SAS Host Bus Adapters



Problem Determination and Service Guide

SAS Host Bus Adapters



Problem Determination and Service Guide

Note: Before using this information and the product it supports, read the general information in Appendix B, "Notices," on page 59.

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Contents

Safety	v vi vi vi
Chapter 1. Introduction	1 1 2 2 3 4 5
Chapter 2. Start here.	7
Chapter 3. Understanding the operating environment	11 11
ServeRAID H1110)	11 12 12
Chapter 4. ServeRAID H1110 features.	13
Chapter 5. Physical hard disk drive utilities	15
Chapter 6. General problem determination tips	17
Chapter 7. Problem determination procedures 1 Hard disk drive LED-to-action 1 POST messages-to-action. 1 Fault codes 2 Boot messages. 2 Event messages-to-actions. 2 Symptoms-to-actions. 2 The SAS HBA is not seen during POST, or the Preboot GUI is not accessible 5 One or more SAS HBAs are inaccessible when multiple storage controllers are installed 5 System events-to-actions index. 5	19 19 21 22 24 27 50 50 52 53
Chapter 8. Replaceable components	55
Appendix A. Getting help and technical assistance	57 57 57 57 58 58 58

Appendix B. Notices																							59
Trademarks				•			•					•	•	•						•			59
Important notes	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	60
Index																							61

Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الأمنية

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.

Guidelines for trained service technicians

This section contains information for trained service technicians.

Inspecting for unsafe conditions

Use the information in this section to help you identify potential unsafe conditions in an IBM product that you are working on. Each IBM product, as it was designed and manufactured, has required safety items to protect users and service technicians from injury. The information in this section addresses only those items. Use good judgment to identify potential unsafe conditions that might be caused by non-IBM alterations or attachment of non-IBM features or optional devices that are not addressed in this section. If you identify an unsafe condition, you must determine how serious the hazard is and whether you must correct the problem before you work on the product.

Consider the following conditions and the safety hazards that they present:

- Electrical hazards, especially primary power. Primary voltage on the frame can cause serious or fatal electrical shock.
- · Explosive hazards, such as a damaged CRT face or a bulging capacitor.
- · Mechanical hazards, such as loose or missing hardware.

To inspect the product for potential unsafe conditions, complete the following steps:

- 1. Make sure that the power is off and the power cord is disconnected.
- 2. Make sure that the exterior cover is not damaged, loose, or broken, and observe any sharp edges.
- 3. Check the power cord:
 - Make sure that the third-wire ground connector is in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohm or less between the external ground pin and the frame ground.
 - Make sure that the power cord is the correct type.
 - Make sure that the insulation is not frayed or worn.
- 4. Remove the cover.
- 5. Check for any obvious non-IBM alterations. Use good judgment as to the safety of any non-IBM alterations.
- 6. Check inside the server for any obvious unsafe conditions, such as metal filings, contamination, water or other liquid, or signs of fire or smoke damage.
- 7. Check for worn, frayed, or pinched cables.
- 8. Make sure that the power-supply cover fasteners (screws or rivets) have not been removed or tampered with.

Guidelines for servicing electrical equipment

Observe the following guidelines when you service electrical equipment:

- Check the area for electrical hazards such as moist floors, nongrounded power extension cords, and missing safety grounds.
- Use only approved tools and test equipment. Some hand tools have handles that are covered with a soft material that does not provide insulation from live electrical currents.
- Regularly inspect and maintain your electrical hand tools for safe operational condition. Do not use worn or broken tools or testers.

- Do not touch the reflective surface of a dental mirror to a live electrical circuit. The surface is conductive and can cause personal injury or equipment damage if it touches a live electrical circuit.
- Some rubber floor mats contain small conductive fibers to decrease electrostatic discharge. Do not use this type of mat to protect yourself from electrical shock.
- Do not work alone under hazardous conditions or near equipment that has hazardous voltages.
- Locate the emergency power-off (EPO) switch, disconnecting switch, or electrical outlet so that you can turn off the power quickly in the event of an electrical accident.
- Disconnect all power before you perform a mechanical inspection, work near power supplies, or remove or install main units.
- Before you work on the equipment, disconnect the power cord. If you cannot disconnect the power cord, have the customer power-off the wall box that supplies power to the equipment and lock the wall box in the off position.
- Never assume that power has been disconnected from a circuit. Check it to make sure that it has been disconnected.
- If you have to work on equipment that has exposed electrical circuits, observe the following precautions:
 - Make sure that another person who is familiar with the power-off controls is near you and is available to turn off the power if necessary.
 - When you are working with powered-on electrical equipment, use only one hand. Keep the other hand in your pocket or behind your back to avoid creating a complete circuit that could cause an electrical shock.
 - When you use a tester, set the controls correctly and use the approved probe leads and accessories for that tester.
 - Stand on a suitable rubber mat to insulate you from grounds such as metal floor strips and equipment frames.
- Use extreme care when you measure high voltages.
- To ensure proper grounding of components such as power supplies, pumps, blowers, fans, and motor generators, do not service these components outside of their normal operating locations.
- If an electrical accident occurs, use caution, turn off the power, and send another person to get medical aid.

Safety statements

Important:

Each caution and danger statement in this document is labeled with a number. This number is used to cross reference an English-language caution or danger statement with translated versions of the caution or danger statement in the *Safety Information* document.

For example, if a caution statement is labeled "Statement 1," translations for that caution statement are in the *Safety Information* document under "Statement 1."

Be sure to read all caution and danger statements in this document before you perform the procedures. Read any additional safety information that comes with the server or optional device before you install the device.

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.

То	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.						
З.	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.								

Chapter 1. Introduction

This *Problem Determination and Service Guide* provides guidance for troubleshooting IBM Host Bus Adapters (HBAs).

Overview

The following SAS HBAs are supported by this document:

- ServeRAID H1110 SAS/SATA Controller for IBM System x
- IBM 6 Gb Performance Optimized HBA
- IBM 6 Gb SAS HBA

The following software is supported by this document:

- MegaRAID Storage Manager (MSM) (for the ServeRAID H1110 only)
- SAS2 BIOS Configuration Utility
- SAS2 Integrated RAID Configuration Utility (sas2ircu command-line tools)

Related documentation

The following documentation comes with the SAS HBAs:

- Quick Installation Guide (product-specific document)
 - This printed document provides the instructions for installing the SAS HBA hardware. You can also downloaded the Portable Document Format (PDF) of this document from the IBM Storage Matrix at http://www-947.ibm.com/systems/ support/supportsite.wss/docdisplay?Indocid=SERV-RAID&brandind=5000008.
- Installation and User's Guide (product-specific document)

This document is in PDF and provides detailed information for using the SAS HBA hardware and software. You can also downloaded this document from the IBM Storage Matrix at http://www-947.ibm.com/systems/support/supportsite.wss/ docdisplay?Indocid=SERV-RAID&brandind=5000008.

- SAS2 BIOS Configuration Utility User's Guide This document is in PDF and provides detailed information about using the SAS2 BIOS Configuration Utility to configure the SAS HBA.
- SAS2 Integrated RAID Configuration Utility User's Guide

This document is in PDF and provides detailed information about using the SAS2 Integrated RAID Configuration Utility to configure the SAS HBA.

MegaRAID Storage Manager (MSM) User's Guide (for the ServeRAID H1110 only)

This document is in PDF and provides detailed information about using the MegaRAID Storage Manager software package for managing and configuring installed ServeRAID controllers.

IBM publishes updates for known issues on a regular basis. For a problem that is not covered by the documentation that comes with the SAS HBA or in this *Problem Determination and Service Guide*, go to http://www.ibm.com/systems/support/.

Notices and statements in this document

The caution and danger statements in this document are also in the multilingual *Safety Information* document, which is on the *Documentation* CD. Each statement is numbered for reference to the corresponding statement in your language in the *Safety Information* document.

The following notices and statements are used in this document:

- 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 potential damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might 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.

Installation guidelines

Before you remove or replace a component, read the following information:

- Read the safety information that begins on page v, the guidelines in "Working inside the server with the power on" on page 4, and "Handling static-sensitive devices" on page 4. This information will help you work safely.
- When you install your new server, take the opportunity to download and apply the most recent firmware updates.

Important: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code. This step will help to ensure that any known issues are addressed and that your server is ready to function at maximum levels of performance. To download firmware updates for your server, complete the following steps:

- 1. Go to http://www.ibm.com/systems/support/.
- 2. Under Product support, click System x.
- 3. Under Popular links, click Software and device drivers.
- Click System x3650 M2 to display the matrix of downloadable files for the server.

For additional information about tools for updating, managing, and deploying firmware, see the System x and xSeries Tools Center at http://publib.boulder.ibm.com/infocenter/toolsctr/v1r0/index.jsp.

- Before you install optional hardware, make sure that the server is working correctly. Start the server, and make sure that the operating system starts, if an operating system is installed, or that a 19990305 error code is displayed, indicating that an operating system was not found but the server is otherwise working correctly. If the server is not working correctly, see Chapter 7, "Problem determination procedures," on page 19 for diagnostic information.
- Observe good housekeeping in the area where you are working. Place removed covers and other parts in a safe place.

- If you must start the server while the cover is removed, make sure that no one is near the server and that no tools or other objects have been left inside the server.
- Do not attempt to lift an object that you think is too heavy for you. If you have to lift a heavy object, observe the following precautions:
 - Make sure that you can stand safely without slipping.
 - Distribute the weight of the object equally between your feet.
 - Use a slow lifting force. Never move suddenly or twist when you lift a heavy object.
 - To avoid straining the muscles in your back, lift by standing or by pushing up with your leg muscles.
- Make sure that you have an adequate number of properly grounded electrical outlets for the server, monitor, and other devices.
- Back up all important data before you make changes to disk drives.
- Have a small flat-blade screwdriver available.
- To view the error LEDs on the system board and internal components, leave the server connected to power.
- You do not have to turn off the server to install or replace hot-swap fans, redundant hot-swap ac power supplies, or hot-plug Universal Serial Bus (USB) devices. However, you must turn off the server before you perform any steps that involve removing or installing adapter cables or non-hot-swap optional devices or components.
- Blue on a component indicates touch points, where you can grip the component to remove it from or install it in the server, open or close a latch, and so on.
- Orange on a component or an orange label on or near a component indicates that the component can be hot-swapped, which means that if the server and operating system support hot-swap capability, you can remove or install the component while the server is running. (Orange can also indicate touch points on hot-swap components.) See the instructions for removing or installing a specific hot-swap component for any additional procedures that you might have to perform before you remove or install the component.
- When you are finished working on the server, reinstall all safety shields, guards, labels, and ground wires.
- For a list of supported optional-devices for the server, see http://www.ibm.com/ servers/eserver/serverproven/compat/us/.

System reliability guidelines

To help ensure proper cooling and system reliability, make sure that:

- Each of the drive bays has a drive or a filler panel and electromagnetic compatibility (EMC) shield installed in it.
- If the server has redundant power, each of the power-supply bays has a power supply installed in it.
- There is adequate space around the server to allow the server cooling system to work properly. Leave approximately 50 mm (2.0 in.) of open space around the front and rear of the server. Do not place objects in front of the fans. For proper cooling and airflow, replace the server cover before turning on the server. Operating the server for extended periods of time (more than 30 minutes) with the server cover removed might damage server components.
- You have followed the cabling instructions that come with optional adapters.
- You have replaced a failed fan within 48 hours.

