USER'S GUIDE

MegaRAID® SAS RAID Controllers

April 2007

LSI LOGIC®

80-00130-01 Rev. B

This document contains proprietary information of LSI Logic Corporation. The information contained herein is not to be used by or disclosed to third parties without the express written permission of an officer of LSI Logic Corporation.

LSI Logic products are not intended for use in life-support appliances, devices, or systems. Use of any LSI Logic product in such applications without written consent of the appropriate LSI Logic officer is prohibited.

Purchase of I^2C components of LSI Logic Corporation, or one of its sublicensed Associated Companies, conveys a license under the Philips I^2C Patent Rights to use these components in an I^2C system, provided that the system conforms to the I^2C standard Specification as defined by Philips.

Document 80-00130-01 Rev. B, April 2007. This document describes the current versions of the LSI Logic Corporation MegaRAID SAS RAID controllers and will remain the official reference source for all revisions/releases of these products until rescinded by an update.

LSI Logic Corporation reserves the right to make changes to any products herein at any time without notice. LSI Logic does not assume any responsibility or liability arising out of the application or use of any product described herein, except as expressly agreed to in writing by LSI Logic; nor does the purchase or use of a product from LSI Logic convey a license under any patent rights, copyrights, trademark rights, or any other of the intellectual property rights of LSI Logic or third parties.

TRADEMARK ACKNOWLEDGMENT
LSI Logic, the LSI Logic logo design, Fusion-MPT, and MegaRAID are trademarks or registered trademarks of LSI Logic Corporation. Microsoft and Windows are registered trademarks of Microsoft Corporation. SUSE is a trademark and NetWare is a registered trademark of Novell, Inc. Red Hat is a registered trademark of Red Hat, Inc. UnixWare is a registered trademark of The Open Group. OpenServer is a trademark of Caldera International, Inc. Linux is a registered trademark of Linus Torvalds. All other brand and product names may be trademarks of their respective companies.

CD

To receive product literature, visit us at http://www.lsi.com.

For a current list of our distributors, sales offices, and design resource centers, view our web page located at

http://www.lsi.com/contacts/index.html

Preface

This document is the primary reference and user's guide for the LSI Logic MegaRAID® Serial Attached SCSI/SATA II RAID Controllers. It contains complete installation instructions for these controllers and includes specifications for them.

The MegaRAID Serial Attached SCSI (SAS) RAID Controller family consists of the following:

- MegaRAID SAS 8204ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8204XLP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8208ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8208XLP PCI-X Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8300XLP PCI-X Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller
- MegaRAID SAS 8304ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8308ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8344ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with External Connectors and Internal Connectors
- MegaRAID SAS 8408E PCI Express Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 8480E PCI Express Serial-Attached SCSI/SATA II Disk Array Controller with External Connectors

- MegaRAID SAS 84016E PCI Express Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors

For details on how to configure the RAID controllers, refer to the *MegaRAID SAS Software User's Guide*. For information about the operating system drivers, refer to the *MegaRAID SAS Device Driver Installation User's Guide*.

Audience

This document assumes that you have some familiarity with RAID controllers and related support devices. The people who benefit from reading this book are:

- Engineers who are designing a system that will include a MegaRAID SAS RAID Controller
- Anyone who is installing a MegaRAID SAS RAID Controller in a RAID system

Organization

This document has the following chapters and appendix:

- Chapter 1, **Overview**, provides an overview of the MegaRAID controllers.
- Chapter 2, **MegaRAID SAS Hardware Installation**, describes the procedures for installing the MegaRAID controllers.
- Chapter 3, **MegaRAID SAS RAID Controller Characteristics**, provides the characteristics and technical specifications for the MegaRAID controllers.
- Appendix A, **Glossary of Terms and Abbreviations**, lists and defines the terms and abbreviations used in this manual.

Related Publications

MegaRAID SAS Device Driver Installation User's Guide

Document Number: 80-00163-01 Rev. A

This document describes how to install the MegaRAID device driver for your operating system. The information in this document is independent of the back-end bus and applies to the MegaRAID SAS RAID controllers.

MegaRAID SAS Software User's Guide

Document Number: 80-00156-01 Rev. A

This document describes how to use the MegaRAID Storage Manager, WebBIOS, and command line interface (CLI) utilities to configure, monitor, and maintain MegaRAID SAS RAID Controllers and the storage-related devices connected to them.

MegaRAID Battery Backup Unit User's Guide

Document Number: 80-00162-01 Rev. A

This document explains how to install and use the LSI Logic battery backup units for MegaRAID SAS RAID Controllers. The SAS boards use the LSI Logic intelligent Battery Backup Unit 01 (LSIiBBU01) and the LSI Logic intelligent Transportable Battery Backup Unit 02 (LSIiTBBU02).

Conventions

The following table describes how the user interacts with the product:

Notation	Example	Meaning and Use
Courier typeface	`.nwk` file	Names of commands, files, and directories, as well as code and screen messages, are shown in Courier.
Bold typeface	**fd1sp**	In a command line, keywords are shown in bold, non-italic typeface. Enter them exactly as shown.

Notation	Example	Meaning and Use
Italics	*module*	In command lines and names, italics indicate user variables. Replace italicized text with appropriate user-specified items. Enter items of the type called for, using lowercase.
Initial capital letters	Undo Edit Apply	Names of menu commands, options, check buttons, text buttons, options buttons, text boxes, list boxes, and so on, are shown in text with Initial Capital lettering to avoid misreading. These elements might appear on your screen in all lowercase.
semicolon, and other punctuation		Use as shown in the text.

Note: Notes contain supplementary information that can affect system performance.

Caution: Cautions are notifications that an action has the potential to adversely affect equipment operation, system performance, or data integrity.

Revision History

Document Number	Date/Version	Remarks
80-00130-01 Rev. B	Version 1.3 April 2007	Removed the reference to Microsoft Cluster Server (MSCS) support by the SAS 8408E RAID controller and the SAS 8480E RAID controller. Added the SAS 8204ELP RAID controller, SAS 8204XLP RAID controller, SAS 8304ELP RAID controller, and the SAS 84016E RAID controller.
80-00130-01 Rev. A	Version 1.2 April 2006	Added the SAS 8208ELP, SAS 8208XLP, and SAS 8300XLP RAID controllers.
DB15-000336-01	Version 1.1 February 2006	Added the SAS 8308ELP RAID controller and SAS 8344ELP RAID controller.
DB15-000336-00	Version 1.0 November 2005	Initial release of document.

Safety Instructions

Use the following safety guidelines to help protect your computer system from potential damage and to ensure your own personal safety.

Note: Use the MegaRAID SAS RAID Controllers with UL-listed Information Technology Equipment (ITE) products only.

When Using Your Computer System – As you use your computer system, observe the following safety guidelines:

Caution: Do not operate your computer system with any covers (such as computer covers, bezels, filler brackets, and front-panel inserts) removed.

- To avoid damaging your computer, make sure that the voltage selection switch on the power supply is set to match the alternating current (AC) power available at your location:
  - 115 volts (V)/60 hertz (Hz) in most of North America and South America, and some Far Eastern countries such as Japan, South Korea, and Taiwan.
  - 230 V/50 Hz in most of Europe, the Middle East, and the Far East. Also be sure your monitor and attached peripherals are electrically rated to operate with the AC power available in your location.
- To avoid possible damage to the system board, wait five seconds after you turn off the system before you remove a component from the system board or disconnect a peripheral device from the computer.
- To prevent electric shock, plug the computer and peripheral power cables into properly grounded power sources. These cables are equipped with three-prong plugs to ensure proper grounding.
- Do not use adapter plugs or remove the grounding prong from a cable. If you must use an extension cable, use a three-wire cable with properly grounded plugs.
- To protect your computer system from sudden, transient increases and decreases in electrical power, use a surge suppressor, line conditioner, or uninterruptible power supply (UPS).
- Be sure nothing rests on your computer system cables and that the cables are not located where they can be stepped on or tripped over.

- Do not spill food or liquids on your computer. If the computer gets wet, consult the documentation that came with it.
- Do not push any objects into the openings of your computer. Doing so can cause fire or electric shock by shorting out interior components.
- Keep your computer away from radiators and heat sources. Also, do not block cooling vents. Avoid placing loose papers underneath your computer; do not place your computer in a closed-in wall unit or on a rug.

When Working Inside Your Computer –

Caution: Do not attempt to service the computer system yourself, except as explained in this guide and elsewhere in LSI Logic documentation. Always follow installation and service instructions closely.

1. Turn off your computer and any peripherals.
2. Disconnect your computer and peripherals from their power sources. Also disconnect any telephone or telecommunications lines from the computer.

   Performing these actions reduces the potential for personal injury or shock.

Also note these safety guidelines:

- When you disconnect a cable, pull on its connector or on its strain-relief loop, not on the cable itself. Some cables have a connector with locking tabs. If you are disconnecting this type of cable, press in on the locking tabs before you disconnect the cable. As you pull connectors apart, keep them evenly aligned to avoid bending any connector pins. Also, before you connect a cable, make sure that both connectors are correctly oriented and aligned.
- Handle components and cards with care. Do not touch the components or contacts on a card. Hold a card by its edges or by its metal mounting bracket. Hold a component, such as a microprocessor chip, by its edges, not by its pins.

Protecting Against Electrostatic Discharge – Static electricity can harm delicate components inside your computer. To prevent static damage, discharge static electricity from your body before you touch any of your computer's electronic components, such as the microprocessor.

To discharge static electricity by touching an unpainted metal surface, such as the metal around the card-slot openings at the back of the computer.

As you continue to work inside the computer, periodically touch an unpainted metal surface to remove any static charge your body may have accumulated. In addition to the preceding precautions, you can also take the following steps to prevent damage from electrostatic discharge:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component in your computer. Just before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.

Contents

Figures

Tables

Chapter 1
Overview

This section provides an overview of the RAID controllers with RAID control capabilities. It consists of the following sections:

1.1 Overview

The MegaRAID SAS controllers are high-performance intelligent PCI Express-to-SCSI/Serial ATA II adapters with RAID control capabilities. RAID controllers provide reliability, high performance, and fault-tolerant disk subsystem management. They are an ideal RAID solution for the internal storage of workgroup, departmental, and enterprise systems. RAID controllers offer a cost-effective way to implement RAID in a server.

SAS technology brings a wealth of options and flexibility with the use of SAS and Serial ATA (SATA) II devices within the same storage infrastructure. However, SAS and SATA devices bring individual characteristics that make each one a more suitable choice depending on your storage needs. MegaRAID gives you the flexibility to combine these two similar technologies on the same controller, within the same enclosure, and in the same virtual disk.

Note: LSI Logic recommends that you carefully assess any decision to mix SAS and SATA drives within the same *virtual disks*. Though you can do this, LSI strongly discourages the practice.

The RAID controllers are based on the LSI Logic first-to-market SAS IC technology and proven MegaRAID technology. As the second-generation PCI Express RAID controller, the MegaRAID SAS controllers address the growing demand for increased data throughput and scalability requirements across midrange and enterprise-class server platforms. LSI Logic offers a family of MegaRAID SAS controllers addressing the needs for both internal and external solutions.

The innovative LSI Logic intelligent Battery Backup Unit 1 (LSIiBBU01) and LSI Logic intelligent Transportable Battery Backup Unit 2 (LSIiTBBU02) for cached data protection allow system builders to protect cached data even during the most catastrophic system failures. Refer to the *MegaRAID Battery Backup Unit User's Guide* or the *MegaRAID iTBBU02 Transportable Battery Backup Unit Quick Installation Guide* on the *MegaRAID Universal Software Suite* CD for more information about these batteries.

The SAS controllers support the ANSI *Serial Attached SCSI standard, version 1.1*. In addition, the controller supports the SATA II protocol defined by the *Serial ATA specification, version 1.0a*. Supporting both the SAS and SATA II interfaces, the SAS controller is a versatile controller that provides the backbone of both server and high-end workstation environments.

Each port on the SAS RAID controller supports SAS devices, SATA II devices, or both using the following protocols:

- SAS Serial SCSI Protocol (SSP), which enables communication with other SAS devices
- SATA II, which enables communication with other SATA II devices
- Serial Management Protocol (SMP), which communicates topology management information directly with an attached SAS expander device
- Serial Tunneling Protocol (STP), which enables communication with a SATA II device through an attached expander

1.2 SAS Controller Descriptions

The 1068-based SAS RAID controllers are described as follows:

- The MegaRAID SAS 8204ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls four internal SAS/SATA ports through one mini SAS 4i internal connector.
- The MegaRAID SAS 8208ELP PCI Express Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight internal SAS/SATA ports through two mini SAS 4i internal connectors.
- The MegaRAID SAS 8204XLP PCI-X Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls four internal SAS/SATA ports through one mini SAS 4i internal connector.
- The MegaRAID SAS 8208XLP PCI-X Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight internal SAS/SATA ports through two mini SAS 4i internal connectors.
- The MegaRAID SAS 8300XLP PCI-X Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller has one Intel 80321 Intelligent I/O processor and is a zero-channel SAS RAID controller.
- The MegaRAID SAS 8304ELP PCI Express Low-Profile Disk Array RAID Controller has one Intel IOP333 I/O processor and one LSI SAS1068 that controls four SAS ports.
- The MegaRAID SAS 8308ELP PCI Express Low-Profile Disk Array RAID Controller has one Intel IOP333 I/O processor and one LSI SAS1068 that controls eight SAS ports.
- The MegaRAID SAS 8344ELP PCI Express Low-Profile Disk Array RAID Controller has one Intel IOP333 I/O processor. This processor controls four internal SAS/SATA ports and four external SAS/SATA ports through one SAS 4x external connector and one mini SAS 4i internal connector.
- The MegaRAID SAS 8408E PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor that controls eight internal SAS/SATA ports through two mini SAS 4i internal connectors.
- The MegaRAID SAS 8480E PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor that controls eight external SAS/SATA ports through two SAS 4x external connectors.

