

IBM ESS expansion
Version 5.3.5

*Hardware Installation and Maintenance
Guide - Model 106*



Note

Before using this information and the product it supports, read the following information:

- The general information in [“Notices” on page 95](#)
- The information in the [“Safety and environmental notices” on page xiii](#)
- The information in the *IBM Environmental Notices and User Guide* (provided on a DVD)

This edition applies to IBM ESS expansion Model 106 and is valid until replaced by new editions.

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Safety and environmental notices

Review the safety notices, environmental notices, and electronic emission notices for IBM ESS expansion (5147-106) before you install and use the product.

Suitability for telecommunication environment: This product is not intended to connect directly or indirectly by any means whatsoever to interfaces of public telecommunications networks.

Here are examples of a caution and a danger notice. Numbers in parentheses refer to message numbers in the *IBM Safety Notices* publication G229-9054, which is included with your product.



CAUTION: A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury. (C001)



DANGER: A danger notice indicates the presence of a hazard that has the potential of causing death or serious personal injury. (D002)

- [“Safety notices” on page xiii](#)
- [“Environmental notices” on page xvi](#)
- [“Support information” on page xvii](#)

Safety notices

Required safety notices for this product.

Familiarize yourself with the *IBM Safety Notices* publication G229-9054, which is included with your product.



DANGER: When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard:

- If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product.
- Do not open or service any power supply assembly.
- Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.
- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected.
- Assume that an electrical safety hazard is present. Perform all continuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements.
- Do not continue with the inspection if any unsafe conditions are present.
- Disconnect the attached power cords, telecommunications system, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.

- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

To disconnect:

1. Turn off everything (unless instructed otherwise).
2. Remove the power cords from the outlets.
3. Remove the signal cables from the connectors.
4. Remove all cables from the devices.

To connect:

1. Turn off everything (unless instructed otherwise).
 2. Attach all cables to the devices.
 3. Attach the signal cables to the connectors.
 4. Attach the power cords to the outlets.
 5. Turn on the devices.
- Sharp edges, corners and joints may be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)



DANGER: Heavy equipment—personal injury or equipment damage might result if mishandled. (D006)



DANGER: Professional movers are to be used for all relocation activities. Serious injury or death may occur if systems are handled and moved incorrectly. (D008)



DANGER: Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)

Do not: Throw or immerse into water, heat to more than 100°C (212°F), repair or disassemble. (C003) Use the following general safety information for all rack mounted devices:



DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment—personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.



- Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

(R001 part 2 of 2):



CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers.) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.



- (For fixed drawers.) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)



DANGER: Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)



or



or



CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)





CAUTION: High levels of acoustical noise are (or could be under certain circumstances) present. Use approved hearing protection and/ or provide mitigation or limit exposure. (L018)

Environmental notices

This information contains all of the required environmental notices for IBM Systems products in English and other languages.

The [IBM Systems Environmental Notices](#) information includes statements on limitations, product information, product recycling and disposal, flat panel display, battery removal and disposal, refrigeration and water-cooling systems, external power supplies, and safety data sheets.

Support information

Your location	Method of contacting the IBM Support Center
In the United States	Call 1-800-IBM-SERV for support.
Outside the United States	Contact your local IBM Support Center or see the Directory of worldwide contacts .

Chapter 1. About this guide

Introduction

This guide provides information about initial hardware installation and setup, as well as removal and installation of field-replaceable units (FRUs), customer-replaceable units (CRUs) for the IBM Elastic Storage® System expansion model 106, 5147-106. The 5147-106 is a high capacity expansion enclosure designed for use in Cloud and Enterprise environments. The 5147-106 measures 4 EAI units of rack height (7") and fits a 1.2 m rack. It conforms to (CFF) Common Form Factor for canister bay support, and it integrates with IBM ESS Data Server 5104-22C. The integral Cable Management Arm (CMA) allows the enclosure to be withdrawn from the rack for servicing, while remaining connected and powered.

Intended audience

This guide is intended for system administrators, storage administrators and service personnel.

Prerequisites

Prerequisites for using this product include knowledge of:

- IBM Power® Server system administration
- IBM Spectrum Scale RAID
- Power servers
- Storage system configuration
- Serial Attached SCSI (SAS) protocol

Chapter 2. Safety guidelines



DANGER: Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)



DANGER: Hazardous voltage, current, or energy levels are present inside any component that has this label attached. Do not open any cover or barrier that contains this label. (L001)



CAUTION: High levels of acoustical noise are (or could be under certain circumstances) present. Use approved hearing protection and/ or provide mitigation or limit exposure. (L018)

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.

- For new enclosures, prepare the site for installation per [Installation checklist](#), and follow safe-handling instructions provided in [“Unpacking the enclosure”](#) on page 29.
- 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.
- To minimize weight for an unpacked or rack-mounted enclosure, you can optionally remove the rear panel CRU modules and the top-loaded CRU modules (accessed from beneath the enclosure’s top lids) before moving the enclosure once it is unpacked. However, CRU removal is not required. If you remove an item, reinstall it into the same module slot from which it was removed—after moving the enclosure. The Model 106 ships with CRUs installed; however, the disks must be installed as part of the system setup, after the enclosure is securely mounted in the rack.
 - Before installing the enclosure into a rack, see [WARNING](#).

- After installing the enclosure, and before installing the disks, see [“ESD precautions” on page 67](#).
- To install disk drive modules into a rack-mounted enclosure, face the front panel, and pull the enclosure outward on its rails. Remove the top lid(s) to provide access to the disk module slots. See [Figure 9 on page 12](#) for removable lids, and see [Figure 10 on page 13](#) and [Figure 11 on page 13](#) for disk slots and CRU module slot indexing.
- Belt straps and optional lift handles are designed to support the weight of the enclosure as shipped. They are not designed to support a fully populated enclosure. See also [“Unpacking the enclosure” on page 29](#).



CAUTION: Use a suitable mechanical lift for hoisting the enclosure for installation into the rack:

- Fully configured Model 106 enclosures can weigh up to 145.6 kg (321 lb). Do not install disks until after the enclosure is secured into the rack.
- When positioning the enclosure into its rack space, use the optional enclosure lift handles (two handles per side). See also [“Requirements for rackmount installation” on page 31](#) for additional information.
- Observe the lifting hazard label affixed to the storage enclosure.
- Avoid use of a vacuum lift because it can potentially damage the Model 106 enclosure.

Relocating ESS racked system 5147-106 (4U106)

Important: Relocation of this enclosure is not a Customer action. You must contact IBM service (www.ibm.com/planetwide) to relocate this enclosure. Loss of data or system damage may result if IBM service does not perform the relocation action.

Shipment or storage conditions that exceed the specified limits can cause permanent damage to your server. These guidelines should be followed when relocating or temporarily storing your server.

Care should be taken to ensure that a server is not stored with chemicals that can cause corrosion damage.

When a server is removed in preparation for shipment or storage, use the packaging bill of material. This might include a protective package, including blocks, braces, and preparation instructions, designed uniquely for each server. This is available from any IBM® branch office. IBM large processors are designed for operation in a controlled temperature and relative humidity range, and require the environment be kept within this range even when they are in a storage area or in transit. See the individual server specifications for operating environment limits. Shipment of large processors should be in an environmentally controlled van with appropriate strapping and padding to avoid any transit damage.

<i>Table 1. Table 1. Typical shipping environment</i>	
Properties	Shipping environment
Temperature	-40°C - 60°C (-40°F - 140°F)
Relative humidity	5% to 100% (no condensation)
Maximum wet bulb	1°C - 27°C (33.8°F - 80.6°F)

If shipping a large processor in a nonenvironmentally controlled van, contact your seller for packing and unpacking instructions.

<i>Table 2. Table 2. Typical storage environment</i>	
Properties	Storage environment
Temperature	1°C - 60°C (33.8°F - 140°F)
Relative humidity	5% - 80%

Table 2. Typical storage environment (continued)	
Properties	Storage environment
Maximum wet bulb	1°C - 29°C (33.8°F - 84.2°F)

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 CRU slots hold modules before the enclosure system is used.

- Observe the module bay caution label affixed to the module being replaced.
- Replace a defective CRU with a fully operational CRU as soon as possible. Do not remove a defective CRU module unless you have a replacement model of the correct type ready for insertion.
- Before removal/replacement of a PSU, disconnect supply power from the PSU to be replaced. Refer to [Replacing a PSU module](#).
- Observe the hazardous voltage warning label affixed to power supply modules.

Electrical safety

- The 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.
- The system requires voltages within minimum fluctuation. The customer-supplied facilities' voltage must maintain a voltage with not more than ± 5 percent fluctuation. The customer facilities must also provide suitable surge protection.

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.
- Model 106 enclosures are intended to operate with two PSUs and four system fans accessed from the rear panel. Two controller channel fan modules accessed from the top of the enclosure provide additional cooling.
- Observe the power-supply disconnection caution label affixed to PSU modules.



CAUTION: Do not remove covers from the PSU or any other CRU module. There is a danger of electric shock inside. Return the plug-in module to your supplier for repair.

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

- Model 106 storage enclosures are suitable for connection to intra-building or non-exposed wiring or cabling only.
- Model 106 storage enclosures are suitable for installation in locations where NEC (National Electrical Code) applies. These enclosures are not suitable for Outside Plant (OSP) installations.

Rack system safety precautions

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

- Before installing a Model 106 enclosure into the rack, see the CAUTION on [page 10](#) and the WARNING on [page 34](#).
- 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. Heavier enclosures should be located beneath lighter enclosures for optimal stability.
- 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 35°C (95°F) for JBODS/EBODs. Above an altitude of 900 meters, derating applies as per ASHRAE Class A2.
- 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 power supply line cord will have an earth leakage current of 1mA. The design of the electrical distribution system must take into consideration the total earth leakage current from all the PSUs in all the enclosures. The rack will require labeling with “High Leakage Current. Earth connection essential before connecting supply.”
- The rack—when configured with the enclosures—must meet the safety requirements of all applicable safety standards.

Product power rating

The product has the following ratings:

- Voltage: 200 to 240 VAC
- Current: 11.5A

Chapter 3. System Overview

Enclosure configuration

The ESS enclosure 5147-106 supports a 4U (rack space) chassis – see [Figure 1 on page 7](#) and [Figure 2 on page 8](#). It holds up to 106 low profile (1-inch high) 3.5" form factor disk drive modules in a vertical orientation (hence, the term: Model 106). Alternatively, disk slots can hold a low profile (5/8-inch high) 2.5" form factor disk with an adapter within the large form factor carrier.

Each individual disk drive is hot pluggable and replaceable on site. Drive modules must be installed during system setup.

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

The enclosure configurations—including chassis, FRUs and CRUs—are described on the following pages. Refer to [Enclosure variants](#) for details about various enclosure options.

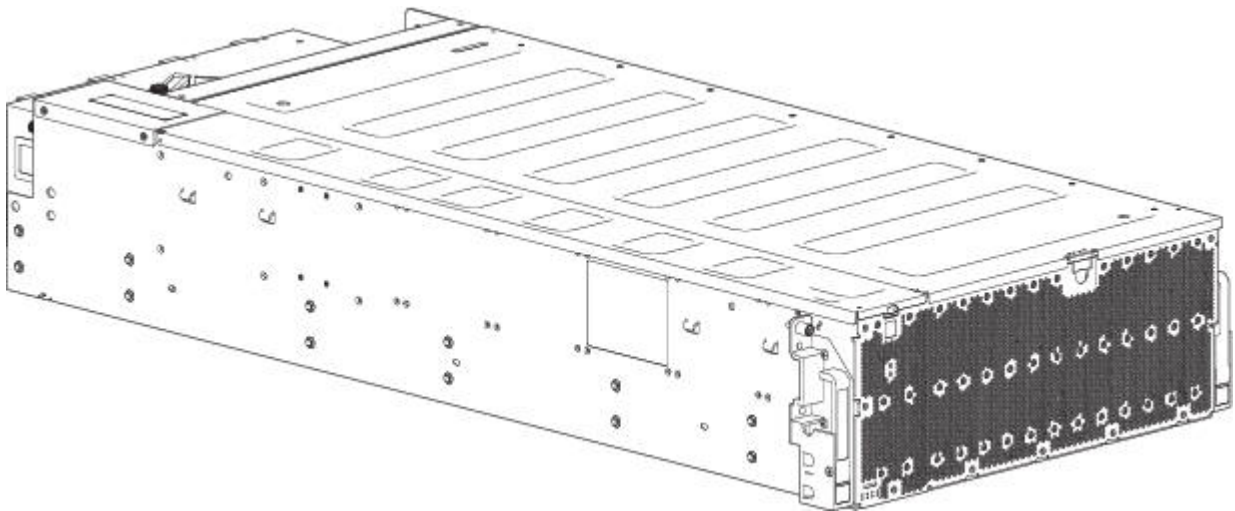


Figure 1. Model 106 enclosure system – dimetric front orientation

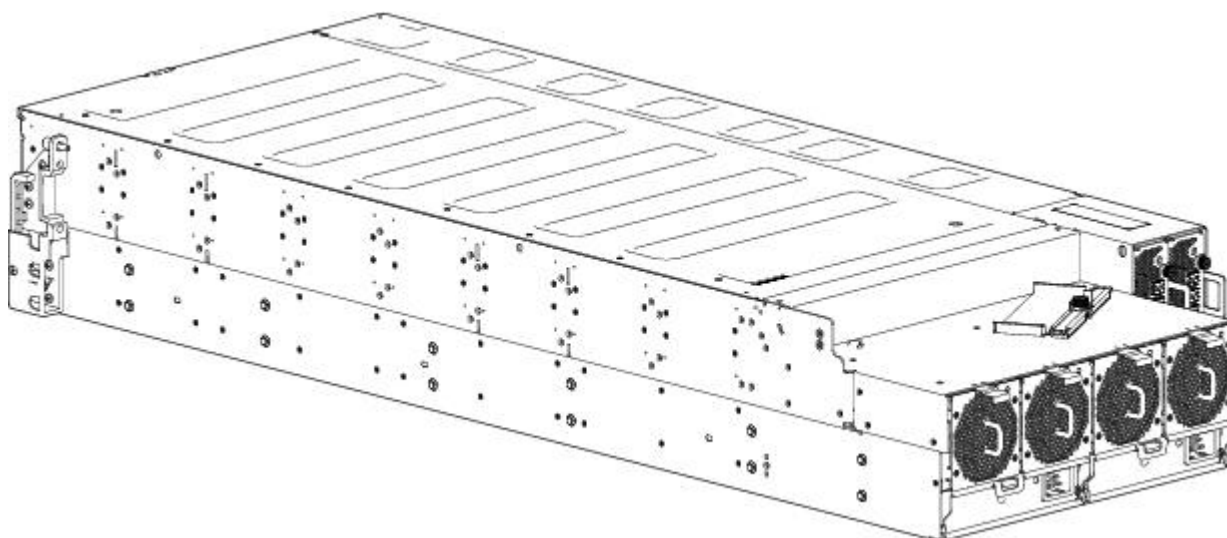


Figure 2. Model 106 enclosure system –dimetric rear orientation

The Model 106 expansion enclosure above is equipped with dual-IOMs/EBOD expander modules.

Enclosure variants

The Model 106 chassis is configured as an expansion enclosure, as shown in [Table 3 on page 8](#).

The enclosure supports 106 qualified disk drive modules installed via the top panel.

- Hot-swappable expanders support 96 disks attached to four 24 HDD baseplanes (12 disks x 8 rows).
If an expander is removed for replacement, the 24 HDD baseplane will continue to operate while the high-availability card is replaced.
- The 10 HDD baseplane PCBA supports 10 disks (2 disks x 5 rows).

Product	Description of configuration	PSUs ¹	Systemfans ²	IOMs/EBOD expander modules ³	IOMfans/EBOD expander module fans ²	Disks ⁴	HSExpanders ⁵
Model 106	12Gb/s direct dock LFF	2	4	2	2	106	8
	Enclosure location of CRU variant:	Rear	Rear	Rear	Top	Top	Top

1. Redundant PSUs must be compatible modules of the same type (both AC).
2. For adequate cooling, four rear-panel system fans are required, and each IOM/EBOD expander module requires a channel fan module, accessed via the top panel.
3. Supported IOMs/EBOD expander modules are used in 5147-106 enclosures for adding storage.
4. LFF disks are supported using the 3.5" tool-less carrier. SFF disks are supported using the 3.5" tool-less carrier with an adapter.
5. Hot-swappable expanders support 12 disk drive slots per disk bay (8 bays total).

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 equipped with several PCBs, including a midplane, sideplane, and baseplane PCBs, and a cluster of integral enclosure status LED indicators located at the lower left area of the enclosure front panel, near the left ear.
- Two 2000W, 200–240V AC power supply unit modules.
- Fan control (system): four system fan modules for enclosure cooling.
- Two interface slots, each of which holds an IOM/EBOD expander module configured with dual CAT5e/6 Ethernet ports (only for diagnostics and service, not available to end user), four ports with four mini-SAS HD (SFF-8644) connectors, and a serial port.
- Fan control (controller): two controller channel fan modules for IOM/EBOD expander module cooling.
- Up to 106 LFF or SFF disk drive modules with tool-less wrap-around carrier.
- One removable HS expander per row.
- A rail kit for rack mounting.
- A Cable Management Arm (CMA) for managing cables, and enabling in-rack servicing of the enclosure.

Note: About enclosure modules

- The disk modules are not installed when the enclosure ships. Do not insert disks into the enclosure until after it has been secured in the rack. See also [“Populating disk drive slots” on page 13](#).
- The module quantities quoted above are the maximum that a Model 106 enclosure can support. The following figures show component locations relative to the enclosure front, rear, and top panels.
- Unless otherwise noted within a passage pertaining to a particular FRU or CRU, the replacement procedure should be completed within 3 minutes of the removal of a defective module.
- Before rack-mounting enclosures, see [CAUTION](#) and [WARNING](#).

Enclosure front panel

This enclosure front panel view intentionally omits the lift handles that attach to the enclosure sides.

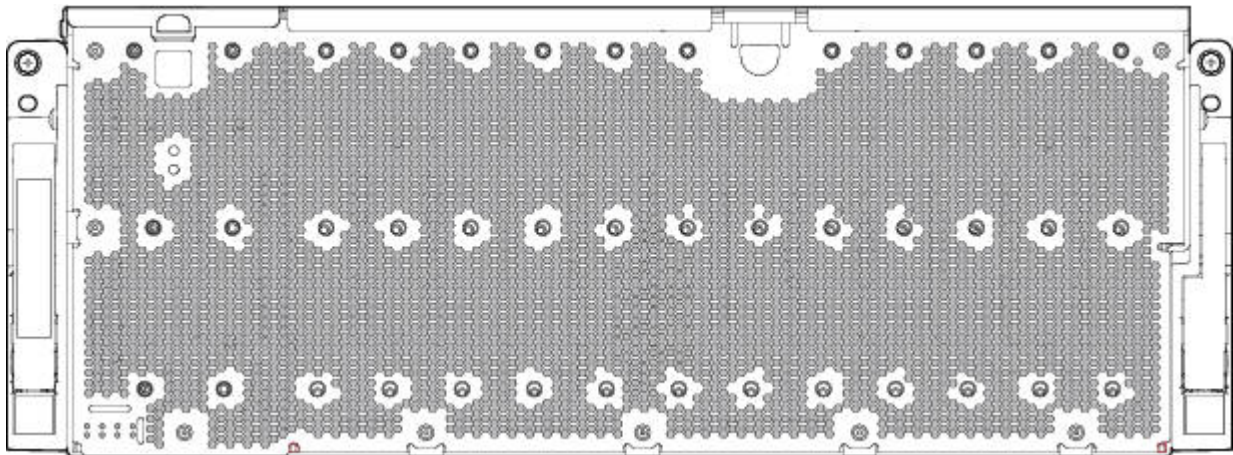


Figure 3. Model 106 enclosure system – front panel components

The enclosure front panel provides access to the seven (7) main enclosure system LEDs, located in the lower left corner. See also [Figure 12 on page 15](#). The front panel also provides access to the left and right enclosure pull handles used to slide the enclosure forward for in-rack servicing tasks.

Enclosure rear panel

The enclosure rear panel intentionally omits the lift handles that attach to the enclosure sides. For clarity, it also omits the rail kit components that are used when installing the enclosure into the rack.

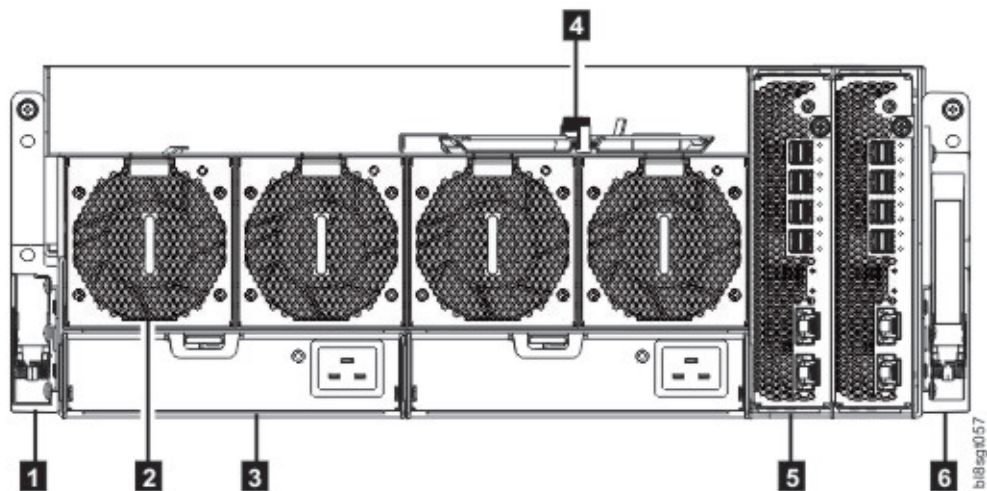


Figure 4. Model 106 enclosure system – rear panel components

No.	Description
1	Right ear assembly (as viewed from back)
2	System fan module (quantity-4)
3	Power supply unit (quantity-2)
4	Cable shelf and CMA bracket for coiled cables
5	IOM/EBOD expander module (quantity-2)
6	Left ear assembly (as viewed from back)

See [Figure 5 on page 10](#) for a conceptual diagram showing module slot-indexing as viewed from the rear panel.

Rear panel components

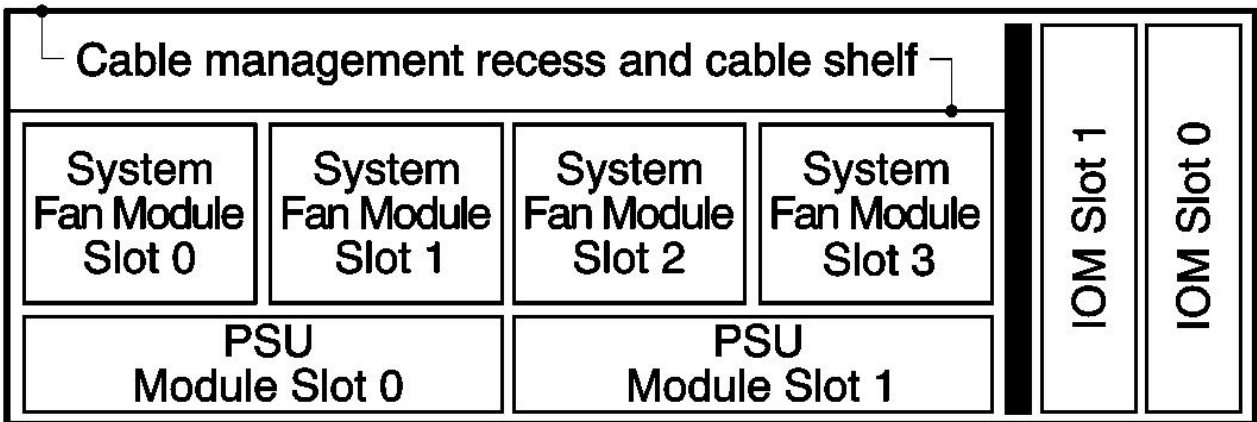


Figure 5. Model 106 enclosure – rear panel module slot index diagram

IOM/EBOD expander module

Figure 6 on page 11 shows the IOM/EBOD expander module used in either IOM/EBOD expander module slot located on the enclosure rear panel. The module is shown resting on its base. To install the module into one of the IOM/EBOD expander module slots located on the enclosure rear panel, you would first revolve the module by 90° along its longitudinal axis, before inserting it into the slot, as shown in Figure 4 on page 10.

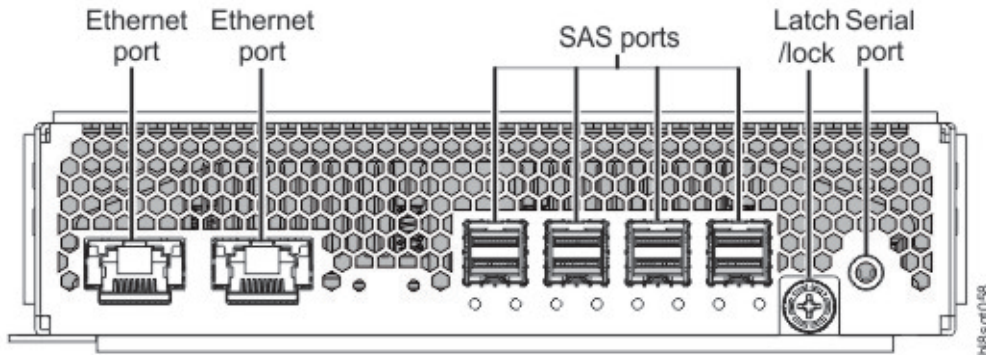


Figure 6. IOM/EBOD expander module detail

Power supply unit

Figure 7 on page 11 shows the power supply unit used in a Model 106 enclosure. The example shows a PSU oriented for use in either PSU slot located on the enclosure rear panel.

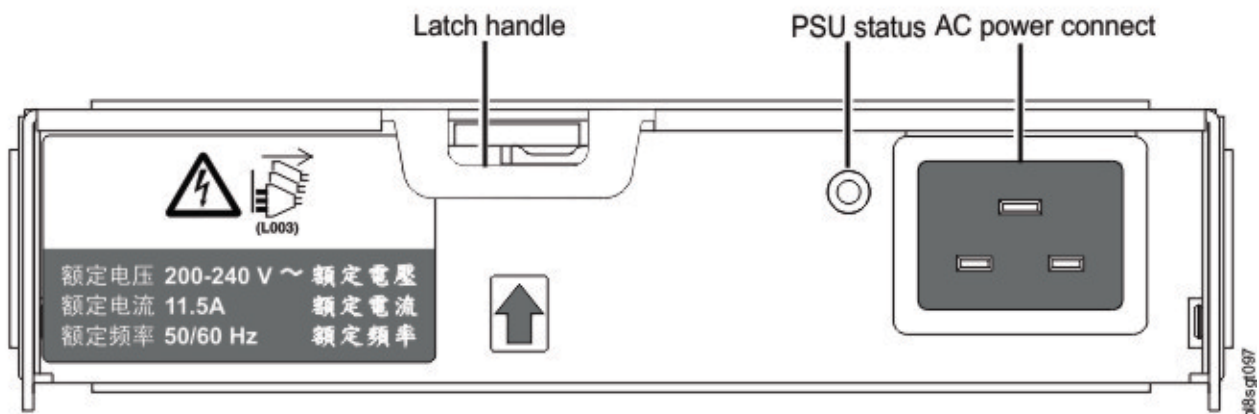


Figure 7. Power supply unit (PSU) module detail

System fan module

Figure 8 on page 12 shows a system fan used in a Model 106 enclosure. The example shows a system fan module oriented for use in any of the system fan slots located on the enclosure rear panel.

