Oracle® Exadata Storage Server X5-2 Extreme Flash Service Manual

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Oracle Exadata Storage Server X5-2 Extreme Flash Service Manual

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Contents

Using This Documentation 11
Product Documentation Library 11
Feedback 11

About the Oracle Exadata Storage Server X5-2 Extreme Flash 13
Product Description 13
About Controls and Connectors 14
Front Panel Components 15
Rear Panel Components and Cable Connections 16
About System Components 17
Illustrated Parts Breakdown 17
Replaceable Components 19

Troubleshooting and Diagnostics 21
Troubleshooting Storage Server Component Hardware Faults 21
Troubleshooting Storage Server Hardware Faults 22
Troubleshooting and Diagnostic Information 26
Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators 26
Troubleshooting System Cooling Issues 32
Troubleshooting Power Issues 34
Managing Server Hardware Faults Through the Oracle ILOM Fault Management Shell 36
Troubleshooting With Diagnostic Tools 36
Diagnostic Tools 37
Diagnostic Tool Documentation 38
Attaching Devices to the Storage Server 38
▼ Attach Devices to the Storage Server 39

Rear Panel Connector Locations 39
Configuring Serial Port Sharing 41
Ethernet Port Boot Order and Device Naming 43
Rear Panel Pinhole Switches 44
Getting Help 45
Contacting Support 45
Related Information 46
Locating the Chassis Serial Number 46

Preparing for Service 47
Safety Precautions 47
Safety Symbols 48
Electrostatic Discharge Safety 48
FRU Key Identity Properties (KIP) Automated Update 49
Related Information 50
Required Tools 50
Preparing the Storage Server for Component Replacement 51
Powering Down the Storage Server 51
▼ Disconnect Cables From the Storage Server 54
▼ Extend the Storage Server to the Maintenance Position 55
▼ Remove the Storage Server From the Rack 57
▼ Take Antistatic Measures 58
▼ Remove the Storage Server Top Cover 59
▼ Remove the Fan Assembly Door From the Storage Server 60

Servicing Components That Do Not Require Storage Server Power-Off 63
Servicing Storage Drives 63
Storage Drives Hot-Plug Conditions 64
▼ Remove a Storage Drive 64
▼ Install a Storage Drive 67
Servicing Fan Modules 68
▼ Remove a Fan Module 69
▼ Install a Fan Module 72
Servicing Power Supplies 73
▼ Remove a Power Supply 74
▼ Install a Power Supply 77

Servicing Components That Require Storage Server Power-Off 81
Servicing the DIMMs 81
DIMM and Processor Physical Layout 82
DIMM Population Rules 83
Inconsistencies Between DIMM Fault Indicators and the BIOS Isolation of Faulty DIMMs 84
Using the Storage Server Fault Remind Button 84
▼ Identify and Remove a Faulty DIMM 85
▼ Install a DIMM 89
Servicing PCIe Cards 91
PCIe Slot Locations 92
▼ Remove a PCIe Card 93
▼ Install a PCIe Card 95
Servicing the Internal USB Flash Drives 98
▼ Remove an Internal USB Flash Drive 98
▼ Install an Internal USB Flash Drive 99
Servicing the Battery 101
▼ Remove the Battery 101
▼ Install the Battery 102
Servicing Processors 103
Processor Removal and Replacement Tool 104
▼ Remove a Processor 104
▼ Install a Processor 111
Servicing the Storage Drive Backplane 117
▼ Remove the Storage Drive Backplane 117
▼ Install the Storage Drive Backplane 120
Servicing NVMe Cables 122
Related Information 122
▼ Remove NVMe Cables 123
▼ Install NVMe Cables 125
▼ Verify NVMe Cable Connections 128
Servicing the Front LED/USB Indicator Modules 131
▼ Remove the Left LED Indicator Module 131
▼ Install the Left LED Indicator Module 135
▼ Remove the Right LED/USB Indicator Module 138
▼ Install the Right LED/USB Indicator Module 141
Servicing the Motherboard Assembly 145

▼ Remove the Motherboard Assembly 145
▼ Install the Motherboard Assembly 154

Returning the Storage Server to Operation 161
Storage Server Filler Panel Requirements 161
▼ Remove and Install Filler Panels 162
▼ Install the Storage Server Top Cover 162
▼ Install the Fan Assembly Door 164
▼ Remove Antistatic Measures 164
▼ Reinstall the Storage Server in the Rack 165
▼ Return the Storage Server to the Normal Rack Position 165
▼ Reconnect Power and Data Cables 167
▼ Power On the Storage Server 168

Identifying the Storage Server Ports 169
Gigabit Ethernet Ports 169
Network Management Port 170
Serial Management Port 171
Video Connector 173
USB Ports 174

Setting Up BIOS Configuration Parameters 177
Managing the BIOS Configuration 177
Accessing the BIOS Setup Utility 178
BIOS Setup Utility Menus 178
BIOS Key Mappings 179
▼ Access BIOS Setup Utility Menus 179
▼ Navigate BIOS Setup Utility Menus 181
Using UEFI 183
Selecting Legacy BIOS or UEFI Boot Mode 183
Switching Between Legacy BIOS and UEFI Boot Modes 184
UEFI Boot Mode Advantages 184
Configuration Utilities for Add-In Cards 185
Using BIOS for Resource Allocation 185
Legacy Option ROM Allocation 186
Common BIOS Setup Utility Tasks 187

▼ Verify BIOS Factory Default Settings 187
▼ Select Legacy BIOS or UEFI BIOS Boot Mode 188
▼ Select the Boot Device 190
▼ Configure TPM Support 192
▼ Configure SP Network Settings 194
▼ Configure Option ROM Settings 197
▼ Configure I/O Resource Allocation 201
▼ Exit BIOS Setup Utility 201

BIOS Setup Utility Menu Options 203
BIOS Main Menu Selections 203
BIOS Advanced Menu Selections 207
BIOS Advanced Menu Processor Configuration Options 208
BIOS Advanced Menu CPU Power Management Configuration Options 209
BIOS Advanced Menu Memory Configuration Option 209
BIOS Advanced Menu USB Ports Options 210
BIOS Advanced Menu Serial Port Console Redirection Options 211
BIOS Advanced Menu Trusted Computing Options 212
BIOS Advanced Menu Network Stack Options 213
BIOS Advanced Menu BMC Network Configuration Options 214
BIOS Advanced Menu iSCSI Configuration Options 217
BIOS Advanced Menu Ethernet Controller Options 218
BIOS IO Menu Selections 220
BIOS IO Menu PCI Subsystem Settings Options 221
BIOS IO Menu IO Virtualization Options 221
BIOS IO Menu I/OAT Configuration Options 222
BIOS IO Menu Internal Devices Options 222
BIOS IO Menu Add In Cards Options 222
BIOS Boot Menu Selections 223
BIOS Exit Menu Selections 225

Monitoring Components and Identifying SNMP Messages 227
Monitoring Component Health and Faults Using Oracle ILOM 227
Monitoring System Components 228
System Chassis Components 229
Cooling Unit Components 231
Disk Backplane Components 232

Memory Device Components 233
Power Unit Components 234
Processor Components 235
System Board Components 236
System Firmware Components 237
Hard Disk Drive Components 238
Identifying SNMP Trap Messages 239
Environmental Events 240
Hard Disk Drive Events 242
Power Events 242
Fan Events 247
Memory Events 248
Entity Presence Events 253
Physical Security Events 254

Index 255

Using This Documentation

- **Overview** – This service manual explains how to remove and replace parts in the Oracle Exadata Storage Server X5-2 Extreme Flash, and how to maintain and troubleshoot the system.
- **Audience** – This guide is intended for trained technicians and authorized service personnel who have been instructed on the hazards within the equipment and qualified to remove and replace hardware.
- **Required knowledge** – Advanced experience troubleshooting and replacing hardware.

Product Documentation Library

Documentation and resources for this product and related products are available at http://www.oracle.com/goto/x5-2l/docs.

Feedback

Provide feedback about this documentation at http://www.oracle.com/goto/docfeedback.

About the Oracle Exadata Storage Server X5-2 Extreme Flash

These sections describe the controls, connectors, LEDs, system components, and replaceable components of the storage server.

Note - Always update the storage server with the latest firmware, drivers, and other hardware-related software by downloading the latest software release package when you first receive the system, and for every new software release.

Description	Links
Review the product description.	"Product Description" on page 13
Review the controls and connectors on the storage server.	"About Controls and Connectors" on page 14
Review system components.	"About System Components" on page 17

Product Description

The Oracle Exadata Storage Server X5-2 Extreme Flash is an enterprise-class, two rack unit (2U) storage server. It supports the following components:

- Two Intel E5-2630, 8-core, 2.4 GHz, 85W processors.
- Four 8 GB DIMMs per processor for a maximum of 8 DDR4 DIMMs and a maximum of 64 GB of memory.
- Six PCIe Gen3 slots. PCIe slots 1, 2, 5, and 6 contain Oracle PCIe NVMe switch cards. PCIe slot 3 contains an InfiniBand QDR-CX3 PCIe HBA card.
- A minimum of eight, or up to a maximum of twelve 2.5-inch hot-pluggable PCIe-based NVMe solid state disk drives (SSDs).
- Two hot-pluggable, redundant 1000W power supplies.
- Two internal USB ports preinstalled with redundant 8 GB USB drives. The primary USB drive contains a GRUB boot loader for the operating system; the secondary USB drive is a mirrored image of the primary USB drive.

- Exadata preinstalled operating system (OS) image located on NVMe drives 0 and 1.
- An on-board Oracle Integrated Lights Out Manager (Oracle ILOM) service processor (SP) based on the Emulex Pilot 3 chip.

About Controls and Connectors

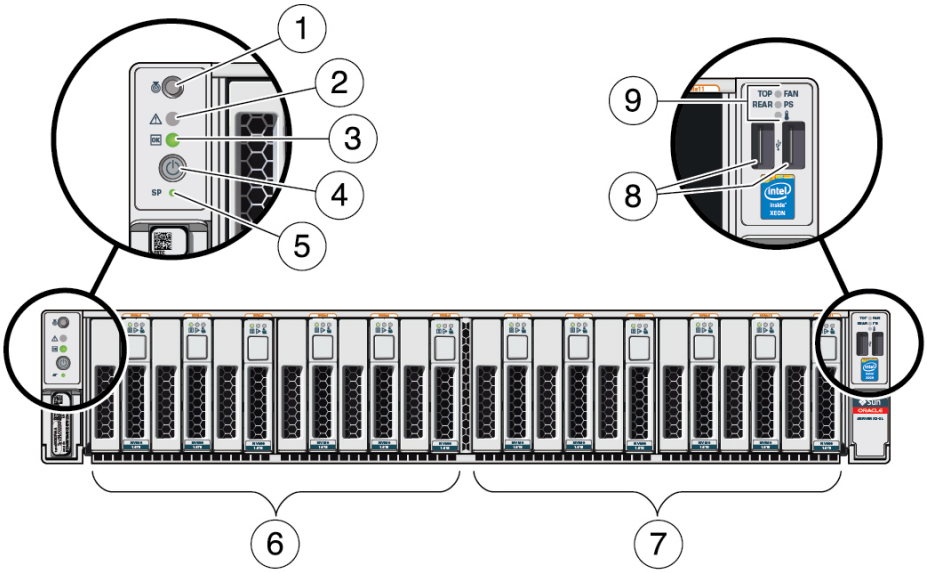
The following sections describe the controls, indicators, connectors, and drives located on the front and rear panels.

- "Front Panel Components" on page 15
- "Rear Panel Components and Cable Connections" on page 16

Related Information

- "About System Components" on page 17
- "Illustrated Parts Breakdown" on page 17
- "Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators " on page 26

Front Panel Components

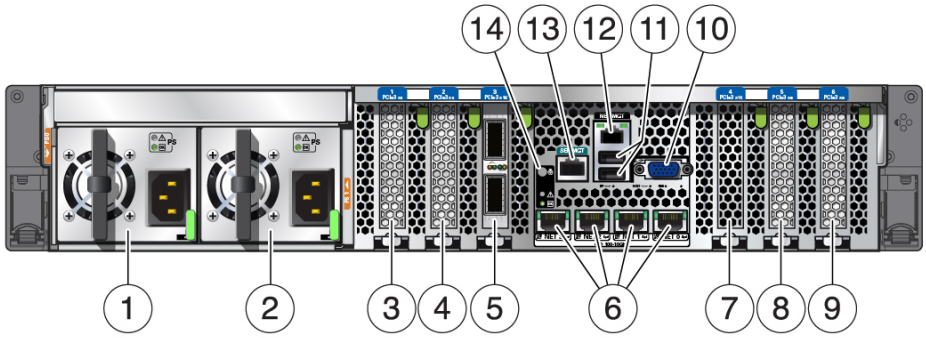


Call Out	Description
1	Locator LED/Locator button: white
2	Service Required LED: amber
3	Power/OK LED: green
4	Power button
5	SP OK LED: green
6	NVM-Express SSDs 0 through 5
7	NVM-Express SSDs 6 through 11
8	USB 2.0 connectors (2)
9	Service Required LEDs (3): Top: Fan Module (amber); Rear: Power Supply (amber); Overtemp Icon: System Over Temperature Warning (amber)

Related Information

- “Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators ” on page 26

Rear Panel Components and Cable Connections



Call Out	Description
1	Power supply unit 0 (PS0)
2	Power supply unit 1 (PS1)
3	PCIe slot 1 (Oracle PCIe NVMe switch card)
4	PCIe slot 2 (Oracle PCIe NVMe switch card)
5	PCIe slot 3 (InfiniBand QDR-CX3 PCIe HCA card)
6	Network (NET) 100/1000/10000 ports (NET3–NET0)
7	PCIe slot 4 (Empty)
8	PCIe slot 5 (Oracle PCIe NVMe switch card)
9	PCIe slot 6 (Oracle PCIe NVMe switch card)
10	DB-15 video connector
11	USB 2.0 ports (2)
12	Oracle Integrated Lights Out Manager (ILOM) service processor (SP) network management 10/100/1000BASE-T port (NET MGT)
13	Serial management (SER MGT) RJ-45 serial port
14	System status LEDs: Locator/Button: white; Service Required: amber; Power/OK: green

Note - For more information on rear panel components and connections, refer to “Rear Panel Connector Locations” on page 39. See also “Rear Panel Pinhole Switches” on page 44.

Related Information

- “Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators ” on page 26
- “Disconnect Cables From the Storage Server” on page 54
- “Reconnect Power and Data Cables” on page 167
- “Identifying the Storage Server Ports” on page 169

About System Components

These sections describe the components of the server:

- “Illustrated Parts Breakdown” on page 17
- “Replaceable Components” on page 19

Related Information

- “Servicing Components That Do Not Require Storage Server Power-Off” on page 63
- “Servicing Components That Require Storage Server Power-Off” on page 81

Illustrated Parts Breakdown

The following figure identifies the major components of the storage server.

FIGURE 1 System Components

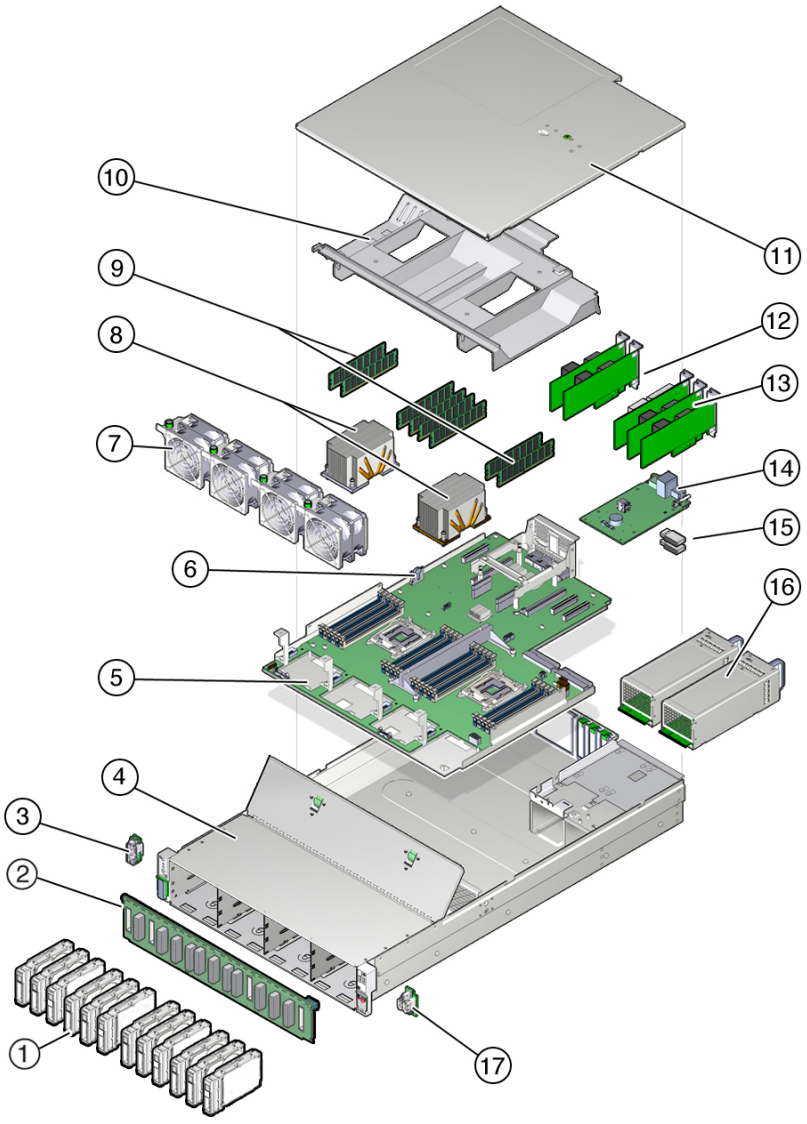


Figure Legend	Description
1	A minimum of eight, or up to a maximum of twelve 2.5-inch NVMe storage drives
2	Front disk backplane that supports up to twelve 2.5-inch NVMe storage drives
3	Left LED indicator module
4	System chassis
5	Motherboard assembly
6	System battery
7	Fan modules
8	Processors and heatsinks
9	DIMMs
10	Air baffle
11	Top cover
12	PCIe cards in slots 5 and 6
13	PCIe cards in slots 1, 2, and 3
14	I/O and internal USB card
15	Internal USB drives
16	Power supplies
17	Right LED indicator module

Replaceable Components

The following table lists the replaceable components in the server and directs you to the replacement instructions.

Component	Description	Replacement Instructions
Battery	Lithium coin-cell battery that powers the CMOS BIOS and real-time clock.	“Servicing the Battery” on page 101
DIMMs	Add or replace memory modules in the storage server.	“Servicing the DIMMs” on page 81
Storage drives	A minimum of eight, or up to twelve 2.5-inch hot-pluggable NVMe storage drives.	“Servicing Storage Drives” on page 63
Fan modules	Four fan modules for cooling the storage server components.	“Servicing Fan Modules” on page 68
PCIe cards	Optional add-on cards that can expand the functionality of the storage server.	“Servicing PCIe Cards” on page 91
Power supply unit (PSU)	Two fully redundant AC-powered power supplies.	“Servicing Power Supplies” on page 73

Component	Description	Replacement Instructions
Processor and heatsink	The processor that carries out the instructions of the storage server.	“Servicing Processors” on page 103
Disk backplane	Provides power and communications connectors for storage drives.	“Servicing the Storage Drive Backplane” on page 117
NVMe cables	Provide signals between the Oracle PCIe NVMe switch cards and the disk backplane.	“Servicing NVMe Cables” on page 122
Front LED/USB indicator modules	Contain the push-button circuitry and LEDs that are displayed on the bezel of the chassis.	“Servicing the Front LED/USB Indicator Modules” on page 131
Motherboard assembly	Provides connectors for the DIMMs, processors, PCIe risers, and other components.	“Servicing the Motherboard Assembly” on page 145

Related Information

- “Illustrated Parts Breakdown” on page 17
- “Servicing Components That Do Not Require Storage Server Power-Off” on page 63
- “Servicing Components That Require Storage Server Power-Off” on page 81

Troubleshooting and Diagnostics

This section includes information about troubleshooting hardware component faults for the Oracle Exadata Storage Server X5-2 Extreme Flash. It contains the following topics.

Description	Link
Maintenance-related information and procedures that you can use to troubleshoot and repair storage server hardware issues.	“Troubleshooting Storage Server Component Hardware Faults” on page 21
Information about software and firmware diagnostic tools that you can use to isolate problems, monitor the storage server, and exercise the storage server subsystems.	“Troubleshooting With Diagnostic Tools” on page 36
Information about attaching devices to the storage server to perform troubleshooting.	“Attaching Devices to the Storage Server” on page 38
Information about contacting Oracle support.	“Getting Help” on page 45

Troubleshooting Storage Server Component Hardware Faults

This section contains maintenance-related information and procedures that you can use to troubleshoot and repair storage server hardware issues. The following topics are covered.

Description	Section Links
Troubleshooting overview information and procedure.	“Troubleshooting Storage Server Hardware Faults” on page 22
Resources for troubleshooting and diagnostic information.	“Troubleshooting and Diagnostic Information” on page 26
Discerning the storage server state using the front and rear panel indicators.	“Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators ” on page 26
Causes, actions, and preventative measures for problems related to the cooling subsystem.	“Troubleshooting System Cooling Issues” on page 32

Description	Section Links
Causes, actions, and preventative measures for problems related to the power subsystem.	“Troubleshooting Power Issues” on page 34

Troubleshooting Storage Server Hardware Faults

When a storage server hardware fault event occurs the system lights the Service Required LED and captures the event in the system event log (SEL). If you have set up notifications through Oracle ILOM, you also receive an alert through the notification method you chose. When you become aware of a hardware fault, you should address it immediately.

To investigate a hardware fault, see the following:

- “Basic Troubleshooting Process” on page 22
- “Troubleshoot Hardware Faults Using the Oracle ILOM Web Interface” on page 23

Basic Troubleshooting Process

Use the following process to address a hardware fault (for the step-by-step procedure, see “Troubleshoot Hardware Faults Using the Oracle ILOM Web Interface” on page 23).

1. **Identify the storage server subsystem containing the fault**.

   You can use Oracle ILOM to identify the failed component.
2. **Review the system product notes.**

   The product notes contain up-to-date information about the storage server, including hardware-related issues.
3. **Prepare the storage server for service using Oracle ILOM**.

   If you have determined that the hardware fault requires service (physical access to the server), use Oracle ILOM to take the server offline, activate the Locate LED, and power off the server.
4. **Prepare the service work space**.

   Before servicing the storage server, prepare the work space, ensuring ESD protection for the storage server and components.

   See “Preparing for Service” on page 47.
5. **Service components**.

   To service the components, see the removal, installation, and replacement procedures in this document.

Note - A component designated as a field-replaceable unit (FRU) must be replaced by Oracle Service personnel. Contact Oracle Service.

6. **Clear the fault in Oracle ILOM**.

   Depending on the component, you might need to clear the fault in Oracle ILOM. Generally, components that have a FRU ID clear the fault automatically.

Related Information

- See "Troubleshoot Hardware Faults Using the Oracle ILOM Web Interface" on page 23

▼ Troubleshoot Hardware Faults Using the Oracle ILOM Web Interface

Note - The screens shown in this procedure might differ from those for your storage server.

This procedure uses the basic troubleshooting steps described in "Basic Troubleshooting Process" on page 22.

Use this procedure to troubleshoot hardware faults with the Oracle ILOM web interface and, if necessary, prepare the storage server for service.

Note - This procedure provides one basic approach to troubleshooting hardware faults. It uses a combination of the Oracle ILOM web interface and command-line interface (CLI). However, the procedure can be performed using only the Oracle ILOM CLI interface. For more information about the Oracle ILOM web interface and CLI, refer to the Oracle ILOM documentation.

Before beginning this procedure, obtain the latest version of the system product notes.

1. **Log in to the server SP Oracle ILOM web interface.**

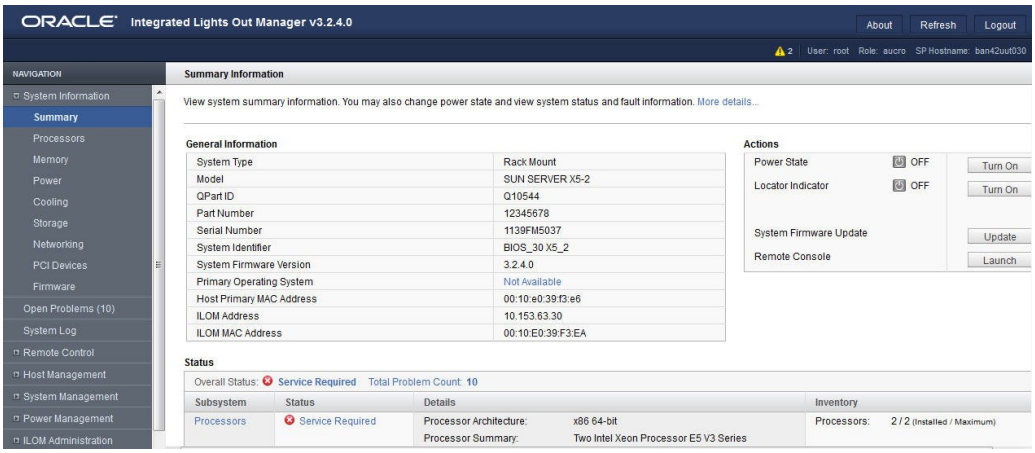
   Open a browser and direct it using the IP address of the server SP. Enter a user name (with administrator privileges) and password at the log-in screen. The Summary Information screen appears.

   The Status section of the Summary Information screen provides information about the server subsystems, including:

   - Processors

- Memory
- Power
- Cooling
- Storage
- Networking

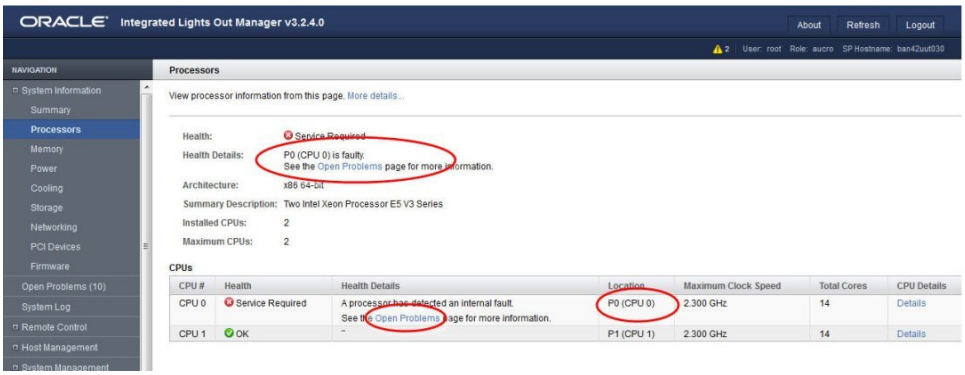
2. **In the Status section of the Summary Information screen, identify the server subsystem that requires service.**



In the above example, the Status screen shows that the Processor subsystem requires service. This indicates that a hardware component within the subsystem is in a fault state.

3. **To identify the component, click on Processors in the Status section.**

The Processor screen appears.



The above example shows the Processors subsystem screen and indicates that CPU 0 has a fault.

4. **To get more information, click one of the Open Problems links.**

The Open Problems screen provides detailed information, such as the time the event occurred, the component and subsystem name, and a description of the issue. It also includes a link to an Oracle KnowledgeBase article.

Tip - The System Log provides a chronological list of all the system events and faults that have occurred since the log was last reset and includes additional information, such as severity levels and error counts. The System Log also includes information on device not reported in the Subsystem Summary screen. To access the System Log, in the left panel, click System Log .

In this example, the hardware fault with CPU 0 requires local/physical access to the server.

5. **Before going to the storage server, review the system product notes for information related to the issue or the component.**

The product notes contain up-to-date information about the storage server, including hardware-related issues.

6. **To prepare the storage server for service, see "Preparing for Service" on page 47.**

After servicing the component, you might need to clear the fault in Oracle ILOM. For more information, refer the service procedure for the component.

7. **Service the component.**

Troubleshooting and Diagnostic Information

The following table lists diagnostic and troubleshooting-related procedures and references that can assist you with resolving storage server issues.

Description	Link
Diagnostic information for the x86 servers, including procedures for performing runtime and firmware-based tests, using Oracle ILOM, and running U-Boot and UEFI Diagnostics tests to exercise the system and isolate subtle and intermittent hardware-related problems.	*Oracle x86 Servers Diagnostics, Applications, and Utilities Guide for Servers with Oracle ILOM 3.1 and Oracle ILOM 3.2.x*
Administrative information for the Oracle Sun Server X5 series servers, including information about how to use Oracle System Assistant and using the Oracle ILOM system event log (SEL) to identify a problem's possible source.	*Oracle X5 Series Servers Administration Guide*
Information about troubleshooting front and rear panel status indicators.	"Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators " on page 26
Information about how to manage server hardware faults using the Oracle ILOM Fault Management Shell.	"Managing Server Hardware Faults Through the Oracle ILOM Fault Management Shell" on page 36

Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators

These sections describe the status indicators (LEDs) located on the front and rear of the storage server, including those found on components and ports. This section includes the following topics:

- "Storage Server Boot Process and Normal Operating State Indicators" on page 27
- "Storage Server System-Level Status Indicators" on page 27
- "Storage Server Fan Status Indicators" on page 29
- "Storage and Boot Drive Indicators" on page 29
- "Power Supply Status Indicators" on page 30
- "Network Management Port Status Indicators" on page 30
- "Ethernet Ports Status Indicators" on page 30

- “Motherboard Status Indicators” on page 31

Related Information

- “Front Panel Components” on page 15
- “Rear Panel Components and Cable Connections” on page 16

Storage Server Boot Process and Normal Operating State Indicators

A normal storage server boot process involves two indicators, the service processor (SP) OK LED indicator and the Power/OK LED indicator.

When AC power is connected to the storage server, the storage server boots into standby power mode:

1. The SP OK LED blinks slowly (0.5 seconds on, 0.5 seconds off) while the SP is starting, and the main Power/OK LED remains off until the SP is ready.
2. After a few minutes, the main Power/OK LED slowly flashes the standby blink pattern (0.1 seconds on, 2.9 seconds off), indicating that the SP (and Oracle ILOM) is ready for use. In standby power mode, the server is not initialized or fully powered on at this point.

When powering on the storage server (either by the Power button or Oracle ILOM), the storage server boots to full power mode:

1. The Power/OK LED blinks slowly (0.5 seconds on, 0.5 seconds off), and the SP OK LED remains lit (no blinking).
2. When the server has successfully booted, the Power/OK LED remains lit. When the Power/OK LED and the SP OK LED indicators remain lit, the server is in full power mode.

Note - The green Power/OK LED indicator and the green SP OK indicator remain lit (no blinking) when the storage server is in a normal operating state.

Storage Server System-Level Status Indicators

There are seven system-level status indicators (LEDs), some of which are located on both the storage server front panel and the storage server back panel. The following table describes these indicators.

TABLE 1 Storage Server System-Level Status Indicators

Status Indicator Name	Icon	Color	State and Meaning
Locator LED and button		White	■ OFF – Server is operating normally. ■ FAST BLINK – Use Oracle ILOM to activate this LED to enable you to locate a particular system quickly and easily. ■ Pressing the Locate button will toggle the LED fast blink on or off.
Service Required		Amber	Indicates the fault state of the server. ■ OFF – The server is operating normally. ■ STEADY ON – A fault is present on the server. This LED indicator lights whenever a fault indicator lights for a replaceable component on the server. **Note -** When this LED indicator is lit, a system console message might appear that includes a recommended service action.
Power/OK		Green	Indicates the operational state of the chassis. ■ OFF – AC power is not present or the Oracle ILOM boot is not complete. ■ STANDBY BLINK – Standby power is on, but the chassis power is off and the Oracle ILOM SP is running. ■ SLOW BLINK – Startup sequence has been initiated on the host. This pattern should begin soon after you power on the server. This status indicates either: power-on self-test (POST) code checkpoint tests are running on the server host system, or the host is transitioning from the powered-on state to the standby state on shutdown. ■ STEADY ON – The server is powered on, and all host POST code checkpoint tests are complete. The server is in one of the following states: the server host is booting the operating system (OS), or the server host is running the OS.
SP OK		Green	Indicates the state of the service processor. ■ OFF – Service processor (SP) is not running. ■ SLOW BLINK – SP is booting. ■ STEADY ON – SP is fully operational.
Top Fan	Top	Amber	Indicates that one or more of the internal fan modules have failed. ■ OFF – Indicates steady state; no service is required. ■ STEADY ON – Indicates service required.
Rear Power Supply Fault	Rear	Amber	Indicates that one of the server power supplies has failed. ■ OFF – Indicates steady state; no service is required. ■ STEADY ON – Indicates service required; service the power supply.
System Over Temperature Warning		Amber	Indicates a warning for an overtemperature condition. ■ OFF – Normal operation; no service is required. ■ STEADY ON – The system is experiencing an overtemperature warning condition.

Status Indicator Name	Icon	Color	State and Meaning
			Note - This is a warning indication, not a fatal overtemperature. Failure to correct this might result in the system overheating and shutting down unexpectedly.

Storage Server Fan Status Indicators

Each fan module has one status indicator (LED). The LEDs are located on the chassis mid-wall adjacent to and aligned with the fan modules and are visible when the top cover fan door is open.

TABLE 2 Server Fan Status Indicators

Status Indicator Name	Icon	Color	State and Meaning
Fan Status	None	Amber	■ Off – The fan module is correctly installed and operating within specification. ■ Amber – The fan module is faulty. The front TOP FAN LED and the front and rear panel Service Required LEDs are also lit if the system detects a fan module fault.

Storage and Boot Drive Indicators

There are three status indicators (LEDs) on each drive.

TABLE 3 Storage Server Front Storage and Boot Disk Drive Indicators

Status Indicator Name	Icon	Color	State and Meaning
OK/Activity	OK	Green	■ OFF – Power is off or installed drive is not recognized by the system. ■ STEADY ON – The drive is engaged and is receiving power. ■ RANDOM BLINKING – There is disk activity. Status indicator LED blinks on and off to indicate activity.
Service Required	⚠	Amber	■ OFF – The storage drive is operating normally. ■ STEADY ON – The system has detected a fault with the storage drive.
OK to Remove		Blue	■ STEADY ON – The storage drive can be removed safely during a hot-plug operation. ■ OFF – The storage drive has not been prepared for removal.

Power Supply Status Indicators

There are two status indicators (LEDs) on each power supply. These indicators are visible from the rear of the storage server.

TABLE 4 Storage Server Power Supply Indicators

Status Indicator Name	Icon	Color	State and Meaning
AC OK/ DC OK	OK	Green	■ OFF – No AC power is present. ■ SLOW BLINK – Normal operation. Input power is within specification. DC output voltage is not enabled. ■ STEADY ON – Normal operation. Input AC power and DC output voltage are within specification.
Service Required	⚠	Amber	■ OFF – Normal operation. No service action is required. ■ STEADY ON – The power supply (PS) has detected a PS fan failure, PS overtemperature, PS over current, or PS over or under voltage.

Network Management Port Status Indicators

The storage server has one 10/100/1000BASE-T Ethernet management domain interface, labeled NET MGT. There are two status indicators (LEDs) on this port. These indicators are visible from the rear of the storage server.

TABLE 5 Network Management Port Status Indicators

Status Indicator Name	Location	Color	State and Meaning
Activity	Top right	Green	■ ON – Link up. ■ OFF – No link or down link. ■ FLASHING – Packet activity.
Link speed	Top left	Green	■ Green ON – 1000BASE-T link. ■ OFF – 10/100BASE-T link.

Ethernet Ports Status Indicators

The server has four Gigabit Ethernet ports (NET 3, NET 2, NET 1, and NET 0). There are two status indicators on each port. These indicators (LEDs) are visible from the rear of the server.

TABLE 6 Gigabit Ethernet Port Status Indicators

Status Indicator Name	Location	Color	State and Meaning
Activity	Top left	Green	■ ON – No function. ■ OFF– No activity. ■ FLASHING – Packet activity.
Link speed	Top right	Bicolored: Amber/ Green	■ OFF – 100BASE-T link. ■ Amber ON – 1000BASE-T link. ■ Green ON – 10GBBASE-T link. ■ FLASHING – No function.

Motherboard Status Indicators

The motherboard contains the following status indicators (LEDs).

- **DIMM Fault Status Indicators:** Each of the 24 DIMM sockets on the motherboard has an amber fault status indicator (LED) associated with it. If Oracle ILOM determines that a DIMM is faulty, pressing the Fault Remind button on the motherboard I/O card signals the service processor to light the fault LED associated with the failed DIMM. For more information on DIMM fault status indicators and the location of the Fault Remind Button, see “Servicing the DIMMs” on page 81.
- **Processor Fault Status Indicators:** The motherboard includes a fault status indicator (LED) adjacent to each of the two processor sockets. These LEDs indicate when a processor fails. Pressing the Fault Remind button on the motherboard I/O card signals the service processor to light the fault status indicators associated with the failed processors. For more information on processor fault status indicators and the location of the Fault Remind Button, see “Servicing Processors” on page 103.
- **Fault Remind Status Indicator:** This status indicator (LED) is located next to the Fault Remind button and is powered from the super capacitor that powers the fault LEDs on the motherboard. This LED lights to indicate that the fault remind circuitry is working properly in cases where no components have failed and, as a result, none of the component fault LEDs illuminate. For more information on the fault remind status indicator and the location of the Fault Remind Button, see “Using the Storage Server Fault Remind Button” on page 84.
- **STBY PWRGD Status Indicator:** This green status indicator (LED) is labeled STBY PWRGD and is located on the motherboard near the rear of the storage server. This LED lights to inform a service technician that the motherboard is receiving standby power from at least one of the power supplies. This LED is provided to help prevent service actions on the storage server internal components while the AC power cords are installed and power is being supplied to the storage server.

Note - The service instructions for all internal components require that all AC power be removed from the power supplies prior to the storage server top cover being removed.

Troubleshooting System Cooling Issues

Maintaining the proper internal operating temperature of the storage server is crucial to the health of the storage server. To prevent storage server shutdown and damage to components, address over temperature and hardware-related issues as soon as they occur. If your storage server has a temperature-related fault, the cause of the problem might be:

- "External Ambient Temperature Too High" on page 32
- "Airflow Blockage" on page 32
- "Cooling Areas Compromised" on page 33
- "Hardware Component Failure" on page 33

External Ambient Temperature Too High

Storage server component cooling relies on the movement of cool air through the storage server. The cool air is pulled into the storage server from its external environment. If the ambient temperature of the storage server's external environment is too high, cooling does not occur, and the internal temperature of the storage server and its components increases. This can cause poor storage server performance or a failure of one or more components.

Action: Check the ambient temperature of the storage server space against the environmental specifications for the storage server. If the temperature is not within the required operating range, remedy the situation immediately.

Prevention: Periodically check the ambient temperature of the storage server space to ensure that it is within the required range, especially if you have made any changes to the storage server space (for example, added additional storage servers). The temperature must be consistent and stable.

Airflow Blockage

The storage server cooling system uses fans to pull cool air in from the storage server front intake vents and exhaust warm air out the storage server back panel vents. If the front or back vents are blocked, the airflow through the storage server is disrupted and the cooling system fails to function properly causing the storage server internal temperature to rise.

Action: Inspect the storage server front and back panel vents for blockage from dust or debris. Additionally, inspect the storage server interior for improperly installed components or cables that can block the flow of air through the storage server.

Prevention: Periodically inspect and clean the storage server vents using an ESD certified vacuum cleaner. Ensure that all components, such as cards, cable, fans, air baffles and dividers are properly installed. Never operate the storage server without the top cover installed.

Cooling Areas Compromised

To function properly, the storage server has cooling areas that are maintained by an air baffle, component filler panels, and the storage server top cover. These storage server components need to be in place for the storage server to function as a sealed system. If internal cooling areas are compromised, the storage server cooling system, which relies on the movement of cool air through the storage server, cannot function properly, and the airflow inside the storage server becomes chaotic and non-directional.

Action: Inspect the storage server interior to ensure that the air baffle is properly installed. Ensure that all external-facing slots (storage drive, DVD, PCIe) are occupied with either a component or a component filler panel. Ensure that the storage server top cover is in place and sits flat and snug on top of the storage server.

Prevention: When servicing the storage server, ensure that the air baffle is installed correctly and that the storage server has no unoccupied external-facing slots. Never operate the storage server without the top cover installed.

Hardware Component Failure

Components, such as power supplies and fan modules, are an integral part of the storage server cooling system. When one of these components fails, the storage server internal temperature can rise. This rise in temperature can cause other components to enter into an over-temperature state. Additionally, some components, such as processors, might overheat when they are failing, which can also generate an over-temperature event.

To reduce the risk related to component failure, power supplies and fan modules are installed in pairs to provide redundancy. Redundancy ensures that if one component in the pair fails, the other functioning component can continue to maintain the subsystem. For example, power supplies serve a dual function; they provide both power and airflow. If one power supply fails, the other functioning power supply can maintain both the power and the cooling subsystems.

Action: Investigate the cause of the over-temperature event, and replace failed components *immediately*. For hardware troubleshooting information, see “Troubleshooting Storage Server Hardware Faults” on page 22.

Prevention: Component redundancy is provided to allow for component failure in critical subsystems, such as the cooling subsystem. However, once a component in a redundant system fails, the redundancy no longer exists, and the risk for storage server shutdown and component failures increases. Therefore, it is important to maintain redundant systems and replace failed components *immediately*.

Troubleshooting Power Issues

If your storage server does not power on, the cause of the problem might be:

- "AC Power Connection" on page 34
- "Power Supplies (PSUs)" on page 34
- "Top Cover" on page 36

AC Power Connection

The AC power cords are the direct connection between the storage server power supplies and the power sources. The storage server power supplies need separate stable AC circuits. Insufficient voltage levels or fluctuations in power can cause storage server power problems. The power supplies are designed to operate at a particular voltage and within an acceptable range of voltage fluctuations (refer to "Power Specifications" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*).

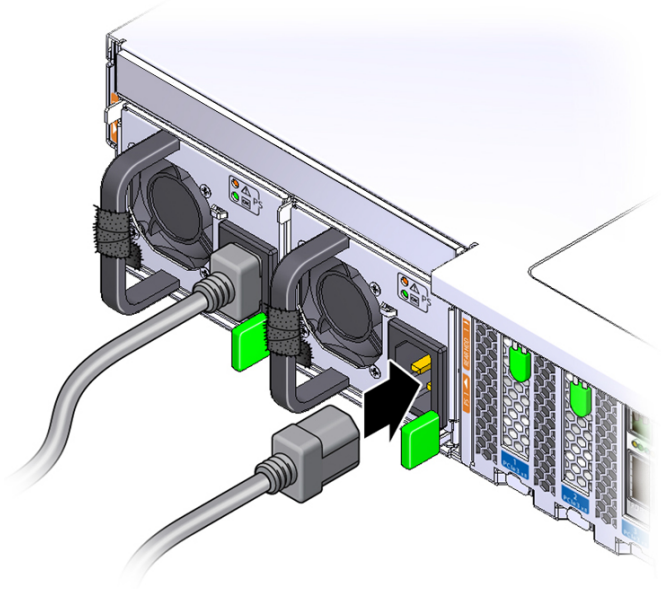
Action: Check that both AC power cords are connected to the storage server. Check that the correct power is present at the outlets and monitor the power to verify that it is within the acceptable range. You can verify proper connection and operation by checking the power supply (PS) indicator panels, which are located at the back of the storage server on the power supplies. Lit green AC OK indicators show a properly functioning power supply. An amber AC OK indicator indicates that the AC power to the power supply is insufficient.

Prevention: Use the AC power cord Velcro retaining clips and position the cords to minimize the risk of accidental disconnection. Ensure that the AC circuits that supply power to the storage server are stable and not overburdened.

Power Supplies (PSUs)

The storage server power supplies (PSUs) provide the necessary storage server voltages from the AC power outlets. If the power supplies are inoperable, unplugged, or disengaged from the internal connectors, the storage server cannot power on.

Note - The Velcro straps shown in the following figure should be used to secure the power cord connectors to the rear of the power supplies. The Velcro retaining straps minimize the risk of accidental disconnection.



Action: Check that the AC cables are connected to both power supplies. Check that the power supplies are operational (the PSU indicator panel should have a lit green AC OK indicator). Ensure that the power supply is properly installed. A power supply that is not fully engaged with its internal connector does not have power applied and does not have a lit green AC OK indicator.

Prevention: When a power supply fails, replace it immediately. To ensure redundancy, the storage server has two power supplies. This redundant configuration prevents storage server downtime, or an unexpected shutdown, due to a failed power supply. The redundancy allows the storage server to continue to operate if one of the power supplies fails. However, when a storage server is being powered by a single power supply, the redundancy no longer exists, and the risk for downtime or an unexpected shutdown increases. When installing a power supply, ensure that it is fully seated and engaged with its connector inside the drive bay. A properly installed power supply has a lit green AC OK indicator.

Top Cover

The storage server top cover is an important component for a properly functioning storage server. The top cover is vital to the storage server cooling subsystem because it helps to maintain the pressure areas within the storage server, and the top cover also protects against accidental exposure to hazardous voltages and damage to internal components. For these reasons, the storage server top cover is interlocked to the storage server power. The interlock is created by a switch that is mounted inside the storage server on the housing for the power supply. The switch engages when the cover is installed, allowing power to be applied to the storage server. When the cover is not installed, the storage server cannot power on. If the storage server is powered on when the cover is removed, power is *immediately* switched off.

Action: If the storage server does not power on, check that the switch is intact and properly aligned. Ensure that the storage server top cover is in place and sits flat and snug on top of the storage server. Ensure that the interlock switch components have not been damaged, removed, or misaligned. For instructions for properly installing the top cover, see "Install the Storage Server Top Cover" on page 162.

Prevention: After removing the top cover, take care that it does not get bent. When servicing the storage server, take care that the internally mounted interlock switch component does not get damaged or misaligned. Never operate the storage server without the top cover installed.

Managing Server Hardware Faults Through the Oracle ILOM Fault Management Shell

The Oracle ILOM Fault Management Shell enables you to view and manage fault activity on a managed servers and other types of devices.

For more information about how to use the Oracle ILOM Fault Management Shell, refer to the *Oracle ILOM User's Guide for System Monitoring and Diagnostics Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

Troubleshooting With Diagnostic Tools

The storage server and its accompanying software and firmware contain diagnostic tools and features that can help you isolate component problems, monitor the status of a functioning

system, and exercise one or more subsystem to disclose more subtle or intermittent hardware-related problems.

Each diagnostic tool has its own specific strength and application. Review the tools listed in this section and determine which tool might be best to use for your situation. Once you have determined the tool to use, you can access it locally, while at the storage server, or remotely.

- "Diagnostic Tools" on page 37
- "Diagnostic Tool Documentation" on page 38

Diagnostic Tools

The selection of diagnostic tools available for your storage server range in complexity from a comprehensive validation test suite (Oracle VTS) to a chronological event log (Oracle ILOM System Log). The selection of diagnostic tools also includes standalone software packages, firmware-based tests, and hardware-based LED indicators.

The following table summarizes the diagnostic tools that you can use when troubleshooting or monitoring your storage server.

Diagnostic Tool	Type	What It Does	Accessibility	Remote Capability
Oracle ILOM	SP firmware	Monitors environmental condition and component functionality sensors, generates alerts, performs fault isolation, and provides remote access.	Can function on either standby power mode or full power mode and is not OS dependent.	Designed for remote and local access.
Preboot Menu	SP firmware	Enables you to restore some Oracle ILOM default settings when Oracle ILOM is not accessible.	Can function on standby power and when operating system is not running.	Local, but remote serial access is possible if the SP serial port is connected to a network-accessible terminal storage server.
Hardware-based LED indicators	Hardware and SP firmware	Indicates status of overall system and particular components.	Available when system power is available.	Local, but sensor and indicators are accessible from Oracle ILOM web interface or command-line interface (CLI).
Power-On Self-Test (POST)	Host firmware	Tests core components of system: CPUs, memory, and motherboard I/O bridge integrated circuits.	Runs on startup. Available when the operating system is not running.	Local, but can be accessed through Oracle ILOM Remote System Console Plus.

Diagnostic Tool	Type	What It Does	Accessibility	Remote Capability
U-Boot	SP firmware	Initializes and test aspects of the service processor (SP) prior to booting the Oracle ILOM SP and operating system. Tests SP memory, SP, network devices and I/O devices.	Can function on standby power and when operating system is not running.	Local, but remote serial access is possible if the SP serial port is connected to a network-accessible terminal storage server.
UEFI Diagnostics	SP firmware	The UEFI diagnostics can test and detect problems on all processors, memory, disk drives, and network ports.	You can use either the Oracle ILOM web interface or the command-line interface (CLI) to run UEFI diagnostics.	Remote access through Oracle ILOM Remote System Console Plus.
Oracle Linux commands	Operating system software	Displays various kinds of system information.	Requires operating system.	Local, and over network.

Diagnostic Tool Documentation

The following table identifies where you can find more information about diagnostic tools.

Diagnostic Tool	Documentation	Location
Oracle ILOM	Oracle Integrated Lights Out Manager 3.2 Documentation Library	http://www.oracle.com/goto/ilom/docs
Preboot Menu	*Oracle x86 Servers Diagnostics Guide*	http://www.oracle.com/goto/x86admindiag/docs
System indicators and sensors	This document	“Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators ” on page 26
U-Boot or UEFI Diags	*Oracle x86 Servers Diagnostics Guide*	http://www.oracle.com/goto/x86admindiag/docs
Oracle VTS	Oracle VTS software and documentation	http://docs.oracle.com/cd/E19719-01/index.html

Attaching Devices to the Storage Server

The following sections contain procedural information for attaching devices to the storage server so you can access diagnostic tools when troubleshooting and servicing the storage server:

- “Attach Devices to the Storage Server” on page 39
- “Rear Panel Connector Locations” on page 39
- “Configuring Serial Port Sharing” on page 41
- “Ethernet Port Boot Order and Device Naming” on page 43
- “Rear Panel Pinhole Switches” on page 44

▼ Attach Devices to the Storage Server

This procedure explains how to connect devices to the server (remotely and locally), so that you can interact with the service processor (SP) and the server console.

