RAID Hardware Installation and Upgrade Instructions

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Contents

Tables

Figures

Introduction

This document is intended to provide field installers with the information to set up, install, or upgrade RAID hardware in CHALLENGE™ / Onyx™ systems and expansion racks. The manual is organized as follows:

- Chapter 1, “Introducing the RAID Hardware Options” describes the RAID hardware and its capabilities and limitations.
- Chapter 2, “Configuring the RAID Hardware” describes the necessary hardware configurations for a successful RAID installation. It also includes guidelines for use of non-RAID drives in a RAID box and cabling / termination issues.
- Chapter 3, “Installing the RAID Box” covers the hardware-specific installation procedures for both the system rack-mounted “stubby” SCSI RAID box and Vault-mounted RAID box. For macro issues such as installing a rack system or Vault (T2) expansion rack, the system support engineer will be referred to existing manuals.
- Chapter 4, “Problem Solving Tips” covers basic troubleshooting procedures for the RAID boxes that may be related to mechanical, cabling, or installation issues. Note that software problem solving will be covered in the *RAID System Administration Guide*.
- Appendix A, “RAID Hardware Upgrades” lists the procedures for converting a non-RAID system to use RAID boxes with existing 2.0 GB IBM® drives. The upgrades are only allowed on CHALLENGE / Onyx systems using IRIX™ 5.0.1 or later.

Start at the beginning to familiarize yourself with the features and operational overview of the RAID hardware, or proceed directly to the information you need using the Table of Contents and Index.

The following manuals provide additional software and hardware information that may be helpful or necessary:

- *RAID System Administration Guide*
- *CHALLENGE/Onyx Rackmount Installation Instructions*
- *CHALLENGE Vault Rackmount and SCSIBox 2 Installation Instructions*

Chapter 1

Introducing the RAID Hardware Options

This chapter contains the following sections:

- Section 1.1, “Features.”
- Section 1.2, “Operational Overview.”
- Section 1.3, “Non-supported RAID Features.”
- Section 1.4, “Hot Plugging a Disk.”
- Section 1.5, “The Disk-Down LEDs.”
- Section 1.6, “Command Line Inquiry.”
- Section 1.7, “Checking the System Log.”
- Section 1.8, “Guidelines for Cabling RAID Boxes.”

This chapter provides an overview of the Silicon Graphics® implementation of a Redundant Array of Inexpensive Disks (RAID). If you are not familiar with RAID subsystems, or are not aware of the features and limitations of Silicon Graphics RAID products, read this chapter. For purposes of brevity, the term RAID in this manual refers to the Silicon Graphics functional implementation as defined in this chapter.

1.1 Features

The SCSI RAID subsystems offered by Silicon Graphics are installed in a variation of the eight-bay SCSIBox 2 drive enclosure that was introduced with the CHALLENGE and Onyx products. The principal difference between a RAID box and non-RAID SCSIBox 2 is the backplane and the RAID adapter board and controller that plug into the backplane of the RAID SCSI box. The

RAID version of the “stubby” SCSI box that installs only in the main system rack uses the same power brick as the non-RAID SCSIBox 2. Note that there is no internal RAID configuration for deskside systems. Deskside systems connect to RAID boxes installed in a Vault (T2) expansion rack. See Figure 1-1 for an example of the two.

Customers who wish to upgrade their installed CHALLENGE / Onyx systems to use RAID may keep and use existing 2.0 GB IBM SCSI disks purchased from Silicon Graphics. A new RAID SCSI box is required for the upgrade. See Appendix A, “RAID Hardware Upgrades”for details on upgrades to existing systems.

Note: Only the single-ended version of the 2.0 GB IBM SCSI disk is supported in the RAID subsystem. Other Silicon Graphics SCSI disks or third-party disks are *not* supported. Differential 2.0 GB disks can be converted to single-ended in the field.

Silicon Graphics RAID subsystems offer the following features:

- Choice of RAID 3 or RAID 5 implementation
- A Vault rack filled with RAID boxes supportable by one SCSI channel
- Two optional non-RAID 5 1 / 4” SCSI devices supportable in each RAID box
- Hot unplugging / plugging of a defective RAID disk during system operation
- Controller status and “disk-down” warning LEDs
- Programmable stripe depth from 2KB to 64KB per disk
- SCSI-2 FAST and WIDE host interface

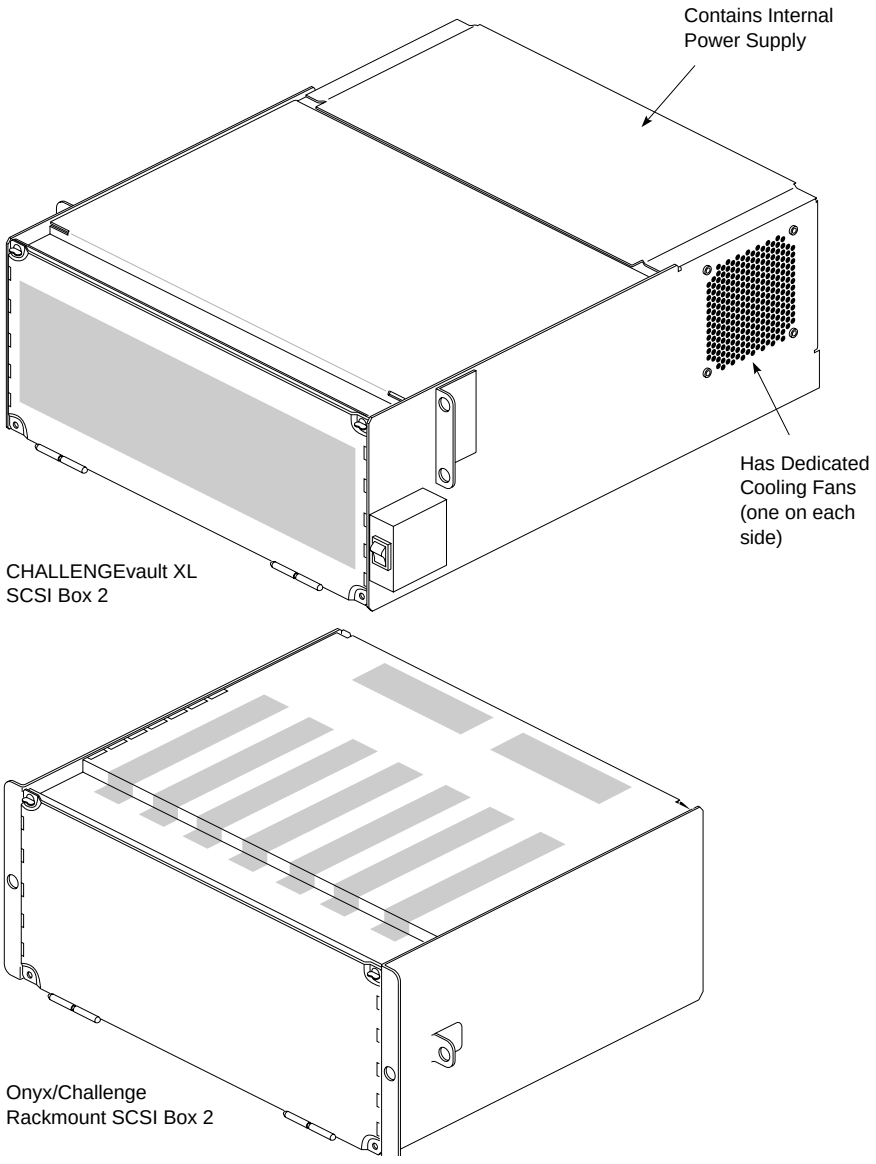


Figure 1-1 Comparison of Vault and System “Stubby” Rack Boxes

1.2 Operational Overview

The RAID subsystem is redundant only to the extent that a single disk failure will not cause loss of data. This presumes that a new disk is properly installed and software recovery is properly executed as soon as possible. There is no redundant power supply for the RAID box.

In the RAID implementation, a set of five disks is controlled by a disk array controller that resides in bay two of the RAID box. Bay zero is always reserved for a non-RAID device, and bay one can be an additional non-RAID SCSI device. Future system software and hardware releases may support a second RAID controller in bay one. Note that a disk in bay 0 can share the same SCSI bus as the RAID array, but it must be a differential device. Any single-ended device installed in bay 0 or 1 has to be controlled by a separate single-ended SCSI channel. See Table 1-1 for an overview of the requirements for each bay in the RAID SCSI box.

Bay Number	Use of the Bay
0	Optional Non-RAID SCSI Device
1	Optional Non-RAID SCSI Device
2	RAID Controller Assembly Location
3	RAID Disk 0
4	RAID Disk 1
5	RAID Disk 2
6	RAID Disk 3
7	RAID Disk 4

Table 1-1 Use of Each Bay in the RAID SCSI Box

Note: Single-ended non-RAID devices can be installed only in RAID boxes that are in the main system chassis. They are not supported in the Vault (T2) expansion rack.

Regardless of whether the implementation is RAID 3 or 5, the disk arrays will use the exclusive OR (XOR) process to generate parity and reconstruct lost data. When one of the disks in the array fails, an XOR strategy will be used to restore the information on the replaced disk. In an XOR strategy, the parity bit

that is written to a disk will always be the bit that leaves the array write pattern in a “true” state. The array will only be in a true state if there is an even number of 1’s written to the five disks. Figure 1-2 shows a very simple example of the XOR parity concept. Disk 4 contains the parity bit and disk 1 is a failed disk. For simplification, the bits shown below the disks represent the last bit written in each 2KB stripe written across a disk.

For example, suppose our RAID array (disks 0 through 4) experiences a failure of disk 1. Because there is now an odd number of ones (three), the array is in a non-true state. When the failed disk (disk 1) is replaced, the system can restore the proper bit (a one) to the new disk 1. The reconstruction program knows that the bit must be a one, because without the original disk 1, there is an odd number of ones written across that stripe subsection in the array.

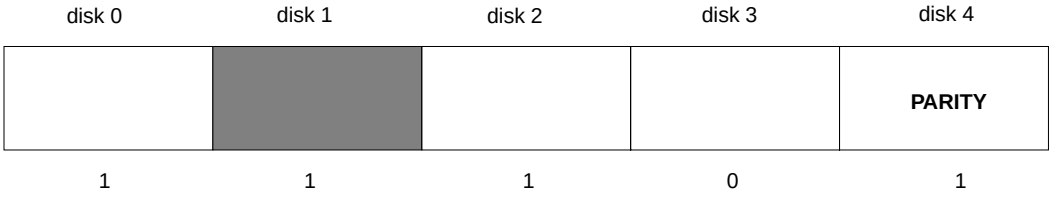


Figure 1-2 Exclusive OR Reconstruction Process Example

If the array in the previous example were a RAID 3 implementation, the parity bit would always be written to disk 0. Disk 0 would be the dedicated parity disk.

If the array in Figure 1-2 were a RAID 5 implementation, the parity bit could be written to any of the disks in the array. RAID 5 uses a section of each disk as a parity disk and spreads the parity bits across the array. See the following two subsections, Section 1.2.1, “RAID 3 Implementation,” and Section 1.2.2, “RAID 5 Implementation,”for more on RAID 3 and 5.

1.2.1 RAID 3 Implementation

In the RAID 3 application, one of the five disks in the array is reserved exclusively for parity data. This allows the performance improvement of disk striping while removing the problems related to data loss if a single disk in the stripe group fails. In a non-RAID group of striped disks, loss of a single disk would mean loss of all data.

The RAID 3 operation is different from RAID 5 in that the parity bits cannot be written to any but the designated parity disk. Note that Silicon Graphics uses a block-striped RAID 3 implementation.

The drawback to a RAID 3 implementation is that writing to a disk in the group means accessing all the disks in the group. Basically this means that the level 3 RAID can perform only one I/O at a time. RAID 3 striping provides fewer I/O's per second than either straight disk striping or RAID 5 implementations.

Use of the dedicated parity disk has drawbacks when multiple write operations are requested at the same time. The parity has to be written to the dedicated disk on each requested write, which can produce an I/O bottleneck.

1.2.2 RAID 5 Implementation

In a RAID 5 application, the concept of striping with parity redundancy is expanded by spreading out the parity information to all the disks in the array rather than having a dedicated parity disk as in RAID 3. Using a section of each disk as a parity disk means the writing of parity bits will be spread out relatively evenly across the disk array.

A performance improvement results because a user can write a segment to disk 0 and parity to disk 1, while another user writes a segment to disk 2 and parity to disk 3. This improves what is called the "transactional" speed of the RAID subsystem. Transactional processing speed is important when many users want access to the disks to read and write data quickly. Since RAID level 5 allows almost tandem accesses, bottleneck problems with I/O are less likely than in RAID level 3.

A RAID 5 array cannot produce write performance that equals straight disk striping, since other operations are needed to make and store the parity bits. When any part of a stripe is modified, the non-modified parts must also be read and parity generated for the entire stripe. After parity generation, the modified data and parity information must be written to the disk; this is generally called a read/modify/write strategy.

Note: RAID 5 is not supported in IRIX release 5.0.1.

1.3 Non-supported RAID Features

Each Silicon Graphics RAID subsystem always consists of a five-disk array and one RAID controller. Future system software and hardware releases are expected to support a second controller. The features offered with Silicon Graphics RAID have been discussed, but it is also important for the system support engineer (SSE) to understand what features are not offered.

The following RAID features are *not* supported in the Silicon Graphics RAID subsystem:

- Disk mirroring
- Hot plugging (removal and replacement) of an active controller
- Hot plugging of more than one disk at a time
- Use of an on-line “hot spare”
- Fewer than five disks in the RAID array
- More than five disks in the RAID array

Note: The RAID array cannot be used as the system disk and the system cannot boot from the RAID array.

1.4 Hot Plugging a Disk

The most important concept to remember when hot unplugging / plugging a disk in the RAID array is to be absolutely sure you are removing the failed disk. If one disk has failed and a different one is removed, the system will experience a double point of failure. The probable result of this will be loss of data across the entire RAID array. Reloading and reformatting from tape backups will probably be necessary.

There will be a noticeable decrease in performance after a failed disk has been replaced. This is due to the overhead required by the reconstruction program to rebuild the information that was on the failed disk onto the replacement disk. See Chapter 4 in the *RAID System Administration Guide* P / N 007-2113-001.

Note: A disk that is signaling imminent failure or needs to be removed for other reasons should always be marked “down” before it is removed. Verify the disk ID and slot number using the information in this chapter. See the *RAID System Administration Guide* for specific instructions on how a disk is marked down.

There are four methods for determining which disk in the RAID array is malfunctioning.

You should check at least two of the following indications of failure before hot plugging a replacement disk:

- A lit disk-down LED on the disk’s front panel
- A lit disk-down LED on the RAID controller
- A direct inquiry to the IRIX™ shell
- A disk failure message in */var/adm/SYSLOG*

Note: In IRIX release 5.0.1 the *SYSLOG* file moved from */usr/adm/SYSLOG* to */var/adm/SYSLOG*.

1.5 The Disk-Down LEDs

The RAID controller lights the amber disk-down indication LED that is visible behind the plastic and metal front panel of each disk. This LED will light when the disk experiences a failure. Figure 1-3 shows the location of the disk-down indication LED behind the disk’s front panel. Figure 1-4 shows the disk-down LED from the front of the drive.

