HP StorageWorks

Carrier-Grade 2324fc Modular Smart Array user guide

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About this guide

This guide provides information about the HP StorageWorks 2324fc Modular Smart Array.

Intended audience

This guide is intended for use by system administrators and technicians who are experienced with the following:

- Direct attach storage (DAS) or storage area network (SAN) management
- Network administration
- Network installation
- Storage system installation and configuration

Prerequisites

Prerequisites for installing and configuring this product include familiarity with:

- Servers and computer networks
- Fibre Channel and Ethernet protocols

Related documentation

In addition to this guide, please refer to other documents for this product:

- HP StorageWorks MSA2000 Family SMU online help
- HP StorageWorks MSA2000 Family CLI online help
- HP StorageWorks MSA2000 Family CLI reference guide

These and other HP documents can be found on the HP documents web site: http://www.hp.com/support/.

Document conventions and symbols

Table 1 Document conventions

Convention	Element
Medium blue text: Figure 1	Cross-reference links and e-mail addresses
Medium blue, underlined text (http://www.hp.com)	Web site addresses
Bold font	• Key names • Text typed into a GUI element, such as into a box • GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
Italics font	Text emphasis
`Monospace font`	• File and directory names • System output • Code • Text typed at the command-line
`Monospace, italic font`	• Code variables • Command-line variables
`Monospace, bold font`	Emphasis of file and directory names, system output, code, and text typed at the command line

△ WARNING!   Indicates that failure to follow directions could result in bodily harm or death.

△ CAUTION: Indicates that failure to follow directions could result in damage to equipment or data.

☞ IMPORTANT: Provides clarifying information or specific instructions.

☑ NOTE: Provides additional information.

☼ TIP: Provides helpful hints and shortcuts.

Rack stability

△ WARNING!   To reduce the risk of personal injury or damage to equipment:
- Extend leveling jacks to the floor.
- Ensure that the full weight of the rack rests on the leveling jacks.
- Install stabilizing feet on the rack.
- In multiple-rack installations, secure racks together.
- Extend only one rack component at a time. Racks may become unstable if more than one component is extended.

HP technical support

Telephone numbers for worldwide technical support are listed on the HP support web site: http://www.hp.com/support/.

Collect the following information before calling:
- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

Customer self repair

HP customer self repair (CSR) programs allow you to repair your StorageWorks product. If a CSR part needs replacing, HP ships the part directly to you so that you can install it at your convenience. Some parts do not qualify for CSR. Your HP-authorized service provider will determine whether a repair can be accomplished by CSR.

For more information about CSR, contact your local service provider. For North America, see the CSR website:

http://www.hp.com/go/selfrepair

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Product warranties

For information about HP StorageWorks product warranties, see the warranty information website:

http://www.hp.com/go/storagewarranty

Subscription service

HP strongly recommends that customers sign up online using the Subscriber's choice web site:
http://www.hp.com/go/e-updates.

- Subscribing to this service provides you with e-mail updates on the latest product enhancements, newest versions of drivers, and firmware documentation updates as well as instant access to numerous other product resources.
- After signing up, you can quickly locate your products by selecting **Business support** and then **Storage** under Product Category.

HP web sites

For other product information, see the following HP web sites:

- http://www.hp.com
- http://www.hp.com/go/storage
- http://www.hp.com/support/
- http://www.docs.hp.com

Documentation feedback

HP welcomes your feedback.

To make comments and suggestions about product documentation, please send a message to storagedocs.feedback@hp.com. All submissions become the property of HP.

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1 Overview

The 2324fc Modular Smart Array is a high-performance storage solution that combines outstanding performance with high reliability, availability, flexibility, and manageability.

Features and benefits

Product features and supported options include:

- Supported servers
  - HP ProLiant servers
  - HP ProLiant C-Class Blade servers
  - HP Integrity servers
  - Certain PA-RISC servers
  - Supports most multi-vendor industry standard 32-bit and 64-bit Intel and AMD-based (X86) servers
- Primary supported operating systems
  - Microsoft Windows Server
  - VMware
  - Red Hat Enterprise Linux
  - SuSE Linux
  - HP-UX

📝 **NOTE:** Check the QuickSpecs for a complete list of servers. QuickSpecs can be found from your HP MSA products page at http://www.hp.com/go/msa. Select MSA SAN Arrays, and then select your product. The link for QuickSpecs will be on the right.

- Capacity up to 99 small form factor (SFF) drives with MSA2324fc and three MSA70 enclosures
- Capacity up to four MSA2000 3.5 12-drive enclosures
- Capacity up to 60 drives in a mixed drive environment: one MSA2324fc (24 SFF) and three MSA2000 3.5 12-drive enclosures (36 LFF)
- Supported drives:
  - MSA2 3.5-inch LFF drives:
    - 450GB/300GB/146GB 15K RPM DP SAS
    - 1TB/750GB/500GB 7.2K RPM DP SATA
  - HP ProLiant 2.5-inch SFF drives:
    - 72GB/36GB 15K RPM SP SAS
    - 72GB/36GB 15K RPM DP SAS
    - 146GB/72GB 10K RPM SP SAS
    - 146GB/72GB 10K RPM DP SAS
    - 120GB/60GB 5.4K RPM SATA
    - 250GB 5.4K RPM SATA
  - Two 4-Gb FC ports per controller
  - 1-GB cache module per controller
  - Battery-free cache backup (with super-capacitor and CompactFlash card)

📝 **NOTE:** Check the QuickSpecs for an updated list of supported operating systems and drives. QuickSpecs can be found from your HP MSA products page at http://www.hp.com/go/msa. Select MSA SAN Arrays, and then select your product. The link for QuickSpecs will be on the right.

2 Components

Front panel components
MSA2324fc
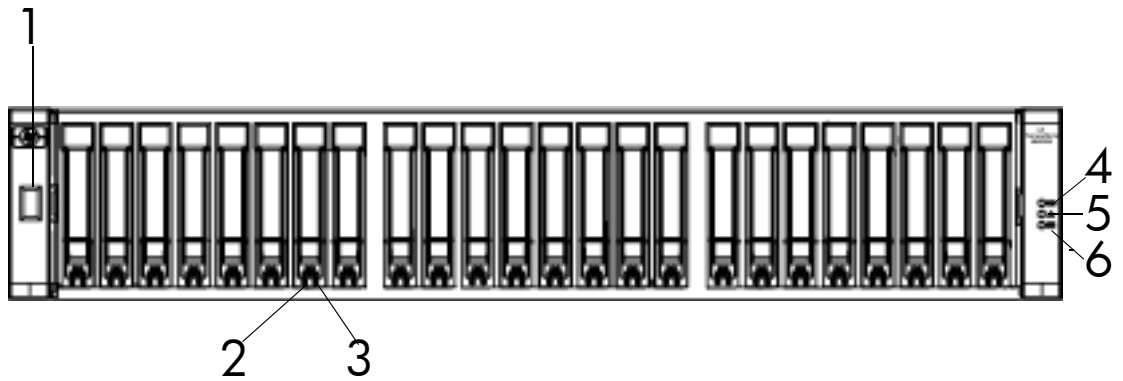
1	Enclosure ID LED	**4**	Unit Identification (UID) LED
2	Hard drive Online/Activity LED	**5**	Fault ID LED
3	Hard drive Fault/UID LED	**6**	Heartbeat LED

Hard drive bay numbers

MSA2324fc
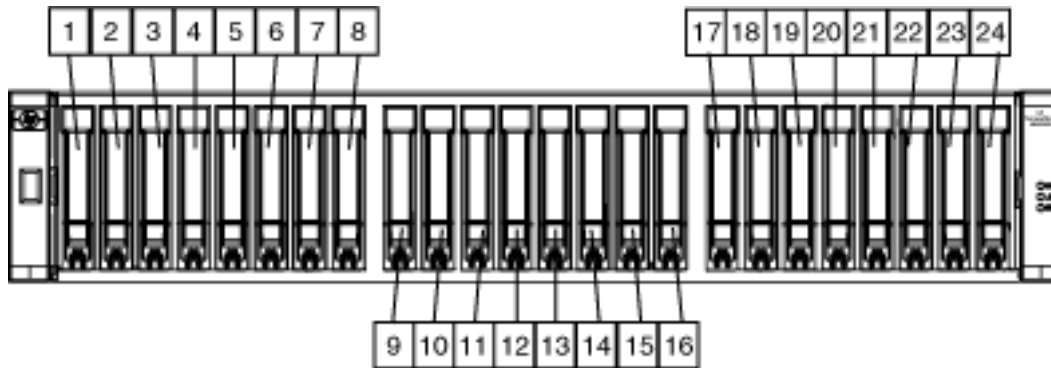
Rear panel components

MSA2324fc
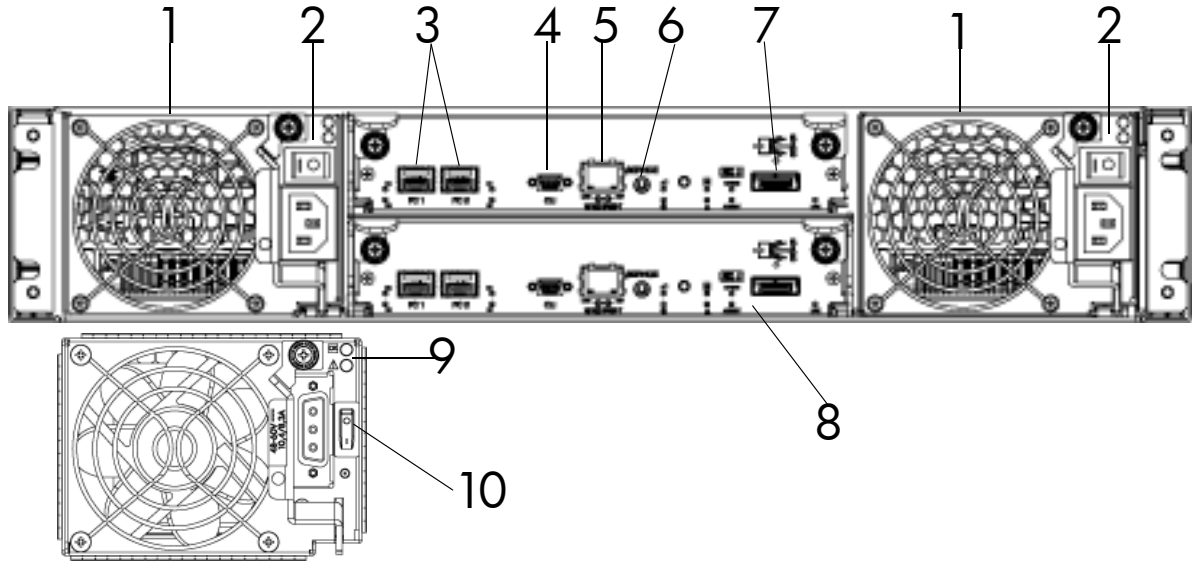
1	Power supplies — AC	**6**	Service port (used by service personnel only)
2	Power switches — AC	**7**	Expansion port
3	Host ports	**8**	Optional FC controller
4	CLI port	**9**	DC Power supply (2) — (DC model only)
5	Ethernet port	**10**	Power switches — DC

MSA2000 3.5 12-drive enclosure
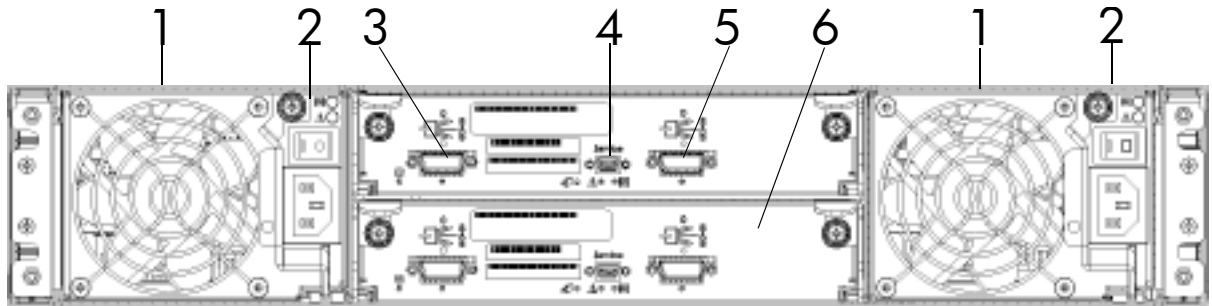
1	Power supplies	**4**	Service port (used by service personnel only)
2	Power switches	**5**	SAS Out port (connects to another drive enclosure)
3	SAS In port (connects to a controller enclosure)	**6**	Optional I/O module

> 📝 **NOTE:** The MSA2324fc can also be attached to an MSA70 that is running firmware version 2.18 or later. For information about the MSA70, see the *HP StorageWorks 70 Modular Smart Array Enclosure user guide* located on the *MSA2000 Software Support/Documentation CD* shipped with your product or at http://hp.com/support/manuals.

Cache

To enable faster data access from disk storage, the following two types of caching are performed:

- Posted-write caching. The controller writes user data in the cache memory on the module rather than directly to the drives. Later, when the storage system is idle, the controller writes the data to the drive array.
- Read-ahead caching. The controller detects sequential array access, reads ahead into the next sequence of data, and stores the data in the read-ahead cache. Then, if the next read access is for cached data, the controller immediately loads the data into the system memory, avoiding the latency of a disk access.

Transportable CompactFlash

During a power loss or array controller failure, data stored in cache is saved off to non-volatile memory (CompactFlash). This data is then written to disk after the issue is corrected. To protect against writing incomplete data to disk, the image stored on the CompactFlash is verified before committing to disk.

