



MegaRAID[®] 6Gb/s SAS RAID Controllers

User Guide

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Revision History

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Chapter 1

Overview

This chapter provides an overview of the MegaRAID 6Gb/s Serial Attached SCSI/Serial ATA II controllers with RAID control capability.

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1.1 Products Described in this Document

This document is the primary reference and user's guide for the LSI MegaRAID® Serial Attached SCSI/SATA II RAID controllers based on the 6Gb/s SAS/SATA RAID On-a-Chip devices. This document contains complete installation instructions for these RAID controllers and includes specifications for them.

The MegaRAID 6Gb/s Serial Attached SCSI (SAS) RAID controller family consists of the following controllers:

- MegaRAID SAS 9240-4i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with an Internal Connector
- MegaRAID SAS 9240-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 9260-4i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with an Internal Connector
- MegaRAID SAS 9260-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 9260DE-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 9260-16i PCI Express 2.0 Standard-Height Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 9261-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors
- MegaRAID SAS 9280-4i4e PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with an Internal Connector and an External Connector

- MegaRAID SAS 9280-8e PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with External Connectors
- MegaRAID SAS 9280DE-8e PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller with External Connectors
- MegaRAID SAS 9280-16i4e PCI Express 2.0 Standard-Height Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors and an External Connector
- MegaRAID SAS 9280-24i4e PCI Express 2.0 Standard-Height Serial-Attached SCSI/SATA II Disk Array Controller with Internal Connectors and an External Connector

1.2 Overview

The MegaRAID 6Gb/s SAS RAID controllers are high-performance intelligent PCI Express-to-SCSI/Serial ATA II adapters with RAID control capability. MegaRAID 6Gb/s SAS RAID controllers provide reliability, high performance, and fault-tolerant drive subsystem management. They are an ideal RAID solution for the internal storage of workgroup, departmental, and enterprise systems. MegaRAID 6Gb/s SAS 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 drive.

NOTE: LSI recommends that you carefully assess any decision to mix SAS drives and SATA drives within the same *virtual drives*. Although you can mix drives, LSI strongly discourages the practice.

LSI offers a family of MegaRAID SAS RAID controllers that address the needs for both internal and external solutions. The MegaRAID 6Gb/s SAS RAID controllers are based on the LSI first-to-market SAS IC technology and proven MegaRAID technology. As second-generation PCI Express RAID controllers, these controllers address the growing demand for increased data throughput and scalability requirements across midrange and enterprise-class server platforms. These controllers provide:

- 6.0 Gb/s Serial Attached SCSI performance
- 3.0 Gb/s SATA II performance
- Eight-lane, 5-Gb/s PCI Express host interface

The SAS 9260DE-8i RAID controller and the SAS 9280DE-8i RAID controller offer data security using disk encryption. This feature offers the ability to encrypt data on drives and use disk-based key management to provide data security. This solution provides data protection in the event of theft or loss of physical drives. With self-encrypting drives, if you remove a drive from its storage system or the server in which it is housed, the data on that drive is encrypted and useless to anyone who attempts to access without the appropriate security authorization.

For more information about self-encrypting drives, refer to the *MegaRAID SAS Software User's Guide*.

The SAS 9260 RAID controllers, the SAS 9261 RAID controllers, and the SAS 9280 RAID controllers use the LSI intelligent Battery Backup Unit 07 (LSIiBBU-07) to provide cached data protection and allow system builders to protect cached data even during the most catastrophic system failures. In addition, the SAS 9260-16i, SAS 9280-16i4e, and SAS 9280-24i4e RAID controllers use the LSI intelligent Battery Backup Unit 08 (LSIiBBU-08).

Refer to the battery backup documentation on the *MegaRAID Universal Software Suite CD* for more information about this battery backup unit.

The SAS controllers support the ANSI *Serial Attached SCSI standard, version 2.0*. In addition, the controller supports the SATA II protocol defined by the *Serial ATA specification, version 1.0a*. Supporting both the SAS interface and the SATA II interface, 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

1.3 SAS Controller Descriptions

The 6Gb/s SAS RAID controllers are described as follows:

- The MegaRAID SAS 9240-4i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller is a PCI-Express 2.0, half-size, full-height RAID controller based on the LSI SAS2008 PCI Express-SAS/SATA I/O Processor chip. The MegaRAID SAS 9240-4i controls four internal 6-Gb/s SAS/SATA ports through one SFF-8087 x4 internal mini SAS connector.
- The MegaRAID SAS 9240-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller is a PCI-Express 2.0, half-size, full-height RAID controller based on the LSI SAS2008 PCI Express-SAS/SATA I/O Processor chip. The MegaRAID SAS 9240-8i controls eight internal 6-Gb/s SAS/SATA ports through two SFF-8087 x4 internal mini SAS connectors.
- The MegaRAID 6Gb/s SAS 9260-4i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls four internal SAS/SATA ports through one SFF-8087 x4 internal mini SAS connector.
- The MegaRAID 6Gb/s SAS 9260-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight internal SAS/SATA ports through two SFF-8087 x4 internal mini SAS connectors.

- The MegaRAID 6Gb/s SAS 9260DE-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight internal SAS/SATA ports through two SFF-8087 x4 internal mini SAS connectors and offers data security using disk encryption.
- The MegaRAID 6Gb/s SAS 9260-16i PCI Express 2.0 Standard-Height Serial-Attached SCSI/SATA II Disk Array Controller controls 16 internal SAS/SATA ports through four SFF-8087 x4 internal mini SAS connectors.
- The MegaRAID 6Gb/s SAS 9261-8i PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight internal SAS/SATA ports through two SFF-8087 mini-SAS 4i connectors.
- The MegaRAID 6Gb/s SAS 9280-4i4e PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls four internal SAS/SATA ports through one SFF-8087 x4 internal mini SAS connector and four external SAS/SATA ports through one SFF-8088 x4 external mini SAS connector.
- The MegaRAID 6Gb/s SAS 9280-8e PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight external SAS/SATA ports through two SFF-8088 x4 external mini SAS connectors.
- The MegaRAID 6Gb/s SAS 9280DE-8e PCI Express 2.0 Low-Profile Serial-Attached SCSI/SATA II Disk Array Controller controls eight external SAS/SATA ports through two SFF-8088 x4 external mini SAS connectors and offers data security using disk encryption.
- The MegaRAID 6Gb/s SAS 9280-16i4e PCI Express 2.0 Standard-Height Serial-Attached SCSI/SATA II Disk Array Controller controls 16 internal SAS/SATA ports through four SFF-8087 x4 internal mini SAS connector and four external SAS/SATA ports through one SFF-8088 x4 external mini SAS connector.
- The MegaRAID 6Gb/s SAS 9280-24i4e PCI Express 2.0 Standard-Height Serial-Attached SCSI/SATA II Disk Array Controller controls 24 internal SAS/SATA ports through six SFF-8087 x4 internal mini SAS connector and four external SAS/SATA ports through one SFF-8088 x4 external mini SAS connector.

1.4 General Description

The MegaRAID 6Gb/s SAS RAID controllers bring 6.0 Gb/s Serial Attached SCSI and 3.0 Gb/s SATA II performance to host adapter, workstation, and server designs. The controllers support internal storage devices and external storage devices, which allow you to use a system that supports enterprise-class SAS drives and desktop-class SATA II drives. Each MegaRAID 6Gb/s SAS RAID controller can connect to drives directly and can use expanders to connect to additional drives. Simplified cabling between devices is an additional benefit.

These SAS controllers are based on the LSISAS2108 RAID On-a-Chip (ROC) device or the LSISAS2008 PCI Express-SAS/SATA I/O Processor chip. These devices are compliant with the Fusion-MPT™ architecture and provides a PCI Express x8 interface.

NOTE: All of these RAID controllers provide an x8 PCI Express 2.0 interface.

The LSI SAS2108 ROC device provides an eight-lane, 5-Gb/s PCI Express host interface, eight 6.0 Gb/s SAS ports or eight 3.0 Gb/s SATA ports, and a full-featured, hardware-based RAID implementation. In addition, it integrates a high-speed DDR/DDR2 800 MHz SDRAM interface with a hardware RAID assist engine for parity calculations. The LSI SAS2108 ROC device provides the maximum benefits of a RAID system and enables you to configure the system to satisfy your system requirements.

The LSI SAS2108 ROC device increases system performance and provides fault-tolerant data storage. The LSI SAS2108 supports data striping across multiple drives, which reduces drive access time because multiple drives simultaneously read or write data. The LSI SAS2108 ROC device backs up data with either data mirroring or a parity block. Either backup method enables you to recover lost data in the event of a drive failure. You can select the data backup method that best suits your needs. A hardware RAID assist exclusive-OR (XOR) engine speeds parity generation and checking and reduces system-access times.

The SAS RAID 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 6.0 Gb/s SAS link rates and 3.0 Gb/s SATA II link rates.

These devices adhere to the *PCI Express Specification, Revision 2.0*. The PCI Express software is backward compatible with previous revisions of the PCI bus and PCI-X bus.

The SAS RAID controllers support the SAS protocol as described in the *Serial Attached SCSI Standard, version 2.0*. The controllers also support the Serial ATA II (SATA II) protocol defined by the *Serial ATA Specification, Version 1.0a* and the *Serial ATAII; Extension to the Serial ATA Specification, Version 1.1*. SATA II is an extension to SATA 1.0a. In addition, the SAS RAID controllers support the following SATA II features:

- 3Gb/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 SSP, SMP, STP, and SATA II. SSP enables communication with other SAS devices. SATA II enables the SAS controllers to communicate with other SATA II devices.

1.5 Configuration Scenarios

You can use the SAS RAID controllers in three main scenarios:

- **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 drives either directly or through a port expander. This configuration is mostly for low-end or entry servers. Enclosure management is provided through an out-of-band I²C bus. Side bands of both types of internal SAS connectors support the SFF-8485 (SGPIO) interface.
- **Midrange internal SAS configuration:** This configuration is like the internal SATA II configurations, but with high-end SAS drives. This configuration is more suitable for low-range to midrange servers.

- High-end external SAS/SATA II configuration:** This configuration is for 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 shows a direct-connect configuration. The Inter-IC (I²C) interface communicates with peripherals. The external memory bus provides a 32-bit memory bus, parity checking, and chip select signals for pipelined synchronous burst static random access memory (PSBRAM), nonvolatile static random access memory (NVSRAM), and Flash ROM.

Figure 1: Example of an LSI SAS Direct-Connect Application

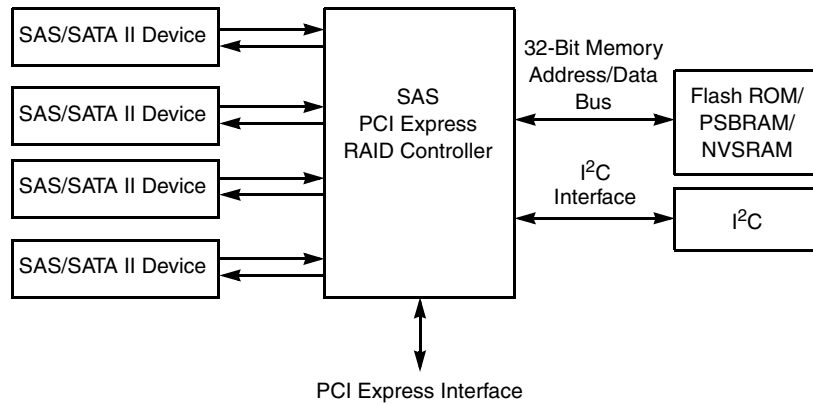
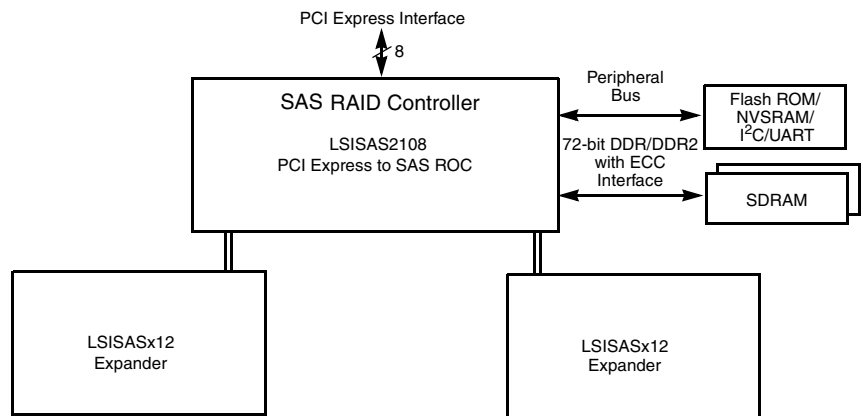


Figure 2 shows an example of a SAS RAID controller configured with an LSISASx12 expander that is connected to SAS drives, SATA II drives, or both.

