Small Optical Disk Library

Service Manual

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U.S.A.

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

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Contents

3 Product Operation and Configuration

4 Troubleshooting and Diagnostics

5 Removal and Replacement

6 Theory of Operation

A Offline Diagnostic Information

B Basic Supplies and Reorderable Parts

C Connecting Multiple Optical Libraries

Index

Figures

Tables

Preface

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

This manual contains the following information:

- 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 RW504-ZA and the RW524-ZA optical disk libraries. This manual refers to these optical disk libraries as RW504 and RW524.
- Chapter 2 provides environmental, installation and preventive maintenance information on the RW504 and RW524 optical disk libraries.
- Chapter 3 provides configuration and operating information on the RW504 and RW524 optical disk libraries.
- Chapter 4 provides troubleshooting and diagnostics information on the RW504 and RW524 optical disk libraries.
- Chapter 5 provides removal and replacement procedures for the field-replaceable assemblies in the RW504 and RW524 optical disk libraries.
- Chapter 6 provides theory of operation information on the RW504 and RW524 optical disk libraries.
- Appendix A provides offline diagnostic information, a VAX system error report sample and SCSI-2 reference.
- Appendix B provides a list of basic supplies and reorderable parts.
- Appendix C lists information about, and procedures for, connecting multiple optical libraries.

Conventions Used in This Guide

Table 1 Conventions Used in This Guide

Convention	Use
Italics	*Italic text* is used for titles of manuals and other publications.
`Monospace type`	`Anything that is displayed on the control panel of the optical disk library is set in this monospace type.`
Boldface type	**Anything that you are asked to type is set in this boldface type.**
Keys	Keys indicate the key to press on the control panel of the optical disk 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 disk library from being damaged.
WARNING	Warning notes provide information that protects you from being harmed.

1
Introduction

1.1 Optical Disk Libraries Overview

The RW504-ZA and RW524-ZA are optical disk libraries that contain a multifunction optical drive. They have storage slots for sixteen 5.25-inch optical disks for a total storage capacity of 10 Gbytes or 20 Gbytes, respectively. Both rewritable and write-once optical disks can be used; they must be 512 bytes per sector format.

There are two basic optical disk libraries:

- RW504-ZA (known as the RW504)
- RW524-ZA (known as the RW524)

The main difference between these two library versions is storage capacity. The RW524 has approximately twice the storage capacity of the RW504. This added capacity is due to a difference in the optical drives contained in the libraries. The RW524 contains a 1.3-Gbyte drive, an enhanced version of the 650-Mbyte drive that is used in the RW504 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 RW524 libraries are mechanically, electrically, and operationally the same as the RW504 libraries, and both versions support the SCSI-2 command set.

1.2 Product Features

The optical disk library has the following features and meets the following specifications:

- Direct online access to data
- High reliability and data security when using rewritable and write-once 5.25-inch optical disks

DEC magneto optical disks meet the following standards:

  - 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.
  - 594 Mbyte write-once disks are Continuous Composite Write-Once (CCW) format, 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 library, preventing disk removal.
- SCSI Interface
  - Single-ended
  - SCSI-2 command set
- Autochanger reliability of:
  - 40,000 hours MTBF (Mean Time Between Failure)
  - 300,000 MSBF (Mean Swaps Between Failure)
- Modular replacement of all major assemblies
- Digital signal processor (DSP) based servo built into the drive mechanism for faster seek times and lower error rates
- Split optics resulting in the use of a lighter optical head for faster and more accurate data access
- Full read and write data caching to optimize system performance

1.3 Optical Library Components

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

Table 1–1 is a discussion of the optical library components. Refer to Figure 1–1 for component locations.

Figure 1–1 Optical Disk Library Components

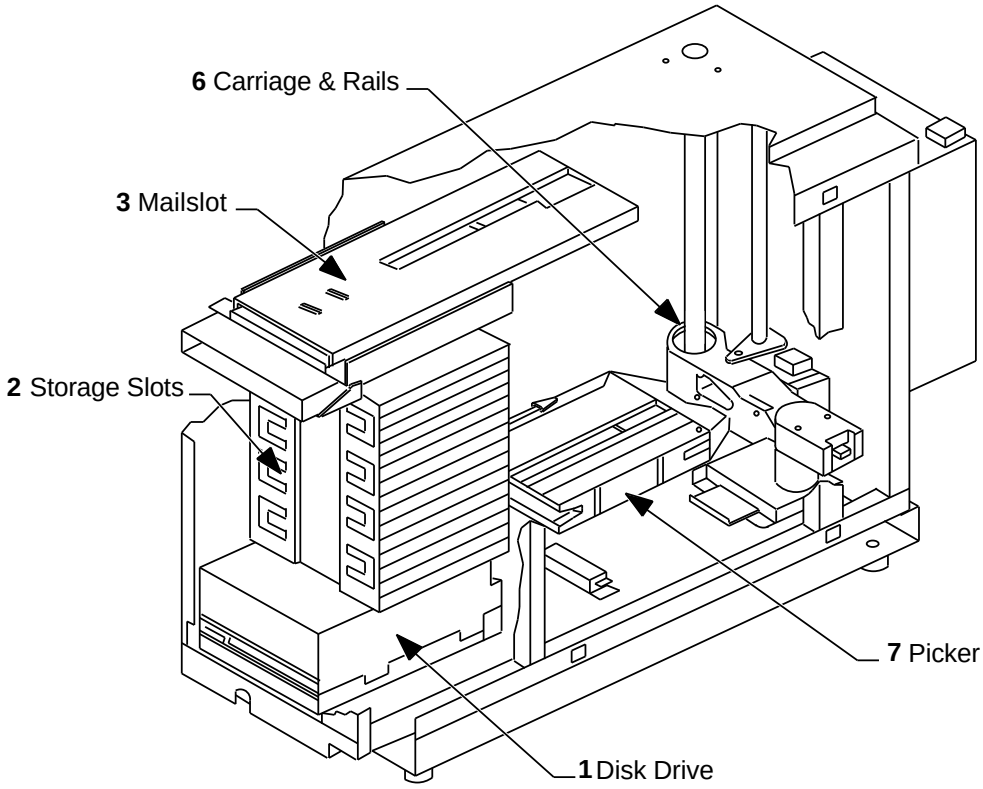


Table 1–1 RW504/RW524 Components

Component	Description
Disk Drive	The optical disk library contains one multifunction optical disk drive for read/write data transfer. The drive requires its own unique SCSI address and is located next to the front panel at the bottom of the optical library. See Section 1.3.1 for additional drive information.
Storage Slots	The optical disk library contains 16 storage slots for holding optical disks.
Mailslot	The mailslot is used to insert or remove optical disks from the disk library.
Front Panel	The front panel includes a control panel used to manage and display library functions and a mailslot for inserting and removing disks. Control panel functions are described in Section 3.1.
Rear Panel	The rear panel includes SCSI and power cord connections, a fuse receptacle, a 9-pin serial connector for attaching an uninterruptable power supply (UPS), and a voltage select switch.
Rail and Carriage	The rail and carriage support the picker for its movement within the disk library.
Picker	The picker rotates, flips, and transports optical disks to and from the storage slots, mailslot, and optical drive.

The RW504/RW524 is available as a single-ended SCSI interface.

1.3.1 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.

1.3.2 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. Optical disk storage capacity varies depending on the disk type. (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 with a single-ended SCSI interface This interface conforms to SCSI standards ANSI X3.131-SCSI-2.

1.4.1 Single-ended SCSI Interface

The single-ended interface specifies the use of a single-ended SCSI repeater PCA. This PCA enables the library to be connected to an external single-ended SCSI bus. The total SCSI cable length between peripherals and the host is 6 meters. In addition, an internal SCSI cable length of 2.1 meters must be included in this calculation.

1.4.2 Differential SCSI Interface

The differential SCSI interface specifies the use of 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 25 meters usually allowed on a differential SCSI bus.

1.5 Product Matrix

The following products are discussed in this manual. To determine the product and option numbers, find the product information labels located on the library's rear panel and check the corresponding information in Table 1–2.

Table 1–2 Optical Disk Library Products Matrix

Product No. /Options	Description	HP Designation
RW504-ZA	10.4-Gbyte multifunction optical disk library—includes one 650-Mbyte 5.25-inch multifunction optical drive mechanism and a single-ended SCSI interface.	Model 10LC (C1718C)
RW524-ZA	20.8-Gbyte multifunction optical disk library—includes one 1.3-Gbyte 5.25-inch multifunction optical drive mechanism and a single-ended SCSI interface.	Model 20LT (C1718T)
RW524-UB	Converts 650-Mbyte multifunction drives to 1.3 Gbyte multifunction drives to be used with a RW504 jukebox. Consists of one 1.3-Gbyte drive, RFI shield, and installation guide.	

1.6 Specifications

This section provides:

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

Performance Specifications

Optical Disk Library System	
Capacity	16 disks
	10.4 Gbytes (RW504) or 20.8 Gbytes (RW524)
Drives	1, 5.25-inch multifunction 650-Mbyte (RW504) or 1.3-Gbyte (RW524) optical disk drive
Average disk exchange time (excluding drive load/unload sequences)	7 seconds
Interface	Single-ended asynchronous SCSI

Multifunction Optical Drives		
	650 Mbytes	**1.3 Gbytes**
Rotational speed	3600 rpm	2400 rpm
Average seek	25 ms	23.5
Short stroke seek (across 2.2 Mbytes)	8 ms	4 ms
Full stroke seek	50 ms	45 ms
Single track seek (track-to-track)	2 ms	2 ms
Average rotational delay	8.33 ms	12.5 ms
Bias magnet rotation time	8 ms (maximum)	8 ms (maximum)
Average access time	35 ms	
Burst transfer rate	3 Mbytes/s (asynchronous)	3 Mbytes/s (asynchronous)
	5 Mbytes/s (synchronous)	5 Mbytes/s (synchronous)
Data transfer rate (host dependent)	1 Mbyte/s (read)	.8-1.6 Mbyte/s (read)
	.5 Mbytes/s (write)	.4-.8 Mbytes/s (write)
Load time (including spin-up)	2.5 seconds (average)	2.3 seconds (average)
Unload time (including spin-down)	2.0 seconds (average)	1.4 seconds (average)

Multifunction Optical Drives		
	650 Mbytes	**1.3 Gbytes**
Read/Write error rate	Less than 1 block in error per 10^{14} bytes	Less than 1 block in error per 10^{14} bytes
Seek error rate	Less than 1 per 10^{5} seeks	
Interface	SCSI-2 single-ended	SCSI-2 single-ended
RW504/RW524 Physical Characteristics		
Height	493.8 mm (19.4 in)	
Width	220.0 mm (8.7 in)	
Depth	693.4 mm (27.3 in)	
Weight (net)	34.9 kg (77.5 pounds)	
Weight (packaged)	40.8 kg (90.0 lbs)	
RW504/RW524 Environmental Specifications		
Temperature gradient	10° C per hour	
Temperature (operating)	10° to 40° C	
Temperature (nonoperating)	-40° to 70° C	
Relative humidity (noncondensing)		
operating	10 to 90%	
nonoperating	5 to 95%	
Max. wet bulb temperature	29° C	
Shock (nonoperating)	292 ips (30 g trapezoidal)	
Vibration (5-500 Hz)		
operating	~0.21 g rms	
nonoperating, random	~2.09 g rms	
nonoperating swept-sine	0.5 g peak	
Altitude (operating)	15,000 ft (4,572 m)	
Altitude (nonoperating)	50,000 ft (15,240 m)	
Acoustic emissions		

RW504/RW524 Environmental Specifications	
operating	61.5 dB (L noise power emission level)
idle	47 dB (L noise power emission level)
Particulates	Less than 200 micrograms/cubic meter particles suspended
Electrostatic discharge	
Airgap (operating)	0 to 10 kV
Airgap (nonoperating survival)	0 to 25 kV
Direct contact (operating)	0 to 5 kV
Direct contact (nonoperating survival)	0 to 8 kV
Cooling requirements	15 CFM bidirectional through drive

RW504/RW524 Power Requirements	
Line voltage (115V setting)	100-127V
Line voltage (230V setting)	200-240V
Line frequency	50-60Hz
Power consumption (typical)	Less than 70 W
Power consumption (maximum)	100 W

RW504/RW524 Service Characteristics	
Mean time between failure	40,000 power-on hours
Mean swaps between failure	300,000
Mean time to repair	1 hour
Preventive maintenance	none required

RW504/RW524 Product Certifications	
Safety	EN 60950/IEC 950 UL 1950 listed or recognized CSA 950-M89 TUV approved to VDE 0805 05.90

RW504/RW524 Product Certifications	
Electromagnetic emissions	FCC 47 CFR Part 15 Subpart J - Class “B” EN 55022/CISPR 22, Level “B”; SABS VCCI Level 2
Laser	CDRH 21 CFR Chapter 1, Subpart J Registered IEC 825 TUV approved to VBG93, VDE 0837 TTL to Decision 472 BS 4803 part 2 Approved

1.7 Optical Disk Specifications

Table 1–3 Specifications and Characteristics of Optical Disks

Physical Characteristics	Rewritable	Write-once
Disk	5.25 in. diameter (130 mm)	5.25 in. diameter (130 mm)
Capacity (512-byte sectors) (1x)[1]	594 Mbytes (297 Mbytes/side) (formatted)	594 Mbytes (297 Mbytes /side) (formatted)
Capacity (512-byte sectors) (2x)[2]	1.2 Gbytes (594 Mbytes/side) (formatted)	1.2 Gbytes (594 Mbytes /side) (formatted)
Format (1x)	Continuous Composite (CC) (ISO 10089)	CCW (ISO 11560)
Format (2x)	Continuous Composite (CC) (ISO 10089),ECMA 184 for CC format	CCW (ISO 11560), ECMA 184 standard for CCW format
Bytes per sector	512 (medium dependent)	512 (medium dependent)
Sectors per track	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
Error Rate	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

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

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

(continued on next page)

Table 1–3 (Cont.) Specifications and Characteristics of Optical Disks

Environmental Specifications	Rewritable	Write-once
Temperature (operating)	10° to 50° C	10° to 50° C
Temperature (nonoperating)	-10° to 50° C long term (> 14 days)	-10° to 50° C long term (> 14 days)
	-10° to 55° C short-term (≤ 14 days)	-10° to 55° C short-term (≤ 14 days)
Temperature gradient	10° C per hour	10° C per hour
Maximum wet bulb temperature	29° C	29° C
Humidity (operating)	10 to 80 percent (noncondensing)	10 to 80 percent (noncondensing)
Humidity (nonoperating)	10 to 90 percent (noncondensing)	10 to 90 percent (noncondensing)

1.8 Related Documents

Table 1–4 Related Documentation

Item	Part Number
Optical Disk Library Conversion Kit Installation Guide	EK–OLCON–IG
Optical Library User's Guide (Shipped with each unit)	EK–STSOP–UG
Optical Storage Desktop Software Installation Guide	AA–PXYKA–TE
Optical Storage Desktop Software User's Guide	AA–PXYLA–TE
Optical Storage Management Software Installation Guide	AA–PXYPA–TE
Optical Storage Management Software Installation Guide	AA–PXYQA–TE
Storage Server 100 Installation Guide	EK–D59SS–IN
Small Optical Disk Library Service Manual	EK–SOL10–SV
Medium Optical Disk Library Service Manual	EK–MOL20–SV
Large Optical Disk Library Service Manual	EK–SS100–SV
Storage Server 100 Optical Disk Service Manual	EK–STSOP–SV‡
Optical Disk Library System Technical Reference Manual	5959-3559 (GSD)†
Technical Guide Optical Drives and Libraries	5960-7605†
Optical Drive and Library SCSI-2 Command Reference	5960-7606†
Offline Diagnostics for HP Optical Products	5960-7626†

†These documents can be ordered directly from Hewlett-Packard
‡Only for older model 10/20 Jukebox shipped with (Ninja) storage server systems

Table 1–5 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

2

Environmental/Installation/PM

2.1 Environmental Requirements

Note

The environmental requirements listed here apply when the RW504 /RW524 optical disk library is not connected to a system. When this device is connected to a system, the more stringent environmental specifications listed for any single device within the system are applicable and supersede these specifications.

2.2 Operating Temperature/Clearance Requirements

The RW504/RW524 optical 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.

A minimum 70-80 mm (3 in.) is required behind the RW504/RW524 optical disk library rear panel to allow air circulation.

2.3 Location Requirements

Position the autochanger away from sources of particulate contamination such as frequently-used doors and walkways, stacks of supplies that collect dust, and smoke-filled rooms.

2.4 Primary Power/External Ground

The power outlet to be used to supply AC power to the RW504/RW524 optical disk library must be checked to ensure that the proper voltage is available for the drive. Permitted voltage range(s), depending on configuration and assuming 50-60 Hz, are 100 to 120 Vac and 200 to 240 Vac. Also check the earth (safety) ground in the power outlet.

2.5 Unpacking Procedure

Check that all materials are included with the disk library (Section 2.6.1). If any items are missing, please 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 or replaced. Billing of the charges depends on whether the damage was caused by the carrier or the factory packaging. The cause of damage will be determined by the field service representative.

Problems determined to be caused by factory packaging should be reported, in detail, to the factory so a warranty claim can be submitted.

Be sure to include the product number and full serial number in any correspondence concerning the unit.

2.6 Installation Procedures

This section provides information on:

- Contents of shipment
- Uncrating and installing an RW504/RW524 optical library
- Connect multiple optical library systems together

Setting up the optical disk library is the customer's responsibility; however this service may be contracted for on a time-and-materials basis. Setup instructions for the disk library are in the *Optical Library User's Guide*, part number EK–STSOP–UG, which is shipped with the product.

The installation and configuration instructions are provided for situations where the customer has arranged for this service.

Note

Before you connect the optical disk library to the host, verify that the host supports it. Refer to the Product Support Plan for the most current list of host systems that support the RW504/RW524 optical disk library.

CAUTION

The shipping screw must be removed from the disk library before connecting power. Directions for removing the shipping screw are printed on the carton, or see Figure 2–1 for the location of the shipping screw.

2.6.1 Contents of Shipment

You should receive a crate containing the RW504/RW524 optical library, and a box, shipped separately, labeled **OPEN FIRST**. Inside this box are several additional packages containing the following:

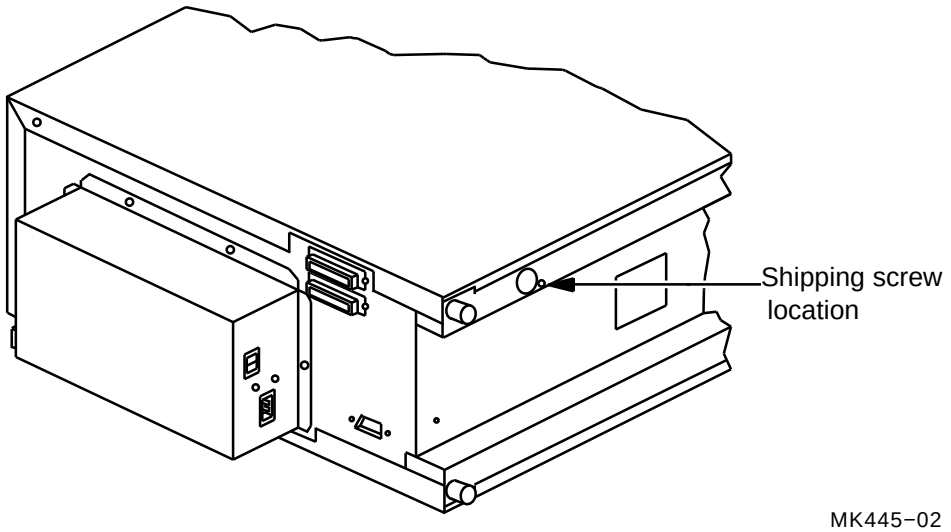
- READ ME FIRST instructions
- *Optical Library User's Guide*
- SCSI cable
- SCSI terminator
- Power cord

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 Uncrating the RW504/RW524 Optical Library

1. Uncrate the Optical Library. Remove the packaging material.
2. Lay the unit on its side and remove the shipping screw as shown in Figure 2–1.

Figure 2–1 Removing the Shipping Screw



2.6.3 Installing the RW504/RW524 Optical Library

The optical disk library has a single-ended SCSI interface. The total allowable cable lengths for a single-ended SCSI is 3.9 meter.

CAUTION

Do not switch off power to any peripheral on the SCSI bus if the bus is active. Switching off power to a peripheral on an active bus may cause data loss, indeterminite bus states, or both.

Connecting the SCSI Cables

To connect the SCSI cables to the optical library, perform the following steps.

1. Make sure the host computer and the optical library are switched off.
2. Locate a SCSI cable.
3. Locate the single-ended SCSI terminator.
4. Is there another SCSI device connected to the host computer?

   NO

   a. Connect the SCSI cable to a SCSI socket on the rear of the autochanger. Press in fully (see Figure 2–3).

