IBM Installation Guide

ServeRAID-4 Ultra160, ServeRAID-5i Ultra320, ServeRAID-6M Ultra320, and ServeRAID-6i Ultra320 SCSI Controllers

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Note:	Before using this information and the product it supports, be sure to read the general information in Appendix A, "Warranty information" on page 83 and Appendix B, "Notices" on page 97.

Seventh Edition (July 2003)

Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information
(安全信息)。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας (safety information).

.לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się
z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по
технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

Statement 1:

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

- **Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.**
- **Connect all power cords to a properly wired and grounded electrical outlet.**
- **Connect to properly wired outlets any equipment that will be attached to this product.**
- **When possible, use one hand only to connect or disconnect signal cables.**
- **Never turn on any equipment when there is evidence of fire, water, or structural damage.**
- **Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.**
- **Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.**

To Connect:	**To Disconnect:**
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Statement 2:

CAUTION:
When replacing the lithium battery, use only IBM Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

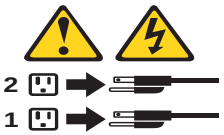
Do not:

- **Throw or immerse into water**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Statement 5:

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



WARNING: Handling the cord on this product or cords associated with accessories sold with this product will expose you to lead, a chemical known to the State of California to cause cancer, and birth defects or other reproductive harm. ***Wash hands after handling.***

ADVERTENCIA: El contacto con el cable de este producto o con cables de accesorios que se venden junto con este producto, pueden exponerle al plomo, un elemento químico que en el estado de California de los Estados Unidos está considerado como un causante de cancer y de defectos congénitos, además de otros riesgos reproductivos. ***Lávese las manos después de usar el producto.***

Contents

Figures

Chapter 1. Introduction

Thank you for purchasing an IBM® ServeRAID™ controller. This *Installation Guide* provides the information needed to:

- Install and cable your controller
- Configure your controller
- Install device drivers and ServeRAID utility programs

Notes:

1. The IBM ServeRAID product can be either a controller on an adapter, such as the one in this option package, or a controller on the system board of a server. For consistency in this manual, the ServeRAID product is referred to as a ServeRAID controller, unless it is specifically noted otherwise.

2. To install device drivers and utility programs for a redundant array of independent disks (RAID) controller that comes as a standard feature on an IBM server system board, see the installation instructions and CDs provided with your server.

Packaged with this *Installation Guide* is the *IBM ServeRAID Support* CD that helps you configure hardware, install device drivers, and install utility programs.

Also, the *IBM ServeRAID Support* CD provides detailed information about this controller. See "ServeRAID publications" on page 5 for more information.

Your controller comes with a three-year limited warranty. If you have access to the World Wide Web, you can obtain up-to-date information about your controller model and other IBM xSeries™ server products from the IBM Web site at http://www.ibm.com/pc/us/eserver/xseries/.

Controller features

The standard features of the ServeRAID controllers are as follows.

Notes:

1. See the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for additional information about arrays, logical drives, and RAID levels.

2. The number of arrays and logical drives varies according to the firmware level and stripe-unit size.

Feature	ServeRAID-6i	ServeRAID-6M	ServeRAID-5i
Arrays (max.)	8	8	8
Battery-backup cache	Yes	Yes	Yes
Cache memory	128 MB	128 MB	128 MB
Hard disk drives (max.)	30	30	30
Logical drives (max.)	8	8	8
Microprocessor	Intel 80321, 400 MHz	Intel 80321, 600 MHz	Intel 80303, 100 MHz
SCSI channels	0	2	0
SCSI transfer speed (max.)	320 MB per sec.	320 MB per sec.	320 MB per sec.
Supported RAID levels	0, 1, 1- Enhanced (1E), 5, 5E-Enhanced (5EE), 00, 10, 1E0, 50	0, 1, 1- Enhanced (1E), 5, 5E-Enhanced (5EE), 00, 10, 1E0, 50	0, 1, 1-Enhanced (1E), 5, 00, 10, 1E0, 50
System PCI data bus	64 bit at 66 to 133 MHz	64 bit at 66 to 133 MHz	64 bit at 66 MHz

Feature	ServeRAID-4H	ServeRAID-4Mx	ServeRAID-4Lx
Arrays (max.)	8	8	8
Battery-backup cache	Yes	Yes	N/A
Cache memory	128 MB	64 MB	32 MB
Hard disk drives (max.)	60	30	15
Logical drives (max.)	8	8	8

Feature	ServeRAID-4H	ServeRAID-4Mx	ServeRAID-4Lx
Microprocessor	IBM PowerPC 750, 266 MHz	Intel 80303, 100 MHz	Intel 80303, 100 MHz
SCSI channels	4	2	1
SCSI transfer speed (max.)	160 MB per sec.	160 MB per sec.	160 MB per sec.
Supported RAID levels	0, 1, 1-Enhanced (1E), 5, 5-Enhanced (5E), 00, 10, 1E0, 50	0, 1, 1-Enhanced (1E), 5, 5-Enhanced (5E), 5E-Enhanced (5EE), 00, 10, 1E0, 50	0, 1, 1-Enhanced (1E), 5, 5-Enhanced (5E), 5E-Enhanced (5EE), 00, 10, 1E0, 50
System PCI data bus	64 bit at 33 MHz	64 bit at 33 to 66 MHz	64 bit at 33 to 66 MHz

Notices and statements used in this book

The caution and danger statements that appear in this book are also in the multilingual *Safety Information Book*, which is on the *IBM Documentation* CD that comes with your server. Each statement is numbered for reference to the corresponding statement in the *Safety Information Book*.

The following types of notices and statements are used in this book:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could occur.
- **Caution:** These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Danger:** These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure step or situation.

Working inside the server with the power on

Your server supports hot-plug, hot-add, and hot-swap devices and is designed to operate safely while turned on with the cover removed. Follow these guidelines when you work inside a server that is turned on:

- Avoid loose-fitting clothing on your forearms. Button long-sleeved shirts before working inside the server; do not wear cuff links while you are working inside the server.
- Do not allow your necktie or scarf to hang inside the server.
- Remove jewelry, such as bracelets, necklaces, rings, and loose-fitting wrist watches.
- Remove items from your shirt pocket (such as pens or pencils) that could fall into the server as you lean over it.
- Avoid dropping any metallic objects, such as paper clips, hair pins, or screws, into the server.

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices, including your server. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

To reduce the possibility of damage from electrostatic discharge, observe the following precautions:

- 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 circuitry.
- Do not leave the device where others can handle and damage it.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the server for at least 2 seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into the server without setting down the device. If it is necessary to set down the device, place it back into its static-protective package. Do not place the device on your server cover or on a metal surface.
- Take additional care when handling devices during cold weather. Heating reduces indoor humidity and increases static electricity.

ServeRAID publications

The following books are available in Portable Document Format (PDF) on the *IBM ServeRAID Support* CD in the BOOKS directory:

- *IBM ServeRAID User's Reference* (SRAID.PDF)
- *IBM ServeRAID Device Driver Installation Instructions* (DEVDRV.PDF)
- *IBM ServeRAID-4 Ultra160, ServeRAID-5i Ultra320, ServeRAID-6M Ultra320, and ServeRAID-6i Ultra 320 SCSI Controllers Installation Guide* (INSTALL.PDF)

Note: Use Adobe Acrobat Reader to view these files. The *IBM ServeRAID Support* CD contains the Acrobat Readers for Microsoft® Windows®, IBM OS/2®, and Linux® in the BOOKS/READERS directory.

If you are installing the IBM ServeRAID Cluster Solution, you might need to see the *IBM Shared Disk Clustering Hardware Reference.* This book provides general information about planning and configuring a shared-disk cluster using IBM server products. It contains illustrations, descriptions, and parts listings for various high-availability, shared-disk cluster examples.

Note: You can obtain this publication from the IBM Support Web site. See "Obtaining ServeRAID updates" on page 17 for additional information.

In addition, the following IBM Redbooks™ might be of interest:

- *Implementing Netfinity Disk Subsystems: ServeRAID SCSI, Fibre Channel, and SSA*
- *Tuning Netfinity Servers for Performance: Getting the most out of Windows 2000 and Windows NT 4.0*
- *Netfinity Director: Integration and Tools*
- *Netfinity Clustering Planning Guide*

You can download these books from the IBM Web site at http://www.ibm.com/redbooks/.

Connector locations

This section provides illustrations of the small computer system interface (SCSI) channel connectors and cable connectors for the ServeRAID-4H, ServeRAID-4Mx, ServeRAID-4Lx, ServeRAID-5i, ServeRAID-6M, and ServeRAID-6i controllers.

The light-emitting diodes (LEDs) on the controllers indicate activity on the SCSI channels and provide diagnostic information for trained service technicians.

ServeRAID-4H controller

The ServeRAID-4H controller has four independent SCSI channels: channel 1, channel 2, channel 3, and channel 4. Each of these SCSI channels supports up to 15 physical devices.

Note: In the event of a power outage or failure, the battery-backup cache protects the data stored in the ServeRAID cache memory when using the write-back setting of the write-cache mode.

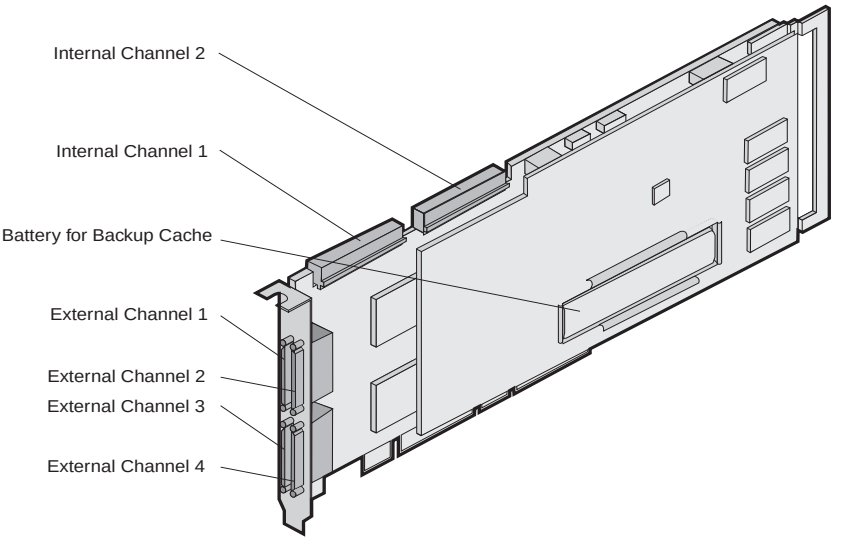


Figure 1. ServeRAID-4H controller

You can attach internal SCSI devices to the internal channel 1 and channel 2 connectors. You can attach external SCSI devices to the external channel 1, channel 2, channel 3, and channel 4 connectors. You cannot attach SCSI devices to both the internal *and* external connectors on the same channel. For example, you cannot attach devices to both external channel 1 and internal channel 1. The ServeRAID-4 controllers do not support configurations that use both the internal and external connectors on the same channel *concurrently*.

Note: The ServeRAID-4H controller uses the module (part number 37L6903) containing a lithium battery.

Statement 2:

CAUTION:
When replacing the lithium battery, use only IBM Part Number 37L6903 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

ServeRAID-4Mx controller

The ServeRAID-4Mx controller has two independent SCSI channels: channel 1 and channel 2. Each of these SCSI channels supports up to 15 physical devices.

Note: In the event of a power outage or failure, the battery-backup cache protects the data stored in the ServeRAID cache memory when using the write-back setting of the write-cache mode.

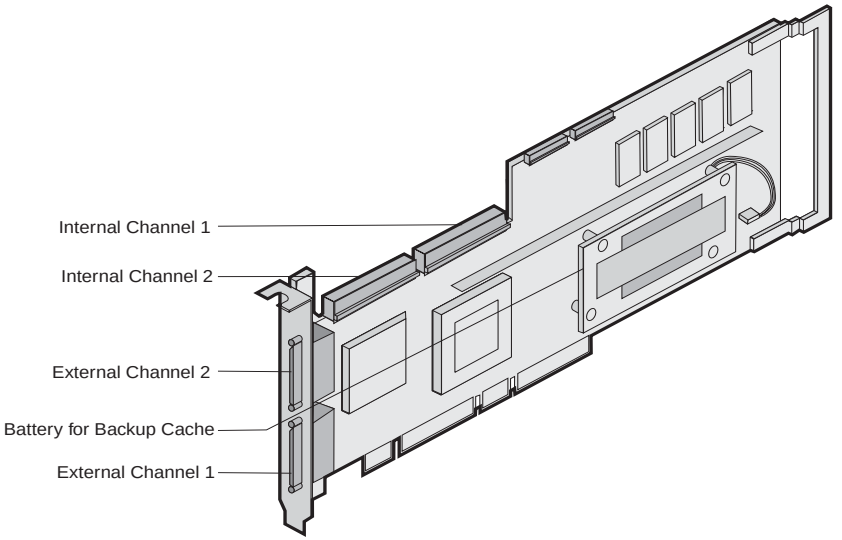


Figure 2. ServeRAID-4Mx controller

You can attach internal SCSI devices to the internal channel 1 and channel 2 connectors. You can attach external SCSI devices to the external channel 1 and channel 2 connectors. You cannot attach SCSI devices to both the internal *and* external connectors on the same channel. For example, you cannot attach devices to both external channel 1 and internal channel 1. The ServeRAID-4 controllers do not support configurations that use both the internal and external connectors on the same channel *concurrently*.

Note: The ServeRAID-4Mx controller uses the module (part number 37L6903) containing a lithium battery.

Statement 2:

CAUTION:
When replacing the lithium battery, use only IBM Part Number 37L6903 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

ServeRAID-4Lx controller

The ServeRAID-4Lx controller has one independent SCSI channel: channel 1. This SCSI channel supports up to 15 physical devices.

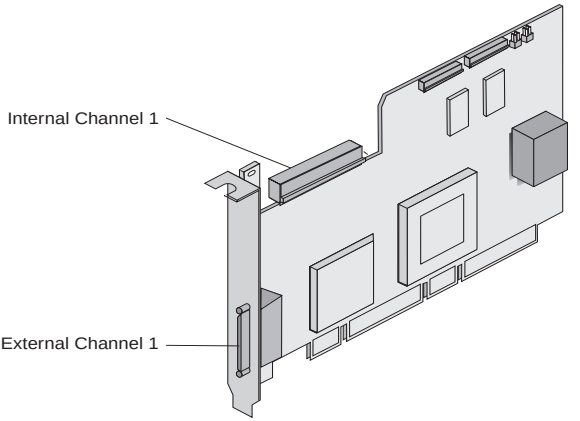


Figure 3. ServeRAID-4Lx controller

You can attach internal SCSI devices to the internal channel 1 connector. You can attach external SCSI devices to the external channel 1 connector. You cannot attach SCSI devices to both the internal *and* external connectors on the same channel. For example, you cannot attach devices to both external channel 1 and internal channel 1. The ServeRAID-4 controllers do not support configurations that use both the internal and external connectors on the same channel *concurrently*.

ServeRAID-5i controller

The ServeRAID-5i controller has no independent SCSI channels. It must be used with an IBM xSeries server that contains an integrated RAID controller. It comes with both a 2-U and 3-U I/O bracket; the 3-U bracket is mounted on the controller.

Note: In the event of a power outage or failure, the battery-backup cache protects the data stored in the ServeRAID cache memory when using the write-back setting of the write-cache mode.

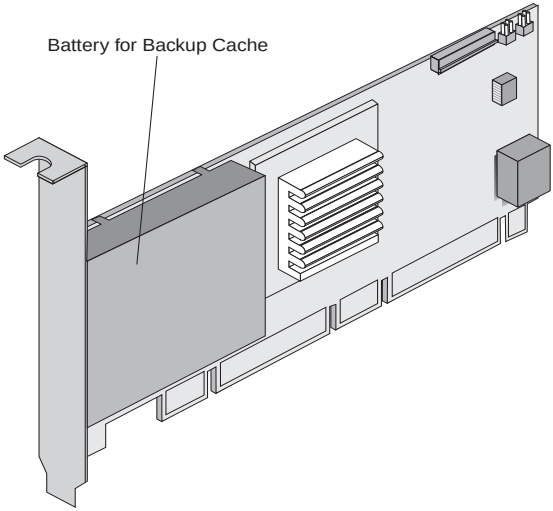


Figure 4. ServeRAID-5i controller

Note: The ServeRAID-5i controller uses the module (part number 25P3482) containing a lithium battery.

Statement 2:

CAUTION:
When replacing the lithium battery, use only IBM Part Number 25P3482 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

ServeRAID-6M controller

The ServeRAID-6M controller has two independent SCSI channels: channel 1 and channel 2. Each of these SCSI channels supports up to 15 physical devices.

Note: In the event of a power outage or failure, the battery-backup cache protects the data stored in the ServeRAID cache memory when the write-back setting of the write-cache mode is used.

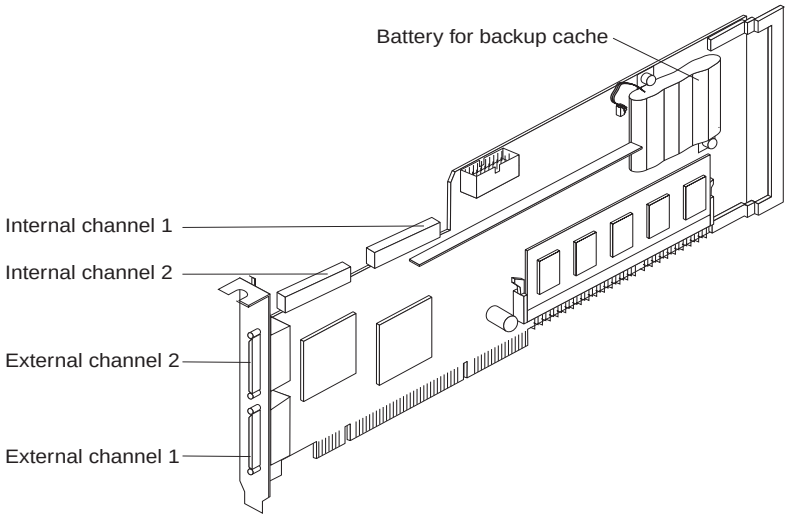


Figure 5. ServeRAID-6M controller

Note: The ServeRAID-6M controller includes a lithium battery module (part number 02R0986).

You can attach internal SCSI devices to the internal channel 1 and channel 2 connectors. You can attach external SCSI devices to the external channel 1 and channel 2 connectors. You cannot attach SCSI devices to both the internal *and* external connectors on the same channel. For example, you cannot attach devices to both external channel 1 and internal channel 1. The ServeRAID-6M controllers do not support configurations that use both the internal and external connectors on the same channel *concurrently*.

Statement 2:

CAUTION:
When replacing the lithium battery, use only IBM Part Number 02R0986 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

ServeRAID-6i controller

The ServeRAID-6i controller has no independent SCSI channels. It must be used with an IBM xSeries server that contains an integrated RAID controller. It comes with both a 2-U and 3-U I/O bracket; the 3-U bracket is mounted on the controller.

Note: In the event of a power outage or failure, the battery-backup cache protects the data stored in the ServeRAID cache memory when using the write-back setting of the write-cache mode.

