IBM FlashSystem 5200

Hardware Guide

Note

Before using this information and the product it supports, read the information in Chapter 2, “Notices ,” on page 3.

This edition applies to version 8, release 7, modification x, and to all subsequent modifications until otherwise indicated in new editions.

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Chapter 1. FlashSystem 5200

Welcome to the FlashSystem 5200 documentation, where you can find information about how to install, maintain, and use the IBM Storage FlashSystem 5200 . This product is ENERGY STAR certified. For more information, see ENERGY STAR certified storage products.

Chapter 2. Notices

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Product support statement

If you have an operating system, Hypervisor, platform or host attachment card in your environment, check the IBM System Storage Interoperation Center (SSIC) to confirm the support status for this product.

SSIC can be found at http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss.

Homologation statement

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact an IBM representative or reseller for any questions.

Safety and environmental notices

Review all safety notices, environmental notices, and electronic emission notices 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.

To find the converted text for a caution or danger notice, complete the following steps.

1. Look for the identification number at the end of each caution notice or each danger notice. In the following examples, the numbers (C001) and (D002) are the identification numbers.

   

   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)
2. Locate the *IBM Systems Safety Notices* document with the user publications that were provided with your system hardware.
3. Find the matching identification number in *IBM Systems Safety Notices*. Then, review the topics about the safety notices to ensure that you are in compliance.
4. (Optional) Read the multilingual safety instructions on the system website.
   a. Go to www.ibm.com/support
   b. Enter the name of your system in the Search field (for example, "IBM Storage FlashSystem 5300").
   c. Click the documentation link.

For more information on Safety and environmental notices, see Environmental and safety notices.

For more details on different notices, see the following pages:

Safety notices and labels

Review the safety notices and safety information labels before you use this product.

To view a PDF file, you need Adobe Acrobat Reader. You can download it at no charge from the Adobe website:

www.adobe.com/support/downloads/main.html

IBM Systems Safety Notices

This publication contains the safety notices for the IBM Systems products in English and other languages. Anyone who plans, installs, operates, or services the system must be familiar with and understand the safety notices. Read the related safety notices before you begin work.

Note: The *IBM System Safety Notices* document is organized into two sections. The danger and caution notices without labels are organized alphabetically by language in the "Danger and caution notices by language" section. The danger and caution notices that are accompanied with a label are organized by label reference number in the "Labels" section. You can download the most current version of *IBM System Safety Notices* at the following site: *Environmental and safety notices*.

The following notices and statements are used in IBM documents. They are listed in order of decreasing severity of potential hazards.

Danger notice definition
A special note that emphasizes a situation that is potentially lethal or extremely hazardous to people.

Caution notice definition
A special note that emphasizes a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice.

Note: In addition to these notices, labels might be attached to the product to warn of potential hazards.

Finding translated notices

Each safety notice contains an identification number. You can use this identification number to check the safety notice in each language.

To find the translated text for a caution or danger notice:

1. In the product documentation, look for the identification number at the end of each caution notice or each danger notice. In the following examples, the numbers (D002) and (C001) are the identification numbers.

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

   CAUTION: A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury. (C001)
2. After you download the *IBM System Safety Notices* document, open it.
3. Under the language, find the matching identification number. Review the topics about the safety notices to ensure that you are in compliance.

Caution notices for the system

Ensure that you understand the caution notices for the system.

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

CAUTION: The battery contains lithium. To avoid possible explosion, do not burn or charge the battery.

Do not throw or immerse into water, heat to more than 100°C (212°F), repair or disassemble. (C003)

CAUTION:

≥ 18 kg (39.7 lb) ≥ 33.6 kg (74 lb) ≥ 46.3 kg (102 lb)

The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)

CAUTION: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.

- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

Danger notices for the system

Ensure that you are familiar with the danger notices for your system.

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

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. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- When connecting power to the product ensure all power cables are properly connected. For racks with AC power, 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. For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring.
- 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.
- When performing a machine inspection: Assume that an electrical safety hazard is present. Perform all ontinuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. Do not attempt to switch power to the machine until all possible unsafe conditions are corrected. Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems.
- Disconnect the attached power cords, telecommunications systems, 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 might 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: 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)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

Special caution and safety notices

This information describes special safety notices that apply to the system.

These notices are in addition to the standard safety notices that are supplied; they address specific issues that are relevant to the equipment provided.

General safety

When you service the IBM Storage FlashSystem 5300, follow general safety guidelines.

CAUTION: The weight of the enclosure exceeds 18kgs, lift the enclosure after referring label

Use the following general rules to ensure safety to yourself and others.

- Observe good housekeeping in the area where the devices are kept during and after maintenance.
- Follow the guidelines when lifting any heavy object:

1. Ensure that you can stand safely without slipping.
2. Distribute the weight of the object equally between your feet.
3. Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
4. Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that weigh more than 18 kg (40 lb) or objects that you think are too heavy for you.*

- Do not perform any action that causes a hazard or makes the equipment unsafe.
- Before you start the device, ensure that other personnel are not in a hazardous position.
- Place removed covers and other parts in a safe place, away from all personnel, while you are servicing the unit.
- Keep your tool case away from walk areas so that other people cannot trip over it.
- Do not wear loose clothing that can be trapped in the moving parts of a device. Ensure that your sleeves are fastened or rolled up above your elbows. If your hair is long, fasten it.
- Insert the ends of your necktie or scarf inside clothing or fasten it with a nonconducting clip, approximately 8 cm (3 in.) from the end.
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing.

  Remember: Metal objects are good electrical conductors.
- Wear safety glasses when you are hammering, drilling, soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
- After service, reinstall all safety shields, guards, labels, and ground wires. Replace any safety device that is worn or defective.
- Reinstall all covers correctly after you have finished servicing the unit.

Inspecting the system for unsafe conditions

Use caution when you are working in any potential safety hazardous situation that is not covered in the safety checks. If unsafe conditions are present, determine how serious the hazards are and whether you can continue before you correct the problem.

Before you begin

Before you start the safety inspection, make sure that the power is off, and that the power cord is disconnected.

About this task

Each device has the required safety items that are installed to protect users and support personnel from injury. Only those items are addressed.

Important: Good judgment must also be used to identify potential safety hazards due to the attachment of non-IBM features or options that are not covered by this inspection guide.

If any unsafe conditions are present, you must determine how serious the apparent hazard might be and whether you can continue without first correcting the problem. For example, consider the following conditions and their potential safety hazards:

Electrical hazards (especially primary power)
Primary voltage on the frame can cause serious or lethal electrical shock.

Explosive hazards
A damaged CRT face or a bulging capacitor can cause serious injury.

Mechanical hazards
Loose or missing items (for example, nuts and screws) can cause serious injury.

To inspect each node for unsafe conditions, use the following steps. If necessary, see any suitable safety publications.

Procedure

1. Turn off the system and disconnect the power cord.
2. Check the frame for damage (loose, broken, or sharp edges).
3. Check the power cables by using the following steps:
   a) Ensure that the third-wire ground connector is in good condition. Use a meter to check that the third-wire ground continuity is 0.1 ohm or less between the external ground pin and the frame ground.
   b) Ensure that the power cord is the appropriate type, as specified in the parts listings.
   c) Ensure that the insulation is not worn or damaged.
4. Check for any obvious nonstandard changes, both inside and outside the unit. Use good judgment about the safety of any such changes.
5. Check inside the node for any obvious unsafe conditions, such as metal particles, contamination, water or other fluids, or marks of overheating, fire, or smoke damage.
6. Check for worn, damaged, or pinched cables.
7. Ensure that the voltage that is specified on the product-information label matches the specified voltage of the electrical power outlet. If necessary, verify the voltage.
8. Inspect the power-supply assemblies and check that the fasteners (screws or rivets) in the cover of the power-supply unit are not removed or disturbed.
9. Check the grounding of the network switch before you connect the system to the storage area network (SAN).

Checking external devices

Ensure that you complete an external device check before you install or service the system.

Procedure

To conduct an external device check, complete the following steps.

1. Verify that all external covers are present and are not damaged.
2. Ensure that all latches and hinges are in the correct operating condition.
3. Check the power cords for damage.
4. Check the external signal cables for damage.
5. Check the cover for sharp edges, damage, or alterations that expose the internal parts of the device.
6. Correct any problems that you find.

Checking internal devices

Ensure that you complete an internal device check before you install or service your system.

About this task

To conduct the internal device check, use the following steps.

Procedure

1. Check for any non-IBM changes that were made to the device.
2. Check the condition of the inside of the device for any metal or other contaminants, or any indications of water, other fluid, fire, or smoke damage.
3. Check for any obvious mechanical problems, such as loose components.
4. Check any exposed cables and connectors for wear, cracks, or pinching.

Handling static-sensitive devices

Ensure that you understand how to handle devices that are sensitive to static electricity.

Attention: Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective bags until you are ready to install them.

To reduce the possibility of electrostatic discharge, observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its antistatic bag, touch it to an unpainted metal part of the system unit for at least 2 seconds. (This action removes static electricity from the package and from your body).
- Remove the device from its package and install it directly into your system, without putting it down. If it is necessary to put the device down, place it onto its static-protective bag. (If your device is an adapter, place it component-side up.) Do not place the device onto the cover of the system or onto a metal table.
- Take additional care when you handle devices during cold weather. Indoor humidity tends to decrease in cold weather, causing an increase in static electricity.

Sound pressure

Attention: Depending on local conditions, the sound pressure can exceed 85 dB(A) during service operations. In such cases, wear appropriate hearing protection.

Environmental notices

This information contains all 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, battery information, flat panel display, refrigeration and water-cooling systems, external power supplies, and safety data sheets.

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When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices that are supplied with the monitor.

Canada Notice

CAN ICES-3 (A)/NMB-3(A)

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This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Warning: This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.

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Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

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Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse A.

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（一社）電子情報技術産業協会　高調波電流抑制対策実施要領に基づく定格入力電力値：IBM Documentationの各製品の仕様ページ参照

This statement applies to products less than or equal to 20 A per phase.

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This statement applies to products greater than 20 A, single phase.

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VCCI ー A

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Responsible Party:
International Business Machines Corporation
New Orchard Road
Armonk, NY 10504
Contact for FCC compliance information only: fccinfo@us.ibm.com

Electromagnetic compatibility Class B notices

The following Class B statements apply to features designated as electromagnetic compatibility (EMC) Class B in the feature installation information.

When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices supplied with the monitor.

Canada Notice

CAN ICES-3 (B)/NMB-3(B)

European Community and Morocco Notice

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Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaatenund hält die Grenzwerte der EN 55022/ EN 55032 Klasse B ein.

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Dieses Produkt entspricht dem “Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)“. Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC Richtlinie 2014/30/EU) für Geräte der Klasse B

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:
International Business Machines Corp.

New Orchard Road
Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
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Tel: +49 (0) 800 225 5426
email: HalloIBM@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse B

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

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Proper cables and connectors are available from IBM-authorized dealers. IBM 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.

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Chapter 3. System overview

FlashSystem 5200 is an NVMe storage option for entry-level enterprises that need compact and powerful storage.

Part of the FlashSystem family, the FlashSystem 5200 unifies data management across the core, cloud and edge, and is designed in a revolutionary 1U form factor. This configuration results in high speeds, robust density, and numerous scale-up and scale-out options. .

Figure 1. Front view of the control enclosure

Table 1. FlashSystem 5200 Models		
Machine Type - Model	**Description**	**Minimum Software Level**
4662-6H2	FlashSystem 5200 controller with Expert Care	8.4.0
4662-UH6	FlashSystem 5200controller with Expert Care - Utility mode	8.4.0
4662-24G	2U24 SAS Expansion enclosure with Expert Care	8.4.0
4662-12G	2U12 SAS Expansion enclosure with Expert Care	8.4.0
4662-92G	5U92 SAS Expansion enclosure with Expert Care	8.4.0

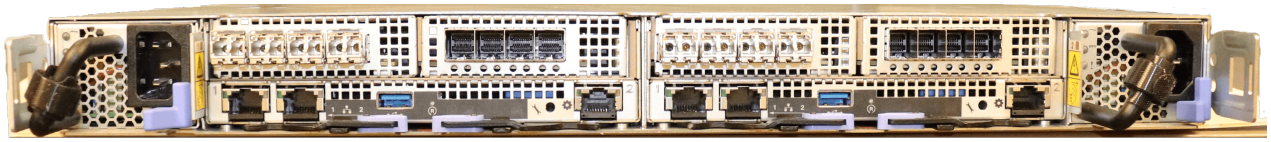


Figure 2. Rear view of the control enclosure, showing the node canisters

IBM Storage Virtualize software

FlashSystem 5200 runs IBM Storage Virtualize which provides the following functions for the host systems that attach to the system:

- A single pool of storage
- Logical unit virtualization
- Management of logical volumes

The software also provides the following functions:

- Replication:
  - Simplify data management by automating configuration tasks.
  - Ensure seamless continuity while maintaining high throughput and low latency to applications.
- Data reduction:
  - Hardware compression with FlashCore Modules (FCM)

  - Thin-provisioned logical volumes
  - Data reduction pool with deduplication and compression
- Ransomware threat detection enhanced with FlashCore Module 4 computational storage assists.
- High-performance Distributed RAID for redundancy and fast rebuild
- Large scalable cache
- Easy to use management and automation that is consistent across the Storage Virtualize portfolio, including RestAPI, Ansible Playbooks, CSI integration, VMWare integration, and a modern Graphical User Interface (GUI).

For more information on IBM Storage Virtualize software, see the relevant IBM Documentation.

Note that some software features are subject to limits on this platform.

Control Enclosure

FlashSystem 5200 comprises a 1 Rack-Unit (1U) Control enclosure, which contains:

- 12 slots for NVMe Flash devices (front)
- Two Node Canisters
- Two Power Supplies.

The system can be expanded with the addition of SAS-based Expansion Enclosures.

NVMe Flash Devices

FlashSystem 5200 supports the use of IBM FlashCore Modules, with inbuilt hardware compression and computational storage assists. The system also supports the use of Industry-Standard Flash Drives.

Note: Only drives that are sold as system options are supported.

Highly Available Architecture

FlashSystem 5200 implements an Active-Active architecture, with the two Node Canisters forming a redundant I/O Group. Because data volumes are served by both node canisters, the volume remains available if one node canister fails or is taken offline.

Node canisters contain the systems CPUs, memory, backup batteries, and Network Attachment adapters.

Flexible Network Attachment

FlashSystem 5200 supports a range of Network Attachment adapter features.

The following adapter types are supported by the system:

Table 2. Adapter types

Adapter Type	Protocols supported	Minimum or maximum per node canister	Minimum software level
Dual-port 32 Gbps Fibre Channel	SCSI, FC-NVMe	0 - 2	8.4.0
Quad-port 16 Gbps Fibre Channel	SCSI, FC-NVMe	0 - 2	8.4.0
Dual-port 25 Gbps Ethernet (RoCE)	iSCSI, NVMe-OF	0 - 2	8.4.0 8.5.0
Dual-port 25 Gbps Ethernet (iWARP)	iSCSI, replication	0 - 2	8.5.0

Table 2. Adapter types (continued)			
Adapter Type	**Protocols supported**	**Minimum or maximum per node canister**	**Minimum software level**
Quad-port 10 Gbps Ethernet	iSCSI, replication	0 - 1 0 - 2	8.4.0 8.6.0
Quad-port 12 Gbps SAS Host attach	SAS (Host attach)	0 - 1	8.4.0
Dual-port 12 Gbps SAS Expansion	SAS (expansion)	0 - 1	8.4.0

Enterprise Warranty and Services

FlashSystem 5200 is available with IBM Storage Expert Care, with several levels of support to suit different deployment models. Refer to IBM Enterprise Support and Preferred Care options for more information.

System components

For more details on the different components of the system, see the following pages:

Node canisters

Canisters are replaceable hardware units that are subcomponents of enclosures.

A *node canister* provides host interfaces, management interfaces, and interfaces to the control enclosure. The node canister in the left-hand enclosure bay is identified as *canister 1*. The node canister in the right-hand bay is identified as *canister 2*. A node canister has cache memory, internal drives to store software and logs, and the processing power to run the system's virtualizing and management software. A node canister also contains batteries that help to protect the system against data loss if a power outage occurs.

The node canisters in an enclosure combine to form a cluster, presenting as a single redundant system with a single point of control for system management and service. System management and error reporting are provided through an Ethernet interface to one of the nodes in the system, which is called the *configuration node*. The configuration node runs a web server and provides a command-line interface (CLI). The configuration node is a role that any node can take. If the current configuration node fails, a new configuration node is selected from the remaining nodes. Each node also provides a command-line interface and web interface to enable some hardware service actions.

Information about the canister can be found in the management GUI.

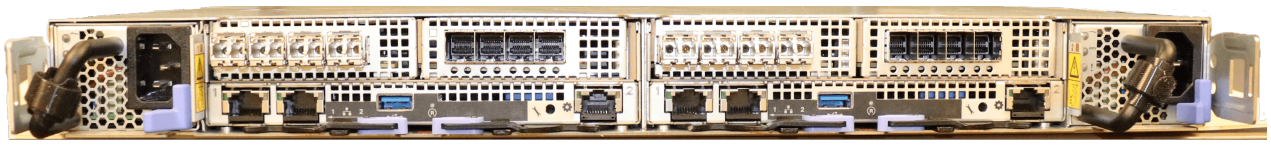


Figure 3. Node canisters - Rear view

Boot drive

Each node canister has an internal boot drive, which holds the system software and associated logs and diagnostics. The boot drive is also used to save the system state and cache data if there is an unexpected power-loss to the system or canister. The boot drive is not a replaceable part.

Batteries

Each node canister contains a battery, which provides power to the canister if there is an unexpected power loss. This allows the canister to safely save system state and cached data.

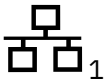
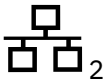
Node canister indicators

A node canister has several LED indicators, which convey information about the current state of the node.

Node canister ports

Each node canister has the following on-board ports:

Table 3. Node canister ports

Port Marking	Logical port name	Connection and Speed	Function
	Ethernet port 1	RJ45 copper, 10 Gbps	Primary Management IP Host I/O (iSCSI) Service IP Ethernet Replication (using TCP)
	Ethernet port 2	RJ45 copper, 10 Gbps	Secondary Management IP (optional) Host I/O (iSCSI) Ethernet Replication (using TCP)
	Technician port	RJ45 copper, 1 Gbps	DCHP port direct service management
	USB port	USB type A	Encryption key storage, Diagnostics collection May be disabled

Adapter cards

Each canister contains two slots for network adapter cards. Each card fits into a cage assembly that contains an interposer to allow the card to be connected to the canister main board. In the system software, adapter card slots are numbered from left to right (1 and 2).

Each node canister supports the following combinations of network adapters:

Table 4. Adapters and supported protocols

Valid cards per slot	Supported protocols/uses
Adapter Slot 1	
Empty	-
Quad-port 16 Gbps Fibre Channel	Host I/O that uses FC or FC-NVMe Replication Communication between systems

Table 4. Adapters and supported protocols (continued)	
Valid cards per slot	**Supported protocols/uses**
Dual-port 32 Gbps Fibre Channel	Host I/O that uses iSCSI or FC-NVMe Replication Communication between systems
Dual-port 25 Gbps Ethernet (RoCE)	Host I/O that uses iSCSI or NVMe/RDMA (RoCEv2)
Dual-port 25 Gbps Ethernet (iWARP)	Host I/O that uses iSCSI or iSER (8.7.0 only) Replication Communication between systems
Quad-port 10 Gbps Ethernet	Host I/O that uses iSCSI Replication Communication between systems
Quad-port 12 Gbps SAS Host attach	Direct-attach Host I/O by using SAS **Note:** This adapter cannot be used with Fibre Channel adapters
Adapter Slot 2	
Empty	-
Quad-port 16 Gbps Fibre Channel	Host I/O that uses FC or FC-NVMe Replication Communication between systems
Dual-port 32 Gbps Fibre Channel	Host I/O that uses FC or FC-NVMe Replication Communication between systems
Dual-port 25 Gbps Ethernet (RoCE)	Host I/O that uses iSCSI or NVMe/RDMA (RoCEv2)
Dual-port 25 Gbps Ethernet (iWARP)	Host I/O that uses iSCSI or iSER (8.7.0 only) Replication Communication between systems
Quad-port 10 Gbps Ethernet	Host I/O that uses iSCSI Replication Communication between systems
Dual-port 12 Gbps SAS Expansion	Connection to SAS Expansion Enclosures

Port Numbering

For each adapter card, ports are numbered from left to right, and from adapter 1 to adapter 2. Fibre Channel ports are numbered from 1 as the leftmost port on the first adapter and continue sequentially across any additional adapters. Ethernet port numbering starts with the on-board ports (1, 2) and

then progresses incrementally across any installed adapter cards, starting with the leftmost slot and numbering across each adapter in turn.

Memory configurations

FlashSystem 5200 supports up to four DIMMs per node with three memory configurations supported.

Table 5. Memory configuration

Configuration	Feature code	DIMMs per node	Memory per node	Best practice recommendation
Base 1 (factory installation)	ALG0	1x32 GiB	32 GiB	Cost-optimised for small capacity (<6 drives) simple workloads that do not require advanced function
Option 1 (field or factory installation	ALGC	4x32 GiB	128 GiB	This configuration is ideal for IOPs latency performance or use of advanced function. Minimum requirement for some advanced software features
Base 2 (factory installation)	ALG1	4x64 GiB	256 GiB	This configuration is ideal for cache-heavy workloads and I/O workloads more than with TBD IOPS
Option 2 (field or factory installation	ALGD	4x64 GiB	256 GiB	This configuration is ideal for cache-heavy workloads and I/O workloads more than with TBD IOPS

Note: To move to Option 2 from Base 1 or Option 1, the 32 GiB DIMMs must be discarded.

For more details on the adapters, see the following pages:

Dual-port 32 Gbps Fibre Channel adapter

The dual-port 32 Gbps Fibre Channel adapter provides two Fibre Channel port connections capable of running at 32 Gbps.

The dual-port 32 Gbps Fibre Channel feature may be supplied as either a dual-port adapter, or a quad-port adapter with two ports blanked. Both types of adapters operate in the same way.

The ports can also auto-negotiate to 16 Gbps or 8 Gbps for compatibility with slower networks.

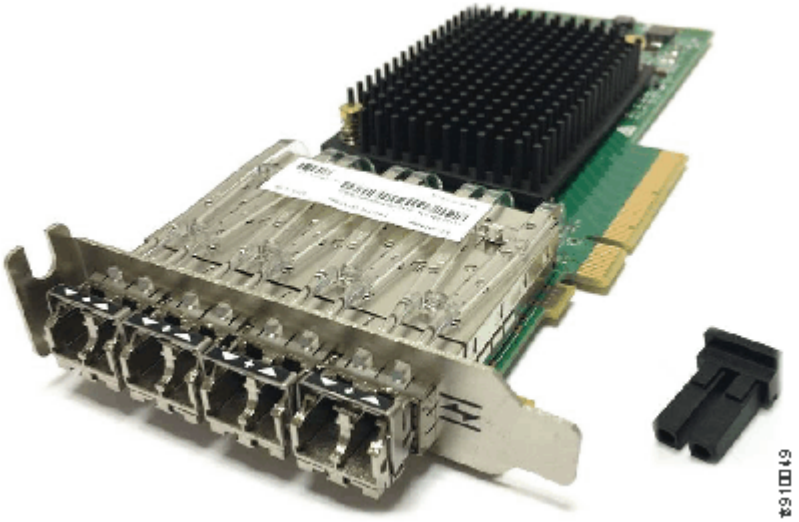


Figure 4. Dual-port 32 Gbps Fibre Channel adapter (quad-port base)

32 Gbps Fibre Channel ports can be used for:

- Host connections by using standard Fibre Chanel (SCSI) or FC-NVMe
- Replication links
- Communications between control enclosures.

Connections can be made via a Fibre Channel switch, or as a direct connection to a host or other FlashSystem controller.

Fibre Channel ports are numbered from 1 upwards, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.

Each port has a Short-wave SFP transceiver that is installed as standard and can be connected with an LC-to-LC Fibre Channel cable. Long-wave SFP transceivers are available as an option for implementation of long-distance links.

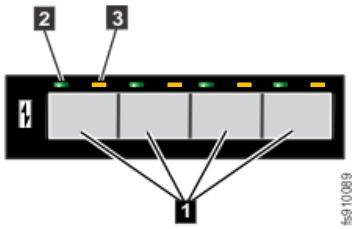


Figure 5. Fibre Channel ports and indicators

1 Fibre Channel port (4-port card)
2 Link-state LED (one for each port)
3 Speed-state LED (one for each port)

For more information, see “Fibre Channel port indicators” on page 204.

Dual-port 25 Gbps Ethernet (RoCE) host interface adapter

The dual-port 25 Gbps Ethernet (RoCE) adapter provides two Ethernet port connections capable of running at 25 Gbps.

The ports can also work at 10 Gbps when a 10 Gbps transceiver module is fitted. The ports can auto-negotiate to 10 Gbps only when non-optical transceiver modules are used.

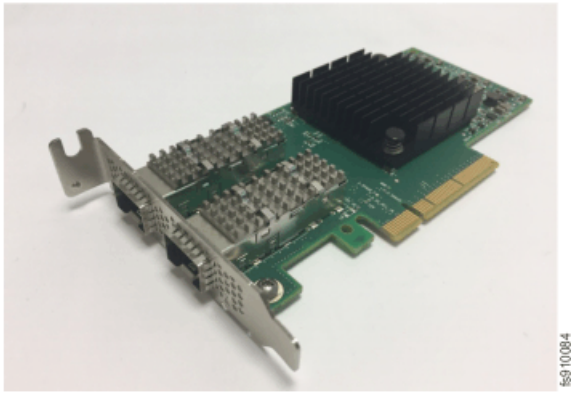


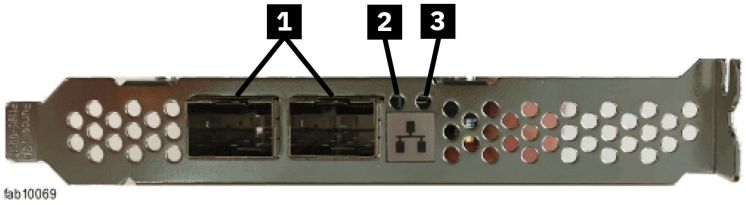
Figure 6. Dual-port 25 Gbps Ethernet (RoCE) host interface adapter

25 Gbps Ethernet ports can be used for:

- Host connections by using iSCSI, NVMe/TCP, or NVMe-RoCE
- IP Replication links

Connections can be made via a Ethernet switch, or as a direct connection to a host or other FlashSystem controller. Use of the NVMe-RoCE protocol requires RoCE-compatible Ethernet switches.

Ethernet ports are numbered from 1 to 4, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.



1 Ethernet port (2-port card)
2 Status LED (port 1)
3 Status LED (port 2)

Figure 7. Ethernet ports and indicators

Each port has an SFP+ receptacle, and a number of physical connection types supported:

Connection type	Supply method	Part number (examples for customer-supplied parts)
Optical Shortwave SFP28 Module - 25 Gb	IBM Orderable Feature	78P5153
Optical Shortwave SFP+ Module – 10 Gb	IBM Orderable Feature	78P1661
Copper 10BASE-T RJ45 Module - 10 Gb	IBM Orderable Feature	45W2412
25 Gbps DAC passive copper cable	Customer supplied	Mellanox MCP2M00-A003

Connection type	Supply method	Part number (examples for customer-supplied parts)
QSFP28 to SFP28 passive Twinax copper cable (100 Gbps to 25 Gb)	Customer supplied	Cisco QSFP-4SFP25G-CU3MMellanox - MCP7F00-A002R
10 Gbps DAC passive copper cable	Customer supplied	Cisco SFP-H10GB-CU3m
QSFP+ to SFP+ splitter cable (40 Gbps to 10 Gb)	Customer supplied	Mellanox MC2609125-005

For more information, see “Dual-port 25 Gbps Ethernet host interface adapter ports and indicators” on page 205.

Dual-port 25 Gbps Ethernet (iWARP) host interface adapter

The dual-port 25 Gb Ethernet (iWARP) adapter provides two Ethernet port connections capable of running at 25 Gbps.

The ports can also work at 10 Gbps when a 10 Gbps transceiver module is fitted. The ports can auto-negotiate to 10 Gbps only when non-optical transceiver modules are used.

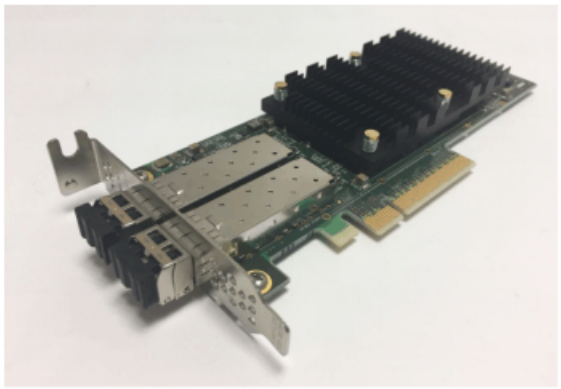


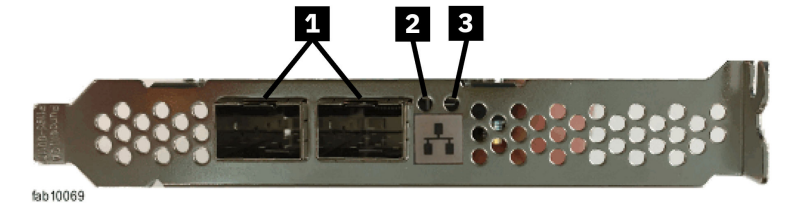
Figure 8. Dual-port 25 Gb Ethernet (iWARP) host interface adapter

25 Gb Ethernet ports can be used for:

- Host connections by using iSCSI
- IP Replication links
- Communications between control enclosures.

Connections can be made via a Ethernet switch, or as a direct connection to a host or other FlashSystem controller.

Ethernet ports are numbered from 1 to 2, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.



1 Ethernet port (2-port card)
2 Status LED (port 1)
3 Status LED (port 2)

Figure 9. Ethernet ports and indicators

Each port has an SFP+ receptacle, and a number of physical connection types supported:

Connection type	Supply method	Part number (examples for customer-supplied parts)
Optical Shortwave SFP28 Module - 25 Gb	IBM Orderable Feature	78P5153
Optical Shortwave SFP+ Module – 10 Gb	IBM Orderable Feature	78P1661
Copper 10BASE-T RJ45 Module - 10 Gb	IBM Orderable Feature	45W2412
25 Gb DAC passive copper cable	Customer supplied	Mellanox MCP2M00-A003
QSFP28 to SFP28 passive Twinax copper cable (100 Gb to 25 Gb)	Customer supplied	Cisco QSFP-4SFP25G-CU3MMellanox - MCP7F00-A002R
10 Gb DAC passive copper cable	Customer supplied	Cisco SFP-H10GB-CU3m
QSFP+ to SFP+ splitter cable (40 Gb to 10 Gb)	Customer supplied	Mellanox MC2609125-005

For more information, see “Dual-port 25 Gbps Ethernet host interface adapter ports and indicators” on page 205.

Quad-port 16 Gbps Fibre Channel adapter

The quad-port 16 Gbps Fibre Channel adapter provides four Fibre Channel port connections capable of running at 16 Gbps.

The ports can also auto-negotiate to 8 Gbps for compatibility with slower networks.

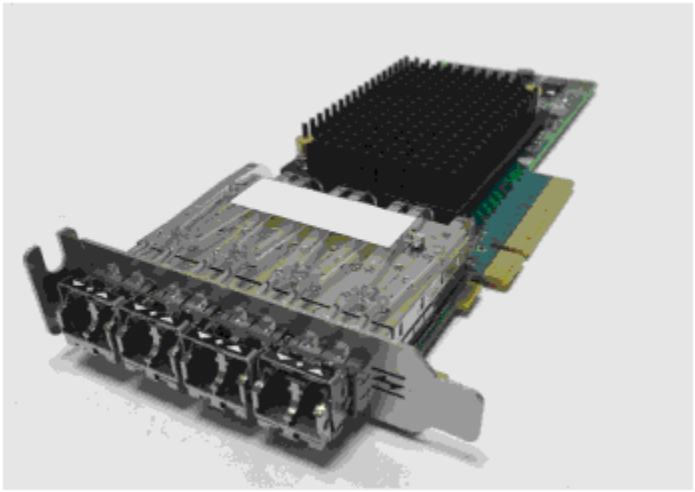


Figure 10. Quad-port 16 Gbps Fibre Channel adapter

16 Gbps Fibre Channel ports can be used for:

- Host connections by using standard Fibre Chanel (SCSI) or FC-NVMe
- Replication links
- Communications between control enclosures.

FC-NVMe is not supported on FlashSystem 5015, 5035 or 5045.

Connections can be made via a Fibre Channel switch, or as a direct connection to a host or other FlashSystem controller.

Fibre Channel ports are numbered from 1 to 4, starting from the left (horizontal placement) or top (vertical placement). Figure 2 shows ports and their indicators.

Each port has a Short-wave SFP transceiver that is installed as standard and can be connected with an LC-to-LC Fibre Channel cable. Long-wave SFP transceivers are available as an option for implementation of long-distance links.

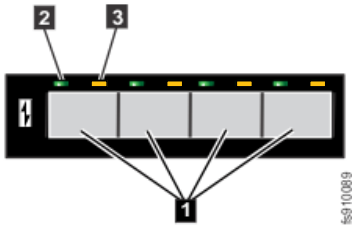


Figure 11. Fibre Channel ports and indicators

1 Fibre Channel port (4-port card)
2 Link-state LED (one for each port)
3 Speed-state LED (one for each port)

For more information, see “Fibre Channel port indicators” on page 204.

Quad-port 12 Gbps SAS host attach adapter

The quad-port 12 Gbps SAS host adapter provides four SAS wide-port connections capable of running at 12 Gbps and providing a maximum bandwidth of 5 Gbps per port.

The ports are for use with direct-connect links with server host SAS adapters. The ports can also auto-negotiate to 6 Gbps for compatibility with slower host-side adapters.

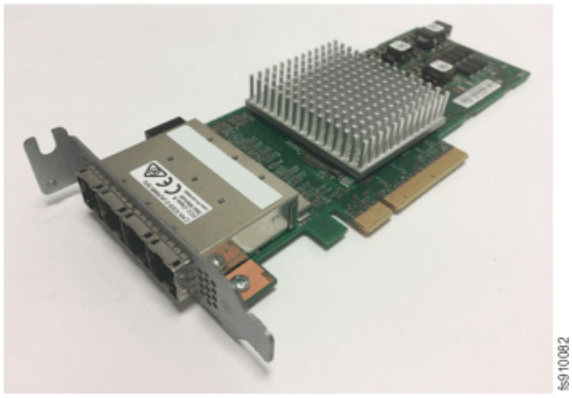


Figure 12. Quad-port 12 Gbps SAS host attach adapter

Only direct point-to-point host to storage connections are supported. The use of SAS network switches is not supported.

SAS ports are numbered from 1 to 4, starting from the left. Figure 2 shows ports and indicators.

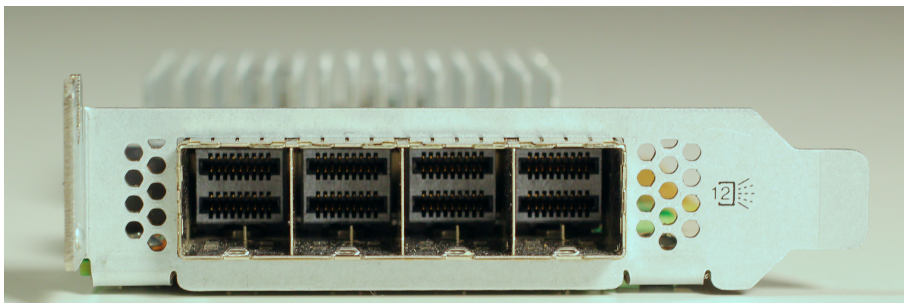


Figure 13. Quad-port 12 Gbps SAS - front view

Each port has a Mini-SAS HD connector and can be connected with a Mini-SAS HD cable of up to six metres. SAS cables are available as IBM orderable features.

For more information, see SAS expansion adapter ports and indicators.

Dual-port 12 Gbps SAS expansion adapter

The 12 Gbps SAS expansion adapter allows FlashSystem NVMe controllers to connect to SAS expansion enclosures to implement a tiered storage system.

The 12 Gbps SAS expansion adapter provides two 12 Gbps SAS wide-port connections, providing a maximum bandwidth of 5 GBps per port. Each port connects to a chain of one or more expansion enclosures.

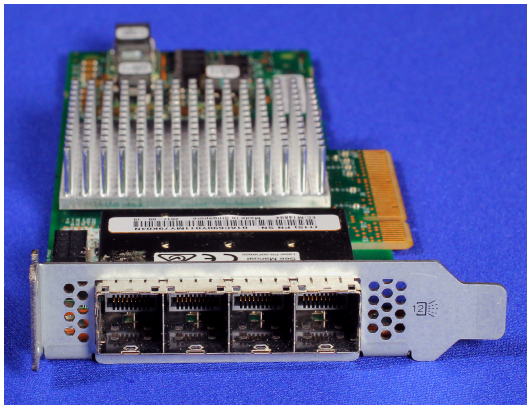


Figure 14. Dual-port 12 Gbps SAS expansion adapter

The SAS expansion adapter is implemented as a quad-port card that is numbered from 1 to 4 starting from the left (horizontal placement) or the top (vertical placement). Only ports 1 and 3 are used for expansion attach, and ports 2 and 4 are unused.

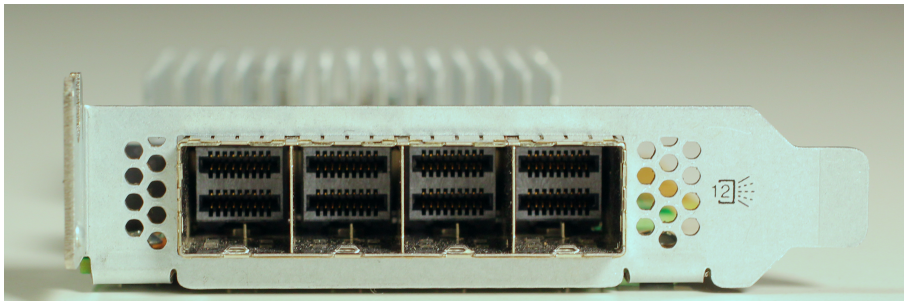


Figure 15. Dual-port 12 Gbps SAS - front view

Each port has a Mini-SAS HD connector and can be connected with a Mini-SAS HD cable of up to six meters. SAS cables are available as IBM orderable features.

Each port has indicators. For more information, see SAS expansion adapter ports and indicators page in the relevant Hardware Guide.

Quad-port 10 Gbps Ethernet adapter

The quad-port 10 Gbps Ethernet adapter provides four Ethernet port connections capable of running at 10 Gbps.

The ports can also auto-negotiate to 1 Gbps for compatibility with slower networks.

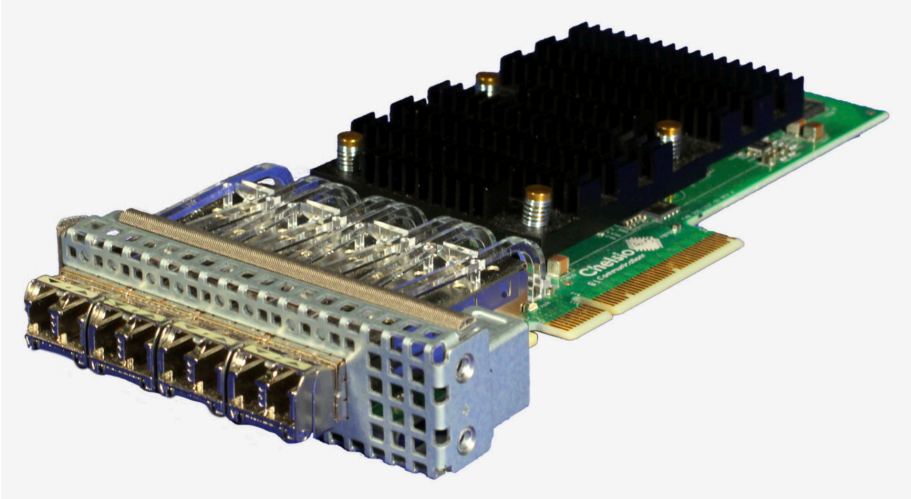


Figure 16. Quad-port 10 Gbps Ethernet adapter

The 10 Gbps Ethernet adapter ports can be used for:

- Host connections, using iSCSI or NVMe/TCP (supporting platforms only)
- Replication links
- Communications between control enclosures.

Connections can be made via an Ethernet switch, or as a direct connection to a host or other FlashSystem controller.

Ethernet ports are numbered from 1 to 4, starting from left. Figure 17 on page 34 shows ports and their indicators.

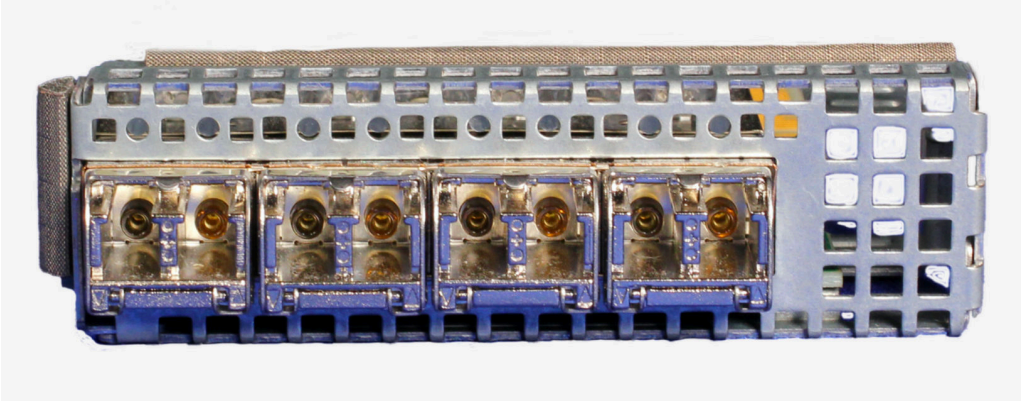


Figure 17. Front view of quad-port 10 Gbps Ethernet adapter

Each port has an SFP+ receptacle and several physical connection types are supported.

Table 6. Connection types

Connection type	**Supply method**	**Part number (examples for customer-supplied parts)**
Copper 10BASE-T RJ45 Module - 10 Gb	IBM Orderable Feature	45W2412
Optical Shortwave SFP+ Module - 10 Gb	IBM Orderable Feature	78P1661
10 Gbps DAC passive copper cable	Customer supplied	Cisco SFP-H10GB-CU3M

Table 6. Connection types (continued)		
Connection type	**Supply method**	**Part number (examples for customer-supplied parts)**
SFP+ to QSFP+ splitter cable	Customer supplied	Mellanox MC2609125-005

Each port has indicators. For more information, see 10 Gbps Ethernet host interface adapter indicators.

Batteries

Each node canister in the control enclosure caches critical data and holds state information in volatile memory.

If power to a node canister fails, the node canister uses an internal battery to provide power to destage cache and state data to its boot drive, before performing an orderly shutdown.

The battery has enough charge capacity to handle two back-to-back power failures. This means that normally the node canister can restart I/O operations immediately after repowering without waiting to recharge the battery, or requiring any operator intervention. If several power events occur in close succession, such as battery does not have enough charge for node to save its internal state, the node remains in service until the batteries are charged sufficiently.

The battery subsystem supports a one-second ride-through capability to handle a brief AC power outage. During this time, the battery powers the node that continues to run normally servicing host I/O requests. If AC power is restored within the ride-through period, the node continues to run and does not shut down. If AC power does not return within the ride-through period, then the node stops servicing I/O and proceeds to save state data and shut down. When started, the shutdown operations run to completion even if the system power is restored during this time.

Note: Expansion canisters do not cache volume data or store state information in volatile memory. Therefore, expansion canisters do not require battery power. If AC power to both power supplies in an expansion enclosure fails, the enclosure powers off. When AC power is restored to at least one power supply, the enclosure restarts without operator intervention.

Important: Although the system is resilient to power failures and brown outs, always install the enclosures in an environment that has reliable, consistent, and required AC power. Consider uninterruptible power supply units to avoid extended interruptions to data access.

Battery management

As a battery ages, it loses capacity. The battery in the node canister lasts at least five years before it cannot hold enough charge to support a successful node shutdown.

The battery management system automatically performs conditioning cycles approximately every three months to ensure accurate determination of their state of health.

When the battery capacity starts to degrade, the system posts an “EOL Warning” event. At this point, the battery subsystem still has enough capacity to be able to support an unscheduled system power-down. If a battery reports an "EOL Warning" event, replace it within approximately six months post the event.

When a battery no longer has capacity to protect against a power loss event, it reports the “EOL Fatal” event. If a battery reports an "EOL Fatal" event, the node goes offline and the battery needs replacing to allow the node to exit from Service state and come online.

If a node canister’s battery fails, that canister goes offline and reports a node error. The remaining canisterdestages its cache and runs the I/O group in “write-through” mode until its partner canister is repaired and online.

The battery is contained within the node canister, which must be removed from the system to replace the battery.

The node canister has a battery status LED, which is described in Node canister indicators.

To access information about the battery in the management GUI, select **Monitoring** > **System**. On the **System - Overview** page, click the directional arrow next to the enclosure that contains the battery module. Select **Battery Module** under **Internal Components** to display information about the battery module. To display information about the battery in the command-line interface, use the **lsenclosurebattery** command.

Power supply units

Power supply units (PSUs) are subcomponents of enclosures. A PSU takes electrical power from the rack Power Distribution Units (PDUs) and provides the power to the components in the enclosure.

For redundancy, the IBM Storage FlashSystem control enclosure has two 1500 W PSUs that provide power to the system. If either PSU fails, the system can still run without any interruptions. The PSUs can be connected to a 240 VAC (high-line) or a 120 VAC (low-line) AC supplies.

Two types of power supply units are available for FlashSystem 5200 as shown in Table 7 on page 36.

Table 7. Types of power supply units

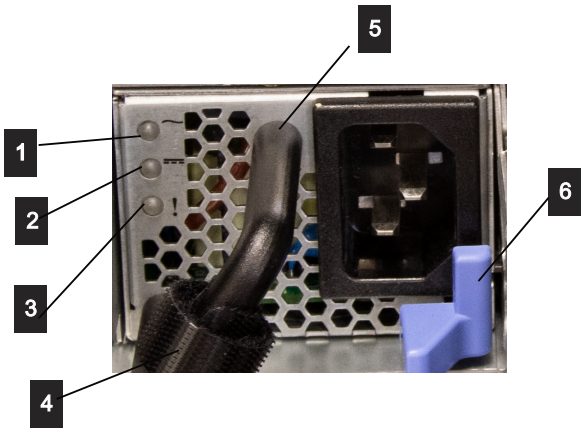
Feature code	Description	Supported voltage
AHPE	1500 W AC High-line power supply unit	200-240 V AC, 1500 W
AHPG	1500 W AC Auto-ranging power supply unit	200-240 V AC, 1500 W 100-127 V AC, 836 W

Power supplies in the IBM Storage FlashSystem control enclosure are 80Plus certified as “Titanium” efficiency.

The information about the health of the PSUs can be found in the management GUI.

Figure 18 on page 37 shows the rear view of a control enclosure and identifies the location of a power supply unit and its indicators. The power supply has no power switch. A power supply is active when the power cord is connected to the power connector and power source.

When viewed from the rear, PSU 1 is on the left side of the control enclosure, and PSU 2 is on the right side.



1 AC good indicator
2 DC good indicator
3 Fault indicator
4 Hook-and-loop strap for securing the power cable
5 Power supply handle
6 Power supply release tab

Figure 18. Power supply details

The power supply indicators provide a summary of the status of the power supply.

Drives

The FlashSystem 5200 system supports several drive classes and capacities.

These drives are used to create arrays that provide capacity for pools and volumes. All drives in an array are the same type and capacity.

The system supports the following drive types:

- IBM FlashCore® Modules
- Industry-standard SSD drives
- Storage-Class Memory drives

FlashSystem 5200 also supports SAS HDDs and SSDs in expansion enclosures.

Note: Do not replace a drive unless the drive fault LED is on or you are instructed to do so by a fix procedure.

FlashCore Modules

IBM® FlashCore Modules (FCM) are a family of high-performance flash drives in a standard 2.5-inch, 15 mm form factor.

The FlashCore Module design uses the NVMe protocol and high-speed NAND memory to provide high throughput and IOPS with consistent and predictable latency. The FlashCore Modules are accessible from the front of the enclosure. Hardware-based data compression, self-encryption, and T10-Diff are supported.

FlashCore Modules are available in 4.8 TB, 9.6 TB, 19.2 TB, and 38.4 TB.

Table 8. FlashCore Modules sizes and capacities		
FlashCore Module	**Terabytes usable**	**Terabytes effective**
FCM 2	4.8 9.6 19.2 38.4	21.99 21.99 43.98 87.96
FCM 3	4.8 9.6 19.2 38.4	21.99 28.8 57.6 115.2
FCM 4	4.8 9.6 19.2 38.4	21.99 28.8 57.6 115.2

FlashCore Module 4 drives have a PCIe Gen 4 interface at all capacity points. In addition, FlashCore Module 4 drives support computational storage assists for real-time ransomware threat detection. To take advantage of this feature, RAID arrays must entirely consist of FlashCore Module 4 drives and must be created on a minimum code level of 8.6.2.

FlashCore Module 4 drives are undergoing FIPS140-3 validation.

Industry-standard NVMe SSDs

FlashSystem 5200 supports Industry-Standard NVMe SSDs with the following capacities: 800 GB, 1.92 TB, 3.84 TB, 7.68 TB, 15.36 TB, and 30.72 TB. These NVMe drives support hardware-based encryption for data at rest as well as standard T-10Diff protection.

Note: Industry-Standard SSDs do not offer the internal compression or computational storage features of FlashCore Modules.

Storage Class Memory drives

Storage Class Memory drives provide the lowest latency for high performance small capacity workloads. FlashSystem 5200 supports Storage Class Memory drives with the following capacities: 375 GB, 750 GB, 800 GB, 1.6 TB, and 3.2 TB.

Drive plug ordering

New systems ordered from IBM follow a particular slot usage pattern. If more drives are installed later, continuing with the same plug ordering pattern ensures optimum system performance.

- Flash Core modules and Industry-Standard drives: fill the enclosure from slot 1 toward slot 12 in order.
- Storage Class Memory drives: fill the enclosure from slot 12 downwards toward slot 1 in order.

Any drive slot without a drive in it should be fitted with a Drive Blank to maintain correct airflow impedance.

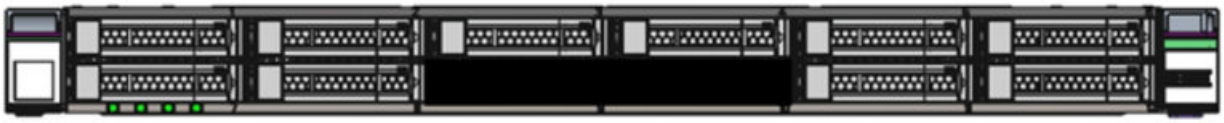


Figure 19. FlashSystem 5200 showing an enclosure with eight FCMs and two SCMs in preferred plug order

Software feature limits

FlashSystem 5200 runs the IBM Storage Virtualize software stack to provide its rich storage functionality. Due to limitations of hardware resource, the following software feature limits should be noted.

Table 9. FlashSystem 5200 Software feature limits

Software function	**Hardware-derived limit**
Embedded VASA Provider/vVols	Requires a minimum of 128 GB memory per node
Deduplication	Requires a minimum of 128 GB memory per node
Policy-based replication	Requires a minimum of 128 GB memory per node
Policy-based high availability (HA)	Requires a minimum of 128 GB memory per node
Storage Insights Integration (Cloud Call-home)	Requires a minimum of 128 GB memory per node
Ransomware Threat Detection	Requires a minimum of 128 GB memory per node

Chapter 4. Expansion enclosures

An FlashSystem 5200 can be expanded beyond the capacity in the control enclosure by using expansion enclosures. This can be used to implement a tiered storage system.

The system supports the following expansion enclosures:

Table 10. FlashSystem 5200 expansion enclosure models

Machine Type - Model	Description	Minimum software level
4662-12G	2U12 SAS Expansion Enclosure with Expert Care	8.4.0
4662-24G	2U24 SAS Expansion Enclosure with Expert Care	8.4.0
4662-92G	5U92 SAS Expansion Enclosure with Expert Care	8.4.0

The system supports specific combinations of SAS expansion enclosures, based on the capacity of each of the enclosures.

High-density enclosures and standard-density enclosures can be supported within a chain, based on the following rules:

- A chain is allowed to have expansions with a total “weight” of 20U.
- Standard-density expansion enclosure are 2U each.
- High-density expansion enclosures are 5U each.

The following table describes the valid combinations of expansion enclosures based on these rules:

Table 11. Valid combinations of expansion enclosures per SAS chain

Expansion enclosures types	Valid combinations				
5U expansion enclosures	0	1	2	3	4
2U expansion enclosures	0-10	0-7	0-5	0-2	0

Supported Drives for FlashSystem 5200 expansion enclosures

The following tables provide the list of supported drives for FlashSystem 5200 SAS expansion enclosures.

All drives are dual-port and hot-swappable. Drives of the same form factor and connector type can be intermixed within an enclosure, however an Array must use drives of the same type.

Table 12. Supported drives, 2U24 Expansion enclosure

Drive type	Capacities supported
2.5 inch 7.2K RPM Nearline hard drive (SAS)	2 TB
2.5 inch 10K RPM hard drive (SAS)	900 GB, 1.2 TB, 1.8 TB, 2.4 TB
2.5 inch Flash drive (SAS)	800 GB, 1.92 TB, 3.84 TB, 7.68 TB, 15.36 TB, 30.72 TB

Table 13. Supported drives, 2U12 Expansion enclosure	
Drive type	**Capacities supported**
3.5 inch 7.2K RPM Nearline hard drive (SAS)	4 TB, 6 TB, 8 TB, 10 TB, 12 TB, 14 TB, 16 TB, 18 TB
3.5 inch 10K RPM hard drive (SAS)	900 GB, 1.2 TB, 1.8 TB, 2.4 TB

Table 14. Supported drives, 5U92 Expansion enclosure	
Drive type	**Capacities supported**
3.5 inch 7.2K RPM Nearline hard drive (SAS)	6 TB, 8 TB, 10 TB, 12 TB, 14 TB, 16 TB, 18 TB
3.5 inch 10K RPM hard drive (SAS)	1.2 TB, 1.8 TB, 2.4 TB
3.5 inch Flash drive (SAS)	1.92 TB, 3.84 TB, 7.68 TB, 15.36 TB, 30.72 TB

For more details on the expansion enclosures, see the following pages:

2U Expansion enclosures

Expansion enclosures provide extra drives that can be managed by the system.

The 2U SAS expansion enclosure has two versions with support for either 24 small form factor (SFF) or 12 large form factor (LFF) SAS drives in a compact 2U footprint.

Figure 20. Front view of an 2U12 expansion enclosure

Figure 21. Front view of an 2U24 expansion enclosure

The front of the enclosure provides access to the hot-pluggable drive bays (either 12 or 24), and an indicator panel that provides high-level status.

Figure 22 on page 43 shows the locations of the expansion canisters and the two power supply units in the rear of the expansion enclosure.

