

PCI 4-Channel Ultra3 SCSI RAID Adapter

Installation and Using Guide

Note

Before using this information and the product it supports, be sure to read the general information under "Product Warranties and Notices" included with your system unit.

First Edition (October 2000)

Before using this information and the product it supports, read the information in "Safety Information" on page vii and "Appendix B. Notices" on page 15.

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Handling Static Sensitive Devices

Attention: Static electricity can damage this device and your system unit. To avoid damage, keep this device in its anti-static protective bag until you are ready to install it. To reduce the possibility of electrostatic discharge, follow the precautions listed below:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its anti-static package, touch it to an unpainted metal part of the system unit for at least two seconds. (This drains static electricity from the package and from your body.)
- Remove the device from its package and install it directly into your system unit without setting it down. If it is necessary to set the device down, place it on its static-protective package. (If your device is an adapter, place it component-side up.) Do not place the device on your system unit cover or on a metal table.
- Take additional care when handling devices during cold weather, as heating reduces indoor humidity and increases static electricity.

Safety Information

DANGER

An electrical outlet that is not correctly wired could place hazardous voltage on metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock.

Before installing or removing signal cables, ensure that the power cables for the system unit and all attached devices are unplugged.

When adding or removing any additional devices to or from the system, ensure that the power cables for those devices are unplugged before the signal cables are connected. If possible, disconnect all power cables from the existing system before you add a device.

Use one hand, when possible, to connect or disconnect signal cables to prevent a possible shock from touching two surfaces with different electrical potentials.

During an electrical storm, do not connect cables for display stations, printers, telephones, or station protectors for communication lines.

About This Book

This book provides information about installing the PCI 4-Channel Ultra3 SCSI RAID Adapter and device driver support software, as well as cabling requirements. Use this book in conjunction with your specific system unit and operating system documentation.

ISO 9000

ISO 9000 registered quality systems were used in the development and manufacturing of this product.

Related Publications

The following publications contain related information:

- System unit documentation for information specific to your hardware configuration
- Operating system documentation for information specific to your software configuration. If your operating system is AIX, refer to the *PCI 4-Channel Ultra3 SCSI RAID Adapter Reference Guide, SA23-1239*
- *PCI Adapter Placement Reference, SA38-0538* (for the latest version, you may need to contact your marketing representative)

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Chapter 1. Overview

The PCI 4-Channel Ultra3 SCSI RAID Adapter is a 33Mhz 64-bit PCI adapter with updatable microcode levels. The PCI 4-Channel Ultra3 SCSI RAID Adapter allows you to connect SCSI hard disk drives in RAID 0, 1, 5 and 5E configurations to system units with a Peripheral Component Interconnect (PCI) bus¹. RAID (Redundant Array of Inexpensive Disks) provides a way to spread stored data among two or more hard disk drives inside or attached to a host system. A PCI bus provides high-speed data transfer.

Note: This guide uses the term *channel* rather than *bus*.

The PCI 4-Channel Ultra3 SCSI RAID Adapter has four channels, 1, 2, 3, and 4. Channels 1 and 2 have both an internal and an external connector. Only one internal or external connector can be used on each channel.

You can create, control, and manage a RAID configuration in combination with supporting host software. For more RAID information, see “Appendix C. Disk Arrays” on page 17. The PCI 4-Channel Ultra3 SCSI RAID Adapter supports fast and wide SCSI synchronous data rates from 20MBs per second (16-bit) up to 160MBs per second (16-bit) on four independent SCSI-2 channels.

This adapter only supports SCSI hard disk drives.

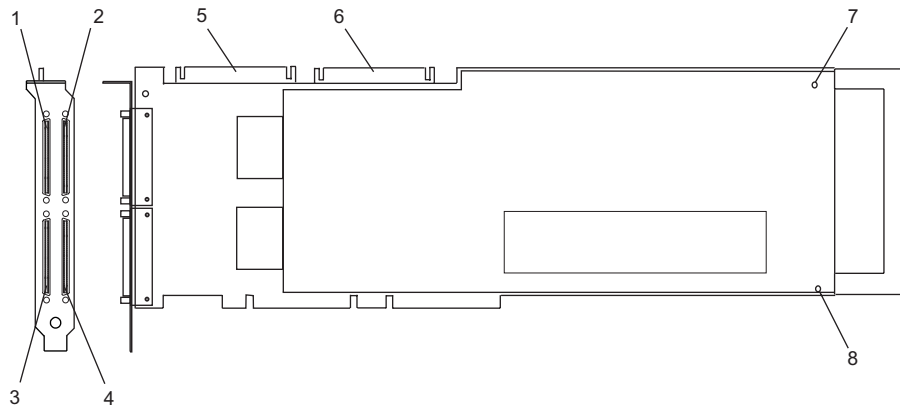


Figure 1. PCI 4-Channel Ultra3 SCSI RAID Adapter

- 1–4 Channels 1, 2, 3, and 4. 68-pin SCSI Very High Density Connector Interface external connectors
- 5–6 Channels 1 and 2. High Density 68-pin connectors
- 7–8 Screws

1. Other SCSI devices cannot be connected to the PCI 4-Channel Ultra3 SCSI RAID Adapter.

The PCI 4-Channel Ultra3 SCSI RAID Adapter conforms to the American National Standards Institute (ANSI) SCSI-2 standard and the PCI local specification, revision 2.2.

Software Requirements

AIX Release 4.3.3.0-05 Recommended Maintenance Package or later is required for use of this adapter.

Chapter 2. Preparing for Installation

This chapter helps you prepare to install the PCI 4-Channel Ultra3 SCSI RAID Adapter.

Note: If AIX is not installed on your system unit, install your adapter prior to installing your operating system. (See “Chapter 4. Installing the PCI 4-Channel Ultra3 SCSI RAID Adapter” on page 7.) When you install AIX, your device software automatically installs. If AIX is operating on your system, install your device software prior to installing your adapter. (See “Chapter 3. Installing the Device Driver Software” on page 5.)

