StorageWorks™

Medium Optical Disk Library (RW551/RW552)

Service Manual

EK–MOL80–SV. B01

Digital Equipment Corporation
Maynard, Massachusetts

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Revision Record

This Revision Record provides a concise publication history of this guide. It lists the guide revision levels, release dates, and reasons for the revisions. It also describes how the changes to affected pages are marked in the guide.

Revision Level	Date	Summary of Changes
EK–MOL80–SV. A01	December, 1996	First Edition
EK–MOL80–SV. B01	November, 1997	Corrects table 5–1; adds table and exploded view of non-exchange parts.

About This Manual

This manual describes how to install, configure, and maintain medium optical disk library RW551/RW552. The manual also discusses the theory of operation of the library.

Audience

This manual supports trained service personnel for the medium optical disk library (also referred to as the "jukebox") RW551/RW552.

Document Organization

This manual contains the following:

Chapter 1: Product Information

Provides general product information and lists important features and specifications.

Chapter 2: Environmental/Installation/PM

Describes disk jukebox environmental requirements and installation procedures.

Chapter 3: Product Configuration and Operation

Provides information about the operational control on the jukebox and how to use those controls to configure and operate the jukebox.

Chapter 4: Troubleshooting and Diagnostics

Contains troubleshooting information about the SCSI-connect.

Chapter 5: Removal and Replacement

Describes how to locate and replace sub-assemblies within the RW551/RW552 enclosure. It also contains a list of Field Replaceable Units (FRUs) and an exchange and non-exchange parts list with an accompanying exploded view of the library.

Chapter 6: Theory of Operation

Describes how the RW551/RW552 works and the relationship between the mechanical operation and command set execution.

Appendix A: Basic Supplies and Re-orderable Parts

A listing of common parts and other optical disk library manuals which may be beneficial to the reader.

Typographical Conventions

The following typographical conventions are used in this manual:

Italic Font - Italic font designates the title of a document and statements that need to be emphasized.

SERIF TYPE – denotes information that is displayed in the display window of the jukebox.

SAN-SERIF TYPE – indicates the key to press on the jukebox control panel

NOTES, CAUTIONS, and WARNINGS

NOTE

A note calls attention to information which can be helpful in understanding the operation of the product.

CAUTION

Caution calls attention to an operating procedure or practice which could result in damage to the product if not correctly performed. Do not proceed beyond this symbol until you fully understand and meet the indicated conditions.

WARNING

Warning calls attention to a procedure or practice which could result in personal in-jury if not correctly performed. Do not proceed beyond this symbol until you fully understand and meet the indicated conditions.

Reader Comments

Digital is committed to providing the best products, and we consider our manuals to be important components of our products. Therefore, you are encouraged to submit your comments, suggestions, and corrections to help us improve our product documentation.

Please submit all comments and corrections to this manual on the Reader Comment Form included at the back of this manual.

1

Product Information

This chapter provides general product information and lists important features and specifications. A matrix of environment specifications provide parameters for several subassemblies.

Figure 1–1 RW551/RW552 Jukebox

Product Features

The SCSI-connect version of the RW551, RW552 optical disk jukeboxes have the following features:

- direct online access to data
- data security through the ability to "lock" the jukebox, preventing disk removal

- SCSI Interface
  - single-ended or differential
  - SCSI-2 command set
- autochanger reliability of:
  - 100,000 hours MTBF (Mean Time Between Failure)
  - 1,000,000 MSBF (Mean Swaps Between Failure)
- modular replacement of all major assemblies
- downloadable firmware for the drive mechanism and the autochanger controller PCA
- a 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
- high reliability and data security when using DEC brand rewritable and write-once 5.25-inch optical disks
- Digital magneto-optical disks meet the following standards:

Table 1–1 Optical Disk Standards Met by Digital Optical Disks

Type	Capacity/Format	Standard
Rewritable	594 Mbyte 512 bytes/sector 650 Mbyte 1024 † bytes/sector	Meets ANSI and ISO standards for Continuous – Composite (CC) format – conforms to ISO/IEC DIS 10089A; ANSI S3.21 2-199x
	1.2 Gbyte 512 bytes/sector 1.3 Gbyte 1024 † bytes/sector	Meets ECMA 184 standard for Continuous – Composite (CC) format
Write-Once	594 byte 512 bytes/sector 650 Mbyte 1024 † bytes/sector	Meets ISO and ANSI standards for Continuous – Composite – Write-Once format (CCW) – conforms to ISO/IEC DIS 11560; ANSI X3.220-199x
	2X – 1.2 Gbyte 512 bytes/sector 1.3 Gbyte 1024 † bytes/sector	Meets ECMA 184 standard for Continuous - Composite - Write-Once format (CCW)
	4X – 2.3 Gbyte 512 bytes/sector 2.6 Gbyte 1,024 bytes/sector	Meets ISO/IEC 10089A, 11560, and 14517 standards for - Continuous - Composite - (CC) format

† DIGITAL Operating Systems only support 512 bytes/sector

The Optical Drive Mechanism

The optical drive mechanisms (RWZ53) in the autochanger of the jukebox are multifunction drives that can operate in both rewritable and write-once modes. The drives use both rewritable and write-once 5.25-inch magneto-optical disks that comply with ANSI and ISO standards for Continuous Composite format. The drives can sense a rewritable or write-once disk by the formatting on the disk and enter the appropriate mode.

Table 1–2 Jukebox Capacities

Disk Capacity/Format	No. of Slots	Max. Jukebox Capacity
1.3 GByte, 1,024 bytes/sector	32	41.6 GBytes
1.3 GByte, 1,024 bytes/sector	64	83.2 GBytes
Capacity Upgrade Kit	32	41.6 GBytes
2.6 Gbyte, 1,024 bytes/sector	32	83.2 Gbytes
2.6 Gbyte, 1,024 bytes/sector	64	166.4 Gbytes

Product Support

Host support for the jukebox is continually expanding; therefore, specific host system support cannot be provided accurately in this manual. However, host system support is documented in the current Product Service Plan and applicable Software Product Descriptions (SPD).

Product Matrix

Table 1–3 RW551/RW552 Jukebox Matrix

Product/Option	HP Designation	Description
RW551-ZC	Model 80fx (1150H) Model OPT 728	Optical jukebox with two multifunction optical drives and capacity for up to 32 rewritable or MO-Worm disks. One blank disk included. Single-ended and differential SCSI interfaces.
RW552-ZF	Model 80Fx (1160H) Model OPT 728	Optical jukebox with four multifunction optical drives and capacity for up to 64 rewritable or MO-Worm disks. One blank disk in cluded. Single-ended and differential SCSI.
RW552-UB		Adds two multifunction drives & 32 disk slots in 8 magazines.

Characteristics

This section provides the physical characteristics and environmental specifications for the jukeboxes.

Optical Disk Jukebox/Drive Mechanism

Technical Characteristics (Drive)	**RWZ53 Drive**
Rotational speed	3000 rpm (1X & 2X)) 3600 rpm (4X)
Average seek	25.0 ms
Average access time	35 ms (4X disks) 33.3 ms (1X & 2X disks)

Technical Characteristics (Drive)	**RWZ53 Drive**
Read transfer rate - max, sustained	- for 1,024 bytes/sector up to 1.69 Mb/s (4X disks) up to 1.24 Mb/s (2X Mb disks) up to 1.04 Mb/s (1X disks)
Write transfer rate- max, sustained	- for 1,024 bytes/sector up to 0.84 Mb/s (4X disks) up to 0.62 Mb/s (2X disks)
Burst transfer rate (synchronous)	5 Mb/s
Burst transfer rate (asynchronous)	3 Mb/s
Read/Write error rate	less than 1 block in error per 10^{14} bytes
Buffer size	1 Mbyte
Read Buffering	readaheads
Write Buffering	immediate reporting write reordering
Interface	SCSI-2 single-ended/Differential asynchronous/ synchronous

Physical Characteristics (Jukebox)

Height 910 mm	910 mm (35.8 in.)
Width	375 mm (33.5 in.)
Depth	480 mm (19.0 in.)
Weight (net)	90.1 kg (198.7 lb.)
Weight (packaged)	120.2 kg (265 lb.)

Environmental Specifications

	Autochanger	**Drive**	**Media**
Temperature			
Operating	10° to 40°C	5° to 45°C	10° to 60°C
Non-operating	-40° to 70°C	-40° to 60°C	-10° to 50°C
Temperature gradient	10°C per hour	10°C per hour	10°C per hour
Transportation			
(<14 consecutive days)			-40° to 60°C

Humidity (non-condensing)

	Autochanger	**Drive**	**Media**
Operating (relative)	10 to 90%	5 to 90%	10 to 80%
Non-operating w/o disk	5 to 95%	5 to 95%	10 to 90%
Maximum wet bulb	29°C	29°C	29°C

Shock (non-operating)

End-use, handling (half-sine)	150 g (3 ms)	25 g (11 ms)	760 mm drop (to 2mm vinyl covered concrete)
Transportation (trapezoidal)	30 g (523 cm/s)	30 g (742 cm/s)	

Vibration (5-500 Hz range)

Operating (max. accel.)	0.21 g rms.	0.3 g rms.	>0.21 g rms.
Non-operating random	2 g rms.	3 g rms.	
Non-operating swept-sine	0.5 g (0-peak)	1 g (0-peak)	

Altitude

Operating	4,572 m (15,000 ft)
Non-operating	15,240 m (50,000 ft)

Acoustic emissions

Operating	61.5 dB (L noise power emission level)
Idle	47 dB (L noise power emission level)

Particulates Less than 200 micro rams/cubic meter particles suspended

Electrostatic discharge

Airgap (operating)	5 to 15 kV	0 to 10 kV
Airgap (non-operating survival)	0 to 25 kV	0 to 25 kV
Direct contact (operating)	0 to 4 kV	0 to 4 kV

Cooling requirements	15 CFM bi-directional through drive

Power Requirements

Line voltage	100-240V	
Line frequency	50-60Hz	
Power consumption (typical)	240 W	819.1 BTU
Power consumption (maximum)	275 W	938.5 BTU

Service Characteristics

Mean time between failure	80,000 power-on hours
Mean swaps between failure	600,000
Mean time to repair	30 minutes
Preventive maintenance	none required

Product Certifications

Safety	EN 60950/IEC 950 UL 1950 listed or recognized CSA 950- TUV approved to VDE 0805 05.90
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

Optical Disks

	1X	**2X**	**4X**
		Formatted Capacity	
1,024-byte sectors	650 Mbytes	1.3 GBytes	2.6 GBytes
512-byte sectors	594 Mbytes	1.2 GBytes	2.3 GBytes

Recording Characteristics (continuous-composite format)

	1X	2X	4X
		Formatted Capacity	
Bytes per sector	1024 (512)	1024 (512)	1024 (512)
Sectors per logical track	17 (31)	17 (31)	17 (31)
Logical tracks per surface	18,751	37,473 (37,527)	75,732 (73,732
Archival life		30 years	30 years

Table 1–4 Optical Disk Standards Met by Digital Optical Disks

Type	Capacity/Format	Standard
	1X – 594 Mbyte 512 bytes/sector 650 Mbyte 1024 bytes/sector	Meets ANSI and ISO standards for Continuous – Composite (CC) format – conforms to ISO/IEC DIS 10089A; ISO/IEC 13549; ISO/IEC N828; ANSI X3.212-1994
	2X – 1.2 Gbyte 512 bytes/sector 1.3 Gbyte	Meets ECMA 184 standard for Continuous – Composite (CC) format
Rewritable	594 byte 512 bytes/sector 650 Mbyte 1024 † bytes/sector	Meets ISO and ANSI standards for Continuous – Composite – Write-Once format (CCW) – conforms to ISO/IEC DIS 11560; ANSI X3.220-199x
	4X – 2.3 Gbyte 512 bytes/sector 2.6 Gbyte 1,024 bytes/sector	Meets ISO/IEC 10089A, 11560, and 14517 standards for - Continuous - Composite - (CC) format
	1X – 594 Mbyte 512 bytes/sector 650 Mbyte 1024 bytes/sector	Meets ANSI and ISO standards for Continuous – Composite (CC) format – conforms to ISO/IEC DIS 11560; ANSI X3.220-1994
Write-Once	4X – 2.3 Gbyte 512 bytes/sector 2.6 Gbyte 1,024 bytes/sector	Meets ISO/IEC 10089A, 11560, and 14517 standards for - Continuous - Composite - (CC) format

2

Environmental/Installation/PM

This chapter describes the optical disk jukebox environmental requirements and installation procedures.

Environmental Requirements

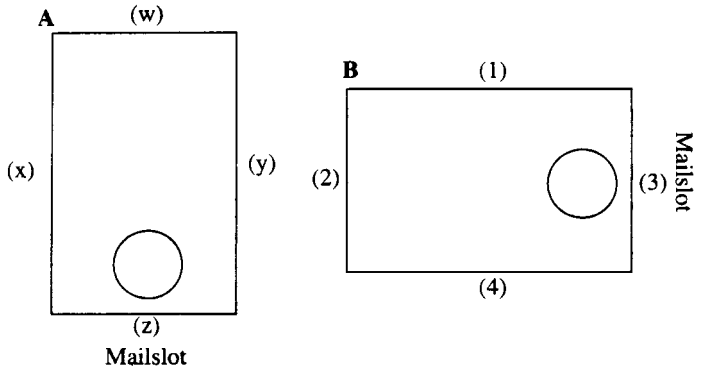
This optical disk jukebox is designed to operate with an ambient air temperature range of 10° to 40° C (50° to 104° F) with a rate of temperature change not to exceed 10° C (18° F) per hour.

Primary Power/External Ground

The power outlet must supply a voltage range of 100 - 240 Vac at 50 - 60 Hz. Also, check the earth (safety) ground of the outlet.

Clearance Requirements

Figure 2–1 Clearance Requirements



"A" orientation - usually in a row of peripheral cabinets.

Rear (w) requires 56 cm (18 in.) for cooling and service. Front (z) requires 86 cm (34 in.) for operator access. Sides (x) and (y) can be adjacent to other cabinets; the service panel (y) would be accessed by pulling the cabinet forward on it wheels.

"B" orientation - free standing or against a wall.

Rear (1) requires 61 cm (24 in.) for service access. Sides (2) and (3) require 30.5 cm (12 in.) for service, operator access, and cooling. Front (4) requires 61 cm (24 in.) for service and operator access, plus additional space if the cabinet must be moved to access the rear panel (1).

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.

Responsibilities

Customer site preparation/verification and installation are the customer's or reseller's responsibility for the jukebox. If the customer/reseller wants Digital to perform the site preparation/verification and/or installation, this should be contracted for on a time-and-materials basis.

Installation and configuration information is in the following manuals:

- *Medium Optical Disk (RW551/RW552) Library Service Manual* (this manual), Chapters 2 and 3.
- *Optical Disk Jukebox Family User's Guide* (EK–RW551–UG).
- Host system documentation.
- Product Service Plan (PSP).

Checkout Procedure

Check that all materials are included with the jukebox (see the "Product Matrix" located in Chapter 1). If any items are missing, please contact the sales representative with the following information:

- original order number or unit serial number
- receiving address

If the unit is damaged, it will be repaired or replaced. 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 with Digital concerning the unit.

Unpacking and Taking the Jukebox Off the Pallet

Using a floor jack, move the jukebox to the chosen location.

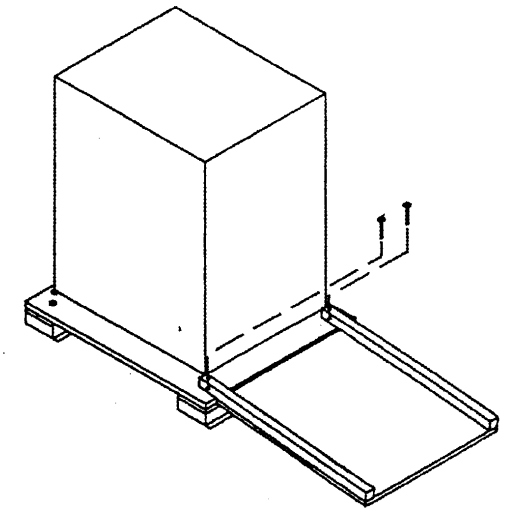
Remove the outer packaging by following the instructions printed on the carton.

Tools Required

- 1/2-inch open-end wrench (for adjusting the leveler feet)
- 9/16-inch wrench (to remove the bolts that clamp the feet to the pallet)

1. Remove the ramp from the top of the protective foam pads that cover the top of the jukebox.
2. Attach the ramp to the pallet (see the figure below).
   a. Remove the plastic bag containing two bolts that is stapled to the front of the pallet. Remove the two bolts from the bag.

Figure 2–2 Installing the Ramp Onto the Pallet



b. Place the ramp with the 2 x 2 wood strips facing up onto the pallet with the holes on the end of the ramp aligning with the two holes in the pallet.

c. Insert the bolts through these holes. (It is not necessary to tighten these bolts.)

3. Remove the four wooden blocks located between the pallet and the bottom of the jukebox cabinet.
4. Using a 9/16-inch wrench, remove the four hold-down bolts that clamp the cabinet to the pallet. (The bolt heads are on the bottom surface of the ramp.)
5. Using a 1/2-inch wrench, ensure that the leveler feet on the cabinet are raised to their highest position.

WARNING

If the leveler feet are not raised to their highest position, they may catch on the ramp and cause the jukebox to tip over.

6. Carefully roll the jukebox down the ramp.

3

Product Configuration and Operation

This chapter provides information about the operational control on the jukebox and how to use those controls to configure and operate the jukebox.

Connections to the RW551/RW552 Jukebox

Figure 3–1 Front Panel

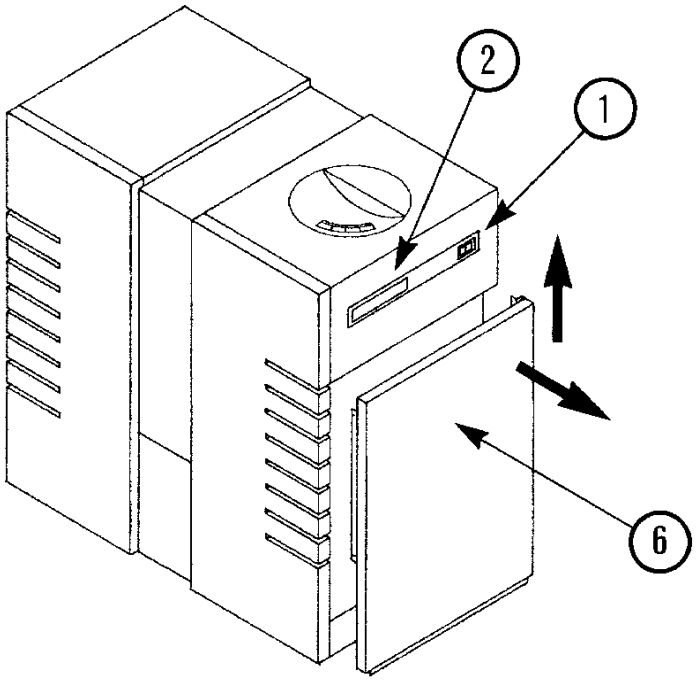
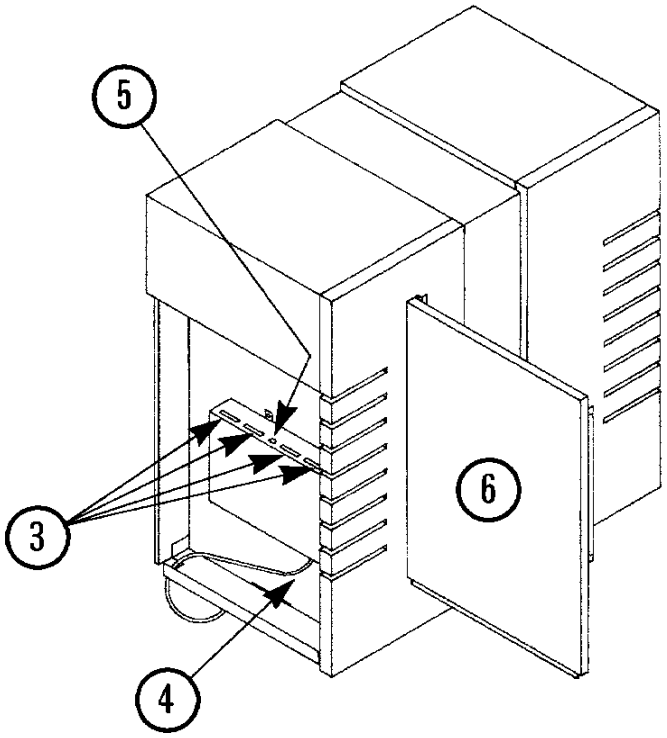


Figure 3–2 Rear Panel (SCSI-Connect)



1	Power switch	Standby power switch. Switches the power to the jukebox electronics on and off.
2	Mailslot	Used to load and unload optical disks.
3	SCSI ports	Used to make the SCSI connection to the host computer. Select either the single-ended or differential connectors (see item 5 in this list).The two SCSI connectors of the type selected must both be used. One port must have the SCSI cable connected to it, and the other connector of that type must have either a terminator connected to it or be daisy-chained to another SCSI peripheral.
4	Power port	Used to connect the power cord.
5	SCSI interface switch	Used to select either the single-ended or differential SCSI ports.
6	Cosmetic side panels	Panels that cover the ends of the jukebox.
7	Active bus indicator	LEDs that indicate which bus (single-ended or differential) is active.

Configuring and Operating the Jukebox

NOTE

Before you connect the optical disk jukebox to the host, verify that it is supported by the host. For the current list of which host systems
support the SCSI-bus jukebox, refer to the RW551/RW552 Product Service Plan.

Connecting an Uninterruptable 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 must be a central UPS used by the entire computer system.

NOTE

This jukebox does not have a UPS connector.

If a power failure occurs during a write operation, the UPS must be able to continue to supply power to the jukebox/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 computer system. With this type of connection, the computer system is informed when power is being supplied by the UPS and can issue commands to automatically write any data from buffers to disk. The computer then refuses any additional write commands until regular power is restored.

CAUTION

If the UPS does not provide a communication link between the UPS and the computer system, an operator will have to shut down the computer system (stop any new writes) before the UPS battery power is drained.

If the UPS is connected to the jukebox, the following power requirements must be met:

Table 3–1 UPS Power Requirements

Volt-Amp	Watts
125 Volt-Amps (typical)	75 Watts (typical)
180 Volt-Amps (max.)	110 Watts (max.)

Connecting the SCSI Cable to the Jukebox

The jukebox connects to the host computer with a high-density SCSI interface cable, and may be configured to use either a single-ended or a differential SCSI interface. The SCSI interface type is selected using the SCSI interface switch on the left side panel of the jukebox (see Figure 3–2). The total allowable length of the SCSI cable depends on which interface type is selected. Refer to Table 3–2 for allowable SCSI cable lengths.

Table 3–2 SCSI Cable Length Limitations

Interface Type	Allowable Cable Length
Single-Ended SCSI	6 meters
Differential SCSI	15 meters

NOTE

Because of signal delays inside the jukebox, the allowable external cable length for differential SCSI interface mode is limited to 15 meters instead of the 25 meters typically available with a differential SCSI bus.

There are two methods of connecting the jukebox to the host computer:

- as the only peripheral device connected to your computer with a SCSI cable.
- as one of a number of peripheral devices connected to the computer with a SCSI cable.

Connecting Power

1. Check to make sure that the standby power switch located on the right end of the jukebox is OFF.

NOTE

The switch located on the right end of the jukebox, frequently referred to as a "power switch" only supplies the logic switch to electronics in the power distribution PCA to enable the 5/12V supplies. It does not physically control input power.

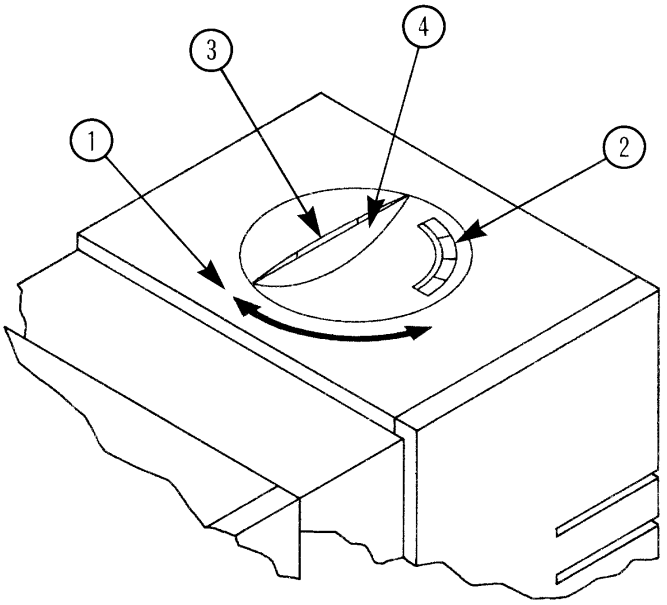
2. Remove the panel on the lower left end of the jukebox. Plug the power cord into the AC line connector located on the bottom of the interface module. (Figure 3–2.)
3. Replace the panel on the lower left end of the jukebox.

4. Plug the power cord into the power outlet.
5. Press the power switch located on the top right end of the jukebox to ON. Initially, the control panel displays **TESTING**. Once the power-on test completes (approximately 1.5 minutes), the control panel displays **READY**.

> **NOTE**
>
> A sequence of tests are run when the jukebox is first switched on. The **READY** status on the control panel indicates that the jukebox is ready of operation. If a **FAIL1** status appears on the control panel display, refer to Chapter 4, "Troubleshooting and Diagnostics," for information on how to resolve the problem.

Control Panel Operation

Figure 3–3 The Jukebox Control Panel



1	Swivel Feature	Allows the control panel to be turned to face towards the front of the jukebox or towards the mailslot side of the jukebox.
2	Selection Buttons	Pressed to perform the following operations: • **CANCEL** cancels the current operation or choice • **PREV** scrolls the display choice backward by one • **NEXT** scrolls the display choice forward by one • **ENTER** selects the displayed option
3	Activity Light	Lit to indicated the following: • steady green - power is on • flashing green - an optical drive is being accessed • amber - fault indicator
4	16-Character Display operation	Displays information about the current

Using Selection Buttons

The **CANCEL**, **NEXT**, **PREV**, and **ENTER** buttons are used to select tasks you want the jukebox to perform. When you push any of these buttons, a message appears in the display window. See the next section for a list of messages. You can hold down the and buttons to scroll the display faster.

Each time you push the **NEXT** button, a task option appears. (If you see an asterisk (*) as part of the message, it indicates more choices are available by pressing the **NEXT**, **PREV**, or **ENTER** keys.)

Understanding Display Window Messages

The display window shows the operations you may select. (Press ENTER to select.) Instructions for using and setting operations follow the explanation of the control panel messages. See Figure 3–4 for the menu tree of the 4X version.

Top-Level Messages

READY	- the jukebox is ready for operation
LOAD *	- select to load disks through the mailslot
EJECT *	- select to eject disks through the mailslot
ADMIN *	- select to access second-level options. (You must enter a security code to access the second-level options).

Second-Level Messages

A security code is required to access the second-level options. See "Entering the Administration Level" after the following menu trees.

