

# **RAID Array 110 Subsystem**

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## **User's Guide**

Order Number: EK-SM2CA-UG. B01

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First Edition, July 1993

Revised, August 1994

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# Contents

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<b>Revision Record</b> .....	ix
------------------------------	----

<b>About This Manual</b> .....	xi
--------------------------------	----

## **1 Product Description**

1.1	Subsystem Overview.....	1-1
1.2	Subsystem Features.....	1-2
1.2.1	Data Reliability.....	1-2
1.2.2	Redundancy .....	1-3
1.2.3	Data Availability.....	1-3
1.2.4	Performance.....	1-3
1.2.5	RAID Overview.....	1-3
1.2.6	Flexibility and Capacity .....	1-4
1.3	Subsystem Component Descriptions .....	1-4
1.3.1	System Building Blocks.....	1-5
1.3.2	Blower Unit.....	1-6
1.3.3	Disk Array Controller and SCSI Interface Cable .....	1-6
1.3.3.1	Firmware .....	1-6
1.3.3.2	Software .....	1-6
1.3.4	Drive Expansion Unit .....	1-7

## **2 Installing a Five-Drive Base Subsystem**

2.1	Installation Procedure.....	2-1
2.1.1	Unpacking and Inspection.....	2-1
2.1.2	HSZ10-AA Controller SCSI ID.....	2-2
2.1.3	Connection to the Host Adapter .....	2-3
2.1.3.1	Connecting to an 8-Bit Differential Host Adapter (BN21K Cable).....	2-3
2.1.3.2	Connecting to a 16-bit Differential Host Adapter (BN21K Cable) .....	2-4
2.1.3.3	Connecting to an 8-Bit Single-Ended Host Adapter (BCO9D Cable) .....	2-5
2.1.4	Cable and Connector Checklist .....	2-6
2.1.5	Power On and Functional Verification Test.....	2-6

## **3 Installing a 10-To-15 Drive Expanded Subsystem**

3.1	Installation Procedure.....	3-1
3.1.1	Unpacking and Inspection.....	3-2
3.1.2	Connecting the Drive Expansion Unit to the Subsystem Base Unit .....	3-2
3.1.3	HSZ10-AA Controller SCSI ID .....	3-5
3.1.4	Connection to the Host Adapter .....	3-5
3.1.4.1	Connecting to an 8-bit Differential Host Adapter (BN21K Cable).....	3-5
3.1.4.2	Connecting to a 16-bit Differential Host Adapter (BN21K Cable).....	3-7

3.1.4.3	Connecting to an 8-Bit Single-Ended Host Adapter (BCO9D Cable) .....	3-8
3.1.5	Cable and Connector Checklist.....	3-9
3.1.6	Power On and Functional Verification Test .....	3-9
<b>4</b>	<b>Installing a 20-To-30 Drive Expanded Subsystem</b>	
4.1	Installation Procedure .....	4-1
4.1.1	Unpacking and Inspection .....	4-2
4.1.2	Connecting the Drive Expansion Units to the Subsystem Base Unit .....	4-2
4.1.3	HSZ10-AA Controller SCSI ID.....	4-5
4.1.4	Connection to the Host Adapter.....	4-5
4.1.4.1	Connecting to an 8-Bit Differential Host Adapter (BN21K Cable).....	4-5
4.1.4.2	Connecting to a 16-bit Differential Host Adapter (BN21K Cable) .....	4-7
4.1.4.3	Connecting to an 8-Bit Single-Ended Host Adapter (BCO9D Cable) .....	4-8
4.1.5	Cable and Connector Checklist.....	4-9
4.1.6	Power On and Functional Verification Test .....	4-9
<b>5</b>	<b>Expanding a 5-Drive Subsystem To 10/15 Drives</b>	
5.1	Verifying the Operation of the Subsystem Base Unit .....	5-1
5.2	Unpacking the Expansion Kit .....	5-2
5.3	Subsystem Base Unit Preparation .....	5-3
5.4	Drive Expansion Unit Preparation.....	5-6
5.5	SCSI Cable Installation .....	5-8
<b>6</b>	<b>Expanding a 10/15-Drive System To 20/30 Drives</b>	
6.1	Verifying the Operation of the 10-to-15 Drive Subsystem.....	6-1
6.2	Unpacking the Expansion Kit .....	6-2
6.3	Drive Expansion Unit Preparation.....	6-3
6.4	SCSI Cable Reconnection Procedure .....	6-7
<b>7</b>	<b>Expanding a 5-Drive System To 20/30 Drives</b>	
7.1	Verifying the Operation of the Subsystem Base Unit .....	7-1
7.2	Unpacking the Expansion Kit .....	7-2
7.3	Base Unit Preparation.....	7-2
7.4	Drive Expansion Unit Preparation.....	7-6
7.5	SCSI Cable Installation .....	7-8
<b>8</b>	<b>Operation and Troubleshooting</b>	
8.1	Subsystem Indicators .....	8-1
8.1.1	Monitoring through the HSZ10-AA Controller .....	8-1
8.1.1.1	LUN Status .....	8-2
8.1.1.2	Drive Status .....	8-3
8.1.2	Monitoring through the Subsystem Pedestal .....	8-4
8.2	User Monitoring Methods.....	8-4
8.2.1	Monitoring using the StorageWorks RAID Array 110 Utilities.....	8-4
8.2.2	Monitoring Operation using LED Indicators.....	8-5
8.2.2.1	HSZ10-AA Controller LED Indicators .....	8-5
8.2.2.2	Power Supply LEDs.....	8-7
8.2.2.3	Drive SBB LEDs.....	8-9
8.3	When and How to Replace a Drive .....	8-10

8.4	When and How to Replace Power Supplies and Blowers.....	8-11
8.4.1	Replacing a Shelf Power Supply .....	8-11
8.4.2	Replacing a Blower.....	8-12
8.5	Removing the HSZ10-AA Controller .....	8-13
8.6	Reconstruction .....	8-13
8.7	Parity Check/Repair .....	8-14
8.8	Upgrading HSZ10-AA Software .....	8-15
8.9	Error Handling/Troubleshooting.....	8-15
8.9.1	Before You Begin Troubleshooting.....	8-15
8.9.2	Troubleshooting Table .....	8-16

## 9 Illustrated Parts

### Appendix A Specifications

A.1	General Specifications.....	A-1
A.2	HSZ10-AA SCSI Disk Controller .....	A-1
A.3	Power Requirements .....	A-1
A.4	Physical .....	A-2
A.5	Environmental.....	A-2
A.6	Regulatory .....	A-2

### Appendix B HSZ10-AA Controller SCSI ID

### Appendix C HSZ10-AA Controller Software

C.1	HSZ10-AA Controller 3.06 Software Upgrade .....	C-1
C.1.1	Software Upgrade Procedure .....	C-1
C.1.2	MS-DOS, SCO UNIX, and NetWare™ Environments .....	C-1
C.1.3	OpenVMS VAX Environment .....	C-2
C.2	Virgin Drive Software Loading .....	C-2
C.2.1	MS-DOS, SCO UNIX, and NetWare Environments .....	C-2
C.2.2	OpenVMS VAX Environment .....	C-3

<b>Index</b> .....	Index-1
--------------------	---------

<b>Reader Comment Form</b> .....	Inside Back Cover
----------------------------------	-------------------

### Figures

1-1	StorageWorks RAID Array 110 Subsystem.....	1-1
1-2	Subsystem Base Unit Components .....	1-5
1-3	Drive Expansion Unit Components .....	1-7
2-1	Base Subsystem Terminator Locations and Drive Map.....	2-2
2-2	Connecting to an 8-Bit Differential Host Adapter (BN21K Cable).....	2-4
2-3	16-Bit Differential Host/Adapter Connection (BN21K Cable) .....	2-4
2-4	Removing a Bezel.....	2-5
2-5	8-Bit Single-Ended Host Adapter Connections (BCO9D Cable) .....	2-6
2-6	HSZ10-AA Controller LED Indicators .....	2-7
3-1	Subsystem Base Unit SCSI Connectors and Terminator/Jumper Locations.....	3-3

### Figures (Cont'd)

3-2	Expanded Subsystem SCSI Cable Connections.....	3-4
3-3	Expanded Subsystem Logical Drive Map.....	3-4
3-4	Removing a Bezel .....	3-6
3-5	Connecting to an Eight-Bit Differential Host Adapter (BN21K Cable).....	3-7
3-6	Sixteen-Bit Differential Host/Adapter Connection (BN21K Cable).....	3-7
3-7	8-Bit Single-Ended Host Adapter Connections (BCO9D Cable).....	3-8
3-8	HSZ10-AA Controller LED Indicators.....	3-10
4-1	Subsystem Base Unit SCSI Connectors and Jumper/Terminator Locations .....	4-3
4-2	Expanded Subsystem Cable Connections Jumper/Terminator Locations .....	4-4
4-3	Expanded Subsystem Logical Drive Map.....	4-4
4-4	Removing a Bezel .....	4-6
4-5	Connecting to an Eight-Bit Differential Host Adapter (BN21K Cable).....	4-7
4-6	Sixteen-Bit Differential Host/Adapter Connection (BN21K Cable).....	4-8
4-7	Eight-Bit Single-Ended Host Adapter Connections (BCO9D Cable) .....	4-9
4-8	HSZ10-AA Controller LED Indicators.....	4-10
5-1	Drive and Channel ID Designations.....	5-2
5-2	Removing a Bezel .....	5-3
5-3	Removing a Filler Panel and Sliding Tray from Base Unit.....	5-4
5-4	Removing A Blower.....	5-4
5-5	Terminator and Jumper.....	5-5
5-6	Subsystem Base Unit Terminator and Jumper Configurations .....	5-6
5-7	Removing a Disk Drive or a Blank Panel.....	5-6
5-8	Expansion Unit Jumper and Terminator Locations.....	5-7
5-9	Base/Expansion Unit Cable Connections .....	5-8
5-10	Expanded Subsystem Logical Drive Map (Rank 1).....	5-10
5-11	Expanded Subsystem Logical Drive Map (Ranks 1, 2, and 3).....	5-11
5-12	Expanded Subsystem SCSI Cable Routing .....	5-11
6-1	10/15-Drive and Channel/ID Designations.....	6-2
6-2	Removing a Bezel .....	6-3
6-3	Removing a Disk Drive or a Blank Panel.....	6-5
6-4	Removing A Blower.....	6-5
6-5	Drive Expansion Unit Jumper and Terminator Locations .....	6-6
6-6	Terminator and Jumper.....	6-6
6-7	Subsystem/Expansion Unit Cable Connections.....	6-7
6-8	Subsystem Logical Drive Map (Ranks 1 through 6).....	6-9
6-9	SCSI Cable Routing between the Base and Drive Expansion Units.....	6-10
7-1	Subsystem Base Unit Drive and Channel ID Designations .....	7-2
7-2	Removing a Bezel .....	7-3
7-3	Removing a Filler Panel and Sliding Tray from Subsystem Base Unit .....	7-4
7-4	Removing A Blower.....	7-5
7-5	StorageWorks Terminator and Jumper.....	7-5
7-6	Subsystem Base Unit StorageWorks Terminator and Jumper Configurations .....	7-6
7-7	Removing a Disk Drive or Blank Panel .....	7-7
7-8	Drive Expansion Unit Terminator/Jumper Locations.....	7-8
7-9	Subsystem Base/Drive Expansion Unit SCSI Cable Connections.....	7-9
7-10	20/30-Drive Subsystem Logical Drive Map (Ranks 1 through 6).....	7-10
7-11	Expanded Subsystem SCSI Cable Routing .....	7-11
8-1	LUN State Diagram.....	8-2

## Figures (Cont'd)

8-2	Controller LED Indicators .....	8-5
8-3	Power Supply Status LEDs .....	8-8
8-4	Drive Status LEDs .....	8-9
8-5	Replacing a Drive .....	8-11
8-6	Removing a Blower .....	8-12
9-1	Subsystem Base Unit, Field Replaceable Parts .....	9-1
9-2	Drive Expansion Unit, Field Replaceable Parts .....	9-3
B-1	Host and Subsystem SCSI IDs .....	B-1

**Tables**

1-1	Drive Number and RAID Level.....	1-4
1-2	Drives Supported by Subsystem.....	1-5
2-1	Base Unit Subsystem Components.....	2-2
3-1	Expanded Subsystem Components.....	3-2
4-1	Expanded Subsystem Components.....	4-2
5-1	Expansion Kit Components.....	5-2
6-1	Expansion Kit Components.....	6-2
7-1	20/30-Drive Expansion Kit Components .....	7-2
8-1	LUN Status .....	8-2
8-2	Drive Status .....	8-3
8-3	Summary of HSZ10-AA Controller LED Display .....	8-6
8-4	Pedestal and Single Power Supply (PS) Status LEDs .....	8-8
8-5	Pedestal and Dual-Power Supply (PS) Status LEDs.....	8-8
8-6	Drive SBB Status LEDs .....	8-9
8-7	Troubleshooting Subsystem Problems.....	8-17
9-1	Subsystem Base Unit Field Replaceable Parts .....	9-2
9-2	Subsystem Cables .....	9-2
9-3	Drive Expansion Unit, Field Replaceable Parts .....	9-3
B-1	Switchpack SW1 SCSI ID Switch Positions.....	B-2

## *Revision Record*

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*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.*

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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 StorageWorks RAID Array 110 Subsystem.

<b>Revision Level</b>	<b>Date</b>	<b>Summary of Changes</b>
EK-SM2CA-UG. A01	July 1993	Original release
EK-SM2CA-UG. B01	August 1994	Adds information needed to expand storage capacity of subsystem, and how to install HSZ10-AA controller software, release 3.06 (Appendix C).



# *About This Guide*

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

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## **StorageWorks RAID Array 110 Subsystem User's Guide**

This guide provides installation and maintenance information for the StorageWorks RAID Array 110 Subsystem.

### **Intended Audience**

This guide is intended for people who will install, operate, and maintain StorageWorks RAID Array 110 Subsystems.

#### **NOTE**

Installing the StorageWorks RAID Array 110 Subsystem requires a general understanding of SCSI devices and basic hardware installation procedures. Otherwise, contact your service representative for installation assistance. If you are unfamiliar with the components of the base subsystem, it is recommended that you review Section 1.3 before proceeding with the installation of your subsystem.

### **Document Structure**

This guide contains the following chapters:

#### **Chapter 1: Product Description**

**Product Description** gives an overview of the StorageWorks RAID Array 110 Subsystem, describes its components, and discusses the subsystem's features.

#### **Chapter 2: Installing a Five-Drive Base Subsystem**

**Installing a Five-Drive Base Subsystem** describes how to unpack the five-drive subsystem base unit and connect the unit to the host adapter. The chapter also discusses the HSZ10-AA controller SCSI ID and the subsystem initial power on and functional verification test.

### **Chapter 3: Installing a 10-to-15 Drive Expanded Subsystem**

**Installing a 10-to-15 Drive Expanded Subsystem** describes how to unpack the 10-to-15 drive expanded subsystem and connect the subsystem to the host adapter. The chapter also discusses the HSZ10-AA controller SCSI ID and the subsystem initial power on and functional verification test.

### **Chapter 4: Installing a 20-to-30 Drive Expanded Subsystem**

**Installing a 20-to-30 Drive Expanded Subsystem** describes how to unpack the 20-to-30 drive expanded subsystem and connect the subsystem to the host adapter. The chapter also discusses the HSZ10-AA controller SCSI ID and subsystem initial power on and functional verification test.

### **Chapter 5: Expanding a Five-Drive Base Unit to 10/15 Drives**

**Expanding a Five-Drive Base Unit to 10/15 Drives** describes how to expand a five-drive subsystem base unit to a storage capacity of 10 or 15 drives. It includes how shut down and disassemble the five-drive subsystem base unit, move and swap terminators and jumpers, install cables, relocate existing drives, and verify the proper operation of the expanded subsystem.

### **Chapter 6: Expanding a 10/15 Drive System to 20/ 30 Drives**

**Expanding a 10/15 Drive System to 20/ 30 Drives** describes how to expand a 10/15-drive subsystem to a storage capacity of 20 or 30 drives. It includes how shut down and disassemble the 10/15 subsystem, move and swap terminators and jumpers, install cables, relocate existing drives, and verify the proper operation of the expanded subsystem.

### **Chapter 7: Expanding a 5-Drive System to 20/ 30 Drives**

**Expanding a 5-Drive System to 20/ 30 Drives** describes how to expand a five-drive subsystem base unit to a storage capacity of 20 or 30 drives. It includes how shut down and disassemble the five-drive subsystem base unit, move and swap terminators and jumpers, install cables, relocate existing drives, and verify the proper operation of the expanded subsystem..

### **Chapter 8: Operation and Troubleshooting**

**Operation and Troubleshooting** describes subsystem LED indicators and how to use them to monitor subsystem operation, when and how to repair the subsystem components, replacement procedures, drive reconstruction, parity check/repair, and error handling/troubleshooting.

### **Chapter 9: Illustrated Parts List**

**Illustrated Parts List** shows exploded views of the subsystem base and drive expansion units with related tables which list the part numbers of the field replaceable units. It also lists subsystem cables and part numbers.

### **Appendix A: Specifications**

**Appendix A** describes the physical, environmental, and electrical specifications for the subsystem.

**Appendix B: HSZ10-AA Controller SCSI ID**

**Appendix B** describes how to set the SCSI ID of the HSZ10-AA controller in the subsystem.

**Appendix C: HSZ10-AA Controller Software**

**Appendix C** describes how to install the HSZ10-AA controller software, release 3.06. Installation procedures are included for both the MS-DOS™, SCO UNIX™, NetWare™ environments and the OpenVMS VAX environment.

**Conventions**

This guide uses the following conventions:

**Documentation Conventions**

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<b>Style</b>	<b>Meaning</b>
<b>boldface type</b>	<b>For emphasis</b>
<i>italic type</i>	<i>For emphasis and manual titles</i>

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## Product Description

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*This chapter contains an overview of the StorageWorks RAID Array 110 Subsystem. It discusses array and subsystem features, product attributes, and subsystem component descriptions.*

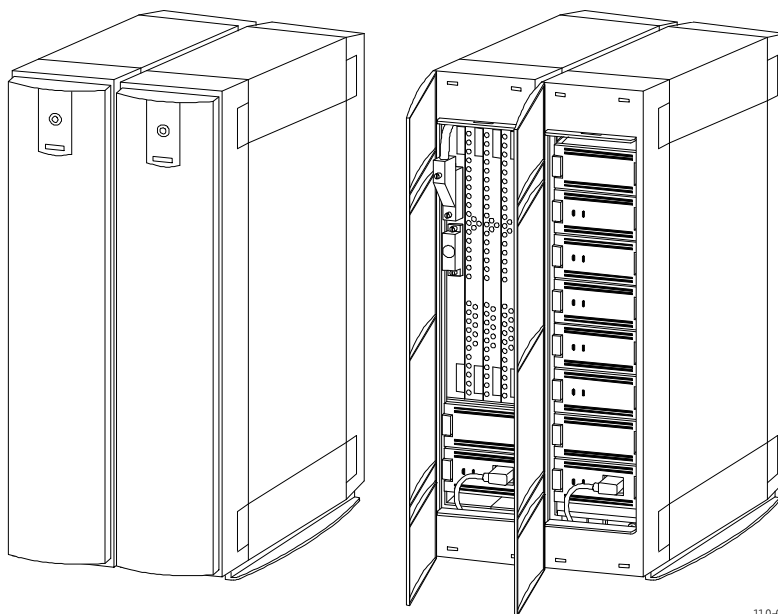
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### 1.1 Subsystem Overview

The StorageWorks RAID (Redundant Array of Independent Disks) Array 110 Subsystem is a desktside data storage subsystem that is modular, integrated, and offers the end-user a complete storage solution. It includes industry-standard 3.5-inch SCSI disk drives, a RAID SCSI controller, power and cooling, and cabling within a dual-pedestal enclosure. The subsystem is preconfigured for RAID 5, but also offers RAID 0, 1, 0+1, and 5 to meet specific application requirements.

The primary units of the subsystem consist of a base unit and a single pedestal SCSI drive expansion unit (Figure 1–1). The base unit is the core unit and the lowest storage capacity offering of the StorageWorks RAID Array 110 storage family. It contains the RAID controller electronics, five SCSI drives, and the SCSI cable to the host adapter.

**Figure 1–1. StorageWorks RAID Array 110 Subsystem**



The SCSI drive expansion unit is a single pedestal disk storage unit with a capacity of six drives and a redundant power supply. The two expansion units connect to the base unit to form an array configuration of 10 to 15 drives. Four expansion units connect to the base unit to form an array configuration of 20 to 30 drives.

## 1.2 Subsystem Features

The subsystem protects your data in two ways: RAID data redundancy ensures high availability at the drive level, and the subsystem's hot-swap capability ensures maximum up time at the subsystem level. The RAID array stores parity information on a redundant disk drive so that if any data drive in the array fails, your data can be regenerated from the parity information on the redundant drive.

The subsystem's hot-swap feature (meaning that the subsystem does not need to be powered down) allows you to replace a drive, power supply, or blower unit with no interruption to your application. The subsystem also self-monitors the status of disk drive, power supply, and blower components using fault light indicators.

The following is a list of major subsystem features:

- Supports up to 30 drives
- Parity generation/checking, reconstruction, and recovery with hardware assist
- Five SCSI drive channels
- Factory preconfigured for RAID 5
- Host interface: 8 or 16-bit differential and 8-bit single ended (with optional DWZZA-VA adapter)
- Fault and activity light indicators
- Modular configuration and upgrade paths

### 1.2.1 Data Reliability

Unlike a single SCSI disk drive, the StorageWorks RAID Array 110 Subsystem provides dependable data reliability in the event of a disk failure. With a SCSI disk drive, the user must power down the system to replace the drive and reconstruct the data through media backup. This results in some loss of data since backup of data is typically done at scheduled or infrequent intervals. Any activity that has occurred since that last backup is not saved. Data backup also results in critical system down time and a loss in productivity.

With RAID 1, 0+1, or 5 in a StorageWorks RAID Array 110 Subsystem configuration, there is no loss of data since redundant elements provide the capability of continuing I/O activity despite the loss of a drive and regeneration of data back onto the replaced drive. This means that data is updated up-to-the-second of a failure and throughout the regeneration process. In addition, your system remains up and operating without interruption.

### 1.2.2 Redundancy

The subsystem provides optional redundancy of the following components:

- Power supplies (optional)
- Disk drives (optional)
- Blowers

All these components are removable and replaceable without powering the subsystem down. These features contribute to making the subsystem fully redundant.

### 1.2.3 Data Availability

One of the key attributes of the subsystem is a high degree of data availability. The different RAID levels offer data protection at the drive level. In addition, the redundancy designed into the subsystem allows you to access data despite other component failures.

### 1.2.4 Performance

Performance of a disk array depends on the environment and the I/O workload. The following are general comments regarding array performance:

- An array of smaller capacity drives can perform better than a single, large capacity drive. Disk arrays may have some or all of three desirable properties compared to individual disks. They may:
  - 1) Improve *I/O performance* by balancing the I/O load evenly across the disks eliminating hot spots.
  - 2) Improve *data reliability* by replicating data so that it is not destroyed if the disk on which it is stored fails.
  - 3) Simplify *storage management* by treating storage capacity as a single manageable entity.

### 1.2.5 RAID Overview

- RAID 0 is the commonly used term that represents "disk striping." Although no redundant information is provided, data is distributed across the disks in the array which achieves high I/O rates by balancing the load across the drives.
- The RAID 1 or "disk mirroring" offers the highest degree of data reliability. All data is duplicated by striping segments across data drives and mirrored data drives in real time. If a drive fails in a RAID 1 array, you can continue to use the array normally since data from the mirrored drive is retrieved. This makes RAID 1 ideal for critical fault-tolerant transaction processing.
- RAID 0+1 is the combination of striping and mirroring and is achieved automatically in a multi-drive RAID 1 set. RAID 0+1 offers the best I/O performance of any type of RAID by combining the performance advantages of RAID 0 and RAID 1. It also provides data redundancy. Performance is equivalent to RAID 0, and cost is the same as RAID 1.

- RAID 5 combines striping (writing data across the set of drives) and storing parity across all drives. If a drive fails in a RAID 5 array, you can continue to use the array normally since the array controller automatically regenerates the data from the failed drive using data and parity blocks from other operational drives. All data remains accessible even when one drive fails. RAID 5 performs slightly better than a group of drives with read requests. However, write performance is slightly impacted due to the need to write parity information.

The choice of RAID level for logical RAID drives depends on the number of drives within a drive group. The following table lists the RAID levels for drive group and RAID level requirements.

**Table 1–1. Drive Number and RAID Level**

RAID Level	Drives in Drive Group	Usable Storage	Data Redundancy
0	1 through 10	All	No
1	2	50%	Yes
0 + 1	4 through 10	50%	Yes
5	3 through 5	66% - 80%	Yes

### 1.2.6 Flexibility and Capacity

There is significant flexibility to expand the subsystem to meet the changing requirements of any business. You can:

- Add disk drives
- Upgrade to higher capacity devices
- Add pedestals (expansion units)

You have the capability to expand the subsystem to support up to 30 disk drives. And since the subsystem is part of Digital's StorageWorks family, you can also install existing components into a larger subsystem to meet future needs.

The disk array controller provides more capacity on a single-host adapter than other data storage alternatives. The controller acts as a multiplexer and allows more SCSI disk drives to be connected to a single-host connection. The controller has the flexibility to support different RAID levels and classes of drives within the same array. The combination of a modular packaging strategy in conjunction with an assortment of pedestal options provides for a flexible storage solution.

## 1.3 Subsystem Component Descriptions

The components of the RAID Array 110 subsystem include the following:

- System building blocks (SBBs)
  - Disk drives
  - Power supplies
  - Optional Differential Wide SCSI-to-SCSI Adapter (DWZZA)

- HSZ10-AA controller and SCSI interconnect cable
- Blowers

Figure 1–2 shows the subsystem base unit and identifies its components.

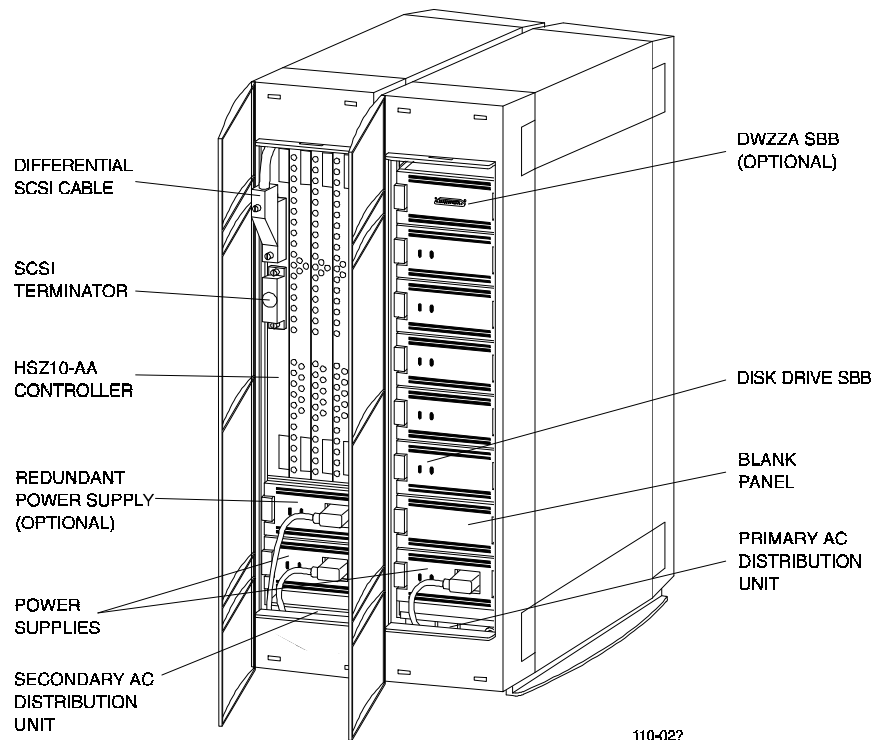
### 1.3.1 System Building Blocks

All disk drive and power units are mounted inside 3.5-inch modular carriers which plug into slots in the subsystem. A key feature is that each SBB can be removed and replaced without removal of power to the system. In addition, each SBB has visual status indicator LEDs which are used to determine whether devices are functioning properly. The base subsystem is preconfigured with five 3.5-inch disk drives, two identical universal power supplies and two ac distribution units which contain the ac power switch and ac power routing to the power supplies. The drives supported by the base subsystem are listed in Table 1–2. If needed, consult your supplier for additional supported disks.

**Table 1–2. Drives Supported by Subsystem**

Drive Model Number	Capacity
RZ25	425 MB
RZ26	1.05 GB
RZ26L	1.05 GB
RZ28	2.0 GB

**Figure 1–2. Subsystem Base Unit Components**



110-02?



The optional DWZZA-VA adapter allows the subsystem to connect to the host adapter through an 8-bit, single-ended SCSI bus. The DWZZA-VA interfaces with the HSZ10-AA controller through a front panel connector and must be installed in slot 0 of the base unit.

### **1.3.2 Blower Unit**

The base and expansion units each contain four blowers for cooling purposes. Two blowers are mounted at the rear of each bay and derive their power through a connector on the backplane. The blowers are secured by a single screw in the corner of each unit.

### **1.3.3 Disk Array Controller and SCSI Interface Cable**

The disk array controller is an intelligent SCSI disk array controller module based on the Motorola MC68EC020 microprocessor. It supports RAID 0, 1, 0+1, 5, and expansion up to 30 drives (6 ranks).

The host SCSI interface supports both synchronous and asynchronous data transfers, and is configurable to an 8- or 16-bit differential data bus or to an 8-bit, single-ended bus using an optional DWZZA-VA bus adapter. It supports SCSI-2 protocol. The host connection is made through a 68-pin, high-density connector (J1). SCSI termination power is provided by the controller.