Note: For best performance, distribute the hard disk drives equally across the available channels 1, 2, 3 and 4.

Checking Prerequisites

To install the PCI 4-Channel Ultra3 SCSI RAID Adapter, you need the following on hand:

- Your system unit documentation
- The device software media (diskette or CD-ROM)
- A flat-blade screwdriver

To connect SCSI hard disk drives to the PCI 4-Channel Ultra3 SCSI RAID Adapter, you need the following:

- External cables (for attaching external hard disk drives).
- An interposer cable, if required for external subsystem connections.
- Internal cables (for attaching internal hard disk drives on backplanes).

Preparing for a PCI Slot Length Installation

To prepare the PCI 4-Channel Ultra3 SCSI RAID Adapter for a PCI slot length installation, do the following:

1. Remove the two screws that hold the handle to the adapter. Refer to Figure 1 on page 1.
2. Remove the handle from the adapter.

Determining Your Cable Requirements

You must use the correct SCSI cables to properly attach SCSI hard disk drives and subsystems.

SCSI specifications limit total cable length to 25 meters (approximately 80 feet).

If you install an Ultra3 SCSI hard disk drive or subsystem that can transfer data at up to 160 MBs per second, the maximum cable length is limited to 25 meters (approximately 80 feet).

For more information on connecting SCSI hard disk drives to the PCI 4-Channel Ultra3 SCSI RAID Adapter, see “Appendix C. Disk Arrays” on page 17 and “Appendix D. Connecting SCSI Hard Disk Drives to the Adapter” on page 25.

Internal Cabling

If you plan to install internal SCSI hard disk drives, you must obtain the necessary cables for your system unit. Refer to your system unit documentation for information about installing internal SCSI backplanes, hard disk drives, and cables.

A SCSI terminator must be located at the end of the internal cable. Terminators are built into the backplane within the computer.

External Cabling

External SCSI hard disk drives and subsystems have a variety of connectors. Ensure that you have cables with the correct connectors for each planned external SCSI attachment.

You may need a 68-pin SCSI Very High Density Connector Interface to standard 68-pin SCSI standard connector interposer cable to externally attach hard disk drives and subsystems to the PCI 4-Channel Ultra3 SCSI RAID Adapter. In most cases, the cabling is delivered with the attaching subsystem.

Chapter 3. Installing the Device Driver Software

The instructions in this chapter pertain to the AIX operating system. If you have another operating system installed, refer to your operating system documentation for information about installing the device software and configuring your system.

Installing the Software

To install the device software, do the following:

1. Be sure to read “Chapter 2. Preparing for Installation” on page 3 to determine:
 - If you should install your device software first, go to step 2 and continue with this section.
 - If you should install your hardware first, go to “Chapter 4. Installing the PCI 4-Channel Ultra3 SCSI RAID Adapter” on page 7. When you install AIX, your device software automatically installs.
2. Turn on the power to your system unit.
3. At the system prompt, log in as **root** user.
4. Insert the device software media (diskette or CD-ROM) into the appropriate media device.
5. To start SMIT, type:

```
smitty devinst
```

Press Enter.
6. The Install Additional Device Software window highlights the **INPUT device/directory for software** option.
7. Select or type the input device:
 - Press F4 to display the input device list. Select the name of the device (example: CD-ROM) that you are using and press Enter
OR
 - In the Entry Field, type the name of the input device you are using, and press Enter.
8. The Install Additional Device Software panel highlights the **SOFTWARE to install** option.
9. Press F4 to display a list of the device software you can install.
10. To display the Find window, type:
/
11. Type:

```
devices.pci.14102e00
```

Press Enter. The system finds and highlights this device software, and displays output similar to the following example:

```
devices.pci.14102e00      All
```
12. Press F7 to select the device software, and press Enter.

13. The INSTALL ADDITIONAL DEVICE SOFTWARE window displays. Entry data fields are automatically updated. Press Enter to accept the data.
14. The ARE YOU SURE window displays. Press Enter to accept the data.
15. The **COMMAND STATUS** window displays.
 - The term RUNNING is highlighted to indicate that the install and configure command is in progress.
 - When RUNNING changes to OK, scroll down to the bottom of the page and locate the Installation Summary.
 - After a successful installation, SUCCESS appears in the Result column of the summary at the bottom of the page.
16. Remove the installation media from the drive.
17. Press F10 to exit SMIT.
18. Go to “Chapter 4. Installing the PCI 4-Channel Ultra3 SCSI RAID Adapter” on page 7.

Chapter 4. Installing the PCI 4-Channel Ultra3 SCSI RAID Adapter

This chapter provides instructions for installing the PCI 4-Channel Ultra3 SCSI RAID Adapter and connecting your SCSI hard disk drives. Save this guide for future reference.

Attention

Be sure you have read “Handling Static Sensitive Devices” on page v before handling your PCI 4-Channel Ultra3 SCSI RAID Adapter.

Installing the Adapter

To install the adapter, do the following:

1. Be sure you have read “Chapter 2. Preparing for Installation” on page 3 to determine:
 - If you should install your PCI Adapter hardware first, go to step 2 and continue with this section.
 - If you should install your device driver software first, go back to “Chapter 3. Installing the Device Driver Software” on page 5. Return here to install your hardware.
2. Refer to the option installation documentation that shipped with your system unit to perform the following and then return here:
 - Some systems support the hot-plugging of adapters. Prepare your system to hot plug this adapter while system power is on. Shut down your system unit if your system does not support hot-plugging.
 - Install the PCI Adapter into your system unit.

Refer to the *PCI Adapter Placement Reference* to see if any placement restrictions apply to your adapter. Return here to complete the process.

Attention

Failure to install your PCI adapter into the correct slot can cause your adapter or system unit to function incorrectly.

