



Large Optical Disk (RW555/RW557) Library

Service Manual

EK-RW55L-SM. B01

Digital Equipment Corporation
Maynard, Massachusetts

Second Edition, November 1997

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Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

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Revision Record

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

The following revision history lists all revisions of this publication and their effective dates. The publication part number is included in the Revision Level column, with the last entry denoting the latest revision. This publication supports the Large Optical Disk Library.

Revision Level	Date	Summary of Changes
EK–RW55L–SM. A01	December, 1996	Original Release
EK–RW55L–SM. B01	November, 1997	Corrects Table 5–1. Also adds recommended service kits and common resource parts to end of Chapter 5.

About This Guide

This section identifies the users of this manual and describes the contents and structure. In addition, it includes a list of conventions used in the manual.

This manual provides a product overview, installation, operation, and maintenance information for the Large Optical Disk Library.

Intended Audience

This manual is intended for people who will install, operate, and maintain the Large Optical Disk Library.

Document Structure

This manual contains the following chapters:

Chapter 1. Product Information

Chapter 1 presents the physical characteristics and environmental specifications for the Large Optical Disk Library.

Chapter 2. Environmental/Installation/PM

Chapter 2 describes the environmental requirements, installation procedures, and preventive maintenance information for the Large Optical Disk Library.

Chapter 3. Product Configuration and Operation

Chapter 3 describes how to configure and operate the Library.

Chapter 4. Troubleshooting and Diagnostics

Troubleshooting and diagnostics describes the troubleshooting procedures and diagnostic routines for the Library.

Chapter 5. Removal and Replacement

This chapter describes how to remove and replace the field replaceable subassemblies in the Library. It also contains a list of field replaceable units and recommended service kits.

Chapter 6. Theory of Operation

This chapter discusses the following aspects of the robotics of the RW555/RW557 jukeboxes, the autochanger, command execution, mechanics, autochanger controller PCA, interposer PCAs, power supplies, LUN conversion, Picker and Picker Modes, Element Numbering and Slot Numbering, and optical disk drives.

Conventions

This manual uses the following conventions:

Style	Meaning
boldface type	For emphasis
italic type	For emphasis and manual titles
MISLOAD	Displayed message
ENTER	Command

1

Product Information

This chapter provides the physical characteristics and environmental specifications for the RW555/RW557 Large Optical Disk Library.

1.1 Product Matrix

Table 1–1 4X-Drive Jukeboxes

Model	Description
RW555	Optical jukebox with four 4X-capacity multi-function optical drives and capacity for up to 128 rewritable or MO-Worm disks. One blank disk included. Single-ended and differential SCSI interfaces with LUN conversion.
RW557	Optical jukebox with six 4X-capacity multi-function optical drives and capacity for up to 238 rewritable or MO-Worm disks. One blank disk included. Single-ended and differential SCSI interfaces with LUN conversion.

Table 1–2 Jukebox Capacities by 7 Disk Density and Number of Slots

Disk Capacity/Format	Number of Slots	Maximum Jukebox Capacity
4X-Density Disks— 2.6 GByte, 1024 bytes/sector	128	332.8 GBytes
	238	618.8 GBytes
2.3 GByte 512 bytes/sector	128	294.4 GBytes
	238	547.4 GBytes

1.2 Product Support

Table 1–3 Optical Disk Standards Met by DIGITAL Optical Disks

Disk Type	Capacity/Format	Standard
Rewritable	1X 594 Mbytes 512 bytes/sector 650 Mbytes 1024 bytes/sector	Meets ANSI and ISO standards for Continuous-Composite (CC) format—conforms to ISO/IEC DIS 10089A; ANSI X3.212-199x.
	2X – 1.2 GByte 512 bytes/sector 1.3 GByte 1024 bytes/sector	Meets ECMA 184 standard for Continuous-Composite (CC) format.
	4X – 2.3 GByte 512 bytes/sector 2.6 GByte 1024 bytes/sector	Meets ISO/IEC 10089A, 11560, and 14517 standards for Continuous-Composite (CC) format.
Write-Once	2X – 1.2 GByte 512 bytes/sector 1.3 GByte 1024 bytes/sector	Meets ECMA 184 standard for Continuous-Composite (CC) format.
	4X – 2.3 GByte 512 bytes/sector 2.6 GByte 1024 bytes/sector	Meets ISO/IEC 10089A, 11560, and 14517 standards for Continuous-Composite (CC) format.

1.3 Characteristics

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

Table 1–4 Optical Disk Drive Mechanism and Jukebox

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

Table 1–4 Optical Disk Drive Mechanism and Jukebox (continued)

	RWZ53 Drive (4X)
Read transfer rate-max. sustained	- for 1024 bytes/sector up to 1.69 Mb/s (4X disks) up to 1.24 Mb/s (2X disks) up to 1.04 Mb/s (1X disks)
Write transfer rate- max. sustained	- for 1024 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 MB
Read buffering	readaheads
Write buffering	immediate reporting write re-ordering
Interface	SCSI-2 single-ended/Differential asynchronous/synchronous
Physical Characteristics (Jukebox)	
Height	1809 mm (71.2 in.)
Width	876 mm (34.5 in.)
Depth	736 mm (28.9 in.)
Weight (net) 4-drive 6-drive	217.73 Kg (480 lb.) 226.23 Kg (498.75 lb.)
Weight (packaged) 4-drive 6-drive	290.3 Kg (640 lb.) 301.64 Kg (665 lb.)

Table 1–5 Environmental Specifications

	Autochanger	Drive	Media
Temperature			
Operating	10° to 40°C	5° to 45°C (4X) 5° to 50°C (2X)	10° to 60°C
Non-operating	-40° to 70°C	-40° to 60°C (4X) -40° to 70°C (2X)	-10° to 50°C
Max. Temperature gradient	10°C per hour	10° per hour (2X and 4X)	10°C per hour
Transportation (<14 consecutive days)			-40° to 60°C
Humidity (non-condensing)			
Operating (relative)	10 to 90%	5 to 90% (2x AND 4x)	10 to 80%
Non-operating w/o disk	5 TO 95%	5 TO 95% (2x AND 4x)	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) (4X) 20 g (11 ms) (2X)	760 mm drop (to 2 mm vinyl-covered concrete)
Transportation (trapezoidal)		30 g (742 cm/s) (4X) 30 g (523 cm/s) (2X)	

Table 1–5 Environmental Specifications (continued)

	Autochanger	Drive	Media
Vibration (5-500 Hz range)			
Operating (max. accel.)	0.21 g rms	0.3 g rms (4X) 0.5 g rms (2X)	>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) (2X and 4X)	
Altitude			
Operating		4,572 m (15,000 ft)	
Non-operating		15,240 m (50,000 ft)	
Acoustic Emissions			
Operating	62.5 dB (L noise power emission level)		
Idle	47.5 dB (L noise power emission level)		
Particulates			
	Less than 200 micrograms/cubic meter particles suspended		
Electrostatic Discharge			
Air gap (operating)	5 to 15 kV	0 to 10 kV (4X)	
Air gap (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

Table 1–6 Power Requirements

Line voltage	100-240 V
Line frequency	50-60 Hz
Power consumption (typical)	340 W 1160.4 BTU
Power consumption (maximum)	560 W 1911.2 BTU

Table 1–7 Service Characteristics

Mean swaps between failures (MSBF)—robotics	2 million
Mean swaps between failures (MSBF)—drive	600,000
Mean time between failures (MTBF)—robotics	100,000
Mean time between failures (MTBF)— drive	80,000 hours (2X) 100,000 hours (4X)
Mean time to repair	2 hours
Preventive maintenance	none required*

* for high-usage or zero downtime installations, see Product Support Plan for special, preventive maintenance schedules

Table 1–8 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 "A" EN 55022/CISPR 22, Level "A"; 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

Table 1–9 DIGITAL 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)			
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 (73,077)
Archival life	30 years		

2

Environmental/Installation/PM

This chapter describes environmental requirements, installation procedures, and preventive maintenance.

2.1 Environmental Requirements

NOTE

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

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.

2.2 Primary Power/External Ground

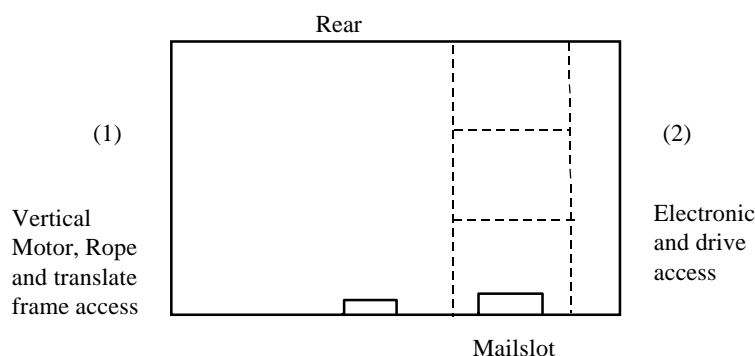
The power outlet must supply a voltage range of 100 - 240 Vac at 50 - 60 Hz. Also, check the earth (safety) ground of the outlet.

2.3 Current Requirements

120 V – 10 amperes 240 V – 5 amperes

2.4 Clearance Requirements

Figure 2–1 Clearance Requirements



There are no clearance requirements for airflow other than to keep the slots on the top panels of the cabinet free from cover or obstructions,

For service, all sides should have approximately 1-meter clearance. Service clearance is particularly important if the customer's applications support on-line drive replacement. For on-line drive replacement, the right side should be accessible without the need to remove power from the jukebox. This is accomplished by either positioning the jukebox so that the right side has service access, or by allowing adequate power and SCSI cable length to move the jukebox to a clear area.

2.5 Weight-Bearing Requirements

The weight of the jukebox is supported by four casters. The maximum load per caster is 150 pounds. The total weight of the jukebox is 600 pounds (when fully loaded with disks) over a footprint of seven square feet. Therefore, to install this jukebox, the floor rating must meet or exceed 85 pounds per square foot. Contact the site manager for verification that these requirements are met.

If located on a raised-tile floor, position the jukebox as close to a corner post as possible. The tiles beneath and surrounding the jukebox should be solid. Special, air-conditioning tiles are not needed near the jukebox.

2.6 Location Requirements

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

2.7 Responsibilities

Customer site preparation/verification and installation are the customer's or reseller's responsibility; DIGITAL will perform the site preparation/verification and/or installation on a time-and-materials basis.

See the RW555 Product Support Plan for further information on support policies.

See the RW555 Product Support Plan for further information on support policies for the RW557 versions.

2.8 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 factory Order Processing Center with the following information:

- original order number or unit serial number
- receiving address

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

If the carrier refuses payment of damages, replacement/repair costs should be entered into the Field Engineering Support (F.E.S.) account.

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.

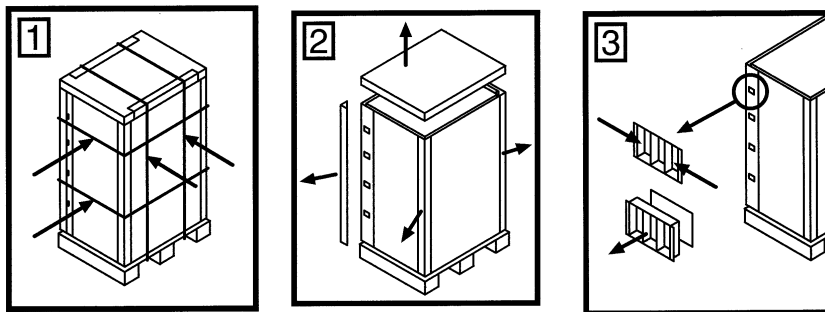
2.9 Unpacking and Taking the Jukebox Off the Pallet

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

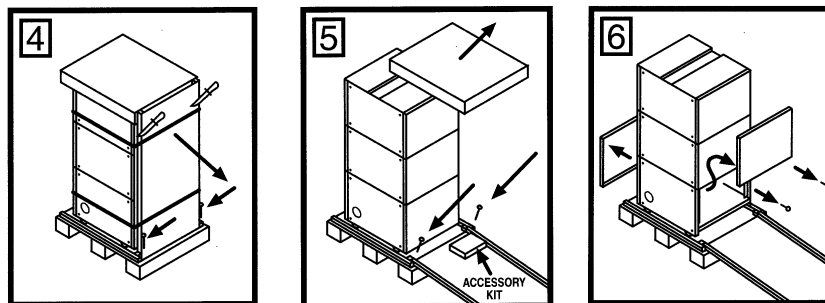
Tools needed:

- heavy scissors or cutters
- 3/4-inch open-end wrench (for removing the tiedown bolts).
- medium slot-blade screwdriver
- T-15 driver

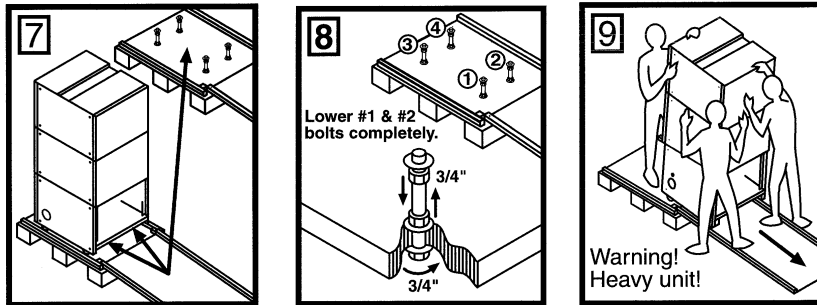
Remove the outer packaging by following the instructions printed on the carton.



1. Cut the bands around the box.
2. Lift the top off.
3. Release plastic latches to remove the cardboard box around the unit.



4. Unbind ramp and lower the ramp to the floor.
5. Use the bolts strapped to the lower sides of the ramp to fasten the ramp to the pallet. Take the top off.
6. Remove the two fasteners on the bottom of each , lower access panel and remove the panels.. the ramp side panel uses a T-20 and the side farthest from the ramp uses a slot-blade screwdriver. This is the customer's access panel.



7. Use an open-end wrench to lower the 3/4-inch nuts on the top of the tie-down bolts to release the jukebox..
8. Raise the 3/4-inch nuts on the tie-down bolt approximately 1-1/2 inches so that the bolt can be retracted down through the pallet. This is done so that the jukebox wheels will not catch on the bolts.
9. Carefully roll the jukebox down the ramp. Two people should steady the jukebox from the ramp side and one person should move the jukebox forward towards the ramp.
10. Lower the bolts nearest the ramp all the way down.

WARNING

Catching a jukebox caster wheel on a pallet bolt during unloading may cause the jukebox to tip over and cause serious injury.

WARNING

The jukebox is heavy. Use TWO PEOPLE to support the jukebox as it rolls down the ramp. One person can be on the pallet, pushing to help it get started.

11. Roll the jukebox down the ramp.
12. Replace the lower access panels on the right and left sides of the jukebox. Replace the two screws at the bottom of each of these panels.

2.10 Moving the Jukebox a Short Distance

1. Unmount (unreserve) any optical disk surfaces in the jukebox if necessary. Refer to the computer operating system, or software application documentation for instructions on how to unmount optical disks.
2. There are optical disks in any of the optical drives, they must be ejected from the drives before moving the jukebox (See "Ejecting an Optical Disk from the Jukebox" in Chapter 3).

CAUTION

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

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, check with the system administrator before shutting off power to the jukebox.

3. Switch off the power to the jukebox using the power switch on the lower left side of the jukebox rear panel.
4. Remove the customer access panel (see Figure 3-1). There may or may not be two screws securing the access panel to the jukebox.
 - If the screws were previously removed, take off the access panel by pulling on the bottom edge of the panel and then lifting the panel off.
 - If the screws are still in place, use either a flat-blade screwdriver or a T-15 TORX driver to remove them. Remove the access panel by pulling on the bottom edge of the panel and then lifting the panel off.

NOTE

The jukebox is shipped from the factory with two screws securing the customer access panel to the side of the jukebox. These screws must be removed when the jukebox is unpacked and may or may not have been replaced when the access panel was reattached.

It is a good idea to use these screws to secure the access panel to the jukebox since they must be in place if the jukebox is ever reshipped.

5. Remove the power cord and the SCSI cable connections from the right side panel of the jukebox.

WARNING

When rolling the jukebox to its new destination, push on the jukebox right side panel only. Pushing on any other side of the jukebox could result in the jukebox tipping over if a wheel catches. (The right side panel is shown in Figure 3–1.)

6. Carefully roll the jukebox to its new destination.
7. Connect the jukebox to the host.
8. Reconnect the power cord and SCSI cables
9. Configure the jukebox to the host. (Refer to the host system manuals and system administrator for configuration information.)

2.11 Shipping the Jukebox

1. Unmount (unreserve) any optical disk surfaces in the jukebox if necessary. Refer to the computer operating system, or software application documentation for instructions on how to unmount optical disks.
2. Eject all disks from the jukebox. If the disks were not labeled with a storage slot location prior to inserting them into the jukebox, the disks should be labeled now. See "Ejecting Optical Disks" in Chapter 3.

CAUTION

Failure to eject disks from the optical drives prior to moving the jukebox could result in damage to the optical drive mechanisms. Failure to eject all disks from the storage slots in the jukebox could result in damage to the jukebox.

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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

3. Switch off the power on the jukebox lower left rear panel.
4. Remove the customer access panel (see Figure 3–1). There may or may not be two screws securing the access panel to the jukebox.

If the screws were previously removed, take off the access panel by pulling on the bottom edge of the panel and then lifting the panel off.

If the screws are still in place, use either a flat-blade screwdriver or a T-15 TORX driver to remove them. Remove the access panel by pulling on the bottom edge of the panel and then lifting off the panel.

NOTE

The jukebox is shipped from the factory with two screws securing the customer access panel to the side of the jukebox. These screws must be removed when the jukebox is unpacked and may or may not have been replaced when the access panel was re-attached.

It is a good idea to use these screws to secure the access panel to the jukebox since they must be in place when the jukebox is shipped.

5. Remove the power cord and the SCSI cable connections from the jukebox right side panel (see Figure 3–1).
6. Repackage the jukebox in the proper shipping materials. A complete set of shipping materials is offered as a product from DIGITAL.

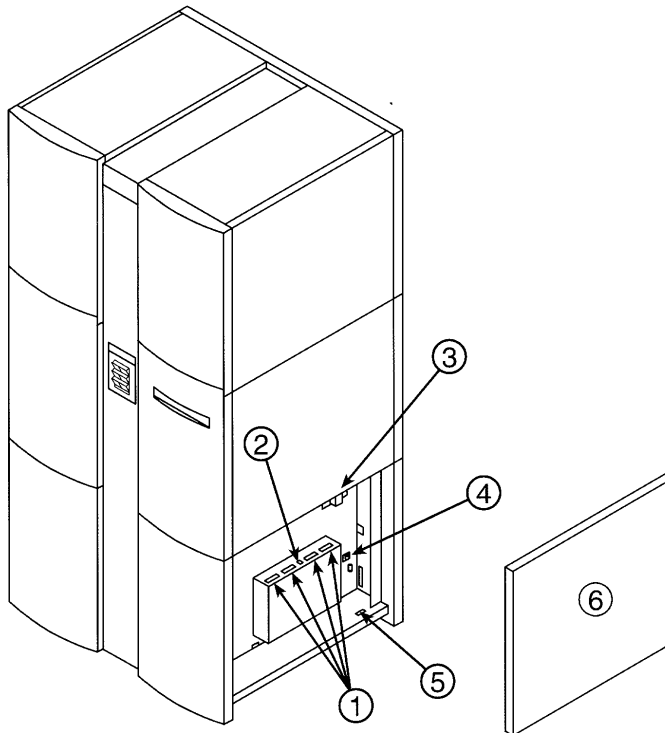
3

Product Configuration and Operation

This chapter describes how to configure and operate the jukebox.

3.1 Connections to the Jukebox

Figure 3–1 Right Side Panel Features (4X version shown)



1) SCSI ports	<p>Used for attaching SCSI cable(s) from the jukebox to the host computer. On 4X models, there are two SCSI cards available (labeled "Bus 1").</p> <p>You must select either the single-ended or the differential pair of connectors (see item 2 in this list), and both SCSI connectors selected must be used. One connector must have a SCSI cable connected, and the other must have either a SCSI terminator connected to it, or it can be used to daisy-chain to another SCSI peripheral or to the other jukebox SCSI card.</p>
2) SCSI interface modes switches	<p>Used to select either a single-ended or differential SCSI interface. In 4X models, there are two SCSI cards. The interface mode switches must be set individually for each card.</p>
3) Power port	<p>Used to connect the power cord. (See the note at the top of the next page.)</p>
4) Power cord clip	<p>Used to route the power cord away from other connectors and provides strain relief for the power cord connection.</p>
5) Product Serial Number Label	<p>Used by service.</p>
6) Customer Access Panel	<p>Covers the interface and power connections on the right side. Two slot-head screws hold the lower edge of the panel.</p>

NOTE

The jukebox runs in reduced power if it has not been used in 30 minutes.

The jukebox is shipped from the factory with two screws securing the customer access panel to the side of the jukebox. These screws are removed during unpacking and may or may not have been replaced when the panel was reattached. Because these screws should be re-inserted if the jukebox is ever shipped, the customer should store these screws in some convenient place.

3.2 Configuring and Operating the Jukebox

NOTE

Before you connect the optical disk jukebox to the host, verify that it is supported by the host.

3.2.1 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-Amps	Watts
900 Volt-Amps (typical)	525 Watts (typical)
1200 Volt-Amps (maximum)	560 Watts (maximum)

3.2.2 Connecting the SCSI Cables to the 4X-Drive Jukebox

The jukebox connects to the host computer with high-density SCSI interface cable(s), and may be configured to use either a single-ended or a differential SCSI interface. Select the SCSI interface type using the SCSI interface switch(es) behind the customer access panel on the right of the jukebox (see Figure 3–1).

Because some jukebox models require from five to thirteen SCSI addresses (one for the jukebox controller and one for each drive contained in the jukebox), two SCSI bus cards are available for jukebox use. Each SCSI bus type (single-ended or differential) must be configured separately using the SCSI interface switch for that SCSI card (see Figure 3–1)

NOTE

Set the SCSI interface switches to the same bus type (single-ended or differential) if both jukebox SCSI bus cards are used.

The total allowable length of the SCSI cable depends on which interface type you select. Refer to the following table 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 total 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.

A 50-pin high-density SCSI cable must be used if the single-ended SCSI mode is used; a 68-pin high-density SCSI cable must be used if the differential SCSI mode is used.(See Chapter 5 for part numbers of SCSI cables.)

Use one of the following methods to connect the jukebox to the host computer:

- as the only peripheral device connected to the host computer
- as one of a number of peripheral devices connected to the host computer

Refer to the following sections to connect the jukebox to the host computer.

3.2.3 Connecting the Jukebox as the Only Peripheral

CAUTION

Make sure that all peripheral devices connected to the host computer have been properly shut down. If the host computer is connected to a network, check with the system administrator before switching off power. The jukebox must be set up initially by a qualified service representative only.

NOTE

Check host system documentation and jukebox application software instructions to verify that the use of LUNs is supported. Also, attaching multiple devices using LUNs may affect the performance of those devices.

The jukebox must be connected to the host computer differently depending upon the number of optical drives contained in the jukebox, and whether the jukebox SCSI LUN mode is ON or OFF. The available configurations are as follows:

- A 4- or 6-drive jukebox with LUN mode OFF or ON. The jukebox is attached using one SCSI cable attached to Bus 1 and the host computer (see Figure 3–2). When LUN mode is OFF, a four-drive jukebox uses five of the available SCSI addresses, and a six-drive jukebox uses all seven available SCSI addresses. When LUN mode is ON only one or two SCSI addresses are used.

3.2.4 Removing the Customer Access Panel

Refer to Figure 3–1 for the locations of the following switches and connectors:

1. Switch off power to the host computer before you connect the jukebox.
2. Remove the customer access panel (see Figure 3–1). There may or may not be two screws securing the access panel to the jukebox.
 - If the screws were previously removed, take off the access panel by pulling on the bottom edge of the panel and then lifting the panel off.
 - If the screws are still in place, use either a flatblade screwdriver or a T-15 TORX driver to remove them. Remove the access panel by pulling on the bottom edge of the panel and then lifting off the panel.

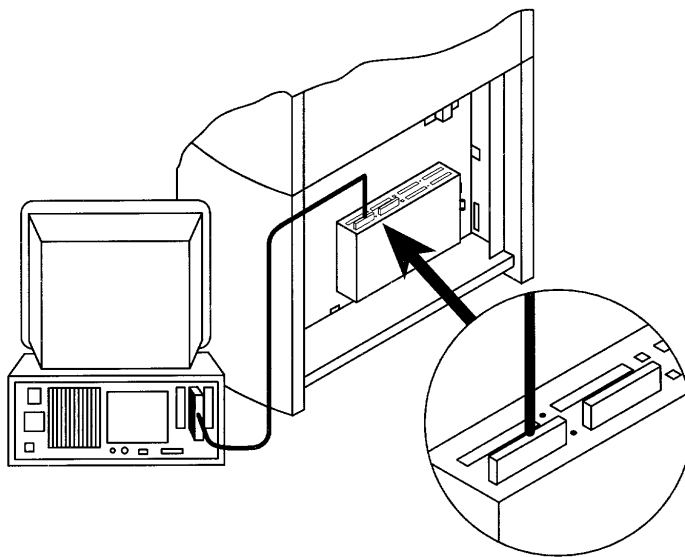
NOTE

The jukebox is shipped from the factory with two screws securing the customer access panel to the side of the jukebox. These screws must be removed when the jukebox is unpacked and may or may not have been replaced when the access panel was reattached. It is a good idea to use the screws to secure the access panel to the jukebox since they must be in place if the jukebox is ever reshipped.

3.2.5 Connecting a 4- or 6-Drive Jukebox as the Only Peripheral

1. Select the SCSI interface mode (single-ended or differential) using the Bus 1 SCSI interface selection switch on the jukebox right side panel.
2. Plug one end of the SCSI cable into one of the Bus 1 SCSI ports on the jukebox right side panel. Make sure that you select the set of SCSI connectors that matches your interface switch setting selected in step 1.
3. Plug a SCSI terminator into the unused SCSI connector on the jukebox right side panel. (See Figure 3-1 and the note on the following page.)

Figure 3-2 Connecting a 4- or 6-Drive Jukebox as the Only Peripheral



4. Route the SCSI cable(s) through the long cable slot at the bottom of the jukebox right side panel, and out through the back of the jukebox.
5. Plug the other end of the SCSI cable into a SCSI port on the host computer. (Each SCSI cable must be connected to a separate connector on the host computer.)

NOTE

Both single-ended and differential SCSI terminators are shipped with the jukebox. The appropriate terminators must be used if no other SCSI devices are connected to the SCSI bus.

A terminator must be used if the jukebox is connected as the only peripheral on the SCSI bus. If both jukebox SCSI cards are used, the unused connector for the bus type selected (either single-ended or differential) on each card must be terminated.

3.2.6 Connecting the Jukebox with Other SCSI Peripherals

CAUTION

Make sure that all peripheral devices connected to the host computer have been properly shut down. If the host computer is connected to a network, check with the system administrator before switching off power. The jukebox must be set up initially by a qualified service representative only.

NOTE

Jukebox models containing four drives can connect to peripheral devices as shown in Figure 3-3.

LUN mode must be set to ON before other peripheral devices can be daisy-chained to jukebox models containing six or more optical drives. (See Figure 3-4 to connect other peripheral devices when the jukebox LUN mode is ON.)

The last device in a chain of SCSI devices on a bus must be terminated.

The jukebox must be connected to the host computer and additional peripherals differently depending upon the number of optical drives contained in the jukebox, and whether the jukebox SCSI LUN mode is ON or OFF.

The available configurations are as listed in the following table:

Table 3–3 SCSI Configuration Choices

No. of Drives	SCSI Address Mode (LUN mode off)	LUN Mode 1 ON-drives & jukebox have one common address	LUN Mode 2 ON-drives have an address, jukebox address is different
4	2 SCSI addresses are available for connecting other devices	6 SCSI addresses are available for connecting other devices to Bus	5 SCSI addresses are available for connecting other devices to Bus 1
6	No additional devices can be connected		

3.2.7 Removing the Customer Access Panel

Refer to Figure 3–1 for the locations of the following switches and connectors.

1. Switch off power to the host computer before you connect the jukebox.
2. Remove the customer access panel (see Figure 3–1). There may or may not be two screws securing the access panel to the jukebox.
 - If the screws were previously removed, take off the access panel by pulling on the bottom edge of the panel and then lifting the panel off.
 - If the screws are still in place, use either a flatblade screwdriver or a T-15 TORX driver to remove them. Remove the access panel by pulling on the bottom edge of the panel and then lifting off the panel.

NOTE

The jukebox is shipped from the factory with two screws securing the customer access panel to the side of the jukebox. These screws must be removed when the jukebox is unpacked and may or may not have been replaced when the access panel was reattached. It is a good idea to use the screws to secure the access panel to the jukebox since they must be in place if the jukebox is ever reshipped.

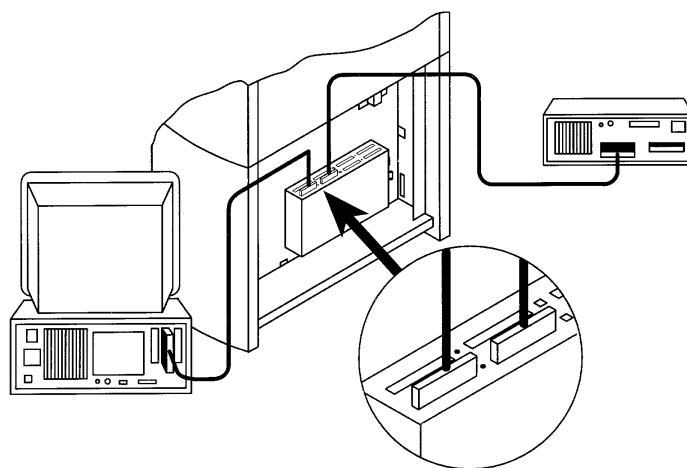
3.2.8 Connecting 4 or 6-Drive Jukeboxes with Other Peripheral Devices

NOTE

LUN mode must be set to ON to connect other peripherals to a 6-drive jukebox.

1. Set the SCSI interface switch for BUS 1 to either single-ended or differential mode. (If you are connecting a peripheral to a jukebox containing four or six drives, only the Bus 1 card is used.)
2. Plug one end of a SCSI cable into one of the SCSI ports on the jukebox right side panel. Make sure that you select the set of SCSI connectors that matches the interface switch setting selected in step 1.
3. Plug one end of another SCSI cable into the other SCSI port (Figure 3–3).

Figure 3–3 Connecting 4- or 6-drive Jukeboxes with Other Peripheral Devices



4. Route the two SCSI cables down through the long cable slot at the bottom of the jukebox right side panel, and out through the back of the jukebox (not shown).
5. Plug one of the SCSI cables into an available SCSI port on the host computer.
6. Plug the remaining SCSI cable into the SCSI port of another peripheral device.
7. Plug a terminator into the last SCSI device connected to the system.

NOTE

You can connect the jukebox to any peripheral device along a chain of peripherals, as long as you plug a terminator into the last device in the chain.

