LENOVO THINKSYSTEM DS SERIES HARDWARE INSTALLATION AND MAINTENANCE MANUAL

ThinkSystem DS Series and DS EXP/D3284 Hardware Installation and Maintenance Guide

Machine Type: 4619/4617/4599/4588/6413

Firmware release: G280

First Edition (December 2019)

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) and D3284 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 2U12, 2U24, and 5U84 chassis. These 2U chassis form factors support controller enclosures and expansion enclosures.

The DS Series controller enclosures can optionally be cabled to supported DS EXP/D3284 expansion enclosures for adding storage. See also "Connecting the controller enclosure and optional expansion enclosures" (page 66) for maximum configuration information.

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 factors.
- 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 2U models are configured with two expansion I/O modules (SBB expansion canisters) per enclosure.
- Optional D3284 5U models are configured with two expansion I/O modules, and hold up to 84 disk drives.
- Optional D3284 5U model is an expansion enclosure supporting DS6200 and DS4200 (not supported by DS2200). This high-density chassis is not configured or used as a controller 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. Using the `set host-port-mode` CLI command, you can set all controller module CNC ports to use either FC or iSCSI protocol. The DS6200/DS4200/DS2200 controller enclosures support the following link speeds:

- 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 73), ,Figure 17 (page 28) and Figure 18 (page 28) 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 do this before inserting the iSCSI SFPs into the CNC ports (see “Change the CNC port mode” (page 86) 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 19 (page 28) and Figure 20 (page 29) 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 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 DS Series and DS EXP/D3284 Getting Started[1]
Using the web interface to configure and manage the product	Lenovo ThinkSystem DS Series and DS EXP/D3284 Storage Manager Guide[2]
Using the command-line interface (CLI) to configure and manage the product	Lenovo ThinkSystem DS Series and DS EXP/D3284 CLI Reference Guide
Event codes and recommended actions	Lenovo ThinkSystem DS Series and DS EXP/D3284 Event Descriptions Reference Guide
Installation and usage instructions for the VSS hardware provider that works with MicroSoft Windows Server, and the CAPI Proxy required by the hardware provider.	Lenovo ThinkSystem DS Series and DS EXP/D3284 VSS Hardware Provider Installation 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 DS Series and DS EXP/D3284 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 power supply modules to minimize weight before you move the enclosure.
- Do not lift the enclosures by the handles on power supply modules—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)
- Fully configured 5U84 enclosures can weigh up to 135 kg (298 lb). An unpopulated enclosure weighs 46 kg (101 lb). Use appropriate lifting methods. Before lifting the enclosure:
  - Unplug all cables and label them for reconnection.
  - Remove DDICs from drawers and verify the drawers are closed firmly and locked. See also Figure 25 (page 33).
  - Use a minimum of three people to lift the enclosure using the lifting straps provided.
  - Avoid lifting the enclosure using the handles on any of the CRUs because they are not designed to take the weight.
  - Do not lift the enclosure higher than 20U. Use mechanical assistance to lift above this height.
- Observe the lifting hazard label affixed to the storage enclosure.

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) in 2U enclosures must hold dummy drive carrier modules. See also Figure 47 (page 55).

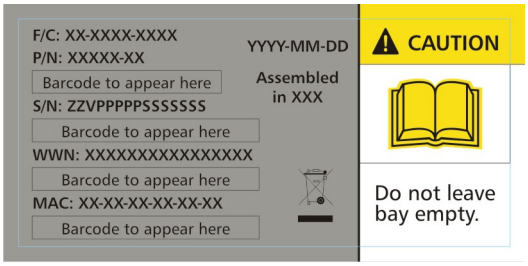


Figure 2 Module Bay Caution label

- 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 or PSU, disconnect supply power from the PCM to be replaced. Please refer to "Replacing a power cooling module" (page 117) or "Replacing a PSU" (page 138).
- Replace any defective module with a fully operational unit as soon as possible. Do not remove a defective module unless a replacement module is available.

△ **CAUTION:** 5U84 enclosures only

- To prevent overturning, drawer interlocks stop users from opening both drawers at the same time. Do not attempt to force open a drawer when the other drawer in the enclosure is already open. In a rack containing more than one 5U84 enclosure, do not open more than one drawer per rack at a time.
- Observe the hot surface label affixed to the drawer. Operating temperatures inside the enclosure drawers can reach 60ºC. Take care when opening drawers and removing DDICs.
- Due to product acoustics, ear protection should be worn during prolonged exposure to the product in operation.
- Observe the drawer caution label. Open drawers must not be used to support any other objects or equipment.

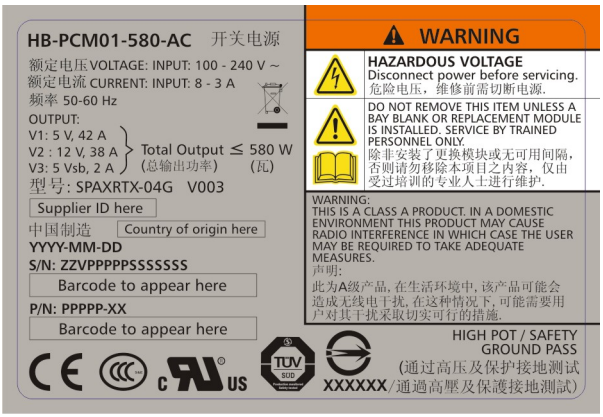


Figure 3 Power Cooling Module Warning label – Hazardous Voltage

Electrical safety

- The 2U enclosure must only be operated from a power supply input voltage range of 100–240 VAC, 50–60 Hz.
- The 5U enclosure must only be operated from a power supply input voltage range of 200–240 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.
- 5U84 enclosures are intended to operate with two PSUs.

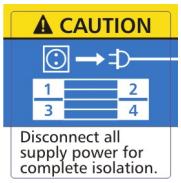


Figure 4 Power Cooling Module Warning label

CAUTION:

- Do not remove the covers from the enclosure or any of the modules—there is a danger of electric shock inside. Do not attempt to disassemble the rear sub-chassis from the enclosure. Return any damaged components to your supplier for repair.
- When bifurcated power cords (Y-leads) are used, these cords must only be connected to a power 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 power supply modules 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 or PSU 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 power supply modules in all 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 22) and Figure 6 (page 22): 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 23) and Figure 8 (page 23): holds up to 24 low profile (5/8 inch high) 2.5" form factor disk drive modules in a vertical orientation.

The same 2U 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. The 5U84 enclosure is also supported as an expansion enclosure, and uses the same expansion IOMs used in 2U expansion enclosures.

The 5U (rack space) expansion enclosure (see Figure 9 (page 24) holds up to 84 low profile (1-inch high) 3.5" form factor disk drive modules in a vertical orientation within the disk drawer. Two vertically-stacked drawers each hold 42 disks. If used, 2.5" disks require 3.5" adapters.

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 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, there is no need to transport failed controller cache to a replacement controller because the cache is duplicated between the controllers, provided that volume cache is set to standard on all volumes in the pool owned by the failed controller.

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 50). Please refer to “Enclosure variants” (page 25) for details about various enclosure options.

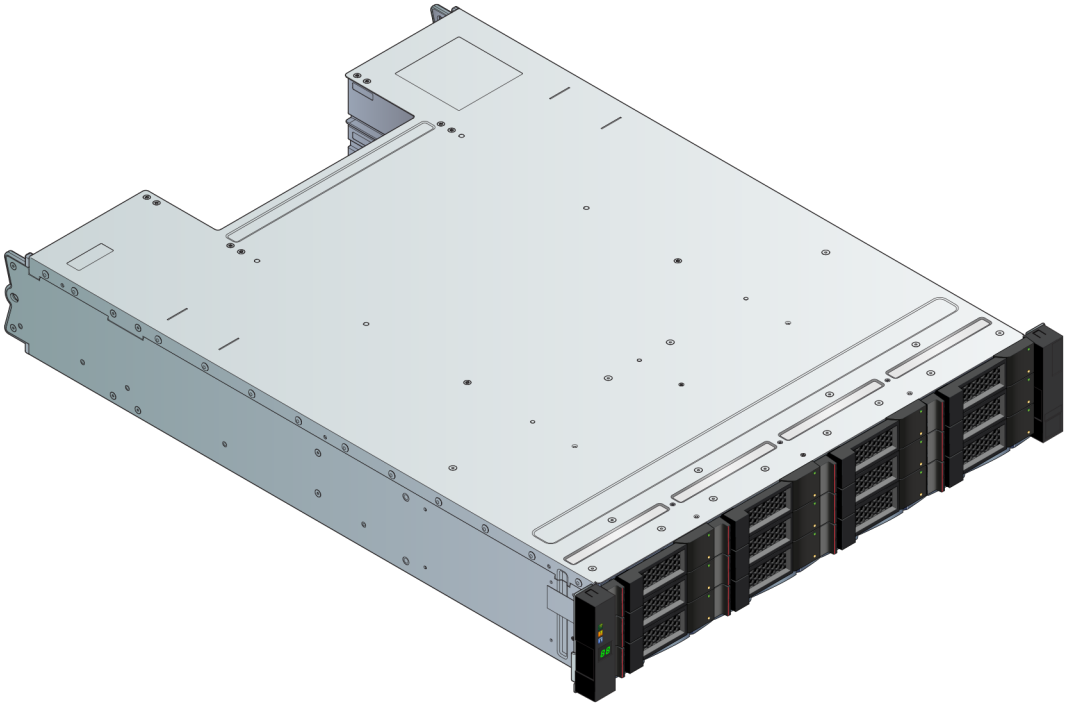


Figure 5 2U12 enclosure system – isometric front orientation

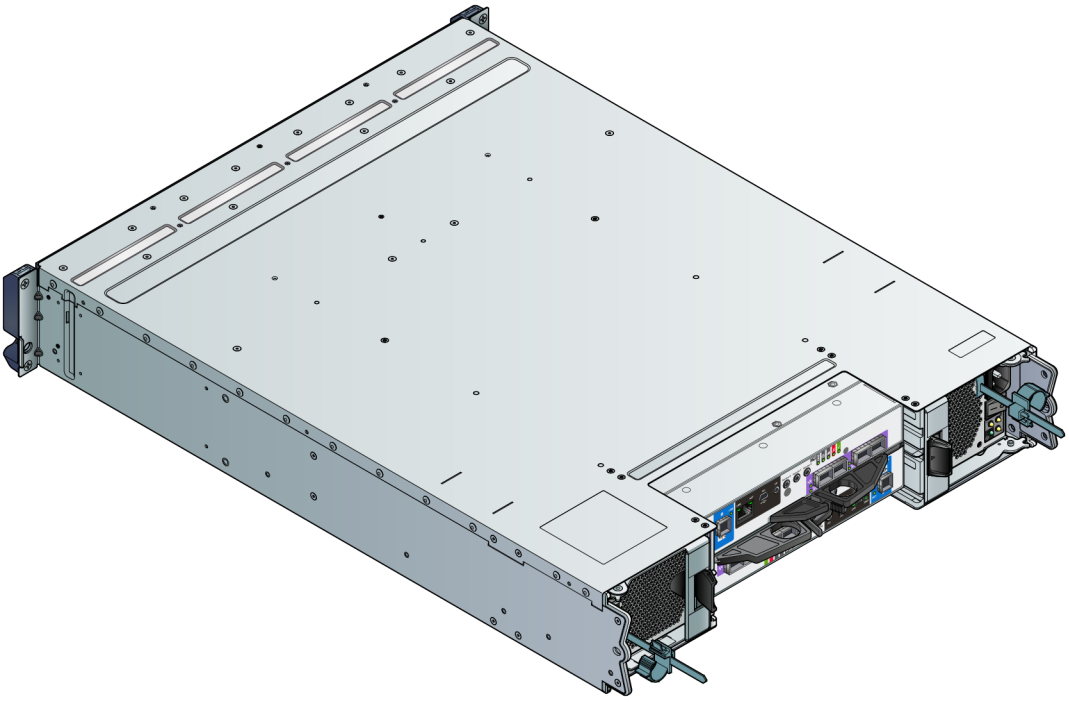


Figure 6 2U12 enclosure system – isometric rear orientation

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

NOTE: Please refer to "Enclosure variants" (page 25) for details about various enclosure options.

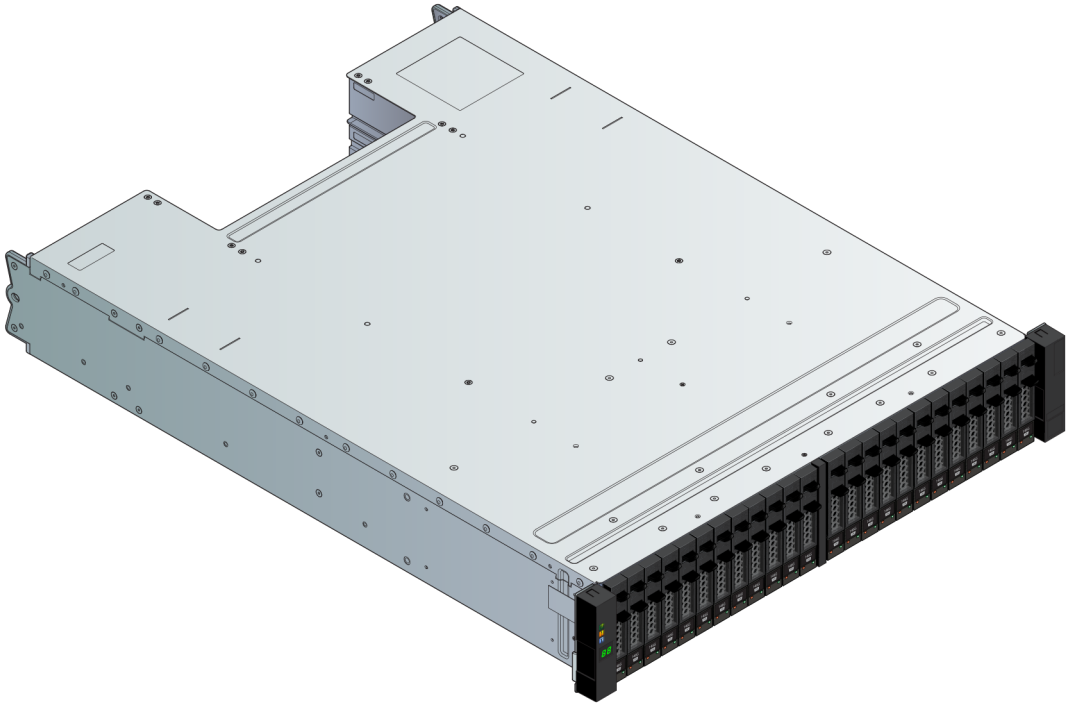


Figure 7 2U24 enclosure system – isometric front orientation

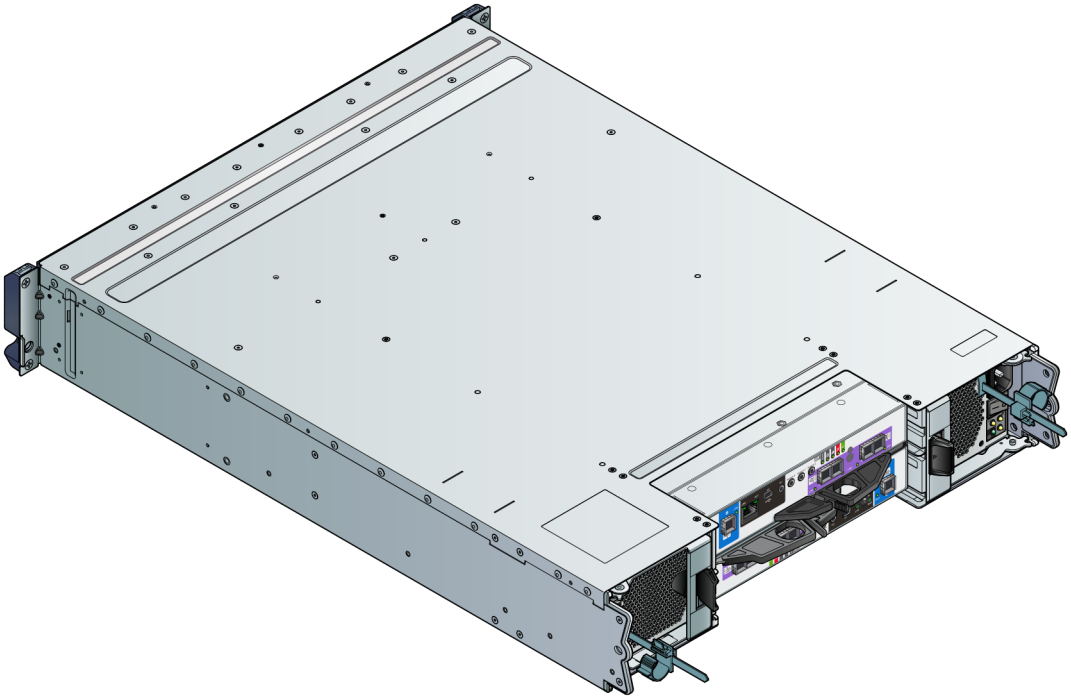


Figure 8 2U24 enclosure system – isometric rear orientation

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

Isometric front view orientation

Isometric rear view orientation
(EBOD is equipped with dual-IOMS)

Figure 9 5U84 enclosure system – isometric front and rear orientations

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. The 5U chassis can be configured as a expansion enclosure (DS EXP) as shown in Table 5.

IMPORTANT: The 2U and 5U core products–including key components and CRUs–are described herein. Although many CRUs differ between the form factors, the IOMs are common to 2U12, 2U24, and 5U84 chassis. The IOMs are introduced in "2U enclosure core product" and cross-referenced from "5U enclosure core product".

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.

D3284

84 x LFF or SFF disk drives (not interchangeable) held in two 42-slot vertically-stacked drawers.

Table 5 D3284 enclosure variants

Product[1]	Configuration	PSUs[2]	FCMs[3]	IOMs[4]
D3284	12Gb/s direct dock SFF SAS	2	5	2

1-The D3284 is not supported by DS2200. The D3284 is compatible with DS6200 and DS4200 controllers.
2-Redundant PSUs must be compatible modules of the same type (both AC).
3-The fan control module is a separate CRU (not integrated into a PCM).
4-The D3284 uses the same 3-port expansion canister used in the 2U EBODs.

IMPORTANT: DS Series and DS EXP/D3284 storage enclosures support dual-controller configuration only. If a partner controller fails, the storage system will fail over and run on a single controller module until the redundancy is restored. For RBODs and EBODs, an IOM must be installed in each IOM slot to ensure sufficient air flow through the enclosure during operation.

NOTE: The enclosure core product definitions follow.

- See "2U enclosure core product" for the 2U12 and 2U24 form factor.
- See "5U enclosure chassis" for the D3284 (5U84) form factor.
- IOMs are used in 2U and 5U chassis, and are described in "Controller modules" and "Expansion module" (page 29).

2U 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 33 (page 39).
- 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 25). 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.

2U enclosure front panel

Integers on disks indicate drive slot numbering sequence.

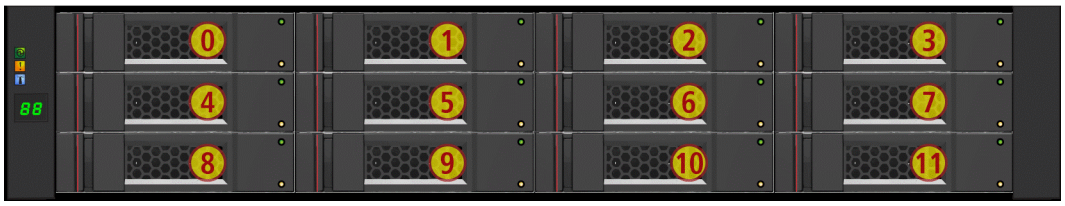


Figure 10 2U12 enclosure system – front panel components

Figure 11 2U24 enclosure system – front panel components

2U 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 DS Series RBODs support the DS EXP EBODs for optionally adding storage. The DS6200 and DS4200 RBODs also support the D3284 EBOD.

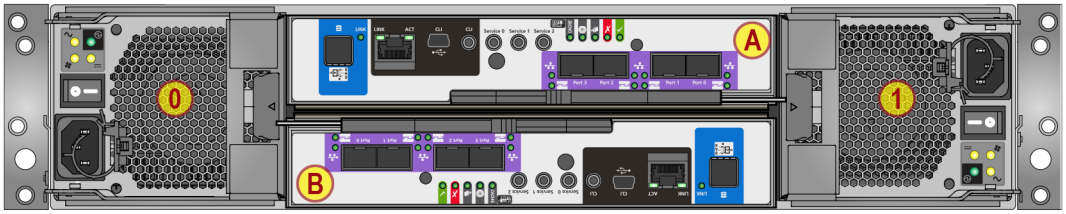


Figure 12 2U controller enclosure – rear panel components (4-port FC/iSCSI)

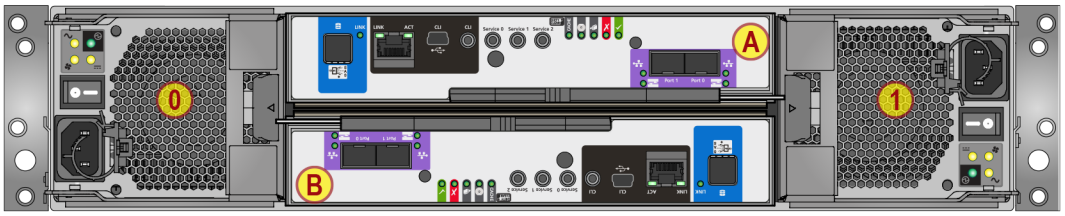


Figure 13 2U controller enclosure – rear panel components (2-port FC/iSCSI)

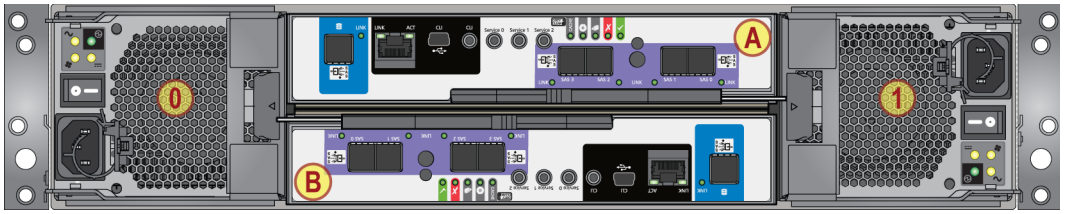


Figure 14 2U controller enclosure – rear panel components (4-port SAS)

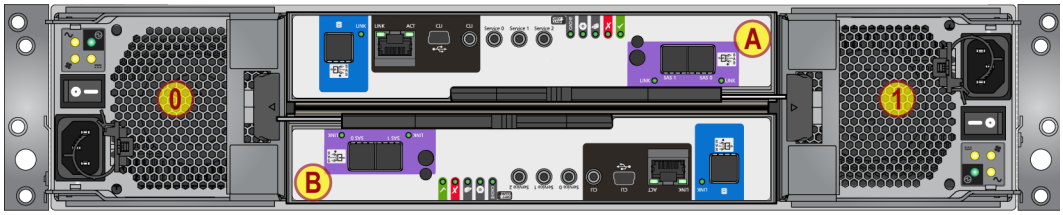


Figure 15 2U controller enclosure – rear panel components (2-port SAS)

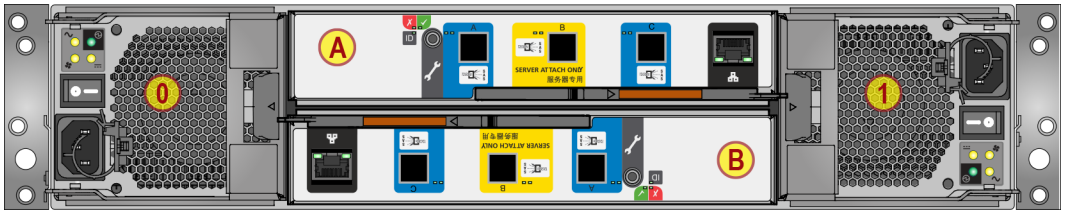


Figure 16 2U expansion enclosure – rear panel components

2U 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. This orientation also applies to canister insertion into IOM slots located on the 5U84 enclosure rear panel.

Figure 17 and Figure 18 show CNC host interface ports that can be configured with 8/16Gb/s FC SFPs, 10GbE iSCSI SFPs, or Gb/s RJ-45 SFPs. See "Install an SFP transceiver" (page 156) for installing qualified SFP options in CNC ports.

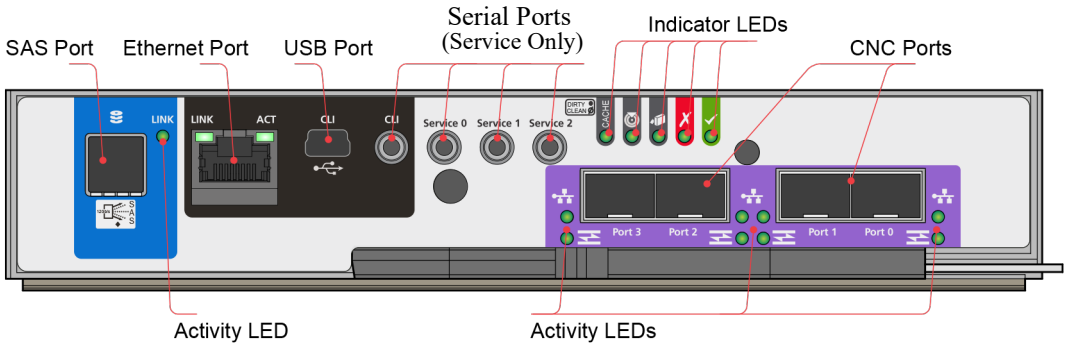


Figure 17 4-port FC/iSCSI controller module detail (DS6200/DS4200)

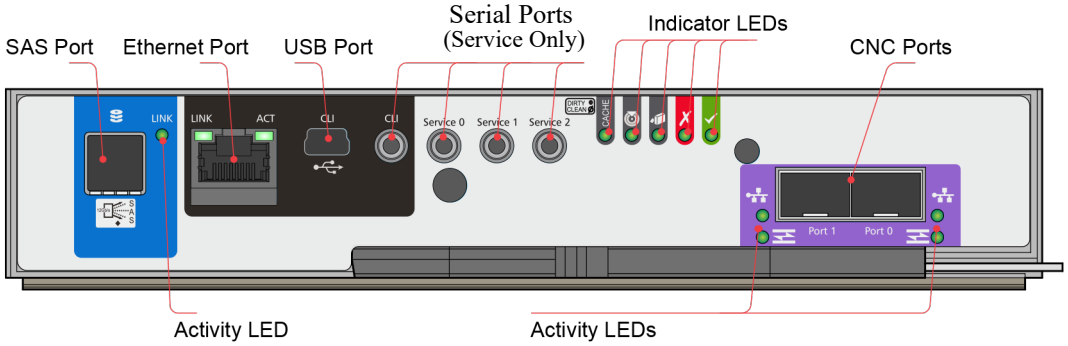


Figure 18 2-port FC/iSCSI controller module detail (DS2200 only)

Figure 19 and Figure 20 show SAS host interface ports that ship configured with 12Gb/s HD mini-SAS (SFF-8644) external connectors.

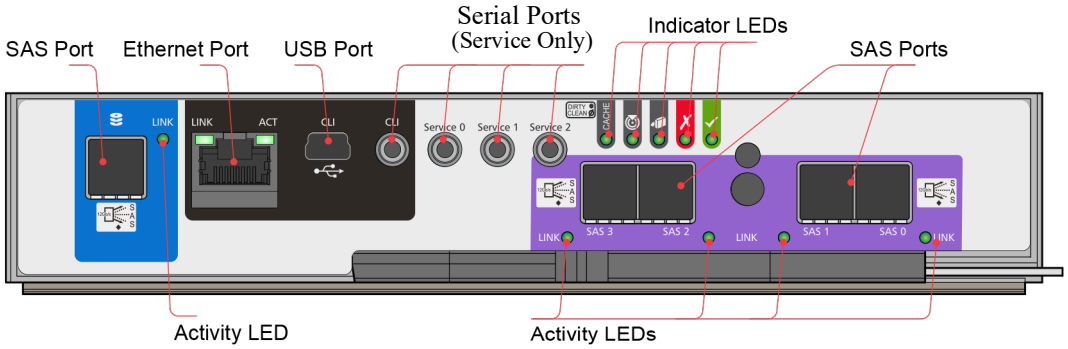


Figure 19 4-port HD mini-SAS controller module detail (DS6200/DS4200)

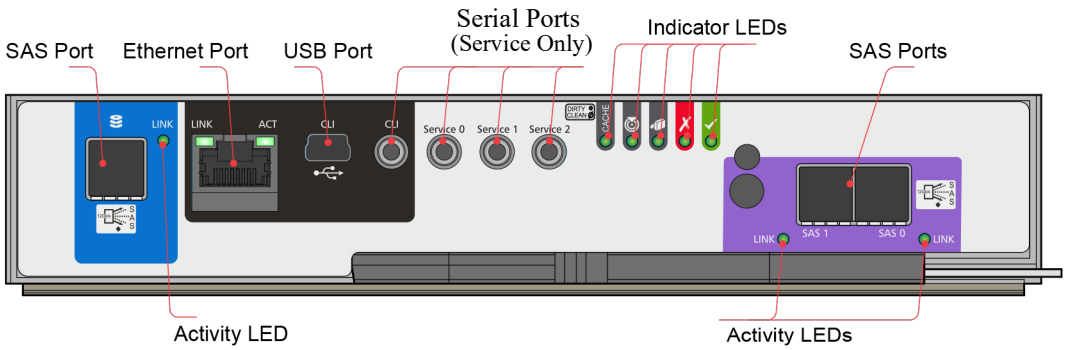


Figure 20 2-port HD mini-SAS controller module detail (DS2200 only)

Expansion module

Figure 21 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. Within 2U enclosures, the top slot for holding IOMs is A and the bottom slot is B. The face plate detail of the expansion canister shows the module aligned for use in A. This orientation also applies to canister insertion into either IOM slot located on the D3284 enclosure rear panel.

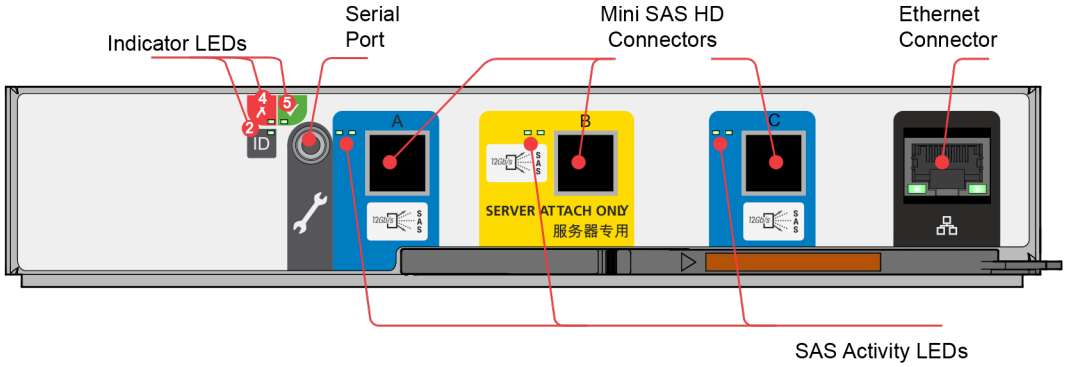


Figure 21 Expansion module detail (DS EXP and D3284)

IMPORTANT: RBOD/EBOD configurations:

- When the expansion module shown above (Figure 21) is used with DS Series controller modules for adding storage, its middle HD mini-SAS expansion port ("B") is disabled by the firmware. See also Figure 55 (page 68).
- The Ethernet port on the expansion module is not used in RBOD/EBOD configurations, and is disabled.

Power cooling module

Figure 22 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.

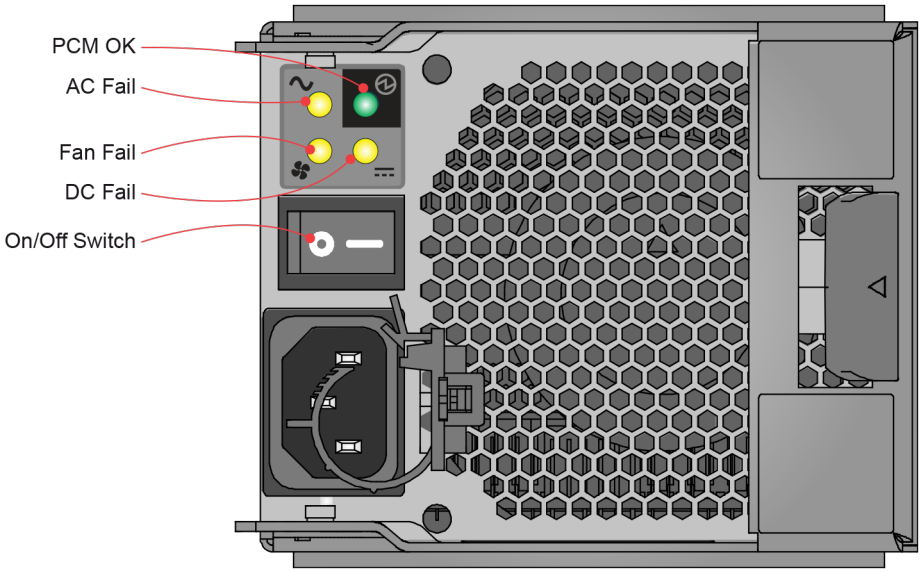


Figure 22 Power cooling module (PCM) detail

2U 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 22)
- 2U24 chassis configured with 24 SFF disks: see Figure 7 (page 23)
- 2U12 empty chassis with midplane: see Figure 23 (page 31)
- 2U24 empty chassis with midplane: see Figure 24 (page 31)

- 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 10 and Figure 11 (page 26). 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 DS Series and DS EXP/D3284 storage enclosures support SBB dual-controller configuration only. If a partner controller fails, the storage system will fail over and run on a single controller module until the redundancy is restored. An IOM must be installed in each IOM slot to ensure sufficient air flow through the enclosure during operation.