Connecting Internal SCSI Hard Disk Drive Backplanes

To connect the internal hard disk drive backplanes, do the following:

1. Set up and install your SCSI hard disk drive backplanes as described in the documentation provided with your system. Power and signal connections are provided to hard disk drives when they are plugged in the backplane on individual carriers. Each position in the backplane has a preassigned SCSI ID.

2. Connect the adapter end of the internal cable to the internal connectors for channel 1 or channel 2 located on the top of the PCI 4-Channel Ultra3 SCSI RAID Adapter. All the connectors are built so that there is only one way you can plug them in. Connect the other end of the cable to the appropriate backplane. The PCI 4-Channel Ultra3 SCSI RAID Adapter provides built-in terminators, so a terminator is not required at the adapter end of the cable. The hard disk drives connect to the terminators that are built into the backplane.
3. Do not attach any external subsystems to a channel if it is internally connected to a backplane.

Important

After you connect the card, internal cables, and backplane, be sure to record which set of hard disk drives are connected to channels 1 and 2. The management software identifies the physical hard disk drives by channel and SCSI ID. To properly remove or add physical hard disk drives, you need the location of the removed or added hard disk drive to the system.

After you install all the internal SCSI hard disk drives and the PCI 4-Channel Ultra3 SCSI RAID Adapter, reinstall the cover to your system unit according to the instructions in your system unit documentation and return here.

Connecting External SCSI Hard Disk Drive Subsystems

After you install the PCI 4-Channel Ultra3 SCSI RAID Adapter and reinstall the cover of your system unit, you can connect the external hard disk drive subsystems. This adapter has four 68-pin Very High Density (VHD) connectors. You may need an interposer cable if you are using a regular 68-pin cable.

To connect external hard disk drives using the VHD interposer cable, do the following:

1. Connect the 68-pin VHD connector of the interposer cable to one of the external ports (channel 1, 2, 3, or 4). Use the fastening screws on the cable connector to securely attach the connector to the adapter.
2. Connect the other end of the VHD connector to the SCSI cable going to your SCSI hard disk drive peripheral.

To connect external hard disk drives using a 68-pin Very High Density Cable Interconnection connector, do the following:

1. Connect one end of the 68-pin VHD connector to one of the external ports (channel 1, 2, 3, or 4). Use the fastening screws on the cable connector to securely attach the connector to the adapter.
2. Connect the other end of the 68-pin VHD cable to your SCSI hard disk drive subsystem.

Notes:

1. The SCSI channels 1, 2, 3, and 4 should never be interconnected. Each channel must operate independently.

2. Only hard disk drives can be connected to the SCSI channels.
3. When you operate with more than one adapter in a system, you cannot share hard disk drives between the adapters.

Verifying the Installation

Verify the initial installation by using the following procedures:

- Verify AIX Hardware Installation (lsdev)
- Verify AIX Software Installation (lspp)

Verifying AIX Hardware Installation

1. To verify that your system unit recognizes the PCI 4-Channel Ultra3 SCSI RAID Adapter, do the following:

- If necessary, log in as **root** user.
- Type:

```
lsdev -Cs pci | grep scraid
```

Press Enter.

2. Possible results are as follows:

- If the PCI 4-Channel Ultra3 SCSI RAID Adapter did install correctly, the following is an example of the data that displays on your screen:

```
scraid0 Available 04-05 PCI 4-Channel Ultra3 SCSI RAID Adapter
```

- If the message on your screen indicates your adapter is Defined instead of Available, shut down your machine. Check the PCI 4-Channel Ultra3 SCSI RAID Adapter to ensure it is installed correctly. Go to “Chapter 4. Installing the PCI 4-Channel Ultra3 SCSI RAID Adapter” on page 7, return to this section and repeat step 1.

Note: If the message on your screen indicates your adapter is Defined a second time, it may be necessary to contact your service representative.

- If no data appears, continue with “Verifying AIX Software Installation”.

Verifying AIX Software Installation

1. To verify that the device software for the PCI 4-Channel Ultra3 SCSI RAID Adapter is installed, do the following:

- If necessary, log in as **root** user.
- Type:

```
lspp -l devices.pci.14102e00*
```

Press Enter.

2. Possible results are as follows:

- If the PCI 4-Channel Ultra3 SCSI RAID Adapter device software is installed, the following is an example of the data that displays on your screen:

devices.pci.14102e00.diag 4.3.3.25 COMMITTED IBM PCI SCSI RAID Adapter Diagnostic Support
devices.pci.14102e00.rte 4.3.3.25 COMMITTED IBM PCI SCSI RAID Adapter Device Software

Note: 4.3.3.25 is the first level of software which enables this adapter.

If this information displays but you continue to have problems, go to “Chapter 4. Installing the PCI 4-Channel Ultra3 SCSI RAID Adapter” on page 7.

- If no data displays on your screen, the PCI 4-Channel Ultra3 SCSI RAID Adapter device driver did not install. Return to “Chapter 3. Installing the Device Driver Software” on page 5. Then return to “Verifying AIX Hardware Installation” on page 9.

If you continue to experience problems, it may be necessary to call your system support organization. Refer to your operating system documentation for instructions.

Configuring Your System

If you must update your system configuration after you install the PCI 4-Channel Ultra3 SCSI RAID Adapter, refer to your operating system documentation for the correct procedure. AIX users should refer to the *PCI 4-Channel Ultra3 SCSI RAID Adapter Reference Guide*, SA23-1239.

Updating Microcode Levels

This device contains microcode that you can update. Contact your service representative for instructions on how to get the latest microcode levels for your device. To install the microcode, follow the instructions in the README file included with the update.

Problem Determination

If you encounter any problems with the adapter after you install it, refer to your system unit documentation for information about running diagnostics or other problem determination procedures. AIX users should refer to the *PCI 4-Channel Ultra3 SCSI RAID Adapter Reference Guide*, SA23-1239.

Appendix A. Communications Statements

The following statement applies to this product. The statement for other products intended for use with this product appears in their accompanying documentation.

