

RA90/RA92 Disk Drive User Guide

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About This Manual

This manual contains the following information:

- RA90/RA92 disk drive specifications
- Environmental considerations
- Installation information and references
- Start-up procedures
- Acceptance testing criteria
- Troubleshooting procedures

Although this manual is written primarily for RA90 and RA92 disk drive customers, installation procedures described or referenced in this manual are intended for Digital Customer Services engineers performing original installation of the RA90 and RA92 disk drives. Qualified Customer Services engineers must be trained in the following:

- RA90 and RA92 disk drives
- DSA concepts
- ESD procedures

This manual does not cover cabinet cable routing and connections. Specific information concerning subsystem cabinet-related procedures can be found in product-specific manuals. Related documentation to supplement this manual is as follows:

Document Title	Order Number
<i>SA600/SA800 Storage Array Family Configuration Guide</i>	EK-SA600-CG
<i>SA650/SA850 Storage Array Family Configuration Guide</i>	EK-SA650-CG
<i>RA90/H9643 Cabinet Installation Guide</i>	EK-RA90H-IN

1

Introduction

1.1 General Information

The RA90 and RA92 disk drives are members of the Digital Storage Architecture/Standard Disk Interconnect (DSA/SDI) family and are, therefore, plug-compatible with all DSA/SDI controllers.

The RA90 and RA92 disk drives use nonremovable, thin film media and thin film heads encased in a unit called the Head Disk Assembly (HDA). These standalone disk drives are independently powered, cooled, and housed. Figure 1-1 shows an RA90/RA92 standalone disk drive.

The RA90 and RA92 disk drives are moving head, random access disk drives. The RA90 disk drive has a formatted data storage capacity of 1.216 gigabytes and an unformatted data storage capacity of 1.604 gigabytes in a 16-bit word format. The RA92 disk drive has a formatted data storage capacity of 1.506 gigabytes and an unformatted data storage capacity of 1.987 gigabytes in a 16-bit word format.

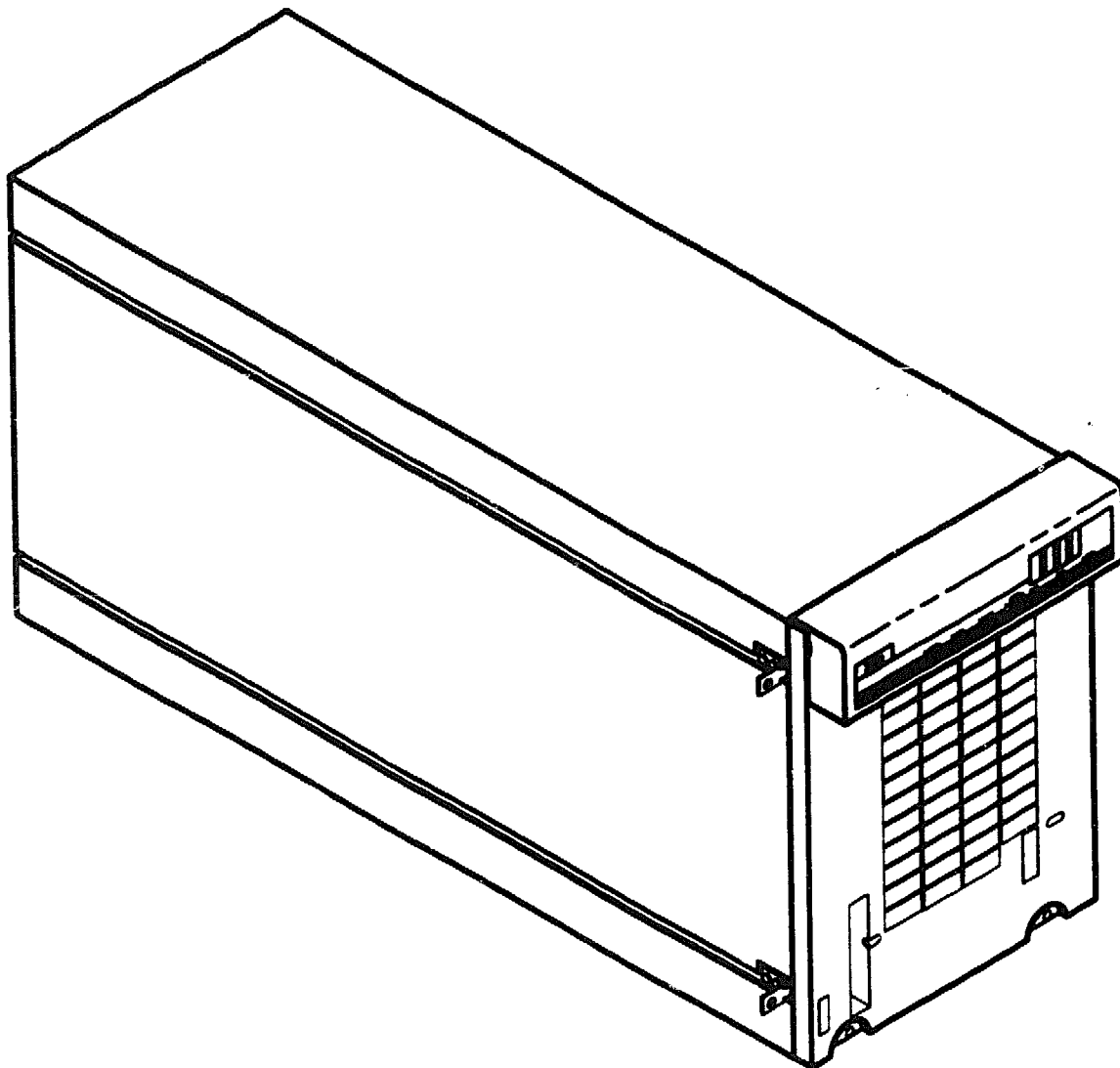
The RA90 and RA92 disk drives have the following common characteristics:

- 2.77 megabytes/second transfer rate
- Dedicated and embedded servo for coarse and fine track positioning
- Three internal microprocessors
- Reduced drive electronic module set
- Extensive resident microcode diagnostics
- Internal error log capabilities
- Multifunction operator control panel (OCP)

Figure 1-2 represents a typical RA90/RA92 subsystem configuration including an SDI controller.

1.2 Hardware Maintainability

The RA90 and RA92 disk drives use modular field replaceable units (FRUs) for easy access and servicing. An extensive set of drive-resident microcode diagnostics and a drive-resident error log help simplify problem isolation. Customer preventive maintenance is limited to monthly cleaning of the storage array air vent grill.



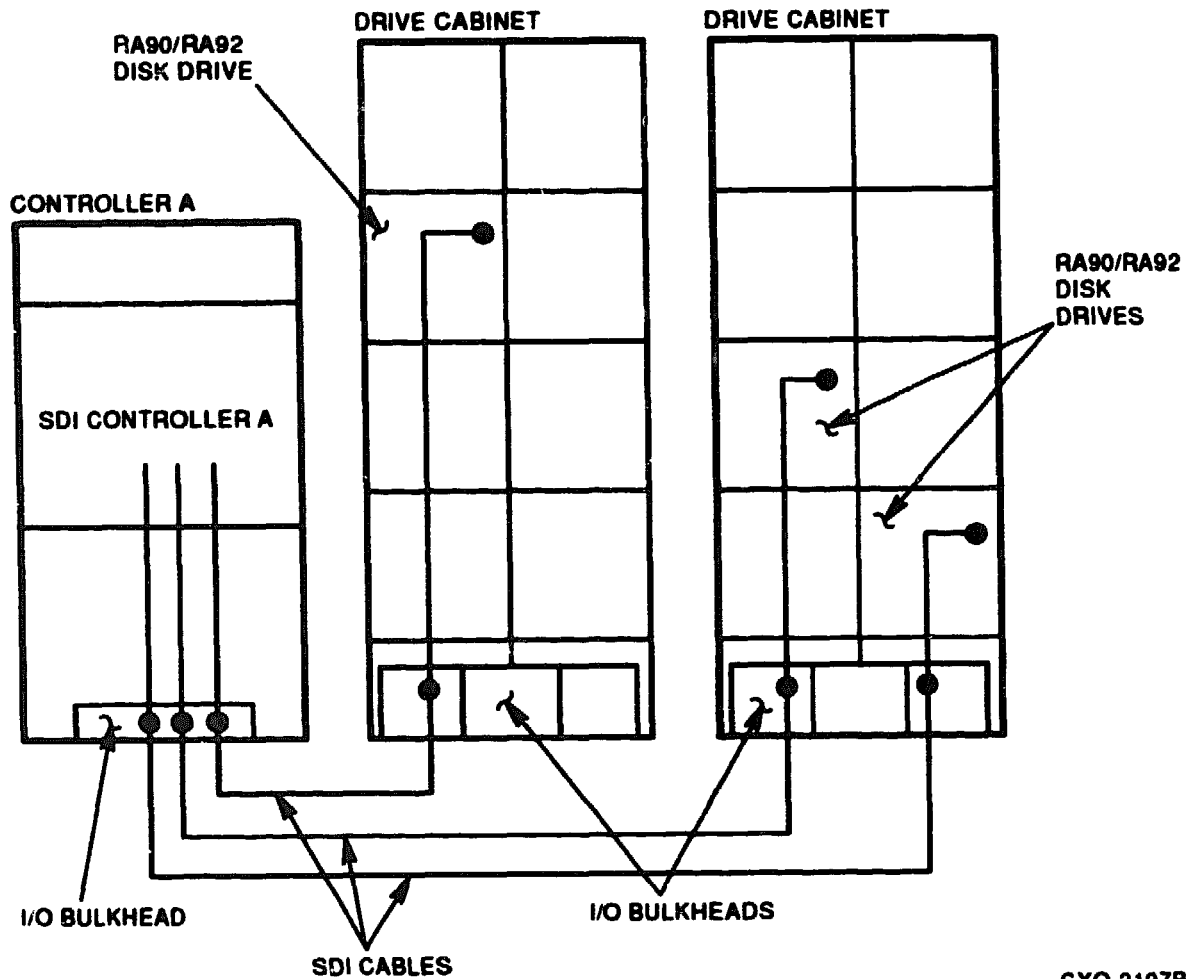
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Figure 1-1 RA90/RA92 Disk Drive

1.3 Dual-Port Capability

Ports are enabled by the port select switches (A or B) on the front of the OCP. With both port switches selected, RA90 and RA92 disk drives operate in a static dual-port mode. Static dual porting means a drive is shared between two controllers but is on line to only one controller at a time for data transfers. The second controller must wait until the drive is available before placing the drive on line.

