

Medium Optical Disk Library

Service Manual

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Preface

This manual assumes you are familiar with computer terms. It is divided into six chapters and three appendixes and is organized to allow you to quickly find the information that you need.

Here's what you'll find in this manual:

- Chapter 1 provides an introduction that lists the features and components, product configurations, and the characteristics of the drive mechanism and the disks for the RW510/RW511/RW530 Optical Library.
- Chapter 2 provides environmental, installation and preventive maintenance information on the RW510/RW511/RW530 Optical library.
- Chapter 3 provides configuration and operating information on the RW510/RW511/RW530 Optical Library.
- Chapter 4 provides troubleshooting and diagnostics information on the RW510/RW511/RW530 Optical Library.
- Chapter 5 provides removal and replacement procedures for the field-replaceable assemblies in the RW510/RW511/RW530 Optical Library.
- Chapter 6 provides theory of operation information on the RW510/RW511/RW530 Optical Library.
- Appendix A provides a VAX system error report sample, SCSI-2 Reference, and offline diagnostic information.
- Appendix B provides a list of basic supplies and reorderable parts.

Conventions Used in This Guide

Table 1 Conventions Used in This Guide

Convention	Use
<i>Italics</i>	<i>Italic text</i> is used for titles of manuals and other publications.
Monospace type	Anything that is displayed on the control panel of the Optical Library is set in monospace type like this.
Boldface type	Anything that you are asked to type is set in boldface type like this.
Keys	Keys indicate the key to press on the control panel of the Optical Library.
Note	A note calls attention to information which is helpful in understanding the operation of the product.
CAUTION	Caution notes provide information that protects your Optical Library from being damaged.
WARNING	Warning notes provide information that protects you from being harmed.

Introduction

1.1 The RW510/RW511/RW530 Optical Disk Library Overview

The RW510/RW511/RW530 are optical disk libraries that contain two multifunction optical drives. The RW510 and the RW530 are the deskside versions. The RW511 is the horizontal rackmount version. Both the RW510/511 have storage slots for 32, 5.25-inch optical disks for a total storage capacity of 20.8 Gbytes. The RW530 also has 32 storage slots, but a storage capacity of 41.6 Gbytes. Rewritable and write-once optical disks can be used, and they must be 512 bytes per sector format.

The main difference between the the RW510 and the RW530 library versions is their storage capacity. The RW530 has approximately twice the storage capacity of the RW510/511. This added capacity is due to a difference in the optical drives contained in the libraries. The RW530 contains a 1.3 Gbyte drive, an enhanced version of the 650 Mbyte drive that is used in the RW510/511 version libraries. The 1.3 Gbyte drive supports the use of 1.2 Gbyte disks as well as the 594 Mbyte disks that are supported for use with 650 Mbyte drives. Other than the added support of 1.2 Gbyte disks, the RW530 libraries are mechanically, electrically, and operationally the same as the RW510/511 libraries, and both versions support the SCSI-2 command set.

1.2 Product Features

The RW510/RW511/RW530 Optical Disk Libraries, regardless of their capacity, have the following features and meet the following specifications:

- direct online access to data
- high reliability and data security when using Digital-supplied rewritable and write-once 5.25-inch optical disks
- multifunction capability (write-once and rewritable technologies)

- Digital 594-Mbyte rewritable optical disks are Continuous Composite (CC) format, conform to ISO/IEC 10089A; ANSI X3.212-199x and 1.2 Gbyte optical disks meet ECMA 184 standard for CC format. Digital 594-Mbyte write-once disks are Continuous Composite Write-Once format (CCW) and conform to ISO/IEC DIS 11560; ANSI X3.220-199x and 1.2 Gbyte optical disks meet ECMA 184 standard for CCW format.
- data security through the ability to "lock" the autochanger (prevent disk removal)
- high autochanger reliability through a design that eliminates the motors, cables, and sensors from the delivery mechanism
- either single-ended asynchronous SCSI-2 or differential asynchronous SCSI-2 bus interface to the host
- autochanger reliability of 1,200,000 MSBF (Mean Swaps Between Failure)
- a seven-second average disk exchange time (excluding the drive load/unload sequence)
- modular replacement of all major assemblies
- full read and write data caching to optimize system performance

1.3 Product Configurations

The RW510/RW511/RW530 Optical Disk Libraries have the following product configurations:

- An autochanger mechanism that moves disks within the cabinet
- 2, 5.25-inch multifunction optical disk drives
- 1 mailslot used to insert and remove disks
- 32 Storage slots for optical disks
- 20.8 Gbytes maximum total storage capacity when all slots are full (based on 512 bytes/sector formatted disks) in a jukebox with 650 Mbyte multifunction drives or 41.6 Gbytes in a jukebox with 1.3 Gbyte drives.
- A SCSI Interface (may be either single-ended or differential)

Note

Each magazine has eight storage slots providing space for 16 optical cartridges. Each slot holds one 594-Mbyte cartridge formatted, 297 Mbytes/side or one 1.2-Gbyte cartridge formatted, 600 Mbytes/side).

The RW510/RW511/RW530 is available in either a desk side orientation or a horizontal rackmountable orientation. In addition, the disk library may have either a single-ended or a differential SCSI interface. Explanations of the different product configurations are given below. Refer to Table 1–2 for related product option numbers.

1.3.1 Deskside Configuration (RW510/RW530)

The deskside configuration is one autochanger contained in its own cabinet. This cabinet must be removed when servicing the optical library. The control panel display assembly and the front panel assembly accommodate the width of the deskside autochanger.

1.3.2 The Horizontal Rackmount Configuration (RW511)

The horizontal rackmount configuration enables up to two optical disk libraries to be mounted in a standard 1-meter (19-inch) cabinet. The control panel display assembly and the front panel assembly accommodate the length of the rackmountable autochanger. The Deskside and Rackmount Optical Disk Library Components are listed in Table 1–1.

Table 1–1 RW510/RW511/RW530 Deskside and Rackmount Optical Disk Library Components

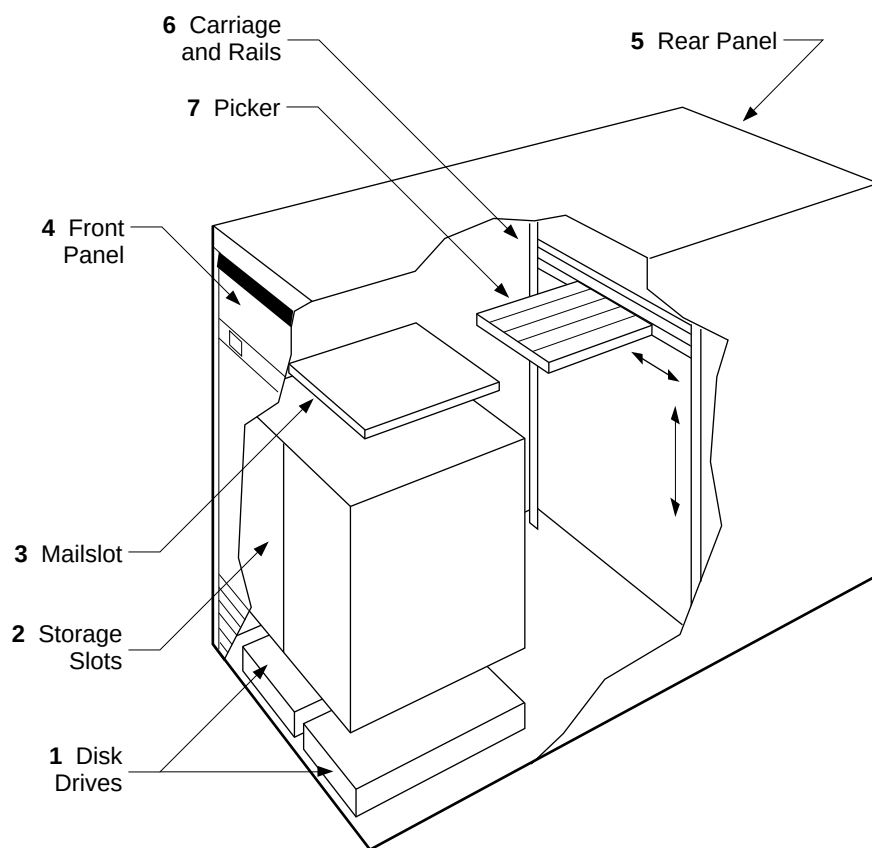
Item	Component	Description
1	Disk Drives	The disk library contains two optical disk drives for read/write data transfer. Each drive requires a unique SCSI address. When you face the front panel of the deskside version, drive 1 is located on the right side and drive 2 is on the left. When you face the front panel of the rackmount version, drive 1 is located on the top and drive 2 is on the bottom. (Figure 1–1 and Figure 1–2)
2	Magazines	The disk library contains four magazines. Each magazine has eight storage slots for a total of 32 optical disk storage slots.
3	Mailslot	The mailslot is used to insert and remove optical disks from the disk library system.
4	Front Panel	The front panel includes a control panel used to manage and display autochanger functions, and a mailslot to insert and remove disks. Control panel features are described in Section 3.1.

(continued on next page)

Table 1–1 (Cont.) RW510/RW511/RW530 Deskside and Rackmount Optical Disk Library Components

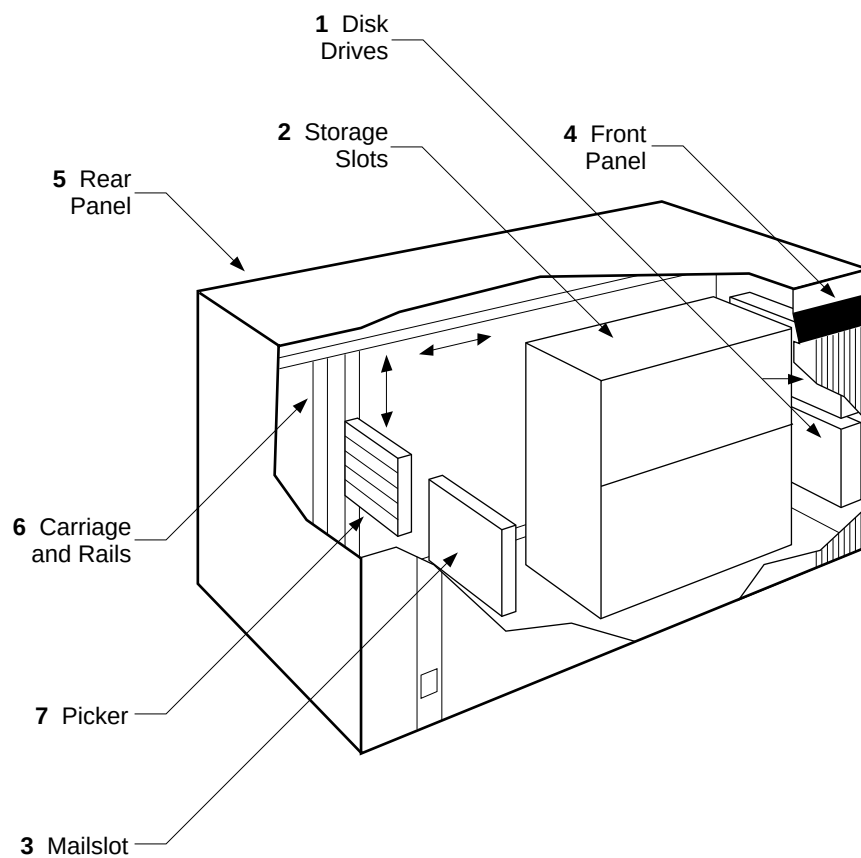
Item	Component	Description
5	Rear Panel	The rear panel includes SCSI, UPS, and power cord connections. Instructions for setting the address select switches are given in Section 3.4. Instructions for connecting a deskside or rackmount version of the autochanger to a host computer are found in Chapter 2.
6	Rails and Carriage	The rails and carriage support the picker for its movement within the disk library system.
7	Picker	The picker rotates, flips, and transports disks to and from storage slots, drives, and the mailslot.

Figure 1-1 Deskside Optical Library Components (RW510/RW530)



ZS-0505-MH

Figure 1-2 Rackmount Optical Library Components (RW511)



ZS-0506-MH

1.3.3 The Optical Drive Mechanism

The optical drive mechanism is a multifunction drive and, therefore, operates in both rewritable and write-once modes. The drive uses both rewritable and write-once 5.25-inch magneto-optical disks that comply with ANSI and ISO standards for Continuous Composite format. The drive senses the disk type and automatically operates in either rewritable or write-once mode.

The drive has a 3600 rpm rotational speed and can achieve a maximum sustained write transfer rate of 0.5 to 0.8 Mbytes per second and a maximum sustained read transfer rate of 1- to 1.6-Mbyte per second depending on the media and drive capacity. The error rate is less than one block in error per 10^{14} bytes.

Immediate response mode and write caching are used by the drive mechanism to achieve its high write performance. However, if a power failure occurs while write data is in the buffer, the drive may not have enough power to complete the write operation and empty the buffer. Therefore we recommend that an uninterruptable power supply (UPS) be used with battery backup to ensure that no data is lost if a power failure occurs.

1.3.4 Magneto-Optical Disks

Magneto-Optical (MO) disks are more durable, more reliable, removable, and cost far less per megabyte than magnetic disks. MO disks are made of the same kind of plastic used in bullet-proof windows. Data can be read through fingerprints and minor scratches. MO disks can withstand x-rays, magnetic interference, and can be dropped from desk height without damage.

Magneto-Optical disks store data on a magnetic layer in the form of magnetic flux reversals rather than on a pitted surface used in other optical technologies. Because surfaces of the MO disk are not physically changed, they can be written to and erased repeatedly with no measurable data degradation. Optical disks have an archival life of thirty years based on accelerated life tests for data retention.

The disk is mounted in a rigid plastic case with a metal shutter, similar to a 3.5-inch magnetic flexible disk. Each optical disk holds 594-Mbytes or 1.2-Gbytes of data when 512 bytes per sector disks are used. (Check the host system documentation to determine which disk format is supported.) The MO disk has two recording sides. To access the second side, the cartridge must be ejected, turned over, and reinserted into the drive.

There are two types of magneto-optical disks: rewritable optical disks and write-once optical disks. (Check the host system documentation to determine which disk type(s) are supported.) The two disk types can be differentiated by the words "rewritable" or "write-once" printed on the disk's metal shutter.

For data safety, you can independently write-protect each side of the disk by setting the write-protect tab on the corner of the cartridge.

1.4 SCSI Interface Options

The optical disk library connects to the host system through a Small Computer Systems Interface (SCSI). This interface conforms to SCSI standards ANSI X3.131-SCSI-2.

Usually each SCSI-connect peripheral requires one SCSI address. With the disk library, however, there are three unique SCSI interface addresses—one SCSI address for the autochanger controller and one for each drive contained in the disk library.

The autochanger controller and the host operating system manage communication through the SCSI bus to each drive's unique SCSI address.

Even though the disk library can have either a single-ended or a differential SCSI interface, only single-ended signals are used within the library. The library comes standard with a single-ended interface, and a differential interface is orderable at a later date as an option by distributors. To determine which option is installed, locate the SCSI connectors on the lower rear panel of the optical disk library. If the SCSI connectors are not labeled, the interface is single-ended SCSI; if the connectors are labeled "Differential," the interface is differential SCSI.

Although both interface types use the same SCSI cables, different terminators are required. Also, the allowable external cable lengths differ as follows:

- single-ended SCSI interface - up to 6 meters of total cable length is allowed
- differential SCSI interface - up to 15 meters of total cable length is allowed

1.4.1 Single-ended SCSI Interface

This option specifies a single-ended SCSI repeater PCA. This PCA enables the optical disk library to be connected to an external single-ended SCSI bus and also provides one other function; bus buffering. Bus buffering makes the library's internal SCSI bus length effectively zero and allows the use of the maximum single-ended SCSI external bus length of 6 meters for connection to the host system. (Actual library-to-host distance depends on whether there are any other SCSI devices on this bus).

1.4.2 Differential SCSI Interface

This option specifies a differential SCSI repeater PCA. This PCA enables the library to be connected to an external differential SCSI bus. The differential SCSI repeater PCA uses the equivalent of 10 meters of SCSI cable internally, so the allowable external cable length is limited to 15 meters, instead of the 5 meters usually allowed on a differential SCSI bus.

Note

With either type of SCSI interface, an internal cable length of 1.44 meters must be included in the total cable length calculation.

1.5 Product Matrix

The following products are discussed in this manual. To determine which product you have, find the product information labels located on the disk library rear panel and check the corresponding information on the following table.

Table 1–2 Disk Library Products Matrix

Product No. /Options	Description	HP Designation
RW510-ZC	A 20 gigabyte Optical Jukebox with a 32 disk slot capacity, one mail slot, two 650-Mbyte multifunction drives, one auto changer mechanism. Floor stand model. Includes packaging, skid, ESD bag, and accessory kit. Single ended SCSI.	Model 20C (C1710C)
RW511-ZC	A 20 gigabyte (Rackmount) Optical Jukebox with a 32 disk slot capacity, one mail slot, two 650-Mbyte multifunction drives, one auto changer mechanism. Includes packaging, skid, ESD bag, and accessory kit. Single ended SCSI.	Model 20C (C1710C)

(continued on next page)

Table 1–2 (Cont.) Disk Library Products Matrix

Product No. /Options	Description	HP Designation
RW530-ZC	A 41 gigabyte Optical Jukebox with a 32 storage slot capacity, one mail slot, two 1.3 Gbyte multifunction drives, one auto changer mechanism. Floor stand model. Plus packaging, skid, ESD bag, and accessory kit. Single-ended SCSI.	Model 40T (C1710T)
RW530-UB	Converts 650-Mbyte multifunction drives to 1.3-Gbyte multifunction drives in a RW510 jukebox. Consists of two (1.3-Gbyte) drives and an installation guide.	

1.6 Specifications

This section provides:

- Performance Specifications
- Physical Characteristics
- Environmental Specifications
- Power Requirements
- Service Characteristics
- Product Certification

Table 1–3 Optical Disk Library System

Optical Disk Library System		
Capacity	32 disks 20.8 Gbytes (RW510/RW511) or 41.6 Gbytes (RW530)	
Drives	2 standard, 5.25-inch multifunction 650-Mbyte (RW510/RW511) or 1.3-Gbyte (RW530) optical disk drives	
Average disk exchange time (excluding drive load/unload sequences)	7 seconds	
Interface	Single-ended asynchronous SCSI Differential SCSI	
Multifunction Optical Drive	650 Mbytes	1.3 Gbytes
Formatted capacity 512 byte sectors	594 MB	1.2 GB
Seek Times		
Short Stroke (across 2.2 Mbytes)	8 ms	4 ms
Average	25 ms	23.5 ms
Full Stroke	50 ms	45 ms
Average Rotational Delay	8.33 ms	12.5 ms
Average load (including spin-up)/unload sequence (including spin-down)	2.5/2.0	2.3/1.4

(continued on next page)

Table 1–3 (Cont.) Optical Disk Library System

Multifunction Optical Drive	650 Mbytes	1.3 Gbytes
Data Transfer Rate¹		
Reads (maximum sustained)	1.0 MB/second	.8-1.6 MB/second
Writes (maximum sustained)	0.5 MB/second	.4-.8 MB/second
Burst (SCSI interface)	5 MB/second (synchronous)	5 MB/second (synchronous)
	3 MB/second (asynchronous)	3 MB/second (asynchronous)
RW510/RW511/RW530 Physical Characteristics		
	Rewritable	Write-once
Disk	5.25 in. diameter (130 mm)	5.25 in. diameter (130 mm)
Capacity (512-byte sectors) (1x) ²	594 Mbytes (formatted)	594 Mbytes (formatted)
Capacity (512-byte sectors) (2x) ³	1.2 Gbytes (formatted)	1.2 Gbytes (formatted)
Format (1x)	Continuous Composite (CC) (ISO/IEC 10089)	CCW (ISO/IEC 11560)
Format (2x)	Continuous Composite (CC) (ISO/IEC 10089), ECMA 184 standard for CC format	CCW (ISO/IEC 13549), ECMA 184 standard for CCW format
Bytes per sector (1x)	512 (medium dependent)	512 (medium dependent)
Bytes per sector (2x)	512 (medium dependent)	512 (medium dependent)
Sectors per track (1x)	31 (medium dependent)	31 (medium dependent)
Sectors per track (2x)	31 (medium dependent)	31 (medium dependent)
Physical tracks per side (1x)	18751	18751
Physical tracks per side (2x)	21600	21600
Physical tracks per inch (1x)	15875	15875
Physical tracks per inch (2x)	18273	18273

¹System and application software dependent

²In this table, 1x refers to 594-Mbyte.

³In this table, 2x refers to 1.2-Gbyte.

(continued on next page)

Table 1–3 (Cont.) Optical Disk Library System

RW510/RW511/RW530 Physical Characteristics	Rewritable	Write-once
Error Rate (1x)	Less than 1 block in error per 10^{14} bytes	Less than 1 block in error per 10^{14} bytes
Error Rate (2x)	Less than 1 block in error per 10^{14} bytes	Less than 1 block in error per 10^{14} bytes
Security	Write protect tab (1 per side)	Write protect tab (1 per side)
Medium archival life	30 years	30 years

RW510/RW511/RW530 Power Requirements

Line Voltage	100-127 Vac or 200-240 Vac
Line Frequency	50-60 Hz
Power Consumption	(per library)
Maximum	200 Watts
Typical	175 Watts

Table 1–4 RW510/RW511/RW530 Environmental Specifications

	Autochanger	Drives	Media
Temperature			
Operating	10° to 40°C	5° to 50°C	10° to 60°C
Non-operating	-30° to 60°C	-40° to 70°C	-10° to 50°C
Temperature gradient (operating)	10°C per hour	10°C per hour	10°C per hour
Transportation			-10° to 55°C
Humidity (non-condensing)			
Operating	10 to 90%	5 to 90%	10 to 80%
Non-operating	5 to 95%	5 to 95%	10 to 90%

(continued on next page)

Table 1–4 (Cont.) RW510/RW511/RW530 Environmental Specifications

	Autochanger	Drives	Media
Maximum wet bulb	29°C	29°C	29°C
Relative Humidity gradient (operating)			10% per hour
Transportation			5 to 90%
Shock (non-operating)			
End-use, handling	10.2 cm tilt drop test, 4 edges		760 mm drop (to 2 mm vinyl-covered concrete)
Transportation (30 G trapezoidal)	427 cm/s	742 cm/s	
Operating, no data loss		40 G @3 ms (half-sine)	
Vibration (5-500 Hz Range)			
Operating	0.21 G rms	0.5 G rms	>0.21 G rms
Non-operating			
Random	2.1 G rms	3 G rms	
Swept Sine	1 G 0-peak	0.75 G 0-peak	
Altitude			
Operating	4,572 m (15,000 ft)	7620 m (25,000 ft.)	
Non-operating	15,240 m (50,000 ft)	15,300 m (50,000 ft.)	
Acoustic Emissions (A-weighted sound power)			
Power on, standby	4.4 Bels	4.7 Bels	

(continued on next page)

Table 1–4 (Cont.) RW510/RW511/RW530 Environmental Specifications

	Autochanger	Drives	Media
Operating	6.7 Bels	6.15 Bels	

Table 1–5 RW510/RW511/RW530 Physical Characteristics

	Deskside Option	Rackmount Option	2nd Library (for 1.0 m Cabinet)
Dimensions:			
Height	715 mm (28.1 in.)	1000 mm (39.4 in.)	400 mm (15.8 in.)
Width	375 mm (14.6 in.)	600 mm (23.6 in.)	450 mm (17.7 in.)
Depth	790 mm (31.0 in.)	800 mm (31.5 in.)	760 mm (29.9 in.)
Weight:			
Net with disks	96 kg (211 lb)	175 kg (385 lb)	64 kg (144 lb)
Net without disks	88 kg (195 lb)	167 kg (369 lb)	58 kg (128 lb)
Shipping Weight:			
With disks	124 kg (274 lb)	188 kg (415 lb)	93 kg (206 lb)
Without disks	117 kg (258 lb)	181 kg (399 lb)	86 kg (190 lb)

Table 1–6 RW510/RW511/RW530 Service Characteristics

Characteristic	Specification
Mean time between failure	100,000 power-on hours
Mean swaps between failure	1,200,000
Mean time to repair	1 hour
Preventive maintenance	none required

Table 1–7 RW510/RW511/RW530 Product Certifications

Parameter	Description
Safety:	UL 1950 (RW510/RW511/RW530-ZC listed; Optical Library recognized component) CSA-C22.2 No. 950-M89 IEC 950 TUV approved to VDE 0805 (EN 60950)
Electromagnetic Emissions	FCC 47 CFR Part 15 Subpart J - Class A EN 55022/CISPR 22 Class A
Compatibility:	pr EN 55024-2/IEC 801-2, 3kV CD, 8 kV AD pr EN 55024-3/IEC 801-3, 3 V/m VCCI Level 1 SABS
Laser:	CDRH 21 CFR Chapter 1, Subpart J, Class 1 Laser TUV approved to VDE 0837 TSH Approved to Decision 472 BS 4803 Part 2 (complies) EN60825/IEC 825, Class 1 Laser
United Kingdom	Approved under Approval Number NS/G/1234/J/100003 for indirect connection to Public Telecommunication Systems within the United Kingdom.

1.7 Related Documents

Table 1–8 Related Documents

Document Title	Part Number
<i>Optical Library Conversion Kit Installation Guide</i>	EK-OLCON-IG
<i>Optical Library User's Guide</i> (shipped with each unit)	EK-STSOP-UG
<i>Optical Storage Desktop Software Installation Guide</i>	AA-PXYKA-TE
<i>Optical Storage Desktop Software User's Guide</i>	AA-PXYLA-TE
<i>Optical Storage Management Software Installation Guide</i>	AA-PXYPA-TE
<i>Optical Storage Management Software Installation Guide</i>	AA-PXYQA-TE
<i>Storage Server 100 Installation Guide</i>	EK-D59SS-IN
<i>Small Optical Disk Library Service Manual</i>	EK-SOL10-SV
<i>Medium Optical Disk Library Service Manual</i>	EK-MOL10-SV
<i>Large Optical Disk Library Service Manual</i>	EK-SS100-SV
<i>Optical Disk Library System Technical Reference Manual</i> †	5959-3559 (GSD)
<i>Technical Guide Optical Drives and Libraries</i> †	5960-7605
<i>Optical Drive and Library SCSI-2 Command Reference</i> †	5960-7608
<i>Offline Diagnostics for HP Optical Products</i> †	5960-7626
<i>Storage Server 100 Optical Disk Service Manual</i>	EK-STSOP-SV ‡
†These documents can be ordered directly from Hewlett-Packard, see Appendix B for ordering information.	
‡Only for older model 10/20 Jukebox shipped with (Ninja) storage server systems	

Table 1–9 Pass Documents

Pass	Entry Number
RW5xx Hardware Pass	7174
Ninja Hardware Pass	6060
Optical Storage Management Software Pass	3731
Optical Storage Desktop Software Pass	3750

Environmental/Installation/PM

2.1 Environmental Requirements

The following environmental requirements should be met at each site before installation.

Note

The environmental specifications listed here apply when the disk library is not connected to a system. When this device is connected to host systems, the more stringent environmental specifications listed for any single device within the host system are applicable and supersede these specifications.

2.2 Operating Temperature/Clearance Requirements

The disk library is designed to operate with an ambient air temperature range of 10° to 40°C (50 to 104°F) with a rate of temperature change not to exceed 10°C (50°F) per hour.

The area does not have to be air-conditioned but maintaining an operating room temperature between 18°C to 24°C (65°F to 75°F) is recommended.

A minimum of 2-3 inches (70-80 mm) should be maintained behind the rear cover of the cabinet to allow air circulation.

2.3 Location Requirements

Position the drive away from sources of particulate contamination such as frequently-used doors and walkways, stacks of supplies that collect dust, and smoke-filled rooms. If possible, allow enough room behind the drive for access to the rear panel and for service.

2.4 Primary Power/External Ground

The power outlet used to supply AC power to the autochanger must be checked to ensure that the proper voltage (listed in Table 2–1) is available.

Table 2–1 Acceptable Voltage/Frequency

Voltage (Nominal Range)	Frequency (Nominal Range)	Voltage (Min/Max Range)	Frequency (Min/Max Range)
100-127	50-60	90-132	47-66
200-240	50-60	180-269	47-66

Also check the earth (safety) ground in the power outlet (which uses NEMA 5-15R). Be aware that the electrical load imposed by the autochanger may reduce the available voltage below the non-load value. If the line voltage is not within the correct range, resolve the power problem.

2.5 Unpacking Procedures

Unpacking is described in the *Unpacking Instructions* found on the box for each major component. If any items are missing, contact the factory Order Processing Center with the following information:

- original order number or unit serial number
- receiving address

If the unit is damaged, it will be repaired in all cases. Billing of the charges depends on whether the damage was caused by the carrier or the factory packaging. The cause of the damage will be determined by the field service representative.

In order to submit a warranty claim, problems determined to be caused by factory packaging should be reported, in detail, to the factory. Be sure to include the model number and full serial number in any correspondence with Digital concerning the optical disk library.

2.6 Installation Procedures

After verifying that the environmental requirements listed earlier in this chapter are met, the product is installed in the following three steps:

- Unpacking (by customer)—inspection for damage and moving to final site

- CE Hardware Installation—removing components from the shipping pallet (according to configuration ordered), installing the mechanism into the rack (if rackmount option), and checking address and power configuration
- Configuring the disk library for use with a specific host.

2.6.1 Contents of Shipment

You should receive a crate containing the RW510/RW511/RW530 Optical Library, and a box, shipped separately, labeled **OPEN FIRST**. Inside this box are several additional packages containing the following:

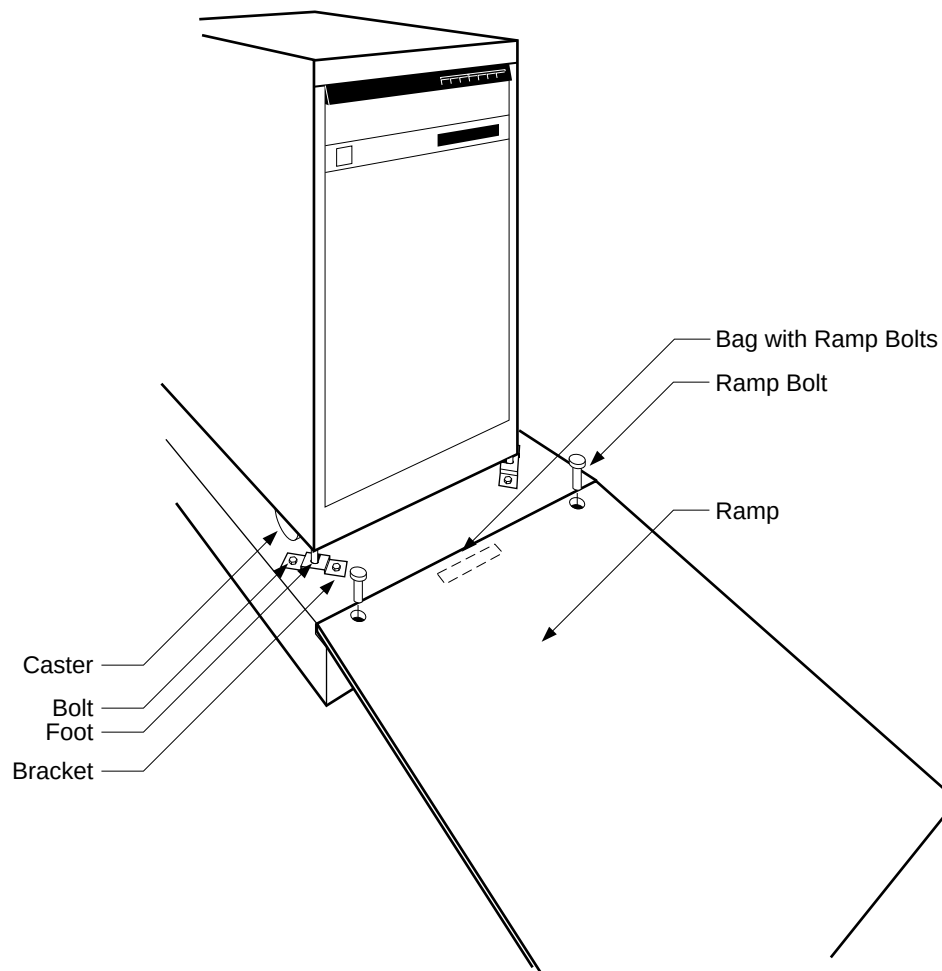
- READ ME FIRST instructions
- *Optical Library User's Guide*
- SCSI cable
- SCSI terminator
- Power cord

In addition to these items, to complete the installation you may need two wrenches—a 1/2 inch wrench and a 9/16 inch wrench—and a TORX T10, T15, T20, and T25 screwdriver (the blade is star-shaped) as well as wire cutters or a knife.

2.6.2 Installing Optical Library Unit

1. The Optical Library is shipped on a pallet covered by a cardboard box Figure 2–1. Move the crate to its final destination before installing the Optical Library.
2. Use wire cutters or a knife to cut the shipping straps.
3. Lift the cardboard box off of the pallet. A plywood ramp is packed on top; remove it and set it aside. Remove the large foam blocks, and the plastic bag surrounding the Optical Library.

Figure 2-1 Uncrating the Optical Library (RW510/RW530)



ZS-0516-MH

4. Locate the small plastic bag containing two large bolts. The bag is stapled to the top of the shipping pallet near the front of the Optical Library. Remove the bolts from the bag.
5. Place the plywood ramp on top of the shipping pallet so that the holes in the ramp line up with the holes in the pallet. Drop the bolts through the holes to secure the ramp to the pallet.

6. Using a 9/16-inch wrench, remove the eight bolts and four brackets that lock the Optical Library feet to the pallet.
7. Using a 1/2-inch wrench, raise the leveler feet so that the Optical Library is free to move on its casters.

WARNING

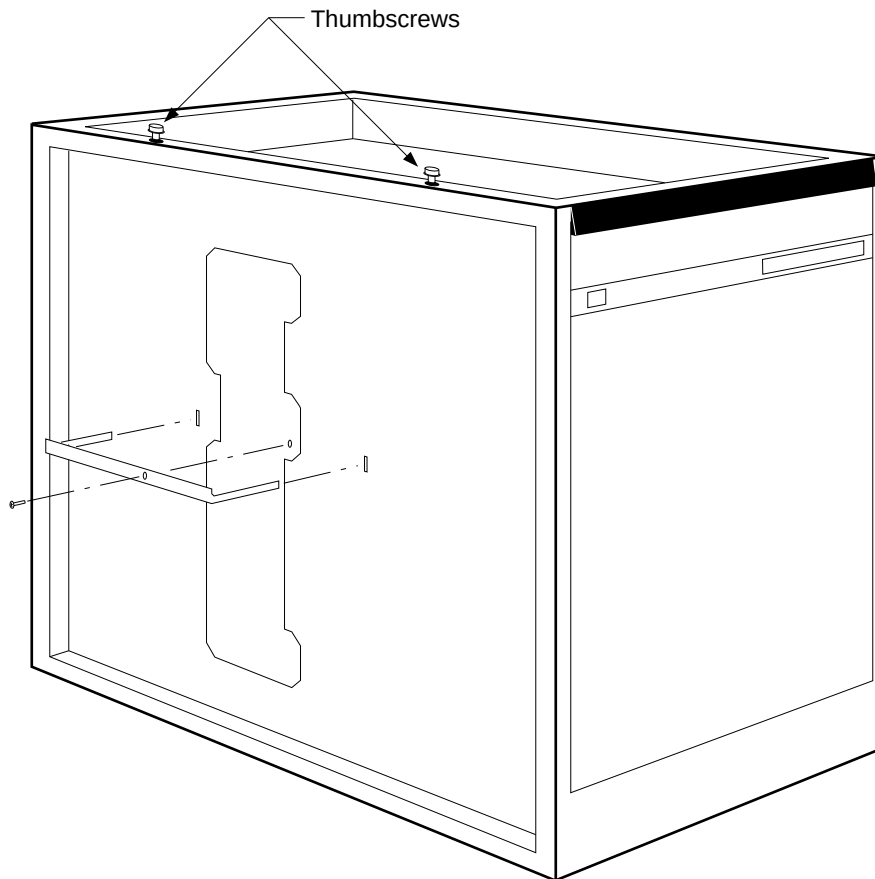
Do not stand at the bottom of the ramp when you perform step 8.

8. Carefully roll the unit down the ramp.

The Optical Library is now uncrated. If possible, save all the shipping materials in case you need to ship the unit to another site, or return it.

2.6.3 Remove the Shipping Bracket

Figure 2-2 Removing the Shipping Bracket (Deskside Unit RW510/RW530)



ZS-0517-MH

1. Remove the shipping bracket.
2. Remove the top cover of the Optical Library by pulling up on the back edge of the cover. Set the top cover aside. Remove the small foam pads from under the front edge.
3. Locate the two knurled thumbscrews on the top, left-edge of the Optical Library. Unscrew them using your fingers or a screwdriver. They are spring loaded and pop up when they are free.

4. Once the screws are loose, pull the left side panel out and off, and set it aside.
5. Locate the orange sheet metal bracket on the left side of the Optical Library. Using a TORX T15 screwdriver, remove the screw holding the bracket in place. Remove the bracket by pulling it straight out. Save the screw and bracket with the rest of the packing material. The bracket must be replaced if the machine needs to be shipped to a different location.
6. Replace the side panel by hooking the bottom edge in place first. Slide the top edge back under the thumbscrews. Tighten the thumbscrews by pressing down and turning. Do not replace the top cover just yet.

2.6.4 Attach SCSI Cable, SCSI Terminator, and Power Cord

The third step is to attach the SCSI cable, SCSI terminator, and the power cord. See Figure 2–3 and follow these steps:

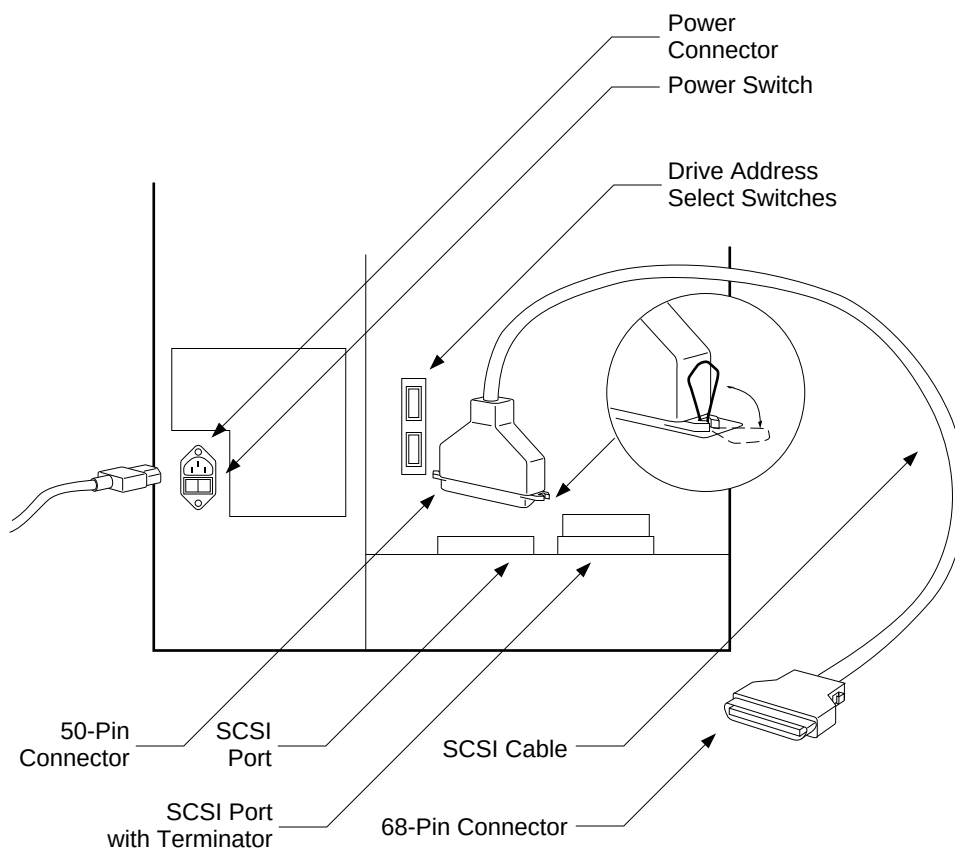
1. Remove the rear cover by pulling the top edge out away from the machine (Medium units only RW510/RW511/RW530).
2. Locate the SCSI cable and SCSI terminator shipped in the same small box containing the wrench and screwdriver.
3. Locate the two SCSI ports on the rear of the machine.
Plug the 50-pin Champ connector end of the SCSI cable into the port nearest the Drive Address Select Switches. The 50-pin Champ end is the one housed in plastic. (The other end is a metal connector with 50 pins and is labeled Honda.) The 50-pin Champ connector is keyed so that it only attaches one way. Lock the wire brackets into the grooves on the sides of the connector.
4. Plug the SCSI terminator into the second SCSI port, the port furthest from the Drive Address Select Switches.