Federal Communications Commission (FCC) Statement

Note: The PCI 4-Channel Ultra3 SCSI RAID Adapter has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an authorized dealer or service representative for help.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Proper cables and connectors are available from authorized dealers. Neither the provider nor the manufacturer are responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Responsible Party:

- International Business Machines Corporation
- New Orchard Road
- Armonk, New York 10504
- Telephone: (919) 543-2193



European Union (EU) Statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. The manufacturer cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of option cards supplied by third parties. Consult with your dealer or sales representative for details on your specific hardware.

This product has been tested and found to comply with the limits for Class B Information Technology Equipment according to CISPR 22 / European Standard EN 55022. The limits for Class B equipment were derived for typical residential environments to provide reasonable protection against interference with licensed communication devices.

International Electrotechnical Commission (IEC) Statement

This product has been designed and built to comply with IEC Standard 950.

United Kingdom Telecommunications Safety Requirements

This equipment is manufactured to the International Safety Standard EN60950 and as such is approved in the UK under the General Approval Number NS/G/1234/J/100003 for indirect connection to the public telecommunication network.

The network adapter interfaces housed within this equipment are approved separately, each one having its own independent approval number. These interface adapters, supplied by the manufacturer, do not use or contain excessive voltages. An excessive voltage is one which exceeds 70.7 V peak ac or 120 V dc. They interface with this equipment using Safe Extra Low Voltages only. In order to maintain the separate (independent) approval of the manufacturer's adapters, it is essential that other optional cards, not supplied by the manufacturer, do not use main voltages or any other excessive voltages. Seek advice from a competent engineer before installing other adapters not supplied by the manufacturer.

Avis de conformité aux normes du ministère des Communications du Canada

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Canadian Department of Communications Compliance Statement

This Class B digital apparatus complies with Canadian ICES-003.

VCCI Statement

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

The following is a summary of the VCCI Japanese statement in the box above.

This product is a Class B Information Technology Equipment and conforms to the standards set by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). This product is aimed to be used in a domestic environment. When used near a radio or TV receiver, it may become the cause of radio interference. Read the instructions for correct handling.

Radio Protection for Germany

Dieses Gerät ist berechtigt in Übereinstimmung mit dem deutschen EMVG vom 9.Nov.92 das EG-Konformitätszeichen zu führen.

Der Aussteller der Konformitätserklärung ist die IBM Germany.

Dieses Gerät erfüllt die Bedingungen der EN 55022 Klasse B.

Appendix B. Notices

This information was developed for products and services offered in the U.S.A.

The manufacturer may not offer the products, services, or features discussed in this document in other countries. Consult the manufacturer's representative for information on the products and services currently available in your area. Any reference to the manufacturer's product, program, or service is not intended to state or imply that only that product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any intellectual property right of the manufacturer may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any product, program, or service.

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Appendix C. Disk Arrays

Disk arrays are groups of disk drives working with a specialized array controller. This cooperation helps the user achieve higher data transfer and input and output (I/O) rates than those provided by single large drives. The array controller keeps track of how the data is distributed across the drives.

Redundant disk arrays can also provide data redundancy. Data redundancy allows you to retain stored data if a single drive in the array fails. Some array configurations allow you to set up spare drives to replace failed ones. You can use two data-writing methods in a RAID subsystem:

Striping

Writes data to different drives in the array, rather than writing all data on a single drive. By using multiple drives, the striping method provides higher data-transfer and I/O rates.

Mirroring

Simultaneously writes to two separate disks within the same array. By writing to two disks, the mirroring method ensures that if one drive fails, another drive can restore lost data.

Each disk in any array must have the same size and speed.

Defined RAID levels and the number of drives determine the writing method used. "Raid Levels" on page 18 discusses the various RAID levels and their functions in detail.

Disk Arrays and Channels

The Disk Arrays and Channels figure illustrates the terms used in describing disk arrays.

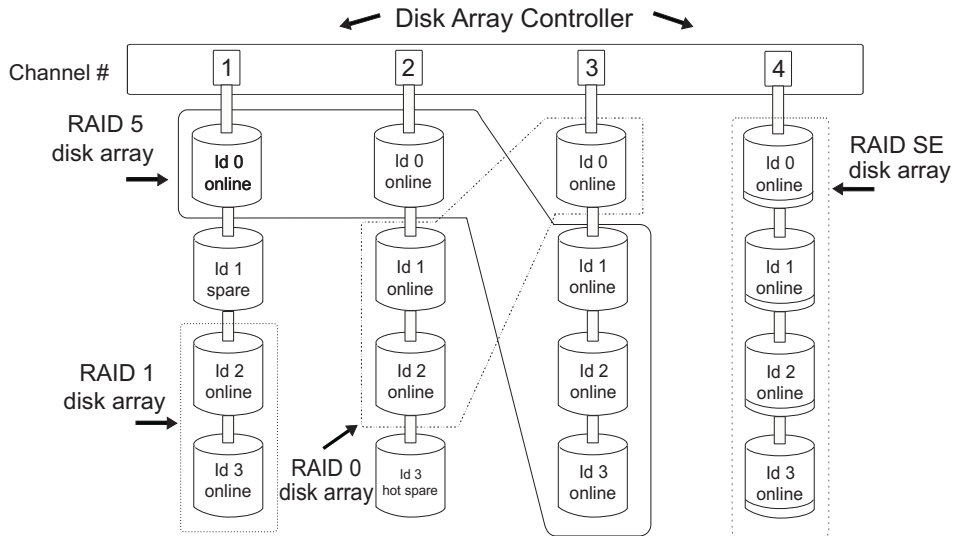


Figure 2. Disk Arrays and Channels

Each disk array is viewed as a single logical device with a unique disk name and location code.

A disk array has its own array parameters (for example, RAID level and capacity). The operating system treats a disk array as a single disk drive. Disk arrays also support raw I/O. When adding a disk array to your system, treat the array in the same way you would treat a single disk drive.

