PCI Express to 6Gb/s Serial Attached SCSI (SAS) Host Bus Adapters

User Guide

September 2010

Revision History

Version and Date	Description of Changes
September 2010	Added information for the LSISAS9202-16e host adapter board.
April 2010	Added information for the LSISAS9201-16i., and LSISAS9201-16e host adapter boards.
March 2010	Updated Figure 2, *LSISAS9200-8e Board Layout, on page 15*, Figure 3, *LSISAS9210-8i Board Layout, on page 17*, Figure 4, *LSISAS9211-8i Board Layout, on page 19*, Figure 5, *LSISAS9211-4i Board Layout, on page 21*, Figure 6, *LSISAS9212-4i4e Board Layout, on page 23*, and Figure 7, *LSISAS9200-16e Board Layout, on page 25*.
October 2009	Added information for the LSISAS9212-4i4e and the LSISAS9200-16e host adapter boards.
July 2009	Initial release of this document.

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Chapter 1

Introduction

This chapter describes the LSI PCI Express to 6Gb/s Serial Attached SCSI host bus adapters.

1.1 Overview

The LSI PCI Express (PCIe) to Serial Attached SCSI (SAS) host bus adapters (HBAs) provide four, eight, or sixteen serial ports for connection to SAS and Serial ATA (SATA) devices. Each port is capable of 1.5Gb/s, 3Gb/s, and 6Gb/s link rates for both SAS and SATA. The PCIe transmission and reception data rate is 5Gb/s in each direction, yielding a total bandwidth of 10Gb/s for each full-duplex lane. The LSI PCIe to SAS HBAs use four, eight, or sixteen PCIe phys, which provide possible host-side maximum transmission and reception rates of up to 8GB/s for the LSISAS9202-16e HBA (x16 interface). The design of the LSI HBAs makes it easy to add SAS interfaces to any computer, workstation, or server that has a PCIe bus.

The LSISAS9211-4i, LSISAS9210-8i, LSISAS9211-8i, LSISAS9200-8e, LSISAS9212-4i4e, LSISAS9200-16e, LSISAS9201-16e, LSISAS9201-16i, and LSISAS9202-16e HBAs include Flash ROM for storing the BIOS and firmware, and NVSRAM for storing nonvolatile RAID information. The LEDs on the HBAs report a heartbeat. Fusion-MPT™ firmware operates the HBA.

The PCIe interface is compliant with the PCI Express Specification, revision 2.0. All PCI software is backward compliant with previous versions of the PCI/PCI-X specifications. The LSI PCIe to SAS HBAs use either a standard PCI bracket or a low-profile, PCI-bracket type. The interface of the LSI HBAs is compatible with the *ANSI Serial Attached SCSI Specification*, revision 2.0 and the *Serial ATA Specification*, revision 2.6.

The PCIe and SAS functionality of LSI PCIe to SAS HBAs is provided by one of the following LSI controller chips:

- The LSISAS2004 controller chip, which integrates four high-performance SAS/SATA phys and connects up to four SAS/SATA devices to a computer system through the PCIe interface.
- The LSISAS2008 controller chip, which integrates eight high-performance SAS/SATA phys and connects up to eight SAS/SATA devices to a computer system through the PCIe interface.
- The LSISAS2116 controller chip, which integrates sixteen high-performance SAS/SATA phys and connects up to sixteen SAS/SATA devices to a computer system through the PCIe interface.

The controller chip on each HBA connects directly to the PCIe bus and generates timing and protocol in compliance with the PCIe specification. The controller chips connect channels directly to the SAS and SATA devices in the computer system. As described in Chapter 3, *Host Bus Adapter Characteristics*, the LSI controllers use either a x4, x8, or x16 PCIe connector.

The following table shows which LSI controllers is used for each model of LSI PCIe to SAS HBA.

Table 1: LSI Controllers and Associated LSI PCIe to SAS HBAs

Controller	LSI PCIe to SAS HBA Model
LSISAS2004	LSISAS9211-4i
LSISAS2008	LSISAS9210-8i, LSISAS9211-8i, LSISAS9200-8e, LSISAS9212-4i4e, and LSISAS9202-16e[1]
LSISAS2116	LSISAS9200-16e, LSISAS9201-16e, and LSISAS9201-16i

1. The LSISAS9202-16e HBA uses two LSISAS2008 controller chips.

1.2 Features

This section lists the features of the LSI PCIe to SAS HBAs:

- Supports serial SCSI protocol (SSP), serial ATA tunneling protocol (STP), and serial management protocol (SMP), as defined, in the *Serial Attached SCSI (SAS) Specification*, version 2.0.
- Supports SATA, as defined in the *Serial ATA Specification*, version 2.6.
- Provides configurable drive spin-up sequencing on a per-phy basis.
- Simplifies cabling with a point-to-point, serial architecture.
- Provides smaller and thinner cables that promote unrestricted airflow.
- Provides a serial, point-to-point, enterprise-level storage interface.
- Transfers data using SCSI information units.
- Provides compatibility with SATA target devices.
- Supports narrow ports and wide ports, as described in the following table.

Table 2: 6Gb/s SAS Bandwidths

Half Duplex	Full Duplex
Narrow Port (1 Lane), 600 MB/s	Narrow Port (1 Lane), 1200 MB/s
Wide Port (2 Lanes), 1200 MB/s	Wide Port (2 Lanes), 2400 MB/s
Wide Port (4 Lanes), 2400 MB/s	Wide Port (4 Lanes), 4800 MB/s

1.3 PCI Performance

The LSI PCIe to SAS HBAs support the following features of the PCIe interface.

- A single-phy (one lane) link transfer rate up to 5Gb/s in each direction
- Link widths of x16, x8, x4, and x1
- Automatic downshift. The LSISAS9202-16e HBA automatically downshifts to a x8-link width if plugged into a x16 connector that is wired as a x8 or x12 connector. Other HBA models automatically downshift to a x4-link if plugged into a x8 connector that is wired as a x4 connector.
- A scalable interface
  - Single-lane aggregate bandwidth of up to 0.5GB/s (500MB/s)
  - Quad-lane aggregate bandwidth of up to 2GB/s (2000MB/s)
  - Eight-lane aggregate bandwidth of up to 4GB/s (4000MB/s)
  - Sixteen-lane aggregate bandwidth of up to 8GB/s (8000MB/s)
- Serial, point-to-point interconnections between devices
  - Reduces the electrical load of the connection
  - Enables higher transmission and reception frequencies
- Lane reversal and polarity inversion
- PCIe hot plug
- Power management
  - Supports PCI Power Management 1.2
  - Supports active-state power management (ASPM), including the L0, L0s, and L1 states, by placing links in a power-saving mode when there is no link activity
- A replay buffer that preserves a copy of the data for retransmission in case a cyclic redundancy check (CRC) error occurs
- PCIe advanced error-reporting capabilities
- Packetized and layered architecture
- High bandwidth per pin with low overhead and low latency
- Software compatibility with PCI and PCI-X software
  - Leverages existing PCI device drivers
  - Supports the memory, I/O, and configuration address spaces
  - Supports memory read/write transactions, I/O read/write transactions, and configuration read/write transactions
- 4 KB of PCI configuration address space per device
- Posted and nonposted transactions
- Quality-of-service (QOS) link configuration and arbitration policies
- Traffic Class 0 and one virtual channel
- Message-signaled interrupts (both MSI and MSI-X), as well as INTx interrupt signaling for legacy PCI support
- End-to-end CRC (ECRC) and advanced error reporting

1.4 Software

The following table shows all of the major operating systems that the LSI PCIe to SAS HBAs support.

