PAC Storage PS 4000 Next Generation Series

Hardware Manual

Version 1.0
September 2019

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Safety Precaution

Read these instructions carefully before you install, operate, or transport any PAC Storage systems and expansion systems.

Energy Hazards Precaution

This equipment is intended to be used in a restricted access location, like a computer room. Only allow access to SERVICE PERSONS or users who have been instructed about the metal chassis of the equipment, which may have hazardous energy that service persons must pay attention or take special protection before touching it. Also, the access is through the use of a key or security identity system. Only the authorized and well-trained personnel can access the restricted access location.

Installation and Operation

- Install the rack cabinet and the associated equipment at a site where the ambient temperature (special room cooling equipment may be required) stays lower than 35°C.
- Install the power source socket outlet near the enclosure where it is easily accessible and ground the rack cabinet.
- Secure airflow clearance inside and around the rack cabinet.
    - Secure an 18 to 20 cm clearance on the rear side.
    - Do not cover the enclosure openings.
    - Route the cables inside the rack cabinet.
    - Do not leave drive bays empty as it will affect airflow efficiency.
- Secure each enclosure module using its retention screws.
- Place power cords and other cables away from foot traffic. Do not place items on top of power cords and ensure they do not rest against data cables.
- Install all modules to the enclosure before turning on the systems.
- Ensure that the correct power range is tested before turning on.
- DO NOT remove the covers or replaceable modules if they are not faulty.
- If the system is not used for a long period of time, disconnect it from the power outlet to avoid transient over-voltage.
- For power source redundancy, please make sure that the two PSUs are plugged into two different power sources (i.e. different circuit breakers).

Service and Maintenance

- Keep the faulty module in place until you have a replacement unit; an empty module greatly affects the airflow efficiency within the enclosure.
- During service operation, place the enclosure on a soft and clean surface to prevent exterior damage. Do not place tools or other items on top.
- When transporting the enclosure, repackage all disk drives separately in the original package foam blocks. Replaceable modules can stay in the enclosure if you are using the original package; if not, repackage them separately as well.
- Disconnect the power cords before servicing or cleaning the enclosure.

- Use a slightly moistened paper sheet or cloth for cleaning. Avoid using liquid or sprayed detergent.

- When replacing components, insert them as gently as possible while assuring full engagement. Vibration and shock can easily damage hard drives.

- Only qualified service personnel should open the enclosure.

- Contact service personnel if any of the following situations occurs:

  - The power cord or plug is damaged.

  - The enclosure has been exposed to moisture.

  - The system has not been working properly.

  - The enclosure was dropped against a hard surface.

  - The enclosure shows obvious signs of breakage.

- To move the enclosure, more than one person might be necessary due to its weight. Drives should be removed from the enclosure beforehand.

Important Notice

The use of PAC Storage certified components is strongly recommended to ensure compatibility, quality, and normal operation with your PAC Storage products. Please contact your distributor for a list of PAC Storage certified components (e.g. SFP, SFP+, HBA card, iSCSI cable, FC cable, memory module, etc.).

ESD Precautions

- Handle the modules by their retention screws, ejector levers, or the module's metal frame/faceplate only. Avoid touching the PCB boards or connector pins.

- Use a grounded wrist strap and an anti-static work pad to discharge static electricity when installing or operating the enclosure.

- Avoid dust, debris, carpets, plastic, vinyl, and Styrofoam in your work area.

- Do not remove any module or component from its anti-static bag before installation takes place.

- Drives must not be stacked on top of each other without their protective drive trays. Even when drives are fixed in the drive trays, contacting the exposed PCB or rear-side interface may damage the drives.

About this Manual

The manual introduces hardware components of PAC Storage PS 4000 Gen2 Series storage system and expansion enclosures. It also describes how to install, monitor, and maintain them.

- For non-serviceable components, please contact our support sites.

- Firmware operation: Consult the Firmware User Manual on the CD-ROM.

Revision History

Version	Date	Description
1.0	September 2019	Initial release

Hardware Specifications

Specification Summary

Form Factor	2U 12-bay PS 4012 Gen2 2U 25-bay PS 4025 Gen2 3U 16-bay PS 4016 Gen2 4U 24-bay PS 4024 Gen2
CPU	**PS 4000 Gen2 Series:** - Intel Skylake-D (Xeon-D) 8-Core
Controller	Dual redundant controllers
Host Ports	**Onboard host ports:** - 8 x 10GbE ports (SFP+) (4 per controller) **More host options:** - 16 x 16Gb/s Fiber Channel ports (8 per controller, No Remote Replication support) - 8 x 32Gb/s Fiber Channel ports (4 per controller) - 8 x 10GbE ports (SFP+) (4 per controller) - 8 x 10GbE ports (RJ-45) (4 per controller) - 8 x 25GbE ports (SFP28) (4 per controller) - 8 x 12Gb/s SAS ports (4 per controller) **NOTE: Fiber channel supports point-to-point and switch mode.**
Cache Memory	Default DDR4 16GB, up to 32GB, 64GB, 128GB, 256GB or 512GB
Cache Backup Technique	Super capacitor + Flash module
Maximum Number of Drives	Via expansion enclosure: 448 and 896 (with expansion board)
Drive Connectivity	12Gb/s SAS
Drive Advanced Features	S.M.A.R.T. support/ Automatic bad-sector reassignment/ Dedicated bandwidth to each connected drive
Supported Drives	2.5-inch SAS SSDs 2.5-inch SATA SSDs 2.5-inch 10,000 RPM SAS drives 2.5-inch 15,000 RPM SAS drives 3.5-inch 7,200 RPM Nearline SAS drives 3.5-inch 7,200 RPM SATA drives **NOTES:** 1. **MUX board is required when using SATA drives for dual controllers.** 2. **For the latest compatibility details, please refer to Compatibility Matrix.**
Protocol Support	**File level protocol:** CIFS / SMB AFP NFS FTP FXP WebDAV

(See next page)

Specification Summary

|	
EonCloud Gateway	**Block level protocol:** FC FCoE iSCSI SAS **Object protocol:** RESTful API
EonCloud Gateway	Support the integration with following cloud providers: - Amazon S3 - Microsoft Azure - Alibaba Cloud - Google Cloud - Baidu Cloud - Tencent Cloud - OpenStack
Expansion Enclosure Supported Models	PS12J2 PS16J3 PS24J2 PS60J4
RAID Functionality	Global, designated, or enclosure hot-spare RAID levels supported: RAID 0, 1, 3, 5, 6, 10, 30, 50, 60 Online expansion by: - Adding new drives - Copying and replacing drives with drives of larger capacity RAID migration Configurable stripe size and write policy per system Intelligent drive handling: - In degraded mode: skips irreparable blocks to continue rebuild - In normal operation: data-block verification and repair
Green Design	- 80 PLUS-certified power supplies delivering more than 80% energy efficiency - Intelligent multi-level drive spin-down
Availability and Reliability	Redundant, hot-swappable hardware modules/ CacheSafe technology/ Device mapper support
Power	Power supplies: Redundant/hot-swappable 530W x 2 AC voltage: 100VAC @ 10A to 240VAC @ 5A with PFC (auto-switching) Frequency: 47-63Hz
Environment	Temperature: - Operating: 0 to 40°C without BBU or CBM / 0 to 35°C with BBU or CBM - Non-operating: -40 to 60°C Altitude: - Operating: sea level to 3,048m (10,000ft.) - Non-operating: sea level to 12,192m (40,000ft.) Relative humidity: - 5 to 95% non-condensing, operating and non-operating

(See next page)

Specification Summary

| Regulatory	Safety: UL, BSMI, CB Electromagnetic compatibility: CE, BSMI, FCC
Dimension	**PS 4012 Gen2** - 447mm x 88mm x 500mm **PS 4025 Gen2** - 447mm x 88mm x 500mm **PS 4016 Gen2** - 447mm x 130mm x 500mm **PS 4024 Gen2** - 447mm x 175mm x 500mm **NOTES:** **· The dimensions do not include chassis ears / protrusions.** **· The dimension order is W x H x D.**
Package Dimension	**PS 4012 Gen2** - 780mm x 379mm x 588mm **PS 4025 Gen2** - 780mm x 340mm x 588mm **PS 4016 Gen2** - 780mm x 423mm x 588mm **PS 4024 Gen2** - 780mm x 465mm x 588mm **NOTE: The dimension order is W x H x D.**

Package Contents

Check the **Unpacking List** for the complete list of contents and exact quantity of the components of your system.

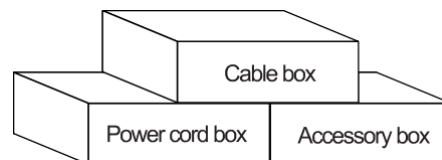**NOTE:** The contents and quantity may vary depending on the system model and order requests.

System Package
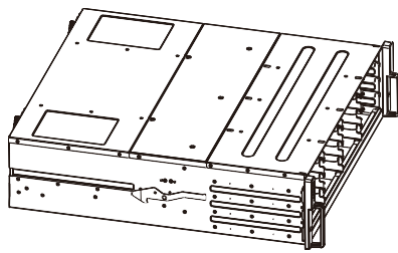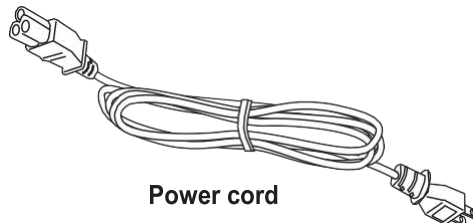
Enclosure chassis
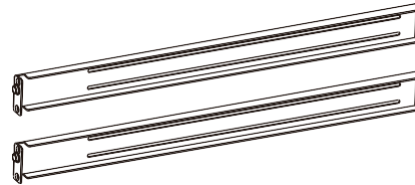
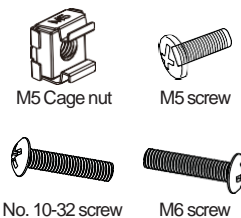**Rackmount kit**

Unpacking list and China RoHS compliance documentation

Cable box

Power cord box   Accessory box

Power cord, cable, and accessory boxes

Power Cord, Cable, and Accessory Boxes

Power cord

M5 Cage nut   M5 screw

No. 10-32 screw   M6 screw

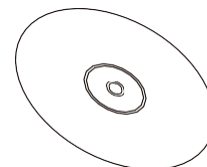**Mounting enclosure screws and nuts**
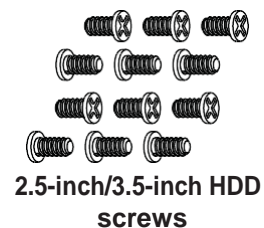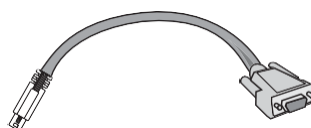
2.5-inch/3.5-inch HDD screws

PAC Management Software Quick start guide

Quick installation guide

PAC Management Software CD

RS-232C serial cable (mini USB to DB9)
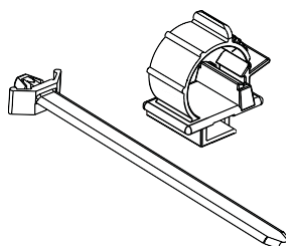
Power cord clamp set

Pre-Installed Components
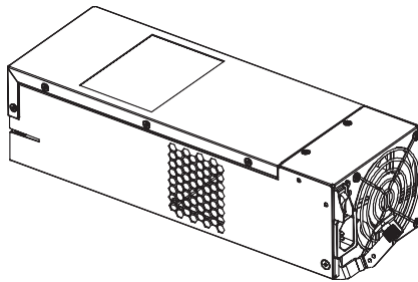
PSU/cooling module
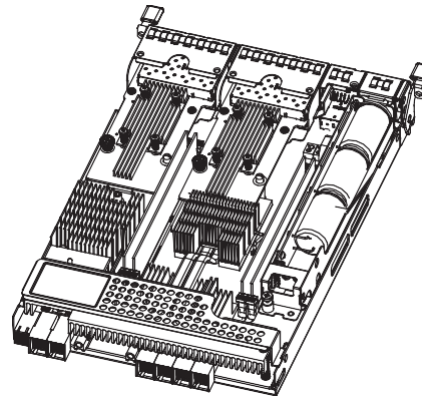
Controller module
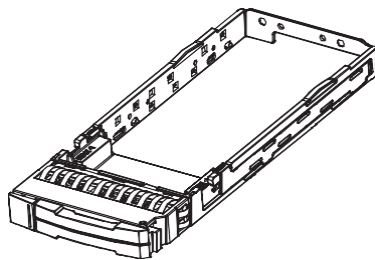
**HDD tray
(PS 4025 Gen2 only)**

Rackmount Kit Contents
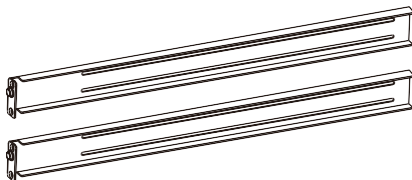
**2 x Rack ear brackets
(left and right)**

- OR -
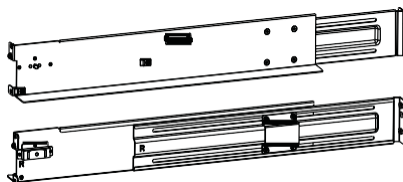
**2 x Rack slide rails
(left and right)**

2 x Inner glides

**6 x L4 No. 6-32
flathead screws**

**8 x 9.0 mm M5
truss head screws**

4 x M5 cage nuts

4 x 25 mm M5 screws

4 x 25 mm M6 screws

**4 x 25.4 mm
No. 10-32 screws**

NOTE: See section **2.2.2 Installing the Rackmount Kit** for the types of mounting kit and the exact package contents.