Note: Disk arrays do not support diagnostic open and SCSI passthroughs.

Raid Levels

When a part of the RAID system fails, different RAID levels help to recover lost data in different ways. With the exception of RAID level 0, if a single drive fails within an array, the array controller can reconstruct the data from that disk from the data stored on other hard drives within the array. This data reconstruction has little or no impact to current system programs and users.

Supported RAID levels vary between different hardware and software platforms, but many platforms support levels 0, 1, 3, and 5.

Note: The PCI 4-Channel Ultra3 SCSI RAID Adapter supports RAID levels 0, 1, 5, and 5E.

Each of the levels supported by the PCI 4-Channel Ultra3 SCSI RAID Adapter uses a different method of writing data, and each RAID level has its own attributes. For example, RAID level 5 creates *array parity* information to reconstruct data loss after a drive has failed. RAID level 1 maintains a duplicate copy of the data in case of drive

failure. RAID level 0 does not provide data redundancy. It does, however, provide a potentially higher I/O rate. The following information details RAID levels 0, 1, and 5.

Raid Level 0

Attention:

It is critical that you regularly back up RAID level 0 array data. Your backup procedures determine your ability to recover data.

Raid level 0 works with a minimum of two drives. Raid level 0 writes data across the drives in the array, one stripe unit at a time. In the following example, a stripe unit is defined as 32 blocks of 512 bytes each (16K stripe unit size), as shown in the following figure. For a 128K write, the controller writes blocks 0 through 31 on drive 1, blocks 32 through 47 on drive 2, blocks 48 through 63 on drive 3, and so on. The disk array controller writes a single stripe unit on each drive. Finally, the controller writes blocks 224 through 255 on drive 3 to complete the write operation.

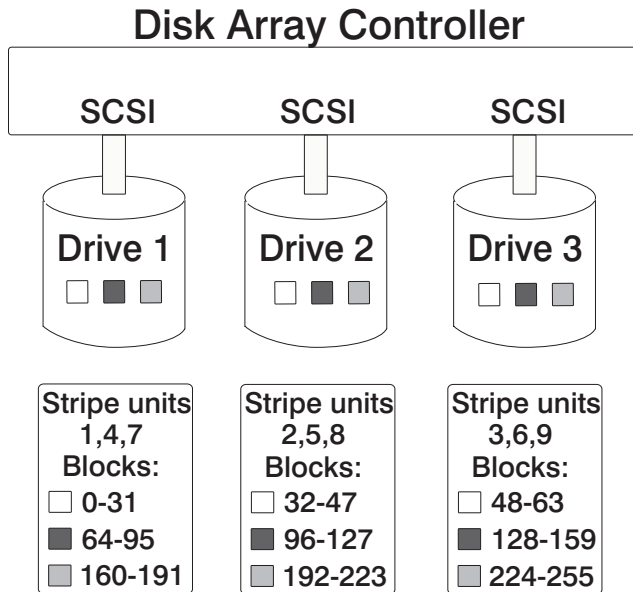


Figure 3. RAID Level 0

The host system treats a RAID level 0 array as it would a standard disk drive. RAID level 0 errors are reported in the same way as those used on a standard disk drive. For example, if a drive fails, the array controller returns the same errors that occur during a read or write retry failure and you can lose all the data on the array. However, unlike other RAID levels, the array controller never marks a RAID level 0 array as degraded if a drive fails. Instead, if a physical drive fails in a RAID 0 disk array, the array controller

marks the disk array as dead. If a disk array fails, you must restore all data to each of the drives on the array after the failing drive has been diagnosed and replaced.

RAID level 0 offers a higher potential I/O rate, but does not offer data redundancy. If a drive fails, the controller cannot reconstruct data because it does not have access to array parity information. Therefore, back up all data regularly to protect against data loss.

RAID Level 1

Attention:

Though a RAID level 1 offers data redundancy, you should regularly back up array data. If you accidentally delete a file, the only way to recover your data is with a backup. You can continue to operate an array in degraded mode until you replace the drive; however, you should replace the drive as soon as possible. If you cannot replace the drive immediately, save your data on a backup device.

RAID level 1 transparently mirrors data by duplicating data stripes across drives, and works with a minimum of two drives.

Mirrored data provides high reliability. When you use a small block size, mirrored data also provides a high I/O rate. However, RAID level 1 costs more because it requires a mirrored data stripe for every drive in the array.

RAID level 1 writes data across the drives in the array, one stripe unit at a time. In this example, a stripe unit is defined as 64 blocks of 512 bytes each (32K stripe unit size) as shown in the following RAID Level 1 figure. For a 32K write, the controller writes blocks 0 through 63 to drive 1 and writes the mirrored data blocks to the mirrored data drive.