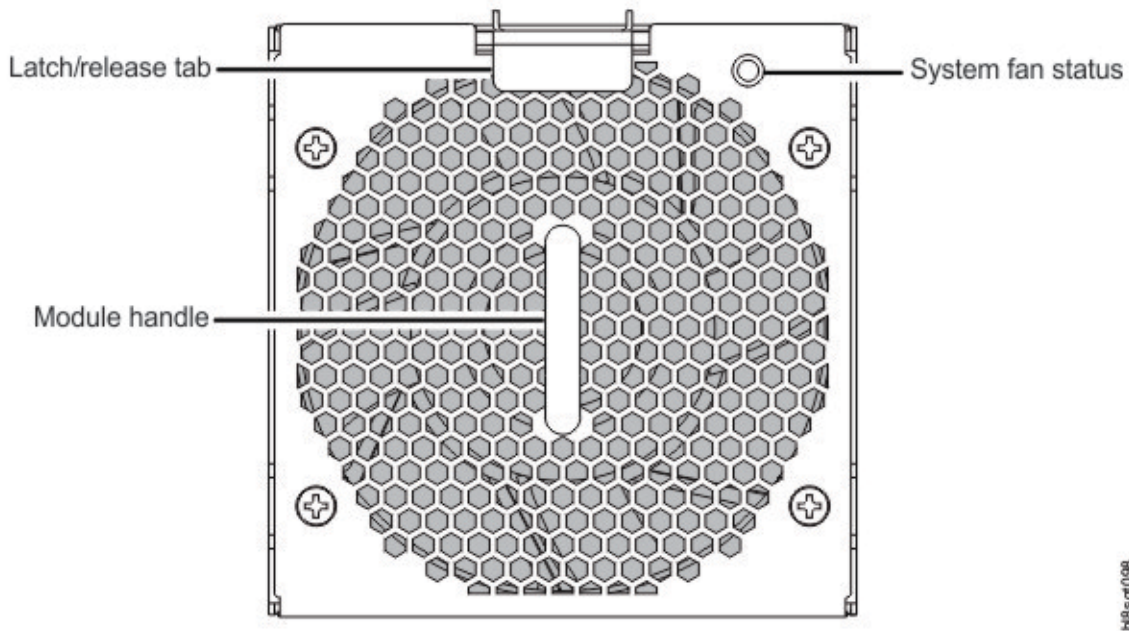


Figure 8. System fan module detail

Enclosure top panel

The enclosure top panel has three different covers, two of which can be removed to provide access to internal components. Within the illustration, the covers are labeled as A/B/C (see callouts below and [Figure 9 on page 12](#)).

- A: removable lid provides access to HS expanders and disk modules.
- B: removable lid provides access to disk modules, IOM/EBOD expander fan modules, and limited access to IOMs/EBOD expander modules.
- C: fixed cover does not remove. It provides protection for the IOMs/EBOD expander modules.

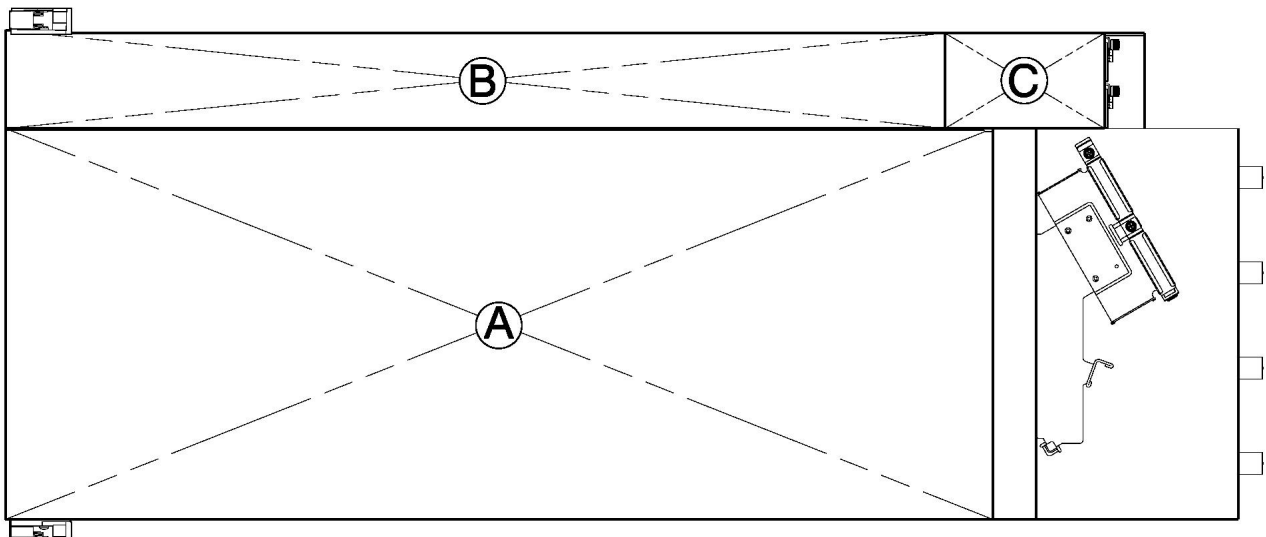


Figure 9. Model 106 expansion enclosure – top panel with covers installed

Figure 9 on page 12 shows a top view of the enclosure with the covers removed. The illustration is oriented such that the front of the enclosure is on left, and the rear of the enclosure is on the right. The enclosure appears as it would if you were observing it on a workbench. The railkit and most of the cable management arm geometry is omitted for clarity.

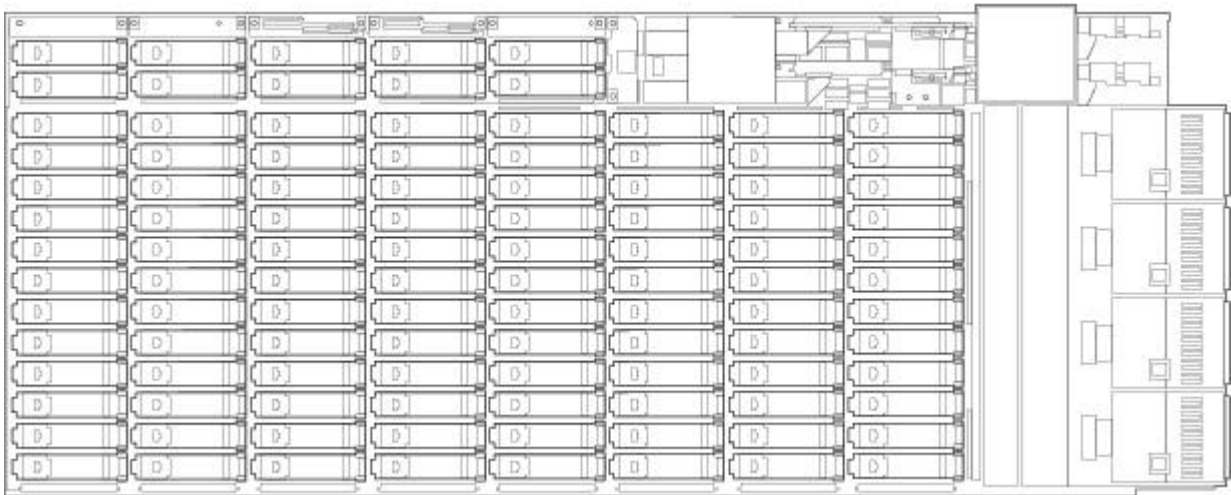


Figure 10. Model 106 expansion enclosure – top panel with covers not shown

Figure 11 on page 13 provides a conceptual diagram of module slot-index numbering as viewed from the top of a Model 106 enclosure with all covers removed. To view, the arrangement of PSU module slots—beneath the system fan slots—see Figure 5 on page 10.

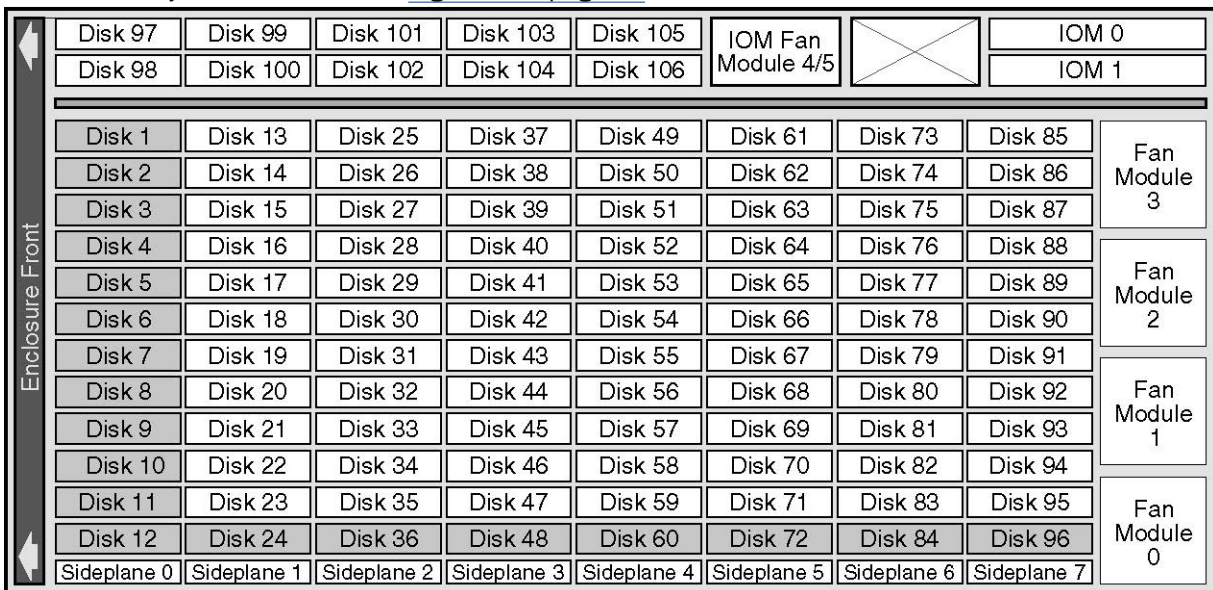


Figure 11. Model 106 enclosure – top panel module – slot index diagram

The Model 106 is designed for use with a full load of disks; however, it may also be partially populated. In Figure 11 on page 13, Gray-colored disk slots indicate minimum disk module placement for power and cooling reasons. These slots should be populated in all cases. The acronym DDIC (Disk Drive In Carrier) is used as a synonym for disk drive module.

Populating disk drive slots

The Model 106 does not ship with pre-installed disk drive modules. When installing disk drive modules, be mindful of the disk slot numbering index shown in Figure 11 on page 13. The following rules apply when populating the Model 106 enclosure with disks possessing 12 watts maximum drive power per slot:

- Populate the minimum disk slot arrangement indicated by gray-colored disk slots in Figure 11 on page 13.
- Populate the remaining disk slots from enclosure front to back—filling an entire lateral bay (e.g., disks 12–22)—before populating the next bay (e.g., disks 24–34), and so on.
- When rack-mounting a Model 106 enclosure, install the disks after the enclosure is installed in the rack.

Populate disk slots 96–105 at any time during the sequence, as they are cooled separately within the enclosure.

Enclosure chassis

The Model 106 chassis consists of a sheet metal enclosure with integrated PCBs and a module runner system. The enclosure is comprised of a drive channel and a controller channel, and features removable top cover lids. Enclosure top and rear panels provide access to plug-in modules known as customer-replaceable units (CRUs). Each enclosure is comprised of sheet steel that is bonded together using rivets, welding, and other forced contact methods. The metal surfaces are free from non-conductive coatings and paint.

- The chassis has a 1.2m rack mounting that enables it to be installed onto standard 1.2m racks, and uses four EIA units of rack space (7") for a Model 106 enclosure. Optional lift handles on the chassis side walls facilitate hoisting and installation. See also [Figure 24 on page 31](#).
- The Cable Management Arm routes cables from the controller channel and external connections—and secures them for in-rack servicing of the installed enclosure. The rails slide outward from the installed position.
- An internal high-speed harness ensures routing of cables controlled to specification; protects the interfaces between cables and connectors; and provides a connector system designed for positive (latched) mating.
- The drive channel bus-bar distributes power from power midplane to 24HDD baseplanes.
- Four 24 HDD baseplane PCBs support 96 disk drive connections in the drive channel.
- 10 HDD baseplane PCB supports 10 disk drive connections in the controller channel.
- The enclosure top panel provides access to 106 low profile (1" high) 3.5" LFF or 2.5" SFF (with adapter) disks, held vertically. Each drive slot holds a plug-in drive carrier module. The top panel also provides access to the HS expander and controller fan CRUs.

Note: Top panel enclosure lids A and B slide out, and can be temporarily removed for a servicing event. See [Figure 9 on page 12](#).

- Eight removable HS expanders connect to 24 HDD baseplanes via expander link cards, providing high availability.
- Within the controller channel compartment, channel fans provide additional cooling for IOMs/EBOD expander modules.
- Within the rear panel, the chassis assembly can hold a maximum of two PSUs, four system fans, two CFF-compliant IOMs/EBOD expander modules, and the flattened cable coils held by the bracket assembly on the CMA shelf (atop system fan sheet metal).

Important: If the Model 106 enclosure is configured with a single expansion module, it must be installed in IOM slot No.0 (as shown in [Figure 11 on page 13](#)). An IOM blank must be installed in the adjacent slot (No.1). This configuration is required to ensure sufficient air flow through the enclosure during operation.

Overview of front panel LEDs

The enclosure front panel displays several LEDs. The front panel displays the functions shown in the illustration below and listed in the table.

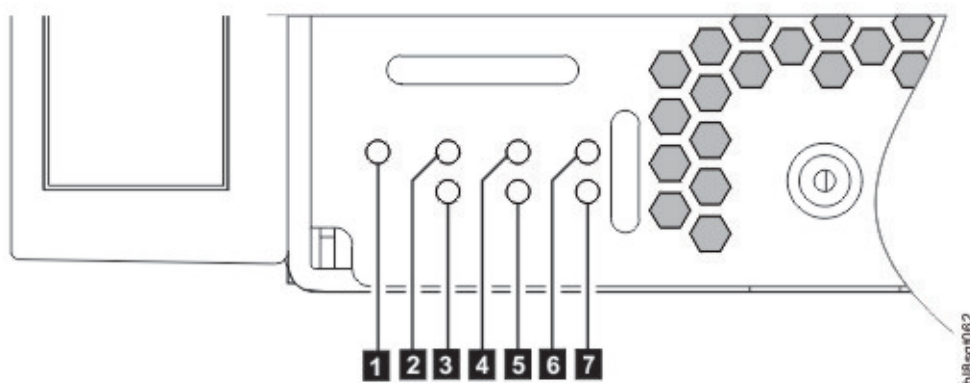


Figure 12. Front panel – lower left corner (partial view)

LED	Front panel functions (lower left corner of panel)
1	System Power On/Standby LED (Green)
2	ID LED (Blue)
3	Drive Activity LED (blinking Green)
4	Fault LED – Top lid (Amber)
5	Firmware Fault LED (Amber)
6	Module Fault LED – rear (Amber)
7	Fault LED– Left rear lid (Amber)

System Power On/Standby LED (green)

The LED illuminates green when system power is available. If the LED is off, either the system is powered off, or there is a power failure in the system. Troubleshooting to identify the root cause is necessary.

Identify LED (blue)

When activated, the Identity LED is blue, and is used to identify the storage system amongst many installed in the rack. This LED is normally off, and illuminates only during the identification process.

Drive Activity LED (Green)

The LED illuminates blinking-green to indicate disk drive activity. If the enclosure is in operation and the LED is not blinking, there is a possibility of a disk drive fault. This LED can be used together with other Fault LEDs to determine whether a drive fault condition exists.

Pull the chassis forward from its installed position within the rack. Remove the top lid and look for an amber LED on any of the disk drive modules or HS expander modules on the side plane. Replace the faulty module per the applicable CRU replacement procedure.

Fault LED–Top lid(amber)

The LED illuminates amber when experiencing a system hardware fault with a component accessible via the enclosure top panel. Amber display indicates that the top lid should be removed to locate the faulty component within the drive channel. This LED is normally off, and illuminates only when a fault occurs with a component beneath the top lid.

Pull the chassis forward from its installed position within the rack. Remove the top lid and look for an amber LED on any of the disk drive modules or HS expander modules on the side plane. Replace the faulty module per the applicable CRU replacement procedure.

Firmware Fault LED

The LED illuminates amber when experiencing a firmware application fault such as a firmware upgrade failure or memory corruption. This LED is normally off, and illuminates only when firmware-related fault occurs. See troubleshooting procedures if this fault displays.

Fault LED–Rear panel (amber)

The LED illuminates amber when experiencing a system hardware fault with a component accessible via the enclosure rear panel (IOMs/EBOD expander modules, PSUs, system fans). This LED is normally off, and illuminates only when a fault occurs with a component installed in the enclosure rear panel.

Observe the enclosure rear panel, and look for a fault indicator on the modules installed.

Fault LED–Top lid left (amber)

The LED illuminates amber when experiencing a system hardware fault with a component accessible via the enclosure top panel. Amber display indicates that the top lid on the left should be removed to locate the faulty component within the controller channel. This LED is normally off, and illuminates only when a fault occurs with a component beneath the top lid on the left.

Pull the chassis forward from its installed position within the rack. Remove the top left lid and look for an amber LED on any of the disk drive modules or controller channel fans. Replace the faulty module per the applicable CRU replacement procedure.

Overview of rear panel LEDs

Power supply unit

AC-DC power is provided by up to two auto-ranging power supply modules (PSUs). Cooling is provided by four separate cooling fans and two controller module fans. The IOM/EBOD expander module provides power and LED control. Also see [System airflow](#) for optimal cooling within the enclosures.

2000W PSU

The 2000W PSU voltage operating range is nominally 200V–240V AC, and operates at 50–60 Hz input frequency. The dimetric rear orientation in [Figure 13 on page 16](#) shows the PSU aligned for insertion into either PSU slot located on the enclosure rear panel.

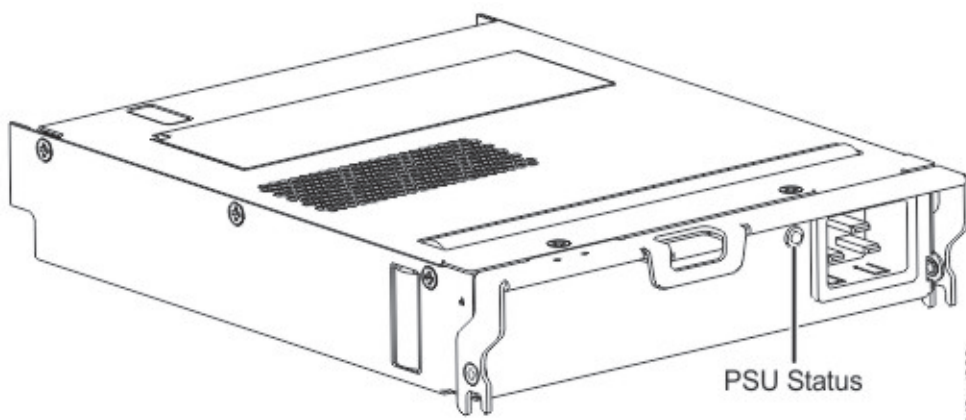


Figure 13. PSU oriented for use in rear panel slot

Module LED	LED behavior states		
PSU Status LED (bitonal):	PSU OK (Green)	PSU fault/failure (Amber/blinking amber)	Power off (Off)

Multiple power supply unit modules

The Model 106 storage system includes two PSUs which provide redundant power control for the system so that if one module fails, the other maintains the power supply, and enclosure operation is not affected while you replace the faulty module.

PSUs are hot-pluggable, and replacement should only take a few seconds. Replacement must be completed as soon as possible after the removal of the defective PSU to avoid a thermal exception. The replacement procedure should be completed within an absolute maximum of 3 minutes.

Note: If the time taken for PSU removal and replacement exceeds 3 minutes, the system might shut down.

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 PSUs prior to powering on the enclosure.

Important: To avoid potential equipment damage during transport and subsequent loss of data, see [Procedure: Transporting a 5U expansion enclosure](#). The procedure describes what to do for the following situations:

- When you are powering off an expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains an expansion enclosure.

The procedure describes how to remove each drive from the enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

System fan module



CAUTION: Hazardous moving parts nearby. (L008)



CAUTION: High levels of acoustical noise are (or could be under certain circumstances) present. Use approved hearing protection and/ or provide mitigation or limit exposure. (L018)

Enclosure cooling is provided by four system fan modules used in combination with two controller channel fan modules. The IOM provides fan and LED control. This section describes system fan modules. See also [“Controller channel fan module”](#) on page 23.

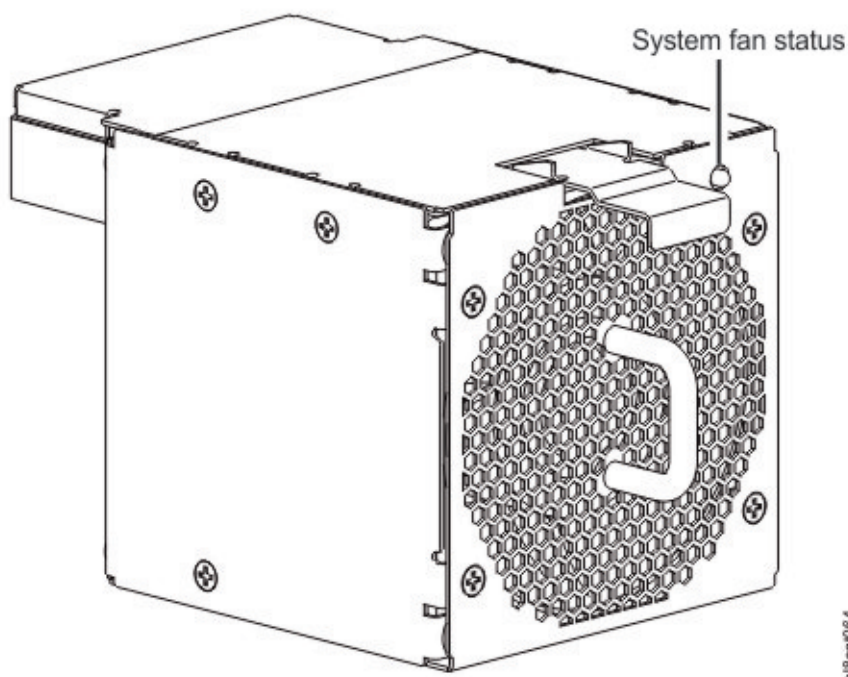


Figure 14. System fan oriented for use in rear panel slot

Module LED	LED behavior states		
System Fan Status LED:	System Fan OK (Off)	Fan fault/failure (Amber/ blinking amber)	Power off (Off)

Multiple system fan modules

The Model 106 storage system includes four system fans CRUs which provide redundant cooling for the system, so that if one module fails, the others maintain airflow circulation, and enclosure operation is not affected while you replace the faulty module. Within this CRU module, if one of the two internal rotors fails, then a fault occurs, indicating module failure. A dual rotor failure is reported as a dual-fault.

System fans are hot-pluggable, and replacement should only take a few seconds. Replacement must be completed as soon as possible after the removal of the defective system fan to avoid a thermal exception. The replacement procedure should be completed within an absolute maximum of 2 minutes for this CRU module.

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 system fans 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.

Expansion module

This section describes the IOM/EBOD expander module used in Model 106 12Gb/s storage enclosures.

The dimetric rear orientation in [Figure 15 on page 19](#) shows a pictorial view of an expansion module. You would revolve the module by 90° along its longitudinal axis, before inserting it into the IOM/EBOD expander module slot, as shown in [Figure 4 on page 10](#) and in [Figure 75 on page 80](#).

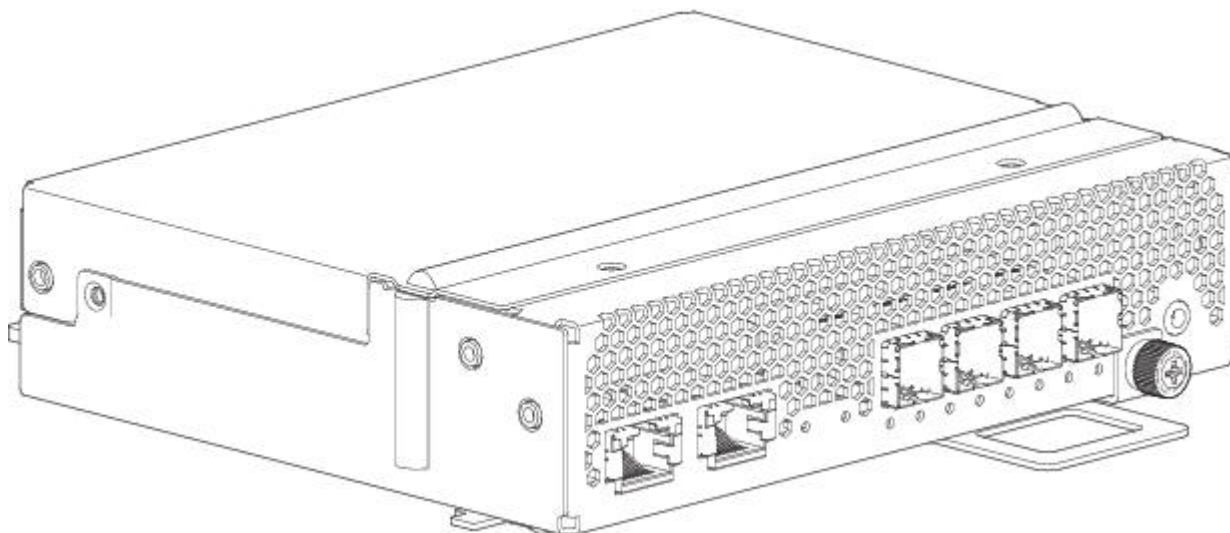


Figure 15. Expansion module – dimetric rear orientation

Each controller module maintains VPD (Vital Product Data) in EEPROM devices, and are interconnected by I²C buses on the midplane. In this way, the modules can discover the type and capabilities of the partner module(s), and vice versa, within the enclosure. An enclosure system fault occurs when incompatible configurations are detected. The replacement procedure should be completed within an absolute maximum of 3 minutes.