TEST * - select to run internal jukebox tests

INFO * - (information) select to retrieve performance information stored in the jukebox logs

CONFIG * - (configurations) select to customize the way the jukebox functions

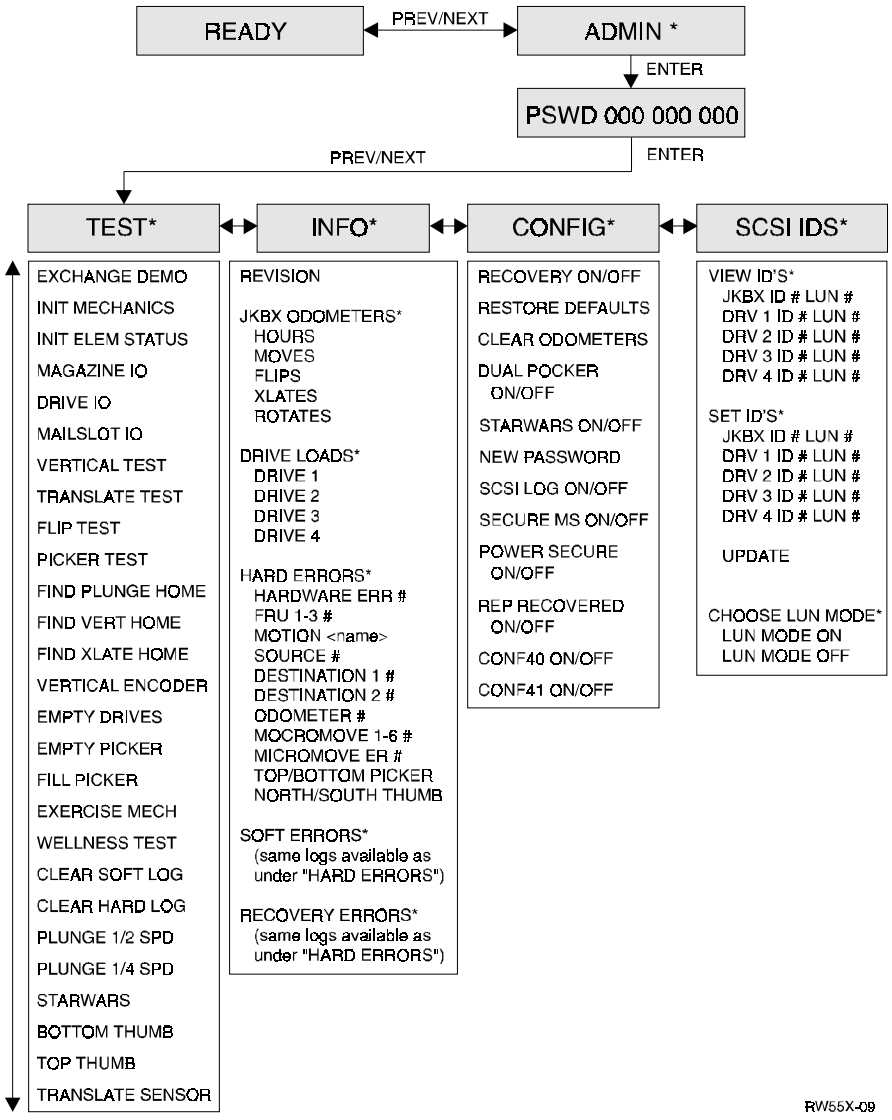
SCSI ID"s * - select to view and/or change the SCSI addresses and Logical Unit Numbers (LUNs). Also, the initial access point for choosing LUN mode

ONLINE REPAIR * - select to view and change power setting and status of the optical drives (used during online drive replacement).

NOTE

An "*" indicates there are multiple selections available for that operation. When a menu selection is flashing, press ENTER to select the option, or press PREV or NEXT to display other available options. Figure 3–4 Illustrates the selections available for the 4X jukebox. You can display the selections listed in boxes below the shaded options (TEXT, INFO, etc.) by pressing ENTER when those shaded options are displayed. Press PREV or NEXT to scroll through the list. To perform the displayed operation, press ENTER.

Figure 3–4 Control Panel Menu Tree



Viewing and/or SCSI Ids and Logical Unit Numbers (LUNs)

The initial keypress sequence is:

To view SCSI IDs and LUNs –

1. Press ENTER.
2. **VIEW ID'S*** displays. Press ENTER.
3. ***If LUN mode is set to OFF***: **JKBX ID #** or **DRV # ID # LUN #** displays. (JKBX ID # stands for the current SCSI ID of the jukebox controller. DRV # ID # is the current SCSI ID setting for the displayed drive number, and "LUN #" is the current logical unit number).

If LUN mode is set to ON: **JKBX ID #** or **DRVs ID #** displays. The # (in either display) is the current SCSI ID for the jukebox or drives when LUN mode is ON.

Press NEXT or PREV to scroll through the current SCSI addresse and LUN settings.

4. Press CANCEL to exit **VIEW ID'S ***.

To change SCSI IDs and LUNs –

NOTE

A brief explanation of how SCSI addresses and logical unit numbers (LUNs) are used in this family of jukeboxes is in Chapter 6.

A SCSI address is required for the jukebox controller and for each optical drive inside the jukebox *unless the jukebox is set to LUN MODE ON*. If the LUN mode is ON, a single SCSI address can be used, and the jukebox controller and optical drives are mapped to pre-assigned logical unit numbers (LUNs).

The default address settings for LUN Mode OFF and ON are shown in Table 3–3.

Table 3–3 Default SCSI and LUN Settings

	LUN MODE OFF (default)		LUN MODE ON	
	SCSI ID	**LUN**	**SCSI ID**	**LUN**
JKBX ID	6	0	6	0
DRV 1 ID	5	0	6	1
DRV 2 ID	4	0	6	2
DRV 3 ID*	3	0	6	3
DRV 4 ID*	2	0	6	4

* 160fx models only

NOTE

The LUN numbers are pre-assigned and may not be changed.

NOTE

By default, all devices are set to SCSI ID 6 when LUN mode is turned ON. *Some host systems do not allow different device types to be under one SCSI address. If this is the case, the "*DRVs ID*" SCSI address must be set to a different address then that of* "JKBX ID." Table 3–4 Shows how LUNs are mapped when the JKBX ID and DRVs ID are set to the *same* address and when they are set to a *different* address.

Table 3–4 Default LUN Settings/LUN Settings if "DRVs ID" Address is Changed

Default LUN Settings	LUN MODE OFF		DRVs ID/JKBX ID Different	LUN MODE ON	
	SCSI ID	**LUN**		**SCSI ID**	**LUN**
JKBX ID	**6**	**0**	JKBX ID	**6**	**0**
DRV 1 ID	**6**	1	DRV 1 ID	5	0
DRV 2 ID	6	2	DRV 2 ID	5	1
DRV 3 ID*	6	3	DRV 3 ID*	5	2
DRV 4 ID*	6	4	DRV 4 ID*	5	3

* 160fx models only

NOTE

The SCSI ID 7 is reserved for service use on the external SCSI port.

The initial keypress sequence is:

1. Press ENTER. **SET ID's** displays. Press ENTER.
2. **VIEW ID's** displays. Press NEXT until **SET ID'S *** displays and press ENTER.
3. ***If LUN mode is set to OFF***: **JKBX ID # LUN #** or **DRV # ID # LUN #** displays. (JKBX ID # stands for the current SCSI ID of the jukebox controller. LUN # is the current logical number, and DRV # ID # is the current SCSI ID setting for the displayed drive number).

If LUN mode is set to ON: **JKBX ID #** or **DRVs ID #** displays. (# is the current SCSI ID for the jukebox or drives when LUN mode is ON.

Press NEXT until the setting you wish to change is displayed, and then press ENTER.

4. The # (current SCSI address setting) flashes. Press NEXT or PREV until the address you want displays and then press ENTER.

NOTE

Some host systems do not allow different device types to be under one SCSI address. See second NOTE after Table 3–3.

5. Press NEXT until **UPDATE** displays, and then press ENTER.
6. **UPDATE** or **WAIT FOR UPDATE** and then **ID's SAVED** displays briefly.

- If the new settings do not conflict with other SCSI addresses on the bus, **SCSI ID's** displays.
- If the new settings conflict with other addresses on the SCSI bus, **CONFLICT-ABORTED** displays briefly and then **VIEW ID'S *** displays. Any changes entered are loss, and you must repeat the steps above to set a new address.

7. Press CANCEL until **READY** displays.

NOTE

After an address is changed, the computer may have to be restarted for the new addresses to be recognized. The new settings can be saved to ROM by power cycling the jukebox. This allows the settings to be recovered if the jukebox is powered off for more than 10 days.

CAUTION

Do not switch off power to the jukebox until you are sure the SCSI bus is inactive. Removing power from a SCSI peripheral when the bus is active can result in data loss and/or indeterminate bus states. (Check the host system manuals for information about checking the SCSI bus status.) If the computer is connected to a LAN, be sure to check with the system administrator before shutting off power to the jukebox.

Changing an Optical Drive SCSI Address

NOTE

Because the host computer usually reads a SCSI IDs on startup, it would be best, for larger computer systems, to schedule setting/resetting of SCSI IDs at times when the host computer will be brought down for other scheduled reasons.

1. With **READY** displayed, press **NEXT** until **ADMIN#** appears in the display window.

> **NOTE**
>
> A three-part security code is required to access any options beneath ADMIN. The security code is set to 0,0,0 at the factory, but you should encourage the customer to change this as soon as possible to avoid access by unauthorized persons.
>
> If **CONFLICT** displays, the jukebox controller and the optical drive mechanism are set to the same address. You must reset one of them.

2. Press **ENTER**. **CODE 1** and a flashing **0** displays. Press **ENTER** if no security code has been set, otherwise press **NEXT** until the first number of the security code displays, and then press **ENTER**. Repeat this step to enter the next two parts of the security code.
3. Press **NEXT** until **SCSI IDS** displays, and then press **ENTER**.
4. **JB CNTRL ID #** displays. (JB CNTRL stands for jukebox controller, and "#" is the SCSI ID that is currently set). Press **NEXT** until **DRIVE ID #** (or the drive number you want to access) and then press **ENTER**. The **#** flashes.
5. Press **NEXT** or **PREV** until the address you want displays and then press **ENTER**.
6. Press **NEXT** until **UPDATE** displays, and then press **ENTER**. **IDS SET** displays if the address you set does not conflict with other addresses on the SCSI bus, otherwise **JB CNTRL ID #** and then **CONFLICT** displays. If **CONFLICT** displayed, the previous SCSI ID settings have been restored and you must reset the SCSI IDs to non-conflicting addresses; if **CONFLICT** does not display, the address you chose is now set.
7. Press **CANCEL** two times to return to the **READY** state.

> **NOTE**
>
> If an ID is changed, the host computer may have to be restarted for the new ID to be recognized.

Changing a Configuration Option

1. With **READY** displayed, press **NEXT** until **ADMIN*** appears in the display window.

> **NOTE**
>
> A three-part security code is required to access any options beneath ADMIN. The security code is set to 0,0,0 at the factory, but you should encourage the customer to change this as soon as possible to avoid access by unauthorized persons.

2. Press **ENTER**. **CODE 1** and a flashing **0** displays. Press **ENTER** if no security code has been set, otherwise press **NEXT** until the first number of the security code displays, and then press **ENTER**. Repeat this step to enter the next two parts of the security code.
3. **TEST*** displays. Press **NEXT** until **CONFIG** displays, and then press **ENTER**. The last configuration option that was in the display will show.
4. Press **NEXT** or **PREV** until the name of the configuration you wish to set displays and then **ENTER**. Press **CANCEL** to return to **READY.**

Table 3–5 Configuration Choices

Configuration Name	Description
RECOVERY ON/OFF	Toggles between ON and OFF. If the configuration is set to ON, the jukebox will attempt to recover from any errors encountered; if the configuration is set to OFF, the jukebox will shut down if an error condition exists. This configuration should be set to ON under normal conditions.
SET DEFAULTS	Sets all jukebox configurations back to their default settings.
CLEAR ODOMETERS	Sets all jukebox odometers back to zero.

Table 3–5 Configuration Choices (continued)

Configuration Name	Description
DUAL PICKER ON/OFF	Toggles between ON and OFF. Default setting is DUAL PICKER ON. If the configuration is set to ON, the jukebox runs with dual picker (disk transport) addressing ON ; if the configuration is set to OFF, the jukebox runs with dual picker (disk transport) addressing OFF. To change the configuration press ENTER to select this option, and then press NEXT or PREV to toggle between ON or OFF. Press ENTER to select your choice. IS SET displays. *This configuration should not be used by the customer.*
STARWARS ON/OFF	Toggles between ON and OFF. If the configuration is set to ON, the jukebox runs with the vertical sensors enabled; if the configuration is set to OFF, the jukebox runs with the vertical sensors disabled. **Do not set this configuration to off during normal operation.** To change the configuration press **ENTER** to select this option, and then press **NEXT** or **PREV** to toggle between ON or OFF. Press **ENTER** to select your choice. # **IS SET** displays.

Table 3–5 Configuration Choices (continued)

Configuration Name	Description
NEW PASSWORD	Allows changing the security code through the control panel. The password allows access to configurations, tests, and information logs. Setting the security code is explained in "Setting a New Security Code" in the user guide.
SCSI LOG ON/OFF	Toggles between ON and OFF. Tracks internal SCSI status and saves the information to a log.
SECURE ON/OFF	Toggles between ON and OFF. If the configuration is set to ON, optical disks can no longer be loaded or ejected. If the configuration is set to OFF, the jukebox operates in its default state, which allows disks to be loaded and ejected. To change the configuration press **ENTER** to select this option, and then press **NEXT** or **PREV** to toggle between ON or OFF. Press **ENTER** to select your choice. **IS SET** displays.
SECURE MAIL IN/OUT	Toggles between IN and OUT. This configuration determines how the mailslot functions when the SECURE ON/OFF configuration is set to ON or a SCSI Prevent Media Removal command has been sent. When SECURE MAIL is set to IN, the mailslot is rotated in so that disks cannot be inserted or removed until SECURE is set to OFF or a SCSI Allow Media Removal command is received. When toggled OUT the mailslot is rotated so it is open even if SECURE is set to ON.

Table 3–5 Configuration Choices (continued)

Configuration Name	Description
POWER SECURE ON/OFF	Toggles between ON and OFF. When set to ON the SECURE ON/OFF configuration setting is retained in the event of a power outage.
REP RECOVERED ON/OFF	Toggles between ON and OFF. When set to ON errors that were recovered from are reported; when set to OFF the recovered errors are not reported.
CONF40 ON/OFF	Toggles between ON and OFF. Select Inquiry Mode. ON selects standard inquiry mode; OFF selects downloadable inquiry mode. Default is OFF to operate with Digital Systems.
CONF41 ON/OFF	Toggles between ON and OFF. ON sets drive inquiry to HP mode. OFF sets drive inquiry to Digital mode. Default is OFF.

Loading an Optical Disk into the Jukebox

NOTE

All disks should be labeled before inserting them into the jukebox.

Some software packages require that disks be inserted and removed using the software. If the customer is using a software package to manage files in the jukebox, check the software documentation before proceeding with these steps.

1. With **READY** displayed, insert a cartridge into the mailslot. The shutter end of the cartridge goes in first. Side A should be facing up. Push the cartridge in gently until it is fully inserted into the mailslot. **LOAD** and **SLOT##** ("##" is the number of the first available storage slot in the jukebox) alternately display.
2. If you want to select the storage slot number in the display, press **ENTER**. If you want to choose a different storage slot, press **NEXT** until the desired slot number is displayed and then press **ENTER**.
3. Initially, flashes in the jukebox display. After the disk has been loaded into the selected storage slot, **LOADED** displays briefly, and then **LOAD*** is again displayed. (See the note below.) You many now load additional disks. Press **ENTER** and then repeat steps 1 and 2 until you have loaded all the disks you want to into the jukebox.
4. Press **CANCEL** to return to the **READY** state.

NOTES

If you get a **LOAD ERROR** message, one of the following conditions may exist:

The disk may not be pushed far enough into the mailslot. Try pushing the disk into the mailslot a little farther.

The disk was inserted incorrectly into the mailslot. The shutter end of the cartridge goes in first.

If you get a **MAILSLOT EMPTY** message, a disk needs to be inserted into the mailslot.

If you get a **RESERVED** message, a security option has been set that prevents disks from being loaded into or removed from the jukebox. See "Setting a Security Code" in this chapter.

If you get a **TRANSPORT FULL** message, the disk transport mechanism already contains a disk.

If you get a **SENSOR** message, verify that the disk has been correctly inserted into the mailslot. If the error cannot be corrected by removing and then re-inserting the disk, the mailslot sensors may have failed.

Ejecting an Optical Disk from the Jukebox

> **NOTE**
>
> Some software packages require that disks be inserted and removed using the software. Check with the system administrator to determine if the software used to manage disks in the jukebox requires ejection under software control.

1. With **READY** displayed, press **NEXT** until **EJECT*** displays, and then press **ENTER**.
2. **EJECT** and **SLOT##** ("##" is the number of the first storage slot in the jukebox that contains an optical disk) alternately display.
3. If you want to select the storage slot number in the display, press **ENTER**. If you want to choose a different storage slot, press **NEXT** or **PREV** until the desired slot number is displayed and then press **ENTER**. (See the note on the following page.)

Initially, **EJECTING** flashes on the jukebox display. When the disk has been moved into the mailslot **EJECTED** displays briefly and the **EJECT*** displays.

4. Remove the optical disk from the mailslot. You may now eject additional disks by pressing **ENTER** and then following steps 2 through 4 until all disks that you wish to eject are removed, or press **CANCEL** to return to the **READY** state.

NOTE

There are several conditions that may prevent an optical disk from being ejected:

If there are no disks in the jukebox storage slots, **EMPTY** is displayed briefly, and then **EJECT*** displays.

If the host system computer has a disk reserved. the slot number of the reserved disk will not be displayed. The disk must be unreserved before the disk can be ejected. (Refer to the host system documentation or the application software documentation for instructions for unreserving a disk.

If the configuration, "Prevent Media Removal" has been set, **RESERVED** displays and disks cannot be removed. (See "Changing a Configuration Option" earlier in this chapter.)

The host computer system has been set to disallow mailsot operation. Refer to the host system documentation or the application software documentation.

EJECT ERROR displays if the mailslot is jammed.

If **MAILSLOT FULL** displays, there is already an optical disk in the mailslot that must be removed before another disk can be ejected.

Setting a Security Code

A security code of 0-0-0 is set at the factory. This three-part security code is required to access any options beneath ADMIN. You should encourage the customer to change this as soon as possible to avoid access by unauthorized persons.

1. With **READY** displayed, press **NEXT** until **ADMIN*** appears in the display window.

> **NOTE**
>
> A three-part security code is required to access any options beneath ADMIN. The security code is set to 0,0,0 at the factory, but you should encourage the customer to change this as soon as possible to avoid access by unauthorized persons.

2. Press **ENTER**. **CODE1** and a flashing **0** displays. Press **ENTER** if no security code has been set, otherwise press **NEXT** until the first number of the security code displays, and then press **ENTER**. Repeat this step to enter the next two parts of the security code.
3. **TEST*** displays. Press **NEXT** until **CONFIG*** displays, and then press **ENTER**. The last configuration in the display will show.
4. Press **NEXT** or **PREV** until **NEW PASSWORD** displays and then press **ENTER**.
5. **NEW1** and a flashing **0** are displayed. Press **NEXT** or **PREV** until the new number you wish to assign to the first part of the security code is displayed and then press **ENTER**.
6. **NEW2** and a flashing **0** are displayed. Press **NEXT** or **PREV** until the new number you wish to assign to the second part of the security code is displayed and then press **ENTER**.
7. **NEW3** and a flashing **0** are displayed. Press **NEXT** or **PREV** until the new number you wish to assign to the third part of the security code is displayed and then press **ENTER**.
8. **IS SET** displays briefly and then **NERW PASSWORD** displays. Press **CANCEL** three times to return to **READY**.
9. Cycle power to the jukebox by switching off the power and then turning it back on. (Cycling power backs up the new security code so it can be recovered if the jukebox is powered off for more than 10 days.)

Moving or Shipping the Jukebox

To move the optical jukebox a short distance (down the hallway or to another floor in the building), use the steps in "Moving the Jukebox a Short Distance." If you want to ship this jukebox, see "Shipping the Jukebox" on the next page.

Moving the Jukebox a Short Distance

1. Unmount (unreserve) any disk surfaces from the host system if necessary. Request that the system administrator do this.
2. Ensure that there are no optical disks in the jukebox drives. Eject the disks if necessary.

CAUTION

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

Do not remove power to the jukebox 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 and/or indeterminate bus states.

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

NOTE

Before moving the jukebox to its new location, make sure all environmental requirements listed in Chapter 2 have been met and the power outlet has been checked to ensure that the proper voltage is available for the drive.

3. Switch off the power switch on the right side panel.
4. Remove the left side lower access panel.
5. Remove the power cord and SCSI cable connections from the interface module.
6. Raise the leveler feet using a 1/2-inch wrench.
7. Carefully roll the jukebox to its new location.

8. Connect the jukebox to the host.
9. Reconnect the power cord.
10. Lower the leveler feet using a 1/2-inch wrench.
11. Configure the jukebox to the host. (Refer to the host system manuals for configuration information.)

Shipping the Jukebox

1. Unmount (unreserve) any disk surfaces from the host system if necessary. Request that the system administrator do this.
2. Eject all disks from the jukebox. If the disks are not labeled with a storage slot location, make sure they are labeled at this time. See "Ejecting Optical Disks." The system administrator should refer to "Labeling an Optical Disk Cartridge" in Chapter 2 of the jukebox user's guide.

> **CAUTION**
>
> Failure to eject a disk from an optical drive prior to moving the jukebox could result in damage to the drive mechanism.
>
> Do not remove power to the jukebox 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 and/or indeterminate bus states.
>
> Refer to the host system reference manuals for information on checking the status of the SCSI bus.

3. Switch off the power switch on the right side panel.
4. Remove the left side lower access panel.
5. Remove the power cord and SCSI cable connections from the interface module.
6. Raise the leveler feet using a 1/2-inch wrench.
7. Repackage the jukebox (lower the leveler feet after the jukebox is on the shipping pallet).

Host Configuration

Once the jukebox is connected to the host system and the device address is set, you are ready to prepare the host system to access the jukebox.

To determine if the host you are connecting to supports this device and for further installation information, check the following documents:

- RW551/RW552 Product Service Plan
- Host system documentation
- Applicable Software Product Description (SPD)

4

Troubleshooting and Diagnostics

This chapter contains troubleshooting information about the SCSI-connect.

Operation/Installation Troubleshooting

Troubleshooting Using the Control Panel and Observation

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

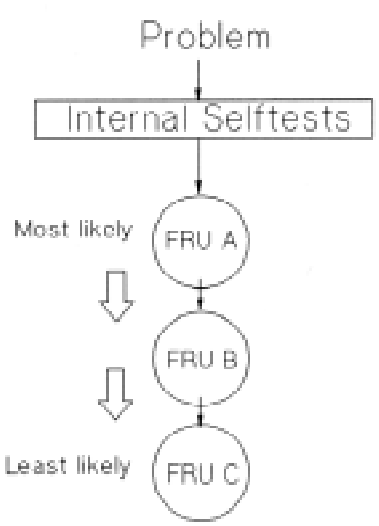
- Troubleshooting Using the Control Panel and Observation - This method is usually used in situations where you have a **hard** error.
- Troubleshooting Through the SCSI Bus - This method is used in situations where you have a intermittent, recoverable) error.

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.

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 (Field Replaceable Units) that may have been at fault is returned.

Figure 4–1 The Autochanger Returns Suspect FRUs



NOTE

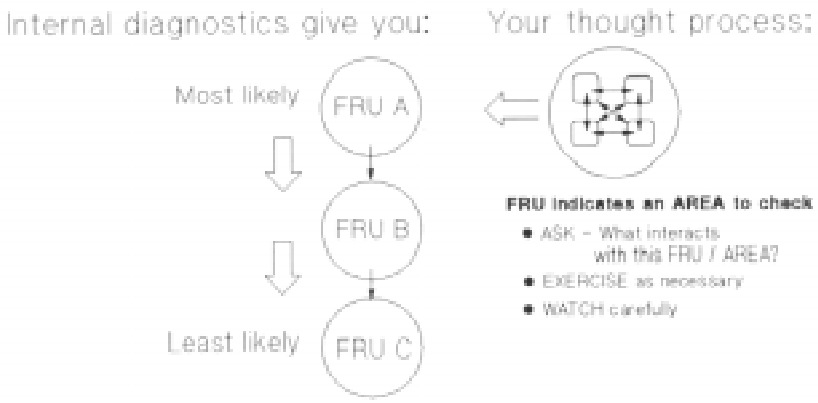
This test sequence returns possible failed FRUs only if there has been a hard failure. The test sequence will NOT find an failure from which a recovery was made.

Evaluating Results of the Internal FRU Isolation

Similar to treating symptoms rather than the real problem, the suspect FRUs given by the FRU isolation procedure 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 4–2 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. To understand what the autochanger does in normal operation, run the various movements available from the control panel and watch it closely. Reading the descriptions in the Micro-move table in this chapter will also help you understand the composition of its movements.

Retrieving Performance Information

1. With **READY** displayed, press **NEXT** until **ADMIN*** appears in the display window.

> **NOTE**
>
> A three-part security code is required to access options beneath ADMIN. This code may be 0-0-0 as set in the factory or another code chosen by the customer after installation.

2. Press **ENTER**.**CODE1** and a flashing **0** displays. Press **ENTER** if no security code has been set, otherwise press **NEXT** until the first number of the security code displays, and then press **ENTER**. Repeat this step to enter the next two parts of the security code.

3. **TEST***displays. Press **NEXT** until **INFO*** displays, and then press **ENTER**.
4. Press **NEXT** until the name of the log you wish to access displays and then **ENTER** (An "*" indicates that there are more choices beneath the displayed choice.)
5. Press **CANCEL** to return to **READY**.

Descriptions of the available information logs are on the following pages.

Table 4–1 Information Logs

Log Name	Description
REVISION	Displays the jukebox's firmware version number.
ODOMETERS *	Press **ENTER** to select the odometer logs described in the next few rows. Step through the logs by pressing **NEXT** and **PREV**.
HOURS	Displays the number of operation hours (operation button on-time).
MOVES	Displays the total number of moves and move attempts by the disk translate mechanism.
FLIPS	Displays total number of disk translate mechanism flips.
XLATES	Displays the total number of horizontal moves between optical disk storage slots.
ROTATES	Displays the total number of mailslot rotations.
DRIVE 1	Displays the number of optical disk loads for optical drive number 1.
DRIVE 2	Displays the number of optical disk loads for optical drive number 2.
DRIVE 3	Displays the number of optical disk loads for optical drive number 3. (RW532 only)
DRIVE 4	Displays the number of optical disk loads for optical drive number 4. (RW532 only)
HARD ERRORS *	Returns either "NO HARD ENTRIES" or "ENTRY #". (There may be multiple hard error numbers.) Press **ENTER** to select the hard error number you wish to view logs for. (The available logs are described in the rows following "RECOVERY ERRORS" in this table.) Step through the log by pressing **NEXT** or **PREV**.

Table 4–1 Information Logs (continued)

Log Name	Description
SOFT ERRORS *	Returns either "NO SOFT ENTRIES" or "ENTRY #". (There may be multiple soft error numbers.) Press **ENTER** to select the soft error number you wish to view logs for. (The available logs are described in the rows following "RECOVERY ERROR" in this table.) Step through the log by pressing **NEXT** or **PREV.**
RECOVERY ERRORS *	Returns either "NO ENTRIES" or the number of recovery errors. Press **ENTER** to select the recovery error number you wish to view logs for. (The available logs are described in the following rows. Step through the log by pressing **NEXT** or **PREV** .
ODOMETER #	The number of moves.
HARDWARE ERR #	This error number indicates the cause of the failure.
FRU 1	The field-replaceable unit most likely to be at fault.
FRU 2	The field-replaceable unit second likely to be at fault.
FRU 3	The field-replaceable unit third likely to be at fault.
MOTION <name>	<name> indicates one of the following types of movements taking place in the jukebox at the time of the failure:
	• EXCHANGE • MOVE • POSITION • INIT ELEM • REZERO • ROTATE • DIAGNOSTIC • RESTORE • PASSTHRU
SOURCE	The element number where the move started
DESTINATION 1	The element that was the first destination of the move.
DESTINATION 2	The element that was the second destination of the move.

Table 4–1 Information Logs (continued)

Log Name	Description
MICROMOVE 1-6	The IDs of the last six micro-moves for the original move command issued prior to the failure (individually displayed). Step through the micro-move IDs by pressing **NEXT** or **PREV**.
MICROMOVE ERR #	The micro-move error ID of the failed move.
TOP or BOTTOM PICKER	Displays either "TOP" or "BOTTOM" indicating which picker side is active.
NORTH or SOUTH THUMB	Displays either “NORTH” or “SOUTH” indicating which thumb on the translate mechanism is alive.

Getting Error Information Through the SCSI Bus

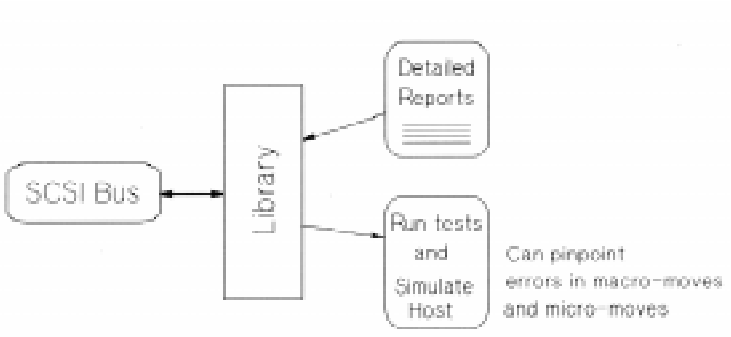
When there are errors in autochanger movements, two main approaches are available to get information and to run exerciser tests. The approach usually depends on whether the error encountered was a **hard** error or whether it was a **soft** or intermittent error.

