ThinkSystem DS6200/DS4200/DS2200/DS EXP Hardware Installation and Maintenance Guide

Machine Type: 4619/4617/4599/4588

Firmware release: G250

Part Number: 01GW901
First Edition (May 2017)

Contents

Figures

Tables

About this guide

Introduction

This guide provides information about initial hardware setup, and removal and installation of customer-replaceable units (CRUs) for the Lenovo ThinkSystem™ DS6200/DS4200/DS2200 controller enclosures, as well as the DS Series Exp Unit (DS EXP) expansion enclosures. In controller enclosures, controller modules can be purchased with either of two types of host interface: SAS or FC/iSCSI. An FC/iSCSI controller module's host ports use converged network adapters, and is informally referred to as a converged network controller (CNC):

- FC/iSCSI controller enclosure:
  - Qualified Fibre Channel SFP option supporting (8/16Gb)
  - Qualified Internet SCSI (10GbE) SFP option
  - Qualified Internet SCSI (1Gb) Copper RJ-45 SFP option
- SAS (12Gb) controller enclosure

The DS6200, DS4200, and DS2200 are SBB-compliant (Storage Bridge Bay) enclosures. These enclosures support large form factor disks or small form factor disks in either a 2U12 or 2U24 chassis. These chassis form factors support controller enclosures and expansion enclosures.

The DS6200/DS4200/DS2200 controller enclosures can optionally be cabled to supported DS Series expansion enclosures for adding storage.

IMPORTANT: Product configuration characteristics for controller and optional expansion enclosures:

- DS6200/DS4200/DS2200 and optional DS EXP products use the same 2U24 and 2U12 chassis form factor.
- DS6200 is only available in the 2U24 chassis.
- DS6200 and DS4200 provide four host ports per controller I/O module (SBB RAID canister).
- DS2200 provides two host ports per controller I/O module.
- DS6200/DS4200/DS2200 models are configured with two controller modules per enclosure.
- Optional DS EXP models are configured with two expansion I/O modules (SBB expansion canisters) per enclosure.

Lenovo ThinkSystem enclosures support virtual storage, which uses paged-storage technology. For virtual storage, a group of disks with an assigned RAID level is called a disk group.

DS6200/DS4200/DS2200 enclosure user interfaces

The DS6200/DS4200/DS2200 enclosures support applications for configuring, monitoring, and managing the storage system. The web-based application GUI and the command-line interface are briefly described:

- Storage Management Console (SMC) is the web interface for the enclosure, providing access to all common management functions for virtual storage.
- The command-line interface (CLI) enables you to interact with the storage system using command syntax entered via the keyboard or scripting.

NOTE: For more information about enclosure user interfaces, see the following:

- Storage Manager Guide or online help

  The guide describes the Storage Management Console GUI.
- CLI Reference Guide

CNC ports used for host connection

Certain models use Converged Network Controller (CNC) technology, allowing you to select the desired host interface protocol from the available Fibre Channel (FC) or Internet SCSI (iSCSI) host interface protocols supported by the system. You can use the CLI to set all controller module CNC ports to use one of these host interface protocols:

- 16Gb FC
- 8Gb FC
- 4Gb FC
- 10GbE iSCSI
- 1GbE iSCSI

Alternatively, for 4-port DS6200/DS4200 models you can use the CLI to set CNC ports to support a combination of host interface protocols. When configuring a combination of host interface protocols, host ports 0 and 1 are set to FC (either both 16Gb/s or both 8Gb/s), and host ports 2 and 3 must be set to iSCSI (either both 10GbE or both 1Gb/s), provided the CNC ports use qualified SFP connectors and cables required for supporting the selected host interface protocol.

The 2-port DS2200 models do not support SFPs for multiple host interface protocols in combination. You must select a common host interface protocol and SFP for use in all CNC ports within the controller enclosure.

See "CNC technology" (page 47), Figure 16 (page 22), and Figure 17 (page 22) for more information.

TIP: See the CLI Reference Guide for information about configuring CNC ports with host interface protocols of the same type or a combination of types.

CNC controller modules ship with CNC ports initially configured for FC. When connecting CNC ports to iSCSI hosts, you must use the CLI (not the SMC) to specify which ports will use iSCSI. It is best to this before inserting the iSCSI SFPs into the CNC ports (see "Change the CNC port mode" (page 56) for instructions).

HD mini-SAS ports used for host connection

DS6200/DS4200 enclosures provide eight high-density mini-SAS ports (4-ports per controller module). DS2200 enclosures provide four high-density (HD) mini-SAS ports (2-ports per controller module). The HD mini-SAS host interface protocol uses the SFF-8644 external connector interface defined for SAS3.0 to support a link rate of 12Gb/s using the qualified connectors and cable options. See Figure 18 (page 23) and Figure 19 (page 23) for more information.

Intended audience

This guide is intended for system administrators and storage administrators.

Prerequisites

Prerequisites for using this product include knowledge of:

- Server system administration
- Microsoft Windows servers
- Storage system configuration
- Storage area network (SAN) management and server-attached storage
- Fibre Channel (FC) protocol
- Serial Attached SCSI (SAS) protocol
- Internet SCSI (iSCSI) protocol

Related documentation

Table 1 Related documents

For information about	See
Obtaining printed documentation	Lenovo customer letter[1]
Obtaining multi-language safety information, environmental notices, warranties, service and support, licenses, and product documentation.	Lenovo Read Me First[1]
Overview of product shipkit contents and setup tasks	Lenovo ThinkSystem DS6200/DS4200/DS2200/DS EXP Getting Started[1]
Overview of hardware installation	Lenovo ThinkSystem DS6200/DS4200/DS2200/DS EXP Getting Started[1,2]
Using the web interface to configure and manage the product	Lenovo ThinkSystem DS6200/DS4200/DS2200/DS EXP Storage Manager Guide[2]
Using the command-line interface (CLI) to configure and manage the product	Lenovo ThinkSystem DS6200/DS4200/DS2200/DS EXP CLI Reference Guide
Event codes and recommended actions	Lenovo ThinkSystem DS6200/DS4200/DS2200/DS EXP Event Descriptions Reference Guide
Enhancements, known issues, and late-breaking information not included in product documentation	Lenovo ThinkSystem Firmware Release Notes

1-Printed document included in product shipkit.

2-The Storage Manager Guide contains the master glossary of terms for the DS6200/DS4200/DS2200/DS EXP documentation set.

To obtain PDF versions of product documentation, visit http://support.lenovo.com.

Document conventions and symbols

Table 2 Document conventions

Convention	Element
Colored text	Cross-reference links
Black, underlined text	Email addresses
Colored, underlined text	Website addresses
Bold text	• Keys that are pressed • Text entered into a GUI element, such as a box • GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
Italic text	Text emphasis
`Monospace` text	• File and directory names • System output • Code • Commands, their arguments, and argument values
`Monospace, italic` text	• Code variables • Command parameters
`Monospace, bold` text	Emphasis of file and directory names, system output, code, and text entered at the command line

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.

1 Safety guidelines

Safe handling

CAUTION: Use this equipment in a manner specified by the manufacturer: failure to do this may cancel the protection provided by the equipment.

- Permanently unplug the enclosure before you move it or if you think that it has become damaged in any way.
- A safe lifting height is 20U.
- Always remove the Power and Cooling Modules (PCMs) to minimize weight before you move the enclosure.
- Do not lift the enclosures by the handles on the PCMs—they are not designed to take the weight.

CAUTION: Do not try to lift the enclosure by yourself:

- Fully configured 2U12 enclosures can weigh up to 32 kg (71 lb)
- Fully configured 2U24 enclosures can weigh up to 30 kg (66 lb)

Figure 1 Lifting hazard label

Operation

IMPORTANT: Operation of the enclosure with any CRU modules missing will disrupt the airflow, and the enclosure will not receive sufficient cooling. It is essential that all slots hold modules before the enclosure system is used. Empty drive slots (bays) must hold dummy drive carrier modules. See also Figure 37 (page 39).

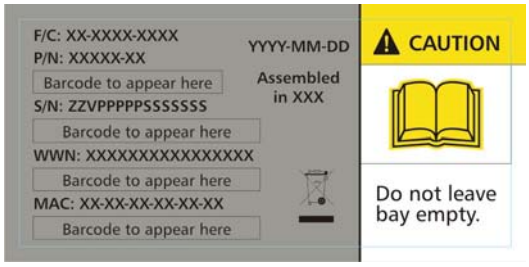


Figure 2 Module Bay Caution label

- Replace a defective PCM with a fully operational PCM within 24 hours. Do not remove a defective PCM unless you have a replacement model of the correct type ready for insertion.
- Before removal/replacement of a PCM, disconnect supply power from the PCM to be replaced. Please refer to “Replacing a power cooling module” (page 79).

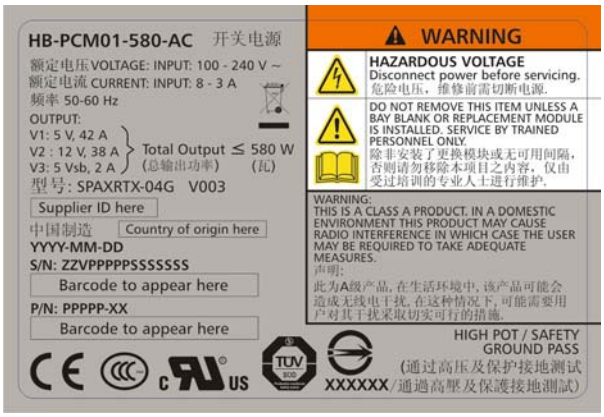


Figure 3 Power Cooling Module Warning label – Hazardous Voltage

Electrical safety

- The enclosure must only be operated from a power supply input voltage range of 100–240 VAC, 50–60 Hz.
- Provide a suitable power source with electrical overload protection to meet the requirements in the technical specification.
- The power cord must have a safe electrical earth connection. Check the connection to earth of the enclosure before you switch on the power supply.

IMPORTANT: The enclosure must be grounded before applying power.

- The plug on the power supply cord is used as the main disconnect device. Ensure that the socket outlets are located near the equipment and are easily accessible.
- 2U enclosures are intended to operate with two PCMs.

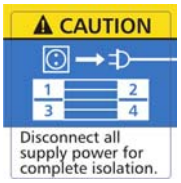


Figure 4 Power Cooling Module Warning label

CAUTION: Do not remove covers from the PCM – there is a danger of electric shock inside. Return the PCM to your supplier for repair.

- When bifurcated power cords (Y-leads) are used, these cords must only be connected to a supply range of 200–240 VAC.

IMPORTANT: The RJ-45 socket on IOMs is for the Ethernet connection only and must not be connected to a telecommunications network.

Rack system safety precautions

The following safety requirements must be considered when the enclosure is mounted in a rack.

- The rack construction must be capable of supporting the total weight of the installed enclosures. The design should incorporate stabilizing features suitable to prevent the rack from tipping or being pushed over during installation or in normal use.
- When loading a rack with enclosures, fill the rack from the bottom up; and empty the rack from the top down.
- Always remove all PCMs to minimize weight, before loading the enclosure into the rack.
- Do not try to lift the enclosure by yourself.

△ **CAUTION:** To avoid danger of the rack falling over, under no circumstances should more than one enclosure be moved out of the cabinet at any one time.

- The system must be operated with low pressure rear exhaust installation. The back pressure created by rack doors and obstacles is not to exceed 5 pascals (0.5 mm water gauge).
- The rack design should take into consideration the maximum operating ambient temperature for the enclosure, which is 35ºC (95ºF) for RBODs and 40ºC (104ºF) for EBODs.
- The rack should have a safe electrical distribution system. It must provide over-current protection for the enclosure and must not be overloaded by the total number of enclosures installed in the rack. When addressing these concerns, consideration should be given to the electrical power consumption rating shown on the nameplate.
- The electrical distribution system must provide a reliable earth connection for each enclosure in the rack.
- Each PCM in each enclosure has an earth leakage current of 1.0mA. The design of the electrical distribution system must take into consideration the total earth leakage current from all the PCMs in all the enclosures. The rack will require labeling with “High Leakage Current. Earth connection essential before connecting supply.”
- The rack—when configured with the enclosures—must meet the safety requirements of UL 60950-1 and IEC 60950-1.

---

2 System overview

Enclosure configurations

The storage system supports two controller enclosure configurations.

- 2U (rack space) controller enclosure – see Figure 5 (page 18) and Figure 6 (page 18): holds up to 12 low profile (1-inch high) 3.5" form factor disk drive modules in a horizontal orientation.
- 2U (rack space) controller enclosure – see Figure 7 (page 19) and Figure 8 (page 19): holds up to 24 low profile (5/8 inch high) 2.5" form factor disk drive modules in a vertical orientation.

These same chassis form factors are used for supported expansion enclosures; albeit with different I/O modules (IOMs). Each individual disk drive is hot pluggable and replaceable on site.

NOTE: Throughout this guide—and the management interfaces documents used with this guide—I/O module (IOM) is a general term denoting either a controller module (RAID canister) or an expansion module (expansion canister).

The enclosure configurations—including chassis and CRUs—are described on the following pages.

Cache

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

- Write-back or write-through caching. The controller writes user data into the cache memory in the controller module rather than directly to the disks. Later, when the storage system is either idle or aging —and continuing to receive new I/O data—the controller writes the data to the disks.
- Read-ahead caching. The controller detects sequential data access, reads ahead into the next sequence of data—based upon settings—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.

TIP: See the Storage Management Guide for more information about cache options and settings.

CompactFlash

During a power loss or controller failure, data stored in cache is saved off to non-volatile memory (CompactFlash). The data is restored to cache, and 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. The CompactFlash memory card is located at the midplane-facing end of the controller module. Do not remove the card; it is used for cache recovery only.

NOTE: In dual-controller configurations featuring one healthy partner controller, cache is duplicated between the controllers (subject to volume write optimization setting).

Supercapacitor pack

To protect controller module cache in case of power failure, each controller enclosure model is equipped with supercapacitor technology, in conjunction with CompactFlash memory, built into each controller module to provide extended cache memory backup time. The supercapacitor 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. In the event of power failure, while cache is maintained by the supercapacitor pack, the Cache Status LED blinks at a rate of 1/10 second on and 9/10 second off. See also “Cache Status LED details” (page 35).

NOTE: Please refer to "Enclosure variants" (page 20) for details about various enclosure options.

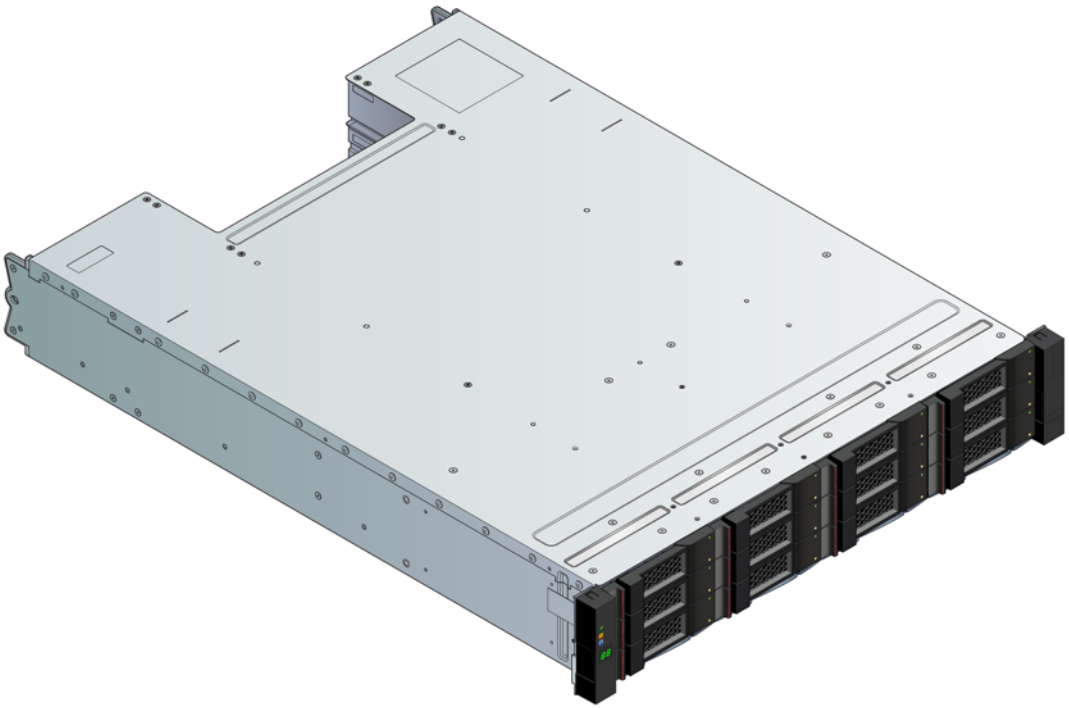


Figure 5 2U12 enclosure system – isometric front orientation

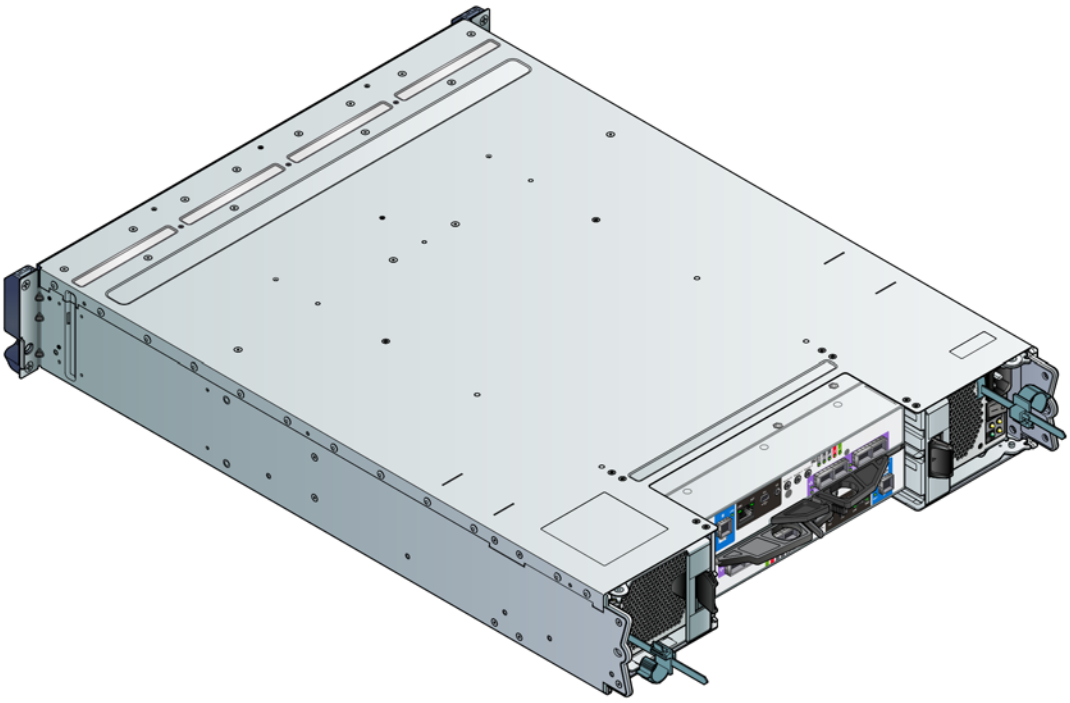


Figure 6 2U12 enclosure system – isometric rear orientation

The 2U12 controller enclosure above is equipped with dual-controllers (4-port FC/iSCSI model shown).

NOTE: Please refer to "Enclosure variants" (page 20) for details about various enclosure options.

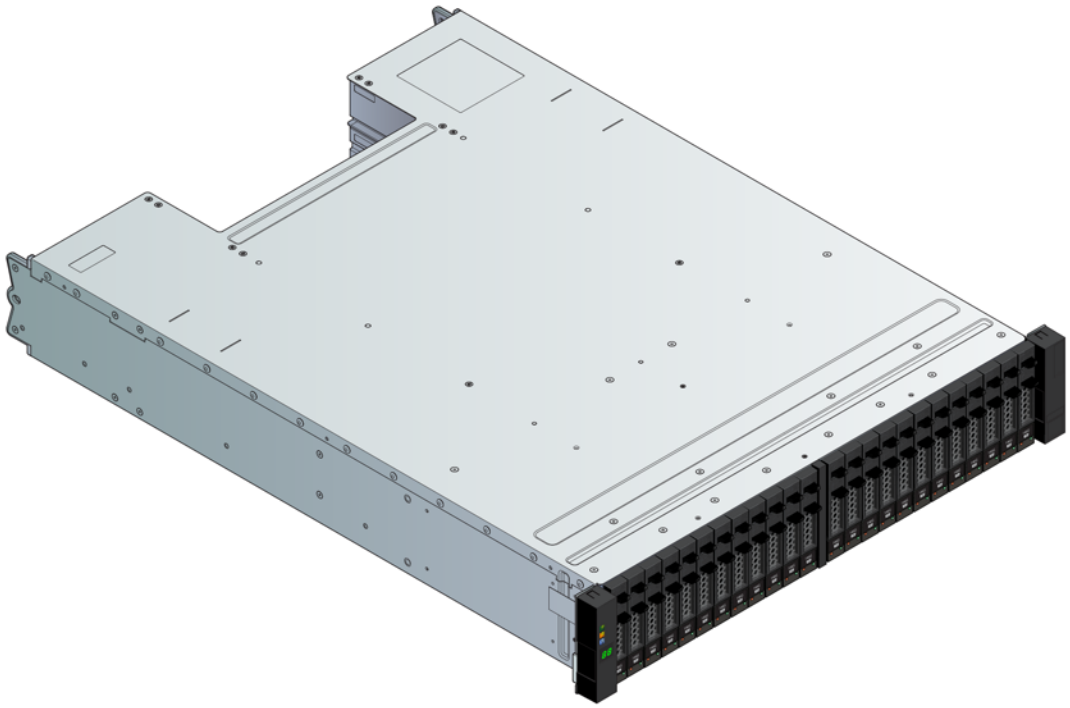


Figure 7 2U24 enclosure system – isometric front orientation

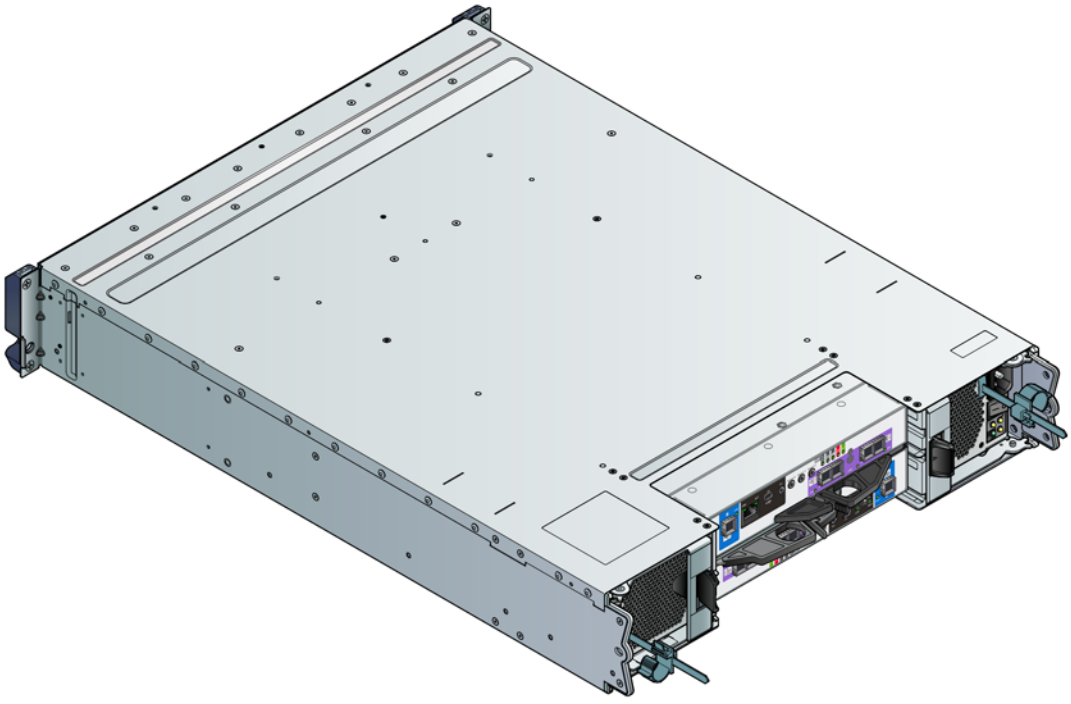


Figure 8 2U24 enclosure system – isometric rear orientation

The 2U24 controller enclosure above is equipped with dual-controllers (4-port SAS model shown).

Enclosure variants

The 2U chassis can be configured as a controller enclosure (DS6200, DS4200, or DS2200) or an expansion enclosure (DS EXP) as shown in Table 3 and Table 4.

2U12

12 x LFF (Large Form Factor) disk drives

Table 3 2U12 enclosure variants

Product	Configuration	PCMs[1]	IOMs[2]
DS4200	12Gb/s direct dock LFF SAS	2	2
DS2200	12Gb/s direct dock LFF SAS	2	2
DS EXP	12Gb/s direct dock LFF SAS	2	2

1-Redundant PCMs must be compatible modules of the same type (both AC).

2-Supported controller module IOMs include 4-port or 2-port FC/iSCSI and 4-port or 2-port HD mini-SAS. Supported expansion module IOMs are used in expansion enclosures for adding storage.

2U24

24 x SFF (Small Form Factor) disk drives

Table 4 2U24 enclosure variants

Product	Configuration	PCMs[1]	IOMs[2]
DS6200	12Gb/s direct dock SFF SAS	2	2
DS4200	12Gb/s direct dock SFF SAS	2	2
DS2200	12Gb/s direct dock SFF SAS	2	2
DS EXP	12Gb/s direct dock SFF SAS	2	2

1-Redundant PCMs must be compatible modules of the same type (both AC).

2-Supported controller module IOMs include 4-port or 2-port FC/iSCSI and 4-port or 2-port HD mini-SAS. Supported expansion module IOMs are used in expansion enclosures for adding storage.

Enclosure core product

The design concept is based on an enclosure subsystem together with a set of plug-in modules. A typical enclosure system—as supplied—includes the following:

- An enclosure chassis which includes the midplane PCB and an integral operator's (Ops) panel that is mounted on the left ear flange at the front of the enclosure.
- Two 580W, 100–240V AC power cooling modules. See also Figure 25 (page 27).
- Two IOMs: 2 x SBB-compliant interface slots.
- Up to 24 disk drive modules. Where appropriate the disk drive carriers will include an Interposer card. See also "Enclosure variants" (page 20). Dummy drive carriers modules must be installed in all empty drive slots.
- A rail kit for rack mounting.

NOTE: The module quantities quoted above are the maximum that a 2U24 enclosure can support. The following figures show component locations relative to 2U enclosure front and rear panels.

Enclosure front panel

Integers on disks indicate drive slot numbering sequence.

Figure 9 2U12 enclosure system – front panel components

Figure 10 2U24 enclosure system – front panel components

Enclosure rear panel

Numeric designators on PCMs and alphabetic designators on IOMs indicate slot sequencing for modules used in 2U enclosures. PCM and IOM modules are available as CRUs. The DS6200 and DS4200 RBODs use 4-port controller modules, whereas the DS2200 RBODs use 2-port controller modules. The DS6200/DS4200/DS2200 RBODs support the DS EXP EBODs for optionally adding storage.

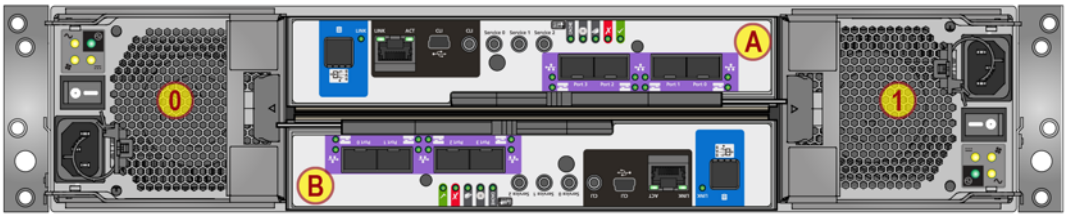


Figure 11 2U controller enclosure – rear panel components (4-port FC/iSCSI)

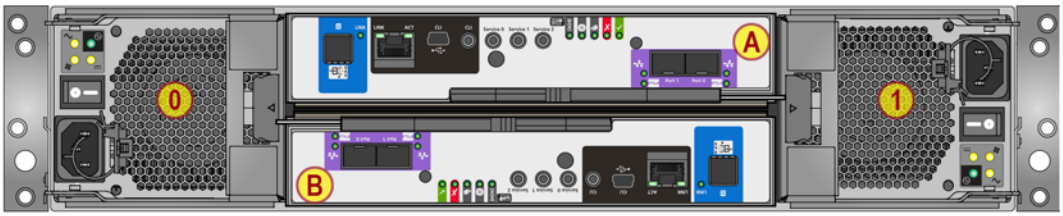


Figure 12 2U controller enclosure – rear panel components (2-port FC/iSCSI)

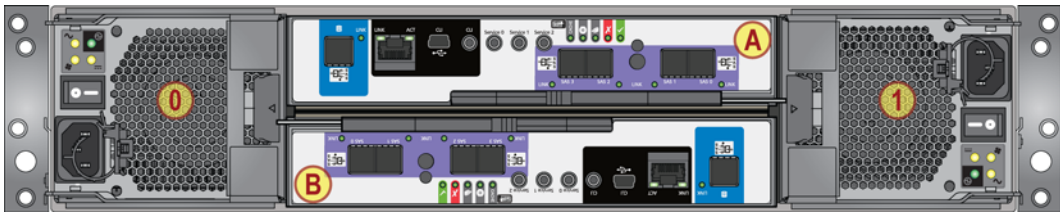


Figure 13 2U controller enclosure – rear panel components (4-port SAS)

Figure 14 2U controller enclosure – rear panel components (2-port SAS)

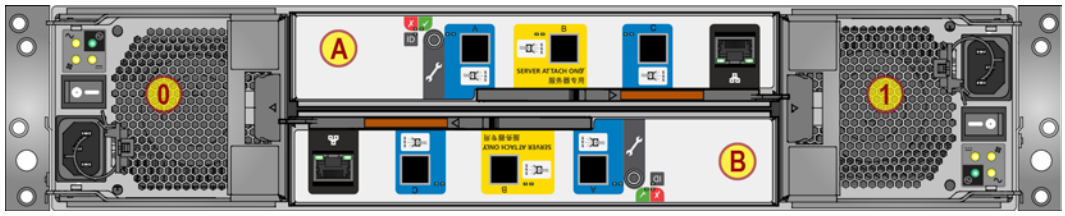


Figure 15 2U expansion enclosure – rear panel components

Rear panel components

Controller modules

The top slot for holding IOMs is A and the bottom slot is B. The face plate details of the IOMs show the modules aligned for use in A.