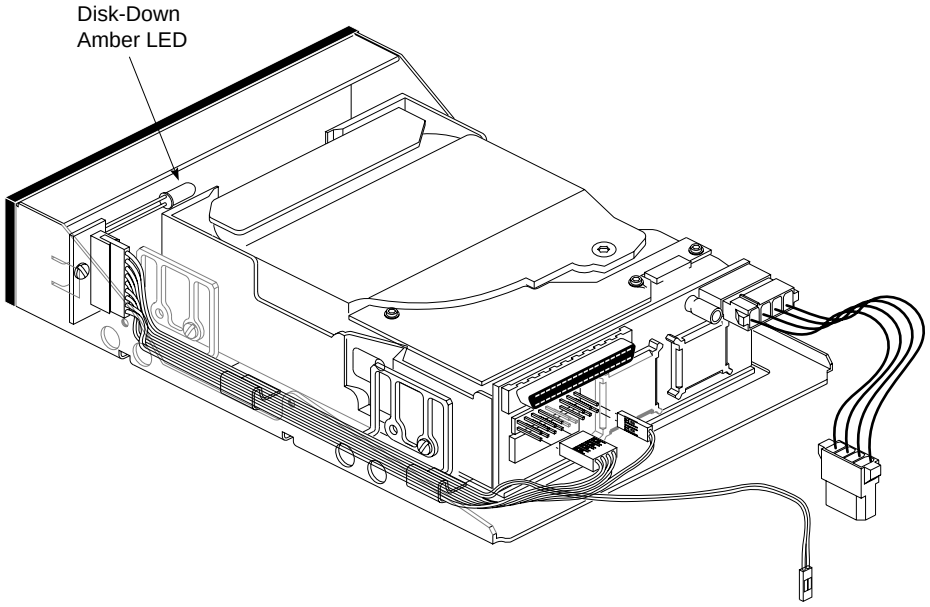


Figure 1-3 Disk-Down LED Behind the Disk Drive Front Panel

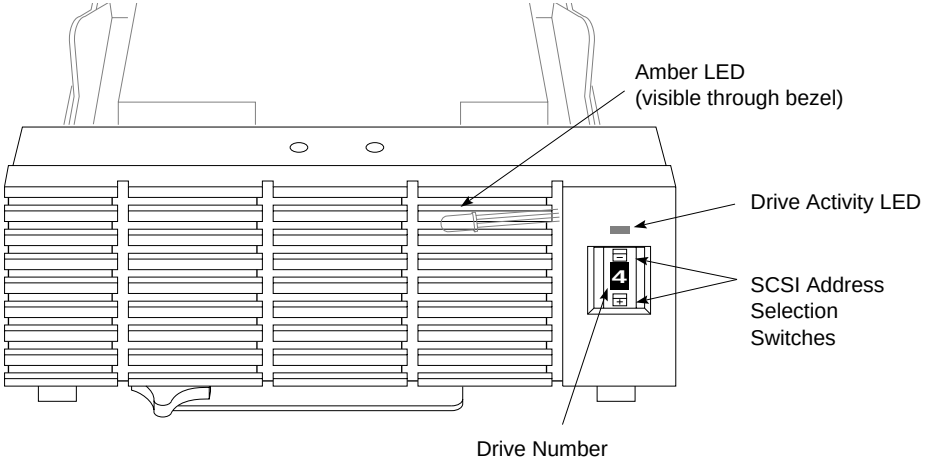


Figure 1-4 Disk-Down LED Location Viewed from Front

1.5.1 The Controller's Disk-Down LEDs

There are a set of eight LEDs on the forward edge of the RAID controller board. The error indication on the RAID controller LED should reflect the error indication shown on the individual disk. If it does not, use one of the procedures in the following two subsections to reconfirm the failure.

See Table 1-2 for a description of all the functions of the RAID controller's eight LEDs.

LED	Lit Means	Off Means	Flashing Means
1	The RAID is processing commands.	The RAID is not processing commands.	The RAID is processing commands.
2	The RAID has failed.	The RAID has failed.	The RAID is operating normally.
3	A maintenance command such as building a disk drive or checking parity is active.	The RAID is operating normally.	A maintenance command such as building a disk drive or checking parity is active.
4	Disk drive 0 is down.	Disk drive 0 is operational.	N / A
5	Disk drive 1 is down.	Disk drive 1 is operational.	N / A
6	Disk drive 2 is down.	Disk drive 2 is operational.	N / A
7	Disk drive 3 is down.	Disk drive 3 is operational.	N / A
8	Disk drive 4 is down.	Disk drive 4 is operational.	N / A

Table 1-2 RAID Controller LEDs

See Figure 1-5 for location and identification of the RAID controller board disk-down LEDs.

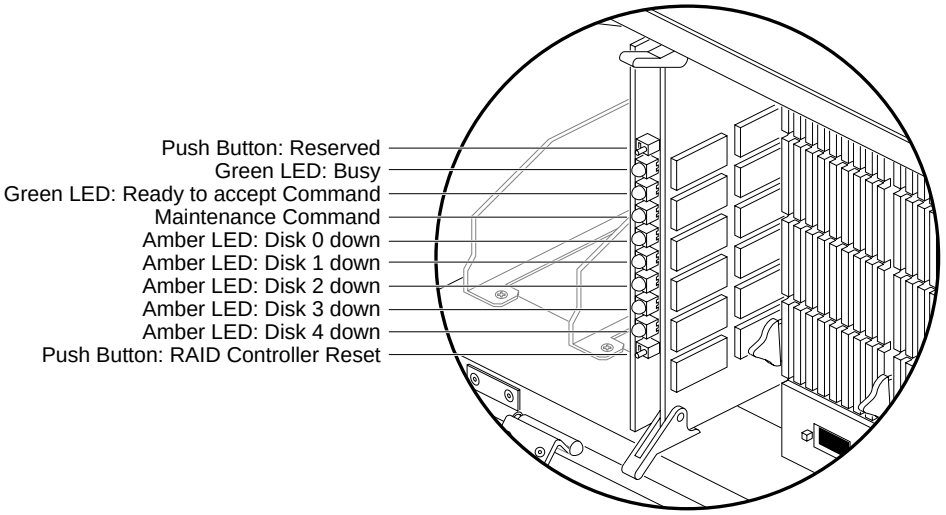


Figure 1-5 RAID Controller Status LEDs

1.6 Command Line Inquiry

You can check on the status of all RAIDs connected to the system by using a direct command to the IRIX shell. Enter the following in any functional IRIX shell:

```
% raid -c
```

If the command line returns no information, there are no down disks.

If you just need to check on the status of a particular RAID array, become superuser and enter:

```
# raid -c /dev/rdsk/radcontrollerdunitvh
```

This returns information on only the specified device. No information is returned if there is no down disk found.

Note that when the system is rebooted, all RAIDs are checked for failed disks automatically using the command:

```
% raid -c -m -L
```

The **-m** option tells the *raid* command to check for disks that were replaced while the system was off. If it finds new disks, it marks them as down and any data on them is not used. The **-L** writes any messages to */var/adm/SYSLOG* and the console window. See the rebuild information in Chapter 4 of the *RAID System Administration Guide*.

Remember that a standard *hinv* inquiry from the IRIX shell sees the RAID array as a single disk. A response from the *hinv* inquiry regarding a RAID might look like the following:

```
Disk drive: unit 1 on controller 1: RAID
```

If you are in the PROM "Command Monitor" level on the system, *hinv* is unable to distinguish between RAID and non-RAID disks. The response you would receive to an *hinv* inquiry is similar to:

```
Disk drive: unit 1 on controller 1
```

The fact that unit 1 is a RAID array is not specified as it is when IRIX is operational.

1.7 Checking the System Log

You can check in */var/adm/SYSLOG* for information on failed disks. The information written to SYSLOG should indicate that disk XX attached to RAID array XX and controller XX failed on a given day and time.

If the system has more than one RAID array connected, you should always check carefully to be sure there is not more than one failure.

Each RAID disk monitors its internal statistical information. The RAID controller monitors the soft error rate on each disk in the array and can use the information to predict an imminent disk failure. The RAID subsystem uses sophisticated predictive failure analysis (PFA) to provide warnings predicting that disks are statistically likely to fail within 24 hours. See the *RAID System Administration Guide* for more information on this topic.

When a disk reaches an error rate that indicates failure within 24 hours, a message is sent to */var/adm/SYSLOG* and to the system console.

If */var/adm/SYSLOG* contains warning messages that indicate both a failed disk and an imminent failure for another disk, it is imperative that the failed disk be replaced immediately. Replace the disk labeled as an imminent failure as soon after that as possible.

If the RAID box is experiencing multiple failures, the failures should be remedied in the following priority order:

1. A failed controller assembly
2. A down disk
3. A disk marked as an imminent failure

1.8 Guidelines for Cabling RAID Boxes

Each RAID SCSI box can be daisy chained to the next until the Vault rack is filled and they can be connected to a single SCSI controller. This is the allowed maximum number of RAIDs on a single SCSI controller. In practice, the customer will probably want far fewer RAIDs connected to each controller in order to maintain maximum throughput on the SCSI bus.

To promote the best system I/O throughput, the following guidelines are recommended for RAIDs:

- The rated capacity of a fast and wide channel is 20 MB per second, but because of overhead, assume that the capacity is 18 MB per second.
- A RAID 3 at maximum throughput uses most of the capacity of a channel.
- A RAID 5 at maximum throughput uses about one quarter of the capacity of a channel.
- For RAID 5, the sizes of the transfers and the number per second determine how many transfers (and therefore RAIDs) can fill the capacity of the channel.
- A non-RAID disk at maximum throughput uses 3 MB to 4 MB per second.
- Putting slow devices such as tape drives and CD-ROM drives on a channel with one or more RAID units can severely impact the performance of the RAIDs.
- In general, RAID units should be put on channels with other RAID units and non-RAID disk drives only.

Note: All SCSI controller connections made to RAID boxes must be from differential IO4 SCSI connectors.

Do *not* attempt to use the following SCSI controllers to support RAID boxes:

- The VME-based 4210 and 4220 differential SCSI controllers
- Single-ended IO4 SCSI buses
- IO2 or IO3 SCSI controller boards
- Any third-party supplied SCSI controller

When connecting multiple RAID boxes in a Vault, be sure not to exceed the maximum differential SCSI cable length of 81 feet (25 meters). Be sure to include the following lengths when calculating SCSI bus distance from the controller:

- 3 feet (0.91 m) from the controller to the system rack's I/O panel
- 25 feet (7.6 m) from I/O panel to the Vault-mounted RAID box
- 1.5 feet (0.46 m) for each daisy-chain link between RAID boxes in the Vault
- 3.5 feet (1.1 m) internal for each Vault-mounted RAID box

Chapter 2

Configuring the RAID Hardware

This chapter contains the following sections:

- Section 2.1, “Drive Sled Configuration.”
- Section 2.2, “SCSI Backplane Configuration.”
- Section 2.3, “Disk and Controller SCSI ID Selection.”
- Section 2.4, “Configuring the RAID Controller.”
- Section 2.5, “Guidelines for Installing Non-RAID Drives in a RAID Box.”
- Section 2.6, “Cabling and Termination Guidelines.”

This chapter provides an overview of the configuration requirements for each RAID box. It also explains how to properly extend or terminate the SCSI bus connected to each RAID box.

2.1 Drive Sled Configuration

Note: Each drive sled and disk assembly used in the RAID array must be configured for single-ended operation. Although the RAID controller communicates with the IO4 using differential signals, it interfaces with the disks in the RAID array using single-ended signals only.

Figure 2-1 shows the proper configuration of the sled board for use in the RAID array.

Caution: Each RAID disk drive SCSI cable must be plugged into the channel A connector on the sled board. Plugging the cable into channel B will cause a “drive missing” condition in the RAID array and the RAID will not come on line.

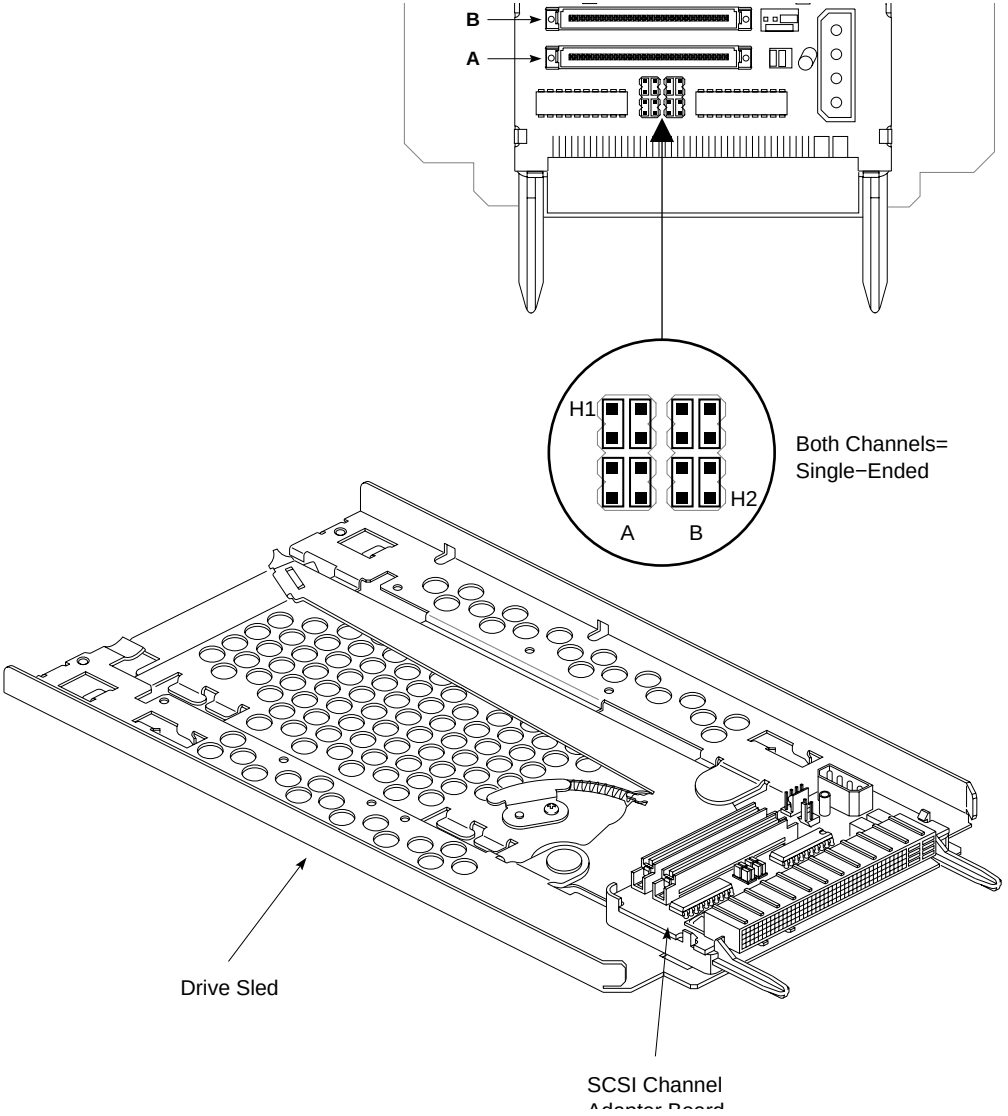


Figure 2-1 Configuring a Drive Sled for the RAID Box

2.2 SCSI Backplane Configuration

As noted in Chapter 1, “Introducing the RAID Hardware Options”, the functionality of the SCSI backplane in the RAID box is different from the ones in the non-RAID SCSIBox 2 products. The jumpering concepts for the RAID backplane, however, are similar to those for the non-RAID box. Use Figure 2-2 and Figure 2-3 to configure the jumpers on a RAID box backplane to use single-ended or differential non-RAID drives in bays 0 and 1 in a RAID box.

Note: Single-ended non-RAID drives can only be installed in the “stubby” RAID box that goes in the system chassisfs. Single-ended non-RAID SCSI devices are not supported in RAID boxes installed in the Vault expansion rack.

Use of optional single-ended non-RAID devices in bay 0 or 1 requires a specific jumper configuration on the backplane in addition to proper RAID jumpering. See Figure 2-2.

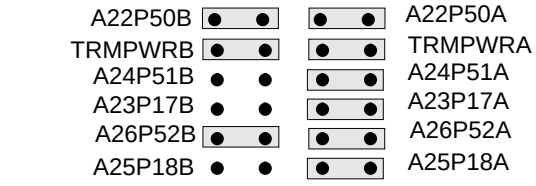


Figure 2-2 RAID Backplane Configuration with Single-ended Non-RAID Drives Installed

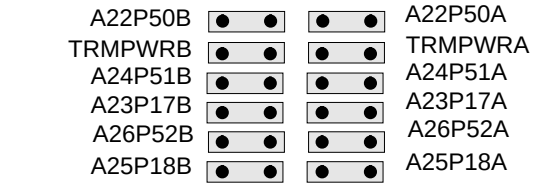


Figure 2-3 RAID Backplane Configuration with Differential Non-RAID Drives Installed

The location of the backplane jumpers on the rear of the “stubby” box RAID backplane is shown in Figure 2-4. Note that the 512S power brick is not shown installed. To reset the backplane jumpers, you will probably have to remove the 512S.

Figure 2-5 shows the location of the backplane jumpers on the rear of the Vault RAID box backplane. The location of the CN_PS connector that links to the Vault box power supply is also indicated.