- The MegaRAID SAS 84016E PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor and two LSI SAS1068s that control 16 internal SAS/SATA ports through four SAS 4x internal connectors.

1.3 General Description

The RAID controllers bring 3.0 Gbit/s Serial Attached SCSI and 3.0 Gbit/s SATA II performance to host adapter, workstation, and server designs. The controllers support internal and external storage devices, which allow you to use a system that supports enterprise-class SAS and desktop-class SATA II drives. Each RAID controller can connect to drives directly and can use expanders to connect to additional drives. Simplified cabling between devices is an additional benefit.

The SAS controllers integrate eight high-performance SAS/SATA II PHYs and a PCI Express bus master DMA core. Each of the eight PHYs is capable of 3.0 Gbit/s SAS link rates and 3.0 Gbit/s SATA II link rates.

The SAS RAID controllers support the SAS protocol as described in the *Serial Attached SCSI Standard*, *version 1.1*. The controllers also support the Serial ATA II (SATA II) protocol defined by the *Serial ATA specification, version 2.5*. The *SATA II specification, version 2.5*, is an integrated version of previous SATA specifications, including SATA 1.0a and extensions to SATA 1.0a. In addition, the SAS RAID controllers support the following SATA II features:

- 3 Gbit/s SATA II
- Staggered spin-up
- Hot plug
- Native command queuing
- Activity and fault indicators for each PHY
- Port selector (for dual-port drives)

Each port on the SAS controllers supports SAS devices, SATA II devices, or both using the SSP, SMP, STP, and SATA II. The SSP enables communication with other SAS devices. SATA II enables the SAS controllers to communicate with other SATA II devices.

1.4 Configuration Scenarios

There are three main scenarios in which you can use the SAS RAID controllers:

- **Low-end, internal SATA II configuration:** In this configuration, use the RAID controller as a high-end SATA II compatible controller that connects up to eight disks either directly or through a port expander. This configuration is mostly for low-end or entry-level servers. Enclosure management is provided through out-of-band I^2C bus. Side bands of both types of internal SAS connectors support the SFF-8485 (SGPIO) interface.
- **Midrange internal SAS configuration:** This configuration is similar to the internal SATA II configuration, but with high-end disks. This is more suitable for low-range to midrange servers.
- **High-end external SAS/SATA II configuration:** This configuration is for both internal and external connectivity, using SATA II drives, SAS drives, or both. External enclosure management is supported through in-band, SCSI-enclosed storage. The configuration must support STP and SMP.

Figure 1.1 shows a direct-connect configuration. The Inter-IC (I^2C) interface communicates with peripherals. The external memory bus provides a 32-bit memory bus, parity checking, and chip select signals for nonvolatile static random access memory (NVSRAM) and Flash ROM.

Figure 1.1 Example of an LSI Logic SAS Direct-Connect Application

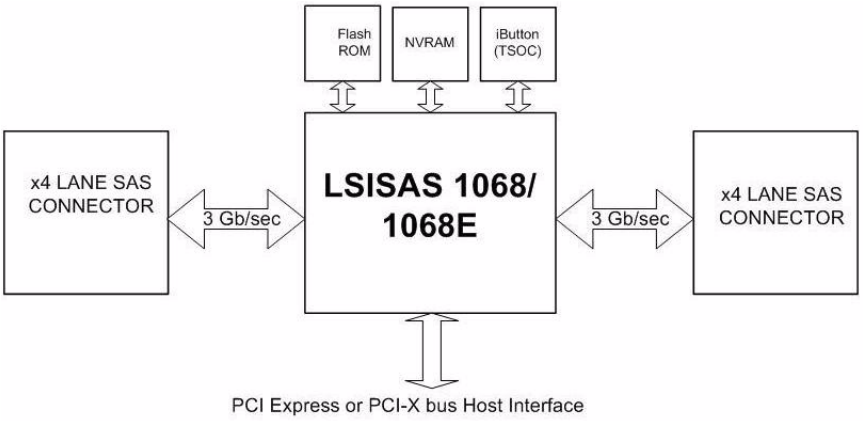
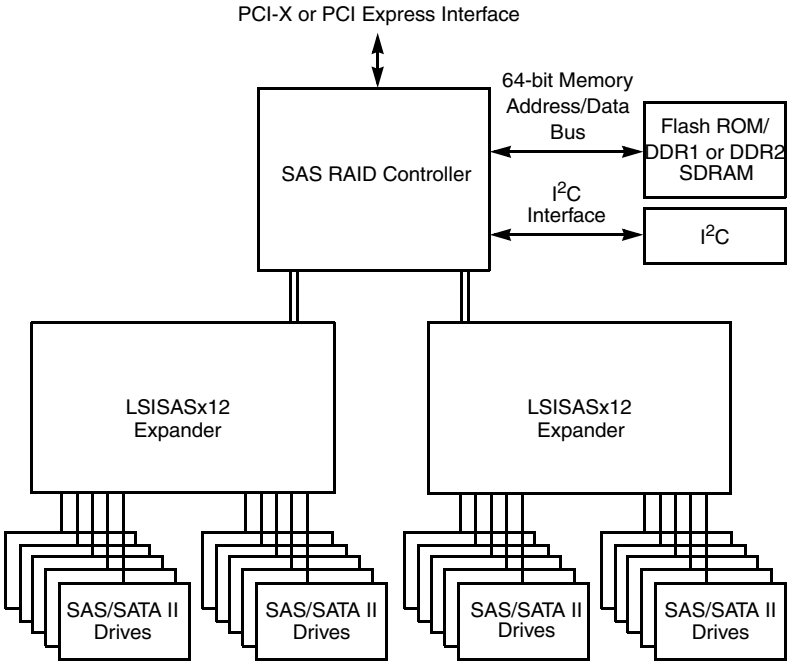


Figure 1.2 shows an example of a SAS RAID controller configured with an LSISASx12 expander that is connected to SAS devices, SATA II devices, or both.

Figure 1.2 Example of LSI Logic SAS RAID Controller Configured with LSISASx12 Expander



1.5 Benefits of the SAS Interface

SAS is a serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. SAS is a convergence of the advantages of SATA II, SCSI, and Fibre Channel, and is the future mainstay of the enterprise and high-end workstation storage markets. SAS offers a higher bandwidth per pin than parallel SCSI, and it improves signal and data integrity.

The SAS interface uses the proven SCSI command set to ensure reliable data transfers, while providing the connectivity and flexibility of point-to-point serial data transfers. The serial transmission of SCSI commands eliminates clock-skew challenges. The SAS interface provides improved performance, simplified cabling, smaller connectors, lower pin count, and lower power requirements when compared to parallel SCSI.

SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS and SATA II protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable. The SAS/SATA II connector and cable are easier to manipulate, allow connections to smaller devices, and do not inhibit airflow. The point-to-point SATA II architecture eliminates inherent difficulties created by the legacy ATA master-slave architecture, while maintaining compatibility with existing ATA firmware.

1.5.1 PCI Express Architecture

PCI Express is a local bus system designed to increase data transfers without slowing down the central processing unit (CPU). You can install MegaRAID PCI Express RAID controllers in PCI Express computer systems with a standard bracket type. With these adapters in your system, you can connect SCSI and SATA II devices over the bus.

PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

1.5.2 Operating System Support

The SAS RAID controllers supports the following operating systems:

- Windows 2000, Windows Server 2003, and Windows XP
- Red Hat Linux
- SUSE Linux
- NetWare
- OpenServer
- UnixWare

To download the latest operating system drivers, you can access http://www.lsi.com/cm/DownloadSearch.do?locale=EN.

The RAID controllers use Fusion-MPT architecture for all major operating systems, thinner drivers, and better performance.

1.6 Summary of SAS RAID Controller Characteristics

This section provides a summary of the features and benefits of the SAS RAID controller. It contains information on SAS features, SATA II features, PCI performance, integration, usability, and flexibility.

The RAID controllers include the following features:

PCI Features –

- PCI Express x4 lane width for the SAS 8204ELP, SAS 8208ELP, SAS 8304ELP, SAS 8308ELP, and SAS 8344ELP RAID controllers
- PCI Express x8 lane width for the SAS 8408E, SAS 8480E, and SAS 84016E RAID controllers (with support for downshifting for system boards with x1 and x4 connections)
- PCI Express performance up to 2.5 Gbits/s per lane
- PCI-X performance up to 1064 Mbytes/s

Cache Configurations –

- Support for 128- and 256-Mbyte DDR1 333 MHz on-board SDRAM with remote LSIiBBU01 intelligent battery backup (SAS 8304ELP, SAS 8308ELP, and SAS 8344ELP RAID controllers)
- Support for a 256 Mbyte DDR2 400 MHz on-board SDRAM with LSIiTBBU02 intelligible transportable battery backup (SAS 8408E and SAS 8480E RAID controllers)
- Support for 256 Mbyte on-board SDRAM with remote LSIiBBU01 intelligent battery backup (SAS 84016E RAID controller)

Connectors –

- One internal connector for the SAS 8204ELP and SAS 8204XLP RAID controllers
- Two internal connectors for the SAS 8208ELP, SAS 8208XLP, SAS 8304ELP, SAS 8308ELP, and SAS 8408E RAID controllers
- Four internal connectors for the SAS 84016E RAID controller
- One external connector and one internal connector for the SAS 8344ELP RAID controller
- Two external connectors for the SAS 8480E RAID controller

Software and Hardware Features –

- Support for RAID levels 0, 1, 5, 10, and 50
- Advanced array configuration and management utilities
- Online RAID level migration
- Drive migration
- Drive roaming
- Patrol read
- No reboot necessary after expansion
- More than 200 Qtags per array
- Hardware clustering support on the board
- User-specified rebuild rate

- 32-Kbyte nonvolatile random access memory (NVRAM) for storing RAID system configuration information; the MegaRAID SAS firmware is stored in flash ROM for easy upgrade.

1.6.1 SAS Features

The following list describes the SAS features:

- Provides eight fully independent PHYs
- Supports 3.0 Gbit/s SAS data transfers per PHY
- Supports SSP to enable communication with other SAS devices
- Supports SMP to communicate topology management information
- Provides a serial, point-to-point, enterprise-level storage interface
- Simplifies cabling between devices
- Provides a scalable interface that supports up to 122 devices through multiple expanders

  Note: The number of devices supported varies depending on the MegaRAID product. Check the LSI Logic web site (http://www.lsi.com) for specific details about your product.
- Supports wide ports consisting of 2, 3, or 4 PHYs within a single quad port
- Supports narrow ports consisting of a single PHY
- Transfers data using SCSI information units

1.6.2 SAS Array Limitations

This section describes the array limitations of the MegaRAID 1068-based SAS RAID controllers. These include limitations such as the number of physical disks supported, the maximum number of disks per controller, and the maximum number of virtual disks allowed per controller.

Table 1.1 lists the array limitations for the 1068-based SAS RAID controllers.

Table 1.1 SAS RAID Controller Array Limitations

	Maximum Virtual Disks per Controller	Maximum Arrays per Controller	Maximum Virtual Disks per Array	Maximum Drives per Array	Maximum Drives per Controller	Maximum Hot Spares	Maximum Spans per Virtual Disk	Maximum Enclosures per Port*	Maximum Ports
SAS 8208 ELP	8	8	8	8	8	8	4	3	2
SAS 8208 XLP	8	8	8	8	8	8	4	3	2
SAS 8300 XLP	64	128	16	8	8	8	4	3	2**
SAS 8304 ELP	64	128	16	8	8	8	4	3	1
SAS 8308 ELP	64	128	16	16	16	16	8	3	2
SAS 8344 ELP	64	128	16	32	122	122	8	7	2
SAS 84016 ELP	64	128	16	32	122	122	8	3	4
SAS 8408 E	64	128	16	32	32	32	8	3	2
SAS 8480 E	64	128	16	32	122	122	8	3	2

* Assumes one SEP (Storage Enclosure Processor) per enclosure.

** Depends on the number of channels on the system board. The maximum is two.

Note: The maximum number of hot spares for each array is equal to the maximum number of drives for each array.

These RAID controllers support 64-bit logical block addressing (LBA), which makes it possible to connect a large number of drives to the RAID controller, directly and through expanders. However, the actual number of drives that you can attach depends on the SAS RAID array controller limits rather than on the actual RAID volume capacity. These limits are listed in Table 1.1.

1.6.3 SATA II Features

The following list describes the SATA II features:

- Supports SATA II data transfers of 3.0 Gbits/s
- Supports STP data transfers of 3.0 Gbits/s
- Provides a serial, point-to-point storage interface
- Simplifies cabling between devices
- Eliminates the master-slave construction used in parallel ATA
- Allows addressing of multiple SATA II targets through an expander
- Allows multiple initiators to address a single target (in a failover configuration) through an expander

1.6.4 PCI Express Performance

The following list describes the PCI Express performance features:

- Provides a PCI Express interface that:
  - Supports a dedicated PCI Express bus
  - Supports x4 or x8 lane configuration
  - Supports transfer rates of up to 2.5 Gbits/s per lane
  - Complies with the *PCI Express Specification*, *Revision 1.0a*
- Provides unequaled performance through the Fusion-MPT architecture
- Provides high throughput and low CPU utilization to offload the host processor
- Uses an Intel IOP333 I/O processor. (The MegaRAID SAS 8208ELP RAID Controller does not use an Intel IOP333 I/O processor.)