- You have replaced a hot-swap fan within 30 seconds of removal.
- You do not operate the server without the air baffles installed. Operating the server without the air baffles might cause the microprocessor to overheat.

Working inside the server with the power on

Attention: Static electricity that is released to internal server components when the server is powered-on might cause the server to halt, which might result in the loss of data. To avoid this potential problem, always use an electrostatic-discharge wrist strap or other grounding system when you work inside the server with the power on.

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

- Avoid wearing 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 and pencils, that could fall into the server as you lean over it.
- Avoid dropping any metallic objects, such as paper clips, hairpins, and screws, into the server.

Handling static-sensitive devices

Attention: Static electricity can damage the server and other electronic devices. 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.
- The use of a grounding system is recommended. For example, wear an electrostatic-discharge wrist strap, if one is available. Always use an electrostatic-discharge wrist strap or other grounding system when you work inside the server with the power on.
- 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 surface on the outside 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, put it back into its static-protective package. Do not place the device on the server cover or on a metal surface.
- Take additional care when handling devices during cold weather. Heating reduces indoor humidity and increases static electricity.

Returning a device or component

If you are instructed to return a device or component, follow all packaging instructions, and use any packaging materials for shipping that are supplied to you.

Chapter 2. Start here

You can solve many problems without outside assistance by following the troubleshooting procedures in this *Problem Determination and Service Guide* and on the IBM website. This document describes the troubleshooting procedures and explanations of event messages and error codes. The documentation that comes with your operating system and software also contains troubleshooting information.

Before you contact IBM or an approved warranty service provider, follow these procedures in the order in which they are presented to diagnose a problem with the server or the SAS HBA:

1. Determine what has changed.

A SAS HBA issue can occur when changes are introduced into an operational server. If there is a clear cause and effect to a change, back out the change until a workaround or a fix is available. If the recent change status is unknown, determine whether any of the following items were added, removed, replaced, or updated before the problem occurred:

- System Unified Extensible Firmware Interface (UEFI) or basic input/output system (BIOS) code
- ServeRAID controller BIOS or firmware
- System or ServeRAID device drivers
- · Other hardware components
- · Other software or device drivers
- Any software configuration changes

Note: IBM does not support updating to previous versions of SAS HBA BIOS and firmware packages.

2. Collect data.

Thorough data collection is necessary for effectively diagnosing hardware and software problems. The following clues are used to determine the best approach to solving specific problems:

Document event messages, error codes, and system-board LEDs.

- Check the system-events logs for hardware faults within the integrated management module (IMM), baseboard management controller (BMC), or Remote Supervisor Adapter (RSA) logs, as applicable to the specific server.
- · Check for operating-system event messages.
- Check the MegaRAID Storage Manager (MSM) software for event messages.
- Document the light path diagnostics LEDs and the LEDs for the attached disk drives.
- · Observe the server for POST messages as the server starts.
- · Observe and record any suspect controller or hard disk drive behavior.

3. Programmatically collect system data by using IBM Dynamic System Analysis (DSA).

If a server can boot to the operating system, Dynamic System Analysis (DSA) can programmatically collect important system and configuration information that you can use to diagnose the problem.

Run DSA to collect information about the hardware, firmware, software, and operating system. Have this information available when you contact IBM or an approved warranty service provider. For more information about running DSA, see the *IBM Dynamic System Analysis Installation and User's Guide*, which is available on the DSA download web page.

If you have to download the latest version of DSA, go to http://www.ibm.com/ systems/support/supportsite.wss/docdisplay?brandind=5000008&Indocid=SERV-DSA.

4. Follow the problem-resolution procedures.

The following four problem-resolution procedures are presented in the order in which they are most likely to solve your problem. Follow these procedures in the order in which they are presented:

a. Apply software updates.

IBM incorporates all known fixes into the latest release of software and firmware for the SAS HBAs. Most known issues are corrected by updates to the software and device drivers for the hardware components. This is the first step in eliminating known issues that might be causing problems.

Server software can also affect the behavior of the SAS HBAs. You must update the server with the latest versions of available software to eliminate known issues. All systems and SAS HBA software updates include "change history" documentation that describes the changes, fixes, or improvements that are made to the software. A change history file has a .chg extension. This file is a plain text downloadable document that is available at the same location where the updated software is downloaded.

Important: Software and device driver updates are best applied to correct behavioral problems within the subsystem or to improve stability. If the server or SAS HBA subsystem is in an Offline or Failed state, it is best not to attempt any updates to the software until the system and configuration are stabilized. After a system experiences a failure, it is usually best to bring the system into an operational state and then apply the software updates.

All SAS HBA software is available on the IBM ServeRAID software matrix web page at http://www.ibm.com/systems/support/support/supportsite.wss/ docdisplay?Indocid=SERV-RAID&brandind=5000008.

The following components come with the software:

- Utilities (MSM and command-line tools)
- SAS HBA firmware updates
- · Device drivers
- Documentation (user guide and device-driver installation guide)

The following other important software updates are in the server support section:

- · Hard disk drive firmware updates
- Enclosure unit updates
- System software updates

After you apply software updates, observer the SAS HBA for correct operation. See the next section if the problem is not solved.

b. Controller hardware checkout procedure.

Review the SAS HBA hardware and software configuration for correct installation.

Safety: Power off the server before you follow these checkout procedures.

- SAS HBA
 - Reseat the HBA in the PCI slot
 - Align and secure the chassis brackets in the slot correctly. This is very important if you are installing the HBA on a riser-card assembly before you install it in the server.
 - Review the server documentation to make sure that the expansion-slot restrictions are observed. A system might limit the use of some slots because of thermal issues, fit restrictions, or interference with other internal components.
- · SAS/SATA cables
 - Reseat any SAS/SATA cable connections. Each connection must latch and click into place from the controller to the backplane.
 - In simple-swap configurations, the SAS/SATA cables might be attached directly to the drive or to a simple-swap connector at the back of a drive cage that is connected to the system board.
 - Make sure that each cable has the correct bend radius. Exceeding the bend radius as outlined in the server documentation can add stress to the components.
 - Make sure that the SAS/SATA cables are not overstretched, nicked, or damaged.
- Internal power cables
 - Backplane power cables are keyed to ensure that they attached correctly to the server and the disk drive backplane. Most power cables latch with a plastic connector. Reseat the backplane power cables.
 - In a simple-swap configuration, the power cables are connected directly to a drive, or the simple-swap connector at the back of the drive cage is attached directly to the power supply.
- I2C

The I2C cable is connected from the hot-swap backplane to the system board. This cable controls the amber LEDs for the hard disk drives and the out-of-band alert notifications. Reseat the I2C cables.

Backplanes

Make sure that the backplanes are seated correctly by using the information in the server documentation. An incorrectly seated or aligned backplane can cause hard disk drive related problems because of a bad connection to a disk drive. Inspect the seating of the backplane and reseat as needed.

- Hard disk drives (including solid state drives)
 - Reseat the hot-swap drives against the backplane to make sure that they are installed correctly.
 - A simple-swap server might require removal of the front bezel to gain access to the hard disks drives to reseat them.

c. Symptom-based problem determination

- Go to "Hard disk drive LED-to-action" on page 19.
- · Go to "POST messages-to-action" on page 21.
- Go to "Event messages-to-actions" on page 27.
- · Go to "Symptoms-to-actions" on page 50.
- Go to "System events-to-actions index" on page 53.
- · Check for updated troubleshooting procedures and RETAIN tips.
- d. RETAIN tips

Troubleshooting procedures and RETAIN tips document known problems and suggested solutions. To search for troubleshooting procedures and RETAIN tips, complete the following steps.

Note: Changes are made periodically to the IBM Web site. The actual procedure might vary slightly from what is described in this document.

- 1) Go to http://www.ibm.com/systems/support/.
- 2) Under Product support, click System x.
- 3) From the **Product family** list, select the server.
- 4) Under Support & downloads, click Troubleshoot.
- 5) Select the troubleshooting procedure or RETAIN tip that applies to your problem:
 - Troubleshooting procedures are under **Diagnostic**.
 - RETAIN tips are under Troubleshoot.
- e. Check for and replace defective hardware.
 - Replace hardware determined to be defective using the problem determination procedures.
 - See Chapter 8, "Replaceable components," on page 55 for more details.

Chapter 3. Understanding the operating environment

This chapter contains information about the SAS HBA operating environment.

Overview

Read the following information about the SAS HBA operating environment:

- The ServeRAID H1110 supports up to two RAID volumes (RAID-0, RAID-1, and RAID-10) and supports hard disk drives that operate as individual physical SAS/SATA disks. This is sometimes known as a drive operating in JBOD (just a bunch of disks) configurations.
- The following IBM SAS HBAs support only individual physical SAS/SATA disks in JBOD configurations:
 - IBM 6 Gb Performance Optimized HBA
 - IBM 6 Gb SAS HBA
- The ServeRAID H1110 supports the following RAID levels. For more information about RAID levels, see the documentation that comes with the controller.
 - RAID-0 volumes are not redundant and provide no protections from a single disk failure.
 - Integrated mirroring is a RAID-1 volume and consists of a simple mirror of two drives providing redundancy if the RAID volume experiences a single disk failure.
 - Integrated mirroring enhanced is a RAID-1E volume that can configure an odd number of drives into a mirrored volume.
 - Integrated mirroring with striping is a RAID-10 volume and consists of a span with two RAID-1 volumes striping the usable space into one virtual disk. Each RAID-1 span is redundant, which means a single disk failure in each can occur without losing data, but two drive failures in the same RAID-1 span results in a lost RAID volume.

Using the PDSG in a mixed RAID and non-RAID environment (configured with a ServeRAID H1110)

For the ServeRAID H1110, the operating environment might be a mix of RAID volumes and one or more non-RAID drives on the same controller. Even though the hard disk drives might be attached to the same controller, hard disk drive issues are reported differently between drives configured in a RAID volume and a physical drive.

To maintain data coherency between hard disk drives configured in a RAID-1 or RAID-10 volume, the drives must conform to error recovery standards defined by the RAID controller firmware. For example, if two drives are configured in a mirror, and one drive has an unrecoverable error or a series of errors that cannot be corrected, the RAID controller rejects the drive from the RAID volume by marking the drive as Failed. The unrecovered errors create inconsistencies between the data on the two drives in the mirror. If the RAID controller cannot correct the inconsistencies within a short period of time, the problem drive must be removed from the mirrored drive group. The RAID controller programmatically makes these decisions to ensure data consistency within the RAID volume. The resulting failed drive is a logical drive state used to ensure the RAID logic does not try to use a problematic drive again. From the operating system perspective, errors from a

single drive in a RAID volume do not typically generate errors while good data is available from the redundant disk in the mirror.

Physical hard disk drives operating without RAID do not have logical states. Drives in this configuration are treated as standard SAS or SATA devices. Controllers and hard disk drives have logic to try to recover from problems to continue operation, but without redundancy, data might be lost. It is important to note that the ServeRAID H1110 will continue to work with the device as long as the controller and drive can communicate. The ServeRAID H1110 will not mark a physical drive as Failed unless it is in a RAID volume.