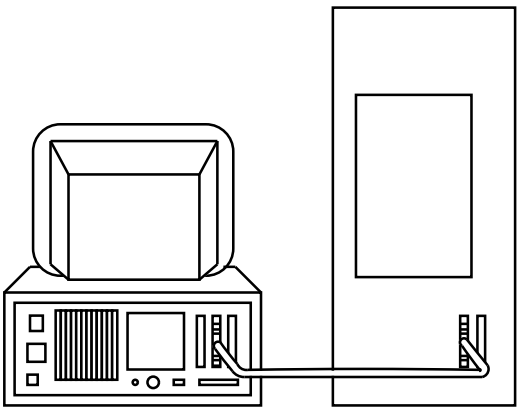
   b. Plug the terminator into the other SCSI socket.

   c. Connect the other end of the SCSI cable to the SCSI interface on the computer (Figure 2–2). Press in fully.

NOTE

Before you connect the SCSI cable to the Host computer, verify the SCSI IDs to ensure that bus address conflicts do not exist. Refer to Section 3.3.4.

Figure 2–2 Attaching the SCSI Cable to the RW504/RW524 Optical Disk Library



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Note

You can position the optical library anywhere along the SCSI bus. Properly terminate the last device on the bus and do not exceed the total SCSI cable length limitations.

YES

a. Determine which SCSI device is last on the chain of SCSI connections.

b. Check SCSI IDs first, then remove the terminator from the SCSI socket on the last device and connect the optical library SCSI cable to that socket. Press in fully.

c. Connect the other end of the SCSI cable to one of the SCSI sockets on the back of the optical library. Press in fully (see Figure 2–3).

d. Plug the terminator into the other SCSI socket on the back of the optical library.

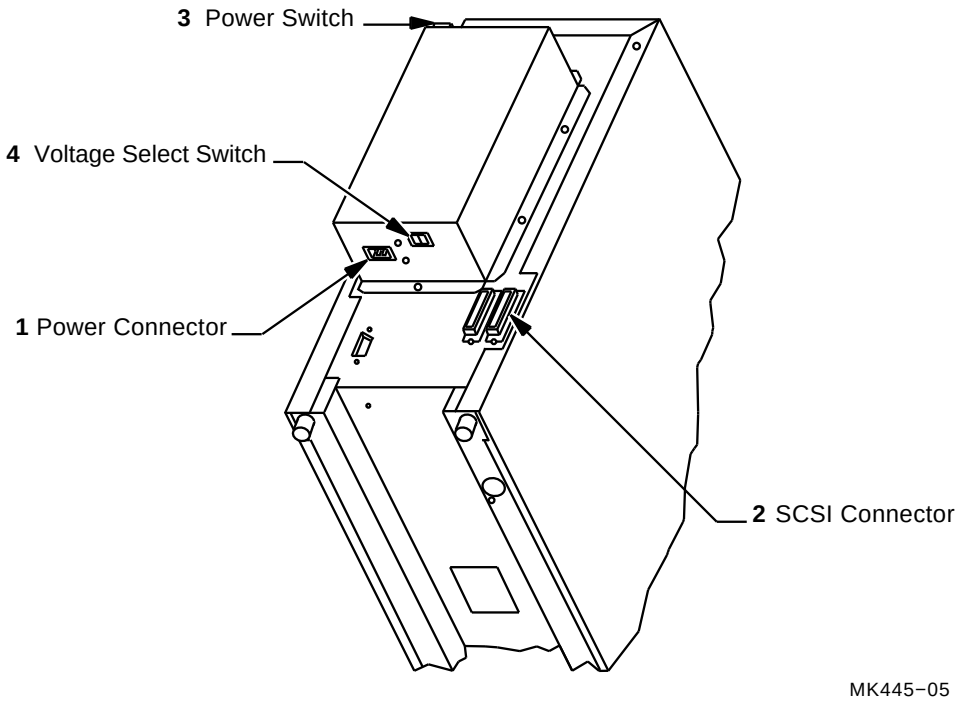
Connecting Power

CAUTION

Verify that the shipping screw has been removed from the disk library before connecting power. Directions for removing the shipping screw are printed on the carton, or see Figure 2–1 for the location of the shipping screw.

1. Check the fuse and the voltage select switch setting (Section 2.6.4).
2. Check to make sure that the power switch (located on the rear panel) and the operation switch (located on the front panel) are switched off.
3. Locate the power cord.
4. Plug the power cord into the AC line connector located on the rear panel.(See Figure 2–3)

Figure 2–3 Rear Panel



5. Plug the power cord into the power outlet.
6. Press the power switch (located on the back panel) and the operation switch (located on the front panel) so they are in the ON position.

   Initially, the control panel displays TESTING. Once the power-on test completes, the control panel displays READY.
7. If necessary, set SCSI IDs to values for your configuration (Section 3.3.4).

Note

A sequence of tests that are run when the disk library is first switched on. The READY status on the control panel indicates that the unit is in sound condition. If a TEST FAIL status appears on the control panel display, refer to Chapter 4, Troubleshooting and Diagnostics for information on how to resolve the problem.

Note

If you want to move the optical library, see Chapter 3.

2.6.4 Checking the Fuse and Voltage Setting

The RW504/RW524 optical disk library should come from the factory configured according to the area designated as the final destination on the order form. Verify that the drive was configured correctly.

CAUTION

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

Switching off power to a peripheral on an active bus may cause data loss, indeterminite bus states, or both.

1. Remove power from the autochanger.
   a. Press the operation switch (located on the front panel) so that it is in the "OFF" position.
   b. Press the power switch (located on the rear panel) so that it is in the "OFF" position.
   c. Disconnect the power cable.
2. Verify that the correct fuse is in the fuseholder cap. Refer to Figure 2–3 for the location of the AC line fuse and Table 2–1 to identify the correct fuse.

Table 2–1 Fuse Specifications and Part Numbers

Operation	Fuse	HP Part Number
120 volt (115 VAC nom.)	3 A 250 V	2110-0003
220 volt (230 VAC nom.)	3 A 250 V	2110-0780

2.6.4.1 Changing the Voltage Configuration

CAUTION

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

Switching off power to a peripheral on an active bus may cause data loss, indeterminite bus states, or both.

1. Remove power from the autochanger.
   a. Press the operation switch (located on the front panel) so that it is in the "OFF" position.
   b. Press the power switch (located on the rear panel) so that it is in the "OFF" position.
   c. Disconnect the power cable.
2. Set the voltage select switch to the correct setting.
   a. Locate the voltage select switch on the rear panel of the autochanger.
   b. If the voltage switch setting is incorrect, change it by sliding the voltage select switch sideways using a flat-blade screwdriver.

2.6.5 Connecting an Uninterruptible Power Supply (UPS)

To fully protect against data loss in the event of a power failure, Digital recommends the use of an uninterruptable power supply (UPS). The UPS can be connected directly to the disk library or it can be a central UPS used by the entire computer system.

If a power failure occurs during a write operation, the UPS will continue to supply power to the auto changer/computer system until the data in the optical drive's buffer can be written to an optical disk.

For the best protection, the customer should choose the type of UPS that provides a communication link between the UPS and the autochanger/computer system. With this type of connection, the computer system/autochanger senses when power is being supplied by the UPS. Any data currently in the buffer is written to the disk, and no additional commands are accepted until regular power is restored.

Note

If the customer's UPS does not provide a communication link between the UPS and the autochanger/computer system, someone will have to shut down the computer system before the UPS battery power is drained or data in the buffer may be lost.

If the UPS is connected to the RW504/RW524 optical disk library, 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)
180 Volt-Amps (maximum)	110 Watts (maximum)

CAUTION

Connecting the UPS to the autochanger incorrectly may not provide full protection against data loss. To insure proper UPS connection, perform the following steps:

- Use the proper cable when connecting a UPS to the autochanger.
- Run test 75 after connecting the UPS to the autochanger. (See Section 4.9.2 for instructions for running test 75.)

2.7 Hardware Verification

The Customer Engineer (CE) 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 needs to execute internal diagnostic tests 2, and 11 through 17 (Section 4.10) and test the autochanger mechanism and drive(s) to verify that all functions of the optical library unit (moves, flips, reads, writes, and so forth) are operating correctly. Refer to the appropriate *Setup Guide* and host configuration guide to complete the installation.

2.8 Moving the RW504/RW524 Optical Disk Library

2.8.1 Moving a Short Distance

To move an RW504/RW524 optical disk library a short distance (down the hallway or to another floor in the building) perform the following steps. If you want to ship the disk library, see Section 2.8.2.

1. Unmount (unreserve) any disk surfaces from the host system if necessary.
2. If there is a disk loaded into the drive mechanism, eject the disk from the drive and return it to its storage slot.

CAUTION

Failure to eject a disk from the optical drive prior to transport could result in damage to the drive mechanism.

Do not switch off the optical disk library or unplug the AC power cord until you are sure that the SCSI bus is inactive. Switching off power or unplugging the power cord when the SCSI bus is active can cause data loss, indeterminate bus states, or both. (Check the host system reference manuals for information on checking the status of the SCSI bus.)

Note

Before you move an optical disk library to a new location, make sure that all environmental requirements listed in Chapter 2 have been met and that the power outlet has been checked to ensure that the proper voltage is available for the drive.

3. Switch off the power switch (located on the back panel) and the operation switch (located on the front panel).
4. Remove the power cord and SCSI cable connections from the disk library.
5. Carefully move the disk library to its new destination.
6. Connect the disk library to the host.
7. Reconnect the power cord.
8. Configure the disk library to the host. (Refer to your host system manual for configuration information.)

2.8.2 Shipping the RW504/RW524 Optical Disk Library

If the disk library must be shipped, do 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 all disks from the optical drive and storage slots prior to transport could result in damage to the drive mechanism, the autochanger, or both.

3. Run TEST 23 to position the picker for shipping.
   a. Press NEXT until TEST * appears, and then press ENTER.
   b. Press NEXT until TEST 23 appears, and then press ENTER.

CAUTION

Do not switch off power or unplug the AC power cord from the optical disk library until you are sure that the SCSI bus is inactive. Switching off the library or unplugging the power cord when the SCSI bus is active can cause data loss, indeterminate bus states, or both. (Check the host system reference manuals for information on checking the status of the SCSI bus.)

4. Press the operation button (located on the optical disk library front panel) and the power switch (located on the back panel) so they are both in the “OFF” position.
5. Remove the power cable and SCSI cable connections from the optical disk library.
6. Lay the disk library on its side and replace the shipping screw (See Figure 2–4).

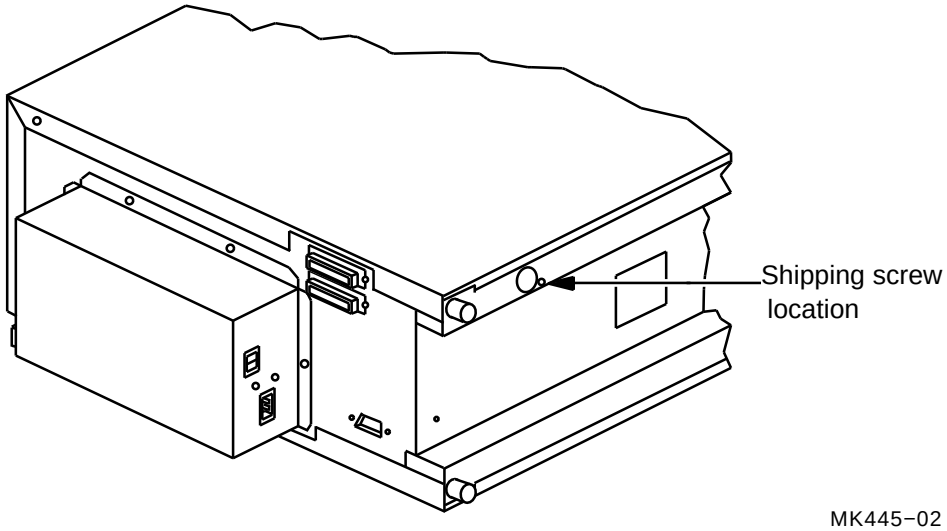
Note

If the shipping screw has been misplaced, you can use a cap screw with the following specifications:

- 6/32 UNC-2B screw
- 1-3/8 inches long

7. Repackage the autochanger in its original shipping carton and have the unit shipped in the same manner in which it was received.

Figure 2–4 Replacing the Shipping Screw



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. Although an autochanger may be used in such a way as to make disk cleaning necessary, it is not recommended.

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

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 RW504/RW524 and will damage the optical drive mechanism.

3

Product Operation and Configuration

3.1 Front Panel/Control Panel Operations

Refer to Figure 3–1 for the location of the front panel controls and features. Table 3–1 lists and describes the callouts.

Figure 3–1 Front Panel

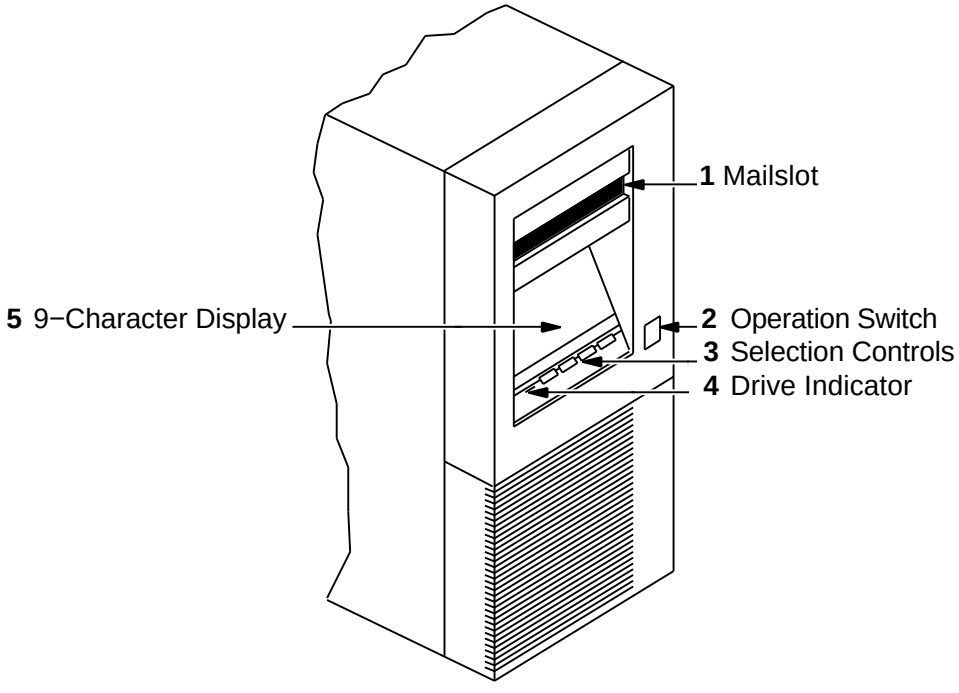


Table 3–1 Front Panel Controls

❶	Mailslot	Allows you to insert or remove optical disks.
❷	Operation Switch	Applies or removes power to enable or disable operation of the optical disk library. (This is NOT the power switch. The power switch is located on the rear panel.)
❸	Selection Controls	Press these buttons to perform the desired operation. CANCEL is pressed to cancel the current operation or choice. NEXT is pressed to display the current operation options available such as LOAD, TEST, INFOrmation, CONFiguration, EJECT, and SCSI ID, or to scroll the displayed choice forward by one. PREV is pressed to scroll the displayed choice backward by one. ENTER is pressed to choose the displayed selection.
❹	Drive Indicator	Lit when a read, write, erase, or seek operation is done. It is also lit during power-on self-test.
❺	9-Character Display	Displays information about the current operation. Generally you press PREV or NEXT to control the selections. Once your selection is displayed, you press ENTER. You may press CANCEL to cancel your selection.

3.2 Rear Panel Features and Controls

Refer to Figure 3–2 for the location of the rear panel controls and features. Table 3–2 lists and describes each control.

Figure 3–2 Rear Panel

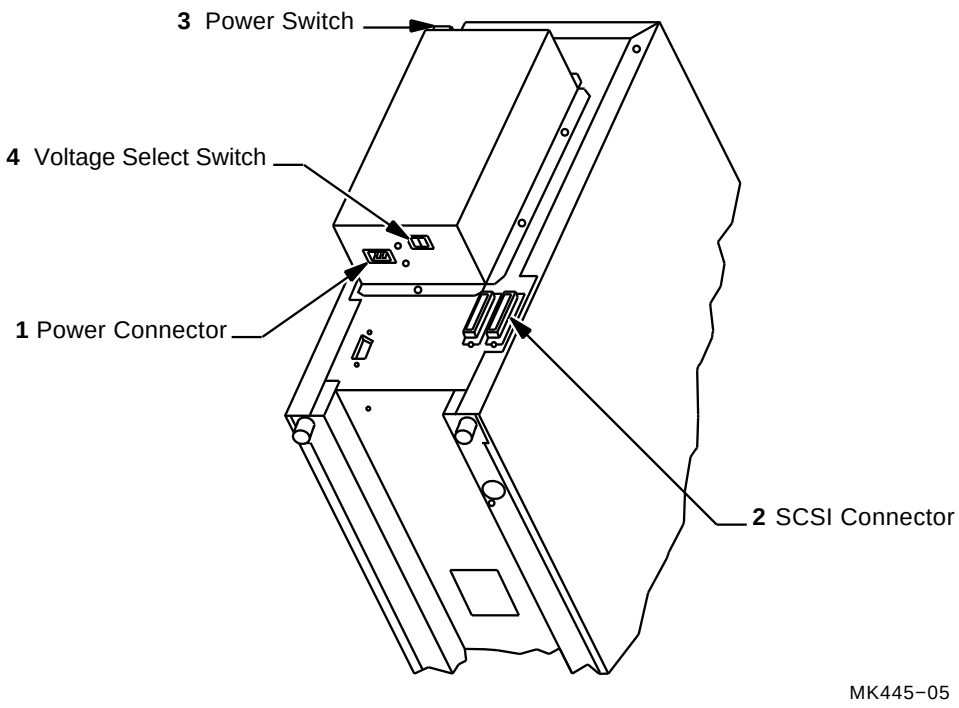


Table 3–2 Rear Panel Features and Controls

❶	Power connector	Connection for power cord.
❷	SCSI connectors	Two SCSI bus format 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.

(continued on next page)

Table 3–2 (Cont.) Rear Panel Features and Controls

❸	Power switch	Used to switch on or off all power to the optical disk library. (This switch must be on before the operation switch on the front panel is functional.)
❹	Voltage select switch	The voltage select switch allows the user to specify either a 115-volt or a 230-volt setting depending on the country in which the disk library will be used.
	UPS (9-pin, serial) Connector	Used to connect a communication cable between the optical disk library and an uninterruptable power supply (UPS). A UPS insures that data in the buffer during a write operation will not be lost in the event of a power failure.
	Fuse receptacle	The fuse receptacle holds the fuse and fuseholder cap.

3.3 Setting and Displaying Configurations

3.3.1 Setting a Configuration (CONF)

Follow these steps if you wish to set an autochanger configuration.

1. With READY displayed, press NEXT until CONF * displays.
2. Press ENTER. CONF 0 displays. (The 0 is blinking.)
3. Press NEXT or PREV until CONF ## displays (where "##" is the configuration number you want to change.)

   Refer to Table 3–3 for a complete listing of configurations.
4. Press ENTER.

   Some configurations require a security code. If prompted, enter the security code. (NO CONFIG displays if you entered the wrong code.)
5. Press NEXT or PREV until the value you want appears in the display.
6. Press ENTER once your choice displays. SET displays briefly followed by CONF *.
7. Press CANCEL twice to return to READY.

3.3.2 Displaying Information Logs (INFO)

1. With READY displayed, press NEXT until INFO * displays.
2. Press ENTER.
3. Press NEXT or PREV until the desired log number displays.

   Refer to Section 4.6 for a complete listing of information logs.
4. Press ENTER. The log information displays.

Note

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

3.3.3 Choosing Tests and Displaying Results (TEST)

Note

A complete listing of diagnostic tests is given in Section 4.9 and Section 4.10.

With READY displayed, press NEXT. TEST * displays.

1. Press ENTER. TEST 0 displays.
2. Press NEXT or PREV until the needed test number displays.
3. 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.

4. Once you press ENTER for the number of test iterations, RUN ## displays (where ## is the test number).
5. The test runs. If no problems are encountered, the message PASS ## displays.

   You may press CANCEL to get back to the READY state; or, you may press ENTER to perform another test.
6. If a problem occurs during the test, 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 to exit this display.

3.3.4 Setting the SCSI Address

Note

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

The default address settings are as follows:

- Autochanger controller - SCSI ID 3
- Optical drive mechanism - SCSI ID 4

If you want to change either address, follow these steps.

Note

Pressing CANCEL at any time will return you to the READY state or will take you back one step each time it is pressed.

1. With READY displayed, press NEXT until SCSI ID * displays.
2. Press ENTER. AC ID 3 displays.

   This is the autochanger controller address. If you want to change this address, press ENTER, otherwise press NEXT to display DRV ID 4 and then press ENTER.
3. Press NEXT or PREV until the address you want is displayed.
4. Press ENTER. The address you chose is now set.
5. Press NEXT until either UPDATE or CONFLICT displays.

   If CONFLICT displays, the drive and controller have been set to the same address and one of them must be reset.

   If UPDATE displays and you are satisfied with the addresses you have selected, press ENTER]].
6. Record the new address setting(s) for future reference.