1.6.5 PCI-X Performance

The following list describes the PCI-X performance features:

- Provides a PCI-X interface that:
  - Supports a dedicated PCI-X bus
  - Supports a maximum transfer rate of 1064 Mbytes/s

  - Complies with the *PCI-X Addendum to the PCI Local Bus Specification, Revision 1.0a*
- Provides unequaled performance through the Fusion-MPT architecture
- Provides high throughput and low CPU utilization to offload the host processor

1.6.6 Usability Features

The following list describes the usability features of the SAS RAID controllers:

- Simplifies cabling with point-to-point, serial architecture
- Supports smaller, thinner cables that do not restrict airflow
- Provides drive spin-up sequencing control
- Provides up to two LED signals for each PHY to indicate link activity and faults
- Provides an I^2C interface for enclosure management
- Supports the internal SAS Sideband signal SFF-8485 (SGPIO) interface

1.6.7 Flexibility Features

These features increase the flexibility of the SAS RAID controllers:

- Supports a Flash ROM interface, a nonvolatile static RAM (NVSRAM) interface, and a Double Data Rate (DDR) 1 or DDR 2 SDRAM interface

  Note: The SAS 8208ELP RAID Controller and the SAS 8208XLP RAID controller do not use DDR memory.
- Offers a flexible programming interface to tune I/O performance
- Allows mixed connections to SAS or SATA II targets
- Leverages compatible connectors for SAS and SATA II connections
- Allows grouping of up to four PHYs in a single quad port to form a wide port
- Allows programming of the World Wide Name

1.6.8 Drive Roaming

Drive roaming occurs when the hard drives are changed to different ports on the same controller. When the drives are placed on different channels, the controller detects the RAID configuration from the configuration data on the drives.

Note: In a clustering environment, drive roaming is supported within the same channel only.

Configuration data is saved in both the NVRAM on the RAID controller and on the hard drives attached to the controller. This action maintains the integrity of the data on each drive, even if the drives have changed their target ID.

Note: If you move a drive that is being rebuilt, the rebuild operation will restart, not resume.

Follow these steps to use drive roaming:

Step 1. Turn off all power to the server and all hard drives, enclosures, and system components. Disconnect power cords from the system.

Step 2. Open the host system by following the instructions in the host system technical documentation.

Step 3. Move the drives to different positions on the backplane to change the targets.

Step 4. Determine the SAS target requirements.

Step 5. Perform a safety check.

a. Make sure that the drives are inserted correctly.

b. Close the cabinet of the host system.

Step 6. Reconnect the power cords to the system.

Step 7. Turn on the power to the system.

The controller then detects the RAID configuration from the configuration data on the drives.

1.6.9 Drive Migration

Drive migration is the transfer of a set of hard drives in an existing configuration from one controller to another. The drives must remain on the same channel and must be reinstalled in the same order as in the original configuration. The controller to which you migrate the drives cannot have an existing configuration.

Note: Only complete configurations can be migrated; individual virtual disks cannot be migrated.

Note: Drive roaming and drive migration cannot be supported at the same time.

Follow these steps to migrate drives:

Step 1. Make sure that you clear the configuration on the system to which you migrate the drives, to prevent a configuration data mismatch between the hard drives and the NVRAM.

Note: When you migrate drives, move only the disks that make up the virtual disk (not all of the physical disks in an array), so you do not see an NVRAM mismatch error (providing a configuration is on the destination controller). The NVRAM mismatch error appears only if you move all of the physical drives to the other controller.

Step 2. Turn off all power to the server and all hard drives, enclosures, and system components. Disconnect power cords from the systems.

Step 3. Open the host system by following the instructions in the host system technical documentation.

Step 4. Either remove the SAS cable connectors from the internal drives, or remove the shielded cables from the external drives that you want to migrate.

a. Make sure that pin 1 on the cable matches pin 1 on the connector.

b. Make sure that the SAS cables conform to all SAS specifications.

Step 5. Remove the hard drives from the first system, and insert them into drive bays on the second system.

Step 6. Connect the SAS cables to the hard drives in the second system.

Step 7. Determine the SAS target requirements.

Step 8. Perform a safety check.

a. Make sure that all of the cables are attached correctly.

b. Make sure that the RAID controller is installed correctly.

c. Close the cabinet of the host system.

Step 9. Reconnect the power cords to the system.

Step 10. Turn on the power to the system.

The controller detects the RAID configuration from the configuration data on the drives.

1.7 Hardware Specifications

You can install the RAID controllers in a computer with a system board that has a PCI Express slot. Table 1.2 describes the hardware configuration features for the MegaRAID SAS controllers.

Table 1.2 MegaRAID Controller Comparisons

Specification	MegaRAID SAS 8208ELP, MegaRAID SAS 8208XLP, MegaRAID SAS 8300XLP, MegaRAID SAS 8304ELP, MegaRAID SAS 8308ELP, MegaRAID SAS 8344ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E and MegaRAID SAS 84016E RAID Controllers
RAID levels	0, 1, 5, 10, and 50
Devices supported per port	1 SAS device or SATA II device for each port. The device can be a physical drive or an expander. If an expander, the controller can access more than one drive through that port-expander connection.
Ports	• MegaRAID SAS 8204ELP RAID controller – Four internal • MegaRAID SAS 8208ELP RAID controller – Eight internal • MegaRAID SAS 8204XLP RAID controller – Four internal • MegaRAID SAS 8208XLP RAID controller – Eight internal • MegaRAID SAS 8304ELP RAID controller – Four internal • MegaRAID SAS 8308ELP RAID controller – Eight internal • MegaRAID SAS 8344ELP RAID controller – Four internal, four external • MegaRAID SAS 8408E RAID controller – Eight internal • MegaRAID SAS 8480E RAID controller – Eight external • MegaRAID SAS 84016E RAID controller – 16 internal
Data transfer rate	Up to 3 Gbits/s per PHY
Bus	PCI Express 1.0a; PCI-X 1.0a
Cache function	Write-back, write-through, adaptive read ahead, non-read ahead, read ahead, cache I/O, direct I/O
Multiple virtual disks/ arrays per controller	Up to 40 virtual disks for each controller or for each logical array

Table 1.2 MegaRAID Controller Comparisons

Specification	MegaRAID SAS 8208ELP, MegaRAID SAS 8208XLP, MegaRAID SAS 8300XLP, MegaRAID SAS 8304ELP, MegaRAID SAS 8308ELP, MegaRAID SAS 8344ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E and MegaRAID SAS 84016E RAID Controllers
Online capacity expansion	Yes
Dedicated and global hot spares	Yes
Hot-swap devices supported	Yes
Non-disk devices supported	Yes
Mixed capacity physical disks supported	Yes
Number of internal connectors	• MegaRAID SAS 8204ELP RAID controller – One (x4 SAS Port) mini SAS 4i connector • MegaRAID SAS 8208ELP RAID controller – Two (x4 SAS Port) mini SAS 4i connectors • MegaRAID SAS 8204XLP RAID controller – One (x4 SAS Port) mini SAS 4i connector • MegaRAID SAS 8208XLP RAID controller – Two (x4 SAS Port) mini SAS 4i connectors • MegaRAID SAS 8304ELP RAID controller – One (x4 SAS Port) SFF-8086 mini SAS 4i connector • MegaRAID SAS 8308ELP RAID controller – Two (x4 SAS Port) SFF-8086 mini SAS 4i connectors • MegaRAID SAS 8344ELP RAID controller – One (x4 SAS Port) SFF-8086 mini SAS 4i connector • MegaRAID SAS 8408E RAID controller – Two (x4 SAS Port) SFF-8484 SAS 4i connectors • MegaRAID SAS 84016E RAID controller – Four (x4 SAS Port) SFF-8086 mini SAS 4i connectors
Number of external connectors	• MegaRAID SAS 8344ELP RAID controller – One (x4 SAS Port) SFF-8470 SAS 4x connector • MegaRAID SAS 8480E RAID controller – Two (x4 SAS Port) SFF-8470 SAS 4x connectors
Hardware exclusive OR (XOR) assistance	Yes
Direct I/O	Yes
Architecture	Fusion-MPT

1.8 Technical Support

For assistance in installing, configuring, or running your RAID controller, contact LSI Logic Technical Support:

Phone Support:

1-800-633-4545 (North America)

Web Site:

http://www.lsi.com/support

Chapter 2
MegaRAID SAS
Hardware Installation

This chapter describes the procedures used to install the MegaRAID Serial Attached SCSI/Serial ATA II RAID controllers with internal and external connectors. It consists of the following sections:

2.1 Requirements

The following items are required to install a MegaRAID SAS RAID controller:

- One of the following RAID controllers: SAS 8204ELP, SAS 8208ELP, SAS 8204XLP, SAS 8208XLP, SAS 8300XLP, SAS 8304ELP, SAS 8308ELP, SAS 8344ELP, SAS 8408E, SAS 8480E, or SAS 84016E
- A host system with an available PCI Express or PCI-X expansion slot
- The *MegaRAID Universal Software Suite* CD, which contains the drivers and documentation
- The necessary internal cables, external cables, or both
- SAS physical drives or SATA II physical disks

Note: LSI Logic strongly recommends using an uninterruptible power supply (UPS).

2.2 Quick Installation

The following steps are for quick MegaRAID SAS RAID controller installation. These steps are for experienced computer users or installers. Section 2.3, "Detailed Installation," contains the steps for all others to follow.

Step 1. Turn off the power to the system, all physical disks, enclosures, and system components, and remove the PC power cord.

Step 2. Open the cabinet of the host system by following the instructions in the host system technical documentation.

Step 3. Check the jumper settings and the memory module.

Step 4. Install the MegaRAID SAS RAID controller in the server and connect SAS or SATA II devices to it. Make sure that the cables you use conform to all specifications.

Step 5. Perform a safety check.

a. Make sure that all cables are attached correctly.

b. Make sure that the MegaRAID SAS RAID controller is installed correctly.

c. Close the cabinet of the host system.

Step 6. After you complete the safety check, turn on the power to the system.

2.3 Detailed Installation

This section provides detailed instructions for installing a MegaRAID SAS RAID controller.

Step 1. Unpack the RAID Controller

Unpack and remove the MegaRAID SAS RAID controller. Inspect it for damage. If it appears damaged, or if any of the following items are missing, contact your LSI Logic support representative. The MegaRAID SAS RAID controller is shipped with these items:

- A CD containing MegaRAID drivers for supported operating systems, an electronic version of this *User's Guide*, and other related documentation
- A license agreement
- Warranty information

Step 2. Turn off the Power to the System

Turn off the power to the computer, and remove the AC power cord. Remove the computer cover. Refer to the system documentation for instructions. Before installing the controller, make sure that the computer is disconnected from the power and from any networks.

Step 3. Review the MegaRAID Controller Jumpers and Controllers

The jumpers are set at the factory, and you usually do not need to change them. See the Chapter 3, "MegaRAID SAS RAID Controller Characteristics" for diagrams of the MegaRAID SAS controllers with their jumpers and connectors.

Step 4. Check the Memory Module

Make sure that the memory module is present and seated firmly in the dual-inline memory module (DIMM) socket.

Step 5. Install the MegaRAID SAS RAID Controller

Select a PCI Express or PCI-X slot, and align the controller's PCI Express or PCI-X bus connector to the slot. Press down gently but firmly to make sure that the card is seated correctly in the slot. Secure the bracket to the computer chassis.

Figure 2.1 shows the installation of a MegaRAID SAS PCI-Express RAID controller in a PCI Express slot. Figure 2.2 shows the installation of a MegaRAID SAS PCI-X RAID controller in a PCI-X slot.