Note

The terminator must remain plugged into the second SCSI port on the back of the Optical Library unless you are connecting two Optical Library systems to your host computer. See Appendix C for instructions on connecting two Optical Library systems.

5. Leave the 50-pin Honda end of the SCSI cable disconnected for now. Instructions for connecting this end to your host computer are provided in your host system documentation.

Figure 2-3 Attaching the SCSI Cable and Power Cord to the Deskside Unit (RW510/RW530)



ZS-0518-MH

6. Locate the power cord shipped in the country kit box. Locate the yellow safety sticker covering the power plug on the rear of the Optical Library. Pull the sticker away and plug in the power cord. Plug the other end of the power cord into an electrical outlet.
7. Before turning on the black power switch, verify that the white operation switch on the front of the Optical Library is off. The operation switch is off when it is in the out position. Turn on the black power switch on the back of the machine, located immediately under the power cord.

2.6.5 Uninterruptible Power Supply Installation

Follow the UPS manufacturer's directions for connecting a UPS. The information in the following section will be helpful.

CAUTION

Improper connection of the UPS with a communication link to the autochanger may not provide full protection against data loss. To insure proper UPS connection, perform the following steps:

1. Use the BC09D-09 interface cable (HP part number C1708-60x80) to connect the UPS to the autochanger.
 2. Run test 75 after connecting a UPS with a communication link to the autochanger. (Refer to Chapter 4 for instructions for running test 75.)
-

If the UPS is connected to the RW510/RW511/RW530, the power requirements shown in Table 2-2 must be met.

Table 2-2 UPS Power Requirements

Volt-Amps	Watts
125 Volt-Amps (typical)	75 Watts (typical)
190 Volt-Amps (worst)	110 Watts (worst)

2.7 Hardware Verification

The Customer Engineer needs to verify that the optical disk library is fully functional. To do this, the CE powers up the unit, which will invoke the poweron diagnostic. After completion of the poweron diagnostic, the CE should run internal diagnostics and test the autochanger mechanism and drive(s) to verify that all functions of the optical library unit (moves, flips, reads, writes, etc.) are operating correctly. This can be accomplished by executing internal diagnostic tests 2 and 11 through 17 (Chapter 4). Refer to the host configuration guide to complete the installation. Ensure that the library and drive SCSI IDs do not conflict with other addresses on the bus before connecting the host system (Section 3.4).

2.8 Moving the Optical Disk Library

2.8.1 Moving the Optical Disk Library a Short Distance

If you simply need to move the disk library system down the hall, to another floor level, or to another building on site, perform the following steps:

1. Unmount (unreserve) any disk surfaces from the host system if necessary.
2. Eject all disks from the autochanger drives. If the disks were not labeled with a storage slot location prior to inserting them into the autochanger, do it now.

CAUTION

Failure to eject the disks from the optical drives prior to transport could result in damage to the drive mechanism.

CAUTION

Do not switch off the disk library system either from the operation switch or from the power switch (located on the rear panel) until you are sure that the SCSI bus is inactive. Pressing either button when the bus is active can cause data loss and/or indeterminate bus states. Check the host system reference manuals for information on checking the status of the SCSI bus.

1. Switch off the disk library system operation switch (located on the front panel) and the power switch (located on the rear panel).
2. Remove the power cord and SCSI cable connections from the disk library system.
3. Raise the leveler feet (if your disk library system is in a cabinet) using a 1/2-inch wrench.
4. Carefully roll the disk library system to its new destination.
5. Connect the disk library system to the host.
6. Re-connect the power cord.
7. Lower the leveler feet using a 1/2-inch wrench.
8. Configure the disk library system to the host. (Refer to your host system documentation for configuration information.)

9. Re-insert the optical disks into their correct storage slot locations. (Refer to "Loading Disks" in Chapter 6 of the *Optical Disk Library User's Guide* for the procedure for loading disks.)

2.8.2 Moving the Optical Disk Library a Long Distance

If you need to move your disk library system a long distance, perform the following steps:

1. Unmount (unreserve) any disk surfaces from the host system if necessary.
2. Eject all disks from the autochanger and, if the disks were not labeled with a storage slot location prior to inserting them into the autochanger, do it now.

CAUTION

Failure to eject the disks from the optical drives prior to moving the transport could result in damage to the drive mechanism.

3. Run "TEST 23" to position the picker for shipping.
4. Press **[OPTION]**.
5. Press **[NEXT]** until "TEST *" appears, and then press **[ENTER]**.
6. Press **[NEXT]** until "TEST 23" appears, and then press **[ENTER]**.

CAUTION

Do not switch off the disk library system either from the operation switch or from the power switch (located on the rear panel) until you are sure that the SCSI bus is inactive. Pressing either button when the bus is active can cause data loss and/or indeterminate bus states. Check the host system reference manuals for information on checking the status of the SCSI bus.

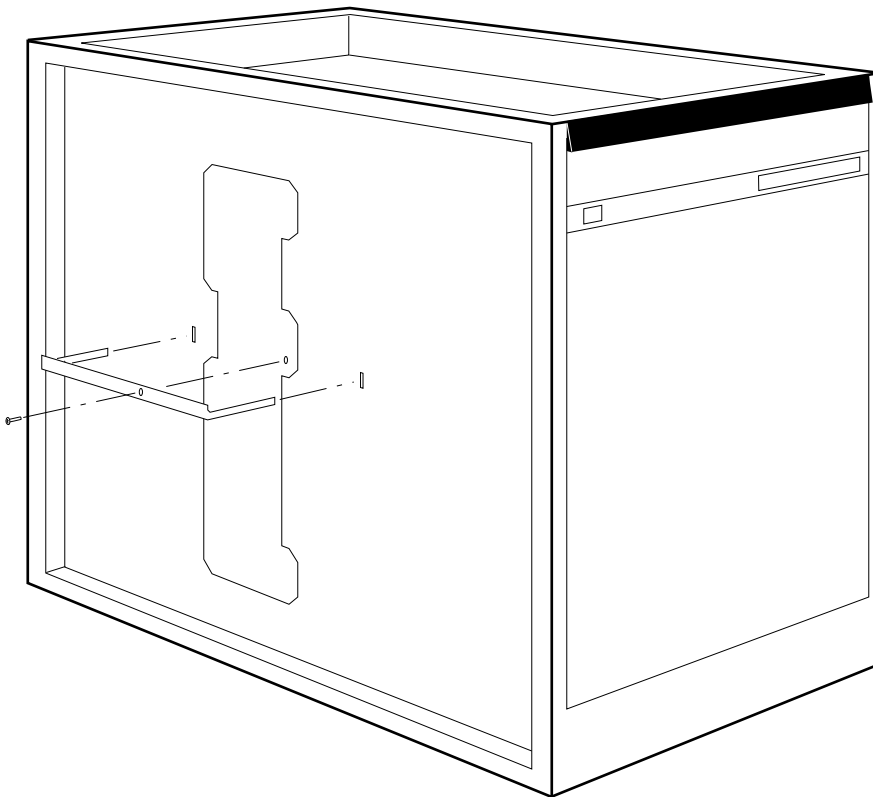
7. Remove the right side rack panel (rack-mounted units only).
8. Attach the orange shipping bracket (Figure 2-4).
9. Switch off the disk library system operation switch (located on the front panel) and the power switch (located on the rear panel).

10. Have the unit repackaged and shipped in the same manner in which it was received.

Note

Your service representative can provide assistance or advise you on how to best repackage and ship your disk library system.

Figure 2-4 Attaching the Shipping Bracket



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2.8.3 Attaching the Shipping Bracket

CAUTION

Before powering on the disk library system once it has reached its destination, the shipping bracket must be removed to allow free movement of the picker.

1. Remove the shipping bracket.
2. Connect the power cable to the disk library system.
3. Connect the one end of a SCSI cable to the disk library system, and connect the other end to the host system.

2.9 Preventative Maintenance

There is no preventive maintenance for the optical disk library, however the optical disks may require cleaning.

Cleaning an optical disk is needed more commonly on standalone drives than with autochangers because of the differences in their environments and usage. However, an autochanger may be used in such a way as to make disk cleaning necessary.

To determine whether or not disk cleaning is appropriate for your customer's situation, refer to Section 4.3.

CAUTION

Do not attempt to clean the optical drive objective lens! Although disk drive cleaning kits are available, they are not approved for use with the RW510/RW511/5RW30 and will damage the optical drive mechanism.

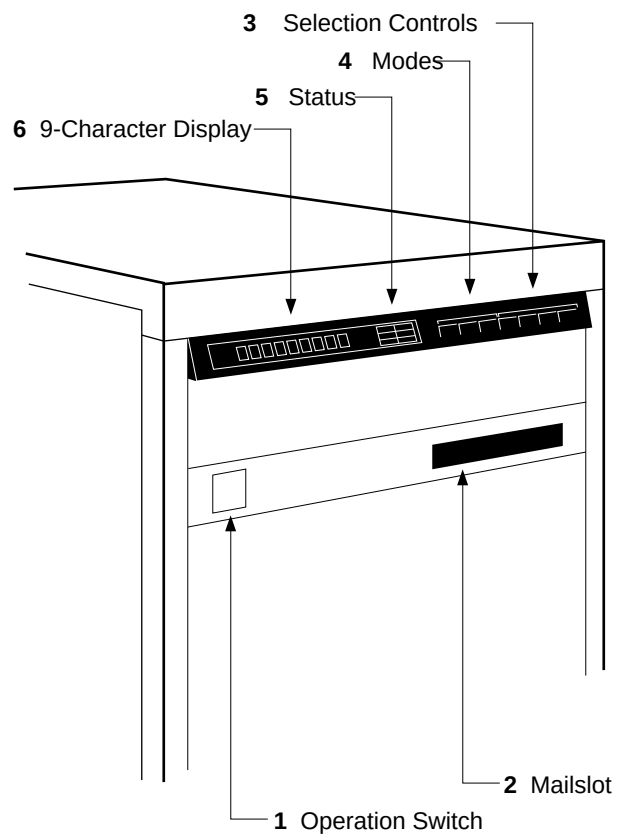
3

Product Configuration and Operation

3.1 Front Panel and Control Panel Operations

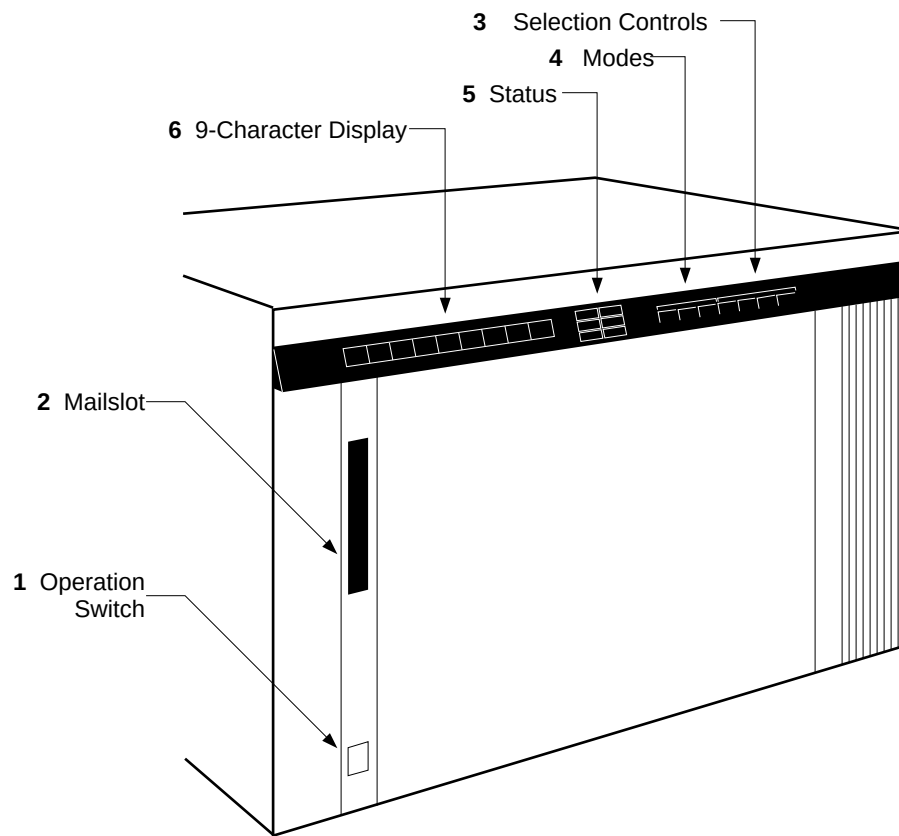
Figure 3–1 shows the Deskside Configuration Front Panel. Figure 3–2 shows the Rackmount Configuration Front Panel. Table 3–1 lists each switch and indicator, and describes its function.

Figure 3-1 Deskside Configuration Front Panel



ZS-0510-MH

Figure 3-2 Rackmount Configuration Front Panel



ZS-0511-MH

Table 3-1 Control Panel

1. Operation Switch	Pushed to enable or disable operation of the disk library. (This is NOT the power switch. The power switch is located on the rear panel.)
2. Mailslot	Allows you to insert or remove disks.

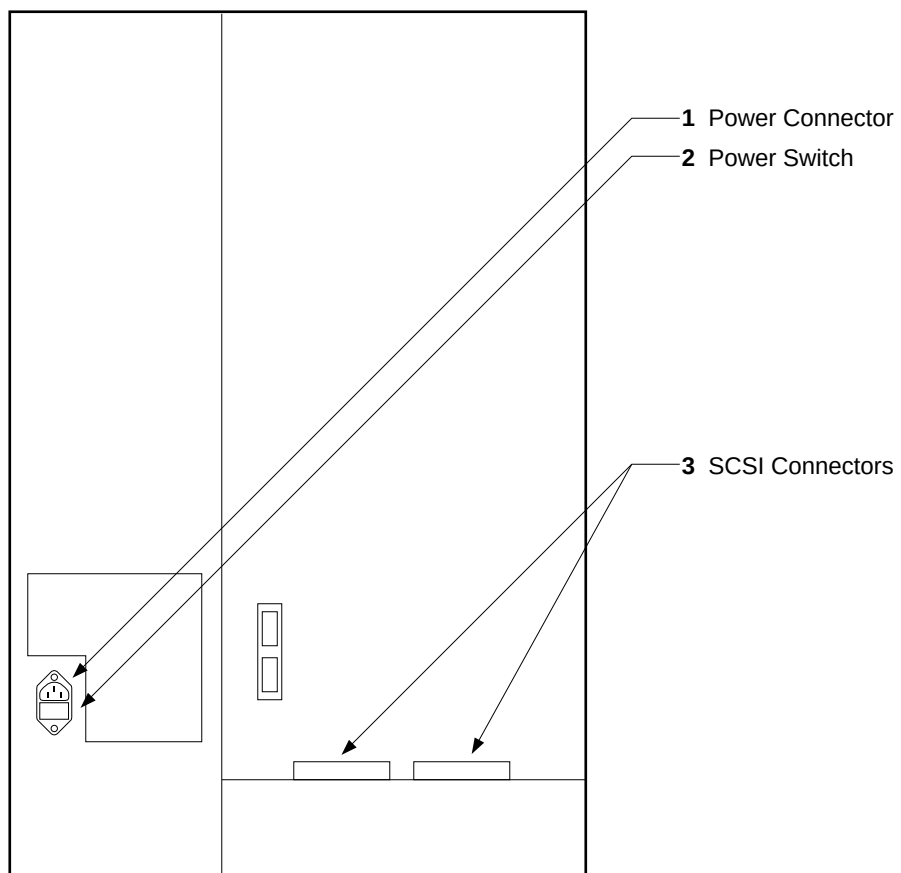
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Table 3–1 (Cont.) Control Panel

3. 9-Character Display	Displays information about the the current operation. Generally you press NEXT or PREV to control the selections. Once your selection is displayed, you press ENTER . You may press CANCEL to cancel your selection.
4. Status Indicators	Lit when the indicated activity is taking place.
5. Modes Buttons	Press these buttons to perform the desired operation. LOAD is pressed after you place the disk in the mailslot. Once LOAD is pressed, the display prompts you for the desired destination inside the unit. Once you choos e the location, press ENTER. The disk loads to that location. EJECT is pressed to remove a disk from storage in the library. Once EJECT is pressed, the display prompts you for which disk location to eject. Once you choose the location, press ENTER. The disk is then brought from that location to the mailslot. OPTION is pressed to display the current operation options available such as TEST, INFOrmation, CONFIguration, and SCSI ID.
6. Selection Control Buttons	Press these buttons to perform the desired operation. CANCEL is pressed to cancel the current operation or choice. PREV is pressed to scroll the display choice backward by one. NEXT is pressed to scroll the display choice forward by one. ENTER is pressed to choose the displayed selection.

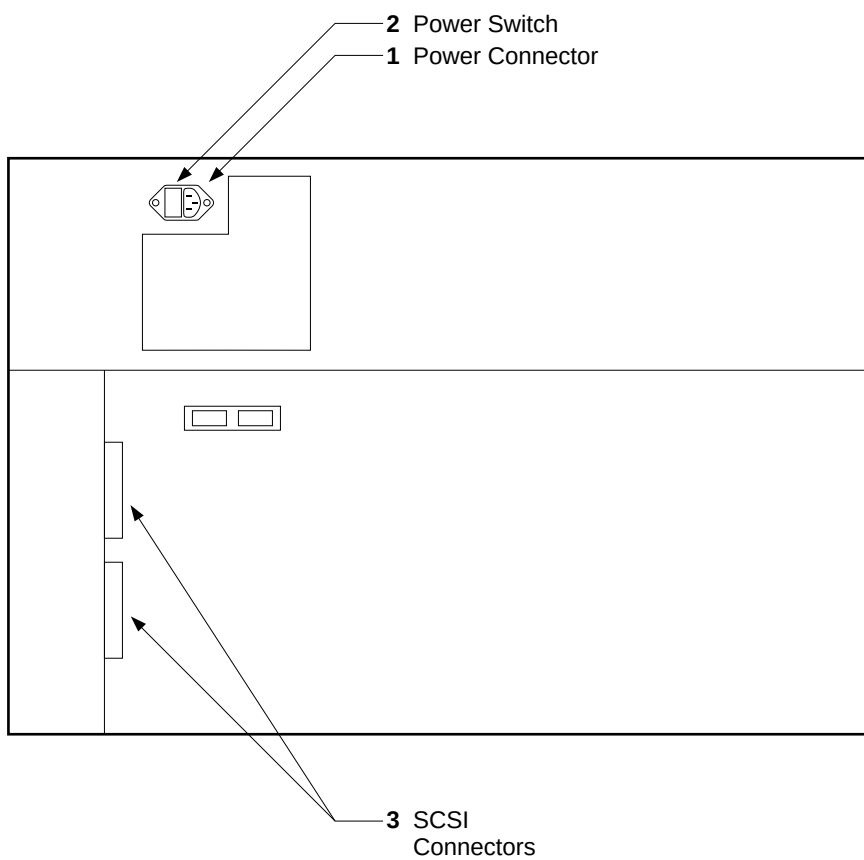
3.2 Rear Panel Connections

Figure 3-3 Deskside Optical Disk Library Rear Panel



ZS-0513-MH

Figure 3-4 Rackmount Optical Disk Library Rear Panel



ZS-0514-MH

Table 3–2 Rear Panel

1. SCSI Connectors	Two SCSI bus connectors that allow SCSI devices to be daisy-chained. If no other SCSI device exists after the current device on the chain, a terminator must be connected to the unused connector.
2. Power Switch	Used for switching on or off power to the disk library.
3. Power Connector	Connection for the power cord.
4. UPS 9-pin D-Connector	Connection for an uninterruptible power supply (UPS).

3.3 Setting a Configuration (READY)

A list of the configuration choices for the optical disk library system can be found in Section 3.6. To set a configuration, complete the following steps:

1. With READY displayed, press **OPTION**. TEST * displays.
2. Press **NEXT**. CONF * displays.
3. Press **ENTER**. CONF 0 displays.
4. Press **NEXT** or **PREV** until CONF ## displays (where ## is the configuration number you want to change.) See Table 3–3 for a complete listing of configurations.
5. Press **ENTER**.
Some configurations require a security code. If prompted, enter the security code.
6. Press **NEXT** or **PREV** until the value you want appears in the display.
7. Press **ENTER** once your choice displays. SET ## displays followed by CONF *.

3.3.1 Setting a Security Code

Note

The default factory-set security code is 0-0-0. When setting a new security code, key in the old one first, and then the new one.)

1. With READY displayed, press **OPTION**. TEST * displays.
2. Press **NEXT**. CONF * displays.
3. Press **ENTER**. CONF 0 displays.
4. Press **NEXT** until CONF 17 displays.
5. Press **ENTER**. 0 displays.
6. Press **NEXT** or **PREV** until first number of old (or default) security code displays.
7. Press **ENTER**. 0 displays.
8. Press **NEXT** or **PREV** until second number of old (or default) security code displays.
9. Press **ENTER**. 0 displays.
10. Press **NEXT** or **PREV** until third number of old (or default) security code displays.

Note

If the security code was keyed in successfully, the display prompts you for the new one. If a mistake was made in keying in the security code, NO CONFIG briefly displays and the unit returns to the CONF 17 display.

If you realize you've made a mistake in keying in a security code, press **CANCEL** to return to the CONF 17 option.

11. Press **ENTER**. A displays.
12. Press **NEXT** or **PREV** until first number of new security code displays.
13. Press **ENTER**. B displays.
14. Press **NEXT** or **PREV** until second number of new security code displays.

15. Press **[ENTER]**. C displays.
16. Press **[NEXT]** or **[PREV]** until third number of new security code displays.
17. Press **[ENTER]**. SET 17 displays.

3.3.2 Restricting Disk Insertion and Removal

Configurations 15 and 20 act together to control disks during normal and powerfail conditions.

- CONF 15 - when this is set to ON, you cannot insert or remove disks without a security code.
- CONF 20 - when this is set to ON, the CONF 15 status is maintained when a power fail occurs. Also, the reserved status on mounted surfaces is maintained if the autochanger power fails.

When setting CONF 15 or CONF 20, the display prompts you for a security code. This security code is 0-0-0 (default) or the one set by the customer using CONF 17.

3.3.3 Setting CONF 15 or CONF 20

1. Press **[NEXT]** or **[PREV]** until CONF 15 or CONF 20 displays.
2. Press **[ENTER]**. 0 displays.
3. Press **[NEXT]** or **[PREV]** until the first security code number displays.
4. Press **[ENTER]**. 0 displays.
5. Press **[NEXT]** or **[PREV]** until the second security code number displays.
6. Press **[ENTER]**. 0 displays.
7. Press **[NEXT]** or **[PREV]** until the third security code number displays.
8. Press **[ENTER]**.
9. Press **[NEXT]** or **[PREV]** to select ON or OFF.
10. Press **[ENTER]**. SET 15 or SET 20 displays.

3.4 Setting the Disk Library Addresses

Note

Determine what SCSI device addresses are currently in use on the host system. You can then correctly determine what available SCSI address to use for the autochanger controller and disk drives.

If you are configuring more than one disk library to the same host, you must change the SCSI addresses on one of the disk libraries to avoid an address conflict.

The disk library uses 3 SCSI addresses—one for each optical drive and one for the autochanger controller. These addresses are set using the front panel.

The default address settings are:

Autochanger Controller	Address 3
Optical Disk Drive #1	Address 4
Optical Disk Drive #2	Address 5

If you want to change one of the addresses, follow these steps.

1. Switch on the disk library if it is not already on.
2. With READY displayed, press **[OPTION]**. TEST * displays.
3. Press **[NEXT]** until SCS I IDs * displays.
4. Press **[ENTER]**. AC ID ## displays (where ## is the current AC ID address).
This is the autochanger controller address.
5. Press **[NEXT]** until the drive or controller selection you want displays.
6. Press **[ENTER]**. The current drive or controller address displays.
7. Press **[NEXT]** or **[PREV]** until the address you want displays.
8. Press **[ENTER]**. The message SET # will display. Address is now set.
Repeat steps 5-8 until all of the desired addresses have been changed.
9. Press **[NEXT]** until UPDATE or CONFLICT displays.

If CONFLICT displays, two or more drives and/or the controller have been set to the same address and must be reset.

If UPDATE displays and you are satisfied with the addresses you have selected, press **ENTER**. UPDATED will display.

10. Record the new address setting(s) for future reference.

CAUTION

Do not remove power to the disk library system until you are sure that the SCSI bus is inactive. Removing power from a SCSI peripheral when the bus is active can cause data loss and/or indeterminate bus states. (Check the host system reference manuals for information on checking the status of the SCSI bus.)

11. Push the operation switch (located on the disk library front panel) off and then back on so the new address setting(s) will be recognized by the host system.

Note

Some host systems must be power cycled to recognize the new disk library address settings.

Note

The drive's parity is enabled at the factory.

3.5 Host Configuration

Once the disk library is connected to the host system and the device address is set, you are ready to prepare the host system to access the library. To determine if the host you are connecting to supports the optical disk library and for further installation information, check the following documents:

- product support plan (available from your local Sales Support Office)
- host system documentation

3.6 Autochanger Configuration Choices

The following table lists the available configurations choices. An explanation of how to access and set these configurations is found in Section 3.3, Setting a Configuration (READY).

Table 3–3 Autochanger Configuration Choices

No.	Function	Default	Options
0	Clear/Save Error Log (Information Log 0)	Save	Clear - clears the error log immediately. Save - saves the error log until Clear is configured.
8	No Break on Failure	Off	Off - if a test encounters a failure, the test stops. On - if a test encounters a failure, the test continues.
10	Clear/Save Move Log (Information Log 10)	Save	Clear - clears the move log immediately. Save - saves the move log until Clear is configured.
11	Clear/Save Runtime Log (Information Log 11)	Save	Clear - clears the runtime log immediately. Save - saves the runtime log until clear is configured.
Configurations 15 - 20 require a security code.			
15	Prevent Media Removal (security code required)	Off	On = No mailslot I/O Off = Normal mailslot I/O
16	Set Default Configurations (security code required)	Save	Clear - restores default configurations immediately. Save - maintains all set configurations.
17	Set New Security Code (security code required)	0-0-0	
18	Clear/Save Logs (security code required)	Save	Clear - clears/zeros the specified logs.

(continued on next page)

Table 3–3 (Cont.) Autochanger Configuration Choices

No.	Function	Default	Options
	Clears/zeros these logs: #4 - Drive Load Count #5 - Poweron Hours #9 - Move #12 - Flip #13 - Translate #14 - Mailslot Rotation		Save - maintains the specified logs until clear is configured.
19	Set Autochanger Retries A - Max. attempts to find home B - Max. attempts to do move C - Max. attempts to restore move after failure.	4 2 1	Sets the number of attempts to retry moves before giving up.
20	Poweron Cartridge Security (security code required)	Off	On - maintains the status of configuration 15 upon power cycle or power failure. Off - Configuration 15 is not maintained through a power cycle or power failure.
21	Enable Autochanger Retries	On	On - Autochanger attempts to correct itself when it encounters difficulty. Off - Autochanger does not attempt to correct itself when it encounters difficulty.
22	Clear Drive 1 Load Count Log (Information Log 4)	Save	Clear - clears the Drive 1 Load Count Log immediately. Save - saves the Drive 1 Load Count Log until clear is configured.
23	Same as config. 22 for Drive 2.		
27	Report Recovered Error	Off	On - reports the SCSI-level error to the host. Off - no reports of SCSI-level errors to the host.

(continued on next page)

Table 3–3 (Cont.) Autochanger Configuration Choices

No.	Function	Default	Options
31	Secured Mailslot Rotation (security code required)	Off	Off - Normal mailslot operation. On - The mailslot rotates in when configuration 15 is set to ON or a Prevent Media Removal command is received. The mailslot remains closed until configuration 15 is set to OFF or an Allow Media Removal command is received. If the autochanger is full, the mailslot will open only for an EJECT command.
32	Mailslot Rotation Command (security code required)	Off	Off - Normal mailslot operation. If the host sends a Rotate mailslot command and config. 32 is set to off, the host will receive a Check Condition followed by a Sense Key of Illegal Request. On - When a Rotate Mailslot command is received (either from the host or via the control panel), the mailslot is toggled open or closed.
40	DEC/OEM Mode	Off	Off - Changes inquiry mode to DEC mode. Required when connected to a DEC computer to ensure integrity. This changes default of Autocontroller PCA. ON - For use with OEM computers (HP).
41	DEC/OEM Mode	Off	Off - Changes inquiry mode to DEC mode. Required when connected to a DEC computer to ensure integrity. This changes default of 1.3 Gbyte multifunction drive only. ON - For use with OEM computers (HP).

(continued on next page)

Table 3–3 (Cont.) Autochanger Configuration Choices

No.	Function	Default	Options
50	Emulate Model 10C or 20T (Must be a Model 20C or 40T. Security code required)	Off	Off - Normal Model 20C mode. On - Emulates a Model 10C or 20T. (Reduces the number of available storage slots from 32 to 16.) This is only used for system integration, and should not normally be used.
66	Zero all RAM	Save	Save - RAM remains unchanged. Clear - Zeros all RAM locations and reboots. Caution - When this configuration is set to "Clear," the product ID and the vendor ID are cleared. DO NOT perform this operation.

4

Troubleshooting/Diagnostics

This chapter is divided into the following sections:

- **Operation/Installation Error Information**

Common problems encountered during operation and installation of the optical disk library are listed in this section, and suggestions for solving these problems are given. This troubleshooting is considered top-level troubleshooting.

- **Control Panel Error Information**

Error messages and log information which are available through the control panel display are provided in this section. This intermediate level of troubleshooting is used when "hard" (repeatable) errors are encountered.

- **Internal Diagnostic Utilities**

Information about the available internal diagnostics used to aid in the troubleshooting process is discussed in this section.

- **Error Information through SCSI Commands**

Error messages and log information available by issuing SCSI commands via an external PC based host computer are discussed in this section. This in-depth level of trouble shooting is used when "soft" (intermittent) errors are encountered.

4.1 Operation/Installation Error Information

The following table lists problems that may occur during operation of the optical disk library. If you cannot find a solution to a problem in this section, go to the next section for more in-depth troubleshooting.

CAUTION

DO NOT CYCLE POWER during any troubleshooting until you are sure the system SCSI bus is INACTIVE and will REMAIN INACTIVE.

Removing power while the bus is active can cause data loss and/or indeterminate bus states. Check the host system reference manuals for information on checking the status of the SCSI bus.

Task	Problem/Symptom	What to do
Communicating host < — > library	Can't get the host to recognize the optical disk library.	• Make sure the disk library is supported on the host operating system. • Make sure the autochanger was installed and configured as described in Section 3.6. • Check the SCSI connections. • Check the SCSI interface address as it relates to the device files. • Make sure SCSI IDs of unit do not conflict with other SCSI devices on the bus. • Make sure the software license was installed correctly. • Make sure CONFIG 40 is set to DEC mode. See Section 3.3 and Section 3.6

Task	Problem/Symptom	What to do
Changing the drive address	Changed drive address but new address is not recognized.	After changing an address, the autochanger power and/or the host system power may need to be cycled for the new address to be recognized. (Refer to the host system documentation for information on setting peripheral addresses and shutting down the host system.)
Inputting Security Code	Security code forgotten or misplaced for the autochanger.	First, try the default security code (0-0-0). If the security code is not set to the default, locate the 8-switch dip switch on the controller PCA, and set switch 1 to the "closed" position. Switch on the autochanger. This sets the security code to the default code. Note—Once the default security code is set, the switch must be reset to its original setting. The customer may now use configuration 17 to set a new security code (refer to Section 3.3.1, Setting a Security Code).
Loading Disks	Disk inserted in mailslot, but the display reads ERROR, EMPTY, or MISLOAD.	Remove the disk from the mailslot and try inserting it again. Push the disk in, shutter-end first, so that the disk is flush with the optical disk library front panel.
Powering on	The optical disk library won't power on.	• Make sure the power cord connections are tight. • Check to see that both the back power switch and the front operation switch are in the ON position. • Make sure the power outlet is operating. • Check the voltage select switch setting. • Replace the fuse with a new one. • Replace the power cord with a known good one. • Replace the power supply module.

Task	Problem/Symptom	What to do
Power fail	Poweron selftest fails.	Turn the unit off, then turn it on again. Observe the poweron test result. If the unit continues to fail, use the error code to begin troubleshooting (refer to Section 4.2, Power-on Self-tests).
	Does not boot correctly.	Ensure that the boot disk is ON, spun up, and ready before applying power to the host computer. The autochanger and the host may then be powered on in any order.
	Only the autochanger power fails.	When power returns, unmount and remount all disk surfaces. Do not eject any disks until the surfaces are unmounted/unreserved.
	Autochanger power fails while a disk is in the drive.	If you need to remove the disk before power can be resupplied to the drive, the eject tool can be used to recover the disk (refer to Section 4.4, Using the Eject Tool to Remove a Disk from the Drive).
	Host computer power fails and the autochanger stays on.	After the host reboots, file system check any write-mounted surfaces.

CAUTION

Do not eject disks from the autochanger until all mounted surfaces are unmounted.

To prevent disks from being removed after a power failure, set configuration 20 (Poweron Cartridge Security) to "ON." Refer to Section 3.6, Autochanger Configuration Choices and Section 3.1, Front Panel and Control Panel Operations for an explanation of configuration 20 and how it is set.

Both the host system and autochanger power fail.

After the host reboots, file system check any write-mounted surfaces. Refer to the previous CAUTION note.

Task	Problem/Symptom	What to do
Reading the Front Panel Display Window	No display messages appear.	• Make sure both the power switch (on the rear panel) and the operation switch (on the front panel) are switched on. • Check that the power cord is connected. • Check AC input. • Check the fuse. • Check the control panel cable connections. • Replace the control panel PCA. • Replace the autochanger controller PCA. • Replace the power supply.
Reading/writing magneto-optical disks	Can't write to the disk.	• Check the file system access permissions. • Check the write-protect tab on each disk side to assure write-enabled status. • Check to make sure the disk was initialized. • Check that the disk file system was mounted correctly. • Refer to Section 4.3, Optical Disk Cleaning. • Check your application software.
Removing disks	Disk removal attempted, but the storage slot or drive location won't display the option.	• Make sure the optical disk surface's file systems have been unmounted.

Task	Problem/Symptom	What to do
	Disk removal attempted, but a FULL, MISLOAD or RESERVED message displays.	- Remove the disk from the mailslot and try to remove the desired disk again. If a disk is not in the mailslot and MISLOAD still displays, this could indicate a drive failure. - In the case of RESERVED, a security code was set to prevent disk removal. See Table 3–3, number 15.
	The unit's power failed while a disk was in the drive.	- Try powering on the unit. - If poweron is unsuccessful, power the unit off. Do not move the unit. Moving the unit with a disk in the drive risks damaging the magneto-optical mechanism in the MO drive. Refer to the "Powering On" and "Power Fail" sections earlier in this table. - If it is critical that the disk be removed from the drive before power can be restored to the drive, refer to Section 4.4, Using the Eject Tool to Remove a Disk from the Drive.

4.2 Power-on Self-tests

CAUTION

When the optical disk library is powered on and selftest is run, the SCSI interface and the terminator must both be either connected or disconnected.

If the controller senses that the optical drive is not connected to a host system via the SCSI interface, additional selftests are run on the SCSI circuitry. If these tests run while a terminator is attached, voltage levels at the SCSI bus connector are different than expected and a selftest failure results.

CAUTION

Do not switch off any peripheral on the SCSI bus without first checking that the bus is not active.

Switching off can cause data loss and/or indeterminate bus states.

To run the poweron selftest, perform the following steps:

1. Insert a formatted disk into the drive either from a storage slot location or through the mailslot/control panel.
2. Remove power from the optical disk library. Press both the power switch on the back panel and the operation switch on the front panel.
3. Remove the disk library top cover and side panels so that you can observe the LEDs on the front of the optical drive mechanism.

Follow the steps in Section 5.4.1, Service Access .

4. Switch on both the rear panel power switch and the front panel operation switch, and wait for the poweron selftest to complete.

Note

A failure will occur under the following circumstances:

- if an UNFORMATTED disk is used during the test
 - if the host is not powered up and properly terminated
 - if the host is not connected and the drive is not correctly terminated.
-

The Poweron Selftest will have one of the following results:

Indication	Description	Further Diagnosis
The busy and the fault LEDs turn off.	No failure has occurred.	
The fault LED remains lit.	A failure had occurred.	Connect the offline diagnostic tool to determine failure.

Indication	Description	Further Diagnosis
The LEDs do not light at all, and the disk does not load.	There are possible loose power connections.	Check all power connections for the drives.

4.3 Optical Disk Cleaning

Note

Cleaning an optical disk is needed more commonly on standalone drives than with autochangers because of the differences in their environments and usage. While the following information is therefore more applicable to standalone drives, an autochanger may be used in such a way as to make the following cleaning information apply. Disk cleaning for libraries in general, however, is NOT RECOMMENDED as a normal user task.

Disk cleaning should only be done after a read/write failure or if a customer notices a loss of autochanger performance. In addition, it must be determined that the failure or loss of performance was not caused by a definite hardware failure.

A failure to read a disk may result from:

- hardware failure
- contamination of the disk surface
- contamination of the drive objective lens

On an otherwise working drive, check to see that the most current firmware code level is being used and/ or that all applicable service notes have been done. If so, contamination could be a cause and cleaning may be necessary.

In the case of a read failure, cleaning might be the only way to get the customer's data back. In the case of performance loss, a few minutes spent cleaning may prevent unnecessary replacement of service parts and present an opportunity to "fix the site" and help the customer prevent contamination in the future.

The following are recommendations for preventing contamination of disks and the disk drive:

- Place the library away from high traffic areas.
- Do not leave a disk in the drive for extended periods of time if possible.

- Do not use the library in "dirty" environments such as coal mines, railroad maintenance yards, etc.

4.3.1 Cleaning Tools Available

Disks may be cleaned with the Optical Disk Cleaning Kit (C1700-88800). This kit contains swab s and alcohol, cleaning instructions, and a special cartridge holder that keeps the sliding sleeve open. Refer to Appendix B, Basic Supplies and Reorderable Parts.

Note

If the problem appeared as loss of performance and cleaning a disk solved the problem, another couple of steps must be done to regain performance using that disk.

As performance was declining because of read/write problems, the disk was probably becoming fragmented through excessive "sparing." To regain performance, the data on each side of the disk should be stored, each side of the disk reformatted, and the data restored back on the disk.

CAUTION

Do not attempt to clean the optical drive objective lens

Although disk drive cleaning kits are available, they cannot be used with the RW510/RW511/RW530. Using these kits to clean the drive in these libraries will damage the optical disk mechanism.