An additional SDI cable is required for dual porting. Figure 1-3 shows an RA90/RA92 dual-port configuration.



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Figure 1-2 Typical RA90/RA92 Subsystem Configuration

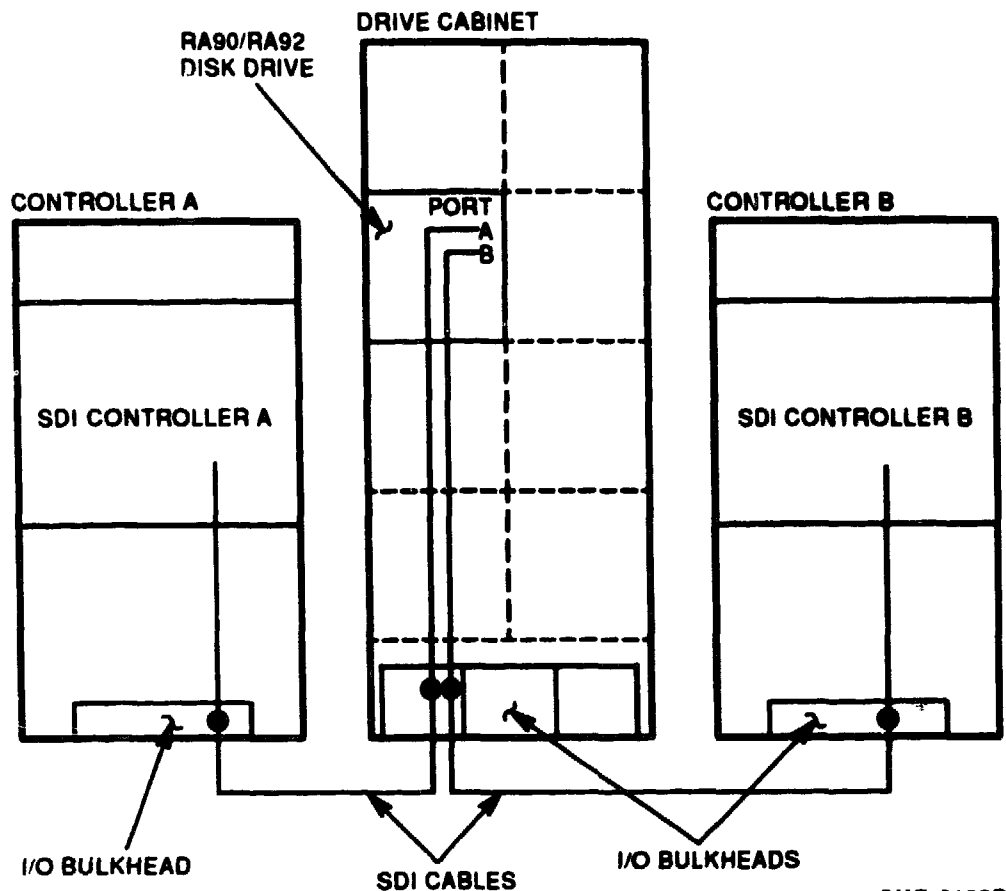
1.4 Drive-Resident Diagnostics Overview

Drive-resident diagnostics run during power-up and spin-up cycles to test basic drive functions. These diagnostics are also invoked by the drive any time the drive enters an idle-loop state and neither port is selected.

Drive-resident diagnostics can be run from the OCP while the drive is off line. See Chapter 4 for a list of drive-resident diagnostics.

1.5 User Precautions/Recommendations

Digital recommends that certain precautions be taken to protect equipment and user data. These precautions involve data backup methods, recommended operating temperatures, and electrostatic discharge protection, all of which are contained in this section.



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Figure 1-3 RA90/RA92 Dual-Port Configuration

1.5.1 Data Recovery

Data is not recoverable on an inoperable HDA. Therefore, it is the user's responsibility to protect data by using proper backup procedures. The following backup methods are recommended for RA90 and RA92 disk drives:

- **File duplication**—This method normally involves copying the data onto removable media, such as magnetic tape.
- **Journaling**—This method is recommended for files in a transaction processing application. Journaling allows reconstruction of files up to the last checkpoint or backup.

1.5.2 Recommended Operating Temperature

The RA90 and RA92 disk drives can operate within a temperature range of 10°C to 40°C (50°F to 104°F). However, it is recommended the RA90 and RA92 disk drives be operated in a temperature range below 25°C (77°F) to increase reliability and product life.

1.5.3 Electrostatic Discharge Protection

Electrostatic discharge (ESD) is caused by the buildup and release of static electricity. An electrical charge from a person or object can damage hardware components and result in premature device or option failure.

CAUTION

To avoid product damage, always use ESD grounding straps when handling static-sensitive modules and components.

Use the following guidelines when handling static-sensitive components and modules:

1. Read all instructions and installation procedures included with the static control materials and kits.
2. Wear a properly grounded ESD wrist strap when handling modules, components, or static-sensitive devices. Figure 1-4 shows an ESD wrist strap in use.

When using an ESD wrist strap:

- Ensure the wrist strap fits snugly for proper conductivity.
 - Attach the alligator clip securely to a clean, unpainted, grounded, metal surface, such as the drive or cabinet chassis.
 - Do not overextend the grounding cord.
3. Use static-protective containers to transfer modules and components (including bags and tote boxes).

1.6 RA90/RA92 Maintenance Strategy

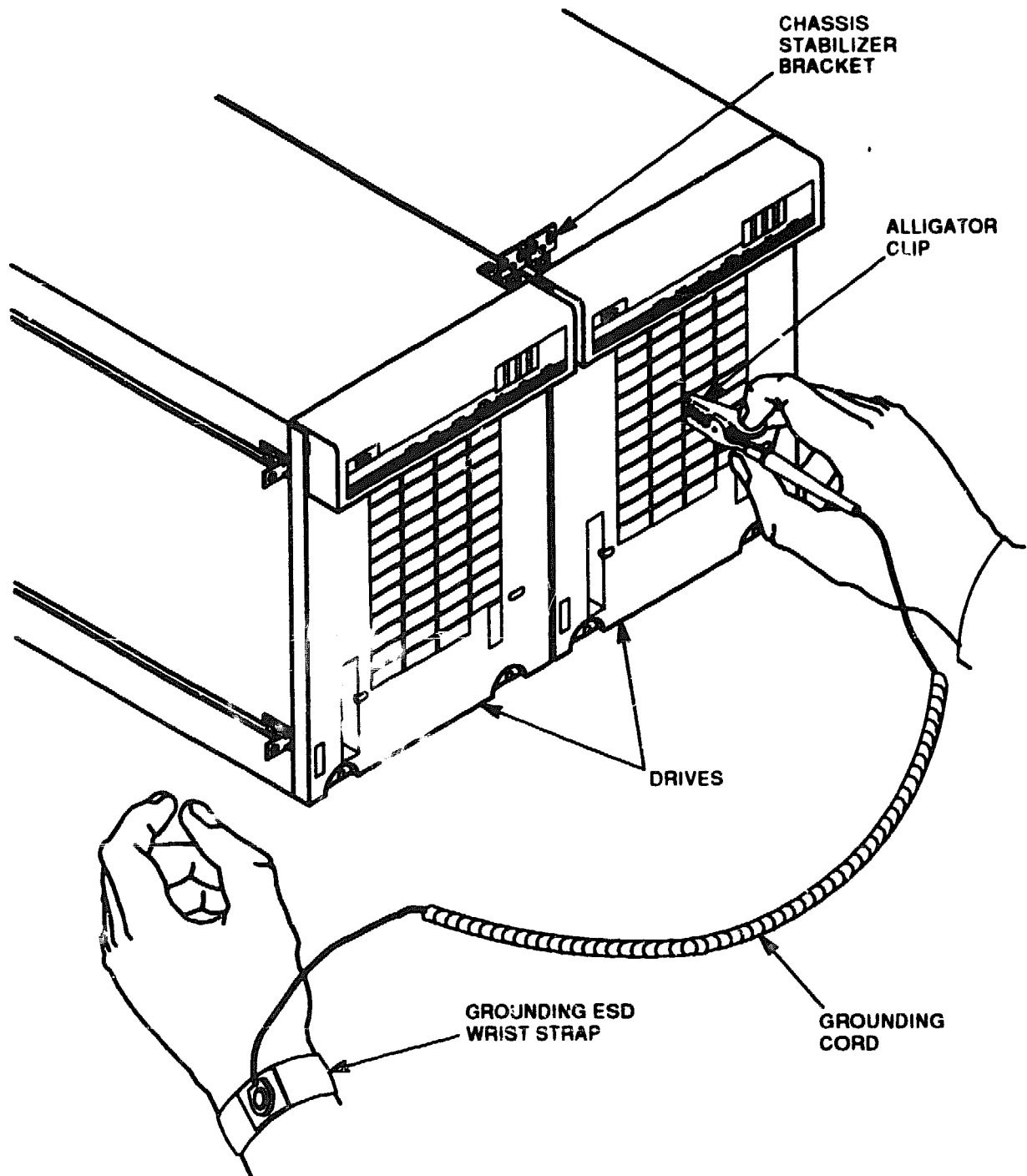
It is recommended that only trained Digital Customer Services engineers attempt to service RA90 and RA92 disk drives.

To repair RA90 and RA92 disk drives, replace the FRU. An extensive set of drive-resident microcode diagnostics and a drive-resident error log help simplify problem isolation.

Appendix A describes the customer's equipment maintenance responsibilities.

1.7 RA90/RA92 Disk Drive Specifications

Table 1-1 lists important operating and nonoperating specifications for RA90 and RA92 disk drives.