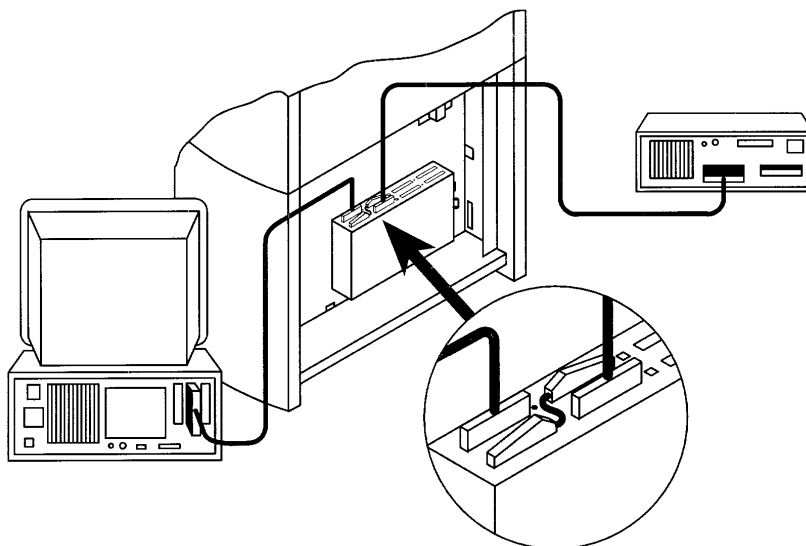
3.2.9 Connecting Peripheral Devices with Bus 1

NOTE

LUN mode must be ON to connect peripheral devices using this method. If Bus 1 and Bus 2 are daisy-chained and the single-ended SCSI connectors are used, a short CIO-to-disk SCSI cable (HP part number A1094-61601) can be used.

1. Connect a SCSI cable to one of the connectors on Bus 1 that matches the interface switch setting.
2. Connect a short SCSI cable to the other connector on Bus 1 that matches the interface switch setting. (This cable is used to daisy-chain Bus 1.)
3. Connect the other end of the SCSI cable attached in Step 2 to the connector on Bus 2 that matches the interface switch setting. If the CIO-to-disk cable is used on the single-ended connectors, it must be attached as shown in Figure 3–4.
4. Connect a SCSI cable to the unused connector on Bus 2 (see Figure 3–4).
5. Route the two longer SCSI cables down through the cable slot at the bottom of the jukebox right side panel, and out through the back of the jukebox.
6. Attach the SCSI cable from Bus 1 to an available SCSI connector on the host computer.
7. Connect the SCSI cable from Bus 2 to a SCSI port on the peripheral device.
8. Plug a terminator into the last SCSI device connected to the system.

Figure 3–4 Connecting Peripheral Devices with Bus 1



1. Connect a SCSI cable to one of the connectors on Bus 1 that matches the interface switch setting.
2. Connect a short SCSI cable to the other connector on Bus 1 that matches the interface switch setting.
3. Route these two SCSI cables down through the cable slot at the bottom of the jukebox right side panel, and out through the back of the jukebox.
4. Plug the other end of the SCSI cable from Bus 1 into an available SCSI connector on the host computer.
5. If you want to connect a peripheral device to Bus 1, plug one end of a SCSI cable into the unused connector that matches the interface switch setting. Otherwise, attach a terminator to the unused connector (see Figure 3–4).

NOTE

LUN mode must be set to ON if a peripheral device is connected to Bus 1.

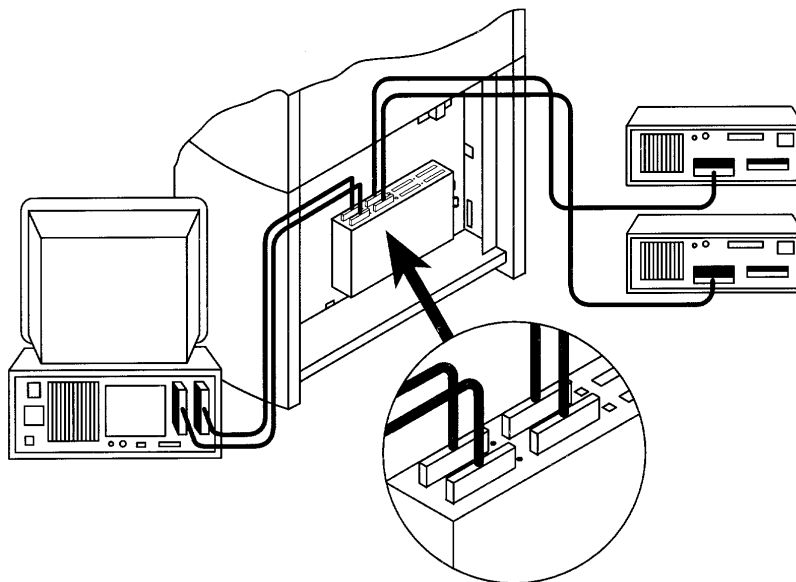
6. If you want to connect a peripheral device to Bus 2, plug one end of a SCSI cable into the unused connector that matches the interface switch setting. Otherwise, attach a terminator to the unused connector (see Figure 3–5).

NOTE

You can connect the jukebox to any peripheral device along a chain of peripherals, as long as you plug a terminator into the last device in the chain.

7. Route the SCSI cable(s) down through the cable slot at the bottom of the jukebox right side panel, and out through the back of the jukebox.
8. Plug the other end of the SCSI cable(s) into an unused SCSI connector on the peripheral device(s).
9. Plug a terminator onto the last device in the chain of devices on each SCSI bus.

Figure 3–5 Connecting Peripheral Devices With Bus 1



3.2.10 Setting the SCSI IDs



The optical jukebox has the option of running in SCSI LUN (logical unit number) mode which allows you to assign from one to three SCSI addresses (depending on the number of drives in the jukebox) to the jukebox. The jukebox controller and drives can then be accessed using logical unit numbers.

If the jukebox is not running in LUN mode, some jukebox models could use all available SCSI addresses on the bus; therefore, if you need to attach additional devices to the same SCSI bus, you must use LUN mode (uses one or two SCSI addresses). See "Setting the LUN Mode" following this section for instructions on changing the LUN mode.

Check the host system documentation and the jukebox application software instructions to verify that the use of LUNs is supported. Also, attaching multiple devices using LUNs may affect the performance of those devices.

If LUN mode is set to "OFF" (the default), the optical jukebox requires the use of from 5 to 13 SCSI IDs--one for each optical drive and one for the jukebox controller. Table 3-4 shows the default SCSI ID and LUN Mode settings.

Table 3-4 Default SCSI and LUN Settings

BUS 1	LUN MODE OFF		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
DRV 5 ID*	1	0	6	5
DRV 6 ID*	0	0	6	6

*may or may not be included in some RW555 models

**may or may not be included in some RW557 models

If you are already using any of these addresses for your computer or another SCSI peripheral device, follow the directions in one of the following sections to change to LUN mode, or change the controller or the drive addresses. To view the current SCSI address settings, see "Viewing the Current SCSI Address Settings" in this chapter.

NOTE

After you change an address, you may have to restart your computer for the new addresses to be recognized.

The new settings can be saved to flash ROM by power cycling the jukebox. This allows the settings to be recovered if the jukebox is powered off for more than ten days. 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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

3.2.11 Setting the LUN Mode



The optical jukebox has the option of running in LUN (logical unit number) mode which allows you to assign one, two or three SCSI addresses (depending on the number of drives in the jukebox) to the jukebox. This may be necessary with some jukebox models since they could use all of the available SCSI addresses on a SCSI bus; therefore, if you need to attach additional devices to the same SCSI bus, you must use LUN mode.

NOTE

Check host system documentation and jukebox application software instructions to verify that the use of LUNs is supported. Also, attaching multiple devices using LUNs may affect the performance of those devices.

Table 3–5 shows the default SCSI address and LUN settings when LUN mode is turned on. You can change the SCSI IDs, but the LUN numbers cannot be changed. (To change the SCSI addresses see "Changing the Current SCSI Address Settings" in this chapter.)

Some host systems do not allow the same SCSI address being assigned to different device types. If your host system does not support this configuration, you must change the "DRVs BUS 1" SCSI address to be different than that of "JKBX BUS 1." (By default all devices on Bus 1 are set to SCSI ID 6 when LUN mode is turned on.) Table 3–3 shows how LUNs are mapped if the JKBX BUS 1 and DRVs BUS 1 addresses are set differently.

When LUN mode is set to "ON" the SCSI addresses of the jukebox controller and drives are mapped internally as described in Table 3–6. (To view the SCSI addresses see "Viewing the Current SCSI Address Settings" in this chapter.)

Table 3–5 Default LUN Settings

BUS 1	LUN MODE ON	
	SCSI ID	LUN
JKBX ID	6	0
DRV 1 ID	6	1
DRV 2 ID	6	2
DRV 3 ID	6	3
DRV 4 ID	6	4
DRV 5 ID*	6	5
DRV 6 ID*	6	6

*may or may not be included in some RW555 models

**may or may not be included in some RW557 models

Table 3–6 LUN Mapping if "DRVs BUS 1" SCSI Address is Changed

BUS 1	LUN MODE ON	
	SCSI ID	LUN
JKBX ID	6	0
DRV 1 ID	4	0
DRV 2 ID	4	1
DRV 3 ID	4	2
DRV 4 ID	4	3
DRV 5 ID*	4	4
DRV 6 ID*	4	5

*may or may not be included in some RW555 models

**may or may not be included in some RW557 models

To change the LUN mode, do the following steps:

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

NOTE

A three-part numerical password is required to access any options beneath ADMIN *. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter.

2. Press **NEXT** until **SCSI ID'S *** displays, and then press **ENTER**.
3. **VIEW ID'S *** displays. Press **NEXT** until **CHOOSE LUN MODE *** displays and then press **ENTER**. **LUN MODE ON** or **LUN MODE OFF** displays and ON or OFF is blinking.
4. Press **NEXT** to change the setting and then press **ENTER**. **WAIT FOR UPDATE** and then **TURNED OFF** or **TURNED ON** display briefly.

SCSI ID'S * displays. You may now view the SCSI ID and LUN numbers using **VIEW ID'S *** or set a new SCSI ID number using **SET ID'S ***. (See the following two sections.)

NOTE

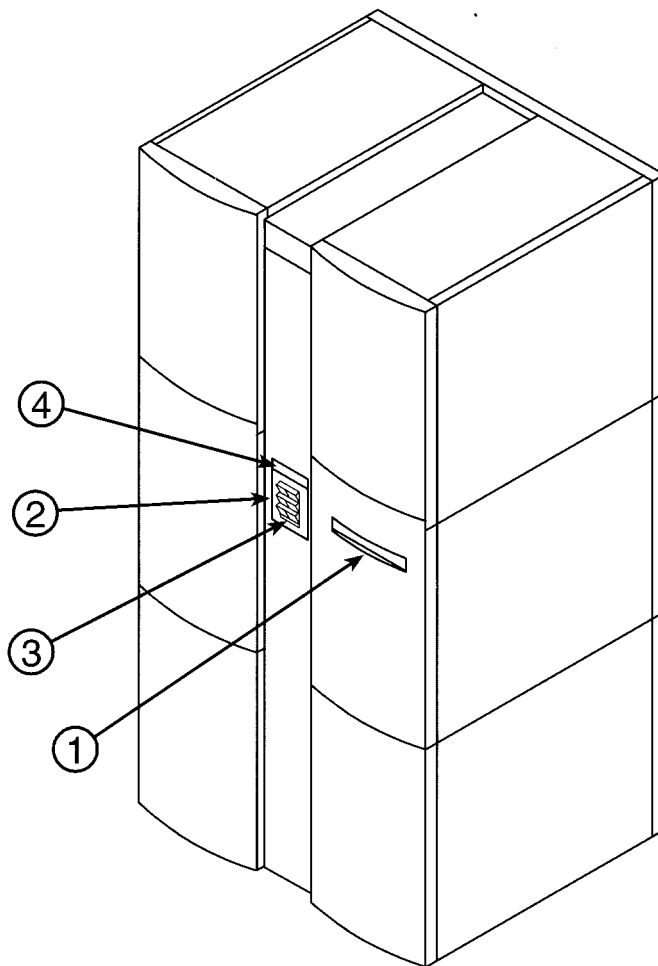
After you change an address you may have to restart your computer for the new addresses to be recognized.

The new settings can be saved to flash ROM by power cycling the jukebox. This allows the settings to be recovered if the jukebox is powered off for more than ten days.

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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

3.3 Control Panel Operation

Figure 3-6 The Jukebox Control Panel and Mailslot



- | | |
|----------------------|---|
| 1) Mailslot | Used to load and unload optical disks. |
| 2) Selection Buttons | Pressed to perform the following operations:
LOAD loads disks into the jukebox
EJECT ejects disks from the jukebox
PREV scrolls the display choice backward by one
NEXT scrolls the display choice forward by one
ENTER selects the displayed option
CANCEL cancels the current operation or choice |
| 3) Activity Light | Lit to indicated the following: <ul style="list-style-type: none">• steady green - power is on• flashing green - an optical drive is being accessed• amber - fault indicator |
| 4) 16-Character | Displays information about the current Display operation |

3.3.1 Using Selection Buttons

The **LOAD** , **EJECT** **NEXT** , **PREV** , **CANCEL**, 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 **NEXT** and **PREV** buttons to scroll the display faster.

Each time you push the **NEXT** button, a task option appears. (If you see an "*" as part of the message, it indicates there is a menu beneath that option, which can be accessed by pressing the **ENTER** key. Additional options are displayed by pressing the **NEXT** or **PREV** key.

NOTE

You can get back to **READY** at any time by pressing **CANCEL**. (You may have to press **CANCEL** more than once in some cases.)

3.3.2 Understanding Display Window Messages

The display window shows you the operations you may select. (To select an option press **ENTER**.) A description of each operation is given below. Instructions for using and setting operations are given in the following sections. (See Figure 3–7 on the following page and the note below.)

3.3.2.1 First Level Messages

READY – the jukebox is ready for operation

ADMIN * – select to access second-level options. (A security code must be entered to access the second-level options.)

3.3.2.2 Second Level Messages

Before the following control panel options can be accessed a security code must be entered. A default code of 000-000-000 is set at the factory, but you will want to change this code to prevent jukebox access by unauthorized personnel. (See "Setting a New Administration Menu Password" in this chapter.)

TEST *–Select to run internal jukebox tests

INFO *–Select to retrieve performance information stored in the jukebox

CONFIG *–(Configurations) select to customize the way the jukebox functions

SCSI ID'S *–Select to set the SCSI addresses for the jukebox controller and the optical drive mechanisms.

ONLINE REPAIR *–Select to set drive power or status.

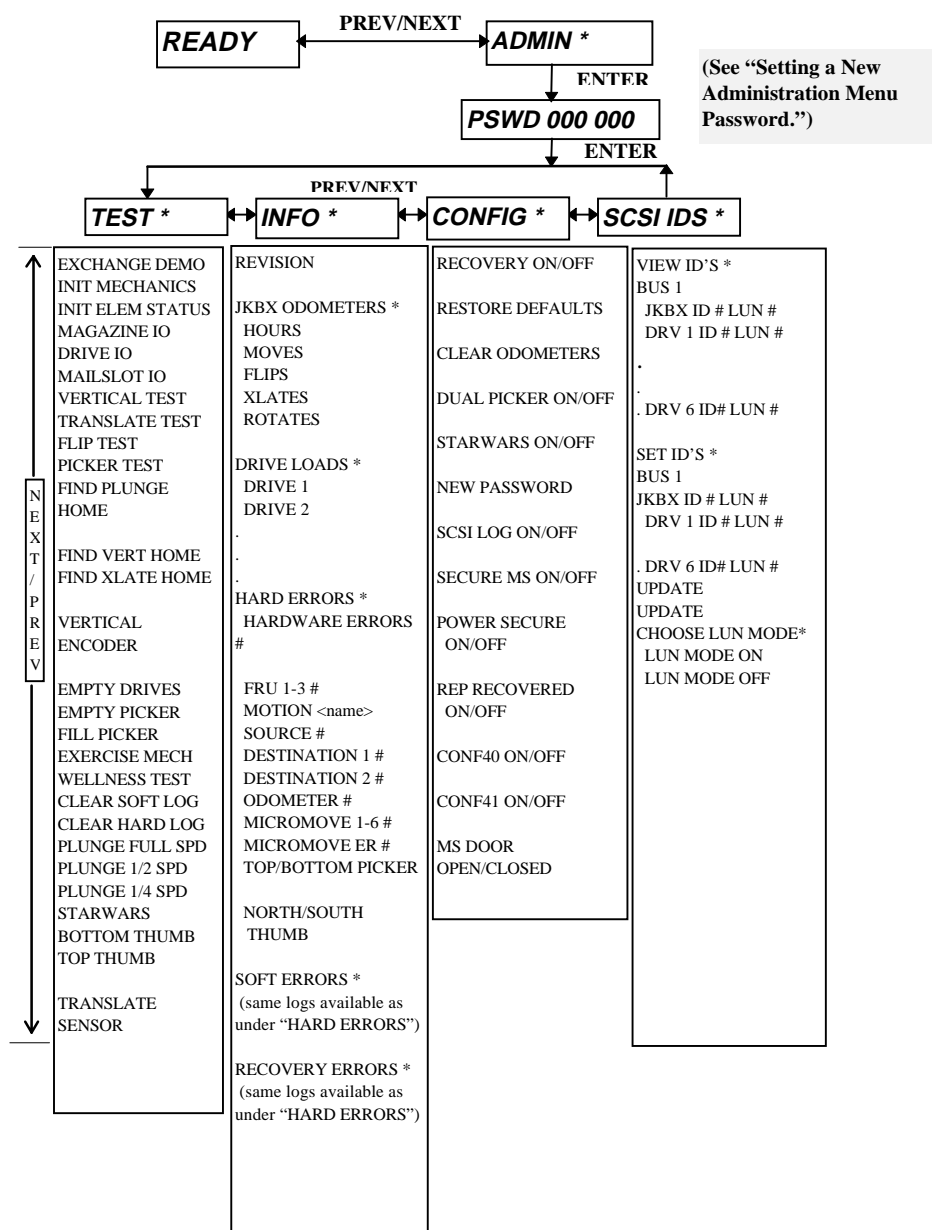
NOTE

You can get back to **READY** at any time by pressing **CANCEL**. 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.

In Figure 3–7, the selections listed in boxes below the shaded options are individually displayed by pressing **ENTER** when the shaded option above that list is displayed. Press **PREV** or **NEXT** to scroll through the list. To perform the displayed operation, press **ENTER**.

Figure 3–7 Jukebox Display Menu Tree–4X Drives



3.3.3 Setting the SCSI IDs



The optical jukebox has the option of running in SCSI LUN (Logical Unit Number) Mapping Active mode which allows you to assign a single SCSI address to the jukebox and then access the jukebox controller and drives using logical unit numbers.

If the jukebox is not running in LUN mode, the RW557 jukebox will use all available SCSI addresses on the bus; therefore if you need to attach additional hardware to the SCSI bus, you may want to consider using LUN mode instead of all of the SCSI addresses. (See "Changing LUN Mode" in this section for instructions for setting a LUN.)

Check the host system documentation to verify that the use of LUNs is supported. Also, attaching multiple devices using LUNs may affect the performance of those devices.

If LUN mode is set to "OFF" (the default), the optical jukebox requires the use of from five to seven SCSI IDs—one for each optical drive and one for the jukebox controller. The following table shows the default SCSI ID and LUN Mode settings:

Table 3–7 Default SCSI and LUN Settings

Bus 1	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
DRV 5 ID*	1	0	6	5
DRV 6 ID*	0	0	6	6

*RW555 models only

If you are already using any of these addresses for your computer or another SCSI peripheral device, follow the directions in one of the following sections to change to LUN mode, or change the controller or the drive addresses. To view the current SCSI address settings, see "Viewing the Current SCSI Address Settings."

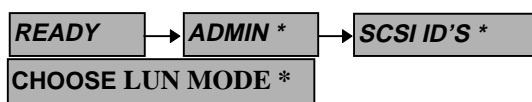
NOTE

After you change an address you may have to restart the computer 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 ten days.

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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

3.3.4 Setting the LUN Mapping Active Mode



The optical jukebox has the option of running in LUN (logical unit number) mode which allows you to assign a single SCSI address (a SCSI logical unit number) to the jukebox. This may be necessary with a RW557 jukebox since it uses all available SCSI addresses on a SCSI bus; therefore if you need to attach additional hardware to the SCSI bus, you may want to consider using LUN mode instead of all the SCSI addresses.

NOTE

Check with the system administrator to verify that the use of LUNs is supported. Also, attaching multiple devices using LUNs may affect the performance of those devices.

When LUN mode is set to "ON" the SCSI addresses of the jukebox controller and drives are mapped internally as follows: (To view the SCSI addresses, see "Viewing the SCSI Addresses" in this chapter.):

Table 3-8 Default LUN Settings

BUS 1	LUN MODE ON	
	SCSI ID	LUN
JKBX ID	6	0
DRV 1 ID	6	1
DRV 2 ID	6	2
DRV 3 ID	6	3
DRV 4 ID	6	4
DRV 5 ID*	6	5
DRV 6 ID*	6	6

*RW555 models only

To change the LUN mode, do the following steps:

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

NOTE

A three-part numerical password is required to access any options beneath **ADMIN ***. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter.

2. Press **NEXT** until **SCSI ID's *** displays, and then press **ENTER**.
3. **VIEW ID'S *** displays. Press **NEXT** until **CHOOSE LUN MODE *** displays and then press **ENTER**. **LUN MODE ON** or **LUN MODE OFF** displays and ON or OFF is blinking.
4. Press **NEXT** to change the setting and then press **ENTER**. **TURNED ON** or **TURNED OFF** displays briefly and then **SCSI ID'S ***.

You may now view the SCSI ID and LUN numbers using **VIEW ID'S ***, or set a new SCSI ID number using **SET ID'S ***. (See the following two sections.)

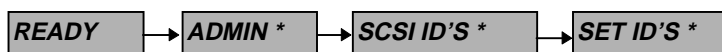
NOTE

A three-part numerical password is required to access any options beneath **ADMIN***. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter. After you change an address you may have to restart your computer 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 ten days.

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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

3.3.5 Viewing the Current SCSI Address Settings



To view the current SCSI address and LUN (logical unit number) settings, do the following steps:

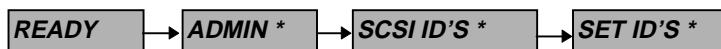
1. With **READY** displayed, press **NEXT** until **ADMIN *** appears in the display window, and then press **ENTER**.

NOTE

A three-part numerical password is required to access any options beneath **ADMIN***. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter.

2. Press **NEXT** until **SCSI ID'S *** displays, and then press **ENTER**.
3. Press **NEXT** until **VIEW ID'S *** displays, and then press **ENTER**.
4. **JKBX ID # LUN #**, or **DRV # ID # LUN #** or **JKBX 0 D1-6 ID #** 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, D1-6 ID# is the current SCSI ID for the drives and jukebox when LUN mode is ON, and "LUN #" is the current logical unit number.)
5. Press **NEXT** to scroll through the current SCSI address and LUN settings.
6. Press **CANCEL** to exit **VIEW ID'S ***.

3.3.6 Changing the Current SCSI Address Settings



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 logical unit numbers (LUNs).

The default address settings are shown below:

Table 3–9 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
DRV 5 ID*	1	0	6	5
DRV 6 ID*	0	0	6	6

*RW555 models only

To change the current SCSI address settings, do the following steps:

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

NOTE

A three-part numerical password is required to access any options beneath **ADMIN***. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter.

2. Press **NEXT** until **SCSI ID'S *** displays, and then press **ENTER**.
3. **VIEW ID'S *** displays. Press **NEXT** until **SET ID'S *** displays and then press **ENTER**.
4. **JKBX ID # LUN #, DRV # ID # LUN #**, or, if LUN mode is set to ON, **JKBX 0 D1-6 ID #** 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, D1-6 ID# is the current SCSI ID for the drives and jukebox when LUN mode is ON, and LUN #" is the current logical unit number.)
5. Press **NEXT** until the setting you wish to change is displayed, and then press **ENTER**.
6. The # (current SCSI address setting) is flashing. Press **NEXT** or **PREV** until the address you want displays and then press **ENTER**.

If the jukebox is set to LUN MODE ON, go to step 7 since only one SCSI address can be changed and the address is automatically updated when you press **ENTER**.

7. Press **NEXT** until **UPDATE** displays, and then press **ENTER**.
8. **WAIT FOR UPDATE** and then **ID'S SAVED** display 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, **VIEW ID'S *** displays, any changes entered are lost, and you must repeat steps 3 through 6 to set a new address.
9. Press **CANCEL** until **READY** displays.

NOTE

After you change an address you may have to restart your computer 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 ten days.

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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

3.3.7 Setting a Configuration Option



You can set certain options to customize the way the jukebox operates. These options are called configurations.

Follow these steps to change a configuration:

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

NOTE

A three-part numerical password is required to access any options beneath **ADMIN***. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter.

2. **TEST *** displays. Press **NEXT** until **CONFIG *** displays, and then press **ENTER**.
3. Press **NEXT** or **PREV** until the name of the configuration you wish to set displays and then press **ENTER**. The current setting will flash. (Configuration options are described on the following pages.)
4. Press **NEXT** or **PREV** until the desired setting is displayed, and then press **ENTER**. **OPTION SAVED** (or another confirmation message) will display.
5. Press **CANCEL** to return to **READY**.

Descriptions of the available configurations are shown in Table 3–10.

Table 3–10 Configuration Choices

Config 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.
RESTORE DEFAULTS	Sets all jukebox configurations back to their default settings.
CLEAR ODOMETERS	Sets all jukebox odometers back to zero.
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. <i>This configuration should not be used by the customer.</i>
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 3–10 Configuration Choices (continued)

Config 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 MS 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.
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
CONF41 ON/OFF	Toggles between the two OEM modes of using parity; ON (parity on) is the OEM-unique mode. OFF (parity off) is the OEM normal mode.
MS DOOR OPEN/CLOSED	Toggles between OPEN and CLOSED. When set to OPEN, the mailslot will always remain open; when set to CLOSED, the mailslot will remain open for ten seconds after disks are loaded or ejected, automatically closes, and will not reopen until the LOAD key is pressed.

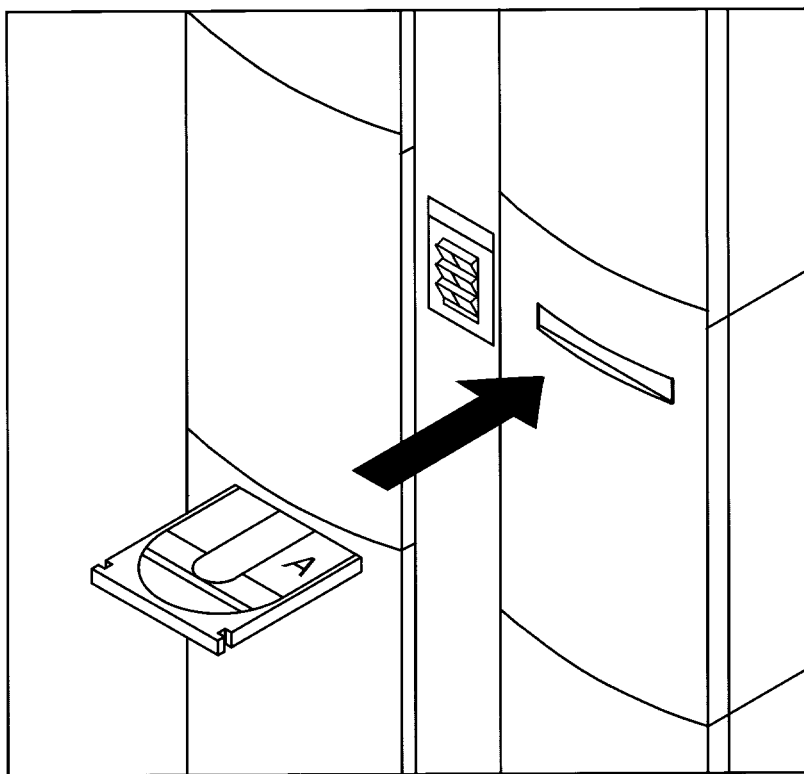
3.4 Loading an Optical Disk into the Jukebox

NOTE

Disks should be labeled before loading them into the jukebox.

Some software packages require that disks be inserted and removed by using instructions in the software. Check with the system administrator to determine if the software they are using manages the files in the jukebox. Check the software documentation before proceeding with these steps.

Figure 3–8 Loading an Optical Disk



1. With **READY**, **LOAD ***, or **EJECT *** displayed, press **LOAD** on the jukebox control panel. (If none of these messages is displayed, press **CANCEL** until **READY** displays.)
2. When the mailslot opens, insert an optical disk into the mailslot so that Side A of the optical disk is facing up and the shutter end of the disk goes in first. When the disk is inserted, it will automatically be pulled into the mailslot. If the disk is inserted incorrectly, it will be rejected, **CART IN WRONG** displays briefly, and then **LOAD SLOT #** displays. ("#" is flashing and is the number of the first available storage slot in the jukebox.)
3. If you want to select the storage slot number in the display, press **LOAD** or **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**.
4. Initially, **LOADING** displays. After the disk has been loaded into the selected storage slot, **LOAD *** is again displayed. (See the note on the following page.) You may now load additional disks by inserting the disks into the mailslot and repeating step 3 until you have loaded all the required disks into the jukebox.

NOTE

There are several conditions that may prevent an optical disk from being loaded: If you get a **LOAD ERROR** message, a disk may have been inserted incorrectly.

- If the host system computer has a slot reserved, the number of the reserved slot will not be displayed. The slot 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, "SECURE MS" has been set, **RESERVED** displays and disks cannot be removed. (See "Changing a Configuration Option" in this chapter.)
- If you get a **MAIL SLOT EMPTY** message, a disk must be inserted into the mailslot.
- If you get a **DISK NOW FULL** message, a disk was moved into that slot before the current disk could be inserted.

NOTE (continued)

- If you get a **RESERVED** message, a security option has been set that prevents disks from begin loaded into, or removed from, the jukebox. (See "Setting a Security Option in this chapter.)
- If you get a **TRANSPORT FULL** message, the disk transport mechanism already contains a disk. If the host application software does not have a procedure for ejecting the disk from the mailslot, the disk will have to be manually removed,
- If you get a **MAIL SLOT 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. (Refer to Chapter 5, "Removal and Replacement.").

5. Press **CANCEL** to return to the **READY** state.

3.5 Ejecting an Optical Disk from the Jukebox

NOTE

Some software packages require that disks be inserted and removed by using instructions in the software. Check with the system administrator to determine if the software they are using manages the files in the jukebox. Check the software documentation before proceeding with these steps.

1. With **READY**, **LOAD ***, or **EJECT *** displayed, press **EJECT** on the jukebox control panel.
2. **EJECT SLOT #** displays. ("#" is flashing and is the number of the first storage slot in the jukebox that contains an optical disk.)
3. If you want to select the storage slot number in the display, press **EJECT** or **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** displays. When the disk has been moved into the mailslot **EJECT *** displays.

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

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 slot reserved, the number of the reserved slot will not be displayed. The slot must be unreserved before the disk can be ejected. (Refer to the host system documentation or the application software documentation for instructions on unreserving a slot.)
- If the configuration, "SECURE MS" has been set, **RESERVED** displays and disks cannot be removed. (See "Changing a Configuration Option" in this chapter.)
- If you get a **TRANSPORT FULL** message, the disk transport mechanism already contains a disk.
- If you get a **SOURCE NOW EMPTY** message, a disk was moved into that slot before the current disk could be inserted.

NOTE

- **EJECT ERROR** displays if the mailslot is jammed. Refer to Chapter 5, "Removal and Replacement" for mailslot access procedures.
- If **MAILSLOT FULL** displays there is already an optical disk in the mailslot that must be removed before another disk can be ejected.