Figure 2: Example of an LSI SAS RAID Controller Configured with an LSISASx12 Expander



1.6 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.

1.6.1 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 controllers in your system, you can connect SAS devices and SATA II devices over the bus.

NOTE: Some PCI-E slots support PCI-E graphics cards only; if a RAID controller is installed on those PCI-E slots, it will not function.

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

1.6.2 Operating System Support

The MegaRAID 6Gb/s SAS RAID controllers supports the following operating systems:

- Windows Vista, Windows Server 2003, and Windows Server 2008
- Red Hat Linux
- SUSE Linux
- Novell NetWare
- SCO OpenServer
- SCO UnixWare
- Solaris
- FreeBSD

To download the latest operating system drivers, go to:
<http://www.lsi.com/cm/DownloadSearch.do>.

The MegaRAID 6Gb/s SAS RAID controllers use Fusion-MPT™ architecture for all major operating systems, thinner drivers, and better performance.

1.7 Summary of SAS RAID Controller Characteristics

This section summarizes the features and benefits of the MegaRAID 6Gb/s SAS RAID controllers. It contains information on SAS features, SATA II features, PCI performance, integration, usability, and flexibility.

The MegaRAID 6Gb/s SAS RAID controllers have the following features:

- PCI Express x8 lane width (with support for x16 connections)
- PCI Express performance up to 5Gb/s per lane
- Support for 512-Mbyte DDR2 800 MHz on-board SDRAM intelligent battery-backed module
- One internal connector for the SAS 9240-4i, SAS 9260-4i, and SAS 9280-4i4e RAID controllers
- Two internal connectors for the SAS 9240-8i, SAS 9260-8i, SAS 9261-8i, and SAS 9260DE-8i RAID controllers
- Four internal connectors for the SAS 9260-16i RAID controller and the SAS 9280-16i4e RAID controller
- Six internal connectors for the SAS 9280-24i4e RAID controller
- One external connector for the SAS 9280-4i4e, SAS 9280-16i4e, and SAS 9280-24i4e RAID controllers
- Two external connectors for the SAS 9280-8e RAID controller and the SAS 9280DE-8e RAID controller
- Support for RAID levels 0, 1, 5, 6, 00, 10, 50, and 60
- Advanced array configuration and management utilities
- Support for global hot spares and dedicated hot spares
- Support for user-defined stripe sizes: 8, 16, 32, 64, 128, 256, 512, or 1024 KB
- Advanced array configuration and management utilities offer:
 - Online capacity expansion to add space to an existing drive or new drive
 - Online RAID level migration
 - Drive migration
 - Drive roaming
 - No reboot necessary after expansion
 - Load balancing
 - Media scan
- User-specified rebuild rate (specifying the percentage of system resources to use from 0 percent to 100 percent)
- 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.

1.7.1 SAS Features

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

- Provides four fully independent PHYs or eight fully independent PHYs, depending on the controller
- Supports 6Gb/s and 3Gb/s SAS data transfers per PHY
- Supports SMP to communicate topology management information
- Supports SSP to enable communication with other SAS devices
- Supports STP to enable communication with a SATA II device through an attached expander
- Provides a serial, point-to-point, enterprise-level storage interface
- Simplifies cabling between devices

- Provides a scalable interface that supports up to 240 devices through the use of expanders

NOTE: The number of devices varies depending on the MegaRAID product. Check the LSI website (<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

1.7.2 SAS Array Limitations

This section describes the array limitations of the MegaRAID 6Gb/s SAS RAID controllers. These limitations include the number of drives supported per controller, the maximum number of drives per controller, and the maximum number of virtual drives allowed per controller.

Table 1 lists the array limitations for the 6Gb/s SAS RAID controllers.

Table 1: SAS RAID Controller Array Limitations

Specification	SAS 9240-4i	SAS 9240-8i	SAS 9260-4i	SAS 9260-8i	SAS 9260-16i	SAS 9261-8i	SAS 9280 4i/4e	SAS 9280-8e	SAS 9280-16i4e	SAS 9280-24i4e
Maximum virtual drives per controller	16	16	64	64	64	64	64	64	64	64
Maximum drive groups per controller	16	16	128	128	128	128	128	128	128	128
Maximum virtual drives per drive group	16	16	16	16	16	16	16	16	16	16
Maximum drives per drive group	16	16	32	32	32	32	32	32	32	32
Maximum drives per controller	16*	16*	32	32	240	32	240	240	240	240
Maximum hot spares per controller	8	8	32	32	240	32	240	240	240	240
Maximum spans per virtual drive	8	8	8	8	8	8	8	8	8	8
Maximum enclosures per port**	2	2	2	2	10	2	10	10	10	10
Number of ports	1	2	1	2	6	2	2	2	6	6
* Can support up to 64 devices, but only 16 can be used in a RAID configuration.										
** Assumes one Storage Enclosure Processor (SEP) per enclosure.										

The maximum numbers in Table 1 depend on how many physical devices you have connected to the RAID controller. For example, the maximum number of drive groups is equal to the number of drives that are supported by the controller. Thus, for the SAS 9240-4i RAID controller, the maximum number of drive groups per controller is eight, which is based on the maximum number of physical devices that you can connected. In addition, the maximum number of hot spares per controller is equal to the maximum number of drives per controller.

Although you can have up to 16 virtual drives per drive group and up to 16 drive groups per controller (depending on the controller), there is a limit of 64 virtual drives per controller.

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 limits listed in [Table 1](#) rather than by actual RAID volume capacity.

1.7.3 SATA II Features

The following list describes the SATA II features of the RAID controllers:

- Supports SATA II data transfers of 3Gb/s
- Supports STP data transfers of 3Gb/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

1.7.4 PCI Express Performance

The following list describes the PCI Express performance features of the RAID controllers:

- Provides a PCI Express interface that does the following:
 - Supports a dedicated PCI Express bus
 - Supports x8 lane configuration
 - Supports transfer rates of up to 5Gb/s per lane
 - Complies with the *PCI Express Specification, Revision 2.0*
- Provides unequaled performance through the Fusion-MPT architecture
- Provides high throughput and low CPU utilization to offload the host processor

1.7.5 Usability Features

The following list describes the usability features of the 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 one LED signal for each PHY to indicate link activity (this is a fault LED only for controllers with internal port connectors)

NOTE: The SAS 9280-8e RAID controller and the SAS 9280DE-8e RAID controller do not have any LEDs to indicate link activity.

- Provides an I²C interface for enclosure management
- Supports the internal SAS Sideband signal SFF-8485 (SGPIO) interface

1.7.6 Flexibility Features

These features increase the flexibility of the RAID controllers:

- Supports a Flash ROM interface, a nonvolatile static RAM (NVS RAM) interface, and a pipelined synchronous burst SRAM (PSBRAM) interface

- Offers a flexible programming interface to tune I/O performance
- Allows mixed connections to SAS targets or SATA II targets
- Leverages compatible connectors for SAS connections 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

1.7.7 Drive Roaming

Drive roaming occurs when the 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.

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

1. Turn off power to the server and all drives, enclosures, and system components. Disconnect the power cords from the system.
2. Open the host system by following the instructions in the host system technical documentation.
3. Move the drives to different positions on the backplane to change the targets.
4. Determine the SAS target requirements.
5. Perform a safety check.
 - a. Make sure that the drives are inserted correctly.
 - b. Close the cabinet of the host system.
6. Reconnect the power cords to the system.
7. Turn on the power to the system.

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

1.7.8 Drive Migration

Drive migration is the transfer of a set of 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: Partial configurations, including individual virtual drives, can be migrated.

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

Follow these steps to migrate drives:

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 drives and the NVRAM.

NOTE: When you migrate drives, move only the drives that make up the virtual drive (not all of the drives 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 drives to the other controller.

2. Turn off power to the server and all drives, enclosures, and system components. Disconnect the power cords from the systems.
3. Open the host system by following the instructions in the host system technical documentation.
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.
5. Remove the drives from the first system, and insert them into drive bays on the second system.
6. Connect the SAS cables to the drives in the second system.
7. Determine the SAS target requirements.
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.
9. Reconnect the power cords to the system.
10. Turn on the power to the system.

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

1.8 Hardware Specifications

You can install the MegaRAID 6Gb/s SAS RAID controllers in a computer with a motherboard that has a PCI Express slot. [Table 2](#) describes the hardware configuration features for the MegaRAID 6Gb/s SAS RAID controllers.

Table 2: MegaRAID 6Gb/s SAS RAID Controller Features

Specification	MegaRAID SAS 9240, SAS 9260, SAS 9261, and SAS 9280 RAID Controllers
RAID levels	0, 1, 5, 6, 00, 10, 50, 60
Devices supported per port	Up to 15 SAS devices or SATA II devices (such as drives and expanders)
Number of ports	<ul style="list-style-type: none"> • MegaRAID SAS 9240-4i RAID controller – Four ports through one SFF-8087 x4 internal mini SAS connector • MegaRAID SAS 9240-8i RAID controller – Eight ports through two SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9260-4i RAID controller – Four ports through one SFF-8087 x4 internal mini SAS connector • MegaRAID SAS 9260-8i RAID controller – Eight ports through two SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9260DE-8i RAID controller – Eight ports through two SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9260-16i RAID controller – 16 ports through four SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9261-8i RAID controller – Eight ports through two SFF-8087 mini-SAS 4i connectors • MegaRAID SAS 9280-4i4e RAID controller – Four ports through one SFF-8087 x4 internal mini SAS connector and four ports through one SFF-8088 x4 external mini SAS connector • MegaRAID SAS 9280-8e RAID controller – Eight ports through two SFF-8088 x4 external mini SAS connectors • MegaRAID SAS 9280DE-8e RAID controller – Eight ports through two SFF-8088 x4 external mini SAS connectors • MegaRAID SAS 9280-16i4e RAID controller – 16 ports through four SFF-8087 x4 internal mini SAS connectors and four ports through one SFF-8088 x4 external mini SAS connector • MegaRAID SAS 9280-24i4e RAID controller – 24 ports through six SFF-8087 x4 internal mini SAS connectors and four ports through one SFF-8088 x4 external mini SAS connector
Data transfer rate	Up to 6Gb/s per PHY
Bus	PCI Express 2.0
Cache function	Write-back, write-through, adaptive read ahead, non-read ahead, read ahead, cache I/O, direct I/O
Multiple virtual drives per controller	Up to 64 (this value is dependent on the firmware)
Online capacity expansion	Yes
Dedicated and global hot spares	Yes
Hot-swap devices supported	Yes
Non-drive devices supported	Yes
Mixed capacity drives supported	Yes
Number of external connectors	<ul style="list-style-type: none"> • MegaRAID SAS 9280-4i4e RAID controller – One SFF-8088 x4 external mini SAS connector • MegaRAID SAS 9280-8e RAID controller – Two SFF-8088 x4 external mini SAS connectors • MegaRAID SAS 9280DE-8e RAID controller – Two SFF-8088 x4 external mini SAS connectors • MegaRAID SAS 9280-16i4e RAID controller – One SFF-8088 x4 external mini SAS connector • MegaRAID SAS 9280-24i4e RAID controller – One SFF-8088 x4 external mini SAS connector

Table 2: MegaRAID 6Gb/s SAS RAID Controller Features (Continued)

Specification	MegaRAID SAS 9240, SAS 9260, SAS 9261, and SAS 9280 RAID Controllers
Number of internal connectors	<ul style="list-style-type: none"> • MegaRAID SAS 9240-4i RAID controller – One SFF-8087 x4 internal mini SAS connector • MegaRAID SAS 9240-8i RAID controller – Two SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9260-4i RAID controller – One SFF-8087 x4 internal mini SAS connector • MegaRAID SAS 9260-8i RAID controller – Two SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9260-16i RAID controller – Four SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9260DE-8i RAID controller – Two SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9261-8i RAID controller – Two SFF-8087 mini-SAS 4i connectors • MegaRAID SAS 9280-4i4e RAID controller – One SFF-8087 x4 internal mini SAS connector • MegaRAID SAS 9280-16i4e RAID controller – Four SFF-8087 x4 internal mini SAS connectors • MegaRAID SAS 9280-24i4e RAID controller – Six SFF-8087 x4 internal mini SAS connectors
Hardware exclusive OR (XOR) assistance	Yes
Direct I/O	Yes
Architecture	Fusion-MPT

1.9 Technical Support

For assistance installing, configuring, or running your MegaRAID 6Gb/s SAS RAID controller, contact LSI Technical Support. Click the following link to access the LSI Technical Support page for storage and board support:

http://www.lsi.com/support/storage/tech_support/index.html

From this page, you can send an email or call Technical Support, or submit a new service request and view its status.