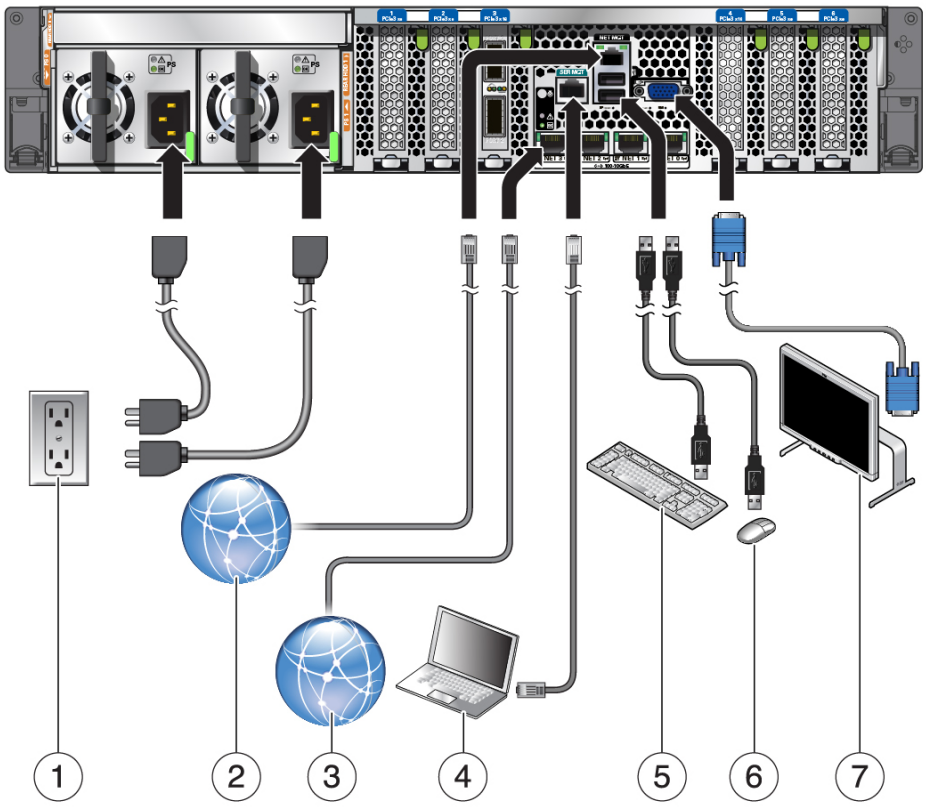
1. **Connect an Ethernet cable to the Gigabit Ethernet (NET) connectors as needed for OS support.**
2. **To connect to the service processor's Oracle ILOM over the network, connect an Ethernet cable to the Ethernet port labeled NET MGT.**
3. **To access the Oracle ILOM command-line interface (CLI) locally using the management port, connect a serial null modem cable to the RJ-45 serial port labeled SER MGT.**
4. **To interact with the system console locally, connect a mouse and keyboard to the USB connectors and a monitor to the DB-15 video connector.**

Related Information

- “Rear Panel Connector Locations” on page 39

Rear Panel Connector Locations

The following illustration shows and describes the locations of the back panel connectors. Use this information to set up the storage server, so that you can access diagnostic tools and manage the storage server during service.



No.	Cable Port or Expansion Slot	Description
1	Power supply 0 input power Power supply 1 input power	The storage server has two power supply connectors, one for each power supply. Do not attach power cables to the power supplies until you have finished connecting the data cables to the storage server. The storage server goes into standby power mode, and the Oracle ILOM service processor initializes when the AC power cables are connected to the power source. System messages might be lost after 60 seconds if the storage server is not connected to a terminal, PC, or workstation. **Note -** Oracle ILOM will signal a fault on any installed power supply that is not connected to an AC power source, since it might indicate a loss of redundancy.
2	Network management port (NET MGT)	The service processor NET MGT port is the optional connection to the Oracle ILOM service processor. The NET MGT port is configured by default to use Dynamic Host Configuration Protocol (DHCP). The service processor NET MGT port uses an RJ-45 cable for a 10/100/1000BASE-T connection.

No.	Cable Port or Expansion Slot	Description
3	Ethernet ports (NET 3, NET 2, NET 1, NET 0)	The four 10-Gigabit Ethernet ports enable you to connect the system to the network.
4	Serial management port (SER MGT)	The service processor SER MGT port uses an RJ-45 cable and is the default connection to the Oracle ILOM service processor. This port supports local connections to the storage server and only recognizes Oracle ILOM command-line interface (CLI) commands. Typically you connect a terminal or terminal emulator to this port. **Note -** This port does not support network connections.
5, 6	USB ports (USB 0, USB 1)	The two USB ports support hot-plugging. You can connect and disconnect USB cables and peripheral devices while the storage server is running without affecting system operations.
7	Video port (VGA)	Use a 15-pin video cable to connect a VGA video device to the storage server. Optionally, you can connect to the VGA port when installing the operating system.

Configuring Serial Port Sharing

By default, the SP console (SER MGT) port sends serial port output from the storage server. Using Oracle ILOM, you can specify that the host console (COM1) be assigned as owner of the storage server serial port output.

You should set up the network on the SP before attempting to change the serial port owner to the host storage server. If the network is not set up, and you switch the serial port owner to the host storage server, you will be unable to connect using the CLI or web interface to change the serial port owner back to the SP. To return the serial port owner setting to the SP, you need to restore access to the serial port on the storage server. For more details about restoring access to the storage server port on your storage server, see the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

You can assign serial port output using either the Oracle ILOM web interface or the command-line interface (CLI). For instructions, see the following sections:

- “Assign Serial Port Output Using the CLI” on page 41
- “Assign Serial Port Output Using the Web Interface” on page 42

▼ Assign Serial Port Output Using the CLI

1. **Open an SSH session and at the command line log in to the SP Oracle ILOM CLI.**

   Log in as a user with root or administrator privileges. For example:

   `ssh root@` *ipaddress*

Where *ipaddress* is the IP address of the storage server SP.

For more information, see "Accessing Oracle ILOM" in the *Oracle X5 Series Servers Administration Guide*.

The Oracle ILOM CLI prompt (`->`) appears.

2. **To set the serial port owner, type:**

```
-> set /SP/serial/portsharing owner=host
```

Note - The serial port sharing value by default is `owner=SP`.

3. **Connect a serial host to the storage server.**

▼ Assign Serial Port Output Using the Web Interface

1. **Log in to the SP Oracle ILOM web interface.**

   To log in, open a web browser and direct it using the IP address of the server SP. Log in as root or a user with administrator privileges. See "Accessing Oracle ILOM" in the *Oracle X5 Series Servers Administration Guide*.

   The Summary Infomration screen appears.

2. **In the Oracle ILOM web interface, select ILOM Administration → Connectivity from the navigation menu on the left side of the screen.**

3. **Select the Serial Port tab.**

   The Serial Port Settings page appears.

Note - The serial port sharing setting by default is `Service Processor`.

4. **In the Serial Port Settings page, select `Host Server` as the serial port owner.**

5. **Click `Save` for the changes to take effect.**

6. **Connect a serial host to the storage server.**

Ethernet Port Boot Order and Device Naming

This section contains information about the boot order and device naming for the four 10-Gigabit Ethernet ports on the rear panel of the storage server. For location information, see “Rear Panel Connector Locations” on page 39. From right to left, the ports are numbered NET 0 to NET 3.

Ethernet Port Boot Order

The order in which the BIOS detects the Ethernet ports during storage server boot is listed below.

Note - You can change the boot priority using the Boot Device Priority screen available in the Boot menu of the BIOS Setup Utility.

---

1. NET 0
2. NET 1
3. NET 2
4. NET 3

Ethernet Port Device Naming

Note - Naming used by the interfaces might vary from that listed below depending on which devices are installed in the system.

The device naming for the Ethernet interfaces is reported differently by different interfaces and operating systems. The following table shows BIOS (physical) and operating system (logical) naming conventions used for each interface. These naming conventions might vary depending on conventions of your operating system and which devices are installed in the storage server.

Port	BIOS	Solaris	Linux	Windows (example default names, see note below)
NET 0	3A00	ixgbe 0	eth 0	Ethernet
NET 1	3A01	ixgbe 1	eth 1	Ethernet 2

Port	BIOS	Solaris	Linux	Windows (example default names, see note below)
NET 2	8200	ixgbe 2	eth 2	Ethernet 3
NET 3	8201	ixgbe 3	eth 3	Ethernet 4

Rear Panel Pinhole Switches

This section shows the location of the rear panel pinhole switches.

FIGURE 2 Rear Panel Pinhole Switches

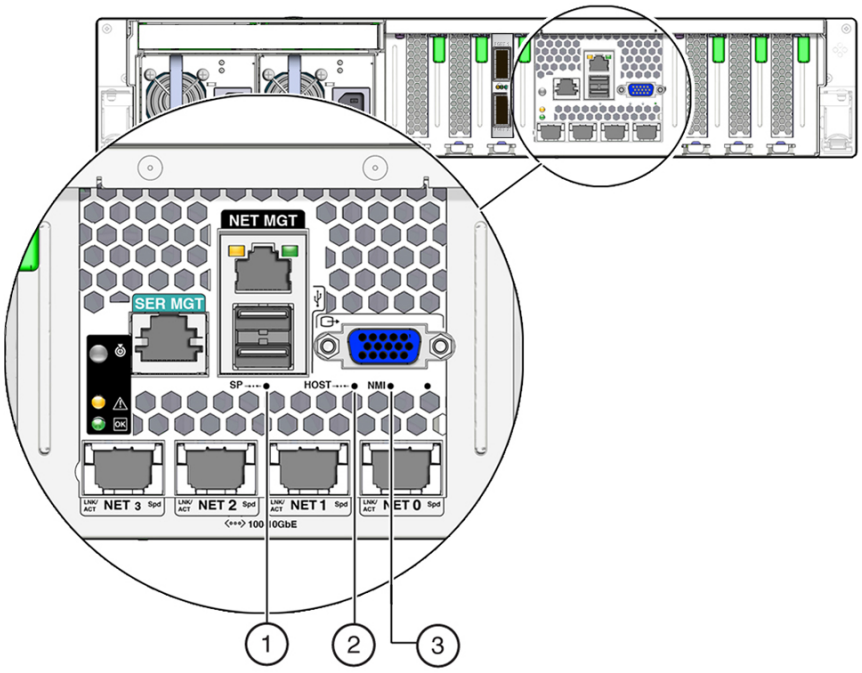


Figure Legend	Description
1	SP Reset
2	Host Warm Reset

Figure Legend	Description
3	Non-maskable interrupt (NMI)†

†Oracle Service use only.

Getting Help

The following sections describe how to get additional help to resolve storage server-related problems.

- "Contacting Support" on page 45
- "Locating the Chassis Serial Number" on page 46

Contacting Support

If the troubleshooting procedures in this chapter fail to solve your problem, use the following table to collect information that you might need to communicate to support personnel.

System Configuration Information Needed	Your Information
Service contract number	
System model	
Operating environment	
System serial number	
Peripherals attached to the system	
Email address and phone number for you and a secondary contact	
Street address where the system is located	
Superuser password	
Summary of the problem and the work being done when the problem occurred	
Other Useful Information	
IP address	
Server name (system host name)	

System Configuration Information Needed	Your Information
Network or internet domain name	
Proxy storage server configuration	

Related Information

- “Locating the Chassis Serial Number” on page 46

Locating the Chassis Serial Number

You might need to have your server serial number when you ask for service on your system. Record this number for future use. Use one of the following resources or methods to locate your server serial number.

- The serial number is located on the Radio-frequency Identification (RFID) label on the bottom left side of the front panel bezel, below the general status LEDs.

  For illustrations of the storage server front panel, see “About Controls and Connectors” on page 14.
- The serial number is recorded on the service label that is attached to the top cover of the system.
- The serial number is recorded on the yellow Customer Information Sheet (CIS) that is attached to your storage server packaging.
- Using Oracle ILOM:
  - From the command-line interface (CLI), type the command: `show/System`.
  - From the web interface, view the serial number on the System Information screen.

Preparing for Service

These sections describe safety considerations and provide prerequisite procedures and information about replacing components within the storage server.

Description	Links
Understand the safety precautions, understand the safety symbols, and take ESD precautions prior to removing or installing parts in the storage server.	"Safety Precautions" on page 47 "Safety Symbols" on page 48 "Electrostatic Discharge Safety" on page 48
Understand the key identity properties auto-update feature.	"FRU Key Identity Properties (KIP) Automated Update" on page 49
Assemble the required tools.	"Required Tools" on page 50
Before working with components within the storage server, power down the storage server and prepare for servicing.	"Preparing the Storage Server for Component Replacement" on page 51

Related Information

- "Returning the Storage Server to Operation" on page 161

Safety Precautions

For your protection, observe the following safety precautions when setting up your equipment:

- Follow all standard cautions, warnings, and instructions marked on the equipment and described in the *Oracle Exadata Storage Server X5-2 Extreme Flash Safety and Compliance Guide* and *Important Safety Information for Oracle's Hardware Systems*.
- Ensure that the voltage and frequency of your power source match the voltage and frequency inscribed on the equipment electrical rating label.
- Follow the electrostatic discharge safety practices as described in "Electrostatic Discharge Safety" on page 48.

- Disconnect both power supply cords before servicing components.

Related Information

- “Safety Symbols” on page 48
- “Electrostatic Discharge Safety” on page 48

Safety Symbols

The following symbols might appear in this document. Note their meanings.



Caution - Risk of personal injury or equipment damage. To avoid personal injury or equipment damage, follow the instructions.



Caution - Hot surface. Avoid contact. Surfaces are hot and might cause personal injury if touched.



Caution - Hazardous voltages are present. To reduce the risk of electric shock and danger to personal health, follow the instructions.

Related Information

- “Safety Precautions” on page 47
- “Electrostatic Discharge Safety” on page 48

Electrostatic Discharge Safety

Devices that are sensitive to electrostatic discharge (ESD), such as the motherboard, PCIe cards, drives, processors, and memory DIMMs require special handling.



Caution - The boards and drives contain electronic components that are extremely sensitive to static electricity. Ordinary amounts of static electricity from clothing or the work environment can destroy components. Do not touch the components along their connector edges.

Do the following when handling ESD-sensitive components:

- Use an antistatic wrist strap.

  Wear an antistatic wrist strap and use an antistatic mat when handling components such as drive assemblies, boards, or cards. When servicing or removing storage server components, attach an antistatic strap to your wrist and then to a metal area on the chassis. Then disconnect the power cords from the storage server. Following this practice equalizes the electrical potentials between you and the storage server.

  Note - An antistatic wrist strap is not included in the Accessory Kit for the storage server. However, antistatic wrist straps are included with options and components.

- Use an antistatic mat.

  Place ESD-sensitive components such as the motherboard, memory DIMMS, and other printed circuit board (PCB) cards on an antistatic mat. The following items can be used as an antistatic mat:

  - An antistatic bag used to wrap an Oracle replacement part
  - An Oracle ESD mat (orderable item)
  - A disposable ESD mat (shipped with some replacement parts or optional system components)

Related Information

- “Safety Precautions” on page 47
- “Safety Symbols” on page 48
- “Preparing the Storage Server for Component Replacement” on page 51
- “Returning the Storage Server to Operation” on page 161

FRU Key Identity Properties (KIP) Automated Update

Oracle ILOM includes a key identity properties (KIP) auto-update feature that ensures product information that is used for service entitlement and warranty coverage is accurately maintained by the server at all times, including during hardware replacement activities.

The KIP includes the server product name, product part number (PPN), and product serial number (PSN). The KIP are stored in the FRUID (field-replaceable unit identifiers) container of the three server FRUs that are designated quorum members.

The quorum members include:

- Disk backplane (DBP), designated as a primary quorum member.
- Motherboard (MB), designated as a backup quorum member.
- Power supply (PS), designated as a backup quorum member.

When a server FRU that contains the KIP is removed and a replacement component is installed, the KIP of the replacement component is programmed by Oracle ILOM to contain the same KIP as the other two components.

Note - Only one of the quorum members can be replaced at a time. Automated updates can only be completed when two of the three quorum members contain matching key identity properties.

Related Information

- “Servicing Power Supplies” on page 73
- “Servicing the Storage Drive Backplane” on page 117
- “Servicing the Motherboard Assembly” on page 145

Required Tools

The storage server can be serviced with the following tools:

- Antistatic wrist strap
- Antistatic mat
- Hex/flat head screwdriver
- No. 2 Phillips screwdriver

Related Information

- “Preparing for Service” on page 47
- “Servicing Components That Do Not Require Storage Server Power-Off” on page 63
- “Servicing Components That Require Storage Server Power-Off” on page 81

Preparing the Storage Server for Component Replacement

Note - When you are replacing the storage drives or power supplies, not all of these procedures are necessary. See the replacement procedures for those components for more information.

Before you can remove and install components that are inside the storage server, you must perform the procedures in the following sections:

- "Powering Down the Storage Server" on page 51
- "Disconnect Cables From the Storage Server" on page 54
- "Extend the Storage Server to the Maintenance Position" on page 55
- "Remove the Storage Server From the Rack" on page 57
- "Take Antistatic Measures" on page 58
- "Remove the Storage Server Top Cover" on page 59
- "Remove the Fan Assembly Door From the Storage Server" on page 60

Related Information

- "Returning the Storage Server to Operation" on page 161

Powering Down the Storage Server



Caution - Before powering down the storage server, refer to your Oracle Exadata documentation for information on required procedures that must be completed prior to powering down the storage server.

Determine how you want to power down the storage server by reviewing the options in the following table.

Description	Link
If the storage server is not responding, or you must shut down the storage server quickly, perform an immediate shutdown.	■ "Power Down the Storage Server for Immediate Shutdown Using the Power Button" on page 52 ■ "Power Down the Storage Server for Immediate Shutdown Using the Oracle CLI" on page 53

Description	Link
	■ "Power Down the Storage Server for Immediate Shutdown Using the Oracle ILOM Web Interface" on page 54

Related Information

- "Power On the Storage Server" on page 168

▼ Power Down the Storage Server for Immediate Shutdown Using the Power Button



Caution - This procedure quickly forces the storage server main power off. You might corrupt your system data during an immediate power-down, so use this procedure to power down the storage server only after attempting the graceful power-down procedure.

1. **Press and hold the Power button for four seconds to force the main power off and to enter standby power mode.**

   When main power is off, the Power/OK LED on the front panel begins flashing, indicating that the storage server is in standby power mode. See "Storage Server System-Level Status Indicators" on page 27.

2. **Disconnect the power cords and data cables from the storage server.**

   See "Disconnect Cables From the Storage Server" on page 54.



Caution - When you power down the storage server using the Power button, the storage server enters standby power mode. Power is still directed to the service processor remote management subsystem and power supply fans. To completely power off the storage server, you must disconnect the power cords from the power supplies.

Related Information

- "Storage Server System-Level Status Indicators" on page 27
- "Power Down the Storage Server for Immediate Shutdown Using the Oracle CLI" on page 53
- "Power Down the Storage Server for Immediate Shutdown Using the Oracle ILOM Web Interface" on page 54
- "Power On the Storage Server" on page 168

▼ Power Down the Storage Server for Immediate Shutdown Using the Oracle CLI



Caution - This procedure quickly forces the storage server main power off. You might corrupt your system data during an immediate power-down, so use this procedure to power down the storage server only after attempting the graceful power-down procedure.

1. **Log in to the Oracle ILOM command-line interface (CLI) using an Administrator account.**

   Oracle ILOM displays the default command prompt (->), indicating that you have successfully logged in to Oracle ILOM.

2. **From the CLI prompt, type the following command:**

   ```
   -> stop -f /System
   ```

   The storage server powers down immediately.

3. **Disconnect the power and data cables from the storage server.**

   See “Disconnect Cables From the Storage Server” on page 54.



Caution - When you power down the storage server using Oracle ILOM, the storage server enters standby power mode. Power is still directed to the service processor remote management subsystem and power supply fans. To completely power off the storage server, you must disconnect the power cords from the power supplies.

Related Information

- “Power Down the Storage Server for Immediate Shutdown Using the Power Button” on page 52
- “Power Down the Storage Server for Immediate Shutdown Using the Oracle ILOM Web Interface” on page 54
- “Power On the Storage Server” on page 168

▼ Power Down the Storage Server for Immediate Shutdown Using the Oracle ILOM Web Interface



Caution - This procedure quickly forces the storage server main power off. You might corrupt your system data during an immediate power-down, so use this procedure to power down the storage server only after attempting the graceful power-down procedure.

1. **Log in to the Oracle ILOM web interface using an Administrator account.**

   The Oracle ILOM web interface System Information → Summary Information page appears.

2. **In the left pane, click Host Management → Power Control, and click Immediate Power Off in the Select Action list.**

3. **Click Save, and then click OK.**

   The storage server powers down immediately.

4. **Disconnect the power and data cables from the storage server.**

   See "Disconnect Cables From the Storage Server" on page 54.



Caution - When you power down the storage server using Oracle ILOM, the storage server enters standby power mode. Power is still directed to the service processor remote management subsystem and power supply fans. To completely power off the storage server, you must disconnect the power cords from the power supplies.

Related Information

- "Power Down the Storage Server for Immediate Shutdown Using the Power Button" on page 52
- "Power Down the Storage Server for Immediate Shutdown Using the Oracle CLI" on page 53
- "Power On the Storage Server" on page 168

▼ Disconnect Cables From the Storage Server



Caution - The system supplies standby power to the circuit boards even when the system is powered off.

1. **Depending on the components that you are servicing, either extend the storage server to the maintenance position, or remove the storage server from the rack.**
2. **Power down the storage server.**

   See “Powering Down the Storage Server” on page 51.
3. **Disconnect the power cords from the rear of the storage server.**
4. **Disconnect all data cables from the rear of the storage server.**
5. **Detach and remove the cables from the cable management device.**

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Powering Down the Storage Server” on page 51
- “Extend the Storage Server to the Maintenance Position” on page 55
- “Remove the Storage Server From the Rack” on page 57
- “Reconnect Power and Data Cables” on page 167

▼ Extend the Storage Server to the Maintenance Position

The following components can be serviced with the storage server in the maintenance position:

- Storage drives
- Fan modules
- Power supplies
- DDR4 DIMMs
- PCIe cards
- NVMe cables
- Internal USB drives
- System battery
- Processors
- Disk backplane
- Front indicator modules
- Motherboard

1. **To prevent the rack from tipping forward when the storage server is extended, extend all rack anti-tilt devices.**

   For instructions for stabilizing the rack, see "Stabilize the Rack for Installation" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

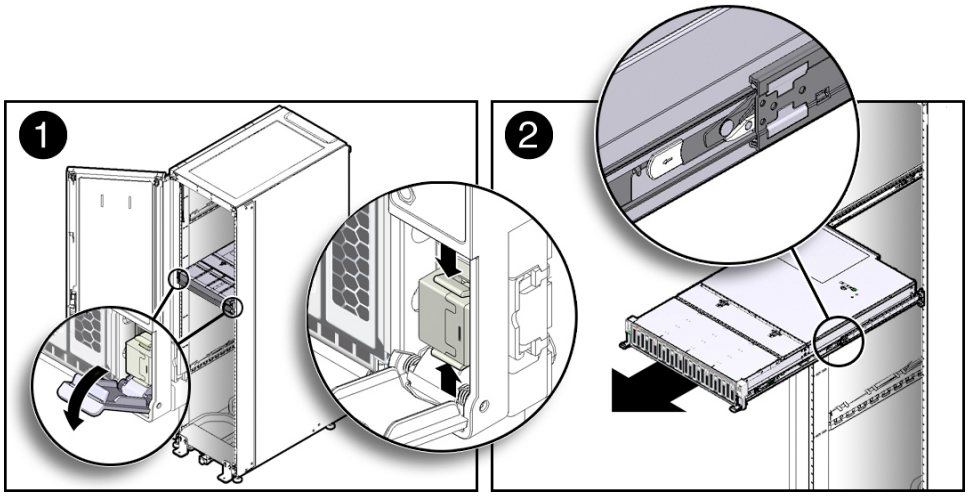
2. **Verify that no cables will be damaged or will interfere when the storage server is extended.**

   Although the cable management arm (CMA) that is supplied with the storage server is hinged to accommodate extending the storage server, you should ensure that all cables and cords are free from obstruction by other devices.

3. **From the front of the storage server, open and hold the left and right release latch covers in the open position.**

   When in an open position, the release latch covers engage the slide-rail release latches [1].

Caution - Deploy any rack anti-tilt mechanism before releasing the slide-rail release latches.



4. **While the release latch covers are in the open position, slowly pull the storage server forward until the slide-rails latch into a locked position [2].**

   The storage server is now in the extended maintenance position.

Related Information

- “Disconnect Cables From the Storage Server” on page 54
- “Remove the Storage Server From the Rack” on page 57
- “Reinstall the Storage Server in the Rack” on page 165

▼ Remove the Storage Server From the Rack

Caution - The storage server weighs approximately 63 pounds (28.5 kg). Two people are required to unmount and carry the chassis.

1. **Disconnect all the cables and power cords from the storage server.**

2. **Remove the cable management arm (CMA).**

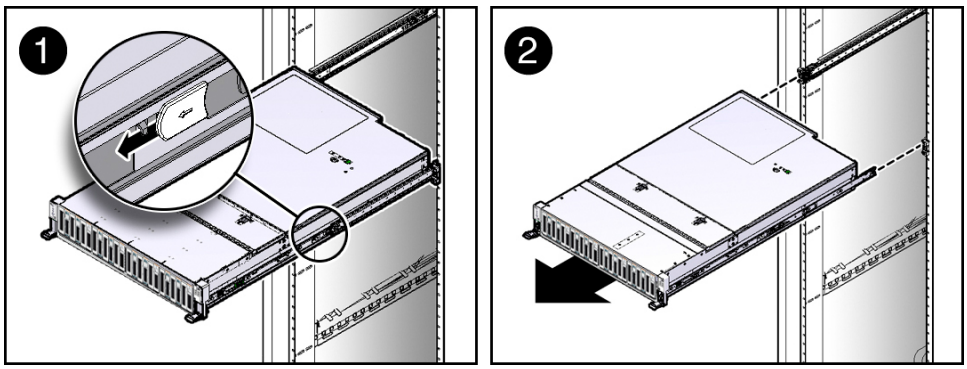
   For instructions for removing the CMA, see the “Remove the Cable Management Arm” in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

3. **Extend the storage server to the maintenance position.**

   See “Extend the Storage Server to the Maintenance Position” on page 55.

4. **From the front of the storage server, pull the green slide-rail release tabs toward the front of the storage server, and pull the storage server out of the rack until it is free of the rack rails [1 and 2].**

   A slide-rail release tab is located on each slide-rail.



5. **Set the storage server on a sturdy work surface.**

Related Information

- “Disconnect Cables From the Storage Server” on page 54
- “Extend the Storage Server to the Maintenance Position” on page 55
- “Reinstall the Storage Server in the Rack” on page 165

▼ Take Antistatic Measures

1. **Prepare an antistatic surface on which to set parts during removal and installation.**

   Place electrostatic discharge (ESD-sensitive components on an antistatic mat. The following items can be used as an antistatic mat:

   - An antistatic bag used to wrap a replacement part
   - An Oracle ESD mat (orderable item)
   - A disposable ESD mat (shipped with some replacement parts or optional system components)

2. **Attach an antistatic wrist strap.**

   When servicing or removing storage server components, attach an antistatic strap to your wrist and then to a metal area on the chassis. Then perform procedures for servicing the storage server.

Note - An antistatic wrist strap is not included in the Accessory Kit for the storage server. However, antistatic wrist straps are included with options and components.

Related Information

- “Extend the Storage Server to the Maintenance Position” on page 55
- “Remove the Storage Server From the Rack” on page 57
- “Remove the Storage Server Top Cover” on page 59
- “Remove the Fan Assembly Door From the Storage Server” on page 60
- “Remove Antistatic Measures” on page 164

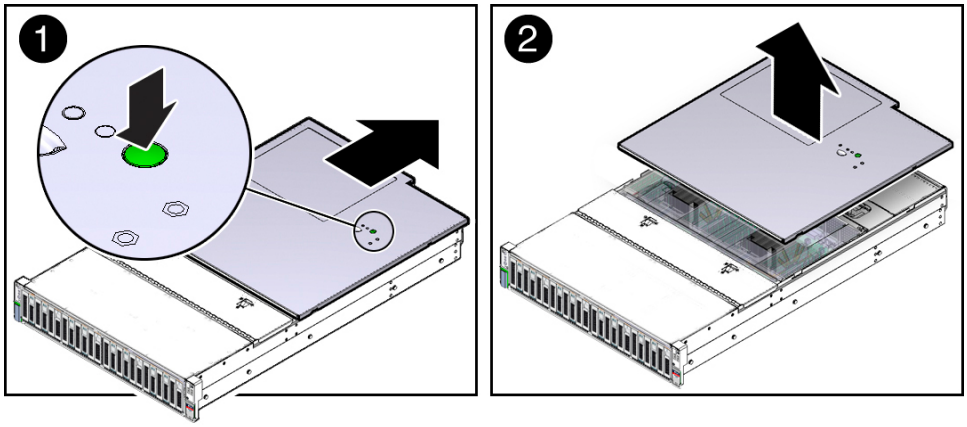
▼ Remove the Storage Server Top Cover

Caution - If you remove the top cover without first removing the AC power cords, then not only will the storage server host shut down, but also this condition will be flagged as a system fault (that is, the fault LEDs will light).

Note - Servicing some components requires that the top cover be removed.

1. **Ensure that the AC power cords are disconnected from the storage server power supplies.**
2. **Unlatch the top cover [1].**

   Press the green release button on the top of the storage server cover.



3. **While pressing the top cover release button, slide the cover toward the rear of the storage server [2].**
4. **If necessary, open the fan assembly door.**
5. **Lift up and remove the top cover [2].**

Related Information

- “Take Antistatic Measures” on page 58

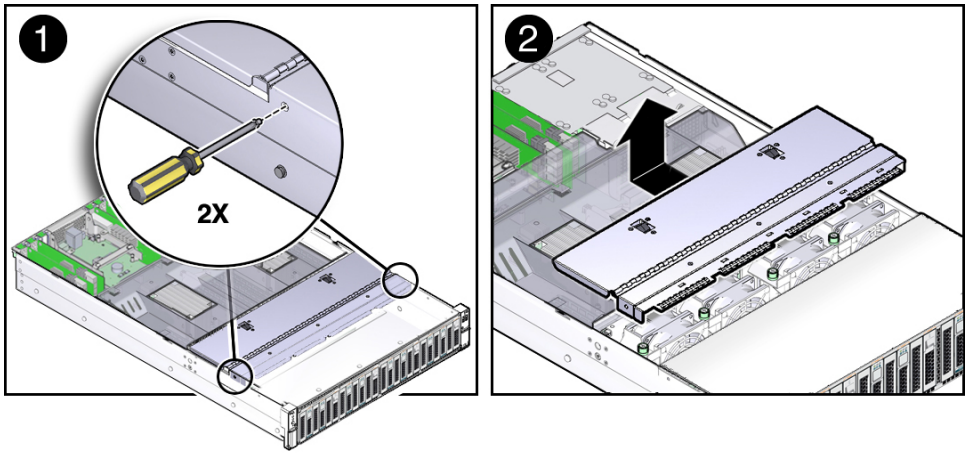
- “Remove the Fan Assembly Door From the Storage Server” on page 60
- “Install the Storage Server Top Cover” on page 162

▼ Remove the Fan Assembly Door From the Storage Server

Before you service the storage server's storage drive backplane, you should first remove the storage server's front fan assembly door.

1. **Ensure that the AC power cords are disconnected from the storage server power supplies.**

2. **Use a No. 2 Phillips screwdriver to remove the two screws on each side of the chassis that secure the fan assembly door [1].**



3. **Slide the fan assembly door toward the rear of the storage server, and lift and remove the door from the chassis [2].**

Related Information

- “Take Antistatic Measures” on page 58
- “Remove the Storage Server Top Cover” on page 59

- “Install the Storage Server Top Cover” on page 162
- “Install the Fan Assembly Door” on page 164

Servicing Components That Do Not Require Storage Server Power-Off

These sections describe how to service replaceable components that do not require you to power off the storage server. For more information, see “Illustrated Parts Breakdown” on page 17 and “Replaceable Components” on page 19.

Description	Links
Service storage and boot drives.	“Servicing Storage Drives” on page 63
Service fan modules.	“Servicing Fan Modules” on page 68
Service power supplies.	“Servicing Power Supplies” on page 73

Related Information

- “Servicing Components That Require Storage Server Power-Off” on page 81

Servicing Storage Drives

These sections describe how to remove and install storage drives.

- “Storage Drives Hot-Plug Conditions” on page 64
- “Remove a Storage Drive” on page 64
- “Install a Storage Drive” on page 67

Related Information

- “Servicing NVMe Cables” on page 122

Storage Drives Hot-Plug Conditions

The NVMe drives installed in the storage server are hot-pluggable, but this capability depends on how the drives are configured. To hot-plug a drive you must be able to take the drive offline before you can remove it. When you take the drive offline, you prevent any application from accessing the drive and remove the logical software links to the drive.

Note - Replacing a drive does not require removing the storage server from a rack.

Related Information

- "Storage and Boot Drive Indicators" on page 29
- "Remove a Storage Drive" on page 64
- "Install a Storage Drive" on page 67

▼ Remove a Storage Drive



Caution - NVMe storage drives are PCIe devices. A PCIe hot-remove operation *must* be performed prior to storage drive removal or a system reset might occur. Refer to your Oracle Exadata documentation for information on required procedures that must be completed prior to removing an NVMe storage drive.

1. **Prepare the system for the drive removal.**

   Refer to "Take Antistatic Measures" on page 58.

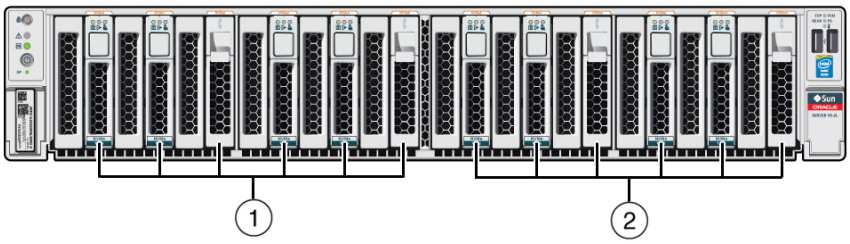
2. **Type the operating system commands required to stop the storage server from using the drive.**

   The exact commands required depend on the configuration of your drives. Unmount file systems, or issue RAID commands as needed.

   Note - The blue OK to Remove status indicator LED on the drive will light once a PCIe hot-remove operation has completed. Do not remove the drive until this LED indicator is lit, otherwise a system reset could occur.

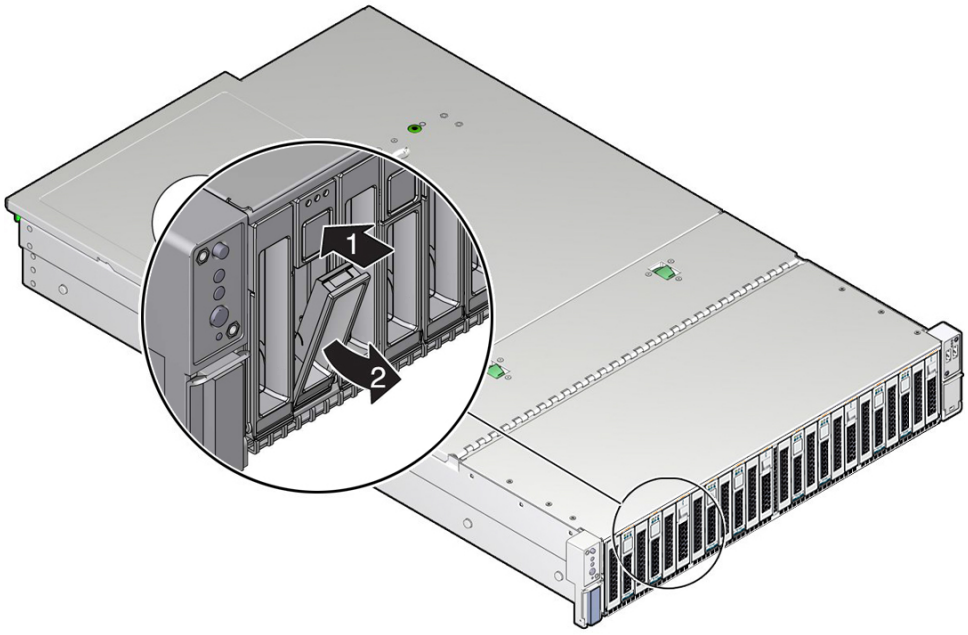
3. **Identify the location of the drive that you want to remove.**

The following illustration shows the location of the drives and the internal system software designations for the drives. For information on storage drive status indicators (LEDs), refer to “Storage and Boot Drive Indicators” on page 29.



Callout	Description
1	NVMe Storage drives 0 through 5
2	NVMe Storage drives 6 through 11

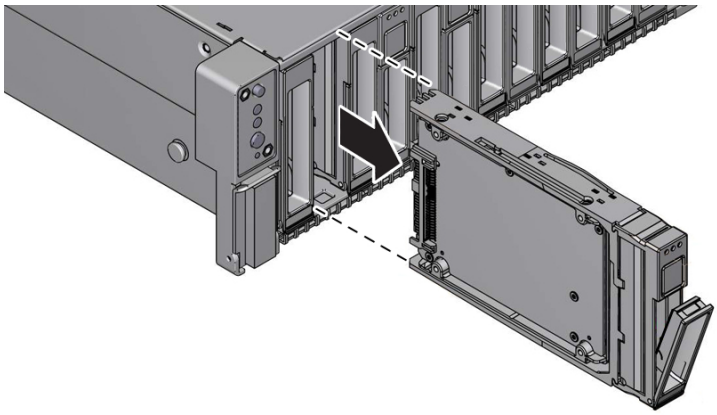
4. **On the drive you plan to remove, push the latch release button to open the drive latch [1, 2].**



Callout	Description
1	Pressing the latch release button.
2	Opening the latch.

Caution - The latch is not an ejector. Do not open the latch too far to the right. Doing so can damage the latch.

5. **Grasp the latch and pull the drive out of the drive slot.**



6. **Consider your next steps:**

   - If you are replacing the drive, continue to “Install a Storage Drive” on page 67.

Caution - Whenever you remove a storage drive, you should replace it with another storage drive; otherwise, the storage server might overheat due to improper airflow.

Related Information

- “Storage and Boot Drive Indicators” on page 29
- “Storage Drives Hot-Plug Conditions” on page 64
- “Install a Storage Drive” on page 67

▼ Install a Storage Drive

1. **Remove the replacement drive from its packaging, and place the drive on an antistatic mat.**

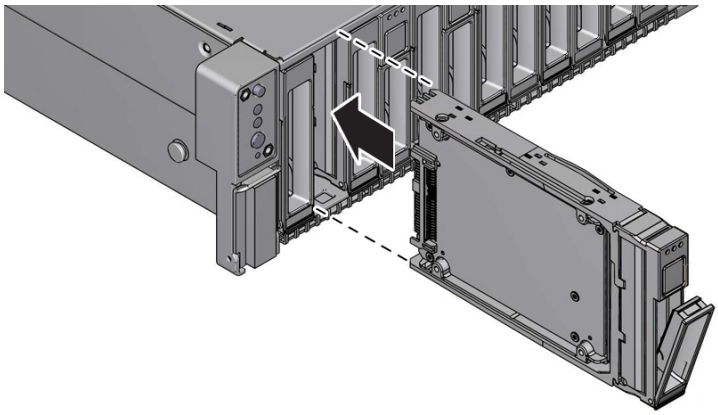
2. **If necessary, remove the drive filler panel.**

   The system might have filler panels covering unoccupied drive slots.

3. **Align the replacement drive with the drive slot.**

   The drive is physically addressed according to the slot in which it is installed. It is important to install a replacement drive in the same slot as the drive that was removed.

4. **Slide the drive into the slot until the drive is fully seated.**



5. **Close the drive latch to lock the drive in place.**

6. **Perform administrative procedures to reconfigure the drive.**

Related Information

- “Storage and Boot Drive Indicators” on page 29
- “Storage Drives Hot-Plug Conditions” on page 64
- “Remove a Storage Drive” on page 64

Servicing Fan Modules

The fan modules are located in the front of the storage server. See the following procedures:

- “Remove a Fan Module” on page 69
- “Install a Fan Module” on page 72

Related Information

- “Remove the Storage Server Top Cover” on page 59

▼ Remove a Fan Module

You do not have to power off the storage server to service fan modules.

You should not begin this procedure unless you have a replacement fan module and you are ready to install it right away.

1. **Extend the storage server to the maintenance position.**

   See “Extend the Storage Server to the Maintenance Position” on page 55.

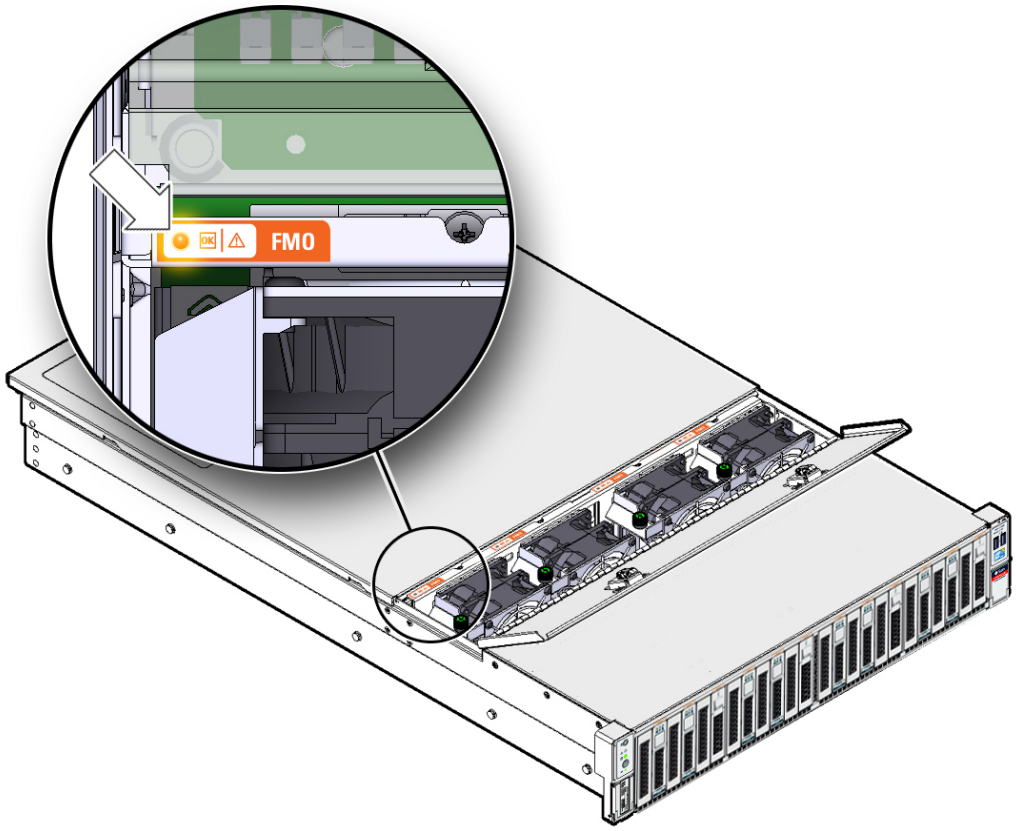
2. **To access the fan modules, open the top cover fan assembly door.**



Caution - Close the top cover fan assembly door within 60 seconds to maintain adequate airflow to properly cool the storage server. Leaving the door open for more than 60 seconds, while the storage server is running, might cause the storage server to automatically shut down.

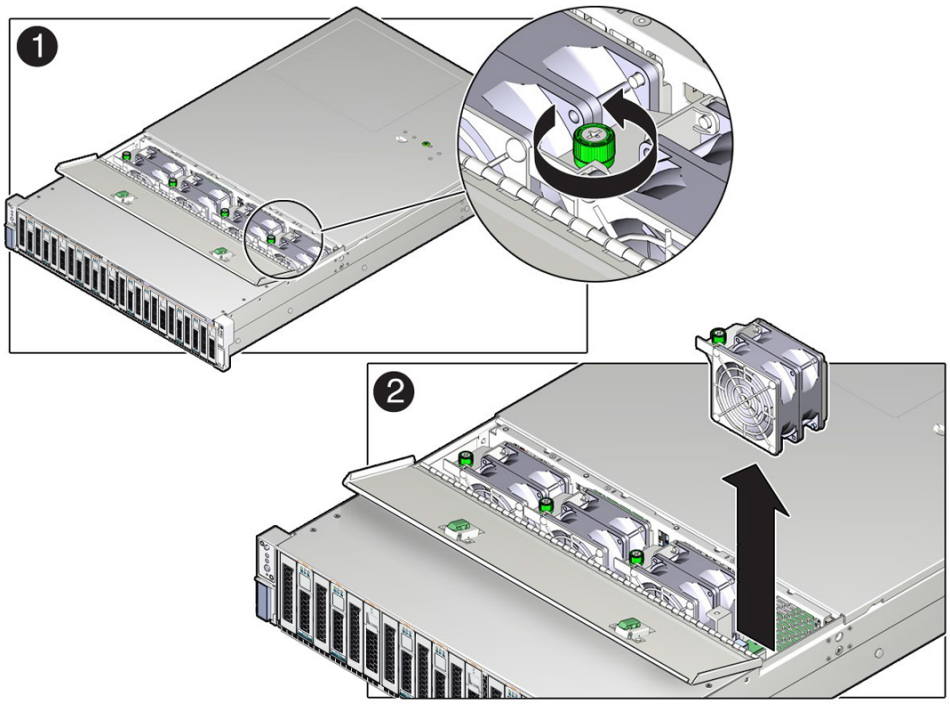
3. **Identify the faulty fan module.**

Each fan module has a fan status indicator (LED) that is located next to the module. If the LED is amber, the fan has failed. The location of the fan status LED is shown in the following figure.



LED Color and State Meaning
Amber – The fan module is faulty. The front Top Fan LED and the front and rear panel Service Required LEDs are also lit if the system detects a fan module fault.

4. **Use a No. 2 Phillips screwdriver to loosen the captive screw that secures the faulty fan module in the chassis [1].**



5. **Grasp both the captive screw and the opposite end of the module and lift the fan module straight up and out of the chassis, and set it aside on an antistatic mat [2].**

Caution - When removing a fan module, do not rock it back and forth. Rocking the fan module can cause damage to the motherboard connectors.

Caution - Do not service any other components in the fan compartment unless the system is shut down and the power cords are removed.

6. **Consider your next step:**

- If you removed the fan assembly as part of another procedure, return to that procedure.
- Otherwise, continue to "Install a Fan Module" on page 72.

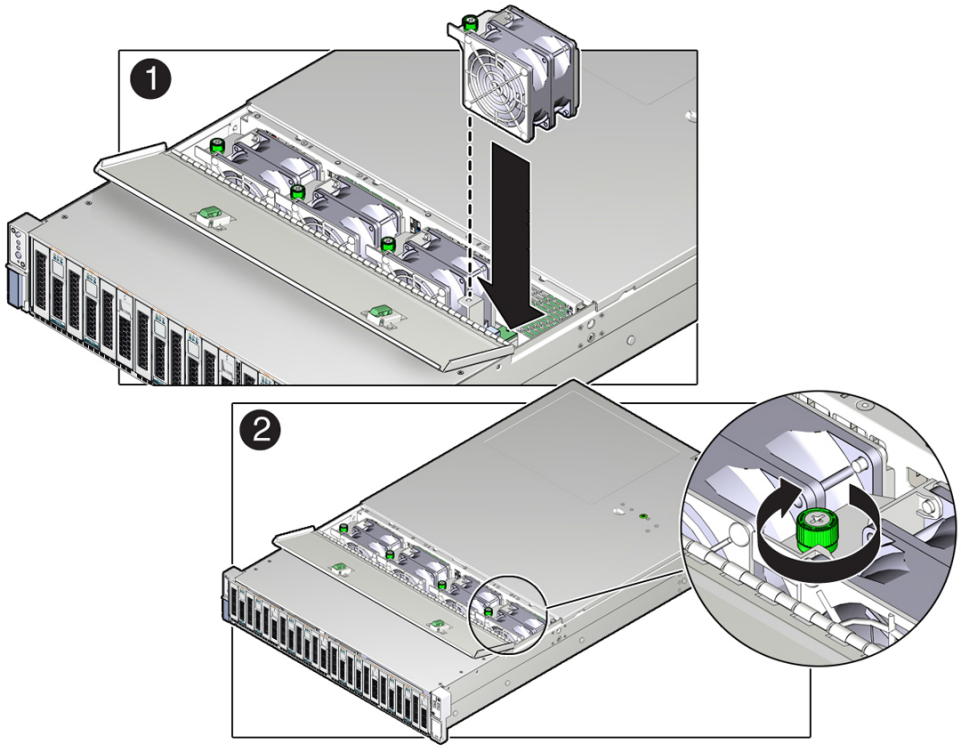
Related Information

- “Install a Fan Module” on page 72

▼ Install a Fan Module

1. **Remove the replacement fan module from its packaging, and place it on an antistatic mat.**

2. **With the top cover fan assembly door open, install the replacement fan module into the storage server [1].**
   The fan modules are keyed to ensure that they are installed in the correct orientation.



3. **Press down on the fan module and apply firm pressure to fully seat the fan module.**

4. **Verify that the fan module status indicator (LED) on the replacement fan module is not illuminated.**

5. **Using your thumb and forefinger, tighten the captive screw to secure the fan module to the chassis. Then use a No. 2 Phillips screwdriver to tighten the screw an additional 1/4 turn to secure the fan module to the chassis [2].**

6. **Close the top cover fan assembly door.**

7. **Verify that the Top Fan Fault LED on the front of the storage server and the Service Required LEDs on the front and rear of the storage server are extinguished.**

   See “Storage Server System-Level Status Indicators” on page 27 for more information about identifying and interpreting system status indicators.

8. **Consider your next step:**

   - If you installed the fan module as part of another procedure, return to that procedure.
   - Otherwise, return the storage server to operation. See “Returning the Storage Server to Operation” on page 161.

Related Information

- “Remove a Fan Module” on page 69

Servicing Power Supplies

The storage server's redundant power supplies support concurrent maintenance, which enables you to remove and replace a power supply without shutting down the storage server, provided that the other power supply is online and working.

The storage server supports model A258 (1000 watt) power supplies. The A258 power supply unit (PSU) provides conversion from the AC lines to the system, accepting ranges from 100-240 volts AC (VAC). These PSUs are designed to be hot-swappable, and in most cases will provide fully redundant “1+1” power, allowing the system to suffer the loss of a PSU or an AC feed with no loss to system availability.

In maximally configured systems, it is possible that the worst-case power consumption of the system could exceed the capacity of a single PSU. The PSUs provide an over-subscription mode, which allows the system to operate with fault-tolerance even with modest excursions

beyond the rated capacity of a single PSU. This over-subscription support is accomplished using hardware signaling between the PSU and motherboard circuitry, which can force the system to throttle CPU and memory power in the event that a PSU is lost. The resulting power savings will be enough to allow the system to continue to run (in a lower-performance state) until the power problem is resolved.

