



USER'S GUIDE

PCI Express to 3.0-Gb/s Serial Attached SCSI (SAS) Host Bus Adapters

Model Numbers:

SAS3041E, SAS3041EL
SAS3042E, SAS3042EL
SAS3080E, SAS3080EL
SAS3081E, SAS3081EL
SAS3442E, SAS3442EL
SAS3444E, SAS3444EL
SAS3800E
SAS3801E, SAS3801EL
SAS31601E

June 2007

Version 2.0



Electromagnetic Compatibility Notices

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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The LSI PCI Express to 3.0-Gb/s SAS host bus adapters (SAS3041E, SAS3041EL, SAS3042E, SAS3042EL, SAS3080E, SAS3080EL, SAS3081E, SAS3081EL, SAS3442E, SAS3442EL, SAS3444E, SAS3444EL, SAS3800E, SAS3801E, SAS3801EL and SAS31601E) are tested to comply with FCC standards for home or office use.

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

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LSI Asia, Inc. Taiwan Branch
10/F, 156, Min Sheng E. Rd., Section 3,
Taipei, Taiwan, R.O.C.
Tel: 886.2.2718.7828
FAX: 886.2.2718.8869

LSI Corporation
North American Headquarters
Milpitas, CA
Tel: 408.433.8000

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Document Description

Document DB15-000363-01, June 2007

This document describes revision/release_2.0 of LSI Corporation's SAS3041E, SAS3041EL, SAS3042E, SAS3042EL, SAS3080E, SAS3080EL, SAS3081E, SAS3081EL, SAS3442E, SAS3442EL, SAS3444E, SAS3444EL, SAS3800E, SAS3801E, SAS3801EL and SAS31601E PCI Express to 3.0-Gb/s SAS host bus adapters user's guide and will remain the official reference source for all revisions/releases of this product until rescinded by an update.

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Preface

This document is the user's guide for the LSI PCI Express to 3.0-Gb/s SAS host bus adapters, referred to as LSI PCIe to SAS host bus adapters. It contains a functional description of the LSI PCIe to SAS host bus adapters as well as physical and electrical specifications. It also contains instructions for installing the host bus adapters and for connecting SAS devices.

Audience

This document assumes that you have some familiarity with Serial Attached SCSI (SAS) devices and PCI Express devices. This document benefits people installing and using the LSI PCIe to SAS host bus adapter.

Organization

This document has the following chapters:

- [Chapter 1, Introduction](#), describes the LSI PCIe to SAS host bus adapters.
- [Chapter 2, Hardware Installation](#), describes how to install the LSI PCIe to SAS host bus adapters in a system.
- [Chapter 3, Host Bus Adapter Characteristics](#), provides the environmental and electrical specifications for the LSI PCIe to SAS host bus adapters. This chapter also provides the mechanical drawings and connector locations for the LSI PCIe to SAS host bus adapters.

Related Publications

LSI Documents

LSISAS1064E PCI Express to 4-Port Serial Attached SCSI Controller Technical Manual, Document No. DB14-000331-02

LSISAS1068E PCI Express to 8-Port Serial Attached SCSI Controller Technical Manual, Document No. DB14-000330-02

Fusion-MPT™ Device Management User's Guide, Document No. DB15-000186-01

Integrated RAID User's Guide, Document No. DB15-000292-00

Integrated RAID for SAS User's Guide, Document No. DB15-000357-00

ANSI

www.ansi.org

InterNational Committee on Information Technology Standards (INCITS) T10 Technical Committee

<http://www.t10.org>

Global Engineering Documents

www.global.ihs.com

PCI Special Interest Group

www.pcisig.com

Revision Record

Version	Date	Remarks
2.0	6/2007	This release provides information about the SAS3042E, SAS3042EL and SAS31601E PCI Express to 3.0-Gbs SAS host bus adapters.
1.0	8/2006	This release provides information about the SAS3041E, SAS3041EL, SAS3080E, SAS3080EL, SAS3081E, SAS3081EL, SAS3442E, SAS3442EL, SAS3443E, SAS3443EL, SAS3444E, SAS3444EL, SAS3800E, SAS3801E, and SAS3801EL PCI Express to 3.0-Gb/s SAS host bus adapters. Several of these host bus adapters were previously featured in the 3-Gb/s Serial Attached SCSI Host Bus Adapters User's Guide (March 2006, Version 2.0).

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Chapter 1

Introduction

This chapter describes the LSI PCI Express to 3.0-Gb/s SAS host bus adapters and consists of the following sections:

- [Section 1.1, “Overview”](#)
- [Section 1.2, “Features”](#)
- [Section 1.3, “PCI Performance”](#)
- [Section 1.4, “Software”](#)

1.1 Overview

The LSI PCIe to SAS host bus adapters (HBAs) provide four or eight serial ports for connection to SAS/SATA (Serial ATA) devices. Each port is capable of a SAS link rate and a SATA link rate of 3.0-Gb/s. The PCI Express transmission and reception data rate is 2.5-Gb/s in each direction, yielding a total bandwidth of 5.0-Gb/s for each full-duplex lane. The LSI PCIe to SAS HBAs are implemented using four or eight PCI Express PHYs, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s.

The LSI PCIe to SAS HBAs contain Flash ROM for storing the BIOS and firmware, and NVSRAM for storing nonvolatile RAID information. The SAS3442E, SAS3442EL, SAS3444E, SAS3444EL, SAS3800E, SAS3801E, SAS3801EL and SAS31601E HBAs provide a 128K x 36-b PBRAM memory device for storing SAS Address Port information allowing for connection to more than 128 devices. The LEDs on the HBAs report a heartbeat, activity, and fault conditions when detected by firmware. Fusion-MPT™ firmware operates the HBA.

The PCI Express interface is compliant with the *PCI Express Specification*, revision 1.0a. All PCI software is backwards compliant with

previous versions of the PCI/PCI-X specifications. The LSI PCIe to SAS products implement the PCI Express interface as a x4 or x8 interface. The LSI PCIe to SAS HBAs use either a standard PCI or a low-profile PCI bracket type. The LSI PCIe to SAS Host bus adapter (HBA) SAS interface is compatible with the *ANSI Serial Attached SCSI Specification*, revision 1.0 and the *Serial ATA Specification*, revision 1.0a.

The functionality of LSI PCIe to SAS HBAs come from either the LSISAS1064E controller chip or the LSISAS1068E controller chip. The LSISAS1064E integrates four high-performance SAS/SATA PHYs and the LSISAS1068E integrates eight high-performance SAS/SATA PHYs. The design of LSI PCIe to SAS HBAs makes it easy to add SAS interfaces to any computer, workstation, or server with a PCI Express bus.