NOTE: Record your controller serial number in a safe location in case you need to contact LSI about your RAID controller.

E-mail:

http://www.lsi.com/support/support_form.html

Phone Support:

http://www.lsi.com/support/storage/phone_tech_support/index.html

NOTE: The international toll-free number does not require country-specific access codes.

Chapter 2

MegaRAID SAS Hardware Installation

This chapter describes the procedures you can follow to install the MegaRAID 6Gb/s Serial Attached SCSI/Serial ATA II controllers with internal and external connectors.

- [Section 2.1, Requirements](#)
- [Section 2.2, Quick Installation](#)
- [Section 2.3, Detailed Installation](#)
- [Section 2.4, After Installing the RAID Controller](#)
- [Section 2.5, SAS Device Cables and Connectors](#)

2.1 Requirements

The following items are required to install a MegaRAID 6Gb/s SAS RAID controller:

- A MegaRAID SAS 92xx RAID controller
- A host system with an available x8 PCI Express 2.0 slot

NOTE: These controllers also work in PCI Express first generation slots. The PCI Express software is backward compatible with previous revisions of the PCI bus and the PCI-X bus.

- The *MegaRAID Universal Software Suite* CD, which contains the drivers and documentation
- The necessary internal cables, external cables, or both
- SAS drives or SATA II drives

NOTE: LSI strongly recommends using an uninterruptible power supply.

2.2 Quick Installation

The following steps are for quick installation of your MegaRAID 6Gb/s SAS RAID controller. These steps are for experienced computer users or installers. [Section 2.3, Detailed Installation](#) contains the steps for all others to follow.

1. Turn off the power to the system, all drives, enclosures, and system components, and disconnect the PC power cord.
2. Open the cabinet of the host system by following the instructions in the host system technical documentation.
3. Check the jumper settings to make sure that they are in the desired position. The jumpers are set at the factory and you usually do not need to change them.

NOTE: See [Chapter 3, *MegaRAID SAS RAID Controller Characteristics*](#) for detailed information about the jumpers and the connectors.

4. Install the MegaRAID 6Gb/s SAS RAID controller in the server, and connect SAS devices or SATA II devices to it. Make sure that the cables you use conform to all specifications.
5. Perform a safety check.
 - a. Make sure that all cables are attached correctly.
 - b. Make sure that the RAID controller is installed correctly.
 - c. Close the cabinet of the host system.
6. Reconnect the power cords to the system.
7. Turn on the power to the system.

Make sure that the power is turned on to any external drives, before the power is turned on to the host computer. If the computer is powered up before these devices, the devices might not be recognized.

2.3 Detailed Installation

This section provides detailed instructions for installing your MegaRAID 6Gb/s SAS RAID controller.

1. Unpack the MegaRAID 6Gb/s SAS RAID controller.

Unpack and remove your RAID controller. Inspect it for damage. If it appears damaged, or if any of the following items are missing, contact your LSI Customer and Technical Support representative. The RAID controller is shipped with the following 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

2. Turn off the power to the system.

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

3. Review the RAID controller jumpers and connectors.

The jumpers are set at the factory, and you usually do not need to change them. See [Chapter 3, *MegaRAID SAS RAID Controller Characteristics*](#) for diagrams of the MegaRAID 6Gb/s SAS RAID controllers with their jumpers and connectors.

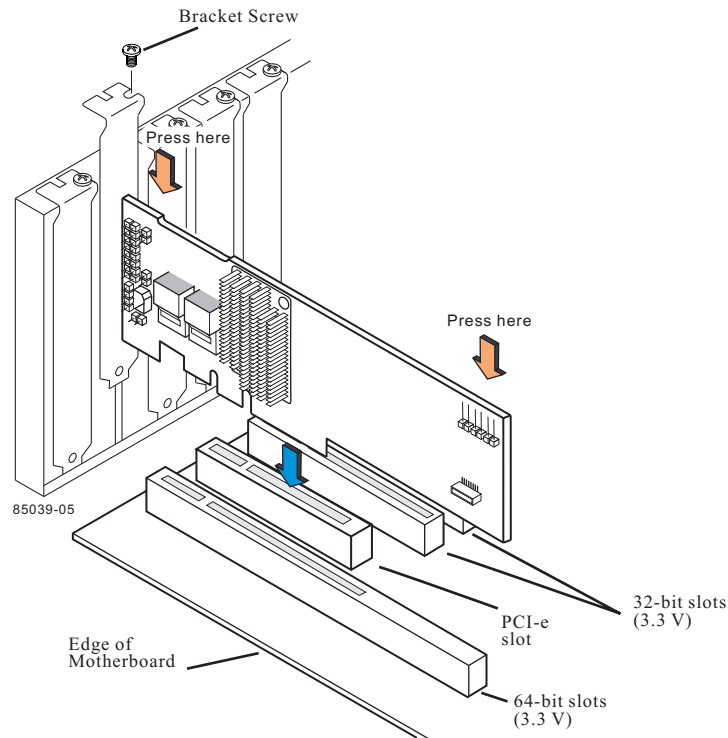
4. Install the RAID controller.

Select a PCI Express slot, and align the controller's PCI Express 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 with the bracket screw.

[Figure 3](#) shows the installation of the MegaRAID SAS 9260-8i RAID controller in a PCI Express slot.

NOTE: Some PCI-E slots support PCI-E graphics cards only; if a RAID controller is installed on those PCI-E slots, it will not function.

Figure 3: Example of the MegaRAID SAS 9260-8i Board Installation in a PCI Express Slot



5. Configure and install the SAS devices, SATA II devices, or both in the host computer case.

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

6. Connect the RAID controller to the devices.

Use SAS cables to connect SAS devices, SATA II devices, or both to the MegaRAID 6Gb/s SAS RAID controller. See [Section 2.5, SAS Device Cables and Connectors](#) for SAS cable and connector information. See [Section 2.5.1, Connecting a SAS RAID Controller with Internal Connectors to Drives](#) for information about connecting the controller to drives.

The maximum cable length is 10 meters (393.37 in.). 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 10 meters (393.37 in.). (LSI recommends using shorter cables, if possible.)
- b. Use cables that meet the SAS specification.
- c. Route the SAS cables carefully.

7. Turn on the power to the system.

Reinstall 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 before or at the same time that the power is turned on to the host computer. If the computer is powered up before these devices, the devices 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 shows the MegaRAID 6Gb/s SAS RAID controller number, firmware version, and cache SDRAM size. The numbering of the controllers follows the PCI slot scanning order used by the host motherboard.

8. Run the WebBIOS Configuration Utility.

Run the WebBIOS Configuration Utility to configure the drive groups and the virtual drives. When the message `Press CTRL+H for WebBIOS` appears on the screen, immediately press CTRL+H to run the utility.

9. 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 controllers on the LSI website at: <http://www.lsi.com/cm/DownloadSearch.do>.

For information about 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 After Installing the RAID Controller

After you install the MegaRAID 6Gb/s SAS RAID controller, you must configure the 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 6Gb/s SAS RAID controller. The *MegaRAID SAS Device Driver Installation User's Guide* provides detailed installation instructions for operating system drivers.

2.5 SAS Device Cables and Connectors

This section describes the cables and the connectors used on the SAS controllers and provides step-by-step instructions for connecting SAS drives, SATA II drives, 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 40-wire ATA cable.

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

Figure 4 shows the SAS cable that connects the internal connectors on a SAS RAID controller to SAS drives, SATA II drives, or both.

Figure 4: Internal SAS Cable for Connection to SAS Drives, SATA II Drives, or Both

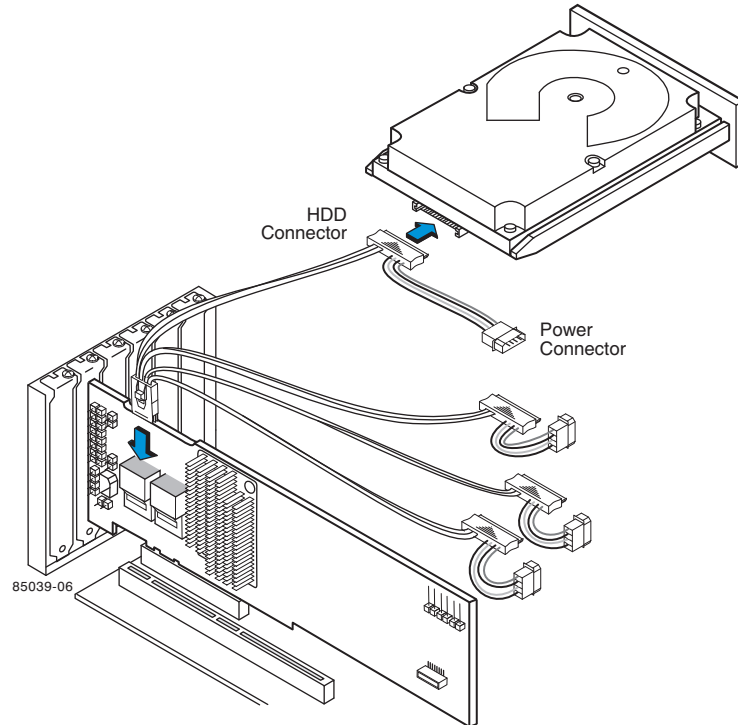


Figure 5 shows the SATA II device plug connector that connects a SAS RAID controller with internal connectors to the host receptacle connector on a backplane. A SATA II connector consists of a signal connector and a power connector.