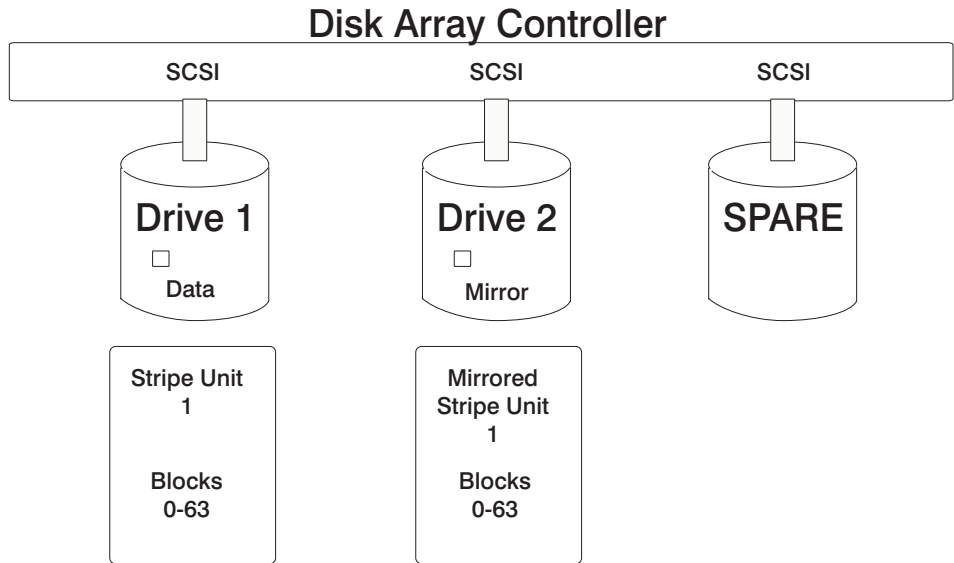


Figure 4. RAID Level 1

If a single drive fails in a RAID level 1 array, you can continue to use the array. A RAID level 1 array operating with a single failed drive is said to be operating in degraded mode. Whenever you read or write to a disk array in degraded mode, the array controller retrieves the failed drive's data from its mirrored drive. Although you can continue to operate the RAID level 1 array with a failed drive, replace the drive and restore the array as soon as possible.

RAID Level 5

Attention:

Although a RAID level 5 array maintains parity information, back up your array data regularly. If you accidentally delete a file, this is the only way to recover your data. You can continue to operate an array in degraded mode until you replace the drive. However, replace the drive as soon as possible. If you cannot replace the drive immediately, save your data on a backup device.

RAID level 5 requires a minimum of three drives. RAID level 5 stripes data across all drives in the array one stripe unit at a time (a stripe unit can contain multiple blocks). RAID level 5 also writes array parity data. The controller spreads parity data across all the drives.

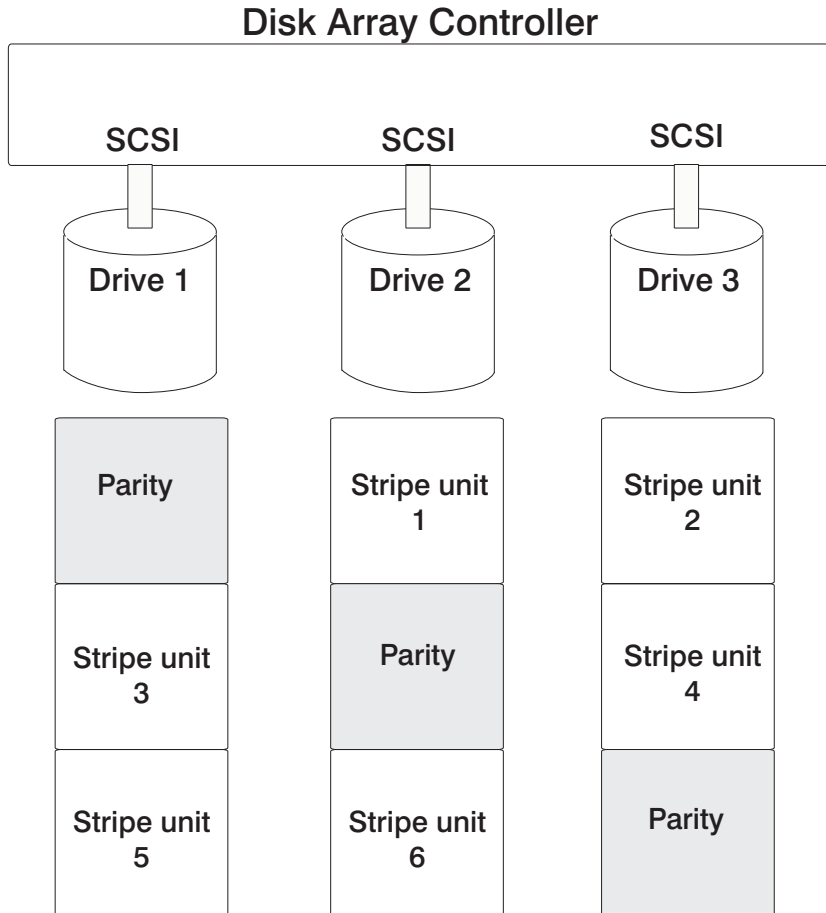


Figure 5. RAID Level 5

In the RAID level 5 example, a stripe unit is defined as 64 blocks of 512 blocks each (32K stripe unit size). Stripes are written as follows:

- Stripe 1 is written in the first position to drive 2
- Stripe 2 is written to drive 3
- Parity data for the data in stripes 1 and 2 are written to drive 1

If a drive fails in a RAID level 5 array, you can continue to use the array normally. A RAID level 5 array operating with a single failed drive is said to be operating in degraded mode. Whenever you access data from a degraded disk array, the array controller reconstructs the data on the failed drive by using data from parity blocks on the operational drives.

For example, to recalculate data in data stripe unit 2 in the RAID level 5 figure (the first position in drive 3), the array controller uses the parity information from drive 1 and the

data from drive 2 (data stripe unit 1) to reconstruct the data. The controller repeats this process to reconstruct each block of the failed drive as needed, so you can continue to operate the RAID level 5 array.

RAID Level 5E

RAID Level 5E is an enhancement of RAID 5. Traditional RAID level 5 has active drives in addition to an inactive hot-spare drive. In a RAID level 5E array, however, the hot-spare drive is incorporated as an active element in the array. Data is laid out so that the spare space is striped across all drives in the array. This technique is designed to provide a performance improvement for smaller arrays (three to five drives) with typical data transfer sizes (8kB of data).