[Table 1.1](#) shows the LSI PCIe to SAS controllers and their associated HBAs that support SAS/SATA devices. All board numbers contain an “E” after the numeric portion of their name, indicating that they use the PCI Express bus. Boards without an “L” after the numbers in their name use a standard PCI bracket type. Boards with an “L” after the numbers in their name use a low-profile PCI bracket type.

Table 1.1 LSI PCIe to SAS HBAs and Controllers

Controllers	LSI PCIe to SAS HBAs
LSISAS1064E	SAS3041E, SAS3041EL, SAS3042E, SAS3042EL
LSISAS1068E	SAS3080E, SAS3080EL, SAS3081E, SAS3081EL, SAS3442E, SAS3442EL, SAS3444E, SAS3444EL, SAS3800E, SAS3801E, SAS3801EL, SAS31601E

1.2 Features

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

- Supports narrow port and wide port as shown in [Table 1.2](#).

Table 1.2 SAS Bandwidths

Half Duplex	Full Duplex
Narrow Port (1 Lane) 300-MB/s	Narrow Port (1 Lane) 600-MB/s
Wide Port (2 Lanes) 600-MB/s	Wide Port (2 Lanes) 1200-MB/s
Wide Port (4 Lanes) 1200-MB/s	Wide Port (4 Lanes) 2400-MB/s

- Supports SSP, STP, and SMP as defined in the *Serial Attached SCSI (SAS) Specification*, version 1.0.
- Supports SATA as defined in the *Serial ATA Specification*, version 1.0a.
- 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 do not restrict airflow.
- Provides a serial, point-to-point, enterprise-level storage interface.
- Transfers data using SCSI information units.
- Provides two LEDs for each PHY to indicate link activity and faults for the SAS3041E, SAS3041EL, SAS3042E, SAS3042EL, SAS3080E, SAS3080EL, SAS3081E, SAS3081EL, SAS3442E, SAS3442EL, SAS3444E, SAS3444EL, SAS3800E, SAS3801E, SAS3801EL and SAS31601E host board adapters (HBAs).
- Provides two light pipes routed through the PCI bracket for the SAS3041E, SAS3041EL, SAS3042E, SAS3042EL, SAS3080E, SAS3080EL, SAS3081E, SAS3081EL, SAS3442E, SAS3442EL, SAS3444E, SAS3444EL, and SAS3800E HBAs. One light pipe indicates activity on any PHY. The other light pipe indicates a heartbeat or a fault condition. The SAS3801E and SAS3801EL use two LEDs routed through the PCI bracket for the same purpose.
- Provides compatibility with SATA target devices.

1.3 PCI Performance

LSI PCIe to SAS HBA boards support the PCI Express interface. The PCI Express features of the LSI PCIe to SAS HBAs include:

- Provides four (boards using LSISAS1064E) or eight (boards using LSISAS1068E) PCI Express PHYs
- Supports a single-PHY (1 lane) link transfer rate up to 2.5-Gb/s in each direction
- Supports x8, x4, and x1 link widths
- Automatically downshifts to a x4 link width if plugged into a x4 connector or into a x8 connector that is wired as a x4 connector
- Provides a scalable interface
 - Single-lane aggregate bandwidth of up to 0.5-GB/s (500-MB/s)
 - Quad-lane aggregate bandwidth of up to 2.0-GB/s (2000-MB/s)
 - 8-lane aggregate bandwidth of up to 4.0-GB/s (4000-MB/s)
- Supports serial, point-to-point interconnections between devices
 - Reduces the electrical load of the connection
 - Enables higher transmission and reception frequencies
- Supports lane reversal and polarity inversion
- Supports PCI express hot plug
- Supports power management
 - Supports PCI power management 1.2
 - Supports Active State Power Management (ASPM), including the L0, L0s, L1 states, by placing links in a power-savings mode during times of no link activity
- Contains a replay buffer that preserves a copy of the data for retransmission in case a CRC error occurs
- Supports the PCI Express advanced error reporting capabilities
- Uses a packetized and layered architecture

- Achieves a high bandwidth per pin with low overhead and low latency
- PCI Express is software compatible 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
- Provides 4-KB of PCI configuration address space per device
- Supports posted and non-posted transactions
- Provides quality of service (QOS) link configuration and arbitration policies
- Supports traffic class 0 and class one virtual channel
- Supports message signaled interrupts (both MSI and MSI-X) as well as INTx interrupt signaling for legacy PCI support
- Supports end-to-end CRC (ECRC) and advanced error reporting

1.4 Software

The LSI PCIe to SAS HBAs support all major operating systems, as shown in [Table 1.3](#).

Table 1.3 Software Support

OS Support	Versions
Windows	XP, 2000, Server 2003 32-b and 64-b (x86, AMD, and IA-64)
Linux: Red Hat Enterprise Linux	(RHEL) 3 and 4
Linux: SuSE Enterprise Server	(SLES) 8 and 9
Novel NetWare	5.1 and 6.5
Sun Sparc Solaris	2.6, 2.7, 2.8, 2.9, and 2.10
Utilities	Install, Flash and BIOS Configuration Utility

The LSI PCIe to SAS 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 an LSI Technical Support representative at 719-533-7230 or visit our web site at <http://www.lsi.com>.

Chapter 2

Hardware Installation

This chapter provides both quick instructions and detailed instructions on how to install the LSI PCIe to 3.0-Gb/s SAS HBA. This chapter consists of the following sections:

- [Section 2.1, “Quick Installation Instructions”](#)
 - [Section 2.2, “More Detailed Installation Instructions”](#)
-

2.1 Quick Installation Instructions

The following steps summarize the installation instructions.

Use these instructions to install your LSI PCIe to SAS HBA if you are comfortable with the installation procedure. [Section 2.2, “More 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 cords.
3. Remove the cover from the system.
4. Insert the HBA in an available PCI Express slot.
5. Secure the bracket to the system's chassis.
6. Connect the serial cables between the HBA and the serial hard disk drives. [Figure 2.1](#) illustrates the locations of the connectors on your HBA.
7. Replace the cover and the power cords, and then power-up the system.

LSI PCIe to SAS HBA hardware installation is complete.