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Figure 1-4 ESD Wrist Strap

Table 1-1 Specifications for RA90 and RA92 Disk Drives

Characteristic	RA90 Disk Drive	RA92 Disk Drive
Head Disk Assembly (HDA)		
Storage capacity, formatted	1.216 gigabytes	1.506 gigabytes
Storage capacity, unformatted	1.604 gigabytes	1.987 gigabytes
HDA word format	16-bit only	Same as RA90
Bits/square inch	40 megabits	49.4 megabits
Tracks/inch	1750	2045
Disk recording method	Rate 2/3 modulation code	Same as RA90
Number of disks	7	Same as RA90
Disk surfaces	14 (13 data and 1 servo)	Same as RA90
Number of heads	14	Same as RA90
Heads per surface	1	Same as RA90
Data tracks	34,437	40,287
Logical cylinders	2656	3101
User logical cylinders	2649	3099
Number of sectors	69 + 1 spare	73 + 1 spare
Number of logical blocks	2,376,153	2,942,849
Seek Times		
One cylinder	5.5 milliseconds	3.0 milliseconds
Average seek	18.5 milliseconds	16.0 milliseconds
Full cylinder seek	31.5 milliseconds	29.0 milliseconds
Latency		
Rotation speed	3600 r/min	3405 r/min
Average latency	8.33 milliseconds	8.81 milliseconds
Maximum latency	16.67 milliseconds	17.62 milliseconds
Single Start/Stop Time		
Start (maximum)	40 seconds	Same as RA90
Inhibit between stop and restart	40 seconds	Same as RA90
Data Rates		
Transfer rate	2.77 megabytes/sec	Same as RA90

Table 1-1 (Cont.) Specifications for RA90 and RA92 Disk Drives

Characteristic	RA90 Disk Drive	RA92 Disk Drive
Physical Characteristics		
Height	26.56 cm (10.42 inches)	Same as RA90
Width	22.19 cm (8.74 inches)	Same as RA90
Depth	68.47 cm (26.96 inches)	Same as RA90
Weight	31.8 kg (70 pounds)	Same as RA90
Inrush Current		
120 Vac	60 amperes peak @ 132 Vac	Same as RA90
220-240 Vac	70 amperes peak @ 264 Vac	Same as RA90
Running current for:		
120 Vac	4.6 amps	Same as RA90
220-240 Vac	2.4 amps	Same as RA90
Power factor:		
120 Vac	0.7	Same as RA90
220-240 Vac	0.58	Same as RA90
Line cord length (from the cabinet)	2.74 meters (9 feet)	Same as RA90

Table 1-2 contains additional electrical specifications by model for the RA90 and RA92 disk drives.

NOTE

The RA90 and RA92 disk drives are not line-frequency dependent.

Table 1-2 Additional Electrical Specifications by Model for RA90 and RA92 Disk Drives

Model	Nominal Voltage	Input Current (Amps) ¹			Power Dissipation	BTUs/Hour [Kj/Hour] ²
		Start-Up Current	PH1	Neutral		
RA90-xx/RA92-xx	120 volts	5.0	3.4	3.4	281 Watts	960
RA90-xx/RA92-xx	240 volts	2.35	1.45	1.45	271 Watts	[976]

¹Currents are for nominal voltages of 120 VAC phase to neutral or for 240 VAC phase to neutral. For 101 VAC and 220 VAC nominal voltages, the drives will have proportionately higher phase currents by a ratio of 120/101 or 240/220 to the currents specified in this table.

²Bracketed figures indicate kilojoules per hour.

Table 1-3 shows the maximum environmental limits and the recommended environmental ranges to optimize equipment performance and reliability.

Table 1-3 RA90/RA92 Environmental Limits

RA90/RA92 Disk Drive	
Maximum Environmental Limits	
Temperature (Required)	
Operating	10°C to 40°C (50°F to 104°F) with a temperature gradient of 20°C/hour (36°F/hour)
Nonoperating	-40°C to +60°C (-40°F to +140°F)
Relative humidity	
Operating	10% to 90% (noncondensing) with a minimum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36° F)
Nonoperating	10% to 90% with no condensation
Recommended Environmental Operating Ranges	
Temperature	18°C to 24°C (64.4°F to 75.2°F) with an average rate of change of 3°C/hour maximum and a step change of 3°C or less
Relative humidity	40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Air quality (maximum particle count)	Not to exceed 500,000 particles per cubic foot of air at a size of 0.5 micron or larger
Air volume (at inlet)	50 cubic feet per minute (.026 cubic meters per second)
Altitude	
Operating	Sea level to 2400 meters (8000 feet); maximum allowable operating temperatures are reduced by a factor of 1.8°C/1000 meters (1°F/1000 feet) for operation above sea level
Nonoperating	300 meters (1000 feet) below sea level to 7500 meters (16,000 feet) above sea level (actual or effective by means of cabin pressurization)

2

Installation

2.1 Introduction

This chapter describes site preparation and planning considerations and procedures for unpacking the RA90 and RA92 disk drives. Cabling, safety precautions, and voltage selection are also discussed.

2.2 Site Preparation and Planning

Site preparation and planning are necessary before installing an RA90 or RA92 disk drive or subsystem. Prior to installation, consider the following:

- **Power Requirements:** The RA90 and RA92 disk drives use a single-phase power supply; however, operating voltages are supplied through an 881, 874, H405, or other applicable (system-specific) power controller.
- **Thermal Stabilization:** Thermal stabilization prevents temperature differences between the equipment and its environment from damaging disk drive components. Equipment must be placed in its operating environment at least 24 hours prior to operation.

CAUTION

The thermal stabilization procedure is mandatory. Failure to thermally stabilize the equipment may cause premature equipment failure.

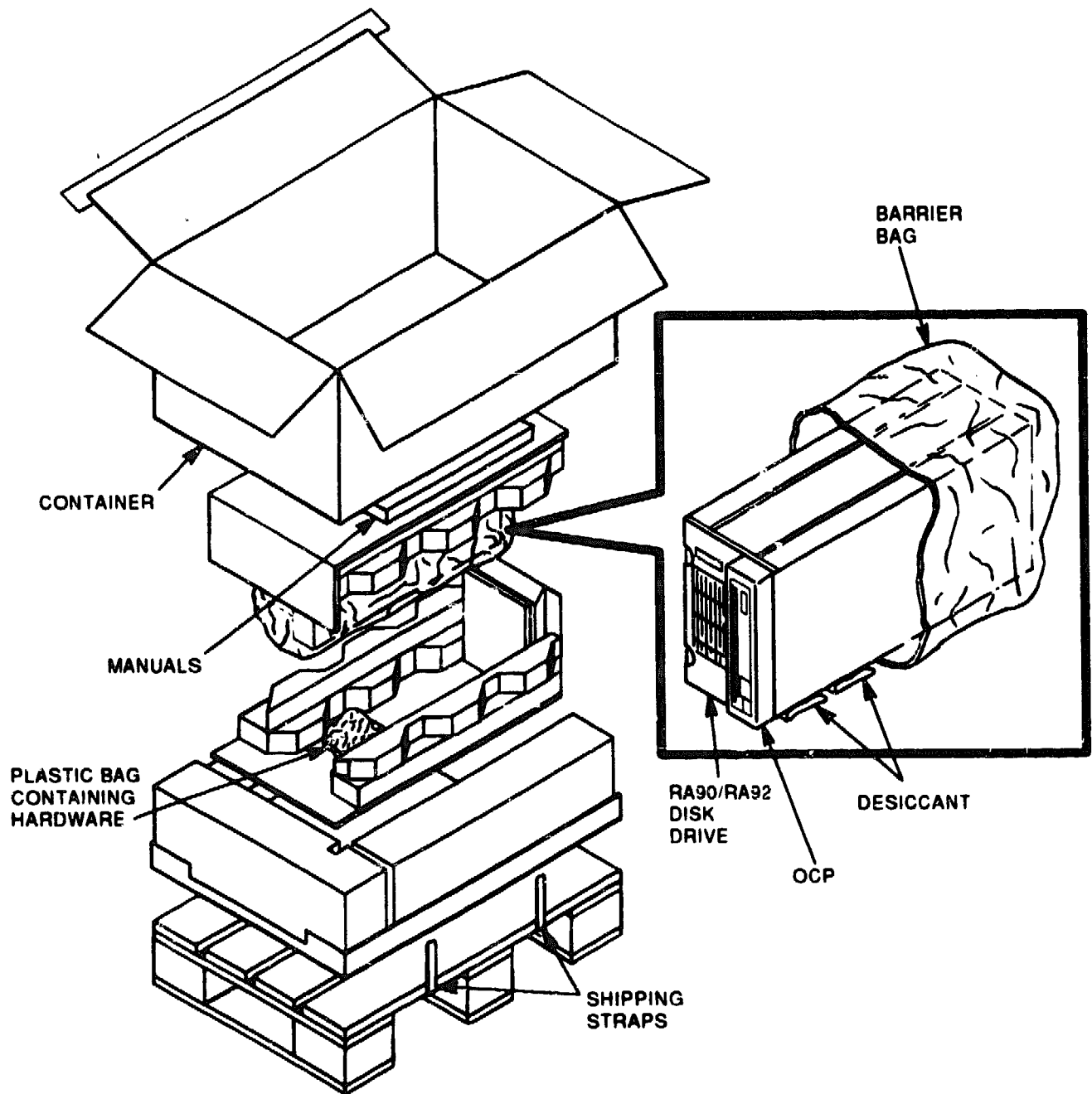
- **Environment:** The RA90 and RA92 disk drives must be operated in an environment where the ambient air particle count does not exceed 500,000 particles (larger than 0.5 micron) per cubic foot of air. (Refer to Chapter 1 for additional environmental specifications.)
- **Floor Loading:** Consider placement and calculate the total weight of your subsystem. An RA90 or RA92 disk drive weighs approximately 31.8 kilograms (70 pounds).
- **Operating Temperature and Humidity:** The required relative humidity range is between 10 percent and 90 percent, with a minimum wet bulb temperature of 28°C (82°F) and a minimum dew point of 2°C (36°F) (noncondensing) with a step change of 10 percent or less.

The RA90 and RA92 disk drives can be operated in temperatures ranging from 10°C to 40°C (50°F to 104°F). However, it is recommended that the RA90 and RA92 be operated in a temperature below 25°C (77°F) to increase reliability and extend product life.

2.3 Unpacking RA90 and RA92 Add-On Disk Drives

Check packaging for external damage. Read and save any packing information. Unpack the RA90 or RA92 disk drive using the following procedure (refer to Figure 2-1):

1. Cut and remove the shipping straps.
2. Open the shipping container.



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Figure 2-1 RA90/RA92 Disk Drive Packaging

3. Remove and save all packing material surrounding the disk drive.
4. Lift the disk drive from the shipping container.

WARNING

RA90 and RA92 disk drives weigh approximately 31.8 kilograms (70 pounds) each and must be handled with care.

Do not use the cardboard handles to lift the disk drive from the shipping container. Injury to personnel or damage to equipment could result if the cardboard handles are used for this purpose.

5. Once the **mandatory** thermal stabilization period has elapsed, remove the barrier bag and desiccant surrounding the disk drive.

CAUTION

The thermal stabilization procedure is mandatory. Failure to thermally stabilize the equipment may cause premature equipment failure.

2.4 Installing SDI Cables and Power Cords

This section is intended as a reference only. For detailed procedures and illustrations, refer to subsystem-specific documentation.