In single-controller configurations, if the controller has failed or does not start, and the Cache Status LED is on or blinking, the CompactFlash will need to be transported to a replacement controller to recover data not flushed to disk. (See Controller failure in a single-controller configuration for more information.)
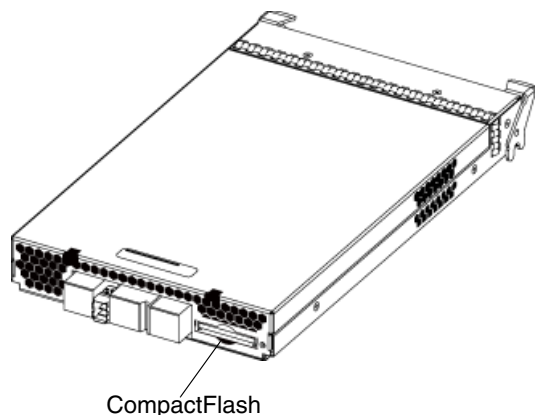
CompactFlash

△ **CAUTION:** To preserve the existing data stored in the CompactFlash, you must transport the CompactfFash from the failed controller to the replacement controller using a procedure outlined in the *HP StorageWorks 2312fc/2324fc controller replacement instructions*, shipped with the replacement controller. Failure to use this procedure will result in the loss of data stored in the cache module. The CompactFlash must stay with the same enclosure. If the CompactFlash is used/installed in a different enclosure, data loss/data corruption will occur.

📝 **IMPORTANT:** In dual controller configurations, there is no need to transport a failed controller's cache to a replacement controller because the cache is duplicated between the controllers.

Super-capacitor pack

To protect RAID controller cache in case of power failure, the MSA2324fc is equipped with super-capacitor technology. The super-capacitor pack and CompactFlash memory in each controller module provide unlimited cache memory backup time. The super-capacitor pack provides energy for backing up unwritten data in the write cache to the CompactFlash in the event of a power failure. Unwritten data in CompactFlash memory is automatically committed to disk media when power is restored. While the cache is being maintained by the super-capacitor, the Cache Status LED flashes at a rate of 1/10 second on and 9/10 second off.

3 Installing the enclosures

Installation checklist

The following table outlines the steps required to install the enclosures and initially configure the system. To ensure a successful installation, perform the tasks in the order they are presented.

Table 2   Installation checklist

Step	Task	Where to find procedure
1.	Install the controller enclosure and optional drive enclosures in the rack, and attach ear caps.	See the racking instructions poster.
2.	Connect enclosures and drive enclosures.	See Connecting controller and MSA2000 3.5 12-drive enclosures.
3.	Connect power cords.	See the installation poster.
4.	Test enclosure connections.	See Testing enclosure connections.
5.	Obtain IP values and set management port IP properties on the controller enclosure.	See Obtaining IP values.
6.	Install required host software.	See Host system requirements.
7.	Connect data hosts.	See Connecting the enclosure to data hosts.
8.	Connect remote management hosts.	See Connecting remote management hosts.
9.	Perform initial configuration tasks:	
	• Verify that controllers and enclosures have the latest firmware.	See Updating firmware.
	• Set the date and time on the controller enclosure.	See Changing the system date and time.
	• Initially configure and provision the system.	See Using the Configuration Wizard and Using the Provisioning Wizard.
	• Test the configuration.	See Testing the configuration.

NOTE: For help with installing your MSA2000 product, also see the *MSA2000 Software Support/Documentation CD* shipped with your product.

Connecting controller and MSA2000 3.5 12-drive enclosures

You can connect up to three MSA2000 3.5 12-drive enclosures to an MSA2324fc. The cabling diagrams shown in this section show the recommended fault-tolerant cabling patterns.

IMPORTANT: Connecting an MSA2000 3.5 12-drive enclosure to an MSA2324fc requires mini SAS to SAS cables. Check the QuickSpecs for an updated list of supported cables. QuickSpecs can be found from your HP MSA products page at http://www.hp.com/go/msa. Select MSA SAN Arrays, and then select your product. The link for QuickSpecs is on the right.

IMPORTANT: The MSA2324fc can also be attached to an MSA70 that is running firmware version 2.18 or later. For information about the MSA70, see the *HP StorageWorks 70 Modular Smart Array Enclosure user guide* located on the *MSA2000 Software Support/Documentation CD* shipped with your product or at http://hp.com/support/manuals.


When connecting multiple drive enclosures, use reverse cabling to ensure the highest level of fault tolerance. Controllers and I/O (expansion) modules are identified by `<enclosure-ID><controller-ID>`. For example, Figure 3 shows controller 1A connected to I/O module 2A, and the chain of connections continuing down. Controller 1B is connected to the lower module (B) of the last drive enclosure in the chain, with connections moving in the opposite direction.

NOTE: For clarity, the schematic illustrations of the controllers shown in this section show only relevant details such as expansion ports. For detailed illustrations showing all components, see Rear panel components.
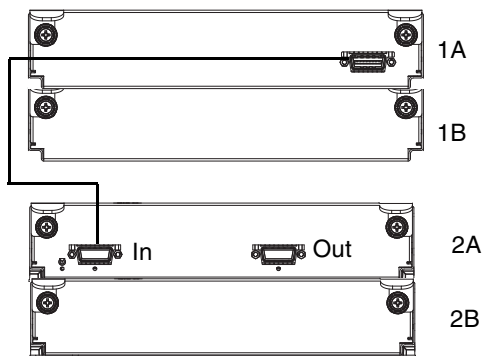
Figure 1 Cabling connections between a single-controller enclosure and one MSA2000 3.5 12-drive enclosure
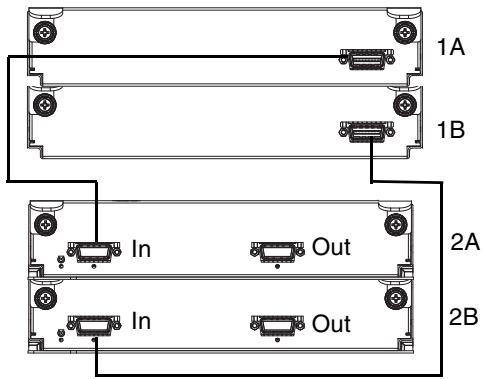
Figure 2 Cabling connections between a dual-controller enclosure and one MSA2000 3.5 12-drive enclosure
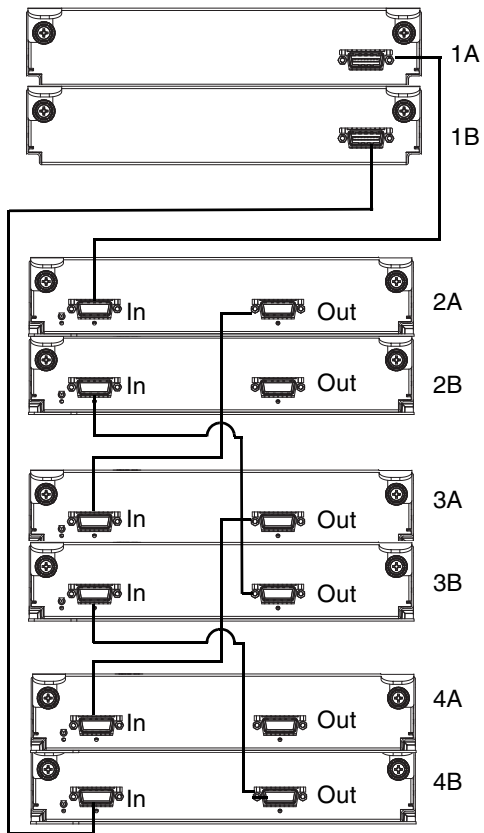
Figure 3 Cabling connections between a dual-controller enclosure and up to three MSA2000 3.5 12-drive enclosures

Testing enclosure connections

1. Press the power switches at the back of each drive enclosure to On.

IMPORTANT: This ensures that the disks in the enclosures have enough time to completely spin up before being scanned by the RAID modules in the controller enclosure.

While enclosures power up, their LEDs blink. After the LEDs stop blinking, if no LEDs on the front and back of the enclosure are amber, the power-on sequence is complete and no faults have been detected. For a description of LED behavior and status, see LED descriptions.

2. Press the power switches at the back of the controller enclosure to On.

Depending on the number and type of drives in the system, it can take several minutes for the system to power up.

If the enclosure's power-on sequence succeeds as described in Step 1, the system is ready to use.

Obtaining IP values

NOTE: For help with configuring your MSA2000 product, also see the *MSA2000 Software Support/Documentation CD* shipped with your product.

Setting management port IP addresses using DHCP

1. Look in the DHCP server's pool of leased addresses for two IP addresses assigned to "HP StorageWorks MSA Storage."
2. Use a network management utility to discover "HP StorageWorks MSA2300fc" storage devices on the local LAN through SNMP.
3. Use a `ping` broadcast to try to identify the device through the host's ARP table.

If you do not have a DHCP server, you will need to ask your system administrator to allocate two IP addresses and set them using the CLI during initial configuration (see Setting management port IP addresses using the CLI).

Setting management port IP addresses using the CLI

NOTE: If you used DHCP to set the IP addresses, you do not have to set them using the CLI as described in this section.

Ethernet Management ports on controller module A and controller module B are configured with the following default values:

- **Management Port IP Address**: 10.0.0.2 (controller A), 10.0.0.3 (controller B)
- **IP Subnet Mask**: 255.255.255.0
- **Gateway IP Address**: 10.0.0.1

If the default IP addresses are not compatible with your network, you must set an IP address for each management port using the command-line interface (CLI) embedded in each controller module. The CLI enables you to access the system using RS-232 communication and terminal emulation software.

Use the CLI commands described in the steps below to set the IP address for the Ethernet management port on each controller module.

Once new IP addresses are set, you can change them as needed using SMU.

NOTE: Changing IP settings can cause management hosts to lose access to the storage system.

---

1. From your network administrator obtain an IP address, subnet mask, and gateway address for controller A and controller B.
2. Use the provided micro-DB9 serial cable to connect controller A to a serial port on a host computer.
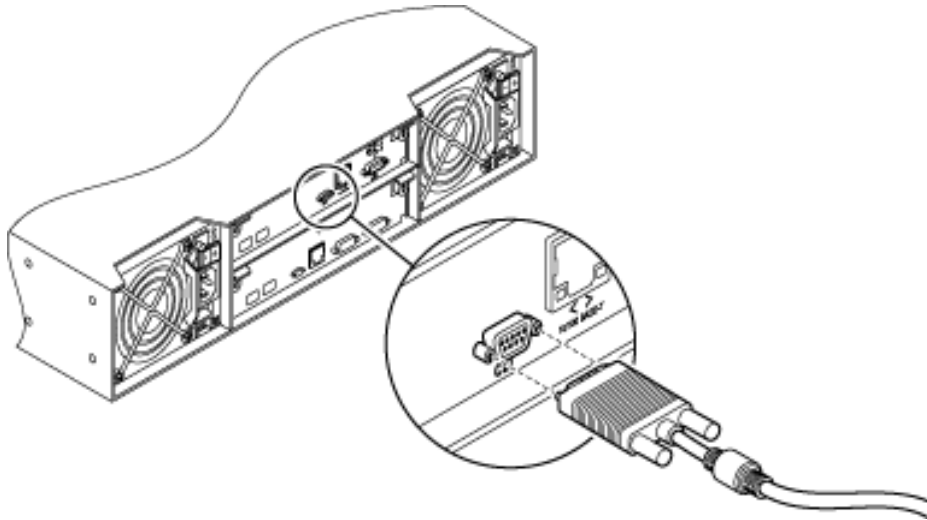
Your package contents include a micro-DB9-to-DB9 serial cable. If necessary, use a DB9-to-DB25 adapter (not included) for connecting the serial cable to a DB25 serial port on the host computer.

3. Start and configure a terminal emulator, such as HyperTerminal or VT-100, using the display settings in Table 3 and the connection settings in Table 4.

Table 3 Terminal emulator display settings

Parameter	Value
Terminal emulation mode	VT-100 or ANSI (for color support)
Font	Terminal
Translations	None
Columns	80

4. In the terminal emulator, connect to controller A.

Table 4 Terminal emulator connection settings

Parameter	Value
Connector	COM1 (typically)
Baud rate	115,200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

5. Press Enter to display the CLI prompt (#).

6. At the prompt, type the following command to set the values you obtained in Step 1 for each Ethernet management port, first for controller A and then for controller B:

```
set network-parameters ip address netmask netmask gateway gateway controller a|b
```
where:
- address is the IP address of the controller
- netmask is the subnet mask
- gateway is the IP address of the subnet router
- a|b specifies the controller whose network parameters you are setting

For example:

```
# set network-parameters ip 192.168.0.10 netmask 255.255.255.0 gateway
192.168.0.1 controller a
```

```
# set network-parameters ip 192.168.0.11 netmask 255.255.255.0 gateway
193.168.0.1 controller b
```

7. Type the following command to verify the new IP addresses:

```
show network-parameters
```
Network parameters, including the IP address, subnet mask, and gateway address are displayed for each controller.

   a. From the CLI you can use the PING command to verify network connectivity

   For example:

   ```
   # ping 16.125.12.1
   Info: Pinging 16.125.12.1 with 4 packets.
   ```
   Success: Command completed successfully. The remote computer responded with 4 packets.

8. Disconnect from the CLI and exit the emulator.

9. In the host computer's command window, type the following command to verify Ethernet connectivity, first for controller A and then for controller B:

```
ping IP-address
```

If you cannot your access your system for at least three minutes after changing the IP address, your network might require you to restart the management controller using the serial CLI. When you restart a management controller, communication with it is temporarily lost until it successfully restarts.