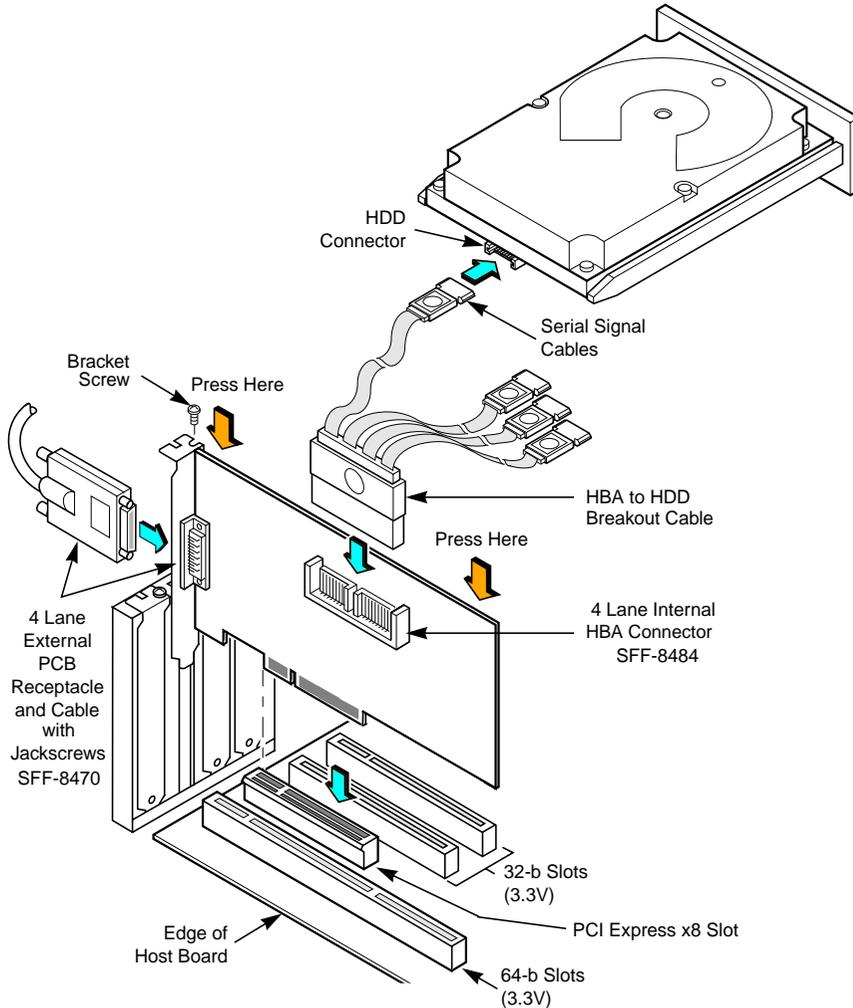
2.2 More Detailed Installation Instructions

The following steps provide detailed installation instructions:

1. Unpack the HBA in a static-free environment. Contact LSI or your OEM support representative if the HBA appears to be damaged.
2. Turn off the system power and physically disconnect the power cord.
3. Remove the cover from the system and disconnect the system from any networks.
4. Insert the HBA in an available PCI Express slot. Press down gently but firmly to properly seat the HBA in the slot. [Figure 2.1](#) illustrates how to insert the HBA in a PCI Express slot.
5. Install the bracket screw, when present, or engage the system's retention mechanism to secure the HBA to the system's chassis.
6. Connect the serial cables between the HBA and the serial hard disk drives (HDD). [Figure 2.1](#) illustrates the locations of the connectors on your HBA.
7. Replace the system's cover, reconnect the power cords, and then power-up the system.

LSI PCIe to SAS HBA hardware installation is complete.

Figure 2.1 Installing an LSI PCIe to SAS x8 HBA in a PCI Express Slot



Note: The HBA shape, size, and locations of components on your x8 (or x4) HBA and its bracket may vary from this illustration. A PCI Express connector is smaller than a PCI/PCI-X connector.

Chapter 3

Host Bus Adapter Characteristics

This chapter describes the characteristics of the LSI PCIe to 3.0-Gb/s SAS HBAs. The chapter includes these topics:

- [Section 3.1, “Characteristics of the LSI PCIe to SAS HBAs”](#)
- [Section 3.2, “Electrical and Environmental Specifications”](#)

3.1 Characteristics of the LSI PCIe to SAS HBAs

The LSI PCIe to SAS HBAs use either the LSISAS1064E controller or the LSISAS1068E controller. The LSISAS1064E controller connects up to four SAS/SATA devices to a computer system through the PCI Express interface. The LSISAS1068E controller connects up to eight SAS/SATA devices to a computer system through the PCI Express interface. The LSI controllers are implemented using either four (LSISAS1064E) or eight (LSISAS1068E) PCI Express PHYs. Each PHY operates at 2.5-Gb/s, which provides possible host-side maximum transmission and reception rates of up to 4.0-GB/s.

The LSISAS1064E controller chip and the LSISAS1068E controller chip contain the PCI Express functionality for the LSI PCIe to SAS HBAs. The controller chip connects directly to the PCI Express bus and generates timing and protocol in compliance with the PCI Express specification.

The LSISAS1064E controller chip and the LSISAS1068E controller chip contain the SAS/SATA functionality for the LSI PCIe to SAS HBAs. The controller chips connect channels directly to the SAS/SATA devices.

The LSI PCIe to SAS HBAs provide a 2M x 8-b Flash ROM for storing the BIOS and firmware. The LSI PCIe to SAS HBAs provide up to 32K x 8-b NVSRAM for storing the nonvolatile RAID information when a system failure happens. The SAS3442E, SAS3442EL, SAS3444E,

SAS3444EL, SAS3800E, SAS3801E, SAS3801EL and SAS31601E HBAs provide a 128K x 36-b PBRAM memory device for storing SAS Address Port information allowing for connection to more than 128 devices.

3.1.1 SAS3041E and SAS3041EL HBAs Characteristics

The SAS3041E and SAS3041EL are the same HBA with the exception of the PCI bracket. The SAS3041E uses a standard PCI bracket and the SAS3041EL uses the low-profile (LPPCI) PCI bracket. [Figure 3.1](#) shows the HBAs and their brackets.

3.1.1.1 LEDs

The SAS3041E and SAS3041EL HBAs have four LEDs, labeled A0–A3, that turn green to indicate an activity condition on any of the four PHYs. There are four LEDs, labeled LNP0–LNP3, that turn yellow to indicate a fault condition on any of the four PHYs. See [Figure 3.1](#) for LED locations.