4.4 Using the Eject Tool to Remove a Disk from the Drive

The optical drive mechanism does not automatically eject a disk from the drive if a power failure occurs. If you need to manually remove a disk from a drive with no power, you must use the eject tool.

If you do not have an eject tool for the optical drive, you may order one of the following (refer to Appendix B for order information):

- Hewlett-Packard part number—C1701-88803
- Marshall Industries part number—R3322

You may also use a small flat-head screwdriver with the following dimensions:

Length	50 mm
Width	2.45 mm
Thickness	.5 mm

A disk can be removed from the drive while the drive is still secured in the autochanger. Follow the service access procedures in Section 5.4.1 to access the front of the drive mechanism, and then perform the following steps to remove a disk from the drive:

1. Disconnect all power to the drive if you have not done so already.
2. Insert the eject tool into the small round hole in the front panel of the drive.
3. Turn the eject tool in a **clockwise** direction (approximately 20 complete rotations) until the disk is ejected through the front of the drive.

CAUTION

Do not reach into the drive to get the disk. Wait until the disk is ejected through the front of the drive before removing it. Premature removal of the disk could damage the drive.

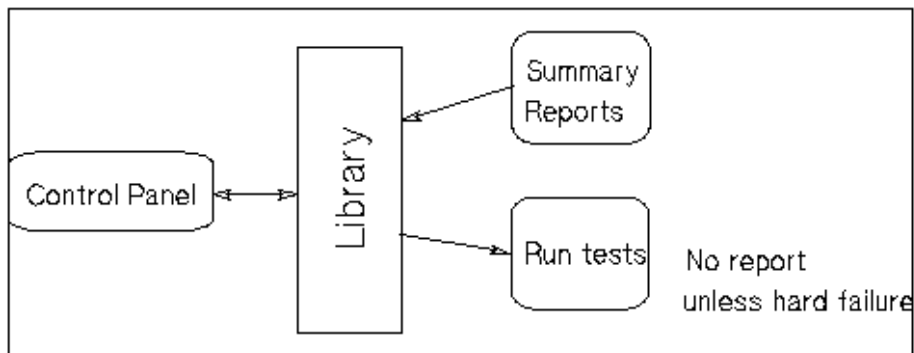
4.5 Troubleshooting Using the Control Panel and Observation

When there are errors in autochanger movements, two main approaches are available to get information and to run exerciser tests. The approach usually depends on whether the error encountered was a **hard** error or whether it was a **soft** (intermittent) error.

- Troubleshooting Using the Control Panel and Observation - This method (described in this section) is usually used in situations where you have a hard error.
- Troubleshooting Through the SCSI Bus - This method (described in the next section) is used in situations where you have a soft (intermittent) error.

Error information and logs accessed through the control panel are summarized. By knowing how the autochanger operates and using the summarized information from the control panel display, there is enough information to troubleshoot many problems that result in a **hard** error.

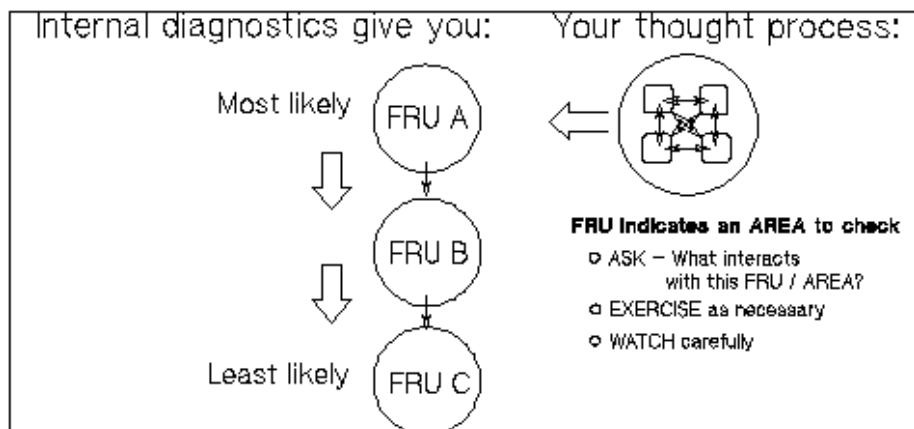
Figure 4-1 Information and Tests Through the Control Panel



4.5.1 The Autochanger Lists the First "Possibles"

At poweron, and after every failed move, the autochanger automatically runs an initialization sequence that comprehensively tests the autochanger. If a hard failure occurs, a list of *possible* FRUs that may have been at fault is returned. Keep in mind that these FRUs are not listed in any prioritized manner. The CE should visually verify the failure in progress to determine the most likely candidate.

Figure 4-2 The Autochanger Returns Suspect FRUs



Note

This test sequence returns possible failed FRUs only if there has been a **HARD FAILURE**. The test sequence will NOT find an intermittent failure. This test sequence, called the "FRU Isolation Test" (test 60), can also be run from the control panel. Similar to its automatic operation, this test sequence only points out ("isolates") FRUs if there has been a hard failure.

What the Autochanger Assumes—

The FRU Isolation Test assumes the following:

- There was a failure.
- The cause of the failure was physical (either mechanical or in the electronics).
- There is only one failed component. Simultaneous failures of unrelated items are not considered possible for purposes of this test.
- Service will be done, if necessary, if a problem is found (i.e., the unit does not have to be left in a "clean" state).

The test takes advantage of this and does whatever is necessary to determine the cause of the failure. Disks are not intentionally rearranged, but if the picker starts this test with a disk in it, the position and orientation of that disk is unknown.

When an error occurs, the cause may be the power supply, cables, drive electronics, motors, encoders, belts, gear s, sensors, or picker. No assumption is made about the integrity of any of these components. To isolate the actual cause of the failure, a process of elimination is used.

The components are tested in a sequence that starts with the most basic functions and builds to the more complex, and interrelating components (i.e., the motors cannot be tested if the power supply is dead).

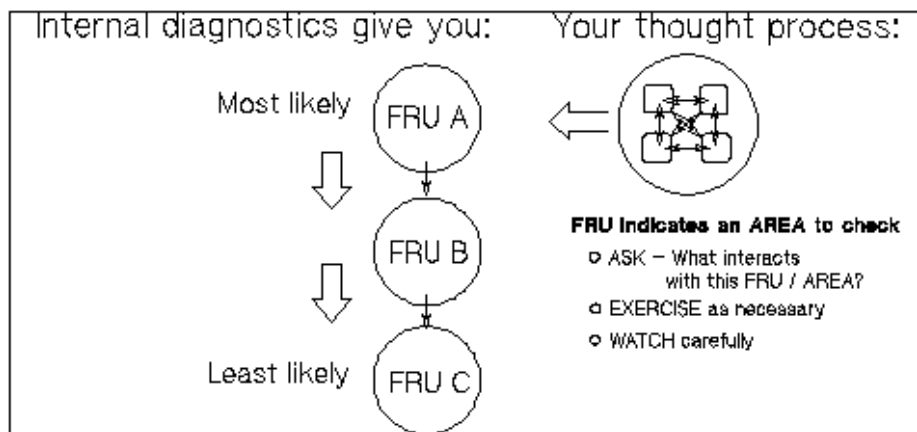
Whenever the initialization sequence is run, FIND HOME is attempted. If the "home" position cannot be found, the FRU isolation test is run automatically. When the FRU isolation test is run from the control panel, the FIND HOME sequence is run.

4.5.2 How to Use the Results of the Internal Tests

Similar to treating symptoms rather than the real problem, the suspect FRUs given by the FRU isolation test may actually mask the root cause of the problem.

The hard move error that caused the autochanger to run the FRU isolation test may have only been a PRODUCT of the actual problem. Blindly and repeatedly replacing the suspect FRU(s) will not solve the problem.

Figure 4-3 How Service Views the Suspect FRUs



If you consider the suspect FRU as a POINTER to the problem area rather than the problem itself, an educated visual inspection, with perhaps some cable and connector wiggling, should reveal the real problem.

A good visual inspection requires an understanding of how the autochanger acts under normal operation. This understanding can be achieved by completing the self-paced training for the autochanger and getting as much hands-on experience as possible. If you are familiar with the moves of the carriage/picker assembly during the FIND HOME sequence and you are familiar with the behavior of the drive, you will be able to more easily detect the real problem pointed to by a suspect FRU.

Note

The specific steps of the FIND HOME sequence and the possible errors which may result are listed in Section 4.10.

An example:

The autochanger fails with an error code of 4D (hexadecimal), "MOTION ERROR CHECKING FOR CARTRIDGE IN THE PICKER," and lists the picker (FRU 27) as the most likely failure. However, when you observe the unit while running the Wellness Test (test 2), you see that the picker is having trouble flipping. As you manually move the carriage/picker assembly around and touch the components

that are involved, you notice that the picker belt is abnormally tight. The belt is tight because the picker motor is skewed.

The error (4D) and suspect FRU gave an AREA to look at when troubleshooting. Visual inspection (concurrent with physical checks) helps to link the suspect FRU with the root cause by providing an area to examine. In the preceding example, the components that INTERACT with, and DRIVE the picker are examined.

Section 4.6.1, Hardware Error Codes and Recovery Procedures lists each error code and procedure for finding the cause of the error, using the autochanger's suspect FRUs as a guide. Error codes and recovery procedures are grouped by functional area in the autochanger.

At the BEGINNING of the list of errors for each functional group, you will find general HINTS about what areas should be checked when errors appear in that group. Be sure to check out those hints.

4.5.3 The FRU Isolation Test Sequence

The following list traces the execution of the FRU isolation test. A failure requires additional tests at that point to determine the actual cause. The original sequence is not continued if a test fails.

1. Look at the error code generated by the FIND HOME sequence, some codes may have obvious, implied FRUs.
(eliminates optical sensors and their cables)
2. Run autochanger controller PCA tests that do not cause host communication loss.
(eliminates power supply, power supply cables, ROMs, RAM, motor control IC, and microprocessor)
3. Check that the motors are capable of moving by attempting to move them very small distances in both directions.
(eliminates motor assemblies (except belts), motor cables, PCA drivers)
4. Pull picker fingers back. They should come to a hard stop with the leadscrew nut completely at the end of the leadscrew.
(eliminates the picker belt)
5. Move carriage/picker assembly toward the drive. It should come to a hard stop.
(eliminates the carriage belt)
6. Move carriage/picker assembly away from the drive. The move has to be far enough to be certain that the leadscrew can move, but not so far that a jammed cartridge will cause the test to fail.
(eliminates the carriage leadscrew assembly)

Note

If the FRU isolation test has been run from the front panel, the FIND HOME sequence will automatically be executed at this point.

7. At this point, there is some level of confidence that the system is capable of moving the carriage/picker assembly. Using the new information learned by running these tests, look at the error codes, the move ID that failed, and how the recovery system failed.

4.5.4 Information Logs

The optical autochanger control panel diagnostic tests have two major purposes. The first is to provide diagnostic information that can lead to early detection of an autochanger problem. The second is to provide fault isolation tests.

All the logs are maintained within non-volatile RAM, and so are not affected by cycling autochanger power. These logs are accessible from the control panel by using the INFO option.

Procedure

To display information about the autochanger (e.g., the error log or move success log) access the INFO option using the following steps.

1. With the autochanger power on and in the READY state, press **NEXT**. TEST * displays.
2. Press **NEXT** until INFO * displays.
3. Press **ENTER**.
4. Press **NEXT** or **PREV** until the desired log number is displayed.
5. Press **ENTER**. The log information will be displayed.

Note

Some logs will display more information when **NEXT** or **PREV** is pressed. Press **CANCEL** to stop the INFO display. Press **ENTER** to choose another log.

You have several information selections that are outlined in Section 4.12.

4.6 Recovery from Hardware Errors

When a hardware failure occurs, a message is displayed on the control panel. If the failure occurs during the poweron sequence, FAIL 1 is displayed. If the failure occurs at some other time, MISLOAD or FAIL 0 is displayed. If a failure occurs while you are running a test, FAIL # is displayed, where # is the number of the test that failed.

When you press **[ENTER]**, the autochanger displays information about the hardware failure.

The autochanger firmware can detect broken components such as a dead motor, a missing belt, etc., but if failures are due to marginal or random problems, the failing component may induce errors in other components. For example, if any portion of the electronics becomes intermittent or if friction increases on a part, different components of the autochanger may appear to fail at varied points as the autochanger runs its code. This results in many different error codes. Additional explanation of some hardware error codes follows the table of hardware error codes and recovery procedures.

Note

Instructions for running internal diagnostic tests are given in the "Diagnostics" section at the end of this chapter. A list of the available test choices and their descriptions are given in Section 4.8.

4.6.1 Hardware Error Codes and Recovery Procedures

The following table shows the hardware error codes possible and recovery procedures for specific hardware errors. In all cases, if you run a test, and no error occurs, monitor for reoccurrence. If the error repeats, use the list of suspect FRUs logged by the FRU isolation test as a guide to determine the problem. Replace the FRU(s) as necessary.

Some error codes require further explanation; see Table 4–1.

Table 4–1 Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
00	No error	No action.
AUTOCHANGER CONTROLLER PCA ERRORS		
		The first step is to make sure the autochanger controller PCA cables are seated in their connectors.
01	ROM Checksum Error	Run test 31—ROM Checksum Test – verify failure.
03	RAM Test Error	Run test 33—RAM Test—verify failure.
04	Microprocessor Test Error	Run test 30 – Microprocessor Operation Test—verify failure.
05	Controlled Area of RAM Checksum Error	Recycle Power—verify failure. If error repeats – run Configuration 66—Zeros all RAM locations and reboots. Caution: When this configuration is set to Clear, the product ID and the vendor ID are cleared. DO NOT use this configuration. If error repeats – replace AC Controller PCA (FRO 01). Poweron—check fix.
09	Firmware Error	Run test 3—Controller Test—(may not be able to duplicate).
SCSI INTERFACE-SPECIFIC ERRORS		
		Visual inspection is not possible for errors 0B to 13.
0B	SCSI Controller Register Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
0C	SCSI Controller IC's RAM Failed	Run test 34—SCSI Interface Controller Chip Test—verify failure.
0D	SCSI Controller Message Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
0E	SCSI Controller Command Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
0F	SCSI Controller Kill Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
10	SCSI Controller FIFO Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
11	SCSI Controller Target Sequence Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
12	SCSI Controller Com'nd Sequence Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
13	SCSI Controller Status Sequence Error	Run test 34—SCSI Interface Controller Chip Test—verify failure.
LOOPBACK ERRORS		CAUTION: Loopback test 41 will always fail when the SCSI repeater PCA is installed. All RW510 /RW511/RW530 units are shipped with the SCSI repeater PCA.
18	SCSI Connector Loopback Error in DBO or I/O	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
19	SCSI Connector Loopback Error in DB1 or C/D	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
1A	SCSI Connector Loopback Error in DB2 or MSG	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
1B	SCSI Connector Loopback Error in DB3 or REQ	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
1C	SCSI Connector Loopback Error in DB4 or ACK	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
1D	SCSI Connector Loopback Error in DB5 or ATN	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
1E	SCSI Connector Loopback Error in DB6 or SEL	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
1F	SCSI Connector Loopback Error in DB7 or BSY	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.
20	SCSI Connector Loopback Error in DBP or RST	Run test 41—SCSI Connector Loopback Test (using loopback connector 88780-60095) —verify failure.

MULTI-FUNCTION PERIPHERAL IC ERRORS

Visual inspection is not possible for errors 29 to 2B

29	RS-232 Loopback data did not match what was sent	Run test 35—Multi-function Peripheral Chip Test—verify failure.
2A	Timed out waiting for RS-232 loopback data	Run test 35—Multi-function Peripheral Chip Test—verify failure.
2B	Timer A did not count down as expected	Run test 35 – Multi-function Peripheral Chip Test—verify failure.

MOTOR CONTROL IC ERRORS

Visual inspection is not possible for errors 2C to 2E

2C	Failed read/write test to motor control IC	Run test 36 – Motor Control Chip Test—verify failure.
2D	Motor Control Loopback Test failed	Run test 36 – Motor Control Chip Test—verify failure.
2E	Motor Control IC RAM Test failed	Run test 36—Motor Control Chip Test—verify failure.

POWER SUPPLY ERRORS

Visually check the power cables and connections.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
33	Low voltage power supply failed	Run test 40—Power Supply Test—verify failure. If error repeats— measure 12V at 4-prong Molex that connects to J81 on mother PCA.
34	High voltage power supply failed	Run test 40 – Power Supply Test—verify failure. If error repeats— measure 12V at 4-prong Molex that connects to J81 on mother PCA.
DRIVE CONNECT ERRORS		
On error codes 38 and 39 be sure to check:		
• drive cabling – good contacts – no cut or exposed wires • drive tray not skewed		
38	Drive 1 not connected	Run test 37—Drive Connector Test—verify failure.
39	Drive 2 not connected	Run test 37—Drive Connector Test—verify failure.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures
MECHANISM ERROR CODES

		Check carriage/picker for free motion. The carriage should travel easily along the rails; you should be able to smoothly translate the picker across the carriage. The picker should also flip easily by pulling the picker belt.
3C	Unspecified mechanical failure	Run test 11—Autochanger Mechanism Exercise Test. On error—go to error code in this table.
3E	Unspecified servo failure	Run test 11—Autochanger Mechanism Exercise Test. On error—go to error code in this table.
		Check the appropriate area for loose labels or other obstructions (drive(s), picker, mailslot, magazine(s).)
40	Unable to free picker fingers for carriage motion	Run test 50—Find Home Sequence—verify failure.
41	Unable to verify picker is at home position (non-leadscrew side)	Run test 50—Find Home Sequence—verify failure.
42	Unable to find home position; Path-Clear sensors blocked	Run test 50—Find Home Sequence—verify failure.
43	Unable to clear Path-Clear sensors by moving picker fingers back	Run test 50—Find Home Sequence—verify failure.
44	Carriage motion failure during Find Home sequence	Run test 50—Find Home Sequence—verify failure.
45	Unable to free picker fingers for translate motion	Run test 50—Find Home Sequence—verify failure.
46	Carriage motion failed while initializing Home position (during Find Home)	Run test 50—Find Home Sequence—verify failure.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
47	Translate failed while moving toward non-leadscREW side during Find Home sequence	Run test 50—Find Home Sequence – verify failure.
48	Carriage motion failed during carriage/picker assembly calibration (leadscREW side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
49	Carriage motion failed during carriage /picker assembly calibration (non-leadscREW side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
4A	Motion error while determining orientation of the picker	Run test 50—Find Home Sequence—verify failure.
4B	No sensor found	Run test 50—Find Home Sequence – verify failure.
4C	Failed flip motion during Find Home sequence	Run test 50—Find Home Sequence—verify failure.
4D	Motion error checking for cartridge in the picker	Run test 50—Find Home Sequence—verify failure.
		Check the optical sensor, if necessary.
4E	Unable to measure height of sensor on the leadscREW side	Run test 51—Carriage/Picker Assy Calibration—verify failure.
4F	Unable to measure height of sensor on the non-leadscREW side	Run test 51—Carriage/Picker Assy Calibration—verify failure.

(continued on next page)

Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
50	Excessive tilt of the carriage/picker assembly (away from the drives)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
51	Excessive tilt of the carriage/picker assembly (toward the drives)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
52	Excessive cone angle on picker	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
53	Excessive stack tilt	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
54	Unable to complete an interrupted move (at power-up)	Run test 60—FRO Isolation Test—verify failure. If no error, monitor for re-occurrence. If test 60 shows an error code, look up the hardware error code in this table and follow the recovery procedures for that error.
55	Unable to find top of unit	Run test 51 – Carriage/Picker Assy Calibration—verify failure.

EXERCISER TEST ERRORS

56	Need to issue Initialize Status command	No FRUs failed. Run test 10 to initialize the element status.
57	Invalid test configuration	No FRUs failed. Check cartridge configuration. Check that the cartridge configuration (number and location) are correct for the test you are doing.
59	Exerciser unrecovered error	No FRUs failed. Exerciser had an unrecovered error. Rerun exerciser. If exerciser fails again— access the recovery log. <i>Recovery log is available only through the SCSI interface. Use the DOSDASS2 utility available through Hewlett-Packard. Refer to Appendix B for order information.</i>

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
5A	Invalid test configuration (elements reserved)	No FRUs failed. Can't do the selected test on a reserved cartridge. Check cartridge reservations. Rerun the test.
5B	Initialize Element Status command failed	No FRUs failed. The initialization of an element status failed. Rerun initialization. If initialization fails again— access the recovery log. Recovery log is available only through the SCSI interface. Use the DOSDASS2 utility available through Hewlett-Packard. Refer to Appendix B for order information.
5C	Shipping diagnostic run with cartridges in autochanger mechanism	No FRUs failed. Shipping warning. Take all disks out of the optical drive mechanism.
CALIBRATION SENSOR SYSTEM ERRORS		
60	Home sensor failed (leadscrew side)	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
61	Home sensor failed (non-leadscrew side)	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
62	Home sensor failed (leadscrew side near mailslot)	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
63	Home sensor failed (non-leadscrew side near mailslot)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
PATH-CLEAR SENSOR SYSTEM ERRORS		
64	Intermittent path-clear sensor beam (leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
65	Intermittent path-clear sensor beam (non-leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
66	Path physically blocked (leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
67	Path physically blocked (non-leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
6B	Path-clear LED failed (leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
6C	Path-clear LED failed (non-leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
6D	Path-clear sensor failed (leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
6E	Path-clear sensor failed (non-leadscrew side)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
6F	Path-clear sensor system failed	Run test 51—Carriage/Picker Assy Calibration—verify failure.

MAILSLOT/STORAGE SLOT ERRORS

		Check for loose labels or other obstructions in errors that involve the mailslot (B0-B2).
B0	Mailslot will not rotate	Run test 17—Mailslot I/O Test—verify failure.
B1	Inside mailslot sensor failed	Run test 17—Mailslot Sensor Test—verify failure.
B2	Mailslot will not accept or release cartridge	Run test 17—Mailslot I/O Test—verify failure.
		Check for loose labels or other obstructions in errors B3 and B4. Also, make sure that the storage slots are not skewed.

(continued on next page)

Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures

Hardware Error Code (Hex.)	Error Description	Recovery Procedures
B3	Storage slot will not accept or release cartridge	Run test 15—Storage Slot Test—verify failure.
B4	Outside mailslot sensor failed	Run test 17 – Mailslot I/O—verify failure.

DRIVE ERRORS

The autochanger only checks for the PRESENCE of a drive. To run complete drive tests requires an external diagnostic.

On drive error codes, check all cabling to/from the drive for:

- no broken wires
- no worn cables
- no loose connections

Check the drive tray.

B8	Drive 1 access error	Run test 16—Drive I/O Test – verify failure.
B9	Drive 2 access error	Run test 16—Drive I/O Test – verify failure.

DRIVE EJECT ERRORS

BC	Drive 1 access failure	Run test 16—Drive I/O Test – verify failure.
BD	Drive 2 access failure	Run test 16—Drive I/O Test – verify failure.

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Table 4–1 (Cont.) Hardware Error Codes and Recovery Procedures
FRU DETECTION TEST ERRORS

		Check carriage/picker for free motion. The carriage should travel easily along the rails; you should be able to smoothly translate the picker across the carriage. You should be able to easily flip the picker using the picker belt.
C8	Unable to gain proper servo control of motors	Run test 60—FRU Isolation Test—verify failure. Replace the FRU(s) if necessary.
C9	Unable to move picker motor	Run test 60—FRU Isolation Test—verify failure.
CA	Unable to move carriage motor	Run test 60—FRU Isolation Test—verify failure.
CB	Unable to move either motor	Run test 60—FRU Isolation Test—verify failure.
CC	Unable to find a hard stop while turning the picker motor	Run test 60—FRU Isolation Test—verify failure.
CD	Unable to find a hard stop while turning the carriage motor	Run test 60—FRU Isolation Test—verify failure.
CE	Excessive force needed to move the carriage leadscrew	Run test 60—FRU Isolation Test—verify failure.

MISCELLANEOUS ERRORS

FB	Door interlock open	
FC	The test can only be run from the control panel or from the RS-232 interface	
FD	The test can only be run from the SCSI interface	
FE	The test did not run	Probably a configuration error
FF	Invalid test number	

4.6.2 Additional Explanation of Some Hardware Error Codes

Error Codes	Explanation
05	Controlled area of RAM checksum error. All of the RAM on the autochanger controller board has battery back-up, but not all of it needs to be retained upon power loss. The portion of the RAM which needs to be valid at poweron is referred to as "Controlled RAM". The stored checksum is re-calculated on this area every time the "Controlled RAM" is modified. The checksum is verified by Test #32. Error 05H is returned any time the calculated checksum does not match the stored checksum. To reset the checksum, clear Configuration 16 using the control panel and switch the autochanger off and on again. This error is deemed to be so unacceptable that all autochanger function is halted. The motors are turned off and the SCSI bus is not accessed.
09	Firmware error There are three conditions where this code is used: 1. case statement which falls through 2. stack overflow 3. divide by zero In case 1, the error code is returned over SCSI to the host. In cases 2 and 3, the motors shut down, the processor halts.
43-4C	Refer to <i>Offline Diagnostics for Hewlett-Packard Optical Storage Products</i>. Refer to Appendix B for order information.
50	Excess upward droop on picker.
51	Excess downward droop on picker. "Droop" is the distance between where the end of a perfectly perpendicular picker (in relationship to the carriage) would be, and where the end of this picker is MEASURED to be. If the picker droops down too far, it will not be able to engage the mailslot correctly. It will first engage the translate pin and move across, rather than out.
52	Excessive cone angle on picker. If the sum of the upward droop on one side of the picker plus the downward droop on the other side of the picker is too great for proper operation, this error is returned.

Error Codes	Explanation
53	Excessive stack tilt. The height of each side of the autochanger, or "stack", is the height of each of the two sensors. Tilt is the measure of the difference of the heights of the sides. If the tilt is too great for proper operation, this error is returned.
54	At power up, unable to complete an interrupted move. If a move was interrupted by a power failure, at the next poweron the autochanger will attempt to return the library to the state it was in before that command was issued. This error is returned if all the poweron tests pass, but the autochanger is unable to put the cartridge(s) back.
B8-BF	Drive Errors. Errors B8 through BB appear when a drive cannot come to a READY state. Errors BC through BF appear if there is a problem either inserting or ejecting a cartridge. These errors also occur when either the drive eject mechanism has failed or the drive eject-control solenoid will not allow the cartridge to come out and be grabbed by the picker.
C8	Unable to close the loops on the motors. When this error occurs, the FRU Isolation code has already confirmed that the motors and encoders appear functional. But, for some reason, the servo system is unable to initiate proper control. This condition is rare.
CC	Unable to find a hard stop while turning the picker motor.
CD	Unable to find a hard stop while turning the carriage leadscrew motor. The FRU Isolation code checks for the presence of the belts by turning the motors until the mechanical system hits something. These errors are returned if the motors continue to spin longer than the maximum expected distances.

4.7 Error Information through SCSI Commands

When there are errors in autochanger movements, two main approaches are available to get information and to run exerciser tests. The approach usually depends on whether the error encountered was a **hard** error or whether it was a **soft** or intermittent error.

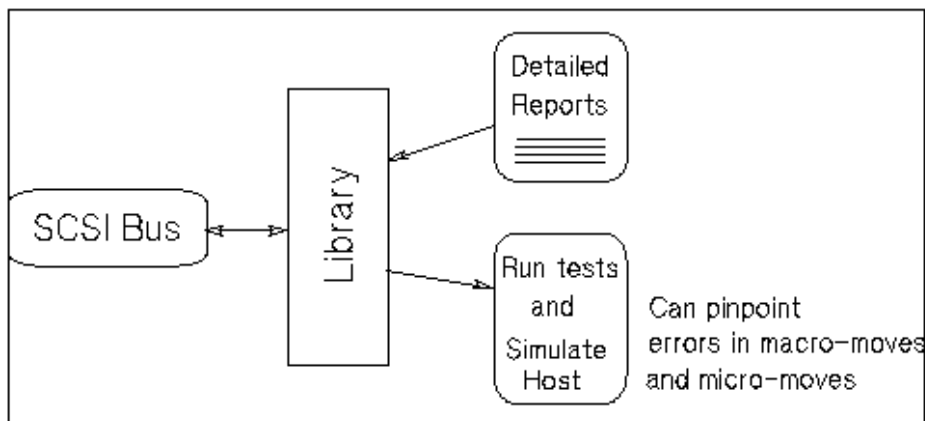
- Troubleshooting Using the Control Panel and Observation - This method is usually used in situations where you have a hard error.
- Troubleshooting Through the SCSI Bus - This method is used in situations where you have a soft or intermittent error.

Using data on the SCSI bus, you can determine exactly what the autochanger was doing when a failure occurred; all the way down to the macro-move and micro-moves.

Also, through the Log Sense and Request Sense commands, you can gather information on the optical drives; which cannot be done through the control panel.

Refer to Appendix A for information on decoding VMS error logs and SCSI-2 error codes.

Figure 4-4 Information and Tests Through the SCSI Bus



An external utility is needed to read the data on the SCSI bus. Hewlett-Packard offers a diagnostic utility called *DOSDASS2* that provides this capability. This utility is not offered to the field. It is available from Hewlett-Packard or Digital CSC. Refer to Appendix B for order information.

4.8 Diagnostics

Several diagnostic programs and tests are available for the disk library. This chapter gives information on how to run these tests/programs or where to find this information.

The main type of diagnostic available for the disk library are internal diagnostics. These tests are run from the control panel and are divided into four groups: sequence tests, exerciser tests, electronic core tests, and mechanism core tests. These tests are fully explained in Section 4.9. Instruction for running these tests are provided in this chapter.

4.8.1 Offline Diagnostics

A diagnostic utility called *DOSDASS2* is available from Hewlett-Packard for accessing the optical disk library through the SCSI bus.

DOSDASS2 fully exercises either standalone multifunction optical drives or autochangers that contain multifunction optical drives. Information for getting and using *DOSDASS2* is found in Appendix B.

4.8.2 Internal Diagnostic Tests

An extensive set of internal diagnostic tests is available for the autochanger. Except for the poweron sequence test, the running of tests is not automatic. The operator may initiate each test from the control panel.

A test is actually a sequence of separate tests that are called and run in series. Each test exercises a specific portion of the autochanger. Each test is identified by a test number that is requested when the test is to be run. Tests return either PASS or FAIL.

All the tests are combined into groups of similar functions.

Sequence Tests (1 - 9) execute sequences of individual tests within the range of test 10 through test 69. Sequences may be used to either test many portions of the autochanger or as an autochanger exerciser. When a sequence test is selected, the autochanger executes the test s in sequence until an error occurs or until the sequence successfully completes.

Exerciser Tests (10 - 29) do simple autochanger mechanism moves to check out elementary functions.

Electronics Core Tests (30 - 49) run basic tests of the autochanger controller PCA.

Autochanger Mechanism Core Tests (50 - 75) run basic tests of the autochanger mechanism. These tests make combinations of moves that can help to detect the source of failures.

Instructions for running these tests are given in the following section. A complete listing of diagnostic tests can be found in Section 4.9.

Procedure for Running Tests

1. With READY displayed, press **OPTION**. TEST * displays.
2. Press **ENTER**. TEST 0 displays.
3. Press **NEXT** or **PREV** until the needed test number displays.
4. When you press **ENTER** for the chosen test, ONCE displays.
You may accept ONCE by pressing **ENTER** or press **NEXT** or **PREV** to choose 10, 100, 1000, or LOOP test repetition times.
LOOP indicates that the test runs continuously until **CANCEL** is pressed or the unit is switched off.

Note

All tests except test 39 may be stopped by pressing **CANCEL**. The current test iteration completes. To stop test 39, press **CANCEL** twice.

5. Once you press **ENTER** for the number of test iterations, TESTING displays.
6. The test runs. If no problems are re-encountered, the message FAIL ## displays. Press **ENTER** to gain information about the failure. An ERROR ## displays. Relevant information is stored in the autochanger Error Log (Log 0). Press **CANCEL** or **OPTION** to exit this display.

4.9 Diagnostic Test Command Descriptions

The following is a description of the diagnostic test commands. Sequences may combine both exercisers and tests.

Sequence Tests

Table 4–2 Sequence Tests

No.	Test Name	Description
1	Poweron	Checks all digital data paths and normal machine operation. This test runs the same sequence of TESTS as when initiated by an actual power on, but does NOT do all operations (see below). Sequence Order: 3 - Controller Test 40 - Power Supply Test – Motor Connection Test (no number) 5 - Initialize Mechanism 46 - Board Configuration – Restore (if needed). If power failed in the middle of a move, the autochanger tries a "restore" of the last move. The autochanger tries to put the cartridge back to where it came from. This attempt could fail (Poweron sequence would fail). POWERON ONLY. 10 - Initialize Element Status (if needed). 38 - "Light Show" in the indicators of the control panel. – Mailslot rotation (if not secured). This rotation could fail(Poweron sequence would fail). POWERON ONLY.
2	Wellness Test	Checks out the general capability of the autochanger. Needs one loaded cartridge; drives and mailslot empty.

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Table 4–2 (Cont.) Sequence Tests

No.	Test Name	Description
3	Controller Test	This sequence is run by the autochanger controller at poweron to check out all paths, and operation of the servo motor and autochanger circuitry. Sequence Order: 30 - Processor Test 31 - ROM Checksum Test 33 - Non-Destructive RAM Test 32 - RAM Checksum Test 34 - SCSI Interface Controller IC Test 36 - Motor Control IC Test 35 - Multi-Function Peripheral IC Test 31 - ROM Checksum Test 33 - Non-Destructive RAM Test 32 - RAM Checksum Test 34 - SCSI Interface Controller IC Test 36 - Motor Control IC Test 35 - Multi-Function Peripheral IC Test 37 - Drive Connect Test
5	Initialize Mechanism	Prepares the unit for movement. Sequence Order: - Initialize RAM variables to defaults 50 - Find Home

Table 4–3 Exerciser Tests

No.	Test Name	Description
10	Initialize Element Status	Does the same function as the SCSI Initialize Element Status command. It physically scans the entire unit to determine which storage slots and drives have disks.
11	Mechanism Exercise Test	Makes a combination of moves with a PASS/FAIL result. This exerciser is a sequence of other exerciser tests—12, 13, 14, 15, 16, and 17. This exerciser returns an error code #57H Invalid Configuration if there are no cartridges loaded into the unit, or if any drive is full. Needs one loaded cartridge.
12	Carriage/Picker Move Test	Moves the carriage/picker assembly the full length of the rails with the picker on first one side, then the other. Returns PASS/FAIL. No cartridges are required.
13	Translate Test	Makes a combination of moves with a PASS/FAIL result. It does several translations from various starting positions. No cartridges are required.
14	Flip Test	Makes a combination of moves with a PASS/FAIL result. It does several flips at various locations. No cartridges are required.
15	Storage Slot Test	Makes a combination of moves with a PASS/FAIL result. It moves a cartridge from a randomly-chosen full to a randomly-chosen empty slot, with a random flip. It then moves the cartridge back to its original storage slot with its original orientation. This exerciser returns an error code 57H, Invalid Configuration, if there are no cartridges loaded into the unit or if all storage slots are full. Needs one loaded cartridge.
16	Drive I/O Test	Makes a combination of moves with a PASS/FAIL result. It moves a cartridge from a randomly-chosen full slot to a drive, with a random flip. It then moves the cartridge back to its original slot with its original orientation. It does this once for each optical drive. Returns an error code 57H, Invalid Configuration, if there are no cartridges loaded into the unit or if any drive is loaded. Needs one loaded cartridge; drives must be empty.

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Table 4–3 (Cont.) Exerciser Tests

No.	Test Name	Description
17	Mailslot I/O	Makes a combination of moves with a PASS/FAIL result. It moves a cartridge from the lowest-numbered full slot to the mailslot with a random flip. It then moves the cartridge back to its original slot with its original orientation. Returns error code 57H, Invalid Configuration if there are no cartridges loaded into the unit or if the mailslot is full. Needs one loaded cartridge; mailslot must be empty.
18	Speed Factor Setting Utility	Allows the setting of the speed factor as the first parameter given. The speed factor determines how fast the system moves the mechanics. The number provides 1/Parameter speed (e.g., Parameter=3 runs the motors at 1/3 of full speed). This test can only be run from the SCSI Interface.
19	Zero Maximum Force Log	The maximum force log is initialized to all zeros.
20	Set Speed Factor to Full Speed	Allows the mechanics to be run at full speed.
21	Set Speed Factor to Half Speed	Allows the mechanics to be run at half speed.
22	Set Speed Factor to Quarter Speed	Allows the mechanics to be run at quarter speed.
23	Shipping	Moves the picker to the appropriate position for preparation for shipping.
24	Fill Picker	Moves a cartridge into the picker from the first storage slot.
25	Empty Picker	Moves a cartridge from the picker to the first empty storage slot.
26	Zero Runtime Log	The entire runtime log is initialized to all zeros.
27	Set Minimum Retries	This sets the number of retries to 1. This may be set to see if the chosen test is doing what you want it to do. After you are satisfied that the test is what you want, run test 28 which resets the number of retries to default values.
28	Set to Default Number of Retries	Resets the number of retries to powerup default values. Used after setting retries to 1 by test 27.
29	Zero Error Log	Zeroes the Error Log.

4.9.1 Electronic Core Tests

Table 4–4 Electronic Core Tests

No.	Test Name	Description
30	Microprocessor Operation Test	Does a functional check of the microprocessor. This test must shut down the servo system; a Initialize Mechanism Test is run when this test finishes.
31	ROM Checksum Test	Does a checksum verification of the ROM.
32	RAM Checksum Test	A checksum of the "Controlled" area of RAM is kept on a continuous basis. This test verifies that the checksum is still valid.
33	Non-Destructive RAM Test	Tests all the controller's RAM, checking for data acceptance and retention. The test is non-destructive to RAM unless interrupted by power failure. To run correctly, this test must shut down the servo system; as a result, a Initialize Mechanism Test runs when this test finishes.
34	SCSI Interface Controller Chip Test	Checks out operations of the SCSI interface controller chip. This test will not be run if initiated via SCSI, it reports PASS.
35	Multi-Function Peripheral Chip Test	Tests the functionality of the Multi-Function Peripheral chip. It verifies the timer by comparing it to the CPU clock and tests RS-232 capabilities with an on-chip loopback.
36	Motor Control Chip Test	Exercises the registers of the motor control IC. To run correctly, this test shuts down the servo system.
37	Drive Connect Test	Checks for expected drive configuration. This is done by polling the drive connect signal on each of the possible drives. This line is grounded at the drive end if a drive is connected. If the drives physically connected do not match the expected configuration, then an error is reported.
38	Control Panel Light Show	Lights each portion of the display individually and then together. No feedback; always passes.
39	Control Panel Button Check	Displays the name of the button pressed. Press CANCEL twice to exit.

(continued on next page)

Table 4–4 (Cont.) Electronic Core Tests

No.	Test Name	Description
40	Power Supply Test	Looks at both the 12-Volt and the 24-Volt power supplies to verify that they are within limits. The limits for the 12V supply are 11V and 13V and the 24V supply limits are 23.5V and 25.5V.
41	SCSI Connector Loopback Test (interactive)	Runs a loopback through SCSI connectors, checking proper operation of the SCSI drivers, receivers, and cables. Requires an external loopback hood with terminator power. Will not run if initiated via SCSI; if so, it reports error FCH Test Did Not Run.
42	Optical Sensor Test (and Mailslot) (interactive)	Checks the status of the two optical sensors. Also checks the status of the Mailslot sensor (see test 43). Three "0"s are placed on the control panel display; one at the left position in the display, one in the middle of the display, and one at the right position in the display. The mark is an open zero if the sensor is not blocked, and a zero filled in with lit segments if a sensor is blocked. No FRU is returned.
43	Mailslot Sensor Test (and Optical Sensor) (interactive)	See description for test 42.
50	Find Home Sequence	Moves the picker to a known "home" spot. This test assumes nothing about the state of the mechanics. The "home" location is at the lower left position of the box. The servo system is initialized to the "home" location. It then automatically runs test 51.
51	Carriage /Picker Assembly Calibration Test	Runs the portion of the mechanism recalibration related to the optical sensors. It measures sensor offsets and calculates picker tilt and droop. This test assumes that the mechanics and servo system are functional.
60	FRU Isolation Test	Assumes that something has physically failed, either electronic or mechanical. A series of special low level tests are run to select the three (or fewer) FRUs that are most likely to be at fault. Tests 30, 31, 33, 35, 36, 40, and 50 are executed as a part of the isolation process. Returns an error code, three suspect FRUs in decreasing order of fault probability, and a time stamp.