To be effective with problem determination, these operating environments must be approached differently. Troubleshooting a configuration with a RAID volume is best accomplished by using the utilities and features available for the RAID controller. When you troubleshoot physical hard disk drives, use the hard disk drive diagnostic tools that are available for IBM servers (for example, after you start the server, press F2 to start DSA Preboot and view the event logs) or the feature utilities provided in the BIOS configuration utility (CTRL+C). RAID controllers are capable of doing many of the same things that the diagnostic tools accomplish during normal operation.

IBM servers that have a hard disk drive backplane

IBM servers that have a hard disk drive backplane have several advantages over systems that only support simple-swap. A drive backplane adds support for hot-swap drives, which means the ability to insert and remove the disks from the front of the server under specific circumstances. Another important advantage is the drive LEDs that offer visual indicators for the current status of each hard disk drive. For more information, see the Table 1 on page 19.

The following hot swap events are supported:

- · Removal of a failed or unconfigured hot-swap hard disk drive
- · Installation of a replacement hot-swap hard disk drive
- · Installation of a new hot-swap hard disk drive into an empty drive bay

Note: The removal of an operational hot-swap hard disk drive is not supported.

IBM servers that support simple-swap hard disk drives

IBM servers that support simple-swap hard disk drives have guide rails in the drive bay that help you insert the drive into the cable connector at the back of the drive cage. You must install a simple-swap hard disk drive when the server is powered off. There is no backplane or electronics to enable simple-swap drives to be installed when the server is turned on. Installing or removing simple-swap drives with the server turned on is not supported.

Chapter 4. ServeRAID H1110 features

The ServeRAID H1110 SAS/SATA Controller for IBM System x uses the following features and technologies:

Resynchronization

The ServeRAID H1110 is designed to automatically resynchronize degraded RAID volumes in the background when a hot spare or a replacement disk is detected. While the resynchronization is running, the RAID volume continues to be accessible for normal operation.

Hot-swap disk replacement

The ServeRAID H1110 controller supports hot-swap disk replacement, and automatically resynchronizes hot-swapped disks in the background without any host or user intervention when the replacement drive meets the disk capacity and drive type requirements. Drive type requirements are such that SAS and SATA drives cannot be mixed within the same RAID volume. The controller detects hot-swap drive removal and new drive installation events with a supported hot-swap backplane.

Note: If a hot spare is configured, a rebuild to the spare begins automatically and the replacement drive becomes the new hot spare.

After a hot-swap event, the firmware makes sure that the new physical disk has enough capacity for the mirrored volume. The firmware resynchronizes all replaced hot-swapped disks, even if the same disk is reinserted. In a mirrored volume with an even number of disks, the firmware marks the hot-swapped disk as a secondary disk and the other disk with data as the primary disk. The firmware resynchronizes all data from the primary disk onto the new secondary disk. In a mirrored volume with an odd number of disks, primary and secondary sets include three disks instead of two.

Simple-swap disk replacement

In simple-swap configuration, a failed disk must be replaced while the server is powered off. When the server is powered on, the controller detects the replaced disk during startup and automatically begins a rebuild to the new drive, if the replacement drive meets the disk capacity and drive type requirements. Drive type requirement are defined such that SAS and SATA drives cannot be mixed within the same RAID volume.

Note: If a hot-spare drive is configured, a rebuild to the spare begins automatically and the replacement drive becomes the new hot-spare drive.

• Hot-spare drives

You can configure hot-spare drives to protect data on the mirrored volumes. Up to two global hot spares can be configured on the IBM SAS HBAs. If the integrated RAID firmware fails one of the mirrored drives, it automatically replaces the failed drive with a hot-spare drive and then resynchronizes the mirrored data. The firmware automatically receives a notification when a failed drive is replaced by a hot-spare drive, and it then designates that drive as the new hot-spare drive. The firmware periodically checks a hot-spare rebuild process so the rebuild can continue from where it stopped, if the server is restarted before the rebuild is completed.

• Online capacity expansion (OCE)

The OCE feature enables you to expand the capacity of an existing two-disk integrated mirroring (RAID-1) volume by replacing the original hard disk drives with higher capacity drives that have the same drive type (SAS or SATA).

Note: The new drives must have at least 50 GB more capacity than the original drives of the volume.

After you replace the hard disk drives and run the OCE command, you must use an independent software vendor tool that is specific to the operating system to move or increase the size of the partition on the volume.

Disk write caching

By default, the integrated RAID firmware disables disk write caching for mirrored volumes. It does this to make sure that data is not lost during an unexpected power outage. Do not enable write caching because it significantly increases the risk of data loss if an unexpected power outage occurs.

Background initialization (BGI)

BGI is the process of copying data from primary to secondary disks in a mirrored volume. The integrated RAID firmware starts BGI automatically as a background task when it creates a new RAID volume. The volume remains in the Optimal state while BGI is in progress.

Consistency check

A consistency check is a background process that reads data from primary and secondary disks in a mirrored volume, and compares it to make sure that the data is identical on both disks. Any inconsistencies are corrected if they are found.

Chapter 5. Physical hard disk drive utilities

The ServeRAID H1110 and the IBM SAS HBA feature several utilities that are designed to work with physical hard disks drives. The tools are accessible through the BIOS configuration utility for the SAS HBA.

 Press CTRL+C, select HBA, and select SAS Topology. Expand Direct Attached Devices and select the disk device. Press ALT+D to open the Device Properties window and select the utility.

Note: These tools are not available in the UEFI Human Interface Infrastructure.

- **Format.** The format tool is a very robust method to low-level format a hard disk drive. You cannot cancel the format tool after it is started. While the format tool is running, all errors are handled and corrected or the format process fails. When you run the format tool, all data on the hard disk drive is permanently erased. If a hard disk drive fails to successfully complete a low-level format, the drive is bad. If the drive successfully completes the formatting process, the drive is usually good.
- Verify. The verify tool performs a non-destructive read test on every sector of the hard disk drive and all errors are handled and corrected or the verify process fails. If the verify process is successful, there is a high degree of confidence that the drive is good with the caveat that no writes were performed during the test. An unsuccessful verify process indicates read problems that cannot be corrected. The drive is going bad and data loss is likely.

Note: The verify tool is available only for SAS hard disk drives.

These utilities are accessible only while the server is offline; therefore, a maintenance window of several hours is usually required to perform these tests.

Chapter 6. General problem determination tips

For problem determination, use the following general tips:

 Using consistency checks to diagnose RAID volumes on the ServeRAID H1110

For RAID volumes, running a periodic consistency check is important to make sure that drive maintenance occurs and that every sector receives attention from the controller. This reduces the number of errors that might occur when an application needs the data when this background operation periodically corrects inconsistencies. The automated media verification is the key. If the hard disk drives in a RAID volume successfully complete a consistency check without a disk failure, the drives are usually good. Serious drive problems are reported by the ServeRAID H1110 to the MegaRAID Storage Manager (MSM) software as event messages. After the consistency check is completed, you can review the event messages in MSM to see if any serious events were reported; however, these events do not determine if the drive is good. The RAID subsystem, including hard disk drives, firmware, and device drivers, are designed to handle and correct many error conditions. Severe errors cause the hard disk drive to be marked as Failed.

• Hard disk drive Predictive Failure Analysis (PFA)

This specification is designed into the hard disk drives to internally monitor and diagnose a likely failure in the near future. When a hard disk drive flags itself with a PFA, meaning that it expects to fail soon, the drive periodically sends a message to the controller with this status. A PFA alert is displayed in several ways:

- The system management (IMM) logs, if the server has a hot-swap backplane
- The MSM software
- SMART alert in the respective operating system event logs

The hard disk drive issuing the PFA alert is subject to fail at anytime and is replaceable as a warranty action as applicable.

Chapter 7. Problem determination procedures

Problem determination procedures have several starting points, depending on the indicator that alerts you to a problem within the subsystem. The troubleshooting paths are as follows:

- · Light path diagnostics LEDs-to-actions
- POST messages-to-actions
- Event messages-to-actions
- Symptom-to-actions
- System events-to-actions

If you cannot diagnose and correct a problem by using the information in this chapter, see Appendix A, "Getting help and technical assistance," on page 57 for more information.

Hard disk drive LED-to-action

Light path diagnostics LEDs on the front panel of the server indicate symptoms within the entire system; however, this *Problem Determination and Service Guide* is focusing only on the LEDs that are relative to the storage subsystem. The front panel display and bezel LEDs are used to solve hard disk drive problems.

If the hard disk drive status LED is lit, it means that an out-of-band alert for the RAID controller was posted to the system-event logs. These messages are helpful for remote administration and alert automation; however, when you are troubleshooting hard drive issues from the front of the system, use the following table to review the LED behaviors and take the applicable actions.

Table 1. Hard disk drive LED-to-action

Symptom	Action
A hard disk drive has failed, and	 Replace the failed hard disk drive that has an amber LED that is lit. Observe the drive LEDs for normal operation. The amber LED turns off, and
the associated amber hard disk	the green activity LED flashes while the hard disk drive is accessed by the
drive status LED is steady.	controller.

Table 1. Hard disk drive LED-to-action (continued)

Symptom	Action
An installed hard disk drive is	1. Is the hard disk drive amber LED lit or off?
not recognized.	 If the LED is lit, it indicates a drive fault.
	 If the LED is off, the drive is working correctly.
	 If the amber LED is lit, remove the drive from the bay, wait 45 seconds, and reinsert the drive, making sure that the tray latches correctly to the system chassis.
	Observe the associated green hard disk drive activity LED and the amber status LED:
	 If the green activity LED is flashing and the amber status LED is not lit, the drive is recognized by the controller and is working correctly. Run Dynamic System Analysis (DSA) to determine whether the drive is detected.
	 If the green activity LED is flashing and the amber status LED is flashing slowly, the drive is recognized by the controller and is rebuilding.
	 If neither LED is lit or flashing when the drive is inserted, the hard disk drive backplane might not have the correct power (go to step 4).
	 If the green activity LED is flashing and the amber status LED is lit, replace the drive. If the activity of the LEDs remains the same, go to step 4. If the activity of the LEDs changes, return to step 1.
	 Make sure that the hard disk drive backplane is correctly seated. When it is correctly seated, the drive assemblies correctly connect to the backplane without bowing or causing movement of the backplane.
	Move the hard disk drives to different bays to determine whether the drive or the backplane is not functioning.
	 Reseat the backplane power cables. Make sure that the cables are connected from the backplane to the server correctly. These black cables are keyed for correct installation and they latch when connected securely. Repeat steps 1 through 3.
	 Reseat the SAS/SATA cable connections. SAS/SATA cables latch and click when securely connected to the controller, backplane, or hard disk drive. Repeat steps 1 through 3.
	 Suspect the backplane signal cable or the backplane. If the server has eight hot-swap bays:
	a. Replace the affected SAS/SATA cable.
	b. Replace the affected SAS backplane.
	9. Run the DSA tests for the SAS controller and hard disk drives:
	 If the controller passes the test but the drives are not recognized, replace the backplane signal cable and run the tests again.
	Replace the backplane.
	 If the controller fails the test, disconnect the backplane signal cable from the controller and run the tests again.
	 If the controller fails the test, replace the controller.
	10. If the problems cannot be corrected with these steps, contact IBM support.
Multiple hard disk drives fail.	Make sure that the hard disk drive, SAS RAID controller, and server device drivers and firmware are at the latest level. Important: Some cluster solutions require specific code levels or coordinated code updates. If the device is part of a cluster solution, verify that the latest level of code is supported for the cluster solution before you update the code.