The SAS3041E and SAS3041EL HBAs have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSISAS1064E heartbeat, or it turns yellow when the LSISAS1064E firmware detects a fault condition.

3.1.1.2 Connectors

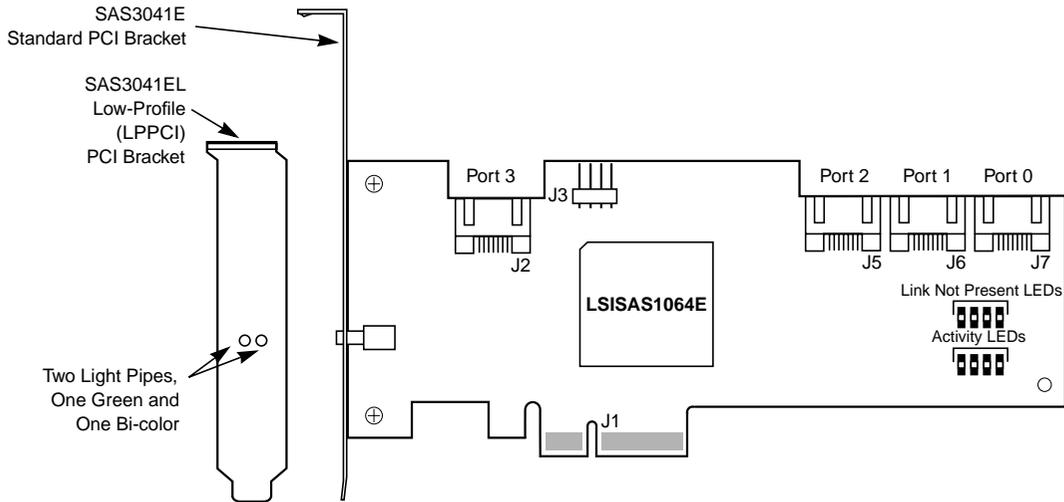
This section describes the connectors on the SAS3041E and SAS3041EL HBAs. See [Figure 3.1](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has four PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 2.0-GB/s. The PCI Express connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2, J5–J7) – The SAS3041E supports SAS/SATA connections through connectors J2 (Port 3), J5 (Port 2), J6 (Port 1), and J7 (Port 0). These connectors are SATA internal right-angle connectors.

Activity LED Header (J3) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.1 SAS3041E and SAS3041EL Board Layout



- J1: PCI Express x4 lane board edge connector
- J2, J5–J7: SATA internal right-angle connectors
- J3: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.1.3 Physical Characteristics

The SAS3041E and SAS3041EL boards are 6.6 inches x 2.713 inches. PCI Express x4 connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3041E and SAS3041EL boards follows the PCI Express specifications.

3.1.2 SAS3042E and SAS3042EL HBAs Characteristics

The SAS3042E and SAS3042EL are identical HBAs with the exception of the PCI bracket. The SAS3042E uses a standard PCI bracket and the SAS3042EL uses a low-profile (LPPCI) PCI bracket. [Figure 3.2](#) shows the HBAs and their brackets.

3.1.2.1 LEDs

The SAS3042E and SAS3042EL HBAs have four LEDs, labeled A0–A3, that turn green to indicate an activity condition on any of the four PHYs. There are four LEDs, labeled LNP0–LNP3, that turn yellow to indicate a fault condition on any of the four PHYs. See [Figure 3.2](#) for LED locations.

The SAS3042E and SAS3042EL HBAs have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSISAS1064E heartbeat, or it turns yellow when the LSISAS1064E firmware detects a fault condition.

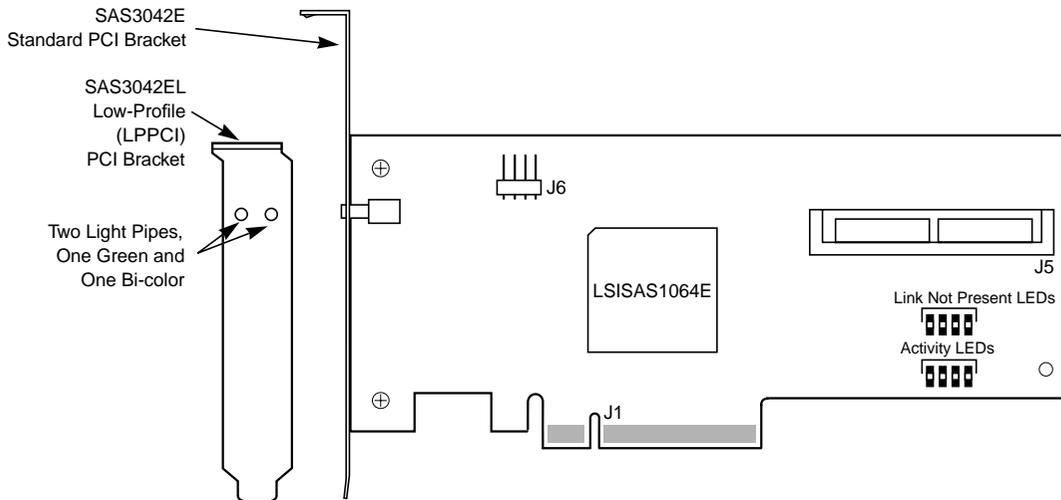
3.1.2.2 Connectors

This section describes the connectors on the SAS3042E and SAS3042EL HBAs. See [Figure 3.2](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3042E or SAS3042EL supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connector (J5) – The SAS3042E and SAS3042EL supports SAS connections through connector J5. The J5 connector is an SFF-8484 SAS internal right-angle connector with four sideband lines.

Activity LED Header (J6) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.2 SAS3042E and SAS3042EL Board Layout

- J1: PCI Express x8 lane board edge connector
- J5: SFF-8484 SAS internal right-angle connector with four sideband lines
- J6: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.2.3 Physical Characteristics

The SAS3042E and SAS3042EL boards are 6.6 inches x 2.713 inches. PCI Express x8 connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3042E and SAS3042EL boards follow the PCI Express specifications.

3.1.3 SAS3080E and SAS3080EL HBAs Characteristics

The SAS3080E and SAS3080EL are identical HBAs with the exception of the PCI bracket. The SAS3080E uses a standard PCI bracket and the SAS3080EL uses a low-profile (LPPCI) PCI bracket. [Figure 3.3](#) shows the HBAs and their brackets.

3.1.3.1 LEDs

The SAS3080E and SAS3080EL HBAs have eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight PHYs. There are eight LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight PHYs. See [Figure 3.3](#) for LED locations.