(continued on next page)

Table 4–4 (Cont.) Electronic Core Tests

No.	Test Name	Description
65	Calibrate Magazines	Calculates a min/max clearance for a magazine. (The selected magazine should be empty.) The autochanger requires a disk in the mailslot. The test passes if clearance is 85 encoder counts (1 mm) up and down. (See info 23 for actual values.) If this test is run by SCSI command, set Byte 1 to the magazine number. (Models 10C and 20T contain 2 magazines; Models 20C and 40T contain 4 magazines.) The test returns: PASS or FAIL.
66	Clear Magazine Offset	Clears the value calculated in test 65.
67	Calibrate Mailslot	Calculates an offset for the Mailslot. The Autochanger requires a disk in the Mailslot.
68	Clear Mailslot Offset	Clears the value calculated in test 67.
70 - 74	Reserved	For design/production use only.
75	UPS Test	Tests whether or not the UPS is connected properly. The test returns PASS if connected properly, FAIL if the UPS is not connected properly or if there is no UPS connected.
76 - 80	Reserved	For design/production use only.

4.10 The FIND HOME Sequence

The following FIND HOME sequence executes all the motions used in normal autochanger operation. Understanding the motions explained here, and the likely errors during these motions, should help you diagnose problems that may be occurring in the unit you are working on.

The following sequence lists each large movement in the FIND HOME sequence. If there is a problem during a movement, the most likely hardware error is listed after the movement in descending order of probability.

Hardware error numbers and recovery procedures are listed in Table 4–1.

Figure 4–5 shows the sequence graphically. The numbers of the following steps correspond to the numbers on the diagram.

Note

When running the FIND HOME sequence, you will be able to see what the mechanism was attempting when an error occurred by setting RETRIES to 1 (Test 27). When limited to a single execution, the autochanger is prevented from entering any error recovery sequences. If you want to examine movements more closely, set the speed to half or quarter speed (Test 21 or Test 22).

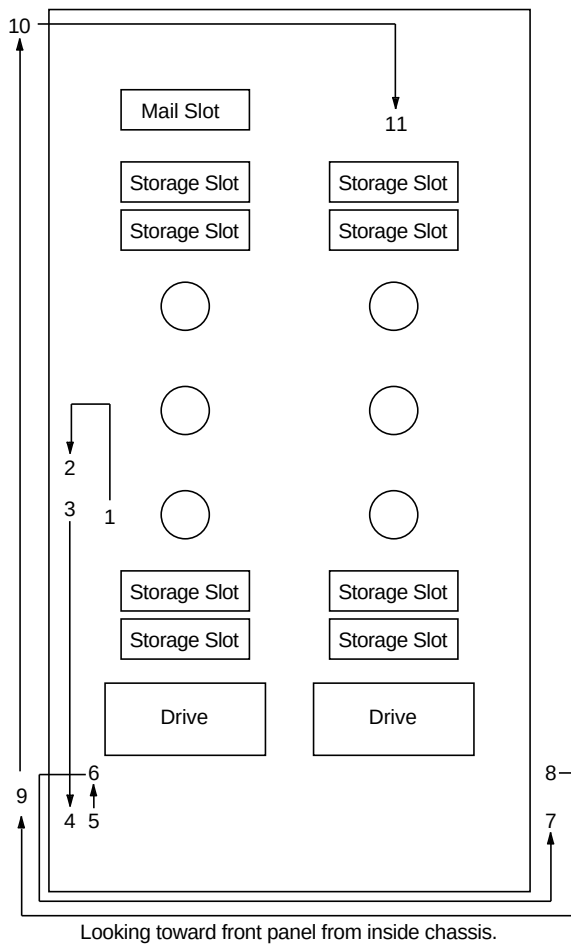
Possible errors are not accessible or displayed through the control panel. Errors returned are micro-move errors. Micro-move errors are explained in Section 6.1.1.

Note

Errors are expressed in hexadecimal format.

1. Clear the picker of any obstructions that would prevent carriage/picker movement.
 - a. Possible error:
 - 40–Unable to free the picker fingers in preparation for carriage motion.

Figure 4-5 The "FIND HOME" Sequence (deskside orientation shown)



2. Clear an area large enough to enable a flip to take place.
 - a. Possible error:
44–Carriage motion failure during the Find Home sequence.
3. Initialize the picker fingers by pulling the fingers back to a hard stop.
 - a. Possible error:
45–Unable to free the picker fingers in preparation for translate motion.
4. Initialize the carriage/picker position by moving it toward the drive-end of the until it hits a hard stop.
 - a. Possible error:
46–Carriage motion failed while initializing Home position during Find Home sequence.
5. Translate to the non-leadscREW side.
 - a. Possible error:
47–Translate failed while moving toward the non-leadscREW side during the Find Home sequence.
6. Verify Home position by looking at the sensor.
 - a. Possible error #1:
41–Unable to verify that the picker is at the home position during Find Home sequence (non-leadscREW side). (Could be a bad sensor.)
 - b. Possible error #2:
61–Optical sensor failed (non-leadscREW side - near drives)
7. Re-initialize the picker fingers by pulling the fingers back to a hard stop (this position may have been lost in the preceding step). (A slow slip occurs.)
 - a. Possible error:
45–Unable to free the picker fingers in preparation for translate motion.
8. Translate the picker to the leadscREW side. Then move the carriage/picker assembly to the maximum distance away from the drives.
 - a. Possible error:
48–Carriage motion failed during carriage/picker assembly calibration (leadscREW side).

9. Determine if there is a cartridge in the picker by plunging the fingers against a hard stop.
 - a. Possible error:
4D–Motion error while checking for a cartridge in the picker
10. Find orientation of the picker using the sensor on the leadscrew side.
 - a. Possible error #1:
4A–Motion error while determining the orientation of the picker.
 - b. Possible error #2:
4C–Failed flip motion during Find Home sequence.
 - c. Possible error #3:
60–Optical sensor failed (leadscrew side)
11. Calibrate the end of the picker with respect to the sensor on the leadscrew side. (Do twice, on each side of the picker, to make sure.)
 - a. Possible error #1:
48–Carriage motion failed during carriage/picker assembly calibration (non-leadscrew side).
 - b. Possible error #2:
4C–Failed flip motion during Find Home sequence.
 - c. Possible error #3:
60–Optical sensor failed (leadscrew side)
12. Calibrate the end of the picker with respect to the sensor on the non-leadscrew side. (Do twice, on each side of the picker, to make sure.)
 - a. Possible error #1:
49–Carriage motion failed during carriage/picker assembly calibration (non-leadscrew side).
 - b. Possible error #2:
4C–Failed flip motion during Find Home sequence.
 - c. Possible error #3:
61–Optical sensor failed (non-leadscrew side)
13. Translate to the non-leadscrew side. Then move the carriage/picker to the maximum distance away from the drives.
 - a. Possible error:

49–Carriage motion failed during carriage/picker assembly calibration
(non-leadcrew side)

14. If the picker leadcrew is NOT facing toward the mailslot actuator arm, the carriage/picker moves toward the drives a short distance and flips once.

- a. Possible error:

- 4C–Failed flip motion during Find Home sequence.

These steps are repeated, in order, until all pass or until any four failures accumulate. If four failures occur, the errors are diagnosed to three FRUs and a hardware error code is reported.

4.11 Micro-Move Reference Table for Viewing FIND HOME Sequence

Table 4–5 RW510/RW511/RW530 Micro-Move ID Table

Move ID (hex)	Description
0	No motion; no commands pending.
1	Carriage motion; full speed; away from drives.
2	Carriage motion; full speed; toward the drives.
3	Carriage motion ; move fingers forward during full speed; away from the drives.
4	Carriage motion; move fingers forward during full speed; toward the drives.
5	Full speed finger motion.
7	Pull fingers back to depress flip button.
8	Flip.
9	Verify flip complete.
A	Push fingers out to release flip button.
B	Translate picker from non-leadcrew to leadcrew side.
C	Translate picker from leadcrew to non-leadcrew side.
D	Verify picker translated from non-leadcrew to leadcrew side.
E	Verify picker translated from leadcrew to non-leadcrew side.
F	Release forces after translating picker from non-leadcrew to leadcrew side.
10	Release forces after translating picker from leadcrew to non-leadcrew side.
11	Move fingers toward storage slot; with intent to grab cartridge.
12	Detect cartridge in storage slot before grab, and during Initialize Element Status.
13	Take up the slack in the fingers before retracting all of the way back with cartridge.
14	Pull fingers back from storage slot with cartridge.
15	Move fingers forward to insert cartridge into storage slot.
16	Detect cartridge in storage slot after insert.
17	Pull fingers back from storage slot after releasing cartridge.

(continued on next page)

Table 4–5 (Cont.) RW510/RW511/RW530 Micro-Move ID Table

Move ID (hex)	Description
18	Move fingers toward drive; prepare to grab cartridge.
19	No motion; waiting for drive to eject the cartridge.
1A	Carriage shake; to assist the cartridge ejected from the drive to slide into the picker.
1B	Move fingers toward drive; with intent to grab cartridge.
1C	Pull fingers back from drive with cartridge.
1D	Insert cartridge into drive, until slider engages.
1E	Insert cartridge into drive, after slider is engaged.
1F	Move fingers with cartridge toward drive, determining distance of cartridge in drive. Look for drive to accept cartridge.
20	Drive failed to accept cartridge, pull fingers back with cartridge.
21	Drive accepted cartridge, release cartridge and pull fingers back.
22	Carriage motion during mailslot access.
23	Move fingers toward mailslot; with intent to grab cartridge.
24	Detect cartridge in mailslot before grab.
25	Take up the slack in the fingers before retracting all the way back with cartridge.
26	Pull fingers back from mailslot with cartridge.
27	Carriage motion during mailslot access.
28	Move fingers forward to insert cartridge into mailslot.
29	Detect cartridge in mailslot after insert.
2A	Pull fingers back from mailslot after releasing cartridge.
2B	Move leadscrew tab toward mailslot actuator arm before pulling mailslot in.
2C	Carriage motion toward actuator arm where mailslot is engaged before pulling mailslot in.
2D	Move leadscrew tab to mailslot actuator arm before pushing mailslot out.
2E	Carriage motion toward actuator arm where mailslot is engaged before pushing mailslot out.
2F	Rotate the mailslot when rotational position unknown.
30	Release tension on the rotate arm.

(continued on next page)

Table 4–5 (Cont.) RW510/RW511/RW530 Micro-Move ID Table

Move ID (hex)	Description
31	Release tension on the rotate arm.
32	Rotate the mailslot.
33	Rotate the mailslot.
34	Verify the rotation of the mailslot is complete.
35	Rotate the mailslot when rotational position unknown.
36	Check for a cartridge in the picker, same motion is used to check for a cartridge in mailslot or storage slot when picker contains a cartridge.
37	Pull fingers back during test for a cartridge.
38	Move fingers at full speed during test for a cartridge.
39	Positioning before and after test for a cartridge in drive.
3A	Check for a cartridge in the drive.
3D	Move carriage to drive bang position.
3E	Verify the presence of a cartridge by pressing cartridge against drive face.
3F	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (toward drives).
40	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (away from drives).
41	Short carriage motion to check for cartridge sticking out of a drive after insertion (toward drives).
42	Short carriage motion to check for cartridge sticking out of a drive after insertion (away from drives).
43	Short carriage motion to check for cartridge sticking out of a drive during error recovery (toward, then away from drives).
44	Translate slowly to leadscrew side in FIND HOME sequence.
45	Short translate after finding leadscrew side (toward non-leadscrew side).
46	Short carriage motion after finding leadscrew side of machine (away from drives).
47	Carriage motion toward drives; looking for hard stop in FIND HOME sequence.
48	Release forces after finding hard stop.

(continued on next page)

Table 4–5 (Cont.) RW510/RW511/RW530 Micro-Move ID Table

Move ID (hex)	Description
49	Carriage motion away from drives; finding room to flip in FIND HOME sequence.
4A	Fast carriage motion toward drives to flip position.
4B	Carriage motion toward drives finding room to flip in FIND HOME sequence.
4C	Fast carriage motion when flip area found in needed direction.
4D	Slow flips during FIND HOME sequence.
4E	Push fingers slowly out of picker after flips in FIND HOME sequence.
4F	Check for picker belts in FRU isolation tests, or slow finger motions during error recovery.
50	Carriage motion toward drives; looking for hardstop before measuring carriage travel.
51	Verify the maximum required carriage travel from drives.
52	Test for presence of cartridge by pushing against hard stop.
53	Long carriage motion during carriage/picker assembly calibration.
54	Short carriage motion during carriage/picker assembly calibration. (Fine measure)
57	Error occurred while inserting cartridge, push cartridge farther into storage slot.
59	Move fingers toward storage slot; during storage slot recovery.
5A	Pull fingers back from storage slot; during storage slot recovery.
5B	Carriage motion; during drive recovery.
5C	Carriage motion; during storage slot recovery.
5D	Carriage motion; during drive insert recovery.
5E	Slowly push fingers out then in during drive recovery.
5F	Drive recovery.
60	Drive recovery.
61	Short carriage motions during drive recovery (wobble motion).
62	Long carriage motion in drive recovery (toward, then away from drives).
63	Drive recovery, restore Z-axis in case of unexpected translate.
64	Pull fingers back into picker during recovery.

(continued on next page)

Table 4–5 (Cont.) RW510/RW511/RW530 Micro-Move ID Table

Move ID (hex)	Description
65	Pull fingers back from storage slot during storage slot recovery.
66	Carriage motion while testing for cartridge in drive during drive insert recovery.
67	Pull back fingers from drive after releasing cartridge during recovery.
68	Move fingers with cartridge towards drive, using short steps, look for drive to accept the cartridge during recovery.
69	Carriage motion during initial recovery (away from drives).
6A	Carriage motion during initial recovery (toward drives).
6B	Push fingers out of picker during initial recovery.
6C	Pull fingers back into picker during initial recovery.
6D	Carriage motion during initial recovery (away from drives).
6E	Carriage motion during initial recovery (toward drives).
6F	Checking for carriage motor belt in FRU isolation test.

4.12 Information Logs

The logs listed in Table 4–6 are accessible from the control panel by using the INFO option.

Table 4–6 Information Logs (INFO Logs)

No.	Log Name	Description
0	Autochanger Error Log	The autochanger maintains a time-stamped history of past diagnostic test errors that have occurred within the autochanger. The error message maintained for each error indicates the failure and the possible Field Replaceable Units (FRUs) that may have caused the failure. Displays as follows: Err <i>n y</i> - <i>n</i>th error; actual error code FRU <i>A</i> - suspect FRU #1 FRU <i>B</i> - suspect FRU #2 FRU <i>C</i> - suspect FRU #3 Test <i>n</i> - test that failed <i>abcdefgh</i> - time stamp
1	Firmware Version Number	Displays the current autochanger firmware version number.

(continued on next page)

Table 4–6 (Cont.) Information Logs (INFO Logs)

No.	Log Name	Description
2	Element Status	Displays the status (empty or full) of the selected autochanger element. Displays three numbers: First Number = Element number 0 = picker 1 = drive 1 2 = drive 2 10 = mailslot 11 - 42 = storage slots Second Number = Element type 1 = picker 2 = storage slot 3 = mailslot 4 = drive Third Number = Data mask 00 = empty 01 = full
3	Software Clock	Displays the current "count" in seconds of the software clock. (hexadecimal)
4	Drive Load Count	Displays the number of cartridge loads for either drive 1 or drive 2.
5	Poweron Hours	Displays the number of hours the unit has been powered on.
	The term Move used in Logs 6 - 10 means SCSI-level moves by the picker mechanism.	
6	Current Move Success Count	Displays the number of successful moves since the most recent autochanger failure.
7	Move Success Average	Displays the average of the values in Log 10 - Move Success Log.
8	Current Move Retry Count	Displays the number of move retries done since the most recent autochanger failure.

(continued on next page)

Table 4–6 (Cont.) Information Logs (INFO Logs)

No.	Log Name	Description
9	Total Move Count	Displays the total number of moves and move attempts.
10	Move Success Log	Contains the number of successful moves that have occurred without a failure. Each time a failure occurs, the number of good moves is entered into the log and a new count is started. This INFO display shows the most recent 10 (or less) entries in the log. This log also shows the retry counts corresponding to each log entry. Example (2 displays for each entity): <pre> 1 33482 3 </pre> First display: 1 = entry number and 33482 = number of moves Second display: 3 = number of retries
11	Display Runtime Log	Flashes to each display until CANCEL is pressed. A - Moves done B - Retries C - Automatic recoveries D - Hard errors
12	Display Flip Count	Displays total number of picker flips.
13	Display Translate Count	Displays total number of picker translates.
14	Display Mailslot Rotation Count	Displays total number of mailslot rotations.
15	Number of Drives	Displays the number of disk drives in the unit.
16	Drive #1 SCSI Address	Displays drive #1's SCSI address.
17	Drive #2 SCSI Address	Displays drive #2's SCSI address.
20	Sensor Height	Displays the measured height of the picker sensor. (hexadecimal)

(continued on next page)

Table 4–6 (Cont.) Information Logs (INFO Logs)

No.	Log Name	Description
21	Picker Cone Angle	Displays the measured picker cone angle from the nominal position. (hexadecimal) The cone angle is the sum of the upward droop on one side of the picker plus the downward droop on the other side of the picker.
22	Stack Tilt	Displays the measured stack tilt of the box. (hexadecimal) The height of each side of the autochanger, or "stack", is the height of each of the two sensors. Tilt is the measure of the difference of the heights of the sides.
	Right & Left Stack Offset	Displays left/right stack offset.
23	Magazine 1	
24	Magazine 2	LEFToffsetRIGHToffset (hexadecimal)
25	Magazine 3	Example:
26	Magazine 4	00DC0028 = 220, 40 FFEC0014 = -20, 20

5

Removal and Replacement

5.1 Field-Replaceable Assemblies

This chapter explains the procedures to remove damaged or nonfunctional components of the disk library system, and then to replace these components with new ones. The servicing of components is organized as follows:

- power supply
- autochanger controller PCA
- SCSI repeater PCA
- autochanger controller PCA code
- MO drive code
- MO drives
- carriage/picker assembly
- carriage motor
- carriage leadscrew
- picker motor
- leadscrew-side carriage way (rail)
- mailslot assembly
- power supply fan
- interconnect PCA

5.2 ESD Precautions

The optical disk library contains very sensitive electrical components. It is **EXTREMELY IMPORTANT** that you follow the proper procedures for preventing ESD (Electrostatic Discharge). Use wrist-grounding straps, anti-static mats, and anti-static work stations when removing and replacing the major assemblies.

CAUTION

Failure to follow proper procedures could lead to intermittent failures and/or premature hard failures in the disk controller and mechanism.

5.3 Tools Required

- #7, #10, #15, Torx®;
- #2 Pozidriv with at least a 10-inch shank (picker removal)
- Medium slot-blade screwdriver
- 3/16- and 7/64-inch Allen wrenches
- 7/16-inch socket or box-end wrench (or crescent wrench)

Note

The deskside option orientation is used in most explanations of disassembly and re-assembly. If access or parts are different between the deskside and rackmount options, these differences are noted.

5.4 Assembly/Disassembly Procedures

WARNING

Be sure to disconnect the power cord before taking the disk library apart to prevent possible electrical shock.

CAUTION

Do not press the optical disk library operation switch to standby or unplug the AC power cord until you are sure that the SCSI bus is inactive. Either selecting standby mode on the operation switch or unplugging the power cord when the SCSI bus is active can cause data loss and/or indeterminate bus states. (Check the host system reference manuals for information on checking the status of the SCSI bus.)

CAUTION

If you will be working on or around the disk magazines, record the slot location and orientation of each cartridge to make sure that the disks can be restored to their original positions if moved.

Always return disks to their original slot and orientation before returning control back to the customer. Serious loss of system integrity will result if this practice is not followed.

5.4.1 Service Access

Keep the following information in mind when servicing an optical disk library system.

WARNING

The magneto-optical drive mechanisms in the autochanger become Class 3B laser mechanisms when disassembled. If a drive is disassembled, exposure to the invisible laser beam and hazardous invisible laser radiation could result in blindness.

CAUTION

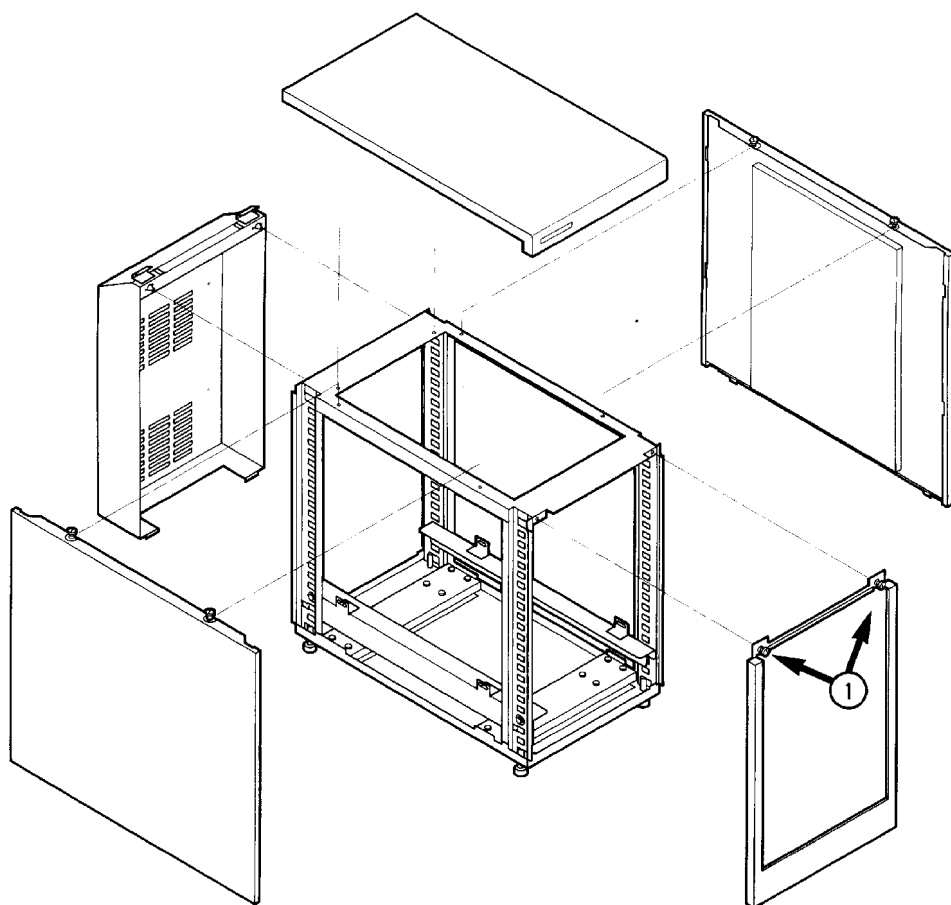
DO NOT disassemble the drive mechanisms. A drive that has been disassembled will **not** be accepted as an exchange assembly.

5.4.2 Deskside option—Removing the Cabinet, Rear Cover, and Front Panel

Cabinet

1. The *top cover* is removed by lifting it from the rear, pushing it slightly towards the front, and lifting it off.
2. Each *side panel* is held at the top by two captive, slotted-head screws. Loosen the screws and pull the panel up and away.

Figure 5-1 Service Access



Rear Panel

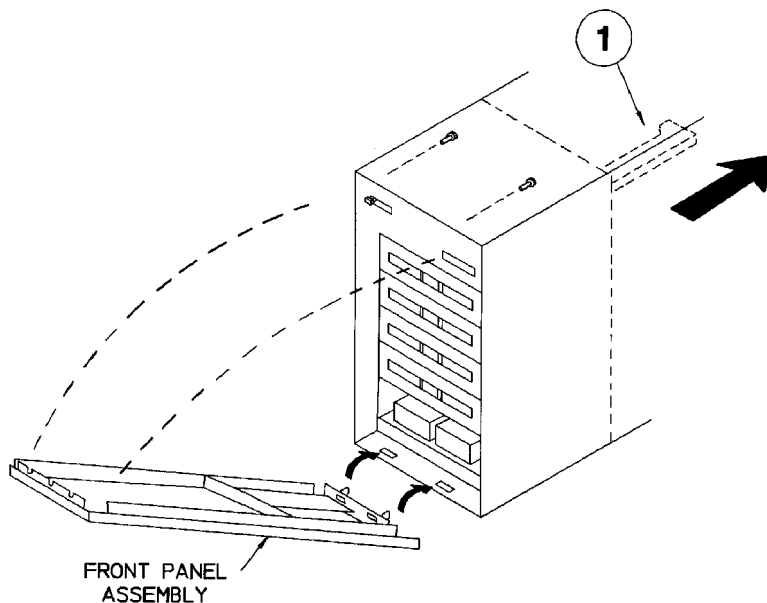
The *rear cover* is held by two snaps at the top. Pull the top of the panel back to release the snaps.

Front Panel

1. The *front panel bezel* is held by two captive screws as shown in Figure 5–1.
2. The *front panel* is held by two Torx screws accessed from the rear of the front panel display (Figure 5–2. Remove these screws and then push a screwdriver through the center, top slot to separate the front panel from the chassis.

The front panel plastic is attached to a metal backing plate. These two pieces should be handled as a single unit. *Do not attempt to separate the pieces.*

Figure 5–2 Removing the Front Panel



When re-assembling:

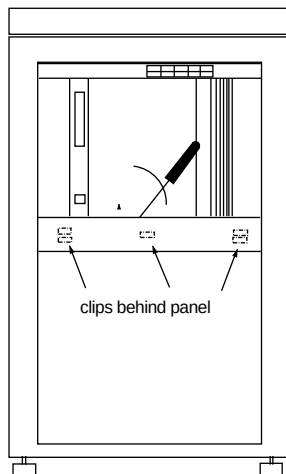
The mailslot door must be lowered to re-install the front panel. Manually pull the mailslot actuator arm all the way back before placing the front panel into position. See Figure 5–2 (1) for the location and movement of the actuator arm.

5.4.3 Rackmount option—Accessing the Autochanger Chassis

1. Remove the rackslide handle cover by inserting a flat-blade screwdriver between the cover and the handle (near the middle of the cover) and GENTLY pry the cover away from the handle (Figure 5–3).

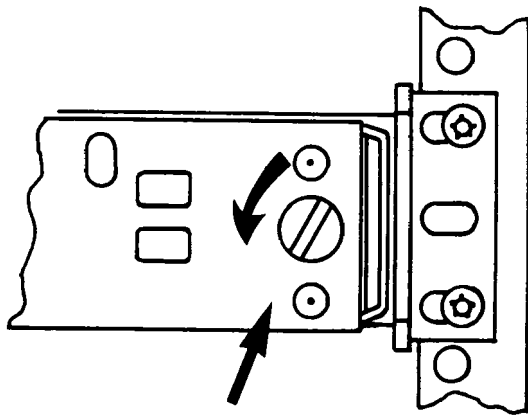
The cover is held by plastic clips near each end and in the middle. If the cover bends but does not release, try moving the screwdriver toward an end while continuing to pry the cover off.

Figure 5–3 Removing the Slide Handle Cover



2. Unlock the slide from the rack by rotating the slotted screws on each side of the handle AWAY from the rack vertical members (rotate the left screw clockwise; rotate the right screw counterclockwise). Figure 5–4 shows the right-side screw and how it is rotated to release the latch.

Figure 5-4 Unlocking the Slide Assembly (Right Side)



3. Pull the slide out until you hear it lock into place.

5.4.4 Rackmount option—Removing the Front Panel

1. The *front panel* is held by two Torx screws as shown in Figure 5–5.
2. Loosen the two screws.

WARNING

The front panel is held in place by two tabs in slots on the drive-end of the chassis (right side as you face a rackmount unit). Be careful when rotating the panel out. When the tabs rotate free from the right side, the panel may drop.

3. Rotate the left side of the front panel outward. **SUPPORT** the right side of the front panel and pull slightly to the left to free the front panel from its tab supports.

Figure 5–5 Front Panel Mounting Screws (Rackmount Option)

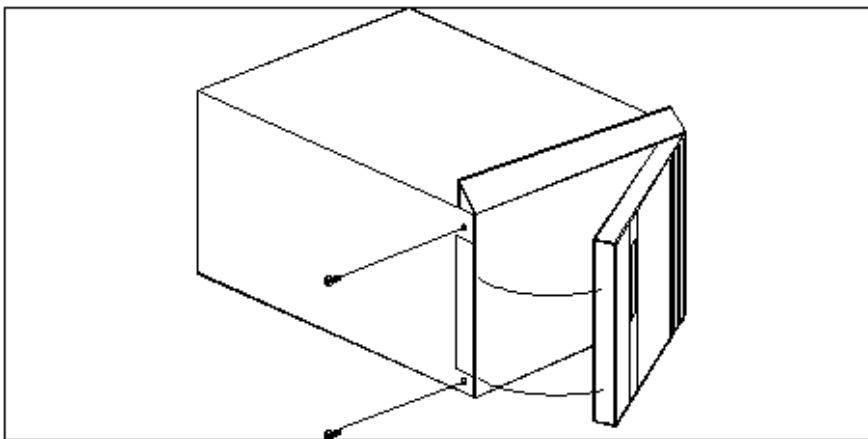
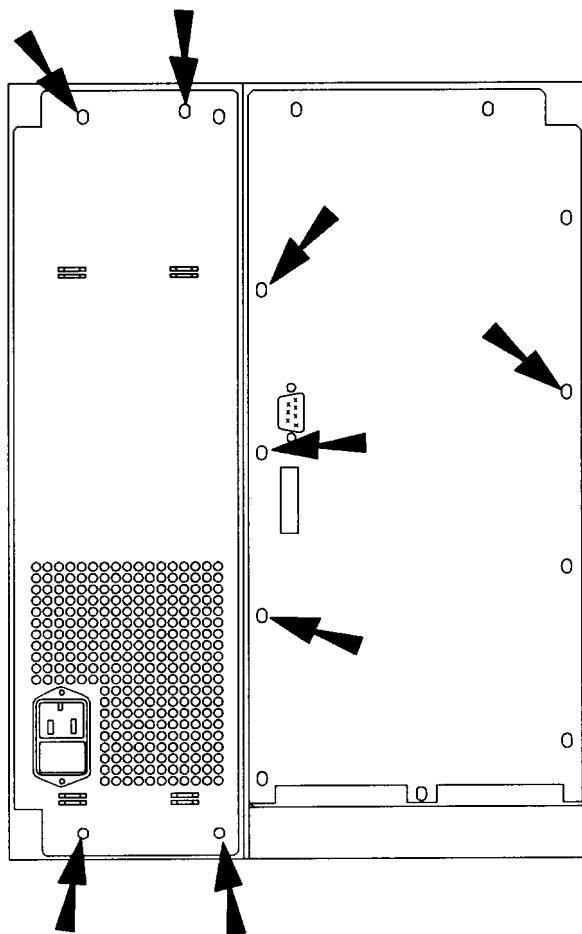


Figure 5-6 The Rear Access Panel and Power Supply

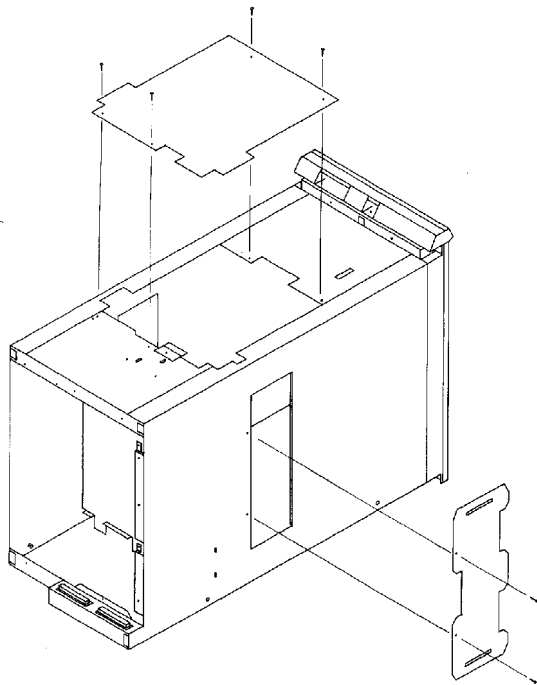


5.4.5 Deskside and Rackmount Electronics and Mechanism Access

- The *rear electronics access panel* is the panel to the right in Figure 5–6. This panel is held by 11 Torx (T-15) screws. The left panel shown in Figure 5–6 is the power supply and is held by 4 Torx (T-15) screws.
- Four Torx (T-10) screws hold the panel covering the large chassis access panel (Figure 5–7).
- Two Torx (T-15) screws hold each panel over the two small, rectangular access panels . On rackmount models only one of these smaller access panels is available while the chassis is mounted on the rackslide (Figure 5–7).

The chassis orientation depends on whether the unit is a deskside model or a rackmount model.

Figure 5-7 The Large and Small Chassis Access Panels



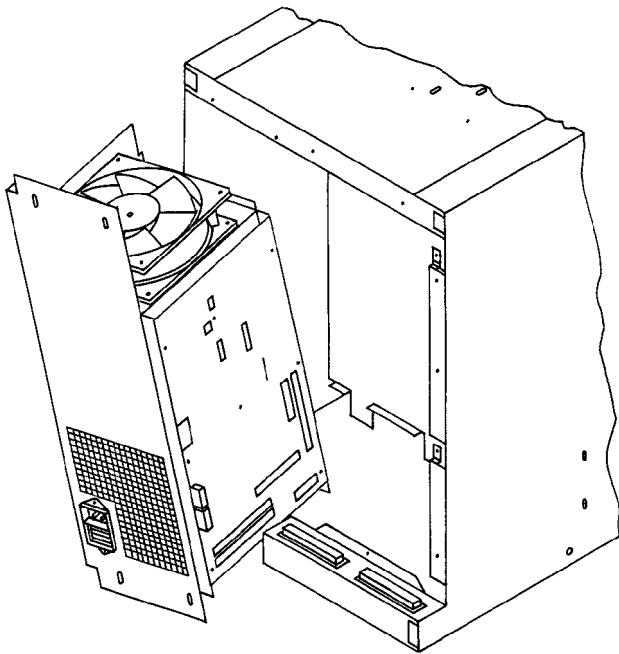
5.4.6 Removing the Power Supply Module

CAUTION

The electronics in the autochanger are very susceptible to damage from Electrostatic Discharge. Use ESD straps and mats to prevent damage.

1. Place the power switch on the rear panel to OFF.
2. Unplug the power cord (Figure 5–6).
3. Remove the 11 T-15 screws that secure the rear access panel.
4. Remove all the cables to the autochanger controller PCA mounted on the side of the power supply.
5. Remove the four T-15 screws that hold the power supply to the chassis (Figure 5–6).
6. Rotate the power supply out from the chassis far enough to disconnect the power cables from the power-receptacle end of the supply (Figure 5–8).

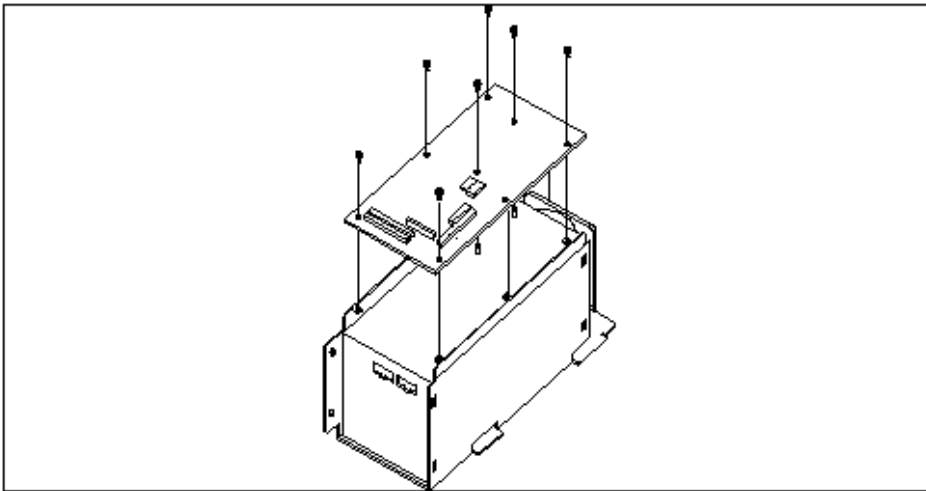
Figure 5-8 Rotating the Power Supply Module out of the Chassis



5.4.7 Removing the Autochanger Controller PCA

1. Perform the first six steps of Section 5.4.6, Removing the Power Supply Module .
2. Remove the eight mounting screws that secure the autochanger controller PCA to the power supply assembly (Figure 5–9). Remove the PCA.

Figure 5–9 Removing the Autochanger Controller PCA



3. Unplug cables from the controller PCA (Figure 5–11).
4. On the replacement PCA, check the configuration of dip switch S2 for correct settings (Figure 5–10 and Table 5–1).

Figure 5-10 Dip Switch Locations on the Autochanger Controller PCA

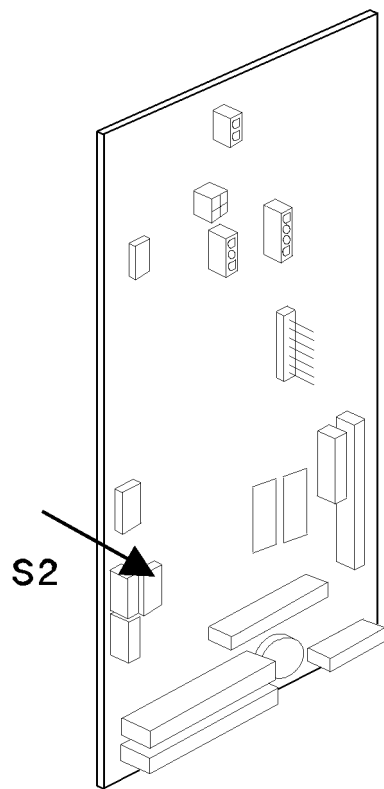


Table 5-1 S2 Switch Settings, Autochanger Controller PCA

Position	Description	Default
1	Factory setting, do not change	open
2	Factory setting, do not change	open
3	Factory setting, do not change	¹

¹The default settings for a "Full" autochanger Configuration (four magazines) are positions 2,3,5 closed.

