

Sun Storage 6 Gb SAS ExpressModule HBA

Installation Guide For HBA Models SGX-SAS6-EM-Z and SG-
SAS6-EM-Z

ORACLE

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Using This Documentation

This installation guide describes how to install and remove Oracle's PCIe, eight-channel Sun Storage 6 Gigabit (Gb) per second Serial Attached SCSI (SAS) ExpressModule host bus adapter (HBA). It also explains how to install any software required by the HBA and provides known issues about the product.

The document is written for technicians, system administrators, application service providers (ASPs), and users who have advanced experience troubleshooting and replacing hardware.

This preface contains the following topics:

- [“Related Oracle Documentation” on page 7](#)
- [“Related Third Party Documentation” on page 7](#)
- [“Documentation Feedback” on page 8](#)
- [“Support and Accessibility” on page 8](#)

Related Oracle Documentation

To view, print, or purchase a broad selection of Oracle documentation, including localized versions, go to: <http://www.oracle.com/documentation>

To access HBA and Converged Network Adapter documentation, go to: <http://www.oracle.com/technetwork/documentation/oracle-storage-networking-190061.html>

Related Third Party Documentation

The documents listed as located online are available at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Application/Hardware	Title	Format	Location
SAS2 Upgrade Utility	<i>SAS2 Flash Utility Quick Reference Guide</i>	PDF	Online

Documentation Feedback

Provide feedback on this documentation at:

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Support and Accessibility

Description	Links
Access electronic support through My Oracle Support.	http://support.oracle.com For hearing impaired: http://www.oracle.com/accessibility/support.html
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◆◆◆ CHAPTER 1

HBA Overview

This chapter provides a basic overview of Oracle's Sun Storage 6 Gigabit per second (Gb) Serial Attached SCSI (SAS) ExpressModule host bus adapter (HBA), which uses LSI technology. The chapter also describes the various operating systems, host platforms, storage, and infrastructure configurations that support the HBA.

This chapter contains the following topics:

- “Kit Contents” on page 9
- “HBA Features” on page 9
- “Operating System and Technology Requirements” on page 12
- “Valid Drive Mix Configurations With HDDs and SSDs” on page 11
- “System Interoperability” on page 12
- “Boot Support” on page 14

Kit Contents

- Sun Storage 6 Gb SAS ExpressModule HBA
- *Accessing Documentation* document

Note - The *Accessing Documentation* document in the HBA ship kit provides instructions on how to access Oracle HBA installation documentation. For information about accessing non-Oracle documents that are related to this HBA, see “[Related Third Party Documentation](#)” on page 7.

HBA Features

The Sun Storage 6 Gb SAS ExpressModule HBA (SGX-SAS6-EM-Z, SG-SAS6-EM-Z) provides eight serial Phys for connection to SAS and/or Serial ATA (SATA) devices. Each Phy

is capable of 1.5 Gb, 3 Gb, or 6 Gb SAS and SATA link rates. The PCI-Express interface is capable of 5 GT/s per lane in each direction. With eight fully duplexed links, the total becomes 80 GT/s. Note that actual transfer rates are a function of the host system environment. The card is packaged in a single-wide PCIe Module that conforms to the PCIe ExpressModule Electromechanical Specification, Rev. 1.0.

The HBA contains on-board Flash ROM for storing the firmware. The board also includes Hot Plug architecture which allows insertion and removal of the module when the system has been alerted via the Attention Switch. The light-emitting diodes (LEDs) on the HBA report a heartbeat, activity, and fault conditions when detected by the firmware. Fusion-MPT firmware operates the HBA.

The functionality of the HBA comes from the LSISAS2008 controller ASIC. The HBA connects up to eight direct connected SAS/SATA devices to a computer system through the PCIe ExpressModule interface. The HBA controller uses eight PCIe Phys.

The HBA supports the following features:

- 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
- Simplified cabling with a point-to-point, serial architecture
- Smaller and thinner cables that promote unrestricted airflow
- A serial, point-to-point, enterprise-level storage interface
- Data transfers using SCSI information units
- Compatibility with SATA target devices
- Narrow and wide ports (See [Table 1-1](#))

TABLE 1-1 6 Gb 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

- Hot-plug insertion in ExpressModule enclosures, as defined in the PCIe ExpressModule Electromechanical Specification, version 1.0
- Several LEDs routed through the front of the enclosure: an Activity LED and Fault LED for each mini-SAS connector, and a Power LED and Attention LED for the HBA

[Figure 1-1](#) depicts the physical features of the HBA.

FIGURE 1-1 Oracle's Sun Storage 6 Gb SAS ExpressModule HBA



Valid Drive Mix Configurations With HDDs and SSDs

The HBA supports connectivity using SATA II drives, SAS drives, or both. Within an enclosure (SAS expander), you can mix any drive types, subject to any restrictions imposed by the enclosure.

Operating System and Technology Requirements

The HBA requires the operating system (OS) and technology levels listed in [Table 1-2](#), at minimum.

TABLE 1-2 Supported Operating System/Technology Versions

Operating System/Technology	Recommended Versions (minimum) [†]
Oracle Solaris OS for the x86 (32-bit and 64-bit) platform	<ul style="list-style-type: none"> ■ Oracle Solaris 11.1 with SRU7 ■ Oracle Solaris 10 01/13 with patches 149176-02 and 145649-04, at minimum <p>To obtain the latest patches and SRUs, go to http://support.oracle.com</p>
Oracle Solaris OS for the SPARC (32-bit and 64-bit) platform	<ul style="list-style-type: none"> ■ Oracle Solaris 11.1 with SRU7 ■ Oracle Solaris 10 01/13 with patches 149175-02 and 145648-04, at minimum <p>To obtain the latest patches and SRUs, go to http://support.oracle.com</p>
Linux OS (64-bit)	<ul style="list-style-type: none"> ■ Red Hat Enterprise Linux (RHEL) 5.9 and 6.4 ■ SUSE Linux Enterprise Server (SLES) 11SP2 ■ Oracle Enterprise Linux 5.9 and 6.4 (Red Hat Compatible Kernel (RHCK) and Unbreakable Enterprise Kernel (UEK) 2, at minimum)
Virtual Machine OS	Oracle VM 3.2.1
Microsoft Windows OS (64-bit)	<ul style="list-style-type: none"> ■ Window Server 2008 R2 including SP1 (64-bit) ■ Windows Server 2012
VMware Technology	<ul style="list-style-type: none"> ■ VMware ESX/ESXi 5.0 ■ VMware ESX/ESXi 5.1

[†]Oracle supports the Oracle Solaris 10 10/09 OS with patches 142676-02 (x86) and 143523-02 (SPARC) as the minimum Oracle Solaris OS level. However, if issues occur with the HBA, Oracle Support requires that you update to the recommended OS levels listed in [Table 1-2](#).