Type the following command to restart the management controller on both controllers:

```
restart mc both
```

Installing the HP seismic rack mounting kit

To install the HP Seismic Rack Mounting kit, follow these steps:

1. Attach the rear brackets to the MSA2324 Carrier-Grade (CG).
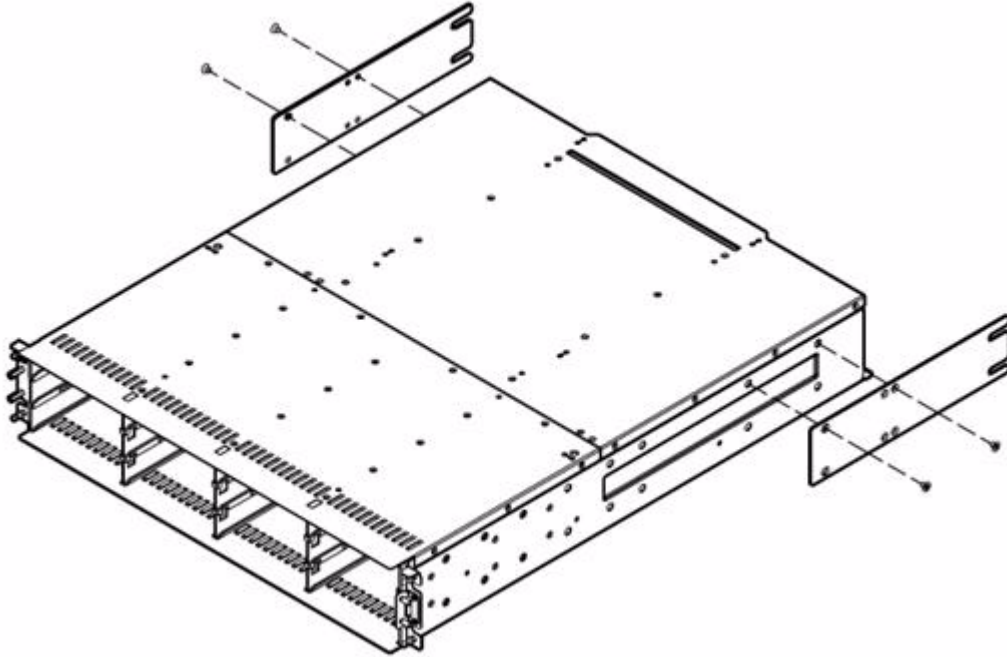
2. Attach the left bracket assembly to the left rack rail.
3. Attach the right bracket assembly to the right rack rail.
4. Insert cage nuts into the rack holes.
5. Align the MSA2324 CG with the rails, and then slide it into the rack until the ears of the MSA2324CG are about 1 to 2 inches from the rack front rails.
6. Attach a flat washer between the right mounting ear (bottom hole) and the rack, and then loosely attach the bracket to the rear bracket assemblies.
7. Attach the single-hole ground cable lug between the front right mounting ear (top hole) and the rack with a lock washer and screw.
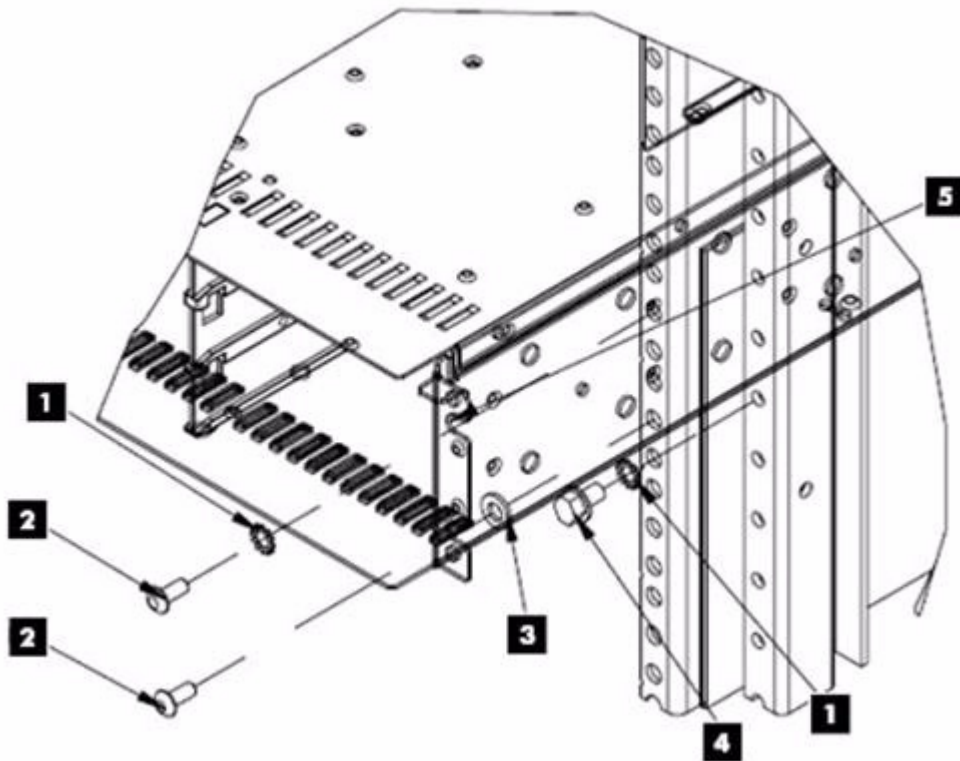
Table 5 Callout locations

1	Lock washer
2	Screw
3	Flat washer
4	Bolt
5	Ground cable lug. Position between ear and rail (cable not shown).

8. Loosely attach the rear brackets to the rear bracket assemblies.
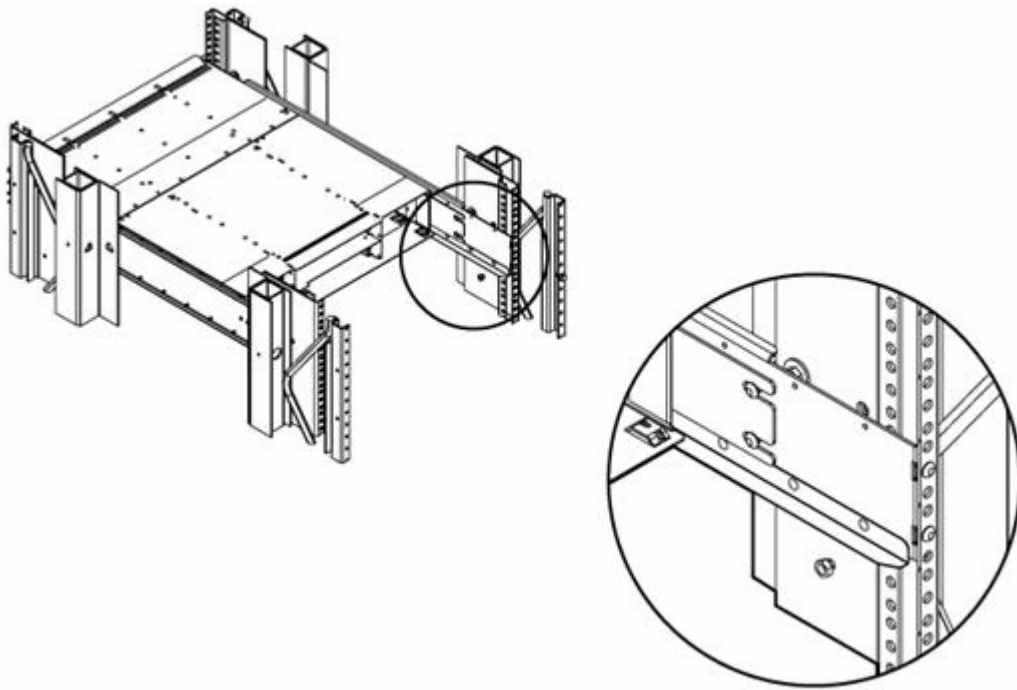
9. Attach the loose end of the ground cable to the front rack ground rail.
10. Verify that the MSA2324 CG is evenly spaced between the right and left rack rails, and then tighten the front and rear bracket screws.

4 Connecting hosts

Host system requirements

Data hosts connected to MSA2324fc arrays must meet the following requirements:

- Depending on your system configuration, data host operating systems may require that multipathing is supported.

  If fault tolerance is required, then multipathing software may be required. Host-based multipath software should be used in any configuration where two logical paths between the host and any storage volume may exist at the same time. This would include most configurations where there are multiple connections to the host or multiple connections between a switch and the storage.

  To obtain the MSA2000 Family MPIO DSM, go to the HP MSA products page at http://www.hp.com/go/msa. Select MSA SAN Arrays, select your product, and go to Related products.

- To prevent **Microsoft Windows 2003** data hosts from displaying the Found New Hardware Wizard when the storage system is discovered, install the MSA2000 Family SCSI Enclosure Services driver. Download MSA2000 Family SCSI Enclosure Services (SES) driver package from http://www.hp.com/go/msa. Select MSA SAN Arrays, select your product, and go to Related products.

> **NOTE:** The MSA2000 Family SCSI Enclosure Services driver is required for Microsoft Windows 2003.

Connecting the enclosure to data hosts

Cable connections vary depending on configuration. Common cable configurations are shown in this section. For a complete list of supported configurations, go to the MSA2000 product site at http://hp.com/support/manuals for the latest *MSA2000 supported cable configurations guide.* This document is updated whenever newly supported configurations are added.

Loop/Point-to-Point Topology

The 2324fc Modular Smart Array uses Fibre Channel Arbitrated Loop (loop) topology by default. Point-to-point topology is supported for switch attach configurations only.

Connecting direct attach configurations

Single controller configuration

One server/one HBA/single path
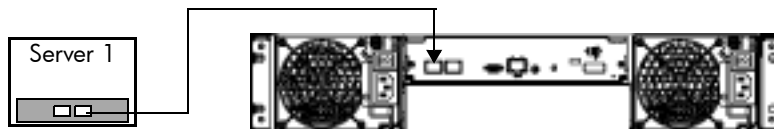
Dual controller configurations

One server/one dual-ported HBA/dual path
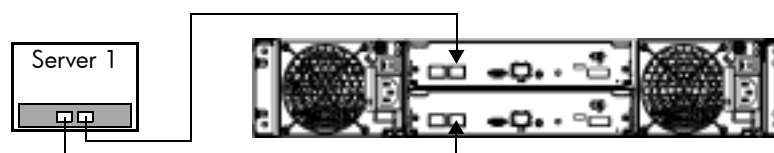
Two servers/one dual-ported HBA per server/dual path
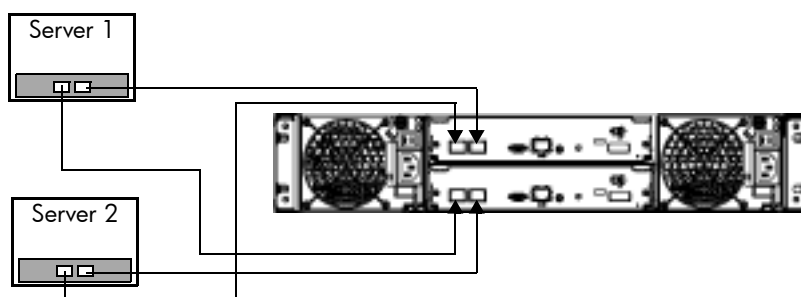
Connecting switch attach configurations

Two servers/two switches
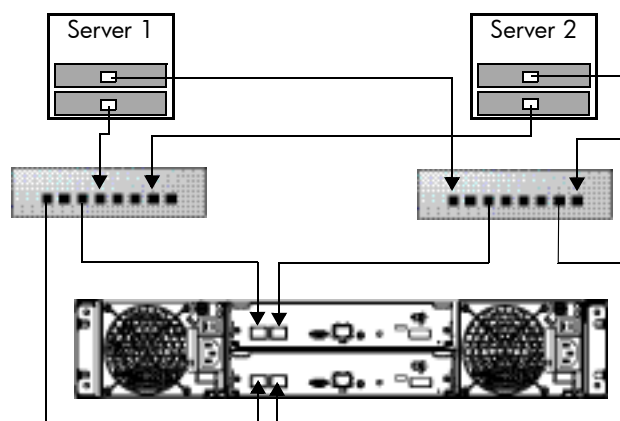
Connecting remote management hosts

The management host directly manages systems out-of-band over an Ethernet network.

1. Connect an Ethernet cable to the Ethernet management port on each controller.
2. Connect the other end of each Ethernet cable to a network that your management host can access (preferably on the same subnet).

NOTE: Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

5 Basic operation

Powering on/powering off

Before powering on the enclosure for the first time:

- Install all hard drives in the enclosure so that the connected host controller can identify and configure them at power-up.
- Connect the cables and power cords to the enclosure as explained in the Installation Poster.
- Generally when powering up, make sure to power up the enclosures and associated data host in the following order:
  - Drive enclosures first
  - Controller enclosure next
  - Data hosts last (if they are powered down for maintenance purposes)

To power on the system:

1. Press the power switches at the back of each drive enclosure to the On position.
2. Press the power switches at the back of the controller enclosure to the On position.

To power off the system:

1. Stop all I/O from hosts to the system.
2. Use SMU to shut down both controllers. See the SMU online help or *CLI reference guide f*or information on shutting down controller.s

    Wait until SMU indicates that processing is complete.
3. Press the power switches at the back of the controller enclosure to the Off position.
4. Press the power switches at the back of each drive enclosure to the Off position.

Updating firmware

After installing the hardware and powering up the enclosure for the first time, be sure to verify that the controllers and drive enclosures have the latest firmware. SMU enables you to view the software, hardware, and other version information for each controller and the enclosures.