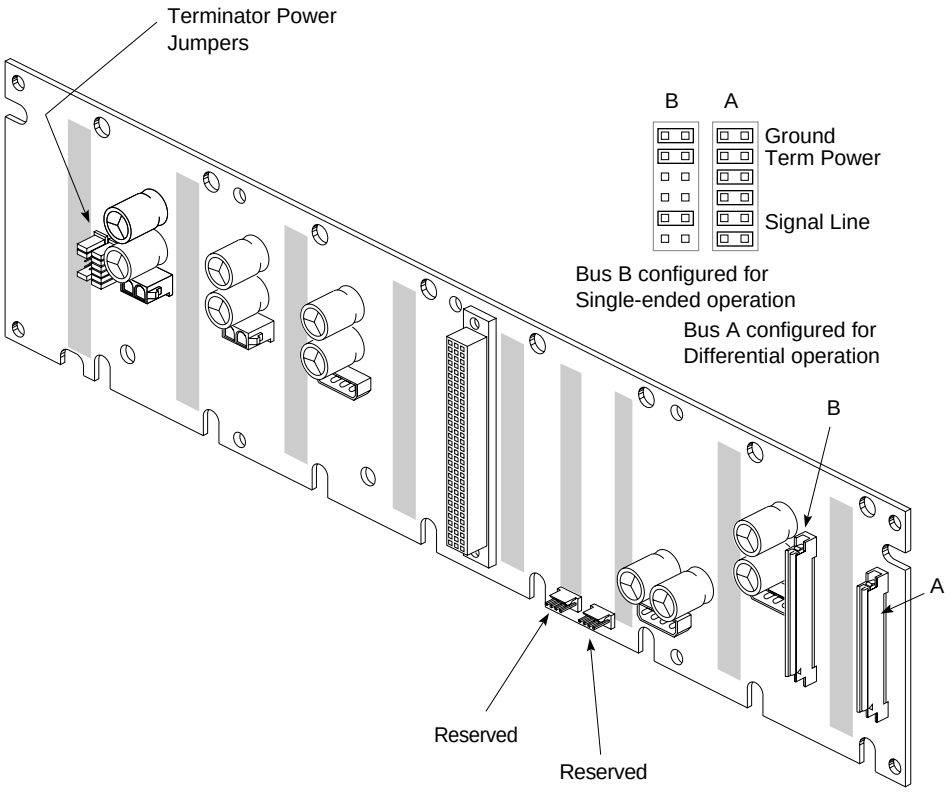


Figure 2-4 RAID System Rack “Stubby” SCSI Box Backplane

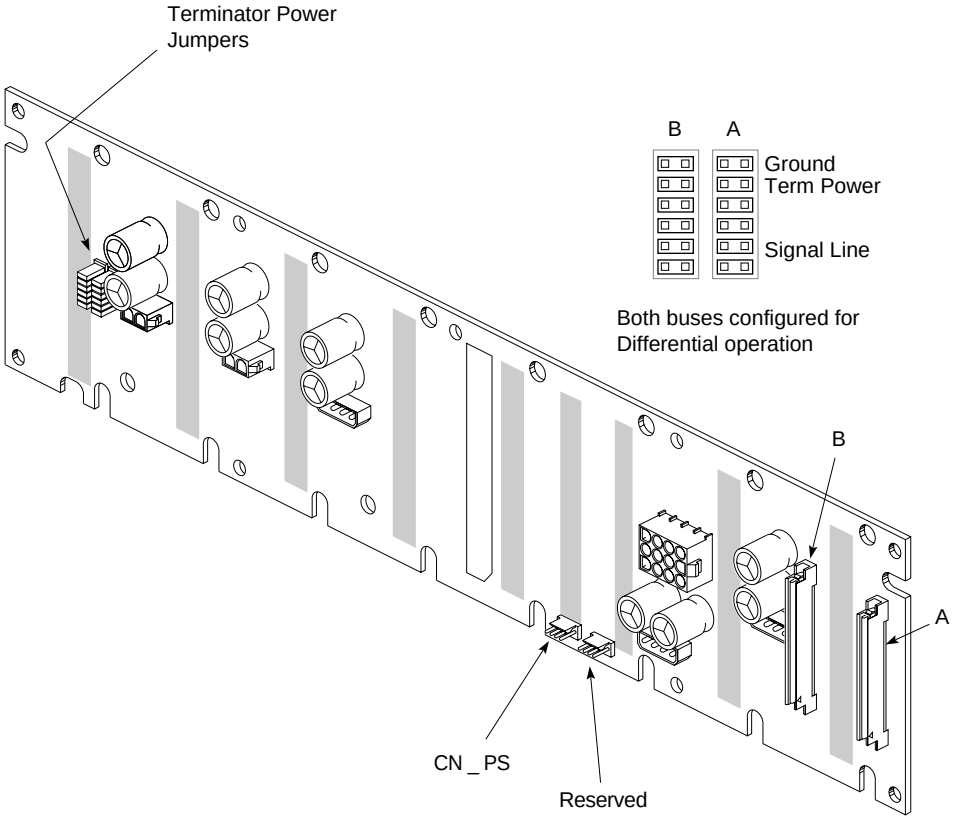


Figure 2-5 RAID Vault Box Backplane

2.3 Disk and Controller SCSI ID Selection

In a non-RAID SCSI-based system, each device on the bus must have an individual SCSI ID number. In a RAID application, the SCSI ID numbering is done in a two-tier configuration. The system's IO4 SCSI controller interface actually only "sees" the RAID controller ID number. The RAID controller in turn communicates with the five disks in the array in a specific disk identification pattern. All the disks "behind" the RAID controller SCSI ID are treated as one large SCSI disk.

2.3.1 Disk ID Numbering

The five drives in each RAID must use 0 through 4 for their drive IDs. From left to right, the drives should be numbered 0, 1, 2, 3, and 4. Use the push buttons on either side of the ID panel to select the proper SCSI ID. See Figure 2-6.

Note: When you remove or replace a RAID drive, be careful not to accidently bump the ID selection buttons on the front panel. You can accidently change a drive ID and cause SCSI bus malfunction in the RAID box. The ID on each drive must match the RAID bay (0-4) it is installed in.

After replacing a defective disk, be sure to select the proper SCSI ID (0-4) for the new device. The RAID controller will not recognize a disk that has a duplicate ID or an ID other than 0-4.

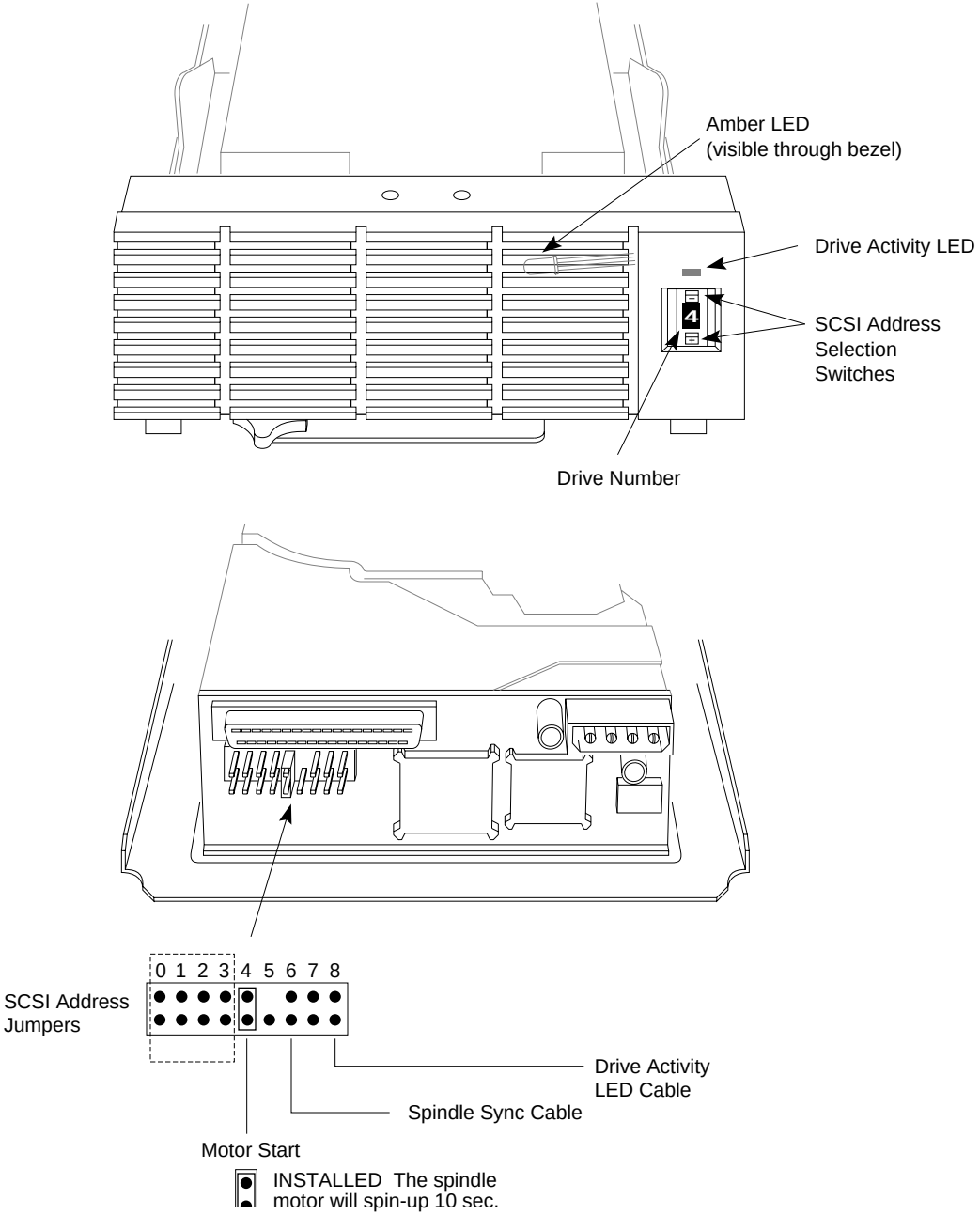


Figure 2-6 SCSI Drive ID Selection and Jumper Plug Selection

2.3.2 Setting the RAID Controller SCSI ID

The RAID controller board has a rotary selection switch that allows you to designate IDs 0 through F as the target SCSI ID of the RAID array. Never set the RAID controller for SCSI ID 0, as this ID is reserved for the (IO4) SCSI controller board.

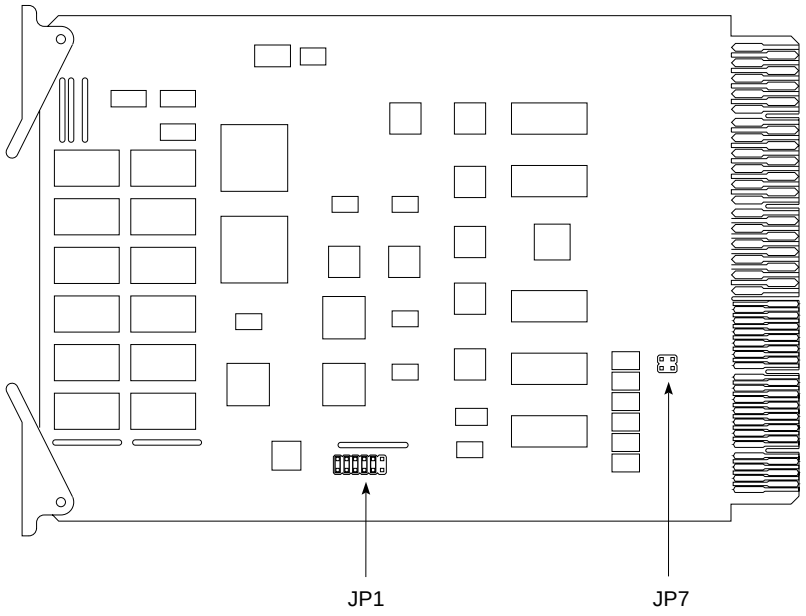
Note: If the RAID array is on the same SCSI bus as the system disk, you must not assign the RAID a SCSI ID of 1. SCSI ID 1 is always used for the system disk.

The RAID controller assembly is always shipped from the factory with a default SCSI ID setting of 2. Use the *hinv* inquiry to the system to be sure of the SCSI IDs assigned to other devices on the SCSI bus. If an existing device on the bus has SCSI ID 2, you must either change the setting on that device or alter the setting on the RAID controller. For additional information on accessing the RAID controller, see Section 3.5.1, “Controller Assembly Removal and Replacement” in Chapter 3. Use the following information to set the ID:

1. Access the left side of the controller assembly and locate the rotary switch at position U87 in the upper middle section of the board. See Figure 2-7 for the exact location.
2. Set the SCSI ID for the controller by turning the arrow to the number you have selected. Do not select ID 0.
3. Reinstall the controller assembly.

2.4 Configuring the RAID Controller

There are four configuration jumper blocks on the RAID controller board that must be configured properly for the array to operate. See Table 2-1 for their proper configuration and functions. Refer to Figure 2-7 for their locations.


JP1
JP7

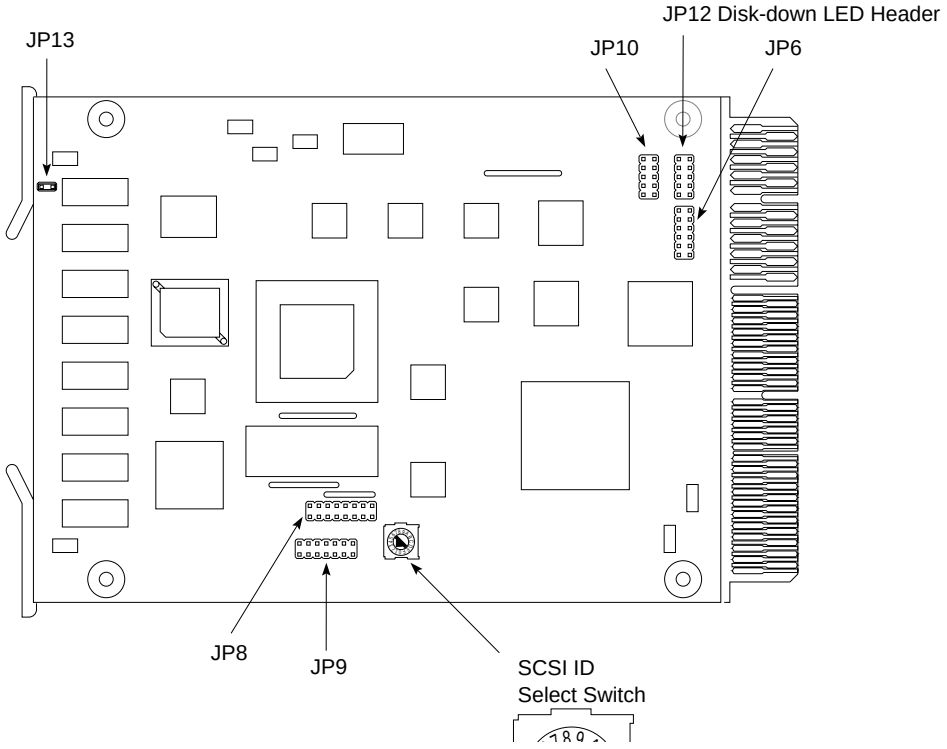

JP13
JP10
JP12 Disk-down LED Header
JP6
JP8
JP9
SCSI ID
Select Switch

Figure 2-7 RAID Controller ID Selector and Board Jumpers

Location	Pin Numbers	Jumper In/Out	Function(s)
JP-1	1-2	In	RAID channel 0 termination
	3-4	In	RAID channel 1 termination
	5-6	In	RAID channel 2 termination
	7-8	In	RAID channel 3 termination
	9-10	In	RAID channel 4 termination
	11-12	Out	Host SCSI termination enable
JP-7	1-2	Out	Local Host SCSI TERMPWR
	3-4	Out	Remote Host SCSI TERMPWR
JP-8	1-2	Out	PRI/SEC, RS-232 Options (not supported)
	3-4	Out	
	5-6	Out	
	7-8	Out	
	9-10	Out	
	11-12	Out	
	13-14	Out	
	15-16	Out	
JP-13	1-2	In	Internal LED enable

Table 2-1 RAID Controller Jumper Configurations and Functions

2.5 Guidelines for Installing Non-RAID Drives in a RAID Box

These restrictions apply to non-RAID devices that you install in a RAID box:

- Non-RAID devices are only allowed in bay 0 or 1
- The device(s) must be differential if they are controlled by the same SCSI bus as the RAID array or are in a Vault rack.
- If the non-RAID devices are single-ended, they must be controlled by a separate SCSI bus (system rack only).