The SAS3080E and SAS3080EL HBAs have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSISAS1068E heartbeat, or it turns yellow when the LSISAS1068E firmware detects a fault condition.

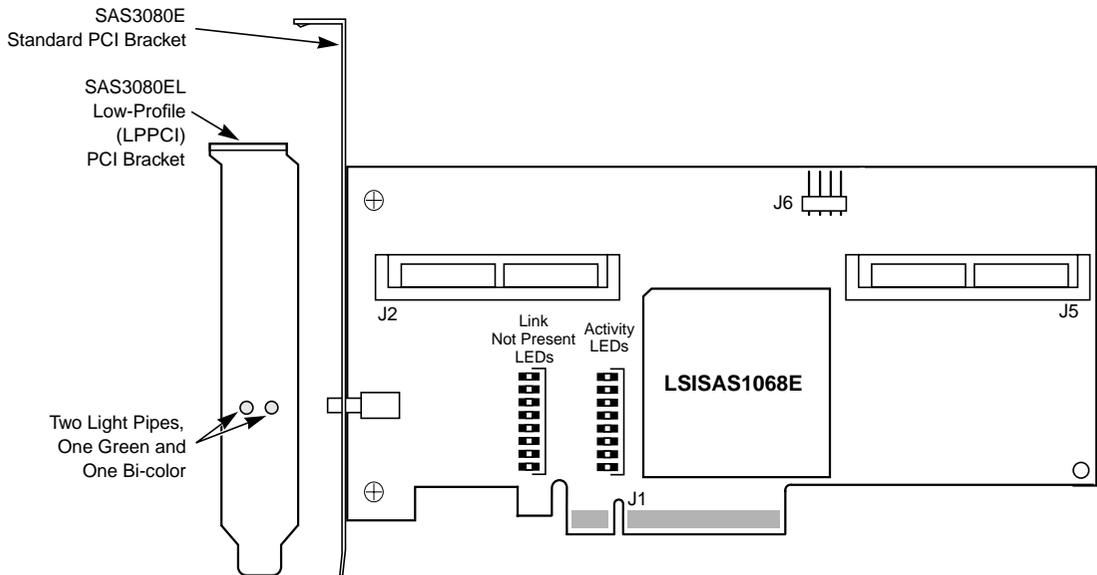
3.1.3.2 Connectors

This section describes the connectors on the SAS3080E and SAS3080EL HBAs. See [Figure 3.3](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3080E or SAS3080EL supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The PCI Express connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2 and J5) – The SAS3080E and SAS3080EL support SAS connections through connectors J2 and J3. The J2 and J3 connectors are SFF-8484 SAS internal right-angle connectors with four sideband lines.

Activity LED Header (J6) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.3 SAS3080E and SAS3080EL Board Layout

- J1: PCI Express x8 lane board edge connector
- J2, J5: SFF-8484 SAS internal right-angle connectors with four sideband lines
- J6: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.3.3 Physical Characteristics

The SAS3080E and SAS3080EL boards are 6.3 inches x 2.713 inches. PCI Express connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3080E and SAS3080EL boards follows the PCI Express specifications.

3.1.4 SAS3081E and SAS3081EL HBAs Characteristics

The SAS3081E and SAS3081EL are identical HBAs with the exception of the PCI bracket. The SAS3081E uses a standard PCI bracket and the SAS3081EL uses a low-profile (LPPCI) PCI bracket. [Figure 3.4](#) shows the HBAs and their brackets.

3.1.4.1 LEDs

The SAS3081E and SAS3081EL HBAs have eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight PHYs. There are eight LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight PHYs. See [Figure 3.4](#) for LED locations.

The SAS3081E and SAS3081EL HBAs have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSISAS1068E heartbeat, or it turns yellow when the LSISAS1068E firmware detects a fault condition.

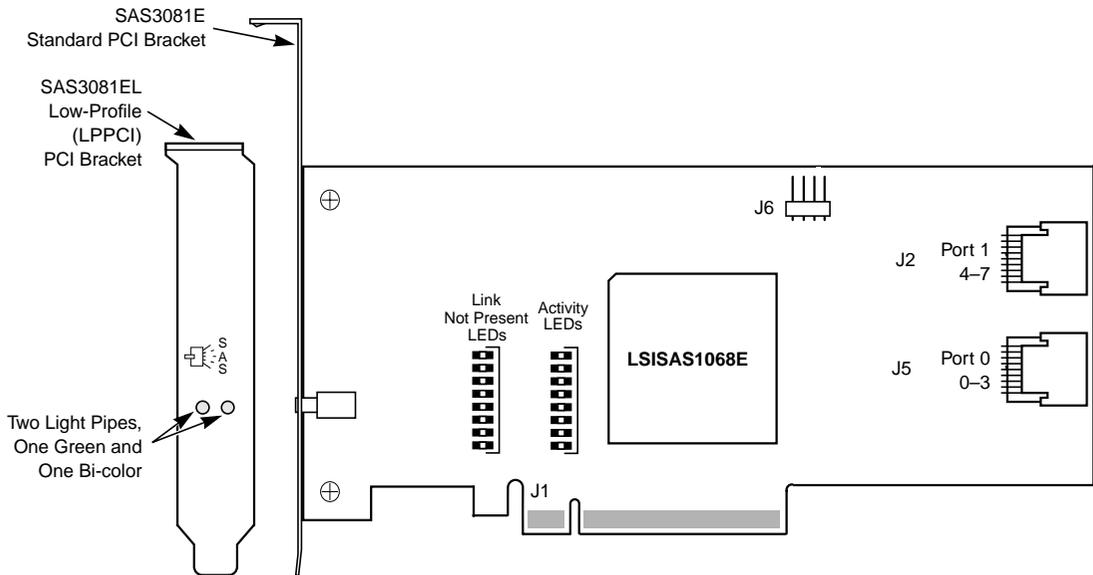
3.1.4.2 Connectors

This section describes the connectors on the SAS3081E and SAS3081EL HBAs. See [Figure 3.4](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3081E or SAS3081EL supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The PCI Express connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2 and J5) – The SAS3081E and SAS3081EL support SAS connections through connectors J2 (Port 1) and J5 (Port 0). The J2 and J5 connectors are SFF-8087 mini-SAS internal right-angle connectors.