The following status indicators (LEDs) are lit when a power supply fault is detected:

- Front and rear Service Required LEDs
- Amber Service Required LED on the faulty power supply
- Rear Power Supply Fault LED located on the storage server front panel

If a power supply fails and you do not have a replacement available, leave the failed power supply installed to ensure proper airflow in the storage server. For more information, refer to the following topic and procedures:

- “Power Supply Status Indicators” on page 30
- “Remove a Power Supply” on page 74
- “Install a Power Supply” on page 77

Related Information

- “Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators ” on page 26
- “Powering Down the Storage Server” on page 51

▼ Remove a Power Supply

1. **Prepare the system for power supply removal.**

   Refer to “Take Antistatic Measures” on page 58.

2. **Identify which power supply requires replacement.**

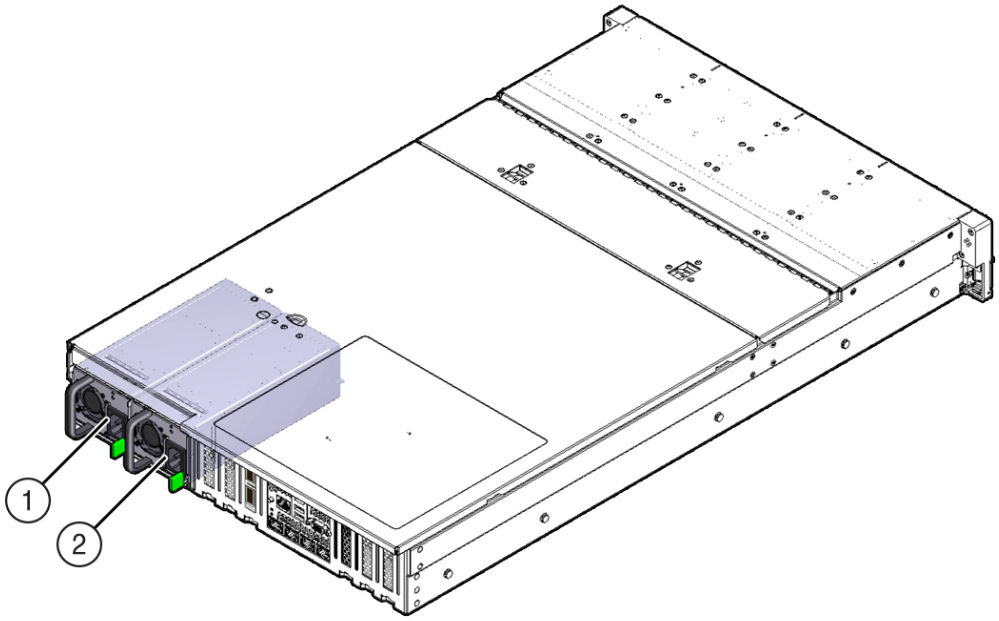


Figure Legend	Description
1	Power supply 0
2	Power supply 1

A lit amber Service Required LED on a power supply indicates that a failure was detected. You can also use the Oracle ILOM `show faulty` command at the Oracle ILOM command-line prompt (`->`) to identify a power supply failure.

Alternatively, to list all known faults in the server, log into the Oracle Solaris OS and issue the `fmadm faulty` command, or log into the Oracle ILOM service processor from the Oracle ILOM Fault Management Shell and issue the `fmadm faulty` command. For more information about how to use the Oracle ILOM Fault Management Shell and supported commands, see the *Oracle ILOM User's Guide for System Monitoring and Diagnostics Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

Note - The fans of a failed power supply might still be spinning when the system is powered on. The fans will stop spinning when you disconnect the power cords.

3. **Gain access to the rear of the storage server where the faulty power supply is located.**

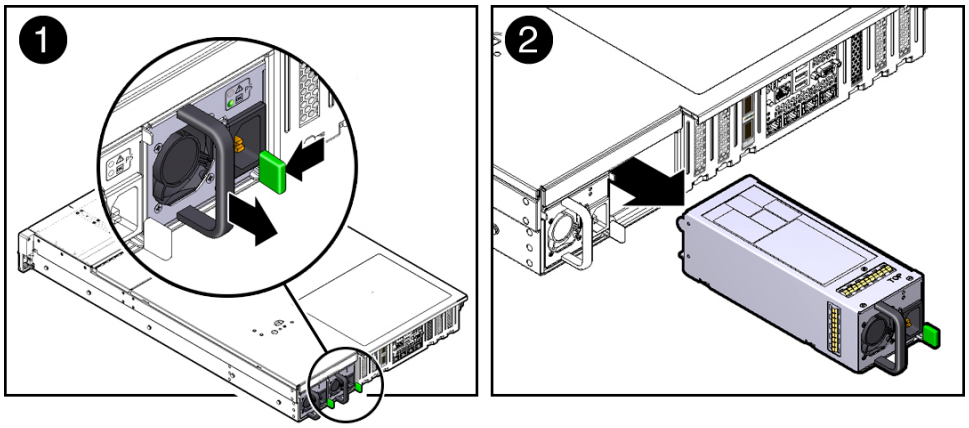
4. **Disconnect both cable management arm (CMA) left-side connectors and move the CMA out of the way.**

   For instructions for disconnecting the CMA left-side connectors, refer to "Remove the Cable Management Arm" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

Caution - When disconnecting the CMA left-side connectors, be sure to use your arm to support the CMA so that it does not hang down under its own weight and stress the right-side connectors; otherwise, the CMA might be damaged. You must continue to support the CMA until you have reconnected both of the left-side connectors.

5. **Disconnect the power cord from the faulty power supply.**

6. **Grasp the power supply handle and push the power supply latch to the left [1].**



7. **Pull the power supply out of the chassis [2].**

Caution - Whenever you remove a power supply, you should replace it with another power supply; otherwise, the storage server might overheat due to improper airflow.

8. **Continue to “Install a Power Supply” on page 77.**

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Power Supply Status Indicators” on page 30
- “Install a Power Supply” on page 77

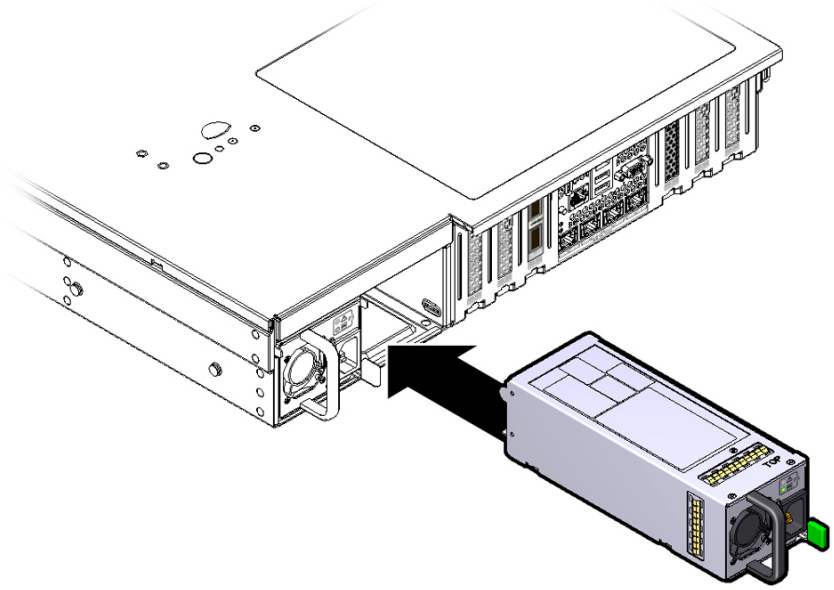
▼ Install a Power Supply



Caution - Always replace the failed power supply with the same type model of power supply.

1. **Remove the replacement power supply from its packaging, and place it on an antistatic mat.**
2. **Align the replacement power supply with the empty power supply slot.**
3. **Slide the power supply into the slot until it is fully seated.**

You will hear an audible click when the power supply fully seats.



4. **Reconnect the power cord to the power supply.**

5. **Verify that the amber Service Required LED on the replaced power supply and the Service Required LEDs are not lit on the front and rear panels.**

Note - After you have replaced Power Supply 0, you might need to reset the Oracle ILOM service processor (SP) to propagate the key identity properties (KIP) data to the new power supply. For instructions on resetting the SP, see the *Oracle Integrated Lights Out Manager (ILOM) 3.2 Configuration and Maintenance Guide* at `http://www.oracle.com/goto/ilom/docs`. Power Supply 1 does not contain KIP data, and therefore does not require an SP reset after replacement.

---

6. **Reconnect the two CMA left-side connectors.**

   For instructions for reconnecting the CMA left-side connectors, refer to "Install the Cable Management Arm" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Power Supply Status Indicators” on page 30
- “Remove a Power Supply” on page 74

Servicing Components That Require Storage Server Power-Off

These sections describe how to service replaceable components that require you to power off the storage server. For more information, see “Illustrated Parts Breakdown” on page 17 and “Replaceable Components” on page 19.

Description	Links
Service the DIMMs.	“Servicing the DIMMs” on page 81
Service the PCIe cards.	“Servicing PCIe Cards” on page 91
Service the internal USB flash drives.	“Servicing the Internal USB Flash Drives” on page 98
Service the battery.	“Servicing the Battery” on page 101
Service the processors.	“Servicing Processors” on page 103
Service the storage drive backplane.	“Servicing the Storage Drive Backplane” on page 117
Service NVMe cables.	“Servicing NVMe Cables” on page 122
Service the front indicator LED/USB modules.	“Servicing the Front LED/USB Indicator Modules” on page 131
Service the motherboard assembly.	“Servicing the Motherboard Assembly” on page 145

Related Information

- “Servicing Components That Do Not Require Storage Server Power-Off” on page 63

Servicing the DIMMs

The Oracle Exadata Storage Server X5-2 Extreme Flash supports 8-GB single-rank (SR) DIMMs.

Caution - These procedures require that you handle components that are sensitive to electrostatic discharge. This sensitivity can cause the components to fail. To avoid damage, ensure that you follow antistatic practices as described in "Electrostatic Discharge Safety" on page 48.

Caution - Ensure that all power is removed from the storage server before removing or installing DIMMs, or damage to the DIMMs might occur. You must disconnect all power cables from the system before performing these procedures.

The following topics and procedures provide information to assist you when replacing a DIMM or upgrading DIMMs:

- "DIMM and Processor Physical Layout" on page 82
- "DIMM Population Rules" on page 83
- "Inconsistencies Between DIMM Fault Indicators and the BIOS Isolation of Faulty DIMMs" on page 84
- "Using the Storage Server Fault Remind Button" on page 84
- "Identify and Remove a Faulty DIMM" on page 85
- "Install a DIMM" on page 89

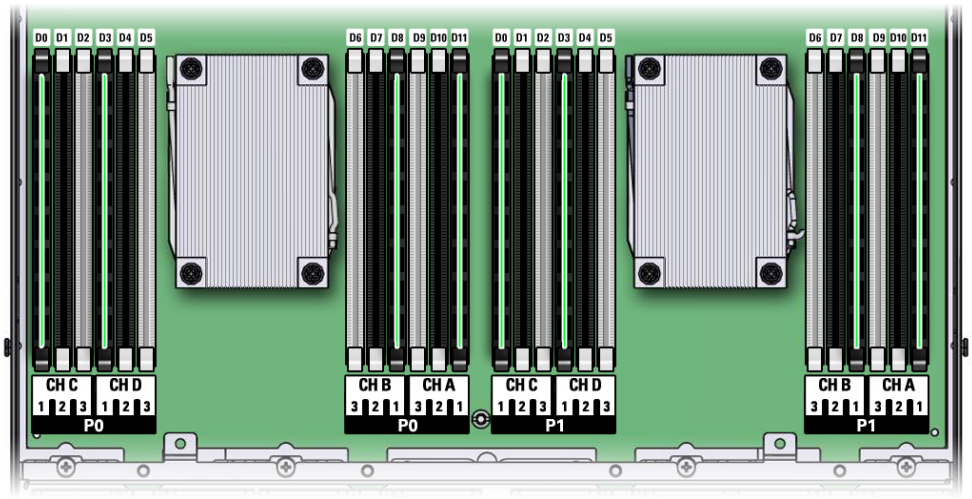
Related Information

- "Servicing Processors" on page 103

DIMM and Processor Physical Layout

The physical layout of the DIMMs and processor(s) is shown in the following figure. When viewing the storage server from the front, processor 0 (P0) is on the left. Notice that each processor, P0 and P1, have four memory channels that are labeled, from left to right, Ch C, Ch D, Ch B, and Ch A. Within each memory channel, only black sockets are populated with DIMMs.

FIGURE 3 DIMM and Processor Physical Layout



Related Information

- "DIMM Population Rules" on page 83

DIMM Population Rules

The population rules for adding DIMMs to the storage server are as follows:

- The storage server supports only 8-GB single-rank (SR) RDIMMs, labeled 1Rx4. Do not attempt to install any other DIMM sizes in the storage server.
- Within each memory channel (four per processor), populate only the black DIMM socket with a DIMM.
- Each processor supports four 8 GB DIMMs, for a maximum of 64 GB of memory.

Inconsistencies Between DIMM Fault Indicators and the BIOS Isolation of Faulty DIMMs

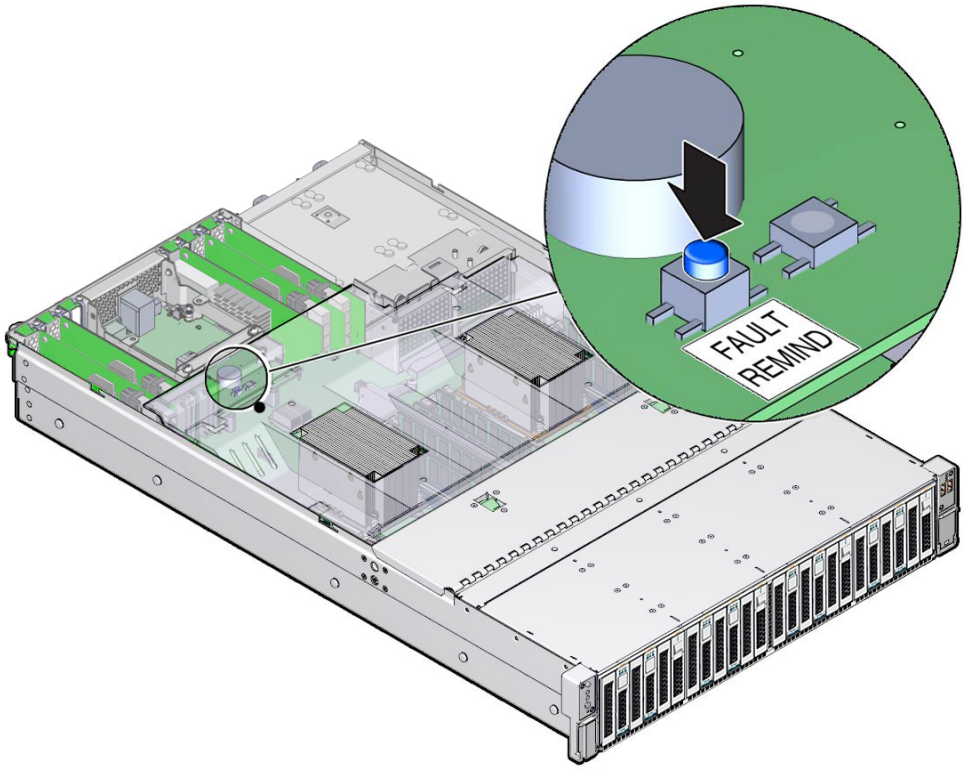
When a single DIMM is marked as failed by Oracle ILOM (for example, `fault.memory.intel.dimm.training-failed` is listed in the SP Event Log), BIOS might disable the entire memory channel that contains the failed DIMM, up to three DIMMs. As a result, none of the memory installed in the disabled channel will be available to the operating system. However, when the Fault Remind button is pressed, only the fault status indicator (LED) associated with the failed DIMM lights. The fault LEDs for the other DIMMs in the memory channel remain off. Therefore, you can correctly identify the failed DIMM.

Using the Storage Server Fault Remind Button

When the storage server Fault Remind button is pressed, an LED located next to the Fault Remind button lights green to indicate that there is sufficient voltage present in the fault remind circuit to light any fault LEDs that were lit due to a component failure. If this LED does not light when you press the Fault Remind button, it is likely that the capacitor powering the fault remind circuit has lost its charge. This can happen if the Fault Remind button is pressed for several minutes with fault LEDs lit or if power has been removed from the storage server for more than 15 minutes.

The following figure shows the location of the Fault Remind button.

FIGURE 4 Fault Remind Button Location



▼ Identify and Remove a Faulty DIMM

1. **Prepare the storage server for service.**

   a. **Power off the storage server, and disconnect the power cords from the storage server power supplies.**

      See "Powering Down the Storage Server" on page 51.

   b. **Extend the storage server into the maintenance position.**

See “Extend the Storage Server to the Maintenance Position” on page 55.

c. **Attach an antistatic wrist strap to your wrist and then to a metal area on the chassis.**

See “Electrostatic Discharge Safety” on page 48.

d. **Remove the storage server top cover.**

See “Remove the Storage Server Top Cover” on page 59.

e. **Swivel the air baffle into the upright position to allow access to DIMMs.**

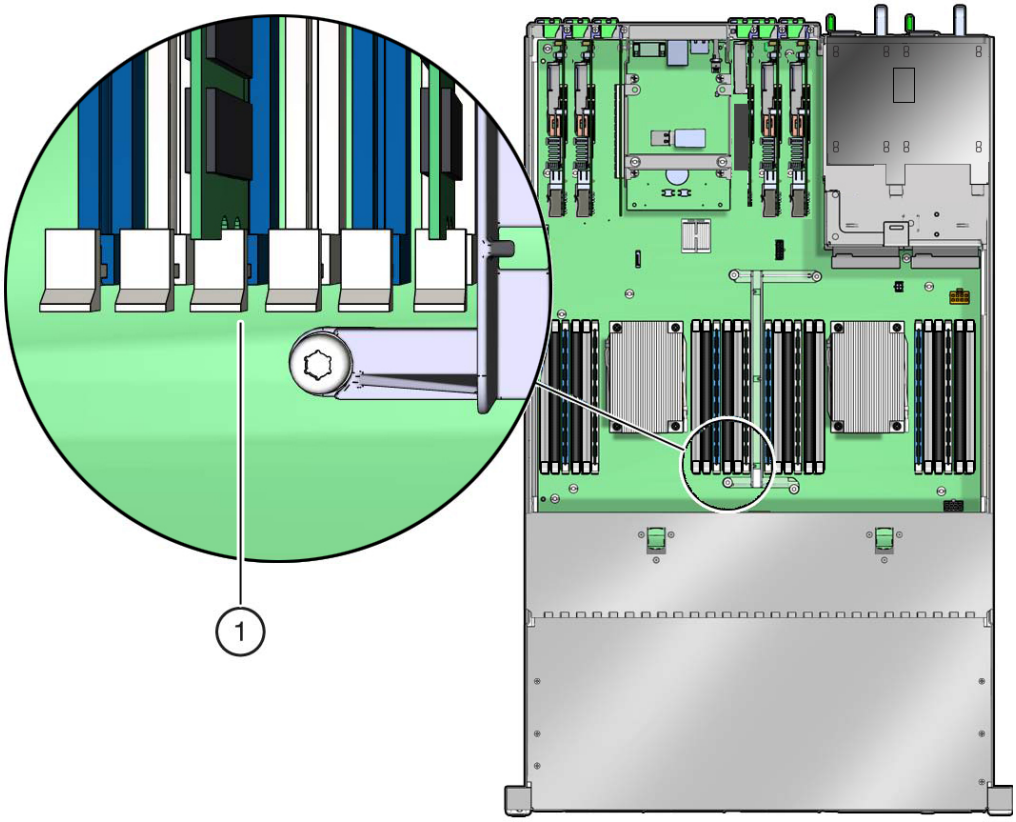
2. **Identify and note the location of the faulty DDR4 DIMM by pressing the Fault Remind button on the motherboard I/O card.**

See “Using the Storage Server Fault Remind Button” on page 84.

Faulty DIMMs are identified with a corresponding amber LED on the motherboard.

- If the DIMM fault LED is off, then the DIMM is operating properly.

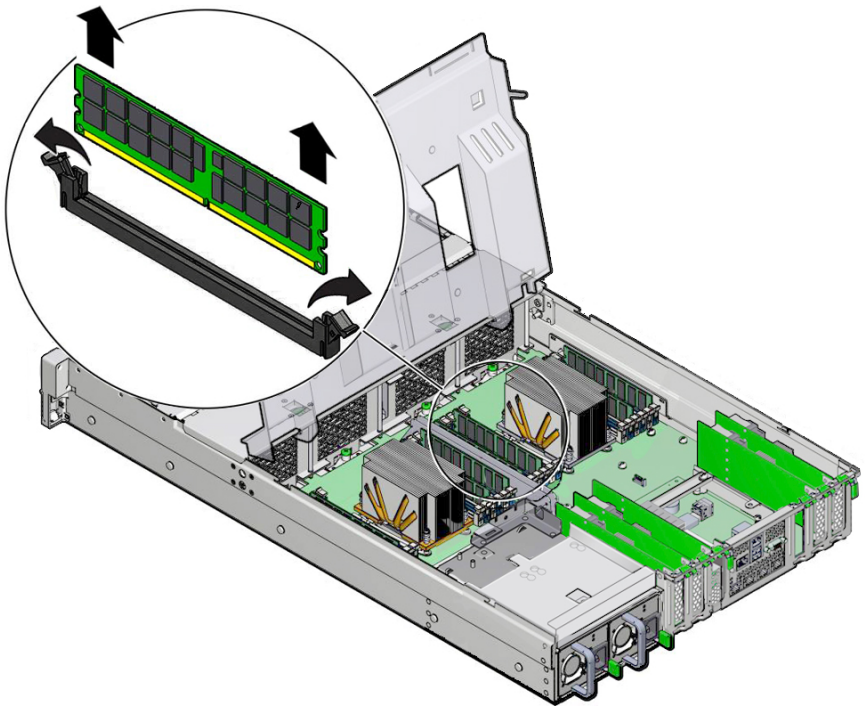
- If the DIMM fault LED is on (amber), then the DIMM is faulty and should be replaced [1].



3. **To remove the faulty DIMM, do the following:**

   a. **Rotate both DIMM socket ejectors outward as far as they will go.**

The DIMM is partially ejected from the socket.



b. Carefully lift the DIMM straight up to remove it from the socket.

4. Replace each faulty DIMM with another DIMM of the same rank size (8-GB, single-rank).

For DIMM replacement instructions, see “Install a DIMM” on page 89.

Related Information

- “DIMM and Processor Physical Layout” on page 82
- “DIMM Population Rules” on page 83
- “Install a DIMM” on page 89

Install a DIMM

1. **Unpack the replacement DDR4 DIMM and place it on an antistatic mat.**
2. **Ensure that the replacement DDR4 DIMM matches the size of the DIMM it is replacing.**

   For DIMM socket population rules, see “DIMM Population Rules” on page 83.
3. **Install a DIMM.**

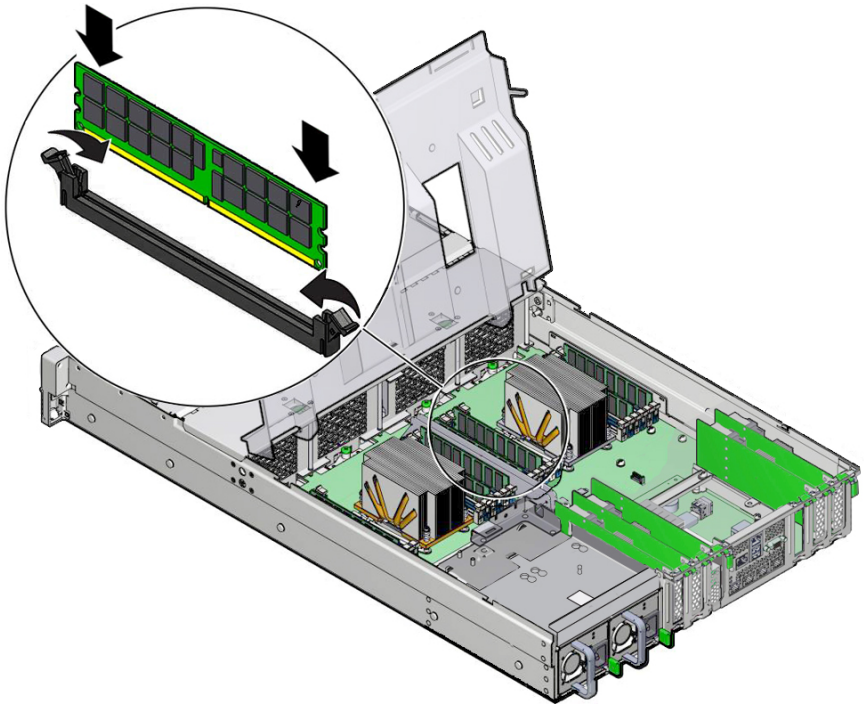
   a. **Ensure that the ejector tabs are in the open position.**

   b. **Align the notch in the replacement DIMM with the connector key in the connector socket.**

      The notch ensures that the DIMM is oriented correctly.

   c. **Push the DDR4 DIMM into the connector socket until the ejector tabs lock the DIMM in place.**

If the DIMM does not easily seat into the connector socket, verify that the notch in the DIMM is aligned with the connector key in the connector socket. If the notch is not aligned, damage to the DIMM might occur.



4. **Repeat Step 3 until all replacement DIMMs are installed.**
5. **Return the storage server to operation:**
   a. **Lower the air baffle to the installed position.**
   b. **Install the storage server top cover.**
      See "Install the Storage Server Top Cover" on page 162.
   c. **Return the storage server to the normal rack position.**
      See "Return the Storage Server to the Normal Rack Position" on page 165.
   d. **Reconnect the power cords and data cables to the storage server.**

See “Reconnect Power and Data Cables” on page 167.

e. **Power on the storage server.**

See “Power On the Storage Server” on page 168.

Verify that the power supply AC OK LED is lit.

6. **(Optional) Use Oracle ILOM to clear storage server DDR4 DIMM faults.**

DDR4 DIMM faults are automatically cleared after a new DIMM has been installed. If you need to manually clear DDR4 DIMM faults, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

Note - If you want to move a faulty DDR4 DIMM to a new DIMM socket or re-seat a DIMM for troubleshooting, you must first manually clear the associated DIMM fault. Otherwise, the DIMM fault might follow the DIMM to the new socket location or reoccur on the current socket location, causing a false DIMM fault condition.

Related Information

- “DIMM and Processor Physical Layout” on page 82
- “DIMM Population Rules” on page 83
- “Identify and Remove a Faulty DIMM” on page 85

Servicing PCIe Cards

These sections describe how to service and install PCIe cards. Refer to your PCIe card documentation for complete software and cabling information about your card.



Caution - These procedures require that you handle components that are sensitive to electrostatic discharge. This sensitivity can cause the components to fail. To avoid damage, ensure that you follow antistatic practices as described in “Take Antistatic Measures” on page 58.



Caution - Ensure that all power is removed from the storage server before removing or installing PCIe cards. You must disconnect all power cables from the system before performing these procedures.

This section covers the following topics:

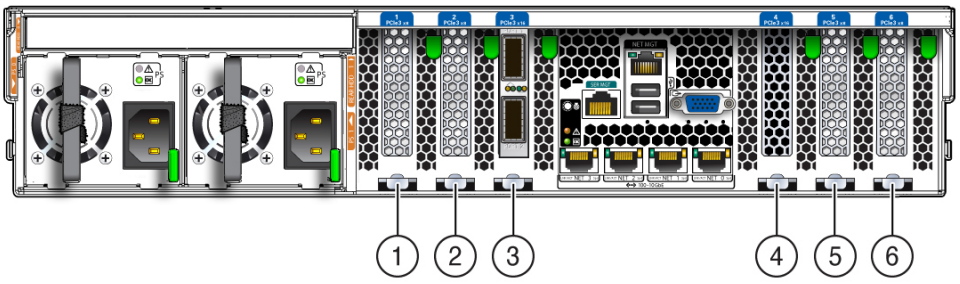
- "PCIe Slot Locations" on page 92
- "Remove a PCIe Card" on page 93
- "Install a PCIe Card" on page 95

Related Information

- "Servicing NVMe Cables" on page 122

PCIe Slot Locations

There are six PCIe slots available for optional PCIe cards. The following figure shows the PCIe slot numbering.



Call Out	Description
1	PCIe slot 1 (Oracle PCIe NVMe switch card)
2	PCIe slot 2 (Oracle PCIe NVMe switch card)
3	PCIe slot 3 (InfiniBand QDR-CX3 PCIe HCA card)
4	PCIe slot 4
5	PCIe slot 5 (Oracle PCIe NVMe switch card)
6	PCIe slot 6 (Oracle PCIe NVMe switch card)

Note - All of the PCIe slots comply with the PCI Express 3.0 specification and can accommodate 25 Watt PCIe3 cards.

Related Information

- “Remove a PCIe Card” on page 93
- “Install a PCIe Card” on page 95

▼ Remove a PCIe Card

Note - Prior to replacing or installing a PCIe card, refer to the card documentation for specific installation and cabling instructions.

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the power supplies.**

      See “Powering Down the Storage Server” on page 51.

   b. **Extend the storage server to the maintenance position.**

      See “Extend the Storage Server to the Maintenance Position” on page 55.

   c. **Attach an antistatic wrist strap.**

      See “Electrostatic Discharge Safety” on page 48.

   d. **Remove the storage server top cover.**

      See “Remove the Storage Server Top Cover” on page 59.

   e. **Swivel the air baffle into the upright position to allow access to PCIe cards.**

2. **Locate the PCIe card that you want to remove.**

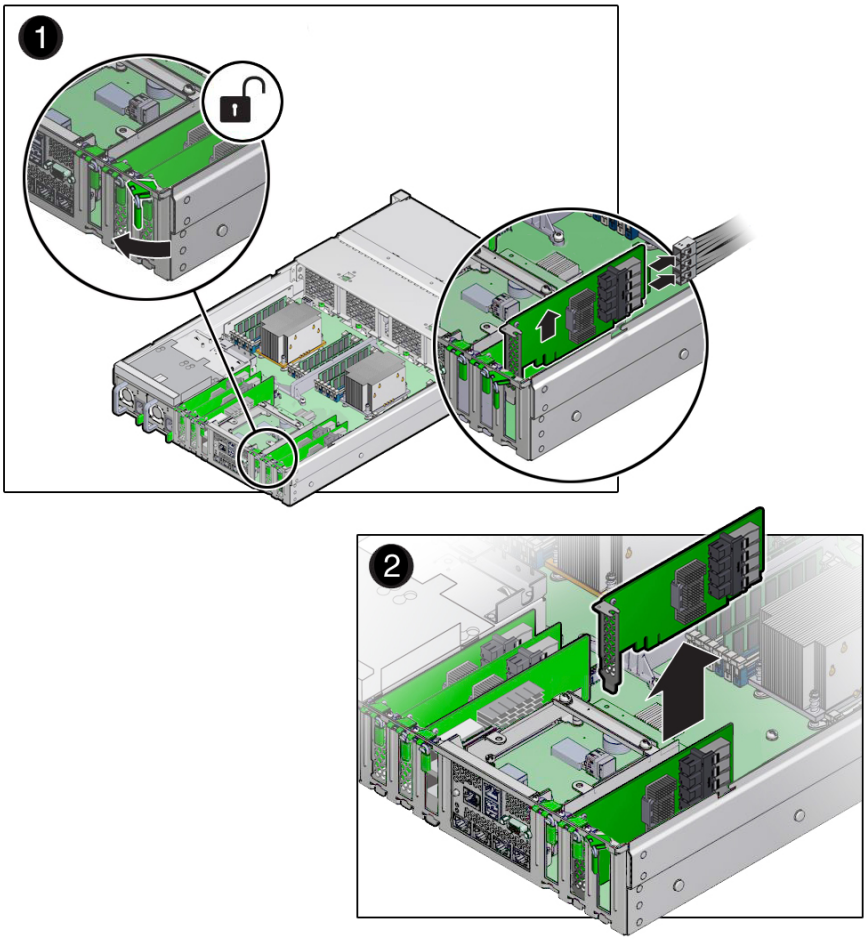
   See “PCIe Slot Locations” on page 92.

3. **If necessary, recrod where the PCIe cards are installed.**

4. **Unplug all data cables from the PCIe card [1].**

   Note the cable connections in order to ease proper reconnection of the cables.

5. **Rotate the PCIe card locking mechanism [1], and then lift up on the PCIe card to disengage it from the motherboard connectors [2].**



6. **Place the PCIe card on an antistatic mat.**

Caution - If you are not immediately inserting a replacement PCIe card into the empty slot, insert a PCIe filler panel in the slot to reduce the possibility of radiated electromagnetic interference (EMI). For instructions for installing a PCIe filler panel, see "Remove and Install Filler Panels" on page 162.

Related Information

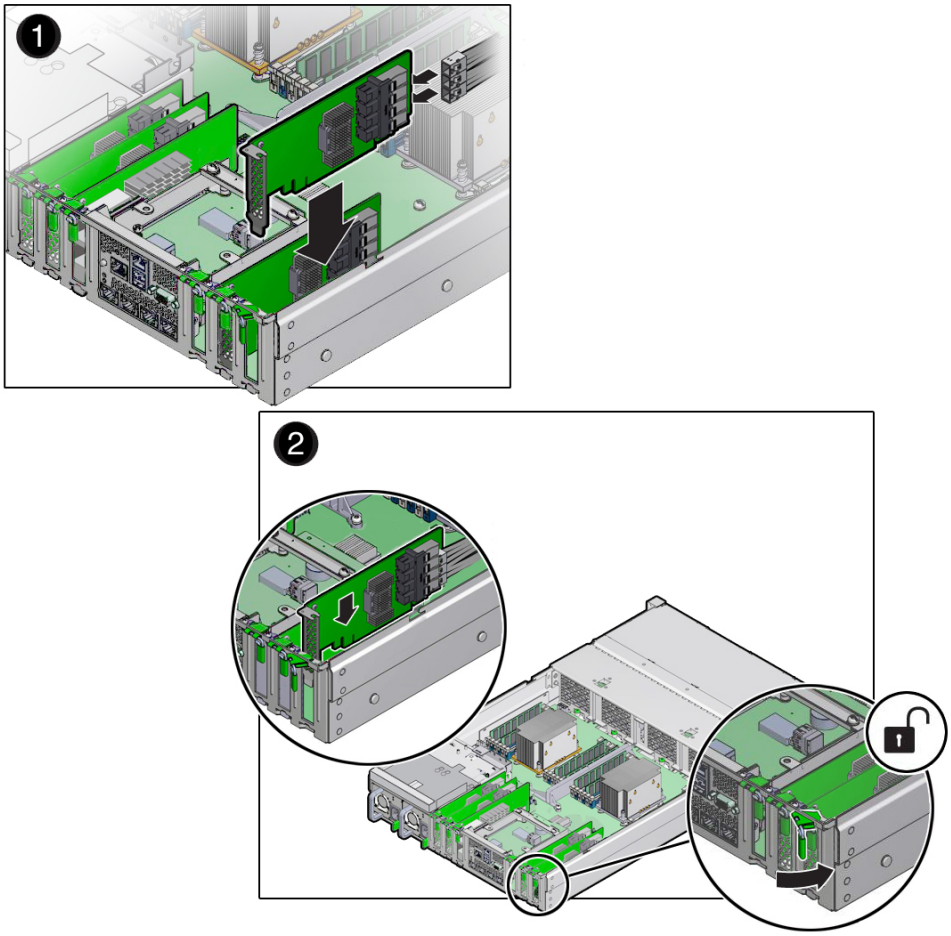
- “PCIe Slot Locations” on page 92
- “Install a PCIe Card” on page 95

▼ Install a PCIe Card

1. **Unpack the replacement PCIe card, and place it on an antistatic mat.**
2. **Locate the proper PCIe slot for the card you are replacing.**
3. **If necessary, remove the PCIe filler panel from the slot.**

Note - Save this filler panel in case you need to remove the PCIe card from the system.

4. **Insert the PCIe card into the correct slot [1], and rotate the PCIe locking mechanism to secure the PCIe card in place [2].**



5. **Reconnect the cables to the PCIe card that you unplugged during the removal procedure [2].**

See also "Install NVMe Cables" on page 125.

Note - After replacing an Oracle PCIe NVMe switch card, the NVMe cable connection test procedure *must* be performed before booting the storage server operating system. This procedure ensures that NVMe PCIe cabling is correct prior to booting the operating system. See "Verify NVMe Cable Connections" on page 128.

6. **Return the storage server to operation.**

   a. **Lower the air baffle to the installed position.**

   b. **Install the top cover.**

      See "Install the Storage Server Top Cover" on page 162.

   c. **Return the storage server to the normal rack position.**

      See "Return the Storage Server to the Normal Rack Position" on page 165.

   d. **Connect any required data cables to the PCIe card.**

      Route data cables through the cable management arm.

   e. **Reconnect the power cords to the power supplies and power on the storage server.**

      See "Reconnect Power and Data Cables" on page 167 and "Power On the Storage Server" on page 168. Verify that the AC OK LED is lit.

7. **Use Oracle ILOM to clear any storage server PCIe card faults.**

   If a PCIe card fault message in Oracle ILOM is not cleared under Open Problems, you must manually clear the fault in Oracle ILOM. For instructions for manually clearing a PCIe card fault, see the procedure "Clear Faults for Undetected Replaced or Repaired Hardware Components" in the *Oracle ILOM User's Guide for System Monitoring and Diagnostics Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

8. **To determine whether additional steps are required to complete the installation of the PCIe card, refer to the storage server product notes for the type of PCIe card you installed.**

Related Information

- "PCIe Slot Locations" on page 92
- "Remove a PCIe Card" on page 93

Servicing the Internal USB Flash Drives



Caution - These procedures require that you handle components that are sensitive to electrostatic discharge. This sensitivity can cause the component to fail. To avoid damage, ensure that you follow antistatic practices as described in "Take Antistatic Measures" on page 58.



Caution - Ensure that all power is removed from the storage server before removing or installing a flash drive or damage to the drive might occur. You must disconnect all power cables from the system before performing these procedures.

This section covers the following procedures:

- "Remove an Internal USB Flash Drive" on page 98
- "Install an Internal USB Flash Drive" on page 99

Related Information

- "USB Ports" on page 174

▼ Remove an Internal USB Flash Drive

The storage server is equipped with two internal USB Flash drives.

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the storage server power supplies.**

      See "Powering Down the Storage Server" on page 51.

   b. **Extend the storage server into maintenance position.**

      See "Extend the Storage Server to the Maintenance Position" on page 55.

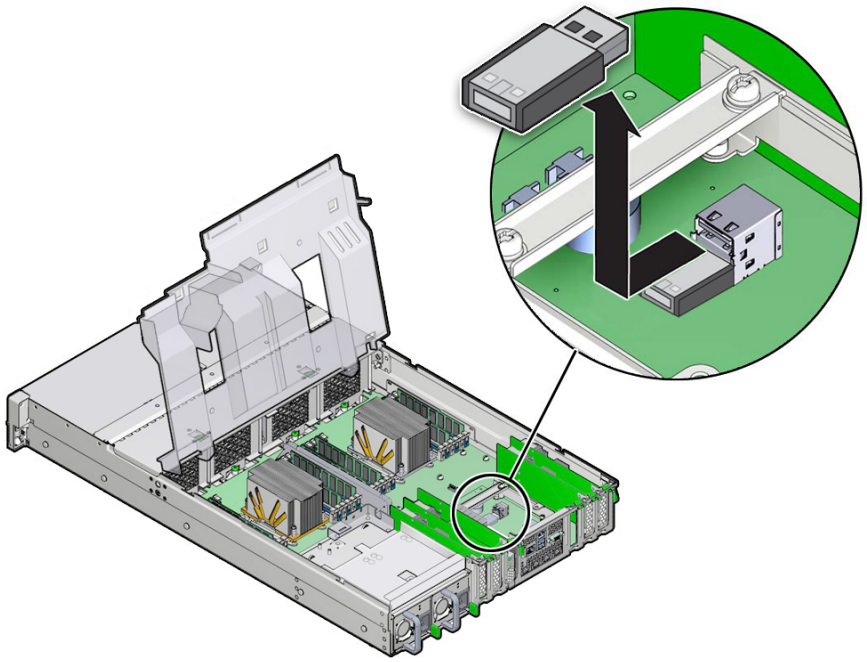
   c. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

      See "Electrostatic Discharge Safety" on page 48.

d. **Remove the storage server top cover.**

   See “Remove the Storage Server Top Cover” on page 59.

2. **To remove a USB flash drive, grasp the flash drive and pull it from the slot.**



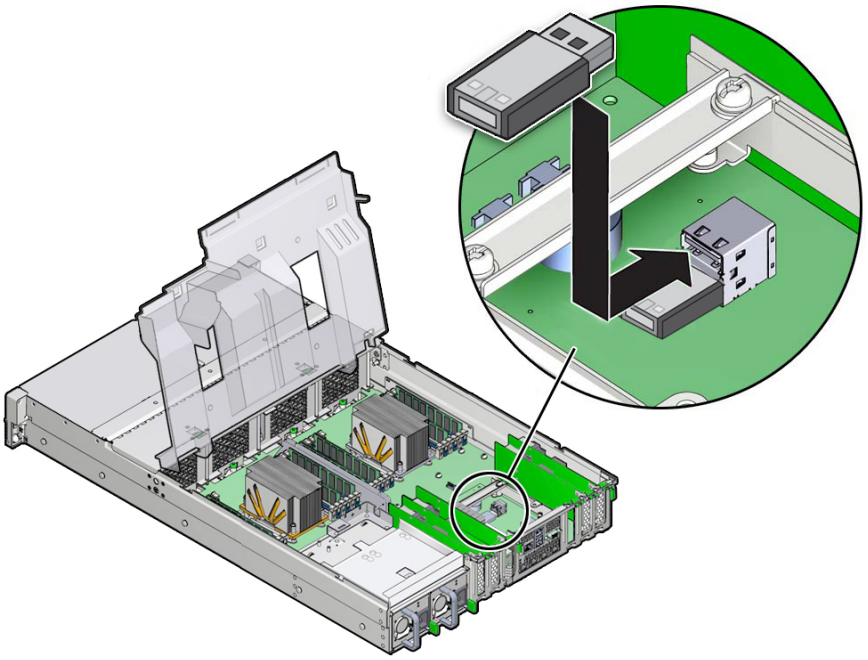
Related Information

- “Install an Internal USB Flash Drive” on page 99

▼ Install an Internal USB Flash Drive

1. **Unpack the replacement USB flash drive.**

2. **Insert the flash drive into the USB slot.**



3. **Return the storage server to operation.**

   a. **Install the storage server top cover.**

      See “Install the Storage Server Top Cover” on page 162.

   b. **Return the storage server to the normal rack position.**

      See “Return the Storage Server to the Normal Rack Position” on page 165.

   c. **Reconnect the power cords to the storage server power supplies and power on the storage server.**

      See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

Related Information

- “Remove an Internal USB Flash Drive” on page 98

Servicing the Battery

The real-time clock (RTC) battery maintains system time when the storage server is powered off and a time storage server is unavailable. If the storage server fails to maintain the proper time when the system is powered off and not connected to a network, replace the battery.



Caution - Ensure that all power is removed from the storage server before removing or installing the battery. You must disconnect the power cables from the system before performing this procedure.

This section covers the following procedures:

- "Remove the Battery" on page 101
- "Install the Battery" on page 102

▼ Remove the Battery

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the storage server power supplies.**

      See "Powering Down the Storage Server" on page 51.

   b. **Extend the storage server into the maintenance position.**

      See "Extend the Storage Server to the Maintenance Position" on page 55.

   c. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

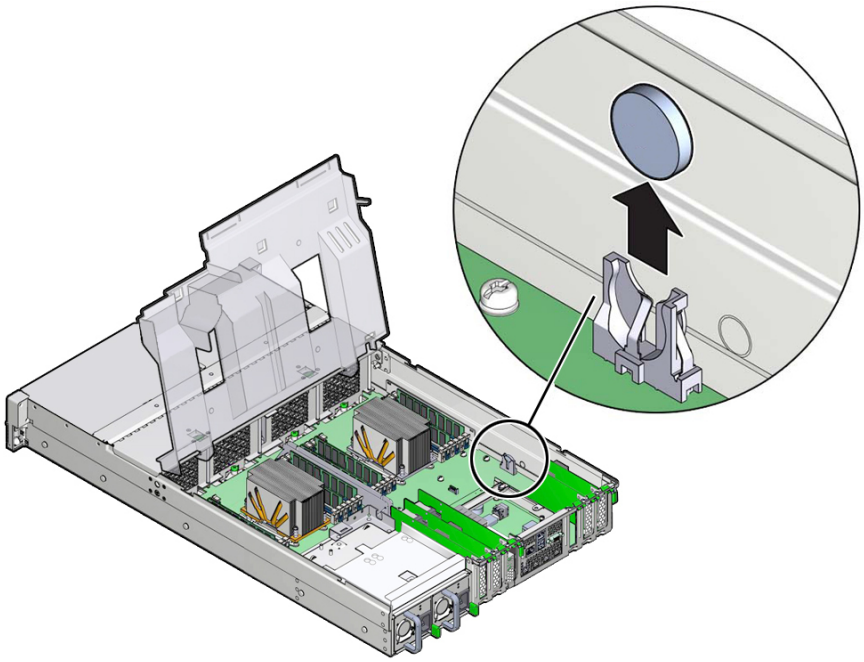
      See "Electrostatic Discharge Safety" on page 48.

   d. **Remove the storage server top cover.**

      See "Remove the Storage Server Top Cover" on page 59.

   e. **Swivel the air baffle into the upright position to allow access to the battery.**

2. **To dislodge the battery from its retainer, gently push the top edge of the battery away from the retainer.**



3. **Lift the battery up and out of its retainer.**

Related Information

- “Install the Battery” on page 102

▼ Install the Battery

1. **Unpack the replacement battery.**
2. **Press the new battery into the battery retainer with the negative side facing inside the storage server chassis.**
3. **Return the storage server to operation.**

a. **Lower the air baffle to the installed position.**

b. **Install the storage server top cover.**

   See “Install the Storage Server Top Cover” on page 162.

c. **Return the storage server to the normal rack position.**

   See “Return the Storage Server to the Normal Rack Position” on page 165.

d. **Reconnect the power cords to the storage server power supplies, and power on the storage server.**

   See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

Note - If the service processor is configured to synchronize with a network time storage server using the Network Time Protocol (NTP), the Oracle ILOM SP clock will be reset as soon as the storage server is powered on and connected to the network; otherwise, proceed to the next step.

---

4. **If the service processor is not configured to use NTP, you must do one of the following:**

   - Reset the Oracle ILOM SP clock using the Oracle ILOM CLI or the web interface.

     For instructions, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.
   - Use the BIOS Setup Utility to reprogram the host clock.

     For the BIOS Main menu that supports this procedure, refer to the *Oracle X5 Series Servers Administration Guide* at `http://www.oracle.com/goto/x86admindiag/docs`.

Related Information

- “Remove the Battery” on page 101

Servicing Processors



Caution - Ensure that all power is removed from the storage server before removing or installing a processor. You must disconnect the power cables from the system before performing these procedures.

Caution - This procedure requires that you handle components that are sensitive to electrostatic discharge. This sensitivity can cause the component to fail. To avoid damage, ensure that you follow electrostatic discharge safety measures and antistatic practices. See "Electrostatic Discharge Safety" on page 48.

This section covers the following topics:

- "Processor Removal and Replacement Tool" on page 104
- "Remove a Processor" on page 104
- "Install a Processor" on page 111

Related Information

- "Servicing the DIMMs" on page 81

Processor Removal and Replacement Tool

Caution - The correct color-coded processor removal and replacement tool (part number G29477-002 or later) must be used to remove and replace a processor; otherwise, the processor or the processor socket might be damaged.

The Oracle Exadata Storage Server X5-2 Extreme Flash uses two Intel E5-2630, 8-core, 2.4 GHz, 85W processors. When replacing the processor, you must use the specifically designed green color-coded processor removal and replacement tool.

Note - The green processor removal and replacement tool is included in the box with the 8-core replacement processor. Additionally, the correct removal and replacement tool ships with replacement motherboards.

▼ Remove a Processor

Caution - The green color-coded processor removal and replacement tool (part number G29477-002 or later) must be used to remove the 8-core processor; otherwise, the processor or the processor socket might be damaged.

Caution - Be careful not to touch the processor socket pins. The processor socket pins are very fragile. A light touch can bend the processor socket pins beyond repair. Always use the processor removal and replacement tool to remove and replace the processor.

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the power supplies.**

      See "Powering Down the Storage Server" on page 51.

   b. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

      See "Take Antistatic Measures" on page 58.

   c. **Extend the storage server to the maintenance position.**

      See "Extend the Storage Server to the Maintenance Position" on page 55

   d. **Remove the storage server top cover.**

      See "Remove the Storage Server Top Cover" on page 59.

   e. **Swivel the air baffle into the upright position to allow access to the processors.**

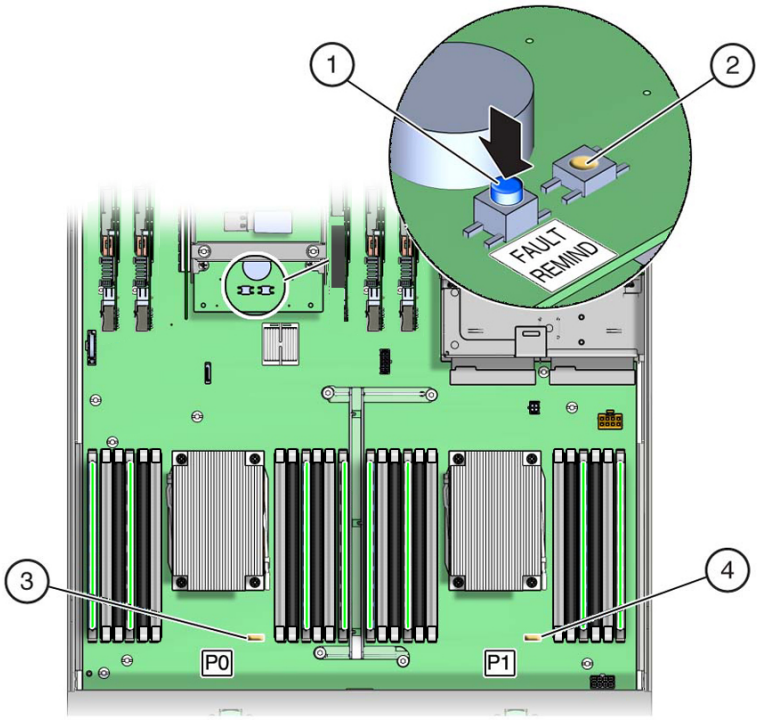
2. **Identify the location of the faulty processor by pressing the Fault Remind button on the motherboard I/O card.**

Note - When the Fault Remind button is pressed, an LED located next to the Fault Remind button lights green to indicate that there is sufficient voltage present in the fault remind circuit to light any fault LEDs that were lit due to a failure. If this LED fails to light when you press the Fault Remind button, it is likely that the capacitor powering the fault remind circuit has lost its charge. This can happen if the Fault Remind button is pressed for a long time with fault LEDs lit or if power has been removed from the storage server for more than 15 minutes.