Most fully configured cabinets have internal SDI cables and power cords in place. Internal SDI cables are connected to the rear I/O bulkhead located at the base of the cabinet.

Drive power cords are connected to the 881 (or system-specific model) power controller located behind the rear I/O bulkhead at the bottom of the cabinet. Figure 2-2 shows the 881 power controller, used with some RA90/RA92 disk drive storage array products, as viewed from the rear of the cabinet. Drive power cords are routed through the grommated cord opening in the front of the power controller, then plugged into the rear power receptacles of the power controller.

NOTE

A list of related documentation is contained in the front of this manual (refer to the preface, *About This Manual*). This list supplies titles and Digital part numbers of subsystem manuals that contain specific RA90 and RA92 disk drive system cabling and power cord information.

2.4.1 Installing Internal SDI Cables

Internal SDI cables are installed at the factory for all drive positions in most subsystem configurations. Refer to subsystem-specific documentation for details about internal SDI cable routing, connections, and availability.

2.4.2 Installing Internal Power Cords

Internal power cords are installed at the factory and connected to existing drives and the power controller for your system. Connect add-on drive power cords using the illustrations and procedures found in your system-specific documentation.

2.4.3 Installing External SDI Cables

When installing external SDI cables from the I/O bulkhead to the host, refer to system-specific documentation for procedures and illustrations of bulkhead port configurations. Many systems have an I/O port label adhered to the rear door/panel of the system.

2.5 Power and Safety Precautions

The RA90 and RA92 disk drives do not present any unusual fire or safety hazards. However, it is recommended that you check ac power wiring for the computer system to determine adequate capacity for expansion. To protect personnel and equipment, ensure power sources meet the specifications required for this equipment.

WARNING

Hazardous voltages are present inside the RA90 and RA92 disk drives. Installation and service must be performed by trained Digital Customer Services personnel. Bodily injury or equipment damage may result from incorrect servicing.

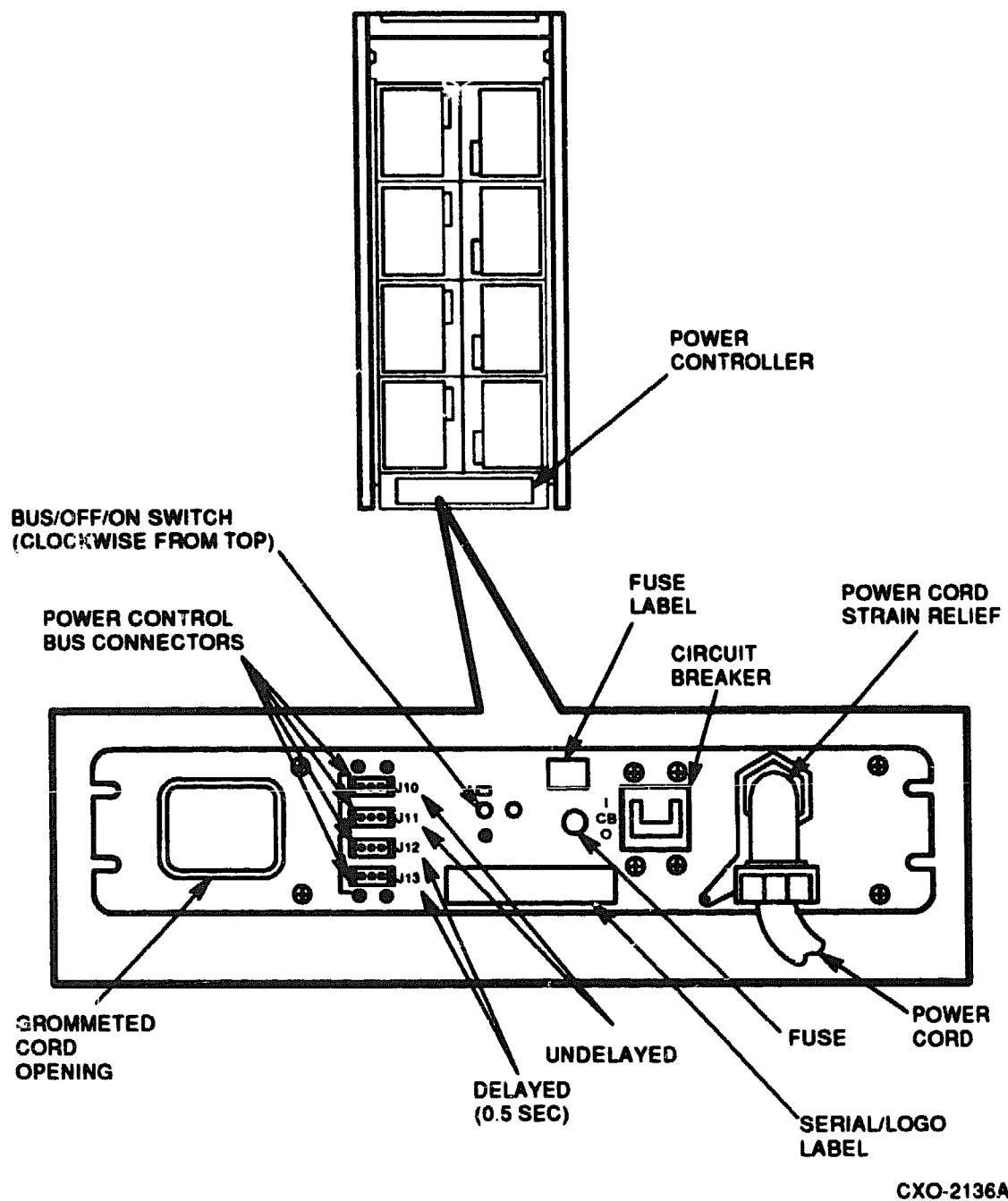


Figure 2-2 881 Power Controller (Example)

2.6 AC Power Wiring

Three-phase power must be present to support the installation of the 60-inch cabinet. The 40-inch cabinet requires single-phase power. Check system-specific documentation for the power requirements for your system.

The wiring used by Digital Equipment Corporation conforms to UL, CSA, and ISE standards. Figure 2-3 shows the ac plug configurations for RA90 and RA92 disk drives and the 881 and 874 power controllers.

NOTE

Do not apply power to the power controller until proper voltage has been selected.

2.7 Voltage Selection

Before applying power to the RA90 or RA92 disk drive, ensure the proper voltage has been selected for your area of operation. The voltage selector is a slide switch capable of selecting 120 volts or 240 volts. (The frequency 60 Hz or 50 Hz is universal.) To select the proper voltage, perform the following steps:

WARNING

Ensure that both the power controller and drive are operating at the same voltages and frequencies (120 Vac or 240 Vac).

1. Remove the subsystem cabinet rear access panel.
2. Verify the ac circuit breaker on the power control unit is off.
3. Verify the circuit breaker on each disk drive is off (0) (refer to Figure 2-4).
4. Locate the voltage selector switch (refer to Figure 2-5).
5. Using a non-conductive pointed object, slide the voltage selector switch into the position applicable to your site.
6. Ensure the drive power cord is plugged into the power controller.
7. Plug the ac power cord from the power controller into an external receptacle.
8. Switch on the ac circuit breaker on the power controller.
9. Switch on (1) the RA90 or RA92 drive circuit breaker (refer to Figure 2-4).

POWER CORDS GOING TO POWER CONTROLLER

120V 60HZ POWER CORD DEC NO A-PS-1700083-23 PLUG - POWER CONTROLLER END	
240V 50HZ POWER CORD DEC NO A-PS-1700083-24 PLUG - POWER CONTROLLER END	
120/240V 47-63HZ 10A/6A POWER CORD DEC NO A-PS-1700442-18 OR A-PS-1700442-19 PLUG - DRIVE END	

PLUGS GOING TO WALL OUTLET (FROM CONTROLLER)

40-INCH CABINET	120V 60HZ 24A 1-PHASE		NEMA NO L5-30P DEC NO 12-11193 (874-D)
	220/240V 50-60HZ 16A 1-PHASE		IEC 309 320-P6W DEC NO 12-14379-03 (874-F)
60-INCH CABINET	120/208V AC 60HZ 30A 3-PHASE WYE USED WITH 881-A AND 881-C POWER CONTROLLERS		5-WIRE NEMA NO L21-30P
	220-240/380-415V AC 50HZ 20A OR 16A 3-PHASE WYE USED WITH 881-B POWER CONTROLLER		5-WIRE, 4-POLE, IEC 309

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Figure 2-3 Electrical Plug Configurations