Note: Only non-RAID devices installed in a “stubby” RAID box in the main system rack can be controlled by a separate single-ended SCSI bus. An external single-ended cable cannot be connected to Vault-mounted RAID boxes.

2.6 Cabling and Termination Guidelines

This section is concerned with cabling in both the drive assembly and the RAID box.

The SCSI ID and LED function cable is on the left-hand side of the disk and sled assembly (when viewed from the rear). This cable supports three separate functions, as shown in Figure 2-8. The cabling on the disk assembly should already be fully connected. If it is not, reference Section A.4, “Converting Existing Drives” in Appendix A.

The RAID channel (A) on either variation of the RAID box must be terminated with a differential termination plug. If channel B (the non-RAID channel) is not being used, it does not need to be terminated.

Caution: Using a single-ended terminator on the RAID channel termination plug will cause SCSI bus malfunction.

2.6.1 LED Disk-Down Signal Cable

Each drive assembly has an LED disk-down signal cable that connects from jumper block CN4 (pins 1 and 2 only) on the drive sled to the LED connection on the front panel. This cable must be connected with the red stripe closest to the power connector for the amber disk-down LED to light up when a disk-down event occurs. See Figure 2-8 for the location of the cable.

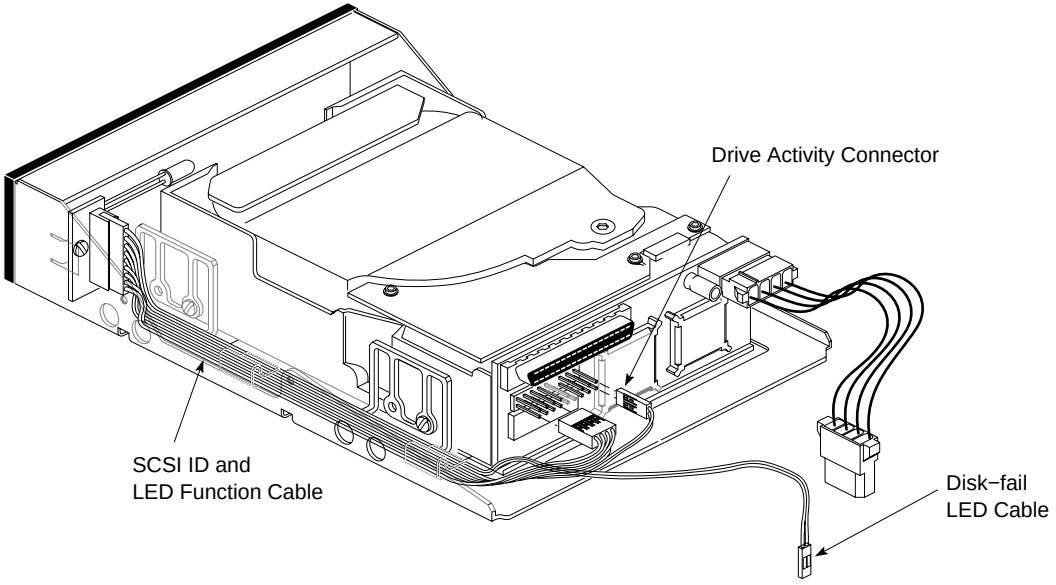


Figure 2-8 SCSI ID and LED Function Cable

2.6.2 RAID SCSI Box Cabling and Termination

A significant difference between the standard SCSIBox2 and the RAID boxes is that the RAID SCSI box backplane does not have terminator plugs. On Vault-mounted RAID boxes, termination is supplied by continuing the incoming SCSI cable back out to the termination port.

In system rack “stubby” RAID boxes, the terminators connect directly to the “tail” of the incoming SCSI RAID cable and are routed back to a plastic retainer bracket on the outside of the system rack chassis. See Figure 2-9 for the Vault RAID box example and Figure 2-10 for the system-mounted “stubby” RAID box example.

The SCSI cable that connects to the “stubby” system rack RAID box backplane is different from the Vault RAID box because it uses a non-fixed termination point. Daisy chaining to another box or device from a “stubby” RAID box is *not* supported as it is in the Vault-mounted boxes.

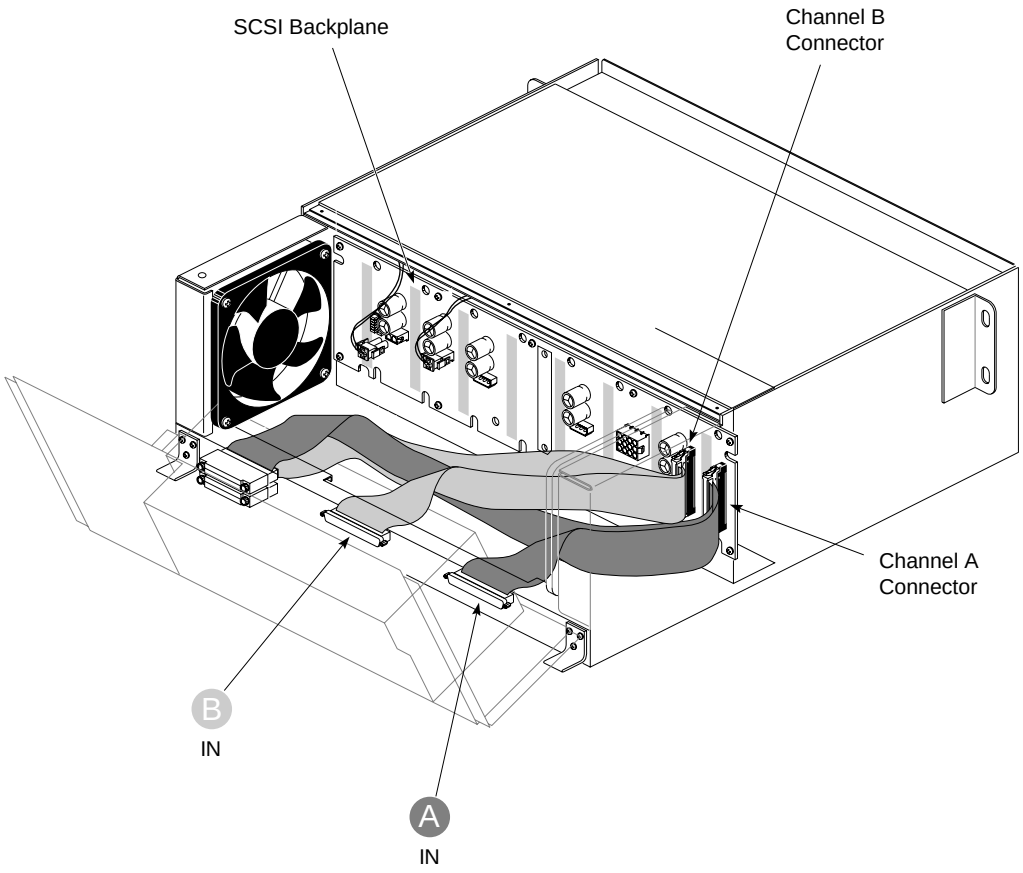


Figure 2-9 Vault RAID SCSI Box Cabling and Termination

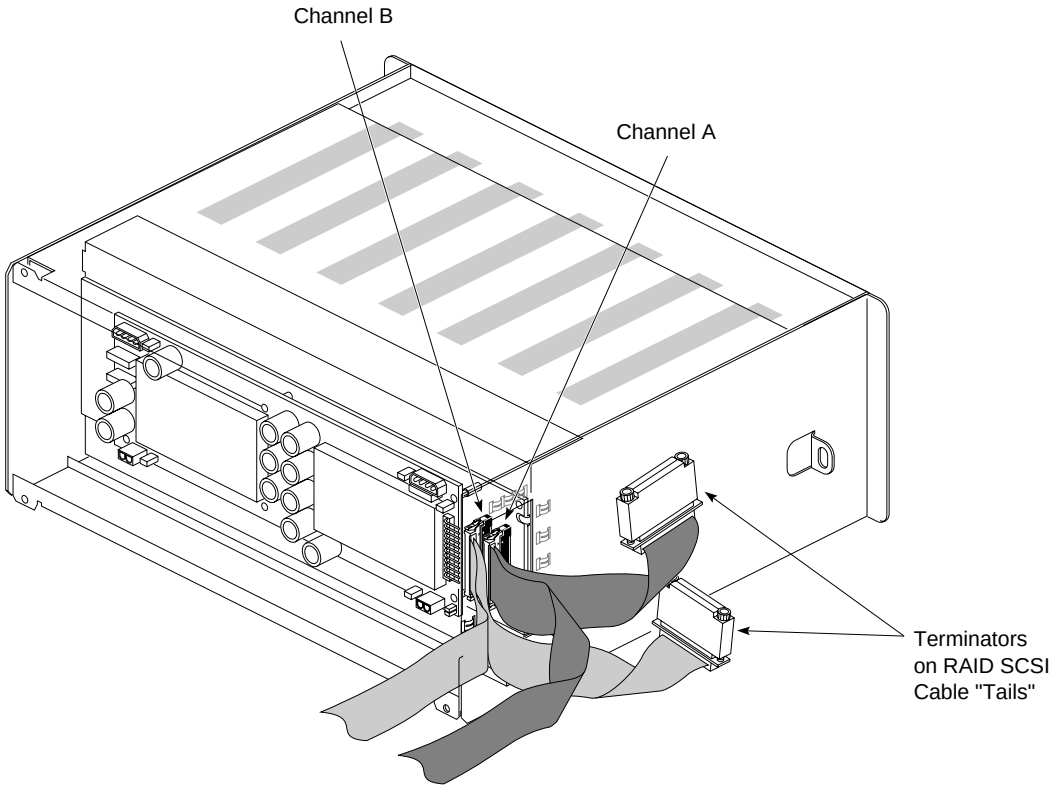


Figure 2-10 "Stubby" RAID Box Cabling and Termination

Chapter 3

Installing the RAID Box

This chapter contains the following sections:

- Section 3.1, “Safety Precautions.”
- Section 3.2, “Powering Down the Chassis.”
- Section 3.3, “Installing a RAID Box in the System Rack.”
- Section 3.4, “Installing a RAID Box in the Vault Rack.”
- Section 3.5, “Installing the Drives and Controller.”
- Section 3.6, “Installing a Full-height Non-RAID Drive.”
- Section 3.7, “Powering On the System.”

This chapter provides information on installing RAID boxes into both the system rack and the Vault expansion rack. It is presumed that the installer has some experience with the Challenge / Onyx rackmounted products. Expanded background information on these chassis is available in the *CHALLENGE/Onyx Rackmount Installation Instructions*, part number 108-7042-0x0 and *CHALLENGE Vault Rackmount and SCSIBox 2 Installation Instructions*, part number 108-7044-0x0.

3.1 Safety Precautions

Caution: Installation of the RAID product requires specific training and technical knowledge. These instructions are provided for use by Silicon Graphics system support engineers or other Silicon Graphics-trained technical personnel.

This equipment is susceptible to damage caused by electrostatic discharge (ESD). Use standard ESD precautions and the following preventive measures whenever possible:

- Connect a ground strap to your wrist when connecting / disconnecting all peripherals.
- Keep boards and drives in their antistatic bags until they are ready for installation.

Note: The SCSI drive box weighs approximately 37 pounds (16.8 kg) without drives. For easier and safer loading, it is recommended that the disks be inserted after the box is installed. The steps for installing the boxes are covered in this chapter prior to the procedures for installing drives in the boxes.

3.2 Powering Down the Chassis

This section covers the power-off procedure for the system rack and the Vault (T2) expansion rack. If the system is already powered off, proceed to the appropriate section and begin the RAID box installation.

Warning: The rackmount chassis operates on 220 or 400VAC. Use extreme caution when working around the chassis. Never install or remove power cords without first turning off the equipment. The rackmount system's midplane carries 48VDC even if the system has been reset or halted.

3.2.1 Powering Down the Main System

The system rack should be completely powered down before installing the RAID box. Before beginning this procedure, log out and shut down the software using the instructions that follow:

1. To halt operating system activity and prepare the system for power-off, become superuser and enter **`/etc/halt`** in a functional IRIX shell. The */etc/halt* command will gracefully shut down the system software and

leave you at the firmware monitor level. If you are remotely logged in to the system, you will be prompted before the shutdown procedure is executed.

2. Turn the System Controller key switch to the Off position to eliminate all power to boards, peripherals, and (if applicable) the Vault expansion rack.
3. Switch the system circuit breaker to the Off position to eliminate power to the off-line switcher (OLS) and backplane.
4. Unplug the power cord from the socket to cut off all electrical power to the system.

3.3 Installing a RAID Box in the System Rack

Use the following instructions to install or remove the RAID SCSI box drive enclosures:

Note: The optional RAID SCSI box is externally similar to the standard "stubby" SCSIBox 2 that is shipped with CHALLENGE/Onyx rackmount systems, and is installed and removed in the same way. This optional box mounts in either of the bays that are directly below the System Controller front panel.

1. Power down the system as described in the previous section.
2. Unpack the RAID SCSI box and check for any obvious shipping damage.
3. Remove the side panels from the left side of the system chassis.

   Note: Use care when handling the side panels. Store them in a safe place during this procedure to avoid scratching or marring them.
4. Slide the RAID box into the enclosure until the flange on either side of the box contacts the system chassis. Fasten the box in place with one screw on each side. See Figure 3-1 for an example.

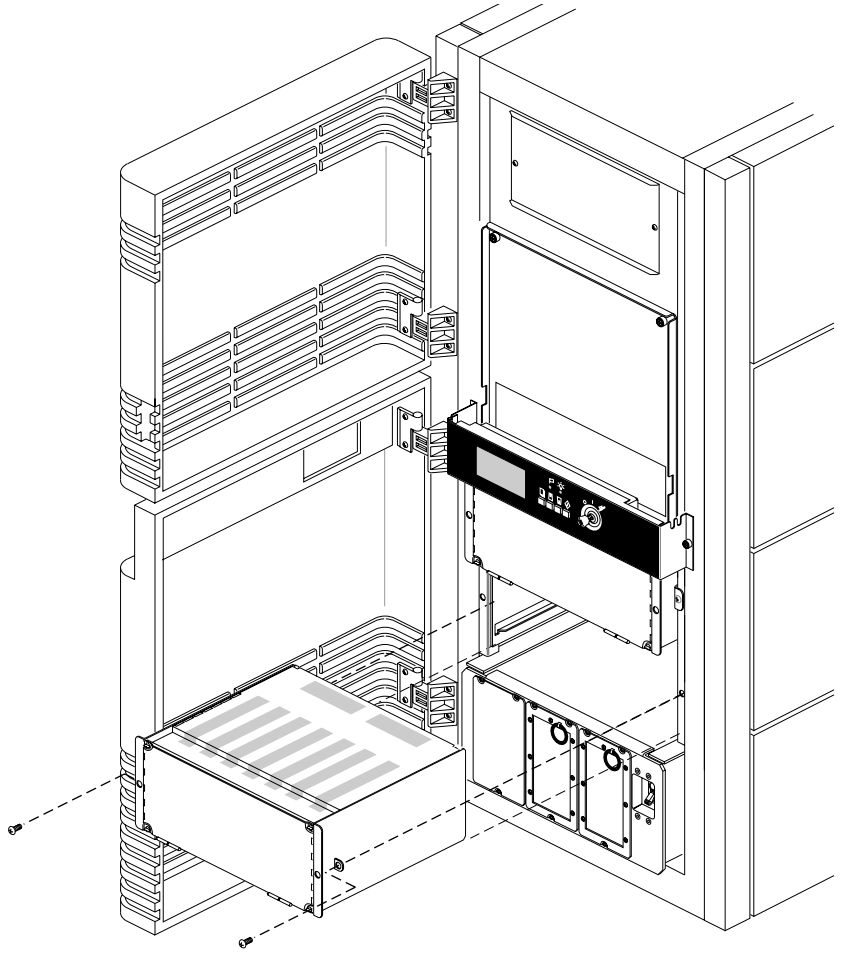


Figure 3-1 Installing the Optional RAID SCSI Drive Box

5. Remove the access port cover (12 nuts) and locate the two SCSI cables and the power cable for the optional RAID SCSI box. The SCSI cables run down the left side of the system chassis and exit from the cable routing box immediately to the rear of the RAID SCSI box access ports. The power cables are integral to the access port cover. Reference Figure 3-2.