Activity LED Header (J6) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.4 SAS3081E and SAS3081EL Board Layout

- J1: PCI Express x8 lane board edge connector
- J2, J5: SFF-8087 mini-SAS internal right-angle connectors
- J6: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.4.3 Physical Characteristics

The SAS3081E and SAS3081EL boards are 6.6 inches x 2.713 inches. PCI Express connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3081E and SAS3081EL boards follows the PCI Express specifications.

3.1.5 SAS3442E and SAS3442EL HBAs Characteristics

The SAS3442E and SAS3442EL are the same HBA with the exception of the PCI bracket. The SAS3442E uses a standard PCI bracket and the SAS3442EL uses a low-profile (LPPCI) PCI bracket. [Figure 3.5](#) shows the HBAs and their brackets.

3.1.5.1 LEDs

The SAS3442E and SAS3442EL HBAs have eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight PHYs. There are eight LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight PHYs. See [Figure 3.5](#) for LED locations.

The SAS3442E and SAS3442EL HBAs have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSISAS1068E heartbeat, or it turns yellow when the LSISAS1068E firmware detects a fault condition.

3.1.5.2 Connectors

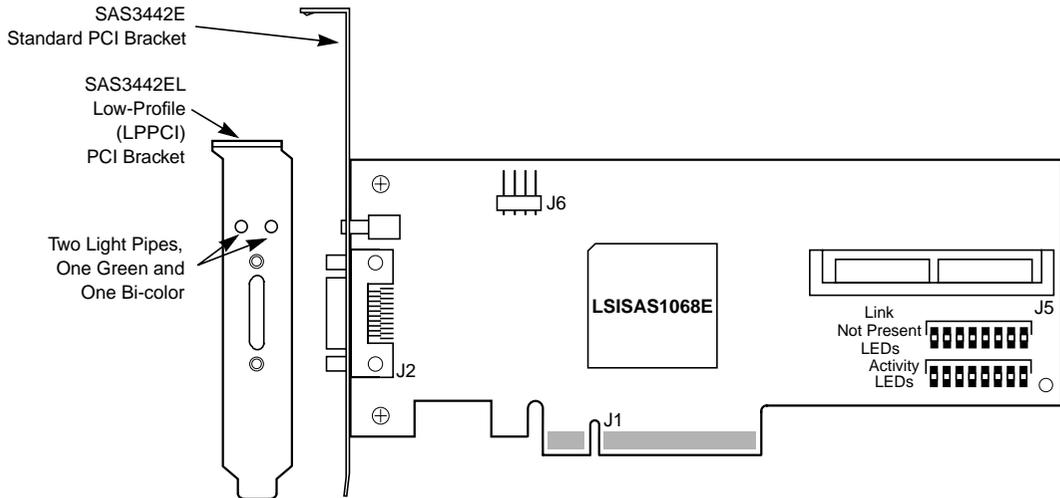
This section describes the connectors on the SAS3442E and SAS3442EL HBAs. See [Figure 3.5](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3442E or SAS3442EL supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2 and J5) – The SAS3442E and SAS3442EL support SAS connections through connectors J2 and J5. The J5 connector is an SFF-8484 SAS internal right-angle connector with four sideband lines. The J2 connector is an SFF-8470 SAS external right-angle connector.

Activity LED Header (J6) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.5 SAS3442E and SAS3442EL Board Layout



- J1: PCI Express x8 lane board edge connector
- J2: SFF-8470 SAS external right-angle connector
- J5: SFF-8484 SAS internal right-angle connector with four sideband lines
- J6: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.5.3 Physical Characteristics

The SAS3442E and SAS3442EL boards are 6.6 inches x 2.713 inches. PCI Express x8 connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3442E and SAS3442EL boards follows the PCI Express specifications.

3.1.6 SAS3444E and SAS3444EL HBAs Characteristics

The SAS3444E and SAS3444EL are the same HBA with the exception of the PCI bracket. The SAS3444E uses a standard PCI bracket and the SAS3444EL uses a low-profile (LPPCI) PCI bracket. [Figure 3.6](#) shows the HBAs and their brackets.

3.1.6.1 LEDs

The SAS3444E and SAS3444EL HBAs have eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight PHYs. There are eight LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight PHYs. See [Figure 3.6](#) for LED locations.

The SAS3444E and SAS3444EL HBAs have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSI SAS1068E heartbeat, or it turns yellow when the LSI SAS1068E firmware detects a fault condition.

3.1.6.2 Connectors

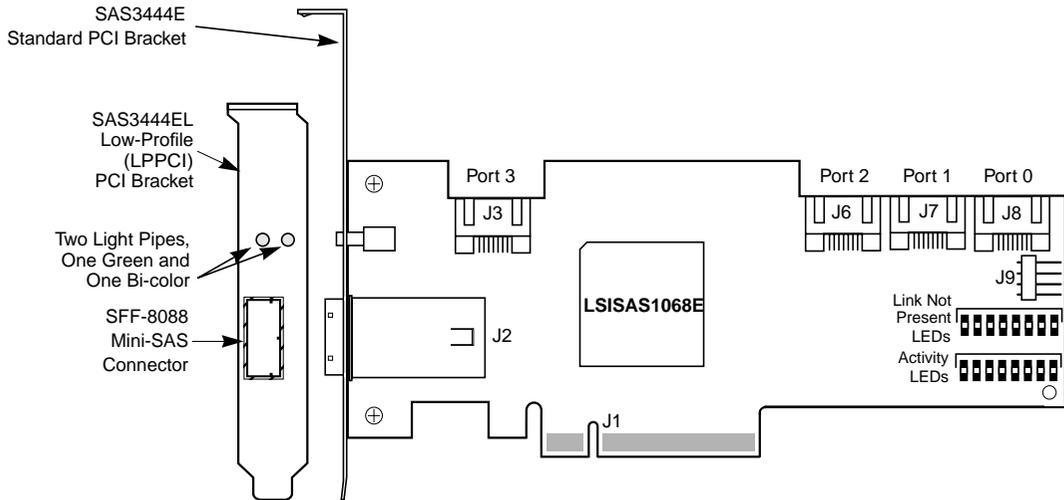
This section describes the connectors on the SAS3444E and SAS3444EL HBAs. See [Figure 3.6](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3444E or SAS3444EL supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2 and J3, J6–J8) – The SAS3444E and SAS3444EL support SAS connections through these connectors. The J3 (Port 3), J6 (Port 2), J7 (Port 1), and J8 (Port 0) connectors are SATA internal latching right-angle connectors. The J2 connector is an SFF-8088 mini-SAS external right-angle connector.