Figure 2.1 Example of MegaRAID SAS Board Installation in a PCI Express Slot

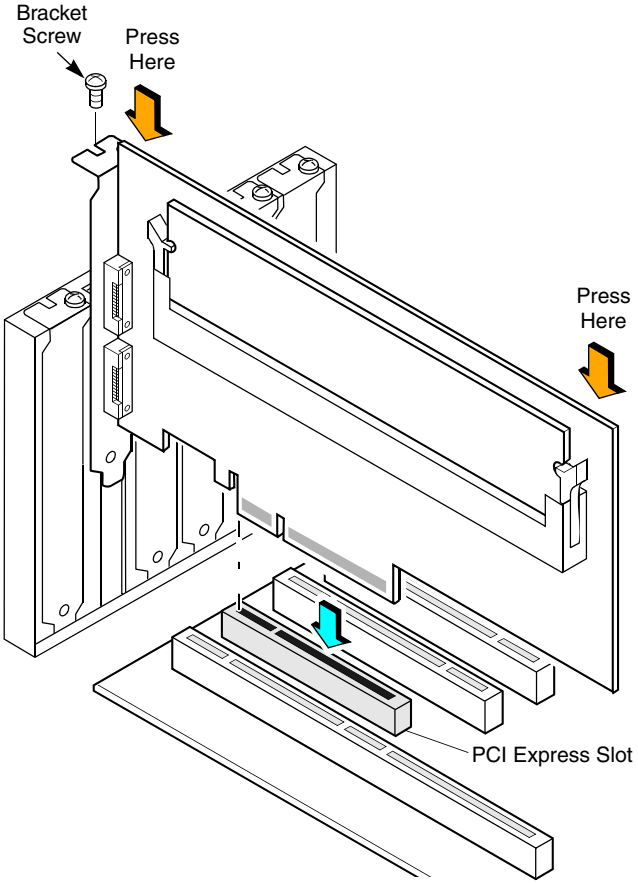
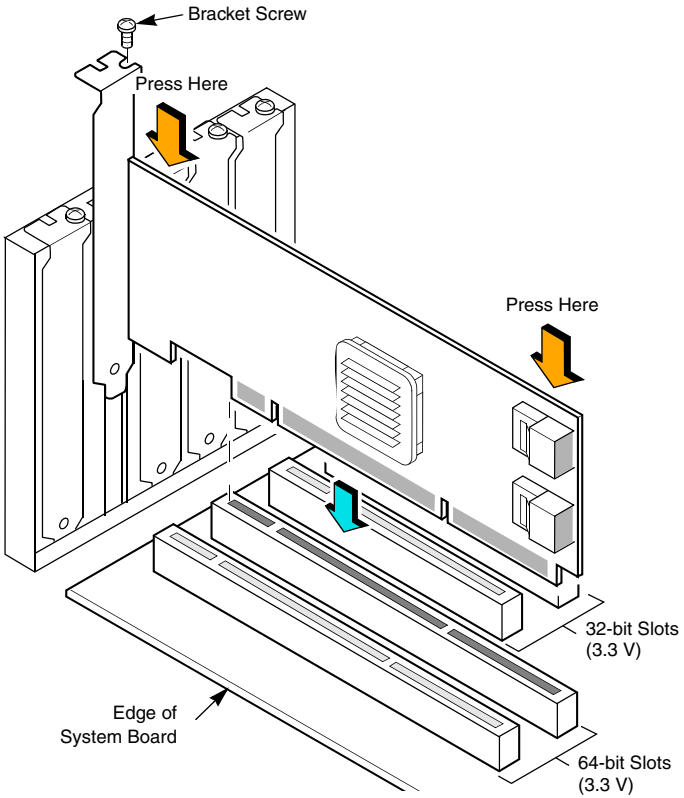


Figure 2.2 Example of MegaRAID SAS Board Installation in a PCI-X Slot



Step 6. Configure and Install the SAS and/or the SATA II Devices in the Host Computer Case

Refer to the documentation for the devices for any preinstallation configuration requirements.

Step 7. Connect SAS and/or SATA II Devices to the RAID Controller

Use SAS cables to connect SAS devices, SATA II devices, or both to the MegaRAID SAS RAID controller. Refer to Section 2.4, “SAS Device Cables” for SAS cable information. Refer to Section 2.4.1, “Connecting the SAS RAID Controller with External Connectors to Drive Boxes and Drive Expanders,” on page 2-10 for details on connecting the controller to physical disks and expanders.

The maximum cable length is 6 external meters. You can connect one device per SAS PHY unless you use an expander.

System throughput problems can occur if the SAS cables are not the correct type. To minimize the potential for problems, use the following guidelines:

a. Use cables no longer than 6 meters (LSI Logic recommends using shorter cables, if possible).

b. Use cables that meet the SAS specification.

c. Route the SAS cables carefully.

Step 8. Turn on the Power to the System

Replace the computer cover, and reconnect the AC power cords. Turn power on to the host computer. Make sure that the power is turned on to the SAS devices, SATA II devices, or both are powered up before or at the same time that the power is turned on to the host computer. If the computer is powered up before a SAS device, SATA II device, or both, the device might not be recognized.

During boot, a BIOS message appears. The firmware takes several seconds to initialize. The configuration utility prompt times out after several seconds. The second portion of the BIOS message displays the MegaRAID controller, number, firmware version, and cache SDRAM size. The numbering of the controllers follows the PCI slot scanning order used by the host system board.

Step 9. Run the WebBIOS Configuration Utility

Run the WebBIOS Configuration Utility to configure the physical arrays and the logical drives. When the message `Press <Ctrl><H> for WebBIOS` appears on the screen, press CTRL+H immediately to run the utility.

Step 10. Install the Operating System Driver

The SAS RAID controllers can operate under various operating systems. To operate under these operating systems, you must install the software drivers. The *MegaRAID Universal Software Suite* CD includes software drivers for the supported operating systems, along with documentation. You can view the supported operating systems and download the latest drivers

for RAID adapters on the LSI Logic web site at: http://www.lsi.com/cm/DownloadSearch.do.

For details on installing the driver, refer to the *MegaRAID SAS Device Driver Installation User's Guide* on the *MegaRAID Universal Software Suite* CD. Be sure to use the latest service packs provided by the operating system manufacturer and to review the `readme` file that accompanies the driver.

2.4 SAS Device Cables

This section describes the cables used on the SAS controllers and provides step-by-step instructions for connecting SAS physical disks, SATA II physical disks, or both to the SAS RAID controller. The SAS and SATA II protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable.

Note: Use only straight SAS cables, not crossover SAS cables.

Figure 2.3 displays the SAS cable that connects the internal connectors on a SAS RAID controller to SAS drives.

Figure 2.3 Internal SAS Cable for Connection to SAS Physical Disks, SATA II Physical Disks, or Both

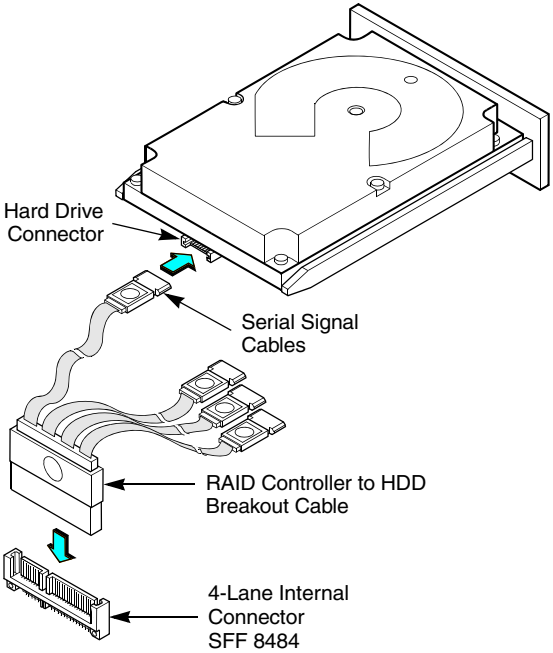


Figure 2.4 displays the SATA II device plug connector that connects a SAS RAID controller with internal connectors to the host receptable connector on a backplane. A SATA II connector consists of a signal connector and a power connector.

Figure 2.4 SATA II Connectors

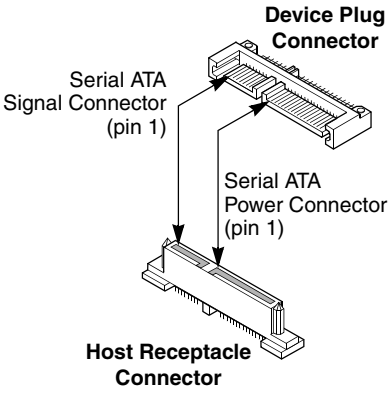
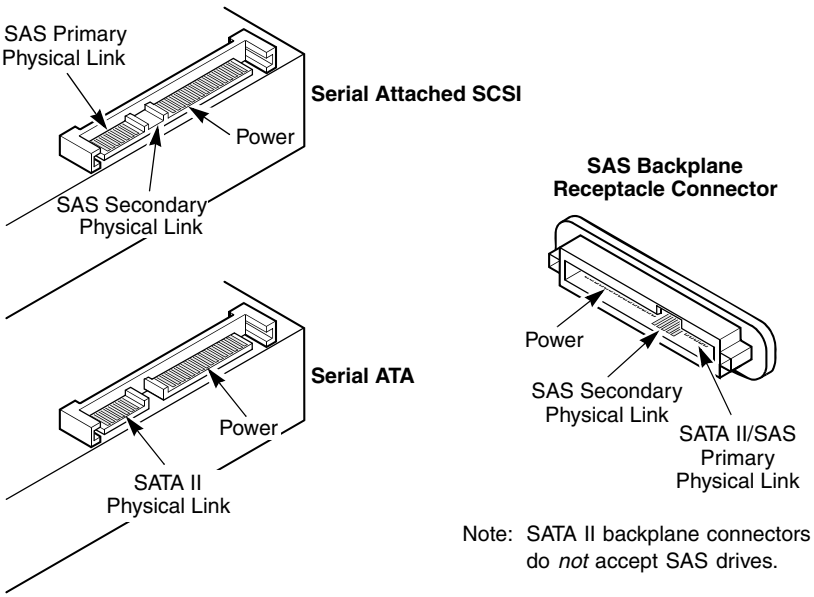


Figure 2.5 shows SAS and SATA II connectors on SAS and SATA II physical disks, respectively. Cables connect internal connectors on the RAID controllers and connectors on SAS drives, SATA II drives, or both, respectively. Both SAS physical disks, SATA II physical disks, or both can connect to SAS backplane receptable connectors. The difference between the SAS connector and the SATA II connector is the bridge between the SAS primary physical link and power connector on the SAS controller, which the SATA II connector does not have.

Note: SAS backplane connectors can accept SAS or SATA II physical disks, but SATA II backplane connectors *cannot* accept SAS drives.

Figure 2.5 SAS and SATA II Plugs and SAS Backplane Receptacle Connector



The following subsections provide step-by-step instructions for connecting the SAS RAID controllers to SAS and SATA II physical disks, either directly or through an expander. Figure 2.6 through Figure 2.8 show the MegaRAID SAS 8408E RAID controller and the MegaRAID SAS 8480E RAID controller connected to physical disks and to expanders, which then connect to physical disks.

2.4.1 Connecting the SAS RAID Controller with External Connectors to Drive Boxes and Drive Expanders

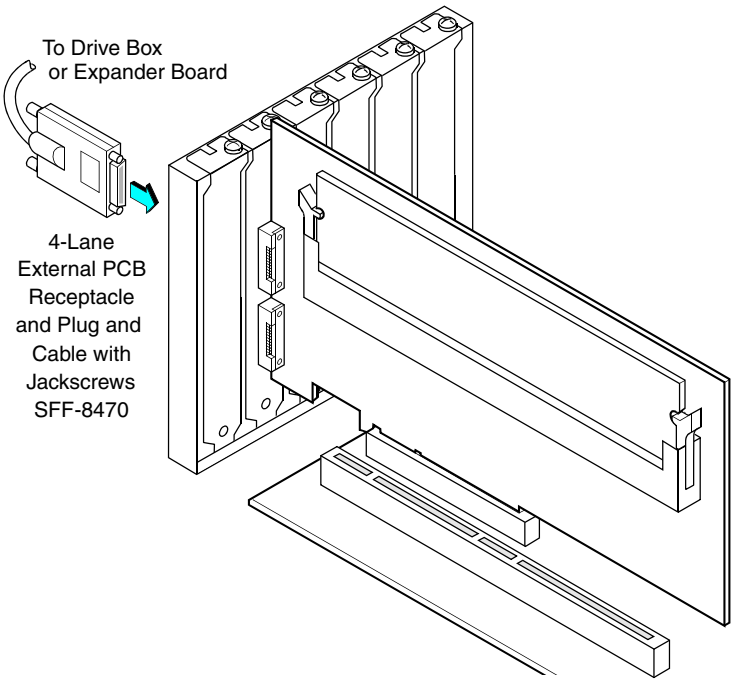
Figure 2.6 shows how to connect the external SAS cable from the SAS RAID controller that has external connectors to drive boxes or drive enclosures.

Follow these steps to connect a SAS RAID controller with external connectors to a drive box or drive enclosure.

Step 1. Connect the 4-lane external PCB receptacle plug on the external cable to the external connector on your SAS RAID controller.

Step 2. Connect the plug on the other end of the SAS cable to the connector on the drive box or drive enclosure.

Figure 2.6 Connecting the SAS 8480E RAID Controller with External Connectors to a Drive Box or Drive Enclosure



2.4.2 Connecting the SAS RAID Controller with Internal Connectors to Physical Disks and Expanders

Figure 2.7 shows how to connect the internal SAS cable from the SAS RAID controller that has internal connectors to SAS and SATA II physical disks or expander boards.

Follow these steps to connect a SAS RAID controller with internal connectors directly to SAS physical disks, SATA II physical disks, or both.

Step 1. Plug the 7-wire connector on the internal cable into the internal connector on a SAS RAID controller.

Step 2. Plug the connector on the other end of the internal cable into the connector on a SAS physical disk, a SATA II physical disk, or both.

Step 3. If you have another physical disk, connect it to another plug on the internal cable.

You can connect other devices if the cable has more connectors.