System Interoperability

This section provides host platform, storage, and software support information. This section contains the following topics:

- [“Host Platform Support” on page 13](#)
- [“Storage System Support” on page 13](#)
- [“Software Support” on page 14](#)

Host Platform Support

The HBA is supported by the platforms listed in [Table 1-3](#). For up-to-date information, see your Oracle system product notes and web pages.

For supported operating system and technology versions, see [Table 1-2](#).

TABLE 1-3 Host Platform Support

Platform	Supported OS/Technology
Oracle SPARC Servers	
Sun Blade T6320	Oracle Solaris
Sun Blade T6340	Oracle Solaris
SPARC T3-1B	Oracle Solaris
SPARC T3-4	Oracle Solaris
SPARC T4-4	Oracle Solaris
SPARC T5-1B Server Module	Oracle Solaris
Oracle x86 Servers	
Netra 6000	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
Sun Fire X4800	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
Sun Blade X3-2B	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
Sun Blade X4-2B	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
Sun Blade X6270 M2	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
Sun Server X2-8	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows

Storage System Support

The HBA supports the following storage:

- Sun Storage F5100 Flash Array, 1.0, running version 5.4.5 Expander Firmware, at minimum
- LT04HH SAS 1U Rackmount
- LTO-3 HH 1U Rackmount Media Tray
- LTO-4HH Desktop
- LTO-4 HH 1U Rackmount Media Tray
- LTO-5HH Desktop

- LTO-5 HH 1U Rackmount Media Tray

Software Support

Install, Flash, and BIOS configuration utilities are provided. The HBA uses the Fusion-MPT architecture for all major operating systems, which allows for thinner drivers for better performance. To obtain the most up-to-date device drivers, firmware, and boot code that support your operating system, go to: <http://www.lsi.com/sep/Pages/oracle/index.aspx>

Boot Support

Booting through the HBA is supported in the following operating system and technology environments:

- Oracle Solaris 10 01/13 OS for the SPARC and x86 platforms
- Oracle Solaris 10 11.1 OS for the SPARC and x86 platforms
- RHEL 5.9 and 6.4 OSes
- SLES 11 SP2 OS
- Oracle Linux 5.9 and 6.4 OSes
- Oracle VM 3.2.1 OS
- Windows Server 2008 R2 including SP1 OS
- Windows Server 2012 OS
- ESX and ESXi Server, version 5.0 and 5.1 technology

Hardware Installation and Removal

This chapter explains how to install and remove the HBA. You do not need to turn off system power or disconnect power cords during the installation, since the enclosures fully support hot-plugging.

This chapter contains the following topics:

- [“Observing ESD and Handling Precautions” on page 15](#)
- [“Installing the HBA” on page 16](#)
- [“HBA LEDs” on page 19](#)
- [“Port to Phys Mapping” on page 21](#)
- [“Next Steps” on page 22](#)
- [“Removing the HBA” on page 22](#)

Observing ESD and Handling Precautions



Caution - Damage to the HBA can occur as the result of careless handling or electrostatic discharge (ESD). Always handle the HBA with care to avoid damage to electrostatic-sensitive components.

To minimize the possibility of ESD-related damage, use both a workstation antistatic mat and an ESD wrist strap. You can get an ESD wrist strap from any reputable electronics store or from Oracle as part number #250-1007.

Observe the following precautions to avoid ESD-related problems:

- Leave the HBA in its antistatic bag until you are ready to install it in the system.
- Always use a properly fitted and grounded wrist strap or other suitable ES protection when handling the HBA and observe proper ESD grounding techniques.
- Always hold the HBA by the metal enclosure.
- Place the HBA on a properly grounded antistatic work surface pad when it is out of its protective antistatic bag.

Installing the HBA

Before you start, read the instructions in this section as well as the installation instructions for the storage devices to be connected to the HBA. This section contains the following topics:

- “To Prepare for Hardware Installation” on page 16
- “To Install the HBA” on page 16

▼ To Prepare for Hardware Installation

1. **Read and observe the safety information for this product.**
2. **Make a backup of your data.**
3. **Familiarize yourself with the physical features of the HBA.**

See the Safety and Compliance documentation for this HBA.

See “HBA Features” on page 9.

4. **Ensure you have the proper cables for the HBA.**

The HBA has two external x4 mini-SAS connectors, each connecting to four 6 Gb SAS ports. You will need to use the appropriate cable to connect the HBA to SAS versus SATA storage devices.

For connection to external drives or backplanes, you must use an external cable with a standard mini-SAS connector (SFF-8088) on the controller side of the cable.

Use only Oracle-provided SAS cables. For more information or to purchase cables for your Oracle system, go to <http://www.oracle.com>. Cable connectors are keyed so that you cannot insert them incorrectly.

5. **Unpack the box containing the HBA in a static-free environment and inspect it for damage.**

Note - Leave the HBA in its protective bag until you are ready to install it. If there is damage, contact Oracle customer support.

▼ To Install the HBA

1. **Attach an ESD wrist strap and remove the HBA from its protective bag.**

See [“Observing ESD and Handling Precautions”](#) on page 15.

2. **Refer to your system installation or service manual to determine how to locate an empty PCIe ExpressModule slot in which you can insert the HBA.**
3. **Grasp the button (the latching mechanism at the end of the ejection lever) on the front of the HBA and pivot the lever downward.**
4. **Insert the HBA into an available PCIe ExpressModule slot in the chassis, as shown in [Figure 2-1](#).**