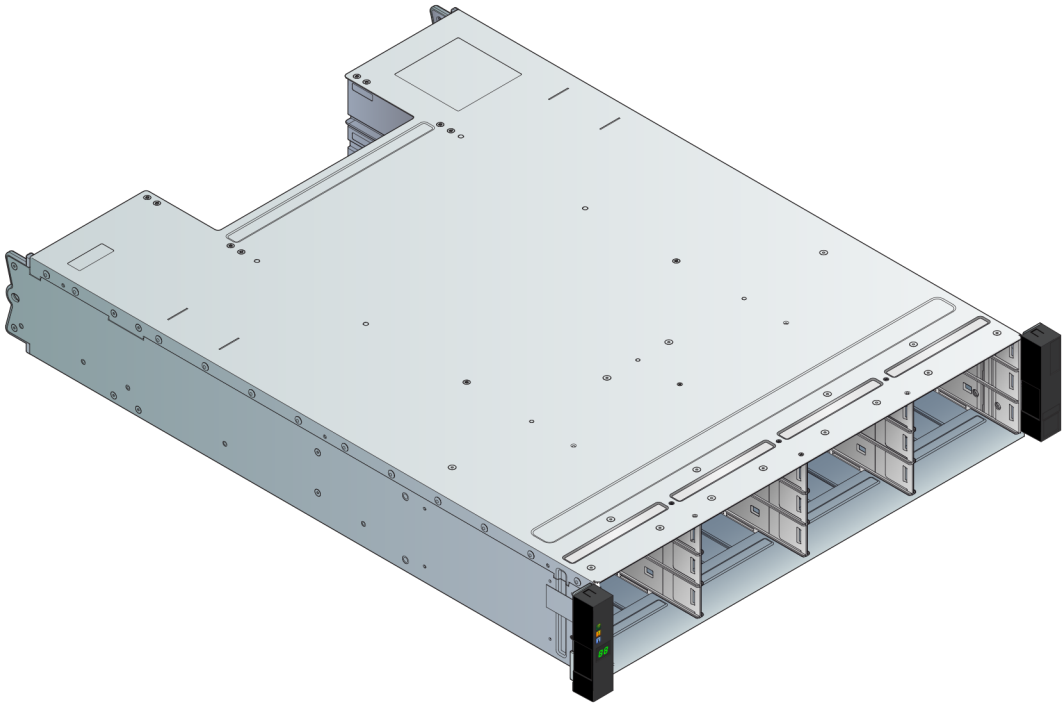


Figure 23 2U12 enclosure chassis – isometric front orientation

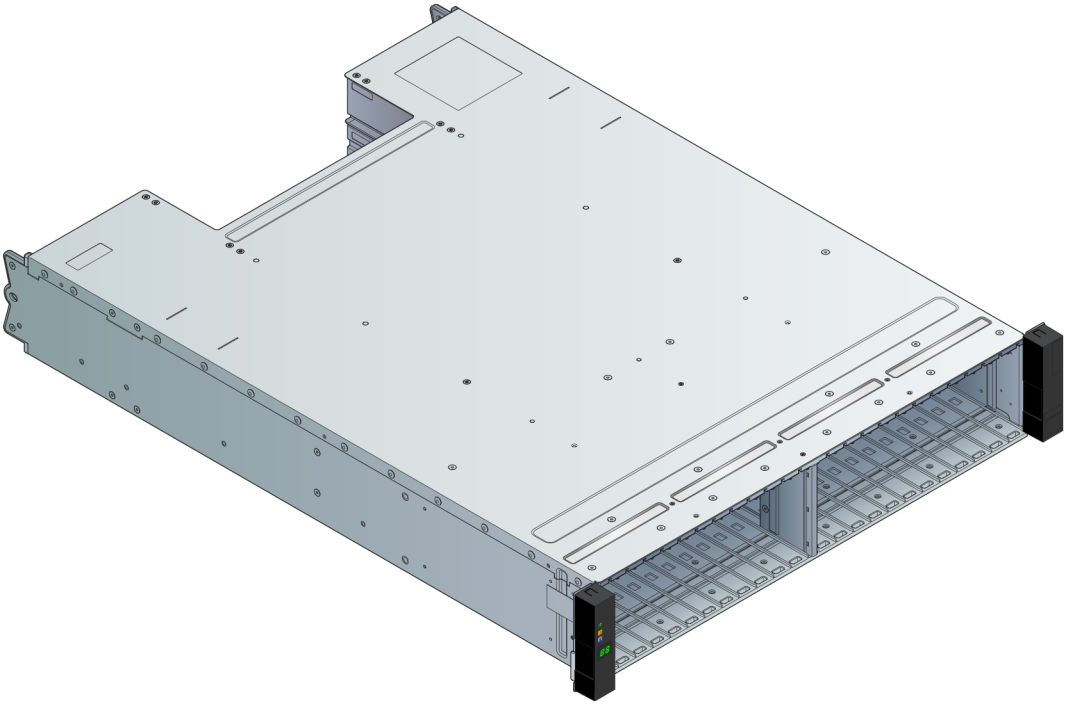


Figure 24 2U24 enclosure chassis – isometric front orientation

---

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

5U enclosure core product

The 5U chassis consists of a sheet metal enclosure, integrated PCBs, and a module runner system. 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 consisting of:
  - Two sliding drawers for holding Disk Drive in Carrier (DDIC) modules (42 disks per drawer).
  - An Operator's (Ops) panel installed on the left ear and a protective cover for the right ear.
  - An enclosure bezel (a bezel cover on each drawer face).
  - A midplane PCB into which other components and CRUs connect.
  - Four sideplanes and six baseplanes providing connectivity for front-end components.
- Two power supply units.
- Five fan cooling modules.
- Two expansion IOMs: 2 x SBB-compliant interface slots.
- Up to 84 DDIC modules populated within two drawers (42 DDICs per drawer; 14 DDICs per row).

TIP: The 5U84 does not ship with DDICs installed. DDICs ship in a separate container, and must be installed into the enclosure drawers during product installation and setup. See the **Installation checklist** table on page 59.

- A rail kit for rack mounting.

NOTE: 5U84 enclosure configuration characteristics

- D3284 is the high-density 5U84 expansion enclosure. It is not configured or used as a controller enclosure.
- The D3284 is supported by DS6200/DS4200 controllers, however, it is not supported by DS2200 controllers.
- A maximum of three D3284s can be cascaded from a supported DS6200 or DS4200 RBOD.
- Although the storage system supports intermixing of 2U expansion enclosures, D3284 expansion enclosures cannot be intermixed with 2U expansion enclosures.

IMPORTANT: To ensure sufficient circulation and cooling throughout the enclosure, all PSU slots, fan cooling module slots, and IOM slots must contain a functioning CRU. Do not replace a faulty CRU unit the replacement is available in hand.

5U enclosure front panel

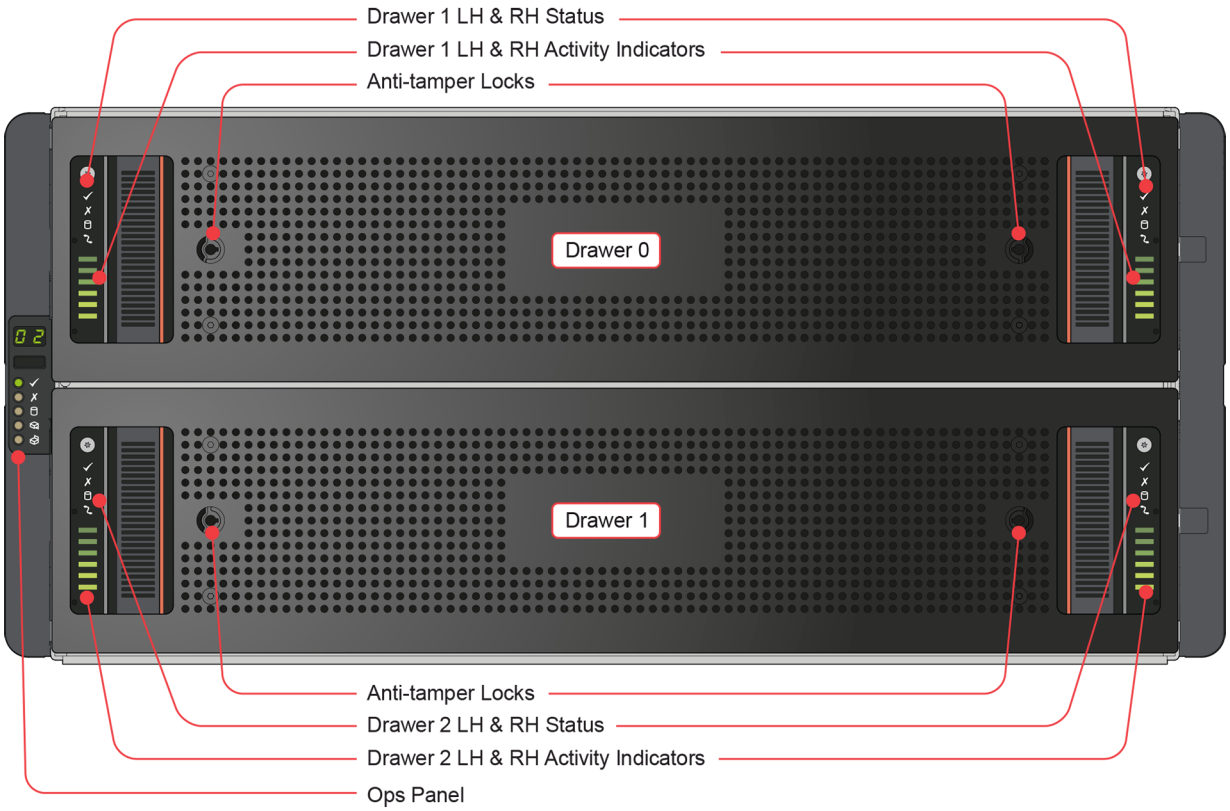


Figure 25 5U84 enclosure system – front panel components

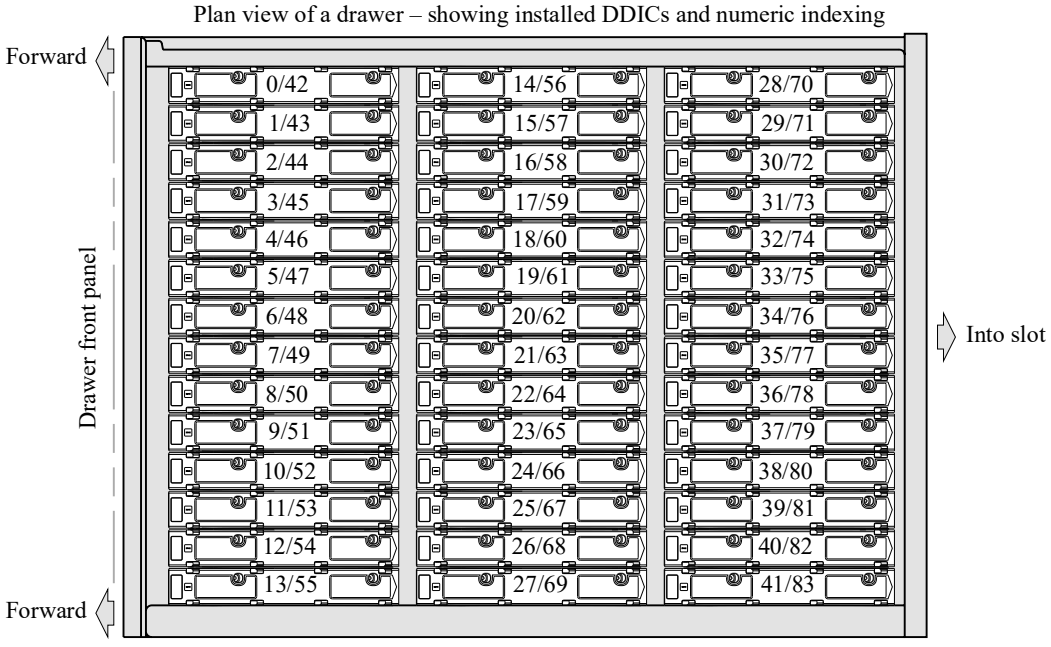


Figure 26 5U84 enclosure system – plan view of drawer accessed from front panel

Figure 26 shows a plan view of an enclosure drawer accessed from the enclosure front panel. The view is scaled and rotated - 90º about the vertical axis to better fit the page, and the conceptual graphics are simplified for clarity.

IMPORTANT: Drawer sideplanes—also known as side cards—can be hot-swapped as field-replaceable units (FRUs). However, these FRUs require a special tool, and replacement should be performed by qualified service personnel. For additional information, contact support.lenovo.com, select Product support and navigate to Storage Products.

5U enclosure rear panel

Numeric designator on PSUs and FCMs, and alphabetic designators on IOMs indicate slot sequencing for modules used in 5U enclosures. PSU, FCM, and IOM modules are available as CRUs. These EBODs use the same 3-port expansion modules used by 2U enclosures for optionally adding storage.

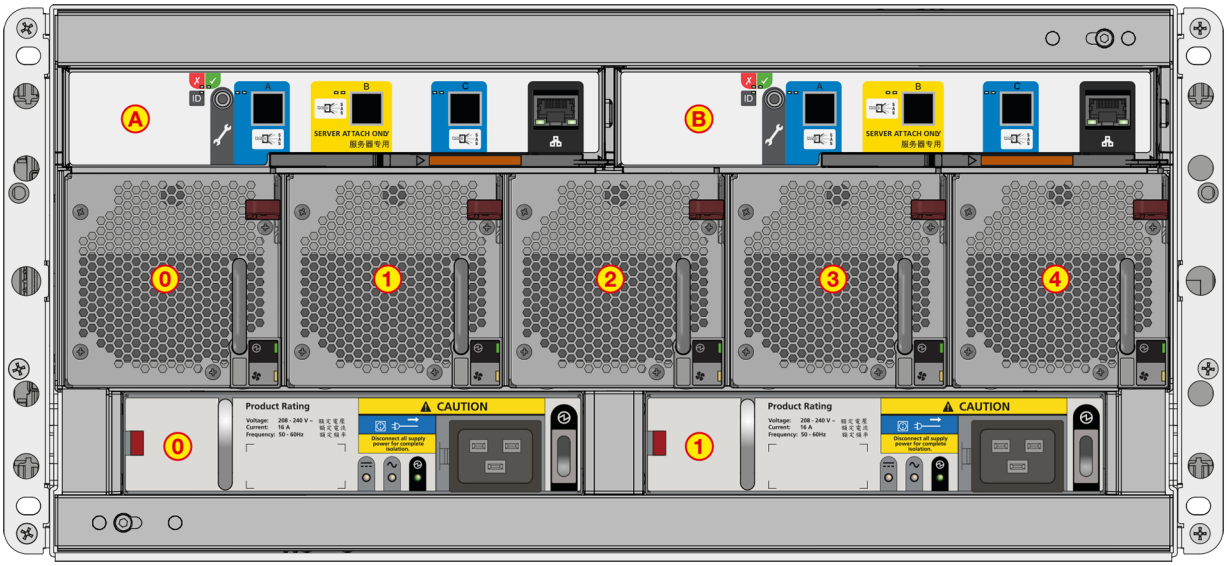


Figure 27 5U84 expansion enclosure – rear panel components

5U rear panel components

Expansion module

The 5U84 expansion enclosure uses the same IOM used by 2U12 and 2U24 enclosures. See “Expansion module” (page 34). See also Figure 21 and the **IMPORTANT** entry on page 53.

Power supply module

Figure 28 shows the power supply unit used in optional 5U84 expansion enclosures.

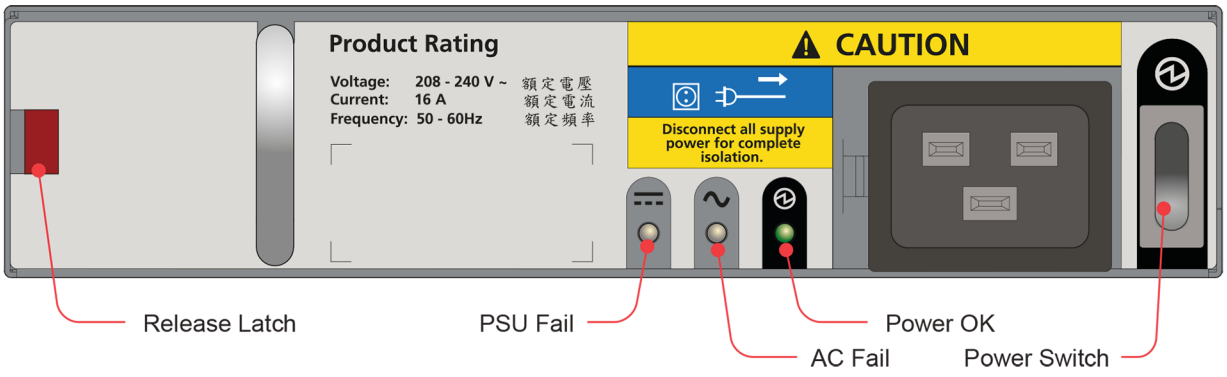


Figure 28 Power supply unit (PSU) detail

The 2U enclosures use a redundant PCM that integrates a power supply and cooling fan within the same CRU module, as shown in Figure 22 (page 30). Conversely, the 5U enclosures use separate CRU modules for power supply and cooling/circulation, respectively.

Figure 28 shows the power supply module, which provides the enclosure with power connection and a power switch. Figure 29 (page 35) shows the fan cooling module used in 5U enclosures. The FCM is smaller than the PCM, and five of them are used within the 5U84 to provide sufficient airflow throughout the enclosure.

Fan cooling module

Figure 29 shows the fan cooling module (FCM) used in optional 5U expansion enclosures.

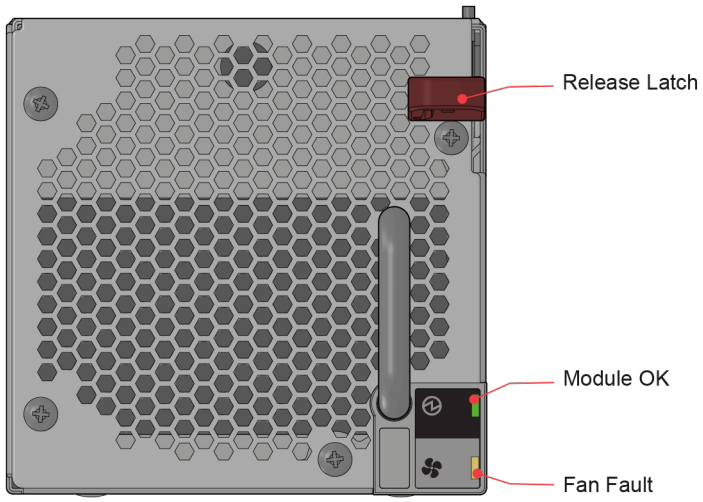


Figure 29 Fan cooling module (FCM) detail

5U enclosure chassis

The 5U chassis consists of a sheet metal enclosure with an integrated midplane PCB, module runner system, and two drawers for drive modules.

NOTE: Supported 5U chassis form factors used for configuring EBODs:

- 5U84 chassis configured with up to 84 LFF disks in DDICs: see Figure 26 (page 33).
- 5U84 chassis configured with SFF disks in SFF disks in 2.5" to 3.5" hybrid driver carrier adapter.
- 5U84 empty chassis with midplane, module runner system and drawers.

- The chassis has a 19-inch rack mounting that enables it be installed onto standard 19-inch racks, and uses five EIA units of rack space (8.75") for a 5U enclosure.
- At the front of the enclosure two drawers can be opened and closed. Each drawer provides access to 42 slots for Disk Drive in Carrier (DDIC) modules. DDICs are top mounted into the drawers as shown in the drawer diagram on page 33. The front of the enclosure also provides enclosure status LEDs and drawer status/activity LEDs.
- At the rear of the enclosure, access is provided to rear panel CRUs: two SBB-compliant IOMs; two PSUs; and five fan cooling modules.

5U enclosure drawers

Each enclosure drawer contains 42 slots, each of which can accept a single DDIC containing a 3.5" LFF disk drive or a 2.5" SFF disk drive with an adapter. See Figure 25 and Figure 26 (page 33).

Opening a drawer does not interrupt the functioning of the storage system, and DDICs can be hot-swapped while the enclosure is in operation. However, drawers must not be left open for longer than 2 minutes, or airflow and cooling will be compromised.

IMPORTANT: During normal operation, drawers should be closed to ensure proper airflow and cooling within the enclosure.

When fully opened, a drawer is designed to support its own weight, plus the weight of the DDICs.

Safety features:

- To reduce the possibility of toppling, only one drawer can be open at a time.
- The drawer locks into place when fully opened and extended. To reduce pinching hazards, two latches must be released before the drawer can be pushed back into the drawer slot within the enclosure.

Power and data are sent via three baseplanes and two sideplanes. The direct-dock SATA version of the 5U enclosure has one active and one passive sideplane, and has dual power paths, but only a single data path.

Each drawer can be locked shut by turning both anti-tamper locks clockwise using a screwdriver with a Torx T20 bit. The anti-tamper locks are symmetrically placed on the left-hand and right-hand sides of the drawer bezel. Drawer status and activity LEDs can be monitored via two Drawer LEDs panels located next to the two drawer-pull pockets located on the left-hand and right-hand side of each drawer.

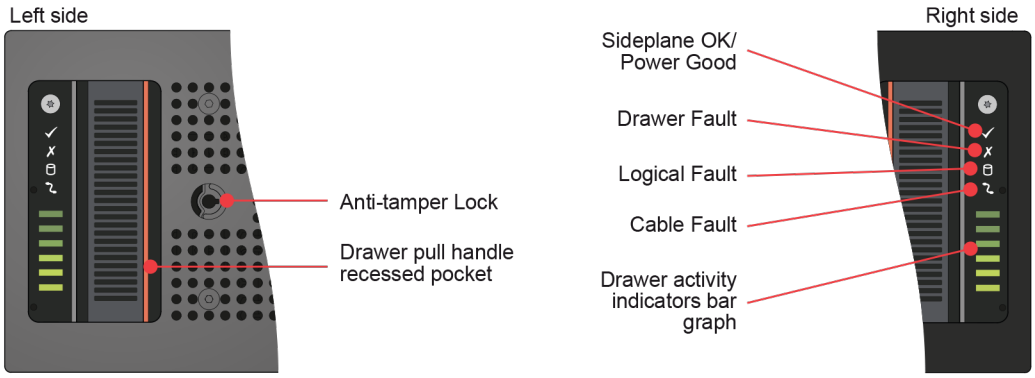


Figure 30 Drawer bezel details

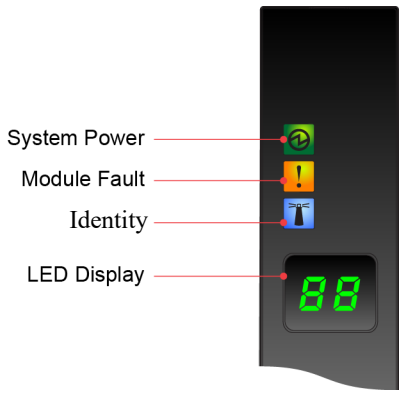
NOTE: Figure 30 shows symmetrical drawer bezel details. The callouts provided on the right side detail also pertain to the left side detail.

Operator's (Ops) panel

Each of the enclosures supported by DS Series and DS EXP/D3284/DS EXP feature an Ops panel located on the chassis left ear flange. The Ops panel for 2U and 5U enclosures are described herein.

2U enclosure 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 96).



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 31 LEDs: Ops panel – 2U 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

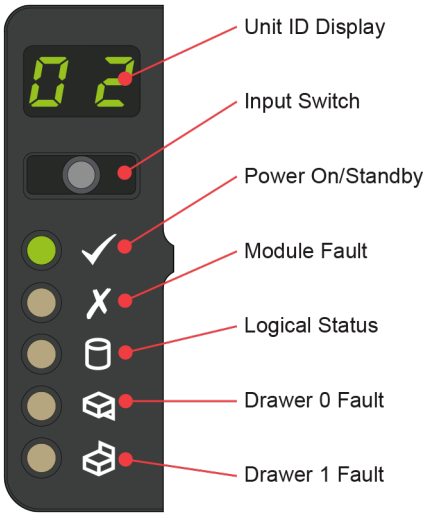
The thermal sensor is located on the outside of the enclosure, and it sends input to the enclosure about its external operating ambient temperature.

5U enclosure 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 100).



Ops panel functions (see left ear on front panel)
Unit Identification LED display
System Power On/Standby LED (Green/Amber)
Module Fault LED (Amber)
Logical Status (Amber)
Top Drawer Fault (Amber)
Bottom Drawer Fault (Amber)

Figure 32 LEDs: Ops panel – 5U enclosure front panel

Unit Identification Display

The UID is a 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.

System Power On/Standby LED (green/amber)

LED displays amber when only standby power is available (non-operational). LED displays green when system power is available (operational).

Module Fault LED (amber)

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

Logical Status LED (amber)

LED indicates a change of status or fault from something other than the enclosure management system. This may be initiated from the controller module or an external HBA. The indication is typically associated with a DDIC and LEDs at each disk position within the drawer, which help to identify the DDIC affected.

Drawer Fault LEDs (amber)

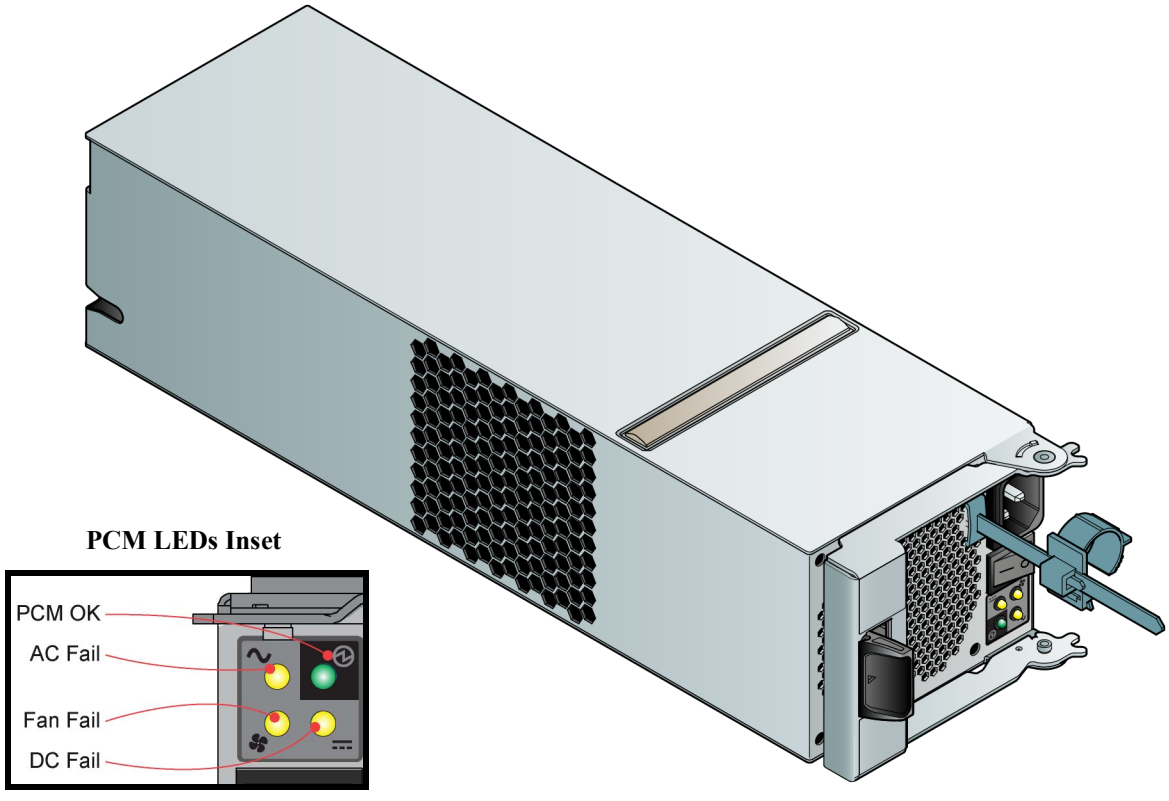
LED indicates a disk, cable, or sideplane fault in the drawer indicated: Top (Drawer 0) or Bottom (Drawer 1).

Power cooling module – 2U enclosures

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 40) 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 33 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 96).	

Figure 33 LEDs: 580W PCM – 2U enclosure rear panel

For a full frontal view of a PCM panel located on the enclosure rear-panel, see Figure 22 (page 30).

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.

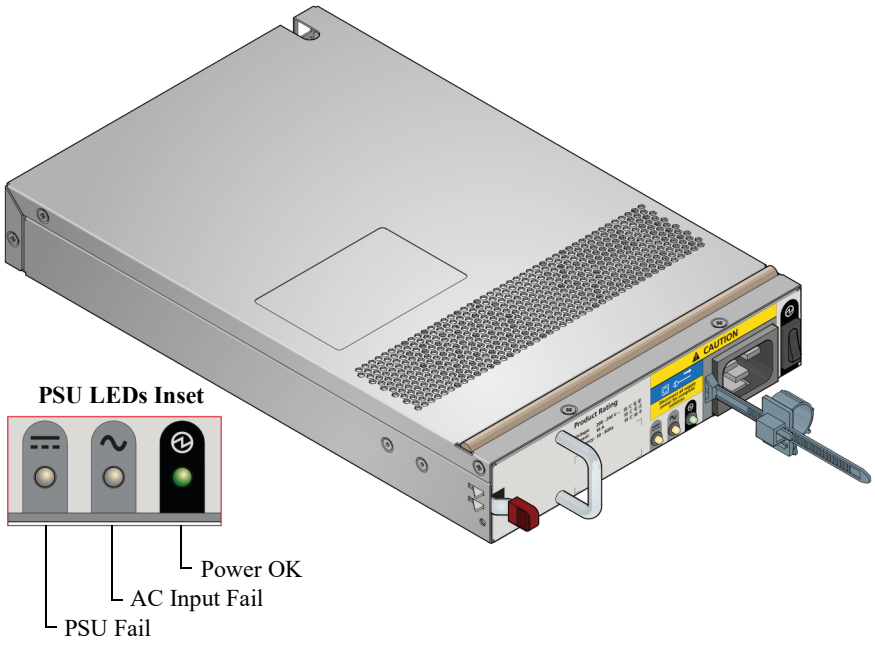
System airflow

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.

Power supply unit – 5U enclosures

Power is provided by two 2,214W PSUs. The PSU voltage operating range is nominally 200V–240V AC, and operates at 50–60 Hz input frequency. The isometric rear orientation in Figure 34 shows the PSU aligned for insertion into its slot located on the enclosure rear panel.



2,214W Power Supply Unit LED descriptions (see inset illustration detail above)	
Power OK LED (Green)	PSU Fail LED (Amber/blinking amber)
AC Input Fail LED (Amber/blinking amber)	
LED behavior	
• If any of the PSU LEDs are illuminated amber, a module fault condition or failure has occurred. • For a detailed description of PCM LED behavior, see “PSU LEDs” (page 100).	