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

Using data on the SCSI bus, you can determine exactly what the autochanger was doing when a failure occurred; all the way down to the macro-move and micromoves. Also, through the Log Sense and Request Sense commands, you can gather information on the optical drive; which cannot be done through the control panel.

An external utility is needed to read the data on the SCSI bus. A diagnostic utility called DOSDASS4 provides this capability. If required, the DODASS4 utility and instructions can be obtained from the Digital Customer Support Center. A PC with a 154X Adaptec controller is required to use the DOSDASS4 utility.

Figure 4–3 Information and Tests Through the SCSI Bus



Refer to the following information when troubleshooting through the SCSI bus: Offline Diagnostics for Hewlett-Packard Optical Products (reference Appendix A for ordering information).

This guide contains information about Hewlett-Packard's offline diagnostic, DOSDASS4, which can be used to access the above information through the SCSI bus.

In addition, refer to the following tables, also contained in this guide:

- *Request Sense Command Tables* – These tables show 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 Tables* – These tables show the error and move information which is stored in various logs during autochanger operation and when running internal diagnostics.

Diagnostics

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

The two types of diagnostics available for the jukebox are:

- *Offline Diagnostics* - Hewlett-Packard offers a diagnostic program called DOSDASS4 for use with the optical disk jukebox. These diagnostics can be obtained from the Digital Customer Support Center at CXO. This PC-based diagnostic program allows you to fully test the autochanger mechanism or the optical drive mechanism.
- *Internal Diagnostics* - These tests are run from the control panel and are under the ADMIN selection. These tests are fully explained later in this chapter.

Offline Diagnostics

A diagnostic utility called DOSDASS4 is available to authorized service organizations from Hewlett-Packard for accessing the jukebox through the SCSI bus or from the Digital Customer Support Center at CXO. DOSDASS4 fully exercises the standalone multifunction optical drives and the autochanger.

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.

Operation and Installation Error information is listed in Table 4–2.

Table 4–2 Operation Errors

Task	Problem/Symptom	What to do
Communicating host<-->jukebox	Can't get the host to recognize the jukebox.	• Check to make sure the jukebox is supported on the host operating system. • Check to make sure the autochanger was installed and configured as described in the users guide and the appropriate host system & software manuals. • Check the SCSI connections.
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.	• First, try the default security code (0-0-0). • If the security code is not set to the default, replace autochanger controller PCA. The customer may now use configuration 17 to set a new security code. (See the "Setting a New Security Code" section in Chapter 3.)

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Loading Disks	Disk inserted in mailslot, but the display reads **LOAD ERROR**, 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 jukebox front panel.
Powering on	The optical disk jukebox won't power on.	• Check to make sure the power cord connections are tight. • Check that the power switch is ON (next to the mailslot). • Check to make sure the power outlet is operating. • Replace the power cord with a known good one. • Replace the power supply module.
	Power on selftest fails.	• Press **ENTER** and record the error message. • Cycle the power. Observe the power on test result. If the unit continues to fail, use the error code to begin troubleshooting. (See the "Power on Selftest" section following this table.)
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 umounted/unreserved.**

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
	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 the instructions for using the eject tool later in this chapter.
	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. See the following CAUTION note.

CAUTION

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

Reading the control panel display window.	No display messages appear.	• Check that the power cord is connected. • Check AC input. • Check the control panel cable connections. • Power cycle the jukebox. • Replace the power cable with a known good one. • Replace the autochanger controller PCA. • Replace the power supply.

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Reading/writing magneto-optical disks	Can't write to the disk.	• Check the file system access permissions. • Check the write-protect tab on each disk side to assure write-enabled status. • Check to make sure the disk was initialized. • Check that the disk file system was mounted correctly. • Refer to the "Optical Disk Cleaning" section in this chapter.
Removing disks	Disk inserted in the mailslot, but **LOADERROR** or **MISLOAD** displays. Disk removal attempted, but a **FULL** or **MISLOAD** error message displays.	• Press **CANCEL** and try inserting the disk into the mailslot again. • If there is a disk in the mailslot, remove it, then try to remove the desired disk again. • If there is no disk in the mailslot and the **MISLOAD** message displays, check hardware errors and Table 4–3.

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
	The unit's power failed while a disk was in the drive.	• Power cycle the unit. • 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 "Using the Eject Tool to Remove a Disk from the Drive" in this chapter.
Running a test	Started a test and need to stop the test.	• Press **CANCEL**. The current test loop continues until it is finished; then the test stops.
Normal operation	**INIT ELEM** (Initialize Element) displays.	• Power cycle the jukebox. *Do not power cycle the jukebox until all other peripherals on the SCSI bus are turned off. Removing power from the jukebox when other devices are active on the SCSI bus may cause data loss and/or other problems with the SCSI interface.*

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, **DEVICE FAILED** is displayed. If the failure occurs when loading a disk you may see **LOAD ERROR** or **FULL**. If a failure occurs while you are running a test, **TEST FAILED** is displayed. When you press **ENTER**, the autochanger displays information about the hardware failure that is held in the error log.

The autochanger firmware can detect broken components such as a dead motor, 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.

The following table shows the hardware error codes possible and recovery procedures for specific hardware errors.

Table 4–3 Hardware Errors and Recovery Procedures

Error Code (hex.)	Error Description	Recovery Procedures
01	ROM checksum error	01 thru 07 are controller tests. These errors only possible on power up. If you get these errors, replace the controller PCA.
02	Register error	See error 01
03	Microprocessor error	See error 01
04	Controlled area of RAM checksum error	See error 01
05	RAM test error	See error 01
06	SCSI chip error	See error 01
07	Jukebox controller chip error	See error 01

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
0A	Drive 1 connection error	• Verify if you can see other drives • Switch cables (see if it stays with the drive or cable) • -If indicates cable - change cable • -If not, change interposer PCA • Change controller PCA • Change drive (low priority, drive just returns a ground signal, so would appear fine, unless the cable was not carrying signal
0B	Drive 2 connection error	See error OA
0C	Drive 3 connection error	See error OA
0D	Drive 4 connection error	See error OA
1E	Translate motor error	• Can not translate the picker and/or sense that it has moved. Picker assembly (umbilical cable, motor, sensor) • If doesn't move at all – likely is the umbilical cable • If it moves a little but can't reach the side – cables good, motor is bad • Got to the side, but can't sense you did – sensor. • Change the controller PCA

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
1F	Vertical motor error	Occurs when trying to sense a move of the carriage assembly) If the translate assembly moves – and you get a failure – that means that we're not reading the encoder strip. If the translate assembly doesn't move – it probably is the motor leads, motor, or 24-volt power supply. • Make sure the encoder strip is inside sensor. • Make sure the motor leads are connected to the vertical motor. • Check that the cable from the sensor is connected through the translate from to the umbilical cable for the picker. • Change the 24-volt power supply. • Change the controller PCA.
20	Plunge motor error	• Check the plunge motor leads. • Change the picker.
28	Mailslot sensor error	• Check the mailslot-to-interposer cable. • Change the mailslot. • Change the interposer PCA.

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
29	Right beam error	• Check that the space between the picker and magazines is physically clear. • Run the STARWARS test to verify that there is a beam on the right side and the indication changes properly when the beam is interrupted. If the STARWARS test can not verify the beam, change the interposer PCA. • Change the controller PCA (receivers are mounted on this PCA).
2A	Left beam error	See error 29 (apply to left beam).
2B	Top thumb sensor error	• Change the picker • Change the umbilical cable • Change the controller PCA
2C	Bottom thumb sensor error	• Change the picker • Change the umbilical cable • Change the controller PCA
32	Invalid test number	User error
33	Invalid configuration	User error
34	Need to initialize element status	Run Init Elem Status
35	Exercise test failed	Run Exercise test again, watch where it fails.
36	Elements reserved	User error

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
3C	Move to	• Vertical motion failed in the middle of a move or exchange. • Look at the micro-move error of the failure in the error log (under INFO *, and Hardware Error in the control panel display). Also check the Source and Destination entries in the error log to verify what move was in process. • Make sure the encoder strip is inside sensor. • Make sure the motor leads are connected to the vertical motor. • Check that the cable from the sensor is connected through the translate from to the umbilical cable for the picker. • 24-volt power supply • Controller PCA.
3D	Flip	• Change picker
3E	Translate	• Change picker
3F	Put magazine in	• Failed plunging cartridge into a magazine. Look at the micro-move error of the failure in the error log (under INFO *, and Hardware Error in the control panel display). Probably the picker.
40	Get magazine out	• Failed extracting a cartridge from a magazine. • Look at the micro-move error of the failure in the error log (under INFO*, and Hardware Error in the control panel display). • Probably the picker

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
41	Test magazine	Failed testing the magazine portion during an ISTAT. • Look at the micro-move error of the failure in the error log (under INFO*, and Hardware Error in the control panel display). • Probably the picker.
42	Put drive in	• Look at the micro-move error of the failure in the error log (under INFO*, and Hardware Error in the control panel display). • Remove rear panel and run the Wellness Test, Drive I/O test, and Exercise Mechanics test. Note where the problem occurs. • If indicates the drive, change the drive. • If it indicates a picker error, change the picker.
43	Get drive out	• Look at the micro-move error of the failure in the error log (under INFO *, and Hardware Error in the control panel display). • Remove rear panel and run the Wellness Test, Drive I/O test, and Exercise Mechanics test. Note where the problem occurs. • If indicates the drive, change the drive. • If it indicates a picker error, change the picker.

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
44	Test drive	• Look at the micro-move error of the failure in the error log (under INFO *, and Hardware Error in the control panel display). • Remove rear panel and run the Wellness Test, Drive I/O test, and Exercise Mechanics test. Note where the problem occurs. • If indicates the drive, change the drive. • If it indicates a picker error, change the picker.
45	Put mailslot in	• Change the picker. • Change the mailslot.
46	Get mailslot out	• Change the picker. • Change the mailslot
47	Test mailslot	• Change the picker. • Change the mailslot.
48	Rotate mailslot in	• Cycle power to the jukebox to initiate a power on test sequence. • Check to see if mailslot rotation works. • If the mailslot rotates in, change the picker. • If the mailslot does not rotate in, change the mailslot.
49	Rotate mailslot out	• Cycle power to the jukebox to initiate a power on test sequence. • Check to see if mailslot rotation works. • If the mailslot rotates in, change the picker. • If the mailslot does not rotate in, change the mailslot.

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
4A	Test picker	This may appear when testing for a cartridge in the picker during an ISTAT. • Replace picker
4B	Switch active picker	Replace picker
4C	Restore picker	Replace picker
4D	Find translate home	Can not translate the picker and/or sense that it has moved. Run FIND XLAT HOME test from the control panel • If the picker does not move at all, check the connections on the umbilical cable. If the connections are good and the picker still does not move, change the umbilical cable. • If the picker moves a little but does not reach the side of the frame, the translate motor on the picker is probably defective. Change the picker. • If the picker moves properly to the side, the translate sensor is probably defective. Change the picker.
4E	Find vertical home	Because a motor test is called before a find vertical home is attempted, the vertical motor is assumed to be at least minimally functional. • Check that the vertical path is physically clear. • Change the vertical motor (probably a marginal error).

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
4F	Find plunge home	We know that we can move the plunge motor. We know that that we can move the plunge motor and sense that we moved it so the motor and umbilical cable are not suspect. • Change the picker
50	Clear flip area	The vertical path is probably blocked. Perhaps falsely over forcing. • Check that the path is clear. • Exercise and visually check the operation of the vertical motor.
51	Clear magazine path	• Check that the path from the picker to the magazine is clear. • Check that the vertical path is clear. • Test the vertical path sensor operation.
52	Clear drive path	• Check that the path from the picker to the drive is clear. • Check that the vertical path is clear. • Test the vertical path sensor operation.
53	Clear mailslot path	• Check that the path from the picker to the mailslot is clear. • Check that the vertical path is clear. • Test the vertical path sensor operation.
5B	Finish switching the picker	Change the picker.
5C	Wait plunge	Change the picker.

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
5D	Wait vertical	Vertical motion failed in the middle of a move or exchange. • Look at the micro-move error of the failure in the error log (under INFO *, and Hardware Error in the control panel display). Also check the Source and Destination entries in the error log to verify what move was in process. • Make sure the encoder strip is inside sensor. • Make sure the motor leads are connected to the vertical motor • Check that the cable from the sensor is connected through the translate from to the umbilical cable for the picker. • 24-volt power supply. • Controller PCA.
5E	Powerfail clear path	• Check that all paths are clear. • Test the vertical path sensor operation.
5F	Powerfail restore cartridges	• A cartridge was physically moved after powerfail and before powerfail recovery. • Check that no cartridges have been moved.
60	Repeater Controller	• Check cables between the controller PCA and the SCSI repeater PCA. • Change repeater PCA • Change controller PCA • Change internal SCSI cable

Table 4–3 Hardware Errors and Recovery Procedures (continued)

Error Code (hex.)	Error Description	Recovery Procedures
61	External SCSI cables	• Check for correct terminator (single-ended or differential) for the type of SCSI interface chosen. • Check that single-ended / differential slide switch is selecting desired interface. • Change external SCSI cable • Change SCSI repeater PCA • Change controller PCA
80	LAN timeout	• Power cycle the jukebox. • Listen for the tone signaling that the LAN module CPU has initialized. Listen for the sounds made by the system disk loading the application software. If the same problem reappears, call the Response Center.
81	NFS error	• see error code 80
82	File system error	• see error code 80

Table 4–4 Micro-Move IDs

ID (hex.)	Description
1	Move picker transport up. Fast.
2	Move picker transport down. Fast.
3	Move picker transport up slowly, looking for resistance. Used in vertical find home sequence.
4	Move picker transport down slowly, looking for resistance. Used in vertical find home sequence.
5	Move a small amount upward, to relieve tension in the servos. Used after finding "home" in the vertical find home sequence.
6	Make a small vertical movement as a plunge is made into a drive. Used to "wiggle" the picker during error recovery.
8	Move picker transport up to the top of the jukebox, checking for a clear path. Used in the vertical find home sequence.
9	Move picker transport to the bottom of the jukebox, checking for a clear path. Used in the vertical find home sequence.
11	Move slowly up far enough to establish that there is enough room to flip the picker. Used in the plunge find home sequence.
12	Move slowly down far enough to establish that there is enough room to flip the picker. Used in the plunge find home sequence.
13	Move slowly to the flip clear area (determined in micro-moves 11 and 12). Used in the plunge find home sequence. Also used in power fail recovery to move the picker off of a cartridge that may have been between the picker and the magazines when the power failed and the picker settled.
14	Move slowly downward to the flip clear area (determined in micro-moves 11 and 12). Used in the plunge find home sequence.
15	Move vertically to restore the picker to the position it had before an error (and error recovery, occurred. Only called in error recovery.
16	Move up. Used in the motor test during power up.
17	Move down. Used in the motor test during power up.
62	Move slowly to one side of the translate frame. Used to find translate home during power up. Movements after power up use the translate home ID, 63.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
63	Move to one side of the translate frame. Used to find translate home.
67	Move a short distance back from the plunge position where an overforce shutdown error occurred. Relaxes the tension.
68	Retract the plunge assembly on the picker all the way back to find "home" in the plunge axis. May start a flip, depending on starting position. (One of three plunge find homes in the sequence; 68, 69, 6A).
69	Retract the plunge assembly on the picker all the way back and flip the picker at the same time. Used to find "home" in the plunge axis. (One of three plunge find homes in the sequence; 68, 69, 6A).
6A	Retract the plunge assembly on the picker all the way back and then flip the picker. Used to find "home" in the plunge axis. Second flip of the sequence. (One of three plunge find homes in the sequence; 68, 69, 6A).
6B	Plunge toward magazine to get cartridge.
6C	First time plunge into magazine (first "get"). Feels for resistance to learn the distance to the cartridge when it is seated.
6D	Retraction to pull the cartridge out of the magazine.
6F	First part of a two-step move to put a cartridge into a magazine. Puts the cartridge nearly all the way in. Next part of move is micro-move 70.
70	Second part of a two-step move to put a cartridge into a magazine. Continues movement of micro-move 6F and puts the cartridge in the rest of the way (distance learned in micro-move 6C).
71	First time plunge into a magazine (first "put"). Feels for resistance to learn the distance to the cartridge when it is seated.
72	Retract picker plunge assembly after putting cartridge into a magazine. Assembly is retracted just far enough that the thumbs are clear of the picker vertical path.
75	First part of a two-step plunge move to put a cartridge into a drive. Cartridge is inserted to a point where the drive shutter arms start to engage.
76	First time "put" plunge into a drive. Slow. Feels for resistance to learn the distance to the cartridge when it is seated.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
77	First time "get" plunge into a drive. Slow. Feels for resistance to learn the distance to the cartridge when it is seated.
78	Fast "put" plunge into a drive (distance has been previously learned).
79	Retract picker plunge assembly after putting cartridge into drive. Assembly is retracted just far enough to that the thumbs are clear of the picker vertical path.
7C	(Used in an emergency cartridge eject). Plunge toward a drive, stopping at a position close to the drive. This the wait position until the drive ejects the cartridge.
7D	(Used in an emergency cartridge eject). Plunge to contact and get the cartridge from the drive. Follows micro-move 7C.
7E	Log ID (no motion). Logs that picker is in position in front of drive, waiting for the drive to eject the cartridge.
7F	Plunge forward to get cartridge from the drive. Thumbs wrap over the ears on the cartridge.
80	Retract a small amount o take up the slack between the picker thumbs and the cartridge ears.
81	Retract plunge assembly fully back into the picker.
83	Flip during plunge when cartridge is in the top picker.
84	Flip during plunge when cartridge is in the bottom picker.
87	Short plunge out to test for a cartridge in the picker. If a cartridge is in the picker, the path clear beam will be interrupted. Used in an ISTAT.
88	Short plunge out to test for a cartridge in a magazine when the picker contains a cartridge. If resistance is felt, this is interpreted as a cartridge in the magazine. Used in an ISTAT.
89	Retract picker plunge assembly into the picker after executing micro-move 88. Used in an ISTAT.
8A	Short plunge to test for a cartridge in a drive when the picker contains a cartridge. If resistance is felt, this is interpreted as a cartridge in the drive. Used in an ISTAT.
8B	Plunge out. Used in error recovery. Is an attempt to push a cartridge out of the vertical picker path and into a magazine.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
8C	Retract thumbs back into the picker. Used in error recovery. Is an attempt to pull a cartridge out of the vertical picker path and into the picker. Either this micro-move or micro-move 8D is used, depending on position of the picker at the start of recovery.
8D	Retract thumbs back into the picker. Used in error recovery. Is an attempt to pull a cartridge out of the vertical picker path and into the picker. Either this micro-move or micro-move 8C is used, depending the on the position of the picker at the start of recovery.
8E	Move picker plunge assembly out to rearm the picker mechanism before switching active picker.
8F	Retract picker plunge assembly to a point just short of tripping the thumb selection mechanism. First of two steps (second step is micro-move 90).
90	Retract picker fingers all the way back. Trips the mechanism that makes the opposite thumb "active."
91	Move picker plunge assembly forward, away from the full retracted position. Clears the tripping mechanism and makes the new thumb "active."
92 to 95	Factory use only. Does not run in normal operating code.
98 to 9F	Factory use only. Does not run in normal operating code.
A2	First of two plunge movements toward the drive during error recovery. Vertical movement is done before the second part of this movement (micro-move A3) is done.
A3	Second of two plunge movements toward the drive during error recovery. Done after a small vertical movement is done to "wiggle" the picker.
A4	Plunge out. Is an attempt to clear the vertical picker path during drive error recovery.
A5	Retract picker. Is an attempt to clear the vertical picker path during drive error recovery.
A5	First part of a two-step move to fully retract the picker plunge assembly. Retract assembly almost all the way back. Next part of move is micro-move A6.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
A6	Second part of a two-step move to fully retract the picker plunge assembly. Continues movement of micro-move A5 and brings picker plunge assembly all the way back.
A7	Move picker plunge assembly forward a small amount from full retracted position. Completes rearm of the picker mechanism.
A8	Move to a position where the picker thumb sensor can be read. Used in the find plunge home recalibration.
A9	Move to a position where the current active picker can be read. Used in the plunge home recalibration.
AA	Fully retract picker plunge assembly to switch the active picker. One of three moves used to make the top picker the active picker during a picker recalibration.
AB	Move picker plunge assembly forward a small amount to complete the rearm of the picker mechanism. One of three moves used to make the top picker the active picker during a picker recalibration.
AC	Move picker plunge assembly forward to normal position after a active picker has been change by micro-moves AA and AB. One of three moves used to make the top picker the active picker during a picker recalibration.
AD	Move the picker plunge assembly a small amount away from the flip mechanism so that the mechanism is rearmed for a flip. Used in a flip sequence.
AE	Move the picker plunge assembly out a small amount from the full retracted position to relieve the pressure on the mechanism after a flip.
AF	First of two moves to move the thumb to the magazine during an ISTAT when no cartridge is in the picker. Next move is micro-move B0.
B0	Second of two moves to move the thumb to the magazine during an ISTAT when no cartridge is in the picker. Slow move to check for an overforce (cartridge in the magazine slot).
B1	Retract picker plunge assembly back into the picker to a point where the thumbs can unsplay. Used during an ISTAT, with no cartridge in the picker, when the thumbs are splayed and are they must be unsplayed.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
B2	Retract picker plunge assembly into the picker to a point just short of where the thumbs would be released and unsplay. Used during an ISTAT, with no cartridge in the picker, when the thumbs are splayed and must be kept splayed.
B3	Retract picker plunge assembly back far enough to release the thumbs and let them go to an unsplayed position. Used during an ISTAT, and the thumbs are being returned to an unsplayed position after contacting, grabbing, and replacing the first cartridge.
B4	Retract picker plunge assembly into the picker to a point just short of where the thumbs would be released and unsplay. Used during an ISTAT, and the thumbs are being retained in the splayed position after contacting, grabbing, and replacing the first cartridge.
B5	Retract picker plunge assembly far enough to get the thumbs out of the vertical picker path. Used during an ISTAT, no cartridge in the picker, and no cartridge was contacted in the first magazine.
B6	Pull picker plunge assembly fully back to rearm a "put." Enable the picker to replace the cartridge it picked up during an ISTAT.
B7	First of two moves that put a cartridge back into the magazine after the cartridge is detected during an ISTAT. Moves the cartridge almost fully into the magazine. Followed by micro-move B8.
B8	Second of two moves that put a cartridge back into the magazine after the cartridge is detected during an ISTAT. Moves the cartridge fully into the magazine.
B9	Second of two moves to test for the presence of a cartridge in a magazine during an ISTAT when there is a cartridge in the picker. Slow move to check for an overforce (cartridge in the magazine slot). Follows micro-move BA.
BA	First of two moves to test for the presence of a cartridge in a magazine during an ISTAT when there is a cartridge in the picker. Fast plunge that places the en of the cartridge in the picker close to the magazine. Followed by micro-move B9.
BB	Testing for media in picker. After the physical force check.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
BC	Retract picker plunge assembly after detecting a cartridge in the drive. Used in an ISTAT when there is a cartridge in the picker.
BD	Retract picker plunge assembly to a point just short of where the thumbs would be released from their splayed position. Used if thumbs are splayed after checking magazines in an ISTAT.
BE	Retract picker plunge assembly after inserting a cartridge into a drive.
BF	Quickly retract the picker plunge assembly if an error occurred while inserting a cartridge into a drive.
C0	Retract picker plunge assembly to a point where the thumbs are released and go to an unsplayed position. Used in an ISTAT.
C1	Insert cartridge into a drive, just past the shutters. Distance has not been learned.
C2	Insert cartridge into a drive, just past the shutters. Distance has not been learned. Part one of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C3	Insert cartridge into a drive, just past the shutters. Distance has been learned. Part one of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C4	Insert cartridge fully into a drive. Distance HAS been learned. Part two of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C5	Insert cartridge fully into a drive. Distance HAS been learned. Additional push in case the drive acknowledge signal was not seen. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.
C6	Insert cartridge fully into a drive. Distance HAS been learned. Part two of a two-stage move. Used in the sequence to return a cartridge into a drive after an emergency eject during an ISTAT.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
C7	Retract picker to rearm position to splay the fingers. Used when an error in the drive acknowledge signal is seen and a drive eject will be done and the thumbs must be in the splayed position.
C8	Plunge thumbs out close to the end of the picker to get ready to "get" a cartridge. Done at the same time as vertical moves and intransit translates and flips.
C9	Same as micro-move C8 but is a retry (if needed)
CB	Retract picker plunge assembly back far enough to clear the thumbs from the vertical picker path. Used after a cartridge is put in the mailslot.
CC	Plunge out to clear the mailslot path. Distance has not been learned. Used in error recovery.
CD	Short plunge out to fully seat a cartridge in the mailslot and to measure the distance of a fully-inserted cartridge.
CE	Plunge out to clear the mailslot path. Used in error recovery.
CF	Retract picker plunge assembly in an attempt to clear the mailslot path. Used in error recovery.
DO	Short plunge to push the cartridge to a fully seated position during a "get" to the mailslot. Distance is learned.
D1	Short plunge during a mailslot "put." Ducks under the mailslot rotation mechanism and positions the picker so it can move up all the way to mailslot insertion position.
D2	Short plunge to put the cartridge all the way into the mailslot.
D3	Short plunge during a mailslot "get". Ducks under the mailslot rotation mechanism and positions the picker so it can move up all the way to the mailslot "get" position.
D4	Plunge to get the cartridge from the mailslot.
D5	Retract cartridge most of the way into the picker. Positions the picker so that it can duck under the mailslot rotation mechanism during a "get."
D6	Continue retraction in micro-move D5. Pull cartridge all the way back into the picker.
D7	Retract thumbs to a point just inside the picker. Used to clear the vertical picker path during error recovery.

Table 4–4 Micro-Move IDs (continued)

ID (hex.)	Description
D8	Plunge to a position where the mailslot rotation actuator can be pulled in.
D9	Plunge to a position where the mailslot rotation actuator can be pushed out.
DA	Move picker plunge assembly to a position where the mailslot rotation actuator can be engaged to rotate the mailslot out. Used when the state of the mailslot is unknown and must be placed in a known state.
DB	Retract the picker plunge assembly a short distance to clear the thumbs away from the mailslot after rotating the mailslot out.
DC	Slow retract of the picker plunge assembly, pulling the mailslot in. Checks that the cartridge is in properly. First move of a rotate in.
DD	Retract thumbs back into the picker after rotating mailslot out.
E1	First of two moves rotating the mailslot in. Quickly retract the picker plunge assembly, pulling the mailslot most of the way in. Followed by micro-move E3.
E2	Plunge out to rotate the mailslot almost all the way out.
E3	Short retraction of the picker plunge assembly until pressure is felt. Used at end of rotating the mailslot in and ensures that the mailslot has been rotated fully in.
E4	Short plunge out to relieve the pressure after rotating the mailslot in.
E5	Short plunge out, feeling for pressure, to ensure that the mailslot is rotated all the way out.
E6	Retract picker plunge assembly a short distance to relieve the pressure after micro-move E5.
E7	On power up, testing for motion in one direction on the plunge motor.
E8	On power up, testing for motion in the plunge motor. Opposite direction than in micro-move E7.
E9	Plunge out to clear the picker vertical path. Used when path is blocked during power up.
EA	Picker plunge assembly retraction to clear the picker vertical path. Used when path is blocked during power up.

Running an Internal Test

CAUTION

Some diagnostic tests can corrupt the file system if a test is not properly completed.

1. With **READY** displayed, press **NEXT** until **ADMIN*** appears in the display window.

NOTE

A three-part security code is required to access any options beneath ADMIN. The security code is set to 0,0,0 at the factory, but you should encourage the customer to change this as soon as possible to avoid access by unauthorized persons.

2. Press **ENTER**. **CODE1** and a flashing **0** displays. Press **ENTER** if no security code has been set, otherwise press **NEXT** until the first number of the security code displays, and then press **ENTER**. Repeat this step to enter the next two parts of the security code.
3. **TEST*** displays. Press **ENTER.**
4. Press **NEXT** until the name of the test you wish to run displays and then press.

Descriptions of the available internal tests are on the following pages.