FIGURE 2-1 Installing the HBA into a PCIe Slot

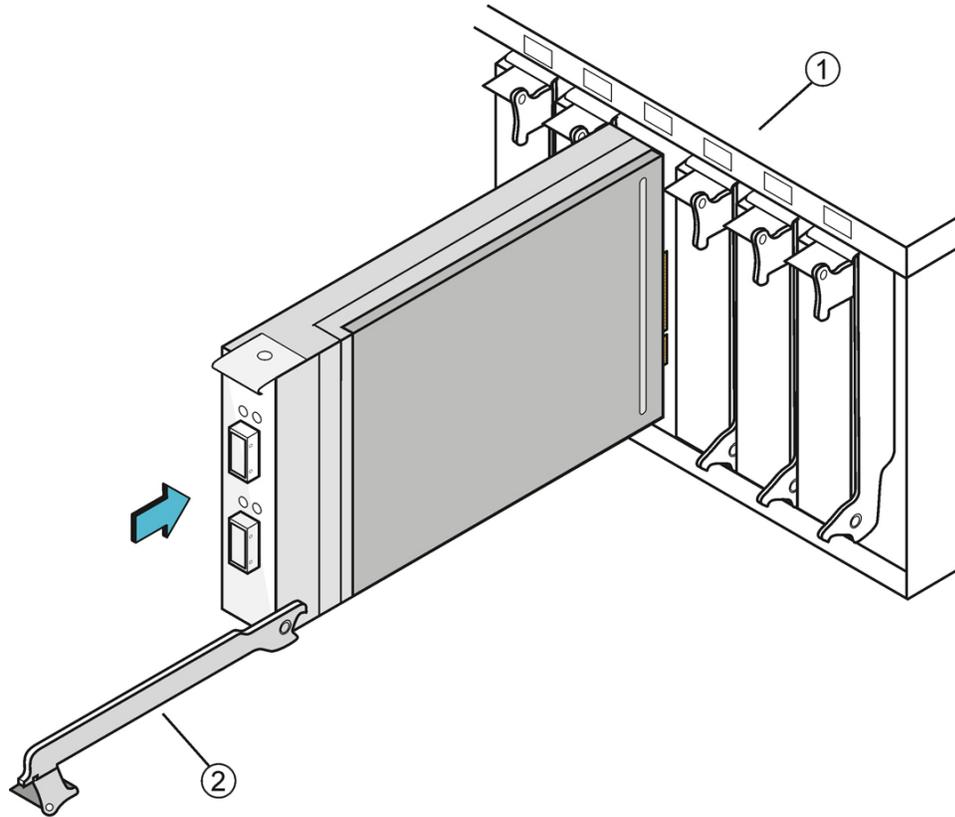


Figure Legend

- 1 Chassis
- 2 Ejection Lever (Open)

Note - The configuration of the enclosure in your system might not be the same as shown in this illustration.

5. **When the HBA is fully inserted in the slot, pivot the ejection lever up to the locked position.**

- 6. Connect SAS cables to the two external x4 mini-SAS connectors and attach the other end of the cables to the disk drives or other SAS/SATA devices, per your requirements.**

Use only Oracle-provided SAS cables (530-3887-01), available for purchase at: <http://www.oracle.com>

- 7. Observe the LEDs to ensure normal operation of the HBA.**

For more information about the LEDs, see “HBA LEDs” on page 19.

HBA LEDs

There are six LEDs on the front of the enclosure. For each port, there is one green Activity LED and one yellow Fault LED that indicate any activity or fault of a Phy in that port. There is also one green Power LED and one yellow Attention LED on the HBA. The Power and Attention LEDs are both controlled by the host system and show through the PCIe ExpressModule enclosure and functionality (see [Table 2-1](#)).

FIGURE 2-2 External Connectors and LEDs.

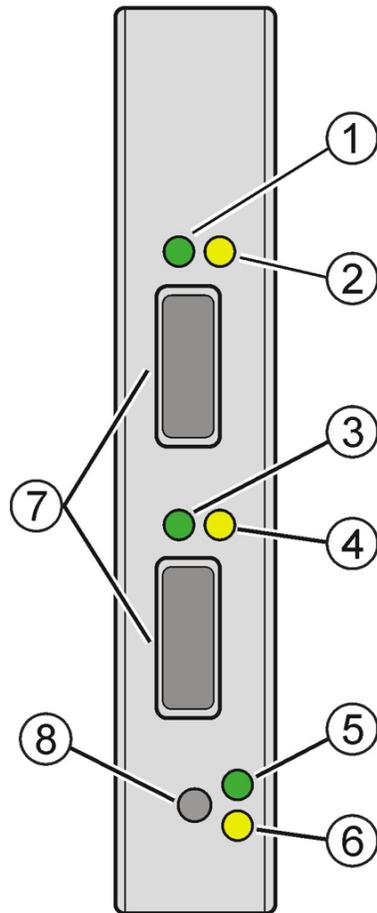


Figure Legend

- 1 Port 1 Activity Green LED
- 2 Port 1 Fault Yellow LED
- 3 Port 2 Activity Green LED
- 4 Port 2 Fault Yellow LED
- 5 Green Power LED
- 6 Yellow Attention LED
- 7 Mini SAS Connectors, or Ports (Port 1 on top and Port 2 below)
- 8 Attention Button

The different states of the Attention and Power LEDs are listed in [Table 2-1](#)

TABLE 2-1 Attention and Power LEDs for the HBA

State	Meaning
Attention LED	
Off	Operations are normal.
On	There are operational problems at the slot.
Blinking	The slot is being identified at the request of the user.
Power LED	
Off	Insertion or removal of the HBA is permitted.
On	Insertion or removal of the HBA is not permitted.
Blinking	Removal of the HBA is not permitted because a hot-plug operation is in progress.

Port to Phys Mapping

[Figure 2-2](#) shows the location of ports 1 and 2 on the HBA. When connecting phys to the HBA ports, ensure you connect to the correct port:

- Phys 4-7 connect to port 1.
- Phys 0-3 connect to port 2.

▼ To Complete the Installation

1. **Refer to your system installation or service manual for instructions on how to replace the system cover, reconnect the AC power cords, and turn power on to the system, if required.**

Note - If you do need to return power to the system, ensure 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 system. If the system is powered up before these devices, the devices might not be recognized.

2. **If you need to install an OS on your system, complete the procedures in [Chapter 3, “Creating a Bootable Drive in a Preboot Environment”](#), and then go to the next step.**

3. **If you already have an OS installed on an x86 system, during the power-up process of the system, review the BIOS bootup messages and look for the LSI BIOS initialization banner and the BIOS utility prompt (pressing `ctrl+c`).**

If you see the banner and are prompted for the utility, it means the BIOS has detected the HBA card.

4. **If you already have an OS installed on a SPARC system, during the power-up process of the system, use the `probe-scsi-all` command at the OpenBoot Prom (OBP) `ok` prompt to verify that the system recognizes the HBA.**

The `probe-scsi-all` command displays the SCSI devices that are connected to the host, as shown in the following example.

```
{0} ok probe-scsi-all
/pci@0/pci@0/pci@8/pci@0/pci@a/LSI,sas@0
MPT Version 2.00, Firmware Version 4.00.00.00
Target 9
  Unit 0   Disk      SEAGATE ST914602SSUN146G0603   286739329 Blocks, 146 GB
  SASAddress 5000c5000b305b4d   PhyNum 0
Target a
  Unit 0   Disk      SEAGATE ST914602SSUN146G0603   286739329 Blocks, 146 GB
  SASAddress 5000c5000b304cad   PhyNum 1
Target b
  Unit 0   Disk      HITACHI H101414SCSUN146GSA23   286739329 Blocks, 146 GB
  SASAddress 5000cca000310015   PhyNum 2
Target c
  Unit 0   Disk      HITACHI H101414SCSUN146GSA23   286739329 Blocks, 146 GB
  SASAddress 5000cca0002cf035   PhyNum 3
{0} ok
```

This example shows a SAS 2 controller (`LSI,sas@0`) connected to four physical drives.