5. Press **CANCEL** to return to the **READY** state.

3.6 Entering the Administration Menu Password to Enter the ADMIN Level

A numeric password is required to access options beneath **ADMIN *** menu of the jukebox. A three-part password of 000-000-000 was set at the factory. Consider changing the password so that only authorized persons can access the jukebox and change operation settings on the jukebox.

Follow these steps to enter the password. Changing the password is in the next section, "Changing the Administration Password."

1. With **READY** displayed, press **NEXT** until **ADMIN *** appears in the display window.
2. Press **ENTER**. **PSWD 000 000 000** displays and the first set of zeros is flashing.
3. Press **ENTER** to accept this number if no password has been set, or press **NEXT** or **PREV** until the number you have set is displayed. Press **ENTER**. The middle set of zeros is now flashing.
4. Press **ENTER** to accept this number if no password has been set, or press **NEXT** or **PREV** until the number you have set is displayed. Press **ENTER**. The last set of zeros is now flashing.
5. Press **ENTER** to accept this number if no password has been set, or press **NEXT** or **PREV** until the number you have set is displayed. Press **ENTER**. **TEST *** displays.

To access options in the **ADMIN *** menu press **PREV** or **NEXT** until the desired option is displayed, and then press **ENTER**.

3.7 Changing the Administration Menu Password

NOTE

Don't forget your password. If you forget it, only your service representative can reset the password to the factory setting so you can set a new one.

1. Follow the steps on the previous page to enter the existing or factory-set password.
2. **PSWD 000 000 000** displays. Press **ENTER** until **ADMIN *** displays, and then press **ENTER**.
3. Press **NEXT** or **PREV** until **PSWD 000 000 000** displays and then press **ENTER**.
4. **PSWD 000 000 000** displays and the first set of zeros is flashing. Press **NEXT** or **PREV** until the new number you wish to assign to the first part of the password is displayed and then press **ENTER**. The second set of zeros is flashing.
5. Press **NEXT** or **PREV** until the new number you wish to assign to the second part of the password is displayed and then press **ENTER**. The last set of zeros is flashing.
6. Press **NEXT** or **PREV** until the new number you wish to assign to the third part of the password is displayed and then press **ENTER**.

4

Troubleshooting and Diagnostics

This chapter describes troubleshooting procedures and diagnostic routines.

4.1 Understanding the Troubleshooting Process

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.

4.1.1 Obtaining Troubleshooting Information

Error information is available through both control panel and through the SCSI bus, using an external diagnostic tool.

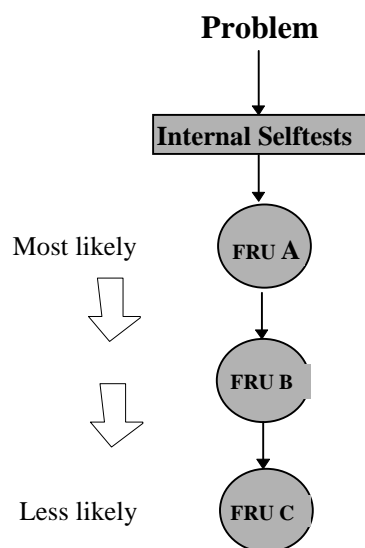
By knowing how the autochanger operates and using the summarized information from the control panel display, there is enough information to troubleshoot many problems that result in a hard error.

In most instances, running internal tests and reading error logs in the control panel display will be enough to troubleshoot problems in the jukebox.

The Autochanger Automatically Lists the First "Possible Causes"

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

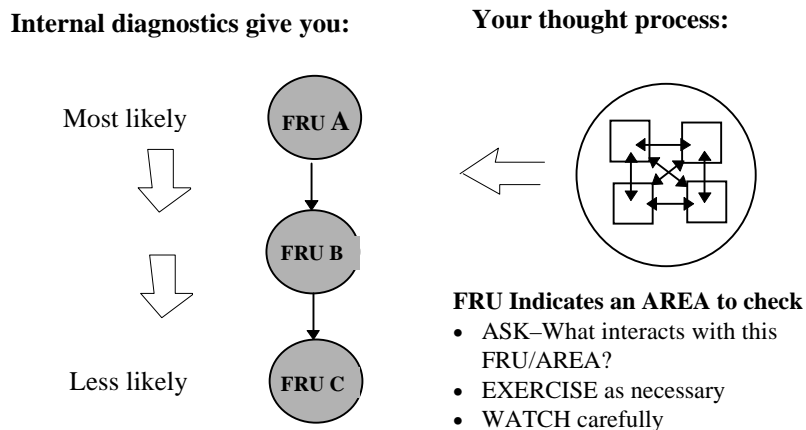
This test sequence returns possible failed FRUs only if there has been a **hard failure**. The test sequence will NOT find a failure from which a recovery was made.

4.2 How "Possible Causes" Should be Evaluated

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 reliably solve a problem.

Figure 4–2 Evaluating 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 ID table in this chapter will also help you understand the small moves that comprise jukebox operation.

4.3 Reading Logs From the Control Panel

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

NOTE

A three-part numerical password is required to access any options beneath **ADMIN ***. Instructions for entering this password are given in the section, "Entering the Administration Level" in Chapter 3.

2. Enter the correct password (See NOTE above).
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.
JXBX 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 transport mechanism.
FLIPS	Displays the total, number of picker mechanism flips.
XLATES	Displays the total number of horizontal moves between optical disk storage slots.
ROTATES	Displays the total number of mailslot rotations.
DRIVE LOADS	Press ENTER to select the logs described in the next few rows. Step through the logs by pressing NEXT and PREV.
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.
DRIVE 4	Displays the number of optical disk loads for optical drive number 4.
DRIVE 5	Displays the number of optical disk loads for optical drive number 5. (If installed)
DRIVE 6	Displays the number of optical disk loads for optical drive number 6. (If installed)

Table 4–1 Information Logs (continued)

Log Name	Description
HARD ERROR *	Log of unrecoverable errors; commands did not successfully complete. 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 ERROR" in this table.) Step through the log by pressing NEXT or PREV .
SOFT ERROR *	Log of unrecovered errors: commands successfully completed. 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 ERROR	Log of errors during most recent move. 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 most likely to be at fault.
*FRU 3	The field-replaceable unit most likely to be at fault.

Table 4–1 Information Logs (continued)

Log Name	Description
MOTION <name>	<p><name> indicates one of the following types of movements taking place in the jukebox at the time of the failure:</p> <ul style="list-style-type: none"> • EXCHANGE • MOVE • POSITION • INIT ELEM • REZERO • ROTATE • DIAGNOSTIC • RESTORE • PASSTHRU
SOURCE	The element number where the move started. (This information is valid for MOVE, EXCHANGE, and POSITION movements only.)
DESTINATION 1	The element that was the first destination of the move. (This information is valid for MOVE and EXCHANGE movements only.)
DESTINATION 2	The element that was the second destination of the move. (This information is valid for the EXCHANGE movement only.)
*MICROMOVE 1-6	<p>The IDs of the last six micro-moves for the original move command issued prior to the failure (individually displayed).</p> <p>Step through the micro-move IDs by pressing NEXT or PREV.</p>
*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 transport mechanism is active.

4.4 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.

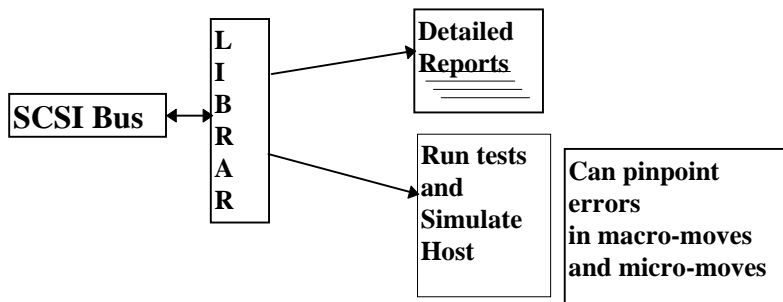
Troubleshooting Through the SCSI Bus - This method is used in situations where you have a soft or intermittent error.

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 micro-moves.

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.

Figure 4-3 Information and Tests Through the SCSI Bus



4.5 Diagnostic

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**—The primary off-line diagnostics will be the Peripheral Test Instruments (PTI) SCSI Toolbox.
- **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.

4.6 Operation/Installation Error Information

CAUTION

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

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

Table 4–2 Operation Errors

Task	Problem/Symptom	What to do
Communicating host<-->jukebox	Can't get the host to recognize the jukebox.	<ul style="list-style-type: none">• Check to make sure the jukebox is supported on the host operating system.• Check to make sure the jukebox is installed and configured as described in the users guide and the appropriate host system manuals.• Check the SCSI connections.• Check the SCSI interface address as it relates to the device files.

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Changing the drive address	Changed drive address but new address is not recognized.	<ul style="list-style-type: none">• After changing an address, the jukebox 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.)• Verify address change by viewing SCSI IDs. The new drive address may have conflicted with another address used by the jukebox and the change was aborted.
Inputting Security Code	Security code forgotten or misplaced.	<ul style="list-style-type: none">• First, try the default security code (000-000-000).• If the security code is not set to the default, use DOWNLD2 or the PTI diagnostics program to download a new copy of the firmware into the unit. This clears NVRAM and sets the security code to the default code. <p>The customer may now set a new security code.</p>

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 FAILED .	<ul style="list-style-type: none"> Press CANCEL. Remove the disk from the mailslot, and try inserting it again. <p>CAUTION: Do not cycle the power if anything on the SCSI bus may be active.</p> <ul style="list-style-type: none"> If the light bar on the control panel is orange, cycle power to the jukebox and try to load the disk again when READY displays. If LOAD ERROR or FAILED continues to display, check for hardware errors. If there is a disk in the mailslot, remove it, then try to remove the desired disk again.
Removing disks	Disk removal attempted, but an EJECT ERROR message displays.	<ul style="list-style-type: none"> If there is no disk in the mailslot and the EJECT ERROR message displays, check the hardware errors.
Removing disks	Disk removal attempted, but a RESERVED message displays.	<ul style="list-style-type: none"> The host may have reserved the element and must unmount the device. <p>A security code was set to prevent disk removal. (See "SECURE ON/OFF" in this chapter under "Setting a Configuration Option.")</p>

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Powering on	The optical disk jukebox won't power on.	<ul style="list-style-type: none"> • Check to make sure the power cord connections are tight. • Check that the power switch is ON (lower left on lower rear panel). • Check to make sure the power outlet is operating. • Replace the power cord with a known good one. • Replace the power supply module. • Test the voltages on the 42V power supply. If good, check the voltages on the 5/12V power supplies. Replace as necessary.
Powering on	Power on selftest fails.	<ul style="list-style-type: none"> • Press ENTER and record the error message. Press ENTER again to decode the message. <p>CAUTION: Do not cycle the power if anything on the SCSI bus may be active.</p> <p>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.)</p>
Power fail	Just the jukebox power fails.	When power returns, unmount and remount all disk surfaces. Do not eject any disks until the surfaces are unmounted/unreserved.

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Power fail	Jukebox power fails while a disk is in the drive. Jukebox did NOT return to READY after the power returns.	<p>CAUTION: Do not cycle the power if anything on the SCSI bus may be active.</p> <ul style="list-style-type: none"> • Press ENTER and record the error message. Press ENTER again to decode the message. • Power cycle the unit. If successful, use the file system check (fsck or equivalent) command. • If power on is unsuccessful, power the unit off. Do not move the jukebox any more than is needed to access the service panels. Moving the jukebox with a disk in a drive risks damaging the magneto-optical mechanism in the MO drive. • 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.

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Power fail	Host computer power fails and the jukebox stays on.	After the host reboots, file system check (<i>fsck</i> or <i>equivalent</i>) any write-mounted surfaces.
Power fail	Both the host system and jukebox power fail.	After the host reboots, file system check (<i>fsck</i> or <i>equivalent</i>) any write-mounted surfaces. CAUTION: Do not eject disks from the jukebox until all mounted surfaces are unmounted.
Reading the control panel display window	No display messages appear.	<ul style="list-style-type: none"> • Check that the power cord is connected. • Check AC input. • Check the control panel cable connections. CAUTION: Do not cycle the power if anything on the SCSI bus may be active. <ul style="list-style-type: none"> • Power cycle the jukebox. • Replace the power cable with a known good one. • Check the 24V and 5/12V supplies. Replace a power supply if necessary. • Replace the autochanger controller PCA.

Table 4–2 Operation Errors (continued)

Task	Problem/Symptom	What to do
Reading/writing magneto-optical disks	Can't write to the disk.	<ul style="list-style-type: none"> • 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 (mediainit and newfs commands or equivalent, depending on operating system). • Check that the disk file system was mounted correctly. <p>Refer to the "Optical Disk Cleaning" section in this chapter.</p>
Running a test	Started a test and need to stop the test.	<ul style="list-style-type: none"> • Press CANCEL. The current test loop continues until it is finished; then the test stops.
Normal operation	<i>RUN ISTAT TEST</i> (Initialize Element) displays.	<p>CAUTION: Do not cycle the power if anything on the SCSI bus may be active.</p> <ul style="list-style-type: none"> • Run <i>INIT ELEM STATUS</i> from the control panel or power cycle the jukebox.

4.7 Recovery from Hardware Errors

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

Table 4–3 shows the hardware error codes possible and recovery procedures for specific hardware errors.

Table 4–3 Hardware Errors and Recovery Procedures

Error Code (hex.)	Recovery Procedures
01 ROM checksum error	01 through 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.)	Recovery Procedures
1E Translate motor error	<p>Can not translate the picker and/or sense that it has moved. Picker assembly (umbilical cable, motor, sensor):</p> <p>If doesn't move at all – likely is the umbilical cable.</p> <p>If it moves a little but can't reach the side – cables good, motor is bad.</p> <p>Got to the side, but can't sense you did– sensor.</p> <p>Change the controller PCA.</p>
1F Vertical motor error	<p>Occurs when trying to sense a move of the carriage assembly):</p> <p>If the transport mechanism moves – and you get a failure – that means that we're not reading the encoder strip.</p> <p>If the transport mechanism doesn't move – it probably is the motor leads, motor, or 24-volt power supply.</p> <p>Make sure the encoder strip is inside sensor.</p> <p>Make sure the motor leads are connected to the vertical motor.</p> <p>Check that the cable from the sensor is connected through the transport mechanism from to the umbilical cable for the picker.</p> <p>Change the 24/42-volt power supply.</p> <p>Change the controller PCA.</p>
20 Plunge motor error	<p>Check the plunge motor leads.</p> <p>Change the picker.</p>
28 Mailslot sensor error	<p>Check the mailslot-to-interposer cable.</p> <p>Change the mailslot.</p> <p>Change the interposer PCA.</p>
2B Top thumb sensor error	<p>Change the picker.</p> <p>Change the umbilical cable.</p> <p>Change the controller PCA.</p>

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

Error Code (hex.)	Recovery Procedures
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 were it fails.
36 Elements reserved	User error.
3C Move to	Vertical motion failed in the middle of a move or exchange. <ul style="list-style-type: none"> 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 transport mechanism from to the umbilical cable for the picker. 24/42-volt power supply Controller PCA.
3D Flip	Change picker.
3E Translate	Change picker.

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

Error Code (hex.)	Recovery Procedures
3F Put magazine in	<p>Failed plunging cartridge into a magazine.</p> <ul style="list-style-type: none"> 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	<p>Failed extracting a cartridge from a magazine.</p> <ul style="list-style-type: none"> 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.
41 Test magazine	<p>Failed testing the magazine portion during an ISTAT.</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 Excrete 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.)	Recovery Procedures
44 Test drive	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Change the picker. Change the mailslot.
46 Get mailslot out	<ul style="list-style-type: none"> Change the picker. Change the mailslot.
47 Test mailslot	<ul style="list-style-type: none"> Change the picker. Change the mailslot.
48 Rotate mailslot in	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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.
4A Test picker	<p>This may appear when testing for a cartridge in the picker during an ISTAT.</p> <ul style="list-style-type: none"> Replace picker.
4B Switch active picker	<ul style="list-style-type: none"> Replace picker.
4C Restore picker	<ul style="list-style-type: none"> Replace picker.

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

Error Code (hex.)	Recovery Procedures
4D Find translate home	<p>Can not translate the picker and/or sense that it has moved.</p> <ul style="list-style-type: none"> • 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	<p>Because a motor test is called before a find vertical home is attempted, the vertical motor is assumed to be at least minimally functional.</p> <ul style="list-style-type: none"> • Check that the vertical path is physically clear. • Change the vertical motor (probably a marginal error).
4F Find plunge home	<p>We know that we can move the plunge motor.</p> <p>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.</p> <ul style="list-style-type: none"> • Change the picker.
50 Clear flip area	<p>The vertical path is probably blocked.</p> <p>Perhaps falsely overforcing.</p> <ul style="list-style-type: none"> • Check that the path is clear. • Exercise and visually check the operation of the vertical motor.
51 Clear magazine path	<p>Check that the path from the picker to the magazine is clear.</p> <ul style="list-style-type: none"> • Check that the vertical path is clear. • Test the vertical path sensor operation.
52 Clear drive path	<p>Check that the path from the picker to the drive is clear.</p> <ul style="list-style-type: none"> • Check that the vertical path is clear. • Test the vertical path sensor operation.

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

Error Code (hex.)	Recovery Procedures
53 Clear mailslot path	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Change the picker.
5C Wait plunge	<ul style="list-style-type: none"> • Change picker.
5D Wait vertical	<p>Vertical motion failed in the middle of a move or exchange.</p> <ul style="list-style-type: none"> • 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 transport mechanism from to the umbilical cable for the picker. • 24/42-volt power supply. • Controller PCA.
5E Powerfail clear path	<ul style="list-style-type: none"> • Check that all paths are clear. • Test the vertical path sensor operation.
5F Powerfail restore cartridges	<p>A cartridge was physically moved after powerfail and before powerfail recovery.</p> <ul style="list-style-type: none"> • Check that no cartridges have been moved.
60 Repeater Controller	<ul style="list-style-type: none"> • 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.)	Recovery Procedures
61 External SCSI cables	<ul style="list-style-type: none"> • 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.

Table 4–4 Micro-Move Error Codes

Error Code (Hex)	Description
00	No error
01	Vertical overvoltage exceeded limit set by firmware
02	Vertical over force exceeded limit set by firmware
03	Vertical servo error
04	Vertical time-out
05	Vertical open path
06	Vertical closed path
0A	Plunge over voltage exceeded limit set by firmware
0B	Plunge over force exceeded limit set by firmware
0C	Plunge servo error
0D	Plunge servo error
0E	Plunge open path
0F	Plunge closed path
10	Top picker expected to be active picker in plunge. Runtime.
11	Bottom picker expected to be active picker in plunge. Runtime.
12	Bottom thumb expected to be active in plunge home. Power up.
13	Top thumb expected to be active in plunge home. Power up.
14	Translate over voltage exceeded limits set by firmware
15	Translate over force exceeded limits set by firmware
16	Translate servo error

Table 4–4 Micro-Move Error Codes (continued)

Error Code (Hex)	Description
1E	No load complete.
1F	Unexpected load complete.
20	Unexpected cartridge in drive.
21	No cartridge in drive.
22	Drive put in accept failed.
23	Drive get out accept failed.
24	Drive eject failed.
25	Drive insert failed.
26	Drive eject retry.
27	Drive insert retry.
28	Clear drive path.
29	Drive signal (not used).
2A	Drive not connected.
32	Magazine put in saturate failed.
33	Magazine get out saturate failed.
34	Magazine put in accept failed.
35	Magazine get out accept failed.
36	Magazine measure failed.
37	Test magazine failed.
38	Return magazine failed.
39	Clear magazine path.
3C	Mailslot put in saturate failed.
3D	Mailslot get out saturate failed.
3E	Mailslot put in accept failed.
3F	Mailslot get out accept failed.
40	Measurement of mailslot depth failed.
41	Recovery did not clear vertical path.

Table 4–4 Micro-Move Error Codes (continued)

Error Code (Hex)	Description
42	Rotate mailslot in failed.
43	Rotate mailslot out failed.
46	Flipped too far.
47	Did not flip far enough.
48	Flip side incorrect.
50	Failed to finish a translate.
51	Extra force needed to translate.
5A	Command received to rotate mailslot but both pickers are full.
5B	Back sensor in mailslot is bad.
5C	Front sensor in mailslot is bad.
5D	Command received to eject from the mailslot, but both pickers are full.
5E	Attempt to load from an empty mailslot.
5F	Engaging the mailslot failed on a rotate in.
60	Disengaging the mailslot failed on a rotate in.
61	Rotate in catch error (not used).
62	Rotate in push out error (not used).
63	Rotate in armed failed (not used).
64	Did not detect hard stop on a rotate in.
65	Rotate in was too much distance.
66	Engaging the mailslot failed on a rotate out.
67	Disengaging the mailslot failed on a rotate out.
68	Did not detect hard stop on a rotate out.
69	Rotate out distance was too short.
6A	Could not move thumbs out of the vertical path after a rotate out.
6B	Vertical distance difference detected after error recovery.
6C	Cartridge in mailslot incorrectly at rotate in.

Table 4–5 Micro-Move ID

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.
18	Vertical move up to find first cartridge during initialize element status command. Fingers are splayed out.
19	A sweep of the stacks while plunging out to determine which slots contain cartridges.
32	Picker is moved to the right side until over force is felt.
33	Picker is moved to the left side until over force is felt.
34	Translate to the right.
35	Translate to the left.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
36	Voltage is taken off translate motor.
37	Slow translate to find center stack sensor. When sensor is found, the count on the translate encoder strip is noted. This count (horizontal position) is used as the center point from which the position of the other stacks is determined.
62	Move slowly to one side of the transport frame. Used to find translate home during power up. Movements after power up use the translate home ID, 63.
63	Move to one side of the transport 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 (the 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.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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.
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 so 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 is 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 to 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 assembly into the picker after executing micro-move 88. Used in an ISTAT.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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.
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 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.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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.
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 picker plunge assembly out a small amount from the full retracted position to relieve 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 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.
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.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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 it is detected during an ISTAT. Moves the cartridge fully into 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 end 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.
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.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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.
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 in-transit 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 thumbs from vertical picker path. Used after a cartridge is put in 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.
D0	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.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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.
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 the 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 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.

Table 4–5 Micro-Move ID (continued)

ID (hex)	Description
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.

4.8 Running an Internal Test



The optical jukebox can run self-diagnostic tests. To run these tests do the following steps.

CAUTION

Some diagnostic tests, such as EXCHANGE DEMO, can corrupt your file system (disks can be placed in unexpected locations), if a test is not properly completed.

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

NOTE

A three-part numerical password is required to access any options beneath **ADMIN ***. Instructions for entering this password are given in the section, "Entering the Administration Menu Password" in this chapter.

2. **TEST *** displays. Press **ENTER**.
3. Press **NEXT** until the name of the test you wish to run displays and then press **ENTER** to start the test.

NOTE

You may press **CANCEL** at any time to abort a test. A delay may occur while the current test loop completes.

Table 4–6 Tests Available from the Control Panel

Test Name	Description
EXCHANGE DEMO	This test moves randomly-chosen optical disks 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, and INIT ELEM STATUS tests. Each test is run one time per test loop.
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. NOTE: This test will appear as "ISTAT TEST" in all control panel error messages.
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.

Table 4–6 Tests Available from the Control Panel (continued)

Test Name	Description
TRANSLATE TEST	Translates from side to side. No optical disks are required.
FLIP TEST	Makes a combination of moves with a PASS/FAIL result. Flips the picker mechanism. No optical disks are required.
PICKER TEST	Flips the disk transport mechanism and switches active thumbs.
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 optical disks are required.
FIND VERT HOME	Recalibrates the vertical position and verifies that the vertical path is clear.
FIND XLATE HOME	Calibrates the translate position.
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 optical disks are required.
EMPTY DRIVES	Moves cartridges out of the drive mechanism(s) and returns them to their storage slots if the locations are known. Otherwise, the disks are placed into the first available empty storage slot.
EMPTY PICKER	Moves an optical disk from the disk transport mechanism to its home storage slot location 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 full both picker slots.
EXERCISE MECHANICS	Runs the VERTICAL TEST, TRANSLATE TEST, FLIP TEST, MAGAZINE IO, DRIVE IO, and MAILSLLOT I/O tests. Each test is run one time per test loop. Requires one loaded cartridge; drives and mailslot must be empty.

Table 4–6 Tests Available from the Control Panel (continued)

Test Name	Description
WELLNESS TEST	Checks out the general capability of the jukebox. Runs INIT MECHANICS and EXERCISE MECHANICS. Requires one loaded cartridge; drives and mailslot must be empty.
CLEAR SOFT LOG	Sets the soft error log to zero.
CLEAR HARD LOG	Sets the hard error log to zero.
PLUNGE FULL SPD	Allows the disk transport mechanics to be run at full speed. This configuration should always be used when during normal jukebox operations.
PLUNGE 1/2 SPD	Allows the disk transport mechanism 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 optical disks. 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. This display is automatically updated if the status changes.
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 the thumbs is the forward position. If NO THUMB is returned, both thumbs are in the back position.
TOP THUMB	Reports ON or OFF. Looks at 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.
TRANSLATE SENSOR	Reports ON or OFF after looking at the translate calibration sensor (verifies that the path for horizontal disk translate movement is clear). This display is automatically updated if the status changes.

4.9 Setting Write Verify

At sites where there is a possibility of a large amount of airborne contamination or where performance can be traded for greater data integrity, you should set Write Verify ON.

The drive configuration data file is an ASCII text file in the drive download code. This file can be edited.

To force Write Verify ON, use DOWNLD3 (or the most current download utility) to download the DRIVE CONFIG DATA file to the drive's configuration entry. This file is an ASCII text file and can be edited.

On line 123 in the VENDOR UNIQUE Page 21H, Byte 15. change 0x88 to 0x98.

Forcing write verify causes a read-and-compare with data immediately after the data is written and before a write is attempted on another cylinder. The drive will error out if the verify fails.

4.10 Optical Disk Cleaning

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 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-connect jukeboxes

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.

4.10.1 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.

4.11 Using the Eject Tool to Remove a Disk From the RWZ53 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.

You may also use a small flat-blade 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

This chapter describes how to remove and replace the subassemblies in the RW555/RW557 Large Optical Disk Library.

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5.1 Field-Replaceable Assemblies

A list of field replaceable assemblies and units is located at the end of this chapter (see Section 5.20).

WARNING

DO NOT DISASSEMBLE the optical drive mechanism.

The optical drive mechanism becomes a Class 3 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.

5.2 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.

5.3 Tools Required

The following tools are needed for the procedures described in this removal and replacement chapter:

- TORX driver with the following bits: T-10, T-15, T-20, T-25
- Needle-nosed pliers
- Flat-blade screwdriver

5.4 Disassembly/Reassembly Procedure

WARNING

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

CAUTION

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.

When servicing the jukebox, be sure that disk cartridges are not moved from their original slot locations.

If you need to remove 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.

Figure 5-1. Access Panels (1 of 2)

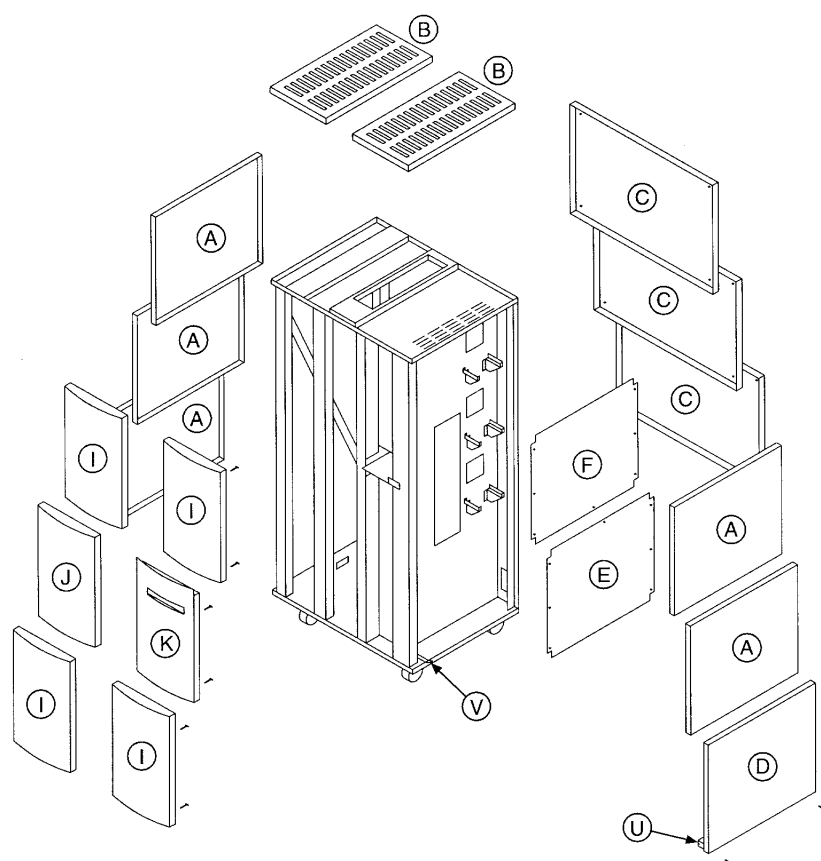
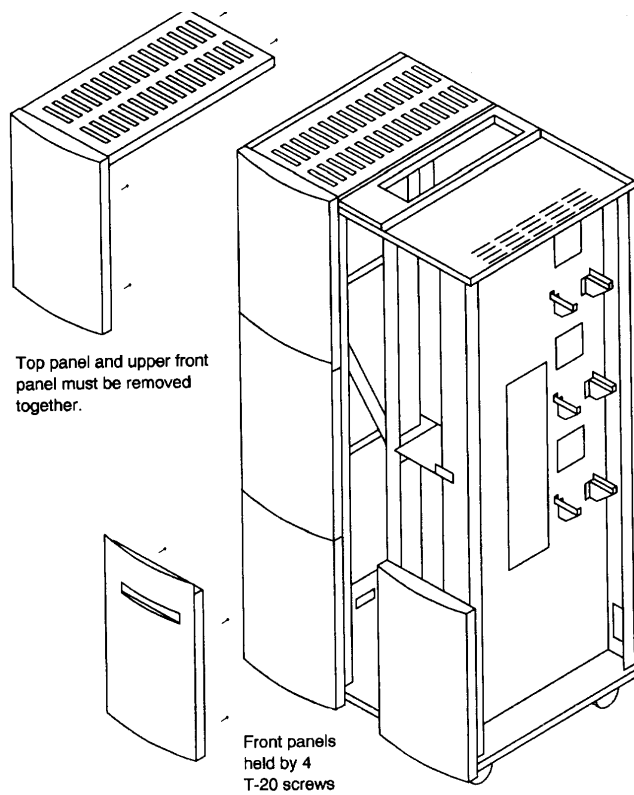


Figure 5-1 Access Panels (2 of 2)



5.5 Replacing an Optical Drive

NOTE

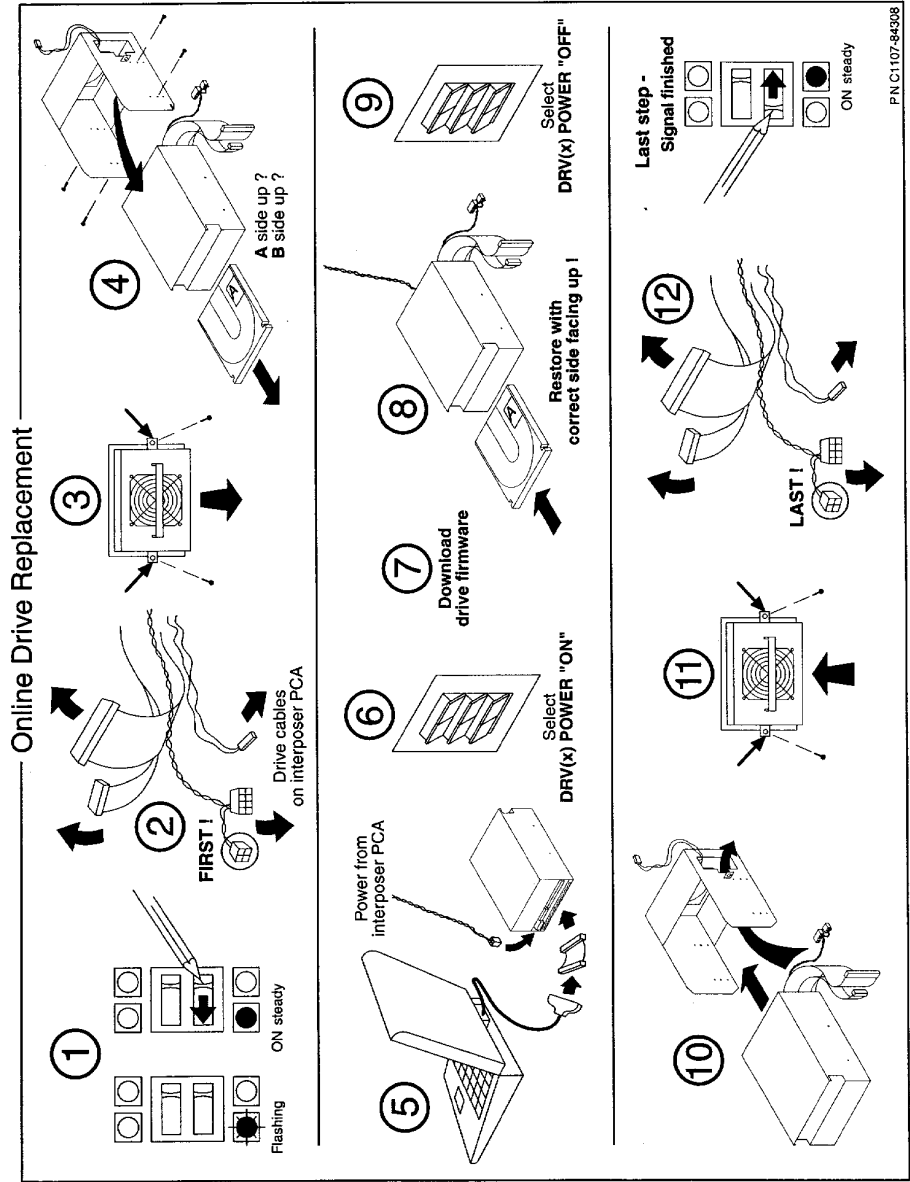
The procedure, as it is explained here, assumes a power on, on-line situation. Differences in the procedure for a power-off drive replacement will be noted as appropriate.