Figure 5: SATA II Connectors

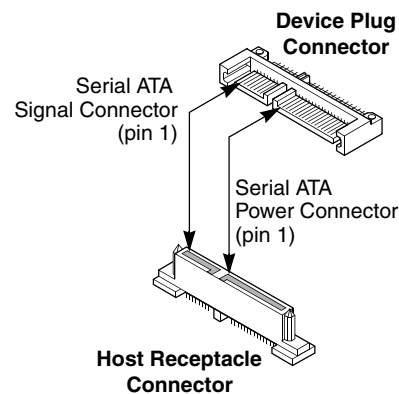
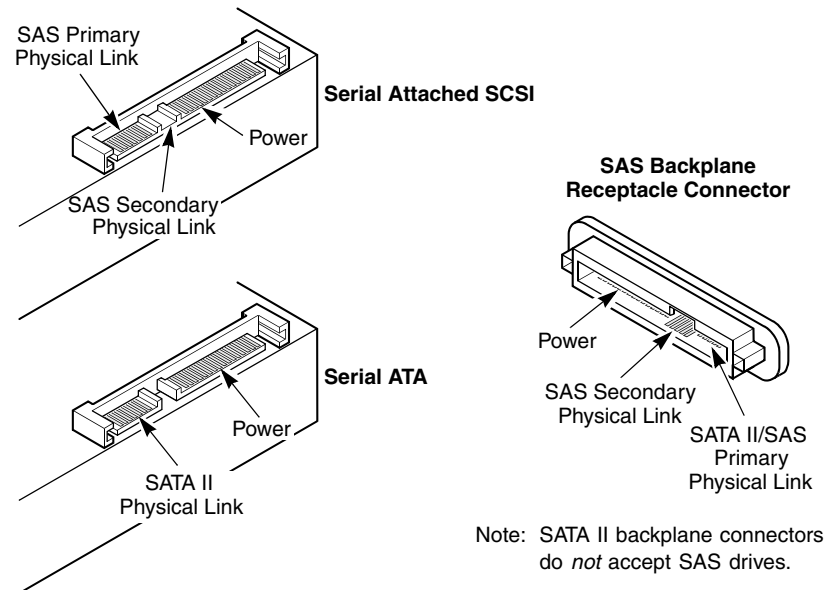


Figure 6 shows SAS connectors and SATA II connectors on SAS drives and SATA II drives, respectively. Cables connect internal connectors on the RAID controllers to connectors on SAS drives, SATA II drives, or both. Both SAS drives and SATA II drives can connect to SAS backplane receptacle connectors. The difference between the SAS connector and the SATA II connector is the bridge between the SAS primary physical link and the power connector on the SAS controller, which the SATA II connector does not have.

NOTE: SAS backplane connectors accept SAS drives or SATA II drives, but SATA II backplane connectors *cannot* accept SAS drives.

Figure 6: SAS Plugs 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 drives and SATA II drives, either directly or through an expander.

2.5.1 Connecting a SAS RAID Controller with Internal Connectors to Drives

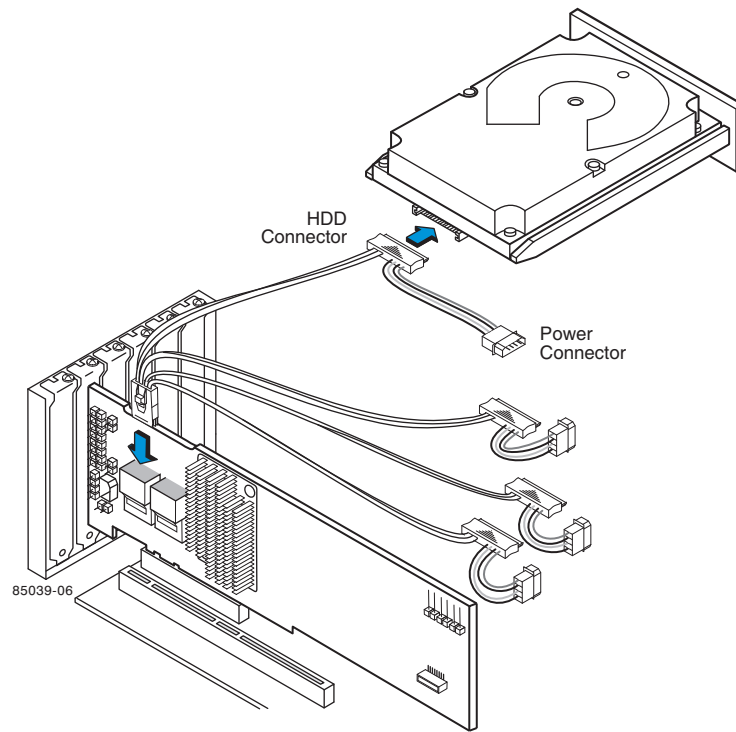
This section provides step-by-step instructions for connecting the SAS cable from the internal connectors on the RAID controller to SAS drives and SATA II drives.

Follow these steps to connect your RAID controller with internal SAS port connectors directly to SAS drives, SATA II drives, or both.

NOTE: The SAS 9260-8i RAID controller is shown as an example. You can connect other SAS controllers with internal SAS port connectors in the same way.

1. Insert the SFF-8087 x4 internal mini SAS connector on the cable into a SFF-8087 x4 internal mini SAS connector on the SAS 9260-8i RAID controller, as shown in [Figure 7](#).
2. Plug the HDD connector on the other end of the internal cable into the connector on the SAS drive or the SATA II drive.
3. If you have another drive, connect it to another plug on the internal cable.

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

Figure 7: Connecting the SAS 9260-8i RAID Controller to a Drive

2.5.2 Connecting a SAS RAID Controller with External Connectors to a Drive Enclosure

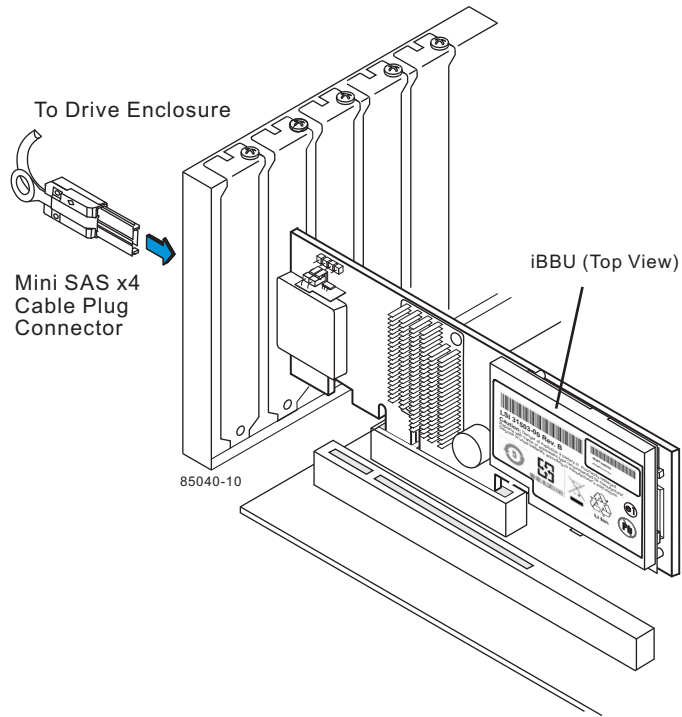
This section provides step-by-step instructions for connecting a SAS RAID controller with external SAS port connectors to a drive enclosure containing SAS drives, SATA II drives, or a combination of both drive types.

Follow these steps to connect the cable from your controller to a drive enclosure.

NOTE: The SAS 9280-8e RAID controller is shown as an example. You can connect other SAS controllers with external SAS port connectors in the same way.

1. Connect the connector on one end of the cable to external port J1A4 or J1B1 on the SAS 9280-8e RAID controller, as shown in [Figure 8](#).
2. Connect the other end of the cable to the external port on the drive enclosure.

Figure 8: Connecting the SAS 9280-8e RAID Controller to a Drive Enclosure



Chapter 3

MegaRAID SAS RAID Controller Characteristics

This chapter describes the characteristics of the LSI MegaRAID Serial Attached SCSI/Serial ATA II 6Gb/s RAID controllers.

- [Section 3.1, MegaRAID 6Gb/s SAS RAID Controller Family](#)
- [Section 3.2, MegaRAID SAS 6Gb/s RAID Controller Characteristics](#)
- [Section 3.3, Technical Specifications](#)

3.1 MegaRAID 6Gb/s SAS RAID Controller Family

The MegaRAID 6Gb/s SAS RAID controllers are dual PHY, SAS PCI Express RAID controllers and are used in a system with a PCI Express slot. PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile devices, servers, communications, and embedded devices.

The following subsection provides graphics and connector information for the 6Gb/s SAS RAID controllers.

3.1.1 MegaRAID SAS 9240 RAID Controllers

The MegaRAID SAS 9240-4i low-profile SAS/SATA II RAID controller controls four internal SAS/SATA ports through one SFF-8087 x4 internal mini SAS connector.

The MegaRAID SAS 9240-8i low-profile SAS/SATA II RAID controller controls eight internal SAS/SATA ports through two SFF-8087 x4 internal mini SAS connectors.

3.1.1.1 MegaRAID SAS 9240 RAID Controllers - Board Layout and Jumper/Connector Information

This subsection provides the board layout, and the connector and jumper information for the SAS 9240 RAID controllers. [Figure 9](#) shows the jumpers and the connectors on the SAS 9240-8i RAID controller.

NOTE: The SAS 9240-4i RAID controller is like the SAS 9240-8i RAID controller except that the SAS 9240-4i does not contain the J5 connector, which supports ports 4–7.

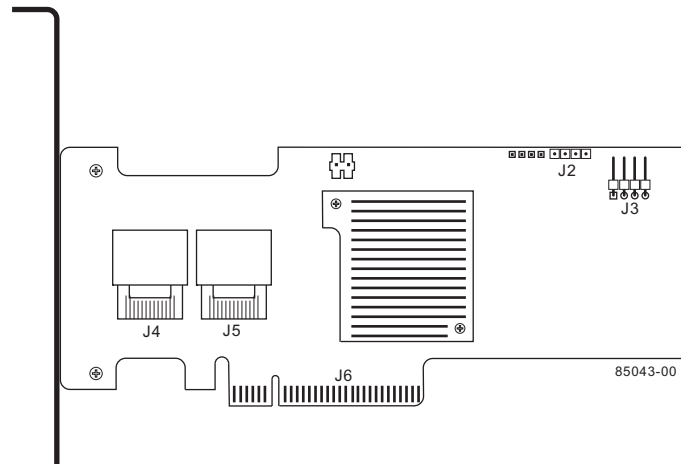


Figure 9: Card Layout for the MegaRAID SAS 9240-8i RAID Controller

Table 3 describes the jumpers and the connectors on the SAS 9240-4i and 9240-8i RAID controllers.

Table 3: SAS 9240-4i and SAS 9240-8i RAID Controllers – Jumpers and Connectors

Jumper	Type	Description
J1	RISCwatch header	16-pin header Reserved for LSI use.
J2	CPLD header	10-pin header Reserved for LSI use.
J3	External LED drive activity/fault header	4-pin connector Connects to external, green or red LEDs that indicate drive activity or faults.
J4	x4 SAS Ports 0–3	SFF-8087 x4 internal mini SAS connector Connects the cables from the controller to SAS drives or SATA II drives, or a SAS expander.
J5	x4 SAS Ports 4–7	SFF-8087 x4 internal mini SAS connector Connects the cables from the controller to SAS drives or SATA II drives, or a SAS expander. NOTE: The SAS 9240-4i RAID controller does not have the J5 connector.
J6	PCI Express x8 board edge connector	x8 interface that provides connections on both the top and the bottom of the board.
TP1	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.
U2	MegaRAID RAID Key connector	2-pin connector To create a RAID 5 configuration, you have to plug a 1-wire key into this connector.

3.1.2 MegaRAID SAS 9260 RAID Controllers

The MegaRAID SAS 9260-4i low-profile SAS/SATA II RAID controller controls four internal SAS/SATA ports through one SFF-8087 x4 internal mini SAS connector.

The MegaRAID SAS 9260-8i low-profile SAS/SATA II RAID controller controls eight internal SAS/SATA ports through two SFF-8087 x4 internal mini SAS connectors.

The MegaRAID SAS 9260DE-8i low-profile SAS/SATA II RAID controller controls eight internal SAS/SATA ports through two SFF-8087 x4 internal mini SAS connectors and offers data security using disk encryption.

The MegaRAID SAS 9260-16i standard-height SAS/SATA II RAID controller controls 16 internal SAS/SATA ports through four SFF-8087 x4 internal mini SAS connectors.

3.1.2.1 MegaRAID SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID Controllers - Board Layout and Jumper/Connector Information

This subsection provides the board layout, and the connector and jumper information for the MegaRAID SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID controllers.

Figure 10 shows the jumpers and the connectors on the SAS 9260-8i RAID controller.

NOTE: The SAS 9260-4i RAID controller has the same connectors as the SAS 9260-8i except for the JT7 connector, which supports ports 4–7. The SAS 9260DE-8i has the same connectors as the SAS 9260-8i.