Table 3: Operating System (OS) Drivers

OS Support	Versions
Windows®	Server 2003/2008, XP/Vista/Windows 7
Linux®: Red Hat® Enterprise Linux® (RHEL)	4 and 5
Linux: SUSE® Enterprise Server (SLES)	9, 10, and 11
Sun™ SPARC® Solaris™	Solaris 10
Utilities	Flash and BIOS Configuration Utility

The LSI HBAs use the Fusion-MPT architecture for all major operating systems, which allows for thinner drivers for better performance. To obtain a device driver that supports your operating system, contact the LSI Technical Support team or visit the LSI website.

Chapter 2

Hardware Installation

This chapter provides both quick instructions and detailed instructions on how to install the LSI PCIe to 6Gb/s SAS HBAs.

2.1 Quick Installation Instructions

Use the following quick installation instructions to install your LSI PCIe to SAS HBA if you are comfortable with the abbreviated installation instructions. Section 2.2, *Detailed Installation Instructions* provides detailed installation instructions.

1. Unpack the HBA and inspect it for damage.
2. Turn off the system and remove the power cord(s).
3. Remove the cover from the system.
4. Insert the HBA in an available PCIe slot.
5. Secure the bracket to the system's chassis.
6. Connect the serial cable(s) between the HBA and the serial hard disk drive(s). Figure 1 shows the locations of the connectors on your HBA.
7. Replace the cover and the power cord(s), then turn on the system.

The installation of your LSI HBA is complete.

2.2 Detailed Installation Instructions

The following are the detailed installation instructions for LSI PCIe to SAS HBAs.

1. **Unpack the HBA and inspect it for damage.** Unpack the HBA in a static-free environment. Remove the HBA from the antistatic bag and carefully inspect it for damage. If you notice any damage, or if any component is missing, contact LSI or your reseller support representative.

CAUTION:
Make a backup of your data before changing your system configuration.

2. **Prepare the computer.** Turn off the computer and disconnect the power cord from the back of the power supply. Remove the cover from the chassis.

WARNING: Be certain to disconnect the computer from the power supply and from any networks before installing the HBA.

3. **Insert the HBA in an available PCIe slot.** Locate an empty PCIe slot. Remove the blank bracket panel on the back of the computer that aligns with the empty PCIe slot. Save the bracket screw, if applicable.

   Align the HBA to a PCIe slot. Press down gently but firmly to properly seat the HBA in the slot. The following figure shows how to insert the HBA in a PCIe slot.

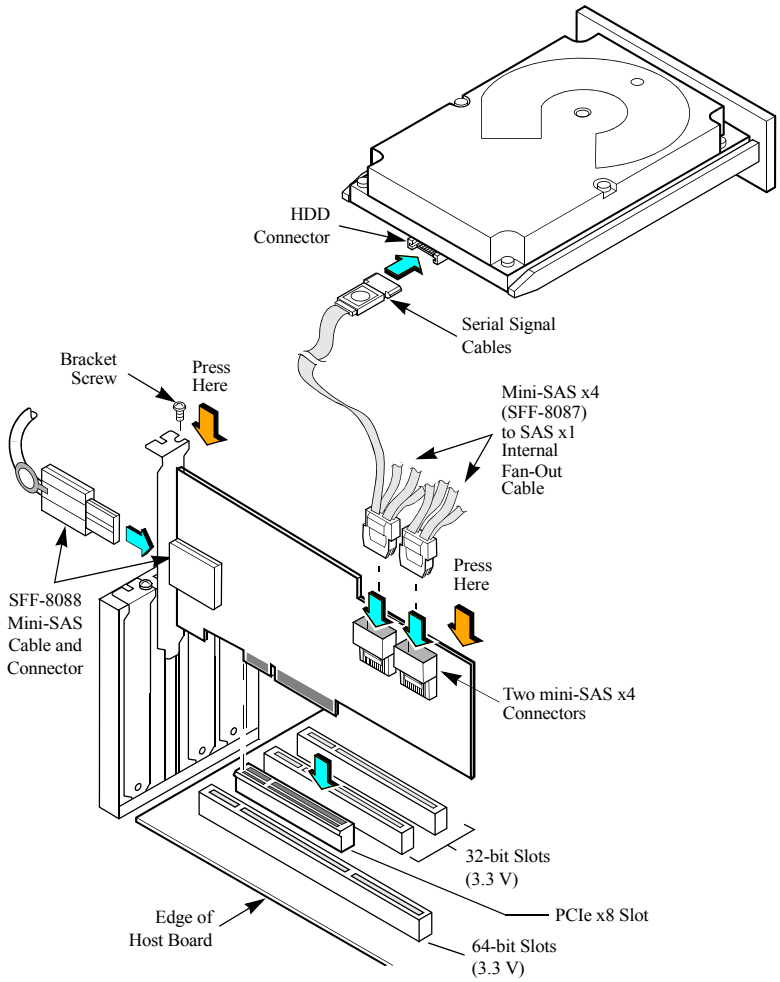

Figure 1: Installing an LSI PCIe to SAS x8 HBA in a PCI Express Slot

NOTE: The shape, size, and locations of components on your HBA and its bracket might vary from this illustration. The LSISAS9202-16e HBA requires a x16 PCIe slot. The LSISAS9211-4i HBA requires a x4 PCIe slot. The LSISAS9211-4i HBA can be up-plugged into a x8 slot or a x16 slot.

4. **Secure the bracket to the system's chassis.** Install the bracket screw, if applicable, or engage the system retention mechanism to secure the HBA to the system's chassis.
5. **Connect the serial cable(s) between the HBA and the serial hard disk drive(s) (HDD).** Connect the serial cable(s) between the host adapter and the serial hard disk drive(s) (HDD). Figure 1 shows the locations of the connectors on your HBA.
6. **Replace the cover and the power cord(s) and power up the system.** Replace the system's cover, reconnect the power cord(s), and reconnect any network cables. Turn on the power.

The installation of your LSI PCIe to SAS HBA is complete.

Chapter 3

Host Bus Adapter Characteristics

This chapter describes the device-specific characteristics of the LSI PCIe to 6Gb/s SAS HBAs.