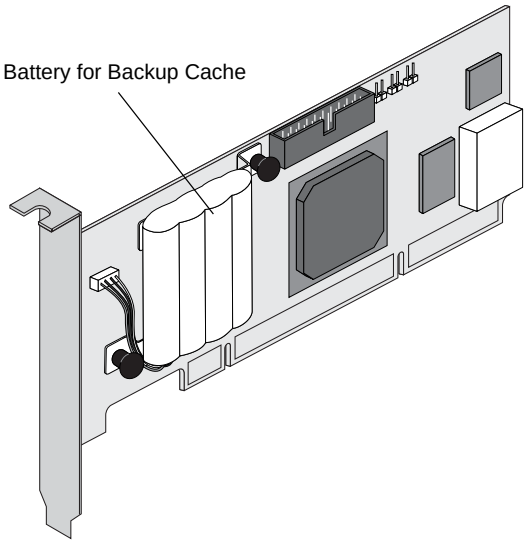


Figure 6. ServeRAID-6i controller

Note: The ServeRAID-6i controller uses the module (part number 71P8628) containing a lithium battery.

Statement 2:

CAUTION:
When replacing the lithium battery, use only IBM Part Number 71P8628 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module

type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:

- **Throw or immerse into water**
- **Heat to more than 100 C (212 F)**
- **Repair or disassemble**

Dispose of the battery as required by local ordinances or regulations.

Chapter 2. Installing and configuring ServeRAID controllers

This chapter covers the following steps in the ServeRAID installation process:

Step 1. Obtaining ServeRAID updates
Step 2. Installing and cabling a ServeRAID controller
Step 3. Updating BIOS and firmware code
Step 4. Configuring the ServeRAID controller
Step 5. Installing ServeRAID device drivers
Step 6. Installing and starting the ServeRAID Manager program

Obtaining ServeRAID updates

IBM periodically makes updated versions of the ServeRAID software available from the IBM Support page on the World Wide Web.

Note: If you download ServeRAID software, you must download and install *all* ServeRAID software at the same time. This will ensure that all levels of the software are compatible. The ServeRAID software includes:

- BIOS and firmware code
- Device drivers
- ServeRAID Manager program
- Command-line programs

Complete the following steps to locate files:

1. Go to http://www.ibm.com/pc/support/.
2. In the **Search** text box at the top of the page, type `ServeRAID`; then, press Enter.

If you do not have access to the World Wide Web, contact your place of purchase, your IBM reseller, or your IBM marketing representative for replacement CDs.

Using a ServeRAID controller in a server with Active PCI features

Note: The ServeRAID-6i and ServeRAID-5i controllers do not support Active™ PCI features. The ServeRAID-6M controller does not support Active PCI features under the Windows operating system.

Some IBM servers support Active PCI (also called hot-plug PCI) features. The following tables summarize which operating systems support specific Active PCI functions.

Feature	Windows NT 4.0	Windows 2000	Windows Server 2003	NetWare 5.x	NetWare 6.0
Hot-add	Yes	Yes	Yes	Yes	Yes
Hot-remove	No	Yes	Yes	Yes	Yes
Hot-replace	Yes	No	No	No	No

You can use the Active PCI features to install, remove, or replace peripheral component interconnect (PCI) controllers without turning off the server.

- Use the hot-add feature to add a controller to a running server, thus expanding its capacity.
- Use the hot-remove feature to remove a controller from a running server.
- Use the hot-replace feature to replace a controller with an identical controller while the server is running.

  Note: When you use the hot-replace feature, some parameters (such as rebuild rate) are not restored. If you have previously saved the controller configuration, refer to it for information.

Attention: Do *not* attempt a hot-replace operation on a server running the Windows 2000, Windows Server 2003, or Novell NetWare operating system by hot-removing a failed controller and then hot-adding a new controller. Loss of data can occur. If a controller fails on these operating systems, you *must* shut down the server to replace the controller.

Using Windows NT 4.0 with Active PCI features

To use Active PCI with Windows NT 4.0 and a ServeRAID controller, you must install the following software components in this order:

1. Desktop Management Interface (DMI) Service provider. A free version is included on the *IBM ServeRAID Support* CD in the following directory:

   e:\WINNT\DMISP\setup.exe

   where *e* is the CD-ROM drive.

   Note: This version is sufficient for most users' needs, but a Year 2000 ready version is available at http://www.enablers.com/.

2. IBM Hot Plug for Windows NT 4.0 Package, version 4.2 or later. This package is available from the IBM Support Web site. See "Obtaining ServeRAID updates" on page 17 for additional information.

   Note: Be sure to read the instructions and restrictions for this software program.

3. ServeRAID Active PCI DMI component. This is an optional component that you can install during the ServeRAID Manager installation.

To perform a hot-replace operation, start the IBM ServeRAID Hot Replace wizard. You can start this program from within either the IBM Hot Plug for Windows NT 4.0 program or the ServeRAID Manager program. You can use the ServeRAID Manager program to start the wizard either on the server with the failed controller or across the network from a remote installation of the ServeRAID Manager.

Note: It is useful to start the IBM ServeRAID Hot Replace wizard from a remote installation when the server with the failed controller does not have a monitor.

Using Windows 2000 with Active PCI features

To use Active PCI with Windows 2000, you must install the IBM Active PCI Software for Windows 2000. This software is available from the IBM Support Web site. See "Obtaining ServeRAID updates" on page 17 for additional information.

Note: Be sure to read the instructions and restrictions for this software program.

Using Windows Server 2003 with Active PCI features

To use Active PCI with Server 2003, you must install the IBM Active PCI Software for Windows Server 2003. This software is available from the IBM Support Web site. See "Obtaining ServeRAID updates" on page 17 for additional information.

Note: Be sure to read the instructions and restrictions for this software program.

Using NetWare with Active PCI features

To use Active PCI with NetWare, you must install the IBM PCI Hot-Plug Controller Driver for NetWare. This software is available from the IBM Support Web site. See "Obtaining ServeRAID updates" on page 17 for additional information.

Note: Be sure to read the instructions and restrictions for this software program.

Installing and cabling a ServeRAID-4 controller

This section provides installation and cabling instructions for ServeRAID-4 controllers.

You can install a maximum of 16 ServeRAID controllers in a server.

Installing the ServeRAID-4 controller

During the installation, you might need a small, flat-blade screwdriver and the documentation that comes with your server.

Complete the following steps to install the ServeRAID-4 controller:

1. Review "Safety" on page iii and the *Safety Information Book* provided with your server. Also, review "Working inside the server with the power on" on page 3 and "Handling static-sensitive devices" on page 4.

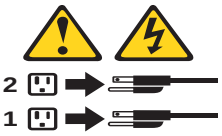
   Note: Some IBM servers support Active PCI features, which enable you to install or remove PCI controllers without turning off the server. If your server model provides Active PCI support and you are using Windows 2000, Windows NT 4.0, Windows Server 2003, NetWare 5.x, or Netware 6.0, you do not need to turn off your server to install this controller. This operation is referred to as a hot-add operation. Review the following information before performing this operation:

   - Review the information provided with your server to determine whether your model supports these features. After you verify that your server supports Active PCI features, verify that the selected PCI slot also supports these features. Although certain servers support Active PCI features, some of the PCI slots might not support these features. Therefore, if you install a ServeRAID controller in a PCI slot that does not support Active PCI features, you cannot perform a hot-add operation in that slot.
   - See the documentation provided with your operating system for information concerning using these features.
   - See "Using a ServeRAID controller in a server with Active PCI features" on page 17.
   - If you intend to perform a hot-add operation, you must first install the required software components for using your operating system with Active PCI. Follow the instructions in the appropriate section of this book:
     - "Using Windows NT 4.0 with Active PCI features" on page 18
     - "Using Windows 2000 with Active PCI features" on page 19
     - "Using Windows Server 2003 with Active PCI features" on page 19
     - "Using NetWare with Active PCI features" on page 19

2. If your server model does *not* support Active PCI, turn off the server and disconnect all power cords and cables from the server.

Statement 5:

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



3. Remove the server cover and locate an empty PCI expansion slot for the controller. Choose a slot that is farthest from other installed components, such as the microprocessor. If necessary, see your server documentation for more detailed information about the expansion slots.

   Note: Some server models require that you install the ServeRAID controller in a specific PCI slot. See the documentation that came with your server for more information.

4. Remove the expansion-slot cover, if applicable.
5. Touch the static-protective package containing the controller to an unpainted metal part of the server for at least 2 seconds. This discharges any static electricity from the package and your body.
6. Holding the controller by the edges, remove it from the static-protective package. Do not touch any exposed components on the controller.
7. Insert the controller into the PCI expansion slot. Press the controller firmly into the slot so that it is fully seated.

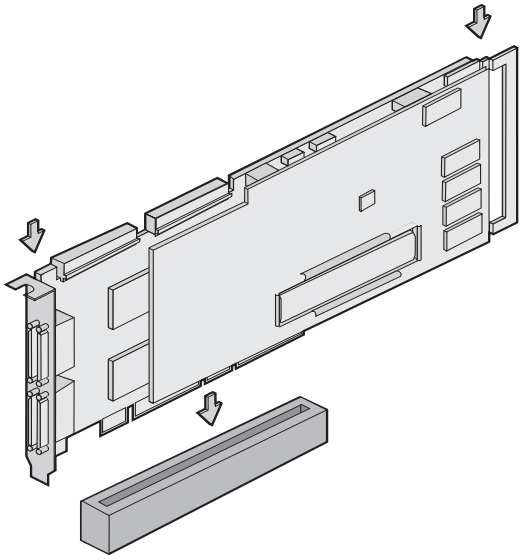


Figure 7. Inserting a ServeRAID-4H controller into the PCI expansion slot

8. Secure the controller by either tightening the expansion-slot screw on the top of the controller or closing the latch, depending on your server.
9. Connect the SCSI cables to the controller. If you intend to attach external devices only, go to step 13 on page 23. Otherwise, go to step 10.
10. Connect one end of a 68-pin standard cable (separately purchased or already in your server) to the internal channel connector on the ServeRAID controller.

    Note: See "Connector locations" on page 5 for the channel connector locations.

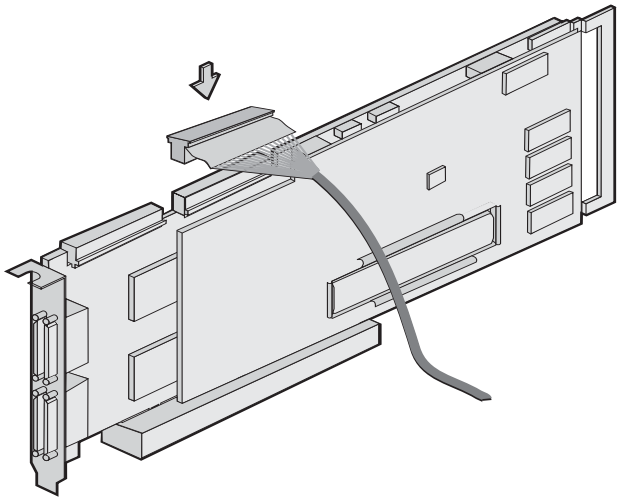


Figure 8. Connecting a ServeRAID-4H controller internal channel connector

11. Connect the other end of the SCSI cable to the SCSI backplane or to a SCSI device in the server. (See your server documentation or the system label inside the server cover for the location of the SCSI connector on the backplane.)
12. If you have physical drives to install, install them now. See your server documentation for drive installation instructions.
13. Install the server cover.
14. If you disconnected the cables and power cords in step 2 on page 20, reconnect the cables and cords. See your server documentation if you need detailed instructions.
15. If you want to attach an external SCSI device to the ServeRAID controller, go to "Connecting external devices to a ServeRAID-4 controller". Otherwise, go to "Updating BIOS and firmware code" on page 35.

Connecting external devices to a ServeRAID-4 controller

Note: You cannot attach internal *and* external SCSI devices to both the internal and external connectors on the same channel. For example, you cannot attach devices to both external Channel 1 and internal Channel 1. The ServeRAID-4 controllers do not support configurations that use both the internal and external connectors on the same channel *concurrently*.

Complete the following steps to attach SCSI devices to an external channel connector on the ServeRAID controller:

1. Connect one end of a 68-pin very-high-density connector interface (VHDCI) SCSI cable to an external channel connector on the ServeRAID controller.

   Note: See "Connector locations" on page 5 for the channel connector locations.

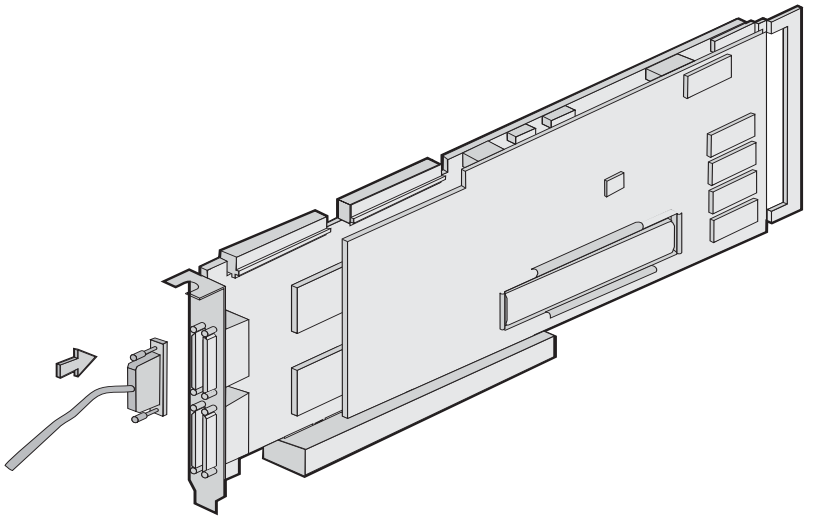


Figure 9. Connecting a ServeRAID-4H controller external channel connector

2. Connect the other end of the SCSI cable to the external SCSI device.
3. Go to "Updating BIOS and firmware code" on page 35.

Installing the ServeRAID-5i controller

Attention: If you plan to install a ServeRAID-5i controller into a server that contains data, back up the data first. When the ServeRAID-5i controller is installed, you will lose access to any data or applications on physical drives connected to the integrated RAID controller.

Review "Handling static-sensitive devices" on page 4.

Preparing for installation

Before you begin the installation procedure, see the documentation that comes with your server. You need to determine:

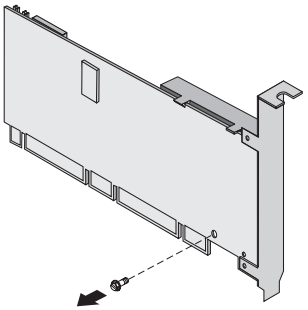
- The PCI expansion slot into which you will install the controller
- Whether you need to install the low-profile 2-U bracket

The IBM ServeRAID-5i Ultra320 SCSI controller has a 3-U bracket. If your server requires a low-profile 2-U bracket, you *must* use the following instructions to install the 2-U bracket.

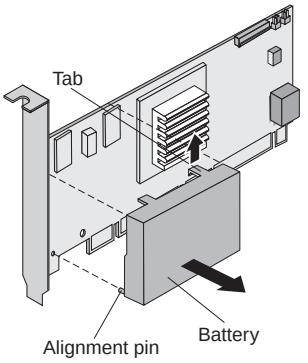
Attention: Failure to follow these instructions might damage the ServeRAID-5i controller.

Complete the following steps to install the 2-U bracket. You will need a small, flat-blade screwdriver.

1. Holding the controller by the edges, remove it from the static-protective package. Do not touch any exposed components on the controller.
2. Set the controller battery-side down on a nonconductive, static-protected surface. Do not place the controller on your server cover or on a metal table.
3. Using a small, flat-blade screwdriver, remove the screw from the battery pack. Set it aside.



4. To remove the battery, gently press the tab up and lift the battery away from the controller.

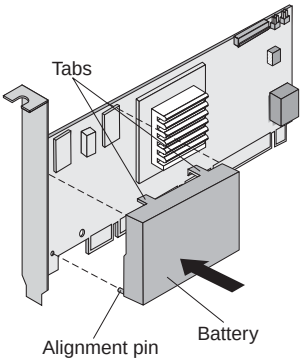


5. Remove the two bracket screws. Set them aside.
6. Remove the 3-U bracket.

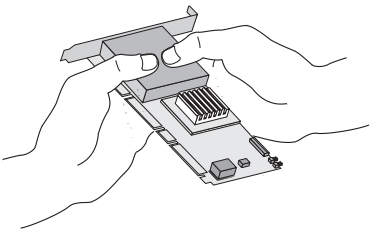
7. Align the two screw holes in the 2-U bracket with the two screw holes on the controller. Using the two screws that you removed in step 5, secure the bracket to the controller. The screws enter the screw holes on the battery side of the controller and then go through the bracket screw holes.

   Attention: Follow steps 8 and 9 carefully. Failure to do so might damage the ServeRAID-5i controller.

8. Carefully reposition the battery pack on the controller. Be sure that the alignment pin and the two tabs are properly aligned.



9. Press gently on the center of the battery pack to snap the battery pack into place. Be sure to apply pressure evenly with both hands and to hold the controller as shown in the figure below. Also, make sure that the tab is properly latched on the controller.



10. Using the screw that you removed in step 3 on page 25, secure the battery to the controller.
11. Return the controller to the static-protective package.

Installation procedure

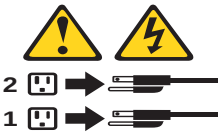
During the installation, you might need a small, flat-blade screwdriver and the documentation that comes with your server.

Complete the following steps to install the ServeRAID-5i controller:

1. Review "Safety" on page iii and the *Safety Information Book* provided with your server.
2. Turn off the server and disconnect all power cords and cables from the server.

Statement 5:

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



3. Remove the server cover and locate the PCI expansion slot.

Notes:

   a. The ServeRAID-5i controller *must* be installed in an extended PCI expansion slot. If you have not already done so, see the documentation that comes with your server to determine the correct PCI expansion slot for the ServeRAID-5i controller.

   b. If another controller is already installed in the extended PCI expansion slot designed for the ServeRAID-5i controller, you must remove the controller before installing the ServeRAID-5i controller.

4. Remove the expansion-slot cover, if applicable.
5. Touch the static-protective package containing the controller to an unpainted metal part of the server for at least 2 seconds. This discharges any static electricity from the package and your body.
6. Holding the controller by the edges, remove it from the static-protective package. Do not touch any exposed components on the controller.
7. Insert the controller into the PCI expansion slot. Press the controller firmly into the slot so that it is fully seated.

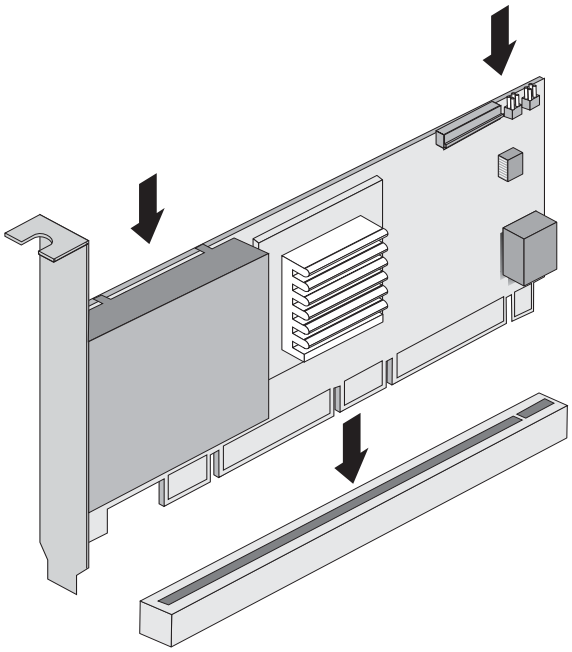


Figure 10. Inserting a ServeRAID-5i controller into the PCI expansion slot

8. Secure the controller by either tightening the expansion-slot screw on the top of the controller or closing the latch, depending on your server.
9. If you have physical drives to install, install them now. See your server documentation for drive installation instructions.
10. Install the server cover.
11. Reconnect the cables and cords. See your server documentation if you need detailed instructions.
12. Go to "Updating BIOS and firmware code" on page 35.