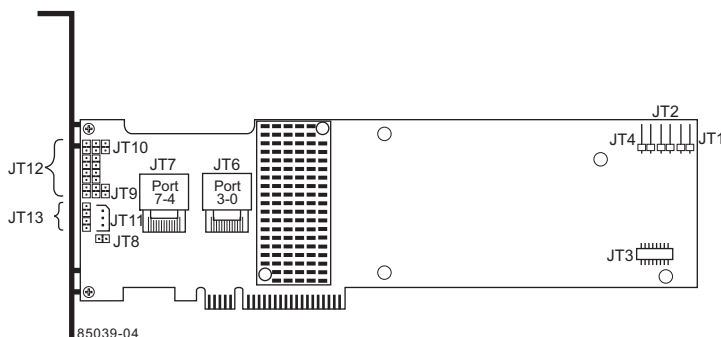


Figure 10: Card Layout for the MegaRAID SAS 9260-8i RAID Controller

NOTE: JT1, JT2, and JT4 are behind the LSIiBBU07 when the iBBU is installed, but they are still accessible.

Table 4 describes the jumpers and connectors on the SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID controllers.

Table 4: SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID Controllers – Jumpers and Connectors

Jumper	Type	Description
JT1	Write-pending Indicator (dirty cache) LED connector	2-pin connector Connects to an LED that indicates when the data in the cache has yet to be written to the storage devices. Used when the write-back feature is enabled.
JT2	SAS Activity LED header	2-pin connector Connects to an LED that indicates drive activity.
JT3	Battery Backup Unit connector	20-pin connector Connects the intelligent Battery Backup Unit LSiBBU07 to the RAID controller remotely.
JT4	Global Drive Fault LED header	2-pin connector Connects to a single LED to indicate whether any drive is in a fault condition.
JT6	x4 SAS Ports 3–0	SFF-8087 x4 internal mini SAS connector Connects the cables from the RAID controller to SAS drives, SATA II drives, or a SAS expander.
JT7	x4 SAS Ports 7–4 NOTE: The SAS 9260-4i RAID controller does not have this connector.	SFF-8087 x4 internal mini SAS connector Connects the cables from the RAID controller to SAS drives, SATA II drives, or a SAS expander.
JT8	Modular RAID Key header	2-pin connector Reserved for LSI use.
JT9	Set Factory Defaults connector	2-pin connector Reserved for LSI use.
JT10	LSI Test header	2-pin connector Reserved for LSI use.

Table 4: SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID Controllers – Jumpers and Connectors (Continued)

Jumper	Type	Description
JT11	IPMI-style SMBus (System Management)/I ² C header	3-pin shielded header Provides enclosure management support.
JT12	Individual Drive Fault LED header for Eight Phys (0-7)	16-pin connector Indicates drive faults. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the Unconfigured-Bad state. Refer to the <i>MegaRAID SAS Software User's Guide</i> for more information about drive states. The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port. NOTE: This header is used for RAID controllers with internal SAS ports only.
JT13	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.

3.1.2.2 MegaRAID SAS 9260-16i RAID Controller - Board Layout and Jumper/Connector Information

This subsection provides the board layout, and the connector and jumper information for the MegaRAID SAS 9260-16i RAID controller. Figure 11 shows the jumpers and connectors on the SAS 9260-16i controller.

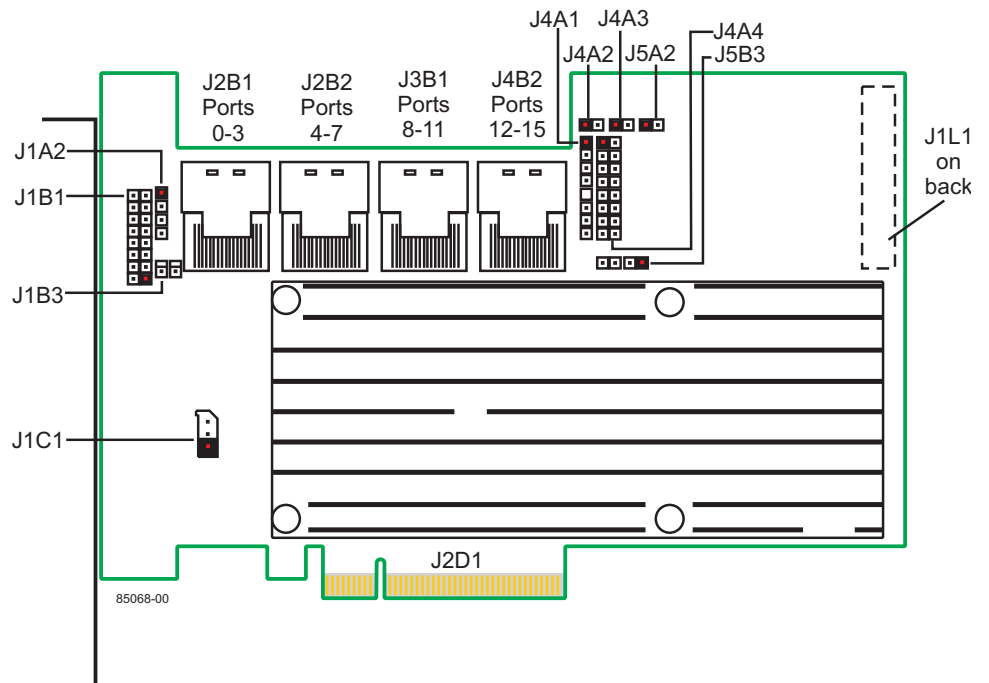


Figure 11: Card Layout for the MegaRAID SAS 9260-16i RAID Controller

NOTE: Pin 1 on the headers and connectors is highlighted in black and red in [Figure 11](#).

[Table 5](#) describes the jumpers and the connectors on the SAS 9260-16i RAID controller. It includes diagrams showing Pin1 and their orientation for several of the connectors.

Table 5: SAS 9260-16i RAID Controller – Connectors

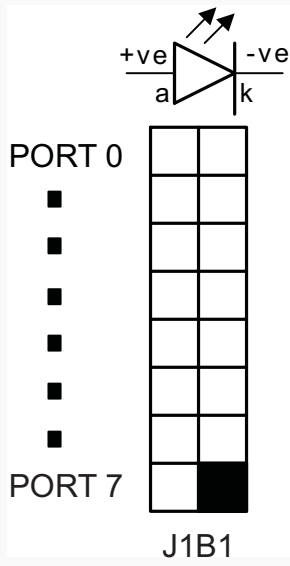
Jumper/ Connector	Type	Description
J1A2	Universal Asynchronous Receiver/ Transmitter (UART) for the Expander	4-pin connector Reserved for LSI use.
J1B1	LED Locate and Fault Indication header Ports 0-3 Ports 4-7 	2x8-pin connector Connects to an LED that indicates whether a drive is in a fault condition. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the unconfigured-bad state. The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port. NOTE: This header is used for RAID controllers with internal SAS ports only.
J1B3	Premium Features Hardware Key header	2-pin header Enables support for selected premium features, which include recovery, CacheCade, FastPath, and SafeStore disk encryption.
J1C1	IPMI-style I ² C connector	3-pin connector Supports SES (SCSI enclosure services) over I ² C through an internal I ² C backplane cable.
J1L1	Remote Battery Backup connector (on the backside of the controller)	20-pin connector Connects the LSIiBBU07 intelligent Battery Backup Unit or the LSIiBBU08 intelligent Battery Backup Unit to the RAID controller remotely.

Table 5: SAS 9260-16i RAID Controller – Connectors (Continued) (Continued)

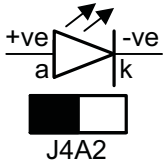
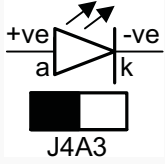
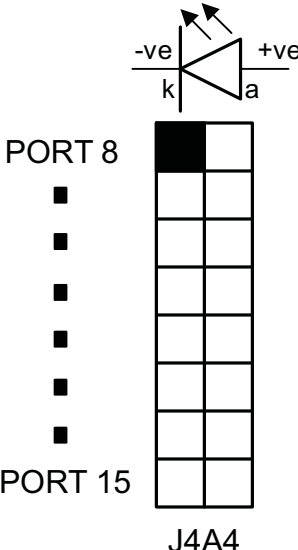
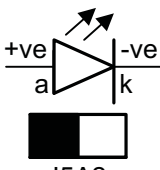
Jumper/Connector	Type	Description
J2B1	x4 SAS Ports 0-3 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J2B2	x4 SAS Ports 4-7 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J2D1	Standard edge card connector	The RAID controller interfaces with the host system through a standard edge card. This interface provides power to the board and an I ² C interface connected to the I ² C bus for IPMI.
J3B1	x4 SAS Ports 8-11 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J4A1	Module CPLD	1x8-pin connector Reserved for LSI use.
J4A2	Activity LED header 	2-pin connector Connects to an LED that indicates activity on the drives connected to the controller.
J4A3	Global drive fault LED header 	2-pin connector Connects to an LED that indicates whether a drive is in a fault condition.

Table 5: SAS 9260-16i RAID Controller – Connectors (Continued) (Continued)

Jumper/Connector	Type	Description
J4A4	LED Locate and Fault Indication header Ports 8-11 Ports 12-15  <p style="text-align: center;">J4A4</p>	2x8-pin header Connects to an LED that indicates whether a drive is in a fault condition. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the Unconfigured-Bad state. The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port. NOTE: This header is used for RAID controllers with internal SAS ports only.
J4B2	x4 SAS Ports 12-15 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J5A2	Write pending LED header  <p style="text-align: center;">J5A2</p>	2-pin connector Connects to an LED that indicates when the data in the cache has yet to be written to the storage devices. Used when the write-back feature is enabled.
J5B3	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.

3.1.3 MegaRAID SAS 9261 RAID Controller

3.1.3.1 MegaRAID SAS 9261-8i RAID Controller - Board Layout and Jumper/Connector Information

The MegaRAID SAS 9261-8i low-profile SAS/SATA II RAID controller controls eight internal SAS/SATA ports through two SFF-8087 mini-SAS 4i connectors.

This subsection provides the board layout, and the connector and jumper information for the SAS 9261-8i RAID controller. [Figure 12](#) shows the jumpers and connectors on the SAS 9261-8i RAID controller.

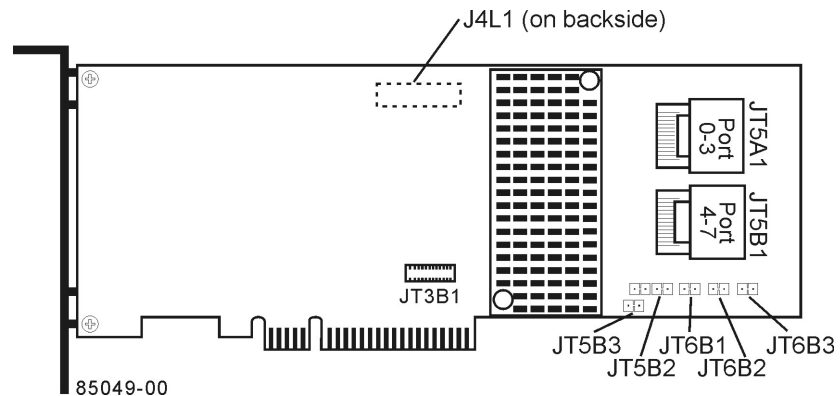


Figure 12: Card Layout for the MegaRAID SAS 9261-8i RAID Controller

Table 6 describes the jumpers and connectors on the SAS 9261-8i RAID controller.