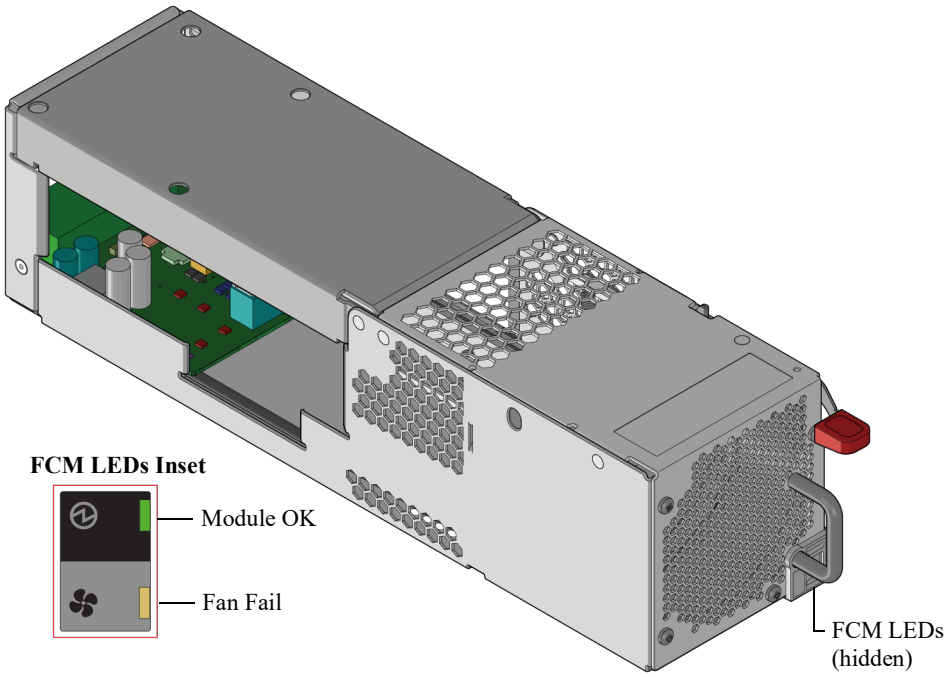
Figure 34 LEDs: 2,214W PSU – 5U enclosure rear panel

Dual PSUs provide redundant power for the 5U system: if one PSU fails, the other keeps the system running while you replace the faulty module. PSUs are hot-swappable. Replacement of a PSU can be performed while the enclosure is running, but the procedure must be completed within two minutes of the removal of the defective module. Verify that you have a replacement PSU on hand before removing the defective module.

Fan cooling module – 5U enclosures

The five fan cooling modules (FCMs) at the rear of the enclosure maintain all system components below their maximum temperature, assuming the ambient temperature is below 35ºC. Fan speed within the FCMs is governed by the controller modules.

FCMs are hot-swappable. Replacement of an FCM can be performed while the enclosure is running, but the procedure must be completed within two minutes of the removal of the defective module. Verify that you have a replacement module on hand before removing the defective FCM.



Fan Cooling Module LED descriptions (see inset illustration detail above)	
Module OK LED (Green)	Fan Fail LED (Amber/blinking amber)
LED behavior	
• If any of the FCM LEDs are illuminated amber, a module fault condition or failure has occurred. • For a detailed description of FCM LED behavior, see “Fan cooling module LEDs” (page 100).	

Figure 35 LEDs: FCM – 5U enclosure rear panel

NOTE: The “System airflow” (page 40) topic introduced for the 2U enclosures applies equally to 5U enclosures.

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 36 shows a frontal face plate view of a 4-port FC/iSCSI controller module aligned for use in the top controller module slot located on the 2U enclosure rear panel.

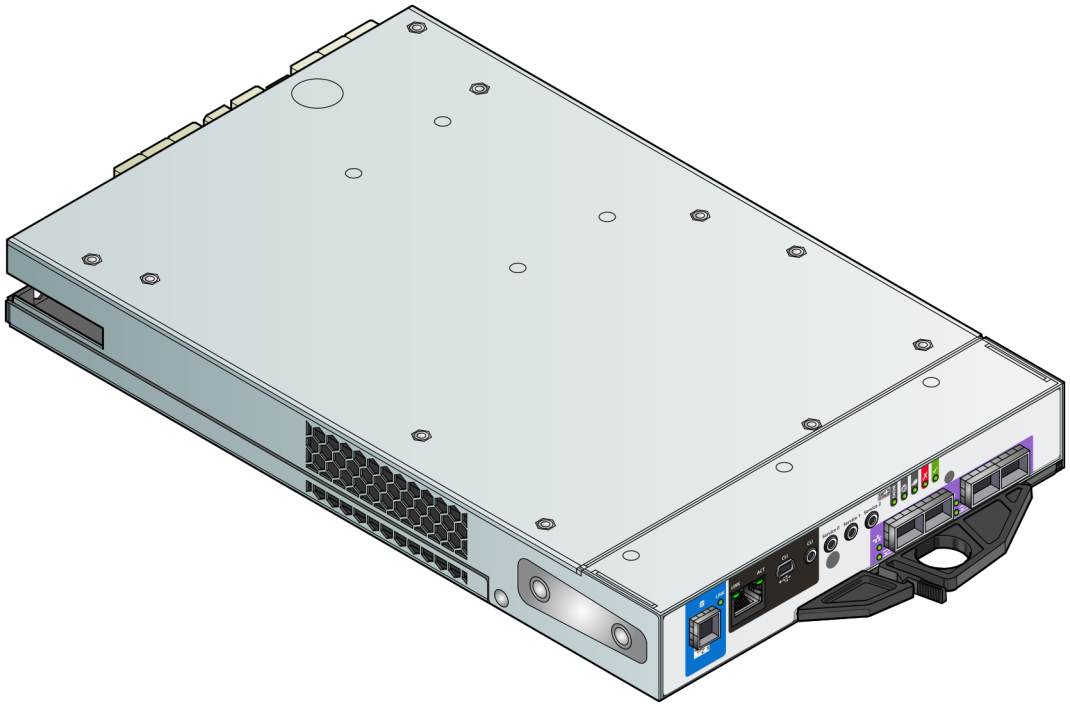


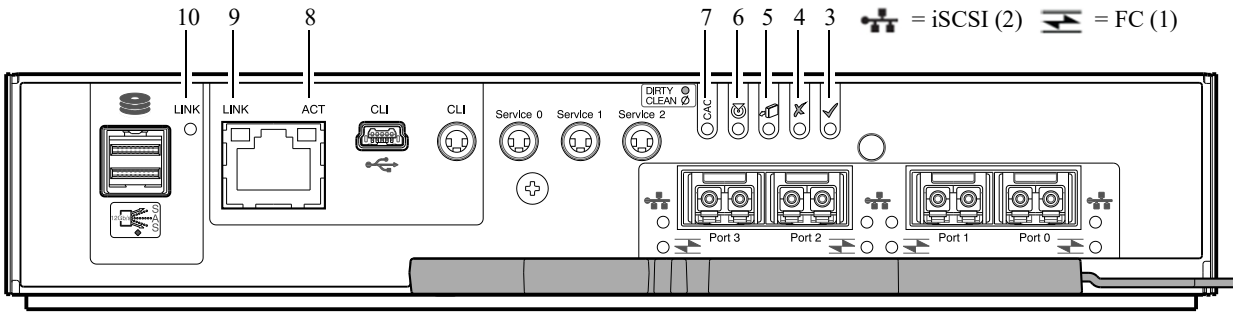
Figure 36 Controller module – isometric rear orientation

NOTE: Given that the 5U84 is configured as an EBOD, it does not support controller modules. Rather, it supports the expansion module used by DS EXP enclosures. See Figure 43 (page 52) and Figure 77 (page 115).

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 a DS Series and DS EXP/D3284 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.

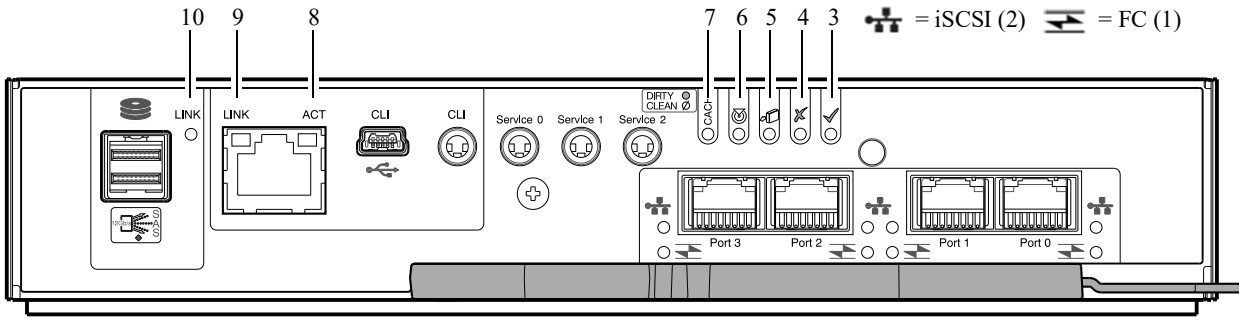
1-When in FC mode, the SFPs must be qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

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 the port is down, both LEDs are off.

Figure 37 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 50).
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.

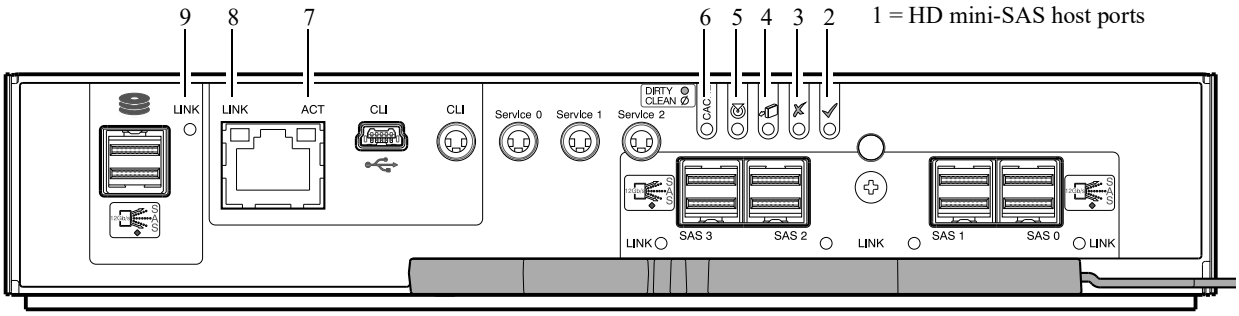
1-When in FC mode, the SFPs must be a qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

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.

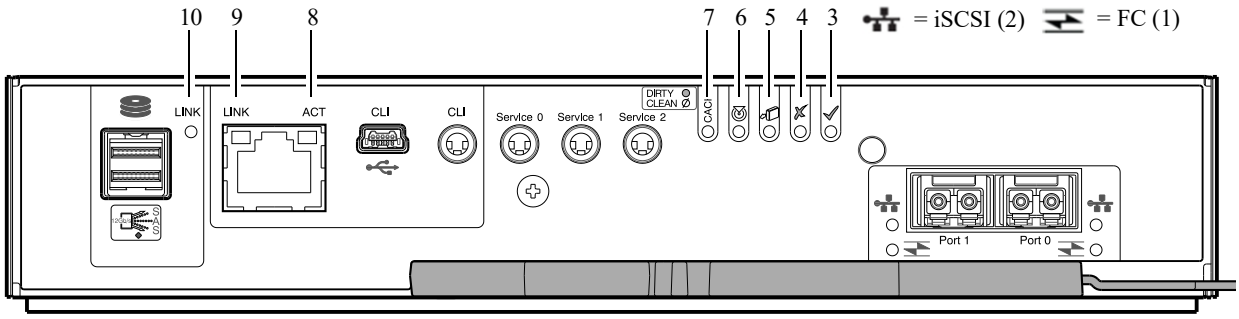
Figure 38 LEDs: DS6200/DS4200 iSCSI controller module (1Gb RJ-45 SFPs)



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 50).
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 39 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.

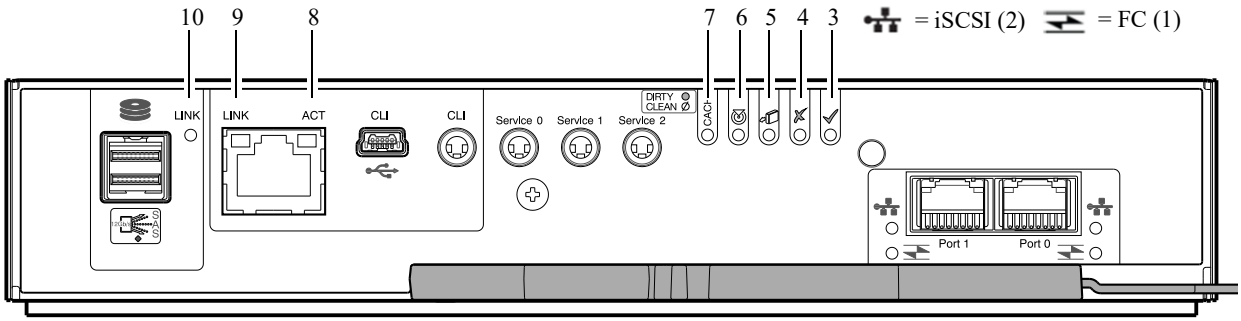
1-When in FC mode, the SFPs must be qualified 8Gb or 16Gb fiber optic option. A 16Gb/s SFP can run at 16Gb/s, 8Gb/s, 4Gb/s, or auto-negotiate its link speed. An 8Gb/s SFP can run at 8Gb/s, 4Gb/s, or auto-negotiate its link speed.

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

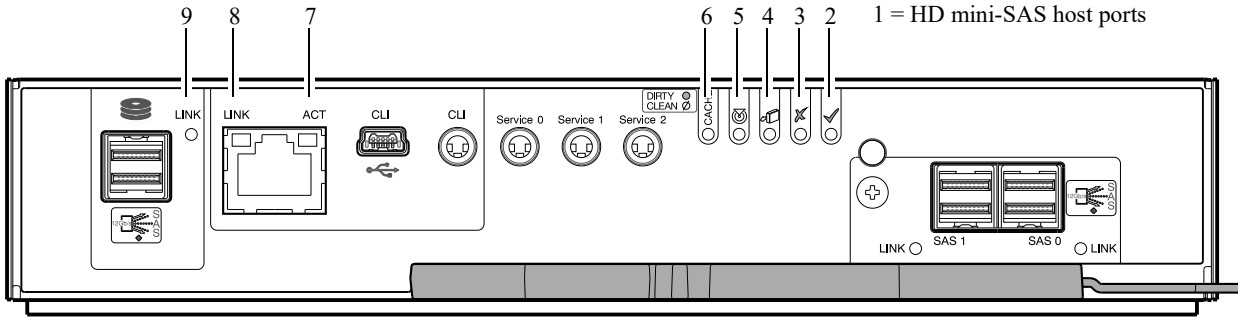


LED	Description	Definition
1	Not used in example[1]	The FC SFP is not shown in this example.
2	Host 1Gb iSCSI[2,3] Link Status/ Link Activity	Off — No link detected. Green — The port is connected and the link is up. Blinking green — The link has I/O or replication activity.
3	OK	Green — The controller 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 50).
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 41 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 50).
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 42 LEDs: DS2200 SAS controller module (HD mini-SAS)

NOTE: When 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

Power on/off behavior

The storage enclosure's unified CPLD provides integrated Power Reset Management (PRM) functions. During power on, discrete sequencing for power on display states of internal components is reflected by blinking patterns displayed by the Cache Status LED (see Table 6).

Table 6 Cache Status LED – power on behavior

Item	Display states reported by Cache Status LED during power on sequence							
Display state	0	1	2	3	4	5	6	7
Component	VP	SC	SAS BE	ASIC	Host	Boot	Normal	Reset
Blink pattern	On 1/Off 7	On 2/Off 6	On 3/Off 5	On 4/Off 4	On 5/Off 3	On 6/Off 2	Solid/On	Steady

Once the enclosure has completed the power on sequence, the Cache Status LED displays Solid/On (Normal), before assuming the operating state for cache purposes.

Cache status behavior

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.

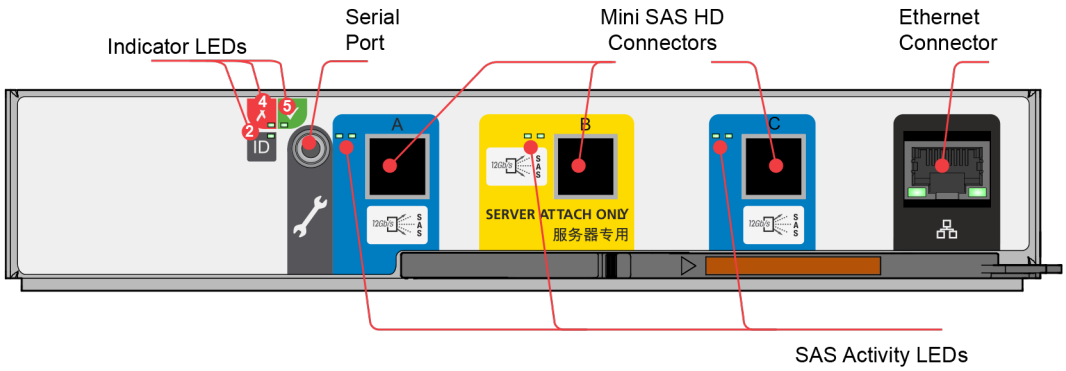
If the controller has failed or does not start, is the Cache Status LED on/blinking?

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 7 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 8 for Activity (Green) and Fault (Amber) LED states.

Figure 43 LEDs: DS EXP and D3284 expansion module

NOTE: See "Expansion module" (page 29) for information about orienting the expansion canister for IOM-slots in DS EXP and D3284 enclosures.

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

Table 8 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 43) is used with DS Series controller modules for adding storage, its middle HD mini-SAS expansion port ("B") is disabled by the firmware. See also Figure 55 (page 68)
- The Ethernet port on the expansion module is not used in RBOD/EBOD configurations, and is disabled.

Disk drive module

DS Series and DS EXP/D3284 supports different disk drive modules for use in 2U and 5U enclosures. The disk drive modules used in 2U enclosures are referred to as drive carrier modules, whereas those used in 5U enclosures are referred to as DDICs (Disk Drive in Carrier).

Drive carrier module in 2U chassis

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.

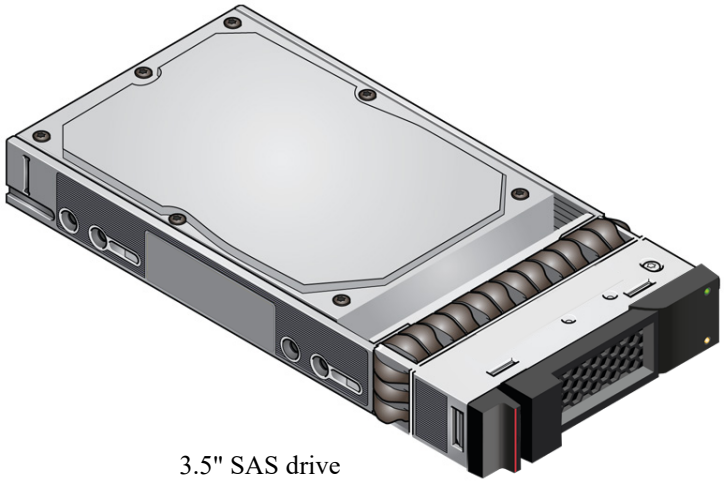
The front cap also has an ergonomic handle which gives the following functions:

- 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 44 Dual path LFF 3.5" disk drive carrier modules

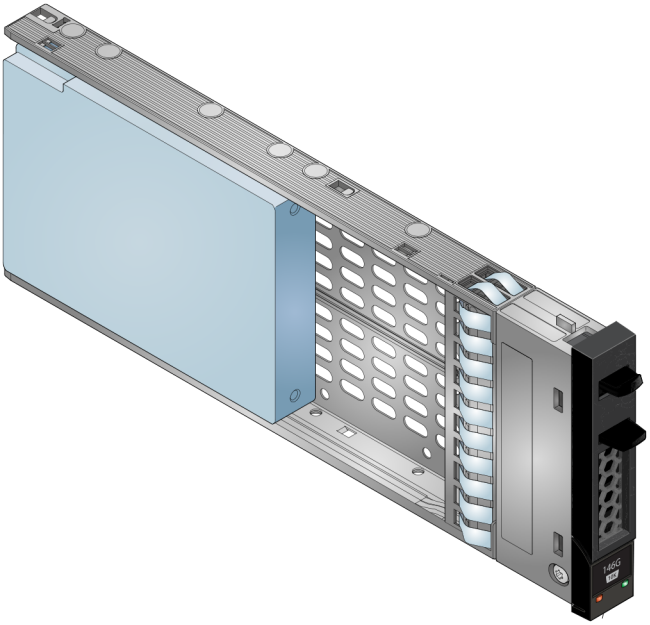


Figure 45 Dual path SFF 2.5" drive carrier module with no Interposer card

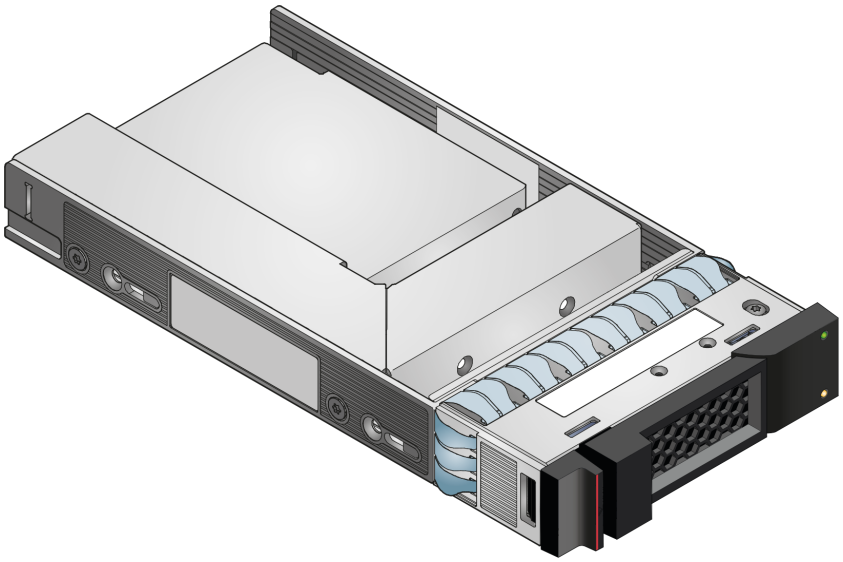


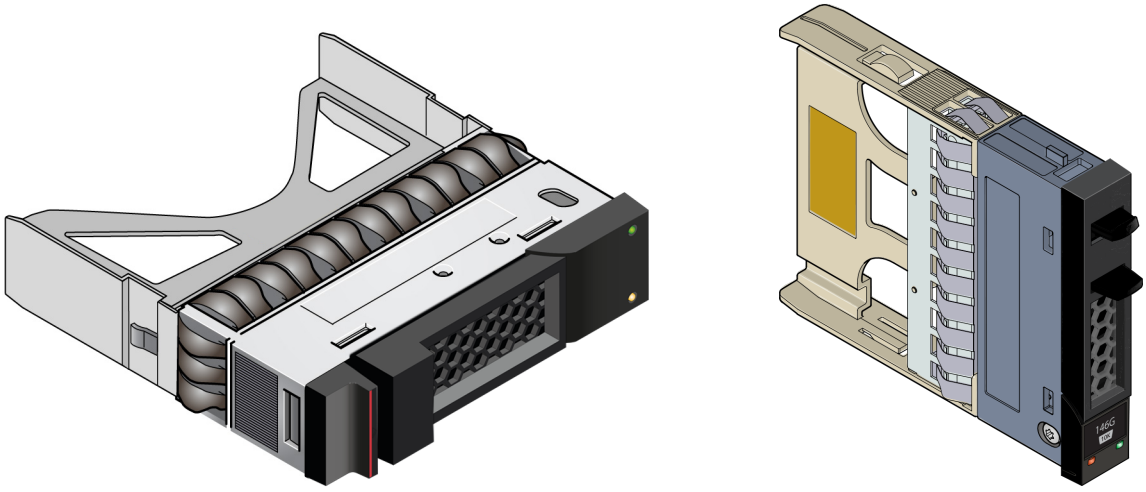
Figure 46 2.5" to 3.5" hybrid drive carrier adapter

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 97) 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 47 LFF HDD Blank Filler and SFF HDD Blank Filler

DDIC in 5U chassis

Each disk drive is housed in a carrier that enables secure insertion of the disk drive into the drawer with the appropriate SAS carrier transition card. Figure 48 shows a DDIC with a 3.5" disk and Figure 49 shows a DDIC with an adapter and a 2.5" disk.

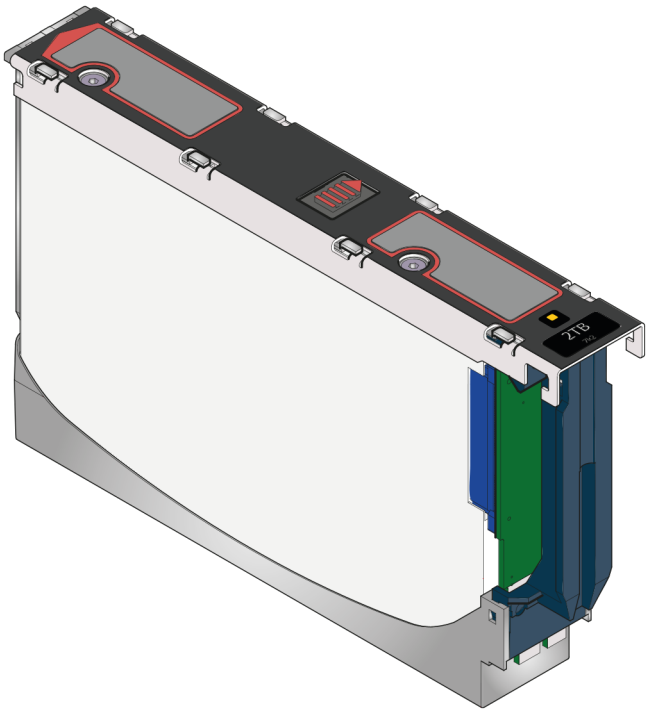


Figure 48 DDIC with 3.5" disk

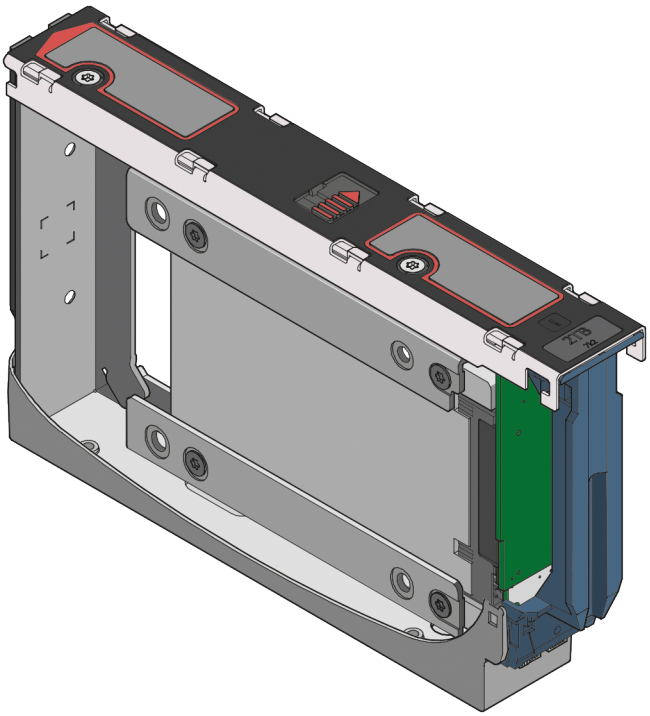


Figure 49 DDIC with an adapter and a 2.5" disk

The DDIC features a latch button (center of top view) and a slide latch with arrow label (left of latch button). These features allow you to install and secure the DDIC into the disk slot within the drawer.

They also allow you to disengage the DDIC from its slot, and remove it from the drawer. The DDIC features a single Drive Fault LED (top view on right), which illuminates amber when the disk has a fault.

Populating drawers with DDICs

The 5U84 enclosure does not ship with DDICs installed. Please refer to Figure 26 (page 33) when reviewing these rules:

- The minimum number of disks supported by the enclosure is 14.
- DDICs must be added to disk slots in rows (14 disks at a time).
- Beginning at the front of the drawer(s), install DDICs consecutively by number, and alternately between the top drawer and the bottom drawer. Namely, install first at slots 0 through 13 in the top drawer, and then 42 through 55 in the bottom drawer. After that, install slots 14 through 27, and so on.
- The number of populated rows must not differ by more than one row between the top and bottom drawers.
- Hard disk drives (HDD) and solid state drives (SDD) can be mixed in the same drawer.
- HDDs installed in the same row should have the same rotational speed.
- Although DDICs holding 3.5" disks can be intermixed with DDICs holding 2.5" disks within the enclosure, each row should be populated with disks of the same form factor (all LFF or all SFF).

NOTE: For additional information, see “Populating drawers” (page 137) within “Module removal and replacement”.

Figure 96 (page 136) shows a partial view of an empty drawer, which is representative of how the 5U84 enclosure is delivered. Figure 50 shows a drawer that is fully populated with DDICs:

- See Figure 48 (page 56) for the DDIC holding the 3.5" disk

- See Figure 49 (page 56) for the DDIC holding the 2.5" disk with 3.5" adapter

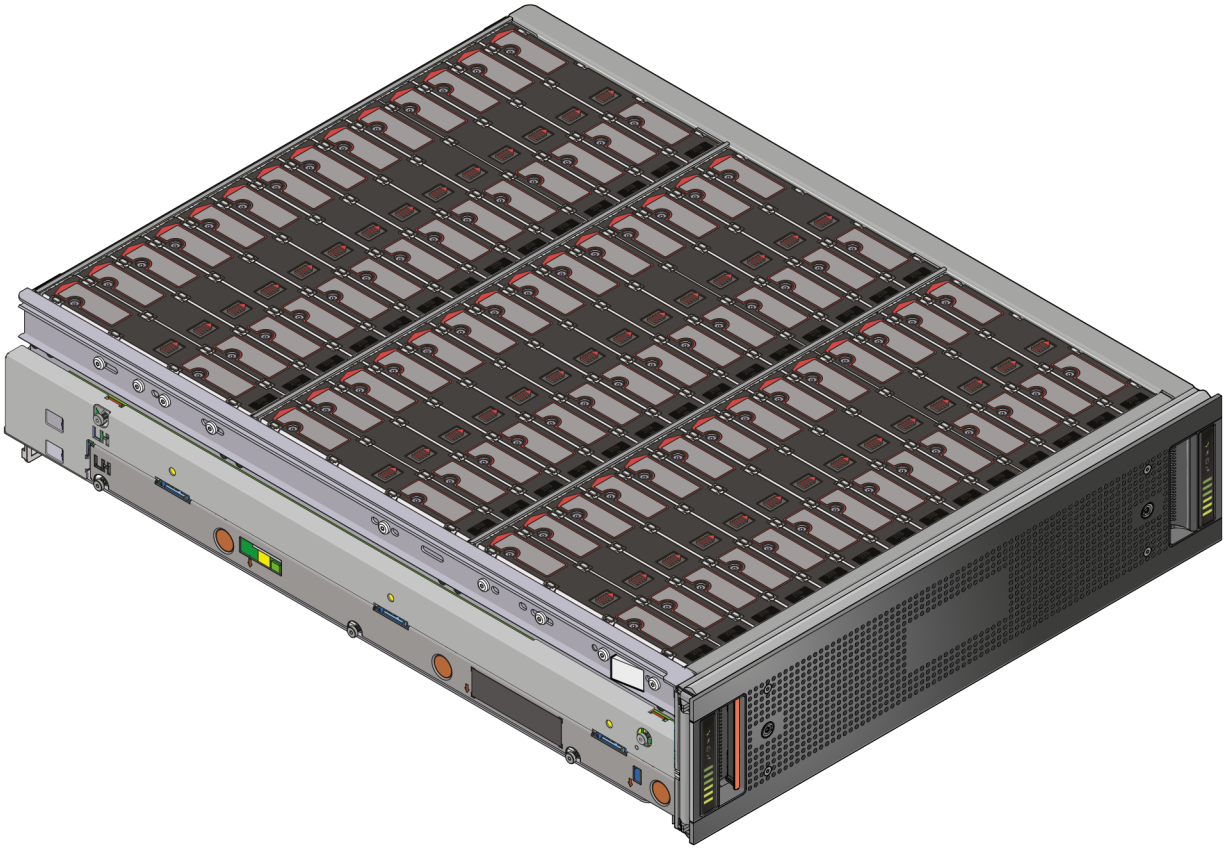


Figure 50 Pictorial view of 5U84 drawer fully populated with DDICs

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".

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 94).

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. Test File.

△ **CAUTION:** To install the system, use only the power cords supplied, or power cables that match the specification quoted in "AC power cords" (page 151).