Installing and cabling a ServeRAID-6M controller

This section provides installation and cabling instructions for ServeRAID-6M controllers.

You can install a maximum of 16 ServeRAID controllers in a server.

Installing the ServeRAID-6M controller

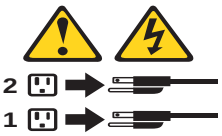
During the installation, you might need a small, flat-blade screwdriver and the documentation that comes with your server.

Complete the following steps to install the ServeRAID-6M Ultra320 SCSI controller:

1. Review "Safety" on page iii and the *Safety Information Book* provided with your server. Also, review "Handling static-sensitive devices" on page 4.
2. Turn off the server and disconnect all power cords and cables from the server.

Statement 5:

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.



3. Remove the server cover and locate an empty PCI expansion slot for the controller. Choose a slot that is farthest from other installed components, such as the microprocessor. If necessary, see your server documentation for more detailed information about the expansion slots.

   Note: Some server models require that you install the ServeRAID controller in a specific PCI slot. See the documentation that comes with your server for more information.

4. Remove the expansion-slot cover, if applicable.
5. Touch the static-protective package containing the controller to an unpainted metal part of the server for at least 2 seconds. This discharges any static electricity from the package and your body.
6. Holding the controller by the edges, remove it from the static-protective package. Do not touch any exposed components on the controller.
7. Insert the controller into the PCI expansion slot. Press the controller firmly into the slot so that it is fully seated.

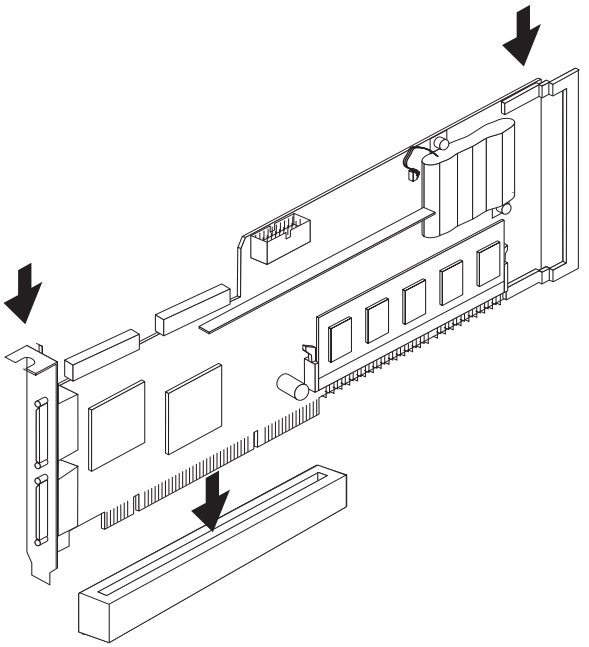


Figure 11. Inserting a ServeRAID-6M controller into the PCI expansion slot

8. Secure the controller by either tightening the expansion-slot screw on the top of the controller or closing the latch, depending on your server.
9. Connect the SCSI cables to the controller. If you intend to attach external devices only, go to step 13 on page 31. Otherwise, go to step 10.
10. Connect one end of a 68-pin standard cable (separately purchased or already in your server) to the internal channel connector on the ServeRAID controller.

    Note: See "Connector locations" on page 5 for the channel connector locations.

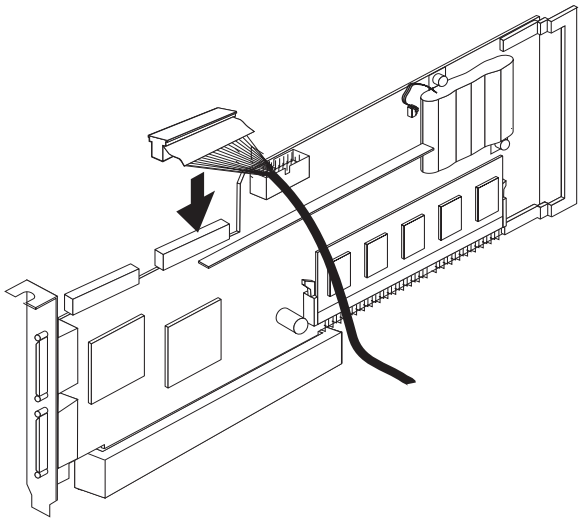


Figure 12. Connecting a ServeRAID-6M controller internal channel connector

11. Connect the other end of the SCSI cable to the SCSI backplane or to a SCSI device in the server. (See your server documentation or the system label inside the server cover for the location of the SCSI connector on the backplane.)
12. If you have physical drives to install, install them now. See your server documentation for drive installation instructions.
13. Install the server cover.
14. Reconnect the cables and cords. See your server documentation if you need detailed instructions.
15. If you want to attach an external SCSI device to the ServeRAID controller, go to "Connecting external devices to a ServeRAID-6M controller". Otherwise, go to "Updating BIOS and firmware code" on page 35.

Connecting external devices to a ServeRAID-6M controller

Note: You cannot attach internal *and* external SCSI devices to both the internal and external connectors on the same channel. For example, you cannot attach devices to both external channel 1 and internal channel 1. The ServeRAID-6M controllers do not support configurations that use both the internal and external connectors on the same channel *concurrently*.

Complete the following steps to attach SCSI devices to an external channel connector on the ServeRAID controller:

1. Connect one end of a 68-pin very-high-density connector interface (VHDCI) SCSI cable to an external channel connector on the ServeRAID controller.

   Note: See "Connector locations" on page 5 for the channel connector locations.

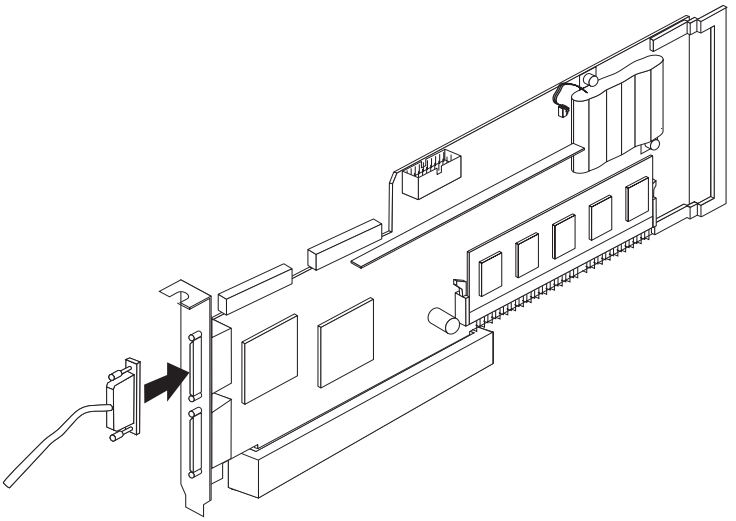


Figure 13. Connecting a ServeRAID-6M controller external channel connector

2. Connect the other end of the SCSI cable to the external SCSI device.
3. Go to "Updating BIOS and firmware code" on page 35.

Installing the ServeRAID-6i controller

Attention: If you plan to install a ServeRAID-6i controller into a server that contains data, back up the data first. When the ServeRAID-6i controller is installed, you will lose access to any data or applications on physical drives connected to the integrated RAID controller.

If you are upgrading a ServeRAID-5i controller to a ServeRAID-6i controller, review the controller upgrade procedure in the *IBM ServeRAID User's Reference*.

Review "Handling static-sensitive devices" on page 4.

Preparing for installation

Before you begin the installation procedure, see the documentation that comes with your server. You need to determine:

- The PCI expansion slot into which you will install the controller

- Whether you need to install the low-profile 2-U bracket

The IBM ServeRAID-6i Ultra320 SCSI controller has a 3-U bracket. If your server requires a low-profile 2-U bracket, you *must* use the following instructions to install the 2-U bracket.

Attention: Failure to follow these instructions might damage the ServeRAID-6i controller.

Complete the following steps to install the 2-U bracket. You will need a small, Phillips or flat-head screwdriver.

1. Holding the controller by the edges, remove it from the static-protective package. Do not touch any exposed components on the controller.
2. Set the controller battery-side down on a nonconductive, static-protected surface. Do not place the controller on your server cover or on a metal table.
3. Using a small, Phillips or flat-head screwdriver, remove the two bracket screws. Set them aside.
4. Remove the 3-U bracket.
5. Align the two screw holes in the 2-U bracket with the two screw holes on the controller. Using the two screws that you removed in step 3, secure the bracket to the controller.
6. Return the controller to the static-protective package.

Installation procedure

During the installation, you might need a small, flat-blade screwdriver and the documentation that comes with your server.

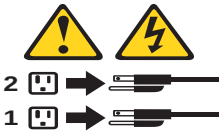
Complete the following steps to install the ServeRAID-6i controller:

1. Review "Safety" on page iii and the *Safety Information Book* provided with your server.
2. Turn off the server and disconnect all power cords and cables from the server.

Statement 5:

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical

current from the device, ensure that all power cords are disconnected from the power source.



3. Remove the server cover and locate the PCI expansion slot.

   Notes:

   a. The ServeRAID-6i controller *must* be installed in an extended PCI expansion slot. If you have not already done so, see the documentation that comes with your server to determine the correct PCI expansion slot for the ServeRAID-6i controller.

   b. If another controller is already installed in the extended PCI expansion slot designed for the ServeRAID-6i controller, you must remove the controller before installing the ServeRAID-6i controller.

4. Remove the expansion-slot cover, if applicable.
5. Touch the static-protective package containing the controller to an unpainted metal part of the server for at least 2 seconds. This discharges any static electricity from the package and your body.
6. Holding the controller by the edges, remove it from the static-protective package. Do not touch any exposed components on the controller.
7. Insert the controller into the PCI expansion slot. Press the controller firmly into the slot so that it is fully seated.

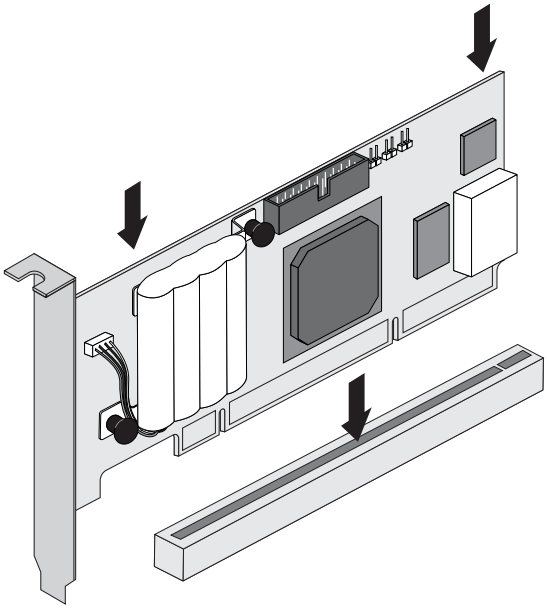


Figure 14. Inserting a ServeRAID-6i controller into the PCI expansion slot

8. Secure the controller by either tightening the expansion-slot screw on the top of the controller or closing the latch, depending on your server.
9. If you have physical drives to install, install them now. See your server documentation for drive installation instructions.
10. Install the server cover.
11. Reconnect the cables and cords. See your server documentation if you need detailed instructions.
12. Go to "Updating BIOS and firmware code".

Updating BIOS and firmware code

You must have the latest BIOS and firmware code installed on your server:

- If you plan to install the ServeRAID controller in a 64-bit server
- Before configuring the ServeRAID controller

Important: You cannot move the ServeRAID controller from a 32-bit server to a 64-bit server without updating the levels of BIOS and firmware code to level 6.00 or later.

Complete the following steps to update the levels of BIOS and firmware code:

1. Insert the *IBM ServeRAID Support* CD into the server CD-ROM drive, and turn on the server.

   The IBM ServeRAID ROM (read-only memory) Update wizard automatically starts. The IBM ServeRAID ROM Update wizard is a program that updates the BIOS and firmware code on ServeRAID controllers. The wizard automatically identifies and scans each ServeRAID controller.

   If the BIOS and firmware code do not require updating, the wizard automatically stops and the ServeRAID Manager program starts. Continue with "Configuring the ServeRAID controller" on page 36.

   If the BIOS and firmware code require updating, a report screen opens with the following information:

   - Controller types found.
   - Controller slot number, if known.
   - Firmware version.
   - BIOS version.
   - Update status. If a controller has outdated BIOS or firmware code, the IBM ServeRAID ROM Update wizard marks the controller as a candidate for update.

   The IBM ServeRAID ROM Update wizard asks if you want to update. You decide whether to update, but you must update all or none of the controllers in your server; you cannot selectively update.

2. If you want to update your ServeRAID controllers, click **Update**. If the wizard detects an error, an error message appears and you are prompted to insert a diskette into your diskette drive. The wizard saves details about the error to a file on the diskette.

   If you do not want to update your ServeRAID controllers, click **Cancel**.

3. When all updates are completed, scroll through the Features window. This window reports the changes that the IBM ServeRAID ROM Update wizard applied to your ServeRAID controllers.

4. Leave the *IBM ServeRAID Support* CD in the CD-ROM drive; shut down and restart the server.

Configuring the ServeRAID controller

This section provides information about starting and using the ServeRAID Manager program. You can use the ServeRAID Manager program to configure your ServeRAID controllers, view the ServeRAID configurations and associated devices, change controller settings, monitor your controllers, and more.

The information in this section focuses on using the ServeRAID Manager program in startable-CD mode to configure your controllers or to change specific

settings. For information about other uses of ServeRAID Manager, see the ServeRAID Manager online help.

If you are configuring an integrated RAID controller, see the instructions in the *Installation Guide* provided with your server.

Important

If you intend to use your ServeRAID controllers in a Microsoft Windows failover or clustering environment, continue with one of the following sections:

- For failover, go to Chapter 6, "Configuring two ServeRAID controllers in a failover environment," in the *IBM ServeRAID User's Reference*.
- For clustering, go to Part 3, "Installing the IBM ServeRAID Cluster Solution," in the *IBM ServeRAID User's Reference*.

The *IBM ServeRAID User's Reference* is located on the *IBM ServeRAID Support* CD.

Using ServeRAID Manager

The ServeRAID Manager program operates in two ways:

- Startable-CD mode
- As an installed software program

When you run the ServeRAID Manager program from the startable *IBM ServeRAID Support* CD, you are using startable-CD mode. Startable-CD mode lets you configure your controller *before* you install your operating system. After you have configured the controller and installed the operating system, you also can use startable-CD mode to change specific controller settings. For additional information, see "Fine-tuning your configuration" on page 45.

To run the ServeRAID Manager program in startable-CD mode, turn on the server; then, insert the *IBM ServeRAID Support* CD (or the CD that contains the ServeRAID Manager program that came with your server) into the CD-ROM drive.

If the ServeRAID Manager program detects unconfigured controllers and ready drives, the program automatically starts the Configuration wizard, and a window similar to the one shown in Figure 15 opens.

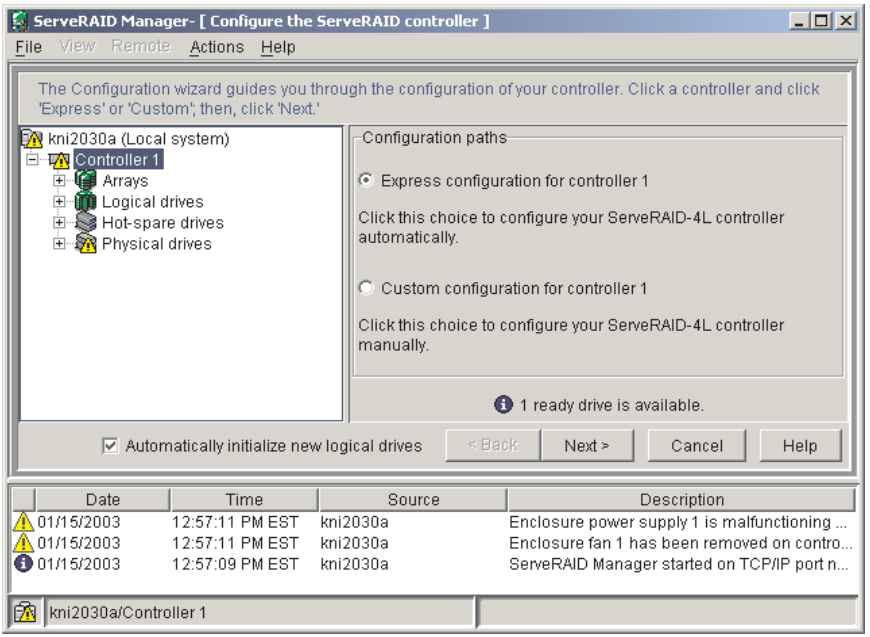


Figure 15. "Configuration wizard" window

You can use the Configuration wizard to create up to eight arrays and up to eight logical drives for each ServeRAID controller. The Configuration wizard provides two configuration options: Express and Custom. Express configuration automatically configures your ServeRAID controller. You can use Custom configuration to configure your controller manually. If you want to use RAID level-1E, level-5E, level-5EE, or level-x0, you must use Custom configuration. For more information about RAID levels, see "RAID technology overview" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD.

Using Express configuration

Express configuration automatically configures your ServeRAID controller. This feature:

- Creates arrays by grouping together same-sized physical drives.
- Creates one logical drive per array.
- Assigns a RAID level based on the number of physical drives in an array:
  - An array with a single physical drive is assigned RAID level-0.
  - An array with two physical drives is assigned RAID level-1.
  - An array with three or more physical drives is assigned RAID level-5.

- Designates a hot-spare drive for the controller. If one or more arrays have four or more physical drives, the largest-sized drive from those arrays is designated the hot-spare drive.

Complete the following steps to use Express configuration:

1. In the ServeRAID Manager tree, click the ServeRAID controller that you want to configure.
2. Click **Express configuration**.
3. Click **Next**. The "Configuration summary" window opens.
4. Review the information that is displayed in the "Configuration summary" window. To change the configuration, click **Modify arrays** or **Modify logical drives**.