1. Use the access panels figures in the beginning of this chapter as a guide to removing ALL THREE right-side access panels.

The reason the upper access panel is removed is to expose the "Online Drive Replacement" decal that is mounted on the upper RFI panel.

2. Remove the lower right-side RFI panel.

Figure 5-2 Online Drive Replacement Procedure



3. *Power on, online only:* Note which drive status LED (orange) is blinking. Slide the communication switch to the left for this drive. Status LED should go ON steady immediately.

Slide the communication switch to the left for the “other” good drive in the same enclosure. If the host is using the good drive, it will wait until it is finished with the drive, eject the disk, and then bring the drive off-line. Both orange and green LEDs for the good drive will go off.

4. *For the failed drive:* Remove the drive power cable from the interposer PCA.

NOTE

The drive power cable is split at the interposer PCA end. The two connectors must straddle the SCSI cable connector to connect to the interposer PCA.

CAUTION

The dual-connector power connector that straddles the SCSI cable must be removed FIRST. This remove power from the optical drive BEFORE the SCSI cable is disconnected.

5. Remove all other drive cables; SCSI, data, power, and the drive fan power cable. You must remove cables for both drives in the enclosure.
6. Remove the two T-20 screws holding the drive enclosure to the chassis.
7. Remove the four T-15 screws that hold the drive in the drive enclosure and slide the drive out from the enclosure.

Pull the drive out carefully while helping to guide the cables on the rear of the drive out through the hole on the side of the drive enclosure. Note that the drive fan power cable is attached to the fan in the enclosure and does not come out with the rest of the drive cables.

WARNING

The jukebox is active during the online drive replacement procedure – the picker may move at any time. After a drive bracket is removed, do not extend your hand through the drive bracket mounting hole into the interior of the jukebox chassis. The picker could injure your hand.

8. *If there is a disk in the failed drive:* Use a disk eject tool to remove the cartridge from the drive.

NOTE

Note the orientation of the disk as you pull it from the drive (Side A or B "up").

The disk must be inserted into the replacement drive in the same orientation.

9. Remove the cables from the rear of the drive (SCSI, data, power).
10. Retrieve the service cables from the clips that hold them to the chassis.
11. Connect a SCSI cable between your diagnostic PC and the replacement drive. (Use the short SCSI cable provided, if necessary).

CAUTION

It is important to power the replacement drive through the connections on the interposer PCA. This provides proper GND/power sequencing for the RWZ53 drives in this jukebox.

12. Connect the drive power cable to the drive and to the two connections on the interposer PCA.

NOTE

If this procedure is being done with power off, power can be applied to the replacement drive at this point by applying power to the jukebox.

If in an online drive replacement, do the next step.

13. Apply power to the replacement drive.

The sequence is: At **READY**, press **NEXT** to display **ADMIN ***. Press **ENTER**.

Either press **ENTER** three times if the password is 000-000-000, or have the system administrator enter the password to get you to the next level.

Press **NEXT** or **PREV** until **ONLINE DRIVE REPAIR*** displays. Press **ENTER**.

Press **NEXT** or **PREV** to display **DRIVE POWER***. Press **ENTER**.

Press **NEXT** or **PREV** to display **DRIVE<x>POWER OFF**, (where DRV <x> is the number of the drive you are replacing).

Press **NEXT** to select **DRV<x>POWER ON**. Press **ENTER**.

This will supply power to the drive in the proper manner. The green LED power light for the drive will come on steady.

14. Download the appropriate firmware into the replacement drive.

NOTE

While power is applied to the replacement drive: If a disk was removed from a failed drive, it should be replaced into the replacement drive at this point.

The disk must be inserted into the drive before the drive, in its enclosure, is inserted back into the chassis.

15. Remove drive power from the replacement drive.

NOTE

If this procedure is being done on an off-line, power off jukebox, drive power can be removed by placing the jukebox power switch to off. If in an online drive replacement procedure, remove power to the replacement drive using the control panel.

Use the same key-press sequence as explained in placing the drive power "ON" earlier in this procedure.

16. Mount the replacement drive into the drive enclosure, fasten the four T-15 screws to secure the drive.
17. Insert the drive enclosure into the chassis with the two T-20 screws.

CAUTION

In the following steps, be sure to connect the drive power cable LAST. The two connectors on the drive power cable straddle the SCSI cable.

18. Connect all the drive cables to the interposer PCA; connect the drive power cable connectors LAST.
19. *If online drive replacement:* Slide the communication slide switch over to the right to signal the jukebox that drive replacement is complete.
This signals the jukebox that the drive replacement is complete. The jukebox applies power to the drive and informs the running application that the drive is ready to go online.
20. Replace the service drive power cable and the short SCSI cable stub into their clips on the side of the jukebox.
21. Replace the lower RFI panel and right-side access panels.

5.6 Replacing the Power Supplies

1. Remove power from the jukebox.
2. Use the access panels figures in the beginning of this chapter as a guide to remove the three right-side access panels.
3. Remove the lower and upper RFI panels.
4. Remove the cables from the power supply you are replacing.
5. Remove the power supply.
6. Remove the two mounting screws located on the top of the power supply bracket and rotate the power supply out and off the support bracket.

Figure 5-3 Power Supplies

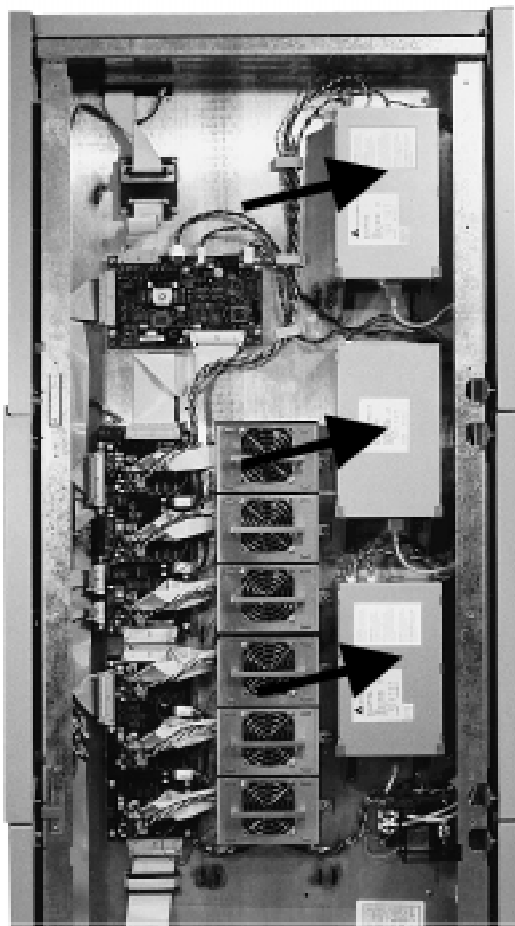
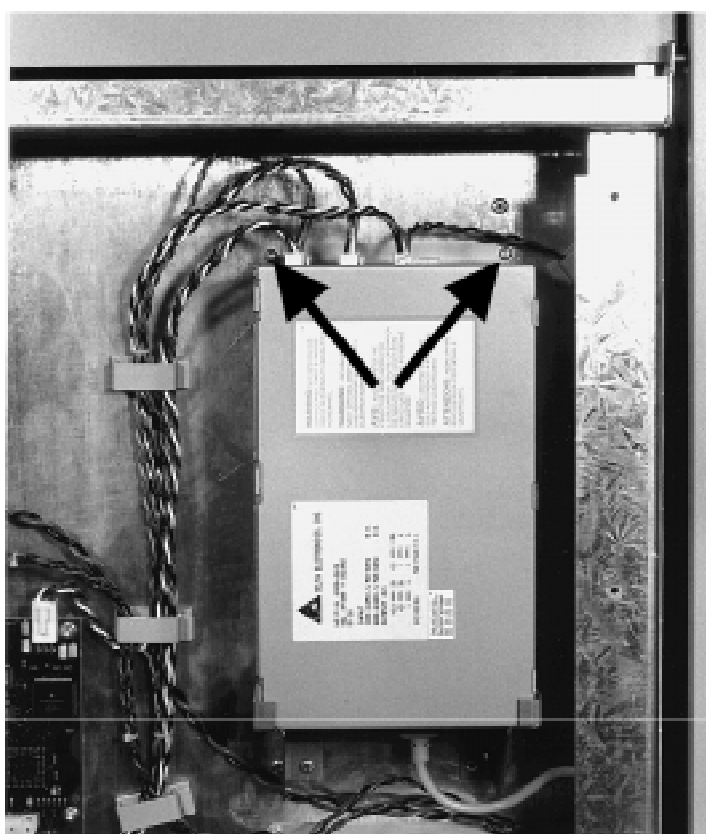


Figure 5–4 Mounting Screws (24/42 V power supply shown)



5.7 Replacing the Mailslot Assembly

1. Use the access panels figures in the beginning of this chapter as a guide to remove the:
 - right-side access panels
 - rear access panels
 - top right panel (vented panel) / top right-side front panel combination
 - middle right-side front panel (panel with slot, the one covering the mailslot)

WARNING

The picker transport encoder strip that runs from the top to the bottom of the jukebox near the mailslot has a sharp edge. Take care when working in this area.

Also, the encoder strip may be easily damaged.

2. Disconnect the mailslot cable from the interposer PCA.
3. Remove the two T-20 mailslot mounting screws from the bottom of the mailslot. Pull the mailslot assembly out of the jukebox.

Figure 5-5 Mailslot Connector on Upper Interposer PCA

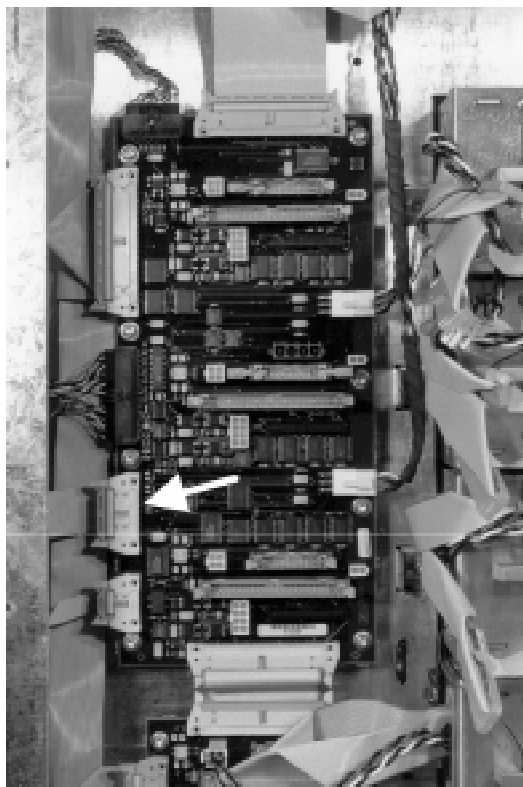
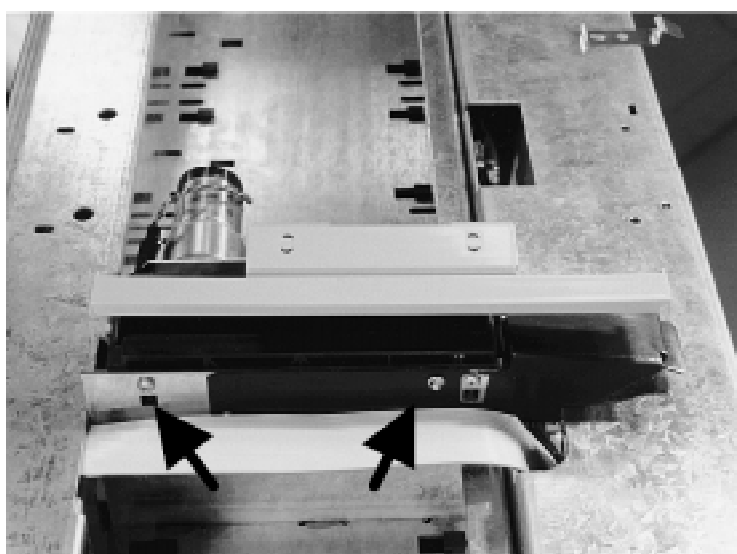


Figure 5-6 Mailslot Assembly Mounting Screws



5.8 Replacing the Control Panel Assembly

1. Use the access panels figures in the beginning of this chapter as a guide to remove the:
 - lower and middle right-side access panels
 - middle and top rear access panels

WARNING

The picker transport encoder strip that runs from the top to the bottom of the jukebox near the mailslot has a sharp edge. Take care when working in this area.

Also, the encoder strip may be easily damaged.

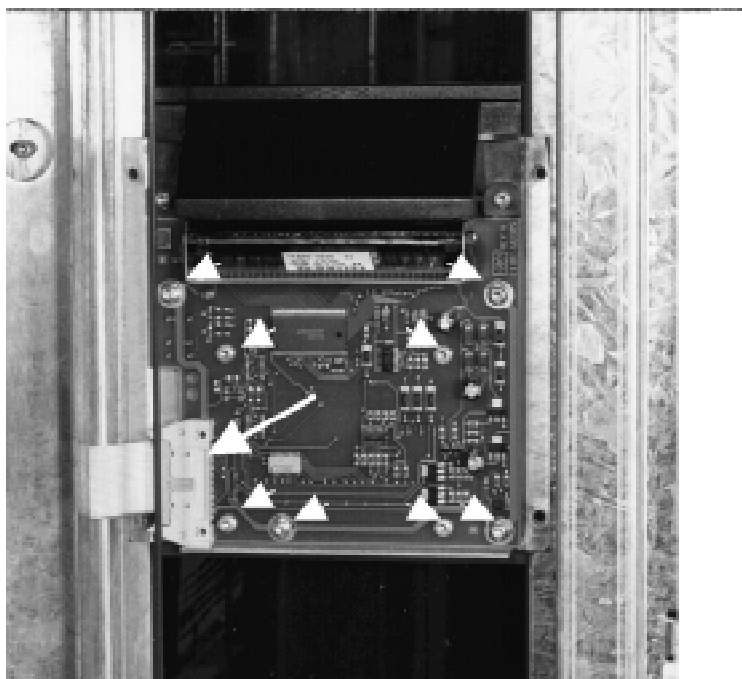
2. Disconnect the control panel cable from the control panel.

NOTE

To prevent the control button panel from falling off the front of the jukebox when the control panel PCA is removed in the next step, you may want to place a strip of adhesive tape across an edge of the button panel.

3. Remove the eight T-15 screws that mount the control panel to the front window. Remove the control panel.

Figure 5-7 Rear of Control Panel Assembly



5.9 Replacing the Interposer PCAs

1. Use the access panels figures in the beginning of this chapter as a guide to remove the lower and middle right-side access panels.
2. Remove the cables from the interposer PCA.
3. Remove the T-20 screws that mount the PCA (six on the top interposer PCA or eight on the lower interposer PCA. Remove the PCA).

Figure 5–8 Upper Interposer PCA

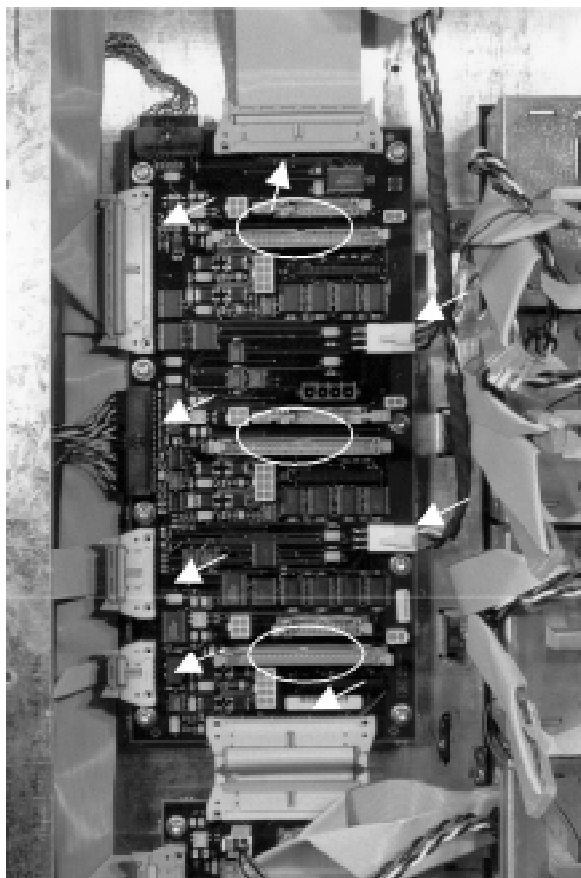
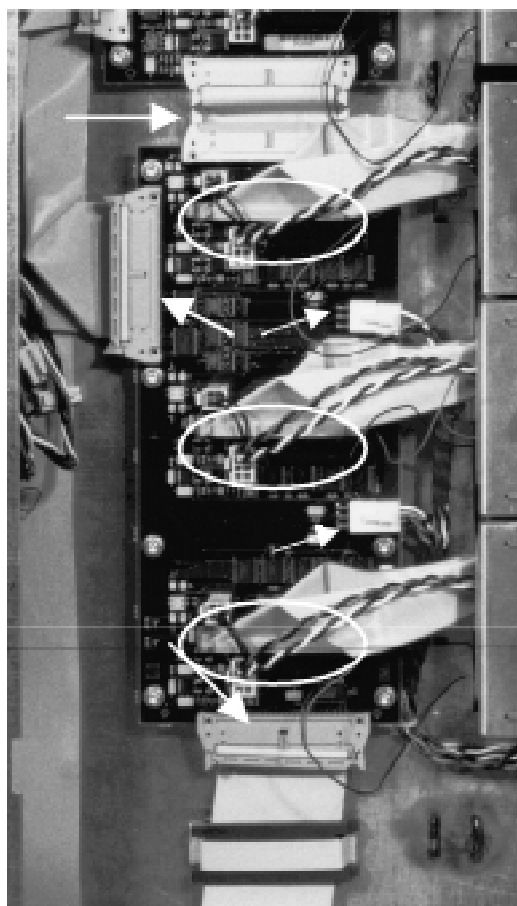


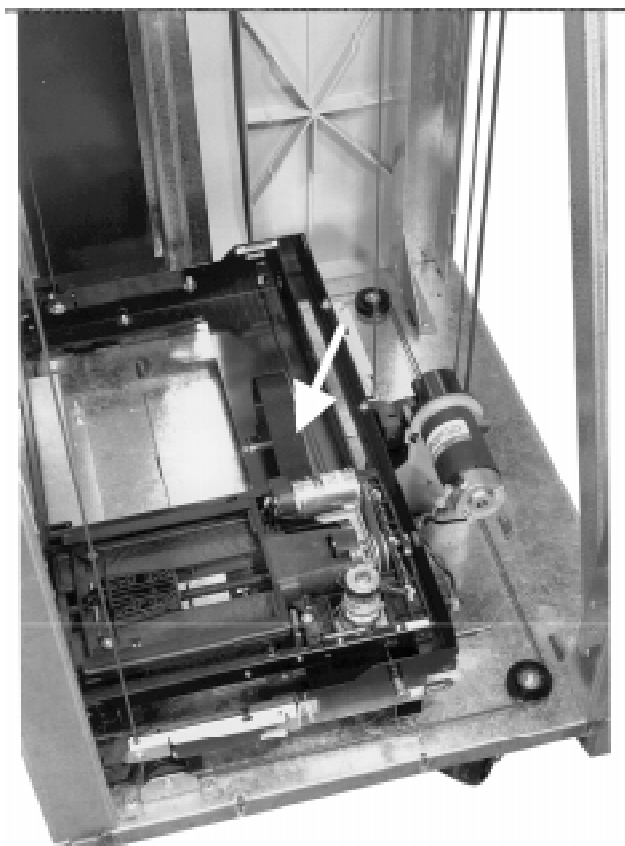
Figure 5–9 Lower Interposer PCA



5.10 Replacing the Picker

1. Use the access panels figures in the beginning of this chapter as a guide to remove the:
 - rear access panels
 - left-side access panels
2. Unplug the picker umbilical cable. To detach the cable, grab the tab on the end of the cable and pull.

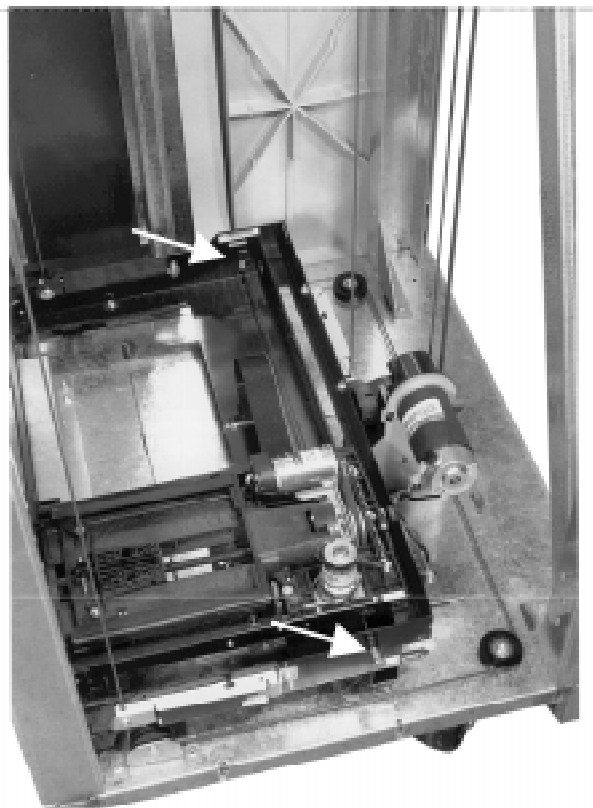
Figure 5-10 Picker umbilical cable



3. Release the translate cable from the (right) side of the translate frame (side nearest the front of the 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 5-11 Picker Translate Cable



4. Release the translate cable from the (left) side of the translate frame (side nearest the rear of the jukebox). Repeat step 3 for the left side of the translate frame.

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 5–12 Picker Translate Cable (stowed)

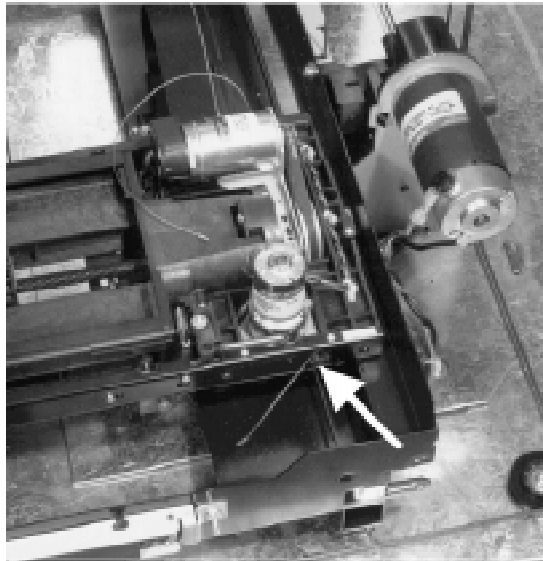
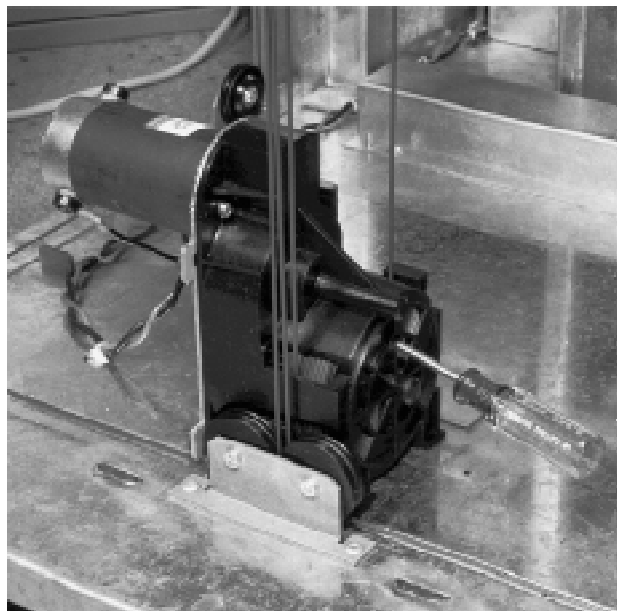
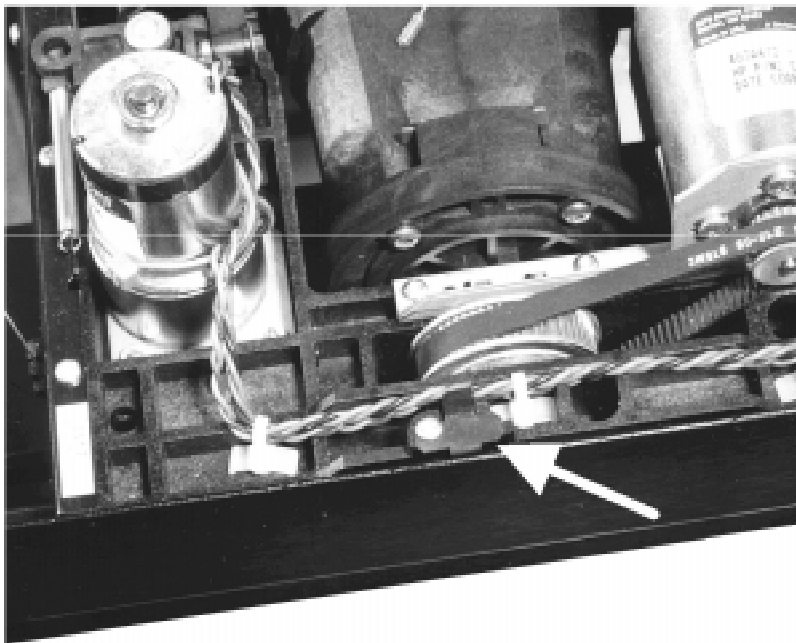


Figure 5–13 Stopping Vertical Motor Gear Box Motion



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

Figure 5-14 Picker Capture Bracket Mounting



7. Raise the translate frame and picker up to a point where you can comfortably access its underside.
Grip the rear of the frame, pull the frame 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 5–15 Picker Capture Bracket

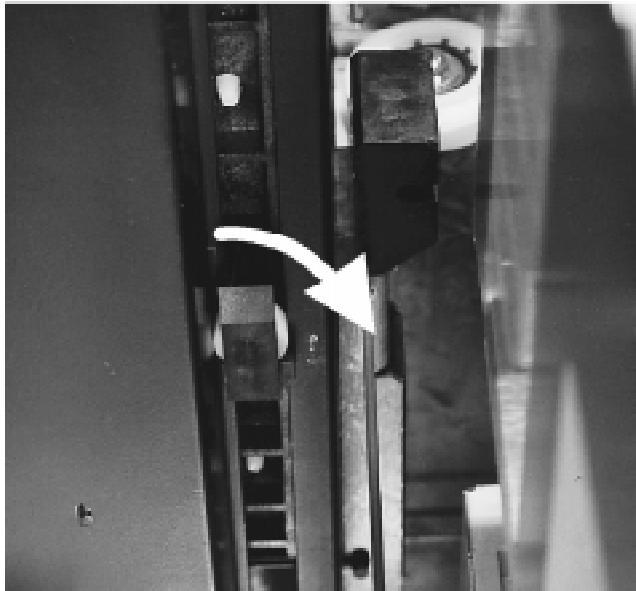
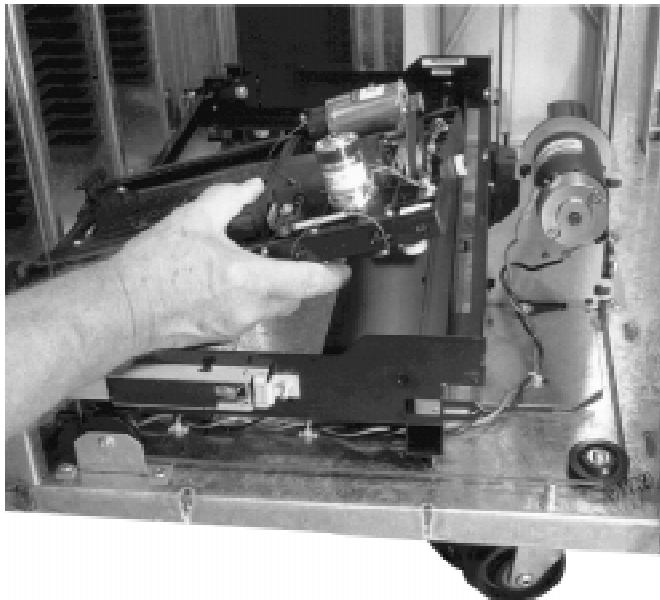


Figure 5–16 Rotating the Picker Assembly Out of the Translate Frame



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.

WARNING

The picker vertical encoder strip has sharp edges. Use care when removing the picker.