The drive array interface consists of five SCSI channels. Each interface is 8-bit, single-ended, synchronous/asynchronous SCSI-2. Active SCSI termination and SCSI termination power are provided on the controller.

The subsystem can connect to a variety of qualified host adapters through various SCSI interconnect schemes in order to meet a variety of needs as follows:

- Connection to a fast/wide differential (FWD) SCSI bus (standard connection)
- Connection to a single-ended SCSI bus
- Connection to a fast differential 8-bit SCSI bus with correct bus termination

#### **1.3.3.1 Firmware**

The controller firmware is the portion of the code which resides in the controller's EPROM. This code is responsible for controller diagnostics, initialization, response to a limited set of SCSI commands, controller software downloading/uploading, and passing control to the controller software.

#### **1.3.3.2 Software**

The controller software is the portion of the code which is stored on the array drives and is automatically loaded to the controller's RAM. This code is responsible for all non-ROM operation of the board, including all RAID algorithms and configurations, read and write operations, and advanced SCSI functionality.

The software tolerates failures in the array by maintaining multiple copies of the array software on multiple drives. The software also maintains configuration information in both EEPROM and on the disk in order to tolerate the loss of one of these components.

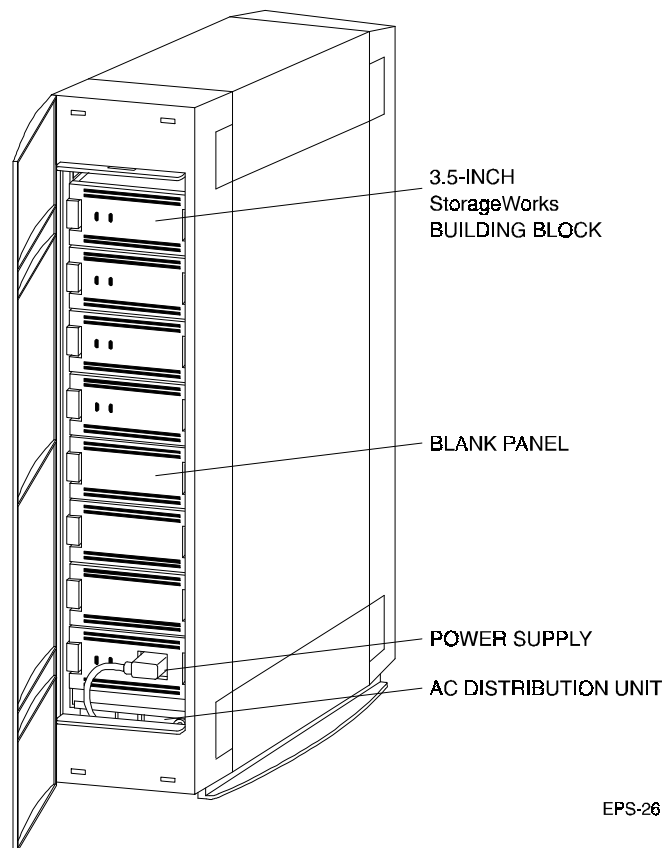
### **1.3.4 Drive Expansion Unit**

The drive expansion unit (Figure 1–3) provides the additional storage capacity required to construct a 10-to-15 drive or 20-to-30 drive subsystem array configuration. The unit can house up to six SCSI drives in each pedestal and contains the identical power supply and blower components as the base unit.

The expansion unit is pre-configured with SCSI drive cables from each pedestal which connect to the backplane of the base unit to form an expanded array configuration. One expansion unit connected to a base unit is needed to create a subsystem array of 10-to-15 drives. The connection of two drive expansion units to the base unit creates a subsystem array of 20-to-30 drives.

The drive expansion unit is powered by its dedicated power supply with an option of two power supplies, one for redundant power. The blower cooling arrangement is the same as the base unit, two blowers at the rear of the pedestal.

**Figure 1–3. Drive Expansion Unit Components**



## *Installing a Five-Drive Base Subsystem*

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*This chapter contains the subsystem configurations and hardware installation procedures for the 5-drive StorageWorks RAID Array 110 Subsystem. The installation describes the SCSI connections to the host adapter followed by the subsystem power-on procedures and a functional verification of the subsystem.*

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### 2.1 Installation Procedure

#### **NOTE**

Installing the StorageWorks RAID Array 110 Subsystem requires a general understanding of SCSI devices and basic hardware installation procedures. Otherwise, contact your service representative for installation assistance. If you are unfamiliar with the components of the base subsystem, it is recommended that you review Section 1.3 before proceeding.

The subsystem-to-host installation procedure consists of making the desired physical bus connection (differential or single-ended), terminating the bus correctly, and powering on and verifying the functionality of the installation. The section is divided into the following topics:

- Unpacking and inspection
- Channel and SCSI IDs
- Connection to the host adapter (8/16-bit differential or 8-bit single-ended)
- A final cable check
- Power on and functional verification test

#### 2.1.1 Unpacking and Inspection

#### **WARNING**

The subsystem base unit weighs approximately 70 lbs. Two persons are required to unpack the unit safely.

Prior to unpacking the base subsystem components, check all packing slips to ensure that the correct equipment has been shipped. Also, inspect the boxes for damage (crushed corners, punctures, and so forth). All boxes and packing material should be retained at the installation site for reshipment, if necessary.

The components of a base unit configuration shipment are listed in Table 2–1.

**Table 2–1. Base Unit Subsystem Components**

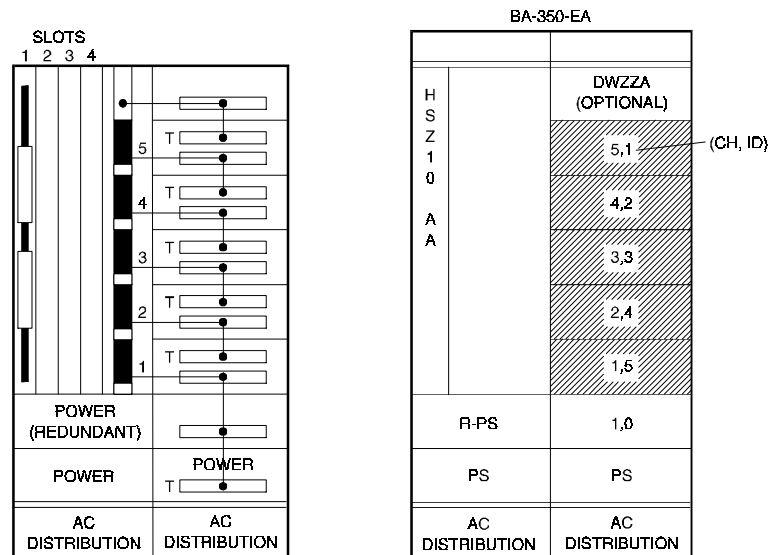
Item	Quantity
Subsystem base unit	1
This guide	1
AC power cords	1

### 2.1.2 HSZ10-AA Controller SCSI ID

The HSZ10-AA controller is preset at the factory to a SCSI ID of "0". Optionally, the HSZ10-AA SCSI ID can be set to any value between 0 and 15. If you wish to change the SCSI ID of the controller, proceed to Appendix B.

The channel and SCSI IDs of the drives in the base unit are preset at the factory by bus terminators and jumpers on the backplane of the base subsystem drive pedestal. Figure 2–1 shows the preconfigured locations of the terminators on the backplane of the base unit. The right view in Figure 2–1 illustrates the channel and SCSI IDs of the five drive slots as viewed from the front of the subsystem.

**Figure 2–1. Base Subsystem Terminator Locations and Drive Map**



NOTE: TERMINATORS AND JUMPERS LOCATED ON REAR PANEL BEHIND BLOWERS

110-04

### 2.1.3 Connection to the Host Adapter

There are three methods of connecting the subsystem's HSZ10-AA controller to the host adapter (described below) depending on the SCSI bus interface. Once your SCSI interface has been defined, proceed to the connection procedure appropriate for your installation. The connection procedures are identified as follows:

- To connect an 8-bit differential host adapter using the BN21K SCSI cable (for example, KZESA), proceed to Section 2.1.3.1
- To connect to a 16-bit differential host adapter using the BN21K SCSI cable, proceed to Section 2.1.3.2
- To connect to an 8-bit single-ended host adapter using the subsystem's installed BCO9D SCSI cable (for example, VAX), proceed to Section 2.1.3.3

#### 2.1.3.1 Connecting to an 8-Bit Differential Host Adapter ( BN21K Cable)

Connecting to an 8-bit, differential host adapter varies depending on the connector and termination on the host adapter. In most cases, the SCSI cable (BN21K) located in the host adapter kit will be used on the HSZ10-AA controller. In the case where the host adapter uses the SCSI-2, 50-pin connector, a second "Y" adapter cable will be required.

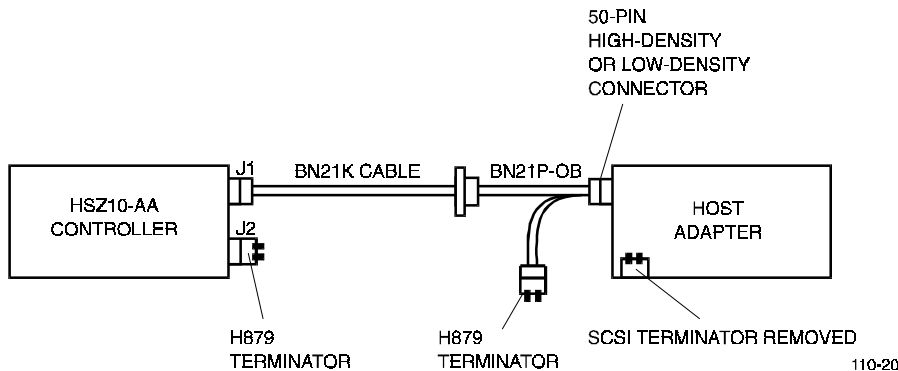
Specifically, connection to an EISA-based host system that uses the KZESA EISA-to-SCSI host adapter requires the following cables and connections (see to Figure 2–2):

1. Locate the host adapter kit and remove the BN21K SCSI cable.
2. Remove the front and rear bezels and the top cover from the base unit by pressing down on the locking tabs at the bottom of each bezel.
3. Uncoil the BN21K SCSI cable and thread the right-angle connector end under the lower rear handle of the tray that holds the secondary ac distribution unit and over the top of the base unit to the front of the controller shelf.
4. Connect the right-angle connector of the SCSI cable to J1 on the controller.
5. Ensure the factory installed H879-AA terminator is firmly seated and tight on the HSZ10-AA controller.
6. Replace the rear bezel, top cover, and front bezel on the base unit and ensure the locking tabs at the bottom of the bezels are snapped in place.
7. Connect the external end of the BN21K cable to either high-density female connector on the "Y" transition cable (BN21P-OB).
8. Attach the H879-AA terminator to the other high-density connector on the "Y" cable.
9. Connect the male, 50-pin, low density straight connector of the "Y" cable to the host adapter.

**NOTE**

Ensure you have removed the SCSI terminator from the host adapter, if installed.

10. Proceed to Sections 2.1.4 and 2.1.5 to check the installation and power on and verify the functional start-up operation of the subsystem.

**Figure 2–2. Connecting to an 8-Bit Differential Host Adapter (BN21K Cable)**

### 2.1.3.2 Connecting to a 16-bit Differential Host Adapter (BN21K Cable)

The BN21K SCSI cable (part of the host adapter kit) is used to connect the base unit to a 16-bit differential host adapter. Figure 2–3 illustrates the cable connections. To connect the subsystem to the host adapter, proceed as follows:

1. Locate the host adapter kit and remove the BN21K SCSI cable.
2. Remove the front and rear bezels and the top cover from the base unit by pressing down on the locking tabs at the bottom of each bezel (Figure 2–4).
3. Uncoil the BN21K SCSI cable and thread the right-angle connector end under the lower rear handle of the tray that holds the secondary ac distribution unit and over the top of the base unit to the front of the controller shelf.
4. Connect the right-angle connector of the SCSI cable to J1 on the controller.
5. Ensure the factory installed H879-AA terminator is firmly seated and tight on the HSZ10-AA controller.
6. Replace the rear bezel, top cover, and front bezel on the base unit and ensure the locking tabs at the bottom of the bezels are snapped in place.
7. Connect the external end of the BN21K cable to the host adapter.
8. Ensure the SCSI terminator is installed in the host adapter.
9. Proceed to Sections 2.1.4 and 2.1.5 to check the installation and power on and verify the functional start-up operation of the subsystem.

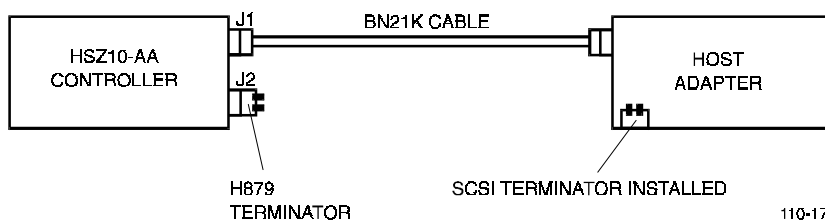
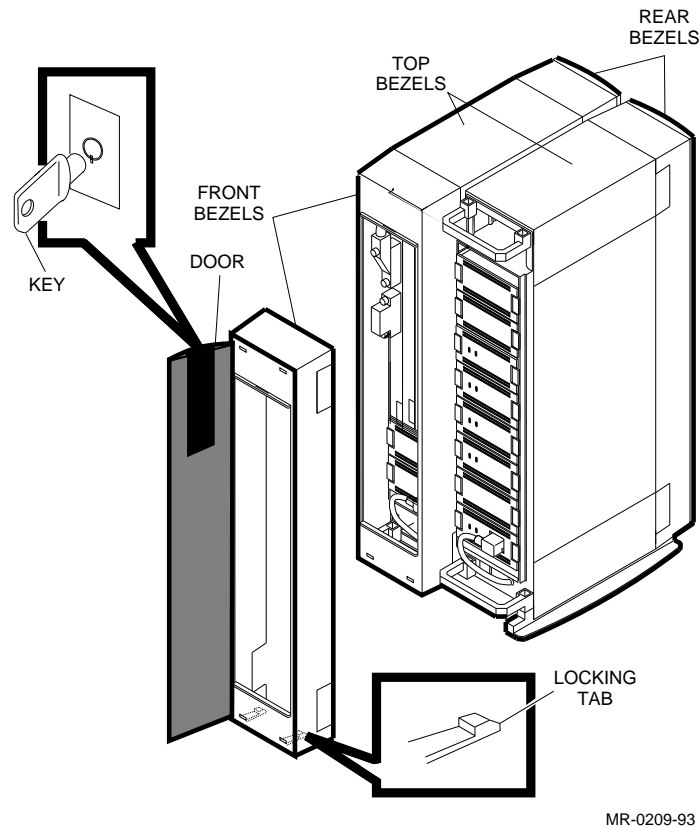
**Figure 2–3. 16-Bit Differential Host/Adapter Connection (BN21K Cable)**

Figure 2–4. Removing a Bezel



### 2.1.3.3 Connecting to an 8-Bit Single-Ended Host Adapter (BCO9D Cable)

#### NOTE

The DWZZA-AA is factory set with its single-ended, host side, termination disabled. If the DWZZA is not factory installed, verify that the terminator is disabled.

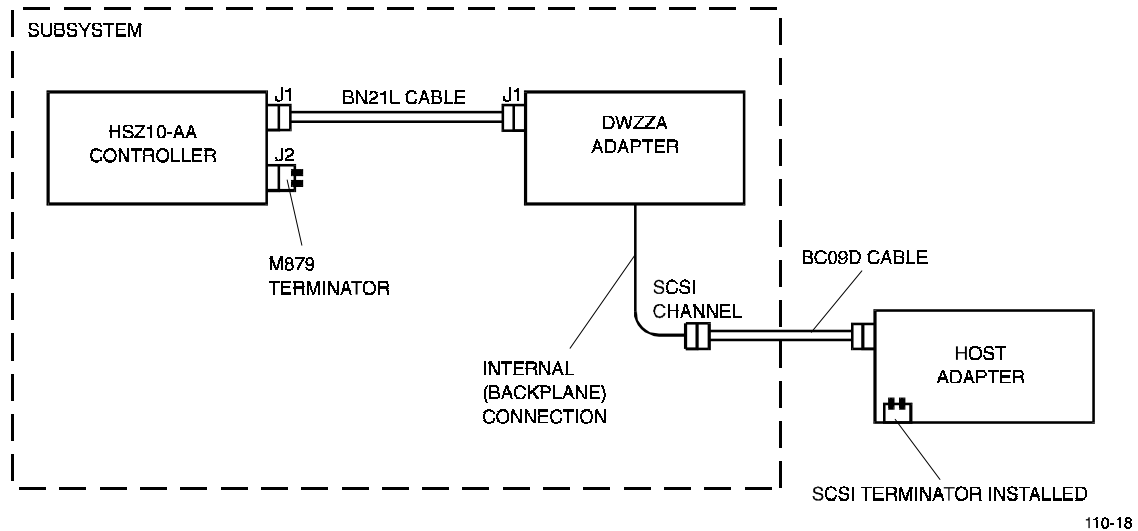
Connecting the HSZ10-AA controller to an 8-bit, single-ended host adapter requires the use of the optional DWZZA-VA single-ended to differential bus adapter. The bus adapter is mounted in a standard 3.5-inch SBB located in slot 0 of the base unit.

Figure 2–5 shows the cable connections required to complete the installation to an 8-bit single-ended host adapter. Proceed as follows:

1. Connect the external end of the BCO9D cable from the subsystem to the host adapter.
2. Ensure a SCSI terminator is installed in the host adapter to terminate the bus.
3. Ensure the factory installed BN21L SCSI cable between the HSZ10-AA controller and the DWZZA-VA adapter and the H879-AA terminator are firmly seated and tightened.

- Proceed to Sections 2.1.4 and 2.1.5 to check the installation and power on and verify the functional start-up operation of the subsystem.

**Figure 2–5. 8-Bit Single-Ended Host Adapter Connections (BC09D Cable)**



### 2.1.4 Cable and Connector Checklist

Verify the physical connections of the cables and connectors as follows:

- Ensure that all cables are securely fastened.
- If there are other SCSI devices connected on the bus, ensure that there are no SCSI ID conflicts (refer to Section 2.1.2 for SCSI IDs).
- Ensure that the host SCSI bus is correctly terminated at both ends of the SCSI bus and is not doubly terminated by other SCSI devices. The bus should only be terminated at each end (refer to the appropriate HSZ10-AA controller to host adapter connection diagram).

### 2.1.5 Power On and Functional Verification Test

#### NOTE

The subsystem LED indicators quickly flash on and off in the following test. Before powering on the subsystem, read through the procedure to locate the LEDs and familiarize yourself with the normal power-on sequence. You may power the subsystem on and off to recheck the functional verification test if necessary.

- Verify that the ac power switch on the primary ac distribution unit (bottom module in the right pedestal) is in the off position.
- Route the ac power cable under the bezel at the rear of the drive pedestal and connect the cable to the power receptacle on the primary ac distribution unit.



3. Connect the other end of the power cable to an ac outlet.
4. Verify that the ac input power cables are inserted firmly into the power supply SBBs and that the power switch on the secondary ac distribution unit is on (Figure 1–2).
5. Turn on the ac power switch on the primary ac distribution unit and verify the following:
  - The LED indicators on all of the power supply SBBs (Figure 8–3) are on
  - All drive SBB activity LEDs (Figure 8–4) initially flash and then go off

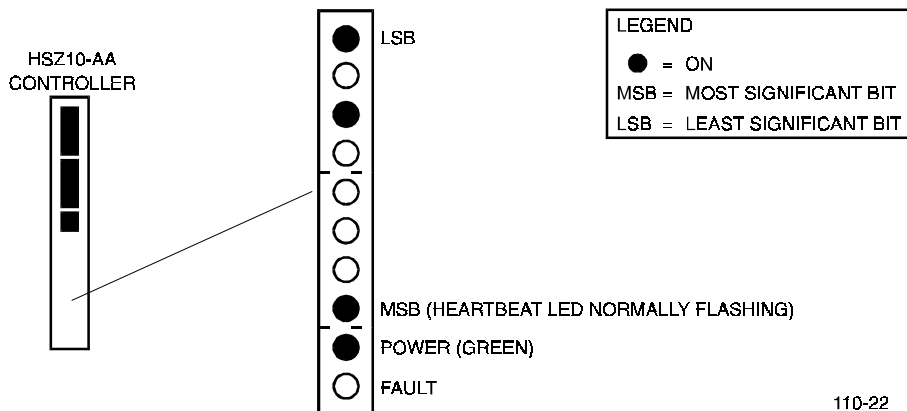
**NOTE**

On the initial power-on of the subsystem, the drive SBB fault LED's (amber) may be lit in a random pattern. This does not necessarily indicate a fault condition. It is important to wait until the unit has been given a "start" command from the host software and has gone through its initialization process before noting any drive has failed.

- The HSZ10-AA controller LEDs indicate the following sequence (Figure 2–6):
  - All the HSZ10-AA controller LEDs flash on
  - The top three LEDs of the controller are as shown in Figure 2–6 (wait state)
  - The Heartbeat LED is flashing and the green power LED is on

If any of the normal indications of the power on sequence do not execute correctly, refer to Section 8.9 for troubleshooting help.

**Figure 2–6. HSZ10-AA Controller LED Indicators**



110-22

You have now completed the hardware installation part of the 5 drive StorageWorks RAID Array 110 Subsystem. Proceed to the appropriate *StorageWorks RAID Array 110 Utility User's Guide* to install the utilities software.



## *Installing a 10-To-15 Drive Expanded Subsystem*

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*This chapter contains the subsystem configurations and hardware installation procedures for the 10-to-15 drive StorageWorks RAID Array 110 Subsystem. The installation describes the SCSI connections to the host adapter followed by the subsystem power-on procedures and a functional verification of the subsystem.*

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### **3.1 Installation Procedure**

#### **NOTE**

Installing the StorageWorks RAID Array 110 Subsystem requires a general understanding of SCSI devices and basic hardware installation procedures. Otherwise, contact your service representative for installation assistance. If you are unfamiliar with the components of the base subsystem, it is recommended that you review Section 1.3 before proceeding.

A 10-to-15 drive expanded subsystem consists of a base unit and two drive expansion units. In this configuration, the base unit must be connected to the drive expansion units to complete the subsystem. The expansion units are preconfigured and properly terminated at the factory for the specific drive capacity ordered.

Basically, the installation of a 10-to-15 drive expanded subsystem consists of connecting the drive expansion units to the base unit, making the subsystem-to-host interface connections, and terminating the SCSI bus correctly. Once the cable connections are made and the subsystem configuration is checked, perform the subsystem power on and functional verification tests to ensure the installation is operating properly. This chapter is divided into the following topics:

- Unpacking and inspection
- Connecting the drive expansion units to the base unit
- Channel and SCSI IDs
- Connection to the host adapter (8 or 16-bit differential or 8-bit single-ended)
- A final cable check
- Power on and functional verification test

### 3.1.1 Unpacking and Inspection

**WARNING**

The subsystem base and drive expansion units weigh approximately 70 lbs each. Two persons are required to unpack the units safely.

Prior to unpacking the 10-to-15-drive expanded subsystem components, check all packing slips to ensure that the correct equipment has been shipped. Also, inspect the boxes for damage (crushed corners, punctures, and so forth). All boxes and packing material should be retained at the installation site for reshipment, if necessary.

The 10-to-15-drive expanded subsystem configuration shipment should contain the following components:

**Table 3-1. Expanded Subsystem Components**

Item	Quantity
Base Unit	1
Drive Expansion Units	2
This guide	1
AC power cords	3

### 3.1.2 Connecting the Drive Expansion Unit to the Base Unit

One end of the drive SCSI cables from the drive expansion unit are internally connected to the backplane of the expansion unit. The other end of the cables must be connected to the proper connectors on the backplane of the base unit before the cable connections between the subsystem and the host adapter are made. To connect the drive expansion unit SCSI drive cables to the backplane of the base unit, perform the following (refer to Figures 3-1 through 3-3):

1. Remove the front bezel from the HSZ10-AA controller side of the base unit by pressing down on the locking tabs at the bottom of the bezel.
2. Uncoil the drive expansion unit cables from the rear of each drive expansion chassis and route the cables to the rear of the base unit, under the bezel, and up over the top of the controller shelf to the front of the base unit.
3. Remove the three filler panels from the shelf of the controller on the base unit to gain access to the backplane connectors in the base unit.
4. Connect the expansion unit SCSI drive cable (BN21H) with a **red/white** band (CHANNEL 1) to the bottom connector (**J51**) on the backplane of the base unit.
5. Connect the expansion unit SCSI drive cable with a **green** band (CHANNEL 2) to connector **J52** on the backplane of the base unit.
6. Connect the expansion unit SCSI drive cable with a **blue** band (CHANNEL 3) to connector **J53** on the backplane of the base unit.

7. Connect the expansion unit SCSI drive cable with a **red** band (CHANNEL 4) to connector **J54** on the backplane of the base unit.
8. Ensure the SCSI drive connections to the base unit connectors are firmly seated.
9. Replace the three filler panels (to facilitate the installation of the BN21K SCSI cable in a subsequent procedure, do not replace the front bezel at this time).
10. At the rear of the subsystem base unit, remove the safety screw from the two blowers on the drive side of the unit.
11. Remove each blower by pressing the locking tabs with your thumb and middle finger and carefully pulling the blower straight out from the power connector.
12. Locate the six terminators at the rear of the disk drive side of the unit (Figure 3-1). Remove the four terminators in the middle of the unit and leave the top and bottom.
13. Install four jumpers in place of the terminators you just removed.
14. Re-install the blowers. Align the blower connector and insert the module straight in until both locking tabs are firmly seated.
15. Replace and tighten the safety screws in the upper-left corner of the top blower and the bottom-right corner of the bottom blower.
16. Proceed to Section 3.1.3 to check the SCSI ID of the HSZ10-AA controller and to Section 3.1.4 to connect the subsystem to the host adapter.

**Figure 3-1. Subsystem Base Unit SCSI Connectors and Terminator/Jumper Locations**

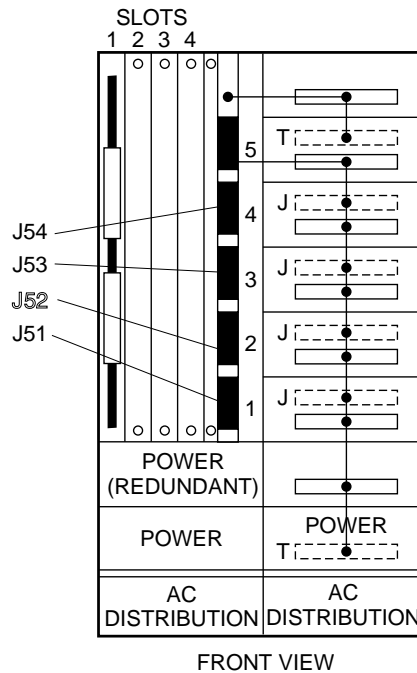
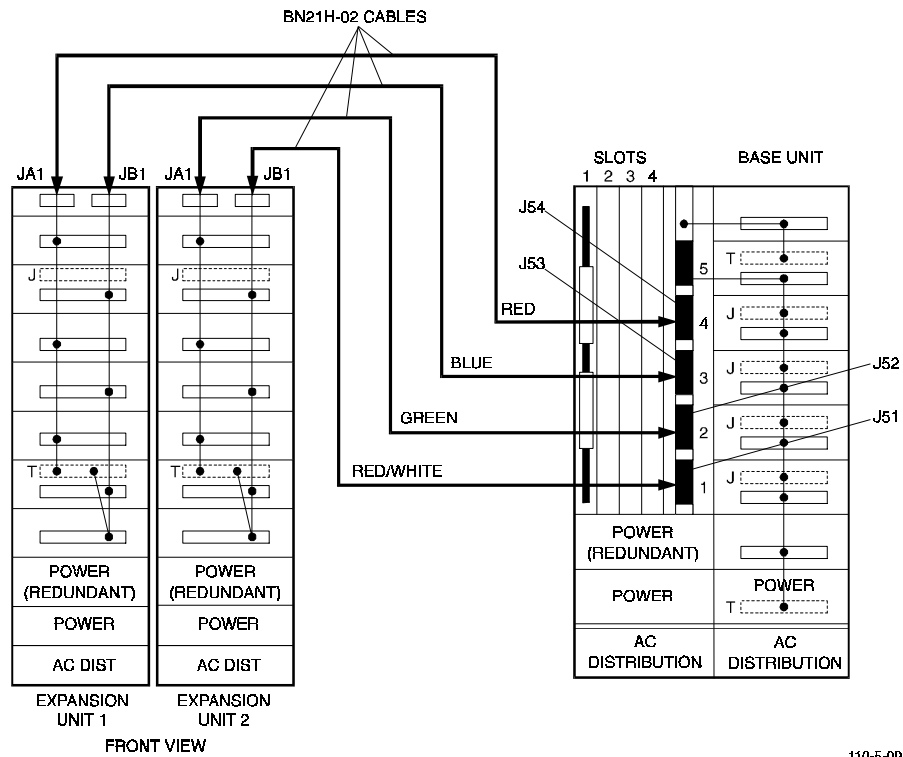
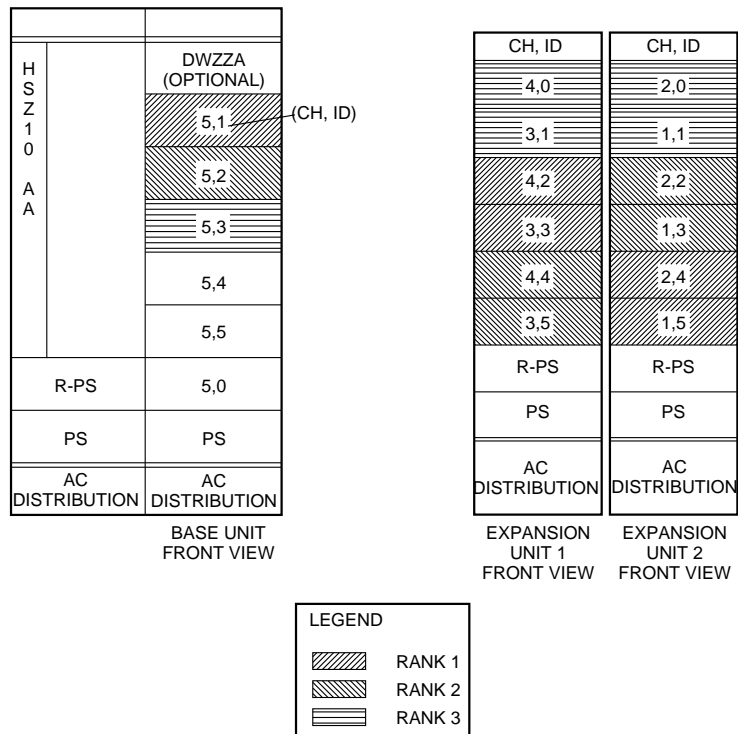


Figure 3–2. Expanded Subsystem SCSI Cable Connections



110-5-09

Figure 3–3. Expanded Subsystem Logical Drive Map



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### 3.1.3 HSZ10-AA Controller SCSI ID

The HSZ10-AA controller is preset at the factory to a SCSI ID of "0". Optionally, the HSZ10-AA SCSI ID can be set to any value between 0 and 15. If you wish to change the SCSI ID of the controller, proceed to Appendix B.