Note: For a description of the expansion enclosure canister LEDs, see [12Gb/s expansionmodule LEDs](#).

12Gb/s expansion module LEDs

The diagram with table that immediately follows provides a description of the expansion module that installs into the rear panel of an 5147-106 enclosure. The module is shown resting on its base. To install the module into one of the IOM/EBOD expander module slots located on the enclosure rear panel, you would first revolve the module by 90° along its longitudinal axis, before inserting it into a slot as shown in [Figure 4 on page 10](#). Showing expansion 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.

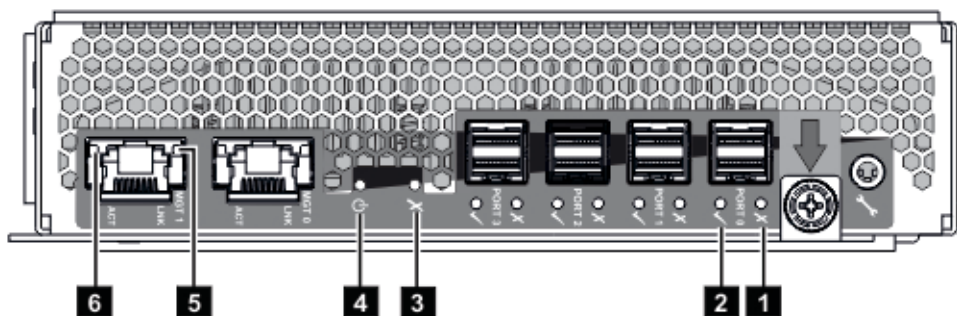


Figure 16. LEDs: Expansion module – rear panel

LED	Description	Definition
1	12Gb SAS Fault ¹	Off — No fault detected. Amber— A fault has been detected on the port.
2	12Gb SAS Link Status and Activity ¹	Off - No link detected. Green — The port is connected and the link is up. Blinking green - The link has I/O activity.
3	Fault	Off— The expansion module is operating normally. Amber— A fault has been detected or a service action is required.
4	Power OK	Green — The expansion module is operating normally. Blinking green — System is booting. Off— The expansion module is powered off.
5	Ethernet Port Link Speed ²	Off— Link is up at 10/100Base-T negotiated speeds. Amber— Link is up and negotiated at 1000base-T.
6	Ethernet Port Link/Active Status ²	Off— The Ethernet link is not established, or the link is down. Green — The Ethernet link is up (applies to all negotiated link speeds).

1. This LED description applies to all 12Gb SAS ports (Port 0 through 3)

2. This LED description applies to both management ports (Port 0 and Port 1)

Overview of top panel LEDs

To view LEDs of components that are accessible from the top panel, you must first remove the lid for the compartment in which the component is installed. The enclosure top panel is shown in [Figure 9 on page 12](#).

Drive carrier module

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

- Each Model 106 drive slot holds a single low profile 1.0-inch high, 3.5-inch form factor disk drive in its carrier.
- Each Model 106 drive slot can hold a single low profile (5/8-inch) 2.5-inch form factor disk with adapter in its carrier.
- The disk drive modules are inserted into vertically aligned slots that are accessible from the top of the enclosure. While facing the front of the enclosure, properly orient the disk drive module for insertion into the slot:
 - Hold the module so that the front is facing you (latch tab on left, and disk PCB facing up).
 - Revolve the module -90° about the horizontal axis (latch is facing up, module is standing on end).
 - Revolve the module 90° about the vertical axis (latch is facing up, disk PCB is facing left).

The carriers have mounting locations for:

- Qualified SAS disk drives (LFF/SFF).

- Qualified SATA disk drives (LFF/SFF).
- Qualified SSDs (SFF).

A plastic casing holds and provides protection for each disk. The disk with protective casing is known as a drive module.

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: Pictorial views of the supported DDIC with LFF disk drive are provided below. Modules are shown oriented for insertion into disk drive slots located on the enclosure top panel.

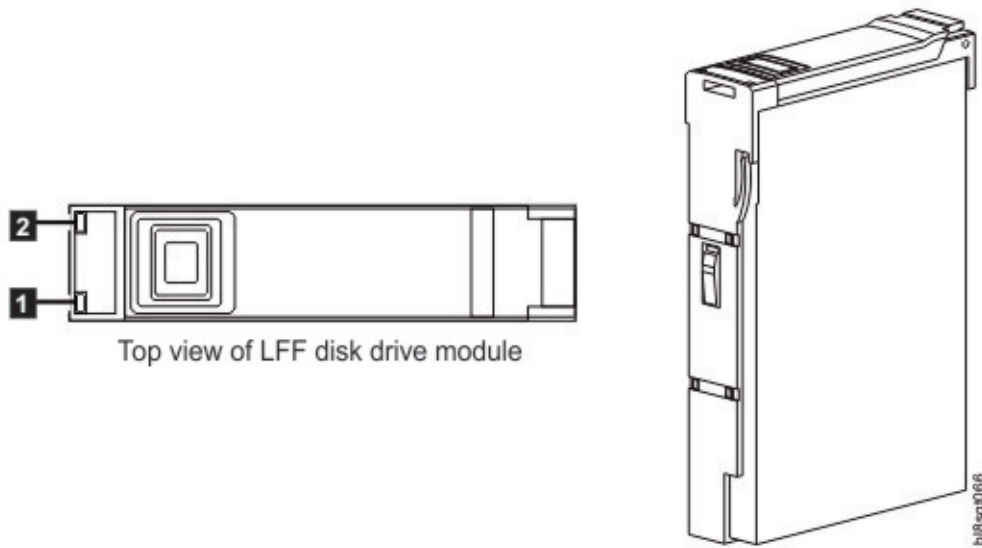


Figure 17. LEDs: Dual path LFF 3.5" disk drive carrier modules – top panel

LED	Description	Definition
1	Identify	Blue— Disk drive module is being identified.
2	Fault	Off— The disk drive module is operating normally. Amber— A fault has been detected or a service action is required.

The replacement procedure should be completed within an absolute maximum of 3 minutes. For additional information about LFF disk LED behavior, see “Disk drive carrier module LEDs” on page 57.

Note: Pictorial views of the supported DDIC with SFF disk drive and adapter are provided below. Modules are shown oriented for insertion into disk drive slots located on the enclosure top panel.

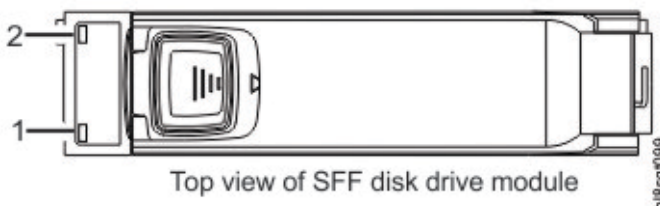


Figure 18. Top view of SFF disk drive module

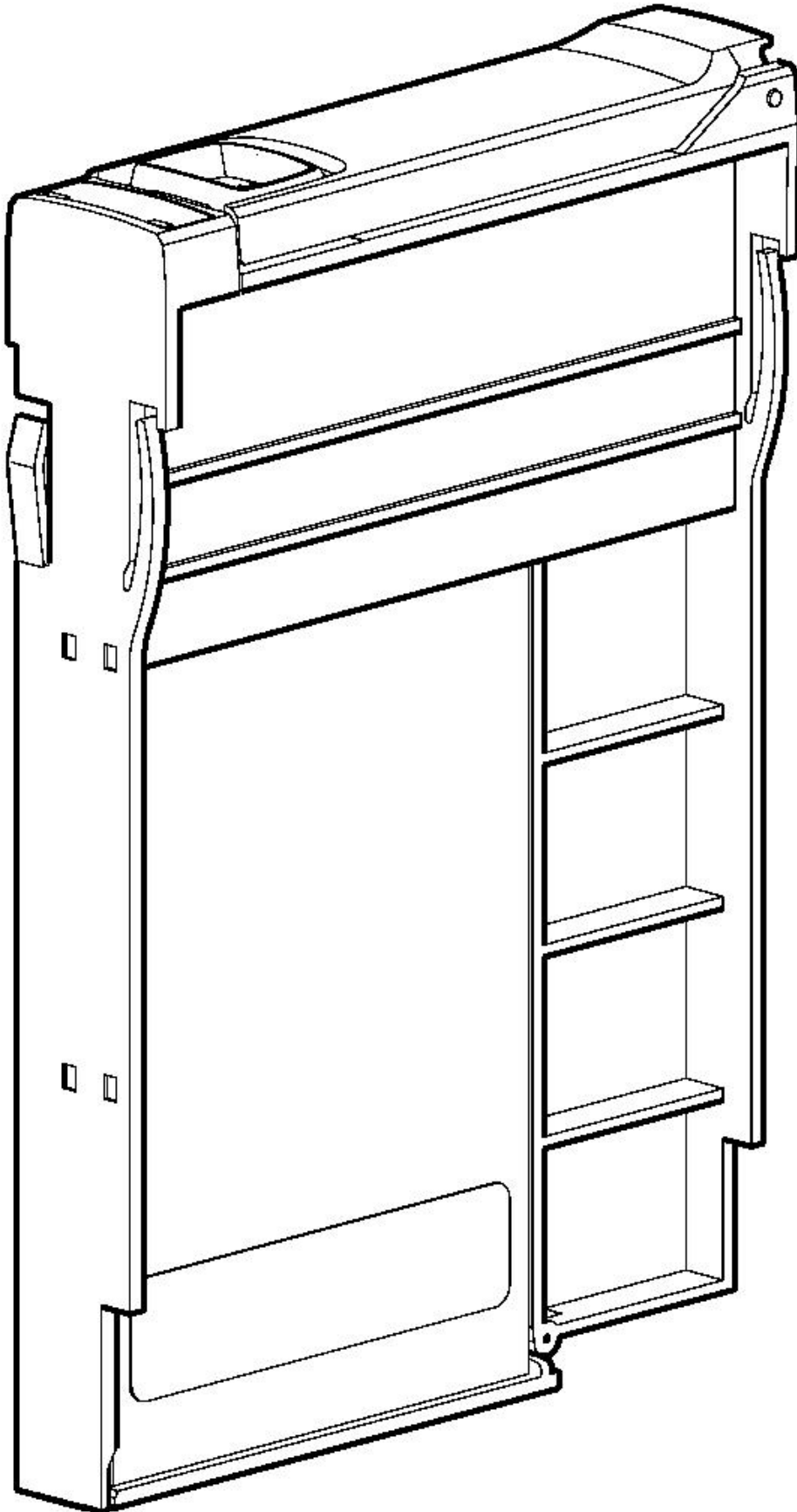


Figure 19. DDIC aligned to module slot

LED	Description	Definition
1	Identify	Blue— Disk drive module is being identified.
2	Fault	Off— The disk drive module is operating normally. Amber— A fault has been detected or a service action is required.

The replacement procedure should be completed within an absolute maximum of 3 minutes. For additional information about SFF disk LED behavior, see [“Disk drive carrier module LEDs”](#) on page 57.

Controller channel fan module

The controller channel fan module supplements the system fans by circulating airflow within the enclosure controller channel, and providing additional cooling for the IOMs/EBOD expander modules. The replacement procedure should be completed within an absolute maximum of 3 minutes.

Channel Fan Status

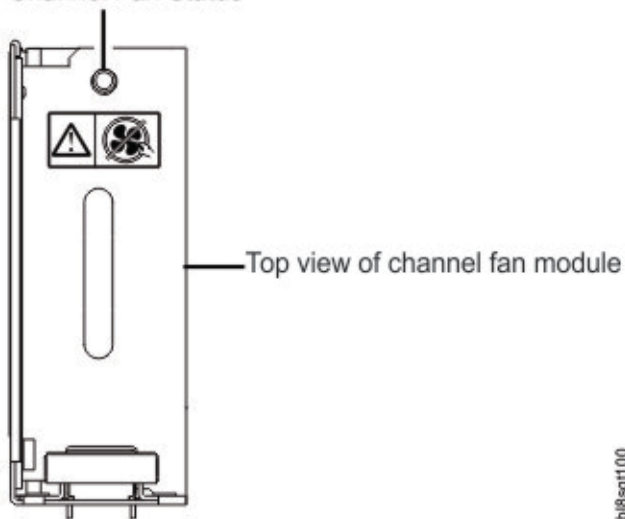


Figure 20. Top view of channel fan module

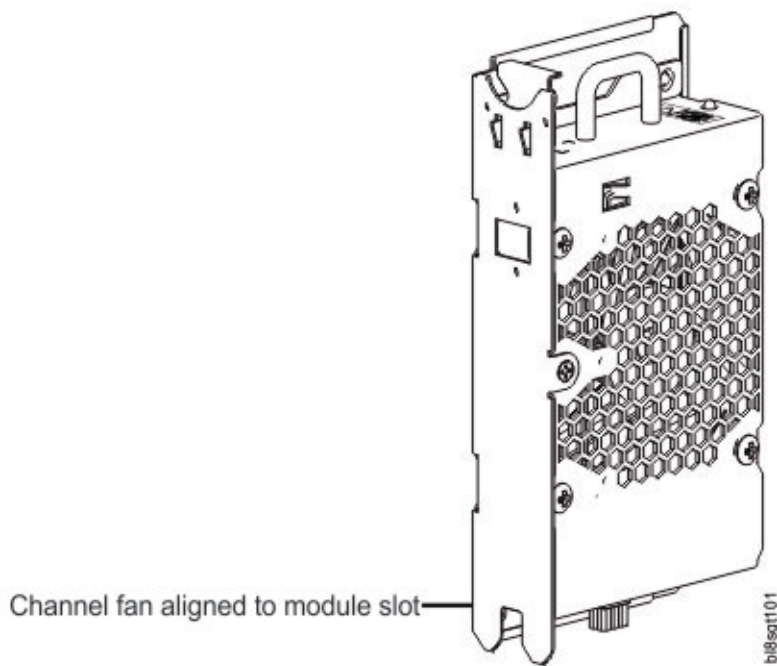


Figure 21. Channel fan aligned to module slot

Module LED	LED behavior states		
Channel Fan Status LED:	Channel Fan OK (Off)	Fan fault ID (Amber/ blinking amber)	Power off (Off)

HS Expander module



CAUTION: A hot surface nearby. (L007)

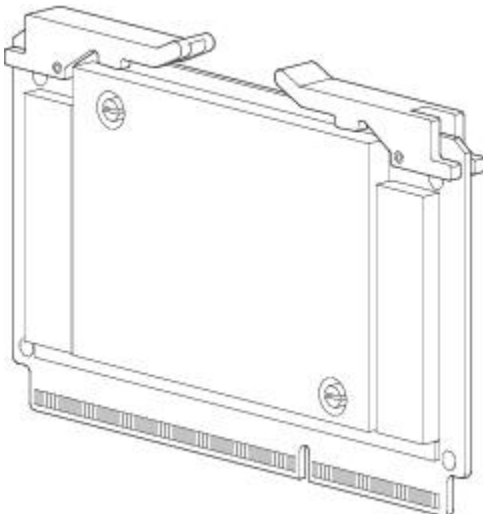


Figure 22. HS Expander module – top panel

Module LED	LED behavior states		
HS Expander Status LED:	Expander OK (Off)	Expander fault ID (Amber/blinking amber)	Power off (Off)

The replacement procedure should be completed within an absolute maximum of 3 minutes.

Enclosure management

IOMs/EBOD expander modules 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 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.

The storage system also provides a command-line Interface (CLI).

Command-line interface

The command line interface can be accessed in the following ways:

- Serial port connection
- Ethernet Telnet connection
- Ethernet WBCLI utility
- SESCLI utility

Chapter 4. Installation

Installation checklist

This chapter shows how to plan for and successfully install your enclosure system into an industry standard 1.2 m rack cabinet.



CAUTION: To install the system, use only the power cords supplied, or power cables that match the specification quoted in [AC power cords/universal jumper cords](#).

The following table outlines the steps required to install the enclosure. To ensure successful installation, perform the tasks in the order presented. For rackmount installation, temporarily place all disk drive modules in a static-protected area, and then install them after the Model 106 is installed in the rack.

Table 4. Installation checklist		
Step	Task	Where to find procedure
1	Unpack the enclosure	See Unpacking the enclosure .
2	Plan and prepare for installing the Model 106 into the rack ¹	See Required tools . See Requirements for rackmount installation .
3	For rackmount installation, defer installing disks until the Model 106 is rack-mounted ²	See “Populating disk drive slots” on page 13 . See “ESD precautions” on page 67 .
4	Install the Model 106 into the rack space	See Installing the 4U enclosure .
5	Cable the Model 106 to the compatible server HBA or RBOD	See #unique_58/unique_58_Connect_42_fig_kjs_q2l_gfb , Figure 58 on page 51 and #unique_58/unique_58_Connect_42_fig_adx_ffl_gfb .
6	Cable the 4U106 to any compatible EBODs	See #unique_58/unique_58_Connect_42_fig_kjs_q2l_gfb , Figure 58 on page 51 and #unique_58/unique_58_Connect_42_fig_adx_ffl_gfb .
7	Connect power cords	See Power cord connection .
8	Test enclosure connectivity	See Testing enclosure connections .

1. The environment in which the enclosure operates must be dust-free to ensure adequate airflow.
2. Locate the disk modules and temporarily place them in a static-protected environment for population of the disk bays once the enclosure is installed and secured into the rack.
3. Removing CRUs before rack-mounting is not necessary, but can be done to lighten the enclosure. See removal and installation steps for individual CRUs. If you temporarily remove the CRUs, label them and place CRUs and disk modules in a static-protected environment.

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

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:

- Model 106 enclosure front panel: see [Figure 3 on page 9](#)
- Model 106 enclosure rear panel: see [Figure 4 on page 10](#)
- Model 106 enclosure top panel: see [Figure 9 on page 12](#), [Figure 10 on page 13](#), and [Figure 11 on page 13](#)

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

Table 5. Storage system configuration		
Module type	Location	Description
Power supply unit	Rear panel	Two PSUs provide full power redundancy, allowing the system to continue to operate while a faulty PSU is replaced.
System fan	Rear panel	Four system fans provide cooling, allowing the system to continue to operate while a faulty system fan is replaced.
I/O module	Rear panel	Up to two IOMs of the same model type are supported. In single-IOM configurations, the IOM must be installed in IOM slot No.0 and an IOM blank must be installed in IOM slot No.1.
Disk drive module	Top panel	See “Populating disk drive slots” on page 13
Channel fan	Top panel	Up to two channel fan modules of the same model type are supported.
HS Expander	Top panel	Eight removable hot swap expanders are supported: one 12-drive bay.

Preparing for installation



or



or



CAUTION:

The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)



CAUTION: The enclosure—together with all its component parts—is too heavy to manually lift and install into the rack cabinet. A minimum of three people and a suitable mechanical lift are required to hoist the enclosure and install it into the rail kit assembly within 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](#).

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 mechanical lift that can safely hoist a 280lb. high-density enclosure for installation into a 1.2 m rack.
- A proper redundant AC power source or a rack power distribution unit (PDU) 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.
- A static-protected environment for temporarily storing CRUs and disk drive modules if the enclosure is intended for rack-mount use. See the [CAUTION](#) before unpacking the enclosure and installing it in the rack.

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

- ESS supported SAS HBA
- Qualified cable options for host connection and EBOD cascades.
- One suitable C20 to C19 power cord per PSU
- Rail kit and Cable Management Arm (for rack installation)
- Disk drive modules for use in populating the disk slots after the enclosure is secured into the rack.

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

Before unpacking the enclosure, familiarize yourself with the exploded view of packaging components that pertain to your enclosure product. See also [Appendix C, “Enclosure packaging,”](#) on page 91.

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 Model 106 enclosures is shown in the following illustrations.



CAUTION: The enclosure does not ship with disk drive modules installed, but all rear panel CRU modules are installed. This partially populated enclosure is quite heavy: 44.9 kg (99 lb).

You can remove the enclosure from its shipping box using the standard belt-style lifting straps. If available, you can remove the enclosure from its box using the optional lift handles instead of the straps.

- a. Default method: remove the enclosure from its box using the straps.

See [Figure 23 on page 30](#) and the [CAUTION](#) above and below the illustration. The illustration shows buckled belt-straps secured longitudinally on the Model 106 enclosure. Only the straps and plastic bag are shown. They are isolated from the remainder of the packaging. As a visual aid for this unpacking task, see [Appendix C, “Enclosure packaging,”](#) on page 91 for more information about the packaging materials.



CAUTION: Verify that each strap is securely wrapped and buckled before performing the lift.

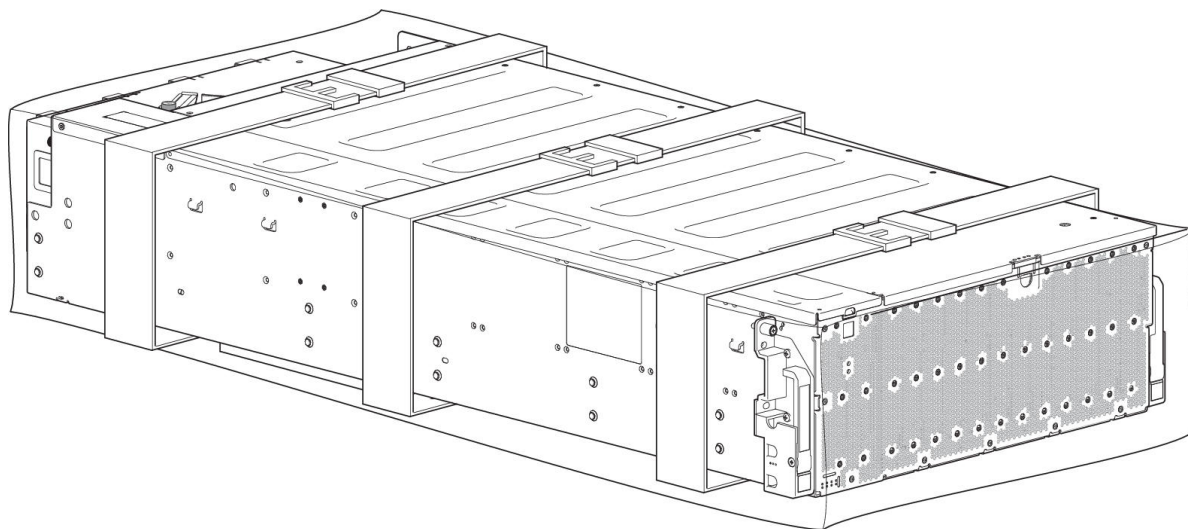


Figure 23. Unpacking the Model 106 enclosure using straps



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

Except for the disk drive modules, enclosures are supplied with all integrated PCBs and all plug-in modules installed. For information about plug-in module replacement, see [Module removal and replacement](#). Disk drive modules are installed separately after the enclosure is mounted in the rack.

Upon completion of this step, go to [Step 3](#).

- b. Alternative method: Remove the enclosure from its box using the optional lift handles.

See Figure 24 on page 31 and the CAUTION above and below the illustration. Only the straps and plastic bag are shown. They are isolated from the remainder of the packaging. As a visual aid for this unpacking task, see Appendix C, “Enclosure packaging,” on page 91 for more information about the packaging materials. The illustration shows two steel lift handles installed on the left side of the chassis just below the enclosure lid. Two additional steel lift handles are symmetrically attached on the right side of the enclosure (hidden in this view).



CAUTION: Verify that each of the four lift handles is securely fastened to the enclosure sheet metal before performing the lift. Optional lift handles are attached to the enclosure side wall using the spring-loaded push-pull attachment pin located on the attachment flange of each lift handle. These handles are designed to support the weight of a partially populated enclosure: chassis and CRUs only (as shipped). The handles are not designed to hold the weight of a fully populated enclosure that also includes the disk drives.

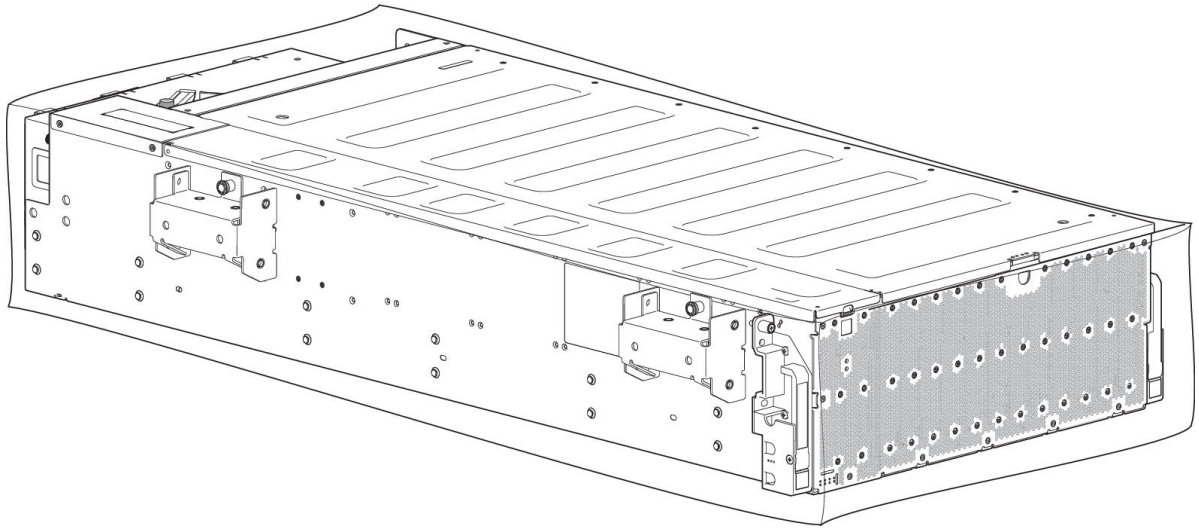


Figure 24. Unpacking the Model 106 using lift handles



CAUTION: With two persons—positioned one on each side of the enclosure—grip the handles securely, and lift the enclosure out of the box using appropriate lifting technique. Place the enclosure in a static-protected area.

Except for the disk drive modules, enclosures are supplied with all integrated PCBs and all plug-in modules installed. For information about plug-in module replacement, see [Module removal and replacement](#).

Disk drive modules are installed separately after the enclosure is mounted in the rack.

3. Prepare to install and set up the enclosure.
 - a. Before installing the enclosure into a rack, see [CAUTION](#) and [WARNING](#).
 - b. For rackmount installation, do not install the disk drive modules until after the enclosure is mounted in the rack.

Required tools

#2 phillips screwdriver

Requirements for rackmount installation

You can install the enclosure in an industry standard 1.2m cabinet capable of holding 4U form factors.