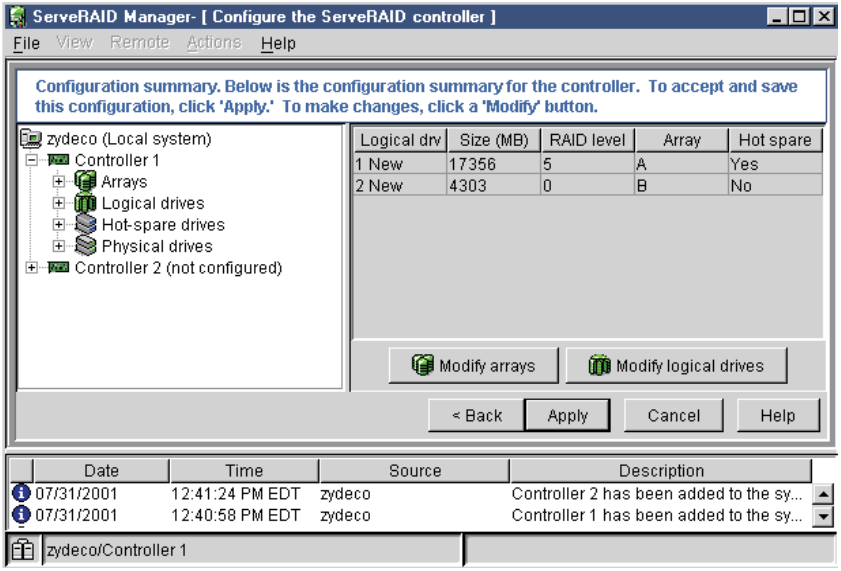


Figure 16. "Configuration summary" window (Express configuration)

Note: Some operating systems have size limitations for logical drives. Before you save the configuration, verify that the size of the logical drive is appropriate for your operating system.

5. Click **Apply**; then, click **Yes** when asked if you want to apply the new configuration. The configuration is saved in the ServeRAID controller and in the physical drives.
6. If you have multiple controllers, perform the following steps:
   a. Click the ServeRAID controller that you want to configure.
   b. From the toolbar, click  (`Configure RAID`).

c. Repeat step 2 through step 6 for each controller.

7. When you have completed configuring your controllers, you can change certain controller settings. See "Fine-tuning your configuration" on page 45 for more information. If you do not want to change any settings, exit from the ServeRAID Manager program, and remove the CD from the CD-ROM drive.
8. Restart the server.
9. Continue with "Installing ServeRAID device drivers" on page 47.

   Note: If you are configuring your startup (boot) ServeRAID controller, you *must* install the device driver while installing the operating system.

Using Custom configuration

Select Custom configuration to configure your controller manually. Complete the following steps to use Custom configuration:

1. In the ServeRAID Manager tree, click the ServeRAID controller that you want to configure.
2. Click **Custom configuration**.
3. Click **Next**. The "Create arrays" window opens. If you want to create spanned arrays, go to step 2 of "Creating spanned arrays" on page 44.

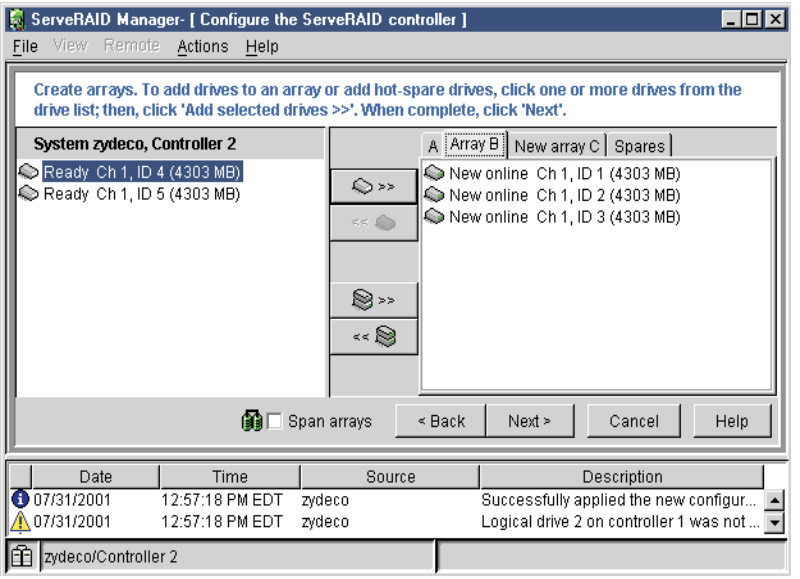


Figure 17. "Create arrays" window

4. Click the appropriate tab in the right pane; then, from the list of ready drives, select the drives that you want to move to the array.

5. Click >> (Add selected drives) to add the drives to the array. You can click >> (Add all drives) to move all ready drives to an array.
6. Repeat steps 4 and 5 for each additional array or hot-spare drive that you want to configure.
7. After you select the ready drives for your arrays and hot-spare drive, click **Next**. The "Create logical drives" window opens.

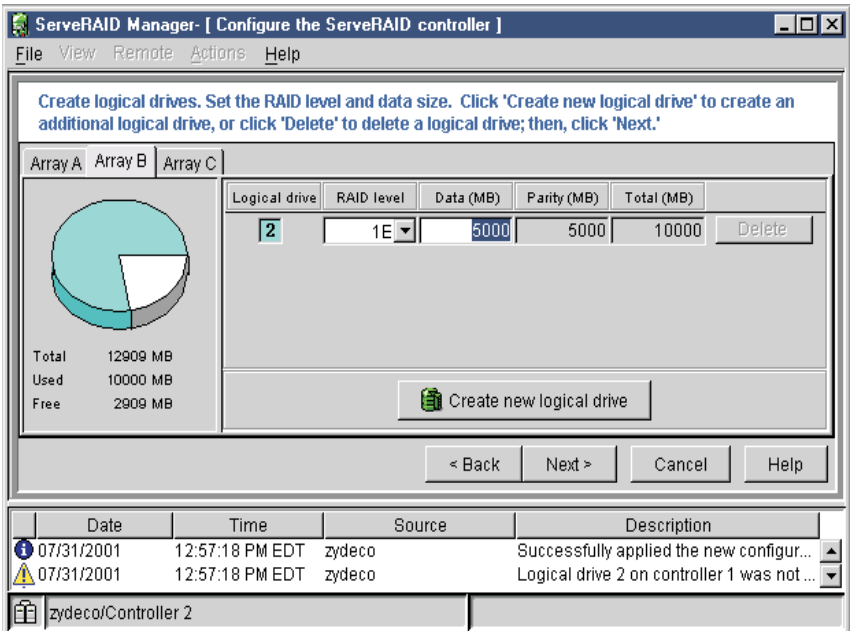


Figure 18. "Create logical drives" window

8. Click the appropriate **Array** tab.
9. Select a RAID level from the drop-down list. (For more information, see "RAID technology overview" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD.)

   Notes:

   a. RAID level-5E allows only one logical drive per array.

   b. If you are configuring a spanned array, you can set the RAID level only for the first logical drive you create.

10. If you do not want to use the maximum size for the logical drive, type the size in the **Data (MB)** field.

Notes:

a. You can define up to eight logical drives per controller. There are two exceptions:
   - If an array contains a logical drive assigned RAID level-5E
   - If you want to use the logical-drive migration feature

   In these cases, one logical drive slot must be left free; therefore, you cannot define more than seven logical drives.

b. Some operating systems have size limitations for logical drives. Before you save the configuration, verify that the size of the logical drive is appropriate for your operating system. For more detailed information, see your operating-system documentation.

c. A logical drive cannot exceed 2048 GB; the minimum size is 5 MB.

d. Typically, the first logical drive defined on the first ServeRAID controller found by system BIOS during startup will be your startup (boot) drive.

11. If you have free space available and want to create additional logical drives, click **Create new logical drive**.

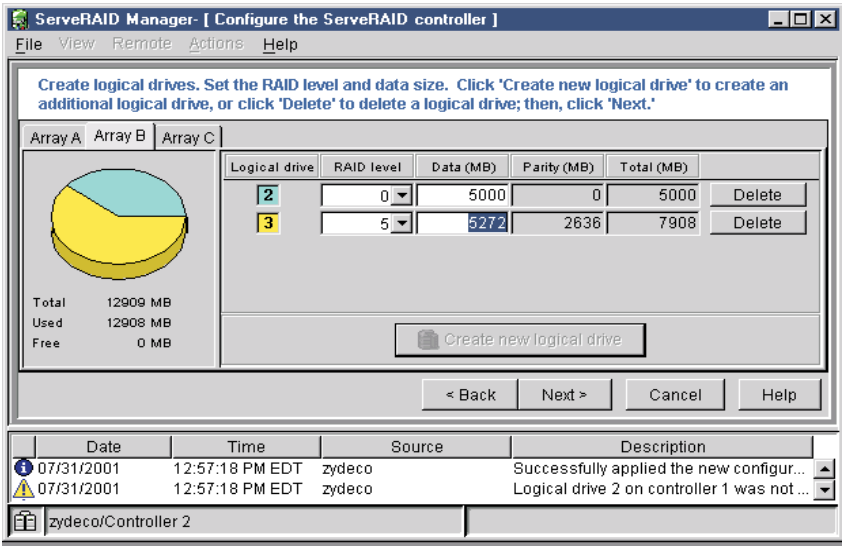


Figure 19. "Adding another logical drive" window

12. Repeat steps 9 through 11 for each logical drive that you want to define in this array.

13. Repeat step 3 on page 40 through step 12 for each additional array that you want to configure.
14. Click **Next**. The "Configuration summary" window opens.

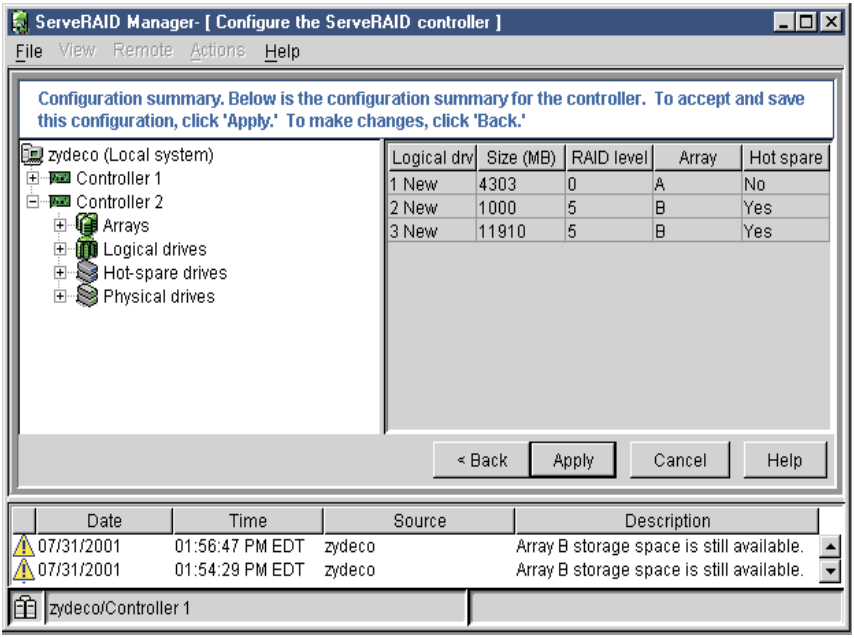


Figure 20. "Configuration summary" window (Custom configuration)

15. Review the information that is displayed in the "Configuration summary" window. To change the configuration, click **Back**.
16. Click **Apply**; then, click **Yes** when asked if you want to apply the new configuration. The configuration is saved in the ServeRAID controller and in the physical drives.
17. If you have multiple controllers, perform the following steps:
    a. Click the ServeRAID controller that you want to configure.
    b. From the toolbar, click (`Configure RAID`).
    c. Repeat step 2 on page 40 through step 17b for each controller.
18. When you have completed configuring your controllers, you can change certain controller settings. See "Fine-tuning your configuration" on page 45 for more information. If you do not want to change any settings, exit from the ServeRAID Manager program, and remove the CD from the CD-ROM drive.
19. Restart the server.
20. Continue with "Installing ServeRAID device drivers" on page 47.

Note: If you are configuring your startup (boot) ServeRAID controller, you *must* install the device driver while installing the operating system.

Creating spanned arrays

If you want to assign RAID level-x0 to an array, you must create a spanned array. For more information about spanned arrays, see "RAID technology overview" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD.

A logical drive cannot exceed 2048 GB; the minimum size is 5 MB.

Complete the following steps to create one or more spanned arrays:

1. If you have not completed steps 1 to 3 in "Using Custom configuration" on page 40, do so now.
2. Create identical arrays by performing the following steps:
   a. Click the **Array** tab in the right panel; then, from the list of ready drives, select the drives you want to move to the array.
   b. Click  (`Add selected drives`) to add the drives to the array.
   c. Repeat steps 2a and 2b for each additional array that you want to configure.

      Note: To create a spanned array, the arrays to be spanned must be identical (that is, they must have the same number of physical drives).

   d. Select the  **Span arrays** check box; then, click **Next**. The "Create spanned arrays" window opens.

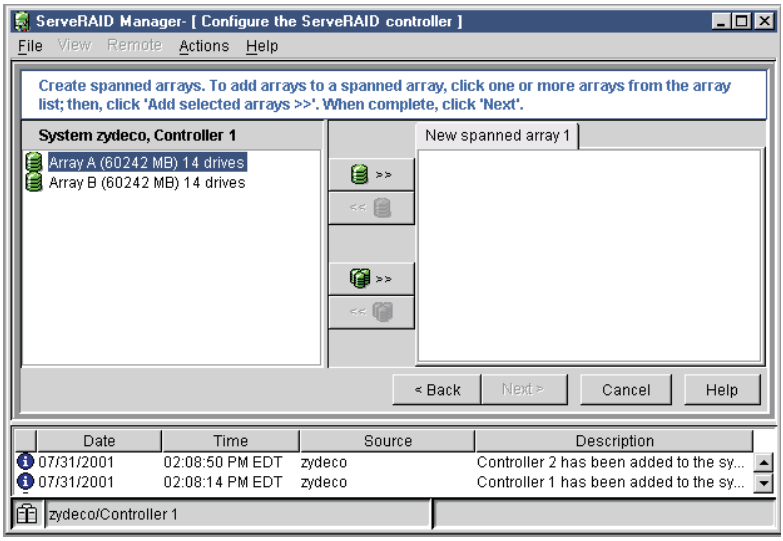


Figure 21. "Create spanned arrays" window

3. Create spanned arrays by performing the following steps:
   a. In the list of arrays, click the arrays that you want to add to your spanned array.
   b. Click >> (Add selected arrays) to add the arrays to the spanned array. You can click >> (Add all arrays) to move *all* arrays to the spanned array.
   c. To create additional spanned arrays, click the **New spanned array** tab in the right pane; then, repeat steps 3a and 3b.
4. Click **Next**; the "Create logical drives" window opens. Continue with step 8 of "Using Custom configuration" on page 40.

Fine-tuning your configuration

Before you store data on the controller, you might need to change the stripe-unit size and write-cache mode.

Changing the stripe-unit size

The new controller stripe-unit size is set at the factory to 8 KB. If you need to change this setting, you *must* change the stripe-unit size before you store data in the logical drives. After you store data in the logical drives, you cannot change the stripe-unit size without destroying the data.

Complete the following steps to change the stripe-unit size:

1. In the ServeRAID Manager tree, click the new controller to select it.
2. Click **Actions → Change stripe-unit size**.
3. Select the new stripe-unit size for your installation.

   Note: Consider your server application environment when you select the controller stripe-unit size setting.

Environment	Stripe-unit size
Groupware (such as Lotus® Notes® or Exchange)	16 KB
Transaction processing database	16 KB
Decision support database	16 KB
Thin client environments	8 KB
File server (Windows 2000, Windows NT 4.0, Windows Server 2003, Novell NetWare)	16 KB
File server (Windows 2000, Windows NT 4.0, Novell NetWare)	8 KB
File server (other)	8 KB
Web server	8 KB
Other	16 KB

Setting the write-cache mode

Set the write-cache mode according to the planned use of each logical drive. For logical drives where read and write performance is important and data can be recovered, set the write-cache mode to write-back. For logical drives where read and write performance is less important but data integrity is a high priority, set the write-cache mode to write-through.

Important: To eliminate data loss, be sure that your controller has battery-backed cache, and set the write-cache mode to write-back.

Notes:

1. If communication with the controller is lost during a read or write operation that involves a logical drive in write-back mode, you might lose some of the data, unless your controller has battery-backed cache.

2. If you plan to use the logical drive as the installation drive for the Novell NetWare 5.x operating system, you must set the write-cache mode to write-through.

To change the write-cache mode on a logical drive, complete the following steps:

1. In the ServeRAID Manager tree, click the logical drive.
2. Click **Actions → Change write-cache mode to write through** (or **Change write-cache mode to write back**).

Installing ServeRAID device drivers

The ServeRAID device drivers are provided on the *IBM ServeRAID Support* CD. The *IBM ServeRAID Device Driver Installation Instructions* (DEVDRV.PDF), located in the BOOKS directory on the *IBM ServeRAID Support* CD, provides detailed instructions for installing the device drivers on the following operating systems:

- Caldera OpenLinux (versions 3.1 and 3.1.1)
- IBM OS/2 WARP® Server for e-business
- Microsoft Windows 2000 Server and Advanced Server
- Microsoft Windows 2000 Professional (ServeRAID-6i, ServeRAID-5i, and ServeRAID-4Lx controllers only)
- Microsoft Windows Server 2003 Standard Edition and Enterprise Edition
- Microsoft Windows Server 2003 Enterprise Edition 64-bit (ServeRAID-4Mx and ServeRAID-6M controllers only)
- Microsoft Windows NT Server 4.0 and Enterprise Edition 4.0
- Microsoft Windows NT 4.0 Workstation (ServeRAID-6i, ServeRAID-5i, and ServeRAID-4Lx controllers only)
- Microsoft Windows XP Professional (ServeRAID-6i, ServeRAID-5i, and ServeRAID-4Lx controllers only)
- Novell NetWare (versions 5.1 and 6.0)
- Red Hat Advanced Server 2.1
- Red Hat Linux (versions 7.3, 8.0, and 9.0)
- SCO OpenServer 5.0.6a and 5.0.7
- SCO Open UNIX 8.0
- SCO UnixWare (versions 7.1.1 and 7.1.3)
- SCO UnitedLinux 4.0
- SuSE Linux Professional (versions 8.0 and 8.1)
- SuSE Linux Enterprise Server 8
- SuSE Linux Enterprise Server 8 64-bit (ServeRAID-4Mx and ServeRAID-6M controllers only)
- Turbolinux (versions 6.5 and 7.0)
- Turbolinux Enterprise Server 8

Note: The *IBM ServeRAID Support* CD includes device drivers for earlier versions of most supported operating systems. These drivers are provided for backward compatibility only. To use the latest drivers, always upgrade to a supported version of your operating system before installing the ServeRAID software. For a complete list of device drivers provided for backward compatibility, see the *IBM ServeRAID Device Driver Installation Instructions*.

If you are configuring your startup (boot) ServeRAID controller, you *must* install the device driver while installing the operating system.

If you are installing files for a RAID controller that comes as a standard feature on your IBM server system board, use the installation instructions and CDs provided with your server.

Installing and starting the ServeRAID Manager program

After installing the operating system and device drivers on your server, you can install the ServeRAID Manager program. The ServeRAID Manager program provides a graphical interface that you can use while your server is running. You can use the interface to perform the following tasks:

- Monitor ServeRAID configuration changes
- Perform configuration functions, including create an array, delete an array, create a logical drive, change the RAID level, dynamically increase the logical drive size, rebuild an array, configure ServeRAID controllers for failover, and configure a cluster

  Note: ServeRAID Manager does not support all of these functions for the integrated RAID controller that is a standard feature in some IBM xSeries servers.

For information about using the ServeRAID Manager program, see the ServeRAID Manager online help or "Configuring the ServeRAID controller" on page 36.

Installing the ServeRAID Manager program

This section provides instructions for installing the ServeRAID Manager program.

When using:	Go to:
Windows XP	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95" on page 50.