The processor fault LED for the faulty processor lights. The processor fault LEDs are located next to the processors:

- If the processor fault LED is off, then the processor is operating properly.

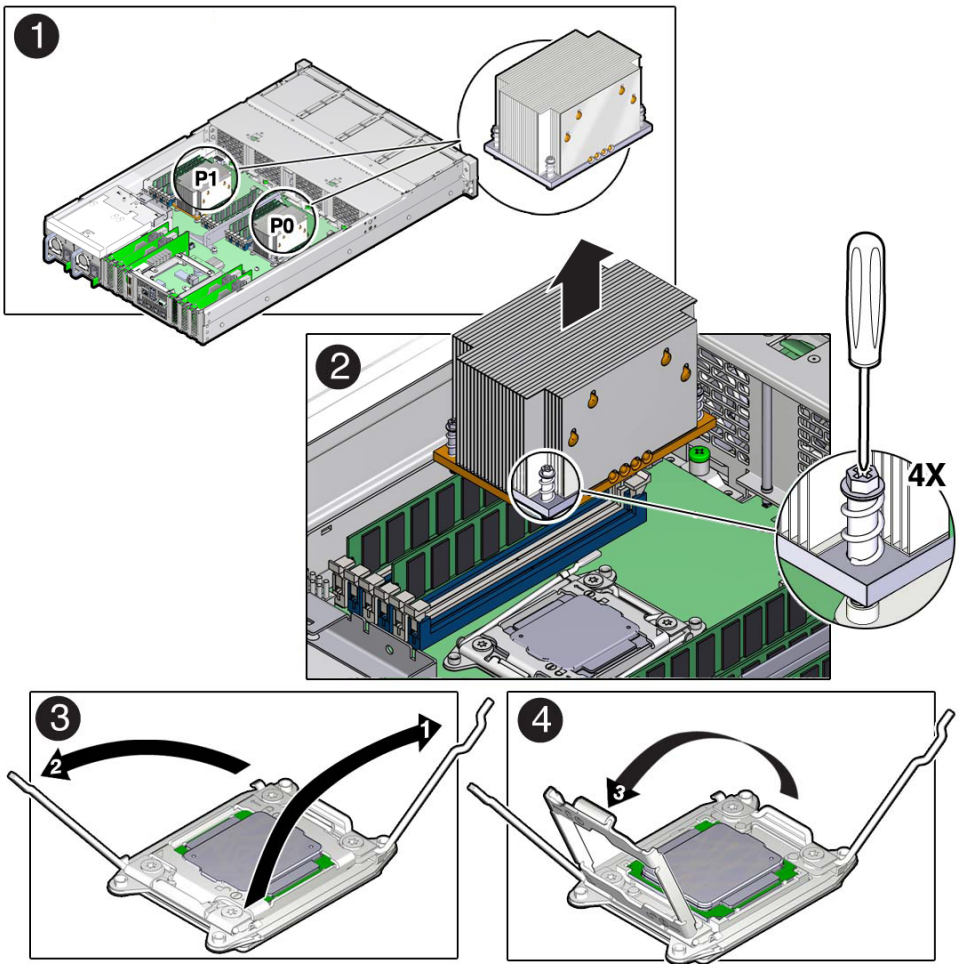
- If the processor fault LED is on (amber), then the processor is faulty and should be replaced.



Callout	Description
1	Fault Remind button
2	Fault Remind LED
3	Processor 0 fault LED
4	Processor 1 fault LED

3. **Gently press down on the top of the heatsink to counteract the pressure of the captive spring-loaded screws that secure the heatsink to the motherboard and loosen the four Phillips captive screws in the heatsink using a No. 2 Phillips screwdriver [2].**

Turn the screws counterclockwise alternately one and one-half turns until they are fully released.



4. **To separate the heatsink from the top of the processor, gently twist the heatsink left and right, while pulling upward, and then lift off the heatsink and place it upside down on a flat surface.**

   A thin layer of thermal grease separates the heatsink and the processor. This grease acts as an adhesive.

Note - Do not allow the thermal grease to contaminate the work space or other components.

5. **Use an alcohol pad to clean the thermal grease from the underside of the heatsink.**

   Be careful not to get the thermal grease on your fingers.



Caution - Failure to clean the heatsink prior to removing the processor could result in the accidental contamination of the processor socket or other components. Also, be careful not to get the grease on your fingers, as this could result in contamination of components.

6. **Disengage the processor release lever on the right side of the processor socket (viewing the storage server from the front) by pushing down on the lever and moving it to the side away from the processor, and then rotating the lever upward [3].**

7. **Disengage the processor release lever on the left side of the processor socket (viewing the storage server from the front) by pushing down on the lever and moving it to the side away from the processor, and then rotating the lever upward [3].**

8. **To lift the ILM assembly load plate off of the processor socket, rotate the processor release lever on the right side of the processor toward the closed position (the ILM assembly load plate is lifted up as the release lever is lowered toward the closed position) and carefully swing the ILM load plate to the fully open position [4].**



Caution - Whenever you remove a processor, you should replace it with another processor and reinstall the processor heatsink; otherwise, the storage server might overheat due to improper airflow. For instructions for installing a processor, see "Install a Processor" on page 111.

9. **To remove the processor from the processor socket, acquire the processor removal and replacement tool and perform the following steps.**



Caution - Before removing the processor, ensure that you are using the correct color-coded processor removal and replacement tool. For information on how to select the correct processor removal and replacement tool, see "Processor Removal and Replacement Tool" on page 104.

   a. **Locate the button in the center of the top of the processor removal tool and press it to the down position [1].**

b. **Properly position the tool over the processor socket and lower it into place over the processor socket [2].**

   To properly position the tool over the processor socket, rotate the tool until the green triangle on the side of the tool is facing the front of the storage server and it is over the left side of the processor socket when viewing the storage server from the front.

c. **Press the release lever on the processor tool to release the center button and engage the processor [3].**

   An audible click indicates that the processor is engaged.

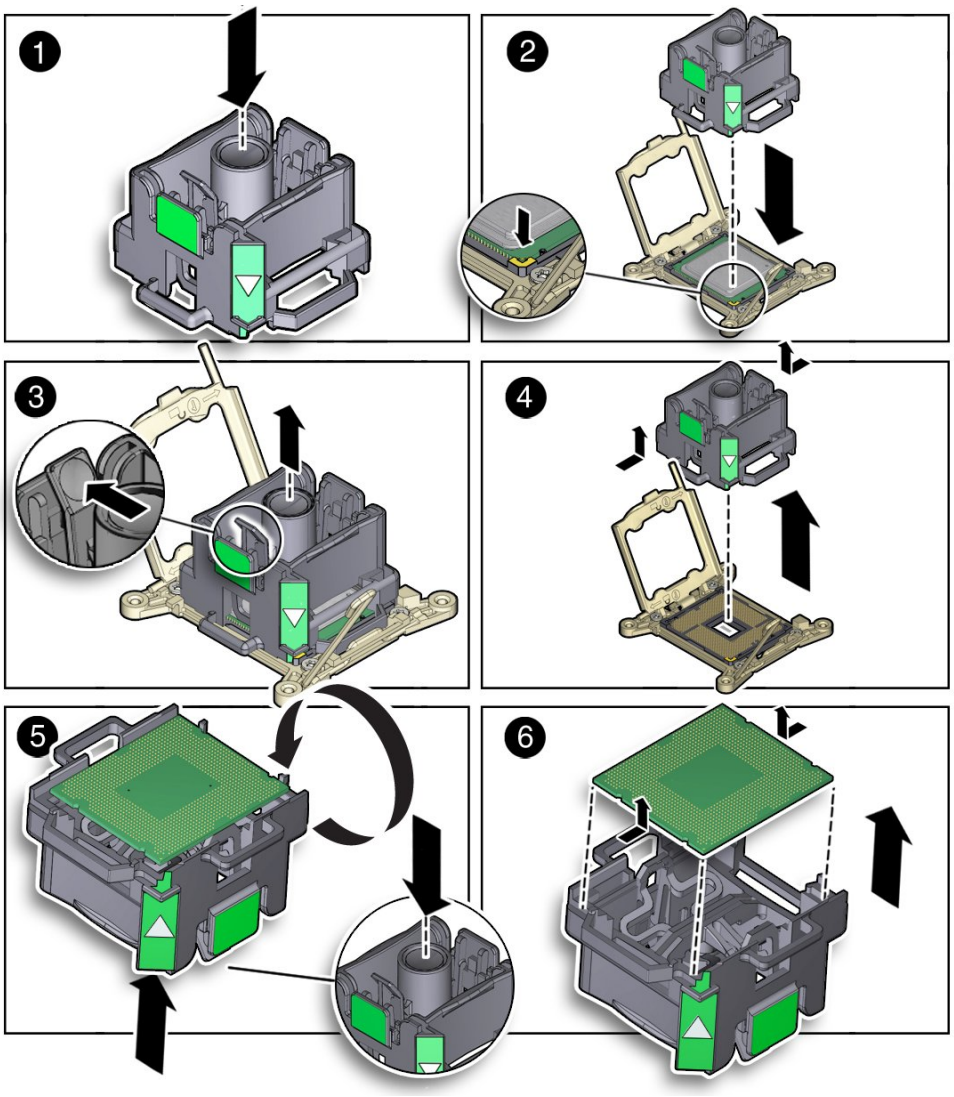
d. **Grasp the tool by the sides and remove it from the storage server [4].**

e. **Turn the tool upside down and verify that it contains the processor [5].**

f. **While holding the processor tool upside down, press the center button on the tool to release the processor [5].**

g. **Carefully grasp the processor by the front and back edges, lift it out of the tool and place it with the circuit side down (the installed orientation) into an antistatic container [6].**

h. Carefully clean the thermal grease off the top of the processor.



Related Information

- “Install a Processor” on page 111

Install a Processor

Caution - The green color-coded processor removal and replacement tool (part number G29477-002 or later) must be used to install the 8-core processor; otherwise, the processor or the processor socket might be damaged.

Caution - Be careful not to touch the processor socket pins. The processor socket pins are very fragile. A light touch can bend the processor socket pins beyond repair. Always use the processor removal and replacement tool to remove and replace the processor.

1. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

   See "Take Antistatic Measures" on page 58.

2. **Unpack the replacement processor, and place it on an antistatic mat.**

3. **Ensure that the replacement processor is identical to the failed processor that was removed.**

   For a description of the processors that are supported by the server, refer to "Storage Server Components" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

4. **Ensure that the two processor ILM assembly levers and the ILM assembly load plate are in the fully open position.**

   For instructions for opening the processor ILM assembly levers and the load plate, see Step 6 through Step 8 of "Remove a Processor" on page 104.

5. **To install the replacement processor into the processor removal/replacement tool, acquire the tool and perform the following steps.**

   a. **Press the button in the center of the tool to the down position [1].**

   b. **Turn the tool upside down, grasp the processor by its front and back edges and position the processor (circuit side up) in the tool so that the triangle on the corner of the processor aligns with the triangle on the side of the processor removal and replacement tool [2].**

   c. **Lower the processor into the tool and press the tool release lever to release the center button and engage the processor [3].**

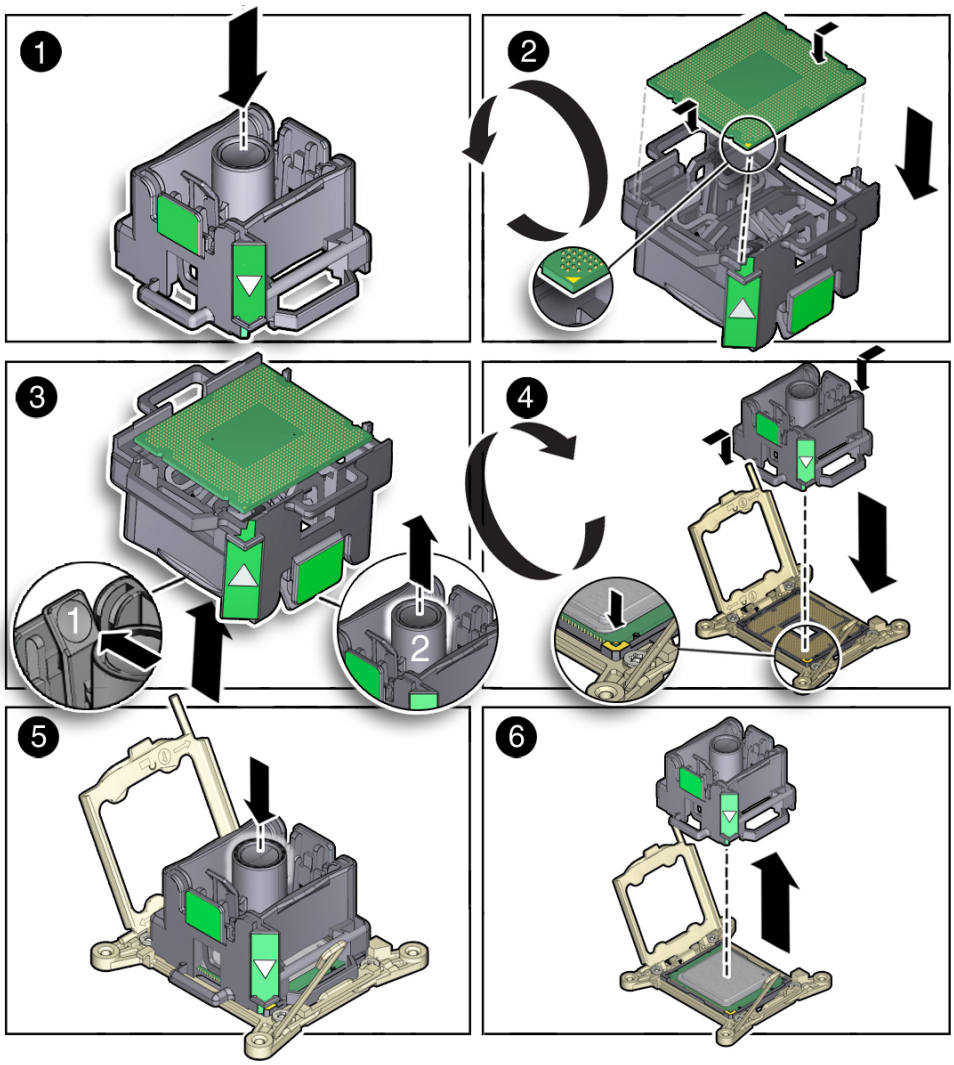
      An audible click indicates that the processor is locked into place.

d. Properly position the tool over the processor socket and lower it into place [4].

To properly position the tool in the processor socket, rotate the tool until the green triangle on the side of the tool is facing the front of the storage server and it is over the left side of the processor socket (when viewing the storage server from the front) and lower the tool into the processor socket.

e. Press the center button on the tool down to release the processor so that it is installed in the socket [5].

f. **Remove the processor removal and replacement tool [6].**



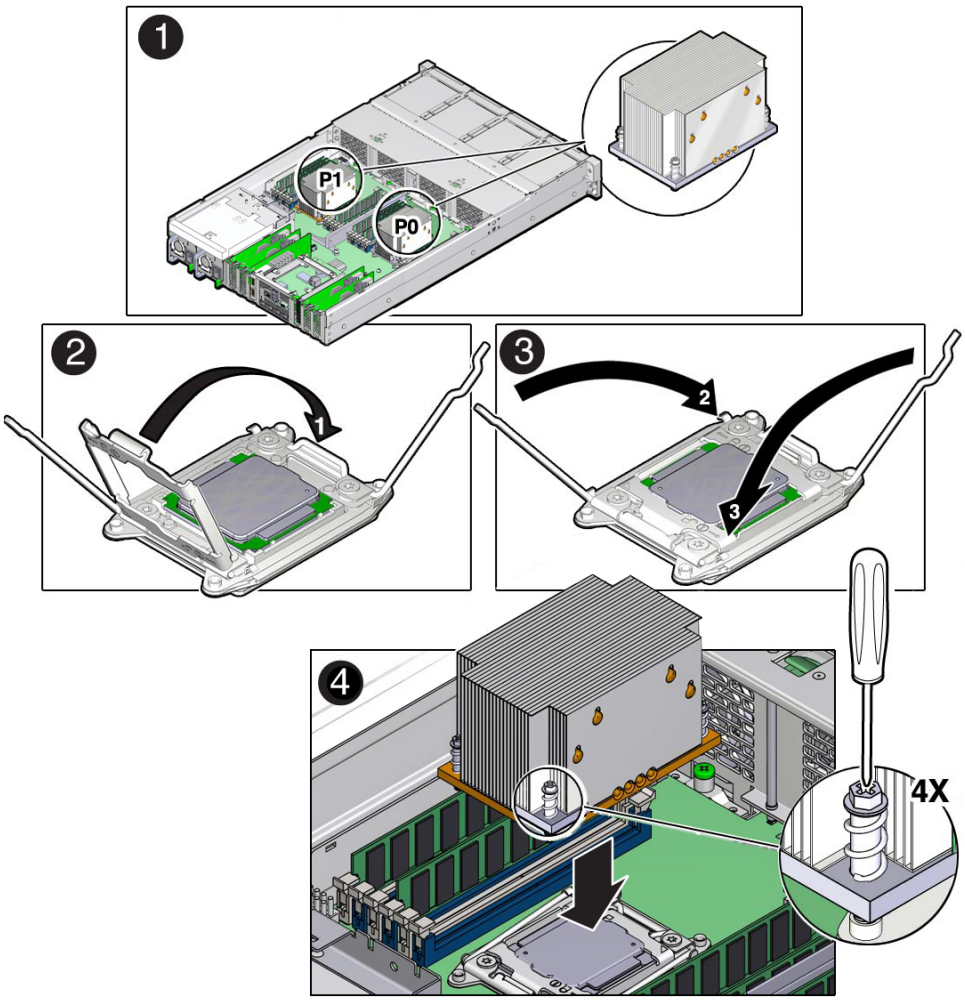
6. **Visually check the alignment of the processor in the socket [1].**

When properly aligned, the processor sits flat in the processor socket.

Caution - Do not press down on the processor. Irreparable damage to the processor or motherboard might occur from excessive downward pressure. Do not forcibly seat the processor into the socket. Excessive downward pressure might damage the socket pins.

7. **Swing the processor ILM assembly load plate into the closed position [2].**

   Ensure that the load plate sits flat around the periphery of the processor.



8. **Engage the socket release lever on the left side of the socket (viewing the storage server from the front) by rotating it downward and slipping it under the catch [3].**

9. **Engage the socket release lever on the right side of the socket (viewing the storage server from the front) by rotating it downward and slipping it under the catch [3].**

10. **Use the syringe (supplied with the new or replacement processor) to apply approximately 0.1 mL of thermal grease to the center of the top of the processor.**
    To measure 0.1 ml of thermal grease, use the graduated scale on the thermal grease syringe.

    Note - Do not distribute the grease; the pressure of the heatsink will do it for you when you install the heatsink.

11. **Inspect the heatsink for dust and lint.**
    Clean the heatsink if necessary.

12. **Orient the heatsink so that the screws line up with the mounting posts [4].**

    Note - The processor heatsink is not symmetrical.

13. **Carefully position the heatsink on the processor, aligning it with the mounting posts to reduce movement after it makes initial contact with the layer of thermal grease [4].**

    Caution - Avoid moving the heatsink after it has contacted the top of the processor. Too much movement could disturb the layer of thermal grease, causing voids, and leading to ineffective heat dissipation and component damage.

14. **Use a No. 2 Phillips screwdriver to tighten the screws alternately one-half turns until fully seated [4].**

15. **Return the storage server to operation.**

    a. **Lower the air baffle to the installed position.**

    b. **Install the storage server top cover.**
       See “Install the Storage Server Top Cover” on page 162.

    c. **Return the storage server to the normal rack position.**

See “Return the Storage Server to the Normal Rack Position” on page 165.

d. Reconnect the power cords to the power supplies, and power on the storage server.

See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

16. Use Oracle ILOM to clear storage server processor faults.

Refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs` for more information about the following steps.

a. To show storage server faults, log in to the storage server as `root` using the Oracle ILOM CLI, and type the following command to list all known faults on the storage server:

```
-> show /SP/faultmgmt
```

The storage server lists all known faults, for example:

```
-> show /SP/faultmgmt
  Targets:
      shell
      0 (/SYS/MB/P0)
  Properties:
  Commands:
      cd
      show
```

Alternatively, to list all known faults in the server, log into the Oracle Solaris OS and issue the `fmadm faulty` command, or log into the Oracle ILOM service processor from the Oracle ILOM Fault Management Shell and issue the `fmadm faulty` command. For more information about how to use the Oracle ILOM Fault Management Shell and supported commands, see the *Oracle ILOM User's Guide for System Monitoring and Diagnostics Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

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b. To clear the fault identified in Step 16a, type the following command:

```
-> set /SYS/MB/P0 clear_fault_action=true
```

For example:

```
-> set /SYS/MB/P0 clear_fault_action=true
Are you sure you want to clear /SYS/MB/P0 (y/n)? y
Set 'clear_fault_action' to 'true'
```

Alternatively, to clear all known faults in the server, log into the Oracle Solaris OS and issue the `fmadm repair` command, or log into the Oracle ILOM service processor from the Oracle ILOM Fault Management Shell and issue the `fmadm repair` command. For more information about how to use the Oracle ILOM Fault Management Shell and supported commands, see the *Oracle ILOM User's Guide for System Monitoring and Diagnostics Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

Related Information

- "Remove a Processor" on page 104

Servicing the Storage Drive Backplane



Caution - Ensure that all power is removed from the storage server before removing or installing the storage drive backplane. You must disconnect the power cables before performing this procedure.

To remove and install the storage drive backplane, follow these procedures:

- "Remove the Storage Drive Backplane" on page 117
- "Install the Storage Drive Backplane" on page 120

Related Information

- "Servicing Storage Drives" on page 63
- "Servicing NVMe Cables" on page 122

▼ Remove the Storage Drive Backplane

1. **Prepare the storage server for service.**

a. **Power off the storage server and disconnect the power cords from the power supplies.**

   See “Powering Down the Storage Server” on page 51.

b. **Extend the storage server into the maintenance position.**

   See “Extend the Storage Server to the Maintenance Position” on page 55.

c. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

   See “Take Antistatic Measures” on page 58.

d. **Open the storage server fan assembly door, and remove the fan modules from the storage server.**

   See “Remove a Fan Module” on page 69.

e. **Remove the fan assembly door from the storage server.**

   See “Remove the Fan Assembly Door From the Storage Server” on page 60.

2. **Pull each storage drive out far enough to disengage if from the disk backplane.**

   See “Remove a Storage Drive” on page 64.

Note - It is not necessary to completely remove the storage drives from the storage server; simply pull them out far enough to disengage them from the disk backplane. If you do remove the storage drives from the storage server, record their locations so that you can reinstall them in the same locations.

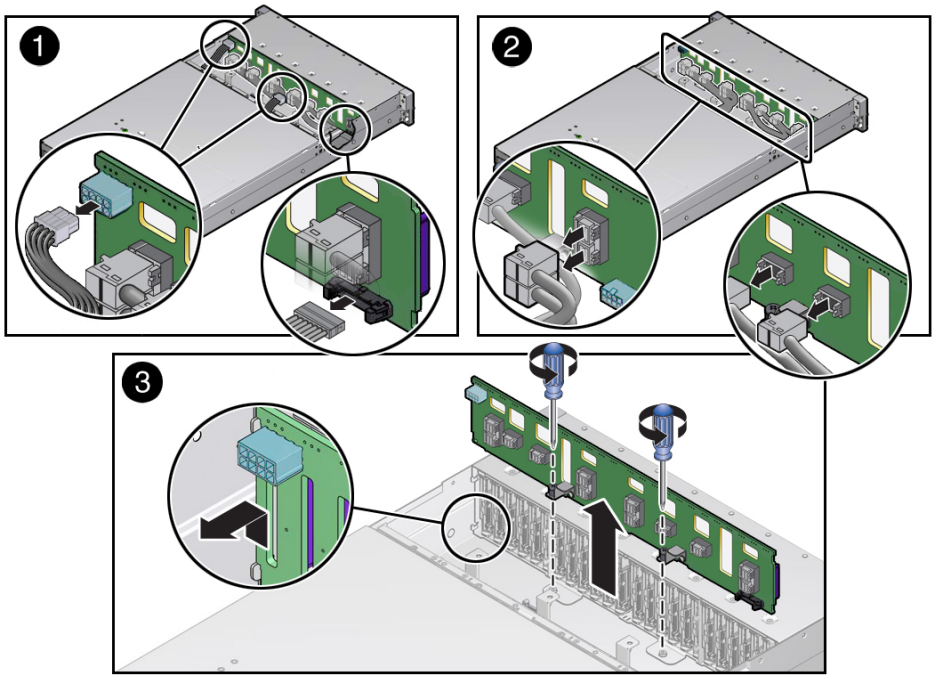
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3. **Disconnect the cables from the storage drive backplane.**

   a. **Disconnect the two power cables and the auxiliary signal cable from the storage drive backplane [1].**

   b. **Disconnect the twelve NVMe cables from the storage drive backplane [2].**

Note the cable connections in order to ease proper reconnection of the cables.



4. **Using a No. 2 Phillips screwdriver, loosen the two spring-mounted screws that secure the storage drive backplane to the chassis [3].**

Note - Due to its location, the left spring-mounted screw might be difficult to remove with a standard No. 2 Phillips screwdriver. If you experience difficulty removing the screw, use a long No. 2 Phillips screwdriver or a torque driver with a long extension.

---

5. **Lift the storage drive backplane up to release it from the standoff hooks, and then pull it away from the standoff hooks and out of the chassis [3].**

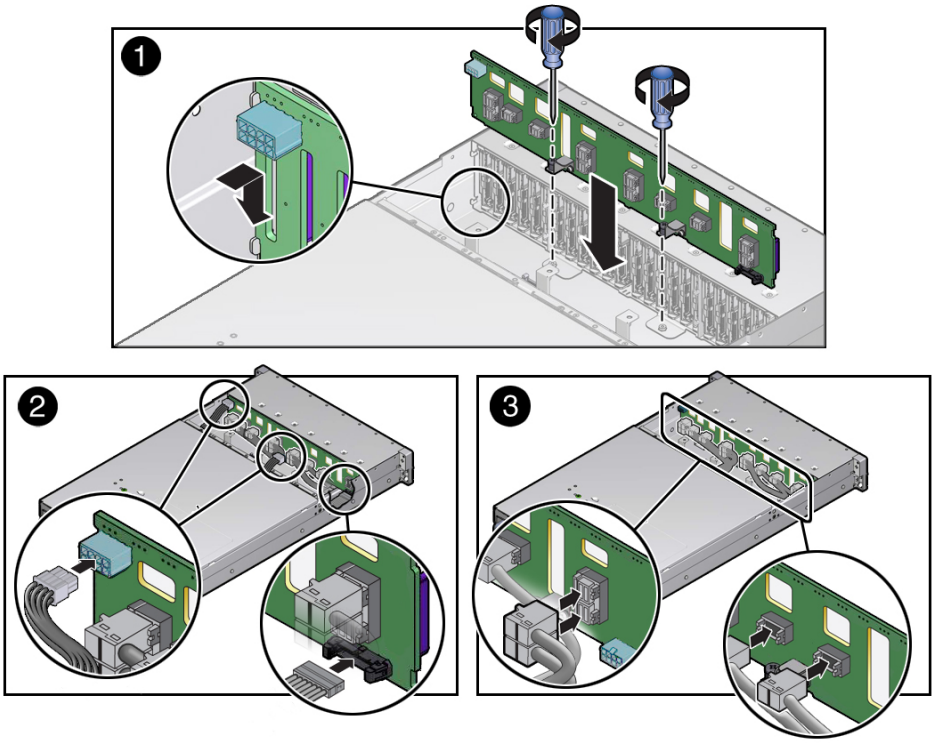
6. **Place the storage drive backplane on an antistatic mat.**

Related Information

- “Install the Storage Drive Backplane” on page 120

▼ Install the Storage Drive Backplane

1. **Lower the storage drive backplane into the storage server, and position it to engage the standoff hooks [1].**



2. **Using a No. 2 Phillips screwdriver, install and tighten the two spring-mounted screws to secure the storage drive backplane to the chassis [1].**

Note - Due to its location, the left spring-mounted screw might be difficult to install with a standard No. 2 Phillips screwdriver. If you experience difficulty installing the screw, use a long No. 2 Phillips screwdriver or a torque driver with a long extension.

3. **Reconnect the cables to the storage drive backplane.**

   a. **Reconnect the two power cables and the auxiliary signal cable to the storage drive backplane [2].**

      Use the following cable part number table to ensure proper cable connections.

Cable Part Number	Description
7079291	Auxiliary signal cable
7064125	Power cable, right
7086654	Power cable, center

   b. **Reconnect the twelve NVMe cables to the storage drive backplane [3].**

      To ensure proper NVMe cable connections, see “Install NVMe Cables” on page 125.

Note - After replacing the storage drive backplane, the NVMe cable connection test procedure *must* be performed before booting the storage server operating system. This procedure ensures that NVMe PCIe cabling is correct prior to booting the operating system. See “Verify NVMe Cable Connections” on page 128.

4. **Return the storage server to operation.**

   a. **Install the fan assembly door top cover.**

      See “Install the Fan Assembly Door” on page 164.

   b. **Install the fan modules and close the fan assembly door.**

      See “Install a Fan Module” on page 72.

   c. **Install all storage drives into the storage drive cage.**

      See “Install a Storage Drive” on page 67.

   d. **Return the storage server to the normal rack position.**

      See “Return the Storage Server to the Normal Rack Position” on page 165.

e. **Reconnect the power cords to the power supplies, and power on the storage server.**

   See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

Note - IMPORTANT: When the disk backplane is replaced, the key identity properties (KIP) of the disk backplane is programmed by Oracle ILOM to contain the same KIP as the other quorum member components. If you have removed other quorum member components, you might need to manually program the product serial number (PSN) into the new disk backplane. For more information, refer to “FRU Key Identity Properties (KIP) Automated Update” on page 49.

Related Information

- “Remove the Storage Drive Backplane” on page 117

Servicing NVMe Cables



Caution - The system supplies power to the cables even when the storage server is powered off. To avoid personal injury or damage to the storage server, you must disconnect power cords before servicing the cables.

This section covers the following procedures:

- “Remove NVMe Cables” on page 123
- “Install NVMe Cables” on page 125
- “Verify NVMe Cable Connections” on page 128

Related Information

- “Servicing Storage Drives” on page 63
- “Servicing the Storage Drive Backplane” on page 117

Remove NVMe Cables

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the power supplies.**

      See “Powering Down the Storage Server” on page 51.

   b. **Extend the storage server to the maintenance position.**

      See “Extend the Storage Server to the Maintenance Position” on page 55.

   c. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

      See “Electrostatic Discharge Safety” on page 48.

   d. **Remove the storage server top cover.**

      See “Remove the Storage Server Top Cover” on page 59.

   e. **Remove the air baffle.**

      Remove the air baffle by lifting the baffle up and out of the storage server.

   f. **Open the server fan assembly door and remove fan modules.**

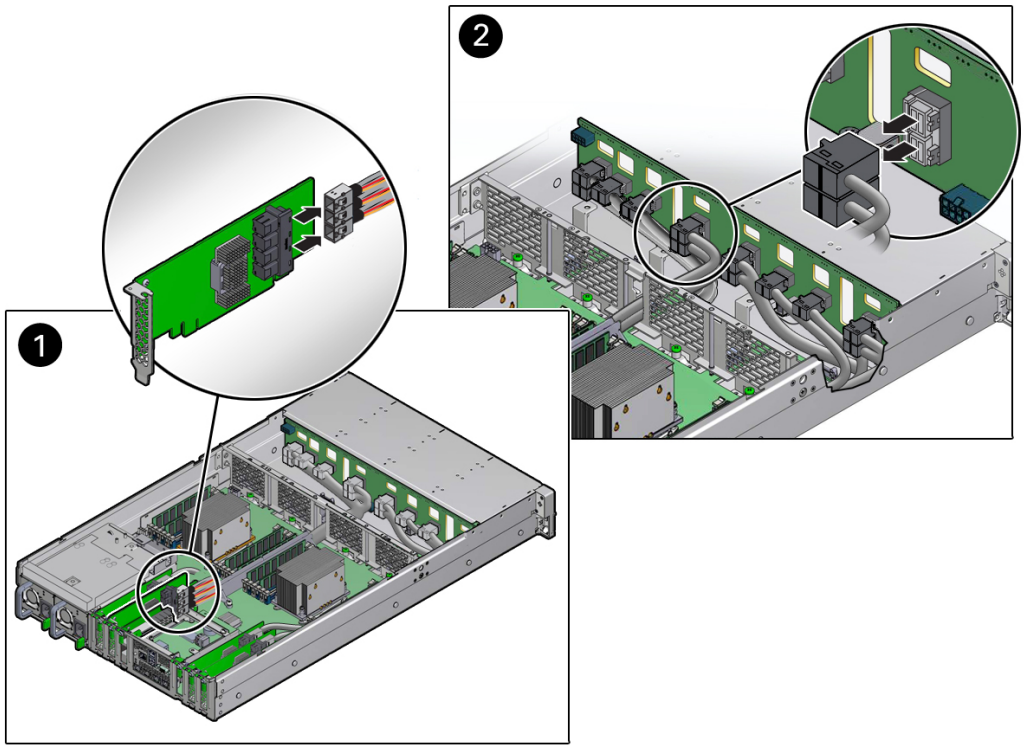
      See “Remove a Fan Module” on page 69.

   g. **Remove the storage server's front fan assembly door.**

      See “Remove the Fan Assembly Door From the Storage Server” on page 60.

2. **Disconnect the NVMe cables from the Oracle PCIe NVMe switch cards in PCIe slots 1, 2, 5, and 6 [1].**

Press each latch, and then pull out to disengage the cable from each connector. See also “Remove a PCIe Card” on page 93.



3. **Disconnect the twelve NVMe cables from the front storage drive backplane [2].**

   Press each latch, and then pull out to disengage the cable from each connector.

4. **Remove the NVMe cables from the server.**

Note - NVMe cable connectors do not fit through the left-side chassis mid-wall. If you are removing NVMe cables between the disk backplane and PCIe slots 5 and 6, you first must remove the chassis mid-wall. For instructions, see Step 8 in “Remove the Motherboard Assembly” on page 145.

Carefully remove the NVMe cable bundles from the center and left-side chassis mid-wall. Be careful not to snag the cables on the server components.

Related Information

- “Install NVMe Cables” on page 125

▼ Install NVMe Cables

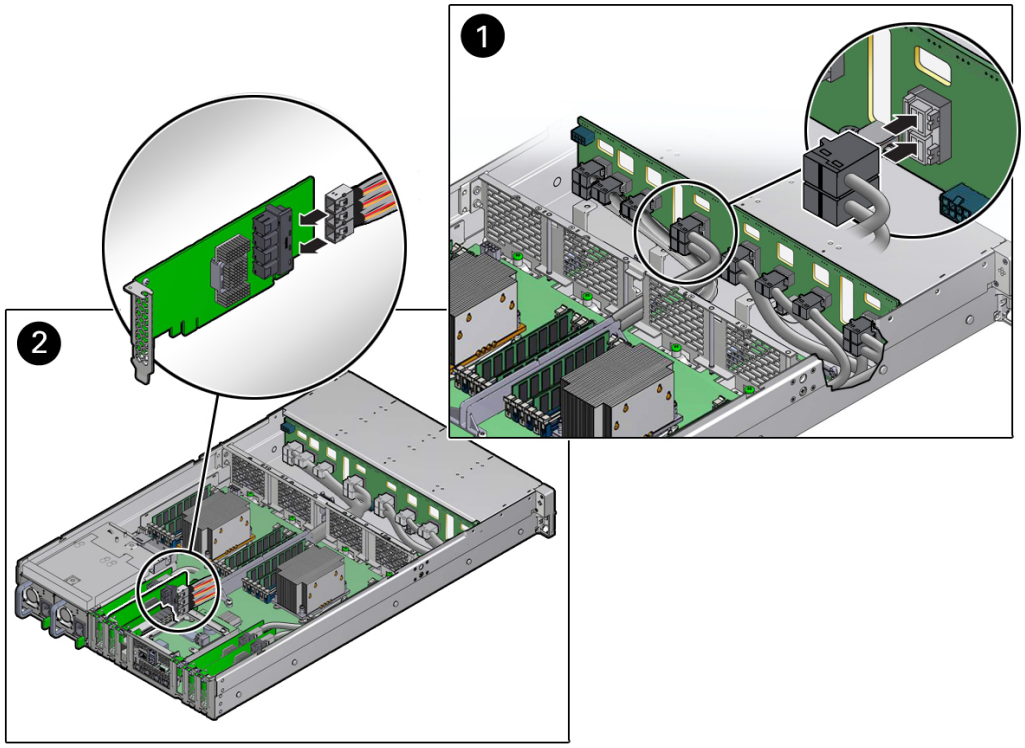
1. **Install the NVMe cables between the front storage drive backplane and the Oracle PCIe NVMe switch cards in the storage server PCIe slots.**

Note - NVMe cable connectors do not fit through the left-side chassis mid-wall. If you are installing NVMe cables between the disk backplane and PCIe slots 5 and 6, you first must remove the chassis mid-wall. For instructions, see Step 3 in “Install the Motherboard Assembly” on page 154.

   - **For Oracle PCIe NVMe switch cards located in PCIe slots 1 and 2, route the NVMe cable bundle through the center chassis mid-wall and via the cable trough between the fan modules and processors.**
   - **For Oracle PCIe NVMe switch cards located in PCIe slots 5 and 6, route the NVMe cable bundle through the left-side chassis mid-wall and along the left side of the chassis.**

2. **Reconnect the twelve NVMe cables to the front storage drive backplane [1].**

Plug each cable into its connector until you hear an audible click.



3. **Reconnect the twelve NVMe cables to the Oracle PCIe NVMe switch cards in PCIe slots 1, 2, 5, and 6 [2].**

   Plug each cable into its connector until you hear an audible click. See also “Install a PCIe Card” on page 95.

   Use the following table to ensure proper NVMe cable connections.

   Note - Each NVMe cable contains a matching label that corresponds to the port on the Oracle PCIe NVMe switch card and the storage drive backplane connector. PCIe NVMe switch card ports are labeled 0, 1, 2, and 3 (from bottom to top). Port 3 is not used.

PCIe Slot to Backplane	PCIe NVMe Switch Card Port	Storage Drive Backplane Connector
PCIe slot 1 to right side disk backplane	0	D
	1	E
	2	F
PCIe slot 2 to right side disk backplane	0	A
	1	B
	2	C
PCIe slot 5 to left side disk backplane	0	D
	1	E
	2	F
PCIe slot 6 to left side disk backplane	0	A
	1	B
	2	C

4. **Return the storage server to operation.**

   a. **Install the storage server's front fan assembly door.**

      See “Install the Fan Assembly Door” on page 164.

   b. **Install the fan modules.**

      See “Install a Fan Module” on page 72.

   c. **Install the air baffle.**

      Install the air baffle by placing it into the storage server and lowering it to its installed position.

   d. **Install the storage server top cover.**

      See “Install the Storage Server Top Cover” on page 162.

   e. **Return the storage server to the normal rack position.**

      See “Return the Storage Server to the Normal Rack Position” on page 165.

   f. **Reconnect the power cords to the power supplies, and power on the storage server.**

      See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

5. **Verify that NVMe cable connections are correct. See "Verify NVMe Cable Connections" on page 128.**

Related Information

- "Remove NVMe Cables" on page 123

▼ Verify NVMe Cable Connections

When NVMe cables are removed or replaced between the storage drive backplane and NVMe switch cards, you must perform the procedure in this section to confirm that all NVMe cable connections are correct. If NVMe cable connections are not correct, the storage server operating system should not be allowed to boot, as it could cause a problem with disk drive mapping.

Before beginning this procedure, ensure that the storage server has been returned to operation. See Step 4 in "Install NVMe Cables" on page 125. This procedure requires access to the Oracle ILOM service processor (SP). The BIOS Setup Utility is used to halt the system so NVMe cable connection tests can be run for NVMe storage drives.

You can access the BIOS Setup Utility screens from the following interfaces:

- Use a USB keyboard and VGA monitor connected directly to the server. (A mouse is not required to access the BIOS Setup Utility.)
- Use a terminal (or terminal emulator connected to a computer) through the serial port on the back panel of the server.
- Connect to the server using the Oracle ILOM Remote System Console Plus application.

1. **Power on the server.**
   For example, to power on the server:
   - **From the local server,** press the Power button on the front panel of the server to power on the server.
   - **From the Oracle ILOM web interface,** click Host Management → Power Control and select Power On from the Select Action list.
   - **From the Oracle ILOM CLI,** type `start /System`

   The power-on self-test (POST) sequence begins.

2. **To enter the BIOS Setup Utility, press the F2 key (Ctrl+E from a serial connection) when prompted and while the BIOS is running the power-on self-tests (POST).**
   This step halts the system so NVMe cable connection tests can be run for the NVMe storage drives.

3. **Open a terminal window. Using SSH (secure shell), log in to the Oracle ILOM command-line interface (CLI) on the server SP.**

4. **To access the Oracle ILOM Restricted Shell, type the `set SESSION mode=restricted` command, and then click Enter.**

5. **Type `y` to confirm that you want to start the Oracle ILOM Restricted Shell.**
   The # prompt appears.

6. **To run the NVMe cable connection tests, type the `hwdiag io nvme_test` command, and then click Enter.**
   Your output should be similar to the following example:

```
hwdiag io nvme_test
HWdiag - Build Number 92713 (Sep 18 2014, 18:11:57)
         Current Date/Time: Sep 26 2014, 11:38:30
    Checking NVME drive fru contents...
        checking fru on drive NVMe 0              OK
        checking fru on drive NVMe 1              OK
        checking fru on drive NVMe 2              OK
        checking fru on drive NVMe 3              OK
        checking fru on drive NVMe 4              OK
        checking fru on drive NVMe 5              OK
        checking fru on drive NVMe 6              OK
        checking fru on drive NVMe 7              OK
        checking fru on drive NVMe 8              OK
        checking fru on drive NVMe 9              OK
        checking fru on drive NVMe 10             OK
        checking fru on drive NVMe 11             OK
    NVME drives fru check:                        PASSED

    Checking NVME drive pcie links...
        checking pcie link on drive NVMe 0        OK
        checking pcie link on drive NVMe 1        OK
        checking pcie link on drive NVMe 2        OK
        checking pcie link on drive NVMe 3        OK
        checking pcie link on drive NVMe 4        OK
        checking pcie link on drive NVMe 5        OK
        checking pcie link on drive NVMe 6        OK
        checking pcie link on drive NVMe 7        OK
        checking pcie link on drive NVMe 8        OK
        checking pcie link on drive NVMe 9        OK
        checking pcie link on drive NVMe 10       OK
        checking pcie link on drive NVMe 11       OK
    NVME drives pcie link check:                  PASSED

    Checking NVME drive DSN...
```

```
        checking DSN on drive NVMe 0              OK
        checking DSN on drive NVMe 1              OK
        checking DSN on drive NVMe 2              OK
        checking DSN on drive NVMe 3              OK
        checking DSN on drive NVMe 4              OK
        checking DSN on drive NVMe 5              OK
        checking DSN on drive NVMe 6              OK
        checking DSN on drive NVMe 7              OK
        checking DSN on drive NVMe 8              OK
        checking DSN on drive NVMe 9              OK
        checking DSN on drive NVMe 10             OK
        checking DSN on drive NVMe 11             OK
    NVME drives DSN check:                        PASSED

    Checking NVME cabling...
        Cables associated with Switch Card 3 in PCIe Slot 6 verified
        Cables associated with Switch Card 2 in PCIe Slot 5 verified
        Cables associated with Switch Card 1 in PCIe Slot 2 verified
        Cables associated with Switch Card 0 in PCIe Slot 1 verified
    NVME cable check:                             PASSED

NVME test PASSED
```

If any of the tests fail, there could be a problem with the cabling. For example:

- If a cable is crossed (plugged into the incorrect port), then the NVMe drive DSN (Drive Serial Number) test should report two drives where the DSN does not match. The cabling for those drives should be inspected to ensure that it is correct.
- If multiple NVMe drive PCIe links are not active, or multiple NVMe drive DSNs are not OK, then check the Port 2 connection on the NVMe switch card. If Port 2 is incorrectly cabled, it could affect all three drives that are connected to that NVMe switch card.

7. **Once issues are resolved, power cycle the system by removing the power cords from the power supplies, waiting 30 seconds, and then reattaching the power cords.**

8. **Retest the system by repeating Step 1 through Step 6.**

   Once all NVMe cable connection tests have passed, the storage server operating system can be booted.

Servicing the Front LED/USB Indicator Modules



Caution - Ensure that all power is removed from the storage server before removing or installing a front LED/USB indicator module. You must disconnect the power cables before performing this procedure.

This section covers the following procedures:

- "Remove the Left LED Indicator Module" on page 131
- "Install the Left LED Indicator Module" on page 135
- "Remove the Right LED/USB Indicator Module" on page 138
- "Install the Right LED/USB Indicator Module" on page 141

Related Information

- "Troubleshooting Using the Storage Server Front and Rear Panel Status Indicators " on page 26

▼ Remove the Left LED Indicator Module

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the power supplies.**

      See "Powering Down the Storage Server" on page 51.

   b. **Extend the storage server into the maintenance position.**

      See "Extend the Storage Server to the Maintenance Position" on page 55.

   c. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

      See "Take Antistatic Measures" on page 58.

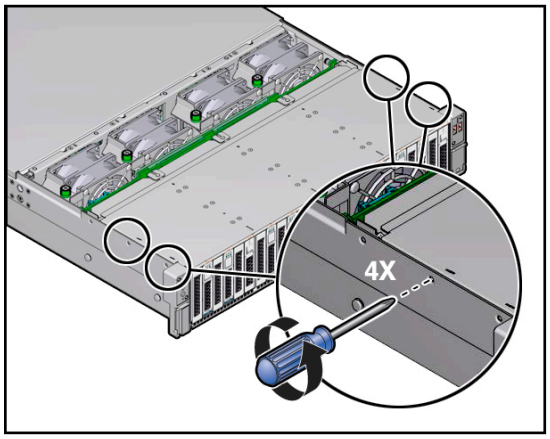
   d. **Remove the storage server top cover.**

      See "Remove the Storage Server Top Cover" on page 59.

2. **Remove the storage server fan assembly door.**

   See “Remove the Fan Assembly Door From the Storage Server” on page 60.

3. **Remove the four remaining No. 2 Phillips screws (two on each side of the chassis) that secure the disk cage assembly to the storage server chassis.**



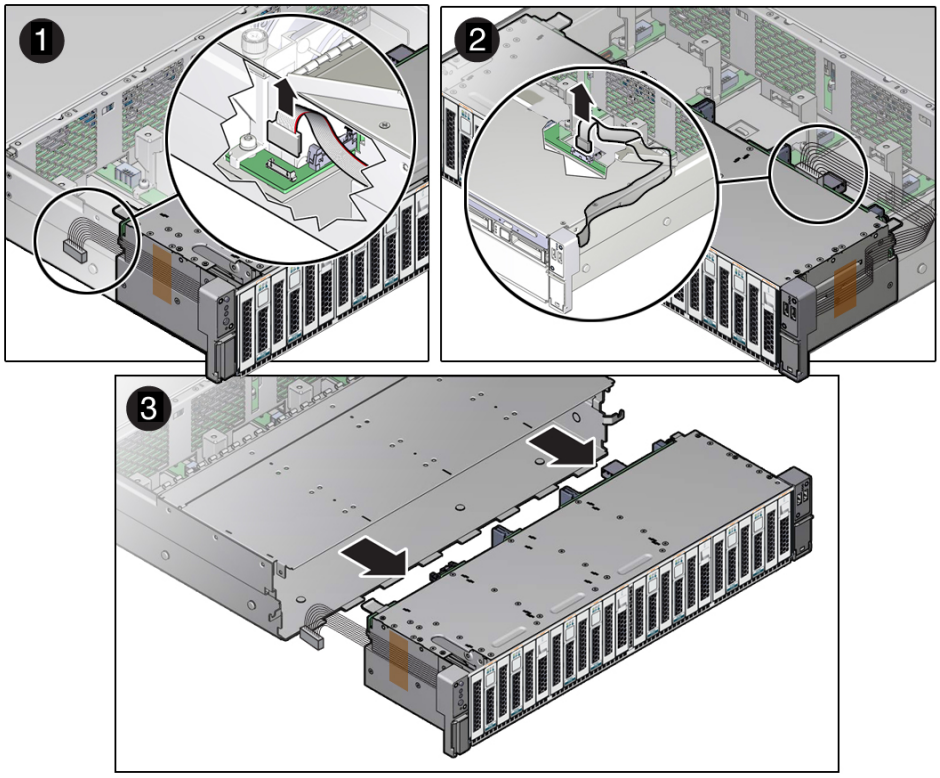
4. **Remove the fan modules from the storage server.**

   See “Remove a Fan Module” on page 69.

5. **Disconnect all cables from the storage drive backplane.**

   See “Remove the Storage Drive Backplane” on page 117.