Product Introduction

This chapter introduces the look and feel of PAC Storage PS 4000 Gen2 Series systems, features, and the supported components.

1.1 Overview

This manual introduces PAC Storage PS 4000 Gen2 systems that support 3 Gbps, 6 Gbps, and 12 Gbps SAS and Nearline SAS, SATA hard drives and SSDs. These systems are designed to utilize 2.5-inch and 3.5-inch hard drives. Drive capacity can be expanded by attaching expansion hard drive enclosures.
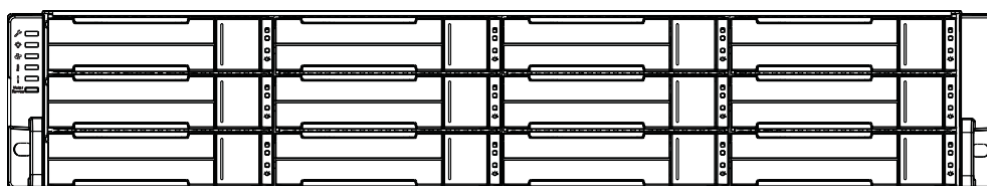
PS 4012 Gen2
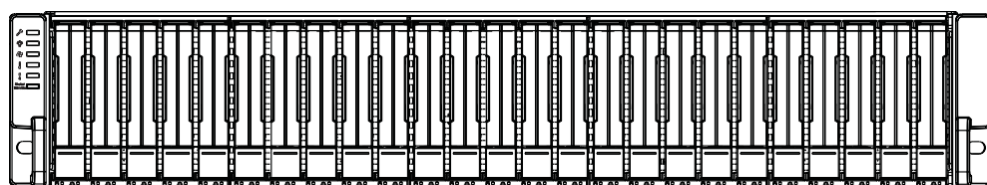
PS 4025 Gen2
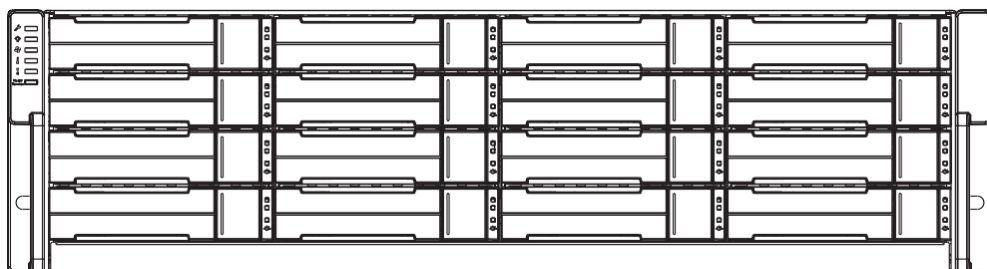
PS 4016 Gen2

PS 4024 Gen2

1.1.1 Major Components

NOTE: Upon receiving the system, check the package contents and compare them to the **Unpacking List**. If one or more of the modules are missing, please contact your system vendor.

Controller and Interface

Each system has controllers, and each controller comes with pre-installed DIMM modules. It also has a CBM (cache backup module), a module that has a super capacitor and an FBM (flash backup module). With the CBM, the cached data is quickly distributed to the FBM to save the data permanently with the support of the super capacitor if power outage occurs. With the super capacitor's fast-charging feature, it can distribute a fair supply of power to the controller, so the controller can save cached data to the FBM immediately and permanently.

Also, the embedded firmware features earth-friendly and smart algorithms that you can use to customize your system's hardware settings such as power-saving modes, variable fan speeds, and exiled drive handling.

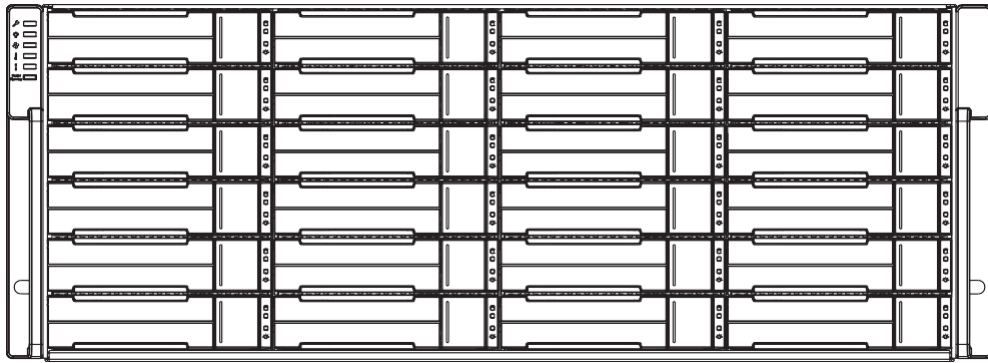#### Expansion Controller and Interface

The expansion enclosure is managed by expander controllers that distribute data flow to individual disk drives and report operating status through a proprietary enclosure service via in-band protocols. The enclosure, along with other expansion systems, connects to a SAN system and serves as a building block of a scalable configuration.

For supported protocols, the firmware supports communications with enclosure devices, SAS/SATA disk drives, and SAN system that features SAS expansion ports.

For physical connection, the SAS interface provides easy cabling routes via mini-SAS connectors. With the backplane-adapting SAS or SATA drives, the system can support enterprise-class SAS, Nearline SAS, and cost-effective SATA-II or SATA-III hard drives or SSDs. This connection is ideal for adding large capacity storages to a storage pool.

Power Supply Unit/Cooling Module

There are two PSUs in the system. Each PSU is hot-swappable and is built with a fan to protect the system from overheating while providing constant power. The modular architecture of the system and easy accessibility to all major components provide you an easy maintenance.

1.2　Chassis

This section describes the front and rear panels of PAC Storage PS 4000 Gen2 Series' rugged storage chassis. The chassis are designed to allow installation to the rack or a cabinet.

1.2.1　Front Panel

2U Systems

PS 4012 Gen2

PS 4025 Gen2

3U System

PS 4016 Gen2
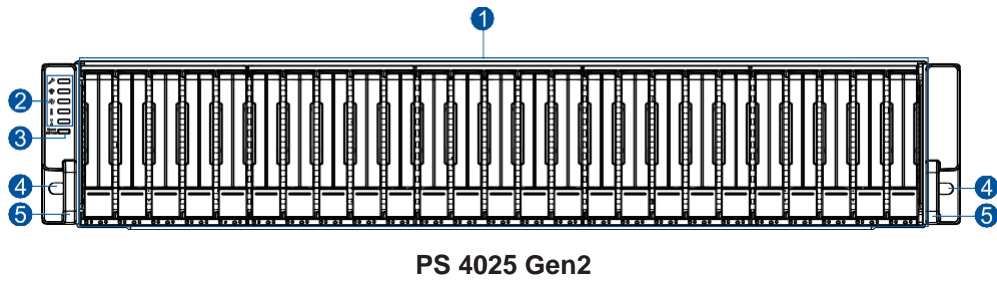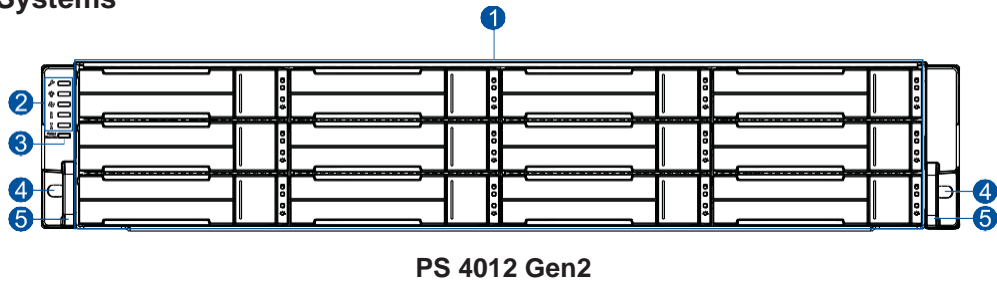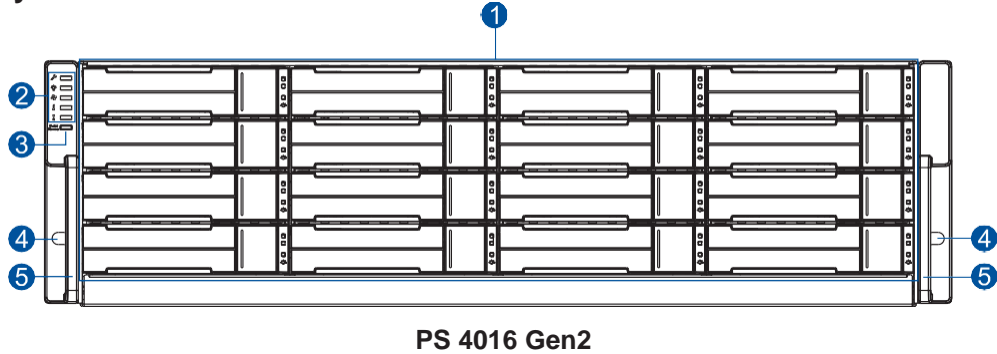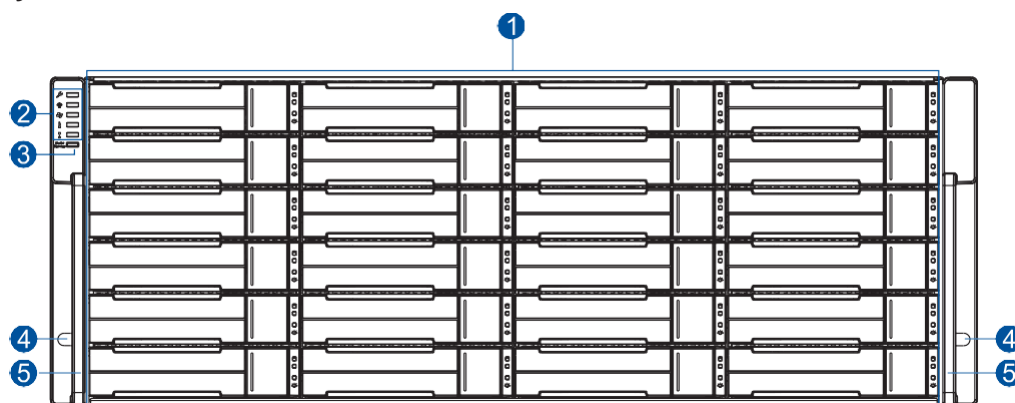
4U System

PS 4024 Gen2

Number	Part	Description
1	Drive Trays	Each drive tray is hot-swappable and holds a 2.5-inch or 3.5-inch hard drive.
2	LED Panel	LED panel has service, power, cooling module, temperature, and system LEDs.
3	Mute Button/ Service LED	This button mutes the alarm while the embedded Service LED notifies you that the system requires service.
4	Rackmount Holes	These holes secure the enclosure to the rackmount kit with the mounting screws.
5	Handles	These handles allow you to push/pull the enclosure to/from the cabinet installed in the rackmount kit.