Table 6: SAS 9261-8i RAID Controller – Jumpers and Connectors

Jumper	Type	Description
J4L1	Remote Battery Backup Unit connector (on the rear of the controller)	20-pin connector Connects the LSIiBBU07 intelligent Battery Backup Unit to the RAID controller remotely.
JT3B1	Battery Backup Unit connector	20-pin connector Connects the LSIiBBU07 intelligent Battery Backup Unit directly to the RAID controller.
JT5A1	x4 SAS Ports 0–3 Mini-SAS 4i connector	Connects the cables from the RAID controller to SAS drives or SATA II drives, or a SAS expander.
JT5B1	x4 SAS Ports 4–7 Mini-SAS 4i connector	Connects the cables from the RAID controller to SAS drives or SATA II drives, or a SAS expander.
JT5B2	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.
JT5B3	Set Factory Defaults connector	2-pin connector Reserved for LSI use.
JT6B1	Test header	2-pin connector Reserved for LSI use.
JT6B2	Global Drive Fault LED header	2-pin connector Connects to an LED that indicates whether a drive is in a fault condition.
JT6B3	SAS Activity LED header	2-pin connector Connects to an LED that indicates drive activity.

3.1.4 MegaRAID SAS 9280 RAID Controllers

The MegaRAID SAS 9280-4i4e low-profile SAS/SATA II RAID controller controls four internal SAS/SATA ports through one SFF-8087 x4 internal mini SAS connector and four external SAS/SATA ports through one SFF-8087 x4 external mini SAS connector.

The MegaRAID SAS 9280-8e low-profile SAS/SATA II RAID controller controls eight external SAS/SATA ports through two SFF-8088 x4 external mini SAS connectors.

The MegaRAID SAS 9280DE-8e low-profile SAS/SATA II RAID controller controls eight external SAS/SATA ports through two SFF-8088 x4 external mini SAS connectors and offers data security using disk encryption.

The MegaRAID SAS 9280-16i4e standard-height SAS/SATA II RAID controller controls 16 internal SAS/SATA ports through four SFF-8087 x4 internal mini SAS connectors and four external SAS/SATA ports through one SFF-8087 x4 external mini SAS connector.

The MegaRAID SAS 9280-24i4e standard-height SAS/SATA II RAID controller controls 24 internal SAS/SATA ports through six SFF-8087 x4 internal mini SAS connectors and four external SAS/SATA ports through one SFF-8087 x4 external mini SAS connector.

3.1.4.1 MegaRAID SAS 9280-8e and SAS 9280DE-8e RAID Controllers - Board Layout and Jumper/Connector Information

This subsection provides the board layout and the connector information for the SAS 9280DE-8e and SAS 9280-8e RAID controllers.

Figure 13 shows the jumpers and the connectors on the SAS 9280DE-8e and SAS 9280-8e RAID controllers.

NOTE: The SAS 9280DE-8e has the same connectors as the SAS 9280-8e.

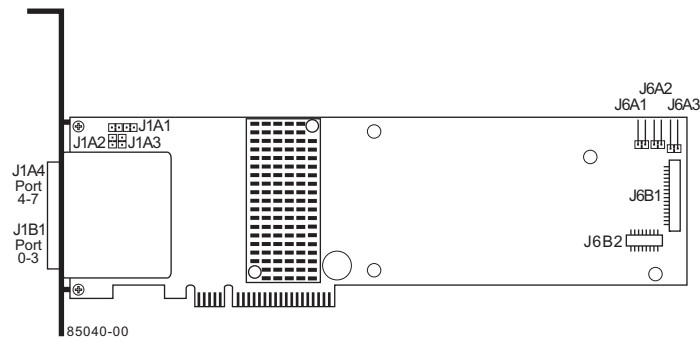


Figure 13: Card Layout for the MegaRAID SAS 9280-8e RAID Controller

NOTE: Connectors J6A1, J6A2, and J6A3 are behind the LSiIBBU07 when the iBBU is installed, but they are still accessible.

Table 7 describes the jumpers and connectors on the SAS 9280-8e RAID controller and the SAS 9280DE-8e RAID controller.

Table 7: SAS 9280-8e and SAS 9280DE-8e RAID Controllers – Connectors

Connector	Description	Comments
J1A1	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.
J1A2	Test header	2-pin connector Reserved for LSI use.
J1A3	Set Factory Defaults connector	2-pin connector Reserved for LSI use.
J1A4	x4 SAS Ports 4–7	SFF-8088 x4 external mini SAS connector Connects the cables from the controller to SAS drives or SATA II drives, or a SAS expander.
J1B1	x4 SAS Ports 0–3	SFF-8088 x4 external mini SAS connector Connects the cables from the controller to SAS drives or SATA II drives, or a SAS expander.
J6A1	Global Drive Fault LED header	2-pin connector Connects to an LED that indicates whether a drive is in a fault condition.
J6A2	SAS Activity LED header	2-pin connector Connects to an LED that indicates drive activity.
J6A3	Write-pending Indicator (dirty cache) LED connector	2-pin connector Connects to an LED that indicates when the data in the cache has yet to be written to the storage devices. Used when the write-back feature is enabled.
J6B1	Remote Battery Backup Unit connector	20-pin connector Connects the intelligent Battery Backup Unit, LSiBBU07, to the RAID controller remotely.
J6B2	Battery Backup Unit connector	20-pin connector Connects the intelligent Battery Backup Unit, LSiBBU07, directly to the RAID controller.

3.1.4.2 MegaRAID SAS 9280-4i4e RAID Controller - Board Layout and Jumper/Connector Information

This subsection provides the board layout and the connector information for the SAS 9280-4i4e RAID controller.

Figure 14 shows the jumpers and the connectors on the SAS 9280-4i4e controller.

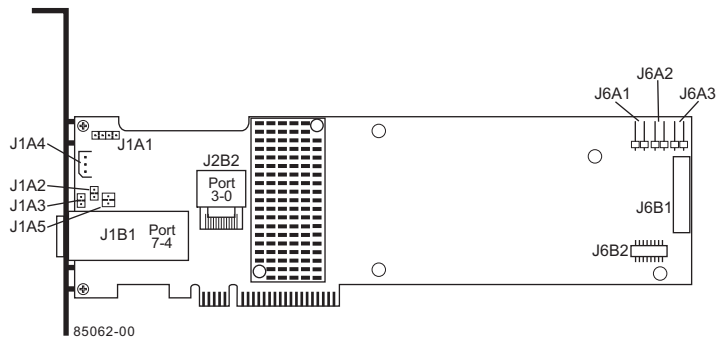


Figure 14: Card Layout for the MegaRAID SAS 9280-4i4e RAID Controller

NOTE: Connectors J6A1, J6A2, and J6A3 are behind the LSiIBBU07 when the iBBU is installed, but they are still accessible.

Table 8 describes the jumpers and the connectors on the SAS 9280-4i4e RAID controller.

Table 8: SAS 9280-4i4e RAID Controller – Connectors

Connector	Description	Comments
J1A1	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.
J1A2	LSI Test header	2-pin connector Reserved for LSI use.
J1A3	Set Factory Defaults connector	2-pin connector Reserved for LSI use.
J1A4	IPMI-style I ² C connector	3-pin connector. Supports SES (SCSI Enclosure Services) over I ² C over internal I ² C backplane cable.
J1A5	Modular RAID Key header	2-pin shielded header Enables support for RAID 5 configurations and self-encrypting disks (SED).
J1B1	x4 SAS Ports 7–4	SFF-8088 x4 external mini SAS connector Connects the controller by cable to SAS drives or SATA II drives, or a SAS expander.
J2B1	Standard edge card connector	The RAID controller interfaces with the host system through a standard edge card x8 PCI-Express 2.0 bus connection as defined in the PCI-Express specification. This interface provides power to the board and to an I ² C interface connected to I ² C bus one for IPMI.
J2B2	x4 SAS Ports 3-0	SFF-8087 x4 internal mini SAS connector Connects to an LED that indicates whether a drive is in a fault condition.

Table 8: SAS 9280-4i4e RAID Controller – Connectors (Continued)

Connector	Description	Comments
J6A1	Global Drive Fault LED header	2-pin connector Connects to an LED that indicates whether a drive is in a fault condition.
J6A2	SAS Activity LED header	2-pin connector Connects to an LED that indicates drive activity.
J6A3	Write-pending Indicator (dirty cache) LED connector	2-pin connector Connects to an LED that indicates when the data in the cache has yet to be written to the storage devices. Used when the write-back feature is enabled.
J6B1	Remote Battery Backup Unit connector	20-pin connector Connects the LSiBBU07 intelligent Battery Backup Unit to the RAID controller remotely.
J6B2	Battery Backup Unit connector	20-pin connector Connects the LSiBBU07 intelligent Battery Backup Unit to the RAID controller remotely.

NOTE: Connectors J6A1, J6A2, and J6A3 are behind the LSiBBU07 when the iBBU is installed, but they are still accessible.

3.1.4.3 MegaRAID SAS 9280-16i4e and SAS 9280-24i4e RAID Controllers - Board Layout and Jumper/Connector Information

This subsection provides the board layout and the connector information for the SAS 9280-16i4e RAID controller and the SAS 9280-24i4e RAID controller.

Figure 15 shows the jumpers and the connectors on the SAS 9280-24i4e controller.

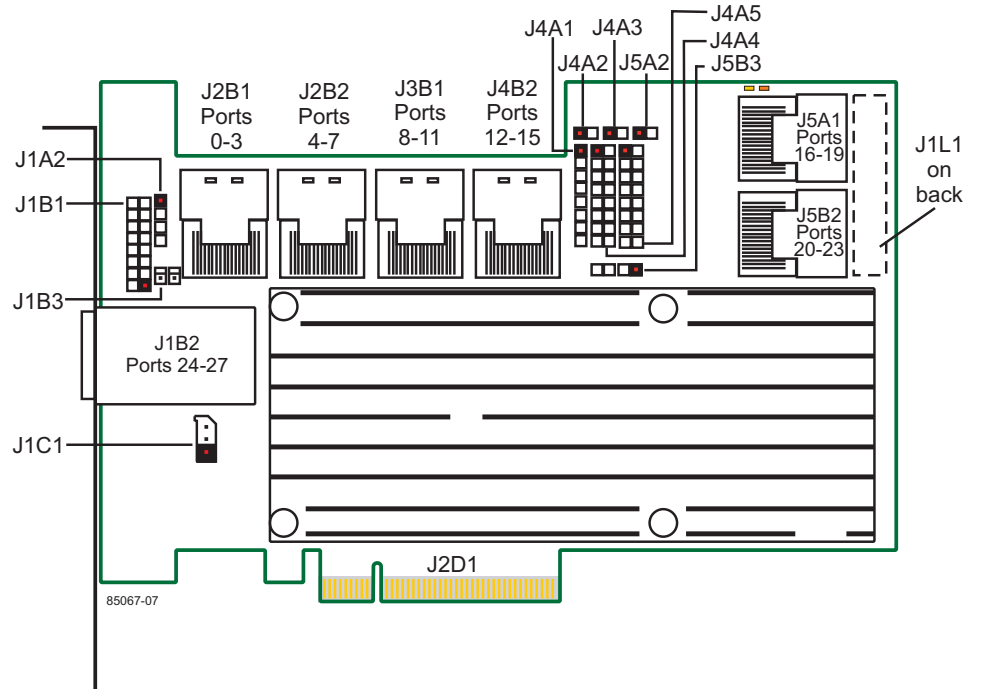


Figure 15: Card Layout for the MegaRAID SAS 9280-24i4e RAID Controller

NOTE: Pin 1 on the headers and connectors is highlighted in black and red in [Figure 15](#).

NOTE: The SAS 9280-16i4e RAID controller is like the SAS 9280-24i4e RAID controller except that the SAS 9280-16i4e does not contain the J4A5, J5A1, or J5B2 connectors.

Table 9 describes the jumpers and the connectors on the SAS 9280-24i4e RAID controller. It includes diagrams showing Pin1 and their orientation for several of the connectors.