Table 4–5 Available Internal Tests for the RW551 and RW552

Test Name	Description
EXCHANGE DEMO	**DO NOT RUN THIS TEST!!** This test moves **randomly-chosen** cartridges to **random** storage slot locations. Do not run this test if the jukebox contains disks with actual file system data on them. This test displays **FAIL** if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.
INIT MECHANICS	Runs the FIND PLUNGE HOME, FIND VERTICAL HOME, FIND XLATE HOME, INIT ELEM STATUS tests, and then rotates the mailslot out. Each test is run one time per test loop.

Table 4–5 Available Internal Tests for the RW551 and RW552 (continued)

Test Name	Description
INIT ELEM STATUS	Functions the same as the SCSI Initialize Element Status command. This test physically scans the entire unit to determine which storage slots contain disks and if the drives contain disks.
MAGAZINE IO	Makes a combination of moves with a PASS/FAIL result. It moves an optical disk from a randomly-chosen full slot to a randomly-chosen empty slot, with a random flip. It then moves the disk back to its original storage slot with its original orientation. This test displays **FAIL** if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.
DRIVE IO	Makes a combination of moves with a PASS/FAIL result. It moves an optical disk from a randomly- chosen full slot to a randomly-chosen drive, with a random flip. It then moves the cartridge back to its original slot with its original orientation. This test displays **FAIL** if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.
MAILSLOT IO	Makes a combination of moves with a PASS/FAIL result. It moves an optical disk 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. This test displays **FAIL** if there are no disks in the jukebox or if all storage slots are full. The drives and mailslot must be empty.
VERTICAL TEST	Moves the disk transport mechanism up and down the full length of the rail. Returns PASS/FAIL. No cartridges are required.
TRANSLATE TEST	Translates from side to side. No cartridges are required.
FLIP TEST	Makes a combination of moves with a PASS/FAIL result. It does several flips at various locations. No cartridges are required.
PICKER TEST	Flips the disk transport mechanism and switches active thumbs. No cartridges are required.

Table 4–5 Available Internal Tests for the RW551 and RW552 (continued)

Test Name	Description
FIND PLUNGE HOME	Runs mechanism recalibration, establishes which picker side is up, and determines the reference points in the picker travel path. This test assumes that the mechanics and servo system are functional. No cartridges are required.
FIND VERT HOME	Recalibrates the vertical position and verifies that the vertical path is clear. No cartridges are required.
FIND XLATE HOME	Calibrates the translate position. No cartridges are required
VERTICAL ENCODER	Moves the disk transport mechanism down, then moves it back up a short distance, and then moves it back down. The last time the disk transport mechanism is moved down the number of encoder counts are verified. Returns PASS/FAIL. No cartridges are required.
CAUTION Use extreme caution when running the next three tests.	
EMPTY DRIVES	Moves cartridges out of the drive mechanism(s) and returns them to their storage slots, if locations are known.
EMPTY PICKER	Moves an optical disk from the disk transport mechanism to its home storage slotlocation if that location is known, otherwise the disk is placed into the first available empty storage slot.
FILL PICKER	Moves an optical disk into the disk transport mechanism from the first storage slot containing a disk. This test must be run twice to fill both slots in the transport mechanism.
EXERCISE MECHANICS	Runs the VERTICAL TEST, TRANSLATE TEST, FLIP TEST, MAGAZINE IO, DRIVE IO, and MAILSLOT IO tests. Each test is run one time per test loop.

Table 4–5 Available Internal Tests for the RW551 and RW552 (continued)

Test Name	Description
WELLNESS TEST	Checks out the general capability of the jukebox. Requires one loaded cartridge; drives and mailslot must be empty. Runs INIT MECHANICS and EXERCISE MECHANICS. Each test is run one time per test loop.
CLEAR SOFT LOG	Sets the soft error log to zero.
CLEAR HARD LOG	Sets the hare error log to zero.
PLUNGE FULL SPD	Allows the disk transport mechanics to be run at full speed. This configuration should always be used under normal circumstances.
PLUNGE 1/2 SPD	Allows the disk transport mechanics to be run at half speed. Use this configuration for diagnostic purposes only.
PLUNGE 1/4 SPD	Allows the mechanics to be run at quarter speed. Use this configuration for diagnostic purposes only.
STARWARS	The display shows **0 0**. Each "0" indicates one of the paths that the disk transport mechanism follows in front of each stack of cartridges. If the path is clear, a "0" is displayed; if the path is blocked (because of an optical disk that is not inserted fully into its storage slot for example), an "*" will be displayed.
BOTTOM THUMB	Reports THUMB A, THUMB B, or NO THUMB. Looks at the top and bottom thumb sensors and reports whether the thumbs on the disk transport mechanism are in the forward or back position. If THUMB A or THUMB B is returned, one of re-turned, both thumbs re in the back position. This configuration should be used by authorized service representatives only.

Table 4–5 Available Internal Tests for the RW551 and RW552 (continued)

Test Name	Description
TOP THUMB	Reports ON or OFF. Looks at the top thumb sensor which reports whether or not the thumb that is currently on the top side of the disk transport mechanism is in the forward position. If ON is reported the thumb is in the back position; if OFF is reported the thumb is in the forward position. This configuration should be used by authorized service representatives only.
TRANSLATE SENSOR	Reports ON or OFF after looking at the translate sensor.

Optical Disk Cleaning–All Jukeboxes

CAUTION

Data may be lost as a result of scratches introduced during optical disk cleaning.

Cleaning optical disks is not a preventive maintenance procedure and should not be attempted unless disks are obviously dirty. Cleaning a disk is a last resort to recover data.

Every effort should be made to instruct the customer of the importance of placing the jukeboxes at locations that do not have a high concentration of airborne dust. A clean environment is especially important if the customer's applications cause optical disks to remain in the drives with the drive's shutter open.

A failure to read a disk may result from:

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

In a service situation where contaminated disks may be a problem, ensure first that failures are not caused by another, perhaps a hardware failure.

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.

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

- Place the jukebox away from high traffic areas.
- Do not leave a disk in the drive for extended periods of time if possible.
- Do not use the jukebox in “dirty” environments.

NOTE

SCSI-connectjukeboxes

If the problem appeared as loss of performance and cleaning the 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.

LAN-connect jukeboxes

No additional actions need to be taken. The server software automatically moves the data to a new disk and removes the effects of sparing. It does this through the Automated LAN Jukebox Maintenance program.

Cleaning Tools Available

CAUTION

Data may be lost as a result of scratches introduced during optical disk cleaning

Cleaning optical disks is not a preventive maintenance procedure and should not be attempted unless disks are obviously dirty. Cleaning a disk is a last resort to recover data.

Every effort should be made to instruct the customer of the importance of placing the jukeboxes at locations that do not have a high concentration of airborne dust. A clean environment is especially important if the customer's applications cause optical disks to remain in the drives with the drive's shutter open.

Disks may be cleaned with the Optical Disk Cleaning Kit (C1700-88800). This kit contains swabs and alcohol, cleaning instructions, and a special cartridge holder that keeps the sliding sleeve open.

CAUTION

Never attempt to clean the optical drive objective lens!

Although disk drive cleaning kits are available, they are not approved for use with the drive in this jukebox and could damage the optical drive mechanism.

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 RWZ52 optical drive, you may order one of these:

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

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

Length: 50 mm

Width: 2.45 mm

Thickness: 0.5 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 do the following steps to remove a disk from the drive:

1. Disconnect 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.

5

Removal and Replacement

Chapter 5 contains removal and replacement procedures.

Contents

Field-Replaceable Assemblies

WARNING

DO NOT DISASSEMBLE the optical 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

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

ESD Precautions

The optical disk jukebox 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.

Tools Required

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

- Torx® driver with the following bits: T-10, T-15, T-25
- needle-nosed pliers
- Pozidriv® magnetized screwdriver
- flatblade screwdriver

Disassembly/Reassembly Procedures (SCSI-Connect Version)

WARNING

Disconnect the power cord before taking the jukebox apart to prevent possible electrical shock.

CAUTION

For SCSI-bus jukeboxes:

Do not switch off power to the jukebox until you are sure the SCSI bus is inactive. Switching off the jukebox when the SCSI bus is active can cause data loss and/or indeterminate bus states.

For all jukeboxes:

When servicing the jukebox, be sure 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 results in a serious loss of file system integrity.

Service Access

Right and Left Lower Access Panels:

Figure 5–1 Right Lower Access Panel

1. Switch off the power to the jukebox by placing the power standby switch to OFF (0) on the right side.
2. Unplug the power cord from the power source.
3. Remove the T-20 screw that holds the bottom edge of the panel.
4. Lift panel up and out. (Internally, the panel rests on four retaining pins).
5. Use the same procedure for the left access panel (except there is no screw).

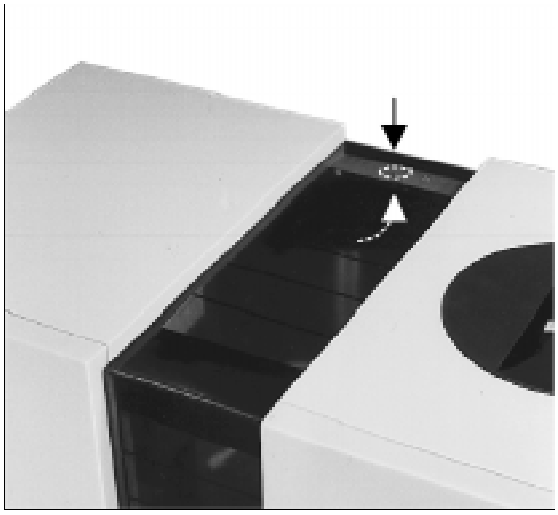
Rear Access Panel:

Figure 5–2 Rear Access Panel

1. Remove the seven T-20 screws around the outer edge of the panel.
2. Remove the single screw underneath the bottom of the panel.
3. Rotate the back panel back and lift if off the frame.

Front Left and Front Right Panels:

Figure 5–3 Center Cover Mounting Screw



For either or both panels:

1. Remove the four T-20 mounting screws from the panel. Two screws are located under the bottom front edge of each panel and two screws are located on the rear of each panel.
2. Remove one T-20, sheet metal screw located under the rear edge of the top, plastic, center cover. Pull the top plastic center cover towards the rear to unlock tabs connecting it to the front plastic cover.

Figure 5–4 Positioning the Control Display Before Removing the Panel

For the front right panel (control panel side)

NOTE

Before removing the front right panel, the control panel must be positioned correctly to clear the chassis.

Rotate the control panel so that the display faces the right end of the jukebox.

Figure 5–5 Accessing the Underside of the Control Panel

3. Remove the T-20 screw that holds the control panel access plate. The right side of the baffle is held by a tab fitting into a slot in the mailslot housing. To remove, rotate the left side of the panel back and away.
4. Disconnect the control panel ribbon cable.
5. Disconnect the power plug.

Figure 5–6 Disconnecting the Control Panel Cable

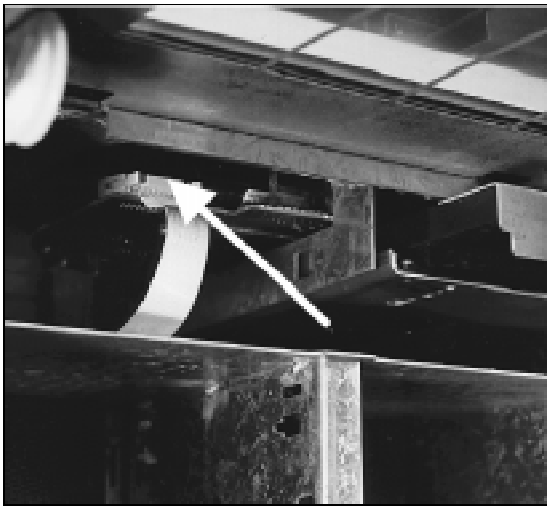
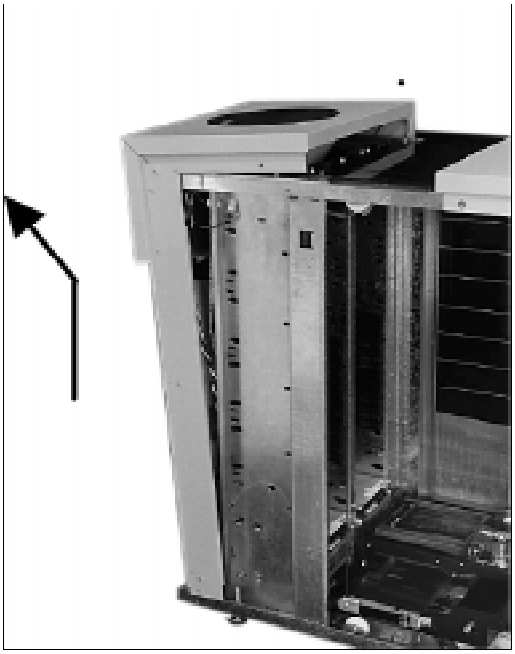


Figure 5–7 Removing the Front Right Panel



6. Disconnect the control panel power cable located at the upper left outside corner (rear access).

> **CAUTION**
>
> In the next step, lift straight up to allow the control panel assembly to clear the jukebox chassis.

7. From the right end lift up the front right panel. Spread the bottom front and rear a bit while lifting up and tilting off.

Reassembly

When replacing the front right panel be sure to put the control panel ribbon cable under the cable clamp on the frame. If the cable is not held in place by the cable clamp it may become entangled with the mailslot assembly.

For the left front panel

1. From the left end lift up the front left panel.
2. Spread the bottom front and rear a bit while lifting up and tilting off.

Replacing the Power Supplies

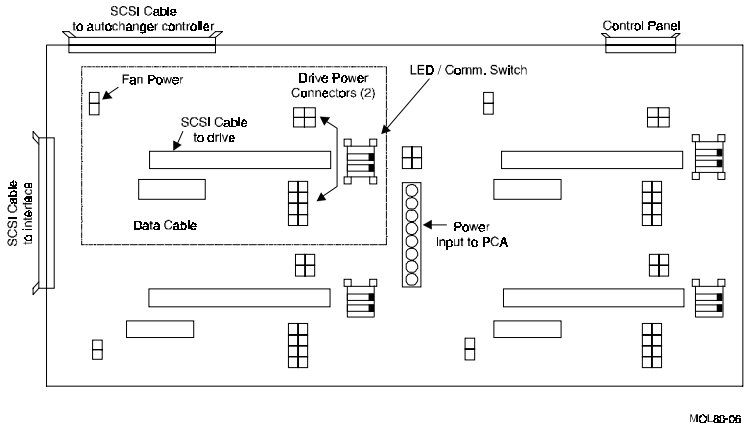
The 24V power supply is nearest the front panel of the jukebox.

1. Remove the rear access panel.

Figure 5–8 Power Supplies

2. Remove the power plug from the bottom of the supply.
3. Disconnect the cables from the top of the supply. The 24V power supply has one cable, the 5V/12V supply has four cables.
4. Remove the two T-20 screws at the top of the supply.
5. Lift the supply up and out.

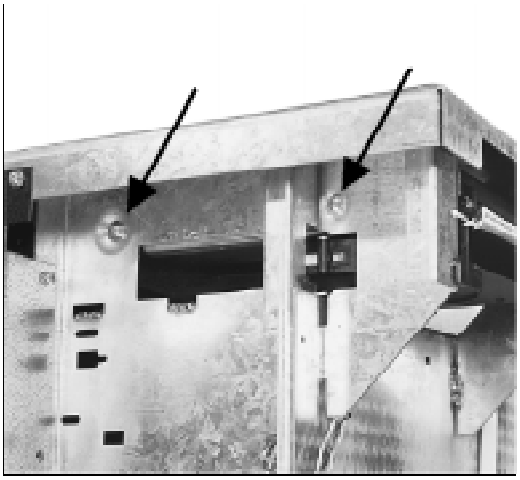
Figure 5–9 Power Test Points on the Interposer PCA



Replacing the Mailslot Assembly

1. Follow the steps at the beginning of this chapter to remove the right access panel, rear access panel and front right panel.
2. Ensure that the Mailslot sensor cable is disconnected from the interposer board.
3. Remove the two T-15 screws from the front right upper area, under the top edge of channel.

Figure 5–10 Accessing the Mailslot Assembly

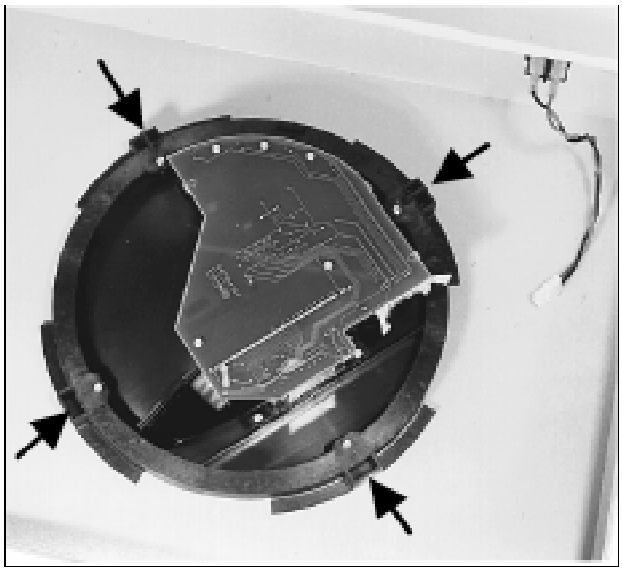


4. Slide Mailslot out of the alignment slots. Grip the Mailslot firmly be cause the rear end will drop down when clear of rear positioning slots.

Replacing the Control Panel Assembly

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel, rear access panel and front right panel.
2. Place front right panel upside down on table.

Figure 5–11 Control Panel Mounting Screws



3. Remove the four T-10 sheet metal screws from the control PCA retaining ring. This detaches the control panel PCA from the mounting assembly on the panel.
4. Lift front right panel up and off the control panel.

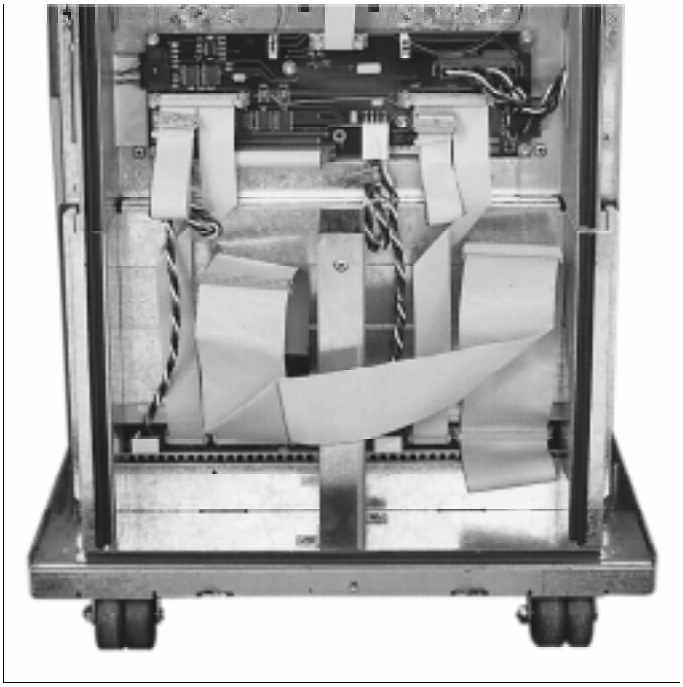
Reassembly

When replacing the front right panel with the control board secured, be sure and orient the control board (viewed from the outside top) by rotating the control board so that it is in a position facing the right end of the unit.

Replacing an Optical Drive

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel.
2. Disconnect the power and SCSI cables from the rear of all drives.

Figure 5–12 Optical Drives – With Cables Connected



3. Remove the RFI panel covering the drives. Remove the two T-20 screws from the top of the RFI panel. Tip the panel out and up. The panel is held at the bottom by positioning tabs. As you pull the RFI panel up and away, help the SCSI cable thread through its hole in the panel.
4. Remove the two T-20 screws from the drive you are replacing.

Figure 5–13 Optical drives - With Cables Disconnected

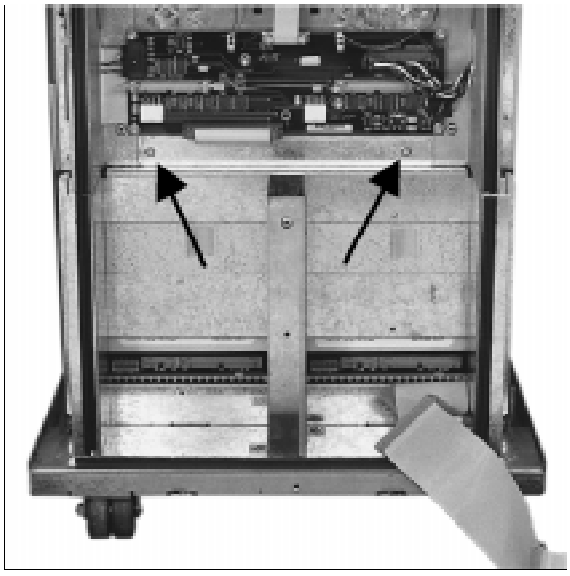
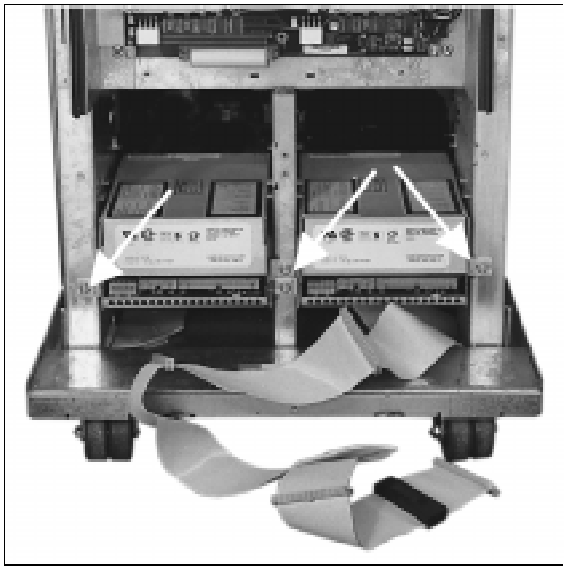


Figure 5–14 Optical Drive Mounting



5. Slide the drive out along its positioning tabs.

Reassembly

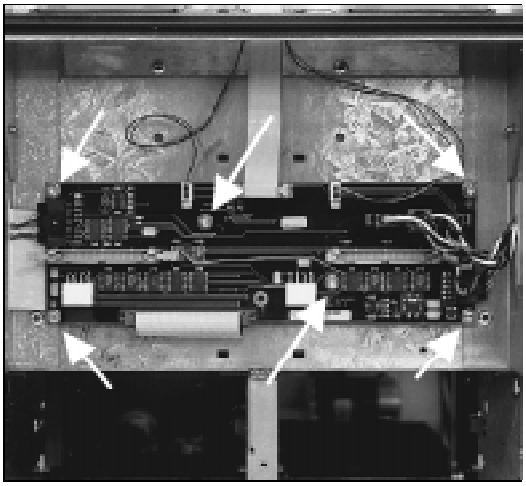
When replacing the drives, apply pressure sideways to the right at rear of drive. This depresses the rounding straps located inside the frame and allows the drive to seat property. When replacing the RFI panel, first thread the SCSI cable back through the opening.

Slide the base of the panel in first to position tabs in slots on the bottom of the jukebox chassis. Work the panel into place and secure with two T-20 screws.

Replacing the Interposer PCA

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel.
2. Disconnect all cables to the PCA.
3. Remove the six T-20 screws holding the PCA to the chassis.

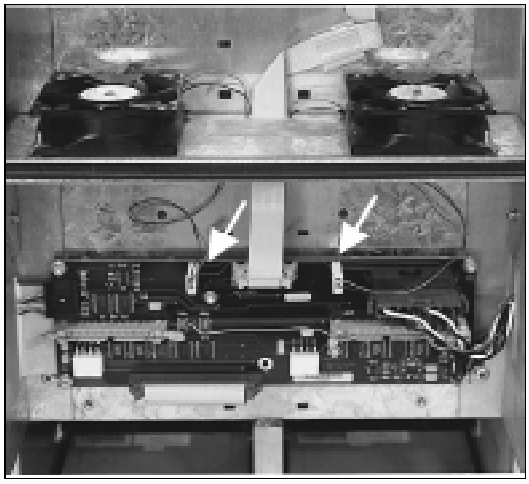
Figure 5–15 Interposer PCA



Replacing a Cooling Fan

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel.
2. Disconnect the fan power cable from interposer board.
3. Remove two T-15 screws holding the fan.

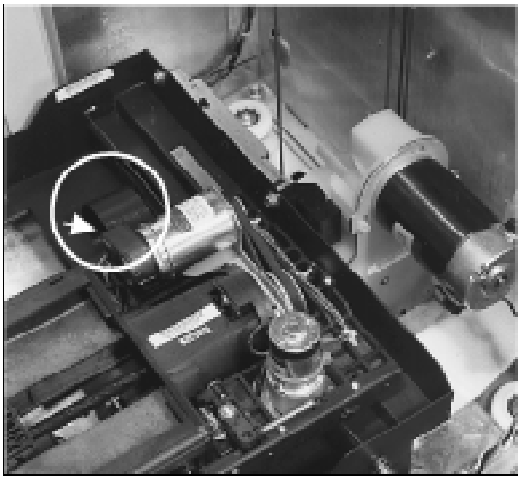
Figure 5–16 Cooling Fans



Replacing the Picker

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel, rear access-panel and front right panel.
2. Unplug the picker umbilical cable. To detach the cable, grab the tab on the end of the cable and pull.

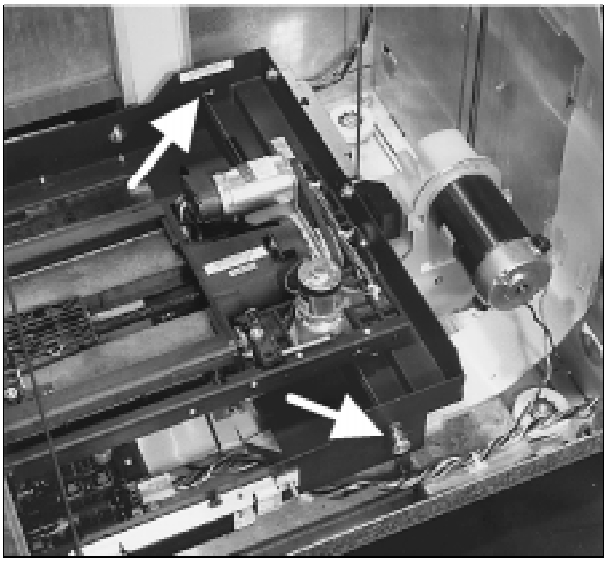
Figure 5–17 Picker Umbilical Cable



3. Release the translate cable from the (right) side of the translate frame (side nearest front of jukebox).

   The cable passes through a slotted hole in the side of the frame. Depress the tension spring on the side of the translate frame to release the tension on the cable and allow you to pass the cable up through the slotted hole. Grip the cable on the end and place it in the pinch slot on the side of the frame. Placing the cable in the pinch slot keeps the cable from unraveling from the central picker hub.

Figure 5–18 Picker Translate Cable



4. Release the translate cable from the (left) side of the translate frame (side nearest rear of jukebox).

   The cable passes through a hole in the side of the frame and into a slotted plug with a tensioner spring. Remove the spring and slotted plug. Grip the cable on the end and place it in the pinch slot on the side of the frame. Placing the cable in the pinch slot keeps the cable from unraveling from the central picker hub.