3.1 Characteristics of the LSI PCIe to SAS HBAs

The LSI PCIe to SAS HBAs provide one or two 4M x 8-bit Flash ROMs for storing the BIOS and firmware. The following table shows the number and type of x4 external and internal SAS connectors provided on each HBA model and also the number of external LED headers.

Table 4: HBA Connector Summary

HBA Model	Internal Connectors	External Connectors	External LED Headers
LSISAS9200-8e[a]	—	2 x4 mini SAS	1 - 4pin header
LSISAS9210-8i[a.]	2 x4 mini SAS	—	1 - 4pin header
LSISAS9211-8i[a.]	2 x4 mini SAS	—	1 - 4pin header
LSISAS9211-4i[a.]	1 x4 mini SAS	—	1 - 4pin header
LSISAS9212-4i4e[a.]	4 x1 mini SAS	1 x4 mini SAS	1 - 4pin header
LSISAS9200-16e	—	4 x4 mini SAS	2 - 4pin headers
LSISAS9201-16i	4 x4 mini SAS	—	2 - 4pin headers
LSISAS9201-16e	—	4 x4 mini SAS	2 - 4pin headers
LSISAS9202-16e[a.]	—	4 x4 mini SAS HD	—

a. Low-profile HBA.

The LSISAS9210-8i, LSISAS9211-8i, LSISAS9211-4i, and LSISAS9212-4i4e HBAs may provide up to 32 K x 8-bit NVSRAM for storing the nonvolatile RAID information when a system failure occurs.

3.1.1 LSISAS9200-8e HBA Characteristics

The LSISAS9200-8e HBA has onboard Flash ROM for firmware and BIOS. The LSISAS2008 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the eight SAS phys on the LSISAS2008 controller is capable of up to 6Gb/s SAS or SATA link rates.

3.1.1.1 LEDs

The LSISAS9200-8e HBA has a 4-pin header for connection of activity LEDs. The 4-pin header connects to two LEDs (see Table 5), which indicate SAS activity on Port 0 and Port 1.

3.1.1.2 Connectors

This section describes the different connectors on the LSISAS9200-8e HBA. See Figure 2 for connector locations.

PCIe Connector (J7). The LSISAS9200-8e HBA supports a x8 interface. The PCIe connection is through the edge connector, J7, which provides connections on both the top (J7B) and bottom (J7A) of the board. The signal definitions and pin numbers conform to the PCIe specification.

SAS/SATA Connectors (J4 and J5). The LSISAS9200-8e HBA supports SAS/SATA connections through connectors J4 and J5, which are SFF-8088 mini-SAS, external, right-angle connectors.

Activity LED Header (J3). The LSISAS9200-8e HBA has a 4-pin, right-angle, 0.1-in. pitch header for driving external activity LEDs.

Table 5: LSISAS9200-8e LED Header

Pin	Function
1	3.3 V
2	Port 0
3	Port 1
4	3.3 V

UART Connector (TP2). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 6: LSISAS9200-8e UART Pinout

Pin	Function
1	UART0_TX
2	Gnd
3	UART0_RX
4	3.3 V

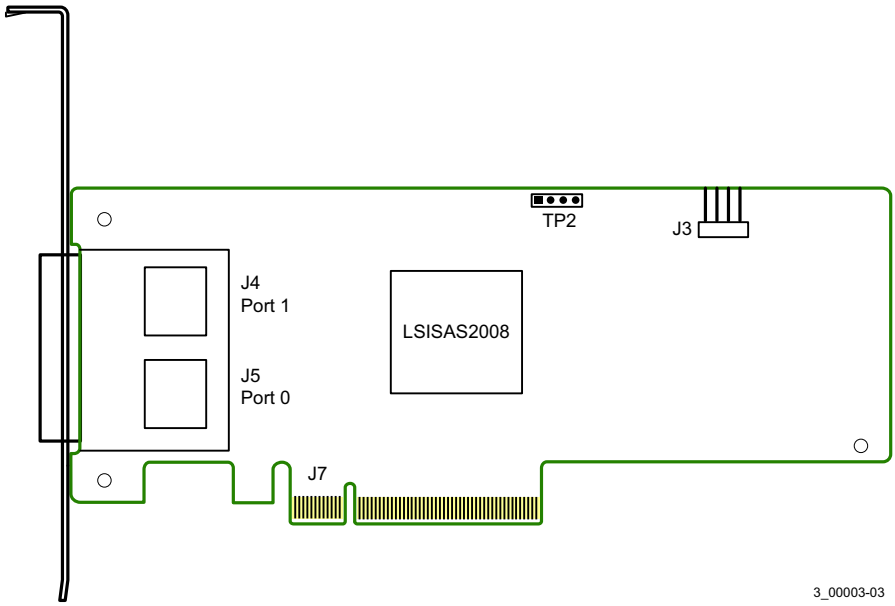

Figure 2: LSISAS9200-8e Board Layout

- J7: PCIe x8-lane board edge connector
- J4, J5: SFF-8088 mini-SAS, external, right-angle connectors
- J3: 4-pin, right angle, 0.1-in. pitch pin header for driving external activity LED
- TP2: UART connection

3.1.1.3 Physical Characteristics

The LSISAS9200-8e HBA is a 6.6-in. x 2.713-in., low-profile board. PCIe connection is through the edge connector, J7. The component height on the top and bottom of the LSISAS9200-8e HBA follows the PCIe specification. The LSISAS9200-8e supports SAS/SATA connections through two SFF-8088 mini-SAS external connectors, J4 and J5.

3.1.2 LSISAS9210-8i HBA Characteristics

The LSISAS9210-8i HBA has onboard Flash ROM for firmware and BIOS, and NVSRAM for embedded mirroring. The LSISAS2008 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the eight SAS phys on the LSISAS2008 controller is capable of up to 6Gb/s SAS or SATA link rates.

3.1.2.1 LEDs

The LSISAS9210-8i HBA has a 4-pin header for connection of activity LEDs. The 4-pin header connects to two LEDs (see Table 7), which indicate SAS activity on Port 0 and Port 1.

3.1.2.2 Connectors

This section describes the different connectors on the LSISAS9210-8i HBA. See Figure 3 for connector locations.

PCIe Connector (J6). The LSISAS9210-8i HBA supports a x8 interface. The PCIe connection is through the edge connector, J6, which provides connections on both the top (J6B) and bottom (J6A) of the board. The signal definitions and pin numbers conform to the PCIe specification.

SAS/SATA Connectors (J4 and J5). The LSISAS9210-8i HBA supports SAS/SATA connections through connectors J4 and J5, which are SFF-8087 mini-SAS, internal, right-angle connectors.

Activity LED Header (J3). The LSISAS9210-8i HBA has a 4-pin, right-angle, 0.1-in. pitch header for driving external activity LEDs.