6. **Disconnect the left LED indicator module cable and the right LED/USB indicator module cable from the motherboard [1 and 2].**



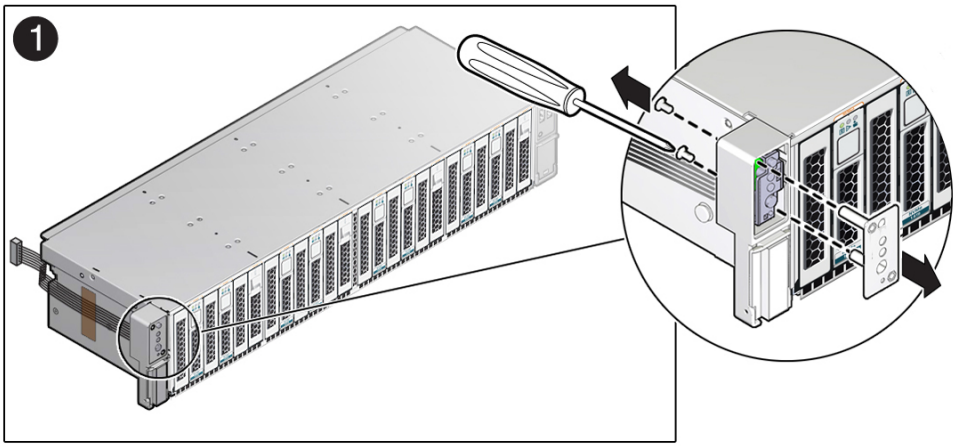
7. **Slide the disk cage assembly forward, and then gently lift the disk cage assembly from the chassis [3].**

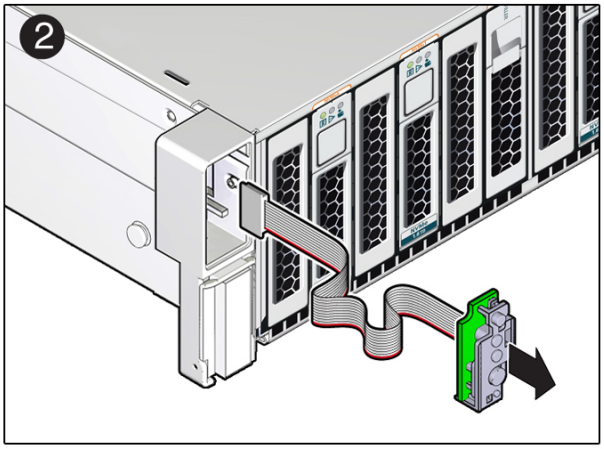
   Set the disk cage assembly on an anti-static mat.

8. **Remove the left LED indicator module.**

   a. **Remove the two No. 2 Phillips screws that secure the LED indicator module to the storage server front panel [1].**

If present, remove the capping tape that secures the cable to the side of the disk cage assembly.





b. Remove the LED indicator module from the server front panel [2].

Related Information

- “Storage Server System-Level Status Indicators” on page 27
- “Install the Left LED Indicator Module” on page 135

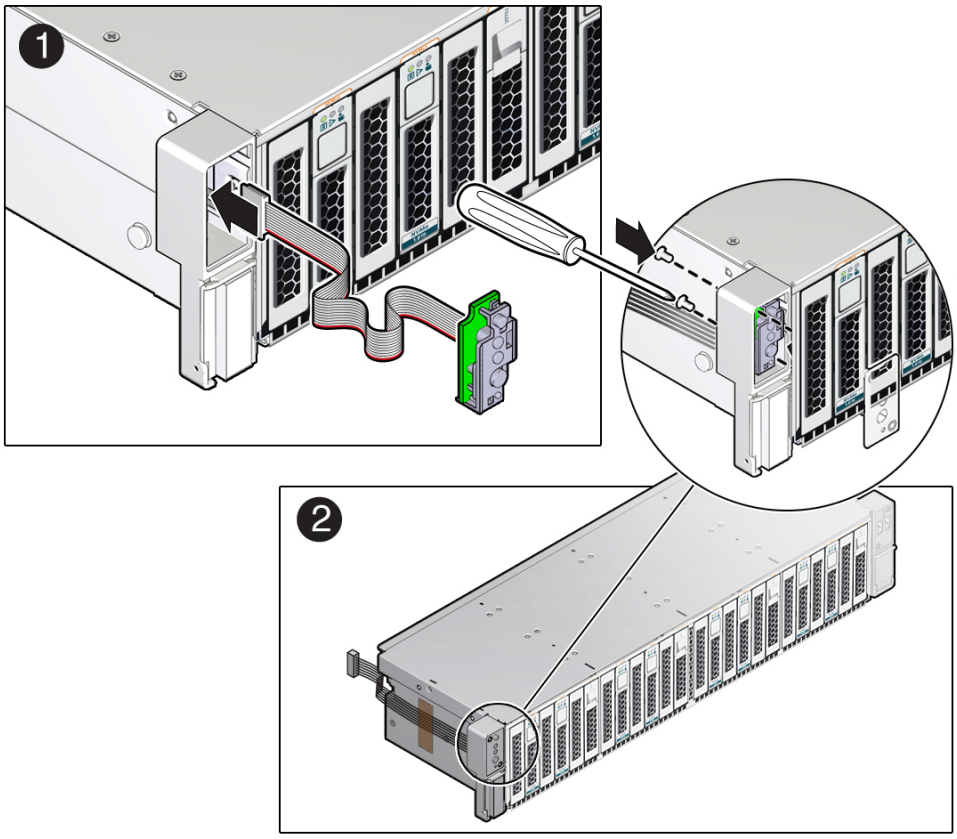
▼ Install the Left LED Indicator Module

1. **Install the left LED indicator module.**

   a. **Push the LED indicator module and cable through the left LED housing on the storage server front panel [1].**

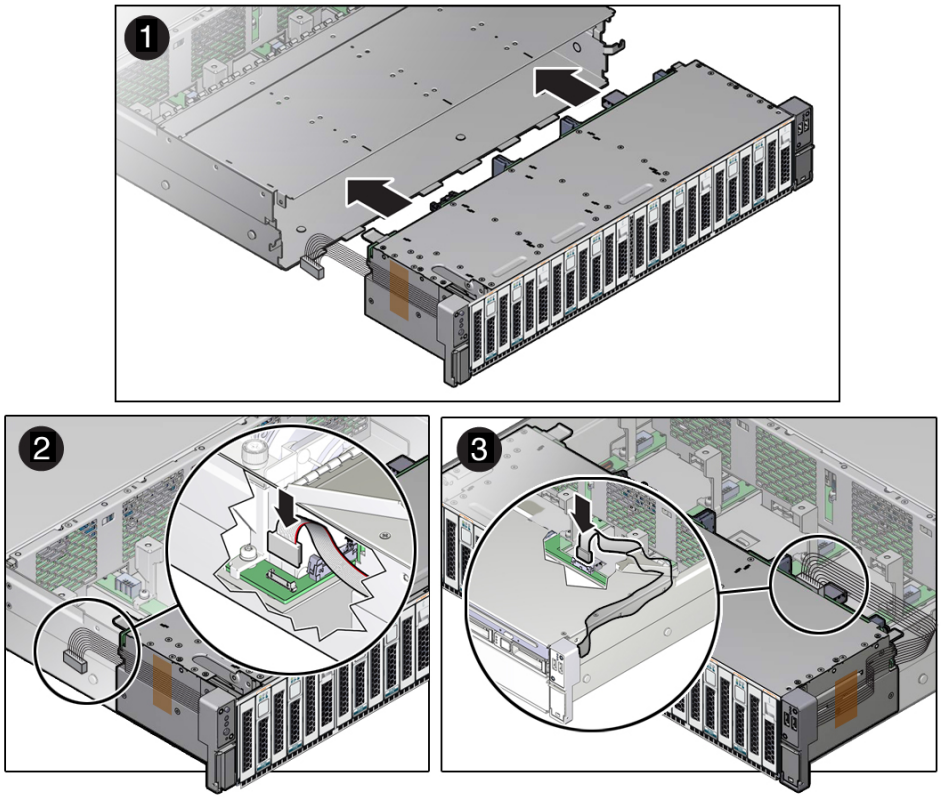
      If necessary, use a piece of capping tape to secure the LED cable to the side of the disk cage assembly.

Note - Cable part number 7064122 is required for the left LED indicator module.



b. **Insert and tighten the two No. 2 Phillips screws to secure the LED indicator module to the storage server front panel [2].**

2. **Gently lift the disk cage assembly and set it into the storage server chassis [1].**
   Slightly push the disk cage assembly into the storage server chassis to ensure that the disk cage screw holes are correctly aligned with the chassis.



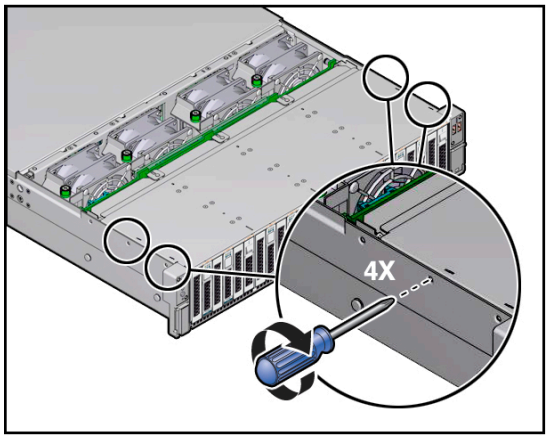
3. **Reconnect the left LED indicator module cable and the right LED/USB indicator module cable to the motherboard [2 and 3].**

4. **Reconnect all cables to the storage drive backplane.**
   See “Install the Storage Drive Backplane” on page 120.

5. **Install the fan modules in the server.**

See “Install a Fan Module” on page 72.

6. **Install the four No. 2 Phillips screws (two on each side of the chassis) that secure the disk cage assembly to the storage server chassis.**



7. **Install the storage server fan assembly door.**
   See “Install the Fan Assembly Door” on page 164.

8. **Return the storage server to operation.**

   a. **Install the storage server top cover.**
      See “Install the Storage Server Top Cover” on page 162.

   b. **Return the storage server to the normal rack position.**
      See “Return the Storage Server to the Normal Rack Position” on page 165

   c. **Reconnect the power cords to the power supplies, and power on the storage server.**
      See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the powewr supply AC OK LED is lit.

Related Information

- “Storage Server System-Level Status Indicators” on page 27
- “Remove the Left LED Indicator Module” on page 131

▼ Remove the Right LED/USB Indicator Module

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the power supplies.**

      See “Powering Down the Storage Server” on page 51.

   b. **Extend the storage server into the maintenance position.**

      See “Extend the Storage Server to the Maintenance Position” on page 55.

   c. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

      See “Take Antistatic Measures” on page 58.

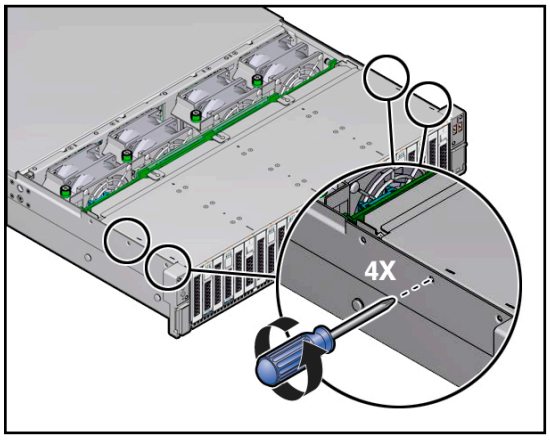
   d. **Remove the storage server top cover.**

      See “Remove the Storage Server Top Cover” on page 59.

2. **Remove the storage server fan assembly door.**

   See “Remove the Fan Assembly Door From the Storage Server” on page 60.

3. **Remove the four remaining No. 2 Phillips screws (two on each side of the chassis) that secure the disk cage assembly to the storage server chassis.**



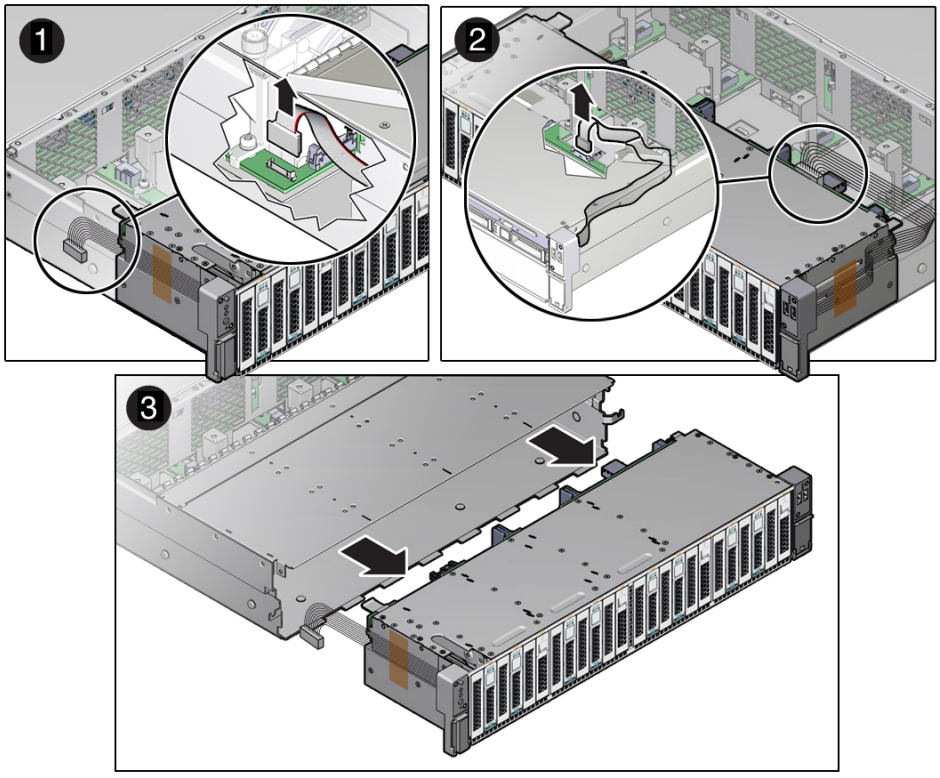
4. **Remove the fan modules from the storage server.**

   See “Remove a Fan Module” on page 69.

5. **Disconnect all cables from the storage drive backplane.**

   See “Remove the Storage Drive Backplane” on page 117.

6. **Disconnect the left LED indicator module cable and the right LED/USB indicator module cable from the motherboard [1 and 2].**



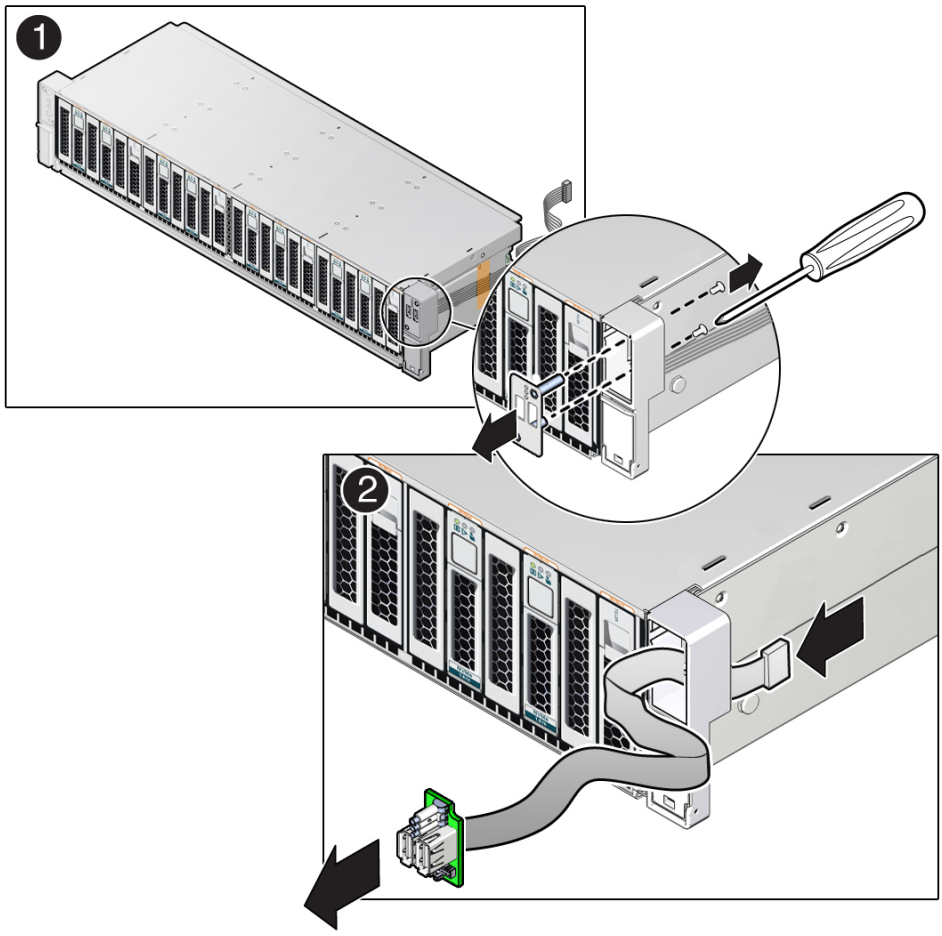
7. **Slide the disk cage assembly forward, and then gently lift the disk cage assembly from the chassis [3].**

   Set the disk cage assembly on an anti-static mat.

8. **Remove the right LED/USB indicator module.**

a. **Remove the two No. 2 Phillips screws that secure the LED/USB indicator module to the storage server front panel [1].**

   If present, remove the capping tape that secures the cable to the side of the disk cage assembly.



b. **Remove the LED/USB indicator module from the storage server front panel [2].**

Related Information

- “Storage Server System-Level Status Indicators” on page 27
- “Install the Right LED/USB Indicator Module” on page 141

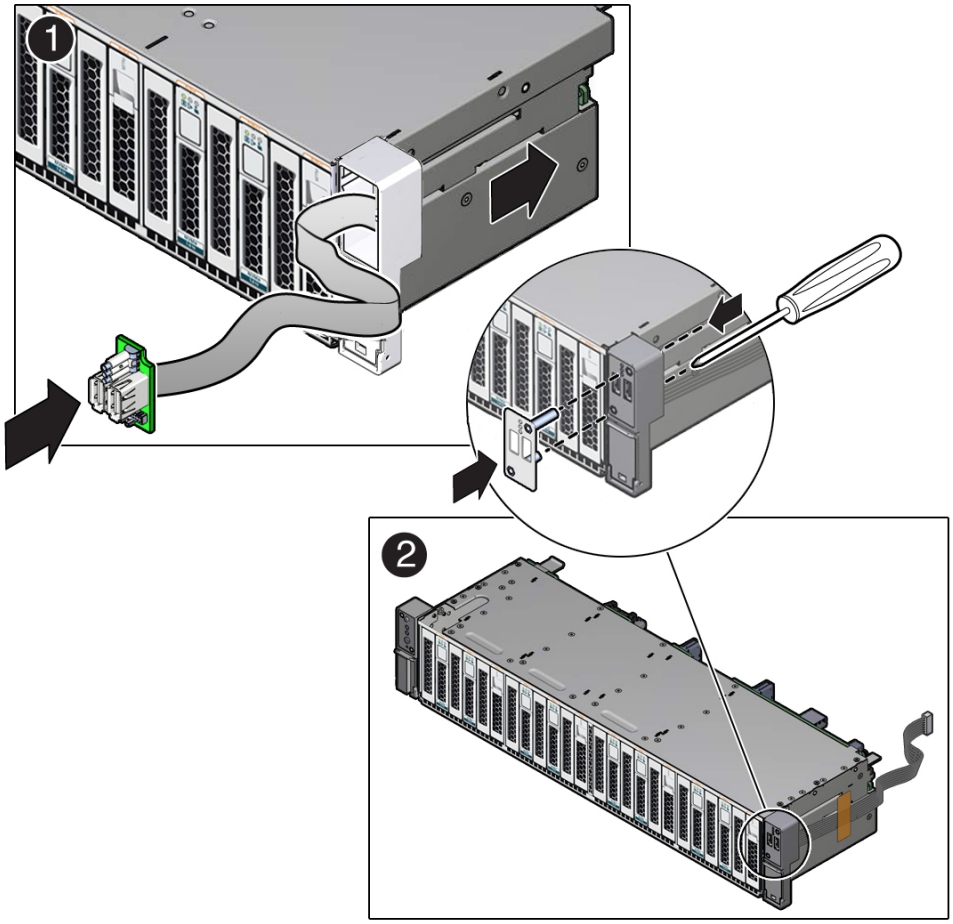
▼ Install the Right LED/USB Indicator Module

1. **Install the right LED/USB indicator module.**

   a. **Push the LED/USB indicator module and cable through the right LED housing on the storage server front panel [1].**

      If necessary, use a piece of capping tape to secure the LED cable to the side of the disk cage assembly.

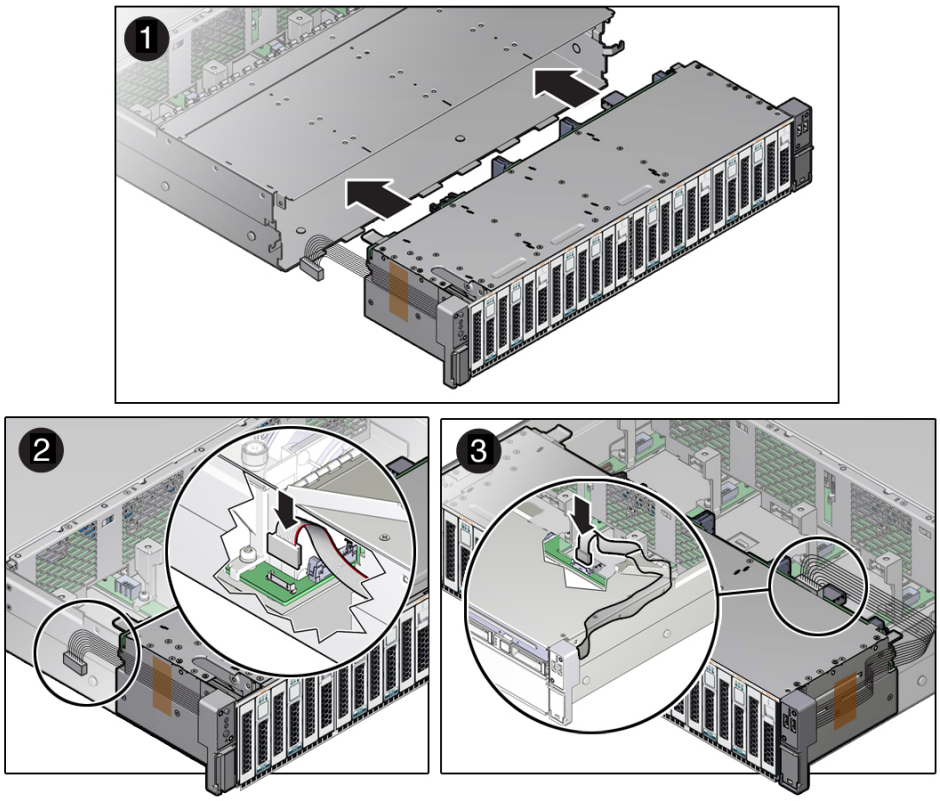
Note - Cable part number 7064124 is required for the right LED/USB indicator module.



b. **Insert and tighten the two No. 2 Phillips screws to secure the LED/USB indicator module to the storage server front panel [2].**

2. **Gently lift the disk cage assembly and set it into the storage server chassis [1].**

Slightly push the disk cage assembly into the storage server chassis to ensure that the disk cage screw holes are correctly aligned with the chassis.



3. **Reconnect the left LED indicator module cable and the right LED/USB indicator module cable to the motherboard [2 and 3].**

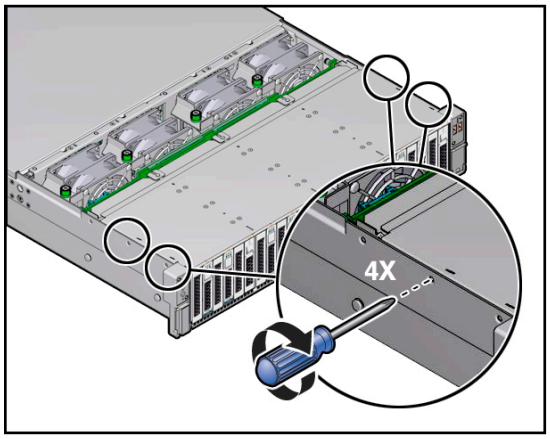
4. **Reconnect all cables to the storage drive backplane.**

   See “Install the Storage Drive Backplane” on page 120.

5. **Install the fan modules in the server.**

   See “Install a Fan Module” on page 72.

6. **Install the four No. 2 Phillips screws (two on each side of the chassis) that secure the disk cage assembly to the storage server chassis.**



7. **Install the storage server fan assembly door.**

   See “Install the Fan Assembly Door” on page 164.

8. **Return the storage server to operation.**

   a. **Install the storage server top cover.**

      See “Install the Storage Server Top Cover” on page 162.

   b. **Return the storage server to the normal rack position.**

      See “Return the Storage Server to the Normal Rack Position” on page 165.

   c. **Reconnect the power cords to the power supplies, and power on the storage server.**

      See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

Related Information

- “Storage Server System-Level Status Indicators” on page 27
- “Remove the Right LED/USB Indicator Module” on page 138

Servicing the Motherboard Assembly



Caution - Ensure that all power is removed from the storage server before removing or installing the motherboard. You must disconnect the power cables before performing these procedures.



Caution - These procedures require that you handle components that are sensitive to electrostatic discharge. This discharge can cause storage server components to fail. To avoid damage, ensure that you follow the antistatic practices as described in "Electrostatic Discharge Safety" on page 48.

This section covers the following procedures:

- "Remove the Motherboard Assembly" on page 145
- "Install the Motherboard Assembly" on page 154

Related Information

- "About System Components" on page 17

▼ Remove the Motherboard Assembly

1. **Prepare the storage server for service.**

   a. **Power off the storage server and disconnect the power cords from the power supplies.**

      See "Powering Down the Storage Server" on page 51.

   b. **Extend the storage server into the maintenance position.**

      See "Extend the Storage Server to the Maintenance Position" on page 55.

   c. **Attach an antistatic wrist strap to your wrist, and then to a metal area of the chassis.**

      See "Take Antistatic Measures" on page 58.

   d. **Remove the storage server top cover.**

See “Remove the Storage Server Top Cover” on page 59.

2. **Remove the air baffle.**

   Remove the air baffle by lifting the baffle up and out of the storage server.

3. **Remove the following reusable components:**

Caution - During the motherboard removal procedure, it is important to label power supplies with the slot numbers from which they were removed (PS0, PS1). This is required because the power supplies must be reinstalled into the slots from which they were removed; otherwise, the server key identity properties (KIP) data might be lost. When a server requires service, the KIP is used by Oracle to verify that the warranty on the server has not expired. For more information on KIP, see “FRU Key Identity Properties (KIP) Automated Update” on page 49.

- Fan modules

  See “Remove a Fan Module” on page 69.
- NVMe cables

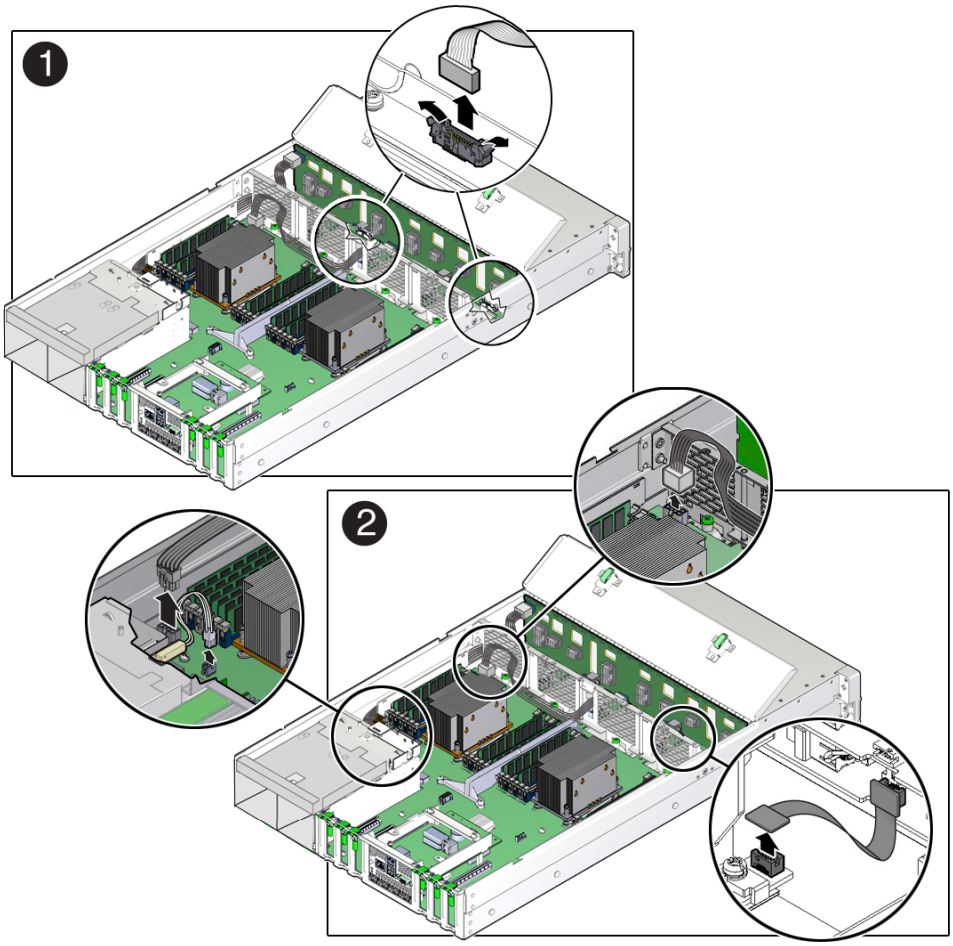
  See “Remove NVMe Cables” on page 123.
- PCIe cards

  See “Remove a PCIe Card” on page 93.
- Power supplies

  See “Remove a Power Supply” on page 74.

4. **Disconnect the ribbon cables from the left front LED indicator module and right front LED/USB indicator module [1].**

See “Servicing the Front LED/USB Indicator Modules” on page 131.



5. **Disconnect the auxiliary signal cable from the motherboard to the front storage drive backplane [2].**

   See “Servicing the Storage Drive Backplane” on page 117.

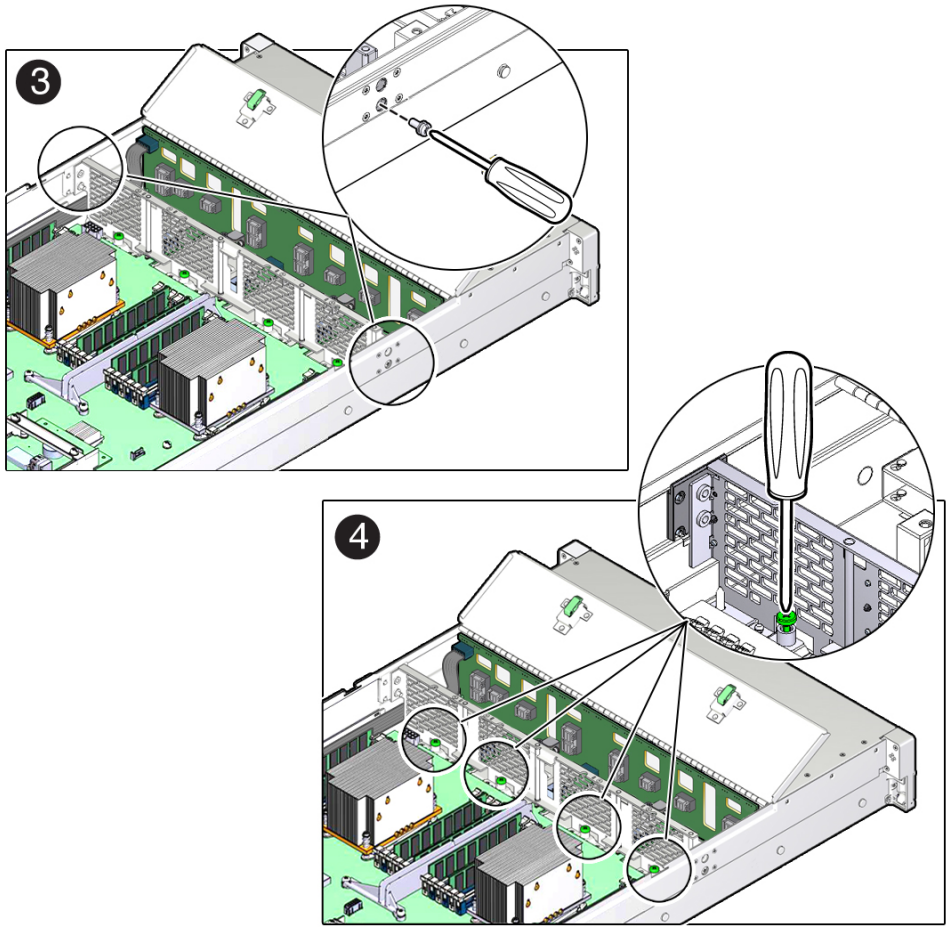
6. **Disconnect the two power cables from the motherboard to the front storage drive backplane [2].**

   See “Servicing the Storage Drive Backplane” on page 117.

7. **Disconnect the signal cable from the storage server intrusion switch [2].**

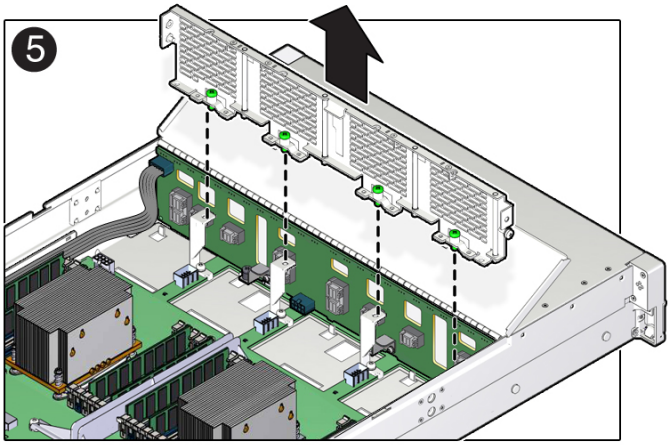
8. **Remove the mid-wall from the chassis.**

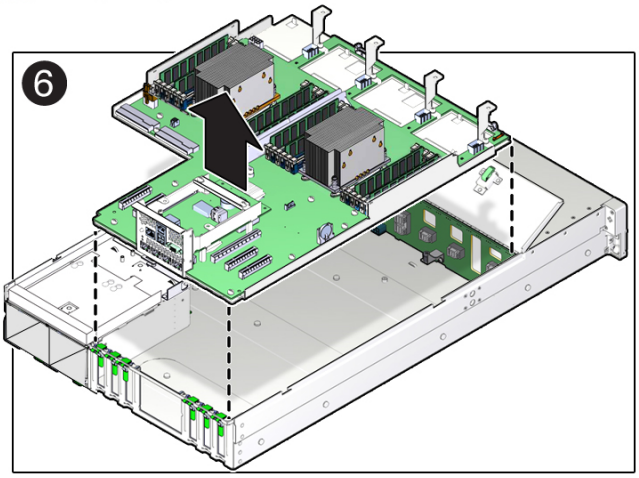
   a. **Using a hex/flat head screwdriver, remove the screw on each side of the chassis that secures the mid-wall to the chassis [3].**



   b. **Using a No. 2 Phillips screwdriver, loosen the four green captive screws that secure the chassis mid-wall to the bottom of the chassis [4].**

c. **Lift the mid-wall out of the chassis [5].**





9. **With the storage server in the extended maintenance position, remove the motherboard from the storage server with all reusable components that populate the motherboard in place.**

   a. **Carefully slide the motherboard forward, and lift it out of the chassis [6].**

   b. **Place the motherboard assembly on an antistatic mat, and next to the replacement motherboard.**

10. **Remove the following reusable components from the motherboard and install them onto the replacement motherboard.**

    - DDR4 DIMMs

      See "Identify and Remove a Faulty DIMM" on page 85 and "Install a DIMM" on page 89.

      Note - Install the DDR4 DIMMs only in the slots (connectors) from which they were removed. Performing a one-to-one replacement of DIMMs significantly reduces the possibility that DIMMs will be installed in the wrong slots. If you do not reinstall the DIMMs in the same slots, storage server performance might be reduced and some DIMMs might not be used.

    - USB flash drives

      See "Remove an Internal USB Flash Drive" on page 98 and "Install an Internal USB Flash Drive" on page 99.

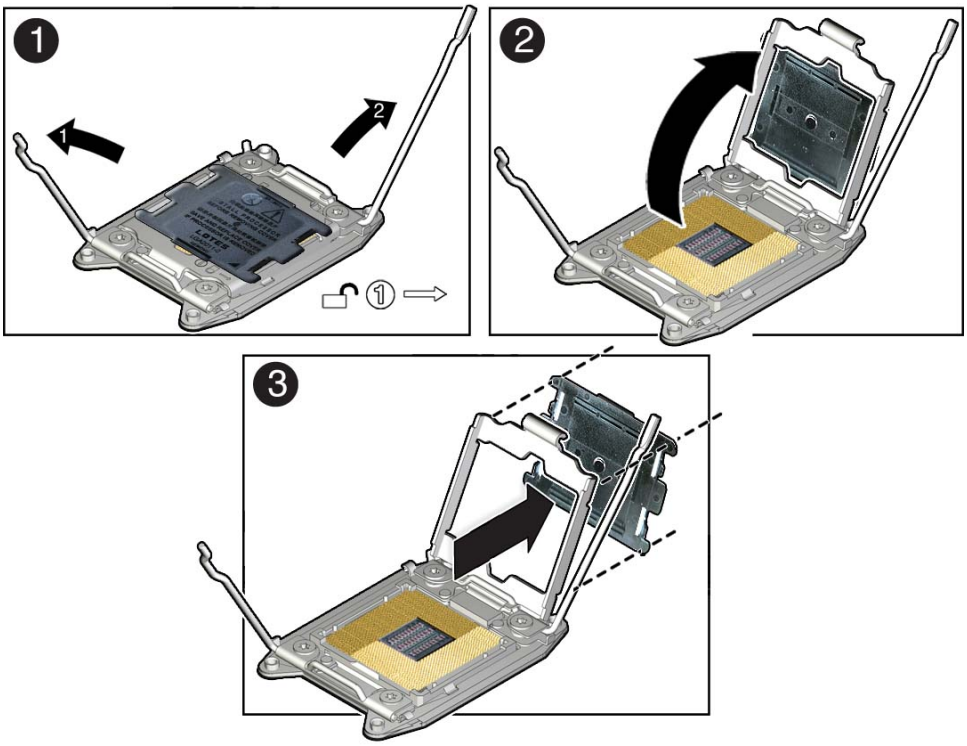
11. **Remove the processors from the failed motherboard.**

    See "Remove a Processor" on page 104.

12. **Remove the processor socket covers from the replacement motherboard and install the processors.**

    a. **Disengage the processor Independent Loading Mechanism (ILM) assembly hinge lever on the right side of the processor socket (viewing the storage**

server from the front) by pushing down on the lever and moving it to the side away from the processor, and then rotating the lever upward [1].



b. Disengage the processor ILM assembly load lever on the left side of the processor socket (viewing the storage server from the front) by pushing down on the lever and moving it to the side away from the processor, and then rotating the lever upward [1].

c. To lift the processor ILM assembly load plate off of the processor socket, rotate the ILM assembly hinge lever on the right side of the processor toward the closed position (the load plate is lifted up as the hinge lever is lowered) and carefully swing the load plate to the fully open position [2].

d. Grasp the top and underside of the processor socket cover with one hand (place your thumb against the underside of the cover), place your other

thumb against the underside of the cover, and carefully push the cover out of the processor ILM assembly load plate [3].

Caution - Be careful not to allow the processor socket cover to fall into the processor socket as this could result in damage to the socket.

e. Install a processor into the socket from which you removed the processor socket cover.

See "Install a Processor" on page 111.

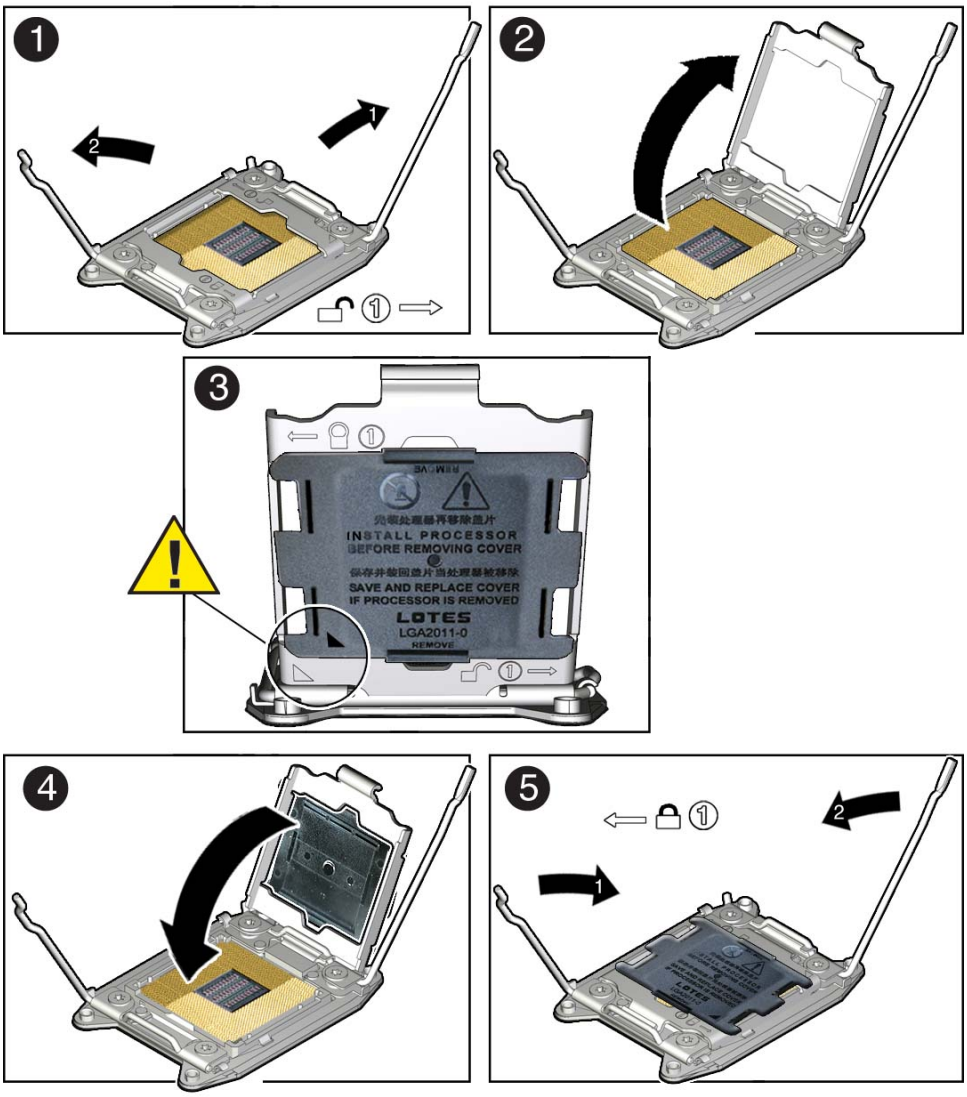
f. Repeat Step 12a through Step 12e to remove the second processor socket cover from the replacement motherboard and install the second processor.

13. Install the processor socket covers on the faulty motherboard.

Caution - The processor socket covers must be installed on the faulty motherboard; otherwise, damage might result to the processor sockets during handling and shipping.

Caution - Be careful not to allow the processor socket cover to fall into the processor socket as this could result in damage to the socket.

a. Open one of the processor ILM assemblies on the faulty motherboard [1 and 2].



b. **Hold the processor ILM assembly load plate open with one hand and position the processor socket cover over the top of the pressure frame so that 1) the arrow on the processor socket cover is aligned with the arrow on the load plate and 2) the fasteners on one side of the cover (the fasteners are located on the underside of the cover) are inside the load plate (it does not matter which side), and use your thumb to press the other side of the processor socket cover into the load plate. [3].**

c. **Close the processor ILM assembly load plate [4 and 5].**

d. **Repeat Step 13a through Step 13c to install the second processor socket cover on the faulty motherboard.**

Related Information

- “About System Components” on page 17
- “Replaceable Components” on page 19
- “Install the Motherboard Assembly” on page 154

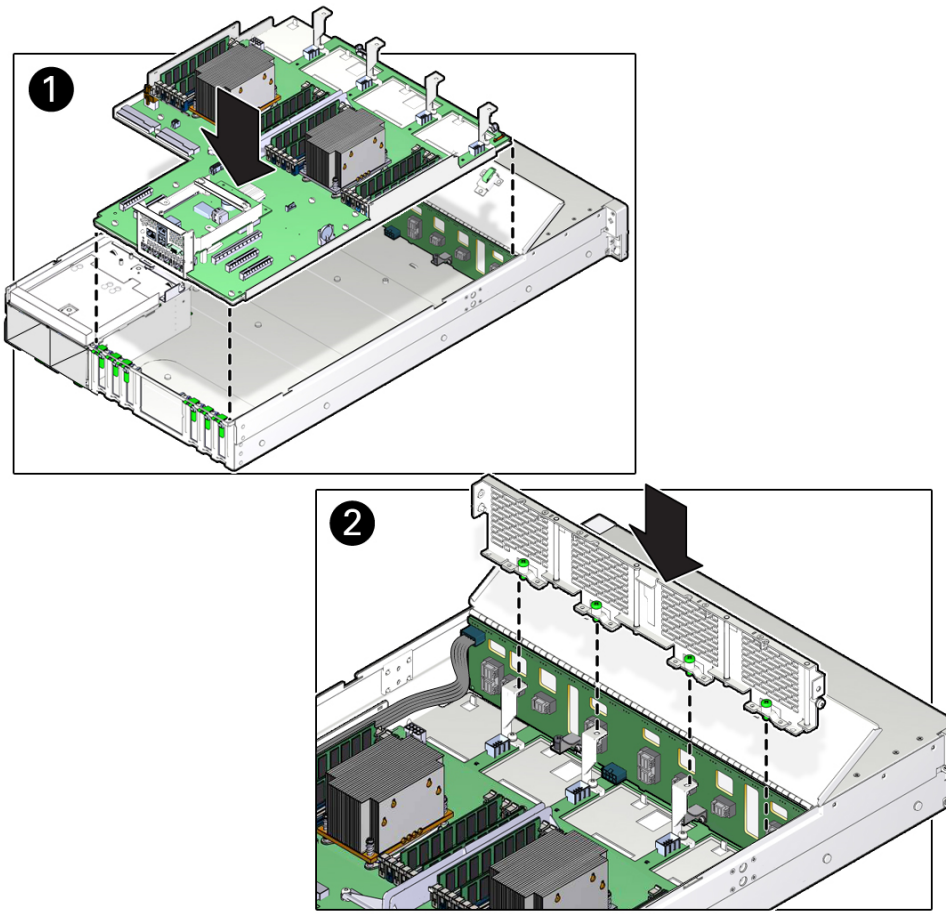
▼ Install the Motherboard Assembly

1. **Attach an antistatic wrist strap to your wrist, and then to a metal area on the chassis.**

   See “Take Antistatic Measures” on page 58.

2. **Carefully lift and place the motherboard assembly into the chassis [1].**

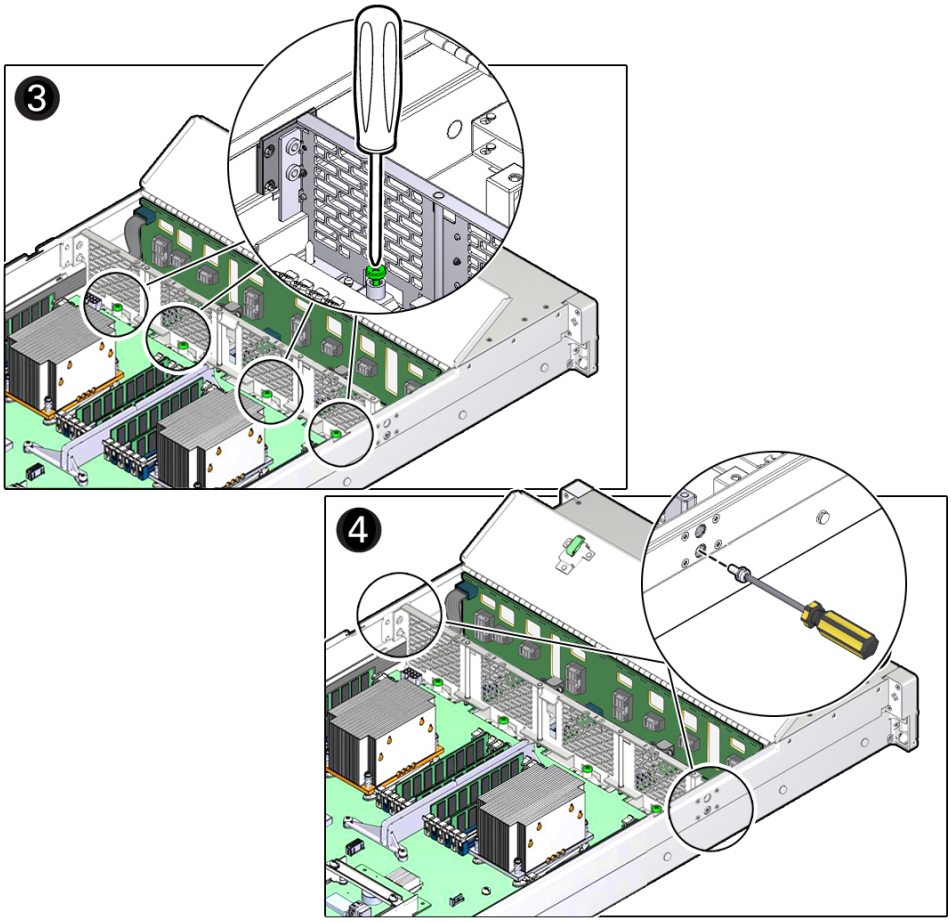
Tilt the motherboard to the right side to fit under the power supply assembly, level the motherboard and place it into the storage server chassis, then slide it to the rear of the storage server to engage the raised standoffs.