Figure 16 and Figure 17 show CNC host interface ports that can be configured with 8/16Gb/s FC SFPs; 10GbE iSCSI SFPs; or 1Gb/s RJ-45 SFPs. See "Install an SFP transceiver" (page 100) for installing qualified SFP options in CNC ports.

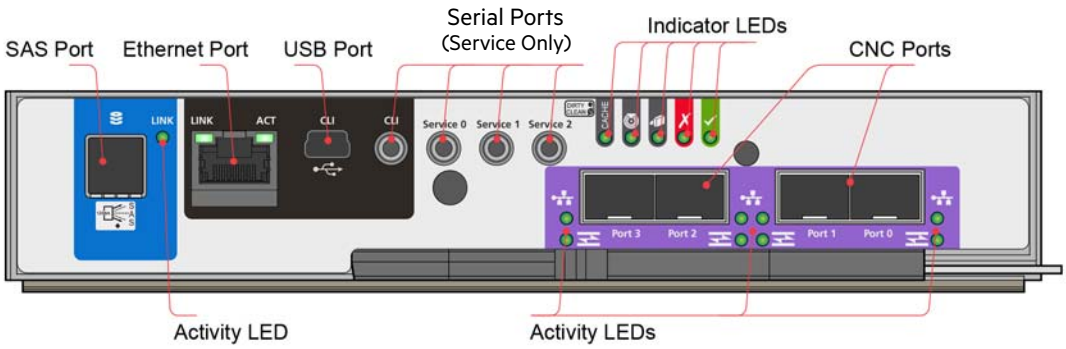


Figure 16 4-port FC/iSCSI controller module detail (DS6200/DS4200)

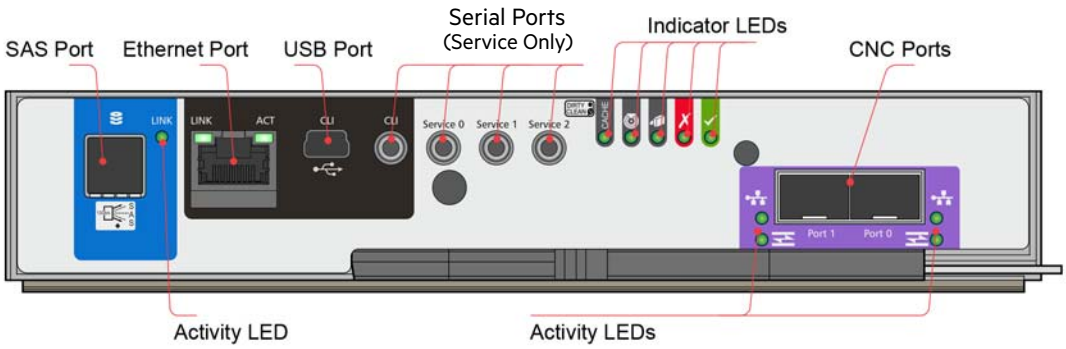


Figure 17 2-port FC/iSCSI controller module detail (DS2200 only)

Figure 18 and Figure 19 show SAS host interface ports that ship configured with 12Gb/s HD mini-SAS (SFF-8644) external connectors.

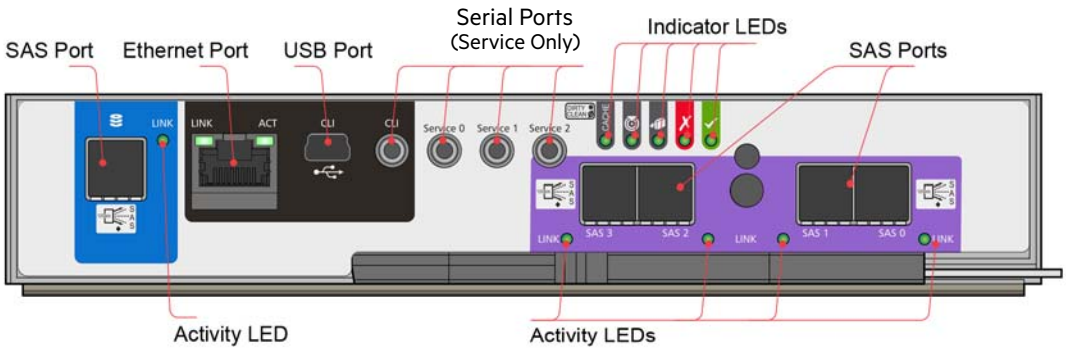


Figure 18 4-port HD mini-SAS controller module detail (DS6200/DS4200)

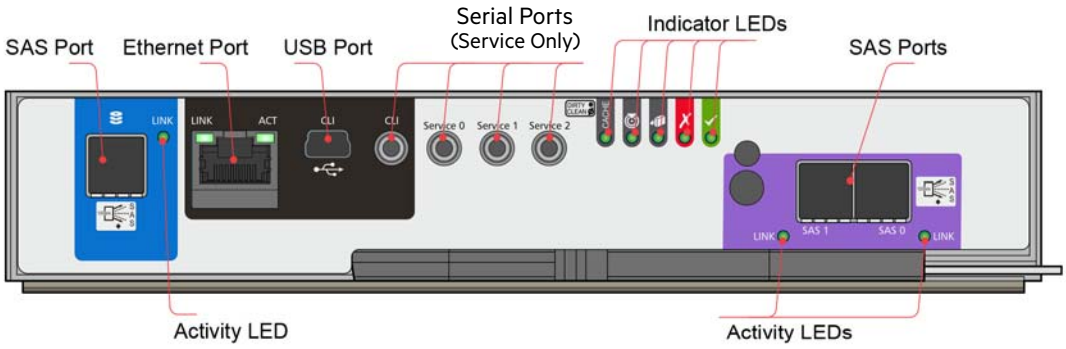


Figure 19 2-port HD mini-SAS controller module detail (DS2200 only)

Expansion module

Figure 20 shows the IOM used in supported DS Series expansion enclosures for adding storage. Ports A/B/C ship configured with 12Gb/s HD mini-SAS (SFF-8644) external connectors.

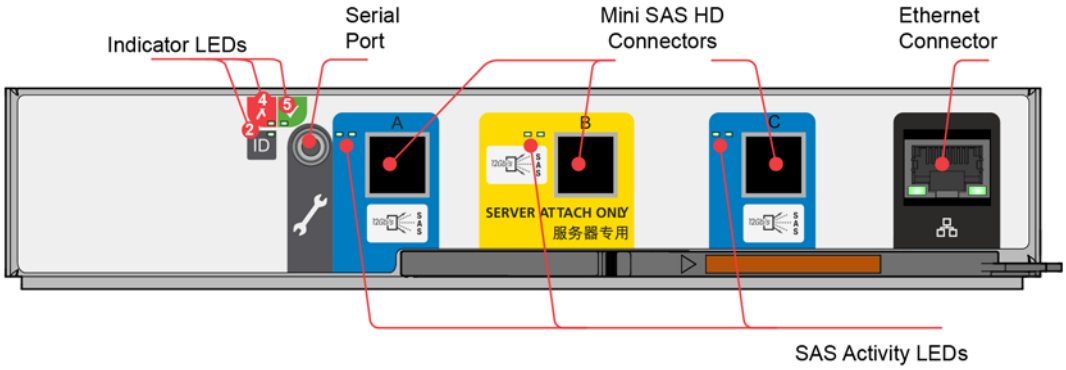


Figure 20 Expansion module detail (DS EXP only)

IMPORTANT: RBOD/EBOD configurations:

- When the expansion module shown above (Figure 20) is used with DS6200/DS4200/DS2200 controller modules for adding storage, its middle HD mini-SAS expansion port ("B") is disabled by the firmware. See also Figure 40 (page 45)
- The Ethernet port on the expansion module is not used in RBOD/EBOD configurations, and is disabled.

Power cooling module

Figure 21 shows the power cooling module (PCM) used in controller enclosures and optional expansion enclosures. The example shows a PCM oriented for use in the left PCM slot of the enclosure rear panel.

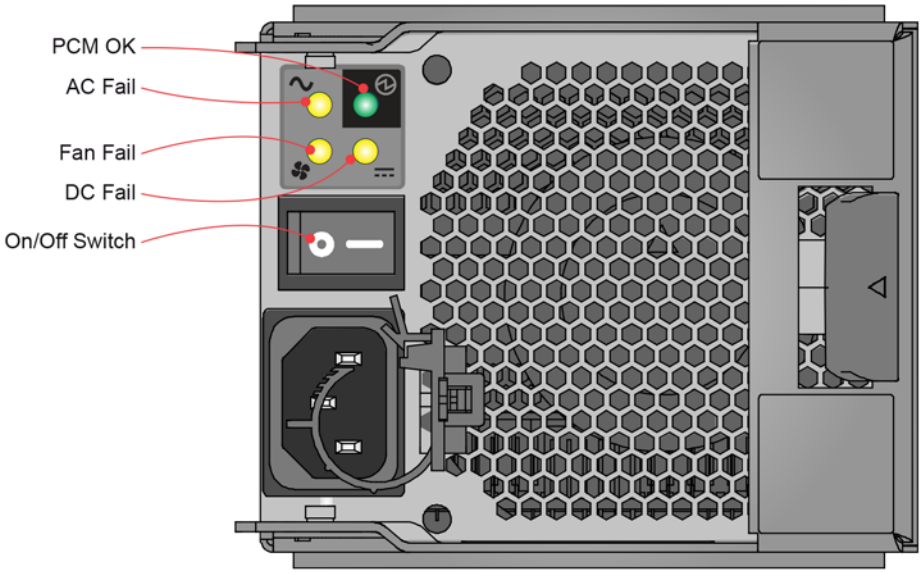


Figure 21 Power cooling module (PCM) detail

Enclosure chassis

The 2U chassis consists of a sheet metal enclosure with an integrated midplane PCB and module runner system.

NOTE: Supported 2U chassis form factors used for configuring RBODs and EBODs:

- 2U12 chassis configured with 12 LFF disks: see Figure 5 (page 18)
- 2U24 chassis configured with 24 SFF disks: see Figure 7 (page 19)
- 2U12 empty chassis with midplane: see Figure 22 (page 25)
- 2U24 empty chassis with midplane: see Figure 23 (page 25)

- The chassis has a 19-inch rack mounting that enables it to be installed onto standard 19-inch racks and uses two EIA units of rack space (3.5") for a 2U enclosure.
- The midplane PCB can support either 12 or 24 disk drive connections.
- There are either 12 or 24 drive slots at the front of the enclosure, in horizontal (12) or vertical (24) orientation, as defined by the enclosure variant. See also Figure 9 and Figure 10 (page 21). Each drive slot holds a plug-in drive carrier module that can hold these drive types, dependent upon the enclosure type:
  - 2U12 enclosure: 12 low profile (1" high) 3.5" LFF disk drives, held horizontally.
  - 2U24 enclosure: 24 low profile (5/8" high) 2.5" LFF disk drives, held vertically.
- At the rear, the chassis assembly can hold a maximum of two PCMs and two SBB-compliant IOMs.

IMPORTANT: The DS6200/DS4200/DS2200/DS EXP storage enclosures support SBB dual-controller configuration only. Single-controller support is provided only when a controller fails over to its partner controller. An IOM must be installed in each IOM slot to ensure sufficient air flow through the enclosure during operation.

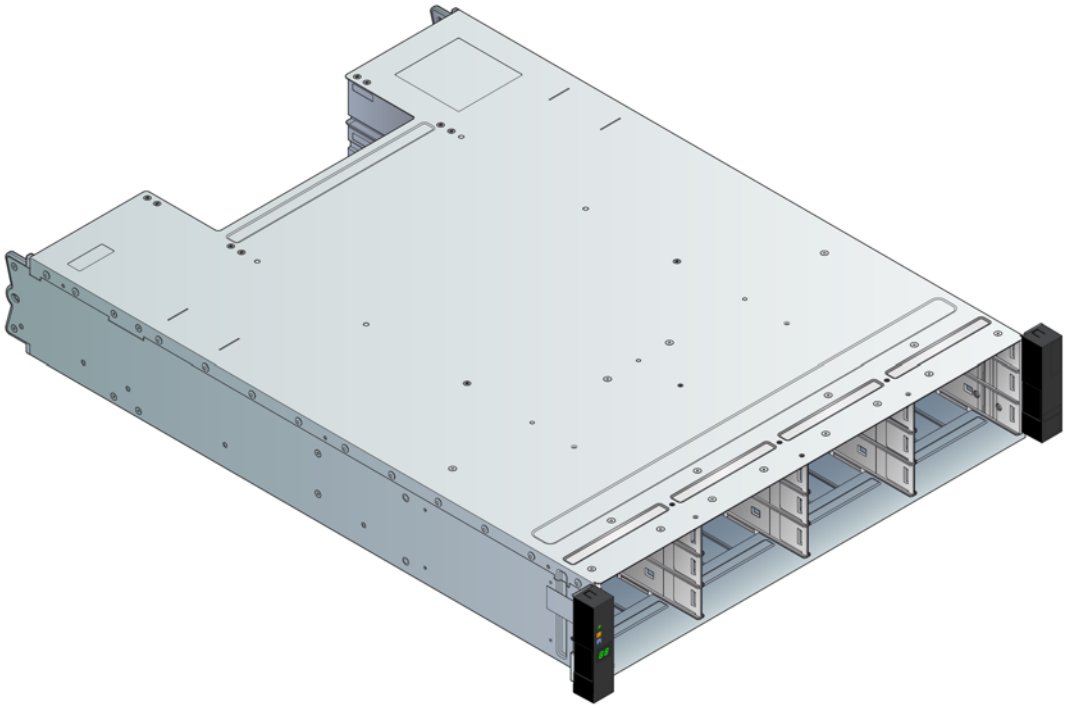


Figure 22 2U12 enclosure chassis – isometric front orientation

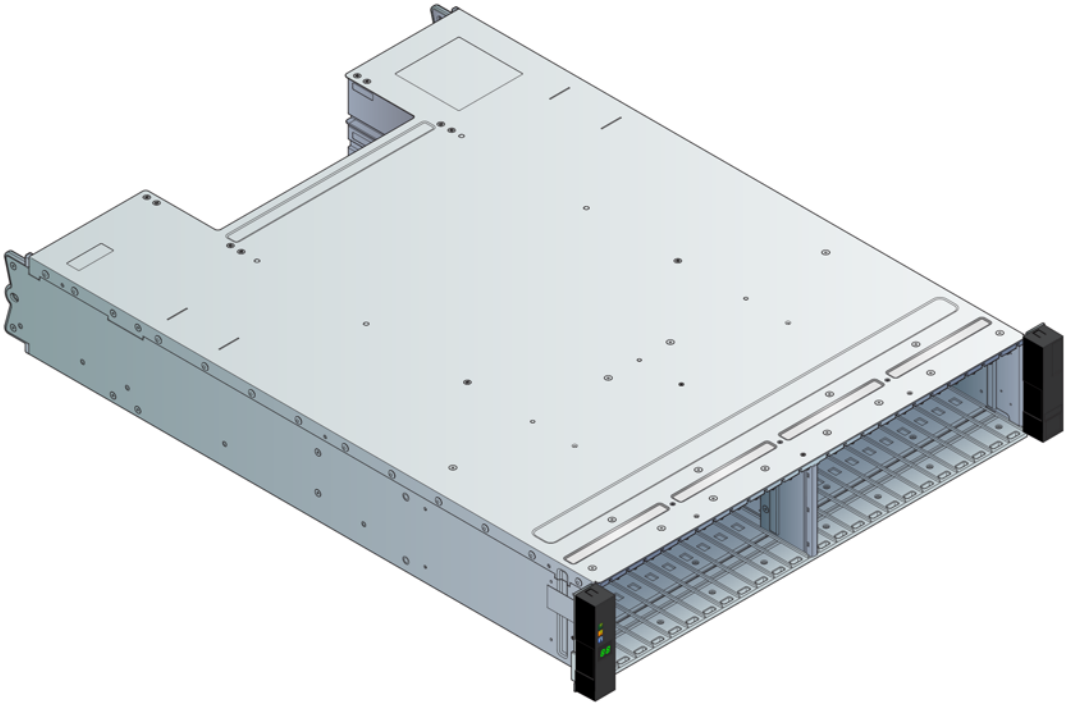


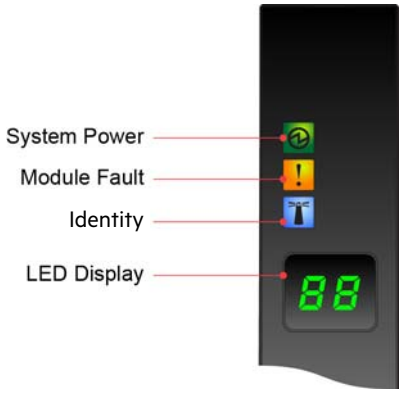
Figure 23 2U24 enclosure chassis – isometric front orientation

---

NOTE: Either 2U chassis can be configured as a controller enclosure or as an *optional* expansion enclosure for adding storage.

Operator's (Ops) panel

The enclosure front panel has an Operator's (Ops) panel mounted on the left ear flange. A flexible cable connects the Ops panel to the midplane. The Ops panel is a passive component: the midplane controls the panel, and the IOMs control all the panel's functions. An integral part of the enclosure chassis, the Ops panel is not replaceable on site. The Ops panel provides the functions shown in the illustration below and listed in the table. See also "Ops panel LEDs" (page 65).



Ops panel functions (see left ear on front panel)
System Power On/Standby LED (Green/Amber)
Module Fault LED (Amber)
Identity LED (Blue) (power on (5s) test state)
Unit Identification LED display
Thermal sensor (located behind panel)

Figure 24 LEDs: Ops panel – enclosure front panel

System Power On/Standby LED (green/amber)

LED displays amber when only standby power is available. LED displays green when system power is available.

Module Fault LED (amber)

LED illuminates when experiencing a system hardware fault. It may be associated with a Fault LED on a PCM or IOM that helps the user to identify which component is causing the fault.

Location LED (blue)

When activated, the Identity LED blinks at a rate of 1s on, 1s off to easily locate the chassis within a data center. The locate function may be enabled/disabled through SES.

NOTE: The Location LED is not activated for this configuration.

Unit Identification Display

The UID is a dual seven-segment display that can be used to provide feedback to the user. Its primary function is to display an enclosure unit identification number to assist users in setting and maintaining multiple enclosure systems.

Thermal sensor

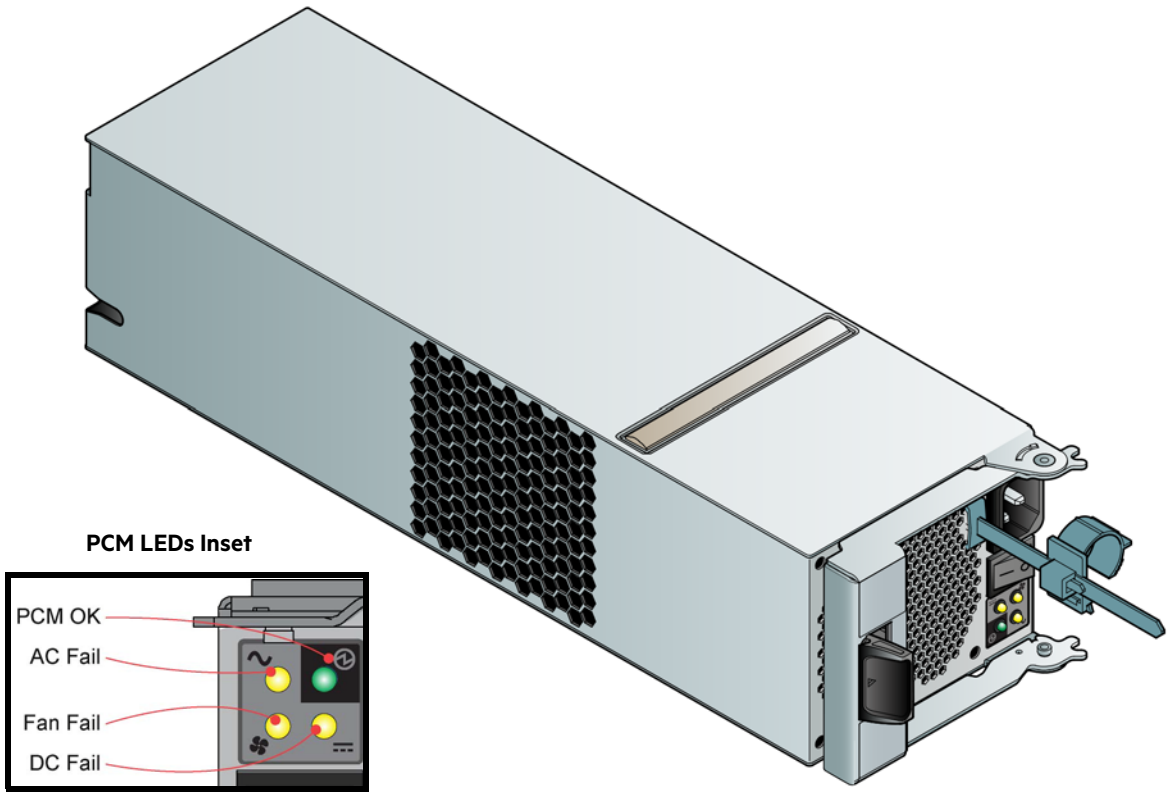
The thermal sensor is located on the outside of the enclosure, and it sends input to the enclosure about its external operating ambient temperature.

Power cooling module

AC-DC power is provided by up to two auto-ranging Power Cooling Modules (PCMs) with integrated axial cooling fans. The IOMs control fan speed. Also see "System airflow" (page 28) for optimal cooling within the enclosure(s).

580W PCM

The 580W PCM voltage operating range is nominally 100V–240V AC, and operates at 50–60 Hz input frequency. The isometric rear orientation in Figure 25 shows the PCM aligned for insertion into the right-hand PCM slot located on the enclosure rear panel.



580W Power Cooling Module LED descriptions (see inset illustration detail above)	
PCM OK LED (Green)	Fan Fail LED (Amber/blinking amber)
AC Input Fail LED (Amber/blinking amber)	DC Fail LED (Amber/blinking amber)
LED behavior	
• If any of the PCM LEDs are illuminated amber, a module fault condition or failure has occurred. • For a detailed description of PCM LED behavior, see "580W PCM LEDs" (page 65).	

Figure 25 LEDs: 580W PCM – rear panel

For a full frontal view of a PCM panel located on the enclosure rear-panel, see Figure 21 (page 24).

Multiple PCMs

The 2U storage system includes two PCMs which provide redundant power control for the system so that if one PCM fails, the other maintains the power supply, and enclosure operation is not affected while you replace the faulty module.

PCMs are hot-pluggable, and replacement should only take a few seconds to do. Replacement must be completed as soon as possible after the removal of the defective PCM to avoid a thermal exception. The replacement procedure should be completed within an absolute maximum of 2 minutes.

IMPORTANT: Operation of the enclosure with any modules missing will disrupt the airflow, and the disks will not receive sufficient cooling. It is essential that all slots are fitted with PCMs prior to powering on the enclosure.

System airflow

The system must be operated with low pressure rear exhaust installation. Back pressure created by rack doors and obstacles is not to exceed 5 pascals (0.5mm water gauge). The cooling system provides sufficient capacity to ensure that maximum temperatures are not exceeded.

IMPORTANT: The environment in which the enclosure operates must be dust-free to ensure adequate airflow.

Controller and expansion modules

This section describes the IOMs used in Lenovo ThinkSystem DS Series storage enclosures. They are mechanically and electrically compliant to the latest SBB v2.1 specification.

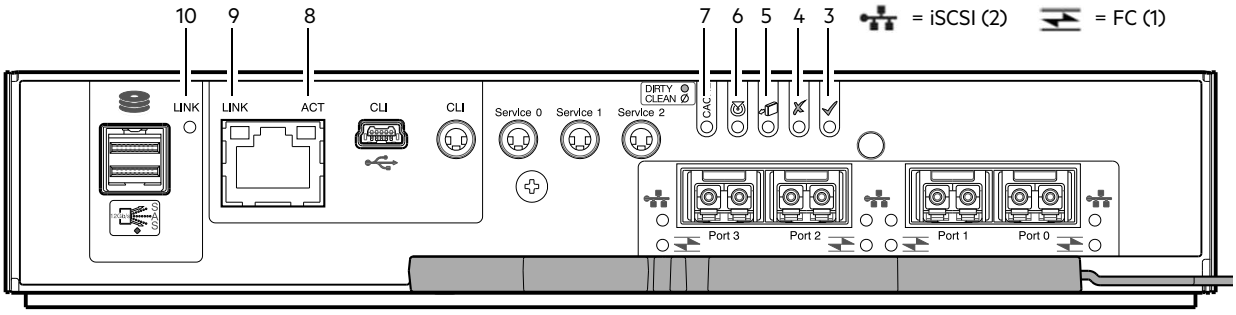
The isometric rear orientation in Figure 26 shows a partial view of a 4-port FC/iSCSI controller module aligned for use in the top controller module slot located on the enclosure rear panel.

Figure 26 Controller module – isometric rear orientation

Each controller module maintains VPD (Vital Product Data) in EEPROM devices, and are interconnected by SBB-defined I^2C buses on the midplane. In this way, the SBB modules can discover the type and capabilities of the partner SBB module(s), and vice versa, within the enclosure. An enclosure system alarm occurs when incompatible configurations are detected.

12Gb/s controller module LEDs

The diagrams with tables that immediately follow provide descriptions for the different controller modules that can be installed into the rear panel of an DS6200/DS4200/DS2200 controller enclosure. Showing controller modules separately from the enclosure enables improved clarity in identifying the component items called out in the diagrams and described in the companion tables within the figure/table ensembles. In each IOM diagram, the controller module is oriented for insertion into the top IOM slot (A). When oriented for use in the bottom IOM slot (B), the IOM labels appear upside down.



LED	Description	Definition
1	Host 4/8/16Gb FC[1] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O activity.
2	Host 10GbE iSCSI[2,3] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O or replication activity.
3	OK	Green — The controller is operating normally. Blinking green — System is booting. Off — The controller module is not OK, or is powered off.
4	Fault	Off — The controller is operating normally. Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled power-up or a cache flush or restore error.
5	OK to Remove	Off — The controller is not prepared for removal. Blue — The controller module is prepared for removal.
6	Identify	White — The controller module is being identified.
7	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. The unwritten information can be log or debug data that remains in the cache, so a Green cache status LED does not, by itself, indicate that any user data is at risk or that any action is necessary. Off — In a working controller, cache is clean (contains no unwritten data). This is an occasional condition that occurs while the system is booting. Blinking green — A CompactFlash flush or cache self-refresh is in progress, indicating cache activity.
8	Network Port Link Active Status[4]	Off — The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).
9	Network Port Link Speed[4]	Off — Link is up at 10/100base-T negotiated speeds. Amber — Link is up and negotiated at 1000base-T.
10	Expansion Port Status	Off — The port is empty or the link is down. Green — The port is connected and the link is up.

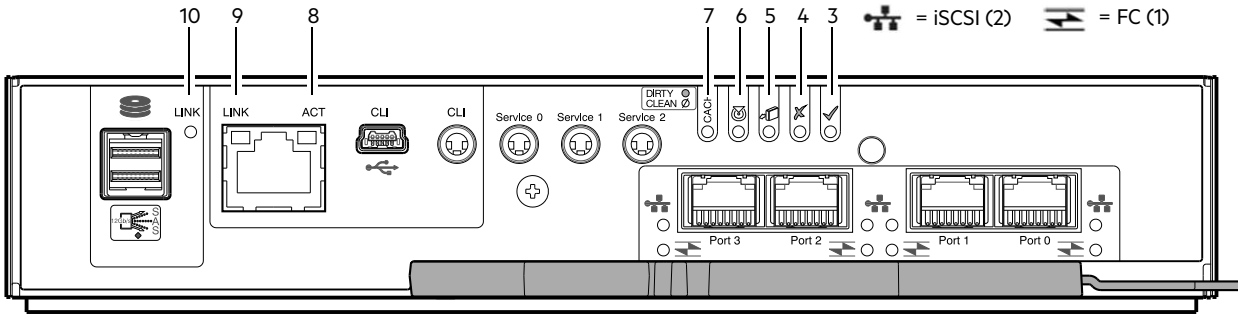
1-When in FC mode, the SFPs must be qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

2-When in 10GbE iSCSI mode, the SFPs must be a qualified 10GbE iSCSI optic option.

3-When powering up and booting, iSCSI LEDs will be on/blinking momentarily, then they will switch to the mode of operation.

4-When port is down, both LEDs are off.

Figure 27 LEDs: DS6200/DS4200 FC/iSCSI controller modules (FC and 10GbE SFPs)



LED	Description	Definition
1	Not used in example[1]	The FC SFP is not shown in this example.
2	Host 1Gb iSCSI[2,3] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O or replication activity.
3	OK	Green — The controller is operating normally. Blinking green — System is booting. Off — The controller module is not OK, or is powered off.
4	Fault	Off — The controller is operating normally. Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled power-up or a cache flush or restore error.
5	OK to Remove	Off — The controller is not prepared for removal. Blue — The controller module is prepared for removal.
6	Identify	White — The controller module is being identified.
7	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. The unwritten information can be log or debug data that remains in the cache, so a Green cache status LED does not, by itself, indicate that any user data is at risk or that any action is necessary. Off — In a working controller, cache is clean (contains no unwritten data). This is an occasional condition that occurs while the system is booting. Blinking green — A CompactFlash flush or cache self-refresh is in progress, indicating cache activity. See also “Cache Status LED details” (page 35).
8	Network Port Activity Status[4]	Off — The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).
9	Network Port Link Speed[4]	Off — Link is up at 10/100base-T negotiated speeds. Amber — Link is up and negotiated at 1000base-T.
10	Expansion Port Status	Off — The port is empty or the link is down. Green — The port is connected and the link is up.