1.2.2   Rear Panel

Single Controller Systems
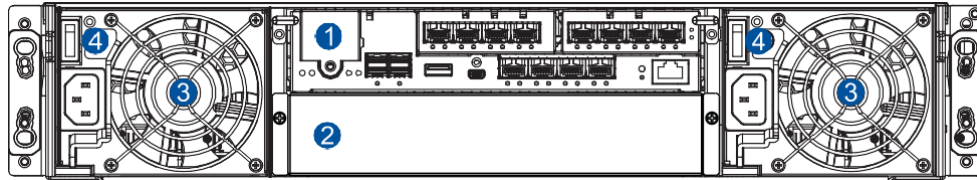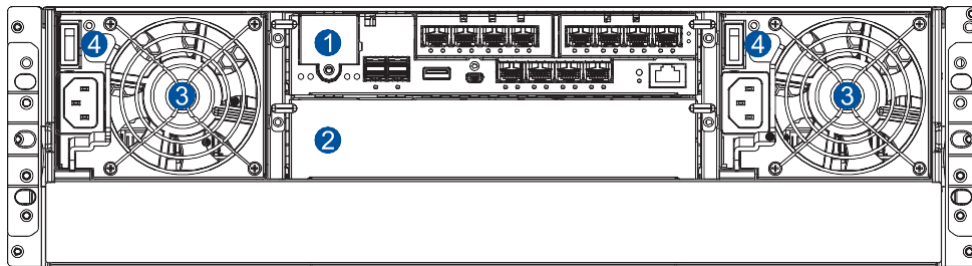
2U Systems
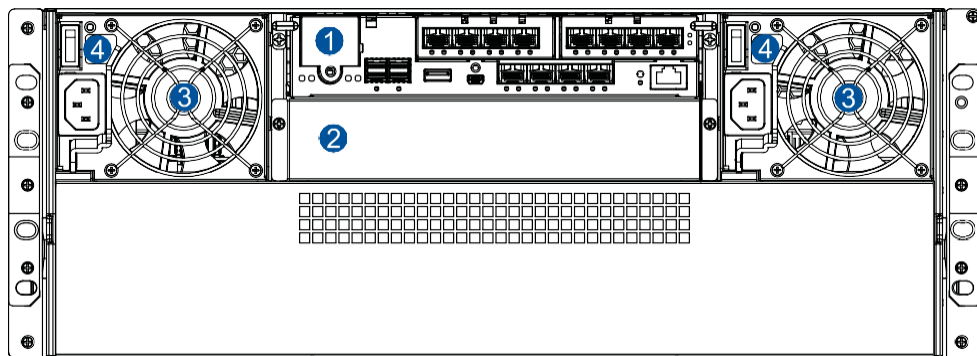
3U System

4U System

Dual Controller Systems
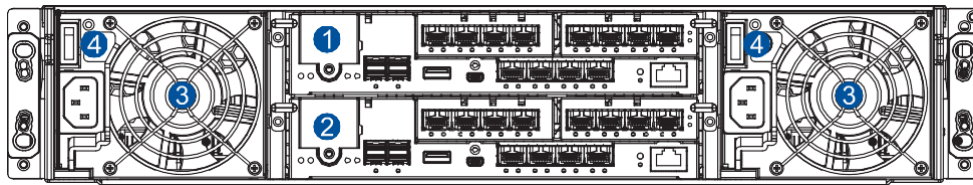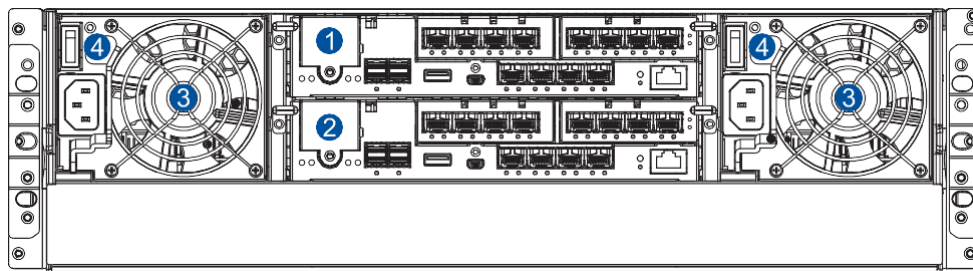
2U Systems
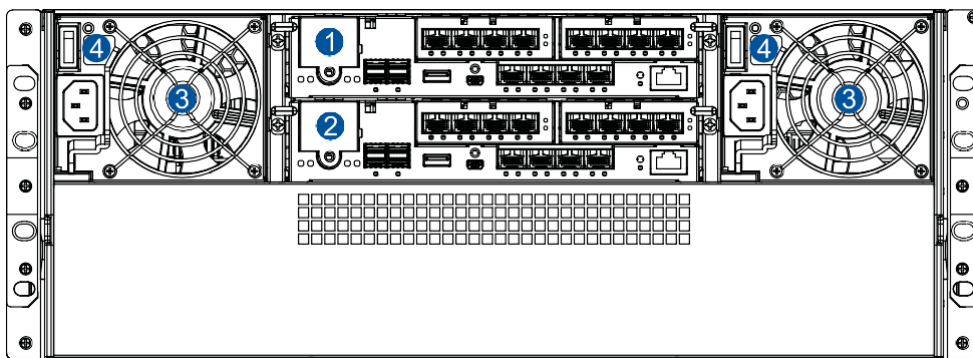
3U System

4U System

Number	Part	Description
①	Controller A	This controller module contains the SAS expansion board which distributes I/O functions to and from the managing RAID system. This also handles the status of the components via the SAS links with the RAID system.
②	Controller B or Dummy Cage	This part contains the second controller, also called the redundant controller. This controller takes over the system functions when Controller A fails to process. For single controller system, this contains a dummy cage.
③	PSUs/Cooling Modules	These hot-swappable PSUs provide power to the storage system and each PSU has a cooling module.
④	Power Buttons	These buttons allow you to turn ON/OFF your storage system.

1.2.3 Internal Backplane

The internal backplane is a circuit board that separates the front and rear parts of the chassis. This board provides logic level signals and low voltage power paths. The thermal sensors and I^2C devices are embedded to detect system temperatures and PSU operating status. This board is comprised of non user-serviceable components.

> **WARNING!**
>
> - Accessing the backplane board may lead to serious damage to the system.
> - Physical contact with the backplane board may cause electrocution.

1.3 Front Panel Components

This section describes the front panel components of PS 4000 Gen2 Series systems.

1.3.1 LEDs and Button Panel

The LEDs on the panels allow you to know your system's current status when turned on, while the buttons have a specific function that you can set.

2U Systems **3U System** **4U System**
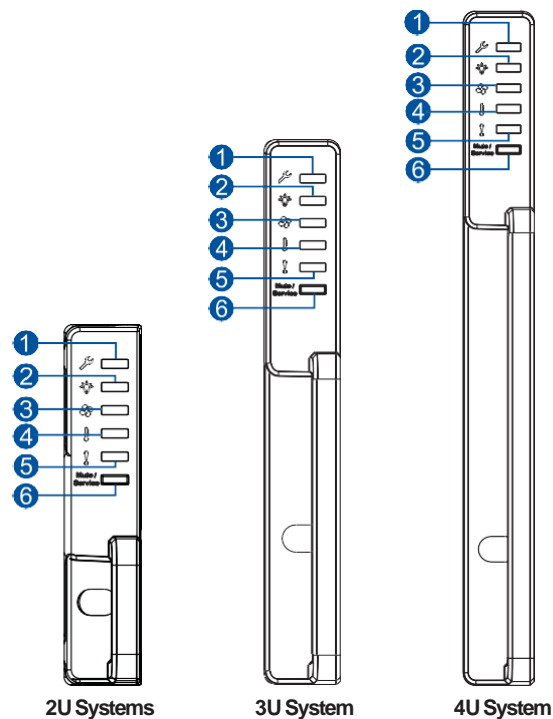
Number	Part	Description
1	Service LED	This LED provides the status when the system requires service or currently in service.
2	Power LED	This LED provides the status of the system's power.
3	Cooling Module LED	This LED provides the cooling module's status.
4	Temperature LED	This LED provides the system's temperature status.
5	System LED	This LED provides the system's operation status.
6	Mute Button/ Service LED	This button mutes the alarm while the embedded Service LED notifies you that the system requires service.

NOTE: For more details regarding the LEDs and their respective status, refer to **3.1.1 LEDs**.

WARNING! If critical faults are indicated on the LED panel, verify the cause of the problem as soon as possible and contact your system vendor for a module replacement.

1.3.2   Drive Tray Bezel

The drive tray bezel is designed to accommodate both SAS and SATA-interfaced hard disk drives. Get familiarized of the components of your system's drive tray bezel.

PS 4012 Gen2, PS 4016 Gen2, and PS 4024 Gen2
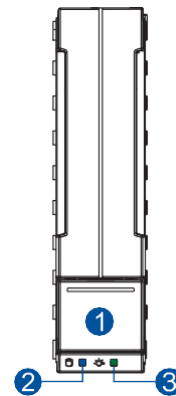
PS 4025 Gen2

Number	Part	Description
1	Release Button	This button unlocks the drive tray from the drive tray slot.
2	Drive Busy LED	This LED provides the status of the hard disk drive.
3	Power Status LED	This LED provides the power status of the hard disk drive.

WARNING! Be careful not to drop or put heavy objects on the drive tray, as these may cause to bend or deform the drive tray's structure. If the drive tray is deformed, it may not fit into the system's drive bay.

1.4 Rear Panel Components

This section describes the rear panel components of GS 3000/4000 Gen2 Series systems.

1.4.1 Controller Module Interface

The I/O interfaces of the controller module allow you to connect to other devices and the LEDs allow you to know the status of your controller.
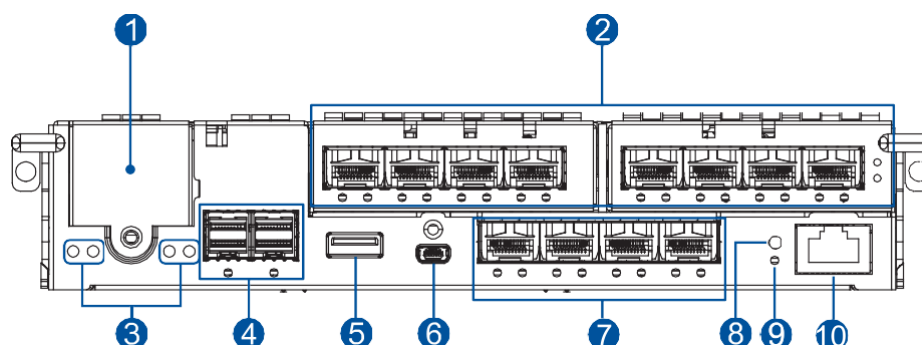
Number	Part
❶	CBM (Cache Backup Module)
❷	Host Board Ports
❸	Controller Status LEDs
❹	SAS Expansion Ports
❺	USB 3.0 Port
❻	Mini USB Connector (Console)
❼	Onboard Host Ports
❽	Restore Default Button
❾	Restore Default LED
❿	Ethernet Management Port

WARNING! The PS 4000 Series controller module is built of sensitive and non-replaceable components. You can only replace the controller module when you already have the replacement. Unnecessary tampering may damage the controller.

NOTES:

• The host boards are add-on components.

• The Ethernet management port supports 100 Mbps and 1 Gbps speeds.

• Whenever an onboard host port cable is not plugged in, insert the dust cap bundled in the package.

• For more information about CBM, see section **1.4.4 Super Capacitor and Flash Backup Module**.

1.4.2   Controller Module Interfaces of the JBOD Models

The expansion controller contains a circuit board within a metal canister, integrated with the hot-swap docking connectors at the backend. The SAS wide ports on the interface faceplate connect to a managing PS system or other expansion systems.

Number	Part
❶	Extraction Levers/Screw Holes
❷	SAS Expansion Port Status LEDs
❸	SAS Expansion Ports
❹	Controller Status LED
❺	Mini USB Service Port

WARNING! You can only remove the controller when you already have the replacement. The JBOD (expansion) controller is built of sensitive components. Unnecessary tampering may damage the controller.

1.4.3   PSUs/Cooling Modules

The PS 4000 Gen2 Series system has two redundant, hot-swappable PSUs that provide power and built with a cooling fan that helps with the airflow, providing an efficient ventilation.
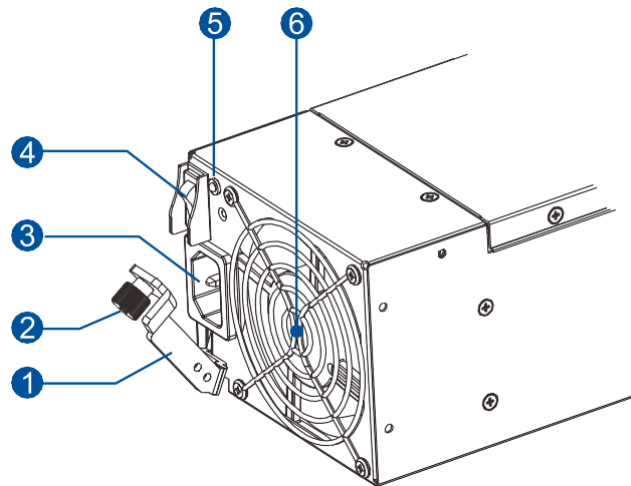
Number	Part
1	Extraction Lever
2	Retention Screw
3	Power Socket
4	Power Switch
5	PSU Status LED
6	Fan

When the cooling modules operate under normal conditions, the cooling fans run at a low speed. The cooling fans raise their rotation speed to increase the airflow under the following conditions:

- Component failure: if the cooling module, PSU, or a temperature sensor failed.

- Elevated temperature: if the temperature breaches the upper threshold set for any of the interior temperature sensors.

- During the initialization stage, the cooling fans operate at a high speed. The speed is lowered when the initialization is complete and no errors are detected.