When using:	Go to:
Windows 2000	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95" on page 50.
Windows NT 4.0	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95" on page 50.
Windows Me	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95" on page 50.
Windows 98	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95" on page 50.
Windows 95	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95".
Windows Server 2003	"Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95".
NetWare	"Installing ServeRAID Manager on NetWare" on page 51.
Linux	"Installing ServeRAID Manager on Red Hat Linux, SuSE Linux, Caldera OpenLinux, Turbolinux, or SCO UnitedLinux" on page 51.
OS/2	"Installing ServeRAID Manager on OS/2" on page 52.
OpenServer	"Installing ServeRAID Manager on OpenServer" on page 53.
UnixWare	"Installing ServeRAID Manager on UnixWare or Open UNIX" on page 54.
Open UNIX	"Installing ServeRAID Manager on UnixWare or Open UNIX" on page 54

If you are installing ServeRAID Manager on an IBM xSeries server that contains an integrated RAID controller, see the documentation provided with your server for a list of supported operating systems.

Installing ServeRAID Manager on Windows XP, Windows 2000, Windows Server 2003, Windows NT 4.0, Windows Me, Windows 98, or Windows 95

Notes:

1. When installed on Windows XP Professional, Windows 2000, Windows NT 4.0, or Windows Server 2003, this version of the ServeRAID Manager program supports up to 16 ServeRAID controllers.

2. When installed on Windows Millennium Edition (Me), Windows 98, and Windows 95, the ServeRAID Manager program works *only* as a console. You can use the console to connect to remote servers that contain ServeRAID controllers. Servers installed with Windows Me, Windows 98, or Windows 95 as the operating system *do not* support ServeRAID controllers.

3. If a previous version of the ServeRAID Manager program is installed on your server, you must remove that version before upgrading to the new version. All customization files (such as the Managed tree system nodes and the Notification list) are saved and used in the upgrade. To remove the ServeRAID Manager program from the Windows operating system on your server, use the Add/Remove Programs wizard.

Complete the following steps to install the ServeRAID Manager program on the Windows XP, Windows 2000, Windows NT 4.0, Windows Server 2003, Windows Me, Windows 98, or Windows 95 operating system:

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. When the installation program starts, follow the instructions on the screen to install the program.

   Note: If you are installing ServeRAID Manager on an IBM server that supports Active PCI under Windows NT 4.0, the installation program installs the ServeRAID Active PCI DMI component automatically. This feature also requires that you install the DMI Service provider and the IBM Hot Plug for Windows NT 4.0 Package, version 4.2 or later. For more information, see "Using a ServeRAID controller in a server with Active PCI features" on page 17.

Installing ServeRAID Manager on NetWare

Note: The NetWare version of the ServeRAID Manager program supports up to 16 ServeRAID controllers.

Important

Before you install the ServeRAID Manager program, complete the following tasks:

- Install the latest Support Pack before installing the Java™ Virtual Machine (JVM) for Novell NetWare. You can download the latest Support Pack from the Novell Web site at http://www.novell.com/download/.
- Check that your JVM for Novell NetWare is version 1.3 or later. Versions older than 1.3 are not compatible with the ServeRAID Manager program. To check your JVM version, load Java and type the following command at the NetWare command prompt:

  ```
  JAVA -VERSION
  ```

  You can download the latest JVM for Novell NetWare from the Novell Web site at http://www.novell.com/download/.

Complete the following steps to install the ServeRAID Manager program on Novell NetWare:

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. From the command-line prompt, type the following command and press Enter:

   ```
   load cdrom
   ```

3. From the command-line prompt, type the following command and press Enter:

   ```
   serveraid:\netware\manager\install
   ```

   The installation program starts.
4. Follow the instructions on the screen to install ServeRAID Manager.

Installing ServeRAID Manager on Red Hat Linux, SuSE Linux, Caldera OpenLinux, Turbolinux, or SCO UnitedLinux

Notes:

1. The ServeRAID Manager program comes with the IBM Java Runtime Environment (JRE).
2. If the ServeRAID Manager program has previously been installed on your server, you must remove that version before upgrading. All customization files (such as Managed system tree nodes and the Notification list) are saved

and used in the upgrade. To remove the ServeRAID Manager program from Linux, type the following command:

```
rpm --erase RaidMan
```

3. When installed on Linux, this version of the ServeRAID Manager program supports up to 12 ServeRAID controllers.

Complete the following steps to install the ServeRAID Manager program on Red Hat Linux, SuSE Linux, Caldera Open Linux, Turbolinux, or SCO UnitedLinux:

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. If your CD-ROM drive automounts, type the following command and go to step 6. Otherwise, go to step 3.

   ```
   rpm --install /mnt/cdrom/linux/manager/RaidMan-v.rr.i386.rpm
   ```

   where *v* is the ServeRAID version number, and *rr* is the ServeRAID release number.
3. If your CD-ROM drive does *not* automount, type the following command and press Enter:

   ```
   mount -r -t iso9660 /dev/cdromdevicefile /mountpoint
   ```

   where *cdromdevicefile* is the specific device file for the CD-ROM block device, and *mountpoint* is the mount point of the CD filesystem.
4. Type the following command and press Enter:

   ```
   rpm --install /mountpoint/linux/manager/RaidMan-v.rr.i386.rpm
   ```

   where *mountpoint* is the mount point used in step 3, *v* is the ServeRAID version number, and *rr* is the ServeRAID release number.
5. When the installation is complete, type the following command:

   ```
   umount /mountpoint
   ```

   where *mountpoint* is the mount point of the Linux system.
6. Press Enter. You can now remove the CD from the CD-ROM drive.

Installing ServeRAID Manager on OS/2

Note: When installed on OS/2, this version of the ServeRAID Manager program supports up to 12 ServeRAID controllers.

Complete the following steps to install the ServeRAID Manager program on OS/2:

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. Open an OS/2 command window.
3. Type the following command and press Enter:

   ```
   e:
   ```

where e is the CD-ROM drive letter.

4. Type the following command and press Enter:

   ```
   cd \os2\manager
   ```

5. Type the following command and press Enter:

   ```
   install
   ```

6. The installation program starts. Follow the instructions on the screen. On the final installation panel, specify the location where you want to install the ServeRAID Manager program.

Installing ServeRAID Manager on OpenServer

Notes:

1. When installed on OpenServer, this version of the ServeRAID Manager program supports up to 12 ServeRAID controllers.

2. To install or remove the ServeRAID Manager package, you *must* have root privileges.

3. If ServeRAID Manager is installed on your system, you must remove the old version before upgrading. All customization files (such as Managed system tree nodes and the Notification list) are saved and used in the upgrade. To remove the ServeRAID Manager program from OpenServer, type the following command:

   ```
   pkgrm RaidMan
   ```

Complete the following steps to install the ServeRAID Manager program on OpenServer:

Note: The ServeRAID Manager program requires that you install either the Java Development Kit (JDK) for SCO operating systems, versions 1.1.7b or 1.1.3u, or the Java Runtime Environment (JRE) for SCO operating systems, version 1.1.8. You can download the JDK and JRE from the Caldera Web site at http://www.caldera.com/download/.

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. Type the following command and press Enter:

   ```
   mount -r -f HS,lower /dev/cd0 /mnt
   ```

3. Type the following command and press Enter:

   ```
   cd /mnt/openserv/manager
   ```

4. Type the following command and press Enter:

   ```
   ./mgr_inst
   ```

5. When the installation is complete, type the following command and press Enter:

   ```
   cd /
   ```

6. Unmount the CD-ROM drive. Type the following command and press Enter:

   ```
   umount /mnt
   ```

   You can now remove the CD from the CD-ROM drive.

Installing ServeRAID Manager on UnixWare or Open UNIX

Notes:

1. The ServeRAID Manager program requires that you install either the JDK for SCO operating systems, versions 1.1.7b or 1.1.3u, or the JRE for Caldera UNIX operating systems, version 1.3.0. You can download the JDK and JRE from the Caldera Web site at http://www.caldera.com/download/.

2. To install or remove the ServeRAID Manager package, you *must* have root privileges.

3. If the ServeRAID Manager program has previously been installed on your server, you must remove that version before upgrading. All customization files (such as Managed system tree nodes and the Notification list) are saved and used in the upgrade. To remove the ServeRAID Manager program from UnixWare or Open UNIX, type the following command:

   ```
   pkgrm RaidMan
   ```

4. When installed on UnixWare or Open UNIX, the current version of the ServeRAID Manager program supports up to 12 ServeRAID controllers.

Complete the following steps to install the ServeRAID Manager program for UnixWare or Open UNIX:

1. Insert the *IBM ServeRAID Support* CD into the CD-ROM drive.
2. Type the following command and press Enter:

   ```
   mount -r -F cdfs /dev/cdrom/cdromdevicefile /mnt
   ```

   where `cdromdevicefile` is the specific device file for the CD-ROM block device. Look in the /dev/cdrom directory to determine what *cdromdevicefile* is on your server, for example, c0b0t010.

3. Type the following command and press Enter:

   ```
   cd /mnt/openunix/manager
   ```

4. Type the following command and press Enter:

   ```
   ./mgr_inst
   ```

5. When the installation is complete, type the following command and press Enter:

   ```
   cd /
   ```

6. Unmount the CD-ROM drive. Type the following command and press Enter:

   ```
   umount /mnt
   ```

   You can now remove the CD from the CD-ROM drive.

Starting the ServeRAID Manager program

After you have configured your ServeRAID controller, installed the device drivers, installed the operating system, and installed the ServeRAID Manager program on your server, you can administer and monitor your ServeRAID controllers, as well as modify the ServeRAID controller configuration.

Starting the ServeRAID Manager program in Windows XP, Windows 2000, Windows NT 4.0, Windows Server 2003, Windows Me, Windows 98, or Windows 95

To start the ServeRAID Manager program in the Windows XP, Windows 2000, Windows NT, Windows Server 2003, Windows Me, Windows 98, or Windows 95 operating system, click **Start → Programs → ServeRAID Manager → ServeRAID Manager**. The ServeRAID Manager program opens, and a window similar to the one in the following illustration appears.

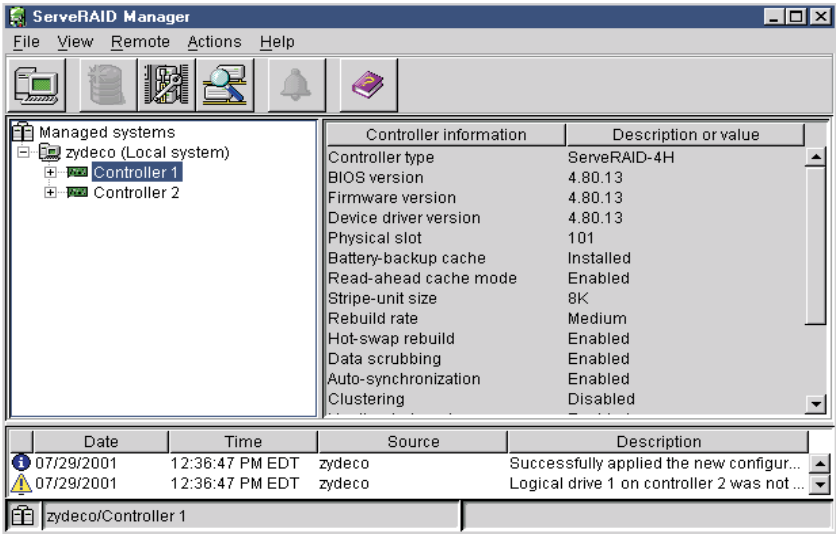


Figure 22. ServeRAID Manager window

Starting the ServeRAID Manager program in NetWare

To start the ServeRAID Manager program in NetWare, type the following command from the NetWare console and press Enter:

```
LOAD RAIDMAN
```

The ServeRAID Manager program opens, and a window similar to the one shown in Figure 22 appears.

Starting the ServeRAID Manager program in OS/2

To start the ServeRAID Manager program from the OS/2 desktop, double-click the **ServeRAID Manager** icon.

To start the ServeRAID Manager program from an OS/2 command line, complete the following steps:

1. Change to the directory where you installed the ServeRAID Manager program. Type the following command and press Enter:

   ```
   cd \RaidMan
   ```

2. Type the following command and press Enter:

   ```
   RaidMan
   ```

   The ServeRAID Manager program opens, and a window similar to the one shown in Figure 22 appears.

Starting the ServeRAID Manager program in OpenServer, UnixWare, Open UNIX, and Linux

Complete the following steps to start the ServeRAID Manager program in OpenServer, UnixWare, Open UNIX, or Linux:

Note: Ensure that you have superuser privileges before starting these procedures.

1. To change to the directory where you installed the ServeRAID Manager program, type one of the following commands:

For OpenServer	`cd /opt/RaidMan`
For UnixWare and Open UNIX	`cd /opt/RaidMan`
For Linux	`cd /usr/RaidMan`

2. Press Enter.
3. Type the following command and press Enter:

   ```
   sh RaidMan.sh
   ```

4. The ServeRAID Manager program opens, and a window similar to the one shown in Figure 22 on page 55 appears.

Note: (UnixWare and Open UNIX only) When installed on UnixWare or Open UNIX, the ServeRAID Manager program might list the installed ServeRAID controllers in a different order than the ServeRAID Manager program in startable-CD mode. To identify a specific controller, refer to its physical slot number.

Chapter 3. Solving ServeRAID problems

This section provides basic troubleshooting information to help you resolve some common problems that might occur while setting up your ServeRAID controller.

If you cannot locate and correct the problem using the information in this section, see the "Solving ServeRAID problems" chapter of the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD.

IBM ServeRAID Support CD warning message while starting

If you start a server with the *IBM ServeRAID Support* CD in the CD-ROM drive, the following warning message might display:

```
You passed an undefined mode number.
Press <RETURN> to see video modes available,
<SPACE> to continue or wait 30 secs
```

Press the Spacebar to continue starting the *IBM ServeRAID Support* CD. Then, the following message displays and the CD starts:

```
Uncompressing Linux... Ok, booting the kernel.
```

ServeRAID controller messages

This section lists the ServeRAID messages that might appear during system startup.

The ServeRAID controllers provide a device event log that collects statistics on the number and types of events that occur on a selected physical drive. After correcting a problem with the disk array, clear the log so that you can identify any subsequent errors quickly.

All physical drives contain unique identifiers, such as the drive serial number and manufacturer. During configuration, the ServeRAID controller stores this information.

The following table lists messages associated with the ServeRAID subsystem in alphabetical order.

Message	Explanation and possible recovery actions
A new drive was installed.	**Explanation:** When the ServeRAID controller detects a new drive that is not part of the current configuration, the following message appears: *x* `new Ready drives found` where *x* is the number of Ready drives found. **Action:** This is an information message. No action is required.
Auto rearrange.	**Explanation:** Auto rearrange is enabled or disabled. **Action:** This is an information message. No action is required.
Battery-backup cache not responding	**Explanation:** BIOS code detected a bad or failed battery-backup cache. **Action:** Press F9 to remove the battery-backup cache from the configuration, or press F10 to exit without change.
Battery-backup cache replacement	**Explanation:** The ServeRAID controller detects that the battery-backup cache is defective. **Action:** If the battery-backup cache must be replaced, contact your IBM service representative. Press F8 if you replaced the battery-backup cache, or press F10 if you have not replaced the battery-backup cache.

Configured drives are missing.	**Explanation:** When the ServeRAID controller detects that a previously configured drive is missing, the following message appears:
	
	x `Online drives not responding or found at new location(s)`
	
	where *x* is the number of drives not responding.
	
	After pressing F2, a more detailed message appears:
	
	`Online Drive on Channel` *x* `SCSI`
	`ID` *y* `is not responding.`
	
	where *x* is the channel ID and *y* is the SCSI ID.
	
	Action: Press one of the following keys:
	F2 Detailed description. Press this key for a detailed description of the problem, such as the example message above.
	F4 Retry. Press this key after correcting a problem. For example, press F4 after you turn on the external storage enclosure that contains the physical drive.

Message	Explanation and possible recovery actions
Configured drives are missing (Continued).	**F5** Change the configuration and set the drives to defunct. Press this key to accept the new state that the ServeRAID controller will assign to the drive. For example, the ServeRAID controller will assign the drive a state of defunct or empty. You can also press F5 when you must remove a drive. RAID level-1 and RAID level-5 logical drives are present, and performance in a degraded mode is acceptable. The ServeRAID controller will assign the drive a state of defunct, but the server can complete startup. However, the array will remain in critical mode and the potential for data loss will exist until you replace and rebuild the defunct drive. To prevent the loss of data, replace and rebuild the defunct drive in a timely manner. **Note:** A physical drive in the defunct state does not necessarily mean that you need to replace the drive. Before you replace the drive, ensure that: 1. All cables are connected properly to the backplane and to the physical drive. Also, ensure that all cables inside the server are connected properly. 2. The hot-swap drive trays are seated properly in the drive bay. 3. If multiple drives fail in separate arrays (one physical drive per array), replace each of the defunct physical drives. If multiple physical drives fail at the same time within the same array, contact your IBM service representative. See "Rebuilding a defunct drive" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information. After you perform these steps, if the physical drive does not function properly, replace the drive. **F10** Continue starting without changing the configuration. Press this key to continue without change to the configuration.

Message	Explanation and possible recovery actions

Configured drives are not in the configured location.	**Explanation:** When the ServeRAID controller detects that a previously configured drive is present, but the drive is in a new location, the following message appears:
	`x Online drive has been rearranged`
	where *x* is the number of drives that have been rearranged.
	After pressing F2, a more detailed message appears:
	`Online Drive on Channel w SCSI ID x moved to Channel y SCSI ID z`
	where *w* and *y* are the channel numbers, and *x* and *z* are the SCSI IDs.
	Action: Press one of the following keys:
	F2 Detailed description. Press this key for a detailed description of the problem, such as the example messages above.
	F4 Retry. Press this key after correcting a problem. For example, press F4 after you move the physical drive to its previously assigned location.
	F5 Change the configuration and set the drive to defunct. Press this key to accept the new state that the ServeRAID controller will assign to the drive. For example, the ServeRAID controller will assign the drive a state of defunct or empty.
	Note: A physical drive in the defunct state does not necessarily mean that you need to replace the drive. Before you replace the drive, ensure that:
	1. All cables are connected properly to the backplane and to the physical drive. Also, ensure that all cables inside the server are connected properly.
	2. The hot-swap drive trays are seated properly in the drive bay.
	3. If multiple drives fail in separate arrays (one physical drive per array), replace each of the defunct physical drives. If multiple physical drives fail at the same time within the same array, contact your IBM service representative. See "Rebuilding a defunct drive" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.
	After you perform these steps, if the physical drive does not function properly, replace the drive.

Message	Explanation and possible recovery actions
Configured drives are not in the configured location (Continued).	**F6** Change the configuration and accept the rearrangement. Press this key to change the configuration to match the current drive location. You might remove the hot-swap drives from the server for security or maintenance reasons. If you replace the drives but install them in different drive bays, you can press F6 to accept the new locations, and the ServeRAID controller will update the configuration. **F10** Continue startup without changing the configuration. Press this key to continue without change to the configuration.
Controller is not responding to commands. No logical drives are installed.	**Explanation:** The ServeRAID controller is not operational. **Action:** Have the server serviced.
Error: Cannot disable this controller BIOS.	**Explanation:** The ServeRAID controller was unable to prevent an extra copy of its BIOS code from being stored on the server. This condition occurs when the server contains multiple ServeRAID controllers. **Action:** Have the server serviced.
Installation stopped.	**Explanation:** The server cannot access the ServeRAID controller. **Action:** This is a follow-on message to a preceding message. Follow the Action instructions for the preceding message to resolve the problem.