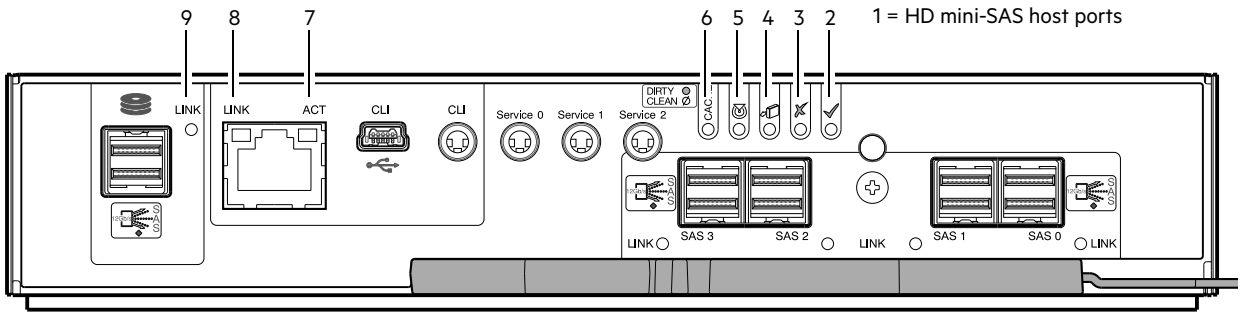
1-When in FC mode, the SFPs must be a qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

2-When in 1GbE iSCSI mode, the SFPs must be a qualified 1GbE iSCSI optic option.

3-When powering up and booting, iSCSI LEDs will be on/blinking momentarily, then they will switch to the mode of operation.

4-When port is down, both LEDs are off.

Figure 28 LEDs: DS6200/DS4200 iSCSI controller module (1Gb RJ-45 SFPs)



LED	Description	Definition
1	Host 12Gb SAS[1-3] Link Status/ Link Activity	Green — The port is connected and the link is up. Amber — Partial link exists (one or more lanes down). Blinking green or amber — Host link activity is detected.
2	OK	Green — The controller is operating normally. Blinking green — System is booting. Off — The controller module is not OK, or is powered off.
3	Fault	Off — The controller is operating normally. Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled power-up or a cache flush or restore error.
4	OK to Remove	Off — The controller is not prepared for removal. Blue — The controller module is prepared for removal.
5	Identify	White — The controller module is being identified.
6	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. The unwritten information can be log or debug data that remains in the cache, so a Green cache status LED does not, by itself, indicate that any user data is at risk or that any action is necessary. Off — In a working controller, cache is clean (contains no unwritten data). This is an occasional condition that occurs while the system is booting. Blinking green — A CompactFlash flush or cache self-refresh is in progress, indicating cache activity. See also “Cache Status LED details” (page 35).
7	Network Port Activity Status[4]	Off — The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).
8	Network Port Link Speed[4]	Off — Link is up at 10/100base-T negotiated speeds. Amber — Link is up and negotiated at 1000base-T.
9	Expansion Port Status	Off — The port is empty or the link is down. Green — The port is connected and the link is up.

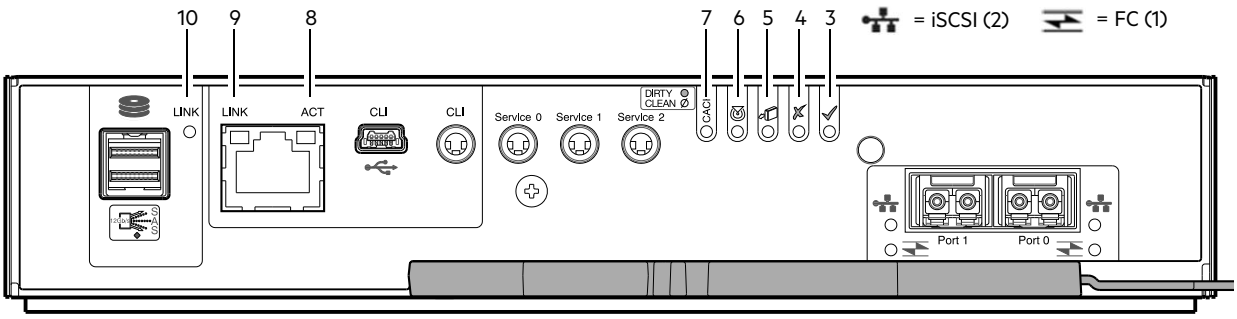
1-Cables must be qualified HD mini-SAS cable options.

2-Use a qualified SFF-8644 to SFF-8644 cable option when connecting the controller to a 12Gb SAS HBA.

3-Use a qualified SFF-8644 to SFF-8088 cable option when connecting the controller to a 6Gb SAS HBA.

4-When port is down, both LEDs are off.

Figure 29 LEDs: DS6200/DS4200 SAS controller module (HD mini-SAS)



LED	Description	Definition
1	Host 4/8/16Gb FC[1] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O activity.
2	Host 10GbE iSCSI[2,3] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O or replication activity.
3	OK	Green — The controller is operating normally. Blinking green — System is booting. Off — The controller module is not OK, or is powered off.
4	Fault	Off — The controller is operating normally. Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled power-up or a cache flush or restore error.
5	OK to Remove	Off — The controller is not prepared for removal. Blue — The controller module is prepared for removal.
6	Identify	White — The controller module is being identified.
7	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. The unwritten information can be log or debug data that remains in the cache, so a Green cache status LED does not, by itself, indicate that any user data is at risk or that any action is necessary. Off — In a working controller, cache is clean (contains no unwritten data). This is an occasional condition that occurs while the system is booting. Blinking green — A CompactFlash flush or cache self-refresh is in progress, indicating cache activity.
8	Network Port Activity Status[4]	Off — The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).
9	Network Port Link Speed[4]	Off — Link is up at 10/100base-T negotiated speeds. Amber — Link is up and negotiated at 1000base-T.
10	Expansion Port Status	Off — The port is empty or the link is down. Green — The port is connected and the link is up.

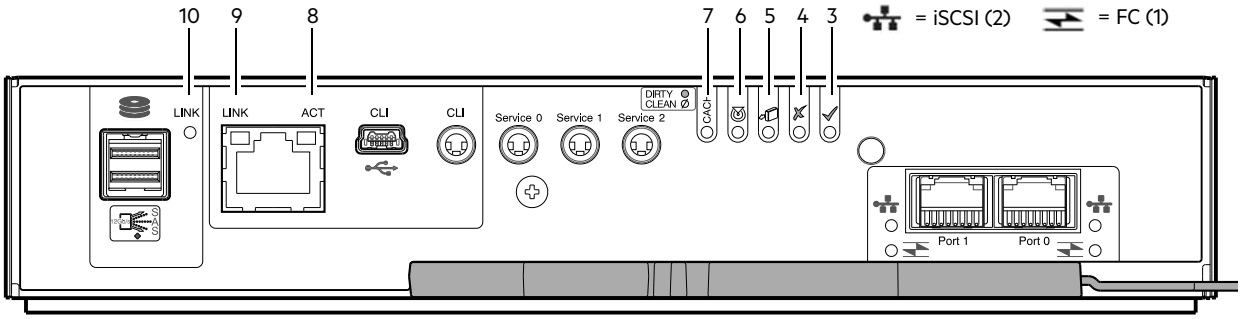
1-When in FC mode, the SFPs must be qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

2-When in 10GbE iSCSI mode, the SFPs must be a qualified 10GbE iSCSI optic option.

3-When powering up and booting, iSCSI LEDs will be on/blinking momentarily, then they will switch to the mode of operation.

4-When port is down, both LEDs are off.

Figure 30 LEDs: DS2200 FC/iSCSI controller modules (FC or 10GbE SFPs)



LED	Description	Definition
1	Not used in example[1]	The FC SFP is not shown in this example.
2	Host 1Gb iSCSI[2,3] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O or replication activity.
3	OK	Green — The controller is operating normally. Blinking green — System is booting. Off — The controller module is not OK, or is powered off.
4	Fault	Off — The controller is operating normally. Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled power-up or a cache flush or restore error.
5	OK to Remove	Off — The controller is not prepared for removal. Blue — The controller module is prepared for removal.
6	Identify	White — The controller module is being identified.
7	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. The unwritten information can be log or debug data that remains in the cache, so a Green cache status LED does not, by itself, indicate that any user data is at risk or that any action is necessary. Off — In a working controller, cache is clean (contains no unwritten data). This is an occasional condition that occurs while the system is booting. Blinking green — A CompactFlash flush or cache self-refresh is in progress, indicating cache activity. See also “Cache Status LED details” (page 35).
8	Network Port Activity Status[4]	Off — The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).
9	Network Port Link Speed[4]	Off — Link is up at 10/100base-T negotiated speeds. Amber — Link is up and negotiated at 1000base-T.
10	Expansion Port Status	Off — The port is empty or the link is down. Green — The port is connected and the link is up.

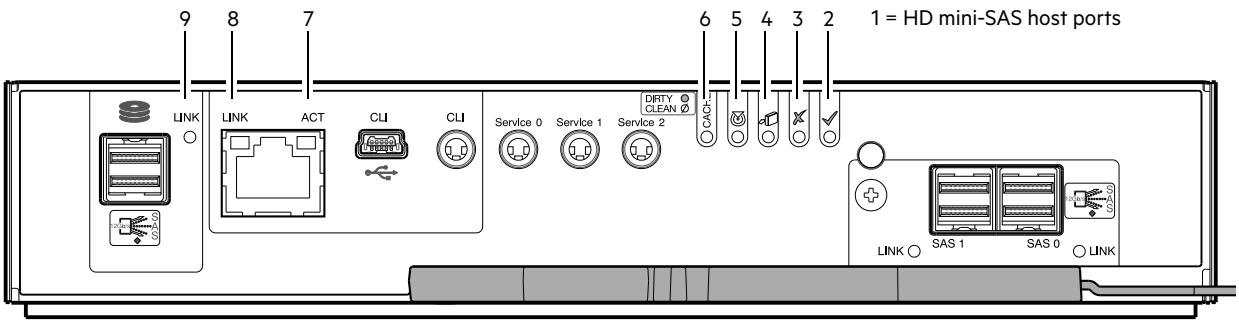
1-When in FC mode, the SFPs must be a qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

2-When in 1GbE iSCSI mode, the SFPs must be a qualified 1GbE iSCSI optic option.

3-When powering up and booting, iSCSI LEDs will be on/blinking momentarily, then they will switch to the mode of operation.

4-When port is down, both LEDs are off.

Figure 31 LEDs: DS2200 iSCSI controller module (1Gb RJ-45 SFPs)



LED	Description	Definition
1	Host 12Gb SAS[1-3] Link Status/ Link Activity	Green — The port is connected and the link is up. Amber — Partial link exists (one or more lanes down). Blinking green or amber — Host link activity is detected.
2	OK	Green — The controller is operating normally. Blinking green — System is booting. Off — The controller module is not OK, or is powered off.
3	Fault	Off — The controller is operating normally. Amber — A fault has been detected or a service action is required. Blinking amber — Hardware-controlled power-up or a cache flush or restore error.
4	OK to Remove	Off — The controller is not prepared for removal. Blue — The controller module is prepared for removal.
5	Identify	White — The controller module is being identified.
6	Cache Status	Green — Cache is dirty (contains unwritten data) and operation is normal. The unwritten information can be log or debug data that remains in the cache, so a Green cache status LED does not, by itself, indicate that any user data is at risk or that any action is necessary. Off — In a working controller, cache is clean (contains no unwritten data). This is an occasional condition that occurs while the system is booting. Blinking green — A CompactFlash flush or cache self-refresh is in progress, indicating cache activity. See also "Cache Status LED details" (page 35).
7	Network Port Activity Status[4]	Off — The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).
8	Network Port Link Speed[4]	Off — Link is up at 10/100base-T negotiated speeds. Amber — Link is up and negotiated at 1000base-T.
9	Expansion Port Status	Off — The port is empty or the link is down. Green — The port is connected and the link is up.

1-Cables must be qualified HD mini-SAS cable options.

2-Use a qualified SFF-8644 to SFF-8644 cable option when connecting the controller to a 12Gb SAS HBA.

3-Use a qualified SFF-8644 to SFF-8088 cable option when connecting the controller to a 6Gb SAS HBA.

4-When port is down, both LEDs are off.

Figure 32 LEDs: DS2200 SAS controller module (HD mini-SAS)

NOTE: Once a Link Status LED is lit, it remains so, even if the controller is shut down via the SMC or the CLI.

When a controller is shut down or otherwise rendered inactive—its Link Status LED remains illuminated— falsely indicating that the controller can communicate with the host. Though a link exists between the host and the chip on the controller, the controller is not communicating with the chip. To reset the LED, the controller must be power-cycled.

Cache Status LED details

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 supercapacitor pack provides backup power to flush (copy) data from write cache to CompactFlash 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 time-out 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 CompactFlash, 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 controller cache and one in CompactFlash of each controller. The Cache Status LED illuminates solid green during the boot-up process. This behavior indicates the cache is logging all POSTs, which will be flushed to the CompactFlash the next time the controller shuts down.

IMPORTANT: If the Cache Status LED illuminates solid green—and you wish to shut down the controller—do so from the user interface, so unwritten data can be flushed to CompactFlash.

Controller failure when a single-controller is operational

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 supercapacitor. This process typically takes 60 seconds per 1Gbyte of cache. After the cache is copied to CompactFlash, the remaining power left in the supercapacitor is used to refresh the cache memory. While the cache is being maintained by the supercapacitor, the Cache Status LED blinks at a rate of 1/10 second on and 9/10 second off.

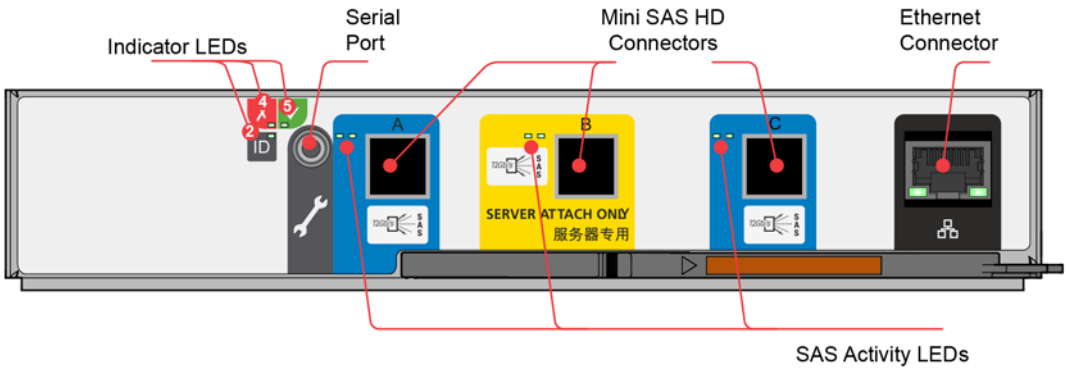
If the controller has failed or does not start, is the Cache Status LED on/blinking?

Answer	Action
No, the Cache LED status is off, and the controller does not boot.	If the problem persists, replace the controller module.
No, the Cache Status LED is off, and the controller boots.	The system has flushed data to disks. If the problem persists, replace the controller module.
Yes, at a strobe 1:10 rate - 1 Hz, and the controller does not boot.	You may need to replace the controller module.
Yes, at a strobe 1:10 rate - 1 Hz, and the controller boots.	The system is flushing data to CompactFlash. If the problem persists, replace the controller module.
Yes, at a blink 1:1 rate - 2 Hz, and the controller does not boot.	You may need to replace the controller module.
Yes, at a blink 1:1 rate - 1 Hz, and the controller boots.	The system is in self-refresh mode. If the problem persists, replace the controller module.

Table 5 LEDs: Rear panel “Cache Status”

12Gb/s expansion module LEDs

If optional expansion enclosures have been cabled to add storage, the supported DS Series expansion enclosures are configured with dual expansion modules.



LED	Description	Definition
1	OK	Green — The expansion module is operating normally. Blinking green — System is booting. Off — The expansion module is powered off.
2	Fault	Off — The expansion module is operating normally. Amber — A fault has been detected or a service action is required.
3	Identify	Blue — Expansion module is being identified.
4	Ethernet Port Link/Active Status (Left)	Not used in this configuration.
5	Ethernet Port Link Speed (Right)	Not used in this configuration.
6	HD mini-SAS connector LEDs (A/B/C)	See Table 6 for Activity (Green) and Fault (Amber) LED states.

Figure 33 LEDs: DS Series expansion module

The following table provides companion data for the figure above relative to LED states for A/B/C SAS port expansion.

Table 6 LEDs: DS Series expansion activity states

Condition	Activity (Green)	Fault (Amber)
No cable present	Off	Off
Cable present: all links up/no activity	On	Off
Cable present: all links up/with aggregate port activity	Blinking	Off
Critical fault: Any fault causing operation of the cable to cease or fail to start (e.g., over current trip).	Off	On
Non-critical fault: any fault that does not cause the connection to cease operation (e.g., not all links are established; over temperature).	Blinking	Blinking 1s on/1s off

IMPORTANT: RBOD/EBOD configurations:

- When the expansion module shown above (Figure 33) is used with DS6200/DS4200/DS2200 controller modules for adding storage, its middle HD mini-SAS expansion port (“B”) is disabled by the firmware. See also Figure 40 (page 45)
- The Ethernet port on the expansion module is not used in RBOD/EBOD configurations, and is disabled.

Drive carrier module

The drive carrier module comprises a hard disk held by a carrier.

- Each 2U12 drive slot holds a single low profile 1.0-inch high, 3.5-inch form factor disk drive in its carrier. The disk drives are horizontal. A 2.5" to 3.5" carrier adapter is available to accommodate 2.5" disk drives.
- Each 2U24 drive slot holds a single low profile 5/8-inch high, 2.5-inch form factor disk drive in its carrier. The disk drives are vertical.

The carriers have mounting locations for:

- Direct dock SAS drives.

A sheet steel carrier holds each drive, which provides thermal conduction, radio frequency, and electro-magnetic induction protection, and physically protects the drive.

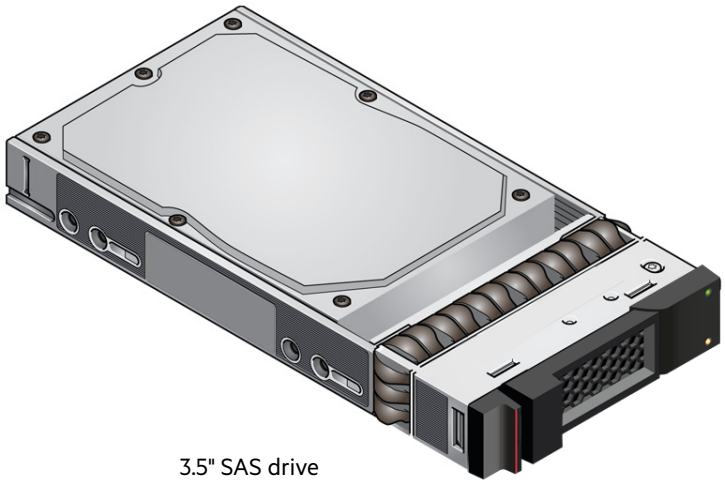
The front cap also has an ergonomic handle which gives the following functions:

- Secure location of the carrier into and out of drive slots.
- Positive spring-loading of the drive/midplane connector.

The carrier can use this interface:

- Dual path direct dock Serial Attached SCSI.

NOTE: Isometric pictorial views of supported drive carriers are provided in the following illustrations. Modules are shown oriented for insertion into disk drive slots located on the enclosure front panel.



3.5" SAS drive

Figure 34 Dual path LFF 3.5" disk drive carrier modules

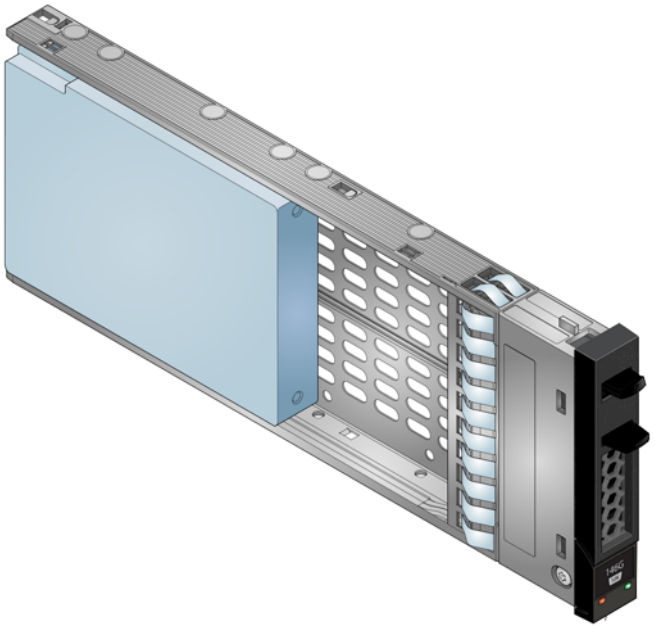


Figure 35 Dual path SFF 2.5" drive carrier module with no Interposer card

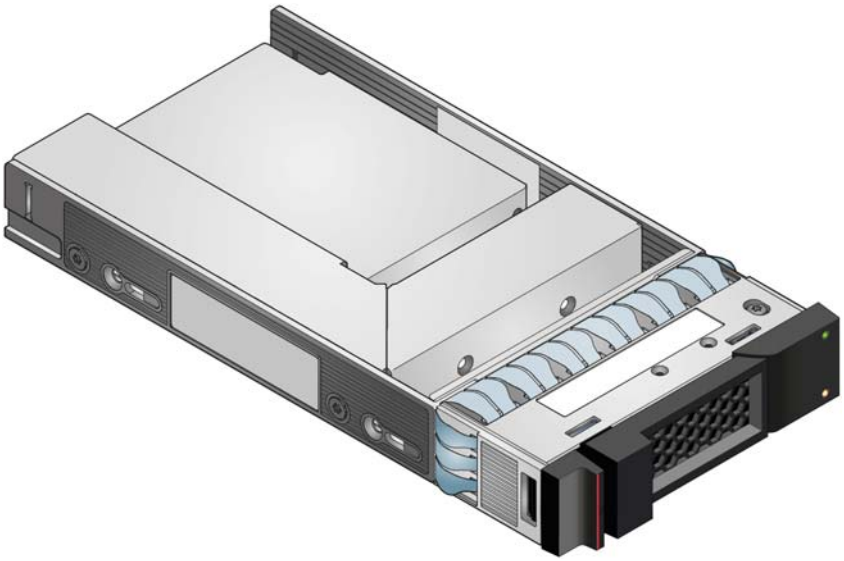


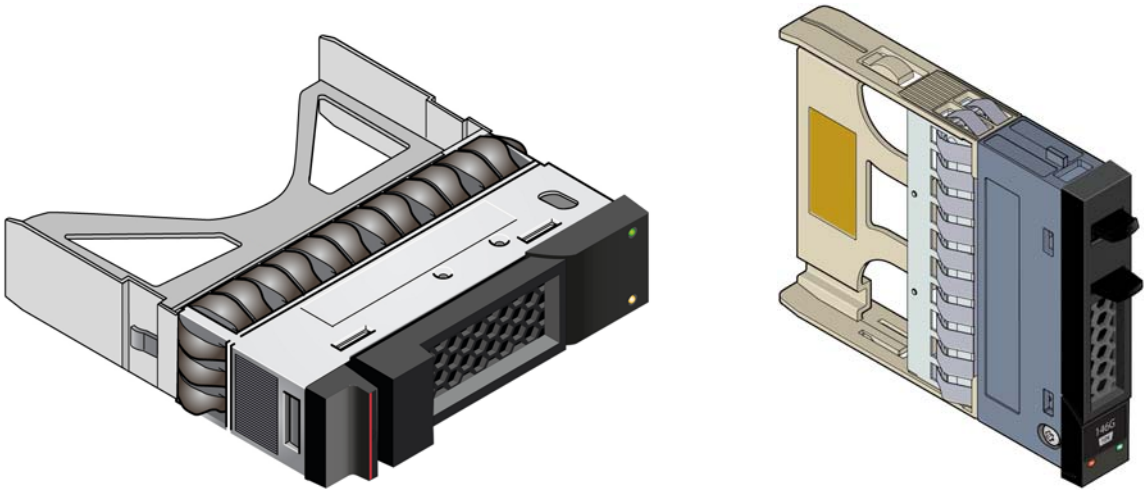
Figure 36 2.5" to 3.5" hybrid drive carrier adapter

Drive status indicators

Green and amber LEDs on the front of each drive carrier module indicate disk drive status. The SEP controls these LEDs. "Disk drive carrier module LEDs" (page 66) describes the LED states.

Dummy drive carrier modules

Dummy drive carrier modules, also known as either an LFF HDD Blank Filler (3.5") or SFF HDD Blank Filler (2.5"), are provided, and they must be installed in all empty drive slots to create a balanced airflow.



LFF HDD Blank Filler
(3.5" drive slot)

SFF HDD Blank Filler
(2.5" drive slot)

Figure 37 LFF HDD Blank Filler and SFF HDD Blank Filler

Enclosure management

SBB IOMs actively manage the enclosure. Each module has a SAS expander with its own storage enclosure processor (SEP) that provides a SES target for a host to interface to through the ANSI SES Standard. If one of these modules fails, the other module will continue to operate.

Refer to a module's specification or the SES Interface specification for definitions of the module's functions and its SES control. See also "Management interfaces" (page 39).

Management interfaces

Upon completing the hardware installation, you can access the controller module's web-based management interface—Storage Management Console (SMC)—to configure, monitor, and manage the storage system. See also "Accessing the SMC" (page 62).

The controller module also provides a CLI in support of command entry and scripting.

3 Installation

Installation checklist

This chapter shows how to plan for and successfully install your enclosure system into an industry standard 19-inch rack cabinet.

⚠ **CAUTION:** To install the system, use only the power cords supplied, or power cables that match the specification quoted in "AC power cords" (page 96).

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

Table 7 Installation checklist

Step	Task	Where to find procedure
1	Unpack the enclosure	See "Unpacking the enclosure" (page 42).
2	Install the controller enclosure and optional drive enclosures in the rack.[1]	See "Required tools" (page 42). See "Requirements for rackmount installation" (page 42).
3	Connect power cords.	See "Power cord connection" (page 46).
4	Test enclosure connectivity.	See "Testing enclosure connections" (page 46).
5	Install required host software.	See "Host system requirements" (page 46).
6	Connect hosts.[2]	See "Host system requirements" (page 46).
7	Connect remote management hosts.	See "Connecting a management host on the network" (page 52).
8	Obtain IP values and set network port IP properties on the controller enclosure.	See "Obtaining IP values" (page 53). For USB CLI port and cable see USB device connection.
9	For CNC models, verify the host interface protocol setting (not necessary for SAS models).	See "CNC technology" (page 47), The CNC IOMs allow for setting the host interface protocol for qualified SFP options. See "Change the CNC port mode" (page 56).
10	Perform initial configuration tasks:[3] • Sign-in to the web-browser interface to access the application GUI. • Verify firmware revisions and update if necessary. • Initially configure and provision the system using the SMC.	Topics below correspond to bullets at left: See the "Getting Started" chapter in Storage Manager Guide. See "Updating firmware" (page 53). Also see the same topic in the Storage Manager Guide. See the topics about configuring the system and provisioning the system in the Storage Manager Guide.

1-The environment in which the enclosure operates must be dust-free to ensure adequate airflow.

2-For more information about hosts, see the About hosts topic in the Storage Manager Guide.

3-The Storage Management Console is introduced in "Accessing the SMC" (page 62). See the Storage Manager Guide or online help for additional information.

Planning for installation

Before beginning the enclosure installation, familiarize yourself with the system configuration requirements. The figures listed below show the locations for each plug-in module:

- 2U12 front panel: see Figure 9 (page 21)
- 2U24 front panel: see Figure 10 (page 21)
- 2U controller enclosure rear panel: see Figure 11 (page 21)

- 2U expansion enclosure rear panel: see Figure 15 (page 22) (product option)

IMPORTANT: Installation work should be performed by qualified service personnel.

Table 8 Storage system configuration

Module type	Location	Description
Drive carrier modules	Front panel	All drive slots must hold either a drive carrier or dummy drive carrier module. Empty slots are not allowed. At least one disk must be installed.
Power cooling modules	Rear panel	Two PCMs provide full power redundancy, allowing the system to continue to operate while a faulty PCM is replaced.
I/O modules	Rear panel	Two IOMs must be installed for this configuration (RBOD and EBOD).

Preparing for installation

NOTE: Enclosures are delivered with all drive carrier modules installed.

CAUTION: The enclosure—together will all its component parts—is too heavy for one person to lift and install into the rack cabinet. Two people are required to safely move a 2U enclosure.

Make sure you wear an effective anti-static wrist or ankle strap and obey conventional ESD precautions when touching modules and components. Do not touch midplane, motherboard, or module connectors. See also “ESD precautions” (page 78).

This section provides important preparation requirements and handling procedures for use during product installation.

Preparing the site and host server

Before beginning the enclosure installation, verify that the site where you will install your storage system has the following:

- A standard AC power supply from a independent source or a rack power distribution unit with an Uninterruptible Power Supply (UPS).
- A host computer configured with the appropriate software, BIOS, and drives. Contact your supplier for the correct software configurations.

Before installing the enclosure, verify the existence of the following:

- Depending upon the controller module: SAS, FC, or iSCSI HBA and appropriate switches (if used)
- Qualified cable options for host connection
- One power cord per PCM
- Rail kit (for rack installation)

Please refer to your supplier for a list of qualified accessories for use with the enclosure. The accessories box contains the power cords and other accessories.

Unpacking the enclosure

1. Examine the packaging for crushes, cuts, water damage, or any other evidence of mishandling during transit.

   If you suspect that damage has happened, photograph the package before opening, for possible future reference. Retain original packaging materials for use with returns.
2. The unpacking sequence pertaining to 2U enclosures is shown in Figure 38.

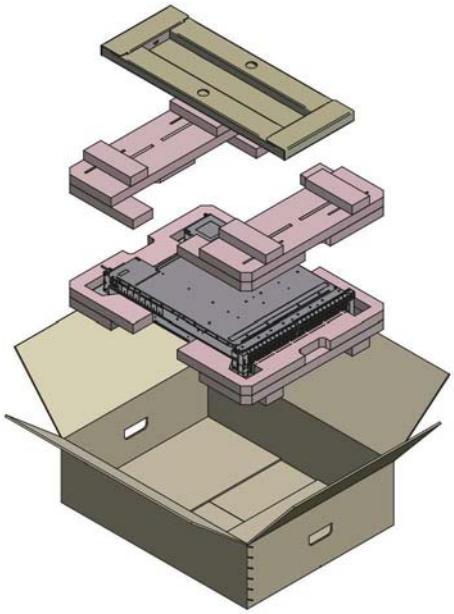


Figure 38 Unpacking the 2U12 and 2U24 enclosures

Enclosures are supplied with the midplane PCB and all plug-in modules installed. For information about plug-in module replacement, see Module removal and replacement. Dummy drive carriers must be installed in unused drive slots.

NOTE: If your product model uses CNC ports for FC or iSCSI, you must locate and install the SFPs. See also “Locate the SFP transceivers” (page 100).