- Minimum depth: 1,206.5 mm (47.5") from rack posts to maximum extremity of enclosure (includes rear panel cabling and cable bend radii).
- Weight: Up to 145.6 kg (321 lbs), dependent upon configuration, per enclosure.
- The rack should cause a maximum back pressure of 5 pascals (0.5 mm water gauge).
- Before you begin, ensure that you have sufficient room in front of the rack for installing the rails and the Cable Management Arm assemblies.
- Follow the sequence of tasks provided in the [“Installation checklist”](#) on page 27.



CAUTION:

Enclosure rackmount precautions

- The mechanical lift and the rack must be level in all planes, and with respect to each other. Failure to comply could result in mechanical failure of the rail kit.
- Use a “spotter” to observe installation from the rear of the rack. The spotter should ensure the inner rail is fully mated with the middle rail track throughout installation.

Rackmount rail kit

Rack mounting rails are developed for use the Model 106 enclosure that installs into 1.2 m rack cabinets. These rails have been designed and tested for the maximum enclosure weight, and to ensure that multiple enclosures may be installed without loss of space within the rack. Use the rail kit and mounting hardware provided by IBM.

Installing the Model 106 enclosure

Enclosure installation involves interrelated steps and product-kit subassemblies.

The rail kit comprises left and right rail subassemblies that attach to the Model 106 enclosure and the rack. The cable management arm (CMA) comprises subassemblies that attach to the Model 106 enclosure, rails, and rack.



Warning: Do not attempt to install the enclosure into the rack with disks preloaded into drive slots. Unload disks (if installed) and CRU modules to a static-protected area, and label them. Failure to heed this Warning and the following guidelines could result in serious injury. Although you can further lighten the enclosure by removing CRUs, it is not necessary to do so.

This procedure describes adjustment and installation of left and right rail subassemblies, followed by installing the Model 106 enclosure into the rack.

1. Measure the rail-span depth distance from rear rack post to front rack post, and record this dimension.



2. Take the left outer rail subassembly in hand; then rotate the middle slide release, and fully extend the middle slide.

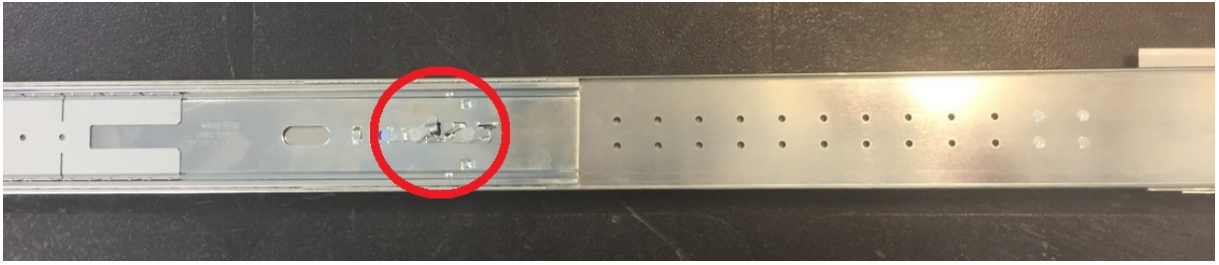


Figure 25. Middle slide – fully extended (Slide release latch identified above)

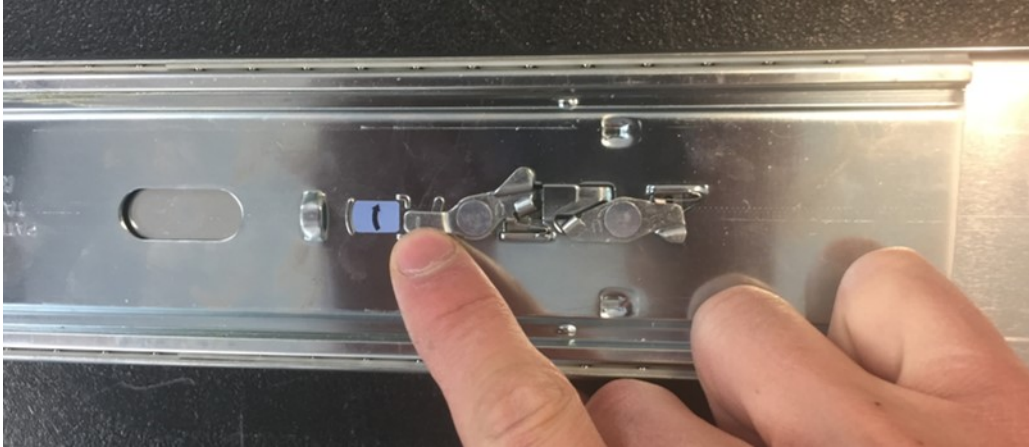


Figure 26. Middle slide release detail

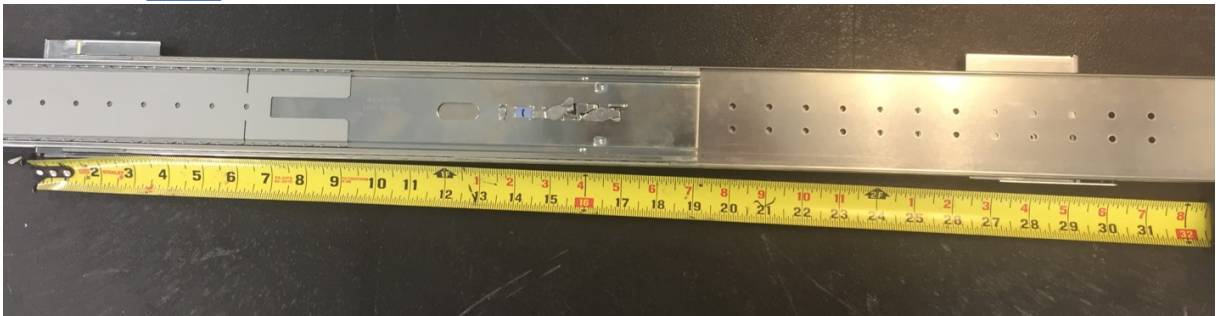
3. Unscrew and remove the quantity-4 rail kit rear-mounting bracket screws to adjust the rack post-to-post distance for the left rail subassembly.

Adjust the rail for the rack post-to-post distance.



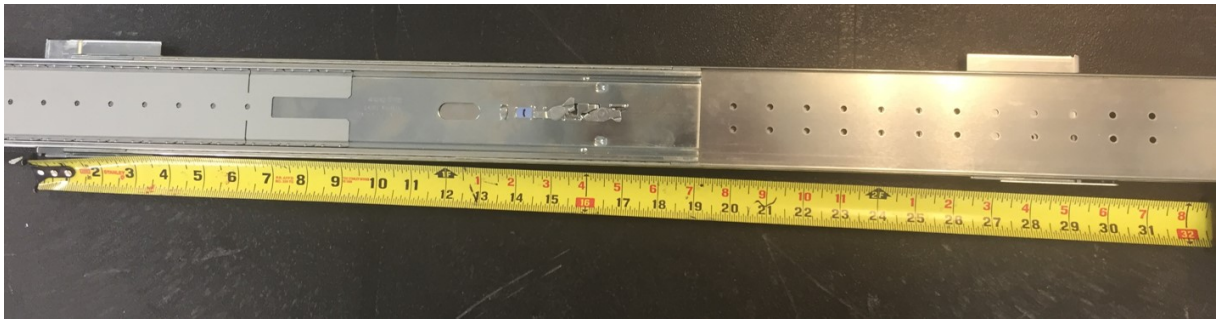
Attachment holes for Step No.3 are identified in the above figure.

4. Relocate the right rail mounting bracket to approximately match the rack post-to-post distance recorded in [step 1](#).



This bracket has 1" of available adjustment after the screws are secured. After torquing the quantity-4 screws removed in [step 3](#), verify that the bracket can be adjusted to the exact rack post-to-post distance determined in [step 1](#).

5. Repeat [step 1](#) through [step 4](#) for the right outer rail subassembly.



6. Take the right outer rail subassembly in hand, and flip it over (rotate it 180° along its longitudinal axis).



Attachment holes for Step No.7 are identified above.

7. Using the quantity-4 panhead screws provided with the CMA kit, attach the CMA attachment bracket to the rear end of the outer slide, on its outside surface. The following images show the progression of steps from top to bottom.



Figure 27. CMA attachment



Figure 28. CMA attachment aligned with outer slide



Figure 29. Panhead screws



Figure 30. CMA attachment installed on outer slide

8. Insert the right rail subassembly into the rack. Attach the adjustable rear mounting bracket to the rail first, ensuring that the rail subassembly occupies the lower 2U portion of the allotted 4U space. The rear mounting bracket spring will clip onto the rail. Ensure that the quantity-2 all-in-one rail kit mounting hardware fully seats into the rack post mounting hole.



Figure 31. Location detail

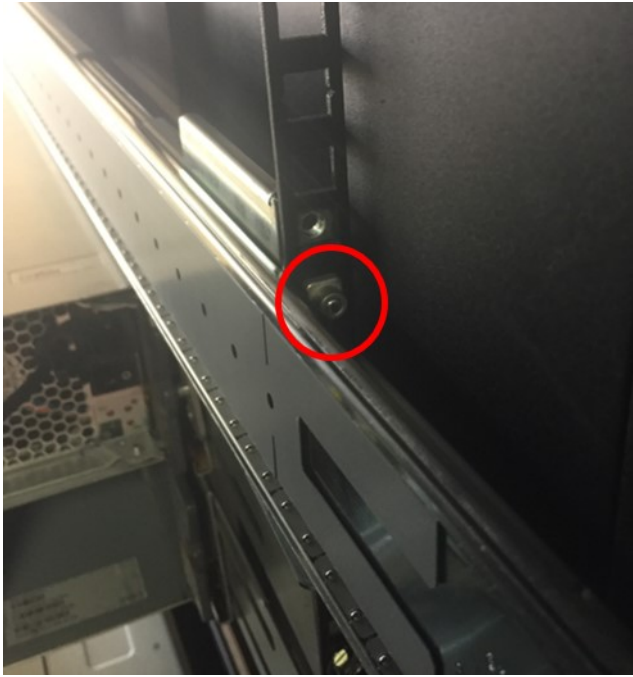


Figure 32. Fastener detail



Figure 33. Attachment spring detail

9. Attach the front mounting bracket to the rack post, ensuring that the rail subassembly occupies the lower 2U portion of the allotted 4U space. The front mounting bracket spring will clip onto the post. Ensure that the quantity-2 all-in-one rail kit mounting hardware fully seats into the rack post mounting hole.



Figure 34. Front rack post attachment details



Figure 35. Attachment spring

10. Secure the front and back rail kit mounting brackets with the quantity-3 10-32 panhead screws provided, on the top and bottom PEM locations on the back mounting bracket, and the bottom PEM location on the front mounting bracket (total quantity-3).



11. Repeat [step 7](#) through [step 10](#) for the left rail subassembly.
12. Insert the quantity-4 (quantity-2 per side) cage nuts provided into the rack in the second-to-top and third-to-top square holes in the 4U space (mates to thumbscrew and panhead screw in [step 21](#)).

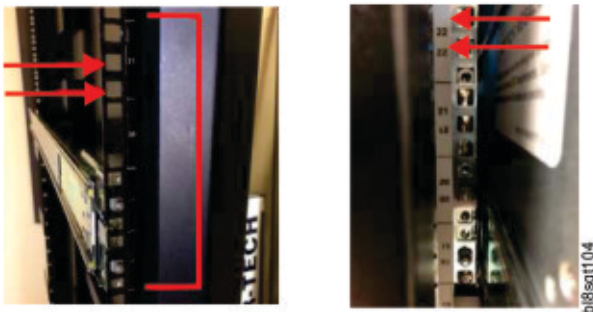


Figure 36. Rack post square hole location detail

13. While heeding the following safe handling precautions, ensure that the middle slide ball bearing track is fully seated to the front of the middle slide. This step is critical for proper rail sequencing and full engagement of the inner rail on the middle rail. In the example on the left (below), the ball bearing track is not fully seated to the front of the middle slide.

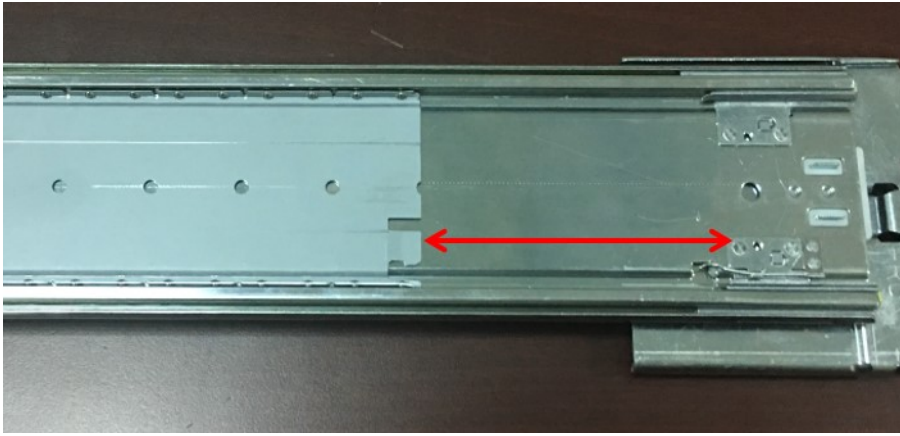


Figure 37. Not good - example

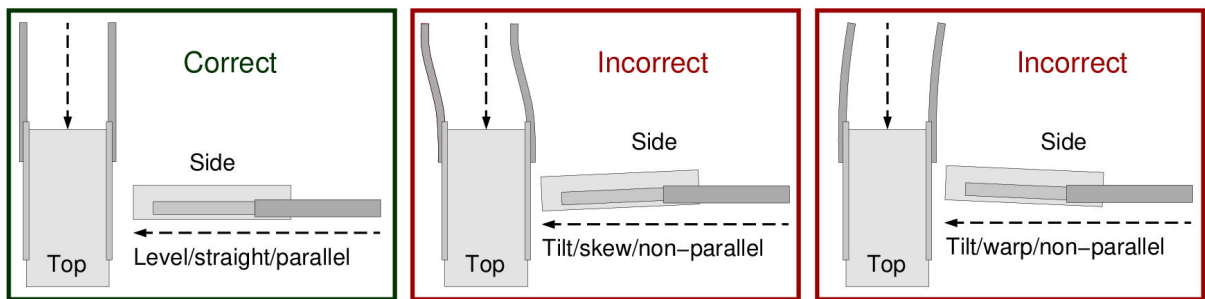


Figure 38. Good - example



Warning: Safe handling precautions:

- Do not drop or lift the chassis using a mechanical lift while inner rails are engaged with middle rails. The middle and inner rails should be properly aligned before engagement, so they glide smoothly during the entire insertion.
- The Model 106 chassis must be entirely supported by the mechanical lift until the rails are locked in the service position. Failure to do so can cause mechanical failure and serious personal injury.
- Do not push the chassis into the rack using the mechanical lift. The insertion force must be manual, and unassisted by mechanical force or additional mass. Using the lift for this purpose could damage rails.
- Do not bend the middle rail in order to force alignment with the inner rail. Alignment should be adequately established with the lift.
- If fine-tuning of alignment adjustments are required, do not adjust using the mechanical lift. Adjustments should be made by shifting the chassis itself; not the lift, and not the middle rail.
- Lower the lift only after the service position is reached, and the rail is locked in place. Lower the lift by no more than 2"– 3" while the chassis is inserted from the service position into the rack.
- The inner rails/chassis and the middle rails must be kept level, straight, and fully parallel during the entire installation. Failure to comply can cause inadequate rail engagement, and possible damage to the rails.



Safe-handling thumbnails: inserting the chassis with rails into the rack

Figure 39. Safe-handling thumbnails: inserting the chassis with rails into the rack

14. Extend the middle rail of both the left and right rail kit subassemblies roughly 3" beyond the face of the rack.
15. Position the chassis with the lift such that the inner rails are lined-up perfectly with the middle rails. The end of both inner rails should be equidistant from the rack face. To make adjustments to the alignment, shift the chassis on the left until alignment of both sides is adequate.



Figure 40. Rail slide alignment detail

16. Keeping the chassis stationary, pull the middle rails forward onto the inner rails, ensuring full engagement of the inner rails onto the middle slide track. Middle slides should slide freely and smoothly onto inner rails. Difficult middle slide movement during this step typically indicates misalignment.
17. Middle rails will eventually “click” into place as the service position locks engage. Ensure both sides engage at the same time, and both inner rails are fully engaged on their respective middle slide tracks.
18. Carefully and slowly lower the mechanical lift 2"– 3" so that the weight of the chassis now fully rests on the rail kit. Keep the lift elevation 2"– 3" below the chassis elevation until the enclosure is fully installed in the rack. This is a safety measure in case the rails are not seated properly, or another mechanical/integration failure occurs.
19. Locate the inner slide lock springs on both the left and right rail kits, and depress both to disengage the service protection lock. Continue depressing springs while inserting the chassis far enough to bypass the locks on both sides.

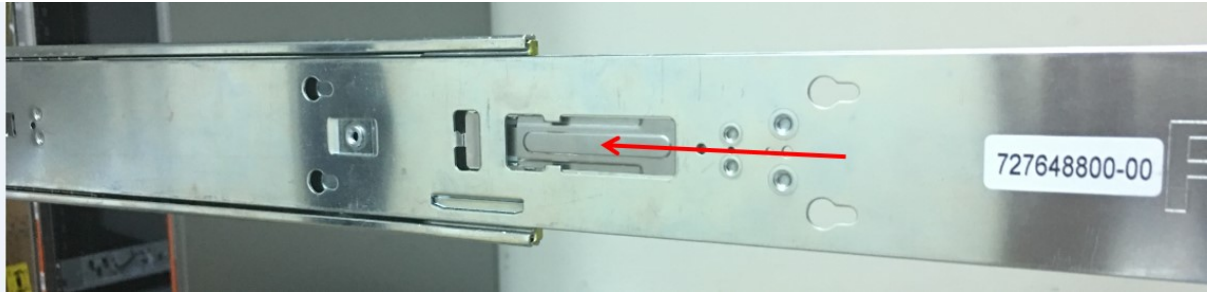
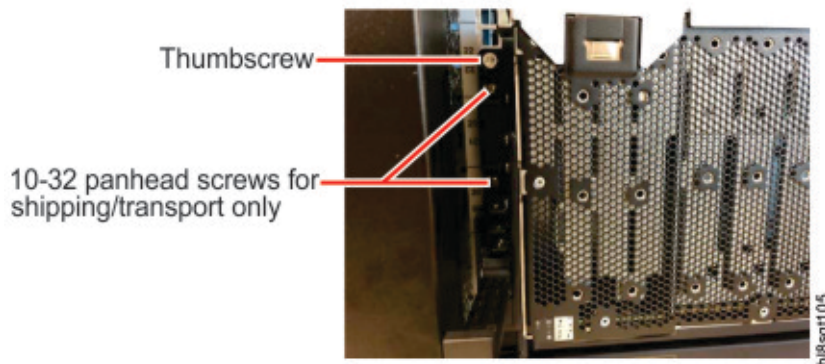


Figure 41. Inner view - example



Figure 42. Outer view - example

20. Continue inserting the chassis all the way into the rack, ensuring the chassis ears are coincident with the rack mounting flanges.
21. Secure the 4U chassis ears to the rack/rail kit with embedded thumbscrews (quantity-2, 1 per side). For shipping and transport, secure the 10-32 panhead screws provided, and torque to 3.96 N-m (35 lbf-in) (quantity-4, 2 per side).



22. Using the quantity-2 panhead screws provided, attach the CMA chassis attachment bracket to the chassis above the CMA shelf, on its inner surface. Torque screws to 1.36 N-m (12 lbf-in). The images below show the progression of steps from left to right.



Figure 43. CMA attachment bracket



Figure 44. Panhead screws



Figure 45. Installed on 4U chassis

23. Clip the CMA “B” bracket onto the right rail subassembly CMA attachment bracket (from [step 7](#)). Ensure that the blue spring clips onto the C-shaped CMA attachment bracket securely, and the arrow next to the “B” mark on the CMA arm is pointed upward. The “B” bracket should reside outside of the CMA ramp “lip” (see middle photo).

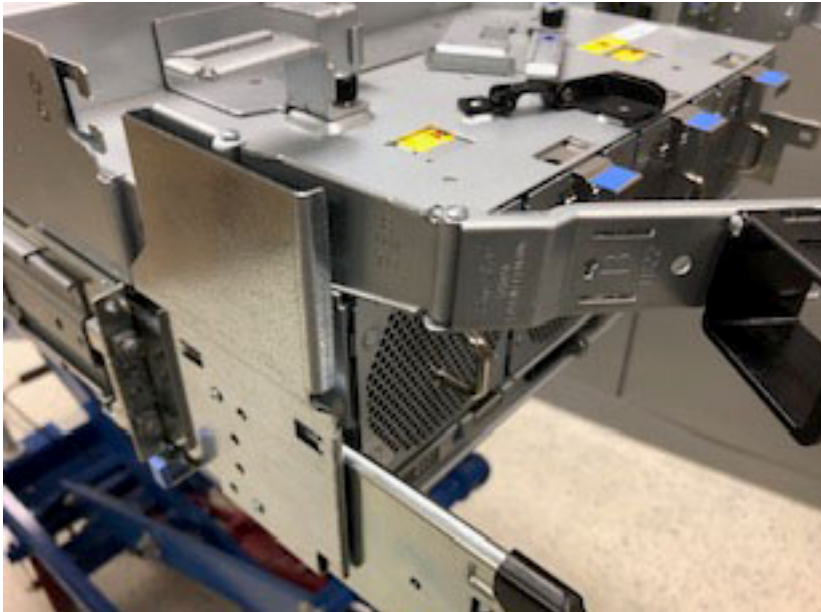


Figure 46. CMA “B” bracket

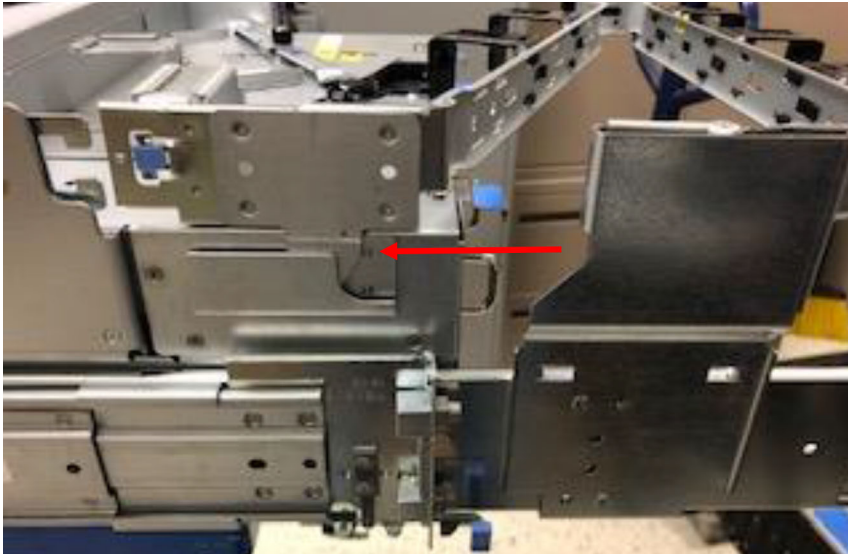


Figure 47. CMA ramp "lip"

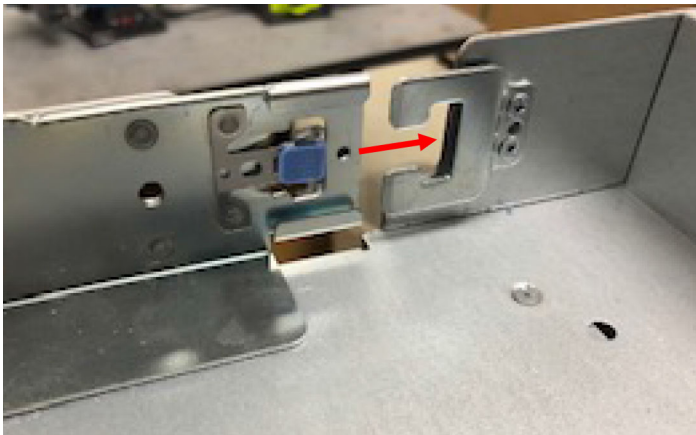


Figure 48. CMA "A" bracket

24. Clip the CMA "A" bracket on to the chassis CMA attachment bracket (from [Step 22](#)). Ensure that the blue spring clips onto the C-shaped CMA attachment bracket securely. The "A" bracket should reside inside the CMA ramp "lip" as shown above.
25. Install the crossbar.



Figure 49. Crossbar with blue thumbscrews stabilizes the two rails at the rear of the chassis

26. Install the shipping screws (optional step required only for preventing non-operating transportation shock/vibration)



The figure above identifies an installed shipping screw using a red arrow. A shipping screw installs above each of the crossbar thumbscrews as shown in the enclosure rear panel view included above this step.

Note: After the enclosure is secured in the rack, the disks should be installed.

Routing cables using the CMA

Routing of power and data cables for the Model 106 is integral to successful rail kit installation and rackmount installation of the enclosure.

Cables must be correctly installed and routed to facilitate efficient operation and in-rack servicing of the enclosure.

This section provides instructions for routing cables through the CMA, to include using the CMA baskets and the CMA storage shelf located at the rear of the enclosure.

1. Install the data cables and route them through the CMA brackets.

- Rotate the CMA cable capture arms so they are out of the way of the data cable routing.
- Route data cables 1-5 onto the CMA shelf and through the CMA brackets in the order and configuration shown below.
- Secure the routed cables with one hand while installing additional cables until data cables 1-5 are installed.
- Rotate the outer cable capture arm close over data cables 1-5, ensuring it seats in the C-flange in between the two cable capture arms.
- Route data cables 6-10 onto the CMA shelf and through the CMA brackets in the order and configuration shown below.