The channel and SCSI IDs of the drives in the base unit are preset at the factory by bus terminators and jumpers on the backplane of the base subsystem drive pedestal.

Figure 3–2 shows the preconfigured locations of the terminators on the backplane of the base unit. Figure 3–3 illustrates the channel and SCSI IDs of the five drive slots as viewed from the front of the subsystem.

### 3.1.4 Connection to the Host Adapter

There are three methods of connecting the subsystem's HSZ10-AA controller to the host adapter (described below) depending on the SCSI bus interface. Once your SCSI interface has been defined, proceed to the connection procedure appropriate for your installation. The connection procedures are identified as follows:

- To connect an 8-bit differential host adapter using the BN21K SCSI cable (for example, KZESA), proceed to Section 3.1.4.1
- To connect to a 16-bit differential host adapter using the BN21K SCSI cable, proceed to Section 3.1.4.2
- To connect to an 8-bit single-ended host adapter using the subsystem's installed BC09D SCSI cable (for example, VAX), proceed to Section 3.1.4.3

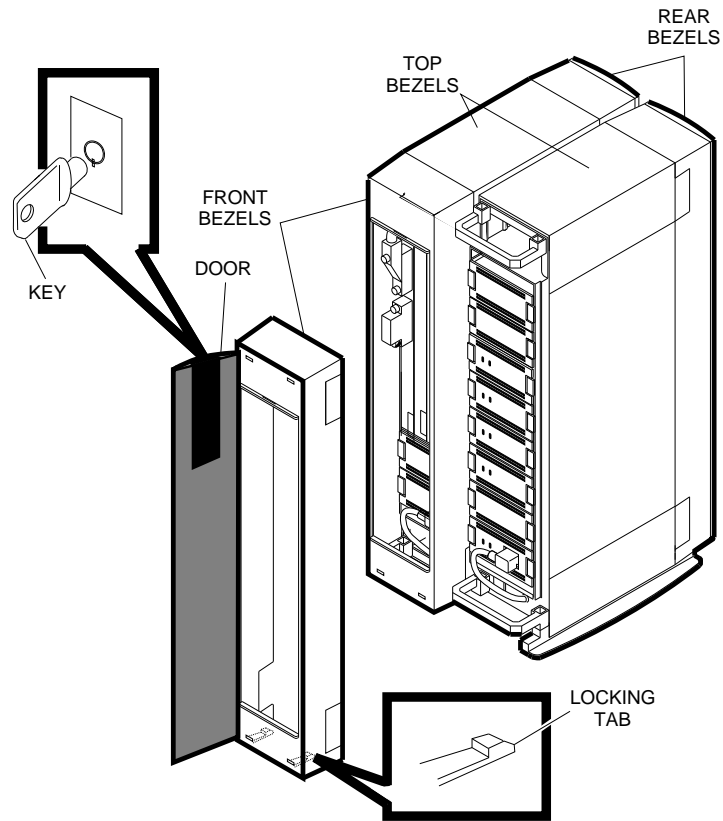
#### 3.1.4.1 Connecting to an 8-bit Differential Host Adapter ( BN21K Cable)

Connecting to an 8-bit, differential host adapter varies depending on the connector and termination on the host adapter. In most cases, the SCSI cable (BN21K) located in the host adapter kit will be used on the HSZ10-AA controller. In the case where the host adapter uses the SCSI-2, 50-pin connector, an additional "Y" adapter cable will be required.

Specifically, connection to an EISA-based host system that uses the KZESA EISA-to-SCSI host adapter requires the following cables and connections (refer to Figure 3–5):

1. Locate the host adapter kit and remove the BN21K SCSI cable.
2. Remove the front and rear bezels and the top cover from the base unit by pressing down on the locking tabs at the bottom of each bezel (Figure 3–4).
3. Uncoil the BN21K SCSI cable and thread the right-angle connector end under the lower rear handle of the tray that holds the secondary ac distribution unit and over the top of the base unit to the front of the controller shelf.
4. Connect the right-angle connector of the SCSI cable to J1 on the controller.
5. Ensure the factory installed H879-AA terminator is firmly seated and tight on the HSZ10-AA controller.
6. Replace the rear bezel, top cover, and front bezel on the base unit and ensure the locking tabs at the bottom of the bezels are snapped in place.
7. Connect the external end of the BN21K cable to either high-density female connector on the "Y" transition cable (BN21P-OB).

**Figure 3-4. Removing a Bezel**



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8. Attach the H879-AA terminator to the other high-density connector on the "Y" cable.
9. Connect the male, 50-pin, low density straight connector of the "Y" cable to the host adapter.

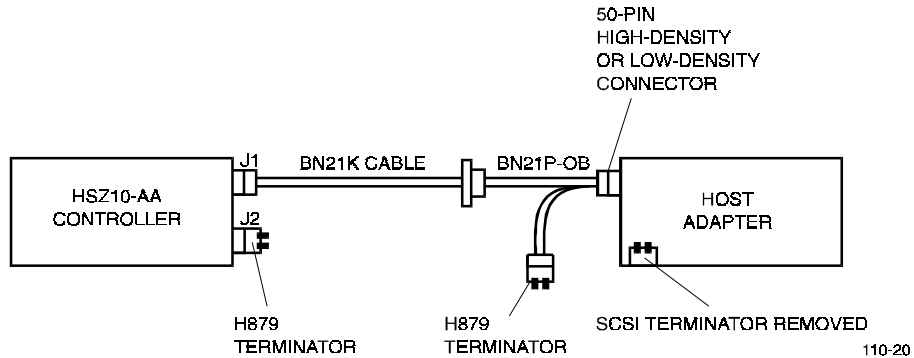
**NOTE**

Ensure you have removed the SCSI terminator from the host adapter, if installed.

10. Proceed to Sections 3.1.5 and 3.1.6 to check the installation and power on and verify the functional start-up operation of the subsystem.



**Figure 3–5. Connecting to an Eight-Bit Differential Host Adapter (BN21K Cable)**

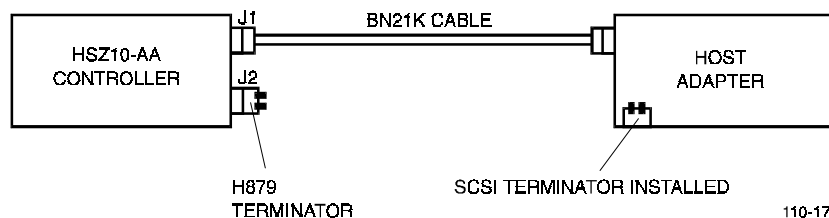


**3.1.4.2 Connecting to a 16-bit Differential Host Adapter via the BN21K Cable**

The BN21K SCSI cable (part of the host adapter kit) is used to connect the base unit to a 16-bit differential host adapter. Figure 3–6 illustrates the cable connections. To connect the subsystem to the host adapter, proceed as follows:

1. Locate the host adapter kit and remove the BN21K SCSI cable.
2. Remove the front and rear bezels and the top cover from the base unit by pressing down on the locking tabs at the bottom of each bezel.
3. Uncoil the BN21K SCSI cable and thread the right-angle connector end under the lower rear handle of the tray that holds the secondary ac distribution unit and over the top of the base unit to the front of the controller shelf.
4. Connect the right-angle connector of the SCSI cable to J1 on the controller.
5. Ensure the factory installed H879-AA terminator is firmly seated and tight on the HSZ10-AA controller.
6. Replace the rear bezel, top cover, and front bezel on the base unit and ensure the locking tabs at the bottom of the bezels are snapped in place.
7. Connect the external end of the BN21K cable to the host adapter.
8. Ensure the SCSI terminator is installed in the host adapter.
9. Proceed to Sections 3.1.5 and 3.1.6 to check the installation and power on and verify the functional start-up operation of the subsystem.

**Figure 3–6. Sixteen-Bit Differential Host/Adapter Connection (BN21K Cable)**



### 3.1.4.3 Connecting to an 8-Bit Single-Ended Host Adapter (BCO9D Cable)

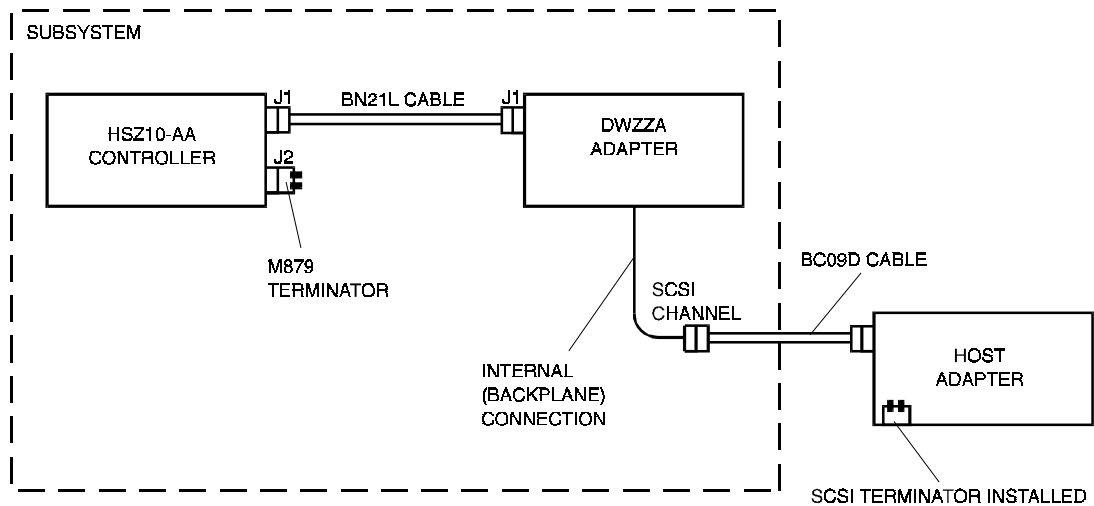
#### NOTE

The DWZZA-AA is factory set with its single-ended, host side, termination disabled. If the DWZZA is not factory installed, verify that the terminator is disabled.

Connecting the HSZ10-AA controller to an 8-bit, single-ended host adapter requires the use of the optional DWZZA-VA single-ended to differential bus adapter. The bus adapter is mounted in a standard 3.5-inch SBB located in slot 0 of the base unit. Figure 3–7 shows the cable connections required to complete the installation to an 8-bit single-ended host adapter. Proceed as follows:

1. Ensure the factory installed BN21L SCSI cable between the HSZ10-AA controller and the DWZZA-VA adapter and the H879-AA terminator are firmly seated and tightened.
2. Connect the external end of the BCO9D cable from the subsystem to the host adapter.
3. Ensure a SCSI terminator is installed in the host adapter to properly terminate the SCSI bus.
4. Proceed to Sections 3.1.5 and 3.1.6 to check the installation and power on and verify the functional start-up operation of the subsystem.

**Figure 3–7. Eight-Bit Single-Ended Host Adapter Connections (BCO9D Cable)**



110-18

### 3.1.5 Cable and Connector Checklist

Verify the physical connections of the cables and connectors as follows:

- Ensure that all cables are securely fastened.
- If there are other SCSI devices connected on the bus, ensure that there are no SCSI ID conflicts (refer to Section 3.1.3 for SCSI IDs).
- Ensure that the host SCSI bus is correctly terminated at both ends of the SCSI bus and is not doubly terminated by other SCSI devices. The bus should only be terminated at each end (refer to the appropriate HSZ10-AA controller/host adapter connection diagram).

### 3.1.6 Power On and Functional Verification Test

**NOTE**

The subsystem LED indicators quickly flash on and off in the following test. Before powering on the subsystem, read through the procedure to locate the LEDs and familiarize yourself with the normal power-on sequence. You may power the subsystem on and off to recheck the functional verification test if necessary.

1. Verify that the ac power switch on the primary ac distribution unit (bottom module in the right pedestal) is in the off position.
2. Route the ac power cable under the bezel at the rear of the drive pedestal and connect the cable to the power receptacle on the primary ac distribution unit.
3. Connect the other end of the power cable to an ac outlet.
4. Verify that the ac input power cables are inserted firmly into the power supply SBBs and that the power switch on the secondary ac distribution unit is on (Figure 1–2).
5. Turn on the ac power switch on the primary ac distribution unit and verify the following:
  - The LED indicators on all of the power supply SBBs (Figure 8–3) are on
  - All drive SBB activity LEDs (Figure 8–4) initially flash and then go off

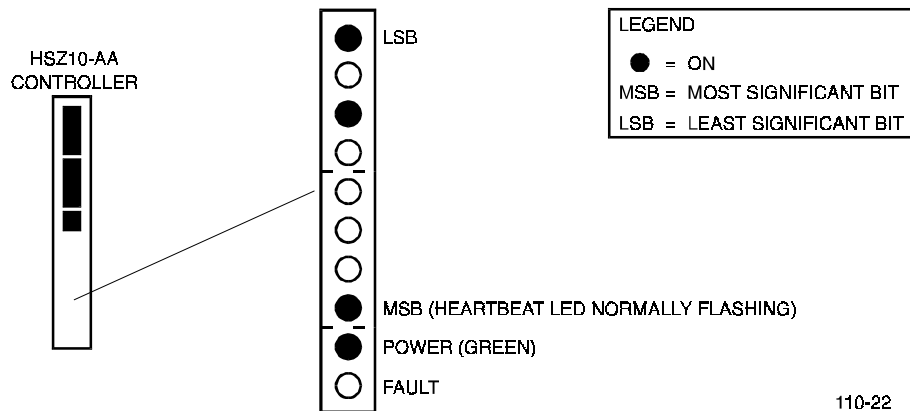
**NOTE**

On the initial power-on of the subsystem, the drive SBB fault LED's (amber) may be lit in a random pattern. This does not necessarily indicate a fault condition. It is important to wait until the unit has been given a "start" command from the host software and has gone through its initialization process before noting any drive has failed.

- The HSZ10-AA controller LEDs indicate the following sequence (Figure 3–8):
  - All the HSZ10-AA controller LEDs flash on
  - Top three LEDs of the controller are as shown in Figure 3–8 (wait state)
  - The Heartbeat LED is flashing and the green power LED is on

If any of the normal indications of the power on sequence do not execute correctly, refer to Section 8.9 for troubleshooting help.

**Figure 3–8. HSZ10-AA Controller LED Indicators**



110-22

You have now completed the hardware installation part of the 10-to-15 drive StorageWorks RAID Array 110 Subsystem. Proceed to the appropriate *StorageWorks RAID Array 110 Utility User's Guide* to install the utilities software.

## *Installing a 20-To-30 Drive Expanded Subsystem*

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*This chapter contains the subsystem configurations and hardware installation procedures for the 20-to-30 drive StorageWorks RAID Array 110 Subsystem. The installation describes the SCSI connections to the host adapter followed by the subsystem power-on procedures and a functional verification of the subsystem.*

---

### **4.1 Installation Procedure**

#### **NOTE**

Installing the StorageWorks RAID Array 110 Subsystem requires a general understanding of SCSI devices and basic hardware installation procedures. Otherwise, contact your service representative for installation assistance. If you are unfamiliar with the components of the base subsystem, it is recommended that you review Section 1.3 before proceeding.

A 20-to-30-drive expanded subsystem consists of a subsystem base unit and four drive expansion units. In this configuration, the base unit must be connected to the drive expansion units to complete the subsystem. The subsystem base and drive expansion units are preconfigured and properly terminated at the factory for the specific drive capacity ordered.

Basically, the installation of a 20-to-30-drive expanded subsystem consists of connecting the drive expansion units to the subsystem base unit, making the subsystem-to-host interface connections, and terminating the SCSI bus correctly. Once the cable connections are made and the subsystem configuration is checked, perform the subsystem power on and functional verification tests to ensure the installation is operating properly. This chapter is divided into the following topics:

- Unpacking and inspection.
- Connecting the four-drive expansion units to the base unit
- HSZ10-AA controller SCSI ID
- Connection to the host adapter (8/16-bit differential or 8-bit single-ended)
- A final cable check
- Power on and functional verification test

### 4.1.1 Unpacking and Inspection

**WARNING**

The subsystem base and drive expansion units weigh approximately 70 lbs each. Two persons are required to unpack the units safely.

Prior to unpacking the 20-to-30 drive expanded subsystem components, check all packing slips to ensure that the correct equipment has been shipped. Also, inspect the boxes for damage (crushed corners, punctures, and so forth). All boxes and packing material should be retained at the installation site for reshipment, if necessary.

The 20-to-30-drive expanded subsystem configuration shipment should contain the following:

**Table 4–1. Expanded Subsystem Components**

Item	Quantity
Subsystem Base Unit	1
Drive Expansion Units	4
This guide	1
AC power cords	5

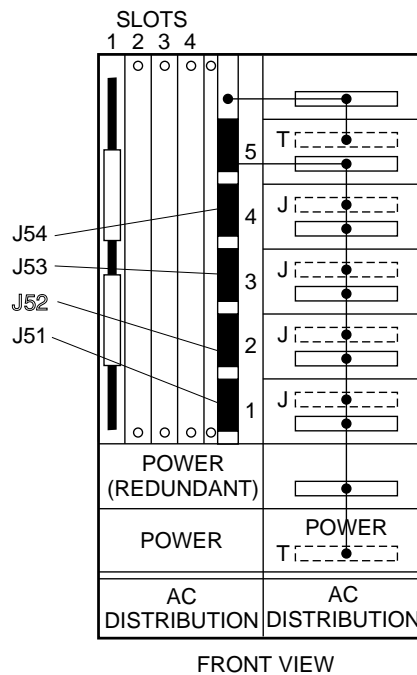
### 4.1.2 Connecting the Drive Expansion Units to the Subsystem Base Unit

One end of the drive SCSI cables from the drive expansion units is internally connected to the backplane of the unit. The other end of the cables must be connected to the proper connectors on the backplane of the base unit before the cable connections between the subsystem and the host adapter are made. To connect the two drive expansion unit SCSI drive cables to the backplane of the subsystem base unit, perform the following (refer to Figures 4–1 through 4–4):

1. Remove the front bezel from the HSZ10-AA controller side of the base unit by pressing down on the locking tabs at the bottom of the bezel.
2. Uncoil the drive expansion unit cables from the rear of each drive expansion chassis and route the cables to the rear of the base unit, under the bezel, and up over the top of the controller shelf to the front of the base unit.
3. Remove the three filler panels from the shelf of the controller on the base unit to gain access to the backplane connectors in the base unit.
4. Connect the expansion unit SCSI drive cable (BN21H) with a **red/white** band (CHANNEL 1) to the bottom connector (**J51**) on the backplane of the base unit.
5. Connect the expansion unit SCSI drive cable with a **green** band (CHANNEL 2) to connector **J52** on the backplane of the base unit.
6. Connect the expansion unit SCSI drive cable with a **blue** band (CHANNEL 3) to connector **J53** on the backplane of the base unit.

7. Connect the expansion unit SCSI drive cable with a **red** band (CHANNEL 4) to connector **J54** on the backplane of the base unit.
8. Ensure the SCSI drive connections to the base unit connectors are firmly seated.
9. Replace the three filler panels (to facilitate the installation of the BN21K SCSI cable in a subsequent procedure, do not replace the front bezel at this time).
10. At the rear of the subsystem base unit, remove the safety screw from the two blowers on the drive side of the unit.
11. Remove each blower by pressing the locking tabs with your thumb and middle finger and carefully pulling the blower straight out from the power connector.
12. Locate the six terminators at the rear of the disk drive side of the unit (Figure 3-1). Remove the four terminators in the middle of the unit and leave the top and bottom
13. Install four jumpers in place of the terminators you just removed.
14. Re-install the blowers. Align the blower connector and insert the module straight in until both locking tabs are firmly seated.
15. Replace and tighten the safety screws in the upper-left corner of the top blower and the bottom-right corner of the bottom blower.
16. Proceed to Section 4.1.3 to check the SCSI ID of the HSZ10-AA controller and Section 4.1.4 to connect the subsystem to the host adapter.

**Figure 4-1. Subsystem Base Unit SCSI Connectors and Terminator/Jumper Locations**



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Figure 4-2. Expanded Subsystem Cable Connections Jumper/Terminator Locations

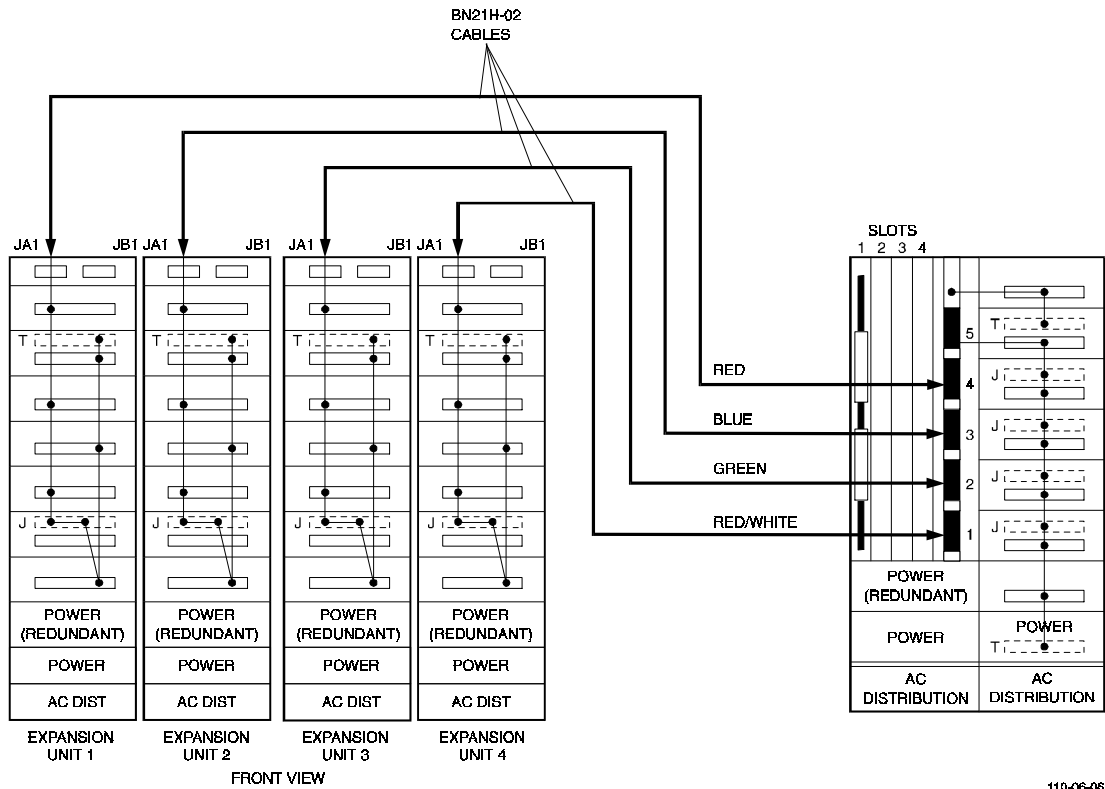
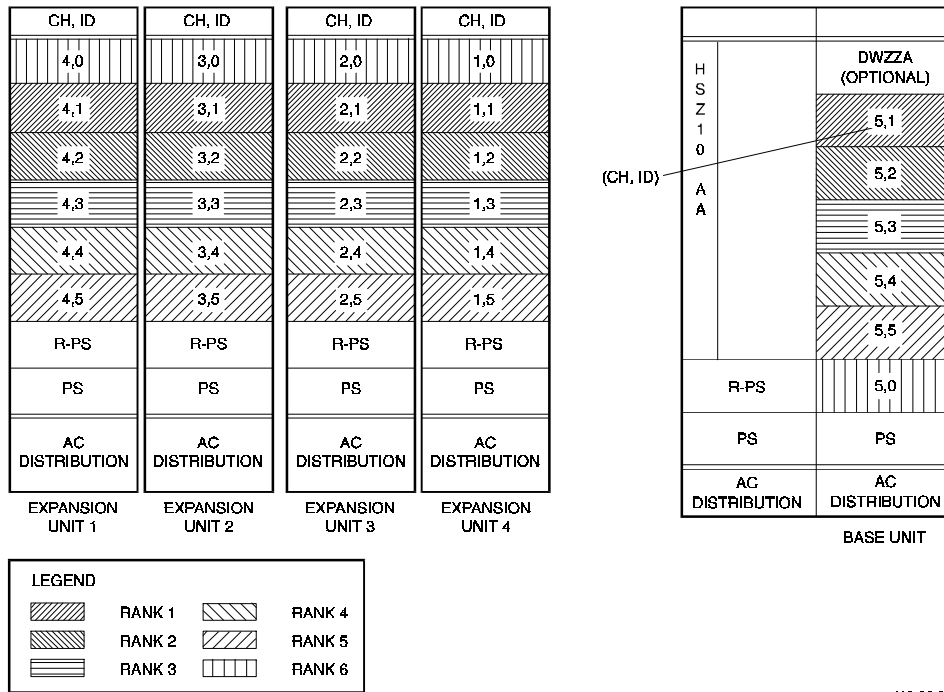


Figure 4-3. Expanded Subsystem Logical Drive Map





### 4.1.3 HSZ10-AA Controller SCSI ID

The HSZ10-AA controller is preset at the factory to a SCSI ID of "0". Optionally, the HSZ10-AA SCSI ID can be set to any value between 0 and 15. If you wish to change the SCSI ID of the controller, proceed to Appendix B.

The channel and SCSI IDs of the drives in the base unit are preset at the factory by bus terminators and jumpers on the backplane of the base subsystem drive pedestal. Figure 4–2 shows the preconfigured locations of the terminators on the backplane of the base unit. The right view in Figure 4–3 illustrates the channel and SCSI IDs of the five drive slots as viewed from the front of the subsystem.

### 4.1.4 Connection to the Host Adapter

There are three methods of connecting the subsystem's HSZ10-AA controller to the host adapter (described below) depending on the SCSI bus interface. Once your SCSI interface has been defined, proceed to the connection procedure appropriate for your installation. The connection procedures are identified as follows:

- To connect an 8-bit differential host adapter using the BN21K SCSI cable (for example, KZESA), proceed to Section 4.1.4.1
- To connect to a 16-bit differential host adapter using the BN21K SCSI cable, proceed to Section 4.1.4.2
- To connect to an 8-bit single-ended host adapter using the subsystem's installed BC09D SCSI cable (for example, VAX), proceed to Section 4.1.4.3

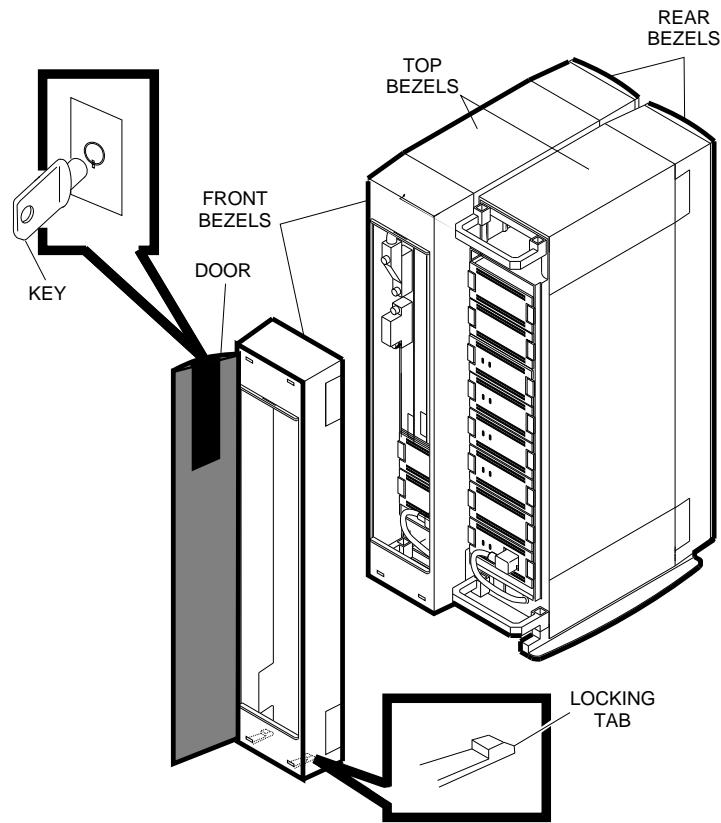
#### 4.1.4.1 Connecting to an 8-Bit Differential Host Adapter (BN21K Cable)

Connecting to an 8-bit, differential host adapter varies depending on the connector and termination on the host adapter. In most cases, the SCSI cable (BN21K) located in the host adapter kit will be used on the HSZ10-AA controller. In the case where the host adapter uses the SCSI-2, 50-pin connector, an additional "Y" adapter cable will be required.