Required tools

- Flat blade screwdriver

Requirements for rackmount installation

You can install the enclosure in an industry standard 19-inch cabinet capable of holding 2U form factors.

- Minimum depth: 707 mm (27.83") from rack posts to maximum extremity of enclosure (includes rear panel cabling and cable bend radii).
- Weight: Up to 32 kg (71 lb), dependent upon configuration, per enclosure.
- The rack should cause a maximum back pressure of 5 pascals (0.5 mm water gauge).
- Before you begin, ensure that you have adequate clearance in front of the rack for installing the rails. See also “Rack system safety precautions” (page 16).

Rackmount rail kit

Rack mounting rails are available for use in 19-inch rack cabinets. These rails have been designed and tested for the maximum enclosure weight, and to make sure that multiple enclosures may be installed without loss of space within the rack. Use of other mounting hardware may cause some loss of rack space.

Contact your supplier to make sure suitable mounting rails are available for the rack you are to use.

Installing the 2U enclosure

1. Remove the rack mounting rail kit from the accessories box, and examine for damage.
2. Use the procedure below to attach the rail kit brackets to the rack post as shown in Figure 39.
   a. Set the location pin at the rear of the rail into a rear rack post hole. Attach the bracket to the rear rack post: use the washers and screws supplied. Leave the screws loose.
   b. Extend the rail to fit between the front and rear rack posts.
   c. Attach the bracket to the front rack post using the washers and screws supplied. Leave the screws loose.
   d. Tighten the two clamping screws located along the inside of the rear section of the rack bracket.
   e. Repeat the above sequence of steps for the companion rail.

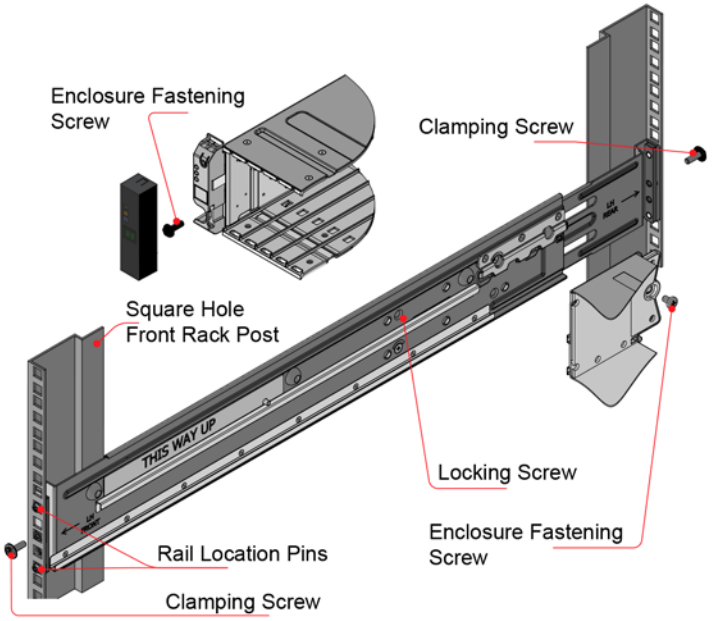


Figure 39 Securing brackets to the rail (left hand rail shown)

3. Install the enclosure into the rack:
   a. Lift the enclosure and align it with the installed rack rails, taking care to ensure that the enclosure remains level.
   b. Carefully insert the chassis slides into the rack rails and push fully in.
   c. Tighten the mounting screws in the rear rail kit brackets.
   d. Remove the enclosure until it reaches the hard stops—approximately 400 mm (15.75")—and tighten the mounting screws in the front rail kit bracket.
   e. Return the enclosure to the fully home position.

FDE considerations

The Full Disk Encryption feature available via the management interfaces requires use of self-encrypting drives (SED) which are also referred to as FDE-capable disk drive modules. When installing FDE-capable disk drive modules, follow the same procedures for installing disks that do not support FDE. The exception occurs when you move FDE-capable disk drive modules for one or more disk groups to a different system, which requires additional steps.

The procedures for using the FDE feature, such as securing the system, viewing disk FDE status, and clearing and importing keys are performed using the SMC or CLI (see the Storage Manager Guide or CLI Reference Guide for more information).

NOTE: For more information about FDE, see the Storage Manager Guide.

Connecting the controller enclosure and optional expansion enclosures

The DS6200 and DS4200 controller enclosures support up to nine (9) expansion enclosures for a maximum of 240 disk drives. The DS2200 controller enclosure supports up to three (3) expansion enclosures for a maximum of 96 disk drives. The enclosures support both *straight-through* and *reverse* SAS cabling. Reverse cabling allows any drive enclosure to fail—or be removed—while maintaining access to other enclosures. Fault tolerance and performance requirements determine whether to optimize the configuration for high availability or high performance when cabling.

Cabling diagrams in this section show fault-tolerant cabling patterns. Controller and expansion modules are identified by enclosure ID and IOM ID, such as 0A and 0B for controller enclosures, 1A and 1B for the first expansion enclosure in a cascade, and so forth. When connecting multiple expansion enclosures, use reverse cabling to ensure the highest level of fault tolerance, enabling controllers to access remaining expansion enclosures if an expansion enclosure fails.

Cable requirements for expansion enclosures

When adding storage, use only Lenovo ThinkSystem or OEM-qualified cables, and observe the following guidelines:

- When installing SAS cables to expansion modules, use only supported HD mini-SAS x4 cables.
- Qualified HD mini-SAS to HD mini-SAS 0.5 m (1.64') cables are used to connect cascaded enclosures in the rack.
- The maximum expansion cable length allowed in any configuration is 2 m (6.56').
- When adding more than two drive enclosures, you may need to purchase additional cables, depending upon number of enclosures and cabling method used.
- You may need to order additional or longer cables when reverse-cabling a fault-tolerant configuration.

The rear panel view of the 2U12 and 2U24 controller enclosures are nearly identical to one another. The rear panel views of the DS Series expansion enclosures are also nearly identical to one another.

NOTE: For clarity, the schematic diagrams show only relevant details such as IOM face plate outlines and expansion ports. For detailed illustrations see "Enclosure rear panel" (page 21).

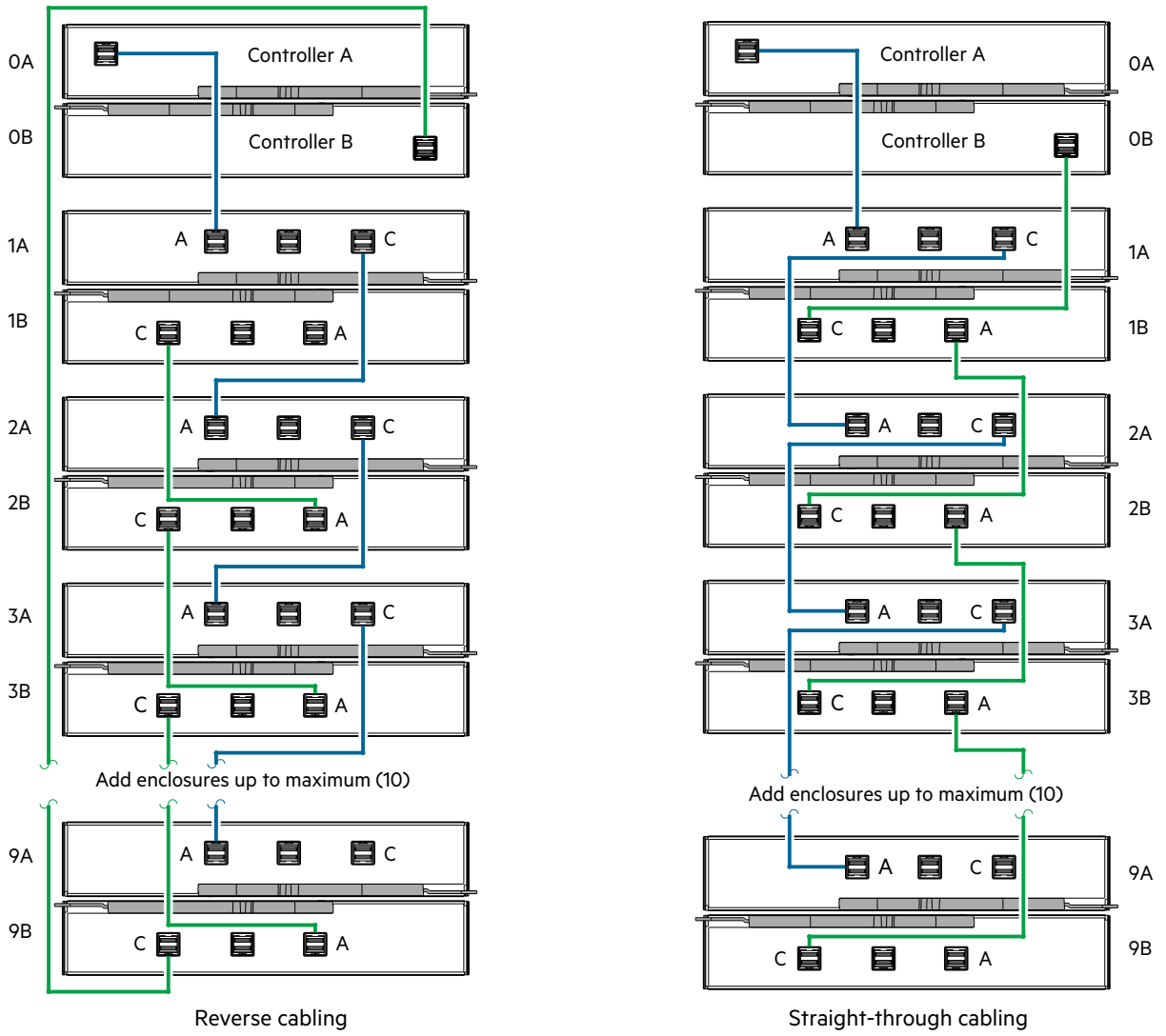


Figure 40 Cabling connections between a 2U controller enclosure and 2U expansion enclosures

The diagram above (left) shows reverse cabling of a DS6200/DS4200/DS2200 dual-controller 2U enclosure and supported DS EXP 2U drive enclosures configured with dual expansion modules. Controller module 0A is connected to expansion module 1A, with a chain of connections cascading down (blue). Controller module 0B is connected to the lower expansion module (9B), of the last expansion enclosure, with connections moving in the opposite direction (green). Reverse cabling allows any expansion enclosure to fail—or be removed—while maintaining access to other enclosures.

The diagram at right (above) shows the same storage components connected to use straight-through cabling. Using this method, if an expansion enclosure fails, the enclosures that follow the failed enclosure in the chain are no longer accessible until the failed enclosure is repaired or replaced.

The 2U drive enclosures shown in the above figure can either be of the same type or they can be a mixture of DS EXP models. Given that supported drive enclosure models use 12Gb/s SAS link-rate and SAS 3.0 expanders, they can be ordered in desired sequence within the system, following the controller enclosure. The middle SAS ports on expansion modules are not used. See also Figure 20 (page 23) and the **Important** text beneath that figure. Refer to these diagrams when cabling multiple DS Series expansion enclosures together with DS6200/DS4200/DS2200 controller enclosures.

Power cord connection

Connect a power cord from each PCM on the enclosure rear panel to the PDU (power distribution unit) as shown in the illustration below (4-port SAS model is shown in the example).

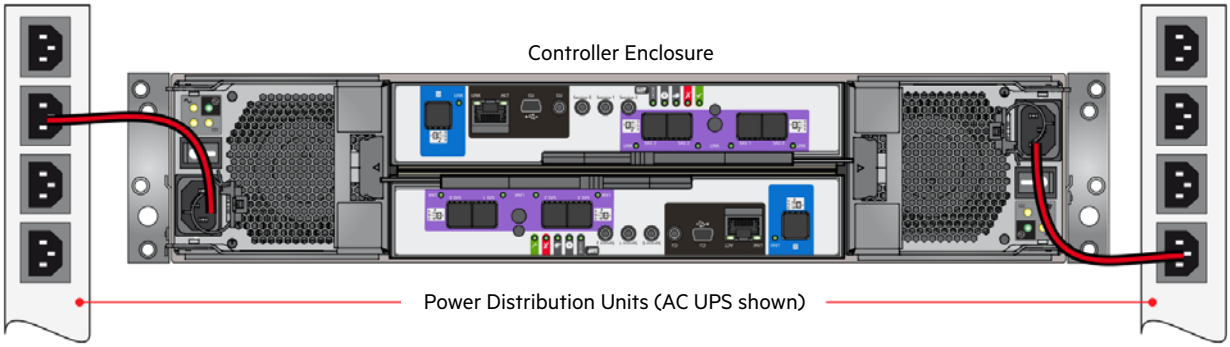


Figure 41 Typical AC power cord connection from PDU to PCM

IMPORTANT: When more than one PCM is fitted, all power cords must be connected to at least two separate and independent power supplies to ensure redundancy. When the storage system is ready for operation, ensure that each PCM power switch is set to the **On** position. See also "Powering on/powering off" (page 61).

CAUTION: Power connection concerns:

- Always remove the power connections *before* you remove the PCM from the enclosure.
- When bifurcated power cords (Y leads) are used, these cords must only be connected to a supply range of 200–240V AC.

Testing enclosure connections

See "Powering on/powering off" (page 61). Once the power-on sequence succeeds, the storage system is ready to be connected as described in "Connecting the enclosure to hosts" (page 47).

Grounding checks

The product must only be connected to a power source that has a safety electrical earth connection.

CAUTION: If more than one 2U enclosure goes in a rack, the importance of the earth connection to the rack increases because the rack will have a larger Earth Leakage Current (Touch Current).

Examine the earth connection to the rack before power on. An electrical engineer who is qualified to the appropriate local and national standards must do the examination.

Host system requirements

Hosts connected to a DS6200/DS4200/DS2200 controller enclosure must meet the following requirements:

Depending on your system configuration, 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.

Use native Microsoft MPIO DSM support with Windows Server 2008, Windows Server 2012, and Windows Server 2016. Use either the Server Manager or the *mpclaim* CLI tool to perform the installation.

See the following web sites for information about using native Microsoft MPIO DSM:

https://support.microsoft.com

https://technet.microsoft.com (search the site for "multipath I/O overview")

Cabling considerations

Common cabling configurations address hosts, controller enclosures, expansion enclosures, and switches. Host interface ports on DS6200/DS4200/DS2200 controller enclosures can connect to respective hosts via direct-attach or switch-attach. Cabling systems to enable use of the optional replication feature—to replicate volumes—is yet another important cabling consideration. See "Connecting a management host on the network" (page 52). The iSCSI product models can be licensed to support replication, whereas the FC and HD mini-SAS models cannot.

Use only Lenovo ThinkSystem or OEM-qualified cables for host connection:

- Qualified Fibre Channel SFP and cable options
- Qualified 10GbE iSCSI SFP and cable options
- Qualified 1Gb RJ-45 SFP and cable options
- Qualified HD mini-SAS cable options

Connecting the enclosure to hosts

A *host* identifies an external port to which the storage system is attached. The external port may be a port in an I/O adapter (such as an FC HBA) in a server. Cable connections vary depending on configuration. This section describes host interface protocols supported by DS6200/DS4200/DS2200 controller enclosures, while showing a few common cabling configurations.

NOTE: DS6200/DS4200/DS2200 controllers use Unified LUN Presentation (ULP), which enables a host to access mapped volumes through any controller host port.

ULP can show all LUNs through all host ports on both controllers, and the interconnect information is managed by the controller firmware. ULP appears to the host as an active-active storage system, allowing the host to select any available path to access the LUN, regardless of disk group ownership.

TIP: See "Using the Configuration Wizard" in the Storage Management Guide to initially configure the system or change system configuration settings (such as Configuring host ports).

CNC technology

The DS6200/DS4200/DS2200 FC/iSCSI models use Converged Network Controller (CNC) technology, allowing you to select the desired host interface protocol(s) from the available FC or iSCSI host interface protocols supported by the system. The small form-factor pluggable (SFP transceiver or SFP) connectors used in CNC ports are further described in the subsections below. Also see "CNC ports used for host connection" (page 11) for more information concerning use of CNC ports.

NOTE: Controller modules are *not* shipped with pre-installed SFPs. Within your product kit, you will need to locate the qualified SFP options and install them into the CNC ports. See "Install an SFP transceiver" (page 100).

IMPORTANT: Use the CLI `set host-port-mode` command to set the host interface protocol for CNC ports using qualified SFP options. DS6200/DS4200/DS2200 models ship with CNC ports configured for FC. When connecting CNC ports to iSCSI hosts, you must use the CLI (not the SMC) to specify which ports will use iSCSI. It is best to do this before inserting the iSCSI SFPs into the CNC ports (see "Change the CNC port mode" (page 56) for instructions).

Fibre Channel protocol

DS6200/DS4200/DS2200 FC controller enclosures support two controller modules using the Fibre Channel interface protocol for host connection. Each DS6200/DS4200 FC controller module provides four host ports, whereas each DS2200 FC controller module provides two host ports. CNC ports are designed for use with an FC SFP supporting data rates up to 16Gb/s.

The controllers support Fibre Channel Arbitrated Loop (public or private) or point-to-point topologies. Loop protocol can be used in a physical loop or for direct connection between two devices. Point-to-point protocol is used to connect to a fabric switch. Point-to-point protocol can also be used for direct connection, and it is the only option supporting direct connection at 16Gb/s. See the CLI `set host-parameters` command within the CLI Reference Guide for command syntax and details about parameter settings relative to supported link speeds. Fibre Channel ports are used for attachment to FC hosts directly, or through a switch used for the FC traffic. The host computer must support FC and optionally, multipath I/O.

TIP: Use the SMC Configuration Wizard to set FC port speed. Within the Storage Manager Guide, see the topic about configuring host ports. Use the CLI `set host-parameters` command to set FC port options, and use the CLI `show ports` command to view information about host ports.

10GbE iSCSI protocol

DS6200/DS4200/DS2200 10GbE iSCSI controller enclosures support two controller modules using the Internet SCSI interface protocol for host connection. Each DS6200/DS4200 10GbE iSCSI controller module provides four host ports, whereas each DS2200 10GbE iSCSI controller module provides two host ports. CNC ports are designed for use with a 10GbE iSCSI SFP supporting data rates up to 10Gb/s, using either one-way or mutual CHAP (Challenge-Handshake Authentication Protocol).

The 10GbE iSCSI ports are used in either of two capacities:

- To connect two storage systems through a switch for use of replication.
- For attachment to 10GbE iSCSI hosts directly, or through a switch used for the 10GbE iSCSI traffic.

The first usage option requires valid licensing for the replication feature, whereas the second option requires that the host computer supports Ethernet, iSCSI, and optionally, multipath I/O.

TIP: See the topic about configuring CHAP in the Storage Management Guide.

TIP: Use the SMC Configuration Wizard to set iSCSI port options. Within the Storage Manager Guide, see the topic about configuring host ports. Use the CLI `set host-parameters` command to set iSCSI port options, and use the CLI `show ports` command to view information about host ports.

1Gb iSCSI protocol

DS6200/DS4200/DS2200 1Gb iSCSI controller enclosures support two controller modules using the Internet SCSI interface protocol for host port connection. Each DS6200/DS4200 1Gb iSCSI controller module provides four host ports,

whereas each DS2200 1Gb iSCSI controller module provides two host ports. The CNC ports are designed for use with an RJ-45 SFP supporting data rates up to 1Gb/s, using either one-way or mutual CHAP.

TIP: See the “Configuring CHAP” topic in the Storage Management Guide.

TIP: Use the SMC Configuration Wizard to set iSCSI port options. Within the Storage Manager Guide, see “Configuring host ports.” Use the CLI `set host-parameters` command to set iSCSI port options, and use the CLI `show ports` command to view information about host ports.

The 1Gb iSCSI ports are used in either of two capacities:

- To connect two storage systems through a switch for use of replication.
- For attachment to 1Gb iSCSI hosts directly, or through a switch used for the 1Gb iSCSI traffic.

The first usage option requires valid licensing for the replication feature, whereas the second option requires that the host computer supports Ethernet, iSCSI, and optionally, multipath I/O.

HD mini-SAS

DS6200/DS4200/DS2200 SAS models use 12Gb/s host interface protocol and qualified cable options for host connection as described in “Cabling considerations” (page 47).

12Gb HD mini-SAS host ports

DS6200/DS4200/DS2200 12Gb SAS controller enclosures support two controller modules. The DS6200/DS4200 12Gb/s SAS controller module provides four SFF-8644 HD mini-SAS host ports, whereas the DS2200 12Gb/s SAS controller module provides two SFF-8644 HD mini-SAS host ports. These host ports support data rates up to 12Gb/s. HD mini-SAS host ports are used for attachment to SAS hosts directly. The host computer must support SAS and optionally, multipath I/O. Use a qualified cable option when connecting to a host.

Host connection

DS6200/DS4200 controller enclosures support up to eight direct-connect server connections, four per controller module. DS2200 controller enclosures support up to four server connections, two per controller module. Connect appropriate cables from the server’s HBAs to the controller module’s host ports as described below, and shown in the following illustrations.

Fibre Channel host connection

To connect controller modules supporting (4/8/16Gb) FC host interface ports to a server HBA or switch, using the controller’s CNC ports, select a qualified FC SFP option.

Qualified options support cable lengths of 1 m (3.28'), 2 m (6.56'), 5 m (16.40'), 15 m (49.21'), 30 m (98.43'), and 50 m (164.04') for OM4 multimode optical cables and OM3 multimode FC cables, respectively. A 0.5 m (1.64') cable length is also supported for OM3.

10GbE iSCSI host connection

To connect controller modules supporting 10GbE iSCSI host interface ports to a server HBA or switch, using the controller’s CNC ports, select a qualified 10GbE SFP option.

Qualified options support cable lengths of 0.5 m (1.64'), 1 m (3.28'), 3 m (9.84'), 5 m (16.40'), and 7 m (22.97') for copper cables; and cable lengths of 0.65 m (2.13'), 1 m (3.28'), 1.2 m (3.94'), 3 m (9.84'), 5 m (16.40'), and 7 m (22.97') for direct attach copper (DAC) cables. In addition to providing host connection, these cables are used for connecting two storage systems via a switch, to facilitate use of the optional replication feature.

1Gb iSCSI host connection

To connect controller modules supporting 1Gb iSCSI host interface ports to a server HBA or switch, using the controller's CNC ports, select a qualified 1Gb RJ-45 copper SFP option supporting (CAT5-E minimum) Ethernet cables of the same lengths specified for 10GbE iSCSI above. In addition to providing host connection, these cables are used for connecting two storage systems via a switch, to facilitate use of the optional replication feature.

HD mini-SAS host connection

To connect controller modules supporting HD mini-SAS host interface ports to a server HBA, using the controller's SFF-8644 dual HD mini-SAS host ports, select a qualified HD mini-SAS cable option.

A qualified SFF-8644 to SFF-8644 cable option is used for connecting to a 12Gb/s enabled host; whereas a qualified SFF-8644 to SFF-8088 cable option is used for connecting to a 6Gb/s host. Qualified SFF-8644 to SFF-8644 options support cable lengths of 0.5 m (1.64'), 1 m (3.28'), 2 m (6.56'), and 4 m (13.12'). Qualified SFF-8644 to SFF-8088 options support cable lengths of 1 m (3.28'), 2 m (6.56'), 3 m (9.84'), and 4 m (13.12').

Dual-controller configurations

Direct attach

A dual-controller configuration improves application availability because in the event of a controller failure, the affected controller fails over to the partner controller with little interruption to data flow. A failed controller can be replaced without the need to shut down the storage system. The DS6200/DS4200/DS2200 enclosures are configured with dual controller modules.

NOTE: In the examples that follow, a single diagram represents CNC and SAS host connections for DS6200 and DS4200 respectively. The location and sizes of the host ports are very similar. A single diagram represents CNC and SAS host connections for DS2200. Blue cables show controller A paths and green cables show controller B paths for host connection.

DS6200/DS4200

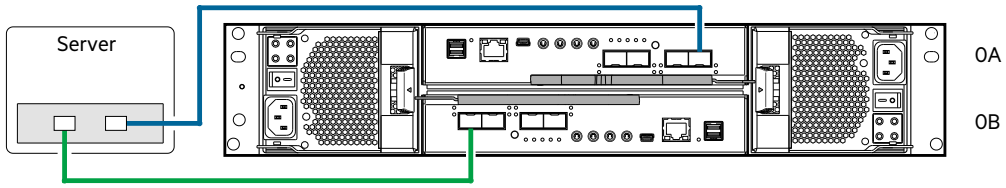


Figure 42 Connecting hosts: DS6200/DS4200 direct attach – one server/ one HBA/ dual path

DS2200

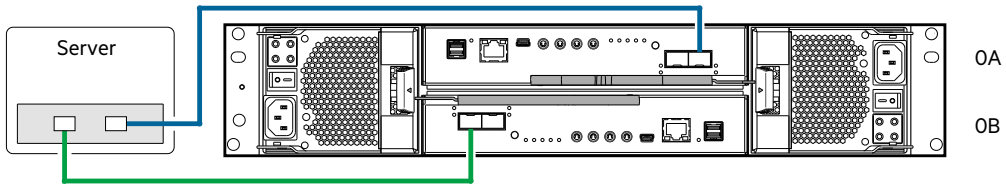


Figure 43 Connecting hosts: DS2200 direct attach – one server/ one HBA/ dual path

DS6200/DS4200

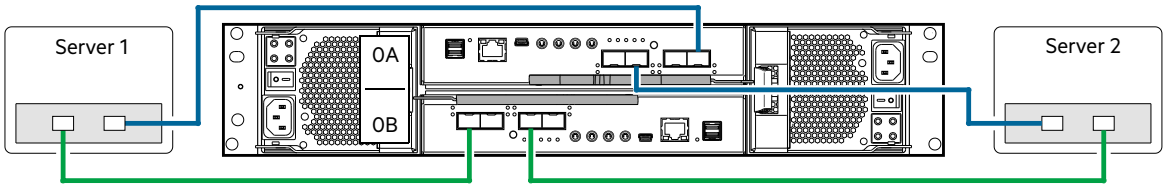


Figure 44 Connecting hosts: DS6200/DS4200 direct attach – two servers/ one HBA per server/ dual path

DS2200

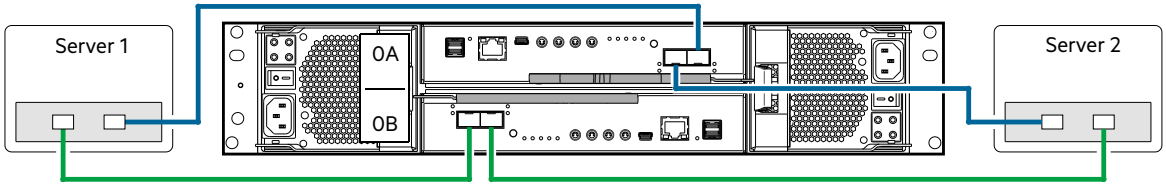


Figure 45 Connecting hosts: DS2200 direct attach – two servers/ one HBA per server/ dual path

DS6200/DS4200

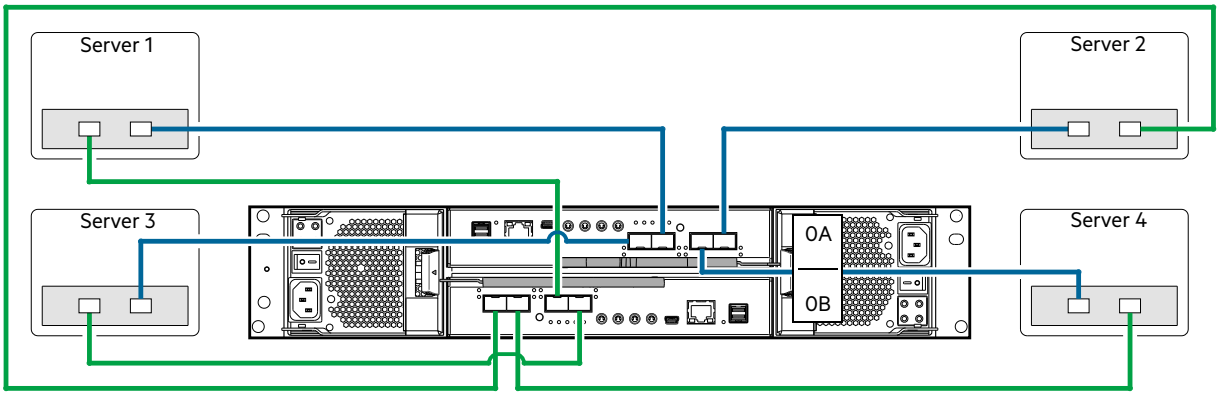


Figure 46 Connecting hosts: DS6200/DS4200 direct attach – four servers/ one HBA per server/ dual path

Switch attach

A switch attach solution—or SAN—places a switch between the servers and the controller enclosures within the storage system. Using switches, a SAN shares a storage system among multiple servers, reducing the number of storage systems required for a particular environment. Using switches increases the number of servers that can be connected to the storage system.