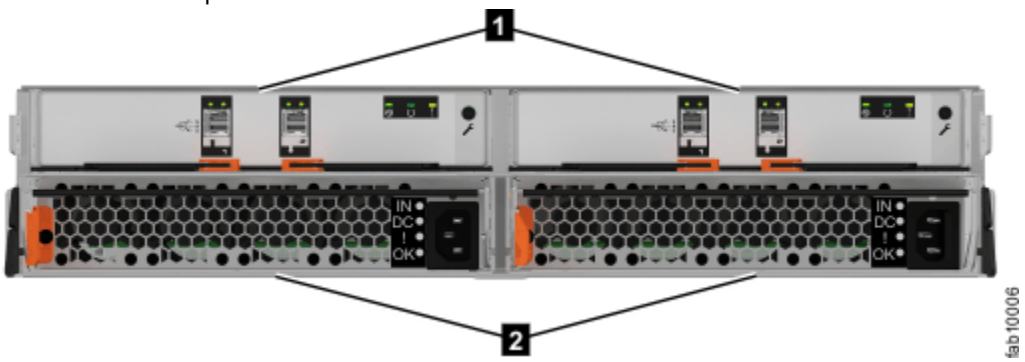


Figure 22. Rear view of an expansion enclosure

1 Expansion canisters
2 Power supply units

The rear of the enclosure provides access to two expansion canisters, and two dual-redundant power supplies.

Each expansion canister has two Wide-SAS ports: the left port is for upstream connection (toward the controller), and the right port is for downstream connection (to more expansion enclosures).

Both expansion canisters can access all the drives in the expansion enclosure, and so provide a redundant path to data.

The Power Supply Units (PSUs) in the 2U expansion enclosure are combined power and cooling units, housing the main cooling fans for the enclosure. Therefore, power supplies should only be removed from the enclosure during a Power supply replacement operation. The 800 W, multi-output PSUs can be connected to 240 VAC (high-line) or 120 VAC (low-line) AC supplies, and are 80Plus certified as “Platinum” efficiency.

The 2U expansion enclosure has several indicators to show status and aid serviceability. For more information, see 2U expansion enclosure indicators.

Drive plug ordering

New systems that are ordered from IBM follow a particular slot usage pattern. If more drives are installed later, continue adding from left to right in increasing slot order.

Any drive slot without a drive in it should be fitted with a Drive Blank to maintain correct airflow impedance.

5U Expansion enclosures

Expansion enclosures provide extra storage capacity that can be managed by the system.

The 5U SAS Expansion enclosure supports up to 92 drives in 3.5” large form factor (LFF) carriers in a 5U footprint, allowing greater rack density than 2U enclosures. The enclosure is mounted on slide rails and moves forward from the rack into a “service position” to remove or replace drives.

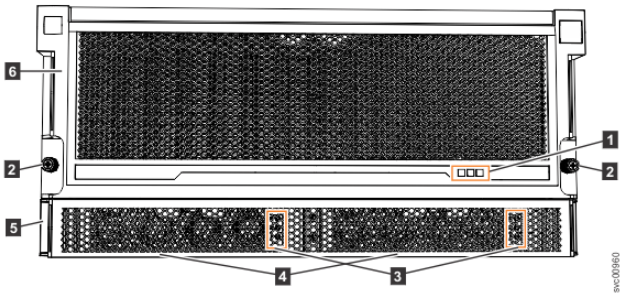


Figure 23. Features on the front of the 5U expansion enclosure

1. Display panel indicators
2. Rack retention thumb screws
3. Power® supply unit indicators
4. Power supply units (PSUs)
5. PSU fascia (1U)
6. Front fascia (4U)

The front of the enclosure provides access to the dual-redundant power supplies, and an indicator panel providing high-level status. The power supplies are housed in the bottom portion of the enclosure, behind a removeable bezel.

However, as Figure 24 on page 44 shows, the 4U and 1U fascias are packaged separately. You must attach them to the front of the 5U expansion enclosure as part of the initial installation process.

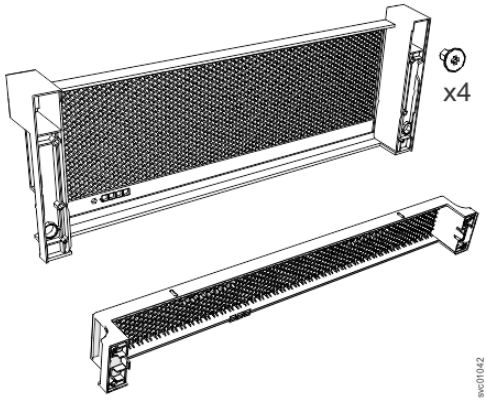


Figure 24. Front fascia of the 5U expansion enclosure

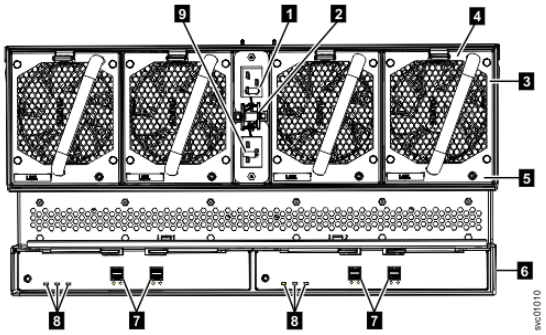


Figure 25. Features on the rear of the 5U expansion enclosure

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

The rear of the enclosure provides access to two primary expansion canisters, four redundant fan modules, and the power connectors. The 5U expansion canisters are mounted upside down into the enclosure compared to their orientation in a 2U expansion enclosure. Thus, Port 1 is to the right of Port 2.

Each primary expansion canister has two Wide-SAS ports: Port 1 (on the right) is for upstream connection (toward the controller), and Port 2 (on the left) is for downstream connection (to more expansion enclosures).

Both expansion canisters can access all the drives in the expansion enclosure, and so provide a redundant path to data.

The 92 drives are accessed by sliding the drawer forward to the Service position and removing the top lid. All the drives are then available for servicing while the drawer continues to operate.

The centre of the drawer includes two “Secondary Expansion Modules”, which provide the additional fanout that is required to connect all 92 SAS endpoints to the primary expansion canisters.

The Power Supply Units (PSUs) in the 2U Expansion Enclosure are combined power and cooling units, housing the main cooling fans for the enclosure. Therefore, power supplies should only be removed from the enclosure during a Power supply replacement operation. The 800W, multi-output PSUs can be connected to 240 VAC (high-line) or 120 VAC (low-line) AC supplies, and are 80Plus certified as “Platinum” efficiency.

A high-density expansion enclosure has sets of LEDs on the front and rear of the enclosure. Inside the expansion enclosure, LEDs also indicate the status of the drives and each secondary expander module. For more information, see 5U Expansion enclosure indicators.

Drive plug ordering

New systems ordered from IBM follow a particular slot usage pattern. If additional drives are installed later, continue adding from back to front and left to right in increasing slot order. It is important to ensure that no holes are left in the filling pattern as this adversely affects airflow and cooling.

Any drive slot without a drive in it should be fitted with a Drive Blank to maintain correct airflow impedance.

Chapter 5. Planning for hardware

This information is intended to help prepare the physical site for the installation of a FlashSystem 5200 .

About this task

Certain physical site specifications must be met before the system can be set up. This activity includes verifying that adequate space is available, and that requirements for power and environmental conditions are met.

Procedure

1. Review all the guidelines in the planning topics to understand where the system can be installed and identify all prerequisites, such as building structure, equipment rack, environmental controls, power supply, and accessibility.
2. Complete the “Planning worksheets” on page 63 to record the information for the initial system creation.

What to do next

For more details on the planning for hardware, see the following pages:

Control enclosure environmental requirements

Before you install a system, your physical environment must meet certain requirements.

These requirements include verifying that adequate space is available and power and environmental conditions are met.

Safety notices

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)

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)

Important: In addition, remember:

- The rack design must support the total weight of the installed enclosures and incorporate stabilizing features suitable to prevent the rack from tipping or being pushed over during installation or normal use.
- The rack must not exceed the maximum enclosure operating ambient temperature of 35-degrees C (95-degrees Fahrenheit). Air is drawn through the control enclosure by fans in each node canister and each power supply.

  In particular, the rack front and rear doors must be at least 60% perforated to enable sufficient airflow through the enclosure. If there is less airflow, additional mechanisms are required to cool the enclosure. An appropriate IBM rack configuration would be the 7014-T42 IBM Rack Model T42, with standard rear door and feature code 6069 Front Door For 2.0 Meter Rack (High Perforation).
- The rack must have a safe electrical distribution system. It must provide overcurrent protection for the enclosure and must not be overloaded by the total number of enclosures installed. The electrical power consumption rating that is shown on the nameplate should be observed.
- The electrical distribution system must provide a reliable ground for each enclosure in the rack.

Power requirements for each power supply

Ensure that your environment meets the following power requirements. To aid in power and cooling requirements planning, Table 15 on page 49 lists the rating of each power supply unit (PSU) by enclosure.

The power that is used by the system depends on various factors, including the number of enclosures and drives in the system and the ambient temperature.

Table 15. Power specifications per power supply				
Model and type	**Part number**	**Input power requirements**	**Maximum input current**	**Maximum power output**
FlashSystem 5200	1500W highline PSU (03GH750)	• 200-240 V single phase AC • At a frequency of 50 Hz or 60 Hz • IEC C14 standardized	7.5 A	1500 W
	Auto-ranging PSU (03GH925)	• 100-127 V (low-line) or 200-240 V single phase AC (high-line) • At a frequency of 50 Hz or 60 Hz • IEC C14 standardized	10 A	

The power and thermal measurements that are shown in Table 16 on page 49 were obtained in the specific operating environment and under the conditions described. These measurements are presented as an illustration; measurements that are obtained in other operating environments might vary. Conduct your own testing to determine specific measurements for your environment.

Table 16. Power consumption examples per enclosure			
Model and type	**Configuration**	**Total power consumption**	**Caloric value (BTU/hr)**
FlashSystem 5200	1 enclosure with 12 FCM 9 TB drives, four 32 Gbps FC adapters, 16K 70/30 with 50% cache hits workload using 24 threads/ queue depth to 72 vdisks	554W	1890

Each enclosure contains two PSUs for redundancy. The total power consumption value is the sum of the power that is drawn by each PSU.

Environmental requirements

System airflow is from the front to the rear of each enclosure:

- Airflow passes between drive carriers and through each enclosure.
- Air exhausts from the rear of each canister.

Ensure that your environment falls within the ranges that are shown in Table 17 on page 49.

Table 17. Temperature requirements				
Environment	**Ambient temperature**	**Altitude**	**Relative humidity**	**Maximum wet bulb temperature**
Operating	5°C to 35°C (41°F to 95°F)	0 - 3048 m (0 - 10000 ft)	8% to 80% noncondensing	23°C (73°F)

Table 17. Temperature requirements (continued)				
Environment	**Ambient temperature**	**Altitude**	**Relative humidity**	**Maximum wet bulb temperature**
Non-operating	1°C to 50°C (34°F to 122°F)	-305 to 12192 m (-1000 to 40000 ft)	8% to 80% noncondensing	27°C (80°F)
Storage	1°C to 60°C (34°F to 140°F)		5% to 80% noncondensing	29°C (84°F)
Shipping	-40°C to 60°C (-40°F to 140°F)		5% to 100% condensing, but not precipitating	

Dimensions and weight requirements for rack installation

Ensure that space is available in a standard 19" rack that is capable of supporting the enclosure. The rack rail kit supports racks with either threaded round or square rail mounting holes. The following table lists the dimensions and weights of the enclosures.

Table 18. Physical characteristics of the enclosures					
Enclosure	**Height**	**Width**	**Depth**	**Maximum weight**	
				Drive ready (without drives)	**Fully configured (with drives)**
FlashSystem 5200 control enclosure	43 mm (1.69 in.)	446 mm (17.5 in.)	770 mm (30.3 in.)	16.8 kg (37.05 lb)	19.5 kg (43.0 lb)

Additional space requirements

Ensure that these additional space requirements, as shown in Table 19 on page 50, are available around the enclosures.

Table 19. Clearances		
Location	**Additional space requirements**	**Reason**
Left and right sides	50 mm (2 in.)	Cooling air flow
Back	Minimum: 100 mm (4 in.)	Cable exit

Acoustical Declaration with Noise Hazard Notice

Table 20. Acoustical Declaration with Noise Hazard Notice									
Declared noise emission values in accordance with ISO 9296 [1-7]									
Product description FlashSystem 5200 MT 4662 Models 6H2, UH6, Y12	Mean A-weighted sound power level, $L_{WA,m}$ (B)		Mean A-weighted emission sound pressure level, $L_{pA,m}$(dB)					Statistical adder for verification, K_v (B)	
	Operating	Idle	Front	Right	Back	Left	Bystander	Operating	Idle

Table 20. Acoustical Declaration with Noise Hazard Notice (continued)

Declared noise emission values in accordance with ISO 9296 [1-7]									
Typical configuration 24 degree C	6.9	6.7	59	48	58	48	56	0.3	0.3
Typical configuration 27 degree C	7.2	6.9	62	53	61	51	59	0.3	0.3
Typical configuration. Fan pulled to force 100% fan speeds	7.9	7.8	69	57	69	57	66	0.3	0.3
Typical configuration. fan pulled to force 100% fan speeds Operator Position (0.5 m distance)	-	-	74	-	74	-	-	0.3	0.3

Note:

1. Declared level $L_{WA,m}$ is the upper-limit A-weighted sound power level.
2. Declared level $L_{PA,m}$ is the mean A-weighted emission sound pressure level that is measured either at the 0.5-meter operator positions with doors open or 1-meter bystander positions with doors closed.
3. The statistical adder for verification, K_v, is a quantity to be added to the declared mean A-weighted sound power level, $L_{WA,m}$ such that there will be a 95% probability of acceptance, when using the verification procedures of ISO 9626, if no more than 6.5% of the batch of new equipment has A-weighted sound power levels greater than ($L_{WA,m}$+K_v).
4. The quantity $L_{WA,c}$(formerly called $L_{WA,d}$), can be computed from the sum of $L_{WA,m}$and K_v.
5. All declared data for systems that are obtained through a combination of measurements made in accordance with ISO 7779 and modeled results. All measurements made in conformance with ISO 7779 and declared in conformance with ISO 9296.
6. Under certain environments, configuration system settings, or workloads, there is an increase in fan speeds that results in higher noise levels.
7. **Notice:** Government regulations (such as those prescribed by OSHA or European Community Directives) might govern noise level exposure in the workplace and might apply to you and your server installation. The actual sound pressure levels in your installation depend upon various 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 various extra 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.

Shock and vibration specifications for enclosures

Table 21 on page 52 and Table 22 on page 52 provide the shock and vibration testing results for your system.

Table 21. Shock testing results		
Shock categories	**Test level**	**Performance**
Operational	5 g 10 ms 1/2 Sine	<= 25 g 10 ms
Non-operational	30 g 10 ms 1/2 Sine	<= 75 g 11 ms

Table 22. Vibration testing results		
Vibration categories	**Test level**	**Performance**
Operational	0.21 grms 5-500 Hz Random	Throughput loss <= 10% FCAL <= 0.68 grms
Non-operational	1.04 grms 2-200 Hz Random	<= 3.12 grms
Shipping	0.3 g 2-200 Hz Sine	<= 5 g
Rotational vibration	Normal operation performance measurements in enclosure with no external vibration.	Throughput loss for all drives of the same type within performance profile.

SAS expansion enclosure environmental requirements

Before you install any 2U or 5U SAS expansion enclosure, your physical environment must meet certain requirements.

These requirements include verifying that adequate space is available and power and environmental conditions are met.

Power requirements for each power supply (two per enclosure)

Ensure that your environment meets the following power requirements.

To aid in power and cooling requirements planning, Table 23 on page 52 lists the rating of each Power Supply Unit (PSU) by enclosure.

The power that is used by the system depends on several factors, including the number of enclosures and drives in the system and the ambient temperature.

Table 23. Power specifications per power supply					
Model and type	**PSU**	**Input power requirements**	**Maximum input current**	**Maximum power output**	**Caloric value (BTU/hr)**
4662-12G, 4662-F12, 4662-24G or 4662-F24	764 W (2)	100 V to 240 V single phase AC at a frequency of 50 Hz to 60 Hz	10A for 100 V 6A for 240 V	764 W	2607

Table 23. Power specifications per power supply (continued)					
Model and type	**PSU**	**Input power requirements**	**Maximum input current**	**Maximum power output**	**Caloric value (BTU/hr)**
4662-92G, 4662-F92 4662-92G, 4662-F92	2400 W (2)	AC 200 - 240 V~ nominal; +/- 10% tolerant) 50 or 60 Hz (nominal; 47 - 63 Hz tolerant)	12 A (x2 - per inlet redundancy) Requires an IEC C20 appliance coupler (16-20A branch circuit or C19 power socket PDU)	2400 W	8189

Note: One or more C19 Power Distribution Units (PDU) are needed in the rack to connect power to the power supplies for 5U expansion enclosures.

The power and thermal measurements that are shown in Table 24 on page 53 were obtained in the specific operating environment and under the conditions described. These measurements are presented as an illustration; measurements that are obtained in other operating environments might vary. Conduct your own testing to determine specific measurements for your environment.

Table 24. Power consumption examples per enclosure		
Model and type	**Configuration**	**Total power consumption**
4662-12G, 4662-F12, 4662-24G or 4662-F24	One enclosure with 24 2.5-inch flash drives	151 W
4662-12G, 4662-F12, 4662-24G or 4662-F24	One enclosure with 24 10 K SAS drives	175 W
4662-12G, 4662-F12, 4662-24G or 4662-F24	One enclosure with 24 15 K SAS drives	234 W
4662-12G, 4662-F12, 4662-24G or 4662-F24	One enclosure with 12 7.2 K nearline SAS drives	158 W
4662-92G, 4662-F92 4662-92G, 4662-F92	One enclosure with 92 10 TB nearline SAS drives	848 W
4662-92G, 4662-F92 4662-92G, 4662-F92	One enclosure with 92 15 TB tier 1 flash drives	748 W

Each SAS expansion enclosure contains two PSUs for redundancy. The total power consumption value is the sum of the power that is drawn from each PSU

Environmental requirements

System airflow is from the front to the rear of each enclosure:

- Airflow passes between drive carriers and through each enclosure.
- Airflow for the upper 4U of the 5U enclosure enters the front, passes between the disk drives, and exits through the large fans in the rear of the enclosure.
- Airflow for the lower 1U of the 5U enclosure is driven through the power supplies with 40 mm X 56 mm fans. Air continues through the chassis, cools the ESMs or controllers, and exits the rear of the enclosure.

- The combined power and cooling module exhausts air from the rear of each canister.

Ensure that your environment falls within the ranges that are shown in Table 25 on page 54.

Table 25. Temperature requirements

Environment	Ambient temperature	Altitude	Relative humidity	Maximum wet bulb temperature
Operating	5°C to 35°C (5°C to 40°C for 24 drives) 41°F to 95°F (41°F to 104°F for 24 drives)	0 - 2133 m(0 - 7000 ft)	8% to 80% noncondensing	23°C (73°F)
	5°C to 30°C (41°F to 86°F)	2134 - 3048 m (7001 - 10000 ft)		
Non-operating	1°C to 50°C (34°F to 122°F)	-305 to 12192 m (-1000 to 40000 ft)	8% to 80% noncondensing	27°C (80°F)
Storage	1°C to 60°C (34°F to 140°F)		5% to 80% noncondensing	29°C (84°F)
Shipping	-40°C to 60°C (-40°F to 140°F)		5% to 100% condensing, but not precipitating	

Dimensions and weight requirements for rack installation

Ensure that space is available in a standard 19" rack that can support the enclosure. The rack rail kits support racks with either threaded round or square mounting holes in the rail. The following table lists the dimensions and weights of the expansion enclosures.

Table 26. Physical characteristics of the expansion enclosures

Enclosure	Height	Width	Depth	Maximum weight	
				Drive ready (without drive)	Fully configured (with drives)
4662-12G, 4662-F12, 4662-24G or 4662-F24	87 mm (3.46 in.)	483 mm (19.0 in.)	556 mm (21.9 in.)	16.7 kg (36.8 lb)	25.0 kg (55.1 lb)
4662-92G, 4662-F92 4662-92G, 4662-F92	222.2 mm (8.75 in.)	483 mm (19.0 in.)	968 mm (38.1 in.)	67 kg (147.7 lb)	135 kg (297 lb)

Attention: To avoid potential equipment damage during transport and subsequent loss of data, see “Procedure: Transporting a 5U 92-drive expansion enclosure” on page 94. The procedure describes what to do for the following situations.

- When you power off a 92F, 92G, or an A9F 5U expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains a 92F, 92G, or an A9F 5U expansion enclosure.

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the enclosure lighter to move.

Warning: Some racks do not provide sufficient space to close the rear door. Expansion enclosures that are 5U need 968 mm from the rack front post to the back of the cable management arm (CMA). In addition, allow 905 mm from the front post to the back of the enclosure. To allow space for the power cables, provide 60 - 70 mm from the back of the enclosure.

Figure 26 on page 55 shows the rack space requirements for the 5U expansion enclosures.

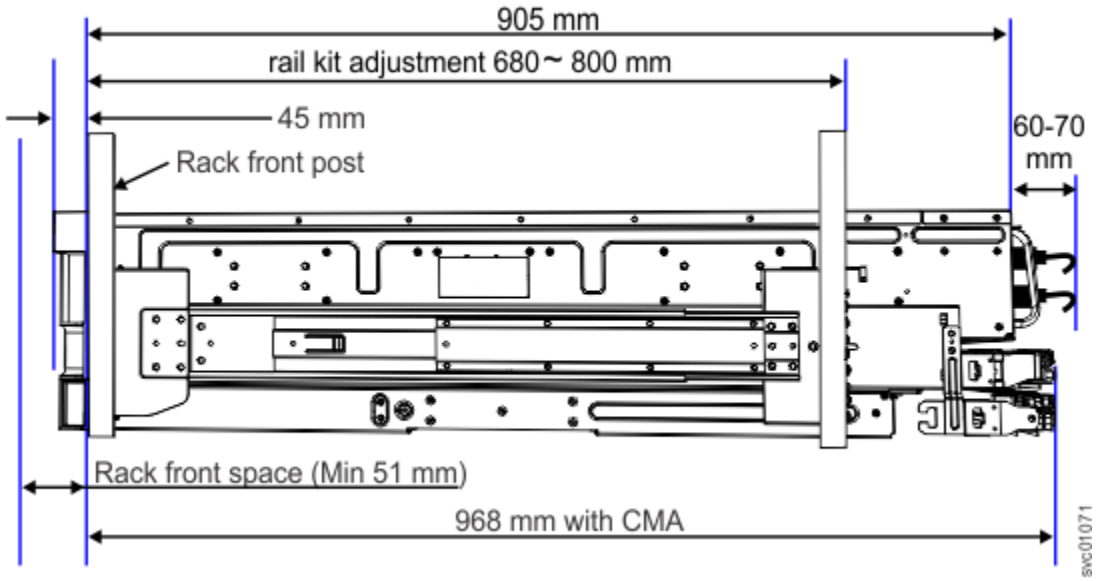


Figure 26. Rack space requirements for the 5U expansion enclosures

The following table shows the rack space requirements for the expansion enclosures in tabular form.

Table 27. Rack space requirements for the SAS expansion enclosures

Enclosure	Minimum rail length	Maximum rail depth
4662-12G, 4662-F12, 4662-24G or 4662-F24	595 mm (23.4 in.)	795 mm (31.3 in.)
4662-92G, 4662-F92 4662-92G, 4662-F92	680 mm (26.8 in.)	800 mm (31.5 in.)

Extra rack space requirements

Ensure that these additional space requirements, as shown in Table 28 on page 55, are available around the enclosures.

Table 28. Clearances

Location	Space requirements	Reason
Left and right sides	50 mm (2 in.)	Cooling air flow
Back	Minimum of 100 mm (4 in.). This space is not needed for 5U expansion enclosure models.	Cable exit

Supported drives for SAS expansion enclosures

Table 29 on page 56 provides drive specifications for SAS expansion enclosures.

All drives are dual-port and hot-swappable. Drives of the same form factor and connector type can be intermixed within an enclosure.

Table 29. Drive specifications		
Model and type	**3.5-inch drive**	**2.5-inch drive**
4662-12G, 4662-F12, 4662-24G or 4662-F24	-	• 2.5” Flash Drive 200 GB, 400 GB, 800 GB, 1.6 TB • 2.5” 15 K RPM HDD 300 GB, 600 GB • 2.5” 10K RPM HDD 600 GB, 900 GB, 1.2 TB, 1.8 TB, 2.4 TB • 2.5” 7.2 K RPM HDD 2 TB
4662-92G, 4662-F92 4662-92G, 4662-F92	N/A	• 2.5” Flash Drive 1.6 TB, 1.92 TB, 3.2 TB, 3.84 TB, 7.68 TB, 15.36 TB

Acoustical specifications for SAS expansion enclosures

The following table provides the acoustical specifications for the 4662-24G or 4662-F24 SAS expansion enclosures.

Table 30. Acoustical specifications for 4662-24G or 4662-F24 SAS expansion enclosures	
Model and type	**Acoustical output per enclosure**
4662-24G or 4662-F24	Less than 6.3 B LwA - Operating (40% Average seek rate) @ 23°C ambient

The noise emission level that is stated is the declared (upper limit) sound power level, in decibels, for a random sample of machines. All measurements are made in accordance with ISO 7779 and reported in conformance with ISO 9296.

Table 31 on page 56 provides the acoustical specifications for the 5U SAS expansion enclosures in accordance with ISO 9296(1,2,3).

Important: Hearing conservation program (HCP) procedures are required for field service personnel who service 5U SAS expansion enclosures.

Table 31. Declared noise emissions for 5U SAS expansion enclosures in accordance with ISO 9296				
Model and type	**Declared A-Weighted Sound Power Level, L_{WAd} (B)**		**Declared A-Weighted Sound Pressure Level, L_{pAm} (dB)**	
	Operating	**Idling**	**Operating**	**Idling**
Fully configured expansion enclosure, MTM / Model 4662-92G, 4662-F92 4662-92G, 4662-F92	8.5	8.5	85	85

Table 31. Declared noise emissions for 5U SAS expansion enclosures in accordance with ISO 9296 (continued)				
Model and type	**Declared A-Weighted Sound Power Level, L_{WAd} (B)**		**Declared A-Weighted Sound Pressure Level, L_{pAm} (dB)**	
	Operating	**Idling**	**Operating**	**Idling**

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 that is measured at the 1-meter bystander positions.
2. All measurements are made in conformance with ISO 7779 and declared in conformance with ISO 9296.
3. "B" and "dB" are abbreviations for bels and decibels. 1 B = 10 dB.

Important: Government regulations (such as regulations prescribed by OSHA or European Community Directives) can govern noise level exposure in the workplace and can apply to you and your server installation. This system is available with an optional acoustical door feature that can help reduce the noise that is emitted from this system. The actual sound pressure levels in your installation depend upon various factors. These factors include the number of racks in the installation. Other factors include the size, materials, and configuration of the room where you designate the racks to be installed. Other factors include the noise levels from other equipment, the room ambient temperature, and the employee's location in relation to the equipment. Further, compliance with such government regulations also depends upon various other factors, including the duration of employees' exposure and whether employees wear hearing protection. It is a good practice to seek qualified expert opinion in this field to determine whether you are in compliance with the applicable regulations.

Shock and vibration specifications for SAS expansion enclosures

Table 32 on page 57 and Table 33 on page 57 provide the shock and vibration testing results for SAS expansion enclosures.

Table 32. Shock testing results

Shock categories	Test level	Performance
Operational	5 g 10 ms 1/2 Sine	<=25 g 10 ms
Non-operational	30 g 10 ms 1/2 Sine	<=75 g 11 ms

Table 33. Vibration testing results

Vibration categories	Test level	Performance
Operational	0.21 G_{rms} 5 - 500 Hz Random	Throughput loss <=10% FCAL <= 0.68 G_{rms}
Non-operational	1.04 G_{rms} 2 - 200 Hz Random	<=3.12 G_{rms}
Shipping	0.3 G_{rms} 2 - 200 Hz Sine	<=5 G_{rms}
Rotational vibration	Normal operation performance measurements in enclosure with no external vibration.	Throughput loss for all drives of the same type within performance profile.

Enclosure location guidelines

Use these guidelines to plan the location of a control enclosure and any expansion enclosures that attach to it.

Each control enclosure contains two node canisters, forming an I/O group. The guidelines apply on an I/O group by I/O group basis.

Note: A mounting rail kit is provided with each control enclosure and expansion enclosure. Each rail can expand to accommodate a range of rack depths, which are measured between the front and rear mounting posts of the rack. However, because there are differences between some types of mounting rails, be sure to use the specific rail kit that is supplied with each control or expansion enclosure.

Plan for one of the following types of installation.

- Control enclosure only

  If you plan to add expansion enclosures in the future, follow the guidelines for a control enclosure and one or more expansion enclosures.
- Control enclosure and one or more expansion enclosures
  - Each control enclosure requires one standard rack unit of space in a rack.
  - Position the control enclosure in the center of the rack to have shorter cabling runs. Balance the number of expansion enclosures above and below the control enclosure.
  - Position the enclosures together. Avoid adding other equipment between enclosures.
  - Position the enclosures in the rack so that you can easily view them and access them for servicing. This action also allows the rack to remain stable and allows two or more people to install and remove the enclosures.
  - A maximal configuration spans multiple racks. When you use multiple racks, locate the racks next to one another.
  - Attach no more than ten 2U or four 5U expansion enclosures to each of SAS ports (port 1 or port 3) of the node canister in the control enclosure.

Planning management connections

The ports on the control enclosure have specific connection requirements.

Figure 27 on page 58 shows a node canister. The numbering of the onboard ports goes from left to right.

Figure 27. Ethernet ports on a canister

1 Node canister 10 Gbps Ethernet port 1
2 Node canister 10 Gbps Ethernet port 2
3 Node canister USB port
4 Node canister Technician port

Management Ethernet connections

Each node canister in a control enclosure provides both a primary and an optional secondary (backup) Ethernet connection for system management. These management ports are used for accessing the management GUI and the service assistant GUI for the node canister. For the FlashSystem 5200, these ports are:

- Ethernet Port 1: 10 GbE RJ45 Primary management port
- Ethernet Port 2: 10 GbE RJ45 Secondary management port

  Note: Ethernet Ports 1 and 2 can also be used for ethernet I/O.

Each node canister also has a Technician Port (denoted by the “cog/settings” symbol) which provides a DHCP service for direct connection to a laptop for initial system setup.

The following Ethernet connections are made to the control enclosure:

- Each control enclosure requires two Ethernet cables to connect it to an Ethernet switch for management. One cable connects to port 1 of the left node canister, and the other cable connects to port 1 of the right node canister. Both Internet Protocol Version 4 (IPv4) and Internet Protocol Version 6 (IPv6) are supported.
- **Note:** For increased redundancy a second Ethernet management connection is supported for each node canister, using port 2.
- To ensure management IP failover, Ethernet port 1 on each node canister must be connected to the same set of subnets. If used, Ethernet port 2 on each node canister must also be connected to the same set of subnets. However, the subnets for Ethernet port 1 do not have to be the same as Ethernet port 2.

For information on the cable standards required, see “Cable reference” on page 62.

IP address allocation and usage

As you plan your installation, you must consider IP address requirements and service access for the system.

Use Table 34 on page 59 to consider the TCP/IP address requirements of the system and the requirements to access other services. You must also plan for the IP address allocation, and for the configuration of the Ethernet router, gateway and firewall.

Table 34. Summary of TCP/IP ports and services

Service	Traffic direction	Protocol	Port	Service type
Email (SMTP) notification and inventory reports	Outbound	TCP	25	Optional
SNMP event notification	Outbound	UDP	162	Optional
Syslog event notification	Outbound	TCP UDP	6514 (TCP) 514 (UDP)	Optional
IPv4 DHCP (Node service address)	Outbound	UDP	68	Optional
IPv6 DHCP (Node service address)	Outbound	UDP	547	Optional
Network time server (NTP)	Outbound	UDP	123	Optional
SSH for command line interface (CLI) access	Inbound	TCP	22	Mandatory
Remote support assistance	Outbound	TCP	22	Optional
HTTPS for GUI access	Inbound	TCP	443	Mandatory
Uploading support packages to IBM	Outbound	TCP	443	Optional
Remote support assistance for HTTPS GUI access	Outbound	TCP	443	Optional
Remote user authentication service - HTTP	Outbound	TCP	16310	Optional
Remote user authentication service - HTTPS	Outbound	TCP	16311	Optional

Table 34. Summary of TCP/IP ports and services (continued)				
Service	**Traffic direction**	**Protocol**	**Port**	**Service type**
Remote user authentication service - Lightweight Directory Access Protocol (LDAP)	Outbound	TCP	389	Optional
iSCSI	Inbound	TCP	3260	Optional
iSCSI iSNS	Outbound	TCP	3260	Optional
IP-based RDMA replication/high availability	Inbound and Outbound	TCP	4791, 21451, 21452, and 21455	Optional
IP-based RDMA replication/high availability	Inbound and Outbound	UDP	4791, 21451, 21452, and 21455	Optional
IP Partnership management IP communication	Inbound and Outbound	TCP	3260	Optional
IP Partnership data path connections[1]	Inbound and Outbound	TCP	3265	Optional
REST API access and replication management	Inbound	TCP	7443	Optional
NVMe over RDMA	Inbound and Outbound	UDP over RoCEv2	4420	Optional
NVMe over TCP	Inbound and Outbound	TCP	4420	Optional
IP quorum application	Inbound and Outbound	TCP	1260	Optional
[1]Ports must be open for IP addresses that are configured for replication and not the system IP address.				

For configuration and management, you must allocate an IP address to the system; this IP address is referred to as the *management IP address*. For extra fault tolerance, you can also configure a second IP address for the second Ethernet port on the node. The addresses must be fixed addresses. If IPv4 and IPv6 are operating concurrently, you must provide an address for each protocol.

Attention: The address for a management IP cannot be the same address that is used for the service IP. Using the same IP address causes communication problems.

Name servers are not used to locate other devices. You must supply the numeric IP address of the device. To locate a device, the device must have a fixed IP address.

Planning for I/O connections

Plan to install the appropriate adapters for your FlashSystem control enclosure so that it is compatible with your networking topology and provides the appropriate connection capability.

The FlashSystem 5200 can support up to two adapters per node canister. Both node canisters must be configured with the same adapters.

Adapter slot 2 can optionally be used to support the attachment of expansion enclosures via a SAS adapter instead of additional host connectivity.

The FlashSystem 5200 has two Onboard 10 Gb Ethernet ports per node that can be used for I/O and replication, in addition to host ports provided by the adapters.

Table 35 on page 61 shows the fabric types that the FlashSystem 5200 supports for communicating to host systems, other FlashSystem controllers, and virtualized storage.

Table 35. Communications types

Functionality	Network speeds supported	On-board or Adapter	Host I/O	System to system	Storage virtualization
Fibre Channel (SCSI)	32 Gb, 16 Gb, 8 Gb	Adapter: 4-port	yes	yes	yes
Fibre Channel (FC-NVMe)	32 Gb, 16 Gb, 8 Gb	Adapter: 4-port	yes	no	no
Ethernet (iSCSI)	25 Gb	Adapter: 2-port	yes	yes	no
	10 Gb	On-board: 2-port	yes	yes	no
	10 Gb	Adapter: 4-port	yes	yes	no
Ethernet (NVMe/RDMA)	25 Gb	Adapter: 2-port	yes	yes	no

Note: 2 port adapter with port speed 25 Gb or 10 Gb depends on transceiver installation. For more information on the adapter, see “Cable reference” on page 62.

Connecting two control enclosures directly with Fibre Channel cables

Two control enclosures can be directly connected to form a partnership (for Policy-based High Availability, migration or replication), or to form a clustered HyperSwap system for legacy high availability support. Creating a clustered system prevents the use of newer features such as storage partitions, policy-based High Availability and vVol replication.

It is best for reliability, availability, and serviceability for control enclosures to communicate with each other through network switches. However, they can be directly connected with Fibre Channel (FC) cables, if needed.

Each node canister must have at least two paths to each node canister in the other control enclosure. This means that at least 8 Fibre Channel cables are needed and at least four Fibre Channel ports on each node canister will be used. Table 36 on page 61 shows an example of Fibre Channel connections between the enclosures.

Table 36. Cabling to direct-connect two control enclosures

	Control enclosure 1		Control enclosure 2	
FC Cable	**Node Canister**	**FC Port**	**Node Canister**	**FC Port**
1	1	1	1	1
2	1	2	2	1
3	1	3	1	2
4	1	4	2	2
5	2	1	1	3
6	2	2	2	3
7	2	3	1	4
8	2	4	2	4

Cable reference

The cable standard tables specify cable types and standards for customer-supplied cables for use with the system.

Table 37 on page 62 provides a list of Ethernet cable standards. Ethernet cables are not supplied with the system. Ensure that the cables that are used meet the minimum standards for the Ethernet port type.

Table 37. Ethernet cable standards

Ethernet adapter type	Ethernet port type	Connector	Cable type	Minimum standard	Remark
On-board Technician ports	1 Gbps Ethernet port	RJ45	Unshielded twisted pair (UTP)	Cat 5e or Cat 6 (up to 100 meters)	
On-board Ethernet ports	10 Gbps Ethernet port	RJ45	Unshielded twisted pair (UTP)	Cat 6a or Cat 7 (up to 100 meters)	
2 Port Ethernet Adapter Card	25 Gbps Ethernet port	LC-SFP28 Transceiver (IBM feature)	Optical fibre	• OM3 (up to 70 m) • OM4 (up to 100 m)	
2 Port Ethernet Adapter Card	25 Gbps Ethernet port	QSFP28 to SFP28	Passive Twinax DAC Cable (up to 2 m)	• SFF-8432 transceiver specification • IEC60825-1 product safety specification • Operational temperature should be 0 deg C - 70 deg C. However, in some cases the temperature can reach to 85 deg C.	
2 Port Ethernet Adapter Card	10 Gbps Ethernet port	RJ45 SFP+ connector (IBM feature)	Unshielded twisted pair (UTP)	• Cat 6a or Cat 7 (up to 100 meters)	
2 Port Ethernet Adapter Card	10 Gbps Ethernet port	LC - SFP+ Transceiver (IBM feature)	Optical fiber	• OM2 (up to 60 meters) or OM3 (60 - 150 meters)	
4 Port Ethernet Adapter Card	10 Gbps Ethernet port	DAC (Direct Attached Copper)	DAC: Twin-ax copper cable (up to 2 m)	• SFF-8432 transceiver specification • IEC60825-1 product safety specification • Operational temperature should be 0 deg C - 70 deg C. However, in some cases the temperature can reach to 85 deg C.	

Table 37. Ethernet cable standards (continued)

Ethernet adapter type	Ethernet port type	Connector	Cable type	Minimum standard	Remark
4 Port Ethernet Adapter Card	10 Gbps Ethernet port	RJ45 SFP+ connector (IBM feature)	Unshielded twisted pair (UTP)	• Cat 6a or Cat 7 (up to 100 meters)	
4 Port Ethernet Adapter Card	10 Gbps Ethernet port	LC - SFP+ Transceiver (IBM feature)	Optical fiber	• OM2 (up to 60 meters) or OM3 (60 - 150 meters)	

Planning worksheets

Planning worksheets can help identify important information that is needed when the system is installed and configured. Complete the relevant sections to help with installation planning.

The planning worksheet is available for download in the following languages:

- English
- Brazilian Portuguese
- French
- Italian
- German
- Spanish
- Simplified Chinese
- Japanese
- Korean

Chapter 6. Installing

This information covers the system hardware installation and initial setup.

After you verify that the power and environmental requirements of the system are met, and planning the location of the enclosure, you are ready to begin installing the hardware components. The installation activity follows the plan that is used in the planning section.

The installation poster provides an illustrated sequence of steps for installing the enclosure in a rack and beginning the setup process. Refer to Installation Poster.

For more details on the installation, see the following pages:

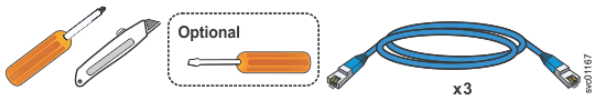
Unpacking the control enclosure

Before you unpack the control enclosure, ensure that you review and follow all related instructions.

Before you begin

Before you start the installation process, complete the information that is requested in “Planning worksheets” on page 63, and ensure the following items are available.

- Philips screw driver
- Box knife
- Flat-blade screw driver (optional)
- Three Ethernet cables



The control enclosure and the following related parts are included in one box. The enclosed inventory sheet lists the part numbers of the items that were ordered. Items such as drives and interface adapters, are preinstalled inside each node canister.

- Control enclosure with the following components preinstalled:
  - Two node canisters with optional interface adapters, SFPs, and memory

    Each node canister contains two interface adapter slots. The same number and type of adapters must be installed in each node canister. The control enclosure can contain 0, 2, or 4 interface adapters.
  - Two power supply units (PSUs)
  - A combination of drives and drive blanks

    The number of drives and drive blanks varies, according to the number of drives that were specified in the product order.
- Rail kit, which includes the left and right rails, and any associated hardware
- Cables, if they were ordered, for the type and number of interface adapters that are installed in each node canister.
- Two power cables.

About this task

CAUTION: The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

To unpack the control enclosure, complete the following steps.

1. Cut the box tape and open the lid of the shipping carton.

2. Remove the rail kit box and set it aside in a safe location.
3. Lift the front and rear foam packing pieces from the carton.
4. Remove the four corner reinforcement pieces from the carton.
5. Using the box knife, carefully cut the four corners of the carton from top to bottom.
6. Fold the sides and back of the carton down to uncover the rear of the control enclosure. If necessary, carefully cut along the lower fold line of the sides and remove them.
7. Carefully cut the raised section of the foam packing away from the rear of the enclosure.
8. Carefully cut open the bag that covers the rear of the enclosure.
9. Carefully cut the raised section of the foam packing away from the front of the enclosure.
10. Lift the enclosure from the shipping carton or push it on to a lift.
11. Record the serial number that is listed on the left end cap of the control enclosure.

Item	Serial Number	MTM
Control Enclosure		

Installing the support rails

You must install the support rails before you install the enclosure in a rack.

Procedure

To install the support rails, complete the following steps.

1. Refer to the rack configuration planning worksheet, and locate the 1-U space that is marked on the rack vertical frame posts where you will install the enclosure.
2. Select the first rail to install. The outer side of each rail is engraved "Left" or "Right."
3. Supporting the rail with one hand, deflect the clip on the bracket slightly 1 and fit the rear bracket into place against the rear vertical rack rail so that the two pins extend through the upper and lower holes in the 1-U space on the vertical rail 2, as shown in the following figure.

   No screws are required.

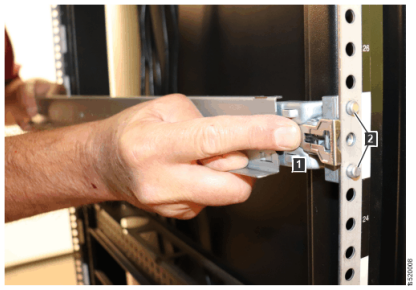


Figure 28. Installing the rear rail bracket

4. To secure the front of the rail to the rack, complete the following steps:
   a. Locate the numbered 1-U space on the front vertical rail that matches the location of the rear bracket.
   b. While continuing to support the rail and holding the rear bracket against the rear vertical frame post 1, compress or extend the rail far enough to fit the front rail bracket onto the inner face of the front vertical frame post, while deflecting the blue latch hook 2 sideways, as shown in the following figure.

Figure 29. Installing the front rail bracket

c. After the two pins are aligned with the upper and lower holes in the 1-U space on the vertical rail , release the latch hook.

5. Repeat steps “3” on page 66 and “4” on page 66 for the opposite rail.

Installing the control enclosure in a rack

After you install the support rails, you can install the control enclosure in the rack.

Before you begin

CAUTION: To avoid any hazard from the rack tipping forward when devices are installed, observe all safety precautions for the rack into which you are installing the device.

CAUTION: The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

Important: The control enclosure requires high line (200-240 V) power. If the power supplies have the auto-ranging PSU (03GH925), they can also accept 100-127 V.

Procedure

To install the control enclosure in the rack, complete the following steps.

1. Using two persons, lift the chassis until the back of the control enclosure is aligned with the front of the rack rails.

   Note: Make sure that the FAN door is pointing up.

2. Slide the control enclosure between the rails.

Figure 30. Installing the control enclosure

3. When fully inserted, the enclosure latch on each front corner of the control enclosure engages with the blue hook on the vertical rail of the rack.

   Note: If the rack is being moved, you can use the captive screws under the enclosure latch levers to secure the enclosure to the rails.

Installing a 2U expansion enclosure

Use the following information to install the optional 2U expansion enclosure.

Unpacking a 2U expansion enclosure

Before you unpack the optional 2U expansion enclosure, ensure that you review and follow all related instructions.

Before you begin

The expansion enclosure and related parts are included in a single box that contains the following items:

- Expansion enclosure with the following components preinstalled:
  - Two power supplies
  - Drives and drive blanks
- Rail kit, which includes left and right rails, black M5 screws, and alternative silver screw pins for other rack types
- Two power cables

Note: You will need a box knife to unpack the expansion enclosure.

About this task

CAUTION: To lift the assembled enclosure requires three persons unless suitable lifting equipment is available or the enclosure is unpacked and dismantled as described in the procedure.

Procedure

1. Cut the box tape and open the lid of the shipping carton.
2. Remove the rail kit box and set it aside in a safe location.
3. Lift the front and back foam packing pieces from the carton.
4. Remove the four corner reinforcement pieces from the carton.
5. Using the box knife, carefully cut the four corners of the carton from top to bottom.
6. Fold the sides and back of the carton down to uncover the front of the expansion enclosure.

   If necessary, carefully cut along the lower fold lines and remove each of the sides.
7. Carefully cut the foam packing away from the front of the enclosure.
8. Carefully cut open the bag that covers the front of the enclosure.
9. Remove the leftmost drive or drive filler. Note it's location (and its serial number, if it is a drive) and set it aside.
10. Repeat until all drives or drive fillers are removed from the enclosure.
11. Lift the enclosure from the shipping carton. Note that the rear half of the enclosure is heavier than the front half.

    Note: With the drives removed, the enclosure weighs approximately 17 kg (37 lb).

Installing support rails for 2U expansion enclosures

Before you install 2U expansion enclosures, you must first install support rails.

Procedure

To install the support rails, complete the following steps.

1. Locate the expansion enclosure rails (Figure 31 on page 69).

   The rail assembly consists of two rails that must be installed in the rack cabinet.

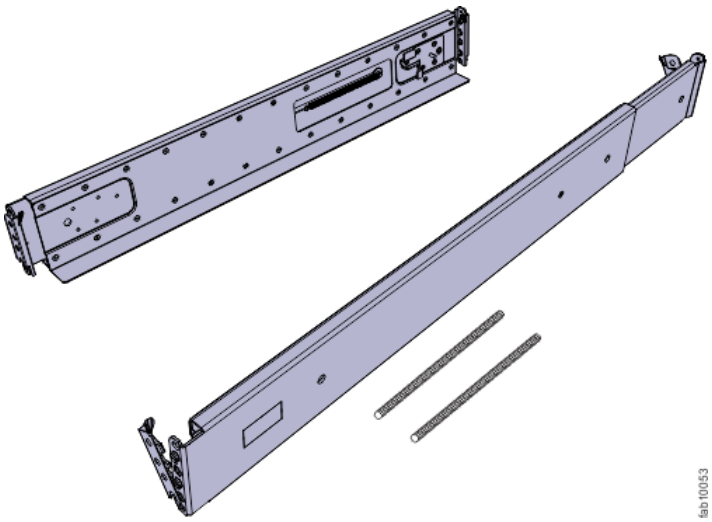


Figure 31. Expansion enclosure support rails

2. Locate the hardware that is used to install the rails, including two rail springs, two sets of eight bracket pins, and two M5 screws.

   Set the hardware aside for use later in the installation process.

3. Install a spring on each rail.

   a) Extend the rail to its full length.

   b) Push one looped end of a spring over one stud on the inside of the rail.

   c) Stretch the spring slightly and push the other looped end of the spring onto the other stud on the inside of the rail.

4. Working at the front of the rack cabinet, identify the two standard rack units (2U) of space in the rack into which you want to install the support rails.

   Figure 32 on page 69 shows two rack units with the front mounting holes identified.

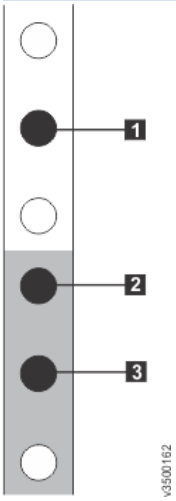


Figure 32. Hole locations in the front of the rack

- 1 Upper rail mounting bracket pin
- 2 Lower rail mounting bracket pin
- 3 Rack mounting screw hole

5. Ensure that the appropriate bracket pins are installed in the front and rear bracket of each rail.

   Each rail comes with four medium pins preinstalled (two in the front bracket and two in the rear bracket). Large and small pins are provided separately. Use the pins that are appropriate for the mounting holes in your rack. See Table 38 on page 70.

Table 38. Selecting bracket pins for your rack	
Mounting holes	**Bracket pins**
Round, unthreaded	Use the preinstalled medium pins.
Round, threaded	Unscrew the medium pins and replace with the smaller pins that are supplied with the rails.
Square	Unscrew the medium pins and replace with the large pins that are supplied with the rails.

6. At each end of the rail, grasp the tab 1 and pull *firmly* to open the hinge bracket (see Figure 33 on page 70).

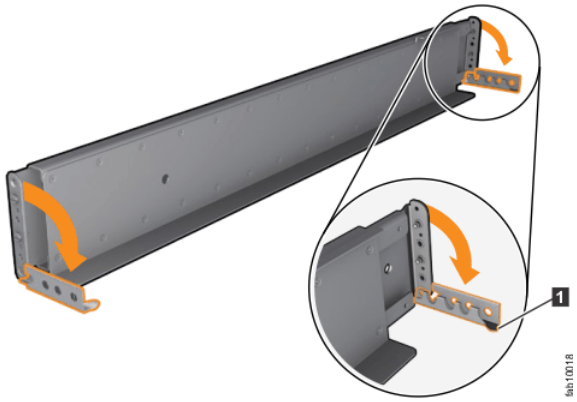


Figure 33. Opening the hinge brackets

7. Align the holes in the rail bracket with the holes on the front and rear rack cabinet flanges.
   Ensure that the rails are aligned on the inside of the rack cabinet.
8. On the rear of the rail, press the two bracket pins into the holes in the rack flanges.
9. Close the rear hinge bracket to secure the rail to the rack cabinet flange.
   (See Figure 34 on page 70.)

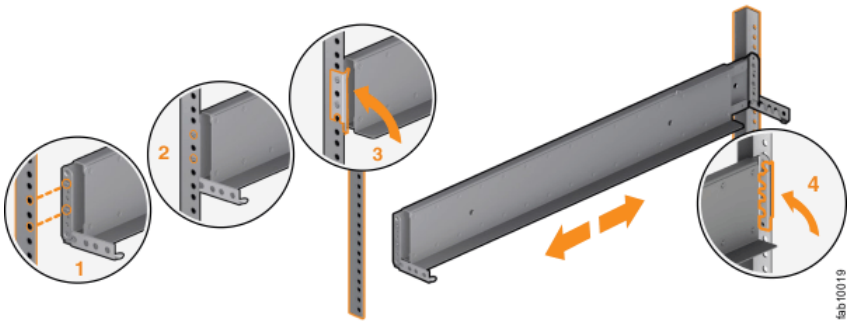


Figure 34. Closing the hinge brackets

10. On the front of the rail, press the two bracket pins into the holes in the rack flanges.
11. Close the front hinge bracket to secure the rail to the rack cabinet flange.
    See Figure 34 on page 70.
12. Secure the rear of the rail to the rear rack flange with an M5 screw that is provided with the rack kit.
13. Repeat the steps to secure the opposite rail to the rack cabinet.
14. Repeat the procedure to install rails for each additional expansion enclosure.

Installing an optional 2U SAS expansion enclosure

The 2U SAS expansion enclosures are installed in the same rack as the control enclosure.

About this task

CAUTION:

- To lift and install the 2U SAS expansion enclosure into the rack requires at least two people.

- Install a 2U SAS expansion enclosure only onto the rails that are supplied with the enclosure.
- Load the rack from the bottom up to ensure rack stability. Empty the rack from the top down.

Procedure

To install an optional 2U SAS expansion enclosure, complete the following steps.

1. Remove the two enclosure end caps by grasping the handle and pulling the bottom of the end cap free, then clearing the tab on the top of the enclosure.
2. Align the enclosure with the front of the rack cabinet.
3. Carefully slide the enclosure into the rack along the rails until the enclosure is fully inserted.
4. Secure the enclosure with screws in the rack mounting screw holes.
5. Reinstall the left and right end caps.

   The left end cap has indicator windows that align with the status LEDs (light-emitting diodes) on the edge of the enclosure.

   a) Ensure that the serial number of the end cap matches the serial number on the rear of the enclosure.

   b) Fit the slot on the top of the end cap over the tab on the chassis flange.

   c) Rotate the end cap down until it snaps into place.

   d) Ensure that the inside surface of the end cap is flush with the chassis.
6. If you are installing additional 2U SAS expansion enclosures, repeat the previous steps to complete the installation.

Powering on the optional 2U SAS expansion enclosures

After you install all the hardware components, power on the optional 2U SAS expansion enclosures and check their status.

About this task

Attention: Do not power on an expansion enclosure with any open bays or slots.

- Every unused drive bay must be occupied by a filler panel.
- Filler panels must be installed in all empty host interface adapter slots.

Open bays or slots disrupt the internal air flow, causing the drives to receive insufficient cooling.

Procedure

To power on the 2U SAS expansion enclosures, complete the following steps.

1. Use the supplied power cords to connect both power supply units of the first expansion enclosure to their power sources.

   If the power sources have circuit breakers or switches, ensure that they are turned on. The expansion enclosure does not have power switches. Repeat this step for each expansion enclosure in the system.

   Note: Each enclosure has two power supply units. To provide power failure redundancy, connect the two power cords to separate power circuits.
2. From the rear of the rack, check the LEDs on each expansion enclosure (see Figure 35 on page 72).

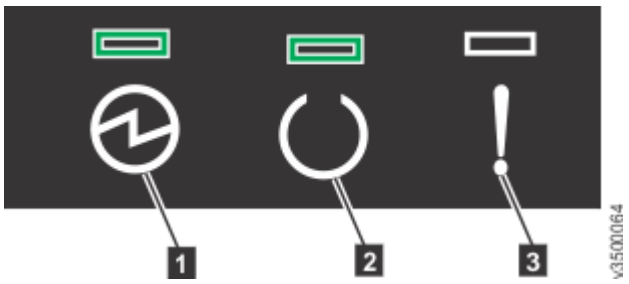


Figure 35. Expansion enclosure LEDs

1 Power
2 Status
3 Fault

The canister is ready with no critical errors when **Power** is illuminated, **Status** is on, and **Fault** is off.

3. Wait for all expansion canisters to finish powering on before you proceed with the system installation process.

Installing a 5U expansion enclosure

Use the following information to install the optional 5U expansion enclosure.