> **NOTE:** There are two upper temperature thresholds: one for event notification and the other for triggering high fan rotation speed. You can change the preset values for event notification using the firmware-embedded configuration utility. Refer to the firmware operation manual for details.

1.4.4   Super Capacitor and Flash Backup Module

PS 4000 Gen2 Series system has a CBM (Cache Backup Module), which is comprised of a super capacitor and flash backup module, installed in the controller. The super capacitor provides power, allowing the system to store cached data to the flash backup module permanently in case of power interruption or outage.

Flash backup module
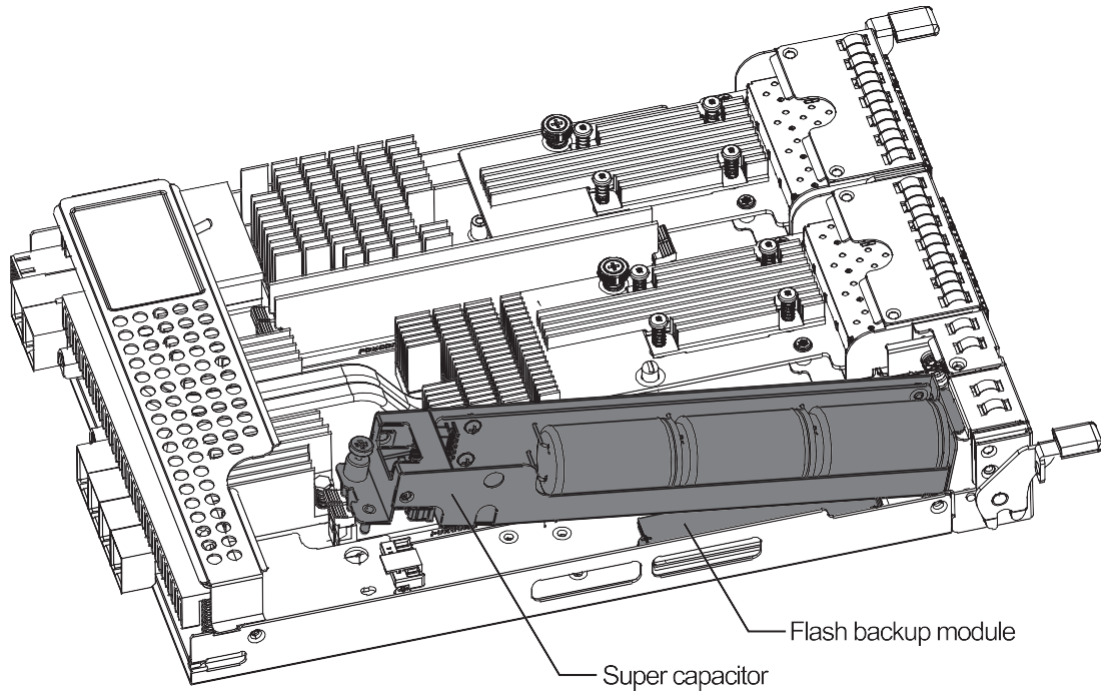
Super capacitor

NOTES:

- The super capacitor is partially charged when shipped. When you turn ON the system, the super capacitor will charge to its full capacity for a few minutes. If it is not charging, there may be a problem. Contact your system vendor immediately. You can also check the status of the super capacitor via the PAC Management Software or the firmware. Refer to the manuals for more details.

- The flash backup module is located under the super capacitor.

1.5 System Monitoring Features

This section describes the different types of system monitoring features that provide the operating status of each component.

1.5.1 Expansion Enclosure Support

Monitoring System

A managing PS system is aware of the status of connected expansion system's components such as:

- Expander controller (presence, voltage, and thermal readings)
- PSU/Cooling module
- Enclosure thermal sensor
- Service (the Service LED signals the specific enclosure)
- Hard disk drives

Expansion System Identifier

The managing system sets off the alarm and delivers the warning messages if there is a conflict between the expansion systems.

If more than one expansion system is connected to the managing PS system, each needs a unique enclosure ID set using the rotary switch on the LED panel. For example, the firmware automatically disconnects the second expansion system if it is connected online and comes with an ID identical to the first expansion system.

> **NOTE:** The expansion system IDs are numbers 1 to 15. For more details, see section **2.3.6 Expansion Connections**.

Cooling Module Speed Adjustment

If any of the detected temperature readings breaches the temperature threshold, the firmware running on the managing PS system automatically increases the rotation speed of all cooling fans.

Expansion Enclosure Status Monitoring

The system connecting with expansion systems (JBOD) can acquire the component status with other enclosures via a proprietary enclosure monitoring service using the in-band connectivity. No additional management connection is required.

I²C Bus

The detection circuitry and temperature sensors are interfaced via a non-user-serviceable I²C bus. When the expansion systems are connected to PS controllers, the component status is reported through in-band protocols over expansion links, which is managed by a proprietary enclosure service.

Firmware (FW) and PAC Management Software

- **Firmware (FW):** The firmware is preloaded and is used to configure the system. Access the FW via a terminal emulation program running on a management computer connected to the system's serial port.

- **PAC Management Software:** PAC Management Software is another browser-based GUI (graphical user interface) software that you can install into a local or remote computer and access via the network. The managing system communicates with the array via connection of the existing host links or the Ethernet link to the array's Ethernet port.

1.5.2   Audible Alarms

The system comes with audible alarms that are triggered when certain active components fail or when specific controller or system thresholds exceed. Whenever you hear an audible alarm, you must determine the cause and solve the problem immediately.

Event notification messages indicate the completion or status of array configuration tasks and are always accompanied by two or three successive and prolonged beeps. You can turn off the alarm using the mute button on the front panel.

> **WARNING!** Failure to respond when an audible alarm is set off can lead to permanent damage to the system. When you hear an audible alarm, solve the problem immediately.

1.6   Hot-Swappable Components

The system has a number of hot-swappable parts that you can change while the system is still online without affecting its operational integrity.

These hot-swappable components are user-maintained:

- Controller module
- PSU/cooling module
- Hard disk drive

> **IMPORTANT!** Only remove these hot-swappable components when replacement is needed.

> **NOTE:** A normal airflow ensures sufficient cooling of the system and this can only be attained when all components are properly installed. Remember to only remove the failed component if there is a replacement on hand. For more information on replacing hot-swappable components, see chapter **System Maintenance**.

Hardware Installation

2

This chapter describes installing the modular components such as hard drives, cards, and other optional installation or connections such as expansions and rackmount.

2.1 Installation Prerequisites

Take note of the following installation prerequisites before you start with the installation:

- **Static-free installation environment**

  Install the system in a static-free environment to minimize the possibility of ESD (electrostatic discharge) damage.

- **Component check**

  Before the installation, ensure that you received all required components by verifying the package contents with the **Unpacking List** document. This document is included in the package. If there are items missing and/or damaged, contact your vendor for a replacement.

- **Hard drives**

  The SAS/SATA drives are purchased separately and must be available before the system installation.

- **Cables**

  All cables that connect the system to the hosts are purchased separately. Contact your vendor for the list of compatible cables.

- **Memory modules**

  If you want to change the pre-installed DIMM modules, ensure that they are compatible and purchased from a qualified vendor. Contact your vendor for the list of compatible DIMMs.

- **Rackmount equipment**

  The rack slide rails are optional accessories. If you need to install it, see section **2.2.2 Installing the Rackmount Kit**.

  > **IMPORTANT!** Install the system first to the rack or cabinet before installing the hard drives into the system.

Ensure that you are familiar with the exact position of each plug-in module and interface connector. Also, ensure to handle the cables with care when connecting between systems installed in the rack with a correct routing paths carefully planned. DO NOT bend or twist the cables as this may cause emission interference and accidental cable disconnection.

2.2   Installation Procedures

This section details the installation procedures of the system, its components, and connections between equipment. The installation procedures in this section are in order, so it is strongly recommended that you follow the said order to reduce the time consumed during installation and prevent installation mistakes, technical mishaps, or physical injuries.

2.2.1   Unpacking the System

When your system package has arrived, check and confirm if the contents of your package are complete by referring to the **Unpacking List** document, which is bundled with your package.

Accessory Box Contents

This box contains the following:

- Serial port cable
- Screws
- Quick installation guide
- Support CD (PAC Management software and manual, firmware operation manual)
- Power cord clamp set
- Dust caps

Pre-Installed Components

Below are the components that are pre-installed in the system:

- Controllers
- LED front panels
- DIMM modules
- CBM (cache backup module)
- PSUs including the cooling modules
- Hard drive trays (for PS4025 Gen2 only)

Components that Need User Installation

You must do the following installation:

- Assembling of the system to the rack/cabinet
- Assembling the hard drives to the hard drive tray
- Installing the host boards
- Cabling in between systems

> **NOTE:** To install the system to the rack/cabinet, see section **2.2.2 Installing the Rackmount Kit**.

2.2.2   Installing the Rackmount Kit

This section details the overview of the rackmount kit, its assembly, and installation with the storage system.

> **IMPORTANT!** Please contact our technical support team if you need further help in installing your system/enclosure to the rack.

Preparing the User-Provided Tools

Before assembling the rackmount kit, you must prepare the following tools:

• 1 x Medium-sized Phillips screwdriver
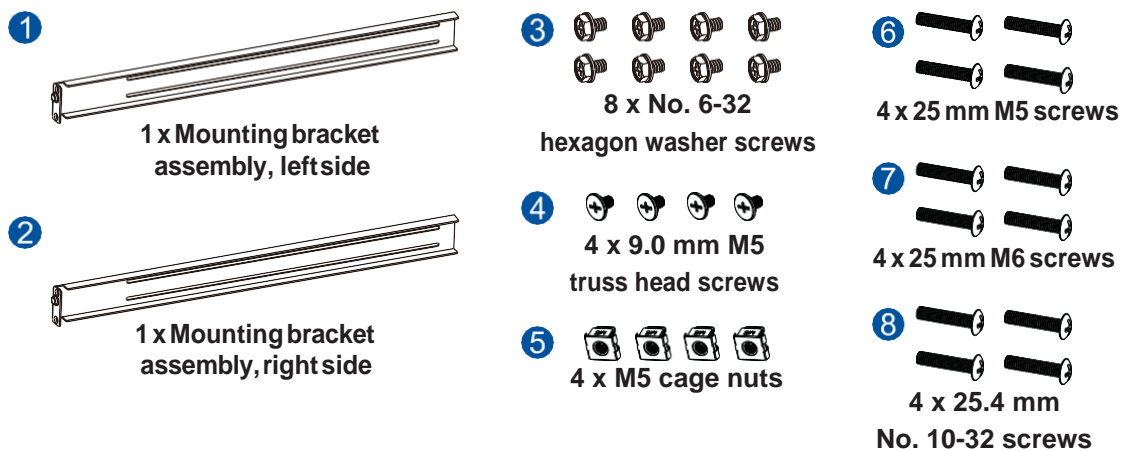
• 1 x Small-sized flat blade screwdriver

Types of Rackmount Kit

There are two types of rackmount kit depending on the systems:

• Rack ear mount kit

• Slide rail kit

Rack Ear Mount Kit Contents

Check your rack ear mount kit for the following contents.

1
1 x Mounting bracket assembly, left side

2
1 x Mounting bracket assembly, right side

3
8 x No. 6-32 hexagon washer screws

4
4 x 9.0 mm M5 truss head screws

5
4 x M5 cage nuts

6
4 x 25 mm M5 screws

7
4 x 25 mm M6 screws
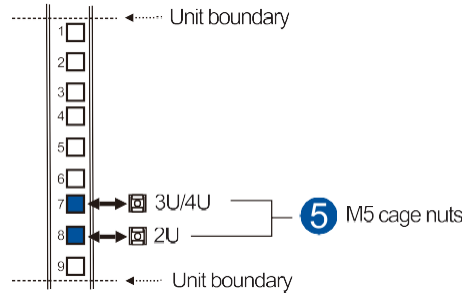
8
4 x 25.4 mm No. 10-32 screws
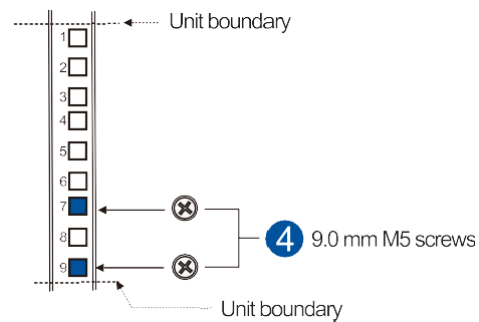
Assembling the Rack Ear Mount Kit

To assemble the rack ear mount kit:

1. Determine the position where the enclosure will be installed to the front and rear rack posts, then insert the cage nuts into the designated holes on the front rack posts.

Front rack post   **Rear rack post**

2. Install the fixed rails to the rear rack posts using the truss head screws.

3. To install the enclosure to the rack ear mount, this requires an assistance of another person. While one person holds the enclosure at the installation height, the other person secures the enclosure using two 25 mm M5 or M6 or 25.4 mm no. 10-32 screws at the front and eight no. 6-32 screws on the side panels, four on each side.