Caution: You must use only a RAID SCSI cable (P / N 018-0415-00x) to connect a RAID box to a differential controller on the IO4. The RAID SCSI box cannot be terminated without use of the RAID SCSI cable. Use steps six and seven if you need to install a RAID SCSI cable, otherwise continue to step eight.

6. Remove the Phillips-head screws securing the cable channel cover. Pull the non-RAID SCSI cable out and carefully install a new RAID SCSI cable set (if applicable).
7. Reinstall the cable channel cover.

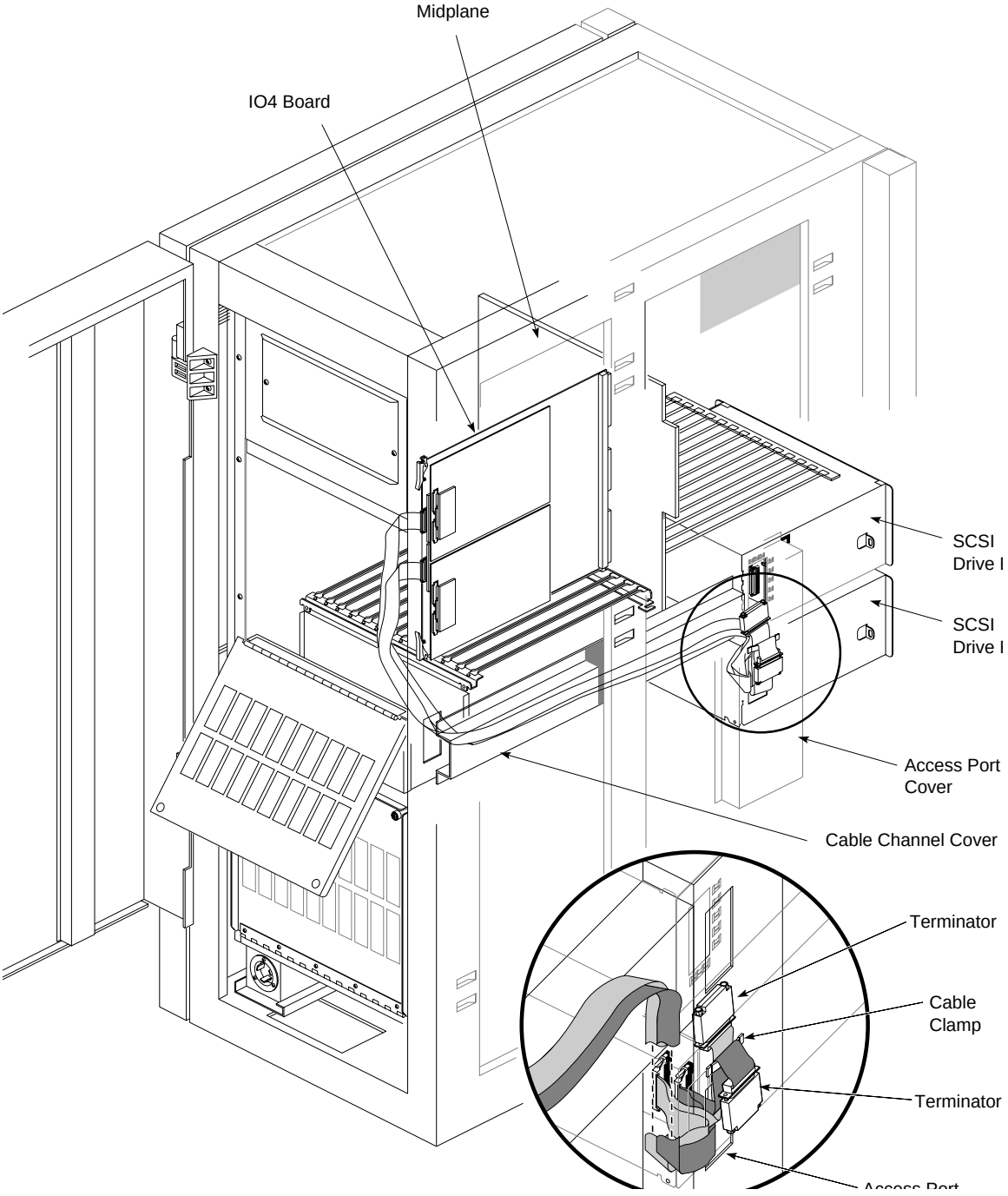

Midplane
IO4 Board
SCSI
Drive I
SCSI
Drive I
Access Port
Cover
Cable Channel Cover
Terminator
Cable
Clamp
Terminator

Figure 3-2 RAID SCSI Box Cable Routing in the System Rack

8. Route the differential RAID SCSI cable past the unattached SCSI cable and into the lower access port and connect it to the channel A connector on the RAID box.
9. Attach the additional RAID SCSI cable to channel B if you want to support non-RAID devices in bay 0 or 1 of the RAID box using a separate SCSI channel.

   Note: Verify that the bus designations on the cables and on the RAID box connectors they are attached to match. No daisy-chaining is allowed between RAID boxes in a system rack. Each box must be connected to a separate SCSI controller.

10. Route the terminated "tails" of the RAID SCSI cables back out the access port.
11. Attach an adhesive plastic bracket to the sheet metal just above the access port and confine the terminated cable "tails" so that the shortest is in a vertical position flush with the chassis sheet metal. The longer "tail" should droop forward back over the front of the bracket and hang flush with the access port. If a second RAID box is installed in the upper bay, tuck the terminated SCSI cable "tails" into the horizontal cable channel box.
12. Connect cable A to a differential SCSI connector on the IO4.
13. If needed, connect cable B to a differential or single-ended SCSI connector on the IO4.
14. Connect the power cable to the pigtail attached to the 512S power board.
15. Install the RAID disks and controller, and any other drives intended for the RAID box. See Section 3.5, "Installing the Drives and Controller" later in this chapter. Be sure all hardware configuration has been implemented as discussed in Chapter 2, "Configuring the RAID Hardware."
16. Reinstall the access port cover and shielded power cables.
17. Reinstall the side panels.
18. Close up the unit and power on the system (use the information in Section 3.7, "Powering On the System").

3.4 Installing a RAID Box in the Vault Rack

The following installation procedure applies only to the Challenge Vault RAID box and *not* the "stubby" RAID box that installs into a Challenge or an Onyx rackmount system.

1. Lift up a SCSI drive box and install it into the first set of rails on the bottom. Always start with the lowest available set of rails, then work your way up. See Figure 3-3.

   Caution: If you install the drive boxes in only the top portion of the Vault, the rack could tip over when you try to remove them.

2. Secure the SCSI drive box to the vertical rails on the chassis using two screws on each side. The location of the screws is also shown in Figure 3-3.
3. If you have multiple drive boxes, install the second box on top of the first box, and so on.
4. Use filler plates as required to cover open areas on the front of the chassis.
5. Route the 25 foot (7.6 m) SCSI cable from the host system to the Vault rack.
6. Connect the cable to channel A on the first (or only) RAID box. Daisy-chain additional boxes using the 1.5 foot (0.47 m) daisy-chain SCSI cable. See Figure 3-4 for a connection example.

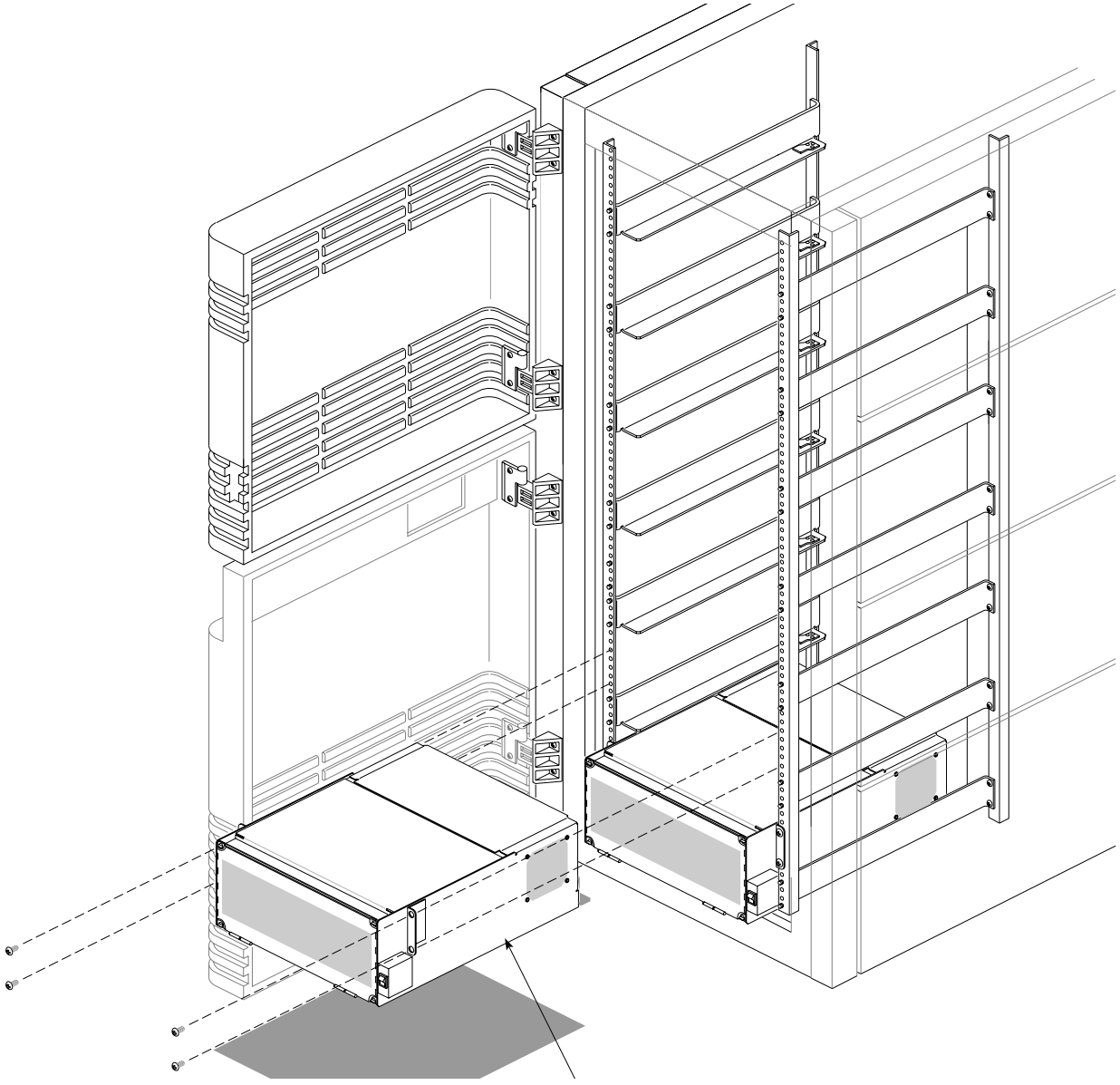


Figure 3-3 Installing the RAID SCSI Box in the Vault Chassis

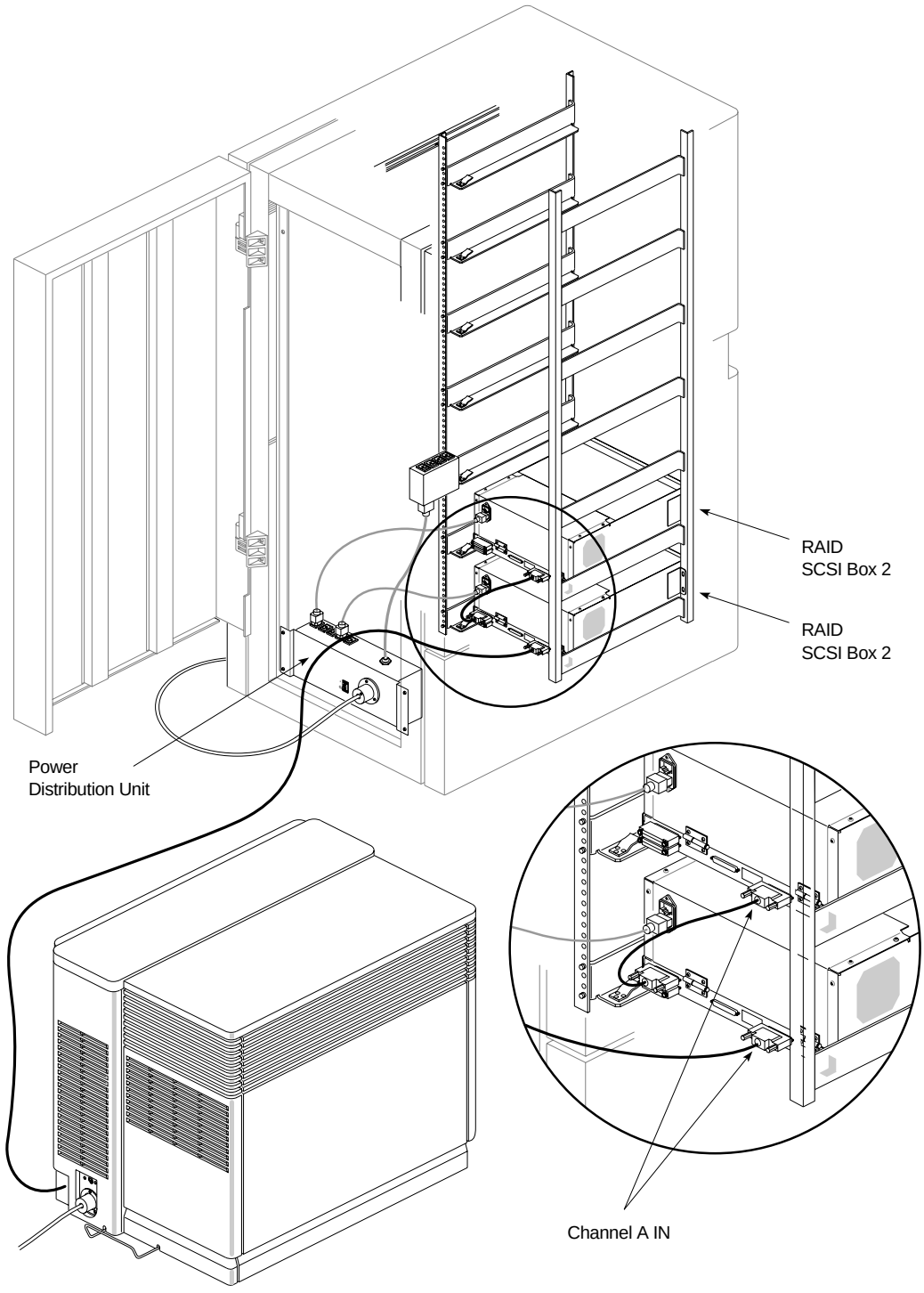

RAID
SCSI Box 2
RAID
SCSI Box 2
Power
Distribution Unit
Channel A IN

Figure 3-4 System to Vault Box SCSI Connection Example

3.5 Installing the Drives and Controller

After you have installed the RAID box(es) and attached all necessary cables, the RAID disks can be inserted.

To install or remove a disk, follow these instructions and see Figure 3-5.

1. Hold the disk assembly sideways, with the top of the disk facing right and the bottom of the drive sled facing left.
2. Install disk and sled assembly 0 into the drive tray in bay 3 and slide it all the way into place, then push the drive lever down. The disk module should click into place, flush with the slot, and should not come out when you pull it.
3. Repeat this process for disk bays 4 through 7 in the RAID box (RAID disks 1-4).
4. Install non-RAID drives only in bay 0 or 1. See Section 3.6, “Installing a Full-height Non-RAID Drive” if necessary.
5. Close and fasten the RAID box cover after you install all of the drives.

   Caution: The front cover must be in place during operation for proper air flow to cool the drives and to comply with FCC and other regulatory requirements. The drive cover on the RAID box uses a retainer to prevent easy removal of the door. The retainer will have to be unscrewed if the door needs to be removed completely.