3.3.5 Securing the Optical Disk Library

In its default condition, the optical disk library is unsecured. Any user can insert or remove disks or access control panel displays, configurations, or tests. In an open environment, some precautions should be taken to secure access to the control panel as well as to the following:

- Sensitive data stored on optical disk surfaces
- Configuration settings
- Diagnostic log information

If the customer is concerned about security, the following procedures might be considered:

- Setting a new disk library security code periodically and limiting the number of people who know the security code
- Implementing security configurations 15 and 20 which restrict disk insertion and removal. This is also done through OSMS software
- Locating the disk library in a physically secure environment

3.3.6 Setting a New Security Code

Note

This procedure is explained in the *Optical Library User's Guide* (EK–STSOP–UG). It is presented here as information to service personnel in case the customer prefers this level of guidance while setting up the disk library.

Note

A security code of 0-0-0 was set at the factory. Digital recommends that the customer change the security code so that only authorized persons can access the optical disk library. Otherwise, anyone can insert and eject disks, and change operation settings on the optical disk library.

When setting a new security code, the old code (or default code, 0-0-0, if none has been set) must be keyed in first and then key in the new code. The customer should key in both the old security code and the new code during this procedure.

1. With READY displayed, press NEXT until CONF * displays.
2. Press ENTER. CONF 0 appears in the display window (0 is flashing).
3. Press NEXT until CONF 17 is displayed.

   You are now prompted to enter the old or default security code.
4. Press ENTER. CODE1 and a flashing 0 is displayed.
5. Press NEXT until the first number of the old or default (0) security code is displayed.
6. Press ENTER. CODE2 and a flashing 0 is displayed.
7. Press NEXT until the second number of the old or default (0) security code is displayed.
8. Press ENTER. CODE3 and a flashing 0 is displayed.
9. Press NEXT until the third number of the old or default (0) security code is displayed.
10. Press ENTER. SET is displayed if you entered the old number correctly.

    NO CONFIG is displayed briefly and then CONF 17 is displayed if a mistake was made in keying in the old security code. Follow steps 4 through 9 again.

Note

It is a good idea for the customer to write down the new security code prior to entering it into the disk library.

Follow these steps to enter the new security code:

1. Press ENTER. NEW1 and a flashing 0 is displayed.
2. Press NEXT to choose the first number of the new security code.
3. Press ENTER. NEW2 and a flashing 0 is displayed.
4. Press NEXT to choose the second number of the new security code.
5. Press ENTER. NEW3 and a flashing 0 is displayed.
6. Press NEXT to choose the third number of the new security code.
7. Press ENTER. SET 17 is displayed.

3.3.7 Restricting Disk Insertion and Removal

Configurations 15 and 20 act together to control disks during normal and power fail 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.

3.3.7.1 Setting CONF 15 or CONF 20

1. Press NEXT until CONF * displays, and then press ENTER.
2. Press NEXT or PREV until CONF 15 or CONF 20 displays.
3. Press ENTER. CODE1 and a flashing 0 displays.
4. Press NEXT or PREV until the first security code number displays.
5. Press ENTER. CODE2 and a flashing 0 displays.
6. Press NEXT or PREV until the second security code number displays.
7. Press ENTER. CODE3 and a flashing 0 displays.
8. Press NEXT or PREV until the third security code number displays.
9. Press ENTER.
10. Press NEXT or PREV to select ON or OFF.
11. Press ENTER. SET 15 or SET 20 displays.

3.3.8 Controlling Mailslot Rotation

Configurations 31 and 32 allow control of mailslot rotation as described below. (See Section 3.3.1)

Note

In its default state, the optical disk library's mailslot stays open, ready to accept an optical disk.

The following configurations allow control over the mailslot's position.

- CONF 31 - when this is set to ON and CONF 15 is also set to ON, the mailslot's default position is closed. The mailslot cannot be opened and disks cannot be inserted or removed until CONF 15, (requires a security code to set), is set to OFF. Setting this configuration to ON makes it visible to the user that the mailslot cannot be used until security configuration 15 is switched OFF.

  If the autochanger is full, the mailslot will only open for an eject command.

- CONF 32 - when this is set to ON, the mailslot can be rotated open or closed from the control panel or it allows the host to control mailslot rotation using a SCSI Rotate Mailslot command. Pressing NEXT on the disk library's control panel displays an OPEN MS or CLOSE MS message. When the open or close message displays, press ENTER to toggle the mailslot open or closed.

  If the autochanger is full, the OPEN/CLOSE MS is not displayed and the mailslot will only open for an eject command.

3.3.9 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.

3.4 Autochanger Configuration Choices

The following table lists the available configurations choices. An explanation of how to access and set these configurations is found in "Setting a Configuration" in Section 3.3.1.

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 con figured.
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 #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.
27	Report Recovered Error	Off	On - reports the SCSI-level error to the host. Off - no reports of SCSI-level errors to the host.

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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
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 configuration operation.

4

Troubleshooting and Diagnostics

This chapter is divided into the following sections:

- Operation/Installation Error Information

  Lists common problems encountered during operation and installation of the optical disk library, and gives suggestions for solving these problems. (top-level troubleshooting)

- Control Panel Error Information

  Provides error messages and log information which are available through the control panel display. This level of troubleshooting is used when “hard” (repeatable) errors are encountered. (intermediate-level troubleshooting)

- Error Information through SCSI Commands

  Error messages and log information available by issuing SCSI commands via an external PC-based host computer. This level of troubleshooting is used when “soft” (intermittent) errors are encountered. (in-depth level troubleshooting)

- Internal Diagnostic Utilities

  Information about the available internal diagnostics used to aid in the troubleshooting process.

4.1 Operation/Installation Error Information

Table 4–1 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 Section 4.5 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.

Table 4–1 Operation/Installation Troubleshooting

Task	Problem/Symptom	What to do
Communicating host to library	Can't get the host to recognize the optical disk library.	Check to make sure the disk library is supported on the host operating system. Check to make sure the autochanger was installed and configured as described in the user's guide and the appropriate host system manuals. Check the SCSI connections. Check the SCSI interface address as it relates to the device files. Make sure SCSI IDs of Jukebox and MF drives do not conflict with other SCSI devices on the bus. Section 3.3.4 Make sure software license was correctly installed. Make sure CONFIG 40 is set to DEC mode. Reference Section 3.3 and Table 3–3

(continued on next page)

Table 4–1 (Cont.) Operation/Installation Troubleshooting

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 (See Figure 5–3), and set switch 1 to the "closed" position. Switch on the autochanger. This clears NVRAM and sets the security code to the default code. NOTE: Once this has been done, the switches must be reset to their original settings in order for NVRAM to be maintained the next time power is switched off. The customer may now use configuration 17 to set a new security code. (See Section 3.3.6)
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.	Check to 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. Check to 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.

(continued on next page)

Table 4–1 (Cont.) Operation/Installation Troubleshooting

Task	Problem/Symptom	What to do
	Power-on self-test fails.	Turn the unit off, then turn it on again. Observe the power-on test result. If the unit continues to fail, use the error code to begin troubleshooting. (See Section 4.2 following this table.)
	Does not boot correctly.	Make sure 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.
Power fail	Just 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. See Section 4.4 for instructions for using the eject tool.
	Host computer power fails and the autochanger stays on.	After the host reboots, file system check any write-mounted surfaces.
	Both the host system and autochanger power fail.	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 (Power-on Cartridge Security) to "ON." See Section 3.3.7 and Section 3.3.1 for an explanation of configuration 20 and how it is set.

(continued on next page)

Table 4–1 (Cont.) Operation/Installation Troubleshooting

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.
		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.
	Disk removal attempted, but a FULL or MISLOAD message displays.	Remove the disk from the mailslot and try to remove the desired disk again.

(continued on next page)

Table 4–1 (Cont.) Operation/Installation Troubleshooting

Task	Problem/Symptom	What to do
	The unit's power failed while a disk was in the drive.	Try powering on the unit. If successful, use the file system check command. If power-on 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, see Section 4.4.

4.2 Power-on Self-tests

CAUTION

When the optical disk library is powered on and the self-test 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 self-tests 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 self-test 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 power-on self-test, do 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.
   a. Remove the four T-20 screws on the back cover.
   b. Slide the top cover towards the back of the unit to free the four tabs from the sides of the autochanger chassis, and then pull the sides of the top cover out slightly while lifting the cover off.
4. Remove the right side panel. (This will allow you to observe the LEDs on the front of the optical drive mechanism.)
   a. Remove the four T-15 screws at the back end of the side panel.
   b. Slide the panel towards the back of the autochanger until the panel can be lifted off.
5. Switch on both the rear panel power switch and the front panel operation switch, and wait for the power-on self-test to complete.

   If the power-on self-test completes successfully, both LEDs will turn off. If power-on self-test fails, the fault LED will remain lit.

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 (see Appendix B for ordering information). This kit contains swabs and alcohol, cleaning instructions, and a special cartridge holder that keeps the sliding sleeve open.

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 RW504/RW524. Damage to the optical drive mechanism could result if unapproved cleaning kits are used.

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 RW504/RW524 optical drive, you may order one of these (refer to Appendix B for ordering information). 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 Chapter 5 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.

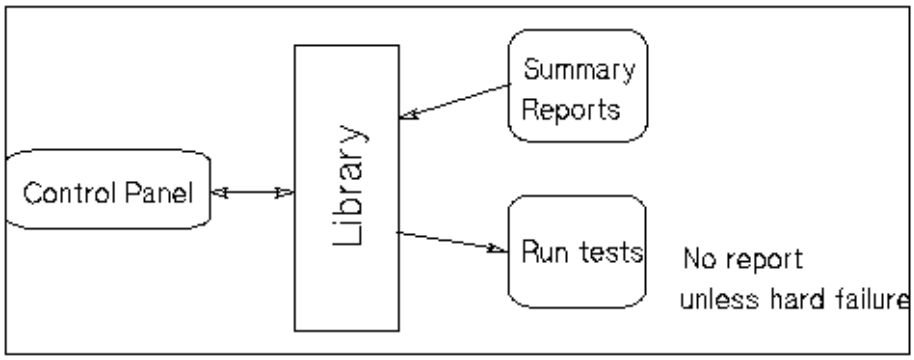
4.5 Troubleshooting Using the Control Panel and Observation

When there are errors in autochanger movements, two main approaches are available to get information and to run execiser 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 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 (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.

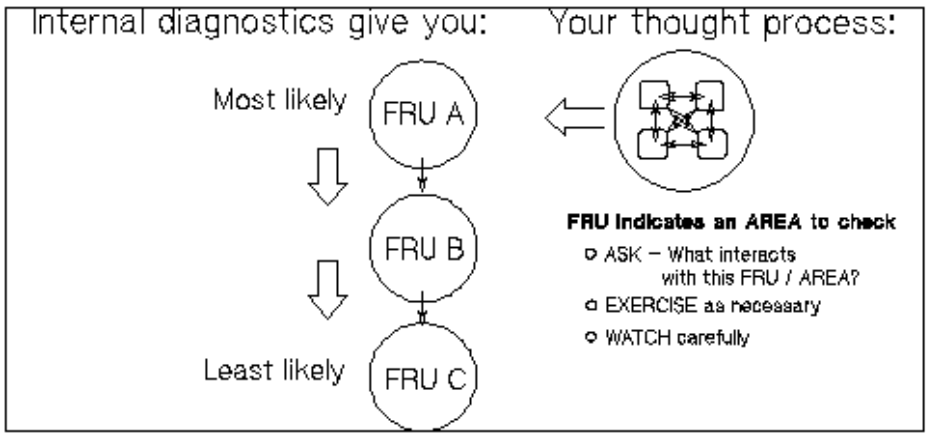
Figure 4–1 Information and Tests Through the Control Panel



4.5.1 The Autochanger Lists the First "Possibles"

At power-on, 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. You should visually inspect 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, gears, 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).

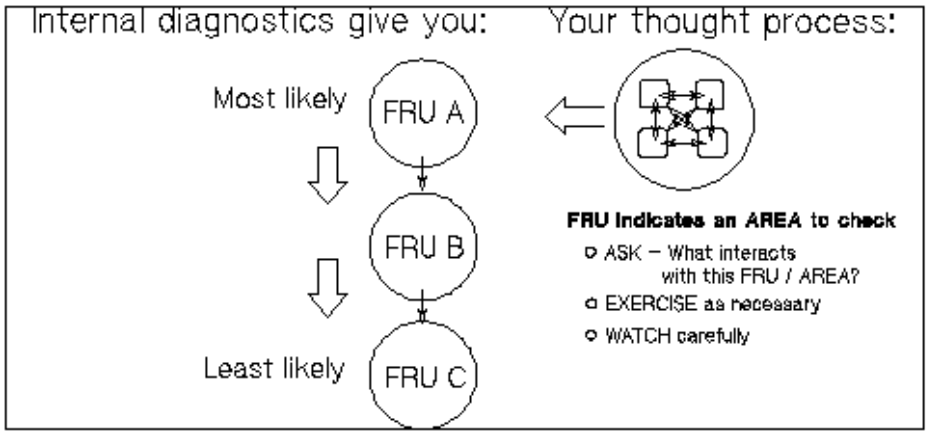
Whenever the initialization sequence is run, FIND HOME is attempted. If the “home” position cannot be found, the FRU isolation test is run automatically. When the FRU isolation test is run from the control panel, the FIND HOME sequence is run.

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 4.11, The FIND HOME Sequence and Information Logs.

An example:

Say 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.

Table 4–3 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)

   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.

4.6 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 4.6.

The logs listed in Table 4–2 are accessible from the control panel by using the INFO option.

Table 4–2 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 *n y* - *n*th error; actual error code FRU *A* - suspect FRU #1 FRU *B* - suspect FRU #2 FRU *C* - suspect FRU #3 Test *n* - test that failed *abcdefgh* - time stamp
1	Firmware Version Number	Displays the current autochanger firmware version number.
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 10 = mailslot 11 - 26 = 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 into the drive.

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Table 4–2 (Cont.) Information Logs (INFO Logs)

No.	Log Name	Description
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.
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): 1 33482 3 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. For this unit, the Translate Count will always be 0

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Table 4–2 (Cont.) Information Logs (INFO Logs)

No.	Log Name	Description
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's SCSI address. (This will always return a "1".)
17	Drive #2 SCSI Address	Will return a "1" (same information as log 16) since RW504/RW524 only has one drive.
20	Sensor Height	Displays the measured height of the picker sensor. (hexadecimal)
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.
23 - 39	Minimum Clearance	Minimum clearance for cartidge insertion into a magazine or storage slot. Up/down clearance is as calculated by Test 65 and Test 67. Up clearance/down clearance (hexadecimal) Example: 00DC 0028 = 220, 40 FFEC 0014 = -20, 20
23	Mailslot	
24	Storage slot 1	
25	Storage slot 2	
26	Storage slot 3	
27	Storage slot 4	
28	Storage slot 5	
29	Storage slot 6	
30	Storage slot 7	

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Table 4–2 (Cont.) Information Logs (INFO Logs)

No.	Log Name	Description
31	Storage slot 8	
32	Storage slot 9	
33	Storage slot 10	
34	Storage slot 11	
35	Storage slot 12	
36	Storage slot 13	
37	Storage slot 14	
38	Storage slot 15	
39	Storage slot 16	

4.7 Recovery from Hardware Errors

When a hardware failure occurs, a message is displayed on the control panel. If the failure occurs during the power-on 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.

Note

Instructions for running internal diagnostic tests are given in Section 4.9. A list of the available test choices and their descriptions are given in Section 4.10.

4.7.1 Hardware Error Codes and Recovery Procedures

Table 4–3 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 FRUs logged by the FRU isolation test as a guide to determine the problem. Replace the FRU(s) as necessary.

Table 4–3 Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
00	No error	No action.
AUTOCHANGER CONTROLLER PCA ERRORS		
		The first step is to make sure all cables are fully inserted into the connectors on the controller pca.
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 16—resets default values. Recycle power. **If error repeats –** Clear NVRAM by switching off power and setting switch 1 on the 8-switch rocker switch located on the controller PCA to the "closed" position and switching the power back on. Clearing NVRAM sets the security code back to the default (0-0-0). **If error repeats –** Replace autochanger controller PCA (FRU 01). Power-on—check fix.
06	Illegal interrupt seen by microprocessor	Same as for error code 05
07	Illegal CPU exception seen by microprocessor	Same as for error code 05
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.

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Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
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.
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		
		Note Loopback connector (88780-60095) is not a Digital stocked part. Refer to Appendix B for vendor ordering information.
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.

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Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
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.
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 2E
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		
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.

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Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
POWER SUPPLY ERRORS		
33 - 34	Power Supply failed	Visually check the power cables and connections. Run test 40—Power Supply Test—verify failure.
DRIVE CONNECT ERRORS		
38	Drive not connected	On error code 38 be sure to check: • Drive cabling – Good contacts – No cut or exposed wires • Drive tray not skewed Run test 37—Drive Connector Test—verify failure.
MECHANISM ERRORS		
		Check carriage/picker for free motion. The carriage should travel easily along the rail.
3C	Unspecified 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—verify failure.
		Check the following assemblies in the autochanger for loose labels or other obstructions—picker, mailslot, drive, and storage slots.
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	Run test 50—Find Home Sequence—verify failure.

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Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
42	Unable to find home position; Path-Clear sensor 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	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.
48 - 49	Carriage motion failed during carriage/picker assembly calibration	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 - 4F	Unable to measure height of sensor	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
50	Excessive tilt of the carriage/picker assembly (away from the drive)	Run test 51—Carriage/Picker Assy Calibration – verify failure.

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Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
51	Excessive tilt of the carriage/picker assembly (toward drive)	Run test 51—Carriage/Picker Assy Calibration—verify failure.
52	Excessive cone angle on picker	Run test 51 – Carriage/Picker Assy Calibration—verify failure.
54	Unable to complete an interrupted move (at power-up)	Run test 60—FRU Isolation Test—verify failure. If no error, monitor for reoccurrence. 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. Recovery log is available only through the SCSI interface. Call CSC. Need to use the DOSDASS2 utility (see Appendix B for ordering information).
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. Call CSC. Need to use the DOSDASS2 utility (see Appendix B for ordering information).

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Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
5C	Shipping diagnostic run with cartridges in drive mechanism	No FRUs failed. Shipping warning. Take all disks out of the optical drive mechanism.
CALIBRATION SENSOR SYSTEM ERRORS		
60 - 61	Home sensor failed	Run test 51—Carriage/Picker Assy Calibration—verify failure.
PATH-CLEAR SENSOR SYSTEM ERRORS		
64 - 65	Intermittent path-clear sensor beam	Run test 44—Clear Path Test—verify failure. Run test 51—Carriage/Picker Assy Calibration—verify failure.
66 - 67	Path physically blocked	Run test 44—Clear Path Test—verify failure. Run test 51—Carriage/Picker Assy Calibration—verify failure.
6B - 6C	Path-clear LED failed	Run test 44—Clear Path Test—verify failure. Run test 51—Carriage/Picker Assy Calibration—verify failure.
6D - 6E	Path-clear sensor failed	Run test 44—Clear Path Test—verify failure. Run test 51—Carriage/Picker Assy Calibration—verify failure.
6F	Path-clear sensor system failed	Run test 44—Clear Path Test—verify failure. 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 43—Mailslot Sensor Test—verify failure.
B2	Mailslot will not accept or release cartridge	Run test 17—Mailslot I/O Test—verify failure.

(continued on next page)

Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
		Check for loose labels or other obstructions in errors B3 and B4. Also, make sure that the storage slots are not skewed.
B3	Storage slot will not accept or release cartridge	Run test 15—Storage Slot Test—verify failure.
B4	Outside mailslot sensor failed	Run test 43 – Mailslot Sensor Test—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 access error	Run test 16—Drive I/O Test – verify failure. Access the drive logs. Drive logs are available only through the SCSI interface. Call CSC.
DRIVE EJECT ERRORS		
BC	Drive access failure	Run test 16—Drive I/O Test – verify failure. Access the drive logs. Drive logs are available only through the SCSI interface. Call CSC.
FRU DETECTION TEST ERRORS		
		Check carriage/picker for free motion. The carriage should travel easily along the rail; you should be able to easily flip the picker using the picker belt.

(continued on next page)

Table 4–3 (Cont.) Recovery Procedures for Specific Hardware Errors

Error Code (hex.)	Error	Recovery Procedures
C8	Unable to gain proper servo control of motors	Run test 60—FRU Isolation Test—verify failure.
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		
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.

4.8 Error Information Through SCSI Commands

When there are errors in autochanger movements, two main approaches are available to get information and to run execiser 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.

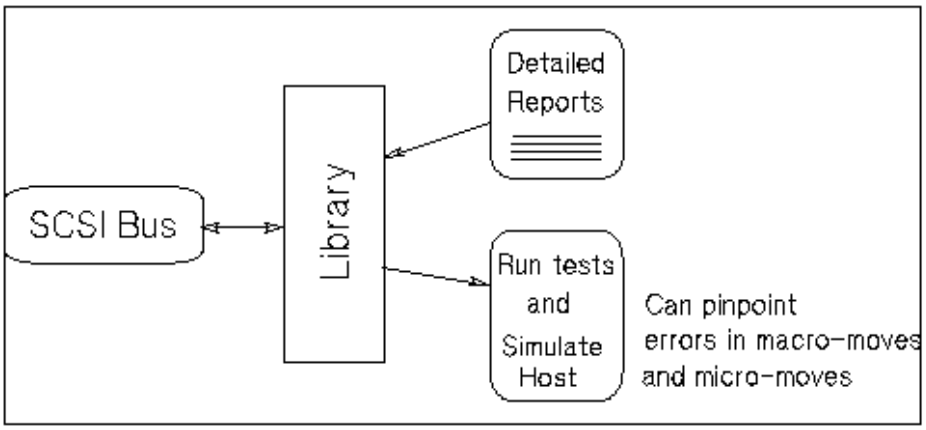
Using data on the SCSI bus, you can determine exactly what the autochanger was doing when a failure occurred; all the way down to the macro-move and micro-moves.