Next Steps

Install any software required by the HBA, specific to your operating system, as described in [Chapter 4, “HBA Software Installation”](#).

Removing the HBA

If you need to remove the HBA, for any reason, follow these steps:

▼ To Remove the HBA

1. **Prepare your operating system for HBA removal.**
2. **Attach an ESD wrist strap.**
See [“Observing ESD and Handling Precautions”](#) on page 15.
3. **Disconnect all SAS cables from the external mini-SAS connectors.**
4. **Press the Attention button on the exposed end of the HBA (see [Figure 2-2](#)).**
5. **When the green Power LED next to the Attention button goes out, pull the ejection lever downward.**

Note - If you decide after pressing the Attention button that you do not want to remove the HBA, you can cancel the operation by pressing the button again within 5 seconds of when the power LED starts blinking.

6. **Pull the HBA out of its slot in the enclosure.**

Creating a Bootable Drive in a Preboot Environment

This chapter describes how to use the HBA for your boot device prior to installing an operating system (OS) on the system.

Note - If you are installing the HBA into a system that already has an OS installed, do not perform any procedures in this chapter. Instead, complete the HBA installation, as described in [“To Complete the Installation” on page 21](#).

This chapter contains the following topics:

- [“Overview of Creating a Bootable Drive in a Preboot Environment” on page 25](#)
- [“Creating a Bootable Drive \(SPARC\)” on page 26](#)
- [“Creating a Bootable Drive \(x86\)” on page 28](#)
- [“Validating the Oracle Solaris Labels of the HBA Drives” on page 33](#)
- [“Installing the Oracle Solaris OS” on page 35](#)

Overview of Creating a Bootable Drive in a Preboot Environment

You can choose to install the HBA into a system that does not yet have an OS installed. You can then install the OS onto a physical drive to enable you to boot from the HBA. On a SPARC system, you would perform these actions through the OpenBoot Prom (OBP) environment. On an x86 system, you would do so through the BIOS Configuration utility.

Note - Entering the BIOS Configuration utility (even if you make no changes in the utility) might cause the system boot order list, provided by the system BIOS, to reset. To ensure that the boot order is accurate after exiting the utility, access the server mainboard BIOS during the next reboot of the system. Review the boot order list to verify that the order is correct, and make any changes, if necessary. This will occur each time you enter the utility.

Based on the type of system in which you are installing the HBA, follow the procedures in one of the following sections:

- **If you are installing the HBA into a SPARC system**, go to [“Creating a Bootable Drive \(SPARC\)” on page 26](#).
- **If you are installing the HBA into an x86 system**, go to [“Creating a Bootable Drive \(x86\)” on page 28](#).

Creating a Bootable Drive (SPARC)

Follow these steps to create a bootable drive in a preboot environment on an SPARC system:

▼ To Create a Bootable Drive (SPARC)

1. **Determine a drive on which you want to install the Oracle Solaris OS**, as described in [“Using the OBP Environment to Set Up a Bootable Drive \(SPARC\)” on page 26](#).
2. **Create an alias for the selected drive and make the drive bootable**, as described in [“Creating an Alias for a Bootable Drive \(SPARC\)” on page 27](#).

Using the OBP Environment to Set Up a Bootable Drive (SPARC)

This section describes how to use the OBP environment to select a drive that you can use as your boot drive upon which to install the Oracle Solaris OS. This section contains the following topic:

- [“To Prepare to Create a Bootable Drive \(SPARC\)” on page 26](#)

▼ To Prepare to Create a Bootable Drive (SPARC)

1. **At an xterm or gnome terminal window, enter the OBP environment by doing one of the following:**
 - **Press STOP+A on a Sun keyboard from Oracle.**
 - **Issue a break from a remote console.**

2. Use the `show-devs` command to list the device paths on the system and select the device path for the HBA.

The `mpt_sas`-based controllers will end with `LSI, sas@number`.

```
{0} ok show-devs
<...>
/pci@1e,600000/pci@0/pci@3/LSI, sas@0
/pci@1e,600000/pci@0/pci@3/LSI, sas@0/disk
/pci@1e,600000/pci@0/pci@3/LSI, sas@1
<...>
```

3. Use the `select` command to select the HBA card.

```
{0} ok select /pci@1e,600000/pci@0/pci@3/LSI, sas@0
```

4. If you were able to determine and select the card that you wanted in the previous step, skip to [Step 5](#). Otherwise, if more than one of the `mpt_sas`-based cards is displayed in the `show-devs` output, use the `select` and `.properties` commands to determine which card you want and then select that card.

```
{0} ok select /pci@1e,600000/pci@0/pci@3/LSI, sas@0
{0} ok .properties
...
subsystem-id          000031c0
```

The ExpressModule facing cards contain a subsystem-ID of `000031c0`. To further specify the card, you can also display the SAS addresses of any connected drives by using the `show-children` command.

5. Go to [“Creating an Alias for a Bootable Drive \(SPARC\)” on page 27](#).

Creating an Alias for a Bootable Drive (SPARC)

This section describes how to create an alias for the drive that you selected in [“To Prepare to Create a Bootable Drive \(SPARC\)” on page 26](#). This section contains the following topic:

- [“To Create an Alias for a Bootable Drive \(SPARC\)” on page 27](#)

▼ To Create an Alias for a Bootable Drive (SPARC)

1. Use the `nvalias alias-name HBA-drive-path/disk` command to create an alias for the drive that you selected in [Step 3](#) (you can press `ctrl+Y` to paste the device path).

Creating an alias for the drive helps simplify the process of booting the drive later. In the following example, the alias name is `mydev`.

```
{0} ok nvalias mydev /pci@1e,600000/pci@0/pci@3/LSI,sas@0/disk
```

2. You can now boot from the drive by using the `boot alias-name` command.

```
{0} ok boot mydev
```

3. To optionally add the drive to the boot-device list and then automatically boot from the drive by controlling the boot device order, issue the following commands, as shown.

```
{0} ok printenv boot-device  
boot-device = disk0 disk1  
{0} ok setenv boot-device mydev disk0  
boot-device = mydev disk0
```

In this example, the `mydev` alias is set as `disk0`, the first disk in the boot device list. This results in the automatic booting of the bootable drive, `/pci@1e,600000/pci@0/pci@3/LSI,sas@0/disk`.

Next Steps

Validate the label of the bootable drive that you created (See [“Validating the Oracle Solaris Labels of the HBA Drives”](#) on page 33).

Creating a Bootable Drive (x86)

Follow these steps to create a bootable drive in a preboot environment on an x86 system.

▼ To Create a Bootable Drive (x86)

1. Set up the bootable drive using the BIOS Configuration utility, as described in [“Using the BIOS Configuration Utility to Set Up a Bootable Drive \(x86\)”](#) on page 29.
2. Select the drive that you set up in [Step 1](#) to be the bootable drive from which to boot, as described in [“Selecting a Bootable Drive \(x86\)”](#) on page 32.