Specifically, connection to an EISA-based host system that uses the KZESA EISA-to-SCSI host adapter requires the following cables and connections (refer to Figure 4–5):

1. Locate the host adapter kit and remove the BN21K SCSI cable.
2. Remove the front and rear bezels and the top cover from the base unit by pressing down on the locking tabs at the bottom of each bezel (Figure 4–4).
3. Uncoil the BN21K SCSI cable and thread the right-angle connector end under the lower rear handle of the tray that holds the secondary ac distribution unit and over the top of the base unit to the front of the controller shelf.
4. Connect the right-angle connector of the SCSI cable to J1 on the controller.
5. Ensure the factory installed H879-AA terminator is firmly seated and tight on the HSZ10-AA controller.
6. Replace the rear bezel, top cover, and front bezel on the base unit and ensure the locking tabs at the bottom of the bezels are snapped in place.
7. Connect the external end of the BN21K cable to either high-density female connector on the "Y" transition cable (BN21P-OB).

**Figure 4-4. Removing a Bezel**



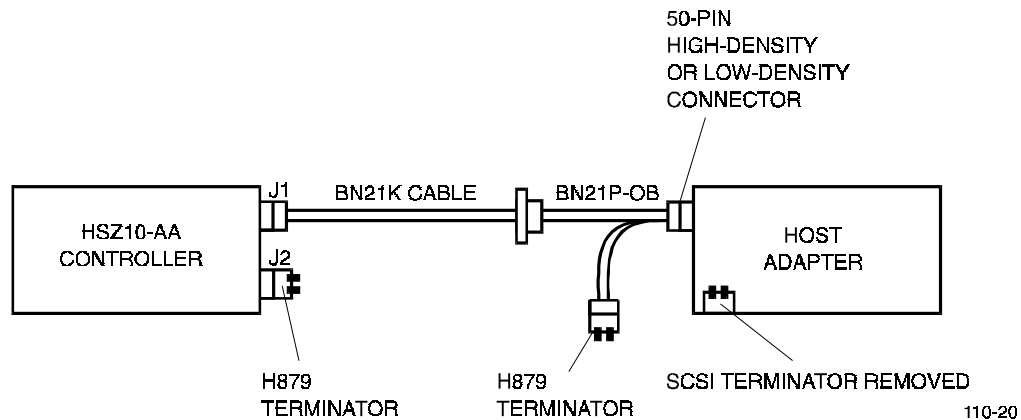
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8. Attach the H879-AA terminator to the other high-density connector on the "Y" cable.
9. Connect the male, 50-pin, low density straight connector of the "Y" cable to the host adapter.

**NOTE**

Ensure you have removed the SCSI terminator from the host adapter, if installed.

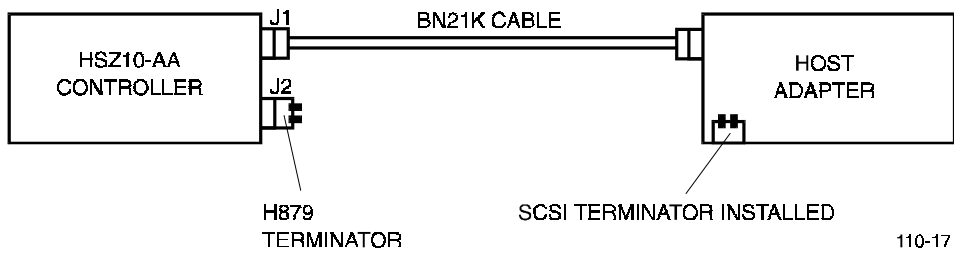
10. Proceed to Sections 4.1.5 and 4.1.6 to check the installation and power on and verify the functional start-up operation of the subsystem.

**Figure 4–5. Connecting to an Eight-Bit Differential Host Adapter (BN21K Cable)**

#### 4.1.4.2 Connecting to a 16-bit Differential Host Adapter (BN21K Cable)

The BN21K SCSI cable (part of the host adapter kit) is used to connect the base unit to a 16-bit differential host adapter. Figure 4–6 illustrates the cable connections. To connect the subsystem to the host adapter, proceed as follows:

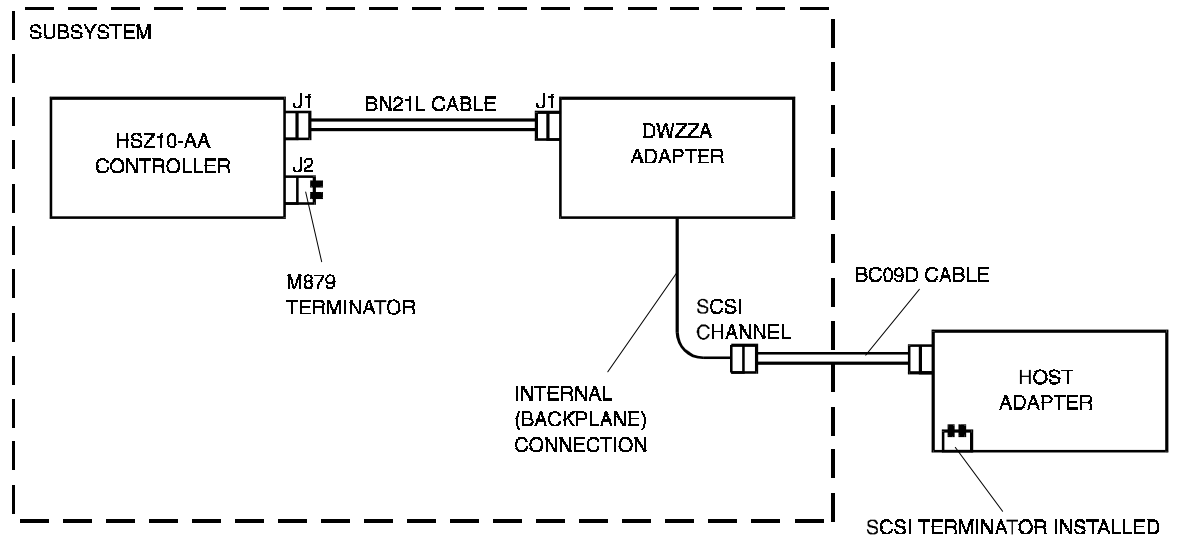
1. Locate the host adapter kit and remove the BN21K SCSI cable.
2. Remove the front and rear bezels and the top cover from the base unit by pressing down on the locking tabs at the bottom of each bezel (Figure 4–4).
3. Uncoil the BN21K SCSI cable and thread the right-angle connector end under the lower rear handle of the tray that holds the secondary ac distribution unit and over the top of the base unit to the front of the controller shelf.
4. Connect the right-angle connector of the SCSI cable to J1 on the controller.
5. Ensure the factory installed H879-AA terminator is firmly seated and tight on the HSZ10-AA controller.
6. Replace the rear bezel, top cover, and front bezel on the base unit and ensure the locking tabs at the bottom of the bezels are snapped in place.
7. Connect the external end of the BN21K cable to the host adapter.
8. Ensure the SCSI terminator is installed in the host adapter.
9. Proceed to Sections 4.1.5 and 4.1.6 to check the installation and power on and verify the functional start-up operation of the subsystem.

**Figure 4-6. Sixteen-Bit Differential Host/Adapter Connection (BN21K Cable)****4.1.4.3 Connecting to an 8-Bit Single-Ended Host Adapter (BCO9D Cable)****NOTE**

The DWZZA-AA is factory set with its single-ended, host side, termination disabled. If the DWZZA is not factory installed, verify that the terminator is disabled.

Connecting the HSZ10-AA controller to an 8-bit, single-ended host adapter requires the use of the optional DWZZA-VA single-ended to differential bus adapter. The bus adapter is mounted in a standard 3.5-inch SBB located in slot 0 of the base unit. Figure 4-7 shows the cable connections required to complete the installation to an 8-bit single-ended host adapter. Proceed as follows:

1. Ensure the factory installed BN21L SCSI cable between the HSZ10-AA controller and the DWZZA-VA adapter and the H879-AA terminator are firmly seated and tightened.
2. Connect the external end of the BCO9D cable from the subsystem to the host adapter.
3. Ensure a SCSI terminator is installed in the host adapter to terminate the SCSI bus.
4. Proceed to Sections 4.1.5 and 4.1.6 to check the installation, and power on and verify the functional start-up operation of the subsystem.

**Figure 4–7. Eight-Bit Single-Ended Host Adapter Connections (BC09D Cable)**

110-18

#### 4.1.5 Cable and Connector Checklist

Verify the physical connections of the cables and connectors as follows:

- Ensure that all cables are securely fastened.
- If there are other SCSI devices connected on the bus, ensure that there are no SCSI ID conflicts (refer to Section 4.1.3 for SCSI IDs).
- Ensure that the host SCSI bus is correctly terminated at both ends of the bus and is not doubly terminated by other SCSI devices. The bus should only be terminated at each end (refer to the appropriate HSZ10-AA controller/host adapter connection diagram).

#### 4.1.6 Power On and Functional Verification Test

##### NOTE

The subsystem LED indicators quickly flash on and off in the following test. Before powering on the subsystem, read through the procedure to locate the LEDs and familiarize yourself with the normal power-on sequence. You may power the subsystem on and off to recheck the functional verification test if necessary.

1. Verify that the ac power switch on the primary ac distribution unit (bottom module in the right pedestal) is in the off position.
2. Route the ac power cable under the bezel at the rear of the drive pedestal and connect the cable to the power receptacle on the primary ac distribution unit.
3. Connect the other end of the power cable to an ac outlet.

4. Verify that the ac input power cables are inserted firmly into the power supply SBBs and that the power switch on the secondary ac distribution unit is on (Figure 1–2).
5. Turn on the ac power switch on the primary ac distribution unit and verify the following:
  - The LED indicators on all of the power supply SBBs (Figure 8–3) are on
  - All drive SBB activity LEDs (Figure 8–4) initially flash and then go off

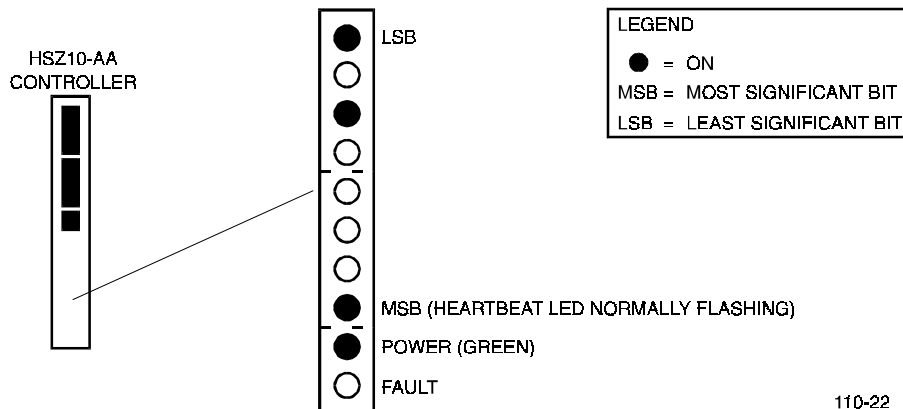
**NOTE**

On the initial power-on of the subsystem, the drive SBB fault LED's (amber) may be lit in a random pattern. This does not necessarily indicate a fault condition. It is important to wait until the unit has been given a "start" command from the host software and has gone through its initialization process before noting any drive has failed.

- The HSZ10-AA controller LEDs indicate the following sequence (Figure 4–8):
  - All the HSZ10-AA controller LEDs flash on
  - The top three LEDs are as shown in Figure 4–8 (wait state)
  - The Heartbeat LED is flashing and the green power LED is on

If any of the normal indications of the power on sequence do not execute correctly, refer to Section 8.9 for troubleshooting help.

**Figure 4-8. HSZ10-AA Controller LED Indicators**



You have now completed the hardware installation part of the 20-to-30 drive StorageWorks RAID Array 110 Subsystem. Proceed to the appropriate *StorageWorks RAID Array 110 Utility User's Guide* to install the utilities software.

## *Expanding a 5-Drive Base Unit to 10/15 Drives*

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*This chapter contains the procedures to expand a five-drive base subsystem to a 10-to-15 drive expanded subsystem. The expansion procedure describes how to shut down and disassemble the base subsystem, move or swap terminators and jumpers, install cables, move existing drives and verify proper subsystem operation.*

---

This chapter is divided into the following major topics:

- Verifying the operation of the base unit
- Unpacking expansion kit
- Base unit preparation
- Expansion unit preparation
- SCSI Cable installation

### **NOTE**

This expansion requires a general understanding of SCSI devices and basic hardware installation procedure and should be performed by qualified service personnel.

### **5.1 Verifying the Operation of the Base Unit**

### **WARNING**

The base unit weighs approximately 70 lbs. More than one person is required to move the unit safely.

Verify that the base unit is operating at optimal level before beginning the expansion using the following procedure:

1. Run the parity check utility if the operating system is set up for RAID 0+1 or RAID 5. RAID 0 does not have parity and therefore cannot be verified.
2. Perform a backup of all LUNs in the array.
3. Label all drives in the base unit by channel and ID. See Figure 5-1.
4. Power down the operating system through normal shutdown procedure.

**Figure 5-1. Drive and Channel ID Designations**

H S Z 1 0  A A		DWZZA (OPTIONAL)
		5,1 (CH, ID)
		4,2
		3,3
		2,4
		1,5
	R-PS	1,0
	PS	PS
	AC DISTRIBUTION	AC DISTRIBUTION

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## 5.2 Unpacking the Expansion Kit

Before unpacking the expansion material, check all packing slips to ensure that the correct components have been shipped. Inspect the boxes for damage. Retain all boxes and packing materials in case you need them.

The 10-to-15 drive expansion kit should contain the following items:

**Table 5-1. Expansion Kit Components**

Item	Quantity
Drive expansion units	2
Disk drives	Optional
StorageWorks jumpers	4
Set of cable color code stickers	1
Cables, 2 meter (BN21H-02)	4
AC power cords	2



### 5.3 Base Unit Preparation

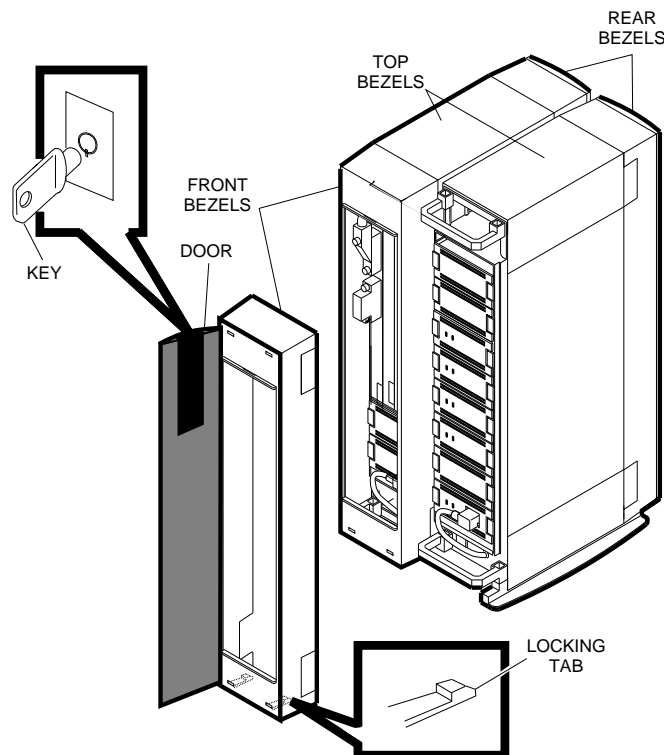
Prepare the base unit for the expansion as follows:

#### CAUTION

Before removing any disk drive SBB from the base unit, ensure to label the SBB with the **Channel** and **ID** number of its pre-installed slot location in the unit. This information must be recorded to allow you to re-install the drives and preserve the original state/configuration of the subsystem. Failure to re-install the drives in the same slot locations may result in loss of data and or state/configuration information.

1. Use the key provided to unlock and open all front and rear bezel doors (Figure 5–2).
2. Remove all front and rear bezels from the base unit by pushing down on the locking tabs at the bottom of each bezel (Figure 5–2).
3. Loosen the captive screws and remove the three filler panels on the controller side of the base unit (Figure 5–3).
4. Loosen sliding tray captive screws and slide tray out of the base unit (Figure 5–3).

**Figure 5–2. Removing a Bezel**



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5. At the rear of the base unit, use a Phillips screwdriver and remove the safety screw from the two blowers on the drive side ( Figure 5–4).
6. Remove each blower by pressing the locking tabs with your thumb and middle finger and carefully pulling the blower straight out from the power connector (Figure 5–4).
7. Locate the six terminators at the rear of the disk drive side of the unit. Figure 5–5 shows a terminator and a jumper. Remove the four terminators in the middle of the unit and leave the top and bottom terminators in place.
8. Install four jumpers in place of the terminators you just removed. Figure 5–6 shows a *before* and *after* view of the terminator/jumper locations in the base unit.
9. Reinstall the blowers. Align the blower connector and insert the module straight in until both locking tabs are firmly seated.
10. Replace and tighten the safety screws in the upper-left corner of the top blower and the bottom-right corner of the bottom blower.

**Figure 5–3. Removing a Filler Panel and Sliding Tray from Base Unit**

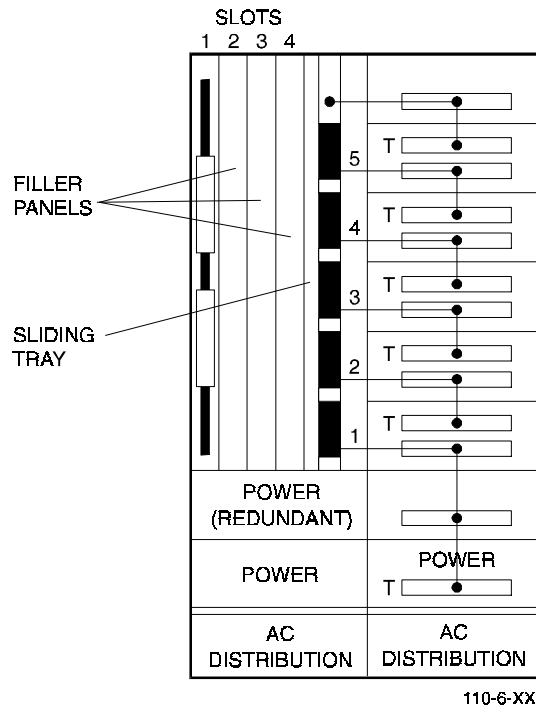


Figure 5-4. Removing A Blower

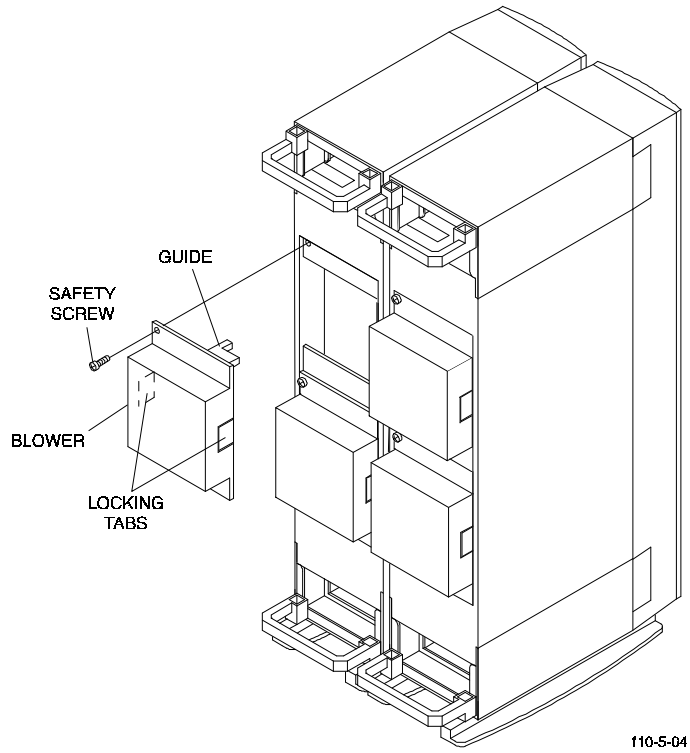
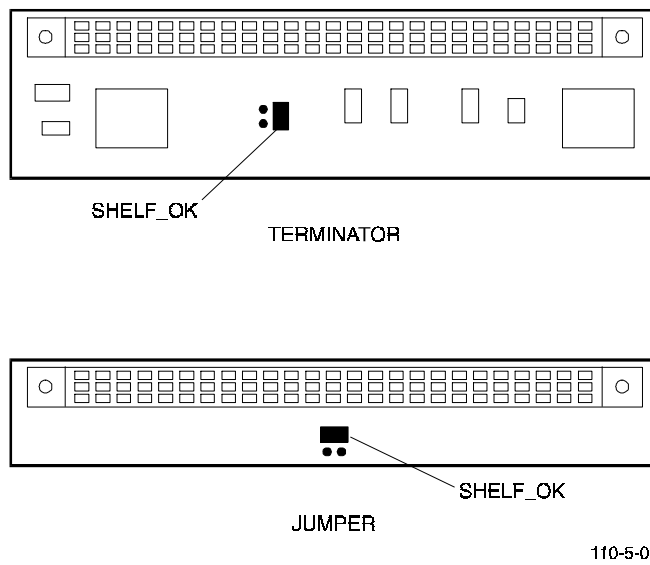
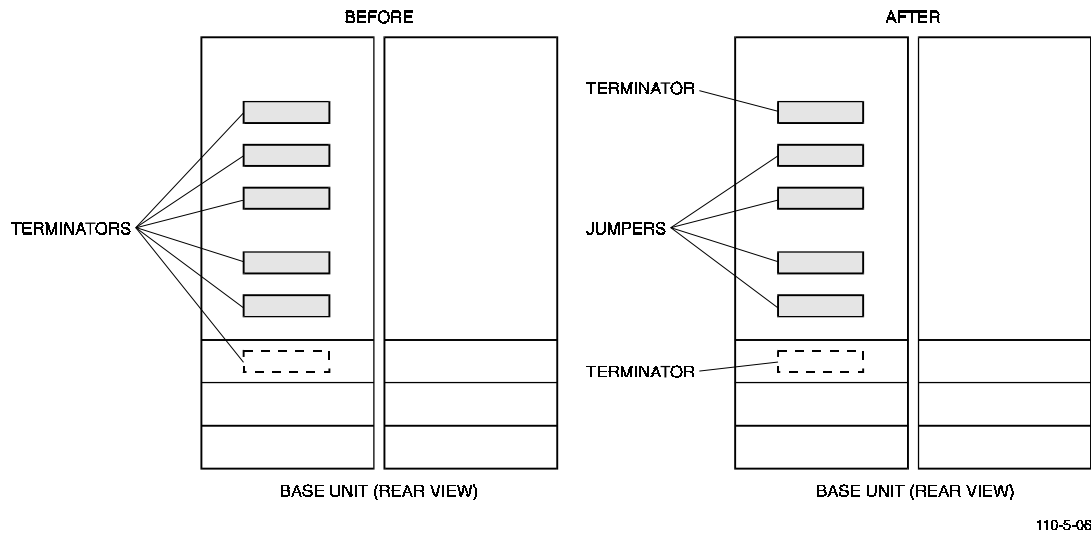


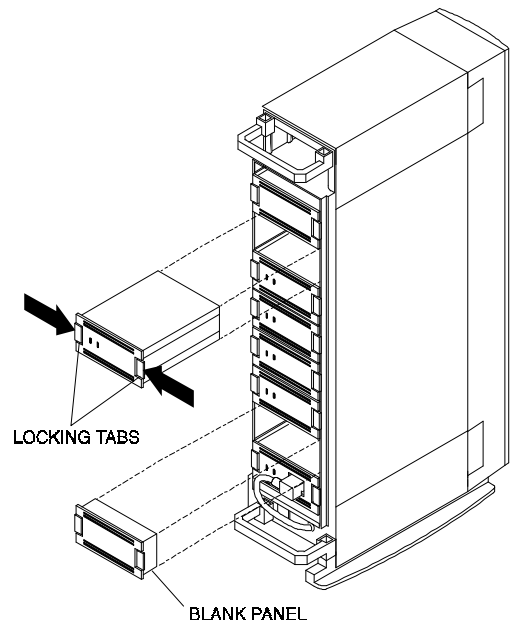
Figure 5-5. Terminator and Jumper



**Figure 5–6. Base Unit Terminator and Jumper Configurations**

## 5.4 Expansion Unit Preparation

1. Use the key provided to unlock and open all front and rear bezel doors ( Figure 5–2).
2. Remove all front and rear bezels from the expansion units by pushing down on the locking tabs at the bottom of each bezel ( Figure 5–2).
3. Remove all drives and blank filler panels in the expansion units. Press the two locking tabs to release a disk drive, and slide the drive out of the expansion unit as shown in Figure 5–7. Do not label the drives removed from the expansion units.

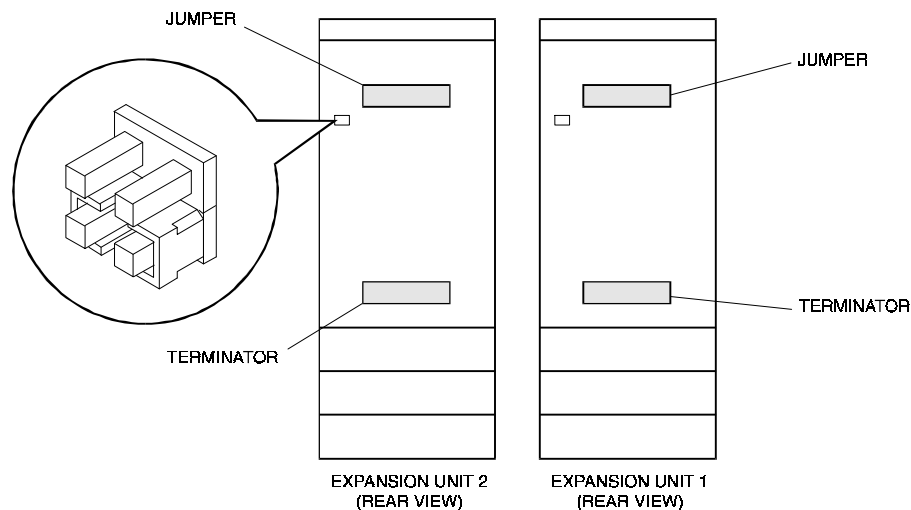
**Figure 5–7. Removing a Disk Drive or a Blank Panel**

4. Remove the safety screw at the upper left corner of the top blower and the lower right corner of the bottom blower at the rear of the expansion units (Figure 5-4).
5. Remove each blower by pressing the locking tabs with your thumb and middle finger and carefully pulling the blower straight out from the power connector (Figure 5-4). Repeat this step for each expansion unit.
6. The appearance of the backplane depends upon the version of your expansion unit. Inspect the backplane of the unit and determine if it has jumper pins next to the slot 2 connector as shown in Figure 5-8.
  - If the jumper pins are **not** present (see blowup, Figure 5-8), proceed to step 7.
  - If the jumper pins are present, install a StorageWorks jumper in the Shelf\_OK\_External\_Cables position as shown in Figure 5-8.
7. Remove the StorageWorks terminator and check that the SHELF\_OK jumper is installed as shown in the top view of Figure 5-5.

**NOTE**

The SHELF\_OK jumper allows the fault signals from the expansion unit to be fed back to the RAID controller. If your jumper/terminator has SHELF\_OK jumper pins, then a jumper must be installed in the SHELF\_OK position.

8. Remove the StorageWorks jumper and check that the SHELF\_OK jumper is installed as shown in the bottom view of Figure 5-5.
9. Replace the StorageWorks terminator and jumper in the locations shown in Figure 5-8.
10. Reinstall the blowers and safety screws in the expansion units.

**Figure 5-8. Expansion Unit Jumper and Terminator Locations**

110-5-08

## 5.5 Cable Installation

Install the BN21H-02 SCSI cables as follows:

1. Attach a red peel-off cable color code sticker at each end of one of the cables, approximately six-to-eight inches from each connector. Repeat this process for each remaining cable using the blue, green, and red/white peel-off stickers.