(continued on next page)

Table 5–1 (Cont.) S2 Switch Settings, Autochanger Controller PCA

Position	Description	Default
4	Factory setting, do not change	²
5	Termpower (see next table, "Termpower Settings")	
6	Termpower (see next table, "Termpower Settings")	
7	Termpower (see next table, "Termpower Settings")	
8	Factory setting, do not change	open

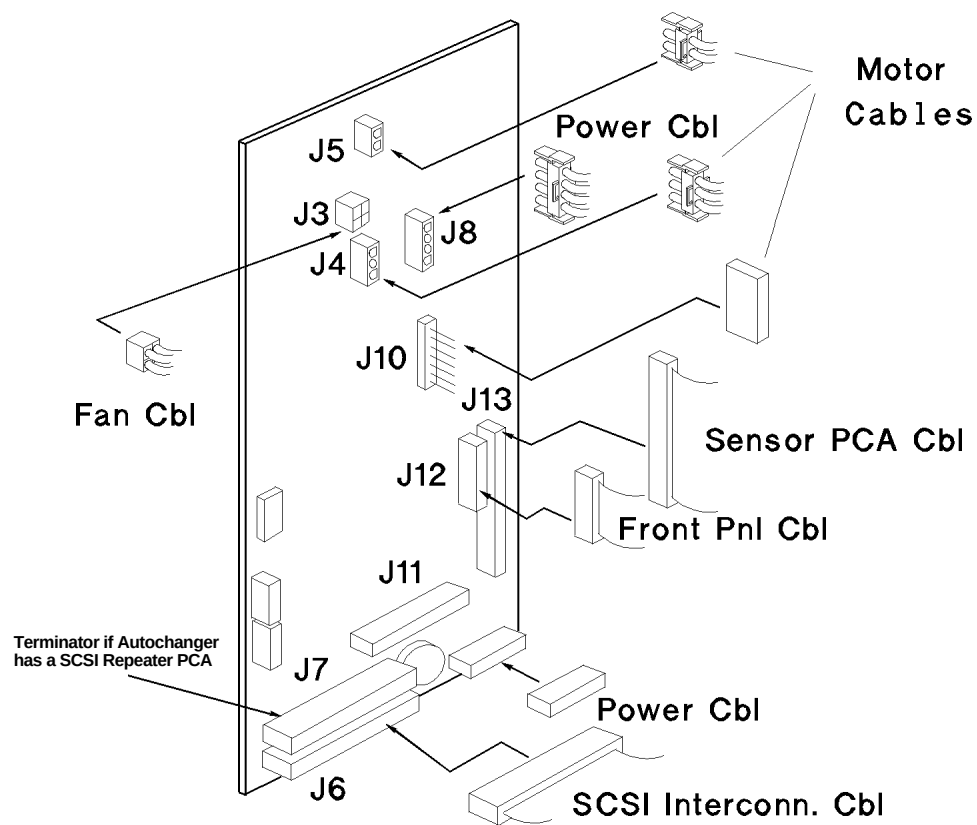
²The default settings for a "Half" autochanger configuration (two magazines) are positions 2,4,5 closed.

Table 5–2 Termpower Settings (S2 Switch, positions 5,6,7)

Supply	Position 5	Position 6	Position 7
Autochanger supply to bus	closed	closed	closed
Autochanger supply to bus	closed	closed	open
Autochanger supply to bus	open	closed	closed
Autochanger supply to Autochanger bus	open	open	closed
Host supply to bus (Default)	closed	open	open

5. Position the new controller PCA on the power supply in the same manner that the old controller PCA was positioned (Figure 5–11).
6. Secure the PCA using the eight screws and washers that were previously removed. Loosely start each screw and then tighten them.
7. Power on the autochanger.
8. Set configurations 16 and 18 using the procedure in Section 3.3. Table 3–3 lists autochanger configuration choices. Section 5.5.1 and Section 5.5.2 provide additional configuration information.
9. Cycle power off and on for new configurations to take effect.

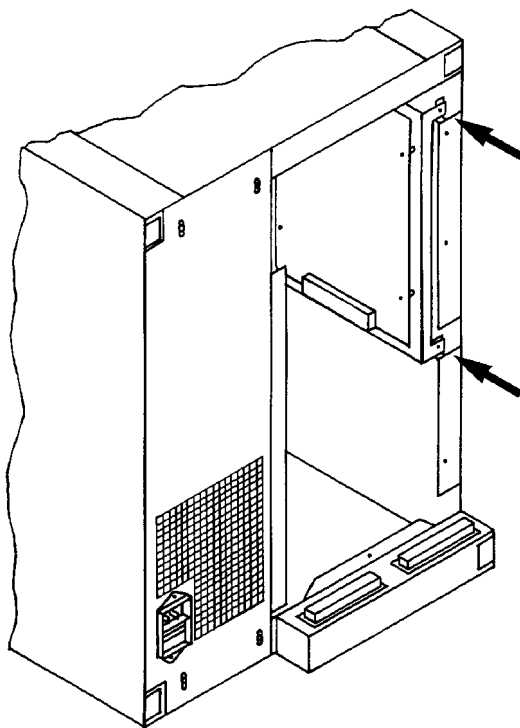
Figure 5-11 Autochanger Controller PCA Cable Connections



5.4.8 Removing the SCSI Repeater PCA

1. Perform the first three steps of Section 5.4.6, Removing the Power Supply Module , then return here.
2. Remove the two screws that hold the SCSI repeater PCA mounting plate to the disk library chassis (Figure 5–12).

Figure 5–12 Removing the SCSI Repeater PCA Mounting Plate



3. Pull the SCSI repeater PCA mounting plate (which still holds the SCSI repeater PCA) out of the chassis far enough to make cable removal easy.
4. Disconnect the cables attached to the SCSI repeater PCA.

5. Remove the four T-15 Torx screws that hold the SCSI repeater PCA to the mounting plate.

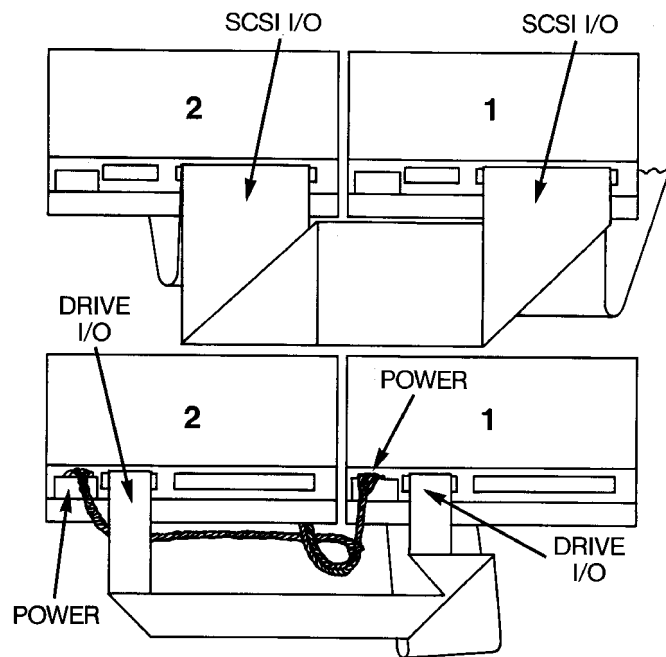
Note

The 90° top connector is the I/O from external connectors and the (flat) bottom connector is I/O to AC controller PCA.

5.4.9 Removing/Replacing the MO Drives

1. Remove the front panel as described in Section 5.4.1. Refer to the deskside option or rackmount option as applicable.
2. Remove one of the access panels (your choice) that will let you remove cables on the inside of the chassis next to the drives.
3. Disconnect the drive power, SCSI, and interface cables from the rear of the drives. Refer to Figure 5–13.

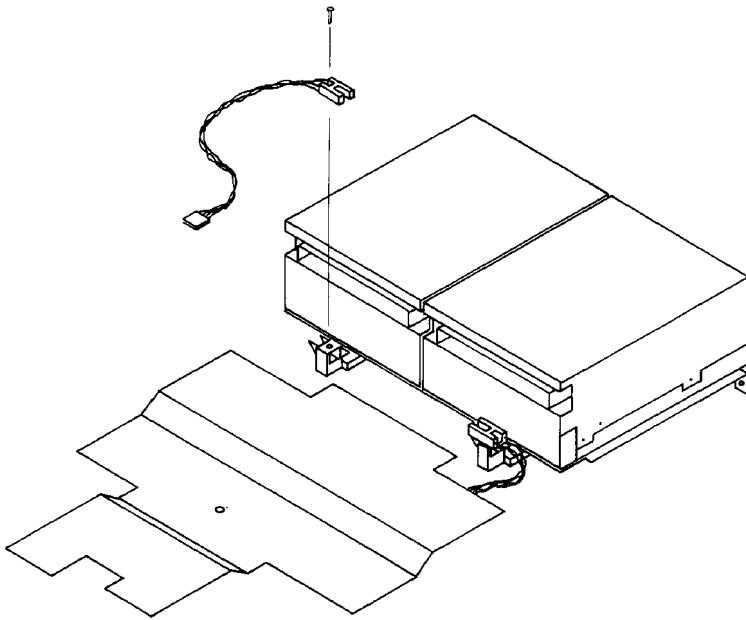
Figure 5-13 Removing the Drive Power, SCSI and Interface Cables from the MO Drives



Refer to Figure 5-14.

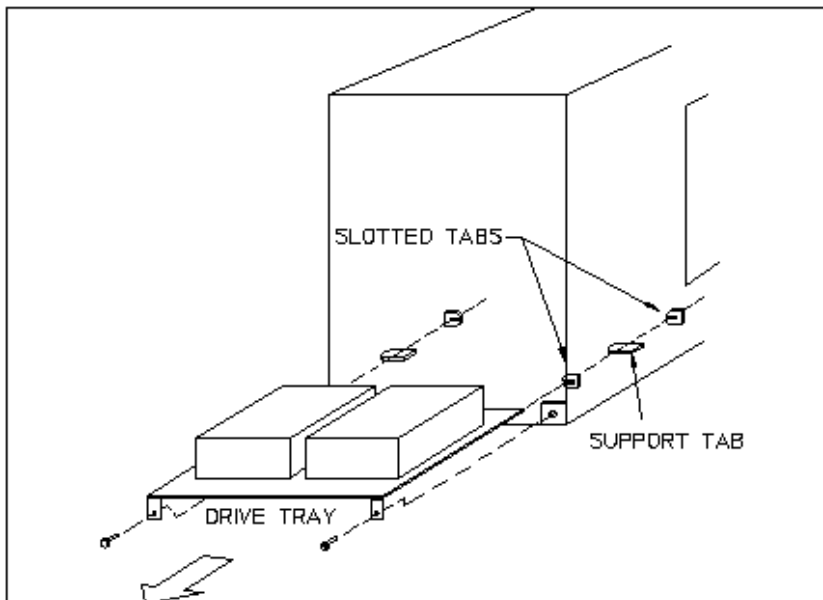
4. Remove the T-15 Torx screws that hold the optical sensors in place.

Figure 5-14 Optical Sensor Positions



5. Loosen the two T-15 screws at each end of the rear of the drive tray (Figure 5-15figure 5-15).

Figure 5-15 Removing the MO Drives



6. Slide the drive assembly out.

IF THE TRAY BINDS, check to see if the tray is hitting the heads of the chassis mounting screws.

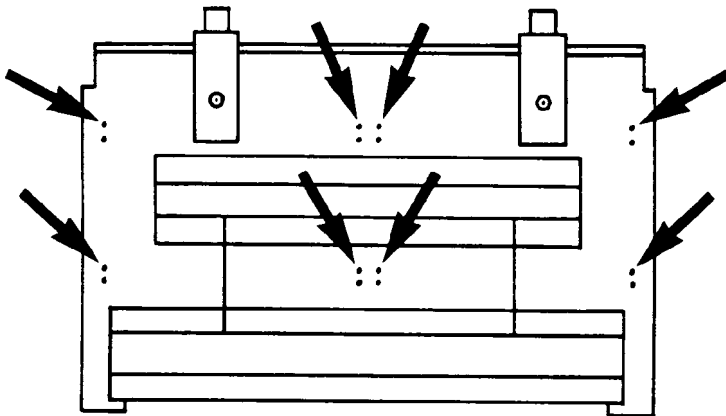
7. Each drive is attached to the tray with four T-10 Torx screws. Remove screws as necessary to replace drive(s).

When re-assembling:

Use the mounting holes closest to the sensor brackets to install the drive(s) (Figure 5-16).

After reversing the disassembly steps and remounting the drives, refer to the re-assembly notes in the section, "Service Access," in this chapter to correctly remount the front panel.

Figure 5-16 Drive Mounting Holes



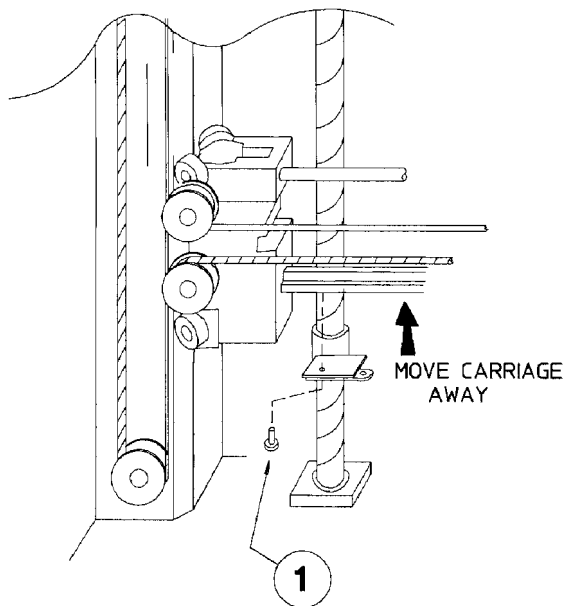
5.4.10 Removing the Carriage/Picker Assembly

1. Remove the large chassis access panel (Figure 5–17).
2. Remove the Torx screw holding the carriage bracket to the bottom of the picker carriage (Figure 5–17 (1)). This screw is sealed by Loctite®.

Note

DO NOT REMOVE the screw that holds the carriage BRACKET to the lead screw.

Figure 5–17 Separating the Carriage from the Carriage Bracket



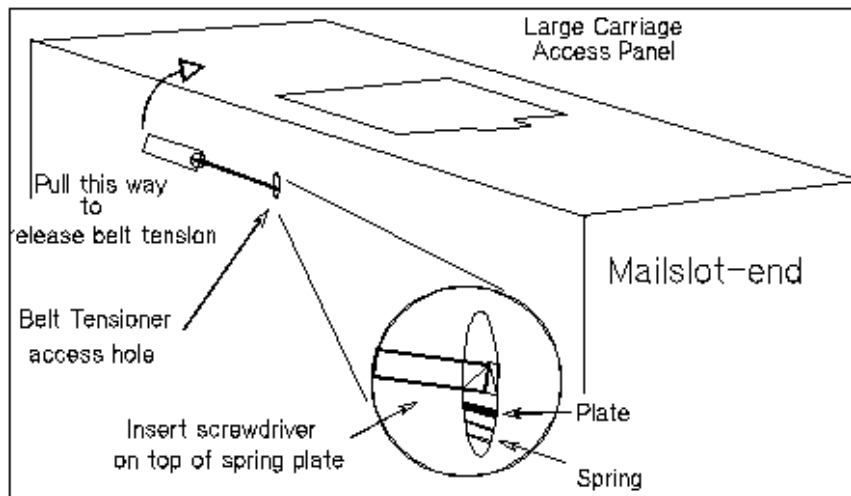
Refer to Figure 5–18.

3. Release the tension on the picker belt by pushing the tensioner spring toward the drives. To push the spring *toward* the drives, pry with the tool you are using as shown in Figure 5–18.

While holding the tensioner spring down, slip the picker Belt off the pulley at the end of the carriage rail (way) on the leadscrew side.

Then remove the belt from one of the pulleys on the leadscrew-side carriage rail.

Figure 5-18 Releasing Picker Belt Tension



4. Position the picker in the center of the carriage so that it can pass through the cutout in the chassis.

Refer to Figure 5-19. (Note that view is of the side of the picker that faces the drive end of the chassis).

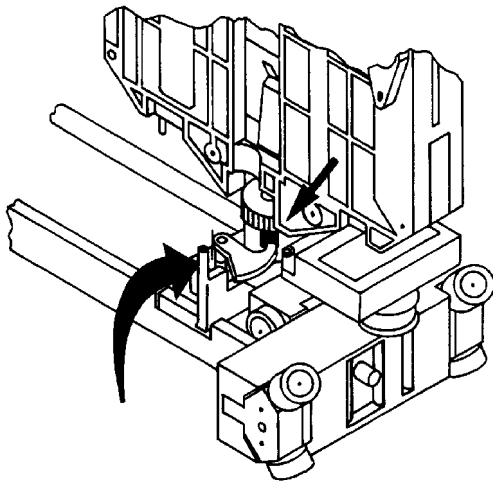
- a. Push the translate latch toward the picker to unlock the picker.

A slot in the bottom of the picker shaft belt pulley must be positioned over the translate latch to allow the translate latch to fully retract.

You may have to rotate the picker shaft belt pulley a little to line up this slot. To do this, jiggle the belt back and forth just a little until you feel the picker release from the rail.

- b. When you feel the picker slide freely, move the picker to the center of the carriage.

Figure 5-19 Releasing the Translate Latch (seen from drive side of picker)



Refer to Figure 5-20.

- c. Release the picker for rotation by pushing on the release lever. Rotate the picker to a position parallel to the carriage rails as shown in Figure 5-21.

Figure 5-20 Releasing the Picker for Rotation

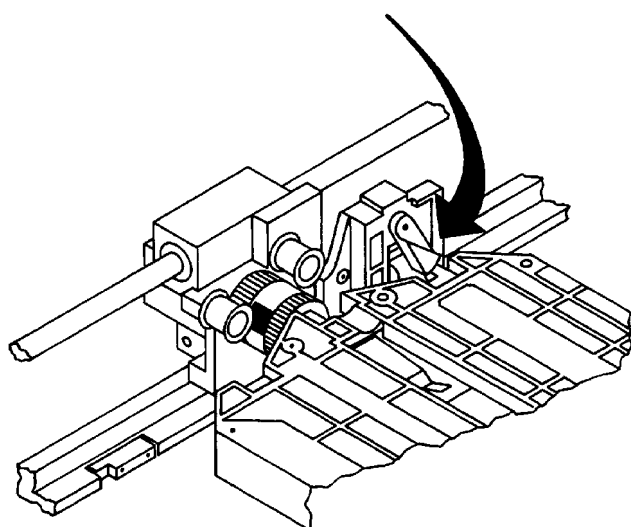
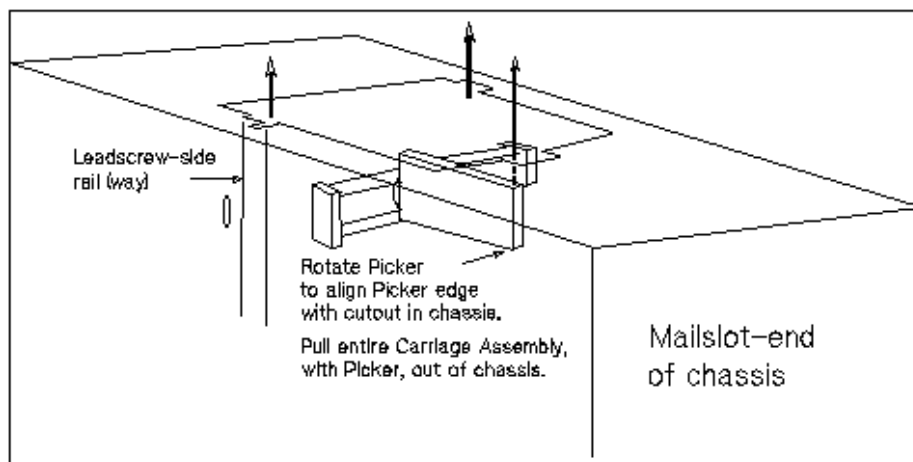


Figure 5-21 Removing the Carriage Assembly and Picker as a Unit



WARNING

As the carriage is pulled off the ends of its rails during the next step, the spring-loaded bearing block assembly on the non-leadcrew side of the carriage assembly can separate from the assembly with considerable force and could cause injury.

Hold the bearing block assembly against the carriage assembly as you pull the carriage assembly off the end of the rails.

Refer to Figure 5–21.

- d. Pull the picker carriage out of the chassis.

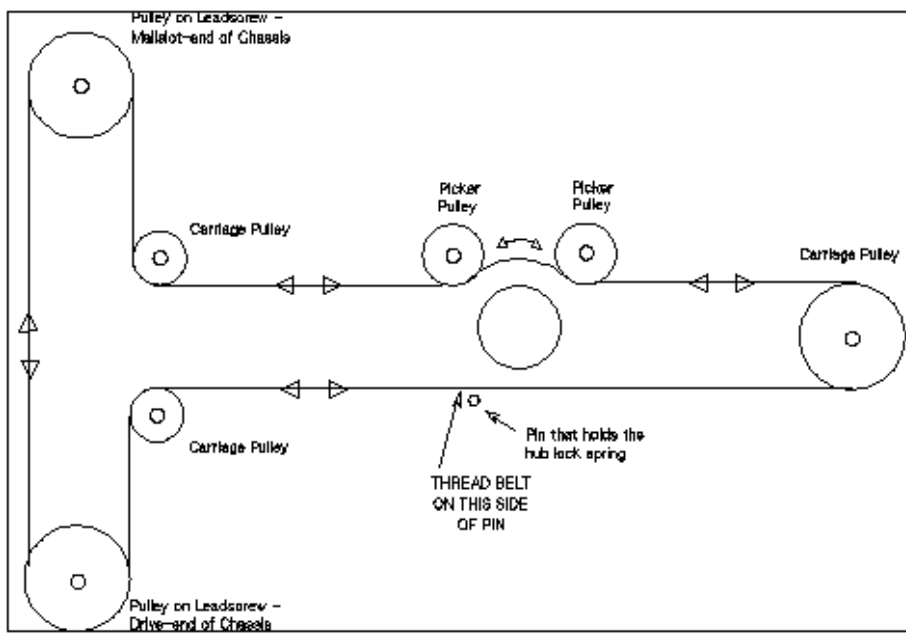
When re-assembling:

Be sure to press in the static pin on the outside of the carriage support (leadcrew-side) as you slide the carriage onto the rails (ways). This pin can be broken off.

Hold the tensioner spring down as explained in Step 3 while replacing the picker belt. Make sure that the picker belt is centered between the two ridges on the pulley.

Refer to Figure 5–22 to correctly thread the picker belt. After the picker belt is in place, verify that the tensioner spring returns to its upmost position by inserting the tool underneath the tensioner plate and gently prying it up.

Figure 5-22 Picker Belt Threading Diagram



5.4.11 Removing the Carriage Motor

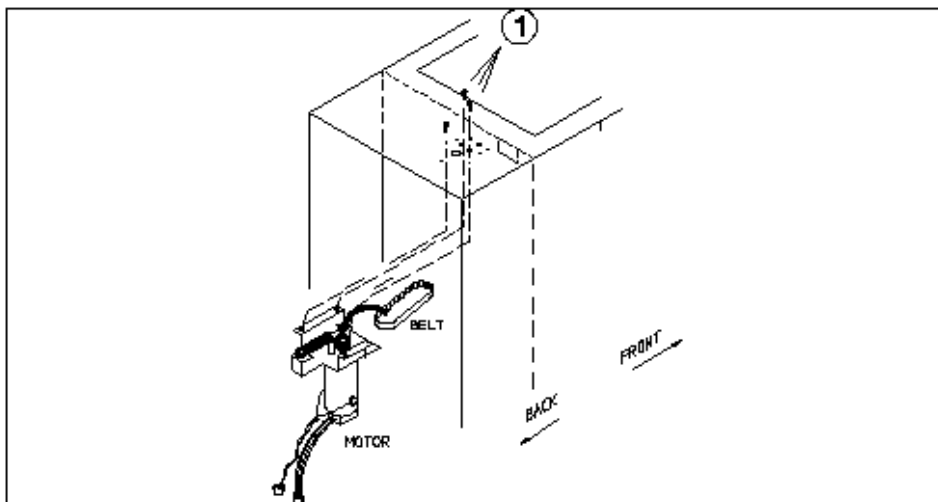
Refer to Figure 5-23.

1. Loosen the screws holding the carriage motor (figure 5-23 (1)).
2. Remove the belt between the carriage motor and the leadscrew.
3. Disconnect the wires on the motor.
4. Remove the carriage motor.

Note

The motor encoder plug goes both ways.

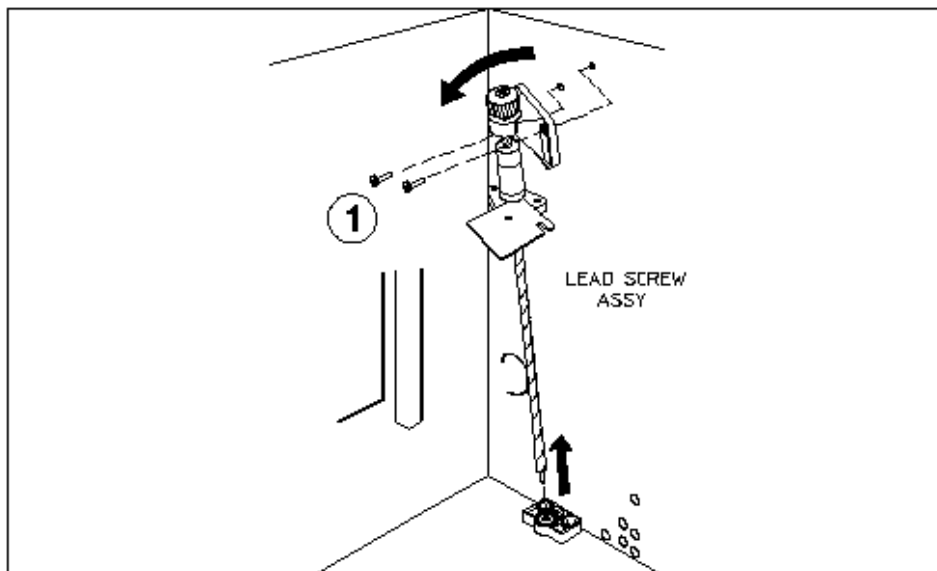
Figure 5-23 Removing the Carriage Motor



5.4.12 Removing the Carriage Leadscrew

1. Remove the belt to the carriage motor. The belt may be removed by pulling the belt over the end of the leadscrew gear as the gear is rotated. Move the carriage assembly up or down to rotate the gear.
2. Remove the screws holding the leadscrew top bracket to the back wall of the chassis (Figure 5-24 (1)).
3. Lift out the leadscrew.

Figure 5-24 Removing the Carriage Leadscrew Assembly



5.4.13 Removing the Picker Motor

Refer to Figure 5-25 and Figure 5-26.

1. Perform the first three steps of Section 5.4.6, Removing the Power Supply Module , then return here.
2. Remove the two cables connecting the picker motor to the autochanger controller PCA.
3. Loosen the tensioner spring (refer to Figure 5-25).

Figure 5-25 Picker Motor Mounting Screws and Drive Belt

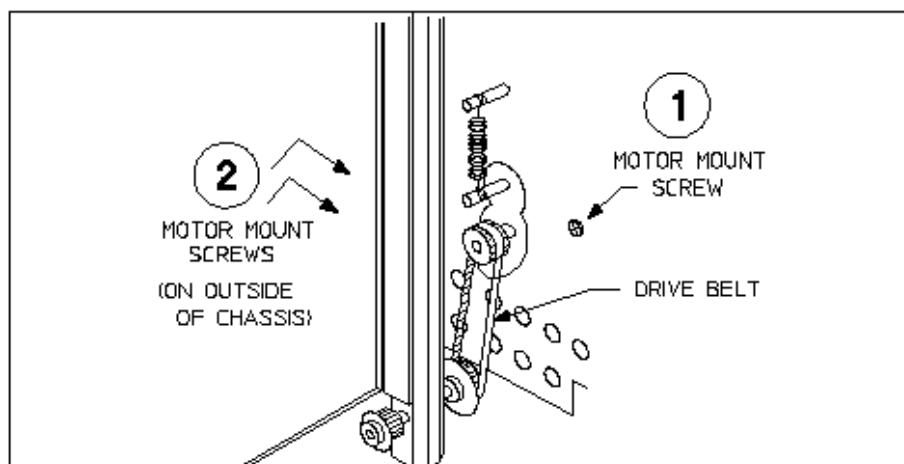
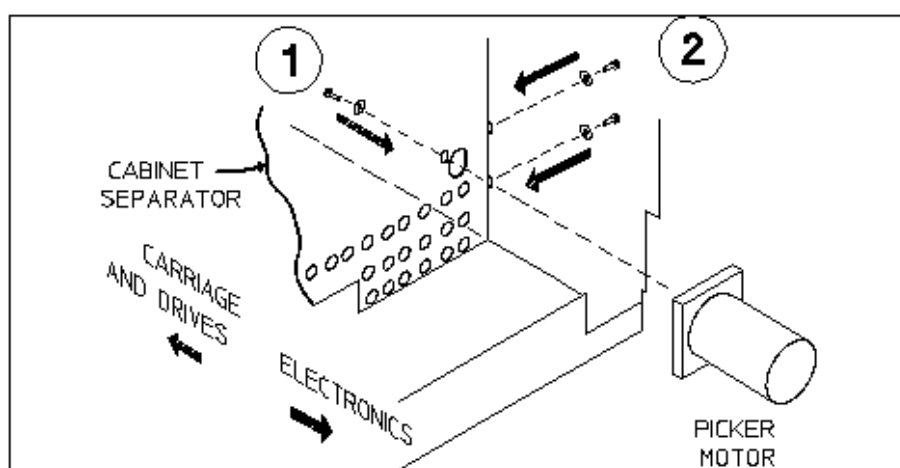


Figure 5-26 Picker Motor Mounting Screws



4. LOOSEN the motor mount screw on the inside of the electronics area (Figure 5-26 (1)) and the two mounting screws on the outside of the chassis (Figure 5-26 (2)). Do not remove the screws.
5. Remove the picker belt.
6. Remove the three picker motor mounting screws.
7. Remove the picker motor.

When re-assembling:

1. Put the replacement picker motor into the unit, attach the tensioning spring, **and** start all three mounting screws. Do not fully tighten the screws yet.

Note

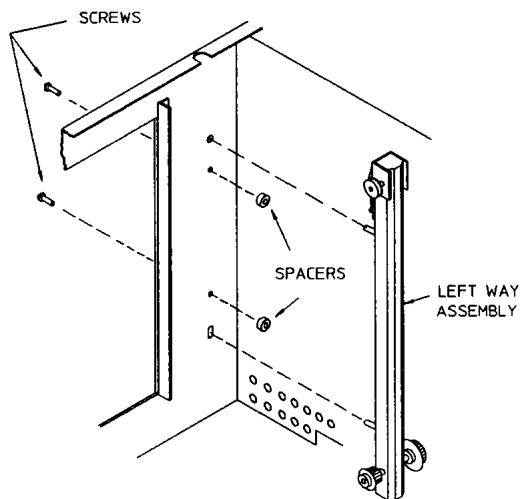
Failure to tighten the screws in the following order will result in premature failure of the belt.

2. Replace the picker belt. Tighten the screw located behind the carriage leadscrew Figure 5–26 (1).
3. Tighten the two remaining screws (Figure 5–26 (2)).
4. Check that the picker assembly can move and flip freely.
5. Replace the two picker motor cable connections on the autochanger controller PCA.

5.4.14 Removing the Leadscrew-side Carriage Way (rail)

1. Remove the carriage/picker assembly.
Refer to Figure 5-25.
2. Loosen the tensioner spring.
3. LOOSEN the motor mount screw on the inside of the electronics area (Figure 5-26 (1)) and the two mounting screws on the outside of the chassis (Figure 5-26 (2)). Do not remove the screws.
4. Remove the picker motor belt.
5. Remove the two mounting screws holding the way. These screws are located on the outside of the chassis. Note that there are two spacers between the way and the side of the chassis (Figure 5-27).

Figure 5-27 Removing the Leadscrew - side Carriage Way (rail)



6. Remove the way from the chassis.

When re-assembling:

1. Replace the way assembly to the chassis. Do not forget the spacers that go between the way and the side of the chassis.
2. Attach the tensioning spring.

Note

Failure to tighten the screws in the following order will result in premature failure of the belt.

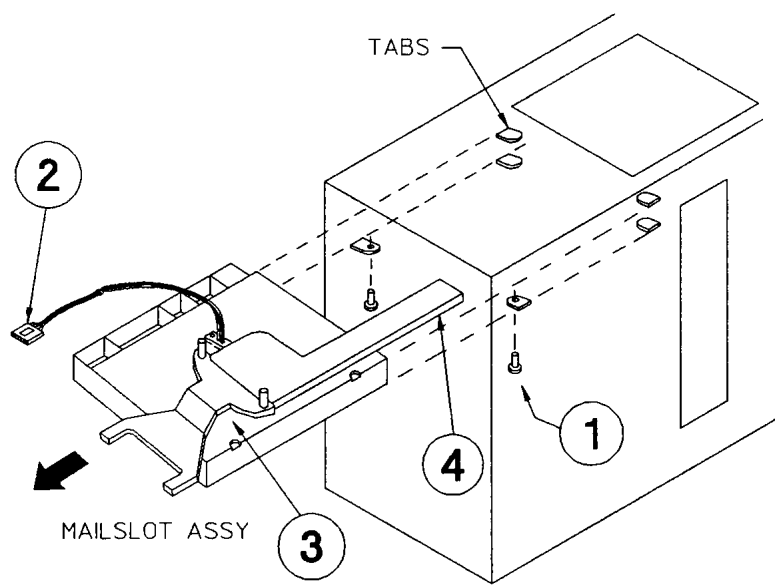
3. Replace the picker belt. Tighten the screw located behind the carriage leadscrew (Figure 5–26 (1)).
4. Tighten the two remaining screws (Figure 5–26 (2)).
5. Check that the picker assembly can move and flip freely.

5.4.15 Removing the Mailslot

Refer to figures 5-28 and 5-29

1. Remove the front panel. Refer to the section, "Service Access" for instructions on how to remove the front panel for either a deskside option unit or a rackmount option unit.
2. Remove the two self-tapping screws on each side of the front of the mailslot (figure 5-28 (1)).
3. Disconnect the mailslot sensor cable.
4. Pull the mailslot out.

Figure 5-28 Removing the Mailslot Assembly



When re-assembling:

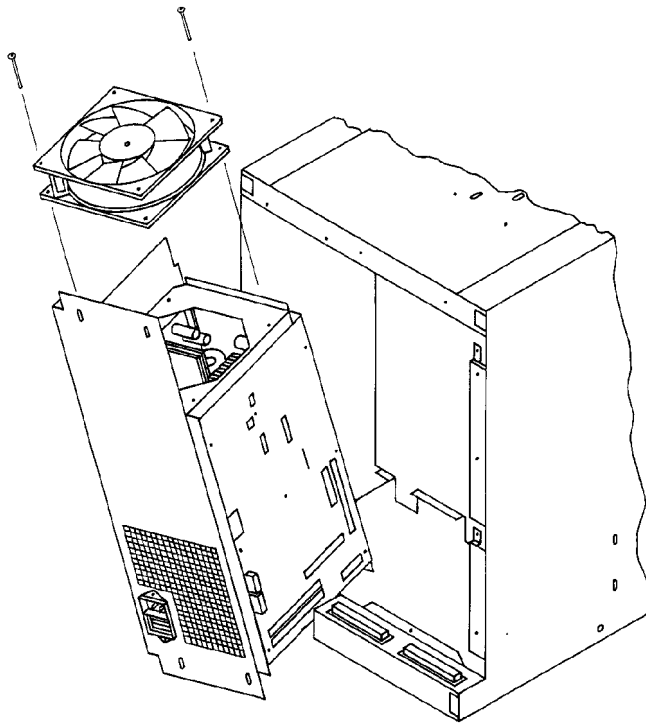
Pull the actuator arm on the mailslot (figure 5-37) all the way back (towards the rear of the unit) before placing the front panel into position.

Pulling the arm back lowers the mailslot door and makes it possible for the Front Panel to be placed into position.

5.4.16 Removing the Power Supply Fan

1. Do the first five steps of Section 5.4.6, Removing the Power Supply Module , then return here.

Figure 5-29 Rotating the Power Supply Out to Access the Fan



2. Rotate the power supply outward enough to access the cooling fan on the top of the power supply.
3. Remove the two screws that hold the cooling fan to the top of the power supply.

5.4.17 Removing the Interconnect PCA

Note

When removing the interconnect board, move the picker out of the way by sliding it to the top of the carriage and inserting a cartridge to hold it there.

- Remove the top access panel. Refer to the "Service Access" section at the beginning of this chapter for further instructions.

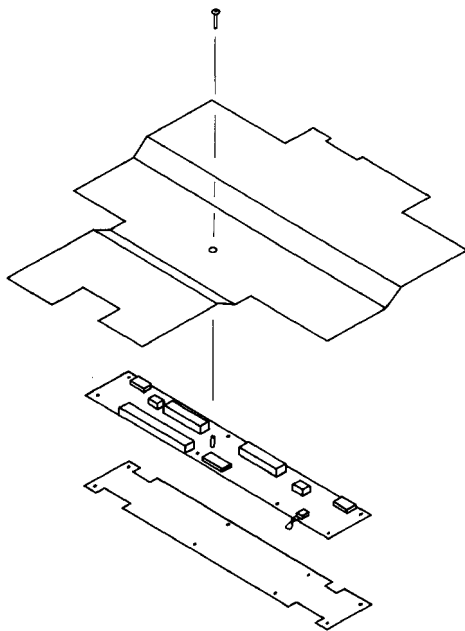
Refer to Figure 5–30

- Remove the T-15 screw from the top of the clear plastic shield that covers the interconnect PCA.
- Pull the clear plastic shield towards the back of the unit. Then pull the front part of the shield up, then out of the unit's large access panel.
- Remove all of the connectors from the interconnect PCA.
- Remove the eight T-15 screws from the interconnect PCA Figure 5–30.
- Pull the interconnect board up and out the unit's large access panel.

Note

There is a plastic shield under the interconnect board that can remain in the unit until the interconnect PCA is replaced. Align the holes on the clear plastic under-shield with the holes on the interconnect board while re-inserting the eight T-15 screws.

Figure 5-30 The Interconnect PCA



5.5 Re-initializing Autochanger Controller PCA RAM After Service

All the RAM on the autochanger controller PCA is battery backed and is, therefore, non-volatile. Most of the RAM is initialized to known values at powerup. Variables that are not changed are customer configurations, autochanger logs, autochanger odometers, element status variables, and variables that help the autochanger recover from power failures. These variables are set by configurations 16 and 18.

NVRAM must be re-initialized after replacing the autochanger controller PCA, after changing the autochanger controller PCA firmware, and after changing a drive mechanism.

5.5.1 Variables set by Configuration 16

- SCSI address of the autochanger
- Configurable options set to system defaults (ROM-dependent)
 - whether the autochanger should report recovered errors (CONF 27)
 - whether the autochanger should rotate the mailslot inwards when in secure mode (CONF 27)
 - whether the autochanger should automatically initialize element status when cartridges are found in unexpected places (ROM-dependent)
- Drive status variables
 - reported SCSI address of the drive set to system defaults
 - clear the source of the disk in the drive
- RS-232 configuration set to system defaults
 - baud rate = 19,200
 - word length = 8
 - start/stop bits = 1
 - parity = none
- Power fail variables
 - whether the last move was started is set to FALSE
 - clear the state of the last move

- Recovery restore variables set to system defaults
 - maximum number of Find Home retries = 3
 - maximum number of error recovery retries = 3
 - maximum number of restore retries = 1
- Security variables
 - clear Unit Reserved
 - clear Prevent Media Removal for each SCSI ID
- Element Status variables
 - clear exception bits
 - clear element reservations
- Clear autochanger logs
 - clear Error Log (INFO 0)
 - clear Move Success Log (INFO 10)
 - clear Recovery Log
 - clear Runtime Log (INFO 11)
 - clear number of major retries
 - clear number of inline retries
- Clear magazine and mailslot offsets
 - (unused in most units/invalid in RSE units)
- Reset the password to 0,0,0

5.5.2 Variables set by Configuration 18

- Reset the move odometer to zero (INFO 9)
- Reset the flip odometer to zero (INFO 12)
- Reset the translate odometer to zero (INFO 13)
- Reset the mailslot rotation odometer to zero (INFO 14)
- Reset the number of poweron hours to zero (INFO 5)
- Reset the number of loads to each drive to zero (INFO 4)

5.6 Replaceable Parts

5.6.1 Recommended Service Kit

The initial recommended service kit for the optical disk library includes the exchange parts list and the non-exchange parts list for stocking at a logistics.