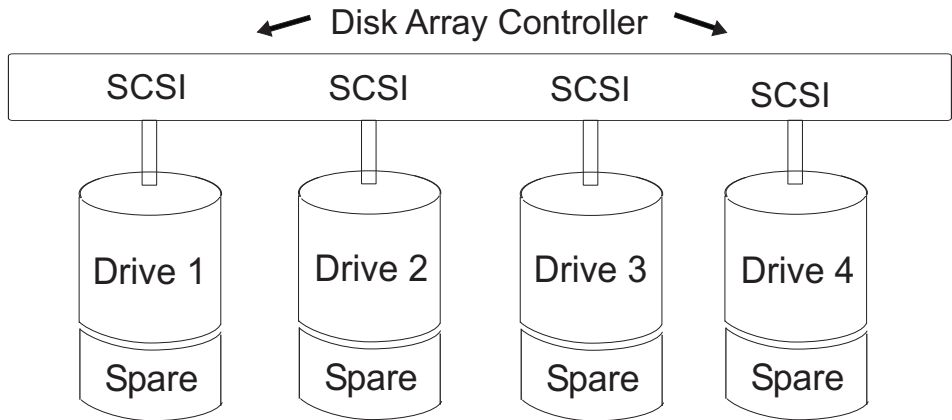


Figure 6. RAID Level 5E: Incorporating a hot-spare drive in the array

- Throughput improvement by actively using the "spare" heads
- Active use of hot spare allows constant monitoring of the "health" of all drives

Appendix D. Connecting SCSI Hard Disk Drives to the Adapter

The RAID adapter connects to a hard disk drive through one of four possible SCSI-2 channels. The connected hard disk drives can be inside the host system unit, outside the system unit in a hard disk drive enclosure, or both. Each hard disk drive on a SCSI channel must have a unique SCSI ID of 0 through 6, 8, 9, A, B, C, D, E, or F.

The addressing scheme is in hex notation. Address 7 is reserved for the adapter and is not to be used for another SCSI hard disk drive. Each of the SCSI channels (1, 2, 3 and 4) is assigned a channel ID.

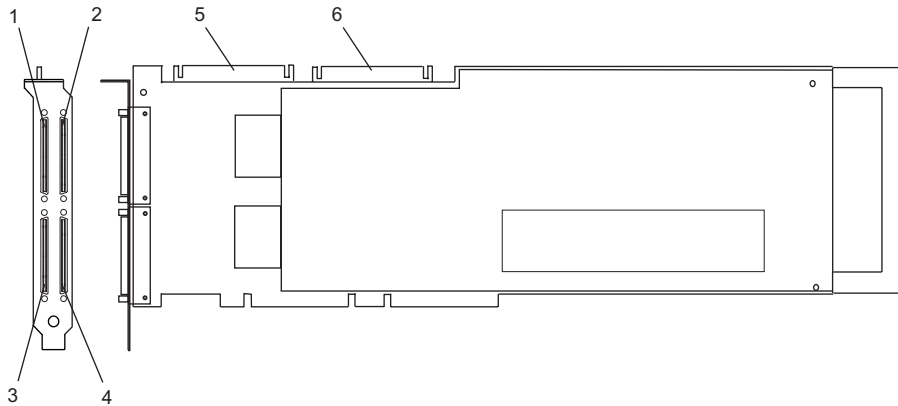


Figure 7. SCSI Channels

- | | |
|---|--------------------|
| 1 | Channel 1 external |
| 2 | Channel 2 external |
| 3 | Channel 3 external |
| 4 | Channel 4 external |
| 5 | Channel 1 internal |
| 6 | Channel 2 internal |

The channel ID and SCSI ID are used to fully identify a hard disk drive connected to the adapter. For example, a hard disk drive with SCSI ID 8 connected to channel 2 on the adapter is identified as hard disk drive 28 (Channel ID 2, SCSI ID 8) by the management software. For best overall performance and data protection, distribute hard disk drives evenly across the four available channels.

Determining Current SCSI Hard Disk Drive Addresses

Hard disk drive backplanes/enclosures or external subsystems automatically set the SCSI address for you. Refer to the documentation for your system or external subsystem for their locations. Be sure to keep a list of all the SCSI addresses you use and the channels to which they are connected for future reference.

To determine the SCSI addresses of any installed hard disk drives, start the RAID manager program and list the attached physical drives. For an AIX system, see *PCI 4-Channel Ultra3 SCSI RAID Adapter Reference Guide*, SA23-1239. If you have another operating system installed, refer to your operating system documentation for the correct procedures.

Notes:

1. The priority of SCSI addresses for the PCI 4-Channel Ultra3 SCSI RAID Adapter is not in sequential order. The order of priority is 7 through 0 and 15 through 8.
2. Address 7 is reserved for the adapter.

Appendix E. Connection Examples

This appendix provides examples of the different ways that you can connect SCSI hard disk drives to the PCI 4-Channel Ultra3 SCSI RAID Adapter.

Internal Hard Disk Drive Connection

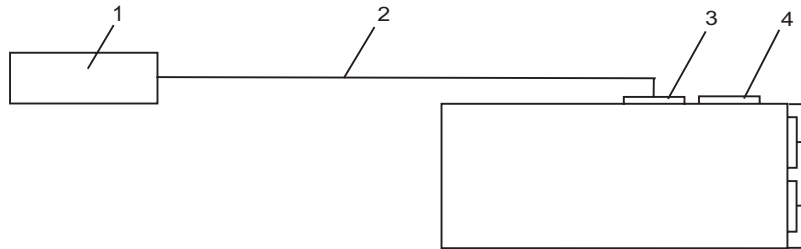


Figure 8. Internal Hard Disk Drive Connection

- 1 SCSI Hot Pluggable Backplane
- 2 System Unique Internal Cable
- 3 Channel 2. 68-pin SCSI Standard Internal Connector
- 4 Channel 1. 68-pin SCSI Standard Internal Connector