Table 1.	Hard	disk	drive	LED-to-action	(continued)
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Symptom	Ac	tion					
Multiple hard disk drives are offline.	1.	Review the storage subsystem logs for indications of problems within the storage subsystem, such as backplane or cable problems.					
	2.	To identify the cause of the problem, collect the storage subsystem logs and contact IBM support to review the logs and determine the corrective actions.					
A replacement hard disk drive does not rebuild.	1.	Make sure that the hard disk drive is recognized by the controller (the green hard disk drive activity LED is flashing).					
		Compare the bezel location to the Preboot GUI utility or the MegaRAID Storage Manager (MSM), or use the CLI command to determine the current state of the device. You might have to configure the device before you use it.					
	2.	If the Automatic Rebuild feature is disabled, the replacement drive will not rebuild. You must configure the replaced drive as a spare.					
	3.	The disk group/virtual drive (DG/VD) might have been protected by a hot spare and rebuilt to an alternative device. Check the configuration and determine whether the DG/VD is still degraded or whether another device is rebuilding.					
	4.	Evaluate the hard disk drive LEDs by using the instructions in "A hard disk drive is not detected after installation" in this table.					
An amber hard disk drive status LED does not accurately	1.	If the amber hard disk drive LED and the RAID controller software do not indicate the same status for the drive, complete the following steps:					
represent the actual state of the		a. Turn off the server.					
		b. Reseat the SAS controller.					
		c. Reseat the SAS/SATA cables.					
		d. Reseat the power cable connections to the backplane.					
		e. Reseat the SAS expander cables, if any are present.					
		f. Reseat the I2C cable from the backplane to the server.					
		g. Reseat the hard disk drive.					
		 Turn on the server and observe the activity of the hard disk drive LEDs for normal operation. 					
		i. Move the drive to another bay, if possible, to see whether the symptom stays with the drive.					
	2.	If the problem remains:					
		Replace the I2C cables.					
		Replace the backplane.					
	3.	If the problems cannot be corrected with these steps, contact IBM support.					

POST messages-to-action

SAS HBA POST messages are displayed after server power-on but before the operating system is loaded. POST messages do not appear during runtime operations, because they usually describe unexpected events that are detected between the previous shutdown and the most recent power on. Note all POST messages and follow the suggested actions.

IBM System x servers use two types of system initialization code: older servers use standard BIOS, and newer servers use UEFI. See your server documentation to determine which system initialization code is used. These two environments have different SAS HBA behaviors during the POST process.

In BIOS-based IBM servers, the SAS HBA displays a POST banner. While the POST banner is displayed, new event messages are displayed to notify you of events or pauses for events that require user interaction.

IBM UEFI-based servers require an operating system that is UEFI supported to take full advantage of the new specification. Most IBM UEFI-based servers support a legacy mode that emulates the standard BIOS for backward compatibility to legacy operating systems that are not UEFI supported. When UEFI detects an operating system that is not UEFI supported, the SAS HBA controllers display a POST banner. If a native UEFI-supported operating system is installed, the SAS HBA might not display a post banner during normal operation; however, critical POST event messages are displayed.

Fault codes

The following fault codes might display during POST.

Fault code	Description
0x01	NO_IO_PORT_ASSIGNED
0x02	MPT_FW_FAULT
0x03	NO_IMAGE_FOR_FWDLB
0x04	FWDLB_CHECKSUM_FAILED
0x05	IOC_HW_ERROR
0x06	MPT_FW_COMM_ERROR
0x07	PCI_BUS_MASTER_ERROR
0x08	STR_IMAGE_NOT_FOUND
0x09	STR_MEM_ALLOC_FAILED
0x0A	STR_UPLOAD_FAILED
0x0B	STR_INVALID_IMAGE
0x0C	UNSUPPORTED_IOC_CONFIG
0x0D	TIMEOUT_AWAITING_IOC_READY
0x0E	TX_DB_HANDSHAKE_ERROR
0x0F	RX_DB_HANDSHAKE_ERROR
0x10	NO_MMIO_ADDRESS_ASSIGNED
0x11	IOC_FACTS_FAILURE
0x12	IOC_INIT_FAILURE
0x13	PORT_ENABLE_FAILURE

Table 2. Fault codes that display during POST

If one of the fault codes in Table 2 is displayed during POST, try to recover the server by completing the following steps:

- 1. Use the controller hardware checkout procedure (see step 4b on page 9) and then check for correct operation.
- 2. If you can access the BIOS Configuration Utility, reset the controller to the default settings by completing the following steps:
 - a. Press CTRL+C.
 - b. Press ALT+N and select Global Properties → Restore Defaults → Save settings and Exit.

Note: RAID volumes on the ServeRAID H1110 are not modified or removed with the previous action.

After the controller is reset, check for correct operation.

- 3. If the server can boot to an operating system, flash the controller to the latest version of software and firmware or reflash the controller to the same code levels, then retry for normal operation.
- 4. Power-off the server and temporarily remove all cables from the controller. Power-on the server and observe for correct operation, or determine if the fault continues to occur or has changed.
 - If the fault continues without cables or hard disk drives attached, replace the controller.
 - If the fault does not occur, power off the server and attach one cable at a time restarting to observe for the problem. Determine if the fault is isolated to a controller channel, cable, or hard disk drive by modifying the configuration and swapping cables, channels, and drives. Replace the component that has failed.

Boot messages

The SAS HBA boot messages are described in the following table.

Table 3. SAS HBA boot messages

Event ID	STR_SAS_ADDRESS_ZERO
Message displayed	SAS Address NOT programmed on controller in slot #
Suggested actions	This message is displayed if no SAS address can be obtained for the adapter. Controllers require a SAS address to operate correctly. The address is lost. Under normal usage, this usually causes a hardware malfunction. If this occurred during a firmware update, retry the update, and then replace the controller if the error persists.
Event ID	STR INSTALL FAIL
Message displayed	LSI Corporation MPT boot ROM, no supported devices found!
Suggested actions	This message is displayed if the BIOS does not discover any devices capable of INT13 control on any compatible adapter initialized in its adapter scan.
Event ID	STR_UNSUPPORTED_DEVICE
Message displayed	One or more unsupported device detected!
Suggested actions	This message is displayed if discovery status for a port detects a device that firmware has flagged as unsupported. Check for unsupported devices that are attached to the controller.
Event ID	STR_DEVICE_NOT_AVAILABLE
Message displayed	Device not available at <bus lun="" tid=""></bus>
Suggested actions	This message is displayed when the core BIOS fails to get a device to spin up in enough time to access its information, and the BIOS has been configured to flag this condition as a hard error.
Event ID	STR_DEVICES_SPINNING_UP
Message displayed	Devices in the process of spinning up!
Suggested actions	This message is displayed when the core BIOS fails to get a device to spin up in enough time to access its information, and the BIOS has been configured to flag this condition as a warning.
Event ID	STR_BOOT_DEVICE_SPINNING_UP
Message displayed	Please wait, spinning up the boot device!
Suggested actions	This message is displayed if the first INT13 device controlled by the server BIOS requires a command to be issued to it before the device is ready for I/O activity. Check for compatibility of the controller in the server. Restart the server and then retry. Update the system code and then retry.
Event ID	STR_TOO_MANY_DEVICES
Message displayed	Failed to add device, too many devices!
Table 3. SAS HBA boot messages (continued)

Suggested actions	This message is displayed if the maximum number of devices that the BIOS can support is reached, and there are additional devices remaining to be scanned. Usually this is the case when a large number of INT13 devices are connected to the controller and you attempt to boot from a CD drive (that is also connected to the controller). Remove any unsupported devices and make sure that only the supported numbers of devices are attached. For more information, see the controller User's Guide.	
Event ID	STR_BUS_MASTER_ERROR	
Message displayed	Bus Master ERROR!	
Suggested actions	This message is displayed if the PCI bus mastering bit was not enabled by the BIOS.	
Event ID	STR_ADAPTER_MALFUNCTION	
Message displayed	ERROR! Adapter Malfunctioning!	
Suggested actions	This message is displayed when the core BIOS fails to get the firmware into an operational state (including performing a hardware reset). Flash or reflash the controller to the latest code, if possible. If the problem persists, replaced the controller.	
Event ID		
Message displayed	Adapter removed from boot order!	
Suggested actions	This message is displayed if the boot order detected on the first adapter contains invalid or missing entries. If multiple adapters are installed, check or configure the server and controller boot options, and retry for normal operation.	
Event ID	STR_BOOT_ORDER_INVALID	
Message displayed	Updating Adapter List!	
Suggested actions	This message is displayed if multiple adapters are installed and the first adapter in the boot order sequence does not contain a valid boot device. The first adapter will perform an update to its internal adapter list so that the next adapter in the boot order can start the server.	
	If this message continues to be displayed, check and configure the server boot options. To change the startup controller or disk, press F1 at server startup and select Boot Manager .	
	SIR_ADAPTER_DISABLED	
Message displayed	Adapter(s) disabled by user	
Suggested actions	This message is displayed when an adapter is detected that is intentionally configured to be disabled from BIOS control by settings in the BIOS Configuration Utility (CU).	
Event ID	STR IR EXCEPTION	
Message displayed	Integrated RAID exception detected: Volume (Hdl:###) is in state N	
Suggested actions	This message is displayed if a volume is detected in a non-optimal state. The ### is the internal device handle assigned to the volume. The value for "N" can be either Inactive, followed by the specific reason for the volume being in an Inactive state, or it can be the Non-Optimal state value that the volume is currently reporting.	

Table 3. SAS HBA boot messages (continued)

Event ID	STR_IR_VOL_FOREIGN_METADATA	
Message displayed	WARNING! Foreign Metadata detected	
Suggested actions	This message is displayed only if the integrated RAID firmware detects metadata on a device that is not compatible with the current firmware implementation.	

Event messages-to-actions

Event messages are found in the MegaRAID Storage Manager (MSM) application. Events that are logged into an operating-system event log usually have a correlating MSM event log entry. This section lists the MSM events that might appear in the event log.

MSM software monitors the activity and performance of all controllers in the server and the devices that are attached to them. When an event occurs, such as the start of an initialization, an event message is displayed in the log at the bottom of the MSM window.

Each message in the event log has an event type that indicates the severity of the event, as shown in the following table.

Event type	Description
Information	Informational message. No user action is necessary.
Warning	Some component might be close to a failure point.
Critical	A component has failed, but the server has not lost data.
Fatal	A component has failed, and data loss has occurred or will occur.

Table 4. MSM event types and descriptions

All of the MSM event messages are listed in the following table. Each event description includes one or more placeholders for specific values that are determined when the event is generated. For example, in message 0x0001 in Table 5, the value %s is replaced by the firmware version, which is read from the firmware when the event is generated.