3. **Install the mid-wall into the chassis.**

   a. **Lift and place the mid-wall into the chassis [2].**

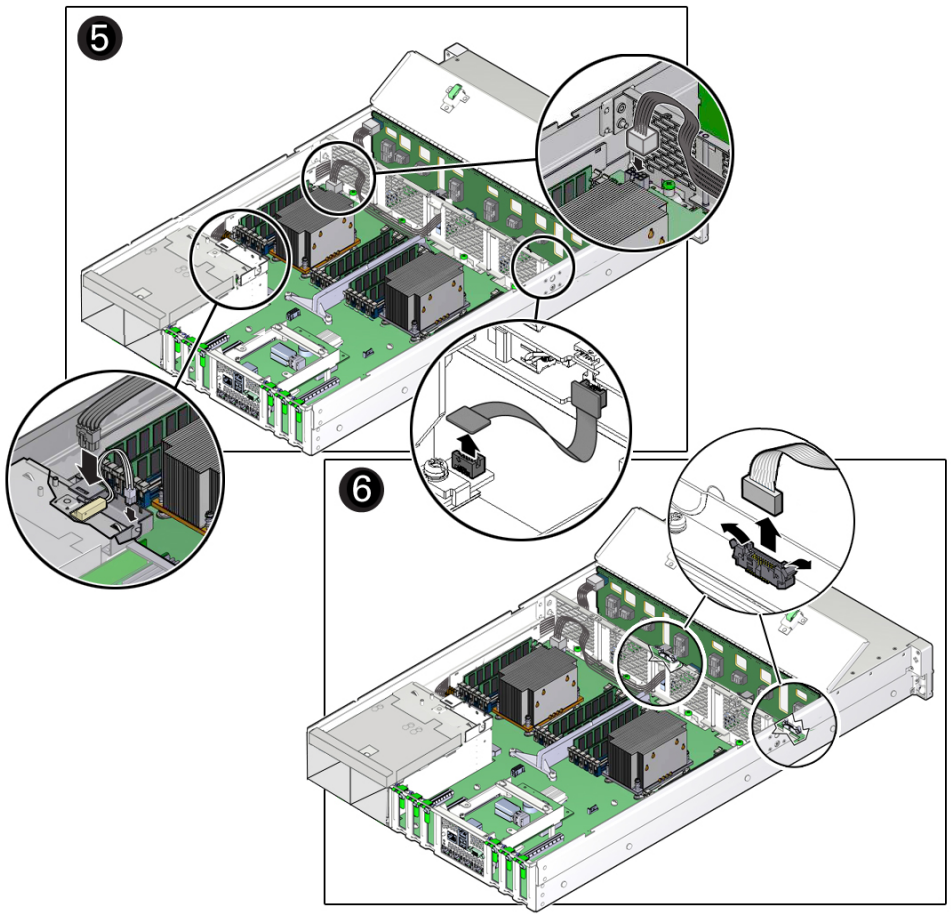
b. **Using a No. 2 Phillips screwdriver, tighten the four green captive screws that secure the mid-wall to the bottom of the chassis [3].**



c. **Using a hex/flat head screwdriver, insert and tighten the screw on each side of the chassis to secure the mid-wall in the chassis [4].**

4. **Reconnect the auxiliary signal cable to the motherboard from the front storage drive backplane [5].**

See “Servicing the Storage Drive Backplane” on page 117.



5. **Reconnect the power cables to the motherboard from the front storage drive backplane [5].**

   See “Servicing the Storage Drive Backplane” on page 117.

6. **Reconnect the storage server intrusion switch cable to the motherboard [5].**

7. **Reconnect the ribbon cables from left and right LED/USB indicator modules to the motherboard [6].**

See “Servicing the Front LED/USB Indicator Modules” on page 131.

8. **Reinstall the following components:**



Caution - When reinstalling power supplies, it is important to reinstall them into the slots from which they were removed during the motherboard removal procedure; otherwise, the server key identity properties (KIP) data might be lost. When a server requires service, the KIP is used by Oracle to verify that the warranty on the server has not expired. For more information on KIP, see “FRU Key Identity Properties (KIP) Automated Update” on page 49.

- Power supplies

  See “Install a Power Supply” on page 77.
- PCIe cards

  See “Install a PCIe Card” on page 95.
- NVMe cables

  See “Install NVMe Cables” on page 125.
- Fan modules

  See “Install a Fan Module” on page 72.

9. **Install the air baffle.**

   Install the air baffle by placing it into the storage server and lowering it to its installed position.

10. **Return the storage server to operation.**

    a. **Install the storage server top cover.**

       See “Install the Storage Server Top Cover” on page 162.

    b. **Return the storage server to the normal rack position.**

       See “Return the Storage Server to the Normal Rack Position” on page 165.

    c. **Reconnect the power cords to the power supplies, and power on the storage server.**

       See “Reconnect Power and Data Cables” on page 167 and “Power On the Storage Server” on page 168. Verify that the power supply AC OK LED is lit.

Note - IMPORTANT: When the motherboard is replaced, the key identity properties (KIP) of the motherboard is programmed by Oracle ILOM to contain the same KIP as the other quorum member components. If you have removed other quorum member components, you might need to manually program the product serial number (PSN) into the new motherboard. For more information, refer to "FRU Key Identity Properties (KIP) Automated Update" on page 49.

Related Information

- "About System Components" on page 17
- "Replaceable Components" on page 19
- "Remove the Motherboard Assembly" on page 145

Returning the Storage Server to Operation

After replacing components inside of the storage server, perform the procedures in the following sections.

Description	Links
Note storage server filler panel requirements.	“Storage Server Filler Panel Requirements” on page 161
Install the storage server top cover.	“Install the Storage Server Top Cover” on page 162
Install the fan door assembly top cover.	“Install the Fan Assembly Door” on page 164
Remove any antistatic measures.	“Remove Antistatic Measures” on page 164
Reinstall the storage server chassis in the rack.	“Reinstall the Storage Server in the Rack” on page 165
Return the storage server to the normal rack position.	“Return the Storage Server to the Normal Rack Position” on page 165
Reconnect power and data cables.	“Reconnect Power and Data Cables” on page 167
Power on the storage server.	“Power On the Storage Server” on page 168

Related Information

- “Preparing for Service” on page 47

Storage Server Filler Panel Requirements

The storage server might be shipped with module-replacement filler panels for storage drives and PCIe cards. These filler panels are installed at the factory and must remain in the storage server until you replace them with a purchased option.

Before you can install an optional storage server component into the storage server, you must remove the filler panel from the location into which you intend to install the component. When you remove a storage drive or a PCIe card from the storage server, you must install either a replacement for the component removed or a filler panel.

Related Information

- “Preparing for Service” on page 47

Remove and Install Filler Panels

- **See the procedures in the following table to remove and install filler panels for storage drives and PCIe cards.**

Filler Panel Type	Removal Procedure	Installation Procedure
Storage drive	1. Locate the storage drive filler panel to be removed from the storage server. 2. To unlatch the storage drive filler panel, pull the release lever, and then tilt the lever out into a fully opened position. 3. To remove the filler panel from the slot, hold the opened release lever, and gently slide the filler panel toward you.	1. Locate the vacant storage drive module slot in the storage server, and then ensure that the release lever on the filler panel is fully opened. 2. Slide the filler panel into the vacant slot by pressing the middle of the filler panel faceplate with your thumb or finger. The release lever will go in as it makes contact with the chassis. Do not slide the filler panel in all the way. Leave the filler panel out approximately 0.25 to 0.50 inch (6 to 12 mm) from the opening. 3. Using your thumb or finger, press on the middle of the filler panel faceplate until the release lever engages with the chassis. 4. Close the release lever until it clicks into place and is flush with the front of the storage server.
PCIe slot	1. Remove the storage server top cover. 2. To remove the PCIe slot filler panel, rotate the PCIe locking mechanism, and then lift and remove the PCIe slot filler panel from the location into which you intend to install the PCIe card.	1. Remove the storage server top cover. 2. To install the PCIe slot filler panel, press the PCIe filler panel into the vacant PCIe slot, and then rotate the PCIe locking mechanism to secure the PCIe slot filler panel.

Install the Storage Server Top Cover

1. **Place the top cover on the chassis.**
   Set the cover down so that it hangs over the rear of the storage server by about 1 inch (25 mm) and the side latches align with the cutouts in the chassis.

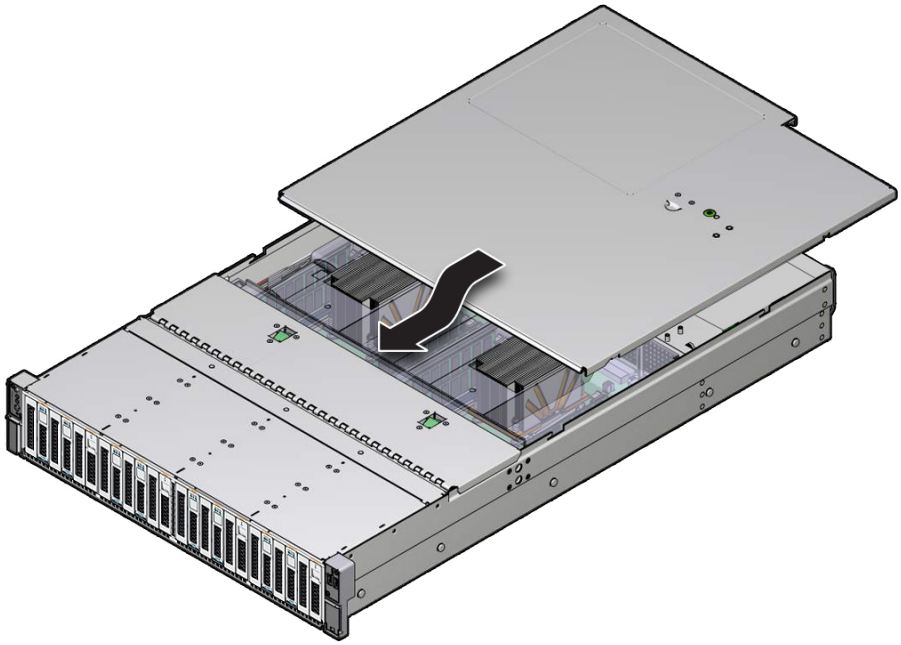
2. **Check both sides of the chassis to ensure that the top cover is fully down and flush with the chassis.**

If the cover is not fully down and flush with the chassis, slide the cover towards the rear of the chassis to position the cover in the correct position.

Caution - If the top cover is not correctly positioned before you attempt to latch the cover, the internal latch that is located on the underside of the cover might be damaged.

3. **Gently slide the cover toward the front of the chassis until it latches into place (with an audible click).**

   As you slide the cover toward the front of the storage server, watch the green release button. You will hear an audible click when the green release button pops up, indicating that the cover is locked.

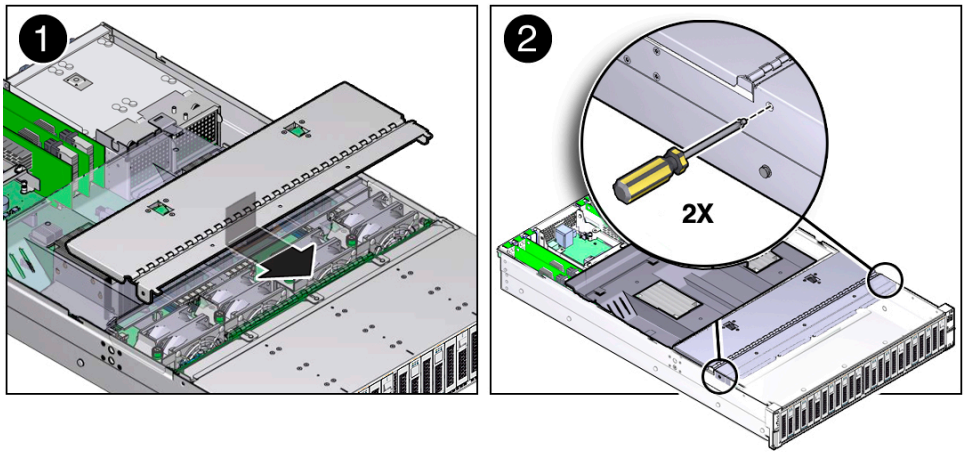


Related Information

- “Remove the Storage Server Top Cover” on page 59

Install the Fan Assembly Door

1. **Place the fan assembly door on the chassis and slightly over the fan assembly.**
2. **Slide the fan assembly door forward and under the lip of the forward top cover until it latches into place [1].**



3. **Use a No. 2 Phillips screwdriver to install and tighten the two screws on each side of the chassis that secure the fan assembly door [2].**

Related Information

- “Remove the Fan Assembly Door From the Storage Server” on page 60
- “Remove the Storage Server Top Cover” on page 59

Remove Antistatic Measures

1. **Remove any antistatic straps or conductors from the storage server chassis.**
2. **Remove the antistatic wrist strap from yourself.**

Related Information

- “Take Antistatic Measures” on page 58

Reinstall the Storage Server in the Rack

After servicing the system, reinstall it into the rack.



Caution - Deploy any rack anti-tilt mechanism before installing the storage server into the rack.



Caution - The storage server weighs approximately 63 pounds (28.5 kg). Two people are required to carry the chassis and install it in the rack.

1. **Lift the storage server from the antistatic mat, and reinstall the storage server into the rack.**
   Refer to "Installing the Storage Server Into a Rack" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide* for the installation instructions specific to your rackmount kit.

2. **If the cable management arm (CMA) is not installed, that is, you removed it because you removed the storage server completely out of the rack, install the CMA.**
   For installation instructions for the CMA, refer to "Install the Cable Management Arm" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

3. **If the cables are disconnected from the rear of the storage server, that is, you disconnected the cables because you removed the storage server completely out of the rack, reconnect the cables.**

   - **For instructions on reconnecting cables to the rear of the storage server, see "Reconnect Power and Data Cables" on page 167.**
   - **For detailed information on connecting cables to the rear of the storage server, see "Rear Panel Connector Locations" on page 39.**

Related Information

- "Remove the Storage Server From the Rack" on page 57
- "Reconnect Power and Data Cables" on page 167

Return the Storage Server to the Normal Rack Position

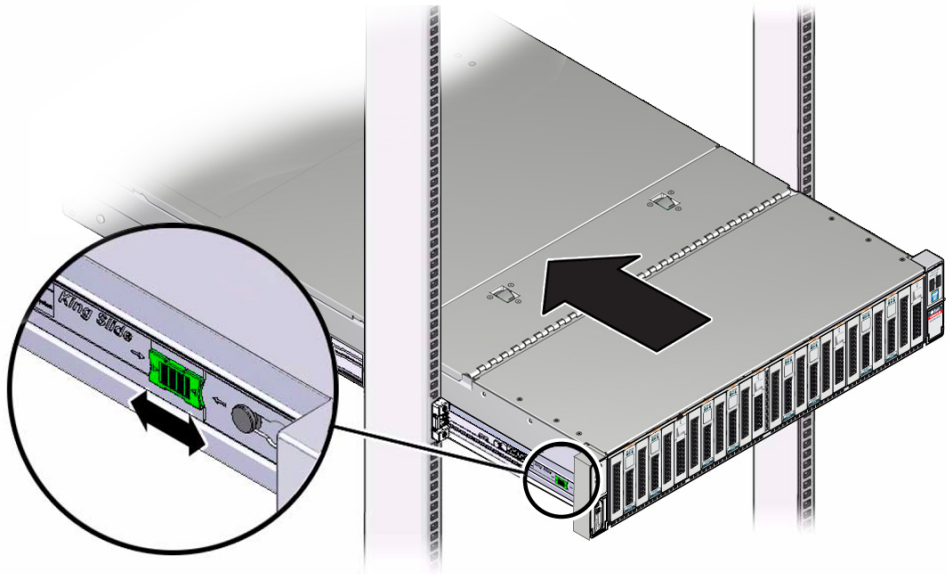
If the storage server is in the extended maintenance position, use this procedure to return the storage server to the normal rack position.

1. **Push the storage server back into the rack, as described in the following steps.**

   a. **Simultaneously pull and hold the two green release tabs (one on each side of the slide rails on the server) toward the front of the server while you push the server into the rack.**

      As you push the storage server into the rack, verify that the cable management arm (CMA) retracts without binding.

Note - To pull the green release tab, place your finger in the center of the tab, not on the end, and apply pressure as you pull the tab toward the front of the storage server.



   b. **Continue pushing the storage server into the rack until the slide-rail locks (on the front of the storage server) engage the slide-rail assemblies.**

      You will hear an audible click when the storage server is in the normal rack position.

2. **If the CMA is not installed, that is, you removed it because you removed the storage server completely out of the rack, install the CMA.**

For installation instructions for the CMA, refer to "Install the Cable Management Arm" in *Oracle Exadata Storage Server X5-2 Extreme Flash Installation Guide*.

3. **If the cables are disconnected from the rear of the server, that is, you disconnected the cables because you extended the server out of the rack, reconnect the cables.**

   - For instructions on reconnecting cables to the rear of the storage server, see "Reconnect Power and Data Cables" on page 167.
   - For detailed information on connecting cables to the rear of the storage server, see "Rear Panel Connector Locations" on page 39.

Related Information

- "Reconnect Power and Data Cables" on page 167

▼ Reconnect Power and Data Cables

1. **Reconnect the data cables to the rear of the storage server, as appropriate.**

   If the cable management arm (CMA) is in the way, extend the storage server approximately 13 cm (5 inches) out of the front of the rack.

2. **Reconnect the power cables to the power supplies.**

3. **If necessary, reinstall the cables into the cable management arm and secure them with Velcro straps.**

4. **Power on the storage server.**

   See "Power On the Storage Server" on page 168.

Related Information

- "Disconnect Cables From the Storage Server" on page 54
- "Reinstall the Storage Server in the Rack" on page 165
- "Return the Storage Server to the Normal Rack Position" on page 165
- "Power On the Storage Server" on page 168

Power On the Storage Server

As soon as the power cords are connected, standby power is applied. In standby power mode, the Power/OK LED on the storage server front panel blinks steadily. Depending on the configuration of the firmware, the system might boot. If it does not boot, follow this procedure.

- **Power on the storage server by performing one of the following actions:**
  - Press the Power button on the front bezel.
  - Log in to the Oracle ILOM web interface, click Host Management → Power Control and select Power On from the Select Action list.
  - Log in to the Oracle ILOM command-line interface (CLI), and type the following command at the Oracle ILOM prompt:

    ```
    -> start /System
    ```

    When the storage server is powered on and the power-on self-test (POST) code checkpoint tests have completed, the green Power/OK status indicator (LED) on the front panel of the storage server lights and remains lit.

Related Information

- “Powering Down the Storage Server” on page 51
- “Reconnect Power and Data Cables” on page 167

Identifying the Storage Server Ports

These sections describe the pinouts of the storage server connectors.

Description	Links
Review the Gigabit Ethernet ports.	“Gigabit Ethernet Ports” on page 169
Review the network management ports.	“Network Management Port” on page 170
Review the serial management ports.	“Serial Management Port” on page 171
Review the video connectors.	“Video Connector” on page 173
Review the USB ports.	“USB Ports” on page 174

Related Information

- “About the Oracle Exadata Storage Server X5-2 Extreme Flash” on page 13

Gigabit Ethernet Ports

The storage server has four auto-negotiating 100/1000/10GBASE-T Gigabit Ethernet (GbE) system domain ports. All four Ethernet ports use a standard RJ-45 connector. The transfer rates are shown in the following table.

TABLE 7 Ethernet Port Transfer Rates

Connection Type	IEEE Terminology	Transfer Rate
Fast Ethernet	100BASE-T	100 Mbps
Gigabit Ethernet	1000BASE-T	1,000 Mbps
10 Gigabit Ethernet	10GBASE-T	10,000 Mbps

The following figure and table describe the 10-GbE port pin signals.

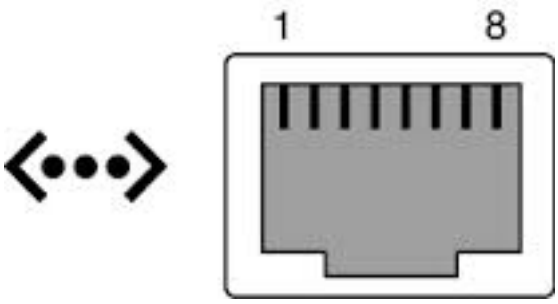


TABLE 8 10GbE Port Signals

Pin	Signal Description	Pin	Signal Description
1	Transmit/Receive Data 0 +	5	Transmit/Receive Data 2 –
2	Transmit/Receive Data 0 –	6	Transmit/Receive Data 1 –
3	Transmit/Receive Data 1 +	7	Transmit/Receive Data 3 +
4	Transmit/Receive Data 2 +	8	Transmit/Receive Data 3 –

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Storage Server System-Level Status Indicators” on page 27
- “Disconnect Cables From the Storage Server” on page 54
- “Reconnect Power and Data Cables” on page 167

Network Management Port

The storage server has one auto-negotiating 10/100/1000BASE-T Ethernet management domain interface, labeled NET MGT. For information about configuring this port for managing the storage server with Oracle ILOM, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.



TABLE 9 Network Management Port Signals

Pin	Signal Description	Pin	Signal Description
1	Transmit Data +	5	Common Mode Termination
2	Transmit Data –	6	Receive Data –
3	Receive Data +	7	Common Mode Termination
4	Common Mode Termination	8	Common Mode Termination

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Storage Server System-Level Status Indicators” on page 27
- “Disconnect Cables From the Storage Server” on page 54
- “Reconnect Power and Data Cables” on page 167

Serial Management Port

The serial management connector (labeled SER MGT) is an RJ-45 connector that can be accessed from the rear panel. This port is the default connection to the storage server. Use this port *only* for storage server management.

TABLE 10 Default Serial Connections for Serial Port

Parameter	Setting
Connector	SER MGT
Rate	9600 baud
Parity	None
Stop bits	1

Parameter	Setting
Data bits	8

The following figure and table describe the SER MGT port pin signals.



TABLE 11 Serial Management Port Signals

Pin	Signal Description	Pin	Signal Description
1	Request to Send	5	Ground
2	Data Terminal Ready	6	Receive Data
3	Transmit Data	7	Data Set Ready
4	Ground	8	Clear to Send

If you need to connect to the SER MGT port using a cable with either a DB-9 or a DB-25 connector, follow the pin descriptions in the tables to create a crossover adapter appropriate for your serial connection.

TABLE 12 RJ-45 to DB-9 Adapter Crossovers Wiring Reference

Serial Port (RJ-45 Connector)		DB-9 Adapter	
Pin	Signal Description	Pin	Signal Description
1	RTS	8	CTS
2	DTR	6	DSR
3	TXD	2	RXD
4	Signal ground	5	Signal ground
5	Signal ground	5	Signal ground
6	RXD	3	TXD
7	DSR	4	DTR
8	CTS	7	RTS

TABLE 13 RJ-45 to DB-25 Adapter Crossovers Wiring Reference

Serial Port (RJ-45 Connector)		DB-25 Adapter	
Pin	**Signal Description**	**Pin**	**Signal Description**
1	RTS	5	CTS
2	DTR	6	DSR
3	TXD	3	RXD
4	Signal ground	7	Signal ground
5	Signal ground	7	Signal ground
6	RXD	2	TXD
7	DSR	20	DTR
8	CTS	4	RTS

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Disconnect Cables From the Storage Server” on page 54
- “Reconnect Power and Data Cables” on page 167

Video Connector

The video connector is a DB-15 connector that can be accessed from the back panel.

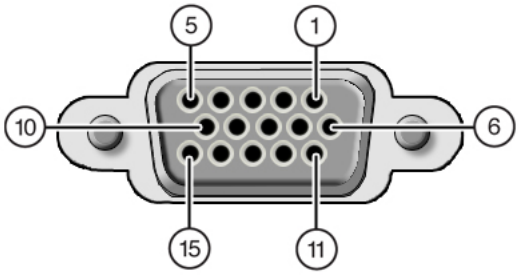


TABLE 14 Video Connector Signals

Pin	Signal Description	Pin	Signal Description
1	Red Video	9	[KEY]

Pin	Signal Description	Pin	Signal Description
2	Green Video	10	Sync Ground
3	Blue Video	11	Monitor ID - Bit 1
4	Monitor ID - Bit 2	12	Monitor ID - Bit 0
5	Ground	13	Horizontal Sync
6	Red Ground	14	Vertical Sync
7	Green Ground	15	N/C (Reserved)
8	Blue Ground		

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Disconnect Cables From the Storage Server” on page 54
- “Reconnect Power and Data Cables” on page 167

USB Ports

The storage server has six USB ports for attaching supported USB 2.0–compliant devices. Two USB ports are on the rear panel, two USB ports are on the front panel, and two USB ports are located on the motherboard.

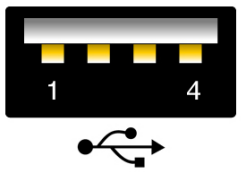


TABLE 15 USB Port Signals

Pin	Signal Description
1	+5 V
2	DAT-
3	DAT+
4	Ground

Related Information

- “Rear Panel Components and Cable Connections” on page 16
- “Disconnect Cables From the Storage Server” on page 54
- “Reconnect Power and Data Cables” on page 167

Setting Up BIOS Configuration Parameters

This section provides an overview of BIOS configuration management, Legacy BIOS, UEFI BIOS, and the BIOS Setup Utility.

Description	Links
Learn about the tools available to manage the BIOS configuration.	“Managing the BIOS Configuration” on page 177
Learn how to access the BIOS Setup Utility.	“Accessing the BIOS Setup Utility” on page 178
Learn about UEFI BIOS.	“Using UEFI” on page 183
Learn how BIOS allocates Option ROM and I/O resources.	“Using BIOS for Resource Allocation” on page 185
Learn how to perform common BIOS setup procedures.	“Common BIOS Setup Utility Tasks” on page 187

Related Information

- “BIOS Setup Utility Menu Options” on page 203

Managing the BIOS Configuration

The BIOS configuration parameters on an Oracle x86 server are manageable from the BIOS Setup Utility and Oracle ILOM. For information about using these tools to manage the BIOS configuration, refer to:

- **Oracle ILOM** – “Maintaining x86 BIOS Configuration Parameters” in the *Oracle ILOM Administrator's Guide for Configuration and Maintenance Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.
- **BIOS Setup Utility** – “Common BIOS Setup Utility Tasks” on page 187

Related Information

- Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at: http://www.oracle.com/goto/ilom/docs

Accessing the BIOS Setup Utility

The BIOS Setup Utility provides five main menus that you can use to view product information, and to configure, enable, and disable, or manage system components.

This section provides the following information:

- "BIOS Setup Utility Menus" on page 178
- "BIOS Key Mappings" on page 179
- "Access BIOS Setup Utility Menus" on page 179
- "Navigate BIOS Setup Utility Menus" on page 181

BIOS Setup Utility Menus

The following table provides descriptions for the top-level BIOS Setup Utility menus.

TABLE 16 BIOS Setup Utility Menus Summary

Menu	Description
Main	General product information, including memory, time/date, security settings, system serial number, and CPU and DIMM information.
Advanced	Configuration information for the CPU, trusted computing, USB, and other information. Set the IP address for the server SP. **Note -** When operating in UEFI Boot Mode, Runtime UEFI driver configuration settings let you manage PCIe drivers for all configurable devices.
Boot	Set the boot mode to Legacy BIOS or UEFI BIOS, and configure the boot device priority.
IO	Manage configuration settings for I/O devices, such as I/O virtualization settings, and enable and disable Option ROMs.
Exit	Save changes and exit, discard changes and exit, discard changes, or restore the default BIOS settings.

See "BIOS Setup Utility Menu Options" on page 203 for examples of each of these screens.

Related Information

- “BIOS Setup Utility Menu Options” on page 203
- “Navigate BIOS Setup Utility Menus” on page 181

BIOS Key Mappings

When viewing the BIOS output from a terminal using the serial console redirection feature, some terminals do not support function keys. BIOS supports the mapping of function keys to Control key sequences when serial redirection is enabled. The following table provides a description of the function key to Control key sequence mappings.

TABLE 17 Function Key to Control Key Sequence Mapping

Function Key	Control Key Sequence	BIOS POST Function	BIOS Setup Function
F1	Ctrl+Q	Not applicable	Activate the Setup Utility Help menu.
F2	Ctrl+E	Enter BIOS Setup Utility while the system is performing the power-on self-test (POST).	Not applicable
F7	Ctrl+D	Not applicable	Discard changes. (Not applicable to UEFI Driver Control menu)
F8	Ctrl+P	Activate the BIOS Boot Menu.	Not applicable
F9	Ctrl+O	Not applicable	Activate Load Optimal Values pop-up menu. (Not applicable to UEFI Driver Control menu)
F10	Ctrl+S	Not applicable	Activate Save and Exit pop-up menu. (Not applicable to UEFI Driver Control menu)
F12	Ctrl+N	Activate Network boot.	Not applicable

Related Information

- “Access BIOS Setup Utility Menus” on page 179
- “Navigate BIOS Setup Utility Menus” on page 181

▼ Access BIOS Setup Utility Menus

You can access the BIOS Setup Utility screens from the following interfaces:

- Use a USB keyboard and VGA monitor connected directly to the server. (A mouse is not required to access the BIOS Setup Utility.)
- Use a terminal (or terminal emulator connected to a computer) through the serial port on the back panel of the server.
- Connect to the server using the Oracle ILOM Remote System Console Plus application.

1. **Reset or power on the server.**

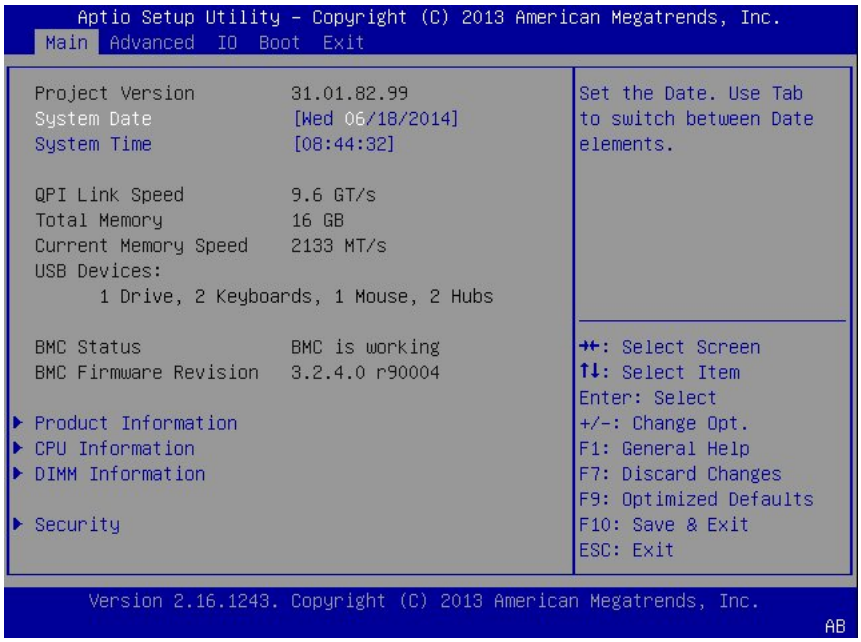
   For example, to reset the server:

   - **From the local server,** press the Power button on the front panel of the server to power off the server, and then press the Power button again to power on the server.
   - **From the Oracle ILOM web interface,** click Host Management → Power Control and select Reset from the Select Action list.
   - **From the Oracle ILOM CLI,** type `reset /System`

   The power-on self-test (POST) sequence begins.

2. **To enter the BIOS Setup Utility, press the F2 key (Ctrl+E from a serial connection) when prompted and while the BIOS is running the power-on self-tests (POST).**

The BIOS Setup Utility Main Menu screen appears.



Related Information

- “BIOS Setup Utility Menus” on page 178
- “BIOS Key Mappings” on page 179
- “BIOS Setup Utility Menu Options” on page 203

▼ Navigate BIOS Setup Utility Menus

To navigate the menus or options listed on a menu, use the arrow keys. The currently selected option or sub-menu is highlighted. For further instructions on how to navigate and change settings in the BIOS Setup Utility, refer to the online information provided on the menu.

1. **Access the BIOS Setup Utility.**

   See “Access BIOS Setup Utility Menus” on page 179.

2. **Use the left and right arrow keys to select the different primary menu options.**

   As you select each menu option, the top-level screen for that menu option appears.

3. **To navigate options presented on a top-level screen, use the up and down arrow keys.**

   Only options that can be modified are highlighted when you press the up and down arrow keys.

   - **If an option can be modified, as you select the option, user instructions for modifying the option appear in the right column of the screen.**
   - **If an option is a link to a sub-screen, a description of the sub-menu content appears in the right column.**

4. **Modify an option by pressing the + or - keys (plus or minus keys) or by pressing Enter and selecting the desired option from the pop-up menus.**

5. **Press the Esc key to return from a sub-menu screen to the previous menu screen.**

   Pressing Esc from a top-level menu is equivalent to selecting the Discard Changes and Exit option from the Save & Exit Menu.

6. **Modify parameters as needed.**

7. **Press the F10 key to save your changes and exit the BIOS Setup Utility.**

   Alternatively, you can select the Exit Menu, and then select the `Save Changes and Reset` to save your changes and exit the BIOS Setup Utility.

Note - After modifying any BIOS settings and selecting `Save Changes and Reset` from the Exit Menu, the subsequent reboot might take longer than a typical reboot where no settings were modified. The additional delay is required to ensure that changes to the BIOS settings are synchronized with Oracle ILOM.

Related Information

- “BIOS Setup Utility Menus” on page 178
- “BIOS Key Mappings” on page 179
- “BIOS Setup Utility Menu Options” on page 203

Using UEFI

The BIOS firmware controls the system from power-on until an operating system is booted.

The Oracle Exadata Storage Server X5-2 Extreme Flash contains a Unified Extensible Firmware Interface (UEFI)-compatible BIOS that can be configured to support either UEFI or Legacy BIOS modes. The BIOS can be configured to support either UEFI or Legacy BIOS modes. Legacy BIOS is the default mode, and should be used with software and adapters that do not have UEFI drivers

This section includes the following information:

- "Selecting Legacy BIOS or UEFI Boot Mode" on page 183
- "Switching Between Legacy BIOS and UEFI Boot Modes" on page 184
- "UEFI Boot Mode Advantages" on page 184
- "Configuration Utilities for Add-In Cards" on page 185

Selecting Legacy BIOS or UEFI Boot Mode

You can select either Legacy BIOS Boot Mode or UEFI Boot Mode. Legacy BIOS Boot Mode is the default.

If you change BIOS boot modes, the boot candidates from the previously selected mode are no longer available from the Boot Options Priority List in the BIOS Setup Utility. The boot candidates from the new mode appear in the Boot Options Priority List only after you select Save Changes and Reset from the BIOS Setup Utility menu. Use the Oracle ILOM BIOS Backup and Restore function to preserve the BIOS configuration in case you want to switch back to the previously selected mode. For information, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

All supported operating systems can use either UEFI Boot Mode or Legacy BIOS Boot Mode. However, once you choose a boot mode and install an operating system, if you reboot the server and select a different boot mode, the installed image can only be used in the mode in which it was installed. For instructions for selecting either UEFI Boot Mode or Legacy BIOS Boot Mode, see "Select Legacy BIOS or UEFI BIOS Boot Mode" on page 188.

Choose Legacy BIOS Boot Mode to allow host bus adapters (HBAs) to use option ROMs, and when software or adapters do not have UEFI drivers. In Legacy BIOS Boot Mode, only boot candidates that support Legacy BIOS Boot Mode appear in the Boot Options Priority List in the BIOS Setup Utility.

Choose UEFI Boot Mode when software and adapters use UEFI drivers. You can manually select UEFI Boot Mode during system setup. In UEFI Boot Mode, only boot candidates that support UEFI Boot Mode appear in the Boot Options Priority List in the BIOS Setup Utility.

Related Information

- “Switching Between Legacy BIOS and UEFI Boot Modes” on page 184
- “UEFI Boot Mode Advantages” on page 184
- “Configuration Utilities for Add-In Cards” on page 185

Switching Between Legacy BIOS and UEFI Boot Modes

When switching between Legacy BIOS Boot Mode and UEFI BIOS Boot Mode (either direction), BIOS settings that affect the Boot Options Priority list settings will be changed. If the boot mode is changed, the boot candidates from the previous boot mode disappear. The boot candidates for the newly changed boot mode appear after you save your changes and reset the host and in the next boot to the BIOS Setup Utility.

Because the settings for a given mode do not persist after a transition between modes, you should use the BIOS Backup and Restore feature to capture and preserve the BIOS configuration if you intend to switch back to the previous boot mode and want to retain your previous BIOS settings. For information about the BIOS Backup and Restore feature, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

Related Information

- “Selecting Legacy BIOS or UEFI Boot Mode” on page 183
- “UEFI Boot Mode Advantages” on page 184
- “Configuration Utilities for Add-In Cards” on page 185

UEFI Boot Mode Advantages

When the option is available to choose between a Legacy BIOS Boot Mode or UEFI BIOS Boot Mode operating system installation, the advantages to choosing a UEFI BIOS Boot Mode installation include the following:

- Avoids Legacy Option ROM address constraints. For more information, see “Legacy Option ROM Allocation” on page 186.
- Supports operating system boot partitions greater than 2 terabytes (2 TB) in size.
- Integrates PCIe device configuration utilities within the BIOS Setup Utility menus. For more information, see “BIOS Setup Utility Menu Options” on page 203.
- Displays bootable operating system images in the boot list as labeled entities, for example, you will see a Windows boot manager label as opposed to raw device labels.

Related Information

- “Selecting Legacy BIOS or UEFI Boot Mode” on page 183
- “Select the Boot Device” on page 190

Configuration Utilities for Add-In Cards

The method for interacting with configuration utilities for add-in cards and (system resident) I/O adapters differs depending on whether Legacy BIOS Boot Mode or UEFI BIOS Boot Mode is used.

In Legacy BIOS Boot Mode, I/O adapter utilities are invoked during BIOS POST progression using hot keys identified by the adapter Option ROM during POST. When the hot key is pressed, the adapter specific configuration utility interface is presented. Often the interface will have a vendor-specific design.

In UEFI BIOS Boot Mode, the configuration screens for the add-in cards will appear as menu items in the BIOS Advanced Menu as part of the standard BIOS Setup Utility screens. For example, if a host bus adapter is installed in the server, the configuration utility for the HBA appears as a menu selection under the iSCSI menu option on the BIOS Advanced Menu.

Related Information

- “Selecting Legacy BIOS or UEFI Boot Mode” on page 183

Using BIOS for Resource Allocation

This section explains how the BIOS allocates Option ROM and I/O resources.

- "Legacy Option ROM Allocation" on page 186

Legacy Option ROM Allocation

In Legacy BIOS Boot Mode, there are PC architecture constraints on Legacy Option ROM allocation. These constraints do not apply to UEFI Option ROMs, which are often referred to as UEFI drivers.

Choose Legacy BIOS Boot Mode to allow host bus adapters (HBAs) to use Option ROMs. Choose UEFI BIOS Boot Mode to use UEFI drivers.

The system BIOS allocates 128 KB of address space for Legacy Option ROMs. This address space is shared between on-board devices and PCIe add-in cards. This fixed address space limitation is imposed by the PC architecture and not by the BIOS itself. It is possible to exhaust the available address space when installing PCIe add-in cards. When the address space is exhausted, Oracle ILOM displays an `Option ROM Space Exhausted` message, which means that one or more devices cannot load Option ROMs.

For example, if you install a SAS PCIe card, you might encounter a message similar to the following message in the Oracle ILOM event log:

```
Option ROM Space Exhausted - Device XXX Disabled
```

By default, all on-board Legacy Options ROMs are enabled in the BIOS. However, you can disable most of these Option ROMs, unless they are required to support booting from the associated device or to provide some other boot-time function. For example, it is not necessary to load the Option ROM for the on-board network ports unless you want to boot from one or more network ports (even then, you can disable the Options ROMs for the remaining ports).

To minimize server boot time and reduce the likelihood of exhausting the available Option ROM address space, disable the Option ROMs for all devices that you do not intend to boot from. Enable Option ROMs only for those devices from which you intend to boot. If Option ROMs are enabled for more than one boot device, you might encounter an Option ROM space exhausted condition. If you encounter the Option ROM space exhausted condition even after disabling all devices from which you do not intend to boot, then disable additional Option ROMs. Under some circumstances it might be necessary to disable Option ROMs for all devices except for the primary boot device.

Related Information

- "Access BIOS Setup Utility Menus" on page 179

- “Configure Option ROM Settings” on page 197

Common BIOS Setup Utility Tasks

This section presents the procedures for some of the BIOS setup tasks that you will typically perform when setting up and managing the server.

- “Verify BIOS Factory Default Settings” on page 187
- “Select Legacy BIOS or UEFI BIOS Boot Mode” on page 188
- “Select the Boot Device” on page 190
- “Configure TPM Support” on page 192
- “Configure SP Network Settings” on page 194
- “Configure Option ROM Settings” on page 197
- “Configure I/O Resource Allocation” on page 201
- “Exit BIOS Setup Utility” on page 201

▼ Verify BIOS Factory Default Settings

In the BIOS Setup Utility, you return the BIOS settings to the optimal factory default values, as well as view and edit settings as needed. Any changes that you make in the BIOS Setup Utility (using the F2 key) persist until the next time you change the settings.

Before you begin, ensure that the following requirements are met:

- A hard disk drive or solid state drive is properly installed in the server.
- A console connection is established to the server.

1. **Reset or power on the server.**

   - **From the local server,** press the Power button on the front panel of the server to power off the server, and then press the Power button again to power on the server.
   - **From the Oracle ILOM web interface,** click Host Management → Power Control and select Reset from the Select Action list.
   - **From the Oracle ILOM CLI,** type `reset /System`

   The server resets.

2. **When prompted, press the F2 key to access the BIOS Setup Utility.**

3. **To ensure that the factory defaults are set, do the following:**

   a. **Press the F9 key to automatically load the optimal factory default settings.**

      A message appears prompting you to continue this operation by selecting OK or to cancel the operation by selecting Cancel.

   b. **In the message, highlight OK, and then press Enter.**

      The BIOS Setup Utility screen appears with the cursor highlighting the first value on the screen.

4. **Press the F10 key to save the changes and exit the BIOS Setup Utility.**

   Alternatively, you can save the changes and exit the BIOS Setup Utility by navigating to the Exit Menu and selecting `Save Changes and Reset`.

Related Information

- “Access BIOS Setup Utility Menus” on page 179
- “BIOS Setup Utility Menus” on page 178
- “BIOS Key Mappings” on page 179

▼ Select Legacy BIOS or UEFI BIOS Boot Mode

The BIOS firmware supports both Legacy BIOS Boot Mode and UEFI BIOS Boot Mode. The default setting is Legacy BIOS Boot Mode. For more information about selecting the BIOS boot mode, refer to “Using UEFI” on page 183.

1. **Access the BIOS Setup Utility menus.**

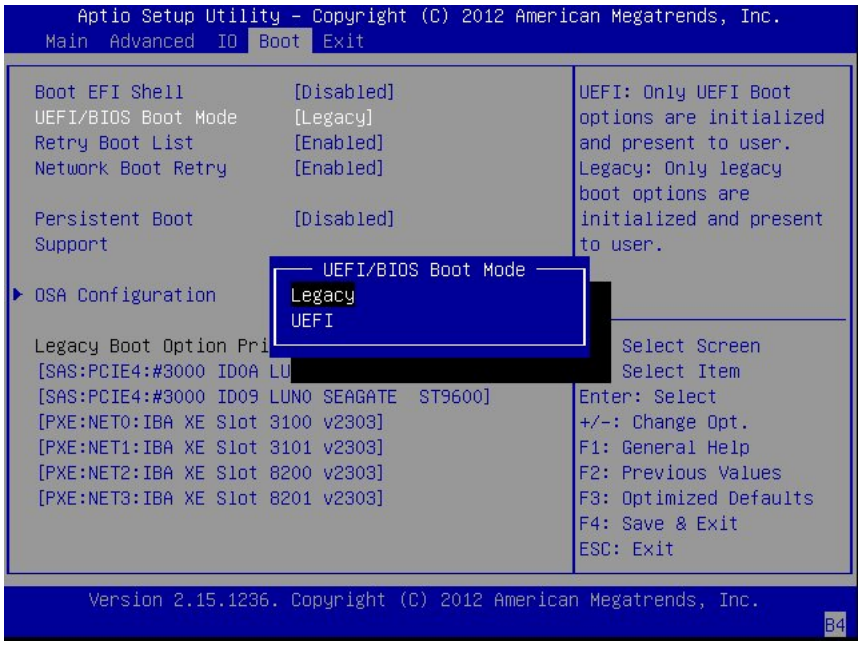
   See “Access BIOS Setup Utility Menus” on page 179.

2. **From the BIOS Main Menu screen, select `Boot`.**

   The Boot Menu screen appears.

3. **From the Boot Menu screen, use the up and down arrow keys to select `UEFI/Legacy BIOS Boot Mode`, and then press Enter.**

The UEFI/BIOS dialog box appears.



Note - You cannot configure the boot device priority after switching the boot mode. A system reboot is required to properly populate the Boot Options Priority list with devices that support the chosen boot mode.

4. **Use the up and down arrow keys to select the appropriate Legacy or UEFI mode, and then press Enter.**

5. **Press F10 to save the changes and exit the BIOS Setup Utility.**

Related Information

- “BIOS Setup Utility Menus” on page 178
- “BIOS Key Mappings” on page 179

Select the Boot Device

The Boot Options Priority list contents depend on which BIOS mode is selected. When UEFI Boot Mode is selected, only UEFI boot candidates will be initialized and displayed in the Boot Options Priority list. When Legacy BIOS is selected, only Legacy BIOS boot candidates are initialized and displayed.

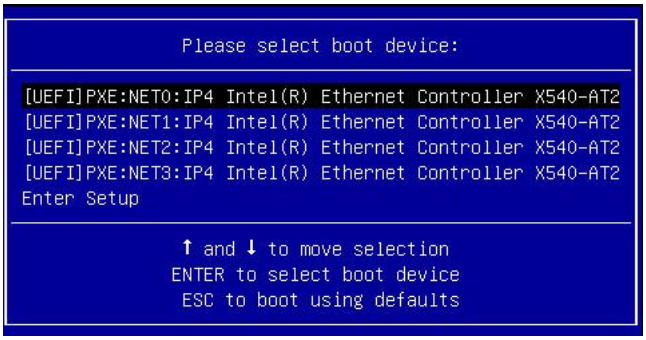
In addition to using the F2 key to view or edit the system BIOS settings, you can use the F8 key during the BIOS startup to specify a temporary boot device. This selected boot device is in effect only for the current system boot. The permanent boot device specified using the F2 key will be in effect after booting from the temporary boot device.

1. **Reset or power on the server.**

   - **From the local server,** press the Power button on the front panel of the server to power off the server, and then press the Power button again to power on the server.
   - **From the Oracle ILOM web interface,** click Host Management → Power Control and select Reset from the Select Action list.
   - **From the Oracle ILOM CLI,** type `reset /System`

2. **Press the F8 key (or Ctrl+P from a serial connection) when prompted while the UEFI is running the power-on self-test (POST).**

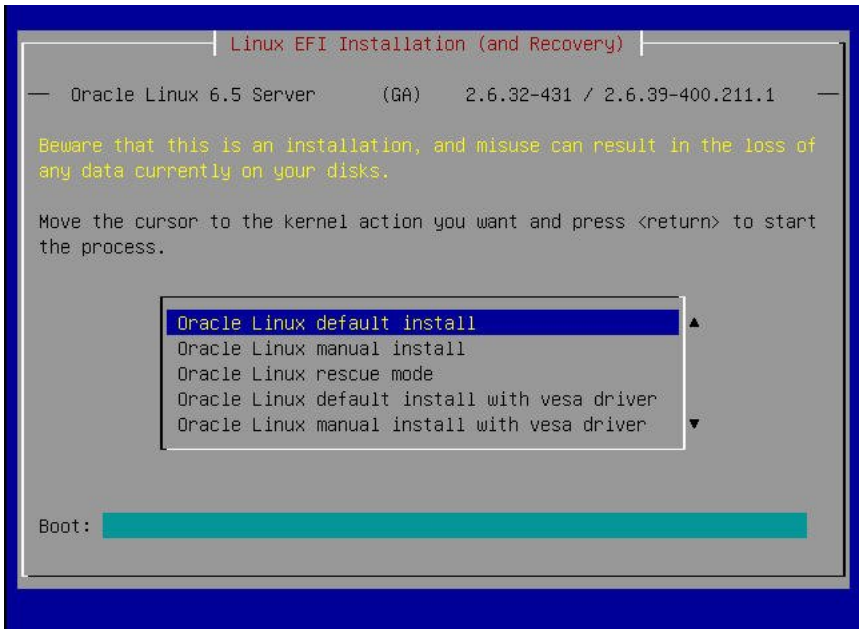
   The Please Select Boot Device dialog box appears.



3. **In the Please Select Boot Device dialog box, select the boot device according to the operating system and UEFI Boot Mode you elected to use, and then press Enter.**

Note - Based on the boot mode you selected (UEFI BIOS Boot Mode or Legacy BIOS Boot Mode), the Please Select Boot Device dialog box displays only the applicable devices. For example, when the UEFI BIOS Boot Mode is elected, only UEFI BIOS boot devices are displayed in the dialog box.

A dialog box similar to the following appears.



4. **Follow the on-screen instructions to install the operating system from the selected boot device.**

Related Information

- “BIOS Setup Utility Menus” on page 178
- “BIOS Key Mappings” on page 179

Configure TPM Support

If you intend to use the Trusted Platform Module (TPM) feature set, you must configure the server to support this feature.

Note - TPM enables you to administer the TPM security hardware in your server. For additional information about implementing this feature, refer to the Windows Trusted Platform Module Management documentation provided by your operating system or third-party software vendor.

1. **Access the BIOS Setup Utility menus.**

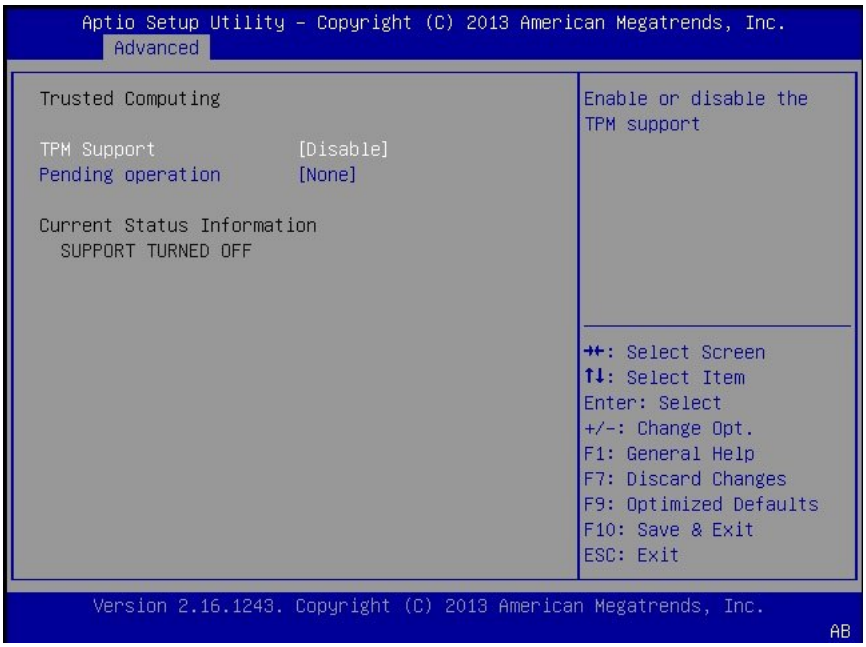
   See "Access BIOS Setup Utility Menus" on page 179.

2. **In the BIOS Setup Utility menus, navigate to the Advanced Menu.**

   The Advanced Menu screen appears.