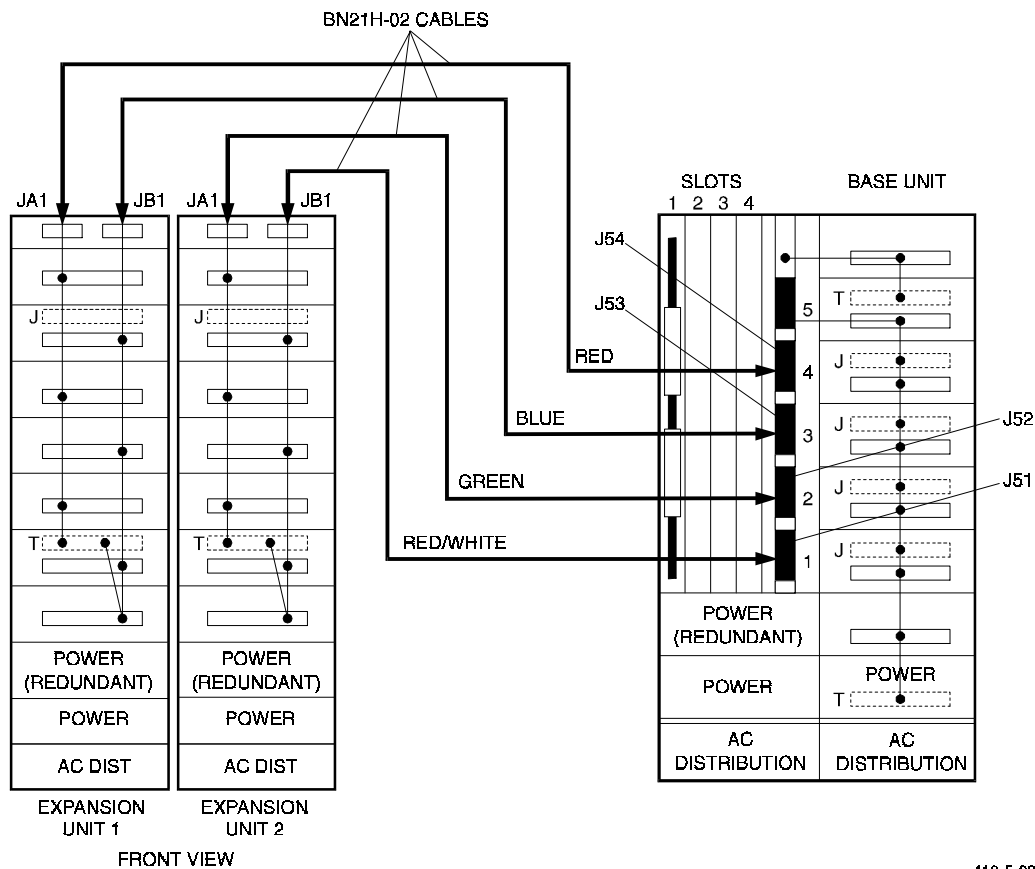
### CAUTION

Before installing any cables, inspect all connectors to make sure that there are no bent pins. Also, ensure the cables are firmly seated following each connection.

Refer to the cable connection diagram shown in Figure 5–9 when performing steps 2 through 10 below.

2. Connect one end of the cable with the **red/white** band to **JB1** of expansion unit 2 (upper-right).

**Figure 5–9. Base/Expansion Unit Cable Connections**



3. Connect one end of the cable with the **green** band to **JA1** of expansion unit 2 (upper-left).
4. Connect one end of the cable with the **blue** band to **JB1** of expansion unit 1 (upper-right).
5. Connect one end of the cable with the **red** band to **JA1** of expansion unit 1 (upper-left).
6. Connect the cable with the **red/white** band (channel 1) to the bottom connector (**J51**) on the backpanel of the base unit ( Figure 5–9).
7. Connect the cable with the **green** band (channel 2) to connector (**J52**) on the backplane of the base unit (Figure 5–9).
8. Connect the cable with the **blue** band (channel 3) to connector (**J53**) on the backplane of the base unit (Figure 5–9).
9. Connect the cable with the **red** band (channel 4) to connector (**J54**) on the backplane of the base unit (Figure 5–9).
10. Verify that the four BN21H-02 SCSI cables connections between the expansion and base units are as shown in Figure 5–9.

**CAUTION**

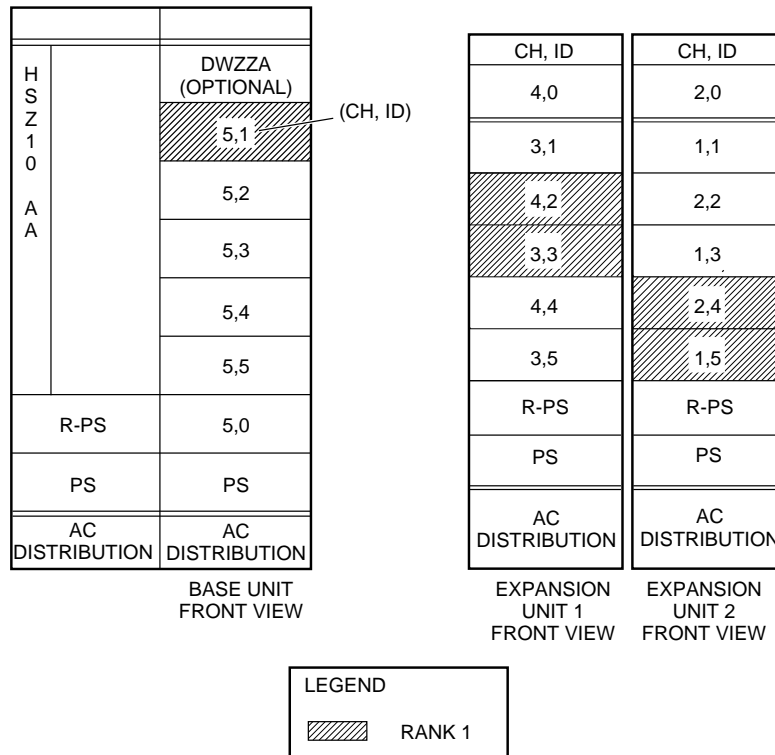
The five drives in the base unit must be inserted in locations with the same channel and SCSI ID as originally assigned to the drive. This allows the operating system to recognize the original LUNs.

11. Move the four labeled drives located at channel, ID: **[4, 2]** **[3, 3]** **[2, 4]** and **[1, 5]** from the base unit to the drive slots in the expansion units as shown in Figure 5–10.
12. Run the RAID utility and verify that the status of the original drives is optimal. If you have any mismatches, shut down the subsystem and recheck all cable connections, terminator/jumper assignments, and drive placements and make the appropriate corrections.

**NOTE**

We recommend adding five drives (one rank) at a time and then verifying that they are configured correctly in the following steps.

13. Once successful, install and label five new drives into the subsystem units to match the configuration shown in Figure 5–11.
14. Run the RAID utility. Verify that the status of the new drives is displayed as spare drives in the proper array channel/SCSI ID position.
15. If you are expanding to a 15-drive subsystem, install and label the five remaining new drives as shown in Figure 5–11.

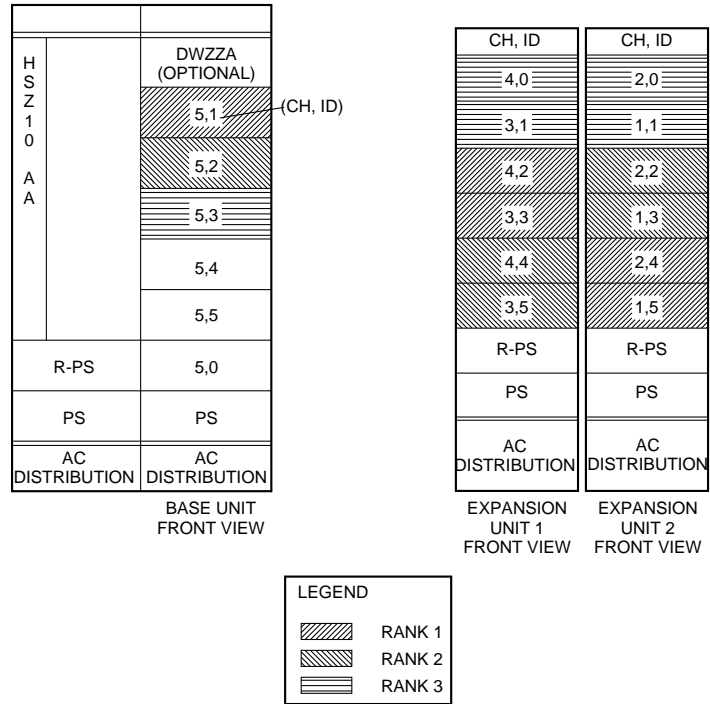
**Figure 5–10. Subsystem Logical Drive Map (Rank 1)**

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16. Run the RAID utility. Verify that the status of the new drives is displayed as spare drives in the proper array channel/SCSI ID position.
17. Replace the filler panels and sliding tray into the base unit and tighten the captive screws.
18. Remove the bottom-left knockout panel from the controller side of the base unit front bezel (Figure 5–12).
19. Install filler panels in any open drive slots in the expansion units.
20. Remove the top-right knockout panel from the front bezel of each expansion unit (Figure 5–12).
21. Replace the front bezel on the base unit and route the SCSI cables through the bottom bezel cutout as shown in Figure 5–12.
22. Replace the front bezels on the expansion units and route the SCSI cables through the top bezel cutouts as shown in Figure 5–12.
23. Use the RAID utility to configure the new drives in the subsystem.

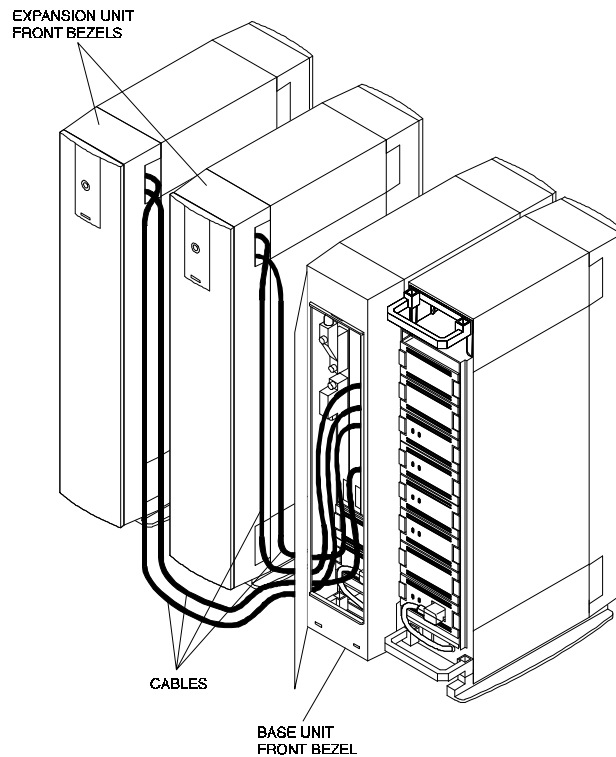


Figure 5–11. Subsystem Logical Drive Map (Ranks 1, 2, and 3)



MR-0177-93

Figure 5–12. Upgraded Subsystem SCSI Cable Routing



110-5-11

## *Expanding a 10/15-Drive System to 20/30 Drives*

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*This chapter contains the procedures to expand a 10 to 15-drive subsystem to a 20 to 30-drive expanded subsystem. The expansion procedure describes how to shut down and disassemble the existing subsystem, change cable connections, move existing drives and verify proper subsystem operation.*

---

This chapter describes the following:

- Verifying the operation of the 10 to 15-drive subsystem
- Unpacking the expansion kit
- Expansion unit preparation
- SCSI cable reconnection procedure

### **NOTE**

This expansion requires a general understanding of SCSI devices and basic hardware installation procedures and should be performed by qualified service personnel.

### **6.1 Verifying the Operation of the 10 to 15-Drive Subsystem**

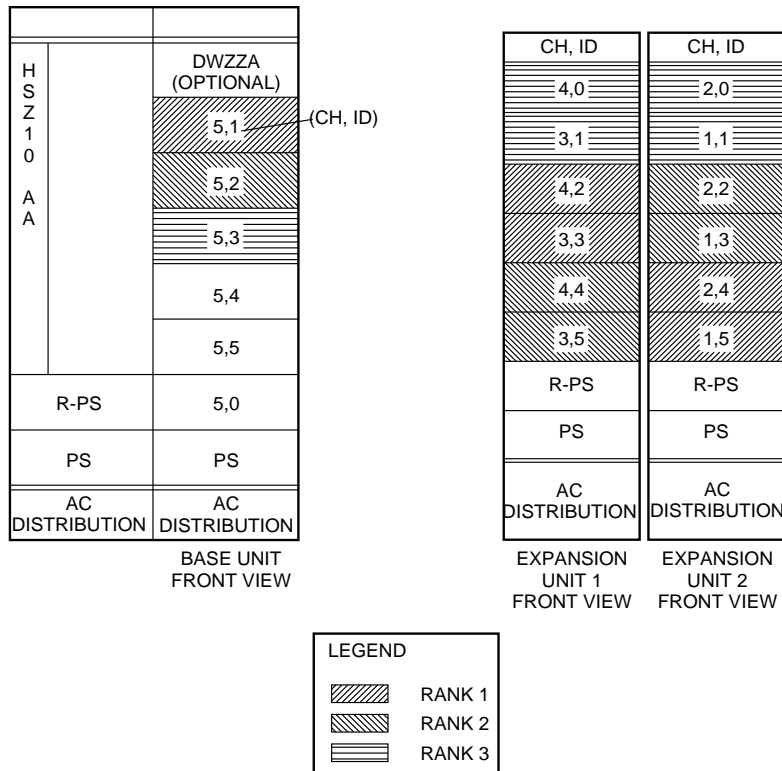
### **WARNING**

The base unit weighs approximately 70 lbs. More than one person is required to move the unit safely.

Verify that the 10 to 15-drive subsystem is operating at optimal level before beginning the expansion using the following procedure:

1. Run the parity check utility if the operating system is set up for RAID 0+1 or 5. RAID 0 does not have parity and therefore cannot be verified.
2. Perform a backup of all LUNs in the array.
3. Label all drives in the existing subsystem by channel and ID. See Figure 6-1.
4. Power down the operating system through normal shutdown procedure.

**Figure 6-1. 10/15-Drive and Channel/ID Designations**



MR-0177-93

## 6.2 Unpacking the Expansion Kit

Before unpacking the expansion kit, check all packing slips to ensure that the correct components have been shipped. Inspect the boxes for damage. Retain all boxes and packing materials in case you need them.

The expansion kit should contain the following items:

**Table 6-1. Expansion Kit Components**

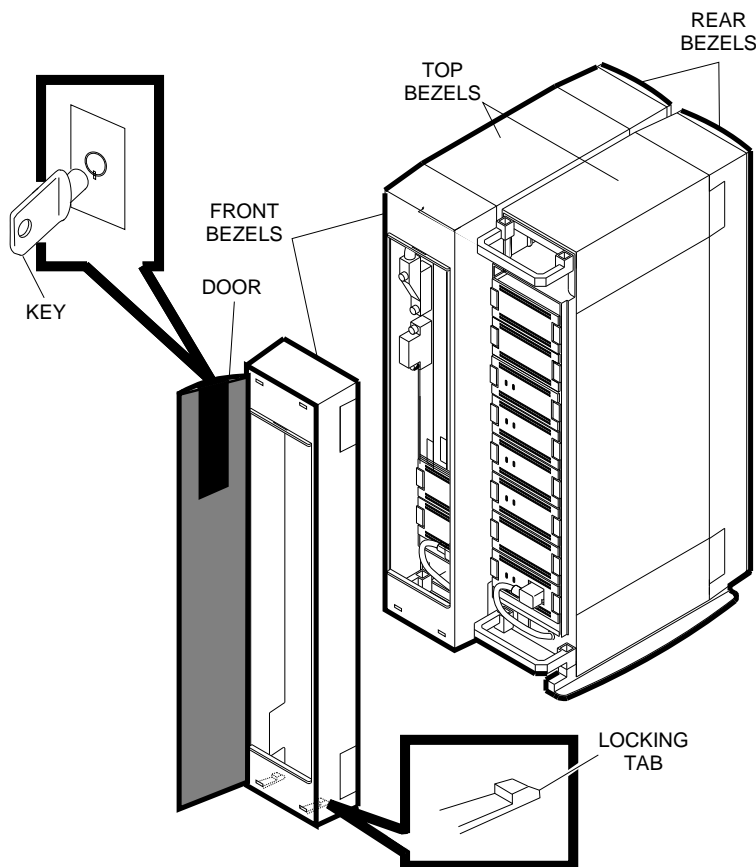
Item	Quantity
Drive expansion units	2
AC power cords	2
Disk Drives	Optional

### 6.3 Expansion Unit Preparation

Prepare the installed and the two new upgrade expansion units as follows:

1. Position the upgrade expansion units near the existing subsystem.
2. Use the key provided to unlock and open all front and rear bezel doors (Figure 6–2).

**Figure 6–2. Removing a Bezel**



MR-0209-93

3. Remove the front and rear bezels from the base and expansion units by pushing down on the locking tabs at the bottom of each bezel.

#### CAUTION

Before removing any disk drive SBB from the base unit, ensure to label the SBB with the **Channel** and **ID** number of its pre-installed slot location in the unit. This information must be recorded to allow you to re-install the drives and preserve the original state/configuration of the subsystem. Failure to re-install the drives in the same slot locations may result in loss of data and/or state/configuration information.

4. Remove all drives and blank panels in the installed and upgrade expansion units by pressing the two locking tabs to release the drive or panel, and sliding them out of the expansion unit as shown in Figure 6–3. Do not label the drives.
5. Remove the safety screw at the upper left corner of the top blower and the lower right corner of the bottom blower at the rear of the expansion units (Figure 6–4).
6. Remove each blower by pressing the locking tabs with your thumb and middle finger and carefully pulling the blower straight out from the power connector (Figure 6–4). Repeat this step for each expansion unit.
7. The appearance of the backplane depends upon the version of your expansion unit. Inspect the backplane of each unit and determine if it has jumper pins next to the slot 2 connector as shown in Figure 6–5.
  - If the jumper pins are **not** present (see blowup, Figure 6–5), proceed to step 8.
  - If the jumper pins are present, install a StorageWorks jumper in the Shelf\_OK\_External\_Cables position as shown in Figure 6–5.
8. Remove the StorageWorks terminator and check that the SHELF\_OK jumper is installed as shown in the top view of Figure 6–6.

**NOTE**

The SHELF\_OK jumper allows the fault signals from the expansion unit to be fed back to the RAID controller. If your jumper/terminator has SHELF\_OK jumper pins, then a jumper must be installed in the SHELF\_OK position.

9. Remove the StorageWorks jumper and check that the SHELF\_OK jumper is installed as shown in the bottom view of Figure 6–6.
10. Replace the StorageWorks terminator and jumper in the locations shown in Figure 6–5.
11. Reinstall the blowers and safety screws in the expansion units.

Figure 6-3. Removing a Disk Drive or a Blank Panel

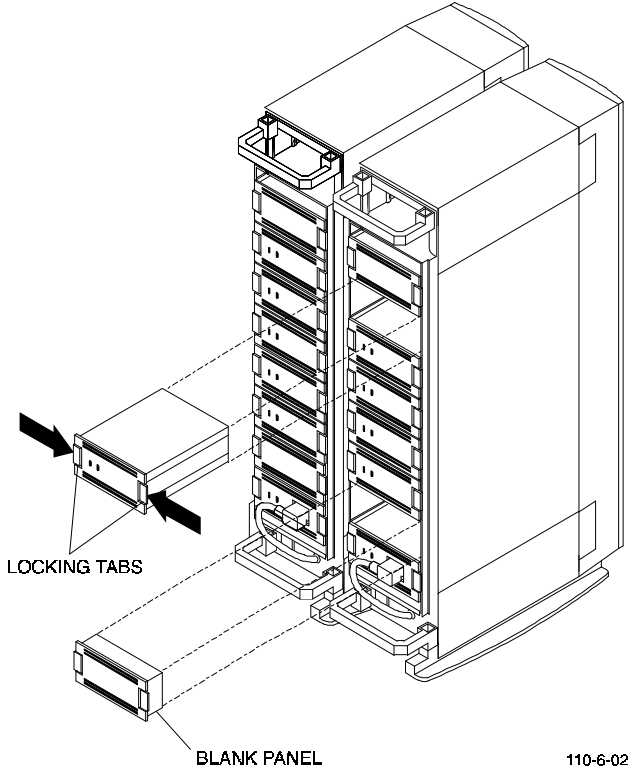
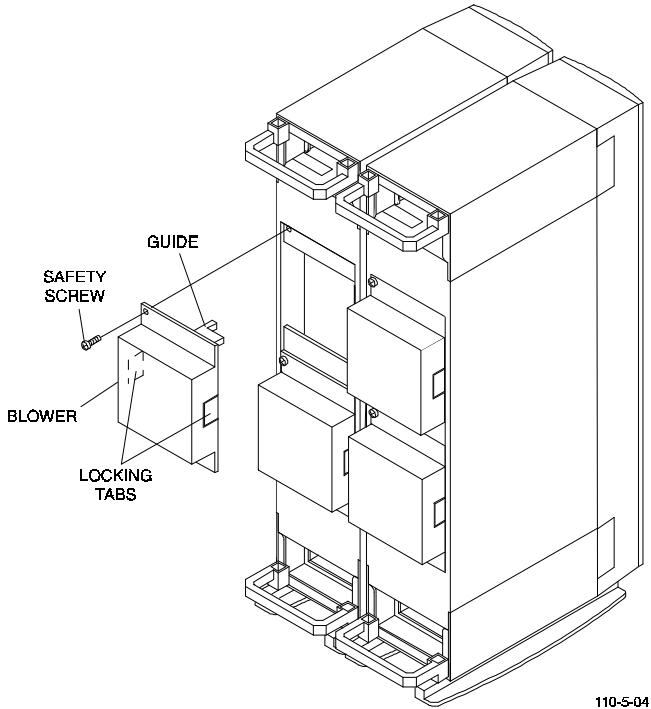
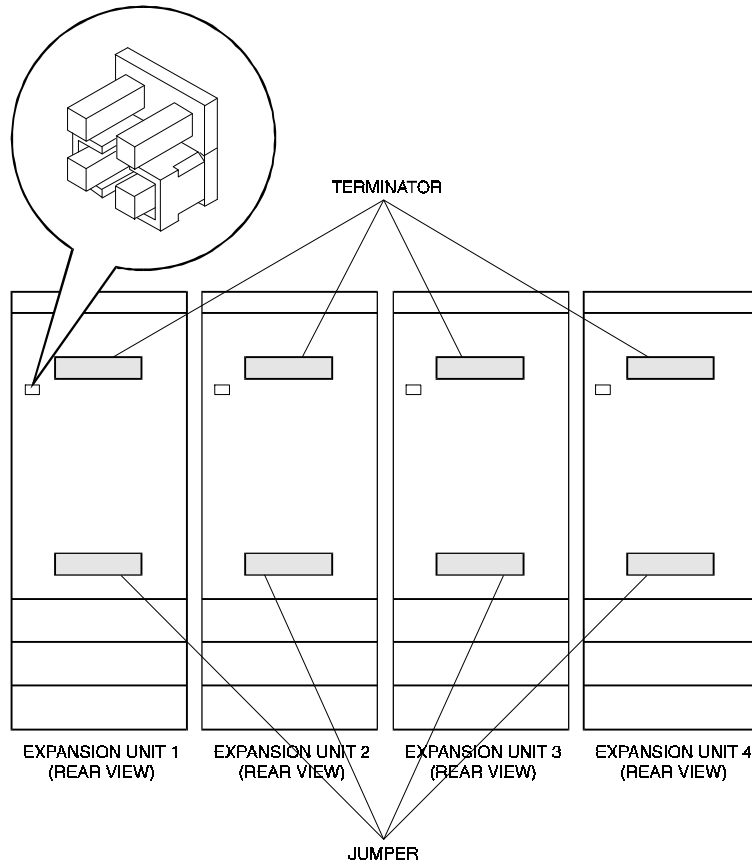


Figure 6-4. Removing A Blower

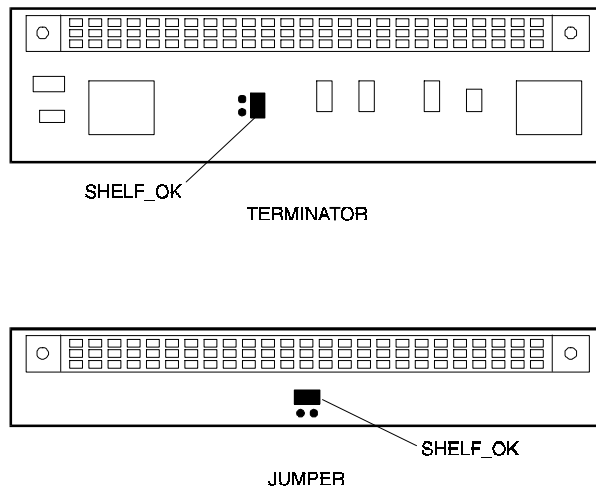


**Figure 6-5. Expansion Unit Jumper and Terminator Locations**



110-X-02

**Figure 6-6. Terminator and Jumper**



110-5-05

## 6.4 SCSI Cable Reconnection Procedure

Reconnect the SCSI cables between the expansion and base units as follows:

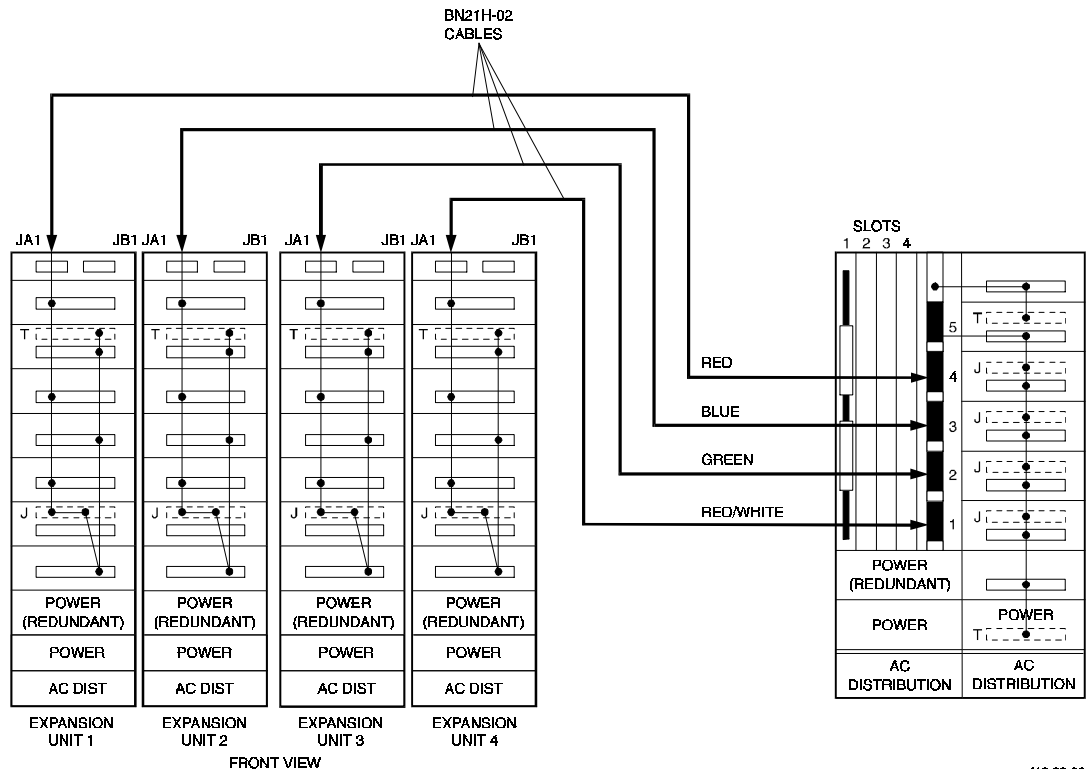
### CAUTION

Before installing any cables, inspect all connectors to make sure that there are no bent pins. Be careful not to bend any pins. Seat the cables on the connectors properly before attempting connection. Applying excessive force may damage a connector if not seated properly.

Refer to Figure 6–7 when performing the following procedure.

1. Disconnect the cable with the **red/white** band from expansion unit 2 connector **JB1** (upper-right) and reconnect it to connector **JA1** of expansion unit 4.
2. Disconnect the cable with the **green** band from expansion unit 2 connector **JA1** (upper-left) and reconnect it to connector **JA1** of expansion unit 3.
3. Disconnect the cable with the **blue** band from expansion unit 1 connector **JB1** and reconnect it to connector **JA1** of expansion unit 2.
4. The cable with the **red** band remains connected to expansion unit 1 connector **JA1**. Do not disconnect this cable.

Figure 6–7. Subsystem/Expansion Unit Cable Connections



110-05-06



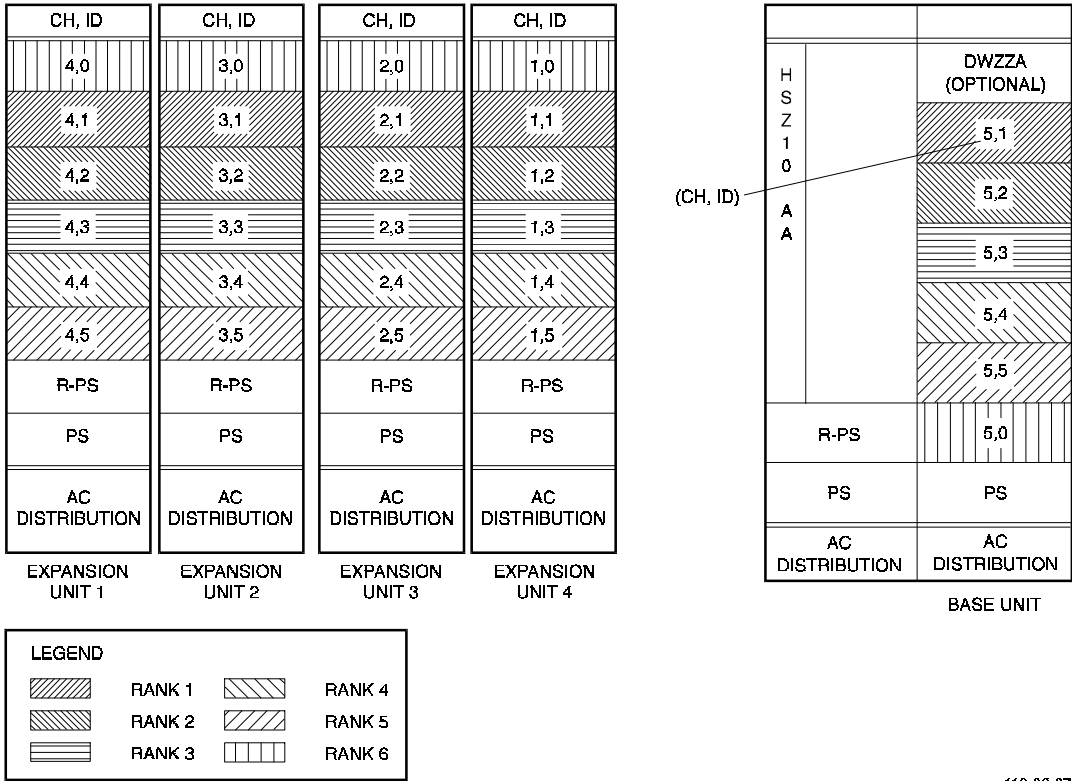
5. Dress the cables out the top front of the expansion units as shown in Figure 6–9 and replace the front bezels.
6. Verify that the cables are connected as shown in Figure 6–7 and that the connectors are firmly seated before proceeding.