Using the BIOS Configuration Utility to Set Up a Bootable Drive (x86)

This section describes how to use the BIOS Configuration utility to set up a drive on an x86 system prior to installing an OS on the system. You can then use the drive as your boot drive upon which to install the OS. This section contains the following topics:

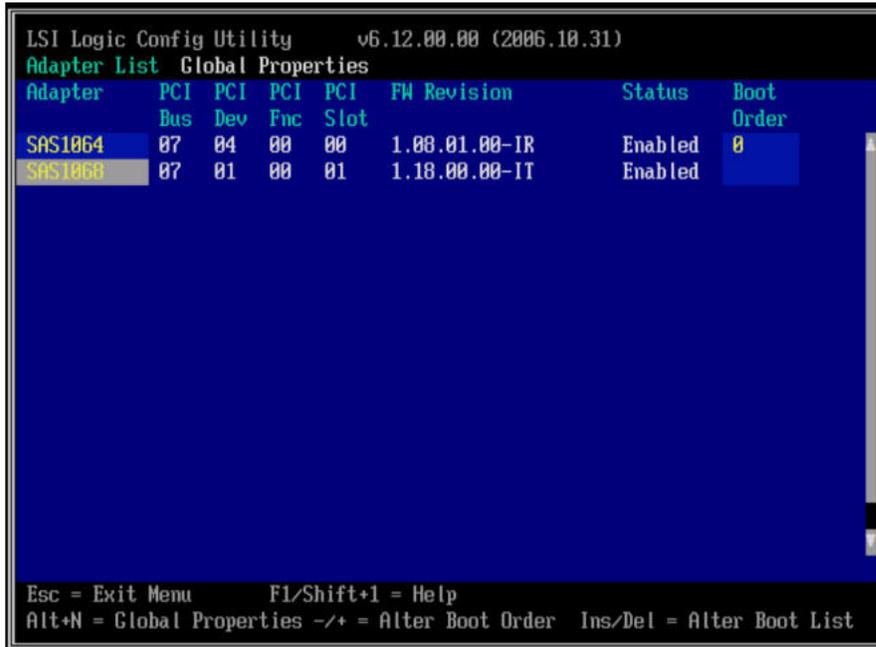
- [“To Prepare to Use the BIOS Configuration Utility” on page 29](#)

▼ To Prepare to Use the BIOS Configuration Utility

1. **From the Integrated Lights Out Manager (ILOM) software or Video Graphics Array (VGA) video port, access the system console.**
2. **Initiate a system boot.**
During the boot process, the BIOS initialization banner lists information about the discovered SAS adapters and devices that are attached to the discovered HBAs in the system.
3. **Upon seeing the prompt, Press Ctrl-C to start LSI Corp Configuration Utility..., immediately press ctrl+c to access the LSI Corp Config Utility menu.**

The LSI Corp Config Utility menu is displayed (see [Figure 3-1](#)).

FIGURE 3-1 LSI Corp Config Utility Menu



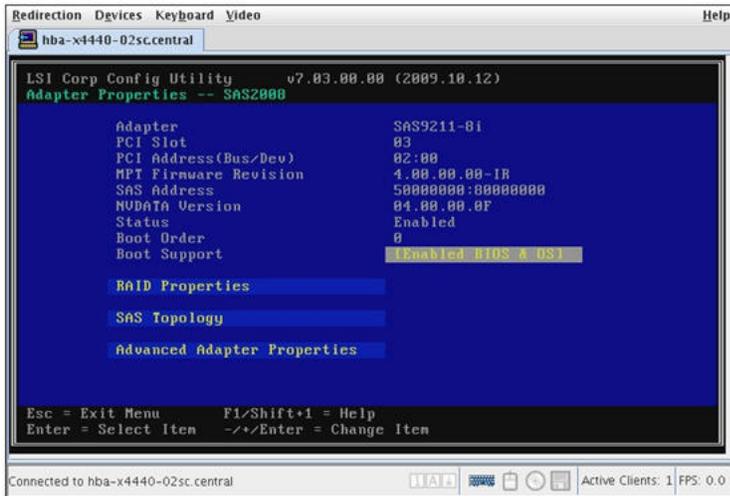
4. To change the boot options, use the arrow keys to navigate to the Boot Order field, and use the keys on your keyboard to change the values.

Key	Function
Insert	Enables booting
Del	Disables booting
Plus (+)	Increases the numeric value in order to change the boot order
Minus (-)	Decreases the numeric value in order to change the boot order

5. To change other options, use the arrow keys to navigate to the Adapter (HBA) that you want, and press Enter.

The Adapter Properties screen is displayed for the selected HBA (see [Figure 3-2](#)).

FIGURE 3-2 Adapter Properties Screen



6. Use the arrow keys to navigate to the Advanced Adapter Properties field, and press Enter.

The Advanced Adapter Properties screen is displayed.

7. Navigate to the Maximum INT 13 Devices for this Adapter field and press Enter to change the field value from 0 to the value of 1 or 2.

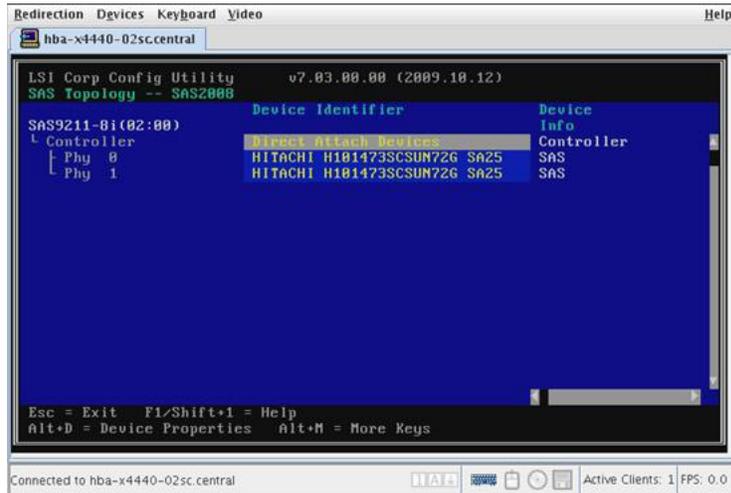
This field specifies the number of devices that the HBA will export to the system BIOS for boot. Changing the value to a low number (such as a value of 1 or 2) simplifies boot maintenance.

8. Press Enter to save your changes and press the Esc key twice to return to the Adapter Properties screen.

9. To view the devices and logical volumes attached to the HBA, use the arrow keys to navigate to the SAS Topology field, and press Enter.

The SAS Topology screen is displayed (see [Figure 3-3](#)).