To view controller version information, in the Configuration View panel, right-click the system, select **View > Overview**, and select the **Versions** button in the System Overview Table. To view drive enclosure information, in the Configuration View panel, right-click the enclosure and select **View > Overview**. The enclosure firmware is listed as EMP A Revision and EMP B Revision.

For software and firmware updates, including language packages and firmware update instructions, go to http://www.hp.com/go/msa. Select MSA SAN Arrays, select your product, and go to Support.

Selecting an appropriate time to perform the online upgrade

To ensure the success of an online upgrade, selecting the appropriate time is essential. Selecting a period of low I/O activity will ensure the upgrade completes as quickly as possible, and will avoid disruptions to host and applications due to timeouts. Attempting to upgrade a storage system that is in the middle of processing a large I/O intensive batch job will likely cause hosts to lose connectivity with the storage system. Consequently, finding an appropriate time for the upgrade is very important.

For software and firmware updates, go to http://www.hp.com/go/msa. Select MSA SAN Arrays, select your product, and go to Support.

For detailed steps on updating the firmware, see the *reference guide or the CLI reference guide.*

For information on logging into SMU, see Configuring a system for the first time.

6 LED descriptions

Front panel LEDs
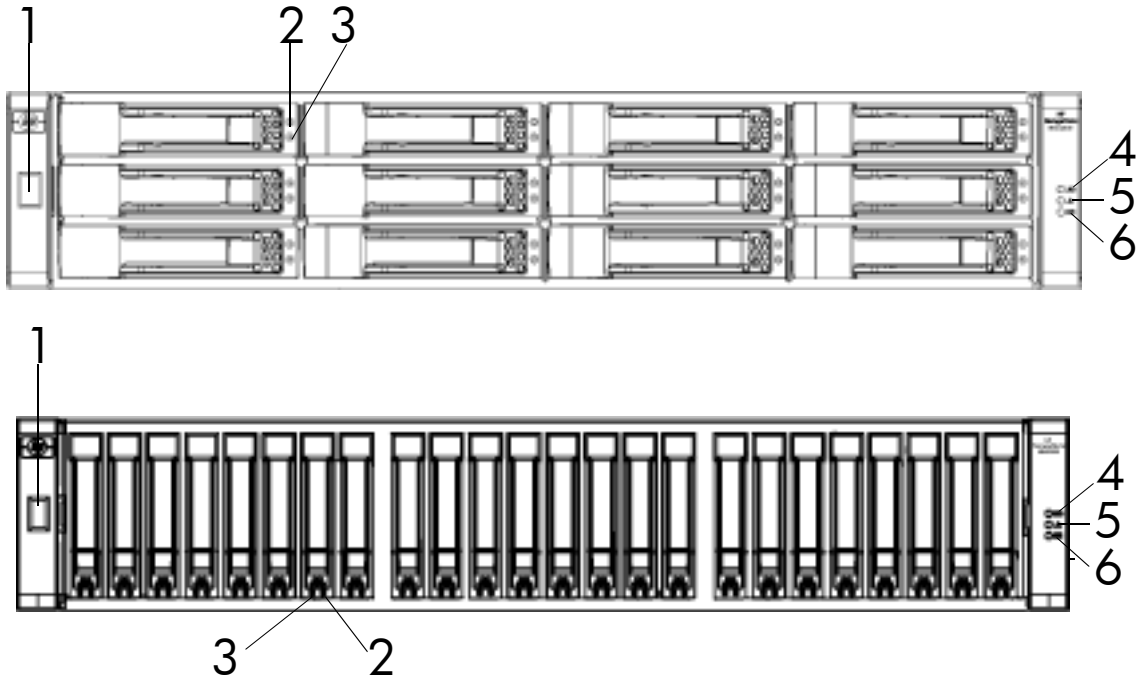
LED	Description	Definition
1	Enclosure ID	Green — On Enables you to correlate the enclosure with logical views presented by management software. The enclosure ID for a controller enclosure is 1.
2	Fault UID	See Table 5, Hard drive LED combinations
3	Online/Activity	See Table 5, Hard drive LED combinations
4	Unit Identification (UID)	Blue — Identified Off — Not identified
5	Fault ID	Amber — Fault condition exists. The event has been acknowledged but the problem needs attention. Off — No fault condition exists.
6	Heartbeat	Green — The enclosure is powered on with at least one power supply operating normally. Off — Both power supplies are off; the system is powered off.

Hard drive LEDs
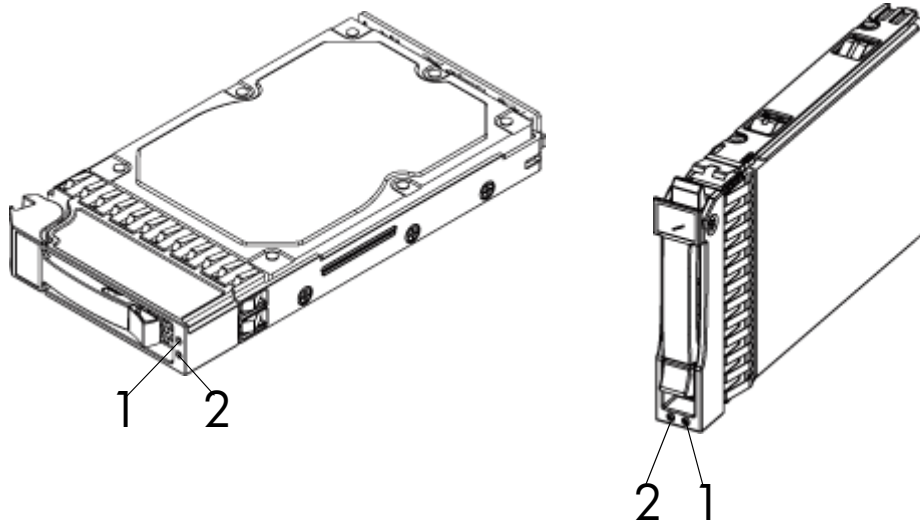
LED	Description
1	Fault/UID (amber/blue)
2	Online/Activity (green)

Table 5 Hard drive LED combinations

Online/Activity (green)	Fault/UID (amber/blue)	Description
On	Off	Normal operation. The drive is online, but it is not currently active.
Blinking irregularly	Off	The drive is active and operating normally.
Off	Amber; blinking regularly (1 Hz)	Offline; the drive is not being accessed. A predictive failure alert may have been received for this device. Further investigation is required.
On	Amber; blinking regularly (1 Hz)	Online; no activity. A predictive failure alert may have been received for this device. Further investigation is required.
Blinking irregularly	Amber; blinking regularly (1 Hz)	The drive is active, but a predictive failure alert may have been received for this drive. Further investigation is required.
Off	Amber; solid	Offline; no activity. A critical fault condition has been identified for this drive.
Off	Blue; solid	Offline. The drive has been selected by a management application (SMU).
On or blinking	Blue; solid	The controller is driving I/O to the drive, and it has been selected by a management application (SMU).

Table 5 Hard drive LED combinations (continued)

Online/Activity (green)	Fault/UID (amber/blue)	Description
Blinking regularly (1 Hz)	Off	**CAUTION:** **Do not remove the drive. Removing a drive may terminate the current operation and cause data loss. The drive is rebuilding.**
Off	Off	Either there is no power, the drive is offline, or the drive is not configured.

Rear panel LEDs
MSA2324fc
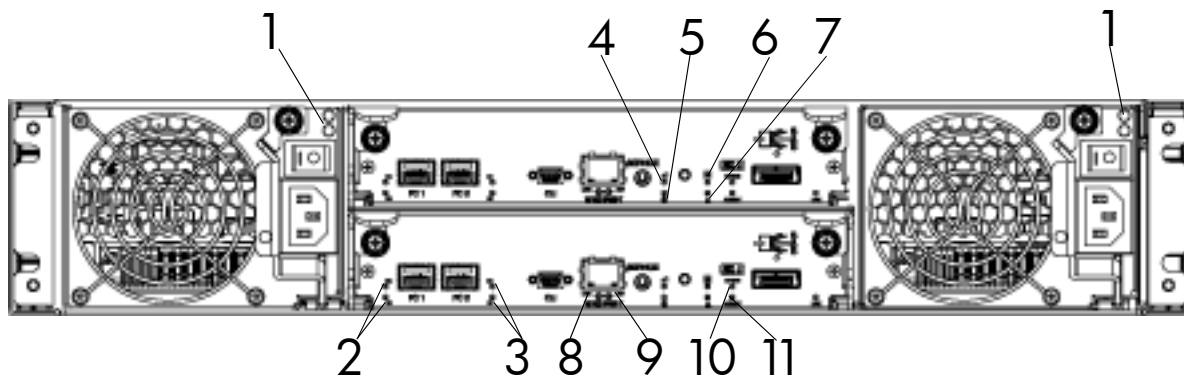
LED	Description	Definition
1	Power supply LEDs	See Power supply LEDs.
2	Host Link Status/Activity FC port 1	Blinking green (1 Hz) — No link is detected.
3	Host Link Status/Activity FC port 2	2G LED illuminates green — Link speed is 2 Gbit/sec. 4G LED illuminates green — Link speed is 4 Gbit/sec. Both LEDs off — Link speed is 1 Gbit/sec.
4	OK to Remove	Off — The controller module is not prepared for removal. Blue — The controller module is prepared for removal.
5	Unit Locator	Off — Normal operation Blinking white— Physically identifies the controller module.
6	OK	Green — Controller module is operating normally. Blinking green — System is booting. Off — Controller module is not OK.
7	Fault/Service Required	Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled powerup or a cache flush or restore error.
8	Ethernet Link Status	Green — The Ethernet link is up. Off — The Ethernet port is not connected or the link is down.
9	Ethernet Activity	Blinking green — The Ethernet link has I/O activity. Off — The Ethernet link has no I/O activity.

LED	Description	Definition
10	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. Off — In a working controller, cache is clean (contains no unwritten data). Blinking green — A CompactFlash flush or cache self-refresh is in progress. Indicates cache activity. (See also If the controller has failed or does not start, is the Cache Status LED on/blinking?) If the LED is blinking evenly, a cache flush is in progress. When a controller module loses power and write cache is dirty (contains data that has not been written to disk), the super-capacitor pack provides backup power to flush (copy) data from write cache to Compact Flash memory. When cache flush is complete, the cache transitions into self-refresh mode. If the LED is blinking momentarily slowly, the cache is in a self-refresh mode. In self-refresh mode, if primary power is restored before the backup power is depleted (3–30 minutes, depending on various factors), the system boots, finds data preserved in cache, and writes it to disk. This means the system can be operational within 30 seconds, and before the typical host I/O timeout of 60 seconds at which point system failure would cause host-application failure. If primary power is restored after the backup power is depleted, the system boots and restores data to cache from Compact Flash, which can take about 90 seconds. The cache flush and self-refresh mechanism is an important data protection feature; essentially four copies of user data are preserved: one in each controller's cache and one in each controller's CompactFlash.
11	Host Activity	Blinking green — At least one host port has I/O activity. Off — Host ports have no activity.

MSA2000 3.5 12-drive enclosure

LED	Description	Definition
1	Power supply LEDs	See Power supply LEDs.
2	Unit Locator	Off — Normal operation Blinking white— Physically identifies the expansion module.
3	SAS In Port Status	Green — Port link is up and connected Off — Port is empty or link is down
4	OK to Remove	Not implemented
5	Fault/Service Required	Amber — A fault has been detected or a service action is required Blinking amber — Hardware-controlled powerup or a cache flush or restore error
6	OK	Green — Expansion module is operating normally Blinking green — System is booting Off — Expansion module is not OK
7	SAS Out Port Status	Green — Port link is up and connected Off — Port is empty or link is down

Power supply LEDs

Power redundancy is achieved through two independent load-sharing power supplies. In the event of a power supply failure, or the failure of the power source, the storage system can operate continuously on a single power supply. Greater redundancy can be achieved by connecting the power supplies to separate circuits.
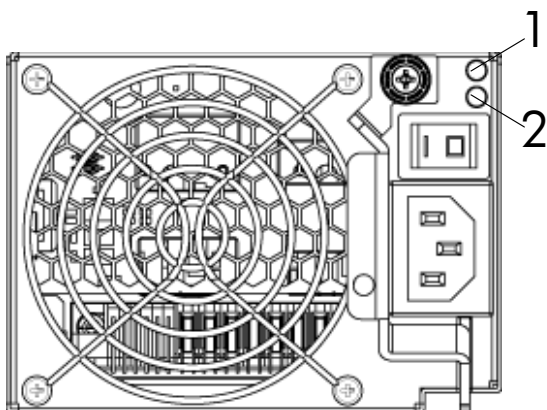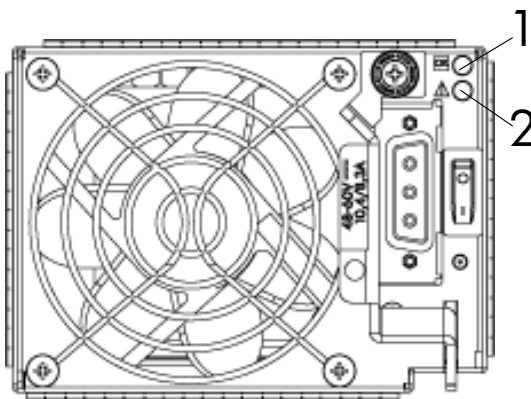
AC model   DC model

LED	Description	Definition
1	Input Source Power good	Green — Power is on and input voltage is normal. Off — Power is off or input voltage is below the minimum threshold.
2	DC Voltage/Fan Fault/Service Required	Amber — DC output voltage is out of range or a fan is operating below the minimum required RPM. Off— DC output voltage is normal.