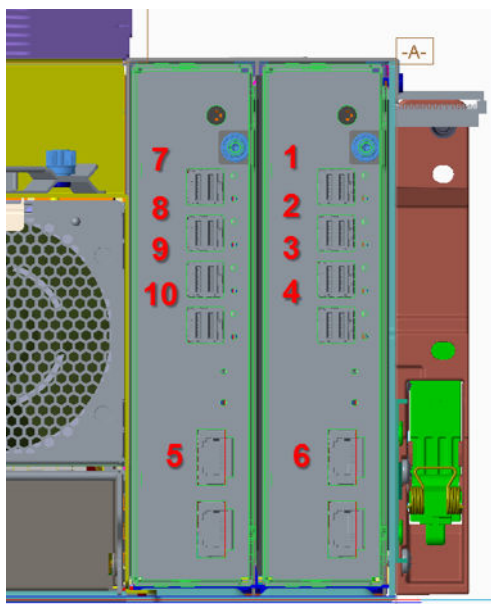


Figure 50. Rear view

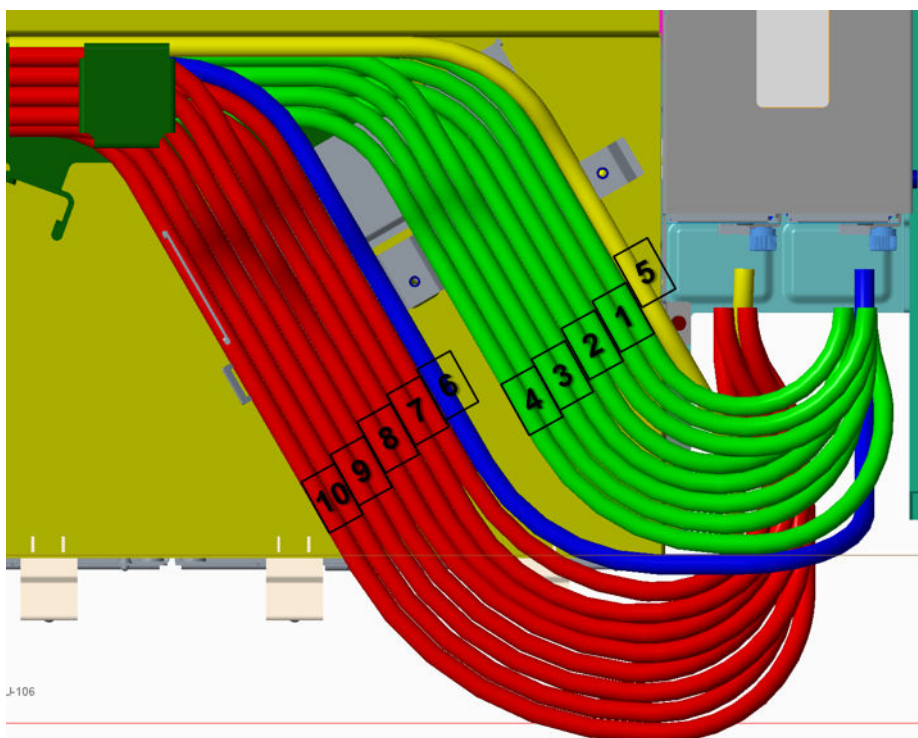


Figure 51. Top view

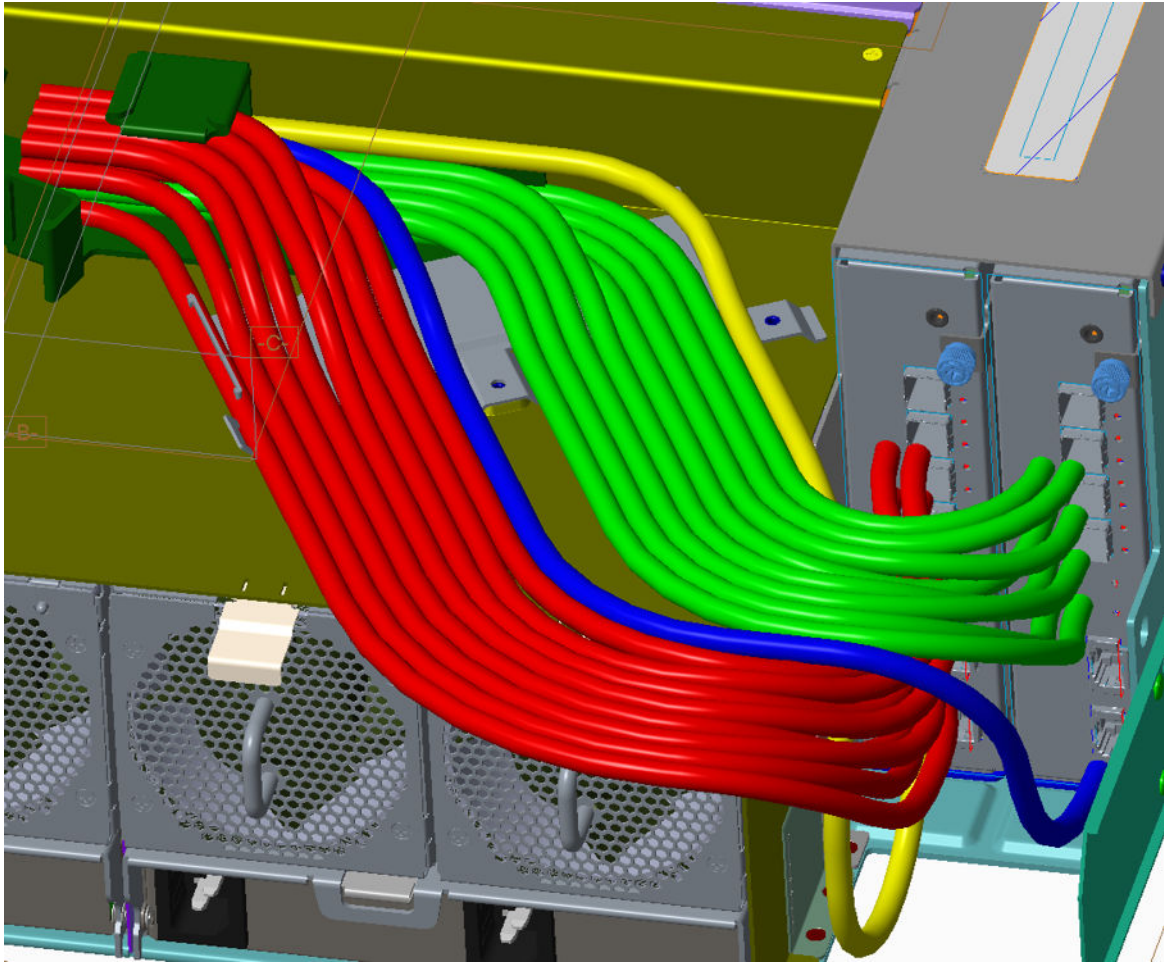


Figure 52. Trimetric projection relative to enclosure rear panel

2. Rotate the inner CMA cable capture arm into the C-bracket to secure the rest of the data cables. The outer CMA cable capture arm may need to be pushed down in the C-bracket to allow the inner cable capture arm to seat properly. The CMA bracket may need to be shifted slightly in order for the thumbscrew to find the PEM thread in the CMA shelf. Secure the thumbscrew.

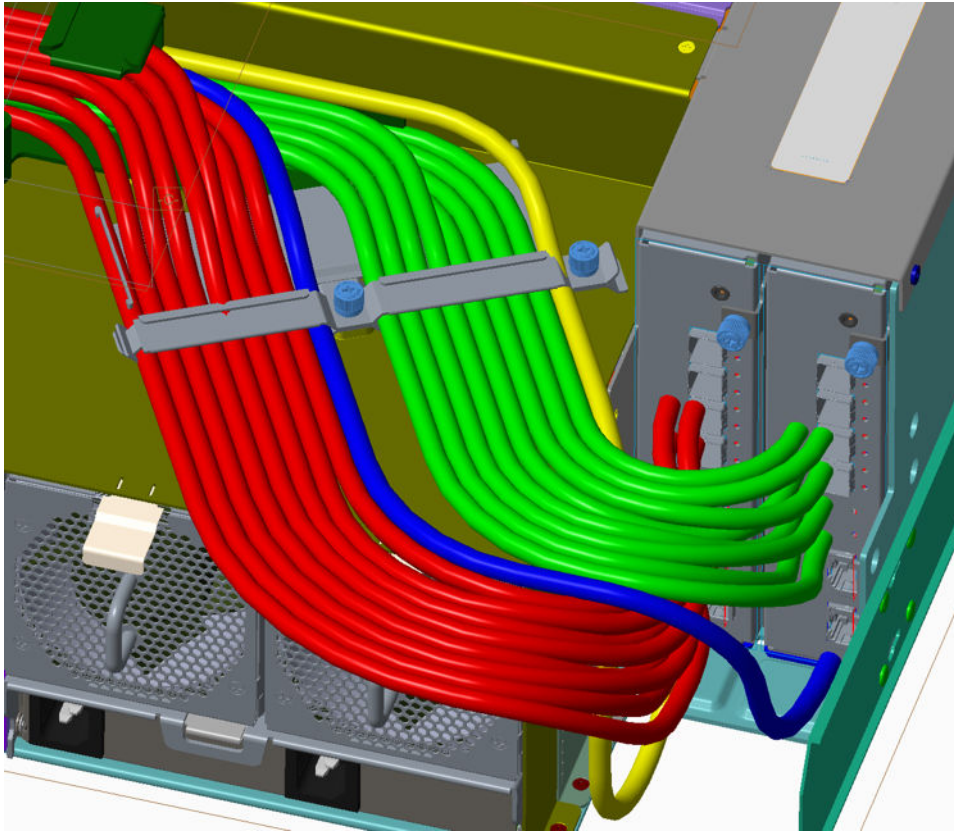


Figure 53. Securing cables with the CMA bracket

3. Install the PSU cables.

Refer to the details provided beneath the sub-steps, noting that the top view details represent the CMA shelf.

- a. Remove the M3 panhead screw from the PSU cable clip assembly, and set it aside for re-installation.
- b. Install the right-angle C19 connectors into the PSUs.
- c. Route the cables as shown, ensuring they lay flat on the CMA shelf and through the PSU cable-clip assembly.
- d. Reinstall the M3 panhead screw from step 3a, while torquing the screw to 5 lbf-in.

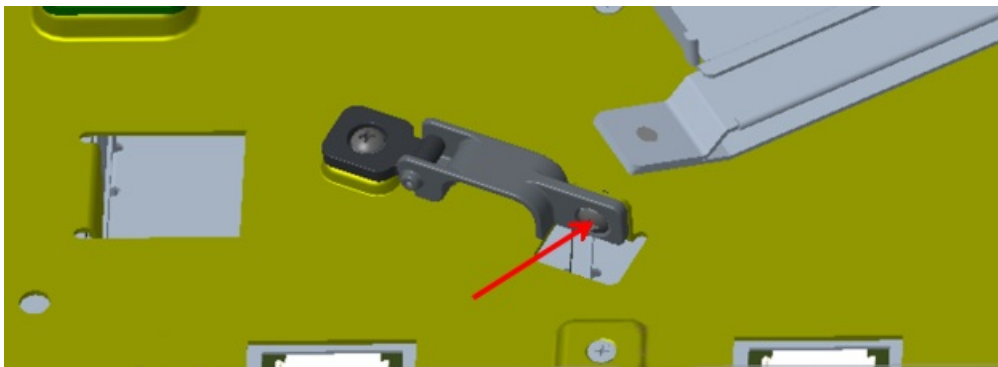


Figure 54. PSU cable clip M3 panhead screw

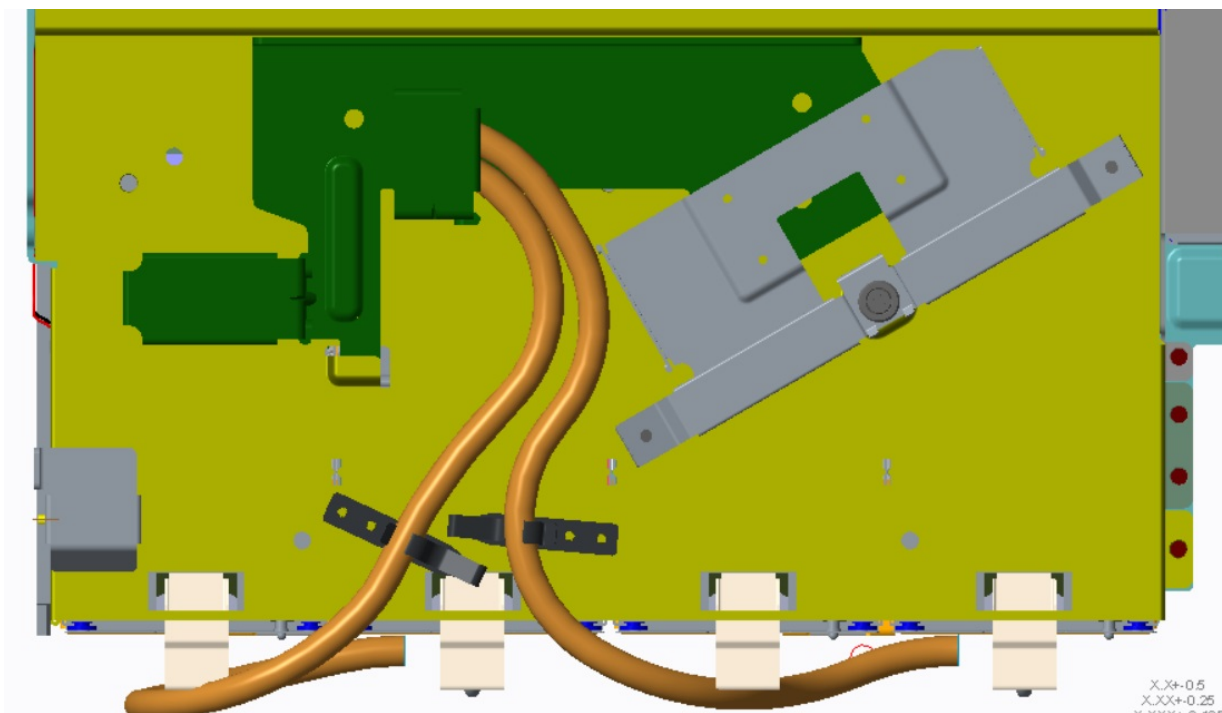


Figure 55. CMA shelf viewed from top panel of Model 106 enclosure

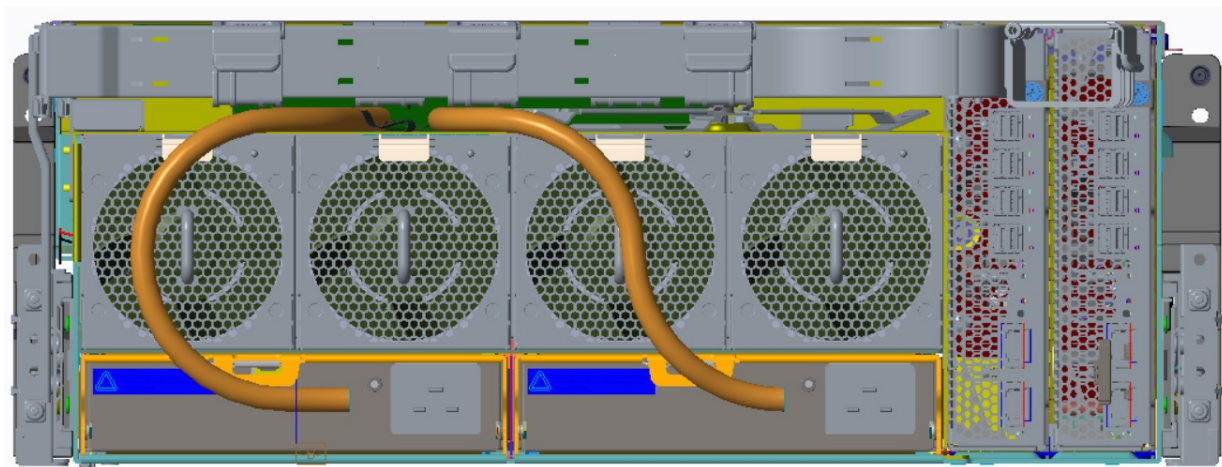


Figure 56. CMA shelf viewed from rear panel of Model 106 enclosure

4. Route cables through CMA baskets.
 - a. Route cables through the first two baskets, ensuring minimal cable crossover to maximize space.
 - b. Use all available space on the CMA shelf to make the first 180° bend into the first CMA basket.
 - c. Keep pairs of dual SAS cables parallel and close together.
 - d. After all cables (including PSU cables) are routed through the first two CMA baskets, route them around a 180° bend into the remaining four CMA baskets.

- Route cables through the first two baskets, ensuring minimal cable crossover to maximize space.
- Use all available space on the CMA shelf to make the first 180° bend into the first CMA basket.
- Keep pairs of dual SAS cables parallel and close together.
- After all cables (including PSU cables) are routed through the first two CMA baskets, route them around a 180° bend into the remaining four CMA baskets.

- b. Use all available space on the CMA shelf to make the first 180° bend into the first CMA basket.

- c. Keep pairs of dual SAS cables parallel and close together.

- d. After all cables (including PSU cables) are routed through the first two CMA baskets, route them around a 180° bend into the remaining four CMA baskets.



Figure 57. Cables routed through CMA baskets

Cable requirements for expansion enclosures

When adding storage, use IBM qualified SAS cables, and observe the following guidelines:

- When installing SAS cables to expansion modules, use only supported HD mini-SAS (SFF-8644) x4 cables.
- Qualified HD mini-SAS copper cables, not to exceed 5 m (16.40'). For more information, see [Table 9 on page 63](#).
- The maximum expansion cable length allowed in any configuration is 5 m (16.40').
- When adding more than two expansion 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 cabling a fault-tolerant configuration.

SAS topology

The star configuration topology of SAS is supported with the Model 106 enclosure.

The star configuration has each expansion enclosure connected from the host (server attached JBOD configuration) or controller enclosure (EBOD configuration).

SAS cabling method

As you face the rear panel of the Model 106 enclosure, the left IOM/EBOD expander module slot is 1 and the right IOM/EBOD expander module slot is 0. See also [Figure 5 on page 10](#) for CRU slot index numbering for the enclosure rear panel. Green is used to show IOM/EBOD expander module 0 paths and blue is used to show IOM/EBOD expander module 1 paths for cabling the expansion enclosures shown in each cascade.

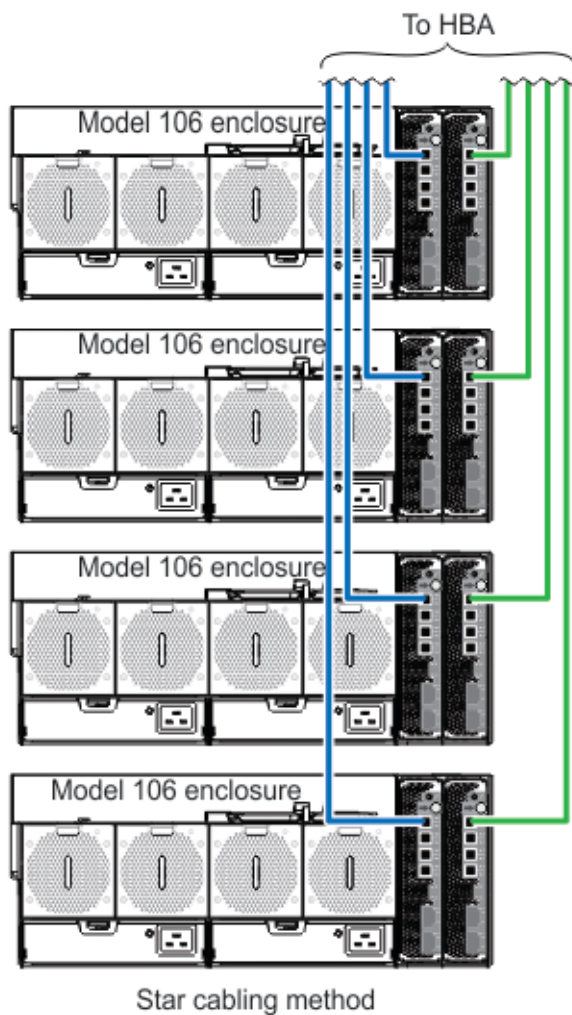


Figure 58. Star cabling method

The above diagram shows Star cabling method.

An advantage of the star configuration is that each expansion enclosure is only one additional expander or “hop” away from the initiator. This reduces delays in the SAS communication path. Those effects are small by measure.

Power cord connection

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

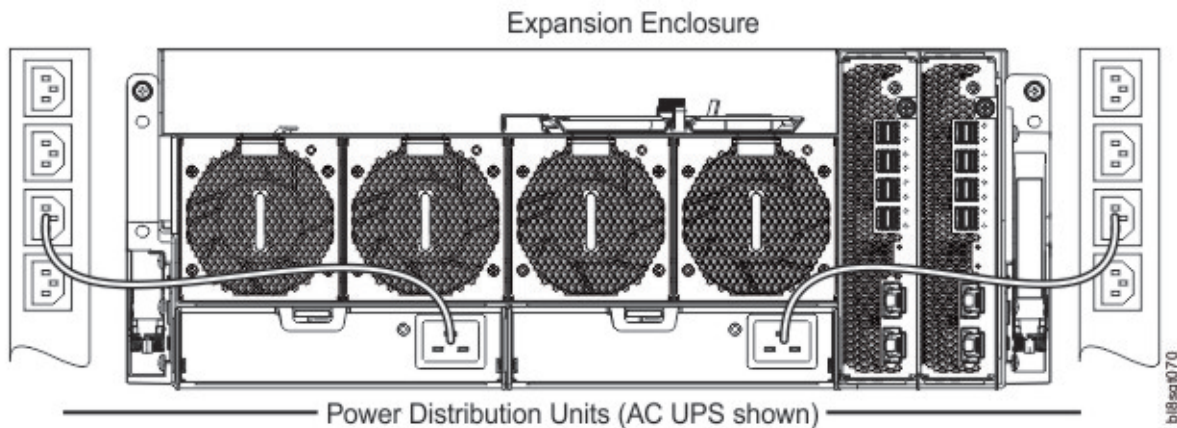


Figure 59. Typical AC power cord connection from PDU to PSU

Important: The Model 106 enclosure is fitted with two redundant PSUs. All power cords must be connected to at least two separate and independent power supplies to ensure redundancy.

- Figure 59 on page 52 shows power connection from a single-core PSU to a PDU using C19 connectors.
- The C20 plug on the PSU connects to the C19 receptacle of the power cord. The C20 plug on the power cord connects to the C19 receptacle in the PDU.



CAUTION: Power connection concerns:

- Never connect the power cord to the PSU before installing the PSU in the system.
- Always remove the power connections before you remove the PSU from the enclosure.
- Whether standard (single-lead) or bifurcated (Y-lead), power cords must only be connected to a supply range of 200–240V AC as indicated on each PSU's hazardous voltage warning label.

Testing enclosure connections

See [Powering on/powering off](#). Once the power-on sequence succeeds, the storage system is ready to be connected.

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.

Updating firmware

See the *mmchfirmware* command for managing the enclosure and drive firmware.

Chapter 5. Operation

Before you begin

Before powering on the enclosure system, ensure that all the modules are firmly seated in their correct slots.

Verify that you have successfully completed the sequential “Installation Checklist” instructions in [Table 4 on page 27](#). Once you have completed these steps, use ESS deployment tools (**gssutils**) 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” on page 84. If the drive modules have been recently installed, make sure they have had time to adjust to the environmental conditions before they are used with production data for I/O.

1. Power on the system by connecting the power cables from the PSU to the PDU. See [Figure 59 on page 52](#).

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

2. Power the system down by disconnecting the power cord from the power supply module.

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, back and top of the enclosure are amber—the power-on sequence is complete, and no faults have been detected.

- See [Overview of front panel LEDs and Figure 12 on page 15](#).
- See [Overview of rear panel LEDs and figures/tables for rear panel CRUs](#).
- See [Overview of top panel LEDs and figures/tables for top panel CRUs](#).

- Controller enclosure next if an RBOD is used. Not applicable to server attached JBOD configuration.

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).

Note: 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 Enclosure will restart automatically.
- **Note:** See “[Front panel LEDs](#)” on page 56 for details pertaining to front panel LEDs and related fault conditions.
- **Important:** To avoid potential equipment damage during transport and subsequent loss of data, see [Procedure: Transporting a 5U expansion enclosure](#). The procedure describes what to do for the following situations:

- When you are powering off an expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains an expansion enclosure.

The procedure describes how to remove each drive from the enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

Unit Identification Number

Software/SES

The enclosure serial number can be displayed using the *mmlsenclosure command*.

It is set at the factory and is reflected in the 1S label on the side of the enclosure. The enclosure serial number should be changed only by a qualified service personnel.

Chapter 6. Troubleshooting and problem solving



DANGER: Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)



CAUTION: High levels of acoustical noise are (or could be under certain circumstances) present. Use approved hearing protection and/ or provide mitigation or limit exposure. (L018)

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

Note: For further troubleshooting help, after setup and when data is present, contact technical support.

Overview

ESS software interacts with the Storage Enclosure Processor (SEP) and performs monitoring and control of the enclosure and drive as needed.

Important: See [Fault isolation methodology](#) when conducting system diagnostics.

Initial start-up problems

Faulty power cords

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

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

Computer does not recognize the enclosure system

1. Verify that the interface cables from the enclosure to the host computer are fitted correctly.
2. Verify that the LEDs on all installed drive carrier modules do not show fault status.

3. Verify that the drive carrier modules have been correctly installed.
4. Check any visible SAS indicators (controller enclosure, expansion enclosure, 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](#).

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
- Blue: identification

PSU LEDs

Under normal conditions, the bitonal PSU Status OK LED will be a constant green.

See also [Figure 13 on page 16](#). When a fault occurs, the color of the LEDs will display as shown in the following table.

Table 6. PSU LED states		
PSU Status (Green)	PSU Status (Amber)	Status
Off	Off	No AC power on this PSU only
On	Off	AC present; PSU working correctly
Off	On	PSU fault(over temperature, over voltage, over current)
Off	Blinking	PSU firmware download is in progress

Front panel LEDs

The front panel displays the aggregated status of all the modules.

The enclosure status LEDs located on the front panel are labeled in [Figure 12 on page 15](#) and they are individually described in the narrative subsections that follow the table.

Disk drive carrier module LEDs

Disk drive status is monitored by an amber LED mounted on the front of each drive carrier module, as shown in the following figure.

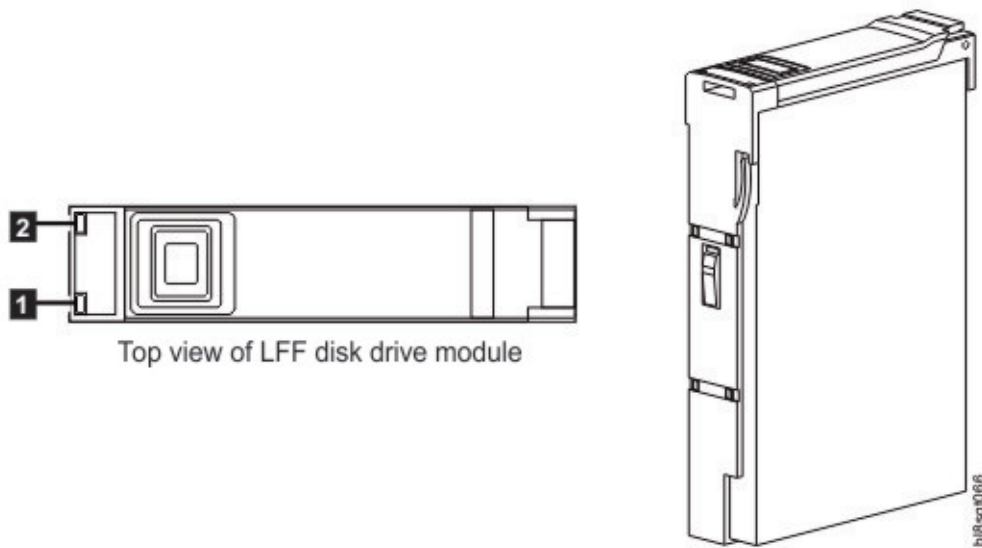


Figure 60. Top view of LFF disk drive module

LED	Description	Definition
1	Not currently used	
2	Identify and fault	Blinking amber means the disk drive module is identifying. Solid amber means the disk drive module has failed. Off means the disk drive module is operating normally.