New controller installed in a configured server or drives are imported.	**Explanation:** When the ServeRAID controller detects that the identifiers of the drives do not match the controller configuration information, the following message appears:
	
	`x Online drive(s) found with incorrect configuration`
	
	where *x* is the number of drives found with incorrect configuration.
	
	After pressing F2, a more detailed message appears:
	
	`Configuration mismatch Channel x with Host ID y`
	
	where *x* is the channel number, and *y* is the Host ID.
	
	Action: Press one of the following keys:
	F2 Detailed description. Press this key for a detailed description of the problem, such as the example message above.
	F4 Retry. Press this key after correcting a problem. For example, press F4 after you turn on the external storage enclosure that contains the physical drive.

Message	Explanation and possible recovery actions
New controller installed in a configured server or drives are imported (Continued).	**F5** Change the configuration and set the drives to defunct. Press this key to accept the new state that the ServeRAID controller will assign to the drive. For example, the ServeRAID controller will assign the drive a state of defunct or empty. You can also press F5 when you must remove a drive. RAID level-1 and RAID level-5 logical drives are present, and performance in a degraded mode is acceptable. The ServeRAID controller will assign the drive a state of defunct, but the server can complete startup. However, the array will remain in Critical mode and the potential for data loss will exist until you replace and rebuild the defunct drive. To prevent the loss of data, replace and rebuild the defunct drive in a timely manner. **Note:** A physical drive in the defunct state does not necessarily mean that you need to replace the drive. Before you replace the drive, ensure that: 1. All cables are connected properly to the backplane and to the physical drive. Also, ensure that all cables inside the server are connected properly. 2. The hot-swap drive trays are seated properly in the drive bay. 3. If multiple drives fail in separate arrays (one physical drive per array), replace each of the defunct physical drives. If multiple physical drives fail at the same time within the same array, contact your IBM service representative. See "Rebuilding a defunct drive" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information. After you perform these steps, if the physical drive does not function properly, replace the drive.

Message	Explanation and possible recovery actions
New controller installed in a configured server or drives are imported (Continued).	**F7** Import configuration information from drive. Press this key to restart the server. Press this key to import the configuration information from the drive and to update the configuration information for the ServeRAID controller. This choice is useful when you replace the ServeRAID controller in an existing ServeRAID subsystem. You also might press F7 if you replace a whole set of drives with drives that were configured in another server with a ServeRAID controller. **Note:** When you install drives in a server that has no logical drives defined, the F7 choice will not appear. The ServeRAID controller does not contain any logical drives in its factory configuration. Therefore, F7 will not appear. In this case, perform the following steps: 1. Restart the server and press Ctrl+I to start the Mini-Configuration program. (See "Using the Mini-Configuration program" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.) 2. Select **Advanced Functions.** 3. Select **Copy the Configuration from Drives to the Controller** and follow the instructions on the screen.
Recoverable configuration error	**Explanation:** The configuration data stored in non-volatile random-access memory (NVRAM) does not match the configuration data stored in the electrically erasable programmable read-only memory (EEPROM). **Action:** 1. Press Ctrl+I to access the ServeRAID Mini-Configuration menu. (See "Using the Mini-Configuration program" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.) 2. Select **Advanced Functions** from the Main Menu. 3. Select **Copy the Configuration from Drives to the Controller**. (See "Using the advanced configuration functions" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.)

Message	Explanation and possible recovery actions
Unrecoverable configuration error	**Explanation:** The configuration data stored in NVRAM does not match the configuration data stored in the EEPROM. **Action:** 1. Press Ctrl+I to access the ServeRAID Mini-Configuration menu. (See "Using the Mini-Configuration program" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.) 2. Select **Advanced Functions** from the Main Menu. **Attention:** Restoring to factory default settings sets all online drives in an array to ready. You must import the configuration from the drives or diskette. Otherwise, you must create a new array and logical drives. When you create new logical drives, they are automatically initialized. All data is lost and you must re-install the operating system and data. 3. Select **Restore to the Factory Default Settings**. (See "Using the advanced configuration functions" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.)
WARNING: **n** logical drives are critical; **n** logical drives are offline.	**Explanation:** One or more physical drives have failed. **Action:** Replace the defunct drives as soon as possible to prevent data loss.
Your server has an error due to a blocked logical drive.	**Explanation:** One or more logical drives are blocked. A blocked logical drive cannot be accessed. (See "Logical drive-state descriptions" in the *IBM ServeRAID User's Reference* on the *IBM ServeRAID Support* CD for more information.) **Action:** Press F4 to unblock the logical drive, or press F5 to continue without unblocking.
Unsupported mix of disk and tape.	**Explanation:** A tape drive connected to the SCSI controller channel is also used for disk drives. This configuration is not supported. **Action:** Remove the tape drive from the SCSI channel. Then, install the tape drive on another channel.

ServeRAID startup (POST) messages

During power-on self-test (POST), the ServeRAID controller compares the stored configuration information to the configuration that is actually present. If a discrepancy exists, one or more status messages appear after POST completes, but before the operating system starts.

```
                IBM ServeRAID BIOS
              Copyright IBM Corp. 1995, 2001
                BIOS Version: 5.10.x

Controller 1 Slot 4, Logical Drive=1, Firmware=4.00.20, Status= Fail
2 Drives(s) not responding or found at new location(s)

Press: F2 - Detailed information
       F4 - Retry
       F5 - Change the configuration and set drive(s) defunct
       F10 - Continue booting without changing the configuration
```

When you press F2 for detailed information, the following register information appears on the screen:

```
                          Detailed information
------------------------------------------------------------------------
   Online Drive on Channel 2 SCSI ID 0 is not responding
   Online Drive on Channel 2 SCSI ID 1 is not responding
------------------------------------------------------------------------
         Controller Status Codes: ISPR = EF10  BCS = 07  ECS = 08

      Press PgUp = Page Up    PgDn = Page Down    Esc = Exit panel
```

The controller status codes include the interrupt status port register (ISPR) code, the basic configuration status (BCS) register code, and the extended configuration status (ECS) register code.

If no errors occur during POST, the following register information is displayed: ISPR = EF10, BCS = 0F or 09, and ECS = 00

If an error occurs, see “ISPR codes” for the ISPR error codes and “BCS and ECS register codes” on page 69 for the BCS and ECS error codes.

ServeRAID ISPR, BCS, and ECS POST error codes

Notes:

1. When the ServeRAID controller requires your input, a list of function keys will appear below the message.

2. Where the Action information tells you to start the IBM ServeRAID configuration program, insert the *IBM ServeRAID Support* CD into the CD-ROM drive; then, restart the server. The Action column also provides general information about the message.

3. Where `sid` or `ch` appears in these messages, `sid` is the SCSI ID for the device, and `ch` is the channel to which the device is attached.

4. Where `m` or `n` appears in these messages, a number will appear in the actual message.

ISPR codes

Code	Explanation	Action
1xxx to 7xxx	The POST detected an internal error.	Contact your IBM service representative.
2601 to 260B	The POST detected an error with the ServeRAID subsystem.	Contact your IBM service representative.
2610	The POST detected an error with the ServeRAID controller hardware.	Contact your IBM service representative.
2620	The POST detected that a ServeRAID configuration or hard disk error occurred.	Start the *IBM ServeRAID Support* CD and view the existing device and configuration information for your ServeRAID subsystem. If you cannot locate and correct the configuration problem or the failing device, or if the problem persists, contact your IBM service representative.
3E20H	The POST detected that the ServeRAID-5i controller is in the wrong PCI expansion slot.	Install the ServeRAID-5i controller in the correct PCI expansion slot. See the documentation that came with your server for more information.

Code	Explanation	Action
3E21H	The POST detected that the ServeRAID-5i controller or ServeRAID-6i controller did not find the integrated SCSI controller.	Make sure the ServeRAID-6i controller is in the correct PCI expansion slot. See the documentation that came with your server for more information. Otherwise, contact your IBM service representative.
3E2xH	The POST detected an error with the integrated SCSI controller: either the wrong controller was found or some other SCSI controller error ocurred.	Contact your IBM service representative.
8xxx to Bxxx	The POST detected an error with the SCSI interface.	Verify that the SCSI cables are correctly connected and the SCSI termination is set properly for each installed SCSI device. If you cannot locate and correct the SCSI problem, or if the problem persists, contact your IBM service representative.

BCS and ECS register codes

BCS	ECS	Explanation	Action
Code not in table		The ServeRAID controller is not functioning properly.	Have the server serviced.
00	**01**	Invalid flash configuration.	Start the *IBM ServeRAID Support* CD and follow the instructions that appear on the screen. If no instructions appear or if the problem persists, have the server serviced.
00	**02**	Invalid NVRAM configuration.	
00	**03**	Invalid flash and NVRAM configuration.	

BCS	ECS	Explanation	Action
01	**08**	No configuration was found in drives, or the online/rebuild drives are not responding.	To correct the problem: 1. If the controller is connected to an enclosure, verify that the enclosure is on. If the enclosure is turned off, turn on the power and press F4 to retry. 2. Verify that all the physical drives are present. If any drives are missing, replace the drives and press F4 to retry. 3. Verify that all the physical drives are connected to the controller correctly. If any drives are unconnected, connect the drives and press F4 to retry. 4. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. 5. If you have intentionally switched physical drives that are connected to this controller, press F7 to import the configuration from the drives and account for the drive rearrangement. To exit without making changes, press F10.
01	**18**	No configuration was found in drives, or the online/rebuild and hot-spare/standby hot-spare drives are not responding.	
01	**28**	No configuration was found in drives, or the online/rebuild and ready/standby drives are not responding.	
01	**38**	No configuration was found in drives, or the online/rebuild, hot-spare/standby hot-spare, and ready/standby drives are not responding.	
01	**48**	No configuration was found in drives, or the online/rebuild drives are not responding and unidentified drives were found.	

BCS	ECS	Explanation	Action
01	**58**	No configuration was found in drives, or the online/rebuild and hot-spare/standby hot-spare drives are not responding and unidentified drives were found.	To correct the problem: 1. If the controller is connected to an enclosure, verify that the enclosure is on. If the enclosure is turned off, turn on the power and press F4 to retry. 2. Verify that all the physical drives are present. If any drives are missing, replace the drives and press F4 to retry. 3. Verify that all the physical drives are connected to the controller correctly. If any drives are unconnected, connect the drives and press F4 to retry. 4. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. 5. If you have intentionally switched physical drives that are connected to this controller, press F7 to import the configuration from the drives and account for the drive rearrangement. To exit without making changes, press F10.
01	**68**	No configuration was found in drives, or the online/rebuild and ready/standby drives are not responding and unidentified drives were found.	
01	**78**	No configuration was found in drives, or the online/rebuild, hot-spare/standby hot-spare, and ready/standby drives are not responding and unidentified drives were found.	

BCS	ECS	Explanation	Action
03	**88**	A drive was imported from another server and it has a valid configuration, and the online/rebuild drives are not responding.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives that were switched and press F4 to retry. 2. To accept the new configuration from the physical drives, press F7. **Attention:** Completing this step might result in a loss of the original configuration and data on the drives. 3. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. To exit without making changes, press F10.
03	**98**	A drive was imported from another server and it has a valid configuration, and the online/rebuild and hot-spare/standby hot-spare drives are not responding.	
03	**A8**	A drive was imported from another server and it has a valid configuration, and the online/rebuild and ready/standby drives are not responding.	
03	**B8**	A drive was imported from another server and it has a valid configuration, and the online/rebuild, hot-spare/standby hot-spare, and ready/standby drives are not responding.	
03	**C8**	A drive was imported from another server and it has a valid configuration, and the online/rebuild drives are not responding and unidentified drives were found.	
03	**D8**	A drive was imported from another server and it has a valid configuration, and the online/rebuild and hot-spare/standby hot-spare drives are not responding and unidentified drives were found.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives that were switched and press F4 to retry. 2. To accept the new configuration from the physical drives, press F7. **Attention:** Completing this step might result in a loss of the original configuration and data on the drives. 3. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. To exit without making changes, press F10.
03	**E8**	A drive was imported from another server and it has a valid configuration, and the online/rebuild and ready/standby drives are not responding and unidentified drives were found.	
03	**F8**	A drive was imported from another server and it has a valid configuration, and the online/rebuild, hot-spare/standby hot-spare, and ready/standby drives are not responding and unidentified drives were found.	

BCS	ECS	Explanation	Action
07	**00**	The specified drive is not responding.	To correct the problem: 1. If the specified physical drive or drives are in an external enclosure, verify that the enclosure is turned on. If the enclosure is not turned on, turn on the power and press F4 to retry. 2. Download and install the latest version of IBM ServeRAID software. See "Obtaining ServeRAID updates" on page 17 for more information. 3. Replace the failed physical drive or drives.
07	**08**	The specified drives are not responding.	
07	**0C**	Online/rebuild drives are not responding, and a drive was found at the incorrect SCSI ID.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives and cable connections that were switched or moved; then, press F4 to retry. **Note:** Pressing F4 might not correct the problem. If you do not return the drives and cables to the previous configuration, the message might return. 2. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. 3. To modify the configuration and accept the rearrangement of the physical drives, press F6. To exit without making changes, press F10.
07	**1C**	Online/rebuild and hot-spare/standby hot-spare drives are not responding, and a drive was found at the incorrect SCSI ID.	
07	**2C**	Online/rebuild and ready/standby drives are not responding, and a drive was found at the incorrect SCSI ID.	
07	**3C**	Online/rebuild, ready/standby, and hot-spare/standby hot-spare drives are not responding, and a drive was found at the incorrect SCSI ID.	
07	**4C**	Online/rebuild drives are not responding, and a drive was found at the incorrect SCSI ID, and unidentified drives were found.	

BCS	ECS	Explanation	Action
07	**5C**	Online/rebuild and hot-spare/standby hot-spare drives are not responding, a drive was found at the incorrect SCSI ID, and unidentified drives were found.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives and cable connections that were switched or moved; then, press F4 to retry. **Note:** Pressing F4 might not correct the problem. If you do not return the drives and cables to the previous configuration, the message might return. 2. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. 3. To modify the configuration and accept the rearrangement of the physical drives, press F6. To exit without making changes, press F10.
07	**6C**	Online/rebuild and ready/standby drives are not responding, a drive was found at the incorrect SCSI ID, and unidentified drives were found.	
07	**7C**	Online/rebuild, ready/standby, and hot-spare/standby hot-spare drives are not responding, a drive was found at the incorrect SCSI ID, and unidentified drives were found.	
07	**18**	Online/rebuild and hot-spare/standby hot-spare drives are not responding.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives and cable connections that were switched or moved; then, press F4 to retry. 2. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. To exit without making changes, press F10.
07	**28**	Online/rebuild and ready/standby drives are not responding.	
07	**38**	Online/rebuild, ready/standby, and hot-spare/standby hot-spare drives are not responding.	
07	**48**	Online/rebuild drives are not responding, and unidentified drives were found.	

BCS	ECS	Explanation	Action
07	**58**	Online/rebuild and hot-spare/standby hot-spare drives are not responding, and unidentified drives were found.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives and cable connections that were switched or moved; then, press F4 to retry. 2. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. To exit without making changes, press F10.
07	**68**	Online/rebuild and ready/standby drives are not responding, and unidentified drives were found.	
07	**78**	Online/rebuild, ready/standby, and hot-spare/standby hot-spare drives are not responding, and unidentified drives were found.	
09	**00**	No error occurred.	No action is required. Press F10 to exit without making any changes.
09	**10**	Hot-spare/standby hot-spare drives are not responding.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives and cable connections that were switched or moved; then, press F4 to retry. 2. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. To exit without making changes, press F10.
09	**20**	Ready/standby drives are not responding.	
09	**30**	Hot-spare/standby hot-spare and ready/standby drives are not responding.	
0F	**00**	No error occurred.	No action is required. Press F10 to exit without making any changes.

BCS	ECS	Explanation	Action
0F	**10**	Hot-spare/standby hot-spare drives are not responding.	To correct the problem: 1. To keep the previous configuration in the controller, replace the physical drives and cable connections that were switched or moved; then, press F4 to retry. 2. If all the physical drives are present and connected correctly, one or more of the drives might be defective. Identify and replace the defective drives; then, press F5 to accept the changes. To exit without making changes, press F10.
0F	**20**	Ready/standby drives are not responding.	
0F	**30**	Hot-spare/standby hot-spare and ready/standby drives are not responding.	
1x	**xx**	Unsupported mix of disk and tape. **Note:** In **BCS** and **ECS** columns, *x* is any value.	A tape drive connected to the SCSI controller channel is also used for disk drives. This configuration is not supported. To correct the problem, remove the tape drive from the SCSI channel. Then, install the tape drive on another channel.

Recovering from problems starting the ServeRAID Manager

Problem	Explanation	Action
The ServeRAID Manager program hangs on the splash screen.	You might be using an old version of the ServeRAID device driver.	Upgrade the ServeRAID device driver to the latest version. See the *IBM ServeRAID Device Driver Installation Instructions* on the *IBM ServeRAID Support* CD for more information.
When starting the ServeRAID Manager in NetWare, the following error message is displayed: `Unable to find load file RAIDMAN`	The ServeRAID Manager program was not installed to the root directory of the SYS volume.	Reinstall the ServeRAID Manager. If the installation is completed properly, there will be a directory called RAIDMAN under the root directory of the SYS volume.
When starting the ServeRAID Manager in NetWare, the following error message is displayed: `-autounload is an invalid parameter`	You are using an old version of the Java Virtual Machine (JVM) for Novell NetWare.	Download and install the latest JVM from the Novell Web site: http://developer.novell.com/ndk/download.htm
When starting the ServeRAID Manager in NetWare, the following error message is displayed: `ERROR: Unable to find Java`	The Java Virtual Machine (JVM) for Novell NetWare is not installed on your server.	Download and install the latest JVM from the Novell Web site: http://developer.novell.com/ndk/download.htm

Problem	Explanation	Action

The ServeRAID Manager program fails to start, and the following error message is displayed:
 	
`Can't find class com.ibm.sysmgt.raidmgr .mgtGUI.Launch`
	Your TCP/IP hosts file is not configured for the local server hostname.	Configure your TCP/IP hosts file for the local server hostname.
		1. Open the /etc/hosts file.
		2. If TCP/IP networking is configured, do the following:
		a. If the hostname of the server is identified on the line starting with 127.0.0.1, remove the hostname from this line.
		b. On a new line, type the IP address of the server.
		c. Press the Tab key to the second column and type the fully qualified hostname.
		d. Press the Tab key to the third column and type the nickname for the server.
		Note: The following is an example of a completed line:
		`1.1.1.1 matrix.localdoma in matrix`
		where 1.1.1.1 is the IP address of the server and matrix is the hostname of the server.
		3. If TCP/IP networking is not configured, type the server name in the third column of the line that starts with 127.0.0.1.
		Note: The following is an example of a completed line:
		`127.0.0.1 localhost matrix`
		where matrix is the server name.
		4. Restart the server for these changes to take effect.

Chapter 4. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you. This chapter contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your xSeries or IntelliStation® system, and whom to call for service, if it is necessary.