Table 5. MSM event messages-to-action

Number	Туре	Event description	Suggested actions
0x0001	Information	MegaRAID firmware version %s	
0x0004	Information	Configuration cleared	
0x0005	Warning	Cluster down; communication with peer lost	Clustering is not supported by IBM
0x0006	Information	Virtual drive % <i>s</i> ownership changed from %02 <i>x</i> to %02 <i>x</i>	
0x0007	Information	Alarm disabled by user	
0x0008	Information	Alarm enabled by user	
0x0009	Information	Background initialization rate changed to %d%%	
0x000a	Fatal	Controller cache discarded due to memory/battery problems	The message is probably the result of a bad battery.
			1. Replace the battery.
			2. Replace the controller.
0x000c	Information	Cache data recovered successfully	
0x000d	Fatal	Controller cache discarded due to firmware version incompatibility	The cache write operations are firmware sensitive and might not be compatible with different versions of code. Return the controller to the previously used firmware version and retry. Update the adapter and enclosure unit firmware.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x000e	Information	Consistency check rate change to %d%%	
0x000f	Fatal	Fatal firmware error: %s	 The firmware error %s states which device had the error. This is expected to be a controller event. 1. Update the adapter and enclosure unit firmware. 2. Replace the device.
0x0010	Information	Factory defaults restored	
0x0011	Information	Flash downloaded image corrupt	
0x0012	Caution	Flash erase error	Update the adapter and enclosure unit firmware.
0x0013	Caution	Flash timeout during erase	Update the adapter and enclosure unit firmware.
0x0014	Caution	Flash error	Update the adapter and enclosure unit firmware.
0x0015	Information	Flashing image: %s	
0x0016	Information	Flash of new firmware images complete	
0x0017	Caution	Flash programming error	Update the adapter and enclosure unit firmware.
0x0018	Caution	Flash timeout during programming	Update the adapter and enclosure unit firmware.
0x0019	Caution	Flash chip type unknown	Update the adapter and enclosure unit firmware.
0x001a	Caution	Flash command set unknown	Update the adapter and enclosure unit firmware.
0x001b	Caution	Flash verify failure	Update the adapter and enclosure unit firmware.
0x001c	Information	Flush rate changed to %d seconds	
0x001d	Information	Hibernate command received from host	
0x001e	Information	Event log cleared	
0x001f	Information	Event log wrapped	
0x0020	Fatal	Multi-bit ECC error: ECAR=% <i>x</i> , ELOG=% <i>x</i> , (% <i>s</i>)	A multi-bit ECC error refers to the memory cache on the controller. Replace the controller.
0x0021	Warning	Single-bit ECC error: ECAR=% <i>x</i> , ELOG=% <i>x</i> , (% <i>s</i>)	A single-bit ECC error refers to the memory on the controller; however, the ECC recovered from the error. Replace the controller if the event repeats on a regular basis. By design, the controller memory can recover from a singe-bit error.
0x0022	Fatal	Not enough controller memory	Replace the controller.
0x0023	Information	Patrol Read complete	
0x0024	Information	Patrol Read paused	
0x0025	Information	Patrol Read Rate changed to %d%%	

Number	Туре	Event description	Suggested actions
0x0026	Information	Patrol Read resumed	
0x0027	Information	Patrol Read started	
0x0028	Information	Rebuild rate changed to %d%%	
0x0029	Information	Reconstruction rate changed to %d%%	
0x002a	Information	Shutdown command received from host	
0x002b	Information	Test event: %s	
0x002c	Information	Time established as <i>%s</i> ; (<i>%d</i> seconds since power on)	
0x002d	Information	User entered firmware debugger	
0x002e	Warning	Background Initialization aborted on %s	Investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might have caused this event. This is usually a symptom of another problem.
0x002f	Warning	Background Initialization corrected medium error (% <i>s</i> at % <i>lx</i>)	By design, the controller and, usually, the hard disk drive correct medium errors. No data is lost with a redundant virtual disk, but there might be a small exposure to data loss in a RAID-0 configuration when the physical medium error is corrected but the data that was stored at the location was not recovered. The controller automatically corrects this exposure within redundant virtual disks.
0x0030	Information	Background Initialization completed on %s	
0x0031	Fatal	Background initialization completed with uncorrectable errors on %s	Replace hard disk drive %s.
0x0032	Fatal	Background initialization detected uncorrectable double medium errors (%s at %lx on %s)	 If the events are targeted to the same hard disk drive, replace the drive. If the events point to two or more drives, investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might have caused this event. This might be a symptom of another problem. 1. Evaluate previous events to determine trending problems with physical devices. 2. If trending problems span multiple devices, check and reseat cable and device connections. 3. If trending problems are isolated to one device, replace that device. 4. Manually begin a consistency check and allow that process to be completed. 5. Evaluate the actions and conditions that exhibited the problem, or observe for normal behavior.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x0033	Caution	Background Initialization failed on %s	If the events are targeted to the same hard disk drive, replace the drive. If the events point to two or more drives, investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might have caused this event. This might be a symptom of another problem.
			 Evaluate previous events to determine trending problems with physical devices.
			 If trending problems span multiple devices, check and reseat cable and device connections.
			 If trending problems are isolated to one device, replace that device.
			 Manually begin a consistency check and allow that process to be completed.
			 Evaluate the actions and conditions that exhibited the problem, or observe for normal behavior.
0x0034	Progress	Background initialization progress on %s is %s	
0x0035	Information	Background initialization started on %s	
0x0036	Information	Policy change on %s from %s to %s	
0x0038	Warning	Consistency Check aborted on %s	A consistency check automatically aborts if the disk group or virtual disk becomes critical or offline for some other reason, or if a user modifies an existing virtual disk. Evaluate the server for these types of changes.
0x0039	Warning	Consistency Check corrected medium error (<i>%s</i> at <i>%lx</i>)	By design, the controller and, usually, the hard disk drive correct medium errors. No data is lost with a redundant virtual disk, but there might be a small exposure to data loss in a RAID-0 configuration when the physical medium error is corrected but the data that was stored at the location was not recovered. The controller automatically corrects this exposure within redundant virtual disks.
0x003a	Information	Consistency Check done on %s	
0x003b	Information	Consistency Check done with corrections on %s	

Number	Туре	Event description	Suggested actions
0x003c	Fatal	Consistency Check detected uncorrectable double medium errors (%s at %lx on %s)	If the events are targeted to the same hard disk drive, replace the drive. If the events point to two or more drives, investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might cause this event. This might be a symptom of another problem.
			1. Evaluate previous events to determine trending problems with physical devices.
			 If trending problems span multiple devices, check and reseat cable and device connections.
			 If trending problems are isolated to one device, replace that device.
			4. Run a new consistency check and evaluate whether it is completed correctly.
0x003d	Caution	Consistency Check failed on %s	 If the events are targeted to the same hard disk drive, replace the drive. If the events point to two or more drives, investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might cause this event. This might be a symptom of another problem. Evaluate previous events to determine trending problems with physical devices. If trending problems span multiple devices, check and reseat cable and device connections. If trending problems are isolated to one device, replace that device. Run a new consistency check and evaluate whether it is completed correctly.
0x003e	Fatal	Consistency Check completed with uncorrectable data on %s	 Investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might cause this event. This is typically a symptom of another problem. Data has been lost, so the order of recovery is as follows: Determine the cause of the failure by evaluating other event entries. Take the applicable corrective action for the failure mode. Determine what data was lost.
			 Recover the hardware (re-create logical drives if necessary).
			5. Restore data.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x003f	Warning	Consistency Check found inconsistent parity on %s at strip %lx	Inconsistencies on a logical drive do not always cause data loss, but they can lead to data loss over an extended period of time.
			Investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might cause this event. This is typically a symptom of another problem.
			 This event might occur if patrol read is disabled for long periods of time. Enable patrol read.
			 Evaluate previous events to determine trending problems with physical devices.
			 If trending problems span multiple devices, check and reseat cable and device connections.
			 If trending problems are isolated to one device, replace that device.
			5. Run a new consistency check and evaluate whether it is completed correctly.
0x0040	Warning	Consistency Check inconsistency logging disabled on %s (too many inconsistencies)	Inconsistencies on a logical drive do not always cause data loss, but they can lead to data loss over an extended period of time.
			Investigate other events to determine the cause of this event. A procedural, environmental, or physical problem within the subsystem might cause this event. This is typically a symptom of another problem.
			 This event might occur if patrol read is disabled for long periods of time. Enable patrol read.
			 Evaluate previous events to determine trending problems with physical devices.
			 If trending problems span multiple devices, check and reseat cable and device connections.
			 If trending problems are isolated to one device, replace that device.
			5. Run a new consistency check and evaluate whether it is completed correctly.
0x0041	Progress	Consistency Check progress on %s is %s	
0x0042	Information	Consistency Check started on %s	
0x0043	Warning	Initialization aborted on %s	This might be the result of an action by firmware or the result of user actions. Evaluate the previous procedures that were used to start and stop the initialization of a new or existing virtual disk. An initialization action is automatically stopped if the array becomes critical or offline or if a user interrupts this process.

 Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x0044	Caution	Initialization failed on %s	This might be the result of an action by firmware or the result of user actions. Evaluate previous procedures that were used to start and stop the initialization of a new or existing virtual disk. An initialization action is automatically stopped if the array becomes critical or offline, or if a user interrupts this process.
0x0045	Progress	Initialization progress on %s is %s	
0x0046	Information	Fast initialization started on %s	
0x0047	Information	Full initialization started on %s	
0x0048	Information	Initialization complete on %s	
0x0049	Information	LD Properties updated to %s (from %s)	
0x004a	Information	Reconstruction complete on %s	
0x004b	Fatal	Reconstruction of %s stopped due to unrecoverable errors	A rebuild stopped abnormally. An environmental, procedural, or physical device problem within the subsystem caused this event. Investigate other logged events to determine the cause of the problem.
			 Evaluate previous events to determine trending problems with physical devices.
			 If trending problems span multiple devices, check and reseat cable and device connections.
			3. If trending problems are isolated to one device, replace that device.
			 Manually begin a new rebuild and allow that process to be completed.
			 Evaluate the actions and conditions that exhibited the problem, or observe for normal behavior.