DS6200/DS4200

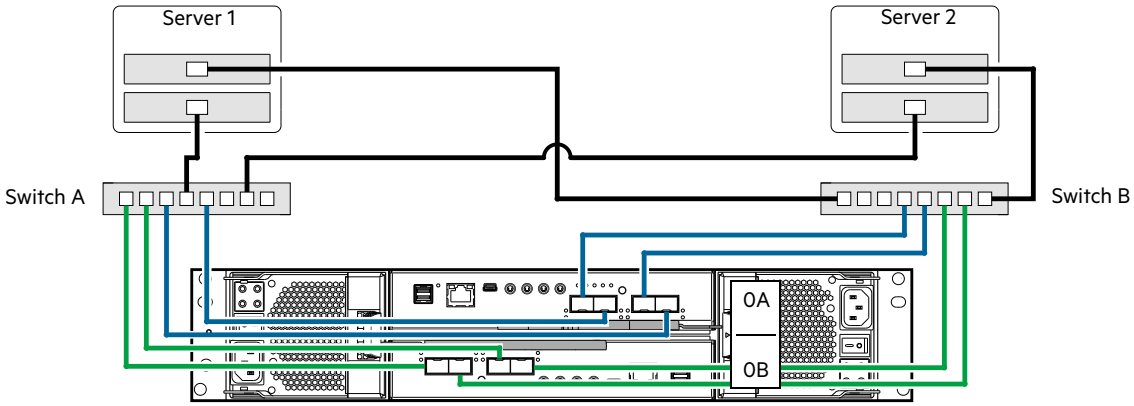


Figure 47 Connecting hosts: DS6200/DS4200 switch attach – two servers/ two switches

DS2200

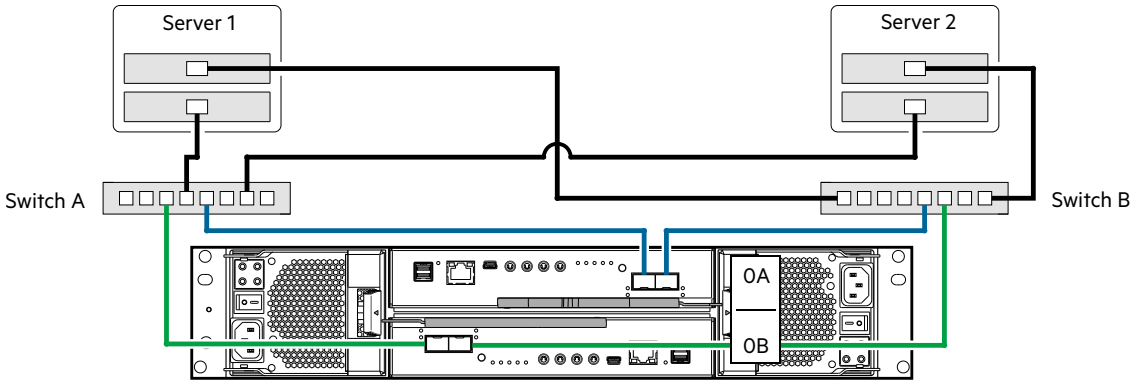


Figure 48 Connecting hosts: DS2200 switch attach – two servers/ two switches

DS6200/DS4200

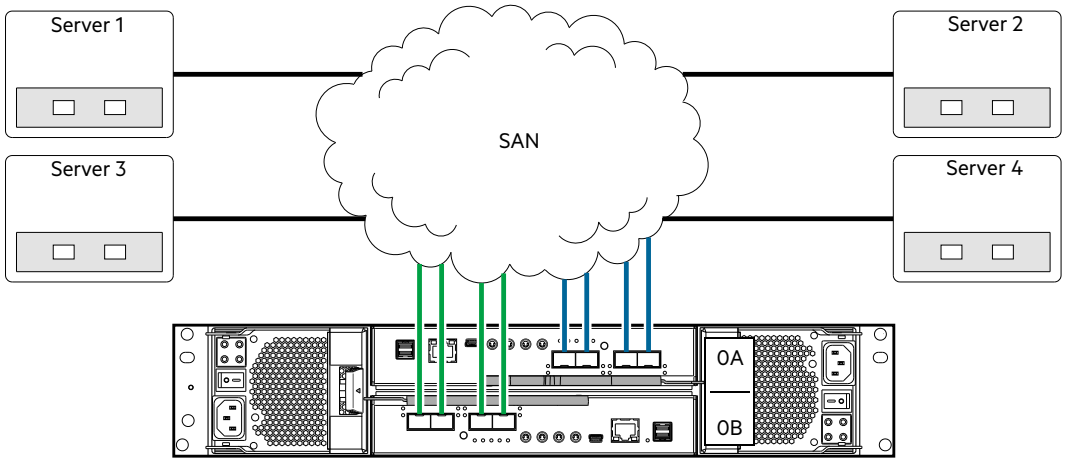


Figure 49 Connecting hosts: DS6200/DS4200 switch attach – four servers/ multiple switches/ SAN fabric

Connecting a management host on the network

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

1. Connect an RJ-45 Ethernet cable to the network 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).

   Do not interconnect iSCSI and management Ethernet on the same network.

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

Updating firmware

After installing the hardware and powering on the storage system components for the first time, verify that the controller modules, expansion modules, and disk drives are using the current firmware release.

Using the Storage Management Console, in the **System** topic, select **Action > Update Firmware**.

The Update Firmware panel opens. The Update Controller Module tab shows versions of firmware components currently installed in each controller.

NOTE: The SMC does *not* provide an option for enabling or disabling Partner Firmware Update for the partner controller. To enable or disable the setting, use the CLI `set advanced-settings` command, and set the `partner-firmware-upgrade` parameter. See the CLI Reference Guide for more information about command parameter syntax.

Optionally, you can update firmware using FTP as described in the Storage Manager Guide.

IMPORTANT: See the "Updating firmware" topic in the Storage Manager Guide before performing a firmware update. Partner Firmware Update (PFU) is enabled by default on DS6200/DS4200/DS2200 systems.

Obtaining IP values

You can configure addressing parameters for each controller module's network port. You can set static IP values or use DHCP. DHCP is enabled by default on DS6200/DS4200/DS2200 systems.

TIP: See the "Configuring network ports" topic in the Storage Manager Guide.

Setting network port IP addresses using DHCP

In DHCP mode, network port IP address, subnet mask, and gateway values are obtained from a DHCP server if one is available. If a DHCP server is unavailable, current addressing is unchanged. You must have some means of determining what addresses have been assigned, such as the list of bindings on the DHCP server.

Setting network port IP addresses using the CLI port and cable

If you did not use DHCP to set network port IP values, set them manually as described below. If you are using the USB CLI port and cable, you will need to enable the port for communication. See also "Using the CLI port and cable—known issues on Windows" (page 99).

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

- **Network 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 network port using the CLI embedded in each controller module. The CLI enables you to access the system using the USB (Universal Serial Bus) communication interface and terminal emulation software.

NOTE: If you are using the mini USB CLI port and cable, see Appendix C - USB device connection:

- Unless using Win 10 or Server 2016, Windows customers should download and install the device driver as described in "Obtaining the software download" (page 98).
- Linux customers should prepare the USB port as described in "Setting parameters for the device driver" (page 99).

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

Once new IP addresses are set, you can change them as needed using the SMC. Be sure to change the IP address before changing the network configuration. See "Accessing the SMC" (page 62) for more information concerning the web-based storage management application.

1. From your network administrator, obtain an IP address, subnet mask, and gateway address for controller A and another for controller B.

   Record these IP addresses so you can specify them whenever you manage the controllers using the SMC or the CLI.
2. Use the provided USB cable to connect controller A to a USB port on a host computer. The USB mini 5 male connector plugs into the CLI port as shown in Figure 50 (generic controller module is shown).

   Within the illustration below, the IOM is aligned for use in the bottom (0B) controller module slot.

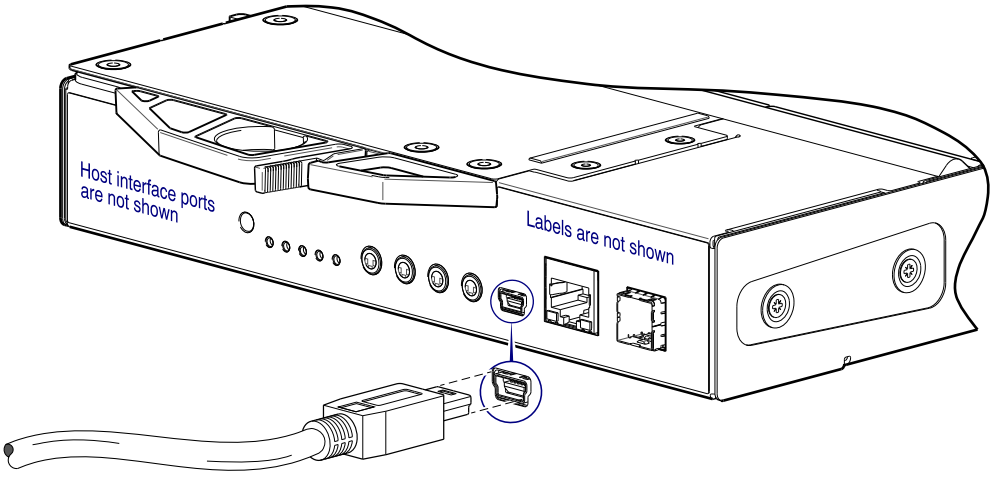


Figure 50 Connecting a USB cable to the CLI port

3. Enable the CLI port for subsequent communication:
   - Linux customers should enter the command syntax provided in "Setting parameters for the device driver" (page 99).
   - Windows customers should locate the downloaded device driver described in "Obtaining the software download" (page 98), and follow the instructions provided for proper installation.

4. Start and configure a terminal emulator, such as HyperTerminal or VT-100, using the display settings used in Table 9 (page 55), and the connection settings in Table 10 (page 55) (also, see the note following this procedure).

Table 9 Terminal emulator display settings

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

Table 10 Terminal emulator connection settings

Parameter	Value
Connector	COM3 (for example)[1,2]
Baud rate	115,200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

1-Your server or laptop configuration determines which COM port is used for Disk Array USB Port.
2-Verify the appropriate COM port for use with the CLI.

5. In the terminal emulator, connect to controller A.
6. Press **Enter** to display the CLI prompt (#).

   The CLI displays the system version, Management Controller version, and login prompt.

   a. At the login prompt, enter the default user **manage**.
   b. Enter the default password **!manage**.

   If the default user or password—or both—have been changed for security reasons, enter the secure login credentials instead of the defaults shown above.
7. At the prompt, enter the following CLI command to set the values you obtained in step 1 for each network 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 192.168.0.1 controller b
   ```
8. Enter the following CLI 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.
9. Use the ping command to verify connectivity to the gateway address.

   For example:

   ```
   # ping 192.168.0.1
   ```

```
A success message will say that the remote computer responded with 4 packets.
```

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

    ```
    ping controller-IP-address
    ```

    If you cannot access your system for at least three minutes after changing the IP address, you might need to restart the Management Controller(s) using the serial CLI.

    When you restart a Management Controller, communication with it is temporarily lost until it successfully restarts.

    Enter the following CLI command to restart the Management Controller in both controllers:

    ```
    restart mc both
    ```

    IMPORTANT: When configuring an iSCSI system or a system using a combination of FC and iSCSI SFPs, do *not* restart the Management Controller or exit the terminal emulator session until configuring the CNC ports as described in Change the CNC port mode.

11. When you are done using the CLI, exit the emulator.
12. Retain the IP addresses (recorded in step 1) for accessing and managing the controllers using the SMC or the CLI.

NOTE: Using HyperTerminal with the CLI on a Microsoft Windows host:

On a host computer connected to a controller module's mini-USB CLI port, incorrect command syntax in a HyperTerminal session can cause the CLI to hang. To avoid this problem, use correct syntax, use a different terminal emulator, or connect to the CLI using telnet rather than the mini-USB cable.

Be sure to close the HyperTerminal session before shutting down the controller or restarting its Management Controller. Otherwise, the host's CPU cycles may rise unacceptably.

If communication with the CLI is disrupted when using an out-of-band cable connection, communication can sometimes be restored by disconnecting and reattaching the mini-USB CLI cable as described in step 2 and Figure 50 (page 54).

Change the CNC port mode

This subsection applies to DS6200/DS4200/DS2200 FC/iSCSI models only. While the USB cable is still connected and the terminal emulator session remains active, perform the following steps to change the CNC port mode from the default setting (FC), to either iSCSI or FC-and-iSCSI used in combination.

When using FC SFPs and iSCSI SFPs in combination, host ports 0 and 1 are set to FC (either both 16Gb/s or both 8Gb/s), and host ports 2 and 3 must be set to iSCSI (either both 10GbE or both 1Gb/s).

Set CNC port mode to iSCSI

To set the CNC port mode for use with iSCSI SFPs, run the following CLI command at the command prompt:

```
set host-port-mode iSCSI
```

The command notifies you that it will change host port configuration, stop I/O, and restart both controllers. When asked if you want to continue, enter **y** to change the host port mode to use iSCSI SFPs.

Once the CLI `set host-port-mode` command completes, it will notify you that the specified system host port mode was set, and that the command completed successfully.

Continue with step 11 of "Setting network port IP addresses using the CLI port and cable" (page 53).

Set CNC port mode to FC and iSCSI

To set the CNC port mode for use with FC SFPs and iSCSI SFPs in combination, run the following CLI command at the command prompt:

```
set host-port-mode FC-and-iSCSI
```

The command notifies you that it will change host port configuration, stop I/O, and restart both controllers. When asked if you want to continue, enter **y** to change the host port mode to use FC and iSCSI SFPs.

Once the CLI `set host-port-mode` command completes, it will notify you that the specified system host port mode was set, and that the command completed successfully.

Continue with step 11 of "Setting network port IP addresses using the CLI port and cable" (page 53).

Connecting two storage systems to replicate volumes

Replication is a licensed feature for disaster recovery. The replication feature performs asynchronous replication of block-level data from a volume in a primary system to a volume in a secondary system by creating an internal snapshot of the primary volume, and copying the snapshot data to the secondary system via iSCSI links.

The two associated standard volumes form a replication set, and only the primary volume (source of data) can be mapped for access by a server. Both systems must be licensed to use the replication feature, and must be connected through switches to the same fabric or network (i.e., no direct attach). The server accessing the replication set need only be connected to the primary system. If the primary system goes offline, a connected server can access the replicated data from the secondary system.

Replication configuration possibilities are many, and can be cabled—in switch attach fashion—to support the CNC-based iSCSI systems on the same network, or on physically split networks (SAS and FC systems do not support replication). As you consider the physical connections of your system—specifically connections for replication—keep several important points in mind:

- Ensure that controllers have connectivity between systems, whether local or remote.
- Although all qualified CNC options support host connection, only iSCSI supports replication.
- Assign specific ports for replication whenever possible. By specifically assigning ports available for replication, you free the controller from scanning and assigning the ports at the time replication is performed.
- Ensure that all ports assigned for replication are able to communicate appropriately with the replication system (see the CLI Reference Guide for more information):

  For virtual replication, use the CLI `query peer-connection` command.
- Allow two ports to perform replication. This permits the system to balance the load across those ports as I/O demands rise and fall. On dual-controller enclosures, if some of the volumes replicated are owned by controller A and others are owned by controller B, then allow at least one port for replication on each controller module—and possibly more than one port per controller module—depending on replication traffic load.
- For the sake of system security, do not unnecessarily expose the controller module network port to an external network connection.

Conceptual cabling examples are provided addressing cabling on the same network and cabling relative to physically split networks.

IMPORTANT: Controller module firmware must be compatible on all systems used for replication. For license information, see the Storage Manager Guide.

Cabling for replication

This section shows example replication configurations for iSCSI controller enclosures.

NOTE: Simplified versions of controller enclosures are used in cabling illustrations to show either 10GbE iSCSI or 1Gb/s iSCSI host interface protocol, given that only the external connectors used in the host interface ports differ.

- Virtual replication supports iSCSI host interface protocol.
- The 2U enclosure rear panel represents DS6200/DS4200 (4-port) and DS2200 (2-port) models.
- iSCSI ports used for replication must be the same type (either both 10GbE or both 1Gb/s).
- Blue cables show I/O traffic and green cables show replication traffic.

Once the iSCSI-based systems are physically cabled, see the Storage Manager Guide or online help for information about configuring, provisioning, and using the optional replication feature.

Dual-controller configurations

Each of the following diagrams show the rear panel of two DS6200, DS4200, or DS2200 controller enclosures equipped with dual-controller modules.

Multiple servers/single network

Figure 51 and Figure 52 show I/O and replication occurring on the same physical network.

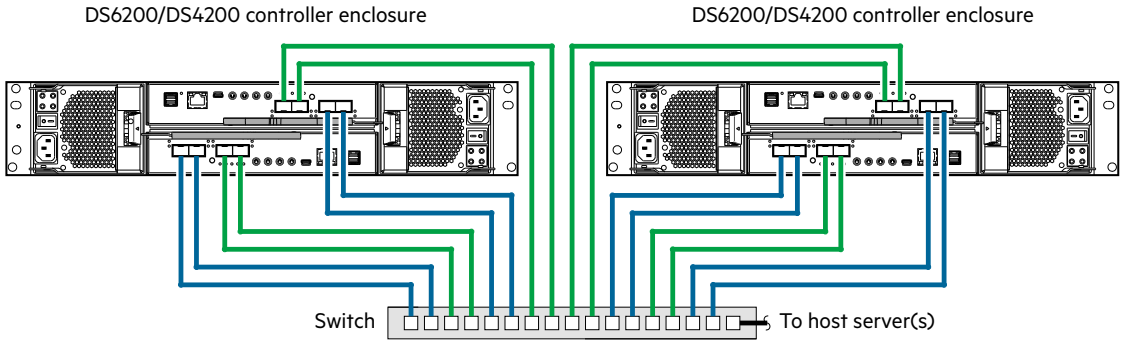


Figure 51 Connecting two DS6200/DS4200 storage systems for replication: multiple servers/one switch/one location

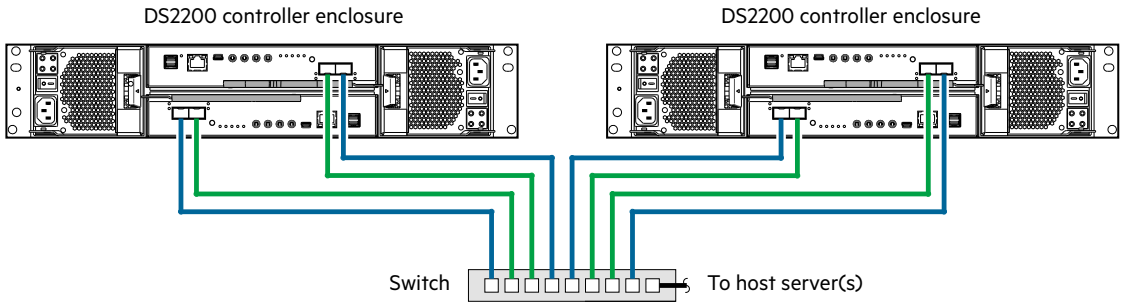


Figure 52 Connecting two DS2200 storage systems for replication: multiple servers/one switch/one location

Figure 53 and Figure 54 (page 59) show I/O and replication occurring on different networks. For optimal protection, use two switches. Connect one (DS2200) or two (DS6200/DS4200) ports from each controller module to the first switch to accommodate I/O traffic, and connect one (DS2200) or two (DS6200/DS4200) ports from each controller module to the second switch to facilitate replication. Using two switches in tandem avoids the potential single point of failure inherent to using a single switch; however, if one switch fails, either I/O or replication will fail, depending on which of the switches fails.

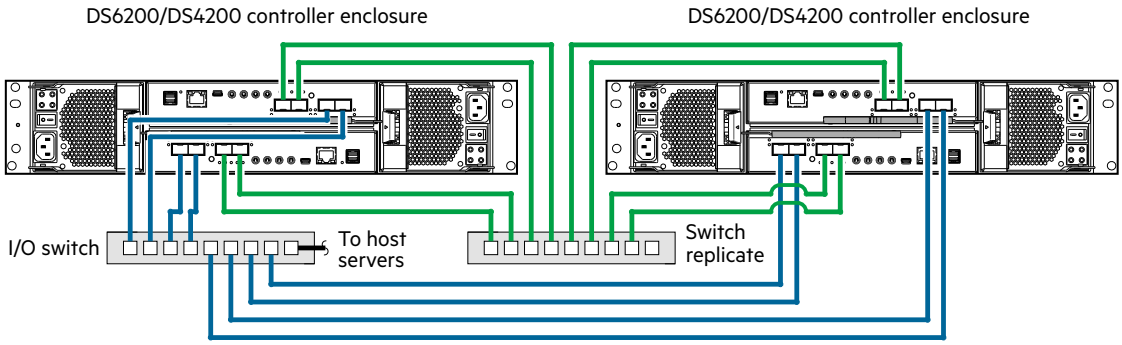


Figure 53 Connecting two DS6200/DS4200 storage systems for replication: multiple servers/switches/one location

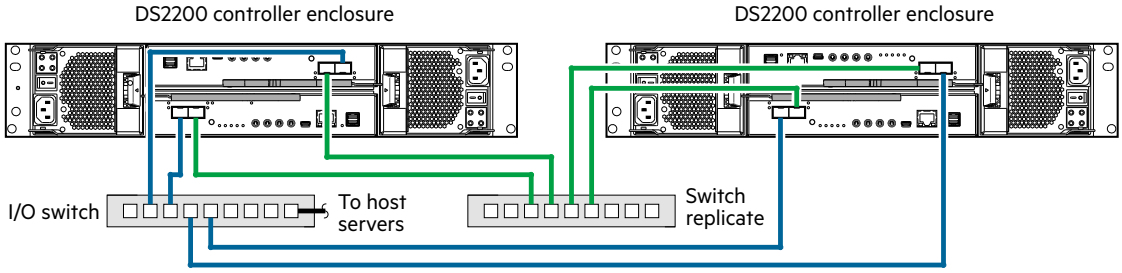


Figure 54 Connecting two DS2200 storage systems for replication: multiple servers/switches/one location

Virtual Local Area Network (VLAN) and zoning can be employed to provide separate networks for iSCSI and FC, respectively. Whether using a single switch or multiple switches for a particular interface, you can create a VLAN or zone for I/O and a VLAN or zone for replication to isolate I/O traffic from replication traffic. Since each switch would include both VLANs or zones, the configuration would function as multiple networks.

Multiple servers/different networks/multiple switches

Figure 55 and Figure 56 (page 60) show I/O and replication occurring on different networks.

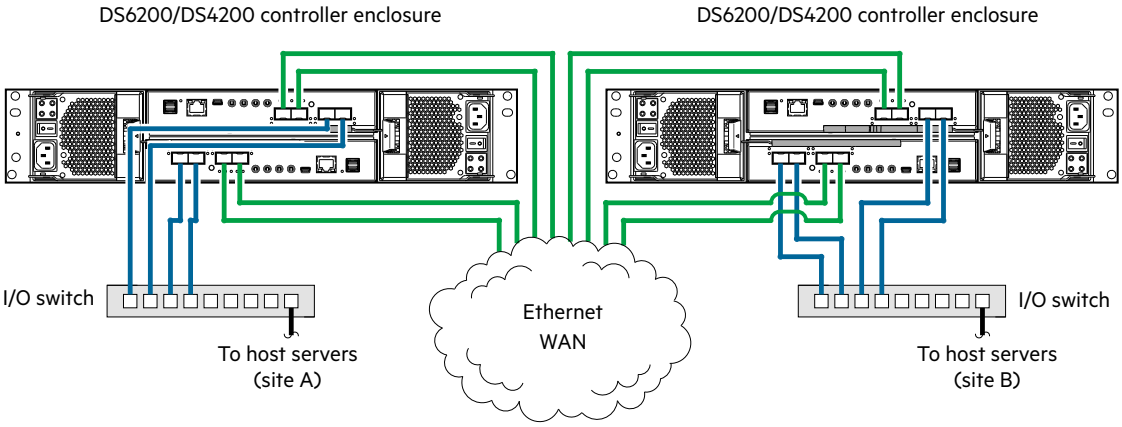


Figure 55 Connecting two DS6200/DS4200 storage systems for replication: multiple servers/switches/two locations

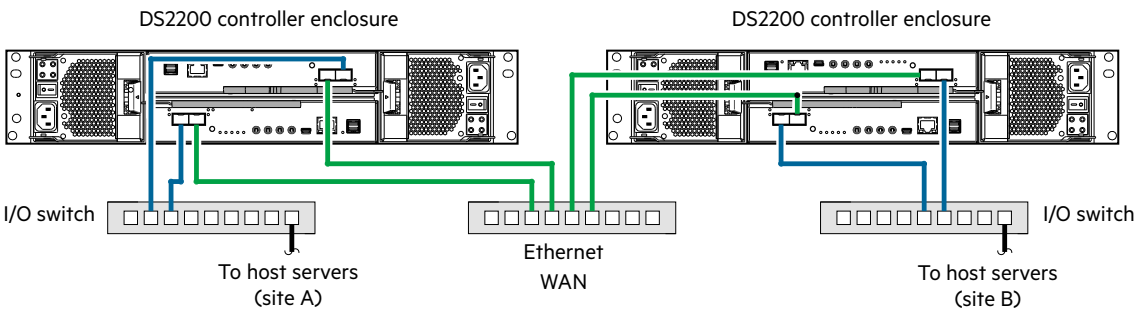


Figure 56 Connecting two DS2200 storage systems for replication: multiple servers/switches/two locations

Figure 55 (page 59) and Figure 56 represent two branch offices cabled to enable disaster recovery and backup. In case of failure at either the local site or the remote site, you can fail over the application to the available site.

4 Operation

Before you begin

Before powering on the enclosure system, make sure that all modules are firmly seated in their correct slots. Verify that you have successfully completed the sequential “Installation Checklist” instructions in Table 7 (page 40). Once you have completed steps 1 through 8, you can access the management interfaces using your web-browser to complete the system setup.

Powering on/powering off

CAUTION: Do not operate the enclosure system until the ambient temperature is within the specified operating range described in “Environmental requirements” (page 93). If the drive modules have been recently installed, make sure they have had time to adjust to the environmental conditions before they are used with production data for I/O.

1. Power on the system by connecting the power cables from the PCM to the PDU, and moving the power switch on the PCM to the **on** position. See Figure 41 (page 46).

   The System Power LED on the Ops panel should be lit green when the enclosure power is activated.
2. Power the system down by moving the power switch on the PCM to the **off** position.

Generally, when powering up, make sure to power up the enclosures and associated data host in the following order:

- Drive enclosures *first*

  This ensures that the disks in the drive enclosure have enough time to completely spin up before being scanned by the controller modules within 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.
- Controller enclosure *next*

  Depending upon the number and type of disks in the system, it may take several minutes for the system to become ready.
- Data host *last* (if powered down for maintenance purposes).

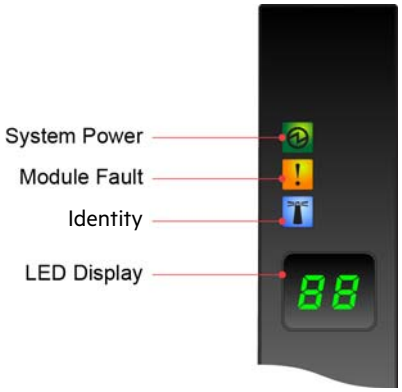
TIP: Generally, when powering off, you will reverse the order of steps used for powering on.

IMPORTANT: If main power is lost for any reason, upon restoration of power, the system will restart automatically.

NOTE: See Table 12 (page 65) for details pertaining to Ops panel LEDs and related fault conditions.

Operator's (Ops) panel LEDs

Figure 57 (page 62) provides an illustration showing the Ops panel layout and a table describing LED behavior. See Table 12 (page 65) for details pertaining to fault indications.



Ops panel LEDs	Behavior
System Power	Constant green: good or positive indication Constant amber: fault condition present
Module Fault	Constant amber or blinking amber: fault condition present
Identity	See Figure 24 (page 26)

Figure 57 LEDs: Ops panel – enclosure front panel

Unit Identification Number

The Unit Identification Display (UID) is a dual seven segment display that is used to provide feedback to the user. Its primary purpose is to display an Enclosure UID number to assist in setting up, monitoring, and managing storage systems comprised of multiple enclosures.

The UID is stored in the enclosure VPD and is used by management interfaces (CLI and the SMC). The UID can drive all seven of the segments, plus the dot/decimal point in each character of the display.

Software/SES

The enclosure UID number can be read and set through the management interfaces and SES.

Disk Drive LEDs

Each disk drive module includes two LEDs (green and amber) as shown in "Disk drive carrier module LEDs" (page 66).

- In normal operation, the green LED will be on and will blink as the drive operates.
- In normal operation, the amber LED state will be:
  - Off if a disk is not present
  - Off as the disk successfully operates
  - On if there is a disk fault

Accessing the SMC

Upon completing the hardware installation, you can access the controller module's web-based management interface—Storage Management Console (SMC)—to configure, monitor, and manage the storage system. Invoke your web browser and enter the IP address of the controller module's network port in the address field, then press **Enter**. To sign-in to the SMC, use the default user name **manage** and password **!manage**. If the default user name or password—or

both—have been changed for security reasons, enter the secure login credentials instead of the defaults shown above. This brief sign-in discussion assumes proper web browser setup.

IMPORTANT: For detailed information about accessing and using the SMC, see the “Getting Started” section in the web-posted Storage Manager Guide.

In addition to summarizing the processes to configure and provision a new system for the first time—using the wizards—the Getting Started section provides instructions for signing in to the SMC, introduces key system concepts, addresses browser setup, and provides tips for using the main window and the help window.

TIP: After signing-in to the SMC, you can use online help as an alternative to consulting the Storage Manager Guide.

Configuring and provisioning the storage system

Once you have familiarized yourself with the SMC, use the interface to configure and provision the storage system. If you are licensed to use the optional replication feature, you may also need to set up the storage systems for replication. Refer to the following topics within the Storage Manager Guide or online help:

- Getting started
- Configuring the system
- Provisioning the system
- Using the optional replication feature

NOTE: See the Storage Manager Guide for instructions about creating a temporary license, or installing a permanent license.

IMPORTANT: If the system is used in a VMware environment, set the system’s Missing LUN Response option to use its Illegal Request setting. To do so, see either the topic about changing the missing LUN response in the Storage Manager Guide, or see the CLI `set advanced-settings` command topic in the CLI Reference Guide.

5 Troubleshooting and problem solving

These procedures are intended to be used only during initial configuration, for the purpose of verifying that hardware setup is successful. They are not intended to be used as troubleshooting procedures for configured systems using production data and I/O.

NOTE: For further troubleshooting help, after setup and when data is present, contact support.lenovo.com, select **Product Support** and navigate to **Storage Products**.

Overview

The enclosure system includes a Storage Enclosure Processor (SEP) and associated monitoring and control logic to enable it to diagnose problems with the enclosure's power, cooling, and drive systems. Management interfaces allow for provisioning, monitoring, and managing the storage system.

IMPORTANT: See "Fault isolation methodology" (page 69) when conducting system diagnostics.

Initial start-up problems

Faulty power cords

Check that you have correctly cabled the system. Contact your supplier for replacements if:

- Power cables are missing or damaged.
- Plugs are incorrect.
- Power cables are too short.

Computer does not recognize the enclosure system

1. Verify that the interface cables from the enclosure to the host computer are fitted correctly.
2. Verify that the LEDs on all installed drive carrier modules are On (green).
3. Verify that the drive carrier modules have been correctly installed.
4. Check any visible SAS indicators (RBOD, EBOD, and HBA).
5. Check HBA BIOS for SAS target visibility.
6. Verify that the operating system driver has been installed correctly.

NOTE: If the enclosure fails initialization, see "If the enclosure does not initialize" (page 72).

LEDs

LED colors are used consistently throughout the enclosure and its components for indicating status:

- Green: good or positive indication
- Blinking green/amber: non-critical condition
- Amber: critical fault

580W PCM LEDs

Under normal conditions, the PCM OK LEDs will be a constant green. See also Figure 25 (page 27). When a fault occurs, the colors of the LEDs will display as shown in the following table.

Table 11 PCM LED states

PCM OK (Green)	Fan Fail (Amber)	AC Fail (Amber)	DC Fail (Amber)	Status
Off	Off	Off	Off	No AC power on any PCM
Off	Off	On	On	No AC power on this PCM only
On	Off	Off	Off	AC present; PCM working correctly
On	Off	Off	On	PCM fan speed is outside acceptable limits
Off	On	Off	Off	PCM fan has failed
Off	On	On	On	PCM fault (over temperature, over voltage, over current)
Off	Blinking	Blinking	Blinking	PCM firmware download is in progress

Ops panel LEDs

The Ops panel displays the aggregated status of all the modules. See also Figure 24 (page 26). The Ops panel LEDs are defined in the following table.

Table 12 Ops panel LED states

System Power (Green/Amber)	Module Fault (Amber)	Identity (Blue)	LED display	Associated LEDs/alarms	Status
On	Off	Off	X		5V standby power present, overall power failed or switched off
On	On	On	On		Ops panel power on (5s) test state
On	Off	Off	X		Power on, all functions good
On	On	X	X	PCM fault LEDs, fan fault LEDs	Any PCM fault, fan fault, over or under temperature
On	On	X	X	SBB module LEDs	Any SBB module fault
On	On	X	X	No module LEDs	Enclosure logical fault
On	Blink	X	X	Module status LED on SBB module	Unknown (invalid or mixed) SBB module type installed, I^2C bus failure (inter-SBB communications). EBOD VPD configuration error
On	Blink	X	X	PCM fault LEDs, fan fault LEDs	Unknown (invalid or mixed) PCM type installed or I^2C bus failure (PCM communications)
		X	Blink		Enclosure identification or invalid ID selected
X = Disregard					

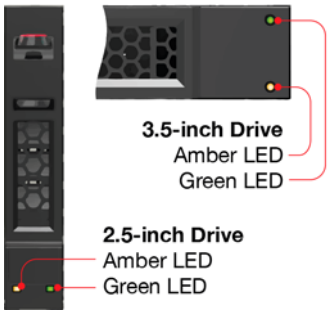
Actions:

- If the Ops panel Module Fault LED is on, check the module LEDs on the enclosure rear panel to narrow the fault to a CRU, a connection, or both.
- Check the event log for specific information regarding the fault, and follow any Recommended Actions.
- If installing an IOM CRU:
  - Remove and reinstall the IOM per "Replacing an IOM" (page 87).
  - Check the event log for errors.
- If the CRU Fault LED is on, a fault condition is detected.
  - Restart this controller from the partner controller using the SMC or CLI.
  - If the restart does not resolve the fault, remove the IOM and reinsert it.
- If the above actions do not resolve the fault, contact Lenovo for assistance.

Disk drive carrier module LEDs

Disk drive status is monitored by a green LED and an amber LED mounted on the front of each drive carrier module, as shown in Figure 58. The drive module LED conditions are defined in the table following the figure.

- In normal operation the green LED will be on, and will flicker as the drive operates.
- In normal operation the amber LED will be:
  - Off if there is no drive present.
  - Off as the drive operates.
  - On if there is a drive fault.



Disk LED (Green)	Disk LED (Amber)	Status
Off	Off	No disk drive module installed
On/blinking	Off	Disk drive module is installed and operational
On	Blinking: 1s on/1s off	SES device identity set
On	On	SES device fault bit set
Off	On	Power control circuit failure
On	Blinking: 3s on/1s off	RAID array status The events in which the controller can set this notification are: • Disk group rebuild in progress • Disk group consistency check • Do not remove device • Disk in failed disk group • Aborted disk group reconstruction

Figure 58 LEDs: Drive carrier LEDs (SFF and LFF modules)

IOM LEDs

IOM LEDs pertain to controller modules and expansion modules, respectively. Expansion enclosures are supported for optionally adding storage. See also “12Gb/s controller module LEDs” (page 28).

Controller module LEDs

Table 13 Controller module LED states

CRU OK (Green)	CRU Fault (Amber)	External host port activity (Green)	Status
On	Off		Controller module OK
Off	On		Controller module fault – see “Replacing an IOM” (page 87)
		Off	No external host port connection
		On	External host port connection – no activity
		Blinking	External host port connection – activity
Blinking			System is booting

Actions:

- If the CRU OK LED is blinking, wait for the system to boot.
- If the CRU OK LED is off, and the IOM is powered on, the module has failed.
  - Check that the IOM is fully inserted and latched in place, and that the enclosure is powered on.
  - Check the event log for specific information regarding the failure.
- If the CRU Fault LED is on, a fault condition is detected.
  - Restart this controller from the partner controller using the SMC or CLI.
  - If the restart does not resolve the fault, remove the IOM and reinsert it.
- If the above actions do not resolve the fault, contact Lenovo for assistance. IOM replacement may be necessary.

Expansion module LEDs

Expansion IOM status is monitored by the LEDs located on the face plate. See also Figure 15 (page 22). LED behaviors for DS Series expansion enclosures are described in Table 14. For actions pertaining to Table 13 or Table 14, see **Actions** above. See also “12Gb/s expansion module LEDs” (page 36).

Table 14 Expansion module LED states

CRU OK (Green)	CRU Fault (Amber)	SAS port activity (Green)	Status
On	Off		Expansion module OK
Off	On		Expansion module fault – see “Replacing an IOM” (page 87)
		Off	No external port connection
		On	HD mini-SAS port connection – no activity
		Blinking	HD mini-SAS port connection – activity
Blinking			EBOD VPD error

Temperature sensors

Temperature sensors throughout the enclosure and its components monitor the thermal health of the storage system. Exceeding the limits of critical values will cause a notification to occur.

Troubleshooting

The following sections describe common problems that can occur with your enclosure system, and some possible solutions. For all of the problems listed in Table 15, the module fault LED on the Ops panel will light amber to indicate a fault. See also "Operator's (Ops) panel" (page 26).

Table 15 Alarm conditions

Status	Severity	Alarm
PCM alert - loss of DC power from a single PCM	Fault - loss of redundancy	S1
PCM fan fail	Fault - loss of redundancy	S1
SBB module detected PCM fault	Fault	S1
PCM removed	Configuration error	None
Enclosure configuration error (VPD)	Fault – critical	S1
Low warning temperature alert	Warning	S1
High warning temperature alert	Warning	S1
Over temperature alarm	Fault – critical	S4
I^2C bus failure	Fault – loss of redundancy	S1
Ops panel communication error (I^2C)	Critical fault	S1
RAID error	Fault – critical	S1
SBB interface module fault	Fault – critical	S1
SBB interface module removed	Warning	None
Drive power control fault	Fault – critical–loss of disk power	S1
Insufficient power available	Warning	None

For details about replacing modules, see "Module removal and replacement" (page 78).

NOTE: See the Event Descriptions Reference Guide for more information about enclosure-related events and recommended actions.

PCM Faults

Symptom	Cause	Recommended action
Ops panel Module Fault LED is amber[1]	Any power fault	Verify AC mains connections to PCM are live
Fan Fail LED is illuminated on PCM[2]	Fan failure	Replace PCM

1-See Figure 24 (page 26) for visual reference of Ops panel LEDs.
2-See Figure 25 (page 27) for visual reference of PCM LEDs.

Thermal monitoring and control

The storage enclosure system uses extensive thermal monitoring and takes a number of actions to ensure component temperatures are kept low, and to also minimize acoustic noise. Air flow is from the front to back of the enclosure.

Symptom	Cause	Recommended action
If the ambient air is below 25ºC (77ºF), and the fans are observed to increase in speed, then some restriction on airflow may be causing additional internal temperature rise. **NOTE:** This is not a fault condition.	The first stage in the thermal control process is for the fans to automatically increase in speed when a thermal threshold is reached. This may be caused by higher ambient temperatures in the local environment, and may be perfectly normal. **NOTE:** This threshold changes according to the number of disks and power supplies fitted.	1. Check the installation for any airflow restrictions at either the front or back of the enclosure. A minimum gap of 25 mm (1") at the front and 50 mm (2") at the rear is recommended. 2. Check for restrictions due to dust build-up. Clean as appropriate. 3. Check for excessive re-circulation of heated air from rear to front. Use of the enclosure in a fully enclosed rack is not recommended. 4. Verify that all blank modules are in place. 5. Reduce the ambient temperature.

Thermal alarm

Symptom	Cause	Recommended action
1. Ops panel Module Fault LED is amber. 2. Fan Fail LED is illuminated on one or more PCMs.	Internal temperature exceeds a preset threshold for the enclosure.	1. Verify that the local ambient environment temperature is within the acceptable range. See also “Environmental requirements” (page 93). 2. Check the installation for any airflow restrictions at either the front or back of the enclosure. A minimum gap of 25 mm (1") at the front and 50 mm (2") at the rear is recommended. 3. Check for restrictions due to dust build-up. Clean as appropriate. 4. Check for excessive re-circulation of heated air from rear to front. Use of the enclosure in a fully enclosed rack is not recommended. 5. If possible, shut down the enclosure and investigate the problem before continuing.

USB CLI port connection

DS6200/DS4200/DS2200 controllers feature a CLI port employing a mini-USB Type B form factor. If you encounter problems communicating with the port after cabling your computer to the USB device, you may need to either download a device driver (Windows), or set appropriate parameters via an operating system command (Linux). See “USB device connection” (page 97) for more information.

Fault isolation methodology

Lenovo DS6200/DS4200/DS2200/DS EXP storage systems provide many ways to isolate faults. This section presents the basic methodology used to locate faults within a storage system, and to identify the pertinent CRUs affected.

As noted in “Accessing the SMC” (page 62), use the Storage Management Console to configure and provision the system upon completing the hardware installation. As part of this process, configure and enable event notification so the system will notify you when a problem occurs that is at or above the configured severity (see the Configuring event notification topic within the Storage Manager Guide). With event notification configured and enabled, you can follow the recommended actions in the notification message to resolve the problem, as further discussed in the options presented below.

Basic steps

- Gather fault information, including using system LEDs as described in “Gather fault information” (page 71).
- Determine where in the system the fault is occurring as described in “Determine where the fault is occurring” (page 71).
- Review event logs as described in “Review the event logs” (page 71).
- If required, isolate the fault to a data path component or configuration as described in “Isolate the fault” (page 71).

Cabling systems to enable use of the licensed replication feature—to replicate volumes—is another important fault isolation consideration pertaining to initial system installation. See “Isolating replication faults” (page 73) for more information about troubleshooting during initial setup.

Options available for performing basic steps

When performing fault isolation and troubleshooting steps, select the option or options that best suit your site environment. Use of any option (four options are described below) is not mutually exclusive to the use of another option. You can use the SMC to check the health icons/values for the system and its components to ensure that everything is okay, or to drill down to a problem component. If you discover a problem, either the SMC or the CLI provide recommended-action text online. Options for performing basic steps are listed according to frequency of use:

- Use the SMC
- Use the CLI
- Monitor event notification
- View the enclosure LEDs

Use the SMC

The SMC uses health icons to show OK, Degraded, Fault, or Unknown status for the system and its components. The SMC enables you to monitor the health of the system and its components. If any component has a problem, the system health will be Degraded, Fault, or Unknown. Use the web application’s GUI to drill down to find each component that has a problem, and follow actions in the component Health Recommendations field to resolve the problem.

Use the CLI

As an alternative to using the SMC, you can run the CLI `show system` command to view the health of the system and its components. If any component has a problem, the system health will be Degraded, Fault, or Unknown, and those components will be listed as Unhealthy Components. Follow the recommended actions in the component Health Recommendation field to resolve the problem.

Monitor event notification