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 9 Installation checklist

Step	Task	Where to find procedure
1	Unpack the enclosure	See "Unpacking the enclosure" (page 61).
2	Install the controller enclosure and optional drive enclosures in the rack.[1]	See "Required tools" (page 63). See "Requirements for rackmount installation" (page 63). See "Installing the 2U enclosure" (page 63). See "Installing the 5U enclosure" (page 64).
3	5U84 enclosure only: populate drawers with disks (DDIC–disk in drive carrier) 2U enclosures ship with disks installed.	See "FDE considerations" (page 66). See "Accessing drawers" (page 133). See "Populating drawers with DDICs" (page 57). See "Installing a DDIC" (page 137).
4	Connect the controller enclosure and optional expansion enclosures.	See "Connecting the controller enclosure and optional expansion enclosures" (page 66)
5	Connect power cords.	See "Power cord connection" (page 71).
6	Test enclosure connectivity.	See "Testing enclosure connections" (page 71).
7	Install required host software.	See "Host system requirements" (page 72).
8	Connect hosts.[2]	See "Host system requirements" (page 72).
9	Connect remote management hosts.	See "Connecting a management host on the network" (page 79).
10	Obtain IP values and set network port IP properties on the controller enclosure.	See "New user setup" (page 80). For USB CLI port and cable see USB device connection.
11	For CNC models, verify the host interface protocol setting (not necessary for SAS models).	See "CNC technology" (page 73), The CNC IOMs allow for setting the host interface protocol for qualified SFP options. See "Change the CNC port mode" (page 86).
12	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 79). 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 94). 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 10 (page 26)
- 2U24 front panel: see Figure 11 (page 26)
- 2U controller enclosure rear panel: see Figure 12 (page 27)
- 2U expansion enclosure rear panel: see Figure 16 (page 27) (product option)
- 5U front panel: see Figure 25 (page 33) (eBezel) and Figure 26 (page 33) (drawer with slot index)
- 5U expansion enclosure rear panel: see Figure 27 (page 34) (product option)

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

Table 10 Storage system configuration

Module type	Location	Description
Drive carrier modules	2U 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.
DDIC	5U Front panel drawers	Maximum 84 disks are installed (42 disks per drawer) Minimum 14 disks are required. Follow drawer population rules on page 57.
Power cooling modules	2U Rear panel	Two PCMs provide full power redundancy, allowing the system to continue to operate while a faulty PCM is replaced.
Power supply unit modules	5U Rear panel	Two PSUs provide full power redundancy, allowing the system to continue to operate while a faulty PSU is replaced.
Fan cooling modules	5U rear panel	Five FCMs provide airflow circulation, maintaining all system components below the maximum temperature allowed.
I/O modules	Rear panel	Two IOMs must be installed for this configuration (RBOD and EBOD).

NOTE: Whether 2U or 5U, DS EXP enclosures use a common expansion module. See Figure 21 (page 29).

Preparing for installation

NOTE: Enclosure configurations

- 2U enclosures are delivered with CRUs and all drive carrier modules installed.
- 5U enclosures are delivered with many CRUs installed; however, DDICs must be installed during system setup.

CAUTION: Lifting enclosures

- A 2U 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.

- A 5U enclosure—delivered without DDICs installed—requires four people to lift it from the box. A suitable mechanical lift is required to hoist the enclosure for positioning in the rack.

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 116).

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 or PSU
- 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 51.

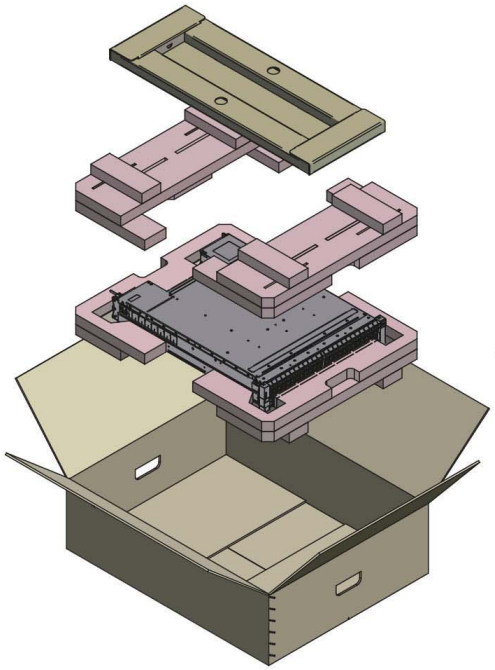


Figure 51 Unpacking the 2U12 and 2U24 enclosures

2U 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.

3. The unpacking procedure pertaining to the 5U84 is shown in Figure 52.

△ **CAUTION:** The enclosure does not include DDICs, but all rear panel modules are installed. This partially-populated enclosure is quite heavy: 64 kg (142 lb). Verify that each strap is securely wrapped and buckled. Four people are required to lift the 5U84 from the box.

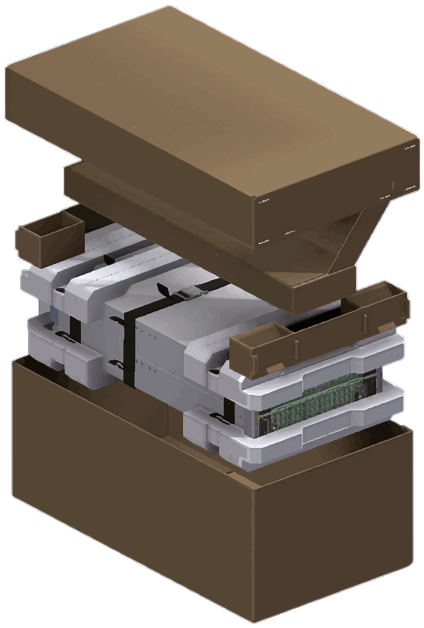


Figure 52 Unpacking the 5U84 enclosure

The railkit and accessories box is located immediately below the box lid in the illustration above.

△ **CAUTION:** With four persons—positioned one at each corner of the enclosure—grip the straps securely by the loops, and lift the enclosure our of the box, using appropriate lifting technique. Place the enclosure in a static-protected area.

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 156).

Required tools

- Flat blade screwdriver. Torx T10/T20 bits for locks and select CRU replacement.

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 2U enclosure.
  - Up to 135 kg (292 lb), depending upon configuration, per 5U 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 18).

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 53.
   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.

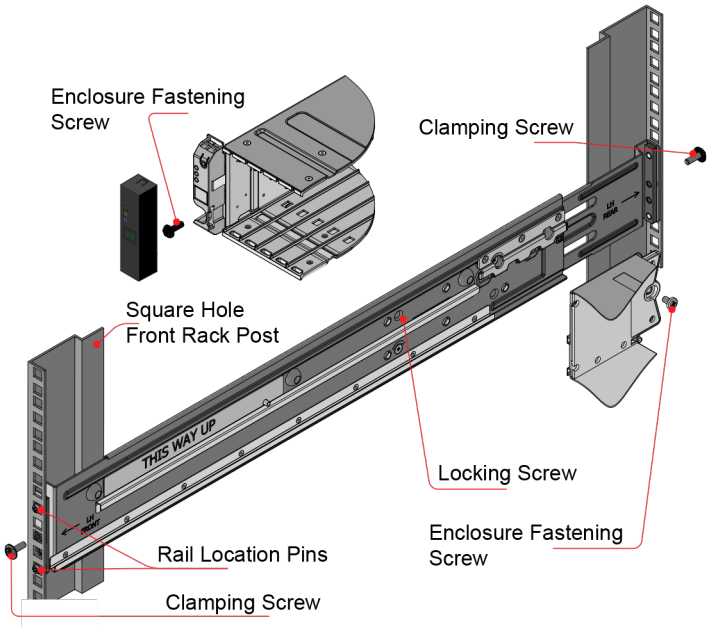


Figure 53 Securing brackets to the rail (left hand rail shown for 2U)

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.

Installing the 5U enclosure

The 5U84 enclosure is delivered without the disks installed. Due to the weight of the enclosure, install it into the rack without DDICs installed, and remove the rear panel CRUs to lighten the enclosure weight.

The adjustment range of the railkit from the inside of the front post to the inside of the rear post is 660 mm – 840 mm. This range suits a one meter deep rack within Rack Specification IEC 60297.

1. To facilitate access, remove the door from the rack.
2. Ensure that the pre-assembled rails are at their shortest length (see also the reference label on the inside of the rail).

3. Locate the rail location pins inside the front of the rack, and extend the length of the rail assembly to enable the rear location pins to locate. Ensure the pins are fully located in the square or round holes in the rack posts. See also Figure 54.

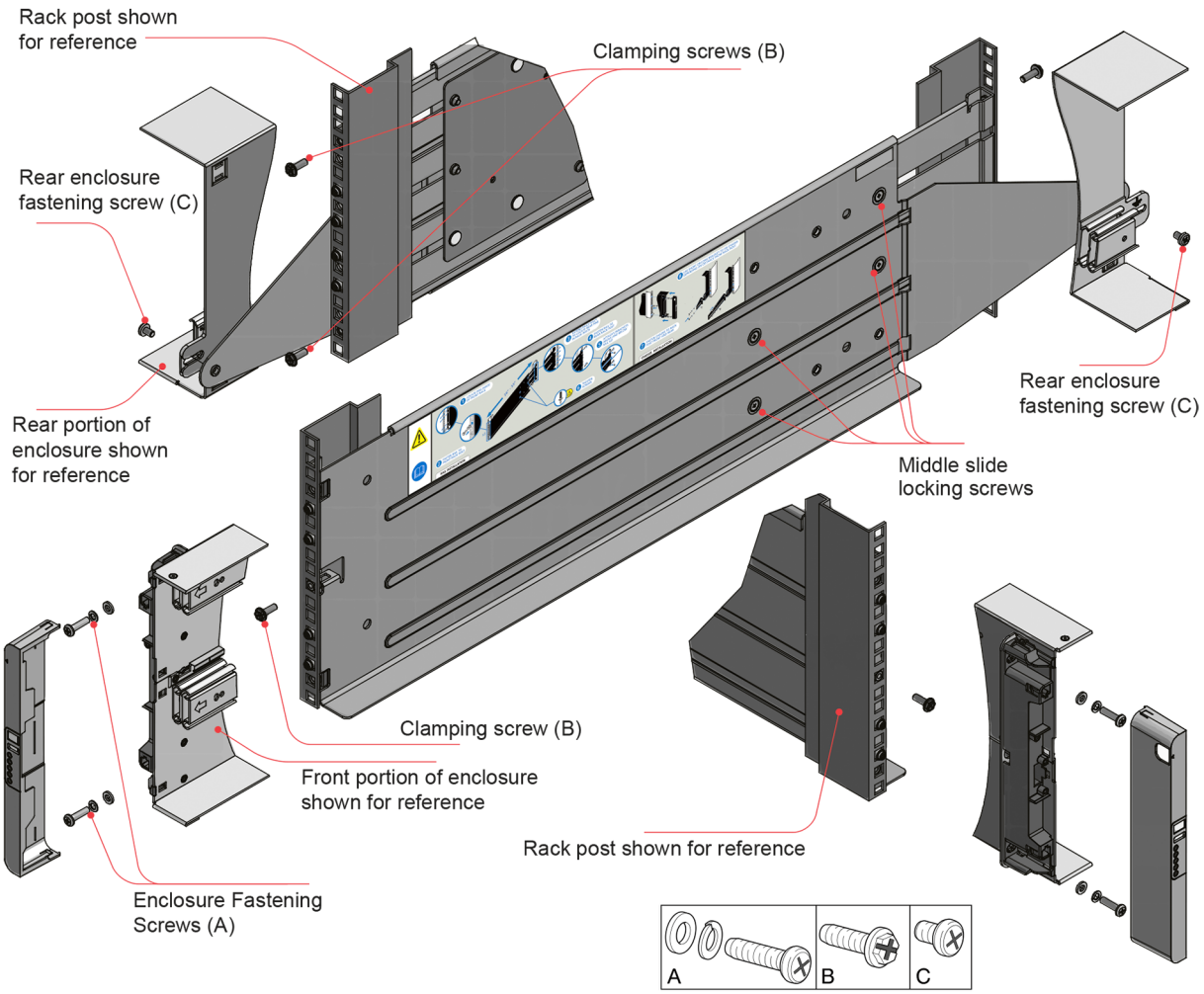


Figure 54 Securing the brackets to the rail (left hand rail shown for 5U)

4. Fully tighten all clamping screws and middle slide locking screws.
5. Ensure the rear spacer clips (x4) are fitted to the edge of the rack post.
6. Slide the enclosure fully home on its rails.
7. Fasten the front of the enclosure using the enclosure fastening screws (x4) as shown in Figure 54.
8. Fix the rear of the enclosure to the sliding bracket with the rear enclosure fastening screws.

△ **CAUTION:** Use only power cords supplied, or power cords that comply with the specifications in Table 37 (page 151).

△ **CAUTION:** Once the enclosure is installed in the rack, dispose of the lifting straps. Due to the difficulty in attaching the straps once the enclosure is installed into the rack, the straps are not suitable for removing the enclosure from the rack.

Reinsert all of the rear panel modules, and install all of the DDICs into the drawers accessed from the front panel per the following instructions:

- Installing a fan cooling module “Installing an FCM” (page 142)
- Installing a PSU “Installing a PSU” (page 140)
- Installing an IOM “Installing an IOM” (page 144)
- Installing a DDIC “Installing a DDIC” (page 137)

  See also:

  - “Accessing drawers” (page 133)
  - “Populating drawers” (page 137)

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 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: When moving FDE-capable disk drive modules for a disk group, stop I/O to any volumes in the disk group before removing the disk drive modules. Follow the procedures in Module removal and replacement for replacing disk drive modules relative to the enclosure type (2U12/2U24/5U84). Import the keys for the disks so that the disk content becomes available.

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

Connecting the controller enclosure and optional expansion enclosures

The DS6200 and DS4200 controller enclosures support up to nine (9) 2U expansion enclosures for a maximum of 240 disk drives. Alternatively, the DS6200 and DS4200 controller enclosures support up to three (3) 5U84 expansion enclosures for a maximum of 276 disk drives.

The DS2200 controller enclosures support up to three (3) 2U expansion enclosures for a maximum of 96 disk drives. The DS2200 controller enclosure does not support the 5U84 expansion enclosure available for use with DS6200/DS4200 controller enclosures.

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.

IMPORTANT: RBOD/EBOD cascades

- The DS6200/DS4200/DS EXP storage system supports intermixing of 2U12 and 2U24 EBODs, but it does not support intermixing of 2U and D3284 EBODs. EBOD cascades must be all 2U or all 5U enclosures.
- The DS2200/DS EXP storage system supports intermixing of 2U12 and 2U24 EBODs, but it does not support the D3284 EBOD.

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 2U expansion enclosures are also nearly identical to one another. The 5U84 uses the same SBB IOM used in the 2U expansion enclosures, but the remaining CRUs accessible from the 5U rear panel differ from those used in the 2U enclosures.

NOTE: For clarity, the schematic diagrams show only relevant details such as IOM face plate outlines and expansion ports. For detailed illustrations see “2U enclosure rear panel” (page 27) and “5U enclosure rear panel” (page 34).

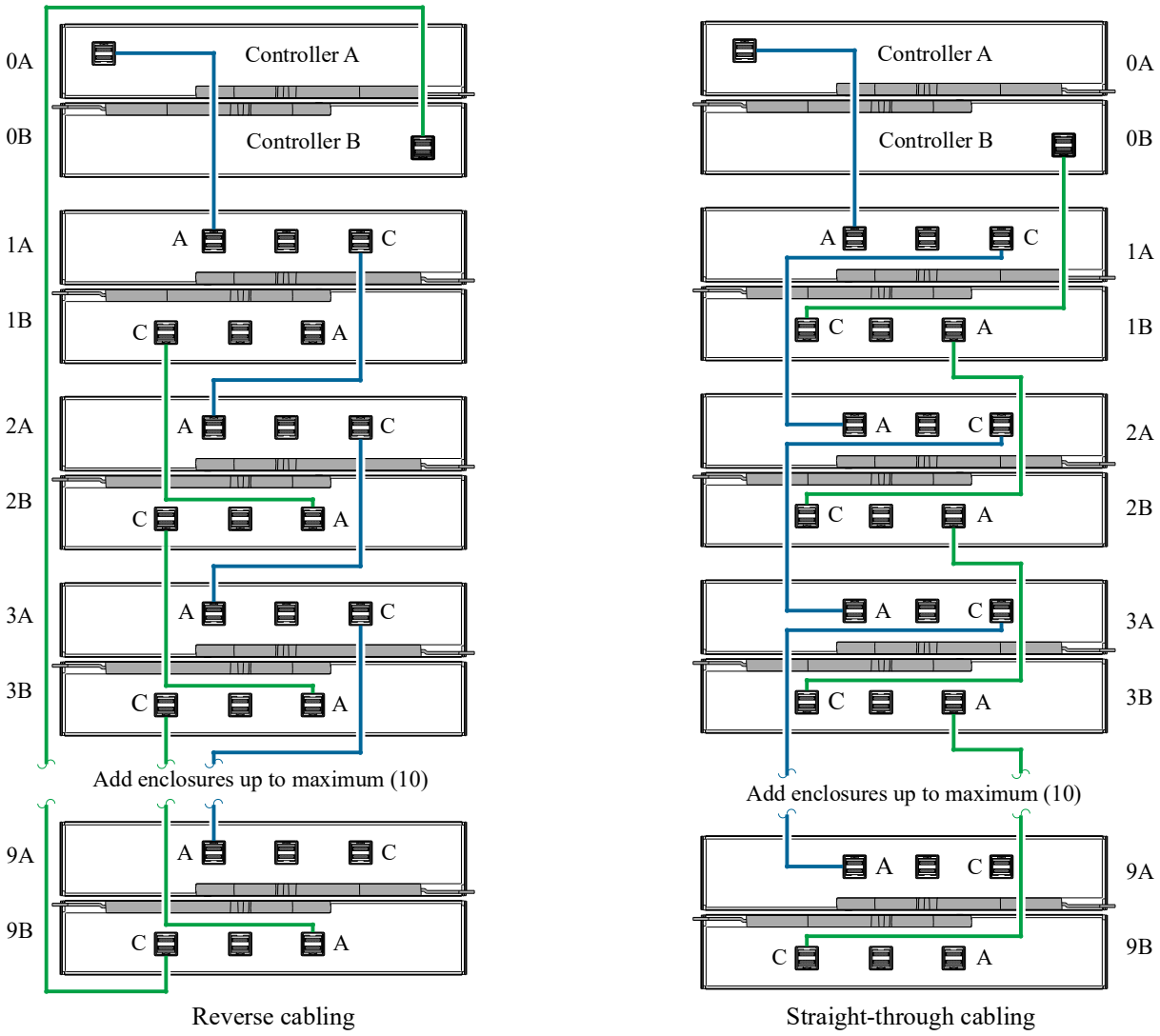


Figure 55 Cabling connections between a 2U controller enclosure and 2U expansion enclosures

The diagram above (left) shows reverse cabling of a DS Series 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 2U models. Given that supported 2U 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 21 (page 29) and the **IMPORTANT** entry beneath that figure. Refer to these diagrams when cabling multiple DS EXP expansion enclosures together with DS Series controller enclosures.

DS Series does not support intermixing of DS EXP and D3284 expansion enclosures when configuring a storage system. Representative examples showing supported configurations and configuration limits are provided above

for DS EXP, and on the following page for DS Series controller enclosures cabled with D3284 expansion enclosures.

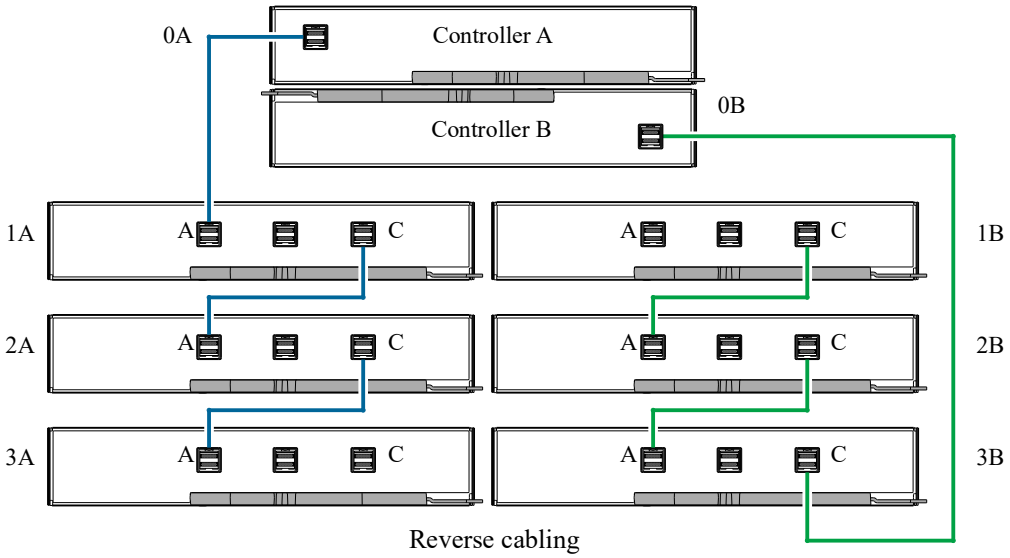


Figure 56 Cabling connections between a 2U controller enclosure and D3284 expansion enclosure–reverse

Figure 56 and Figure 57 show maximum configuration cabling for a DS6200/DS4200 controller enclosure with D3284 expansion enclosures.

NOTE: See also Figure 21 (page 29) and the **IMPORTANT** entry beneath that figure. Refer to these diagrams when cabling D3284 expansion enclosures together with DS6200/DS4200 controller enclosures.

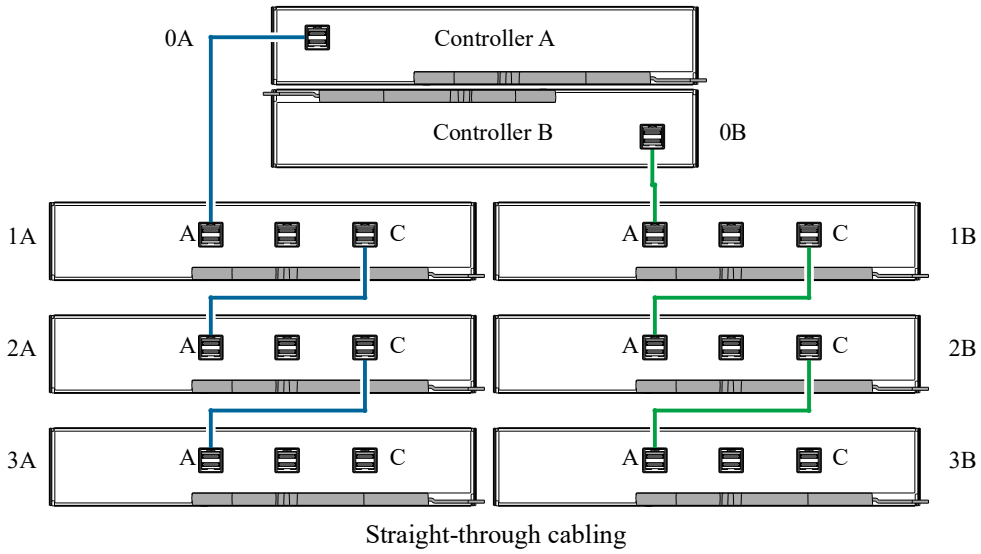


Figure 57 Cabling connections between a 2U controller enclosure and D3284 expansion enclosure–straight-through

The comparative characteristics of using either reverse cabling or straight-through cabling methods are discussed beneath Figure 55 (page 68).

Power cord connection

Connect a power cord from each PCM or PSU on the enclosure rear panel to the PDU (power distribution unit) as shown in the illustrations below.

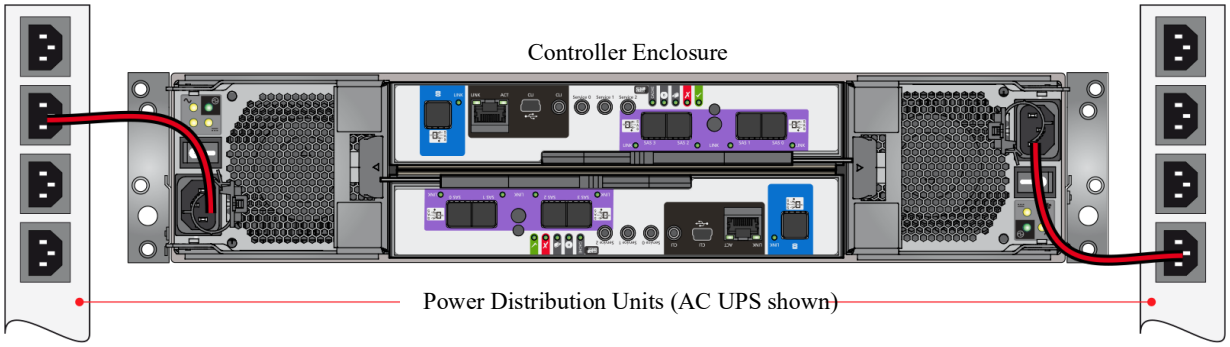


Figure 58 Typical AC power cord connection from PDU to PCM (2U)

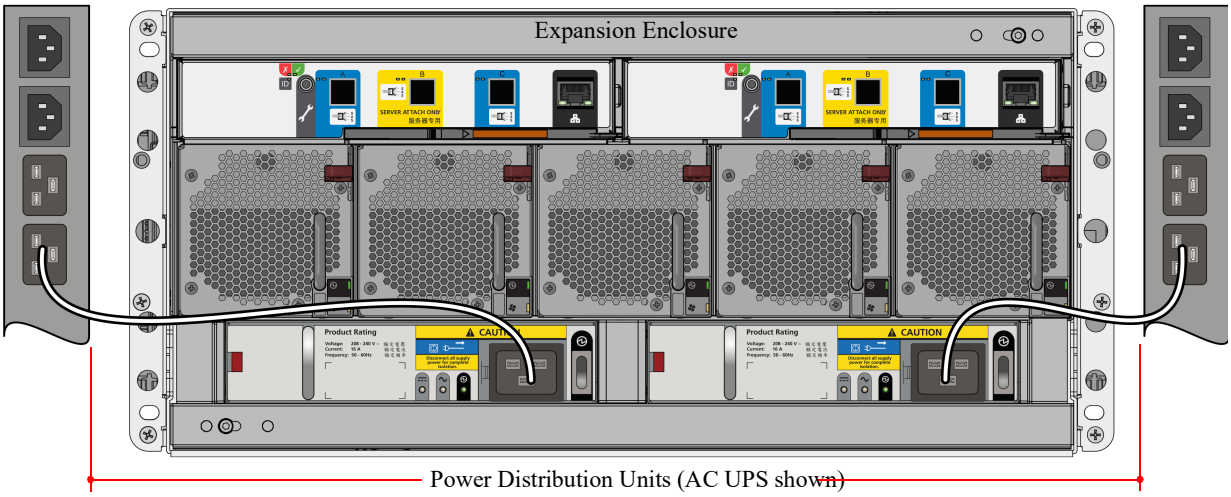


Figure 59 Typical AC power cord connection from PDU to PSU (D3284)

IMPORTANT: When more than one PCM (2U) or PSU (5U) 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 or PSU power switch is set to the **On** position. See also "Powering on/powering off" (page 92).

CAUTION: Power connection concerns:

- Always remove the power connections *before* you remove the PCM (2U) or PSU (5U) 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 92). Once the power-on sequence succeeds, the storage system is ready to be connected as described in "Connecting the enclosure to hosts" (page 72).

Grounding checks

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

△ **CAUTION:** If more than one 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 DS Series 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 DS Series 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 79). The FC and iSCSI product models can be licensed to support replication, whereas the 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 DS Series controller enclosures, while showing a few common cabling configurations.

NOTE: DS Series 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 the topic about configuring system settings in the Storage Management Guide to initially configure the system or change system configuration settings (such as configuring host ports).

CNC technology

The DS Series 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 13) 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 156).

IMPORTANT: Use the `set host-port-mode` CLI command to set the host interface protocol for CNC ports using qualified SFP options. DS Series 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 86) for instructions).

Fibre Channel protocol

DS Series 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 `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.

The Fibre Channel ports are used in either of two capacities:

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

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

10GbE iSCSI protocol

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

1Gb iSCSI protocol

DS Series 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 topic about configuring CHAP in the Storage Management Guide.

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

DS Series SAS models use 12Gb/s host interface protocol and qualified cable options for host connection as described in “Cabling considerations” (page 72).

12Gb HD mini-SAS host ports

DS Series 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. 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.

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 DS Series 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

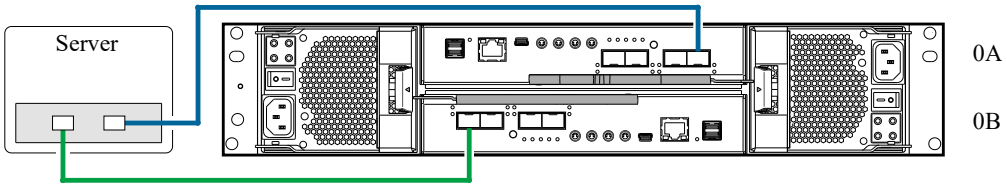


Figure 60 Connecting hosts: DS6200/DS4200 direct attach – one server/ one HBA/ dual path

DS2200

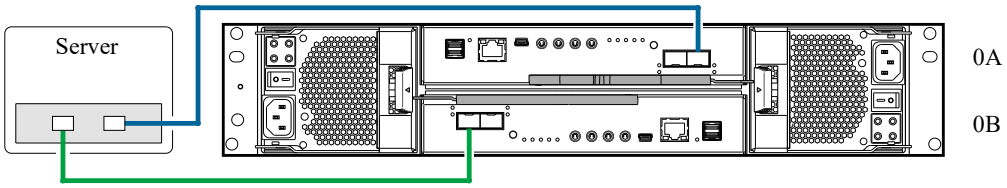


Figure 61 Connecting hosts: DS2200 direct attach – one server/ one HBA/ dual path

DS6200/DS4200

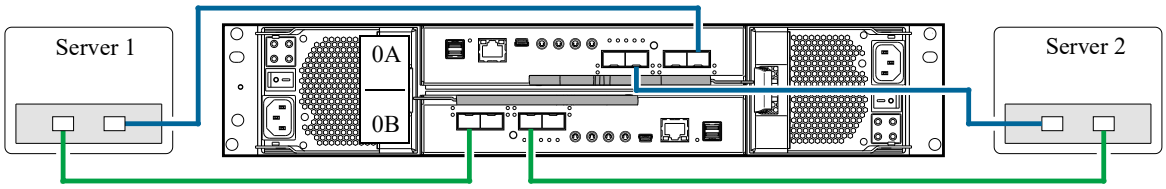


Figure 62 Connecting hosts: DS6200/DS4200 direct attach – two servers/ one HBA per server/ dual path

DS2200

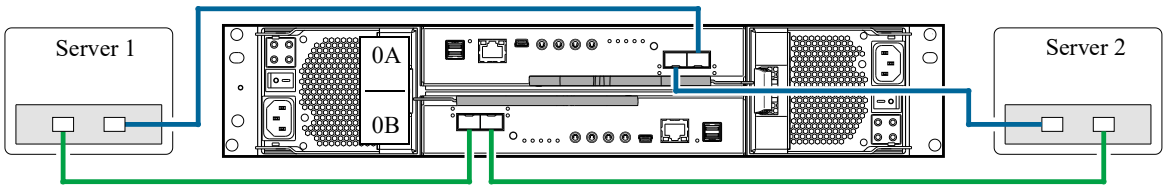


Figure 63 Connecting hosts: DS2200 direct attach – two servers/ one HBA per server/ dual path

DS6200/DS4200

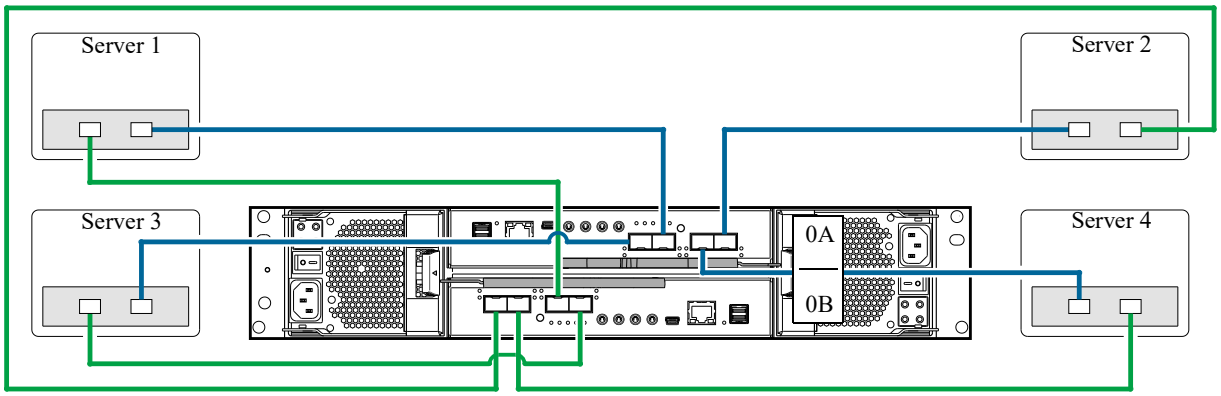


Figure 64 Connecting hosts: DS6200/DS4200 direct attach – four servers/ one HBA per server/ dual path

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

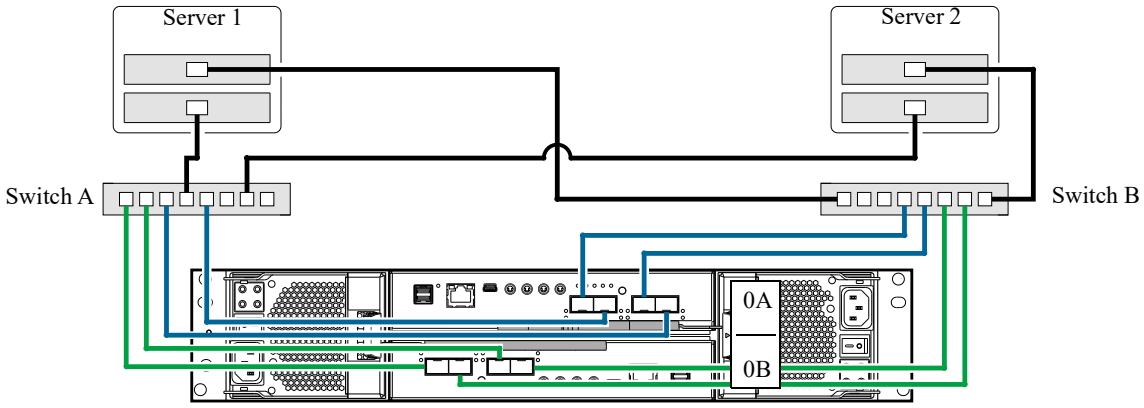


Figure 65 Connecting hosts: DS6200/DS4200 switch attach – two servers/ two switches

DS2200

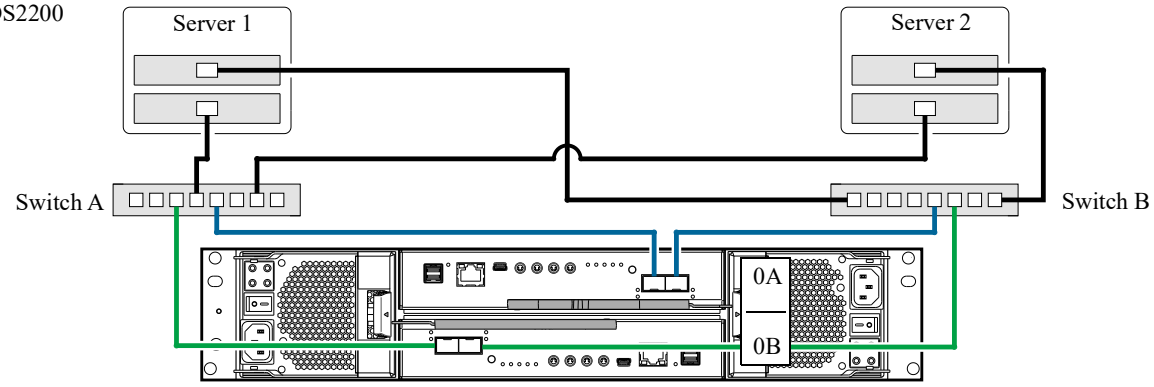


Figure 66 Connecting hosts: DS2200 switch attach – two servers/ two switches

DS6200/DS4200

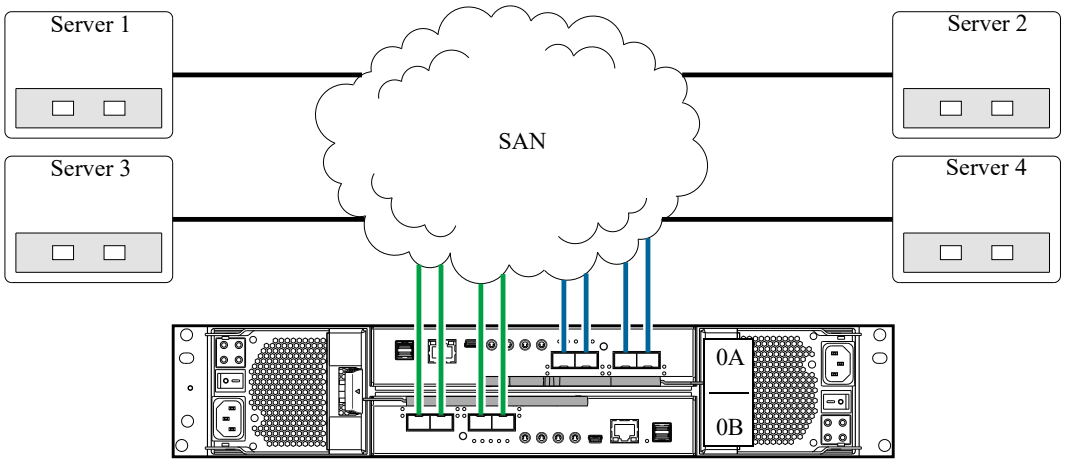


Figure 67 Connecting hosts: DS6200/DS4200 switch attach – four servers/ multiple switches/ SAN fabric

Connecting a management host on the network

The management host directly manages storage systems 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 `set advanced-settings` CLI 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 or SFTP as described in the Storage Manager Guide.