Table 7: LSISAS9210-8i LED Header

Pin	Function
1	3.3 V
2	Port 0
3	Port 1
4	3.3 V

UART Connector (TP1). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 8: LSISAS9210-8i UART Pinout

Pin	Function
1	UART0_TX
2	Gnd
3	UART0_RX
4	3.3 V

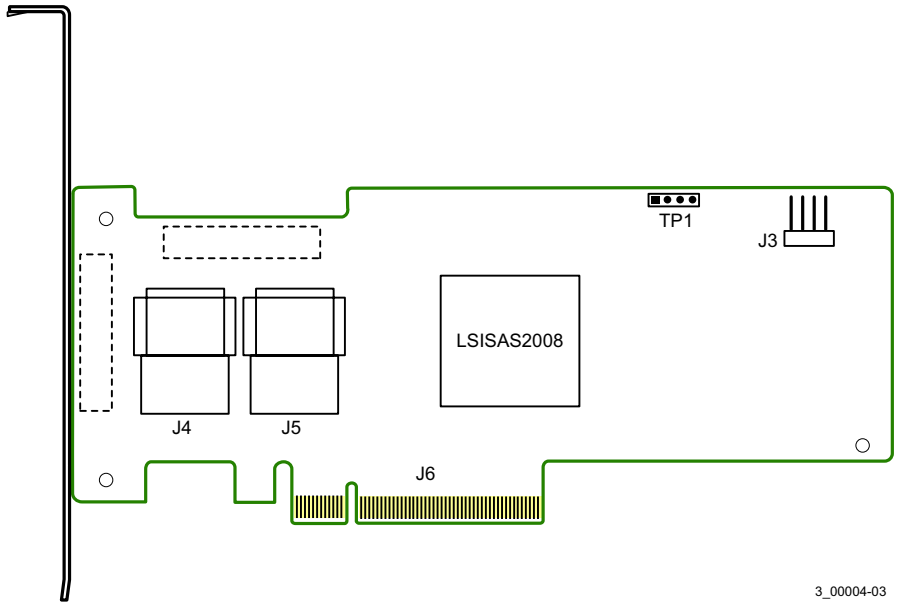

Figure 3: LSISAS9210-8i Board Layout

- J6: PCIe x8-lane board edge connector
- J4, J5: SFF-8087 mini-SAS, internal, right-angle connectors
- J3: 4-pin, right angle, 0.1-in. pitch pin header for driving external activity LEDs
- TP1: UART connection

3.1.2.3 Physical Characteristics

The LSISAS9210-8i HBA is a 6.6-in. x 2.713-in. low-profile board. PCIe connection is through the edge connector, J6. The component height on the top and bottom of the LSISAS9210-8i HBA follows the PCIe specifications. The LSISAS9210-8i HBA supports SAS/SATA connections through two SFF-8087 mini-SAS internal connectors, J4 and J5.

3.1.3 LSISAS9211-8i HBA Characteristics

The LSISAS9211-8i HBA has onboard Flash ROM for firmware and BIOS, and NVSRAM for embedded mirroring. The LSISAS2008 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the eight SAS phys on the LSISAS2008 controller is capable of up to 6Gb/s SAS or SATA link rates.

3.1.3.1 LEDs

The LSISAS9211-8i HBA has a 4-pin header for connection of activity LEDs. The 4-pin header connects to two LEDs (see Table 9), which indicate SAS activity on Port 0 and Port 1.

3.1.3.2 Connectors

This section describes the different connectors on the LSISAS9211-8i HBA. See Figure 4 for connector locations.

PCIe Connector (J1). The LSISAS9211-8i HBA supports a x8 interface. The PCIe connection is through the edge connector, J1, which provides connections on both the top (J1B) and bottom (J1A) of the board. The signal definitions and pin numbers conform to the PCIe specification.

SAS/SATA Connectors (J7 and J8). The LSISAS9211-8i HBA supports SAS connections through connectors J7 and J8, which are SFF-8087 mini-SAS, internal, right-angle connectors.

Activity LED Header (J6). The LSISAS9211-8i HBA has a 4-pin, right-angle, 0.1-in. pitch header for driving external activity LEDs.

Table 9: LSISAS9211-8i LED Header

Pin	Function
1	3.3 V
2	Port 0
3	Port 1
4	3.3 V

UART Connector (J3). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 10: LSISAS9211-8i UART Pinout

Pin	Function
1	UART0_TX
2	Gnd
3	UART0_RX
4	3.3 V

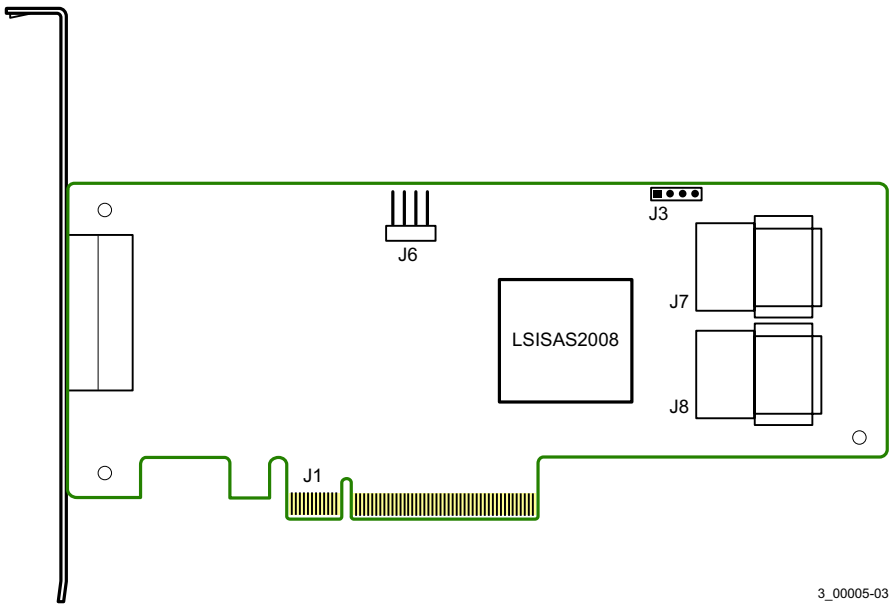

Figure 4: LSISAS9211-8i Board Layout

- J1: PCIe x8-lane board edge connector
- J3: UART connection
- J7, J8: SFF-8087 mini-SAS, internal, right-angle connector
- J6: 4-pin, right angle, 0.1-in. pitch, pin header for driving external activity LED

3.1.3.3 Physical Characteristics

The LSISAS9211-8i HBA is a 6.6-in. x 2.713-in. low-profile board. PCIe connection is through the edge connector, J1. The component height on the top and bottom of the LSISAS9211-8i board follows the PCIe specifications. The LSISAS9211-8i HBA supports SAS/SATA connections through two SFF-8087 mini-SAS internal connectors, J7 and J8.

3.1.4 LSISAS9211-4i HBA Characteristics

The LSISAS9211-4i HBA has onboard Flash ROM for firmware and BIOS, and NVSRAM for embedded mirroring. The LSISAS2004 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the four SAS phys on the LSISAS2004 controller is capable of up to 6Gb/s SAS or SATA link rates.

