	Read test, partial failure
65	R/W test, sector sync timeout error
66	Read and off track
67	Write test not executable
69	R/W test, faulty data detect error
67	Diagnostic write attempt while write-protected
7B	Internal test cannot run while spindle is spinning
80	Hybrid ROM consistency fault
81	SDI wrap test, command available did not reset
83	SDI wrap test, INIT-out received error
84	SDI wrap test, INIT failed to clear
85	Hybrid-RAM test failure on RAM 0
87	Hybrid ROM 0 checksum error
8A	SDI wrap test, bit stuck in SDI error register
8C	SDI wrap test, SDI transfer error
8F	Hybrid ROM 1 checksum error
94	SDI wrap test, command available timeout
95	SDI wrap test, frame code receive error
96	SDI wrap test, data byte receive error
97	Hybrid ROM 2 checksum error
9E	Hybrid ROMs in wrong sockets
A0	R/W safety port stuck bit fault
A2	Failed to fault during forced multi-chip select while reading
A3	Failed to fault during forced simultaneous read gate and write gate

Table A-1 (Cont.) RA82 LED Error Codes

LED Error Code	Error Name
A4	Failed to fault during forced write current and no write gate
A5	Failed to fault during forced write gate and no write current
A9	Servo fault during R/W forced fault test
AA	Test completed ok
B0	Test does not run due to a drive fault
B3	Hybrid microprocessor has test error
B6	USART transmit/receive error
B8	No stream test write clock
B9	No stream ECL read clock
BA	No stream buffered servo clock
BB	No stream ECL write data
BC	No stream extended write data
BD	No stream recorded read data
BE	No stream ECL read data
BF	Stream flip-flop reset error
C0	Fine track timer error
C1	Fine track status not true error
C2	Fine track status not false error
C3	Fine track over range error
C4	Fine track under range error
C5	Wrong fine track channel detected
C6	PLO error
C8	ADC/DAC reference voltage out of range
C9	ADC/DAC bit error
CA	ADC/DODAC bit error
CC	Difference counter load error
CD	Difference counter "count" error or incorrect gray code bits

Table A-1 (Cont.) RA92 LED Error Codes

LED Error Code	Error Name
CF	Servo faulty timer error
D0	Head load attempt failed
D1	Outer guard band status error after load
D2	Inner guard band status error after load
D3	Seek into outer guard band failed
D4	Outer guard band false after outer guard band seek
D5	Load from outer guard band failed
D6	Spindle not up to speed
D7	Seek into inner guard band failed
D8	Inner guard band false after inner guard band seek
D9	Load from inner guard band failed
DA	Spindle not spinning
DB	Diagnostic seek failed
DC	F.E. diagnostic set up error
DD	Recalibration error
DE	Low velocity seek error
E0	Random seek error
E2	Slave ROM consistency error
E3	Slave ROM 0 checksum error
E4	Slave ROM 1 checksum error
E5	Slave ROM 2 checksum error
E6	Slave ROM 3 checksum error
E7	A diagnostic test is executing
E8	RAM test error on servo RAM 0
E9	RAM test error on servo RAM 1
FE	Non-existent test number specified
F1	Slave load timeout

Table A-1 (Cont.) RA82 LED Error Codes

LED Error Code	Error Name
F2	Slave sent unexpected message
F3	Slave received command packet with checksum error
F4	Slave opcode parity error
F5	Slave received invalid opcode
F6	Master detected checksum error from slave
F7	Slave recalibration timeout
F8	Slave seek timeout
F9	Slave offset timeout
FA	Slave spin-up timeout
FB	Slave spin-down timeout
FC	Slave send status timeout
FD	Slave speed check timeout
FE	Slave disable embedded servo timeout

B

STATIC CONTROL MATERIALS

Table B-1 Static Control Materials Part Number List

Part Number	Description
29-25435-00	ESD demonstration kit 110V
29-25433-00	ESD demonstration kit 220V
29-11762-00	Velostat TS grounding kit (complete) includes:
29-25492-00	10 foot coil cord (for wrist strap)
29-25493-00	Velostat PS work surface
29-25494-00	Insulated alligator clip
29-25496-00	Wrist strap, small
29-25497-00	Wrist strap, medium
29-25498-00	Wrist strap, large
99-07092-01	Static shielding bag, 4 inches x 6 inches I.D.
99-07092-02	Static shielding bag, 6 inches x 8 inches I.D.
99-07092-03	Static shielding bag, 8 inches x 12 inches I.D.*
99-07092-04	Static shielding bag, 10 inches x 14 inches I.D.
99-07092-05	Static shielding bag, 12 inches x 18 inches I.D.
99-07092-06	Static shielding bag, 14 inches x 18 inches I.D.**
99-07092-07	Static shielding bag, 18 inches x 24 inches I.D.
99-07092-08	Static shielding bag, 15 inches x 20 inches I.D.