Figure 2.7 Connecting the SAS 8408E RAID Controller with Internal Connectors to a Physical Disk

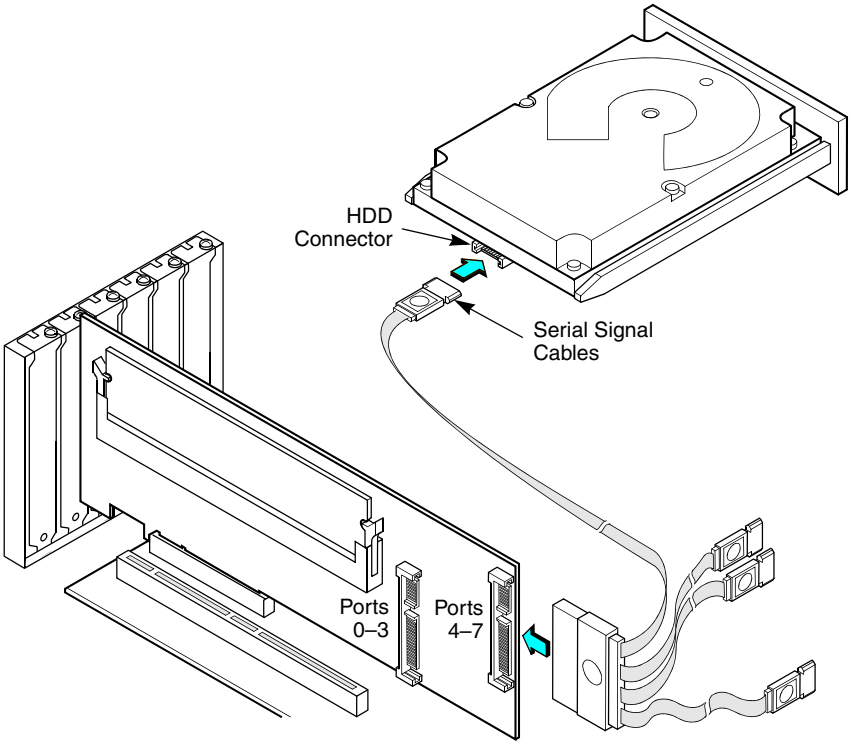


Figure 2.8 shows how to connect the internal SAS cables to the SAS RAID controller with internal connectors and an expander board.

Follow these steps to connect the SAS RAID controller that has internal connectors to an expander board.

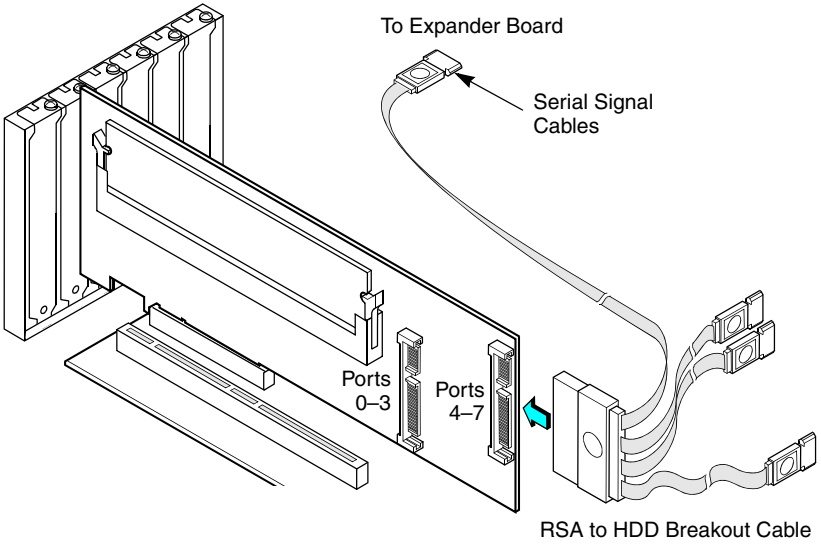
Step 1. Plug the 7-wire connector on the internal cable into the internal connector on a SAS RAID controller.

Step 2. Plug the connector on the other end of the internal cable into the connector on an expander board.

Step 3. If you have another expander board, connect the SAS cable between the expander board and the SAS RAID controller.

You can connect other devices if the cable has more connectors.

Figure 2.8 Connecting the SAS 8408E RAID Controller with Internal Connectors to an Expander Board



2.5 Replacing a Failed Controller Containing Data in the intelligent Transportable Battery Backup Unit 02

The MegaRAID intelligible Transportable Battery Backup Module 2 (LSIiTBBU02) is a cache memory module with an integrated battery pack. The module provides an uninterrupted power source to the module if power is unexpectedly interrupted while cached data is still present. If the power failure is the result of the MegaRAID SAS RAID controller itself failing, then the LSIiTBBU02 can be moved to a new controller and the data can be recovered. The replacement controller must have a cleared configuration.

Follow these steps to replace a failed controller with data in the transportable battery backup unit.

Step 1. Turn off the power to the system and to the drives.

Step 2. Remove the failed controller from the system.

Step 3. Remove the LSIiTBBU02 from the failed controller.

Step 4. Insert the LSIiTBBU02 into the replacement controller.

Step 5. Insert the replacement controller into the system.

Step 6. Turn on the power to the system.

The controller then reads the disk configuration into NVRAM and flushes cache data to the virtual disks.

Note: Refer to the *MegaRAID Battery Backup Unit User's Guide* for installation instructions for the LSIiTBBU02.

2.6 After Installing the RAID Controller

After you install MegaRAID SAS RAID controller, you must configure the RAID controller and install the operating system driver. The *MegaRAID SAS Software User's Guide* instructs you on the configuration options and how to set them on your MegaRAID SAS RAID controller. The *MegaRAID SAS Device Driver Installation User's Guide* provides detailed installation instructions for operating system drivers.

Chapter 3
MegaRAID SAS RAID Controller Characteristics

This chapter describes the characteristics of the LSI Logic MegaRAID Serial Attached SCSI/Serial ATA II RAID Controllers. It consists of the following sections:

3.1 MegaRAID SAS RAID Controller Family

The MegaRAID SAS RAID controllers are dual PHY, SAS PCI Express and PCI-X RAID controllers and are used in a system with a PCI Express slot or PCI-X slot. PCI-X is a high performance local bus specification that allows connection of devices directly to computer memory. PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

The following subsections provide graphics and connector information for the SAS RAID controllers.

3.1.1 MegaRAID SAS 8204ELP/SAS 8208ELP RAID Controllers

The MegaRAID SAS 8204ELP PCI Express Low-Profile Disk Array RAID Controller controls four internal SAS or SATA ports through one mini SAS 4i internal connector.

The MegaRAID SAS 8208ELP PCI Express Low-Profile Disk Array RAID Controller controls eight internal SAS ports or SATA ports through two mini SAS 4i internal connectors.

Note: The SAS 8204ELP RAID controller does not contain the J6 (ports 4–7) connector. The missing J6 connector is the only difference between the SAS 8204ELP RAID controller, and the SAS 8208ELP RAID controller.

This subsection provides the board layout, and connector and jumper information for the SAS 8204ELP RAID controller, and the SAS 8208ELP RAID controller. Figure 3.1 shows the jumpers and the connectors on the controller, and Table 3.1 describes them.

Figure 3.1 Layout of the MegaRAID SAS 8208ELP RAID Controller

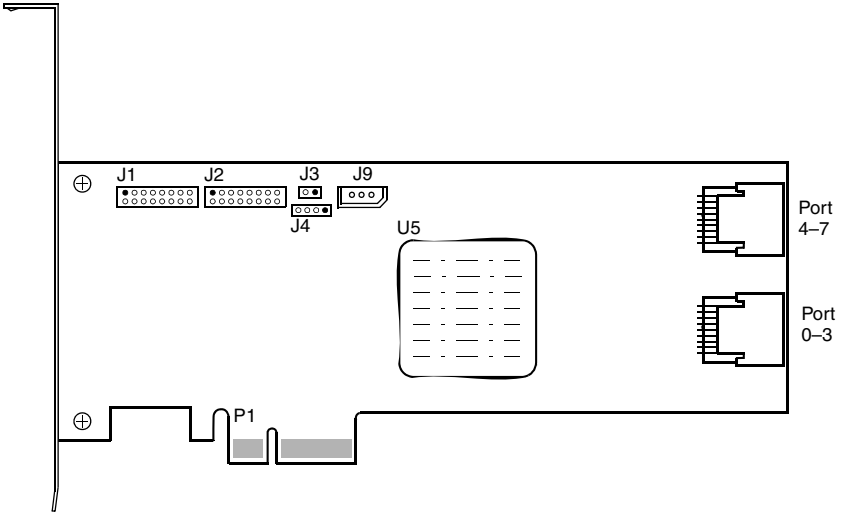


Table 3.1 SAS 8204ELP RAID Controller and SAS 8208ELP RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	Drive Fault LED Connector Interface	16-pin (8x2) connector	Provides an LED interface individually to eight SAS ports. The LED indicates a drive fault on a specific port.
J2	Individual Activity LED header for all eight ports	16-pin (8x2) header	Provides an LED interface individually to eight SAS ports. The LED indicates activity on a specific port.
J4	Serial port (RS232) header	4-pin header	Provides access between an integrated UART and a local bus. The onboard UART can be used for diagnostics with the appropriate firmware modification.
J6	SAS Ports Note: The SAS 8204ELP RAID controller does not contain this connector.	Ports 4–7	The ports connect the cables from the controller to SAS physical drives, SATA II physical drives, or a port multiplier.
J7	SAS Ports	Ports 0–3	The ports connect the cables from the controller to SAS physical drives, SATA II physical drives, or a port multiplier.
J9	IPMI-style SMBus (System Management) /I^2C header	3-pin header	Reserved for LSI Logic internal use.

3.1.2 MegaRAID SAS 8204XLP/SAS 8208XLP RAID Controllers

The MegaRAID SAS 8204XLP PCI-X Low-Profile Disk Array RAID Controller controls four internal ports that can support SAS devices or SATA devices through one mini SAS 4i internal connector.

The MegaRAID SAS 8208XLP PCI-X Low-Profile Disk Array RAID Controller controls eight internal ports that can support SAS devices or SATA devices through two mini SAS 4i internal connectors.

Note: The SAS 8204XLP RAID controller does not contain the J5 (ports 4–7) connector. This is the only difference between the SAS 8204XLP RAID controller and the SAS 8208XLP RAID controller.

This subsection provides the board layout and connector/jumper information for the SAS 8204XLP RAID controller, and the SAS 8208XLP RAID controller. Figure 3.2 shows the jumpers and the connectors on the controller, and Table 3.2 describes them.

Figure 3.2 Layout of the MegaRAID SAS 8208XLP RAID Controller

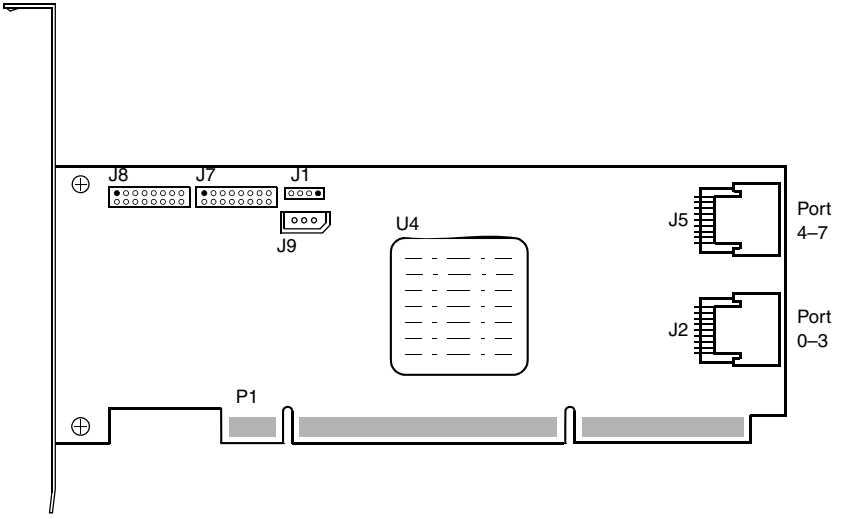


Table 3.2 SAS 8204XLP RAID Controller and SAS 8208XLP RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	Serial port (RS232) header	4-pin header	Provides access between an integrated UART and a local bus. The on-board UART can be used for diagnostics with the appropriate firmware modification.
J2	SAS Ports	Ports 0–3	The ports connect the cables from the controller to SAS physical drives, SATA II physical drives, or a port multiplier.
J5	SAS Ports Note: The SAS 8204XLP RAID controller does not contain this connector.	Ports 4–7	The ports connect the cables from the controller to SAS physical drives, SATA II physical drives, or a port multiplier.
J7	Individual Activity LED header for all eight ports	16-pin (8x2) header	Provides an LED interface individually to eight SAS ports. The LED indicates activity on a specific port.
J8	Drive Fault LED connector interface	16-pin (8x2) connector	Provides an LED interface individually to eight SAS ports. The LED indicates a drive fault on a specific port.
J9	IPMI-style SMBus System Management) /I^2C header	3-pin header	Reserved for LSI Logic internal use.

3.1.3 MegaRAID SAS 8300XLP RAID Controller

The MegaRAID SAS 8300XLP PCI-X Low-Profile Disk Array RAID Controller has one Intel 80321 Intelligent I/O processor and is a zero-channel SAS RAID controller.

This subsection provides the board layout and connector/jumper information for the MegaRAID SAS 8300XLP RAID controller. See Figure 3.3 and Table 3.3 for information about the jumpers and the connectors.

Figure 3.3 Layout of the MegaRAID SAS 8300XLP RAID Controller

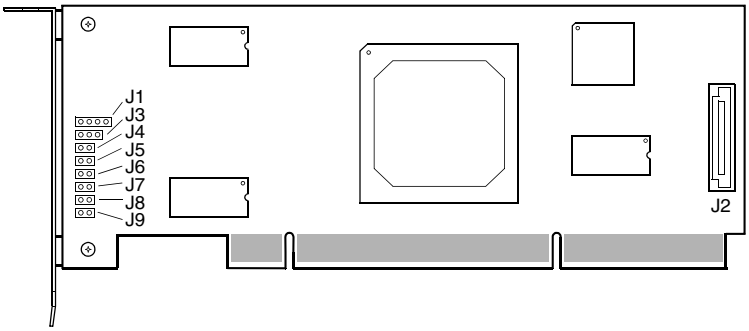


Table 3.3 SAS 8300XLP RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	IPMI-style SMBus (System Management) /I^2C header	4-pin header	Reserved for LSI Logic internal use.
J2	Connector for battery backup daughtercard	40-pin connector	This connector is for an optional daughtercard that provides battery backup on the onboard cache SDRAM.
J3	Universal Asynchronus Receiver/Transmitter (UART) debugging	3-pin connector	Reserved for LSI Logic internal use.
J4	Mode Select	2-pin connector	Reserved for LSI Logic internal use.