Figure 5–19 Picker Translate Cable (stowed)

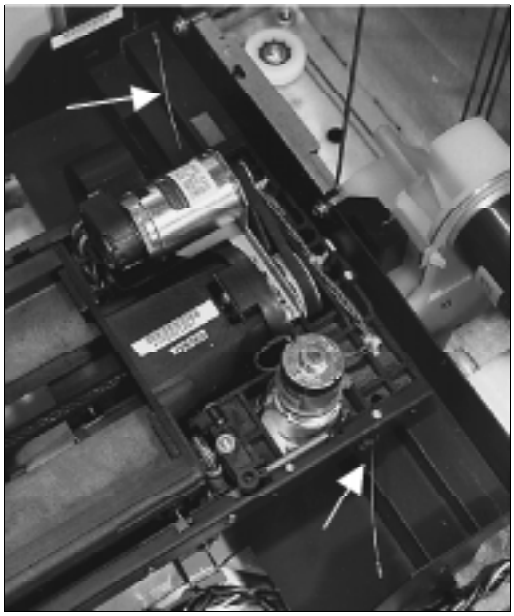
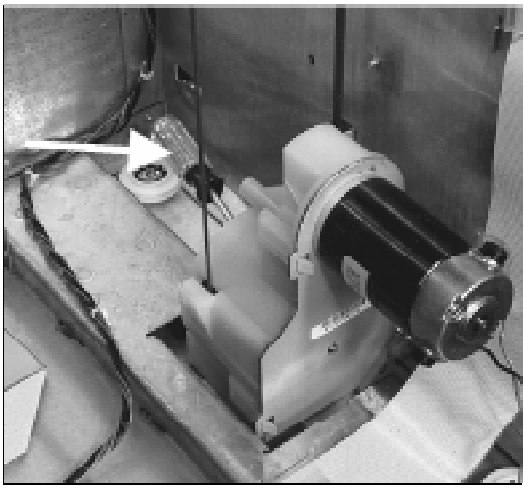
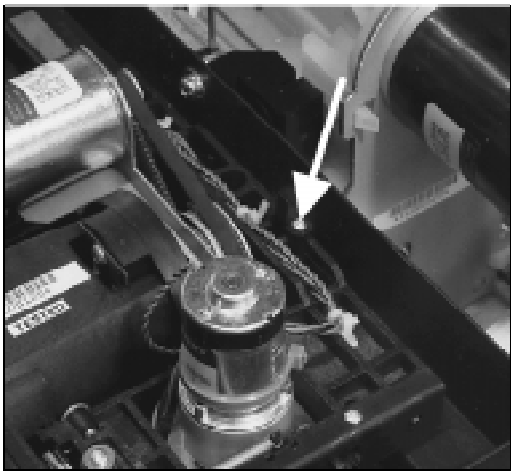


Figure 5–20 Stopping Vertical Motor Gear Box Motion



5. Remove the T-10 sheet metal screw that holds that holds the capture spring down.
6. Remove the capture spring by pulling up and out.

Figure 5–21 Picker Capture Bracket Mounting



7. Raise the translate frame and picker up to near the top of the jukebox, where you can access its underside.

   Grip the rear of the frame, pull it up to the desired position, and then insert a screwdriver into the gear box securing hole to prevent the frame from descending.

8. Release the picker from the translate frame by removing the capture bracket on the rear, underside of the picker. Rotate the capture bracket 90 degrees and pull the bracket down and out.

Figure 5–22 Picker Capture Bracket

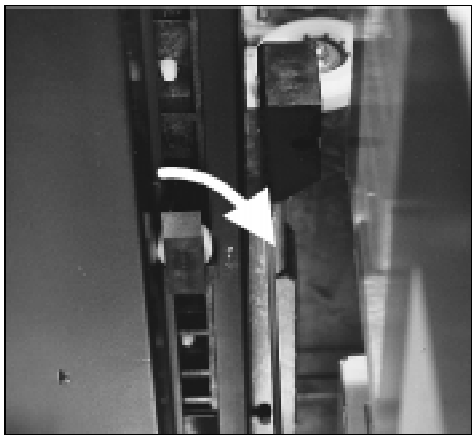


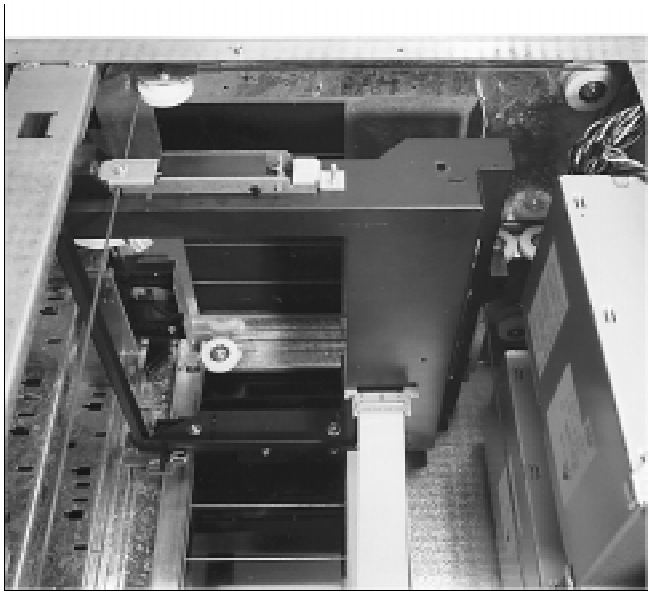
Figure 5-23 Rotating the Picker Assembly Out of the Translate Frame

9. Remove whatever tool is being used in the vertical motor gear box.
10. Lower the translate frame and picker to the bottom of the jukebox.
11. Tilt up the rear end of the picker and slide it out towards the rear.

Removing/Replacing the Translate Frame

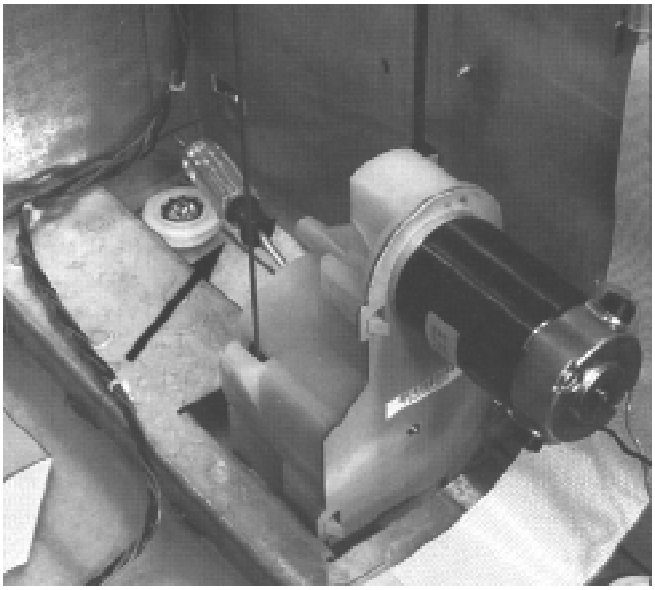
1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel, rear access panel and front right panel.
2. Follow the steps in the previous "Removing the Picker" section to remove the picker.

Figure 5–24 Translate Frame Raised For Easier Access



3. Raise the translate frame up to the top of the jukebox and secure with a screwdriver placed in the vertical motor gear box securing hole.

Figure 5–25 Stopping Vertical Motor Gear Box Motion



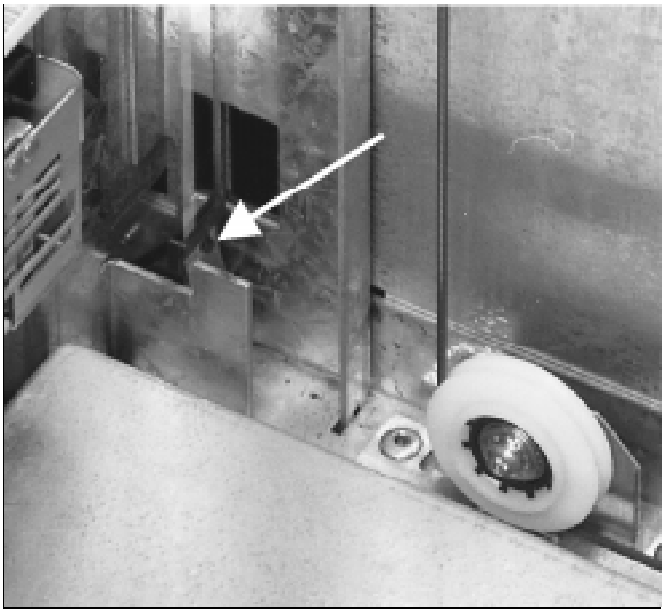
WARNING

Take care when handling the encoder strip. Its edges are sharp.

4. Unhook the encoder strip.

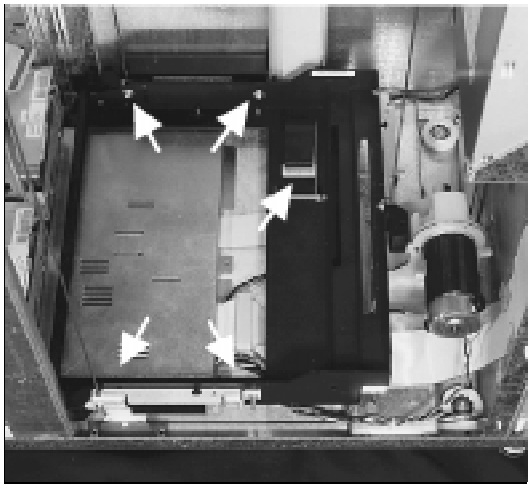
   Pull down on the encoder strip to remove the strip from its retaining peg. Once released, the strip will slide up and out of the plastic guide.

Figure 5–26 Encoder Strip Mounting Peg



5. Hang the encoder strip out of the way.
6. Remove the "visual locator" bracket on the (front) side of the picker translate frame as follows:
   a. Remove the two T-20 screws holding the bracket.
   b. Rotate the bracket out and off, under the frame.

Figure 5–27 Picker Translate Frame Tensioners



7. Disconnect the umbilical cable on the underside of the frame. Do this before moving the translate frame down to the bottom of the jukebox in the next step.
8. Remove whatever tool has been inserted in the vertical motor gear box securing hole to release the frame.
9. Move the translate frame down to the bottom of the jukebox.

Figure 5–28 Translate Frame Rear Tensioner Mount

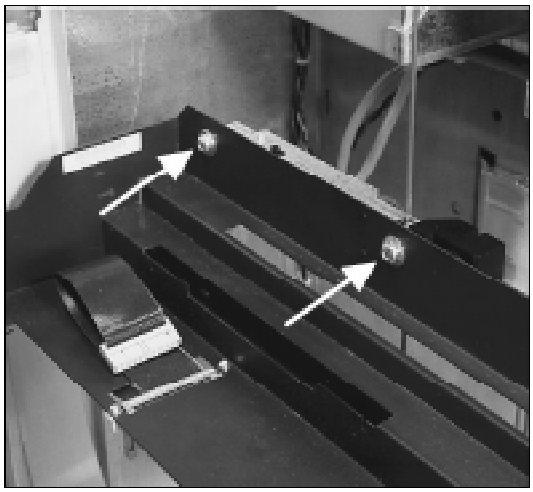
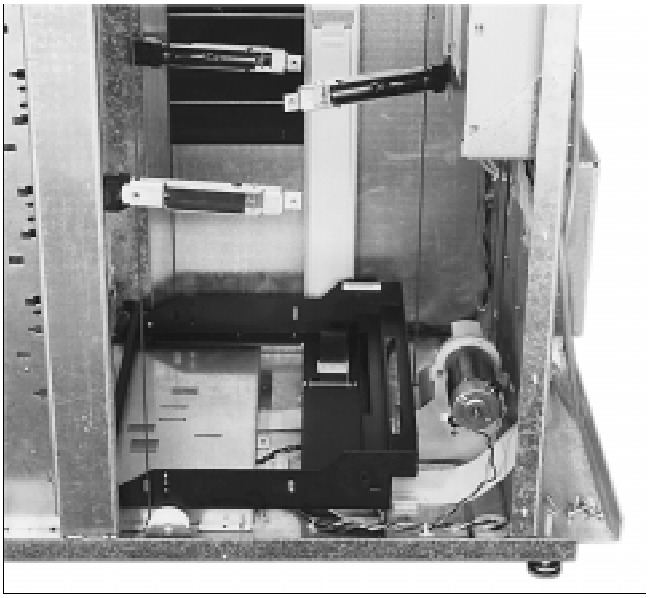


Figure 5–29 Translate Frame Tensioners Released



10. Remove the three rope tensioners from the frame as follows:
    a. Remove two T-25 long screws per rope tensioner. Start with the rope tensioner at the rear end of the frame.
    b. Each rope tensioner has two positioning pegs which position and seat each rope tensioner properly on the translate frame. Work all three rope tensioners free of the frame.
    c. Grip the rope tensioner at the rear of the frame and raise all three rope tensioners up and out of the way.
    d. Grip the side of the translate frame nearest you and shift to the rear a bit, rotate the far side up and the rear side up and out.

Reassembly

When replacing the translate frame, be sure that the frame is seated `flat' on three positioning points at the bottom of the main frame, Two points are located in front, left and right in front of the optical drives. One point is located at the rear edge center area where the frame will rest.

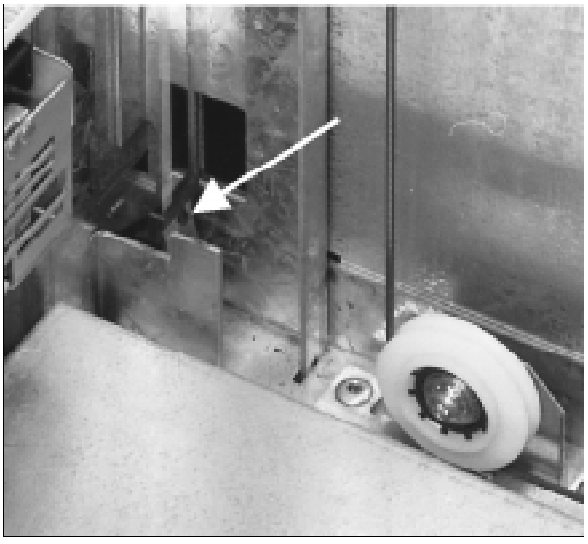
When replacing the encoder strip be sure and thread the encoder strip end back through the plastic slot and attach it securely to the retaining peg.

Also be sure the encoder strip passes through the sensor slot on the sensor PCA mounted on the side of the picker frame. The strip may be moved off its mounting peg while you are replacing the translate frame in the chassis.

Removing/Replacing the Encoder Strip

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel, rear access panel and front right panel.
2. Release the encoder strip. Pull down on the encoder strip to remove the strip from its retaining peg. Once released, the strip will slide up and out of the plastic guide.

Figure 5–30 Retaining Peg On Lower End Of The Encoder Strip



3. Remove the encoder strip anchor. Remove the T- 15 screw located on the top front edge of the unit.
4. Remove the encoder strip with the plastic anchor.

Figure 5–31 Encoder Strip Mounting Screw

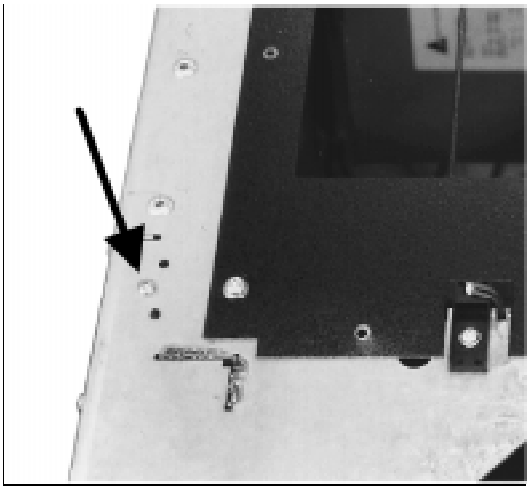


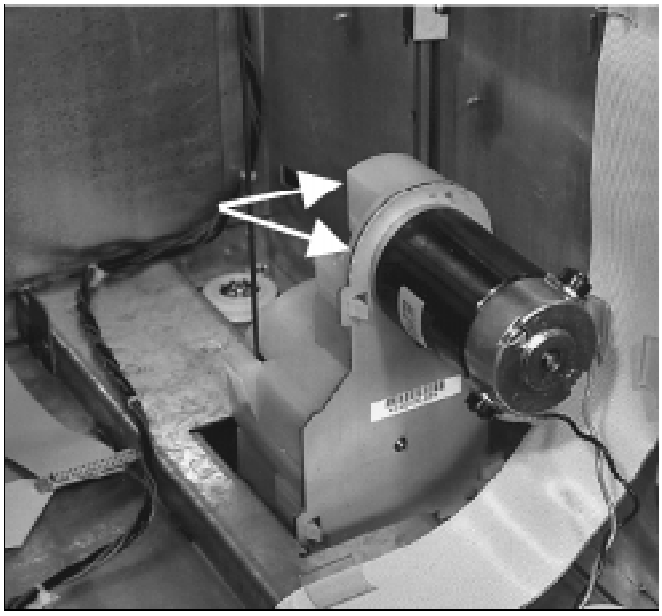
Figure 5–32 Top Mount Of Encoder Strip

Replacing the Vertical Motion Motor

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the rear access panel.

2. Disconnect the two power cables to the vertical motor. Note the orientation of the motor and its cable connections with respect to the gear box (for reassembly).

Figure 5–33 Vertical Motion Motor



3. Remove two T-15 motor mounting screws on the gear box.

Reassembly:

When replacing the motor, use the orienting pegs on the motor to place it correctly on the gear box.

Replacing the Vertical Motor Gear Box

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the right access panel, rear access panel and front right panel.
2. Follow the steps in "Removing the Picker" and "Removing the Picker /Translate Frame" to remove the picker and translate frame.
3. Grip the rope tensioner at the rear of the frame and raise all three rope tensioners up far enough to position the rear rope tensioner and rope coupler at a convenient working height.

Figure 5–34 Slave Rope Tensioner Assembly

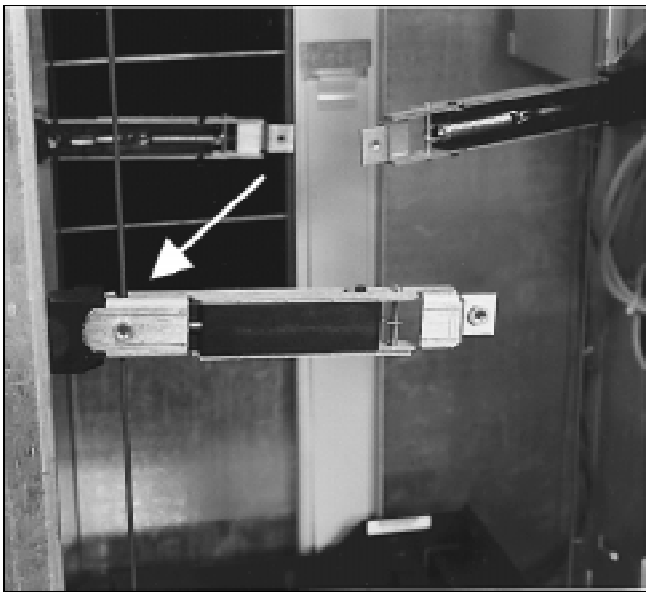
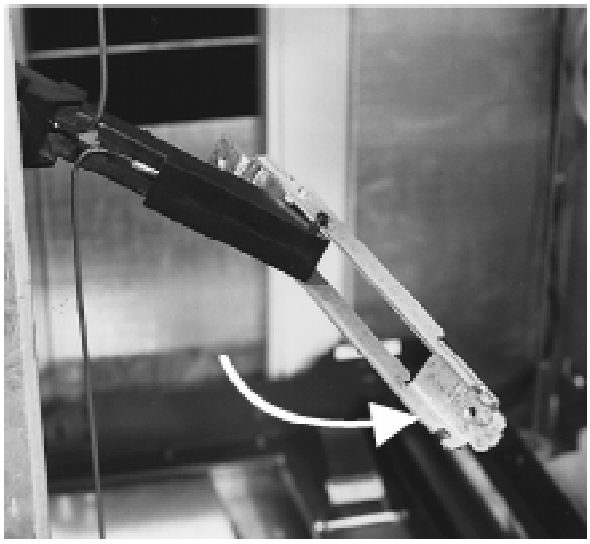


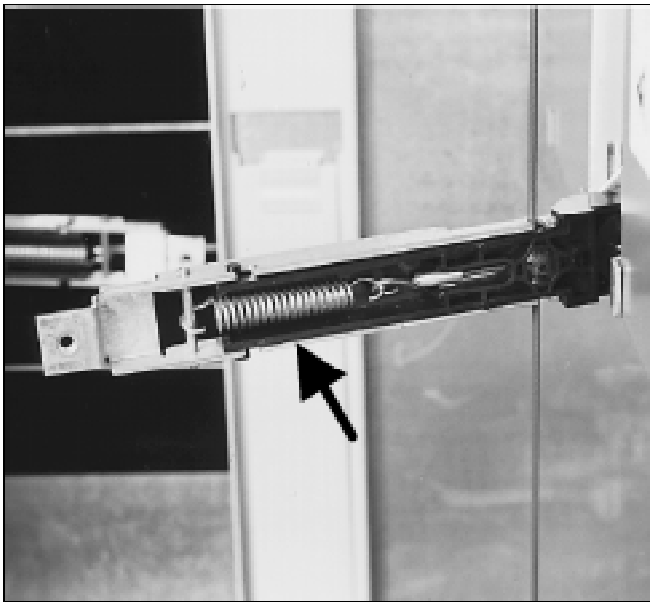
Figure 5–35 Pivoting The Tensioner Lever To Release Tension



4. Release the tension on the rear rope tensioner (drive rope). Grip the rope tensioner plastic section with one hand and pull back the metal section with your other hand to release the metal securing tab seated in the plastic section. The metal section will swing out and off pivoting pegs on the plastic section.
5. Take the drive rope off the top two pulleys.
6. Unhook the rope tensioner spring from drive rope end and remove the drive rope end from the rope tensioner.
7. Remove the other end of the drive rope from the rope tensioner. The drive rope will now hang loose except for where it is connected to the rope coupler
8. Remove one T-15 screw from the rope coupler cover.

Figure 5–36 Taking The Drive Rope Off the Top Pulleys

Figure 5–37 Disconnecting the Drive Rope From a Tensioner



9. Remove the first two ropes from the rope coupler. The center (second) rope is the drive rope. It is not necessary to remove the rope coupler completely.

Figure 5–38 Two Ends of the Slave Rope in the Tensioner

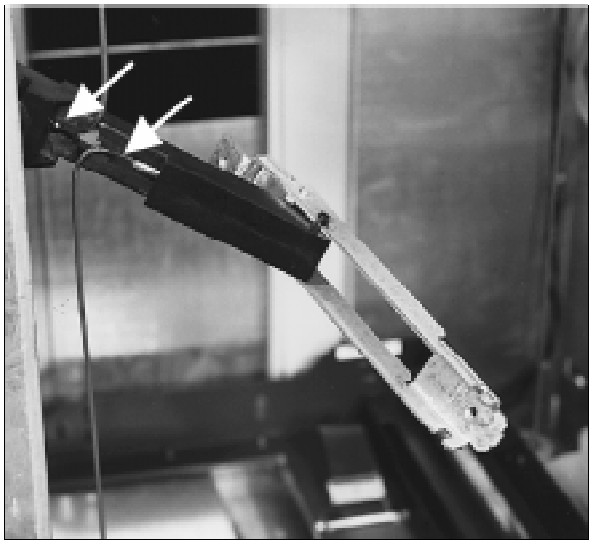
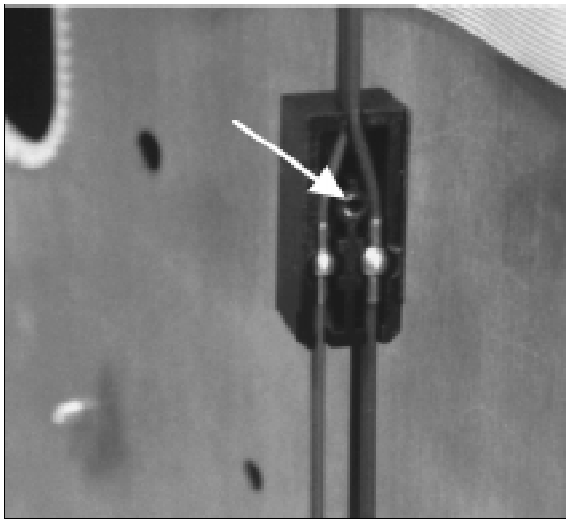


Figure 5–39 Disconnecting the 3-Rope Coupler



10. Remove the gear box. Remove one T-25 screw from the base of the gear box. Tip the gear box forward and lift it out. When gear box is removed, note the locating and securing slots on the base of the gear box opposite the screw hole.

Figure 5–40 Rear Side of Vertical Motor Gear Box

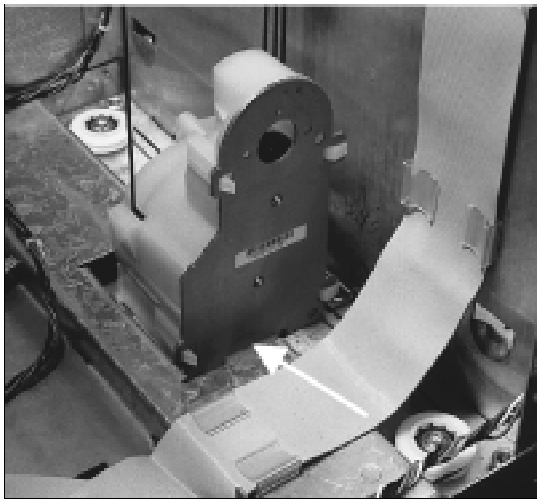
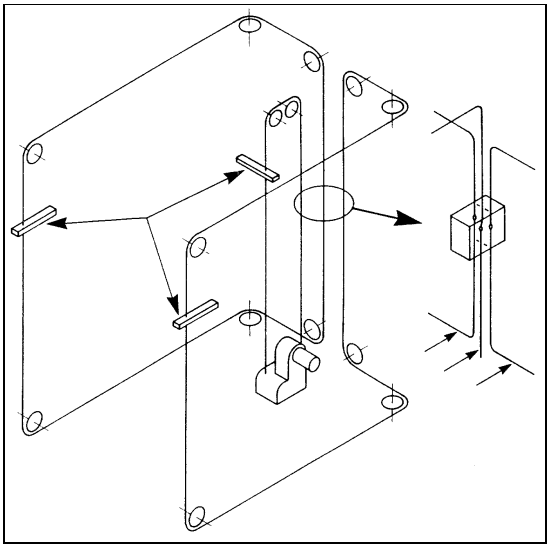


Figure 5–41 The Rope and Pulley System



Reassembly:

*When replacing the rear rope tensioner be sure that the tensioner `spring' area is positioned in such a way that it is facing you. This will insure that the rope tensioner is in the right position to fasten to the translate frame. To give yourself enough rope slack, fasten the drive rope ends to the rope tensioner *before* hanging the drive rope over the top two pulleys.*

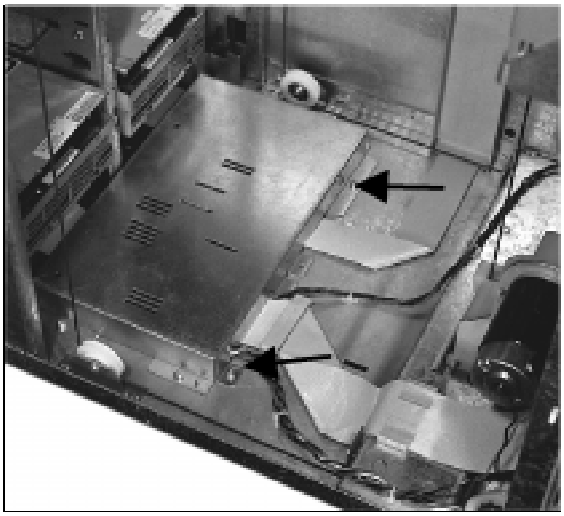
Before applying tension by setting the rope tensioners, insert the ropes into the rope coupler and attach the coupler cover plate.

Figure 5–42 Positioning the Tensioner to Mount on Translate Frame

Replacing the Controller PCA

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the rear access panel.
2. Remove the seven T-20 screws on the controller PCA cover. Note the two reference pin holes on the rear edge of the cover.

Figure 5–43 Controller PCA – Cover On



3. Disconnect the following cables from the controller PCA: SCSI cable, Power cable, Motor encoder and power cables, Picker cable.
4. Remove the seven T-20 screws from the controller PCA and remove the PCA.