**CAUTION**

The 10-to-15 drives in the base subsystem must be inserted in locations with the same channel and SCSI ID as originally assigned to the drive. This allows the operating system to recognize the original LUNs. Also, the drives removed from expansion units 1 and 2 at the beginning of this procedure are re-installed in different slot locations in the expansion units. Figure 6–8 is a logical drive map of the fully installed 20/30-drive expansion. Refer to Figure 6–8 for the slot locations of each rank when re-installing the drives in the following procedure. We recommend that you re-install five drives at a time and then verify that they are configured correctly by running the RAID utility in the following step.

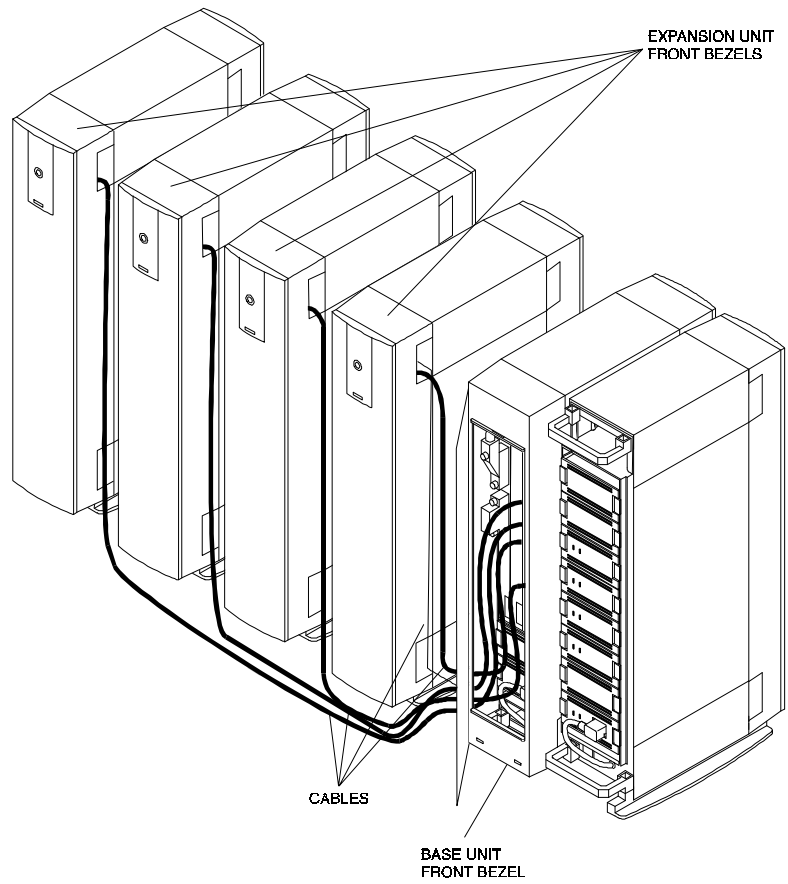
7. Re-install all of the drives removed from expansion units 1 and 2 (Figure 6–8) and run the RAID utility to verify that the status of the original drives is set to optimal. If you have any mismatches, recheck all cable connections, terminator/jumper assignments, and drive placements and make the appropriate corrections.
8. Install the new drives into the expansion units (five at a time) and run the RAID utility to verify that the new drives are displayed as spare drives in the correct array channel/SCSI ID position as defined in Figure 6-8.
9. Replace the base unit front bezel while routing the four cables through the bottom-left cutout as shown in Figure 6-9.
10. Remove the upper-right knockout panel from the front bezel of each expansion unit and route the four SCSI cables from the base unit through the top cutout of each expansion unit as shown in Figure 6-9.
11. Replace all other bezels and use the key provided to lock all bezel doors.
12. Use the RAID utility to configure the LUNs/RAID sets in the subsystem.

Figure 6-8. 20/30 Drive Subsystem Logical Drive Map



110-06-07

**Figure 6-9. SCSI Cable Routing between the Base and Expansion Units**



110-6-08

## *Expanding a 5-Drive System to 20/30 Drives*

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*This chapter contains the procedures to expand a 5-drive base subsystem to a 20 to 30-drive expanded subsystem. The expansion procedure describes how to shut down and disassemble the base subsystem, move or swap terminators and jumpers, install cables, move existing drives and verify proper subsystem operation.*

---

This chapter is divided into the following major topics:

- Verifying the operation of the base unit
- Unpacking expansion kit
- Base unit preparation
- Expansion unit preparation
- SCSI cable installation

### **NOTE**

This expansion requires a general understanding of SCSI devices and basic hardware installation procedures and should be performed by qualified service personnel.

### **7.1 Verifying the Operation of the Base Unit**

### **WARNING**

The base unit weighs approximately 70 lbs. More than one person is required to move the unit safely.

Verify that the base unit is operating at optimal level before beginning the expansion using the following procedure:

1. Run the parity check utility if the operating system is set up for RAID 0+1 or 5. RAID 0 does not have parity and therefore cannot be verified.
2. Perform a backup of all LUNs in the array.
3. Label all drives in the base unit by channel and ID. See Figure 7-1.
4. Power down the operating system through normal shutdown procedure.

**Figure 7-1. Base Unit Drive and Channel/ID Designations**

H S Z 1 0  A A	DWZZA (OPTIONAL)	
	5,1	(CH, ID)
	4,2	
	3,3	
	2,4	
	1,5	
R-PS	1,0	
PS	PS	
AC DISTRIBUTION	AC DISTRIBUTION	

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## 7.2 Unpacking the Expansion Kit

Before unpacking the expansion material, check all packing slips to ensure that the correct components have been shipped. Inspect the boxes for damage. Retain all boxes and packing materials in case you need them.

The 20 to 30-drive expansion kit should contain the following items:

**Table 7-1. 20/30-Drive Expansion Kit Components**

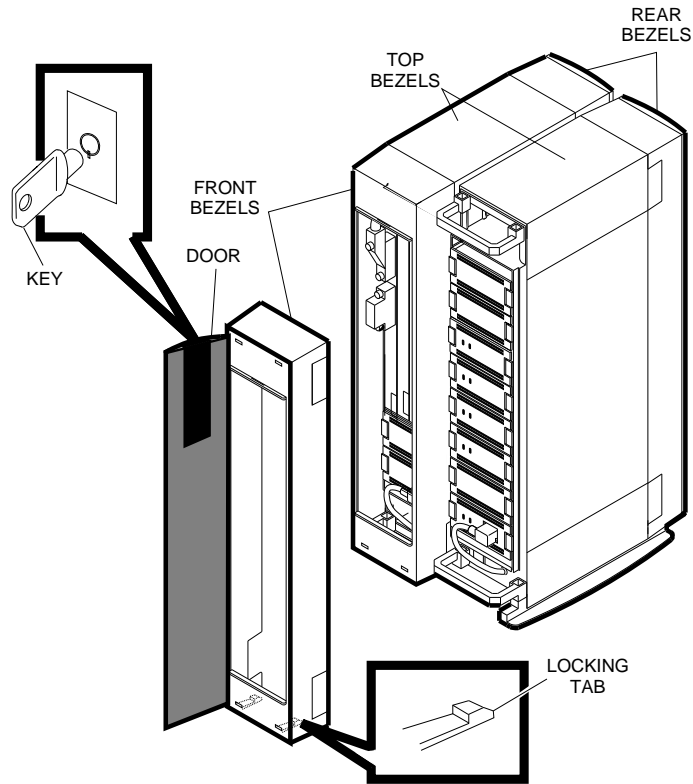
Item	Quantity
Drive expansion units	2
Disk drives	Optional
StorageWorks jumpers	4
Cable color code stickers	1
Cables, 2 meter (BN21H-02)	4
AC power cords	2

## 7.3 Base Unit Preparation

Prepare the base unit for the upgrade as follows:

1. Use the key provided to unlock all front and rear bezel doors (Figure 7-2).
2. Remove the front and rear bezels from the base unit by pushing down on the locking tabs at the bottom of each bezel (Figure 7-2).

Figure 7-2. Removing a Bezel



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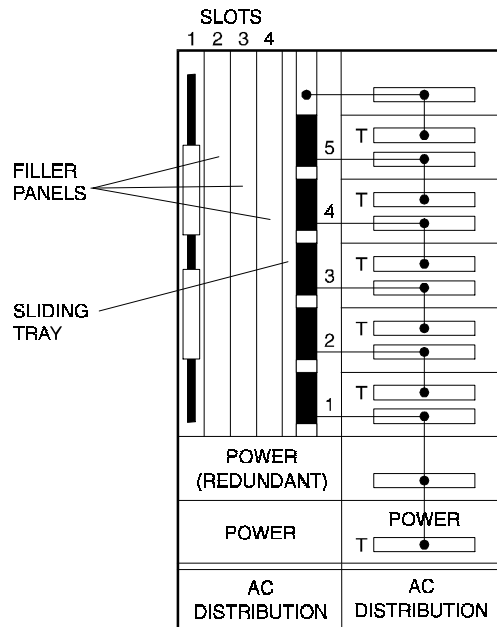
**CAUTION**

Before removing any disk drive SBB from the base unit, ensure to label the SBB with the **Channel** and **ID** number of its pre-installed slot location in the unit. This information must be recorded to allow you to re-install the drives and preserve the the original state/configuration of the subsystem. Failure to re-install the drives in the same slot locations may result in loss of data and or state/configuration information.

3. Loosen the captive screws and remove the three filler panels on the controller side of the base unit (Figure 7-3).
4. Loosen the sliding tray captive screws and slide the tray out of the base unit (Figure 7-3).
5. At the rear of the base unit, use a Phillips screwdriver and remove the safety screw from the two blowers on the drive side ( Figure 7-4).
6. Remove each blower by pressing the locking tabs with your thumb and middle finger and carefully pulling the blower straight out from the power connector (Figure 7-4).
7. Locate the six terminators at the rear of the disk drive side of the unit. Figure 7-5 shows a jumper and a terminator.

8. Remove the four terminators in the middle of the unit and leave the top and bottom terminators in place (bottom terminator is hidden).
9. Install four jumpers in place of the terminators you just removed. Figure 7-6 shows a *before* and *after* view of the jumpers and terminators in the base unit.
10. Reinstall the blowers by aligning the blower connector and insert the module straight in until both locking tabs snap into place.
11. Tighten the safety screw in the upper-left corner of the top blower and in the lower right-hand corner of the bottom blower.

**Figure 7-3. Removing Filler Panel and Sliding Tray from Base Unit**



110-6-XX

Figure 7-4. Removing A Blower

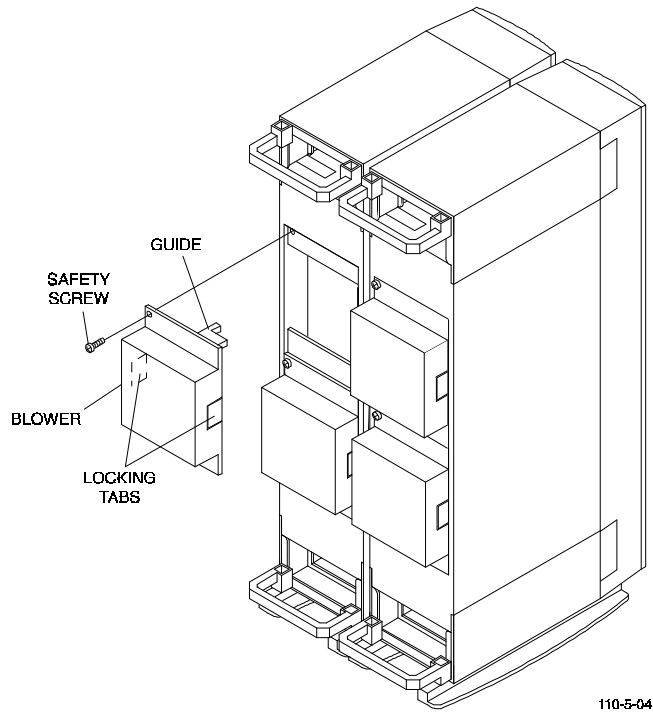
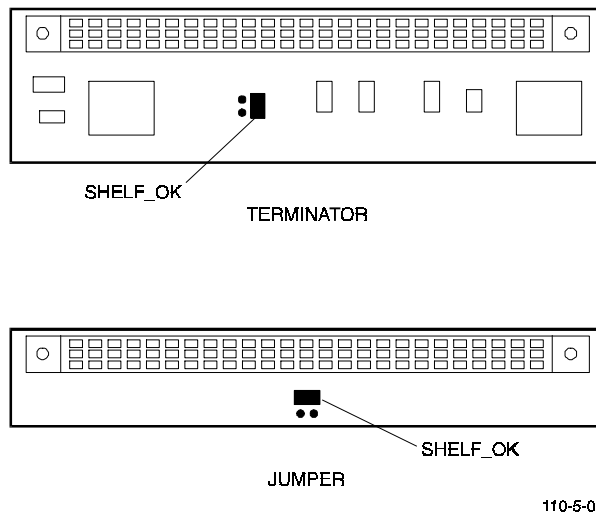
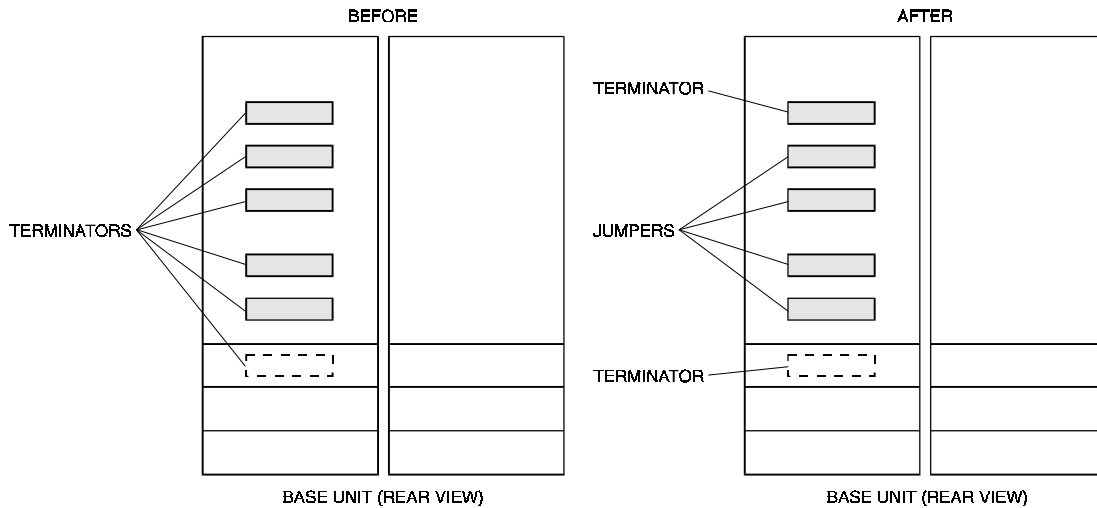


Figure 7-5. Terminator and Jumper





**Figure 7-6. Base Unit Terminator and Jumper Configurations**

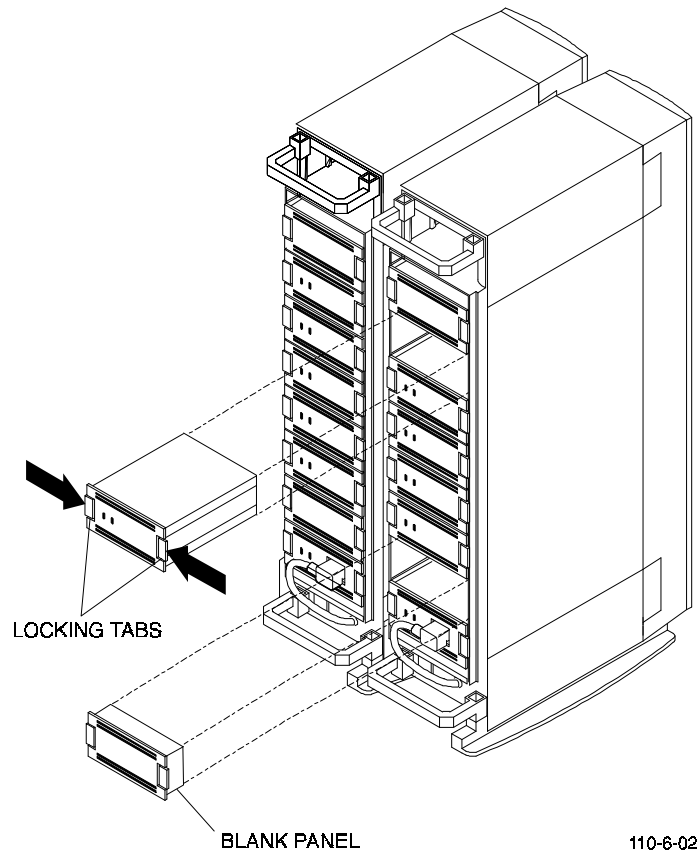
110-5-06

## 7.4 Expansion Unit Preparation

Prepare the four expansion units as follows:

1. Use the key provided to unlock and open all front and rear bezel doors (Figure 7-2).
2. Remove all front and rear bezels from the expansion units by pushing down on the locking tabs at the bottom of each bezel (Figure 7-2).
3. Remove all drives and blank filler panels in the expansion units. Press the two locking tabs to release a disk drive, and slide the drive out of the expansion unit as shown in Figure 7-7. Do not label the drives.
4. Remove all of the blowers from the four expansion units by removing the safety screw in the upper left-corner of the top blower and the lower-right corner of the bottom blower. Repeat this step for each expansion unit.
5. The appearance of the backplane depends upon the version of your expansion unit. Inspect the backplane of each unit and determine if it has jumper pins next to the slot 2 connector as shown in Figure 7-8.
  - If the jumper pins are **not** present (see blowup, Figure 7-8) proceed to step 6.
  - If the jumper pins are present, install a StorageWorks jumper in the Shelf\_OK\_External\_Cables position as shown in Figure 7-8.
6. Remove the StorageWorks terminator and check that the SHELF\_OK jumper is installed as shown in the top view of Figure 7-5.

**Figure 7-7. Removing a Disk Drive or a Blank Panel**

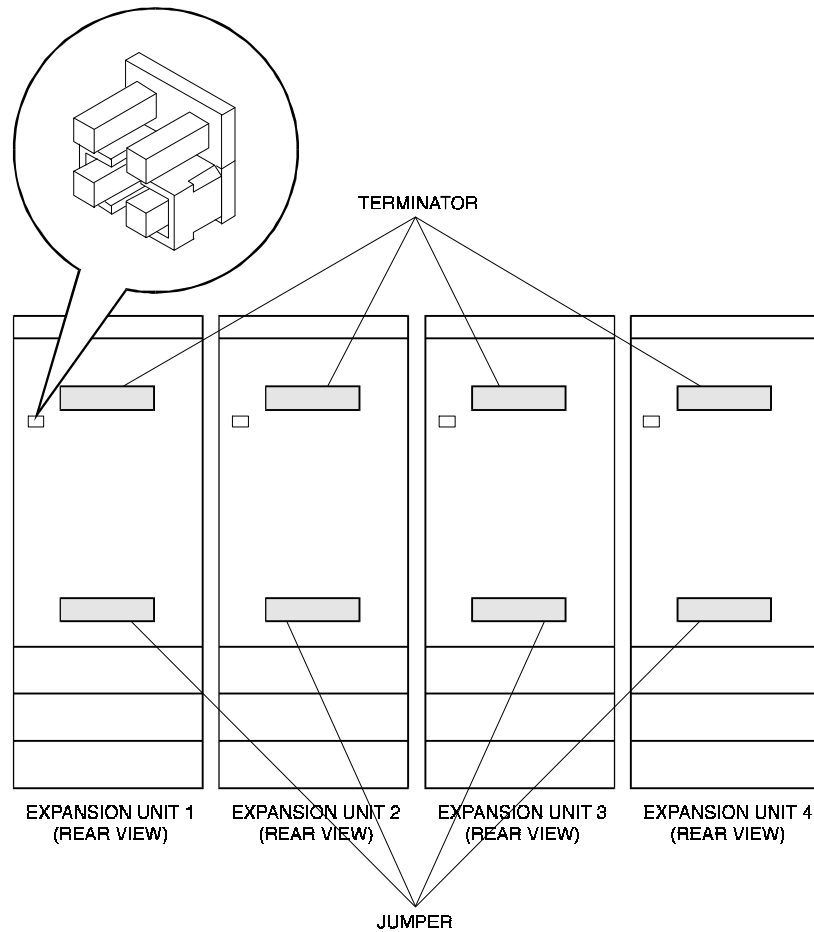


**NOTE**

The SHELF\_OK jumper allows the fault signals from the expansion unit to be fed back to the RAID controller. If your jumper/terminator has SHELF\_OK jumper pins, then a jumper must be installed in the SHELF\_OK position.

7. Remove the StorageWorks jumper and check that the SHELF\_OK jumper is installed as shown in the bottom view of Figure 7-5.
8. Replace the StorageWorks terminator and jumper in the locations shown in Figure 7-8.
9. Reinstall the blowers and safety screws in the expansion units.

**Figure 7-8. Expansion Unit Jumper/Terminator Locations**



110-X-02

## 7.5 SCSI Cable Installation

Install the BN21H-02 SCSI cables as follows:

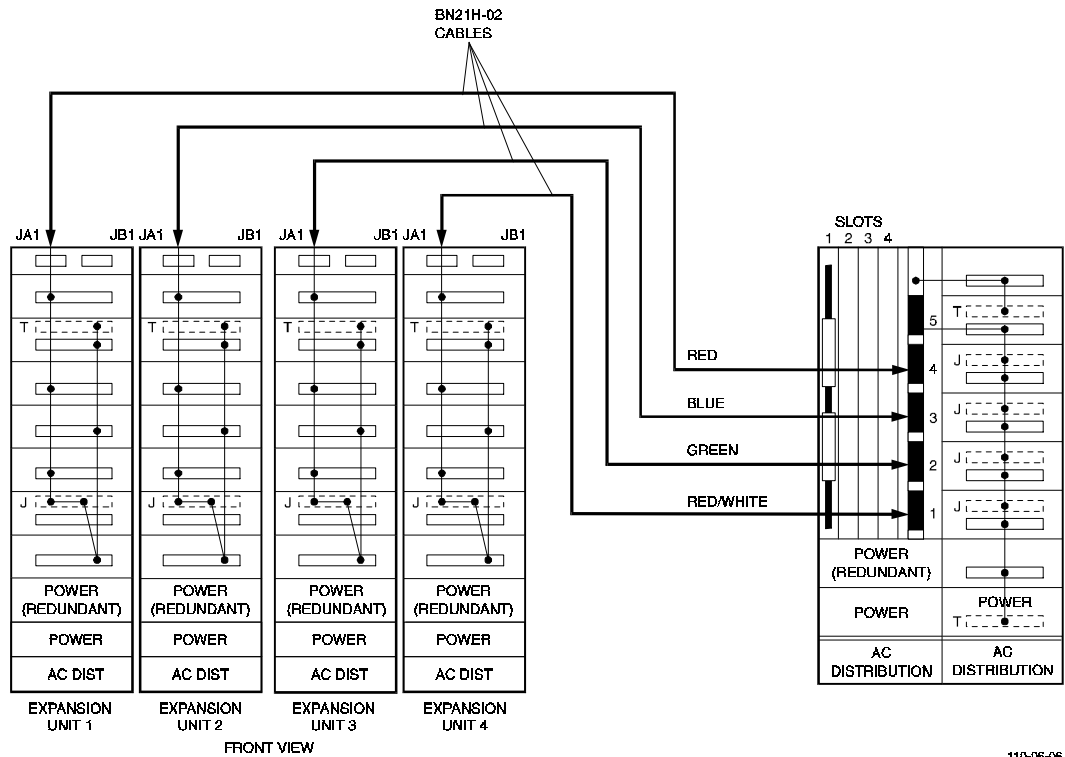
1. Attach a red peel-off sticker at each end of one of the cables, approximately six-to-eight inches from each connector. Repeat this process for each remaining cable using the blue, green, and red/white peel-off stickers

### CAUTION

Before installing any cables, inspect all connectors to make sure that there are no bent pins. Also, ensure the cables are firmly seated following each connection.

Refer to Figure 7-9 when performing steps 2 through 9.

Figure 7-9. Base/Expansion Unit SCSI Cable Connections



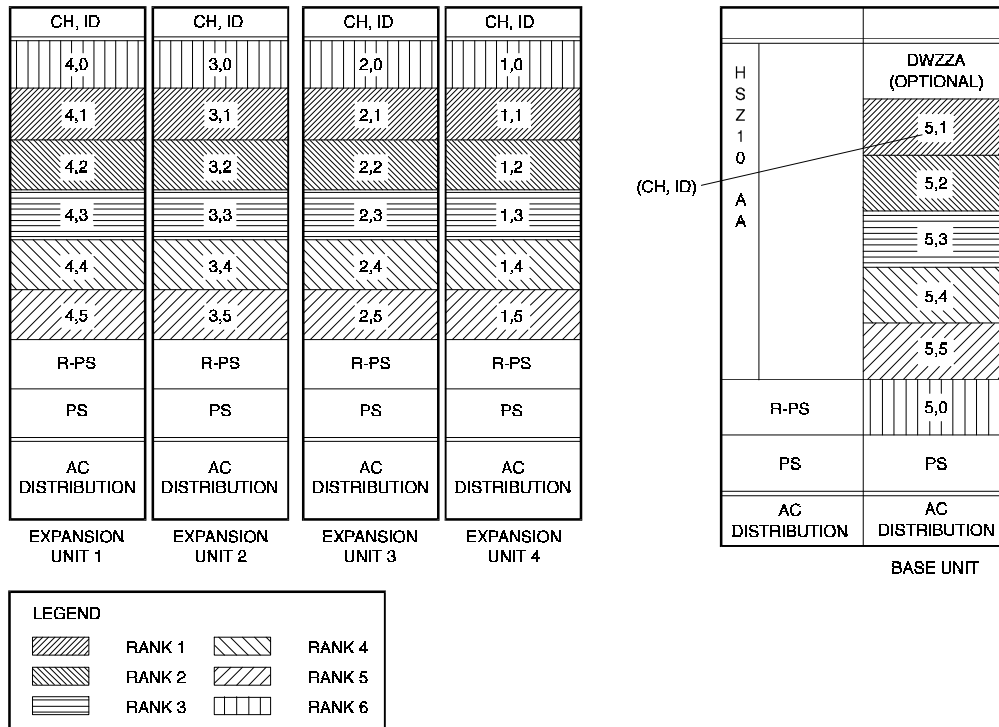
2. Connect one end of the cable with the **red/white** band to connector **JA1** of expansion unit 4 (upper-left).
3. Connect one end of the cable with the **green** band to connector **JA1** of expansion unit 3 (upper left).
4. Connect one end of the cable with the **blue** band to connector **JA1** of expansion unit 2 (upper left).
5. Connect one end of the cable with the **red** band to connector **JA1** of expansion unit 1 (upper left).
6. Connect the cable with the **red/white** band (channel 1) to the bottom connector (**J51**) on the backplane of the base unit.
7. Connect the cable with the **green** band (channel 2) to connector **J52** on the backplane of the base unit.
8. Connect the cable with the **blue** band (channel 3) to connector **J53** on the backplane of the base unit.
9. Connect the cable with the **red** band (channel 4) to connector **J54** on the backplane of the base unit.
10. Dress the cables out the top front of the expansion units as shown in Figure 7-11.
11. Verify that the cables are connected as shown in Figure 7-9 and that the connectors are firmly seated before proceeding.

**CAUTION**

The drives removed from the base unit must be re-installed in slot locations with the same channel and SCSI ID as originally assigned to the drive. This allows the operating system to recognize the original LUNs. Figure 7-10 is a logical drive map of the fully installed 20/30-drive subsystem upgrade. Refer to Figure 7-10 for the slot locations of each rank when re-installing the drives in the following procedure. We recommend that you install five drives at a time and then verify that they are configured correctly by running the RAID utility.

12. Re-install the drives removed from the base unit into the *rank 1* slot locations as defined in Figure 7-10 and run the RAID utility to verify that the original drives are set to optimal condition. If you have any mismatches, recheck all cable connections, terminator/jumper assignments, and drive placements and make the appropriate corrections.
13. Install the new drives into the expansion units into the *rank 2* through *6* slot locations (five at a time) and run the RAID utility after each rank installation to verify that the new drives are displayed as spare drives in the correct array channel/SCSI ID position as defined in Figure 7-10.