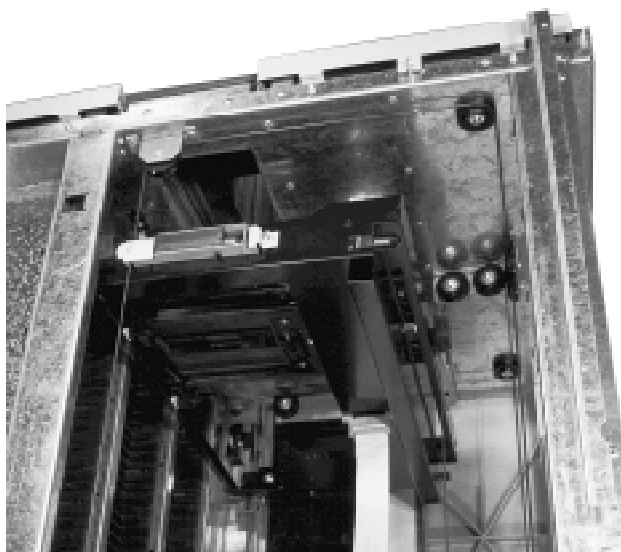
Also, the strip can be damaged if you are not careful when you lift the picker out of the translate frame.

11. Tilt up the rear end of the picker and slide it out towards the rear of the translate frame.

5.11 Removing/Replacing the Translate Frame

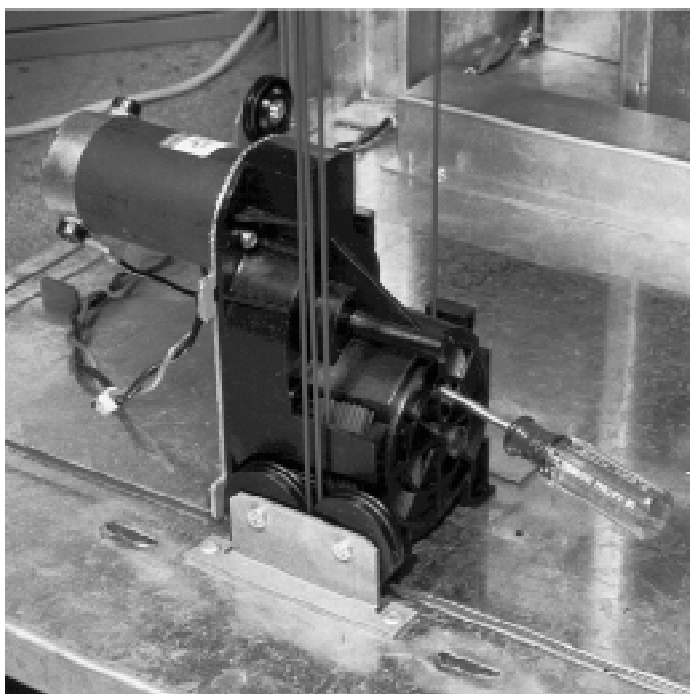
1. Use the access panels figures in the beginning of this chapter as a guide to remove the left-side and rear access panels.
2. Follow the steps in the previous "Removing the Picker" section to remove the picker.

Figure 5-17 Translate Frame Raised for Easier Access



3. Raise the translate frame up to about midpoint in the jukebox (a comfortable height for working) and hold the frame at that point by inserting a screwdriver or similar tool into the vertical motor gear box securing hole.

Figure 5-18 Stopping Vertical Motor Gear Box Motion



WARNING

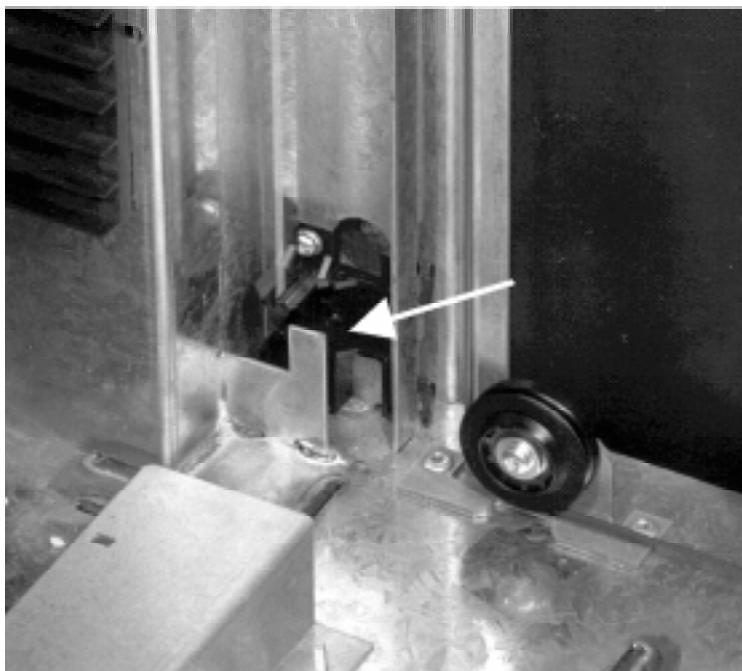
The edge of the encoder strip is sharp. Use care when handling.

Also, the encoder strip can be damaged if struck with tools, etc.

4. Unhook the picker encoder strip from the side of the translate frame (side nearest the front of the jukebox).

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

Figure 5-19 Vertical Encoder Strip Mounting Peg



5. Hang the encoder strip out of the way.
6. Remove the "visual locator" bracket on the (jukebox front) side of the picker translate frame.
 - a. Remove the T-20 screw holding the bracket.
 - b. Rotate the bracket out and off the three positioning tabs; pass the bracket over the frame.

Figure 5–20 Removing the Visual Locator Bracket

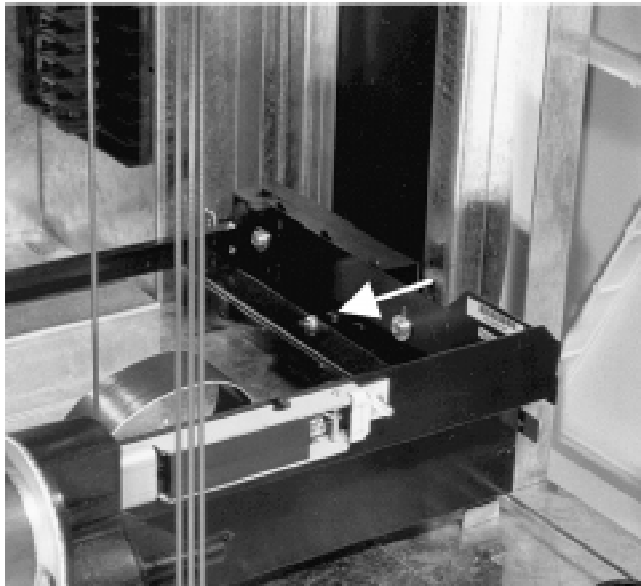
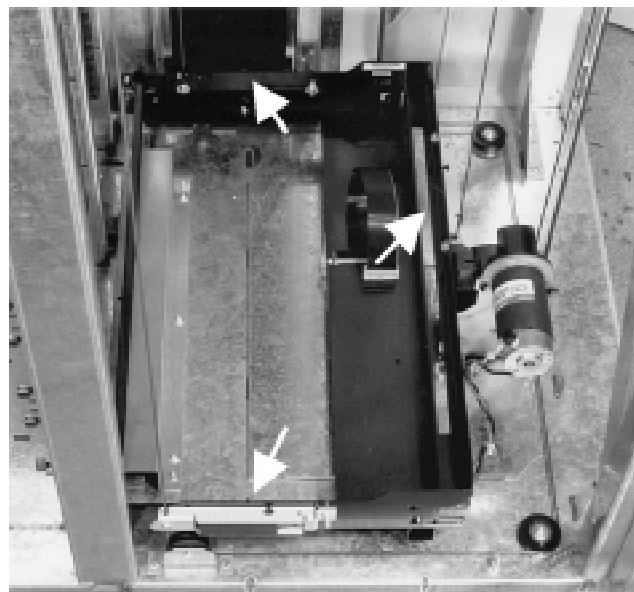


Figure 5–21 Picker Translate Frame Tensioners



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 5–22 Translate frame rear tensioner mount

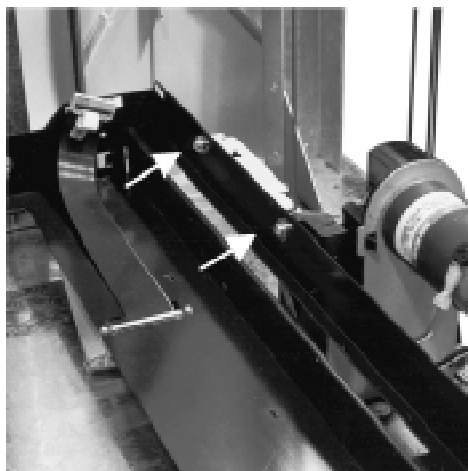
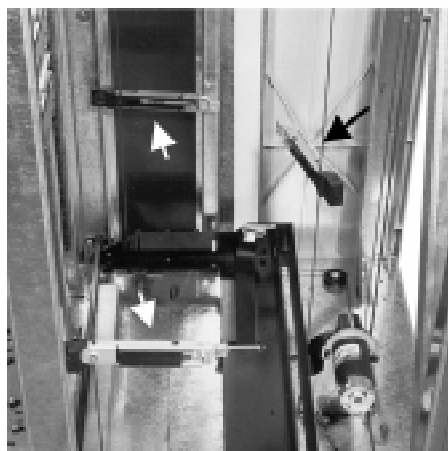


Figure 5–23 Translate Frame Tensioners Released



Remove the three rope tensioners from the frame.

- 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 picker encoder strip be sure and thread the encoder strip end back through the slot and attach it securely to the retaining peg.

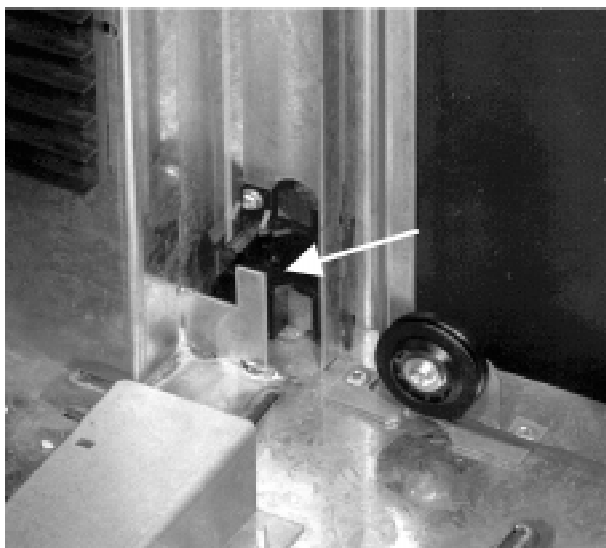
Also be sure the vertical encoder strip passes through the sensor slot on the sensor PCA mounted on the side of the translate frame. Use care when placing the translate frame back into its position in the jukebox. Make sure you do not damage the vertical encoder strip.

5.12 Removing/Replacing the Vertical Encoder Strip

1. Use the access panels figures in the beginning of this chapter as a guide to remove the three rear access panels.
2. *On the lower encoder strip mount:* Release the encoder strip from the lower encoder strip mounting.

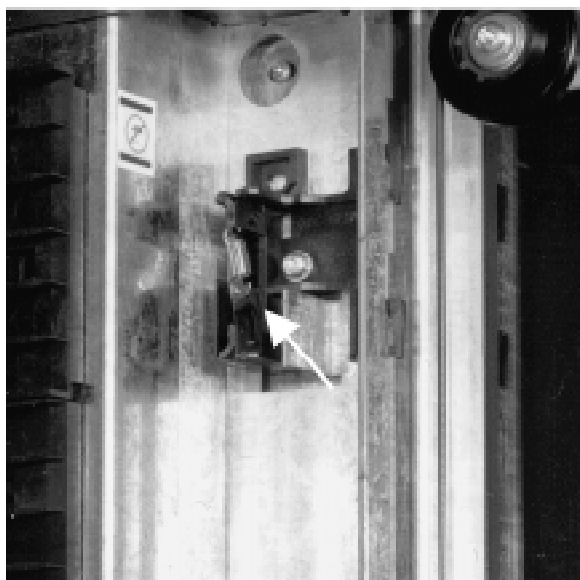
Pull down on the encoder strip to remove the strip from its retaining peg. Once released, the strip will slide up and out of the plastic guide.

Figure 5-24 Retaining Peg on Lower End of the Vertical Encoder Strip



3. *On the upper encoder strip mount:* Detach the top of the encoder strip from the tension spring. Remove the strip.

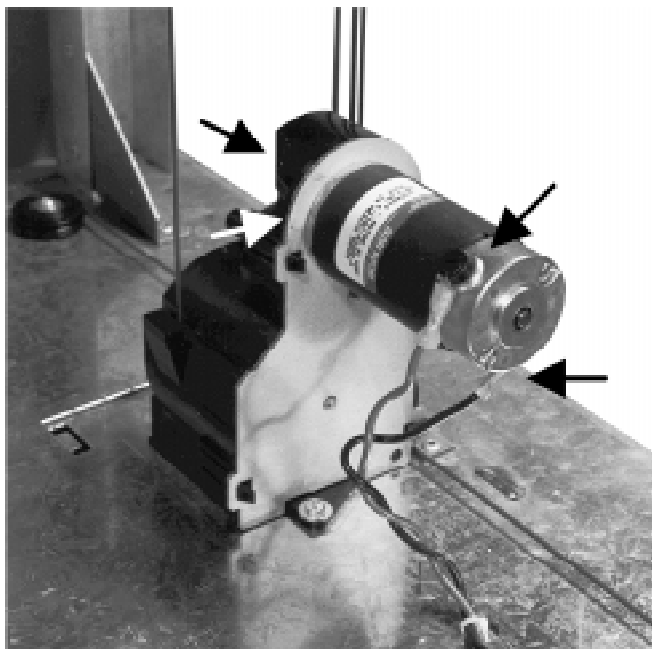
Figure 5-25 Upper Encoder Strip Mount



5.13 Replacing the Vertical Motion Motor

1. Use the access panels figures in the beginning of this chapter as a guide to remove the:
 - lower and middle rear access panels
 - lower and middle left-side access panels.
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 5-26 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.

Replace the power cable connections in the orientation that you observed in Step 2.

5.14 Replacing the Vertical Motor Gear Box

1. Use the access panels pictures in the beginning of this chapter as a guide to remove the -
 - lower and middle rear access panels
 - lower and middle left-side access panels.
2. Follow the steps in "Replacing the Picker" and "Removing the 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 5-27 Slave Rope Tensioner Assembly

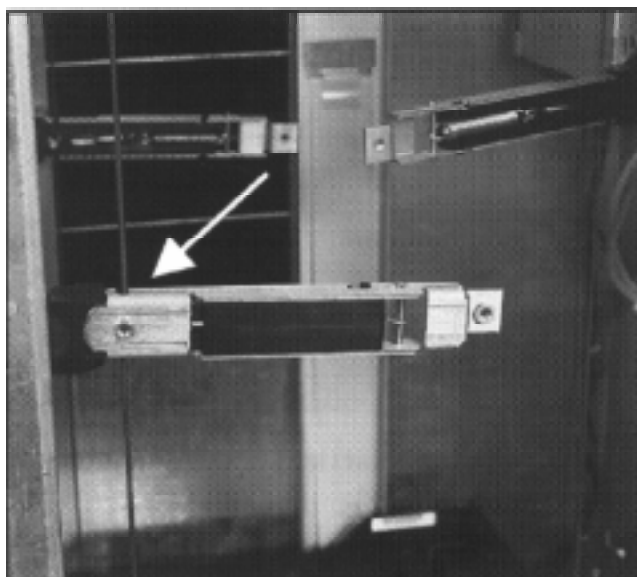
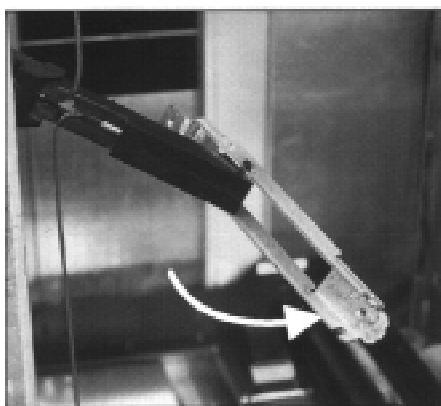
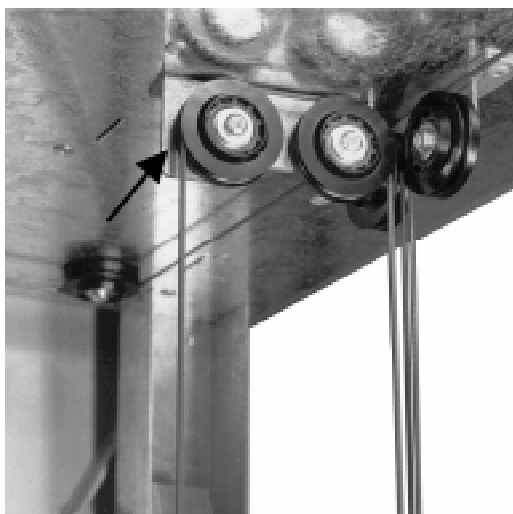


Figure 5–28 Pivoting the Tensioner Lever to Release Tension



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.

Figure 5–29 Taking the Drive Rope Off the Top



5. Take the drive rope off the top two pulleys.

Figure 5–30 Disconnecting the Drive Rope from a Tensioner

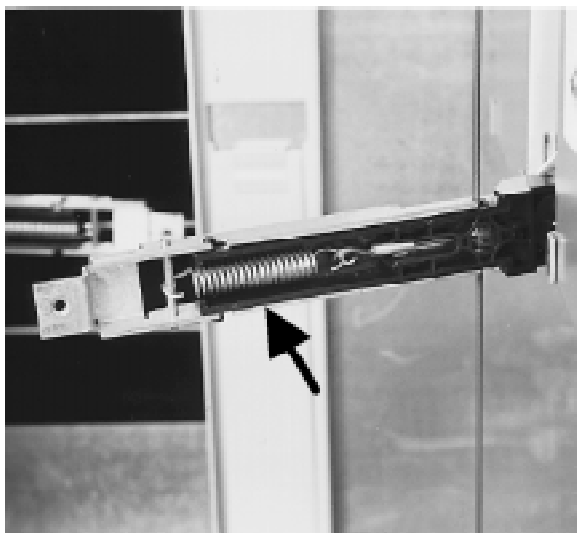
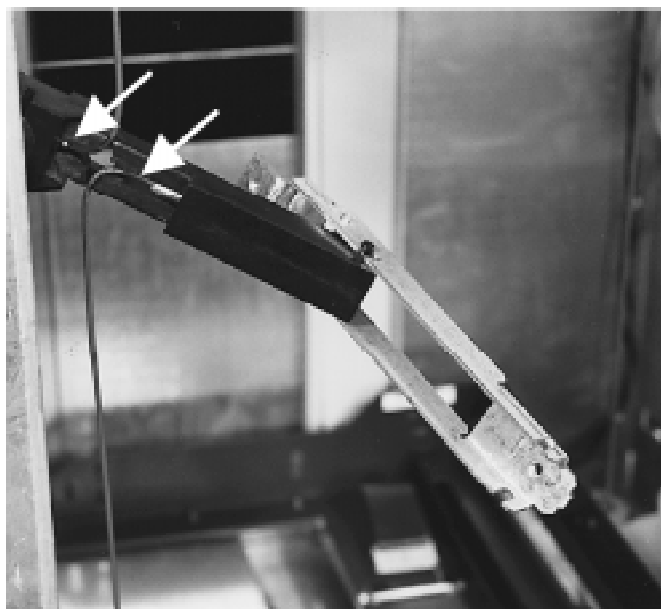
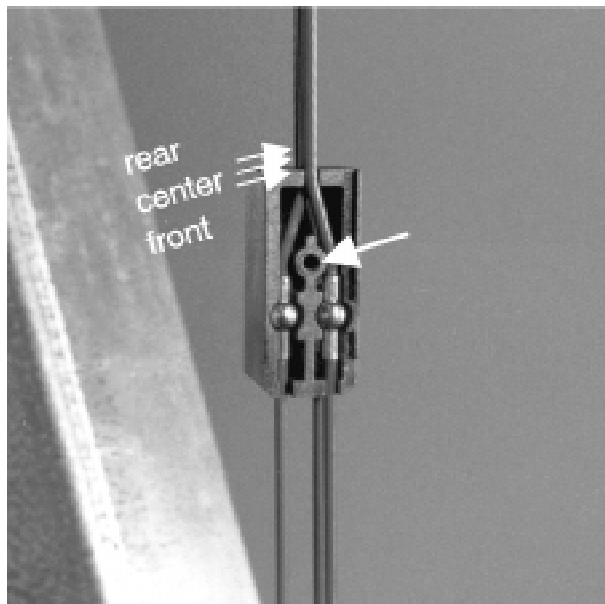


Figure 5–31 Two Ends of the Slave Rope in the Tensioner



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 5-32 Disconnecting the 3-rope Coupler



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.
10. Remove the gear box.
11. 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 5–33 Rear Side of Vertical Motor Gear Box

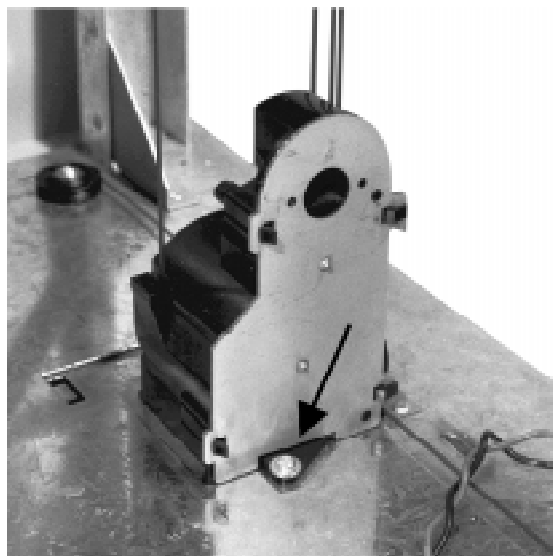
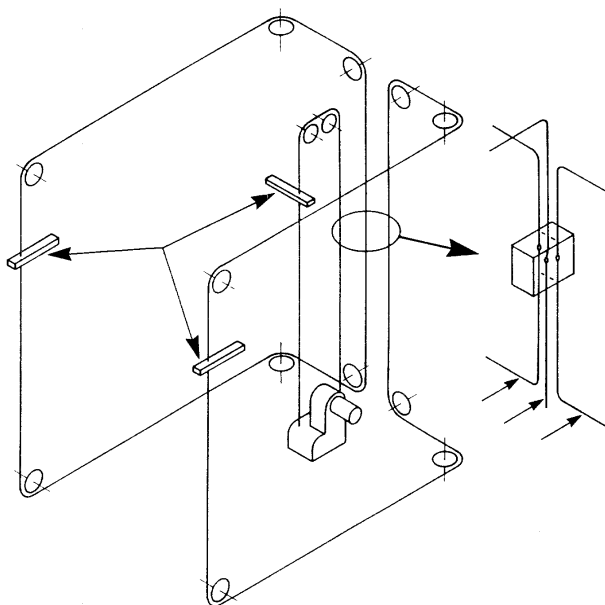


Figure 5–34 The Rope and Pulley System



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 (see picture on previous page).

*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.

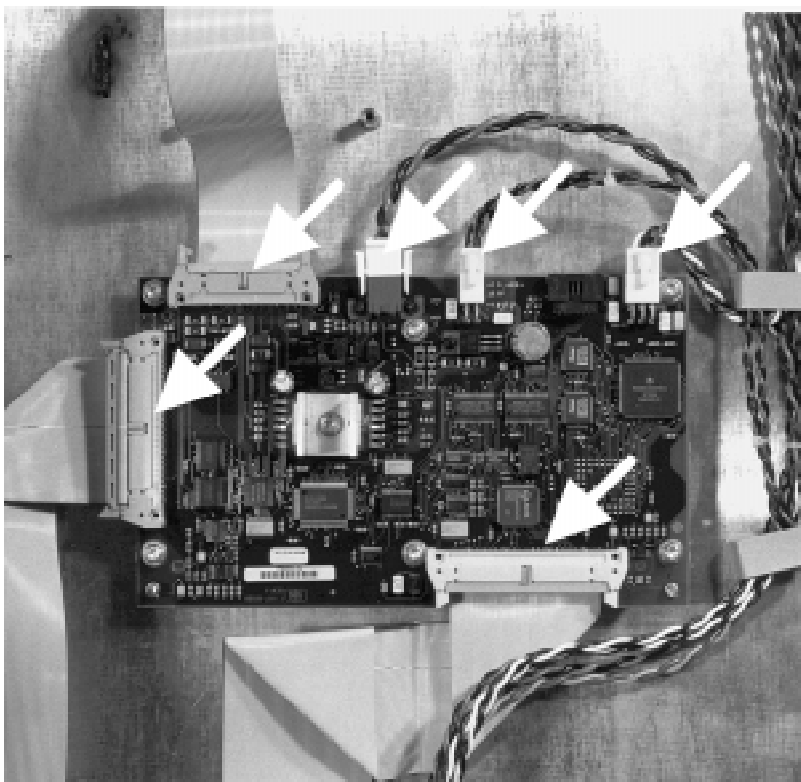
Figure 5–35 Positioning the Tensioner to Mount on Translate Frame



5.15 Replacing the Controller PCA

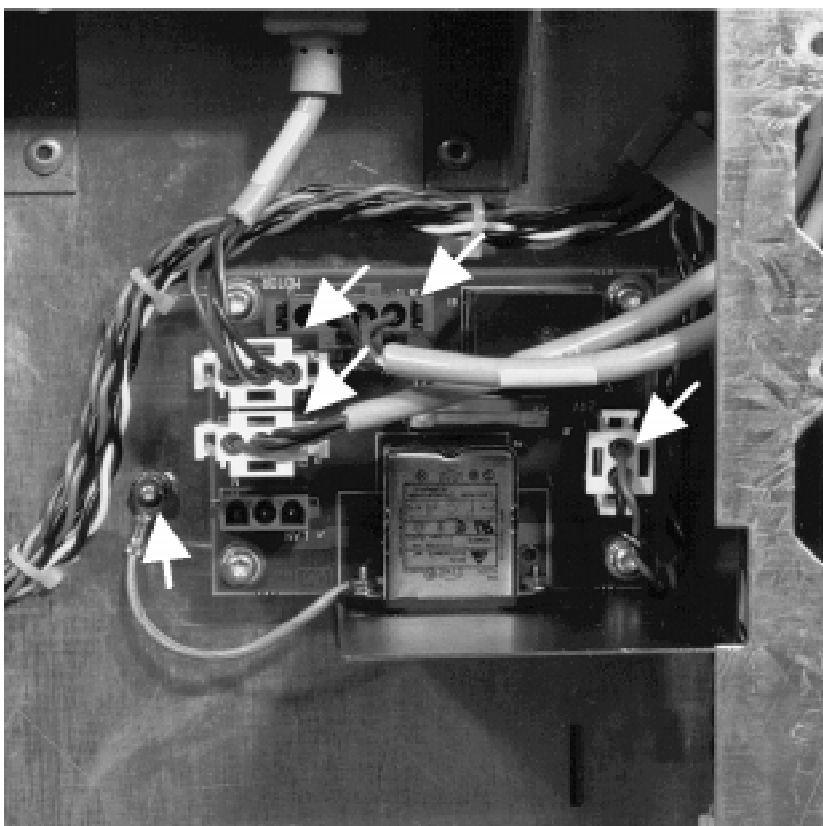
1. Remove power from the jukebox.
2. Use the access panels figures in the beginning of this chapter as a guide to remove the right-side access panels.
3. Remove the upper RFI panel.
4. Remove the cables from the controller PCA.
5. Remove the seven T-20 screws that mount the PCA. Remove the PCA.

Figure 5-36 Controller PCA



5.16 Replacing the Power Distribution PCA

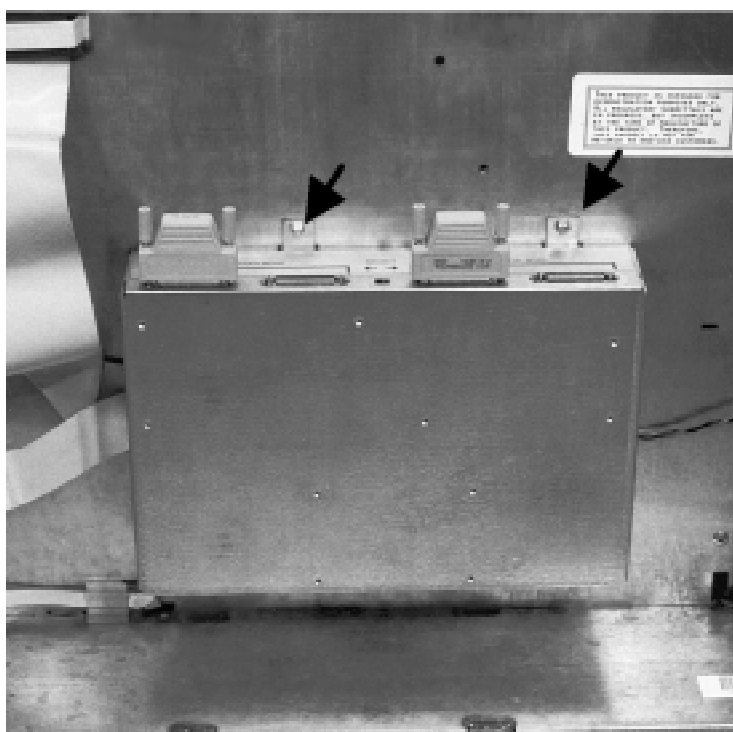
Figure 5-37 Power Distribution PCA



1. Remove power from jukebox.
2. Use the access panels pictures in the beginning of this chapter as a guide to remove the lower right-side access panels.
3. Remove the power cable and other power distribution cables from the PCA.
4. Remove the six T-20 screws the mount the PCA to the chassis (four screws are on the PCA; two are on power plug bracket). Remove the PCA.

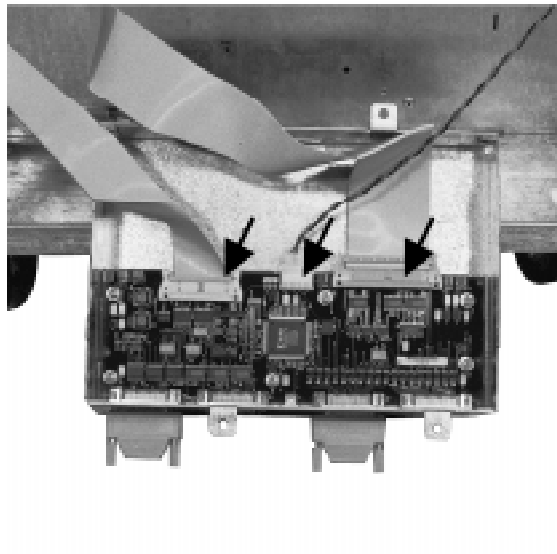
5.17 Replacing the SCSI Interface/LUN Converter PCA

Figure 5–38 SCSI Repeater / LUN Converter Enclosure



1. Remove power from jukebox.
2. Use the access panels figures in the beginning of this chapter as a guide to remove the lower right-side access panel.
3. Remove the cables from the interface enclosure.
4. Remove the four T-20 screws that mount the interface enclosure. Remove the enclosure.
5. Remove the six T-15 screws that mount the interface/LUN converter PCA to the inside of the enclosure.