FIGURE 3-3 SAS Topology Screen



You can now use the BIOS Configuration utility to set up a bootable drive, as described in [“To Select a Bootable Drive \(x86\)”](#) on page 32.

Selecting a Bootable Drive (x86)

After preparing to use the BIOS Configuration utility (as described in [“To Prepare to Use the BIOS Configuration Utility”](#) on page 29), you can select the bootable drive on which to install the OS on an x86 system. This section contains the following topic:

- [“To Select a Bootable Drive \(x86\)”](#) on page 32

▼ To Select a Bootable Drive (x86)

1. From the Adapter Properties screen ([Figure 3-3](#)), navigate to the SAS Topology field, and press Enter.

The SAS Topology screen is displayed.

2. Navigate to the device that you want, and press Alt+B to select the device as the primary boot device.

3. **If you want an alternate boot device, navigate to the device that you want, and press Alt+A.**
4. **Confirm the changes you have made, save the configuration, and then press Esc to exit out of the utility.**

Note - Additional boot devices for the HBA might be present in the system BIOS as possible disk selections. However, these devices are not guaranteed to be consistent through storage configuration changes.

Next Steps

Validate the label of the bootable drive that you created (See [“Validating the Oracle Solaris Labels of the HBA Drives”](#) on page 33).

Validating the Oracle Solaris Labels of the HBA Drives

Note - You do not need to perform the steps in this section if you installed the HBA in a system that has an OS other than the Oracle Solaris OS installed.

This section describes how to verify the Oracle Solaris labels of any physical raw drives that are attached to the HBA. The drives must have valid Oracle Solaris labels in order to be recognized by the Oracle Solaris OS. Sometimes, logical drives need to be relabeled using the `format` command (in the case of SPARC systems) or the `fdisk` command (in the case of x86 systems) in order to be recognized. This section contains the following topic:

- [“To Verify That the Oracle Solaris Label of a Drive is Valid”](#) on page 33

▼ To Verify That the Oracle Solaris Label of a Drive is Valid

Note - For your reference, this section provides an example procedure for a SPARC system that runs the Oracle Solaris OS. For an x86 system that runs a supported OS, you would use the `fdisk` command for that OS to verify the label of a disk. For more information about labeling disks using the `fdisk` command, see the documentation for your OS.

1. Become a root user on the system and issue the format command.

```
# format
Searching for disks...done
AVAILABLE DISK SELECTIONS:
 0. c1t0d0 <DEFAULT cyl 24611 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450a/pci17c2,10@4/sd@0,0
 1. c1t1d0 <DEFAULT cyl 24810 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450a/pci17c2,10@4/sd@1,0
 2. c3t8d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@8,0
 3. c3t9d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@9,0
 4. c3t10d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@a,0
 5. c3t11d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@b,0
 6. c3t12d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@c,0
 7. c3t13d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@d,0
Specify disk (enter its number):
```

2. When prompted, type the number of a disk drive that is attached to the newly installed HBA card, and press Enter.

The Format menu is displayed.

```
# format
Searching for disks...done
AVAILABLE DISK SELECTIONS:
 0. c1t0d0 <DEFAULT cyl 24611 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450a/pci17c2,10@4/sd@0,0
 1. c1t1d0 <DEFAULT cyl 24810 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450a/pci17c2,10@4/sd@1,0
 2. c3t8d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@8,0
 3. c3t9d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@9,0
 4. c3t10d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@a,0
 5. c3t11d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@b,0
 6. c3t12d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@c,0
 7. c3t13d0 <DEFAULT cyl 24619 alt 2 hd 27 sec 107>
   /pci@0,0/pci1022,7450b/pci1000,10c0@1,1/sd@d,0
Specify disk (enter its number): 2
selecting c3t8d0
[disk formatted]
```

3. **If you see a Disk not labeled. Label it now? message, type y to label the selected disk.**
4. **Type q twice to exit the utility.**

```

FORMAT MENU:
  disk - select a disk
  type - select (define) a disk type
  partition - select (define) a partition table
  current - describe the current disk
  format - format and analyze the disk
  fdisk - run the fdisk program
  repair - repair a defective sector
  label - write label to the disk
  analyze - surface analysis
  defect - defect list management
  backup - search for backup labels
  verify - read and display labels
  save - save new disk/partition definitions
  inquiry - show vendor, product and revision
  scsi - independent SCSI mode selects
  cache - enable, disable or query SCSI disk cache
  volname - set 8-character volume name
  !<cmd> - execute <cmd>, then return
  quit
format> q
#

```

Next Steps

If you are installing the HBA in a SPARC system, install the Oracle Solaris OS, as described in [“Installing the Oracle Solaris OS” on page 35](#).

If you are installing the HBA in an x86 system, install a supported OS (for a list of supported OSs, see [“Operating System and Technology Requirements” on page 12](#)). If you plan to install the Oracle Solaris OS on an x86 system, follow the instructions in [“Installing the Oracle Solaris OS” on page 35](#).

Installing the Oracle Solaris OS

You can install the Oracle Solaris 10 01/13 OS, at minimum, on the bootable drive that you created, as described in this chapter. Starting with the Oracle Solaris 10 01/13 OS, the driver required by the HBA is provided with the Oracle Solaris OS.

This section provides general instructions on how to install the Oracle Solaris 10 OS. This section contains the following topics:

- [“To Prepare to Install the Oracle Solaris OS” on page 36](#)
- [“To Install the Oracle Solaris OS” on page 36](#)

▼ To Prepare to Install the Oracle Solaris OS

- Ensure that you have a bootable drive upon which to install the Oracle Solaris OS, as described in this chapter.

▼ To Install the Oracle Solaris OS

1. Obtain the Oracle Solaris 10 01/13 OS, at minimum, from the download site:

<http://www.oracle.com/technetwork/server-storage/solaris10/overview/index.html>

2. Perform a normal installation, as described in the Oracle Solaris 10 installation documentation.

3. Apply any patches that are specifically required for the system.

You can obtain these Oracle Solaris patches at:

<http://support.oracle.com>

4. Reboot the system.

```
# reboot
```

The system will now be able to see, and boot from, the logical drive on which you installed the Oracle Solaris OS.

5. Continue with the HBA installation, as described in [“To Complete the Installation” on page 21](#).

◆◆◆ CHAPTER 4

HBA Software Installation

After you have completed the hardware installation and powered on the system, follow the instructions listed in this chapter for your operating system to install the HBA driver and any other utilities required for the installation.