Figure 5–44 Controller PCA – Cover Off

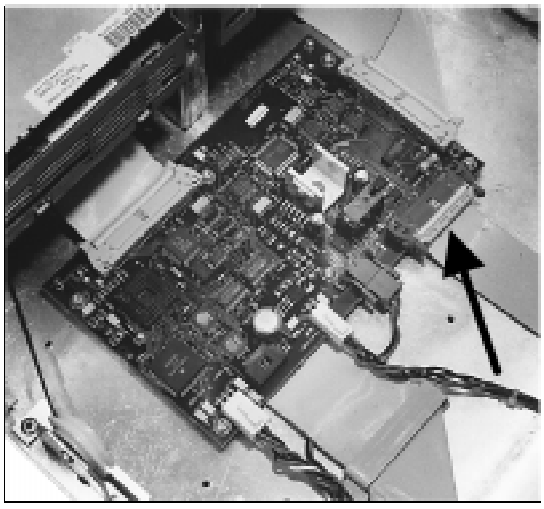
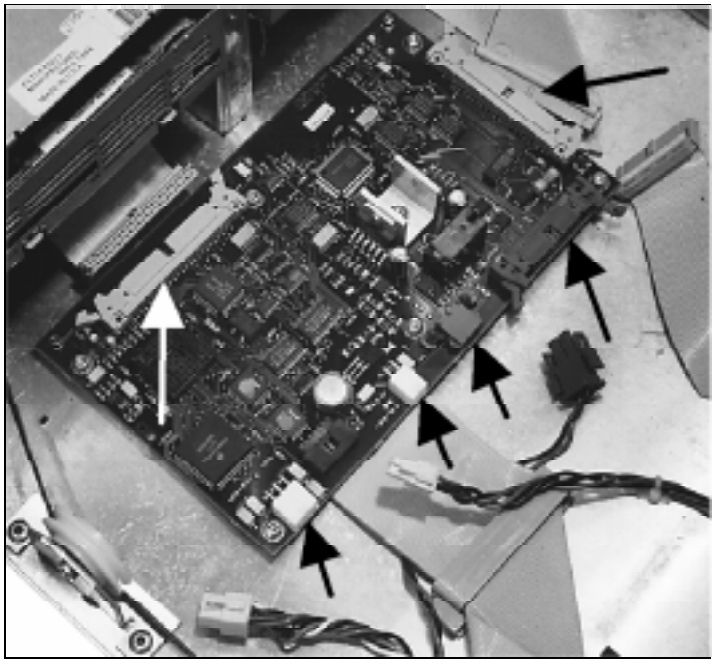


Figure 5–45 Controller PCA – Cables Off



5. After replacing the Controller PCA, re-initialize the NVRAM by executing tests *"SET DEFAULTS" & "CLEAR ODOMETERS"*. Reference section *"Re-initializing the Jukebox Controller PCA After Service"*.

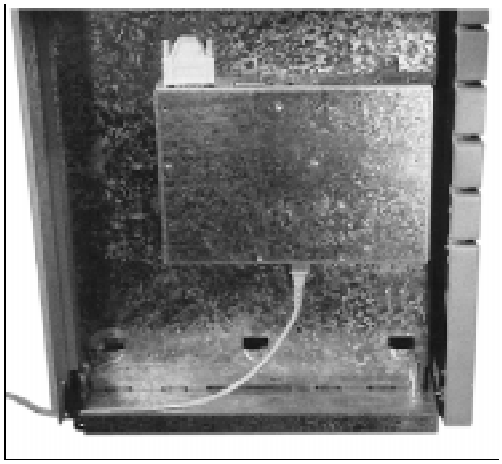
Replacing the Internal SCSI Cable

1. Follow the steps in the service access procedure at the beginning of this chapter to remove the rear access panel and right left side access panel.
2. Remove the SCSI cable.

   Follow the procedures in "Replacing the Controller PCA" and "Replacing an Optical Drive" to access the SCSI cable.
3. Remove the SCSI cable.

Replacing the SCSI Interface PCA

Figure 5–46 Interface/Power Distribution Assembly



1. Follow the steps in the service access procedure at the beginning of this chapter to remove the left side lower access panel.
2. Remove the two T-20 screws holding the interface PCA/power distribution PCA cover.

Figure 5–47 SCSI Converter/Repeater PCA; Power Distribution PCA (Below)

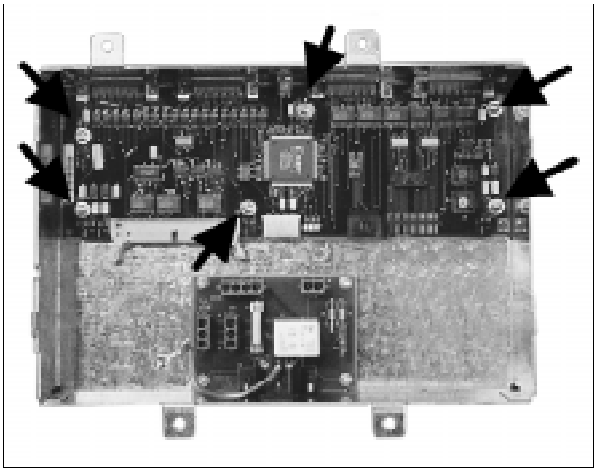
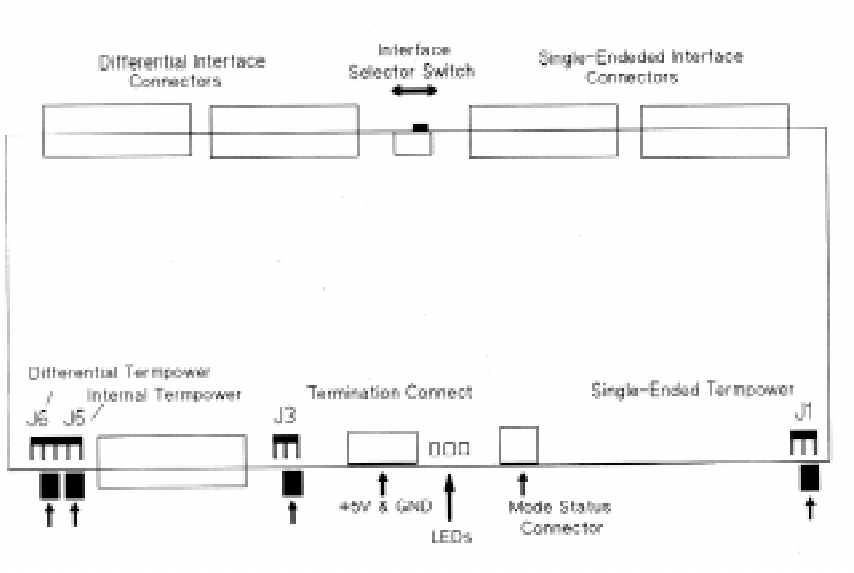


Figure 5–48 SCSI PCA Jumpers



3. Disconnect the cables to the PCA.
4. Remove the six T-15 screws holding the PCA.

Re-initializing the Jukebox Controller PCA RAM After Service

All the RAM on the autochanger controller PCA is kept alive through a charged capacitor, and is, therefore, relatively non-volatile. If this RAM is backed up to flash EEPROM after any changes, the values are held permanently. If not backed up to flash EEPROM, information bleeds off in approximately 10 to 60 days.

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 the "Set Defaults" and "Clear Odometers" configurations.

NVRAM must be re-initialized after replacing the autochanger controller PCA, after updating or changing the autochanger controller PCA firmware, and after replacing a drive mechanism. This is done by selecting and executing both the "Set Defaults" and "Clear Odometers" configurations on the control panel.

Also, the jukebox should be power cycled after setting these configurations so that an automatic execution of ISTAT will occur. This re-establishes which slots are full and which are empty.

Variables set by "Set Defaults"

- SCSI address of the autochanger
- Configurable options set to system defaults (ROM-dependent)
  - whether the autochanger should report recovered errors
  - whether the autochanger should rotate the mailslot inwards when in secure mode
  - 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
- Power fail variables
  - whether the last move that was started is set to FALSE
  - clear the state of the last move
- Security variables
  - clear Unit Reserved
  - clear Prevent Media Removal for each SCSI ID
- Element Status variables
  - clear exception bits
  - clear element reservations
  - empty/full status of all storage slots (ISTAT needed)

- Clear autochanger logs
  - clear Soft Error Log
  - clear Hard Error Log
  - clear Recovery Error Log)
- Reset the password to 0,0,0

Variables set by "Clear Odometers"

- Reset the move odometer to zero
- Reset the flip odometer to zero
- Reset the translate odometer to zero
- Reset the mailslot rotation odometer to zero
- Reset the number of power-on hours to zero
- Reset the number of loads to each drive to zero

Field Replaceable Units (FRU) in the (*Medium*) Library

Table 5–1 is a list of FRU's in the Large Optical Disk Library. The information includes a cross-reference between Digital and vendor part numbers, a description of the unit, the standard cost in US $, the Mean Time Between Failures for the assembly in hours (x 1000), and the repair cost in US $.

Table 5–1 List of Field Replaceable Units

Digital P/N	Vendor P/N	Description	Uniq Y/N	R&R Y/N	Std. US$	MTBF (KHrs.)	Repair Cost US$
RWZ53-AA	C1113-Opt 728	4x MO Drive	N	Y	1516.00	80	see next
RWZ53-AA	5063-xxxx	4x Exchgd Drive	N	Y	N/A	80	942.50
29-33416-01	C1100-60229	Mailslot Assy	Y	Y	130.00	150	*
29-33417-01	5063-2784	Svr Ctrl PWA (half)	Y	Y	286.00	100	*
29-33418-01	5063-2785	Svr Ctrl PWA (full)	Y	Y	2795.95	100	see next
29-33418-01	5063-2786	Svr Ctrl PWA (full-repaired)	Y	Y	N/A	100	286.00
29-33421-01	C1170-60004	Interposer PWA	Y	Y	264.00	125	*
29-33427-01	C1170-60308	LUN Conv /Repeater Assy	Y	Y	371.25	100	*
29-32792-01	C1160-60022	Display Assy	N	Y	143.00	200	*
29-32793-01	C1160-60023	Vert. MotorGear-box Assy	N	Y	107.25	150	*
29-32794-01	C1160-60024	V. Motion Motor	N	N	91.00	150	N/A
29-32797-01	C1160-60027	Dual-Picker Assy	N	Y	253.50	150	*
29-32798-01	C1160-60028	Pwr Supply (200 w), 5/12V	N	Y	234.00	200	*
29-32800-01	C1160-60033	Pwr Supply (120 w), 24V	N	Y	169.00	200	*
29-32812-01	C1160-60051	Main Harness	N	Y	130.00		*
29-33423-01	C1170-60054	Cable, Dr. Pwr	Y	N	17.60		N/A
29-32814-01	C1160-60057	Vert. Path CLR Sensor Cable	N	N	22.75		N/A

* Reflects parts under one-year warranty from Hewlett Packard.

Table 5–1 List of Field Replaceable Units (continued)

Digital P/N	Vendor P/N	Description	Uniq Y/N	R&R Y/N	Std. US$	MTBF (KHrs.)	Repair Cost US$
29-33424-01	C1170-60059	Cable, Internal SCSI	Y	N	23.10		N/A
29-33425-01	C1170-60062	Drv. I/O Cable	Y	N	25.30		N/A
29-32817-01	C1160-60065	Cable, Front Panel	N	N	8.12		N/A
29-33426-01	C1170-60066	Interposer Cable	Y	N	25.85		N/A
29-33047-01	C1160-60080	R. Panel Stby Pwr Sw. Cable	N	N	15.95		N/A
29-32518-01	C1100-60026	Magz. Guides	N	N	68.25		N/A
29-32795-01	C1160-60025	Idler Pulley Assy	N	N	0.78		N/A
29-32796-01	C1160-60026	Magazine	N	N	18.20		N/A
29-32799-01	C1160-60030	Encoder Strip	N	N	23.40		N/A
29-32801-01	C1160-60034	Slave Rope	N	N	28.60		N/A
29-32802-01	C1160-60035	Xlate Rope	N	N	13.33		N/A
29-32803-01	C1160-60036	Coupler Assy	N	N	4.23		N/A
29-32804-01	C1160-60037	Tensioner Assy	N	N	5.69		N/A
29-32809-01	C1160-60043	Xlate Umbilical PCA	N	N	29.46		N/A
29-32810-01	C1160-60046	Cap Roller Assy	N	N	20.80		N/A
29-32811-01	C1160-60048	Fan	N	N	18.85		N/A
29-32819-01	C1160-60083	Vert. Umb. Channel Cable	N	N	15.93		N/A
29-33045-01	C1160-60074	Enclosure Kit	N	N	426.25		*
29-33046-01	C1160-60078	Window Cover	N	N	25.85		N/A
29-33419-01	C1160-60086	AC SW Board	Y	N	56.88		N/A
29-33420-01	C1163-60022	DISP Assy Blk Key	Y	N	143.00		*
29-33422-01	C1170-60047	Drv. Brkt. Assy	Y	N	93.50		*
29-33428-01	C1173-60059	Internal Drv. SCSI Cable	Y	N	13.75		N/A

Recommended Service Kits

The initial recommended service for the optical jukebox includes the exchange parts list and the non-exchange parts list for stocking at a field-level office.

NOTE

The "x" in the part numbers listed in the following parts tables represents a number from "0" to "9" depending 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 increments to "1"; the second time the part is revised, the number increments to "2", and so on.

If you are unsure of the current part number, enter a "0" or a "1" in place of the "x" when checking your parts database and the current part number will be displayed.

Table 5–2 Exchange Parts

FRU No.	Part Number	Description	Version: SCSI or LAN
1	C1170-69x01	Autochanger Controller PCA (4X-drive, full capacity jukeboxes only)	- SCSI
2	C1113-69x00	4X Optical Drive Mechanism	- SCSI
8	C1170-69x08	SCSI Single-Ended/Differential Repeater/Converter PCA	- SCSI

Table 5–3 Non-Exchange Parts (See Figure 5–49)

FRU No.	Part Number	Description	Version: SCSI or LAN
1	C1153-60x01	Half-Capacity Autochanger Controller PCA (4X-drive)	- SCSI
4	C1170-60x04	Interposer PCA (4X-drive)	- SCSI
8	C1170-60x08	SCSI Repeater/Converter/LUN PCA (4X-drive versions)	- SCSI
22	C1160-60x22	Display Assembly	- SCSI
23	C1160-60x23	Vertical Motor Gearbox Assembly	- SCSI
24	C1160-60x24	Vertical Motion Motor	- SCSI
25	C1160-60x25	Idler Pulley Kit	- SCSI
26	C1100-60x26	Magazine (pair) 8-slots	- SCSI
27	C1160-60x27	Dual Cartridge Picker	- SCSI
29	C1100-60129	Mailslot Assembly	- SCSI
30	C1160-60x30	Encoder Strip	- SCSI
31	C1160-60x26	Magazine (pair) 6-slots	- SCSI
32	C1160-60x28	Power Supply (200W, 5/12V)	- SCSI
33	C1160-60x33	Power Supply (120W, 24V)	- SCSI
34	C1160-60x34	Slave Rope	- SCSI
35	C1160-60x35	Translate Rope	- SCSI
36	C1160-60x36	Coupler Assembly	- SCSI
37	C1160-60x37	Tensioner Assembly	- SCSI
39	C1160-60x39	Encoder Mount	- SCSI
40	C1160-60x40	Transport Frame	- SCSI
41	C1160-60x41	Vertical Umbilical Cable	- SCSI
42	C1160-60x42	Mount Guide - Slider	- SCSI
43	C1160-60x43	Transport Umbilical Cable	- SCSI
46	C1160-69x46	Capture Roller Assembly	- SCSI
47	C1160-60x47	Drive Bracket (2) (2X-drive versions)	- SCSI
47	C1170-60x47	Drive Bracket (4) (4X-drive versions)	- SCSI
48	C1160-60x48	Fan	- SCSI
51	C1160-60x51	Main Power Harness	- SCSI

Table 5–3 Non-Exchange Parts (continued)

FRU No.	Part Number	Description	Version: SCSI or LAN
54	C1160-60x54	Drive Power Cable (2X-drive versions)	- SCSI
54	C1170-60x54	Drive Power Cable (4X-drive versions)	- SCSI
57	C1160-60x57	Vertical Path-Clear Sensor Cable	- SCSI
59	C1173-60x59	Internal SCSI Cable (4X-drive versions)	- SCSI
61	----------	RJ-45 Cable (although FRU 61 may be seen in diagnostic display on the control panel, the cable does not exist in this jukebox).	---------
62	C1170-60x62	Drive I/O 4X Cable (4X-drive versions)	- SCSI
63	----------	AIU Cable (although FRU 63 may be seen in diagnostic display on the control panel, the cable does not exist in this jukebox).	---------
65	C1160-60x65	Control Panel Cable	- SCSI
66	C1160-60x66	Interposer Cable	- SCSI
74	C1160-60x74	Enclosure Panels Kit - standard color	- SCSI
78	C1160-60x78	Cover Window	- SCSI
80	C1160-60x80	Right Panel Standby Power Switch Cable	- SCSI
83	C1160-60x83	Vertical Umbilical Cable Channel	- SCSI
86	C1160-60x86	AC Switch PCA	- SCSI

Figure 5–49 Jukebox Exploded View (1 of 2)

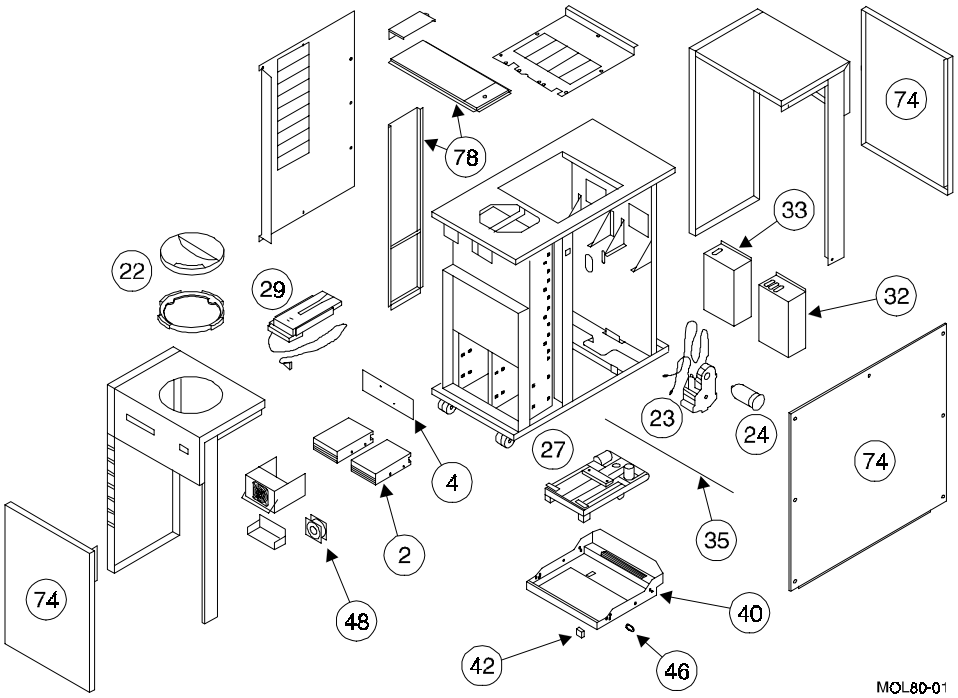
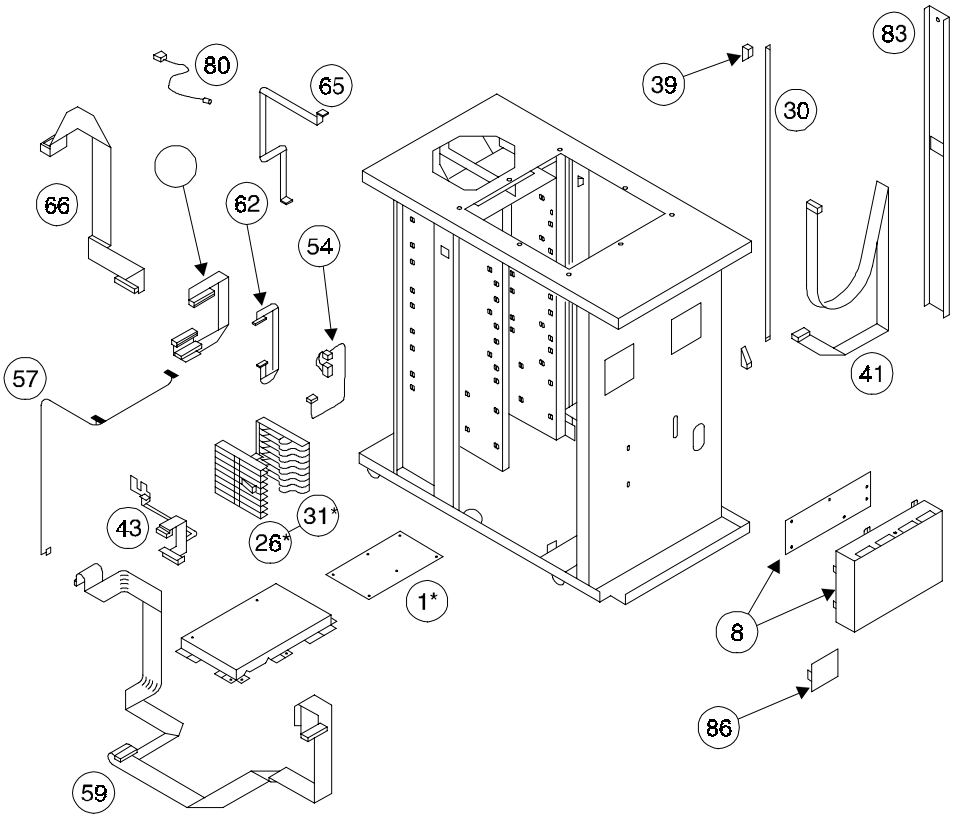


Figure 5–49 Jukebox Exploded View (2 of 2)



* 6-slot magazines (26) used in bottom positions on 76-slot version (100st and 200fx)

* 8-slot magazines (31) used in 32- and 64-slot versions (40st &80st, 80fx & 160fx)

MOL80-02

Figure 5–50 Jukebox Power Harness

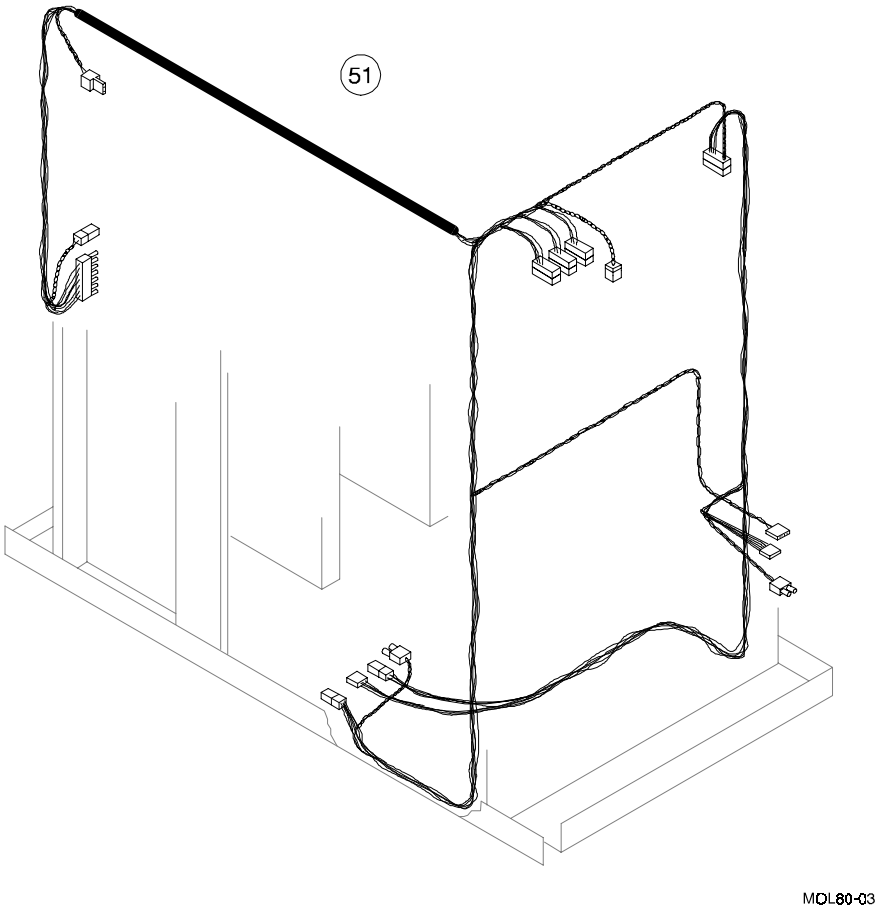
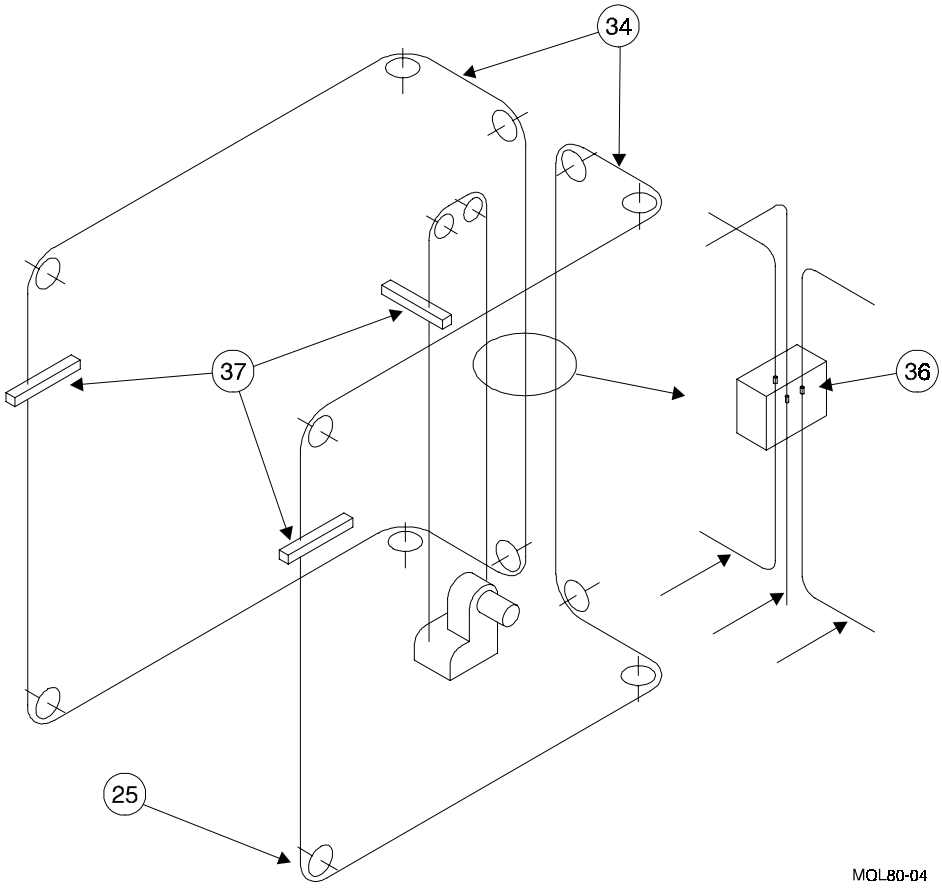


Figure 5–51 Jukebox Pulley and Rope Diagram



Miscellaneous

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

Table 5–4 Common Resource Parts

Item	HP Part Number
1 m (3.3 ft.) SCSI cable; high density with thumb screws (50 pin) to low-density with bail lock (50 pin), m-to-m	K2296
1.5 m (4.9 ft.) SCSI cable; high density with thumb screws (50 pin) to low density with bail lock (50 pin), m-to-m	K2297
1 m (3.3 ft.) SCSI cable; high density with thumb screws (50 pin) to high density with thumb screws (50 pin), m-to-m	C2908A
0.5 m (1.6 ft.) SCSI cable; high density with thumb screws (50 pin) to high density with thumb screws (50 pin), m-to-m	C2955A
1.5 m (4.9 ft.) SCSI cable; high density with thumb screws (50 pin) to high density with thumb screws (50 pin), m-to-m	C2956A
2 m (6.5 ft.) SCSI cable; high density with thumb screws (50 pin) to high density with thumb screws (50 pin), m-to-m	C2957A
5 m (16.5 ft.) SCSI cable; high density with thumb screws (50 pin) to high density with thumb screws (50 pin), m-to-m	C2958A
Single-ended SCSI terminator, 50-pin, high density, active	1250-2548
Differential SCSI terminator, 50-pin, high density	1252-6492
Fan grill	3260-0444
Eject tool (2X drive)	C1701-88803
Optical disk media cleaning kit	C1700-88800
Optical disk cleaner accessory kit (extra swabs and alcohol)	C1700-88801

6

Theory of Operation

This chapter discusses the following aspects of the robotics of the Medium Optical Disk Library RW551 and RW552 jukeboxes.