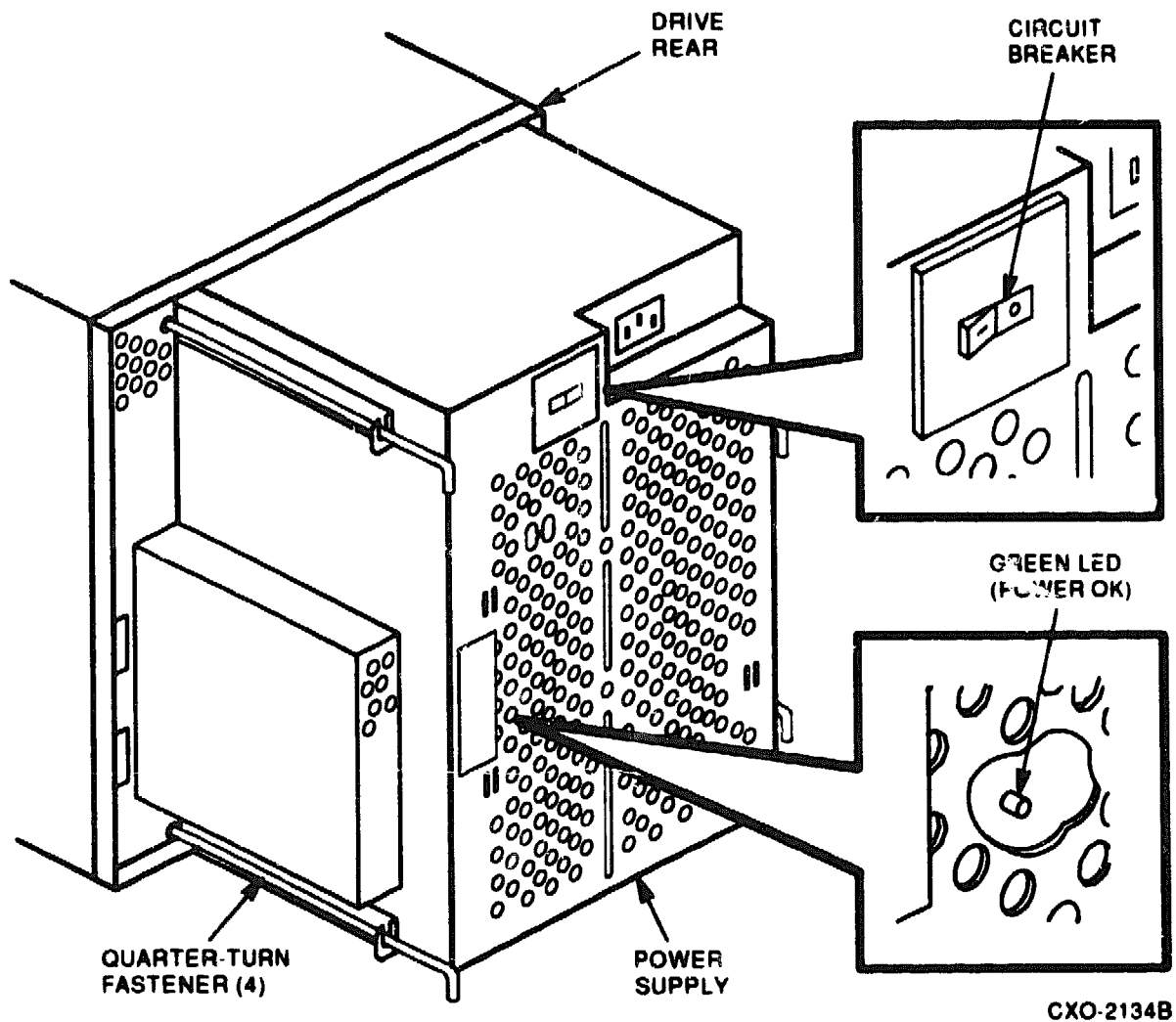
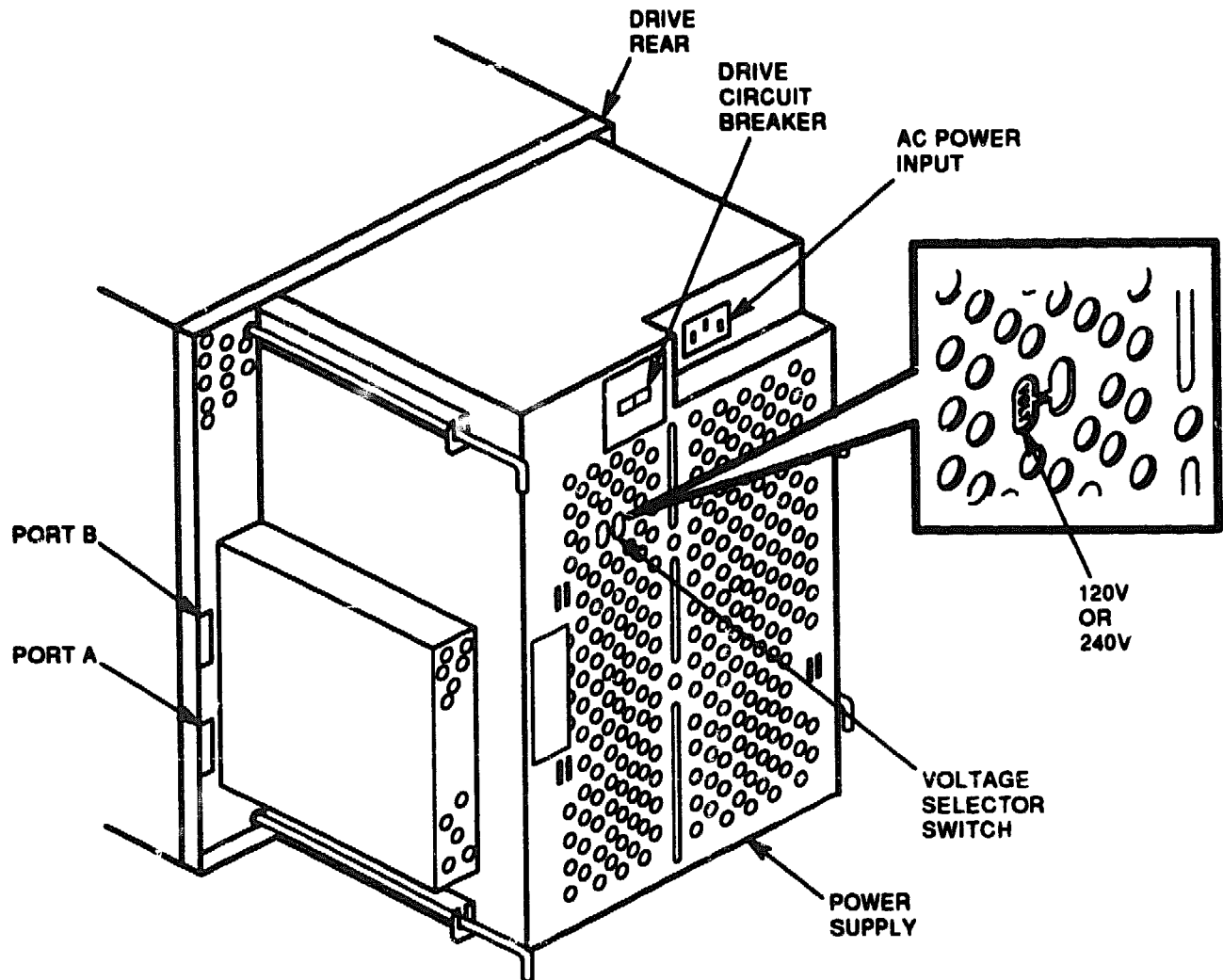


Figure 2-4 Drive Circuit Breaker Location



NOTE: VOLTAGE MARKINGS ON SOME POWER SUPPLIES READ 115/230V.

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Figure 2-5 Drive Voltage Selector Switch

3

Operating Instructions

3.1 Introduction

This chapter describes the operator control panel (OCP), drive-resident power-up diagnostics, acceptance tests, and RA90/RA92 disk drive operating modes. Functional flowcharts are included to aid the user when operating the RA90 or RA92 disk drive.

3.2 OCP Functions, Switches, and Indicators

The OCP is the interface to the RA90/RA92 disk drive. The OCP performs the following functions:

- Selects and displays the unit address number.
- Selects Run, Write Protect, Port A, and Port B.
- Displays faults and error codes.
- Selects tests in the test mode.
- Communicates with the RA90 or RA92 master processor.

These functions are executed using the following OCP switches and indicators (refer to Figure 3-1):

- Six input switches (Run, Fault, Write Protect, Port A, Port B, and Test)
- Seven LED indicators (Ready, Run, Fault, Write Protect, Port A, Port B, and Test)
- A four-character alphanumeric display

There are no physical in or out states for the OCP switches. Instead, the logical state of the switch is changed each time a switch is selected, similar to the way a calculator works.

The switch states are shown in the OCP display. The LED indicators show the state of the drive relative to the controller.

3.3 Power-Up Diagnostics

Do not select any OCP switches.

A sequence of drive-resident diagnostics run when power is applied to the drive. This sequence consists of hardcore tests and basic processor tests. Successful completion of these tests is indicated by a series of OCP displays, as follows:

1. Blank (1 second).
2. [WAIT] (16 seconds).
3. [0000] (If previously programmed, the drive unit number is displayed; otherwise, zeros are displayed.)