3.1.4.1 LEDs

The LSISAS9211-4i HBA has a 4-pin header for connection of activity LEDs. The header connects to two LEDs (see Table 11), which indicate SAS activity on port 0 and port 1.

3.1.4.2 Connectors

This section describes the different connectors on the LSISAS9211-4i HBA. See Figure 5 for connector locations.

PCIe Connector (J1). The LSISAS9211-4i HBA supports a x4 interface. The PCIe connection is through the edge connector, J1, which provides connections on both the top (J1B) and bottom (J1A) of the board. The signal definitions and pin numbers conform to the PCIe specifications.

SAS/SATA Connector (J7). The LSISAS9211-4i supports SAS connections through connector J7, which is an SF8087 mini-SAS, internal, right-angle connector.

Activity LED Header (J3). The LSISAS9211-4i HBA has a 4-pin, right-angle, 0.1-in. pitch header for driving external activity LEDs.

Table 11: LSISAS9211-4i LED Header

Pin	Function
1	3.3 V
2	Port 0
3	Port 0
4	3.3 V

UART Connector (J5). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 12: LSISAS9211-4i UART Pinout

Pin	Function
1	UART0_TX
2	Gnd
3	UART0_RX
4	3.3 V

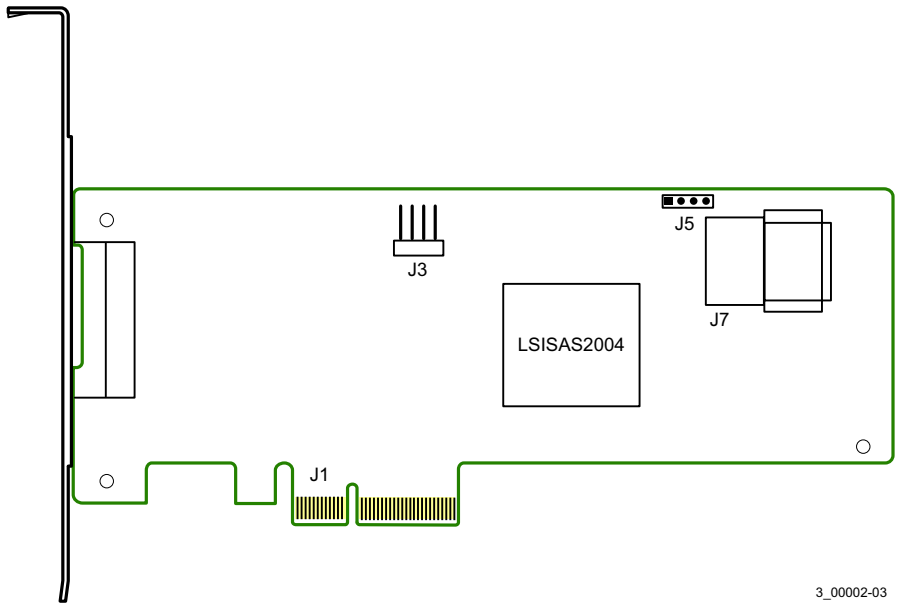

Figure 5: LSISAS9211-4i Board Layout

- J1: PCIe x4-lane board edge connector
- J7: SFF-8087 mini-SAS, internal, right-angle connector
- J3: 4-pin, right angle, 0.1-in. pitch, pin header for driving external activity LED
- J5: UART connection

3.1.4.3 Physical Characteristics

The LSISAS9211-4i HBA is a 6.6-in. x 2.713-in., low profile board. PCIe connection is through the edge connector, J1. The component height on the top and bottom of the LSISAS9211-4i HBA follows the PCIe specifications. The LSISAS9211-4i HBA supports SAS/SATA connections through one SFF-8087 mini-SAS internal connector, J7.

3.1.5 LSISAS9212-4i4e HBA Characteristics

The LSISAS9212-4i4e HBA has onboard Flash ROM for firmware and BIOS, and NVSRAM for embedded mirroring. The LSISAS2008 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the eight SAS phys on the LSISAS2008 controller is capable of up to 6Gb/s SAS or SATA link rates.

3.1.5.1 LEDs

The LSISAS9212-4i4e HBA has a 4-pin header for external connection of activity LEDs. The 4-pin header connects to two LEDs (see Table 13), which indicate SAS activity on Port 0 and Port 1.

3.1.5.2 Connectors

This section describes the different connectors on the LSISAS9212-4i4e HBA. See Figure 6 for connector locations.

PCIe Connector (J1). The LSISAS9212-4i4e HBA supports a x8 interface. The PCIe connection is through the edge connector, J1, which provides connections on both the top (J1B) and bottom (J1A) of the board. The signal definitions and pin numbers conform to the PCIe specifications.

SAS/SATA Connector (J5, J6, J7, J8, and J12). The LSISAS9212-4i4e HBA supports SAS/SATA connections through connector J12, which is an SFF-8088 mini-SAS, external, right-angle connector, and connectors J5, J6, J7, and J8, which are 7-pin SATA connectors.

Activity LED Header (J11). The LSISAS9212-4i4e HBA has a 4-pin, right-angle, 0.1-in. pitch header for driving external activity LEDs.

Table 13: LSISAS9212-4i4e LED Header

Pin	Function
1	3.3 V
2	Port 0
3	Port 1[a]
4	3.3 V

a. Port 1 consists of the 7-pin SATA connectors on this HBA.

UART Connector (J3). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 14: LSISAS9212-4i4e UART Pinout