Slide Rail Kit Contents

Check your slide rail kit for the following contents.

1 1 x Mounting bracket assembly, left side

2 1 x Mounting bracket assembly, right side

3 2 x Inner glides

4 6 x L4 No. 6-32 flathead screws

5 8 x 9.0 mm M5 truss head screws

6 4 x M5 cage nuts

7 4 x 25 mm M5 screws

8 4 x 25 mm M6 screws

9 4 x 25.4 mm No. 10-32 screws

Assembling the Slide Rail Kit

To assemble the slide rail kit:

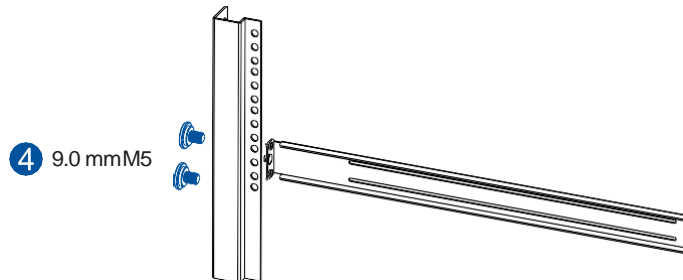1. Determine the position where the enclosure will be installed to the front and rear rack posts, then insert the cage nuts into the designated holes on the front rack posts and the truss head screws on the front and rear rack posts.
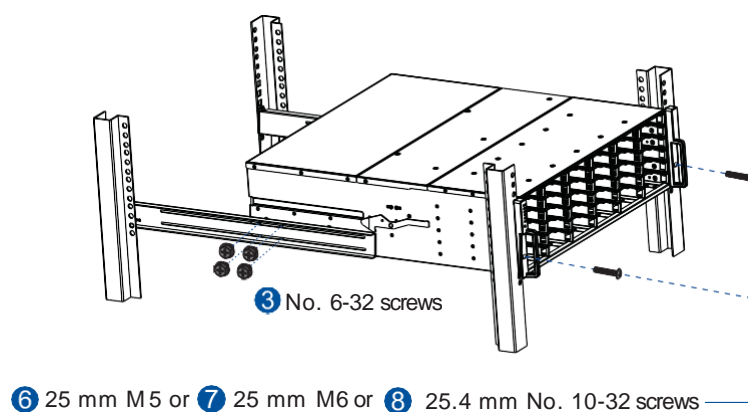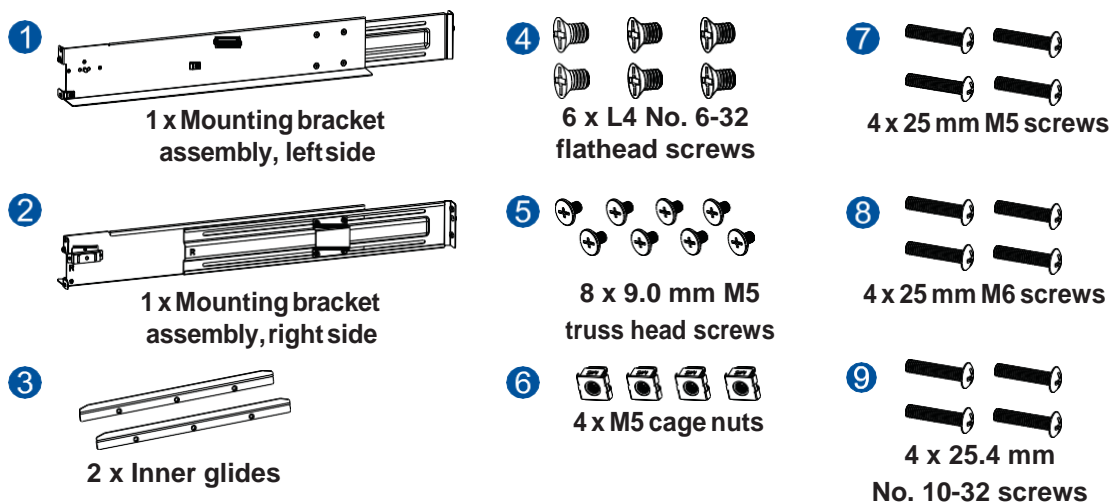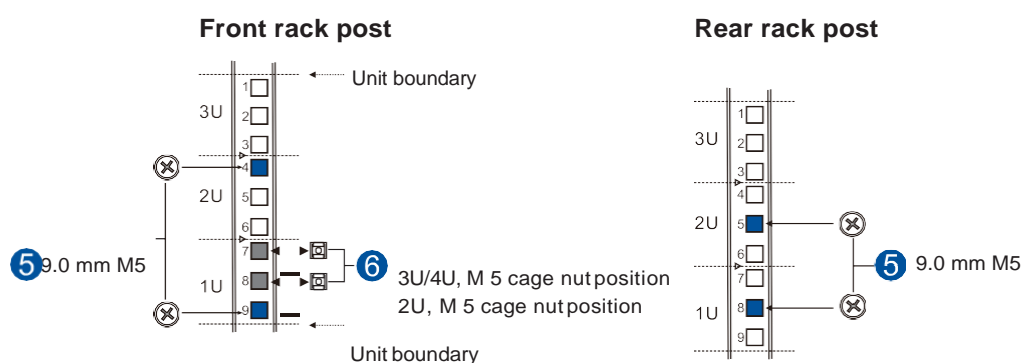
Front rack post

Unit boundary

3U
2U
1U

5 9.0 mm M5

6 3U/4U, M5 cage nut position
2U, M5 cage nut position

Unit boundary

Rear rack post

3U
2U
1U

5 9.0 mm M5

2. Loosen the four screws on the slide rail to adjust the length. After the length adjustment, secure the slide rails to the front and rear rack posts with the 9.0mm M5 truss head screws. Tighten the four screws on the slide rail to fix the length.

5 9.0 mm M5 screws

Inner glide rail

5 9.0 mm M5 screws
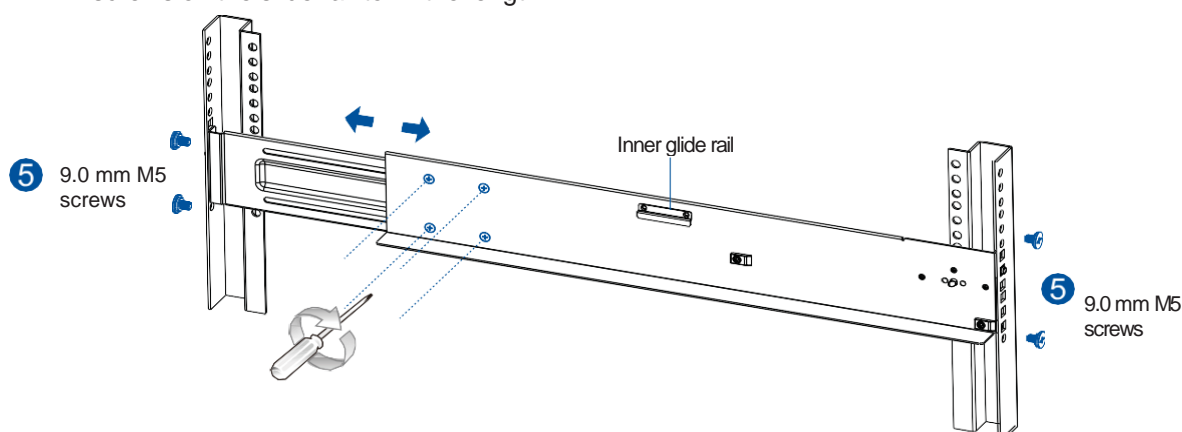
3. Attach the inner glides to both sides of the enclosure using the no. 6-32 flathead screws.
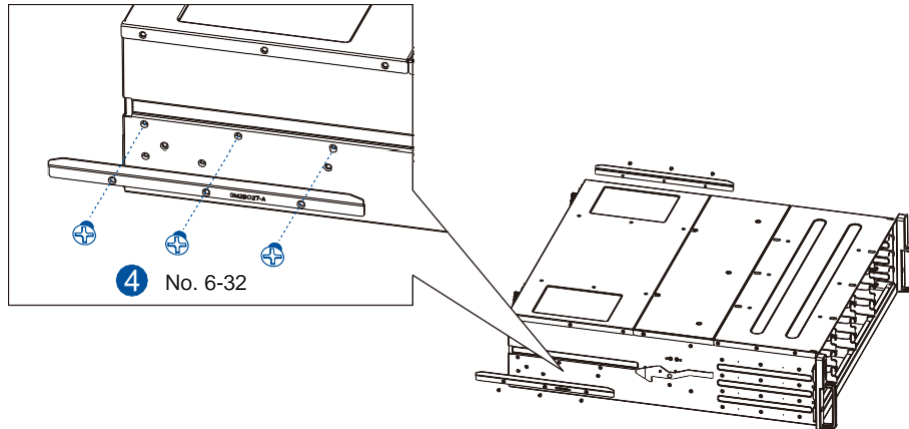
4. With the assistance of other two persons, lift and insert the enclosure onto the slide rails. Ensure that the inner glides on both sides of the enclosure meet the inner glide rails.

Chapter 2: Hardware Installation
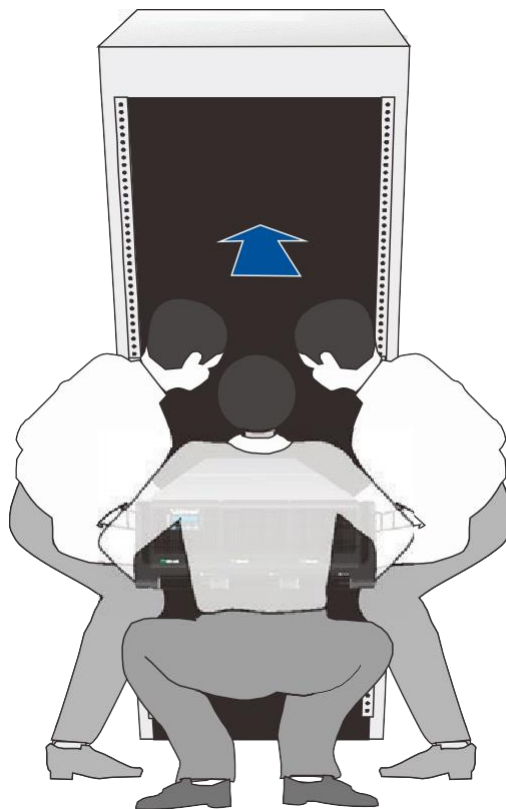
5. Secure the enclosure using the M5, M6, or no. 10-32 screws from the front.

⑦ 25 mm M5 or ⑧ 25 mm M6 or ⑨ 25.4 mm No. 10-32
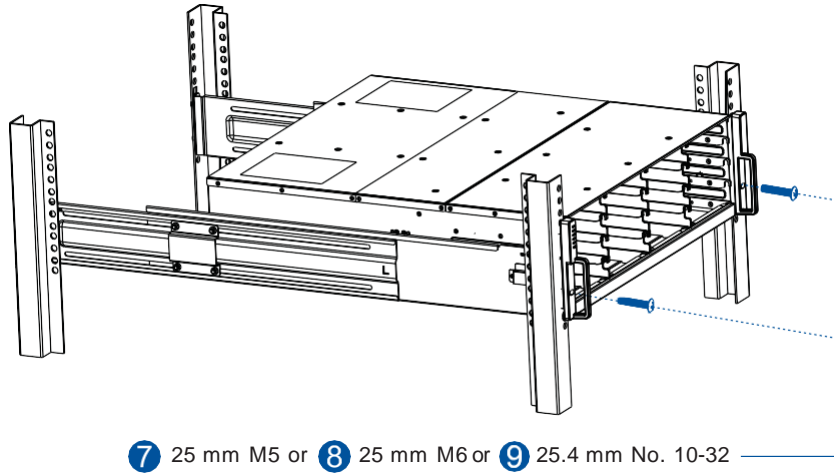
When the enclosure is already assembled to the cabinet, you can proceed to the next installation procedures of other components.

2.2.3   Installing the Hard Drives

This section gives you an overview of the hard drive requirements, installation, and important notices that you must take note.

NOTE: The hard drives are purchased separately.

IMPORTANT! • Ensure to install the enclosure to the rack first before installing the hard drives to the enclosure's drive bay. • You must install at least four hard drives for RAID 5 configuration or five hard drives for RAID 6 configuration to create an initial volume.

Hard Drive Installation Prerequisites

When purchasing hard drives, ensure to consider the following factors:

•   **Capacity (Mb/Gb)**

Purchase the hard drives that have the same capacity. This SAN storage uses the *least common denominator* approach, which means that the maximum capacity used in each drive to create a RAID array is the maximum capacity of the smallest drive. We strongly suggest using large storage capacity hard drives.