Activity LED Header (J9) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.6 SAS3444E and SAS3444EL Board Layout



- J1: PCI Express x8 lane board edge connector
- J2: SFF-8088 mini-SAS external right-angle connector
- J3, J6–J8: SATA internal latching right-angle connectors
- J9: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.6.3 Physical Characteristics

The SAS3444E and SAS3444EL boards are 6.6 inches x 2.713 inches. PCI Express x8 connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3444E and SAS3444EL boards follows the PCI Express specifications.

3.1.7 SAS3800E HBA Characteristics

The SAS3800E uses a standard PCI bracket. [Figure 3.7](#) shows the HBA and its bracket.

3.1.7.1 LEDs

The SAS3800E HBA has eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight PHYs. There are eight LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight PHYs. See [Figure 3.7](#) for LED locations.

The SAS3800E HBA has two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any PHY. The other light pipe is bi-color. It flashes green to indicate the LSISAS1068E heartbeat, or it turns yellow when the LSISAS1068E firmware detects a fault condition.

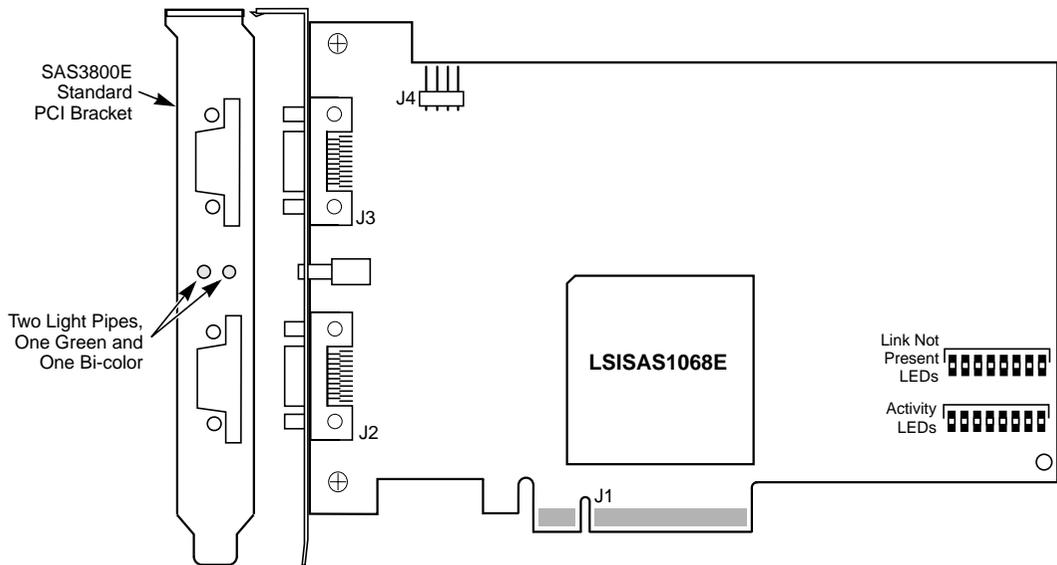
3.1.7.2 Connectors

This section describes the connectors on the SAS3800E HBA. See [Figure 3.7](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3800E supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2 and J3) – The SAS3800E supports SAS/SATA connections through connectors J2 and J3. The J2 and J3 connectors are SFF-8470 SAS external right-angle connectors.

Activity LED Header (J4) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.7 SAS3800E Board Layout

- J1: PCI Express x8 lane board edge connector
- J2 and J3: SFF-8470 SAS external right-angle connector
- J4: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.7.3 Physical Characteristics

The SAS3800E is 6.6 inches x 4.375 inches. PCI Express connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3800E board follows the PCI Express specifications.

3.1.8 SAS3801E and SAS3801EL HBAs Characteristics

The SAS3801E and SAS3801EL are the same HBA with the exception of the PCI bracket. The SAS3801E uses a standard PCI bracket and the SAS3801EL uses a low-profile (LPPCI) PCI bracket. [Figure 3.8](#) shows the HBAs and their brackets.

3.1.8.1 LEDs

The SAS3801E and SAS3801EL HBAs have eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight PHYs. There are also eight LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight PHYs. See [Figure 3.8](#) for LED locations.

The SAS3801E and SAS3801EL HBAs contain two additional LEDs. One LED turns green to indicate activity on any PHY. The other LED is bi-color. It flashes green to indicate the LSI SAS1068E heartbeat, or it turns yellow when the LSI SAS1068E firmware detects a fault condition.

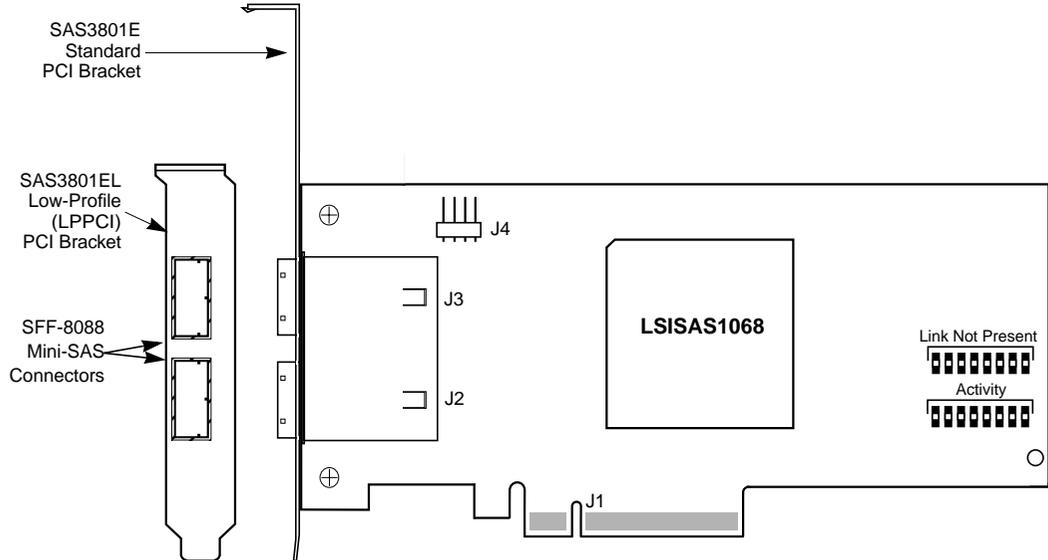
3.1.8.2 Connectors

This section describes the connectors on the SAS3801E and SAS3801EL HBAs. See [Figure 3.8](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS3801E or SAS3801EL supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

SAS/SATA Connectors (J2 and J3) – The SAS3801E and SAS3801EL support SAS connections through connectors J2 and J3. These connectors are SFF-8088 mini-SAS external right-angle connectors.