Safety notices and considerations

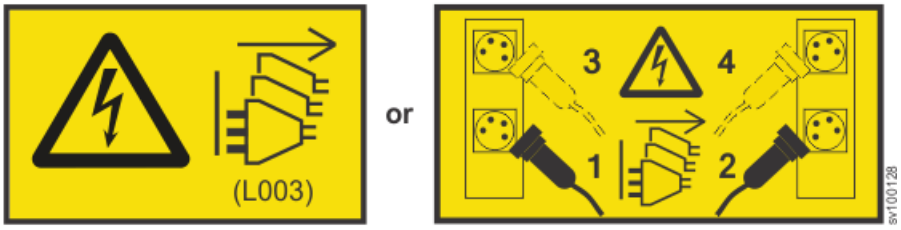
Before you install, service, or move a 5U expansion enclosure, always read and follow the safety notices and guidelines.

Safety notices

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

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)

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



DANGER:

Hazardous voltage present. Voltages present constitute a shock hazard, which can cause severe injury or death. (L004)

DANGER:

Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

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)

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)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.

  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

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: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely.

Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: If the System slide rails are installed above EIA location 29U, the [ServerLIFT®] tool (or other qualified lift tool) must be used as a safety precaution for servicing. Position the lift tool platform slightly below the bottom of the System drawer to account for the slight downward flex when the drawer is extended out fully on its slides. Then gently raise the lift tool platform to stably contact the bottom of the drawer, minding not to over force it as it could put upward stress to the slide rails. A service-qualified ladder may have to be used to reach or properly work around the System at such heights. While using a ladder, do not lean on or against the system drawer or lift tool during service, and follow safe practices. (C051)

Weight considerations: 5U expansion enclosure

Before you install, move, or perform service on a 5U SAS expansion enclosure, you must be prepared to handle the weight of the enclosure and its parts.

Safety notices and considerations

Important: Always read and follow the safety notices and instructions before you install, move, or service the expansion enclosure and its parts. See “Safety notices and considerations” on page 72 for information.

- Do not exceed the specified maximum load of the rack where the enclosure is to be installed.
- Do not exceed any load limit of the building and flooring where the enclosure is to be installed.
- Always use a suitably rated mechanical lift or four persons when you are performing any of the following tasks:
  - Removing the expansion enclosure from its packing material
  - Lifting and installing the expansion enclosure in the rack for the first time
  - Reinstalling the expansion enclosure after you complete a service task (for example, replacing the enclosure FRU).
- At least three persons are required to move the enclosure while it is in the rack (if you are moving the enclosure off the rails). Even after the drives, power supply units, secondary expander modules, canisters, fans, and top cover are removed, the enclosure weighs approximately 43 kg (95 lbs).
- To maximize rack stability, always install the expansion enclosure in the lowest possible position in the rack.

Weight of expansion enclosure parts

Table 39 on page 76 summarizes the weight and quantity of the parts (FRUs) that are shipped with the 5U expansion enclosure.

Table 39. Weight of expansion enclosure parts

FRU description	Weight per unit		Quantity shipped	Total weight	
	kg	lbs		kg	lb
Enclosure FRU	42.5	93.696	1	42.500	93.696
Rail kit	9.231	20.351	1	9.231	20.351
Front fascia (4U front cover)	0.303	0.668	1	0.303	0.668
Display panel assembly	0.020	0.044	1	0.020	0.044
PSU fascia (1U cover)	0.010	0.022	1	0.010	0.022
Power supply unit (PSU)	3.335	7.352	2	6.670	14.705
Secondary expansion module	0.826	1.821	2	1.652	3.642
Fan module	0.890	1.962	4	3.560	7.848

Table 39. Weight of expansion enclosure parts (continued)					
FRU description	**Weight per unit**		**Quantity shipped**	**Total weight**	
	kg	**lbs**		**kg**	**lb**
Expansion canister	1.588	3.501	2	3.176	7.002
Cable management arm (lower and upper arms)	1.373	3.027	1	1.373	3.027
Top cover	3.720	8.201	1	3.720	8.201
Fan interface board	0.118	0.260	1	0.236	0.260

Weight of expansion enclosure SAS drives

The SAS drives are shipped in a separate package from the 5U expansion enclosure. The enclosure can support up to 92 SAS drives; however, the quantity varies depending on the number of drives ordered.

Weight increases as FRUs are installed

The 5U expansion enclosure supports up to 92 SAS drives. As Table 40 on page 77 shows, substantial weight is added to the enclosure when all drives are installed.

Table 40. Weight of an enclosure with 92 SAS drives					
FRU description	**Approximate weigh per unit**		**Maximum supported**	**Approximate extra weight**	
	kg	**lb**		**kg**	**lb**
2.5-inch tier 0 flash drive 2.5-inch tier 1 flash drive	0.224	0.494	92	20.608	45.433
2.5-inch hard disk drive	0.304	0.670	92	27.968	61.659
3.5-inch Near-Line SAS hard disk drive	0.876	1.931	92	80.592	177.675

As you install or replace FRUs, the overall weight of the expansion enclosure increases. For example, Table 41 on page 77 shows the weight progression as different combinations of FRUs are installed.

Table 41. Enclosure weight as FRUs are installed			
Enclosure assembly		**Approximate weight**	
FRUs installed	**FRUs not installed**	**kg**	**lb**
• Enclosure	• Secondary expansion modules • Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly • Drives • Cover	42.5	93.7
• Enclosure • Secondary expansion modules	• Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly • Drives • Cover	44.3	97.7

Table 41. Enclosure weight as FRUs are installed (continued)

Enclosure assembly		Approximate weight	
FRUs installed	**FRUs not installed**	**kg**	**lb**
• Enclosure • Secondary expansion modules • Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly	• Drives • Cover	58	127.9
Note: The following FRUs are installed when the enclosure is initially shipped. • Enclosure • Secondary expansion modules • PSUs • Expansion canisters • Fan modules • Fan interface board • Display assembly • Cover	• Fascia (1U and 4U) • Drives	61.5	135.4
• Enclosure • Secondary expansion modules • Fascia (1U and 4U) • PSUs • Expansion canisters • Fan modules • Fan interface boards • 92 2.5-inch tier 1 flash drives	• Cover	78.6	173.3
• Enclosure • Secondary expansion modules • Fascia • PSUs • Expansion canisters • Fan modules • Fan interface board • 92 2.5-inch hard disk drives	• Cover	86	189.6
• Enclosure • Secondary expansion modules • Fascia • PSUs • Expansion canisters • Fan modules • Fan interface board • 92 3.5-inch Near-Line SAS hard disk drives	• Cover	138.6	305.6

Conversely, the overall weight of the expansion enclosure is reduced as you remove parts. However, even with parts removed, the 5U expansion enclosure is heavy. Depending on the number of parts that remain, you might need four persons or a mechanical lift to support the weight of the expansion enclosure.

Identify the hardware components

You should become familiar with the external components of the 5U expansion enclosure.

Components on the front of the enclosure

Figure 36 on page 79 shows the front of the 5U expansion enclosure. In the figure, all parts are installed in the enclosure.

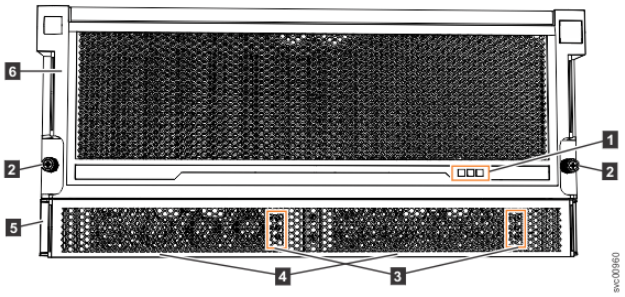


Figure 36. Features on the front of the 5U expansion enclosure

1. Display panel indicators
2. Rack retention thumb screws
3. Power supply unit indicators
4. Power supply units (PSUs)
5. PSU fascia (1U)
6. Front fascia (4U)

However, as Figure 37 on page 79 shows, the 4U and 1U fascias are packaged separately. You must attach them to the front of the 5U expansion enclosure as part of the initial installation process.

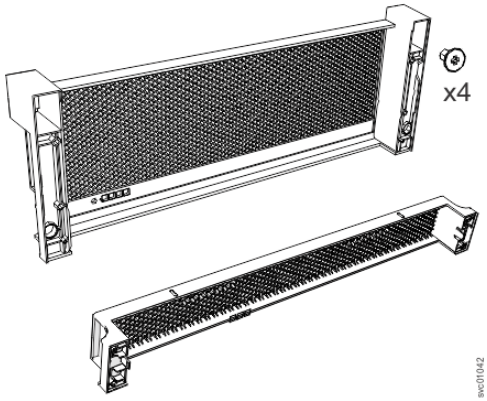


Figure 37. Front fascia of the 5U expansion enclosure

Components on the rear of the enclosure

Figure 38 on page 80 shows the components on the rear of the 5U expansion enclosure. Four fan modules and two expansion enclosures are accessible from the back of the enclosure.

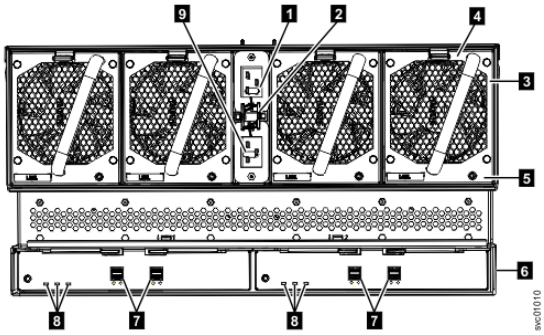


Figure 38. Features on the rear of the 5U expansion enclosure

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

Support rails

Figure 39 on page 80 shows the support rails for the expansion enclosure. The support rails are packaged separately from the expansion enclosure.

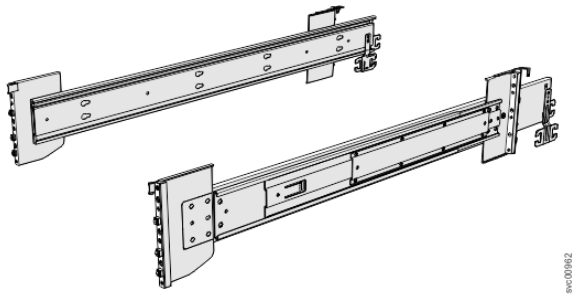


Figure 39. Support rails

Cable management arm

The cable management arm (CMA), which consists of an upper and lower assembly, are packaged separately from the expansion enclosure. As Figure 40 on page 81 shows, each CMA assembly is attached to the rear end of the support rails.

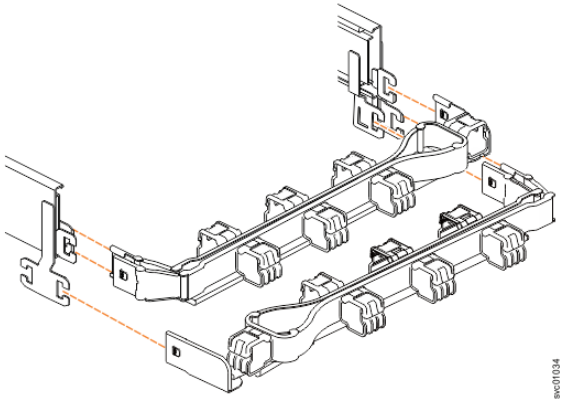


Figure 40. CMA assemblies

Unpacking an optional 5U expansion enclosure

Before you unpack an optional 5U expansion enclosure, ensure that you review and follow all related instructions and safety notices.

Before you begin

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: To avoid personal injury, before you lift this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

Important: Before you unpack, move, install, or service the expansion enclosure and its parts, always complete the following tasks:

- Read and follow the safety notices and instructions, as described in "Safety notices and considerations" on page 72.
- Read and follow the guidelines that are described in "Weight considerations: 5U expansion enclosure" on page 76.
- Ensure that a suitably rated mechanical lift is available to support the weight of the expansion enclosure when it is inserted into the rack for installation.

About this task

The expansion enclosure and most parts are shipped together in one large box. A tray on top of the enclosure contains the front fascia (1U and 4U pieces), the cable management arm (CMA), and the slide rail kit. Figure 41 on page 82 shows how the enclosure is packaged for shipment.

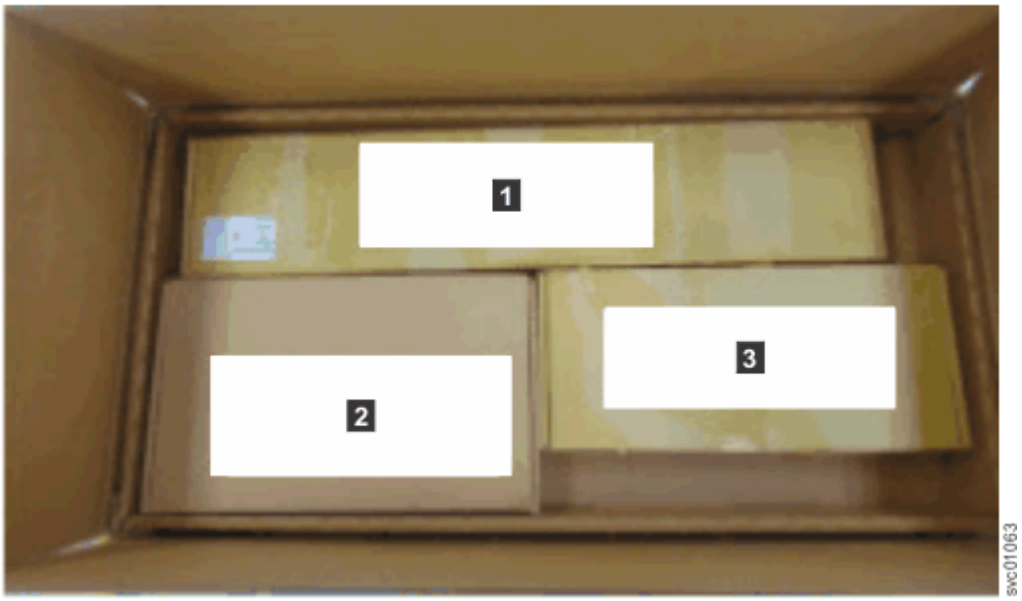


Figure 41. Tray containing expansion enclosure parts

1 Slide rail kit
2 Cable management arm
3 Fascia

Note: Drives are not included in installation package for the enclosure; they are provided in a separate package.

Procedure

1. Remove the cardboard tray that contains the slide rails, cable management arm, and fascia from cardboard box in which the expansion enclosure was shipped.
2. Remove the foam end pieces from the top of the expansion enclosure.
3. Cut the corners of the shipping box and fold them down to uncover the sides and faces of the expansion enclosure, as shown in Figure 42 on page 83.

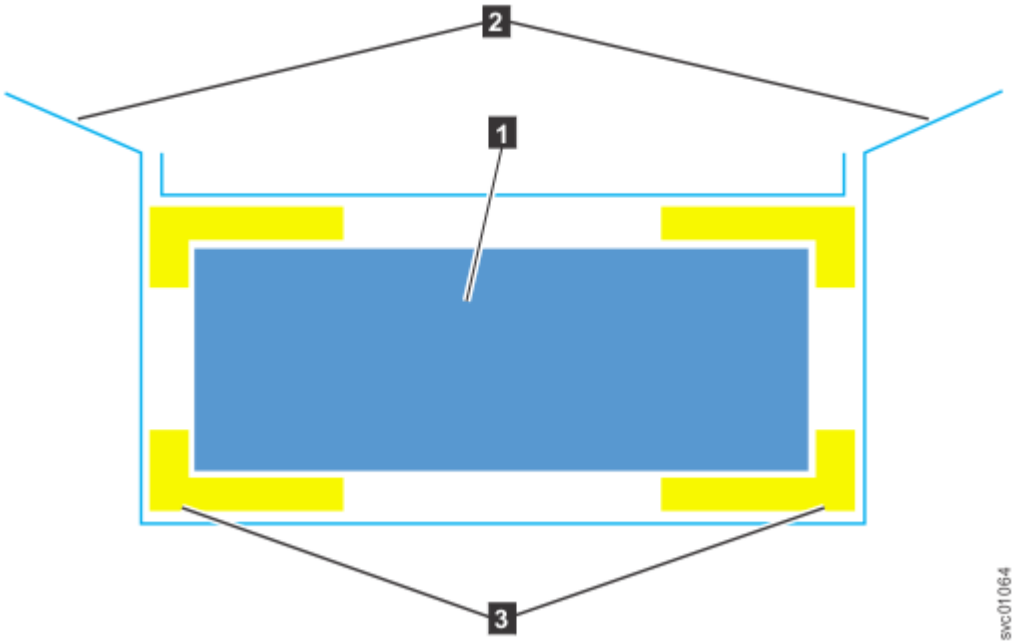


Figure 42. Packaging materials

1 Enclosure
2 Top of shipping box, folded back
3 Foam protectors

4. With four or more persons, push the expansion enclosure sideways onto an adjacent flat bed lift. Keep the remaining foam block protectors attached to the enclosure.
5. Remove the support rail kit from the box in which it was shipped (1, as shown in Figure 41 on page 82).
6. Remove the 4U and 1U fascia from the boxes in which they were shipped, as shown in Figure 43 on page 83.

Figure 43. Packaging for fascia

1 4U fascia (front)

2 1U fascia (power supply units)

7. Remove the cable management arm assembly from its packaging (2 in Figure 41 on page 82).

Installing or replacing the support rails

You must install the support rails before you can install a 5U expansion enclosure in a rack.

Procedure

1. Locate the hardware that is used to install the rails, including the M4xL6 and M5xL13 screws.
   Set the hardware, which is shown in Figure 44 on page 84, aside for use later in the installation process.

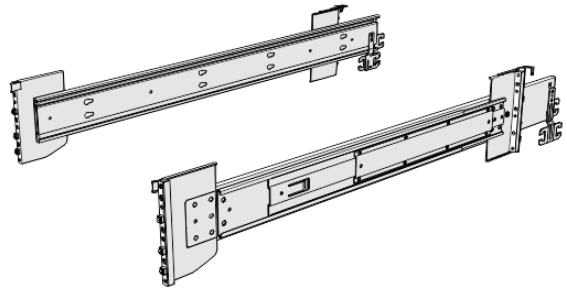


Figure 44. Support rails

2. Select an available 5U space in your rack to install the expansion enclosure.

   Important notes:

   - When you select a rack location, ensure that the enclosure and its parts are easily accessible. Allow enough space for the lid to be easily removed and for internal components, such as drives and secondary expansion modules, to be serviced.
   - When all components and drives are installed, the expansion enclosure is heavy. Install the support rails and enclosure at the lowest available position. Do not install the rails and enclosure above position U25 in the rack.

3. Remove the inner member of the rail. Push the tab (a) and slide the middle rail member back, as shown in Figure 45 on page 84.

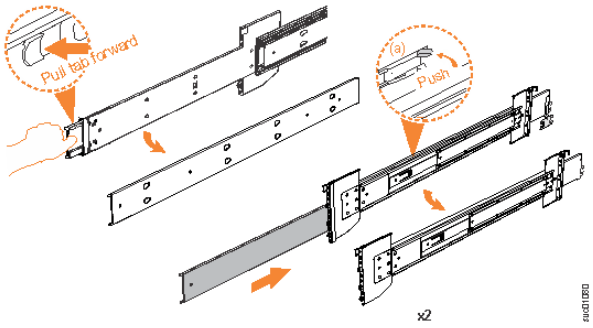


Figure 45. Detaching the inner rail section

4. Use four M4 screws to attach the inner rail to the side of the enclosure. Figure 46 on page 84 shows the screw locations.

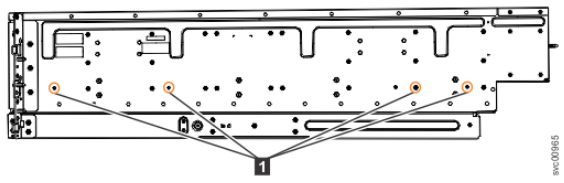


Figure 46. Screw locations to attach the inner rail to the enclosure

5. Install the inner section of the rail onto each side of the expansion enclosure, as shown in Figure 47 on page 85.

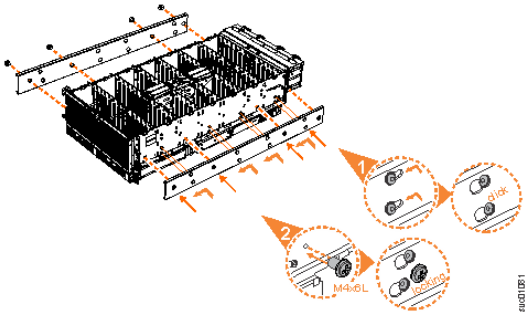


Figure 47. Attaching the inner rail section to the enclosure

6. Use the M5 screws to install the outer rail member and bracket assembly to the rack, as shown in Figure 48 on page 85.

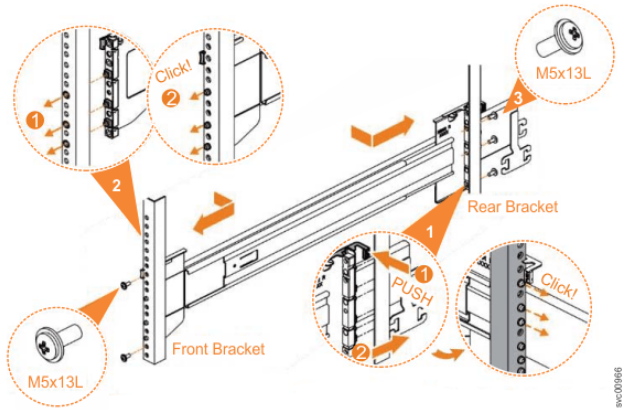


Figure 48. Installing the rail assembly to the rack frame

For example, Figure 49 on page 85 shows the front of the rail that is attached to the frame.

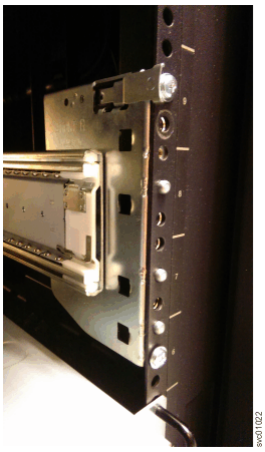


Figure 49. Example of the required rack space

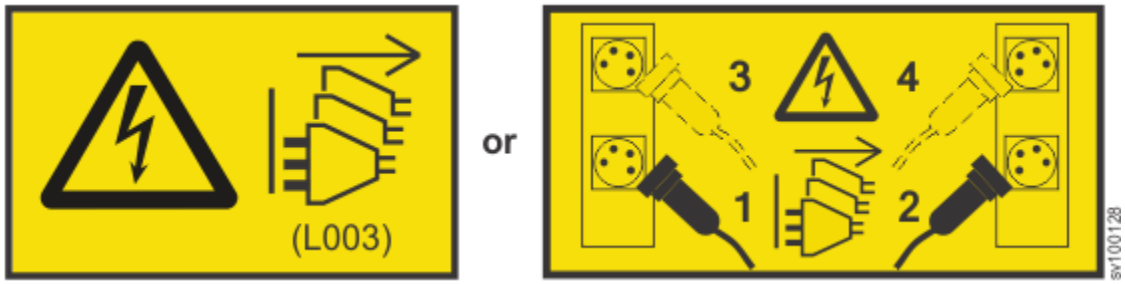
7. Repeat steps "5" on page 85 through "6" on page 85 to install the opposite rail.
8. Install the expansion enclosure in the rack, as described in "Installing a 5U expansion enclosure in a rack" on page 86.

Installing a 5U expansion enclosure in a rack

Use the following procedure to place a 5U expansion enclosure in a rack during the installation process. To complete some service tasks, you might also need to slide the enclosure back in to the rack.

Before you begin

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



Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

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)

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)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with ⏚. (R010)

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: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.

- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

CAUTION: If the System slide rails are installed above EIA location 29U, the [ServerLIFT®] tool (or other qualified lift tool) must be used as a safety precaution for servicing. Position the lift tool platform slightly below the bottom of the System drawer to account for the slight downward flex when the drawer is extended out fully on its slides. Then gently raise the lift tool platform to stably contact the bottom of the drawer, minding not to over force it as it could put upward stress to the slide rails. A service-qualified ladder may have to be used to reach or properly work around the System at such heights. While using a ladder, do not lean on or against the system drawer or lift tool during service, and follow safe practices. (C051)

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)

About this task

Important: The 5U expansion enclosure is heavy. Before you install the expansion enclosure in the rack for the first time or replace it in the rack to complete a service task, review and implement the following tasks:

- Always use a suitably rated mechanical lift or four persons to raise the enclosure to install it in the rack. Even after the drives, power supply units, secondary expander modules, canisters, fans, and top cover are removed, the enclosure weighs 43 kg (95 lbs).
- Install the expansion enclosure in the lowest position in the rack. Figure 50 on page 90 shows an example.

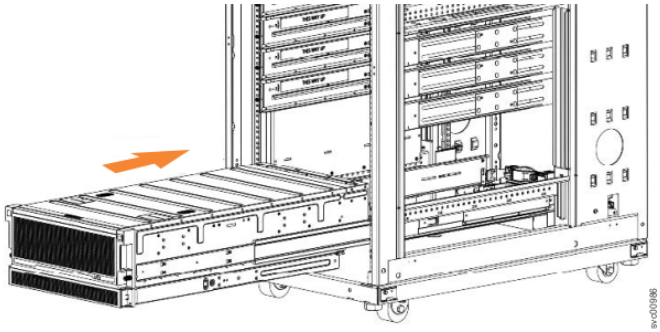


Figure 50. Example installation of the enclosure in the rack

- Ensure that the drives are easily accessible. Avoid installing the 5U expansion enclosure above position 22U in the rack.

If you are reinstalling the expansion enclosure in the rack after you performed a service task (for example, replacing the enclosure), you must also perform the following tasks:

- Reinstall all of the following parts:
  - Cover
  - Drives
  - Fan modules
  - Power supply units and 1U fascia
  - Secondary expander modules
  - Expansion canisters (and SAS cables)
- Reconnect both power cables to the expansion enclosure.

Procedure

1. Fully extend the left and right drawer sections from the rack to lock the rails in the extended position (**1** in Figure 51 on page 90).

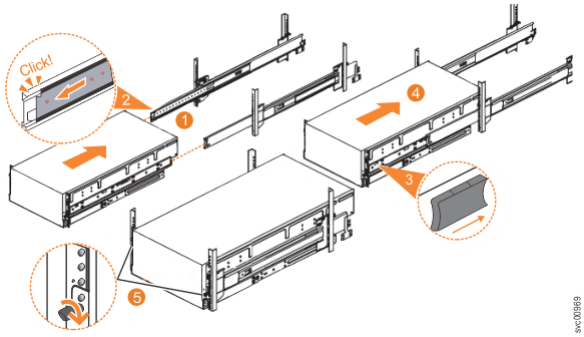


Figure 51. Replacing the 5U enclosure in the rack

2. Ensure that the ball bearing retainer clicks into place inside the front of the left and right drawer sections (**2** in Figure 51 on page 90).

Reinstalling parts into the enclosure

3. If you took the enclosure out of the rack, reinstall the following parts inside of the enclosure, as described in the following procedures. You can reinstall the parts in any order.
   - "Removing and replacing a drive" on page 169
   - "Removing and replacing a secondary expander module" on page 173

   Remember: The weight of the enclosure increases as more drives are installed.
4. Replace the top cover, as described in "Removing and replacing the top cover" on page 167.

5. Reinstall the remaining enclosure parts, as described in the following topics. You can reinstall the parts in any order.
   - “Removing and replacing a power supply” on page 184
   - “Removing and replacing the fascia” on page 181
   - “Removing an expansion canister” on page 191
   - “Removing and installing a SAS cable” on page 192
   - “Removing and replacing a fan module” on page 194

Sliding the enclosure into the rack

6. Locate the left and right blue release tabs near the front of the enclosure. Press both release tabs forward to unlock the drawer mechanism (3 in Figure 51 on page 90).
7. Push the enclosure firmly into the rack (4 in Figure 51 on page 90).
8. Tighten the locking thumb screws (5 in Figure 51 on page 90) to secure the enclosure in the rack.
9. Reconnect power to the expansion enclosure.

Powering on the optional 5U expansion enclosure

Use the following procedure to provide power to the 5U expansion enclosure as part of the initial installation process or after a service procedure.

Before you begin

Important: Before you connect the power cables to the rear of the enclosure, always check that the expansion enclosure is secured in the rack. If needed, tighten the thumbscrews on the front of the enclosure (2 in Figure 52 on page 91) to ensure that the enclosure drawer does not roll open.

About this task

The 5U expansion enclosure has two power supply units (PSUs) that are accessible from the front of the enclosure (4 in Figure 52 on page 91). As the figure also shows, the PSUs are covered by the 1U fascia (5).

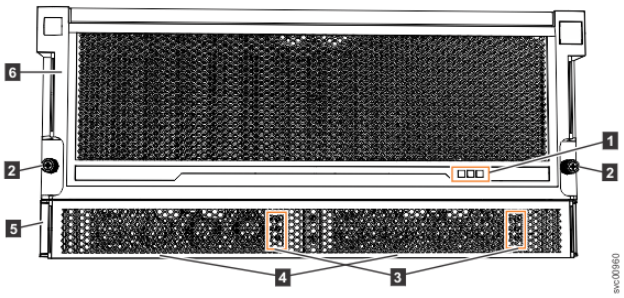


Figure 52. Features on the front of the 5U expansion enclosure

1 Display panel LEDs
2 Rack retention thumb screws
3 Power supply unit LEDs
4 Power supply units (PSUs)
5 PSU fascia (1U)
6 Front fascia (4U)

Each PSU has a power supply connector and power cable, which are accessible from the back of the enclosure. Power is provided by plugging a C19-C20 power cable into each power supply unit and, if necessary, turning on the power source. The expansion enclosure does not have a power button.

Procedure

1. Connect the C19-C20 power cables to the power connectors on the rear of the expansion enclosure.

   The enclosure automatically powers on and begins its Power On Self-Tests (POST).
2. Secure the power cables in the cable retainer at each power connector on the rear of the enclosure, as shown in Figure 53 on page 92. Also, ensure that each cable is installed along one of the cable management arms. The cable management arms also support the SAS cables.

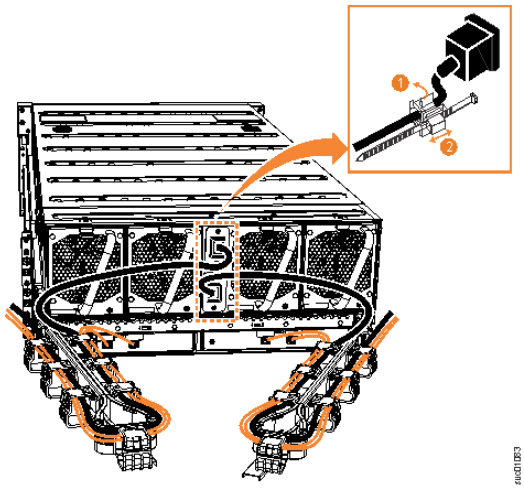


Figure 53. Secure power cables

Important: Always secure each power cable with a cable retainer and ensure that the cable is installed along one of the cable management arms. When secured, the power and SAS cables stay connected when you slide the expansion enclosure out of the rack to perform service tasks.\

Figure 54. Power and SAS cable connections on the back of the enclosure

3. Verify that the expansion enclosure and its components are operating as expected.

   On the back of the expansion enclosure, all four fans and the expansion canister indicators (3 and 8 in Figure 55 on page 92) become active when the power is connected.

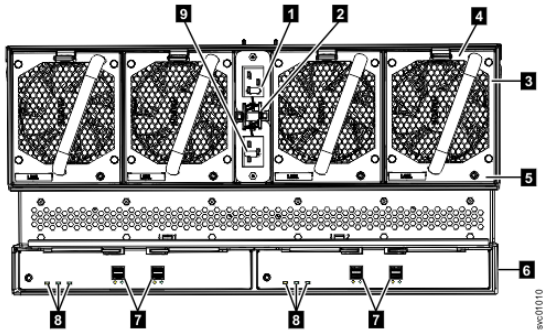


Figure 55. Features on the rear of the 5U expansion enclosure

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

On the front of the enclosure, the indicators on the front display panel and each PSU (1 and 3 in Figure 52 on page 91) are also lit when the power is connected. See "High density expansion enclosure LEDs and indicators" on page 212 for information about the status that is provided by the indicators.

4. Verify that the system recognizes the expansion enclosure.

   In the management GUI, view information about the system status and the expansion enclosure.

   - If a new expansion enclosure was installed, make sure that the enclosure was discovered by the system. A newly recognized expansion enclosure is visible in the management GUI.
   - If the expansion enclosure was powered off as part of a service procedure, view the information in the management GUI to confirm that the enclosure is operating as expected. You can also access the Event Log to view enclosure and component events and complete any remaining fix procedures.

Powering off the 5U expansion enclosure

Before you power down a 5U expansion enclosure, review the following procedure.

Before you begin

Attention: To avoid potential equipment damage during transport and subsequent loss of data, see "Procedure: Transporting a 5U 92-drive expansion enclosure" on page 94. The procedure describes what to do for the following situations.

- When you are powering off a 92F, 92G, or A9F 5U expansion enclosure because you intend to transport it to another location
- When you intend to move a rack that contains a 92F, 92G, or A9F 5U expansion enclosure

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

When you power off an expansion enclosure, the drives in that enclosure are no longer available to the control enclosure. The SAS chain also breaks. Any expansion enclosures that are beyond the enclosure that is powered down are also disconnected from the control enclosure.

Before you power off an enclosure, use the management GUI to show the volumes that depend on that enclosure. In the system view, select the expansion enclosure to be powered off. Then, select **Dependent Volumes**. If no configuration changes are made, other volumes remain available to the system.

Procedure

1. Stop all I/O to the system from hosts that access the expansion enclosure.
2. Unmount any associated file systems.
3. Wait 5 minutes for all write data to be flushed to the drives.
4. Unplug both of the power cords from the rear of the expansion enclosure to remove all power from the enclosure.

Procedure: Transporting a 5U 92-drive expansion enclosure

Safely transport a 5U expansion enclosure by following this procedure.

Procedure

To transport a model 92F, 92G, or A9F expansion enclosure between locations, or to transport an entire rack that contains one or more of these 5U enclosures, follow these steps to protect against drive damage.

1. Safely power down the 5U enclosure by referring to “Powering off the 5U expansion enclosure” on page 93. Do not remove rack power until systems are safely powered down.
2. Transfer all of the drives in the 5U enclosure into their original packaging or equivalent packaging for safe transportation.

   The original packaging consists of an anti-static bag for each drive, an inner carton with slots for 20 drives, and an outer carton to hold three inner cartons of drives.
3. Disconnect only the cables necessary for the equipment move.
4. To remove the 5U enclosure from the rack, see “Removing a 5U expansion enclosure from a rack” on page 158.
5. Return all components, **but not the drives**, to the 5U enclosure for shipping.

   Do not return the drives to the 5U enclosure until the enclosure is at its new location and is not to be moved again.

Connecting the components

After installing the rails and enclosures in the rack, the storage enclosure and control enclosures are connected to power, the network, and any optional expansion enclosures.

After all cabling connections are completed, the system components are powered on.

Connecting Ethernet cables to the node canisters

To provide system management connectivity for your system, you must connect Ethernet cables to at least Ethernet port 1 of each node canister in the control enclosure.

Procedure

To install the Ethernet cables, complete the following steps.

1. Connect Ethernet port 1 of both node canisters to the IP network that provides connection to the system management interfaces, as shown in Figure 56 on page 95 .

   This port can also be used for iSCSI connectivity to the system by hosts on the network. Where more than one control enclosure is present in the system, ensure port 1 of every node canister is connected to the same network to provide access if the configuration node fails.

Figure 56. Ethernet ports on a canister

1 Node canister Ethernet port 1
2 Node canister Ethernet port 2
4 Node canister technician port - do not use for Ethernet connections.

2. Optionally, connect Ethernet port 2 of each node canister in the system to a second IP network that will provide redundant connection to the system management interfaces.

   This port can also be used for iSCSI connectivity to the system by hosts on the network. If there is more than one control enclosure in the system, ensure that port 2 of every node canister is connected to the same network to provide access if the configuration node fails.

Connecting Fibre Channel cables to the control enclosure

If your system has one or more Fibre Channel adapters installed, use Fibre Channel cables to connect the two node canisters in the enclosure to the switches in the Fibre Channel SAN.

Before you begin

Obtain the network cable connections worksheet that you completed during your planning to determine the number of required cables and their intended port locations.

Procedure

To install the cables, complete the following steps.

1. Referring to the “Planning worksheets” on page 63, connect the required number of Fibre Channel cables to the node canisters in the control enclosure.

   Note: Both canisters must have the same number of cables connected.

2. To connect additional Fibre Channel cables, connect the same number of cables to each canister.

Connecting expansion enclosures to the control enclosure

This is a guide to using SAS cables to connect 2U and 5U expansion enclosures in a rack to the control enclosure in the rack.

About this task

This task applies if you are installing one or more expansion enclosures.

Note: It is recommended that you read the following "SAS Cabling Guidelines" before you connect any SAS cables between the control enclosure and any expansion enclosures in the rack.

SAS cabling guidelines

Orienting the connector

When you insert SAS cables, make sure the connector (Figure 57 on page 96) is oriented correctly.

- The orientation of the connector must match the orientation of the port before you push the connector into the port. The cable connector and socket are keyed, and it is important that you have proper alignment of the keys when the cable is inserted.
- Insert the connector **gently** until it clicks into place. If you feel resistance, the connector is probably oriented the wrong way. Do **not** force it.
- When inserted correctly, the connector can be removed only by pulling the tab.
- When both ends of a SAS cable are inserted correctly, the green link LEDs next to the connected SAS ports are lit.
- For FlashSystem control enclosure node canisters and 2U expansion enclosures, the blue pull tab must be below the cable (1 in Figure 57 on page 96).

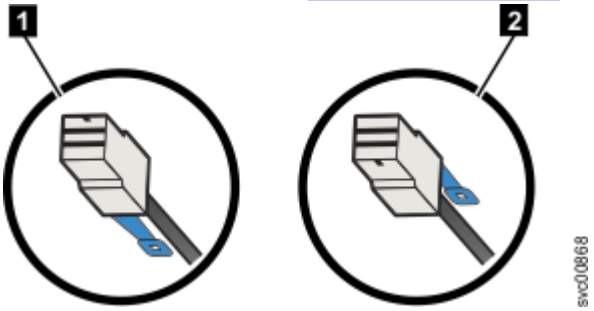


Figure 57. SAS cable connector orientation

- For 5U expansion enclosure canisters, the blue pull tab must be above the connector (2 in Figure 57 on page 96).
- Insert the connector gently until it clicks into place. If you feel resistance, the connector is probably oriented the wrong way. Do not force it. See Figure 58 on page 96.

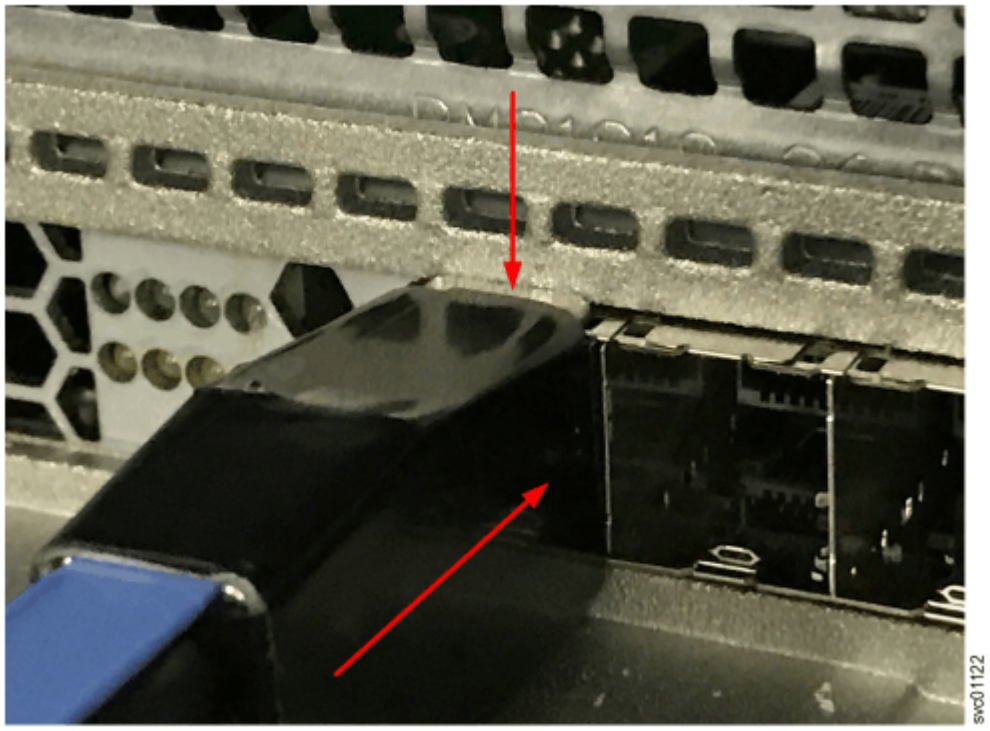


Figure 58. Pushing the SAS cable latch closed

- When inserted correctly, the connector can be removed only by pulling the tab.

Guidelines

Be aware of the following guidelines when you connect the SAS ports of a control enclosure canister to the SAS ports of a 2U and 5U expansion enclosure canister.

- The FlashSystem models support 4-port SAS interface adapters. However, only ports 1 and 3 are used for SAS connections, as Figure 59 on page 98 shows.
- See "Enclosure location guidelines" on page 57 for the number and type of expansion enclosures that can be chained to SAS port 1 and SAS port 3 of a node canister. The expansion enclosures in this chain must be installed below the control enclosure (as shown in Figure 59 on page 98).
- Do not connect a cable between a SAS port on a left canister and a SAS port on a right canister.
- Do not connect a cable between SAS ports in the same enclosure.
- Do not connect a SAS port on a control canister to more than one SAS port on an expansion canister. Cables that split the SAS connection out into separate physical connections are not supported.
- Attach cables serially between enclosures; do not skip an enclosure.
- It is recommended that SAS cables be routed through the cable management arms to reduce the risk of disconnecting the nodes from their storage arrays. This step also helps to protect the SAS cables from getting damaged if you slide the node or enclosure out of the rack while they are attached. Arrange your cables to provide access to the following components:
  - Ethernet ports, including the technician port. The technician port is used for initial setup of the system by directly attaching to a personal computer. It can also be used to complete service actions for the system.
  - USB ports.
  - The nodes and the enclosures themselves. Access is required to the hardware for servicing and for safely removing and replacing components by using two or more people.
- Do not place any cables in SAS port 2 of canister 1 or SAS port 2 of canister 2, of the last expansion enclosure in a chain.
- Ensure that cables are installed in an orderly way to reduce the risk of cable damage when replaceable units are removed or inserted.

Note:

- Figure 59 on page 98 shows an example configuration of a control enclosure that is connected to two SAS chains.
- Each chain consists of a 2U expansion enclosure and a 5U high-density expansion enclosure.
- Figure 59 on page 98 is a generic cabling diagram intended to illustrate how to cable the different types of expansion enclosure. Some systems do not allow for a mixture of expansion enclosure types in the same chain. See Chapter 4, "Expansion enclosures," on page 41 for details on the supported expansion enclosures for your specific system model.

The order of the SAS ports on the 5U high-density expansion enclosure differs from the order of the SAS ports of a 2U expansion enclosure because the canisters in the 5U expansion enclosure are rotated.

Procedure

Using the supplied SAS cables, connect the control enclosure to the expansion enclosure at rack position 1, as shown in Figure 59 on page 98.

1. Connect SAS port 1 of the uppermost or leftmost node canister in the control enclosure to SAS port 1 of the left expansion canister in the first expansion enclosure.
2. Connect SAS port 1 of the lowermost or rightmost node canister in the control enclosure to SAS port 1 of the right expansion canister in the first expansion enclosure.

To add further expansion enclosures, continue to connect the expansion canisters as shown in Figure 59 on page 98.

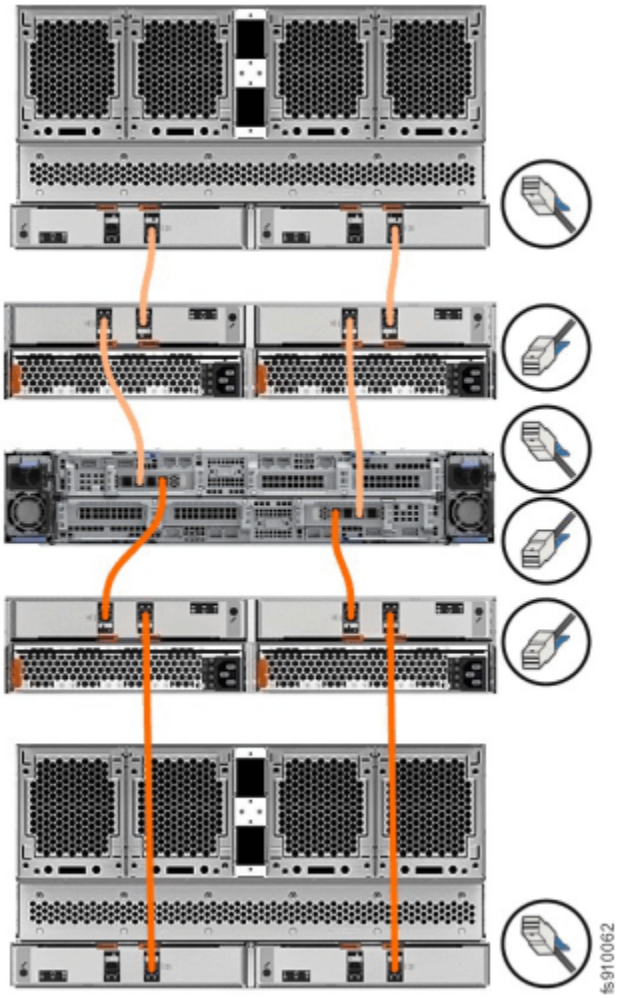


Figure 59. Connecting the SAS cables to control enclosure

Powering on the control enclosure

After you install all hardware components, you must power on the system and check its status.

About this task

Attention: Do not power on the system with any open bays or slots. Open bays or slots disrupt the internal air flow, causing the drives to receive insufficient cooling.

- Every unused drive bay must be occupied by a filler panel.
- Filler panels must be installed in all empty host interface adapter slots.

Procedure

To power on the system, complete the following steps.

1. Wait for all expansion enclosures to finish powering on.
2. Power on the control enclosure. Use the supplied power cords to connect all of the power supply units of the enclosure to their power sources.

   If the power sources have circuit breakers or switches, ensure that they are turned on. The enclosure does not have power switches.

   Notes:

- Each enclosure has two power supply units. To provide power failure redundancy, connect the two power cords to separate power circuits.
- Ensure that each power cable is secured to each PSU on the back of the enclosure.
- The system requires 200-240 V power. If the power supply has an auto-ranging PSU (03GH925), it can also accept 100-127 V.

3. From the rear of the control enclosure, check the LEDs on each node canister.

Figure 60 on page 99 shows the light-emitting diodes (LEDs) on a canister.

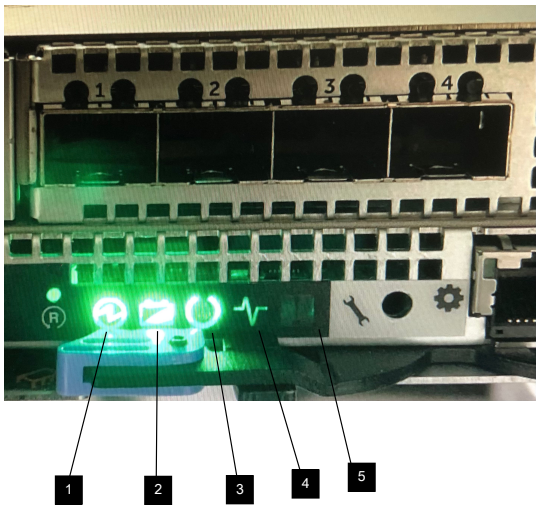


Figure 60. Canister and node status LEDs

1 Canister power LED
2 Battery status LED
3 Node status LED
4 Activity LED
5 Canister fault LED

Table 42 on page 99 describes the various LED states that you might observe.

Table 42. Canister and node status LED descriptions

LED Name	Icon	Color	States
1 Canister power		Green	• OFF – No power is supplied to the canister, or it is running temporarily on internal battery power. • ON – The CPU is active (not in standby) on at least one node canister • SLOW FLASH – Power is available but the canister is in standby mode (the CPU is not active). • FAST FLASH – The BIOS is in POST.
2 Battery status			• OFF – The battery has a fault or is otherwise not available for use. • ON – The battery is fully charged and can support two fire hose dumps (FHDs). • FLASH – The battery is charging but it can support a single fire hose dump. (FHD). • FAST FLASH – The battery is charging but has insufficient charge to complete a single fire hose dump. (FHD).

Table 42. Canister and node status LED descriptions (continued)			
LED Name	**Icon**	**Color**	**States**
3 Node status		Green	• OFF – The canister is in standby mode (the CPU is off , POST is running, or the operating system is loading), or power is not supplied to the canister. • SOLID – The node is in active state (part of a cluster). • FLASH – The node is in candidate or service state. It is safe to remove the node. • FAST FLASH – A destage is occurring.
4 Activity		Green	Not used
5 Canister fault		Amber	• – OFF – There are no isolated FRU failures in the canister. – ON –A FRU in the canister has failed, and will require service or replacement. – FLASHING – The node is being identified.

The canister is ready for initialization with no critical errors when **Canister Power** is illuminated, **Node Status** is flashing, and **Canister Fault** is off.

What to do next

Next, you will connect an Ethernet cable to the technician port on the control enclosure, and initialize the system.

Initializing the system with the technician port

To initialize the system, connect a computer to a technician port of the node canister by using an Ethernet cable, and then open a wizard in a supported web browser.

Before you begin

View the “Planning worksheets” on page 63.

Procedure

1. Ensure the system is powered on.
2. Configure an Ethernet port on the personal computer to enable Dynamic Host Configuration Protocol (DHCP) configuration of its IP address and DNS settings.

   If you do not have DHCP, you must manually configure the personal computer. Specify the static IPv4 address `192.168.0.2`, subnet mask `255.255.255.0`, gateway `192.168.0.1`, and DNS `192.168.0.1`.
3. Locate the technician port on each node canister, as shown in the following figure:

   The technician port is labeled with the "gear" icon.

Figure 61. Technician port

4 Node canister technician port

4. Disconnect the personal computer from all networks. Connect an Ethernet cable between the port of the personal computer that is configured in step "2" on page 100 and the technician port in the left canister (1) that is shown in Figure 61 on page 101.
5. After the Ethernet port of the personal computer is connected, open a supported browser and browse to address `https://install`. (If you do not have DCHP, open a supported browser and go to the following static IP address `192.168.0.1`.)

   The browser is automatically directed to the initialization tool.
6. Follow the instructions that are presented by the initialization wizard to configure the system with a management IP address.
7. After you complete the initialization process, disconnect the cable between the personal computer and the technician port. Continue to initial system setup, see "Completing the initial system setup (customer task)" on page 102.
8. Using the initialization GUI, enter the requested information by using the worksheets that you created during the planning phase, including the management IP address, subnet mask, and gateway.

What to do next

Important:

- Connect to the system CLI using SSH and use **`sainfo lsrootcertificate`** and **`satask exportrootcertificate`** to export the system's root certificate and add it to the browser's trust store. The root certificate must be exported from the node that will be used to initialize the system.
- Browser security features might alert the user that the system certificate does not contain a valid subject alternative name. It is safe to accept the risk and continue. A new certificate that contains a valid subject alternative name can be created after completing system initialization. See System Certificates for instructions to create a new certificate.
- It might be necessary to remove old certificates that are stored in the browser before the browser accepts the request.
- The web browser might display a warning about a potential security risk if the root certificate is not added to the browser truststore. It is safe to accept the risk and continue.
- After the technician port physical connection is completed (that is, connected both ends), it can take up to 45 seconds before the port is fully up and able to process requests. Submitting requests before this interval might result in 404 error responses.
- If the `https://service` request in the browser causes a 404 error, or fails to produce a response, it might be necessary to use the url `https://192.168.0.1` in the browser request to connect to the system.

Completing the initial system setup (customer task)

After the initialization of the new system is complete, use the management GUI to do the initial system setup.

Before you begin

Have the following information on hand:

- The management IP address of the system
- Licensed key information
- The worksheets that were completed during the system planning process.

Procedure

To complete the initial setup of your system, use the management GUI to complete the following high-level tasks.

1. Use a web browser to open: `https://your_management_IP`
2. Log in to the management GUI for the first time by using ID `superuser` and password `passw0rd`.

   After you log in, the initial setup wizard helps you get started.

   Use the information on your worksheets to inform your inputs.

   a) Choose and create a new password.

   b) Configure licensed functions.

   - If encryption was purchased, you can activate it now or later by opening the management GUI and selecting **Settings** > **Security** > **Encryption**.
   - The base license entitles the system to all licensed functions such as Virtualization, FlashCopy®, Global Mirroring, and Metro Mirroring.

     The system supports an optional External Storage Virtualization license to include external storage controllers to your configuration. The license is based on the total amount of capacity that you plan to virtualize from these external storage systems.

   c) If you already use IBM Storage Insights, log in to Storage Insights, select **Add Storage System** and register the new system by using the IP address.

   Important: If you do not use IBM Storage Insights, you were registered during the initial system setup. When your Storage Insights interface is ready to use, you receive an email notification. IBM® Storage Insights is an *IBM Cloud®™ software as a service* offering that can help you monitor and optimize the storage resources in the system and across your data center.

   d) If errors exist, you are prompted to resolve them.

   e) Review the system summary page, then click **Finish**.

   The Initial Setup Wizard closes.
3. If there is more than one control enclosure for your system, go to **Monitoring** > **System** > **System--Overview** and click **Add Enclosure**.

   Add Enclosure is shown only when a candidate control enclosure exists.
4. Use the **System update** page of the management GUI to check whether software updates are available for this system. Use the management GUI to help you install any updates.

   During the automatic update process, each node canister in the system is updated one at a time. After all the nodes in the system are successfully restarted with the new code level, the new level is automatically committed.
5. After you complete system set up and add any additional enclosures, create pools and add storage before creating volumes.

To create pools and add storage, complete these steps:

a. In the management GUI, select **Pools** > **Pools** > **Create**.

b. Right-click the new pool on **Pools** page and select **Add Storage**. The management GUI displays storage configuration for the drives based on the recommended configuration for the drives within the storage array.

6. Referring to the Call Home and Storage Insights configuration worksheet, use the following URL to register the new system:

   `https://call-home.w3ibm.mybluemix.net/activate`

7. If you activated an encryption license, click **Enable Encryption** to complete the encryption setup wizard.
8. If exactly two control enclosures are in the system (release 8.7.0 or earlier), you must set up a quorum disk or application outside of the system. If the two control enclosures lose communication with each other, the quorum disk prevents both I/O groups from going offline. For more information, see Quorum.

Results

You completed the initial setup of your system as the final part of installation.

What to do next

You are ready to migrate data from another system and configure your system.

After the installation and initial configuration of the hardware is complete, IBM strongly suggests that the customer checks to see whether a later level of system software is available, and update to that level. After completing the software update, if necessary, you may also need to update the firmware on the drives in the system.

- For software updates, go to https://www.ibm.com/support/pages/node/5692850 to view available updates.
- For IBM FlashCore® Module updates, go to https://www.ibm.com/support/pages/node/873170 to view available updates.

Adding a control enclosure to an existing system

To add a control enclosure to an existing system (release 8.7.0 and earlier), you must first install it in the rack.

About this task

When SAN is being used, connect the new control enclosure to the system through a zone that you configure in the SAN. When you are using RDMA over Ethernet, you must assign IP addresses. When you are connecting the Fibre Channel adapters directly, you can bypass network setup.