IMPORTANT! • The hard drives may carry different block numbers, which means that the capacity may not be the same even if they are of the same model with the same rate capacity made by the same manufacturer. • When configuring the hard drives into a RAID array, you can use a smaller capacity as the *maximum disk capacity* in every hard drive. For configuration options, refer to the interface-specific firmware manual that came with your enclosure.

•   **Profile**

The drive trays and bays of the system are designed for 2.5-inch or 3.5-inch hard drives.

•   **Drive type**

The system uses 3 Gbps SAS, 6 Gbps SAS, 12 Gbps SAS, and nearline SAS and SATA 3G/6G 2.5-inch and 3.5-inch hard drives.

| |
|---|
| **IMPORTANT!**

• Ensure that you purchase the correct hard drives.

• If you prefer using SATA hard drives in the attached expansions, ensure that you purchase MUX kits. |

Understanding the MUX Kit's Port Mechanism

If you install a SATA hard drive in a dual-controller system, this may require an MUX board. The MUX board is paired with a hard drive in order to switch data signals between controllers A and B's signal ports.

Controller A

Controller B

Standby mode

Hard drive

Backplane

MUX board
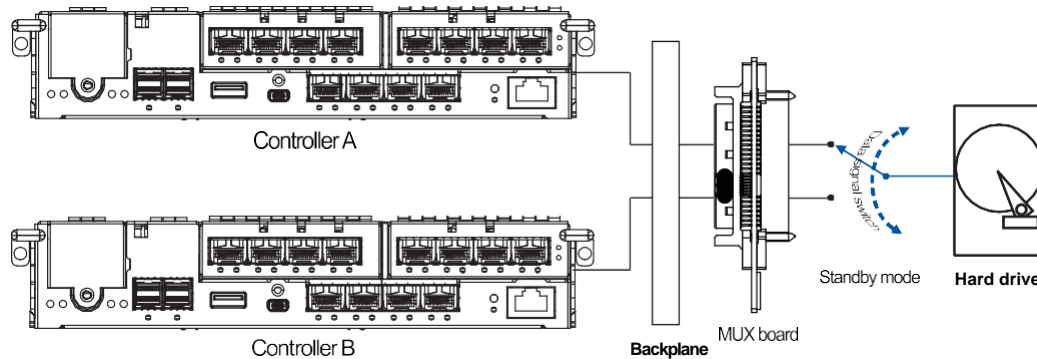
Under normal circumstances, the controller B's signal ports are in standby mode.

SAS and SATA Interfaces

The SAS interface features a dual-ported connectivity with pins on both sides of its connector while the SATA drives have only one port. In a redundant-controller system, the MUX-supported drive trays must be separately purchased and applied. The single-controller expansion systems do not require an MUX kit.


Keying notch

Data port

Power connector

SAS interface

Data port

Power connector
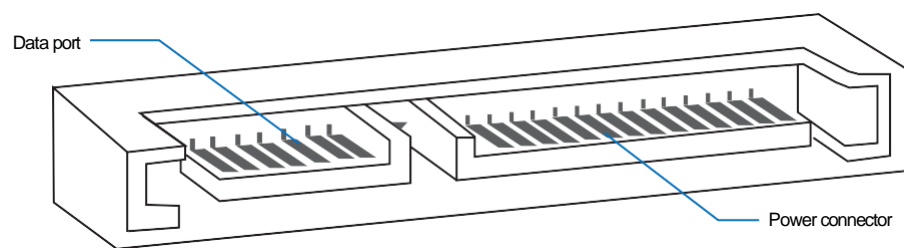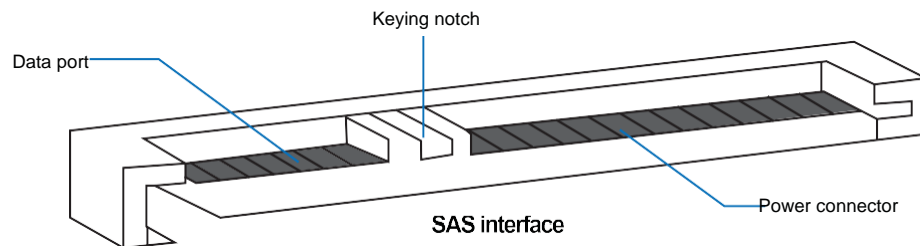
SATA interface

IMPORTANT!

- ONLY install the drive trays to the system if the system is already mounted to the rack. If the hard drives are installed to the system before mounting to the rack, the system will be heavy to mount and possible impact during installation may damage the hard drives.

- Handle the disk drives with extreme care and observe all ESD prevention procedures when installing the hard drives.

- ONLY use the screws that are bundled in the system package. Securing the drives with longer screws may damage them.

Hard Drive Designation

Get to know the exact order of the hard drives to avoid removing the wrong drives out of the enclosure.

PS 4012 Gen2

PS 4025 Gen2

PS 4016 Gen2
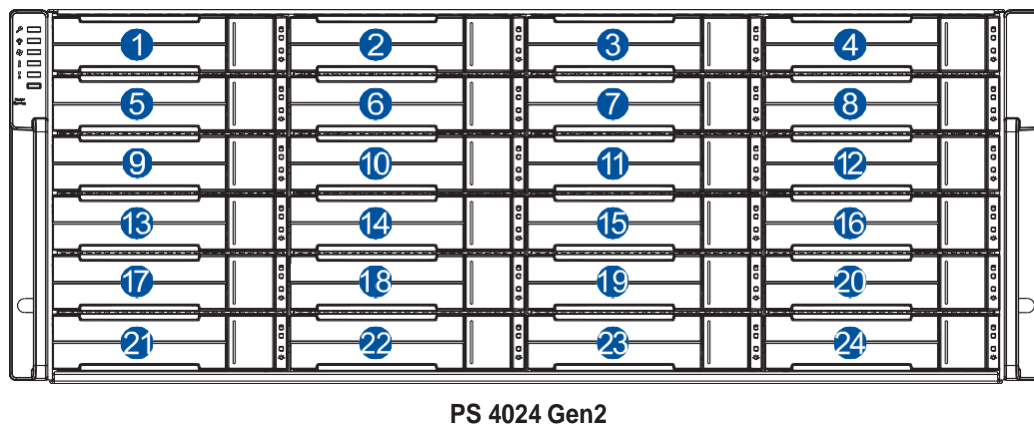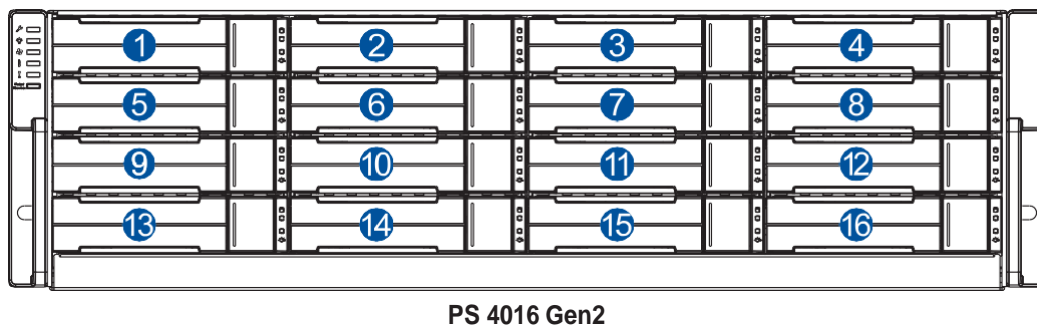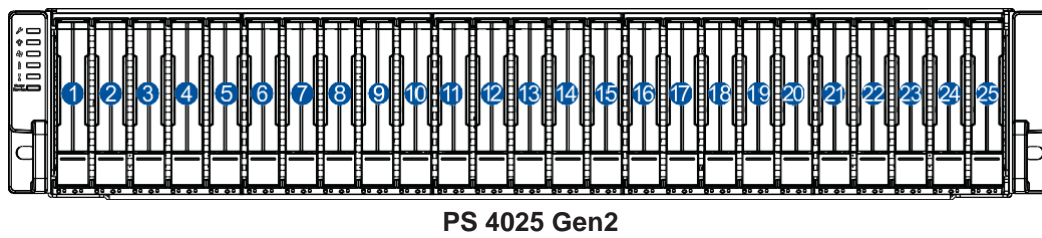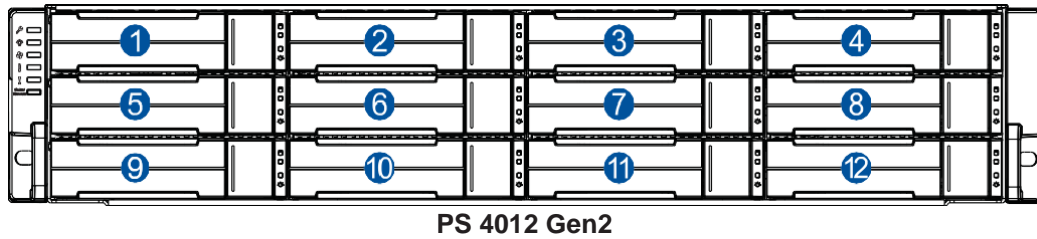
PS 4024 Gen2

> **IMPORTANT!** Install at least four hard drives for RAID 5 and five hard drives for RAID 6 to create an initial volume.

Installing the Hard Drive into the Drive Tray and Enclosure (for PS 4012 Gen2, PS 4016 Gen2, and PS 4024 Gen2)

To install the hard drive into the drive tray and enclosure, follow the steps below:

1. Press the release button to open the spring handle, then gently pull out the tray.
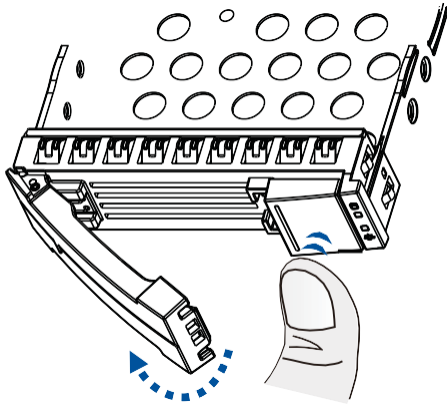
2. Orient the hard drive to the tray with the interface connectors facing the open side of the tray and the label is facing up.
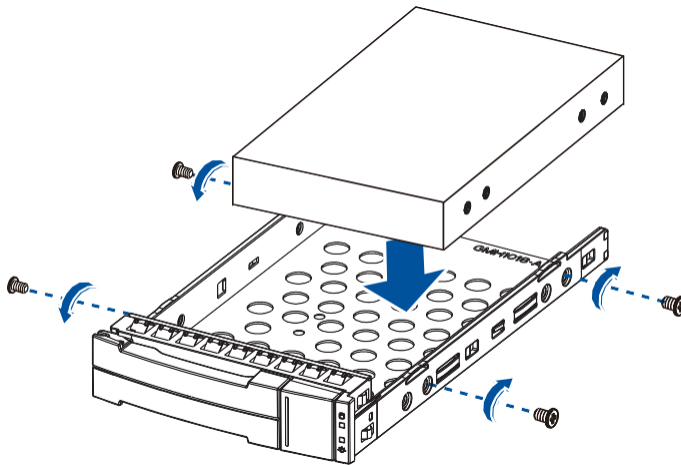
3. Secure the drive to the correct holes of the tray using the four bundled screws.