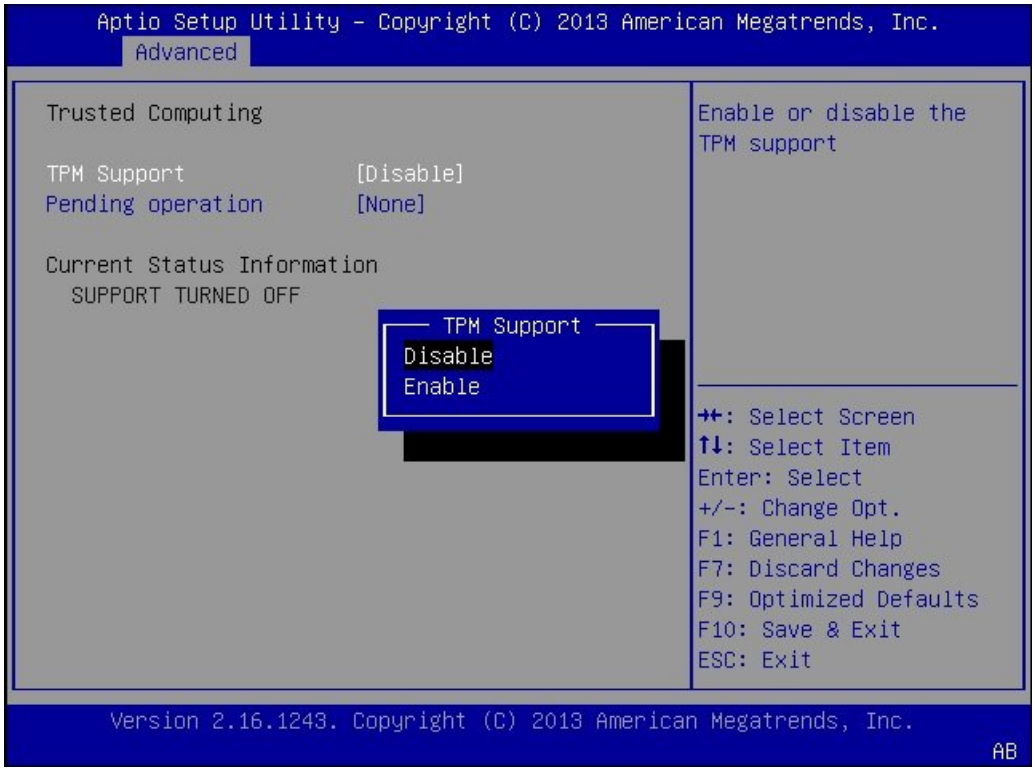
3. **In the Advanced Menu screen, select `Trusted Computing`.**

   The TPM Configuration screen appears.



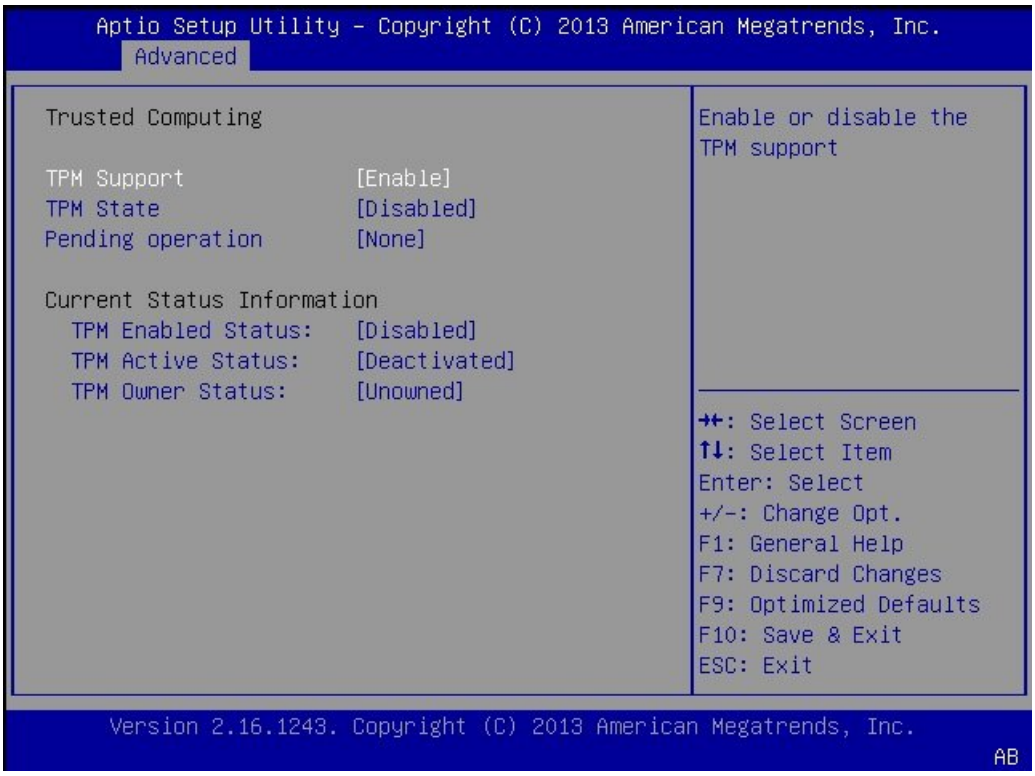
4. **TPM Support is listed as `Disabled` (it is disabled by default). Select `TPM Support` and press Enter.**

   A TPM Support dialog box appears.



5. **In the dialog box, set `TPM Support` to `Enable`, and then press Enter.**

The updated TPM Configuration screen appears.



6. **Press the F10 key to save the changes and exit the BIOS Setup Utility.**

Related Information

- "BIOS Setup Utility Menus" on page 178
- Microsoft's Windows Trusted Platform Module Management documentation

▼ Configure SP Network Settings

Choose one of the following methods to specify service processor (SP) network settings:

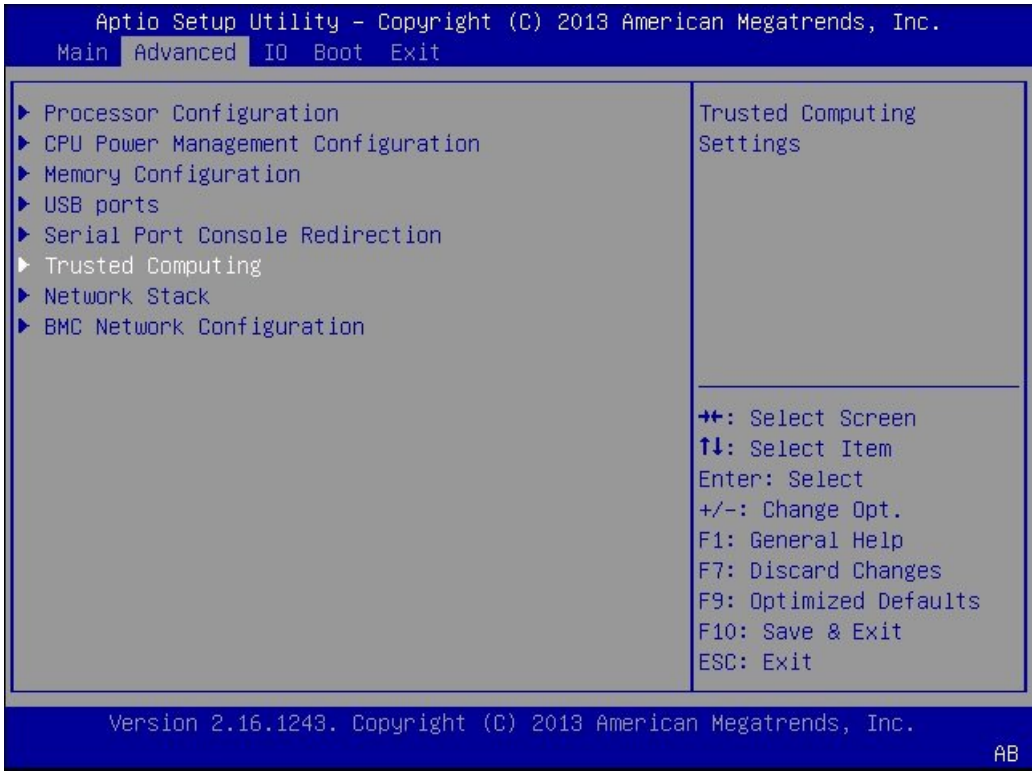
- **BIOS** – Assign the IP address for the server SP from the BIOS Setup Utility on the Advanced Menu.
- **Oracle ILOM** – For instructions on setting the IP address for the server SP using Oracle ILOM, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com./goto/ILOM/docs`.

1. **Access the BIOS Setup Utility menus.**

   See "Access BIOS Setup Utility Menus" on page 179.

2. **In the BIOS Setup Utility menus, navigate to the Advanced Menu.**

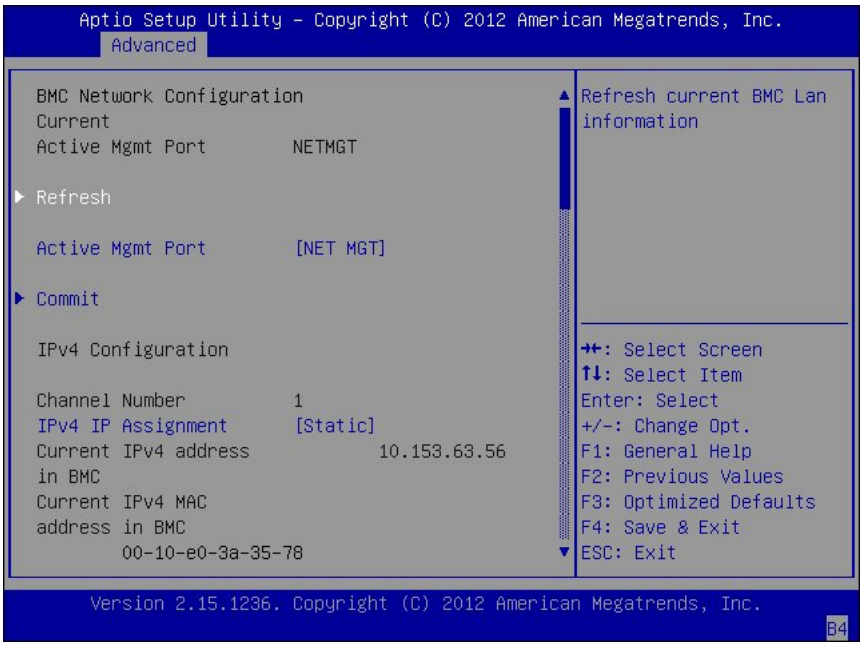
   The Advanced Menu screen appears.



3. **In the Advanced Menu, select `BMC Network Configuration`, and then press Enter.**

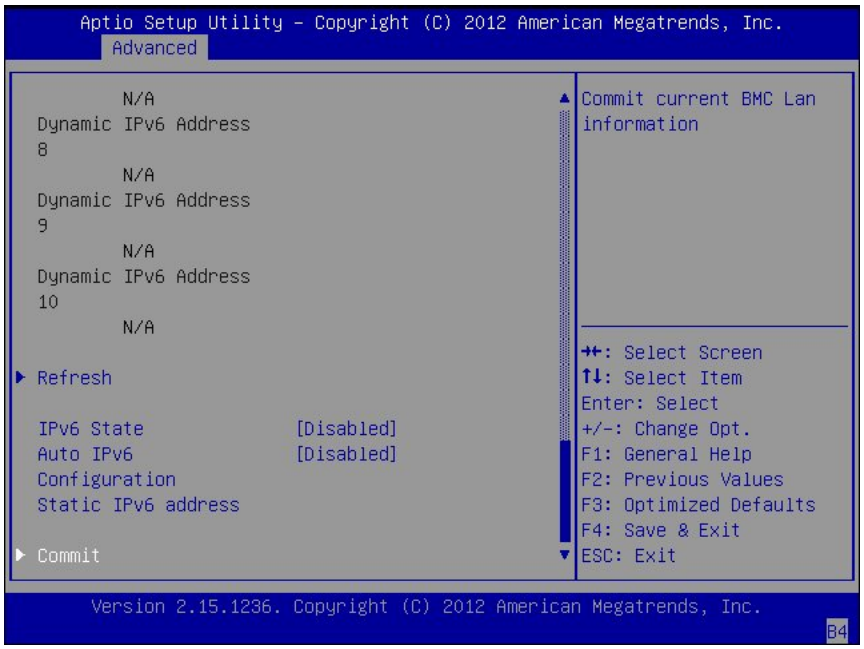
   The BMC Network Configuration screen appears.

The BMC is the Baseboard Management Controller.



4. **Select `Refresh`, and then press Enter to display the current BMC network settings.**

The BMC Network Configuration screen refreshes. Scroll down to review BMC network settings.



5. **Select `Commit` to update the BMC network settings with the latest values.**
6. **Press the F10 key to save the changes and exit the BIOS Setup Utility.**

Related Information

- “BIOS Setup Utility Menus” on page 178

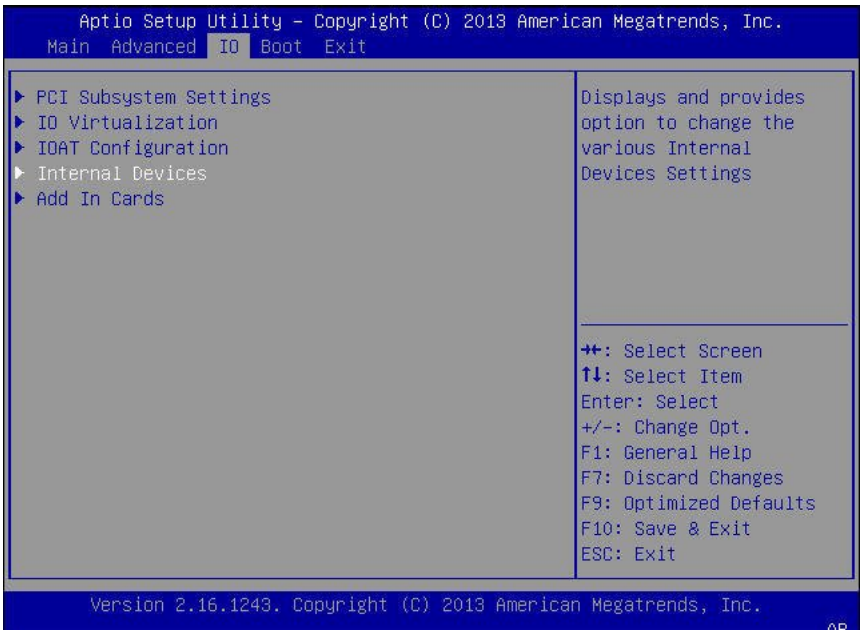
▼ Configure Option ROM Settings

1. **Access the BIOS Setup Utility menus.**

   See “Access BIOS Setup Utility Menus” on page 179.

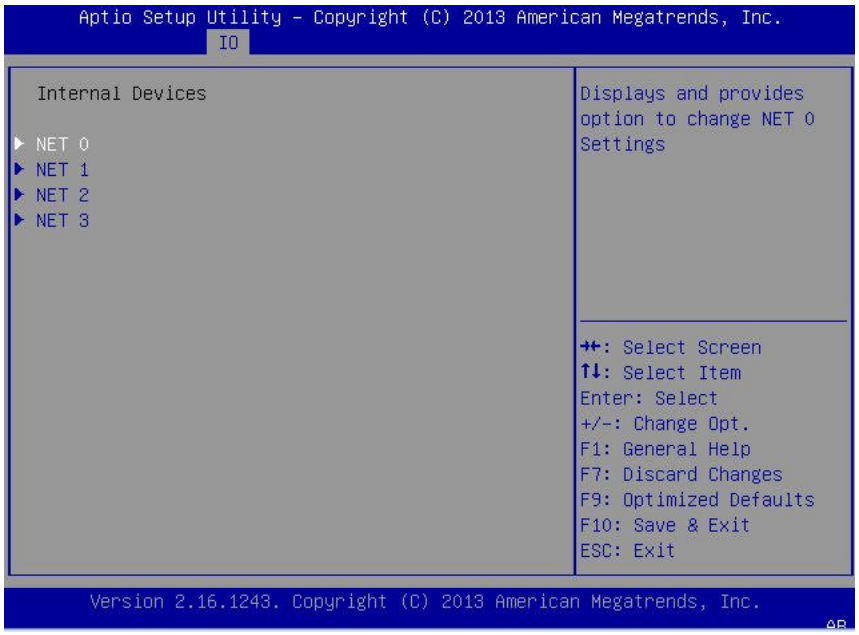
2. **In the BIOS Setup Utility menus, navigate to the IO Menu.**

The IO Menu screen appears.



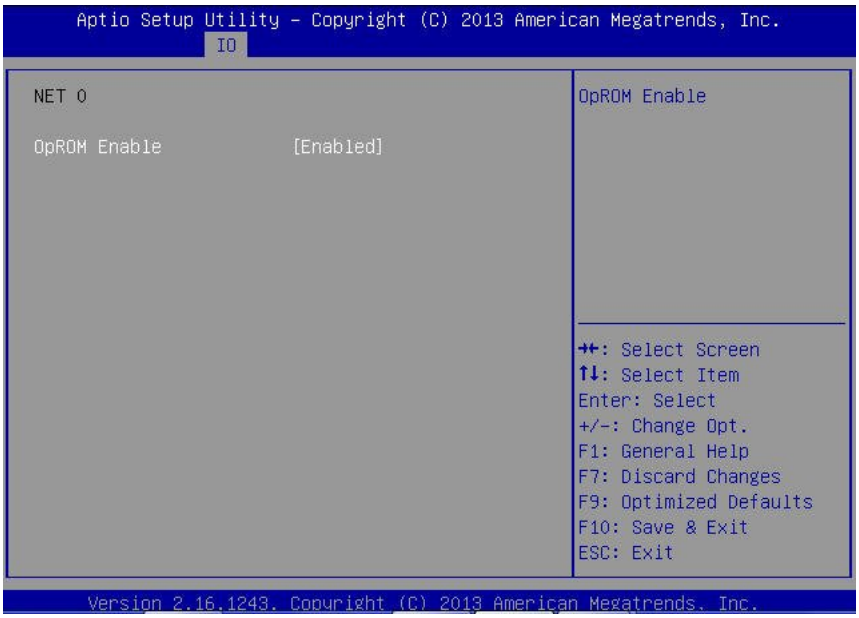
3. **In the IO Menu, select either Internal Devices or Add In Cards and press Enter to display the internal device or add-in card slot for which you want to enable or disable Option ROM.**

The Internal Devices or Add In Cards screen appears.



4. **Select the internal device or add In card slot that you want to configure.**

The Option ROM screen for that internal device or add-in card slot appears.



5. **Select OpROM Enable and press Enter. Do one of the following:**

   - **Select `Enabled` to enable the Option ROM setting.**
   - **Select `Disabled` to disable the Option ROM setting.**

6. **Press the F10 key to save the changes and exit the BIOS Setup Utility.**

Related Information

- “Legacy Option ROM Allocation” on page 186
- “Access BIOS Setup Utility Menus” on page 179
- “BIOS Setup Utility Menus” on page 178

Configure I/O Resource Allocation

1. **Access the BIOS Setup Utility menus.**
   See “Access BIOS Setup Utility Menus” on page 179.
2. **In the BIOS Setup Utility menus, navigate to the IO Menu.**
   The IO Menu screen appears.
3. **Select Add In Cards and press Enter to display the add-in card slots.**
4. **Select the slot for which you want to configure the card, and press Enter.**
5. **Do one of the following:**
   - **Select `Enabled` to enable I/O resource allocation for the I/O card.**
   - **Select `Disabled` to disable I/O resource allocation for the I/O card.**
6. **Press the F10 key to save the changes and exit the BIOS Setup Utility.**

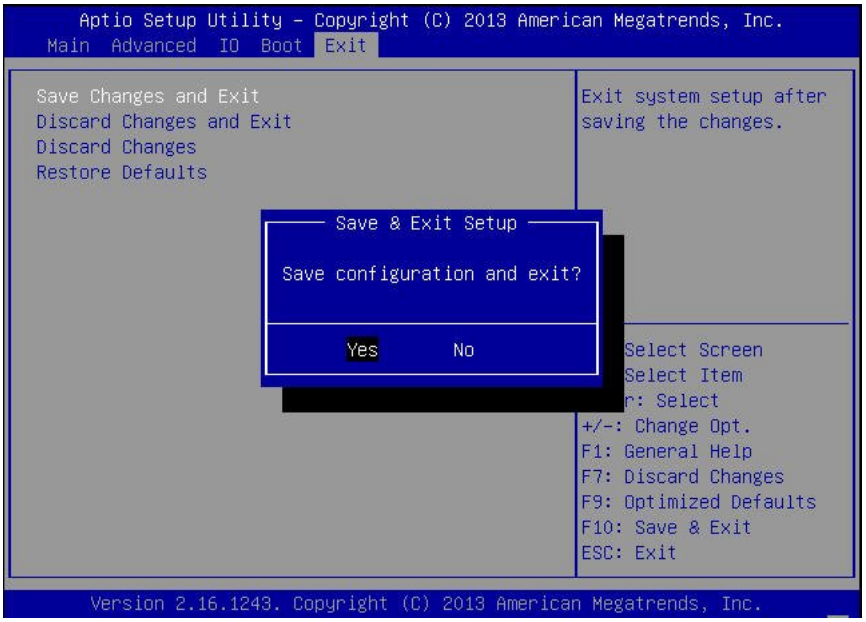
Related Information

- “Access BIOS Setup Utility Menus” on page 179
- “BIOS Setup Utility Menus” on page 178

Exit BIOS Setup Utility

1. **Use the left and right arrow keys to navigate to the top-level Exit Menu.**
2. **Use the up and down arrow keys to select the desired action.**
3. **Press Enter to select the option.**

A confirmation dialog box appears.



4. **In the confirmation dialog box, select `Yes` to proceed and exit the BIOS Setup Utility, or select `No` to stop the exit process.**

Note - After modifying any BIOS settings and selecting `Save Changes and Exit` from the Exit Menu, the subsequent reboot might take longer than a typical reboot where no settings were modified. The additional delay is required to ensure that changes to the BIOS settings are synchronized with Oracle ILOM.

Related Information

- “Access BIOS Setup Utility Menus” on page 179
- “BIOS Setup Utility Menus” on page 178

BIOS Setup Utility Menu Options

This section includes screenshots of the main menus in the BIOS Setup Utility for the Oracle Exadata Storage Server X5-2 Extreme Flash. Following the screenshot for each menu is a table of the options available from that menu.



Caution - This section is for reference purposes only. Default Exadata storage server settings should not be changed.

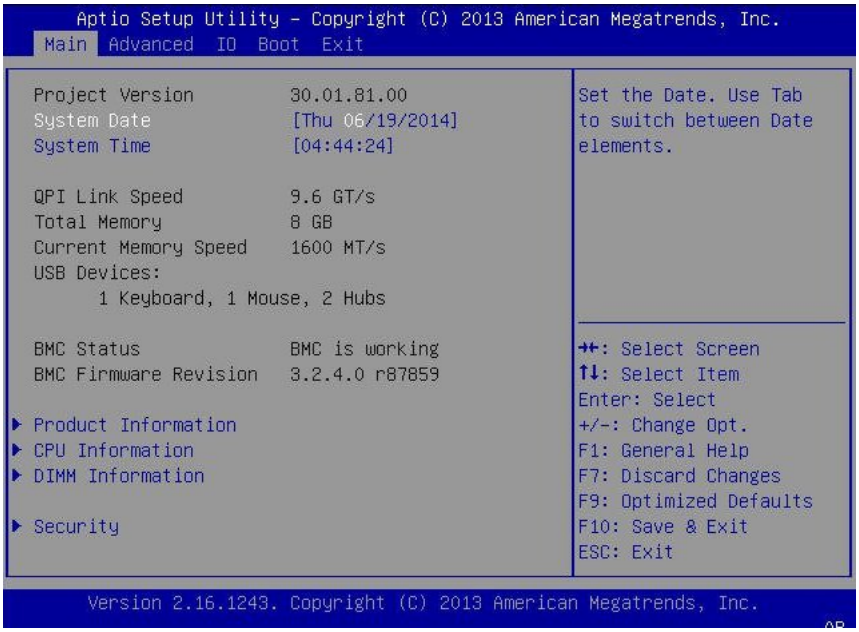
Description	Links
Review the BIOS Main Menu selections.	"BIOS Main Menu Selections" on page 203
Review the BIOS Advanced Menu selections.	"BIOS Advanced Menu Selections" on page 207
Review the BIOS IO Menu selections.	"BIOS IO Menu Selections" on page 220
Review the Boot Menu selections.	"BIOS Boot Menu Selections" on page 223
Review the BIOS Exit Menu selections.	"BIOS Exit Menu Selections" on page 225

Related Information

- *Oracle X5 Series Servers Administration Guide* at: `http://www.oracle.com/goto/x86admindiag/docs`
- "Setting Up BIOS Configuration Parameters" on page 177

BIOS Main Menu Selections

This section includes a screenshot of the BIOS Main Menu. The options that are available from the Main Menu are described in the table that follows. Options in the table that are marked as "(R/O)" are read-only information and cannot be changed.



The following table describes the options provided by the BIOS Main menu and sub-menus.

TABLE 18 BIOS Main Menu Options

Setup Options	Options	Defaults	Description
Project Version (R/O)			BIOS version is displayed. This string is a unique identifier used to reference a specific BIOS release. Format is XXYYZZPP, which indicates: ■ XX - Unique project/platform code. ■ YY - BIOS major release. ■ ZZ - BIOS minor release. ■ PP - Build number. Example: 18.01.04.01
System Date			Current date is displayed. You can change the date setting. Example: [Thu 06/20/2014]
System Time			Current time is displayed. You can change the time setting. Example: [13:38:27]

Setup Options	Options	Defaults	Description
QPI Link Speed (R/O)	SLOW/ 6.4 GT/s 7.2 GT/s 8.0 GT/s 9.6 GT/s		Intel Quick Path Interconnect (QPI) operational speed is displayed.
Total Memory (R/O)			Memory in gigabytes is displayed. Example: 224 GB
Current Memory Speed (R/O)			Memory speed is displayed. Example: 1333 MHz
USB Devices (R/O)			Detected USB devices are displayed. Example: 1 Drive, 2 keyboards, 1 mouse, 3 hubs
BMC Status (R/O)			Detected condition of the service processor. Example: BMC is working
BMC Firmware Revision (R/O)			The service processor firmware version is displayed. Example: 3.2.0.0 r84011
PRODUCT INFORMATION (R/O)			Product information is displayed.
Product Name			Product name is displayed. Example: Oracle Exadata Storage Server X5-2 Extreme Flash
Product Serial Number			Product serial number is displayed. Example: 1134FML00V
Board Serial Number			Board serial number is displayed. Example: 0328MSL-1132U900
CPU INFORMATION (R/O)			Attributes of a single processor (CPU) are defined. A separate information structure is provided for each processor supported in the system. Most of the values are dependent on the processor.
Socket 0 CPU Information (R/O)			If CPU socket 0 is populated, the following options are listed. Otherwise, displays “Not Present.”
Genuine Intel CPU @ 2.6 GHz			Processor ID brand is displayed.
CPU Signature			Processor information is displayed.

Setup Options	Options	Defaults	Description
			Example: 306F1
Microcode Patch			Software update (microcode patch) information is displayed. Example: 80000011
Max CPU Speed			Maximum non-turbo speed of the processor is displayed. Example: 2100 MHz
Min CPU Speed			Minimum speed of the processor is displayed. Example: 1200 MHz
Processor Cores			Number of available processor cores is displayed. Example: 18
Active processor cores			Number of active processor cores is displayed.
Intel HT Technology			Indicates whether Intel Hyper Threading is supported.
Intel VT-x Technology			Indicates whether Intel Virtualization Technology is supported.
L1 Data Cache			Example: 448
L1 Code Cache			Example: 448
L2 Cache			Example: 3584 KB
L3 Cache			Example: 35840 KB
Socket 1 CPU Information (R/O)			If CPU socket 1 is populated, the same options as Socket 0 CPU Information are displayed. Otherwise, displays “Not Present.”
DIMM INFORMATION (R/O)			Memory module (DIMM) presence and size information are displayed.
Socket 0 DIMMs (R/O)			For D0...D11, if a DIMM is present, memory size (in gigabytes) is displayed. Otherwise, displays “Not Present.”
Socket 1 DIMMs (R/O)			Same as CPU socket 0.
SECURITY SETTING			Configure the security setting.
Administrator Password			Set the Administrator password.

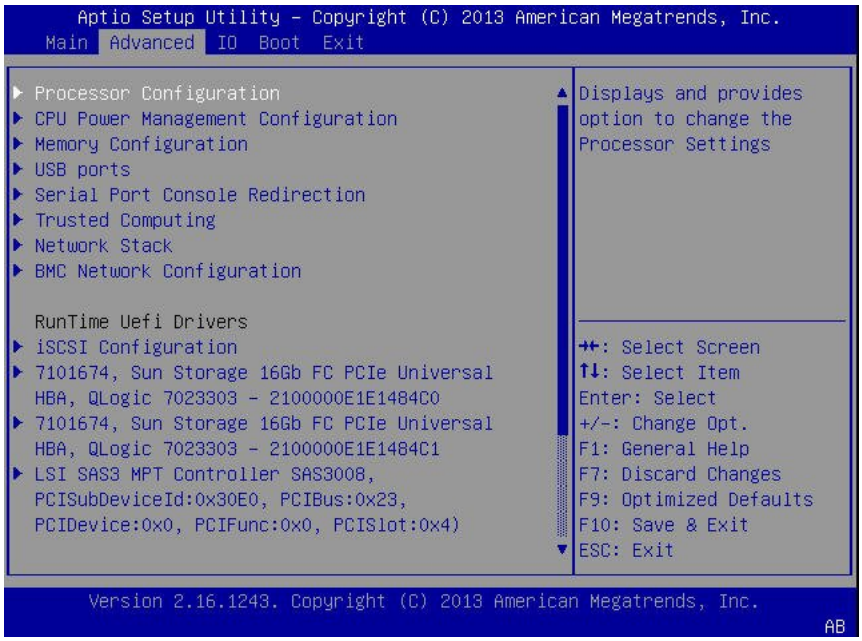
Related Information

- “BIOS Advanced Menu Selections” on page 207

- “BIOS IO Menu Selections” on page 220
- “BIOS Boot Menu Selections” on page 223
- “BIOS Exit Menu Selections” on page 225

BIOS Advanced Menu Selections

This section includes a screenshot of the BIOS Advanced Menu. The options that are available from the Advanced Menu are described in the sections that follow. Options in the tables that are marked as “(R/O)” are read-only information and cannot be changed.



The following sections describe the BIOS Advanced Menu options:

- “BIOS Advanced Menu Processor Configuration Options” on page 208
- “BIOS Advanced Menu CPU Power Management Configuration Options” on page 209
- “BIOS Advanced Menu Memory Configuration Option” on page 209
- “BIOS Advanced Menu USB Ports Options” on page 210
- “BIOS Advanced Menu Serial Port Console Redirection Options” on page 211

- "BIOS Advanced Menu Trusted Computing Options" on page 212
- "BIOS Advanced Menu Network Stack Options" on page 213
- "BIOS Advanced Menu BMC Network Configuration Options" on page 214
- "BIOS Advanced Menu iSCSI Configuration Options" on page 217
- "BIOS Advanced Menu Ethernet Controller Options" on page 218

BIOS Advanced Menu Processor Configuration Options

The following table describes the BIOS Advanced Menu processor configuration options.

TABLE 19 BIOS Advanced Menu Processor Configuration

Setup Options	Options	Defaults	Description
Hyper-threading	Disabled/Enabled	Enabled	Use to enable Hyper Threading. When enabled, two threads are available per enabled core. When disabled, only one thread per enabled core is available.
Active Processor Cores	A minimum of one up to the maximum number of cores available in the processor package.	All	The number of cores to enable in each processor package.
Execute Disable Bit	Disabled/Enabled	Enabled	When disabled, forces XD features flag to always return 0.
Hardware Prefetcher	Disabled/Enabled	Enabled	Enable the mid-level cache (MLC) streamer prefetcher (MSR 1A4h bit [0]).
Adjacent Cache Prefetch	Disabled/Enabled	Enabled	Enable the mid-level cache (MLC) streamer prefetcher (MSR 1A4h bit [1]).
DCU Streamer Prefetcher	Disabled/Enabled	Enabled	Enable DCU streamer prefetcher, which is a L1 data cache prefetcher (MSR 1A4h [2]).
DCP IP Prefetcher	Disabled/Enabled	Enabled	Enable DCU IP prefetcher, which is a L1 data cache prefetcher (MSR 1A4h [3]).
Intel Virtualization Technology	Disabled/Enabled	Enabled	When enabled, a Virtual Machine Manager (VMM) can utilize the additional hardware capabilities provided by Intel Virtualization Technology.

BIOS Advanced Menu CPU Power Management Configuration Options

The following table describes the BIOS Advanced Menu CPU power management configuration options.

TABLE 20 BIOS Advanced Menu CPU Power Management Configuration

Setup Options	Options	Defaults	Description
Power Technology	Disabled/Energy Efficient/ Custom	Custom	Enables the power management features.
EIST (GV3)	Enabled/Disabled	Enabled	Enable or disable Enhanced Intel SpeedStep Technology (EIST).
Turbo Mode	Enabled/Disabled	Enabled	Enabled mode is supported only if Turbo Mode is supported in the CPU. Enabled mode also requires that Enhanced Multi Threaded Thermal Monitoring (EMTTM) be enabled on the CPU.
CPU C3 report	Enabled/Disabled	Disabled	Enable/disable the CPU C3 (ACPI C3) report to the operating system.
CPU C6 report	Enabled/Disabled	Enabled	Enable/disable the CPU C6 (ACPI C3) report to the operating system.
CPU C7 report	Enabled/Disabled	Disabled	Enable/disable the CPU C7 (ACPI C3) report to the operating system.
Package C State limit	Enabled/Disabled	Enabled	Enable/disable Package C State limit.
Energy_PERF_BIAS_CFG mode	PERF/Balanced Perf/Balanced Power/Power	Balanced Perf	Use this option to select the Energy_PERF_BIAS_CFG mode.
Uncore Frequency Scaling	Enabled/Disabled	Disabled	Enable/disable Uncore Frequency Scaling (USF).

BIOS Advanced Menu Memory Configuration Option

The following table describes the BIOS Advanced Menu memory configuration option.

TABLE 21 BIOS Advanced Menu Memory Configuration Option

Setup Option	Options	Defaults	Description
Numa	Enabled/Disabled	Enabled	Enable or disable Non Uniform Memory Access (NUMA)

BIOS Advanced Menu USB Ports Options

The following table describes the BIOS Advanced Menu USB ports options.

TABLE 22 BIOS Advanced Menu USB Ports

Setup Options	Options	Defaults	Description
EHCI Hand-off	Disabled/Enabled	Disabled	Enable or disable Enhanced Host Controller Interface (EHCI) hand-off support. This is a workaround for operating systems without EHCI hand-off support. The EHCI change of ownership should be claimed by the EHCI driver.
Port 60/64 Emulation	Disabled/Enabled	Enabled	Enable I/O port 60h/64h emulation support. Enable this setting for the complete USB keyboard legacy support for non-USB aware operating systems.
EHCI Controller 1	Disabled/Enabled	Enabled	Enable or disable EHCI Controller 1.
EHCI Controller 2	Disabled/Enabled	Enabled	Enable or disable EHCI Controller 2.
Rear Port #0	Disabled/Enabled	Enabled	Enable or disable USB Rear Port 0.
Rear Port #1	Disabled/Enabled	Enabled	Enable or disable USB Rear Port 1.
Front Port #0	Disabled/Enabled	Enabled	Enable or disable USB Front Port 0.
Front Port #1	Disabled/Enabled	Enabled	Enable or disable USB Front Port 1.
Internal Port #0	Disabled/Enabled	Enabled	Enable or disable USB Internal Port 0.
Internal Port #1	Disabled/Enabled	Enabled	Enable or disable USB Internal Port 1.

BIOS Advanced Menu Serial Port Console Redirection Options

The following table describes the BIOS Advanced Menu serial port console redirection options.

TABLE 23 BIOS Advanced Menu Serial Port Console Redirection Options

Setup Options	Options	Defaults	Description
EMS Console Redirection	Disabled/Enabled	Disabled	Enable or disable console redirection for Windows Emergency Management Service (EMS) administration.
Console Redirection	Disabled/Enabled	Enabled	Enable or disable console redirection.
Terminal Type	VT100/VT100+/VT-UTF8/ ANSI	VT100+	Select the emulation for the terminal: ■ VT100: ASCII character set. ■ VT100+: Extends VT100 to support color, function keys, etc. ■ VT-UTF8: Uses UTF8 encoding to map Unicode characters onto one or more bytes. ■ ANSI: Extended ASCII character set.
Bits per Second	9600 19200 38400 57600 115200	9600	Select the serial port transmission speed. The speed must be matched on the connecting serial device. Long or noisy lines require lower speeds.
Data Bits	7/8	8	Select the data bits.
Parity	None/Even/Odd/Mark/Space	None	A parity bit can be sent with the data bits to detect some transmission errors. ■ None: No parity bits are sent. ■ Even: Parity bit is 0 if the number of 1s in the data bits is even. ■ Odd: Parity bit is 0 if the number of 1s in the data bits is odd.

Setup Options	Options	Defaults	Description
			■ Mark: Parity bit is always 1. ■ Space: Parity bit is always 0. Mark and Space parity do not allow for error detection. They can be used as an additional data bit.
Stop Bits	1/2	1	Stop bits indicate the end of a serial data packet. (A start bit indicates the beginning of a serial data packet.) The standard setting is 1 stop bit. Communication with slow devices may require more than 1 stop bit.
Flow Control	None, Hardware RTS/CTS, Software Xon/Xoff	None	Flow control can prevent data loss from buffer overflow. When sending data, if the receiving buffers are full, a 'stop' signal can be sent to stop the data flow. Once the buffers are empty, a 'start' signal can be sent to restart the flow. Hardware flow control uses two wires to send start/stop signals.

BIOS Advanced Menu Trusted Computing Options

The following table describes the BIOS Advanced Menu trusted computing options.

TABLE 24 BIOS Advanced Menu Trusted Computing Options

Setup Options	Options	Defaults	Description
TPM Support	Disabled/Enabled	Disabled	Enable or disable Trusted Platform Module (TPM) support. Only UEFI BIOS implements this setup option. If disabled, the OS will not show TPM. Reset of the platform is required.
TPM State	Disabled/Enabled	Disabled	Displays whether TPM Support is enabled.

Setup Options	Options	Defaults	Description
			Note - This option is available only if TPM Support is set to enabled.
Pending Operation	None/Enable Take Ownership/ Disable Take Ownership/TPM Clear	None	Used to schedule an operation for the security device. **Note -** Your computer will reboot during restart in order to change the state of a security device.
Current Status Information			If TPM Support is disabled, Current Status Information displays SUPPORT Turned OFF.”
TPM Enabled Status	Disabled/Enabled	Disabled	Use this option to provide the current capability state of the security device. **Note -** This option is available only if TPM Support is set to enabled.
TPM Active Status	Deactivated/Activated	Deactivated	Use this option to provide the current capability state of the security device. **Note -** This option is available only if TPM Support is set to enabled.
TPM Owner Status	Owned/Unowned	Unowned	Use this option to provide the current ownership state. **Note -** This option is available only if TPM Support is set to enabled.

BIOS Advanced Menu Network Stack Options

The following table describes the BIOS Advanced Menu network stack options.

TABLE 25 BIOS Advanced Menu Network Stack Options

Setup Options	Options	Defaults	Description
Network Stack	Disabled/Enabled	Enabled	Enable or disable the UEFI network stack.
Ipv4 PXE Support	Disabled/Enabled	Enabled	Enable or disable IPv4 PXE Boot support. If disable, the IPv4 Boot Option will not be created.
Ipv6 PXE Support	Disabled/Enabled	Disabled	Enable or disable IPv6 PXE Boot support. If disable, the

Setup Options	Options	Defaults	Description
			IPv6 Boot Option will not be created.

BIOS Advanced Menu BMC Network Configuration Options

The following table describes the BIOS Advanced Menu BMC network configuration options.

TABLE 26 BIOS Advanced Menu BMC Network Configuration Options

Setup Options	Options	Defaults	Description
Current Active Management Port (R/O)	NA	NETMGT	The currently active management port.
Refresh	NA	NA	Refresh current BMC LAN information with the latest information from the service processor.
Active Mgmt Port	NET MGT/NET0/NET1/NET2/ NET3	NET MGT	Use to change the currently active network management port.
Commit	NA	NA	Commit the current BMC network LAN information.
IPv4 Configuration	NA	NA	Current configuration of the IPv4 settings is displayed.
Channel Number (R/O)		1	Current channel number is displayed.
Current IPv4 IP Assignment in BMC (R/O)	Static/Dynamic	Static	Set the IPV4 IP assignment to Static or Dynamic. This setting determines whether the service processor is assigned a static IPv4 address or assigned a dynamic IPv4 address using Dynamic Host Control Protocol (DHCP).
Current IPv4 address in BMC (R/O)	NA	NA	Displays the current IPv4 address in the BMC.
Current IPv4 MAC Address in BMC (R/O)	NA	NA	If IPv4 Assignment is set to Static, set the IPv4 address for the service processor. Example: 172.31.255.255
Current IPv4 Subnet Mask in BMC (R/O)	NA	NA	If the IPv4 Assignment is set to Static, set the IPv4 subnet mask.

Setup Options	Options	Defaults	Description
			Example: 255.255.255.0
Current IPv4 Default Gateway in BMC	NA	NA	If the IPv4 Assignment is set to Static, set the IPv4 default gateway Example: 172.31.255.255
Refresh			Refresh the current BMC LAN information.
IPv4 IP Assignment	Static/Dynamic	Static	Current IPv4 assignment.
IPv4 Address	NA	NA	If set, current IPv4 address is displayed.
IPv4 Subnet Mask	NA	NA	If set, current IPv4 Subnet Mask is displayed.
IPv4 Default Gateway	NA	NA	If set, current IPv4 Default Gateway is displayed.
Commit			Commit the current BMC LAN information.
IPv6 Configuration			Current configuration of the IPv6 settings is displayed. IPv6 addresses are written with hexadecimal digits and colon separators. For example: 2001:0db0:000:82a1:0000:0000:1234:abcd. IPv6 addresses are composed of two parts: a 64-bit subnet prefix and a 64-bit host interface ID. To shorten the IPv6 address, you can (1) omit all leading zeros, and (2) replace one consecutive group of zeros with a double colon (::). For example: 2001:db0:0:82a1::1234:abcd.
Channel Number (R/O)		1	Current channel number is displayed.
Current IPv6 State (R/O)	Enabled/Disabled	Enabled	Current IPv6 state is displayed.
Current IPv6 Auto Configuration (R/O)	Stateful/Stateless	Stateless	Current IPv6 autoconfiguration parameters are displayed.
Link Local IPv6 Address (R/O)			Current link local IPv6 address is displayed. Example: fe80::214:4fff:feca:5f7e/64
Static IPv6 Address (R/O)			Current static IPv6 address is displayed.

Setup Options	Options	Defaults	Description
			Example: 2001:0db0:000:82a1:0000:0000:1234:abcd
IPv6 Gateway (R/O)			Current IPv6 gateway address is displayed. Example: fe80::211:5dff:febe:5000/128
Dynamic IPv6 Address 1-*n* (R/O)			Current dynamic IPv6 addresses are displayed. Example: fec0:a:8:b7:214:4fff:feca:5f7e/64
Refresh			Select Refresh to update to the current settings.
IPv6 State	Disabled/Enabled	Disabled	Set the IPv6 state to enabled or disabled.
Auto IPv6 Configuration	Disabled/ Stateless/ Dhcpv6_stateless/ Dhcpv6_stateful	Disabled	Autoconfiguration options are: ■ Disabled: When autoconfiguration is disabled, only the Link Local address is set. None of the autoconfiguration options to configure an IPv6 address are run. ■ Stateless: When enabled, the IPv6 Stateless autoconfiguration is run to learn the IPv6 addresses for the device. ■ Dhcpv6_stateless: When enabled, the Dhcpv6_stateless autoconfiguration is run to learn the DNS and domain information for the device. ■ Dhcpv6_stateful: When enabled, the Dhcpv6_stateful autoconfiguration is run to learn the IP addresses and DNS information for the device.
Static IPv6 Address (R/O)			Set the static IPv6 address. Example: 2001:0db0:000.82a1:0000:0000:1234:abcd
Commit			Commit the current BMC LAN information.

BIOS Advanced Menu iSCSI Configuration Options

The following table describes the BIOS Advanced Menu iSCSI configuration options.

TABLE 27 BIOS Advanced Menu iSCSI Configuration Options

Setup Options	Options	Defaults	Description
iSCSI Initiator Name	NA (must be specified)	None	The worldwide unique name of the iSCSI Initiator. Only IQN format is accepted.
Add an Attempt			
iSCSI Attempt Name	NA (must be specified)	None	The readable name that you assigned to this attempt.
iSCSI Mode	Disabled/Enabled/Enabled for MPIO	Disabled	Set to Enabled for multipath I/O (MPIO). MPIO can boost the performance of an application by load balancing traffic across multiple ports.
Internet Protocol	IP4/IP6/Autoconfigure	IP4	Can be set to IP4, IP6, or Autoconfigure. The initiator IP address is assigned by the system to IP6. In Autoconfigure mode, the iSCSI driver attempts to connect to the iSCSI target using the IPv4 stack. If this fails, then the iSCSI driver attempt to connect using the IPv6 stack.
Connection Retry Count	0 to 16	0	The count range is 0 to 16. If set to 0, there are no retries.
Connection Establishing Timeout	NA	1,000	The timeout value in milliseconds. The minimum value is 100 milliseconds and the maximum is 20 seconds.
Configure ISID	Derived from the MAC address	The default value is derived from the Mac Address	The OUI-format ISID is 6 bytes. The default value is derived from the MAC address. Only the last 3 bytes are configurable. Example: Update 0ABBCCDDEEFF to 0ABBCCF07901 by inputting F07901
Enable DHCP	Disabled/Enabled	Disabled	Enable or disable DHCP
Initiator IP Address	NA	0.0.0.0	Use to set initiator IP address in dotted-decimal notation.

Setup Options	Options	Defaults	Description
Initiator Subnet Mask	NA	0.0.0.0	Use to set initiator subnet mask IP address in dotted-decimal notation.
Gateway	NA	0.0.0.0	Use to set initiator gateway IP address in dotted-decimal notation.
Target Name	NA	NA	The worldwide unique name of the target. Only IQN format is accepted.
Target IP address	0.0.0.0	None	Use to set target IP address in dotted-decimal notation.
Target Port		3260	Use to change target port number.
Boot LUN		0	Use to set the hexadecimal representation of the boot logical unit number (LUN). Example: 4752-3A4F-6b7e-2F99
Authentication Type	CHAP/None	CHAP	Define the Challenge-Handshake Authentication Protocol (CHAP). Available settings are CHAP, Kerberos, and None.
CHAP Type	One Way/Mutual	One Way	Use to set CHAP type to either One Way or Mutual.
CHAP Name	NA	None	Use to set CHAP name.
CHAP Secret	NA	None	Use to set the CHAP secret password. The secret length range is 12 to 16 bytes.
Delete Attempts	NA	NA	Use to delete one or more attempts.
Change Attempt Order	NA	NA	Use to change the order of attempts. Use arrow keys to select the attempt, then press +/- keys to move the attempt up/ down in the attempt order list.

BIOS Advanced Menu Ethernet Controller Options

The following table describes the BIOS Advanced Menu Ethernet controller options.

TABLE 28 BIOS Advanced Menu Ethernet Controller Options

Setup Options	Options	Defaults	Description
Port Configuration Menu			
NIC configuration			Use to configure the network device port.
Link Speed (R/O)	Supported port speeds/Auto Negotiate	NA	Specifies the port speed used for the selected boot protocol. **Note -** This option is not supported
Wake on LAN	Disable/Enabled	NA	Enable or disable wake on LAN. **Note -** This option is not supported
Blink LEDs	0/1/2/3	0	Use to identify the physical network port by blinking the associated LED.
Port Configuration Information			Displays and specifies the port settings for the network device.
UEFI Driver (R/O)	NA	NA	Identifies the UEFI driver.
Adapter PBA (R/O)	NA	NA	Product board adapter (PBA) number. You can use the Intel Network Adapter PBA number to search for the adapter's model number. The PBA number is a nine digit number that is the last part of the adapter board serial number. The PBA number is presented in this format: *xxxxxxx-xxx*, for example, C80222-001.
Chip Type (R/O)	NA	NA	Manufacturer and model number
PCI Device ID (R/O)		1528	Device identifier
PCI Address (R/O)	NA	NA	Bus device function identifier Example format: Bus:Device: Function
Link Status	Connected/Disconnected	Disconnected	Specifies the link status of the network port.
MAC Address (R/O)	NA	None	Lists the MAC address of the network interface card (NIC).

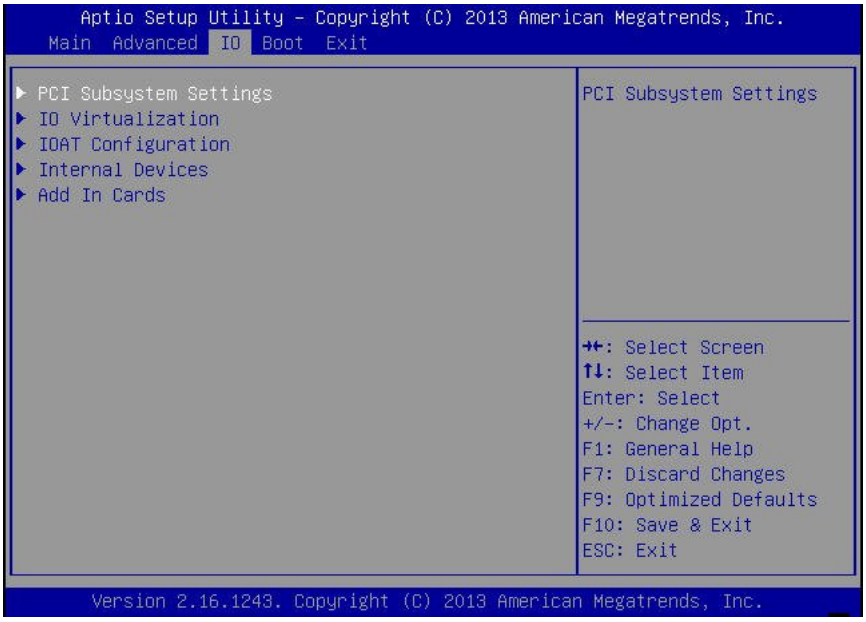
Related Information

- “BIOS Main Menu Selections” on page 203
- “BIOS IO Menu Selections” on page 220
- “BIOS Boot Menu Selections” on page 223

- “BIOS Exit Menu Selections” on page 225

BIOS IO Menu Selections

This section includes a screenshot of the BIOS IO Menu. The options that are available from the IO Menu are described in the sections that follow.



The following sections describe the BIOS IO Menu options.