Procedure

To add a control enclosure to an existing system, complete the following steps.

1. Connect the canisters directly, connects them to the storage area network, or connects them to a 25 Gbps or faster Ethernet network.
   a) To connect the new control enclosure that uses the SAN, see “Connecting Ethernet cables to the node canisters” on page 94 and “Connecting Fibre Channel cables to the control enclosure” on page 95.
   b) To connect the new control enclosure by using RDMA-capable Ethernet, see Configuration details for using RDMA-capable Ethernet ports for node-to-node communications.
2. For SAN connections, complete all SAN configuration before installation and see “Cable reference” on page 62 about the cabling requirements.

The correct zoning provides a way for the Fibre Channel ports to connect to each other.

3. For RDMA connections, ensure that the new control enclosure is connected to the same Ethernet subnet as the existing system.

   For the new node canisters to use RDMA over Ethernet, use the service assistant tool or the **satask chnodeip** command to set the node IP of each new node in the system.
4. In the management GUI, select **Monitoring** > **System**. On the **System -- Overview** page, select **Add Enclosure**. When a new enclosure is cabled correctly to the system, the **Add Enclosure** action automatically displays on the **System -- Overview** page. If this action does not appear, review the installation instructions to ensure that the new enclosure is cabled correctly. You can also add an enclosure by selecting **Add Enclosure** from the **System Actions** menu.
5. Complete the instructions in the **Add Enclosures** wizard until the control enclosure is added to the system.
6. If exactly two control enclosures are in the system, you must set up a quorum disk or application outside of the system. If the two control enclosures lose communication with each other, the quorum disk prevents both I/O groups from going offline. For more information, see Quorum.

Installing optional features

Optional hardware features can be installed in an enclosure. For example, drives, network adapters, and more memory modules.

The optional features that an enclosure supports are shown in the sales manual within the IBM Documentation. To find the relevant IBM Sales Manual, search “in all of IBM Sales manuals” for the machine type or the product name of the enclosure.

If an optional feature was ordered with the enclosure order, it is fitted at IBM manufacturing.

Drives can be added to a control enclosure or an expansion enclosure without powering off the enclosure. The IBM Storage Virtualize software discovers the drives. Use the management GUI to add the drives to an existing array or use them to make a new array.

Pluggable network port modules (for example SFP) can be added or changed without powering off the node canister.

A node canister must be logically removed from the system (by using the **rmnode** command) and power off before adding memory modules to it. When putting the node canister back in to the enclosure, it is automatically added back into the system if there are no unrecoverable node errors. Ensure that hosts can access volumes via this node canister before logically removing the other node canister from the system (by using the **rmnode** command) and power it off to add memory modules to it.

A node canister must be logically removed from the system (by using the **rmnode** command) and powered off before adding or changing any network adapter to it.

When a node canister comes online with new adapters in it, the addresses of the ports might move. Some reconfiguration might be needed to restore all communication links before proceeding to update the next node canister. If portmasks or portsets are being used, they might need to be changed.

Always check that hosts, other Storage Virtualize nodes, and any back-end storage controllers can access the partner node canister before powering off a node canister.

Note: Wait for the power LED to start flashing (standby mode) before removing the node canister from the enclosure.

Use the management GUI to check that access to volumes is not lost if a node is offline. Host administrators can check that there are still paths to volumes if a node is offline.

If there are partnerships with other IBM Storage Virtualize systems, use the management GUI to check that communication with the partner system is not lost when a node is offline.

Use the management GUI to power off or remove a node canister from the system. However, if the node is logically removed from the system, use the service assistant tool or CLI to power it off.

Use the management GUI to make any port configuration changes that might be needed to a node with new or different network adapters.

See the Removing and replacing a drive page appropriate to the product for the specific information about how and where to fit drives in the node canister type.

See the Removing and replacing a memory module page appropriate to the product for the specific information about how and where to fit memory modules in the node canister type.

See the Removing and replacing a interface adapter page appropriate to the product for the specific information about how and where to fit adapters in the node canister type.

Related concepts

“Removing and replacing control enclosure parts” on page 107
Parts can be removed and replaced in the control enclosures to perform service procedures or during the initial installation process.

Related information

Troubleshooting

Chapter 7. Hardware Servicing

The following topics contain information about service procedures for control and expansion enclosures.

This section describes removing and replacing field-replaceable units (FRUs) from the nodes and expansion enclosures.

Each part has its own removal procedure. Sometimes a step within a procedure refers you to a different remove or replace procedure. Complete the new procedure before you continue with the first procedure that you started.

Note: Do not use FRUs from containers with broken seals or try to transfer FRUs between systems. If you open a FRU container but do not use the part, do not re-seal the container; instead, send the FRU back for reconditioning per the Certified Service Parts (CSP) process.

For more details on the service procedures, see the following pages:

Removing and replacing control enclosure parts

Parts can be removed and replaced in the control enclosures to perform service procedures or during the initial installation process.

Important: Read the safety precautions in the IBM Systems Safety Notices. These guidelines help you safely work with the system.

Procedure: Identifying which enclosure or canister to service

Use this procedure to identify which enclosure or canister must be serviced.

About this task

To prevent data access loss or data loss when servicing the system, identify the correct enclosure or canister when you complete a service action.

- Labels on the enclosure front and rear indicate the enclosure model and serial number.
- The node canister can be identified by the enclosure it is in, and the serial number of the node canister. The label on the release handles of the canister displays the serial number.

Depending on the system model, the rear of the enclosure might have different features. But, in general, looking at the rear of a rack:

- Control enclosures contain node canisters that have slots for networking adapters, Ethernet ports, SAS ports, and USB ports. LED indicators are also visible.
- Expansion enclosures have SAS ports and LED indicators and a service port. The model type is shown on a label.

A canister can also be located by the enclosure that contains it and its slot location. This ID is shown as *E*-*C* or *E*|*C*, where *E* is the enclosure ID and *C* is the canister slot location. On the service assistant, the ID is known as the Panel.

Note: When a node canister is added to a system as a node, it is given a node name and a node ID. The default node name is *nodeN*, where *N* is the node ID. The node ID does not represent the slot location of the node.

To display the node name and canister location in the management GUI, complete the following steps:

1. Select **Monitoring** > **System Hardware**.
2. On the **System Hardware - Overview** page, select the directional arrow next to the enclosure that contains the node canister that you want to display.

3. On the **Enclosure Details** page, click **Node Canister** to highlight the node canister in the graphic and display details for the node canister.

The service assistant home-page also shows both the node name and the canister location. If you have only the node name, use these panels to determine the node canister location. Use this procedure to identify which enclosure or canister must be serviced, as completing a service action on the wrong canister can lead to data access loss or data loss.

To control the identify LED of an enclosure or online canister, use the management GUI:

1. Select **Monitoring** > **System Hardware** .
2. On the **System Hardware - Overview** page, select the directional arrow next to the enclosure that contains the node canister that you want to identify.
3. On the **Enclosure Details** page, right-click the node canister in the graphic and select **Identify** from the **Actions** menu.

Alternatively, if a node canister is not online to the system, use the service assistant to control the identified LED.

1. Log in to the service assistant of the node canister to be identified.
2. Click **Identify** at the upper left of the page to control the identified LEDs.

Procedure: Understanding system volume dependencies

If one component in a redundant pair is offline or powered off, host access to volumes can be disrupted. Before you remove or power off a node canister or enclosure, verify whether any volumes depend on those components.

The following examples describe scenarios where the system or node status can impact if a volume is available to a host.

- If a control enclosure has only one node canister online, access to a volume depends on the online node canister. For example, a host might lose access to a volume that is stored partially or wholly on an array that uses drives in the offline node or its expansion enclosures.
- If one expansion canister in an expansion enclosure is powered off, further expansion canisters to that down side chain get isolated from the control canister of the side chain. In this case, host access to volumes depends on the online canister if the volume uses drives in an isolated enclosure or the enclosure with the offline canister.
- If an entire expansion enclosure is powered off, both sides of the SAS chain are broken. In this case, host access to some volumes can be considered to depend on the entire expansion enclosure.

The impact that a service procedure might have on host access to data can be understood by using the management GUI. To do so, use the following procedure:

1. In the management GUI, select **Monitoring** > **System** .
2. On the **System -- Overview** page, use the directional arrow near the enclosure that contains the node canister to open the **Enclosure Details** page.
3. Under **Rear View** of the system, right-click the canister and select **Dependent Volumes** from the **Actions** menu to display all volumes that become disabled to hosts if the canister is powered off.

During a maintenance procedure, if the **Dependent Volumes** action identifies dependent volumes, you may choose to stop the procedure. Then, investigate whether it is possible to reinstate the redundancy in the system to carry out the procedure without loss of access to data. For example, first complete procedures to ensure that both canisters in the enclosure are online. Then, complete any procedure that powers off the only online canister in the enclosure.

Procedure: Powering off the system

Sometimes, it is necessary to power down all node canisters in a system. For example, you might need to shut down the system before you do the maintenance actions in your data center.

Before you begin

Notes:

- It is not necessary to shut down the entire system (all node canisters) when you complete service actions.
- Service actions upon a node canister require only one node canister in the control enclosure to be shut down. If one node canister of an I/O group is online and communicating with hosts and other nodes, volumes that depend on resources of the I/O group can remain online.
- Service actions upon a control enclosure might require the control enclosure to be shut down. In this case, the I/O group that is provided by the control enclosure goes offline. All volumes that depend on that I/O group become disabled. However, other I/O groups in the system can continue to operate.

Procedure

1. Stop all host I/O to volumes on the system.
2. Shut down the system by using the management GUI. Click **Monitoring** > **System**. From the **System Actions** menu, select **Power Off System**.
3. Wait for the shutdown operation to complete. When complete, the power LED on each node canister, which is shown in Figure 62 on page 109, blinks at a 1 Hz rate (slow flash). Refer to the LEDs page for details.

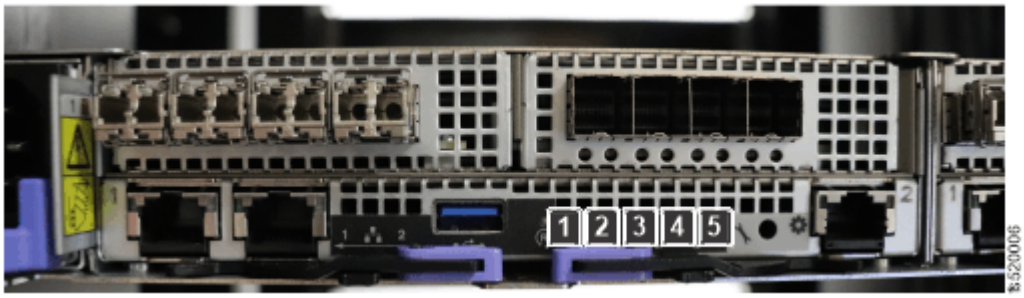


Figure 62. Canister power LED location

1 Canister power LED

4. Disconnect the power cords.
   a) If you are servicing the control enclosure only, disconnect the power cords from both power supply units (PSUs) in the control enclosure.

      Note: You do not need to power off the expansion enclosures.

   b) If you are preparing for site maintenance, disconnect the power cords from both power supplies in each expansion enclosure in the control enclosure's SAS chains.

      Note: The 2U and 5U expansion enclosures do not have a power button. Each expansion enclosure has two PSUs.
5. When you are ready to restore power to the control enclosure and any expansion enclosures, follow the appropriate procedures for your system configuration.
   a) Powering on the optional 2U SAS expansion enclosures
   b) Powering on the optional 5U expansion enclosures
   c) Powering on the control enclosures

Procedure: Powering off a node canister

To complete some service tasks, you must ensure that the node canister is powered off safely.

About this task

Attention: If your system is powered on and doing I/O operations, the system must power off correctly to ensure that no data is lost. If possible, always use the fix procedures that are presented by the management GUI to manage and maintain your system. The fix procedures ensure that the canister is powered off safely.

While a node canister is powered off, some volumes can become inaccessible. Refer to "Procedure: Understanding system volume dependencies" on page 108 to determine whether it is appropriate to continue this procedure.

Procedure

To power off a node canister, complete the following steps:

1. Determine the volume dependencies for the node canister that you are shutting down. For more information, see "Procedure: Understanding system volume dependencies" on page 108.
2. Go to the service assistant for the node with the canister to shut down.
3. On the home page, select the node canister to shut down.
4. If you are working on a maintenance procedure, complete the following steps to ensure that the correct node canister is identified.
   a) Go to the **Node Details** panel in the service assistant.
   b) Select the **Node** tab. Then, make a note of the last 6 digits that appear in the **Part Identity** field.
   c) Select the **Hardware** tab. Then, take note of the values in the **Canister Location** (slot), **Machine Type and Model**, and **Serial Number** fields.
   Table 43 on page 110 summarizes the information that can help you identify the correct node canister.

Table 43. Information to identify a node canister

Tab	Field name	Node canister value
Node	Part Identify	
Hardware	Canister Location (slot)	
	Machine Type and Model	
	Serial Number	

   d) To activate the identified indication on the node canister, you can also click the **Identify** button. The fault LED indicator on the node canister blinks so that you can confirm its location.
5. Use the **Power off** action to power off the canister.
6. After the node is powered off, the service assistant shows that the node status is offline. The status LED indicators on the canister show that the node is powered off.

Removing and replacing an enclosure ear

You might need to replace a faulty enclosure ear.

Before you begin

Have the following items on hand before you begin this procedure:

- Antistatic mat and wrist strap
- T8 Torx driver

About this task

To remove and replace an enclosure ear, complete the following steps:

Procedure

1. Take the system offline, as described in “Procedure: Powering off the system ” on page 109.
2. Slide the enclosure of the rack forward far enough to access the faulty enclosure ear.
3. You must remove the drives or drive fillers in the two drive bays next to the faulty ear. Label the drives and drive fillers with their slot numbers and then remove them, as described in “Removing and replacing a drive” on page 116 and “Removing and replacing a drive blank” on page 117.
4. Working inside the drive slot, remove the three T8 Torx screws that secure the ear, as shown in the following figure.

Figure 63. Enclosure ear mounting screws

5. On the left ear, the tag records the enclosure MTM and serial number. Copy these values to the tag on the replacement latch before you install it.
6. To install the new ear, hold the ear in place against the corner of the enclosure and install the three screws by using a T-8 Torx driver, being careful not to cross-thread the screws.
7. Replace the drives or drive fillers in the two drive bays, as described in “Removing and replacing a drive” on page 116 and “Removing and replacing a drive blank” on page 117.
8. Slide the enclosure back into the rack.

Removing and replacing the enclosure

You might need to remove the enclosure from the rack as part of a service procedure.

Before you begin

CAUTION: To avoid any hazard from the rack tipping forward when devices are installed, observe all safety precautions for the rack into which you are installing the device.

CAUTION: The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

Procedure

Removing the enclosure

1. Shut down both canisters in the enclosure by using the service assistant. Follow the steps in “Procedure: Powering off a node canister” on page 110.
2. Use the Power LED indicators on the canisters to confirm that it is safe to remove the enclosure from the enclosure.
3. Record which data cables are plugged into the specific ports on the rear of the canisters and the enclosure.

   The cables must be inserted back into the same ports after the replacement is complete; otherwise, the system cannot function properly.
4. Disconnect the data cables that are connected to the canisters and the enclosure.
5. Disconnect the power cables from the power supplies.
6. Disconnect the Cable Management Arm (CMA) from the inner CMA brackets on the rear corners of the enclosure. Do not disconnect the outer brackets that connect the CMA to the rack.
7. Open the two latches at the front corners of the enclosure, and, by using two persons, slide the enclosure out of the rack.

Replacing the enclosure

8. With the help of two persons, lift the chassis until the back of the enclosure is aligned with the front of the rack rails.
9. Slide the enclosure between the rails.

   When fully inserted, the enclosure latch on each front corner of the enclosure engages with the blue hook on the vertical rail of the rack.
10. Connect the CMA to the inner CMA brackets on the rear corners of the enclosure.
11. Connect the data cables to their original locations on the enclosure and interface adapters.
12. Connect the power cables to the enclosure.

Removing and replacing the support rails

You might need to remove and replace the support rails to relocate an enclosure or replace a faulty rail.

Procedure

To remove the support rails, complete the following steps:

1. Remove the enclosure from the rack, as described in “Removing and replacing the enclosure” on page 111.
2. Remove the cable management arm, as described in “Removing or moving the cable-management arm” on page 163.
3. To remove the two CMA brackets, complete the following steps:
   a) To remove the CMA bracket 1 from the vertical frame post, remove the Philips screw in the center of the flange 2, as shown in the following figure.

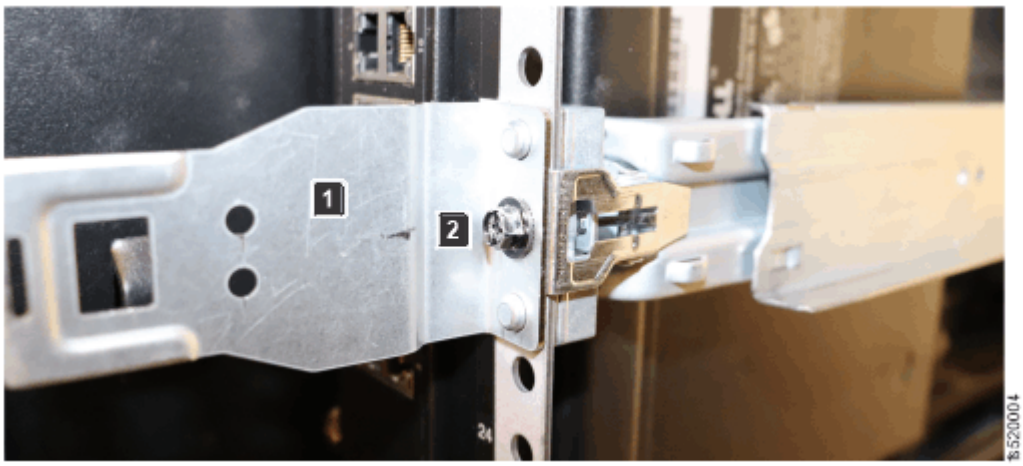


Figure 64. CMA bracket

b) Repeat step a to remove the other CMA bracket.

4. Support one of the rails with one hand.
5. To disengage the front of the rail from the vertical frame post 1, with the other hand, deflect the blue latch hook 2 sideways, as shown in the following figure, and slide the rail backwards slightly to release the front bracket from the rack.

Figure 65. Front rail bracket

6. Guide the rail out of the rack.
7. Repeat steps “4” on page 113 through “6” on page 113 for the opposite rail.

To install the support rails, complete the following steps:

8. Locate the 1-U space marked on the rack vertical rails that you will use for the enclosure.
9. Select the first rail to install. The outer side of each rail is engraved "Left" or "Right."
10. To install the back of the rail, while supporting the rail with one hand, deflect the clip on the bracket slightly 1 and fit the rear bracket into place against the rear vertical frame post so that the two pins extend through the upper and lower holes in the 1-U space on the vertical rail 2, as shown in Figure 66 on page 114.

Figure 66. Installing the rear rail bracket

11. To secure the front of the rail to the rack, complete the following steps:
    a. Locate the numbered 1-U space on the front vertical rail that matches the location of the rear bracket.
    b. While continuing to support the rail, while holding the rear bracket against the vertical rail, compress the rail far enough to fit the front rail bracket onto the inner face of the front vertical rack post, while deflecting the blue latch hook sideways, as shown in Figure 65 on page 113.
    c. Once the two pins are aligned with the upper and lower holes in the 1-U space on the vertical rail, release the latch hook.
12. To install the two CMA brackets onto the vertical frame posts, complete the following steps:
    a) The two brackets are identical. With the bracket facing toward the outside of the rack, fit the flange on the bracket over the two pins on the left rail bracket, and secure the bracket with a Philips screw, as shown in Figure 64 on page 113.
    b) Repeat step a to install the right CMA bracket.
13. Repeat steps “10” on page 113 through “11” on page 114 for the opposite rail.
14. Reinstall the CMA assembly, as described in “Removing or moving the cable-management arm” on page 163.
15. Reinstall the enclosure, as described in “Removing and replacing the enclosure” on page 111.

Removing and replacing the cable management arm

You may need to remove and replace the cable management arm (CMA) as part of a service procedure.

Procedure

To remove the CMA, complete the following steps.

1. Remove the cables from the channels in the CMA arms.
2. To disconnect the CMA arms from the brackets on the enclosure and rack, press the spring-loaded clips at the ends of the four CMA arms, as shown in Figure 67 on page 115.

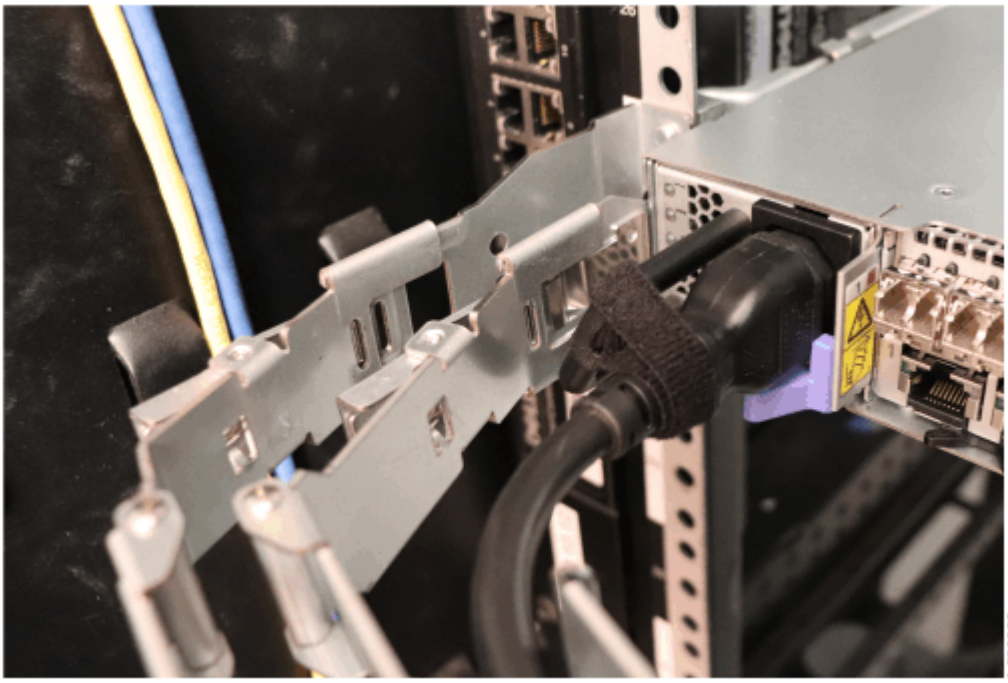


Figure 67. CMA attachment to the inner and outer mounting brackets

To reinstall the CMA, complete the following steps.

3. Identify the four ends of the CMA arms, which are labeled “left inner,” “left outer,” “right inner,” and “right outer.”
4. Connect the two left CMA arms to the inner and outer brackets at the left corner of the enclosure, as shown in Figure 67 on page 115.
5. Repeat step “4” on page 115 to connect the two right CMA arms.
6. Route the power and data cables by completing the following steps:
   a) First, place the power cables in the channels (troughs) in the CMA arms shown in the following figure.

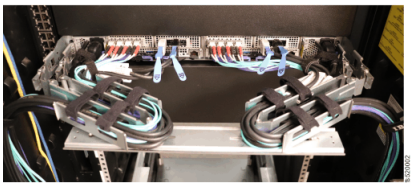


Figure 68. Cable placement in the CMA

   b) Connect the data cables and place them in the channels (troughs) in the CMA arms in the following order:
      i) SAS cables
      ii) Ethernet cables
      iii) Fibre Channel cables
   c) Secure the bundle of power and data cables in the CMA channels (troughs) by using hook and loop straps.

      You should either:

      - Wrap the hook and loop strap completely around the outside of the CMA, *or*
      - Thread the strap through the slots in the sides of the CMA so the strap passes over the top of the cables, and then wraps underneath the CMA.

Note: Do not route the hook and loop strap between the underside of the bundle of cables and the CMA trough.

Important: Examine the bundles of cables where they exit the inner end of each CMA arm to ensure that none of the cables are caught or pinched in the hinge or spring between the arm and the CMA bracket.

Removing and replacing a drive

Use the following procedure to remove and replace a drive in the enclosure.

Before you begin

Attention:

- 
When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices.
- No tools are required to complete this task. Do not remove or loosen any screws on the drive.
- You can identify a failed drive by the flashing amber fault LED on the drive. If the fault LED is lit on a drive, it is safe to replace the drive.

  If you are not sure which drive is faulty, go to the management GUI and follow the fix procedures to prevent loss of data or access to data. If an incorrect part is removed, it is possible to lose access to data.
- Every drive slot must contain either a drive or a blank filler, and must not be left empty for more than 10 minutes during servicing. Ensure that you read and understand the instructions. Also, ensure that the replacement drive is available and unpacked before you remove the existing drive.
- IBM FlashCore Modules are not interchangeable with the flash modules that are used in IBM Storage FlashSystem 900 storage enclosures.
- The version of firmware on the replacement drive might not be the latest drive firmware available, and might not match the firmware version of other drives in the system. If necessary, firmware on the replacement drive should be updated after this procedure is complete. For more information about the drive firmware, see Updating drive firmware using the CLI and Updating drive firmware using the GUI.

For more information about the supported drives, see “Control enclosure replaceable units” on page 217.

Attention: Never remove a drive when its green activity LED is flashing. You can replace only a failed drive when its amber fault LED is lit (not flashing) or when the drive activity LED is off.

Procedure

The following video demonstrates removing and replacing a drive. Watch the video before performing the steps. The video applies to IBM Storage FlashSystem 5300 as well as IBM Storage FlashSystem 5200.

1. Read the safety precautions in the *IBM Systems Safety Notices*. These guidelines help you safely work with the system.

Removing the drive

2. Remove the enclosure ear. For details, see “Removing and replacing an enclosure ear” on page 110.
3. To release the drive handle, press the release latch 2, on the right end of the drive, identified by a blue triangle.

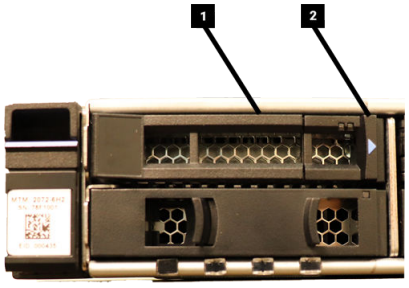


Figure 69. Drive release latch and handle

4. Pull the handle 1 to the open position.
5. Slide the drive out of the enclosure.

Replacing the drive

6. Orient the drive so that the LED indicators and the blue touchpoint are on the right.
7. Press the blue touchpoint to release the handle, then open the handle completely.
8. Slide the replacement drive into the enclosure.
9. Close the handle until the release latch clicks into place.
10. Press the drive handle to ensure that the drive is fully inserted into the drive slot.
11. Install the enclosure ear. For details, see “Removing and replacing an enclosure ear” on page 110.

Results

For RAID arrays, if the replaced drive is a failed drive, the system automatically reconfigures the replacement drive as a spare, and the replaced drive is removed from the configuration. The initialization of the replacement drive can take a few minutes. For Distributed RAID, if the replaced drive is a failed drive, the system automatically reconfigures the replacement drive as a member. The initialization of the replacement can take a number of hours.

If necessary, you can update the drive firmware of the replacement drive. For more information, see `Drive update` topic from the software guide.

Removing and replacing a drive blank

Use the following procedures to remove a faulty drive slot filler (blank) and replace it with a new one from stock. Drive slot fillers are passive components that regulate airflow through the control enclosure.

About this task

Notes:

- Every drive slot of an operational control enclosure must contain either a drive or a drive slot filler. A drive slot must not be left empty for more than **10 minutes** during servicing. Ensure that you read and understand the removal and replacement instructions, and the unpacked replacement part is available, before you remove the existing drive slot filler.
- No tools are required to complete this task. Do not remove or loosen any screws.

Procedure

1. Unpack the replacement drive-slot filler from its packaging.

Removing the drive-slot filler

2. Squeeze the two tabs on the front of the faulty drive slot filler inwards, and slide the filler out of the enclosure.

Replacing a drive blank assembly

3. Slide the replacement drive slot filler (blank) into the empty drive slot until the latches engage.

Removing and replacing a power supply unit

You can remove and replace either of the two hot-swap redundant power supply units (PSUs) in the enclosure. These redundant power supplies operate in parallel, one continuing to power the enclosure if the other fails.

About this task

Notes:

- Do not operate the enclosure without a PSU in a PSU slot for longer than **5 minutes**. Operating for longer than this period might cause the enclosure to shut down due to overheating.
- Remove the replacement PSU from its packaging and have it available before you carry out this procedure.
- No tools are required to complete this task. Do not remove or loosen any screws.
- Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.
- 

When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices.

Procedure

1. Identify the location of the control enclosure that requires service. The Event Log contains the enclosure MTM and serial number.
2. Identify the PSU that requires service; the Event Log contains the ID of the PSU that failed.

Removing the PSU

3. Unwrap the hook-and-loop fastener cable retention strap and disconnect the power cord from the power supply unit that you are replacing.

   This figure shows the location of the AC power LED 1, PSU handle and cable retention strap 2, and PSU latch 3.

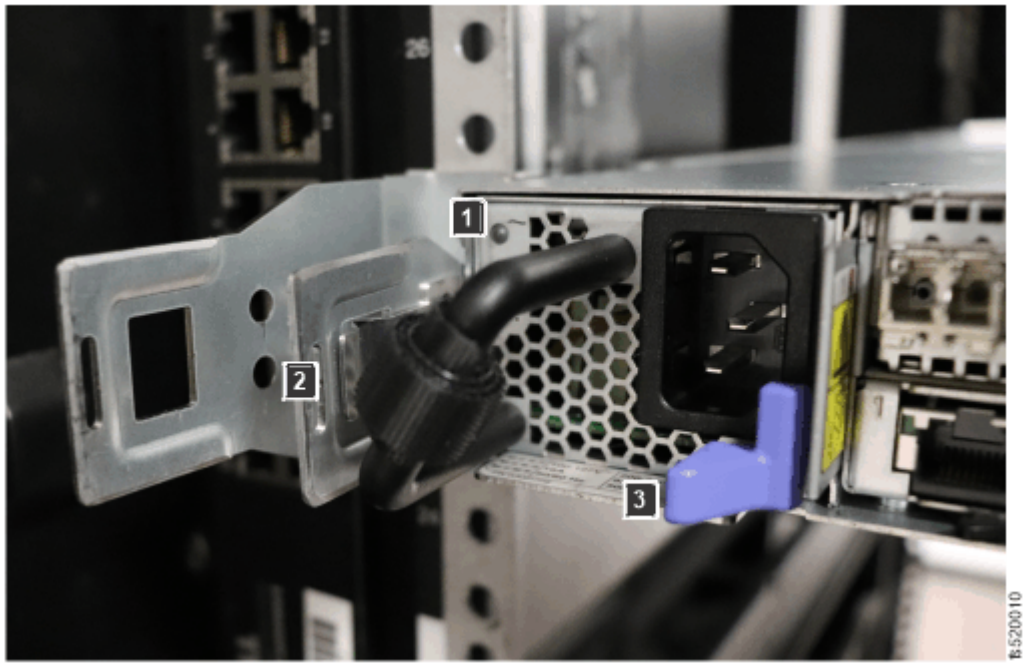


Figure 70. Features of a power supply unit

4. Being careful to not dislodge any cables, disconnect the cable management arm from the two brackets on the side of the enclosure nearest to the faulty PSU, and swing the CMA arms out of the way.
5. While holding the PSU handle with your index and middle fingers, press and hold the release latch with thumb and pull the handle horizontally to slide the PSU from the enclosure.

   Support the PSU with your other hand as it is removed from the enclosure.

Replacing the PSU

6. While supporting the PSU, slide the power supply into the enclosure until the release tab engages with a "click".
7. Reconnect the CMA to the rail and rack.
8. Connect the power cord to the power supply and to a properly grounded electrical outlet. Secure the cable with the cable hook-and-loop strap on the rear of the power supply unit.

   Note: After the power cord is connected to the electrical outlet, make sure that the PSU LED indicator 1 shown in Figure 70 on page 119, is lit.

Removing and replacing an SFP transceiver

When a failure occurs on an optical link in a control enclosure, the SFP transceiver in the port that provides the link might need to be removed and replaced.

About this task

No tools are required to complete this task. Do not remove or loosen any screws.

Although many components are hot-swappable, their intended use is only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

CAUTION: Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following information: laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam. (C030)

When you replace this part, you must follow recommended procedures for handling electrostatic discharge (ESD)-sensitive devices

Procedure

1. Carefully determine the failing physical port connection. In the Event Log, its location is identified by the following information:
   - Enclosure (MTM and serial number)
   - Canister (serial number)
   - Adapter (slot number) - if applicable
   - Port (port number).

   Important:
   - For correct operation, use the correct replacement SFP transceivers with each adapter. See Replaceable units for the applicable information for your system.
     - Use only the appropriate 25 Gbps SFP transceiver in the 25 Gbps Ethernet adapters.
     - Use only the appropriate 32 Gbps SFP transceivers in the 32 Gbps Fibre Channel adapter.
   - Removing the wrong SFP transceiver might result in loss of data access.

Replacing the SFP

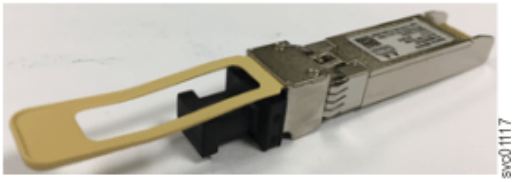
2. Locate the faulty SFP device. The enclosure MTM and serial number are at the rear of the enclosure. The canister serial number is at the rear of the canister. Adapter slots and canister Ethernet ports are numbered on the canister, from left to right. Ports on each adapter are numbered from left to right.

   The enclosure MTM and serial number are located on the front left corner of the enclosure. The adapter slots are numbered on the canisters.
3. Record or mark the cable that is to be removed.
4. Unlatch and remove the cable from the faulty SFP device.

   As Table 44 on page 120 shows, the SFP transceiver and latching mechanism can vary per each type of host interface adapter.

Table 44. SFP transceiver example

Host interface adapter	SFP transceiver example
Quad-port 32 Gbps Fibre Channel	

Table 44. SFP transceiver example (continued)	
Host interface adapter	**SFP transceiver example**
Dual-port 25 Gbps Ethernet (RoCE)	
Dual-port 25 Gbps Ethernet (iWARP)	
Dual-port 100 Gbps Ethernet	

5. Remove the faulty SFP transceiver from its aperture.
   a) Unclip the handle of the SFP transceiver.
   b) Pull on the handle of the SFP transceiver to slide it out of the slot.

Replacing the SFP

6. Install the replacement SFP transceiver into the aperture that is vacated in step “5” on page 121.
   a) Open the latch on the replacement SFP transceiver.
   b) Push the new SFP transceiver into the aperture until it stops.
   c) Close the release latch.
   d) Gently pull the SFP transceiver. If it is installed correctly, it does not move from its aperture.
7. Reconnect the optical cable.
8. Check the Event Log to confirm that the error is cleared. Mark the error as fixed or restart the node, depending on the failure indication originally noted.

Removing and replacing an interface adapter

Use this procedure to remove and replace an interface adapter or SAS adapter with a new one received from stock.

About this task

Notes:

- When a canister is removed, do not operate the system for more than **16 minutes**. Operating the system for longer than this period might cause the control enclosure to shut down due to overheating.
- No tools are required to complete this task. Do not remove or loosen any screws when you remove or replace an interface adapter. The interface adapter is not attached to the PCIe riser by screws.

Procedure

1. Identify the canister with the faulty interface adapter.
   a) Identify any dependencies on the canister by using the management GUI. Understand the impact of any dependencies and resolve them if necessary.
   b) Locate the canister that requires servicing by its MTM and serial number (S/N), which are labeled on the enclosure front left latch.
   c) Use the Event Log to identify the location of the adapter that requires replacement. Location information includes the enclosure MTM and S/N, canister (slot number/serial number), and the adapter slot number.
2. Label each network cable connection or record all cables that are connected to the canister. This information is used to reconnect the cables to the canister.

   Table 45 on page 122 summarizes the type of adapter that is used in each PCIe slot and the port configurations of canister 1 (the left canister).

Table 45. Canister 1 PCIe slots and port connections

PCIe slot 1 **Adapter type**				**PCIe slot 2** **Adapter type**			
Port 1	**Port 2**	**Port 3**	**Port 4**	**Port 1**	**Port 2**	**Port 3**	**Port 4**

   Table 46 on page 122 summarize the adapters that can be used in each PCIe slot and the port number configuration of canister 2 (the right canister)

Table 46. Canister 2 PCIe slots and port connections

PCIe slot 1 **Adapter type**				**PCIe slot 2** **Adapter type**			
Port 1	**Port 2**	**Port 3**	**Port 4**	**Port 1**	**Port 2**	**Port 3**	**Port 4**

Removing the interface adapter

3. Remove the canister, as described in “Removing and reseating a node canister” on page 128.
4. At the back of the canister, locate the PCIe slot of the adapter that is to be replaced.

   The PCIe adapter slots are numbered 1 - 2, left to right.
5. If applicable, remove the SFPs from the adapter ports, as described in “Removing and replacing an SFP transceiver” on page 119.

   Record the serial number of each SFP device as you remove them from the adapter ports.

6. To remove the riser - interface adapter assembly, grasp the assembly by the inner end of the metal riser card cover and the round hole in the cover, and lift the assembly out of the canister, as shown in the following figure.

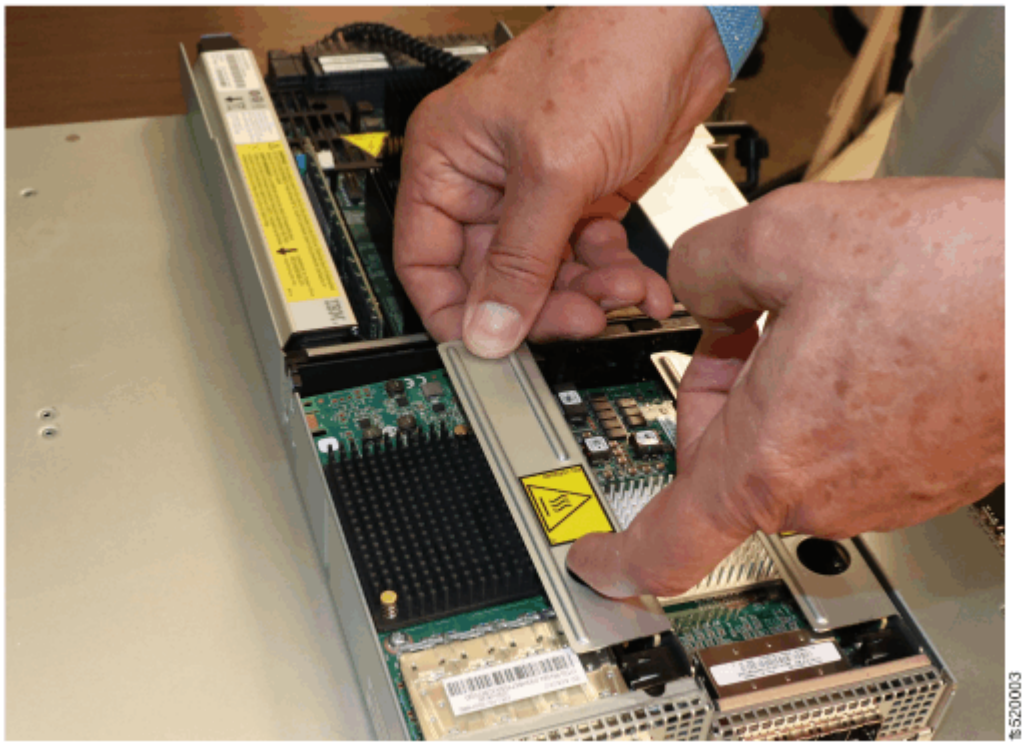


Figure 71. Removing an interface adapter assembly

Replacing the interface adapter

7. Review Table 47 on page 123 to ensure that you are using the correct replacement adapter. See “Replaceable units” on page 217 for the applicable part numbers.

Table 47. Summary of interface adapters and SFP devices

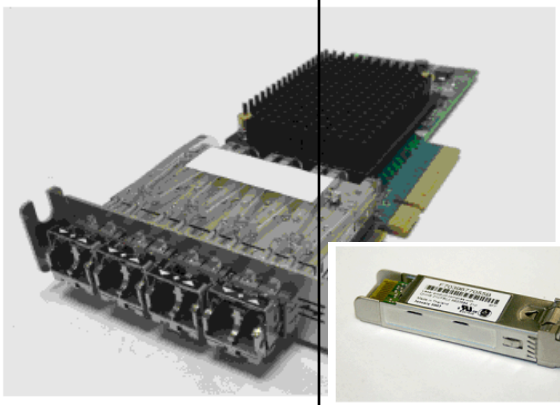
Type	Adapter	SFP device
Quad-port 16 Gbps Fibre Channel		

Table 47. Summary of interface adapters and SFP devices (continued)

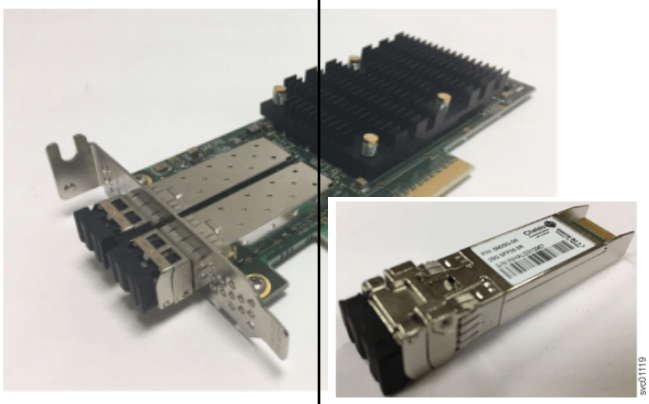
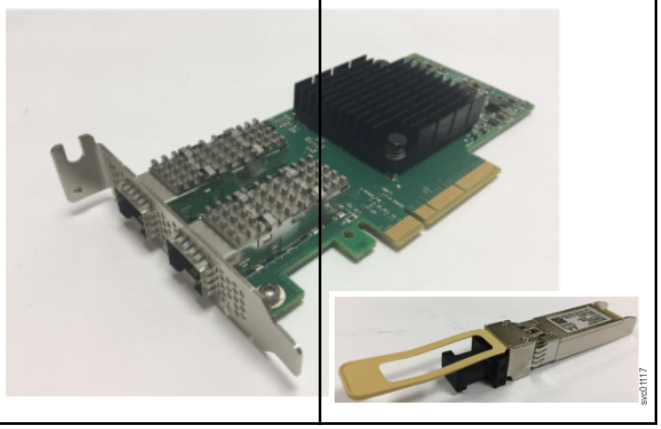
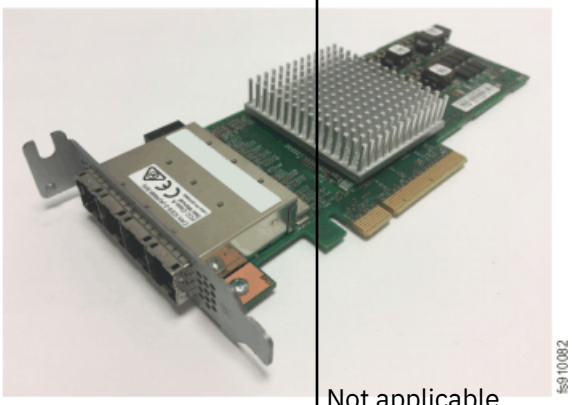
Type	Adapter	SFP device
Quad-port 32 Gbps Fibre Channel		
Dual-port 25 Gbps Ethernet (iWARP)		
Dual-port 25 Gbps Ethernet (RoCE)		

Table 47. Summary of interface adapters and SFP devices (continued)

Type	Adapter	SFP device
Quad-port 12 Gbps SAS		Not applicable

Notes:

- If used for host connections, you must install the SAS adapter in PCIe slot 1.
- If used for connections to expansion enclosures, you must install the SAS adapter in PCIe slot 2. Although it is a 4-port adapter, only ports 1 and 3 are supported for SAS connections to expansion enclosures.

8. Align the interface adapter assembly with the side and back of the canister and fit it into place until the riser card connector is fully seated.
9. Insert any SFP devices that were removed in step "5" on page 122 into the adapter. See Table 47 on page 123 to ensure that you are using the correct SFP device.
10. Replace the canister, as described in "Removing and reseating a node canister" on page 128.
11. Verify that the error is cleared from the Event Log.

Removing and replacing the canister battery

You must replace the canister battery if the battery fails.

About this task

To replace a canister battery, complete the following steps:

Procedure

1. Read the safety precautions in the *IBM Systems Safety Notices*. These guidelines help you safely work with the system.
2. Remove the canister with the faulty battery, as described in "Removing and reseating a node canister" on page 128.
3. Remove the canister fan assembly, as described in "Removing and replacing the canister fans" on page 126.
4. To remove the battery, firmly hold the battery by the blue touch points on each end of the battery, and lift the battery out of the canister, as shown in the following figure.

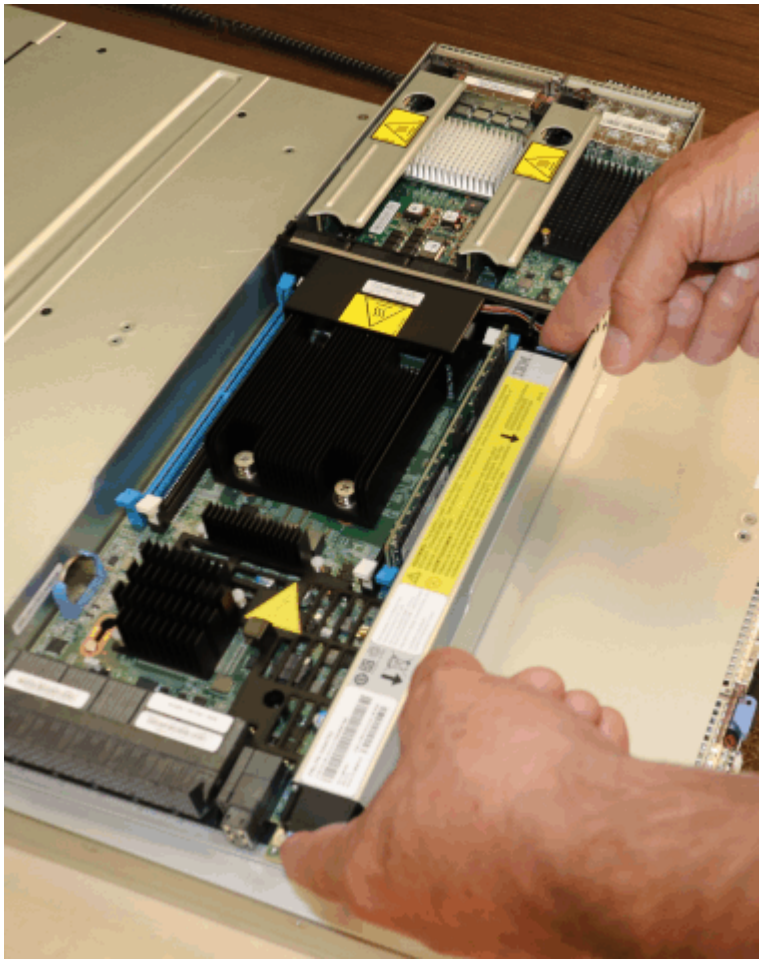


Figure 72. Removing the canister battery

5. To install the new battery, orient the battery so that the two arrows on the battery label are aligned with the engraved arrows on the outside of the canister, then lower the battery into the canister until the battery connector is fully seated.
6. Replace the canister fan assembly, as described in “Removing and replacing the canister fans” on page 126.
7. Replace the canister, as described in “Removing and reseating a node canister” on page 128.

   It takes up to an hour for the new battery to charge sufficiently to support a single destage.
8. Check the system logs in the enclosure management GUI to verify that the new battery is recognized and functioning normally.

What to do next

Dispose of the failed battery as required by local ordinances or regulations.

Removing and replacing the canister fans

If a canister fan fails, replace the fan assembly.

About this task

To replace the canister fans, complete the following steps:

Procedure

1. Read the safety precautions in the *IBM Systems Safety Notices*. These guidelines help you safely work with the system.
2. Remove the canister that contains the faulty fan, as described in "Removing and reseating a node canister" on page 128.
3. To remove the canister fan assembly, grasp the assembly by the blue touch point on each end of the plastic frame and lift the assembly straight up, as shown in the following figure.

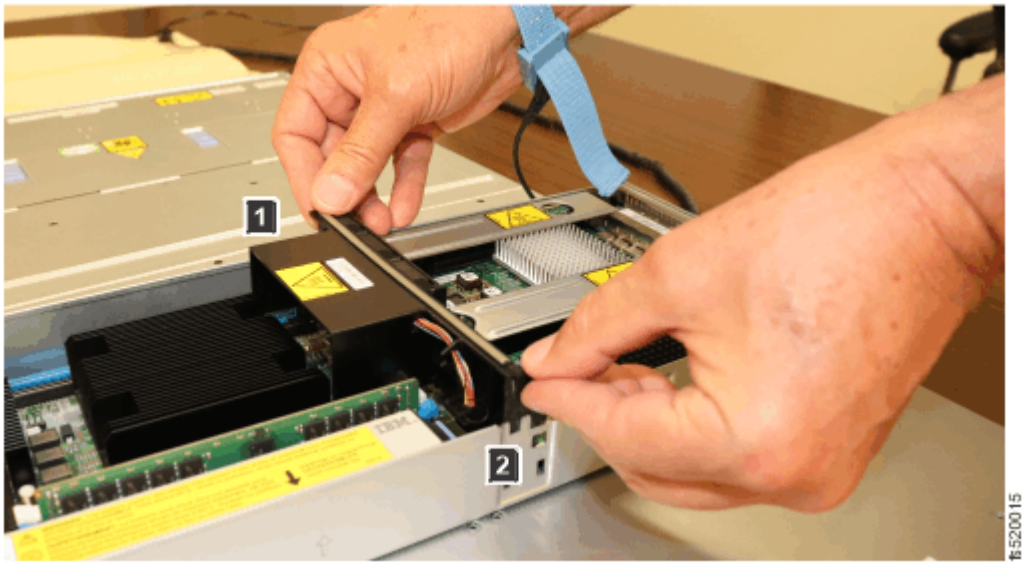


Figure 73. Removing the canister fans

4. To install the fan assembly, align the guide pins at each end of the assembly with notches in the upper edge of the canister sides. Then, lower the assembly into place until the connector is seated.

   Note: You might need to deflect the sides of the canister outwards slightly to fit the fan assembly between them.
5. Replace the canister, as described in "Removing and reseating a node canister" on page 128.

Removing and replacing the canister CMOS battery

You must replace the canister CMOS battery if the battery fails.

About this task

To replace a canister CMOS battery, complete the following steps:

Procedure

1. Read the safety precautions in the *IBM Systems Safety Notices*. These guidelines help you safely work with the system.
2. Remove the canister that contains the faulty battery, as described in "Removing and reseating a node canister" on page 128.
3. To release the battery from its socket, pull the battery's uppermost edge inwards toward the canister battery, then lift the CMOS battery out of the socket, as shown in the following figure.

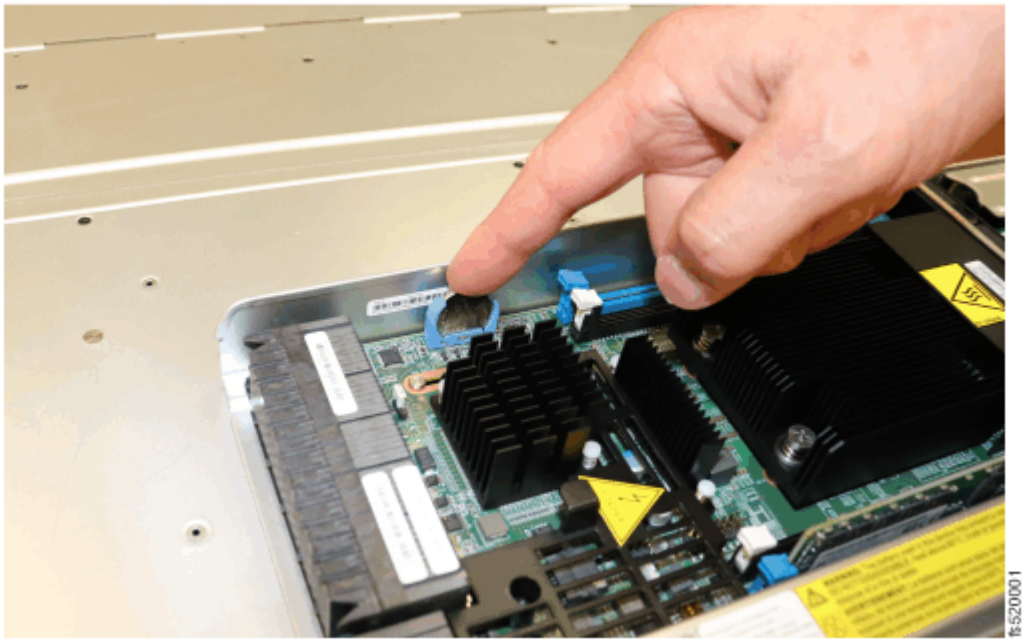


Figure 74. Removing the CMOS battery

4. To install the new battery, hold the battery with the positive "+" side that faces the canister battery.
5. Fit the lower edge of the battery into the battery socket, then push the upper edge toward the outside of the canister to seat the battery in the socket.
6. Replace the canister as described in "Removing and reseating a node canister" on page 128.

What to do next

Dispose of the failed battery as required by local ordinances or regulations.

Removing and reseating a node canister

To access or replace some components during service procedures, a canister might need to be temporarily removed from, and reinserted into, the enclosure.

Before you begin

Note: This topic provides instructions for temporarily removing and replacing a canister and should be used only when instructed to do so by other service procedures. To replace a faulty node canister with one from FRU stock, follow the procedure that is described in "Removing and replacing a faulty node canister" on page 130.

Make a note of the following points before replacing a canister:

- No tools are required to complete this task. Do not remove or loosen any screws.
- Before removing a canister, it must be powered off or be in service state. Otherwise, it can result in loss of data or loss of access to data.
- If a canister was recently removed from the system, and then added again, ensure that the canister is online for at least 25 minutes before you remove its partner canister. This delay allows multipath drivers to fail over to the online canister when the partner canister is removed.
- Use care when you remove a canister from the enclosure. Have a flat surface ready to receive the canister after removal.
- Use care when you lift and insert the canister.

Before you start the removal procedure, make sure to transfer the following components from the faulty canister to the replacement canister:

- DIMMs
- PCIe adapters
- Backup battery

To remove and reinsert a canister in the enclosure, complete the following steps.

Procedure

1. Shut down the canister by using the service assistant. Follow the steps in “Procedure: Powering off a node canister” on page 110.
2. Use the LED indicators on the canister to confirm that it is safe to remove it from the enclosure, as described in “Node canister indicators” on page 202.
3. Record which data cables are plugged into the specific ports on the rear of the canister. The cables must be inserted back into the same ports after the replacement is complete; otherwise, the system cannot function properly.
4. Disconnect the data cables that are connected to the canister.
5. If you are reinserting the canister while the enclosure is installed in the rack, disconnect the CMA arm from the adjacent side of the enclosure to allow room to slide the canister out of the enclosure.
6. Locate the left and right release levers for the canister, marked by blue touchpoints on the ends of the levers.
7. Holding the canister release levers by the blue touch points, open the two levers horizontally 90 degrees, then slide the canister out of the enclosure and place it onto an antistatic mat.