Expansion module LEDs

IOM/EBOD expander module status is monitored by the LEDs located on the faceplate.

See also Figure 16 on page 19. LED behaviors for expansion enclosures are described in Table 7 on page 57. For actions pertaining to Table 7 on page 57, see Actions below.

Table 7. 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/EBOD expander module” on page 78
		Off	No external port connection
		On	HD mini-SAS port connection – no activity
		Blinking	HD mini-SAS port connection – activity

<i>Table 7. Expansion module LED states (continued)</i>			
CRU OK (Green)	CRU Fault (Amber)	SAS port activity (Green)	Status
Blinking			Expansion enclosure VPD error

Actions:

- If the Power OK LED is blinking, wait for the system to boot.
- If the Power OK LED is off, and the IOM/EBOD expander module is powered on, the module has failed.
 - Check that the IOM/EBOD expander module is fully inserted and latched in place, and that the enclosure is powered on.
 - Check for logs pertaining to the failure.
- If the Fault LED is on, a fault condition is detected.
 - Reseat the IOM/EBOD expander module in its slot.
 - Check for logs pertaining to the failure.
- If the above actions do not resolve the fault, contact your supplier for assistance.

Temperature sensors

Temperature sensors throughout the enclosure and its components monitor the thermal health of the storage system.

Exceeding the limits of critical values will cause a notification to occur.

Troubleshooting

The following sections describe common problems that can occur with your enclosure system, and some possible solutions.

For the problems listed in Table 8 on page 58, the pertinent fault LEDs on the enclosure front panel will light amber to indicate a fault and report to ESS software where appropriate. See also [Overview of front panel LEDs](#).

<i>Table 8. Fault conditions</i>	
Status	Severity
PSU alert -loss of DC power from a single PSU	Fault - loss of redundancy
PSU fan fail	Fault - loss of redundancy
CFF module detected PSU fault	Fault
PSU removed	Configuration error
Enclosure configuration error (VPD)	Fault– critical
Low warning temperature alert	Warning
High warning temperature alert	Warning
Over temperature alarm	Fault– critical
I ² C bus failure	Fault– loss of redundancy
Front panel communication error (I2C)	Critical fault

Table 8. Fault conditions (continued)	
Status	Severity
RAID error	Fault– critical
CFF interface module fault	Fault– critical
CFF interface module removed	Warning
Drive power control fault	Fault– critical–loss of disk power
Insufficient power available	Warning

1. The enclosure will continue operating, requiring an administrator to take appropriate action; such as replacing a PSU or reducing the room temperature. Alarm messages are signaled by the SES pages (page 29).
2. An alarm is not issued for this status and severity condition.
3. The enclosure will take action; such as shutting down in order to protect the enclosure’s data content. Alarm messages are signaled by the SES pages (page 29).

PSU and system fan faults

Symptom	Cause	Recommended action
Front panel Module Fault LED is amber ¹	Any power fault	Verify AC mains connections to the PSU are live
Amber LED is illuminated on fan module ²	Fan failure	Replace system fan module

1-See [Figure 12 on page 15](#) for visual reference of front panel LEDs.

2-See [Figure 13 on page 16](#) for visual reference of PSU LEDs. See [Figure 14 on page 18](#) for visual reference of system fan module 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 25°C (77°F), and the fans are observed to increase in speed, then some restriction on airflow maybe 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. Front panel Module Fault LED is amber. 2. Fan Fail LED is illuminated on one or more PSUs.	Internal temperature exceeds a preset threshold for the enclosure.	1. Verify that the local ambient environment temperature is within the acceptable range. 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.

Fault isolation methodology

This section presents the basic methodology used to locate faults within a Model 106 storage system, and to identify the pertinent CRUs affected.

Basic steps

- Gather fault information, including using system LEDs.
- Determine where in the system the fault is occurring.
- The **gsssnap** script will gather all required information.
- If required, isolate the fault to a data path component or configuration as described in [Isolate the fault](#).

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 in the lower left corner of the enclosure front panel—illuminates.

See also [Overview of front panel LEDs](#). Check the status of the other front panel LEDs. Also check the LEDs on the back and top panels (must remove a lid) of the enclosure to narrow the fault to a CRU, connection, or both.

- See [Overview of rear panel LEDs](#)
- See [Overview of top panel LEDs](#)

The LEDs help you identify the location of a CRU reporting a fault.

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:

- Power cycle the system
- Make sure the power cord is properly connected, and check the power source to which it is connected
- Check log for errors

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](#).

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](#).

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](#). Avoid contact with midplane components, module connectors, leads, pins, and exposed circuitry.

Continuous operation during replacement

ESS software provides 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 PSUs, sufficient power is provided to the system while the faulty module is replaced.

Note: Model 106 enclosures support hot-plug replacement of redundant expansion enclosure canisters, power supplies, fan modules, and HS expanders. 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. Product Release Notes® describe the process for updating firmware. Contact your account manager for additional information.

Procedure: Transporting an expansion enclosure

Safely transport an expansion enclosure by following this procedure.

See [“Relocating ESS racked system 5147-106 \(4U106\)”](#) on page 4 before you start transporting the enclosure.

To transport an expansion enclosure between locations, or to transport an entire rack that contains one or more of these enclosures, follow these steps to protect against drive damage.

1. Safely power down the enclosure by referring to [“Powering on/powering off”](#) on page 53. Do not remove rack power until systems are safely powered down.
2. Transfer all of the drives in the enclosure into their original packaging or equivalent packaging for safe transportation. For more information on removing the disk drive, see [“Removing a LFF drive carrier module”](#) on page 76.

The original packaging consists of an anti-static bag for each drive, an inner carton with protective, padded slots for each drives, and an outer carton to hold three inner cartons of drives.

3. Disconnect only the cables necessary for the equipment move and remove the enclosure from the rack.
4. Return all components, **but not the drives**, to the enclosure for shipping.

Do not return the drives to the enclosure until the enclosure is at its new location and is not to be moved again.

Customer-replaceable units

CRUs addressing Model 106-drive chassis

Item	Enclosure component description	Access
1	Disk drive (LFF/SFF) module: DDIC (Disk in drive carrier) 1. DDIC 3.5" LFF (disks of differing type/speed and storage capacity: SAS/SATA/SSD) 2. DDIC 2.5" SFF with adapter (disks of differing type/speed and storage capacity: SAS/SATA/SSD)	Top
2	Power supply unit (PSU) module available as AC unit (chassis uses two PSUs of same model type)	Rear
3	Expansion module (EBOD canister) for storage expansion	Rear
4	System fan module	Rear
5	Controller fan module	Top
6	HS Expander module (PCBA card)	Top
7	Optical SAS Cable 4.3m (FRU and Production PN) Optical SAS Cable 4.5m (FRU and Production PN) MiniSAS HD to MiniSAS HD, L = 4.0m (COPPER) - Production MiniSAS HD to MiniSAS HD, L = 4.0m (COPPER) - FRU MiniSAS HD to MiniSAS HD, L = 5.0m (COPPER) - Production MiniSAS HD to MiniSAS HD, L = 5.0m (COPPER) - FRU	N/A
8	AC power cord compatible with AC PSU	N/A

Part #	Part Desc	Substitute Part
001LU642	10TB 3.5 HDD	
001LU841	14TB 3.5 HDD	
078P5611	4.3M Cable (Optical SAS)	
078P5605	4.5M Cable (Optical SAS)	
001LU640	4TB 3.5 HDD	

Table 10. Part numbers of Customer-replaceable units (continued)

Part #	Part Desc	Substitute Part
001LU643	800GB 2.5 SSD	
001LU641	8TB 3.5 HDD	
001LU160	FRU: Bezel Ears	
001NN743	Power Cable, 3M, C19/C20	
001NN744	Power Cable, 4M, C19/C20	
001NN740	EBOD (Expander) Asm	
001ML987	Serial Cable Asm	
001NN739	FRU FAN T-1	
001LU138	Kit, Lift Handles	
001NN745	MiniSAS Cable, 5m (Copper)	
001LU136	MiniSAS Cable, 4m (Copper)	
001NN738	FRU PSU 2KW	002AE983
001NN749	Power Cable, 2.5, C19/C20	
078P6721	5.5M Cable (Optical SAS)	
002YC507	16TB 3.5 HDD	
001LU177	LABELS (DRIVE NUMBERING)	
001LU172	Foam/Clamps Kit for Cables	
001LU167	Foam/Clamps Kit for Cables	001LU172

1. The Access column lists the enclosure panel from which the CRU is observed and accessed. It does not apply to other components.
2. See “Enclosure chassis” on page 14 for a description of the chassis CRU.
3. See “Rackmount rail kit” on page 32 and “Routing cables using the CMA” on page 45 for descriptions of the rail kit and CMA.

Tip: Enclosure panel access diagrams for locating CRUs:

- Front panel: see [Figure 3 on page 9](#) and [Figure 12 on page 15](#)
- Rear panel: see [Figure 4 on page 10](#)
- Top panel: see [Figure 9 on page 12](#), [Figure 10 on page 13](#), and [Figure 11 on page 13](#)

Tip: Enclosure dimetric pictorial views:

- Projection from enclosure front panel: see [Figure 1 on page 7](#)
- Projection from enclosure rear panel: see [Figure 2 on page 8](#)

Field-replaceable units

FRUs addressing Model 106-drive chassis

Table 11. Model 106 product FRU components for Model 106-drive chassis

Item	Enclosure component description
1	Chassis (sheet metal enclosure) with integrated PCBAs (included with chassis; not available separately)
2	Rail kit (variable attachment options)
	a) Rack mount kit, shelf, long(1.2 m), HW
	b) Cable Management Arm (CMA) and brackets

Table 12. Part numbers of Field replaceable units

Part #	Part Desc	Substitute Part
001LU187	Kit, Slide Rails	
001YK763	Kit, Slide Rails	001LU187
001YK729	Kit, Slide Rails	001YK763
001LU186	FRU Chassis	
001YK761	FRU Chassis	
001NN741	FRU Chassis	001YK761
002AE940	FRU CMA	
001YK767	FRU CMA	002AE940
001NN746	FRU CMA	001YK767
001NN748	FRU FAN T-2	
002AE987	PSU 2KW FRU Assembly FRU PSU URL	
002AE983	PSU 2KW FRU PSU HAL	
001NN747	FRU SAS Expander	
001YK792	CRU TOP LID 4U	

Chapter 7. 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.

Note: Unless otherwise noted within a passage pertaining to a particular CRU, the replacement procedure should be completed within 3 minutes of the removal of a defective module. Do not remove a faulty module unless you have the replacement module available and ready for insertion into the slot.

ESD precautions



DANGER: Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)



CAUTION: High levels of acoustical noise are (or could be under certain circumstances) present. Use approved hearing protection and/ or provide mitigation or limit exposure. (L018)

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 1megohm ($\pm$ 10percent) 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 technical support.

Replacing a PSU module

This section provides procedures for replacing a failed power supply unit (PSU) module.

Illustrations in PSU replacement procedures show rear panel views of the enclosure, with the PSU properly oriented for insertion into the rear panel of the enclosure.

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



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

See CAUTION bullets regarding [electrostatic discharge](#) and [anti-static protection](#).

Tip: The illustrations show PSU module replacement as you face the enclosure rear panel. See also [Figure 4 on page 10](#) and [Figure 7 on page 11](#).

Removing a PSU module



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 physically removing the power source in order to ensure your system has warning of imminent power shutdown. A faulty PSU must be replaced by a fully operational PSU as soon as possible. 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](#).

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.

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

3. Disconnect the power cable from the PSU power connector to power off the faulty PSU (it has no power switch).

Note: Power cables are typically routed to the PSU from the cable management arm (CMA). Verify that the 180° power cable bends lie flat in the CMA baskets. Ensure that the cable lays flat on the CMA shelf and through the cable clip assembly. See also [Figure 4 on page 10](#) and step 3 of [Routing cables using the CMA](#).

4. If replacing a single PSU via hot-swap, proceed to [step 6](#).
5. If replacing both PSUs, verify that all I/O from hosts to the enclosure were stopped and that the enclosure is powered off.
6. Verify that the power cord is disconnected.
7. Grasp the PSU handle latch between the thumb and forefinger and press the latch tab down to unlock the handle.

Revolve the handle out and downward to cam the PSU out of the enclosure as shown in [Figure 61 on page 69](#).

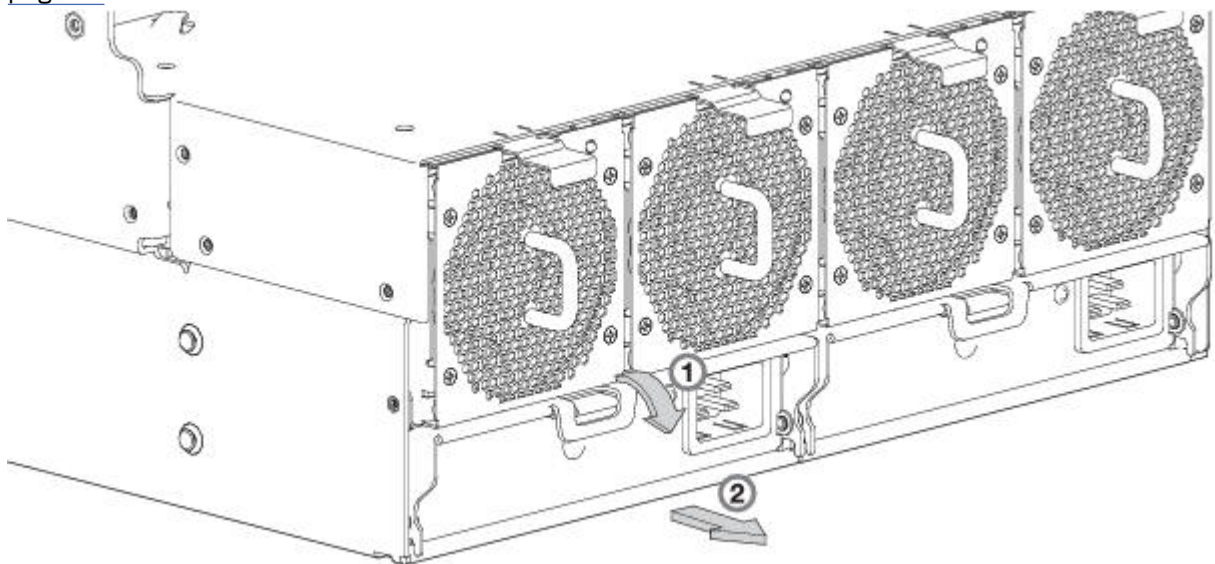


Figure 61. Removing a PSU (1 of 2)

8. Grip the handle and withdraw the PSU, taking care to support the base of the module with both hands as you remove it from the enclosure as shown in [Figure 62 on page 70](#).

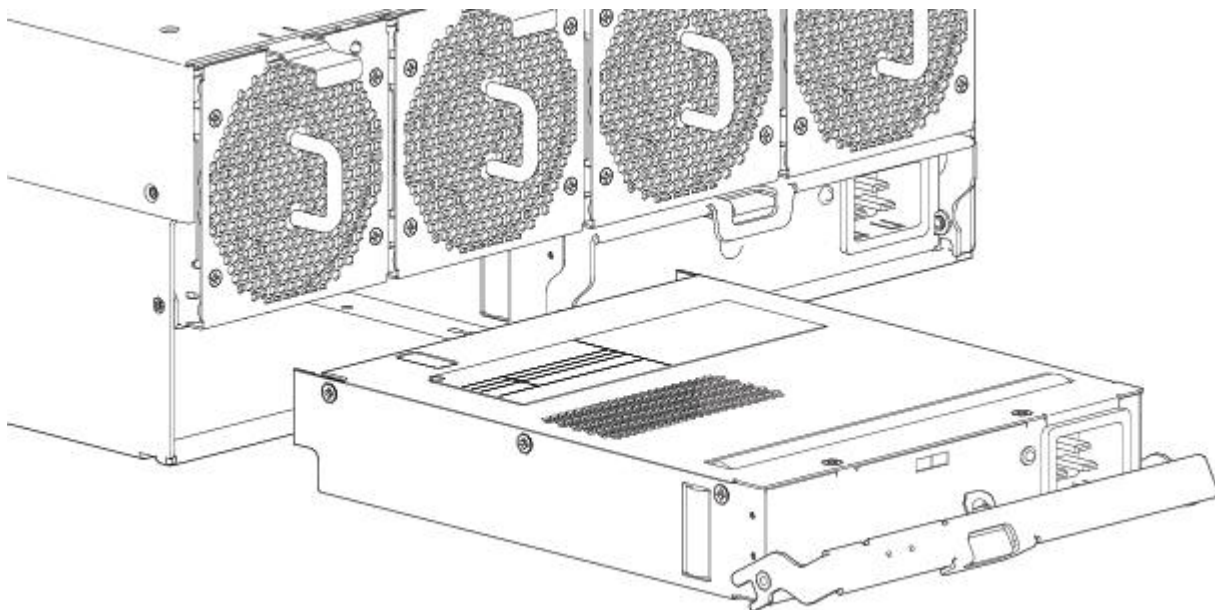


Figure 62. Removing a PSU (2 of 2)

Note: The remove PSU illustrations show a single-core module with single power connection. The procedure applies equally to single-core and dual-core PSUs used in Model 106 enclosures.

9. If replacing two PSUs, repeat steps 5 through 8, being mindful of the illustrations [TIP](#).

Installing a PSU module

Refer to Figure 61 on page 69 and Figure 62 on page 70 when performing this procedure, but ignore the directional arrow—since you will insert the module into the slot—rather than remove it.

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

1. Check for damage, especially to all module connectors.
2. With the PSU 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. Lever the module home by manually closing the PSU handle. You should hear a click as the latch handle engages and secures the PSU to its connector on the back of the power midplane.
4. Connect the power cable to the power source and the PSU.

Power cables are typically routed to the PSU from the cable management arm (CMA). Verify that the 180° power cable bends lie flat in the CMA baskets. Route the cables as shown in step 3 of [Routing cables using the CMA](#), ensuring they lay flat on the CMA shelf and through the PSU cable clips assembly. See also [Figure 4 on page 10](#).

5. Verify that the bitonal PSU Status LED is on/Green. Verify that cooling fans are spinning with no fail states. Verify that the front panel LED states show no amber module faults.
6. If replacing two PSUs, repeat steps 1 through 5, being mindful of the illustrations [TIP](#).

Replacing a system fan module

This section provides procedures for replacing a failed system fan module. Within this CRU module, if one of the two internal rotors fails, then a fault occurs, indicating module failure. Illustrations in system fan replacement procedures show rear panel views of the enclosure, with the fan properly oriented for insertion into the rear panel of the enclosure.

If a system fan module fails, the remaining three fans are sufficient to maintain operation of the enclosure. You need not halt operations and completely power-off the enclosure when replacing only one system fan; however, a complete orderly shutdown is required if replacing multiple system fans modules simultaneously.



CAUTION: Do not remove the cover from the system fan module due to danger from electric shock inside. Return the module to your supplier for repair.

See CAUTION bullets regarding electrostatic discharge and anti-static protection.

Tip: The illustrations show system fan module replacement as you face the enclosure rear panel. See also [Figure 4 on page 10](#) and [Figure 8 on page 12](#).

Removing a system fan module



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

1. Press down on the latch tab to release the fan from its locked position. See detail No.1 in [Figure 63 on page 71](#).

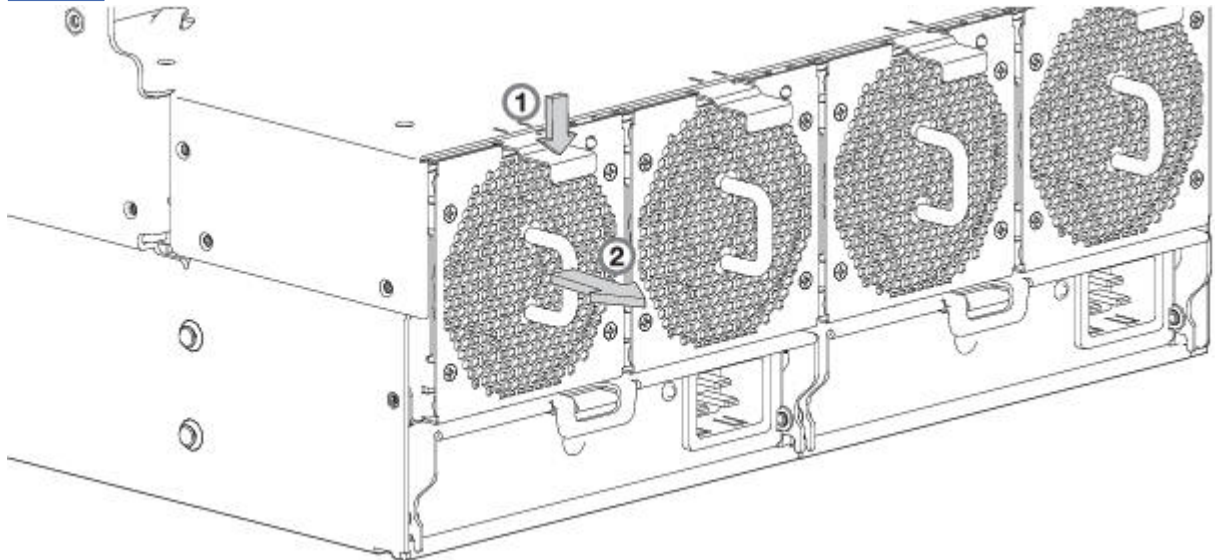


Figure 63. Removing a system fan (1 of 2)

2. Grasp the fan module handle and carefully pull the fan out of its slot. See detail No.2 in [Figure 64 on page 72](#).

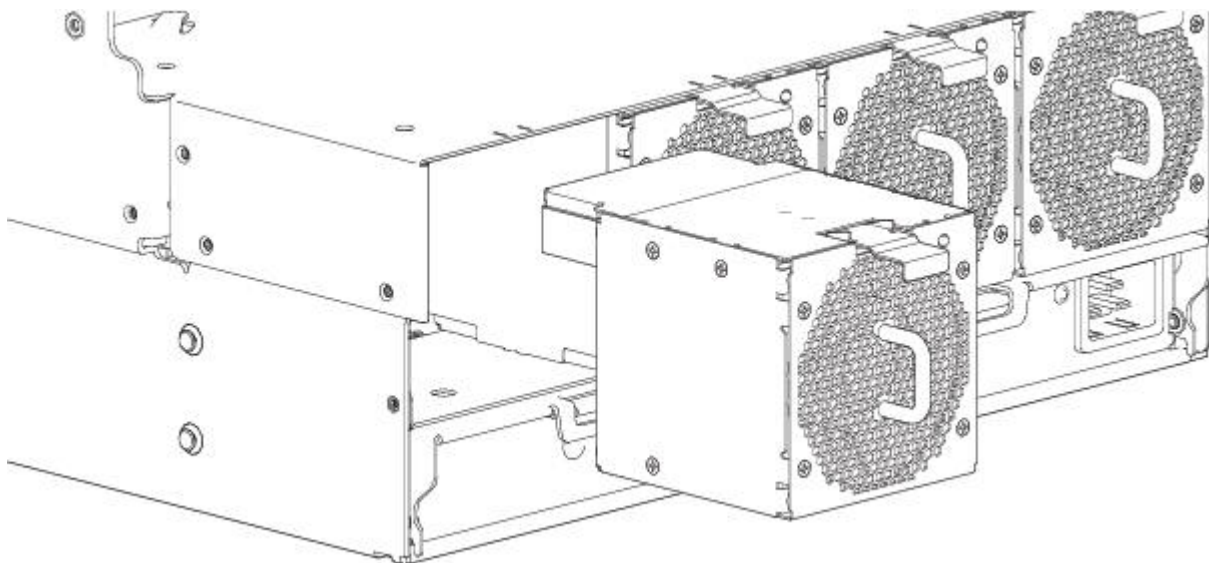


Figure 64. Removing a system fan (2 of 2)

Installing a system fan module

Refer to Figure 63 on page 71 and Figure 64 on page 72 when performing this procedure, but ignore the directional arrow—since you will insert the module into the slot—rather than remove it.

Important: Handle the system fan carefully, and avoid damaging connectors.

1. Check for damage, especially to all module connectors.
2. Align the system fan module for insertion into its slot, as shown in Figure 64 on page 72.
3. Insert the system fan, and slide the module into the enclosure, taking care to support the base and weight of the module with both hands.

Gently, but firmly, push the fan module into its fully seated position with its mating connector in the enclosure.

4. Verify that the System Fan Status LED is off. Verify that the cooling fans are spinning with no fail states. Verify that the front panel LED states show no amber module faults.
5. If replacing multiple fans, repeat steps 1 through 4. The replacement procedure should be completed within an absolute maximum of 2 minutes for this CRU module.

Replacing a controller fan module

This section provides procedures for replacing a failed controller fan module.

Illustrations in controller fan replacement procedures show top panel views of the enclosure, with the fan properly oriented for insertion into top panel of the enclosure, near the IOMs/EBOD expander modules. Remove the top lid “B” to access the controller module fan. See Figure 9 on page 12. Re-attach top lid “B” when you complete the procedure.

If a system fan module fails, the remaining fan is sufficient to maintain operation of the enclosure. You need not halt operations and completely power-off the enclosure when replacing only one controller module fan.



CAUTION: Do not remove the cover from the controller fan module due to danger from electric shock inside. Return the module to your supplier for repair.

See CAUTION bullets regarding [electrostatic discharge](#) and [anti-static protection](#).

Tip: The illustrations show controller fan module replacement as you face the enclosure rear panel. See also Figure 11 on page 13, Figure 20 on page 23 and Figure 21 on page 24.

Removing a controller fan module



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

1. Grasp the latch tab on the interior channel wall of the enclosure, and squeeze the tab against the wall to release the channel fan from its locked position as shown in [Figure 65 on page 73](#).