Table 3.3 SAS 8300XLP RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J5	Clear NVRAM	2-pin connector	Used to clear the contents of the non-volatile random access memory.
J6	Write-pending indicator (dirty cache) LED	2-pin header	Connector for an LED mounted on the system enclosure. The LED indicates when the data in the cache has yet to be written to the storage devices.
J7	Onboard BIOS disabled	2-pin header	Disables the BIOS so that it does not run on the firmware.
J8	Serial EEPROM	2-pin connector	Provides board information to the host: serial number, revision, and manufacturing date. This eliminates the need to open a system to obtain board information.
J9	NMI (non-maskable interrupt)	2-pin connector	Reserved for LSI Logic internal use.

3.1.4 MegaRAID SAS 8304ELP/8308ELP RAID Controller

The MegaRAID SAS 8304ELP PCI Express Low-Profile Disk Array RAID Controller has one Intel IOP333 I/O processor and one LSI SAS1068, which controls four SAS ports.

The MegaRAID SAS 8308ELP PCI Express Low-Profile Disk Array RAID controller has one Intel IOP333 I/O processor, and one LSI SAS1068 device, which controls eight SAS ports.

Note: The SAS 8304ELP RAID controller does not contain the J10 (ports 4–7) connector. This is the only difference between the SAS 8304ELP RAID controller, and the SAS 8308ELP RAID controller.

This subsection provides the board layout for the SAS 8308ELP RAID controller, and the connector and jumper information for both the SAS 8304ELP RAID controller and the SAS 8308ELP RAID controller. Figure 3.4 shows the jumpers and the connectors, and Table 3.4 describes them.

Figure 3.4 Layout of the MegaRAID SAS 8308ELP RAID Controller

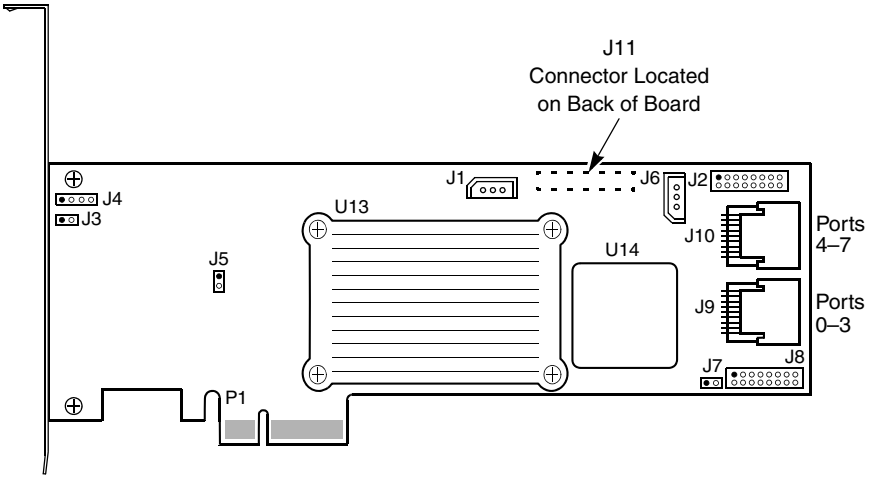


Table 3.4 SAS 8304ELP RAID Controller and SAS 8308ELP RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	IPMI-style I^2C Debug header (Intelligent Platform Management Interface)	3-pin connector	Used for diagnostic purposes.
J2	Individual Activity LED header for all eight ports	16-pin (8x2) jumper	Provides an LED interface individually to eight SAS ports. The LED indicates activity on particular ports.
J3	Debugger	2-pin jumper	Used for diagnostic purposes.
J4	Serial header for debug use	4-pin jumper	Used for diagnostic purposes. Note: The serial port is not compliant with the RS232 voltage level standard.

Table 3.4 SAS 8304ELP RAID Controller and SAS 8308ELP RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J5	Mode Select	2-pin connector	If the firmware flashed onto the board is corrupted, you need to place a jumper on J5 (this holds the CPU core in reset), so you can flash the firmware. Remove the jumper after you flash the new firmware. No jumper: This is the setting during normal operation (Mode 3). This is the default. Jumper: This holds the CPU core in reset (Mode 0). Note: The card does not function as a RAID controller if this jumper is mounted.
J6	IPMI-Style System Management SMBUS/I^2C header	3-pin connector	Provides support for enclosure managements.
J7	Cache Write Pending LED	2-pin connector	Connector for enclosure LED. Provides a signal that indicates when the on-board cache contains data and a write from the cache to the hard drives is pending. Optional.
J8	LED Drive Fault Connector interface	16-pin (8x2) jumper	Provides LED interface individually to eight SAS ports. The LED indicates a drive fault on particular ports.

Table 3.4 SAS 8304ELP RAID Controller and SAS 8308ELP RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J9	SAS ports	Ports 0–3	The ports connect the cables from the RAID controller to SAS or SATA II physical drives, or a port multiplier.
J10	SAS ports Note: This connector is not supported on the SAS 8304ELP RAID controller.	Ports 4–7	The ports connect the cables from the RAID controller to SAS or SATA II physical drives, or a port multiplier.
J11	Battery Backup connector (located on the back side of the RAID controller)	20-pin connector	Provides interface to the remote battery pack.

3.1.5 MegaRAID SAS 8344ELP RAID Controller

The MegaRAID SAS 8344ELP PCI Express Low-Profile Disk Array RAID Controller has one Intel IOP333 I/O processor, which controls one SAS 4x external connector and one mini SAS 4i internal connector.

This subsection provides the board layout and jumper/connector information for the MegaRAID SAS 8344ELP RAID controller, which has four external and four internal port connectors. Figure 3.5 shows the connectors and the jumpers on the controller, and Table 3.5 describes them.

Figure 3.5 Layout of the MegaRAID SAS 8344ELP RAID Controller

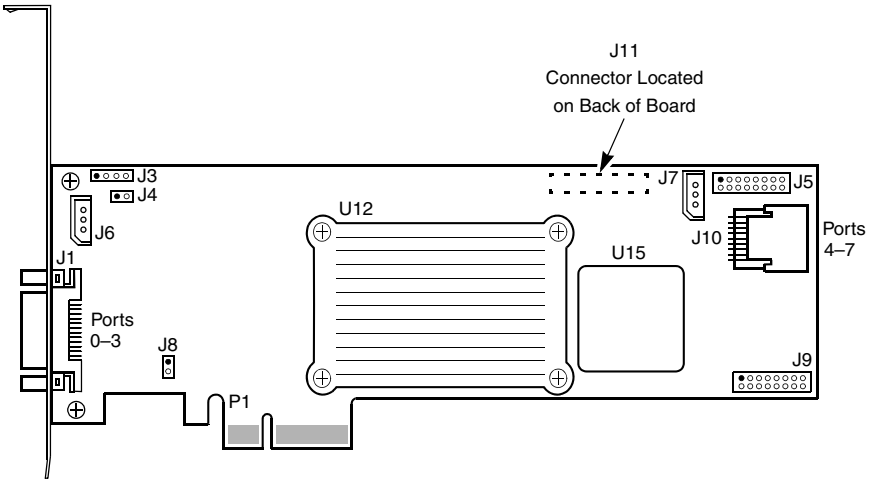


Table 3.5 SAS 8344ELP RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	SAS 8344ELP ports	Ports 0–3	The ports connect the cables from the adapter to SAS or SATA II physical drives, or a port multiplier.
J3	Serial header for debug use	4-pin header	Used for diagnostic purposes. Note: The serial port is not RS232 voltage level compliant.
J4	Mode Select header	2-pin connector	If the firmware flashed onto the board is corrupted, you need to place a jumper on J4 (this holds the CPU core in reset), so you can flash the firmware. Remove the jumper after you flash the new firmware. No jumper: This is the setting during normal operation (Mode 3). This is the default. Jumper: This holds the CPU core in reset (Mode 0). Note: The card does not function as a RAID controller if this jumper is mounted.
J5	Individual Activity LED header for all eight ports	16-pin (8x2) header	Provides an LED interface individually to eight SATA II ports. The LED indicates activity on a specific port.
J6	System Management (SM) Bus/I^2C header	3-pin header	Provides support for enclosure management.
J7	IPMI-style LSI1068 SMBUS System Management debug header	3-pin header	Used for diagnostic purposes.
J8	Cache Write Pending LED	2-pin connector	Connector for an enclosure LED. Provides a signal that indicates when the on-board cache contains data and a write from the cache to the hard drives is pending. Optional.

Table 3.5 SAS 8344ELP RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J9	LED Drive Fault Connector interface	16-pin (8x2) connector	Provides an LED interface individually to eight SATA II ports. The LED indicates a drive fault on particular ports.
J10	SAS 8344ELP ports	Ports 4–7	The ports connect the cables from the controller to the SATA II physical drives or a port multiplier.
J11	Battery backup connector (located on the back side of the controller)	20-pin connector	Provides interface to the remote battery pack.

3.1.6 MegaRAID SAS 8408E RAID Controller

The MegaRAID SAS 8408E PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor, which controls eight internal SAS ports or SATA ports through two mini SAS 4i internal connectors.

This subsection provides the board layout, and connector and jumper information for the SAS 8408E RAID controller. Figure 3.6 shows the connectors and the jumpers on the controller, and Table 3.6 describes them.

Figure 3.6 Layout of the MegaRAID SAS 8408E RAID Controller

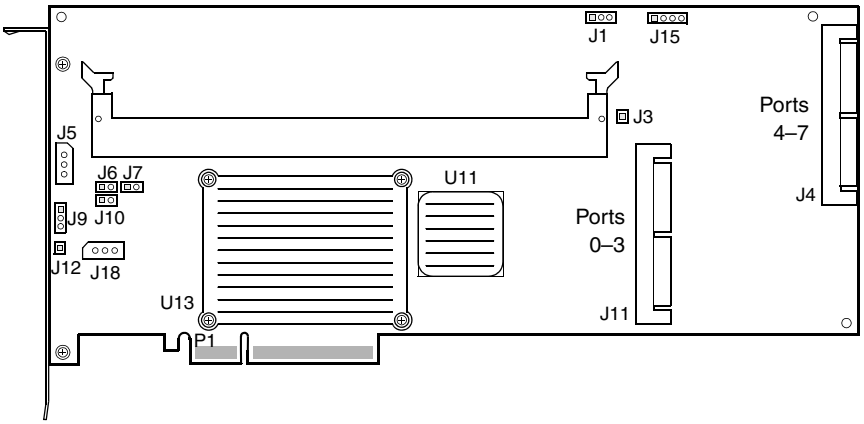


Table 3.6 SAS 8408E RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	Universal Asynchronous Receiver/Transmitter (UART) debugging	3-pin connector	Reserved for LSI Logic internal use.
J3	GND connector	1-pin connector	Reserved for LSI Logic internal use.
J4	Ports 4–7	x4 SAS ports	A SAS 4i connector that connects to physical drives and expanders.
J5	Keyed I^2C connector	3-pin connector	Provides support for enclosure management. Reserved for LSI Logic internal use.
J6	On-board BIOS Enable	2-pin connector	The optional BIOS function is enabled or disabled in software depending on the status of this jumper. No jumper: BIOS is enabled (default). Jumper: BIOS is disabled.
J7	Firmware initialization mode 0 or 3 Select	2-pin connector	Reserved for LSI Logic internal use.
J9	Unkeyed I^2C connector	3-pin connector	Provides support for enclosure management. Reserved for LSI Logic internal use.

Table 3.6 SAS 8408E RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J10	Write pending indication LED	2-pin connector	The connector for the enclosure LED. When lit, the LED indicates that the on-board cache contains data and a write from the cache to the hard drives is pending. Optional.
J11	Ports 0–3	x4 SAS ports	A SAS 4i connector that connects to physical drives and expanders.
J12	GND connector	1-pin connector	Reserved for LSI Logic internal use.
J15	Keyed I^2C connector	4-pin connector	Provides support for enclosure management. Reserved for LSI Logic internal use.
J18	SMBUS header for enclosure management	3-pin header	Provides support for enclosure management. Reserved for LSI Logic internal use.

3.1.7 MegaRAID SAS 8480E RAID Controller

The MegaRAID SAS 8480E PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor, which controls eight internal SAS ports or SATA ports through two SAS 4x internal connectors.

This subsection provides the board layout, and connector and jumper information for the SAS 8480E RAID controller. Figure 3.7 shows the connectors and the jumpers on the controller, and Table 3.7 describes them.