7 Configuring a system for the first time

Configuring your web browser for SMU

Before using SMU to perform remaining steps, ensure that your web browser is properly configured according to the following guidelines:

- Your browser must be Internet Explorer 7 or Mozilla Firefox 1.5 or later. (Check the QuickSpecs for an updated list of supported browsers. QuickSpecs can be found from your HP MSA products page at http://www.hp.com/go/msa. Select MSA SAN Arrays, and then select your product. The link for QuickSpecs will be on the right.)
- To see the help window, you must enable pop-up windows.
- To optimize the display, use a color monitor and set its color quality to the highest setting.
- To navigate beyond the Sign In page (with a valid user account):
  - Set the browser's local-intranet security option to medium or medium-low.
  - Verify that the browser is set to allow cookies at least for the IP addresses of the storage-system network ports.

Logging in to SMU from a local management host

To log in to SMU from a local management host:

1. In the web browser's address field, type the IP address of one of the controller enclosure's Ethernet management ports and press Enter.

   The SMU Sign In page is displayed. If the Sign-in page does not display, verify that you have entered the correct IP address.

2. On the Sign In page, type the default management user name `manage` and default password `!manage`.

   If you are logging in to the SMU for the first time and no language packages have been installed, the Language field displays **user setting** or **English**, either of which when selected results in English. See the *reference guide* for information on configuring languages.

3. Click Sign In.

   The System Overview page is displayed.

Tips for using the main window

- The Configuration View panel displays logical and physical components of the storage system. To perform a task, select the component to act on and then either:
  - Right-click to display a context menu and select the task to perform. This is the method that help topics describe.
  - Click a task category in the main panel and select the task to perform.
- The System Status panel shows how many events of each severity have occurred in the system. To view event details, click a severity icon.
- Many tables can be sorted by a specific column. To do so, click the column heading to sort low to high; click again to sort high to low.
- Do not use the browser's Back, Forward, Reload, or Refresh buttons. The application is essentially a single page that is automatically updated to show current data. You do not need to refresh it and if you click Back, you may exit the application.
- If an option name has an asterisk (*), the option is required.

Tips for using the help window

- In the main panel, clicking the help icon displays help for the last-selected item, whether it is a component in the Configuration View panel or a subpanel in the main panel.
- In the help window, clicking the arrowed border on the left displays or hides the help contents pane.

A topic remains displayed until you browse to another topic in the help window, display help for a different item in the main window, or close the help window.

Changing the system date and time

You can change the storage system's date and time, which are displayed in the System Status panel. It is important to set the date and time so that entries in system logs and event-notification email messages have correct time stamps.

You can set the date and time manually or configure the system to use Network Time Protocol (NTP) to obtain them from a network-attached server. When NTP is enabled, and if an NTP server is available, the system time and date can be obtained from the NTP server. This allows multiple storage devices, hosts, log files, and so forth to be synchronized. If NTP is enabled but no NTP server is present, the date and time are maintained as if NTP was not enabled.

NTP server time is provided in Universal Time (UT), which provides several options:

- If you want to synchronize the times and logs between storage devices installed in multiple time zones, set all the storage devices to use UT.
- If you want to use the local time for a storage device, set its time zone offset.
- If a time server can provide local time rather than UT, configure the storage devices to use that time server, with no further time adjustment.

To use manual date and time settings

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Date, Time**. The date and time options appear.
2. Set the options:
   - Time. Enter the time in the format *hh:mm:ss*.
   - Month.
   - Day.
   - Year. Enter the year using four digits.
   - NTP. Select **Disabled**.
3. Click **Set Time Values**.

To obtain the date and time from an NTP server

1. In the Configuration View panel, right-click the system and select **Configuration > System Settings > Date, Time**. The date and time options appear.
2. Set the options:
   - NTP. Select **Enabled**.
   - NTP Time Zone Offset. Optional. If the system timestamps should use the NTP server's time zone instead of the local time zone, enter the time zone offset.
   - NTP Server Address. Optional. If the system should retrieve time values from a specific NTP server, enter the address of an NTP server. If no IP server address is set, the system listens for time messages sent by an NTP server in broadcast mode.
3. Click **Set Time Values**.

Using the Configuration Wizard

The Configuration Wizard helps you initially configure the system or change system configuration settings. The wizard has several steps, which are highlighted at the bottom of the panel as you complete them. The last step prompts you to confirm changes before applying them. If you cancel the wizard, no changes are made.

To use the wizard, in the Configuration View panel, right-click the system, select **Wizards > Configuration Wizard**, and follow the online prompts to specify the basic settings described below. See the online help for detailed information about the settings. When the configuration task is complete, you will be prompted to provision the box at which time you are taken directly to the Provisioning Wizard.

- Password setup (`manage` and `monitor`).
- Network configuration, including IP addresses, IP mask, and gateway for controller A and controller B.
- System-management services, including:
  - Web Browser Interface (WBI). The primary interface for managing the system. You can enable use of HTTP, of HTTPS for increased security, or both.
  - Command Line Interface (CLI). An advanced user interface for managing the system. You can enable use of Telnet, of SSH (secure shell) for increased security, or both.
  - Storage Management Initiative Spec (SMIS). Used for remote management of the system through your network.
  - File Transfer Protocol (FTP). Used as an alternative to the WBI for installing firmware updates and collecting diagnostic bugs.
  - Simple Network Mgmt Protocol (SNMP). Used for remote monitoring of the system through your network.
  - Service Interface. Used for technical support only.
  - Service Debug. Used for technical support only.

  In-band management interfaces operate through the data path and can slightly reduce I/O performance. The in-band options are:
  - Inband CAPI Capability. Used for in-band management of the system from custom, host-based management applications written using the Configuration Application Programming Interface (CAPI).
  - Inband SES Capability. Used for in-band monitoring of system status based on SCSI Enclosure Services (SES) data.

  If a service is disabled, it continues to run but cannot be accessed.
- System information, including system name, contact, location, and description.
- Up to four email addresses and three SNMP trap hosts to receive notifications of system events.
- Parameters for FC and iSCSI controller host ports.

Using the Provisioning Wizard

The Provisioning Wizard helps you create a vdisk with volumes and to map the volumes to hosts. The wizard has several steps, which are highlighted at the bottom of the panel as you complete them. The last step prompts you to confirm changes before applying them. If you cancel the wizard, no changes are made.

To use the wizard, in the Configuration View panel, right-click the system, select **Wizards > Provisioning Wizard,** and follow the online prompts to specify the settings described below. See the online help for detailed information about the settings.

- The vdisk name and RAID level appropriate for the level of fault tolerance that the vdisk's data will require. If you select RAID-10 or RAID-50, you can select the number of sub-vdisks to use.
- Disks to include in the vdisk. The table specifies the minimum and maximum number of disks to select. Only available disks can be selected.
- Number and size of volumes to create in the vdisk. By default the new vdisk will have one volume. You can change the number of volumes and optionally change the default size and base name for the volumes. To postpone creating volumes, you can change the number of volumes to zero.
- The default mapping allows no access to the volume by all hosts.

Testing the configuration

To determine that your system is ready for use, test the configuration as follows:

1. Using SMU, right-click the vdisk, and select **View > Overview**.
2. From the data host:
   b. Create a file system on the volume.
   c. Verify that you can access the mapped volume and the volume size shown on the data host matches the size shown in SMU.
   d. Verify that you can write data to the volume.

   If the above tests succeed, your system is ready for use.
3. Optionally, unmount the volume and delete the vdisks for test.

Logging out of SMU

If you do not log out of SMU when you have finished using it, other `manage` users cannot log in to the same controller module and your IP address stays logged in for 30 minutes (the default auto-logout timeout setting).

1. Click Sign Out in the upper right-hand corner.
   The Logout Request dialog is displayed.
2. Click Logout.

8 Troubleshooting

Fault isolation methodology

The MSA2000 Family storage system provides many ways to isolate faults within the system. This section presents the basic methodology used to locate faults and the associated FRUs.

The basic fault isolation steps are:

- Gather fault information, including using system LEDs
- Determine where in the system the fault is occurring
- Review event logs
- If required, isolate the fault to a data path component

Gather fault information

When a fault occurs, it is important to gather as much information as possible. Doing so will help you determine the correct action needed to remedy the fault.

Begin by reviewing the reported fault. Is the fault related to an internal data path or an external data path? Is the fault related to a hardware component such as a drive module, controller module, or power supply? By isolating the fault to one of the components within the storage system, you will be able to determine the necessary action more rapidly.

Determine where the fault is occurring

Once you have an understanding of the reported fault, review the enclosure LEDs. The enclosure LEDs are designed to alert users of any system faults and might be what alerted the user to a fault in the first place.

When a fault occurs, the Fault ID status LED on an enclosure's right ear (see Front panel components) illuminates. Check the LEDs on the back of the enclosure to narrow the fault to a FRU, connection, or both. The LEDs also help you identify the location of a FRU reporting a fault.

Use SMU to verify any faults found while viewing the LEDs. SMU is also a good tool to use in determining where the fault is occurring if the LEDs cannot be viewed due to the location of the system. SMU provides you with a visual representation of the system and where the fault is occurring. It can also provide more detailed information about FRUs, data, and faults.

Review the event logs

The event logs record all system events. It is very important to review the logs, not only to identify the fault, but also to search for events that might have caused the fault to occur. For example, a host could lose connectivity to a virtual disk if a user changes channel settings without taking the storage resources assigned to it into consideration. In addition, the type of fault can help you isolate the problem to hardware or software.

Isolate the fault

Occasionally it might become necessary to isolate a fault. This is particularly true with data paths due to the number of components the data path consists of. For example, if a host-side data error occurs, it could be caused by any of the components in the data path: controller module, cable, or data host.

If the enclosure does not initialize

It may take up to two minutes for the enclosures to initialize. If the enclosure does not initialize:

- Perform a rescan.
- Power cycle the system.
- Make sure the power cord is properly connected and check the power source that it is connected to.
- Check the event log for errors.

Correcting enclosure IDs

When installing a system with drive enclosures attached, the enclosure IDs might not agree with the physical cabling order. This is because the controller might have been previously attached to some of the same enclosures during factory testing and it attempts to preserve the previous enclosure IDs if possible. To correct this condition, make sure that both controllers are up and perform a rescan using SMU or the CLI. This will reorder the enclosures, but can take up to two minutes for the enclosure IDs to be corrected.

To perform a rescan using the CLI, type the following command:

```
rescan
```

To rescan using SMU:

1. Verify that both controllers are operating normally.
2. In the Configuration View panel, right-click the system and select **Tools > Rescan Disk Channels.**
3. Click **Rescan**.

Diagnostic steps

This section describes possible reasons and actions to take when an LED indicates a fault condition. See LED descriptions for descriptions of all LED statuses.

Is the front panel Fault LED amber?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	A fault condition exists.	• Check the LEDs on the back of the controller to narrow the fault to a FRU, connection, or both. • Check the event log for specific information regarding the fault.

Is the controller back panel OK LED off?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	The controller module is not powered on. The controller module has failed.	• Check that the controller module is fully inserted and latched in place, and that the enclosure is powered on. • Check the event log for specific information regarding the failure.

Is the controller back panel Fault/Service Required LED amber?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes (blinking)	One of the following errors occurred: • Hardware-controlled power-up error • Cache flush error • Cache self-refresh error	• Restart this controller from the other controller using SMU or the CLI. • Remove the controller and reinsert it. • Contact an authorized service provider for assistance. • Replace the controller.

Are both drive module LEDs off (Online/Activity and Fault/UID)?

Answer	Possible Reasons	Actions
Yes	• There is no power. • The drive is offline. • The drive is not configured.	• Check that the drive is fully inserted and latched in place, and that the enclosure is powered on.

Is the drive module Fault/UID LED blinking amber?

Answer	Possible Reasons	Actions
No, but the **Online/Activity LED** is **blinking**.	The drive is rebuilding.	No action required. **NOTE:** Do not remove a drive that is rebuilding. Removing a drive might terminate the current operation and cause data loss.
Yes, and the **Online/Activity LED** is **off**.	The drive is offline. A predictive failure alert may have been received for this device.	• Check the event log for specific information regarding the fault. • Isolate the fault. • Contact an authorized service provider for assistance.
Yes, and the **Online/Activity LED** is **blinking**.	The drive is active, but a predictive failure alert may have been received for this device.	• Check the event log for specific information regarding the fault. • Isolate the fault. • Contact an authorized service provider for assistance.

Is a connected host port's Host Link Status LED off?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	The link is down.	• Check cable connections. • Reseat cables. • Replace cables. • In SMU, review the event logs for indicators of a specific fault in a host data path component.

Is a connected port's Expansion Port Status LED off?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	The link is down.	• Check cable connections. • Reseat cables. • Replace cables. • In SMU, review the event logs for indicators of a specific fault in a host data path component.

Is a connected port's Ethernet link status LED off?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	The link is down.	Use standard networking troubleshooting procedures to isolate faults on the network.

Is the power supply's AC Power Good LED off?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	The power supply is not receiving adequate power.	• Verify that the power cord is properly connected and check the power source it is connected to. • Check that the power supply FRU is firmly locked into position. • Check the event log for specific information regarding the fault. • Isolate the fault. • Contact an authorized service provider for assistance.

Is the drive enclosure back panel OK LED off?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes	The power supply unit or a fan is operating at an unacceptable voltage/RPM level, or has failed.	When isolating faults in the power supply, remember that the fans in both modules receive power through a common bus on the midplane, so if a power supply unit fails, the fans continue to operate normally. • Check that the power supply FRU is firmly locked into position. • Check that the AC cord is connected to a power source. • Check that the AC cord is connected to the power supply.