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.

See Appendix A for information on decoding VMS operating system error logs and SCSI-2 codes.

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, however, it is available from Hewlett-Packard or Digital CSC (refer to Appendix B for ordering information).

Figure 4–4 Information and Tests Through the SCSI Bus



When troubleshooting through the SCSI bus, refer to the following information:

- Ordering information for Offline Diagnostics for Optical Library Products located in Appendix B.

  This offline diagnostic, DOSDASS2, can be used to access the above information through the SCSI bus.

  In addition, refer to the following tables:

  – Request Sense Command Tables (Table A–4)

    This table shows error information and information about the state of the autochanger after an error has occurred, which is returned when a Request Sense command is issued through the SCSI bus.

  – Log Sense Command Table (Table 4–2)

    This table shows the error and move information which is stored in various logs during autochanger operation and when running internal diagnostics.

4.9 Diagnostics

Several diagnostic programs and tests are available for the disk library. This section 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 4.10. Instruction for running these tests are provided in Section 4.9.2.

4.9.1 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 obtaining and using *DOSDASS2* is found in Appendix B.

4.9.2 Internal Diagnostic Tests

An extensive set of internal diagnostic tests is available for the autochanger. Except for the power-on 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 tests 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.

Note

Section 4.10 contains a complete listing and description of these diagnostic tests. The following instructions provide information for running these tests.

Procedure for running tests

To display test information and to choose tests to execute, access the TEST option using the following steps.

1. With the autochanger power on and in the READY state, press NEXT. TEST * displays.
2. Press ENTER. TEST 0 displays.
3. Press NEXT or PREV until the test number you want shows in the display.
4. Press ENTER to choose the test. ONCE displays. You may accept ONCE by pressing ENTER or press NEXT or PREV to choose 10, 100, 1000, or LOOP times. LOOP runs the test continuously until OPTION is pressed or the unit is powered off.

   Note

   Any test may be stopped, at any time, by pressing CANCEL. (Some tests require that CANCEL be pressed twice.) The unit will stop the test after it completes its current activity.

5. Once you have pressed ENTER for the number of times the test will repeat, RUN nn displays.
6. At this point the test runs. If no problems are encountered, the message PASS nn displays. You may press CANCEL to get back to the READY state; or, you may press ENTER to run another test.

   If a problem occurs during the test, the message FAIL nn displays. Press ENTER to gain information about the failure. An ERROR nn displays. The error log stores the FRU information, TEST nn information, and a time stamp.

4.10 Diagnostic Test Command Descriptions

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

4.10.1 Sequence Tests

Table 4–4 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.

(continued on next page)

Table 4–4 (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 4–5 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.

(continued on next page)

Table 4–5 (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.

4.10.2 Electronic Core Tests

Table 4–6 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 he 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.
40	Power Supply Test	Looks at both the 12-Volt and the 24-Volt pow 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.

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Table 4–6 (Cont.) Electronic Core Tests

No.	Test Name	Description
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 s 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.

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Table 4–6 (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 storage slot number. (There are 16 storage slots.) The test returns: Byte 2-3 - clearance up Byte 4-5 - clearance down
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.
153	Random Exerciser	Randomly exercises the autochanger. Needs at least two cartridges and these cartridges will be randomly changed. THIS TEST IS NOT TO BE USED BY THE CUSTOMER. DO NOT USE TEST WHEN CUSTOMER'S DISKS ARE IN THE LIBRARY. *Parameter A* is drive usage (1=every time 10=every 10th time). *Parameter B* is mailslot usage. Default is 50, which is every 50th time the mailslot is used. *Parameter C* is the number of exchanges between exchanges. Default is 0. Hit CANCEL to stop.

4.11 The FIND HOME Sequence and Information Logs

4.11.1 Specific Steps of 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 decending order of probability.

Hardware error numbers and recovery procedures are listed in Table 4–7.

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 accessable or displayed through the control panel. Errors returned are micro-move errors. Micro-move errors are explaned in Chapter 6.

Note

Errors are expressed in hexadecimal format.

1. Clear the picker of any obstructions that would prevent carriage/picker movement. (MMID# 56 to 6E)
   a. Possible error:

      40–Unable to free the picker fingers in preparation for carriage motion.
2. Clear an area large enough to enable a flip to take place. (MMID# 49 to 4C)
   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 and calibrate flip mechanism. (MMID# 4D, 4F, 7, 8)
   a. Possible error:

      45–Unable to free the picker fingers.
4. Initialize the carriage/picker position by moving it toward the drive-end of the until it hits a hard stop. (MMID# 47, 48)
   a. Possible error:

      46–Carriage motion failed while initializing Home position during Find Home sequence.
5. Determine if the library is in the tower or the rackmount configuration. (MMID# 1, 2, 50, 51)
   a. Possible error:

      41–Carriage motion failed during carriage/picker assembly calibration.
6. Determine if there is a cartridge in the picker by plunging the fingers against a hard stop (MMID# 2, 52, 5)
   a. Possible error #1:

      4D–Motion error while checking for cartridge in picker.
   b. Possible error #2:

      65–Intermittent path-clear sensor beam.
7. Find orientation of the picker (MMID# 1,2, 53, 54, 7, 8)
   a. Possible error #1:

      4A–Motion error while determining the orientation of the picker.
   b. Possible error #2:

      4C–Failed flip motion during the Find Home sequence
   c. Possible error #3:

      60–Optical sensor failed
8. Calibrate the end of the picker with respect to the sensor (Do twice on each side of the picker, to be sure) (MMID# 1, 2, 53, 54, 7, 8)
   a. Possible error #1:

      49–Carriage motion failed during carriage/picker calibration.
   b. Possible error #2:

      4C–Failed flip motion during the Find Home sequence

c. Possible error #3:

   60–Optical sensor failed

d. Possible error #4:

   50–Excessive tilt of cartridge/picker assembly (away from the drive)

e. Possible error #5:

   51–Excessive tilt of cartridge/picker assembly (toward the drive)

9. Filp the carriage/picker assembly with the nut facing upward if necessary (MMID# 1, 2, 7, 8)

   a. Possible error:

      4C–Failed flip motion during Find Home sequence

10. Initialize the mailslot. (MMID# 2, 2B to 35)

    a. Possible error:

       B0–Mailslot will not rotate.

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.

4.12 Micro-Move Reference Table for Viewing FIND HOME Sequence

Table 4–7 RW504/RW524 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 drive
4	Carriage motion; move fingers forward during full speed; toward the drive
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
11	Move fingers toward storage slot
12	Detect cartridge in storage slot before grab and during Initialize Element Status
13	Take up the slack in the fingers before grabbing the carriage
14	Pull cartridge back from storage slot with cartridge
15	Push cartridge forward into storage slot
16	Detect cartridge in storage slot after insert
17	Pull fingers back from storage slot after releasing cartridge
18	Move fingers toward drive; prepare to grab cartridge
19	No motion; waiting for the drive to eject the cartridge
1A	Cartridge 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

(continued on next page)

Table 4–7 (Cont.) RW504/RW524 Micro-Move ID Table

Move ID (hex)	Description
1E	Insert cartridge into drive after slider has 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 cartridge back
21	Drive accepted cartridge; release cartridge and pull fingers back
22	Carriage motion; during mailslot access
23	Move fingers toward drive with intent to grab cartridge
24	Detect a cartridge in the mailslot before grab
25	Take up the slack in the fingers before grabbing the cartridge
26	Pull cartridge back from the mailslot with cartridge
27	Carriage motion during mailslot access
28	Push cartridge forward into the mailslot
29	Detect a cartridge in the mailslot after insert
2A	Pull fingers back from mailslot after releasing cartridge
2B	Move leadscrew tab toward 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
30	Release tension on the mailslot rotate arm
31	Release tension on the mailslot 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

(continued on next page)

Table 4–7 (Cont.) RW504/RW524 Micro-Move ID Table

Move ID (hex)	Description
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 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 drive)
40	Short carriage motion to check for cartridge sticking out of a storage slot after insertion (away from drive)
41	Short carriage motion to check for cartridge sticking out of the drive after insertion (toward drive)
42	Short carriage motion to check for cartridge sticking out of the drive after insertion (away from drive)
43	Short carriage motion to check for cartridge sticking out of the drive during error recovery (toward, then away from drive)
47	Carriage motion toward drive; looking for hard stop in the Find Home sequence
48	Release forces after finding hard stop
49	Carriage motion away from drive finding room to flip in FIND HOME sequence
4A	Fast carriage motion toward drive to flip position
49	Carriage motion toward drive finding room to flip in FIND HOME sequence
4A	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 belt in FRU isolation tests, or slow finger motions during error recovery
50	Carriage motion toward drive looking for hard stop before measuring carriage travel
51	Verify the maximum required carriage travel from the drive
52	Test for presence of cartridge by pushing against hard stop

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Table 4–7 (Cont.) RW504/RW524 Micro-Move ID Table

Move ID (hex)	Description
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 (wiggle motion)
62	Long carriage motions in drive recovery (toward, then away from the drive)
64	Pull fingers back into picker during recovery
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 toward drive, using short steps, look for drive to accept the cartridge during recovery
69	Carriage motion during initial recovery (away from drive)
6A	Carriage motion during initial recovery (toward drive)
6B	Push fingers out of picker during initial recovery
6C	Push fingers back into picker during initial recovery
6D	Carriage motion during initial recovery (away from drive)
6E	Carriage motion during initial recovery (toward drive)
6F	Check for carriage motor belt in FRU isolation tests

5

Removal and Replacement

5.1 Field-Replaceable Assemblies

The RW504/RW524 optical disk library contains the following major assemblies:

- Multifunction optical drive mechanism
- Mailslot assembly
- Power supply
- Front panel assembly
- Leadscrew assembly
- Picker/carriage assembly
- Autochanger controller

5.2 ESD Precautions

The RW504/RW524 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

The following tools are needed for assembly/disassembly of the autochanger:

- Torx® driver with the following bits: T-10, T-15, T-25
- Dags
- Needle-nosed pliers
- Pozidriv® magnetized screwdriver
- Flatblade screwdriver

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 switch off power to the disk library until you are sure the SCSI bus is inactive. Switching off the disk library when the SCSI bus is active can cause data loss and/or indeterminate bus states.

Use caution when servicing the optical disk library to insure that disk cartridges are not moved from their original slot locations. If you need to remove the cartridges, record their slot locations and orientation so they can be replaced to their original positions. Failure to follow this practice will result in a serious loss of file system integrity.

5.4.1 Service Access

WARNING

DO NOT disassemble the drive mechanism.

The optical drive mechanism becomes a Class 3B laser device when disassembled. If the drive is disassembled, exposure to the invisible laser beam and hazardous invisible laser radiation could result in blindness.

Note

A drive that has been disassembled will not be accepted as an exchange assembly.

1. Remove power from the optical disk library. Switch off both the power switch on the back panel and the operation switch on the front panel.
2. Unplug the power cord from the back panel.
3. Remove the disk library top cover.
   a. Remove the four T-25 screws on the back cover.
   b. Slide the top cover toward the back of the unit to free the four tabs from the sides of the autochanger chassis, and then pull the sides of the top cover out slightly while lifting the cover off.
4. Remove the service access panel (located on the right side of the disk library when facing the front panel).
   a. Remove the four T-15 screws at the back end of the access panel.
   b. Slide the side panel toward the back of the autochanger until the four tabs on the access panel are released from the autochanger chassis.

Note

When removing the access panel, be careful not to detach the four copper clips from the front of the access panel.

   c. Lift the panel off and away from the autochanger chassis.
5. Remove the clear plastic center shield by pushing on the center section of the shield until the top of the shield can be pulled out from under the top of the chassis.

When reassembling:

- When replacing the clear plastic shield, the tab fits into a slot at the bottom of the autochanger chassis.
- When replacing the access panel, make sure the SCSI cable at the back of the autochanger is out of the way and doesn't get pinched between the access panel and the autochanger chassis.

- When replacing the top cover, make sure the tabs on the bottom of the top cover fit into the slots on the bottom of the autochanger chassis.

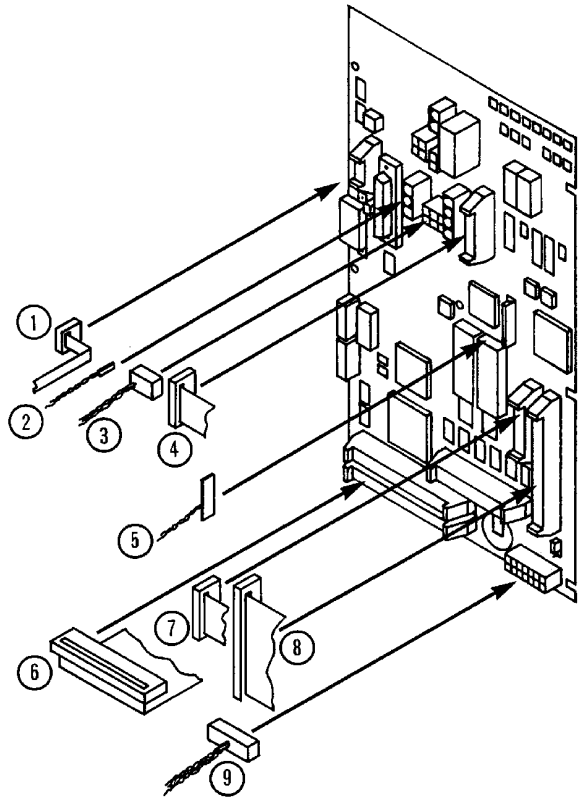
5.4.2 Replacing the Autochanger Controller PCA

Note

The front bezel assembly can be removed and the operation switch cable disconnected if you wish, to allow more clearance for removing/replacing the controller PCA. (See Section 5.4.3.)

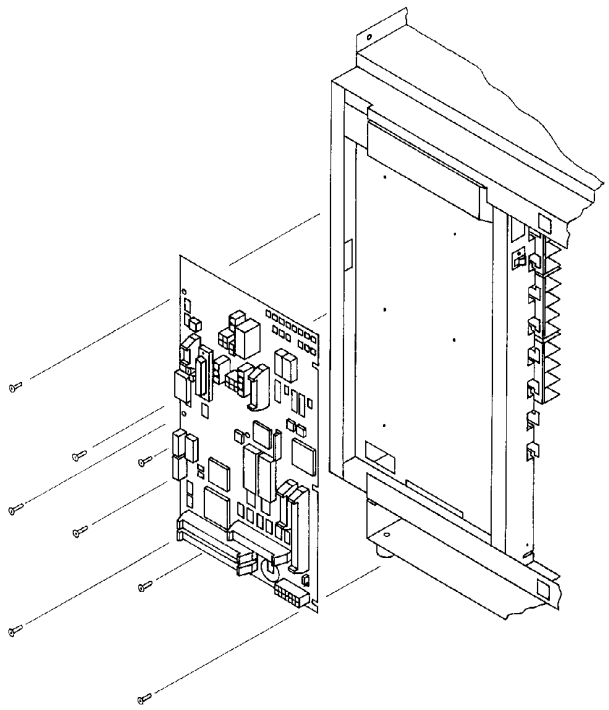
1. Follow the steps in the service access procedure at the beginning of this chapter.
2. Unplug the following cables from the controller PCA (refer to Figure 5–1):
   - ❶ UPS cable
   - ❷ Carriage motor power cable
   - ❸ Motor power cable
   - ❹ Carriage assembly umbilical cable
   - ❺ Carriage motor encoder cable
   - ❻ SCSI ribbon cable (and terminator if differential SCSI interface)
   - ❼ Front panel cable
   - ❽ Interconnect cable
   - ❾ Module power cable

Figure 5–1 Controller PCA Cable Connections



3. Remove the controller PCA from the chassis.
   a. Remove the eight T-15 screws that secure the PCA to the chassis (See Figure 5–2).
   b. Lift the side of the controller PCA that faces toward the back of the autochanger out towards you slightly, and then slide the PCA towards the rear of the autochanger until it can be removed without catching any cabling.

Figure 5–2 Removing the Autochanger Controller PCA



When reassembling:

- Verify that the jumper at J19 on the controller PCA is on the upper two pins. (See Figure 5–3 for correct jumper position.)
- Verify that the 8 switch rocker switch (SW2) on the controller PCA is set to the positions called out in Table 5–1. Refer to Figure 5–3 for the location of the dip switch.
- Note that not all connectors are used on the controller PCA when reattaching the cables. (See Figure 5–1.)
- Switch power to the disk library back on, and set configurations 16 and 18. (See Section 3.3.1 and Section 5.5.)
- Cycle power off and on to allow the new configurations to take effect.
- Refer to Section 5.4.3 to reattach the front bezel if it was removed.

- Refer to Section 5.4.1 to replace the access panel and top cover.

Figure 5–3 Dip Switch Location on the Controller PCA

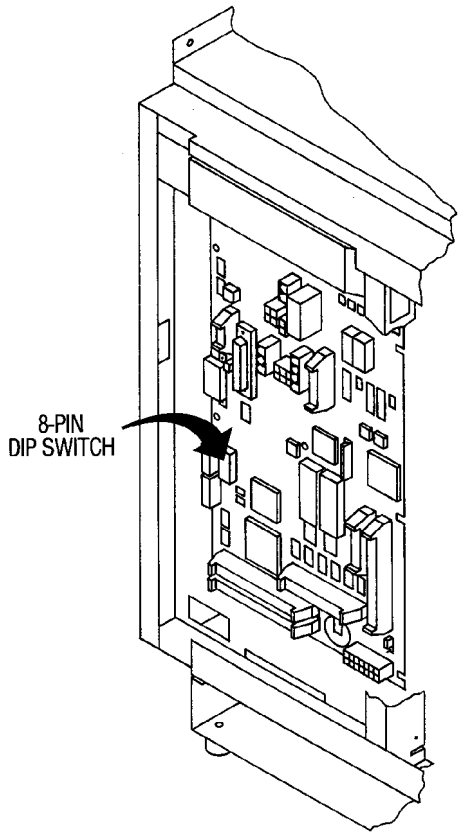


Table 5–1 SW2 Default Settings

Switch Number	Position	Function
1	OPEN	Clears NVRAM and security code when “CLOSED”.
2	OPEN	Not field usable
3	OPEN	Not field usable
4	OPEN	Not field usable
5	CLOSED	Term power
6	OPEN	Term power
7	OPEN	Term power
8	OPEN	Not field usable

5.4.3 Replacing the Front Bezel Assembly

Note

The front bezel must be removed in order to replace the following assemblies:

- Fan
- Display/operation buttons
- Drive mechanism
- Magazine guides
- Mailslot
- Operation switch

1. Follow the service access procedure at the beginning of this chapter.
2. Snap off the small front access panel if necessary. (This panel only needs to be removed if the fan is being replaced.)
   a. Pull the bottom of the panel until it pops free.

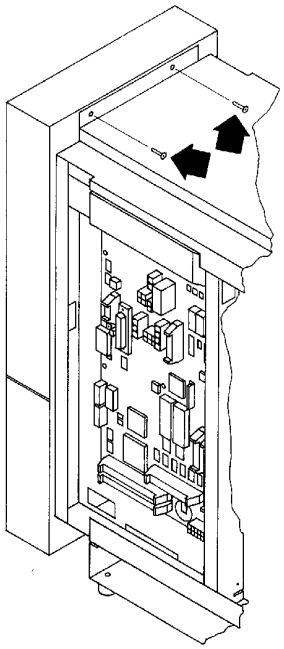
b. Slide the tabs at the top of the panel downward until the panel is released and can be removed.

CAUTION

Hold on to the front bezel to prevent it from dropping and being damaged while removing the front panel mounting screws.

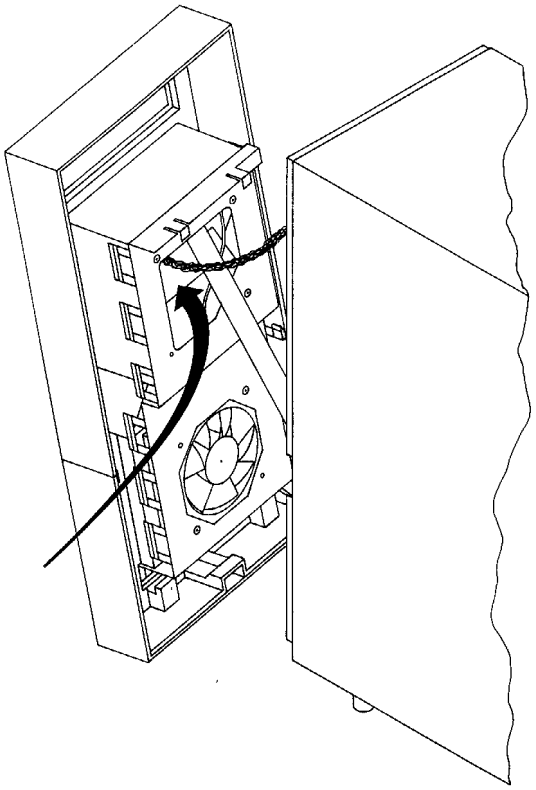
3. Remove the two T-25 screws that secure the front bezel to the chassis. These screws are located behind the front bezel as shown in Figure 5–4.