Note

The "x" in the part numbers listed below represents a number from "0" to "9" depending on the revision of the part. For example, if the part is newly released, the number will be "0". The first time the part is revised, the number will be incremented to a "1"; the second time the part is revised, the number will be incremented to a "2", and so on.

If you are unsure of the current part number, check your parts database for part number information.

5.6.2 Assemblies

Refer to figures 5-31, 5-32, and 5-33 for exploded views of the optical disk library, labeled with FRU numbers.

Table 5-3 Exchange Assemblies

FRU No.	HP Part Number	Description	Digital Part Number
1	C1708-66503 ‡	Autochanger Controller PCA	29-30865-01
1†	5063-2703	Autochanger Controller PCA with code	29-30865-01
20	C1716C-opt728	Optical Drive Mechanism (650-Mbyte drive)	29-30871-01
20	C1716T-opt728	Optical Drive Mechanism (1.3-Gbyte drive)	29-31453-01
20†	5063-2701	Optical Drive Mechanism with code (650-Mbyte drive)	29-30871-01

†Always order exchange version with code installed

‡HP Part numbers containing a 66 as in C1708-66503 are silk screened on the boards, but these translate to order numbers containing a 60 or 69 as in C1708-69x03. The 60 or 69 numbers are on the outside of the box that the board is shipped in.

(continued on next page)

Table 5–3 (Cont.) Exchange Assemblies

FRU No.	HP Part Number	Description	Digital Part Number
20†	5063-2715	Optical Drive Mechanism (1.3-Gbyte drive)	29-31453-01
40	C1708-60x40	Carriage assembly	29-30036-01
27	C1700-60x27	Picker assembly	29-30152-01

†Always order exchange version with code installed

Table 5–4 Non-Exchange Assemblies

FRU Number	HP Part Number	Digital Part Number	Description
7	C1700-60x07	29-30876-01	Interconnect PCA
22	C1700-60x12	29-30868-01	Horizontal Display Panel
23	C1700-60x23	29-30042-01	Vertical Motor
22	C1700-60x22	29-30869-01	Vertical Display Panel (Rackmount units only)
26	C1700-60x26	29-30047-01	Magazine Assembly
30	C1700-60x30	29-30033-01	Optical Sensor
32	C1700-60x32	29-30038-01	Leadscrew
34	C1700-60x34	29-30064	Horizontal Belt
35	C1700-60x35	29-30065	Vertical Belt
41	C1700-60x42	†	Bearing Block-Long
45	C1700-60x45	29-30067-01	Side Access Panel
68	C1700-60x68	†	I/O Power Cable
69	C1700-60x69	†	SCSI I/O Cable
70	C1700-60x70	29-30050-01	Dual Mailslot Cable
73	C1700-60x73	†	Internal SCSI Cable
83	C1700-60x83	†	UPS Cable
21	C1700-60x21	29-30875-01	Left Way

†These parts are not stocked by Digital but can be ordered from Hewlett-Packard by placing a P1 order through Digital Logistics

(continued on next page)

Table 5–4 (Cont.) Non-Exchange Assemblies

FRU Number	HP Part Number	Digital Part Number	Description
25	C1700-60x25	29-30041-01	Horizontal Motor
27	C1700-60x27	29-30152-01	Picker
39	C1700-60x39	29-30040-01	Bearing Block Assembly
47	C1700-60x47	†	Drive Tray
40	C1700-60x40	29-30036-01	Carriage Assembly
29	C1700-60x29	29-30867-01	Mailslot
28	C1703-60x28	29-30864-01	Power Supply
44	C1703-60x44	29-30066-01	Top Access Panel
50	C1703-60x50	29-30051-01	5/12/24V Power Cable
56	C1703-60x56	29-30062-01	Front Panel Cable
59	C1703-60x59	29-30063-01	Sensor Cable
66	C1700-60x66		Line Switch Cable
38	C1703-60x68	29-30028-01	Power Supply Fan
	C1703-60x79	29-30061-01	Switch Cable
80	C1703-60x80	29-30059-01	Motor Power Cable
8	C1708-60x08	29-30874-01	Single-Ended Repeater PCA
9	C1708-60x09	29-30873-01	Differential Converter PCA
20	C1716-60x01	29-30871-01	MO/MF Single-Ended Optical Drive (Storage Server - Sony Drives)
24	C1700-60088	†	Horizontal Front Panel
24	C1700-60089	†	Vertical Front Panel (Rackmount units only)
28	C1703-69028	29-30864-01	Power Supply
	C1700-60046	†	Horizontal Slide Kit

†These parts are not stocked by Digital but can be ordered from Hewlett-Packard by placing a P1 order through Digital Logistics

Table 5–5 Exchange Assemblies for Model 20, Storage Server/Ninja

FRU Number	HP Part Number	Digital Part Number	Description
1	C1703-69201 †	29-30026-01	Autochanger Controller PCA
	C1713-60237 †	29-30039-01	C1710M Autochanger Code
20	C1710-69010	29-30027-01	MO Drive
	C1700-60005 †	29-30029-01	MO Drive Controller PCA
	C1716-60222 †	29-30153-01	MO Drive Controller ROM

†Controller PCAs must be ordered together with controller codes. Reference Service Manual EK-ST SOP-SV for other model 10 assemblies and removal and replacement procedures.

Figure 5-31 Replacement Parts - View 1

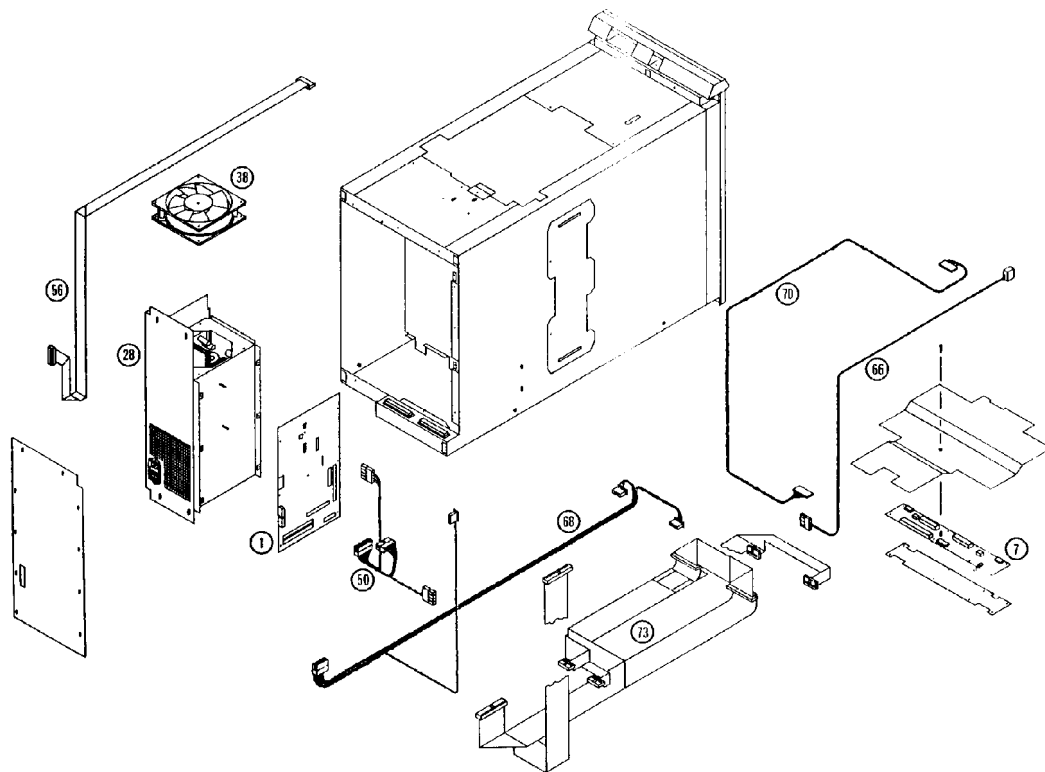
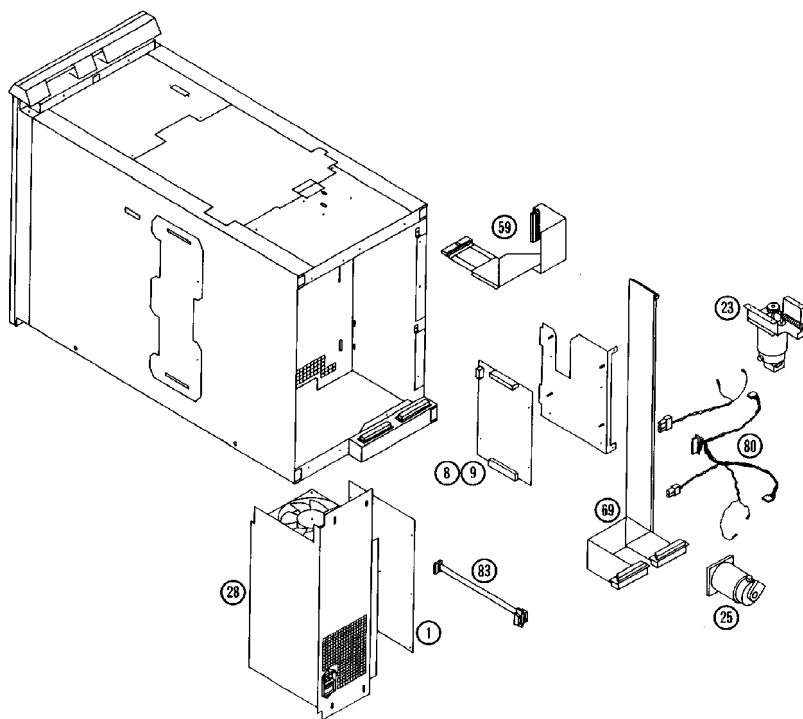
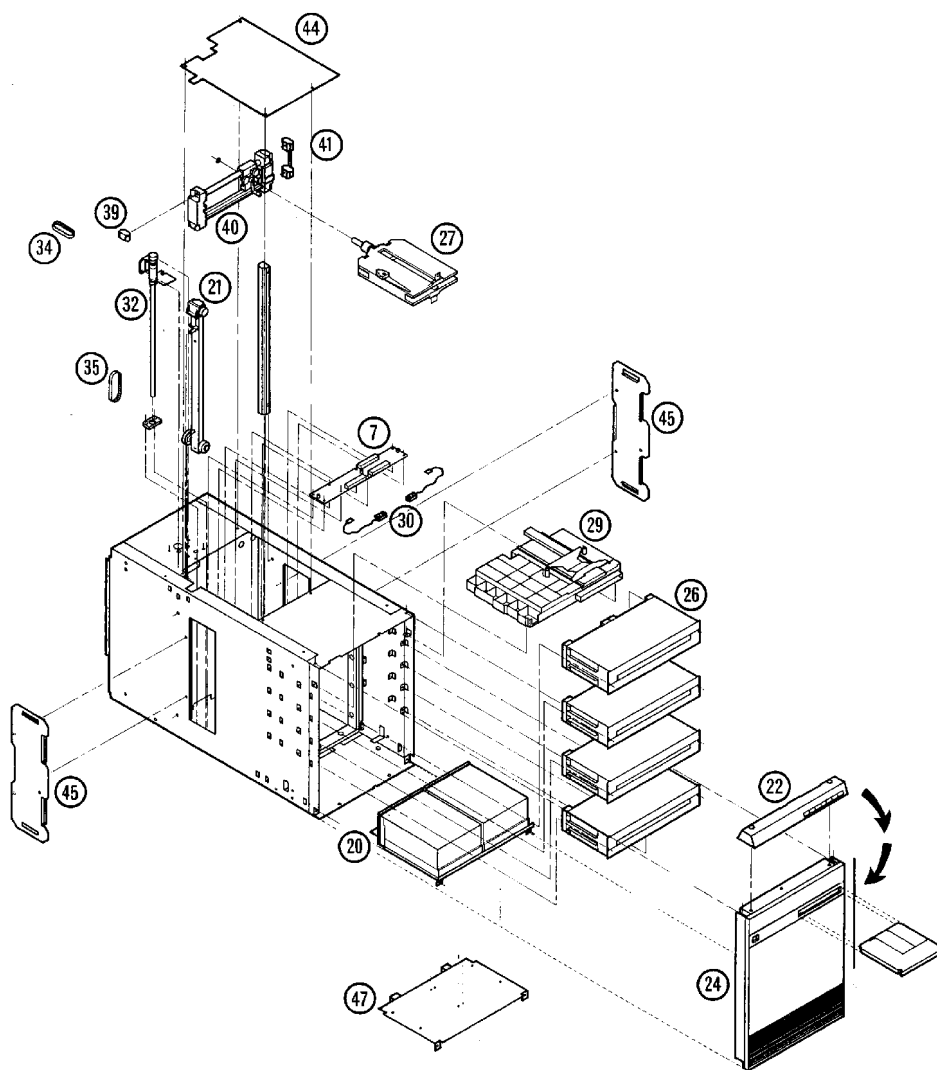


Figure 5-32 Replacement Parts - View 2





6

Theory of Operation

This chapter discusses the following aspects of the optical disk library:

- the autochanger
 - command execution
 - mechanics
- autochanger controller PCA
- power supply
- optical disk drive

In addition, autochanger error detection, diagnostic strategy, and the SCSI interface and command set are discussed.

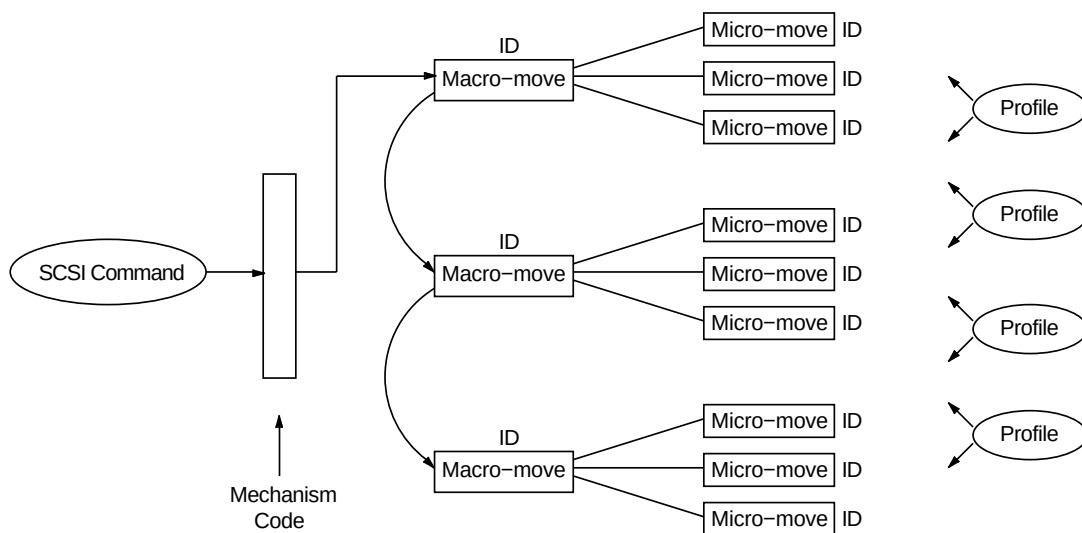
6.1 The Autochanger

6.1.1 Movements

The mechanism code of the autochanger accepts high-level SCSI commands from the interface, translates these commands into servo code for the autochanger, executes the command, and reports status.

When a SCSI command is received, it is translated into a series of smaller submoves in the servo code of the autochanger and executed.

Figure 6-1 SCSI Command Translation for Autochanger Operation



Examples of high-level commands are:

- Move/Exchange—move a cartridge from element A to element B.
- Seek—position the transport at a target element
- Test—test for the presence of a cartridge at a target element
- Actuate mailslot—rotate the mailslot assembly to perform I/O with the user

The commands are translated into a series of moves which are basic autochanger functions. These submoves are called macro-moves. In this library the macro-moves are as follows.

- move carriage—position the picker transport to a position along the rails.
- flip—rotate the picker
- cartridge I/O—plunge and retrieve the picker finger assembly to move cartridges between the picker and magazines, drives, or the mailslot.
- rotate mailslot—plunge and retrieve the picker finger assembly/leadscrew nut to rotate the mailslot assembly toward and away from the user.

For example, "Move element 11 to element 2 with flip" is transformed into the following sequence of autochanger functions.

1. Determine that element 11 is a storage slot and element 2 is a drive.

2. Move the picker to the front of the storage element.
3. Get the cartridge from the storage element.
4. Do a flip.
5. Move the picker to the front of the disk insertion slot on the drive element.
6. Put the cartridge into the drive element.

The basic autochanger functions (macro-moves) are then divided into a series of smaller movements called "micro-moves." There are two types of micro-moves:

- position move—move the driving motors a given distance at peak speed
- saturation move—same as a position move except that motion is halted if force exceeds a specified threshold.

Position moves are used for high-speed, unobstructed movements of a known distance. Saturation moves are used in low-speed, adaptive movements of variable distance.

Macro-moves consists of one or more combinations of position or saturation type micro-moves. Each macro-move has a tailored set of these submoves to insure that the macro-move will be gentle. As a macro-move is executed, servo gains are adjusted to allow for changes in load characteristics.

An example of the process for a flip is as follows.

1. Move picker finger assembly backwards a fixed distance to engage the flip lock.
2. Change the gain to prepare for upcoming flip.
3. Move the picker finger assembly backwards a fixed distance to trip the mechanism and start the flip.
4. Make sure the flip is completed by doing a saturate on the picker motor until the force exceeds a fixed threshold.
5. Change the gain to prepare for picker finger assembly movement.
6. Move the picker finger assembly forward to relieve the force.

Each micro-move within a specific macro-move has a unique set of stability, performance, error recovery, force, and reliability criteria. Therefore, each micro-move is assigned a unique identification code (ID) which is used to determine how the move should be performed. Before a micro-move is executed, its ID is used to fetch acceleration, velocity and force limits to use. If the move fails, its ID determines the type of error recovery scheme to employ. This tailored technique provides gentle, stable control of the mechanism, resulting in increased reliability.

6.2 The Autochanger Mechanism

The mechanics consist of the following major assemblies:

- carriage assembly
- picker assembly (mounted to the carriage assembly)
- mailslot (disk loading and ejecting assembly)
- carriage motor and carriage leadscrew
- picker motor

The carriage/picker assembly is the heart of the mechanism. This assembly positions disks in front of storage slots, drives, and the mailslot. The picker inserts, removes, and flips disks. It also activates the mailslot mechanism.

The carriage has a slot at both ends of a rail that spans the carriage. When the picker is translated to either end, a latch on the picker can enter the slot. When latched at either of these two positions, the picker may be flipped.

The picker may be translated from one side of the carriage to the other when the translate roller contacts the translate bar mounted across either end of the chassis.

The disk insertion slot, referred to as the mailslot, accepts a disk (inserted shutter-end-first) and rotates the disk 180 degrees. This allows the picker to grasp the rear of the disk and insert the disk shutter-end into a drive or storage slot.

The carriage motor rotates the carriage leadscrew, driving the carriage. The motor also monitors the amount of movement with a built-in encoder wheel.

The picker motor provides drive to translate and flip the picker. Power is transferred from the picker motor to the picker assembly by a toothed belt.

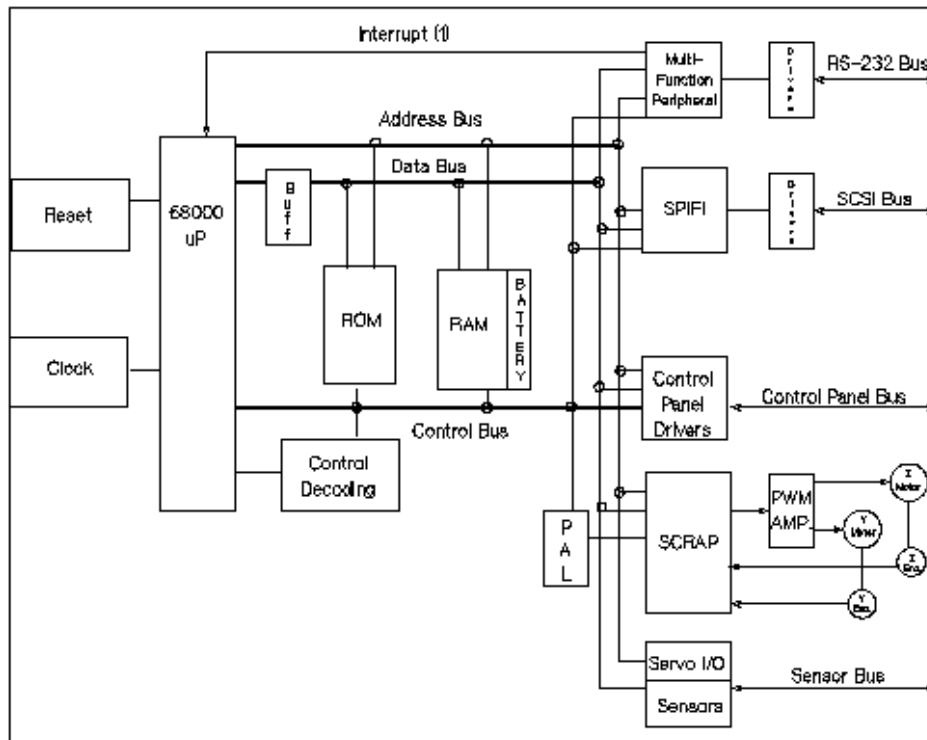
6.3 The Controller PCA

The autochanger controller PCA contains the following major components:

- Microprocessor
- Motor Control Chip (MCC) (interface from digital-to-analog pulse width modulation)
- SPIFI Chip (SCSI bus control)
- ROM
- RAM

- Pulse Width Modulation Amplifier
- Front Panel Control and Filament Drive
- SCSI Interface
- Multi-function Peripheral Chip

Figure 6-2 Autochanger Controller PCA Block Diagram



The microprocessor is a Motorola 68000 running at 12 MHz. This microprocessor controls all processes on the controller PCA such as servos, SCSI interface, and commands to the control panel.

Associated with the microprocessor is clocking circuitry, battery-backed-up RAM, decoding logic, and ROM.

The MCC is the interface between the 68000 processor and the servo system. The MCC reads the position encoders via Schmitt triggers and uses that information to increment or decrement counters on the chip. The MCC also provides pulse width modulation (PWM) output signals to drive the motor circuitry.

The SPIFI chip handles the SCSI protocol of the SCSI interface.

ROM. The controller firmware resides in two 128K X 8, 170 ns EEPROMs.

RAM. The two RAM chips are special, low-power CMOS static RAMs. A standby battery on the PCA takes over powering these chips if main power is lost. The chips remain in standby mode, providing a non-volatile memory storage capability on the PCA.

The pulse width modulation (PWM) amplifier takes the signals from the MCC and changes them into voltages for the picker motor (Z on Figure 6–2) and carriage motor (Y on Figure 6–2). Motor speed control is by feedback from the picker and carriage motors through Z and Y encoders back to the MCC.

The vacuum filament display uses a 7.5-volt supply tied to a 5-volt reference resulting in an excitation voltage of from two to three volts. The grids of the display are at approximately 20 volts.

The SCSI interface is basically the SPIFI chip and its associated transceiver. All SCSI protocol is handled by the SPIFI under control of the main 68000 processor. The bus transceiver provides the necessary drive to operate the bus properly.

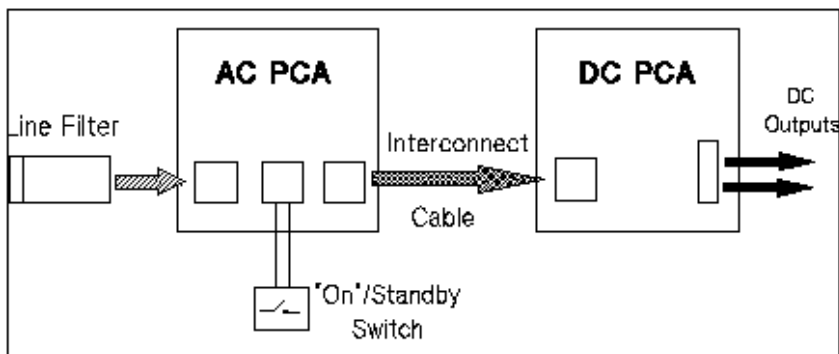
The multifunction peripheral chip controls interrupts, RS-232 functions, and certain timers throughout the controller PCA.

The servo, I/O, and sensors circuitry handle the servo communications (e.g. shutdown control), I/O communications (e.g. drive eject and drive busy), and sensor communications (e.g. mailslot sensor and vertical calibration sensor).

6.4 The Power Supply Module

The power supply module consists of an AC PCA and a DC PCA in a distributed power architecture.

Figure 6-3 Overall Diagram of the Power Supply



6.4.1 The AC PCA

The AC PCA

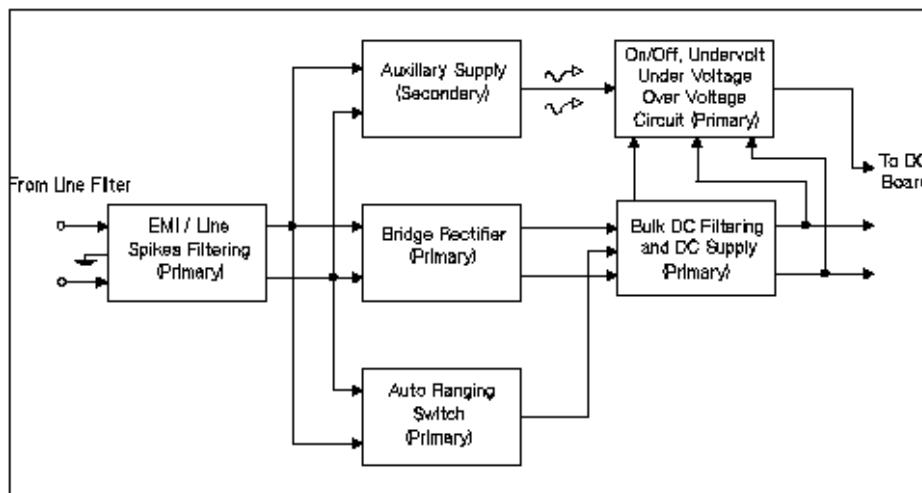
- takes the LINE and NEUTRAL from the site power
- rectifies the AC to DC
- produces a 300 VDC (nominal) crudely-regulated output bus.
- produces an ENABLE signal

The line filter (not shown) - filters some transients and conducted interference noise. This filter is in a box mounted on the top of the power supply cage. This filter also provides a plug for the line input.

The EM/line spike filter block passes the primary and neutral inputs while attenuating noise that the power supply tries to conduct back to the line. The circuit also filters line transients such as high voltage noise, lightning, etc.

This filter, in combination with the line filter, enables the power supply to withstand 6 KV spikes.

Figure 6-4 The AC PCA in the Power Supply



The bridge rectifier block takes the sinusoidal ac signal and turns it into pulsating dc voltage. This dc voltage is stored in the bulk filtering capacitors at a nominal value of 300 VDC.

The autoranging switch is a hybrid chip that senses the voltage across the primary. If the voltage is below 145 Vac, the neutral line is connected to the middle of the two bulk filtering capacitors. That, in effect, makes the bridge rectifier/capacitor combination a voltage doubler; enabling a 300-volt output from 120-volt AC input.

If the chip senses more than 145 VAC, the autoranging switch stays out of the circuit and the bridge rectifier passes its output to the bulk DC supply.

This switch supplies the function of a 120/240 switch, automatically correcting for any input.

The on/off and limits block works in parallel with the bulk DC block on the 300 VDC bus. The circuitry here senses the DC voltage on the bus and turns the power modules on the DC PCA on or off according to the operating range needs of the modules.

The DC power modules must have between 200 and 400 volts to operate without damage. While the DC bus is powering up, the limits block keeps the DC power modules off until the voltage level reaches 200. If a surge increases the voltage level to above 400 volts, the DC power modules are turned off to prevent them from being damaged.

The DC power modules may also be turned on or off through the operation switch and the auxiliary supply circuit.

The operation switch is a "Safe Extra-Low Voltage" (SELV) switch on the operator's control panel. In previous products, this switch on the control panel cut primary power, but this switch in the Models 60/100 is on the secondary side, isolated from line potentials through the auxiliary supply block. Placing this switch to on supplies the enable signal to the DC power modules.

The operation switch, in combination with the auxiliary power supply and on/off/limits circuitry, allows the DC power modules to operate if all of the following conditions are met:

- the power switch is ON
- the operation switch is on
- the on/off and limits circuitry senses more than 200 volts on the bulk DC bus
- the on/off and limits circuitry senses less than 400 volts on the bulk DC bus.

CAUTION

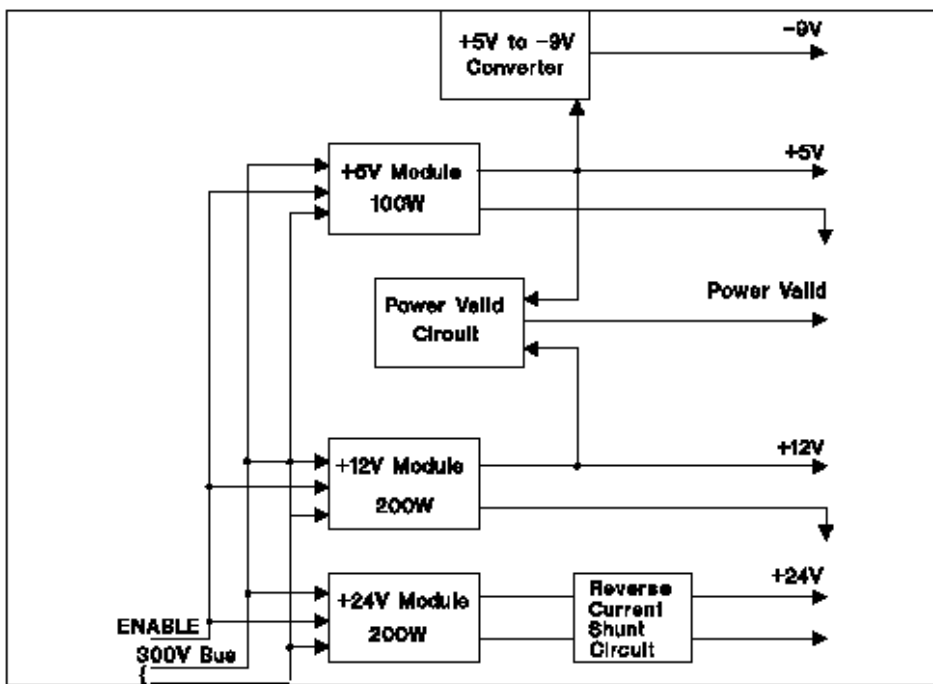
Hazardous primary voltages are always present on the AC PCA as long as the unit is plugged in and the power switch is ON.

6.4.2 The DC PCA

The DC PCA receives the 300-volt bulk DC input from the AC PCA and converts this to regulated outputs of +5, +12, and +24 volts if the enable signal is present.

Some of the +5 VDC that is generated is fed into a chip that further converts this to +9.5 VDC. This voltage is used to bias some op amps.

Figure 6-5 The DC PCA in the Power Supply



The power valid block looks at the +5 V and +12 V outputs. When these outputs rise to operating range (~4.5 V and ~11 V), this circuit triggers a power-on reset.

The reverse current shunt block absorbs any reverse current generated by the autochanger motors as they slow down.

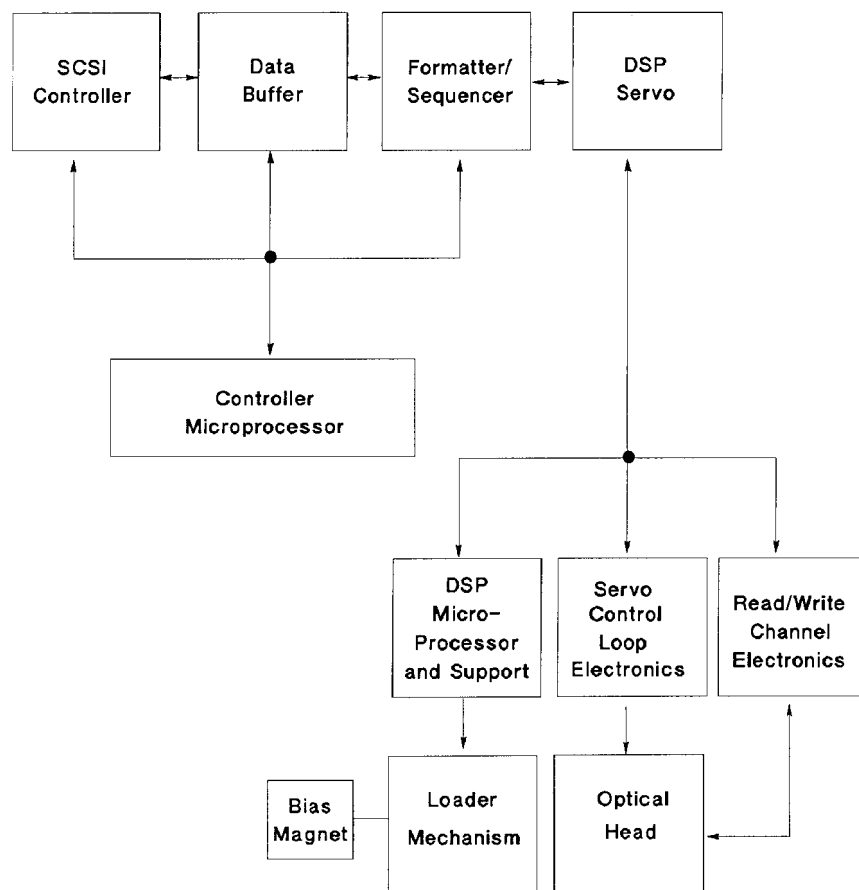
6.4.3 Power Supply Specifications

Table 6–1 Input Requirements

	Range
Input Voltage	100 to 240 VAC RMS
Input frequency	47 to 66 Hertz
Input current	< 6 amperes AC RMS
Input power	< 300 W
Inrush current	< 40.0 amperes peak at cold start
Input fusing	on PCA
Power factor	0.6
Line surge	Steps from 129 to 150 VAC for 500 milliseconds with no failure (including fuse)
Line sag	Steps from 108 to 80 VAC for 500 milliseconds with no failure (including fuse)
Line brownout and recovery	a. Linearly decrease from 90 to 0 VAC in 30 minutes. Then 120 volts is reapplied b. Linearly increase input voltage from 0 to 90 VAC in 30 minutes
Total output power	250 W (sum of all outputs)

6.5 The Multifunction Magneto-Optical Drives

Figure 6-6 Functional Diagram



There are four major sub-assemblies within the optical drive: the controller printed circuit assembly (PCA), servo printed circuit assembly (PCA), loader mechanism, and the optical head.

6.5.1 Controller PCA

The controller PCA is a microprocessor-based collection of digital electronics that handles functions performed by a SCSI controller, a data buffer, and a formatter/sequencer.

6.5.1.1 SCSI Controller

The SCSI controller provides the SCSI interface connection to the host computer. This interface consists of both the electrical signals and the firmware which decodes the various commands and messages on the SCSI bus and instructs the drive to take appropriate action.

6.5.1.2 Data Buffer

The data buffer and associated control electronics provide a buffer to speed match transfers to and from the host computer and the optical disk. The data buffer provides a cache for read and write operations, optimizing the speed of these transfers. The RW510/RW511 data buffer contains 256-Kbytes of buffer RAM; the RW530 data buffer contains 512-Kbytes of buffer RAM.

6.5.1.3 Formatter/Sequencer

The formatter/sequencer function formats and decodes data for read and write transfers. During a write function user data is sent via the SCSI bus as bytes (8 bits each). The formatter converts these 8 bits of parallel data into an encoded serial bit stream that includes all the format and error correction features required to meet the ANSI and ISO specifications. During reads, the decoder converts the serial data stream, which includes format and error correction features, into parallel data.

6.5.2 Servo PCA

The servo PCA includes a digital signal processor (DSP) that controls the actions of the many servo loops that interact with the optical head and the loader assembly.

6.5.2.1 DSP Microprocessor and Support/Servo Control Loops

Most of the electronics on the servo PCA are analog circuitry. This circuitry is designed into the control loops of the following servos: spindle motor/speed, laser power control, track following, seek/position maintenance, focus actuation, fine position actuation, and coarse position actuation. Whenever the drive is performing a read or write operation, all these servos are activated.

Also on the servo PCA are control electronics for the loader assembly. Included are drivers for the loader and spindle (speed control) motors, sensor circuitry for the cartridge loaded and write protect detectors, LED drivers for the front

panel LEDs, and control circuitry for the bias magnet subassembly of the loader mechanism.

6.5.2.2 Read and Write Channel Electronics

Read channel electronics take analog data from the optical head and convert it into digital "transitions." These transitions are decoded by the decoder electronics on the controller PCA in order to extract data from format and error correction features. The write channel electronics take the serial data stream from the formatter/sequencer and convert the digital pulses into analog data. This analog data is then sent to the optical head.

6.5.3 Mechanism Assembly

6.5.3.1 Loader Mechanism

The loader mechanism consists of two motors: a spindle motor for speed control and a loader motor for loading and unloading of the cartridge. The loader motor includes a gear train and rack-and-pinion system that allow the cartridge shuttle to raise and lower the cartridge within the loader housing. The bias magnet subassembly sits on top of the cartridge shuttle and provides the correct polarity for erasing or writing data.

6.5.3.2 Optical Head

A major feature of the optical head is a "split optics" design. This design physically separates the laser diode and its associated detectors from the focus/fine position actuators. This design results in a significant seek time performance advantage due to less mass on the moving portion of the optical head.

There are several actuators in the optical head. The coarse position actuator moves the focus/fine position actuators to the vicinity of the desired sector on the optical disk. The fine actuator makes small corrections (± 25 tracks) to center the optical head on the desired sector. The focus actuator then moves up and down to provide optimal focus on the light beam. All these actuators, and the laser diode (and its detectors) are controlled by the servo PCA.

The laser diode and its associated detectors are part of a flex circuit on the optical head assembly. On this flex circuit are analog electronics which further condition the control signals for the laser diode, and pre-amplifiers for the servo and data control signals that are returned to the servo PCA.

6.6 Optical Disk Layout and Error Correction

6.6.1 Disk Formats

Two optical disk formats are available. The RW510/511 optical drive can read from and write to 650-Mbyte optical disks. The RW530 optical drive can read from and write to both 650-Mbyte and 1.3-Gbyte optical disks. The target's role is to manage the 130mm multifunctional drive and disk as an optical memory device through its SCSI interface. These optical drives support 130mm rewritable optical disks conforming to ISO/IEC 10089 Format A, and write-once optical disks conforming to ISO/IEC DIS 11560, for 650-Mbyte capacity. The RW530 also supports the ECMA 184 standard for 1.3-Gbyte capacity, both rewritable and write-once.

The following sections outline disk layout for both 650-Mbyte and 1.3-Gbyte optical disks. Throughout this section, the sector number is that of a 1024 bytes/sector disk. The value of a 512-bytes/sector disk is written inside parentheses just after the value for the 1024 bytes/sector disk.