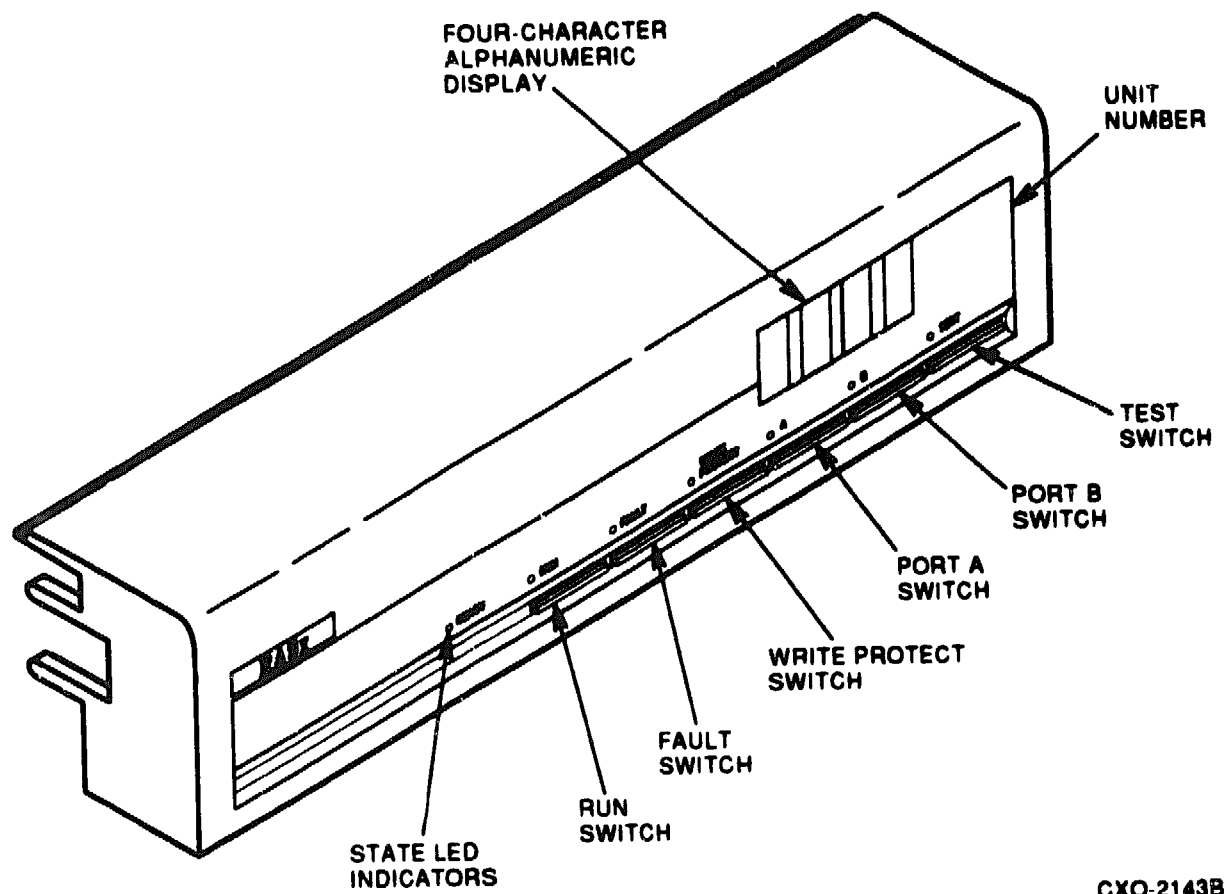


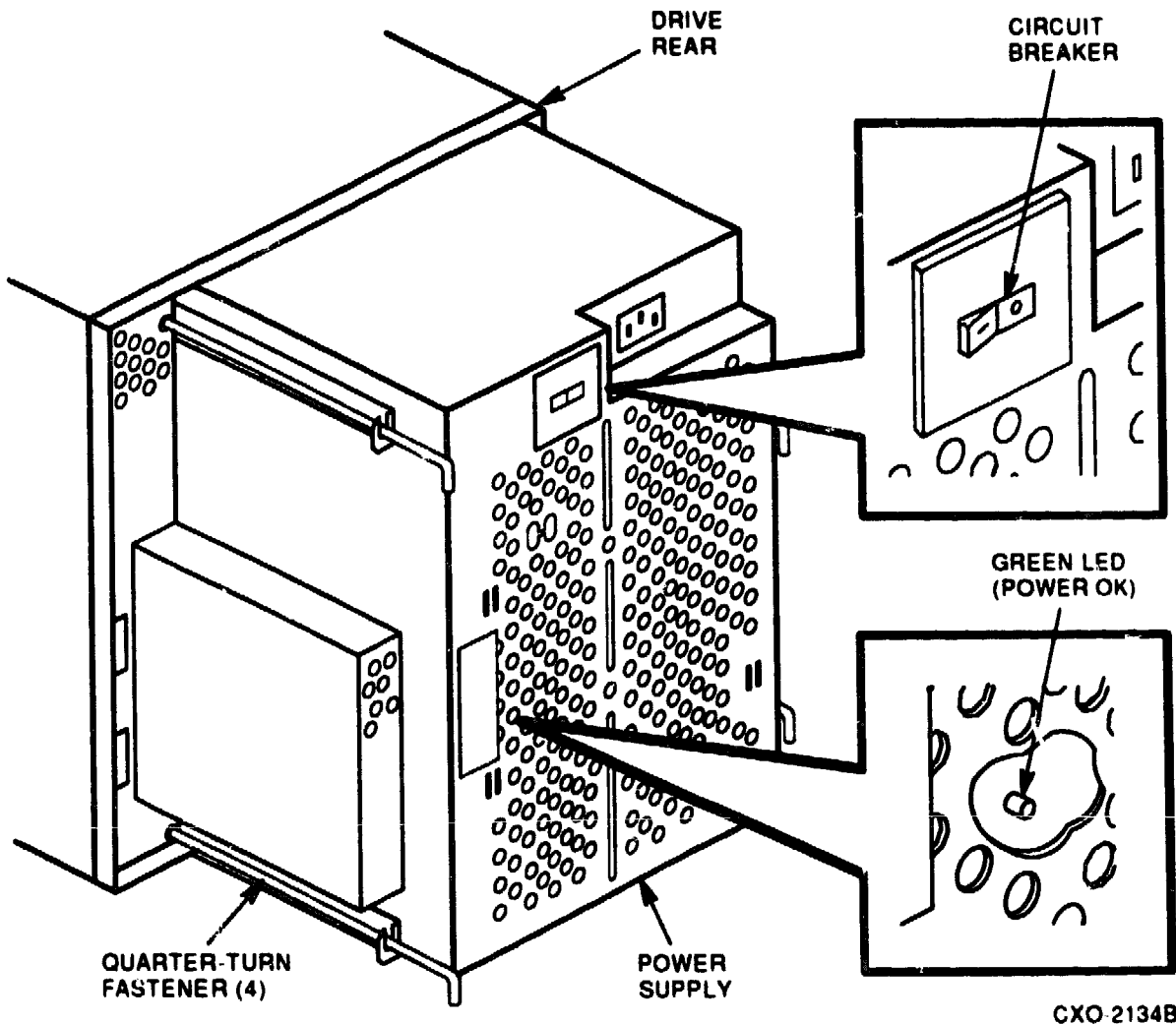
Figure 3-1 RA90/RA92 OCP

3.3.1 Problems at Power-Up

If a problem occurs during power-up, the Fault LED indicator should light. However, if any of the basic processor functions fail and no front panel activity occurs, perform the following steps:

1. Ensure the OCP is seated properly.
2. Check ac power at the outlet.
3. Ensure the green LED at the rear of the power supply is lit (refer to Figure 3-2).
4. Ensure the power supply is properly seated by checking the four quarter-turn fasteners at the rear of the power supply. They should be properly secured.
5. Ensure the drive power cord is properly seated at the rear of the supply, and at the power controller receptacle.
6. Ensure that all drive FRUs are properly seated.

If the previous actions do not reveal the source of the problem, contact your Digital Customer Services representative.



CXO 2134B

Figure 3-2 Power Supply Indicator

If the Fault LED indicator lights during power-up, enter the fault display mode to determine the cause of the problem. To enter the fault display mode, select the Fault switch on the OCP. The OCP then displays a three-character error code in the format [E 00], where 00 is a two-digit error code. Refer to Table 3-1 for a list of error codes and possible solutions.

Table 3-1 OCP Error Codes

Error	Description	Action
0F	Drive write protected	Disable write protection with the OCP Write Protect switch or turn off software write protection.
22	Drive over-temperature condition	Spin down and remove power from the drive. Ensure cabinet air vent grill is clean and room temperature is within recommended limits. Call Digital Customer Services if air vent grill or temperature has not caused an over-temperature condition.
2D	Power supply over-temperature condition	Spin down and remove power from the drive. Ensure cabinet air vent grill is clean and room temperature is within recommended limits. Call Digital Customer Services if air vent grill or temperature has not caused an over-temperature condition.
3A, 6F	Write protect error	Disable write protection with the OCP Write Protect switch or turn off software write protection.

NOTE

Error codes not found in Table 3-1 indicate problems beyond the scope of this manual. Call your Digital Customer Services representative. Report the displayed error code when requesting service.

3.4 Acceptance Testing

Do not select any OCP switches.

After the hardware diagnostics have run successfully, the drive automatically enters an idle-loop diagnostic test sequence. This test sequence is indicated by the front panel Test LED indicator lighting.

Allow the drive to remain spun down and in idle-loop testing for 5 minutes. If you select the Run switch during this time, the drive will not respond until it has finished its current idle-loop routine.

NOTE

If an error occurs during idle-loop testing, refer to Table 3-1 for possible solutions and operator actions. Error codes not found in Table 3-1 are beyond the scope of this manual. Call your Digital Customer Services representative. Report the displayed error code when requesting service.

3.4.1 Operator Control Panel Lamp Testing

Next, perform an OCP lamp test to ensure the LED indicators and alphanumeric display are functioning properly. Use the following procedure:

1. Select the Test switch. (The Test LED indicator lights.)
2. Select the Fault switch. (All lamps light momentarily.)
3. Deselect the Test switch.

3.4.2 Testing Spun-Down Drive

The next step in the acceptance test process requires running drive-resident diagnostics with the drive in a spun-down state. To invoke resident diagnostics while the drive is spun down:

1. Select the Test switch. (The Test LED indicator lights.)
2. Select the Write Protect switch. (The OCP displays [T 00].)
3. Select the Write Protect switch again, to start testing.

The drive is now running a sequence of resident diagnostics. A number of displays are seen during execution of the diagnostics. Refer to Figure 3-3 for an example of a normal test sequence.

DISPLAY =

T		0	1*
---	--	---	----

DISPLAY =

S		0	1
---	--	---	---

 (START)

DISPLAY =

C		0	1
---	--	---	---

 (COMPLETE)

DISPLAY =

S		0	2
---	--	---	---

* INDICATES FLASHING DISPLAY

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Figure 3-3 OCP Displays During Normal Testing

Allow drive diagnostics to complete before continuing acceptance testing. This will take about 2 minutes and terminate with a [T 00] display.

NOTE

If an error occurs, refer to Table 3-1 for possible solutions and operator actions. Error codes not found in Table 3-1 indicate problems beyond the scope of this manual. Contact your Digital Customer Services representative. Report the displayed error code when requesting service.

3.4.3 Testing Spun-Up Drive

To spin up the drive:

1. Deselect the Test switch. (The Test LED indicator extinguishes and the unit address (if programmed) is displayed.)
2. Select the Run switch. (An R appears in the OCP display, and the Run LED indicator lights.)

Allow the drive to reach the ready state, as indicated by the front panel Ready LED indicator.

The steps that follow invoke a sequence of resident diagnostic tests. These tests check drive functions in the following areas:

- Processor
- Servo bus

3-6 Operating Instructions

- Positioner
- Head select
- Read/Write circuitry
- Fault detection circuitry

To invoke resident diagnostics while the drive is spun up:

1. Select the Test switch. (Test LED indicator lights.)
2. Select the Write Protect switch. (The OCP displays [T 00].)
3. Select the Write Protect switch again, to start testing.

Allow the tests to run to completion (about 8 minutes). To halt testing:

1. Select the Port A or Port B switch.
2. Select the Test switch.

The drive exits the test mode and the OCP displays an R with the Ready and Run LED indicators illuminated. The drive can now be placed on line, assuming no problems have been encountered.

NOTE

If an error occurs, refer to Table 3-1 for possible solutions and operator actions. Error codes not found in Table 3-1 indicate problems beyond the scope of this manual. Contact your Digital Customer Services representative. Report the displayed error code when requesting service.