6. To remove a disk, push the drive lever up and then slide the module out.

   Caution: The SCSI drive box does not have a set of safety rails to hold it in place. If you have drives installed, never pull the drive box too far out on the railing. It may fall and cause damage to equipment or personnel.

The RAID controller board assembly ships from the factory already installed with the disk- down LED cable connected. If you should need to replace a controller for any reason, use the information in the next section.

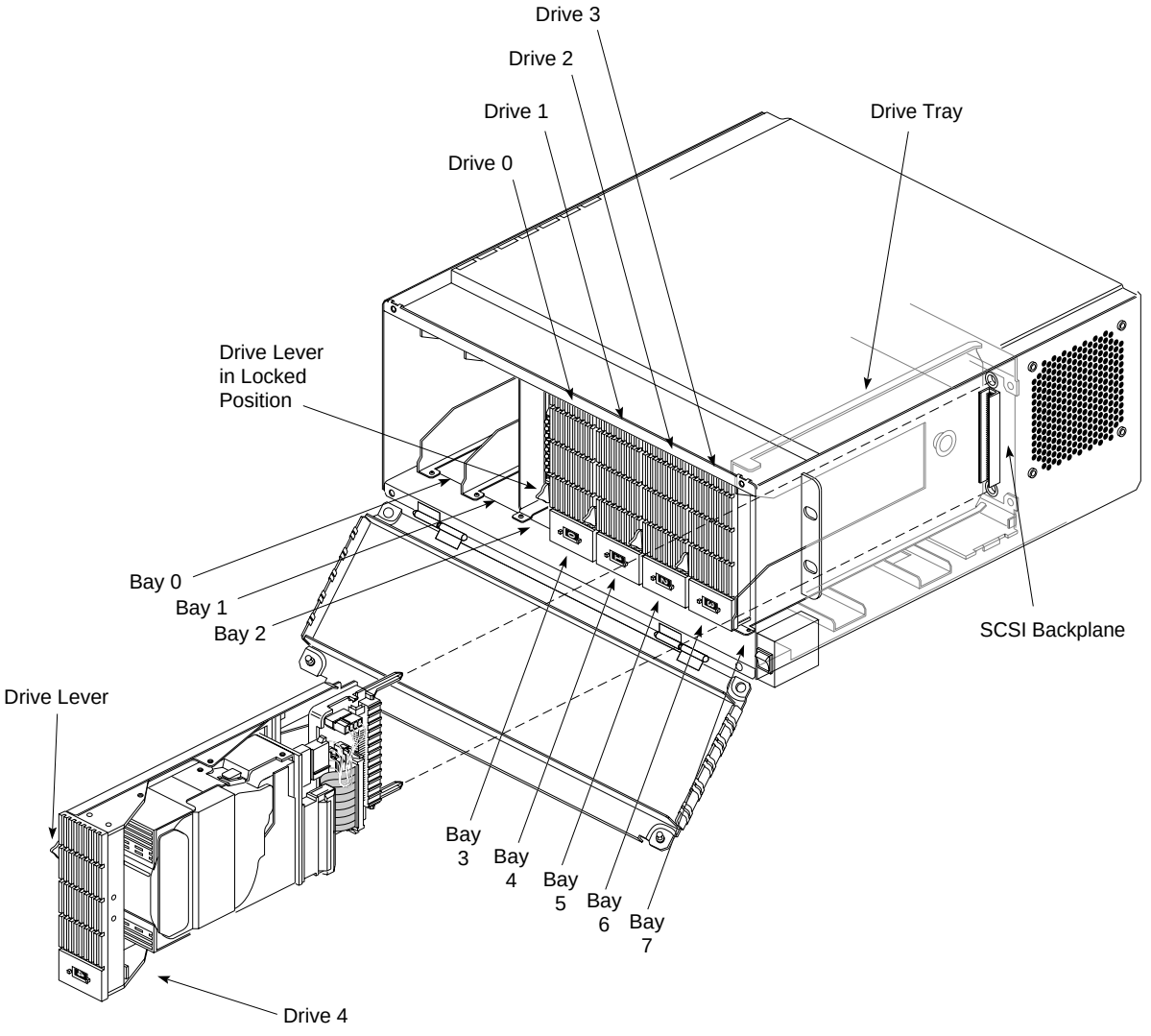


Figure 3-5 Installing or Removing a RAID Drive

3.5.1 Controller Assembly Removal and Replacement

Remove a controller board using the following steps:

1. Take all the drives in the RAID box off line and power off the box.
2. Use a small Phillips-head screwdriver to undo the screw at the front of the bent L- shaped metal retainer at the front of the controller.
3. Remove the retainer and use the plastic ejector handles at the top and bottom of the assembly to carefully pull the controller out of the box. Try not to snag the disk-down LED cable on the left side of the assembly.
4. Locate and unplug the disk-down LED cable connected to the RAID controller board at plug location JP12. See Figure 3-6.

Install a new controller board using the following information:

1. Take the controller board assembly out of its antistatic packaging and align it so that the green LEDs are facing you and are in the top position.
2. Plug one end of the disk-down LED cable into jumper JP12 on the lower left portion of the board (furthest from the LEDs). The red stripe on the cable indicates which end of the connector has pin 1. The other end of the cable should already be plugged into the controller interface board on the backplane. See Figure 3-6.

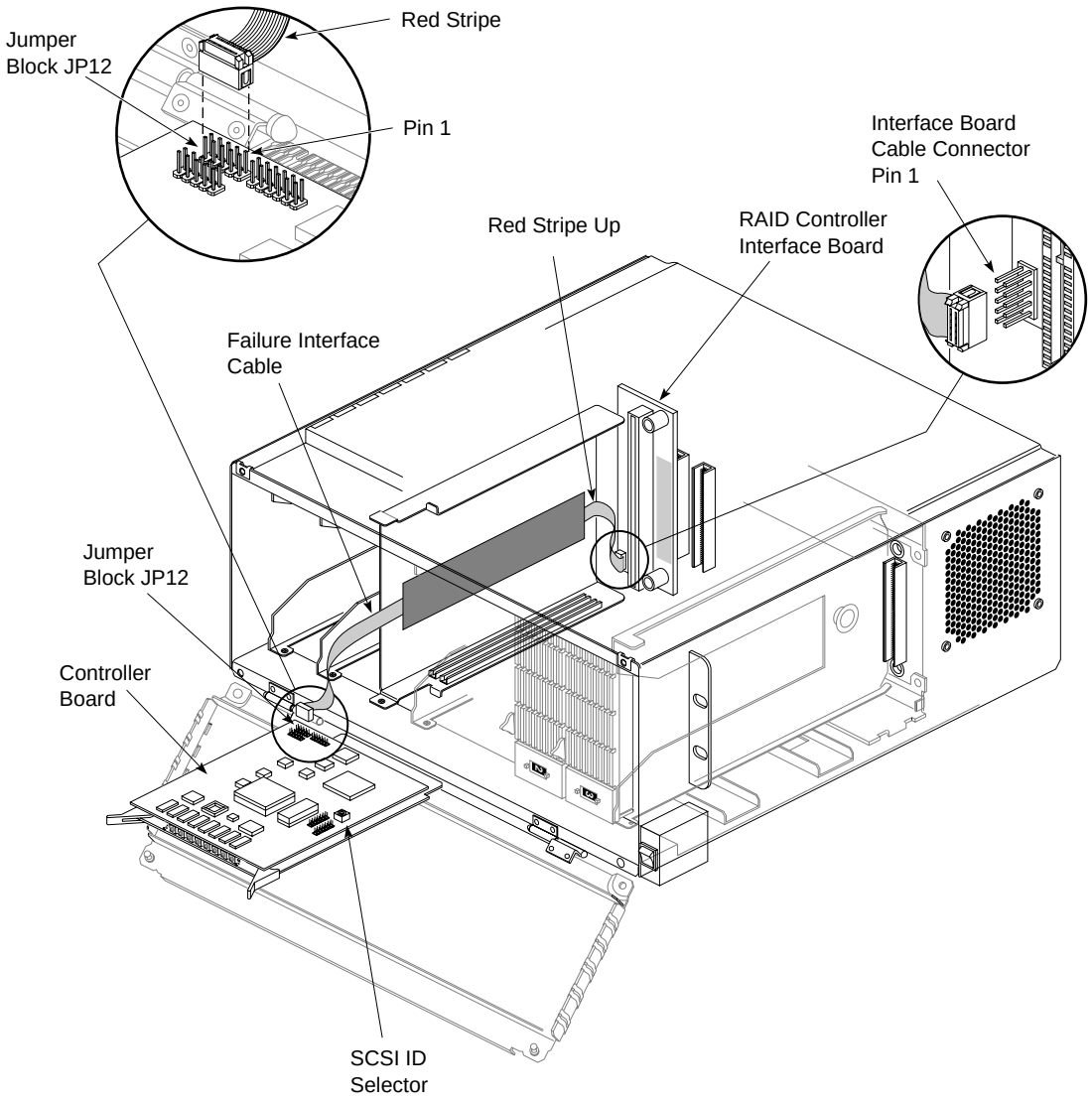


Figure 3-6 Removing the Controller

3. Align the controller's boards in the two plastic guides and slide the controller assembly back into the RAID box until it seats firmly in the connector. See Figure 3-7.

Note: The RAID controller must be firmly seated for proper installation. The connection is a dual stage insertion; the first connection will require little force, but the final seating of the connector requires a firm push.

4. Place the bent L-shaped metal retainer at the front of the controller. Its screw hole should be aligned over the hole in the RAID box frame. If you have difficulty installing the L retainer, see the note above.
5. Secure the metal retainer with the small Phillips-head screw while pushing the retainer against the lower card ejector handle.

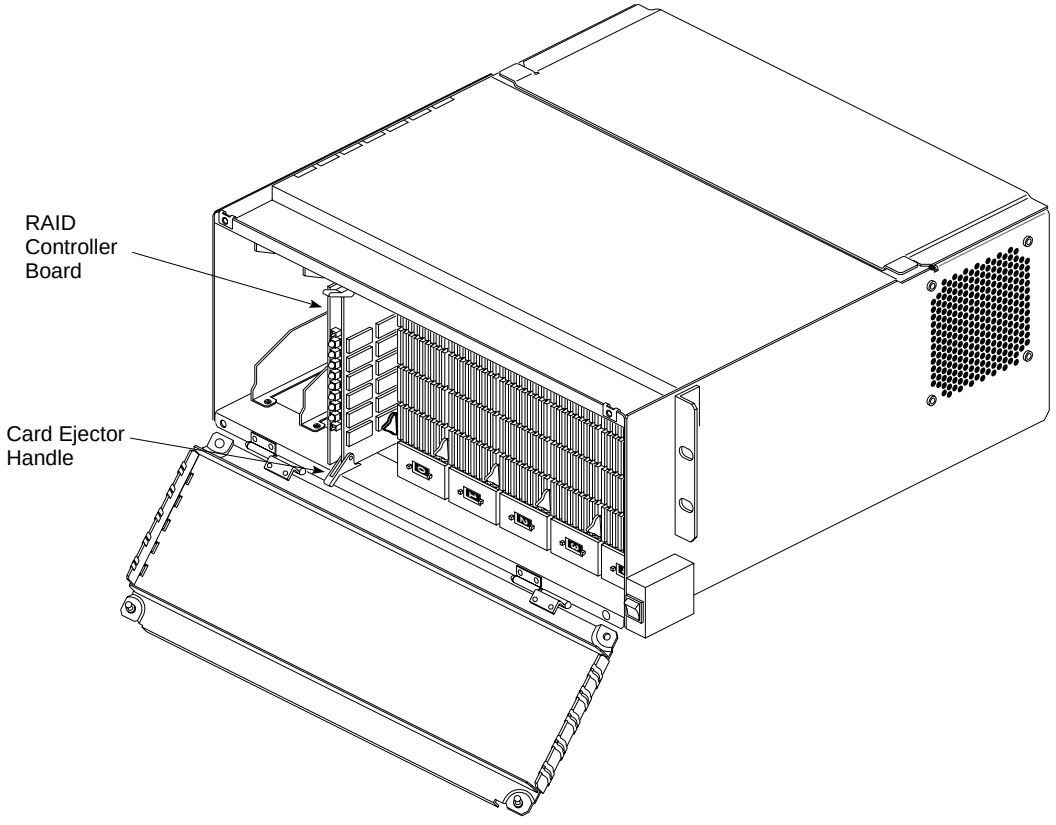


Figure 3-7 Replacing the RAID Controller

3.6 Installing a Full-height Non-RAID Drive

Full-height drives require two half-height drive slots. To accommodate the greater width of the full-height drive, you must remove the drive tray that separates bay 0 from bay 1 in the RAID box:

1. Open the front door of the RAID box.
2. Remove the two screws that secure the drive tray to the top and bottom of the RAID box chassis (see Figure 3-8).
3. Pull the drive tray out of the chassis.
4. Follow the drive installation instructions listed in the previous section.

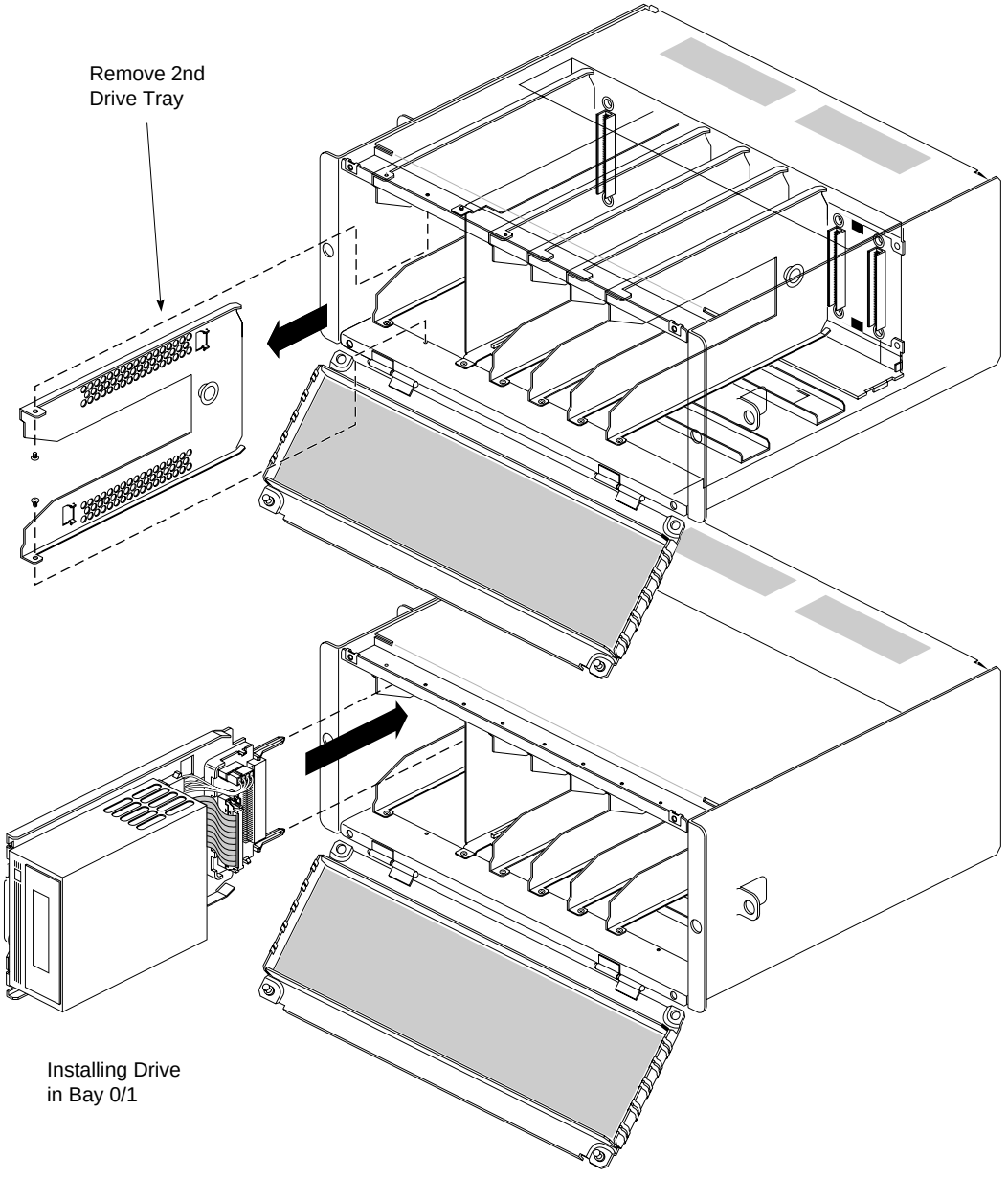


Figure 3-8 Removing the Drive Tray and Installing the Full-height Drive

3.7 Powering On the System

Use the following procedure to power on the chassis after all installations are complete:

1. Plug in the power cords that feed into each component in the system. Make sure to connect the cords to properly rated grounded outlets only.
2. Turn on the power switches in the following order:
   - Breaker switch located on the power-in panel on the back of the chassis
   - Breaker switch located on the power-in panel on the back of the Vault (if applicable)
   - Terminal, monitor, or other video output devices
   - Vault SCSI boxes, printers, or other peripherals (if installed)
   - System Controller key switch
3. After you turn on the system power, the system begins the boot process.
4. Do not reboot the system during this time or you will continue to delay system initialization.
5. The System Controller begins the power-on sequence. As the system comes up, its progress is automatically displayed on the controller's front panel by using a series of boot messages. Pushing any of the function keys at this time will interrupt the sequence of boot messages that are appearing, see Table 3-1. Pushing a function key during the boot process may cause the following message to appear:

   ```
   BOOT ARBITRATION ABORTED
   ```

Boot Status Message	Message Description
BOOT ARBITRATION NOT STARTED	The system CPU boards have not begun the arbitration process.
BOOT ARBITRATION IN PROCESS	The system CPU boards are communicating to decide which one will be the system master CPU.