Number	Туре	Event description	Suggested actions
0x004c	Fatal	Reconstruct detected uncorrectable double medium errors (%s at %lx on %s at %lx)	 The rebuild process detected multiple error conditions within the disk group, and some data might be lost or inaccessible. This error halts the rebuild operation and identifies the drives that are reporting the errors. Investigate other logged events to determine trending errors on the identified drives and replace drives as necessary. Evaluate previous events to determine trending problems with physical devices. If trending problems span multiple devices, check and reseat cable and device connections. If trending problems are isolated to one or several devices, replace the devices. Determine whether data was lost. Restore data, if necessary. Evaluate the actions and conditions that exhibited the problem, or observe for
	<u> </u>		normal behavior.
0x004d	Progress	Reconstruction progress on %s is %s	
0x004e	Information	Reconstruction resumed on %s	
0x004f	Fatal	Reconstruction resume of <i>%s</i> failed due to configuration mismatch	The configuration might have changed after a rebuild operation was started and before it was completed. This can be the result of an action by firmware or the result of some user intervention. Evaluate the previous procedures that were used to start and stop the consistency check. Investigate previous related logged events to determine the cause of this event. A rebuild operation is automatically stopped if another drive fails or goes offline for some other reason, or if a user interrupts this process. If the user made physical changes to the subsystem while the server was powered off, the controller might not be able to resume a rebuild operation from a previous runtime session.
0x0050	Information	Reconstructing started on %s	
0x0051	Information	State change on %s from %s to %s	
0x0052	Information	Drive Clear aborted on %s	

Table 5. MSM event messages-to-action (continued)

Number Туре **Event description** Suggested actions 0x0053 Caution Drive Clear failed The physical drive could not initialize or clear its data structures. This might be a communication problem with the disk drive, or there is a low probability that the drive might be defective. 1. Evaluate previous events to determine trending problems with physical devices. 2. If trending problems span multiple devices, check and reseat cable and device connections. 3. Move the drive to a different drive bay location, if another drive bay is available. 4. Update the hard disk drive firmware. 5. Run Dynamic System Analysis on the hard disk drive to determine its status. 6. If the hard disk drive fails the diagnostic test or trending problems are isolated to one device, replace that device. 7. Try again to clear the drive, and evaluate whether this was completed correctly. 0x0054 Progress Drive Clear progress on %s is %s 0x0055 Information Drive Clear started on %s 0x0056 Information Drive Clear completed on %s 0x0057 Error on %s (Error %02x) Warning The indicated drive has errors. Monitor the drive and consider replacing it if the error count is excessive. Format complete on %s 0x0058 Information 0x0059 Information Format started on %s 0x005a Caution Hot Spare SMART polling failed The controller polled the identified device for SMART events, and the polling operation failed. This might be a communication problem with the disk drive, or there is a low probability that the drive might be defective. 1. Evaluate previous events to determine trending problems with physical devices. 2. If trending problems span multiple devices, check and reseat cable and device connections. 3. Move the drive to a different drive bay location, if another drive bay is available. 4. Update the hard disk drive firmware. 5. Run Dynamic System Analysis on the hard disk drive to determine its status. 6. If the hard disk drive fails the diagnostic test or trending problems are isolated to one device, replace that device. 7. Try again to clear the drive, and evaluate whether this was completed correctly. 0x005b Information Drive inserted: %s 0x005c Warning Drive %s is not supported

Number	Туре	Event description	Suggested actions
0x005d	Warning	Patrol Read corrected medium error on %s at %lx	
0x005e	Progress	Patrol Read progress on %s is %s	
0x005f	Fatal	Patrol Read found an uncorrectable medium error on % <i>s</i> at % <i>lx</i>	 The controller background patrol read operation found a media error on the identified drive, and the medium error cannot be corrected. This event usually causes the drive to be marked as failed. 1. Update the hard disk drive firmware. 2. Manually begin a consistency check and evaluate the drive for normal operation. 3. If the problems remain, replace the drive at %s.
0x0060	Caution	Predictive failure: CDB: %s	The drive has reached its internal error threshold and has sent a SMART alert (Predictive Failure Analysis alert) to the controller. The hard disk drive remains operational until it is marked as failed; however, the drive is predicted to fail soon. Replace the drive.
0x0061	Fatal	Patrol Read puncturing bad block on %s at %lx	The technique of "puncturing bad block" is an earlier method of managing bad blocks and is used only with older firmware versions. Upgrade the firmware as soon as possible. Run a consistency check to convert the bad block management into the current method, which is managed with a "bad block table." Puncturing bad blocks is not supported on storage devices that are larger than 72 GB.
0x0062	Information	Rebuild aborted by user on %s	
0x0063	Information	Rebuild complete on %s	
0x0064	Information	Rebuild complete on %s	
0x0065	Caution	Rebuild failed on %s due to source drive error	 The rebuild failed because of errors in the redundant data. In a critical mirror (RAID-1, 10) the source of the error is the online disk member. The drive at %s is the drive that is rebuilding, which is usually an operational disk. Make sure that there is a recent backup of the data, and try the rebuild operation again. If the rebuild operation continues to fail, you might have to re-create the disk group or virtual disks. There are usually other errors in the event logs that identify the source disk with an unrecoverable error. Note: This error might indicate some data loss because the error occurs while the disk group or virtual disk is critical and nonredundant. 1. Update the hard disk drive firmware. 2. Manually begin a new rebuild operation and evaluate the drive for normal operation. 3. If the problem remains, replace the source drive.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x0066	Caution	Rebuild failed on %s due to target drive error	The rebuild operation failed because of errors on the rebuilding hard disk drive. Replace the drive at % <i>s</i> .
0x0067	Progress	Rebuild progress on %s is %s	
0x0068	Information	Rebuild resumed on %s	
0x0069	Information	Rebuild started on %s	
0x006a	Information	Rebuild automatically started on %s	
0x006b	Caution	Rebuild stopped on %s due to loss of cluster ownership	IBM does not support clustering.
0x006c	Fatal	Reassign write operation failed on %s at %lx	Replace hard disk drive %s.
0x006d	Fatal	Unrecoverable medium error during rebuild on <i>%s</i> at <i>%lx</i>	Replace hard disk drive %s.
0x006e	Information	Corrected medium error during recovery on %s at %lx	
0x006f	Fatal	Unrecoverable medium error during recovery on %s at %lx	Replace hard disk drive %s.
0x0070	Information	Drive removed: %s	
0x0071	Warning	Unexpected sense: % <i>s</i> , CDB% <i>s</i> , Sense: % <i>s</i>	 As commands are sent to the hard disk drives, the controller expects applicable responses. When this error occurs, the controller received an unexpected response to a command. In a very busy server, this might occur infrequently without any significant problems; however, repeated events might indicate some level of incompatibility. 1. Update the hard disk drive firmware. 2. Update the controller firmware and device drivers. 3. Reboot the server (the reset might clear the problem).
0x0072	Information	State change on %s from %s to %s	
0x0073	Information	State change by user on $\%s$ from $\%s$ to $\%s$	
0x0074	Warning	Redundant path to %s is broken	 There is a communication problem within the SAS/SATA subsystem. The controller can no longer communicate with the %s device. 1. If this is a new installation, see the documentation for correct cabling instructions. 2. Check cables for damage, and reseat each cable. 3. If the problem remains, replace the applicable cables within the identified connections. 4. Replace the backplane. Note: Swap cables to identify the bad component through the process of elimination as needed.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x0075	Information	Redundant path to %s restored	
0x0076	Information	Dedicated Hot Spare Drive %s no longer useful due to deleted drive group	
0x0077	Caution	SAS topology error: Loop detected	There is a communication problem within the SAS/SATA subsystem. The controller can no longer communicate with the <i>%s</i> device.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.
0x0078	Caution	SAS topology error: Unaddressable device	There is a communication problem within the SAS/SATA subsystem. The controller cannot address the <i>%s</i> device.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.
0x0079	Caution	SAS topology error: Multiple ports to the same SAS address	There is a communication problem within the SAS/SATA subsystem. The controller detected multiple ports to the same SAS address.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x007a	Caution	SAS topology error: Expander error	 There is a communication problem within the SAS/SATA subsystem. The controller detected a problem with the expander on the backplane. 1. If this is a new installation, see the documentation for the correct cabling instructions. 2. Check cables for damage, and reseat each
			cable.
			update is available).
			4. Replace the backplane.
0x007b	Caution	SAS topology error: SMP timeout	There is a communication problem within the SAS/SATA subsystem. The controller detected problems with SMP commands timing out.
			1. If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.
0x007c	Caution	SAS topology error: Out of route entries	There is a communication problem within the SAS/SATA subsystem. The controller can no longer communicate with the devices.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.

Number	Туре	Event description	Suggested actions
0x007d	Caution	SAS topology error: Index not found	There is a communication problem within the SAS/SATA subsystem. The controller cannot locate a valid index of devices.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.
0x007e	Caution	SAS topology error: SMP function failed	There is a communication problem within the SAS/SATA subsystem. The controller detected problems with the SMP operations.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.
0x007f	Caution	SAS topology error: SMP CRC error	There is a communication problem within the SAS/SATA subsystem. The controller detected CRC errors in the SMP communication.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			4. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.

Number	Туре	Event description	Suggested actions
0x0080	Caution	SAS topology error: Multiple subtractive	There is a communication problem within the SAS/SATA subsystem. The controller detected multiple subtractive issues, which indicates that there are problems with the external enclosure unit cabling or the cables that chain the external enclosure units together.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			 Update the backplane or enclosure unit firmware (if a newer version is available).
			5. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.
0x0081	Caution	SAS topology error: Table to table	There is a communication problem within the SAS/SATA subsystem. The controller detected table-to-table issues, which usually indicates that there are problems with the external enclosure unit cabling or the cables that chain the external enclosure units together.
			 If this is a new installation, see the documentation for the correct cabling instructions.
			2. Check cables for damage, and reseat each cable.
			 If the problem remains, replace the applicable cables within the identified connections.
			 Update the backplane or enclosure unit firmware (if a newer version is available).
			5. Replace the backplane.
			Note: Swap cables to identify the bad component through the process of elimination as needed.

Number	Туре	Event description	Suggested actions
0x0082	Caution	SAS topology error: Multiple paths	 There is a communication problem within the SAS/SATA subsystem. The controller detected multiple path issues, which usually indicates that there are problems with the external enclosure unit cabling or the cables that chain the external enclosure unit together. 1. If this is a new installation, see the documentation for the correct cabling instructions. 2. Check cables for damage, and reseat each cable. 3. If the problem remains, replace the applicable cables within the identified connections. 4. Replace the backplane.
			component through the process of elimination as needed.
0x0083	Fatal	Unable to access device %s	 There is a communication problem within the SAS/SATA subsystem. The controller cannot access the device %s. 1. If this is a new installation, see the documentation for the correct cabling instructions. 2. Check cables for damage, and reseat each cable. 3. If the problem remains, replace the applicable cables within the identified connections. 4. Move device %s to a different slot (if available). 5. Replace the backplane. Note: Swap cables to identify the bad component through the process of elimination as needed.
0x0084	Information	Dedicated Hot Spare created on %s (%s)	
0x0085	Information	Dedicated Hot Spare %s disabled	
0x0086	Caution	Dedicated Hot Spare %s no longer useful for all drive groups	Check the size of the spare and then review the configuration to determine whether any active drive members are larger than the spare. If so, this event is correctly notifying you that a larger dedicated spare is required to protect the disk groups and virtual drives.
0x0087	Information	Global Hot Spare created on %s (%s)	
0x0088	Information	Global Hot Spare %s disabled	

Table 5. MSM event messages-to-action (continued)