Figure 5–4 Front Bezel Mounting Screws



4. Pull the front bezel off far enough to enable you to disconnect the front panel cable and the mailslot sensor cable (see Figure 5–5).

Figure 5–5 Disconnecting the Mailslot Sensor Cable and Front Panel Cable



5.4.4 Replacing the Front Operation Switch/Cable Assembly

1. Pull off the operation button from the front of the disk library.
2. Remove the two pozidriv screws that secure the operation switch to the front of the disk library.
3. Feed the switch through the opening in the chassis so the cable is in the midsection of the disk library.
4. Disconnect the two power connectors from the controller PCA if they have not already been disconnected.

5. Disconnect the power cable from the back of the drive mechanism (located at the front of the disk library).
6. Feed the power cable assembly through the opening in the sheetmetal bracket that secures the magazine guides to the chassis (near the center of the disk library).

Note

To ensure there is enough room for the large power connector to fit through this opening, feed the power switch through first and the large power connector last.

7. Remove the four screws that secure the power supply assembly to the disk library rear panel.
8. Lift up the power supply far enough to release the two tabs that secure the left side of the power supply to the rear panel. Pull the power supply assembly away from the rear panel just far enough to allow you to disconnect the power cable from the power supply PCA. (Set the power supply assembly aside.)
9. Cut the four cable ties that secure the power cable assembly to the top of the disk library chassis.
10. Feed the large power connector that was just removed from the power supply through the opening in the shield at the back of the disk library and remove the cable assembly.

When reassembling:

- Feed cables through the opening in the sheetmetal at the center of the disk library in the reverse order in which they were removed.
- Resecure the power cable assembly to the top of the autochanger chassis using four cable ties.
- Refer to Figure 5–1 to reconnect cables to the controller PCA.

5.4.5 Replacing the Fan/Display/Operation Button Assemblies

1. Follow the service access procedure at the beginning of this chapter.
2. Remove the front bezel assembly. (See Section 5.4.3.)

CAUTION

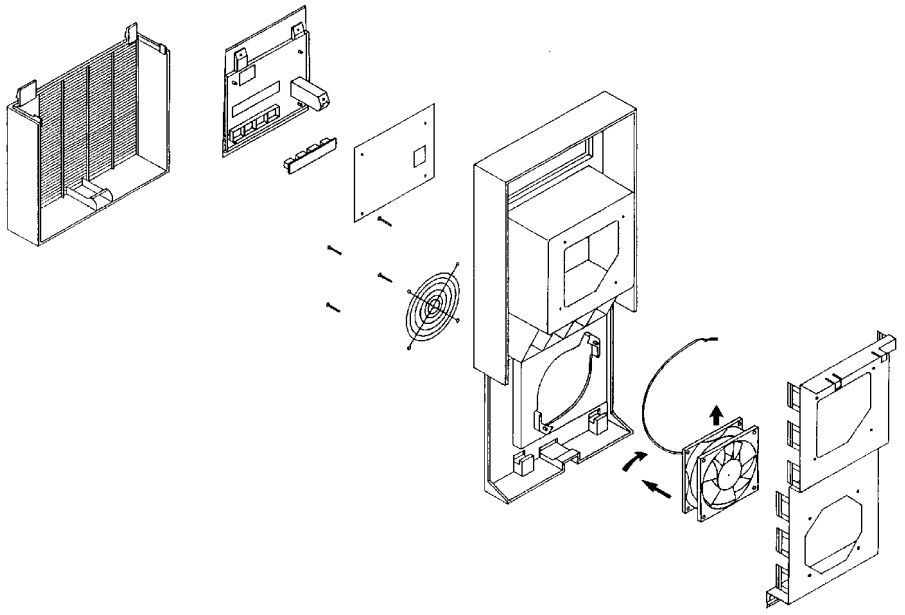
Hold your hand over the front of the display while removing the screws that secure it to the front bezel. The display assembly will fall out of the front bezel and could be damaged when these screws are removed.

Note

The display assembly must be removed in order to replace the fan assembly.

3. Lay the front bezel on its side and remove the three T-15 screws that secure the display assembly to the back of the front bezel. (See Figure 5–6.)

Figure 5–6 Removing the Display Assembly



Note

When assembling/disassembling the display assembly, place the display on an anti-static mat to prevent the display from being scratched.

4. Carefully disconnect the fan cable from the display PCA using a pair of needle-nosed pliers.
5. Remove the display PCA by removing the four T-10 screws that secure it to the display assembly.

   Once the display PCA is removed, the rubber key pads can also be removed from the display assembly and replaced if necessary.
6. Snap off the lower front section of the front bezel if it was not removed earlier (see Section 5.4.3).
7. Remove the two T-25 screws that secure the fan grill to the front bezel.

8. Remove the two T-20 fan mounting screws and flat washers that secure the fan to the back side of the front bezel. Lift off the RFI shield.
9. Turn the fan counterclockwise to release the two fan tabs from the slots in the front bezel and remove the fan.

When reassembling:

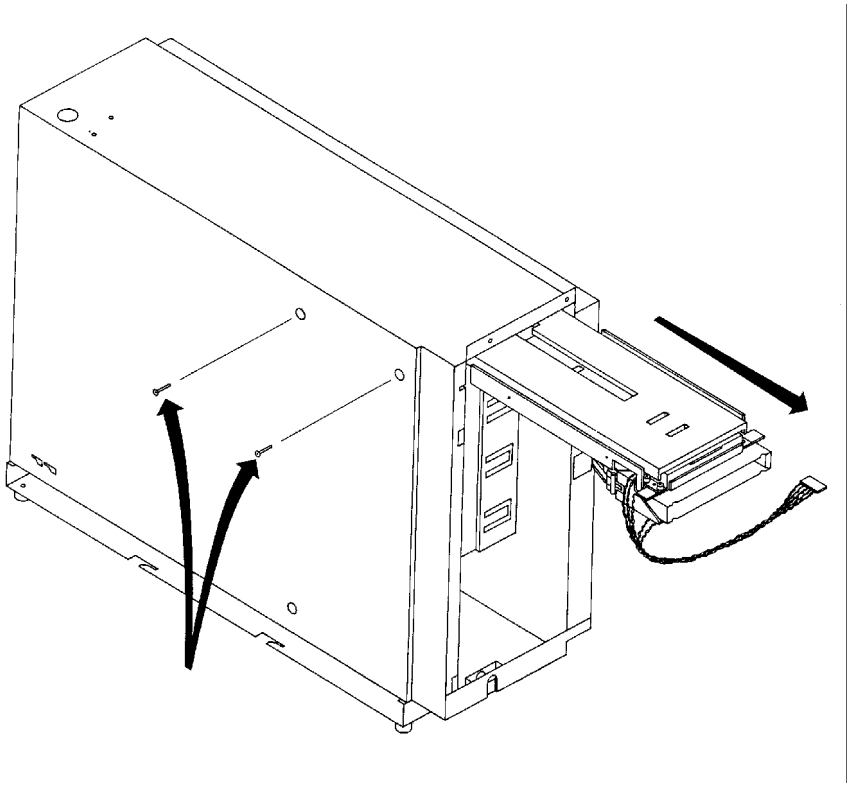
- When replacing the fan:
  - Position the fan so that the cable faces toward the display assembly and the airflow indicator faces up.
  - The fan cable is not routed through the fan housing or under the RFI shield.
  - The bend in the grill "feet" face down toward the bezel.
- When replacing the display:
  - Hold the display in place while reattaching it to the front bezel to avoid damaging the display.
  - Reconnect the fan cable to the display PCA before attaching the display to the front bezel.
  - Insert the top of the display assembly into the front bezel before inserting the operation buttons.
  - Position the operation buttons in the front bezel so they do not obstruct the hole used to attach the display to the front bezel.
  - Remember to replace the cable clamp (with the fan cable inserted) when reattaching the display/RFI shield to the front bezel. Verify that this screw/cable clamp is secured to the plastic standoff at the bottom of the display.
- Refer to Section 5.4.3 to reattach the front bezel.
- Refer to Section 5.4.1 to replace the access panel and top cover.

5.4.6 Replacing the Mailslot Assembly

1. Follow the service access procedure at the beginning of this chapter.
2. Remove the front bezel assembly. (See Section 5.4.3.)
3. Remove the two T-15 mailslot mounting screws from the upper left side of the chassis. (See Figure 5–7.)

4. Slide the mailslot forward out of the autochanger.

Figure 5–7 Mailslot Mounting Screws



When reassembling:

- When reinserting the mailslot into the chassis, lift up on the mailslot assembly from inside the chassis to ensure the mailslot is seated properly on the guides.
- Refer to Section 5.4.3 to reattach the front bezel.
- Refer to Section 5.4.1 to replace the access panel and top cover.

5.4.7 Replacing the Optical Drive Mechanism

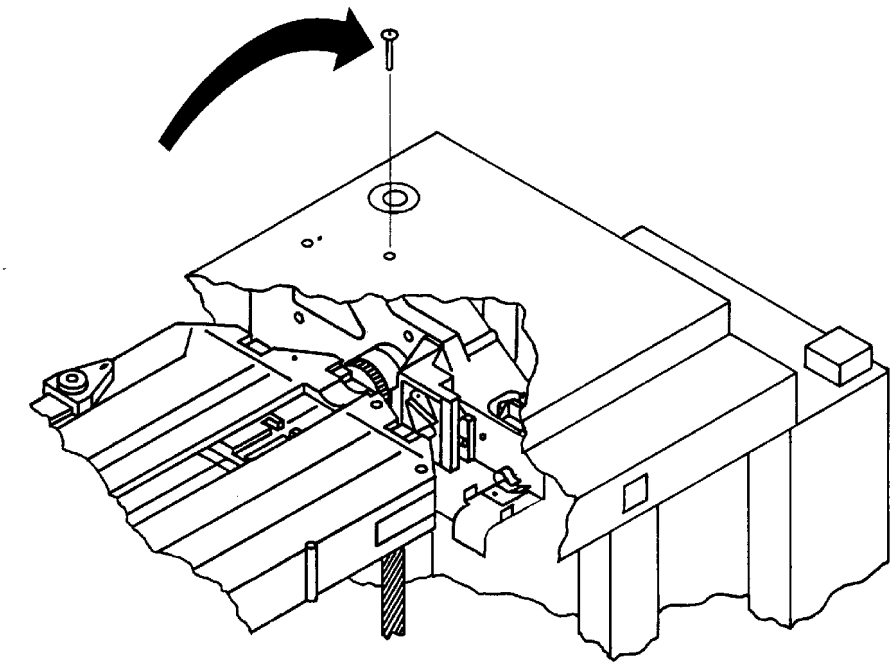
Note

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. Instructions for using the eject tool are given in Section 4.4.

The drive mechanism does not need to be removed to remove a disk from the drive.

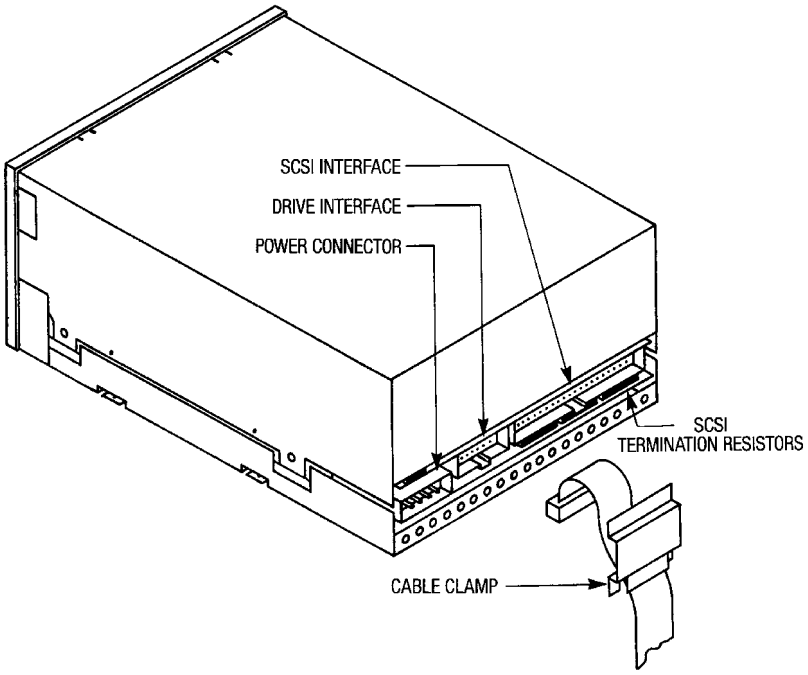
1. Follow the service access procedure at the beginning of this chapter.
2. Remove the front bezel assembly. (See Section 5.4.3.)
3. Slide the picker up as far as it will go and secure it to the top of the autochanger chassis using a T-25 screw. (See Figure 5–8.)

Figure 5–8 Picker Service Position



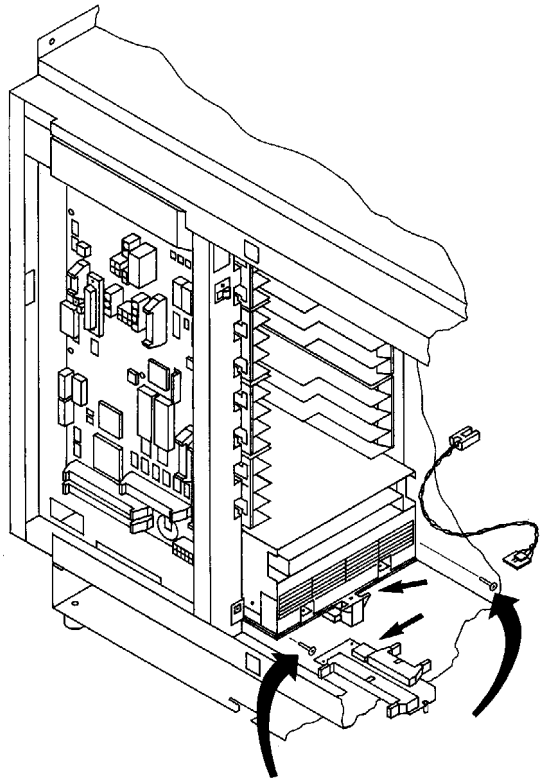
4. Remove the following cables from the back side of the drive mechanism (See Figure 5–9):
   a. Power cable
   b. Drive interface cable and clamp
   c. SCSI cable

Figure 5–9 Optical Drive Mechanism Cable Connections



5. Disconnect the optical sensor cable from the interconnect PCA. (See Figure 5–10.)
6. Remove the two T-25 screws that are located on each side of the front of the optical drive mechanism. (See Figure 5–10.)

Figure 5–10 Drive Mounting Screws and Optical Sensor Cable Locations

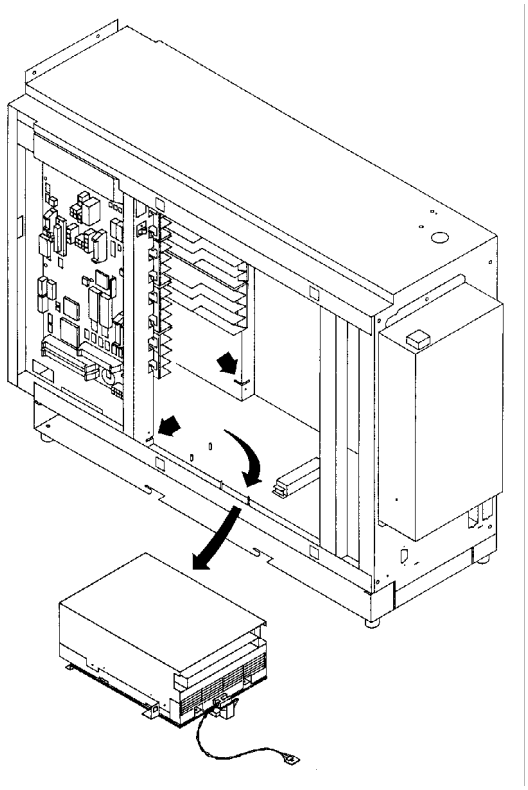


7. Slide the drive mechanism assembly out through the center of the disk library (see Figure 5–11).

CAUTION

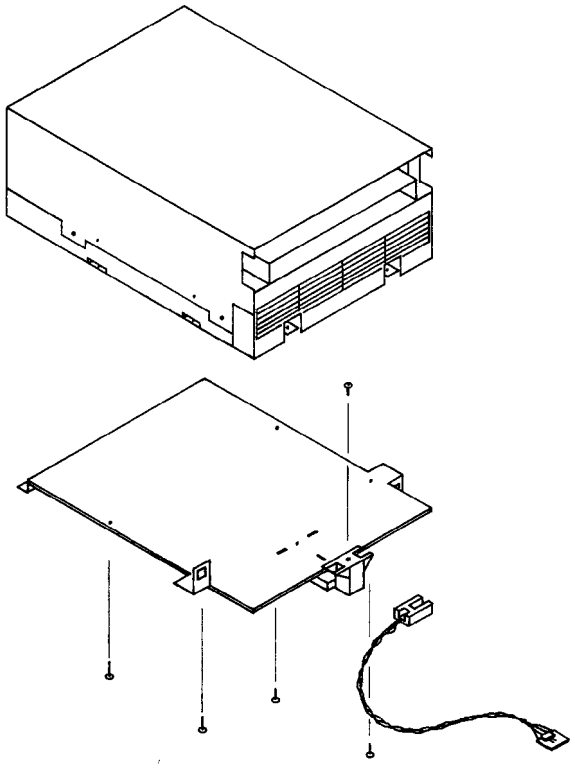
Be careful not to catch the optical sensor cables on the drive mechanism while removing the drive.

Figure 5–11 Sliding the Drive Mechanism Out of the Library



8. Remove the four T-10 screws that secure the drive to the drive plate (see Figure 5–12).
9. If you need to replace the optical sensor, remove the T-15 screw that secures the optical sensor to the sensor bracket (see Figure 5–12).

Figure 5–12 Removing the Drive Plate and Optical Sensor



When reassembling:

- Make sure the drive is positioned correctly when reattaching the drive to the drive plate:
  - Position the drive mechanism in upside down in front of you so that the front of the drive mechanism is facing toward you. Set the drive plate on top of the drive mechanism so that the sensor is facing toward you with the opening on the sensor facing to the right and the cables to the left.
  - Replace the screw in the left hole closest to you first. (Loosely tightening this screw will cause the other holes in the drive plate to correctly align with the holes in the drive mechanism.)

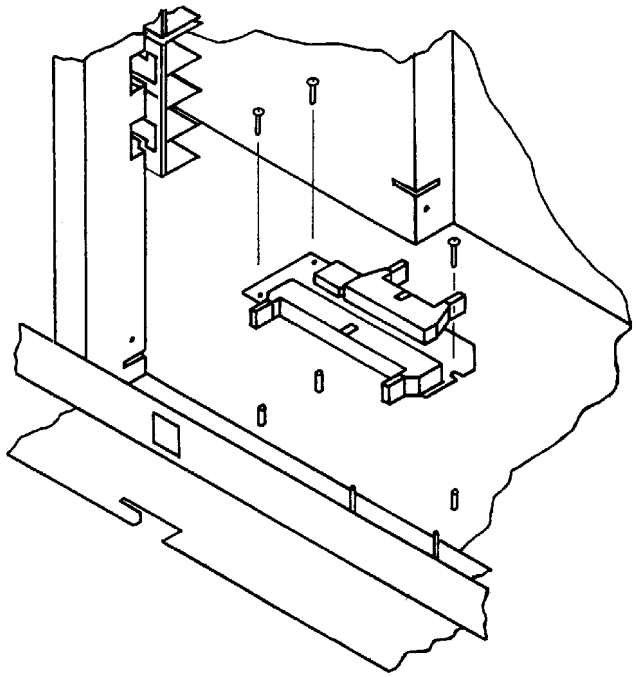
- Verify that the drive and drive plate are properly aligned and that none of the screws are catching on the raised part of the drive plate.

- The front of the drive mechanism faces towards the leadscrew assembly.
- The tabs on the drive plate slide on rails at the bottom of the disk library chassis.
- The back of the drive mechanism must be lifted slightly after it has been inserted into the chassis so that the notch on the drive plate fits into the slot at the front of the chassis. (See Figure 5–11.)
- Refer to Section 5.4.3 to reattach the front bezel.
- Refer to Section 5.4.1 to replace the access panel and top cover.
- Verify that the drive contains the correct firmware revision.

5.4.8 Replacing the Interconnect PCA

1. Follow the service access procedure at the beginning of this chapter.
2. Disconnect the optical sensor connector.
3. Disconnect the drive interface cable.
4. Disconnect the sensor cable from the controller PCA, if it has not already been disconnected.
5. Remove the two T-9 screws (located closest to the drive mechanism) and loosen the third T-9 screw that secures the interconnect PCA to the chassis (See Figure 5–13).
6. Slide the PCA out of the library.