Figure 3.7 Layout of the MegaRAID SAS 8480E RAID Controller

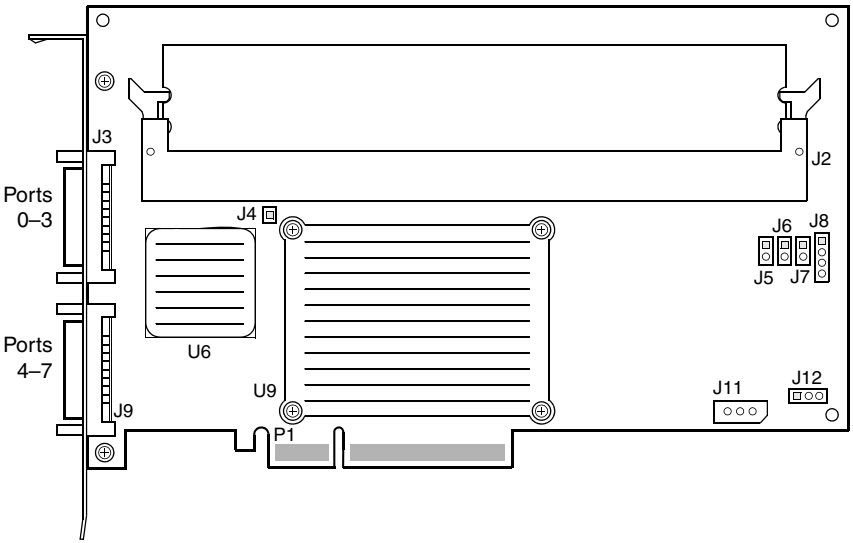


Table 3.7 SAS 8480E RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J2	DIMM Socket	Socket	Holds cache memory module.
J3	SAS Ports 0–3	x4 SAS ports	A SAS 4x connector that connects to physical drives and expanders.
J4	GND connector	1-pin connector	Reserved for LSI Logic internal use.
J5	Write pending indication LED	2-pin connector	The connector for the enclosure LED. When lit, the LED indicates the on-board cache contains data and a write from the cache to the hard drives is pending. Optional.
J6	Firmware initialization mode 0 or 3 select	2-pin connector	No jumper: Optional BIOS is enabled by the firmware. Jumper: The optional BIOS is disabled.
J7	On-board BIOS enable	2-pin connector	The optional BIOS function is enabled or disabled in software depending on the status of this jumper. No jumper: BIOS enabled (default) Jumper: BIOS disabled
J8	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector	Reserved for LSI Logic internal use.
J9	SAS Ports 4–7	x4 SAS ports	SAS 4x connector that connects to physical drives and expanders.
J11	Keyed I^2C connector	3-pin connector	Provides support for enclosure management. Reserved for LSI Logic internal use.
J12	Unkeyed I^2C connector	3-pin connector	Provides support for enclosure management. Reserved for LSI Logic internal use.

3.1.8 MegaRAID SAS 84016E RAID Controller

The MegaRAID SAS 84016E PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor and two LSI SAS1068s that control eight internal SAS or SATA ports.

This subsection provides the board layout and connector/jumper information for the MegaRAID SAS 84016E RAID controller. Figure 3.7 shows the connectors and the jumpers on the controller, and Table 3.7 describes them.

Figure 3.8 Layout of the MegaRAID SAS 84016E RAID Controller

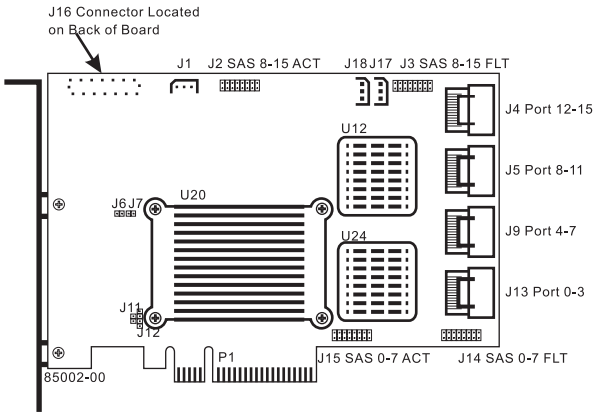


Table 3.8 SAS 84016E RAID Controller – Jumpers and Connectors

Jumper	Description	Type	Comments
J1	IPMI-style I^2C connector	3-pin connector	Provides support for enclosure management using the SCSI Accessed Fault-Tolerant Enclosure (SAF-TE) protocol.
J2	Individual activity LED header for 8 ports (8-15)	16-pin (8x2) header	Provides an LED interface to each of the eight SAS ports (0-7). The LED indicates activity on a port.
J3	LED Drive Fault Connector Interface	16-pin (8x2) connectors	Provides an LED interface to each of the eight SAS ports (8-15). The LED indicates a drive fault on a port.

Table 3.8 SAS 84016E RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J4	SAS Ports 12-15	x4 SAS connector	The x4 SAS connectors connect the cables from the controller to SAS physical drives, SATA II physical drives, or to a SAS expander.
J5	SAS Ports 8-11	x4 SAS connector	The x4 SAS connectors connect the cables from the controller to SAS physical drives, SATA II physical drives, or to a SAS expander.
J6	Cache Write Pending LED	2-pin header	Connector for the enclosure LED. Provides a signal that indicates when the on-board cache contains data and a write from the cache to the hard drives is pending. Optional.
J9	SAS Ports 4-7	x4 SAS connector	The x4 SAS connectors connect the cables from the controller to SAS physical drives, SATA II physical drives, or to a SAS expander.
J11	Mode Select	2-pin connector	If the firmware flashed onto the board is corrupted, you need to jumper J5 (this holds the CPU core in reset), so that you can flash the firmware. Remove the jumper after you flash the new firmware. No jumper: This is the setting during normal operation (Mode 3). This is the default. Jumper: This holds the CPU core in reset (Mode 0). Note: The card does not function as a RAID controller if this jumper is mounted.
J12	UART	4-pin connector	Used for diagnostic purposes. You need an LSI RS232 adapter to interface with a PC.

Table 3.8 SAS 84016E RAID Controller – Jumpers and Connectors (Cont.)

Jumper	Description	Type	Comments
J13	SAS Ports 0-3	x4 SAS connector	The x4 SAS connectors connect the cables from the adapter to SAS physical drives, SATA II physical drives, or to a SAS expander
J14	Individual fault LED header for 8 ports (0-7)	16-pin (8x2) header	Provides an LED interface to each of the eight SAS ports. The LED indicates errors on a port.
J15	Individual activity LED header for 8 ports (0-7)	16-pin (8x2) header	Provides an LED interface to each of the eight SAS ports. The LED indicates errors on a port.
J16	Battery backup connector (located on the back side of the RAID controller)	20-pin connector	Provides an interface to the remote LSIiBBU01 battery pack.
J17	IPMI-style I^2C connector	3-pin connector	Provides support for enclosure management.
J18	IPMI-style I^2C connector	3-pin connector	Provides support for enclosure management.

3.2 MegaRAID SAS RAID Controller Characteristics

Table 3.9 shows the general characteristics for all MegaRAID SAS RAID controllers.

Table 3.9 MegaRAID SAS RAID Controller Characteristics

Flash ROM[1]	Serial EEPROM[2]	SAS Data Transfers	Features
Yes	Yes	Up to 3 Gbits/s per port	Plug and Play scatter/gather activity LED

1. For boot code and firmware.
2. For BIOS configuration storage.

Each MegaRAID SAS RAID controller ensures data integrity by intelligently validating the compatibility of the SAS domain. The

MegaRAID SAS RAID controllers use Fusion-MPT architecture, which allows for thinner drivers and better performance.

3.3 Technical Specifications

The design and implementation of the MegaRAID SAS RAID controllers minimize electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The MegaRAID SAS RAID controllers show the following marks and certifications:

- CE mark
- C-Tick mark
- FCC Self-Certification logo
- Canadian Compliance Statement
- Korean MIC
- Taiwan BSMI
- Japan VCCI
- CISPR Class B

The following hardware is compliant with CSA C22.2 No. 60950-1, UL 60950-1 First Edition-listed accessory, UL file number E257743:

- MegaRAID SAS 8208ELP RAID controller (model 01105)
- MegaRAID SAS 8208XLP RAID controller (model 01093)
- MegaRAID SAS 8300XLP RAID controller (model 01026)
- MegaRAID SAS 8308ELP RAID controller (model 01091)
- MegaRAID SAS 8344ELP RAID controller (model 01104)
- MegaRAID SAS 8408E RAID controller (model 01079)
- MegaRAID SAS 8480E RAID controller (model 01080)
- MegaRAID SAS 84016E RAID controller (model 01114)
- LSIiBBU01 intelligent battery backup unit (model 01058)
- LSIiTBBU02 intelligent transportable battery backup unit (model 01089)

3.3.1 RAID Controller Specifications

Table 3.10 lists the specifications for the MegaRAID SAS RAID controllers.

Table 3.10 RAID Controller Specifications

Specification	MegaRAID SAS 8204ELP, MegaRAID SAS 8204XLP, MegaRAID SAS 8208ELP, MegaRAID SAS 8208XLP, MegaRAID SAS 8300XLP, MegaRAID SAS 8304ELP MegaRAID SAS 8308ELP, MegaRAID SAS 8344ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E, and MegaRAID SAS 84016E RAID Controllers
Processor (PCI Express host controller to PCI secondary I/O controller)	• 8204ELP RAID controller: No integrated I/O processor • 8204XLP RAID controller: No integrated I/O processor • 8208ELP RAID controller: No integrated I/O processor • 8208XLP RAID controller: No integrated I/O processor • 8300XLP RAID controller: Intel 80321 Intelligent processor • 8304ELP RAID controller: Intel IOP333 I/O processor @ 500 MHz • 8308ELP RAID controller: Intel IOP333 I/O processor @ 500 MHz • 8344ELP RAID controller: Intel IOP333 I/O processor @ 500 MHz • 8408E RAID controller: Intel IOP333 I/O processor @ 500 MHz • 8480E RAID controller: Intel IOP333 I/O processor @ 500 MHz • 84016E RAID controller: Intel IOP333 I/O processor @ 500 MHz
Part number	• 8204ELP RAID controller: 01105 • 8204XLP RAID controller: 01093 • 8208ELP RAID controller: 01105 • 8208XLP RAID controller: 01093 • 8300XLP RAID controller: 01026 • 8308ELP RAID controller: 01091 • 8344ELP RAID controller: 01104 • 8408E RAID controller: 01079 • 8480E RAID controller: 01080 • 84016E RAID controller: 01114 • LSIiBBU01 intelligent Battery Backup Unit 01: 01058 • LSIiTBBU02 intelligent Transportable Battery Backup Unit 02: 01089
Operating voltage	+3.3 V, +12 V

Table 3.10 RAID Controller Specifications (Cont.)

Specification	MegaRAID SAS 8204ELP, MegaRAID SAS 8204XLP, MegaRAID SAS 8208ELP, MegaRAID SAS 8208XLP, MegaRAID SAS 8300XLP, MegaRAID SAS 8304ELP MegaRAID SAS 8308ELP, MegaRAID SAS 8344ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E, and MegaRAID SAS 84016E RAID Controllers
Card size	• 8204ELP RAID controller: Low-profile PCI Express adapter card size (6.600 in. x 2.713 in.) • 8204XLP RAID controller: Low-profile PCI-X adapter card size (6.600 in. x 2.713 in.) • 8208ELP RAID controller: Low-profile PCI Express adapter card size (6.600 in. x 2.713 in.) • 8208XLP RAID controller: Low-profile PCI-X adapter card size (6.600 in. x 2.713 in.) • 8300XLP RAID controller: Low-profile PCI-X adapter card size (6.6 in. x 2.536 in.) • 8304ELP RAID controller: Low-profile PCI Express adapter card size (7.710 in. x 2.535 in.) • 8308ELP RAID controller: Low-profile PCI Express adapter card size (7.710 in. x 2.535 in.) • 8344ELP RAID controller: Low-profile PCI Express adapter card size (7.710 in. x 2.535 in.) • 8408E RAID controller: Standard height, full-length PCI Express adapter card size (9.5 in. x 4.376 in.) • 8480E RAID controller: Standard height, half-length PCI Express adapter card size (6.6 in. x 4.376 in.) • 84016E RAID controller: Standard height, half-length PCI Express adapter card size (6.6 in. x 4.2 in.)
Array interface to host	PCI Express Rev 1.0a, PCI-X Rev 1.0a
PCI Express bus data transfer rate	• Up to 2.5 Gbits/s per lane • x4 lane width for the following RAID controllers: SAS 8204ELP, SAS 8204XLP, SAS 8208ELP, SAS 8208ELP, SAS 8304ELP, SAS 8308ELP, and SAS 8344ELP • x8 lane width for the following RAID controllers: SAS 8408E, SAS 8480E, and SAS 84016E (with support for downshifting for system boards with x1 and x4 connections) • Up to 2 Gbytes/s per direction for PCI-E x8 cards (4 Gbytes/s total)

Table 3.10 RAID Controller Specifications (Cont.)

Specification	MegaRAID SAS 8204ELP, MegaRAID SAS 8204XLP, MegaRAID SAS 8208ELP, MegaRAID SAS 8208XLP, MegaRAID SAS 8300XLP, MegaRAID SAS 8304ELP MegaRAID SAS 8308ELP, MegaRAID SAS 8344ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E, and MegaRAID SAS 84016E RAID Controllers
Serial port	• 3-pin RS232-compatible connector (for manufacturing use only) (SAS 8300XLP) • UART interface connector (not RS232 compatible; an adapter is required) (SAS 8408ELP, SAS 8308ELP, SAS 8344ELP, SAS 8408E, SAS 8480E, and SAS 84016E) • No serial port (SAS 8208ELP and SAS 8208XLP)
SAS controller(s)	One LSISAS1068 SAS controller for all of the RAID controllers except for the SAS 84016E RAID controller, which has two LSISAS1068 SAS controllers, and the SAS 8300XLP RAID controller, which has no SAS controller
SAS bus speed	3 Gbits/s
SAS ports	Two SAS connectors with four SAS ports each, except for the SAS 8300XLP RAID controller, which has no SAS connectors, and the SAS 84016E RAID controller, which has four SAS (mini SAS 4i) connectors with four SAS ports each
Cache configuration	The SAS 8308ELP RAID controller and the SAS 8344ELP RAID controller support the following battery-backed cache configurations: • Integrated 128 Mbyte Double Data Rate (DDR) I 333 MHz SDRAM with remote battery backup • Integrated 256 Mbyte Double Data Rate (DDR) I 333 MHz SDRAM with remote battery backup The SAS 8408E RAID controller, SAS 8480E RAID controller, and SAS 84016E RAID controller support the following battery-backed cache configuration: • Integrated 256 Mbyte DDR II 400 MHz SDRAM intelligent transportable battery-backed DIMM module
Size of flash ROM for firmware	4 Mbytes
Nonvolatile random access memory (NVRAM)	32 Kbytes for storing RAID configuration

3.3.2 Array Performance Features

Table 3.11 shows the array performance features for the MegaRAID 1068-based SAS RAID controllers.