Table 5. MSM event messages-to-action	(continued)
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Number	Туре	Event description	Suggested actions
0x0089	Caution	Global Hot Spare does not cover all drive groups	Check the size of the spare and then review the configuration to determine whether any active drive members are larger than the spare. If so, this event is correctly notifying you that a larger global spare is required to protect the disk groups and virtual drives.
0x008a	Information	Created %s}	
0x008b	Information	Deleted %s}	
0x008c	Information	Marking LD %s inconsistent due to active writes at shutdown	
0x008d	Information	Battery Present	
0x008e	Warning	Battery Not Present	Check the battery and the connection to the adapter. Install the battery if it was removed.
0x008f	Information	New Battery Detected	
0x0090	Information	Battery has been replaced	
0x0091	Caution	Battery temperature is high	Check the ambient temperature of the server. Make sure that the environmental configuration, temperatures, and airflow are correct for the server and rack.
0x0092	Warning	Battery voltage low	1. Begin a battery calibration and allow it to be completed.
			2. Observe for battery events and normal operation.
0.0000			3. If the problem remains, replace the battery.
0x0093	Information	Battery started charging	
0x0094	Information	Battery is discharging	
0x0095	Information	Battery temperature is normal	Deplace the bettery
0x0096		Bad	
0x0097	Information	Battery relearn started	
0x0098	Information	Battery relearn in progress	
0x0099	Information	Battery relearn completed	
0x009a	Caution	Battery relearn timed out	1. Reseat the battery connections.
			2. Begin a battery calibration and allow it to be completed.
			3. Observe for battery events and normal operation.
			 If the problem remains, update the controller firmware (if a new version is available) and retry.
			5. If the problem remains, replace the battery and try again.
			6. If the problem remains, replace the controller.
0x009b	Information	Battery relearn pending: Battery is under charge	

Number	Туре	Event description	Suggested actions
0x009c	Information	Battery relearn postponed	
0x009d	Information	Battery relearn will start in 4 days	
0x009e	Information	Battery relearn will start in 2 day	
0x009f	Information	Battery relearn will start in 1 day	
0x00a0	Information	Battery relearn will start in 5 hours	
0x00a1	Information	Battery removed	
0x00a2	Information	Current capacity of the battery is below threshold	
0x00a3	Information	Current capacity of the battery is above threshold	
0x00a4	Information	Enclosure (SES) discovered on %s	
0x00a5	Information	Enclosure (SAFTE) discovered on %s	
0x00a6	Caution	Enclosure %s communication lost	 There is a communication problem within the SAS/SATA subsystem. The controller lost communication with the backplane or external storage enclosure. 1. If this is a new installation, see the documentation for the correct cabling instructions. 2. Check cables for damage, and reseat each cable. 3. If the problem remains, replace the applicable cables within the identified connections. 4. For an internal enclosure unit, replace the backplane. 5. For an external enclosure unit, see the enclosure unit documentation for more information. Note: Swap cables to identify the bad component through the process of elimination
0x00a7	Information	Enclosure %s communication restored	
0x00a8	Caution	Enclosure %s fan %d failed	 Check the enclosure unit fan for correct operation. See the enclosure unit documentation for more information.
0x00a9	Information	Enclosure %s fan %d inserted	 Check the enclosure unit fan for correct operation. See the enclosure unit documentation for more information.
0x00aa	Caution	Enclosure %s fan %d removed	 Check the enclosure unit fan for correct operation. See the enclosure unit documentation for more information.

Table 5. MSM event messages-to-action (continued)

Table 5. MSM event messages-to-action ((continued)
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Number	Туре	Event description	Suggested actions
0x00ab	Caution	Enclosure %s power supply %d failed	 Check the enclosure unit power supply for correct operation. See the enclosure unit documentation for more information
0x00ac	Information	Enclosure %s power supply %d inserted	
0x00ad	Caution	Enclosure %s power supply %d removed	 Check the enclosure unit power supply for correct operation. See the enclosure unit documentation for more information.
0x00ae	Caution	Enclosure %s SIM %d failed	See the enclosure unit documentation for more information.
0x00af	Information	Enclosure %s SIM %d inserted	
0x00b0	Caution	Enclosure %s SIM %d removed	See the enclosure unit documentation for more information.
0x00b1	Warning	Enclosure % <i>s</i> temperature sensor % <i>d</i> below Warning threshold	Check the ambient temperature of the server. Make sure that the environmental configuration, temperatures, and airflow are correct for the server and rack.
0x00b2	Caution	Enclosure % <i>s</i> temperature sensor % <i>d</i> below error threshold	Check the ambient temperature of the server. Make sure that the environmental configuration, temperatures, and airflow are correct for the server and rack.
0x00b3	Warning	Enclosure % <i>s</i> temperature sensor % <i>d</i> above Warning threshold	Check the ambient temperature of the server. Make sure that the environmental configuration, temperatures, and airflow are correct for the server and rack.
0x00b4	Caution	Enclosure % <i>s</i> temperature sensor % <i>d</i> above error threshold	Check the ambient temperature of the server. Make sure that the environmental configuration, temperatures, and airflow are correct for the server and rack.
0x00b5	Caution	Enclosure %s shutdown	This might be an expected event if the enclosure unit was intentionally shut down. Otherwise, check the enclosure unit power and cables. See the enclosure unit documentation for more information.
0x00b6	Warning	Enclosure unit %s is not supported; too many enclosure units are connected to a port	There is a communication problem within the enclosure unit subsystem. The controller detected too many enclosure units connected to a port. This usually indicates problems with external enclosure unit cabling or the cables that chain the external enclosure units together. See the enclosure unit documentation for more information.
0x00b7	Caution	Enclosure unit %s firmware mismatch	Update the controller and enclosure unit firmware until they operate together correctly.
0x00b8	Warning	Enclosure %s sensor %d bad	A sensor cannot report its status or has failed. If it has failed, some information might be missing from the management of the unit. See the enclosure unit documentation to determine which part should be serviced.

Table 5. MSM event messages-to-acti	ion (continued)
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Number	Туре	Event description	Suggested actions
0x00b9	Caution	Enclosure %s phy %d bad	PHY is the physical port connector. Check the cable from the adapter to the enclosure unit. Check the enclosure unit power. Examine the enclosure unit LEDs.
0x00ba	Caution	Enclosure %s is unstable	 Check the enclosure unit LEDs for correct operation. See the enclosure unit documentation for more information.
0x00bb	Caution	Enclosure %s hardware error	 Check the enclosure unit LEDs for correct operation. See the enclosure unit documentation for more information.
0x00bc	Caution	Enclosure %s not responding	 Check the enclosure unit LEDs for correct operation. See the enclosure unit documentation for more information.
0x00bd	Information	SAS/SATA mixing not supported in enclosure; Drive %s disabled	
0x00be	Information	Enclosure (SES) hotplug on %s was detected, but is not supported	
0x00bf	Information	Clustering enabled	IBM does not support clustering.
0x00c0	Information	Clustering disabled	IBM does not support clustering.
0x00c1	Information	Drive too small to be used for auto-rebuild on %s	
0x00c4	Warning	Bad block table on drive %s is 80% full	This event causes the %s hard disk drive to be marked as failed. Replace the drive at %s.
0x00c5	Fatal	Bad block table on drive %s is full; unable to log block %lx	This event causes the % <i>s</i> hard disk drive to be marked as failed. Replace the drive at % <i>s</i> .
0x00c6	Information	Consistency Check Aborted due to ownership loss on %s	
0x00c7	Information	Background Initialization (BGI) Aborted Due to Ownership Loss on %s	
0x00c8	Caution	Battery/charger problems detected; SOH Bad	 Reseat the battery connections. Begin a battery calibration and allow it to be completed. Observe for battery events and normal operation. If the problem remains, update the controller firmware (if a new version is available) and try again. If the problem remains, replace the battery and try again. If the problem remains, replace the controller.

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x00c9	Warning	Single-bit ECC error: ECAR=%x, ELOG=%x, (%s); Warning threshold exceeded	A single-bit ECC memory error threshold was exceeded. The controller is alerting you that the memory on the controller will probably fail soon. Replace the controller. Note: At this time there is no data loss.
0x00ca	Caution	Single-bit ECC error: ECAR=% <i>x</i> , ELOG=% <i>x</i> , (% <i>s</i>); critical threshold exceeded	A single-bit ECC memory error threshold was exceeded, and the number of errors is excessive. The controller is alerting you that the memory on the controller is failing rapidly. Shut down the server and replace the controller as soon as possible. Note: At this time there is no data loss.
0x00cb	Caution	Single-bit ECC error: ECAR=%x, ELOG=%x, (%s); further reporting disabled	A single-bit ECC memory error threshold was exceeded, and any new events are not logged. The controller is alerting you that the memory on the controller is not trustworthy. Shut down the server and replace the controller as soon as possible. Note: Additional single-bit ECC errors might cause bad data, and these errors are not reported.
0x00cc	Caution	Enclosure %s Power supply %d switched off	 Check the enclosure unit power supply for correct operation. See the enclosure unit documentation for
			more information.
0x00cd	Information	Enclosure %s Power supply %d switched on	
0x00ce	Caution	Enclosure %s Power supply %d cable removed	 Check the enclosure unit power supply cabling. See the enclosure unit documentation for more information
0x00cf	Information	Enclosure %s Power supply %d cable removed	
0x00d0	Information	Enclosure %s Power supply %d cable inserted	
0x00d4	Information	NVRAM Retention test was initiated on previous boot	
0x00d5	Information	NVRAM Retention test passed	
0x00d6	Caution	NVRAM Retention test failed!	Replace the controller.
0x00d7	Information	%s test completed %d passes successfully	
0x00d8	Caution	%s test FAILED on %d pass.	 Check the cables and connections. Reseat the %s device. If this is a new configuation, check the device by swapping it to a new slot position and determine whether the problem is the device, backplane, or cable. Observe the server for normal operation. If the problem remains, replace the %s
			device.

Number	Туре	Event description	Suggested actions
0x00d9	Information	Self check diagnostics completed	
0x00da	Information	Foreign Configuration Detected	
0x00db	Information	Foreign Configuration Imported	
0x00dc	Information	Foreign Configuration Cleared	
0x00dd	Warning	NVRAM is corrupt; reinitializing	Allow the controller enough time to try to correct the problem programmatically. If the controller is stopped or is unable to recover, power off and disconnect the hard disk drives from the controller. Power on the server and start the WebBIOS. Clear the controller configuration (reset to defaults). If the controller stabilizes, reattach the drives and allow the RAID configuration to import the existing configuration. If the controller does not
0x00de	Warning	NVRAM mismatch occurred	Allow the controller enough time to try to correct the problem programmatically. If the controller is stopped or is unable to recover, power off and disconnect the hard disk drives from the controller. Power-on the server and start the WebBIOS. Clear the controller configuration (reset to defaults). If the controller stabilizes, reattach the drives and allow the RAID configuration to import the
			existing configuration. If the controller does not stabilize, update the firmware on the controller.
0x00df	Warning	SAS wide port <i>%d</i> lost link on PHY <i>%d</i>	The controller lost a wide port link. A wide port link in this configuration usually means that a 4-channel connection to an expander-based backplane or enclosure unit was downgraded from 4 active channels to 3 active channels. The controller will take a channel down when too many errors occur on the link and will often reset the channel and restore the link programmatically. This is normal operation; however, repeating events might indicate a systemic problem within that connection.
0x00e0	Information	SAS wide port <i>%d</i> restored link on PHY <i>%d</i>	
0x00e1	Warning	SAS port <i>%d</i> , PHY <i>%d</i> has exceeded the allowed error rate	
0x00e2	Warning	Bad block reassigned on %s at %lx to %lx	
0x00e3	Information	Controller Hot Plug detected	
0x00e4	Warning	Enclosure % <i>s</i> temperature sensor % <i>d</i> differential detected	An enclosure unit is reporting a temperature threshold event.
0x00e5	Information	Drive test cannot start. No qualifying drives found	
0x00e6	Information	Time duration provided by host is not sufficient for self check	

Table 5. MSM event messages-to-action (continued)

Number	Туре	Event description	Suggested actions
0x00e7	Information	Marked Missing for %s on drive group %d row %d	
0x00e8	Information	Replaced Missing as %s on drive group %d row %d	
0x00e9	Information	Enclosure %s Temperature %d returned to normal	
0x00ea	Information	Enclosure %s Firmware download in progress	
0x00eb	Warning	Enclosure %s Firmware download failed	The controller is reporting from the enclosure unit that the recent firmware update failed. Review the firmware update procedure for the enclosure unit and try the firmware update again.
0x00ec	Warning	%s is not a certified drive	The controller is reporting that an uncertified drive is detected at a specific location. If the drive is newly inserted in the controller, remove the drive and check for any specific drive requirements or labeling that is defined for this solution.
0x00ed	Information	Dirty cache data discarded by user	
0x00ee	Information	Drives missing from configuration at boot	
0x00ef	Information	Virtual drives (VDs) missing drives and will go offline at boot: %s	
0x00f0	Information	VDs missing at boot: %s	
0x00f1	Information	Previous configuration completely missing at boot	
0x00f2	Information	Battery charge complete	
0x00f3	Information	Enclosure %s fan %d speed changed	
0x0128	Information	Cache discarded on offline virtual drive. When a VD with cached data goes offline or missing during runtime, the cache for the VD is discarded. Because the VD is offline, the cache cannot be saved.	