Is the drive enclosure Fault/Service Required LED amber?

Answer	Possible Reasons	Actions
No	System functioning properly.	No action required.
Yes (blinking)	One of the following errors occurred: • Hardware-controlled power-up error • Cache flush error • Cache self-refresh error	• Check the event log for specific information regarding the fault. • Isolate the fault. • Contact an authorized service provider for assistance. • Replace if necessary.
Yes	A fault occurred. If installing an I/O module FRU, the module has not gone online and likely failed its self-test.	• Check the event log for specific information regarding the fault. • Isolate the fault. • Contact an authorized service provider for assistance. • Replace if necessary. • If installing an I/O module FRU, try removing and reinstalling the new I/O module, and check the event log for errors.

Controller failure in a single-controller configuration

Cache memory is flushed to CompactFlash in the case of a controller failure or power loss. During the write to CompactFlash process only the components needed to write the cache to the CompactFlash are powered by the super-capacitor. This process typically takes 60 seconds per 1 Gbyte of cache. After the cache is copied to CompactFlash, the remaining power left in the super-capacitor is used to refresh the cache memory. While the cache is being maintained by the super-capacitor, the Cache Status LED flashes at a rate of 1/10 second off and 9/10 second on.

📝 **IMPORTANT:** Transportable cache only applies to single-controller configurations. In dual controller configurations, there is no need to transport a failed controller's cache to a replacement controller because the cache is duplicated between the controllers.

If the controller has failed or does not start, is the Cache Status LED on/blinking?

Answer	Actions
No, the Cache LED status is off, and the controller doesn't boot.	If valid data is thought to be in Flash, see Transporting Cache; otherwise, replace the controller.
No, the Cache Status LED is off, and the controller boots.	The system is flushing data to disks. If the problem persists, replace the controller.
Yes, at a strobe 1:10 rate - 1 Hz, and the controller doesn't boot.	See Transporting Cache.
Yes, at a strobe 1:10 rate - 1 Hz, and the controller boots.	The system is flushing data to disks. If the problem persists, replace the controller.
Yes, at a blink 1:1 rate - 1 Hz, and the controller doesn't boot.	See Transporting Cache.
Yes, at a blink 1:1 rate - 1 Hz, and the controller boots.	The system is flushing data to disks. If the problem persists, replace the controller.

Transporting Cache

To preserve the existing data stored in the CompactFlash, you must transport the CompactFlash from the failed controller to a replacement controller using a procedure outlined in the *HP StorageWorks 2312fc/2324fc controller replacement instructions*, shipped with the replacement controller. Failure to use this procedure will result in the loss of data stored in the cache module.

⚠ **CAUTION:** Remove the controller only after the copy process is complete, which is indicated by the Cache Status LED being off.

Isolating a host-side connection fault

During normal operation, when a controller module host port is connected to a data host, the port's host link status LED and host link activity LED are green. If there is I/O activity, the host activity LED blinks green. If data hosts are having trouble accessing the storage system, and you cannot locate a specific fault or cannot access the event logs, use the following procedure. This procedure requires scheduled downtime.

IMPORTANT: Do not perform more than one step at a time. Changing more than one variable at a time can complicate the troubleshooting process.

---

1. Halt all I/O to the storage system.
2. Check the host activity LED.

   If there is activity, halt all applications that access the storage system.
3. Reseat the SFP and FC cable.

   Is the host link status LED on?

   - Yes – Monitor the status to ensure that there is no intermittent error present. If the fault occurs again, clean the connections to ensure that a dirty connector is not interfering with the data path.
   - No – Proceed to the next step.
4. Move the SFP and cable to a port with a known good link status.

This step isolates the problem to the external data path (SFP, host cable, and host-side devices) or to the controller module port.

   Is the host link status LED on?

   - Yes – You now know that the SFP, host cable, and host-side devices are functioning properly. Return the SFP and cable to the original port. If the link status LED remains off, you have isolated the fault to the controller module's port. Replace the controller module.
   - No – Proceed to the next step.
5. Swap the SFP with the known good one.

   Is the host link status LED on?

   - Yes – You have isolated the fault to the SFP. Replace the SFP.
   - No – Proceed to the next step.
6. Re-insert the original SFP and swap the cable with a known good one.

   Is the host link status LED on?

   - Yes – You have isolated the fault to the cable. Replace the cable.
   - No – Proceed to the next step.
7. Replace the HBA with a known good HBA, or move the host side cable and SFP to a known good HBA.

   Is the host link status LED on?

   - Yes – You have isolated the fault to the HBA. Replace the HBA.
   - No – It is likely that the controller module needs to be replaced.
8. Move the cable and SFP back to its original port.

   Is the host link status LED on?

   - No – The controller module's port has failed. Replace the controller module.
   - Yes – Monitor the connection for a period of time. It may be an intermittent problem, which can occur with SFPs, damaged cables, and HBAs.

Isolating a controller module expansion port connection fault

During normal operation, when a controller module's expansion port is connected to a drive enclosure, the expansion port status LED is green. If the connected port's expansion port LED is off, the link is down. Use the following procedure to isolate the fault.

This procedure requires scheduled downtime.

📝 **NOTE:**   Do not perform more than one step at a time. Changing more than one variable at a time can complicate the troubleshooting process.

---

1. Halt all I/O to the storage system.
2. Check the host activity LED.

   If there is activity, halt all applications that access the storage system.

3. Reseat the expansion cable.

   Is the expansion port status LED on?

   - Yes – Monitor the status to ensure there is no intermittent error present. If the fault occurs again, clean the connections to ensure that a dirty connector is not interfering with the data path.
   - No – Proceed to Step 4.

4. Move the expansion cable to a port on the RAID enclosure with a known good link status.

   This step isolates the problem to the expansion cable or to the controller module's expansion port.

   Is the expansion port status LED on?

   - Yes – You now know that the expansion cable is good. Return cable to the original port. If the expansion port status LED remains off, you have isolated the fault to the controller module's expansion port. Replace the controller module.
   - No – Proceed to the next step.

5. Move the expansion cable back to the original port on the controller enclosure.
6. Move the expansion cable on the drive enclosure to a known good expansion port on the drive enclosure.

   Is the expansion port status LED on?

   - Yes – You have isolated the problem to the drive enclosure's port. Replace the expansion module.
   - No – Proceed to Step 7.

7. Replace the cable with a known good cable, ensuring the cable is attached to the original ports used by the previous cable.

   Is the host link status LED on?

   - Yes – Replace the original cable. The fault has been isolated.
   - No – It is likely that the controller module needs to be replaced

Resolving voltage and temperature warnings

1. Check that all of the fans are working by making sure each power supply's DC Voltage/Fan Fault/Service Required LED is off or by using SMU to check for yellow yield icon hardware warnings. (In the Configuration View panel, right click the enclosure and click **View > Overview**.)
2. Make sure that all modules are fully seated in their slots and that their latches are locked.
3. Make sure that no slots are left open for more than two minutes.

   If you need to replace a module, leave the old module in place until you have the replacement or use a blank module to fill the slot. Leaving a slot open negatively affects the airflow and can cause the enclosure to overheat.

4. Try replacing each power supply one at a time.
5. Replace the controller modules one at a time.

Sensor locations

The storage system monitors conditions at different points within each enclosure to alert you to problems. Power, cooling fan, temperature, and voltage sensors are located at key points in the enclosure. In each controller module and expansion module, the enclosure management processor (EMP) monitors the status of these sensors to perform SCSI enclosure services (SES) functions.

The following sections describe each element and its sensors.

Power supply sensors

Each enclosure has two fully redundant power supplies with load-sharing capabilities. The power supply sensors described in the following table monitor the voltage, current, temperature, and fans in each power supply. If the power supply sensors report a voltage that is under or over the threshold, check the input voltage.

Table 6 Power supply sensors

Description	Event/Fault ID LED condition
Power supply 1	Voltage, current, temperature, or fan fault
Power supply 2	Votlage, current, temperature, or fan fault

Cooling fan sensors

Each power supply includes two fans. The normal range for fan speed is 4000 to 6000 RPM. When a fan's speed drops below 4000 RPM, the EMP considers it a failure and posts an alarm in the storage system's event log. The following table lists the description, location, and alarm condition for each fan. If the fan speed remains under the 4000 RPM threshold, the internal enclosure temperature may continue to rise. Replace the power supply reporting the fault.

Table 7 Cooling fan sensor descriptions

Description	Location	Event/Fault ID LED condition
Fan 1	Power supply 1	< 4000 RPM
Fan 2	Power supply 1	< 4000 RPM
Fan 3	Power supply 2	< 4000 RPM
Fan 4	Power supply 2	< 4000 RPM

During a shutdown, the cooling fans do not shut off. This allows the enclosure to continue cooling.

Temperature sensors

Extreme high and low temperatures can cause significant damage if they go unnoticed. Each controller module has six temperature sensors. Of these, if the CPU or FPGA temperature reaches a shutdown value, the controller module is automatically shut down. Each power supply has one temperature sensor.

When a temperature fault is reported, it must be remedied as quickly as possible to avoid system damage. This can be done by warming or cooling the installation location.

Table 8 Controller module temperature sensors

Description	Normal operating range	Warning operating range	Critical operating range	Shutdown values
CPU temperature	3–88°C	0–3°C, 88–90°C	> 90°C	0°C 100°C
FPGA temperature	3–97°C	0–3°C, 97–100°C	None	0°C 100°C

Table 8 Controller module temperature sensors (continued)

Description	Normal operating range	Warning operating range	Critical operating range	Shutdown values
Onboard temperature 1	0–70°C	None	None	None
Onboard temperature 2	0–70°C	None	None	None
Onboard temperature 3 (Capacitor temperature)	0–70°C	None	None	None
CM temperature	5–50°C	<=5°C, >= 50°C	<=0°C, >= 55°C	None

When a power supply sensor goes out of range, the Fault/ID LED illuminates amber and an event is logged to the event log.

Table 9 Power supply temperature sensors

Description	Normal operating range
Power Supply 1 temperature	−10–80°C
Power Supply 2 temperature	−10–80°C

Power supply module voltage sensors

Power supply voltage sensors ensure that an enclosure's power supply voltage is within normal ranges. There are three voltage sensors per power supply.

Table 10 Voltage sensor descriptions

Sensor	Event/Fault LED condition
Power supply 1 voltage, 12V	< 11.00V > 13.00V
Power supply 1 voltage, 5V	< 4.00V > 6.00V
Power supply 1 voltage, 3.3V	< 3.00V > 3.80V

A. Parts catalog

This product contains the parts illustrated in Figure 4, Figure 5, and Figure 6.

Parts that are available for customer self repair (CSR) are indicated as follows:

Mandatory CSR	Order the part directly from HP and repair the product yourself. On-site or return-to-depot repair is not provided under warranty.
Optional CSR	Order the part directly from HP and repair the product yourself, or you can request that HP repair the product. If you request repair from HP, you may be charged for the repair depending on the product warranty.
No CSR	The part is not available for customer self repair. For assistance, contact an HP-authorized service provider.

NOTE: For an updated list of customer self repair parts, go to http://www.hp.com/support/.
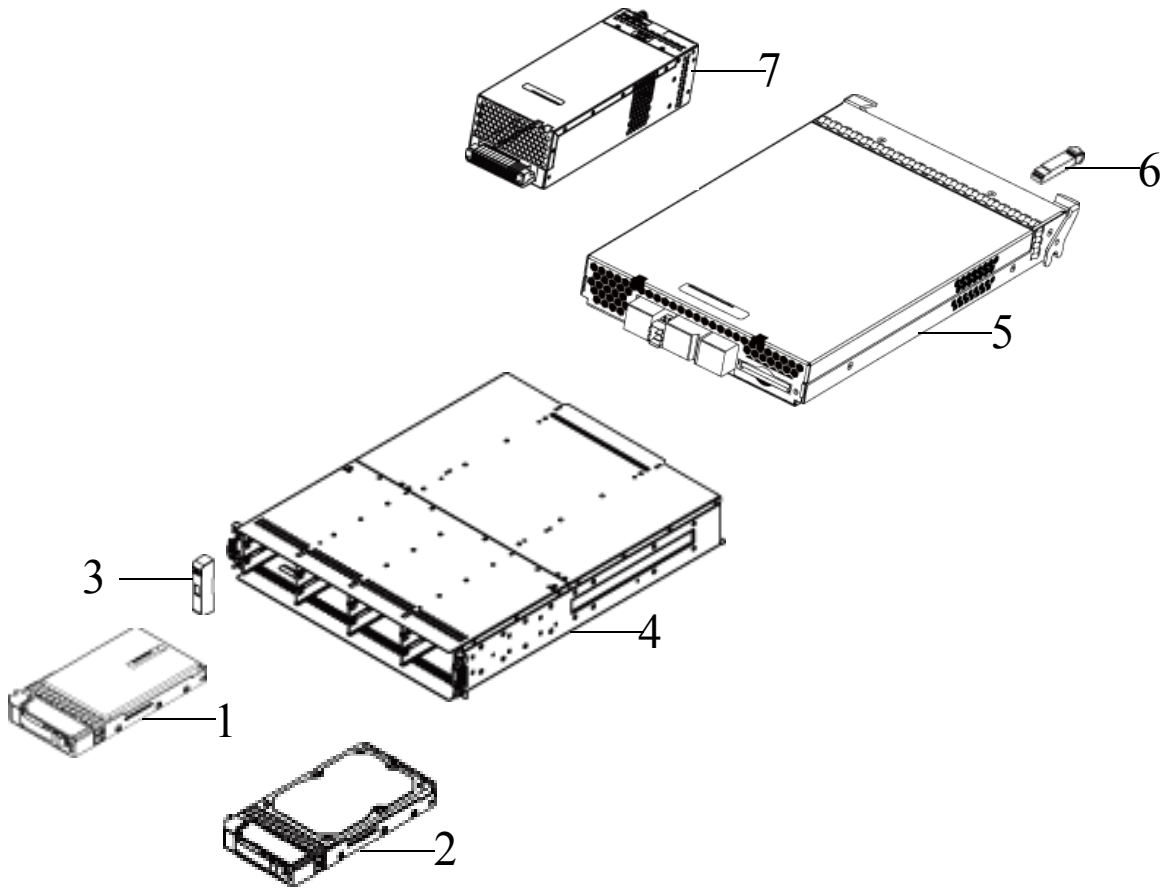
Figure 4 MSA2312fc exploded view