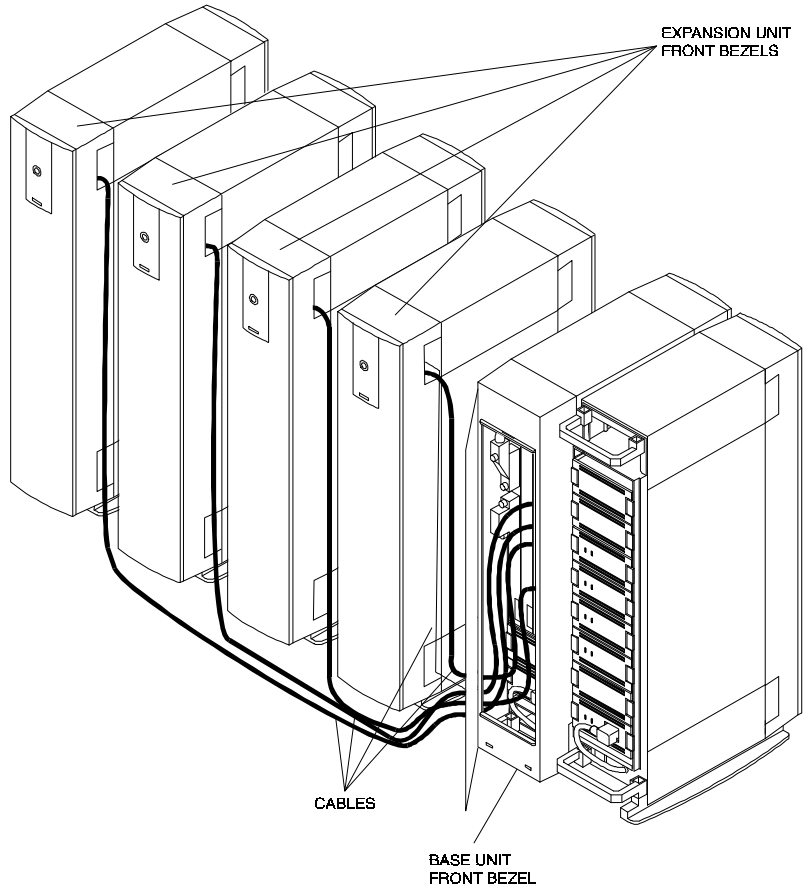
**Figure 7-10. 20/30-Drive Subsystem Logical Drive Map (Ranks 1-6)**



110-08-07

14. Replace the base unit front bezel while routing the four cables through the bottom-left cutout as shown in Figure 7-11.
15. Remove the upper-right knockout panel from the front bezel of each expansion unit and route the four SCSI cables from the base unit through the top cutout of each expansion unit as shown in Figure 7-11.
16. Replace all other bezels and use the key provided to lock all bezel doors.
17. Use the RAID utility to configure the LUNs/RAID sets in the subsystem.

**Figure 7-11. Expanded Subsystem SCSI Cable Routing**



110-6-08

## Operation and Troubleshooting

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*This chapter describes subsystem indicators, monitoring methods, error handling and troubleshooting information. It also contains component replacement procedures, subsystem reconstruction, the parity/repair check required after a component has been replaced, and a troubleshooting table which lists symptoms and corrective actions.*

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The chapter is divided into the following discussions:

- Subsystem indicators
- User monitoring methods
- SBB, controller, and blower replacement
- Drive reconstruction
- Parity check/repair
- Error handling and troubleshooting

### 8.1 Subsystem Indicators

Once installed and configured, the subsystem runs with little user intervention. Intervention is required only if a disk drive fails, the array configuration needs to be changed, or if any other subsystem component needs to be replaced.

The subsystem provides self-monitoring through two major components:

- HSZ10-AA controller
- Subsystem shelves

#### 8.1.1 Monitoring through the HSZ10-AA Controller

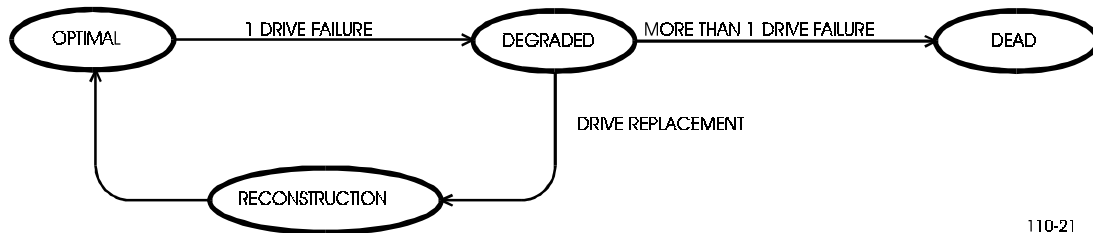
The controller monitors drive operation and logical unit (LUN) status. If certain errors occur on a drive, the controller changes the status of a drive or LUN. A change in drive or LUN status is a mechanism to alert the user to the current condition of the array or drives and that maintenance steps may be needed. LUN status is discussed in detail in Section 8.1.1.1; drive status is discussed in detail in Section 8.1.1.2.

In addition, the HSZ10-AA controller is responsible for setting the fault indicators on the disk drive SBBs. This is done when the controller determines a drive has failed or the user has actively failed a drive through the utilities. Refer to the appropriate *StorageWorks RAID Array 110 Utility User's Guide* for information on your operating system.

### 8.1.1.1 LUN Status

The LUN or grouping of the drives can be in different states. There are four possibilities for status as illustrated in Figure 8–1.

**Figure 8–1. LUN State Diagram**



110-21

**Table 8–1. LUN Status**

Status	Description
Optimal	The array is operating at an optimal level. This is the condition during normal operation.
Degraded	The LUN is operating in degraded mode. The array is still functioning, but a single drive could have failed. This state is only valid for RAID levels that provide redundancy (1, 0+1, 3, and 5). In order to return the LUN unit to optimal, reconstruction of the data must be done.
Dead	The LUN unit is no longer functioning. This is typical when two or more drives have failed.
Reconstruction	The array controller is currently reconstructing the LUN unit using good data and parity information. This state is valid only for RAID levels, 1, 0+1, 3, and 5 which provide redundancy.

As described in Table 8–1, an *optimal* status is the desired condition for normal operation. If a drive failure does occur in a redundant configuration (RAID 1, 0+1, 3, or 5), the subsystem is operating in a degraded mode. When the array is in the *degraded* mode, you can still continue to use the array.

In the RAID 1 and 0+1 case, the array controller retrieves the failed drive's data from its mirrored drive whenever you read or write to a LUN in the *degraded* mode. In the RAID 3 and 5 case, the array controller determines if the I/O would be directed to the failed drive as data or parity. For the I/O that must be written to the data block on the failed drive, the array controller writes the new data to the operational drives in data blocks. For the I/O that must be written to a data block on the failed drive, the array controller writes the data to the drives that contain the data blocks for the I/O, and recalculates the parity for the parity block of the I/O.

Whenever you issue an I/O that requires the array controller to read from the failed drive, the array controller recalculates the data and parity blocks from the data and parity on the operational drives.



If a second drive failure occurs, the array is in a *dead* state. The data now is no longer valid. For this reason, it is crucial to replace a drive that has failed right away before a second drive failure occurs.

The process of bringing a degraded LUN back to optimal condition is known as *reconstruction*. Reconstruction is a valid state only for redundant RAID configurations. Data is recreated on the replaced drive using data and parity from the other drives.

### 8.1.1.2 Drive Status

Similar to LUN status, drive states are also classified according to status. Table 8–2 lists the status classifications for drives.

**Table 8–2. Drive Status**

Status	Description
Optimal	The drive is operating at optimal level.
Warning	The drive has been put into a warning status by the controller as a result of a read or write error. The severity of this status depends to some extent on the RAID level of the LUN. In all cases, the drive is still usable but should be replaced as soon as possible.
Failed	The drive was failed by the array controller or by using a RAID utility. The drive must be replaced.
Spare	The drive is connected to an array but not configured into a LUN.
Mismatch	The array controller has sensed that the drive has different parameters or configuration information than it expected. This is typical if the user attempted to insert the wrong drive into a LUN.

An *optimal* drive is the desired condition for normal array operation.

A drive is in a *warning* condition when an error occurs that may require drive replacement, but does not affect the reliability of the data on the drive. Conditions that cause a drive to be put into a warning state are as follows:

- Unrecoverable read errors
- Read failures due to the drive being removed or transient error

A drive in the *warning* state is still used by the controller since it may prove to be available later. In the case of a read error, the data will be obtained using redundant information on the other drives. The warning condition provides an early warning to the user that drive degradation may be occurring. A drive in a warning state should be replaced with the same urgency as a drive failure.

A drive is marked as *failed* by the array controller when an error occurs that leaves the consistency of the user data and redundant information in a questionable state after using all available recovery actions. When the array determines that a drive has failed, it will not be used again. Conditions that cause a drive to be marked as failed include the following:

- Unrecoverable errors during a write on a data or redundant information drive
- An error restoring data to a drive after the automatic reallocation of a logical block

- Unrecoverable errors during the read portion of a read/modify/write operation (RAID 5)
- The user marked a drive as failed using a SCSI command or StorageWorks RAID Array 110 utility
- An error was reported during the disk array format sequence

### **8.1.2 Monitoring through the Subsystem Pedestal**

The subsystem monitors the blowers and the power supplies. The task is accomplished using a backplane signal. Two LED indicators are located on the power SBBs for status. A fault condition represents one or more of the following problems:

- Power supply failure
- Blower problem
- Input power problem

Tables 8–4 and 8–5 describe a power supply or blower fault condition.

## **8.2 User Monitoring Methods**

There are two methods for monitoring the operation of the subsystem:

- StorageWorks RAID Array 110 utilities
- LED indicators (Tables 8–4, 8–5, and 8–6)

### **8.2.1 Monitoring using the StorageWorks RAID Array 110 Utilities**

The StorageWorks RAID Array 110 utilities are key tools to maintaining a disk array. They provide the user with the ability to monitor, configure, repair and maintain the subsystem. Specific utility functionality is dependent on each operating system since each environment has different needs or capabilities. However, there are some common concepts and functions that are needed across all environments. The following is a generic list of functionality available:

- Check LUN and drive status
- Restore the logical unit (RAID 1, 0+1, and 5) after a drive failure
- Check and repair array parity on LUNs
- Configure, reconfigure, and modify LUNs
- Change default array parameters
- Change RAID configuration parameters (scheduled parity time, parity file name, and so forth)
- Format a logical array
- Download controller software
- Check error logs

For more information, refer to the *Storage Works RAID Array 110 Utility User's Guide* for your operating system.

## 8.2.2 Monitoring Operation using LED Indicators

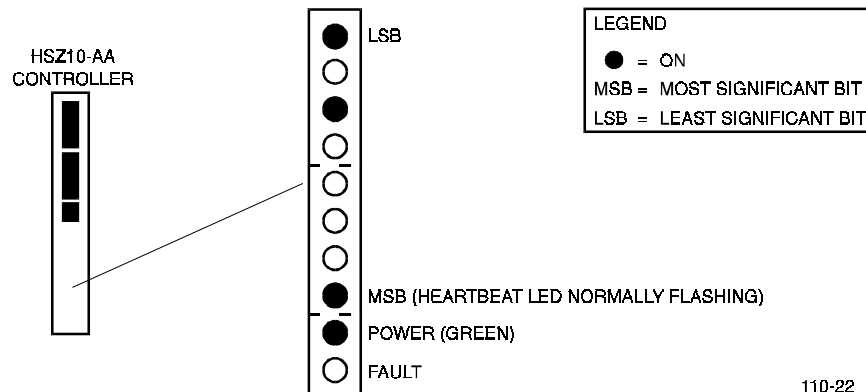
The StorageWorks RAID Array 110 Subsystem also provides visual indicators for maintaining array operation. The controller, shelf, power supply, and disk status can be monitored using the LEDs. There are three sets of LED indicators on the subsystem:

- HSZ10-AA controller LEDs
- Power supply SBB LEDs
- Drive SBB LEDs

### 8.2.2.1 HSZ10-AA Controller LED Indicators

There is a single bank of ten LEDs on the controller. The LEDs, which are visible behind the front edge of the controller, provide status information about the boot phase and possible errors. Figure 8–2 identifies the LEDs and their functions.

**Figure 8–2. Controller LED Indicators**



110-22

Once all the controller diagnostics have passed and the controller is ready to begin uploading the array software from the disk, the Heartbeat LED begins flashing periodically (once per second). During the upload process, the top four LEDs display a binary 5 while the Heartbeat LED beats rhythmically. After the array software has been uploaded and is running, the firmware clears the upper LEDs. Thus, as far as the firmware is concerned, the normal operating mode of any uploaded software has the Heartbeat LED beating and the power LED on. The bottom indicator is the Fault LED. This indicator is on when an error code is displayed by the controller.

Table 8–3 depicts the LED error codes that could be displayed by the HSZ10-AA controller. Solid codes indicate a boot phase and are considered normal. Cyclic or flashing codes indicate an error condition.

#### NOTE

The LED display in the first column of Table 8–3 shows only the top eight LEDs which represent the status of the controller. Also, the display has been rotated 90 degrees to facilitate the presentation of the listing.

Table 8–3. Summary of HSZ10-AA Controller LED Display

MSB* LSB	S/F/C	State	Description
○ ○ ○ ○   ○ ○ ○ ○	Solid	None	LEDs are all off, used to flash a value
○ ○ ○ ○   ○ ○ ○ ●	Solid	Normal	Attempting to load controller software from disk**.
○ ○ ○ ○   ○ ○ ● ○	Solid	Normal	Boot scratch memory being tested.
○ ○ ○ ○   ○ ○ ● ●	Solid	Normal	ROM is being searched for partitions.
○ ○ ○ ○   ○ ● ○ ○	Solid	Normal	ROM partitions are being validated.
○ ○ ○ ○   ○ ● ● ●	Solid	Normal	RAM is being searched for partitions.
○ ○ ○ ○   ○ ● ● ○	Solid	Normal	ROM application partition has been called.
○ ○ ○ ○   ● ● ● ●	Solid	Debug	Debug mode has been entered.
○ ○ ● ○   ○ ○ ● ○	Solid	Normal	68020 diagnostics in progress.
○ ○ ● ○   ○ ○ ● ○	Cyclic	Error	68020 diagnostics failed.
○ ○ ● ●   ○ ○ ○ ●	Solid	Normal	EPROM diagnostics in progress.
○ ○ ● ●   ○ ○ ○ ●	Cyclic	Error	EPROM diagnostics failed.
○ ○ ● ●   ○ ○ ● ●	Solid	Normal	EEPROM (58C65) diagnostics in progress.
○ ○ ● ●   ○ ○ ● ●	Cyclic	Error	EEPROM (58C65) diagnostics failed.
○ ○ ● ●   ○ ● ○ ○	Solid	Normal	Processor SRAM diagnostics in progress.
○ ○ ● ●   ○ ● ○ ○	Cyclic	Error	Processor SRAM diagnostics failed.
○ ○ ● ●   ○ ● ● ○	Solid	Normal	Processor DRAM diag. in progress.
○ ● ○ ●   ○ ○ ● ●	Solid	Normal	68901 diagnostics in progress.
○ ● ○ ●   ○ ○ ● ●	Cyclic	Error	68901 failed.
○ ● ● ○   ○ ● ○ ●	Solid	Normal	53C916 diagnostics in progress.
○ ● ● ○   ○ ● ○ ●	Cyclic	Error	53C916 diagnostics failed.
○ ● ● ○   ● ○ ○ ○	Solid	Normal	53C920 diagnostics in progress.


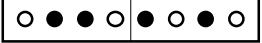
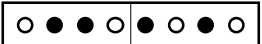
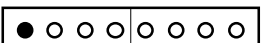

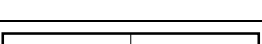
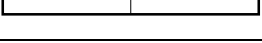
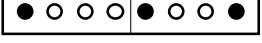




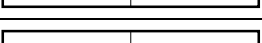
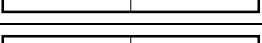


	Cyclic	Error	53C920 diagnostics failed.
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Table 8-3. Summary of HSZ10-AA Controller LED Display (Continued)

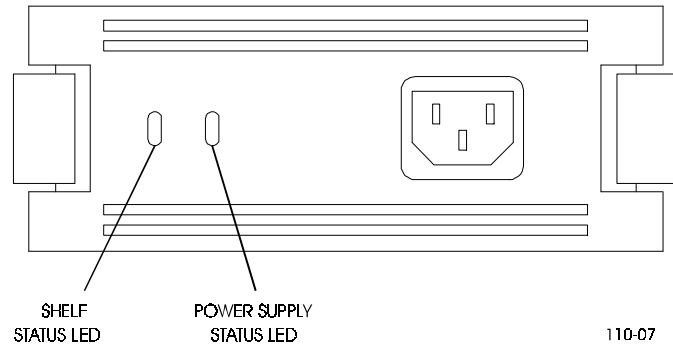
MSB* LSB	S/F/C	State	Description
	Solid	Normal	53C96 diagnostics in progress.
	Cyclic	Error	53C96 diagnostics failed.
	Flashing	Normal	Heartbeat LED.
	Solid	Normal	SCSI channel data turnaround diagnostics in progress.
	Cyclic	Error	SCSI channel data turnaround diagnostics failed.
	Solid	Normal	Subsystem turnaround diagnostics in progress.
	Cyclic	Error	Subsystem turnaround diagnostics failed
	Cyclic	Error	General fatal error.
	Cyclic	Error	General exception error,
	Cyclic	Error	Address error.
	Cyclic	Error	Instruction error.
	Cyclic	Error	Arithmetic error.
	Cyclic	Error	Privilege error.
	Solid	Normal	Board is in passive mode.
	Solid	Normal	Board is held in a hardware reset state failed.

\* Heartbeat LED

\*\* The RAID Array 110 Subsystem is configured at the factory with a copy of the HSZ10-AA controller software loaded on all disk drives for redundancy. During the HSZ10-AA power-up sequence, the controller loads a copy of this software from disk. If the controller cannot find or load a copy of this software from disk, it will remain in the **loading controller software** state indefinitely. If needed, the HSZ10-AA controller software can be re-loaded under MS-DOS, VMS, or OSF. For details, contact the Digital Customer Support Center.

### 8.2.2.2 Power Supply LEDs

Pedestal and power supply status are displayed on the power supply LEDs shown in Figure 8–3. The left LED displays the status of the pedestal and the right LED displays the status of the supply.

**Figure 8–3. Power Supply Status LEDs**

- When the left LED is on, both blowers and power supplies are operating properly
- When the left LED is off, one of the following fault conditions exists

**Table 8–4. Pedestal and Single Power Supply (PS) Status LEDs**

Pedestal Status LED	PS Status LED	Indication
On	On	Normal Status. Pedestal functioning properly.
Off	On	Bad blower unit. Replace blower.
Off	Off	Bad power supply. Replace power supply.

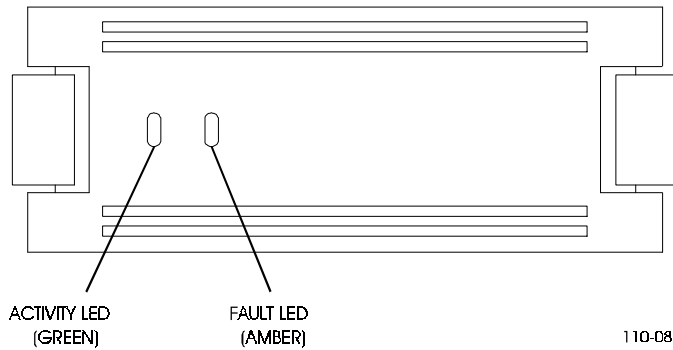
**Table 8–5. Pedestal and Dual Power Supply (PS) Status LEDs**

Ped. LED	PS1 LED	Ped. LED	PS2 LED	Indication
On	On	On	On	Normal Status
Off	On	Off	On	Bad blower unit. Replace blower.
Off	Off	On	Off	PS1 bad. Replace power supply.
On	On	Off	On	PS2 bad. Replace power supply.
Off	Off	Off	Off	PS1 and/or PS2 bad. Possible input power problem.

### 8.2.2.3 Drive SBB LEDs

Each drive SBB has two LED indicators (Figure 8–4) which display the drive's SBB status. These LEDs have states: *On*, *Off*, and *Flashing*.

**Figure 8–4. Drive Status LEDs**



- The left LED (green) is the device activity LED and is on or flashing when the drive is active
- The right LED (amber) is the drive SBB fault LED and defines the error condition, as indicated by the state of the LED - either on or flashing

**NOTE**

On initial power-on of the subsystem, the right LED (amber) may be lit. This does not indicate a fault condition. A bus reset is required from the host to clear these lights.

**Table 8–6. Drive SBB Status LEDs**

Activity Status LED	Fault Status LED	Indication
On	Off	Device is operating properly.
Off	Off	Device is inactive and operating normally. No fault.
On	On	Fault status. Device is probably hung up. It is recommended that you replace the drive.
Off	On	Fault status. Device is inactive and spun down. It is recommended that you replace the drive.
On	Flashing	Fault state. Device is active and drive is being spun down because of fault.

If a fault state exists, proceed to the next section for instructions on how to replace a drive SBB.



### 8.3 When and How to Replace a Drive

Replace a drive when the following occurs:

- StorageWorks RAID Array 110 utilities provide information stating that a drive is in a *warning* or *failed* state
- Drive SBB fault indicator is on

The HSZ10-AA controller and subsystem products allow for hot swapping a drive SBB. This means that a user can remove and replace a drive without interrupting host operation or removing power to the subsystem. When replacing a drive, ensure the new drive is the same type and size and that the firmware revision is equal to or greater than the drive being replaced.

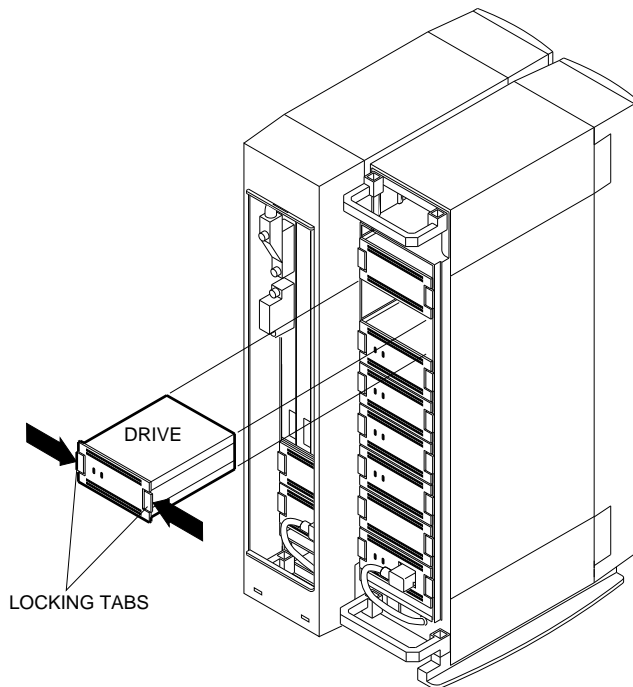
To replace a drive, perform the following:

**NOTE**

It is important that you wait at least 10 seconds before inserting a new drive SBB. The controller requires this period of time to scan the SCSI buses and to become informed of a drive removal.

1. If the drive is not yet in a failed state, fail the drive using the RAID utilities.
2. Wait until the amber LED on the drive is solid (flashing has stopped).
3. Remove the front bezel by pushing down on the locking tabs at the bottom of the bezel.
4. Press the two locking tabs to release the disk drive, and slide the unit out of the shelf as shown in Figure 8-5.
5. Wait 10 seconds before inserting a new drive SBB.
6. Insert the replacement drive unit into the guide slots and push it in until the tabs lock into place.
7. Wait for the controller to spin up the new drive.
8. Perform the reconstruction process, if needed (see Section 8.6 for more information).
9. Replace the front bezel and ensure the bezel locking tabs snap into place.

**Figure 8-5. Replacing a Drive**



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## 8.4 When and How to Replace Power Supplies and Blowers

You need to replace a power supply or blower when the LEDs indicate a fault condition as outlined in Tables 8-4, 8-5, and 8-6.

The hot-swapping method of replacing a power supply may be used when there are two power supplies in a shelf. This method allows you to remove the defective power supply while the other power supply furnishes dc power to the subsystem.

The input power for each ac power supply is controlled by a switch on the ac distribution unit. Setting this switch to off removes power from all power supplies in the cabinet. To remove power from a single power supply, simply disconnect the power cable from that power supply and remove the unit.

### 8.4.1 Replacing a Shelf Power Supply

Perform the following procedure to replace either a shelf primary or redundant power supply:

1. Remove the input power cable from the power supply.
2. Press the two locking tabs to release the unit, and slide it out of the shelf (similar to replacing a drive as shown in Figure 8-5).
3. Insert the replacement supply into the guide slots and push it in until the tabs lock into place.
4. Reconnect the input power cord.

- Observe the LEDs and ensure the power supply is functioning properly (refer to Tables 8–4 and 8–5). If replacing a single power supply, sequentially place the storage devices on line and observe the LEDs on both the power supply and the storage device for normal operating indications.

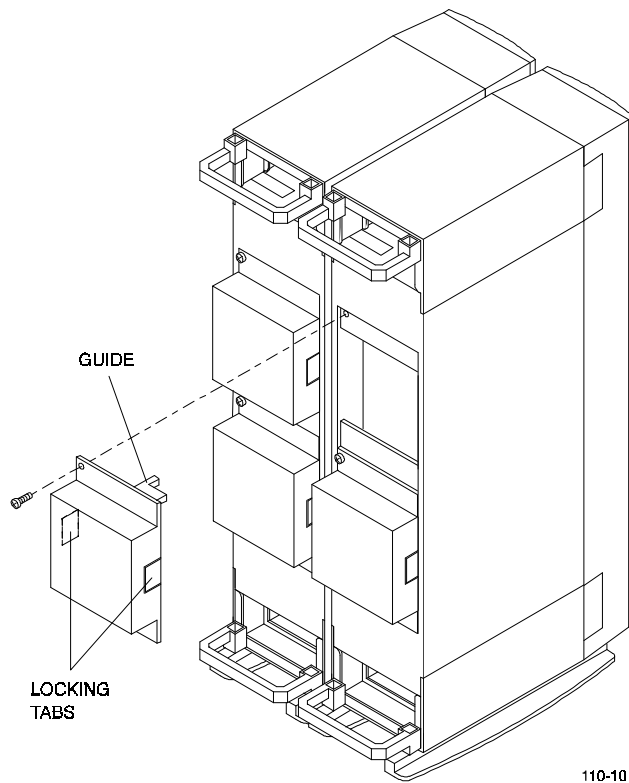
### 8.4.2 Replacing a Blower

#### WARNING

To prevent an overheating condition, the replacement blower should be readily available to immediately replace the faulty blower during the following procedure.

Each shelf has two blowers mounted at the rear. Connectors on the backplane provide the +12 Volts dc to operate the blowers. As long as one blower is operational on each shelf, there is sufficient airflow to prevent an overheating condition. When either blower fails, the right shelf status LED on the power supply SBB turns on. When a blower is removed, the change in the airflow pattern reduces the cooling to the point that the shelf can overheat in 60 seconds. Figure 8–6 shows the removal of a blower.

**Figure 8–6. Removing a Blower**



#### WARNING

Hot swapping the blowers must be performed only by qualified service personnel. To reduce the risk of electrical shock, disconnect the power cables from the shelf power SBBs before removing shelf blower assemblies or performing service in the backplane area, such as modifying the SCSI bus.

**NOTE**

Replacing a blower requires access to the rear shelf. When you cannot access the rear of the shelf, you must turn off ac power, remove the shelf from the cabinet, and perform Steps 1 through 6 listed below. Then replace the shelf in the cabinet reconnect and apply ac power.

To replace a blower, perform the following procedure:

1. Using a Phillips screwdriver, remove the safety screw in the upper corner of the blower.
2. Press the side locking tabs to release the blower.
3. Pull the blower straight out to disconnect it from the shelf power connector.
4. Align the replacement blower connector and insert the module straight in, making sure that both locking tabs are firmly seated in the shelf.
5. Replace the safety screw in the upper corner of the blower.
6. Connect the shelf power cables and verify that the shelf and all SBBs are operating properly.

## **8.5 Removing the HSZ10-AA Controller**

You may need to remove the controller to check or set host SCSI ID switch SW1 or replace a faulty module. To remove the controller perform the following procedure:

1. Loosen the filler panel handle screws next to the controller to facilitate its removal.
2. Using a flat-head screwdriver, loosen the captive connector screws from the SCSI cable connected to J1 and remove the cable.
3. Grasp the ends of the front panel and slowly pull the controller forward until clear of the shelf.
4. If the controller is being replaced, ensure you remove and reconnect the SCSI terminator to the new controller to properly terminate the SCSI bus.

## **8.6 Reconstruction**

Reconstruction is a process used to restore a degraded RAID 1, 0+1, or RAID 5 LUN to its original state after a single drive has been replaced. During reconstruction, the HSZ10-AA controller recalculates the data on the drive that was replaced using data and parity from the other drives in the LUN. The controller then writes this data to the replaced drive. Note that although RAID level 1 and 0+1 do not have parity, the array controller can reconstruct data on a RAID 1 LUN unit by copying data from the mirrored

disk. By default, the HSZ10-AA controller automatically initiates the reconstruction process after you replace a drive in a degraded RAID 1, 0+1, or 5 LUN. Through the RAID utilities, you may change the default configuration and schedule reconstruction or manually start reconstruction on the replaced drive.

**NOTE**

Reconstruction applies only to a degraded RAID 1, 0+1, or 5 LUN with a single-drive failure.

Once reconstruction is initiated (either by you or the array controller), the HSZ10-AA controller completes the following actions:

- Formats the new drive (if the array controller determines it is necessary)
- Copies special array software to the new drive
- Recalculates the data and parity from the data and parity on the other LUN drives
- Writes the recalculated data and parity to the new drive

Once reconstruction is started, it can take place while the LUN is in use. You do not need to shut down the subsystem. You can see the access to all the drives in the logical unit for a period of time. The length of time it takes for reconstruction to complete depends upon the drive capacity and the reconstruction settings.

**CAUTION**

To prevent the loss of data, do not remove a second drive during the reconstruction process.

## 8.7 Parity Check/Repair

It is important for the user to perform periodic parity checks on the redundant arrays, especially if there is a power failure or an abnormal shutdown.

Parity Check/Repair is the process of verifying and repairing parity information so that data can be maintained and reconstructed if there is a drive failure. Parity/Check Repair functionality is provided by the StorageWorks RAID Array 110 utilities.

**NOTE**

Parity check/repair applies to only RAID 0+1, 3, and 5. RAID 0 does not have array parity, and therefore cannot be checked and repaired. RAID 1 does not have parity either, but parity check compares data on the mirrored drives. Parity check/repair cannot be performed on a degraded LUN.