Table 5. MSM event messages-to-action (continued)

Symptoms-to-actions

This section lists common symptoms and suggested actions to take.

The SAS HBA is not seen during POST, or the Preboot GUI is not accessible

Applicability:

- The server is BIOS-based, and the SAS HBA does not display a POST banner.
- The Preboot GUI configurator (Ctrl+C) is inaccessible or does not start.
- The server is UEFI-based, and the Preboot GUI configurator in "Applications and Settings" is inaccessible or does not start.

Possible causes:

- The keyboard or mouse is faulty.
- There is a problem with UEFI, BIOS, or a device driver.
- PCI ROM execution is disabled in the setup utility.
- There is no power to the PCI slot. Check the light path diagnostics panel (NMI/SMI).
- The SAS HBA is malfunctioning.
- There are bad storage disk drives.
- · The controller or riser card is not correctly seated in the PCI slot.
- There is a problem with the system board.

Problem determination procedure:

- 1. Reseat the keyboard and mouse connections. If a KVM is used, test a local keyboard and mouse to make sure that you can interact with the server.
- 2. Check the server light path diagnostics panel for possible issues.
- 3. Restart the server, and start the BIOS or UEFI setup utility by pressing F1.
- 4. From the setup utility, check the following settings to make sure that the PCI slot is configured correctly:
 - a. Check the advanced PCI settings to enable PCI ROM execution for the slot.
 - b. Check and enable Rehook Int 19h in the Start Options.
- 5. If the controller is not detected correctly, power off the server, remove all disk drives from the backplane, and power on the server. If the controller is still not detected correctly, go to the next step.
- 6. Power off the server and open the server cover.
- 7. Disconnect all SAS/SATA cables (including external SAS/SATA cables).
- 8. Disconnect the remote battery.
- 9. Remove the SAS HBA.
- 10. Inspect the PCI slot and controller for damage.
- 11. Make sure that the controller is in a supported PCI slot.
- 12. Inspect the SAS/SATA cables for damage, overstretching, nicks, or an excessive bend radius.
- 13. Reseat the SAS HBA (do not attach SAS/SATA cables or battery).
- 14. Make sure that any PCI hot-plug latches are correctly seated.

15. Power on the server.

If these setting changes do not correct the problem, load the default settings to try to correct the problem.

- 16. Observe for system power good indicators. (For more information, see the *Problem Determination and Service Guide* that comes with the server.)
- 17. Observe for correct LED activity on the SAS HBA. Not all controllers have LEDs. For more information, see the *Quick Installation Guide* for each controller.
- 18. If the server is now able to detect the SAS HBA, power off the server and attach the missing SAS/SATA cables and remote battery one at a time while you try the tests again each time.
- 19. Reseat the battery (if applicable) and power on the server.

Note: If you get a battery error message, you might have a faulty battery.

Other considerations:

With only one controller and one PCI slot, it is difficult to determine which component is at fault. Additional hardware, another available PCI slot, or another test server greatly increases your ability to isolate the fault. For example, you can test whether other adapters work in the suspect PCI slot and whether the controller works correctly in another PCI slot or server.

One or more SAS HBAs are inaccessible when multiple storage controllers are installed

Applicability:

- Two or more SAS HBAs are installed.
- Additional non-ServeRAID adapters are installed in the server.
- The server does not boot correctly after another controller is installed.
- The server generates an 1801 POST error after a new controller is installed.

Possible causes:

- The new controller takes a higher position in the PCI scan order and becomes the primary boot controller.
- No option ROM memory space is available for additional adapters.

Problem determination procedure:

- If the controller was recently added and caused the boot failure, remove the new controller to confirm that the original configuration continues to work. If it does, the cause of the problem is probably the scan order of the PCI buses in the server. In some servers, you can change the scan order by using the BIOS or UEFI setup utility, and in other servers, the scan order is fixed. In a server with a fixed PCI scan order, a good work-around is to swap the slot locations of the controllers in the server to make sure that the boot controller takes the highest priority slot location.
- Use the advanced PCI settings to enable or disable PCI ROM execution for the slot. Only the boot SAS HBA requires the BIOS to be enabled. Usually you can disable other SAS storage controllers without affecting their operational status. This also frees up option ROM space for other adapters.
- Make sure that both controllers are operating with the same software. For multiple SAS HBAs to operate correctly within the same server, both controllers must have the same BIOS and firmware to reduce the probability of incompatibilities.
- 4. For the secondary controller, make sure that the attached drives do not contain a bootable virtual disk from another configuration. If the data is not needed, clear the configuration from the added drives by using the Preboot GUI.

System events-to-actions index

System events originate from the server and are logged in the service processor in the server. Service processors vary from server to server, depending on the current technology and generation of the hardware. System events can significantly impact the operational status of the SAS HBA or provide clues to resolving complex issues. Generally, the following list of event types can indicate a wide impact to the server and in some cases can help to isolate a hardware problem from a software or firmware problem:

- · PCI events
- · Memory events
- · Processor events

For details about troubleshooting, see the *Problem Determination and Service Guide* for the server and review the information about system-event logs and service processors, such as the integrated management module (IMM), baseboard management controller (BMC), and Remote Supervisor Adapter.

Chapter 8. Replaceable components

Field replaceable units (FRUs) must be replaced only by a trained service technician, unless they are classified as customer replaceable units (CRUs).

Tier 1 CRU: Replacement of Tier 1 CRUs is your responsibility. If IBM installs a Tier 1 CRU at your request without a service contract, you will be charged for the installation.

Tier 2 CRU: You may install a Tier 2 CRU yourself or request IBM[®] to install it, at no additional charge, under the type of warranty service that is designated for your product.

For information about the terms of the warranty, see the *Warranty Information* document and that comes with the SAS HBA. For information about getting service and assistance, see Appendix A, "Getting help and technical assistance," on page 57.

Part number	Description	
81Y4494	ServeRAID H1110 SAS/SATA Controller for IBM System x	
68Y7363	IBM 6 Gb Performance Optimized HBA and expansion-slot bracket	
68Y7354	IBM 6 Gb SAS HBA and expansion-slot bracket	

Table 6. Field replaceable units for the SAS HBSs

Appendix A. 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 section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your 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 and any optional devices are turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system. Information about diagnostic tools is in the *Problem Determination and Service Guide* on the IBM *Documentation* CD that comes with your system.
- Go to the IBM support website at http://www.ibm.com/supportportal/ to check for technical information, hints, tips, and new device drivers or to submit a request for information.

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

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, 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/supportportal/ and follow the instructions. Also, some documents are available through the IBM Publications Center at http://www.ibm.com/shop/publications/order/.

Getting help and information from the World Wide Web

On the World Wide Web, the IBM website has up-to-date information about IBM systems, optional devices, services, and support. The address for IBM System x[®] and xSeries[®] information is http://www.ibm.com/systems/x/. The address for IBM BladeCenter[®] information is http://www.ibm.com/systems/bladecenter/. The address for IBM IntelliStation[®] information is http://www.ibm.com/systems/intellistation/.

You can find service information for IBM systems and optional devices at http://www.ibm.com/supportportal/.

Software service and support

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

For more information about Support Line and other IBM services, see http://www.ibm.com/services/, or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services. To locate a reseller authorized by IBM to provide warranty service, go to http://www.ibm.com/partnerworld/ and click **Find Business Partners** on the right side of the page. For IBM support telephone numbers, see http://www.ibm.com/planetwide/. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

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.

IBM Taiwan product service



IBM Taiwan product service contact information: IBM Taiwan Corporation 3F, No 7, Song Ren Rd. Taipei, Taiwan Telephone: 0800-016-888

Appendix B. Notices

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UNIX is a registered trademark of The Open Group in the United States and other countries.

Important notes

Processor speed indicates the internal clock speed of the microprocessor; other factors also affect application performance.

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1024 bytes, MB stands for 1,048,576 bytes, and GB stands for 1,073,741,824 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1,000,000 bytes, and GB stands for 1,000,000 bytes. Total user-accessible capacity can vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives that are available from IBM.

Maximum memory might require replacement of the standard memory with an optional memory module.

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Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.
Index

Α

assistance, getting 57 attention notices 2

С

caution statements 2 collecting data 7 collecting data using DSA 7 CRU part numbers 55 customer replaceable units (CRUs) 55

D

danger statements 2 data collection 7 documentation, related 1 DSA, using to collect data 7

Ε

electrical equipment, servicing vi event messages 27 MegaRAID Storage Manager 27 POST 21

F

FRU part numbers 55

G

getting help 57 guidelines installation 2 servicing electrical equipment vi system reliability 3 trained service technicians vi

Η

handling static-sensitive devices 4 hard disk drive LEDs 19 hardware service and support 58 help, getting 57

IBM Support Line 58 important notices 2 inspecting for unsafe conditions vi installation guidelines 2

L

LEDs, hard disk drive 19

Μ

MegaRAID Storage Manager event messages event 27 MegaRAID Storage Manager 27 POST 21

Ν

notes 2 notes, important 60 notices 59 notices and statements 2

Ρ

parts listing 55 POST messages 21 power on, working inside server 4

R

related documentation 1 replacement parts 55 RETAIN tips 10 returning components 5

S

Safety v safety hazards, considerations vi safety statements viii servicing electrical equipment vi software service and support 58 software updates 8 statements and notices 2 static-sensitive devices, handling 4 support, website 57 symptoms-to-actions 50 system events 53 system reliability guidelines 3

Т

telephone numbers 58 trademarks 59 troubleshooting procedures 10

U

updates, applying for software 8 using DSA to collect data 7

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W

website publication ordering 57 support 57 support line, telephone numbers 58 working inside server 4

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