This chapter contains the following topics:

- “Installing the Oracle Solaris Driver and Firmware” on page 37
- “Installing the Linux Driver and Firmware” on page 38
- “Installing the Windows Server Driver and Firmware” on page 38
- “Installing the VMware Driver and Firmware” on page 39

Installing the Oracle Solaris Driver and Firmware

The latest driver (`mpt_sas`) for this HBA is included as part of the Oracle Solaris 10 01/13 OS and the Oracle Solaris 11.1 OS. You can obtain the latest version of the Oracle Solaris OS at:

<http://www.oracle.com/technetwork/server-storage/solaris10/overview/index.html>

The HBA requires the the following patches and SRUs, at minimum, for the driver to work:

- **Oracle Solaris 10 01/13 (for the SPARC environment):** patches 149175-02 and 145648-04
- **Oracle Solaris 10 01/13 (for the x86 environment):** patches 149176-02 and 45649-04
- **Oracle Solaris 11.1:** SRU 7

You can obtain these Oracle Solaris patches at:

<http://support.oracle.com>.

Firmware Updates

The Oracle Solaris firmware and boot code update for the HBA, along with any accompanying documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Installing the Linux Driver and Firmware

Consult your system documentation to determine which Linux releases are supported on your specific system.

The Linux driver required to run the HBA with the Linux OS is available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

▼ To Install the Linux Driver

1. **Log in to the host.**
2. **In a browser, go to <http://www.lsi.com/sep/Pages/oracle/index.aspx>.**
3. **Select the model of the HBA that you want (SG(X)-SAS6-EM-Z).**
4. **Select and download the Linux driver that is supported by the Linux release (Red Hat Enterprise Linux, SuSE Linux Enterprise Server, or Oracle Linux) on your system.**
5. **Select and download the corresponding Readme file for the Linux driver, and follow the instructions in the Readme file to complete the driver installation.**

Firmware Updates

The Linux firmware and boot code update for the HBA, along with any accompanying documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Installing the Windows Server Driver and Firmware

Consult your system documentation to determine which Windows releases are supported on your specific system.

The Windows Server driver required to run the HBA is available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

▼ To Install the Windows Driver

1. **Log in to the host.**
2. **In a browser, go to <http://www.lsi.com/sep/Pages/oracle/index.aspx>.**
3. **Select the type and then model of the HBA that you want (SG(X)-SAS6-EM-Z).**
4. **Select and download the specific Windows driver that is supported by the Windows release on your system.**
5. **Select and download the corresponding Readme file for the Windows driver, and follow the instructions in the Readme file to complete the driver installation.**

Firmware Updates

The Linux firmware and boot code update for the HBA, along with any accompanying documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Installing the VMware Driver and Firmware

The HBA driver is included as part of the VMware ESX Server installation. The VMware ESX Server installation requires nothing from the user.

Known Issues

This chapter provides supplementary and workaround information about the HBA. Specific bug identification numbers are provided for service personnel.

This chapter contains the following topics:

- [“MegaRAID Storage Manager GUI-Related Issues” on page 41](#)
- [“Storage-Related Issues” on page 43](#)

MegaRAID Storage Manager GUI-Related Issues

This section contains the following topics:

- [“Cannot Hotplug the HBA Card Through the MSM GUI” on page 41](#)
- [“Cannot Assign a Global Hot Spare Through the MSM GUI” on page 42](#)
- [“Cannot Upgrade Firmware on the HBA Through the MSM GUI” on page 42](#)
- [“Cannot Reboot After Upgrading Firmware on the HBA ” on page 42](#)

Cannot Hotplug the HBA Card Through the MSM GUI

Bugs 15700904, 15757240

Issue: If the MegaRAID Storage Manager (MSM) software is installed on the system, and the MSM software services are running, you cannot perform hotplug remove and insert operations on the HBA. When attempting to perform such an operation, a popup window is displayed stating that the HBA card is busy and that you must close the program that is accessing the card.

Workaround: Use the Task Manager application to stop the following MSM software services:

- MSMFramework
- MegaMontiorSrv

After you have stopped these services, you can perform HBA card hotplug operations. You can restart the MSM software services after the hotplug operations are complete.

Cannot Assign a Global Hot Spare Through the MSM GUI

Bug 15762780

Issue: From the MegaRAID Storage Manager (MSM) graphical user interface (GUI), after creating a drive using 2 hard disks, the option to create a global hot spare from a third hard drive becomes inactive.

Workaround: Assigning global hot spares is not supported through the MSM GUI. Instead, use the SAS2IRCU utility to assign global hot spares. You can obtain the SAS2IRCU utility from the Oracle support area of the LSI web site:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Cannot Upgrade Firmware on the HBA Through the MSM GUI

Bug 15664024

Issue: The firmware level on the HBA remains the same after using the MegaRAID Storage Manager software to upgrade the firmware. You might also encounter a message that states the update failed.

Workaround: Upgrading firmware through the MegaRAID Storage Manager software is not supported for this HBA. To upgrade firmware on the HBA, use the SAS2IRCU utility. You can obtain the SAS2IRCU utility from the Oracle support area of the LSI web site:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Cannot Reboot After Upgrading Firmware on the HBA

Bug 15637402

Issue: The MegaRAID Storage Manager (MSM) software provides a feature for upgrading firmware on the HBA. If you attempt to upgrade the HBA firmware using this MSM feature,

the OS might not boot if the boot disk is installed on a drive that is connected to the newly upgraded HBA.

Workaround: Reboot the system two times after the firmware upgrade. For future upgrades, do not use the MSM software. Instead, upgrade the HBA firmware through the SAS2IRCU utility. You can obtain the SAS2IRCU utility from the Oracle support area of the LSI web site:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Storage-Related Issues

This section contains the following topics:

- [“Only 24 Devices Are Displayed In The System BIOS Boot List” on page 43](#)
- [“Kernel Panic During Oracle Solaris Operating System Installation” on page 43](#)
- [“The Oracle Solaris OS Installation Hangs” on page 44](#)
- [“The System Hangs After Deleting a RAID Volume” on page 44](#)

Only 24 Devices Are Displayed In The System BIOS Boot List

Bug 15648283

Issue: If you install multiple HBA cards in an x86 system, the total number of devices populated across all cards can be no more than 24. Additional devices will not be displayed in the system BIOS boot list.

Workaround: None. This is an architectural and implementation limitation of the HBA.

Kernel Panic During Oracle Solaris Operating System Installation

Bug 15757220

Issue: After removing and reinserting drives connected to the HBA, and then performing an Oracle Solaris operating system (OS) installation on a volume configured on the HBA, a kernel panic might occur during the “Configuring Devices” portion of the OS installation process.

Workaround: Verify that the volume on which you plan to install the OS is not a resyncing RAID 1 or RAID 10 volume. To prevent panics, ensure that the volume is in optimal mode, rather than resync mode, prior to installing the OS.

The Oracle Solaris OS Installation Hangs

Bug 15761911

Issue: If you use the graphical user interface (GUI) mode to install the Oracle Solaris operating system (OS), and you install the OS onto a volume configured on the HBA, the OS installation might hang during the “detecting locale” portion of the OS installation.