Activity LED Header (J4) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

Figure 3.8 SAS3801E and SAS3801EL Board Layout

- J1: PCI Express x8 lane board edge connector
- J2 and J3: SFF-8088 mini-SAS external right-angle connectors
- J4: 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs

3.1.8.3 Physical Characteristics

The SAS3801E and SAS3801EL boards are 6.6 inches x 2.713 inches. PCI Express x8 connection is made through the edge connector J1. The component height on the top and the bottom of the SAS3801E and SAS3801EL boards follows the PCI Express specifications.

3.1.9 SAS31601E HBA Characteristics

The SAS31601E uses a standard PCI bracket. [Figure 3.9](#) shows the HBA and its bracket.

3.1.9.1 LEDs

The SAS31601E HBA has sixteen LEDs, labeled A0–A15, that turn green to indicate an activity condition on any of the sixteen PHYs. There are sixteen LEDs, labeled LNP0–LNP15, that turn yellow to indicate a link not present condition on any of the sixteen PHYs. See [Figure 3.9](#) for LED locations.

The SAS31601E HBA has one LED for each of the two LSISAS1068E chips. It flashes green to indicate the LSISAS1068E heartbeat. The Activity LED turns green to indicate activity on any PHY.

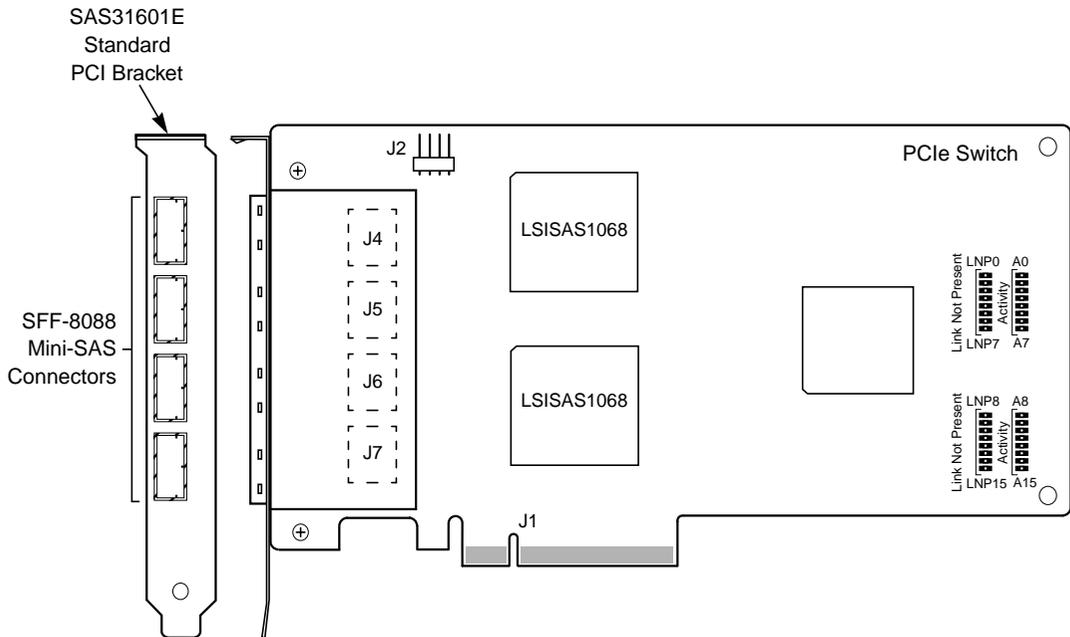
3.1.9.2 Connectors

This section describes the connectors on the SAS31601E HBA. See [Figure 3.9](#) for connector locations.

PCI Express Connector (J1) – The PCI Express interface has eight PCI Express lanes, which provide possible host-side maximum transmission and reception rates of up to 4.0-GB/s. The SAS31601E supports x8, x4, and x1 PCI Express link widths, and automatically downshifts if plugged into either a x4 connector or into a x8 connector that is wired as a x4 connector. The connection is made through the edge connector J1. The signal definitions and pin numbers conform to the PCI Express specifications.

Activity LED Connector (J2) – The connector is a 4-pin, right angle, 0.1-inch pitch, pin header for driving external activity LEDs.

SAS/SATA Connectors (J4, J5, J6 and J7) – The SAS31601E supports SAS connections through connectors J4, J5, J6 and J7. These connectors are SFF-8088 mini-SAS external right-angle connectors.

Figure 3.9 SAS31601E Board Layout

- J1: PCI Express x8 lane board edge connector
- J2: Activity LED connector
- J4-J7: SFF-8088 mini-SAS external right-angle connectors

3.1.9.3 Physical Characteristics

The SAS31601E is 4.376 inches x 7.5 inches. PCI Express connection is made through the edge connector J1. The component height on the top and the bottom of the SAS31601E board follows the PCI Express specifications.

3.2 Electrical and Environmental Specifications

The design and implementation of the LSI PCIe to SAS HBAs minimize 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 MIC, Taiwan BSMI, Japan VCCI, 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

Table 3.1 lists the maximum power requirements for the LSI PCIe to SAS HBAs under normal operation.

Table 3.1 Maximum Power Requirements

HBAs	PCI Express +12.0V	Power	Operating Range
SAS3041E, SAS3041EL	0.5A	6.0W	0°C to 60°C
SAS3042E SAS3042EL	0.5A	6.0W	0°C to 60°C
SAS3080E, SAS3080EL	0.5A	6.0W	0°C to 60°C
SAS3081E, SAS3081EL	0.5A	6.0W	0°C to 60°C
SAS3442E, SAS3442EL	0.5A	6.0W	0°C to 60°C
SAS3444E, SAS3444EL	0.5A	6.0W	0°C to 60°C
SAS3800E	0.5A	6.0W	0°C to 60°C
SAS3801E, SAS3801EL	0.5A	6.0W	0°C to 60°C
SAS31601E	0.7A	8.4W	0°C to 60°C

3.2.2 Thermal and Atmospheric Characteristics

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

- Temperature range: 0°C to 60°C (dry bulb)
- Relative humidity range: 5% to 90% non-condensing
- 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% non-condensing

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 PCI Express bus slot, all voltages are below the SELV 42.4V limit.

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