* Minimum size shielding bag required for read/write module or operator control panel (OCP) module.

** Minimum size shielding bag required for RA82 hybrid module or servo module.

A

- AC plug configurations, 3-2
- Air filter
 - cleaning, 2-13
 - part number, 2-14
 - removal, 2-12
 - replacement, 2-14

B

- Backup of data, 1-2

C

- Cable retainer, 5-9, 6-16
- Circuit breaker
 - disk drive, 2-11
 - power controller, 2-7
- Customer care, 2-12

D

- Data backup, 1-2
- Diagnostic checkout, 3-20
- Diagnostics
 - internal (drive-resident), 1-8
- Diagnostic terminal, 3-21
- Diagnostic terminal connector, 3-25
- Disk drive subsystem, 1-8
- Documentation
 - related, how to order, 1-18
- Drive cabinets, 1-3
- Drive description, 1-2
- Drive operation
 - drive power removal, 2-11
 - spin-down, 2-11
 - spin-up, 2-11
- Drive operation checkout, 3-22
- Drive power-up, 2-21
- Drive unit address plug, 3-20
- DSEA, 1-1
- Dual-port, 1-8

E

- Electrical plug configurations, 3-2
- Electrostatic discharge (ESD), 1-15

- Equipment unpacking (40-inch cabinet), 4-1
- Error codes
 - hybrid test, 2-3
- ESD protection, 1-16

F

- Fault codes
 - front panel, 2-3
- Fault indicator, 2-3
- Fault switch, 2-3
- Files
 - duplication of, 1-2
 - reconstruction of, 1-2
- Four-high cabinet
 - actuator assembly, 3-6
 - cabinet interlock, 3-6
 - cable standoff installation, 5-23, 6-28
 - drive mounting, 5-18, 6-23
 - electrostatic discharge brackets, 5-36
 - extending drive slides, 3-7
 - external SDA cables, 5-19
 - front panel removal, 5-1
 - I/O bulkhead mounting, 5-23, 6-27
 - interlock reset actuator, 5-18
 - power controller, 5-33, 6-39
 - power cord installation, 5-33, 6-38
 - rear door removal, 3-4
 - retracting drive slides, 3-7
 - sdh cable installation, 5-24
 - SDI cable installation, 6-29
 - SDI interface bracket, 5-23, 6-27
 - sequence cable installation, 5-29, 6-36
 - slide installation, 5-13, 6-18
 - stabilizer foot extension, 3-4
 - terminator plug installation, 5-32, 6-37
- Front panel lamp test, 2-3

G

- General drive information, 1-1

H

- HDA, 1-3
- HDA removal, 5-6, 6-39
- HDA replacement, 5-23, 6-41
- HDA shipping bracket removal, 3-9

2 Index

Head disk assembly, 1-3

I

Indicator lights, 2-1

Installation

environmental considerations, 3-1

floor loading, 3-2

heat dissipation, 3-2

site preparation, 3-1

Internal drive diagnostics, 1-8

Internal shipping bracket removal, 3-9

J

Journaling (as method of file reconstruction), 1-2

L

LED error codes, 2-3

Leveler feet adjustment, 3-2

O

Operator control panel, 2-1

P

Pull select switches, 2-6

R

Ready plug and indicator, 2-5

Rear power controls, 2-7

RUN/STOP indicator, 2-2

RUN/STOP switch, 2-2

S

SA482 cabinet

electrostatic discharge brackets, 6-25

SDI, 1-1

SDI cables

description, 3-16

Sequence cables (description), 3-19

Slide installation (preparation), 5-9, 6-16

Specifications, 1-9

Static protection, 1-16

Subsystem, 1-8

T

Thermal stabilization, 3-1

Three-high cabinet

cable retainer, 4-15

cable standoff installation, 4-26

drive mounting, 4-20

electrostatic discharge brackets, 4-4

external SDI cables, 4-6

Three-high cabinet (cont'd.)

front panel removal, 4-15

I/O bulkhead connectors, 4-6, 4-26

opening the rear door, 4-5

power cord installation, 4-12, 4-33

removing a drive, 4-34

removing the rear door, 4-5

SDI cable installation, 4-26

sequence cable installation, 4-12, 4-30

sequence cable removal, 4-35

sequence terminator plug, 4-33

slide installation, 4-12, 4-18, 4-20

stabilizer foot extension, 4-15

U

Unit address plug, 2-5

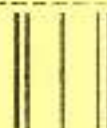
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WRITE PROTECT indicator, 2-5

WRITE PROTECT switch, 2-5

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