Workaround: Verify that the volume on which you plan to install the OS is not a resyncing RAID 1 or RAID 10 volume. To prevent hangs, ensure that the volume is in *optimal* mode, rather than *resync* mode, prior to installing the OS.

The System Hangs After Deleting a RAID Volume

Bug 15764098

Issue: If you delete a RAID volume configured on this HBA, and that volume is in *resync* mode, the system in which the HBA is installed might hang..

Workaround: When you need to delete a RAID volume that is configured on the HBA, verify that the volume is in *optimal* mode, not in *resync* mode. If the volume is resyncing, wait to delete the volume until after the resync process is complete.

HBA Specifications

This appendix contains the specifications for the HBA. The appendix contains the following topics:

- [“Physical Characteristics” on page 45](#)
- [“PCI Performance” on page 45](#)
- [“SAS Port Bandwidths” on page 46](#)
- [“Environmental Requirements” on page 46](#)
- [“HBA Connectors” on page 47](#)

Physical Characteristics

The HBA board enclosure is 6.25 in. x 4.50 in. (not including the ejection lever). The enclosure conforms to the PCIe ExpressModule Electromechanical Specifications.

PCI Performance

The PCI Express features of the HBA include the following:

- 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
- Supports lane reversal and polarity inversion
- Supports PCI Express Hot-Plug and 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 when there is no link activity
 - Contains a replay buffer that preserves a copy of the data for retransmission in case a cyclic redundancy check (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 nonposted transactions
- Provides quality of service (QOS) link configuration and arbitration policies
- Supports traffic class 0 and class 1 virtual channels
- 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

SAS Port Bandwidths

The HBA supports narrow and wide ports, as described in [Table A-1](#).

TABLE A-1 6 Gb 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

Environmental Requirements

The HBA environmental requirements are listed in [Table A-2](#).

TABLE A-2 HBA Environmental Specifications

Specification	Operating	Non-Operating
Temperature	<ul style="list-style-type: none"> ■ +10°C to +60°C without battery backup unit ■ +10°C to +44.8°C with iBBU battery backup 	<ul style="list-style-type: none"> ■ -30°C to +80°C without battery backup unit ■ 0°C to +45°C with iBBU battery backup

Specification	Operating	Non-Operating
Humidity	5% to 90% RH, non-condensing, 40°C max, 27°C max wet bulb, 16-hour dwells at extreme	93% RH, non-condensing, 40°C max, 120 hours
Altitude	3200m at 40°C, 4-hour dwells	12,200 m at 0°C, 4-hour dwells
Vibration	0.25 G in all axes swept for 5-500-5 Hz, 5 sweeps in all at 1 octave/min	1.2 G in all axes swept for 5-500-5 Hz, 5 sweeps in all at 1 octave/min
Shock	5.5 G, 11 ms half-sine, 10 shocks in x-, y-, and z-axes	33 G, 11 ms half-sine, 3 shocks in x-, y-, and z-axes
Airflow	At least 200 linear feet per minute (LFPM)	At least 200 linear feet per minute (LFPM)

HBA Connectors

This section provides a description of the different connectors on the host bus adapter.

- PCIe Connector (J6). Supports x8 interface. The PCIe connection is through the edge connector, J6, which provides connections on both the top (J6B) and the bottom (J6A) of the board. The signal definitions and pin numbers conform to the PCIe ExpressModule Card Electromechanical Specifications, Revision 1.0.
- UART Connector (J5). Debug port requiring a special cable and Oracle support to gather detailed IOC status.
- SAS/SATA Connectors (J3 and J7). Supports SAS connections through connectors J3 and J7. These connectors are SFF-8088 mini-SAS, external connectors.

[Table A-3](#) lists the UART connection Pins on the HBA.

TABLE A-3 UART Connections

Pin	Function
1	UART_TX
2	GND
3	UART_RX
4	3.3 V

Glossary

A, B

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.

C

configuration Refers to the way a computer is set up, the combined hardware components (computer, monitor, keyboard, and peripheral devices) that comprise a computer system, or the software settings that enable the hardware components to communicate with each other.

D

device driver A program that enables 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.

E

EEPROM Acronym for electronically erasable programmable read-only memory. It is a memory chip that typically stores configuration information, as it provides stable storage for long periods without electricity and can be reprogrammed. Refer to NVRAM.

external SAS device A SAS device installed outside the computer cabinet. These devices are connected using specific types of shielded cables.

F

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.

G, H

host The computer system in which a RAID adapter is installed. It uses the RAID adapter 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.

host bus adapter A piece of hardware that connects a host to network and storage devices.

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 adapter.

When a drive fails, the adapter 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.

I

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

J, K, L, M

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

N

NVRAM Acronym for nonvolatile random access memory. An EEPROM (electronically erasable read-only memory) chip that stores configuration information. Refer to EEPROM.

O, P

PCI Acronym for peripheral component interconnect. A high-performance, local bus specification that enables the connection of devices directly to computer memory. The PCI Local Bus enables 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 enables 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 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 enable concurrent data transmission in both the receive and the transmit directions.

Q, R, S

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 adapters leverage a common electrical and physical connection interface that is compatible with Serial ATA. The SAS adapters support the ANSI Serial Attached SCSI Standard, Version 2.0. In addition, the adapter 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 adapter is a versatile adapter that provides the backbone of both server and high-end workstation environments. Each port on the SAS RAID adapter 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 adapters (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 enable 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 adapter can function as an SMP initiator.
- spanning** A method for combining multiple drives into a single logical drive. If you want to have all of the drive capacity in one drive group, you can span (merge) the drives so that the operating system sees just one large drive. For more information, refer to the *MegaRAID SAS Software User's Guide*, located at: <http://www.lsi.com/sep/Pages/oracle/index.aspx>.
- SSP** Acronym for Serial SCSI Protocol. SSP enables communication with other SAS devices. Each PHY on the SAS adapter 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 adapter can function as an STP initiator.
- stripe size** The total drive space consumed by a stripe not including a parity drive. For example, consider a stripe that contains 64 Kbytes of drive space and has 16 Kbytes of data residing on each drive in the stripe. In this case, the stripe size is 64 Kbytes and the stripe element size is 16 Kbytes. The stripe depth is four (four drives in the stripe). You can specify stripe sizes of 8 Kbytes, 16 Kbytes, 32 Kbytes, 64 Kbytes, 128 Kbytes, 256 Kbytes, 512 Kbytes, or 1 Mbyte for each logical 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.

T, U, V

- virtual drive** A storage unit created by a RAID controller from one or more drives. Although a virtual drive may be created from several drives, it is seen by the operating system as a single drive. Depending on the RAID level used, the virtual drive can retain redundant data in case of a drive failure.

W, X, Y, Z