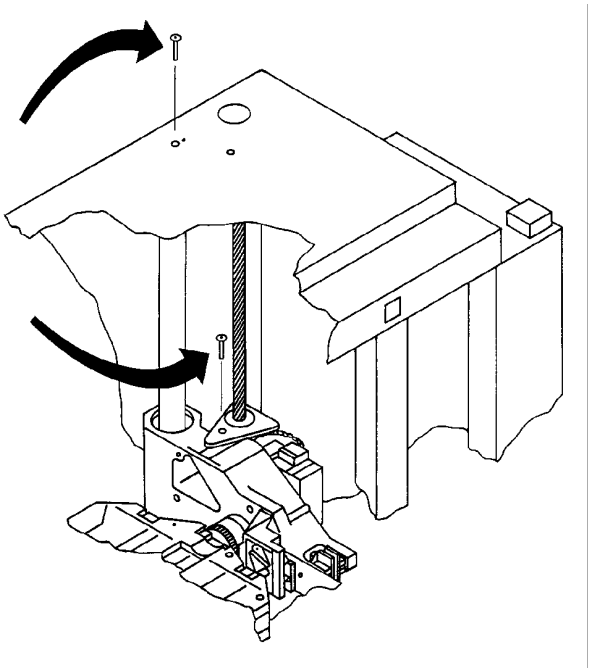
Figure 5–13 Removing the Interconnect PCA



5.4.9 Replacing the Picker/Carriage Assembly

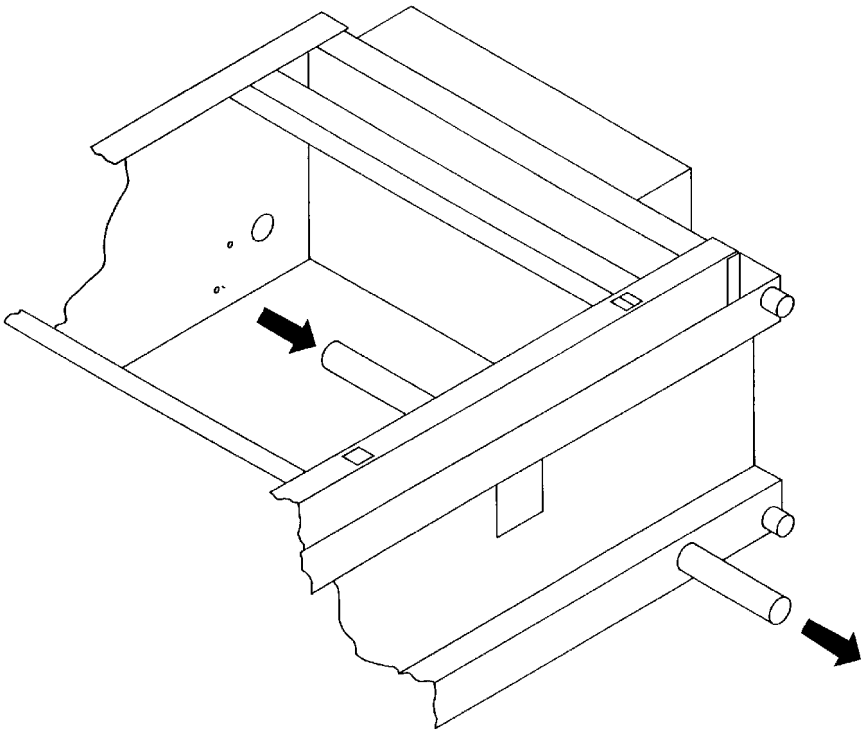
1. Follow the service access procedure at the beginning of this chapter.
2. Lay the disk library on its side.
3. Remove the T-15 screw that secures the carriage to the leadscrew assembly. (This screw is sealed with Loctite®.)
4. Disconnect the front panel ribbon cable from controller PCA if it has not already been removed.
5. Remove the T-25 screw that secures the carriage shaft to the top of the autochanger chassis (see Figure 5–14).

Figure 5–14 Removing the Carriage/Picker Assembly



6. Slide the carriage shaft out of the opening in the bottom of the library chassis (see Figure 5–15).

Figure 5–15 Removing the Carriage Shaft



7. Remove the picker assembly by lifting up on the side of the picker that the carriage shaft was, and then rotating the picker to a horizontal position. Carefully lift the picker assembly out of the chassis.

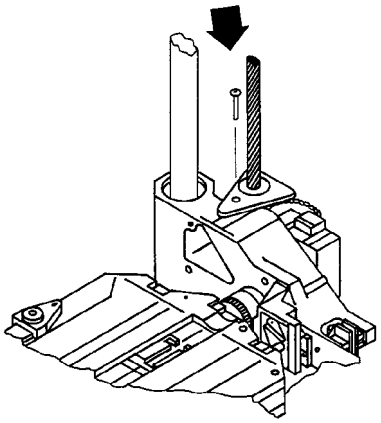
When reassembling:

- Position the picker assembly in the autochanger before reinserting the carriage shaft.
- The slotted end of the carriage shaft fits into a round metal protrusion at the top of the autochanger chassis.
- Refer to Section 5.4.1 to replace the access panel and top cover.

5.4.10 Replacing the Leadscrew Assembly

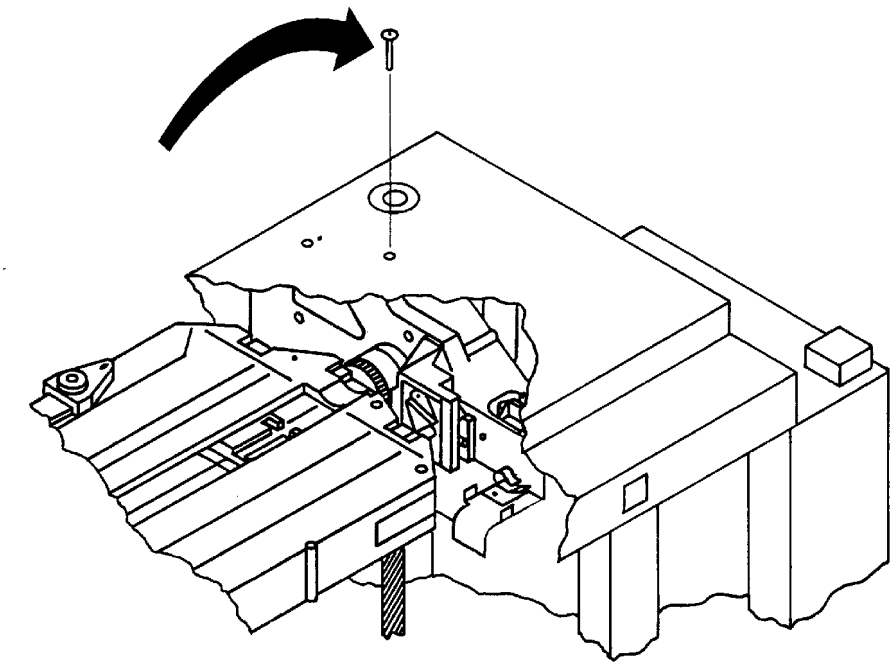
1. Follow the service access procedure at the beginning of this chapter.
2. Remove the T-15 screw that secures the leadscrew assembly to the carriage /picker assembly (see Figure 5–16). (This screw is sealed with Loctite®.)
3. Rotate the end of the bracket that was attached to the carriage picker assembly toward you, and slide the bracket up out of the way of the picker.

Figure 5–16 Removing the Leadscrew Mounting Screw



4. Slide the picker assembly up and secure it to the top of the autochanger using a T-25 screw. (See Figure 5–17.)

Figure 5–17 Securing the Picker to the Top of the Autochanger



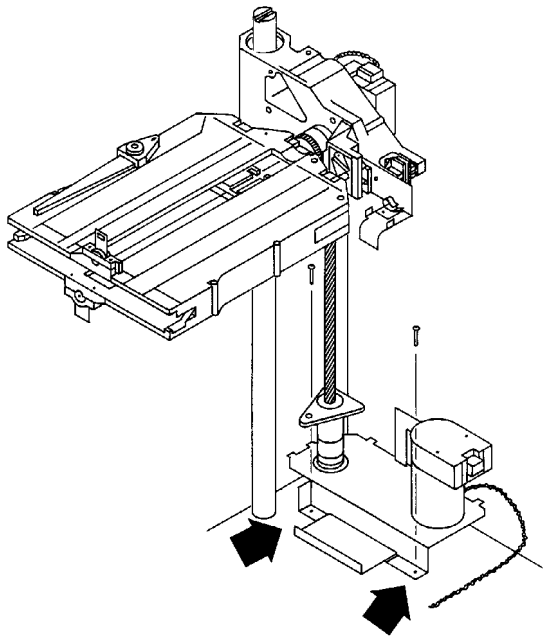
5. Disconnect the power and encoder cables from the leadscrew motor using a flatblade screwdriver. Place the screwdriver between the cable connector and the plastic tab on the motor, and lift the screwdriver upward while pulling off the connector.
6. Remove the two T-15 screws that secure the leadscrew base to the bottom of the chassis (see Figure 5–18).

Note

When lifting the leadscrew assembly out of the disk library, be careful to keep the assembly in an upright position to prevent the bearings from falling off the top of the leadscrew.

7. Pull on the large tab on the leadscrew base to release the tabs that secure the base to the back of the autochanger.
8. Rotate the motor end of the base in toward the center of the autochanger and carefully lift the base out of the autochanger.

Figure 5–18 Removing the Leadscrew Assembly



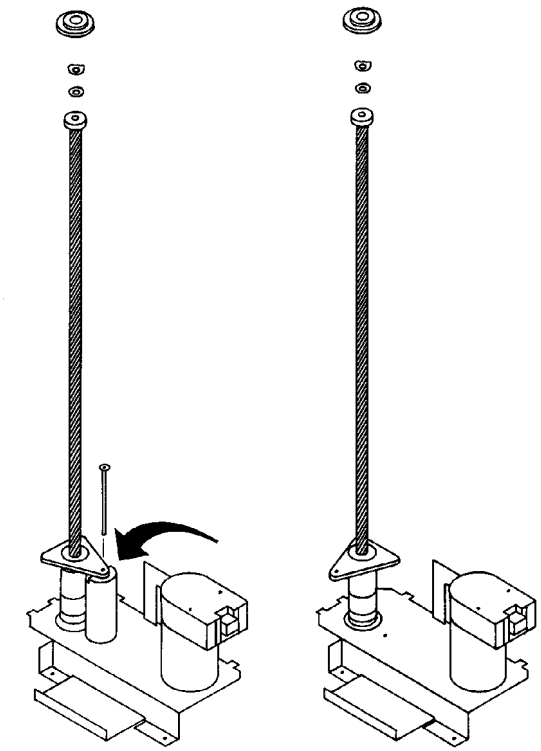
When reassembling:

(Refer to Figure 5–19 when replacing the leadscrew assembly.)

- Verify that the bearings are positioned correctly at the top of the leadscrew.
- Align the tabs on the leadscrew base with the slots in the autochanger chassis and replace the two screws that secure the base to the chassis.
- Remove the metal shipping bracket on the new leadscrew assembly (see Figure 5–19.)
- When you reconnect the encoder cable, the wires face upward.

- Refer to Section 5.4.1 to replace the access panel and top cover.

Figure 5–19 Preparing the Leadscrew Assembly for Replacement



5.4.11 Replacing the Power Supply

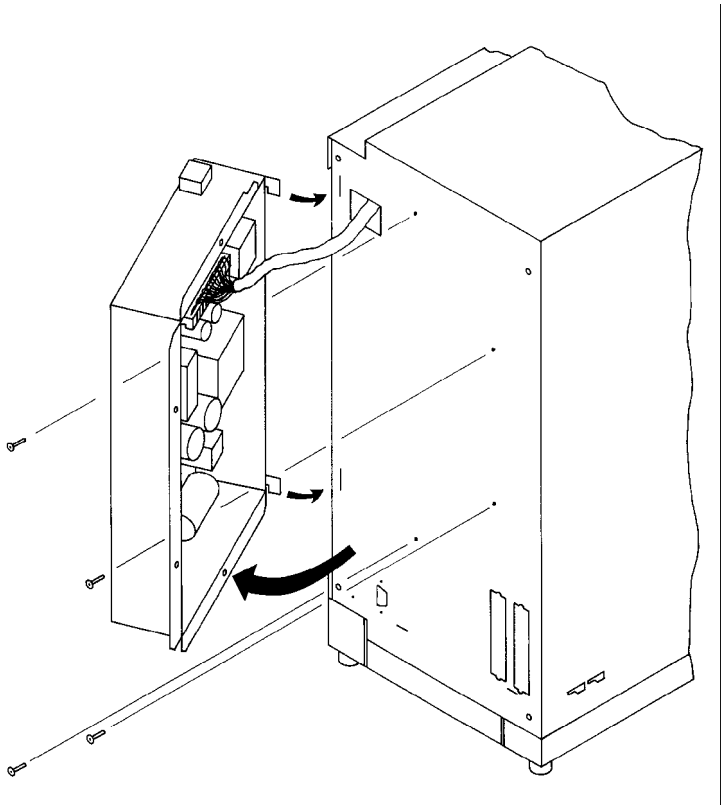
1. Remove power from the optical disk library. Switch off both the power switch on the back panel and the operation switch on the front panel.
2. Unplug the power cord from the back panel.
3. Remove the four T-15 screws that secure the power supply assembly to the disk library back panel (see Figure 5–20).

4. The power supply is hinged on the left side (when facing the back of the autochanger). Open the right side of the power supply far enough to disconnect the power cable from the power supply PCA.
5. Remove the power supply assembly by lifting up the power supply until the tabs on the power supply are released from the slots on the back panel.

Note

No further disassembly of the power supply is required. The power supply assembly is replaced as an entire unit.

Figure 5–20 Removing the Power Supply Assembly



When reassembling:

- Verify that the voltage switch is set correctly and that the fuseholder contains the correct fuse.
- It is important that the power supply assembly is reassembled in the exact reverse order in which it was disassembled.

5.4.12 Replacing the Magazine Guides

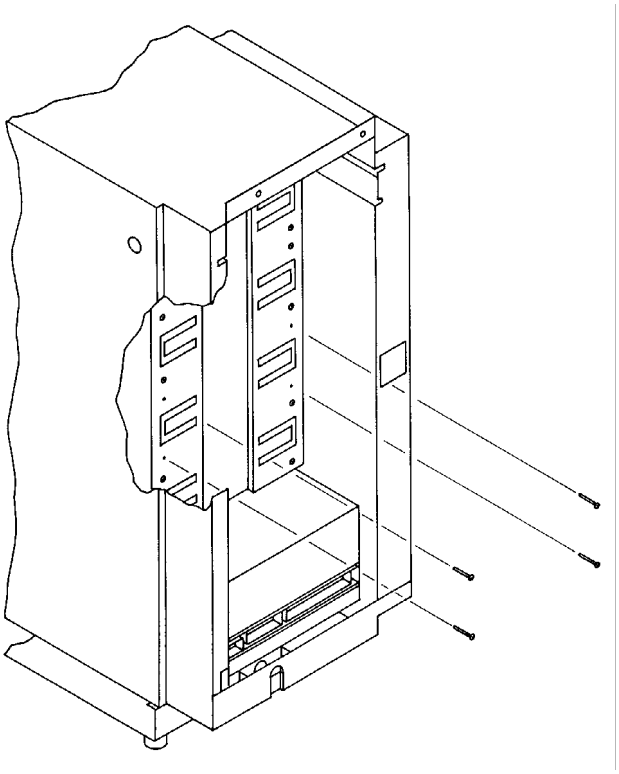
1. Follow the service access procedure at the beginning of this chapter.
2. Remove the front bezel assembly. (See Section 5.4.3.)

Note

Replacement part number C1708-60026 includes two magazine guides. Both guides must be replaced even though only one guide may be defective.

3. Remove the four T-15 screws (two per side) that secure the magazine guides to a storage slot (see Figure 5–21).
4. Slide the magazine guides out of the disk storage slot inside the autochanger chassis.

Figure 5–21 Removing the Magazine Guides



When reassembling:

- Make sure the tab on the back of each magazine guide fits into the slot in the front of the disk library before the guides are resecured to the storage slot.
- Refer to Section 5.4.3 to reattach the front bezel.
- Refer to Section 5.4.1 to replace the access panel and top cover.

5.4.13 Replacing the Internal UPS Cable

1. Follow the service access procedure at the beginning of this chapter.
2. Remove the leadscrew assembly. (See Section 5.4.10.)
3. Remove the two T-10 screws that secure the UPS cable to the inside of the disk library back panel.
4. Pull the UPS cable out through the inside of the autochanger chassis.

5.4.14 Replacing the SCSI Cable

Note

The following assemblies must be removed prior to replacing the SCSI cable:

- Leadscrew assembly - see Section 5.4.10
- Front bezel assembly - see Section 5.4.3
- Drive assembly - see Section 5.4.7

1. Follow the service access procedure at the beginning of this chapter.
2. Remove the four T-10 screws that secure the two SCSI connectors to the disk library back panel.
3. Release the large cable clamp at the bottom center section of the disk library chassis.
4. Disconnect the drive interface cable from the sensor PCA.
5. Disconnect the SCSI cable from the controller PCA and feed the cable through the slot in the sheetmetal beneath the controller PCA.
6. Pull the SCSI cable assembly out through the center of the disk library chassis.

5.5 Reinitializing the 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 Configs 16 and 18.

NVRAM must be reinitialized after replacing the autochanger controller PCA, after updating or changing the autochanger controller PCA firmware, and after adding drive mechanisms.

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 31)
  - 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 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 power-on 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 atlogistics. Refer to Figure 5–22, Figure 5–23, and Figure 5–24 for exploded views of optical disk library with FRU numbers.

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.

Table 5–2 Exchange Assemblies

FRU No.	HP Part Number	Description	Digital Part Number
1	C1708-66x01‡	Autochanger Controller PCA	29-30856-01
1†	5063-2711	Autochanger Controller PCA with code	29-30856-01
20	C1716C-opt728	Optical Drive Mechanism (650-Mbyte)	29-30871-01
20	C1716T-opt728	Optical Drive Mechanism (1.3-Gbyte)	29-31453-01
20†	5063-2701	Optical Drive Mechanism with code (650-Mbyte)	29-30871-01
20†	5063-2715	Optical Drive Mechanism with code (1.3-Gbyte)	29-31453-01

†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 C1708-69x01 The 60 or 69 numbers are on the outside of the box that the board is shipped in.

(continued on next page)

Table 5–2 (Cont.) Exchange Assemblies

FRU No.	HP Part Number	Description	Digital Part Number
25,27,40[1]	C1708-60x40	Carriage/Picker Assembly	29-30860-01

[1]These FRUs have been combined into a single replaceable part. If any one of the listed FRU numbers needs to be replaced, reorder the part number for the entire assembly.

Table 5–3 Non-exchange Assemblies

FRU No.	HP Part Number	Description	Digital Part Number
4	C1708-60x02	Interconnect PCA	29-30857-01
9	C1708-60x08	SCSI S/E Repeater	29-30874-01
9	C1708-60x09	SCSI Diff. Converter	29-30873-01
22	C1708-60x05	Front Panel PCA	†
23, 32[1]	C1708-60x32	Leadscrew Assy	29-30863-01
26	C1708-60x26	Magazine Guides (2)	NA
28	C1708-60x28	Power Supply	29-30858-01
29	C1708-60x29	Mailslot w/Sensors	29-30859-01
30	C1700-60x30	Optical Sensor w/Cable	†
41	C1708-60x41	Carriage/Picker Flex Cbl	†
42	C1708-60x42	Carriage Rod	29-30861-01
47	C1708-60x47	Drive Tray	†
48	C1708-60x48	Fan	29-30862-01
51	C1708-60x51	Module Power Cable	†
53	C1708-60x53	Drive Interface Cable	†
54	C1708-60x54	UPS Cable	†
58	C1708-60x58	Carriage Mtr Encoder Cbl	†

[1]These FRUs have been combined into a single replaceable part. If any one of the listed FRU numbers needs to be replaced, reorder the part number for the entire assembly.

†These parts are not stocked by Digital. Digital Logistics can place P1 orders for these parts directly to Hewlett-Packard.

(continued on next page)

Table 5–3 (Cont.) Non-exchange Assemblies

FRU No.	HP Part Number	Description	Digital Part Number
59	C1708-60x59	SCSI I/O Cable Loop	†
65	C1708-60x65	Front Panel Cable	†
66	C1708-60x66	Interconnect/Controller Cbl	†
75	C1708-60x75	RFI Shield	†
76	C1708-60x76	Key Pads (dove gray)	†
76	C1718-60x76	Key Pads (black)	†
77	C1708-60x77	Display Window (dove gray)	†
78	C1708-60x78	Vent Cover (dove gray)	†
79	C1708-60x79	Front Bezel (dove gray)	†
82	C1708-60x82	Power Button	†
83	C1708-60x83	Carriage Shield	†
84	C1708-60x84	Enclosure	†
	C1708-60x85	Front Bezel	†
	Fan Grill	3160-0444	†
	Light Pipe	C1708-48308	†
	Access Panel	C1708-00604	†

†These parts are not stocked by Digital. Digital Logistics can place P1 orders for these parts directly to Hewlett-Packard.