Pin	Function
1	UART_TX
2	Gnd
3	UART_RX
4	3.3 V

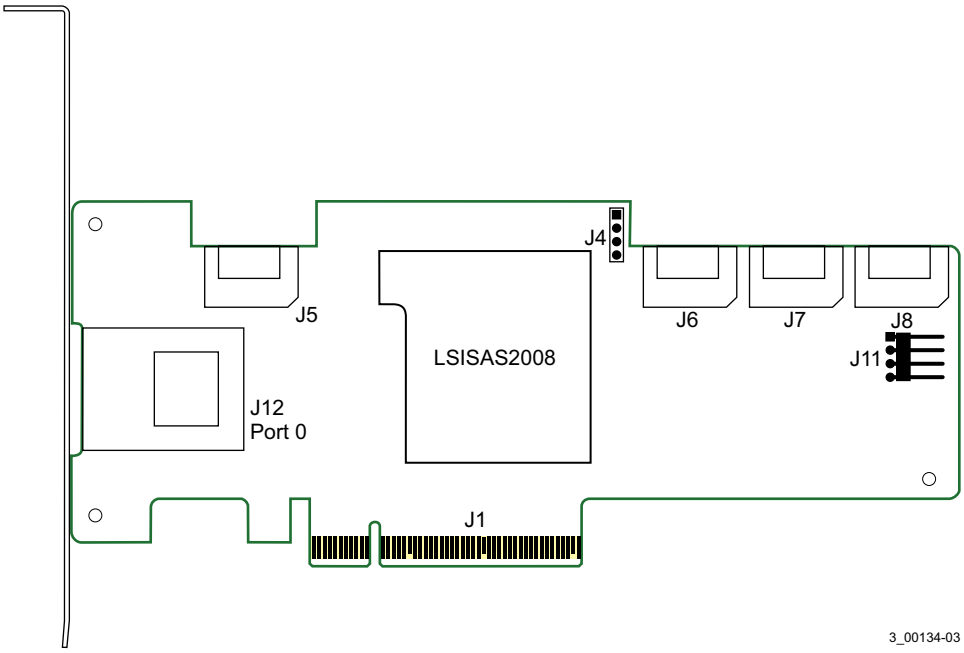

Figure 6: LSISAS9212-4i4e Board Layout

- J1: PCIe x4-lane board edge connector
- J12: SFF-8088 mini-SAS, external, right-angle connector
- J5, J6, J7, J8: 7-pin SATA connectors
- J11: 4-pin, right angle, 0.1-in. pitch, pin header for driving external activity LED
- J4: UART connection

3.1.5.3 Physical Characteristics

The LSISAS9212-4i4e HBA is a 6.6-in. x 2.7-in. low profile board. PCIe connection is through the edge connector, J1. The component height on the top and bottom of the LSISAS9212-4i4e HBA follows the PCIe specification. The LSISAS9212-4i4e HBA supports SAS/SATA connections through one SFF-8088 mini-SAS external connector (J12) and four individual x1 internal SATA connectors (J5, J6, J7, and J8).

3.1.6 LSISAS9200-16e HBA Characteristics

The LSISAS9200-16e HBA has onboard Flash ROM for firmware and BIOS, and onboard DDR2 SDRAM. The LSISAS2116 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the sixteen SAS phys on the LSISAS2116 connector is capable of up to 6Gb/s SAS or SATA link rates.

3.1.6.1 LEDs

The LSISAS9200-16e HBA has two 4-pin headers for external connection of activity LEDs. The LEDs on header J4 correspond to activity on ports 2 and 3, and header J5 corresponds to activity on Port 0 and Port 1.

3.1.6.2 Connectors

This section describes the different connectors on the LSISAS9200-16e HBA. See Figure 7 for connector locations.

PCIe Connector (J10). The LSISAS9200-16e HBA supports a x8 interface. The PCIe connection is through the edge connector, J10, which provides connections on both the top (J10B) and bottom (J10A) of the board. The signal definitions and pin numbers conform to the PCIe specification.

SAS/SATA Connector (J6, J7, J8, J9). The LSISAS9200-16e HBA supports SAS connections through four external connectors: J6, J7, J8, and J9, which are SFF-8088 mini-SAS, external, right-angle connectors.

Activity LED Headers (J4 and J5). The LSISAS9200-16e HBA has two 4-pin, right-angle, 0.1-in. pitch headers for driving external activity LEDs.

Table 15: LSISAS9200-16e LED Header for J4

Pin	Function
1	3.3 V
2	Port 2
3	Port 3
4	3.3 V

Table 16: LSISAS9200-16e LED Header for J5

Pin	Function
1	3.3 V
2	Port 0
3	Port 1
4	3.3 V

UART Connector (J3). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 17: LSISAS9200-16e UART Pinout

Pin	Function
1	UART_TX
2	Gnd
3	UART_RX
4	3.3 V

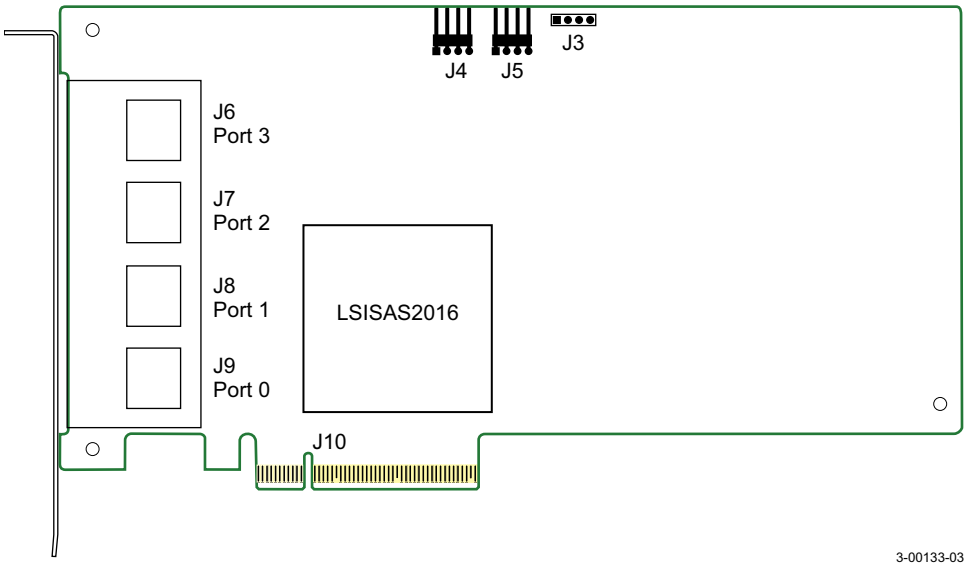

Figure 7: LSISAS9200-16e Board Layout

- J10: PCIe x8-lane board edge connector
- J6, J7, J8, J9: SFF-8088 mini-SAS, external, right-angle connectors
- J4 and J5: 4-pin, right angle, 0.1-in. pitch pin header for driving external activity LED
- J3: UART connection

3.1.6.3 Physical Characteristics

The LSISAS9200-16e HBA is 9.0-in. x 4.2-in. PCIe connection is through the edge connector, J10. The component height on the top and bottom of the LSISAS9200-16e HBA follows the PCIe specifications. The SAS/SATA interface is through four SFF-8088 mini-SAS internal connectors, J6, J7, J8, and J9.

3.1.7 LSISAS9201-16i HBA Characteristics

The LSISAS9201-16i HBA has onboard Flash ROM for firmware and BIOS, and onboard DDR2 SDRAM. The LSISAS2116 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the sixteen SAS phys on the LSISAS2116 connector is capable of up to 6Gb/s SAS or SATA link rates.

3.1.7.1 LEDs

The LSISAS9201-16i HBA has two 4-pin headers for connection of activity LEDs. The LEDs on header J4 correspond to activity on ports C and D, and header J5 corresponds to activity on Port A and Port B.

3.1.7.2 Connectors

This section describes the different connectors on the LSISAS9201-16i HBA. See Figure 8 for connector locations.

PCIe Connector (EC1). The LSISAS9201-16i HBA supports a x8 interface. The PCIe connection is through the edge connector, EC1, which provides connections on both the top (EC1B) and bottom (EC1A) of the board. The signal definitions and pin numbers conform to the PCIe specifications.

SAS/SATA Connector (J6, J7, J8, J9). The LSISAS9201-16i HBA supports SAS connections through four external connectors: J6, J7, J8, and J9, which are SFF-8087 mini-SAS, internal, right-angle connectors.