Table 9: SAS 9280-24i4e RAID Controller – Connectors

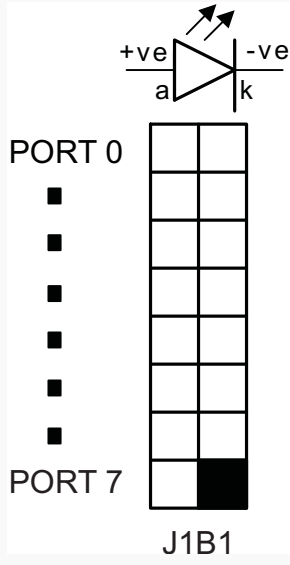
Jumper/ Connector	Type	Description
J1A2	Universal Asynchronous Receiver/ Transmitter (UART) for the Expander	4-pin connector Reserved for LSI use.
J1B1	LED Locate and Fault Indication header Ports 0-3 Ports 4-7 	2x8-pin connector Connects to an LED that indicates whether a drive is in a fault condition. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the unconfigured-bad state. The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port. NOTE: This header is used for RAID controllers with internal SAS ports only.
J1B2	x4 SAS Ports 24-27 external connector	SFF-8088 x4 external mini SAS connector Connects the controller by cable to a SAS/ SATA backplane or an expander.
J1B3	Premium Features Hardware Key header	2-pin header Enables support for selected premium features, which include recovery, CacheCade, FastPath, and SafeStore disk encryption.
J1C1	IPMI-style I ² C connector	3-pin connector Supports SES (SCSI enclosure services) over I ² C through an internal I ² C backplane cable.
J1L1	Remote Battery Backup connector (on the backside of the controller)	20-pin connector Connects the LSIiBBU07 intelligent Battery Backup Unit or the LSIiBBU08 intelligent Battery Backup Unit to the RAID controller remotely.

Table 9: SAS 9280-24i4e RAID Controller – Connectors (Continued) (Continued)

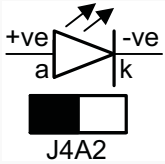
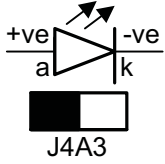
Jumper/Connector	Type	Description
J2B1	x4 SAS Ports 0-3 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J2B2	x4 SAS Ports 4-7 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J2D1	Standard edge card connector	The RAID controller interfaces with the host system through a standard edge card. This interface provides power to the board and an I ² C interface connected to the I ² C bus for IPMI.
J3B1	x4 SAS Ports 8-11 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J4A1	Module CPLD	1x8-pin connector Reserved for LSI use.
J4A2	Activity LED header 	2-pin connector Connects to an LED that indicates activity on the drives connected to the controller.
J4A3	Global drive fault LED header 	2-pin connector Connects to an LED that indicates whether a drive is in a fault condition.

Table 9: SAS 9280-24i4e RAID Controller – Connectors (Continued) (Continued)

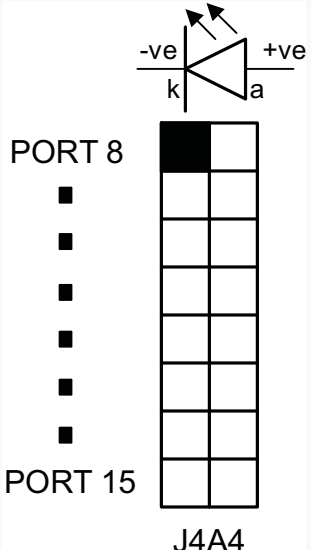
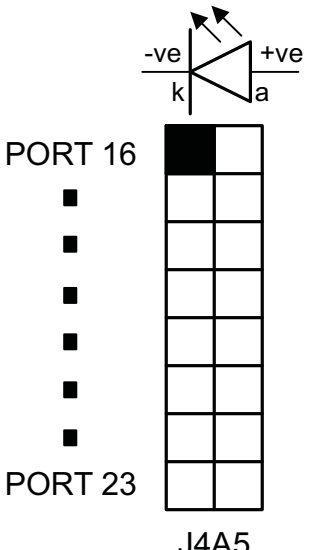
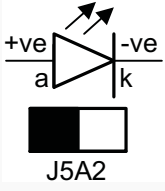
Jumper/ Connector	Type	Description
J4A4	<p>LED Locate and Fault Indication header Ports 8-11 Ports 12-15</p>  <p style="text-align: center;">J4A4</p>	<p>2x8-pin header</p> <p>Connects to an LED that indicates whether a drive is in a fault condition. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the Unconfigured-Bad state.</p> <p>The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port.</p> <hr/> <p>NOTE: This header is used for RAID controllers with internal SAS ports only.</p>
J4A5	<p>LED Locate and Fault Indication header Ports 16-19 Ports 20-23</p>  <p style="text-align: center;">J4A5</p>	<p>2x8-pin header</p> <p>Connects to an LED that indicates whether a drive is in a fault condition. There is one LED per port. When lit, each LED indicates the corresponding drive has failed or is in the unconfigured-bad state.</p> <p>The LEDs function in a direct-attach configuration (there are no SAS expanders). Direct attach is defined as a maximum of one drive connected directly to each port.</p> <hr/> <p>NOTE: This header is used for RAID controllers with internal SAS ports only.</p>

Table 9: SAS 9280-24i4e RAID Controller – Connectors (Continued) (Continued)

Jumper/Connector	Type	Description
J4B2	x4 SAS Ports 12-15 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J5A1	x4 SAS Ports 16-19 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J5A2	Write pending LED header 	2-pin connector Connects to an LED that indicates when the data in the cache has yet to be written to the storage devices. Used when the write-back feature is enabled.
J5B2	x4 SAS Ports 20-23 internal connector	SFF-8087 x4 internal mini SAS connector Connects the controller by cable to SAS drives or SATA 2 drives.
J5B3	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector Reserved for LSI use.

3.2 MegaRAID SAS 6Gb/s RAID Controller Characteristics

Table 10 shows the general characteristics for all MegaRAID 6Gb/s SAS RAID controllers.

Table 10: MegaRAID 6Gb/s SAS RAID Controller Characteristics

Flash ROM ^a	Serial EEPROM ^b	Data Transfer Rates	SCSI Features	SCSI Termination
Yes	Yes	Up to 6Gb/s per port for SAS and up to 3Gb/s per port for SATA II	Plug and Play Scatter/Gather Activity LED	Active

a.For boot code and firmware.

b.For BIOS configuration storage.

Each MegaRAID 6Gb/s SAS RAID controller ensures data integrity by intelligently validating the compatibility of the SAS domain. The MegaRAID 6Gb/s 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 6Gb/s SAS RAID controllers minimize electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The MegaRAID 6Gb/s 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 9240-4i RAID controller (model 25083)
- MegaRAID SAS 9240-8i RAID controller (model 25091)
- MegaRAID SAS 9260-4i RAID controller (model 25121-45A)
- MegaRAID SAS 9260-8i RAID controller (model 25121-44)
- MegaRAID SAS 9260DE-8i RAID controller (model 25121)
- MegaRAID SAS 9260-16i RAID controller (model L5-25243-06)
- MegaRAID SAS 9261-8i RAID controller (model 25239)
- MegaRAID SAS 9280-4i4e RAID controller (model 25305)
- MegaRAID SAS 9280-8e RAID controller (model 25152)
- MegaRAID SAS 9280DE-8e RAID controller (model 25152)
- MegaRAID SAS 9280-16i4e RAID controller (model L5-25243-07)
- MegaRAID SAS 9280-24i4e RAID controller (model L5-25243-05)
- LSI intelligent battery backup unit 07 (model 25034)
- LSI intelligent battery backup unit 08 (model 25343)

3.3.1 RAID Controller Specifications

[Table 11](#) lists the specifications for the MegaRAID 6Gb/s SAS RAID controllers.

Table 11: RAID Controller Specifications

Specification	MegaRAID SAS 9240, SAS 9260, SAS 9261, and SAS 9280 RAID Controllers
Processor (PCI Express host controller to PCI secondary I/O controller)	SAS 9240 - LSI SAS2008 PCI Express-SAS/SATA I/O Processor chip SAS 9260, SAS 9261, and SAS 9280 - LSI SAS2108 ROC device with Integrated PowerPC processor
Part number	<ul style="list-style-type: none"> • SAS 9240-4i RAID controller: 25083 • SAS 9240-8i RAID controller: 25091 • SAS 9260-4i RAID controller: 25121 • SAS 9260-8i RAID controller: 25121 • SAS 9260DE-8i RAID controller: 25121 • SAS 9260-16i RAID controller: L5-25243-06 • SAS 9261-8i RAID controller (model 25239) • SAS 9280-4i4e RAID controller: 25305 • SAS 9280-8e RAID controller: 25152 • SAS 9280DE-8e RAID controller: 25152 • SAS 9280-16i4e RAID controller: L5-25243-07 • SAS 9280-24i4e RAID controller: L5-25243-05 • LSI BBU07 intelligent Battery Backup Unit: 25034 • LSI BBU08 intelligent Battery Backup Unit: 25343
Operating voltage	+3.3 V, +12 V
Card size	<ul style="list-style-type: none"> • SAS 9240-4i RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9240-8i RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9260-4i RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9260-8i RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9260DE-8i RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9260-16i RAID controller: Standard-height PCI Express adapter card size (167.64 mm x 111.15 mm) • SAS 9261-8i RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 94.31 mm) • SAS 9280-4i4e RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9280-8e RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9280DE-8e RAID controller: Low-profile PCI Express adapter card size (167.64 mm x 68.91 mm) • SAS 9280-16i4e RAID controller: Standard-height PCI Express adapter card size (167.64 mm x 111.15 mm) • SAS 9280-24i4e RAID controller: Standard-height PCI Express adapter card size (167.64 mm x 111.15 mm)
Array interface to the host	PCI Express Rev. 2.0

Table 11: RAID Controller Specifications (Continued)

Specification	MegaRAID SAS 9240, SAS 9260, SAS 9261, and SAS 9280 RAID Controllers
PCI Express bus data transfer rate	<ul style="list-style-type: none"> • Up to 5 Gb/s per lane • x8 lane width
Serial port	4-pin RS232-compatible connector (for manufacturing use only)
SAS controller	<ul style="list-style-type: none"> • LSISAS2108 Single SAS controller • LSISAS2008 PCI Express-SAS/SATA I/O Processor chip
SAS bus speed	6Gb/s
SAS ports	SAS connectors with four SAS ports each
Cache configuration	<p>The RAID controllers support the following battery-backed cache configuration:</p> <ul style="list-style-type: none"> • 512 MB – 72b arrangement (5) 64Mx16, Double Data Rate II (DDR2) @ 800 MHz battery-backed module
Size of flash ROM for firmware	8 MB
Nonvolatile random access memory (NVRAM)	32 KB for storing RAID configurations

3.3.2 Array Performance Features

Table 12 shows the array performance features for the MegaRAID 6Gb/s SAS RAID controllers.

Table 12: Array Performance Features

Specification	MegaRAID SAS 9240, SAS 9260, SAS 9261, and SAS 9280 RAID Controllers
PCI Express host data transfer rate	5Gb/s per lane
Drive data transfer rate	6Gb/s per lane
Maximum scatter/gather I/O	80 elements
Maximum size of I/O requests	6.4 MB in 64-KB stripes
Maximum queue tags per drive	As many as the drive can accept
Stripe sizes	8 KB, 16 KB, 32 KB, 64 KB, 128 KB, 256 KB, 512 KB, or 1 MB
Maximum number of concurrent commands	255

3.3.3 Fault Tolerance

Table 13 lists the fault tolerance features for the MegaRAID 6Gb/s SAS RAID controllers.

Table 13: Fault Tolerance Features

Specification	MegaRAID SAS 9240, SAS 9260, SAS 9261, and SAS 9280 RAID Controllers
Support for SMART ^a	Yes
Drive failure detection	Automatic
Drive rebuild using hot spares	Automatic
Parity generation and checking	Yes

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

3.3.4 Electrical Characteristics

3.3.4.1 Power Supply Requirements for SAS 9240 RAID Controllers

This subsection provides the power supply requirements for the MegaRAID 6Gb/s SAS RAID controllers.

All power is supplied to the SAS 9240 RAID controllers through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a hard reset
- State 2: During a drive stress test
- State 3: While sitting idle at the DOS prompt

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). [Table 14](#) lists the power supply for the RAID controllers for each of the three states at the different voltages.