IMPORTANT: See the topic about updating firmware in the Storage Manager Guide before performing a firmware update. Partner Firmware Update (PFU) is enabled by default on DS Series systems.

New user setup

This product does not provide default users. When you first connect to the system, you will be prompted to set up a new user with *manage* capability.

NOTE: At start up, the CLI (Serial/SSH) and WBI (HTTPS) are the only interfaces through which the system can be configured until the new user is created.

If you connect to the CLI console via the USB port, the following interactive shell output will be presented for creating a new user.

```
System Version:

OS Version: xxxxxxx

MC Version: xxxxxxx

Serial Number: xxxxxxx

Login: setup

Password: <empty>

System Name: Uninitialized Name

System Location: Uninitialized Location

Version: No Bundle Version

This system has been factory configured. You must create a new user to manage this system. You
will be asked to provide a username and password. Once the password is confirmed, the system will
automatically log you in with your new user credentials in order to continue setting up the
system. Would you like to continue? (y) y

Enter username> <New Username>

Enter Password> <password>

Confirm password> <password>
```

The shell will prompt you up to three times for a valid user name, and up to three times for a valid and matching password. If you do not enter a valid user name or password in those attempts, the shell will disconnect and you will have to log in again.

The newly-created user will have *manage*, *standard*, and *monitor* roles.

Obtaining IP values

You can manually set static IP values (default method) for each controller, or you can specify that IP values should be set automatically for both controllers through communication with a Dynamic Host Configuration Protocol (DHCP) server.

TIP: See the topic about configuring controller network ports 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.

- You can use the generic mini-USB cable and the USB CLI port. If you plan on using a mini-USB cable, you will need to enable the port for communication using DB9 serial cable. See also "Using the CLI port and cable—known issues on Windows" (page 155).

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 Windows 10 or Server 2016, Windows customers should download and install the device driver as described in "Obtaining the software download" (page 154).
- Linux customers should prepare the USB port as described in "Setting parameters for the device driver" (page 155).

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 94) 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.
2. Record these IP addresses so you can specify them whenever you manage the controllers using the SMC or the CLI.

   –or–
3. 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 68 (generic controller module is shown).

Within the illustration below, the IOM is aligned for use in the bottom (0B) controller module slot in a 2U enclosure.

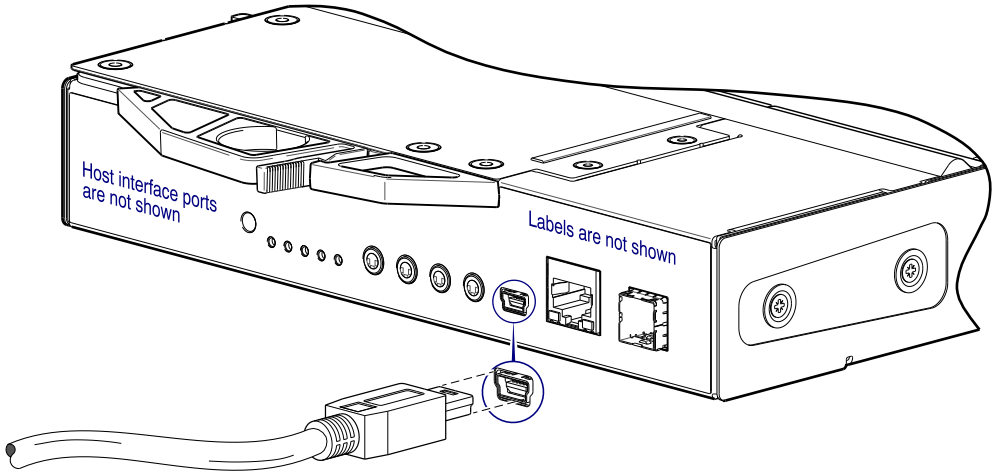


Figure 68 Connecting a USB cable to the CLI port

4. If using a mini-USB cable, enable the CLI port for subsequent communication.
   - Linux customers should enter the command syntax provided in "Setting parameters for the device driver" (page 155).
   - Windows customers should locate the downloaded device driver described in "Obtaining the software download" (page 154), and follow the instructions provided for proper installation.
5. Start and configure a terminal emulator, such as HyperTerminal or VT-100, using the display settings used in Table 11 (page 82), and the connection settings in Table 12 (page 82) (See the note following this procedure).

Table 11 Terminal emulator display settings

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

Table 12 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.

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

7. Press **Enter** to display the CLI prompt (#).

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

NOTE: Follow the new user setup process to create the first user on the system. See "New user setup" (page 80) for details.