With event notification configured and enabled, you can view event logs to monitor the health of the system and its components. If a message tells you to check whether an event has been logged, or to view information about an event in the log, you can do so using the SMC or the CLI. Using the SMC, you would view the event log and then click on the event message to see detail about that event. Using the CLI, you would run the `show events detail` command (with additional parameters to filter the output) to see the detail for an event.

View the enclosure LEDs

You can view the LEDs on the hardware (while referring to LED descriptions for your enclosure model) to identify component status. If a problem prevents access to the SMC or the CLI, this is the only option available. However,

monitoring/management is often done at a management console using storage management interfaces, rather than relying on line-of-sight to LEDs of racked hardware components.

Performing basic steps

You can use any of the available options described above in performing the basic steps comprising the fault isolation methodology.

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 disk drive module, controller module, or power supply unit?*

By isolating the fault to *one* of the components within the storage system, you will be able to determine the necessary corrective action more quickly.

Determine where the fault is occurring

When a fault occurs, the Module Fault LED—located on the Ops panel on an enclosure's left ear illuminates. See also "Operator's (Ops) panel" (page 26). Check the LEDs on the back of the enclosure to narrow the fault to a CRU, connection, or both. The LEDs also help you identify the location of a CRU reporting a fault. See also "Enclosure rear panel" (page 21).

Use the SMC to verify any faults found while viewing the LEDs. The SMC 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. This web-application provides you with a visual representation of the system and where the fault is occurring. The SMC also provides more detailed information about CRUs, data, and faults.

Review the event logs

The event logs record all system events. Each event has a numeric code that identifies the type of event that occurred, and has one of the following severities:

- Critical. A failure occurred that may cause a controller to shut down. Correct the problem *immediately*.
- Error. A failure occurred that may affect data integrity or system stability. Correct the problem as soon as possible.
- Warning. A problem occurred that may affect system stability, but not data integrity. Evaluate the problem and correct it if necessary.
- Informational. A configuration or state change occurred, or a problem occurred that the system corrected. No immediate action is required.

NOTE: Some events also have a Resolved severity that indicates that a previously logged non-Informational condition has been resolved. See the Event Descriptions Reference Guide for information about specific events.

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 disk group 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 either 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 comprising the data path. 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 all enclosures to initialize. If an enclosure does not initialize:

- Perform a rescan
- Power cycle the system
- Make sure the power cord is properly connected, and check the power source to which it is connected
- 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 enclosures in a different configuration, 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 the SMC 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 perform a rescan using the SMC:

1. Verify that both controllers are operating normally.
2. Do one of the following:
   - Point to the **System** tab and select **Rescan Disk Channels**.
   - In the **System** topic, select **Action > Rescan Disk Channels**.
3. Click **Rescan**.

Host I/O

When troubleshooting disk drive and connectivity faults, stop I/O to the affected disk groups from all hosts as a data protection precaution. As an additional data protection precaution, it is helpful to conduct regularly scheduled backups of your data. See also “Stopping I/O” (page 89).

Dealing with hardware faults

Ensure that you have obtained a replacement module of the same type before removing any faulty module as described in “Module removal and replacement” (page 78).

IMPORTANT: If the enclosure system is powered up and you remove any module, replace it immediately. If the system is used with any modules missing for more than a few seconds, the enclosure(s) can overheat, causing power failure and potential data loss. Such action can invalidate the product warranty.

IMPORTANT: Observe applicable/conventional ESD precautions when handling modules and components, as described in “ESD precautions” (page 78). Avoid contact with midplane components, module connectors, leads, pins, and exposed circuitry.

Isolating a host-side connection fault

For additional information, contact support.lenovo.com, select **Product Support**, and navigate to **Storage Products**.

Host-side connection troubleshooting featuring CNC ports

For additional information, contact support.lenovo.com, select **Product Support**, and navigate to **Storage Products**.

Host-side connection troubleshooting featuring SAS host ports

For additional information, contact support.lenovo.com, select **Product Support**, and navigate to **Storage Products**.

Isolating a controller module expansion port connection fault

For additional information, contact support.lenovo.com, select **Product Support**, and navigate to **Storage Products**.

Isolating replication faults

For additional information, contact support.lenovo.com, select **Product Support**, and navigate to **Storage Products**.

Continuous operation during replacement

Your hardware or software enclosure management application determines the capability for replacing a failed disk without the loss of access to any file system on the enclosure. Enclosure access and use during this period is uninterrupted. If an enclosure is equipped with redundant PCMs, sufficient power is provided to the system while the faulty PCM is replaced.

NOTE: DS6200/DS4200/DS2200/DS EXP enclosures support hot-plug replacement of redundant controller modules, power supplies, and expansion modules. Hot-add replacement of expansion enclosures is also supported.

Firmware updates

After installing the hardware and powering on the storage system components for the first time, verify that the controller modules, expansion modules, and disk drives are using the current firmware release. Periodically, you should ensure that the firmware versions used in enclosure modules are compatible. Also see “Updating firmware” (page 53).

Customer-replaceable units

NOTE: The following tables share the table endnotes located beneath them. See Figure 59 (page 77) for pictorial views of IOM CRUs used in the different Lenovo ThinkSystem enclosures.

Table 16 DS6200 enclosure models

Lenovo ThinkSystem DS6200: 4-port controller enclosure matrix		
2.5" (SFF) 24-drive controller enclosures		
Model	**Description**	**Form**
DS6200	Fibre Channel (8/16Gb/s) SFP[1,4]	2U24
DS6200	Internet SCSI (10GbE) SFP[2,4]	2U24
DS6200	Internet SCSI (1Gb/s) SFP[3,4]	2U24
DS6200	HD mini-SAS (12Gb/s)[5]	2U24

Table 17 DS4200 enclosure models

Lenovo ThinkSystem DS4200: 4-port controller enclosure matrix					
2.5" (SFF) 24-drive controller enclosures			**3.5" (LFF) 12-drive controller enclosures**		
Model	**Description**	**Form**	**Model**	**Description**	**Form**
DS4200	Fibre Channel (8/16 Gb/s) SFP[1,4]	2U24	DS4200	Fibre Channel (8/16 Gb/s) SFP[1,4]	2U12
DS4200	Internet SCSI (10GbE) SFP[2,4]	2U24	DS4200	Internet SCSI (10GbE) SFP[2,4]	2U12
DS4200	Internet SCSI (1 Gb/s) SFP[3,4]	2U24	DS4200	Internet SCSI (1 Gb/s) SFP[3,4]	2U12
DS4200	HD mini-SAS (12 Gb/s)[5]	2U24	DS4200	HD mini-SAS (12 Gb/s)[5]	2U12

Table 18 DS2200 enclosure models

Lenovo ThinkSystem DS2200: 2-port controller enclosure matrix					
2.5" (SFF) 24-drive controller enclosures			**3.5" (LFF) 12-drive controller enclosures**		
Model	**Description**	**Form**	**Model**	**Description**	**Form**
DS2200	Fibre Channel (8/16Gb/s) SFP[1]	2U24	DS2200	Fibre Channel (8/16Gb/s) SFP[1]	2U12
DS2200	Internet SCSI (10GbE) SFP[2]	2U24	DS2200	Internet SCSI (10GbE) SFP[2]	2U12
DS2200	Internet SCSI (1Gb/s) SFP[3]	2U24	DS2200	Internet SCSI (1Gb/s) SFP[3]	2U12
DS2200	HD mini-SAS (12Gb/s)[5]	2U24	DS2200	HD mini-SAS (12Gb/s)[5]	2U12

1-This model uses a qualified FC SFP option within the CNC ports (used for host connection). When in FC mode, the SFPs must be a qualified 8Gb or 16Gb fiber-optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

2-This model uses a qualified 10GbE iSCSI option within the controller module CNC ports (used for host connection).

3-This model uses a qualified 1 Gb iSCSI SFP option within the controller module CNC ports (used for host connection).

4-CNC ports support same-type or mixed-type SFPs in combination as described in "CNC ports used for host connection" (page 11).

5-This model uses SFF-8644 connectors and qualified cable options for host connection.

CRUs addressing 2U 12-drive chassis

Table 19 DS4200/DS2200 product components for 2U 12-drive chassis

Item	Enclosure component description
1	Disk drive (LFF)
	a) 3.5" disk drive module (disks of differing type/speed and storage capacity: SAS, SSD)
	b) Dummy drive carrier module (blank to maintain optimum air flow within enclosure)
2	Ear components (not customer replaceable)
	a) Left ear assembly
	b) Right ear assembly
3	Chassis (sheet metal enclosure that is configurable as an RBOD or EBOD)
4	Midplane PCB (included with chassis; not available separately)
5	Power cooling module (PCM) available as AC unit (chassis uses two PCMs of same model type)
6	Expansion module for storage expansion I/O (used when chassis is configured as an EBOD)
	a) 3-port 12 Gb/s SBB expansion module
7	Controller module host interfaces for storage system (used when chassis is configured as an RBOD)
	a) DS4200 4-port FC/iSCSI supports (8/16Gb/s FC; 10GbE iSCSI; or 1Gb/s iSCSI) qualified SFP options*
	b) DS2200 2-port FC/iSCSI supports (8/16Gb/s FC; 10GbE iSCSI; or 1Gb/s iSCSI) qualified SFP option*
	c) DS4200 4-port mini-SAS (12Gb/s) supports various qualified SFF-8644 to SFF-8644 or SFF-8088 options
	d) DS2200 2-port mini-SAS (12Gb/s) supports various qualified SFF-8644 to SFF-8644 or SFF-8088 options
8	Small form-pluggable SFP connectors
	a) SFP transceiver: 8/16Gb/s FC; 10GbE iSCSI; 1Gb/s iSCSI
9	Rail kit (variable attachment options)
	a) Rack mount kit, shelf, short, all HW
10	Cable kit [Cable package: standard HD mini-SAS (SFF-8644) to HD mini-SAS (SFF-8644)] Cable kit [Cable package: standard HD mini-SAS (SFF-8644) to mini-SAS (SFF-8088)] Cable kit [Cable package: USB Type B; CLI (USB)]
11	AC power cord compatible with AC PCM
*DS4200 models support FC and iSCSI SFPs used in combination; whereas DS2200 models do not.	

NOTE: Figure 59 (page 77) shows isometric pictorial representations of controller modules and expansion modules used in 2U 12-drive Lenovo ThinkSystem enclosures. Modules are shown oriented for insertion into IOM slot A located on the enclosure rear panel.

CRUs addressing 2U 24-drive chassis

Table 20 DS6200/DS4200/DS2200 product components for 2U 24-drive chassis

Item	Enclosure component description
1	Disk drive (SFF)
	a) 2.5" disk drive module (disks of differing type/speed and storage capacity: SAS, SSD)
	b) Dummy drive carrier module (blank to maintain optimum air flow within enclosure)
2	Ear components (not customer replaceable)
	a) Left ear assembly
	b) Right ear assembly
3	Chassis (sheet metal enclosure that is configurable as an RBOD or EBOD)
4	Midplane PCB (included with chassis; not available separately)
5	Power cooling module (PCM) available as AC unit (chassis uses two PCMs of same model type)
6	Expansion module for storage expansion I/O (used when chassis is configured as an EBOD)
	a) 3-port 12 Gb/s SBB expansion module
7	Controller module host interfaces for storage system (used when chassis is configured as an RBOD)
	a) DS6200 4-port FC/iSCSI supports (8/16Gb/s FC; 10GbE iSCSI; or 1Gb/s iSCSI) qualified SFP options*
	b) DS4200 4-port FC/iSCSI supports (8/16Gb/s FC; 10GbE iSCSI; or 1Gb/s iSCSI) qualified SFP options*
	c) DS2200 2-port FC/iSCSI supports (8/16Gb/s FC; 10GbE iSCSI; or 1Gb/s iSCSI) qualified SFP options*
	d) DS6200 4-port mini-SAS (12Gb/s) supports various qualified SFF-8644 to SFF-8644 or SFF-8088 options
	e) DS4200 4-port mini-SAS (12Gb/s) supports various qualified SFF-8644 to SFF-8644 or SFF-8088 options
	f) DS2200 2-port mini-SAS (12Gb/s) supports various qualified SFF-8644 to SFF-8644 or SFF-8088 options
8	Small form-pluggable SFP connectors
	a) SFP transceiver: 8/16Gb/s FC; 10GbE iSCSI; 1 Gb/s iSCSI
9	Rail kit (variable attachment options)
	a) Rack mount kit, shelf, short, all HW
10	Cable kit [Cable package: standard HD mini-SAS (SFF-8644) to HD mini-SAS (SFF-8644)] Cable kit [Cable package: standard HD mini-SAS (SFF-8644) to mini-SAS (SFF-8088)] Cable kit [Cable package: USB Type B; CLI (USB)]
11	AC power cord compatible with AC PCM
*DS6200 and DS4200 models support FC and iSCSI SFPs used in combination, whereas DS2200 models do not.	

NOTE: Figure 59 (page 77) shows isometric pictorial representations of controller modules and expansion modules used in 2U 24-drive Lenovo ThinkSystem enclosures. Modules are shown oriented for insertion into IOM slot A located on the enclosure rear panel.

4-port SAS controller module

4-port FC/iSCSI controller module

3-port expansion module

2-port SAS controller module

2-port FC/iSCSI controller module

Figure 59 SBB IOMs used in DS Series storage enclosures

6 Module removal and replacement

Overview

This chapter provides procedures for replacing CRUs (customer-replaceable units), including precautions, removal instructions, installation instructions, and verification of successful installation. Each procedure addresses a specific task. Certain procedures refer to related documentation. See "Related documentation" (page 12) for a list of these documents and where to find them online.

ESD precautions

Before you begin *any* of the procedures, consider the following precautions and preventive measures.

Preventing electrostatic discharge

To prevent electrostatic discharge (ESD) from damaging the system, be aware of the precautions to consider 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.

△ **CAUTION:** Parts can be damaged by electrostatic discharge. Follow these 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-protected workstations.
- Place parts in a static-protected area before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly.
- Remove clutter (plastic, vinyl, foam) from the static-protected workstation.

Grounding methods to prevent electrostatic discharge

Several methods are used for grounding. Adhere to the following precautions when handling or installing electrostatic-sensitive parts.

△ **CAUTION:** Parts can be damaged by electrostatic discharge. Use proper anti-static protection:

- Keep the replacement CRU in the ESD bag until needed; and when removing a CRU from the enclosure, immediately place it in the ESD bag and anti-static packaging.
- Wear an ESD wrist strap connected by a ground cord to a grounded workstation or unpainted surface of the 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.
- If an ESD wrist strap is unavailable, touch an unpainted surface of the chassis before handling the component.
- 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 technician install the part. For more information about static electricity or assistance with product installation, contact support.lenovo.com, select **Product Support** and navigate to **Storage Products**.

Replacing a power cooling module

This section provides procedures for replacing a failed power cooling module (PCM). Illustrations in PCM replacement procedures show rear panel views of the enclosure, with the PCM properly oriented for insertion into the rear panel of the enclosure.

A single PCM is sufficient to maintain operation of the enclosure. You need not halt operations and completely power-off the enclosure when replacing only one PCM; however, a complete orderly shutdown is required if replacing both units simultaneously.

△ **CAUTION:** Do not remove the cover from the PCM due to danger from electric shock inside. Return the PCM to your supplier for repair.

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 78.

TIP: The illustrations show PCM module replacement within the right slot as you view the enclosure rear panel. To replace a PCM in the left slot, you would first rotate the module 180° about its longitudinal axis, so that it properly aligns with its connectors on the back of the midplane. See also Figure 15 (page 22).

Removing a PCM

△ **CAUTION:** Removing a power supply unit significantly disrupts the enclosure's airflow. Do not remove the PCM until you have received the replacement module. It is important that all slots are filled when the enclosure is in operation.

Before removing the PCM, disconnect the power from the PCM by either the mains switch (where present) or by physically removing the power source in order to ensure your system has warning of imminent power shutdown. A faulty PCM must be replaced by a fully operational PCM within 24 hours. Ensure that you correctly identify the faulty PCM before beginning the step procedure.

1. Stop all I/O from hosts to the enclosure. See also "Stopping I/O" (page 89).

   TIP: This step is not required for hot-swapping. However, it is required when replacing both PCMs at once.

   ---

2. Use management software to shut down any other system components necessary.

   TIP: This step is not required for hot-swapping. However, it is required when replacing both PCMs at once.

   ---

3. Switch off the faulty PCM, and disconnect the power supply cable.
4. If replacing a single PCM via hot-swap, proceed to step 6.
5. If replacing both PCMs, verify that the enclosure was shut down using management interfaces, and that the enclosure is powered off.
6. Verify that the power cord is disconnected.

7. Grasp the latch and the side of the PCM handle between thumb and fore-finger, squeeze together and open the handle to cam the PCM out of the enclosure as shown in Figure .

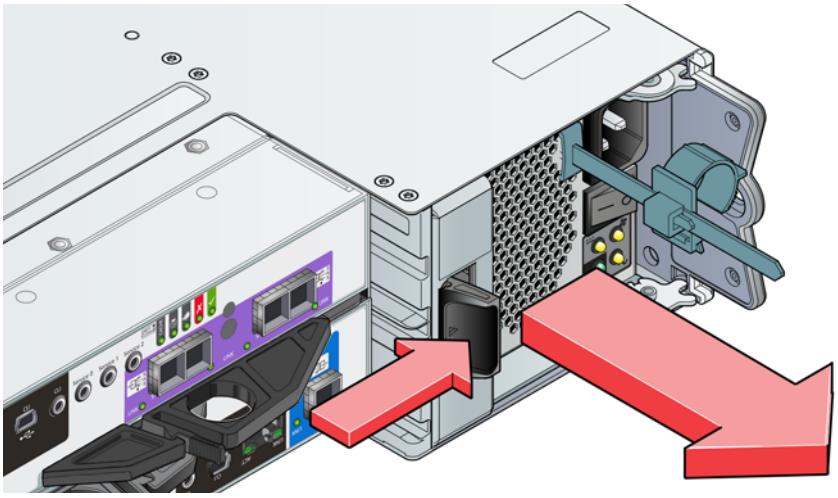


Figure 60 Removing a PCM (1 of 2)

8. Grip the handle and withdraw the PCM, taking care to support the base of the module with both hands as you remove it from the enclosure as shown in Figure 61.

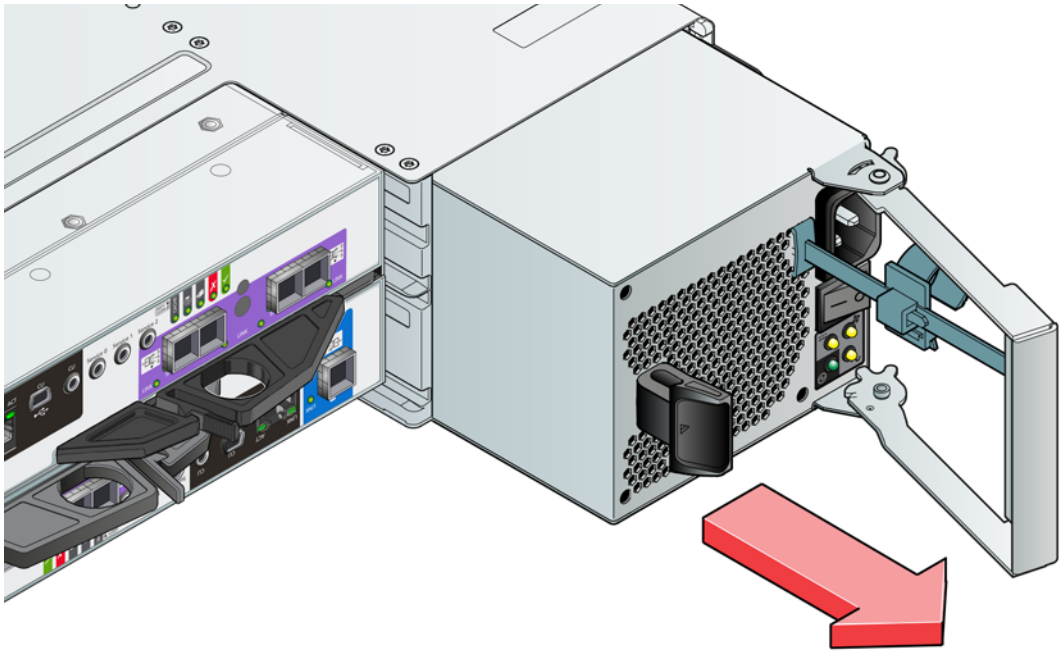


Figure 61 Removing a PCM (2 of 2)

9. If replacing two PCMs, repeat steps 5 through 8, being mindful of the illustrations TIP on page 79.

Installing a PCM

Refer to Figure 60 (page 80) and Figure 61 (page 80) when performing this procedure, but ignore the directional arrows—since you will insert the module into the slot—rather than extracting it.

IMPORTANT: Handle the PCM carefully, and avoid damaging the connector pins. Do not install the PCM if any pins appear to be bent.

1. Check for damage, especially to all module connectors.
2. With the PCM handle in the open position, slide the module into the enclosure, taking care to support the base and weight of the module with both hands.
3. Cam the module home by manually closing the PCM handle. You should hear a click as the latch handle engages and secures the PCM to its connector on the back of the midplane.
4. Connect the power cable to the power source and the PCM.
5. Secure the strain relief bales.
6. Using the management interfaces (the SMC or CLI), verify whether the health of the new PCM is OK. Verify that the green PCM OK LED is on/blinking per Table 11 (page 65). Verify that cooling fans are spinning with no fail states. Verify that Ops panel states show no amber module faults.
7. If replacing two PCMs, repeat steps 1 through 5, being mindful of the illustrations TIP on page 79.

Replacing a drive carrier module

A disk drive module consists of a disk in a carrier or sled. Disk drive modules are hot-swappable, which means they can be replaced without halting I/O to the disk groups, or powering off the enclosure. The new disk must be of the same type, and possess capacity equal to or greater than the one being replaced. Otherwise, the storage system cannot use the new disk to reconstruct the disk group.

CAUTION: Removing a disk drive module impacts the airflow and cooling ability of the enclosure. If the internal temperature exceeds acceptable limits, the enclosure may overheat and automatically shut down or restart. To avoid potential overheating, wait 20 seconds to allow the internal disks to stop spinning, then insert the new disk drive module.

IMPORTANT: Familiarize yourself with FDE considerations relative to disk module installation and replacement. See also “FDE considerations” (page 43).

NOTE: When moving FDE-capable disk drive modules for a disk group, stop I/O to the disk group before removing the disk drive modules. Import the keys for the disks so that the disk content becomes available. See the Storage Manager Guide or CLI Reference Guide for more information.

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 78.

TIP: The illustrations show disk module replacement within the drive slots as you view the enclosure front panel.

Removing a LFF drive carrier module

1. Press the latch in the carrier handle towards the handle hinge to release the carrier handle as shown below.

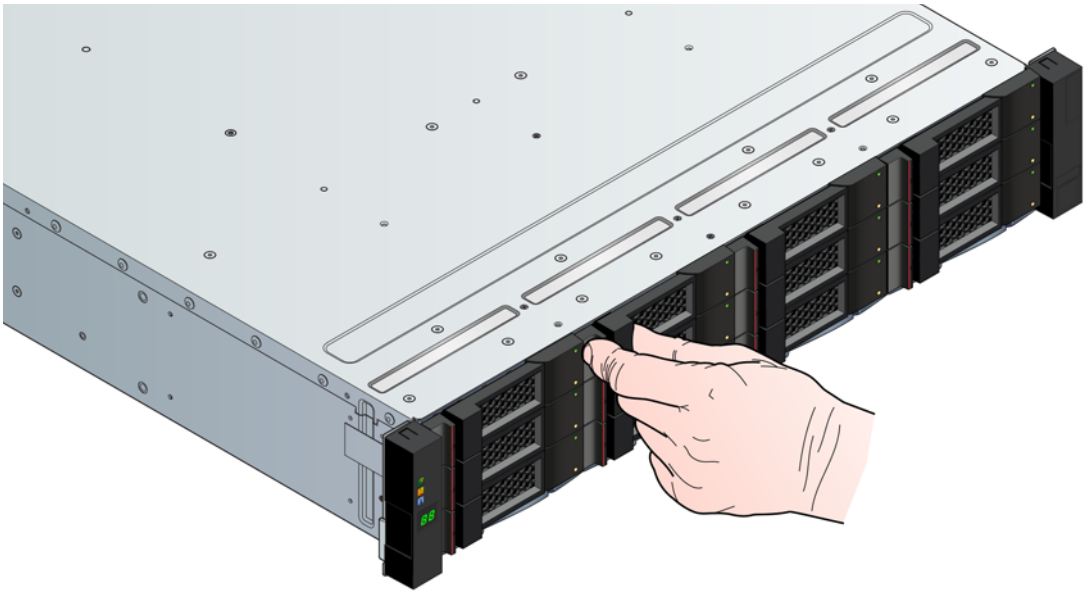


Figure 62 Removing a LFF disk drive module (1 of 2)

2. Gently move the drive carrier module approximately 25 mm (1-inch), then wait 30 seconds.

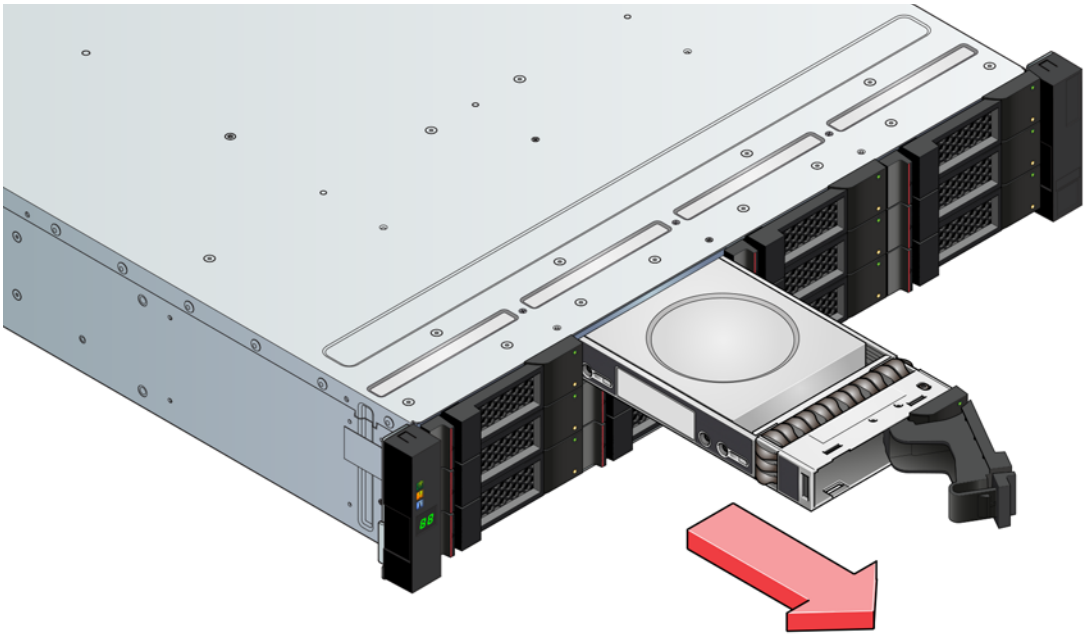


Figure 63 Removing a LFF disk drive module (2 of 2)

3. Remove the module fully from the drive slot.

△ **CAUTION:** To ensure optimal cooling throughout the enclosure, dummy drive carrier modules must be fitted to all unused drive slots. See also Figure 37 (page 39).

Installing a LFF drive carrier module

1. Release the drive carrier handle by depressing the latch in the handle.

Figure 64 LFF drive carrier module in open position

2. Insert the drive carrier module into the enclosure. Make sure that the drive carrier is positioned such that the top of the disk is facing up, and the handle opens from the left as you face the enclosure front panel.

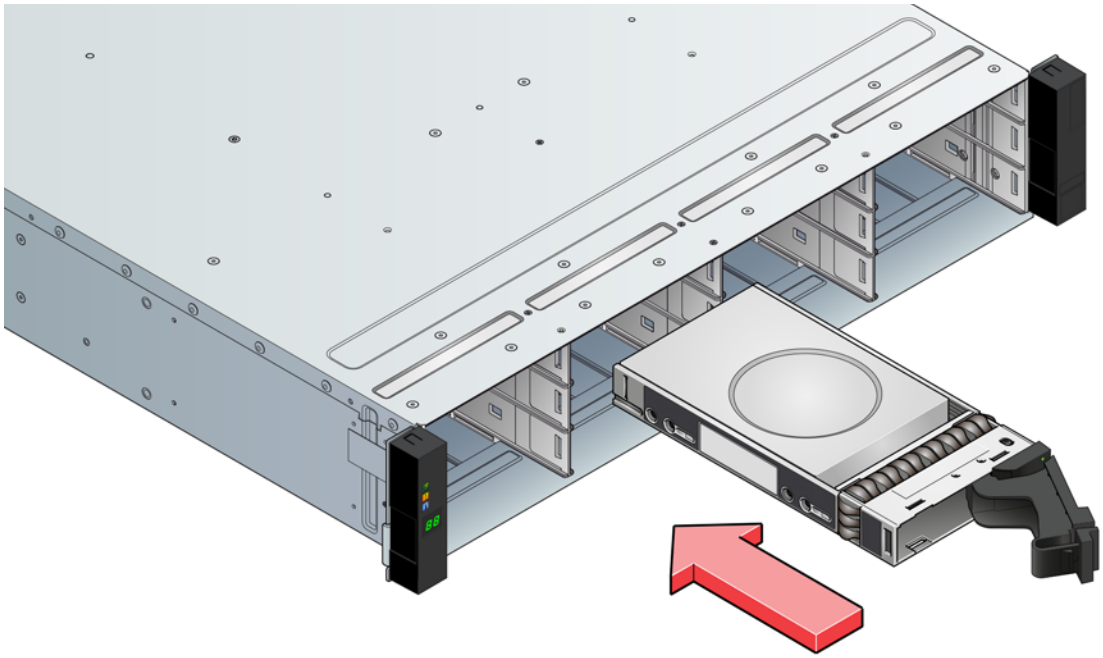


Figure 65 Installing a LFF drive carrier module (1 of 2)

3. Slide the drive carrier fully into the enclosure.

4. Cam the drive carrier home. The camming foot on the carrier will engage into a slot in the enclosure. Continue to push firmly until the handle fully engages. You should hear a click as the latch handle engages and holds the handle closed.

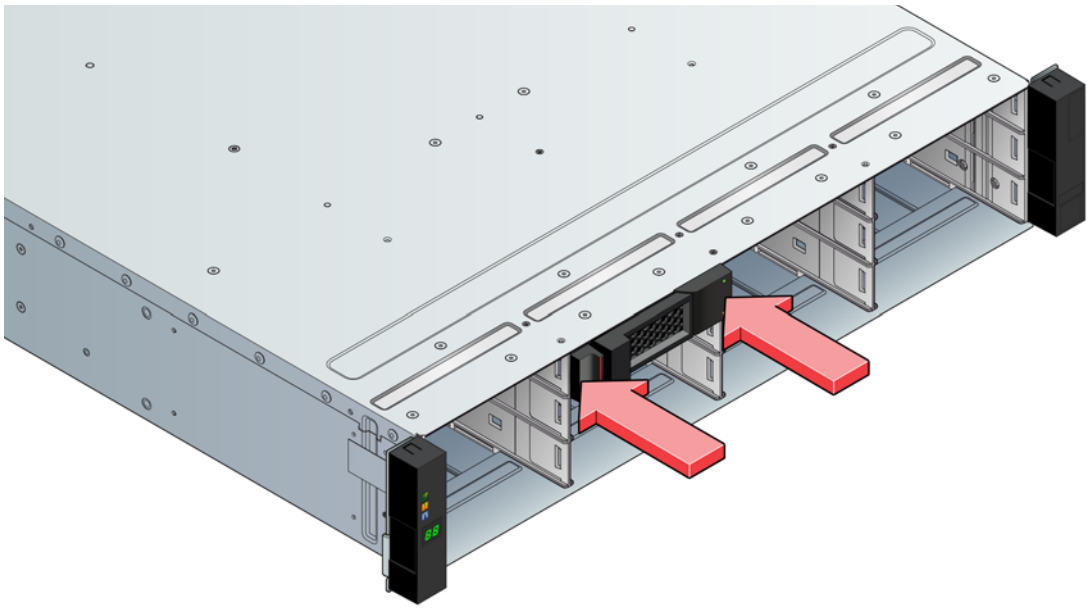


Figure 66 Installing a LFF drive carrier module (2 of 2)

5. Using the management interfaces (the SMC or CLI), verify whether the health of the new disk is OK. Verify that the Green Drive LED is on/blinking per Figure 58 (page 66). Verify that Ops panel states show no amber module faults.

Removing a SFF drive carrier module

The removal/replacement procedure for SFF drive carrier modules is basically the same as for LFF models, except that the SFF carriers are mounted vertically.

1. Press the latch in the carrier handle downward to release the carrier handle so that it can revolve outward as shown below.

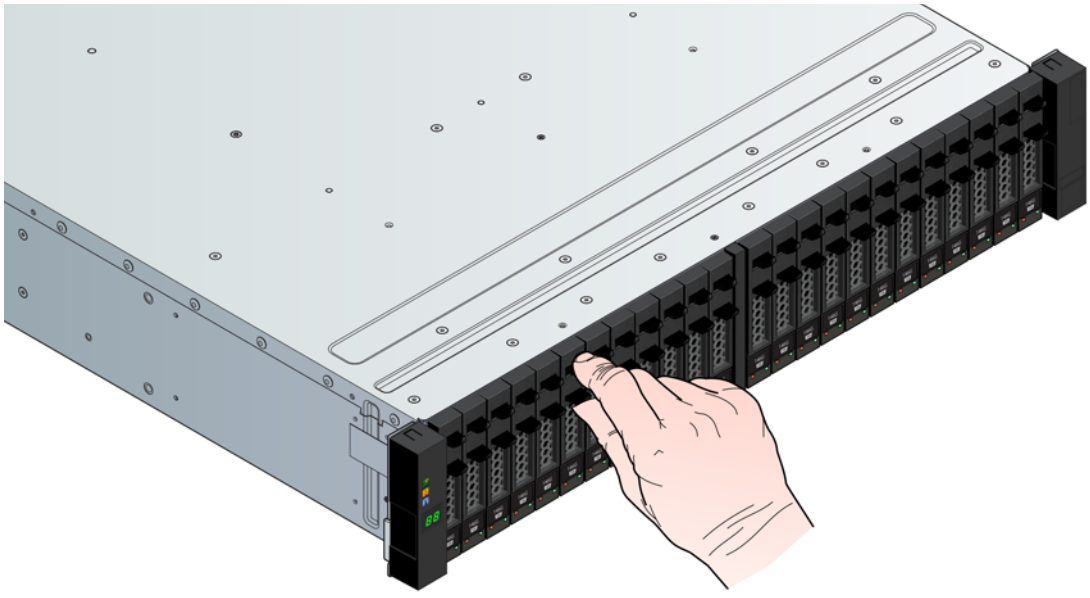


Figure 67 Removing a SFF disk drive module (1 of 2)

2. Gently move the drive carrier module outward from the drive slot.

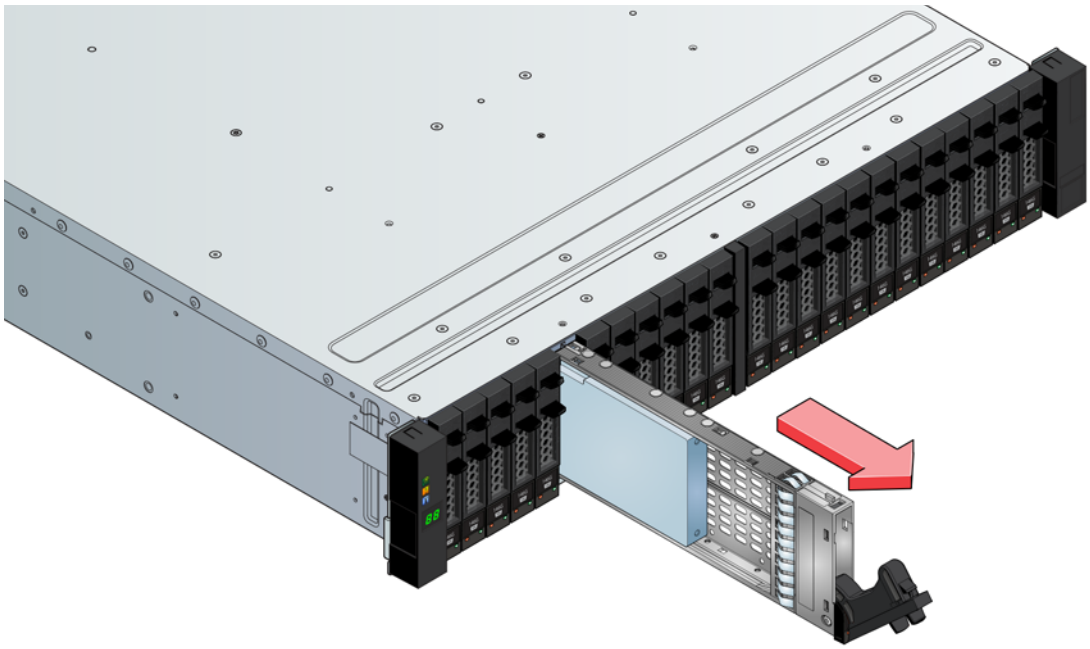


Figure 68 Removing a SFF disk drive module (2 of 2)

3. Remove the module fully from the drive slot.

△ **CAUTION:** To ensure optimal cooling throughout the enclosure, dummy drive carrier modules must be fitted to all unused drive slots. See also Figure 37 (page 39).

Installing a SFF drive carrier module

1. Release the carrier handle by pressing the latch in the handle downwards, and opening the hinged handle as shown in Figure 69 (page 86). Insert the carrier into the enclosure in a vertical position.

IMPORTANT: Make sure the carrier is positioned such that the disk is on its left side and the handle opens from the top.

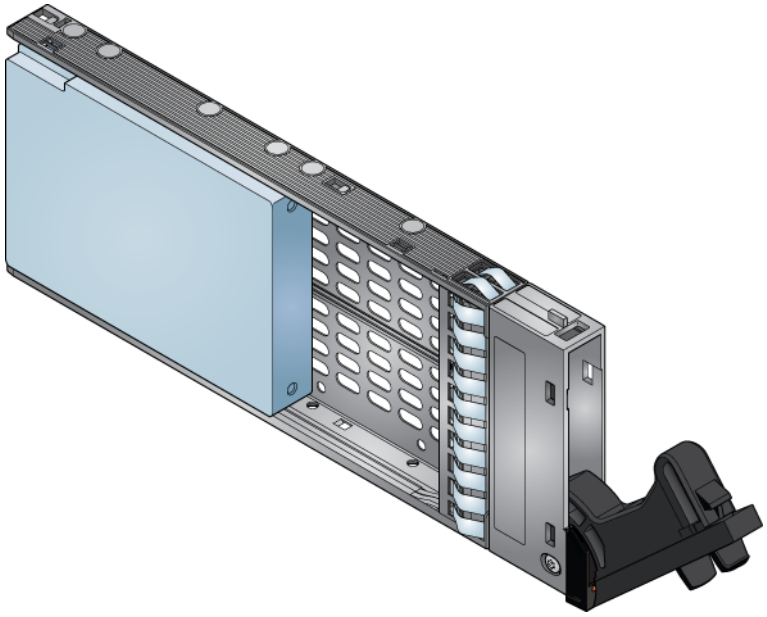


Figure 69 SFF drive carrier module in open position

2. Slide the carrier fully into the enclosure until it is stopped by the camming lever on the bottom of the carrier.

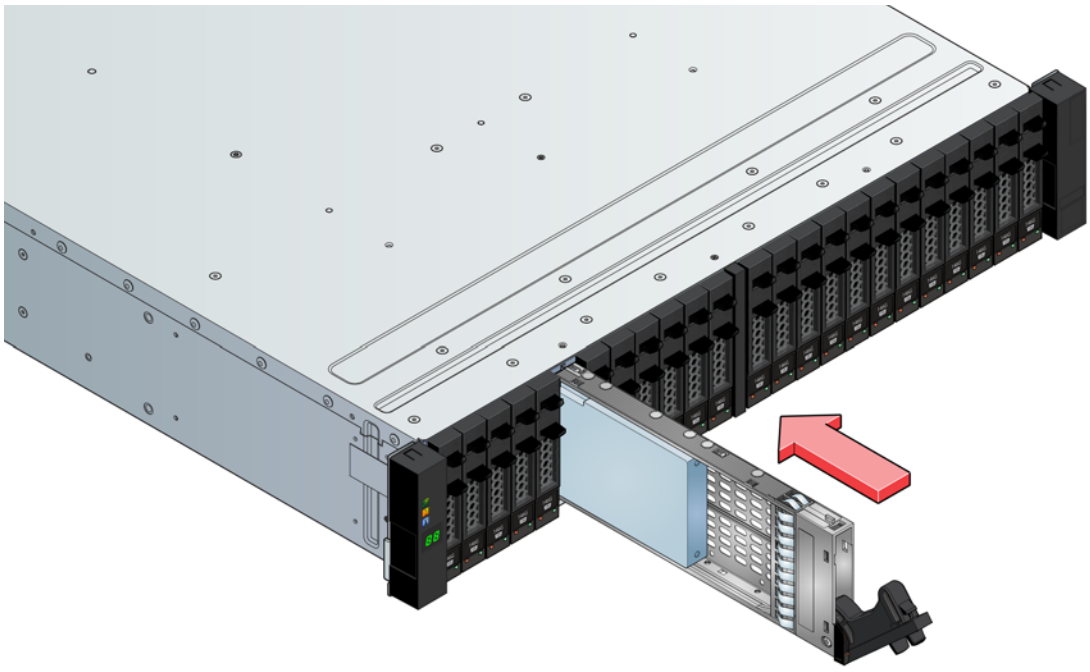


Figure 70 Installing a SFF drive carrier module (1 of 2)

3. Cam the carrier home. The camming lever on the carrier will engage into the a slot in the enclosure. Continue to push firmly until the handle fully engages. You should hear a click as the latch handle engages and holds the handle closed.

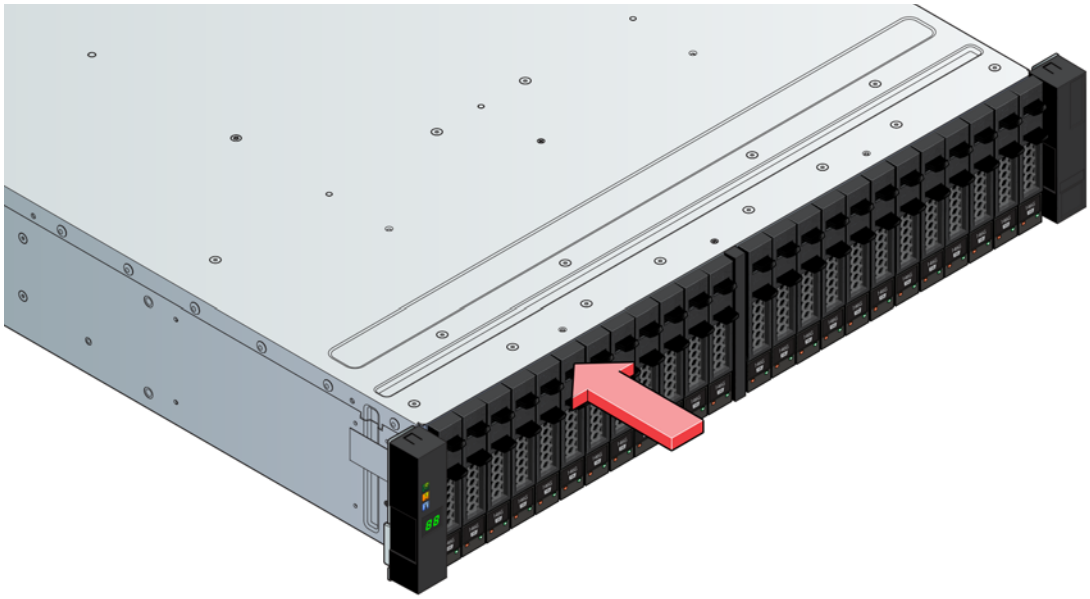


Figure 71 Installing a SFF drive carrier module (2 of 2)

4. Using the management interfaces (the SMC or CLI), verify whether the health of the new disk is OK. Verify that the Green Drive LED is on/blinking per Figure 58 (page 66). Verify that Ops panel states show no amber module faults.

Replacing a dummy drive carrier

A dummy drive carrier module is removed from the enclosure simply by pulling the module out of the drive slot. A dummy drive carrier module is installed in the enclosure by properly aligning it and inserting it into the drive slot, followed by pushing it securely into place.

△ **CAUTION:** To ensure optimal cooling throughout the enclosure, dummy drive carrier modules must be fitted to all unused drive slots. See also Figure 37 (page 39).

Replacing an IOM

ⓘ **IMPORTANT:** The DS6200/DS4200/DS2200/DS EXP storage enclosures support SBB dual-controller configuration only. Single-controller support is provided only when a controller fails over to its partner controller. A controller module must be installed in each IOM slot to ensure sufficient air flow through the enclosure during operation.

I/O module (IOM) denotes either a controller module (RAID canister) or an expansion module (expansion canister). In a dual-controller configuration, controller and expansion modules are hot-swappable, which means you can replace one module without halting I/O to disk groups, or powering off the enclosure. In this case, the second module takes over operation of the storage system until you install the new module.

You may need to replace a controller module or an expansion module when:

- The Fault LED is illuminated
- Health status reporting in the SMC indicates a problem with the module
- Events in the SMC indicate a problem with the module
- Troubleshooting indicates a problem with the module

TIP: The illustrations show IOM module replacement within the top slot (A) as you view the enclosure rear panel. To replace an IOM in the bottom slot (B), you would first rotate the module 180° about its longitudinal axis, so that it properly aligns with its connectors on the back of the midplane. See also Figure 15 (page 22).