Table 14: Power Supply for SAS 9240 RAID Controllers

PCI Edge Connector	State 1	State 2'	State 3
3.3V supply	330mA	330mA	330mA
+12V supply	1.00A	1.81A	1.53A
3.3V auxiliary supply	30mA	30mA	30mA

3.3.4.2 Operating and Non-operating Conditions for the SAS 9240 RAID Controllers

For the SAS 9240 RAID controllers, the operating (thermal and atmospheric) conditions are:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSISAS2008 processor above the maximum ambient temperature.
- Temperature range: +10 °C to +60 °C.

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

- Relative humidity range is 5 percent to 90 percent noncondensing.

3.3.4.3 Power Supply Requirements for MegaRAID SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID Controllers

- Temperature range: -30° C to +80° C.

All power is supplied to the MegaRAID SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID controllers through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a hard reset
- State 2: During a drive stress test
- State 3: While sitting idle at the DOS prompt

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). [Table 15](#) lists the power supply for the RAID controllers for each of the three states at the different voltages.

Table 15: Power Supply for SAS 9260 RAID Controllers

PCI Edge Connector	State 1	State 2'	State 3
3.3V supply	330mA	330mA	330mA
+12V supply	1.00A	1.81A	1.53A
3.3V auxiliary supply	30mA	30mA	30mA

NOTE: +12V is used in the charging circuitry for the battery pack on the optional iBBU battery-backed daughter card. If the BBU daughter card is mounted, the following power consumption figures apply:

During trickle charging of the battery pack: N/A (no trickle charge for Li-ION).
 During fast charging of the battery pack: 230mA in +12V current.

3.3.4.4 Operating and Non-operating Conditions for MegaRAID SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID Controllers

For the MegaRAID SAS 9260-4i, SAS 9260-8i, and SAS 9260DE-8i RAID controllers, the operating (thermal and atmospheric) conditions are:

- Relative humidity range is 5 percent to 90 percent noncondensing (20 percent to 80 percent noncondensing for the RAID controllers)
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSISAS2108 processor above the maximum ambient temperature
- Temperature range: +10 °C to +60 °C without battery backup unit
- Temperature range: +10 °C to +44.5 °C with iBBU battery backup

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

- Temperature range: -30° C to +80° C without the battery backup unit
- Temperature range: 0° C to +45° C with the battery backup unit

3.3.4.5 Power Supply Requirements for the SAS 9260-16i RAID Controller

All power is supplied to the SAS 9260-16i RAID controller through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a consistency checks of all RAID 5 virtual drives at one time
- State 2: While sitting idle at the DOS prompt
- State 3: During a RAID 5 stress test
- State 4: During a drive stress test while the BBU is under fast charging

The supply voltages are 12V \pm 8 percent (from PCI edge connector only) and 3.3V \pm 9 percent (from PCI edge connector only). [Table 16](#) lists the power supply for the controller for each of the three states at the different voltages.

Table 16: Power Supply for the SAS 9260-16i RAID Controller

PCI Edge Connector	State 1	State 2'	State 3	State 4
3.3V supply	1.339A	1.174A	1.225A	1.356A
+12V supply	1.466A	1.426A	1.487A	1.773A
3.3V auxiliary supply	0.048A	0.026A	0.214A	0.168A
Total Power	21.509W	21.072W	22.593W	26.3052W

NOTE: +12V is used in the charging circuitry for the battery pack on the optional iBBU battery-backed daughter card. If the iBBU daughter card is mounted, refer to State 4 in [Table 16](#) for typical current consumption values.

3.3.4.6 Operating and Non-operating Conditions for the SAS 9260-16i RAID Controller

The operating (thermal and atmospheric) conditions for the SAS 9260-16i RAID controller are:

- Relative humidity range is 20 percent to 80 percent noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSISAS2108 processor above the maximum ambient temperature.
- Operating ambient temperature: +55° C (The iBBU is not included in the limit as it is present remotely in the system. You need to make sure that maximum operating ambient temperature around the iBBU07 is 45° C and 55° C for the iBBU08).

NOTE: The operating ambient temperature of these RAID controllers can be raised to +60° C, provided the airflow over the controller is at least 300 LFPM.

The parameter for the non-operating (such as storage and transit) environment for the controller is:

- Temperature range: -30° C to +80° C without the battery backup unit
- Temperature range: 0° C to +45° C with the iBBU07 battery backup unit and 0° C to +55° C with the iBBU08 battery backup unit

3.3.4.7 Power Supply Requirements for the SAS 9261 RAID Controller

All power is supplied to the SAS 9261 RAID controller through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a hard reset
- State 2: During a drive stress test
- State 3: While sitting idle at the DOS prompt

The supply voltages are 12V \pm 8 percent (from PCI edge connector only) and 3.3V \pm 9 percent (from PCI edge connector only). [Table 17](#) lists the power supply for the RAID controller for each of the three states at the different voltages.

Table 17: Power Supply for SAS 9261 RAID Controllers

PCI Edge Connector	State 1	State 2'	State 3
3.3V supply	330mA	330mA	330mA
+12V supply	1.00A	1.81A	1.53A
3.3V auxiliary supply	30mA	30mA	30mA

NOTE: +12V is used in the charging circuitry for the battery pack on the optional iBBU battery-backed daughter card. If the BBU daughter card is mounted, the following power consumption figures apply:

During trickle charging of the battery pack: N/A (no trickle charge for Li-ION).
During fast charging of the battery pack: 230mA in +12V current.

3.3.4.8 Operating and Non-operating Conditions for the SAS 9261 RAID Controller

For the SAS 9261 RAID controllers, the operating (thermal and atmospheric) conditions are:

- Relative humidity range is 5 percent to 90 percent noncondensing (20 percent to 80 percent noncondensing for the RAID controllers)
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSISAS2108 processor above the maximum ambient temperature
- Temperature range: +10 °C to +60 °C without battery backup unit
- Temperature range: +10 °C to +44.5 °C with iBBU battery backup

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

- Temperature range: -30° C to +80° C without the battery backup unit
- Temperature range: 0° C to +45° C with the battery backup unit

3.3.4.9 Power Supply Requirements for SAS 9280-4i4e, SAS 9280-8e, and SAS 9280DE-8e RAID Controllers

All power is supplied to the SAS 9280-4i4e, SAS 9280-8e, and SAS 9280DE-8e RAID controllers through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a hard reset

- State 2: During a disk stress test
- State 3: While sitting idle at the DOS prompt

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). Table 18 lists the power supply for the controller for each of the three states at the different voltages.

Table 18: Power Supply for SAS 9280-4i4e, SAS 9280-8e, and SAS 9280DE-8e RAID Controllers

PCI Edge Connector	State 1	State 2'	State 3
3.3V supply	330mA	330mA	330mA
+12V supply	1.00A	1.81A	1.53A
3.3V auxiliary supply	30mA	30mA	30mA

NOTE: +12V is used in the charging circuitry for the battery pack on the optional iBBU battery-backed daughter card. If the iBBU daughter card is mounted, the following power consumption figures apply:

During fast charging of the battery pack: 230mA in +12V current.

3.3.4.10 Operating and Non-operating Conditions for SAS 9280-4i4e, SAS 9280-8e, and SAS 9280DE-8e RAID Controllers

The operating (thermal and atmospheric) conditions for the SAS 9280-4i4e, SAS 9280-8e, and SAS 9280DE-8e RAID controllers are:

- Relative humidity range is 5% to 90% noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSI SAS2108 processor above the maximum ambient temperature.
- Temperature range: +10 °C to +60 °C without battery backup unit.
- Temperature range: +10 °C to +44.5 °C with iBBU battery backup.

The parameters for the non-operating (such as storage and transit) environment for the controller are:

- Temperature range: -30 °C to +80 °C without battery backup unit.
- Temperature range: 0 °C to +45 °C with iBBU battery backup.

3.3.4.11 Power Supply Requirements for the SAS 9280-16i4e and SAS 9280-24i4e RAID Controllers

All power is supplied to the SAS 9280-16i4e RAID controller and the SAS 9280-24i4e RAID controller through the PCI Express 3.3V rails and the 12V rail. Onboard switching regulator circuitry operating from the 3.3V rails and the 12V rail provide the necessary voltages. The following states determine the typical current consumption of the controller:

- State 1: During a consistency checks of all RAID 5 virtual drives at one time
- State 2: While sitting idle at the DOS prompt
- State 3: During a RAID 5 stress test
- State 4: During a drive stress test while the BBU is under fast charging

The supply voltages are 12V ± 8 percent (from PCI edge connector only) and 3.3V ± 9 percent (from PCI edge connector only). [Table 19](#) lists the power supply for the controller for each of the three states at the different voltages.

Table 19: Power Supply for the SAS 9280-16i4e RAID Controller and the SAS 9280-24i4e RAID Controller

PCI Edge Connector	State 1	State 2'	State 3	State 4
3.3V supply	1.339A	1.174A	1.225A	1.356A
+12V supply	1.466A	1.426A	1.487A	1.773A
3.3V auxiliary supply	0.048A	0.026A	0.214A	0.168A
Total Power	21.509W	21.072W	22.593W	26.3052W

NOTE: +12V is used in the charging circuitry for the battery pack on the optional iBBU battery-backed daughter card. If the iBBU daughter card is mounted, refer to State 4 in [Table 19](#) for typical current consumption values.

3.3.4.12 Operating and Non-operating Conditions for the SAS 9280-16i4e RAID Controller and the SAS 9280-24i4e RAID Controllers

The operating (thermal and atmospheric) conditions for the SAS 9280-16i4e RAID controller and the SAS 9280-24i4e RAID controller are:

- Relative humidity range is 20% to 80% noncondensing.
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the LSISAS2108 processor above the maximum ambient temperature.
- Operating ambient temperature: +55° C (The iBBU is not included in the limit as it is present remotely in the system. You need to make sure that maximum operating ambient temperature around the iBBU07 is 45° C and 55° C for the iBBU08).

NOTE: The operating ambient temperature of these RAID controllers can be raised to +60° C, provided the airflow over the controller is at least 300 LFPM.

The parameter for the non-operating (such as storage and transit) environment for the controller is:

- Temperature range: -30° C to +80° C without the battery backup unit
- Temperature range: 0° C to +45° C with the iBBU07 battery backup unit and 0° C to +55° C with the iBBU08 battery backup unit

3.3.5 Safety Characteristics

All MegaRAID 6Gb/s 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

This appendix lists terms and abbreviations that are used in this user guide.

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 motherboard 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.

drive group. A group of physical drives that combines the storage space on the drives into a single segment of storage space. A hot spare drive does not actively participate in a drive group.

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. See 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. An acronym for Fusion-Message Passing Technology architecture. Fusion-MPT 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. It 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 that is ready for immediate use in case of drive failure. A hot spare 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 drive 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 drives with redundancy (RAID levels 1, 5, 6, 10, 50, and 60; 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. See 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, 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 (group) of multiple independent drives managed together to yield higher reliability, performance, or both exceeding that of a single drive. The RAID array appears to the controller as a single storage unit. I/O is expedited because several drives can be accessed simultaneously. Redundant RAID levels (RAID levels 1, 5, 6, 10, 50, and 60) provide data protection.

RAID levels. A set of techniques applied to drive groups to deliver higher data availability, performance characteristics, or both to host environments. Each virtual drive 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 2.0. 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 interface and the SATA II interface, 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 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.

strip. The portion of a stripe that resides on a single drive.

stripe size. The total drive space consumed by a stripe not including a parity drive. For example, consider a stripe that contains 64 KB of drive space and has 16 KB of data residing on each drive in the stripe. In this case, the stripe size is 64 KB and the strip is 16 KB. The stripe depth is four (four drives in the stripe). You can specify stripe sizes of 8 KB, 16 KB, 32 KB, 64 KB, 128 KB, 256 KB, 512 KB, or 1 MB for each virtual drive.

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

Appendix B

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This appendix provides a form you can fill out to help us improve our documentation.

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