---

8. To use DHCP to set network port IP values, enter the following command at the prompt:

   ```
   # set network-parameters dhcp
   ```

   –or–

9. To use custom static IP addresses, enter the following CLI command at the prompt 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
   ```

10. 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.

11. 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 four packets.

12. 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" (page 86).

    ---

13. When you are done using the CLI, exit the emulator.
14. 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 3 and Figure 68 (page 82).

Configure controller network ports

IMPORTANT: If you used the default 10.0.0.2/10.0.0.3 addresses to access the guided setup, it is important to consider changing those IPv4 addresses to avoid an IP conflict should you have more than one ME4 Series array on your network.

You can manually set static IP addressing parameters for network ports or you can specify that IP values be set automatically using DHCP for IPv4 or Auto for IPv6, which uses DHCPv6 and/or SLAAC. When setting IP values, you can choose either IPv4 or IPv6 formatting for each controller. Additionally, you can set the addressing mode and IP version differently for each controller and use them concurrently. For example, you could set IPv4 on controller A to Manual to enable static IP addressing, and IPv6 on controller B to Auto to enable automatic IP addressing.

When using DHCP mode, the system obtains values for the network port IP address, subnet mask, and gateway 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. When using Auto mode, addresses are retrieved from both DHCP and Stateless address auto-configuration (SLAAC). DNS settings are also automatically retrieved from the network.

Each controller has the following factory-default IP settings:

- IP address source: DHCP
- Controller A IP address: 10.0.0.2
- Controller B IP address: 10.0.0.3
- IP subnet mask: 255.255.255.0
- Gateway IP address: 10.0.0.1

When DHCP is enabled in the storage system, the following initial values are set and remain set until the system is able to contact a DHCP server for new addresses:

- Controller IP addresses: 169.254.x.x (where the value of x.x is the lowest 16 bits of the controller serial number)
- IP subnet mask: 255.255.0.0
- Gateway IP address: 10.0.0.0

169.254.x.x addresses (including gateway 169.254.0.1) are on a private subnet that is reserved for unconfigured systems and the addresses are not rout-able. This prevents the DHCP server from reassigning the addresses and possibly causing a conflict where two controllers have the same IP address. As soon as possible, change these IP values to proper values for your network.

For IPv6, when Manual mode is enabled you can enter up to four static IP addresses for each controller. When Auto is enabled, the following initial values are set and remain set until the system is able to contact a DHCPv6 and/or SLAAC server for new addresses:

- Controller A IP address: fd6e:23ce:fed3:19d1::1
- Controller B IP address: fd6e:23ce:fed3:19d1::2
- Gateway IP address: fd6e:23ce:fed3:19d1::3

CAUTION: Changing IP settings can cause management hosts to lose access to the storage system after the changes are applied in the confirmation step.

Set IPv4 values for network ports

1. Perform one of the following to access Network options:
   - In the **Home** topic, select **Action** > **System Settings**, and then click the **Network** tab.
   - In the **System** topic, select **Action** > **System Settings**, and then click the **Network** tab.
2. Select the **IPv4** tab. IPv4 uses 32-bit addresses.
3. Select the type of IP address to use for each controller. Choose **Source** > **manual** to enter static IP addresses or choose **Source** > **DHCP** to have the system automatically obtain values from a DHCP server.
4. If you chose manual, enter the unique IP address, IP mask, and gateway values for each controller, then record the IP values you assign.

NOTE: The following IP addresses are reserved for internal use by the storage system: 169.254.255.1, 169.254.255.2, 169.254.255.3, 169.254.255.4, and 127.0.0.1. Because these addresses are rout-able, do not use them anywhere in your network.

---

5. Perform one of the following:
   - To save your settings and continue configuring your system, click **Apply**.
   - To save your settings and close the panel, click **Apply and Close**.

A confirmation panel appears.

6. Click **OK** to continue. If you chose DHCP and the controllers successfully obtained IP values from the DHCP server, the new IP values appear. Record the new addresses and sign out to use the new IP address to access the MESM.

Set IPv6 values for network ports

1. Perform one of the following to access network options:
   - In the **Home** topic, select **Action** > **System Settings**, and then click the **Network** tab.
   - In the **System** topic, select **Action** > **System Settings**, and then click the **Network** tab.
2. Select the **IPv6** tab. IPv6 uses 128-bit addresses.
3. Select the type of IP address to use for each controller. Choose **Source** > **manual** to enter up to four static IP addresses for each controller, or choose **Source** > **auto** to have the system automatically obtain values.
4. If you chose manual, perform the following:
   a. Enter the unique IP address, gateway value, and address for each controller.
   b. Record the IP values you assign.
   c. Click **Add**.
5. Click **Add Address** to continue adding up to four IP addresses.

NOTE: The following IP addresses are reserved for internal use by the storage system: 169.254.255.1, 169.254.255.2, 169.254.255.3, 169.254.255.4, and 127.0.0.1. Because these addresses are routable, do not use them anywhere in your network.

6. Perform one of the following:
   - To save your settings and continue configuring your system, click **Apply**.
   - To save your settings and close the panel, click **Apply and Close.**

     A confirmation panel appears.
7. Click **Yes** to save your changes. Otherwise, click **No**.
8. Sign out to use the new IP addresses to access the Storage Manager Console.

Change the CNC port mode

This subsection applies to DS Series 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 `set host-port-mode` CLI command completes, it will notify you that the specified system host port mode was set, and that the command completed successfully.

Continue with step 13 of "Setting network port IP addresses using the CLI port and cable" (page 81).

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

Continue with step 13 of "Setting network port IP addresses using the CLI port and cable" (page 81).

Connecting two storage systems to replicate volumes

Replication is a licensed feature for disaster recovery. This 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 changes to the data since the last replication to the secondary system via FC or 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 (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 systems (SAS systems do not support replication) on the same network, or on different networks.

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 the destination system is co-located or remotely located.
- Qualified Converged Network Controller options can be used for host I/O or replication, or both.
- The storage system does not provide for specific assignment of ports for replication. However, this can be accomplished using virtual LANs for iSCSI and zones for FC, or by using physically separate infrastructure. See also the paragraph above Figure 69 (page 89).
- For remote replication, 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 `query peer-connection` CLI command.
- Allow a sufficient number of ports to perform replication. This permits the system to balance the load across those ports as I/O demands rise and fall. 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 different networks.

IMPORTANT: The replication feature must be licensed on all systems configured for replication, and the controller module firmware must be compatible on all systems used for replication. See the topic about licensed features in the Storage Manager Guide.

Cabling for replication

This section shows example replication configurations for CNC-based controller enclosures.

NOTE: Simplified versions of controller enclosures are used in cabling illustrations to show CNC host ports used for I/O or replication, given that only the external connectors used in the host interface ports differ.

- Replication supports FC and iSCSI host interface protocols.
- The 2U enclosure rear panel represents DS6200/DS4200 (4-port) and DS2200 (2-port) models.
- Host ports used for replication must use the same protocol (either FC or iSCSI).
- Blue cables show I/O traffic and green cables show replication traffic.

Once the CNC-based systems are physically cabled, see the Storage Manager Guide or online help for information about configuring, provisioning, and using the optional replication feature with out-of-band management.

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 69 and Figure 70 show I/O and replication occurring on the same physical network. With these configurations, Virtual Local Area Network (VLAN) and zoning could be employed to provide separate networks for iSCSI and FC, respectively. Create a VLAN or zone for I/O and a VLAN or zone for replication to isolate I/O traffic from replication traffic. The configuration would appear physically as a single network, while logically, it would function as multiple networks.

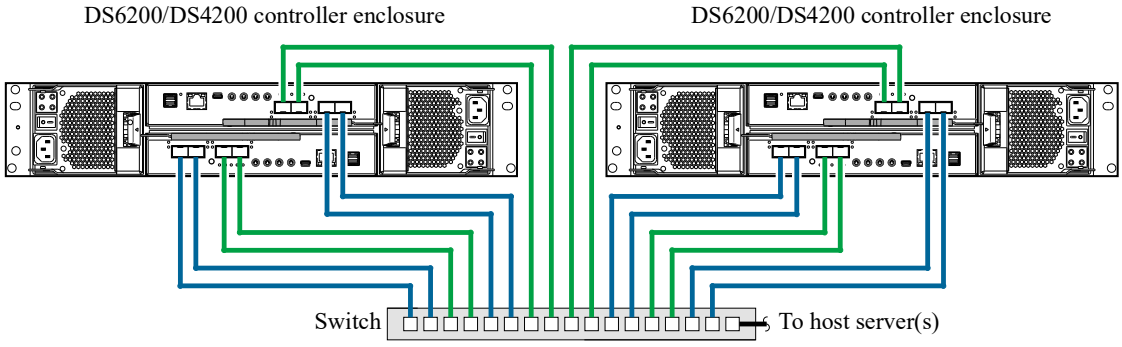


Figure 69 Connecting two DS6200/DS4200 storage systems for replication: multiple servers/one switch/one location

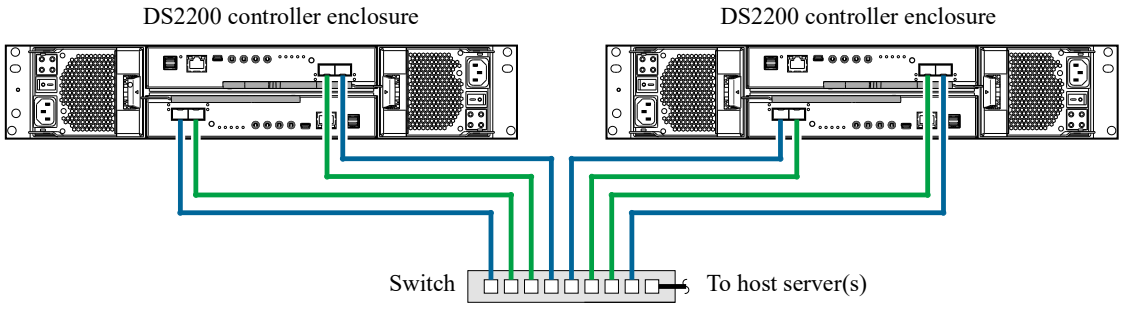


Figure 70 Connecting two DS2200 storage systems for replication: multiple servers/one switch/one location

Figure 71 and Figure 72 (page 90) show I/O and replication occurring on different physical networks. For optimal protection, use three switches. Connect one (DS2200) or two (DS6200/DS4200) ports from each controller module to the left switch. Connect one (DS2200) or two (DS6200/DS4200) ports from each controller module to the right switch.

Connect one (DS2200) or two (DS6200/DS4200) ports from each controller module to the middle switch. Use multiple switches to avoid a single point of failure inherent to using a single switch, and to physically isolate replication traffic from I/O traffic.

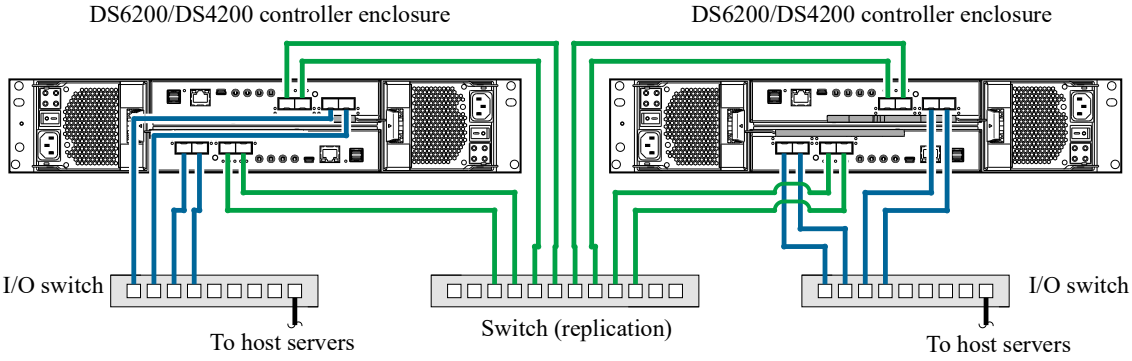


Figure 71 Connecting two DS6200/DS4200 storage systems for replication: multiple servers/switches/one location

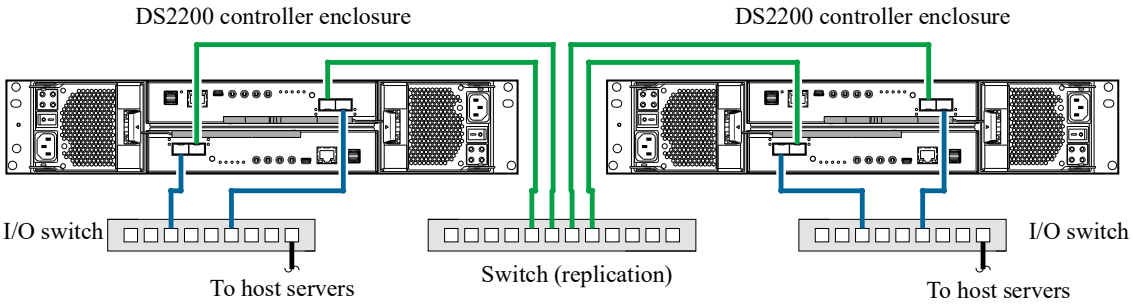


Figure 72 Connecting two DS2200 storage systems for replication: multiple servers/switches/one location

Multiple servers/different networks/multiple switches

Figure 73 and Figure 74 (page 91) show I/O and replication occurring on different networks.

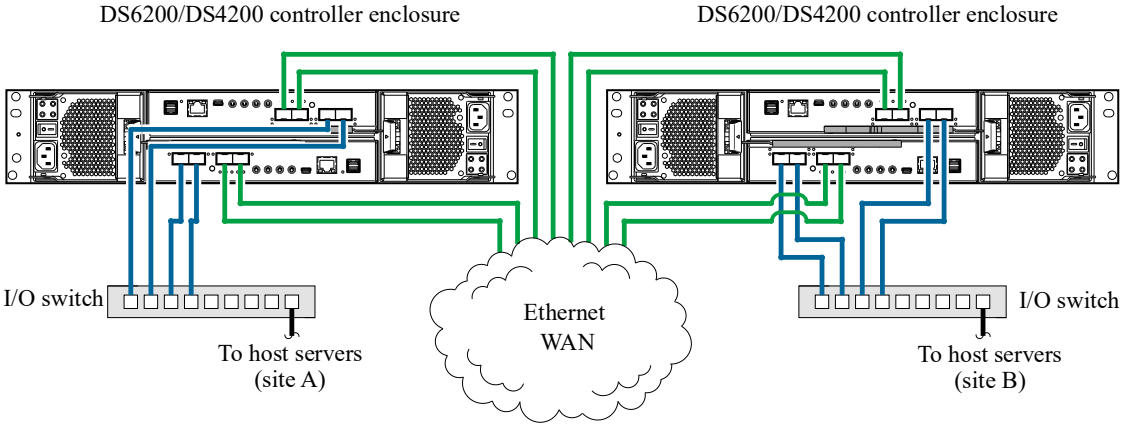


Figure 73 Connecting two DS6200/DS4200 storage systems for replication: multiple servers/switches/two locations

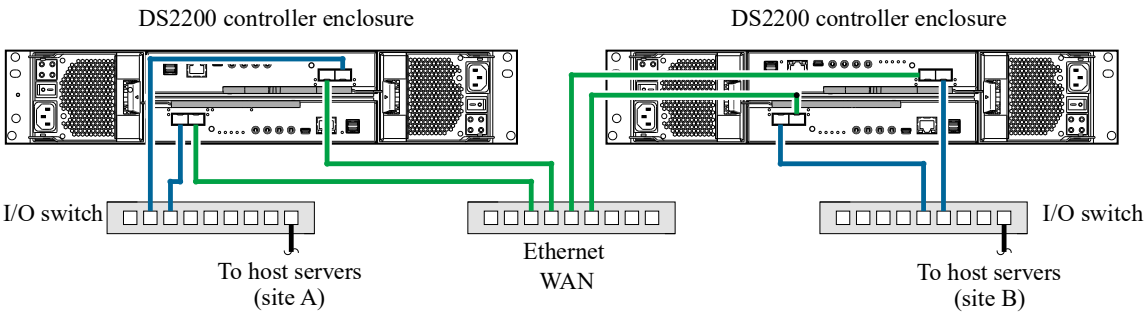


Figure 74 Connecting two DS2200 storage systems for replication: multiple servers/switches/two locations

Figure 73 (page 90) and Figure 74 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 9 (page 59). Once you have completed steps 1 through 11, 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 147). 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. With 2U enclosures, power on the system by connecting the power cables from the PCM to the PDU, and moving the power switch on each PCM to the **on** position. See Figure 58 (page 71).

   The System Power LED on the 2U Ops panel should be lit green when the enclosure power is activated.

   With 5U enclosures, power on the system by connecting the power cables from the PSUs to the PDU, and moving the power switch on each PSU to the **on** position. See Figure 59 (page 71).

   The System Power LED on the 5U 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 or PSU to the **off** position.

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: 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: Enclosure Ops panels

- See Table 14 (page 96) for details pertaining to 2U Ops panel LEDs and related fault conditions.
- See Table 19 (page 100) for details pertaining to 5U Ops panel LEDs and related fault conditions.

NOTE: Guidelines for consideration when powering enclosures on and off

- Remove the AC power cord before inserting or removing a PCM (2U) or PSU (5U).
- Move the PCM or PSU power switch to the **off** position *before* connecting or disconnecting the AC power cord.
- Allow 15 seconds between powering off and powering on the PCM or PSU.
- Allow 15 seconds before powering on one PSU or PCM in the system, and powering off another PCM or PSU.
- Never power off a PCM or PSU while any amber LED is lit on the partner PCM or PSU.
- The enclosure must be left in a power on state for 30 seconds following resumption from standby, before the enclosure can be placed into standby again (applies to 5U84 only).
- Although the enclosure supports standby, the expansion module shuts off completely during standby and cannot receive a user command to power back on. An AC power cycle is the only method to return the enclosure to full power from standby (applies to 5U84 only).

Operator's (Ops) panel LEDs

Once the enclosure has successfully powered on, you can observe its Ops panel–located on the left ear of the front panel–for LED behavior reflecting enclosure status. Refer to the appropriate figure/table from the options below for descriptions of enclosure status LEDs and related fault conditions.

- For 2U12 and 2U24 enclosures, see Figure 31 (page 37).
- For 5U84 enclosures, see Figure 32 (page 38).

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

Disk modules used in 2U chassis

Each disk drive module includes two LEDs (green and amber) as shown in "Disk drive carrier module LEDs" (page 97).

- 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

DDICs used in 5U chassis

Each disk has a single amber drive fault LED as shown in "DDIC LED" (page 102). If the LED is illuminated, a disk failure condition has occurred. The DDIC should be replaced as soon as possible, using the procedure

described in “Replacing a DDIC” (page 134), while adhering to guidelines provided in “Populating drawers” (page 137).

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, enter the secure login credentials. This assumes proper web browser setup.

IMPORTANT: For more information about accessing and using the SMC, see the topic about getting started in the Storage Manager Guide.

In addition to summarizing the processes to configure and provision a new system for the first time, the getting started topics provide instructions for signing in to the SMC, introduce key system concepts, address browser setup, and provide 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 topic about licensed features in 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 `set advanced-settings` CLI 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 additional information, navigate to support.lenovo.com. In the **All Products** field, search for your ThinkSystem product by typing the name (e.g., DS6200).

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 105) 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. For 2U enclosures, verify that the LEDs on all installed drive carrier modules are On (green). For 5U84 enclosures, verify that the DDIC Drive Fault LED is not lit (amber).
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 109).

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

2U enclosure LEDs

580W PCM LEDs

Under normal conditions, the PCM OK LEDs will be a constant green. See also Figure 33 (page 39). When a fault occurs, the colors of the LEDs will display as shown in the following table.

Table 13 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 31 (page 37). The Ops panel LEDs are defined in the following table.

Table 14 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					

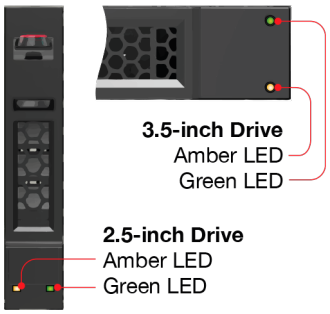
Actions:

- 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 127).
  - 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 75. The drive module LEDs are identified in the figure, and the LED behavior is described 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 Activity LED (Green)	Disk Fault LED (Amber)	Status/condition*
Off	Off	Off (disk module/enclosure)
Off	Off	Not present
Blink off with activity	Blinking: 1s on/1s off	Identify
1 down: Blink with activity 2 down: Off	On	Drive link (PHY lane) down
On	On	Fault (leftover/failed/locked-out)
Blink off with activity	Off	Available
Blink off with activity	Off	Storage system: Initializing
Blink off with activity	Off	Storage system: Fault-tolerant
Blink off with activity	Off	Storage system: Degraded (not critical)
Blink off with activity	Blinking: 3s on/1s off	Storage system: Degraded (critical)
On	Off	Storage system: Quarantined
Blink off with activity	Blinking: 3s on/1s off	Storage system: Offline (dequarantined)
Blink off with activity	Off	Storage system: Reconstruction
Blink off with activity	Off	Processing I/O (whether from host or internal activity)
*If multiple conditions occur simultaneously, the LED state will behave as indicated by the condition listed earliest in the table, as rows are read from top to bottom.		

Figure 75 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 43).

Controller module LEDs

Table 15 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 127)
		Off	No external host port connection
		On	External host port connection – no activity

Table 15 Controller module LED states (continued)

CRU OK (Green)	CRU Fault (Amber)	External host port activity (Green)	Status
		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 16 (page 27). LED behaviors for DS Series expansion enclosures are described in Table 16. For actions pertaining to Table 15 or Table 16, see **Actions** above. See also “12Gb/s expansion module LEDs” (page 52).

Table 16 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 127)
		Off	No external port connection
		On	HD mini-SAS port connection – no activity
		Blinking	HD mini-SAS port connection – activity
Blinking			EBOD VPD error

5U enclosure LEDs

NOTE: When the 5U enclosure is powered on, all LEDs are lit for a short period to ensure they are working. This behavior does not indicate a fault unless LEDs remain lit after several seconds.

PSU LEDs

See Figure 28 (page 34) for a visual description of the Power Supply Unit (PSU) module faceplate.

Table 17 PSU LED states

CRU Fail (Amber)	AC Missing (Amber)	Power (Green)	Status
On	Off	Off	No AC power to either PSU.
On	On	Off	PSU present, but not supplying power or PSU alert state. (usually due to critical temperature)
Off	Off	On	Mains AC present, switch on. This PSU is providing power.
Off	Off	Blinking	AC power present, PSU in standby (other PSU is providing power).
Blinking	Blinking	Off	PSU firmware download in progress.
Off	On	Off	AC power missing, PSU in standby (other PSU is providing power).
On	On	On	Firmware has lost communication with the PSU module.
On	—	Off	PSU has failed. Follow procedure in "Replacing a PSU" (page 138).

Fan cooling module LEDs

See Figure 29 (page 35) for a visual description of the Fan Cooling Module (FCM) faceplate.

Table 18 FCM LED descriptions

LED	Status/description
Module OK	Constant green indicates that the FCM is working correctly. Off indicates the fan module has failed. Follow procedure in "Replacing an FCM" (page 140).
Fan Fault	Amber indicates the fan module has failed. Follow procedure in "Replacing an FCM" (page 140).