Figure 75. Removing and replacing the canister

8. To reinstall the canister, ensure that both of the canister release levers are fully open (90 degrees relative to the canister), and then slide the canister into the enclosure, ensuring that both release levers engage with the canister and begin to close.
9. Press the release levers closed to lock the canister into the enclosure. Press the latch ends to ensure that the latches are engaged with the canister.
10. Reconnect the CMA to the enclosure and rack.
11. Reconnect all cables that were removed from the back of the canister.

12. If the canister does not begin to power up, check that it is fully inserted into the enclosure. If necessary, remove the power and cables; then, repeat steps “8” on page 129 through “12” on page 130.

Removing and replacing a faulty node canister

You can use this procedure to remove a faulty node canister and replace it with a new node canister. You can remove the parts from the faulty node canister and reinstall them into the new node canister. You can also use this procedure to allow for replacement of parts inside the node canister.

About this task

Notes:

- Ensure the FRU part number (P/N) of the replacement part matches that of the failed node canister, or is an approved substitute. The FRU P/N is identified on the label of the canister and on the FRU packaging.
- Do not operate the control enclosure with one node canister that is removed for longer than **16** minutes. Operating for longer than this period might cause the enclosure to shut down due to overheating.
- No tools are required to complete this task. Do not remove or loosen any screws.
- Use care when you remove a node canister from the control enclosure. The node canister is long and its center of gravity is far forward. It can be helpful to have a lift or other sturdy, flat surface ready to receive the node canister during removal.

Procedure

1. Review the Event Log to identify the faulty node canister.
2. Review “Procedure: Understanding system volume dependencies” on page 108 to identify any volume dependencies on the node canister.
3. Follow Procedure: Powering off a node canister to verify that the hosts do not lose access to data in volumes.
4. From the rear of the control enclosure, label each cable and remove it from the node canister.

Removing the faulty node canister

5. Remove the node canister, as described in “Removing and reseating a node canister” on page 128, and place it on a flat, level surface.
6. Remove the new node canister from its packaging.

   Ensure that the FRU P/N of the replacement node canister matches that of the failed node canister or that the new P/N is an approved substitute. See “Replaceable units” on page 217 for more information.
7. Complete the following procedures to remove parts from the faulty node canister and install them in the replacement node canister.
   - “Removing and replacing a memory module” on page 131
   - “Removing and replacing the canister battery” on page 125
   - “Removing and replacing an interface adapter” on page 122

     Notes:

     – You do not need to remove each adapter from its adapter cage. Each assembled riser and adapter are transferred to the replacement node canister.

     – When you install each PCIe risers and adapter assembly into the replacement node canister, use the same numbered slot that was used in the faulty node canister.

Replacing the new node canister

8. Install the new node canister into the control enclosure, as described in “Removing and reseating a node canister” on page 128.

9. Reconnect the cables that were removed in step “4” on page 130 to the appropriate ports in the replacement node canister.
10. If the node canister was communicating with other node canisters using RDMA over Ethernet, then use the Service Assistant Tool or the **sainfo lsnodeip** command to check if the node IP configuration has been lost. Use the Service Assistant Tool or the **satask chnodeip** command to set the node IP if needed.

    Note: Step “10” on page 131 and “11” on page 131 are only needed for a new node canister.
11. Connect directly with the replaced canister CLI. Using the following methods:

    a. Via technician port (DHCP) at 192.168.0.1

    b. Via service IP on Ethernet port1, if known (blank USB key to retrieve if needed)

    Once connected issue **sainfo lsservicenodes** command to verify the node status.

    Note: Node error code 545 is expected. For more information, see 545.

    If error 545 is present, issue command **satask chbootdrive -replacecanister** to update the drives to match the serial number of the new node canister. The node will automatically reboot and join cluster.

    To help identify the node canister, the inside of the release levers is labeled with the serial number.
12. Use the management GUI or service assistant GUI to check that the node canister is online (or is Active) in the system.
13. Review the management GUI to determine that all errors are resolved.

Removing and replacing a memory module

You can remove and replace a faulty dual in-line memory module (DIMM) from the enclosure. You can also use this procedure to add DIMMs to increase the memory capacity of the node canister.

Before you begin

Notes:

- 

The memory modules are sensitive to electrostatic-discharge (ESD). Take precautions to avoid damage from static electricity. When you remove or replace this part, you must follow recommended procedures for handling ESD-sensitive devices.
- No tools are required to complete this task. Do not remove or loosen any screws.

About this task

Figure 76 on page 132 illustrates the physical layout of the four DIMM slots and CPU as present inside the node canister. DIMM slot numbering, as seen in this figure, also appears embossed on the adjacent fan assembly.

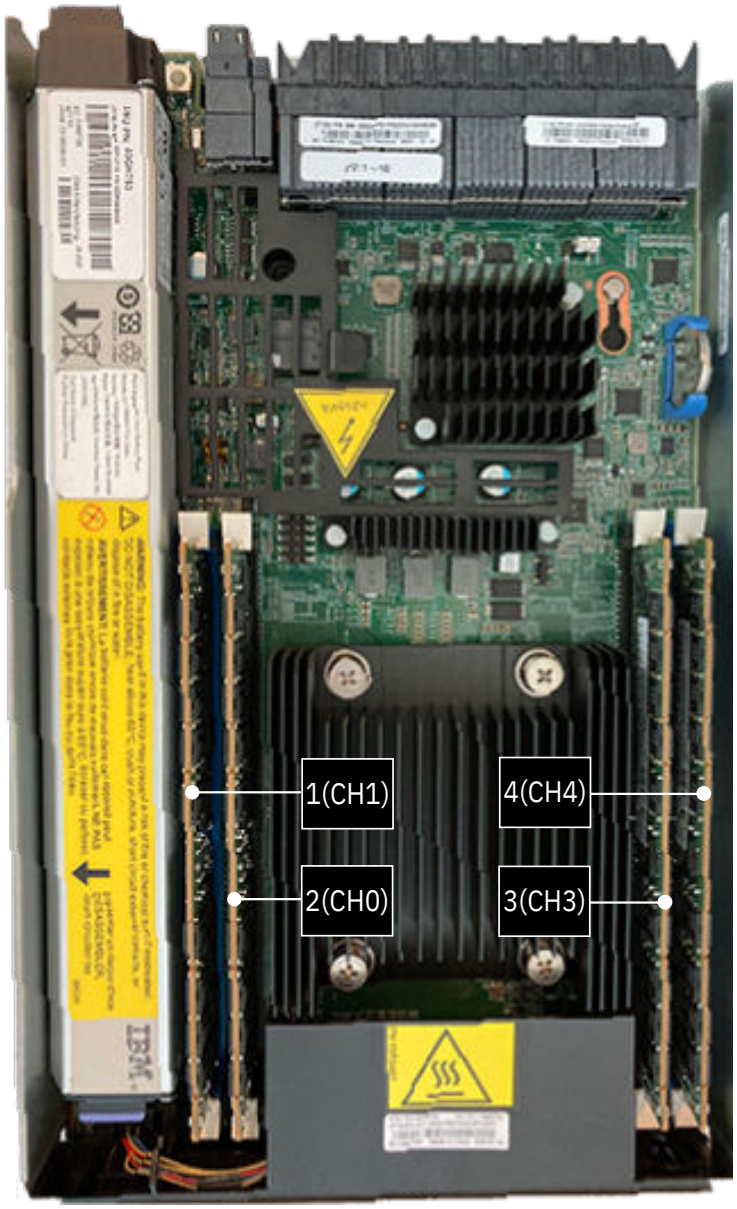


Figure 76. Location and numbering of the DIMM slots

Review Table 48 on page 132 to understand mapping between a DIMM slot and its corresponding CPU memory channel. The channel name is also included in the slot label printed on the canister circuit board.

Table 48. Summary of slot numbers and channel names

Slot number	**Channel Name**
1	CH1
2	CH0
3	CH3
4	CH4

The number of DIMMs installed in each node canister depends on the enclosure memory configuration. See Table 49 on page 133 for valid memory configurations per node canister.

Procedure

DIMM Installation considerations

1. The number of DIMMs installed in each node canister depends on the enclosure memory configuration. Review for valid memory configurations per node canister.

Table 49. Summary of valid node canister memory configurations

Configuration	Node canister (total)	Slot 1	Slot 2	Slot 3	Slot 4
Base (ALG0)	32 GiB	32 GiB	Empty	Empty	Empty
Base (ALG0) with upgrade (ALGC)	128 GiB	32 GiB	32 GiB	32 GiB	32 GiB
Base (ALG1), or upgrade (ALGD)	256 GiB	64 GiB	64 GiB	64 GiB	64 GiB

2. In an operational enclosure, both node canisters always have the same memory configuration except when you are upgrading node canister memory. To upgrade enclosure memory, one node canister is upgraded at a time. The system logs an error when the node canister memory configurations differ. After the second node canister in the enclosure is upgraded, the error is cleared and the nodes use the upgraded memory.

Identifying failed DIMMs

3. Use the service assistant or the **System Event Log** in the management GUI to obtain the system event log with error code 1022 and the sense data. The sense data includes information that is also used to identify which DIMM is faulty.
   - If a node error 510 is logged and event ID 073510, the sense data includes information such as, the detected size of the DIMM in slot 1, 2, 3 and 4, followed by the expected size for each slot. Compare each detected capacity with the expected size to determine which DIMMs are faulty. See Table 49 on page 133 for permitted configurations and Figure 76 on page 132 for the physical location of each DIMM slot inside the node canister.
   - If a event ID 076101 is logged, the object ID of the event identifies the slot number of the faulty DIMM. The sense data includes information on the channel name of the faulty DIMM, along with manufacturer and serial number of the DIMM to aid identification. The channel name is another way to refer to the slot number, as described in Table 48 on page 132.
4. See the Replaceable units for the correct FRU part number for each size of DIMM.

Removing the DIMM

Important: Do not start service status on the node. Power off the node to replace a DIMM or run the **rmnode** command to add DIMMs.

If you are upgrading memory of a node canister as a part of an enclosure upgrade, you must remove that node from the system configuration before you start the following procedure. To do so, you can use the management GUI or the CLI.

- To use the management GUI, right-click the node canister and select **Remove**.
- To use the CLI, enter the following command, where *object_id* | *object_name* identifies the node canister that receives the additional memory:

```
rmnodecanister object_id | object_name
```

If you are replacing a faulty DIMM with a new one from FRU stock, you do not need to remove the node canister from the system configuration.

5. Remove the canister that contains the faulty DIMM, as described in "Removing and reseating a node canister" on page 128.
6. Refer to Figure 76 on page 132 to locate the appropriate DIMM slot.
7. Press the locking tabs on the ends of the DIMM to eject it.
8. Lift the DIMM up and out of the slot.

Replacing or adding the DIMM

9. Touch the static-protective package that contains the new DIMM to any unpainted metal surface on the node canister. Remove the DIMM from the package.
10. Turn the DIMM so that the DIMM keys align correctly with the connector on the main board.
11. Insert the DIMM into the connector by aligning the edges of the DIMM with the slots at the ends of the DIMM connector.
12. Firmly press the DIMM straight down into the connector by applying pressure on both ends of the DIMM simultaneously. The retaining clips snap into the locked position when the DIMM is firmly seated in the connector.
13. Repeat steps “9” on page 134 through “12” on page 134 until all the new or replacement DIMMs are installed.
14. Reinsert the node canister, as described in “Removing and reseating a node canister” on page 128.

    If the canister power does not on, check that the canister is fully inserted into the enclosure.
15. Use the management GUI to monitor the system as the node powers on and resolve any unfixed events that appear in the event log.
16. If you are upgrading the memory of an enclosure, use the Management GUI to ensure that the removed node is automatically added back into the system configuration and is active. Then repeat the procedure to upgrade the second node canister in the enclosure.

Removing and replacing an enclosure fan

You may need to replace a faulty enclosure fan.

About this task

No tools are required to complete this task. Do not remove or loosen any screws on the enclosure.

To remove and replace an enclosure fan, complete the following steps:

Procedure

1. Locate the latches on the left and right front corners of the enclosure.
2. Lift the lower edge of each latch to release the enclosure from the rack, and then slide the enclosure forward until the fan door is accessible.

   Important: To avoid a tipping hazard, do not pull the enclosure forward any farther than half-way.

   Important: If you encounter resistance while sliding the enclosure forward, check that there is adequate slack in the cables in the cable management arm at the back of the enclosure.
3. To open the fan door, slide the two latches identified by blue touchpoints towards the back of the enclosure, then lift the front edge of the fan door, as shown in the following figure.

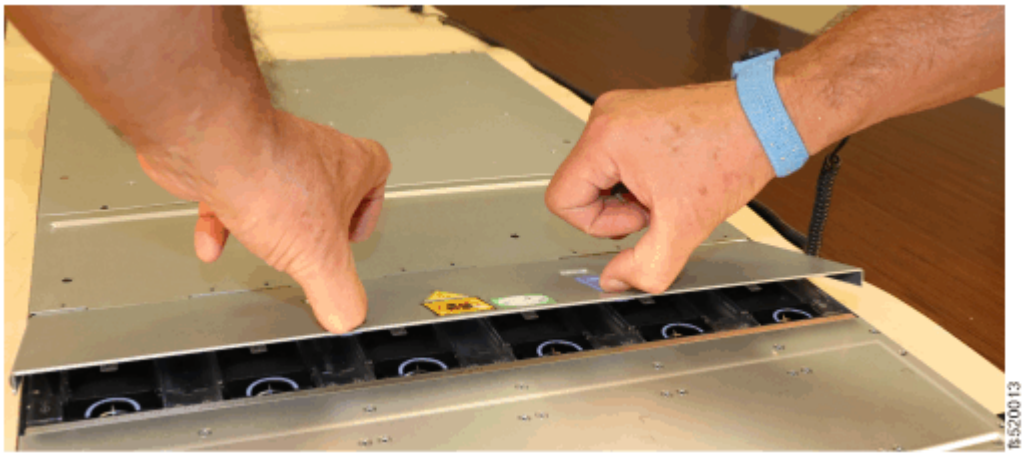


Figure 77. Opening the fan door

4. The six fan modules are numbered 1 through 6 from left to right. The failed fan is identified by an LED.
5. Grasp the failed fan by the two blue two touchpoints and lift it vertically to remove it from the enclosure, as shown in the following figure.

Figure 78. Opening the fan door

6. To install the new fan, orient the fan so that the arrow indicating airflow points towards the back of the enclosure, matching the other five fans, then lower the fan vertically into the plastic guide until the fan is fully seated in the enclosure.
7. Close the fan door
8. Slide the enclosure back into the rack.

   When the enclosure is fully inserted into the rack, the latches on each end of the front panel will engage.

   Important: Check that none of the cables at the back of the canisters were disconnected when the enclosure was moved forward.

Removing and replacing the midplanes (IBM SSR procedure)

This procedure must be performed by an IBM SSR.

Before you begin

Have the following items on hand:

- Antistatic mat and wrist strap
- Stickers to label the original location of the canisters and drives.
- T8 and T10 Torx drivers
- Philips screwdriver

About this task

Note: Remote copy services including HyperSwap, Metro Mirror, Global Mirror, Global Mirror are supported till software version 8.7.0 only. These services are replaced with policy-based high availability and policy-based replication from 8.7.1 and higher versions.

To remove and replace the midplanes in the enclosure, complete the following steps.

Procedure

1. Log in to the service assistant on one of the node canisters in the control enclosure. In the **Node Details** panel, select the **Location** tab. Note the following values for the enclosure in Table 50 on page 136. This information might be needed later.

Table 50. Recording control enclosure information

Item	Value
WWNN 1	
WWNN 2	
Machine type and model	
Serial number	

2. If the control enclosure is still active, stop host I/O, FlashCopy, Global Mirror, or Metro Mirror activities on all the volumes that depend on the control enclosure.

   This step applies to all I/O group volumes that are managed by this control enclosure. It also applies to any volumes in other I/O groups that depend on the drives in the affected I/O group.
3. Complete “Procedure: Powering off a node canister” on page 110 for both node canisters that requires the midplane assembly replacement.
4. Remove the enclosure from the rack, as described in “Removing and replacing the enclosure” on page 111.
5. Label the drives and drive fillers with their slot numbers and then remove them, as described in “Removing and replacing a drive” on page 116 and “Removing and replacing a drive blank” on page 117.
6. Remove the power supply units (PSUs), as described in “Removing and replacing a power supply unit” on page 118.
7. Label and remove the canisters, as described in “Removing and reseating a node canister” on page 128.
8. Remove the six enclosure fans, as described in “Removing and replacing an enclosure fan” on page 134.
9. Remove the fan cover, as described in “Removing and replacing the enclosure fan cover” on page 141.
10. Remove the six clear plastic fan guides.

    Note: The two guides next to the canister sides have an alignment slot that fits over a pin on the side of the canister. Lift the front end of the guide slightly to free it from the guide pin, then lift the guide out of the canister.

Removing the drive midplane

Attention: When reattaching the enclosure midplane cables, follow proper cable disconnection procedure as described in step “23” on page 139.

The drive midplane and enclosure midplane are connected by six high-speed data cables **1** and two power cables **2**, as shown in Figure 79 on page 137.

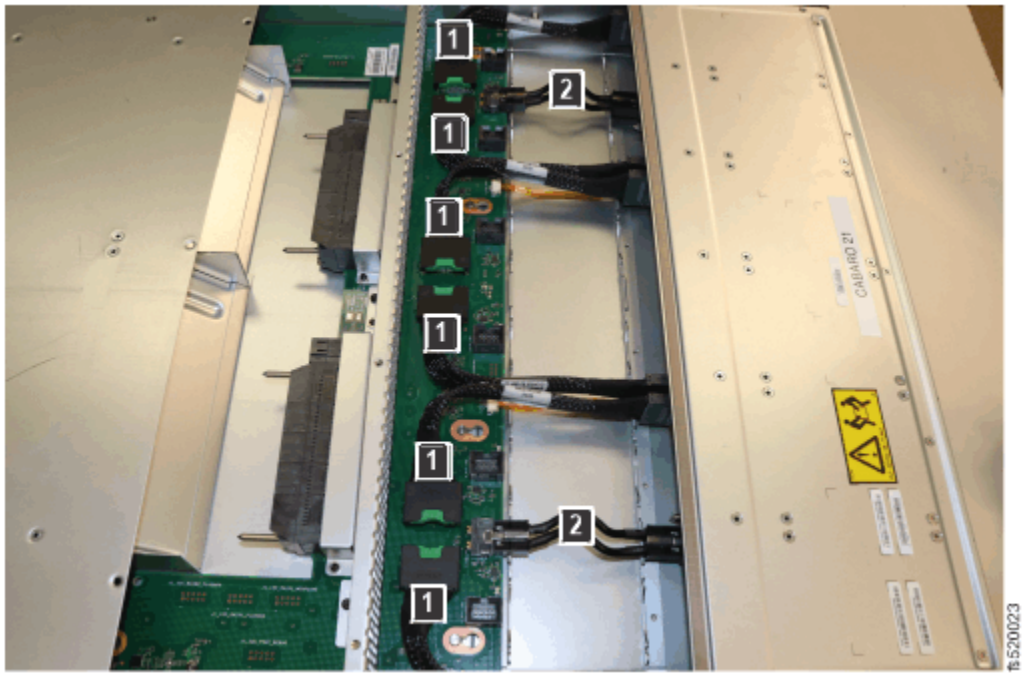


Figure 79. Midplane power and data cables

11. To disconnect the six high-speed data cables from the drive midplane, press the latches on the outer sides of each connector to release the connector, as shown in Figure 80 on page 137

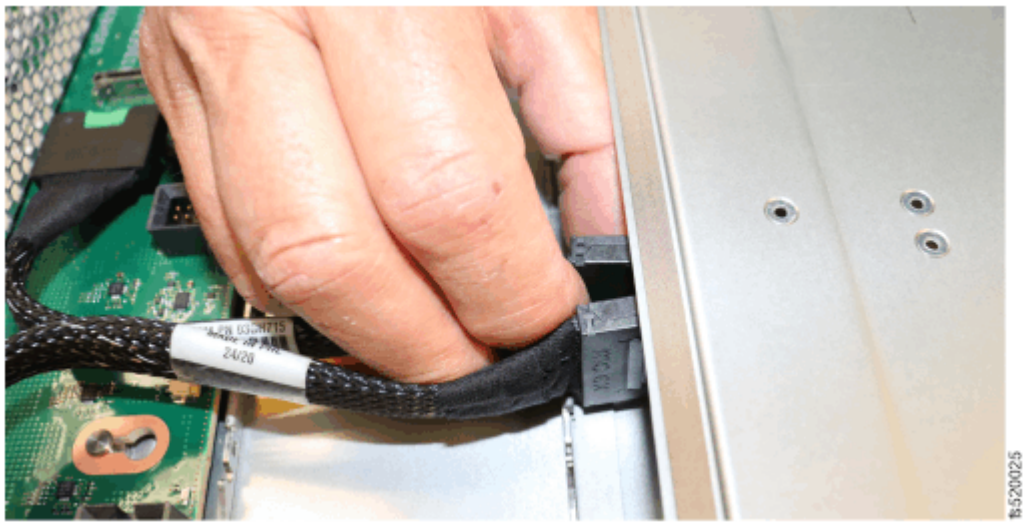


Figure 80. Disconnecting a high-speed data cable

12. To disconnect the two power cables from the drive midplane, press the latch on the top of the connector to release the connector, as shown in Figure 81 on page 138

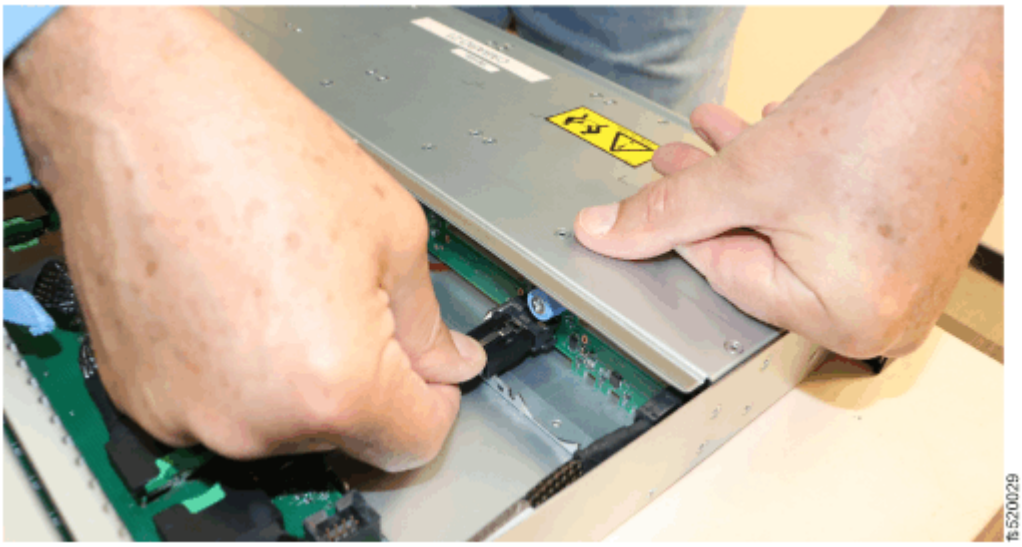


Figure 81. Disconnecting a power cable

13. To remove the drive midplane, loosen the three blue captive screws 1 shown in Figure 82 on page 138 by hand, or by using a Philips screwdriver if necessary.

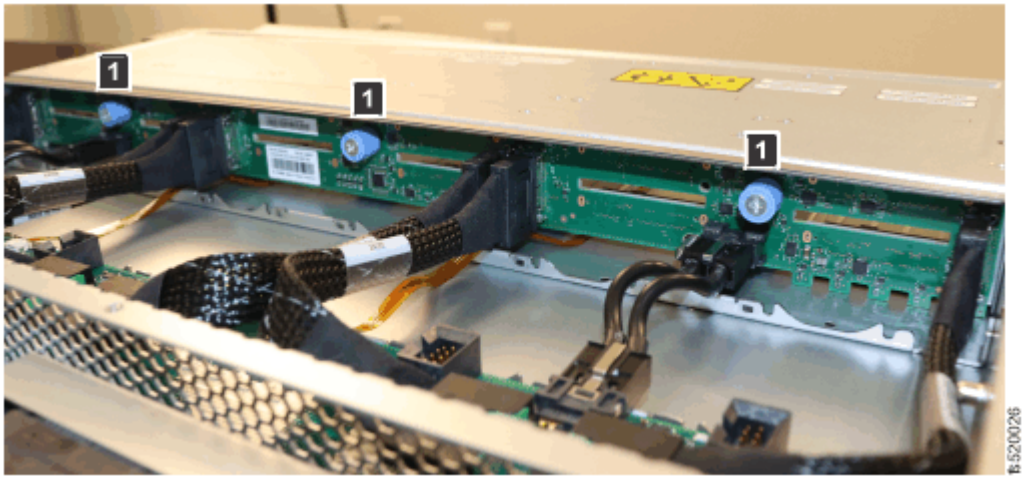


Figure 82. Drive midplane captive screws

14. Tip the upper edge of the midplane back slightly, and then lift the midplane out of the enclosure.

Removing the enclosure midplane

15. To disconnect the two thermal-sensor ribbon cables from the enclosure midplane, pull forward the tabs on either side of the cable connector to release cable from the connector. Then, remove the ribbon cable.
16. Disconnect the other eight cables that lead to the enclosure midplane, which is shown in Figure 79 on page 137:
    a) To disconnect the six high-speed data cables, press the latch on the upper side of the connector, then remove the cable.
    b) To disconnect the two four-conductor power cables, press the metal tab at the back of the connector to release the latch at the front of the connector, then remove the cable.
17. Use a T10 Torx driver to remove the five screws that secure the metal chassis brace to the enclosure, as shown in Figure 83 on page 139:

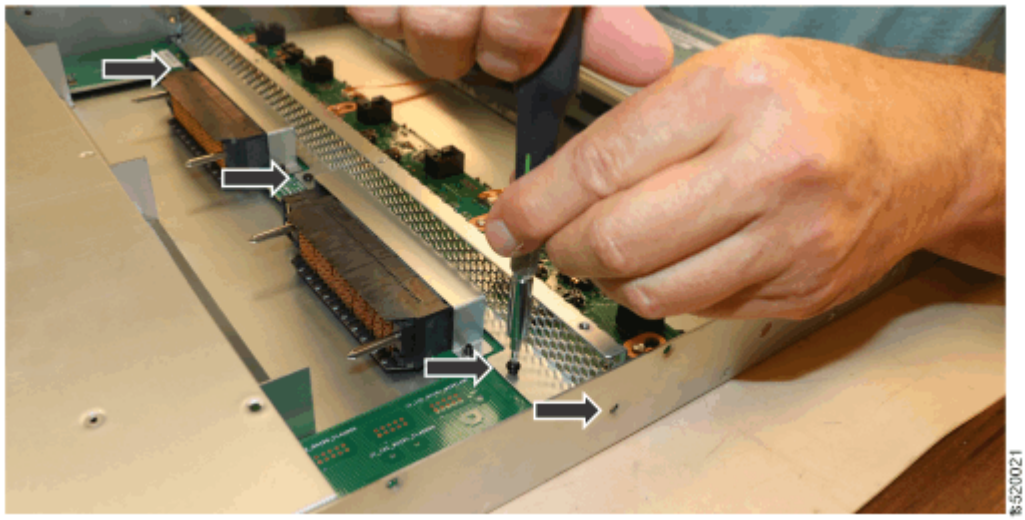


Figure 83. Chassis brace

- Remove one screw from each outer side of the enclosure.
- Remove three screws from the flange on the base of the metal chassis brace.

18. Slide the midplane toward the front of the enclosure slightly to disengage the guide pins, then lift the midplane out of the enclosure.

Replacing the enclosure midplane

19. Lower the new enclosure midplane into the chassis just in front of the alignment pins. Make sure that you do not trap the thermal sensor ribbon cables or scrape the midplane on the ridged enclosure fan support on the enclosure floor.
20. Slide the midplane toward the back of the enclosure to engage the guide pins in their slots.
21. Secure the midplane with three screws though the metal chassis brace and two screws through the sides of the enclosure, as shown in Figure 83 on page 139.
22. Insert the two thermal sensor ribbon cables into the connectors on the enclosure midplane.

    Make sure that the tabs on the ribbon cable connector are pulled forward to open the connector slot. Then, insert the cable until it is fully seated and slide the tabs forward to secure the cable.
23. Reconnect the six high-speed data cables to the enclosure midplane. When reattaching the midplane high-speed data cables to the enclosure midplane, you must squeeze the green button on the connector as you push it down to ensure that it is seated. Examine the connectors closely after you attach them to make sure that the connectors are seated all the way down and are parallel to the midplane.
24. Reconnect the two power cables to the enclosure midplane.

Replacing the drive midplane

25. Holding the midplane by the outermost blue captive screws, guide the midplane into position in the enclosure, then tighten the three blue captive screws.
26. Reconnect the six high-speed data cables to the drive midplane.

    Four of the cables are installed in pairs. When connecting these cables, orient the connectors so that the release tabs on the connectors face outward and are easily accessible.
27. Reconnect the two power cables to the drive midplane.

Completing the procedure

28. Replace the six plastic fan guides.

    Some of the fan guides cover one or more cables. You may need to adjust a cable slightly to allow the fan cover to drop fully into place.
29. Replace the six enclosure fans, as described in “Removing and replacing an enclosure fan” on page 134.

30. Replace the fan cover and reinstall the nine screws to secure the cover, as described in “Removing and replacing the enclosure fan cover” on page 141.
31. Replace the canisters, as described in “Removing and reseating a node canister” on page 128.
32. Replace the drives in their original locations, as described in “Removing and replacing a drive” on page 116.
33. Replace the drive fillers in their original locations, as described in “Removing and replacing a drive blank” on page 117.
34. Replace the enclosure in the rack, as described in “Removing and replacing the enclosure” on page 111.
35. Reconnect power to the control enclosure.

    The node canisters restart. The yellow fault LED indicators are on because the new enclosure was not set with the identity of the old enclosure. The node canisters log node error 504 to report that they are in the wrong location. In the system Event log, the error code is 1192.
36. Use an **ssh** client to log in as the superuser to the service IP address of either node canister. Then, access the service assistant CLI.

    Note: If you replaced a node canister, log in to the node canister that was not replaced.
37. Enter the **satask chvpd -replacemidplane** command.

    If the command is successful, the node canister modifies the VPD data. You are disconnected from the CLI as both node canisters reboot.

    If the **satask chvpd -replacemidplane** command fails, complete the following steps:

    a) Connect to the Service Assistant Tool of the node canister. Go to `http://service_ip/service` or connect to the technician port of the node canister.

    If you replaced a node canister at the same time as the midplane assembly, connect to the node canister that was not replaced.

    If you cannot access the service assistant, see *Problem: Cannot connect to the service assistant*.

    b) In the Service Assistant tool, use the **Configure Enclosure** panel.

    c) Select to use the node copy of the data that you recorded in step “1” on page 136 (WWNN 1, WWNN 2, machine type and model, and serial number).

    If the node copy for any of the values is not available, select the **Specify** option for each missing value. Then, enter the value that you recorded at step “1” on page 136.

    d) After you specify all values in the **Enclosure Information** panel, click **Modify**.

    The node canisters restart. When the restart finishes, the system comes online with both node canisters online.

    Important:

    - Do not reset the system ID.
    - After the replacement midplane is modified, it cannot be used as a replacement part for a different enclosure. Do **not** return a modified midplane assembly to FRU stock.
38. Wait for the green status LED of both node canisters to light and indicate that the node canisters are active in the system.

Note: Customers can complete the following tasks after the new midplane is installed and the control enclosure is operating again.

39. Use the management GUI to check the status of all volumes and physical storage to ensure that the system is operating normally.
40. Go to **Monitoring** > **Events** to check the Event Log for other events or errors.
41. Restart the host application and any FlashCopy, Global Mirror, or Metro Mirror activities that were stopped.

Removing and replacing the enclosure fan cover

You might need to have the enclosure fan cover replaced or temporarily removed as part of another procedure. This procedure must be performed by an IBM SSR.

Before you begin

Note: You need a T8 Torx driver to complete this procedure.

About this task

To remove and replace the enclosure fan cover, complete the following steps:

Procedure

1. If you did not already remove the enclosure from the rack as part of another service procedure, remove the enclosure from the rack as described in “Removing and replacing the enclosure” on page 111.
2. To remove the enclosure fan cover, complete the following steps:
   a) Using a T8 Torx driver, remove the nine mounting screws, as shown in Figure 84 on page 141.

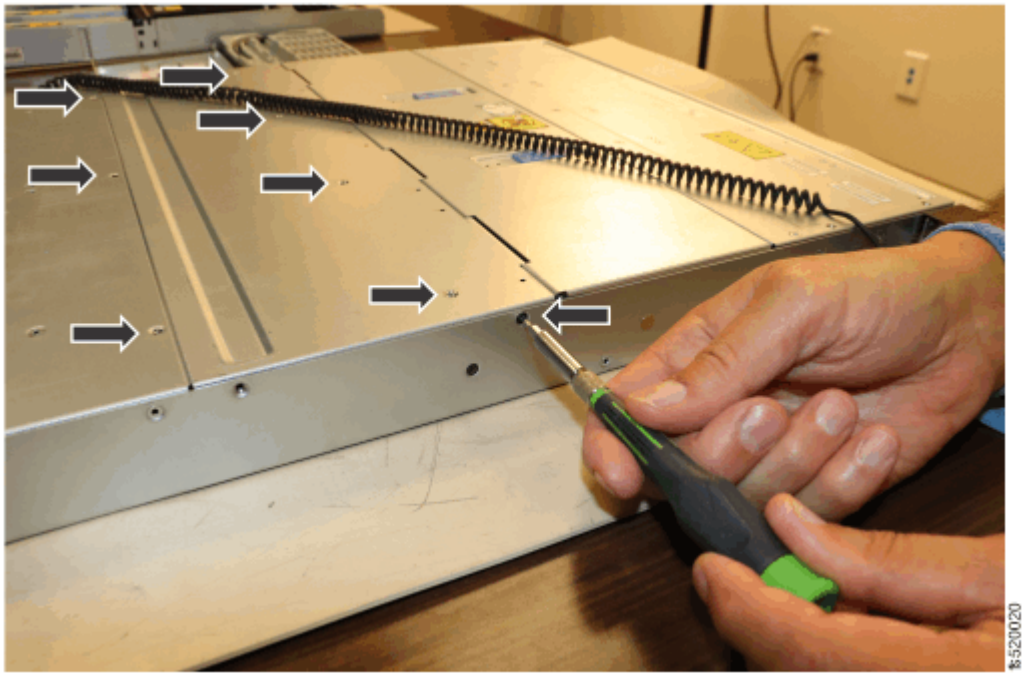


Figure 84. Enclosure fan cover mounting screws

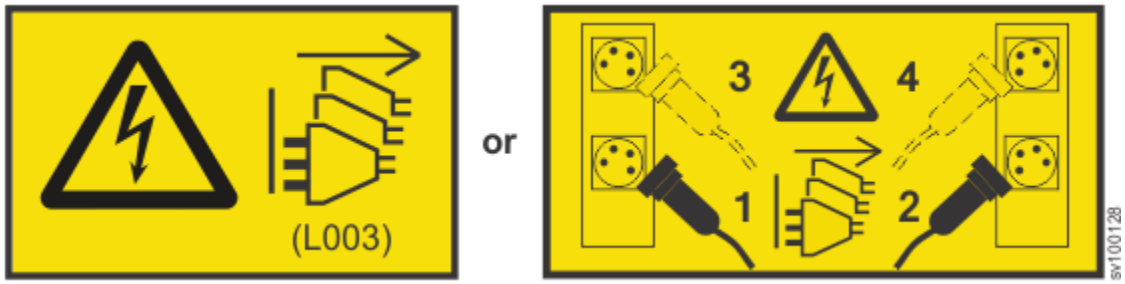
   b) Remove the three screws along the rear edge of the door.
   c) Remove the four screws near the door hinge line.
   d) Remove the two screws half-way down each side of the enclosure.
   e) Lift the enclosure fan cover from the enclosure.
3. Place the new fan cover onto the enclosure, and reinstall the nine screws to secure the cover, as shown in Figure 84 on page 141.
4. If you are replacing only a faulty fan cover, replace the enclosure in the rack, as described in “Removing and replacing the enclosure” on page 111.

Removing and replacing a thermal sensor

You might need to replace a faulty thermal sensor. This sensor is used to detect the ambient temperature of the air that is coming into the enclosure.

Before you begin

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



About this task

To remove and replace a thermal sensor, complete the following steps:

Procedure

1. Refer to the system log for the location of the faulty sensor. The thermal sensors are located in drive bays 8 and 10.
2. Take the system offline, as described in “Procedure: Powering off the system ” on page 109.
3. Disconnect both power cords.
4. Locate the latches on the left and right front corners of the enclosure.
5. Lift the lower edge of each latch to release the enclosure from the rack, and then slide the enclosure forward until the fan door is accessible.

   Important: To avoid a tipping hazard, do not pull the enclosure forward any farther than half-way.

   Important: If you encounter resistance while sliding the enclosure forward, ensure that there is adequate slack in cables in the cable management arm at the back of the enclosure.
6. To open the fan door, slide the two latches that are identified by blue touchpoints toward the back of the enclosure. Then, lift the front edge of the fan door, as shown in the following figure.

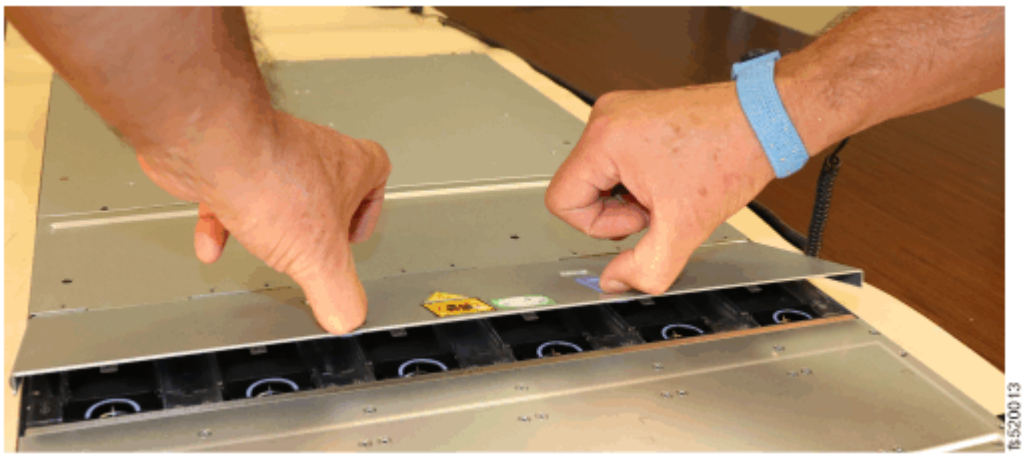


Figure 85. Opening the fan door

7. Label the drive or drive filler in drive bays 8 and 10, and then remove them, as described in “Removing and replacing a drive” on page 116 and Removing and replacing a drive slot filler.
8. The thermal sensors are attached to the floor of the drive bays by using adhesive, as shown in the following figure.

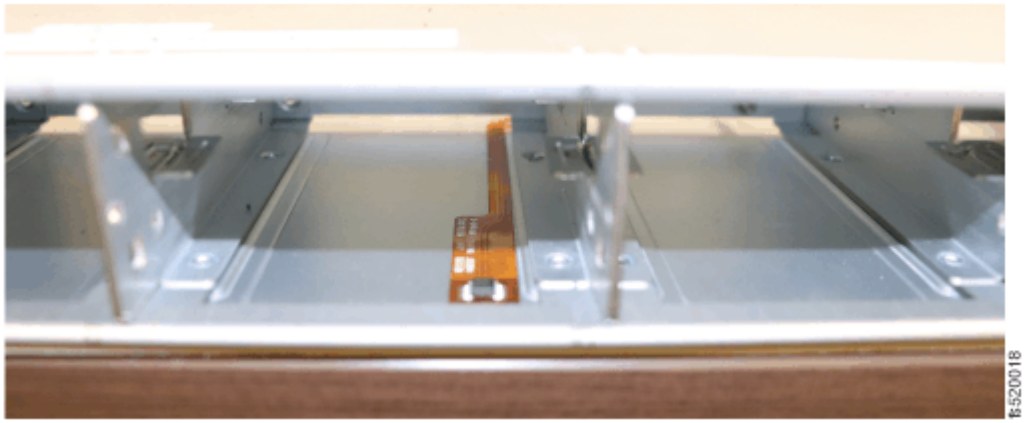


Figure 86. Thermal sensor

9. Remove the fans that are next to the faulty sensor’s ribbon cable, as described in Removing and replacing an enclosure fan.
10. Remove the plastic fan guides next to the faulty sensor’s ribbon cable.
11. To disconnect the thermal sensor's ribbon cable from the enclosure midplane, pull forward on the tabs on either side of the cable connector to release the cable from the connector. Then, remove the sensor.

    You might need to deflect the data cables above the ribbon cable slightly to access the ribbon cable connector.
12. Lift the sensor from the floor of the drive bay and remove the faulty thermal sensor from the enclosure.
13. Making sure that the new thermal sensor is facing upwards, insert the ribbon cable through the drive bay and beneath the lower edge of the drive midplane.
14. Align the new sensor with its original location in the drive bay and press the sensor downwards to adhere it to the chassis.
15. To connect the ribbon cable to the connector on the enclosure midplane, insert the cable until it is fully seated and slide back the tabs on the connector to secure the cable.
16. Replace the plastic fan guides.
17. Replace the enclosure fans, as described in Removing and replacing an enclosure fan.
18. Replace the drives or drive fillers in their original locations, as described in “Removing and replacing a drive” on page 116 or Removing and replacing a drive slot filler.
19. Slide the enclosure back into the rack until the latches on the enclosure engage with the rack.
20. Reconnect the two power cords.

Removing and replacing 2U expansion enclosure parts

You can remove and replace parts from the 2U expansion enclosure to perform service or during the initial installation process.

About this task

Attention: Even though many of these components are hot-swappable, they are intended to be used only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the

replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.

Each replaceable unit has its own removal procedure. Sometimes you can find that a step within a procedure might refer you to a different remove and replace procedure. You might want to complete the new procedure before you continue with the first procedure that you started.

Remove or replace parts only when you are directed to do so.

Procedure: Powering off a 2U expansion enclosure

Follow the procedure to power off a 2U expansion enclosure. For example, it might be required to power off a 2U expansion enclosure when maintenance is planned.

About this task

To power off the 2U expansion enclosure, complete the following steps.

Procedure

1. Read the safety precautions in the IBM Systems Safety Notices. These guidelines help you safely work with the system.
2. Read Procedure: Understanding system volume dependencies to determine whether to continue this procedure.
3. Disconnect the power cords from both power supplies in the expansion enclosure so that the expansion enclosure is powered off.
4. Confirm that all the LEDs on the rear of the enclosure are off.

Removing and replacing the 2U enclosure end caps

You can remove and replace enclosure end caps.

About this task

Attention: The left end cap is printed with information that helps identify the enclosure.

- Machine type and model
- Enclosure serial number

The information on the end cap should always match the information that is printed on the rear of the enclosure. It should also match the information that is stored on the enclosure midplane.

Procedure

To remove and replace either the left or right end cap, complete the following steps.

1. If the enclosure is on a table or other flat surface, elevate the enclosure front slightly or carefully extend the front over the table edge.
2. Grasp the end cap by the blue touch point and pull it until the bottom edge of the end cap is clear of the bottom tab on the chassis flange.
3. Lift the end cap off the chassis flange.
4. Fit the slot on the top of the new end cap over the tab on the top of the chassis flange.
5. Rotate the end cap down until it snaps into place.

Replacing 2U expansion enclosure support rails

You can replace faulty support rails of a 2U expansion enclosure with new ones that are received from CRU / FRU stock.

Before you begin

Two persons are required at step “7” on page 145.

Procedure

To replace the support rails, complete the following steps.

1. Identify the enclosure that is mounted on the rails that are being replaced.

   Follow the steps in “Procedure: Identifying which enclosure or canister to service” on page 107 to ensure that you identify the correct enclosure.
2. Shut down the system by following the steps in “Procedure: Powering off the system ” on page 109.
3. Remove power from the enclosure by unplugging both power cables from the electrical outlets.
4. Ensuring you identify which port each cable connects to, remove all cables from the back of the enclosure that has faulty support rails.
5. Remove the end caps from the front flanges of the enclosure by following the removal instructions in topic “Removing and replacing the 2U enclosure end caps” on page 144.
6. Unscrew the M5 screw from the left flange.

   Repeat with the M5 screw in the right flange.
7. Slide the enclosure from the rack.

   CAUTION: The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)
8. Locate the left support rail.

   Record the shelf number of the support rail so that the replacement rails can be installed into the same position.
9. At the rear of the rack, remove the securing M5 screw from the bottom hole of the rear bracket of the rail, then open the rear hinge bracket (Figure 87 on page 146).

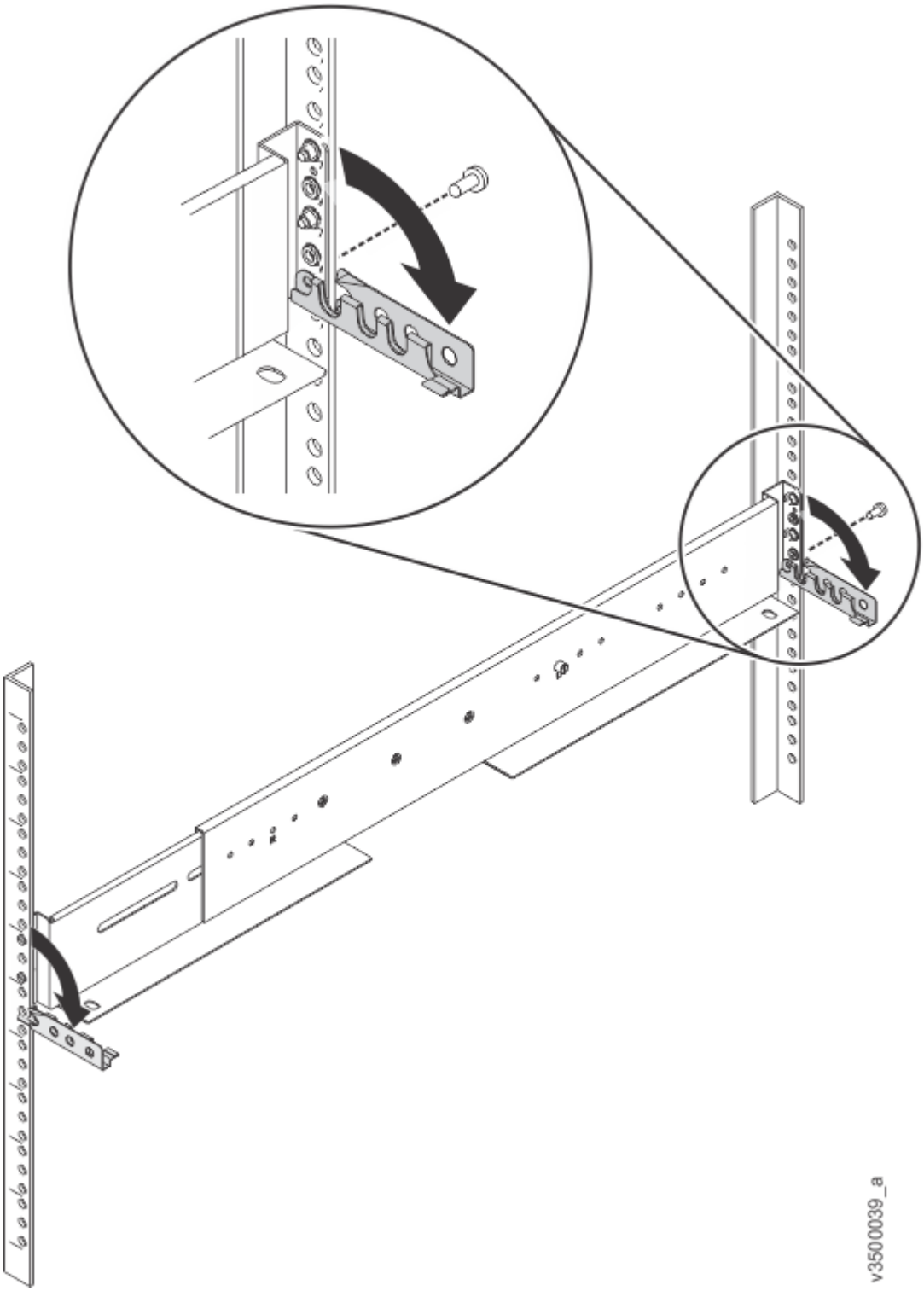


Figure 87. Opening rear hinge bracket of mounting rail

10. At the front of the rack, hold onto the rail and open the front hinge bracket.
11. Compress the rail against its spring to shorten it, then remove it from inside the rack (Figure 88 on page 147).

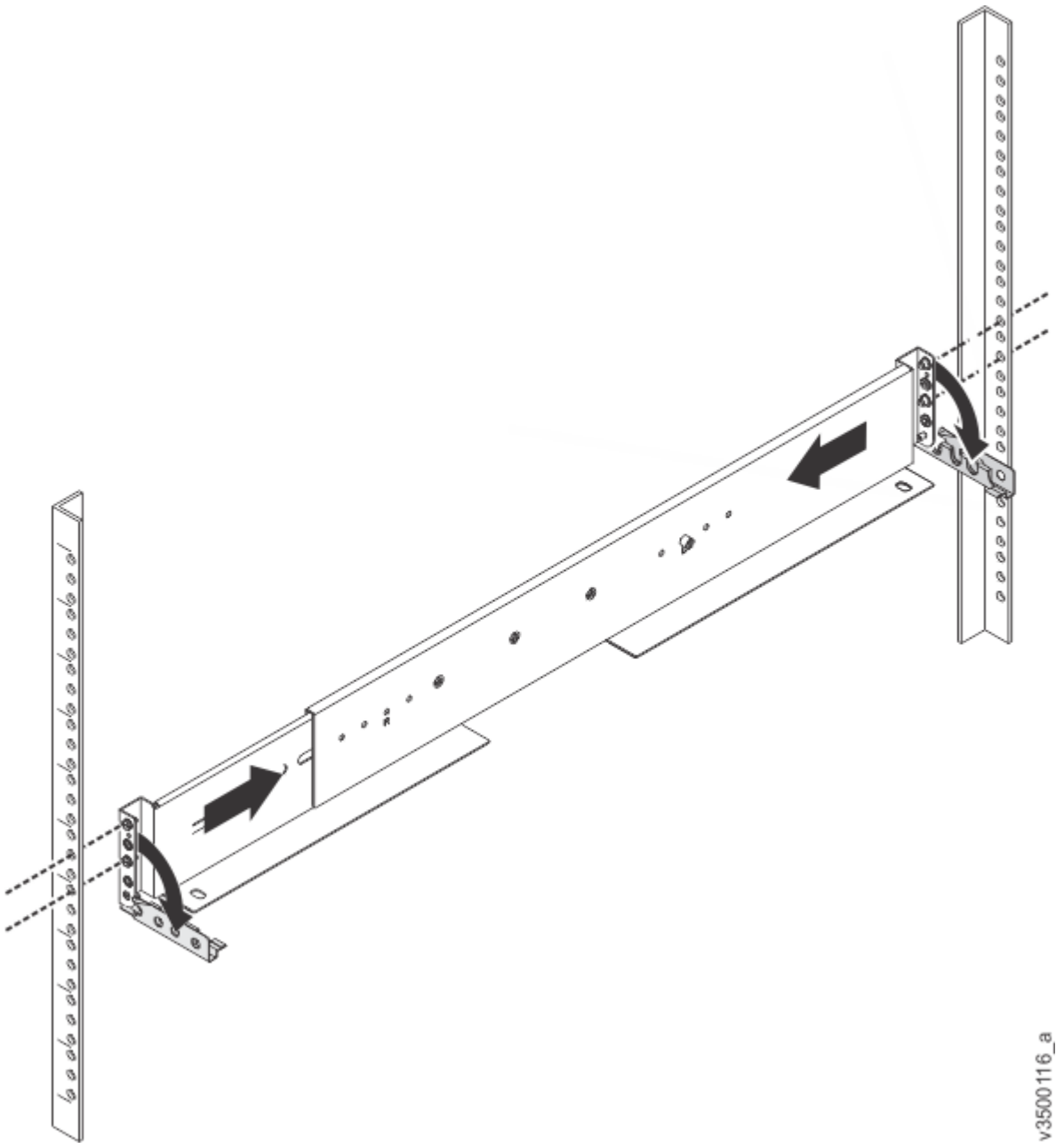


Figure 88. Compressing rail for removal from rack

12. Repeat steps “9” on page 145 to “11” on page 146 on the right support rail.
13. If components were removed from the enclosure at step “7” on page 145, return each canister, drive assembly, and power supply unit to its labeled slot.
14. Reconnect the cables, ensuring that they are connected to their original ports.
15. Reconnect the power supply cables to their original power supply and electrical outlet.

    The system starts.
16. After the system is online, use the management GUI to verify that the system is correct.

Removing and replacing a drive assembly

You can replace a faulty 2.5-inch drive in the 2U expansion controller with a new one received from stock.

Before you begin

Ensure that the drive is not a spare or a member of an array. The drive status is shown in **Pools** > **Internal Storage** in the management GUI.

Attention:

- Do not replace a drive unless the drive fault LED is on or you are instructed to do so by a fix procedure.
- If the drive is a member of an array, go to the management GUI and follow the fix procedures. The fix procedures mitigate loss of data and loss of access to data and manage use of the drive by the system.
- Do not leave a drive slot empty for extended periods. Do not remove a drive assembly or a blank filler without having a replacement drive or a blank filler with which to replace it.

Procedure

To prepare to replace a drive assembly, complete the following steps.

1. Read the safety information in the IBM Systems Safety Notices publication that was provided with your system hardware.
2. Locate the slot that contains the drive assembly that you want to replace.
   a) Refer to Procedure: Identifying which enclosure or canister to service to ensure correct identification of the correct system or enclosure.
   b) The drive slots are numbered 1-12 starting at the top left of the enclosure drive bay slots. The drive slots 1-6 run from the top left to the top right. The drive slots 7-12 run from the bottom left to the bottom right.
   c) If the drive in the slot is faulty, the lit, amber fault LED on the drive helps to identify it.
3. To further help identify the drive assembly, go to the management GUI to **Pools** > **Internal Storage**, select the drive to replace, and click **Actions** > **Identify**. Verify that the correct drive fault LED flashes.

Attention: Never hot-swap a disk drive when its green activity LED is flashing. Hot-swap a drive only when its amber fault LED is lit (not flashing) or when the drive activity LED is off.

Remove a drive assembly

4. Gently slide the orange release latch up to unlock the handle.
5. Pull out the tray handle to the open position (see Figure 89 on page 149).