Table 3-1 System Controller Boot Status Messages

Boot Status Message	Message Description
BOOT ARBITRATION IS COMPLETE SLOT #0X PROC #0X	The chosen CPU master has identified itself to the Controller and communication is fully established.
BOOT ARBITRATION INCOMPLETE FAULT NO MASTER	The system was unable to assign a master CPU.
BOOT ARBITRATION ABORTED	An operator pushed one of the front panel buttons while the System Controller was searching for the master CPU.

Table 3-1 System Controller Boot Status Messages

Note: To better monitor and understand the boot process on the System Controller's front panel, see the system's installation guide or check Chapter 3 in the *CHALLENGE/Onyx Diagnostic Roadmap* P / N 108-7045-0x0.

6. When the power-on diagnostic has completed, enter the PROM "Command Monitor."
7. The >> prompt is displayed.

   Note: You should test the function of the disk-down LEDs on the drives and controller board at this point. Push the small square button at the bottom of the RAID controller board. Refer back to Figure 1-5 if you are unsure of its location. When you push this reset button, the fault cable function is tested and all the amber fault LEDs should light up.

   Type **hinv**, then press **<Enter>** to display the hardware inventory of your system. At the PROM level, the system will *not* differentiate between RAID and non-RAID SCSI drives. IRIX must be fully booted before *hinv* can report the drives as RAID devices.

   Note: See Chapter 4 in the *RAID System Administration Guide* for information about configuring a new RAID disk array in the system.

8. Quit the PROM monitor by typing **Exit** at the >> prompt.

The System Maintenance menu reappears. Type **1** to select the “Start System” command. The system will come up.

Chapter 4

Problem Solving Tips

This chapter contains the following sections:

- Section 4.1, “A Malfunctioning Disk.”
- Section 4.2, “Power Supply and On / Off Switch.”

This chapter provides tips for troubleshooting a RAID system and describes possible solutions for common problems. If you are called to a site with a failed RAID subsystem or disk controller problem, you should check the following lists if the solution is not immediately obvious.

If a particular RAID array is off line but other disks on the same bus are functioning:

- Two or more disks in the array may have failed.
- The controller may be malfunctioning.
- There could be a voltage problem on the RAID backplane.
- There could be a voltage problem on the RAID backplane adapter.
- There could be an unrecognized disk(s) in the RAID array.
- The RAID box On / Off switch or power supply may have failed.
- The physical cable connections and termination may be faulty.

If there are high rates of SCSI bus errors on the bus supporting the RAID(s):

- Check the terminators if the bus is only supporting a single RAID box.
- Make sure each SCSI disk in the RAID is a Silicon Graphics 2.0 GB IBM.
- Check all cable connections and the backplane configuration in the box.
- Verify that there are not duplicate SCSI IDs on the bus.

- Verify that the 81-foot (25 m) differential SCSI bus length limitation has not been exceeded.

Note: Although all Vault-mounted RAID systems ship with a 25-foot (7.6 m) cable, non-RAID Vault expansion chassis may have a 50-foot (15.2 m) cable connecting them to the host system.

4.1 A Malfunctioning Disk

If the RAID array has taken a disk off line because of a malfunction of some type, there are at least four ways to determine which disk it is. Most likely the disk has failed because of mechanical problems or an extremely high soft error rate. Chapter 1, “Introducing the RAID Hardware Options” lists the ways to positively identify a failed disk.

It is possible that the disk failed because the 5V or 12V supply feeding the disk assembly has failed. When you remove the failed disk during the hot-plugging procedure, check the two green voltage indication LEDs on the backplane where you will plug in the new disk. If one or both are dark, you probably have a voltage supply problem rather than a bad disk. The RAID box backplane should be replaced.

4.2 Power Supply and On/Off Switch

If you must service a Vault-mounted RAID box that will not power on, check the switch function before replacing the supply. A faulty switch can eliminate power even if the supply is in perfect working order.

Replacing the switch is a five-minute procedure that could save the bother and expense of replacing a power supply. You should carry a spare switch to every site that uses the Vault-mounted SCSI boxes.

You will need a small Phillips-head screwdriver and a pair of needle-nose pliers to quickly and safely remove the switch. Use the following information to replace a suspect switch;

1. Power off the Vault RAID SCSI box and unplug the power cord from the back.
2. Remove the two Phillips-head screws on the side of the switch housing.
3. Using the pliers, remove the two green and two brown connecting wires from the back of the switch. Be sure to note their positions for reference when the new switch is installed.
4. Press down on the bow retainers on the switch and pop it out the front of the housing.
5. Pop the new switch into the housing, making sure that the "O" shows on the top.
6. Reattach the four connecting wires to the back of the switch.
7. Resecure the switch housing to the side of the Vault box.
8. Reestablish power to the Vault box and try the new switch.

Appendix A

RAID Hardware Upgrades

This appendix contains the following sections:

- Section A.1, “Preparing for the Upgrade.”
- Section A.2, “Removing Existing Drives.”
- Section A.3, “Removing a Non-RAID Box.”
- Section A.4, “Converting Existing Drives.”
- Section A.5, “Installing the RAID Box, Controller, and Drives.”
- Section A.6, “Powering On the System.”

The upgrade process from using non-RAID SCSI boxes to RAID boxes requires that the customer have five Silicon Graphics-supplied 2.0 GB IBM SCSI disks for each RAID upgrade. These disks use a 68-pin FAST (10 Megatransfers) and WIDE (16-bit) SCSI-2 interface and have special firmware parameters programmed. The RAID box will not work with other types of drives.

Each RAID upgrade kit should have the following:

- A RAID SCSI box with RAID backplane and controller interface board assembly
  - System Rack box (P / N 013-0664-00x)
  - Vault Rack box (P / N 013-0665-00x)
- A RAID controller assembly and disk-down LED cable (should be already installed in the RAID box)
- Five 5-inch (12.7 cm) spindle sync connector cables (P / N 015-0151-00x)
- A 1.5-foot (0.47 m) 68-pin daisy-chaining SCSI cable (P / N 9290051)
- An 8.2-foot (2.5 m) power cord (P / N 9350053)

- A 25-foot (7.6 m) SCSI cable for Vault-mounted boxes (P / N 9290102)
- A 6-foot (1.8 m) internal RAID cable set for system racks (P / N 018-0415-00x)

A.1 Preparing for the Upgrade

For safety and electrostatic discharge (ESD) precautions, refer to the beginning of Chapter 3, “Installing the RAID Box” and follow the guidelines.

Fully back up or transfer information from all the 2.0 GB disks that will be used for the new RAID installation. During RAID formatting, all existing information will be overwritten. Shut down the system chassis or expansion rack and open the bottom outer door to access the SCSI boxes.

Note: If you are uncertain about the proper shutdown procedure, refer to Section 3.2, “Powering Down the Chassis” in Chapter 3.

Tools you will need for this upgrade procedure include:

- A medium size Phillips screwdriver
- A medium size flat-bladed screwdriver
- A number T7 Torx® driver
- A 1/8-inch (3.2 mm) hex (Allen) wrench

A.2 Removing Existing Drives

If the 2.0 GB drives for the upgrade are already removed, go to Section A.4, “Converting Existing Drives” for instructions on converting them for use in the RAID box. If the 2.0 GB disks that will be converted to RAID use have not been removed from the existing SCSIBox 2, use the following steps to extract them:

1. Twist open the fasteners at the top of the box door and lower it into a fully open position.
2. Working from right to left, lift the drive-sled locking lever into the unlocked position on each of the drives you wish to remove.

3. Remove the drives and close and secure the SCSI box door.

The non-RAID 2.0 GB drive *must* be converted before being used in the RAID SCSI box. Use the instructions in Section A.4, “Converting Existing Drives” to convert each drive that you will install in the RAID.

A.3 Removing a Non-RAID Box

If the customer wishes to continue using the SCSI box from which you have removed the 2.0 GB drives, it may be left in place. It can be used with remaining or additional non-RAID devices. The information in the following steps is aimed at removal of a Vault-mounted box; removal/replacement of a box in the system rack is a more complex procedure. Reference Chapter 3, Section 3.3, “Installing a RAID Box in the System Rack,” for details on the “stubby” box.

If it is necessary to remove the non-RAID box in order to make room for installation of the new RAID box, use the following steps:

1. Push the SCSI box’s front power switch to the Off position (Vault SCSI boxes only).

   Note: You may want to remove any remaining drives from the box to make it easier to handle as you remove it. See steps one through three in the previous section for the procedure. The Vault-mounted SCSI box weighs approximately 37 pounds (16.8 kg) with all drives removed.

2. Access the rear of the SCSI box and unplug the power cord and SCSI cable(s).
3. Use the 1/8-inch (3.2 mm) hex-head (Allen) wrench to remove the four screws (two on either side of the box) that connect the box to the front rails. Note that the “stubby” box has only one screw on each side.
4. Carefully pull the box out of the chassis and lift it free. See Figure A-1.

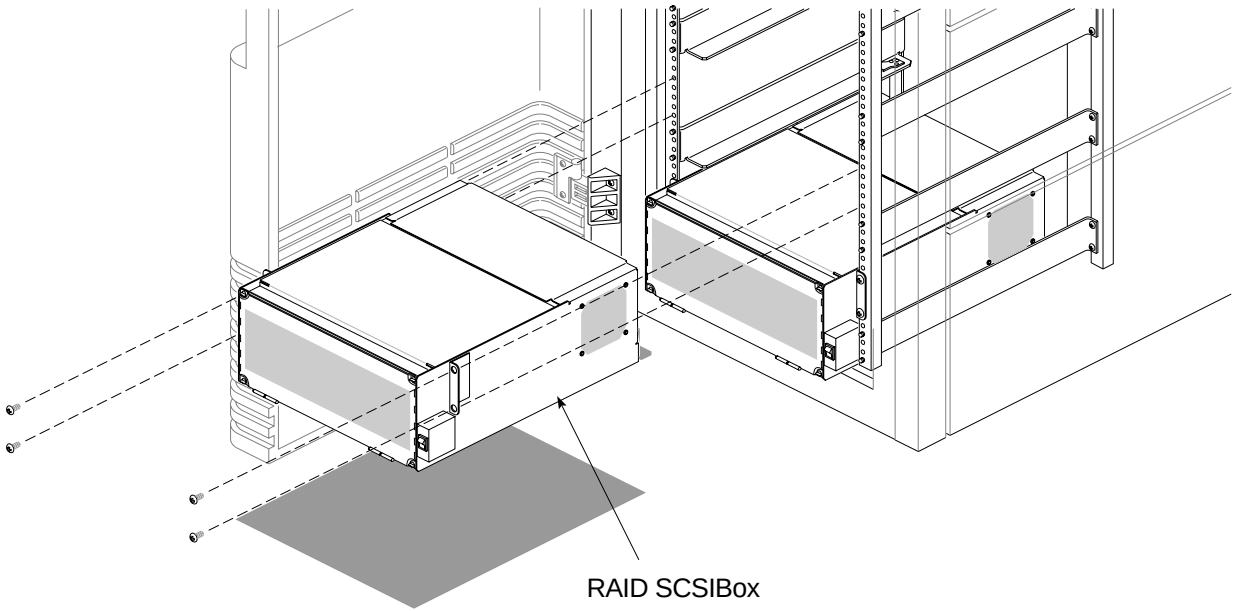


Figure A-1 Removing a RAID Box from the Vault

A.4 Converting Existing Drives

There are three basic processes that must be accomplished before a disk is ready for installation in a RAID box:

- Removal of the single-ended to differential converter board
- Moving the drive position back, placing it closer to the adapter board
- Installation of cables between the drive and sled adapter board

Note: Use only the screws that came with the drive/sled assembly. Screws that are too long can short-circuit components on the drive.

You will need a number T7 Torx driver and medium-sized Phillips-head and flat-bladed screwdrivers to accomplish the conversion modifications on the disk/sled assembly. When you have completed the tasks listed in the following steps, you will be ready to install the disk and sled assembly into the RAID box:

1. Set the disk on a flat, non-conductive surface and remove the power and SCSI connectors from the differential converter board on the back of the disk.
2. Using the Torx driver, remove the two screws at either end of the differential converter board.
3. Unplug the converter board from the back of the 2.0 GB disk and set it aside. The converter board is the customer's property and should be left on-site.
4. Undo the four Phillips-head screws (two on either side) that hold the disk to the sled assembly. See Figure A-2.
5. Unscrew the four slot-head screws (two on either side of the disk) and move the disk back (toward the sled board) approximately a half inch (12.5 mm) to the next set of screw holes and resecure the disk with the four screws.

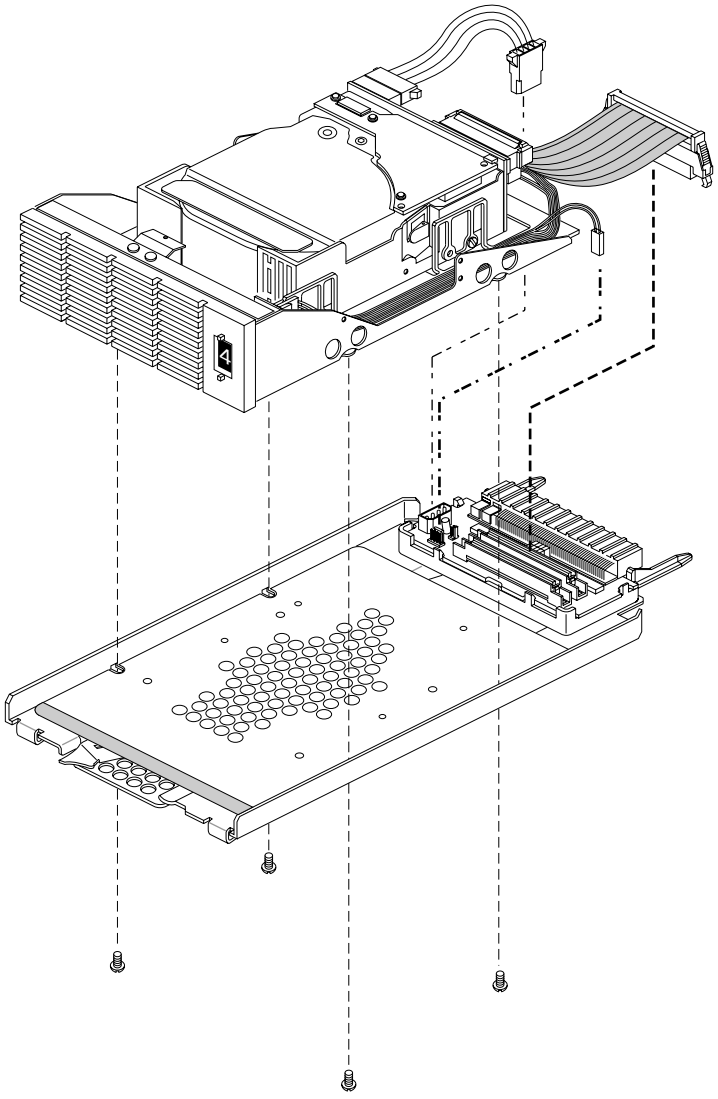


Figure A-2 Remove the Screws from the Disk and Sled Assembly

6. Remount the disk assembly to the sled with the four Phillips-head screws.

7. Plug one end of the 68-pin bridge cable into channel A on the adapter board and the other into the back of the disk, then reconnect the power plug to the disk. See Figure A-3.