Figure 5–22 Optical Disk Library Exploded View (Sheet 1 of 3)

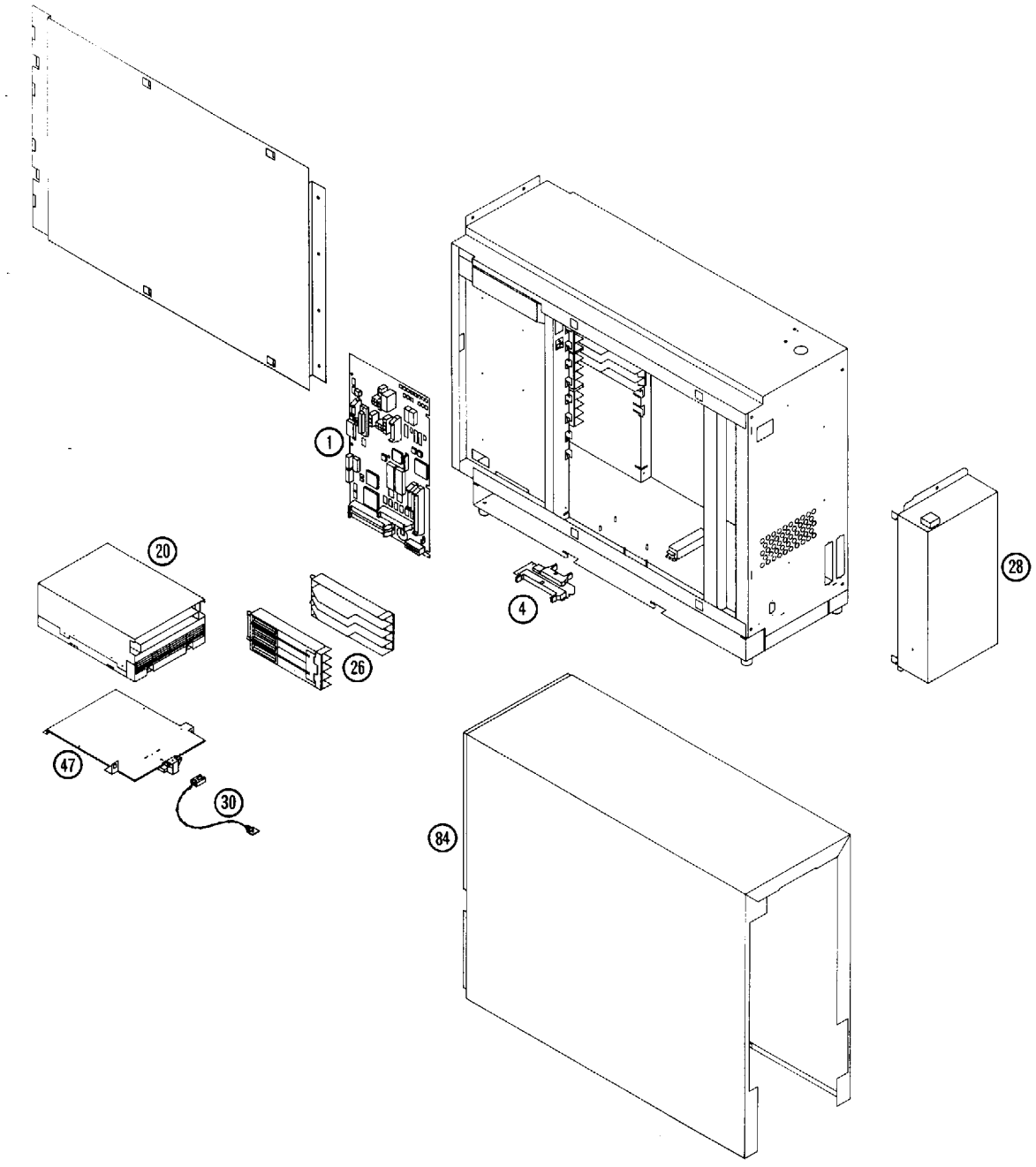


Figure 5–23 Optical Disk Library Exploded View (Sheet 2 of 3)

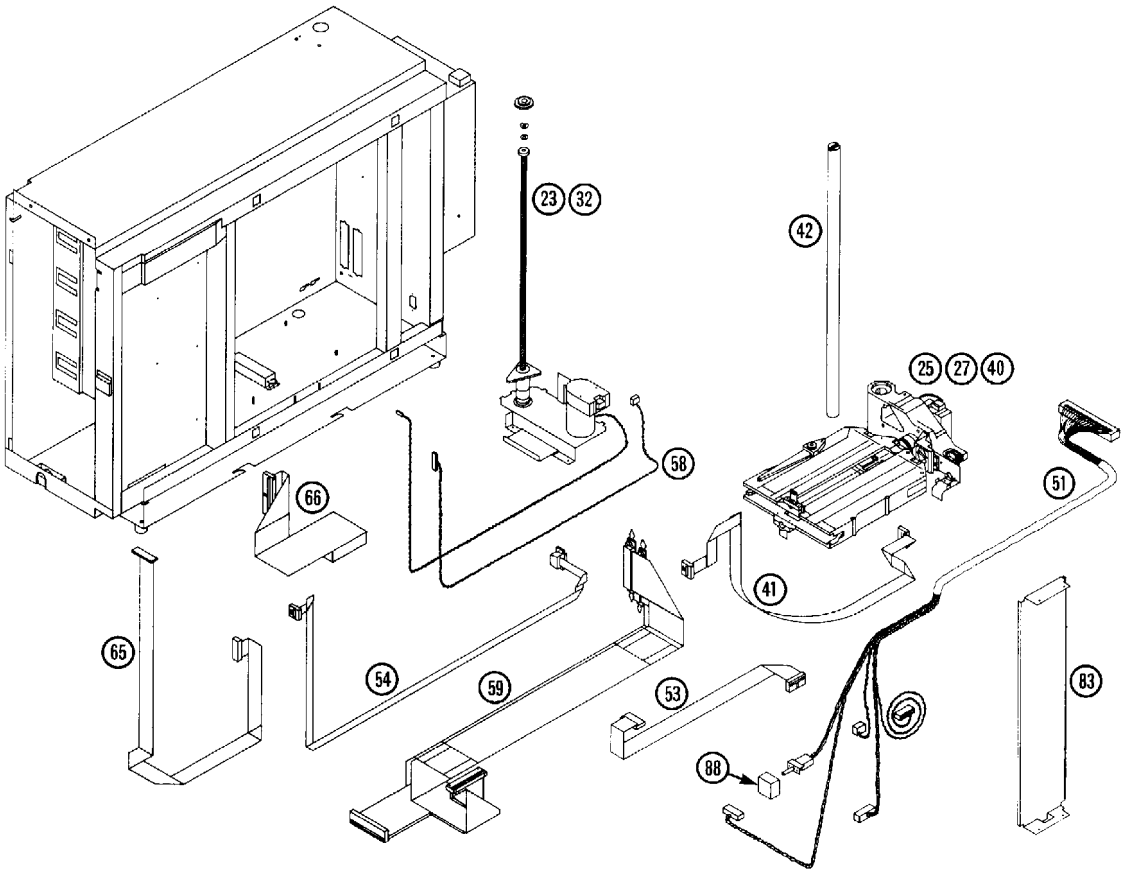
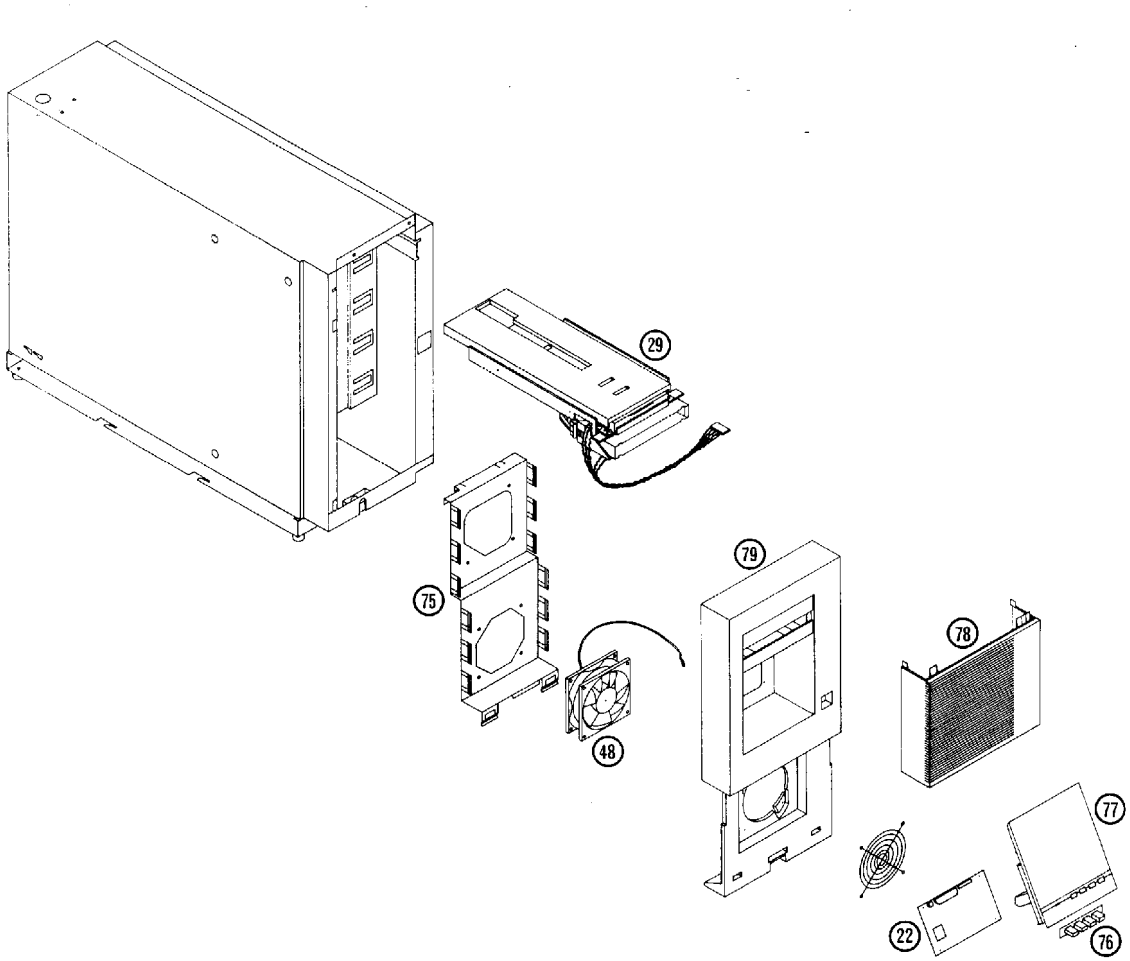


Figure 5–24 Optical Disk Library Exploded View (Sheet 3 of 3)



6
Theory of Operation

This chapter discusses the following aspects of the RW504/RW524 optical disk library:

- 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.

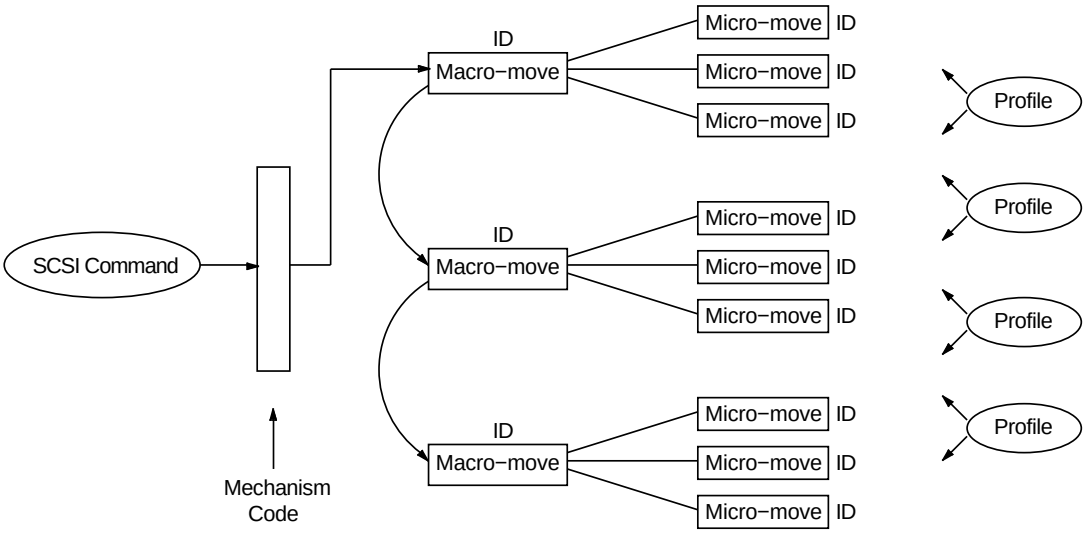
6.1 The Autochanger

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 a high force is expected within a given distance; however, 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.

6.1.2 Mechanics

The mechanics consist of the following major assemblies:

- Leadscrew assembly
- Picker/carriage assembly
- Mailslot (disk loading and ejecting assembly)

The picker/carriage 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/picker assembly includes active payload electronics that are similar in design to a plotter's. A single-axis plunge is used since the picker does not need to travel horizontally (translate). The picker electronics include the picker motor with a ribbon cable connecting the motor to the carriage and the autochanger controller PCA.

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-first into the drive or a 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.

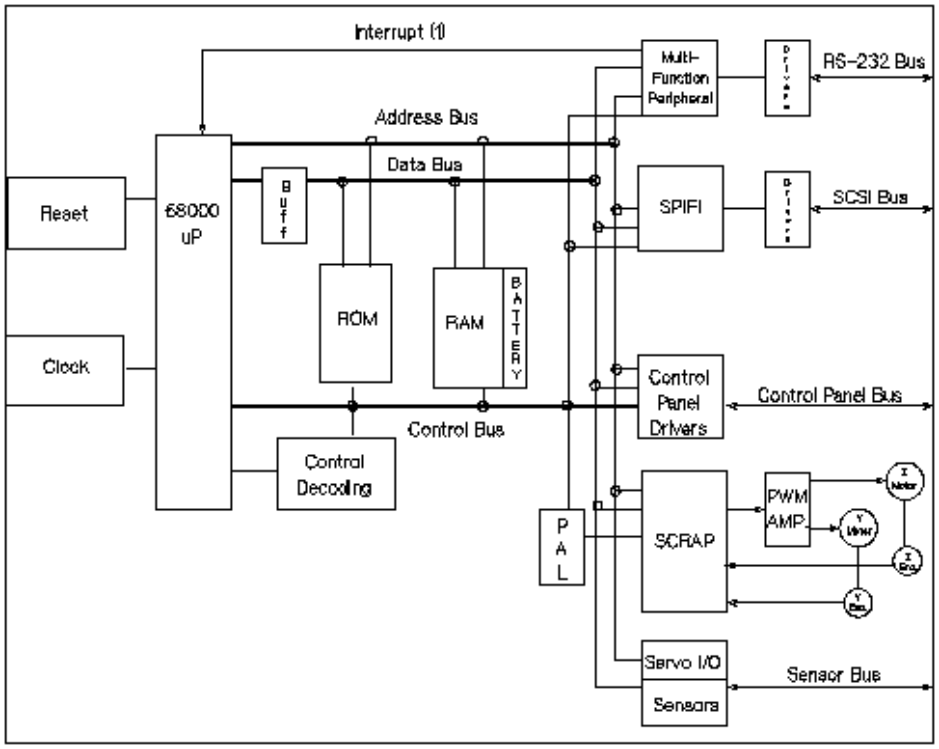
6.2 The Autochanger Controller PCA

The autochanger controller PCA contains the following major components:

- Microprocessor
- Motor Control Chip (MCC - Interface between the processor and Pulse Width Modulation)
- SPIFI Chip (SCSI bus control)
- ROM
- RAM
- Pulse Width Modulation Amplifier
- Front Panel Control and Filament Drive
- SCSI Interface

- Multifunction 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 MOTOR CONTROL CHIP (MCC) is the interface between the 68000 processor and the motors. 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 FLASH ROMs. These FLASH ROMs allow new firmware versions to be downloaded into ROM in the field.

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 nonvolatile memory storage capability when the unit is powered off.

The PULSE WIDTH MODULATION (PWM) amplifier takes the signals from the MCC changes them into voltages form the picker motor and carriage motor. 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 exitation voltage of from two to three volts. The grids of the display are at approximately 20 volts.

The SCSI INTERFACE is the SPIFI chip. All SCSI protocol is handled by the SPIFI under control of the main 68000 processor.

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).

6.3 The Power Supply

The power supply is a switching supply that provides +5V at 5.6 amperes, +12V at 0.5 amperes, +12V at 2.7 amperes, and -12V at 0.6 amperes. The supply also provides the drive power-on reset signal.

The AC line voltage is connected to the power supply through a line cord receptacle mounted on the power supply PCA. A PCA-mounted power on/off switch controls both sides of the AC line. The one hot side of the AC line is fused in the 115 VAC setting. Note that both sides may be hot in the 230 VAC setting. The fuse rating for both 115 VAC and 230 VAC is 3 amperes (the fuse and fuse holder cap lengths are different). An input line filter is provided to reduce the level of AC line transients and the amount of switching noise leaving the supply.

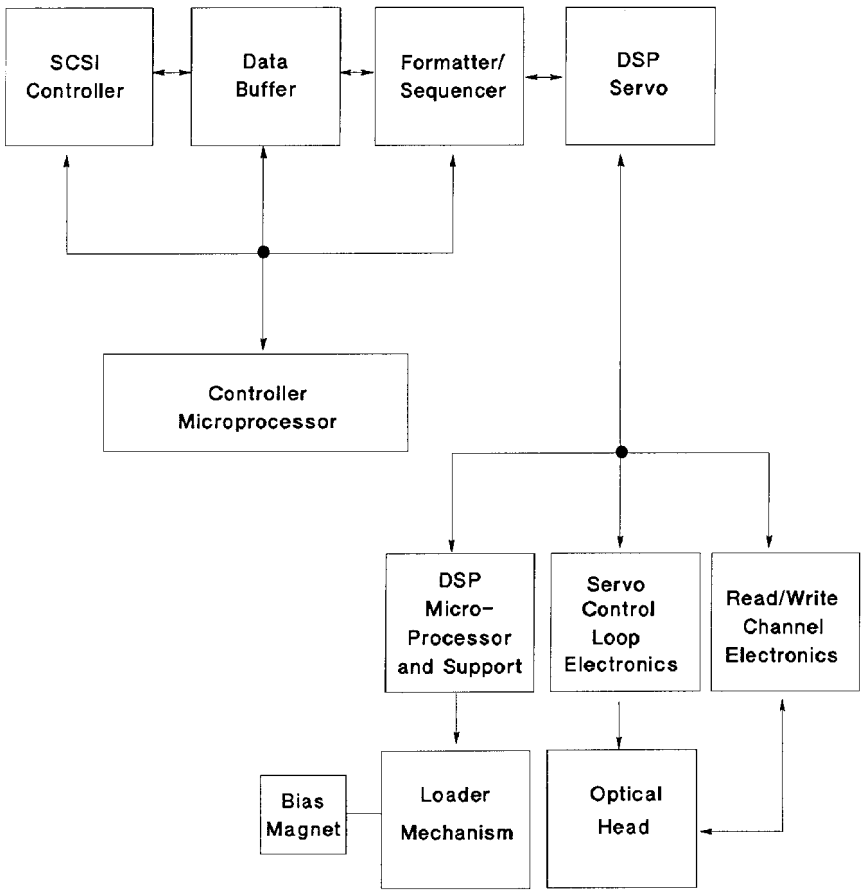
For additional protection, an over-voltage protection device is enabled while in the 115 VAC position in the event that 230 volts in inadvertently connected (a blown fuse is the only damage that would occur). A diode array and several capacitors rectify and filter the incoming AC. Included are two thermistors that limit the initial power-on surge current to approximately 25 amperes peak at both voltage settings.

The power-on (PVAL-H) reset signal, which is used to control wake-up and shut-down operations in the drive, is activated by the +5V output. At power-on, PVAL-H remains high for at least 100 milliseconds after the +5V output reaches 4.75 volts or higher. PVAL-H goes high (shutting the drive down for protection) 500 milliseconds before +5V goes below 4.75 volts.

6.4 The Multifunction Optical Drive and Drive Controller

There are four major subassemblies within the optical drive: the controller PCA, servo PCA, loader mechanism, and the optical head (Figure 6–3).

Figure 6–3 Functional Diagram



6.4.1 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.

6.4.1.1 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.

6.4.1.2 Data Buffer

The 256-Kbyte 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.

6.4.1.3 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.

6.4.2 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.

6.4.2.1 DSP Microprocessor and Support/Servo Control Loops

Most of the electronics on the servo PCA is 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.

6.4.2.2 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.

6.4.3 Mechanism Assembly

6.4.3.1 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.

6.4.3.2 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 preamplifiers for the servo and data control signals that are returned to the servo PCA.

6.5 Optical Disk Layout and Error Correction

Two optical disk formats are available. Optical Drives in the RW504/RW524 can read from and write to 650-Mbyte optical disks. The RW524 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 RW524 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.

6.5.1 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.

6.5.2 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.

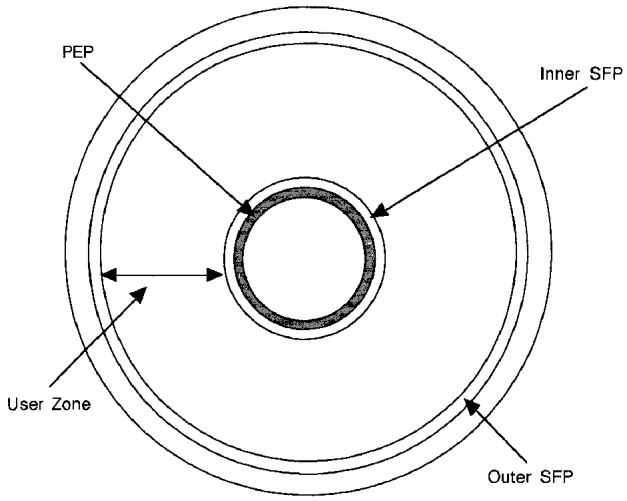
Although the User Zone consists of tracks and sectors, it is often easier to think of it in terms of a large memory space of consecutive sectors. Figure 6–5 shows the following parts of the User Zone for 650-Mbyte media.