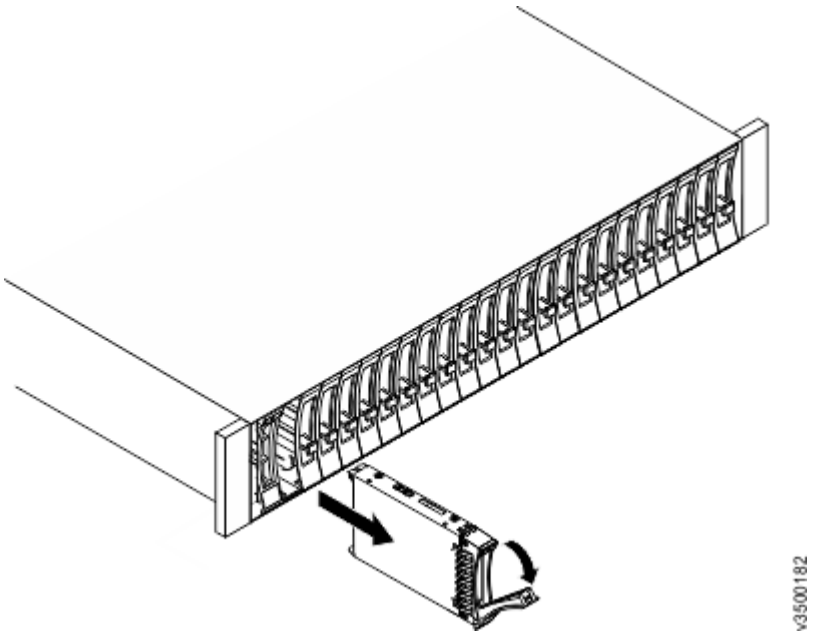


Figure 89. Unlocking and removing a 2.5-inch drive from its slot

6. Grasp the handle and pull the drive partially out of the bay.
7. To avoid possible damage to the drive, wait at least 20 seconds before you remove the drive assembly from the enclosure.
8. Gently slide the drive assembly out of the enclosure.
9. Make sure the drive assembly has proper identification, such as a label on the hard disk drive.

   If the drive fails, record that information on the label.

Replace a drive assembly

10. Touch the static-protective package that contains the drive assembly to any unpainted surface on the outside of the enclosure.
11. Remove the drive assembly from its package.
12. Make sure that its drive-tray handle is in the open (unlocked) position.
13. Align the drive assembly with the guide rails in the bay (see Figure 90 on page 149).

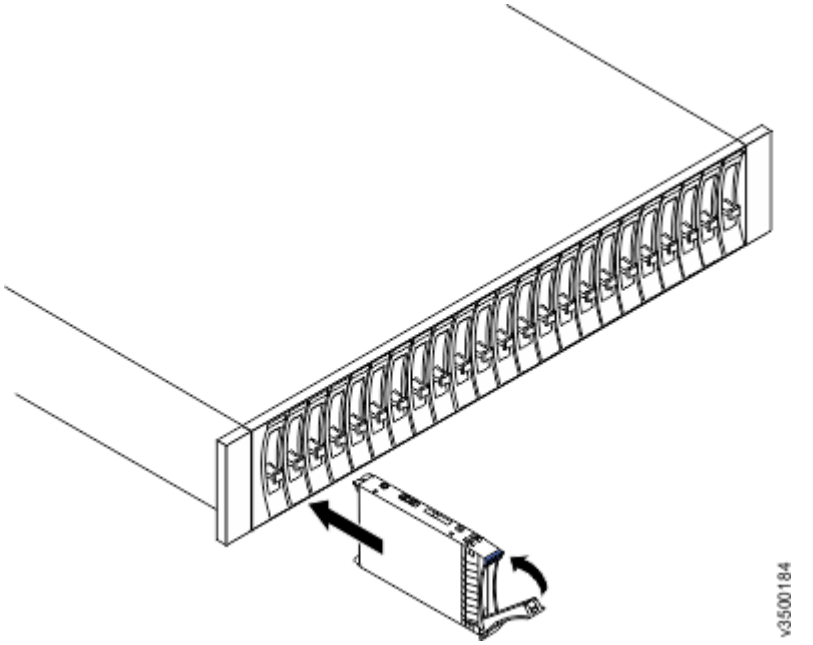


Figure 90. Installing and locking a 2.5-inch drive into its slot

14. Gently push the drive assembly into the bay until the drive stops.
15. Rotate the drive handle to the closed (locked) position.

Results

If the replaced drive was a failed drive, the system automatically reconfigures the replacement drive as a spare and the replaced drive is removed from the configuration. The process can take a few minutes.

Removing and replacing a drive blank

Use the following procedures to remove a faulty drive slot filler and replace it with a new one from stock. Drive slot fillers are passive components that regulate airflow through the control enclosure.

About this task

Notes:

- Every drive slot of an operational control enclosure must contain either a drive or a drive slot filler. A drive slot must not be left empty for more than **10 minutes** during servicing. Ensure that you have read and understood the removal and replacement instructions, and have the replacement part unpacked before you remove the existing drive slot filler.
- No tools are required to complete this task. Do not remove or loosen any screws.

Procedure

1. Unpack the replacement drive slot filler from its packaging.

Removing the drive slot filler

2. Use your thumb and fore finger to pinch the latch of the faulty drive blank.

Removing a drive blank assembly

3. Gently slide the release latch up to unlock the handle.
4. Pull the faulty drive slot filler from the drive slot.

Replacing a drive blank assembly

5. Hold the drive blank the correct way up, as shown in Figure 91 on page 150.

   Figure 91 on page 150 relates to the 2.5" slots in the 2U24 expansion enclosure. Note that the drive blanks are also available in 3.5" form factor for the 2U12 expansion enclosure.

Figure 91. Correct drive blank orientation

6. Slide the replacement drive blank into the empty drive slot.

Replacing a power supply unit for an expansion enclosure

You can replace either of the two hot-swap redundant power supplies in an enclosure. These redundant power supplies operate in parallel, one continuing to power the canister if the other fails.

Before you begin

Attention:

- Although many components are hot-swappable, their intended use is only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.
- Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.
- Ensure that you are aware of the procedures for handling static-sensitive devices before you replace the power supply.

Procedure

1. Before you remove and replace parts, you must be aware of all safety issues. First, read the safety precautions in the IBM Systems Safety Notices. These guidelines help you work safely with the system.
2. Confirm that you know which power supply must be replaced. Go to “Procedure: Identifying which enclosure or canister to service” on page 107.
3. Disconnect the power cord from the electrical outlet. Release the cable retention clip and disconnect the power cord from the power supply that you are replacing.
4. On the left side of the power supply, press the orange release tab to the right slightly to release the handle (no more than 6 mm [0.25 in.]) as you rotate the handle downward.
5. Using the handle, gently slide the power supply out of the enclosure, as shown in Figure 92 on page 151.

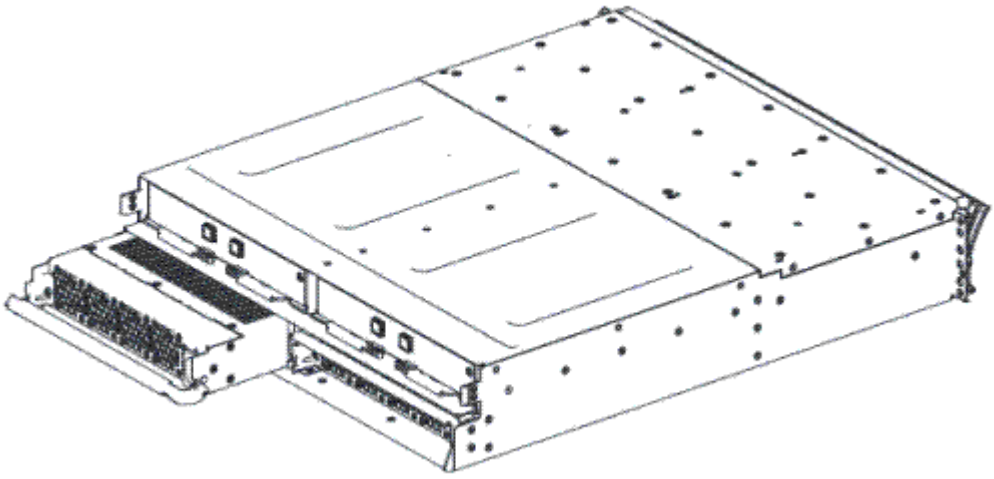


Figure 92. Removing the power supply unit from the left side of the expansion enclosure

6. Hold the new power supply so that the handle is fully extended.
7. Slide the power supply into the enclosure until it stops. Rotate the handle upward into the closed position until it clicks.
8. Hold the new power supply so that the handle is fully extended.
9. Connect the power cord to the power supply and to a properly grounded electrical outlet.

Note: After the power cord is connected to the electrical outlet, make sure that the AC and DC power (green) LEDs are lit and the fault (amber) LED is off.

Installing or replacing a 2U expansion canister

To replace a faulty expansion canister with a new one received from CRU / FRU stock, use this procedure.

About this task

Attention: Although many components are hot-swappable, they are intended to be used only when your system is not active (no I/O operations). If your system is powered on and processing I/O operations, go to the management GUI and follow the fix procedures. Initiating the replacement actions without the assistance of the fix procedures can result in loss of data or loss of access to data.

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

Do not remove an expansion canister unless directed to do so by a service procedure.

To replace an expansion canister, do the following steps:

Procedure

1. Read the safety information in IBM Systems Safety Notices.
2. Refer to “Procedure: Understanding system volume dependencies” on page 108 to determine whether to do this procedure.
3. Carefully identify the expansion canister that you are replacing. If possible, go to **Monitoring** > **System** in the management GUI. On the **System -- Overview** page, select the directional arrow near the expansion enclosure that you are replacing. On the **Enclosure Details** page, select **Enclosure Actions** > **Turn Identify On** to set the canister fault LED blinking.
4. Record which SAS cables are plugged into the specific ports of the expansion canister. Select **SAS Chain View** to display the SAS ports that are currently used by the system.

   The cables must be inserted back into the same ports after the replacement is complete; otherwise, the system cannot function properly.
5. Disconnect the SAS cables from the canister.
6. Open the two release levers as shown in Figure 93 on page 153.

   The canister moves out of the slot approximately 0.6 cm (0.25 inch).
7. Slide the canister out of the slot.
8. Open the release levers of the replacement canister.
9. Push the replacement canister into the slot until it stops.
10. Finish inserting the canister by closing both release levers so that both orange latches click into place.
11. The canister is correctly installed when the rear face of the canister is flush with the rear edge of the enclosure.

    If the enclosure is powered on and the canister is correctly installed, the canister starts automatically.
12. Reattach each SAS cable into the port from which it was removed in step “5” on page 152.
    a) Ensuring the SAS cable connectors are inserted with the pull tab to the bottom of the connector, gently push the connector in until a slight click is felt or heard.
    b) Verify that the connector is fully inserted by gently pulling on it (not on the tab).

       You should not be able to remove it.

       If the enclosure is powered on and the SAS connector is correctly inserted into the port, the green SAS link LED above the port lights up.

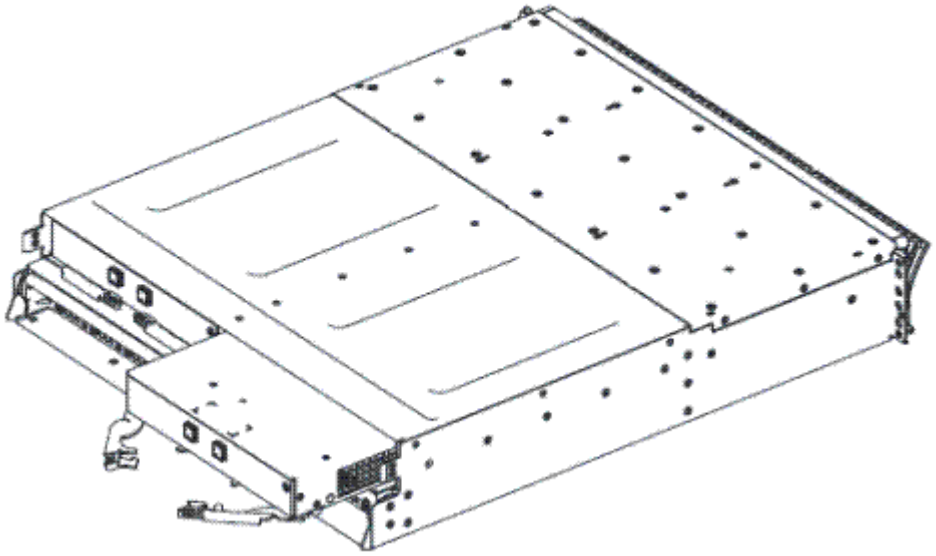


Figure 93. Removing and replacing the IBM Storage FlashSystem expansion canister

Replacing a 2U expansion enclosure midplane assembly

A trained service provider can use this procedure to replace a faulty 2U expansion enclosure midplane assembly with a new one received from CRU / FRU stock.

Before you begin

Three persons are required at step “11” on page 154.

About this task

Attention: To prevent data loss, you must shut down the system before you begin the procedure to replace an expansion enclosure midplane assembly.

The expansion enclosure midplane assembly must be replaced only by a trained service provider.

There are two models of expansion enclosure. Before you replace an expansion enclosure midplane assembly, ensure the FRU part number of the replacement part matches that of the enclosure that is being repaired.

Procedure

To replace the expansion enclosure midplane, complete the following steps.

1. Before you remove and replace parts, you must be aware of all safety issues. First, read the safety precautions in the IBM Systems Safety Notices. These guidelines help you work safely with the system.
2. Read “Procedure: Understanding system volume dependencies” on page 108 to determine whether to continue this procedure.
3. Disconnect each power supply unit in the expansion enclosure from its power outlet so that the expansion enclosure is powered off.
4. Confirm that all the LEDs on the rear of the enclosure are off.
5. Disconnect all cables, labeling each cable to record exactly which port it was attached to (so that the cables can be inserted back into the same ports).

6. Carefully remove each hard disk drive and label it with the drive slot from which it was removed (so that the drives can be inserted back into the same slots). Refer to Figure 94 on page 154 or Figure 95 on page 154.

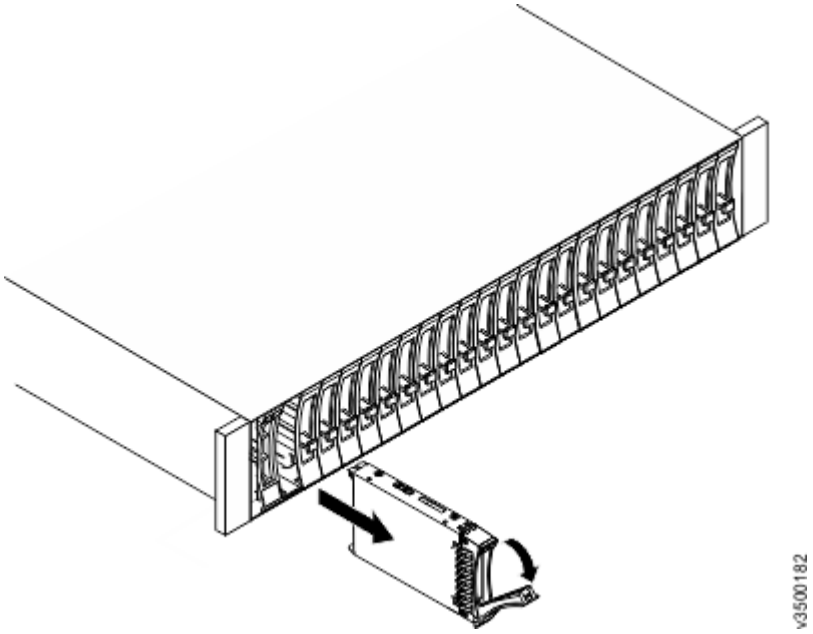


Figure 94. Removing a vertical style hard disk drive

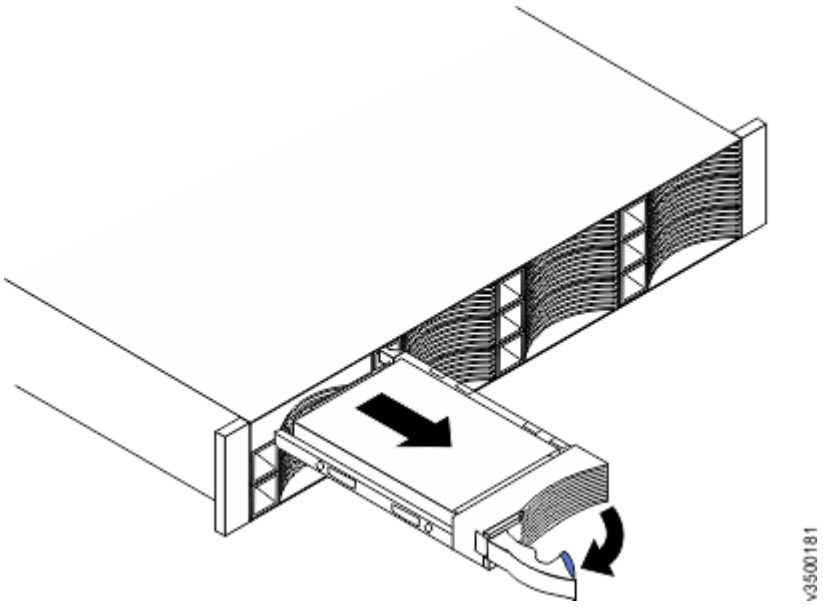


Figure 95. Removing a horizontal style hard disk drive

7. Remove the two power supplies from the enclosure. Refer to "Replacing a power supply unit for an expansion enclosure" on page 151 for guidance.
8. Remove the expansion canisters from the enclosure. Label them to indicate which canister came from which slot.
9. Remove the ear from the enclosure, as described in "Removing and replacing an enclosure ear" on page 110.
10. Remove the two screws that secure the front of the enclosure into the rack. Label these screws to indicate the location from which they are removed and place them aside.
11. Slide the enclosure from the rack cabinet, turn it onto its back so that the bottom of the enclosure is facing upwards, and place the enclosure on a flat surface.

CAUTION:

The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)

12. Remove the four screws from the bottom of the enclosure (see Figure 96 on page 155). Remove the three screws that are near the front and the screw that is near the middle. Label these screws to indicate the location from which they are removed and place them aside.

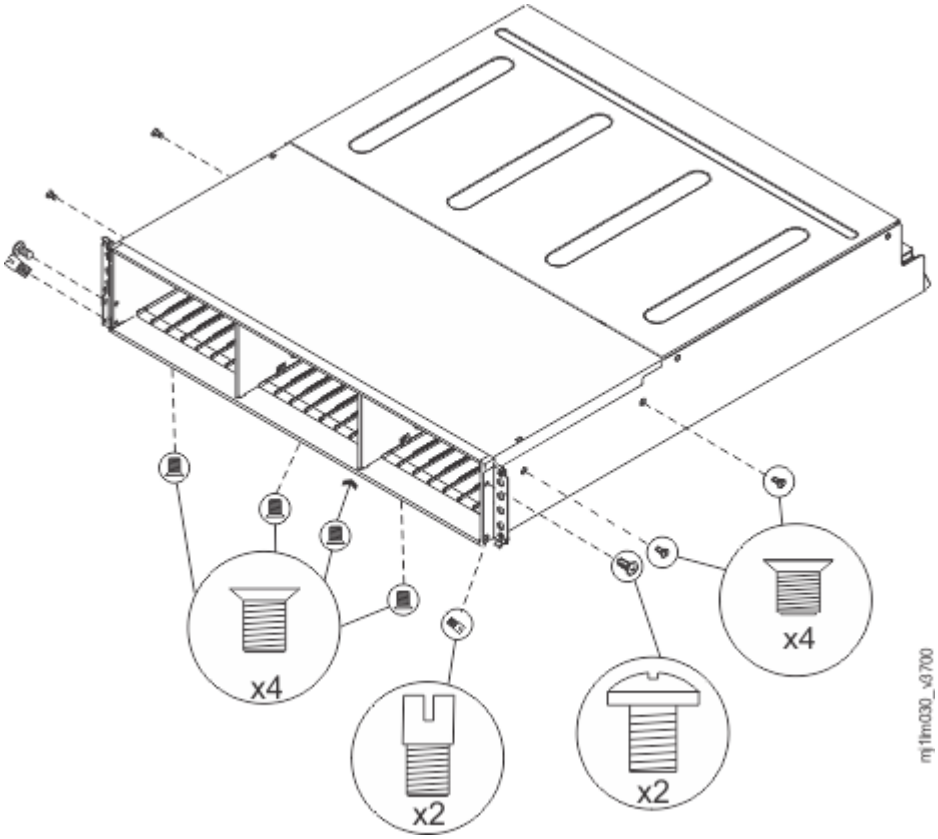


Figure 96. Removing the screws of an expansion enclosure assembly

13. Turn the enclosure top side up and place it on a flat surface.
14. Remove the three screws and one screw-pin on the right side that secure the midplane assembly to the enclosure (see Figure 96 on page 155). Label the screws to indicate the location from which they are removed and place them aside.
15. Remove the three screws and one screw-pin on the left side that secure the midplane assembly to the enclosure (see Figure 96 on page 155). Label the screws to indicate the location from which they are removed and place them aside. See Figure 4.
16. Remove the midplane assembly from the chassis by rotating the midplane assembly up about 45° and then lifting it out. Set the midplane assembly on a flat surface.
17. Unpack the replacement midplane assembly. Grasp the midplane assembly with two hands and hold it at a 45° angle.
18. Insert the tabs on the midplane assembly into the tab holes in the enclosure and rotate the front of the assembly down.

19. Secure the midplane assembly to the chassis on both the right and left sides of the enclosure by using the six screws and two screw-pins that you removed in steps “14” on page 155 and “15” on page 155.
20. Turn the enclosure over so the bottom faces upwards and insert the four screws on the bottom of the enclosure that you removed in step “12” on page 155.
21. Reinstall the enclosure in the rack cabinet, securing it with the two screws that are removed at step “10” on page 154.
22. Reinstall the ear at the front of the enclosure, as described in “Removing and replacing an enclosure ear” on page 110.
23. Reinstall the hard disk drives at the front of the enclosure. Ensure that each drive is inserted back in the same slot from which it was removed.
24. Reinstall the canisters into the same slots they were removed from.
25. Reinstall the two power supplies.
26. Reconnect the data cables at the rear of the enclosure.
27. Reconnect the power to the expansion enclosure. The expansion canisters restart and the system logs an error in the event log alerting you to the unrecognized enclosure.

    Important: Step “28” on page 156 writes the enclosure identity into the replacement midplane. The replacement midplane cannot be used as a replacement part for a different enclosure after step “28” on page 156 is completed.
28. Go to **Monitoring** > **Events** in the management GUI. Find the error that relates to the enclosure ID of the replaced enclosure and run the fix procedure for the error.

Replacing an expansion enclosure attachment SAS cable

To replace a faulty expansion enclosure attachment SAS cable with a new one received from CRU or FRU stock, use this procedure.

About this task

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

Attention:

If you need to replace more than one cable, record which two ports, canisters, and enclosures each cable connects. By doing so, you can match the connections with the replacement cables. The system cannot operate if the expansion enclosure attachment SAS cabling is incorrect.

Expansion enclosure attachment SAS cables are connected only between SAS port 3 or 4 of a node canister and SAS port 1 of an expansion canister, or between SAS ports 1 and 2 of different expansion canisters.

More information about correct expansion enclosure attachment SAS cabling can be found in the troubleshooting description of a problem with IBM Storage FlashSystem SAS cabling.

Procedure

To replace a SAS cable, complete the following steps.

1. Locate the connector at one end of the SAS cable that is to be removed.
2. Grasp the connector by its blue tag. Pull the tag.

   The connector is released and slides out of the port.
3. Repeat steps 2 and 3 on the other end of the SAS cable.
4. To connect the replacement expansion-enclosure attachment SAS cable, connect each end to the vacated ports.

Attention: When you insert a SAS connector into a SAS port, ensure that the orientation of the connector matches the orientation of the port before you push the connector into the port.

- The cable connector and socket are keyed and it is important that you have proper alignment of the keys when the cable is inserted.
- Before you insert the connector into the port, ensure that the connector is rotated such that the blue tag is the lowest part.
- Figure 97 on page 157 shows the correct orientation. The blue tab is always below the port for expansion enclosure attachment SAS cables.

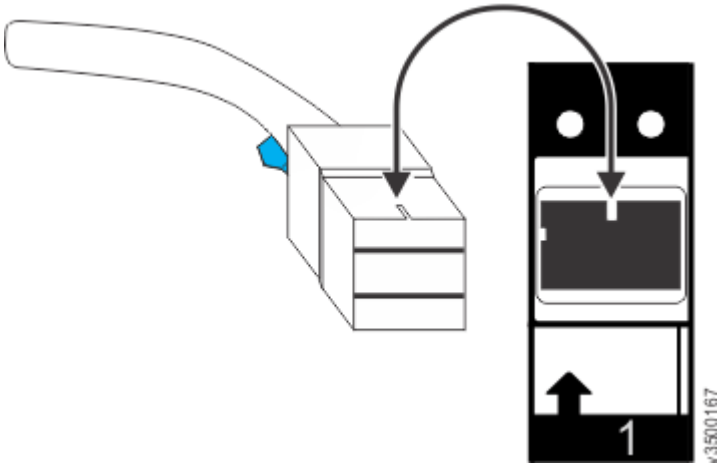


Figure 97. Proper orientation for SAS cable connector

- A click is heard or felt when the cable is successfully inserted and you should not be able to disconnect the cable without pulling on the blue tag.
- When both ends of a SAS cable are correctly connected, the green link LED next to the connected SAS ports are lit.

  For more information, see the troubleshooting procedure for finding the status of SAS connections.

Removing and replacing 5U expansion enclosure parts

You can remove parts from the 5U expansion enclosure to perform service or during the initial installation process.

Removing the support rails of the 5U expansion enclosure

You can remove the support rails for the 5U expansion enclosure.

About this task

This task assumes the following conditions:

- The cable management arm is removed, as described in Removing the cable-management arm.
- The expansion enclosure is removed from the rack, as described in Removing a 5U expansion enclosure from a rack .

Procedure

1. Remove the two screws that attach the outer rail section to the front bracket assembly, as shown in Figure 98 on page 158.

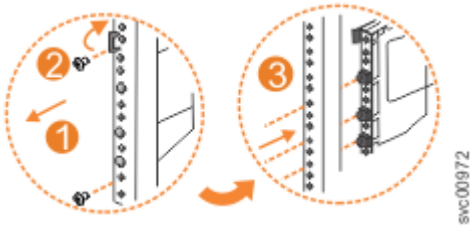


Figure 98. Remove the rail assembly from the front frame bracket

2. Remove the rail section by pulling it away from the front bracket, as shown in Figure 98 on page 158.
3. Remove the two screws that attach the inner rail section to the rear bracket, as shown in Figure 99 on page 158.

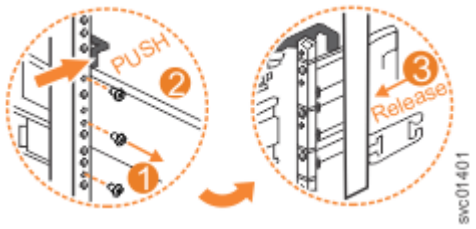


Figure 99. Remove the rail assembly from the rear frame bracket

4. Pull the rail forward away from the rear bracket, as shown in Figure 99 on page 158.
5. Repeat step "1" on page 157 through step "4" on page 158 for the other side of the rail assembly.

Replace the support rails

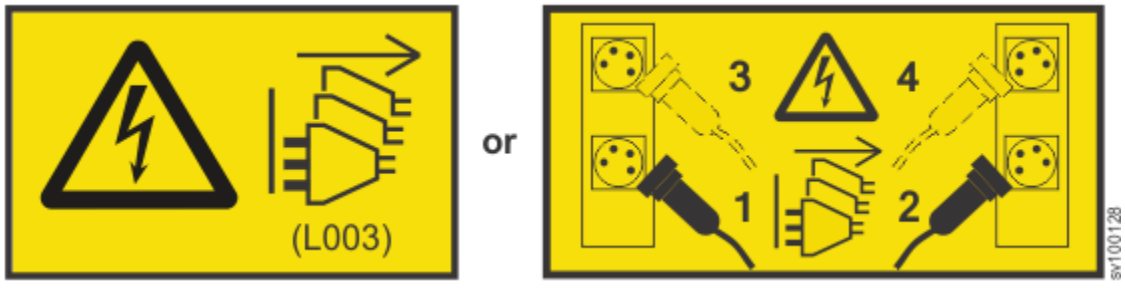
6. To reinstall the support rails, or replace them with support rails from FRU stock, follow the procedure in "Installing or replacing the support rails" on page 84.

Removing a 5U expansion enclosure from a rack

You might need to slide the 5U expansion enclosure out of the rack to apply service. For some tasks, you might need to completely remove the expansion enclosure from the rack.

Before you begin

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



Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

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)

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)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.

- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

DANGER: Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

DANGER: Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

DANGER:

Main Protective Earth (Ground):

This symbol is marked on the frame of the rack.

The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with . (R010)

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)

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: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

CAUTION: CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not

practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.

- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL.
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048)

About this task

Attention: To avoid potential equipment damage during transport and subsequent loss of data, see Procedure: Transporting a 5U 92-drive expansion enclosure . The procedure describes what to do for the following situations.

- When you are powering off a 92F, 92G, or an A9F 5U expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains a 92F, 92G, or an A9F 5U expansion enclosure.

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

To complete some service tasks, you might need to slide the enclosure out of the rack to gain access to parts. For these tasks, you do not have to completely remove the enclosure from the rack. However, in limited circumstances, you must remove the enclosure completely from the rack.

Important:

The 5U expansion enclosure is heavy. Always use a suitably rated mechanical lift or four persons to support the weight of the enclosure whenever you slide the enclosure out from the rack or remove it completely.

In addition to using a mechanical lift, always complete the following tasks before you attempt to remove the expansion enclosure from the rack.

- Remove both power cables from the expansion enclosure.
- Remove all the following parts:
  - Cover
  - Drives
  - Fan modules
  - Power supply units and 1U fascia
  - Secondary expansion modules
  - Expansion canisters and SAS cables

  When the enclosure is not secured to the rails in a rack, you can minimize the risk of injury and make maneuvering the enclosure on a lift easier. However, even after you remove the drives, power supply units, secondary expander modules, canisters, fans, and cover, the enclosure weighs 43 kg (95 lbs).

Procedure

Sliding the expansion enclosure out of the rack

Note: You can accomplish most service actions when the expansion enclosure is fully extended from the rack on its slide rails.

1. Loosen the locking thumb screws (1) on the front of the enclosure, as shown in Figure 100 on page 163.

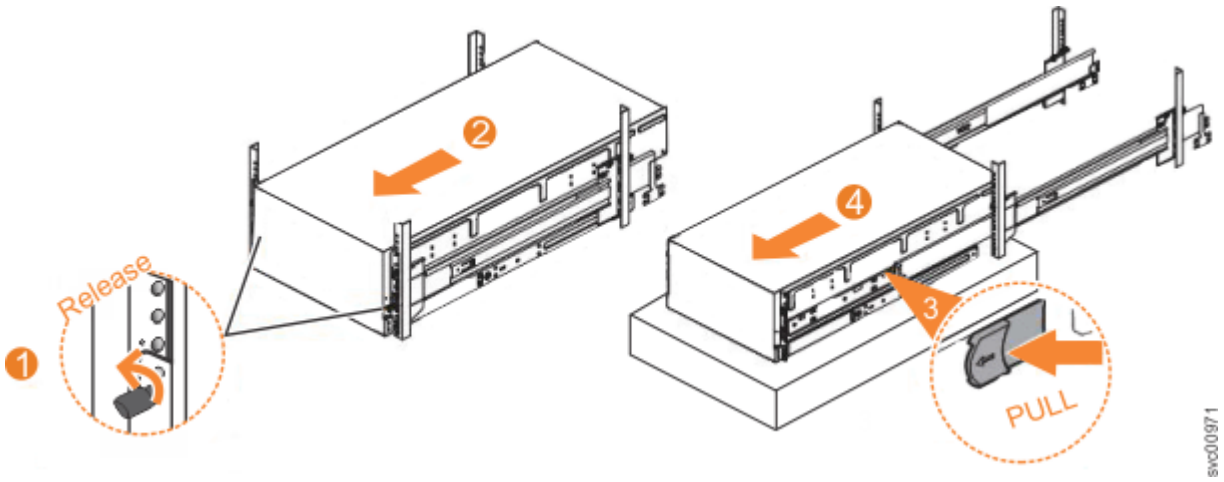


Figure 100. Removing the 5U expansion enclosure from the rack

2. Carefully slide the enclosure forward out of the rack (2), as shown in Figure 100 on page 163.
3. Locate the left and right blue release tabs near the front of the enclosure. Pull both release tabs forward to unlock the drawer mechanism (3 in Figure 100 on page 163).
4. Slide the enclosure and inner rail member out of the rack (4 in Figure 100 on page 163).

   For safety, ensure that a mechanical lift or other mechanism is available to support the weight of the enclosure.

Removing the expansion enclosure from the rack

Note: Continue the procedure (step "5" on page 163 through step "7" on page 163) only if you must completely remove the expansion enclosure from the rack to complete a service procedure.

5. Power down the expansion enclosure and disconnect all power cords.
6. Remove all the following parts from the enclosure, as described in the following procedures:
   - "Removing and replacing the top cover" on page 167
   - "Removing and replacing the fascia" on page 181 (for the PSU fascia) and "Removing and replacing a power supply" on page 184
   - "Removing and replacing a drive" on page 169
   - "Removing and replacing a secondary expander module" on page 173
   - "Removing an expansion canister" on page 191 and "Removing and installing a SAS cable" on page 192
   - "Removing and replacing a fan module" on page 194
7. With the help of multiple persons or a mechanical lift, lift and remove the enclosure from the rack.

Replace the enclosure in the rack

8. To reinstall or return the expansion enclosure in the rack, follow the procedure in "Installing a 5U expansion enclosure in a rack" on page 86.

Removing or moving the cable-management arm

You might need to move the cable-management arm (CMA) aside to complete service tasks. If needed, you can also remove the CMA from the 5U expansion enclosure.

About this task

The Cable Management Arm (CMA) consists of an upper and lower arm assembly, as the figure Figure 101 on page 164 shows. The upper and lower are independent of each other. They can be installed, moved, or removed from the enclosure individually.

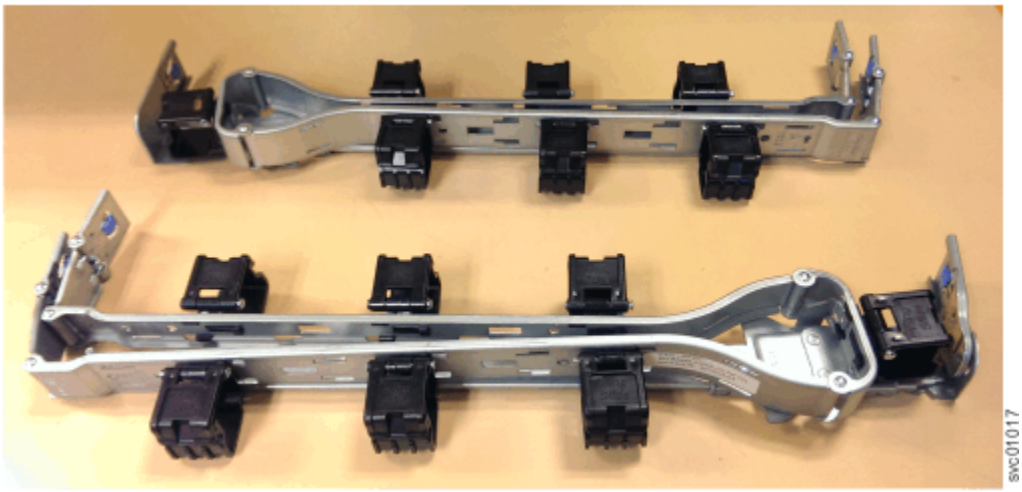


Figure 101. Upper and lower cable-management arms

To complete many service tasks, you can swing the CMA assemblies away from the expansion enclosure. You do not have to completely remove the CMA assemblies from the enclosure. For these service tasks, complete step “1” on page 166 through step “4” on page 167 in “Moving the cable management arms” on page 166.

However, you might need to remove a CMA assembly from the 5U expansion enclosures. To do so, complete step “1” on page 165 through step “8” on page 165 in following procedure.

Procedure

Remove the upper CMA assembly

The connectors of the CMA are installed on the rail hooks at the end of the support rails. Figure 102 on page 164 shows the connectors on the upper CMA assembly.

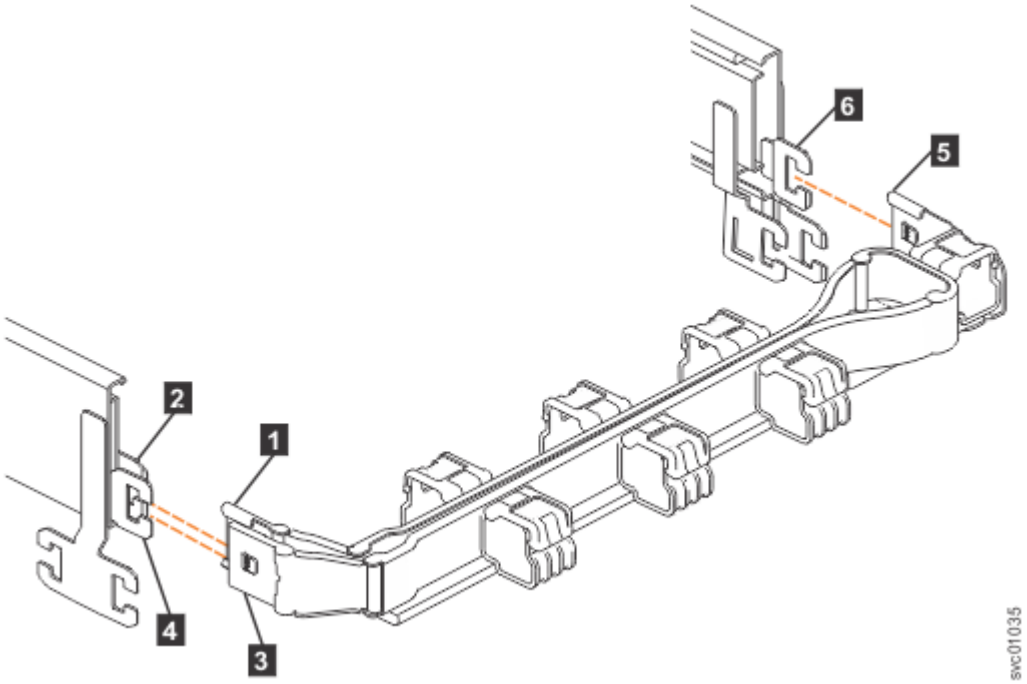


Figure 102. Connectors for the upper cable management arm

1 Inner connector on the upper CMA

2 Connector base on inner rail member
3 Outer connector on the upper CMA
4 Connector base on outer rail member
5 Support rail connector on the upper CMA
6 Connector base on outer rail member

1. Press the latch on the connector base on the upper CMA assembly (5 in Figure 102 on page 164).
2. Pull the connector to remove it from the connector base on the right support rail (6 in Figure 102 on page 164).
3. Press the latch on the outer connector of the upper CMA assembly (3 in Figure 102 on page 164).
4. Remove the outer connector from the inner member of the left support rail (4 in Figure 102 on page 164).
5. Remove the inner connector of the upper CMA assembly (1) from the inner member of the left support rail (2), as shown in Figure 102 on page 164.

Remove the lower CMA assembly

Note: The procedure for removing the lower CMA assembly is the same as the procedure to remove the upper CMA assembly. However, the connector locations are reversed. For example, the connector base of the upper CMA (5 in Figure 102 on page 164) connects to the right rail. The connector base of the lower CMA (11 in Figure 103 on page 165) attaches to the left rail.

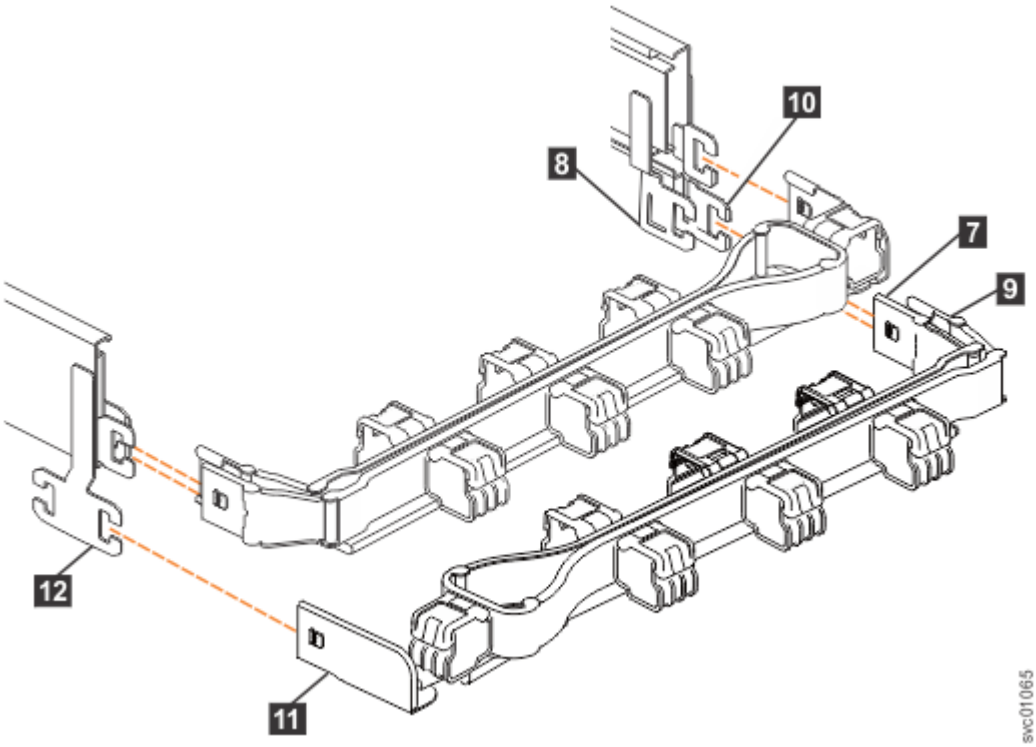


Figure 103. Components of the lower CMA assembly

6. Remove the connector base on the lower CMA assembly (11) from the connector on the left support rail (12), as Figure 103 on page 165.
7. Remove the inner connector of the lower CMA assembly (9) from the outer member of the right support rail (10), as shown in Figure 103 on page 165.
8. Remove the outer connector of the lower CMA assembly (7) from the inner member of the right support rail (8), as shown in Figure 103 on page 165.

Replace the CMA assembly

9. To reinstall the CMA, or replace it with one from FRU stock, follow the procedure in Removing and replacing the cable-management arm.

Moving the cable management arms

About this task

To complete most service tasks, you can swing the CMA assemblies out of the way. You can move each arm independently or you can move both arms. For example, Figure 104 on page 166 shows that both of the CMA assemblies are swung away from the rear of the enclosure.

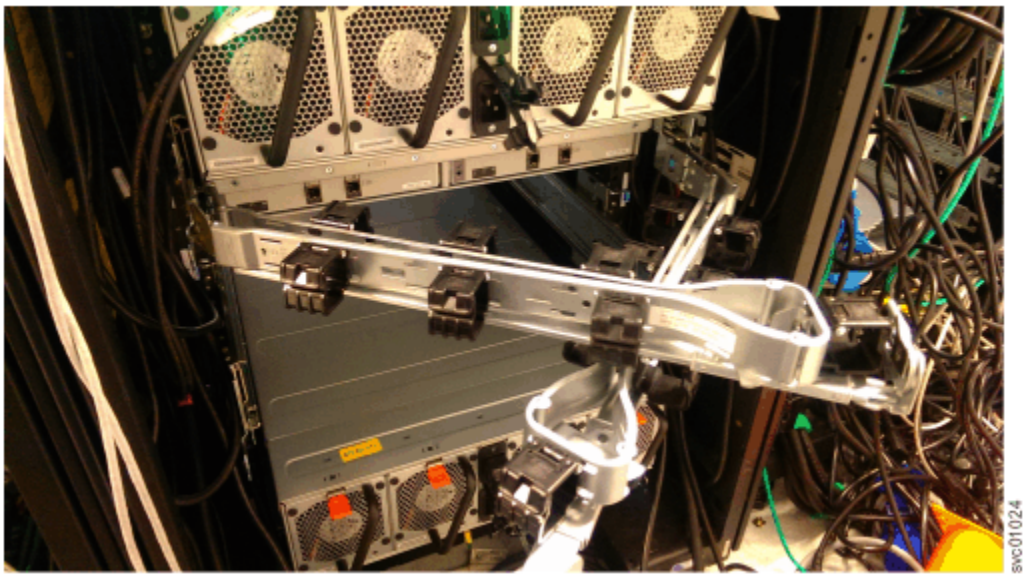


Figure 104. Upper and lower CMA assemblies moved aside

Figure 105 on page 166 shows that the lower CMA assembly is swung away from the rear of the enclosure so that the expansion canister is accessible.

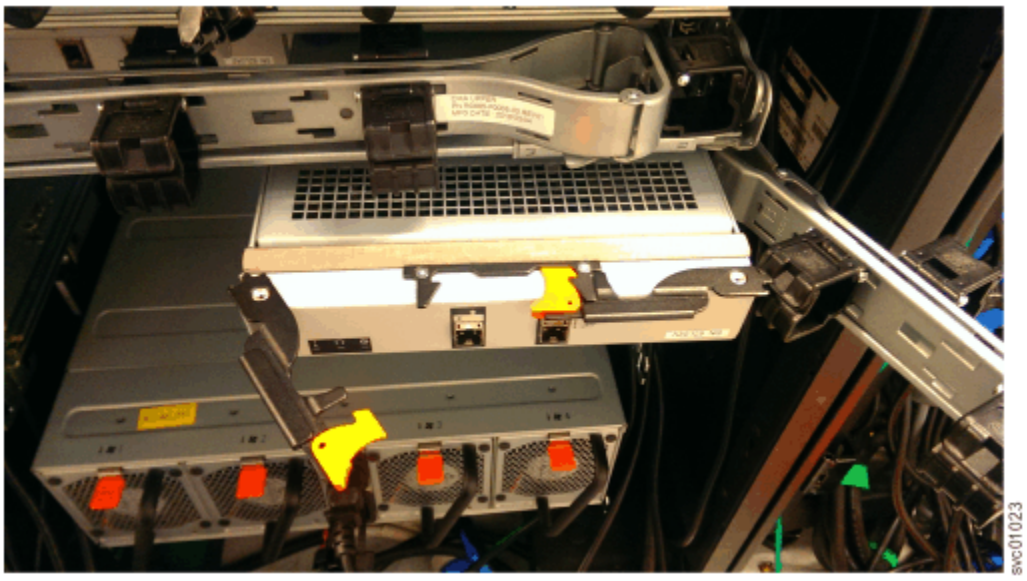


Figure 105. Lower CMA assembly moved

Procedure

1. To release the upper CMA, push the latch on the support rail connector 5 to release it from the connector base 6 on the right rail.

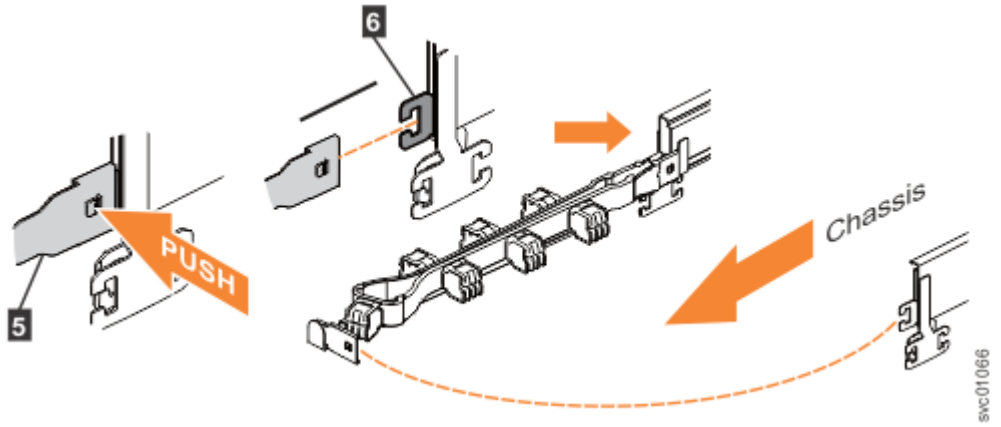


Figure 106. Release the upper CMA assembly

2. Move the upper CMA to the left to swing it out of the way.
   a) To reattach the upper CMA to the rail, reverse the procedure.
3. To release the lower CMA, push the latch on the support rail connector 11 to release it from the connector base 12 on the left rail.

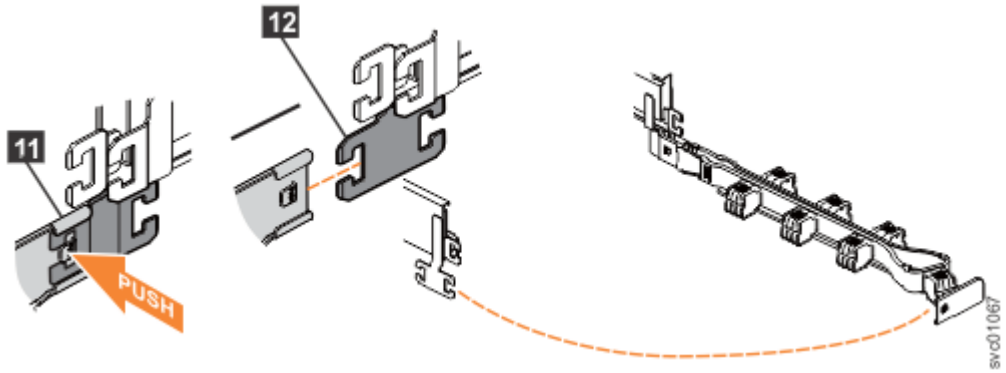


Figure 107. Release the lower CMA assembly

4. Move the lower CMA to the right to swing it out of the way.
   a) To reattach the lower CMA to the rail, reverse the procedure.

Removing and replacing the top cover

To complete some service tasks, you might need to remove the top cover from a 5U expansion enclosure.

Before you begin

Important: You can remove the cover without powering off the expansion enclosure. However, to maintain operating temperature, replace the cover within 15 minutes of its removal. When the cover is removed, the reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

Procedure

1. Use the slide rails to pull the enclosure out from the rack.
2. Slide the release latch (1) in the direction that is shown in Figure 108 on page 168.

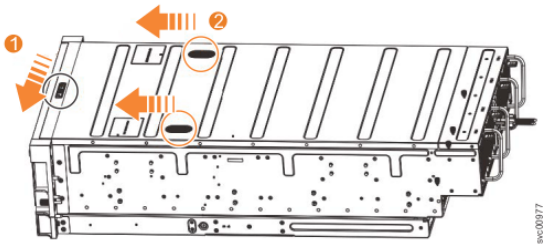


Figure 108. Releasing the 5U expansion enclosure cover

3. Slide the cover toward the front of the expansion enclosure (2), as shown in Figure 108 on page 168.
4. Carefully lift the cover up, as shown in Figure 109 on page 168.

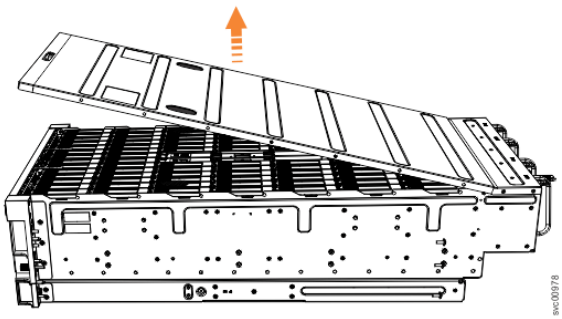


Figure 109. Removing the 5U expansion enclosure cover

5. Place the cover in a safe location.

Replace the cover

6. Carefully lower the cover and ensure that it is aligned correctly with the back of the enclosure, as shown in Figure 110 on page 168.

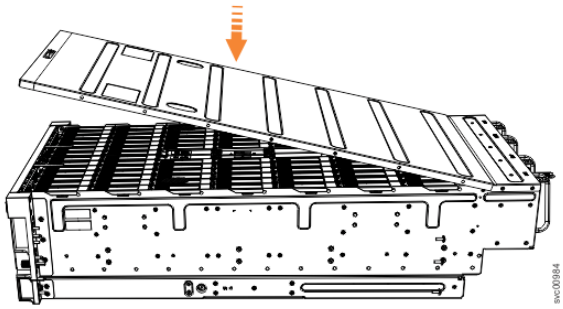


Figure 110. Aligning the top cover

7. Push the cover release lever to the side (2) as shown in Figure 111 on page 168.
8. Slide the cover towards the back of the enclosure (3) back until it stops, as shown in Figure 111 on page 168.

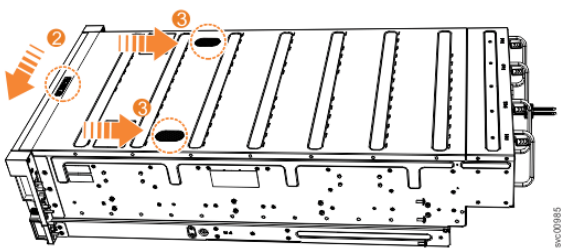


Figure 111. Replacing the top cover

9. Verify that the cover correctly engages the cover release latch and all of the inset tabs on the expansion enclosure.
10. Lock the cover into position by sliding the release lever 4, as shown in Figure 112 on page 169

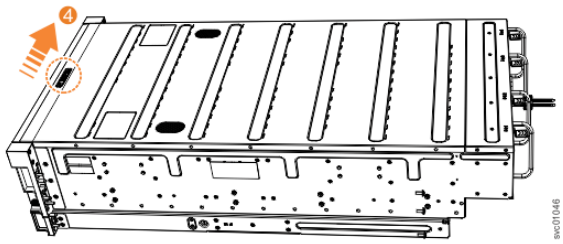


Figure 112. Locking the top cover

Removing and replacing a drive

You can remove a faulty drive from a 5U expansion enclosure to replace it with a new one received from FRU stock.

Before you begin

Ensure that the drive is not a spare or a member of an array. The drive status is shown in **Pools** > **Internal Storage** in the IBM Storage FlashSystem. If the drive is a member of an array, follow the fix procedures in the IBM Storage FlashSystem. The fix procedures minimize the risk of losing data or access to data. The procedures also manage the system's use of the drive.

Important: You can remove a drive assembly without powering off the expansion enclosure. However, to maintain operating temperature, complete the following tasks.

- Do not remove a faulty drive assembly until its replacement is ready to be installed.
- Do not keep the cover off an operational enclosure for more than 15 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

The 5U expansion enclosure supports 92 drives. Figure 113 on page 169 shows an example of a drive assembly.

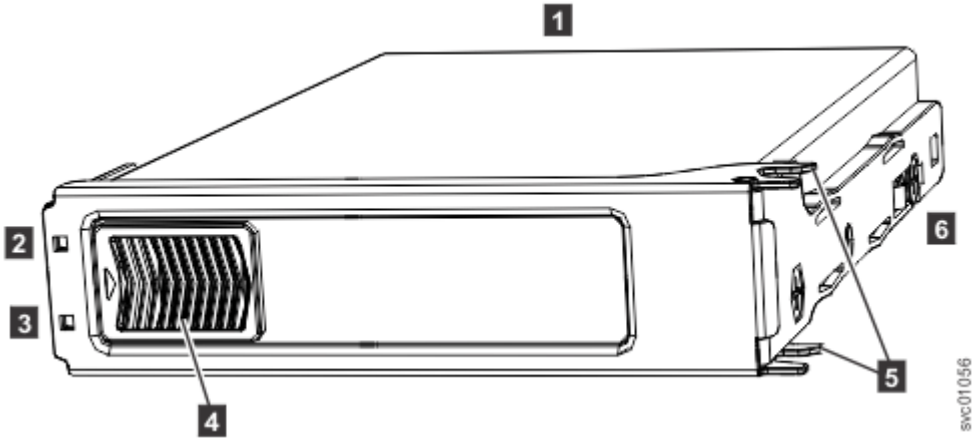


Figure 113. Drive assembly

1 Disk drive
2 Online indicator
3 Fault indicator
4 Release latch
5 Drive latch toes
6 Drive carrier

Procedure

1. Read all available safety information.
2. Use the slide rails to pull the enclosure out from the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 158.
3. Remove the top cover, as described in “Removing and replacing the top cover” on page 167.
4. Locate the slot that contains the drive assembly that you want to remove.