Before you begin

Removing a controller or expansion module from an operational enclosure significantly changes air flow within the enclosure. Openings must be populated for the enclosure to cool properly. Leave modules in the enclosure until ready to install a replacement. If replacing both controllers in a dual-controller enclosure, use the SMC to record configuration settings before installing the new controller modules. See "Removing an IOM" (page 90), and "Installing an IOM" (page 92) for instructions on installing an additional controller module.

CAUTION: When replacing a controller module, ensure that less than 10 seconds elapse between inserting it into a slot and fully latching it in place. Not doing so might cause the controller to fail. If it is not latched within 10 seconds, remove the controller module from the slot, and repeat the process.

When two controller modules are installed in the enclosure, they must be of the same model type. When replacing both controller modules in an operational enclosure, follow these guidelines:

1. Replace one controller as described in these instructions.
2. Wait 30 minutes: this pause ensures that the controller and its ownership of disk groups has sufficient time to stabilize. See also "Verifying component operation" (page 92).
3. Check the system status and event logs to verify that the system is stable.
4. Replace the partner controller as described in these instructions.

Configuring partner firmware update

In a dual-controller system in which PFU is enabled, when you update firmware on one controller, the system automatically updates the partner controller. Disable partner firmware update *only* if requested by a service technician.

Use the CLI to change the PFU setting.

IMPORTANT: See the "Updating firmware" topic within the Storage Manager Guide before performing a firmware update.

NOTE: The CLI provides an option for enabling or disabling Partner Firmware Update for the partner controller as described in the Storage Manager Guide. To enable or disable the setting via the CLI, use the `set advanced-settings` command, and set the `partner-firmware-upgrade` parameter. See the CLI Reference Guide for more information about command parameter syntax.

Verifying component failure

Select from the following methods to verify component failure:

- Use the SMC to check the health icons/values of the system and its components to either ensure that everything is okay, or to drill down to a problem component. The SMC uses health icons to show OK, Degraded, Fault, or Unknown status for the system and its components. If you discover a problem component, follow the actions in its Health Recommendations field to resolve the problem.

- As an alternative to using the SMC, you can run the CLI `show system` command to view the health of the system and its components. If any component has a problem, the system health will be Degraded, Fault, or Unknown. If you discover a problem component, follow the actions in its Health Recommendations field to resolve the problem.
- Monitor event notification — With event notification configured and enabled, use the SMC to view the event log, or run the CLI `show events detail` command to see details for events.
- Check Fault LED (back of enclosure on IOM face plate): Amber = Fault condition.
- Check that the OK LED (back of enclosure) is off.

Stopping I/O

When troubleshooting disk drive and connectivity faults, stop I/O to the affected disk groups from all hosts as a data protection precaution. As an additional data protection precaution, it is helpful to conduct regularly scheduled backups of your data.

IMPORTANT: Stopping I/O to a disk group is a host-side task, and falls outside the scope of this document.

When on-site, you can verify that there is no I/O activity by briefly monitoring the system LEDs; however, when accessing the storage system remotely, this is not possible. Remotely, you can use the `show disk-group-statistics` command to determine if input and output has stopped. Perform these steps:

1. Using the CLI, run the `show disk-group-statistics` command.

   The `Reads` and `Writes` fields show the number of these operations that have occurred since the statistic was last reset, or since the controller was restarted. Record the numbers displayed.
2. Run the `show disk-group-statistics` command a second time.

   This provides you a specific window of time (the interval between requesting the statistics) to determine if data is being written to or read from the disk group. Record the numbers displayed.
3. To determine if any reads or writes occur during interval, subtract the set of numbers you recorded in step 1 from the numbers you recorded in step 2.
   - If the resulting difference is zero, then I/O has stopped.
   - If the resulting difference is not zero, a host is still reading from or writing to this disk group.

   Continue to stop I/O from hosts, and repeat step 1 and step 2 until the difference in step 3 is zero.

NOTE: See the CLI Reference Guide for additional information. Optionally, you can use the SMC to monitor IOPs and MB/s.

Shutting down a controller module

Shutting down the Storage Controller in a controller module ensures that a proper failover sequence is used, which includes stopping all I/O operations and writing any data in write cache to disk. If the Storage Controller in both controller modules is shut down, hosts cannot access the system's data. Perform a shut down before you remove a controller module from an enclosure, or before you power off its enclosure for maintenance, repair, or a move.

Use the SMC or the CLI to perform a shut down.

Using the SMC

1. Sign-in to the SMC
2. In the System panel in the banner, select **Restart System**.

   The Controller Restart and Shut Down panel opens.
3. Select the **Shut Down** operation, which automatically selects the controller type **Storage**.
4. Select the controller module to shut down: A, B, or both.
5. Select **OK**. A confirmation panel appears.

6. Select **Yes** to continue; otherwise, select **No**. If you selected Yes, a message describes shutdown activity.

NOTE: If an iSCSI port is connected to a Microsoft Windows host, the following event is recorded in the Windows event log: `Initiator failed to connect to the target.`

NOTE: See the Storage Manager Guide for additional information.

Using the CLI

1. Log-in to the CLI.
2. In your dual-controller system, verify that the partner controller is online by running the command;

   `show controllers`
3. Shut down the failed controller—A or B—by running the command:

   `shutdown a` *or* `shutdown b`

   The blue OK to Remove LED (back of enclosure) illuminates to indicate that the controller module can be safely removed.
4. Illuminate the white Identify LED of the enclosure that contains the controller module to remove by running the command:

   `set led enclosure 0 on`

   The Display LED on the Ops panel located on the enclosure left ear will be blinking green when the above command is invoked.

NOTE: See the CLI Reference Guide for additional information.

Removing an IOM

IMPORTANT: Considerations for removing controller modules:

- In a dual-controller environment, you may hot-swap a single controller module in an operational enclosure, provided you first shut down the faulty controller using the SMC or the CLI.
- In a dual-controller environment—if replacing both controller modules—you must adhere to the instructions provided in "Before you begin" (page 88).
- Do not remove a faulty module unless its replacement is on-hand. All modules must be in place when the system is in operation.

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 78.

Illustrations in the controller module replacement procedures show rear panel views of the enclosure, and IOMs are properly aligned for insertion into the rear panel of the enclosure.

1. Verify that you have successfully shut down the controller module using the SMC or the CLI.
2. Locate the enclosure whose UID LED (Ops panel on enclosure front left ear) is illuminated, and within the enclosure, locate the controller module whose OK to Remove LED is blue (rear panel).
3. Disconnect any cables connected to the controller.

   Label each cable to facilitate re-connection to the replacement IOM.
4. Grasp the module latch between the thumb and forefinger, and squeeze the flange and handle together to release the latch handle from its docking member as shown in the first illustration within Figure 72 (page 91).

5. Swing the latch handle open as shown in the second illustration within the figure.

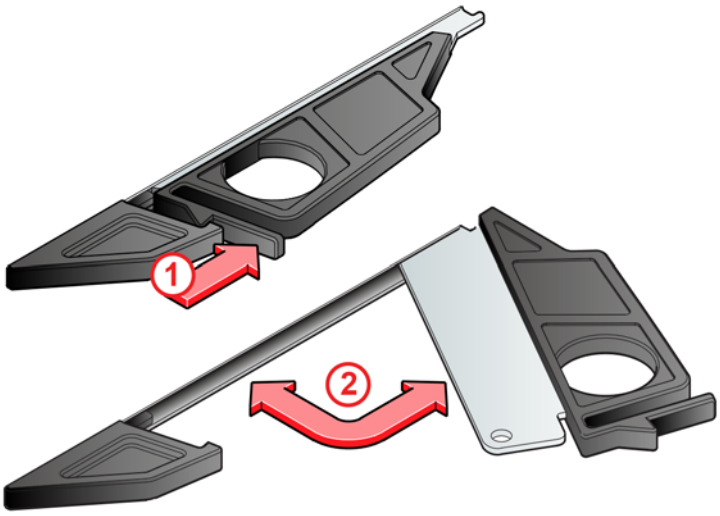
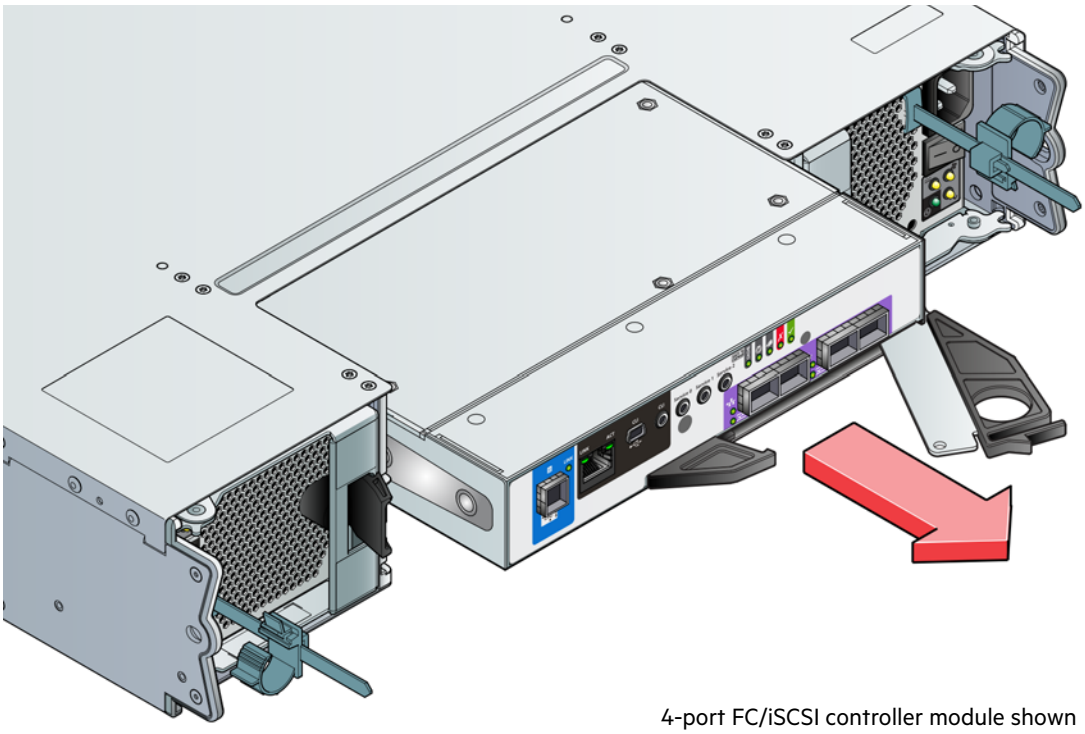


Figure 72 IOM latch operation

6. Grip the latch handle and ease the IOM forward from the slot as shown in Figure 73.



4-port FC/iSCSI controller module shown

Figure 73 Removing an IOM

NOTE: The illustration above shows a 4-port controller module of model type FC/iSCSI. However, the procedure applies to all IOMs discussed herein. They all use the same latch mechanism, but feature different face plate geometry.

7. Place both hands on the canister body, and pull it straight out of the enclosure such that the controller module remains level during removal.

Installing an IOM

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 78.

CAUTION: If passive copper cables are connected, the cable must not have a connection to a common ground/earth point.

NOTE: When performing the following procedure, refer to Figure 73 (page 91) while ignoring the directional arrow. For installation, the IOM will travel in the opposite direction relative to the arrow shown.

1. Examine the IOM for damage, and closely inspect the interface connector. Do not install if the pins are bent.
2. Grasp the IOM using both hands, and with the latch in the open position, orient the module and align it for insertion into the target IOM slot.
3. Ensuring that the IOM is level, slide it into the enclosure as far as it will go.

   A controller module that is only partially seated will prevent optimal performance of the controller enclosure. Verify that the controller module is fully seated before continuing.
4. Set the module in position by manually closing the latch.

   You should hear a click as the latch handle engages and secures the IOM to its connector on the back of the midplane.
5. Reconnect the cables.

NOTE: In a dual-controller system in which PFU is enabled, when you update the firmware on one controller, the system automatically updates the partner controller.

Verifying component operation

Controller module

After replacing the controller module, verify that the CRU OK LED (rear panel) illuminates green, indicating that the controller has completed initializing, and is online/operating normally. It may take two to five minutes for the replacement controller to become ready. If you are replacing either controller module, and PFU is enabled, you may need to wait 30 minutes to ensure that the two controllers—with their respective ownership of the disk groups—have enough time to fully stabilize.

IMPORTANT: Use the SMC or CLI to perform a restart *only* if necessary. See the “Restarting controllers “topic in the Storage Manager Guide for more information.

Expansion module

If the storage system is configured with expansion enclosures, the replacement expansion module may take up to one minute to initialize after the cables are connected.

A Technical specifications

Enclosure dimensions

Table 21 2U enclosure dimensions

Specification	Metric units	Imperial units
Overall enclosure height (2U)	87.9 mm	3.46 in
Width across mounting flange (located on front of chassis)	483 mm	19.01 in
Width across body of enclosure	443 mm	17.44 in
Depth from face of mounting flange to back of enclosure body	576.8 mm	22.71 in
Depth from face of mounting flange to rearmost enclosure extremity	602.9 mm	23.74 in
Depth from face of Ops panel to rearmost enclosure extremity	629.6 mm	24.79 in

1-The 2U24 enclosure uses 2.5" SFF disks.
2-The 2U12 enclosure uses 3.5" LFF disks.

Enclosure weights

Table 22 2U enclosure weights

CRU/component	2U12 (kg/lb)	2U24 (kg/lb)
Storage enclosure (empty)	4.8/10.56	4.8/10.56
Disk drive carrier	0.9/1.98	0.3/0.66
Dummy disk drive carrier (air management sled)	0.05/0.11	0.05/0.11
Power Cooling Module (PCM)	3.5/7.7	3.5/7.7
SBB controller module (maximum weight)	2.6/5.8	2.6/5.8
SBB expansion module	1.5/3.3	1.5/3.3
RBOD enclosure (fully populated with modules: maximum weight)	32/71	30/66
EBOD enclosure (fully populated with modules: maximum weight)	28/62	25/55

1-Weights shown are nominal, and subject to variances.
2-Rail kits add between 2.8 kg (6.2 lb) and 3.4 kg (7.4 lb) to the aggregate enclosure weight.
3-Weights may vary due to different power supplies, IOMs, and differing calibrations between scales.
4-Weights may vary due to actual number and type of disk drives (SAS or SSD) and air management modules installed.

Environmental requirements

Table 23 Ambient temperature and humidity

Specification	Temperature range	Relative humidity	Max. Wet Bulb
Operating	RBOD: 5ºC to 35ºC (41ºF to 95ºF) EBOD: 5ºC to 40ºC (41ºF to 104ºF)	20% to 80% non-condensing	28ºC
Non-operating (shipping)	-40ºC to +70ºC (-40ºF to +158ºF)	5% to 100% non-precipitating	29ºC

Specification	Measurement/description
Airflow	System must be operated with low pressure rear exhaust installation. Back pressure created by rack doors and obstacles not to exceed 5Pa (0.5 mm H_2O)
Altitude, operating	0 to 3,045 meters (0 to 10,000 feet) Maximum operating temperature is de-rated by 5ºC above 2,133 m (7,000 feet)

Specification	Measurement/description
Altitude, non-operating	-305 to 12,192 m (-1,000 to 40,000 feet)
Shock, operating	5.0 g, 10 ms, ½ sine pulses, Y-axis
Shock, non-operating	30.0 g, 10 ms, ½ sine pulses
Vibration, operating	0.21 G_{rms} 5 Hz to 500 Hz random
Vibration, non-operating	1.04 G_{rms} 2 Hz to 200 Hz random
Vibration, relocation	0.3 G_{rms} 2 Hz to 200 Hz 0.4 decades per minute
Acoustics	Sound power 2U enclosures: ≤ L_{WAd} 6.6 Bels (re 1 pW) @ 23ºC
Orientation and mounting:	19" rack mount (2 EIA units)
• Rack rails	To fit 800 mm depth racks compliant with the SSI server rack specification
• Rack characteristics	Back pressure not exceeding 5Pa (~0.5 mm H_20)

Power cooling module

Specifications for the HE580W PCM are provided in the table.

Table 24 Power cooling module specifications

Specification	Measurement/description
Dimensions (size)	84.3 mm high x 104.5 mm wide x 340.8 mm long: • X-axis length: 104.5 mm (4.11 in) • Y-axis length: 84.3 mm (3.32 in) • Z-axis length: 340.8 mm (37.03)
Maximum output power	580 W
Voltage range	100–200 VAC rated
Frequency	50–60 Hz
Voltage range selection	Auto-ranging: 90–264 VAC, 47–63 Hz
Maximum inrush current	20A
Power factor correction	≥ 95% @ nominal input voltage
Harmonics	Meets EN61000-3-2
Output	+5 V @ 42A, +12 V @ 38A, +5 V standby voltage @ 2.7A
Operating temperature	0 to 57ºC (32ºF to +135ºF)
Hot pluggable	Yes
Switches and LEDs	AC mains switch and four status indicator LEDs
Enclosure cooling	Dual axial cooling fans with variable fan speed control

B Standards and regulations

International standards

The enclosure system complies with the requirements of the following agencies and standards:

- CE to EN 60950-1
- CB report to IEC 60950-1
- UL & cUL to UL 60950-1 second edition

Potential for radio frequency interference

USA Federal Communications Commission (FCC)

Notice

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 instruction manual, 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 his or her expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. The supplier is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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.

European regulations

This equipment complies with European Regulations EN 55022 Class A: Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment and EN50082-1: Generic Immunity.

Safety compliance

Table 25 Safety compliance specifications

System product type approval	UL/cUL/CE
Safety compliance	UL 60950-1 second edition
	IEC 60950
	EN 60950

EMC compliance

Table 26 EMC compliance specifications

Conducted emissions limit levels	CFR47 Part 15B Class A
	EN55022 Class A
	CISPR Class A

Table 26 EMC compliance specifications (continued)

Radiated emissions limit levels	CFR47 Part 15B Class A
	EN55022 Class A
	CISPR Class A
Harmonics and flicker	EN61000-3-2/3
Immunity limit levels	EN55024

AC power cords

Table 27 AC power cord specifications

1	United States if America	
	Must be NRTL Listed (National Recognized Test Laboratory – e.g., UL)	
	Cord type	SV or SVT, 18 AWG minimum, 3 conductor, 2.0M max length
	Plug	NEMA 5–15P grounding-type attachment plug rated 120V 10A;
		or
		IEC 320, C-14, 250V, 10A
	Socket	IEC 320, C-13, 250V, 10A
2	Europe and others	
	General requirements:	
	Cord type	Harmonized, H05-WF-3G1.0
	Socket	IEC 320, C-13, 250V, 10A

IMPORTANT: The plug and the complete power cable assembly must meet the standards appropriate to the country, and must have safety approvals acceptable in that country.

Recycling of Waste Electrical and Electronic Equipment (WEEE)

At the end of the product's life, all scrap/waste electrical and electronic equipment should be recycled in accordance with national regulations applicable to the handling of hazardous/toxic electrical and electronic waste materials.

Please contact your supplier/Lenovo for a copy of the Recycling Procedures applicable to your country.

IMPORTANT: Observe all applicable safety precautions detailed in the preceding chapters (weight restrictions, handling batteries and lasers, etc.) when dismantling and disposing of this equipment.

C USB device connection

Rear panel USB ports

Lenovo ThinkSystem DS6200/DS4200/DS2200 controllers contain a USB (Universal Serial Bus) Device interface pertaining to the Management Controller (MC). The Device interface is accessed via a port on the controller module face plate. This appendix describes the USB Type B port labeled CLI, which enables direct connection between a management computer and the controller, using the command-line interface and appropriate cable.

USB CLI port

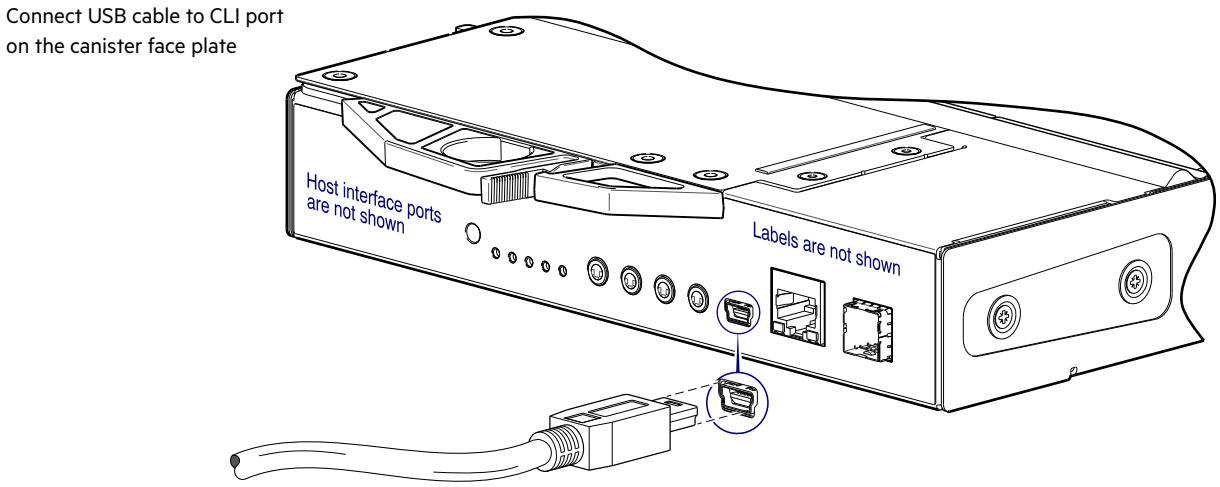


Figure 74 USB device connection—CLI port

DS6200/DS4200/DS2200 controllers feature a USB CLI port used to cable directly to the controller and initially set IP addresses, or perform other configuration tasks. The USB CLI port employs a mini-USB Type B form factor, and requires a specific cable and additional support, so that a server or other computer running a Linux or Windows operating system can recognize the controller enclosure as a connected device. Without this support, the computer might not recognize that a new device is connected, or might not be able to communicate with it.

For Linux computers, no new driver files are needed, but a Linux configuration file must be created or modified. See also “Setting parameters for the device driver” (page 99). For Windows computers a special device driver file, `gserial.inf`, must be downloaded from a CD or web site, and installed on the computer that will be cabled directly to the controller’s CLI port. See also “Microsoft Windows” (page 98).

Emulated serial port

Once attached to the controller module, the management computer should detect a new USB device. Using the Emulated Serial Port interface, the DS6200/DS4200/DS2200 controller presents a single serial port using a *customer vendor ID* and *product ID*. Effective presentation of the emulated serial port assumes the management computer previously had terminal emulator installed. See also “Supported host applications” (page 98). Serial port configuration is unnecessary.

IMPORTANT: Certain operating systems require a device driver or special mode of operation to enable proper functioning of the USB CLI port. See also “Device driver/special operation mode” (page 98).

Supported host applications

DS6200/DS4200/DS2200 controllers support the following applications to facilitate connection.

Table 28 Supported terminal emulator applications

Application	Operating system
HyperTerminal and TeraTerm	Microsoft Windows (all versions)
Minicom	Linux (all versions)
	Solaris
	HP-UX

Command-line interface

Once the management computer detects connection to the USB-capable device, the Management Controller awaits input of characters from the host computer via the command-line. To see the command-line prompt, you must press **Enter**. The MC provides direct access to the CLI.

NOTE: Directly cabling to the CLI port is an out-of-band connection, because it communicates outside of the data paths used to transfer information from a computer or network to the controller enclosure.

Device driver/special operation mode

Certain operating systems require a device driver or special mode of operation. Product and vendor identification information required for such setup is provided below.

Table 29 USB vendor and product identification codes

USB identification code type	Code
USB Vendor ID	0x210c
USB Product ID	0xa4a7

Microsoft Windows

Microsoft Windows operating systems provide a USB serial port driver. However, the USB driver requires details for connecting to DS6200/DS4200/DS2200 controller enclosures. Lenovo provides a device driver for use in the Windows environment. The USB device driver and installation instructions are available via a download.

Obtaining the software download

IMPORTANT: If using Windows 10/Server 2016, the operating system provides a native USB serial driver that supports the controller module's USB CLI port. However, if using an older version of Windows, you should download and install the USB device driver, using the procedure below.

---

1. Verify that the management computer has Internet access.
2. See Lenovo's customer support website: support.lenovo.com.
   a. Select **Product Support** and navigate to **Storage Products**.
      Peruse the location for information about the "USB driver."
   b. Follow the instructions accompanying the device driver topic for Microsoft Windows.

Although Linux operating systems do not require installation of a device driver, certain parameters must be provided during driver loading to enable recognition of the DS6200/DS4200/DS2200 controller enclosures.

Setting parameters for the device driver

1. Enter the following command:

   `modprobe usbserial vendor=0x210c product=0xa4a7 use_acm=1`

2. Press **Enter** to execute the command.

   The Linux device driver is loaded with the parameters required to recognize the controllers.

NOTE: Optionally, this information can be incorporated into the `/etc/modules.conf` file.

Using the CLI port and cable—known issues on Windows

When using the CLI port and cable for setting network port IP addresses, be aware of the following known issues on Microsoft Windows platforms.

Problem

On Windows operating systems, the USB CLI port may encounter issues preventing the terminal emulator from reconnecting to storage after the Management Controller (MC) restarts or the USB cable is unplugged and reconnected.

Workaround

Follow these steps when using the mini-USB cable and USB Type B CLI port to communicate out-of-band between the host and controller module for setting network port IP addresses.

To create a new connection or open an existing connection (HyperTerminal):

1. From the Windows Control Panel, select Device Manager.
2. Connect using the USB COM port and Detect Carrier Loss option.
   a. Select **Connect To > Connect using: >** pick a COM port from the list.
   b. Select the **Detect Carrier Loss** check box.

   The Device Manager page should show “Ports (COM & LPT)” with an entry entitled “Disk Array USB Port (COM*n*)”—where *n* is your system’s COM port number.
3. Set network port IP addresses using the CLI (see procedure on page 53).

To restore a hung connection when the MC is restarted (any supported terminal emulator):

1. If the connection hangs, disconnect and quit the terminal emulator program.
   a. Using Device Manager, locate the COM*n* port assigned to the Disk Array Port.
   b. Right-click on the hung **Disk Array USB Port** (**COM***n*), and select **Disable**.
   c. Wait for the port to disable.
2. Right-click on the previously hung—now disabled—**Disk Array USB Port** (**COM***n*), and select **Enable**.
3. Start the terminal emulator and connect to the COM port.
4. Set network port IP addresses using the CLI (see procedure on page 53).

NOTE: When using Windows 10/Server 2016 with PuTTY, the `XON/XOFF` setting must be disabled, or the COM port will not open.

D SFP option for CNC ports

Locate the SFP transceivers

Locate the qualified SFP options for your FC/iSCSI controller canister within your product ship kit. The SFP transceiver (SFP) should look similar to the generic SFP shown in the figure below and in Figure 76 (page 101). When installing an SFP, refer to the 4-port or 2-port figure that corresponds to your product.

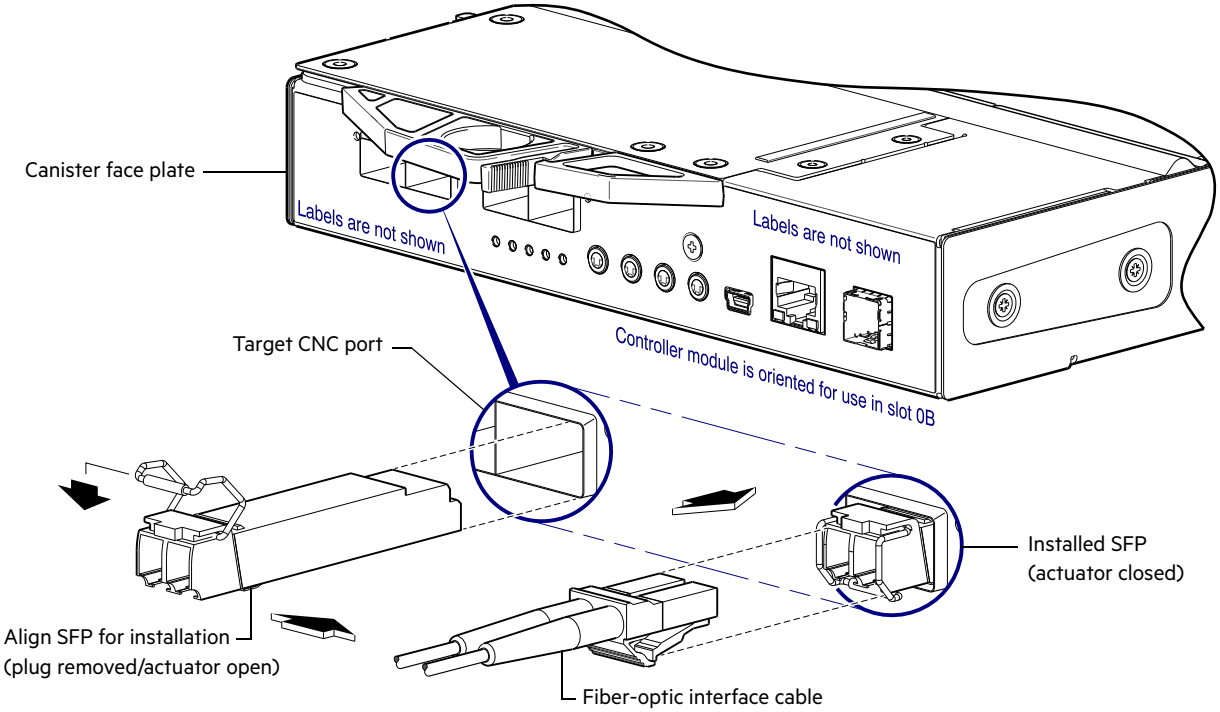


Figure 75 Install a qualified SFP option into an DS4200 or DS6200 FC/iSCSI controller module

Install an SFP transceiver

For each target CNC port, perform the following procedure to install an SFP. Refer to the figure above when performing the steps. Follow the guidelines provided in "ESD precautions" (page 78) when installing an SFP.

1. Orient the SFP for the target CNC port and canister position, and align it for insertion.

   Depending upon whether the SFP is installed into controller A or B, it will either install right-side up, or upside down.
2. If the SFP has a plug, remove it before installing the transceiver. Retain the plug.
3. Flip the actuator open (sweep up or down) according to the SFP position and alignment for canister slot 0A (top) or 0B (bottom).

   The actuator on your SFP option may look slightly different than the one shown, and it may not open to a sweep greater than 90° (as shown in the figure above).
4. Slide the SFP into the target CNC port until it locks securely into place.
5. Flip the actuator closed (sweep up or down) according to its position in canister slot 0A or 0B.

   The installed SFP should look similar to the position shown in the right detail view above.
6. When ready to attach to the host, obtain and connect a qualified fiber-optic interface cable into the duplex jack at the end of the SFP connector.

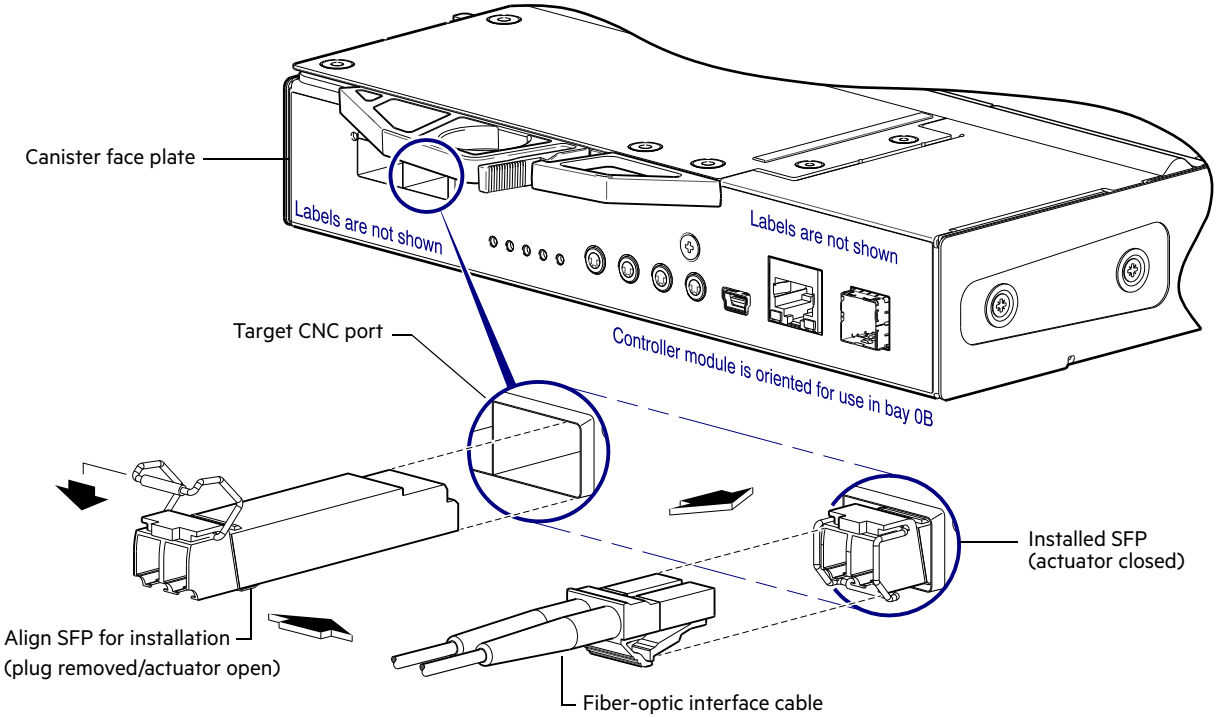


Figure 76 Install a qualified SFP option into an DS2200 FC/iSCSI controller module

Verify component operation

View the CNC port Link Status/Link Activity LED on the controller canister face plate. A green LED indicates that the port is connected and the link is up:

- For FC SFPs, see Figure 27 (page 29) or Figure 30 (page 32), and refer to table entry No.1
- For 10GbE iSCSI SFPs, see Figure 27 (page 29) or Figure 30 (page 32), and refer to table entry No.2
- For 1Gb iSCSI SFPs, see Figure 28 (page 30) or Figure 31 (page 33), and refer to table entry No.2

NOTE: To remove an external SFP connector, perform the installation steps in *reverse* order relative to what is described in "Install an SFP transceiver" (page 100).

Index

M

O

P

R

S

T

U