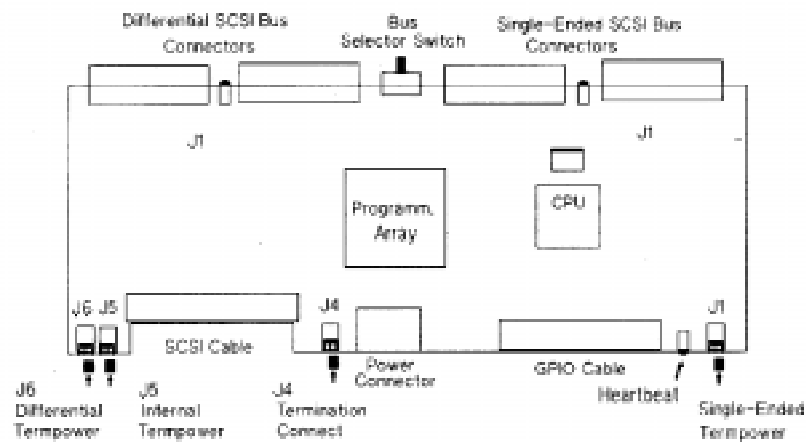
Figure 5–39 SCSI Repeater / LUN Converter PCA



Reassembly:

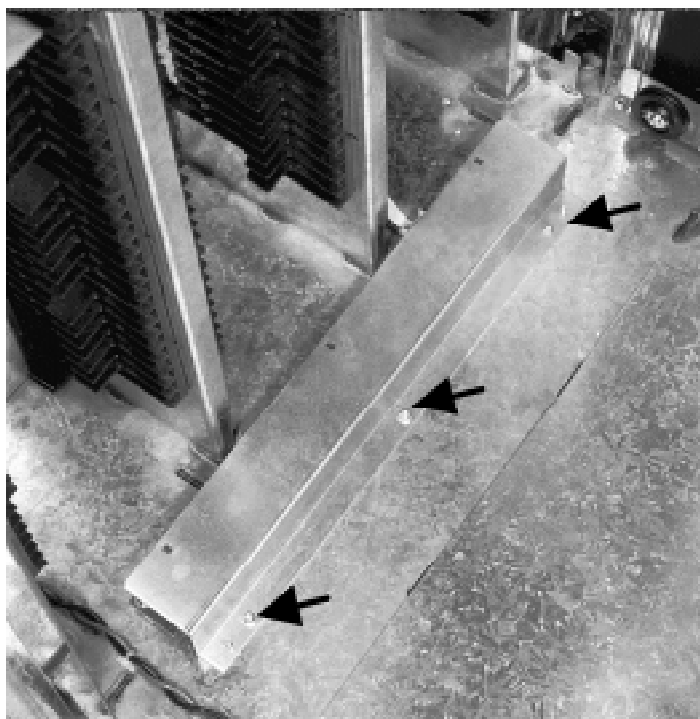
Check that the jumpers on the replacement PCA are the same as shown below.

Figure 5–40 SCSI Repeater / LUN Converter PCA Jumpers



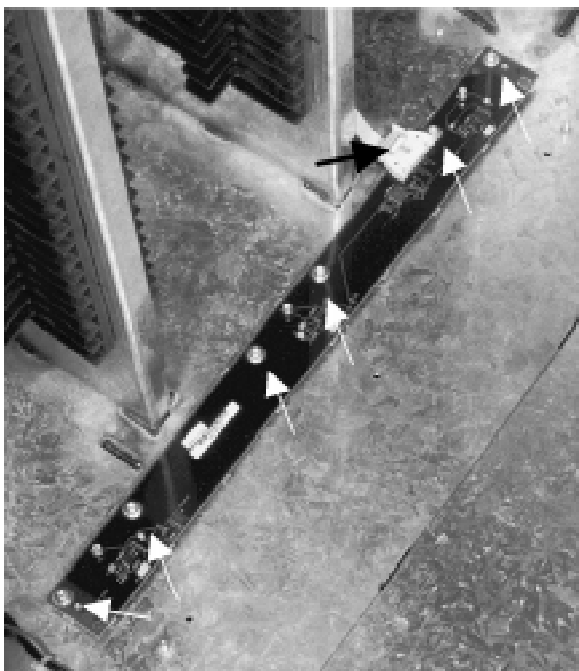
5.18 Replacing the Vertical-Path-Clear PCA

Figure 5-41 Vertical Path Clear



1. Remove power from jukebox.
2. Use the access panels figures in the beginning of this chapter as a guide to remove the lower and middle rear access panels
3. Remove the three T-20 screws that mount the PCA cover.
4. Remove the cable from the rear of the PCA.
5. Remove the six T-20 screws that mount the PCA to the chassis. Remove the PCA.

Figure 5-42 Vertical Path Clear PCA Mounting Screws



5.19 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 power up. 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 "Restore 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 the an automatic execution of ISTAT will occur. This re-establishes which slots are full and which are empty.

5.19.1 Variables Set by "Set Defaults"

- SCSI address of the autochanger
- Configurable options set to system defaults (ROM-dependent)
 - whether autochanger should report recovered errors
 - whether autochanger should rotate mailslot inwards when in secure mode
 - whether 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

5.19.2 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

5.20 Field Replaceable Units (FRU) in the 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
29-33413-01	5063-2780	Svr Ctrl PWA (RW555)	Y	Y	286.00	100	*
29-33412-01	5063-2781	Svr Ctrl PWA (RW557)	Y	Y	500.00	100	see next
29-33412-01	5063-2782	Svr Ctrl PWA (RW557-exchg.)	Y	Y	N/A	100	286.00
29-33411-01	C1107-69018	LUN Conv. Assy	Y	Y	682.50	100	see next
29-33411-01	C1107-69018	LUN Conv. Assy Exchg.	Y	Y	N/A	100	455.00
29-33374-01	C1107-60004	Interposer Upper	Y	Y	357.50	150	*
29-33414-01	C1107-60005	Interposer Lower PCA	Y	Y	286.00	125	*
29-33375-01	C1107-60006	Star Wars	Y	Y	139.75	150	*
29-33380-01	C1107-60024	V. Motion Motor	Y	Y	130.00	150	*
29-33381-01	C1107-60027	Picker Guide Assy	Y	Y	585.00	150	*
29-33382-01	C1107-60029	Mailslot Assy	Y	Y	260.00	150	*
29-33383-01	C1107-60032	P. S. (200 w)	Y	Y	247.00	200	*
29-33384-01	C1107-60033	P. S. (160 w)	Y	Y	201.50	200	*
29-33390-01	C1107-60047	Dr. Brkt Assy	Y	N	63.38	250	N/A
29-33408-01	C1107-60085	Top Window	Y	N	39.00		N/A
29-33409-01	C1107-60086	AC Switch Bd.	Y	N	48.75		N/A
29-33410-01	C1107-60087	Front Window	Y	N	107.25		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\$
29-32518-01	C1100-60026	Mag. Guides	N	Y	139.75	700	*
29-33376-01	C1107-60009	Umb. Feed Thru	Y	Y	201.50	700	*
29-33377-01	C1107-60021	Key Pad Assy	Y	N	53.63	700	N/A
29-33378-01	C1107-60022	Display PCA	Y	Y	159.25	700	*
29-33379-01	C1107-60023	Vertical Motor	Y	Y	156.00	700	*
29-33385-01	C1107-60041	Vert. Umb. Cable	Y	Y	56.88	700	N/A
29-33386-01	C1107-60042	Umb. Jumper Cable	Y	Y	7.80	700	N/A
29-33387-01	C1107-60043	Umb. Cable	Y	Y	100.75	700	*
29-33388-01	C1107-60044	YMTR Power Cable	Y	Y	14.63	700	N/A
29-33389-01	C1107-60046	4x Dr. SCSI Cable	Y	N	29.25	700	N/A
29-33391-01	C1107-60049	SCSI Cable	Y	N	12.35	700	N/A
29-33392-01	C1107-60050	5/12V Power Supply	Y	N	24.05	700	N/A
29-33393-01	C1107-60051	Lower Power Cable	Y	N	13.98	700	N/A
29-33394-01	C1107-60052	Motor Power Cable	Y	N	22.10	700	N/A
29-33395-01	C1107-60055	4x Dr. Power Cable	Y	N	32.50	700	N/A
29-33396-01	C1107-60057	SW Emitter Cable	Y	N	45.50	700	N/A
29-33397-01	C1107-60058	SW Receiver Cable	Y	N	11.05	700	N/A
29-33398-01	C1107-60061	Hi SCSI Cable	Y	N	19.50	700	N/A
29-33399-01	C1107-60063	4x Drive IPC Cable	Y	N	16.25	700	N/A
29-33400-01	C1107-60065	Front Panel Cable	Y	N	9.75	700	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\$
29-33401-01	C1107-60166	Interposer Cable	Y	N	32.50	700	N/A
29-33402-01	C1107-60167	Upper Dr. Pwr.	Y	N	31.20	700	N/A
29-33403-01	C1107-60068	Lower Dr. Pwr.	Y	N	22.75	700	N/A
29-33404-01	C1107-60070	Srv. Pwr. Cable	Y	N	13.00	700	N/A
29-33405-01	C1107-60071	Srv SCSI Cable	Y	N	27.30	700	N/A
29-33406-01	C1107-60078	Display Window	Y	N	26.00	700	N/A
29-33407-01	C1107-60080	Front Panel (TL/BR)	Y	N	45.50	700	N/A
29-32795-01	C1160-60025	Idler Pulley Assy	N	N	0.78	700	N/A
29-32796-01	C1160-60026	Magazine	N	N	4.23	700	N/A
29-32803-01	C1160-60036	Coupler Assy	N	N	5.69	700	N/A
29-32804-01	C1160-60037	Tensioner Assy	N	N	3.58	700	N/A
29-32808-01	C1160-60042	Mnt Guide	N	N	20.80	700	N/A
29-32810-01	C1160-60046	Cap Rllr Assy	N	N	18.85	700	N/A
29-32811-01	C1160-60048	Fan	N	N	18.85	700	N/A
29-33047-01	C1160-60080	CB Mtr Power	N	N	18.85	700	N/A
29-33415-01	C1107-60060	Low SCSI Cable	Y	N	16.25	700	N/A

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

5.21 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

This document is not necessarily revised as each part number is revised.

In the preceding list, an “x” is placed in “service” part numbers (parts orderable from Support Materials Organization) to designate that this digit increments when the part is revised. This digit usually starts at “0” and increments up to “9”. Knowing this should help you locate the correct part at SMO.

Table 5–2 Exchange Parts

FRU No.	Part Number	Description
1	C1107-69x01	Autochanger Controller PCA
2	C1113-69x00	4X Optical Drive Mechanism
8	C1170-69x08	SCSI Repeater/LUN PCA (4X drive models)

Table 5–3 Non-Exchange Parts (See Figure 5–43)

FRU No.	Part Number	Description
1	C1104-60x01	Half-Capacity Autochanger Controller PCA
4	C1107-60x04	Upper Interposer PCA
5	C1107-60x05	Lower Interposer PCA
6	C1107-60x06	Vertical-Path-Clear PCA
21	C1107-60x21	Operator Panel Key Pad Assembly
22	C1107-60x22	Display PCA
23	C1107-60x23	Vertical Motor Gearbox Assembly
24	C1107-60x24	Vertical Motion Motor
25	C1160-60x25	Idler Puller (maximum of 9 in the rope system)
26	C1100-60x26	Magazine (pair) 8-slots
27	C1107-60x27	Picker/Guide Assembly
29	C1107-60x29	Mailslot Assembly
30	C1107-60x30	Vertical Encoder Strip
31	C1160-60x26	Magazine (pair) 6-slots
32	C1107-60x32	Power Supply (200W, 5/12V)
33	C1107-60x33	Power Supply (160W, 24/42V)
34	C1107-60x34	Slave Rope
36	C1160-60x36	Coupler Assembly
37	C1160-60x37	Tensioner Assembly
38	C1107-60x38	Translate Encoder Strip
39	C1107-60x39	Encoder Mount
40	C1107-60x40	Translate Frame Assembly
41	C1107-60x41	Vertical Umbilical Cable
42	C1160-60x42	Mount Guide - slider
43	C1107-60x43	Translate Umbilical Cable
44	C1107-60x44	Vertical Motor Power Cable
45	C1107-60x46	4X-Drive SCSI Cable Stub (1 per 2 drives in enclosure)
46	C1160-60x46	Capture Roller Assembly
47	C1107-60x47	Drive Bracket Assembly
48	C1160-60x48	Drive Cooling Fan
49	C1107-60x49	SCSI Cable - Top Interposer PCA-to-Controller PCA

Table 5–3 Non-Exchange Parts (continued)

50	C1107-60x50	Lower 5/12V Power Supply AC Input Cable
51	C1107-60x51	Logic Power Cable
52	C1107-60x52	Motor Power Cable
53	C1107-60x53	Interposer Jumper Cable
54	C1107-60x55	4X Optical Drive Power Cable (1 per 2 drives used in enclosure)
57	C1107-60x57	Vertical Path Clear Emitter Cable with Emitters
58	C1107-60x58	Vertical Path Clear Receiver Cable
59	C1107-60x59	LUN SCSI Cable
60	C1107-60x60	Lower SCSI Cable
61	C1107-60x61	Upper SCSI Cable
62	C1107-60x63	4X Drive Interface Cable (1 per 2 drives in enclosure)
65	C1107-60x65	Control Panel Cable
66	C1107-60x66	2X - and 4X - Drive Model Interposer Cable
67	C1107-60x67	2X - and 4X - Drive Model Upper Drives Power Cable
68	C1107-60x68	Lower Drives Power Cable
70	C1107-60x70	Service Power Cable
71	C1107-60x71	Service SCSI Cable
78	C1107-60x78	Display Window Assembly
80	C1107-60x80	AC Power Cord Assembly
86	C1107-60x86	AC Switch PCA

Figure 5-43 Jukebox Exploded View (1 of 6)

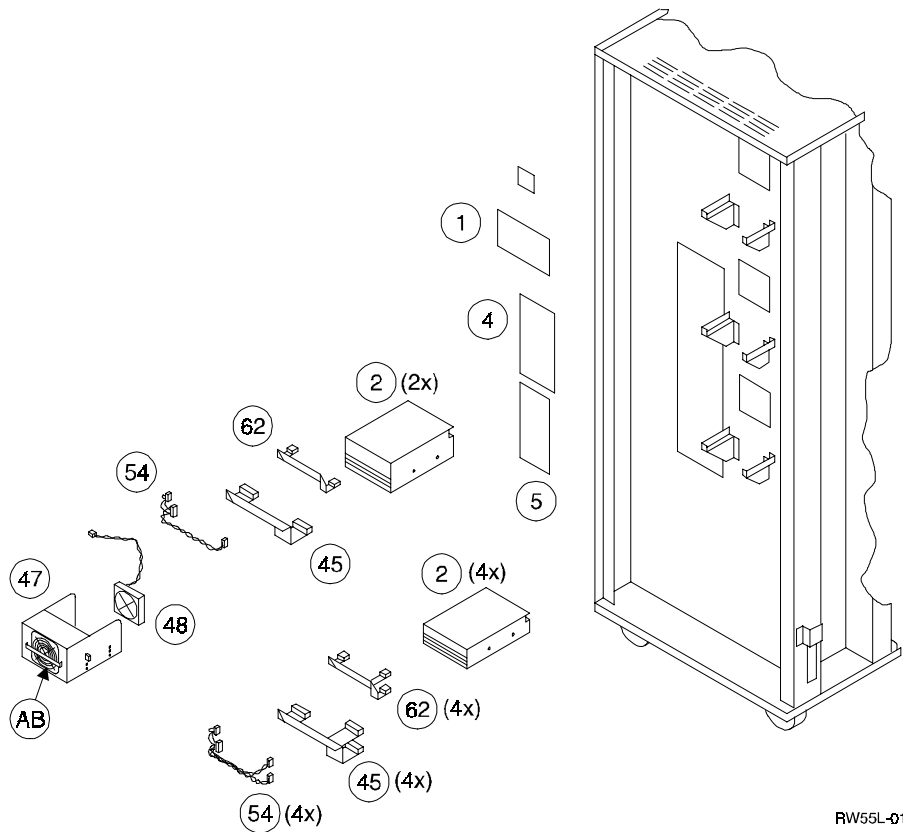
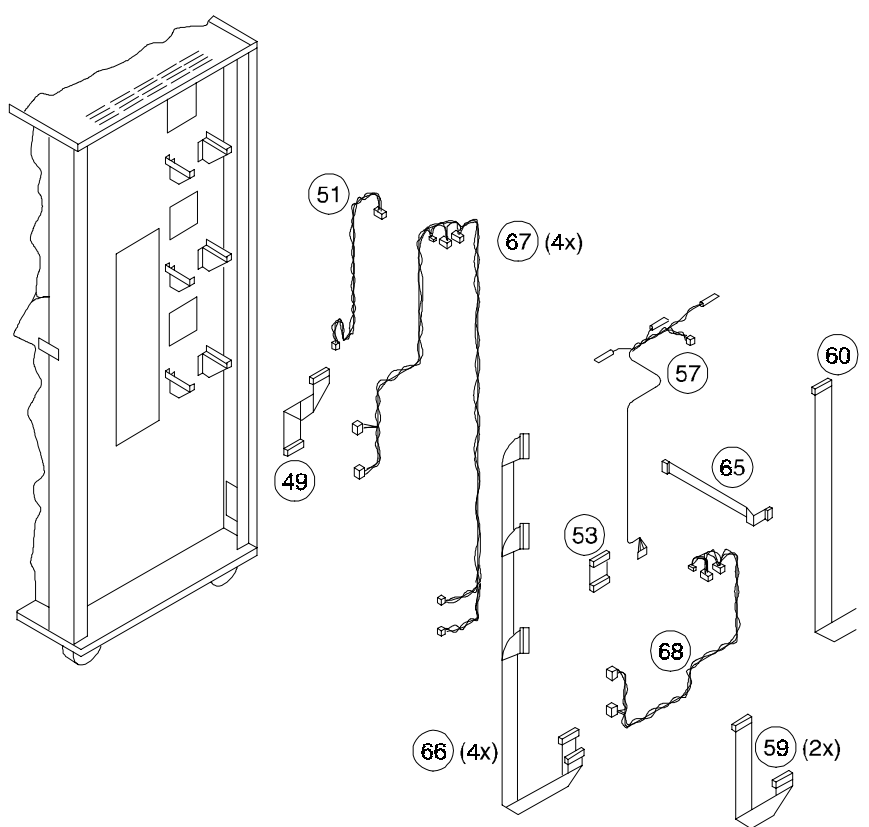


Figure 5-43 Jukebox Exploded View (2 of 6)



* 6-slot magazines and 8-slot magazines are used

RW55L-02

Figure 5-43 Jukebox Exploded View (3 of 6)

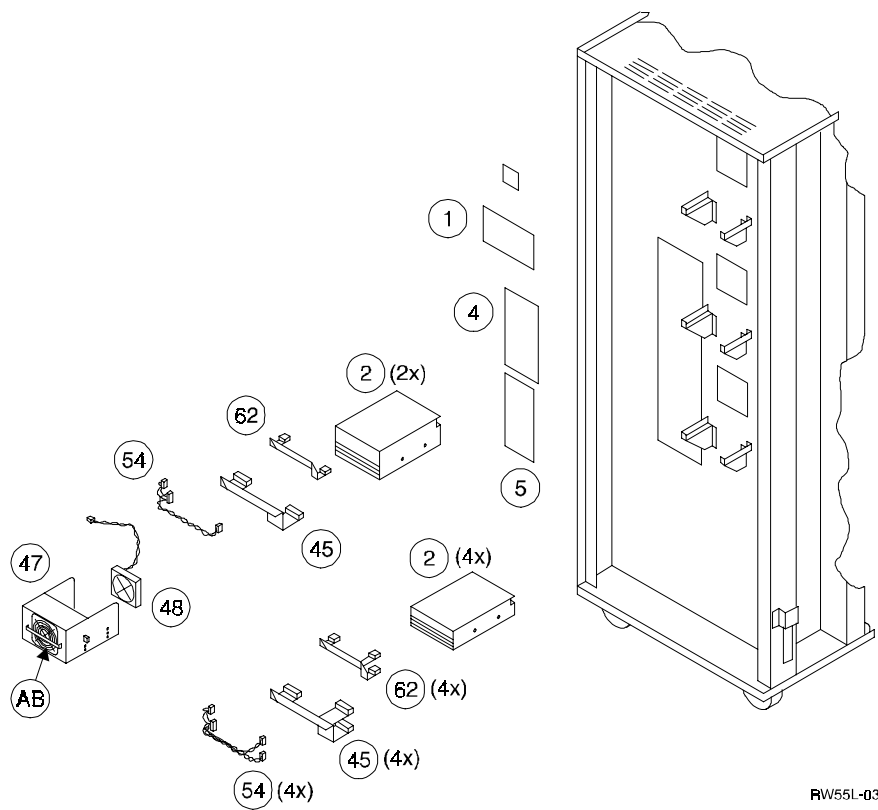
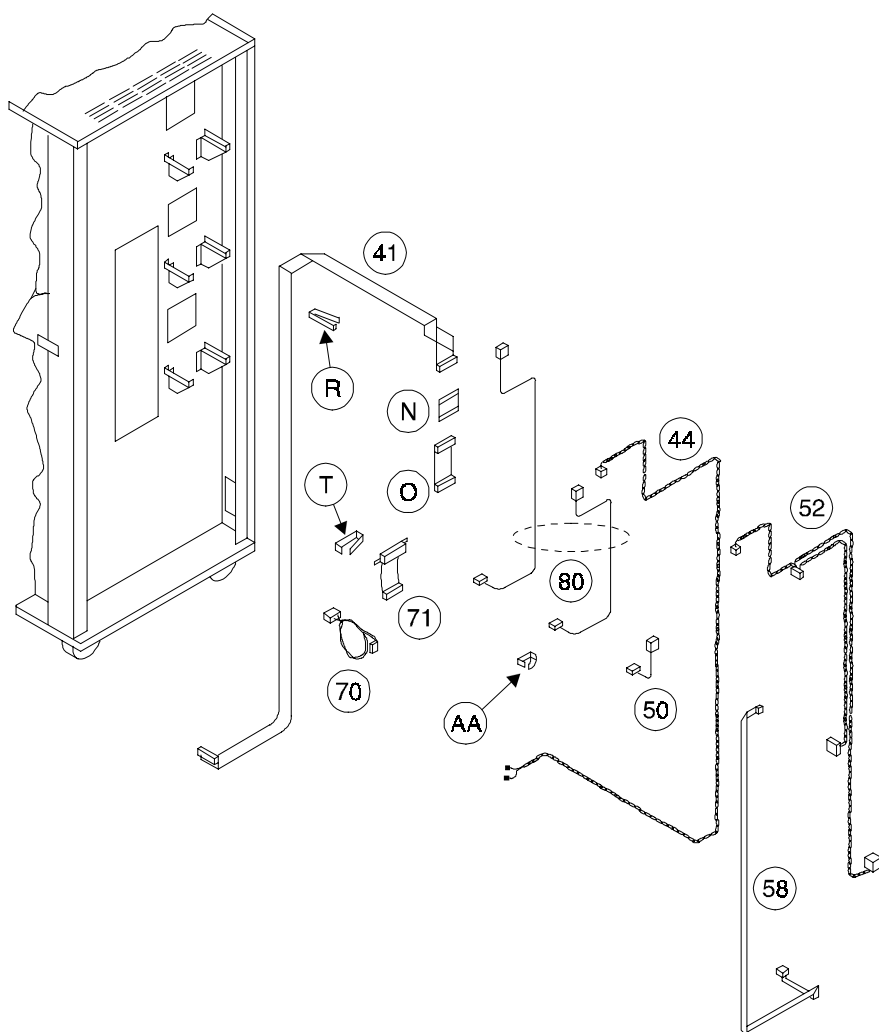


Figure 5-43 Jukebox Exploded View (4 of 6)



RW55L-04

Figure 5-43 Jukebox Exploded View (5 of 6)

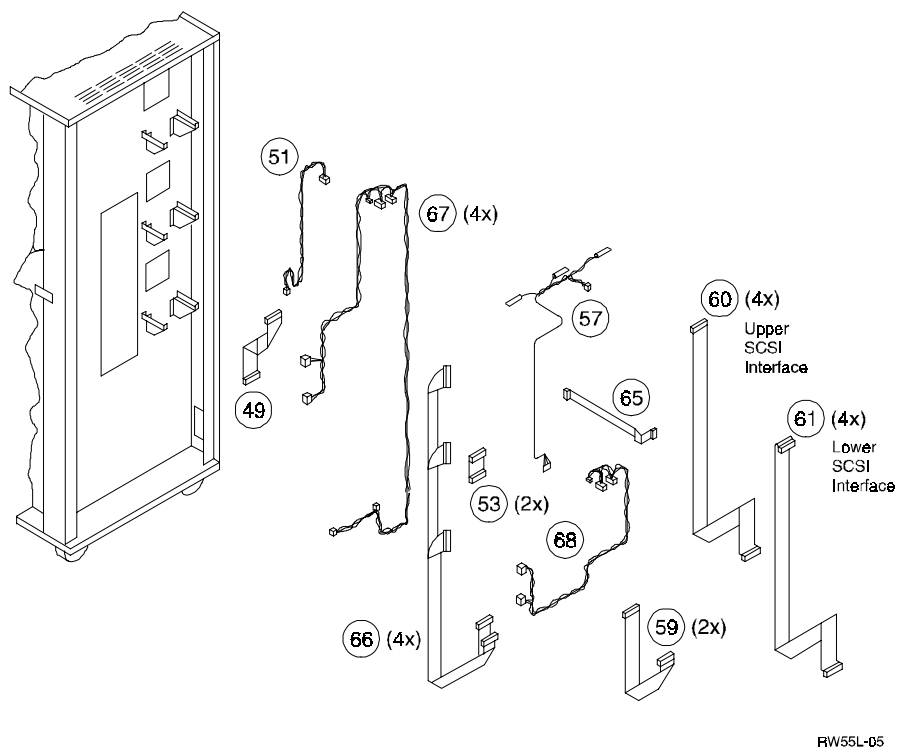
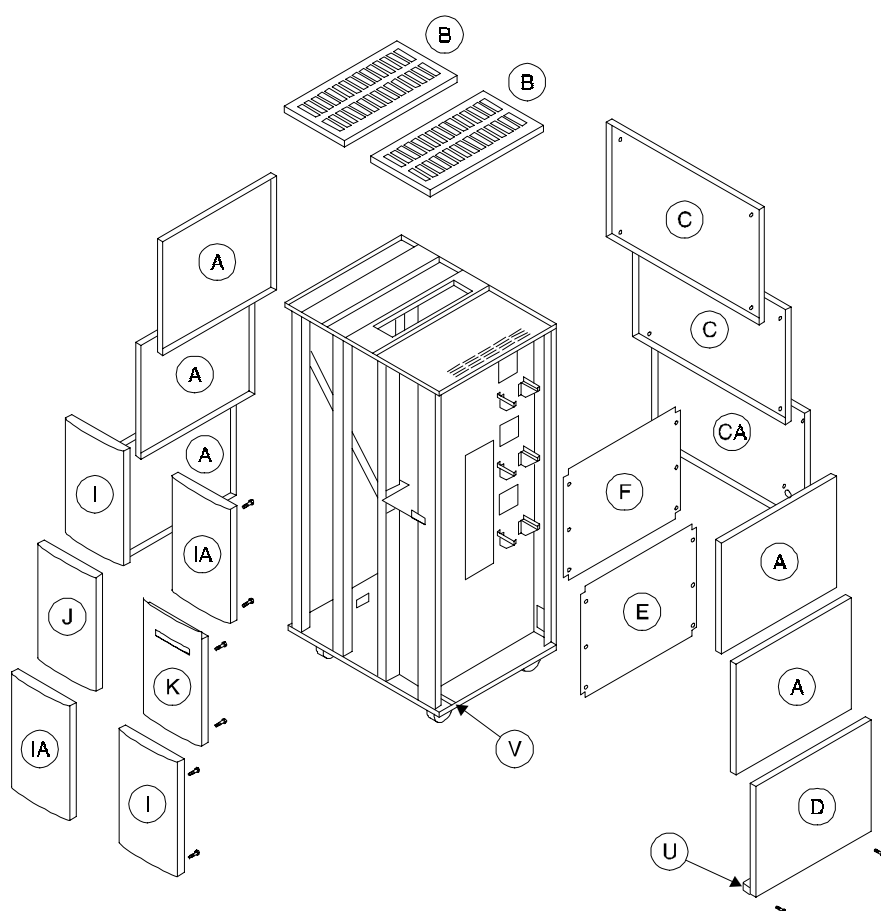
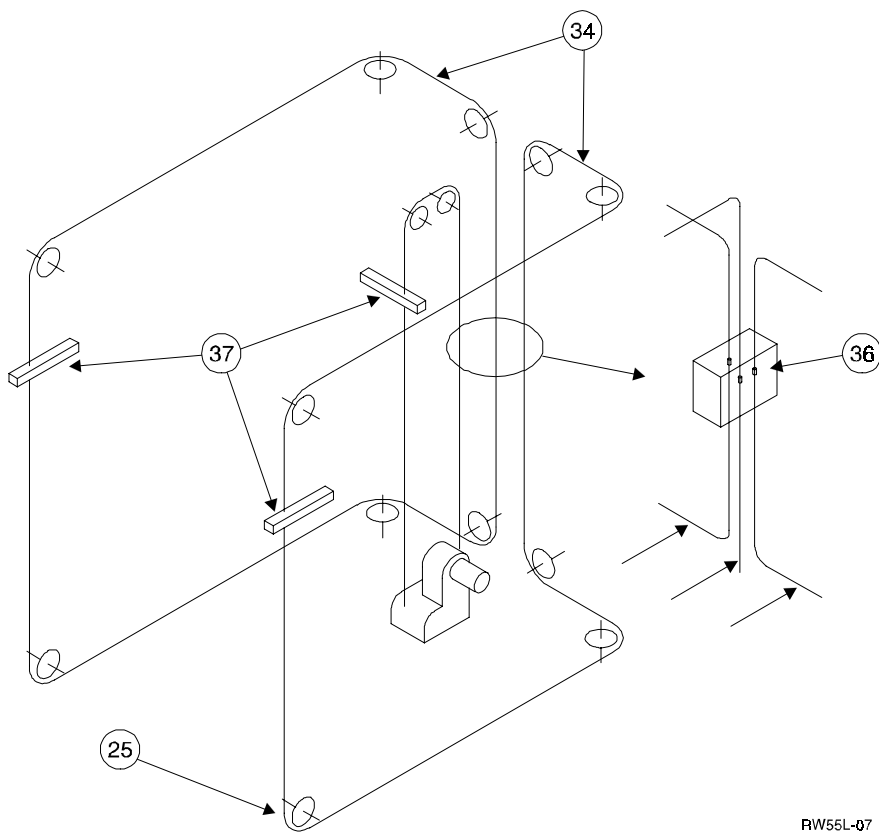


Figure 5-43 Jukebox Exploded View (6 of 6)



RW55L-06

Figure 5-44 Jukebox Pulley and Rope Diagram



RW55L-07

5.22 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
0.9 m (2.9 ft.) SCSI cable; wide, high density with thumb screws (68 pin) to wide, high density with thumb screws (68 pin)	C2911A
2.5 m (8.2 ft.) SCSI cable; wide, high density with thumb screws (68 pin) to wide, high density with thumb screws (68 pin)	C2924A
10 m (32.8 ft.) SCSI cable; wide, high density with thumb screws (68 pin) to wide, high density with thumb screws (68 pin)	C2925A
2 m (6.5 ft.) SCSI cable; wide, high density with thumb screws (68 pin) to wide, high density with thumb screws (68 pin)	C2906A
Single-ended SCSI terminator, 50-pin, high density, active	1250-2548
Differential SCSI terminator, 50-pin, high density	1252-6492
Differential SCSI terminator, 68-pin, high density	C2905A
Eject Tool – C1716T (2X drive)	C1701-88803
Eject tool – C1113 (x) (4X drive)	8710-2325
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 RW555IRW557 jukeboxes, the autochanger, command execution, mechanics, autochanger controller PCA, interposer PCAs, power supplies, LUN conversion, Picker and Picker Modes, Element Numbering and Slot Numbering, and optical disk drives.