Screw hole location of 2.5-inch HDD/SSD on a 3.5-inch drive tray
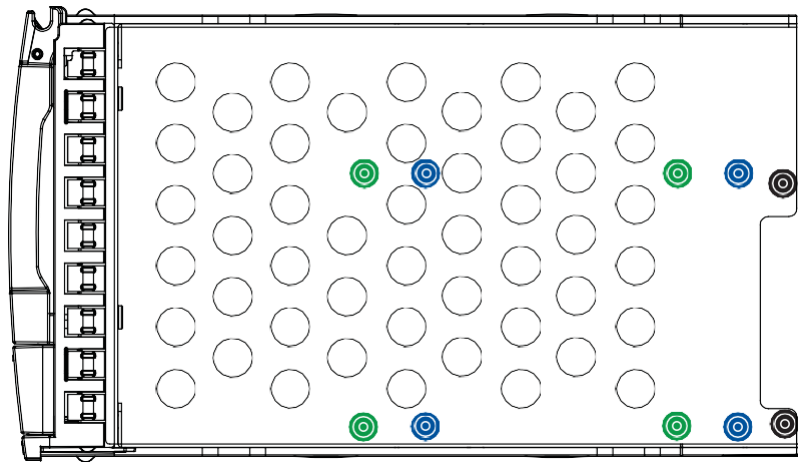
● HDD/SSD with MUX board
● HDD/SSD without MUX board
● MUX board screw holes

Screw holes of 3.5-inch SAS and SATA HDD

● HDD with MUX board
● HDD without MUX board

Screw holes of 2.5-inch SAS and SATA HDD

● HDD with MUX board
● HDD without MUX board

Chapter 2: Hardware Installation

4. Insert the assembled hard drive and tray to the enclosure with the spring handle open.
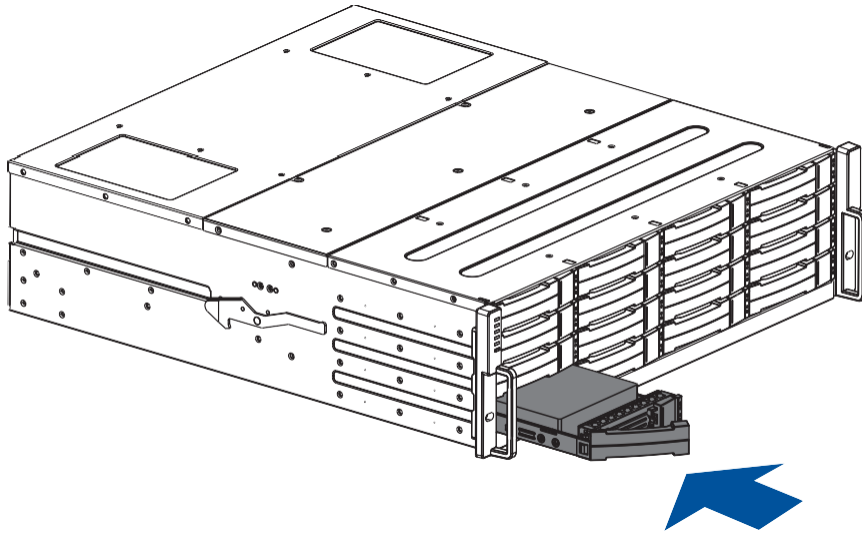
> **WARNING!** Ensure that your system has all the drive bays occupied with the drive trays even if there are no hard drives installed. Without the drive trays, the ventilation is compromised and may cause overheating.

5. When the tray is fully inserted to the bay, close the spring handle.
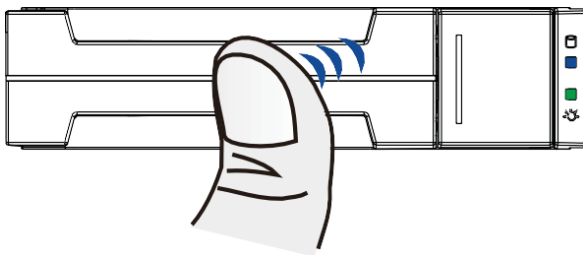
**Installing the Hard Drive into the Drive Tray and Enclosure (for PS 4025 Gen2 only)**

To install the hard drive into the drive tray and enclosure, follow the steps below:

1. Press the release button to open the spring handle, then gently pull out the tray.
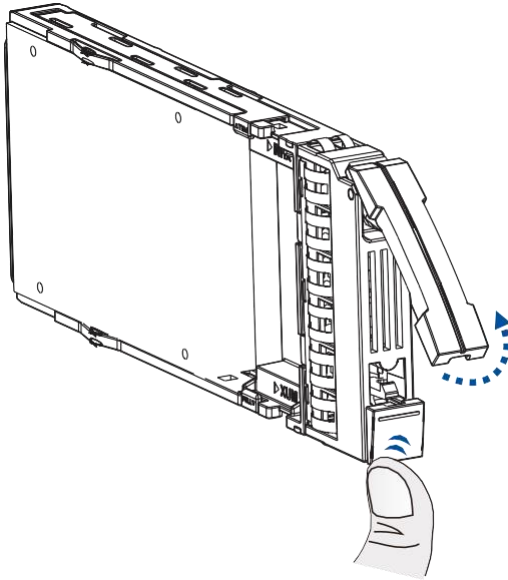
2. Place the hard drive into the tray.

    With MUX Board:

    a. Attach the MUX board to the drive.
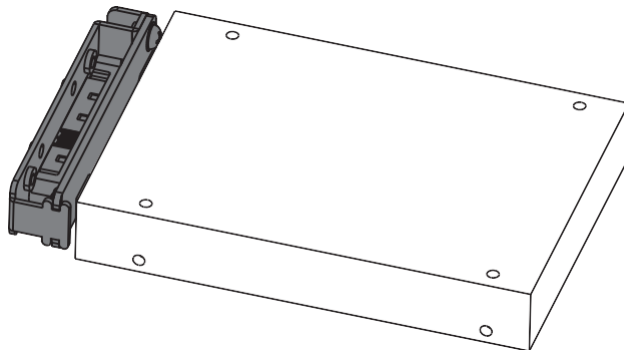
    b. Place the hard drive on the tray (A), then secure the clips to both sides of the tray (B).
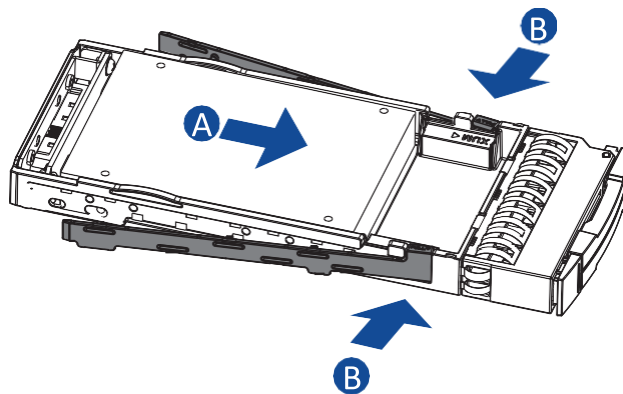
Without MUX Board:

Place the hard drive on the tray (A), then secure the clips to the both sides of the tray (B).
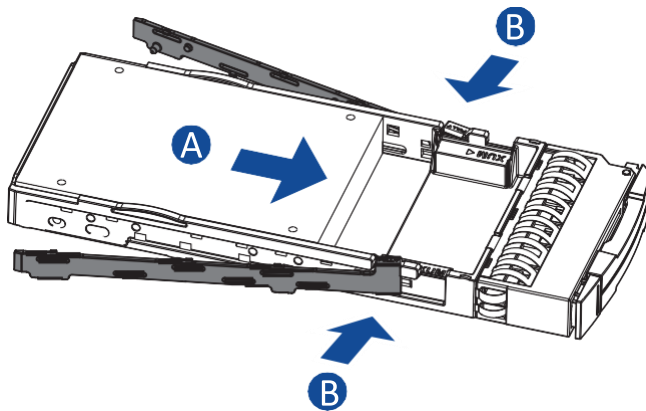
3. Insert the assembled hard drive and tray to the enclosure with the spring handle open, then close the spring handle when the drive is fully inserted to the bay.

2.2.4   Installing the Host Board

NOTES:

- A downtime may occur when upgrading the controller/host board.
- If you are using a SAS expansion host board, it can be ONLY inserted into host board 2 (which is on the right), and you cannot insert two SAS expansion host boards.
- To add or replace a host board, the firmware automatically restores the default factory settings of your system.

IMPORTANT! When installing a host board in a single-controller system, ensure that you shut down the applications and the system.

To install a host board:

1. Disconnect all cables from the controller module that you want to be replaced.

2. Loosen the screws that secure the controller module's ejection levers to the chassis.
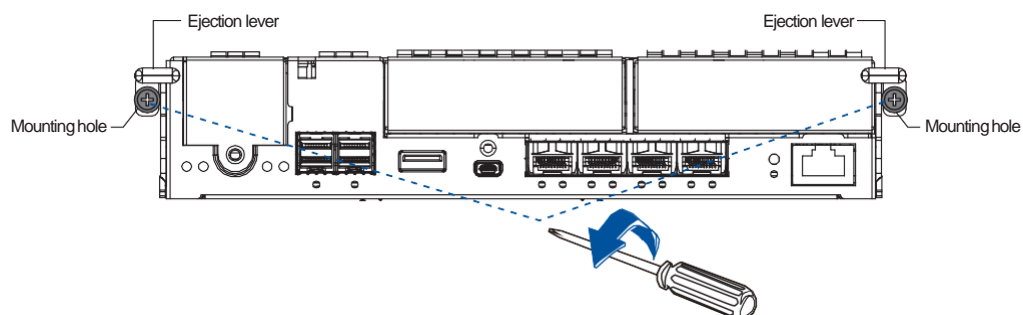
3. Push the ejection levers downwards to dislodge the controller from the system (A), then pull to remove from the enclosure (B).
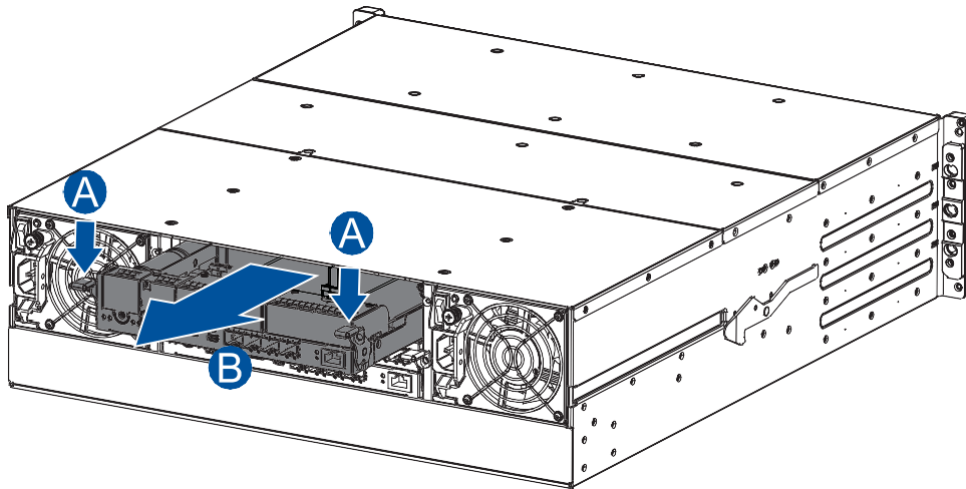
4. Loosen the screws that secure the dummy covers to the controller and remove the dummy covers.
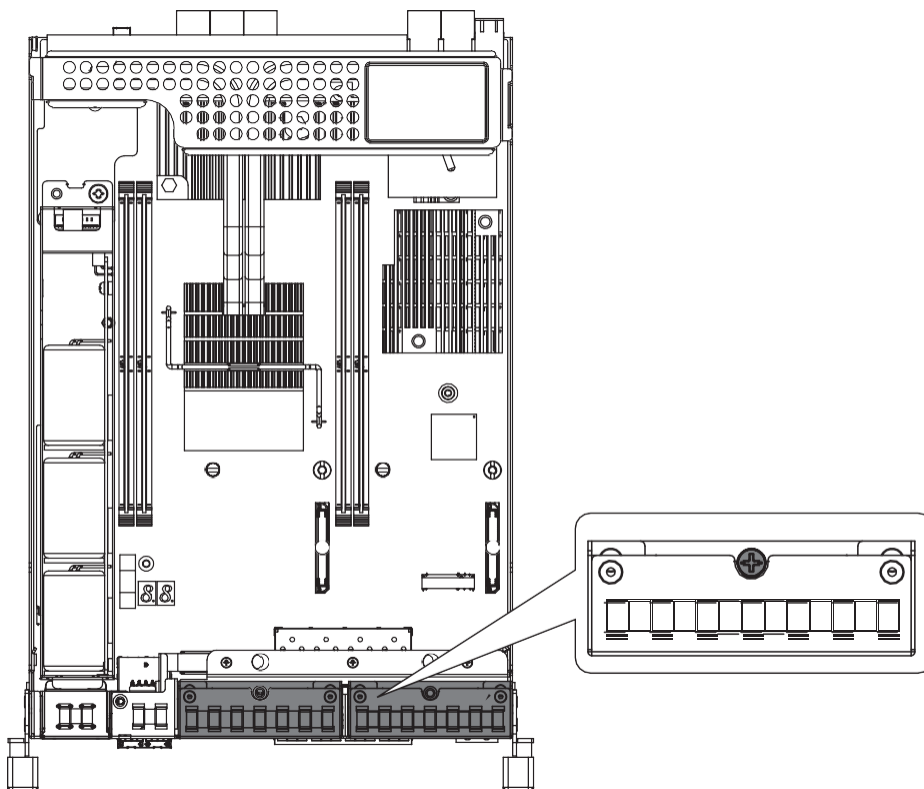
5. Use the guide pin to position the new host board to the host board slot, place it carefully (A), then tighten the thumb screws to secure the host board in place (B).