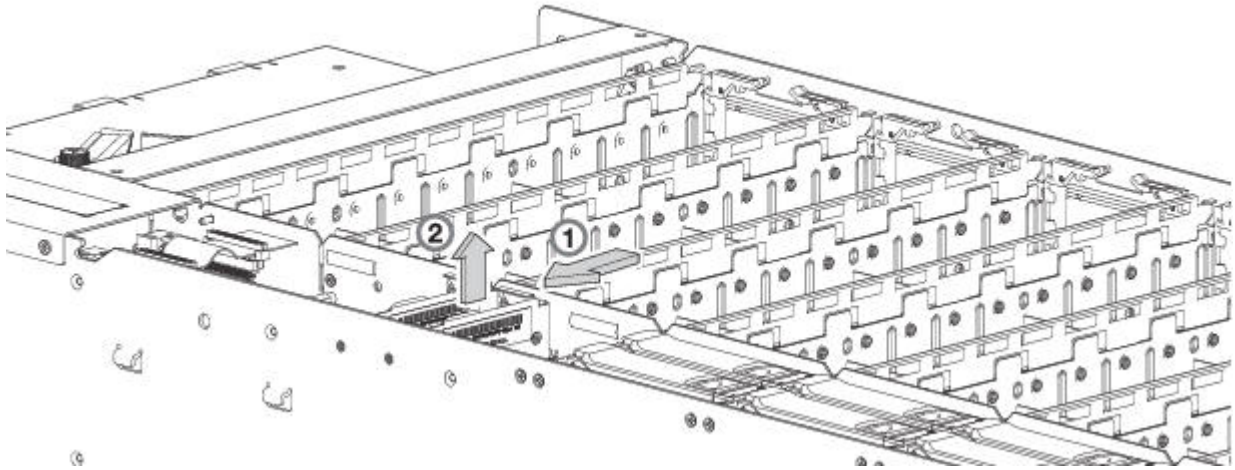


Figure 65. Removing a controller fan (1 of 2)

2. With your other hand, grasp the handle located on the top of the fan, and pull upwards to remove the fan from its slot as shown in [Figure 66 on page 73](#).

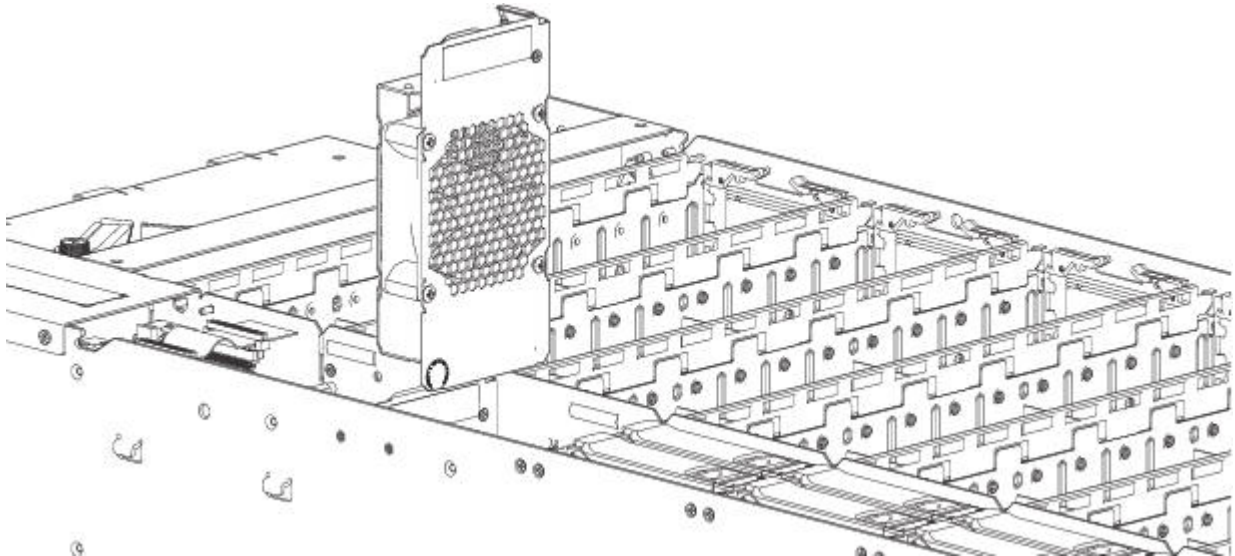


Figure 66. Removing a controller fan (2 of 2)

Installing a controller fan module

Refer to [Figure 65 on page 73](#) and [Figure 66 on page 73](#) when performing this procedure, but ignore the directional arrow—since you will insert the module into the slot—rather than remove it.

Important: Handle the controller fan carefully, and avoid damaging connectors.

1. Check for damage, especially to all module connectors.
2. Align the controller fan module for use in the fan slot that is accessible from the top panel.

3. Insert the controller fan module into the slot, and gently press down on the module until it seats firmly in its connector.
4. Verify that the Controller Fan Status LED is off. Verify that the front panel LED states show no amber module faults.
5. If replacing multiple fans, repeat steps 1 through 4.

Replacing a HS Expander Module

This section provides procedures for replacing a failed HS Expander module. Illustrations in HS Expander replacement procedures show top panel views of the enclosure, with the module properly oriented for insertion into the top panel of the enclosure near the right wall.

If a HS Expander module fails, the remaining modules are sufficient to maintain operation of the enclosure. You need not halt operations and completely power-off the enclosure when replacing only one HS Expander module. See CAUTION bullets regarding [electrostatic discharge](#) and [anti-static protection](#).

Tip: The illustrations show HS Expander module replacement as you face the enclosure front and view the top panel. See also [Figure 9 on page 12](#) and [Figure 11 on page 13](#).

Removing a HS Expander module



CAUTION: A hot surface nearby. (L007)



CAUTION: Removing this hot-swappable PCBA disrupts the enclosure's airflow. Do not remove the PCBA until you have received the replacement. It is important that all module slots are filled when the enclosure is in operation.

1. Remove the top lid "A" to access the HS Expander module. See [Figure 9 on page 12](#).
2. On the faulty HS Expander, grasp each of the two plastic swing-arms between thumb and index finger as shown in [Figure 67 on page 74](#).

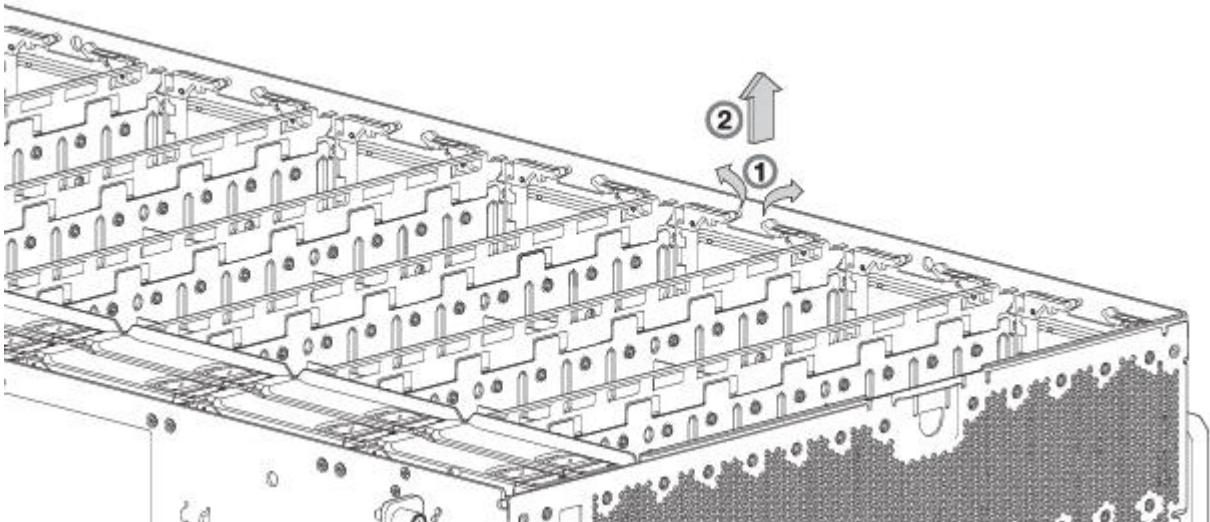


Figure 67. Removing a HS Expander (1 of 2)

3. Revolve each swing-arm upward to release the PCBA carrier from its slot as shown in [Figure 68 on page 75](#).

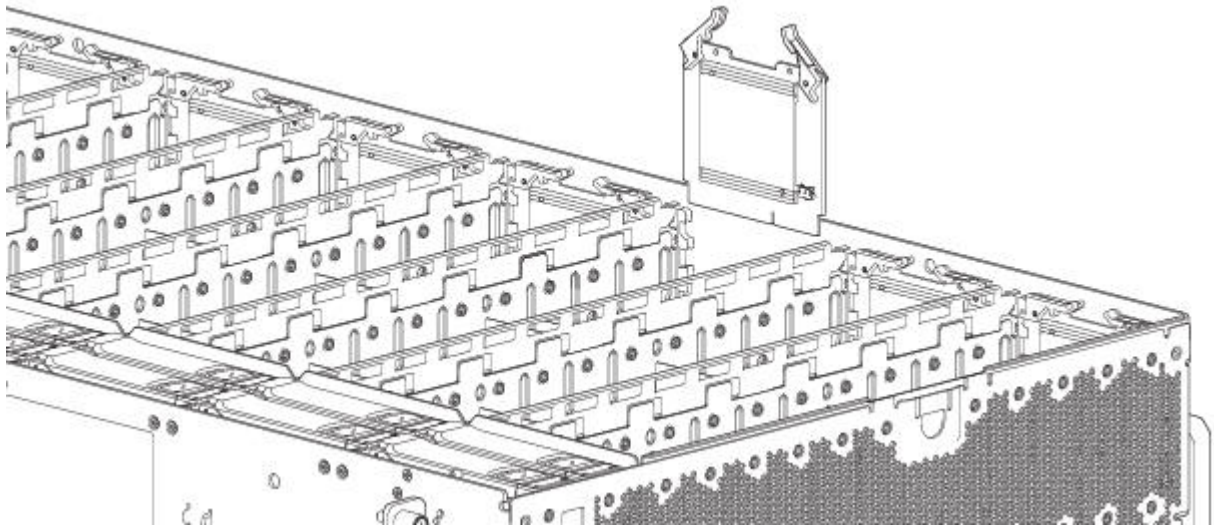


Figure 68. Removing a HS Expander (2 of 2)

4. While grasping the swing-arm handle, pull upwards to lift the HS Expander and remove it from its slot.

Installing a HS Expander module

Refer to [Figure 67 on page 74](#) and [Figure 68 on page 75](#) when performing this procedure, but ignore the directional arrow—since you will insert the module into the slot—rather than remove it.

Important: Handle the HS Expander module carefully to avoid damage to the connector and swing arms.

1. Check for damage, especially to all module connectors.
2. Align the controller HS Expander module for use in the module slot that is accessible from the top panel along the right wall of the enclosure.
3. Insert the controller module into the slot, and gently press down on the module until it seats firmly in its connector.
4. Verify that the HS Expander Status LED is off. Verify that the front panel LED states show no amber module faults.
5. If replacing multiple HS Expanders, repeat steps 1 through 4.
6. Reattach top lid “A” when you complete the procedure.

Replacing a drive carrier module

A disk drive module consists of a disk in a carrier or sled.

Disk Drive in Carrier (DDIC) modules are hot-swappable, which means they can be replaced without halting I/O to the declustered array 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. Remove the top lid “A” to access DDICs. See [Figure 9 on page 12](#) for enclosure lid locations and labeling. Reattach top lid “A” when the procedure is completed. If accessing DDICs in disk slots 96–105, remove top lid “B”, and reattach it when the procedure is completed. See also [Figure 11 on page 13](#) for disk slot indexing..



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.

See CAUTION bullets regarding [electrostatic discharge](#) and [anti-static protection](#).

Tip: The illustrations show disk module replacement within the drive slots as you view the enclosure top panel. See also [Figure 11](#) on page 13 for disk drive slot numbering. Although the DDIC with LFF disk is used in the illustrated procedures, the procedures also apply to the DDIC with SFF disk and adapter.

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.

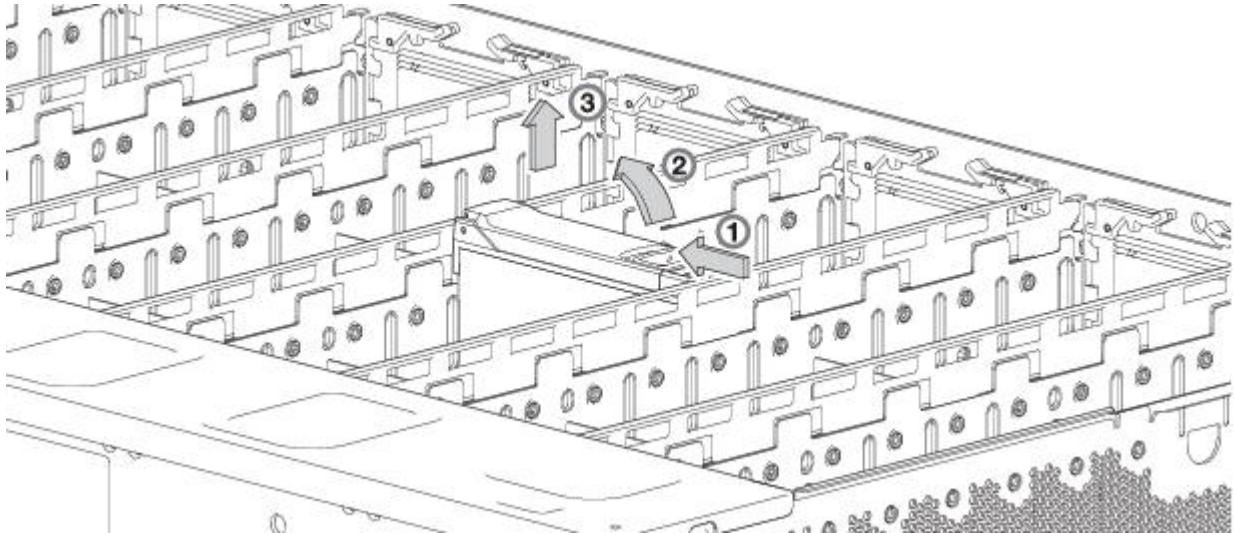


Figure 69. Removing a LFF disk drive module (1 of 2)

2. Revolve the handle outward to cam the module out of its connector on the base plane.

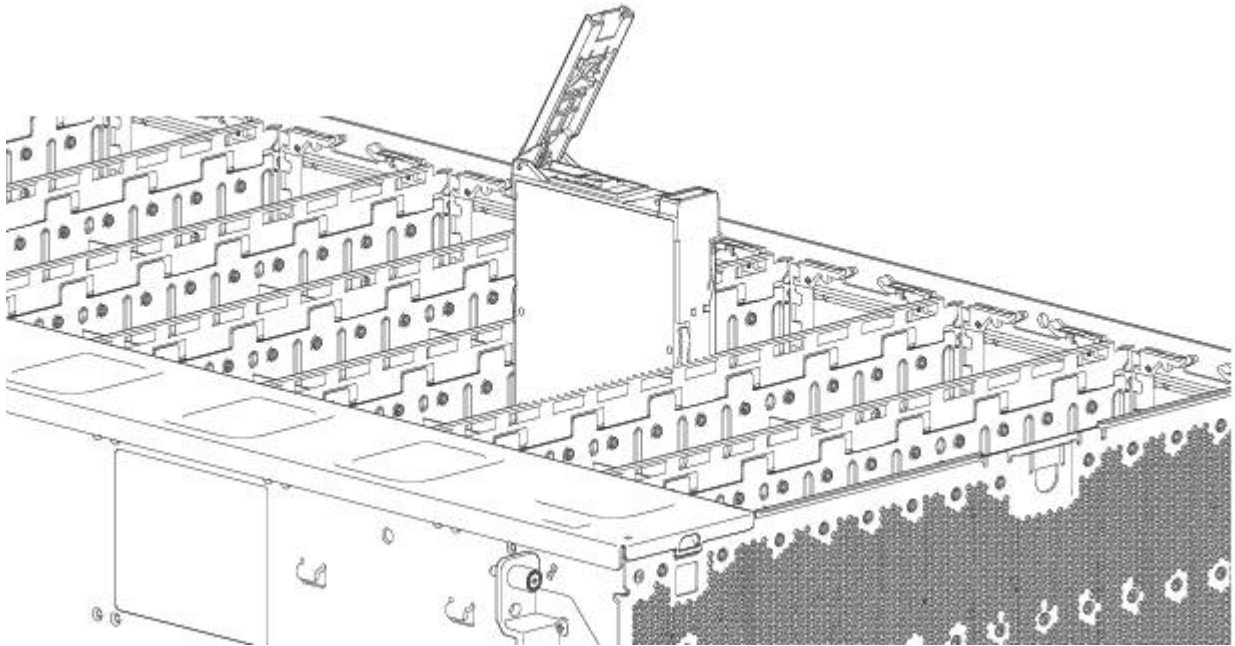


Figure 70. Removing a LFF disk drive module (2 of 2)

3. Lift and remove the module fully from the drive slot.

Installing a LFF drive carrier module

1. Release the drive carrier handle by pressing the latch in the carrier handle towards the handle hinge to release the carrier handle as shown below.



Figure 71. 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 front face of the disk is facing up, and the handle opens from the left as you face the enclosure top panel. The module should be revolved such that its horizontal axis is parallel to the chassis longitudinal axis, as shown.

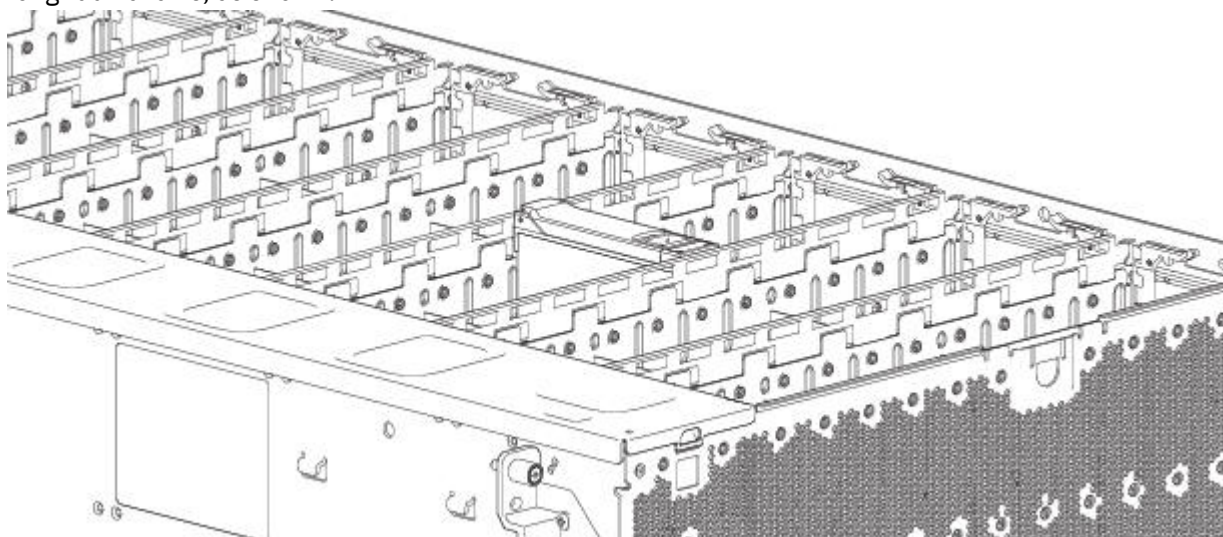


Figure 72. Installing a LFF drive carrier module (1 of 2)

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

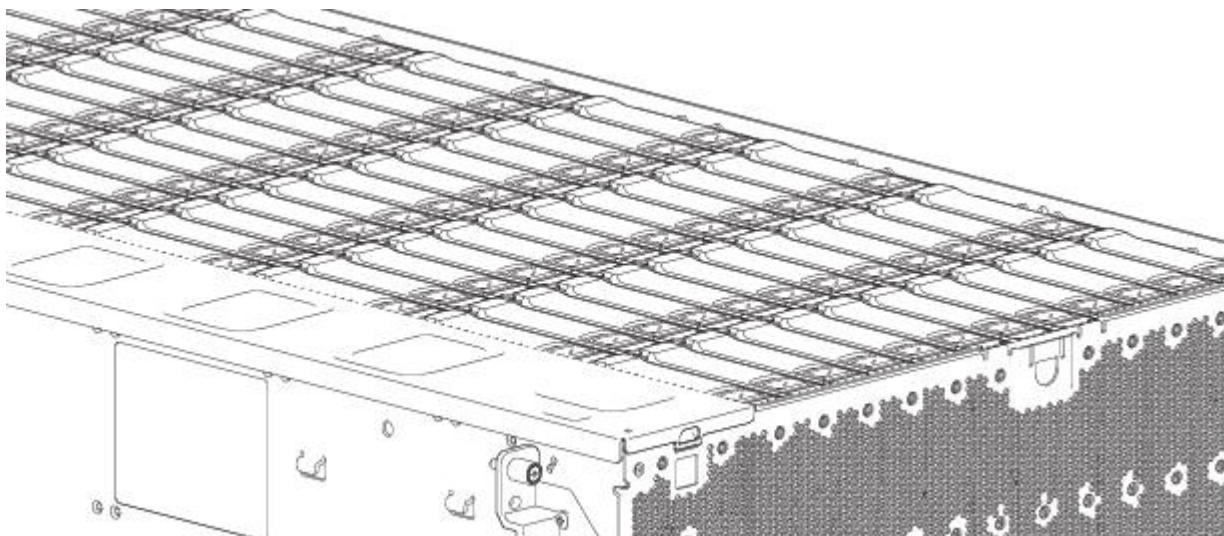


Figure 73. Installing a LFF drive carrier module (2 of 2)

5. Verify that the Amber Fault LED on the disk module handle is off. Verify that the front panel LED states show no amber module faults. The enclosure front panel Drive Activity LED will blink Green to show disk activity.

Replacing an IOM/EBOD expander module

Important: If the Model 106 enclosure is configured with a single expansion module, it must be installed in IOM/EBOD expander module slot No.0. As you face the enclosure rear panel, this is the IOM/EBOD expander module slot located on the right. An IOM/EBOD expander module blank must be installed in the adjacent slot (No.1) as shown in [Figure 5 on page 10](#). This configuration is required to ensure sufficient air flow through the enclosure during operation.

Model 106 only supports dual-IOM/EBOD expander module configuration. The I/O modules are hot-swappable, which means you can replace one module without halting I/O to declustered array or powering off the enclosure. In this case, the second module provides paths to the drives until you install the new module.

You may need to replace an expansion module when:

- The Fault LED is illuminated
- Logs or events in the firmware indicate a problem with the module
- Troubleshooting indicates a problem with the module

Before you begin

Removing an I/O 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 IOMs/EBOD expander modules in a dual-canister enclosure, record configuration settings before installing the new controller modules. See [“Removing an IOM/EBOD expander module” on page 79](#), and [“Installing an IOM/EBOD expander module” on page 80](#) for instructions about installing an additional controller module.

Verifying component failure

- Check Module Fault LED – rear (front of enclosure): Amber= Fault condition.
- Check Fault LED (back of enclosure on IOM/EBOD expander module faceplate): Amber = Fault condition.

- Check that the OK LED (back of enclosure) is off.

Stopping I/O

During troubleshooting disk drive and connectivity faults, stop I/O to the affected declustered array from all hosts as a data protection precaution.

Removing an IOM/EBOD expander module

Important: Considerations for removing IOMs/EBOD expander 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.
- In a dual-controller environment—if replacing both controller modules—you must adhere to the instructions provided in [Before you begin](#) and perform an orderly shutdown of the enclosure.
- Do not remove a faulty module unless its replacement is on-hand. All CRU modules must be in place when the system is in operation.

See CAUTION bullets regarding [electrostatic discharge](#) and [anti-static protection](#).

Illustrations in the IOM/EBOD expander module replacement procedures show rear panel views of the enclosure, and IOMs/EBOD expander modules are properly aligned for insertion into the rear panel of the enclosure.

1. Locate the enclosure whose ID LED (enclosure front panel – left side) is illuminated, and within the enclosure, locate the IOM/EBOD expander module to be replaced.
2. Disconnect any cables connected to the IOM/EBOD expander module.
Label each cable to facilitate re-connection to the replacement IOM/EBOD expander module.
3. Unlock the IOM/EBOD expander module latch handle by turning the thumbscrew counter-clockwise as shown in detail No.1 in [Figure 74 on page 79](#).

Take care not to remove the thumbscrew from the IOM/EBOD expander module latch handle.

4. Grasp the IOM latch handle between the thumb and index finger and pull. Revolve the handle out and downward to lever the IOM/EBOD expander module out of the enclosure as shown in details No.2 and No.3 in [Figure 74 on page 79](#).

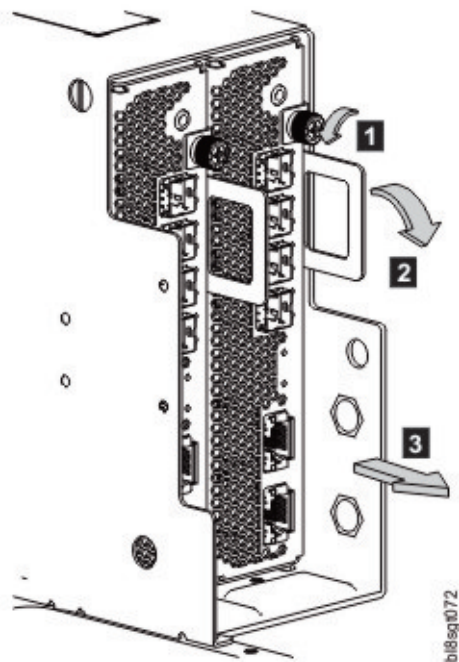


Figure 74. Removing an IOM/EBOD expander module (1 of 2)

5. Grip the latch handle and ease the IOM/EBOD expander module forward from the slot as shown within [Figure 75 on page 80](#).
6. Place both hands on the IOM/EBOD expander module body, and pull it straight out of the enclosure such that the IOM/EBOD expander module remains level during removal.