- Autochanger Command Execution and Mechanics
- Autochanger Controller PCA
- Interposer PCA
- Power Supply
- Optical Disk Drive
- Autochanger Error Detection
- Diagnostic Strategy
- SCSI Interface

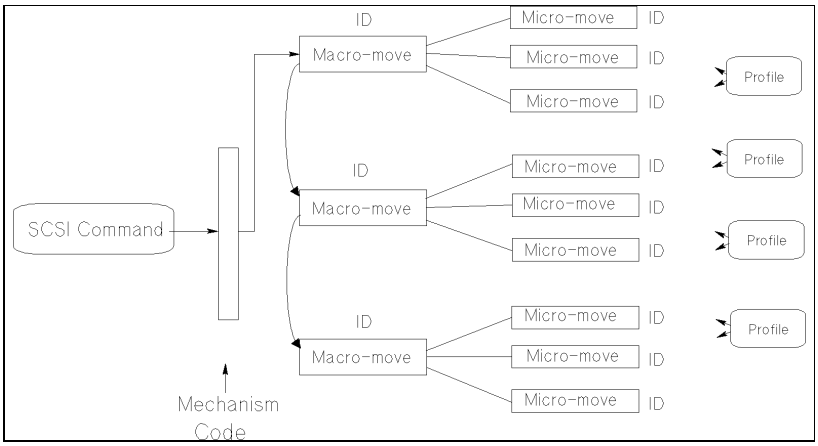
Autochanger Robotics

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 SCSI-2 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 jukebox the macro-moves are as follows.

- move carriage – position the picker transport to a specific vertical position
- 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 to rotate the mailslot assembly toward and away from the user.

For example. "Move element 33 to element 2 with flip" is transformed into the following sequence of autochanger functions.

1. Determine that element 33 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.

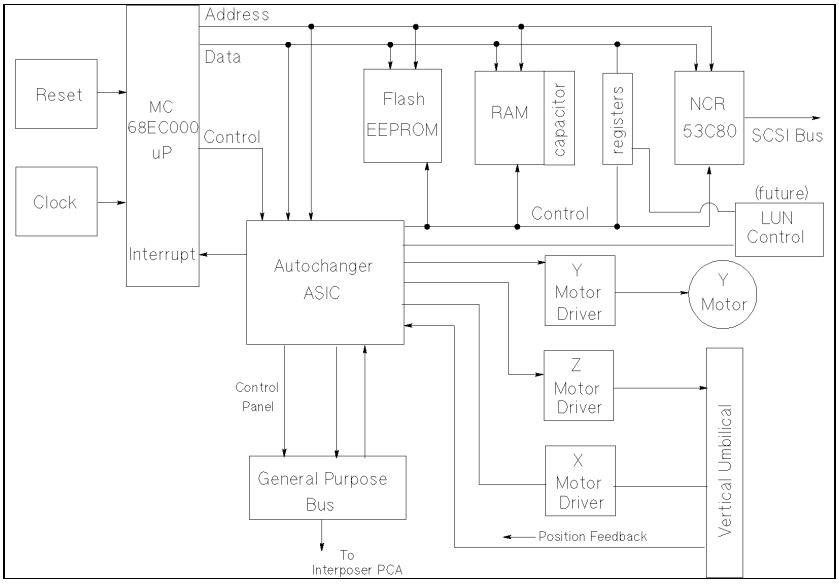
Each micro-move within a specific macro-move has a unique set of stability, performance, error recovery, force, and reliability criteria. Therefore, each micro-move is assigned a unique identification code (ID) which is used to determine how the move should be performed.

The Autochanger Controller PCA

The autochanger controller PCA contains the following major components:

- microprocessor
- autochanger ASIC
- NCR 53C80 Chip (SCSI bus control)
- flash EEPROM
- RAM
- SCSI interface

Figure 6–2 Autochanger Controller PCA Block Diagram



The MICROPROCESSOR is a Motorola MC68EC000 running at 12.288 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, RAM with standby power supplied by a capacitor, and ROM.

The AUTOCHANGER APPLICATION-SPECIFIC INTEGRATED CIRCUIT (ASIC) provides the processor interface, programmable features, and a servo system.

The processor interface functions are: decoding the processor's address space, and generating select and strobe signals to give the processor access to the flash EEPROM, RAM, the SCSI controller, internal registers, I/O ports, and optional external registers. Also, the processor interface function of the chip includes the handling of internally- and externally-generated interrupt sources.

The programmable features section of the chip provides a control panel display state machine and firmware-configurable feature and general-purpose ports.

The servo system section of the chip provides servo timers, three motor control pulse-width modulators, and three quadrature encoder channels.

The General Purpose Bus is controlled by the ASIC. This bus provides access to registers located on other PCAs. This bus is primarily used for the drive interface.

Drive interface signals EJECT and BUSY are also handled by this chip.

The ASIC is also the interface between the processor and the motors. The ASIC monitors the position encoders and uses that information to increment or decrement counters on the chip. The ASIC also provides pulse width modulation (PWM) output signals to drive the motor circuitry.

All SCSI signals are handled by the NCR 53C80 chip under control of the MC68EC000 processor and the Autochanger ASIC chip.

FLASH EEPROM— The controller firmware resides in two flash EEPROMs. These flash EEPROMs allow new firmware versions to be downloaded to the controller in the field.

RAM— The two RAM chips are special, low-power CMOS static RAMs. A standby capacitor on the PCA takes over powering these chips if main power is lost. The chips remain in standby mode (from about 10 to 60 days), providing a non-volatile memory storage capability when the unit is powered off.

The X,Y, and Z MOTOR CONTROL DRIVERS take the pulse-width modulated signals from the motor control chip and change them into power signals for the translate, vertical, and plunge motors.

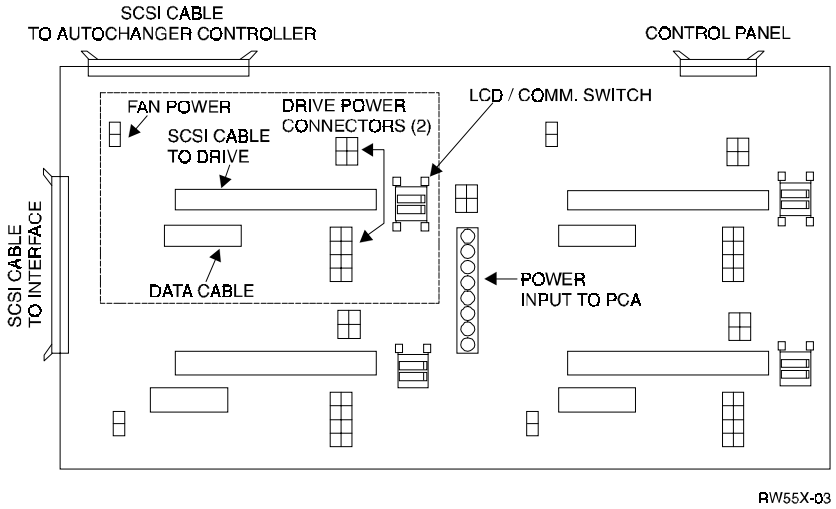
Motor position is by returned through the vertical umbilical cable. The translate motor position is determined by a photomicro sensor on the picker PCA. The plunge motor position is determined by an optical encoder mounted on the motor itself. The vertical position is determined by an optical strip encoder located on the translate frame.

The CONTROL PANEL INTERFACE provides a serial data interface and power for the display.

Interposer PCA

This PCA provides the drive interface to control the loading and unloading of the optical disk drives from the controller PCA. Drive status is read from here and all ejects are issued from registers on this PCA.

Figure 6–3 Interposer PCA



The drive register interface is read by the controller through the 50-pin cable connector. The cable connector on the top edge of the interface is a controller PCA pass-though connection to the control panel.

Power and data connections for four drives are installed on all jukeboxes, whether four drives are installed or not. Installing cables in this way prepares two-drive units for possible upgrade to four-drive units. Two sets of two 20-pin data connectors and two sets of 8-pin power connectors are installed on the PCA.

An input connector and two output connectors route fan power to the fans located just above the PCA. If neither of the fans are plugged in to the interposer PCA or are inoperative, the 5/12V power supply will shut down. Loss of fans is detected in the 5/12V power supply; not on the interposer PCA.

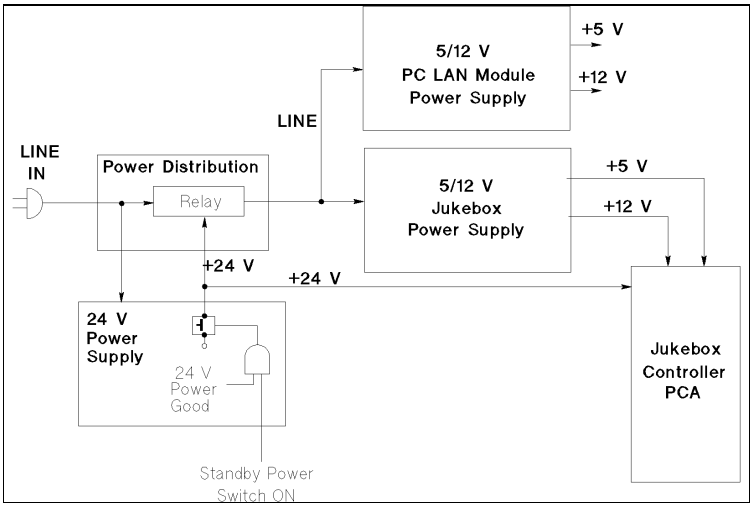
There is a mailslot status connector on the left side and a connector to route power to the two picker vertical path clear (starwars) transmitters.

Power Supplies

There are two power supplies, both autoranging.

One supplies +5 volts at 15 amperes and +12 volts at 10 amperes. This supply powers the drives and the autochanger logic. The other supply provides +24 volts at 5 amperes. This supply powers the motors.

Figure 6–4 Power Supplies and Power-on Sequence



Line power is connected through the power distribution PCA in the interface (or LAN module) enclosure. Connection is direct to the 24-volt power supply.

When the 24-volt power supply comes up and is good, AND if the power standby switch on the right side of the jukebox is in the ON position, the output of the 24-volt power supply is enabled. The 24-volt output closes the relay on the power distribution PCA, allowing line power to be applied to the 5/12-volt power supply for the jukebox (and the LAN-connect power supply, depending on the model).

The 24V power supply is equipped with a fan-detect circuit that turns the supply off if the fans over the drives stop operating.

SCSI Repeater/Converter/LUN PCA – 4X Versions

Internally, the jukebox has a single-ended SCSI bus. Through a repeater/converter PCA, it can connect to either a single-ended or a differential external bus.

See the following diagram:

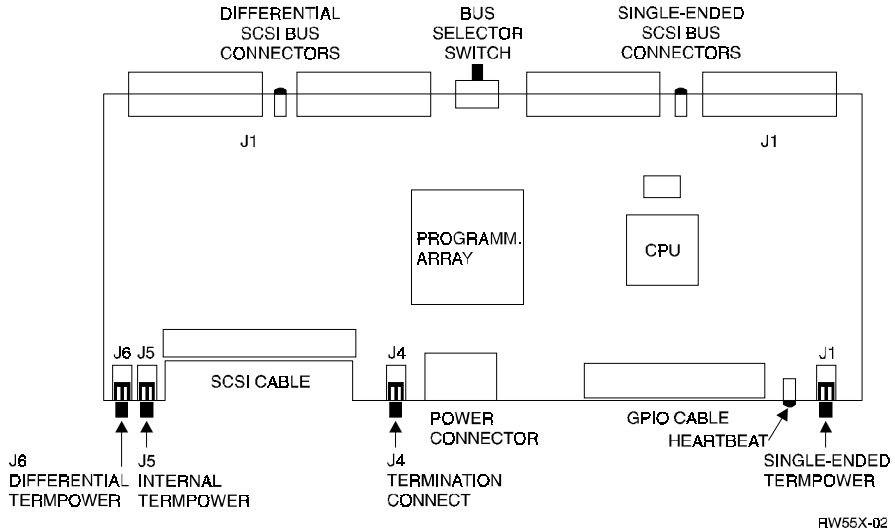
The autochanger communicates to the PCA through a GPIO bus.

The differential and single-ended connectors are on the top of the PCA and the single-ended bus connection to the jukebox are on the bottom. A slider switch between the two external connectors selects which type of input will be accepted.

Four jumpers select the configuration for termination alternatives (listed from left to right as seen at the bottom of the diagram):

- J6 – enable/disable differential host TERMPOWER. PIN 1 and 2 jumpered together allows the PCA to provide TERMPOWER to the differential external [host] SCSI bus (default).
- J5 – enable/disable internal bus TERMPOWER. PINS 1 and 2 jumpered together allows the PCA to provide TERMPOWER to the internal SCSI bus (default).
- J4 – bus terminator configuration. PIN 1 and 2 jumpered together enable bus termination (default). When enabled, active termination is supplied for the internal bus at this PCA; termination at the other end of the SCSI cable is by a clamp terminator attached to the SCSI cable near the last drive connection.
- J1 – enable/disable single-ended host TERMPOWER. PIN 1 and 2 jumpered together allows the PCA to provide TERMPOWER to the single-ended external [host] bus (default).

Figure 6–5 SCSI Repeater/Converter/LUN PCA – 4X-Drive Versions



The two large components on the PCA are the Field-Programmable Gate Array and the microprocessor. The microprocessor is an 80C52 that has flash-programmable memory on board. (There are no boot ROMs on this PCA). The chip can be programmed, however it must be disconnected from the PCA to do so. The Field-Programmable Gate Array can not be programmed.

After the jukebox runs its self test on wakeup, it instructs the SCSI PCA to come up in whichever mode has been selected by the user. It can come up either as a repeater or in the LUN mode. Communication from the autochanger controller is through the GPIO bus cable. (If the GPIO cable is not connected at start up, the PCA will come up as a repeater).

A “heartbeat” LED is located on the bottom edge of the board. This LED will continuously flash at a slow rate when power is applied. If the LED is either on steady, or off, this indicates a problem with the PCA.

In repeater mode, the SCSI PCA looks transparent on the bus and passes all SCSI transactions through. The interface type may also be converted from single-ended to differential if that is the interface selected by the slide switch on the top of the PCA.

A LED, visible through the top of the interface enclosure, is mounted between the interface connectors on each side. These LEDs light to show which interface has been selected. If the wrong interface type is connected to the interface connector on this PCA, the LED will continuously and rapidly flash to alert the user to this error. No damage is caused to the chips on the PCA by having connectors in the wrong position.

During powerup, the position of the interface selector switch is checked to see which external bus is active and if the proper bus type is on the selected interface port.

If the differential bus is active, the DIFFSENSE signal on the SCSI bus is checked. If this signal is LOW, it means that a single-ended bus has erroneously been connected to the differential connector. The bus is immediately made inactive, to protect the chips.

In addition to checking the position of the interface select switch on power up, the controller is informed of any change to this switch during normal operation. If the switch position is changed, a BUS RESET signal is sent to the autochanger on the internal SCSI bus.

NOTES

It is important to provide proper termination on whichever external SCSI bus (single-ended or differential) that is in use. If the SCSI bus is not being daisy-chained to another peripheral (and terminated there) then termination must be provided at this PCA.

Single-ended and differential SCSI terminators are different.

NOTE

The unused ports can either have external cables/terminators connected to them or not.

Picker

The picker is capable of holding two disk cartridges at once. Its two thumbs can be addressed in two ways. One way is to address the picker in single-picker mode, and the second way is to address the picker in dual-picker mode.

Single-Picker Mode

In single-picker mode, the picker is addressed as a single element number. The driver cannot address each thumb individually; the firmware makes the best choice for which thumb to use.

SCSI commands, such as Read Element Status and Mode Sense, report back a single element address for the transport element. In this jukebox, the single element address is 0.

Dual-Picker Mode

In dual-picker mode, each thumb on the picker is considered an element and is addressed individually by its own element number, 16 or 17.

Even though it is in dual-picker mode, the picker can also be addressed as a single element when the translate assembly is executing Exchange, Move and Position to Element commands. The translate assembly may be given the single element numbers of 0 (default), 16 or 17.

When moving cartridges where the source or destination element is the picker, each thumb must be addressed. One thumb is at element address 16 and the other thumb is at element address 17. The SCSI commands, such as Read Element Status and Mode Sense report back the two element addresses for the transport element.

Two-Move Exchange

In jukeboxes, where the picker is used in single-picker mode, exchanges are made using two moves.

The first move takes the cartridge from the drive, moves to the home slot, and puts the cartridge in its home slot. The second move takes a different cartridge from its home slot, moves it to the drive, and inserts the cartridge in the drive.

The following is a detailed description of the two-move exchange.

1. a) Move to the drive (destl).
   b) Eject the cartridge from the drive (spin down included).
2. Grab the cartridge from the drive.
3. Move the cartridge to its home slot (dest2).
4. Put the cartridge into the slot.
5. Move to the source slot.
6. Grab the cartridge from the slot.
7. Move to the drive.
8. Insert the cartridge into the drive.
9. Spin up the drive.

NOTE

Steps 1a and 1b occur simultaneously. Both must complete before step 2 occurs.

The two move exchange can be performed by executing these two moves:

1. Move from destl to dest2.
2. Move from source to destl.

The drive exchange time is the time it takes to execute steps 1 through 8. The drive down time is the time it takes to execute steps 1 through 9. When using the two move exchange, everything is performed serially. A step cannot begin until the previous step has completed.

Dual-Picker Exchange

Using dual-picker mode, true disk exchanges can occur. The picker gets the source cartridge from its home slot, moves it to the drive, EXCHANGES the cartridge with the cartridge in the drive, and then puts the cartridge that was in the drive in its home slot.

The advantage of using the exchange comes from the ability to spin the drive up and down simultaneously with other moves. Below is a detailed description of this type of exchange.

NOTE

Step 1a and 1b occur simultaneously. Step 1b must complete before Step 2 begins. Step 1b must complete before Step 4 begins.

Steps 6a and 6b occur at the same time. Both must complete before step 2 occurs. Step 6a must complete before Step 7 begins.

1. a) Move to the source slot.
   b) Eject the cartridge from the drive(spindown).
2. Grab the cartridge(source) from the slot.
3. Move to the drive(destl).
4. Grab the cartridge from the drive.
5. Insert the cartridge(source) into the drive.
6. a) Move to the cartridge's home slot(dest2).
   b) Spinup the drive.
7. Put the cartridge into the slot.

The exchange is performed by the following command:

```
Exchange source destl dest2.
```

The drive exchange time is the time it takes to execute steps 1 through 7, but there is no waiting for the drive to spin up. The drive down time is the time it takes to execute steps 1 through 6b, waiting for the spinup to complete on step 6b. Several steps occur in parallel during a dual-picker exchange. First, while the picker is getting the source cartridge, the drive is spinning down and ejecting. Second, while the picker is putting away the cartridge that was in the drive, the drive is spinning up.

Quick Exchange

A "quick exchange" is also possible when operating in dual-picker mode. A quick exchange is just an exchange from one thumb of the picker, to the drive, and then to the other thumb of the picker.

To do a quick exchange, the driver in the host has to be smart enough to see an "exchange sequence" coming up and issue serial commands in an order that minimizes the drive downtime.

The driver must get the source cartridge into the picker, and, while still allowing processes to access the drive, move the picker to the drive.

After the picker arrives in front of the drive, an Exchange command must be sent that takes the cartridge from the drive into the empty thumb, and then inserts the new disk into the drive from the other thumb.

Then the drive is spun up. After the drive is spun up, the disk in the picker may either be returned to its home slot or retained in the picker for the next exchange. Below is a detailed description of this type of exchange.

1. Move to the source slot.
2. Grab the cartridge from slot.
3. Move to the drive.
4. Eject the cartridge from the drive (spindown).
5. Grab the cartridge (destl) from the drive.
6. Insert the cartridge (source) into the drive.
7. Spinup the drive.
8. Move to the home slot(dest2).
9. Put the cartridge into the home slot.

The quick exchange is performed by executing the following sequence:

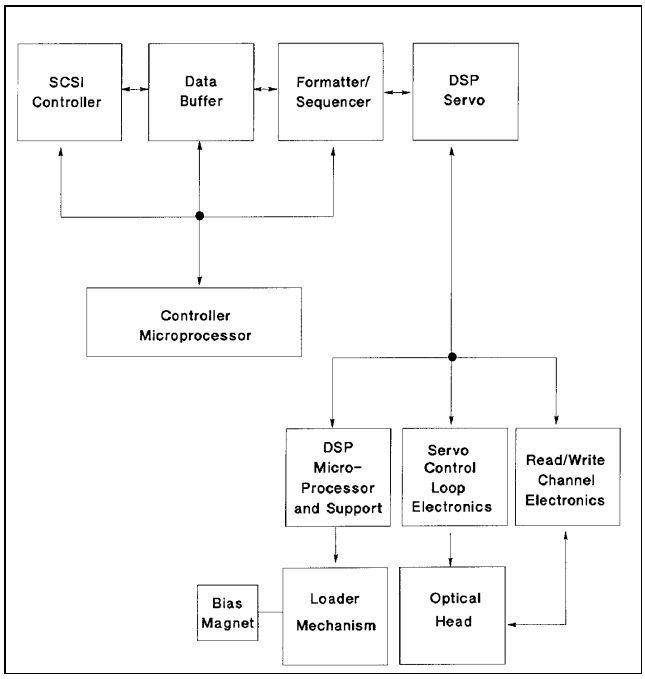
1. Move from source to pickerl.
   Position to element destl(the drive).
2. Exchange picker_thumb1 desti picker_thumb2.
3. Move from picker2 to dest2.

The drive exchange time is the time it takes to execute steps 4 through 6. This does not include the time to get the source cartridge, or put away the dest2 cartridge.

The drive down time is the time it takes to execute steps 4 through 7, waiting for the drive to spin up. The drive's downtime is mainly a function of the drive's spinup/spindown time. This type of exchange is useful only on drives with short spinup/spindown times.

The Multifunction Optical Drive and Drive Controller

Figure 6–6 Functional Diagram



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

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.

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.

Data Buffer

The data buffer and associated control electronics provide a buffer to speed match transfers to and from the host computer and the optical disk. The data buffer provides a cache for read and write operations, optimizing the speed of these transfers. The RWZ52 drive contains 512 Kbytes of buffer RAM.

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. The formatter converts the 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.

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.

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

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.

Mechanism Assembly

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.

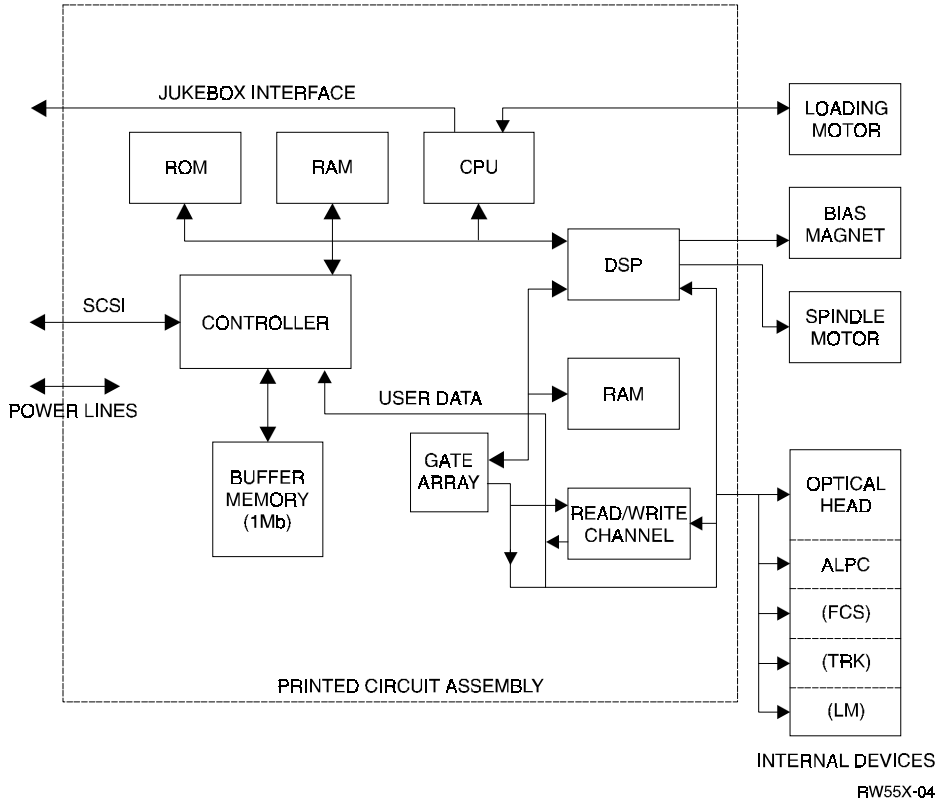
Optical Head

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

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

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

Figure 6–7 4X-Drive Functional Diagram



Optical Disk Layout and Error Correction

Disk Formats

Two optical disk formats are available. The RWZ53 optical drive can read from and write to both 650-Mbyte and 2.6-GByte optical disks. The target's role is to manage the 130 mm multifunctional drive and disk as an optical memory device through its SCSI interface. These optical drive supports 130 mm 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 and the drive also supports the ECMA 184 standard for 2.6-GByte capacity, both rewritable and write-once.

The following sections outline disk layout for the 650-Mbyte and 1.3-GByte optical disks. Throughout this section, the sector number is that of a 1,024 bytes/sector disk. The value of a 512 bytes/sector disk is written inside parentheses just after the value for the 1,024 bytes/sector disk.

Controller

The controller is a highly-specialized integrated circuit that handles SCSI control, data buffering, and encode/decode.

The data buffer function provides a buffer to speed match transfers to and from the host computer and the optical disk. The data buffer provides a cache for read and write operations, optimizing the speed of these transfers. The C1113 uses a one-megabyte buffer memory.

This 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.

The encode/decode function encodes and decodes data for read and write transfers. During a write function user data is sent via the SCSI bus. The encoder converts the 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.

CPU

The central processing unit processes all device functions including the loading motor.

Gate Array

This component contains circuitry to interconnect the major blocks (CPU, DSP, and write/read channel).

DSP (Digital Signal Processor)

The DSP controls 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 actuated.

Read/Write Channel Electronics

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

Loading Motor

The loading motor loads and unloads the optical disk cartridge. The loader motor includes a gear train and a rack and pinion system that allow the cartridge shuttle to raise and lower the cartridge within the loader housing.

Bias Magnet

The bias magnet subassembly sits on top of the cartridge shuttle and provides the correct polarity for erasing or writing data.

Optical Head

The optical head assembly contains both mechanical and electronic components and is a “slip optics” design. This design physically separates the laser diode and its associated detectors from the focus/fine position actuators, providing significant seek time performance advantage due to less mass on the moving portion of the optical head.

The actuators and laser diode (and associated detectors) are on a small PCA on the optical head assembly. The main components are as follows:

Auto Laser Power Control (ALPC)

Controls the intensity and duration of the laser beam for erase, write, and read operations.

Focus Servo (Fcs)

Controls the vertical motion of the objective lens to focus the laser beam on the disk surface.

Fine Tracking Servo (Trk)

Controls the horizontal motion of the objective lens to follow the track of the disk.

Linear Motor (LM)

Positions the actuator in the vicinity of the desired track on the disk.

Optical Disk Layout and Error Correction

Disk Formats

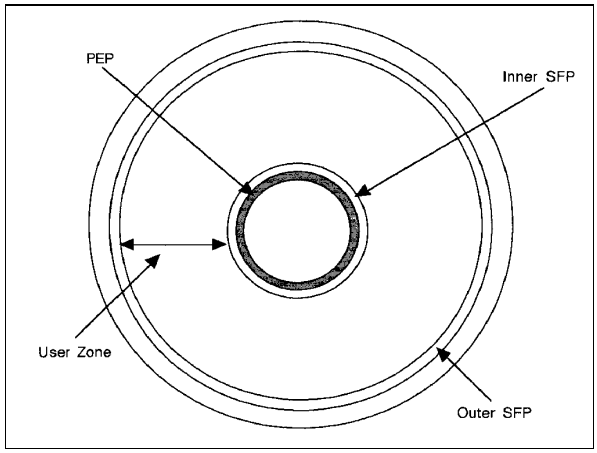
The RWZ52 optical drive can read from and write to both 650-Mbyte (1X) and 1.3 Gbyte optical disks. The RWZ53 (4X) can read and write to both the 1.3 Gbyte and 2.6 Gbyte disks; it can also read 650 Mbyte disks.

The following sections outline disk layout for 650-Mbyte, 1.3 Gbyte, and 2.6 Gbyte optical disks. When sectors are mentioned in this section, the first number applies to a 1,024 bytes/sector disk. The value of 512 bytes/sector disk is written inside parentheses just after the value for the 1,024 bytes/sector disk.