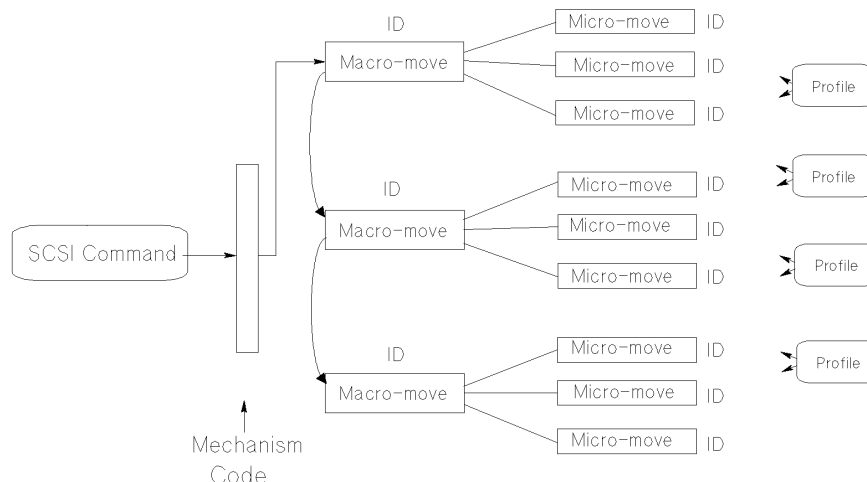
6.1 Autochanger Robotics

6.1.1 Movements

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

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

Figure 6-1 SCSI Command Translation for Autochanger Operation



- 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 1/0 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 1/0—lunge 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.

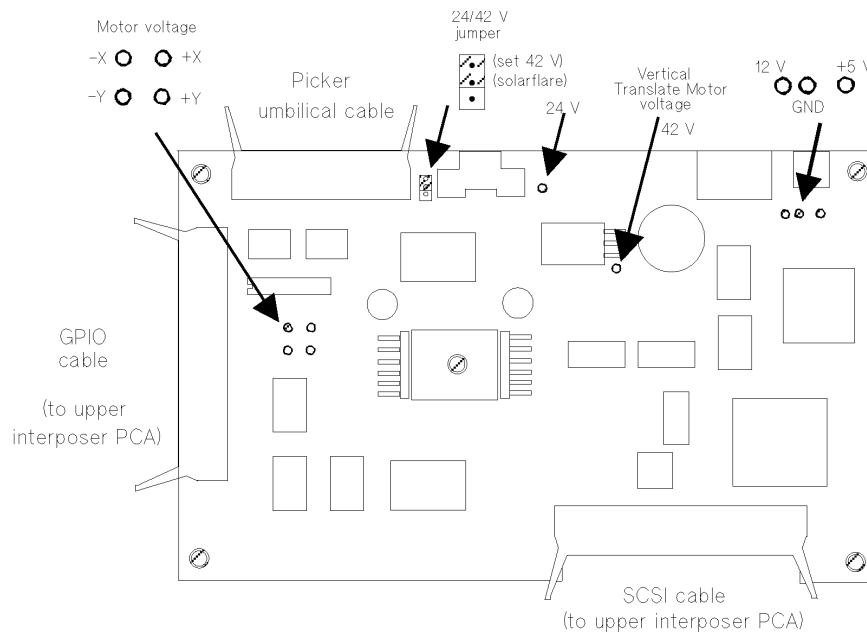
Each micro-move within a specific macro-move has a unique set of stability, performance, error recovery, force, and reliability criteria. Therefore, each micro-move is assigned a unique identification code (ID) which is used to determine how the move should be performed.

6.2 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



The MICROPROCESSOR is a Motorola MC68E000 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 MC68E000 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.

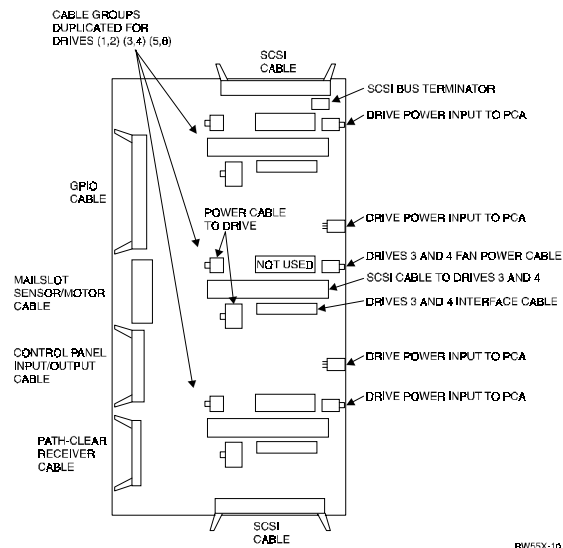
6.3 Interposer PCAs

There are two interposer PCAs; an upper and a lower. They are located on the right side of the jukebox, next to the optical drives.

Both interposer PCAs perform the following optical drive functions:

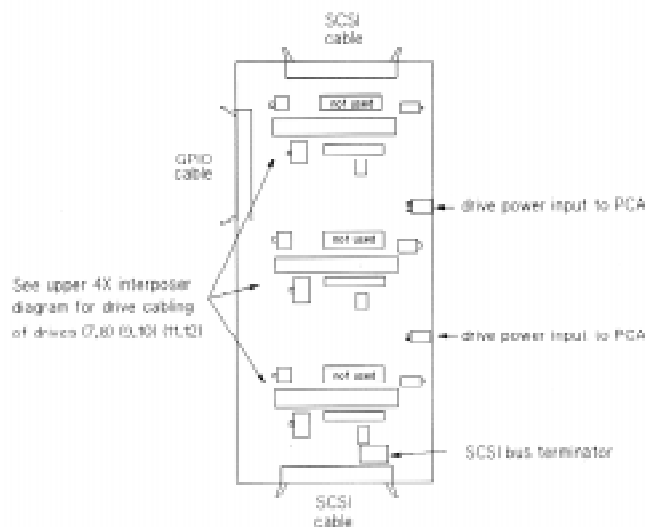
- SCSI cabling
- drive interconnect cabling
- registers to drive the EJECT input and receive the ERROR output to the drives
- drive power and sequencing,
- drive fan power,
- switches and indicators for online drive replacement,

Figure 6-3 Upper interposer PCA



RW55X-10

Figure 6–4 Lower Interposer PCA



The upper interposer also has additional functions: connections for the path-clear (Starwars) sensors, control panel circuitry and connection, and connections for the mailslot sensors and auxiliary sensors.

An important overall function of both interposer PCAs is to apply power to the optical drives in the correct sequence and prevent "hot plugging" the drives.

"Hotplugging" the RWZ53 drive can cause problems with the drive firmware and may cause drive failures.

Optical drive firmware control and control power from the controller PCA are passed to a series of registers on the interposer PCA.

The interposer PCAs take the SCSI signals from the SCSI repeater / LUN PCA and route these signals to the drives. The SCSI cable, originating at the SCSI repeater / LUN converter, passes into the lower interposer PCA, through a short connector between the lower and upper interposer PCAs, and then from the top of the upper interposer PCA to the controller PCA that is near the top of the right side area. All interconnect cables in this path are keyed.

The SCSI signals tee off the lower and upper interposer PCAs to the drives next to these PCAs. In a 4-drive configuration, the top interposer PCA supplies SCSI bus connection to drives 1 and 2, the lower PCA supplies drives 3 and 4. In a 6-drive configuration, the top interposer PCA supplies SCSI bus connection to drives 1,2, and 5; the lower PCA supplies drives 3, 4, and 6.

NOTE

Issues that affect optical drive handling during service.

Each 5/12 power supply monitors the power it supplies - through it's, assigned interposer PCA - to the fan, motors of the drives connected to that interposer PCA. The upper 5/12 V power supply serves the upper interposer PCA and the controller PCA. The lower 5/12 V power supply serves the lower interposer PCA.

If a 5/12 V power supply senses that NO fan power is being sent to its respective interposer PCA, the power supply will shut down.

To turn the power supply back on, the jukebox must be power cycled.

If the upper 5/12 V supply is the one that shuts down, power is also removed from the controller PCA, **which immediately halts jukebox operation**. The jukebox must be power cycled to bring it back into operation.

Either power supply shutdown involves bringing the jukebox down at some point (either immediately if the upper supply shuts down, or later, if the lower supply shuts down and the jukebox must be powered cycled to bring the supply up again). In either case, online drive replacement is defeated.

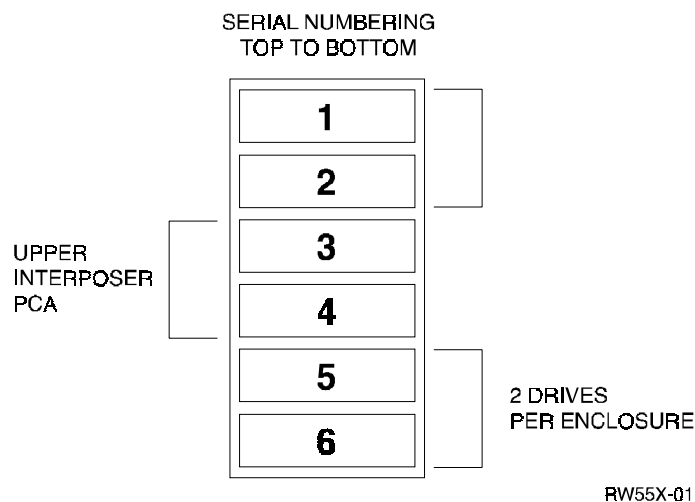
Optical drives are placed in the jukebox so that the possibility of shutting down the lower 5/12 V power supply by removing fan power to a single drive during online drive replacement is prevented. Four-drive jukeboxes have two drives powered from each interposer PCA. This prevents shutting down the lower interposer PCA when replacing a single drive. (which would happen if the drives had been placed in the "logical order" of 1, 2,3 on the upper PCA and drive 4 on the lower PCA.

NOTE (CONTINUED)

The only step for service is to remember is to make sure that, even if the application designates that the two drives served by the lower PCA have failed, remove fan power (i.e. replace) only one drive at a time.

Overall guide: do not remove all fan power from either interposer PCA during online drive replacement.

Figure 6-5 Drive Numbering



The Interposer PCA also distributes signals from the controller PCA out to other devices. The 50-pin (GPIO) ribbon cable originating at the controller PCA connects to both interposer PCAs.

A 10-pin cable (bottom connector on the left side) goes from the upper interposer PCA to the vertical-path-clear receiver PCA at the bottom of the chassis. Infrared signals from the three Starwars emitters on the top of the chassis are directed down to this receiver PCA.

Circuitry for the control panel is on the upper interposer PCA and the 20-pin cable (second connector from the bottom on the left side) goes from this PCA to the control panel. This cable carries key input and control panel display output.

Circuitry for the motorized mailslot is also on the upper interposer PCA. The mailslot cable (third connector up front the bottom on the left side) carries pulse-width-modulation outputs to the motor on the mailslot. Mailslot sensor inputs also are received on this cable.

The connector at the top left corner of the upper interposer PCA has several purposes. Three of the cable sets go to the path-clear infrared emitters. Also in that cable are the wires for the translate sensor - which detects the picker "flag" during picker position initialization. When this "flag" signal is received, the position of the picker on the picker encoder strip is recorded and used as the center stack "O" point.

There are three 2-pin connectors on the right edge of each interposer PCA for drive fan power.

There are two LEDs to indicate power for each drive; a yellow one and a green one. A switch assembly has two switches. At the present time, the lower switch (and the lower LEDs) apply to the drive in the drive enclosure. The normal switch position is to the right and the green LED is on steady, which indicates that the drive is ON.

When the yellow LED blinks, it means that the application has taken the drive offline. Pushing the switch over to the left requests the jukebox that the drive be placed in a status where the power can be turned off. At that point, the yellow LED will go on steady.

When the switch is placed to the right, it informs the jukebox that the drive power should be placed ON. This is done after an online drive replacement. The yellow LED will go off and the green LED will go on steady.

The SCSI comes from a single, teed stub (a cable that goes out from the PCA but does not return).

There is also a 20-pin ribbon drive interface connector going out from the interposer PCA. The interposer PCA also contains registers to receive the output signal to the drives such as EJECT or ERROR.

Power into each interposer PCA enters by two 6-pin connectors. Each connector receives drive power and drive fan power. The top connector on each interposer also receives 5 volts.

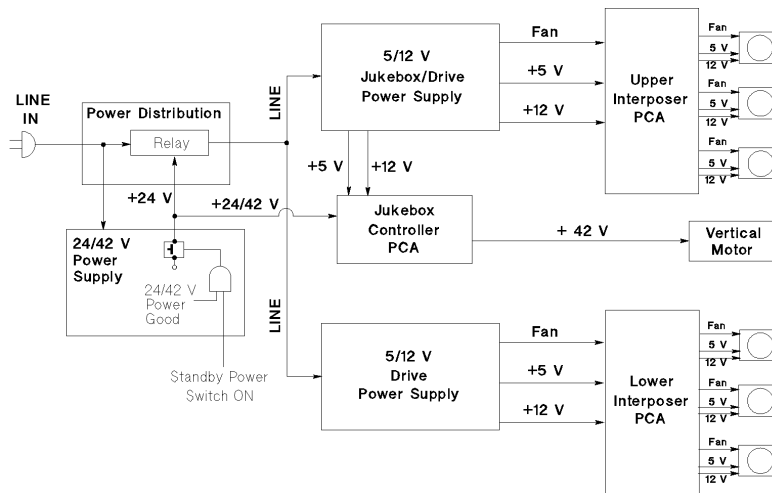
The upper interposer PCA receives power from the upper 5/12 V power supply, the lower interposer PCA receives power from the lower 5/12 V power supply.

6.4 Power Supplies

There are three autoranging power supplies.

Two identical supplies provide +5 volts at 15 amperes and +12 volts at 10 amperes (peak). This supply powers the drives and the autochanger logic. The other supply provides +24 and +42 volts, both at 4 amperes (peak). This supply powers the vertical motion motor (+42 V) and the power on sequence relay (+24V).

Figure 6–6 Power Supplies and Power on Sequence



Line power is connected through the power distribution PCA on the lower right side of chassis. Connection is direct to the 24/42-volt power supply. When the 24/42-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 24/42-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 two 5/12-volt power supplies for the jukebox.

6.5 SCSI Repeater / LUN Converter PCA

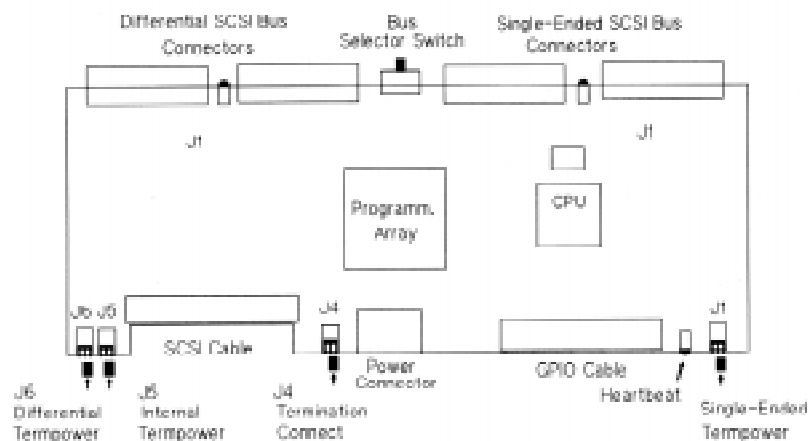
The SCSI repeater / LUN converter PCA has two major functions:

- logically connects the active host SCSI bus (single-ended or differential) to the internal single-ended SCSI device bus
- operate in a LUN mapping mode on HP hosts.

6.5.1 Component Description

Internally, the jukebox has a single-ended SCSI bus. This PCA has connectors for both single-ended and differential cables. A differential SCSI connection is converted to single-ended SCSI.

Figure 6–7 SCSI Repeater / LUN Converter PCA



Refer to the diagram above to locate the components discussed in the following paragraphs.

Differential and single-ended connectors are on the top edge of the PCA (two for each type of interface). Between the single-ended and differential sets of connectors is a slide switch so that the user can specify which set of connectors will be used by the jukebox.

Both single-ended and differential terminators are shipped with the jukebox. A terminator must be used if the jukebox is the last or only, peripheral on the host SCSI bus.

Jumper J1 - enables/disables supply of single-ended bus TERMPOWER from this PCA. Default is ON (pins 1 and 2 connected).

Jumper J3 - enables/disables the active bus termination for the internal SCSI bus (U8). Default is ON (pins 1 and 2 connected).

Jumper J5 - enables/disables TERMPOWER for the internal bus. Default is ON (pins 1 and 2 connected).

Jumper J6 - enables/disables supply of differential TERMPOWER from this PCA. Default is ON (pins 1 and 2 connected).

Jumper J7 - selects Bank 0 or Bank 1. Multiple banks will be implemented in future implementations of this PCA that will support more optical drives. Default is Bank 1 (pins 1 and 2 connected).

Boot ROMs, U1 and U6 are located on the lower right side of the PCA.

Currently, U1 is being used and U6 is inactive (no load). When the gate array is a programmable gate array, it gets its configuration from these boot ROMs. When the gate array is a masked gate array, these boot ROMs will not be used.

After the jukebox runs its selftest on wakeup, it instructs the SCSI PCA to go into repeater mode unless LUN mapping mode was selected and is in non-volatile memory. This PCA, during its wakeup sequence, waits for this communication from the jukebox controller before it enables the external buses. Communication of commands and status between the controller and this PCA is through a GPIO cable that connects to the 34-pin connector on the bottom right of the PCA.

In repeater mode, the SCSI PCA looks transparent on the bus and passes all SCSI transactions through. The jukebox sets drive IDs on the jukebox internal bus so that each drive can respond appropriately.

In LUN mapping active mode, the PCA will take one SCSI ID and assign Logical Unit Numbers to the drives and autochanger controller (see LUN converter function discussion that follows this section).

After this PCA successfully boots (green LED ON), it initializes the drives within the jukebox. It then waits for a valid mode signal (either repeater mode or LUN mapping mode) from the controller PCA. The host system bus select switch is checked and the appropriate host system bus receivers are enabled.

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

If the selector switch is selecting the single-ended connector, the single-ended SCSI bus is active. Control signals on that bus are checked to insure that a differential device has not been connected to that bus. If a differential device has been erroneously connected to the single-ended connector, the single-ended external bus is made inactive to protect the chips.

Proper connections to the single-ended and differential ports are checked only at power up, so power should be cycled to check for any mismatch when there is any possibility that a cable or selection may have been moved/changed.

NOTE

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.

NOTE

Single-ended and differential SCSI terminators are different.

NOTE

The unused ports can either have external cables/terminators connected to them or not. But if there is a connection to an unused port, it must be of the proper type for that port.

Green LED - PCA is successfully booted and ready.

Yellow LED - indicates activity on the bus. Flashes when activity present.

Red LED - some type of error condition. Ex. the PCA has not successfully booted or there is a cabling problem on the host side. Check that the interface select switch is set to select the bus that you desire to be active (single-ended or differential) and that the appropriate terminators are on the appropriate connectors (single-ended terminator connector to single-ended side, differential terminator connector to differential side). Check that the bus that the connector is hooked to has the appropriate type of peripherals on it (a mixture of single-ended and differential peripherals on either bus will cause a failure).

The large chip in the center of the PCA is the 10,000 gate array that accommodates the LUN mapping function.

The clock (U7) is 20 MHz.

6.5.2 Logical Unit Number Mapping Capability

LUN means Logical Unit Number. The LUN Converter PCA enables connecting up to seven jukeboxes on a single SCSI bus. Also, the SCSI bus may be either single-ended or differential. Internally, the jukebox has a single-ended SCSI bus.

The LUN converter function operates in either of two modes: Passthru (no LUN mapping - default) and LUN mapping active.

Passthru Mode-

Addressing

Each device has its own SCSI ID. The IDs are configured on the control panel.

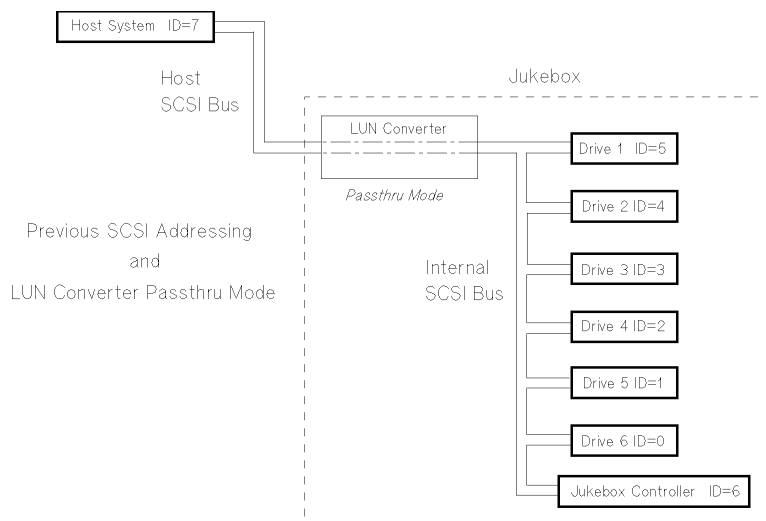
The table below shows the default addressing.

Table 6–1 Passthrough Mode - Six Drives

Device Type	Device ID	LUN Address
Drive 1	5	0
Drive 2	4	0
Drive 3	3	0
Drive 4	2	0
Drive 5	1	0
Drive 6	0	0
Jukebox Controller	6	0

Only one jukebox may be connected to the SCSI bus at one time.

Figure 6–8 SCSI Repeater / LUN Converter Passthrough Mode (6 drive)



6.5.2.1 LUN Mapping Active Mode,

Allows more than one jukebox on the same SCSI bus.

LUN Addressing

Each device in the jukebox has a LUN assigned under a single jukebox device ID. The device ID and its LUN addressing are configured using the control panel. The LUNs, however, are predefined and not configurable. Table 6–2 shows the default addressing when in LUN mapping mode.

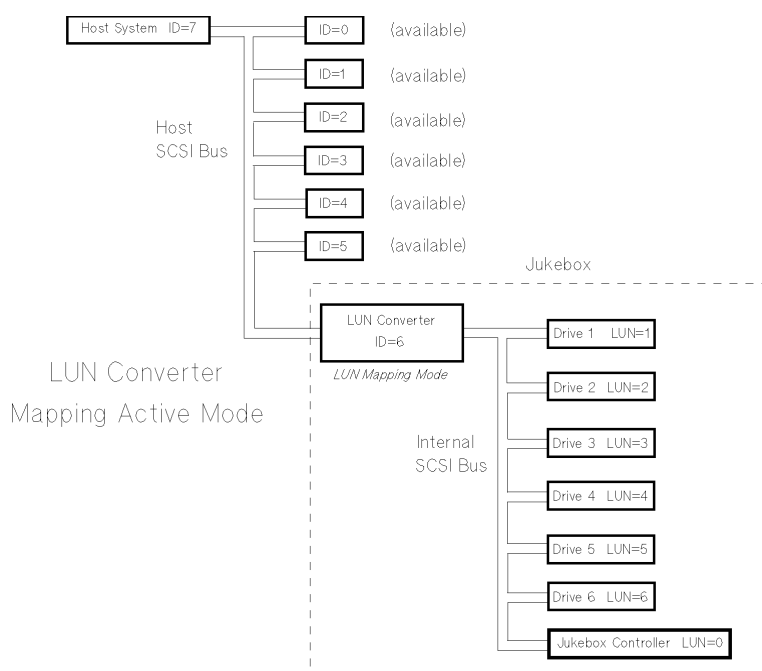
Table 6–2 LUN Mapping Active - Six Drives

Device Type	Device ID	LUN Address
Drive 1	6	1
Drive 2	6	2
Drive 3	6	3
Drive 4	6	4
Drive 5	6	5
Drive 6	6	6
Jukebox Controller	6	0

The jukebox controller is set at LUN 0 to be compatible with hosts that do 1/0 scans and require a device at LUN 0.

With LUN mapping, seven jukeboxes (theoretically) may be connected to a single SCSI bus. However, performance and cabling issues will limit the number of jukeboxes to a maximum of 2 for a single-ended host bus and 5 for a differential host bus.

Figure 6–9 SCSI Repeater / LUN Converter Mapping Active Mode (6 drive)



The LUN of the addressed device is specified through an IDENTIFY message immediately following the SELECTION procedure (setting the LUN in the command Control Data Byte is not supported). After the LUN is set, commands, data, status, and messages are routed to the appropriate device. The Read Element Status command that is sent to the jukebox controller will report the drive's SCSI ID and LUN through a Read Element Status placed in the Data Transfer Element Descriptor Block.

The optical jukebox has the option of running in SCSI LUN (logical unit number) mode which allows you to assign from one to three SCSI addresses (depending on the number of drives in the jukebox) to the jukebox. The jukebox controller and drives can then be accessed using logical unit numbers.

If the jukebox is not running in LUN mode, some jukebox models could use all available SCSI addresses on the bus; therefore, if you need to attach additional devices to the same SCSI bus, you must use LUN mode (uses one or two SCSI addresses). See "Setting the LUN Mode" following this section for instructions on changing the LUN mode.

Check the host system documentation and the jukebox application software instructions to verify that the use of LUNs is supported. Also, attaching multiple devices using LUNs may affect the performance of those devices.

If LUN mode is set to "OFF" (the default), the optical jukebox requires the use of from 5 to 13 SCSI IDs—one for each optical drive and one for the jukebox controller. Table 6–3 shows the default SCSI ID and LUN Mode settings.

Table 6–3 Default SCSI and LUN Settings

BUS 1	LUN MODE OFF		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
DRV 5 ID*	1	0	6	5
DRV 6 ID*	0	0	6	6

*may or may not be included in some RW555/RW557 models

If you are already using any of these addresses for your computer or another SCSI peripheral device, follow the directions in one of the following sections to change to LUN mode, or change the controller or the drive addresses. To view the current SCSI address settings, see "Viewing the Current SCSI Address Settings" in this chapter.

NOTE

After you change an address, you may have to restart your computer for the new addresses to be recognized.

The new settings can be saved to flash ROM by power cycling the jukebox. This allows the settings to be recovered if the jukebox is powered off for more than ten days. 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 your host system manuals for information about checking the SCSI bus status.) If your computer is connected to a LAN, be sure to check with your system administrator before shutting off power to the jukebox.

6.6 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.

6.6.1 Disk Exchanges in Single-Picker Mode

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.

- (a) Move to the drive (dest1)
 - (b) Eject the cartridge from the drive (spin down included).
1. Grab the cartridge from the drive.
 2. Move the cartridge to its home slot (dest2).
 3. Put the cartridge into the slot.
 4. Move to the source slot.

5. Grab the cartridge from the slot.
6. Move to the drive.
7. Insert the cartridge into the drive.

6.7 Element Numbering

Element numbers designate any location that a disk can occupy in the jukebox.

Table 6–4 Element numbering in the jukebox

Element Name	Element Number
Optical drives	1 to 6
Mailslot	20
Disk storage slots 1-128 (half configuration)	31 to 158

6.8 Disk Storage Slot Numbering Sequence

To improve access times, cartridge slot numbering starts close to the drives and expands out. The lower-numbered slots are close to the optical drives and the higher-numbered slots are farther away from the drives.

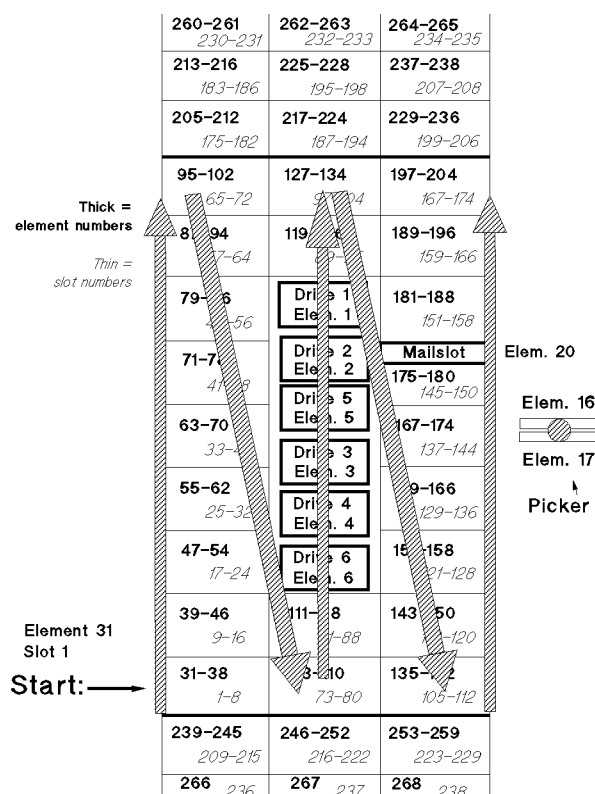
Figure 6–10 Element and Slot Numbers

Thick = element numbers Thin = slot numbers	260–261 <i>230–231</i>	262–263 <i>232–233</i>	264–265 <i>234–235</i>	
	213–216 <i>183–186</i>	225–228 <i>195–198</i>	237–238 <i>207–208</i>	
	205–212 <i>175–182</i>	217–224 <i>187–194</i>	229–236 <i>199–206</i>	
	95–102 <i>65–72</i>	127–134 <i>97–104</i>	197–204 <i>167–174</i>	
	87–94 <i>57–64</i>	119–126 <i>89–96</i>	189–196 <i>159–166</i>	
	79–86 <i>49–56</i>	Drive 1 Elem. 1	181–188 <i>151–158</i>	
	71–78 <i>41–48</i>	Drive 2 Elem. 2	Mailslot <i>175–180</i> <i>145–150</i>	Elem. 20
	63–70 <i>33–40</i>	Drive 5 Elem. 5	167–174 <i>137–144</i>	Elem. 16
	55–62 <i>25–32</i>	Drive 3 Elem. 3	159–166 <i>129–136</i>	Elem. 17
	47–54 <i>17–24</i>	Drive 4 Elem. 4	151–158 <i>121–128</i>	Picker
	39–46 <i>9–16</i>	Drive 6 Elem. 6		
		111–118 <i>81–88</i>	143–150 <i>113–120</i>	
	31–38 <i>1–8</i>	103–110 <i>73–80</i>	135–142 <i>105–112</i>	
	239–245 <i>209–215</i>	246–252 <i>216–222</i>	253–259 <i>223–229</i>	
	266 <i>236</i>	267 <i>237</i>	268 <i>238</i>	

The following diagrams and discussion explain the sequence in which the slots are numbered. Knowing this sequence allows you to correlate slot numbers, as displayed from the control panel, and element numbers.