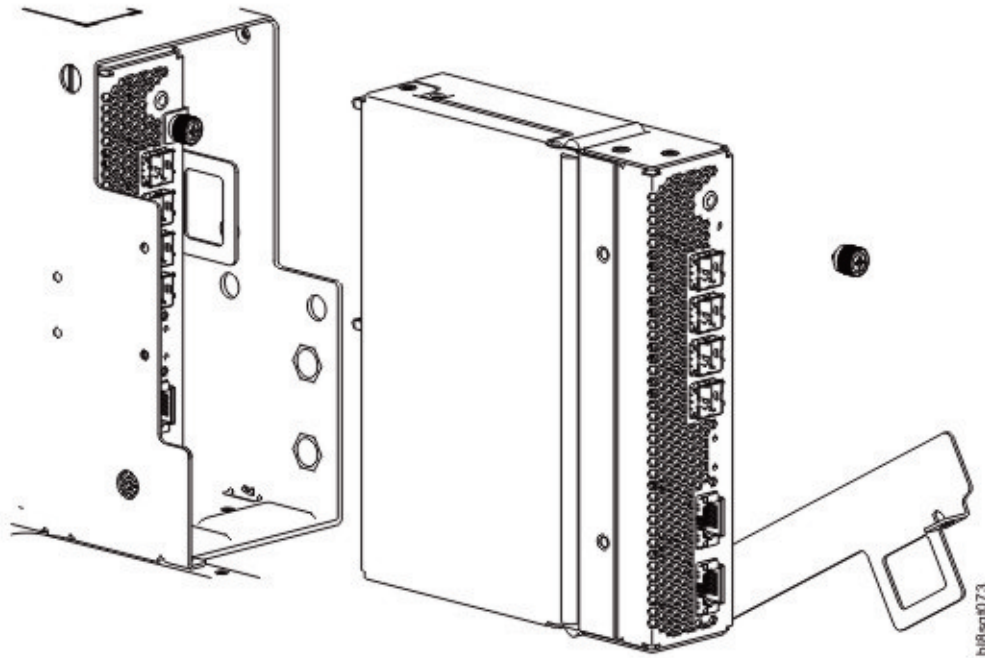


Figure 75. Removing an IOM/EBOD expander module (2 of 2)

Installing an IOM/EBOD expander module

See CAUTION bullets regarding [electrostatic discharge](#) and [anti-static protection](#).



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 75 on page 80](#) and [Figure 74 on page 79](#) while ignoring the directional arrow. For installation, the IOM/EBOD expander module will travel in the opposite direction relative to the arrow shown.

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

An expansion enclosure canister that is only partially seated will prevent optimal performance of the enclosure. Verify that the 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/EBOD expander module to its connector on the back of the midplane. Tighten the thumbscrew to secure the latch in place.

5. Reconnect the cables.

Note: Verify that the firmware in both IOMs/EBOD expander modules is compatible.

Verifying component operation

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 there are no illuminated Fault LEDs on the enclosure front panel or the IOM/EBOD expander module faceplate.

Appendix A. Technical specifications

Enclosure dimensions

Table 13. Model 106 enclosure dimensions		
Specification	Metric units	Imperial units
Height (including top cover)	176.4 mm	6.94 in
Width (excluding ears and rails)	441 mm	17.36 in
Depth (including handles, excluding cables)	1,139 mm	44.84 in

Enclosure weights

Table 14. Model 106 enclosure weights		
CRU/component	Metric units	Imperial units
Storage enclosure (empty)	36 kg	79.4 lb
Disk drive carrier (3.5" LFF disks or 2.5" SFF disk with LFF adapter)	Up to 0.8 kg	Up to 1.8 lb
Power Supply Unit (PSU)	1.45 kg	3.2 lb
System fan module	0.7 kg	1.5 lb
IOM/EBOD expander module	0.8 kg	1.8 lb
IOM/EBOD expander module fan module	0.345 kg	0.8 lb
HS Expander module	0.1 kg	0.2 lb
JBOD/EBOD enclosure (fully populated with 106 drives: maximum weight)	145.6 kg	321 lb

Note:

1. Weights shown are nominal, and subject to variances. Disk drive module weights vary by type of disk used.
2. Rail kit adds approximately 6.75 kg (14.9 lb) to the aggregate enclosure weight. The CMA adds 0.91 kg (2.0 lb) to aggregate enclosure weight.
3. Weights may vary due to number and type of disks, number of IOMs, and differing calibrations between scales.

Declared Noise Emissions in Accordance with ISO 9296^(1,2,3)

Product Description	Declared A-Weighted Sound Power Level, L_{WAd} (B)		Declared A-Weighted Sound Pressure Level, L_{pAm} (dB)	
	Operating	Idling	Operating	Idling
5147-106 (at 23 degrees C)	8.1 ⁽⁵⁾	7.9 ⁽⁵⁾	66 ⁽⁴⁾	63 ⁽⁴⁾
5147-106 (at 27 degrees C)	8.8 ⁽⁵⁾	8.3 ⁽⁵⁾	72 ⁽⁴⁾	67 ⁽⁴⁾
5147-106 Maximum ambient temperature Maximum work load (operation)	9.9 ⁽⁵⁾	9.9 ⁽⁵⁾	83 ⁽⁴⁾	83 ⁽⁴⁾
5147-106 Acoustical Doors FC EC07 = back	9.4 ⁽⁴⁾⁽⁵⁾	9.4 ⁽⁴⁾⁽⁵⁾	78 ⁽⁴⁾	78 ⁽⁴⁾

Notes:

1. Declared level L_{WAd} is the upper-limit A-weighted sound power level; Declared level L_{pAm} is the mean A-weighted sound pressure level measured at the 1-meter bystander positions.
2. All measurements made in conformance with ISO 7779 and declared in conformance with ISO 9296.
3. B, dB, abbreviations for bels and decibels, respectively. 1 B = 10 dB.
4. Estimate
5. *Notice:* Government regulations (such as those prescribed by OSHA or European Community Directives) may govern noise level exposure in the workplace and may apply to you and your server installation. This IBM system is available with an optional acoustical door feature that can help reduce the noise emitted from this system. The actual sound pressure levels in your installation depend upon a variety of factors, including the number of racks in the installation; the size, materials, and configuration of the room where you designate the racks to be installed; the noise levels from other equipment; the room ambient temperature, and employees' location in relation to the equipment. Further, compliance with such government regulations also depends upon a variety of additional factors, including the duration of employees' exposure and whether employees wear hearing protection. IBM recommends that you consult with qualified experts in this field to determine whether you are in compliance with the applicable regulations.

Environmental requirements

Table 15. Ambient temperature and humidity		
Specification	Temperature range	Relative humidity
Operating	5°C to 35°C (41°F to 95°F, derated by 1°C per 300m above 900m) (ASHRAE A2 2015 thermal guidelines)	-12°C DP/10 to 80% (Max) (Non-condensing)

<i>Table 15. Ambient temperature and humidity (continued)</i>		
Specification	Temperature range	Relative humidity
Non-operating	-40°C to +70°C (-40°F to +158°F) (Max rate of change: 20°C)	-12°C DP/5 to 100% (Max) (Non-condensing)

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 mmH ₂ O)
Altitude, operating	-100 to 3,048 meters (0 to 10,000 feet). Maximum operating temperature is de-rated by 1°C for each 300 m above 900 m (2952.76 feet)
Altitude, non-operating	-100 to 12,192 m (-328 to 40,000 feet)
Shock, operating	3.0 g, 11 ms (per axis)
Shock, non-operating	20.0 g, 7ms, 10 shock pulses (2 shocks per axis X, Y in positive and negative direction, and 2 shocks in positive Z axis) OR ISTA 3H (mounted in a rack, horizontal impact on all sides, 4-in drop tests)
Vibration, operating	0.18 G _{rms} 5 Hz to 500 Hz, 30 min per axis
Vibration, non-operating	0.54 G _{rms} 6Hz to 200 Hz (ISTA 3E)
Vibration, relocation	ISTA3H air ride for 60 min
Acoustics	4U enclosures: Sound power operating ≤ 8.5 Bels LW _{Ad} @ 23°C
Orientation and mounting:	1.2 m rack mount (4 EIA units)
Rack rails	To fit 1.2m depth racks compliant with the SSI server rack specification
Rack characteristics	Back pressure not exceeding 5Pa (~0.5 mm H ₂ O)

Power supply unit (PSU) module

Specifications for the power supply unit are provided.

<i>Table 16. Power cooling module specifications</i>	
Specification	Measurement/description
Dimensions (size)	38.1 mm high x 169.9 mm wide x 211.1mm long: • X-axis length: 169.9 mm (6.69 in) • Y-axis length: 38.1 mm (1.5 in) • Z-axis length: 211.1 mm (8.3 in)
Maximum Watts	1568W
Maximum VA	1650 VA
Voltage range	200–240 VAC rated

Table 16. Power cooling module specifications (continued)

Specification	Measurement/description
Frequency	50–60Hz
Voltage range selection	Auto-ranging: 90–264 VAC, 47–63Hz
Maximum inrush current	55A
Power conversion efficiency	>=94%@ 230 VAC (50% load)
Harmonics	Meets EN61000-3-2 (EU), EN 31000-3-3 (EU), EN 55024 (EU), KN 24/KN 35 (S. Korea)
Output	+12V @ 164A, +12V Standby Voltage @ 3.5A
Hot pluggable	Yes
Switches and LEDs	AC power cable connect and one bi-tonal status indicator LED
Enclosure cooling	Four dual-impeller, counter rotating axial fans (enclosure rear panel)
	Two single-impeller axial fans (controller bay)

Appendix B. Standards and regulations

International standards

The system complies to all applicable safety standards to allow for shipments worldwide including the America's, European Union Member States, Middle East, and Asia.

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 55032 Class A: Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment and EN50082-1: Generic Immunity.

Safety compliance

The system complies to all applicable safety standards to allow for shipments worldwide including the America's, European Union Member States, Middle East, and Asia.

EMC compliance

Table 17. EMC compliance specifications	
Emissions	FCC CFR 47 Part 15 Subpart B Class A (USA)
	ICES/NMB-003 Class A (Canada)
	EN 55032:2015 Class A (EU)
	AS/NZS EN 55032:2012 (Australia/New Zealand) Class A (Australia/New Zealand)
	VCCI Class A (Japan)
	KN 32:2015 Class A (S. Korea)
	CNS 13438 Class A (Taiwan)
Harmonics	EN61000-3-2 (EU)
Flicker	EN61000-3-3 (EU)
Immunity	EN55024 (EU)
	KN 35:2015 (S. Korea)

AC power cords/universal jumper cords

Table 18. AC power cord and universal jumper cords specifications		
1	United States and Canada	
	Must be NRTL Listed (National Recognized Test Laboratory –e.g., UL)	SVT or SJT, 14 AMG, 3 conductor, 2.0M max length
	Cord type	
	Plug	NEMA 6–15P grounding-type attachment plug rated 240V 15A
		or
		IEC320, C-20, 250V, 15A or 16A
	Socket	IEC320, C-19, 250V, 15A or 16A
2	General requirements: Europe and others	
	Cord type	Harmonized, H05-VVF, 15A or 16A, 250V, 14 AMG, 3*1.5sq mm
	Socket	IEC 320, C-19/C-20, 250V, 15A or 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.

- Countries include the US, Canada, EU/NEMA, Mexico, Argentina, AUS/NZ, Japan, South Korea, Brazil, Vietnam, China, India, and EAC.
- Standards include RoHS, VDE, and low halogen.

Environmental Standards

- The RoHS Directive (2011/65/EU)
- The WEEE Directive (2012/19/EU)
- The REACH Directive (EC/1907/2006)

Along with the standards listed above, this product will meet all applicable requirements listed in the IBM Environmental Engineering Specification, 46G3772. These requirements include material substance restrictions, batteries, energy efficiency, environmental making for batteries, WEEE , China RoHS, environmental notice user guides and chemical usage.

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 for a copy of the Recycling Procedures applicable to your country.

Important: Observe all applicable safety precautions detailed in the preceding chapters when dismantling and disposing of this equipment.

Appendix C. Enclosure packaging

Supported packaging configurations are included for reference. Identify your packaging configuration from the palletized enclosure ship kit assemblies shown below. Read the documentation provided in your ship kit before unpacking, disposing of, or storing packing materials. See also [“Unpacking the enclosure”](#) on page 29.

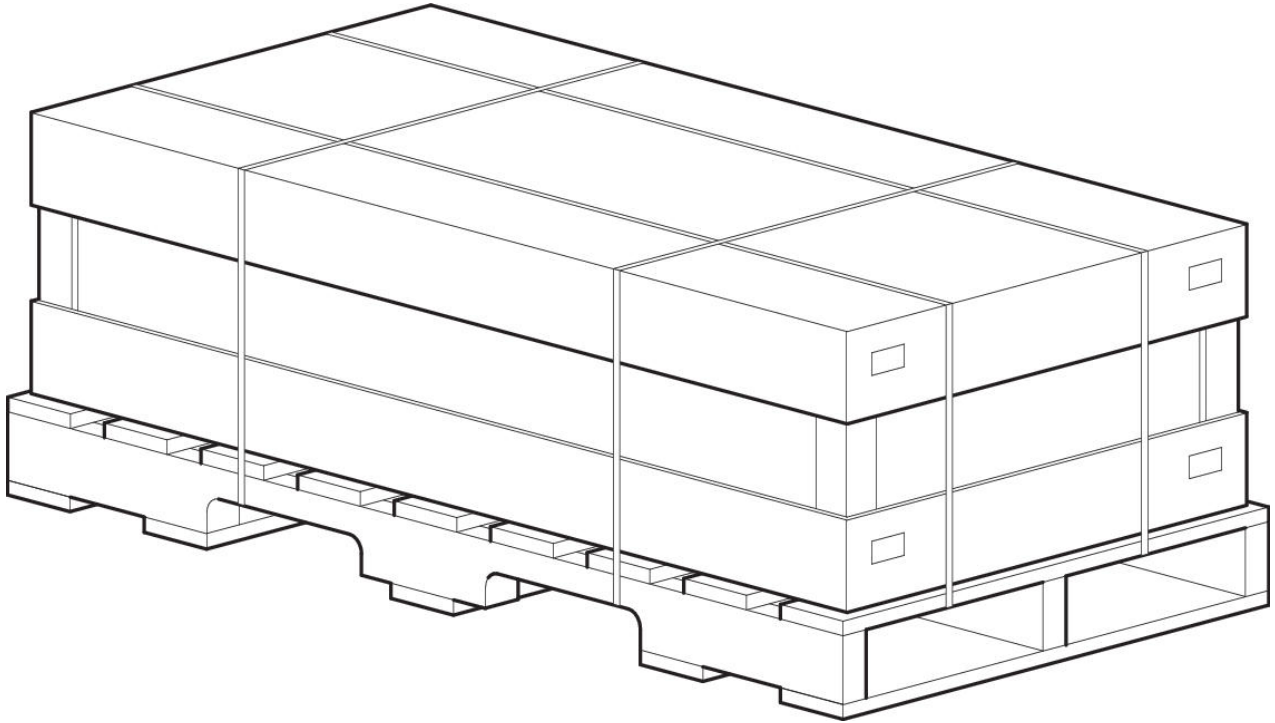


Figure 76. Unpacking the enclosure: 3-piece box with packing

[Figure 78 on page 93](#) shows an illustrated parts catalog (IPC) representation of the enclosure master container to complement the assembly view shown above.

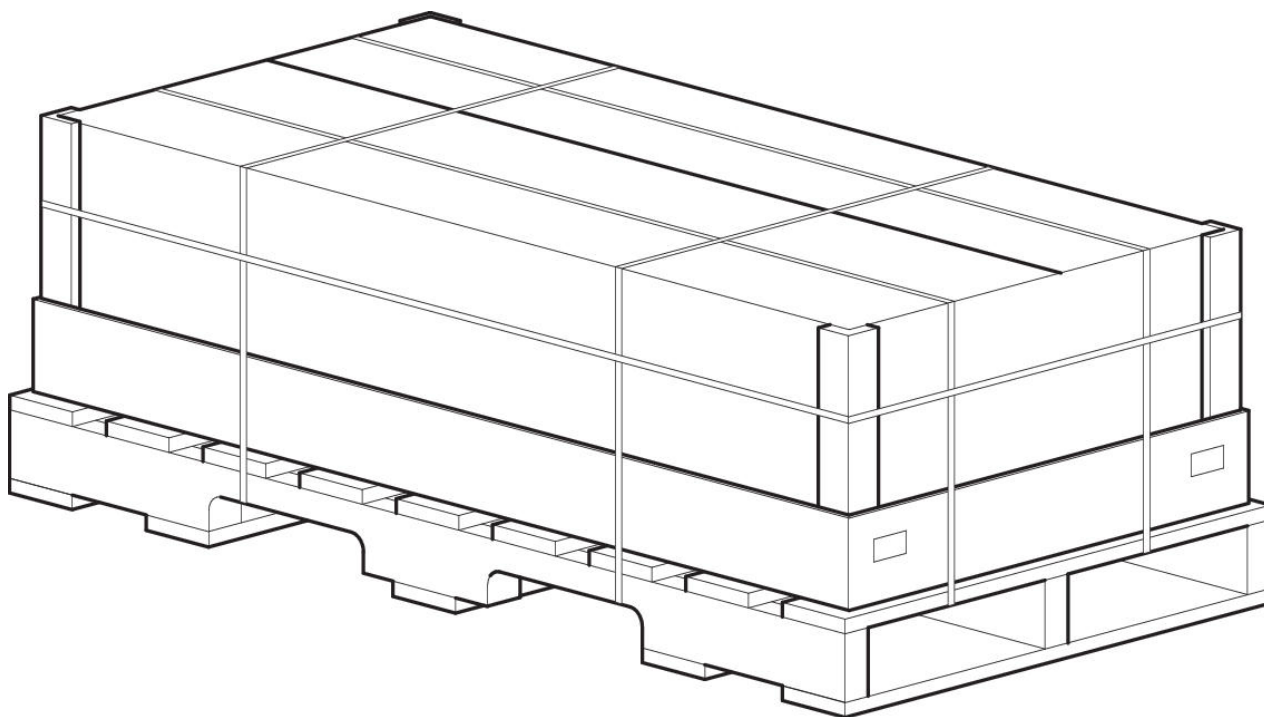


Figure 77. Unpacking the enclosure: RSC box with packing

The Regular Slotted Container (RSC) box option is shown directly above. [Figure 79 on page 94](#) shows an illustrated parts catalog representation of the RSC enclosure master container. This box uses a split flap-style, as opposed to the removable lid shown in [Figure 76 on page 91](#). The RSC configuration differs from the 3-piece configuration: it does not include the rail kit box, CMA box, or accessory box. These items are provided separately for this configuration.

Important: Disk drives in carriers (DDICs) are packaged separately from the Model 106 enclosure, and are available in different assortments (single, 12-pack, 24-pack). Do not populate disk slots with DDICs until after the enclosure has been installed in the rack using a suitable mechanical lift. See also the [CAUTION on page 10](#) and [“Populating disk drive slots” on page 13](#).

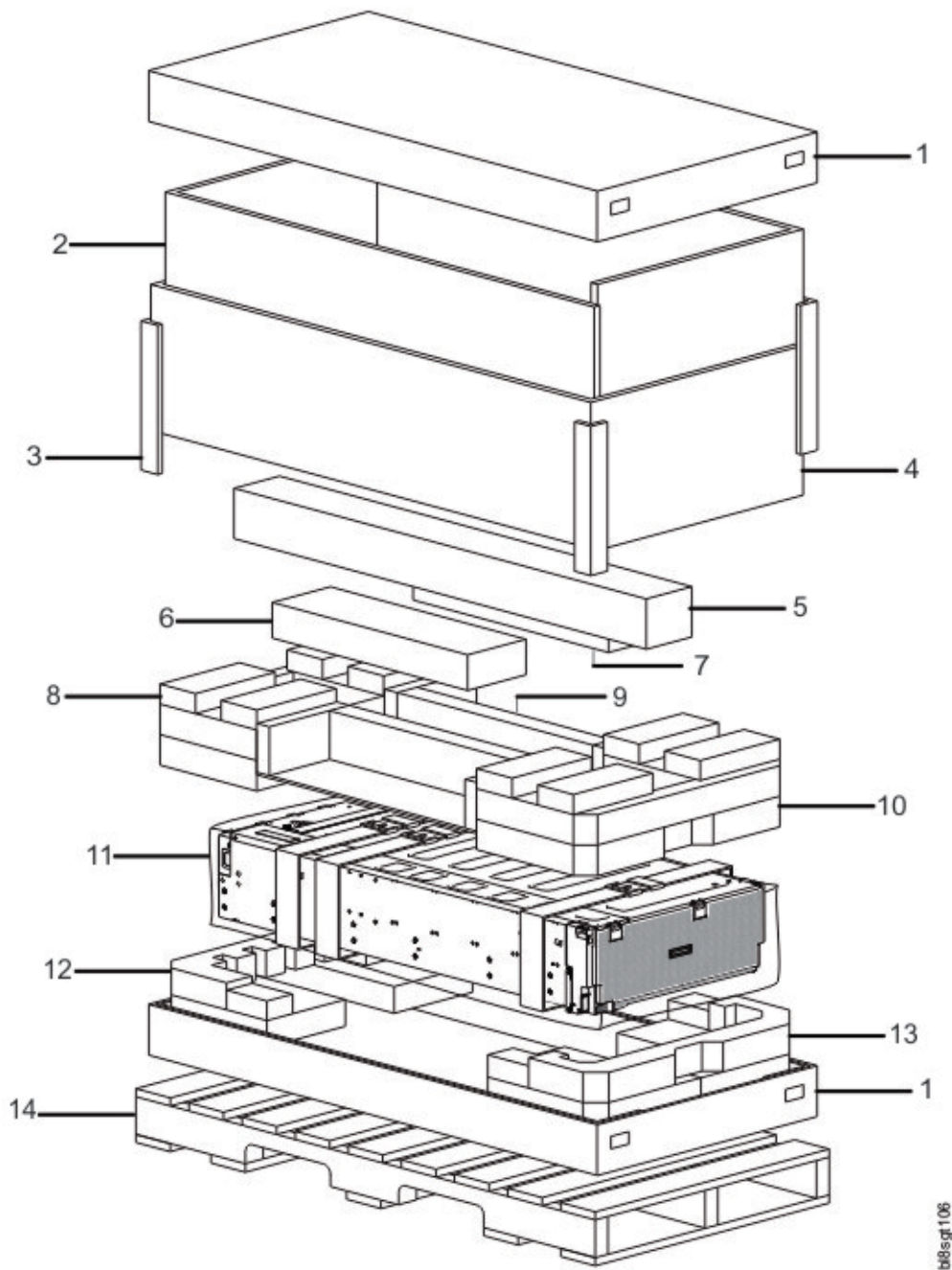


Figure 78. Unpacking the enclosure: 3-piece box with packing

No.	Component description	Qty.	No.	Component description	Qty.
1	Base/lid, cardboard	2	8	Foam, inner, drawer rear, top	1
2	Insert, strength L, cardboard	2	9	Insert, CMA holder, cardboard	2
3	Edge protector, height, each corner	4	10	Foam, inner, drawer front, top	1
4	Insert, wall, cardboard	1	11	Plastic bag (with enclosure/belt straps)	1
5	Rail kit box	1	12	Foam, inner, drawer rear, bottom	1

No.	Component description	Qty.	No.	Component description	Qty.
6	Box, accessory kit	1	13	Foam, inner, drawer front, bottom	1
7	CMA box	1	14	Custom pallet, wood	1

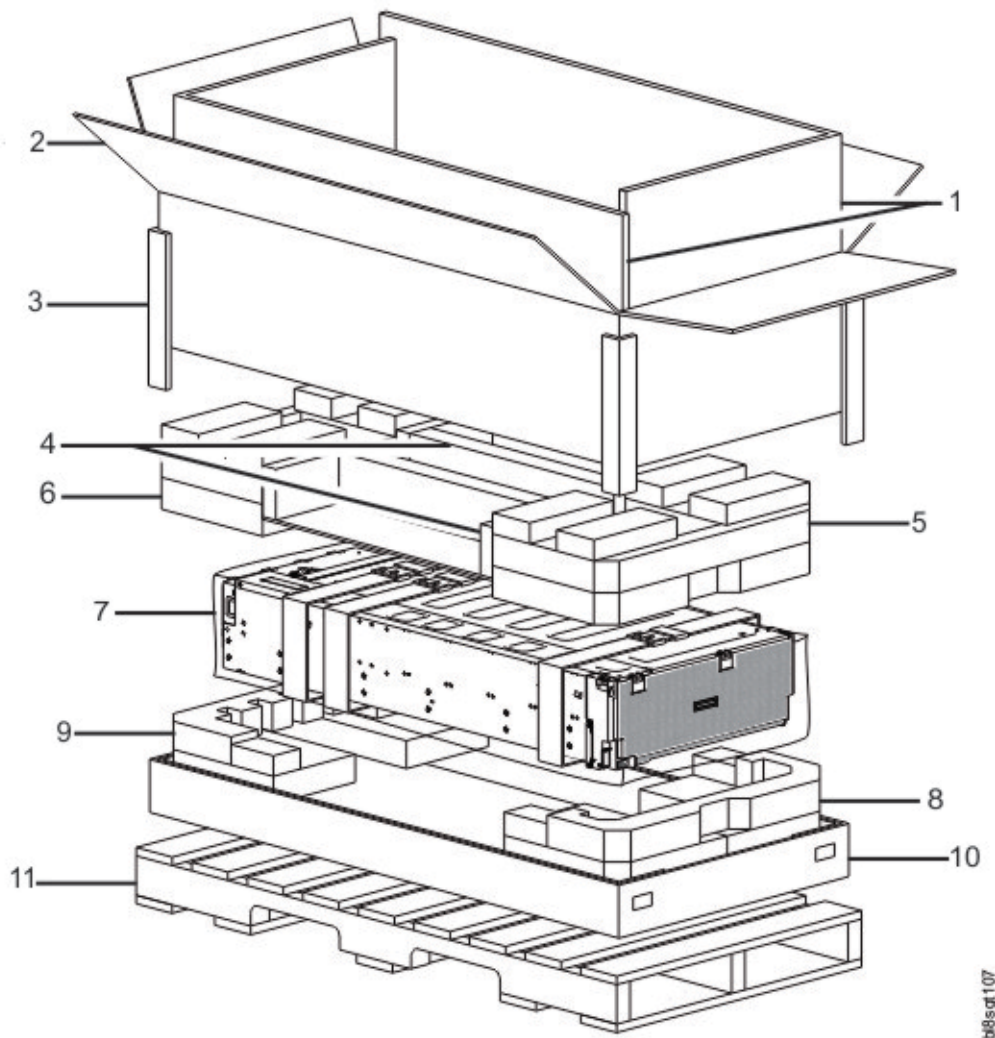


Figure 79. Unpacking the enclosure: RSC box with packing

No.	Component description	Qty.	No.	Component description	Qty.
1	Insert, strength L, cardboard	2	7	Plastic bag (with enclosure/belt straps)	1
2	Lid, cardboard with AW	1	8	Foam, inner, drawer front, bottom	1
3	Edge protector, height, each corner	4	9	Foam, inner, drawer rear, bottom	1
4	Insert, CMA holder, cardboard	2	10	Base, cardboard	1
5	Foam, inner, drawer front, top	1	11	Custom pallet, wood	1
6	Foam, inner, drawer rear, top	1			

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International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
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European community contact:

IBM Deutschland GmbH Technical Regulations, Department M372 IBM-Allee 1, 71139 Ehningen,
Germany Tele: +49 7032 15-2941 Email: lugi@de.ibm.com

Germany Electromagnetic Compatibility Directive

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