Internal and Single External Hard Disk Drive Connections

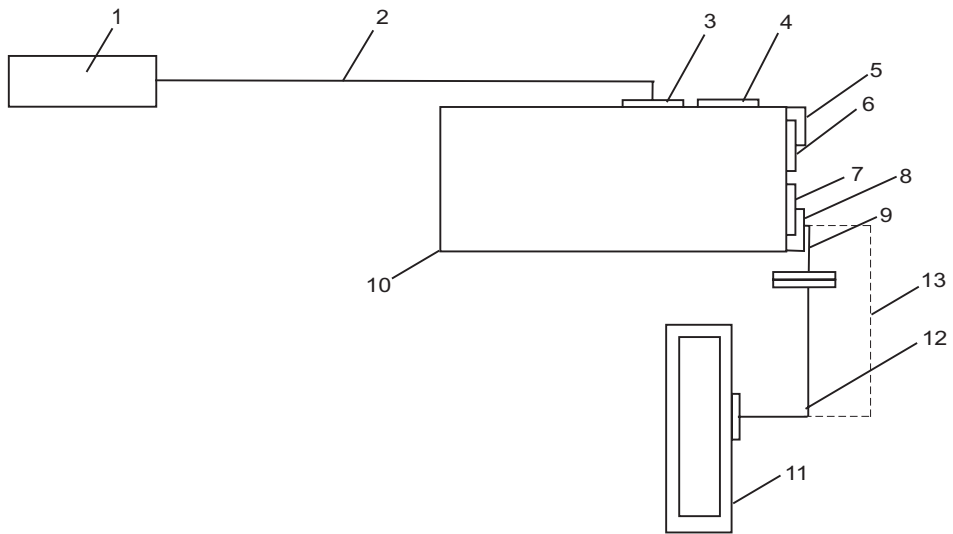


Figure 9. Internal and External Hard Disk Drive Connections

- 1 SCSI Hot Pluggable Backplane
- 2 System Unique Internal Cable
- 3 Channel 2. 68-pin SCSI Standard Internal Connector
- 4 Channel 1. 68-pin SCSI Standard Internal Connector (VHDCI)
- 5 Channel 1. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 6 Channel 2. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 7 Channel 3. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 8 Channel 4. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 9 Interposer Cable FC 2118 (76H0518) for use only when cables with high density connectors are available
- 10 PCI 4-Channel Ultra3 SCSI RAID Adapter
- 11 External Subsystem Enclosure
- 12 Cable with two High Density Connectors, which is used with Interposer Cable FC 2118 (76H0518)
- 13 Cable with two VHDCI connectors, which attaches the PCI 4-Channel Ultra3

SCSI RAID Adapter directly to the attaching subsystem enclosure (Note: This cable is usually supplied with the subsystem enclosure)

Double Internal and Double External Hard Disk Drive Connections

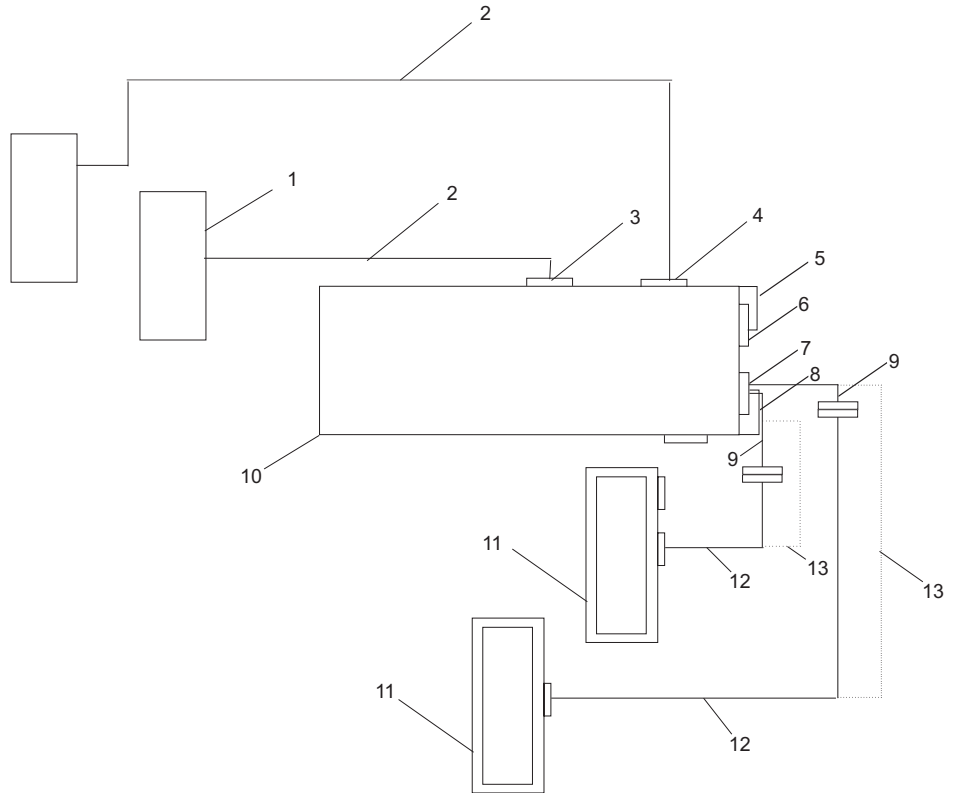


Figure 10. Internal and Double External Hard Disk Drive Connections

- 1 SCSI Hot Pluggable Backplane
- 2 System Unique Internal Cable
- 3 Channel 2. 68-pin SCSI Standard Internal Connector
- 4 Channel 1. 68-pin SCSI Standard Internal Connector
- 5 Channel 1. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 6 Channel 2. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 7 Channel 3. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)

- 8** Channel 4. 68-pin SCSI Very High Density Connector Interface External Connector (VHDCI)
- 9** Interposer Cable FC 2118 (76H0518) for use only when cables with high density connectors are available.
- 10** PCI 4-Channel Ultra3 SCSI RAID Adapter
- 11** External Subsystem Enclosure
- 12** Cable with two High Density Connectors and used with Interposer Cable FC 2118 (76H0518)
- 13** Cable with two VHDCI connectors, which attaches the PCI 4-Channel Ultra3 SCSI RAID Adapter directly to the attaching subsystem enclosure. (Note: This cable is usually supplied with the subsystem enclosure).

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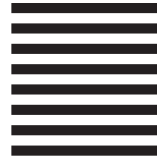
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