Activity LED Headers (J4 and J5). The LSISAS9201-16i HBA has two 4-pin, right-angle, 0.1-in. pitch headers for driving external activity LEDs.

Table 18: LSISAS9201-16i LED Header for J4

Pin	Function
1	3.3 V
2	Port C
3	Port D
4	3.3 V

Table 19: LSISAS9201-16i LED Header for J5

Pin	Function
1	3.3 V
2	Port A
3	Port B
4	3.3 V

UART Connector (J1). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 20: LSISAS9201-16i UART Pinout

Pin	Function
1	UART_TX
2	Gnd
3	UART_RX
4	3.3 V

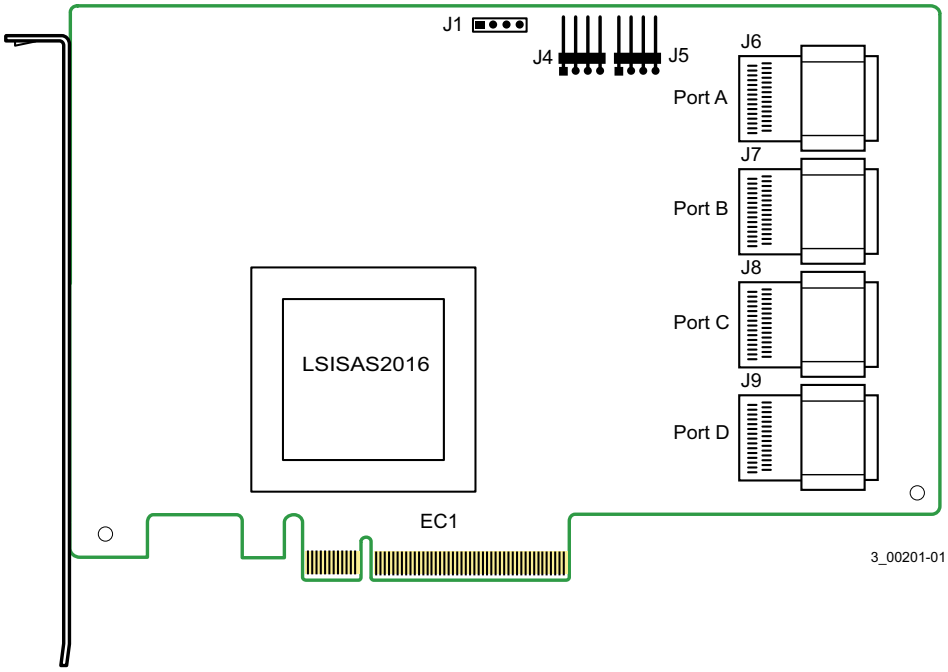

Figure 8: LSISAS9201-16i Board Layout

- EC1: PCIe x8-lane board edge connector
- J6, J7, J8, J9: SFF-8087 mini-SAS, internal, right-angle connectors
- J4 and J5: 4-pin, right angle, 0.1-in. pitch pin header for driving external activity LED
- J1: UART connection

3.1.7.3 Physical Characteristics

The LSISAS9201-16i HBA is 6.6-in. x 4.2-in. PCIe connection is through the edge connector, EC1. The component height on the top and bottom of the LSISAS9201-16i board follows the PCIe specifications. The SAS/SATA interface is through four SFF-8087 mini-SAS internal connectors, J6, J7, J8, and J9.

3.1.8 LSISAS9201-16e HBA Characteristics

The LSISAS9201-16e HBA has onboard Flash ROM for firmware and BIOS, and onboard DDR2 SDRAM. The LSISAS2116 controller brings 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the sixteen SAS phys on the LSISAS2116 connector is capable of up to 6Gb/s SAS or SATA link rates.

3.1.8.1 LEDs

The LSISAS9201-16e HBA has two 4-pin headers for external connection of activity LEDs. The LEDs on header J3 correspond to activity on ports C and D, and header J4 corresponds to activity on ports A and B.

3.1.8.2 Connectors

This section describes the different connectors on the LSISAS9201-16e HBA. See Figure 9 for connector locations.

PCIe Connector (EC1). The LSISAS9201-16e HBA supports a x8 interface. The PCIe connection is through the edge connector, EC1, which provides connections on both the top (EC1B) and bottom (EC1A) of the board. The signal definitions and pin numbers conform to the PCIe specifications.

SAS/SATA Connector (J6, J7, J8, J9). The LSISAS9201-16e HBA supports SAS connections through four external connectors: J6, J7, J8, and J9, which are SFF-8088 mini-SAS, external, right-angle connectors.

Activity LED Headers (J3 and J4). The LSISAS9201-16e HBA has two 4-pin, right-angle, 0.1-in. pitch headers for driving external activity LEDs.

Table 21: LSISAS9201-16e LED Header for J3

Pin	Function
1	3.3 V
2	Port C
3	Port D
4	3.3 V

Table 22: LSISAS9201-16e LED Header for J4

Pin	Function
1	3.3 V
2	Port A
3	Port B
4	3.3 V

UART Connector (J5). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status.

Table 23: LSISAS9201-16e UART Pinout

Pin	Function
1	UART_TX
2	Gnd
3	UART_RX
4	3.3 V

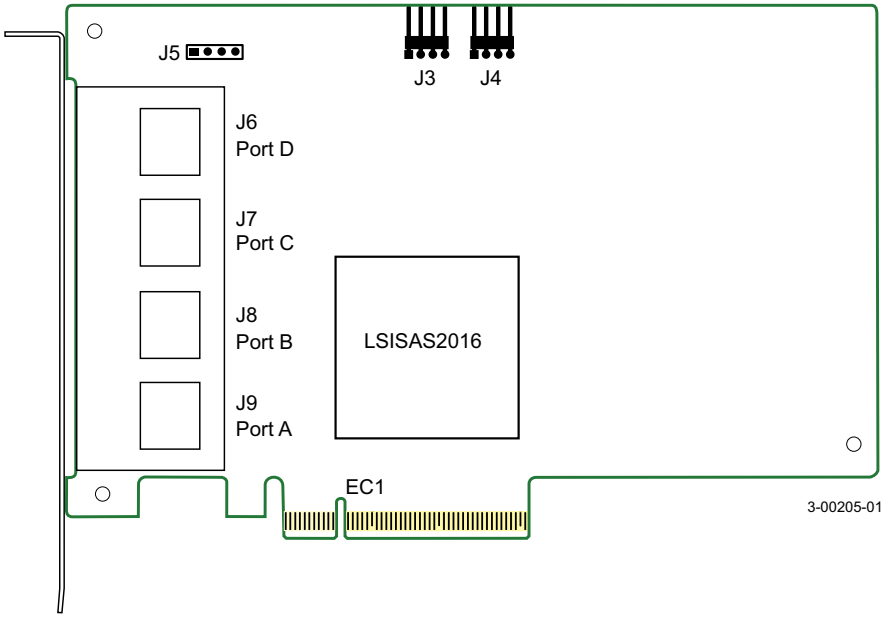

Figure 9: LSISAS9201-16e Board Layout

- EC1: PCIe x8-lane board edge connector
- J6, J7, J8, J9: SFF-8088 mini-SAS, external, right-angle connectors
- J3 and J4: 4-pin, right angle, 0.1-in. pitch, pin header for driving external activity LED
- J5: UART connection

3.1.8.3 Physical Characteristics

The LSISAS9201-16e HBA is 6.6-in. x 4.2-in. PCIe connection is through the edge connector, EC1. The component height on the top and bottom of the LSISAS9200-16e HBA follows the PCIe specification. The SAS/SATA interface is through four SFF-8088 mini-SAS external connectors, J6, J7, J8, and J9.