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system.
- Go to the IBM Support Web site at http://www.ibm.com/pc/support/ to check for technical information, hints, tips, and new device drivers.
- Use an IBM discussion forum on the IBM Web site to ask questions.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the publications that are provided with your system and software. The information that comes with your system also describes the diagnostic tests that you can perform. Most xSeries and IntelliStation systems, operating systems, and programs come with information that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the information for the operating system or program.

Using the documentation

Information about your IBM xSeries or IntelliStation system and preinstalled software, if any, is available in the documentation that comes with your system. That documentation includes printed books, online books, README files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/pc/support/ and

follow the instructions. Also, you can order publications through the IBM Publications Ordering System at http://www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi.

Getting help and information from the World Wide Web

On the World Wide Web, the IBM Web site has up-to-date information about IBM xSeries and IntelliStation products, services, and support. The address for IBM xSeries information is http://www.ibm.com/eserver/xseries/. The address for IBM IntelliStation information is http://www.ibm.com/pc/intellistation/.

You can find service information for your IBM products, including supported options, at http://www.ibm.com/pc/support/. If you click **Profile** from the support page, you can create a customized support page. The support page has many sources of information and ways for you to solve problems, including:

- Diagnosing problems, using the IBM Online Assistant
- Downloading the latest device drivers and updates for your products
- Viewing Frequently Asked Questions (FAQ)
- Viewing hints and tips to help you solve problems
- Participating in IBM discussion forums
- Setting up e-mail notification of technical updates about your products

Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with xSeries servers, IntelliStation workstations, and appliances. For information about which products are supported by Support Line in your country or region, go to http://www.ibm.com/services/sl/products/.

For more information about Support Line and other IBM services, go to http://www.ibm.com/services/, or go to http://www.ibm.com/planetwide/ for support telephone numbers.

Hardware service and support

You can receive hardware service through IBM Integrated Technology Services or through your IBM reseller, if your reseller is authorized by IBM to provide warranty service. Go to http://www.ibm.com/planetwide/ for support telephone numbers.

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

Appendix A. Warranty information

This section contains information about your warranty period and the service and support that are provided by your warranty.

Warranty period

The warranty period varies by machine type and country or region.

Contact your place of purchase for warranty service information. Some IBM Machines are eligible for on-site warranty service depending on the country or region where service is performed.

Prior to on-site warranty service, you are required to go through problem determination with an IBM service specialist call center technician.

This paragraph applies only to products with a warranty period of 3 years on parts and 1 year on labor. A warranty period of 3 years on parts and 1 year on labor means that IBM will provide warranty service without charge for:

1. parts and labor during the first year of the warranty period
2. parts only, on an exchange basis, in the second and third years of the warranty period. IBM will charge you for any labor it provides in performance of the repair or replacement.

The IBM Machine Warranties Web site at http://www.ibm.com/servers/support/machine_warranties/ contains a worldwide overview of the IBM Statement of Limited Warranty for IBM Machines, a glossary of terms used in the Statement of Limited Warranty, Frequently Asked Questions (FAQ), and links to Product Support Web pages. The IBM Statement of Limited Warranty is available from this Web site in 29 languages in Portable Document Format (PDF).

Machine

- IBM ServeRAID-4H Ultra160 SCSI Controller
- IBM ServeRAID-4Mx Ultra160 SCSI Controller
- IBM ServeRAID-4Lx Ultra160 SCSI Controller
- IBM ServeRAID-5i Ultra320 SCSI Controller
- IBM ServeRAID-6M Ultra320 SCSI Controller
- IBM ServeRAID-6i Ultra320 SCSI Controller

Country or region	Warranty period	Service delivery method
Worldwide	3 years	Customer carry-in or mail-in

Problem determination

Prior to on-site warranty service, you are required to go through problem determination with an IBM service specialist call center technician. The service specialist will run diagnostic tests on the hardware and check the software.

Running diagnostics

The IBM service specialist will help you determine whether your equipment is functioning as specified. It might be necessary to isolate the failing xSeries, Netfinity®, or IntelliStation system; IBM component; or both from any active production environment to run diagnostics and perform defect-isolation programs. You are responsible for making the system, IBM component, or both available for running diagnostics and defect-isolation programs.

Checking software

The IBM service specialist will help you ensure that the correct BIOS code, firmware, device drivers, and other supporting IBM software are installed and correctly configured. It might be necessary to manually gather information about the relevant software levels or run IBM-approved utility programs to gather this information. It might be necessary to isolate the failing system from any active production environment to gather this information. You are responsible, with assistance from the service specialist, for gathering this information. The IBM Statement of Limited Warranty does not include on-site assistance with this activity.

Warranty service and support

With the original purchase of an IBM xSeries or IntelliStation system, you have access to extensive service and support. During the IBM Machine warranty period, you may call IBM or your reseller for problem-determination assistance under the terms of the IBM Statement of Limited Warranty.

The following services are available during the warranty period:

- **Problem determination** - Trained personnel are available to assist you with determining if you have a hardware problem and deciding what action is necessary to fix the problem.
- **IBM hardware repair** - If the problem is determined to be caused by IBM hardware under warranty, trained service personnel are available to provide the applicable level of service, either on-site or at an IBM service center as determined by IBM.
- **Engineering Change management** - Occasionally, there might be changes that are required after a product has been shipped from IBM. In those instances, IBM will make Engineering Changes (ECs) available that apply to your hardware.
- **Customer replaceable units (CRUs)** - Some parts of IBM xSeries and IntelliStation systems are designated as customer replaceable units. IBM ships CRUs to you for replacement by you. CRUs include keyboards, monitors, memory, diskette drives, hard disk drives, and mice (this list is not inclusive of all CRUs).

The following items are not covered under warranty service:

- Replacement or use of non-IBM parts. All IBM parts contain a 7-character identification in the format IBM FRU XXXXXXX.
- Identification of software problem sources.
- Installation of customer replaceable units (CRUs).
- Installation and configuration of BIOS code, firmware, or device drivers that are designated as customer installable.

See the IBM Statement of Limited Warranty for a full explanation of IBM warranty terms. Be sure to retain your proof of purchase to obtain warranty service.

Please have the following information ready when you call:

- The machine type and model of your IBM hardware product (if available)
- Serial numbers of your IBM hardware products
- A description of the problem
- The exact wording of any error messages
- Hardware and software configuration information

International Warranty Service

If you travel with your xSeries or IntelliStation system or relocate it to a country or region where your system is sold and serviced by IBM or IBM resellers authorized to perform warranty service, International Warranty Service (IWS) is available during the warranty period. Eligible IBM systems are identified by their four-digit machine types.

You can obtain IWS through the service delivery method (such as depot, carry-in, or on-site) provided in the servicing country or region. Service methods and procedures vary by country or region, and some service or parts might not be available in all countries and regions. Service centers in certain countries or regions might not be able to service all models of a particular machine type. In addition, some countries or regions might have fees and restrictions that apply at the time of service.

To determine whether your system is eligible for IWS, go to http://www.ibm.com/pc/support/ and click **Warranty lookup**.

Purchasing additional services

During and after the warranty period, you can purchase additional services, such as support for IBM and non-IBM hardware, operating systems, and application programs; network setup and configuration; upgraded or extended hardware repair services; and custom installations. Service availability and service name might vary by country or region.

For more information about these services, contact your IBM marketing representative.

IBM Statement of Limited Warranty Z125-4753-06 8/2000

Part 1 - General Terms

This Statement of Limited Warranty includes Part 1 - General Terms and Part 2 - Country-unique Terms. The terms of Part 2 replace or modify those of Part 1. The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you purchase for your use, and not for resale, from IBM or your reseller. The term "Machine" means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. The term "Machine" does not include any software programs, whether pre-loaded with the Machine, installed subsequently or otherwise. Unless IBM specifies otherwise, the following warranties apply only in the country where you acquire the Machine. Nothing in this Statement of Limited Warranty affects any statutory rights of consumers that cannot be waived or limited by contract. If you have any questions, contact IBM or your reseller.

The IBM Warranty for Machines: IBM warrants that each Machine 1) is free from defects in materials and workmanship and 2) conforms to IBM's Official Published Specifications ("Specifications"). The warranty period for a Machine is a specified, fixed period commencing on its Date of Installation. The date on your sales receipt is the Date of Installation unless IBM or your reseller informs you otherwise.

If a Machine does not function as warranted during the warranty period, and IBM or your reseller are unable to either 1) make it do so or 2) replace it with one that is at least functionally equivalent, you may return it to your place of purchase and your money will be refunded.

Extent of Warranty: The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment, improper maintenance by you, or failure caused by a product for which IBM is not responsible. The warranty is voided by removal or alteration of Machine or parts identification labels.

THESE WARRANTIES ARE YOUR EXCLUSIVE WARRANTIES AND REPLACE ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THESE WARRANTIES GIVE YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF EXPRESS OR IMPLIED WARRANTIES, SO THE ABOVE EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU. IN THAT EVENT, SUCH WARRANTIES ARE LIMITED IN DURATION TO THE WARRANTY PERIOD. NO WARRANTIES APPLY AFTER THAT PERIOD.

Items Not Covered by Warranty: IBM does not warrant uninterrupted or error-free operation of a Machine. Any technical or other support provided for a Machine under warranty, such as assistance via telephone with "how-to" questions and those regarding Machine set-up and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND.**

Warranty Service: To obtain warranty service for a Machine, contact IBM or your reseller. If you do not register your Machine with IBM, you may be required to present proof of purchase.

During the warranty period, IBM or your reseller, if approved by IBM to provide warranty service, provides without charge certain types of repair and exchange service to keep Machines in, or restore them to, conformance with their Specifications. IBM or your reseller will inform you of the available types of service for a Machine based on its country of installation. At its discretion, IBM or your reseller will 1) either repair or exchange the failing Machine and 2) provide the service either at your location or a service center. IBM or your reseller will also manage and install selected engineering changes that apply to the Machine.

Some parts of IBM Machines are designated as Customer Replaceable Units (called "CRUs"), e.g., keyboards, memory, or hard disk drives. IBM ships CRUs to you for replacement by you. You must return all defective CRUs to IBM within 30 days of your receipt of the replacement CRU. You are responsible for downloading designated Machine Code and Licensed Internal Code updates from an IBM Internet Web site or from other electronic media, and following the instructions that IBM provides.

When warranty service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty service status of the replaced item. Many features, conversions, or upgrades involve the removal of parts and their return to IBM. A part that replaces a removed part will assume the warranty service status of the removed part.

Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service.

You also agree to

1. ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange;
2. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and
3. where applicable, before service is provided:
   a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provides;

b. secure all programs, data, and funds contained in a Machine;
c. provide IBM or your reseller with sufficient, free, and safe access to your facilities to permit them to fulfill their obligations; and
d. inform IBM or your reseller of changes in a Machine's location.

IBM is responsible for loss of, or damage to, your Machine while it is 1) in IBM's possession or 2) in transit in those cases where IBM is responsible for the transportation charges.

Neither IBM nor your reseller is responsible for any of your confidential, proprietary or personal information contained in a Machine which you return to IBM or your reseller for any reason. You should remove all such information from the Machine prior to its return.

Limitation of Liability: Circumstances may arise where, because of a default on IBM's part or other liability, you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages from IBM (including fundamental breach, negligence, misrepresentation, or other contract or tort claim), except for any liability that cannot be waived or limited by applicable laws, IBM is liable for no more than

1. damages for bodily injury (including death) and damage to real property and tangible personal property; and
2. the amount of any other actual direct damages, up to the charges (if recurring, 12 months' charges apply) for the Machine that is subject of the claim. For purposes of this item, the term “Machine” includes Machine Code and Licensed Internal Code.

   This limit also applies to IBM's suppliers and your reseller. It is the maximum for which IBM, its suppliers, and your reseller are collectively responsible.

UNDER NO CIRCUMSTANCES IS IBM LIABLE FOR ANY OF THE FOLLOWING: 1) THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES (OTHER THAN THOSE UNDER THE FIRST ITEM LISTED ABOVE); 2) LOSS OF, OR DAMAGE TO, YOUR RECORDS OR DATA; OR 3) SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES, LOST PROFITS OR LOST SAVINGS, EVEN IF IBM, ITS SUPPLIERS OR YOUR RESELLER IS INFORMED OF THEIR POSSIBILITY. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

Governing Law: Both you and IBM consent to the application of the laws of the country in which you acquired the Machine to govern, interpret, and enforce all of your and IBM’s rights, duties, and obligations arising from, or relating in any manner to, the subject matter of this Agreement, without regard to conflict of law principles.

Part 2 - Country-unique Terms

AMERICAS

BRAZIL

Governing Law: *The following is added after the first sentence:*
Any litigation arising from this Agreement will be settled exclusively by the court of Rio de Janeiro.

NORTH AMERICA

Warranty Service: *The following is added to this Section:*
To obtain warranty service from IBM in Canada or the United States, call 1-800-IBM-SERV (426-7378).

CANADA

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*
laws in the Province of Ontario.

UNITED STATES

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*
laws of the State of New York.

ASIA PACIFIC

AUSTRALIA

The IBM Warranty for Machines: *The following paragraph is added to this Section:*
The warranties specified in this Section are in addition to any rights you may have under the Trade Practices Act 1974 or other similar legislation and are only limited to the extent permitted by the applicable legislation.

Limitation of Liability: *The following is added to this Section:*
Where IBM is in breach of a condition or warranty implied by the Trade Practices Act 1974 or other similar legislation, IBM's liability is limited to the repair or replacement of the goods or the supply of equivalent goods. Where that condition or warranty relates to right to sell, quiet possession or clear title, or the goods are of a kind ordinarily acquired for personal, domestic or household use or consumption, then none of the limitations in this paragraph apply.

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*
laws of the State or Territory.

CAMBODIA, LAOS, AND VIETNAM

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*
laws of the State of New York.

The following is added to this Section:
Disputes and differences arising out of or in connection with this Agreement shall be finally settled by arbitration which shall be held in Singapore in accordance with the rules of the International Chamber of Commerce (ICC). The arbitrator or arbitrators designated in conformity with those rules shall have the power to rule on their own competence and on the validity of the Agreement to submit to arbitration. The arbitration award shall be final and binding for the parties without appeal and the arbitral award shall be in writing and set forth the findings of fact and the conclusions of law.

All proceedings shall be conducted, including all documents presented in such proceedings, in the English language. The number of arbitrators shall be three, with each side to the dispute being entitled to appoint one arbitrator.

The two arbitrators appointed by the parties shall appoint a third arbitrator before proceeding upon the reference. The third arbitrator shall act as chairman of the proceedings. Vacancies in the post of chairman shall be filled by the president of the ICC. Other vacancies shall be filled by the respective nominating party. Proceedings shall continue from the stage they were at when the vacancy occurred.

If one of the parties refuses or otherwise fails to appoint an arbitrator within 30 days of the date the other party appoints its, the first appointed arbitrator shall be the sole arbitrator, provided that the arbitrator was validly and properly appointed.

The English language version of this Agreement prevails over any other language version.

HONG KONG AND MACAU

Governing Law: *The following replaces "laws of the country in which you acquired the Machine" in the first sentence:*
laws of Hong Kong Special Administrative Region.

INDIA

Limitation of Liability: *The following replaces items 1 and 2 of this Section:*

1. liability for bodily injury (including death) or damage to real property and tangible personal property will be limited to that caused by IBM's negligence;
2. as to any other actual damage arising in any situation involving nonperformance by IBM pursuant to, or in any way related to the subject of

this Statement of Limited Warranty, IBM's liability will be limited to the charge paid by you for the individual Machine that is the subject of the claim.

JAPAN

Governing Law: *The following sentence is added to this Section:*
Any doubts concerning this Agreement will be initially resolved between us in good faith and in accordance with the principle of mutual trust.

NEW ZEALAND

The IBM Warranty for Machines: *The following paragraph is added to this Section:*
The warranties specified in this Section are in addition to any rights you may have under the Consumer Guarantees Act 1993 or other legislation which cannot be excluded or limited. The Consumer Guarantees Act 1993 will not apply in respect of any goods which IBM provides, if you require the goods for the purposes of a business as defined in that Act.

Limitation of Liability: *The following is added to this Section:*

Where Machines are not acquired for the purposes of a business as defined in the Consumer Guarantees Act 1993, the limitations in this Section are subject to the limitations in that Act.

PEOPLE'S REPUBLIC OF CHINA (PRC)

Governing Law: *The following replaces this Section:*
Both you and IBM consent to the application of the laws of the State of New York (except when local law requires otherwise) to govern, interpret, and enforce all your and IBM's rights, duties, and obligations arising from, or relating in any manner to, the subject matter of this Agreement, without regard to conflict of law principles.

Any disputes arising from or in connection with this Agreement will first be resolved by friendly negotiations, failing which either of us has the right to submit the dispute to the China International Economic and Trade Arbitration Commission in Beijing, the PRC, for arbitration in accordance with its arbitration rules in force at the time. The arbitration tribunal will consist of three arbitrators. The language to be used therein will be English and Chinese. An arbitral award will be final and binding on all the parties, and will be enforceable under the Convention on the Recognition and Enforcement of Foreign Arbitral Awards (1958).

The arbitration fee will be borne by the losing party unless otherwise determined by the arbitral award.

During the course of arbitration, this Agreement will continue to be performed except for the part which the parties are disputing and which is undergoing arbitration.

EUROPE, MIDDLE EAST, AFRICA (EMEA)

THE FOLLOWING TERMS APPLY TO ALL EMEA COUNTRIES:
The terms of this Statement of Limited Warranty apply to Machines purchased from IBM or an IBM reseller.

Warranty Service: If you purchase an IBM Machine in Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland or United Kingdom, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM. If you purchase an IBM Personal Computer Machine in Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Kazakhstan, Kirghizia, Federal Republic of Yugoslavia, Former Yugoslav Republic of Macedonia (FYROM), Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, or Ukraine, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

If you purchase an IBM Machine in a Middle Eastern or African country, you may obtain warranty service for that Machine from the IBM entity within the country of purchase, if that IBM entity provides warranty service in that country, or from an IBM reseller, approved by IBM to perform warranty service on that Machine in that country. Warranty service in Africa is available within 50 kilometers of an IBM authorized service provider. You are responsible for transportation costs for Machines located outside 50 kilometers of an IBM authorized service provider.

Governing Law: The applicable laws that govern, interpret and enforce rights, duties, and obligations of each of us arising from, or relating in any manner to, the subject matter of this Statement, without regard to conflict of laws principles, as well as Country-unique terms and competent court for this Statement are those of the country in which the warranty service is being provided, except that in 1) Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Hungary, Former Yugoslav Republic of Macedonia, Romania, Slovakia, Slovenia, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan, the laws of Austria apply; 2) Estonia, Latvia, and Lithuania, the laws of Finland apply; 3) Algeria, Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Djibouti, Democratic Republic of Congo, Equatorial Guinea, France, Gabon, Gambia, Guinea, Guinea-Bissau, Ivory Coast, Lebanon, Mali, Mauritania, Morocco, Niger, Senegal, Togo, and Tunisia, this Agreement will be construed and the legal relations between the parties will be determined in accordance with the French laws and all disputes arising out of this Agreement or related to its violation or execution, including summary proceedings, will be settled exclusively by the Commercial Court of Paris; 4) Angola, Bahrain, Botswana, Burundi, Egypt, Eritrea, Ethiopia, Ghana, Jordan, Kenya, Kuwait, Liberia, Malawi, Malta, Mozambique, Nigeria, Oman, Pakistan, Qatar, Rwanda, Sao Tome, Saudi Arabia,

Sierra Leone, Somalia, Tanzania, Uganda, United Arab Emirates, United Kingdom, West Bank/Gaza, Yemen, Zambia, and Zimbabwe, this Agreement will be governed by English Law and disputes relating to it will be submitted to the exclusive jurisdiction of the English courts; and 5) in Greece, Israel, Italy, Portugal, and Spain any legal claim arising out of this Statement will be brought before, and finally settled by, the competent court of Athens, Tel Aviv, Milan, Lisbon, and Madrid, respectively.