- “BIOS IO Menu PCI Subsystem Settings Options” on page 221
- “BIOS IO Menu IO Virtualization Options” on page 221
- “BIOS IO Menu I/OAT Configuration Options” on page 222
- “BIOS IO Menu Internal Devices Options” on page 222
- “BIOS IO Menu Add In Cards Options” on page 222

BIOS IO Menu PCI Subsystem Settings Options

The following table describes the BIOS IO Menu PCI subsystem settings options.

TABLE 29 BIOS IO Menu PCI Subsystem Settings Options

Setup Options	Options	Defaults	Description
PCI 64 Bit Resources Allocation	Disabled/Enabled	Enabled	Enable or disable 64-bit capable devices to be decoded in above 4G address space. This setting is available only if the system supports 64-bit decoding.

BIOS IO Menu IO Virtualization Options

The following table describes the BIOS IO Menu IO virtualization options.

TABLE 30 BIOS IO Menu IO Virtualization Options

Setup Options	Options	Defaults	Description
VT-d	Disabled/Enabled	Enabled	Enable or disable Intel Virtualization Technology for directed I/O (VT-d) by reporting the I/O device assignment to VMM through DMA remapping reporting (DMAR) Advance Configuration Power Interface (ACPI) tables.
SR-IOV	Disabled/Enabled	Enabled	Single Root I/O Virtualization (SR-IOV) is used to configure devices into multiple virtual devices that can be used on virtual OS installations. If supported by the hardware and set to enabled, all devices within the system that are SR-IOV capable are configured to support SR-IOV and I/O resources are allocated to the device as normal. If set to disabled, I/O resources are not allocated to the device.
ARI	Disabled/Enabled	Disabled	If Alternate Routing ID (ARI) is supported by the hardware and set to enabled, devices are permitted to locate virtual

Setup Options	Options	Defaults	Description
			functions (VFs) in function numbers 8 to 255 of the captured bus number, instead of normal function numbers 0 to 7.

BIOS IO Menu I/OAT Configuration Options

The following table describes the BIOS IO Menu I/OAT configuration options.

TABLE 31 BIOS IO Menu I/OAT Configuration Options

Setup Options	Options	Defaults	Description
Intel I/OAT	Disabled/Enabled	Enabled	Enable or disable Intel I/OAT.
DCA Support	Disabled/Enabled	Enabled	Enable or disable direct cache access (DCA) support.

BIOS IO Menu Internal Devices Options

The following table describes the BIOS IO Menu internal devices options.

TABLE 32 BIOS IO Menu Internal Devices Options

Setup Options	Options	Defaults	Description
NET0			Displays and provides options to change the internal device settings.
OpROM Enable	Disabled/Enabled	Enabled	Enable or disable Option ROM. If set to enabled, Option ROM for the card executes as normal. If set to disabled, Option ROM for the card is not copied into memory and the execution of the Option ROM is inhibited.
NET1, NET2, and NET3			See NET0 description.

BIOS IO Menu Add In Cards Options

The following table describes the BIOS IO Menu add in cards options.

TABLE 33 BIOS IO Menu Add In Cards Options

Setup Options	Options	Defaults	Description
Slot 1			Displays and provides options to change the settings of the devices in PCIe slots.
OpROM Enable	Disable/Enabled	Enabled	Enable or disable Option ROM for add-in card.
Slot 2, Slot 3, Slot 4, Slot 5, and Slot 6			See Slot 1 description

Related Information

- “BIOS Main Menu Selections” on page 203
- “BIOS Advanced Menu Selections” on page 207
- “BIOS Boot Menu Selections” on page 223
- “BIOS Exit Menu Selections” on page 225

BIOS Boot Menu Selections

This section includes a screenshot of the BIOS Boot Menu. The options that are available from the Boot Menu are described in the table that follows.

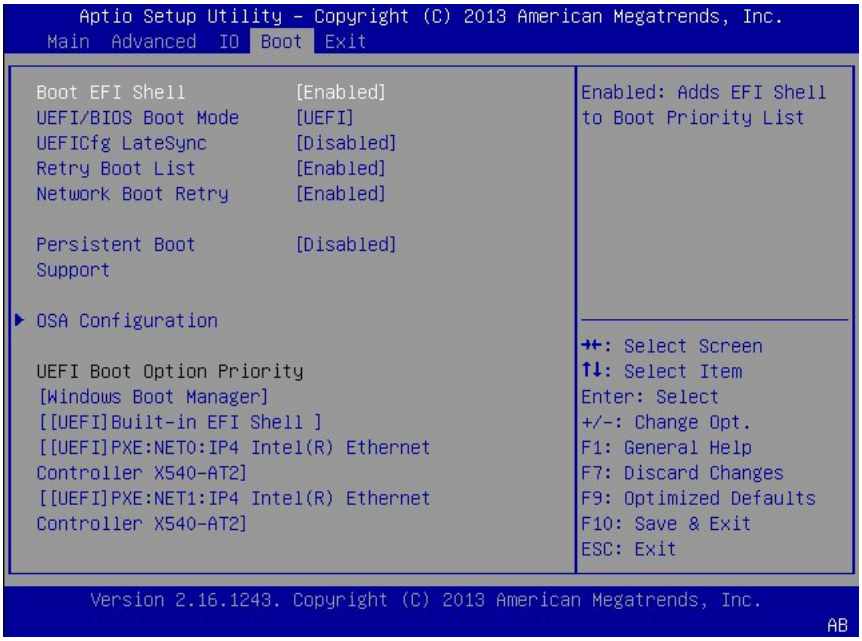


TABLE 34 BIOS Boot Menu Options

Setup Options	Options	Defaults	Description
UEFI/BIOS Boot Mode	Legacy/UEFI	Legacy	Select either Legacy BIOS or UEFI as the boot mode. ■ Enable UEFI: Only UEFI BIOS boot options are initialized and presented to the user. ■ Enable Legacy BIOS: Only Legacy BIOS boot options are initialized and presented to the user.
Retry Boot List	Disabled/Enabled	Enabled	If enabled, BIOS automatically retries to boot from the top of the Boot Options Priority list when all devices have been attempted and failed.
Network Boot Retry	Disabled/Enabled/Boot List	Enabled	If enabled, BIOS automatically retries the PXE list present in the system when all PXE attempts have failed. If set to disabled, the system halts and displays the error message “Network Boot Failed” when all PXE boots failed. If set to Boot List, fail over to the main Boot Options Priority list.

Setup Options	Options	Defaults	Description
Persistent Boot Support	Disabled/Enabled	Disabled	If enabled, the Persistent Boot feature is enabled. If disabled, system reverts back to the default boot handling from the next boot.
Legacy Boot Option Priority	UEFI/Legacy	Legacy	Displays the system boot order.

Related Information

- “BIOS Main Menu Selections” on page 203
- “BIOS Advanced Menu Selections” on page 207
- “BIOS IO Menu Selections” on page 220
- “BIOS Exit Menu Selections” on page 225

BIOS Exit Menu Selections

This section includes a screenshot of the BIOS Exit Menu. The options that are available from the Exit Menu are described in the table that follows.

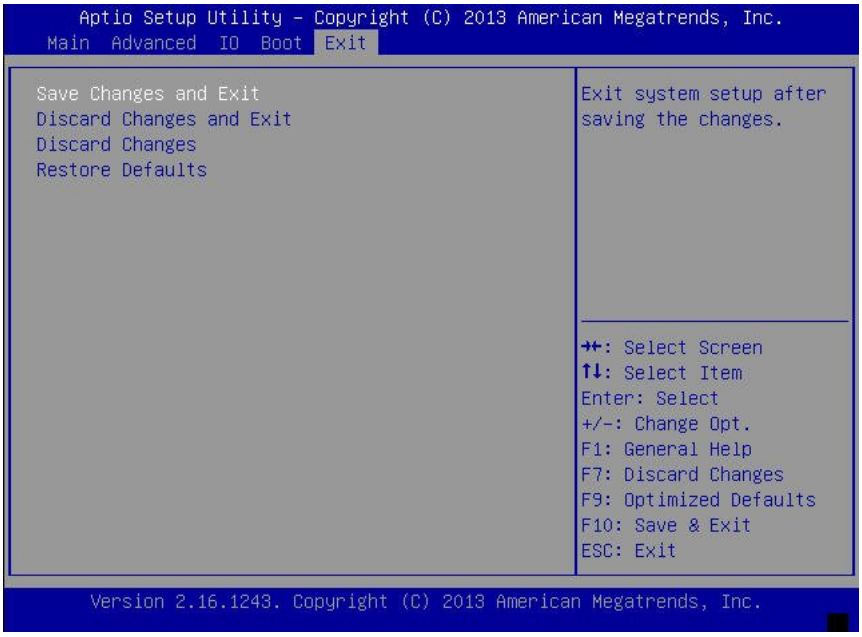


TABLE 35 BIOS Exit Menu Options

Setup Options	Description
Save Changes and Exit	Save changes and exit the BIOS Setup Utility.
Discard Changes and Exit	Exit the BIOS Setup Utility without saving changes.
Discard Changes	Discard any changes made to the setup options.
Restore Defaults	Restore/load the optimal default values for all of the setup options.

Related Information

- “BIOS Main Menu Selections” on page 203
- “BIOS Advanced Menu Selections” on page 207
- “BIOS IO Menu Selections” on page 220
- “BIOS Boot Menu Selections” on page 223

Monitoring Components and Identifying SNMP Messages

This section includes information about monitoring components and identifying SNMP messages for the Oracle Exadata Storage Server X5-2 Extreme Flash.

Description	Links
Review how Oracle ILOM monitors component health and faults.	"Monitoring Component Health and Faults Using Oracle ILOM" on page 227
Review information about system components and nomenclature.	"Monitoring System Components" on page 228
Review SNMP traps generated by the storage server.	"Identifying SNMP Trap Messages" on page 239

Related Information

- Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at: `http://www.oracle.com/goto/ilom/docs`

Monitoring Component Health and Faults Using Oracle ILOM

The Oracle ILOM 3.2 interfaces provide easy-to-view information about the health status of system components. From the Oracle ILOM web interface or in the Oracle ILOM command-line interface (CLI), you can collect system-specific information about the storage server, determine the health state of discrete components, and view any open problems on the storage server. Oracle ILOM automatically detects system hardware faults and environmental conditions on the storage server. If a problem occurs on the storage server, Oracle ILOM will automatically do the following:

- Illuminate the Service Required status indicator (LED) on the storage server front and back panels.
- Identify the faulted component in the Open Problems table.

- Record system information about the faulted component or condition in the event log.

For further information about administering open problems that are detected and reported by Oracle ILOM, refer to “Administering Open Problems” in the *Oracle ILOM Administrator's Guide for Configuration and Maintenance Firmware Release 3.2.x* in the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

Related Information

- Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at: `http://www.oracle.com/goto/ilom/docs`

Monitoring System Components

The tables in this section identify the system components and describe the naming conventions applied to the components of the Oracle Exadata Storage Server X5-2 Extreme Flash.

Each section corresponds to an IPMI entity ID and lists sensors, indicators, and field-replaceable units (FRUs) related to that entity. The tables contain the following fields:

- **Component Name** – Shows the user-visible component name used in management interfaces to refer to a specific sensor, indicator, or FRU. The IPMI name is a shortened form of the component name, and is indicated by the **boldface** portion of the component name.
- **IPMI Type** – Indicates the type of sensor, indicator, or FRU represented.
- **Description** – Describes the particular component name reference.
- **Values** – Defines the states of the sensor, indicator, or FRU entity, and any specific units or values that are expected, if applicable.

Note - Some component names are hidden in the Oracle ILOM user interfaces. These names are marked as hidden in the tables. Further, as of Oracle ILOM 3.1, the Oracle ILOM 3.0 legacy targets `/SYS` and `/STORAGE` have been replaced by `/System`. Even though these legacy targets might be hidden, you can still use them to issue commands. For information on legacy targets, see the ILOM 3.1 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

This section includes information for the following storage server components:

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231

- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “System Firmware Components” on page 237
- “Hard Disk Drive Components” on page 238

System Chassis Components

The following table lists the system chassis components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/**SYS**	FRU	Product information only	
/SYS/**UUID**	FRU	Unique system ID	Derived from host MAC address. Used for PXE boot and licensing.
/SYS/**ACPI**	State sensor	Advanced Configuration and Power Interface	(*hidden*) 01h-ACPI_ON_WORKING 20h-ACPI_SOFT_OFF
/SYS/**VPS**	Threshold sensor	Virtual power sensor	Watts
/SYS/**VPS_CPUS**	Threshold sensor	Virtual power sensor (CPUs)	Watts
/SYS/**VPS_MEMORY**	Threshold sensor	Virtual power sensor (Memory)	Watts
/SYS/**VPS_FANS**	Threshold sensor	Virtual power sensor (Fans)	Watts
/SYS/**INTSW**	Discrete sensor	Chassis intrusion switch	01h-Deasserted 02h-Asserted
/SYS/**T_AMB**	Threshold sensor	Ambient temperature on system motherboard, located behind the left side front SIS indicator.	Degrees Celsius
/SYS/**TEMP_FAULT**	Indicator	Temperature Fault LED	Color: Amber Location: Front panel Off: Normal On: Chassis overtemp fault

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**OK**	Indicator	Power OK LED	Color: Green Location: Front panel Off: Power is off. Standby blink: Standby power is on; Oracle ILOM SP is running. Slow blink: Startup sequence initiated on host. On: Host is booting OS or running the OS.
/SYS/**SERVICE**	Indicator	Service Required LED	Color: Amber Location: Front panel Off: Normal On: Server requires service.
/SYS/**LOCATE**	Indicator	Locator LED	Color: White Location: Front and rear panels Off: Normal Fast blink: Locate function is activated; self-extinguishes after 30 minutes.
/SYS/**HOST_ERR**	Discrete sensor	Host asserted error sensor	01h-Deasserted 02h-Asserted
/SYS/**PS_FAULT**	Indicator	Rear Power Supply Fault LED	Color: Amber Location: Mainboard Off: Normal On: General power supply fault
/SYS/**FAN_FAULT**	Indicator	Top Fan Fault LED	Color: Amber Location: Mainboard Off: Normal On: General fan fault

Related Information

- “Cooling Unit Components” on page 231

- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “System Firmware Components” on page 237
- “Hard Disk Drive Components” on page 238

Cooling Unit Components

The system has 3.5-inch fan modules with two fans in each module. The following table lists the system cooling unit components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**MB/FM[0-3]**	FRU	Fan module FRU	
/SYS/**MB/FM[0-3]/F[0-x]**	FRU	Individual fan	
/SYS/**MB/FM[0-3]/PRSNT**	Discrete sensor	Fan module is present.	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/**MB/FM[0-3]/F[0-x]/TACH**	Threshold sensor	Fan module fan speed	RPM
/SYS/**MB/FM[0-3]/SERVICE**	Indicator	Fan Service Required LED	Color: Amber Location: Mainboard Off: Normal On: Fan module was diagnosed as faulty.

Related Information

- “System Chassis Components” on page 229
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “System Firmware Components” on page 237

■ “Hard Disk Drive Components” on page 238

Disk Backplane Components

The following table lists the disk backplane (DBP) components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**DBP**	FRU	Disk backplane FRU	
/SYS/**DBP/SASEXP**	FRU	SAS Expander FRU	
/SYS/**DBP/SASEXP/PRSNT**	Discrete sensor	SAS Expander board presence	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/**DBP/SASEXP/T_CORE**	Threshold sensor	SAS Expander board temperature, reported by Expander CPLD	Degrees Celsius
/SYS/**DBP/HDD[0-*x*]**	Pseudo	Hard disk drives	
/SYS/**DBP/HDD[0-*x*]/PRSNT**	Discrete sensor	Hard disk drive presence	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/**DBP/HDD[0-*x*]/STATE**	State sensor	Hard disk drive state	02h-DRIVE_FAULT 04h-PREDICTIVE_FAILURE 08h-HOT_SPARE
/SYS/**DBP/HDD[0-*x*]/SERVICE**	Indicator	Service Required LED	Color: Amber Location: Hard disk drive (HDD) Off: Normal On: HDD was diagnosed as faulty
/SYS/**DBP/HDD[0-*x*]/OK2RM**	Indicator	OK to remove	Color: Blue Location: HDD drive Off: Normal On: OK to remove HDD
/SYS/**DBP/NVME[0-*x*]**		NVMe drives	
/SYS/**DBP/NVME[0-*x*]/PRSNT**	Discrete sensor	NVMe device presence	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “System Firmware Components” on page 237
- “Hard Disk Drive Components” on page 238

Memory Device Components

The following table lists the memory device components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/MB/**P[0-*x*]/D[0-11]**	FRU	Host CPU DIMM FRU	
/SYS/MB/**P[0-*x*]/D[0-11]/PRSNT**	Discrete sensor	Host CPU DIMM is present.	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/MB/**P[0-*x*]/D[0-11]/SERVICE**	Indicator	Host CPU DIMM Service Required LED	Color: Amber Location: Mainboard Off: Normal On: DIMM was diagnosed as faulty.

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Power Unit Components” on page 234
- “Processor Components” on page 235

- "System Board Components" on page 236
- "System Firmware Components" on page 237
- "Hard Disk Drive Components" on page 238

Power Unit Components

The following table lists the power unit components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**PS[0-1]**	FRU	Power supply FRU	
/SYS/**PS[0-1]/PRSNT**	Discrete sensor	Power supply is present	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/**PS[0-1]/STATE**	Discrete sensor	Multistate, power supply sensor type, per IPMI	Presence detected Failure detected Predictive failure Power supply input lost Power supply input lost or out-of-range Power supply input out-of-range Configuration error
/SYS/**PS[0-1]/P_IN**	Power sensor	Input power draw	Watts
/SYS/**PS[0-1]/P_OUT**	Power sensor	Output power	Watts
/SYS/**PS[0-1]/V_IN**	Voltage sensor	Input voltage	Volts
/SYS/**PS[0-1]/V_12V**	Voltage sensor	12V output voltage	Volts
/SYS/**PS[0-1]/V_12V_STBY**	Voltage sensor	12V standby output voltage	Volts
/SYS/**PS[0-1]/T_OUT**	Temperature sensor	Ambient temperature	Degrees Celsius

Related Information

- "System Chassis Components" on page 229
- "Cooling Unit Components" on page 231

- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Processor Components” on page 235
- “System Board Components” on page 236
- “System Firmware Components” on page 237
- “Hard Disk Drive Components” on page 238

Processor Components

The following table lists the processor (CPU) components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**MB/P[0-*x*]**	FRU	Host CPU FRU	
/SYS/**MB/P[0-*x*]/PRSNT**	Discrete sensor	Host CPU is present.	01h-ENTITY_PRESENT 02h-ENTITY_ABSENT
/SYS/**MB/P[0-*x*]/SERVICE**	Indicator	Host CPU Service Required LED	Color: Amber Location: Mainboard Off: Normal On: Processor was diagnosed as faulty.
/SYS/**MB/P[0-*x*]/V_DIMM**	Static sensor	CPU DIMM bank operating voltage	1.2V

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “System Board Components” on page 236
- “System Firmware Components” on page 237
- “Hard Disk Drive Components” on page 238

System Board Components

The following table lists the system board components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**MB**	FRU	General host system board FRU	
/SYS/**MB/CPLD**	FRU	Mainboard CPLD/FPGA firmware version	
/SYS/**MB/NET[0-3]**	FRU	Host Ethernet FRU	
/SYS/**MB/PCIE[1-6]**	FRU	PCIe slot	
/SYS/**MB/PCIE[1-6]/PRSNT**	Discrete sensor	Option card inserted into PCIe slot	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/**MB/PCIE3/PCIESW**	FRU	PCIe switch for NVMe support, optional, dedicated slot	
/SYS/**MB/T_OUT_ZONE[0-2]**	Threshold sensor	Cooling zone chassis exhaust temperature, located behind the specified PCIe slots. ■ Zone 0 – PCIe slot 5 ■ Zone 1 – PCIe slot 4 ■ Zone 2 – PCIe slot 1	Degrees Celsius
/SYS/**MB/T_IN_ZONE[0-2]**	Threshold sensor	Cooling zone chassis inlet temperature, located in front of the specified PCIe slots. ■ Zone 0 – PCIe slot 5 ■ Zone 1 – PCIe slot 4 ■ Zone 2 – PCIe slot 1	Degrees Celsius
/SYS/**MB/T_CORE_NET01**	Threshold sensor	Gigabit Ethernet controller die temperature	CPU 0, NET 0+1 Degrees Celsius
/SYS/**MB/T_CORE_NET23**	Threshold sensor	Gigabit Ethernet controller die temperature	CPU 1, NET 2+3 Degrees Celsius
/SYS/**MB/T_IN_PS**	Threshold sensor	Power supply unit (PSU) inlet temperature, located directly in front of the PSU 0 air inlet.	Degrees Celsius
/SYS/**SP**	FRU	Service processor FRU	
/SYS/**SP/OK**	Indicator	SP OK LED	Color: Green Location: Front panel On: SP is operating.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
			Off: SP requires service.
/SYS/**SP/NET[0-1]**	FRU	SP Ethernet FRU	

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Firmware Components” on page 237
- “Hard Disk Drive Components” on page 238

System Firmware Components

The following table lists the system firmware components.

Component Name (Oracle ILOM CLI Target)	IPMI Type	Description
/SYS/**MB/BIOS**	FRU	BIOS FRU
/SYS/**MB/CPLD**	FRU	Mainboard CPLD/FPGA firmware

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “Hard Disk Drive Components” on page 238

Hard Disk Drive Components

The following table lists the hard disk drive (HDD) components.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**MB/RHDD[0-1]**	FRU	Rear hard disk drive FRU	From host
/SYS/**MB/RHDD[0-1]/PRSNT**	Discrete sensor	Rear hard disk drive presence	01h-ENTITY_PRESENT, 02h-ENTITY_ABSENT
/SYS/**MB/RHDD[0-1]/SERVICE**	Indicator	Rear hard disk drive Service Required LED	Color: Amber Location: Rear HDD Off: Normal On: Hard disk drive (HDD) was diagnosed as faulty.
/SYS/**MB/RHDD[0-1]/OK2RM**	Indicator	Rear hard disk drive OK to Remove LED	Color: Blue Location: Rear HDD Off: Normal On: OK to remove
/SYS/**MB/RHDD[0-1]/STATE**	Discrete sensor	Rear hard disk drive state	02h-DRIVE_FAULT 04h-PREDICTIVE_FAILURE 08h-HOT_SPARE
/SYS/**DBP/HDD[0-*x*]**	FRU	Hard disk drive FRU	From host
/SYS/**DBP/HDD[0-*x*]/PRSNT**	Discrete sensor	Hard disk drive presence	01h-ENTITY_ABSENT 02h-ENTITY_PRESENT
/SYS/**DBP/HDD[0-*x*]/STATE**	Discrete sensor	Writable multistate, slot/connector sensor type, per IPMI	02h-DRIVE_FAULT 04h-PREDICTIVE_FAILURE 08h-HOT_SPARE
/SYS/**DBP/HDD[0-*x*]/SERVICE**	Indicator	Hard disk drive Service Required LED	Color: Amber Location: HDD Off: Normal On: Hard disk drive was diagnosed as faulty.

Component Name (Oracle ILOM CLI Targets)	IPMI Type	Description	Values (if applicable)
/SYS/**DBP/HDD[0-*x*]/OK2RM**	Indicator	Hard disk drive OK to Remove LED	Color: Blue Location: HDD Off: Normal On: OK to remove
/SYS/**DBP/NVME[0-*x*]**	FRU	NVMe drive FRU	
/SYS/**DBP/NVME[0-*x*]/PRSNT**	Discrete sensor	PCIe NVMe drive	01h-ENTITY_PRESENT 02h-ENTITY_ABSENT

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “System Firmware Components” on page 237

Identifying SNMP Trap Messages

It is possible to configure Oracle ILOM to generate Simple Network Management Protocol (SNMP) traps when hardware problems occur. For information about how to configure SNMP alert rule destinations to start receiving these traps, refer to the Oracle Integrated Lights Out Manager (ILOM) 3.2 Documentation Library at `http://www.oracle.com/goto/ilom/docs`.

The tables in these sections list the set of SNMP traps that are generated from Oracle ILOM.

- “Environmental Events” on page 240
- “Hard Disk Drive Events” on page 242
- “Power Events” on page 242
- “Fan Events” on page 247
- “Memory Events” on page 248
- “Entity Presence Events” on page 253

- "Physical Security Events" on page 254

Environmental Events

The following table lists environmental events.

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapTempFatalThresholdExceeded **Oracle ILOM Event Message:** Lower fatal threshold exceeded **Severity and Description:** Critical; A temperature sensor has reported that its value has gone above an upper fatal threshold setting or below a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/T_OUT /SYS/MB/T_IN_ZONE0 /SYS/MB/T_OUT_ZONE0 /SYS/MB/T_IN_ZONE1 /SYS/MB/T_OUT_ZONE1 /SYS/MB/T_IN_ZONE2 /SYS/MB/T_OUT_ZONE2
SNMP Trap: sunHwTrapTempFatalThresholdDeasserted **Oracle ILOM Event Message:** Lower fatal threshold no longer exceeded **Severity and Description:** Informational; A temperature sensor has reported that its value has gone below an upper fatal threshold setting or above a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/T_OUT /SYS/MB/T_IN_ZONE0 /SYS/MB/T_OUT_ZONE0 /SYS/MB/T_IN_ZONE1 /SYS/MB/T_OUT_ZONE1 /SYS/MB/T_IN_ZONE2 /SYS/MB/T_OUT_ZONE2
SNMP Trap: sunHwTrapTempCritThresholdExceeded **Oracle ILOM Event Message:** Upper critical threshold exceeded **Severity and Description:** Critical; A temperature sensor has reported that its value has gone above an upper critical threshold setting or below a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/T_OUT /SYS/MB/T_IN_ZONE0 /SYS/MB/T_OUT_ZONE0 /SYS/MB/T_IN_ZONE1 /SYS/MB/T_OUT_ZONE1 /SYS/MB/T_IN_ZONE2 /SYS/MB/T_OUT_ZONE2
SNMP Trap: sunHwTrapTempCritThresholdDeasserted **Oracle ILOM Event Message:** Upper critical threshold no longer exceeded	/SYS/PS[0-1]/T_OUT /SYS/MB/T_IN_ZONE0

Messages and Descriptions	Component Name
Severity and Description: Informational; A temperature sensor has reported that its value has gone below an upper critical threshold setting or above a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/T_OUT_ZONE0 /SYS/MB/T_IN_ZONE1 /SYS/MB/T_OUT_ZONE1 /SYS/MB/T_IN_ZONE2 /SYS/MB/T_OUT_ZONE2
SNMP Trap: sunHwTrapTempFatalThresholdExceeded **Oracle ILOM Event Message:** Lower fatal threshold exceeded **Severity and Description:** Critical; A temperature sensor has reported that its value has gone above an upper fatal threshold setting or below a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/T_AMB /SYS/MB/T_CORE_NET01 /SYS/MB/T_CORE_NET23 /SYS/MB/T_IN_PS
SNMP Trap: sunHwTrapTempFatalThresholdDeasserted **Oracle ILOM Event Message:** Lower fatal threshold no longer exceeded **Severity and Description:** Informational; A temperature sensor has reported that its value has gone below an upper fatal threshold setting or above a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/T_AMB /SYS/MB/T_CORE_NET01 /SYS/MB/T_CORE_NET23 /SYS/MB/T_IN_PS
SNMP Trap: sunHwTrapTempCritThresholdExceeded **Oracle ILOM Event Message:** Upper critical threshold exceeded **Severity and Description:** Critical; A temperature sensor has reported that its value has gone above an upper critical threshold setting or below a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/T_CORE_NET01 /SYS/MB/T_CORE_NET23 /SYS/MB/T_IN_PS
SNMP Trap: sunHwTrapTempCritThresholdDeasserted **Oracle ILOM Event Message:** Upper critical threshold no longer exceeded **Severity and Description:** Informational; A temperature sensor has reported that its value has gone below an upper critical threshold setting or above a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/T_CORE_NET01 /SYS/MB/T_CORE_NET23 /SYS/MB/T_IN_PS

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232

- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “Hard Disk Drive Components” on page 238

Hard Disk Drive Events

The following table lists hard disk drive events.

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapSlotOrConnectorError **Oracle ILOM Event Message:** Assert **Severity and Description:** Major: A sensor associated with a slot or connector has detected an error.	/SYS/DBP/HDD[0-*x*]/STATE
SNMP Trap: sunHwTrapSlotOrConnectorOk **Oracle ILOM Event Message:** Deassert **Severity and Description:** Informational; A sensor associated with a slot or connector has returned to its normal state.	/SYS/DBP/HDD[0-*x*]/STATE

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “Hard Disk Drive Components” on page 238

Power Events

The following table lists power events.

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_PRESENCE ASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_PRESENCE DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_FAILURE ASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_FAILURE DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_PREDICTIVE_FAILURE ASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_PREDICTIVE_FAILURE DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_INPUT_LOST ASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_INPUT_LOST DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_INPUT_ERROR ASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_INPUT_ERROR DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError	/SYS/PS[0-1]/STATE

Messages and Descriptions	Component Name
Oracle ILOM Event Message: PS_INPUT_RANGE_ERROR ASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_INPUT_RANGE_ERROR DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_CONFIG_ERROR ASSERT **Severity and Description**Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapPowerSupplyError **Oracle ILOM Event Message:** PS_CONFIG_ERROR DEASSERT **Severity and Description:** Major; A power supply sensor has detected an error.	/SYS/PS[0-1]/STATE
SNMP Trap: sunHwTrapSensorNonCritThresholdExceeded **Oracle ILOM Event Message:** Upper noncritical threshold exceeded **Severity and Description:** Minor; A sensor has reported that its value has gone above an upper non critical threshold setting or below a lower non critical threshold setting. This generic 'sensor' trap is generated when the SNMP agent does not recognize the component type. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/VPS
SNMP Trap: sunHwTrapSensorThresholdOk **Oracle ILOM Event Message:**Upper noncritical threshold no longer exceeded **Severity and Description:** Informational; A sensor has reported that its value is in the normal operating range. This generic 'sensor' trap is generated when the SNMP agent does not recognize the component type.	/SYS/VPS
SNMP Trap: sunHwTrapSensorNonCritThresholdExceeded **Oracle ILOM Event Message:** Upper noncritical threshold exceeded **Severity and Description:** Minor; A sensor has reported that its value has gone above an upper non critical threshold setting or below a lower non critical threshold setting. This generic 'sensor' trap is generated when the SNMP agent does not recognize the component type. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower.	/SYS/VPS_FANS /SYS/PS[0-1]/P_IN /SYS/PS[0-1]/P_OUT
SNMP Trap: sunHwTrapSensorThresholdOk **Oracle ILOM Event Message:** Upper noncritical threshold no longer exceeded **Severity and Description:** Informational; A sensor has reported that its value is in the normal operating range. This generic 'sensor' trap is generated when the SNMP agent does not recognize the component type.	/SYS/VPS_FANS /SYS/PS[0-1]/P_IN /SYS/PS[0-1]/P_OUT
SNMP Trap: sunHwTrapSensorFatalThresholdExceeded	/SYS/PS[0-1]/P_IN

Messages and Descriptions	Component Name
Oracle ILOM Event Message: Lower fatal threshold exceeded **Severity and Description:** Critical; A power supply sensor has reported that its value has gone above an upper fatal threshold setting or below a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/P_OUT
SNMP Trap: sunHwTrapSensorFatalThresholdDeasserted **Oracle ILOM Event Message:** Lower fatal threshold no longer exceeded **Severity and Description:** Informational; A power supply sensor has reported that its value has gone below an upper fatal threshold setting or above a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/P_IN /SYS/PS[0-1]/P_OUT
SNMP Trap: sunHwTrapSensorCritThresholdExceeded **Oracle ILOM Event Message:** Lower critical threshold exceeded **Severity and Description:** Major; A power supply sensor has reported that its value has gone above an upper critical threshold setting or below a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/P_IN /SYS/PS[0-1]/P_OUT
SNMP Trap: sunHwTrapSensorCritThresholdDeasserted **Oracle ILOM Event Message:** Lower critical threshold no longer exceeded **Severity and Description:** Informational; A power supply sensor has reported that its value has gone below an upper critical threshold setting or above a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/P_IN /SYS/PS[0-1]/P_OUT
SNMP Trap: sunHwTrapVoltageFatalThresholdExceeded **Oracle ILOM Event Message:** Lower fatal threshold exceeded **Severity and Description:** Critical; A voltage sensor has reported that its value has gone above an upper fatal threshold setting or below a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/V_12V /SYS/PS[0-1]/V_12V_STBY /SYS/PS[0-1]/V_IN /SYS/MB/P[0-*x*]/V_DIMM
SNMP Trap: sunHwTrapVoltageFatalThresholdDeasserted **Oracle ILOM Event Message:** Lower fatal threshold no longer exceeded **Severity and Description:** Informational; A voltage sensor has reported that its value has gone below an upper fatal threshold setting or above a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/V_12V /SYS/PS[0-1]/V_12V_STBY /SYS/PS[0-1]/V_IN /SYS/MB/P[0-*x*]/V_DIMM
SNMP Trap: sunHwTrapVoltageCritThresholdExceeded	/SYS/PS[0-1]/V_12V

Messages and Descriptions	Component Name
Oracle ILOM Event Message: Upper critical threshold exceeded **Severity and Description:** Critical; A voltage sensor has reported that its value has gone above an upper critical threshold setting or below a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/V_12V_STBY /SYS/PS[0-1]/V_IN /SYS/MB/P[0-*x*]/V_DIMM
SNMP Trap: sunHwTrapVoltageCritThresholdDeasserted **Oracle ILOM Event Message:** Upper critical threshold no longer exceeded **Severity and Description:** Informational; A voltage sensor has reported that its value has gone below an upper critical threshold setting or above a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/V_12V /SYS/PS[0-1]/V_12V_STBY /SYS/PS[0-1]/V_IN /SYS/MB/P[0-*x*]/V_DIMM
SNMP Trap: sunHwTrapVoltageNonCritThresholdExceeded **Oracle ILOM Event Message:** Upper noncritical threshold exceeded **Severity and Description:** Minor; A voltage sensor has reported that its value has gone above an upper non critical threshold setting or below a lower non critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/PS[0-1]/V_12V /SYS/PS[0-1]/V_12V_STBY /SYS/PS[0-1]/V_IN /SYS/MB/P[0-*x*]/V_DIMM
SNMP Trap: sunHwTrapVoltageOk **Oracle ILOM Event Message:** Upper noncritical threshold no longer exceeded **Severity and Description:** Informational; A voltage sensor has reported that its value is in the normal operating range.	/SYS/PS[0-1]/V_12V /SYS/PS[0-1]/V_12V_STBY /SYS/PS[0-1]/V_IN /SYS/MB/P[0-*x*]/V_DIMM

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “Hard Disk Drive Components” on page 238

Fan Events

The following table lists fan events.

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapFanSpeedCritThresholdExceeded **Oracle ILOM Event Message:** Lower critical threshold exceeded **Severity and Description:** Major; A fan speed sensor has reported that its value has gone above an upper critical threshold setting or below a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/FM[0-3]/F[0-1]/TACH
SNMP Trap: sunHwTrapFanSpeedCritThresholdDeasserted **Oracle ILOM Event Message:** Lower critical threshold no longer exceeded **Severity and Description:** Informational; A fan speed sensor has reported that its value has gone below an upper critical threshold setting or above a lower critical threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/FM[0-3]/F[0-1]/TACH
SNMP Trap: sunHwTrapFanSpeedFatalThresholdExceeded **Oracle ILOM Event Message:** Lower fatal threshold exceeded **Severity and Description:** Critical; A fan speed sensor has reported that its value has gone above an upper fatal threshold setting or below a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/FM[0-3]/F[0-1]/TACH
SNMP Trap: sunHwTrapFanSpeedFatalThresholdDeasserted **Oracle ILOM Event Message:** Lower fatal threshold no longer exceeded **Severity and Description:** Informational; A fan speed sensor has reported that its value has gone below an upper fatal threshold setting or above a lower fatal threshold setting. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower threshold.	/SYS/MB/FM[0-3]/F[0-1]/TACH

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232

- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “Hard Disk Drive Components” on page 238

Memory Events

The following table lists memory events.

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapSensorNonCritThresholdExceeded **Oracle ILOM Event Message:** Upper noncritical threshold exceeded **Severity and Description:** Minor; A sensor has reported that its value has gone above an upper non critical threshold setting or below a lower non critical threshold setting. This generic 'sensor' trap is generated when the SNMP agent does not recognize the component type. The sunHwTrapThresholdType object indicates whether the threshold was an upper or lower.	/SYS/VPS_CPUS /SYS/VPS_MEMORY
SNMP Trap: sunHwTrapSensorThresholdOk **Oracle ILOM Event Message:** Upper noncritical threshold no longer exceeded **Severity and Description:** Informational; A sensor has reported that its value is in the normal operating range. This generic 'sensor' trap is generated when the SNMP agent does not recognize the component type.	/SYS/VPS_CPUS /SYS/VPS_MEMORY
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.cpu.intel.quickpath.link_slow "The Quickpath Interconnect (QPI) link is operating below normal speed." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.cpu.intel.quickpath.link_slow "The Quickpath Interconnect (QPI) link is operating below normal speed." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.cpu.intel.quickpath.unknown-errcode "An unknown error code from the Quickpath Interconnect (QPI) reference code has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared	/SYS/MB

Messages and Descriptions	Component Name
Oracle ILOM Event Message: event fault.cpu.intel.quickpath.unknown-errcode "An unknown error code from the Quickpath Interconnect (QPI) reference code has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.none "An invalid memory DIMM configuration has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.none "An invalid memory DIMM configuration has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.memtest-failed "All memory channels have been disabled due to memory test failures." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.memtest-failed "All memory channels have been disabled due to memory test failures." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.quadrank-3rd-slot "A quad-rank memory DIMM has been installed in the third slot of a memory channel." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.quadrank-3rd-slot "A quad-rank memory DIMM has been installed in the third slot of a memory channel." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.ddr3u-unsupported "An unsupported DDR3 ultra low voltage memory DIMM has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.ddr3u-unsupported "An unsupported DDR3 ultra low voltage memory DIMM has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.mrc.unknown-errcode "An unknown error code from the Memory Reference Code (MRC) has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.mrc.unknown-errcode "An unknown error code from the Memory Reference Code (MRC) has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.udimm-unsupported "An unbuffered memory DIMM (UDIMM) has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.udimm-unsupported "An unbuffered memory DIMM (UDIMM) has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.sodimm-unsupported "An unsupported SODIMM has been detected in system." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.sodimm-unsupported "An unsupported SODIMM has been detected in system." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.4gb-fused "An unsupported 4-gb memory DIMM has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.4gb-fused "An unsupported 4-gb memory DIMM has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.8gb-fused "An unsupported 8-gb memory DIMM has been detected."	/SYS/MB/P[0-*x*]/D[0-11]

Messages and Descriptions	Component Name
Severity and Description: Major; A memory component is suspected of causing a fault.	
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.8gb-fused "An unsupported 8-gb memory DIMM has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.incompatible "A memory DIMM is incompatible with the memory controller." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.incompatible "A memory DIMM is incompatible with the memory controller." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.incompatible-maxranks "The number of ranks allowed on a memory channel has been exceeded." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.incompatible-maxranks "The number of ranks allowed on a memory channel has been exceeded." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.incompatible-quadrank "An invalid quad-rank memory DIMM configuration has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.incompatible-quadrank "An invalid quad-rank memory DIMM configuration has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.numranks-unsupported "A memory DIMM with an unsupported number of ranks has been detected." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared	/SYS/MB/P[0-*x*]/D[0-11]

Messages and Descriptions	Component Name
Oracle ILOM Event Message: event fault.memory.intel.dimm.numranks-unsupported "A memory DIMM with an unsupported number of ranks has been detected." **Severity and Description:** Informational; A memory component fault has been cleared.	
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.speed-slow "A memory DIMM has been detected that is unable to run at speeds required by the platform." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.speed-slow "A memory DIMM has been detected that is unable to run at speeds required by the platform." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.disable-quadrank "Memory channel is populated with too many quad-rank memory DIMMs." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.disable-quadrank "Memory channel is populated with too many quad-rank memory DIMMs." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.population-invalid "Memory DIMM is improperly populated or is a type that is not compatible with other DIMMs installed." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.population-invalid "Memory DIMM is improperly populated or is a type that is not compatible with other DIMMs installed." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.out-of-order "The memory DIMMs in a channel are not populated in sequential order." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.out-of-order "The memory DIMMs in a channel are not populated in sequential order." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapMemoryFault **Oracle ILOM Event Message:** event fault.memory.intel.dimm.category-unknown "Memory DIMM is of an unknown type or category." **Severity and Description:** Major; A memory component is suspected of causing a fault.	/SYS/MB/P[0-*x*]/D[0-11]
SNMP Trap: sunHwTrapMemoryFaultCleared **Oracle ILOM Event Message:** event fault.memory.intel.dimm.category-unknown "Memory DIMM is of an unknown type or category." **Severity and Description:** Informational; A memory component fault has been cleared.	/SYS/MB/P[0-*x*]/D[0-11]

Related Information

- “System Chassis Components” on page 229
- “Cooling Unit Components” on page 231
- “Disk Backplane Components” on page 232
- “Memory Device Components” on page 233
- “Power Unit Components” on page 234
- “Processor Components” on page 235
- “System Board Components” on page 236
- “Hard Disk Drive Components” on page 238

Entity Presence Events

The following table lists entity presence events.

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapProcessorError **Oracle ILOM Event Message:** ENTITY_PRESENT ASSERT **Severity and Description:** Major; A processor sensor has detected an error. Device absent.	/SYS/MB/P[0-*x*]/PRSNT
SNMP Trap: sunHwTrapProcessorOk **Oracle ILOM Event Message:** ENTITY_PRESENT DEASSERT **Severity and Description:** Major; A processor sensor has returned to its normal state. Device present.	/SYS/MB/P[0-*x*]/PRSNT

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapProcessorError **Oracle ILOM Event Message:** ENTITY_DISABLED ASSERT **Severity and Description:** Major; A processor sensor has detected an error. Device disabled.	/SYS/MB/P[0-*x*]/PRSNT
SNMP Trap: sunHwTrapProcessorOk **Oracle ILOM Event Message:** ENTITY_DISABLED DEASSERT **Severity and Description:** Major; A processor sensor has returned to its normal state. Device enabled.	/SYS/MB/P[0-*x*]/PRSNT

Physical Security Events

Messages and Descriptions	Component Name
SNMP Trap: sunHwTrapSecurityIntrusion **Oracle ILOM Event Message:** Assert **Severity and Description:** Major; General Chassis intrusion asserted.	/SYS/INTSW

Index

A

activity indicator, 28
add-in cards
  configuration utilities in Legacy BIOS Boot Mode, 185
  configuration utilities in UEFI BIOS Boot Mode, 185
Advanced BIOS screen, 207
antistatic
  mat, 48
  measures
    applying, 58
  wrist strap, 48
antistatic measures
  removing, 164
attaching devices to storage server, 38

B

battery
  description, 19
  installing, 102
  removing, 101
BIOS
  configuring serial port sharing, 41
  Ethernet ports booting priority, 43
BIOS boot mode, switching between Legacy BIOS and UEFI modes, 184
BIOS factory defaults, verifying, 187
BIOS Setup Utility
  accessing, 179
  Advanced screen, 207
  boot mode, 183
  Boot screen, 223
  Exit screen, 225
  exiting from, 201
  function keys, 179
  IO screen, 220
  legacy boot mode, 183
  Main screen, 203
  menus, accessing, 179
  navigating menu options, 181
  service processor network settings, 194
  setup screens summary, 178
  shortcut key sequences, 179
  TPM support, 192
  UEFI boot mode, 183
  UEFI-compliant, description, 183
board components, 229
boot device, selecting, 190
boot drive
  LEDs, 29
boot mode
  preserving settings when switching modes, 184
  selecting, 188
buttons
  Fault Remind, 105
  Power, 52, 168

C

cable part number
  auxiliary signal cable, 121
  left LED indicator module cable, 135
  NVMe cables, 126
  power cable, center, 121
  power cable, right, 121
  right LED/USB indicator module cable, 142

cables
  connecting, 167
  disconnecting, 54
cabling the storage server, 39
chassis components, 229
chassis serial number, locating, 46
components and nomenclature, 229
connecting devices to storage server, 38
connector locations, 38
controls, front panel, 14
cooling unit components, 231
crossover pinouts for SER MGT port, 172

D

default boot mode, 188
diagnosing
  hardware faults, 26
DIMMs
  description, 19
  fault LEDs
    inconsistencies with BIOS, 84
  Fault Remind button, 84
  identifying a faulty DIMM, 85
  installing, 89
  physical layout, 82
  population rules, 83
  removing, 85
  supported configurations, 83
disk backplane components, 232
disk components, 238
disk drive backplane
  description, 19
disk drives *See* drive
drive
  hot-plugging, 64
  identification, 64
  installing, 67
  latch release button, 66
  removing, 64

E

electrostatic discharge
  prevention, 58
  safety precautions, 48
entity presence events, 253
environmental events, 240
Ethernet cables, connecting, 39
Ethernet ports
  booting priority, 43, 43
  device and driver naming, 43
  pinout, 170
Exit BIOS screen, 225
exploded view of server, 17
external cables, connecting, 39

F

fan assembly door
  installing, 164
  removing, 60
fan events, 247
fan module
  installing, 72
  removing, 69
fan modules
  description, 19
Fault Remind button
  location, 84, 105
  using, 84
firmware components, 229
function keys within BIOS Setup Utility, 179

G

Gigabit Ethernet ports, 169
  pinout, 170

H

hard disk drive components, 238
hard disk drive events, 242
hard drives *See* drive

hardware faults
  diagnosing, 26
hot-plugging drives, 64

I

illustrated parts breakdown, 17
installing
  battery, 102
  DIMMs, 89
  drive, 67
  fan assembly door, 164
  fan module, 72
  LED indicator module (left), 135
  LED/USB indicator module (right), 141
  motherboard assembly, 154
  PCIe cards, 95
  power supply, 77
  processors, 111
  storage drive backplane, 120
  storage server into rack, 165
  storage server top cover, 162
  USB flash drive, 99
IO allocation
  enabling and disabling resources, 201
IO BIOS screen, 220
IP address, setting, 194
IPMI type, 228

L

latch release button, drive, 66
LED indicator module (left)
  installing, 135
  removing, 131
LED/USB indicator module (right)
  installing, 141
  removing, 138
LED/USB indicator modules
  description, 19
  replacing, 131
LEDs
  boot drive, 29
  power supply, 30, 74, 75
  storage drive, 29
  system status, 27
Legacy BIOS Boot Mode
  selecting, 183
  switching between UEFI Boot Mode, 184
locating chassis serial number, 46
Locator LED button, 28

M

Main BIOS screen, 203
memory device components, 233
memory events, 248
menus, BIOS Setup Utility, 179
motherboard assembly
  description, 19
  installing, 154
  LED/USB cables, 146
  removing, 145
  replacing, 145

N

NET MGT port
  pinout, 30, 170, 171
network settings, service processor, 194
Network Time Protocol (NTP), 102
NVMe cables
  description, 19
  replacing, 122

O

operating system
  supported by UEFI BIOS, 183
Option ROMs
  enabling and disabling, 197
  legacy BIOS allocation, 186
  minimizing resource exhaustion, 186
Oracle Integrated Lights Out Manager (Oracle ILOM)

key identity properties (KIP) for FRUID auto-update feature, 49

P

PCIe cards
description, 19
installing, 95
removing, 93
replacing, 91
slot characteristics, 92
PCIe slot numbering, 92
physical security events, 254
pinout
Ethernet ports, 170
Gigabit Ethernet ports, 170
network management port, 171
RJ-45 to DB-25 crossover pinout, 172
serial management port, 172
USB port, 174
video connector, 173
ports
Ethernet, 169
Gigabit Ethernet, 169
network management (NET MGT), 30, 170
serial management (SER MGT), 171
USB, 174
video, 173
power
button, 52, 168
standby power mode, 54
storage server on, 168
power down storage server
emergency, 52
power events, 242
power supplies
description, 19
power supply
installing, 77
LEDs, 30, 74, 75
removing, 74
power unit components, 234
power-on self-test (POST) code checkpoint tests, 28
Power/OK indicator, 28
processor components, 235
processor removal and replacement tool, 104
processor socket cover
installing, 145
removing, 145
processor(s)
physical layout, 82
processors
description, 19
identifying faulty processor, 105
installing, 111
maximum DIMMs supported, 83
removal and replacement tool, 104
removing, 104
replacing, 103
PSU *See* power supply

R

removing
antistatic measures, 164
battery, 101
DIMMs, 85
drive, 64
fan assembly door, 60
fan module, 69
LED indicator module (left), 131
LED/USB indicator module (right), 138
motherboard assembly, 145
PCIe cards , 93
power supply, 74
processors, 104
storage drive backplane, 117
storage server top cover, 59
USB flash drive, 98
replacing
battery, 101
DIMMs, 81
fan module, 68
LED/USB indicator modules, 131
motherboard assembly, 145
NVMe cables, 122

power supply, 73
processors, 103
storage drive backplane, 117
storage server top cover, 162

S

safety
ESD precautions, 48
precautions, 47
symbols, 48
screens, BIOS Setup Utility, 178, 179
serial management (SER MGT) port
pinout, 172
RJ-45 to DB-9 crossover pinout, 172
serial number, locating, 46
serial port sharing, configuring, 41
server, power on, 180
service
preparing storage server, 51
service processor
network settings, configuring, 194
Service Required LED, 28
`set` command, 116
shortcut key sequences in BIOS Setup Utility, 179
`show` command, 116
shutting down the storage server
immediately, using the Power button, 52
shutting down the system
immediately, using Oracle ILOM CLI, 53
immediately, using Oracle ILOM web interface, 54
Simple Network Management Protocol (SNMP) Traps
generated by system, 239
standby power, 52, 53, 54, 54
`start` command, 168
storage drive
LEDs, 29
storage drive backplane
installing, 120
removing, 117
replacing, 117
storage drives
description, 19
storage server
diagnosing, 26
installing into rack, 165
returning storage server to operation, 161
troubleshooting, 21
storage server top cover
installing, 162
removing, 59
storage server troubleshooting, information needed
when contacting support, 45
support for product, 45
system board components, 236
system chassis components, 229
system components and nomenclature, 228
system firmware components, 237

T

technical support, 45
tools required for service, 50
troubleshooting
information needed when contacting support, 45
overview, 36
storage server, 21
Trusted Platform Module (TPM), configuring support
for, 192

U

UEFI boot mode
advantages of using, 184
selecting, 183
supported operating systems, 183
UEFI-compliant BIOS, description, 183
USB flash drive
installing, 99
removing, 98
USB port
pinout, 174

V

video port

pinout, 173

W

weight of storage server, 57