3.1.9 LSISAS9202-16e HBA Characteristics

The LSISAS9202-16e HBA has onboard Flash ROM for firmware and BIOS. The two LSISAS2008 controllers bring 6Gb/s SAS performance to HBA, workstation, and server designs, making it easy to add a SAS interface to any PCIe system. Each of the SAS phys on the two LSISAS2008 connectors is capable of up to 6Gb/s SAS or SATA link rates.

3.1.9.1 Connectors

This section describes the different connectors on the LSISAS9202-16e HBA. See Figure 10 for connector locations.

PCIe Connector (EC1). The LSISAS9202-16e HBA supports a x16 interface. The PCIe connection is through the edge connector, EC1, which provides connections on both the top (EC1B) and bottom (EC1A) of the board. The signal definitions and pin numbers conform to the PCIe specification.

SAS/SATA Connector (J3). The LSISAS9202-16e HBA supports SAS connections through four external connectors: J3, ports A, B, C, and D, which are SFF-8644 mini-SAS HD, external, right-angle connectors. The LSISAS9202-16e HBA also supports active cables.

UART Connector (J2, J5). The UART connector debug port requires a special cable and LSI support to gather detailed IOC status. Both of the UART headers have the following pinout.

Table 24: LSISAS9202-16e UART Pinout

Pin	Function
1	UART_TX
2	Gnd
3	UART_RX
4	3.3 V

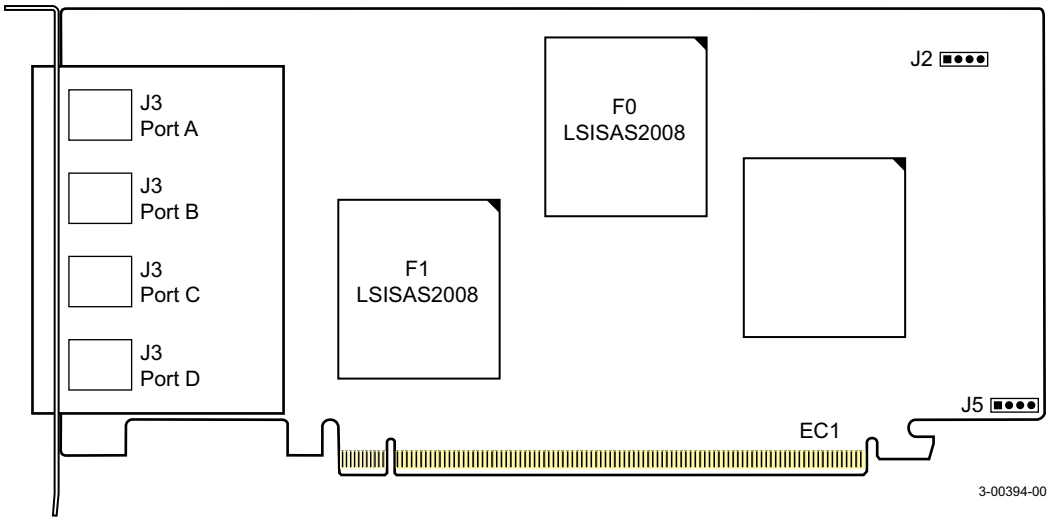

Figure 10: LSISAS9202-16e Board Layout

- EC1: PCIe x16-lane board edge connector
- J3, Ports A, B, C, D: SFF-8644 mini-SAS HD external connectors
- J2, J5: UART connections

3.1.9.2 Physical Characteristics

The LSISAS9202-16e HBA is 6.6-in. x 2.7-in. PCIe connection is through the edge connector, EC1. The component height on the top and bottom of the LSISAS9202-16e HBA follows the PCIe specification. The SAS/SATA interface is through four SFF-8644 mini-SAS HD external connectors, labeled ports A, B, C, and D of connector J3.

3.2 Electrical and Environmental Specifications

The design and implementation of the LSI PCIe to SAS HBAs minimizes electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The board carries the CE mark, C-Tick mark, Canadian Compliance Statement, Korean KCC, Taiwan BSMI, Japan VCCI, and FCC Class B, and it is marked with the FCC Self-Certification logo. The board also meets the requirements of CISPR Class B.

3.2.1 Electrical Characteristics

The following table lists the maximum power requirements for the LSI PCIe to SAS HBAs under normal operation.

Table 25: Maximum Power Requirements

HBA Model	PCIe 12.0 V	Power	Operating Range
LSISAS9200-8e	0.74 A	8.84 W	0 °C to 55 °C
LSISAS9210-8i	0.66 A	7.92 W	0 °C to 55 °C
LSISAS9211-8i	0.70 A	8.38 W	0 °C to 55 °C
LSISAS9211-4i	0.57 A	6.86 W	0 °C to 55 °C
LSISAS9212-4i4e	0.67 A	7.2 W	0 °C to 55 °C
LSISAS9200-16e	1.35 A	16.2 W	0 °C to 55 °C
LSISAS9201-16i	1.35 A	16.2 W	0 °C to 55 °C
LSISAS9201-16e	1.35 A	16.2 W	0 °C to 55 °C
LSISAS9202-16e[a]	1.91 A	24.3 W	0 °C to 55 °C

a. The power requirements data for this HBA assumes 4 active mini-SAS HD cables drawing 1 W each.

3.2.2 Thermal and Atmospheric Characteristics

The atmospheric characteristics for the LSI PCIe to SAS HBAs are as follows:

- Temperature range: 0 °C to 55 °C (dry bulb)
- Relative humidity range: 5% to 90% noncondensing
- Maximum dew point temperature: 32 °C

The following parameters define the storage and transit environment for the LSI PCIe to SAS HBAs:

- Temperature range: –45 °C to +105 °C (dry bulb)
- Relative humidity range: 5% to 90% noncondensing

3.2.3 Safety Characteristics

All LSI PCIe to SAS HBAs meet or exceed the requirements of UL flammability rating 94V-0. Each bare board is marked with the supplier's name or trademark, type, and UL flammability rating. Because these boards are installed in a PCIe bus slot, all voltages are below the SELV 42.4-V limit.


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