THE FOLLOWING TERMS APPLY TO THE COUNTRY SPECIFIED:

AUSTRIA AND GERMANY

The IBM Warranty for Machines: *The following replaces the first sentence of the first paragraph of this Section:*
The warranty for an IBM Machine covers the functionality of the Machine for its normal use and the Machine's conformity to its Specifications.

The following paragraphs are added to this Section:

The minimum warranty period for Machines is six months. In case IBM or your reseller is unable to repair an IBM Machine, you can alternatively ask for a partial refund as far as justified by the reduced value of the unrepaired Machine or ask for a cancellation of the respective agreement for such Machine and get your money refunded.

Extent of Warranty: *The second paragraph does not apply.*

Warranty Service: *The following is added to this Section:*
During the warranty period, transportation for delivery of the failing Machine to IBM will be at IBM's expense.

Limitation of Liability: *The following paragraph is added to this Section:*
The limitations and exclusions specified in the Statement of Limited Warranty will not apply to damages caused by IBM with fraud or gross negligence and for express warranty.

The following sentence is added to the end of item 2:
IBM’s liability under this item is limited to the violation of essential contractual terms in cases of ordinary negligence.

EGYPT

Limitation of Liability: *The following replaces item 2 in this Section:*
as to any other actual direct damages, IBM's liability will be limited to the total amount you paid for the Machine that is the subject of the claim. For purposes of this item, the term “Machine” includes Machine Code and Licensed Internal Code.

Applicability of suppliers and resellers (unchanged).

FRANCE

Limitation of Liability: *The following replaces the second sentence of the first paragraph of this Section:*
In such instances, regardless of the basis on which you are entitled to claim damages from IBM, IBM is liable for no more than: *(items 1 and 2 unchanged).*

IRELAND

Extent of Warranty: *The following is added to this Section:*
Except as expressly provided in these terms and conditions, all statutory conditions, including all warranties implied, but without prejudice to the generality of the foregoing all warranties implied by the Sale of Goods Act 1893 or the Sale of Goods and Supply of Services Act 1980 are hereby excluded.

Limitation of Liability: *The following replaces items one and two of the first paragraph of this Section:*
1. death or personal injury or physical damage to your real property solely caused by IBM's negligence; and
2. the amount of any other actual direct damages, up to 125 percent of the charges (if recurring, the 12 months' charges apply) for the Machine that is the subject of the claim or which otherwise gives rise to the claim.

Applicability of suppliers and resellers (unchanged).

The following paragraph is added at the end of this Section:
IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default shall be limited to damages.

ITALY

Limitation of Liability: *The following replaces the second sentence in the first paragraph:*
In each such instance unless otherwise provided by mandatory law, IBM is liable for no more than:
1. *(unchanged)*
2. as to any other actual damage arising in all situations involving nonperformance by IBM pursuant to, or in any way related to the subject matter of this Statement of Warranty, IBM's liability, will be limited to the total amount you paid for the Machine that is the subject of the claim.
Applicability of suppliers and resellers (unchanged).

The following replaces the third paragraph of this Section:
Unless otherwise provided by mandatory law, IBM and your reseller are not liable for any of the following: *(items 1 and 2 unchanged)* 3) indirect damages, even if IBM or your reseller is informed of their possibility.

SOUTH AFRICA, NAMIBIA, BOTSWANA, LESOTHO AND SWAZILAND

Limitation of Liability: *The following is added to this Section:*
IBM's entire liability to you for actual damages arising in all situations involving nonperformance by IBM in respect of the subject matter of this Statement of Warranty will be limited to the charge paid by you for the individual Machine that is the subject of your claim from IBM.

UNITED KINGDOM

Limitation of Liability: *The following replaces items 1 and 2 of the first paragraph of this Section:*

1. death or personal injury or physical damage to your real property solely caused by IBM's negligence;
2. the amount of any other actual direct damages or loss, up to 125 percent of the charges (if recurring, the 12 months' charges apply) for the Machine that is the subject of the claim or which otherwise gives rise to the claim;

The following item is added to this paragraph:
3. breach of IBM's obligations implied by Section 12 of the Sale of Goods Act 1979 or Section 2 of the Supply of Goods and Services Act 1982.

Applicability of suppliers and resellers (unchanged).

The following is added to the end of this Section:
IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default shall be limited to damages.

Appendix B. Notices

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

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

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Eserver	Update Connector
FlashCopy	Wake on LAN
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IntelliStation	XA-64
Light Path Diagnostics	X-Architecture
NetBAY	XceL4
Netfinity	XpandOnDemand
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OS/2 WARP	

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Glossary

A

array. Two or more physical drives combined for increased capacity, speed, or fault tolerance. Once created, an array is configured as one or more logical drives. The operating system in the server recognizes a logical drive as a single drive.

auto-synchronization. Synchronization on RAID level-5, level-5E, and level-50 drives that is automatically initiated when logical drives are created. This type of synchronization works in the background.

B

battery-backup cache. Buffer storage that protects data during write-back operations; in the event of a power failure, it preserves the data in the controller cache.

BIOS-compatibility mapping. A ServeRAID controller setting with two options: **Limited** and **Extended**. The default option is **Extended**.

BIOS-compatibility mapping—Extended.

An option of BIOS compatibility mapping. When the BIOS compatibility mapping is set to **Extended**, the ServeRAID BIOS is aware that the operating system supports 8 GB or smaller physical drives.

BIOS-compatibility mapping—Limited.

An option of BIOS compatibility mapping. When the BIOS compatibility mapping is set to **Limited**, the ServeRAID BIOS is aware that the operating system supports 2 GB or smaller physical drives. This enables the user to migrate data from older PCI or Micro Channel® adapters.

block. A data unit created when data is striped across physical drives.

blocked. A logical-drive state in which the data in a RAID level-0 logical drive might be damaged and will need to be restored. After an array fails and a rebuild operation is initiated, the ServeRAID controller sets RAID level-0 logical drives to the blocked state.

C

cluster. In ServeRAID technology, two independent computer systems organized into a network for the purpose of sharing resources and communicating with each other. A cluster provides fault-tolerance at the server level.

compaction. The process by which a RAID level-5EE logical drive utilizes the distributed spare drive in the event of a physical drive failure. After the data is reconstructed, the original array undergoes compaction, and the distributed spare drive becomes part of the new array. The logical drive remains RAID level-5EE.

compression. The process by which a RAID level-5E logical drive utilizes the distributed spare drive in the event of a physical drive failure. After the data is reconstructed, the original array undergoes compression and the distributed spare drive becomes part of the new array.

controller. A device that coordinates and controls the operation of one or more input/output devices, such as workstations, and synchronizes the operation of such devices with the operation of the system as a whole.

controller names. In a cluster or failover pair, the unique names that identify the members of the pair to one another.

copy back. A method of restoring a logical drive's original configuration after replacing a failed drive in an array.

critical. The state of a RAID level-1, level-1E, level-5, level-5E, level-5EE, level-10, level-1E0, or level-50 logical drive that contains a defunct drive.

D

data mirroring. A technique that creates a single logical drive from two physical drives. All data written to the logical drive is written to both physical drives, creating a pair of physical drives containing exactly the same data.

data scrubbing. A feature that provides automatic, continuous synchronization during system use. This features works in the background, and ensures that the redundant data and/or parity is correct.

data striping. A technique that divides a logical drive into data blocks, called stripes, which are then distributed over the physical drives. The layout is such that a sequential read of data on the logical drive results in parallel reads to each of the physical drives, resulting in improved performance.

decompression. The process by which a compressed array returns to its original striping scheme, after a failed drive is replaced in a RAID level-5E logical drive. Contrast with compression.

defunct. A physical-drive state in which the ServeRAID controller cannot communicate properly with the drive.

distributed spare drive. In RAID level-5E and level-5EE, the logical drive designated as a spare drive. Because this spare drive is spread over several physical drives, it is described as distributed.

E

enclosure. A storage expansion unit, such as the Netfinity EXP300, that contains SCSI disk drives.

expansion. The process by which a compacted array returns to its original striping scheme, after a failed drive is replaced in a RAID level-5EE logical drive. Contrast with compaction.

F

fault tolerance. The ability of a computer system to operate correctly even though one or more of its component parts are malfunctioning.

firmware. Proprietary code that is usually delivered as microcode as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and more adaptable to change than pure hardware circuitry. An example of firmware is the Basic Input/Output System (BIOS) in read-only memory (ROM) on a PC system board.

H

hot add. To add and configure a new ServeRAID controller while the server is operational.

hot-spare drive. A physical drive that is defined for automatic use when a similar drive fails.

hot-pluggable. Pertaining to a system in which components can be added while the system is running.

hot-swappable. Pertaining to a component that can be removed or replaced while the system is running.

hot-swap rebuild. An operation that is started by the ServeRAID controller when it detects that a physical drive that is part of an array and in the defunct state has been

removed and replaced on a SCSI cable or backplane.

I

integrated RAID controller. An integrated SCSI controller with RAID capabilities, such as the LSI 1020 and LSI 1030. These integrated RAID controllers are standard features on some IBM xSeries servers; they can be used to create a RAID level-1 logical drive from two physical drives. A third physical drive can be used as a hot-spare drive.

initialize logical drive. In the ServeRAID utilities, to erase the first 1024 sectors on a drive, preventing access to any data previously stored on the drive.

initiator identifiers. The SCSI initiator IDs assigned to a cluster or failover pair.

IPSSEND command-line program. An advanced command-line program that can be used to manage your ServeRAID controllers. It can be used to configure your controller, isolate and debug problems, recover from errors, and to copy controller configurations from one server to another.

L

logical drive. A grouping of physical drives that the operating system recognizes as a single drive.

logical-drive migration. To add or remove physical drives from an existing array, to change RAID levels, change logical-drive size, or effect an increase in free space.

M

merge-group number. In a clustering configuration, the numbers that identify each logical drive. Non-shared logical drives are assigned merge-group numbers of either 206 or 207; shared logical drives need unique merge-group numbers, so that they can be identified even if they move to the other server.

merge-group state. In a clustering environment, whether or not a logical drive is shared.

migrating. The state of a logical drive undergoing a logical-drive migration.

mirror role. The role assigned to the two physical drives that an integrated RAID controller uses to create a RAID level-1 logical drive. When the logical drive is created, data is copied from the primary physical drive to the secondary physical drive. Any data on the secondary drive is destroyed.

N

Notification Manager. A tool used to notify remote systems of events, problems, and configuration changes occurring on a local system.

O

offline. A logical-drive state in which the logical drive is inaccessible.

okay. A logical-drive state in which the logical drive is functional.

online. A physical-drive state in which the physical drive is functioning properly and is part of an array.

P

partner name. In a cluster or failover pair, one of the two controller names entered during configuration.

parity. A characteristic of the data stored on a RAID level-5, level-5E, level-5EE, or level-50 logical drive that can be used, in conjunction with the data on the remaining drives, to recreate data on a failed physical drive.

parity block. In a RAID level-5, level-5E, level-5EE, or level-50 logical drive, a data unit that contains a representation of the data from other blocks in the same stripe.

physical drive. A hard disk drive.

POST. Power-on self-test. During POST, the ServeRAID controller compares the stored configuration information to the configuration that is actually present. If a discrepancy exists, one or more status messages appear after the POST completes but before the operating system loads.

Q

quorum drive. In the Microsoft Clustering Solution, a logical drive that stores the quorum resource information.

R

rack enclosure. See enclosure.

RAID. A technology of grouping several physical drives in a computer into an array that you can define as one or more logical drives. Each logical drive appears to the operating system as a single drive. This grouping technique greatly enhances logical-drive capacity and performance beyond the physical limitations of a single physical drive.

RAID level-0. A RAID level that uses data striping to distribute data evenly across physical drives. While it enables full utilization of physical drive capacity and performance acceleration, RAID level-0 provides neither fault tolerance nor redundancy.

RAID level-1. A RAID level that uses data mirroring to distribute data across two physical drives. It provides data redundancy and performance acceleration, although the usable physical drive space is reduced by 50 percent.

RAID level-1E. A RAID level that uses both data striping and data mirroring to distribute data across three or more physical drives. Data is striped across each disk in the array; the first set of stripes are the data stripes, and the second sets of stripes are mirror copies of the first stripe, shifted one drive. It provides data redundancy and performance acceleration, although the usable physical drive space is reduced by 50 percent.

RAID level-5. A RAID level that uses data striping and block interweaving to distribute data across three or more physical drives. It provides full data protection and performance acceleration, although only 67-94% of physical drive storage capacity can be used.

RAID level-5E. A RAID level that uses data striping and block interweaving to distribute data across four or more physical drives. It uses some space on each physical drive as a distributed hot-spare. It provides full data protection and performance acceleration, although only 50-88% of physical drive storage capacity can be used.

RAID level-5EE. A RAID level that uses data striping and block interweaving to more efficiently distribute data across four or more physical drives. Like RAID level-5E, it uses some space on each physical drive as a distributed hot-spare. However, RAID level-5EE offers a more efficient distributed spare drive and faster rebuild times. The spare drive is actually part of the RAID level-5EE array. A RAID level-5EE spare drive is interleaved with the parity blocks. This enables data to be reconstructed more quickly if a physical drive in the array fails. RAID level-5EE provides full data protection and performance acceleration, although only 50-88% of physical drive storage capacity can be used.

RAID level-x0. RAID level-00, level-10, level-1E0, and level-50. These RAID levels use spanned arrays (arrays of arrays) to enable the use of up to 60 physical drives. RAID level-00 provides no data redundancy but provides performance acceleration and

enables 100% of the physical drive storage capacity to be used. RAID level-10, level-1E0, and level-50 provide full data protection, performance acceleration, and greater reliability, although only 50-94% of physical drive storage capacity can be used.

read-ahead cache mode. A ServeRAID controller setting that determines whether the ServeRAID controller transfers data from disk to its local cache in increments equal to the stripe-unit size or the system I/O requests. The options are **enabled**, **disabled**, and **adaptive**; the default option is adaptive.

read-ahead cache mode—Adaptive. The default-value of the read-ahead cache mode. When the read-ahead cache mode is set to adaptive, the ServeRAID controller continually reevaluates whether to set the read-ahead cache mode to **enabled** or **disabled**.

read-ahead cache mode—Disabled. An option of the read-ahead cache mode. When the read-ahead cache mode is disabled, the ServeRAID controller transfers data from the logical drive to its local cache in increments equal to the system I/O request size. This optimizes performance when the workload is random or the system I/O requests are smaller than the stripe-unit size.

read-ahead cache mode—Enabled. An option of the read-ahead cache mode. When the read-ahead cache mode is enabled, the ServeRAID controller transfers data from the logical drive to its local cache in increments equal to the stripe-unit size. This optimizes performance when workloads are steady and sequential.

ready. A physical-drive state in which the drive is available for definition.

rebuild. An operation to reconstruct data after the problem that caused a physical drive to become defunct has been resolved.

rebuilding. The state of a physical drive undergoing a rebuild operation.

rebuild rate. The speed (high, medium, or low) at which a rebuild operation will occur.

redundant array of independent disks (RAID). See RAID.

restore to factory-default settings. An action that restores all parameters in the controller to the factory-default settings. If logical drives are defined, the data stored on them will be lost.

S

SCSI. See small computer system interface.

SCSI ID. A unique ID assigned to each SCSI device connected to a SCSI controller. This ID enables the controller to identify the device and ensure that different devices on the same SCSI channel do not transfer data simultaneously.

SCSI initiator ID. In a failover or clustering environment, the ID assigned to a SCSI controller. Each ServeRAID controller and its partner must have different SCSI initiator IDS; one must be 6 and the other 7.

SCSI transfer speed. The speed at which data can be transferred between a physical drive and the ServeRAID controller.

ServeRAID Manager. A program used to configure ServeRAID controllers, view the ServeRAID configuration, create arrays and logical drives, delete arrays, dynamically increase the logical-drive size, change RAID levels, and more.

ServeRAID Mini-Configuration program.

A program that allows the user to display the ServeRAID controller settings, and to perform a limited set of configuration functions without using the *IBM ServeRAID Support* CD.

ServeRAID ROM Update wizard. A program that updates the BIOS and firmware codes on ServeRAID controllers.

shared drives. The physical drives controlled by a cluster or failover pair.

small computer system interface. A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

spanned array. An array of arrays. Used in RAID level-00, level-10, level-1E0, and level-50 to permit the use of larger numbers of physical drives. The spanned array contains arrays, each of which contains a sub-logical drive, which can be RAID level-0, level-1, level-1E, or level-5. The RAID-level for the logical drive contained within the spanned array is 0.

standby hot spare. A hot-spare physical drive that the ServeRAID controller has spun down. If an online drive becomes defunct and no suitable hot-spare drive is available, a standby drive of the appropriate size automatically spins up and enters the rebuild state.

stripe-unit size. The granularity at which data is stored on one drive of the array before subsequent data is stored on the next drive of the array. The performance of a ServeRAID controller is maximized if the stripe-unit size is close to the size of the system input/output requests.

stripes. The collection of stripe units, from the first to last drive of the array.

sub-logical drive. In a RAID level-x0 configuration, a logical drive contained within each array of the spanned array. A sub-logical drive can be RAID level-0, level-1, level-1E, or level-5.

synchronization. The process of recalculating and rewriting either redundant data (RAID level-1, level-1E, level-10, and level-1E0 logical drives) or parity data (RAID level-5, level-5E, level-5EE, and level-50 logical drives).

T

throughput. The speed at which data can be moved from one place to another, usually expressed in MB per second.

U

unattended mode. A ServeRAID controller setting that determines how the BIOS handles failures during system startup. The options are **enabled** and **disabled**; the default value is **disabled**.

unattended mode—Disabled. An option of the unattended mode. When the unattended mode is disabled and the BIOS detects a failure, the system stops at the recovery option screen and waits for the user to respond.

unattended mode—Enabled. An option of the unattended mode. When the unattended mode is enabled and the BIOS detects a failure, the system waits for 30 seconds for the user to respond to the recovery option screen. Then, the BIOS automatically selects an appropriate option and continues the system startup process. Unattended mode must be enabled in a clustering environment.

W

write-cache mode. A ServeRAID controller setting that determines whether the controller writes data to the physical drive before or after sending a confirmation to the operating system. The settings are **write back** and **write through**.

write-cache mode—write back. A setting of the write-cache mode. When the write-cache mode is set to write back and the operating system sends data to the controller, the controller sends a confirmation back to the operating system before actually writing the data to a storage device. This increases performance, but, if a battery-backup cache is not used, increases

the risk of data loss in the event of a power failure.

write-cache mode—write through. A setting of the write-cache mode. When the write-cache mode is set to write through and the operating system sends data to the controller, the controller writes the data to a storage device before sending a confirmation to the operating system. This mode decreases performance, but does not risk data loss.

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