6.6.2 Optical Disk Layout—650-Mbyte Capacity

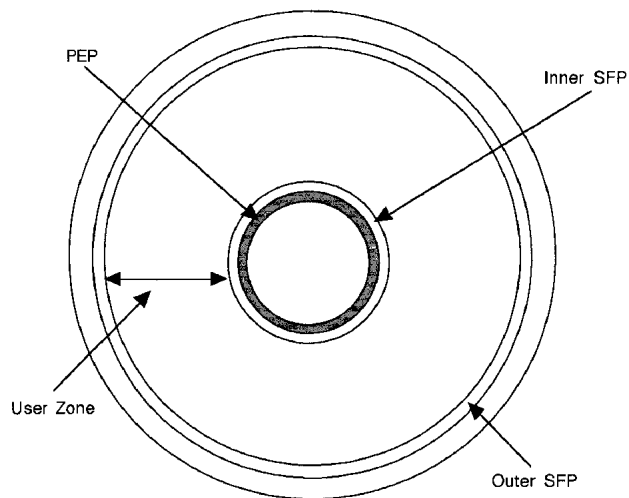
This section highlights some of the aspects of an optical disk as outlined by the ISO standard DIS 10089A and ISO/IEC DIS 11560.

There are three recording styles used on the optical disk that correspond to three specified areas on the disk:

- Phase encoded part (PEP)
- Standard formatted part (SFP)
- User zone

Both the PEP and SFP are areas that have been “recorded” by the media manufacturer and cannot be altered by a drive. They contain information that the drive uses to best read and write to the optical disk. Consult the ISO standard for more information.

Figure 6–7 Optical Disk Layout



6.6.3 User Zone Layout—650-Mbyte Capacity

The User Zone consists of Defect Management Areas (DMAs), a User Area and a Slipping Area. The DMAs contain information on the organization of the User Area into User Groups and Spare Groups. The DMAs also contain a Primary Defect List (PDL) and a Secondary Defect List (SDL) that provide information on the locations of defects. The drive uses this information to perform defect management.

Although the User Zone consists of tracks and sectors, it is often easier to think of it in terms of a large memory space of consecutive sectors. Figure 6–8 shows the following parts of the User Zone for 650-Mbyte media.

1. Four Defect Management Areas (DMAs) that each consist of:

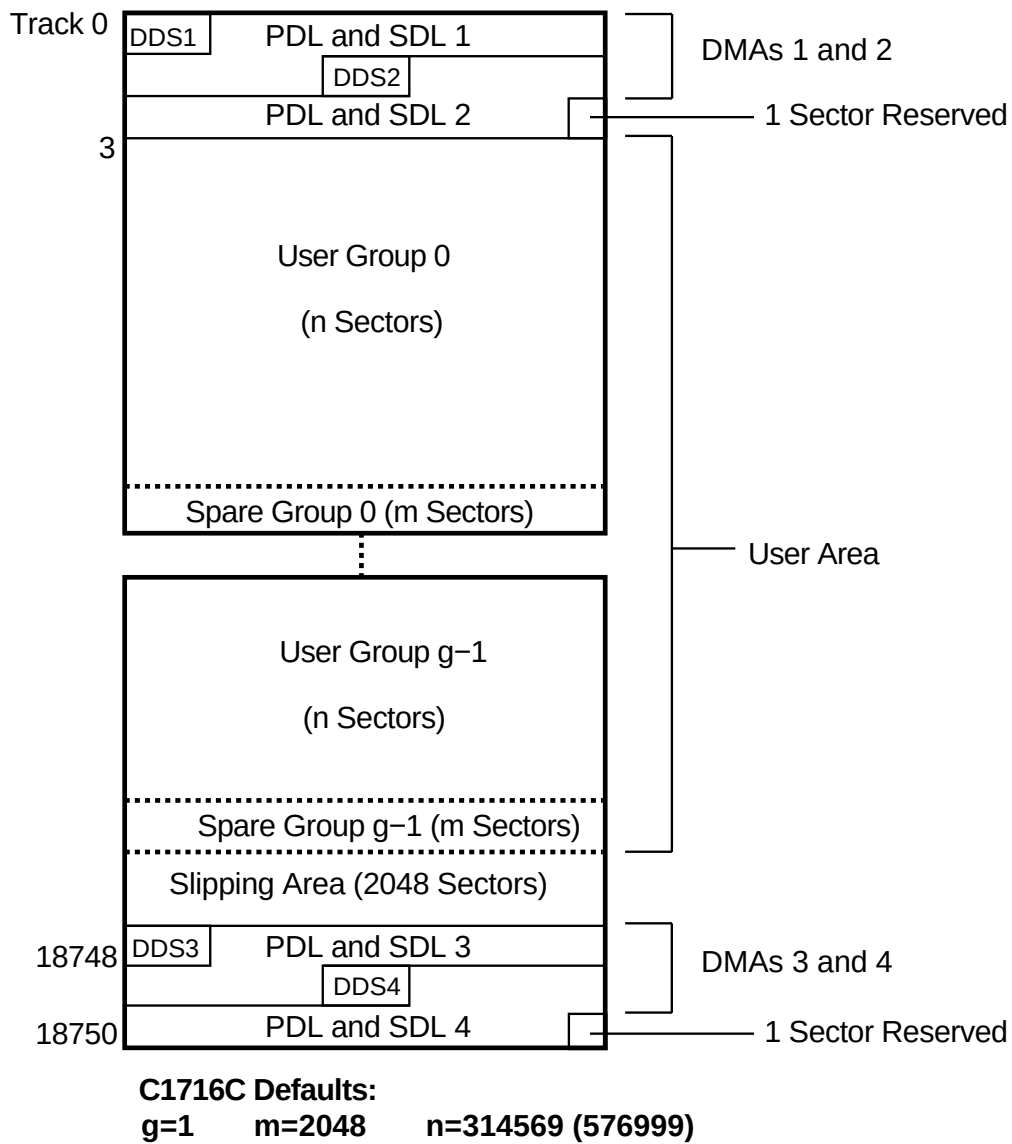
- Disk Definition Structure (DDS)
- Primary Defect List (PDL)
- Secondary Defect List (SDL)

2. Slipping Area

3. User Area that consists of:

- g User Groups, of n sectors each
- g Spare Groups, of m sectors each

Figure 6-8 User Zone Layout for 650-Mbyte Media



6.6.4 Optical Disk Layout—1.3-Gbyte Capacity

This section highlights some of the aspects of 1.3-Gbyte Capacity optical disks as outlined by ECMA 184.

The disk is divided into various zones, similar to the 650-Mbyte capacity. See Figure 6–7. In addition to the User Zone, where user data is stored, there are other zones including the PEP and SFP zones. Both the PEP and SFP contain information prerecorded by the media manufacturer and cannot be altered by a drive. They contain information about media parameters that the drive uses to read from and write to the optical disk. Consult the ISO standard for more information.

6.6.5 User Zone Layout—1.3-Gbyte Capacity

The User Zone consists of Defect Management Area (DMAs), and User Area. The DMAs contain information about the organization of the User Area into User Groups and Spare Groups. The DMAs also contain a Primary Defect List (PDL) and a Secondary Defect List (SDL) that provide information on the locations of defects. The drive uses this information to perform defect management.

Although the User Zone consists of tracks and sectors, it is often easier to think of it in terms of a large memory space of consecutive sectors. Figure 6–9 shows the following parts of the User Zone for 1.3-Gbyte media.

1. Four Defect Management Areas (DMAs) each consisting of a
 - Disk Definition Structure (DDS)
 - Primary Defect List (PDL)
 - Secondary Defect List (SDL)
2. Slipping Area
3. User Area consisting of
 - g User Groups, of n sectors each
 - g Spare Groups, of m sectors each

Note

$g = 1 \text{ or } 16$

Figure 6–9 and Figure 6–10 show the User Zone Layout for 1.3-Gbyte, for both $g=1$ and $g=16$, respectively. It is important to note one significant difference between 650-Mbyte and 1.3-Gbyte media. Both types of media can contain multiple groups, however the start of each group on 650-Mbyte media can “slip out” with any slip spares found prior to that group. 1.3-Gbyte media establishes groups BEFORE accounting for slip spares. (Please refer to Section 6.6.6 for more details.

Figure 6–9 User Zone Layout for 1.3-Gbyte Media, $g=1$

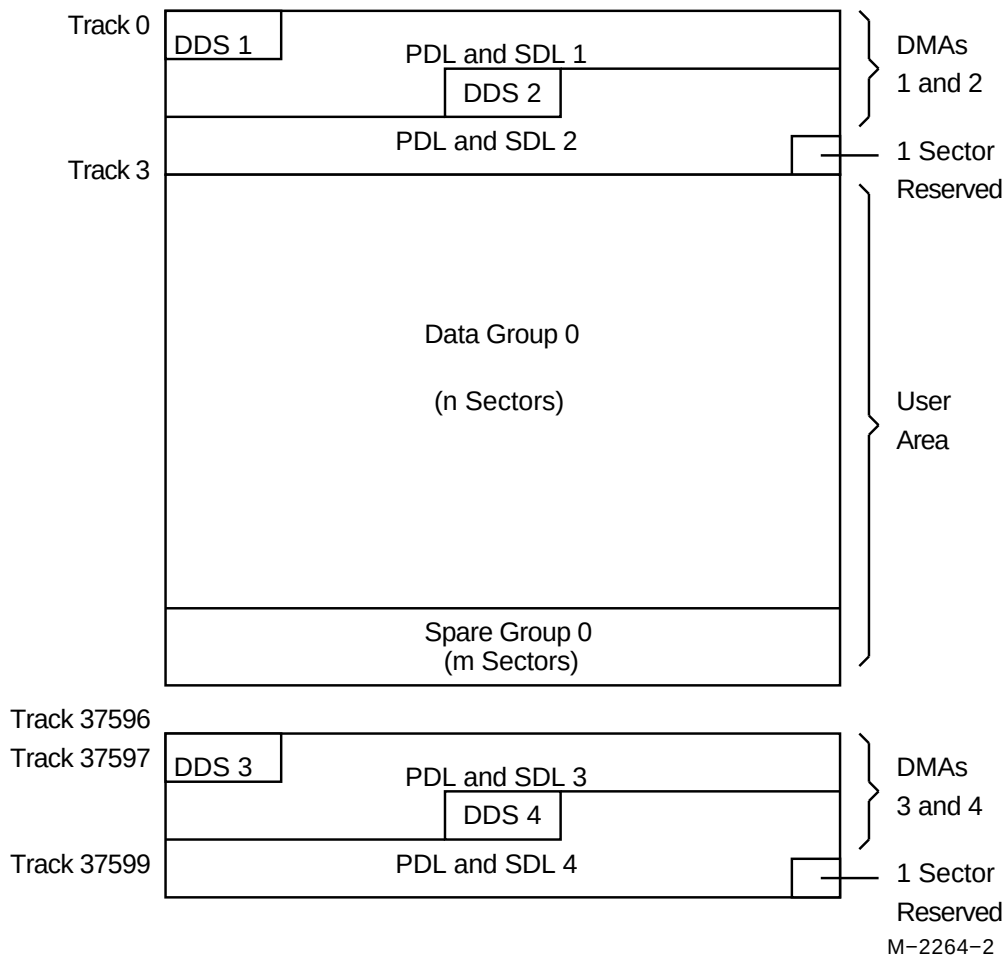
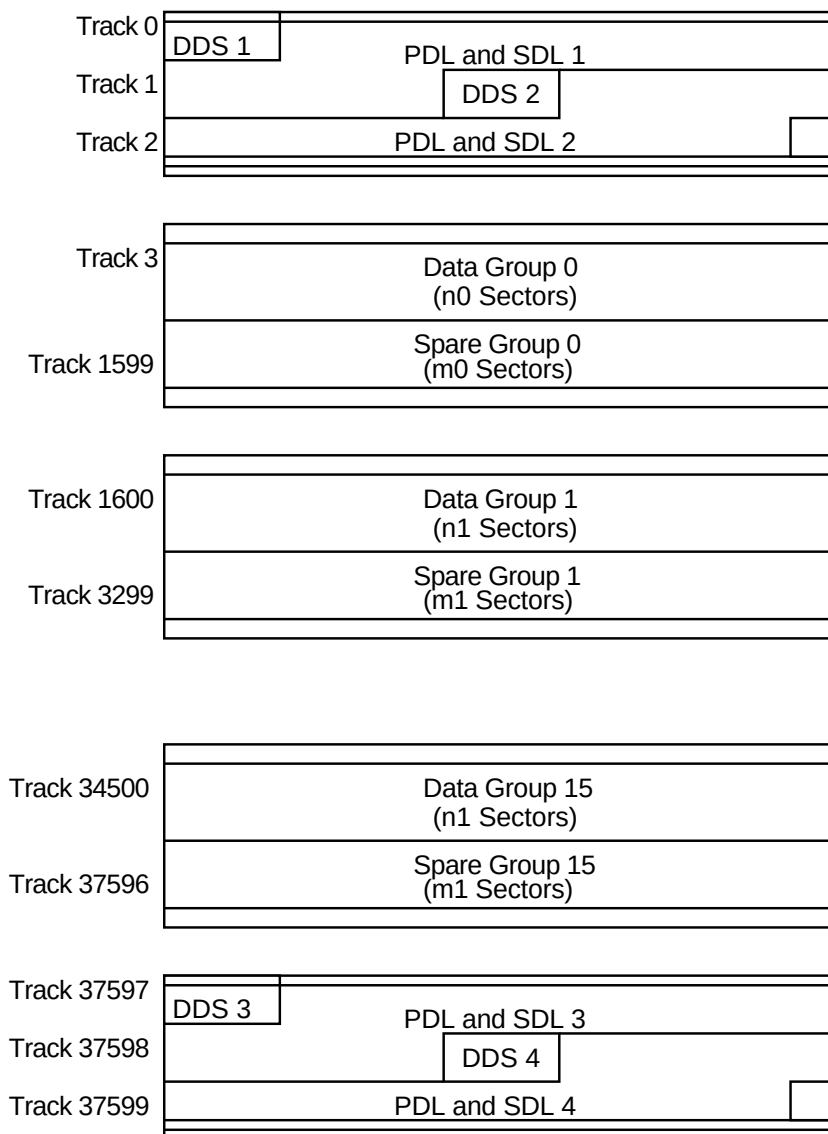


Figure 6–10 User Zone Layout for 1.3-Gbyte,g=16



M-2264-1

Table 6–2 shows the values for n and m for 1.3-Gbyte with g=16 (1024 media).

Table 6–2 Values for n and m for 1.3-Gbyte with g=16 (1024 media)

Band	n	m
Data Band 0	27064	85
Data Band 1	28815	85
Data Band 2	30498	102
Data Band 3	32198	102
Data Band 4	33898	102
Data Band 5	35581	119
Data Band 6	37281	119
Data Band 7	38981	119
Data Band 8	40664	136
Data Band 9	42364	136
Data Band 10	44064	136
Data Band 11	45747	153
Data Band 12	47447	153
Data Band 13	49147	153
Data Band 14	50830	170
Data Band 15	52462	187

The format of 1.3-Gbyte media is often referred to as a “sliding sector” format. This means that logical tracks do not necessarily align with physical revolutions. Table 6–3 details the physical revolution to logical track layout for 1.3-Gbyte media.

Table 6–3 Physical Revolution to Logical Track Layout

Zone or Band	Physical Revolution Range	Logical Track Range
Inner SFP	(-369,-161)	(-369,-161)
Inner Mfg	(-128,-33)	(-128,-33)
Data Band 0	(0,1349)	(0,1599)
Data Band 1	(1350,2699)	(1600,3299)

(continued on next page)

Table 6–3 (Cont.) Physical Revolution to Logical Track Layout

Zone or Band	Physical Revolution Range	Logical Track Range
Data Band 2	(2700,4049)	(3300,5099)
Data Band 3	(4050,5399)	(5100,6999)
Data Band 4	(5400,6749)	(7000,8999)
Data Band 5	(6750,8099)	(9000,11099)
Data Band 6	(8100,9449)	(11100,13299)
Data Band 7	(9450,10799)	(13300,15599)
Data Band 8	(10800,12149)	(15600,17999)
Data Band 9	(12150,13499)	(18000,20499)
Data Band 10	(13500,14849)	(20500,23099)
Data Band 11	(14850,16199)	(23100,25799)
Data Band 12	(16200,17549)	(25800,28599)
Data Band 13	(17550,18899)	(28600,31499)
Data Band 14	(18900,20249)	(31500,34499)
Data Band 15	(20250,21599)	(34500,37599)
Outer Mfg	(21600,22949)	(37600,37785)
Outer SFP	(22950,24299)	(37786,38046)

6.6.6 Drive Defect Management

The optical drive mechanism supports the defect management scheme specified by ISO 10089A and ISO DIS 11560, and ECMA 184.

Each DMA consists of a:

- Disk definition structure (DDS)
- Primary defect list (PDL)
- Secondary defect list (SDL).

The DDS contains information about the number of User and Spare groups on the disk and their sizes.

The PDL contains a list of defective sectors determined by the manufacturer or by a certification of the User Area, i.e. during a SCSI Format Unit Command. Defective sectors in the PDL are associated with the slip sparing algorithm described in this chapter.

The SDL contains a list of defective sectors and corresponding replacement sectors determined during disk use after certification. Defect/replacement entries in the SDL are associated with the replacement sparing algorithm described in this chapter.

The Slipping Area is a reserved portion of the user zone used by the slip sparing algorithm. Defects found during certification are excluded from use. The user-accessible space is slipped by a corresponding number of sectors into this slip area. This area is large enough to account for a maximum of 2048 slip spares. Any unused sectors in the Slipping Area are unavailable for user data.

Note

The Slipping Area applies only to 650-Mbyte media.

The information in the DDS provides a means for controlling the placement of reserved sectors that can be used by the replacement sparing algorithm. There are three important parameters; the variables g, n, and m are used in the ISO standard, and will also be used here for consistency:

- g - number of groups
- n - number of sectors in a user group
- m - number of sectors in a spare group

If the User Groups is where user data will be stored initially, and the Spare Groups are reserved sectors for the replacement sparing algorithm g, n, and m are generally chosen so that they maximize the number of spare sectors allowed, and maximize the size of the User Area. (The ISO standard for 650-Mbyte media allows for a maximum of 2048 spare sectors total from the PDL and the SDL, while the ECMA standard for 1.3-Gbyte allows for 2057 or 1077, depending on the sector size of 1024 or 512 bytes per sector, respectively.) For 1.3-Gbyte the value for g must be 1 or 16.

In general for 650-Mbyte: $g * (n + m) \leq (\text{size of User Area})$

In general for 1.3-Gbyte: $g = 1 \text{ or } 16, (n, m, \text{ or } n_0 \text{ thru } n_{15} \text{ and } m_0 \text{ thru } m_{15} \text{ are predefined based on } g).$

For more details consult the ISO or ECMA standard.

6.6.7 Slip Sparing Algorithm

The slip sparing algorithm is used to manage the defective sectors listed in the PDL during address translation between logical and physical blocks. During an address translation, the logical blocks are “slipped” past any defective sectors, thus the name “slip sparing.” As an example, say there are defective sectors at block addresses 20 and 30, and you want the physical address of logical block 40. Since addresses 20 and 30 are defective they should be slipped past, so logical block address 20 is now physical block address 21, and logical block address 30 is now physical block address 32, taking into account both physical blocks 20 and 30 being slipped past. This would result in physical block address 42 being the translation for logical block address 40.

Note that this is not a truly accurate example for three reasons:

1. PDL entries are given in track/sector form, not as block addresses. The final translated address must also be in track/sector form.
2. There is a 3-track offset added to the physical block address, 51 sectors for 1024 bytes/sector media and 93 sectors for 512 bytes/sector media.
3. This example does not take into account the effects of Spare Groups preceding this sector. The User and Spare Groups are determined after slip sparing, for 650-Mbyte media, and before slip sparing for 1.3-Gbyte media.

For 650-Mbyte media, slip sparing is always the first step of address translation, followed by User and Spare Grouping, and replacement sparing. For 1.3-Gbyte media, user and Spare Grouping is always the first step of address translation, followed by slip sparing, and replacement sparing.

The data structures for slip sparing and User and Spare Grouping (the PDL and DDS respectively) are created or updated only during a certification/format process, such as during a SCSI Format Unit Command. After certification, any additional defect management updating is done through the replacement sparing algorithm.

6.6.8 Replacement Sparing Algorithm

Once a disk has been certified and is being used by a customer, additional defective sectors may develop. The replacement sparing algorithm is intended to manage these defective sectors.

As was mentioned earlier, the DDS allows for a number of sectors to be reserved for future use by the replacement sparing algorithm. These "spare sectors" reside in the Spare Groups, and are referred to via entries in the SDL. Each SDL entry consists of a defect and its replacement pair. The defect is always a sector in a User Group, and the replacement is a sector from a Spare Group. Both are given in track/sector form.

During normal address translation, after the original physical address is found via the slip sparing algorithm, the SDL is checked to see if that physical address was 'spared' through the replacement sparing algorithm. If so, the replacement physical address is substituted for the original physical address.

In the event a sector needs to be replaced, i.e. due to a Reassign Blocks Command or automatic reallocation during a write command, a new defect/replacement pair is added to the SDL (if the new defect is not already in the SDL). (Updating an existing defect/replacement pair only occurs on 650-Mbyte media. For 1.3-Gbyte media a new defect/replacement pair is added, thus creating a "chain" of defect/replacement pointers.

6.6.9 Error Thresholds

Although not directly related to disk format, the various error thresholds are the basis for deciding whether or not to spare a sector. This could happen during the certification process (i.e. the slip sparing algorithm) or auto-reallocation during a SCSI Write command (i.e. the replacement sparing algorithm). These error thresholds are related to the format of a sector in the user zone.

Each sector in the user zone consists of a header, user data, and error correction information. The first error threshold of importance involves information in the sector header. Each header consists of three copies of the sector's track number, sector number, and a Cyclic Redundancy Check (CRC). The error threshold is determined by the number of sectors found "good."

The other error threshold of interest involves information about error correction. The error correction information that follows the data is often referred to as ECC (Error Correction Code) data. This data is a compact way to encrypt information about the original data written to the disk. With this information a drive can correct up to 8 bytes per data interleave in the User Data of a sector. Each sector has 10 (5) interleaves with 120 (122) bytes in each interleave. The actual number of bytes per interleave requiring correction is used as an error threshold. (Please consult the ISO standard for more details.) Table 6-4 shows the error thresholds for the optical drive. The sector IDs column refers to the minimum number of sector IDs that must be read correctly for the corresponding operation to be deemed successful. The ECC level column refers to the maximum number of bytes per interleave that require correction in order for the corresponding operation to be deemed successful.

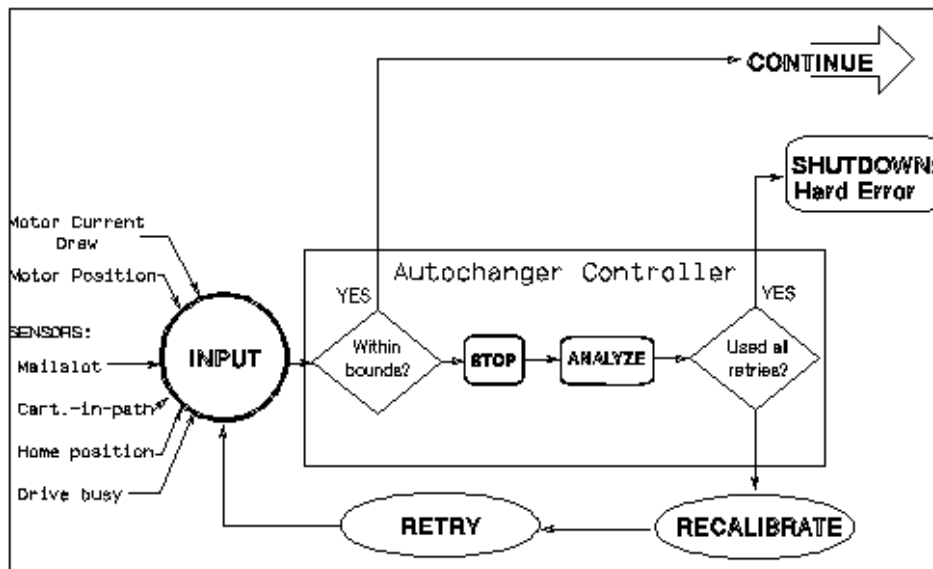
Table 6–4 Error Thresholds

Operation	Sector IDs	ECC Level
Format	2	3
Write	2	-
Erase	2	-
Verify	2	4
Read (Recovered)	1	7
Read	1	8

6.7 Error Detection and Recovery

Refer to Figure 6–11 during the discussion in the next two sections.

Figure 6–11 Error Detection and Recovery



6.7.1 Error Detection

The autochanger error detection methods are extensive. Both processes and sensors detect errors.

Each of the processes that detect errors are interrelated. Depending on the error condition, the autochanger expects feedback from one or more of the following processes before a diagnosis is made:

- overforce shutdown
- sense of touch
- motor position

An overforce shutdown occurs when the motors exert more force than is expected or required. If this occurs, the servo automatically shuts itself down to prevent parts damage. After an overforce shutdown occurs, the autochanger analyzes the situation, self-calibrates, and attempts a retry.

Sense of touch is the process where actual force used is compared to the recommended force for each move. The autochanger uses this information to detect errors or qualify moves. The difference between sense of touch and overforce shutdown is that the servo is not automatically shut down if sense of touch detects an error.

The positions of the motors are continuously monitored by the controller PCA. The position, along with the sense of touch feedback, is a valuable source of error detection.

These processes also combine to detect errors. For example, the sense of touch and the motor position processes continuously monitor the motor position and motor force levels to sense whether a potential error has occurred. It does not imply a sensing of complete force profiles, but the ability to continuously sample the force profile.

The physical parts of the error detection system are the sensors. These hard-wired sensors provide information that is impossible to determine through other means. This feedback information is fed to the autochanger controller PCA.

There are two forms of sensors:

- drive handshake - the drive provides a set of signals back to the autochanger controller to indicate the status of certain loader operations.
- optical sensors - detect conditions that are otherwise difficult to detect and are used to calibrate the unit. There are two mailslot sensors to detect if a cartridge is properly inserted into the mailslot, and a sensor for detecting

which side of the picker faces the mailslot-end of the chassis and allow calibration of the picker's position in relation to the drive and storage slots.

6.7.2 Error Recovery Processes

The autochanger uses the following processes to recover from errors:

- Inline Recovery
- Find Home Sequence
- Calibrate

For certain well-defined error conditions, recovery operations that have little effect on position or performance of the autochanger are executed inline. These are used only if the error condition can be determined exactly, and in cases where further motion may make recovery difficult.

The purpose of FIND HOME is to initialize the machine to a known state. For power-on, this means finding a "home" (zero) position for the carriage/picker assembly.

The calibrate procedure is then called to further locate reference points other than the zero locations found during FIND HOME. Using sensors, the picker is characterized as to its relationship with the mechanism. The positions of the drive, mailslot, and storage slots are calculated based on the location of the sensors.

For recovery after power-on, many subsets of FIND HOME may be called. One mode, for example, only determines which side of the picker faces the mailslot-end of the chassis. If any of the subsets of FIND HOME fail, the full FIND HOME sequence is run. A successful running of FIND HOME gives the autochanger code the exact positions of each end of the carriage rail and the rear plane of the picker assembly. Also, the autochanger then knows which side of the picker is facing the mailslot-end of the chassis and whether the picker holds a disk or not.

6.7.3 SCSI Detected Errors

For the vast majority of potential error conditions that may exist, the SCSI interface retrieves immediate information about the error with no motion required. Potential error conditions include:

- the machine not being ready for a new command due to another previously-issued command or a previously-detected hardware fault that prevents motion
- an illegal request to move a cartridge from an empty location or to a full location
- an illegal request to do an unsupported command or operation

- invalid syntax or parameters in a command
- various bus-level communication errors

In all of these cases, the command is rejected immediately and the autochanger is not moved.

6.7.4 Move Errors

If an error is detected during an autochanger motion, the state of the machine is recorded in internal memory and a retry procedure is called. Errors of this type may be either physical or logical, and may be recoverable or unrecoverable. Results of the error recovery are returned to the host when the command completes. If possible, the cartridge is returned to its original location before command completion, putting the autochanger back into its original state.

Logical errors refer to conditions in which source locations were found unexpectedly empty or destination locations were found unexpectedly full. These conditions indicate that a cartridge was moved without the knowledge of the autochanger, possibly during service. At this point, the host must become involved in locating the source of the error.

The host's actions can include issuing a Read Element Status command to find the difference between the host's location (element) list and that of the autochanger, followed by an Initialize Element Status command to find the actual locations of all disks. When the differences are determined, a final check of data on the disk should be done, with replacement to the appropriate location (element).

The picker "element status" always reflects the physical state of the picker. The autochanger will not give a status when the picker is found unexpectedly full or empty because this logical error is not allowed. At power-on, the picker is checked to see if it contains a cartridge. The mechanical design of the picker prevents a cartridge from being fully inserted into the picker without first going through an initial power-on cycle in the autochanger.

Physical errors refer to conditions in which something physically changes in the system that prevents normal operation of the motion. These can be either temporary or permanent. Error recovery attempts to recover from every physical error without host intervention. Any error that is detected through overforce, sense of touch, or by a sensor calls a procedure to attempt the recovery.

One exception to the no-host-intervention rule is in the drive/autochanger interaction. If the autochanger indicates that a cartridge has been inserted into the drive, but the drive does not read it, the host must become involved in identifying the source of the problem. Likewise, if the drive is commanded to eject a cartridge and does not do so, the drive is considered to be empty and the

host must identify either the final position of the cartridge or determine if the drive has failed.

6.7.5 Hardware Error Codes

If an error is unrecoverable (i.e., something is broken or jammed to a point that manual intervention is required), the autochanger takes an additional step in an attempt to identify the Field Replaceable Unit (FRU) that is causing the failure.

A routine is called automatically that performs a process of elimination for various FRUs. This routine attempts to isolate the error to three (or less) FRUs. If no error can be found (or if recovery was made from the error), the unit returns a "no error" status. If an error is found, a hardware error code and a move error code is returned when the command completes. Up to three FRU numbers are returned. The FRUs, and a time stamp, are listed in decreasing order of probability. Hardware error codes are listed in Table 4–1.

6.7.6 Real Time Event Logging

Information Logs

The optical disk library provides information logs about the autochanger's operation and error history. The logs can provide predictive information which could lead to early detection of autochanger problems.

All the logs are maintained within the non-volatile RAM and are accessible through the control panel and by the SCSI Log Sense command over the SCSI interface. The main functions provided with operational logs are described below.

Error Log

The autochanger maintains a history of past diagnostic test errors which have occurred within the autochanger, together with a time stamp of when they occurred. The error message maintained for each error indicates the failure and the possible FRUs which may have caused the failure.

Move Success Log

A cumulative number of move recoveries and a total move count are maintained. This gives service a view of the history of the autochanger soft error rate. The last ten hard errors are marked in this log by indicating how many good moves occurred since the last hard error.

Force Log

Each cartridge move is actually a sequence of many small moves, known as micro-moves. This log is a record of the maximum force measured during every micro-move situation.

Recovery Log

This is a record of recoverable (soft) errors, and related information on error recovery methods used and their success or failure.

Drive Log

This data indicates the number of times the autochanger uses each drive.

Run-Time Log

An entry is put into this log each time an error occurs which requires any form of recovery. Both "on-the-fly" and extensive recovery methods are logged. The type of error, the method of recovery, and the number of moves to that point are recorded.

Odometer

This value indicates the total number of moves executed since the non-volatile RAM was first initialized. Power-on hours are also logged.

6.8 The SCSI Interface

As defined by ANSI (American National Standards Institute), SCSI allows up to eight devices on the bus in any combination of computers and peripherals. The devices can communicate with one another without control from a host computer.

Another powerful feature is the ability of SCSI to perform arbitration. SCSI allows the host to initiate transactions, then break communication with a device, do something else, and re-establish communication when the device is ready.

Finally, SCSI is capable of high data transfer rates. Synchronous data transfer rates may be as fast as 4 Mbytes/second, and asynchronous rates up to 1.5 Mbytes/second, limited only by the capabilities of the computer and peripheral.

CAUTION

Do not switch off any peripheral on the SCSI bus without first checking that the bus is not active.

Switching off can cause data loss and/or indeterminate bus states.

6.8.1 SCSI Command Set

The following SCSI-2 commands can be used with the optical disk library.

Note

Detailed descriptions of these commands and their functionality with optical products can be found in the following documents:

- Offline Diagnostics for Hewlett-Packard Optical Products, located in Appendix B.
 - American National Standards Institute (ANSI) document titled, "Small Computer System Interface - 2 (SCSI-2)," revision 10H which is dated September, 1991. Copies of this publication can be obtained by writing to: Global Engineering Documents, 2805 McGaw, Irvine, CA 92714, or call: (800) 854-7179 or (714) 261-1455. Please refer to document X3.131-SCSI-2.
 - Multifunction Optical Drive and Library SCSI-2 Command Reference. This document can be obtained by ordering part number 5960-7606 from the Sales Response Center at Hewlett-Packard. Refer to Appendix B for order information.
 - HP Technical Guide Optical Drives and Libraries, obtained by ordering part number 5960-7605 from the Sales Response Center at Hewlett-Packard. Refer to Appendix B for order information.
-

The following tables list the SCSI-2 commands numerically, by group.

Table 6-5 Group 0 Commands (6-byte command)

Code (Hex.)	Name	Description
00	Test Unit Ready	Provides a means to check if the logical unit is ready
01	Rezero Unit	Moves the optical head to its recalibration position
03	Request Sense	Requests the detailed error information
04	Format Unit	Initializes the optical disk (done only once for unformatted, write-once disks)

(continued on next page)

Table 6–5 (Cont.) Group 0 Commands (6-byte command)

Code (Hex.)	Name	Description
07	Reassign Blocks	Reassigns defective sectors
08	Read	Reads data from the specified logical block address
0A	Write	Writes data to the specified logical block address
0B	Seek	Moves the optical head to the physical track where the specified logical block exists
12	Inquiry	Reads the information related to the controller and the drive unit
15	Mode Select	Sets optical disk, drive unit, or controller unit parameters
16	Reserve	Gains the exclusive control of a specified logical unit
17	Release	Releases a specified logical unit from the reservation state
1A	Mode Sense	Reads optical disk, drive unit, or controller unit parameters
1B	Start/Stop Unit	Starts or stops rotating the optical disk, and/or ejects the optical disk from the drive unit
1C	Receive Diagnostic Results	Requests analysis data be sent to the initiator
1D	Send Diagnostic	Requests the disk controller to perform diagnostic tests
1E	Prevent/Allow Medium Removal	Prevents or allows removal of the optical disk in the logical unit

Table 6–6 Group 1 and 2 Commands (10-byte command)

Code (Hex.)	Name	Description
25	Read Capacity	Reads the capacity of the optical disk
28	Read	Reads data from the specified logical block address
2A	Write	Writes data to the specified logical block address

(continued on next page)

Table 6–6 (Cont.) Group 1 and 2 Commands (10-byte command)

Code (Hex.)	Name	Description
2B	Seek	Moves the optical head to the physical track where the specified logical block exists
2C	Erase	Executes erase operation from the specified logical block address on rewritable disks only
2E	Write and Verify	Writes data to the optical disk and then verifies the written data by checking the error correction code
2F	Verify	Verifies the data starting from the specified logical block address by checking the error correction code
34	Pre-Fetch	Reads the data from the specified logical block address into the drive's controller cache memory
35	Synchronize Cache	Initiates the writing of all cached write data to the optical disk
37	Read Defect Data	Reads the optical disk defect information
3B	Write Buffer	Writes data to the controller data buffer
3C	Read Buffer	Reads data from the controller data buffer
3E	Read Long	Reads data from the specified logical block address including ECC data
3F	Write Long	Writes data to the specified logical block address without using the ECC generation circuitry
4C	Log Select	Clears drive resident logs and odometers
4D	Log Sense	Reads drive resident logs and odometers
55	Mode Select	Sets optical disk, drive unit, or controller unit parameters
5A	Mode Sense	Reads optical disk, drive unit, or controller unit parameters

Table 6–7 Group 5 Commands (12-byte command)

Code (Hex.)	Name	Description
A8	Read	Reads data from the specified logical block address
AA	Write	Writes data to the specified logical block address
AC	Erase	Executes erase operation from the specified logical block address on rewritable disks only
AE	Write and Verify	Writes data to the optical disk and then verifies the written data by checking the error correction code
AF	Verify	Verifies the data starting from the specified logical block address by checking the error correction code
B7	Read Defect Data	Reads the optical disk defect information

A

Offline Diagnostic Information

A.1 System Error Report

Figure A-1 shows a typical VAX/VMS system error report. After analyzing the report for symptoms, proceed to Section A.2.

Figure A-1 System Error Report

VAX / VMS SYSTEM ERROR REPORT COMPILED 8-APR-1993 15:11:43
PAGE 1.

***** ENTRY 9. *****
ERROR SEQUENCE 6552. LOGGED ON: SID 0A000005
DATE/TIME 8-APR-1993 15:10:09.37 SYS_TYPE 04010102
SYSTEM UPTIME: 5 DAYS 21:14:31 VAX/VMS V5.4-2
SCS NODE: KAWA

DEVICE ERROR KA420 CPU FW REV# 6. **SCSI Command Code**
GENERIC DK SUB-SYSTEM, UNIT KAWA\$WDB300: **Internal Device Code (15h = 21d)**

HW REVISION	00A50015	HW REVISION = ..#.
ERROR TYPE	05	EXTENDED SENSE DATA RECEIVED
SCSI ID	03	SCSI ID = 3.
SCSI LUN	00	SCSI LUN = 0.
SCSI SUBLUN	00	SCSI SUBLUN = 0.
PORT STATUS	00000054	%SYSTEM-F-CTRLERR, FATAL CONTROLLER ERROR
SCSI CMD	00000003 0078	REQUEST SENSE
SCSI STATUS	00	GOOD

EXTENDED SENSE DATA

EXTENDED SENSE	000B0070	Extended Sense Data Sense Key 0Bh
	0A000000	1st Byte of Extended Sense
	00000000	
	0000004E	Byte 12
	00A50000	
	1A000000	SCSI Command Packet
	00000100	
	07030000	
	00	

UCB\$B_ERTCNT	03	ABORTED COMMAND Sense Key
UCB\$B_ERTMAX	03	SENSE CODE = 4E(X) Additional Sense Code (ASC) 4Eh = Bus Protocol Error
ORB\$L_OWNER	00000000	3. RETRIES REMAINING
UCB\$L_CHAR	1CC54008	3. RETRIES ALLOWABLE

OWNER UIC [000,000]

DIRECTORY STRUCTURED
FILE ORIENTED
SHARABLE
AVAILABLE
ERROR LOGGING
ALLOCATED
CAPABLE OF INPUT

A.2 Autochanger Error Codes

This section contains the following autochanger error code tables:

- Request Sense Codes
- Request Sense Maps
- Move Error Codes
- Micro-Move Failure Type Codes

Figure A-2 Jukebox Request Sense Data Parameter Block Format

Byte	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70h or 71h)						
1	Reserved (0)							
2	Reserved (0)				Sense Key *			
3–6	Reserved (0)							
7	Additional Sense Length *							
8–11	Reserved (0)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved (0)							
15	SKSV	Sense Key Specific						
16–17	Sense Key Specific							

Error Code Either 70h (current error under VMS) or 71h (deferred error)

* = See Table A-1

Table A–1 Sense Key and Additional Sense Length Values

Sense Key (hex)	Description	Additional Sense Length
00	No Sense—Normal conditions	10
01	Recovered Error—Usually everything is OK	70
02	Not Ready—Typically a disk isn't spun up or inserted	10
03	Medium Error—May or may not be a serious problem	
04	Hardware Error—Usually a serious problem	70
05	Illegal Request—Usually a software problem	10
06	Unit Attention—Power on, RESET, a disk inserted, etc.	10
07	Data Protect—Tried to write to a write-locked disk	
08	Blank Check—A blank sector was encountered on a READ or wasn't blank on a WRITE	
0B	Aborted Command	10

Additional Sense Code— The Additional Sense Code specifies detailed information related to the error reported in the Sense Key field.