Ops panel LEDs

The Ops panel displays the aggregated status of all the modules. See also Figure 32 (page 38).

Table 19 Ops panel LED descriptions

LED	Status/description
Unit ID Display	Usually shows the ID number for the enclosure, but can be used for other purposes.
Power On/Standby	Amber if the system is in standby. Green if the system has full power.
Module Fault	Amber indicates a fault in a PSU, FCM, or IOM. Check the drawer LEDs for indication of a disk fault. See also "Drawer LEDs" (page 101).
Logical Status	Amber indicates a fault from something other than firmware (usually a disk, an HBA, or an internal or external RAID controller). Check the drawer LEDs for indication of a disk fault. See also "Drawer LEDs" (page 101).
Drawer 0 Fault	Amber is there is a disk, cable, or sideplane fault in drawer 0. Open the drawer and check DDICs for faults.
Drawer 1 Fault	Amber is there is a disk, cable, or sideplane fault in drawer 1. Open the drawer and check DDICs for faults.

Drawer LEDs

See Figure 30 (page 36) for a visual description of the Drawer LED inserts located on each drawer bezel.

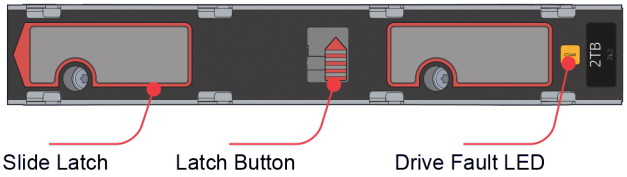
Table 20 Drawer LED descriptions

LED	Status/description
Sideplane OK/ Power Good	Green if the sideplane card is working and there are no power problems.
Drawer Fault	Amber if a drawer component has failed. If the failed component is a disk, the LED on the failed DDIC will light amber. Follow procedure in "Replacing a DDIC" (page 134). If the disks are OK, contact your service provider to identify the cause of the failure, and resolve the problem.
Logical Fault	Amber (solid) indicates a disk fault. Amber (blinking) indicates that one or more arrays are in an impacted state.
Cable Fault	Amber indicates the cabling between the drawer and the back of the enclosure has failed. Contact your service provider to resolve the problem.
Activity Bar Graph	Displays the amount of data I/O from zero segments lit (no I/O) to all six segments lit (maximum I/O).

DDIC LED

The DDIC supports LFF 3.5" and SFF 2.5" disks as shown in Figure 48 (page 56) and Figure 49 (page 56). The illustration below shows the top panel of the DDIC as viewed when the disk is aligned for insertion into the drawer slot. See also Figure 25 (page 33) and Figure 26 (page 33).

DDIC
(longitudinal view–top face of carrier)



Drive Fault LED (Amber)	Status/condition*
Off	Off (disk module/enclosure)
Off	Not present
Blink: 1s on/1s off	Identify
Any links down: On	Drive link (PHY lane) down
On	Fault (leftover/failed/locked-out)
Off	Available
Off	Storage system: Initializing
Off	Storage system: Fault-tolerant
Off	Storage system: Degraded (not critical)
Blinking: 3s on/1s off	Storage system: Degraded (critical)
Off	Storage system: Quarantined
Blinking: 3s on/1s off	Storage system: Offline (dequarantined)
Off	Storage system: Reconstruction
Off	Processing I/O (whether from host or internal activity)
*If multiple conditions occur simultaneously, the LED state will behave as indicated by the condition listed earliest in the table, as rows are read from top to bottom.	

Figure 76 LEDs: DDIC – 5U enclosure disk slot in drawer

Each DDIC has a single Drive Fault LED. A disk drive fault is indicated if the Drive Fault LED is lit amber. In the event of a disk failure, follow the procedure in “Replacing a DDIC” (page 134).

IOM LEDs

NOTE: The expansion module CRU is common to 2U and 5U enclosures. For information about expansion module LEDs see “12Gb/s expansion module LEDs” (page 52).

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 2U enclosures

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 21, the module fault LED on the Ops panel will light amber to indicate a fault. See also “Operator’s (Ops) panel” (page 36).

Table 21 2U 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	Warning – no loss of disk power	S1
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 116).

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 31 (page 37) for visual reference of Ops panel LEDs.
2-See Figure 33 (page 39) 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 147). **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.

Troubleshooting 5U enclosures

The table describes common problems that can occur with your enclosure system, together with possible solutions. For all of the problems listed in Table 22, the Module Fault LED on the Ops panel will light amber to indicate a fault. See also “5U enclosure Ops panel” (page 37). All alarms also report via SES.

Table 22 5U alarm conditions

Status	Severity
PSU alert–loss of DC power from a single PSU	Fault–loss of redundancy
Cooling module fan failure	Fault–loss of redundancy
SBB I/O module detected PSU fault	Fault
PSU removed	Configuration error
Enclosure configuration error (VPD)	Fault–critical
Low temperature warning	Warning
High temperature warning	Warning
Over-temperature alarm	Fault–critical
Under-temperature alarm	Fault–critical
I^2C bus failure	Fault–loss of redundancy
Ops panel communication error (I^2C)	Fault–critical
RAID error	Fault–critical
SBB I/O module fault	Fault–critical
SBB I/O module removed	Warning
Drive power control fault	Warning–no loss of drive power
Drive power control fault	Fault–critical: loss of drive power
Insufficient power available	Warning

For information about replacing modules, see “Module removal and replacement” (page 116).

Thermal considerations

NOTE: Thermal sensors in the 5U enclosure and its components monitor the thermal health of the storage system.

- Exceeding the limits of critical values will activate the over-temperature alarm.
- For information about 5U enclosure alarm notification, see Table 22 (page 105).

USB CLI port connection

DS Series 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 153) for more information.

Fault isolation methodology

DS Series and DS EXP/D3284 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 94), 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 108).
- Determine where in the system the fault is occurring as described in “Determine where the fault is occurring” (page 108).
- Review event logs as described in “Review the event logs” (page 108).
- If required, isolate the fault to a data path component or configuration as described in “Isolate the fault” (page 108).

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 110) 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 Recommendation 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. 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 "2U enclosure rear panel" (page 27) and "5U enclosure rear panel" (page 34).

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 128).

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 116).

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 116). Avoid contact with midplane components, module connectors, leads, pins, and exposed circuitry.

Isolating a host-side connection fault

For additional information, navigate to support.lenovo.com. In the **All Products** field, search for your ThinkSystem product by typing the name (e.g., DS6200).

Host-side connection troubleshooting featuring CNC ports

For additional information, navigate to support.lenovo.com. In the **All Products** field, search for your ThinkSystem product by typing the name (e.g., DS6200).

Host-side connection troubleshooting featuring SAS host ports

For additional information, navigate to support.lenovo.com. In the **All Products** field, search for your ThinkSystem product by typing the name (e.g., DS6200).

Isolating a controller module expansion port connection fault

For additional information, navigate to support.lenovo.com. In the **All Products** field, search for your ThinkSystem product by typing the name (e.g., DS6200).

Isolating replication faults

For additional information, navigate to support.lenovo.com. In the **All Products** field, search for your ThinkSystem product by typing the name (e.g., DS6200).

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 power supply modules, sufficient power is provided to the system while the faulty module is replaced.

NOTE: DS Series and DS EXP/D3284 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 79).

Customer-replaceable units

NOTE: The following tables share the table endnotes located beneath them. See Figure 77 (page 115) for pictorial views of IOM CRUs used in the different Lenovo ThinkSystem enclosures.

Table 23 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 24 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 25 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 13).

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

CRUs addressing 2U 12-drive chassis

NOTE: The 2U12 chassis is configurable as either an RBOD (DS4200/DS2200) or an EBOD (DS EXP).

Table 26 DS4200/DS2200/DS EXP 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 77 (page 115) 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

NOTE: The 2U24 chassis is configurable as either an RBOD (DS6200/DS4200/DS2200) or an EBOD (DS EXP).

Table 27 DS6200/DS4200/DS2200/DS EXP 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 77 (page 115) 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.

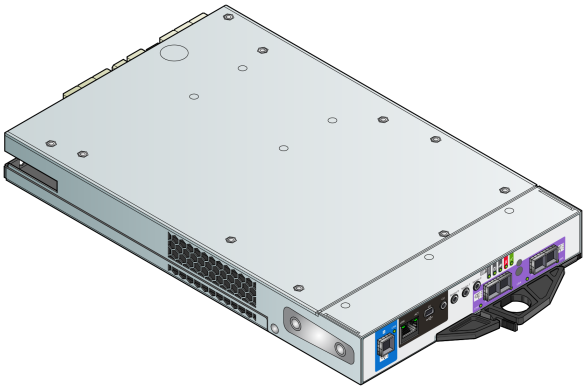
CRUs addressing high-density 5U 84-drive chassis

NOTE: The 5U84 chassis is configured as an EBOD (D3284) for use with DS6200/DS4200 controllers.

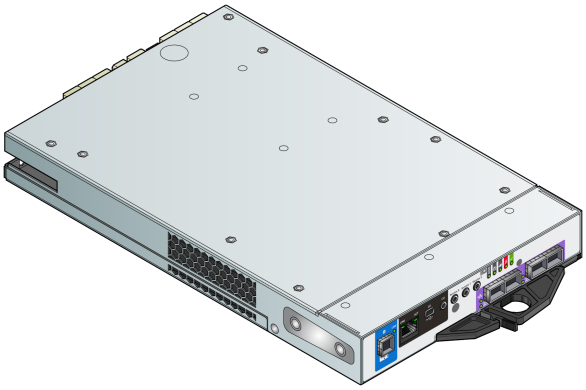
Table 28 D3284 product components for 5U 84-drive chassis

Item	Enclosure component description
1	Disk drive in carrier (DDIC) LFF (DDICs must be installed into drawers after delivery)
	a) 2.5" disk with 3.5" adapter (disks of differing type/speed and storage capacity: SAS, SSD)
	b) 3.5" disk (disks of differing type/speed and storage capacity: SAS, SSD)
2	Ear components (not customer replaceable)
	a) Left ear assembly
	b) Right ear assembly
3	Drawers for holding DDICs (included with chassis; not available separately)
	Top drawer accessible from enclosure front panel (empty–42 DDIC slots)
	Bottom drawer accessible from enclosure front panel (empty–42 DDIC slots)
4	Chassis (sheet metal enclosure that is configurable as an RBOD or EBOD)
5	PCBs –midplane sideplane, baseplanes (included with chassis; not available separately)
6	Power supply unit (PSU) available as AC module (chassis uses two PSUs of same model type)
7	Fan cooling module (FCM) (chassis uses five FCMs of same model type)
8	Expansion module for storage expansion I/O (used when chassis is configured as an EBOD)
	a) 3-port 12Gb/s SBB expansion module
9	Small form-pluggable SFP connectors
	a) SFP transceiver: 8/16Gb/s FC; 10GbE iSCSI; 1Gb/s iSCSI
10	Rail kit (variable attachment options)
	a) 5U rack mount kit, shelf, long, all HW
11	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)]
12	AC power cord compatible with AC PSU (each PSU uses a power cord)

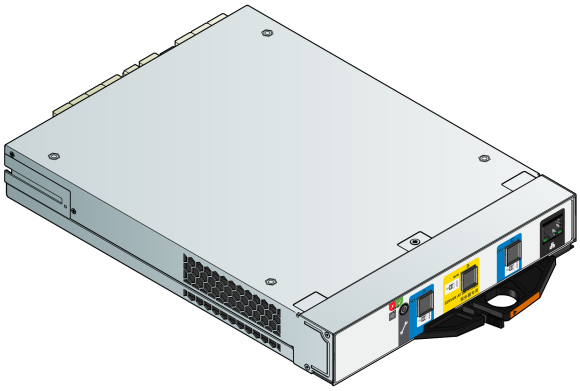
NOTE: Figure 77 (page 115) shows an isometric pictorial representation of the expansion module used in 5U 84-drive Lenovo ThinkSystem enclosures. The expansion module is shown oriented for insertion into either IOM slot located on the D3284 enclosure rear panel.



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 77 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 14) for a list of these documents and where to find them online.

NOTE: CRU replacement procedures are grouped by chassis form factor.

- For 2U12 and 2U24 CRU replacement, see “CRU replacement for 2U chassis” (page 117).
- For 5U84 CRU replacement, see “CRU replacement for 5U chassis” (page 133).

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**.

CRU replacement for 2U chassis

NOTE: Unless noted otherwise within a passage pertaining to a particular CRU, the replacement procedure should be completed within two minutes of the removal of the defective module.

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 116.

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 180º about its longitudinal axis, so that it properly aligns with its connectors on the back of the midplane. See also Figure 16 (page 27).

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 128).

   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 78.

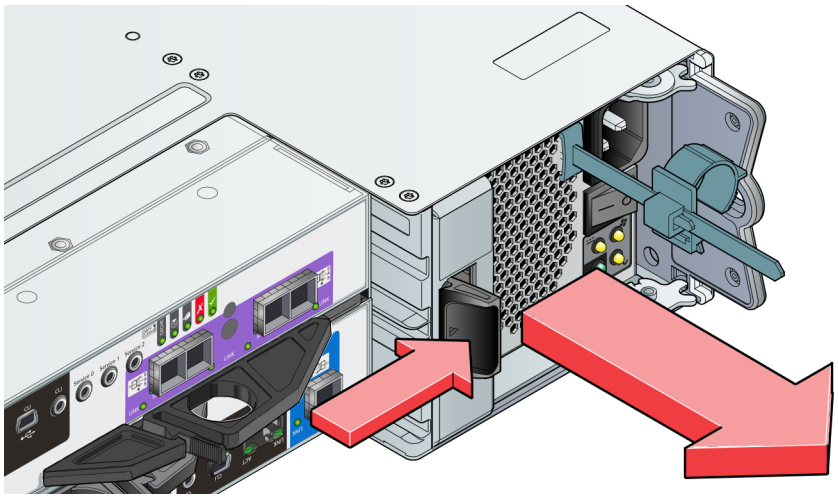


Figure 78 Removing a PCM (1 of 2)

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 79.

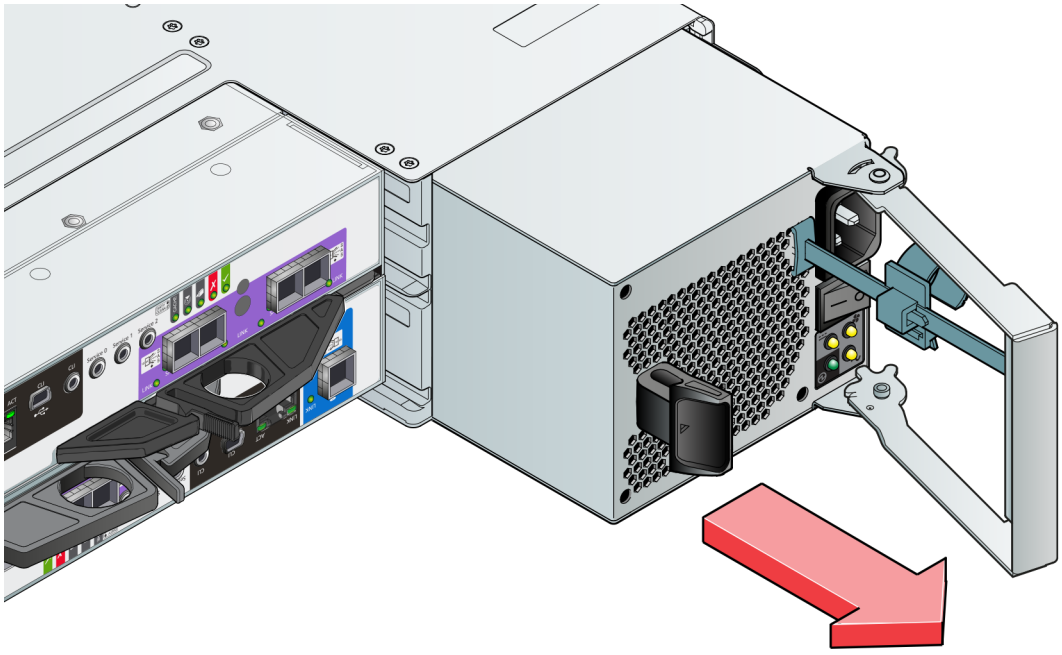


Figure 79 Removing a PCM (2 of 2)

9. If replacing two PCMs, repeat steps 5 through 8, being mindful of the illustrations TIP on page 117.

Installing a PCM

Refer to Figure 78 (page 118) and Figure 79 (page 118) 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 13 (page 96). 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 117.

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 66).

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 116.

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.

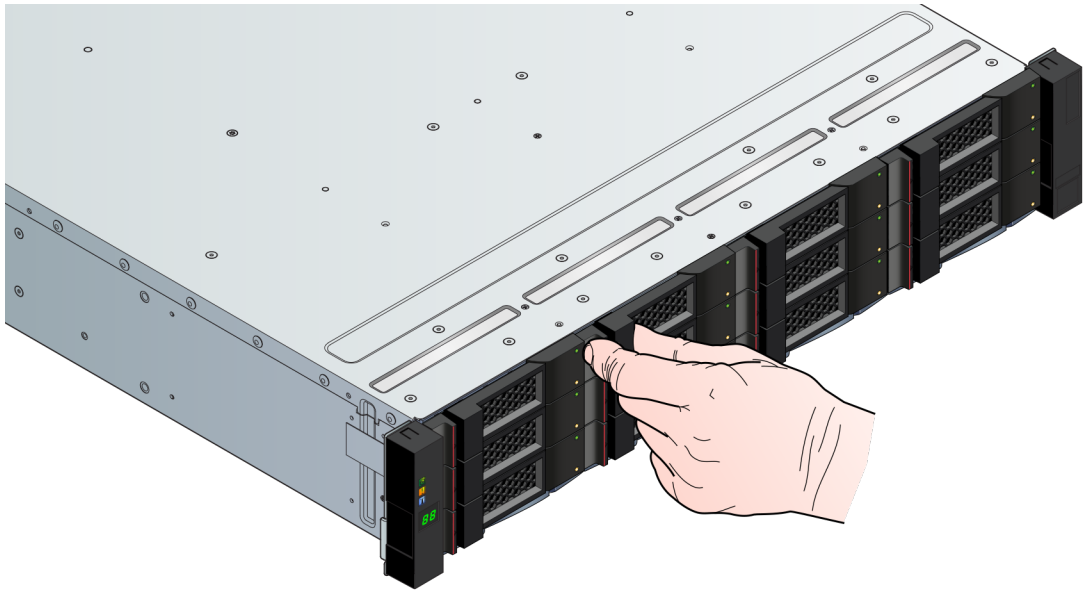


Figure 80 Removing a LFF disk drive module (1 of 2)

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

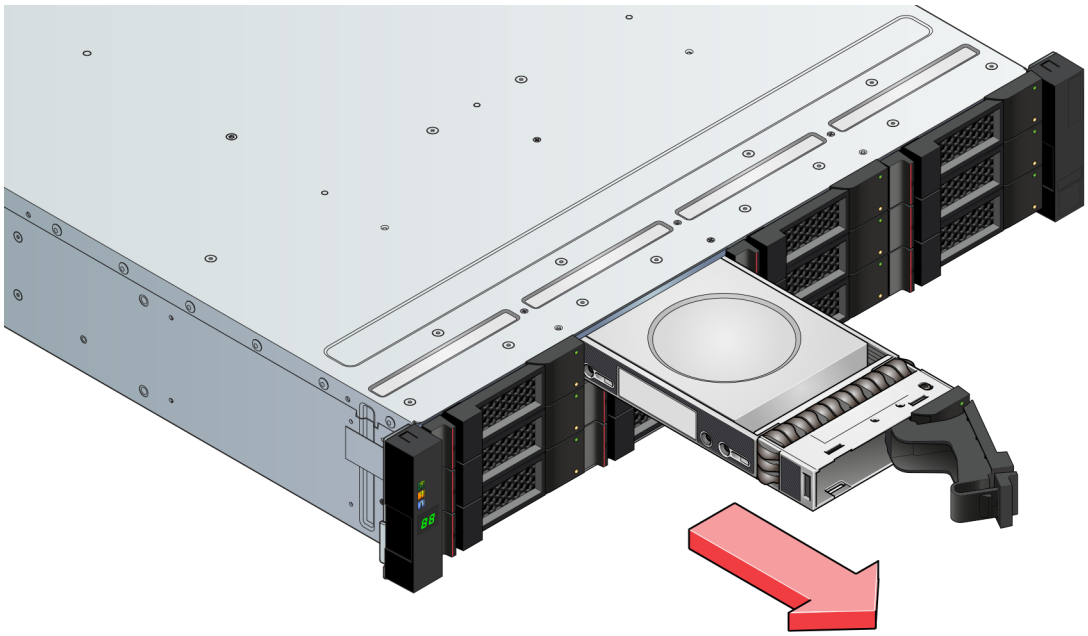


Figure 81 Removing a LFF disk drive module (2 of 2)

3. Remove the module fully from the drive slot.

△ **CAUTION:** To ensure optimal cooling throughout the 2U enclosure, dummy drive carrier modules must be fitted to all unused drive slots. See also Figure 47 (page 55).

Installing a LFF drive carrier module

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

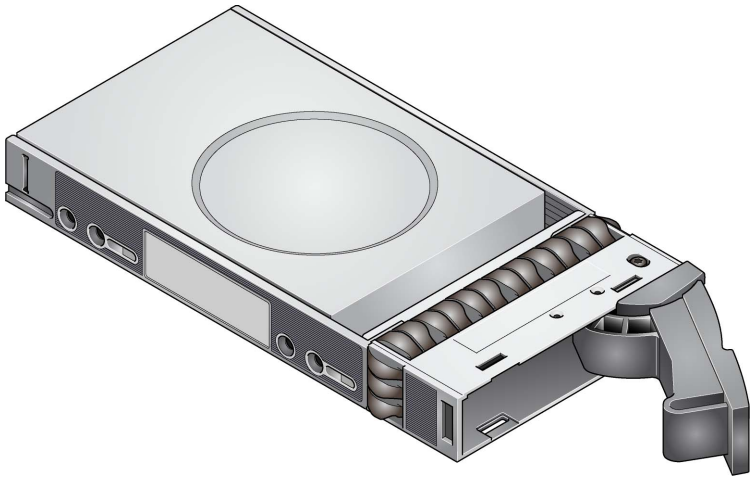


Figure 82 LFF drive carrier module in open position

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.

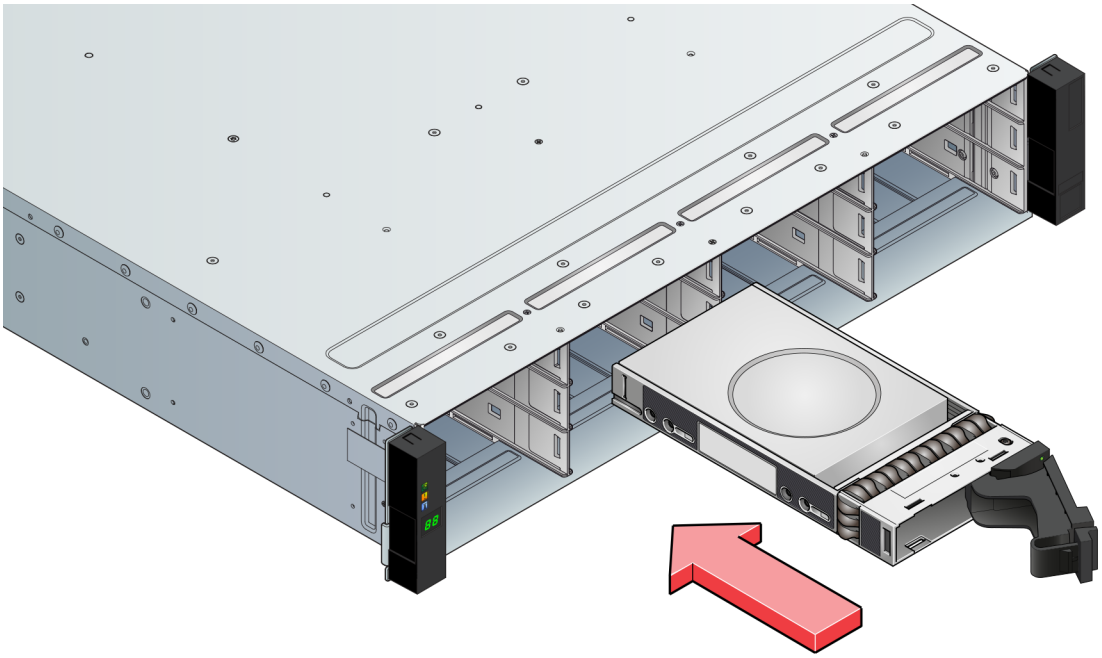


Figure 83 Installing a LFF drive carrier module (1 of 2)

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.

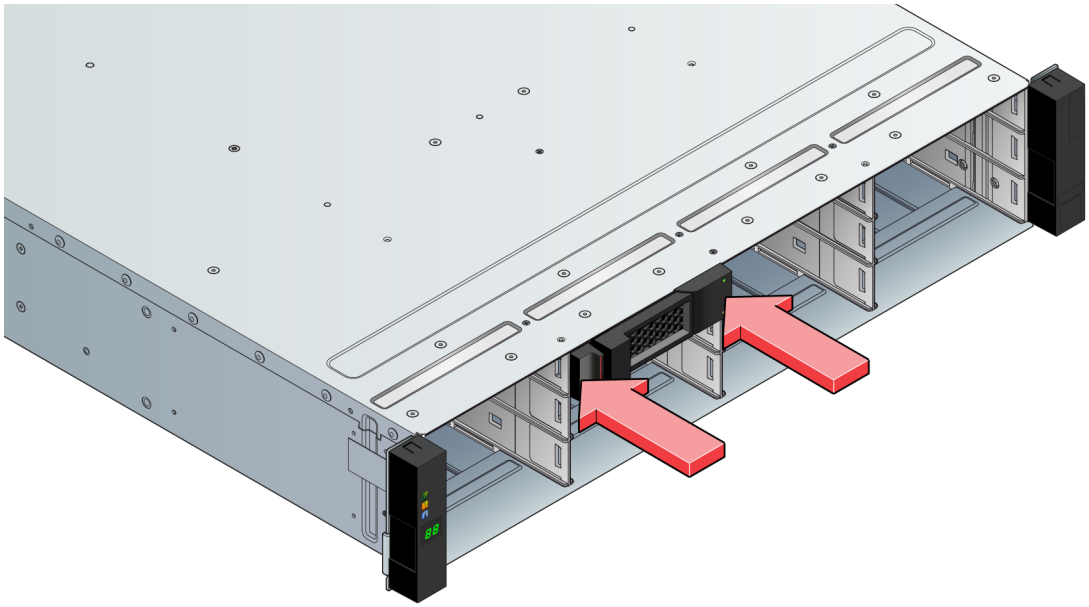


Figure 84 Installing a LFF drive carrier module (2 of 2)

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 75 (page 98). 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.

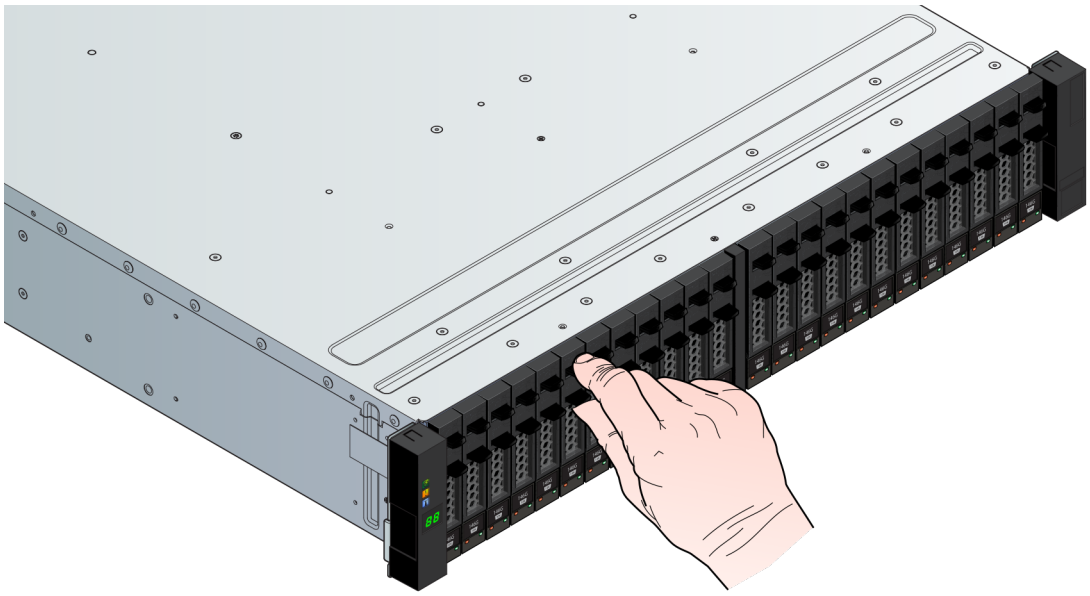


Figure 85 Removing a SFF disk drive module (1 of 2)

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

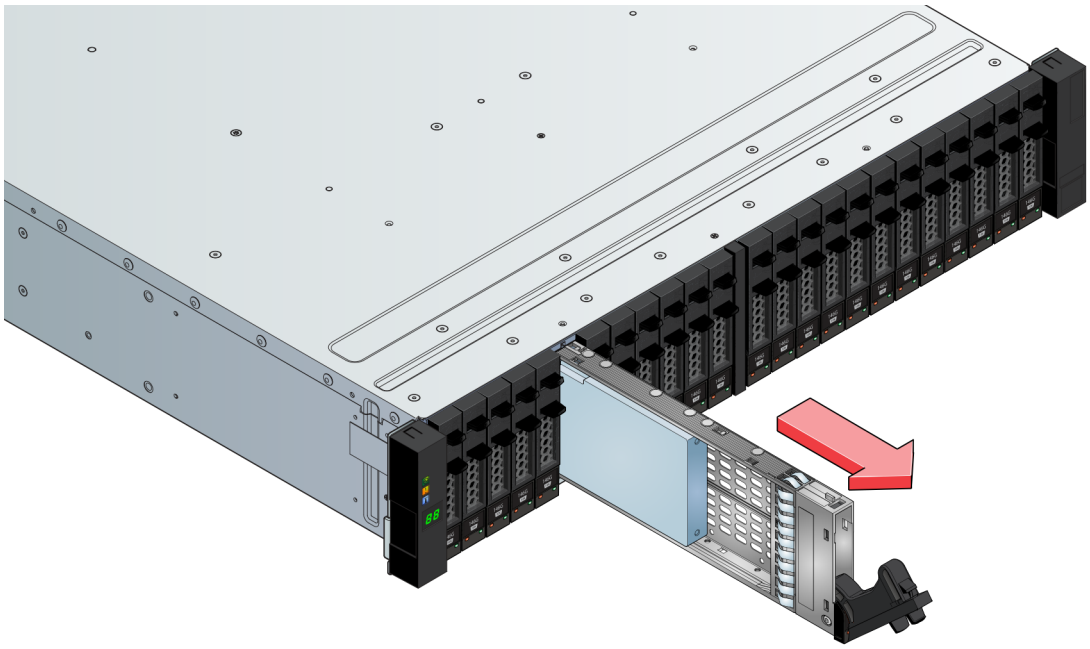


Figure 86 Removing a SFF disk drive module (2 of 2)

3. Remove the module fully from the drive slot.

△ **CAUTION:** To ensure optimal cooling throughout the 2U enclosure, dummy drive carrier modules must be fitted to all unused drive slots. See also Figure 47 (page 55).

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 87 (page 125). 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.

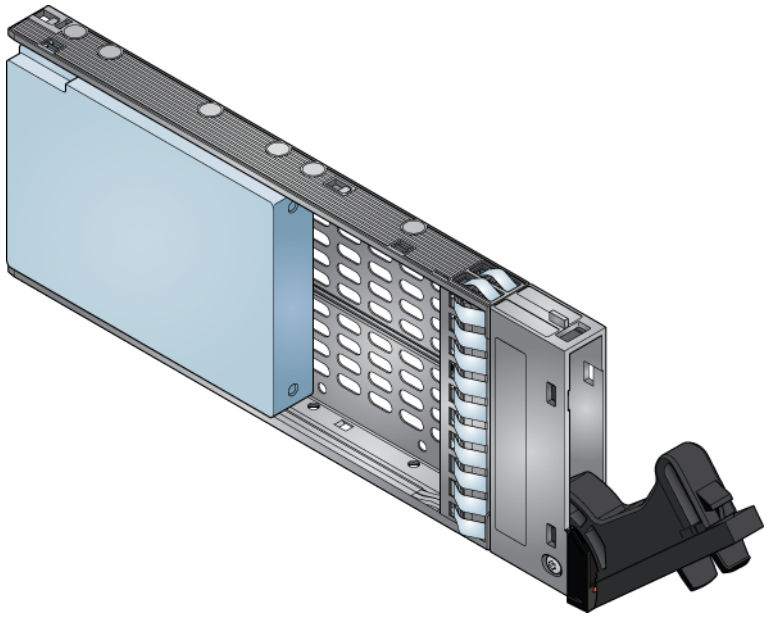


Figure 87 SFF drive carrier module in open position

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

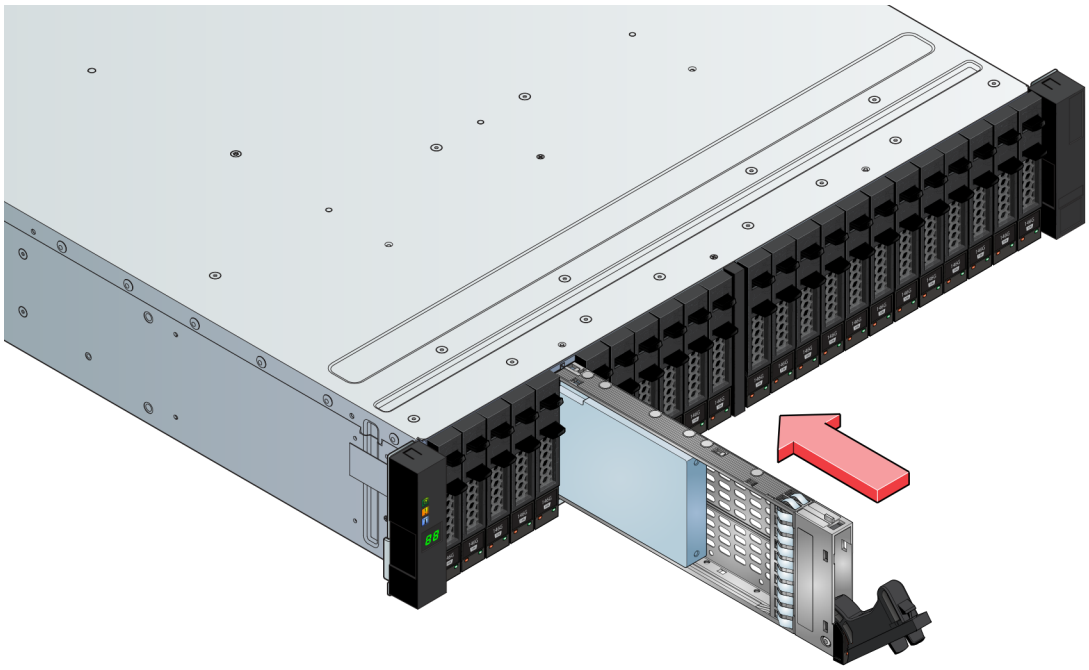


Figure 88 Installing a SFF drive carrier module (1 of 2)

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.

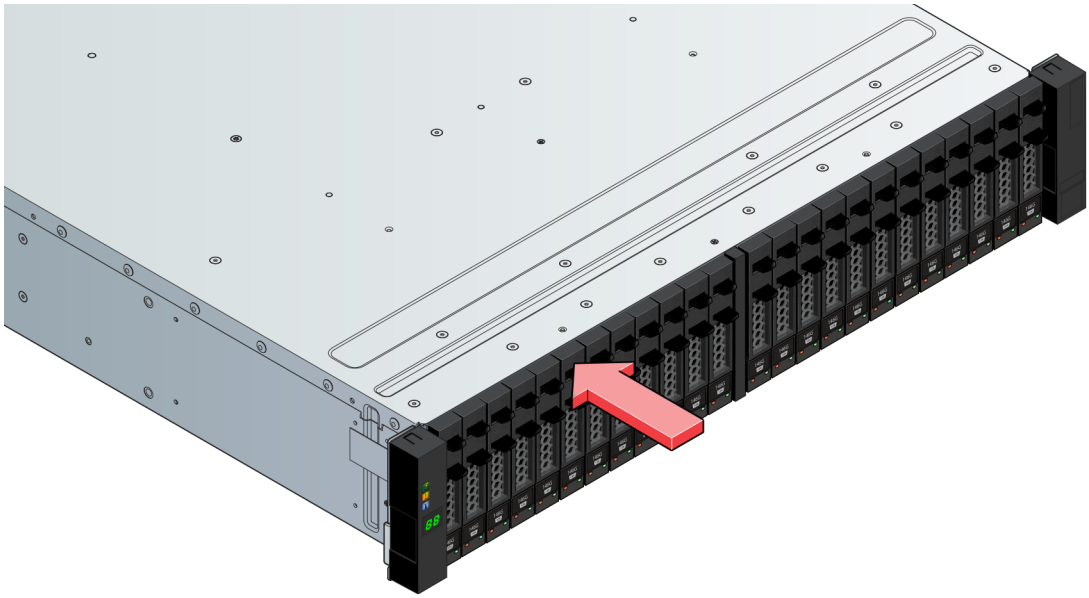


Figure 89 Installing a SFF drive carrier module (2 of 2)

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 75 (page 98). Verify that Ops panel states show no amber module faults.

Replacing a dummy drive carrier

A dummy drive carrier module is removed from the 2U 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 2U enclosure, dummy drive carrier modules must be fitted to all unused drive slots. See also Figure 47 (page 55).

Replacing an IOM

IMPORTANT: The DS Series and DS EXP/D3284 storage enclosures support dual-controller configuration only. If a partner controller fails, the storage system will fail over and run on a single controller module until the redundancy is restored. For RBODs and EBODs, an IOM 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 180º about its longitudinal axis, so that it properly aligns with its connectors on the back of the midplane. See also Figure 16 (page 27).

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 130), and “Installing an IOM” (page 131) 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 132).

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 topic about updating firmware 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 Recommendation field to resolve the problem.
- As an alternative to using the SMC, you can run the `show system` CLI 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 `show events detail` CLI 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 127).
- Do not remove a faulty module unless its replacement is on-hand. All modules must be in place when the system is in operation.

NOTE: See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 116.

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 90 (page 130).
5. Swing the latch handle open as shown in the second illustration within the figure.

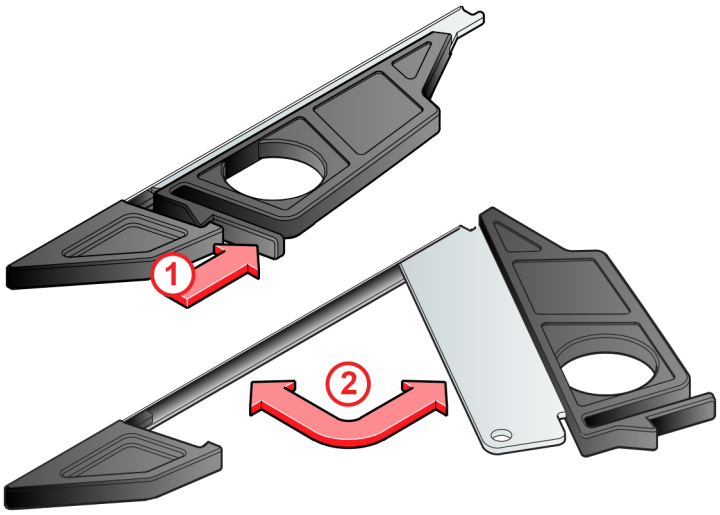
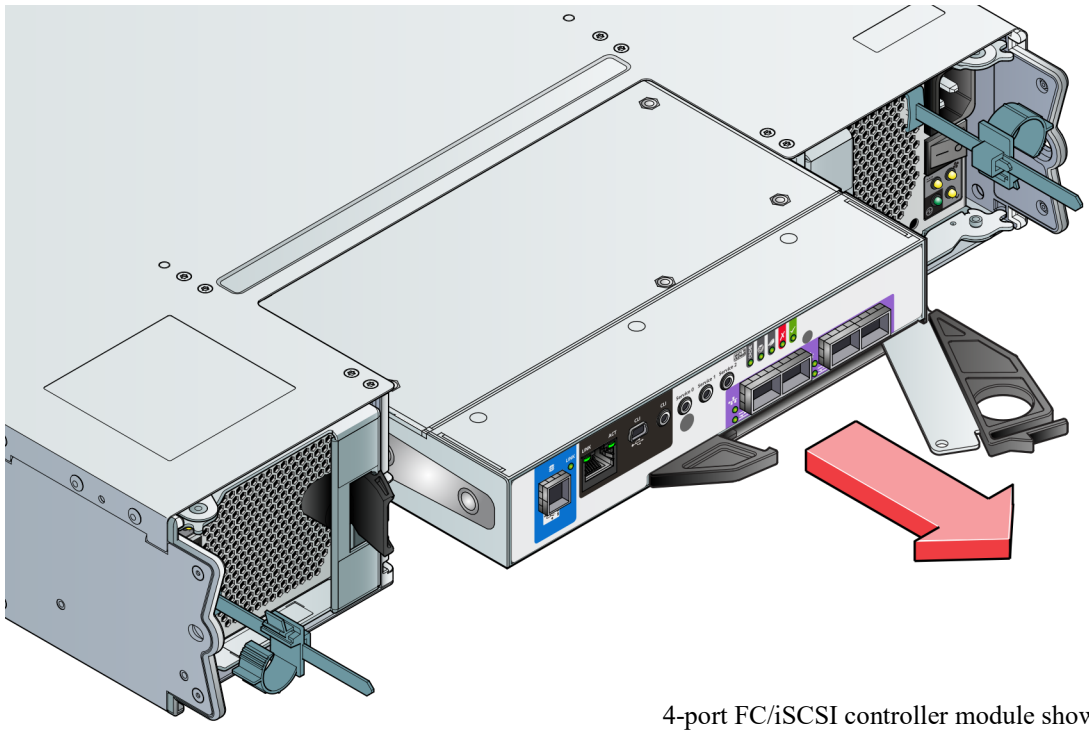


Figure 90 IOM latch operation

6. Grip the latch handle and ease the IOM forward from the slot as shown in Figure 91.



4-port FC/iSCSI controller module shown

Figure 91 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 116.

△ **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 91 (page 131) 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 topic about restarting controllers 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. Verify that firmware on both expansion modules is compatible and current.

NOTE: See the topic about updating expansion module firmware within the Storage Manager Guide.

CRU replacement for 5U chassis

NOTE: Unless noted otherwise within a passage pertaining to a particular CRU, the replacement procedure should be completed within two minutes of the removal of the defective module.

Accessing drawers

To observe or replace a DDIC, you must open the drawer in which it resides. The top drawer (Drawer 0) and the bottom drawer (Drawer 1) are accessed from the enclosure front panel. See also Figure 25 (page 33).

Opening a drawer

1. Verify that the anti-tamper locks are not engaged. The red arrows on the locks point inward if the locks are disengaged as shown in Figure 92. If necessary, unlock them by rotating counter-clockwise using a Torx T20 bit.

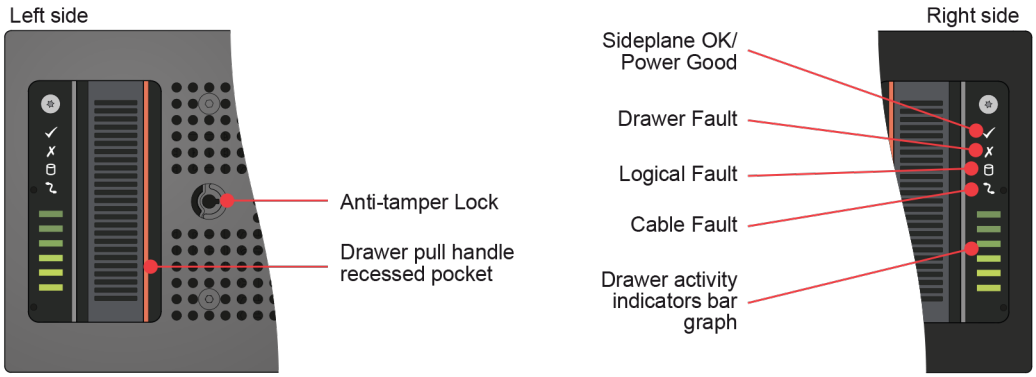


Figure 92 Drawer front panel details

2. Push the drawer latches inward and hold them as shown in Figure 93.

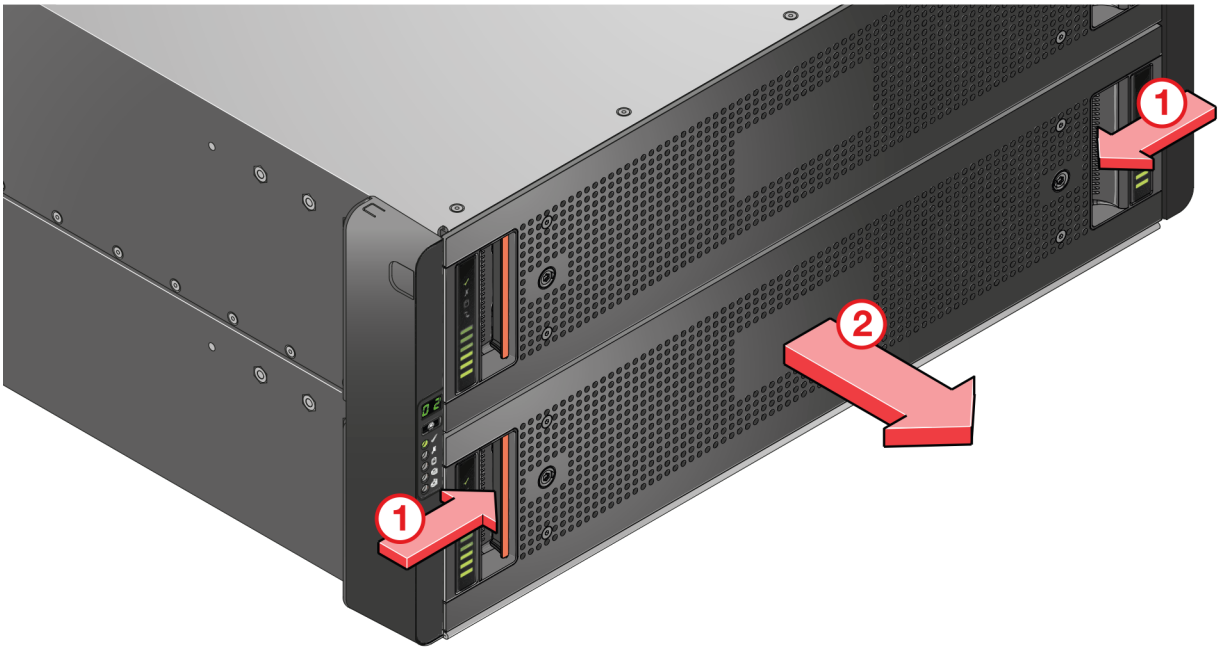


Figure 93 Opening a drawer (1 of 2)

3. Pull the drawer outward until it locks at the drawer stops as shown in Figure 94 (page 134).
   This drawer has been fully populated with DDICs.

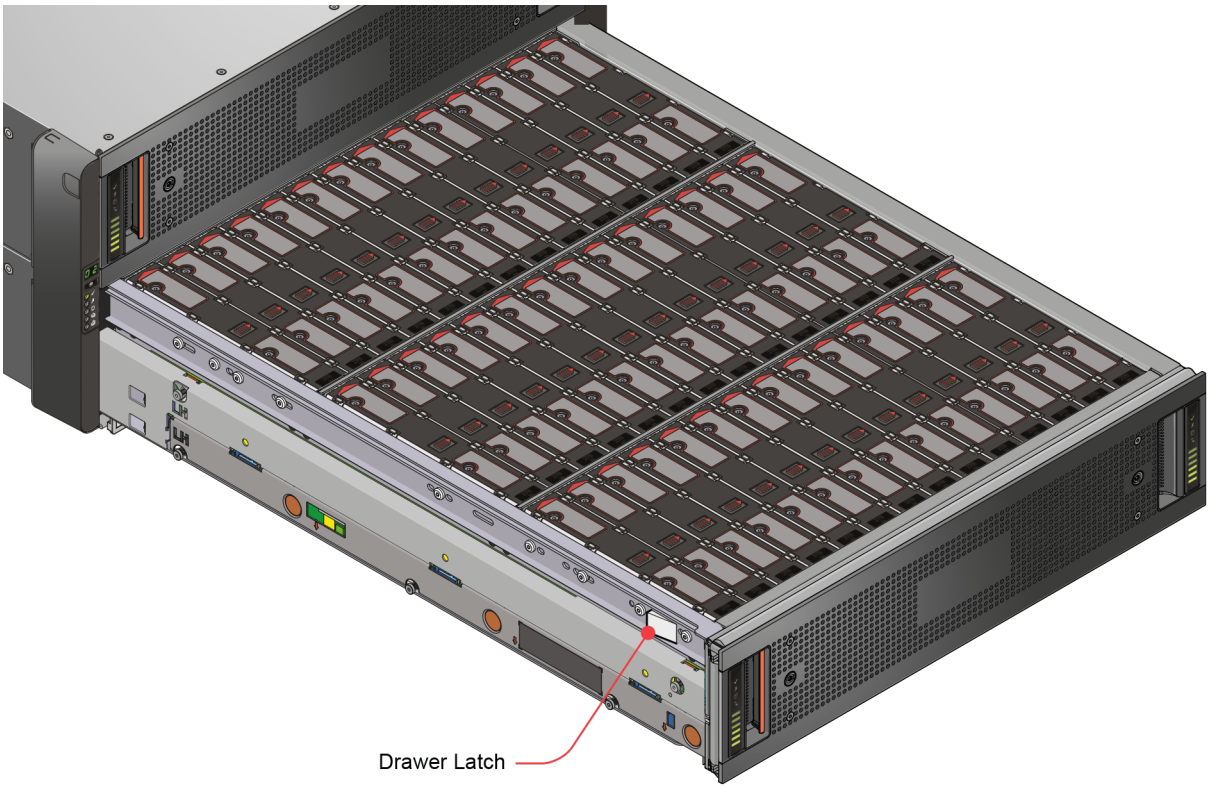


Figure 94 Opening a drawer (2 of 2)

IMPORTANT: The drawer must not remain open for more than two minutes while the enclosure is powered on.

Closing a drawer

1. Press and hold the drawer latches on the sides of the open drawer in each extended top rail.
   Figure 94 calls out a drawer latch, which resides on the left and right drawer rails.
2. Push the drawer in slightly.
3. Release the drawer latches.
4. Push the drawer all the way into the enclosure, making sure that it clicks home.

Replacing a DDIC

This procedure describes removal and installation of a Disk Drive in Carrier (DDIC). Illustrations in the DDIC replacement procedures show drawer-centric views of the enclosure, and DDICs are properly aligned for insertion into the disk slots.

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 116.

Removing a DDIC

NOTE: Remove a DDIC only if a replacement is available. Closing a drawer with one or more drives missing can potentially cause cooling problems. See also "Populating drawers" (page 137).

1. Determine which drawer contains the disk to be replaced.

- If the drive number is known, use the information contained in Figure 26 (page 33), which provides a single plan view of a drawer that is dual-indexed with *top drawer* (left integer) and *bottom drawer* (right integer) slot numbering.