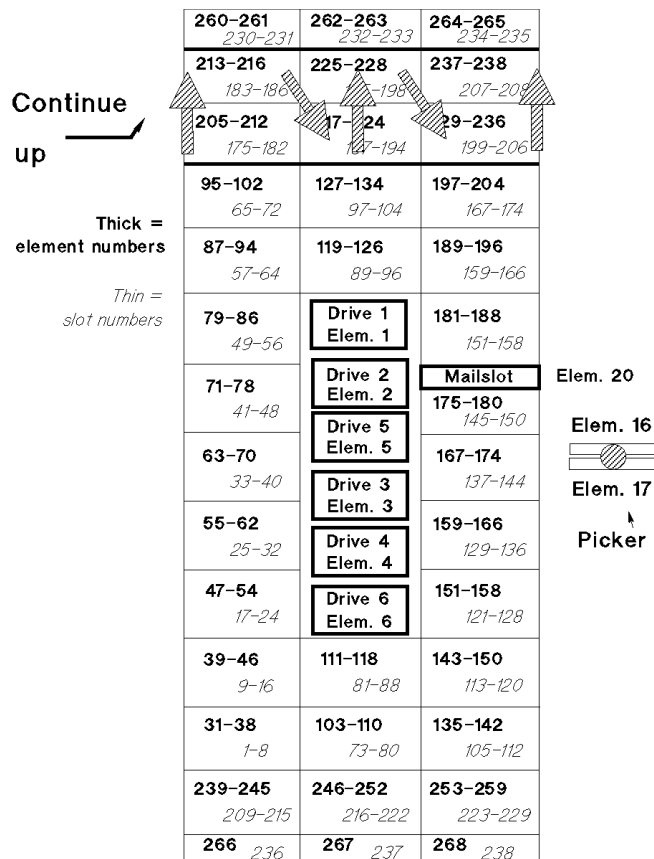
At the end of the explanation of sequencing, there is a picture of the decal that is mounted inside the jukebox left panels. You can use this decal for finding slot numbers - you can convert between storage slot numbers and element numbers by adding 30 to the slot number.

Figure 6-11 Slot and Element Numbering Sequence (1 of 3)



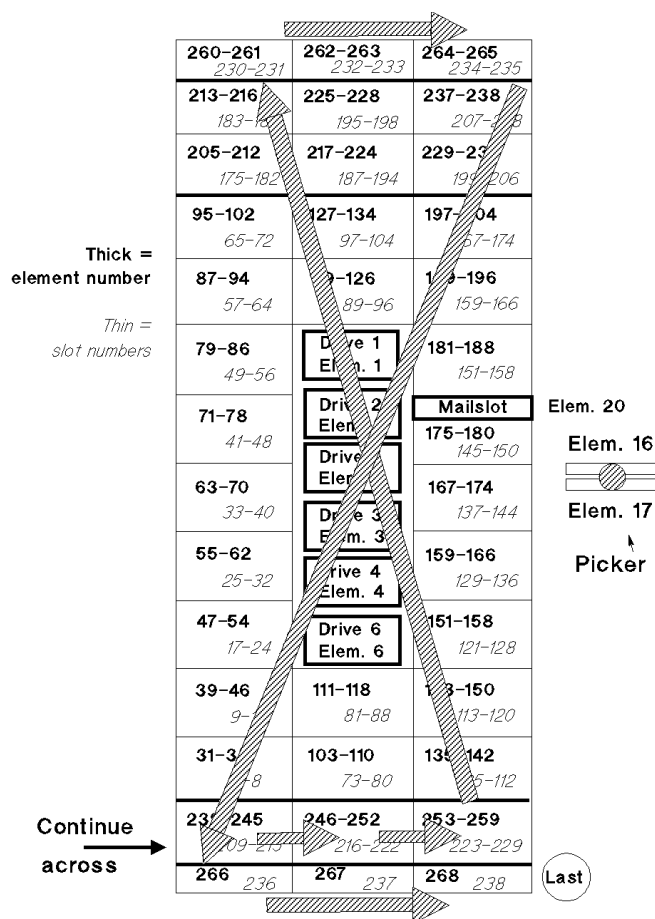
Slot I (element 3 1) starts at the lower left as you look at the stacks. SLOT numbering increases up to 72, drops down to continue with 73 up to 104, drops down again to continue with 105 and goes up to 174.

Figure 6-12 Slot and Element Numbering Sequence (2 of 3)



The pattern covers the slots from 175 to 208—passing just below the limited-access slots at the top.

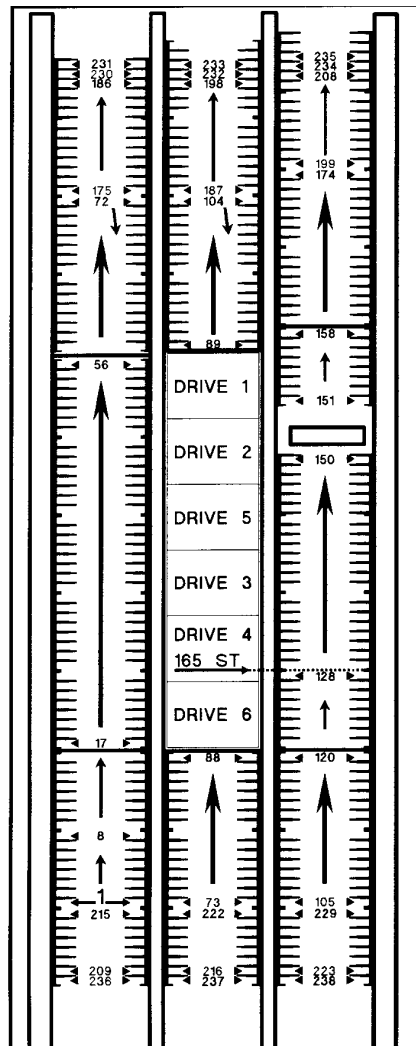
Figure 6-13 Slot and Element Numbering Sequence (3 of 3)



The sequence continues with 209 through 229 across the bottom – just below the limited-access slots on the bottom.

Finally, back up to the top to include slots 230 through 235.

Figure 6–14 Slot Numbering Decal



A decal that shows the slot numbering is inside the left-side panels on the jukebox.

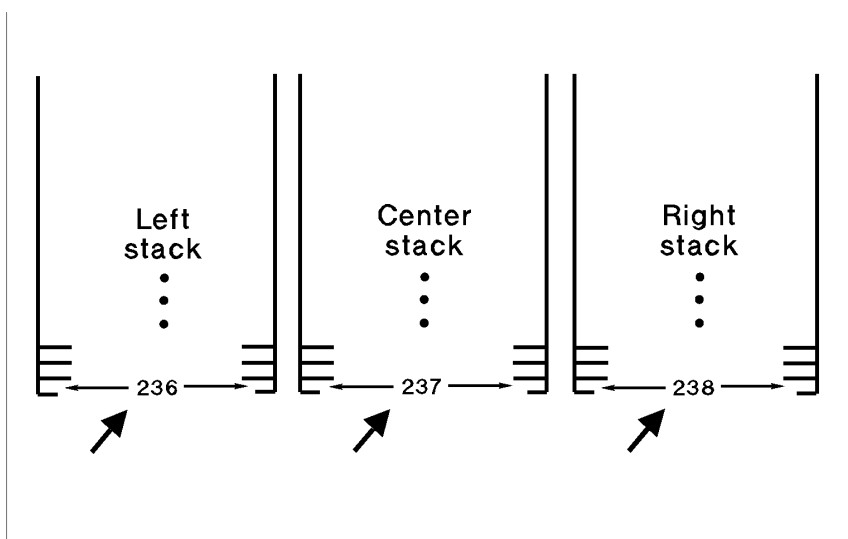
6.8.1 Limited Access Slots

Because of physical constraints, some physical slots can have either limited access or can not be accessed at all.

At the lower limit of picker transport travel, there are 3 slots, 1 in each stack, that can only be accessed by the lower picker.

Also, at the upper limit of picker travel, there is a level of slots that can be accessed only by the topmost picker.

Figure 6–15 Limited Access Slots at the Bottom of the Stacks



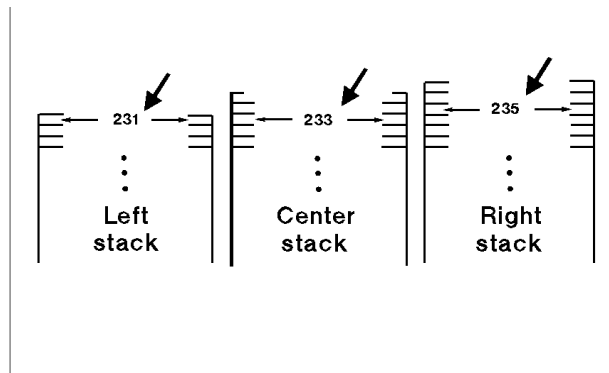
These limitations on picker access to these upper and lower-limit slots will normally be transparent to you.

The only operation these access limitations affect is dual-picker high-speed exchanges.

The jukebox controller knows the limitations of these slots and will not attempt to do these types of exchanges when using them.

Because the optical drives are located in the middle of the center stack instead of across the bottom, and because the mailslot is mounted within the right-hand stack, the physical magazines are staggered upwards.

Figure 6-16 Limited Access Slots at the Top of the Stacks

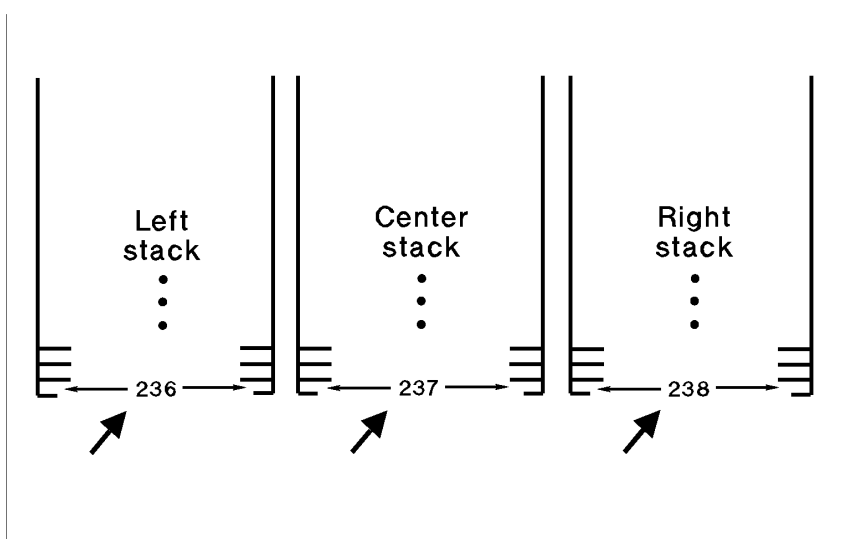


This results in some slots at the top that are inaccessible.

The top TWO slots on the right stack and the TOP slot in the center stack can not be accessed by the picker at all. Never manually load a disk into any of these slots.

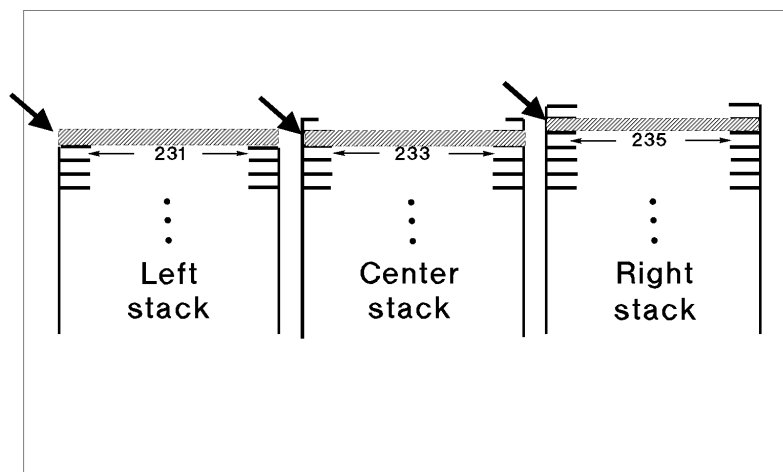
The slot just below the top slot in the middle stack may only be accessed by the top picker and is used by the firmware for a special, error-recovery case - to recover when a cartridge has been grabbed by only one finger. If the recovery does not work, you will find the cartridge left in this slot. You must manually replace the cartridge in the slot from which it came before it can be used again. Never put a cartridge into this slot either.

Figure 6-17 One-Finger Grab Recovery Areas at the Bottom of the Stacks



We have placed decals next to these slots to remind you that you should never manually load disks in the two top slots in the center and right-hand stacks.

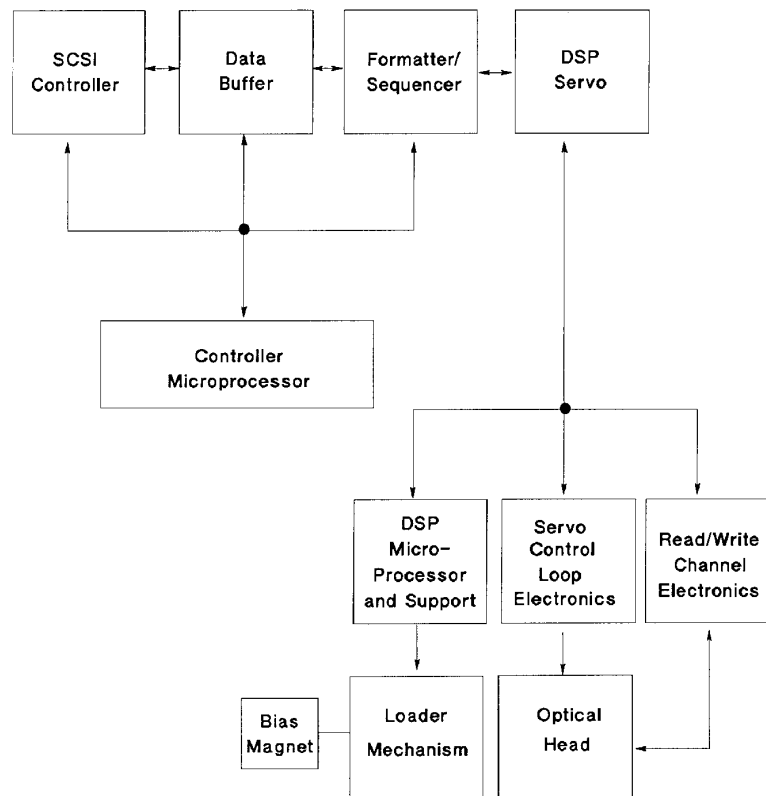
Figure 6-18 One-Finger Grab Recovery Areas at the Top of the Stacks



6.9 4X Multifunction Optical Drives

4X-Drive Mechanism

Figure 6-19 4X-Drive Functional Diagram



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

6.9.1 Controller PCA

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

6.9.2 SCSI Controller

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

6.9.3 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 RWZ53 drive contains 512 Kbytes of buffer RAM.

6.9.4 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.

6.9.5 Servo PCA

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

6.9.6 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.

6.9.7 Read and Write Channel Electronics

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

6.10 Mechanism Assembly

6.10.1 Loader Mechanism

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

6.10.2 Optical Head

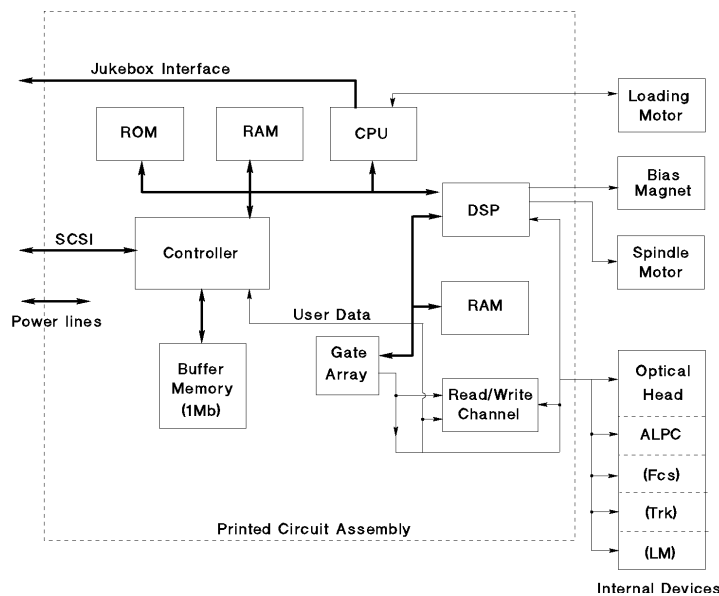
"Split optics" design. This design physically separates the laser diode and its associated detectors from the focus/fine position actuators, providing significant seek time performance advantage due to less mass on the moving portion of the optical head.

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

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

6.10.3 4X-Drive Mechanism

Figure 6–20 4X-Drive Functional Diagram



6.10.4 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 RWZ53 uses a 1-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.

6.10.5 CPU

The central processing unit for all drive functions including the loading motor.

6.10.6 Gate Array

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

6.10.7 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 activated.

6.10.8 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 analog data is then sent to the optical head.

6.10.9 Loading Motor

The loading motor loads and unloads the optical disk 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.

6.10.10 Bias Magnet

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

6.10.11 Optical Head

The optical head assembly contains both mechanical and electronic components and is a "split optics" design.

A "split optics" 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.

6.11 Optical Disk Layout and Error Correction

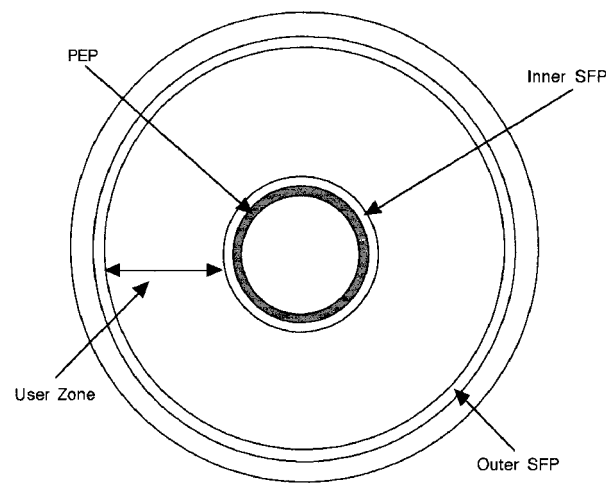
6.11.1 Disk Formats

The RWZ52 (2X) optical drive can read from and write to both 650-Mbyte (IX) and 1.3-Gbyte optical disks. The RWZ53 (4X) drive 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 a 512 bytes/sector disk is written inside parentheses just after the value for the 1,024 bytes/sector disk.

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

Figure 6–21 Optical Disk Layout

6.11.3 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 6–6 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 Mbytes disks only)
 - User Area consisting of:
 - g User Groups, of n sectors each
 - g Spare Groups, of m sectors each

650-Mbyte Disk User and Spare Groups

Figure 6–22 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

Figure 6–24 and Figure 6–25 show the User Zone Layout for 1.3-Gbyte, for both g=1 (single data area and one 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 "slip out" with any slip 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 6–22 User Zone Layout for 650-Mbyte Media

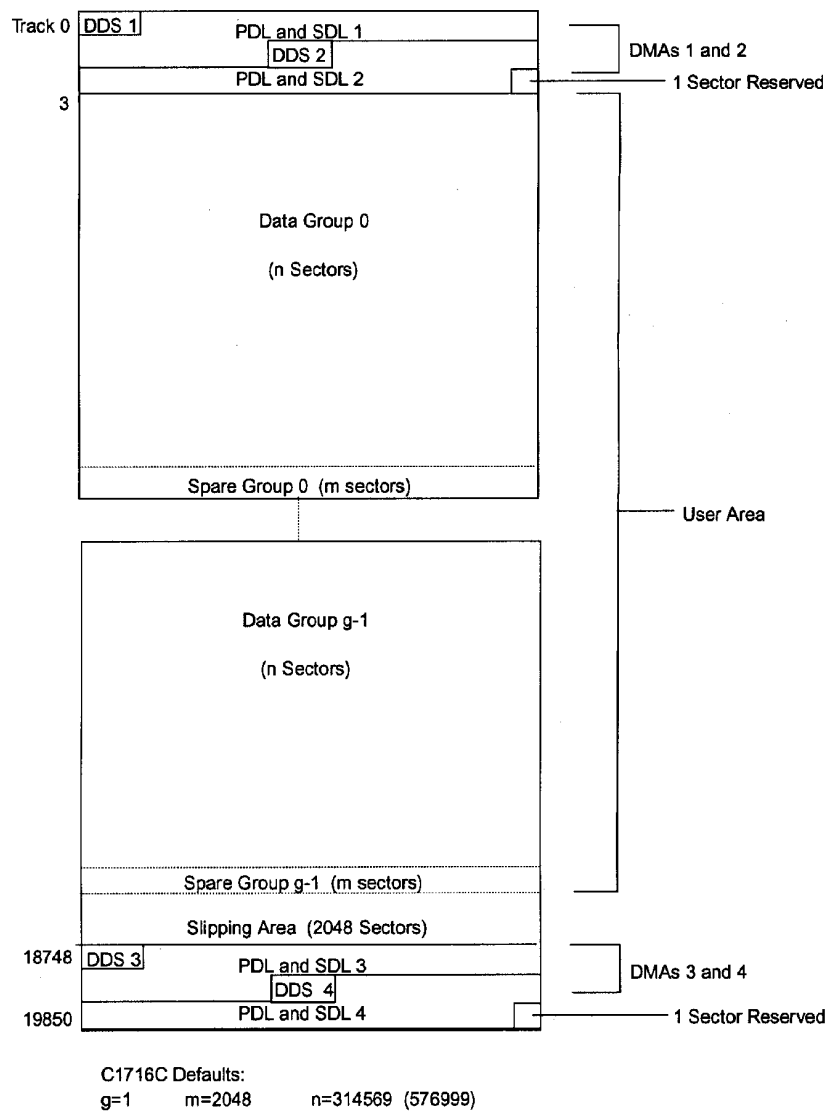


Figure 6–23 User Zone Layout for 1.3-Gbyte Media, g=1

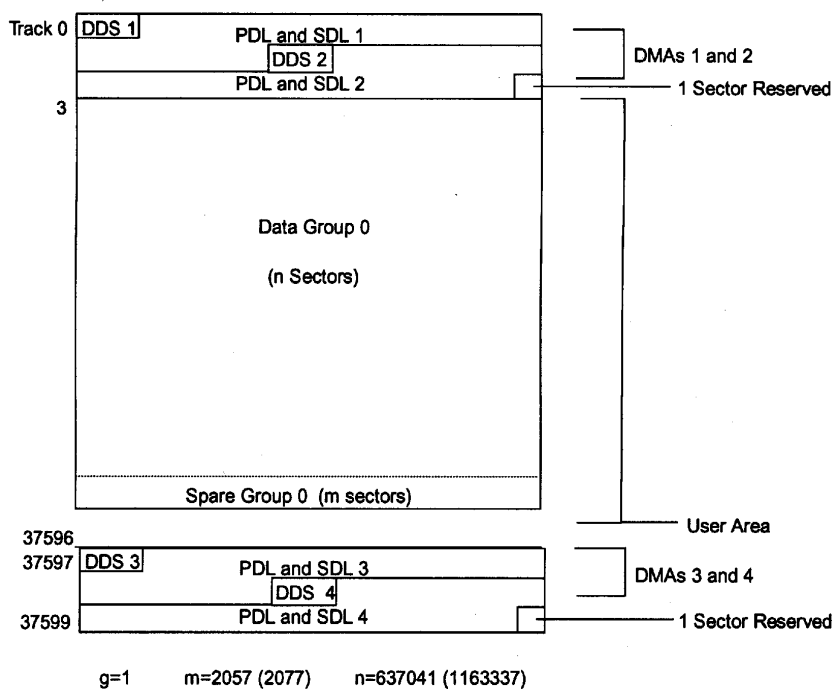


Figure 6–24 User Zone Layout for 1.3-Gbyte media, g=16

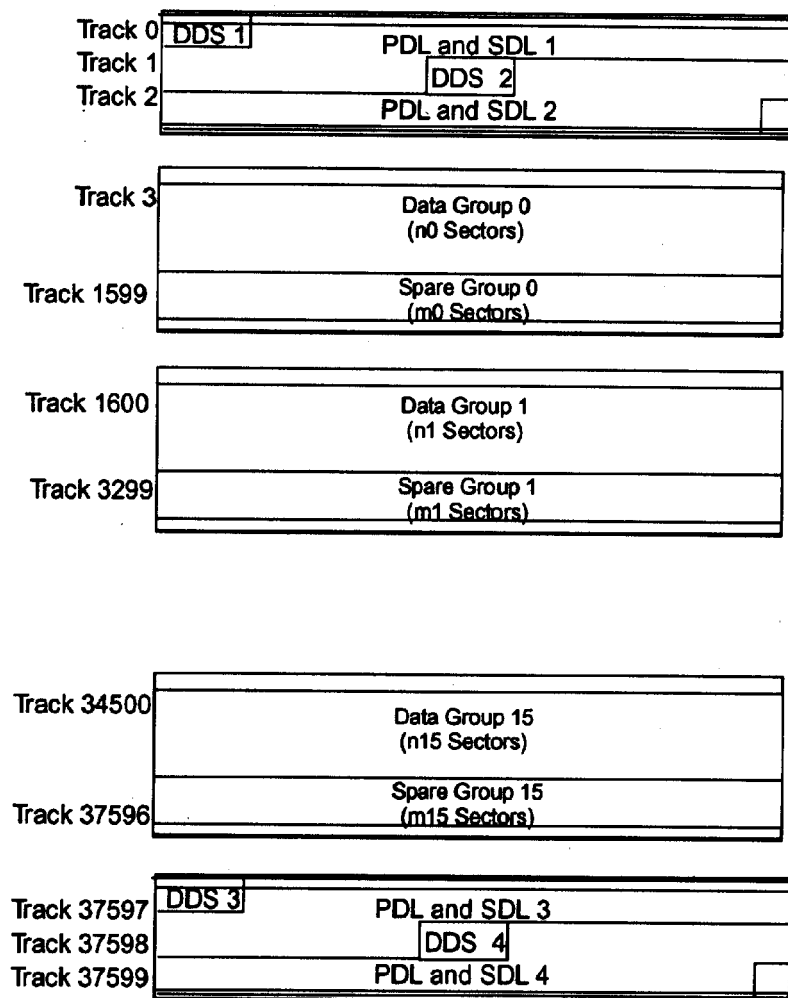


Table 6–5 Values for n and m for 1.3-Gbyte with g=1 6 (1,024 media)

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

Table 6–6 Physical Revolution to Logical Track Layout

Zone or Band	Physical Revolution Range	Logical Track
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, 16199)	(23100, 25799)
Data Band 12	(16200, 17549)	(25800, 28599)
Data Band 13	(17550, 18899)	(28600, 31499)
Data Band 14	(18900, 20249)	(31500, 34499)
Data Band 15	(20250, 21599)	(34500, 37599)
Outer Mfg.	(21600, 22949)	(37600, 37785)
Outer SFP	(22950, 24299)	(37786, 38046)

Figure 6–25 User Zone Layout for 2.3 Gbyte Media, 512 Bytes/Sector

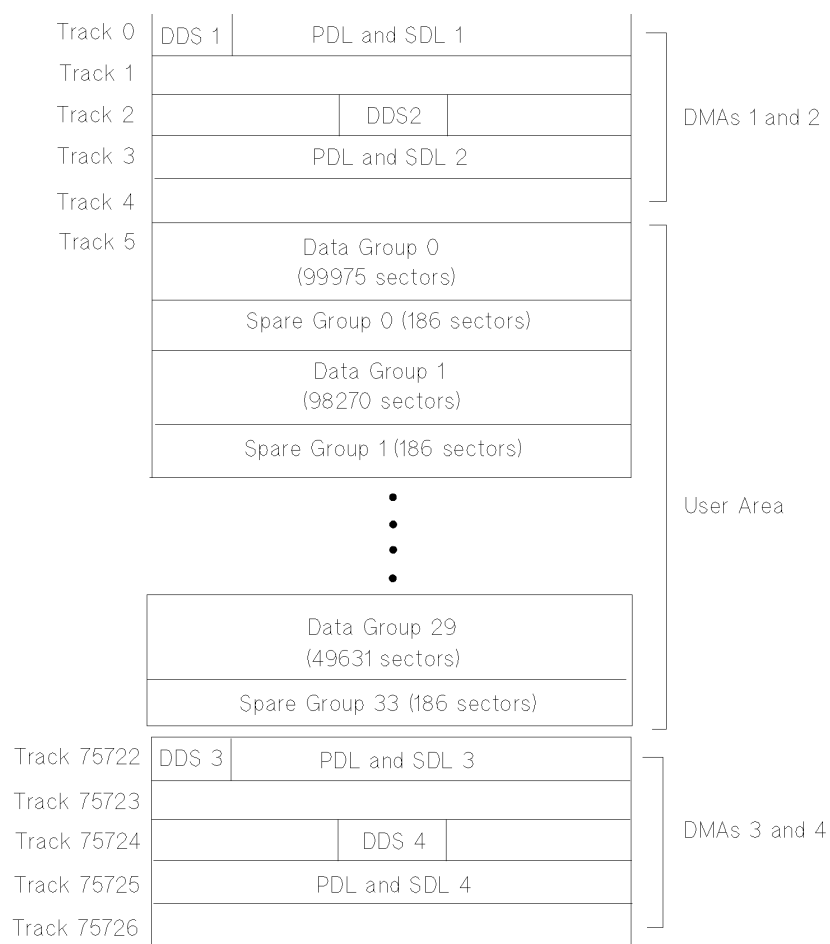


Table 6–7 4X 1024 Bytes/Sector Disk Structure

Zone #	Start Track	End Track	No. Tracks	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	2945	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
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 6–8 4X, 512 Bytes/Sector Disk Structure

Zone #	Start Track	End Track	No. Tracks	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
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 6–9 Technical Comparison of 1 X, 2X, and 4X Optical Drives

	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) 66 (116)
sectors per revolution OD	17 (31)	40.3 (73.5)	
modulation method	PPM	PPM	PWM
bit density ID (bpi)	24.9K	29.5K	48.7K (49.1 K)
bit density OD (bpi)	12.5K	29.5K	50.9K (50.8K)
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)	644 (.591)	1,300 (1.189)	2,607 (2.296)

6.12 Drive Defect Management

The RWZ53 drive support the defect management scheme specified by ISO 10089A and ISO 11560, and ISO/IEC 14517. 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/IEC standard for 650-Mbyte media allows for a maximum of 2048 spare sectors total from the PDL and the SDL. The standard for 1.3-Gbyte allows for 2057 or 1077, depending on the sector size of 1,024 or 512 bytes per sector. The standard for 2.6 -Gbyte media allows for 5202 or 558, depending on the sector size of 1,024 or 512 bytes per sector. For 1.3 Gbyte, the value for g must be 1 or 16; for 2.6 Gbyte media, the value for g must be 34.

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

In general for 1.3-Gbyte: $g = 1 \text{ or } 16$, (n, m or nO through n15 and mO through m15 are predefined based on g).

In general for 2.6-Gbyte: $g = 34 \text{ or } 30$, (n, m or through n33/29 and mO through m33/29 are predefined based on g)

For more details consult the ISO/IEC 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.

6.12.1 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:

- PDL entries are given in track/sector form, not as block addresses. The final translated address must also be in track/sector form.
- There is a 3-track offset added to the physical block address, 51 sectors for 1,024 bytes/sector media and 93 sectors for 512 bytes/sector media.
- 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- and 2.6-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-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.

6.12.2 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- and 2.6-Gbyte media, a new defect/replacement pair is added, thus creating a "chain" of defect/replacement pointers.)

6.12.3 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 6–10 shows the error thresholds for the RWZ53 (4X) 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 6–10 Error Thresholds

Operation	Sector Ids	ECC Level
Format	RWZ53=1	3
Write	2	-
Erase	2	-
Verify	2	4
Read (recovered)	1	7
Read	1	8

6.13 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.

6.13.1 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 the 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.

Reader's Comments

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