Additional Sense Code Qualifier—The Additional Sense Code Qualifier specifies detailed information related to the Additional Sense Code.

SKSV—When set to 1, the Sense Key Specific bytes contains valid data. When set to 0, bytes 15, 16, and 17 are null.

Sense Key Specific— Valid only when the Sense Key field is set to Illegal Request (05H) and SKSV is 1.

Additional Sense Bytes—This field may contain information when the Additional Sense Length field contains a value greater than 10. See Figure A–3.

Figure A-3 Jukebox Request Sense—Additional Sense Data

Byte	7	6	5	4	3	2	1	0
18	Move Error Code *							
19	Hardware Error Code (See list of Hardware Errors in Service Manual)							
20	First FRU (See list of FRUs in Service Manual)							
21	Second FRU							
22	Third FRU							
23	MvCap	Last	Rsvd (0)	PosLost	Cartin	Reserved (0)		
24–25	Reserved (0)							
26	DinRty	DEjRty	PkrRec	CarAssy	Reserved (0)		BFHm	FHR
27	Retry Count							
28–29	Reserved (0)							
30	DinRty	DEjRty	PkrRec	CarAssy	Reserved (0)		BFHm	FHR
31	Recovery Count							
32–34	Reserved (0)							
35	Valid	ErrEn	Cartin	CartEl	UnexpMt	UnexpF	Cartinv	ElRty
36–37	Source Element Number							

* = See Table A-2

Jukebox Request Sense – Additional Sense Data (continued)

Byte	7	6	5	4	3	2	1	0
38	Valid	ErrEn	Cartin	CartEl	UnexpMt	UnexpF	Cartinv	ElRty
39–40	Destination Element Number							
41	Valid	ErrEn	Cartin	CartEl	UnexpMt	UnexpF	Cartinv	ElRty
42–43	Secondary Source Element Number							
44	Valid	ErrEn	Cartin	CartEl	UnexpMt	UnexpF	Cartinv	ElRty
45–46	Second Destination Element Number							
47–49	Reserved (0)							
50–54	Micro–Move ID History *							
55	Failed Micro–Move ID							
56	Micro–Move Error Code **							
57–60	Vertical Motor Commanded Position							
61–64	Vertical Motor Actual Position							
65–68	Horizontal Motor Commanded Position							
69–72	Horizontal Motor Actual Position							
73–77	Reserved (0)							

* = See the Micro-Move ID Table

** = See Table A–3

Move Error Code— The movement that was being performed when the error occurred. The values of the Move Error Codes are in Table A-2.

Hardware Error Code – Determined by fault isolation, this error code indicates the cause of the failure. Hardware error codes are listed in the “Troubleshooting and Diagnostics” chapter of the service manual.

First FRU –The most likely field replaceable unit (FRU) to be the cause of the failure. See the “Removal and Replacement” chapter of the service manual for a list of FRUs.

Second FRU— The second most likely field replaceable unit (FRU) to be the cause of the failure. See the “Removal and Replacement” chapter of the service manual for a list of FRUs.

Third FRU—The third most likely field replaceable unit (FRU) to be the cause of the failure. See the “Removal and Replacement” chapter of the service manual for a list of FRUs. **NOTE** The FRUs returned should be considered ++pointers++ to the best area within the unit to check for the fault. Simply changing the FRU listed may or may not fix the associated problem.

MvCap— A Move Capable bit of 1 indicates the autochanger is capable of performing move commands.

LastSCSI – A Last bit of 1 indicates the autochanger has successfully returned the cartridge to the state they were in before the failed command was executed.

PostLost— A Position Lost bit of 1 indicates the autochanger cannot calibrate the mechanism and has lost position of the picker.

CartTrans— A Cartridge in Transport bit of 1 indicates a cartridge is in the picker mechanism.

DInRty—A Drive Insert Retry bit of 1 indicates that more than one attempt was needed to insert the cartridge into the drive. (For byte 26, this attempt refers to Retry algorithm and for byte 30 it refers to Recovery algorithm).

DEjRty—A Drive Eject Retry bit of 1 indicates that more than one attempt was needed to eject the cartridge from the drive. (For byte 26, this attempt refers to Retry algorithm and for byte 30 it refers to Recovery algorithm).

PkrRec—A Picker Retracted bit of 1 indicates the picker fingers were fully retracted after a failure. (For byte 26, this attempt refers to Retry algorithm and for byte 30 it refers to Recovery algorithm).

CarAssy—A Carriage Locked bit of 1 indicates the picker fingers were fully retracted after a failure and the translate pin is engaged. (For byte 26, this attempt refers to Retry algorithm and for byte 30 it refers to Recovery algorithm).

BFHm—A Bad Find Home bit of 1 indicates the Find Home algorithm was started while the optical sensors were inoperable. (For byte 26, this attempt refers to Retry algorithm and for byte 30 it refers to Recovery algorithm).

FHR—A Find Home Recalibration bit of 1 Find Home algorithm was invoked to recalibrate the mechanism (For byte 26, this attempt refers to Retry algorithm and for byte 30 it refers to Recovery algorithm).

Retry Count— The total number of retry attempts that were performed.

Recovery Count— The total number of recovery attempts that were performed.

Valid— A “0” indicates that this and the next two bytes contain invalid data. Valid in bytes 41 and 44 are only set during the Exchange Medium Command.

ErrEn—An Error Encountered bit of 1 indicates an error occurred while the picker was enroute to this element.

CartEl—A Cartridge in Element bit of 1 indicates the cartridge associated with this move is in this element.

UnexpMt—An Element Unexpected Empty bit of 1 indicates this element was unexpectedly empty.

UnexpFl—An Element Unexpected Full bit of 1 indicates this element was unexpectedly full.

CartInv—A Cartridge Inverted bit of 1 indicates the cartridge is inverted from its state before the operation began.

ElRty—An Element Required Retry bit of 1 indicates an operation in or out of this element required one or more retries.

Source Element Number—The Element Number to which the Source Element Bit Map (byte 35) refers.

Destination Element Number—The Element Number to which the Destination Element Bit Map (byte 38) refers.

Secondary Source Element Number—The Element Number to which the Secondary Source Element Bit Map (byte 41) refers.

Second Destination Element Number— The Element Number to which the Second Destination Element Bit Map (byte 44) refers.

Micro-Move ID History—The last five autochanger Micro-Move IDs for the original movement command prior to the failure. Refer to the Micro-Move ID Table in this manual.

Failed Micro-Move ID—Actual micro-move that failed.

Micro-Move Error Code—The error code associated with the failed Micro-Move ID. See Table A–3.

Vertical Motor Commanded Position—The position to which the carriage motor was commanded.

Vertical Motor Actual Position—The actual position of the carriage motor.

Horizontal Motor Commanded Position—The position to which the picker motor was commanded.

Horizontal Motor Actual Position—The actual position of the picker motor.

Table A–2 Autochanger Move Errors

Error Codes	Failure Description
00	Failure occurred before any servo-controlled motions were attempted during Power on Selftest.
02	Failure while Picker is not moving.
04	Failure while moving the carriage/picker assembly away from drives.
06	Failure while moving the carriage/picker assembly toward drives.
08	Failure while flipping the picker.
0A	Failure while translating the picker assembly.
0E	Failure while moving the picker fingers back in preparation to translate.
10	Failure while moving the picker fingers to engage the cartridge from the source storage element.
12	Failure while moving the picker fingers back to remove the cartridge from the source storage element.
18	Failure while moving the picker fingers forwards to insert a cartridge in the destination storage element.
1A	Failure while moving the picker fingers back after inserting a cartridge in the destination storage slot.
20	Failure while moving the picker fingers forwards to engage the cartridge ejected from the drive (source).
22	Failure while moving the picker fingers back to remove the cartridge from the drive (source).
28	Failure while moving the picker fingers forwards to insert the cartridge into the drive (destination).

(continued on next page)

Table A-2 (Cont.) Autochanger Move Errors

Error Codes	Failure Description
2A	Failure while moving the picker fingers back after inserting a cartridge into the drive (destination).
30	Failure while moving the picker fingers forward to engage the cartridge in the mailslot (source).
32	Failure while moving the picker fingers back to remove the cartridge from the mailslot (source).
38	Failure while moving the picker fingers forward to insert the cartridge in the mailslot (destination).
3A	Failure while moving the picker fingers back after inserting the cartridge in the mailslot (destination).
40	Failure while rotating the mailslot actuator inward.
42	Failure to ensure that the mailslot rotated inward.
48	Failure while rotating the mailslot actuator outward.
4A	Failure to ensure that the mailslot rotated outward.
50	Failure while the finding the home position.
52	Failure while calibrating the carriage/picker assembly.
60	Initializing element status failed while testing an element with a cartridge in the picker assembly.
80	Failure to remove a cartridge from a source element.
84	Failure to leave a cartridge properly in a destination element.
88	An obstruction was encountered before the cartridge had been inserted the proper distance.
90	Source element unexpectedly empty.
94	Destination element unexpectedly full.
A0	Front mailslot sensor failed.
A2	Inside mailslot sensor failed.
A4	Drive light stuck on.
B0	Door interlock open.

Table A–3 Autochanger Micro-Move Error Codes

Error Code (hex)	Description
Micro-Move Errors are reported in byte 56 of the additional sense bytes (Figure A–3).	
0	No error.
1	Carriage motor drive voltage exceeded limit set by firmware.
2	Carriage motor overcurrent detected by hardware.
3	Carriage motor force exceeded limit set by firmware.
4	Picker motor drive voltage exceeded limit set by firmware.
5	Picker motor overcurrent detected by hardware.
6	Picker motor force exceeded limit set by firmware.
7	Low power supply during motion.
8	High power supply during motion.
9	Move stopped because cartridge-in-path beam blocked.
A	Cartridge not detected by cartridge-in-path beam.
B	Carriage motor not tracking properly.
C	Picker motor not tracking properly.
D	Carriage motor measured voltage less than expected.
E	Picker motor measured voltage less than expected.
10	Find origin failed.
11	Calibrate failed.
12	Diagnose FRU failed.
13	Initial recovery failed.
14	Find home failed.
15	Picker initialization failed.
16	Cartridge-in-path beams are blocked.
20	Failed to find hard stop at end of flip.
22	Failed to see sensor close at the end of translate.
23	Failed to move to the vertical position needed to engage the translate pin.
24	Failed to see sensor close at the start of translate.

(continued on next page)

Table A-3 (Cont.) Autochanger Micro-Move Error Codes

Error Code (hex)	Description
25	Failed to see height sensor re-open after closing at the start of a translate.
28	The translate distance was too long.
29	The translate distance was too short.
31	Failed while checking for cartridge in a drive.
32	Failed to find a hard stop returning cartridge to storage after testing for presence of cartridge.
33	Failed while checking for cartridge in a storage slot.
34	Failed while checking for cartridge in the Picker.
35	Failed while checking for cartridge in the mailslot.
36	Could not free fingers after testing for a cartridge in a drive.
38	Failed to verify that cartridge exists after insert.
40	Failed finding the back of storage slot during retraction.
41	Failed to verify that a disk is in the storage slot on get using cartridge-in-path beams.
42	Not able to measure the depth of the storage slot.
43	Failed to free fingers from the storage slot.
48	Could not find the back of the storage slot after insert.
49	Failed to verify that a cartridge exists in the storage slot after insert.
4A	Could not free fingers from storage slot after insert.
50	Could not find the back of the mailslot after get.
51	Failed to verify that a disk is in the mailslot on get using cartridge-in-path beams.
52	Not able to measure the depth of the mailslot.
58	Could not find the back of the mailslot after insert.
59	Failed to verify that a cartridge exists in the mailslot after insert.
60	Failed to rotate the mailslot in.
61	Failed to rotate the mailslot out.
70	Exhausted retries while attempting to get the drive to eject the cartridge.

(continued on next page)

Table A-3 (Cont.) Autochanger Micro-Move Error Codes

Error Code (hex)	Description
71	Could not verify that the drive ejected the cartridge.
72	Could not free fingers from the drive.
73	No cartridge in drive.
74	No load complete.
75	Drive error signal.
76	Unexpected cartridge in the drive.
77	Unexpected load complete.
78	Exhausted retries attempting to get drive to accept the cartridge.
79	Could not verify that the drive accepted the cartridge.
7E	Inline recovery attempts exhausted.
Errors above are counted in the runtime log as in-line, errors below as retries.	
90	Drive access was disallowed because drive busy signal was active.
91	Drive light stuck off.
94	Outside mailslot sensor failed.
95	Inside mailslot sensor failed.
96	Mailslot rotation failure; possibly caused by operator.
FA	Test drive insert retry.
FB	Timed out waiting for drive to eject when testing for the presence of a cartridge; retry being attempted.
FC	Retry being attempted on drive insert.
FD	Retry being attempted on drive eject.
FE	Mechanism error.

A.3 Drive SCSI-2 Reference

This section contains the following information:

- Request Sense Command sense key values
- Request Sense Command additional sense code values
- HP-Specific Error Codes

Figure A-4 Drive Request Sense Data Parameter Format

Byte	7	6	5	4	3	2	1	0
0	AV	Error Code (70H or 71H)						
1	Reserved (0)							
2	Reserved (0)		ILI	Rsvd (0)	Sense Key*			
3	Information (MSByte)							
4	Information							
5	Information							
6	Information (LSByte)							
7	Additional Sense Length (0AH)							
8	Command Specific Information (MSByte) (reassign blocks only)							
9	Command Specific Information (reassign blocks only)							
10	Command Specific Information (reassign blocks only)							
11	Command Specific Information (LSByte) (reassign blocks only)							
12	Additional Sense Code**							
13	Additional Sense Code Qualifier**							
14	Reserved (0)							
15	SKSV	Sense Key Specific Information (if Sense Key = 1,3,4,5)						
16	Sense Key Specific Information							
17	Sense Key Specific Information							
18	HP-Specific Error Code***							
19	HP-Specific Error Code***							
20	Reserved (0)							
21	HP-Specific DSP Error Information (MSByte)							
22	HP-Specific DSP Error Information (LSByte)							
23	HP-Specific DSP Status Byte							

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These asterisks are keyed to Figure A-4:

* = See Table A-1

** = See Table A-4

*** = See Table A-5

AV- A Valid bit of 1 indicates the information field contains valid information. A Valid bit of 0 indicates that the information field does not contain valid data.

ILI- An Incorrect Length Indicator bit of 1 usually indicates that the requested logical block length did not match the logical block length of the data on the medium.

Information-

1. The logical block address associated with the sense key.
2. The difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command, when the ILI bit is set.

Command Specific Information- The logical block address of the first defect descriptor not reassigned is returned in this field.

SKSV- A Sense Key Specific Valid bit of 1 indicates that the Sense Key Specific Information is valid. A SKSV bit of 0 indicates that there is no sense key specific information.

Sense Key Specific Information- If the Sense Key equals 1, 3, or 4, then byte 16 (MSbyte) and byte 17 (LSbyte) indicate Actual Retry Count.

If the Sense Key Specific Information (Byte 2, Bits 0-3) is set to 5-Illegal Request and the SKSV bit is set to 1, the sense key specific field is defined as Field Pointers, byte 16 (MSbyte) and byte 17 (LSbyte).

The Field Pointer field indicates which illegal parameters in command descriptor blocks or data parameters are in error.

A data bit of 1 in byte 6 indicates bad command.

A data bit of 0 indicates bad data.

Table A–4 Drive Request Sense - Additional Sense Code Values

Sense Code and Qualifier (hex)	Sense Key	Description (Bytes 12 and 13)
00 00	0H - NS	No Additional Sense Information
02 00	4H - HE	No ESDI Command Complete
04 01	2H - NR	LUN in Process of Becoming Ready
04 02	2H - NR	LUN Not Ready, Initializing Command Required
04 03	2H - NR	LUN Not Ready, Manual Intervention Needed
04 04	2H - NR	LUN Not Ready, Format in Progress
06 00	4H - HE	No Reference Position Found
09 01	4H - HE	Tracking Servo Failure
09 02	4H - HE	Focus Servo Failure
09 03	4H - HE	Spindle Servo Failure
0C 01	1H - RE	Write Error Recovered with Auto Reallocation
0C 02	3H - ME	Write Error - Auto Reallocation Failed
10 00	4H - HE	ID CRC or ECC Error
11 00	3H - ME	Unrecovered Read Error
11 02	3H - ME	Error Too Long to Correct
11 07	3H - ME	Data Resynchronization Error
11 0B	3H - ME	Uncorrected Read Error - Recommend reassignment
11 0C	3H - ME	Uncorrected Read Error - Recommend rewrite
11 80	3H - ME	Unrecovered error, sparing failed
12 00	3H - ME	Address Mark Not Found for ID Field
13 00	3H - ME	Address Mark Not Found for Data Field
15 01	4H - ME	Mechanical Positioning Error
17 01	1H - RE	Recovered Data With Retries
17 05	1H - RE	Recovered Data Using Previous Sector ID
17 80	1H - RE	Recovered Data With Retries, Data Auto Reallocated
17 81	1H - RE	Recovered data - Auto Reallocate Failed
18 00	1H - RE	Recovered Read Data With ECC Procedure

(continued on next page)

Table A–4 (Cont.) Drive Request Sense - Additional Sense Code Values

Sense Code and Qualifier (hex)	Sense Key	Description (Bytes 12 and 13)
18 01	1H - RE	Recovered Data With ECC/Retries
18 02	1H - RE	Recovered Data With ECC/Retries, Data Auto Reallocated
19 01	3H - ME	Defect List Not Available
19 02	3H - ME	Defect List Error in Primary List
19 03	3H - ME	Defect List Error in Grown List
1A 00	5H - IR	Parameter List Length Error
1C 01	3H - ME	Primary Defect Lists Not Found
1C 02	3H - ME	Grown Defect Lists Not Found
1D 00	3H - ME	Miscompare During Verify Operation
20 00	5H - IR	Invalid Command Operation Code
21 00	5H - IR	Illegal Logical Block Address
22 00	5H - IR	Illegal Function
24 00	5H - IR	Invalid Field In CDB
25 00	5H - IR	Invalid LUN
26 00	5H - IR	Invalid Field In Parameter List
27 00	7H - DP	Write Protected
28 00	6H - UA	Medium Changed
29 00	6H - UA	Power-On, Reset or Bus Device Reset Occurred
29 80	4H - HE	Power-on, Reset or Bus Device Reset Occurred and Selftest Failed
2A 01	6H - UA	Mode Parameters Changed
2F 00	BH - AC	Commands Cleared by Initiator
30 01	3H - ME	Cannot Read Medium - Unknown Format
30 02	3H - ME	Cannot Read Medium - Incompatible Format
31 00	3H - ME	Medium Format Corrupted
32 00	3H - ME	No Defect Spare Location Available
32 01	3H - ME	Defect List Update Error

(continued on next page)

Table A–4 (Cont.) Drive Request Sense - Additional Sense Code Values

Sense Code and Qualifier (hex)	Sense Key	Description (Bytes 12 and 13)
3A 00	2H - NR	Medium Not Present
3D 00	5H - IR	Invalid Bits in Identify Message
3F 01	6H - UA	Microcode Has Been Changed
3F 03	6H - UA	Inquiry Data Has Changed
44 00	4H - HE	Internal target failure
40 80	4H - HE	Diagnostic Failure in NVRAM Odometers
40 81	4H - HE	Diagnostic Failure in NVRAM Configurations
40 82	4H - HE	Diagnostic Failure in NVRAM Logs
40 83	4H - HE	DSP Poweron Failure
40 84	4H - HE	DM Exception (unexpected flag)
43 00	BH - AC	Message Error
47 00	BH - AC	SCSI Parity Error
48 00	BH - AC	Initiator Detected Error
4E 00	BH - AC	Overlapped Commands Attempted
53 00	4H - HE	Media Load/Unload Failed
53 02	5H - IR	Medium Removal Prevented
55 00	2H - NR	System Resource Failure (xaction queue full)
92 00	8H - BC	Overwrite Attempted
93 00	8H - BC	Empty Sector Detected
94 00	8H - BC	Written Sector Detected
95 00	2H NR	Power Interruption Pending

Table A-5 HP-Specific Drive Error Codes

Error Code (hex)	Message
0201	No seek complete
0202	No reference position found
0203	Tracking servo failed
0204	Focus servo failed
0205	Spindle servo failed
0206	Mechanical position error
0207	Load unload failed
0208	DSP download failed
0209	DSP import x failed
020A	DSP import y failed
020B	DSP import p failed
020C	DSP export x failed
020D	DSP export y failed
020E	DSP export p failed
020F	DSP upload log failed
0210	DSP log checksum failed
0211	DSP passthru failed
0212	Fault spinup failed
0213	Recalibrate optical disk gain failed
0214	DSP log command error
0215	DSP log unsupported
0216	DSP log status error
0220	Active sector SPDET error
0221	Active sector empty sector
0222	Data DMA error
0223	PECC DMA error
0224	EDAC shift register error

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
0225	ID CRC OR ECC error
0226	Data resync error
0227	Address mark error
0228	Sync mark error
0229	Incompatible format
022A	Active sector ENDEC unexpected
022B	Active sector higain with syncdet error
022C	Active sector syncmark dubbed error
022D	Active sector underflow/overflow error
022E	Active sector not empty
022F	Active sector no DSP status
0230	ENDEC locked on sector
0231	ENDEC locked prearmed
0232	ENDEC locked unexpected
0240	SEQ no transfer started
0241	SEQ unexpected EOHG
0242	SEQ unexpected status
0250	Media recognition failed
0251	Pearmed Watchdog timeout
0260	DM Task bad event
0261	DM mailbox bad event
0262	Next CD bad state
0263	Next operation bad state
0264	DM retry sector operations bad state
0265	Retry drive state bad state
0266	Retry sector operations bad state
0267	DM retry operations, bad operation type

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
02FF	DM abort transaction
2001	DSP recovery
2002	DSP error
2003	DSP fault
2004	DSP warning
2011	Active sector DSP recovery
2012	Active sector DSP error
2013	Active sector DSP fault
2014	Active sector DSP warning
2021	DSP unsolicited recovery
2022	DSP unsolicited error
2023	DSP unsolicited fault
2024	DSP unsolicited warning
202A	DSP unresponsive
202B	DSP over responsive
202C	DSP poweron failure
3001	SCSI controller kill error
3002	SCSI controller message error
3003	SCSI controller command error
3004	SCSI controller RAM error
3005	SCSI controller register error
3006	SCSI controller FIFO error
3007	SCSI controller target sequence error
3008	SCSI controller command sequence error
3009	SCSI controller STS sequence error
3010	Reselection timeout
4101	Error too long to correct

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
4102	Data CRC failure
4103	ECC errors in interleave threshold exceeded
4401	DDS sector not found
4402	DDS reserved field not zero
4403	PDL reserved field not zero
4404	SDL reserved field not zero
4405	DDS ID field invalid
4406	PDL indicator field invalid
4407	Number of user groups (G) field invalid
4408	Number of user blocks per group (N) field invalid
4409	Number of spare blocks per group (M) field invalid
440A	User + spare blocks too large for media
440B	PDL sector not found
440C	SDL sector not found
440D	PDL length field invalid
440E	SDL number of sublists field not equal to one
440F	SDL list length field invalid
4410	PDL list incomplete
4411	PDL list not sorted
4412	PDL entry invalid
4413	SDL list incomplete
4414	SDL list not sorted
4415	SDL defect entry invalid
4416	SDL replacement entry invalid
4417	SDL defect entry in a spare group
4418	SDL replacement entry in a user group
4419	Too many defects (PDL + DSL)

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
441A	DMA length too short for PDL to exist
441B	DMA length too short for SDL to exist
441C	No spare remaining
441D	Number of SDLs greater than total spares allocated
441E	DDS ID invalid for CCW media
441F	CCW media rejected
4420	Certification, erase pass failure
4421	Certification, write pass failure
4422	Certification, verify pass failure
4423	Certification, no defects remain
4424	Certification aborted
4425	No SD list for certification erase
4426	No maximum SD list for certification erase
4427	No SD list for certification write
4428	No maximum SD list for certification write
4429	No SD list for certification verify
442A	No maximum SD list for certification verify
442B	No write image memory available for certification
442C	No write buffer memory available for certification
442D	No SD list for reassign blocks read
442E	No SD list for reassign blocks write
442F	No SD list for reassign blocks read long
4430	No SD list for reassign blocks write long
4431	Reassign blocks, unexpected CD before read
4432	Reassign blocks, unexpected CD before write
4433	Reassign blocks, unexpected CD before read long
4434	Reassign Blocks, unexpected CD before write long

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
4435	Reassign blocks, can't move data on CCW
4436	No defect maps found
4437	PDL duplicate entry found
4438	SDL duplicate entry found
4439	SFP not found
443A	SFP format field invalid
443B	SFP modulation field invalid
443C	SFP angular velocity field invalid
443D	SFP ECC code field invalid
443E	SFP sector size differs from detected
443F	SFP sectors in track 0 invalid
4440	SFP medium type invalid
4441	SFP largest track less than or equal to zero, invalid
4442	SFP download P-block failed
4443	DMA write failed all attempts
4444	EWR calibration error, no memory
4445	EWR calibration error, retries failed
4446	Spare retries were exhausted
4447	No memory for next spare table
4448	No working memory for read maps
4449	Retry error after DM error
444A	Sector was spared successfully
444B	No SD list for Reassign Blocks erase
444C	Reassign Blocks, unexpected CD before erase
444D	Format, number of user groups
444E	Format, number of user sectors per group
444F	Format, number of spare sectors per group

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
4450	Sparing, empty sector following spare attempt
4451	Sparing, overwritten sector following spare attempt
4452	DMA 1 write failed
4453	DMA 2 write failed
4454	DMA 3 write failed

Be aware that error codes printed in **boldface type** are unique to a 1.3-Gbyte, Multifunction Drive.

4455	SFP at outer diameter is invalid
4456	SFP at inner diameter is invalid
4457	SFP track pitch is invalid
4458	SFP number of bands is invalid
4459	SFP banding constant is invalid
445A	SFP number revolutions per band is invalid
445B	SFP media type differs
445C	SDL ID is invalid
445D	SDL 2X group kind invalid
445E	Format, no replacement CD available
445F	Too many PDL entries per band
4460	Format, initial erase maps failed
4461	DMA erase during write failed
4462	Blank check during format/certification failed
4463	No SD list for certification blank check
4464	No maximum SD list for certification blank check
8201	Previous sector ID
8401	Recovered data spare failed

(continued on next page)

Table A-5 (Cont.) HP-Specific Drive Error Codes

Error Code (hex)	Message
C000	Invalid diagnostic test
C001	Register error
C002	RAM test error
C003	Checksum error
C004	CPU test error
C005	Forced test error
C006	NVRAM test error
C007	Microprocessor test error
C008	Microprocessor ROM test error
C009	Microprocessor RAM test error
C00A	EDAC test error
C00B	SEQ test error
C00C	ENDEC test error
C00D	Active sector test error
C00E	HMAC test error
C00F	Buffer RAM test error
C010	Data loopback error
C020	Connector loopback DBO IO error
C021	Connector loopback DB1 CD error
C022	Connector loopback DB2 MSG error
C023	Connector loopback DB3 REQ error
C024	Connector loopback DB4 ACK error
C025	Connector loopback DB5 ATN error
C026	Connector loopback DB6 SEL error
C027	Connector loopback DB7 BSY error
C028	Connector loopback DBP RST error

A.4 Offline Diagnostics

A diagnostic utility called DOSDASS2 is available from Hewlett-Packard for accessing the optical disk library through the SCSI bus.

DOSDASS2 fully exercises either standalone multifunction optical drives or autochangers that contain multifunction optical drives. Information for getting and using DOSDASS2 is found in Appendix B.

B

Basic Supplies and Reorderable Parts

B.1 Basic Supplies and Reorderable Parts

While no special tools are required to service the optical library, there are some commonly used items that may be stocked and available as an area resource.

Item	HP Part Number	Digital Part Number
Rewritable Optical Disk Cartridges (512 bytes/sector) Formatted capacity is 594 Mbytes per disk†		RWX1K-01 (30-38754-01)
Rewritable Optical Disk Cartridges (512 bytes/sector) Formatted capacity is 1.2 Gbytes per disk†		RWX5K-01 (30-38754-02)
Quantity 5 of RWX1K-01 Cartridges		DL-RWX1K-AA
Write-Once Optical Disk Cartridges (512 bytes/sector) Formatted capacity is 594 Mbytes per disk†		RWX1K-02 (30-40952-01)
Write-Once Optical Disk Cartridges (512 bytes/sector) Formatted capacity is 1.2 Gbytes per disk†		RWX5K-02 (30-40952-02)
Quantity 5 of RWX1K-02 Cartridges		DL-RWX1K-BA
0.9m (3 ft) SCSI jumper cable; Champ to Champ connectors		BC09K-03
1.8m (6 ft) SCSI interface cable		BC06P-06 (17-02659-02)
2.7m (9 ft) SCSI interface cable (External UPS); Champ to Honda connectors	C1708-60080	BC09D-09 (Storage Server)
Power cord		RW1KA-AA
Single-ended SCSI terminator	K2291	H8574-A

†To reorder media, call 1-800-DIGITAL or 1-800-344-4825

Item	HP Part Number	Digital Part Number
Differential SCSI terminator‡	A1658-62024	
115 V replacement fuse 3A 250 V‡	2110-0003	
230 V replacement fuse 3A 250 V‡	2110-0780	
Eject tool‡	C1708-88803	
Optical disk cleaning kit‡	C1700-88800	
Optical disk cleaner accessory kit (extra swabs and alcohol)‡	C1700-88801	
<i>Optical Disk Library System Technical Reference Manual</i>	5959-3559 (GSD)	
<i>Technical Guide Optical Drives and Libraries</i>	5960-7605	
<i>Optical Drive and Library SCSI-2 Command Reference</i>	5960-7606	
<i>Offline Diagnostics for HP Optical Products</i> ‡	5960-7626	
‡These parts can be ordered directly from the Hewlett-Packard SMO facility in California. Call 1-800-227-8164 between the hours of 6 A.M. and 5 P.M. Pacific Standard Time.		

The Instruction Manual for the Offline PC based diagnostics, DOSDASS2, can also be ordered from the Hewlett-Packard SMO facility in California. The title of this manual is *Offline Diagnostics for Hewlett-Packard Optical Products* and the part number is 5960-7626. Extra copies may be available from Digital's Storage External Products Continuation Engineering Group in Shrewsbury (SHR), MA.

NOTE

To run the DOSDASS2 diagnostics, you must have an IBM AT-compatible computer, an adapter interface board (152x/154x), a SCSI cable, and the *Offline Diagnostics for Hewlett-Packard Optical Products* manual.

All other manuals and the DOSDASS2 diagnostic software are available from the Hewlett-Packard Support Center in Greeley, Colorado. Call the Hewlett-Packard Support Hotline, (303) 350-4646, to order. Diagnostics and SCSI-2 Command Reference manuals are also available from internal CSC or from the Storage External Products, Continuation Engineering Group in Shrewsbury (SHR), MA.

RECTO_HEAD>(CANCEL_H)

C

Connecting Multiple Optical Libraries

If the back panel of your host computer is configured with more than one SCSI port, you can attach an Optical Library to each port. See Section C.1 for directions.

You can also connect two units to a single SCSI port on your host computer by daisy-chaining the units together; that is, by connecting the first Optical Library to the host computer, and then connecting the second Optical Library to the first Optical Library. See Section C.2 for directions.

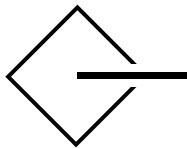
Note

Only two Optical Library units may be daisy-chained together and connected to a single SCSI port. Each SCSI port is limited to a total of seven SCSI addresses, therefore, the large unit (RW514/RW516) is not supported for daisy chaining because each unit has 5 IDs.

If two Optical Library units are daisy-chained to one SCSI port on the host computer, you must properly terminate the SCSI chain by installing the SCSI terminator in the second SCSI port of the second Optical Library. See Section C.2 for directions. You must also set a new SCSI address for the autochanger controller and the two optical disk drives of the second Optical Library unit. See Section C.2.1 for directions.

C.1 Connecting Two Optical Library Units to Two SCSI Ports

To connect two Optical Library units to separate SCSI ports on your host computer, first check the back panel of your host computer to see that two SCSI ports are available. SCSI ports are marked by the PMAZ label and the SCSI icon:



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If there are two SCSI ports available, uncrate and prepare each Optical Library for connection to the host computer.

Change SCSI IDs for drive and controller address if necessary before connecting to the host computer.

Plug the 50-pin Honda connector of the SCSI cable from the first Optical Library unit into the lowest-numbered SCSI port on the host computer back panel.

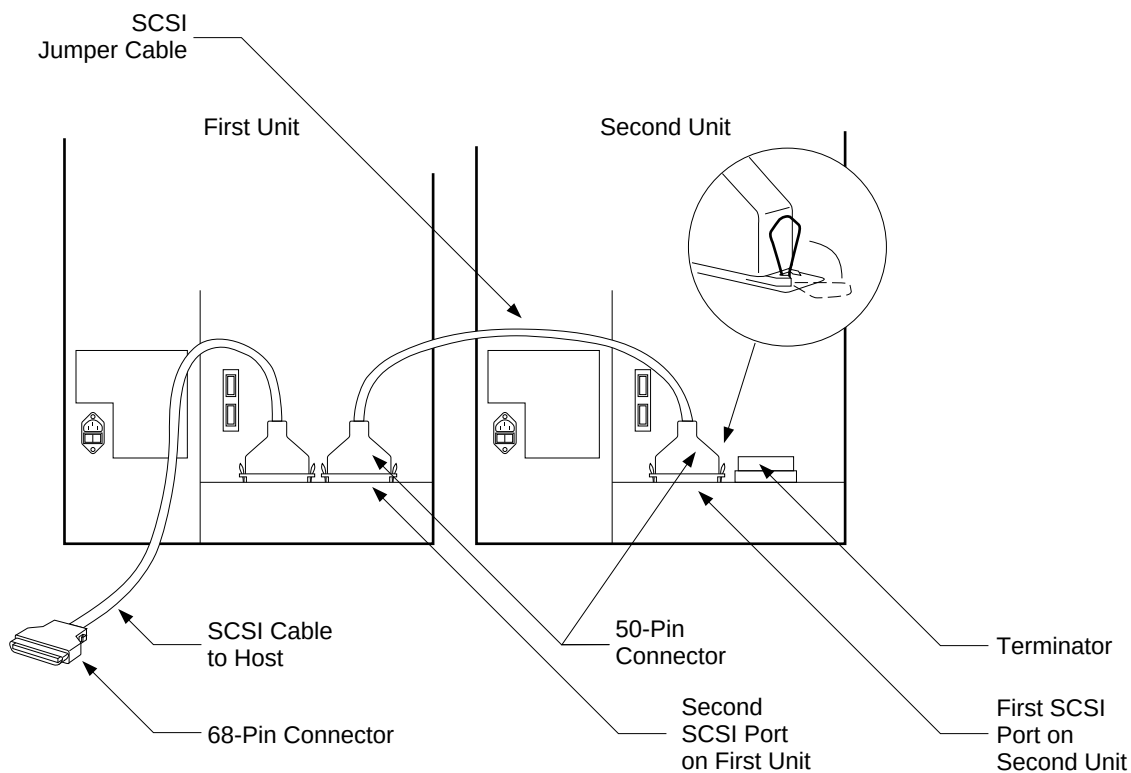
Then, plug the 50-pin Honda connector of the SCSI cable from the second Optical Library unit into the next-lowest-numbered SCSI port on the host computer back panel.

For example, if option slots 0 and 2 are labeled PMAZ and have the SCSI icon, plug the SCSI cable from the first Optical Library unit into the 50-hole connector in option slot 0, and plug the second Optical Library unit into option slot 2.

C.2 Connecting Two Optical Library Units to One SCSI Port

To connect two Optical Library units to one SCSI port on your host computer, uncrate and prepare each Optical Library for connection to the host computer. Then, see Figure C-1 and follow these steps:

Figure C-1 Connecting Two Deskside Optical Library Units (RW510/RW530) to One SCSI Port

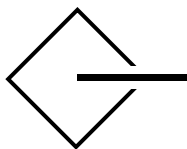


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1. If you have already connected one Optical Library to the host system, then go to the next list item.

If you have not already connected one Optical Library to the host system, then locate the lowest-numbered SCSI port on the host computer back panel.

Each SCSI port is labeled with the option identifier PMAZ and the SCSI icon:



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Plug the 50-pin Honda connector of the SCSI cable from the first Optical Library unit into the lowest-numbered SCSI port on the host computer.

2. Remove the terminator from the second SCSI port on the back panel of the first Optical Library if a terminator is in place.

Plug the terminator into the second SCSI port of the second Optical Library. The second SCSI port is the port furthest from the Drive Address Select Switches.

3. Locate the 50-pin Champ to 50-pin Champ SCSI jumper cable shipped in the box marked **OPEN FIRST**.
4. Plug one end of the SCSI jumper cable into the second SCSI port on the first Optical Library (the port from which you removed the terminator). The connector is keyed so that it only attaches one way. Lock the wire brackets into the grooves on the sides of the connector.
5. Plug the other end of the SCSI jumper cable into the first SCSI port on the back of the second Optical Library. The first SCSI port is the port nearest the Drive Address Select Switches. Lock the wire brackets into the grooves on the sides of the connector. If you have not already done so, place the terminator on the second port of the second Optical Library.

Then, complete the installation by following the directions in Section C.2.1 to change the SCSI addresses of the second Optical Library.

If the first Optical Library is not already connected to the host system, connect the first Optical Library unit to the host by following the instructions in your host system documentation, after SCSI IDs are changed.

C.2.1 Resetting Controller and Drive SCSI Addresses

If two Optical Library units are daisy-chained together such that the first Optical Library unit is connected to one SCSI port on the host computer and the second unit is connected to the SCSI port on the first Optical Library, the SCSI addresses of the second unit's controller and disk drives must be reset so that they are different from the controller and drive addresses of the first unit. Follow the instructions in Section 3.4 to reset the controller and optical disk drive SCSI addresses.

The autochanger controller default SCSI address is 3 for both the medium and small units. Leave the SCSI address of the autochanger controller in the first Optical Library unit set to the current ID number, and change the address of the controller in the second unit to an unused ID number by performing the following steps.

1. To avoid bus conflicts, before changing defaults, first verify the IDs of all SCSI devices connected to the host system and the autochanger and drive IDs of the first Optical Library.
2. Shut down the host system.
3. Ensure that the Optical Library is switched on. For the small unit, go to step 5.
4. With READY displayed, press **[OPTION]**. TEST * displays.
5. Press **[NEXT]** until SCSI IDs * displays.
6. Press **[ENTER]**. AC ID # displays where # may be the default number indicated in Table 4-2 or the current address.

This is the Autochanger controller address. If you want to change this address press **[ENTER]**, otherwise continue to press **[NEXT]** until the drive number whose address you want to change is displayed, (DRV1 ID 1, DRV2 ID 2, etc)

7. Press **[PREV]** or **[NEXT]** until the desired address number displays.
8. Press **[ENTER]**. The message SET # displays. Address is now set.
9. If you want to change additional drive addresses, Press **[NEXT]** until that drive number is displayed and repeat steps 6 through 8 to set the new address.
10. Press **[NEXT]** until UPDATE or CONFLICT displays.

If CONFLICT displays, two or more drives and/or the controller have been set to the same address and must be reset.

If UPDATE displays and you are satisfied with the address you have selected, press **[ENTER]**.

11. Record the new address settings for future reference.

CAUTION

Do not press the Optical Library operation switch (located on the front panel) or the power switch (located on the rear panel) until you are sure that the SCSI bus is inactive. Pressing either button when the bus is active can cause data loss and indeterminate bus states.

Check the host system reference manuals for information on checking the status of the SCSI bus.

12. Push the operation switch (located on the Optical Library front panel) off and then back on so the new address setting is recognized by the host system.

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