   Note: When a drive is faulty, the amber fault indicator is lit (3 in Figure 113 on page 169). Do not replace a drive unless the drive fault indicator is on or you are instructed to do so by a fix procedure. When lit, the green indicator shows that activity is occurring on the drive.

   A label on the enclosure cover (Figure 114 on page 170) shows the location of the drive slots. The drive slots are numbered 1-14 from left to right and A-G from the back to the front of the enclosure.

   The drive locations are also marked on the enclosure itself. The rows (A-G) are marked on the left and right edges of the enclosure. The columns (1-14) are marked on the front edge of the enclosure. The row and column marks are visible when the top cover is removed.

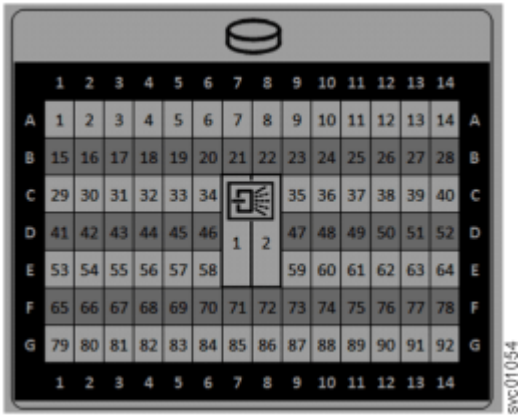


Figure 114. Drive locations in a 5U expansion enclosure

5. Slide the release latch forward (1), as shown in Figure 115 on page 171.

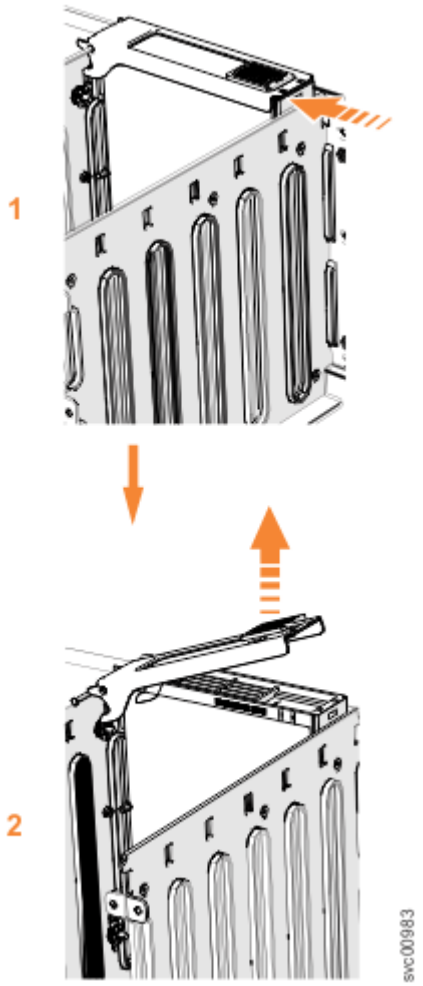


Figure 115. Remove the drive assembly

6. Lift the handle (2) to unlock the drive carrier from the partition, as shown in Figure 115 on page 171. Ensure the toe on the bottom of the latch is fully disengaged.
7. Carefully lift the drive carrier up to remove it from the expansion enclosure.
8. Repeat step "4" on page 170 through step "7" on page 171 for each drive you need to remove.

Replace the drive

9. Read all of the available safety information.
10. Carefully slide the expansion enclosure out of the rack.
11. Remove the cover, as described in "Removing and replacing the top cover" on page 167.
12. Locate the empty drive slot to receive the new drive or that contains the faulty drive that you want to replace.

    Note: When a drive is faulty, the amber fault indicator is lit (3 in Figure 113 on page 169). Do not replace a drive unless the drive fault indicator is on or you are instructed to do so by a fix procedure.

    A label on the enclosure cover (Figure 116 on page 172) shows the drive locations in the enclosure. The drive slots are numbered 1-14 from left to right and A-G from the back to the front of the enclosure.

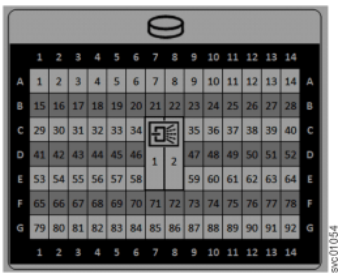


Figure 116. Drive locations in a 5U expansion enclosure

The drive slots must be populated sequentially, starting from the back-left corner position (slot 1, grid A1). Sequentially install the drive in the slots from left to right and back row to front. Always complete a full row before you install drives in the next row.

For example, in Figure 117 on page 172, the drives are installed correctly. Drives are installed in slots 1 -14 of row A and the installation continues in slot 15 in row B.

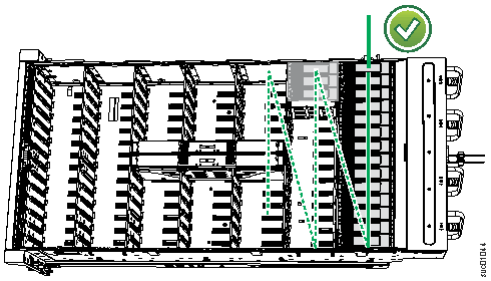


Figure 117. Correct drive installation

In Figure 118 on page 172, the drives are not installed correctly. Slot 1 (A1) does not contain a drive. In addition, drives are installed in row B even though row A contains empty drive slots.

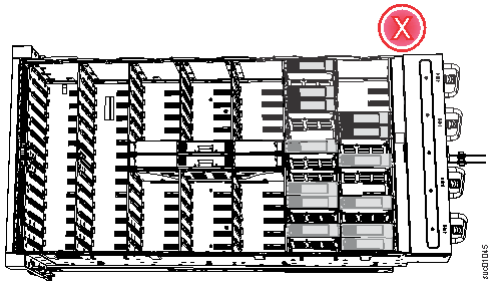


Figure 118. Incorrect drive installation

13. Touch the static-protective package that contains the drive to any unpainted metal surface on the enclosure. Wear an anti-static wrist strap to remove the drive from the package.
14. Ensure that the drive handle (**1** in Figure 119 on page 173) of the drive assembly is in the open (unlocked) position.
15. Hold the drive by two top corners so that it hangs squarely over the appropriate drive slot.

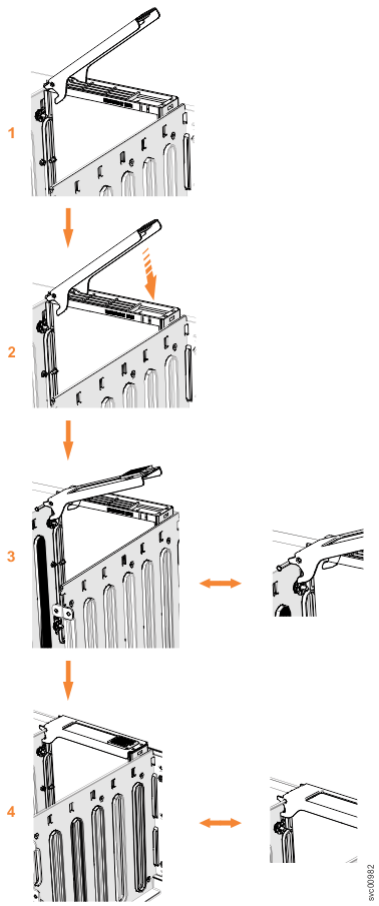


Figure 119. Replace the drive

16. Lower the drive down, without pushing, until it stops and the bottom of the latch is aligned with the top of the partition. Ensure that the handle is not open more than 45 degrees from the drive carrier. (2 in Figure 119 on page 173). If the drive does not slide down easily then inform IBM remote technical support.
17. Rotate the handle down to lock the drive assembly into the chassis (3 in Figure 119 on page 173).
18. Ensure the toe on the bottom of the latch is fully engaged with the partition in the chassis.
19. Ensure that the top toe of the latch is also fully engaged (4 in Figure 119 on page 173).
20. Repeat steps "13" on page 172 through "19" on page 173 for each drive you are replacing.
21. Replace the cover, as described in "Removing and replacing the top cover" on page 167.
22. Slide the expansion enclosure back into the rack, as described in "Installing a 5U expansion enclosure in a rack" on page 86.

Removing and replacing a secondary expander module

You can remove a secondary expander module from a 5U expansion enclosure if it is faulty or to perform other service tasks.

Before you begin

DANGER:

Hazardous voltage present. Voltages present constitute a shock hazard, which can cause severe injury or death. (L004)

DANGER:

Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

CAUTION:

- Only an IBM Service Support Representative (SSR) can remove or replace the secondary expander module from an enclosure (FRU P/N 01LJ112) that is powered on. If the 01LJ112 enclosure is powered on, use caution and avoid contact with the connectors on the main board.
- If the FRU part number of the enclosure is 01LJ607, you can remove or replace the secondary expander module while the enclosure is powered on.

Important: You can remove a secondary expander module without powering off the expansion enclosure. However, to maintain operating temperature, perform the following tasks.

- Do not remove a faulty secondary expander module until its replacement is ready to be installed.
- Do not keep the cover off an operational enclosure for more than 15 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

The secondary expander modules provide SAS connectivity between the expansion canisters and the drives. Each drive has 2 SAS ports. SAS port 1 of each drive is connected to secondary expander module 1. SAS port 2 of each drive is connected to secondary expander module 2. Each expansion canister is connected to both secondary expander module 1 and secondary expander module 2. If secondary expander module 2 is missing or is faulty, the expansion canisters can communicate only with SAS port 1 on each drive. Similarly, if secondary expander module 1 is missing or is faulty, the expansion canisters can communicate only with SAS port 2 on each drive.

The two secondary expansion modules are already installed when the 5U expansion enclosure is shipped, as Figure 120 on page 174 shows.

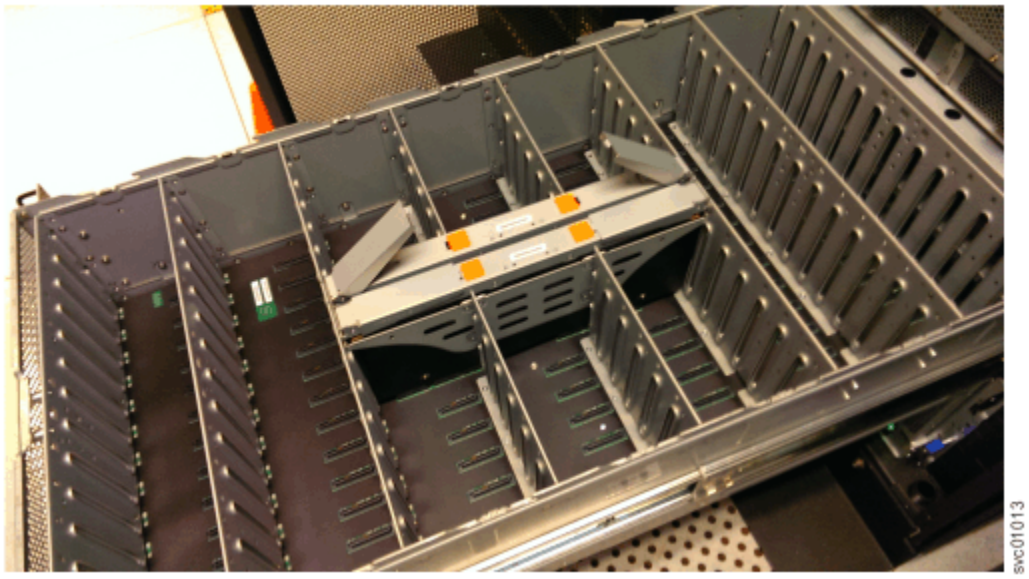


Figure 120. Location of secondary expander modules

Figure 121 on page 175 shows the location of the LED indicators on the top of the secondary expander module. Each secondary expander module has its own set of LEDs. When power is connected to the expansion enclosure, the LEDs identify the operational status of the secondary expander modules.

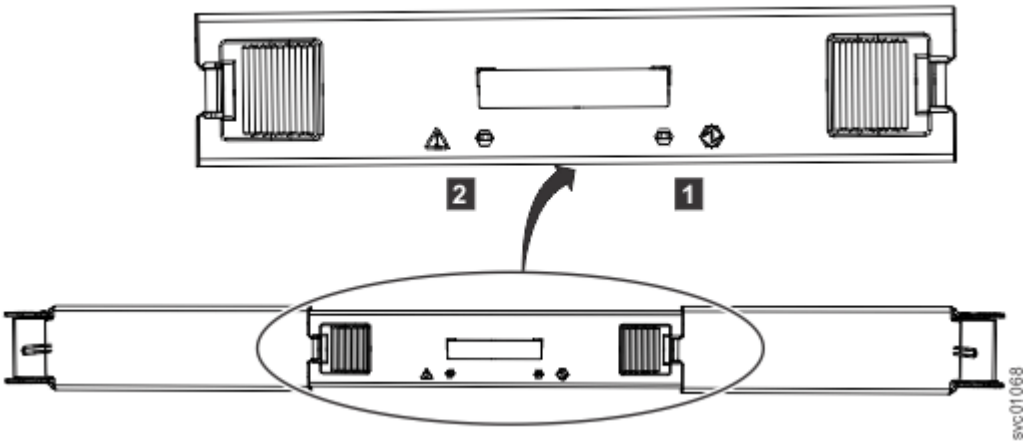


Figure 121. Location of LEDs on the secondary expander module

Table 51 on page 175 describes the function and status values of each LED indicator.

Table 51. LEDs on the secondary expander modules

LED	Color	Status	Description
Power 1	Green	On	The secondary expander module is receiving power.
		Off	The secondary expander module is not receiving power.
Fault 2	Amber	On	Not used.
		Blink	The secondary expander module is being identified.
		Off	Normal operation.

This task assumes that the following conditions were met:

- The expansion enclosure is slid out from the rack, as described in "Removing a 5U expansion enclosure from a rack" on page 158.
- The top cover was removed, as described in "Removing and replacing the top cover" on page 167.

Procedure

1. Identify the secondary expander module to be replaced; refer to Table 51 on page 175.
2. Press the release buttons on top of the secondary expander module to release the handles.
3. Rotate the handles outward to the unlocked position.
4. Lift the secondary expander module carefully out of the enclosure, as shown in Figure 122 on page 176.

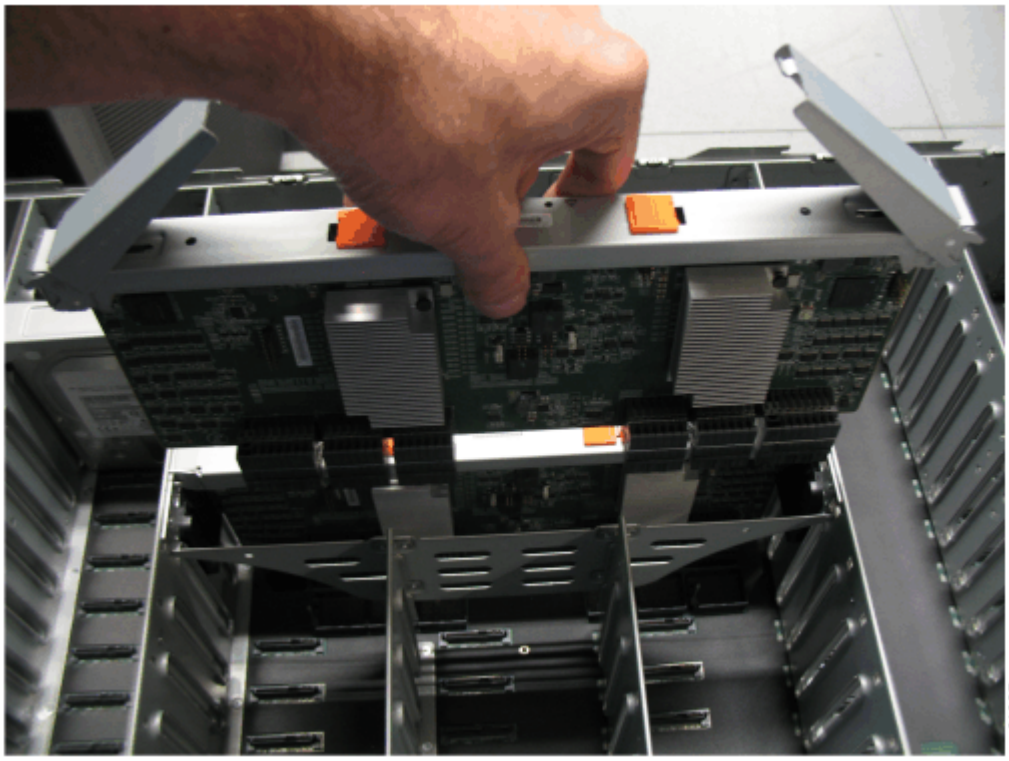


Figure 122. Remove the secondary expander module

Important: To avoid electric shock after you remove the secondary expander module, do not touch the connectors inside the enclosure (FRU P/N 01LJ112), which are shown in Figure 123 on page 176.

Figure 123. Secondary expander module connectors

5. Place the secondary expander module in a safe location, as shown in Figure 124 on page 177.

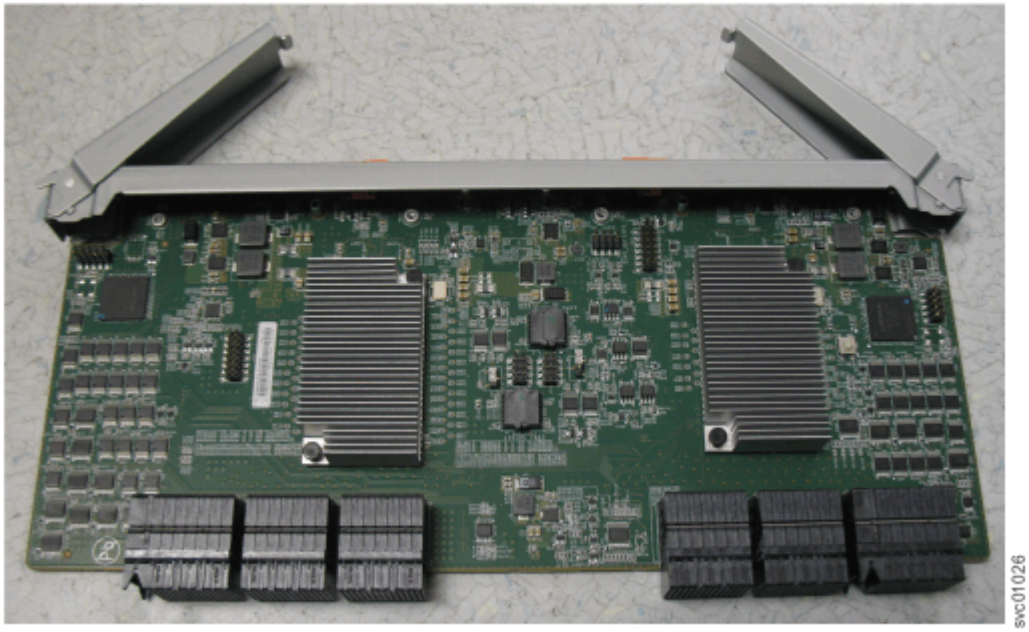


Figure 124. Secondary expander module removed from the enclosure

6. If needed, repeat step “2” on page 175 through step “5” on page 176 to remove the other secondary expander module.

Replace the secondary expansion module

7. Slide the expansion enclosure out from the rack, as described in Removing a 5U expansion enclosure from the rack.
8. Identify the secondary expander module to be replaced; LEDs on a secondary expander module shows the LEDs on top of a secondary expander module.

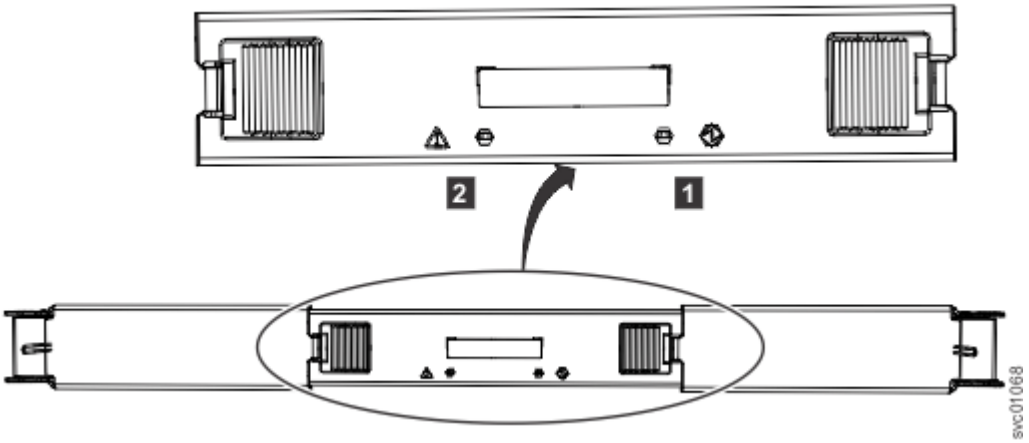


Figure 125. LEDs on a secondary expander module

1 Online indicator
2 Fault indicator

9. Rotate both handles on the new secondary expander module to an open position, as shown in Open the secondary expander module handles.

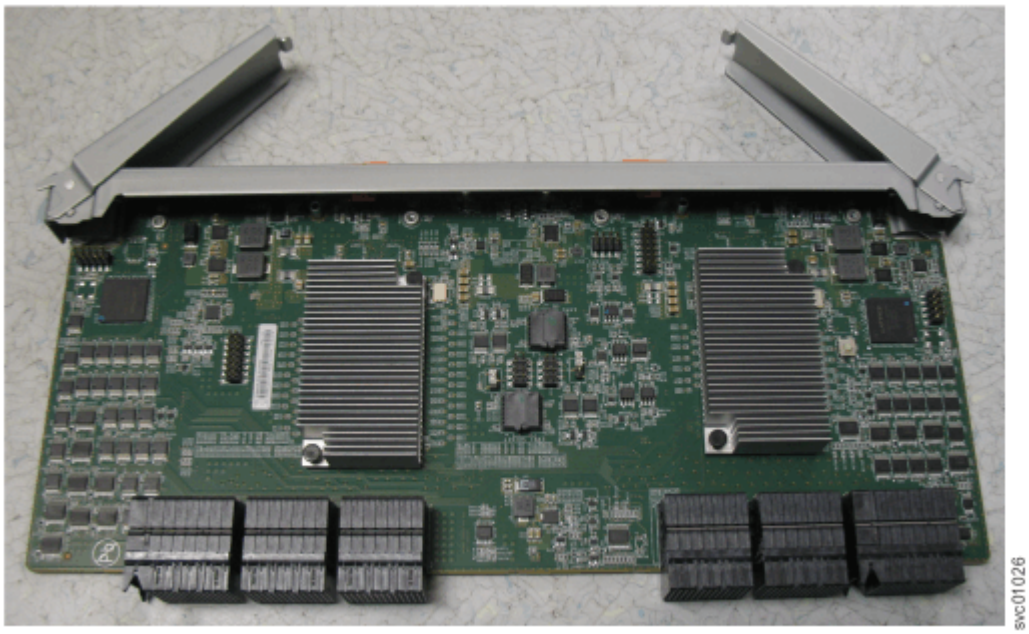


Figure 126. Open the secondary expander module handles

10. Align the edges of the secondary expander module carefully in the guide slot in the enclosure, as shown in Replace the secondary expander module.

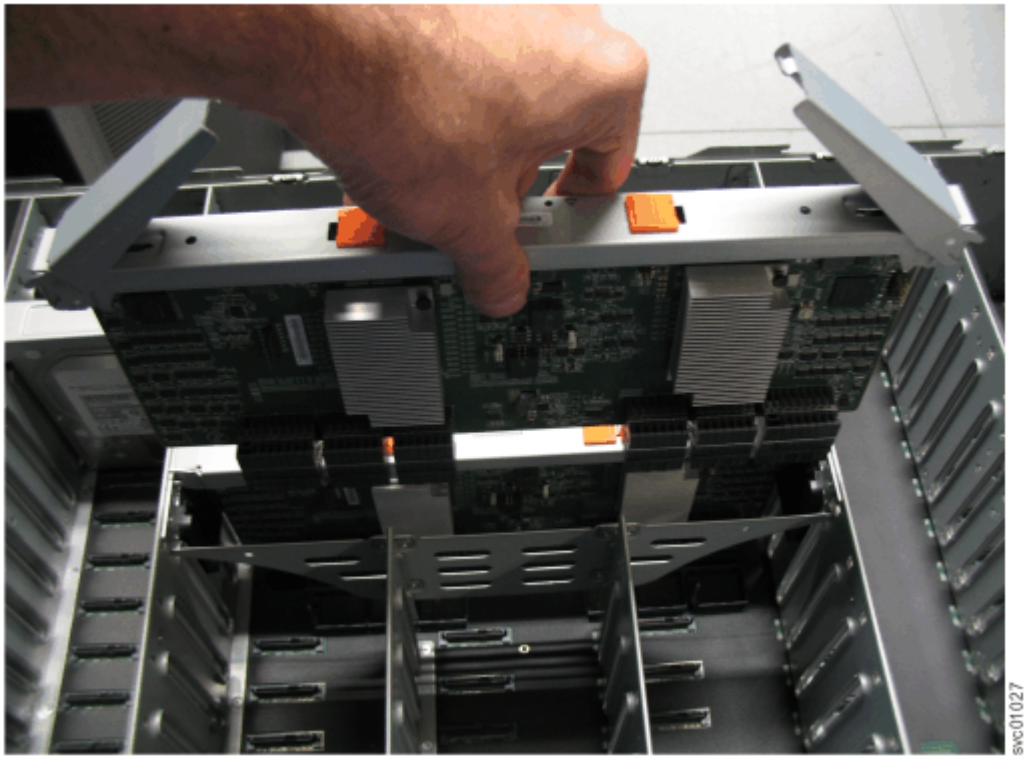


Figure 127. Replace the secondary expander module

11. Press the secondary expander module down into position in the enclosure.
12. Rotate the handles on the secondary expander module to the closed position to lock it in the enclosure.
13. If needed, repeat step 9 through step 12 to replace the other secondary expander module.
14. Replace the top cover, as described in Removing and replacing a top cover.

15. If needed, reconnect the power cables to the expansion enclosure, as described in Powering on the optional 5U expansion enclosure.
16. Check the LEDs on the top of the secondary expander module to verify that it is receiving power.

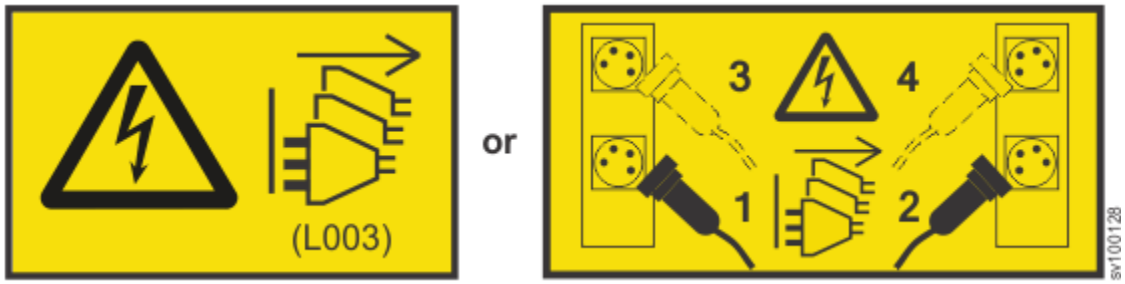
    High density expansion enclosure LEDs and indicators describes the status indicated by the LEDs.

Replacing an expansion enclosure

You can replace a faulty enclosure of a 5U expansion enclosure with a new one from FRU stock.

Before you begin

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



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: To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

Notes:

- Perform the following procedure only if directed to do so by IBM Remote Technical support or by a fix procedure in the management GUI.
- An enclosure can have FRU P/N 01LJ112 or FRU P/N 01LJ607. When needed, an enclosure with FRU P/N 01LJ607 is used to replace FRU P/N 01LJ112.

This task assumes that the following conditions are met:

- All power cables were removed from the enclosure, as described in Powering off the 5U expansion enclosure.
- All SAS cables were removed, as described in Removing and installing a SAS cable .
- The following FRUs were removed from the enclosure, as described in the applicable tasks:
  - Top cover (“Removing and replacing the top cover” on page 167)
  - Drives (Removing and replacing a drive)
  - PSU (1U) fascia (Removing and replacing a fascia)
  - Power supply units (Removing and replacing a power supply)
  - Secondary expander modules (Removing and replacing a secondary expander module)
  - Expansion canisters (Removing an expansion canister)
  - Fan modules (Removing and replacing a fan module)

- The expansion enclosure was removed from the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 158.
- A suitably rated mechanical lift is available to support the weight of the enclosure.

About this task

The expansion enclosure contains the drive board, signal interconnect board, and internal power cables. If a fault with the drive board or the intercanister link is suspected, you can replace the enclosure. However, you can remove the parts from the old expansion enclosure and reinstall them in the replacement enclosure.

Procedure

1. Remove the front display (4U) and PSU (1U) fascia from the old enclosure, as described in Removing or replacing the fascia.
   a) Install the front display (4U) and PSU (1U) fascia on the new enclosure, as described in Removing or replacing the fascia.
2. Remove the display panel assembly from the old enclosure, as described in Removing and replacing a display panel assembly.
   a) Install the display panel assembly into on the new enclosure, as described in Removing or replacing the display panel assembly.
3. Remove the fan interface boards from the old enclosure, as described in Removing and replacing a fan interface board.
   a) Install the fan interface boards into on the new enclosure, as described in Removing and replacing a fan interface board.
4. Remove the inner section of the slide rail from the old enclosure, as described in “Removing the support rails of the 5U expansion enclosure” on page 157.
5. Attach the inner rail section to the new enclosure, as described in Installing or replacing the support rails.
6. Replace the new enclosure in rack, as described in Installing the 5U expansion enclosure in the rack.
7. Reinstall the remaining parts into the enclosure, as described in the following topics. You can install the parts in any order.

   Important: Ensure that a mechanical lift is available and in place to support the additional weight as the FRUs are reinstalled in the enclosure.

   - Removing and replacing a power supply.
   - Removing and replacing a drive.
   - “Removing and replacing a secondary expander module” on page 173.
   - “Installing or replacing a 2U expansion canister” on page 152.
   - “Removing and replacing a fan module” on page 194.
   - “Removing and replacing the top cover” on page 167.
8. Reconnect the SAS cables, as described in Removing and installing a SAS cable .
9. Reconnect the power cables, as described in “Powering on the optional 5U expansion enclosure” on page 91.
10. Run the next recommended fix procedure in the management GUI to set the serial number of the 5U expansion enclosure.

Removing and replacing the fascia

To complete some service tasks, you can remove each component of the fascia from the front of a 5U expansion enclosure.

About this task

The 5U expansion enclosure has a 4U front fascia that covers the display panel and a 1U fascia that covers the power supply units (PSUs). As Figure 128 on page 181 shows, the fascias are independent; you can remove or replace one without having to remove or replace the other.

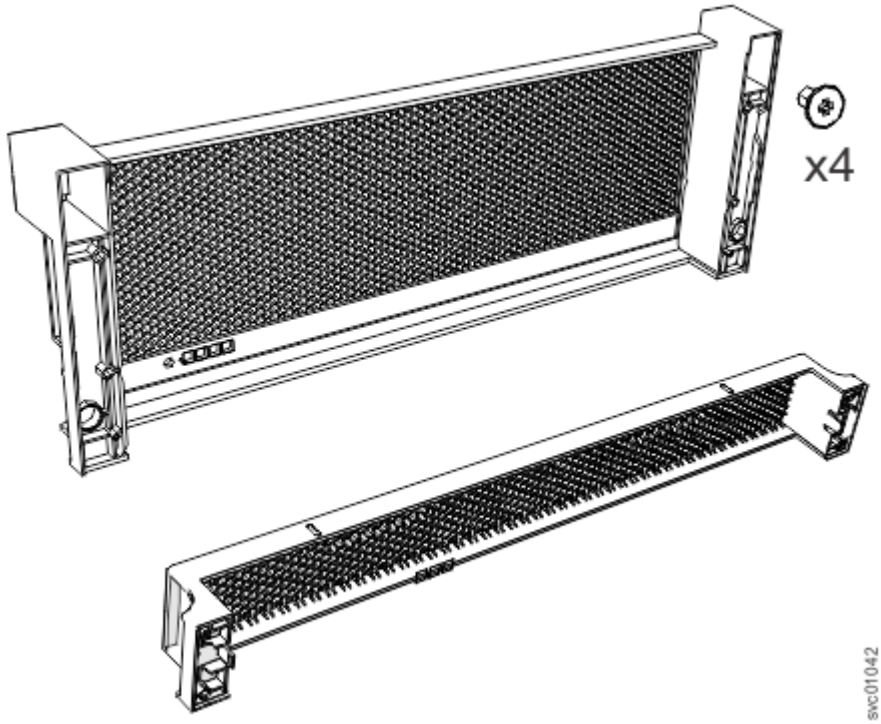


Figure 128. Fascia components on the expansion enclosure

Note: When the expansion enclosure is shipped, the 4U and 1U fascia are not installed. You must install them as part of the initial installation process.

Procedure

1. Use the slide rails to pull the enclosure out of the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 158.

   Ensure that a mechanical lift is available to support the weight of the enclosure.

Remove the front (4U) fascia

2. Remove the front fascia by removing the two screws that attach the fascia to the flange on each side of the chassis, as shown in Figure 129 on page 182.

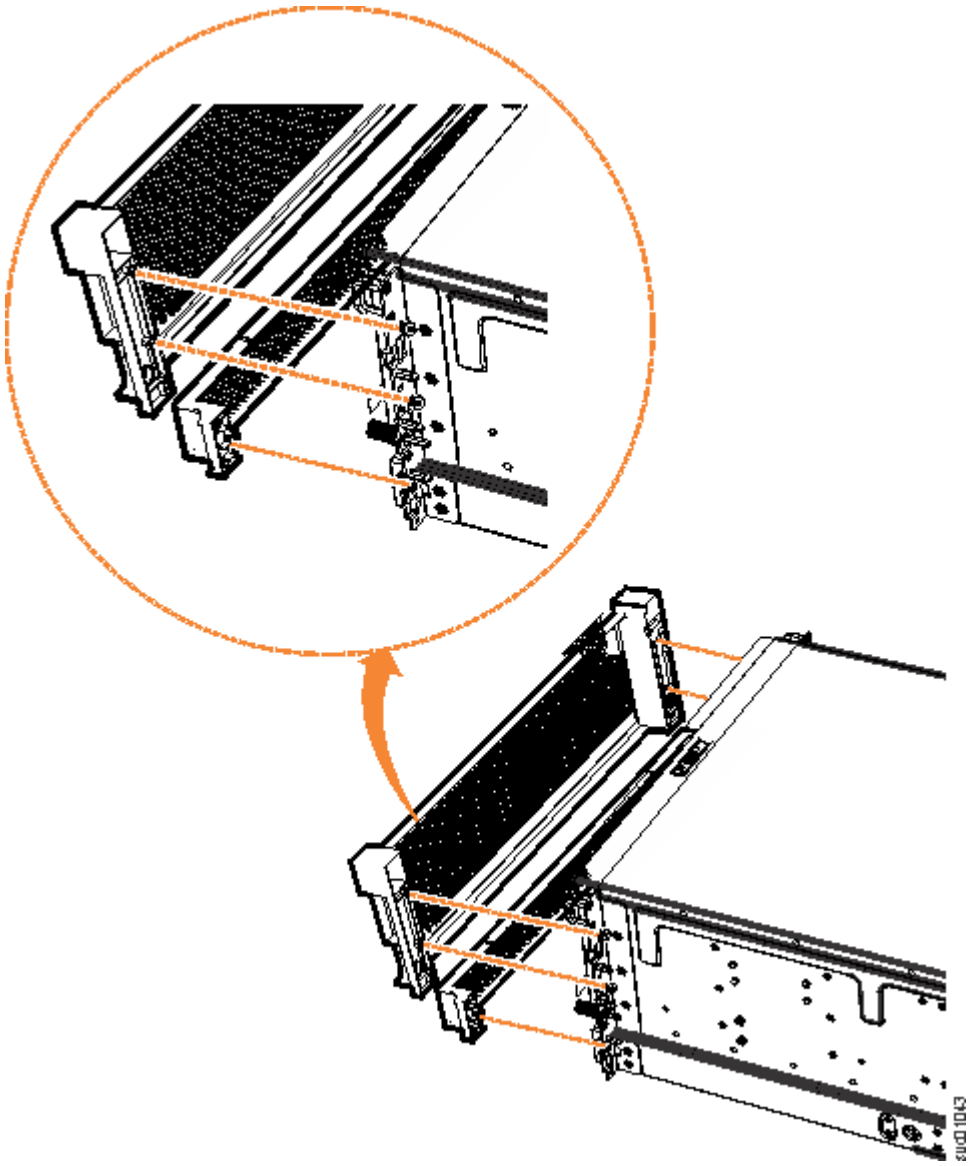


Figure 129. Remove fascia components from the expansion enclosure

Remove the bottom (1U) fascia

3. Gently pull on each side of the PSU fascia to remove it from the chassis, as shown in Figure 129 on page 182. The PSU fascia disengages from the slot and pin that connect it to each side of the chassis.

   You must remove the bottom fascia to access and service either PSU. However, as Figure 130 on page 183 shows, you do not have to remove the front fascia.

Figure 130. Fascia removed from the PSUs

Replace the fascia

4. Use the slide rails to pull the enclosure out of the rack.

Attach the front (4U) fascia

5. Align the front 4U fascia with the enclosure so that the thumbscrews go through the holes on each side. As Figure 4 shows, this action aligns the screw holes on the back of the fascia with the screw holes on the front flange of the enclosure.
6. Replace the four screws to reattach the 4U fascia. Secure the screws from the back of the flange and into the rear of the fascia. Each side of the 4U fascia contains two screws.

Attach the bottom (1U) fascia

7. Reattach the bottom 1U fascia that covers the power supply units (PSUs). Align the fascia with the enclosure and gently push it until it clicks into place on the chassis, as shown in Figure 4.

   Align the tab on each side of the 1U fascia with the corresponding slots on the enclosure flange. Pins on each flange must also align with a hole in each side of the 1U fascia.

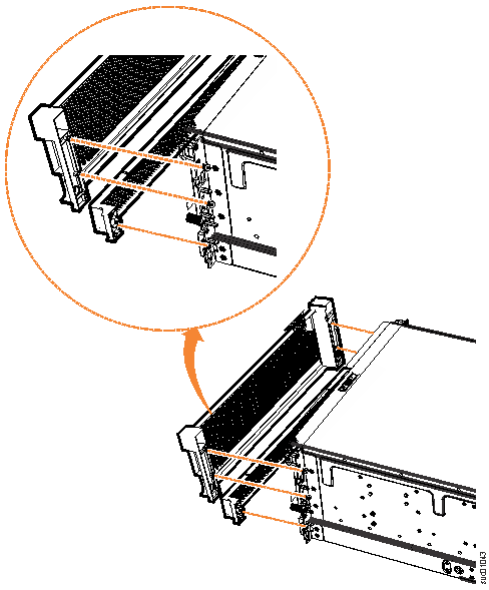


Figure 131. Replace fascia components on the expansion enclosure

Removing and replacing a power supply

You can remove either of the redundant power supply units in a 5U expansion enclosure. Redundant power supplies operate in parallel; one continues to provide power to the enclosure if the other fails.

Before you begin

Important: You can remove a PSU without powering off the expansion enclosure. However, to maintain operating temperature, ensure that you perform the following tasks.

- Do not remove a faulty PSU until its replacement is ready to be installed.
- Do not remove a PSU from an operational enclosure for more than approximately 10 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

Each PSU provides cooling to the lower part of the enclosure. Ensure that the second PSU in the enclosure is powered on and operating correctly. For example, in Figure 132 on page 185, PSU 1 is operating while PSU 2 is being removed.

Review and follow the procedures for handling static-sensitive devices before you remove the power supply unit (PSU).

Procedure

1. Read all safety information.
2. Remove the 1U fascia that covers the PSUs on the front of the expansion enclosure, as described in “Removing and replacing the fascia” on page 181.
3. Press on the handle lock to release the handles on the PSU.
4. Rotate the handles outward, as shown in Figure 132 on page 185.

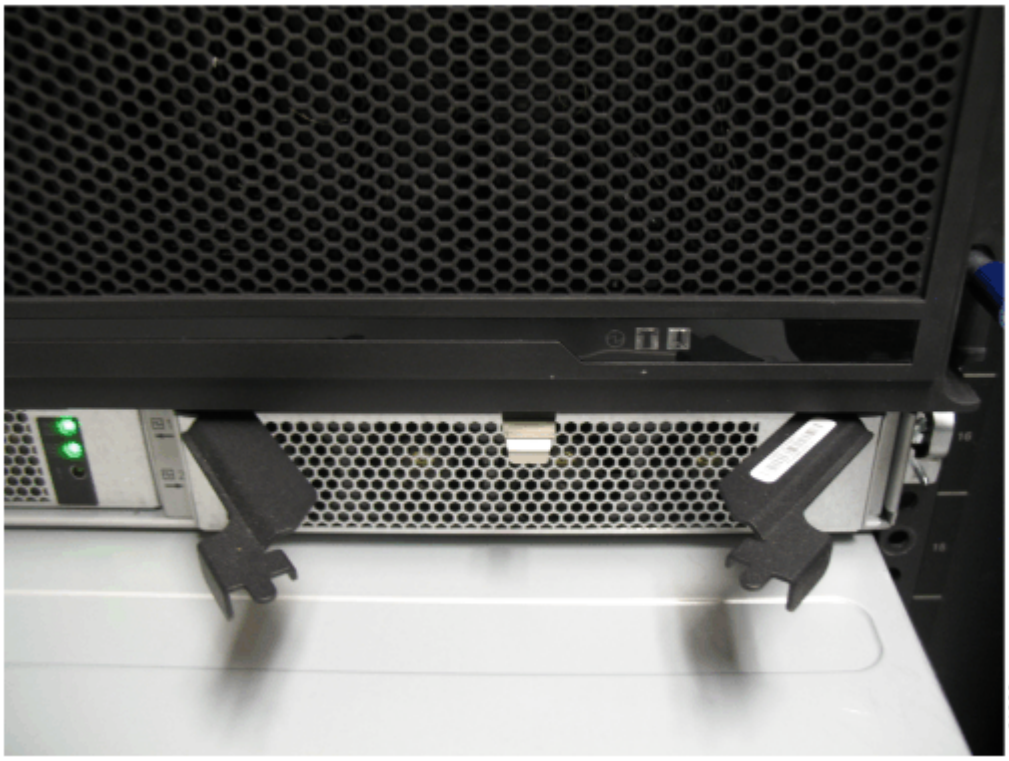


Figure 132. Releasing the power supply handles

5. Carefully pull the PSU out of the expansion enclosure chassis and place it in a safe location, as shown in Figure 133 on page 186.

Figure 133. Removed power supply

6. If you are instructed to return the power supply, follow all packaging instructions. Use any packaging materials for shipping that are supplied to you.

Replace the power supply

7. Read all safety information.
8. Rotate the handles on the PSU outward, as shown in Figure 3.

Figure 134. Preparing to install the power supply

9. Slide the PSU forward into the chassis until it clicks in to place, as shown in Figure 4.

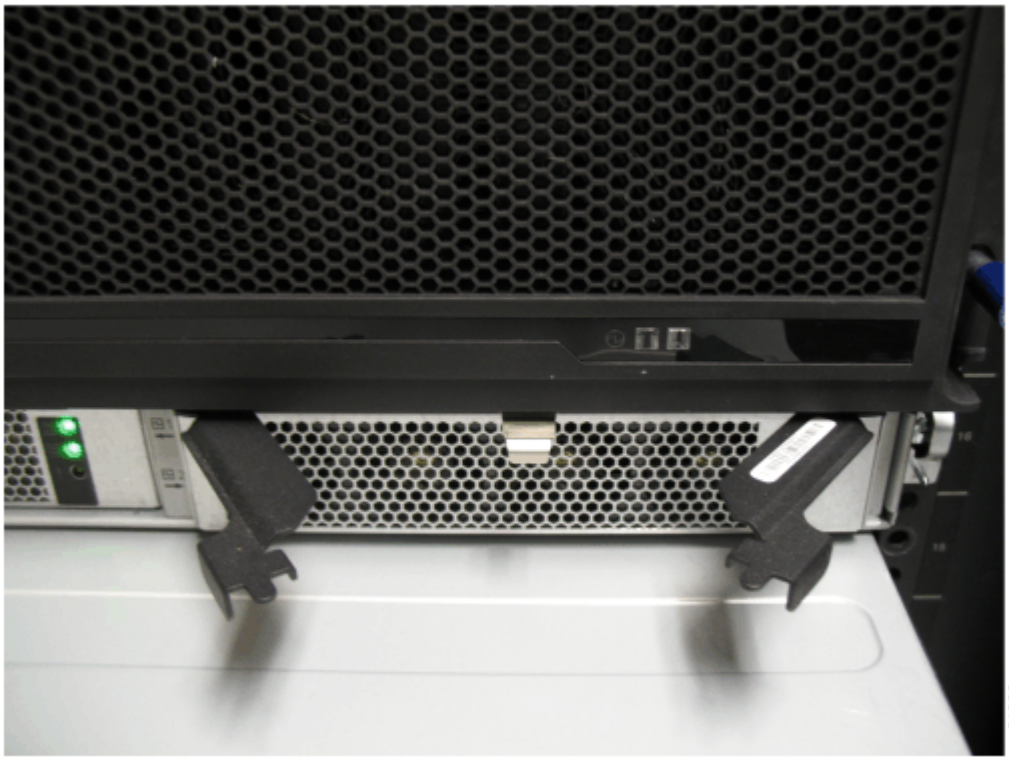


Figure 135. Install the power supply

10. Close the handles on the PSU and ensure the handle lock clicks in to place.
11. Verify that the AC input and the DC power indicators are lit on the front of the PSU, as shown in Figure 5.

Figure 136. Power supply indicators

For more information about the power supply indicators, see High density expansion enclosure LEDs and indicators.

Removing and replacing a display panel assembly

You can remove the display panel assembly from a 5U expansion enclosure.

Procedure

1. Slide the expansion enclosure out of the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 158.
2. Remove the top cover, as described in “Removing and replacing the top cover” on page 167.
3. Press the release tab at the top of the display panel assembly, as shown in Figure 137 on page 189.

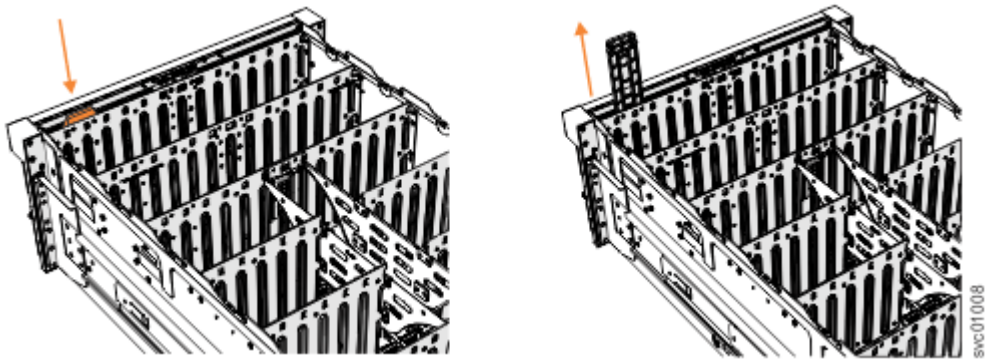


Figure 137. Removing the display panel assembly

4. Carefully pull the display panel assembly, which is shown in the Figure 138 on page 190, out of the chassis.

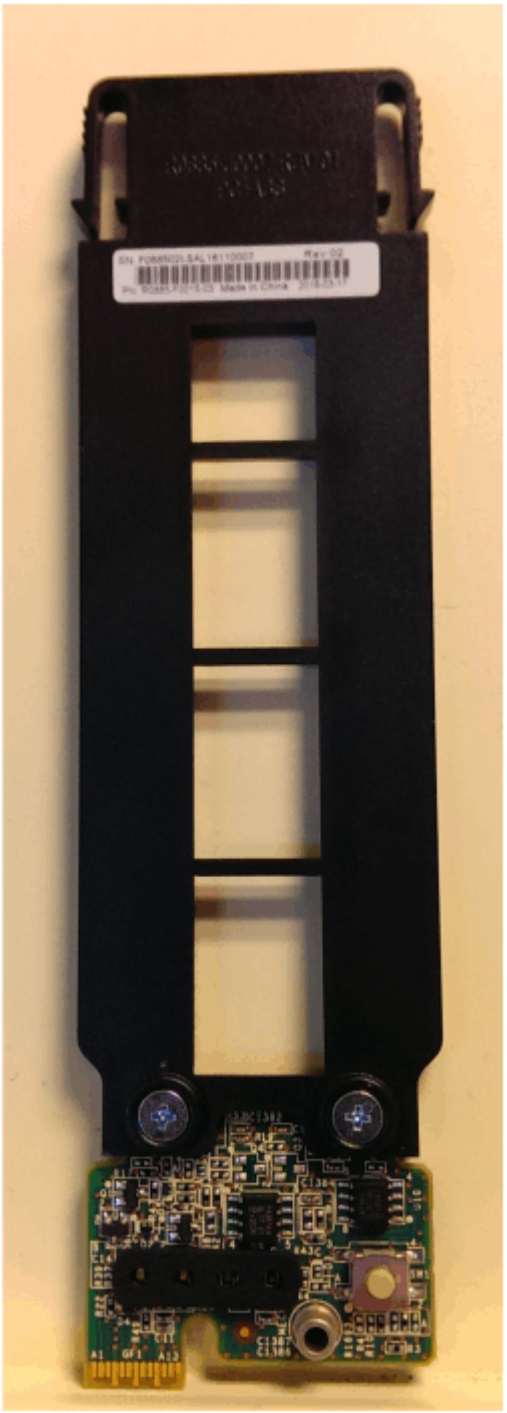


Figure 138. Display panel assembly

Replace the display panel assembly

5. Remove the display panel assembly, which is shown in Figure 138 on page 190, from its packaging.
6. Carefully align the display panel assembly in the slot at the front of the expansion enclosure, as shown in Figure 139 on page 191.

   Ensure the display panel assembly, which is shown in Figure 138 on page 190, faces toward the outside of the chassis.

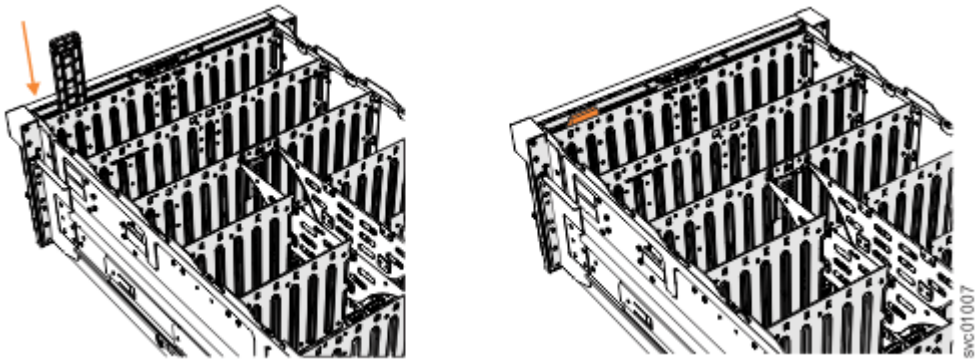


Figure 139. Installing the display panel assembly

7. Insert the display panel assembly until it clicks into position.
8. Replace the top cover, as described in “Removing and replacing the top cover” on page 167.
9. Ensure the LEDs on the display panel are lit correctly. See “High density expansion enclosure LEDs and indicators” on page 212 for details.

Removing an expansion canister

You can remove the expansion canisters in a 5U expansion enclosure.

Before you begin

Important: You can remove an expansion canister without powering off the expansion enclosure. However, to maintain operating temperature, perform the following tasks.

- Do not remove a faulty expansion canister until its replacement is ready to be installed.
- Do not remove an expansion canister from an operational enclosure for more than approximately 10 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

An expansion canister provides SAS connectivity between the 5U expansion enclosure and control enclosure system. If either of the two expansion canisters has a failure, the other expansion canister assumes the full I/O load. Figure 140 on page 191 shows the features of an expansion enclosure.

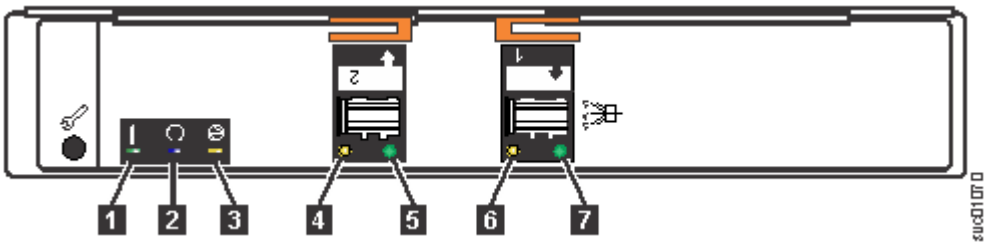


Figure 140. Expansion canister

1 Canister fault indicator
2 Canister status
3 Canister power indicator
4 and 6 SAS link fault indicators
5 and 7 SAS link operational indicators
8 Canister release handles

Procedure

1. Read all safety information.
2. Locate the expansion canister to be removed.
3. Release the lower cable management arm to swing it out of the way, as described in Figure 140 on page 191.
4. Remove the SAS cables from the expansion canister, as described in “Removing and installing a SAS cable” on page 192.
5. Rotate the handles on the expansion canister outward, as shown in Figure 141 on page 192.

Figure 141. Removing the expansion canister

6. Carefully pull the expansion canister out of the chassis and place it on a safe, level surface.

Replace the expansion canister

7. To reinstall an expansion canister, or replace it with one from FRU stock, follow the procedure in Installing or replacing an expansion canister.

Removing and installing a SAS cable

Use the following procedures to attach SAS cables to the 5U enclosure during the initial installation process. You can also remove a faulty SAS cable and replace it with a new one received from FRU stock.

About this task

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

If you replace more than one cable, record which two ports, canisters, and enclosures each cable connects, so you can match the connections with the replacement cables. The system cannot operate if the SAS cabling to the expansion enclosure is incorrect.

When the 5U expansion enclosure is installed in the rack, the expansion canisters are upside down. The input cable connects to the right port (port 1) on the expansion canister. The output cable connects to the left port (port 2) on the canister.

Procedure

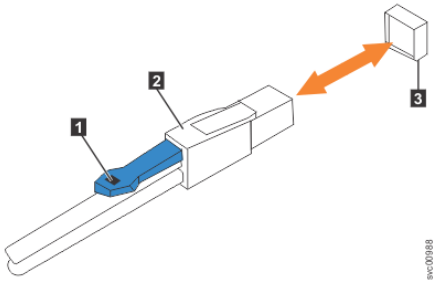
Removing a SAS cable

1. Locate the connector at the end of the SAS cable that is to be removed from the expansion enclosure.

2. Grasp the connector by its blue tag. Pull the tag.
3. Release the connector and slide it out of the SAS port.
4. Repeat steps “2” on page 193 and “3” on page 193 on the other end of the SAS cable.