Optical Disk Layout

The disk is divided into various zones. 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 the SFP contain information prerecorded by the media manufacturer and cannot be altered by a drive. They contain media information about media parameters that the drive uses to read and write to the optical disk. Consult the ISO/IEC standard for more information.

Figure 6–8 Optical Disk Layout



User Zone Layout

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 6–9 shows the following parts of the User Zone for 650-Mbyte 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 (650-Mbyte disks only).
3. User Area consisting of:
   - g User Groups, of n sectors each
   - g Spare Groups, of m sectors each.

650-Mbyte Disk and Spare Groups

Figure 6–9 shows the User Zone Layout for 650-Mbyte disks. The values for g, m, and n are variable depending on how the disk is formatted.

1.3-Gbyte Disk User and Spare Groups

Figures 6–10 and 6–11 show the User Zone Layout for 1.3 Gbyte, for both g=1 (single data area and one more spare area) and g=16 (16 data areas and 16 spare areas, 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 “split out” with any split spares found PRIOR to that group. The 1.3-Gbyte media establishes groups BEFORE accounting for slip spares. (Please refer to the section on Drive Defect Management for more details).

2.6-Gbyte Disk User and Spare Groups

There are 34 User/Spare groups for 1,024 bytes/sector media and 30 groups for 512 bytes/sector media. The 2.6-Gbyte media establishes groups BEFORE accounting for slip spares. (Refer to the following section, “Drive Defect Management” for more details.)

Figure 6–9 User Zone Layout for 650-Mbyte Media

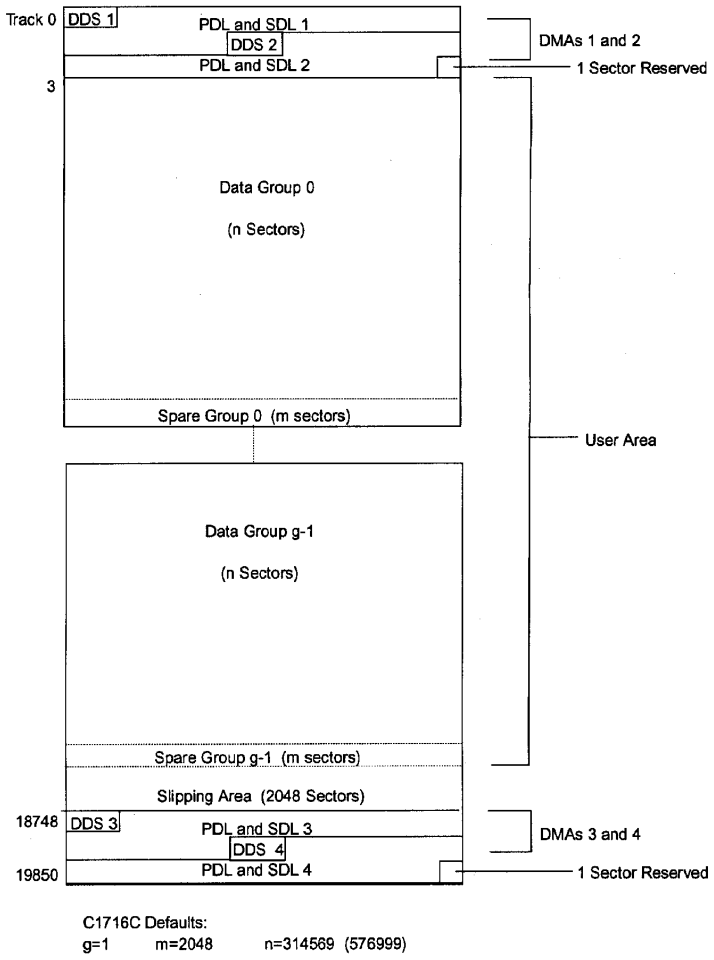


Figure 6–10 User Zone Layout for 1.3-Gbyte Media, g=1

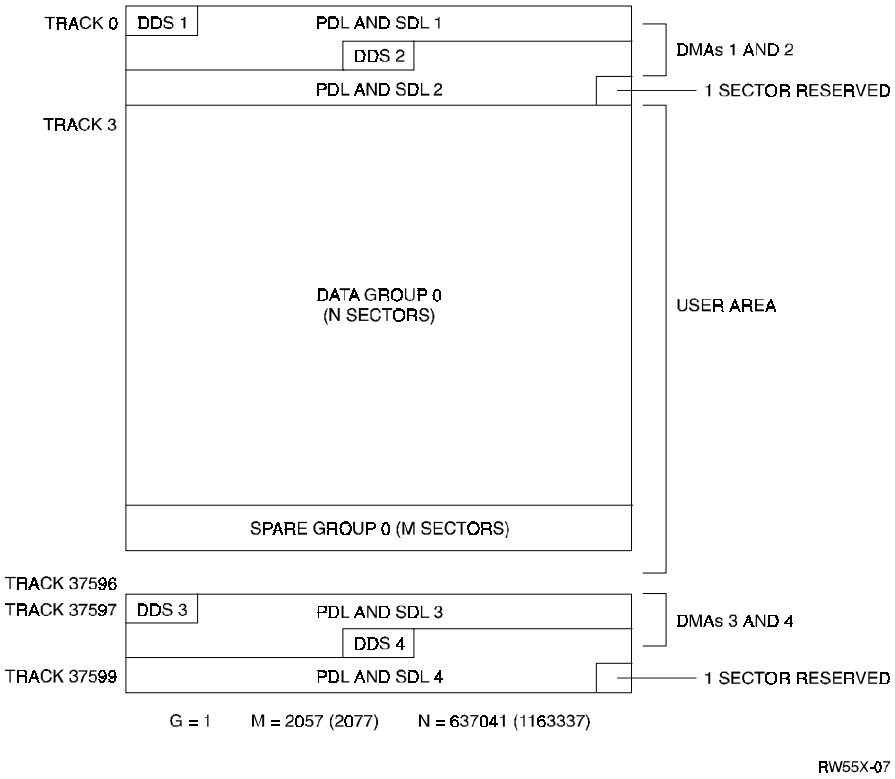


Figure 6–11 User Zone Layout for 1.3-Gbyte, g=16

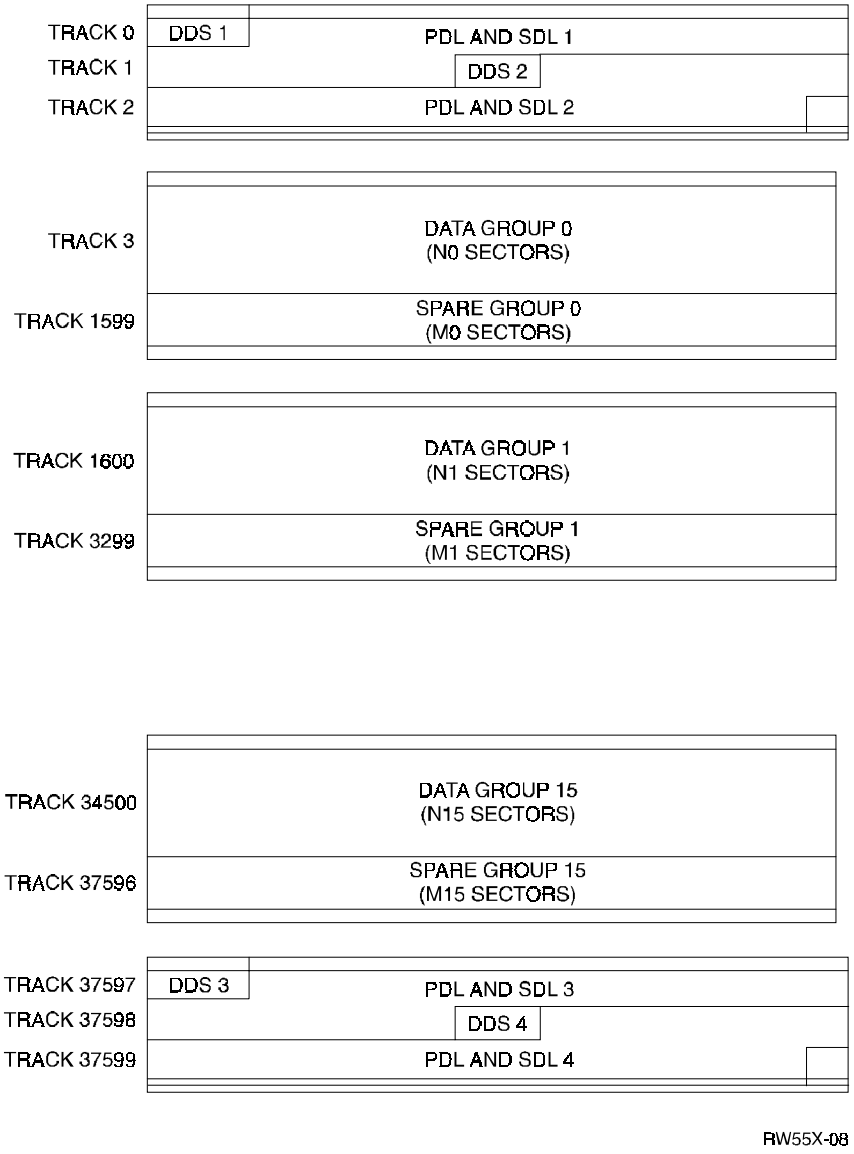


Figure 6–12 User Zone Layout for 2.6-Gbyte Media, 1,024 bytes/sector

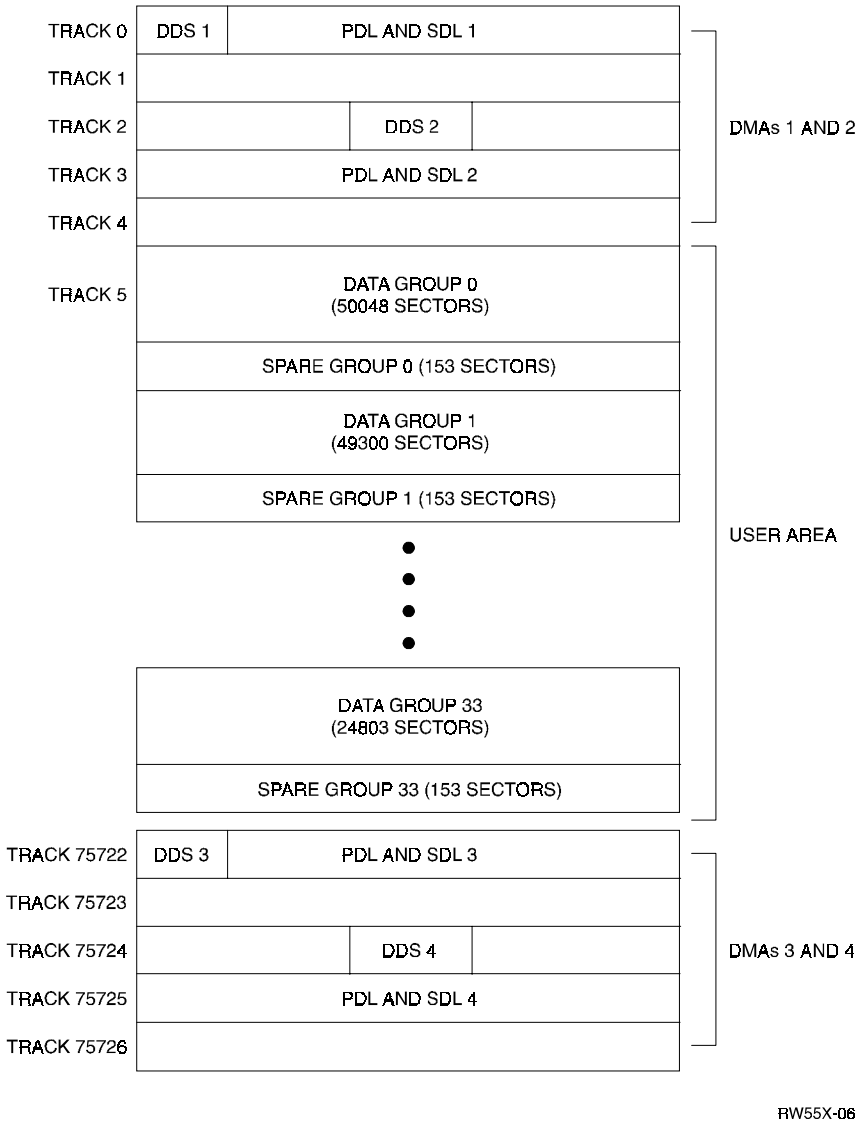


Figure 6–13 User Zone Layout for 2.3-Gbyte Media, 512 bytes/sector

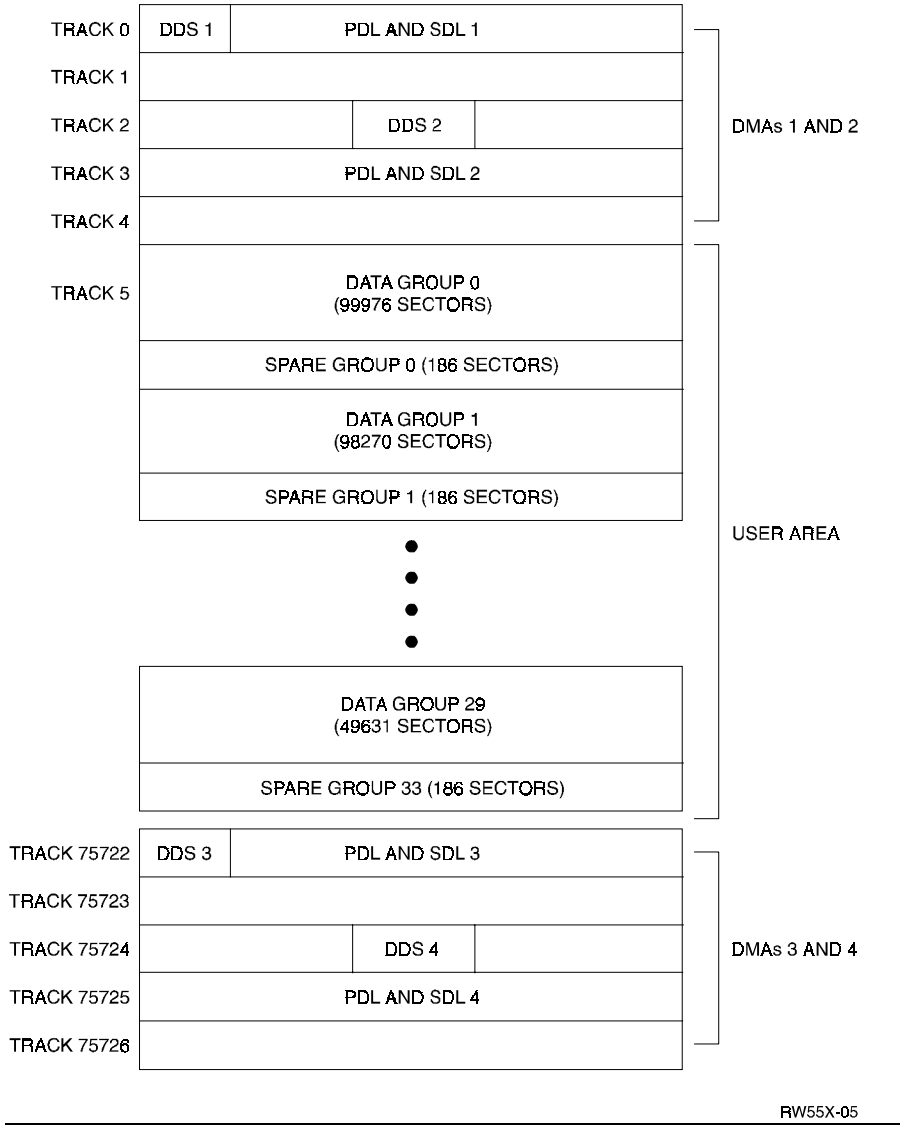


Table 6–1 Values for n and m for 1.3 Gbyte with g=16 (1,024 media)

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. The following table details 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)
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, 18899)	(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)

Table 6–3 4X 1,024 Bytes/Sector Disk Structure

Zone #	Start Track	End Track	No. Track	No. LBAs	Start LBA	End LBA
0	5	2948	2944	50048	0	50047
1	2974	5873	2900	49300	50048	99347
2	5899	8753	2855	48535	99348	147882
3	8779	11588	2810	47770	147883	195652
4	11614	14378	2765	47005	195653	242657
5	14404	17123	2720	46240	242658	288897
6	17149	19823	2675	45475	288898	334372
7	19849	22478	2630	44710	334473	379082
8	22504	25088	2585	43945	379083	423027
9	25114	27653	2540	43180	423028	466207
10	27679	30173	2495	42415	466208	508622
11	30199	32648	2450	41650	508623	580272
12	32674	35078	2405	40885	550273	591157
13	35104	37463	2360	40120	591158	631277
14	37489	39803	2315	39355	631278	670632
15	39829	42098	2270	38590	670633	709222
16	42124	44348	2225	37825	709223	747047
17	44374	46553	2180	37060	747048	784107
18	46579	48713	2135	36295	784108	820402
19	48739	50828	2090	35530	820403	855932
20	50854	52898	2045	34765	855933	890697
21	52924	54923	2000	34000	890698	924697
22	54949	56903	1955	33235	924698	957932
23	56929	58838	1910	32470	957933	990402
24	58864	60728	1865	31705	990403	1022107
25	60754	62573	1820	30940	1022108	1053047
26	62599	64373	1775	30175	1053048	1083222
27	64399	66128	1730	29410	1083223	1112632
28	66154	67838	1685	28645	1112633	1141277
29	67864	69503	1640	27880	1141278	1169157

Table 6–3 4X 1,024 Bytes/Sector Disk Structure (continued)

Zone #	Start Track	End Track	No. Track	No. LBAs	Start LBA	End LBA
30	69529	71123	1595	27115	1169158	1196272
31	71149	72698	1550	26350	1196273	1222622
32	72724	74228	1505	25585	1222623	1248207
33	74254	75712	1459	24803	1248208	1273010

Table 6–4 4X 512 Bytes/Sector Disk Structure

Zone #	Start Track	End Track	No. Track	No. LBAs	Start LBA	End LBA
0	5	3229	3225	99975	0	99974
1	3252	6421	3170	98270	99975	198244
2	6444	9557	3114	96534	198245	294778
3	9580	12637	3058	94798	294779	389576
4	12660	15661	3002	93062	389577	482638
5	15684	18629	2946	91326	482639	573964
6	18652	21541	2890	89590	573965	663554
7	21564	24397	2834	87854	663555	751408
8	24420	27197	2778	86118	751409	837526
9	27220	29941	2722	84382	837527	921908
10	29964	32629	2666	82646	921909	1004554
11	32652	35261	2610	80910	1004555	1085464
12	35284	37837	2554	79174	1085465	1164638
13	37860	40357	2498	77438	1164639	1242076
14	40380	42821	2442	75702	1242077	1317778
15	42844	45229	2386	73966	1317779	1391744
16	45252	47581	2330	72230	1391745	1463974
17	47604	49877	2274	70494	1463975	1534468
18	49900	52117	2218	68758	1534469	1603226
19	52140	54301	2162	67022	1603227	1670248
20	54324	56429	2106	65286	1670249	1735534

Table 6–4 4X 512 Bytes/Sector Disk Structure (continued)

Zone #	Start Track	End Track	No. Track	No. LBAs	Start LBA	End LBA
21	56452	58501	2050	63550	1735535	1799084
22	58524	60517	1994	61814	1799085	1860898
23	60540	62477	1938	60078	1860899	1920976
24	62500	64381	1882	58342	1920977	1979318
25	64404	66229	1826	56606	1979319	2035924
26	66252	68021	1770	54870	2035925	2090794
27	68044	69757	1714	53134	2090795	2143928
28	69780	71437	1658	51398	2143929	2195326
29	71460	73060	1601	49631	2195327	2244957

Table 6–5 Technical Comparisons of 1X, 2X, and 4X Optical Drives

Item	1X	2X	4X
bytes per sector	1,024 (512)	1,024 (512)	1,024 (512)
track pitch	1.60	1.39	1.15
spiral direction	outward	outward	inward
data encoding	(2, 7) RLL	(2, 7) RLL	(1, 7) RLL
channel bits per byte	16	16	12
raw bytes per sector	1,360 (746)	1,360 (746)	1,410 (799)
headers aligned	yes	no	yes
sectors per revolution ID	17 (31)	20.1 (36.7)	33 (58)
sectors per revolution OD	17 (31)	40.3 (73.5)	66 (116)
modulation method	PPM	PPM	PWM
bit density ID (bpi)	24.9K	29.5K	48.7K (49.1K)
bit density OD (bpi)	12.5K	29.5K	50.9K (50.9K)
sectors per logical track	17 (31)	17 (31)	17 (31)
number of user bands	1	16	34 (30)
physical tracks per band	18,751	1,350	765 (868)
physical tracks per user zone	18,751	21,600	26,010 (26,040)
logical tracks per user zone	18,751	37,473 (37,527)	75,732 (73,077)
logical tracks per band ID		1.600	1,485 (1,624)
logical tracks per band OD		3,100	2,970 (3,248)
number of sectors for spares	4,096	2,057 (2,077)	5,287 (6,479)
number of buffer/test sectors	0	0	9,112 (16,616)
number of sectors for DMAs	102 (186)	102 (186)	170 (310)
usable capacity per disk (GB)	0.644 (0.591)	1.300 (1.189)	2.607 (2.296)

Drive Defect Management

The RWZ53 drive 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 used 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 the SDL, while the ECMA standard for 1.3 GByte allows for 2057 or 1077, depending on the sector size of 1024 or 512 bytes per sector, respectively.) For 1.3 Gbyte, the value for g must be 1 or 16.

In general, for 650-Mbyte: g * (n + m) <= (size of User Area)

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

In general, for 2.6-GByte: g = 34 or 30, (n, m, or n0 through n33/29 and m0 through m33/29 are predefined based on g).

For more details consult the ISO or ECMA standard.

The PDL contains a list of defective sector addresses as determined by the manufacturer or by a certification of the User Area, i.e. during a SCSI Format Unit Command. Defective sectors listed 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.

Slip Sparing Algorithm

The slip sparing algorithm is used to manage the defective sectors listed in the PDL during address translation between logical and physical blocks. During an address translation, the logical blocks are "slipped" past any defective sectors, thus the name slip sparing. As an example, suppose there are defective sectors at physical block addresses 20 and 30, and the user wants the physical address of logical block 40. Since physical addresses 20 and 30 have defective sectors 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.

This is not a truly accurate example for the following reasons:

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

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

For 1.3-Gbyte and 2.6 Gbyte media, user and Spare Grouping is always the first step of address translation, followed by Slip sparing, and replacement sparing.

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

Replacement Sparing Algorithm

The replacement sparing algorithm is intended to manage defective sectors found after initialization.

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

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

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

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

The other error threshold of interest pertains to the degree of error correction required on the data. The error correction code (ECC) used causes parity bytes to be written following the user data. During a data recovery operation, these bytes are used to detect and correct up to 8 defective bytes in an interleave. Each sector has 10 (5) interleaves with 120 (122) bytes in each interleave. The actual number of bytes per interleave requiring correction is used as an error threshold. Consult the ISO standard for more details.

Table 6–6 shows the error thresholds for the RWZ52 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 6–6 Error Thresholds

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

Diagnostic Strategy

Internal Autochanger Diagnostics

The internal tests and exercisers provided by the jukebox provide diagnostic capabilities that are not available in the standard set of SCSI autochanger commands. The tests are run from the control panel.

Offline Diagnostics

DOSDASS4 is a PC-based diagnostic that fully exercises both the autochanger and the drive mechanisms. DOSDASS4 is available from the Digital Customer Support Center at CXO.

The SCSI Interface

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

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

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

CAUTION

DO NOT 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.

Single-Ended and Differential SCSI Interfaces

The SCSI interface on this jukebox accepts either single-ended or differential SCSI buses. Internally, the jukebox is a single-ended interface. A single-ended external connection is repeated onto the jukebox bus. A differential external connection is converted into the internal single-ended bus (and also repeated).

Because the single-ended interface is repeated onto the internal bus, maximum external bus length remains at the maximum SCSI single-ended bus length of 6 meters. Even though the differential bus is also repeated as it is converted, propagation delays require shortening the maximum differential SCSI external bus available (25 meters) by 10 meters. This leaves a maximum of 15 meters available.

A single-ended SCSI interface may be preferable when peripherals are physically close to the host and short SCSI cables are adequate to connect (or daisy chain) them. An example of an appropriate use of a single-ended SCSI interface is when a host and several peripherals are daisy-chained and located in an upright cabinet with 1-meter cables connecting them.

A differential SCSI interface is used when up to 15 meters of SCSI cabling is needed, and the peripherals need to be physically located farther apart than the single-ended SCSI interface allows. An example of an appropriate use of a differential SCSI interface is when a peripheral must be located in a different location than the host system for security reasons or for user convenience.

SCSI Command Set

NOTE

Detailed descriptions of the SCSI-2 commands and their functionality with optical products can be found in the following documents:

Offline Diagnostics for Hewlett-Packard Optical Products, reference appendix section of this manual.

American National Standards Institute (ANSI) document titled, Small Computer System Interface - 2 (SCSI-2), revision 10H which is dated September, 1991. Copies of this publication can be obtained by writing to: Global Engineering Documents, 2805 McGaw, Irvine, CA 92714, or call: (800) 854-7179 or (714) 261-1455. Please refer to document X3.131SCSI-2.

Multifunction Optical Drive and Library SCSI-2 Command Reference. This document can be obtained by ordering part number 5960-7606 from Kendall Printing, see Appendix A.

Optical Drives and Libraries Technical Guide, obtained by ordering part number 5960-7605 from Kendall Printing, see Appendix A.

A

Basic Supplies and Re-orderable Parts

Commonly used items that may be stocked and available as an area resource.

Basic Supplies & Re-orderable Parts

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

Table A–1 Common Resource Parts

Item	Digital Part Number	HP Part Number
3m (9.8 ft) Single-ended SCSI interface cable, high density (50-pin) to low-density (50-pin), m-to-m	BN23G-03	
3m (9.8 ft) Differential SCSI interface cable, high density (50-pin) to (68-pin), m-to-m	BN21N-03	
Single-ended SCSI terminator, 50-pin, high-density		1250-2548
Differential SCSI terminator, 50-pin, high-density		1252-6492
Fan grill		3160-0444
Eject tool		C1701-88803
Optical disk media cleaning kit		C1700-88800
Optical disk cleaner accessory kit (extra swabs and alcohol)		C1700-88801
Rewritable optical disk (2.3 GBytes, 512 bytes/sector)	RWX6K-01	
Single disk	DL-RWX6K-AA	
Pack of 5 disks		

Table A–1 Common Resource Parts (continued)

Item	Digital Part Number
Write-Once optical disk (594 Mbytes, 512 bytes/sector)	
Single disk	RWX6K-02
Pack of 5 disks	DL-RWX6K-BA
Rewritable optical disk (1.2 GBytes, 512 bytes/sector)	RWX5K-01
Write-Once optical disk (1.2 GBytes, 512 bytes/sector)	RWX5K-02

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

Related Documents

Table A–2 Related Documentation

Item	Part Number
Optical Disk Jukebox Family User's Guide (Shipped with each unit)	*EK-RW5XX-UG*
Optical Storage Desktop Software Installation Guide	*AA-QLRHB-TE*
Optical Storage Desktop Software User's Guide	*AA-QLRJB-TE*
Optical Storage Management Software Installation Guide	*AA-QLRMB-TE*
Optical Storage Management Software User's Guide	*AA-QLKNB-TE*
Storage Server 100 Installation Guide	*EK-D59SS-IN*

† These documents can be ordered directly from Kendall Printing.
Call 970-330-8895

‡ This manual is available from the Digital Customer Support Center at CXO.

Table A–3 Tima Documents

Product Service Plans	Entry Number	Keyword(s)
RW525	TA-0618	RW5xx, optical, store
RW531	TA-0651	RW5xx, optical, store
RW532	TA-0650	RW5xx, optical, store
Optical Jukebox Series	7174	RW5xx, Jukebox, store
Optical Storage Management SW	3731	OSMS
Optical Desktop Description SW	3750	OSDS

The Instruction Manual for the Offline PC based diagnostics, DOSDASS4 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 (SHR), MA.

NOTE

To run the DOSDASS(4) 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.

The DOSDASS4 diagnostic software 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.