Parity check/repair performs the following functions:

- Scans the LUN and checks the array parity for each block in the LUN. On a RAID 1 LUN, parity check compares the data on each mirrored pair of disks, block by block
- Repairs any array parity errors found during the parity check

Note that if the array parity errors resulted from corrupted data, the data is not repaired, only the array parity. Also, note that you may still lose some data as a result of the power failure or abnormal shutdown, especially if you do not have an uninterruptable power supply (UPS). Data cached in buffers is lost and cannot be reconstructed if you do not have a UPS. This is one of the reasons you should always maintain backup files, even with a redundant array.

Parity Check/Repair utilities can be run at the following times:

- Automatic Parity Check/Repair guarantees the integrity of the data of the LUN so that you can reconstruct the data on the array if a drive fails. This procedure is either set at a time determined during the installation of the RAID utility, or it can be set by means of a script that runs at a set time
- Manually after an abnormal server or array shutdown. As the result of such a shutdown, required array parity may not have been updated, resulting in potential corruption of data

For more detailed information, refer to the *StorageWorks RAID Array 110 Utility User's Guide* for your operating system.

## 8.8 Upgrading HSZ10-AA Software

The disk array software can be upgraded using a RAID utility, which provides downloading capability. Upgrading software does not affect the user data. Refer to the appropriate *StorageWorks RAID Array 110 Utility User's Guide* and Appendix C for more detailed information regarding upgrading software.

## 8.9 Error Handling/Troubleshooting

This section contains troubleshooting information to correct problems that may be easy to repair. It also directs you to the appropriate documentation for additional troubleshooting if needed. The section discusses the following:

- Before you begin troubleshooting
- Using the troubleshooting table

### 8.9.1 Before You Begin Troubleshooting

To determine where the problem with your StorageWorks RAID Array 110 Subsystem exists, follow these steps:

1. Turn off the subsystem.
2. Turn off the host system.
3. Check the following connections:
  - SCSI cable connected to the HSZ10-AA controller (or the DWZZA-VA adapter when using a single-ended connection)
  - SCSI bus terminator
  - SCSI cable connected to host system
  - 50-pin SCSI cables to BA350-SA shelves (if applicable)

4. If a channel or internal SCSI ID conflict is suspected, remove the rear bezel(s) and blowers from the rear of the subsystem units and check the locations of the jumpers/terminators to ensure they are not loose or disconnected. They should be installed to define your subsystem configuration as follows:
  - For the base subsystem, refer to Figure 2–1
  - For a 10-to-15 drive expanded subsystem, refer to Figure 3–2
  - For a 20-to-30 drive expanded subsystem, refer to Figure 4–2
5. Turn the subsystem back on.
6. Verify that all the drive SBBs LED indicators flash on initial power on.
7. Verify that the two LED indicators on the power supplies are lit.
8. Verify that the HSZ10-AA controller LED indicators flash and the controller begins its diagnostics.

### **8.9.2 Troubleshooting Table**

When the subsystem does not operate correctly, follow the information in this section to help diagnose the problem. The troubleshooting techniques outlined below do not identify all possible problems with the subsystem, nor do the corrective actions suggested remedy all problems.

To use Table 8–7, follow these steps:

1. Note and record the symptoms of the problem with your subsystem.
2. Check the *Symptom* column in Table 8–7 for a match.
3. Check the conditions for that symptom in the *Possible Cause* column. If more than one possible cause is given, check all of the possible causes in the order listed.
4. Follow the advice in the *Corrective Action* column.

**Table 8–7. Troubleshooting Subsystem Problems**

Symptom	Possible Cause	Corrective Action
Drive SBB fault LED is on.	Drive has failed.	Replace drive (Section 8.3)
Drive SBB fault and activity LEDs are on.	Drive has failed or is hung up.	Replace drive (Section 8.3)
Drive SBB fault LED is flashing.	Drive has been failed and is spinning down	Replace drive (Section 8.3).
Replaced drive has not spun up.	Drive not seen by controller.	Remove drive, wait 10 seconds, reinsert drive.
Power supply shelf status LED is off.	Shelf fault.	Refer to Section 8.2.2.2 for fault condition and resolution.
Both power supply LEDs are off.	Input power problem.	Check input power connection.
	Shelf and power supply fault.	Power off subsystem and refer to Section 8.2.2.2 for fault condition and resolution.
HSZ10-AA controller LEDs are off.	Controller is not installed properly.	Power off subsystem and remove and reseat controller.
	HSZ10-AA controller has failed.	Replace controller.
HSZ10-AA controller LEDs 1 and 3 on. Disk not spun-up.	HSZ10-AA controller software not loaded.	Refer to Appendix C.
Subsystem is not seen by host.	SCSI cable is not connected.	Check SCSI cable both at the host and subsystem ends for proper connection.
	Incorrect termination.	Check that both ends of SCSI bus are terminated correctly. Verify that proper termination scheme is being used.
	Duplicate SCSI IDs on bus.	Check SCSI ID settings on all devices connected to bus for duplication. Run bus scan console diagnostics if they are available on your host system.
	Defective HSZ10-AA controller.	Refer to Section 8.2.2.1 for a description of the possible LED status. Determine whether controller has failed. Replace the controller if necessary.
	HSZ10-AA controller software not loaded.	Refer to Appendix C.
Software does not boot from the subsystem.	A problem exists with the subsystem.	Use any available system console diagnostics or the subsystem utilities to test subsystem. Boot subsystem for some other source.
	Operating system not properly installed on the subsystem.	Reinstall operating system on the subsystem.

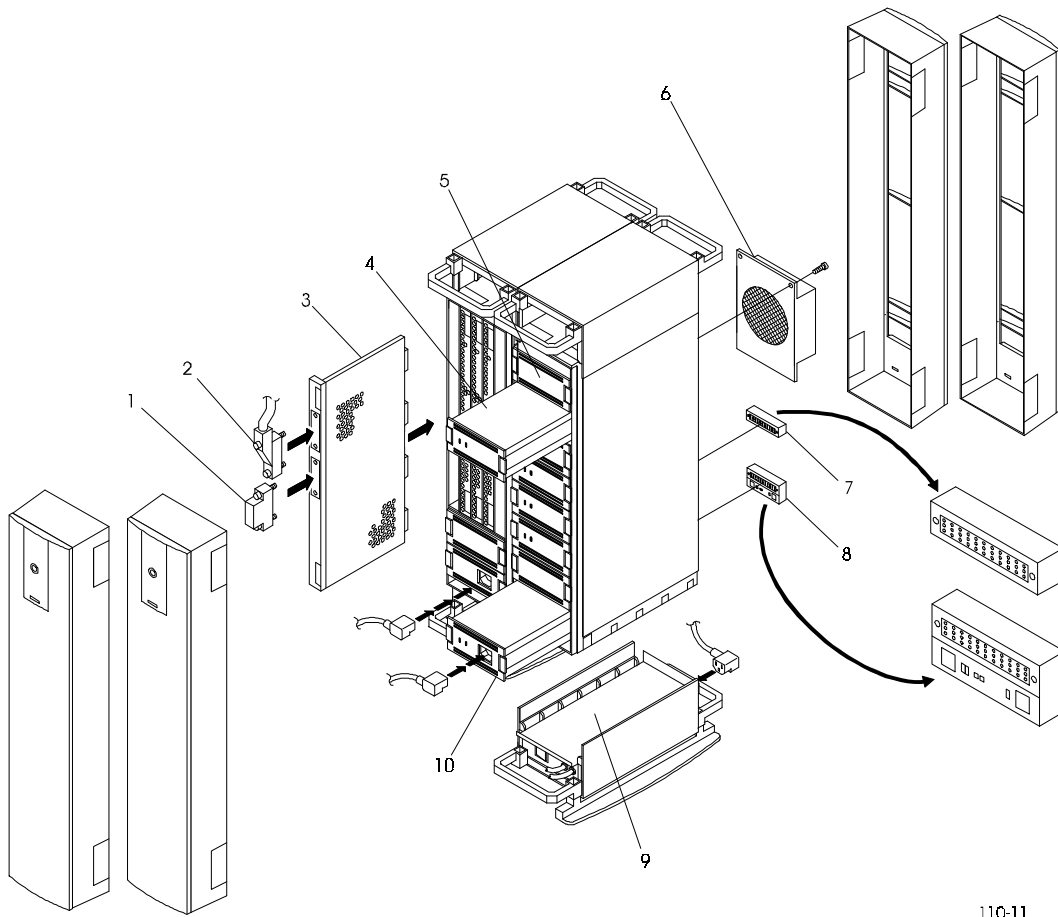




## Illustrated Parts

This chapter contains an illustrated breakdown of the field replaceable parts in the StorageWorks RAID Array 110 Subsystem. The information consists of exploded views of the subsystem base and drive expansion units, and item part numbers and descriptions. The chapter also contains a list of subsystem cables and components.

**Figure 9–1. Subsystem Base Unit, Field Replaceable Parts (Refer to Table 9–1)**



110-11

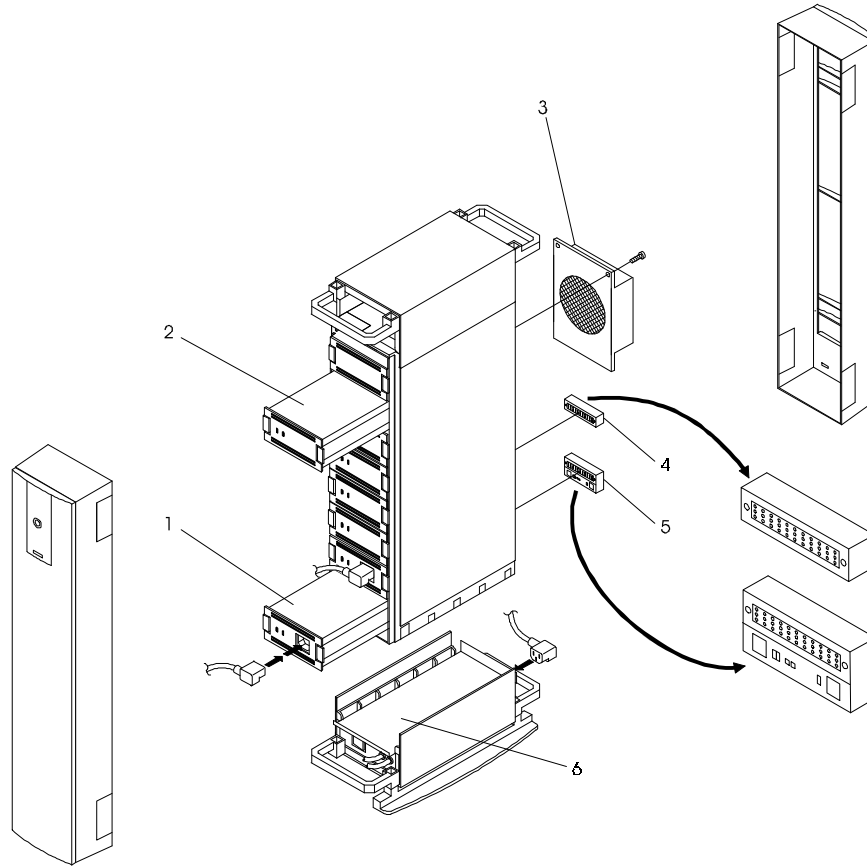
**Table 9–1. Subsystem Base Unit Field Replaceable Parts (Figure 9–1)**

Item	Part Number	Description
1	H879	SCSI terminator
2	BN21K	High Density 68-pin SCSI 3 "P" cable
3	HSZ10-AA	SCSI controller module
4	RZ26	1.05 GB SCSI disk drive
5	DWZZA	Differential Wide SCSI-to-SCSI Adapter (optional)
6	70-29761-01	Blower fan
7	BA35X-MC	SCSI backplane jumper
8	BA35X-MB	SCSI backplane terminator
9	70-29914-01	AC distribution unit
10	BA35X-HA	Subsystem DC power supply

**Table 9–2. Subsystem Cables**

Cable	Description
BN21P-OB	68-to-50 pin "Y" transition cable
BC09D	DWZZA adapter cable
BN21L	68-pin high-density SCSI 3 "P" cable
BN21H-02	Expansion SCSI cable
BN27S-03	AC power cable

**Figure 9–2. Drive Expansion Unit, Field Replaceable Parts (Refer to Table 9–3)**



110-23

**Table 9–3. Drive Expansion Unit Field Replaceable Parts (Figure 9–2)**

Item	Part Number	Description
1	BA35X-HA	Subsystem DC power supply
2	RZ26	1.05 GB SCSI disk drive
3	70-29761-01	Blower fan
4	BA35X-MC	SCSI backplane jumper
5	BA35X-MB	SCSI backplane terminator
6	70-29914-01	AC distribution unit



## Specifications

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*This appendix describes the physical, environmental, and electrical specifications for the StorageWorks RAID Array 110 Subsystem.*

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### A.1 General Specifications

Host Interface	FWD SCSI-2
Host Transfer Rate	20 MB/sec., max (FWD)
Drive Interface	Single-ended, 8-bit SCSI-2
Drive Interfaces Channels	Five
Max. Drives/Controller	35
RAID Levels Supported	0, 1, 0+1, 5
Power Supplies	2/shelf
MTBF	250,000 hours
Serviceability	“Hot-swap” allowed

### A.2 HSZ10-AA SCSI Disk Controller

- 68EC020 microprocessor operating at 25 MHz
- DRAM, 1 MBytes for program and structures
- EPROM, 256 Kbytes (expandable to 512 Kbytes) for diagnostics and start-of-day code
- EEPROM, 8 Kbytes for configuration and logging
- 68901 multifunction peripheral controller for timers, serial communications, and interrupt control
- Host SCSI target ID switch (4-bit)
- Status LEDs (8-bit)
- Self-test capability

### A.3 Power Requirements

Input Voltage	120 VAC $\approx$ 2.5 amps (auto sense) 240 VAC $\approx$ 1.5 amps (auto sense)
Frequency	50-60 hz

### A.3 Power Requirements (Con't)

Power Supply Rating	131 watts
Serviceability	“Hot-swap” allowed

### A.4 Physical

Height	565 mm (22.2")
Width	356 mm (14.0")
Depth	432 mm (17.0")
Max. Weight	28 kg (62 lbs.)

### A.5 Environmental

Operating Temperature	10°C to 40°C
Non-operating	-40°C to 66°C
Relative Humidity	10% to 80% (non-condensing)

### A.6 Regulatory

Approvals	FCC-B, UL, CSA, VDE, TUEV
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# B

## HSZ10-AA Controller SCSI ID

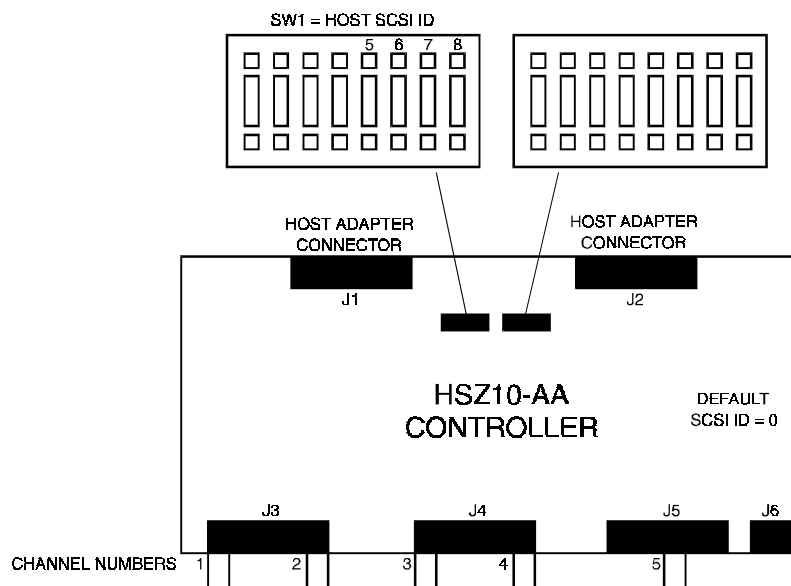
This appendix contains information for changing the SCSI ID of the HSZ10-AA controller in the subsystem base unit.

### NOTE

If the HSZ10-AA SCSI controller is to be used with 8-bit devices on the host SCSI bus, then the SCSI ID of the controller should be restricted to values between 0 and 7. Also, before you use any SCSI address above 7, ensure that both the host adapter and host system support SCSI addresses in the range of 8 to 15.

The SCSI ID on the host channel is set by switchpack SW1 on the HSZ10-AA controller as shown in Figure B-1. SW1 is an eight-switch device that sets the SCSI ID on the host channel. SW2, also an eight-switch switchpack, is for factory test purposes only and all switches should be set to *off*. To change the default SCSI ID, you must remove the controller from the subsystem base unit (refer to Chapter 8, Section 8.5 for removal procedure) and set SW1 for the desired SCSI ID number. Table B-1 lists the sixteen SCSI ID numbers and the switch positions of SW1 required to obtain them.

Figure B-1. Host and Subsystem SCSI IDs



**CAUTION**

To prevent component damage due to electrostatic discharge, take the appropriate precautions before removing and handling the HSZ10-AA controller module.

**Table B-1. Switchpack SW1 SCSI ID Switch Positions**

SCSI-ID #	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	SW1-7	SW1-8
0	Off	Off	Off	Off	Off	Off	Off	Off
1	Off	Off	Off	Off	Off	Off	Off	On
2	Off	Off	Off	Off	Off	Off	On	Off
3	Off	Off	Off	Off	Off	Off	On	On
4	Off	Off	Off	Off	Off	On	Off	Off
5	Off	Off	Off	Off	Off	On	Off	On
6	Off	Off	Off	Off	Off	On	On	Off
7	Off	Off	Off	Off	Off	On	On	On
8	Off	Off	Off	Off	On	Off	Off	Off
9	Off	Off	Off	Off	On	Off	Off	On
10	Off	Off	Off	Off	On	Off	On	Off
11	Off	Off	Off	Off	On	Off	On	On
12	Off	Off	Off	Off	On	On	Off	Off
13	Off	Off	Off	Off	On	On	Off	On
14	Off	Off	Off	Off	On	On	On	Off
15	Off	Off	Off	Off	On	On	On	On

Figure B-1 also shows the HSZ10-AA controller and its interfaces to the subsystem disk drives and the host adapter. On the host adapter side of the configuration, two connectors provide the SCSI interconnect to the host system either for local termination or for “daisy chaining” to another host.

The physical slot position of the HSZ10-AA controller determines its SCSI ID (6 or 7) on the drive buses in the subsystem. The controller is pre-configured in the first slot of the controller shelf. The position of the controller is important because its SCSI ID on the array channels is set by the backplane. In this slot position, the controller is set to SCSI ID 7. To re-configure the controller to SCSI ID 6, it must be installed in slot 3 of the shelf.





## *HSZ10-AA Controller Software*

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*This appendix contains the procedure required to install the HSZ10-AA controller software, release 3.06.*

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### **C.1 HSZ10-AA Controller 3.06 Software Upgrade**

HSZ10-AA software release 3.06 contains a feature called *mixed drive support*. This feature enables you to use a single drive which has a storage capacity equal to or greater than the largest disk in your subsystem as a replacement drive in the event of a failure.

In previous versions, when creating a RAID set or LUN, the user was restricted to using the same drive type in the RAID set. With *mixed drive support*, RAID sets can be created using a "mix" of drives or drives of different types and sizes.

The following explanations provide additional details describing *mixed drive support*:

1. If a drive group contains drives of different capacities, then the size of the smallest drive will determine the assumed size of each drive. This will leave unused areas on the larger drives which cannot be included in this or another RAID set. For example, if you want to create a three-drive RAID 0 set, and two of the drives are 2 GB each and the third drive is 1 GB, then the RAID set will be created with a size of 3 GB. This is because the controller will use the size of the smallest drive as the "size" of each drive in the group. Each of the two larger drives will contain 1 GB of unusable space that cannot be assigned to either this RAID set, or another RAID set.
2. If you attempt to replace a failed drive with a drive of *less* capacity, the controller will fail the drive and will not reconstruct the LUN. If the failed drive is replaced with a device of *greater* capacity, then only the drive with an equivalent capacity of the other drives in the LUN will be used.

#### **C.1.1 Software Upgrade Procedure**

The 3.06 release software upgrade procedure is accomplished using the download microcode function in the utility kit for your operating system. Refer to the appropriate section in the supporting documentation which describes your operating system.

#### **C.1.2 MS-DOS, SCO UNIX, and NetWare™ Environments**

The StorageWorks RAID Array 110 Utility for MS-DOS will be used to download the software to the controller in each of these operating system environments. This floppy, Digital part number P/N AK-PV7XB-CA, is included in the platform kit ordered with the subsystem. The floppy containing the software was shipped with this upgrade kit (P/N AK-PV8EB-CA).

### C.1.3 OpenVMS VAX Environment

The HSZ10-AA controller software is included on the distribution media for the StorageWorks RAID Array 110 Utility for OpenVMS VAX and is included in the OpenVMS VAX platform kit. Specify that you want mixed drive support when ordering the platform kit.

The installation procedure for the utility will copy the HSZ10-AA controller software file into the HSZ10\$DIR directory. The file can be downloaded via the ACF utility download command.

## C.2 Virgin Drive Software Loading

The HSZ10-AA controller software is stored on multiple subsystem disks and is then loaded onto the controller on initialization. If the subsystem was not factory configured with disks or a new set of virgin disks have been installed, then the software must be downloaded to the subsystem disk.

### C.2.1 MS-DOS, SCO UNIX, and NetWare Environments

To download the HSZ10-AA software to the controller and subsystem disk, perform the following:

1. Boot the system with the StorageWorks RAID Utilities for MS-DOS disk, Digital part number AK-PV7XB-CA.
2. The drives must be spun-up in order to successfully download the software. Type the following command line to ensure that the drives in the array are spun up:

```
>fad -f7 -zpy -x2
```

with the command line options defined as:

Option		Explanation
fad		This is the RAID utility to execute manual commands to the Array.
-f	<b>7</b>	<b>7</b> is the spin up option.
-zp	<b>y</b>	<b>y</b> is the SCSI ID of the HSZ10 controller board as defined by its switch settings.
-x	<b>2</b>	<b>2</b> instructs FAD.EXE to use the ASPI driver.

3. The drives in the RAID Array 110 Subsystem will now spin-up if they were not previously spinning.

- To load the software type the following command line:

```
>acf -l -zpy -x2 -f a:92030601.afw
```

Option		Explanation
acf		This is the RAID utility to download HSZ10 software to the RAID 110 Subsystem.
-l		l is the download software option ( the letter L).
-zp	y	y is the SCSI ID of the HSZ10 controller board as defined by its switch settings.
-x	2	2 instructs ACF.EXE to use the ASPI driver.
-f	a:	Drive which contains the HSZ10 software.

The host system will respond with a request that the diskette containing the software be installed. Insert the floppy “DEC RAID HSZ10 software” (Digital part number AK-PU8EA-CA) into the floppy drive.

- The host will keep you updated with the download progress with the line:

```
xx complete
```

where,

Option		Explanation
n/a	xx	xx % of the download completed.

- When the download is complete, the host system will issue a message:

```
“Loaded firmware is now in service”
```

- The HSZ10-AA controller software upgrade is now complete.

### C.2.2 OpenVMS VAX Environment

The installation procedure for the utility will copy the HSZ10-AA controller software file into the HSZ10\$DIR directory. The file can be downloaded via a utility download command. To download the software:

- The drives must be spun-up in order to successfully download the software. Because the drives have never been connected to the HSZ10-AA controller, they will not have configuration information loaded on them. In this case, the controller will create five new LUNs on the subsystem, one LUN per drive channel, all RAID 0. At the console prompt, type a SHOW DEVICE command to spin-up the drives.
- Boot the system and login to the system account.

3. The HSZ10-AA controller software (filename 92030601.AFW) is located in the directory referenced by the HSZ10\$DIR logical. This logical was defined when you invoked the HSZ10\$STARTUP.COM file in the SYSTARTUP\_V5.COM script to initialize the LUN. To download the software, issue the following commands at the DCL prompt:

```
$SET DEF HSZ10$DIR
$ACF DOWNLOAD DKAxxx /INPUT=92030601.AFW
```

where DKAxxx is a valid LUN on the controller you want to upgrade. The utility will update you with completion percentages as the download proceeds, and will return you to the DCL prompt when the download is complete.

## **A**

---

- Adapters
  - DWZZA–VA, 1–4
- Array,
  - features, 1–2
  - status, 8–2
- Audience, xi

## **B**

---

- Base subsystem
  - 5-drive base subsystem installation, 2–1
- Blower unit, 1–6, 8–12

## **C**

---

- Cables
  - checklist, 2–6, 3–9, 4–9
- Component descriptions, 1–4
  - blower unit, 1–6
  - disk array controller, 1–6
  - drive expansion unit, 1–7
  - SCSI interface cable, 1–7
  - system building blocks, 1–5
- Connectors
  - checklist, 2–6, 3–9, 4–9

## **D**

---

- Disk array controller, 1–6
  - firmware, 1–6
  - software, 1–6
- Disk drive
  - how and when to replace, 8–10
- Disk drives configurations
  - 10/15 drive to a 20/30 drive subsystem
    - logical drive map, 6–9
  - 5 drive to a 10/15-drive subsystem logical drive map, 5–11
  - 5 drive to a 20/30 drive subsystem logical drive map, 7–10
- Drive expansion unit
  - connection to the subsystem base unit, 3–2, 4–2, 5–8, 6–7, 7–8
- DWZZA
  - definition, 1–6

## **E**

---

- Error handling
  - see troubleshooting, 8–15
- Expanded subsystem
  - 10-to-15 drive expanded subsystem
    - installation, 3–1
  - 20-to-30 drive expanded subsystem
    - installation, 4–1
  - 5-drive subsystem to 10/15 drives, 5–1
  - 10/15-drive system to 20/30 drives, 6–1
  - 5-drive system to 20/30 drives, 7–1

## **F**

---

- Features, 1–2
  - capacity, 1–4
  - data availability, 1–3
  - data reliability, 1–2
  - flexibility, 1–4
  - performance, 1–3
  - RAID overview, 1–3
  - redundancy, 1–3
- Firmware, 1–6

## **H**

---

- Host channel
  - see HSZ10–AA controller, 2–2, 3–4, 4–5
- HSZ10–AA controller
  - cables and connectors, 2–6, 3–7, 4–7
  - connection to the host adapter, 2–3, 3–5, 4–5
  - host channel and controller SCSI ID, 2–2, 3–5, 4–5
  - how and when to replace, 8–13
  - LED display summary table, 8–6
  - LEDs, 2–7, 3–8, 4–8
  - power on and functional verification test, 2–6, 3–9, 4–9
  - SCSI ID, B–1
  - software installation, C–1
  - specifications, A–1

## **I**

### Illustrated parts

- subsystem base unit, table of, 9-2
- cables, table of, 9-2
- drive expansion unit, table of, 9-3

### Installation

- 5-drive base subsystem, 2-1
- 10-to-15 drive expanded subsystem, 3-1
- 20-to-30 drive expanded system, 4-1

## **L**

### LEDs

- drive SBB, 8-9
- HSZ10-AA controller, 8-5
- power supply, 8-7

### LUN

- definition, 8-2
- reconstruction, 8-13
- status, 8-2

## **O**

### Operation

- subsystem indicators, 8-1
  - drive status, 8-3
  - LUN status, 8-2
  - monitoring through the HSZ10-AA controller, 8-1
  - monitoring through the subsystem shelf, 8-4
  - user monitoring methods, 8-4
- drive SBB LEDs, 8-9
- HSZ10-AA controller LED indicators, 8-5
- monitoring through the StorageWorks RAID Array 110 utilities, 8-4
- monitoring using the LED indicators, 8-5
- power supply LEDs, 8-8

### Operation and troubleshooting

- chapter, 8-1

### Overview

- RAID subsystem, 1-3

## **P**

### Parity check/repair, 8-14

### Performance, 1-3

### Power

- requirements, A-1

### Power supplies

- how and when to replace, 8-11

### Product description

- chapter, 1-1

## **R**

### RAID

- definition, 1-2
- description
  - RAID 0, 1-3
  - RAID 0+1, 1-3
  - RAID 1, 1-3
  - RAID 5, 1-4

### Reconstruction, LUN, 8-13

### Removal/replacement

- bezels
  - subsystem base unit, 5-3, 6-3, 7-3
- blowers, 8-12
  - subsystem base unit, 5-4, 6-4, 7-3
- HSZ10-AA controller, 8-13
- power supplies, 8-11
- sliding tray, 5-4, 6-4, 7-3

## **S**

### SCSI ID, B-1

- on the host channel, B-2
- see HSZ10-AA controller, 2-2, 3-4, 4-5

### SCSI ID switch settings

- table of, B-2

### Software, 1-7

- upgrading, 8-15
- HSZ10-AA controller, C-1

### Specifications, A-1

- environmental, A-2
- general, A-1
- HSZ10-AA controller, A-1
- physical, A-2
- power requirements, A-1
- regulatory, A-2

### SW1

- see SCSI ID, B-2

### SW2

- see SCSI ID, B-2

## **T**

### Terminator and jumper configurations

- subsystem base unit, 5-6, 7-6
- drive expansion unit, 5-8, 6-6, 7-6

### Tests

- functional verification, 2-6, 3-9, 4-9

### Troubleshooting

- before you begin, 8-15
- error handling and troubleshooting, 8-15
- table of subsystem problems, 8-16

## **U**

---

### Unpacking and inspection

- 10-to-15 drive expanded subsystem, 3-2
- 10-to-15-drive expansion kit, 5-2
- 20-to 30-drive expanded subsystem, 4-2
- 20-to-30-drive expansion kit, 6-2, 7-2
- 5-drive base subsystem, 2-2

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### Most-Liked Features

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### Least-Liked Features

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### Suggestions for Improvement

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