Replacing a SAS cable

5. Ensure that the SAS connector is oriented correctly, as shown in Figure 142 on page 193. The blue tab must face toward the top of the enclosure canister.



1 Blue pull tab
2 SAS cable
3 SAS port

Figure 142. Correct orientation for SAS cable connectors

6. Insert the SAS cable into the SAS port until you hear or feel a click. When the cable is successfully inserted, you cannot disconnect the cable without pulling on the blue tag.

Connecting to a system node

7. Connect the SAS cable to the SAS port with blue tab **above** the connector (that is, facing toward the top of the node).

   You hear or feel a click when the cable is successfully inserted. You cannot disconnect the cable without pulling on the blue tag.
8. Route the SAS cables through the cable management arms, as shown in Figure 143 on page 193.

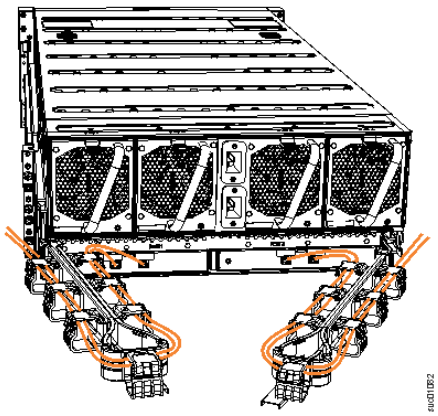


Figure 143. Example of SAS cables routed through the cable management arms

9. When both ends of a SAS cable are correctly connected, the green link-LED next to the connected SAS ports are lit.

   For example, Figure 144 on page 194 shows the LEDs of expansion canister 1 on a 5U expansion enclosure. The SAS cable is successfully inserted in to port 1 (input); port 2 (output) does not contain a SAS cable.

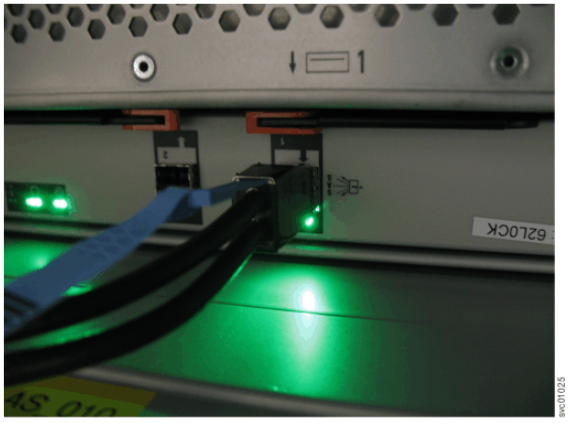


Figure 144. SAS cable correctly inserted into the SAS port

Removing and replacing a fan module

You can remove a fan module from a 5U expansion enclosure.

Before you begin

Important: You can remove a fan module without powering off the expansion enclosure. However, to maintain operating temperature, do not remove more than one fan module at a time.

- Remove a faulty fan module only when its replacement is ready to be installed.
- Do not remove a fan module from an operational enclosure for more than approximately 10 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

About this task

Note: If you plan to remove the expansion enclosure from the rack, you must remove all of the fan modules.

Procedure

1. Identify the fan module to be replaced. When lit, the amber LED on the front of the fan module (1 in Figure 145 on page 194) identifies a fault.

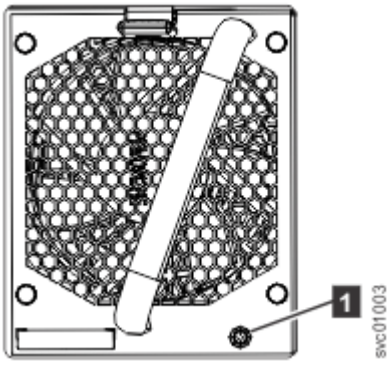


Figure 145. Fan module LED

   You can also issue the **lsenclosurefanmodule** command to display the status of the fan modules.
2. Press the release tab on the fan module, as Figure 146 on page 195 shows.

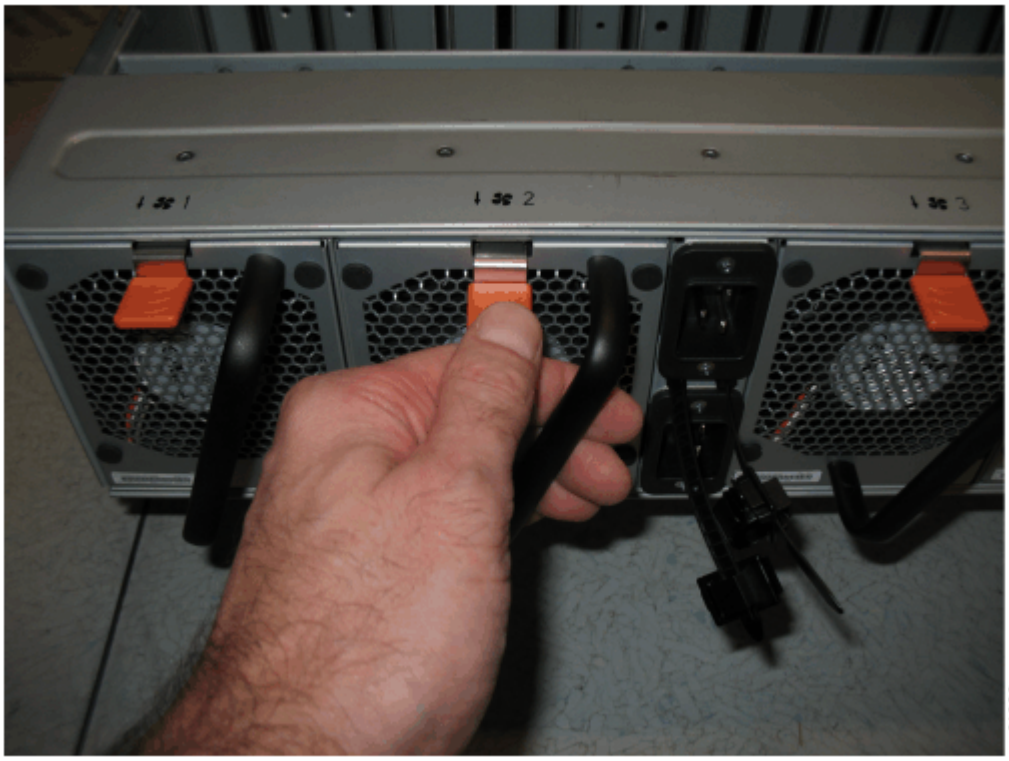


Figure 146. Fan module release tab

3. Use the handle to pull the fan module out of the expansion enclosure chassis, as shown in Figure 147 on page 195.

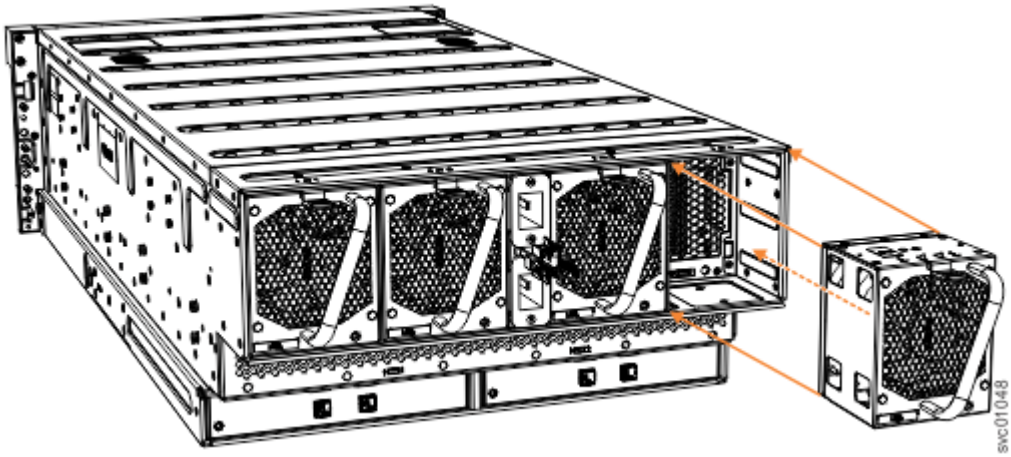


Figure 147. Remove and replace a fan module

4. Repeat steps “2” on page 194 and “3” on page 195 for each additional fan module you need to remove.

Replace a fan module

5. Hold the fan module with the release tab on top and the connector pin on the bottom, as shown in Figure 148 on page 196.

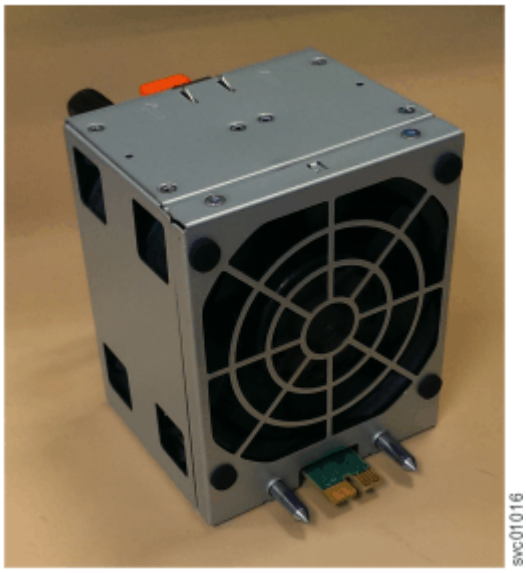


Figure 148. Fan module orientation

6. Carefully insert the fan module into the chassis until it clicks in place, as shown in Figure 147 on page 195.
7. Repeat the steps “5” on page 195 and “6” on page 196 for each fan module to be replaced.

Removing and replacing a fan interface board

You can remove a fan interface board (FIB) from a 5U expansion enclosure.

Before you begin

This task assumes that the following conditions were met:

- All power cables were removed from the enclosure, as described in “Powering off the 5U expansion enclosure” on page 93.
- The top cover, fan modules, and the other heavy FRUs (drives, secondary expander modules) were removed before the enclosure was removed from the rack.
- The expansion enclosure was removed from the rack, as described in “Removing a 5U expansion enclosure from a rack” on page 158.

  Ensure that you use a lift to support the weight of the enclosure.

About this task

The 5U expansion enclosure contains two fan interface boards (FIBs). The FIBs act as the interface between the fans and the system drive board. FIB 1 connects fan modules 1 and 2 to the drive board; FIB 2 connects fan modules 3 and 4. If both fan modules controlled by a FIB fail, it is possible that the FIB needs to be replaced.

Important: Because this task is disruptive to the storage system, always attempt fan replacement first. See “Removing and replacing a fan module” on page 194 for information about the removal and replacement procedures. Ensure that both fans are installed correctly. Perform the following procedure only if the amber fault LED on each fan remains lit (1 in Figure 149 on page 197).

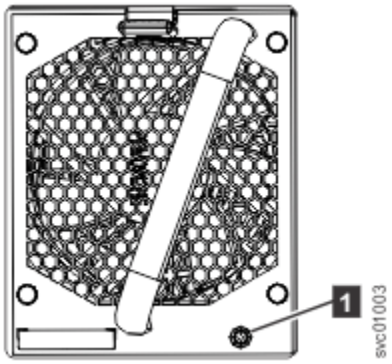


Figure 149. Fan module LED

Procedure

1. Using a cross head screwdriver, remove the narrow metal cover that is over the FIBs, as shown in Figure 150 on page 197. The screws are on each side of the chassis. Place the cover and cover screws in a safe location.

Figure 150. Location of the FIB cover

2. Use a cross head screwdriver to loosen the retaining screws on the FIB, as shown in Figure 151 on page 198.

Figure 151. Loosen the FIB screws

3. Use the handle to pull the FIB out of the expansion enclosure chassis, as shown in Figure 152 on page 198.

Figure 152. Remove the FIB from the chassis

4. Place the FIB (shown in Figure 153 on page 199) in a safe location.

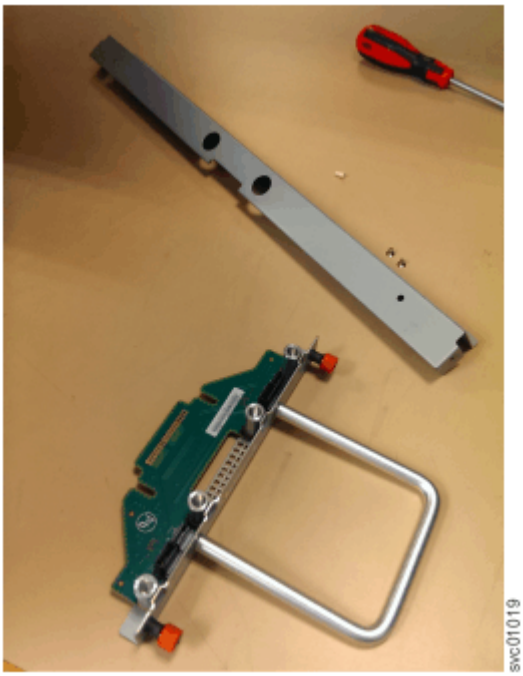


Figure 153. FIB parts removed from the chassis

5. If needed, repeat the steps "2" on page 197 through "3" on page 198 to remove the other FIB.

Replace the fan interface board

6. Assemble the new FIB, cover, and the cover screws in a safe location as shown in Figure 153 on page 199.
7. Carefully insert the new FIB into the expansion enclosure chassis, as shown in Figure 152 on page 198.
8. Use a cross head screwdriver to tighten the retaining screws that secure the FIB to the drive board, as shown in Figure 151 on page 198.
9. If needed, repeat steps "7" on page 199 and "8" on page 199 to replace the other FIB.
10. Replace the narrow metal cover, which is shown in Figure 150 on page 197, over the FIB assemblies. The attachment screws are on each side of the chassis.
11. Place the enclosure back in the rack, as described in "Installing a 5U expansion enclosure in a rack" on page 86.
12. Replace each of the fan modules. Follow the procedure that is described in "Removing and replacing a fan module" on page 194.
13. Replace the drives, secondary expander modules, and other heavy FRUs that were removed before the enclosure was removed from the rack.
14. Replace the top cover, as described in "Removing and replacing the top cover" on page 167.
15. Reconnect power to the enclosure, as described in "Powering on the optional 5U expansion enclosure" on page 91.

System indicators summary

An system contains several control and expansion enclosures, each of which has LED indicators for identification and fault diagnosis. The details of these indicators are covered in the following topics.

Note: For optimal usage, configure call home and event notifications rather than using the LED indicators as the primary means of fault diagnosis. As a best practice, configure call home and event notifications to precisely detect the fault and failure of the system.

Health LED indicators

The front panel of the enclosure has four light-emitting diodes (LEDs) that display the overall health of the enclosure.

Figure 154 on page 200 shows the enclosure health light-emitting diodes (LEDs) on the enclosure front panel.

Figure 154. Enclosure health LEDs

Table 52 on page 200 describes the various LED states that you might observe.

Table 52. Enclosure health LED indicators

LED Name	Color	States
1 Power	Green	• OFF – No external power is supplied to the enclosure. • ON – Power is supplied to the enclosure and the CPU is active (not in standby) on at least one node canister. • SLOW FLASH – Both canisters are in standby mode.
2 Identify	Blue	• OFF – The enclosure is not in an identify state. • SOLID – The enclosure was identified in response to the management system or the chassis ecosystem.
3 Enclosure Fault	Amber	• OFF – There are no isolated FRU failures in the enclosure. • ON –A FRU in the enclosure has failed, and will require service or replacement.
4 Check Log	Amber	Not used in Storage Virtualize implementation

Drive indicators

Drives are accessible from the front of the control enclosure. Each drive has two light-emitting diode (LED) indicators.

The following figure shows the location of the LEDs on a small form factor (SFF) 2.5-inch drive.

Figure 155. Drive LEDs

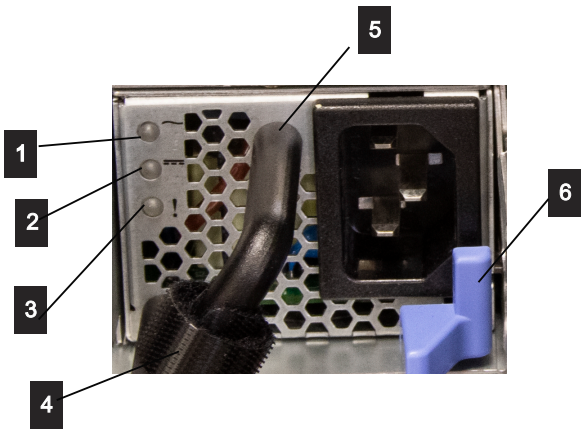
Table 53 on page 201 lists the status descriptions for the two LED indicators.

Table 53. Drive LED status

LED name	Callout	Color	State	Meaning
Activity	1	Green	Off	The drive is not ready for use.
			Flashing	The drive is ready. Activity is in progress.
			On	The drive is ready. No activity is in progress.
Fault	2	Amber	Off	No known fault exists.
			Flash	The drive is identified.
			On	A fault exists on the drive.

Power supply indicators

IBM Storage FlashSystem power supplies have three LED indicators to convey information about the state of the supply.



1 AC good indicator
2 DC good indicator
3 Fault indicator
4 Hook-and-loop strap for securing the power cable
5 Power supply handle
6 Power supply release tab

Figure 156. Power supply details

Table 54 on page 202 describes the meaning of each indicator.

Table 54. Summary of LED indicators for the PSUs

Indicator	Color	Meaning
AC Good	Green	• Off - There is no AC input to the PSU, or the PSU is in a fault state that does not allow AC input. • On - The power supply is receiving AC line cord power and is operating normally.
DC Good	Green	• Off - There is no DC output from the PSU to the enclosure. • On - The power supply is providing DC power; no action is required.
FAULT	Amber	A fault needs to be resolved. • On - The associated PSU is isolated and require service or replacement. • Off - There are no isolated FRU failures on the PSU. • Flash - The PSU is being identified by using an identify command.

Node canister indicators

Each node canister has five Light-Emitting Diode (LED) indicators that display the state of the individual canister and the node.

Figure 157 on page 203 shows the LEDs on a canister.

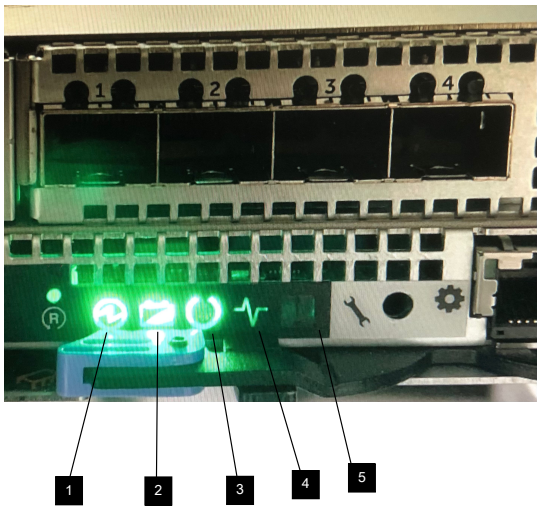


Figure 157. Canister and node status LEDs

1 Canister power LED
2 Battery status LED
3 Node status LED
4 Activity LED
5 Canister fault LED

Table 55 on page 203 describes the various LED states that you might observe.

Table 55. Canister and node status LED descriptions

LED Name	Icon	Color	States
1 Canister power		Green	• OFF – No external power is supplied to the canister. • ON – The canister is in a power-on state. • SLOW FLASH – The canister is in standby mode. • FAST FLASH – The BIOS is in POST.
2 Battery status		Green	• OFF – The battery has a fault or is otherwise not available for use. • ON – The battery is fully charged and can support two fire hose dumps (FHDs). • FLASH – The battery is charging but it can support a single fire hose dump. (FHD). • FAST FLASH – The battery is charging but has insufficient charge to complete a single fire hose dump. (FHD).
3 Node status		Green	• OFF – The canister is in standby mode (the CPU is off , POST is running, or the operating system is loading), or power is not supplied to the canister. • ON – The node is in active state (part of a cluster). • FLASH – The node is in candidate or service state. It is safe to remove the node. • FAST FLASH – A destage is occurring.
4 Activity		Green	Not used

Table 55. Canister and node status LED descriptions (continued)			
LED Name	**Icon**	**Color**	**States**
5 Canister fault		Amber	• – OFF – There are no isolated FRU failures in the canister. – ON –An FRU in the canister has failed, and requires service or replacement. – FLASHING – The node is being identified.

Node port indicators

Each Node canister Ethernet port has a pair of green LEDs with the following meanings. Table 56 on page 204 describes the LED indicators.

Table 56. Onboard Ethernet port LEDs				
Name	**Symbol**	**Color**	**State**	**Meaning**
Link speed	None	Green	OFF	No link connection or the link is connected at less than 1 Gbps.
			ON	There is a 1 Gbps link connection to a remote device.
Activity	None	Green	OFF	No activity.
			FLASHING	Activity on link.

Network adapter port indicators

A control enclosure can support several types of optional host interface adapters. Each host interface adapter has its own Light-Emitting Diode (LED) indicators to help with status and fault diagnosis, as documented in the following sections:

Fibre Channel port indicators

The system supports dual-port and quad-port fibre channel adapters and the status is shown by the indicators.

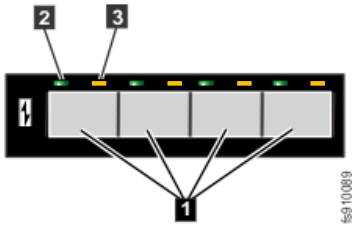


Figure 158. Fibre Channel ports and indicators

1 Fibre Channel port (4-port card)
2 Link-state LED (one for each port)
3 Speed-state LED (one for each port)

The following table lists the possible link status values for the Fibre Channel LEDs.

Table 57. Link status values for Fibre Channel adapter LEDs		
Green LED	**Amber LED**	**Meaning**
Off	Off	One of the following situations is in effect: • The port is not configured. • The port is not active.
Off	On	The port is configured, but the link is not detected at the transport layer. This situation is the result of the port not being connected or of a failed link negotiation with the switch.
On	Off	The link is up and running at the expected port speed. This display does not imply logical connectivity, that is completion of FLOGI or FIP.
On	On	The link is up but running at a degraded speed.

Quad-port 10 Gbps Ethernet host interface adapter indicators

Each port of the quad-port 10 Gbps Ethernet host interface adapter has an LED indicator.

Figure 159 on page 205 shows the quad-port 10 Gbps Ethernet host interface adapter. Each port has two LEDs that indicate the status of the port and link.

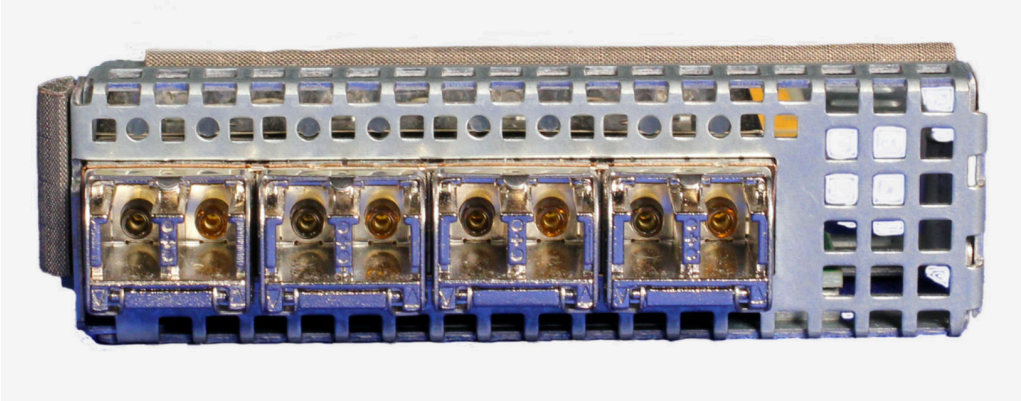


Figure 159. Quad-port 10 Gbps Ethernet host interface adapter ports and LEDs

Table 58 on page 205 summarizes the possible values of the LEDs on the 10 Gbps Ethernet host interface adapter.

Table 58. LED indicators for 10 Gbps Ethernet host interface adapter		
Color	**State**	**Description**
Off	Off	The ports and links are not active.
Green	Solid	The ports have a valid link.

Dual-port 25 Gbps Ethernet host interface adapter ports and indicators

Each port on the dual-port 25 Gbps Ethernet host interface adapter has one bi-color LED that indicates the status of the link and port. The location of the LEDs varies depending on the type of adapter.

Figure 160 on page 206 shows the front of a dual-port 25 Gbps Ethernet (RoCE) host interface adapter.

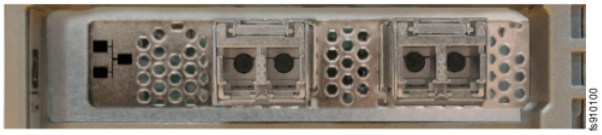


Figure 160. Dual-port 25 Gbps Ethernet host interface adapter ports and LEDs (RoCE)

The LED states and their descriptions are explained in Table 59 on page 206.

Table 59. LED indicators for dual-port 25 Gbps Ethernet host interface adapter (RoCE)

Color	State	Description
None	Off	The port is not active.
Green	Solid	The port has a valid link with no active traffic.
Green	Blinking	The port has a valid link with active traffic.
Yellow	Blinking	The link has a problem.

Figure 161 on page 206 shows the 25 Gbps Ethernet (iWARP) host interface adapter. Each port has a single LED that indicates the status of the port and link.

Figure 161. Dual-port 25 Gbps Ethernet host interface adapter ports and LEDs (iWARP)

Table 60 on page 206 summarizes the possible values of the LEDs on the 25 Gbps Ethernet host interface adapter (iWARP).

Table 60. Table 2. LED indicators for dual-port 25 Gbps Ethernet host interface adapter (iWARP)

Color	State	Description
Off	Off	The ports and links are not active.
Green	Solid	The ports have a valid link.

Quad-port 12 Gbps SAS network adapter ports and indicators

The system uses quad-port 12 Gbps SAS networking adapters to connect to expansion enclosures.

The system does not have onboard SAS ports. The SAS adapters are not used to connect to host systems.

The SAS networking adapters are installed in the PCIe slots that are located in the back of the control enclosure. The orientation of the node canisters, PCIe slots, and SAS connectors differs between the top node canister (node canister 1) and the bottom node canister (node canister 2). For more information, see “Planning management connections” on page 58.

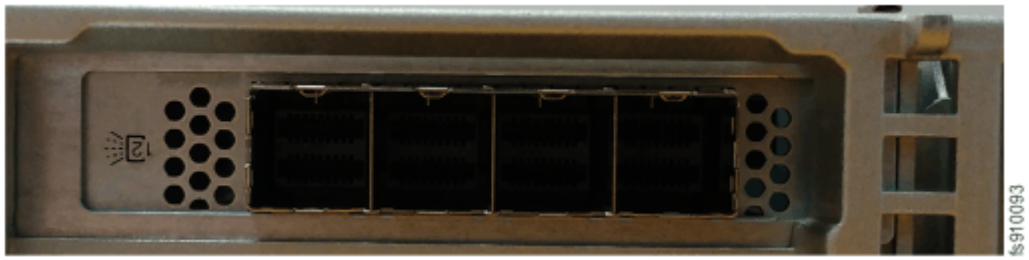


Figure 162. Quad-port 12 Gbps SAS network adapter

Status indicators

The status LED indicators of the SAS adapters are not visible because the metal work on the node canister covers the LEDs, as shown in Figure 162 on page 206. To determine the status of the SAS adapter, use the management GUI or a CLI command.

If a SAS port or cable is not functioning correctly, the system writes an entry to the system Error Log. To find the entry in the management GUI, select **Monitoring** > **Events**.

You can also use the management GUI to display status information about the SAS ports. To do so, select **Monitoring** > **System - Overview**; then, select the control enclosure that contains the SAS ports. Select **System - Enclosure Details** for the control enclosure; then, select **SAS Ports** to see the status of the SAS ports.

You can also use the **lsportsas** command to display the status and configuration of the SAS ports within the entire clustered system. Use the *node_id*, *node_name*, *port_id*, and *status* fields of the command output to locate information about the node and SAS ports of interest.

Quad-port 12 Gbps SAS expansion-adapter port indicators

Quad-port 12 Gbps SAS expansion adapters are used to connect to SAS expansion enclosures.

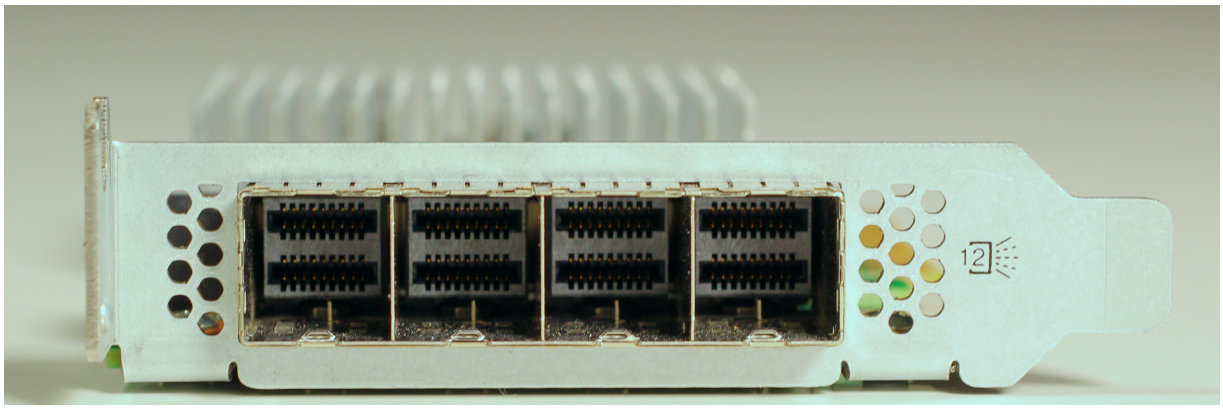


Figure 163. Quad-port 12 Gbps SAS expansion adapter

Status indicators

If a SAS port or cable is not functioning correctly, the system writes an entry to the system Error Log. To find the entry in the management GUI, select **Monitoring** > **Events**.

You can also use the management GUI to display status information about the SAS ports. To do so, select **Monitoring** > **System - Overview**; then, select the control enclosure that contains the SAS ports. Select **System - Enclosure Details** for the control enclosure. Then, select **SAS Ports** to see the status of the SAS ports.

You can also use the lsportsas command to display the status and configuration of the SAS ports within the entire system. Use the *node_id*, *node_name*, *port_id*, and *status* fields of the command output to locate information about the node and SAS ports of interest.

Expansion enclosure indicators

The expansion enclosure has several sets of Light-Emitting Diodes (LEDs) that provide information about the overall status of the enclosure, power, drives, canisters, and SAS connections.

2U expansion enclosure indicators

The 2U expansion enclosure has several sets of Light-Emitting Diodes (LEDs) that provide information about the overall status of the enclosure, power, drives, canisters, and SAS connections.

LEDs on the front of the expansion enclosure

System Status LEDs

Labels and indicators on the left end cap of the expansion enclosure provide information about the enclosure status. When multiple enclosures are in a rack, the serial number is used to identify the enclosure that is being referenced.

Figure 164. Left enclosure end cap

Table 61 on page 208 summarizes the possible meanings of each indicator.

Table 61. Summary of LED Indicators

Indicator Name	Callout	Color	Symbol	Meaning
Control enclosure operational	1	Green		• Off - There is no external power to the enclosure. • Slow flash - The enclosure is in a stand by state. • On - There is AC power to the enclosure and at least one canister is not in standby mode.

Table 61. Summary of LED Indicators (continued)				
Indicator Name	**Callout**	**Color**	**Symbol**	**Meaning**
Identify enclosure	2	Blue		• Off - The enclosure is not being identified. • On - The enclosure is set to be identified.
Enclosure fault	3	Amber		• Off - There are no isolated FRU failures in the enclosure. • On - There are one or more isolated FRU failures in the enclosure requiring service or replacement.
Check Log	4	Amber		Not used in Storage Virtualize implementation

Drive Status LEDs

Each drive on the expansion enclosure has two light-emitting diode (LED) indicators; they have no controls or connectors. Figure 165 on page 209 shows the location of the LEDs on a SFF 2.5-inch drive.

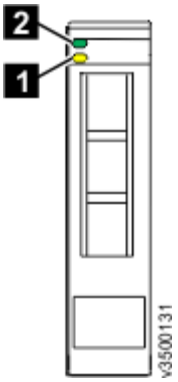


Figure 165. LED indicators on a vertical 2.5 in. (6.35 cm) drive

Table 62 on page 210 describes the LED status values for the two LEDs on each drive.

Table 62. Drive LED status				
LED name	**Callout**	**Color**	**State**	**Meaning**
Fault	1	Amber	OFF	No known fault exists.
			FLASHING	The drive is being identified; a fault might or might not exist.
			ON	A fault exists on the drive.
Activity	2	Green	OFF	The drive is not ready for use.
			FLASHING	The drive is ready. Activity is in progress.
			ON	The drive is ready. No activity is in progress.

LEDs on the rear of the expansion enclosure

Canister indicators

Each expansion canister has three LED indicators that provide status and identification for the expansion canister.

Three LEDs are located in a horizontal row on the right side (when viewed from the rear) of the expansion canister. Figure 166 on page 210 shows the expansion canister indicators.

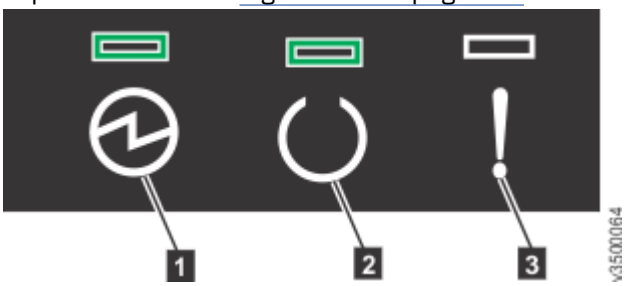


Figure 166. Expansion canister LEDs

Table 63 on page 210 describes the function and meaning of each indicator.

Table 63. Expansion canister LED descriptions			
Name	**Description**	**Color**	**Symbol**
1 Power	Indicates whether the expansion canister has power. • If the LED is on, the canister has power. • If the LED is off, the canister does not have power.	Green	
2 Status	Indicates whether the expansion canister is active. • If the LED is on, the canister is active. • If the LED is off, the canister is not active. • If the LED is flashing, there is a vital product data (VPD) error.	Green	

Table 63. Expansion canister LED descriptions (continued)			
Name	**Description**	**Color**	**Symbol**
3 Fault	Indicates whether a fault is present and identifies the expansion canister. • If the LED is on, a fault exists. • If the LED is off, no fault exists. • If the LED is flashing, the expansion canister is being identified. This status might or might not be a fault.	Amber	

SAS port indicators

Each of the two SAS ports on the expansion canister has two status LEDs above the port: Link (left-hand indicator) and Fault (right-hand indicator), as shown in Figure 167 on page 211.

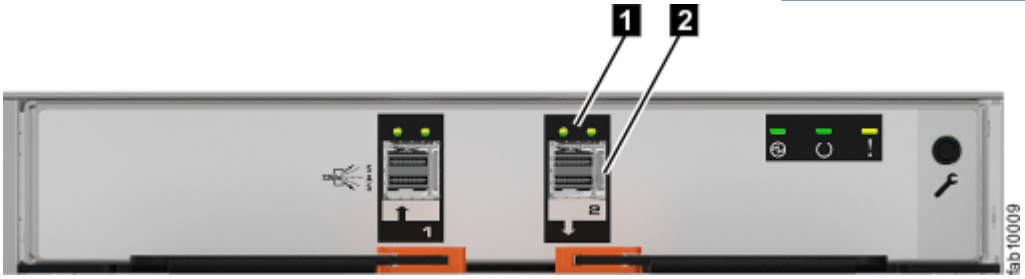


Figure 167. SAS ports and LEDs at the rear of an expansion canister

Figure 166 on page 210 describes the LED states for each of the two LEDs per SAS port. The link LED is on the left of each set of ports.

Table 64. SAS port LEDs on the expansion canister			
Name	**Color**	**State**	**Meaning**
SAS Port 1 Link	Green	OFF	No physical link connection on any phys. The connection is down.
		ON	There is a connection on at least one physical lane. At least one of the lanes to that connector is up.
SAS Port 1 Fault	Amber	OFF	No fault. All four physical lanes have a link connection.
		ON	This value indicates a number of different error conditions: • One or more, but not all, of the four physical lanes are connected. • Not all four physical lanes are at the same speed. • One or more of the connected physical lanes are attached to an address different from the others.
SAS Port 2 Link	Green	OFF	No link connection on any physical lanes. The connection is down.
		ON	There is a connection on at least one physical lane. At least one of the lanes to that connector is up.

Table 64. SAS port LEDs on the expansion canister (continued)			
Name	**Color**	**State**	**Meaning**
SAS Port 2 Fault	Amber	OFF	No fault. All four physical lanes have a link connection.
		ON	This value indicates a number of different error conditions: • One or more, but not all, of the four physical lanes are connected. • Not all four physical links are at the same speed. • One or more of the connected physical links are attached to an address different from the others

Power supply indicators

Each power supply unit has four LED indicators that are described in Table 65 on page 212.

Table 65. Power supply LEDs			
Name	**Label**	**Color**	**Description**
Input status	IN ⎓	Green	**Off** No input power detected **On** Direct current input power detected
Output status	DC ⎓	Green	**Off** PSU is not providing DC output power **On** PSU is providing DC output power
Fault	!	Amber	**Off** No fault detected **On** PSU fault detected **Flash** PSU is being identified. A fault might have been detected.
(None)	OK	Blue	Not used

High density expansion enclosure LEDs and indicators

The high density expansion enclosure has several sets of LEDs that provide information about the overall status of the enclosure, power, drives, fans, canisters, and SAS connections.

A high density expansion enclosure has sets of LEDs on the front and rear of the enclosure. Inside of the expansion enclosure, LEDs also indicate the status of the drives and each secondary expander module.

LEDs on the front of the expansion enclosure

As Figure 168 on page 213 shows, the front of the 5U expansion enclosure contains LEDs for the display panel (1) and for each of the power supply units (3).

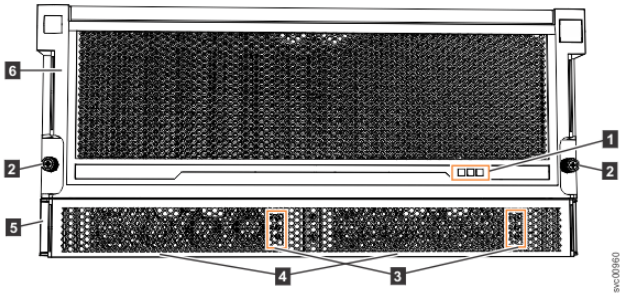


Figure 168. LEDs on the front of the expansion enclosure

1 Display panel LEDs
2 Rack retention thumb screws
3 Power supply unit LEDs
4 Power supply units (PSUs)
5 PSU fascia (1U)
6 Front fascia (4U)

The display panel (1) contains three LEDs that describe the operational status of the expansion enclosure. Table 66 on page 213 describes the function and meaning of the LEDs on the front display panel.

Table 66. Display panel LEDs

Function	Color	Status	Description
Power	Green	On	The expansion enclosure power is on; this LED is controlled by the expansion enclosure.
		Off	The expansion enclosure power is off.
Identify	Blue	On	Identifies the expansion enclosure; this LED is controlled by the system. Use the management GUI or service interface to identify an enclosure.
		Off	The expansion enclosure is operating normally.
Enclosure fault	Amber	On	The expansion enclosure is coming up or a fault is detected against a component within the enclosure.
		Off	No faults are detected.

The 5U expansion enclosure contains two PSUs (4 in Figure 168 on page 213) that are accessible from the front of the enclosure. Each PSU has its own a set of LEDs, as shown in Figure 169 on page 213.

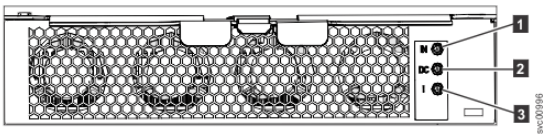


Figure 169. LEDs on the front of a power supply unit

1 Input power
2 DC power
3 Fault indicator

Table 67 on page 214 explains the function and status that is indicated by each of the LEDs. The power cords for each PSU are accessible from the rear of the expansion enclosure (1), as shown in Figure 171 on page 215.

Table 67. Power supply unit LEDs			
Function	**Color**	**Status**	**Description**
1 Input power	Green	On	The input voltage is within specification.
		Off	No power input detected.
2 DC power	Green	On	DC power outputs are within specification.
		Off	DC power is not available.
3 Fault	Amber	On	A fault is detected in the PSU.
		Off	No faults are detected.

LEDs inside of the expansion enclosure

As Figure 170 on page 214 shows, each of the drives and secondary expansion modules within the expansion enclosure has two LEDs.

Figure 170. LEDs on drives and SEMs

Table 68 on page 214 describes the meaning of the LEDs. The function and description might vary depending on whether the LED is on a drive or a secondary expansion module.

Table 68. LEDs on drives and secondary expansion modules			
Function	**Color**	**Status**	**Description**
• Activity (for drives) • Power (for secondary expansion modules)	Green	On	• The drive is ready to be used. • The secondary expansion module is receiving power.
		Flashing	• The drive is operating and I/O is occurring. • Not used for secondary expansion modules.
		Off	• The drive is not installed or an installed drive is not ready to be used. • The secondary expansion module is not receiving power.

Table 68. LEDs on drives and secondary expansion modules (continued)			
Function	**Color**	**Status**	**Description**
Fault	Amber	On	• A fault occurred on the drive. The LED is turned off when the drive is removed and replaced. • Not used for secondary expansion modules.
		Flash	• The drive is being identified; a fault might or might not be detected. • The secondary expansion module is being identified.
		Off	The installed drive or secondary expansion module is operating normally; no faults are detected.

LEDs on the rear of the expansion enclosure

Figure 171 on page 215 shows the rear view of a expansion enclosure. LEDs on the rear of the enclosure provide information about each fan module, each expansion canister, and SAS links.

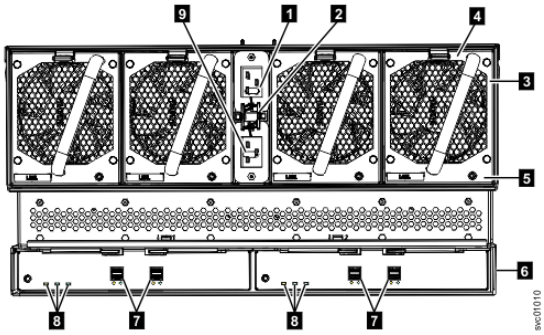


Figure 171. LEDs on the back of the expansion enclosure

The expansion enclosure has four fans. Each fan has one LED; for example, Figure 171 on page 215 shows the location of the LED (5) for fan number four. When a fan is operating normally, the LED is not lit. If a fault is detected, the amber LED is lit.

As Figure 171 on page 215 also shows, the expansion enclosure contains two expansion canisters. Each expansion canister contains its own set of LEDs, as shown in Figure 172 on page 215. The LEDs provide status information about the expansion canister itself and the SAS connections.

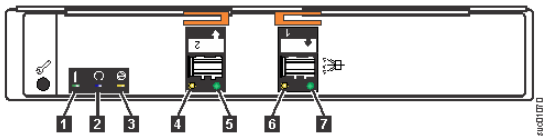


Figure 172. LEDs on the back of the expansion canister

1 Canister fault
2 Canister status
3 Canister power
4 and 6 SAS link fault
5 and 7 SAS link operational

Table 69 on page 216 describes the values and meaning of each LED.

Table 69. Expansion canister and SAS port LEDs

Name	Color	State	Meaning
1 Canister fault	Amber	Off	Normal operation.
		On	A fault was detected.
		Flashing	The expansion canister is being identified. A fault might or might not be detected.
2 Canister status	Green	Off	Canister is off.
		On	Normal operation.
		Flashing	A vital product data (VPD) error occurred.
3 Canister power	Green	Off	Canister is off.
		On	Canister is receiving power.
4 and 6 SAS link fault	Amber	Off	No faults are detected. All four phys have a link connection.
		On	Several error conditions are possible: • Only 1, 2, or 3 phys are connected, but not all 4. • The phys are not operating at the same speed. • All phys are not connected to the same remote port. One or more of the connected lanes are attached to a different address.
5 and 7 SAS link operational	Green	Off	No link connection on any lane. The connection is down.
		On	The SAS link is active. At least one of the four lanes is connected.

Note:

To monitor your system, configure call home and event notifications rather than checking the LED indicators. It is highly recommended to configure call home and event notifications to precisely detect the fault and failure of the system

Replaceable units

Each system consists of several replaceable units, such as cables, SFP transceivers, canisters, power supply units, batteries, drives, and enclosure chassis. The part numbers vary depending on the model of the control enclosure or expansion enclosure.

Control enclosure replaceable units

Most replaceable parts of IBM Storage FlashSystem 5200 are customer-replaceable units (CRUs), unless they have an extended service agreement, that is expert care. The parts that have an extended service agreement are field-replaceable units (FRUs) and are replaced by IBM trained service technicians.

Table 70. CRU and FRU list

Part number	Description
03GU876	DIMM - 32 GB
03GU877	DIMM - 64 GB
03GU518	NVMe FlashCore Module, 4.8 TBu
03GU519	NVMe FlashCore Module, 9.6 TBu
03GU520	NVMe FlashCore Module 19.2 TBu
03GU521	NVMe FlashCore Module, 38.4 TBu
03GU522	NVMe flash drive, 800 MB
03GU523	NVMe flash drive, 1.92 MB
03GU524	NVMe flash drive, 3.84 TBu
03GU525	NVMe flash drive, 7.68 TBu
03GU526	NVMe flash drive, 15.36 TBu
03GU527	NVMe SCM drive, 375 GB
03GU528	NVMe SCM drive, 750 GB
03GU529	NVMe SCM drive, 800 GB
03GU530	NVMe SCM drive, 1.6 TBu
03GH757	Enclosure fans cover
03GH750	1500W AC power supply unit
03GH925	Autoranging unit
01ML137	Drive slot filler
O3GH804	PCIe interface slot filler
03GH751	40 mm enclosure fan module
03GH752	30 mm canister fan assembly
03GH756	Node canister
03JK179	32 Gbps FC dual-port adapter
03JK178	16 Gbps FC quad-port adapter
03GH743	12 Gbps SAS quad-port adapter

Table 70. CRU and FRU list (continued)	
Part number	**Description**
03GH773	10 Gbps iSCSI quad-port adapter
03GH779	25 Gbps Ethernet (RoCE) adapter
03GH785	25 Gbps Ethernet (iWARP) adapter
03JK184	16 Gbps quad-port and 32 Gbps dual-port Fibre Channel
78P2856	16 Gbps short-wave (SW) SFP
78P4521	16 Gbps long-wave (LW) SFP
02CL041	32 Gbps FC SW SFP Transceiver
31P1549	10 Gbps SR SFP
03JK732	10 Gbps RJ45 module for Ethernet adapters
03GH278 03GH316	25 Gbps SR SFP28
03GH754	Midplanes Includes two midplanes and associated cables
03GH753	Canister battery module
03GH804	PCIe interface adapter slot filler
00RY543	CMOS coin-cell battery
03GH880	Enclosure mounting ears (IBM- branded)
03GH758	1U rail kit
03GH759	Cable management arm
03GH819	Ambient temperature sensor
39M5068	ac power cord Argentina
39M5199	ac power cord Japan
39M5123	ac power cord Europe/Africa
39M5165	ac power cord Italy, Chile
39M5102	ac power cord Australia and New Zealand
39M5130	ac power cord Denmark
39M5144	ac power cord S. Africa
39M5151	ac power cord EMEA
39M5158	ac power cord Switzerland
39M5172	ac power cord Israel
39M5206	ac power cord China
39M5240	ac power cord Brazil
39M5247	ac power cord Taiwan

Table 70. CRU and FRU list (continued)	
Part number	**Description**
39M5081	ac power cord US Group 1
39M5226	ac power cord India
39M5219	ac power cord Korea
39M5377	Power cord for 10 amp PDU outlet
00D2142	Host 0.6 m mSAS-mSASHD
00D2144	Host 1.5 m mSAS-mSASHD
00D2148	Host 3 m mSAS-mSASHD
45D4773	1 m OM3 optical cable
45D4774	5 m OM3 optical cable
41V2120	10 m OM3 optical cable
15R8848	25 m OM3 optical cable

2U expansion enclosure replaceable units

You might have to replace a part on a 2U expansion enclosure. Unless otherwise noted, all parts are customer-replaceable units (CRUs). If a part is described as a field replaceable unit (FRU), it is only replaceable by IBM trained service technicians.

The following table summarizes the replaceable units and part numbers for the 2U expansion enclosures. An "X" indicates the model for which the part is applicable.

Table 71. Summary of 2U expansion enclosure replaceable parts			
P/N	**Description**	**4662-12G or 4662-F12**	**4662-24G or 4662-F24**
00AK287	Expansion enclosure bezel, left	X	X
00AR272	0.6 m m-SAS-HD	X	X
00AR311	1.5 m m-SAS-HD	X	X
00AR317	3 m m-SAS-HD	X	X
00RY190	16 Gb short wave (SW) SFP	X	
00RY191	16 Gb long wave (LW) SFP	X	X
00RY309	Rack rail kit	X	X
00WK715	Power cord - DC	X	X
00Y2418	1 Gb Ethernet 4-port adapter	X	
00Y2436	LFF Enclosure bezel, right	X	
00Y2512	SFF Enclosure bezel, right		X
01AC311	DC Power supply	X	X
01AC381	SFF Enclosure midplane (FRU)		X

Table 71. Summary of 2U expansion enclosure replaceable parts (continued)			
P/N	**Description**	**4662-12G or 4662-F12**	**4662-24G or 4662-F24**
01AC404	AC Power supply	X	X
01AC555	LFF Enclosure midplane (FRU)	X	
01AC579	Expansion canister	X	X
01AC594	300 GB 15 K SFF HDD		X
01AC595	600 GB 15 K SFF HDD		X
01AC596	900 GB 10K SFF HDD		X
01AC597	1.2 TB 10K SFF HDD		X
01AC598	1.8 TB 10K SFF HDD		X
01AC599	2 TB NL SFF HDD		X
01AC600	400 GB SFF SSD		X
01AC601	800 GB SFF SSD		X
01AC602	1.6 TB SFF SSD		X
01AC604	4 TB NL LFF HDD	X	
01AC605	6 TB NL LFF HDD	X	
01AC606	8 TB NL LFF HDD	X	
01AC607	900 GB 10K LFF HDD	X	
01AC608	1.2 TB 10K LFF HDD	X	
01AC609	1.8 TB 10 K LFF HDD	X	
01EJ184	Quad-port 12 Gb SAS adapter	X	
01EJ186	Quad-port 10 Gb Ethernet adapter	X	
01EJ187	Quad-port 16 Gb FC adapter	X	
01EJ188	300 GB 15 K LFF HDD	X	
01EJ189	600 GB 15 K LFF HDD	X	
01EJ190	6 m m-SAS-HD	X	X
01EJ598	2 TB LC SFF SSD		X
01EJ599	4 TB LC SFF SSD		X
01EJ975	3.2 TB SFF SSD		X
01EJ995	10 TB 7.2 K 3.5-Inch NL HDD		X
01EJ997	7.68 TB 2.5" RI Flash drive		X
01EJ998	15.36 TB 2.5" RI Flash drive		X

Table 71. Summary of 2U expansion enclosure replaceable parts (continued)			
P/N	**Description**	**4662-12G or 4662-F12**	**4662-24G or 4662-F24**
01YM203	2.4 TB 10 K SFF HDD		X
01YM219	2.4 TB 10 K LFF HDD	X	
31P1630	10 Gb SW SFP	X	X
39M5068	Power cord - Argentina	X	X
39M5080	Power cord - Chicago	X	X
39M5081	Power cord - US/Group 1	X	X
39M5102	Power cord - Australia/NZ	X	X
39M5123	Power cord - Europe/ Africa	X	X
39M5130	Power cord - Denmark	X	X
39M5144	Power cord - South Africa	X	X
39M5151	Power cord - EMEA	X	X
39M5158	Power cord - Switzerland	X	X
39M5165	Power cord - Chile/Italy	X	X
39M5172	Power cord - Israel	X	X
39M5199	Power cord - Japan	X	X
39M5206	Power cord - China	X	X
39M5219	Power cord - Korea	X	X
39M5226	Power cord - India	X	X
39M5240	Power cord - Brazil	X	X
39M5247	Power cord - Taiwan	X	X
39M5377	Power cord - PDU Connection	X	X

High density expansion enclosure replaceable units

On 5U expansion enclosures, all replaceable parts are customer-replaceable units (CRUs).

Replacement parts listed here are for a 4662-92G, 4662-F92 expansion enclosure.

Expansion enclosure drives

Table 72. Supported expansion enclosure SAS drives	
Part Number	**Description**
01LJ037	600 GB 15 K disk drive
01LJ038	1.2 TB 10 K disk drive
01LJ039	1.8 TB 10 K disk drive
01LJ040	6 TB 7.2 K Near-Line SAS disk drive
01LJ041	8 TB 7.2 K Near-Line SAS disk drive

Table 72. Supported expansion enclosure SAS drives (continued)	
Part Number	**Description**
01LJ042	10 TB 7.2 K Near-Line SAS disk drive
01YM235	12 TB 7.2 K Near-Line SAS disk drive
01LJ043	1.6 TB tier 0 flash drive
01LJ044	3.2 TB tier 0 flash drive
01LJ045	1.92 TB tier 1 flash drive
01LJ046	3.84 TB tier 1 flash drive
01LJ047	7.68 TB tier 1 flash drive
01LJ048	15.36 TB tier 1 flash drive

Other expansion enclosure parts

Table 73 on page 222 summarizes the part numbers and feature codes for other parts.

Table 73. Other expansion enclosure parts		
Part Number	**Description**	**Comments**
00AR317	3 m 12 Gb SAS Cable (mSAS HD)	
00AR439	6 m 12 Gb SAS Cable (mSAS HD)	
01LJ114	Rail kit	
01LJ116	Front fascia (4U front cover)	
01LJ118	Display panel assembly	
01LJ120	PSU 1U fascia (cover)	The fascia must be removed to access the power supply units.
01LJ122	Power supply unit (PSU)	The expansion enclosure contains 2 PSUs. Each PSU requires a C19/C20 power cord.
01LJ124 (for use with enclosure P/N 01LJ112) 01LJ860 (for use with enclosure P/N 01LJ607	Secondary expansion module	The expansion enclosure supports two-secondary expansion modules. **CAUTION:** Use caution when you are removing or replacing a secondary expansion module from an enclosure with part number 01LJ112. Avoid contact with the connectors on the main board.
01LJ126	Fan module	The expansion enclosure contains four fan modules.
01LJ128	Expansion canister	
01LJ130	Cable management arms (CMA)	The part contains the upper and lower CMA.
01LJ132	Top cover	

Table 73. Other expansion enclosure parts (continued)

Part Number	Description	Comments
01LJ134	Fan interface board	
01LJ607	Enclosure **Note:** Replaces enclosure P/N 01LJ112.	Includes the drive board, signal interconnect board, and internal power cables, in an otherwise empty enclosure.
39M5388	16A power cord C19/C20 2 m