Table 3.11 Array Performance Features

Specification	MegaRAID SAS 8208ELP, MegaRAID SAS 8208XLP, MegaRAID SAS 8300XLP, MegaRAID SAS 8304ELP, MegaRAID SAS 8308ELP, MegaRAID SAS 8344ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E and MegaRAID SAS 84016E RAID Controllers
PCI-E host data transfer rate	2.5 Gbits/s per lane
Drive data transfer rate	3.0 Gbits/s per lane
Maximum scatter/gathers	26 elements
Maximum size of I/O requests	6.4 Mbytes in 64 Kbyte stripes
Maximum queue tags per drive	As many as the drive can accept
Stripe sizes	8, 16, 32, 64, or 128 Kbytes
Maximum number of concurrent commands	255
Support for multiple initiators	Yes

3.3.3 Fault Tolerance

Table 3.12 shows the fault tolerance features for the MegaRAID 1068-based SAS RAID controllers.

Table 3.12 Fault Tolerance Features

Specification	MegaRAID SAS 8308ELP, MegaRAID SAS 8300XLP, MegaRAID SAS 8344ELP, MegaRAID SAS 8304ELP, MegaRAID SAS 8408E, MegaRAID SAS 8480E, and MegaRAID SAS 84016E RAID Controllers
Support for SMART[1]	Yes
Optional battery backup for cache memory	SAS 8304ELP RAID controller, SAS 8308ELP RAID controller, SAS 8344ELP RAID controller, and SAS 84016E RAID controller: - LSIiBBU01 battery backup. <3.6V/880mAH battery pack; up to 72 hours of data retention for 128 Mbytes SAS 8408E and SAS 8480E RAID controllers: - LSIiTBBU02 battery backup. 4.8V/880mAH battery pack; up to 72 hours of data retention for 256 Mbytes
Drive failure detection	Automatic
Drive rebuild using hot spares	Automatic
Parity generation and checking	Yes

1. The Self Monitoring Analysis and Reporting Technology (SMART) detects up to 70 percent of all predictable disk drive failures. In addition, SMART monitors the internal performance of all motors, heads, and drive electronics.

3.3.4 Electrical Characteristics

This subsection provides the power requirements for the MegaRAID 1068-based SAS RAID controllers. Table 3.13 lists the maximum power requirements.

Table 3.13 Maximum Power Requirements

RAID Controller	PCI-E +12 V	PCI-E +3.3 V	PCI-X +3.3 V	PCI-X +5 V	PCI-X +12 V	Operating Range
MegaRAID SAS 8204ELP and SAS 8208ELP	N/A	3.2 W	N/A	N/A	N/A	0 °C to 45 °C
MegaRAID SAS 8204XLP and SAS 8208XLP	N/A	N/A	3.2 W	N/A	N/A	0 °C to 45 °C
MegaRAID SAS 8300XLP	N/A	N/A	N/A	7.3 W	0.4 W without battery charging; 2.4 W with battery charging	0 °C to 45 °C
MegaRAID SAS 8304ELP and SAS 8308ELP	15.6 W without battery charging 18.3 W with battery charging	6.6 W	N/A	N/A	N/A	0 °C to 45 °C with LSIiBBU01 battery backup
MegaRAID SAS 8344ELP	15.6 W without battery charging 18.3 W with battery charging	6.6 W	N/A	N/A	N/A	0 °C to 45 °C with LSIiBBU01 battery backup
MegaRAID SAS 8408E	9.78 W without battery charging; 12.78 W with battery charging	8 W	N/A	N/A	N/A	0 °C to 45 °C with LSIiTBBU02 battery backup
MegaRAID SAS 8480E	8 W without battery charging; 11 W with battery charging	7.5 W	N/A	N/A	N/A	0 °C to 45 °C with LSIiTBBU02 battery backup
MegaRAID SAS 84016E	18.85 W without battery charging; 21.85 W with battery charging	5.96 W	N/A	N/A	N/A	0 °C to 45 °C with LSIiBBU01 battery backup

3.3.5 Operating and Non-operating Conditions

For the MegaRAID SAS RAID controllers, the operating (thermal and atmospheric) conditions are:

- Maximum ambient temperature: 55° C (45° C without battery backup)
- Relative humidity range is 5% to 90% noncondensing (20% to 80% noncondensing for the SAS 8300XLP RAID controller)
- Airflow must be at least 200 linear feet per minute (LFPM) to prevent operating the Intel IOP333 processor above the maximum junction temperature

The parameters for the non-operating (such as storage and transit) environment for the MegaRAID SAS RAID controllers are:

- Temperature range: -30° C to +80° C without battery backup unit (-40 °C to + 115 °C for the SAS 8300XLP RAID controller)
- Temperature range: 0° C to +45° C with battery backup unit

3.3.6 Safety Characteristics

All MegaRAID SAS RAID controllers meet or exceed the requirements of UL flammability rating 94 V0. Each bare board is also marked with the supplier name or trademark, type, and UL flammability rating. For the boards installed in a PCI Express bus slot, all voltages are lower than the SELV 42.4V limit.

Appendix A
Glossary of Terms and Abbreviations

active termination	The electrical connection required at each end of the SCSI bus, composed of active voltage regulation and a set of termination resistors.
array	An array of disk drives combines the storage space on the disk drives into a single segment of storage space. A hot spare drive does not actively participate in an array.
BIOS	Acronym for Basic Input/Output System. Software that provides basic read/write capability. Usually kept as firmware (ROM-based). The system BIOS on the system board of a computer boots and controls the system. The BIOS on your host adapter acts as an extension of the system BIOS.
configuration	Refers to the way a computer is set up, the combined hardware components (computer, monitor, keyboard, and peripheral devices) that make up a computer system, or the software settings that allow the hardware components to communicate with each other.
device driver	A program that allows a microprocessor (through the operating system) to direct the operation of a peripheral device.
domain validation	A software procedure in which a host queries a device to determine its ability to communicate at the negotiated data rate.
EEPROM	Acronym for Electronically Erasable Programmable Read-Only Memory. It is a memory chip that typically stores configuration information, as it provides stable storage for long periods without electricity and can be reprogrammed. Refer to NVRAM.
external SAS device	A SAS device installed outside the computer cabinet. These devices are connected using specific types of shielded cables.
Fusion-MPT Architecture	Fusion-MPT (Message Passing Technology) architecture consists of several main elements: Fusion-MPT firmware, the Fibre Channel and SCSI hardware, and the operating system level drivers that support these

architectures. Fusion-MPT architecture offers a single binary, operating system driver that supports both Fibre Channel and SCSI devices.

host The computer system in which a RAID controller is installed. The host uses the RAID controller to transfer information to and from devices attached to the SCSI bus.

host adapter board A circuit board or integrated circuit that provides a device connection to the computer system.

hot spare An idle, powered on, standby drive ready for immediate use in case of disk failure. It does not contain any user data. A hot spare can be dedicated to a single redundant array or it can be part of the global hot-spare pool for all arrays managed by the controller.

When a disk fails, the controller firmware automatically replaces and rebuilds the data from the failed drive to the hot spare. Data can be rebuilt only from virtual disks with redundancy (RAID levels 1, 5, 10, and 50; not RAID level 0), and the hot spare must have sufficient capacity.

Internal SAS device A SAS device installed inside the computer cabinet. These devices are connected by using a shielded cable.

main memory The part of computer memory that is directly accessible by the CPU (usually synonymous with RAM).

NVRAM Acronym for nonvolatile random access memory. An EEPROM (Electronically Erasable Read-Only Memory chip) that stores configuration information. Refer to EEPROM.

PCI Acronym for peripheral component interconnect. A high-performance, local bus specification that allows the connection of devices directly to computer memory. The PCI Local Bus allows transparent upgrades from 32-bit data path at 33 MHz to 64-bit data path at 33 MHz, and from 32-bit data path at 66 MHz to 64-bit data path at 66 MHz.

PCI Express Acronym for peripheral component interconnect Express. A high-performance, local bus specification that allows the connection of devices directly to computer memory. PCI Express is a two-way, serial connection that transfers data on two pairs of point-to-point data lines. PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

peripheral devices A piece of hardware (such as a video monitor, disk drive, printer, or CD-ROM) used with a computer and under the control of the computer. SCSI peripherals are controlled through a SAS MegaRAID SAS RAID Controller (host adapter).

PHY The interface required to transmit and receive data packets transferred across the serial bus.

Each PHY can form one side of the physical link in a connection with a PHY on a different SATA device. The physical link contains four wires that form two differential signal pairs. One differential pair transmits signals, while the other differential pair receives signals. Both differential pairs operate simultaneously and allow concurrent data transmission in both the receive and the transmit directions.

RAID Acronym for Redundant Array of Independent Disks (originally Redundant Array of Inexpensive Disks). An array of multiple independent physical disks managed together to yield higher reliability, performance, or both, exceeding that of a single physical disk. The RAID array appears to the controller as a single storage unit. I/O is expedited because several disks can be accessed simultaneously. Redundant RAID levels (RAID levels 1, 5, 10, and 50) provide data protection.

RAID levels A set of techniques applied to disk groups to deliver higher data availability, and/or performance characteristics to host environments. Each virtual disk must have a RAID level assigned to it.

SAS Acronym for Serial Attached SCSI. A serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. The SAS interface provides improved performance, simplified cabling, smaller connections, lower pin count, and lower power requirements when compared to parallel SCSI. SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA. The SAS controllers support the ANSI *Serial Attached SCSI Standard, Version 1.0*. In addition, the controller supports the Serial ATA II (SATA II) protocol defined by the *Serial ATA Specification, Version 1.0a*. Supporting both the SAS and SATA II interfaces, the SAS controller is a versatile controller that provides the backbone of both server and high-end workstation environments. Each port on the SAS RAID controller supports SAS devices, SATA II devices, or both.

SAS device Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS RAID controllers (host adapters) and SAS peripherals.

SATA Acronym for Serial Advanced Technology Attachment. A physical storage interface standard, SATA is a serial link that provides point-to-point connections between devices. The thinner serial cables allow for better airflow within the system and permit smaller chassis designs.

SMP Acronym for Serial Management Protocol. SMP enables communicates topology management information directly with an attached SAS expander device. Each PHY on the controller can function as an SMP initiator.

SSP Acronym for Serial SCSI Protocol. SSP enables communication with other SAS devices. Each PHY on the SAS controller can function as an SSP initiator or SSP target.

STP Acronym for Serial Tunneling Protocol. STP enables communication with a SATA II device through an attached expander. Each PHY on the SAS controller can function as an STP initiator.

Stripe size The total disk space consumed by a stripe not including a parity disk. For example, consider a stripe that contains 64 Kbytes of disk space and has 16 Kbytes of data residing on each disk in the stripe. In this case, the stripe size is 64 Kbytes and the stripe element size is 16 Kbytes. The stripe depth is four (four physical disks in the stripe). You can specify stripe sizes of 8 Kbytes, 16 Kbytes, 32 Kbytes, 64 Kbytes, or 128 Kbytes for each virtual disk. A larger stripe size produces improved read performance, especially if most of the reads are sequential. For mostly random reads, select a smaller stripe size.

striping Disk striping writes data across two or more disks. Each stripe spans two or more disks but consumes only a portion of each disk. Each disk, therefore, may have several stripes. The amount of space consumed by a stripe is the same on each disk that is included in the stripe. The portion of a stripe that resides on a single disk is a stripe element. Striping by itself does not provide data redundancy; striping in combination with parity provides data redundancy.

Customer Feedback

We would appreciate your feedback on this document. Please copy the following page, add your comments, and fax it to us at the number shown.

If appropriate, please also fax copies of any marked-up pages from this document.

Important: Please include your name, phone number, fax number, and company address so that we may contact you directly for clarification or additional information.

Thank you for your help in improving the quality of our documents.

Reader's Comments

Fax your comments to: LSI Logic Corporation
Technical Publications
M/S E-198
Fax: 408.433.4333

Please tell us how you rate this document: *MegaRAID SAS RAID Controllers User's Guide.* Place a check mark in the appropriate blank for each category.

	Excellent	Good	Average	Fair	Poor
Completeness of information	____	____	____	____	____
Clarity of information	____	____	____	____	____
Ease of finding information	____	____	____	____	____
Technical content	____	____	____	____	____
Usefulness of examples and illustrations	____	____	____	____	____
Overall manual	____	____	____	____	____

What could we do to improve this document?

If you found errors in this document, please specify the error and page number. If appropriate, please fax a marked-up copy of the page(s).

Please complete the information below so that we may contact you directly for clarification or additional information.

Name _____ Date _____

Telephone _____ Fax _____

Title _____

Department _____ Mail Stop _____

Company Name _____

Street _____

City, State, Zip _____