Table 11 MSA2312fc parts list

Item	Description	Spares part number	CSR Mandatory Optional
1	SPS-BLANK,HDD	481344-001	Mandatory
2	Hard drives	—	—
	a) SPS—DRV, HD 146GB MSA2 3.5" 15K DP SAS	480937-001	Mandatory
	b) SPS—DRV, HD 300GB MSA2 3.5" 15K DP SAS	480938-001	Mandatory
	c) SPS—DRV, HD 450GB MSA2 3.5" 15K DP SAS	480939-001	Mandatory
	d) SPS—DRV, HD 500GB MSA2 3.5" 7.2K SATA	480940-001	Mandatory
	e) SPS—DRV, HD 750GB MSA2 3.5" 7.2K SATA	480941-001	Mandatory
	f) SPS—DRV, HD 1TB MSA2 3.5" 7.2K SATA	480942-001	Mandatory
3	SPS-EAR KIT	508296-001	Mandatory
4	SPS-CHASSIS-w/midplane	481321-001	Mandatory
5	SPS-CONTROLLER,2300fc	490092-001	Mandatory
6	SPS-SFP,XCVR	481345-001	Mandatory

Table 11 MSA2312fc parts list (continued)

Item	Description	Spares part number	CSR Mandatory Optional
7	Power supplies	—	—
	SPS-POWER SUPPLY (AC)	481320-001	Mandatory
	SPS-DC DISK ENCL, POWER SUPPLY	545764-001	Mandatory
Not shown	SPS-RAIL KIT VLS9000	457637-001	Mandatory
Not shown	SPS-CABLE KIT (CLI and SAS expansion cables)	481322-001	Mandatory
Not shown	SPS-CA KIT, DB9 DB9-M to DB9-F (CLI cable)	508297-001	Mandatory

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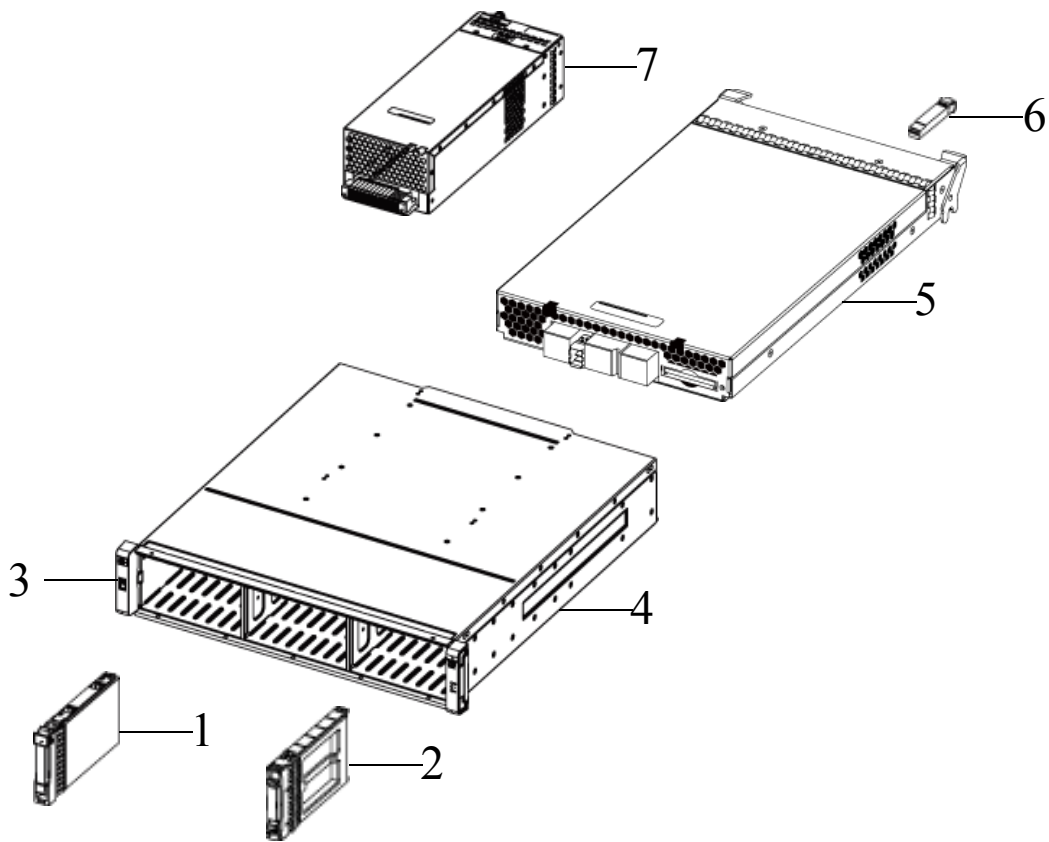
Figure 5 MSA2324fc exploded view

Table 12 MSA2324fc parts list

Item	Description	Spares part number	CSR Mandatory Optional
1	SPS-BLANK,HDD	376383-002	Mandatory
2	Hard drives	—	—
	a) 36-GB SAS, 10K rpm	376596-001	Mandatory
	b) 36-GB SAS, 15K rpm	432332-001	Mandatory
	c) 72-GB SAS, 10K rpm	447447-021	Mandatory
	d) 72-GB SAS, 15K rpm	418373-001	Mandatory
	e) 146-GB SAS, 10K rpm	432320-001	Mandatory
	f) 60-GB SATA, 5.4 rpm	405419-001	Mandatory
	g) 80-GB SATA, 5.4 rpm	431907-00	Mandatory
	h) 160GB SATA, 5.4 rpm	431909-00	Mandatory
3	SPS-EAR KIT	508296-001	Mandatory
4	SPS-CHASSIS-w/midplane	490095-001	Mandatory
5	SPS-CONTROLLER,2300fc	490092-001	Mandatory
6	SPS-SFP,XCVR	481345-001	Mandatory

Table 12 MSA2324fc parts list (continued)

Item	Description	Spares part number	CSR Mandatory Optional
7	Power supplies	—	—
	a) SPS-POWER SUPPLY	481320-001	Mandatory
	b) SPS-DC DISK ENCL, POWER SUPPLY	545764-001	Mandatory
Not shown	SPS-RAIL KIT VLS9000	457637-001	Mandatory
Not shown	SPS-CABLE KIT (CLI and SAS expansion cables)	481322-001	Mandatory
Not shown	SPS-CA KIT, DB9 (DB9-M to DB9-F CLI cable)	508297-001	Mandatory
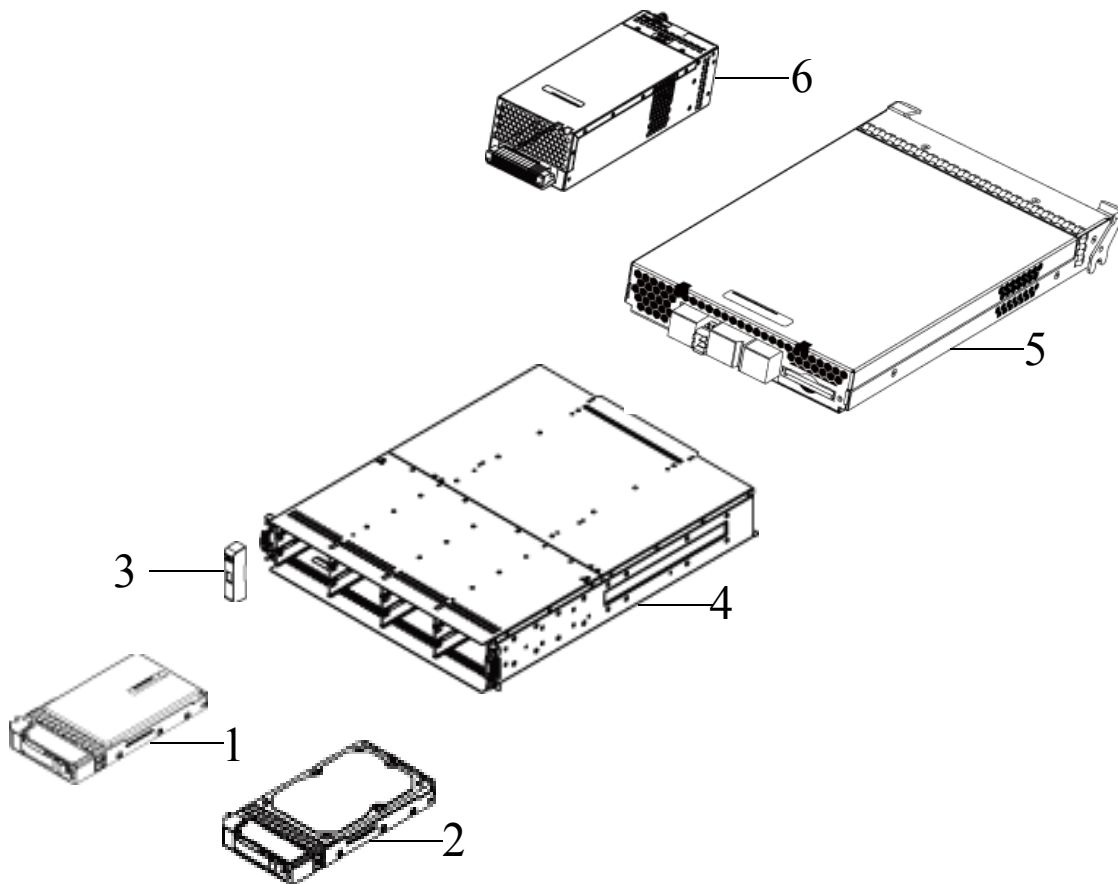
Figure 6 MSA2000 3.5 12-drive enclosure exploded view

Table 13 MSA2000 3.5 12-drive enclosure parts list

Item	Description	Spares part number	CSR Mandatory Optional
1	SPS-BLANK,HDD	481344-001	Mandatory
2	Hard drives	—	—
	a) SPS—DRV, HD 146GB MSA2 3.5" 15K DP SAS	480937-001	Mandatory
	b) SPS—DRV, HD 300GB MSA2 3.5" 15K DP SAS	480938-001	Mandatory
	c) SPS—DRV, HD 400GB MSA2 3.5" 10K DP SAS	480939-001	Mandatory
	d) SPS—DRV, HD 500GB MSA2 3.5" 7.2K SATA	480940-001	Mandatory
	e) SPS—DRV, HD 750GB MSA2 3.5" 7.2K SATA	480941-001	Mandatory
	f) SPS—DRV, HD 1TB MSA2 3.5" 7.2K SATA	480942-001	Mandatory
3	SPS-EAR KIT	508296-001	Mandatory
4	SPS-CHASSIS-w/midplane	481321-001	Mandatory
5	SPS-ENCLOSURE,I/O MODULE	481342-001	Mandatary
6	SPS-POWER SUPPLY	481320-001	Mandatory

Table 13 MSA2000 3.5 12-drive enclosure parts list (continued)

Item	Description	Spares part number	CSR Mandatory Optional
Not shown	SPS-RAIL KIT VLS9000	457637-001	Mandatory
Not shown	SPS-CABLE KIT (CLI and SAS expansion cables)	481322-001	Mandatory

- For more information about CSR, contact your local service provider. For North America, see the CSR website at http://www.hp.com/go/selfrepair.
- To determine the warranty service provided for this product, see the warranty information website at http://www.hp.com/go/storagewarranty.
- To order a replacement part, contact an HP-authorized service provider or see the HP Parts Store online at http://www.hp.com/buy/parts.

B   Environmental requirements and specifications

Safety requirements

Install the system in accordance with the local safety codes and regulations at the facility site. Follow all cautions and instructions marked on the equipment.

Site requirements and guidelines

The following sections provide requirements and guidelines that you must address when preparing your site for the installation.

When selecting an installation site for the system, choose a location not subject to excessive heat, direct sunlight, dust, or chemical exposure. These conditions greatly reduce the system's longevity and might void your warranty.

Site wiring and AC power requirements

The following are required for all installations using AC power supplies:

- All AC mains and supply conductors to power distribution boxes for the rack-mounted system must be enclosed in a metal conduit or raceway when specified by local, national, or other applicable government codes and regulations.
- Ensure that the voltage and frequency of your power source match the voltage and frequency inscribed on the equipment's electrical rating label.
- To ensure redundancy, provide two separate power sources for the enclosures. These power sources must be independent of each other, and each must be controlled by a separate circuit breaker at the power distribution point.
- The system requires voltages within minimum fluctuation. The customer-supplied facilities' voltage must maintain a voltage with not more than ± 5 percent fluctuation. The customer facilities must also provide suitable surge protection.
- Site wiring must include an earth ground connection to the AC power source. The supply conductors and power distribution boxes (or equivalent metal enclosure) must be grounded at both ends.
- Power circuits and associated circuit breakers must provide sufficient power and overload protection. To prevent possible damage to the AC power distribution boxes and other components in the rack, use an external, independent power source that is isolated from large switching loads (such as air conditioning motors, elevator motors, and factory loads).