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

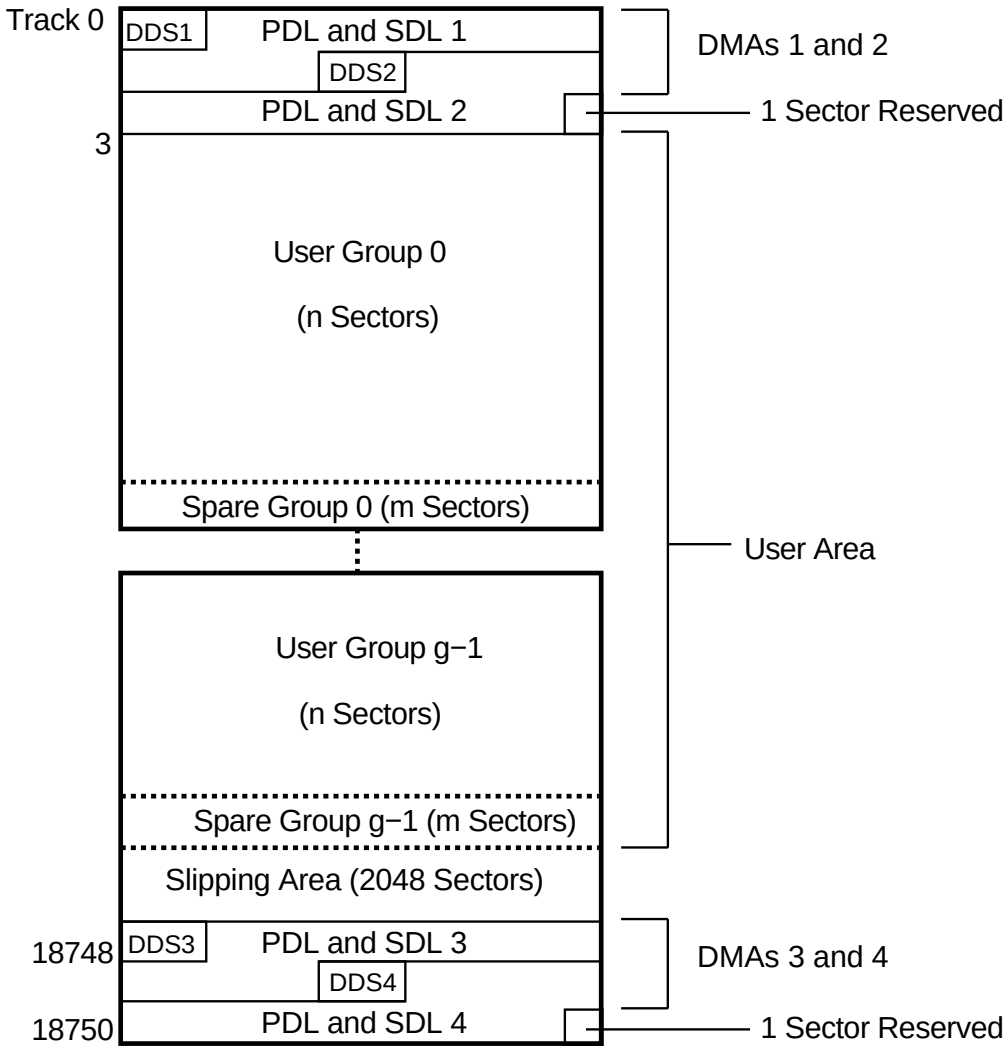
Figure 6–4 Optical Disk Layout



3. User Area that consists of:

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

Figure 6–5 User Zone Layout for 650-Mbyte Media



C1716C Defaults:
g=1 m=2048 n=314569 (576999)

6.5.3 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 6–4. 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.

6.5.4 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 6–6 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 or 16

Figure 6–6 and Figure 6–7 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 6.5.5 for more details.

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

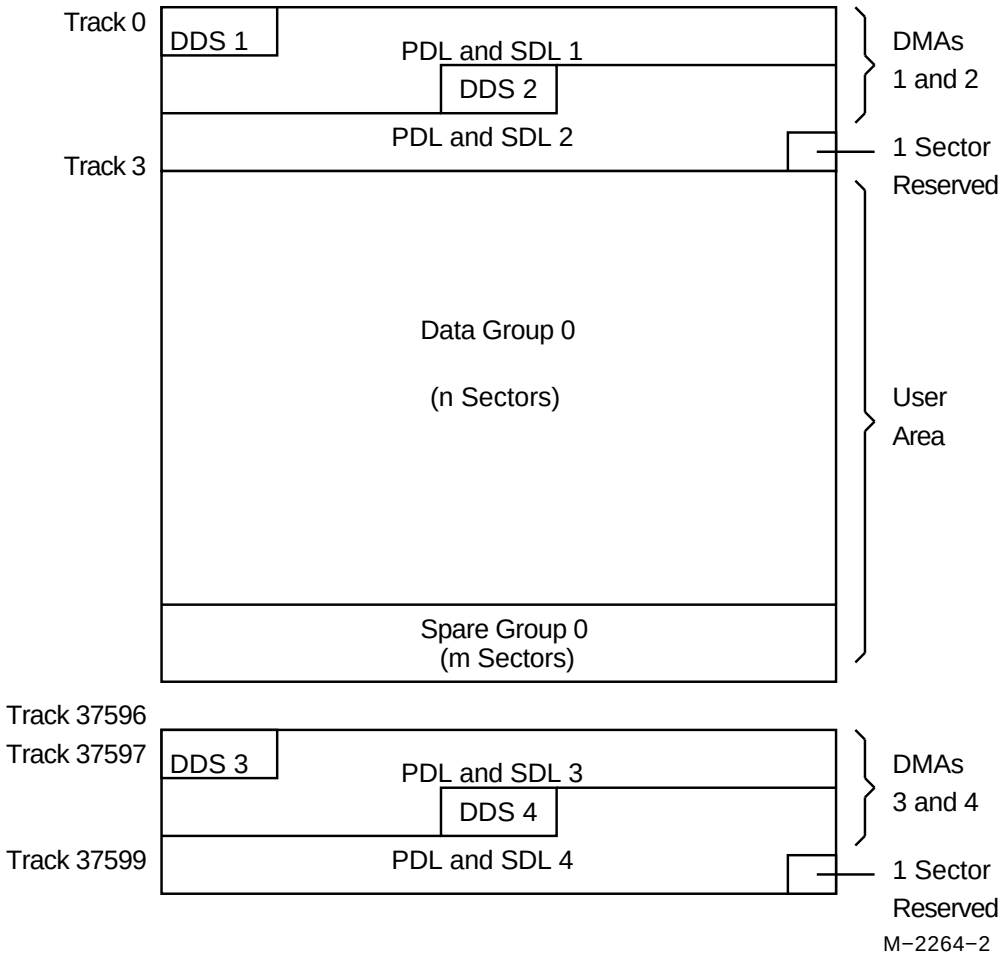


Figure 6–7 User Zone Layout for 1.3-Gbyte,g=16

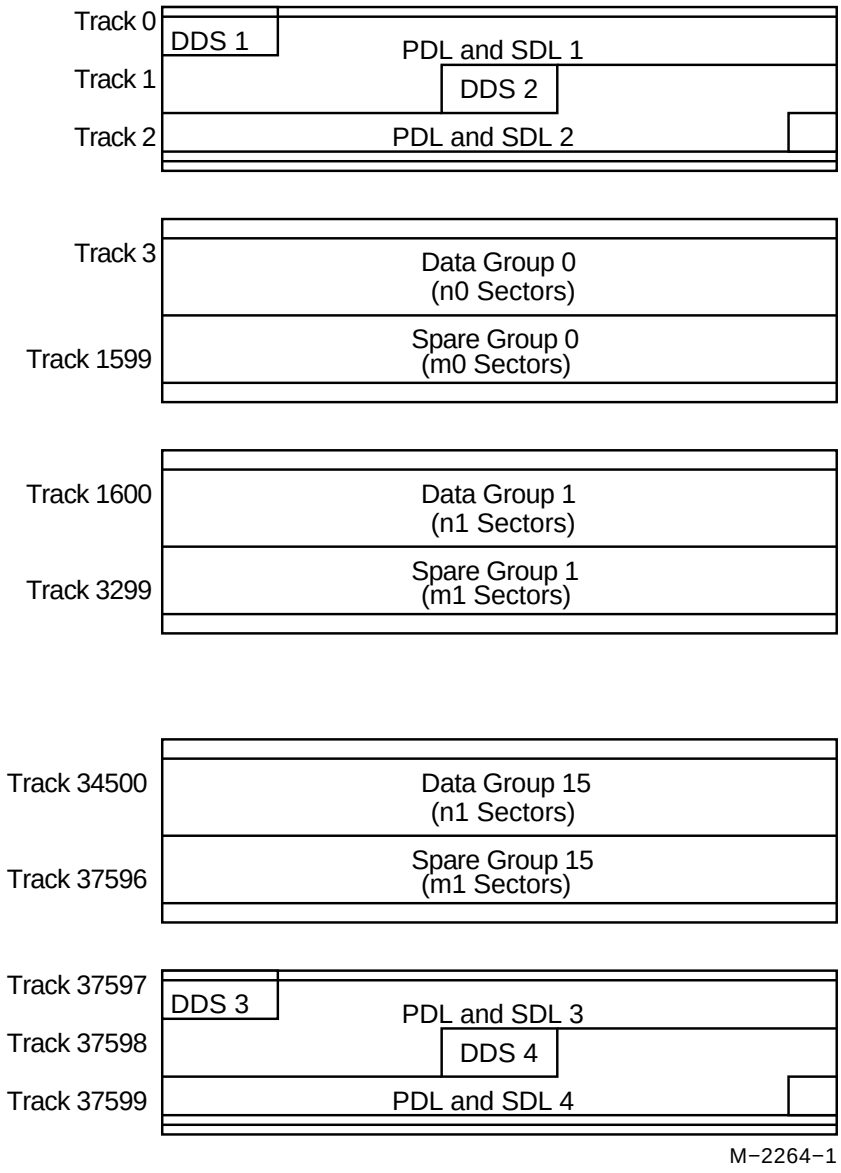


Table 6–1 shows the values for n and m for 1.3-Gbyte with g=16 (1024 media).

Table 6–1 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 6–2 details the physical revolution to logical track layout for 1.3-Gbyte media.

Table 6–2 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 6–2 (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)

6.5.5 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 on how the disk is organized into user and spare groups. There are three important parameters; the variables g, n, and m are used in the ISO standard, and are here for consistency:

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

User data is stored initially in the sectors of the user group, while the spare groups are reserved sectors for the linear replacement sparing algorithm. The values of 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 th 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) <= (size of User Area)

In general for 1.3-Gbyte: g = 1 or 16, (n, m or n0 thru n15 and m0 thru m15 are predefined based on g).

For more details consult the ISO or ECMA standard.

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 managed according to 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 managed according to the replacement sparing algorithm described in this chapter.

The Slipping Area is a 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 the 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.

6.5.6 Slip Sparing Algorithm

The slip sparing algorithm maps logical blocks to physical blocks to avoid defective sectors found during a certification process. The list of defective sectors is maintained in the Primary Defect List (PDL). 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, in a type of intermediate block addressing.

Slip sparing is always the first step of address translation for 130 mm optical disks, followed by User and Spare Grouping, 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.

6.5.7 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. The SDL can contain up to 2048 entries. Again, the maximum number of total defective sectors in the PDL and SDL combined is 2048.

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 will be added to the SDL (if the new defects not already in the SDL) or an existing defect/replace will be updated (if the new defect is already in the SDL).

6.5.8 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 number of these "sector IDs" is used as an error threshold.

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. (Consult the ISO standard for more details.) The actual number of bytes per interleave requiring correction is used as an error threshold. Table 6–3 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.

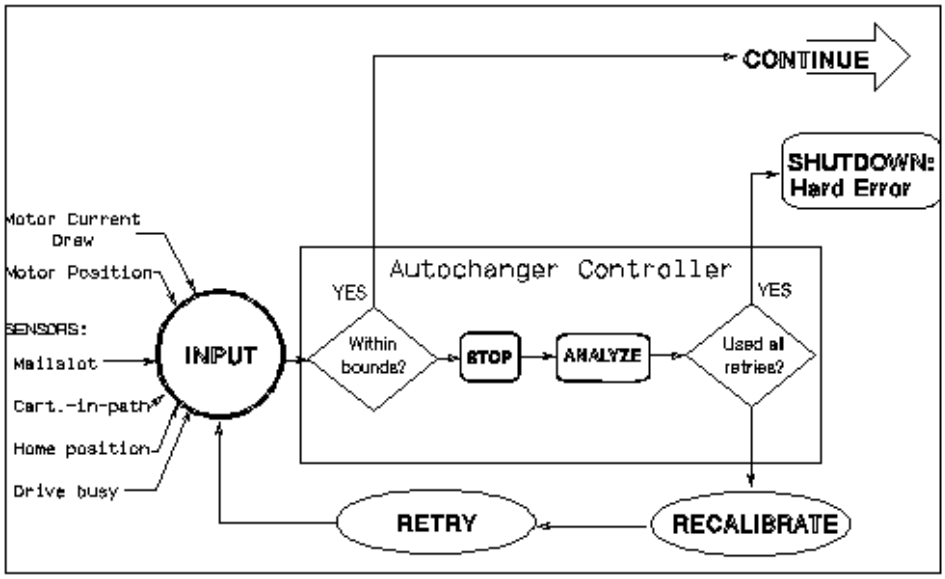
Table 6–3 Error Thresholds

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

6.6 Error Detection and Recovery

Refer to Figure 6–8 during the discussion in the next two sections.

Figure 6–8 Error Detection and Recovery



6.6.1 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 “BUSY” signal 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.

6.6.2 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.

6.6.3 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:

- Machine not being ready for a new command due to another previously-issued command or a previously-detected hardware fault that prevents motion
- Illegal request to move a cartridge from an empty location or to a full location
- 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.

6.6.4 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 unrec overable. 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, and the disk must be returned to the appropriate location (element).

The picker "element status" always reflects the physical state of the picker. The autochanger does 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.

6.6.5 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 Section 4.7

6.6.6 Real Time Event Logging

Logs

The optical disk library provides information logs about its operation and error history. These logs provide predictive information that can lead to early detection of autochanger problems.

All logs are maintained within the nonvolatile 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 that have occurred within the autochanger, along with a time stamp of when they occurred. The error message maintained for each error indicates the failure and the possible FRUs that 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 measure 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 the drive.

Runtime Log

An entry is put into this log each time an error occurs that 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 nonvolatile RAM was first initialized. Power-on hours are also recorded.

6.7 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 reestablish 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, indeterminate bus states, or both.

6.7.1 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:

- 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. 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 6–4 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)
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

(continued on next page)

Table 6–4 (Cont.) Group 0 Commands (6-byte command)

Code (Hex.)	Name	Description
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, ejects the optical disk from the drive unit, or both
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 6–5 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
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

(continued on next page)

Table 6–5 (Cont.) Group 1 and 2 Commands (10-byte command)

Code (Hex.)	Name	Description
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 6–6 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

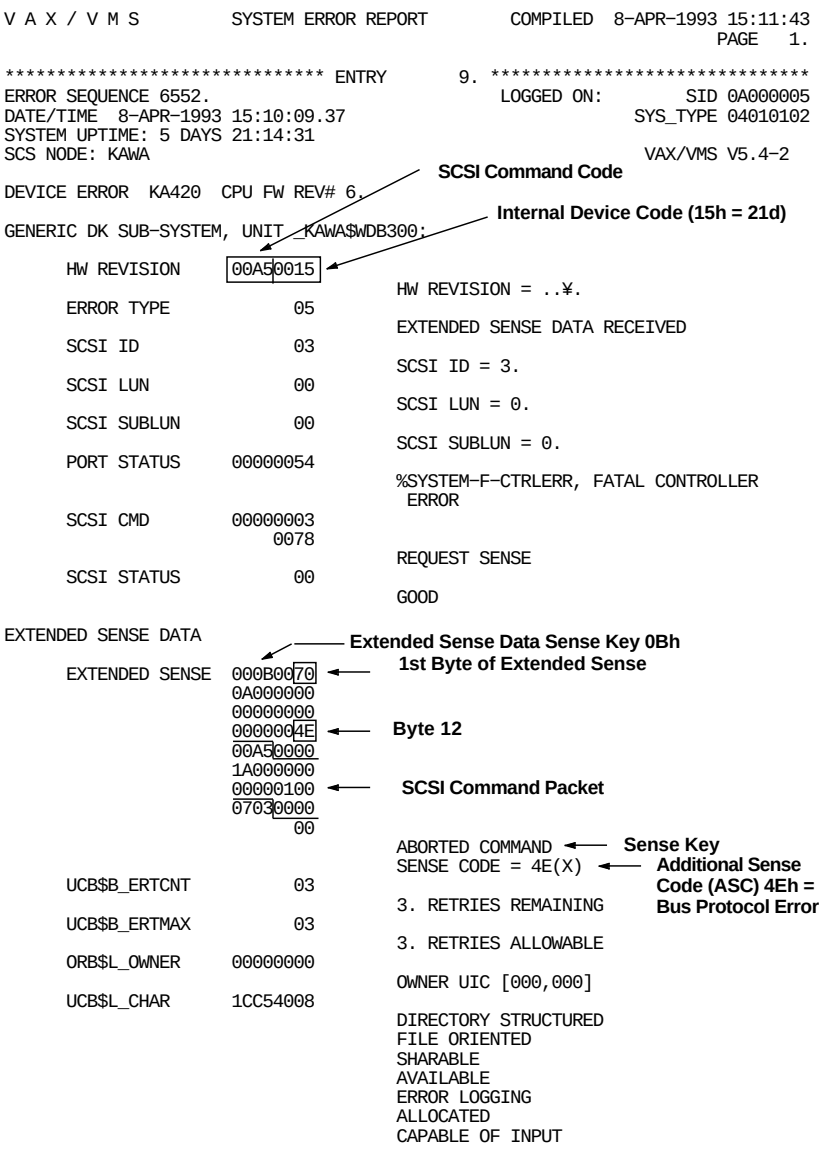
A

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



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 occured. 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							

MR−6080−RA

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	Prearmed 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	
Optical Disk Library System Technical Reference Manual	5959-3559 (GSD)	
Technical Guide Optical Drives and Libraries	5960-7605	
Optical Drive and Library SCSI-2 Command Reference	5960-7606	
Offline Diagnostics for HP Optical Products ‡	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.

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 Optical Library 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.

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.3 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.

If there are two SCSI ports available, follow the steps in Section 2.6.2 to 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. Refer to Section C.3.

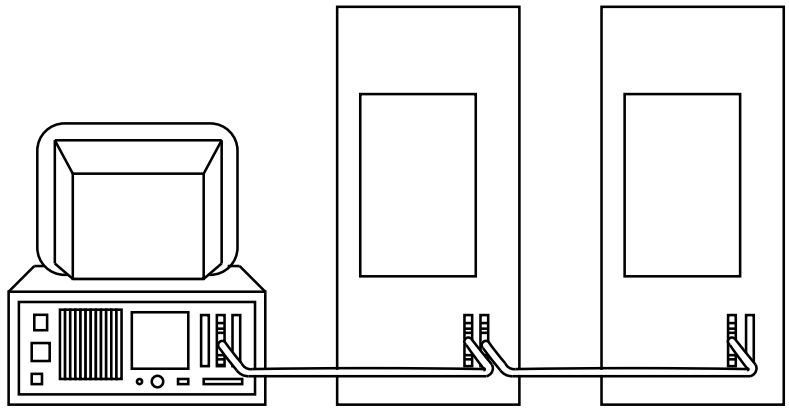
Plug the 50-pin Honda connector of the SCSI cable from the first Optical Library unit into the lowest-numbered SCSI port on the host computer back panel. Then, plug the 50-pin Honda connector of the SCSI cable from the second Optical Library unit into the next-lowest-numbered SCSI port on the host computer 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 remove the shipping screw on each Optical Library for connection to the host computer. Then, see Figure C–1 and follow these steps:

Figure C–1 Connecting Two Optical Library Units (RW504/RW524) to One SCSI Port



MK445–07

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.

   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.

Complete the installation by following the directions in Section C.3 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.3 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.

The autochanger controller default SCSI address is 3 for the Optical Library 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.

4. Press NEXT until SCSI IDs * displays.
5. Press ENTER. AC ID # displays where # may be the default number 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)
6. Press PREV or NEXT until the desired address number displays.
7. Press ENTER. The message SET # displays. Address is now set.
8. If you want to change additional drive addresses, Press NEXT until that drive number is displayed and repeate steps 5 through 7 to set the new address.
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 address you have selected, press ENTER.
10. 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.

11. 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.

Index

E

F

G

H

I

L

M

O

P

R

S

T

U

V