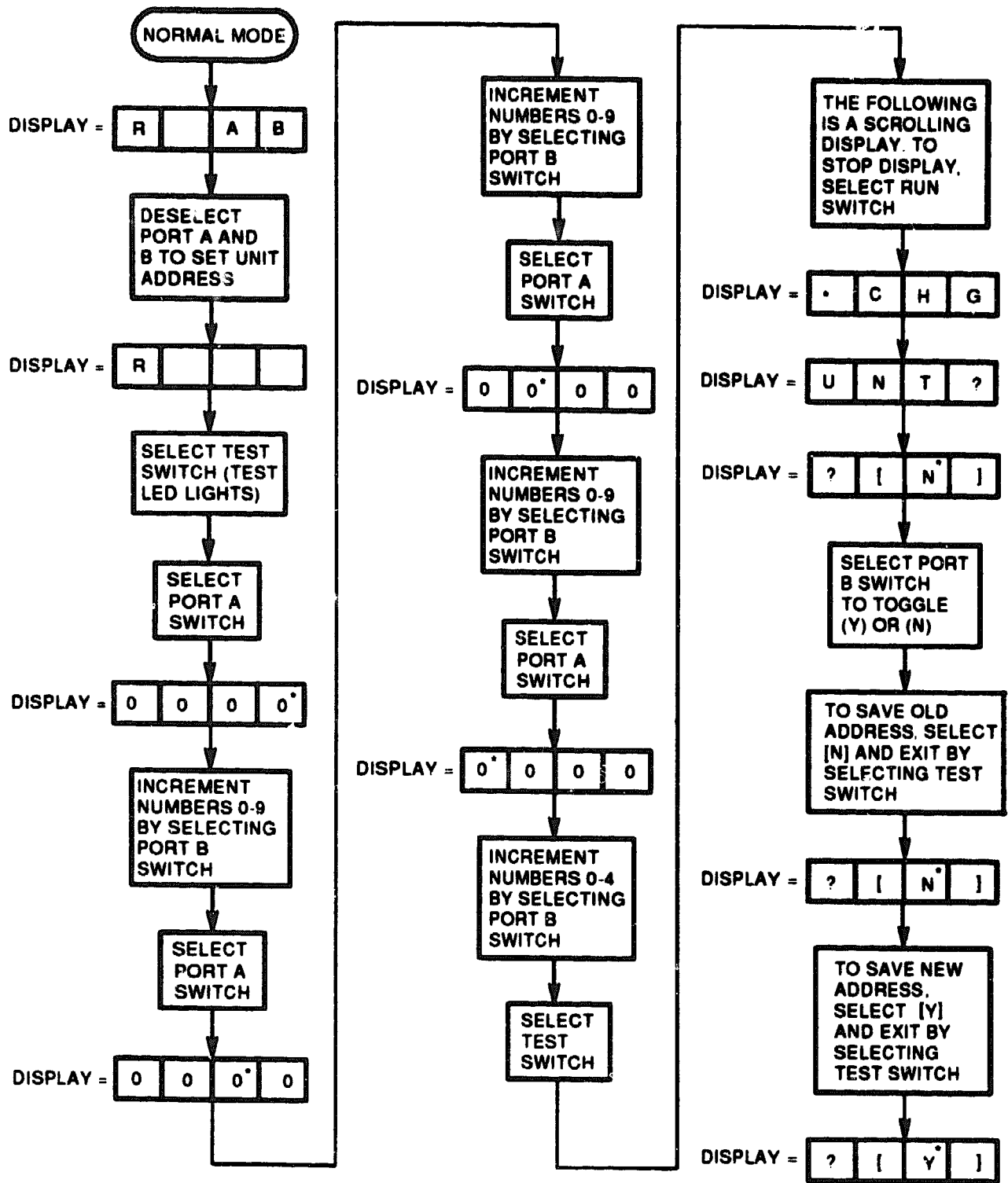
3.5 Programming the Drive Unit Address

The unit address can be set once power has been applied to the drive. You must set the drive unit address before placing the RA90 or RA92 disk drive on line.

The RA90 or RA92 unit address is programmable from 0 to 4094. (Remember that the operating system or subsystem type can limit the unit address range.)

Use the following procedure to set the drive unit address. Refer to Figure 3-4 for a flowchart of this procedure.

1. Select the Test switch. (The Test LED indicator lights and a unit address (if previously programmed) is displayed; otherwise, zeros are displayed.)
2. Select the Port A switch for the ones position. (Position zero blinks.)
3. Select the Port B switch. (Position zero increments 1 through 9 every time Port B is selected.)
4. Select the Port A switch for the tens position. (Position one blinks.)
5. Select the Port B switch. (Position one increments 1 through 9 every time Port B is selected.)
6. Select the Port A switch for the hundreds position. (Position two blinks.)
7. Select the Port B switch. (Position two increments 1 through 9 every time Port B is selected.)
8. Select the Port A switch for the thousands position. (Position three blinks.)
9. Select the Port B switch. (Position three increments 1 through 4 every time Port B is selected.)
10. Select the Test switch to exit.



* INDICATES FLASHING READOUT

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Figure 3-4 Unit Address Programming Flowchart

At this point, the OCP prompts you to verify that you want to change the unit address. The following prompt scrolls through the OCP display:

CHG UNT # (? [N])

- If you do not want to change the unit address, select the Test switch a second time. The drive returns to normal mode.
- To change the unit address:
 1. Toggle the Port B switch. (The OCP displays (? [Y]).)
 2. Select the Test switch.

The old unit address is overwritten with the new address. The new unit address is displayed in the OCP.

NOTE

The new unit address is written to EEPROM and is not lost if the drive loses power.

3.5.1 Alternate Unit Address Display Mode

Future RA90 and RA92 disk drives will incorporate a microcode enhancement that will provide an alternate unit address display mode. To display the unit address, refer to Figure 3-5 while performing the following procedure:

1. The OCP display shows an **R**, **A**, and/or **B**.
2. While in normal mode, select the Port A and/or Port B switch.
3. Select the Test switch. At this point, the Run, Fault, Write Protect, Port A, and Port B switches are disabled.
4. The unit address is displayed until:
 - The Test switch is deselected.
 - Power is cycled.
 - An SDI HARD INIT occurs, or the drive forces a hard initialization due to a fatal error.

Any of these conditions will clear the OCP from the alternate display mode.

3.6 RA90/RA92 Operating Modes

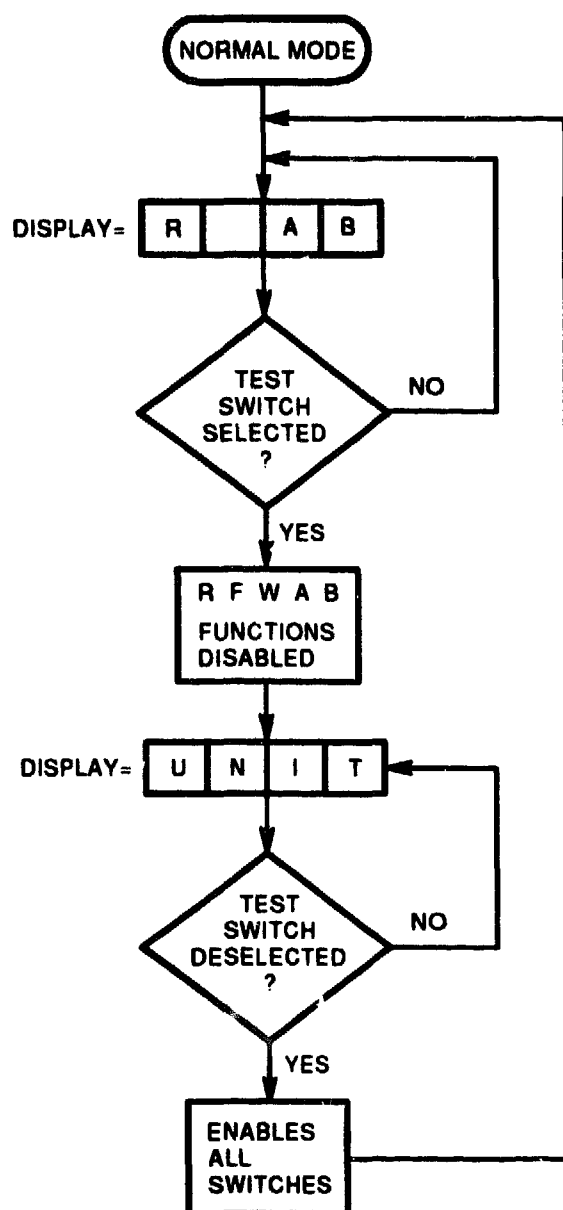
The RA90 and RA92 disk drives operate in three set-up modes: normal, fault display, and test. The following sections describe the functions of each mode.

3.6.1 Normal Mode Setup

The normal mode setup is the usual operating mode of the RA90 and RA92 disk drives. Switch selection during normal operation usually consists of the Run switch, Write Protect switch (for normal write protection), and Port A or B switches. No Fault or Test LED indicators are lit.

During normal operations:

- Selecting the Run switch causes an **R** to appear in the OCP display and causes the drive to spin up. Additionally, the Run LED indicator lights. The Ready LED indicator lights once the drive is up to speed.



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Figure 3-5 Alternate Unit Address Display Mode Flowchart

- Selecting the Port A or Port B switch causes an A or B to appear in the OCP display and logically makes the drive available to the controller.
- Selecting the Write Protect switch logically write protects the drive and lights the Write Protect LED indicator.
- Selecting the Fault switch:
 - (Without a fault indication) causes a 2-second OCP lamp test.
 - (With a fault indication) causes an error code to display. Selecting the Fault switch a second time (with a fault indication) clears the fault.

- **Selecting the Test switch:**
 - (With the Port A or Port B switch selected) causes a 2-second display of the unit address. (Refer to Section 3.5.1 for information on the alternate unit address display mode.)
 - (Without the Port A or Port B switch selected) causes the drive to enter the test mode.

3.6.2 Fault Display Mode Setup

To enter the fault display mode, select the Fault switch. The fault display mode can only be entered if the Fault LED indicator is lit; otherwise, selecting the Fault switch causes a 2-second OCP lamp test.

An error code is displayed in the format shown in Figure 3-6. To exit the fault display mode and clear the fault, select the Fault switch a second time.