Site wiring and DC power requirements

The following are required for all installations using DC power supplies:

- All DC mains and supply conductors to power distribution boxes for the rack-mounted system must comply with local, national, or other applicable government codes and regulations.
- Ensure that the voltage of your power source matches the voltage inscribed on the equipment's electrical label.
- To ensure redundancy, provide two separate power sources for the enclosures. These power sources must be independent of each other, and each must be controlled by a separate circuit breaker at the power distribution point.
- The system requires voltages within minimum fluctuation. The customer-supplied facilities' voltage must maintain a voltage within the range specified on the equipment's electrical rating label. The customer facilities must also provide suitable surge protection.
- Site wiring must include an earth ground connection to the DC power source. Grounding must comply with local, national, or other applicable government codes and regulations.
- Power circuits and associated circuit breakers must provide sufficient power and overload protection.

Weight and placement guidelines

Refer to Physical requirements for detailed size and weight specifications.

- The weight of an enclosure depends on the number and type of modules installed.
- Ideally, use two people to lift an enclosure. However, one person can safely lift an enclosure if its weight is reduced by removing the power and cooling modules and drive modules.
- Do not place enclosures in a vertical position. Always install and operate the enclosures in a horizontal orientation.
- When installing enclosures in a rack, make sure that any surfaces over which you might move the rack can support the weight. To prevent accidents when moving equipment, especially on sloped loading docks and up ramps to raised floors, ensure you have a sufficient number of helpers. Remove obstacles such as cables and other objects from the floor.
- To prevent the rack from tipping and to minimize personnel injury in the event of a seismic occurrence, securely anchor the rack to a wall or other rigid structure that is attached to both the floor and to the ceiling of the room.

Electrical guidelines

- These enclosures work with single-phase power systems having an earth ground connection. To reduce the risk of electric shock, do not plug an enclosure into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.
- Enclosures are shipped with a grounding-type (three-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.
- Do not use household extension cords with the enclosures. Not all power cords have the same current ratings. Household extension cords do not have overload protection and are not meant for use with computer systems.

Ventilation requirements

Refer to Environmental requirements for detailed environmental requirements.

- Do not block or cover ventilation openings at the front and rear of an enclosure. Never place an enclosure near a radiator or heating vent. Failure to follow these guidelines can cause overheating and affect the reliability and warranty of your enclosure.
- Leave a minimum of 6 inches (15 cm) at the front and back of each enclosure to ensure adequate airflow for cooling. No cooling clearance is required on the sides, top, or bottom of enclosures.
- Leave enough space in front and in back of an enclosure to allow access to enclosure components for servicing. Removing a component requires a clearance of at least 15 inches (37 cm) in front of and behind the enclosure.

Cabling requirements

- Keep power and interface cables clear of foot traffic. Route cables in locations that protect the cables from damage.
- Route interface cables away from motors and other sources of magnetic or radio frequency interference.
- Stay within the cable length limitations.

Management host requirements

A local management host with at least one serial port connection is recommended for the initial installation and configuration of a controller enclosure. After you configure one or both of the controller modules with an Internet Protocol (IP) address, you then use a remote management host on an Ethernet network to configure, manage, and monitor.

NOTE: Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Physical requirements

The floor space at the installation site must be strong enough to support the combined weight of the rack, controller enclosures, expansion enclosures, and any additional equipment. The site also requires sufficient space for installation, operation, and servicing the enclosures, and also requires sufficient ventilation to allow a free flow of air to all enclosures.

Table 14 and Table 15 list enclosure dimensions and weights. Weights are based on an enclosure having 12 drive modules, two controller or expansion modules, and two power supplies installed.

Table 14 Rackmount enclosure dimensions

Specifications	Rackmount
Height	2U 3.5 inches (8.9 cm)
Width: • Chassis • To back of power supply handle	21.8 inches (55.4 cm) 23.7 inches (60.2 cm)

Table 15 Rackmount enclosure weights

Specifications	Rackmount
2312fc Modular Smart Array • SAS drives • SATA drives	64.5 lb (29.3 kg) 65.5 lb (29.8 kg)
2324fc Modular Smart Array • SAS drives • SATA drives	58.5 lb (26.6 kg) 54.2 lb (24.6 kg)
MSA2000 3.5 12-drive enclosure (12 drives) • SAS drives • SATA drives	62 lb (28.2 kg) 63 lb (28.6 kg)

Environmental requirements

Table 16 Operating environmental specifications

Specification	Range
Altitude	To 9842 feet (3000 meters), derate 35.6°F (2°C) for every 3281 feet (1 km) up to 9842 feet (3000 meters)
Relative humidity	10% to 90% RH, 104°F (40°C) non condensing
Temperature	41°F to 104°F (5°C to 40°C)
Shock	5.0 g, 10 ms, half-sine
Vibration	0.5 g, 1 octave/minute, 5 Hz to 500 Hz to 5 Hz, swept-sine

Electrical requirements

Site wiring and power requirements

Each enclosure has two power and cooling modules for redundancy. If full redundancy is required, use a separate power source for each module. The AC power supply unit in each power and cooling module is auto-ranging and is automatically configured to an input voltage range from 88–264 VAC with an input frequency of 47–63 Hz. The power and cooling modules meet standard voltage requirements for both U.S. and international operation. The power and cooling modules use standard industrial wiring with line-to-neutral or line-to-line power connections.

Power cord requirements

Each enclosure is shipped with two AC power cords that are appropriate for use in a typical outlet in the destination country. Each power cord connects one of the power and cooling modules to an independent, external power source. To ensure power redundancy, connect the two power cords to two separate circuits; for example, to one commercial circuit and one uninterruptible power source (UPS).

C Electrostatic discharge

Preventing electrostatic discharge

To prevent damaging the system, be aware of the precautions you need to follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

To prevent electrostatic damage:

- Avoid hand contact by transporting and storing products in static-safe containers.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free workstations.
- Place parts on a grounded surface before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly.

Grounding methods to prevent electrostatic discharge

Several methods are used for grounding. Use one or more of the following methods when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground card to a grounded workstation or computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm ± 10 percent resistance in the ground cords. To provide proper ground, wear the strap snug against the skin.
- Use heel straps, toe straps or boot straps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have an authorized reseller install the part.

For more information on static electricity or assistance with product installation, contact an authorized reseller.

D   Regulatory compliance and safety

Regulatory compliance

Federal Communications Commission notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (i.e., personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows which class (A or B) the equipment falls into. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or FCC ID on the label. Once the class of the device is determined, refer to the following corresponding statement.

Class A equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

Class B equipment

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

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

Declaration of conformity for products marked with the FCC logo, United States only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, visit http://www.hp.com.

For questions regarding this FCC declaration, contact us by mail or telephone:

- Hewlett-Packard Company
  P.O. Box 692000, Mailstop 510101
  Houston, Texas 77269-2000

- 1-281-514-3333

To identify this product, refer to the part, Regulatory Model Number, or product number found on the product.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Hewlett-Packard Company may void the user's authority to operate the equipment.

Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Regulatory compliance identification numbers

For the purpose of regulatory compliance certifications and identification, your product has been assigned a unique Regulatory Model Number. The RMN can be found on the product nameplate label, along with all required approval markings and information. When requesting compliance information for this product, always refer to this RMN. The Regulatory Model Number should not be confused with the marketing name or model number of the product.

Regulatory compliance label location

The Regulatory Compliance label for the array is located behind the left ear on the side of the chassis.

Laser device

All HP systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission (IEC) 825. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous light.

Laser safety warning

⚠ **WARNING!** To reduce the risk of exposure to hazardous radiation:

- Do not try to open the laser device enclosure. There are no user-serviceable components inside.
- Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
- Allow only HP authorized service technicians to repair the laser device.

Certification and classification information

This product contains a laser internal to the fiber optic (FO) transceiver for connection to the Fibre Channel communications port.

In the USA, the FO transceiver is certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR, Subchapter J. A label on the plastic FO transceiver housing indicates the certification.

Outside the USA, the FO transceiver is certified as a Class 1 laser product conforming to the requirements contained in IEC 825-1:1993 and EN 60825-1:1994, including Amendment 11:1996 and Amendment 2:2001.

Laser product label

The optional label in Figure 6-1 or equivalent may be located on the surface of the HP supplied laser device.

CLASS 1 LASER PRODUCT

This optional label indicates that the product is classified as a CLASS 1 LASER PRODUCT. This label may appear on the laser device installed in your product.

Figure 6-1 Class 1 Laser Product Label

International notices and statements

Canadian notice (avis Canadien)

Class A equipment

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

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B equipment

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

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European Union notice

Products bearing the CE marking comply with the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community and if this product has telecommunication functionality, the R&TTE Directive (1999/5/EC).

Compliance with these directives implies conformity to the following European Norms (in parentheses are the equivalent international standards and regulations):

- EN55022 (CISPR 22) - Electromagnetic Interference
- EN55024 (IEC61000-4-2, IEC61000-4-3, IEC61000-4- 4, IEC61000-4-5, IEC61000-4-6, IEC61000-4-8, IEC61000-4-11) - Electromagnetic Immunity
- Power Quality:
  - EN61000-3-2 (IEC61000-3-2) - Power Line Harmonics
  - EN61000-3-3 (IEC61000-3-3) - Power Line Flicker
- EN60950 (IEC60950) - Product Safety
- Also approved under UL 60950/CSA C22.2 No. 60950-00, Safety of Information Technology Equipment.

BSMI notice

警告使用者:
這是甲類的資訊產品,在居住的
環境中使用時,可能會造成射頻
干擾,在這種情況下,使用者會
被要求採取某些適當的對策。

Japanese notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文を
お読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会(VCCI)の基準
に基づくクラスB情報技術装置です。この装置は、家庭環境で使用すること
を目的としていますが、この装置がラジオやテレビジョン受信機に近接して
使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会(VCCI)の基準に
基づくクラスA情報技術装置です　この装置を家庭環境で使用すると電波
妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ず
るよう要求されることがあります。

Korean notices

A급 기기 (업무용 정보통신기기)

이 기기는 업무용으로 전자파적합등록을 한 기기이오니
판매자 또는 사용자는 이 점을 주의하시기 바라며, 만약
잘못판매 또는 구입하였을 때에는 가정용으로 교환하시기
바랍니다.

B급 기기 (가정용 정보통신기기)

이 기기는 가정용으로 전자파적합등록을 한 기기로서
주거지역에서는 물론 모든지역에서 사용할 수 있습니다.

Safety

Battery replacement notice

Your computer is equipped with a lithium manganese dioxide, a vanadium pentoxide, or an alkaline internal battery or battery pack. There is a danger of explosion and risk of personal injury if the battery is incorrectly replaced or mistreated. Replacement is to be done by an HP authorized service provider using the HP spare part designated for this product. For more information about battery replacement or proper disposal, contact an HP authorized reseller or HP authorized service provider.

⚠ **WARNING!**   Yur computer contains an internal lithium manganese dioxide, a vanadium pentoxide, or an alkaline battery pack. There is risk of fire and burns if the battery pack is not properly handled. To reduce the risk of personal injury:

- Do not attempt to recharge the battery.
- Do not expose to temperatures higher than 60°C.
- Do not disassemble, crush, puncture, short external contacts, or dispose of in fire or water.
- Replace only with the HP spare part designated for this product.
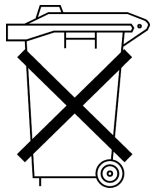
Batteries, battery packs, and accumulators should not be disposed of together with the general household waste. To forward them to recycling or proper disposal, please use the public collection system or return them to HP, an authorized HP Partner, or their agents.

For more information about battery replacement or proper disposal, contact an HP authorized reseller or service provider.

Taiwan battery recycling notice

廢電池請回收   The Taiwan EPA requires dry battery manufacturing or importing firms in accordance with Article 15 of the Waste Disposal Act to indicate the recovery marks on the batteries used in sales, giveaway or promotion. Contact a qualified Taiwanese recycler for proper battery disposal.

Power cords

The power cord set must meet the requirements for use in the country where the product was purchased. If the product is to be used in another country, purchase a power cord that is approved for use in that country.

The power cord must be rated for the product and for the voltage and current marked on the product electrical ratings label. The voltage and current rating of the cord should be greater than the voltage and current rating marked on the product. In addition, the diameter of the wire must be a minimum of 1.00 mm^2 or 18 AWG, and the length of the cord must be between 1.8 m (6 ft) and 3.6 m (12 ft). If you have questions about the type of power cord to use, contact an HP authorized service provider.

Route power cords so that they will not be walked on and cannot be pinched by items placed upon or against them. Pay particular attention to the plug, electrical outlet, and the point where the cords exit from the product.

Japanese power cord notice

製品には、同梱された電源コードをお使い下さい。
同梱された電源コードは、他の製品では使用出来ません。

Electrostatic discharge

To prevent damage to the system, be aware of the precautions you need to follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

Preventing electrostatic damage

To prevent electrostatic damage, observe the following precautions:

- Avoid hand contact by transporting and storing products in static-safe containers.

- Keep electrostatic-sensitive parts in their containers until they arrive at static-free workstations.
- Place parts on a grounded surface before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly (see "Grounding methods" on page 72).

Grounding methods

There are several methods for grounding. Use one or more of the following methods when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground cord to a grounded workstation or computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm (±10 percent) resistance in the ground cords. To provide proper ground, wear the strap snug against the skin.
- Use heel straps, toe straps, or boot straps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have an HP authorized reseller install the part.

NOTE: For more information on static electricity, or assistance with product installation, contact your HP authorized reseller.

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