   Note: Be sure to plug the 68-pin cable into the channel A connector. The RAID array will not work if any of the disks are connected to channel B.

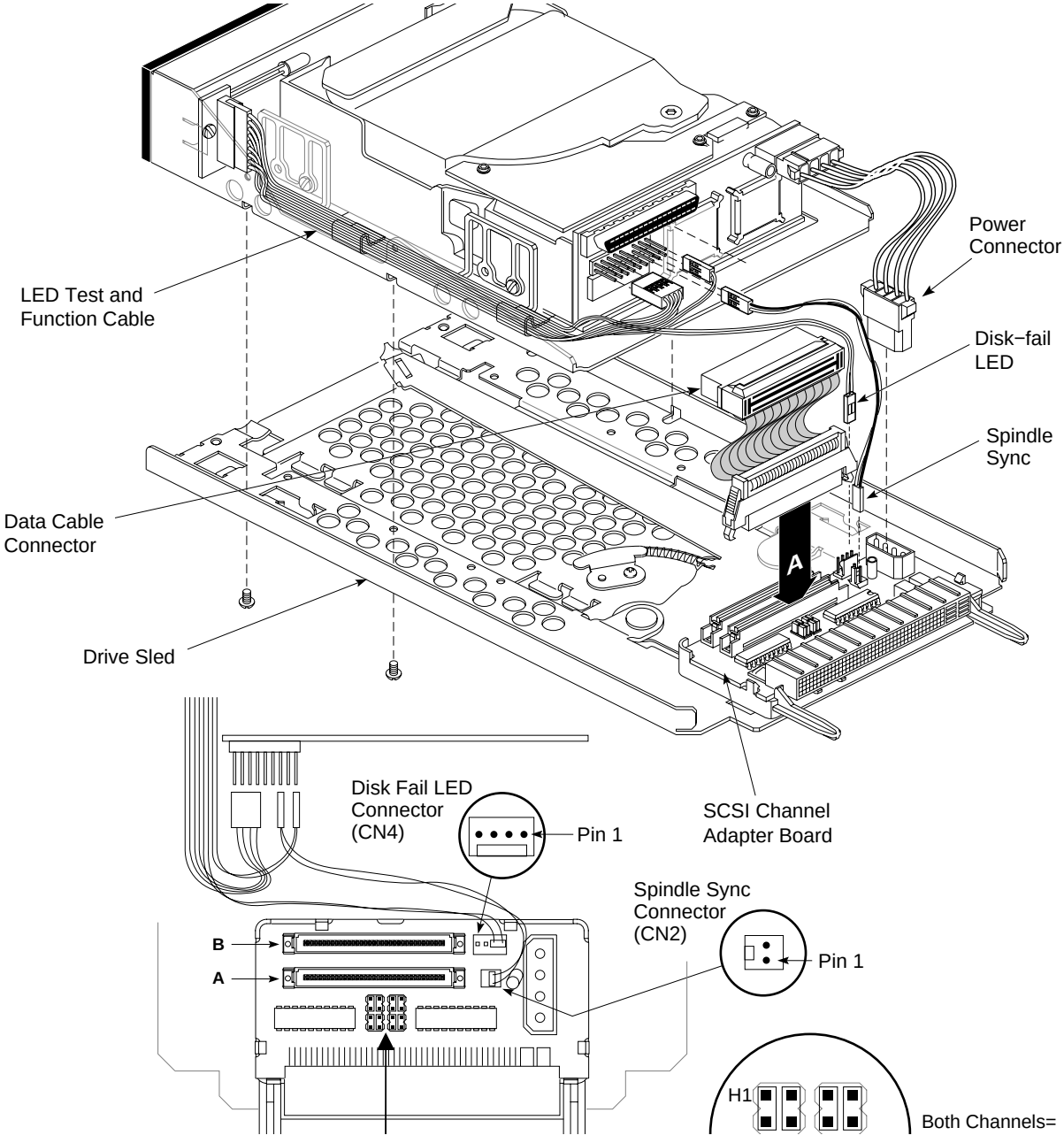


Figure A-3 Configuring the Converted Disk

8. Plug a spindle sync cable onto position CN2 on the sled adapter board with the red wire on pin 2, closest to the disk drive. Refer to Figure A-3. Connect the other end to the row header at position 6 (third from the right) on the nine-row header on the rear of the 2.0 GB disk. The red wire must be in the lower position. See Figure A-4.
9. Confirm that the LED fault cable is plugged into pins 1 and 2 of header CN4 on the sled adapter board. The red wire should be on pin 1 (closest to the power connector).

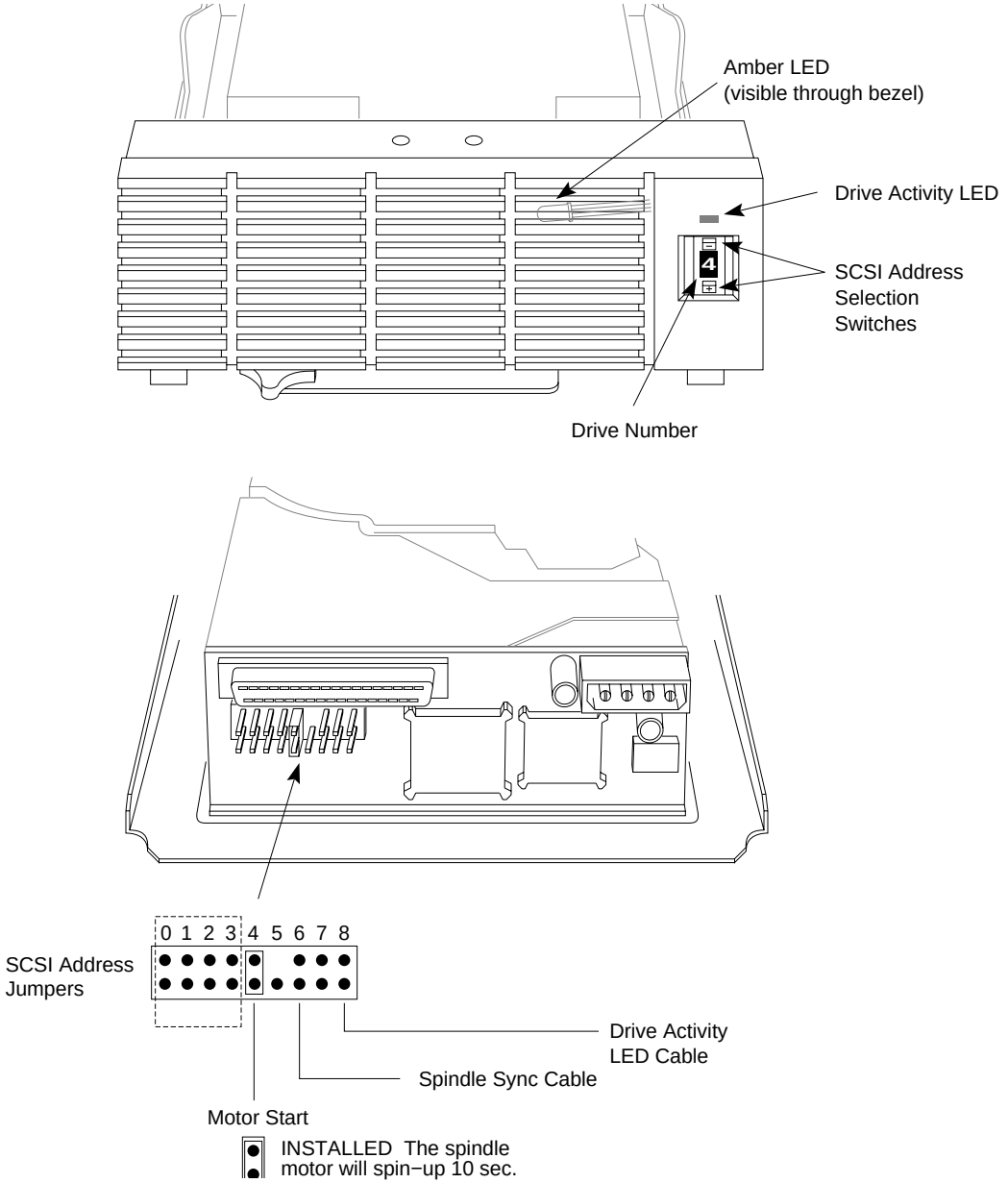


Figure A-4 The 2.0 GB Drive Settings

A.5 Installing the RAID Box, Controller, and Drives

This section contains a brief description of how to install the new RAID box and the controller and drives that go in it.

A.5.1 Installing a RAID SCSI Box

The following installation procedures apply mainly to the Vault-mounted RAID box. Installing and cabling a RAID box in a system rack is a more complex and time-consuming procedure than installing one in the Vault rack. The original non-RAID SCSI cables will have to be removed, and new system rack RAID cables installed and connected. Reference Chapter 3, Section 3.3, “Installing a RAID Box in the System Rack,” for details on the “stubby” box.

Use the following basic steps to install the RAID box:

Note: For easier loading, it is recommended that the drives be inserted after the box is installed.

1. Lift up the SCSI drive box and install it into the first set of rails on the bottom. Always start with the lowest position available, then work your way up.

   Caution: If you install the drive boxes in only the top portion of the Vault, the rack could tip over when you try to remove them.

2. Secure the SCSI drive box to the vertical rails on the chassis using two screws for the box in the system rack and four on the Vault-mounted box.
3. If you have multiple drive boxes in a Vault chassis, install the second box directly above the first box, and so on.
4. Use filler plates as required to cover open areas on the front of the Vault chassis.

Note: See the instructions and figures in Chapter 3, “Installing the RAID Box” if you need more detailed information on the procedures.

A.5.2 Installing the RAID Controller and Drives

After you have installed the RAID box(es) and attached all necessary cables, the RAID disks can be inserted.

Before installing drives, be sure that the following configuration requirements are met:

- The SCSI ID for the drives is selected.
- The correct channel (A) on the drive sled is selected.
- The drive sled jumpers are set correctly.
- The spindle sync cable is properly connected to CN2.
- The disk-down cable is properly connected to CN4.

To install or remove a drive, follow these instructions and see Figure A-5.

1. Hold the drive sideways, with the top of the drive facing right and the bottom of the drive sled facing left. See Figure A-5.
2. Install the drive sled assembly into the drive tray in bay 3 and slide it all the way into place, then push the drive lever down. The drive module should click into place, flush with the slot, and should not come out when you pull it.
3. Repeat this process for drive bays 4 through 7 in the RAID box.

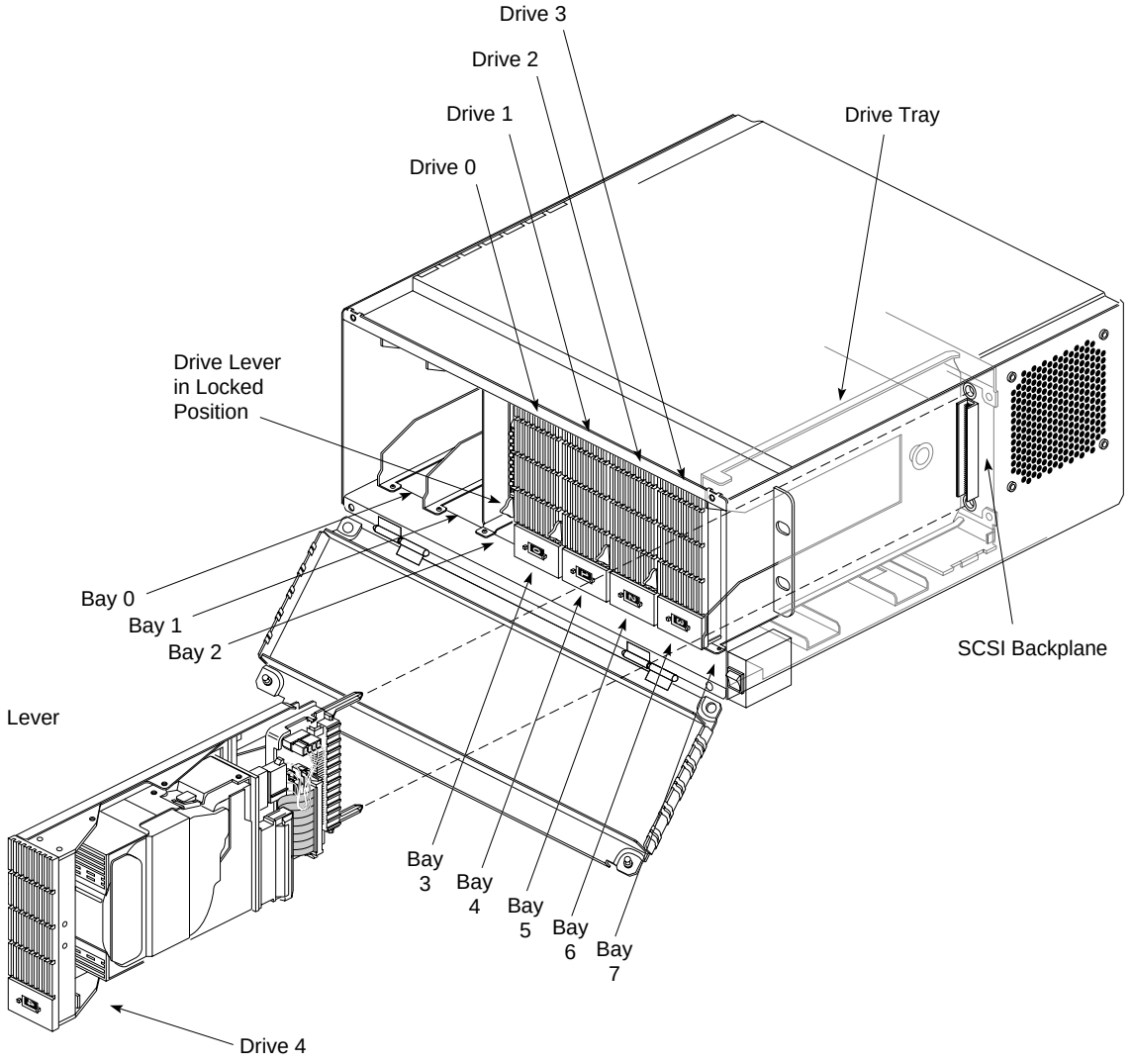


Figure A-5 Installing Disks in the RAID Box

4. Install non-RAID devices only in bay 0 or 1. See Section 3.6, “Installing a Full-height Non-RAID Drive” in Chapter 3 if necessary.

5. Close and fasten shut the RAID SCSI box door after you install all of the drives.

Caution: The front door of the RAID box must be in place during operation for proper air flow to cool the drives and to comply with FCC and other regulatory requirements.

6. To remove a drive, push the drive lever up and then slide the module out.

Caution: The SCSI box does not have a set of safety rails to hold it in place. If you have drives installed, never pull the RAID box too far out on the railing. It may fall and cause damage to equipment or personnel.

The RAID controller board assembly ships from the factory installed with the disk-down LED cable already connected. If you should need to replace a controller for any reason, use the information in Section 3.5.1, "Controller Assembly Removal and Replacement" in Chapter 3.

A.6 Powering On the System

When all installation / upgrade work is completed, you should power on the system and check to see that the RAID drives are on line. Use the power on procedures in Section 3.7, "Powering On the System" at the end of Chapter 3.

Note: After you have enabled power to the RAID box, push the small, square reset button at the bottom of the RAID controller board. Refer to Figure 1-5 if you are unsure of its location. When you push this reset button, the disk-down cable function is tested and all the amber fault LEDs should light up. The controller goes through a hardware reset.

See Chapter 4 in the *RAID System Administration Guide* to configure and bring the new RAID drives on line.

Index

G

H

I

L

M

N

O

P

S

T

U

V

W