- If the disk has failed, a fault LED is lit on the front panel of the affected drawer. The illuminated LED will either be the Drawer LED or the Logical LED.
- If the disk has failed, the Drive Fault LED on the DDIC cover is lit amber.

2. Open the relevant drawer per the instructions provided in "Opening a drawer" (page 133).
3. Locate the DDIC to be replaced using any of the methods listed in step 1 above.
4. On the face of the DDIC, push the latch button in the direction shown in Figure 95 (page 135) to unlock the DDIC from its seated position in the slot.

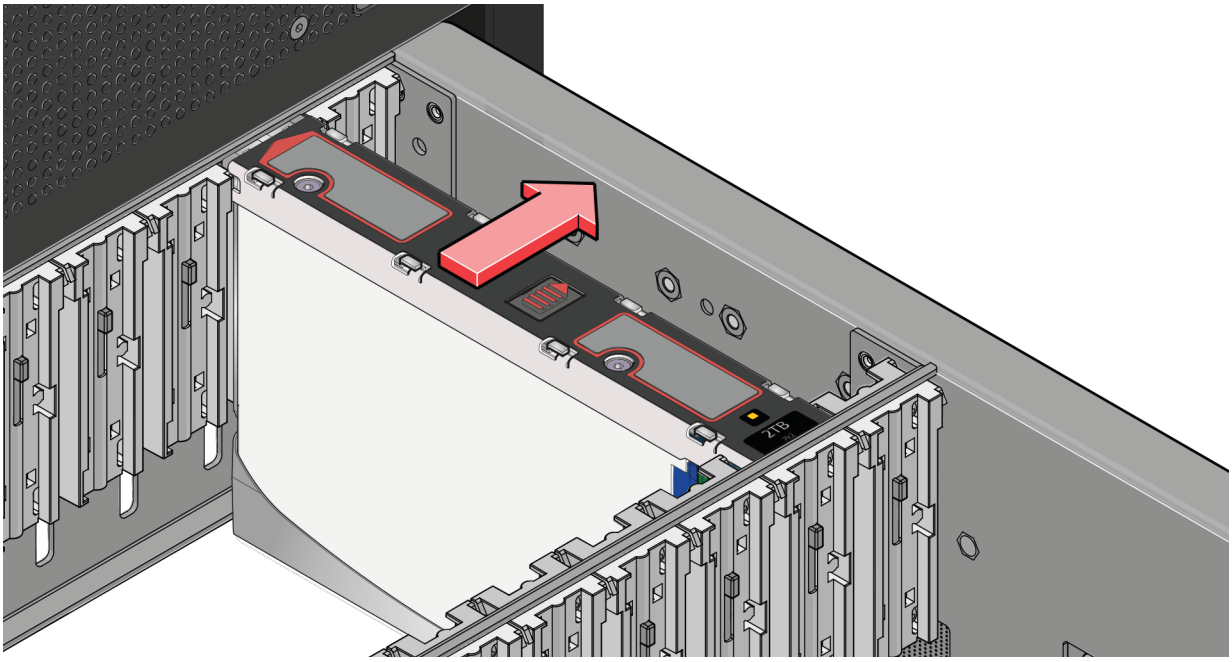


Figure 95 Removing a DDIC (1 of 2)

5. Pull the DDIC upwards and out of the drawer slot.

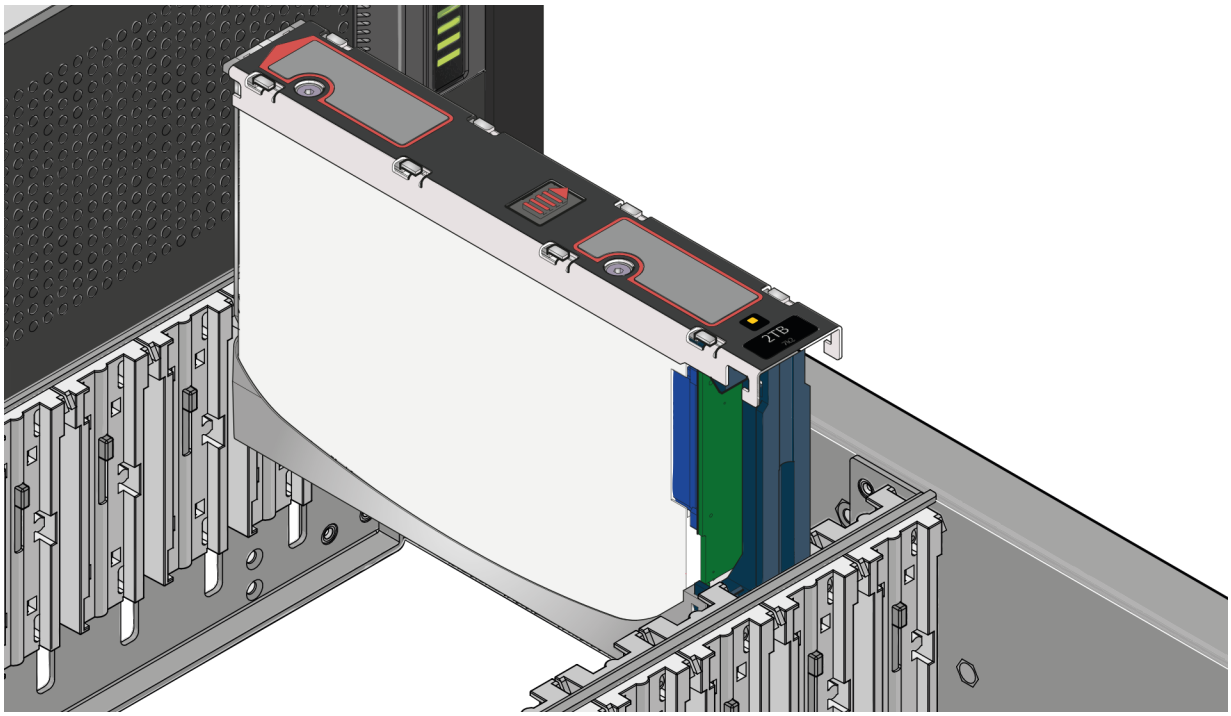


Figure 96 Removing a DDIC (2 of 2)

Installing a DDIC

IMPORTANT: Failed disks must be replaced with approved disks. Contact your service provider for details.

1. Open the relevant drawer per the instructions provided in "Opening a drawer" (page 133).
2. Align the DDIC with the target disk slot as shown in Figure 95 (page 135) and insert it into the disk slot.
3. Lower the DDIC into the disk slot.
   a. Push the DDIC downwards and hold it down.
   b. Move the slide latch leftward as shown in Figure 97.

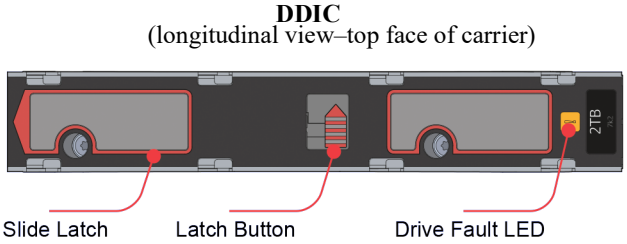


Figure 97 Installing a DDIC

4. Verify the following:
   a. The latch button is in the locked position, as shown in Figure 97 (page 137).
   b. The Drive Fault LED is not lit.
5. Close the drawer per the instructions provided in "Closing a drawer" (page 134).

Populating drawers

General guidelines for populating a drawer with DDICs are provided at "Populating drawers with DDICs" (page 57). Additional guidelines are provided for replacing disks in previously populated drawers, or populating enclosures delivered with the half-populated enclosure configuration option.

Preparation

Customers with multiple enclosures may spread the 42 disks of an expansion package across those enclosures, provided the DDICs are installed 14 at a time to completely fill empty rows. The installation pattern providing the best airflow and thermal performance is described in this section.

The drawers must be populated with DDICs in whole rows. Each drawer contains 3 rows of 14 DDICs. Rules and assumptions are listed:

- The minimum number of disks in an enclosure is 14.
- The number of rows must not differ by more than 1 between the top and bottom drawers.
- The rows should be populated from front to rear of drawer.
- The disks of the expansion package must match the disks originally shipped with the 5U84 enclosure. Both groups of disks must share the same model type and capacity.

NOTE: Part numbers for expansion packages are not listed because they change over time when disks ship with new firmware, or new disk models become available. Contact your account manager for part numbers.

- If the two groups of disks have different firmware, all disks must be updated with current/compatible firmware. See the Storage Manager Guide or online help for additional information about updating firmware.

Installation guidelines

The recommended order for partially populating drives in the 5U84 enclosure optimizes the airflow through the chassis. Please reference the following illustrations:

- Figure 25 (page 33) shows location and indexing of drawers accessed from the enclosure front panel.
- Figure 26 (page 33) shows dual-indexing of disk slots across front, middle, and back rows of a drawer.

The 5U84 ships with drawers installed in the chassis, However, to avoid shock and vibration issues during transit, the enclosure does not ship with DDICs installed in the drawers. An enclosure is configured with either 42 disks (half-populated) or 84 disks (fully populated) for customer delivery. If half-populated, the rows containing disks should be populated with a full complement of DDICs (no blank slots in the row). The bullet-list below identifies rows in drawers that should contain DDICs when the enclosure is configured as half-populated:

- Top drawer–front row
- Top drawer–middle row
- Bottom drawer–front row

If additional disks are incrementally installed into a half-populated enclosure, the DDICs must be added one row at a time (no blank slots in row) in the sequence listed:

- Bottom drawer–middle row
- Top drawer–back row
- Bottom drawer–back row

Replacing a PSU

Illustrations in the power supply unit module replacement procedures show rear panel views of the enclosure, and PSUs are properly aligned for insertion into the PSU slots.

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 116.

Removing a PSU

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

Before removing the PSU, disconnect the power from the PSU 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. Ensure that you correctly identify the faulty PSU before beginning the step procedure.

1. Stop all I/O from hosts to the enclosure. See also "Stopping I/O" (page 128).

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

   ---

3. Per Figure 28 (page 34), verify the Power OK LED is lit, then switch off the faulty PSU, and disconnect the power supply cable.

4. If replacing a single PSU via hot-swap proceed to step 6.
5. If replacing both PSUs, 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. Refer to Figure 98 when performing this step:
   a. Push the release latch to the right and hold it in place (detail No.1).
   b. With your other hand, grasp the handle and pull the PSU outward (detail No.2). Supporting the PSU with both hands, remove it from the enclosure. See also Figure 99.

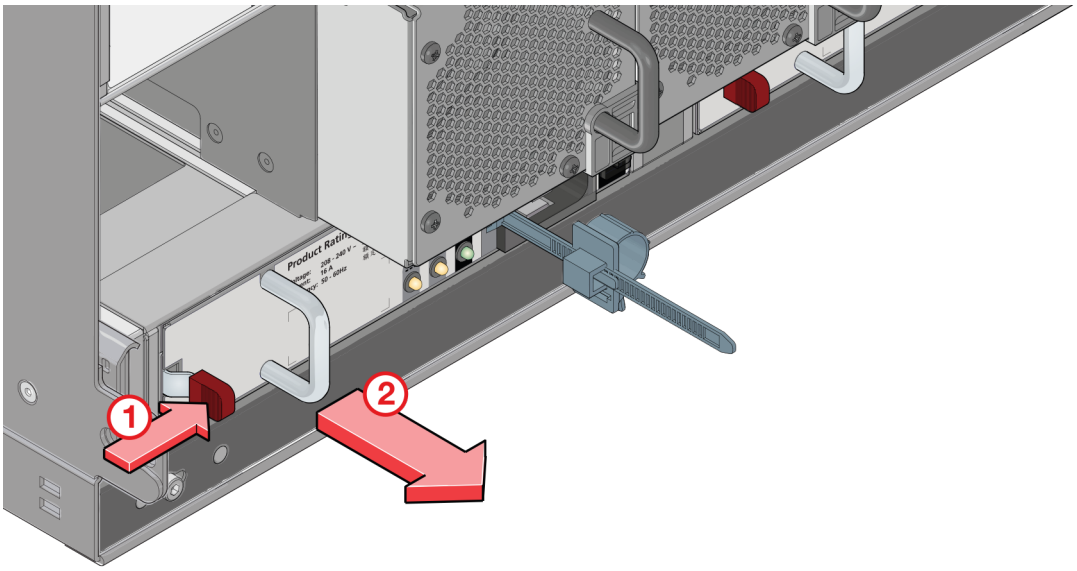


Figure 98 Removing a PSU (1 of 2)

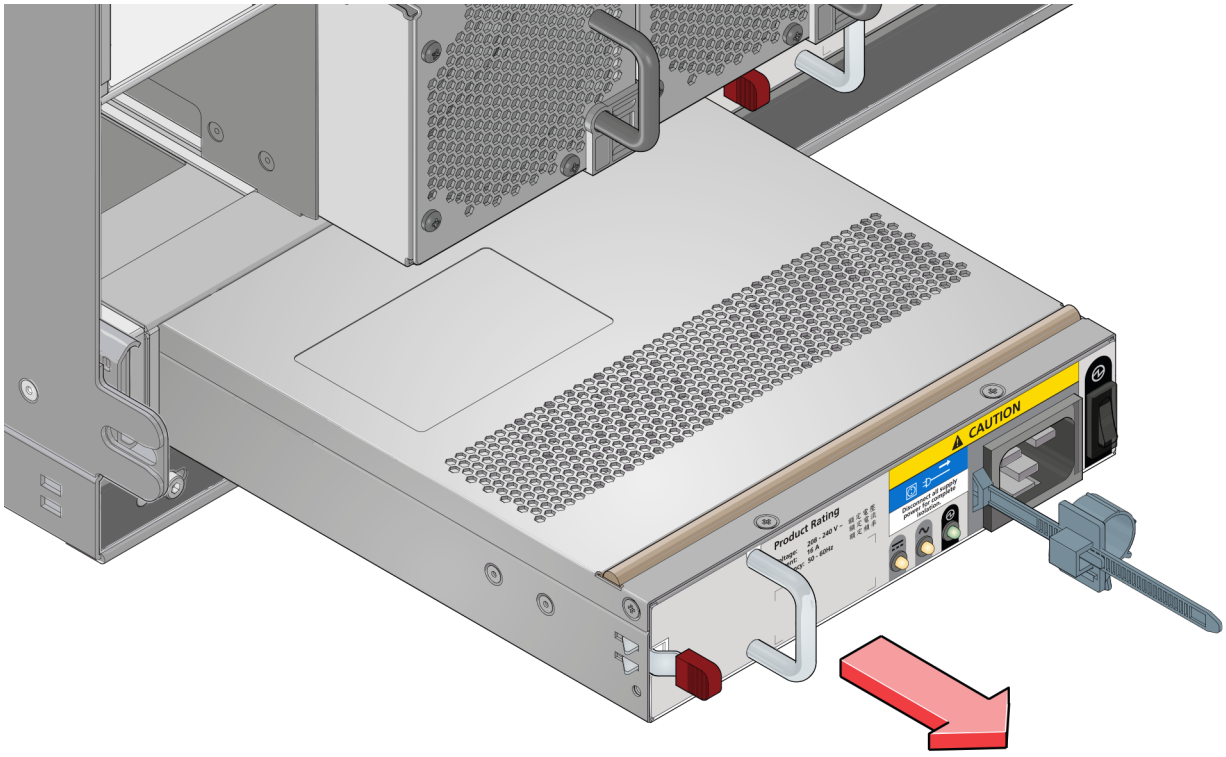


Figure 99 Removing a PSU (2 of 2)

8. If replacing both PSUs, repeat step 5 through step 7.

IMPORTANT: The PSU slot must not be empty for more than 2 minutes while the enclosure is powered.

Installing a PSU

1. Ensure that the PSU is switched off.

   If replacing both PSUs, the enclosure must be powered off via an orderly shutdown using the management interfaces.
2. Orient the PSU for insertion into the target slot on the enclosure rear panel, as shown in Figure 99 (page 139).
3. Slide the PSU into the slot until the latch clicks home.
4. Connect the AC power cord.
5. Move the PSU power switch to the **On** position.
6. Wait for the Power OK LED on the newly inserted PSU to illuminate green. See also Figure 28 (page 34).
   - If the Power OK LED does not illuminate, verify that the PSU is properly inserted and seated in the slot.
   - If properly seated, the module may be defective. Check the SMC and the event logs for more information.
   - Using the management interfaces (the SMC or CLI), determine if the health of the new PSU is OK. Verify that the Power OK LED is green, and that the Ops panel states show no amber module faults.
7. If replacing both PSUs, repeat step 1 through step 7.

Replacing an FCM

Illustrations in the fan cooling module replacement procedures show rear panel views of the enclosure, and FCMs are properly aligned for insertion into the FCM slots.

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 116.

Removing an FCM

CAUTION: Removing an FCM significantly disrupts the enclosure's airflow. Do not remove the FCM until you have received the replacement module. It is important that all slots are filled when the enclosure is in operation.

1. Identify the fan cooling (FCM) module to be removed. If the FCM module has failed, the Fan Fault LED will illuminate amber. See also Figure 29 (page 35).
2. Refer to Figure 100 (page 141) when performing this step:
   a. Push the release latch down and hold it in place (detail No.1).
   b. With your other hand, grasp the handle and pull the FCM outward (detail No.2). Supporting the FCM with both hands, remove it from the enclosure. See also Figure 101 (page 141).

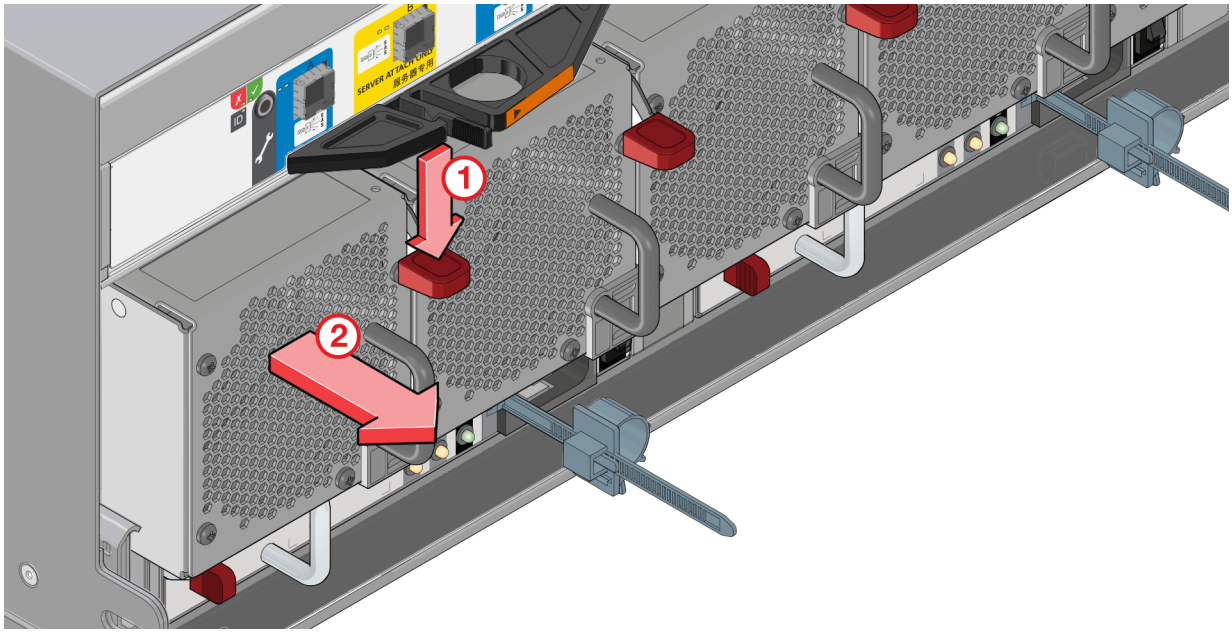


Figure 100 Removing an FCM (1 of 2)

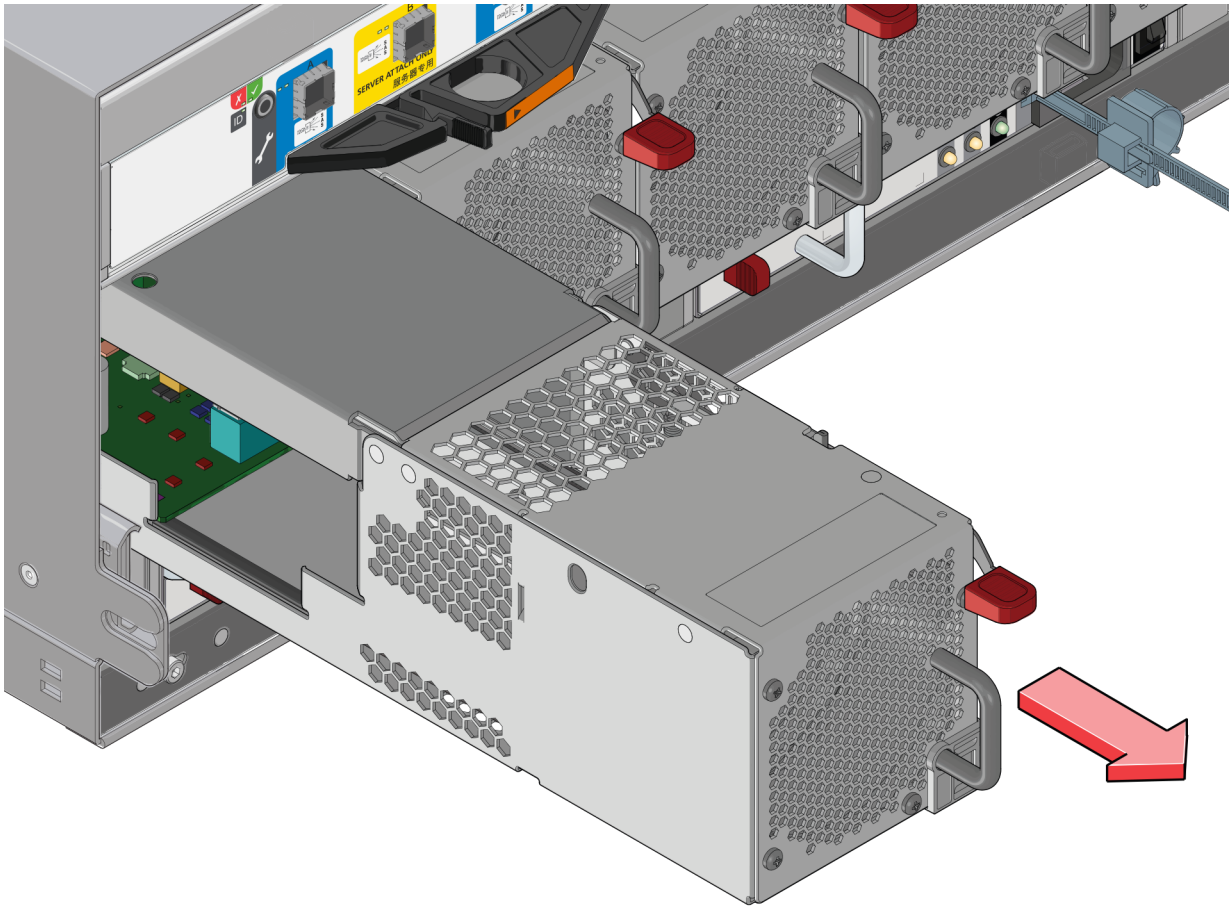


Figure 101 Removing an FCM (2 of 2)

IMPORTANT: The FCM slot must not be empty for more than 2 minutes while the enclosure is powered.

Installing an FCM

1. You can hotswap the replacement of a single FCM; however, if replacing multiple FCMs, the enclosure must be powered off via an orderly shutdown using the management interfaces.
2. Orient the FCM for insertion into the target slot on the enclosure rear panel, as shown in Figure 101 (page 141).
3. Slide the FCM into the slot until the latch clicks home.

   The enclosure should automatically detect and make use of the new module.
4. Wait for the Module OK LED on the newly inserted FCM to illuminate green. See also Figure 29 (page 35).
   - If the Module OK LED does not illuminate, verify that the FCM is properly inserted and seated in the slot.
   - If properly seated, the module may be defective. Check the SMC and the event logs for more information.
   - Using the management interfaces (the SMC or CLI), determine if the health of the new FCM is OK. Verify that the Module OK LED is green, and that the Ops panel states show no amber module faults.
5. If replacing multiple FCMs, repeat step 1 through step 4.

Replacing an IOM

DS Series and DS EXP/D3284 supports a common set of controller modules in 2U RBODs, and a common expansion module in 2U and 5U enclosures configured as EBODs. Be mindful of the intricacies associated with enclosure IOMs before engaging in replacement. Key considerations pertaining to replacement of a controller module are described on the following pages.

- **Important** and ensuing discussion on page 127
- “Before you begin” (page 127)
- “Configuring partner firmware update” (page 128)
- “Verifying component failure” (page 128)
- “Stopping I/O” (page 128)
- “Shutting down a controller module” (page 129)

NOTE: Given that the 5U84 is configured exclusively as an EBOD, the replacement procedure is specific to an expansion canister. See also the topic about updating expansion module firmware within the Storage Manager Guide.

Removing an IOM

IMPORTANT: Considerations for removing expansion modules:

- Do not remove a faulty module unless its replacement is on-hand. All modules must be in place when the system is in operation.
- In a dual-IOM environment—if replacing both expansion modules—power off the expansion enclosure before replacing the two IOMs. Power on the EBOD after replacing both canisters. See “Powering on/powering off” (page 92).

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 116.

Illustrations in the expansion module removal procedure show rear panel views of the enclosure, and IOMs are properly aligned for insertion into the IOM slots.

1. Locate the enclosure containing the expansion canister you wish to replace.
2. Disconnect any cables connected to the IOM.

   Label each cable to facilitate re-connection to the replacement IOM.
3. 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 (detail No.1), and swing the latch out to release the IOM from its seated position (detail No.2) as shown in Figure 102 and Figure 103.

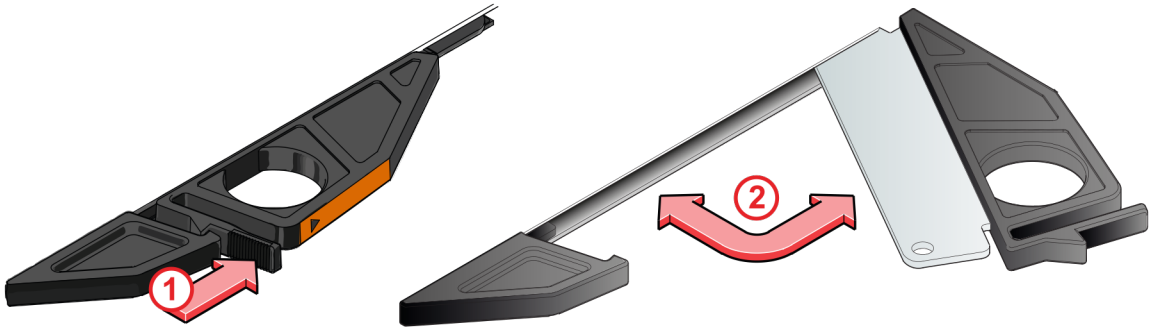


Figure 102 IOM latch operation detail

4. Grip the latch handle and ease the IOM outward from its installed position as shown in Figure 103.

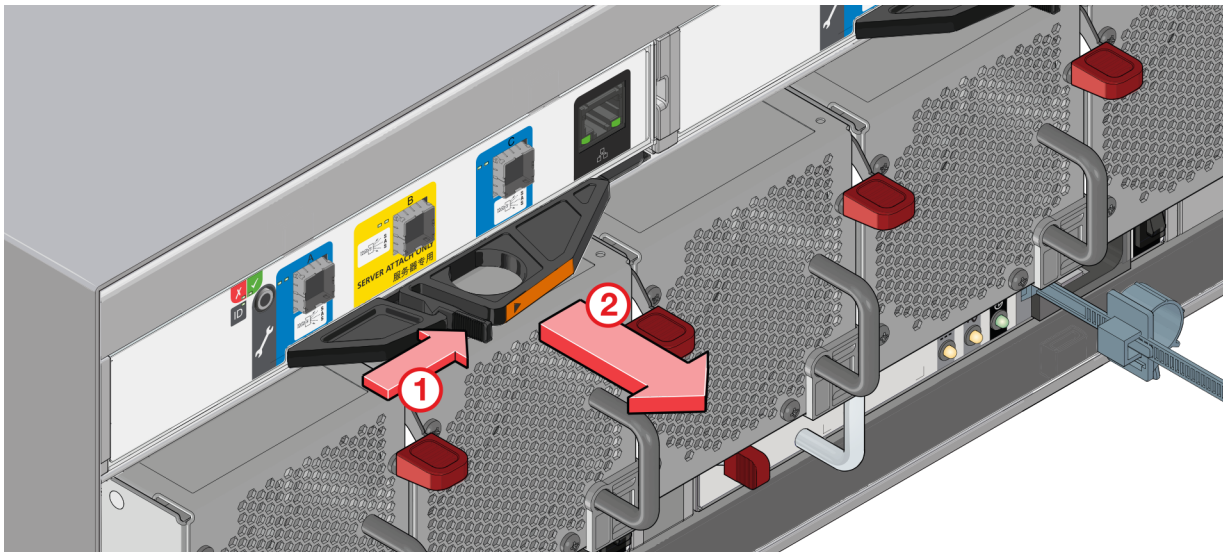


Figure 103 Removing an IOM (1 of 2)

5. Place both hands on the expansion canister body, and pull it straight out of the enclosure as shown in Figure 104 (page 144).

IMPORTANT: The SBB IOM slot must not be empty for more than 2 minutes while then enclosure is powered.

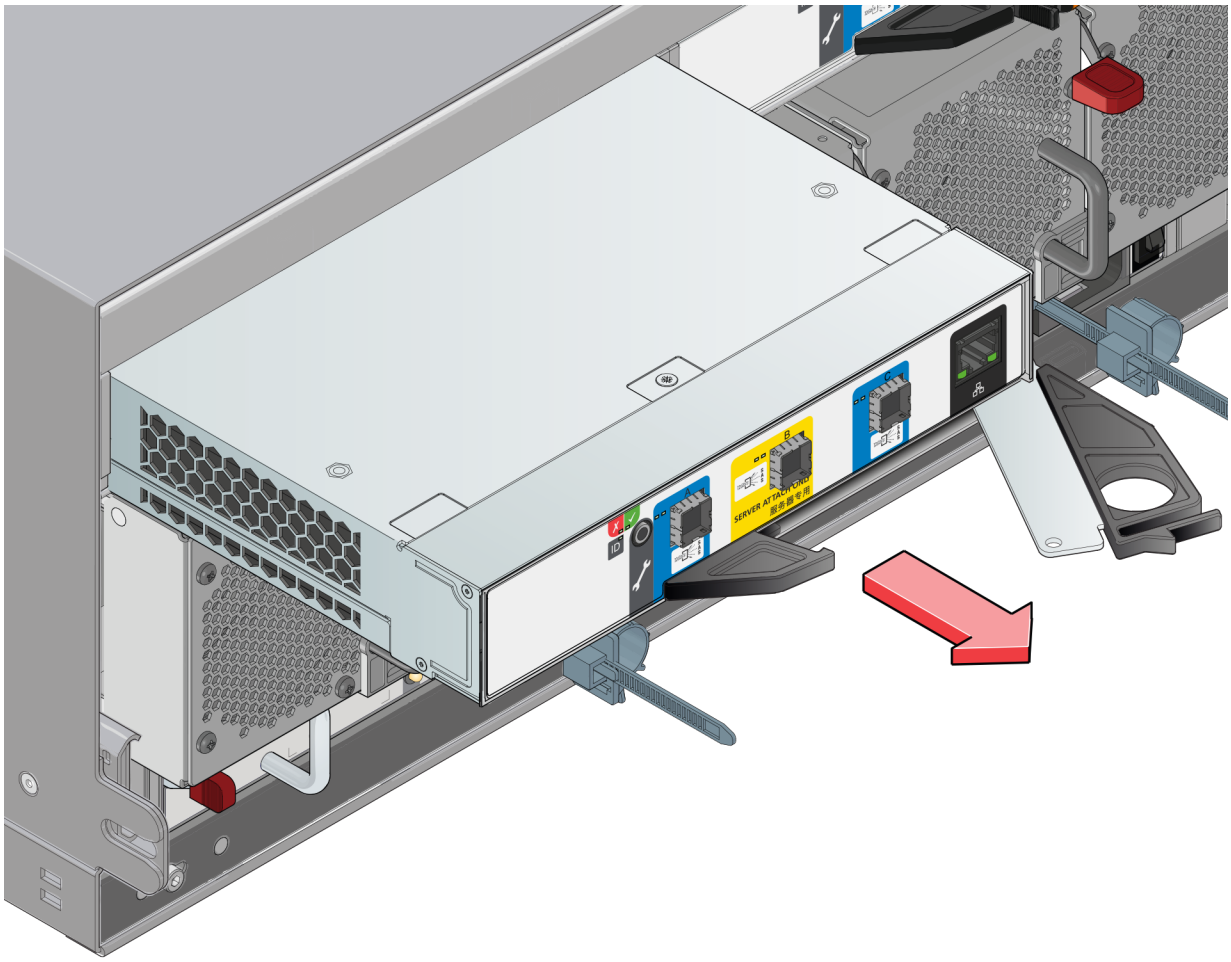


Figure 104 Removing an IOM (2 of 2)

Installing an IOM

See CAUTION bullets regarding *electrostatic discharge* and *anti-static protection* on page 116.

△ **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 104 (page 144).

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 as shown in the reference figure.
3. Ensuring that the IOM is level, slide it into the enclosure as far as it will go.

   An expansion module that is only partially seated will prevent optimal performance of the storage system. Verify that the module is fully seated before continuing.
4. Set the module in position by manually closing the latch. See detail No.2, followed by No.1 in Figure 102 (page 143).

   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.
6. See “Verifying component operation” (page 132).

A Technical specifications

Enclosure dimensions

Table 29 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.

Table 30 5U84 enclosure dimensions

Specification	Metric units	Imperial units
Overall enclosure height (5U)	222.3 mm	8.75 in
Width across mounting flange (located on front of chassis)	483 mm	19.01 in
Width across body of enclosure	444.5 mm	17.50 in
Depth from face of mounting flange to back of enclosure body	892.2 mm	35.12 in
Depth from face of mounting flange to rearmost enclosure extremity	974.7 mm	38.31 in
Depth from face of Ops panel to rearmost enclosure extremity	981 mm	38.63 in

1-The 5U84 enclosure uses 3.5" LFF disks in the DDIC carrier. It can also use 2.5" SFF disks with 3.5" adapter in the DDIC.

Enclosure weights

Table 31 Enclosure weights

CRU/component	2U12 (kg/lb)	2U24 (kg/lb)	5U84 (kg/lb)
Storage enclosure (empty)	4.8/10.56	4.8/10.56	64/141
Disk drive carrier	0.9/1.98	0.3/0.66	0.8/1.8
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	—
Power Supply Unit (PSU)	—	—	2.7/6
Fan Cooling Module (FCM)	—	—	1.4/3
SBB controller module (maximum weight)	2.6/5.8	2.6/5.8	—
SBB expansion module	1.5/3.3	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	130/287

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 32 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	2U enclosures: 0 to 3,000 meters (0 to 10,000 feet) Maximum operating temperature is de-rated by 5ºC above 2,133 meters (7,000 feet)
	5U enclosures: -100 to 3,000 meters (-330 to 10,000 feet) Maximum operating temperature is de-rated by 1ºC above 900 meters (3,000 feet)
Altitude, non-operating	-100 to 12,192 meters (-330 to 40,000 feet)
Shock, operating	5.0 g, 10 ms, ½ sine pulses, Y-axis
Shock, non-operating	2U enclosures: 30.0 g, 10 ms, ½ sine pulses
	5U enclosures: 30.0 g, 10 ms, ½ sine pulses (Z-axis); 20.0 g, 10 ms, ½ sine pulses (X- and Y-axes)
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 5U enclosures: ≤ L_{WAd} 8.0 Bels (re 1 pW) @ 23ºC
Orientation and mounting:	19" rack mount (2 EIA units; 5 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 33 2U 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	
Efficiency	115 VAC/60 Hz	230 VAC/50 Hz
	> 80% @ 10% load > 87% @ 20% load > 90% @ 50% load > 87% @ 100% load > 85% @ surge	> 80% @ 10% load > 88% @ 20% load > 92% @ 50% load > 88% @ 100% load > 85% @ surge
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	
Mains inlet connector	IEC60320 C14 with cable retention	

Power supply unit

Table 34 5U84 Power supply unit specifications

Specification	Measurement/description
Maximum output power	2,214 W maximum continuous output power at high line voltage
Voltage	+12 V at 183 A (2,196 W) +5 V standby voltage at 2.7 A
Voltage range	200–240 VAC rated
Frequency	50–60 Hz
Power factor correction	≥ 95% @ 100% load
Efficiency	82% @ 10% load 90% @ 20% load 94% @ 50% load 91% @ 100% load

Table 34 5U84 Power supply unit specifications

Specification	Measurement/description
Holdup time	5 ms from ACOKn high to rails out of regulation (see SBB v2 specification)
Hot pluggable	Yes
Mains inlet connector	IEC60320 C20 with cable retention
Weight	3 kg (6.6 lb)
Cooling fans	Separate fan cooling module CRU provides 2 adjacent fans: 80x80x38mm

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 35 Safety compliance specifications

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

EMC compliance

Table 36 EMC compliance specifications

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

Table 36 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 37 AC power cord specifications

1	United States of America–Must be NRTL Listed (National Recognized Test Laboratory – e.g., UL):		
	Chassis form factor	**2U12/2U24**	**5U84**
	Cord type	SV or SVT, 18 AWG minimum, 3 conductor, 2.0M max length	SJT or SVT, 12 AWG minimum, 3 conductor
	Plug (AC source)	NEMA 5–15P grounding-type attachment plug rated 120V 10A *or* IEC 320, C-14, 250V, 10A	IEC 320 C-20, 250V, 20A *or* A suitable plug rated 250V, 20A
	Socket	IEC 320, C-13, 250V, 10A	IEC 320, C-19, 250V, 20A
2	Europe and others–General requirements:		
	Chassis form factor	**2U12/2U24**	**5U84**
	Cord type	Harmonized, H05-WF-3G1.0	Harmonized, H05-WF-3G2.5
	Plug (AC source)		IEC 320 C-20, 250V, 16A *or* A suitable plug rated 250V, 16A
	Socket	IEC 320, C-13, 250V, 10A	IEC 320, C-19, 250V, 16A

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.

Taiwan BSMI RoHS declaration

設備名稱：Data Storage System(資料儲存系統） 型號 （型式）：4587, 4588, 4599, 4617, 4619,6413

Equipment name

單元 Unit	限用物質及其化學符號 Restricted substances and its chemical symbols					
	鉛 Lead (Pb)	汞 Mercury (Hg)	鎘 Cadmium (Cd)	六價鉻 Hexavalent chromium (Cr^{+6})	多溴聯苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
Chassis Subassembly 機箱子組件	-	o	o	o	o	o
Power Supply 電源	-	o	o	o	o	o
Printed Board Assemblies, PBA 印刷板組件	-	o	o	o	o	o
Disk Drives 硬碟	-	o	o	o	o	o

備考 1. 〝超出 0.1 wt %〞及 〝超出 0.01 wt %〞係指限用物質之百分比含量超出百分比含量基準值。

Note 1: "Exceeding 0.1 wt %" and "exceeding 0.01 wt %" indicate that the percentage content of the restricted substance exceeds the reference percentage value of presence condition.

備考 2. 〝○〞係指該項限用物質之百分比含量未超出百分比含量基準值。

Note 2: "○" indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence.

備考 3. 〝—〞係指該項限用物質為排除項目 。

Note 3: The "-" indicates that the restricted substance corresponds to the exemption.

C USB device connection

Rear panel USB ports

Lenovo ThinkSystem DS Series 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

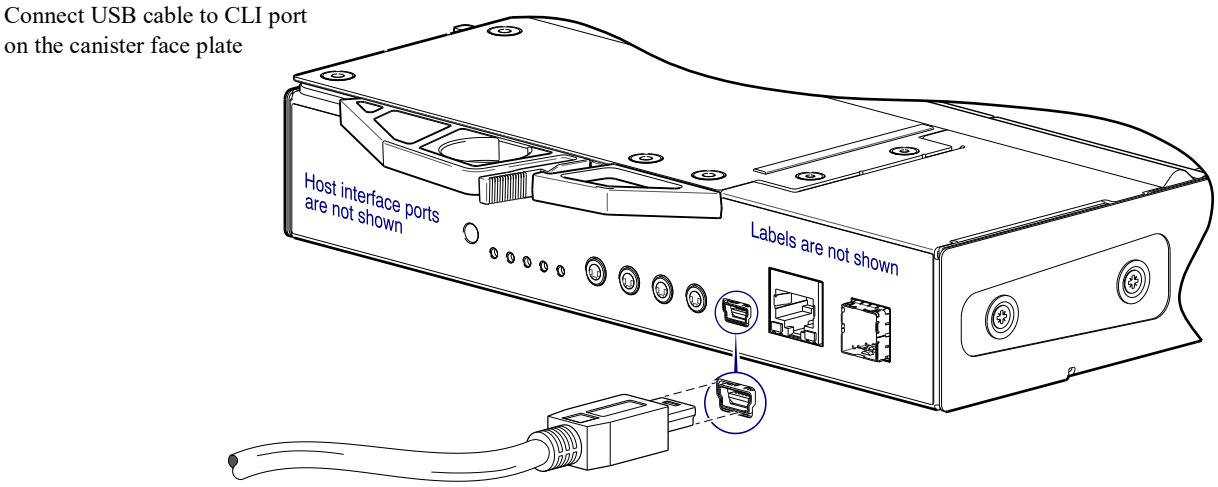


Figure 105 USB device connection—CLI port

DS Series 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 155). 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 154).

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 DS Series 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 154). 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 154).

Supported host applications

DS Series controllers support the following applications to facilitate connection.

Table 38 Supported terminal emulator applications

Application	Operating system
HyperTerminal, TeraTerm, PuTTY	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 39 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 DS Series 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 DS Series 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 81).

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 81).

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 107 (page 157). When installing an SFP, refer to the 4-port or 2-port figure that corresponds to your product.

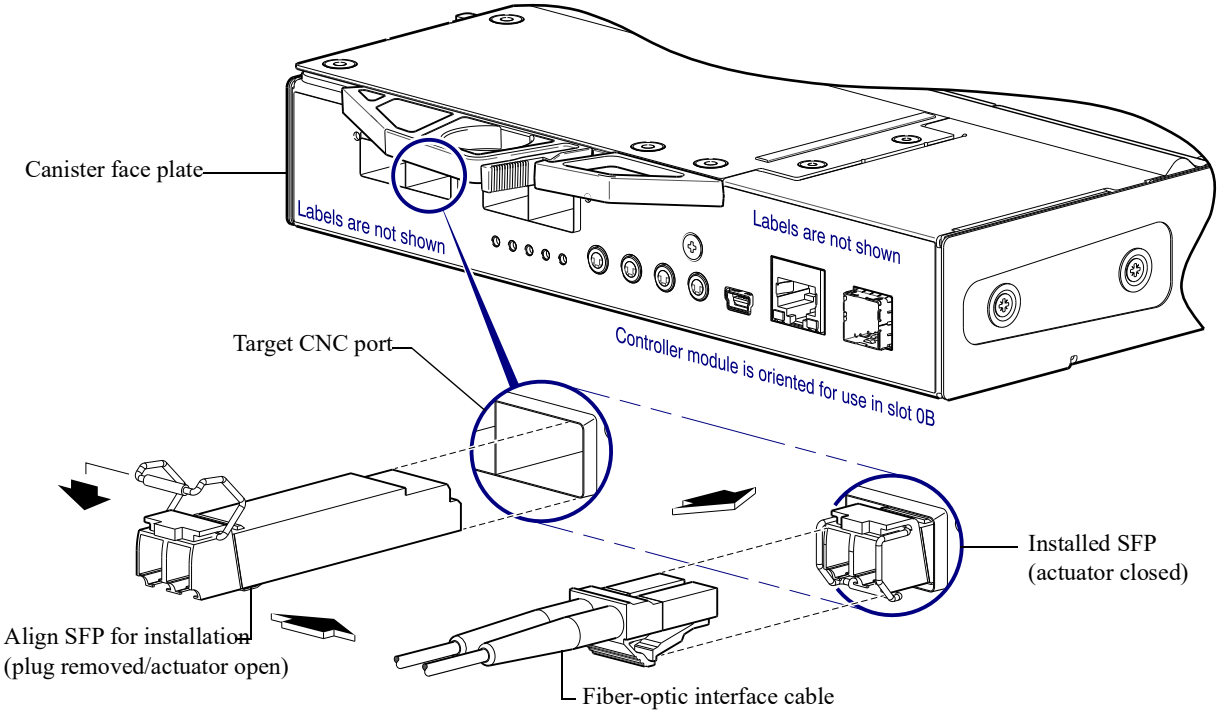


Figure 106 Install a qualified SFP option into an DS4200 or DS6200 FC/iSCSI controller module

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 116) 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.

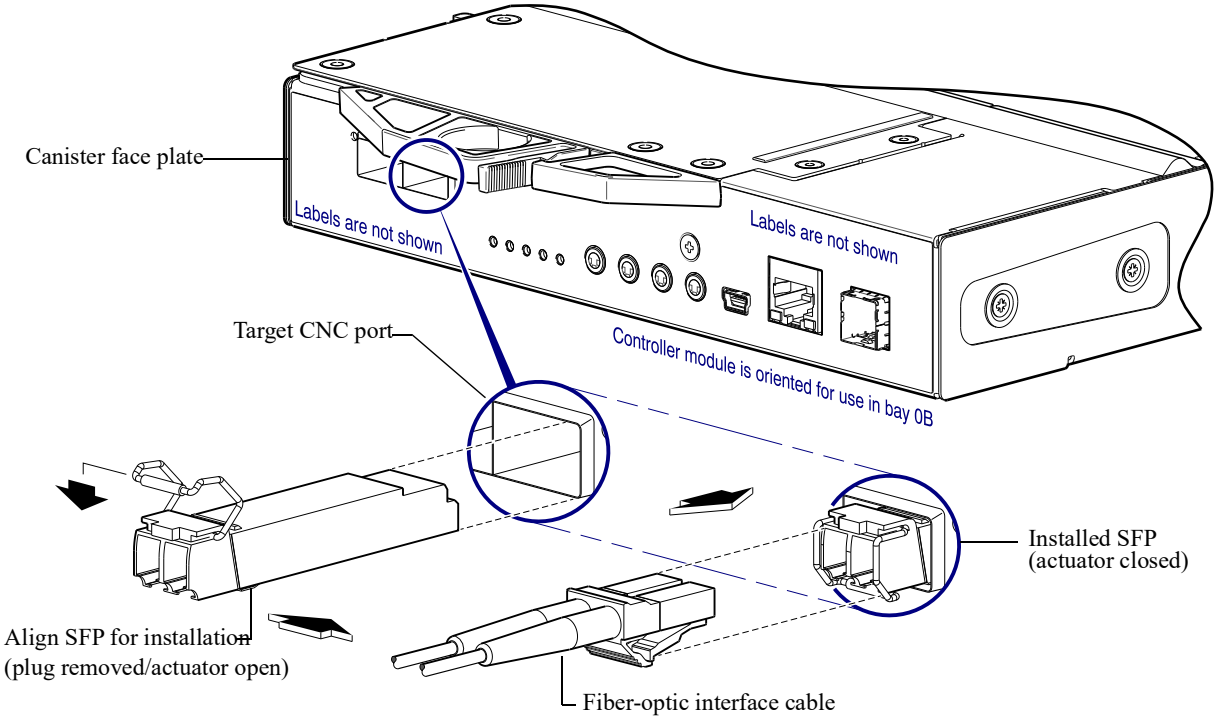


Figure 107 Install a qualified SFP option into an DS2200 FC/iSCSI controller module

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 37 (page 45)or Figure 41 (page 49), and refer to table entry No.1
- For 10GbE iSCSI SFPs, see Figure 37 (page 45) or Figure 41 (page 49), and refer to table entry No.2
- For 1Gb iSCSI SFPs, see Figure 38 (page 46) or Figure 41 (page 49), 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 156).

Index

M

O

P

R

S

T

U