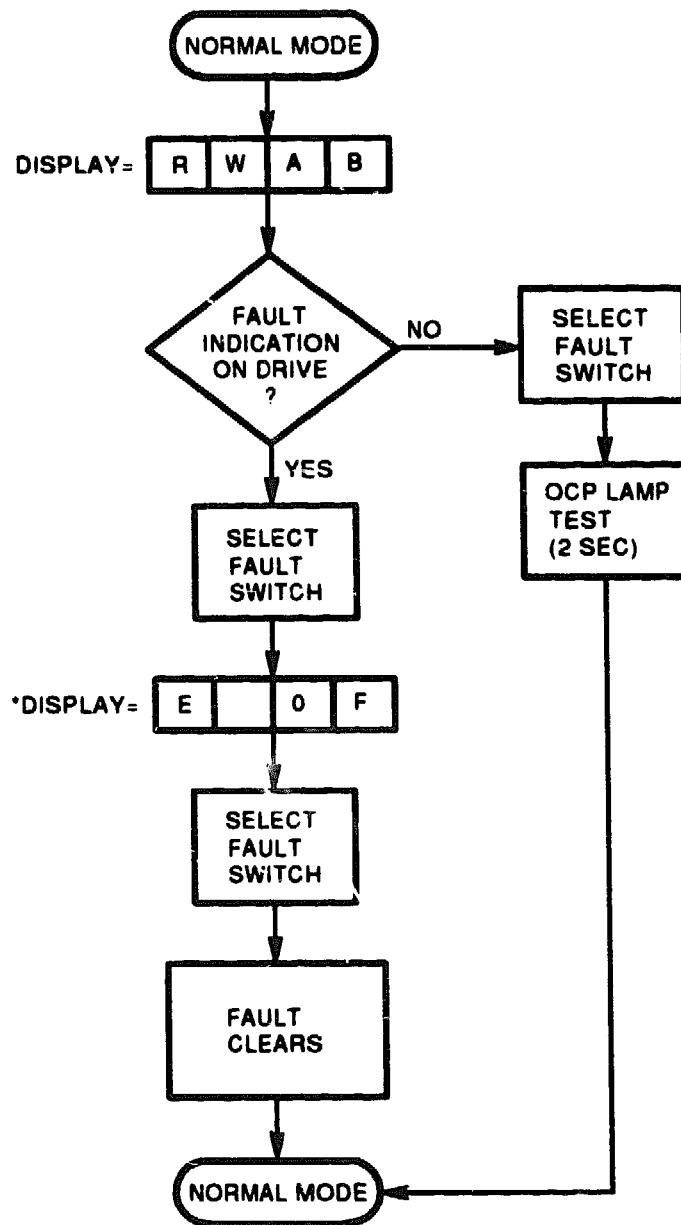
NOTE

Hard faults will not clear. If a hard fault occurs, note the error code and contact Digital Customer Services.



Figure 3-6 Fault Display Example

Refer to Figure 3-7 for a fault display mode flowchart.



*NOTE: ANY COMBINATION OF LEGAL ALPHANUMERIC ERROR CODES (HEX)

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Figure 3-7 Fault Mode Flowchart

3.6.3 Test Mode Setup

You must enter the test mode to set the RA90 or RA92 unit address or to run resident diagnostic tests. In this mode, Port A and Port B switches have the function of selecting both the unit address numbers and test numbers. In addition, the port switches are used to abort running diagnostics. The Write Protect switch starts the tests and the Port A or Port B switches stop selected tests.

The test mode is characterized by three displays. Figure 3-8 shows an OCP after test selection is made. Figure 3-9 shows a display while the test is running.

DISPLAY =

T		0	1*
---	--	---	----

* INDICATES FLASHING DISPLAY
CXO-2192A

Figure 3-8 RA90/RA92 Test Display

DISPLAY =

T		0	1*
---	--	---	----

DISPLAY =

S		0	1
---	--	---	---

 (START)

DISPLAY =

C		0	1
---	--	---	---

 (COMPLETE)

DISPLAY =

T		0	1*
---	--	---	----

* INDICATES FLASHING DISPLAY
CXO-2137A

Figure 3-9 Running Test OCP Display

4

Diagnostics

4.1 General Information

This chapter contains general information concerning drive-resident diagnostics and acceptance testing procedures.

4.2 Drive-Resident Diagnostics

Drive-resident diagnostics are invoked under four conditions:

- Power-up or master processor reset
- External init (SDI command)
- Operator control panel (OCP) test mode selection
- Functional firmware sequences (idle loop)

Drive-resident diagnostics test three hardware areas. These areas are:

- Hardcore (CPU, ROM, RAM, SCI, and timer)
- Logic (processor board, servo board, and PCM board)
- Functional (guardband detect, seek/timing, and read/write)

4.2.1 Power-Up Resident Diagnostics

The drive-resident diagnostics that run at power-up or master processor reset run without manual intervention in the following order:

- Master CPU test
- Master ROM test
- Master RAM test
- Master timer test
- Servo data bus loopback test
- Head select test

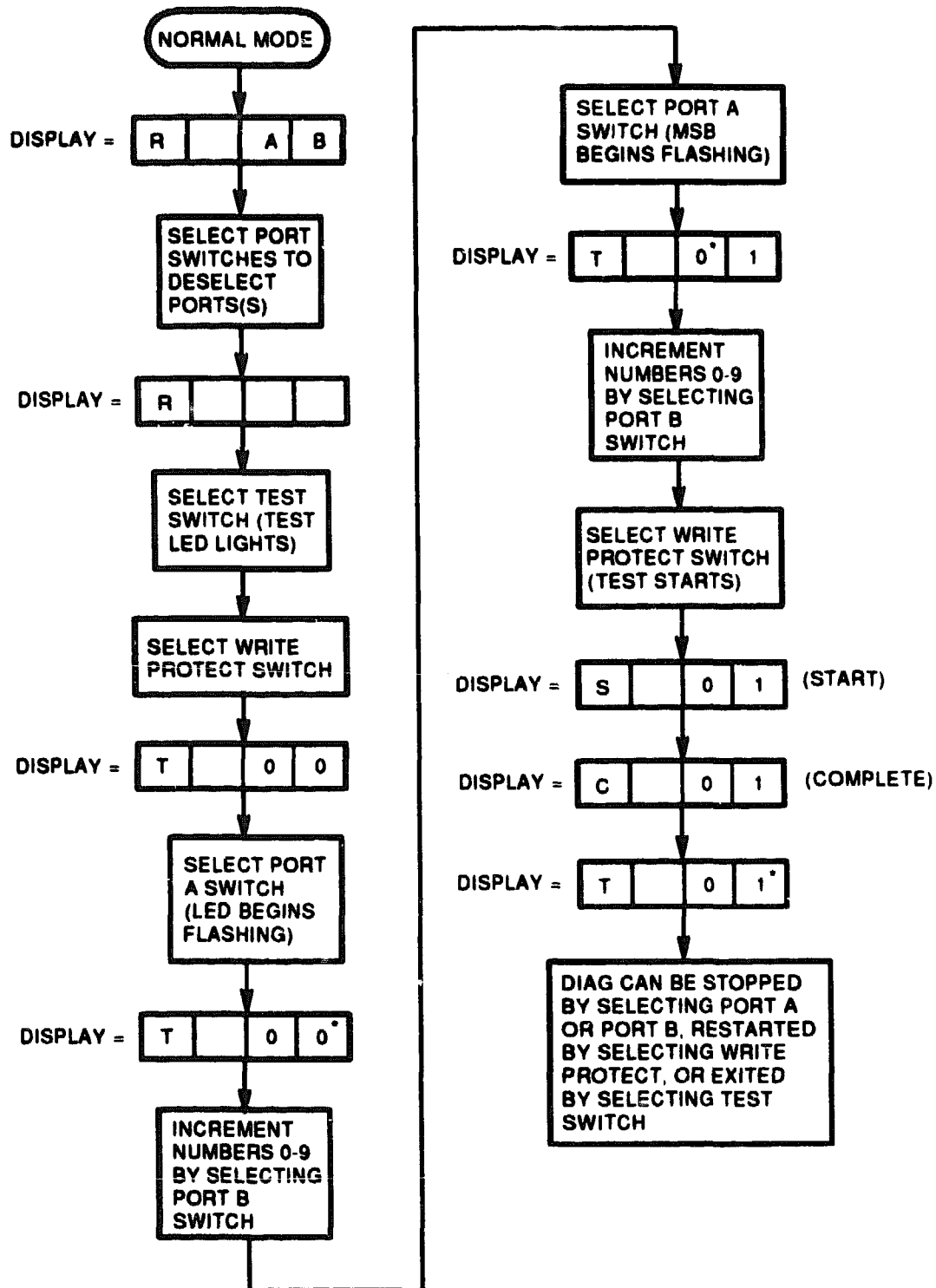
4.3 Test Selection from the OCP

Use the following procedure to select and run resident diagnostics from the OCP (refer to Figure 4-1):

1. Select the Test switch. (Test defaults to zero.)
2. Select the Write Protect switch to initiate resident diagnostics.
3. Select the diagnostic using Port A and Port B switches (refer to Figure 4-1).
4. Start the test by selecting the Write Protect switch.
5. Stop the test by selecting the Port A or Port B switch.
6. Restart the test by selecting the Write Protect switch again.
7. Select the Test switch to exit the test mode.

Run the resident diagnostics from the OCP in the following order:

1. Test T 00: Drive spun down.
2. Test T 00: Drive spun up.



* INDICATES FLASHING READOUT

CXO-2139B

Figure 4-1 Test Selection Flowchart

A

Customer Equipment Maintenance

This appendix will assist customers in maintaining their equipment to ensure the highest level of equipment performance and reliability. Specifically, this appendix addresses the maintenance of SA6xx/SA8xx storage array cabinet systems.

A.1 Customer Responsibilities

The customer is directly responsible for:

- Supplying accessories, including storage racks, cabinetry, tables and chairs, as required.
- Making the appropriate documentation available in a location convenient to the system.
- Obtaining cleaning supplies specified in this appendix.
- Performing the specific equipment maintenance described in this appendix.

A.1.1 Cleaning Supplies

To properly maintain the equipment, the customer must acquire the following items and supplies:

- Vacuum cleaner with flexible hose and nonmetallic, soft-bristle brush attachment
- Isopropyl alcohol (at least 91%) (Digital P/N 29-19665)
- Lint-free tissues or cloths
- All-purpose spray cleaner

CAUTION

When using spray cleaner, do not spray cleaner directly into computer equipment. This could adversely affect equipment reliability or damage electrical components.

A.1.2 Ongoing Equipment Care

The following should be performed on an ongoing basis:

- Keep the immediate area in front of the storage array cabinets free of obstructions.
- Keep the exterior of the cabinets and the surrounding area clean. Use a lint-free cloth and isopropyl alcohol to remove sticky residue left on painted surfaces by customer cabinet number labels, and so forth.
- Maintain the site temperature/humidity to comply with Digital's recommended environmental range (reference product-specific documentation). This will ensure the highest product reliability and product life goals are achieved.

A.1.3 Monthly Equipment Maintenance

The following tasks should be performed on a monthly basis, or more often if environment warrants:

CAUTION

Avoid touching the operator control panel switches during cleaning operations. The state of the drives could change and affect the operation of the subsystem.

- Vacuum and/or wipe top of storage array cabinet with a lint-free cloth.
- With a soft-bristle brush attachment, vacuum the air vent grill on the front door of the storage array cabinet. Leave the front door assembly attached to the storage array cabinet while vacuuming.

A.1.4 Maintenance Records

Digital suggests the customer keep an accurate log of all equipment maintenance. A maintenance log form for SA6xx/SA8xx storage array cabinets is included in this appendix for customer use. This form may be reproduced and inserted in the customer's site management guide for record-keeping purposes.

[illegible]

[illegible][illegible]

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