Guide pin

Host board 2

Host board 1
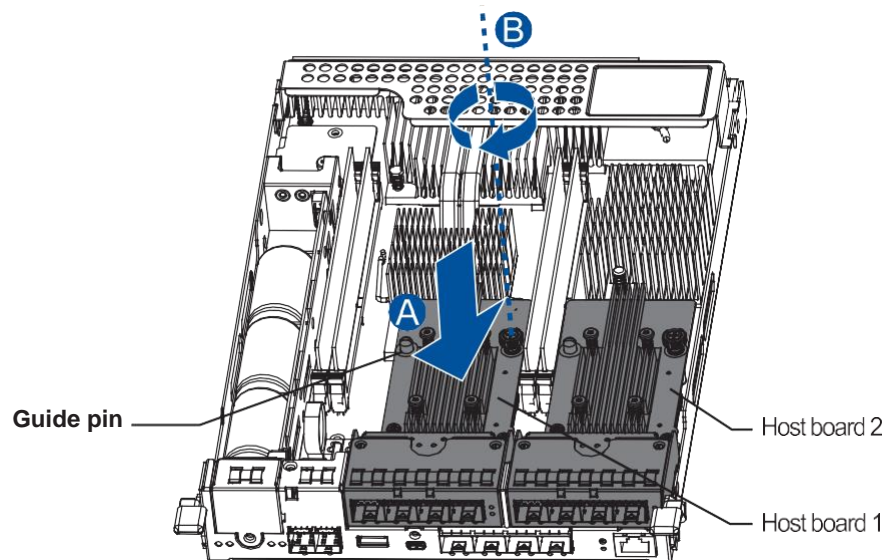
6. Insert back the controller carefully into the module slot (A). When you feel a contact resistance, use a small but careful force and push the ejection levers upwards to secure the controller into chassis (B).
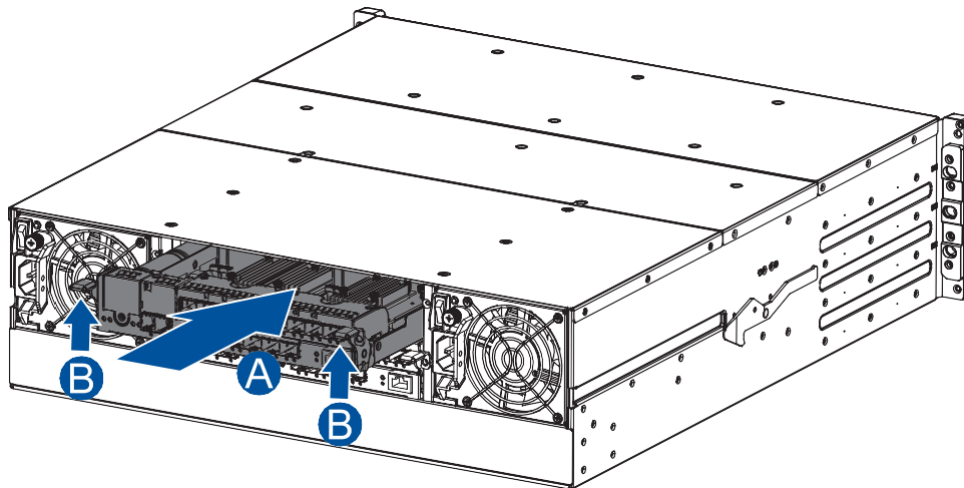
7. Secure the controller to the enclosure with the retention screws. Reconnect the cables to the controller module.

2.3　Connections

This section details the connection procedures of the PS system to the expansions, power source, connection status, topologies, and other connection configurations.

2.3.1　General Considerations in Connecting Devices

When selecting the number of hard drives to assemble a logical drive, the host channel bandwidth and the performance of each drive must be considered. It is a good practice that you calculate the performance against the host port bandwidth when designing an application topology.

For example, if eight drives are included in a logical drive and is associated with a host ID (LUN mapping), the combined performance of this logical drive must estimate the channel bandwidth. If two 6-drive logical arrays are associated with two IDs residing in a single host channel, there may be a trade-off with the performance.

If your system comes with a total of eight or more host ports, we recommend that you use more disk drives to an expansion so that you can create a host-port that corresponds to 6-member logical drives (RAID 5) or 8-member logical drives (RAID 6). These logical drives bring up the bandwidth of each host.

You must also take note of these considerations:

- A spare drive that carries no data stripes and does not contribute to disk-level performance. For performance data information of your hard drive, refer to its documentation.

- Disk drives in the same logical drive must have the same capacity, but it is preferred that all disk drives in a chassis have the same capacity. Tiered storage configuration is supported in this setup. However, you must not include both SAS and SATA drives in a logical drive.

- A spare drive must have a minimum capacity equivalent to the largest drive that needs replacement. If the capacity of the spare drive is less than the capacity of the drive to be replaced, the controller will not proceed with the failed drive rebuild.

- When connecting between devices, follow all the specifications. Pay attention to the signals and avoid electronic noise from adjacent interfaces. DO NOT put power cords on optical cables.

- When rackmounting, leave enough space for the cables. DO NOT bend them to a diameter of less than 76 mm (3 inches).

- Route the cables away from places where it can be damaged by other devices such as foot traffic or fan exhaust.

- DO NOT over-tighten, twist, or bend the cables.

Configuring the Host-Side Topologies

When configuring host-side topologies, avoid the points of failure. It is recommended that the host ports are connected to at least two HBAs (Host Bus Adapters).

NOTES:

- To manage the fault-tolerant data paths and optimize data throughput on multiple data paths, you must apply multipathing utilities such as Linux Device Mapper.

- Host port channel designation may vary by system. Refer to the topologies of this manual to create your own connections that suit your needs.

Configuring the Host-Side Parameters

For the host-side parameters, we strongly recommend that you use the default settings of your system. If you need to adjust the host-side parameters, consult your on-site technical personnel or seek technical support from your vendor.

Familiarizing the Maximum Concurrent Host LUN Connection (Nexus in SCSI)

The menu option *Max Number of Concurrent Host-LUN Connection* allows you to set the maximum number of concurrent host LUN connections. This is the arrangement of the controller internal resources to use with a number of current host nexus.

For example, if you have four hosts (A, B, C, and D) and four host IDs/LUNs (IDs 0, 1, 2, and 3) in a configuration, where:

- Host A accesses ID 0 (one nexus)

- Host B accesses ID 1 (one nexus)

- Host C accesses ID 2 (one nexus)

- Host D accesses ID 3 (one nexus)

These connections are queued in the cache, which are called four nexus. If there is an I/O in the cache with these four nexus and another host I/O comes with a nexus different from the four in the cache (e.g. host A accesses ID 3), the controller returns as busy. This happens with the concurrent active nexus. If the cache is cleared, it accepts four different nexus again. Many I/O operations can be accessed via the same nexus.

Knowing the Maximum Queued I/O Count

The menu option *Maximum Queued I/O Count* allows you to configure the maximum number of I/O operations per host channel that can be accepted from the servers. The predefined range is from 1 to 1024 I/O operations per host channel. You can also choose **Auto**, which sets the automatic configuration. The default value is 256 I/O operations. The appropriate setting for this option depends on how many I/O operations the attached servers are performing. This varies according to the amount of the host memory present as well as the number of drives and their respective sizes. Usually, the optimum performance occurs from using **Auto** or **256** settings. For more information, refer to the firmware manual that came with your system.

2.3.2   Fiber-Host Connections

The FC (Fiber Channel) standard allows optical connections. The optical cables are used over long distances and have been proven to be more reliable. Due to the demands of high transfer rates, optical cables are preferred for a 4 Gbps, 8 Gbps, 16 Gbps, or 32 Gbps fiber connectivity, as they are not vulnerable to EMI.

The fiber host ports are connected to fiber channel HBAs (host bus adapters) that feature SFP interface with full duplex transfer support in a PCIe interface. For the latest certified items, please contact the vendor near you.

> **WARNING!**
>
> • All fiber cables are sensitive and must be handled with care. To avoid interference, the cabling path must be carefully planned without the cables getting bent.
>
> • Lasers are hazardous and may cause blindness or permanent eye damage. Use them with utmost caution. Never look directly when lasers are turned on or operating.

Detecting Auto Speed

Speed auto-detection is specified by the fiber channel standard. If a 16 Gbps port is connected to an 8 Gbps port, the speed slows down at 8 Gbps. If there are 16 Gbps ports on both ends of the link, the speed runs at 16 Gbps.

SFP/SFP+ Transceivers

An SFP transceiver converts electrical data signals into light signals then transfers these signals transparently via the optical fiber. A transceiver provides bi-directional data links, a laser transmitter (for fiber optic cables), LC connector, and a metal enclosure to lower the EMI.

Other features of a typical SFP transceiver include a single power supply, low power dissipation, and hot-swap capability. It is also important that the transceiver you use meets the FC performance and reliability specifications.

> **WARNING!** The SFP transceiver has a laser diode featuring a Class 1 laser. To ensure safety, DO NOT remove any covers or attempt access of the inside of the device. If problems arise or if you need technical service, contact qualified personnel.

FC Port Dust Caps

Dust caps are bundled in the package. Whenever a onboard host port cable is not plugged in, insert the dust cap.

Dust cap
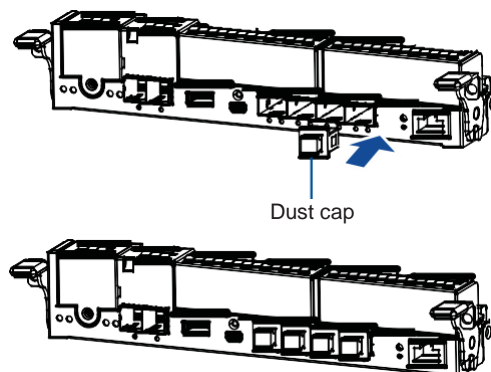
Fiber-Host Topologies

The fiber-host standard supports three topologies:

- **Point-to-Point Topology**

  A direct connection between two fiber-channel devices. The simplest among the three topologies.

- **FC-AL (Fiber Channel Arbitrated Loop)**

  The fiber-channel devices are all connected to a loop. Each device is assigned to an AL_PA (Arbitrated Loop Physical Address). FC-AL supports 124 devices in a single loop. This is the most commonly-used topology among the three.

- **Fabric Switch**

  This topology can support up to 224 fiber-channel devices and allows multiple devices to communicate simultaneously. A fiber switch is required to implement this topology.

  > **IMPORTANT!** If different servers need to access your logical drive, file locking, FC switch zoning, port binding, and multipath access control configurations are necessary.

Fiber Cabling

Before you set up your fiber cabling connection, you must:

a. Create a configuration plan. In addition to cabling topologies and the list of networking components, you must also include the firmware and software maintenance details.

b. Confirm that your fiber-channel cable's loop measures 6 inches or longer.

c. Ensure proper airflow and keep the cables away from ventilation outlets.

To connect devices using fiber cable:

1. Take out the SFP transceiver module from the static protective package.

2. Remove the dust cap from the SFP transceiver module.
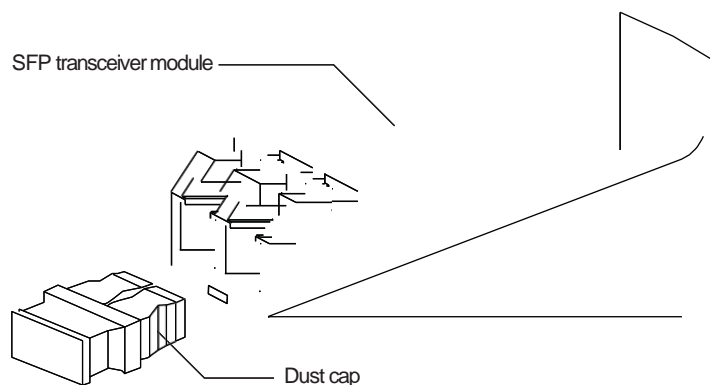
3. Insert the SFP module into one of the system host ports. The module will snap into place.
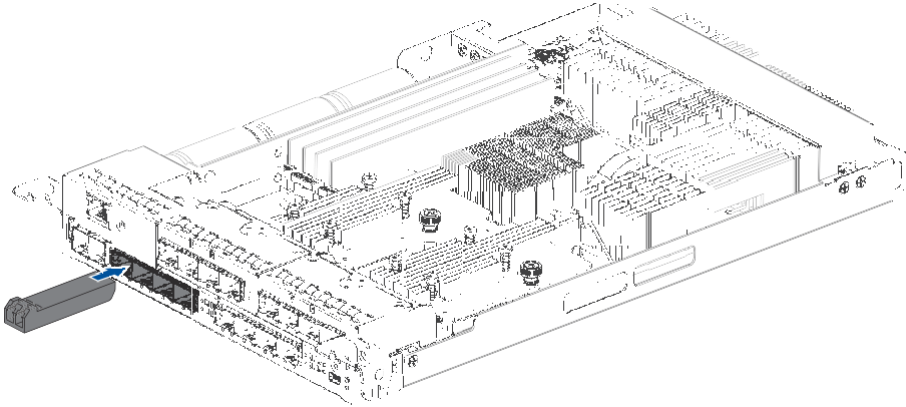
4. Remove the two protective caps from the LC-to-LC type cable. Save the protective caps for future use.

Protective caps
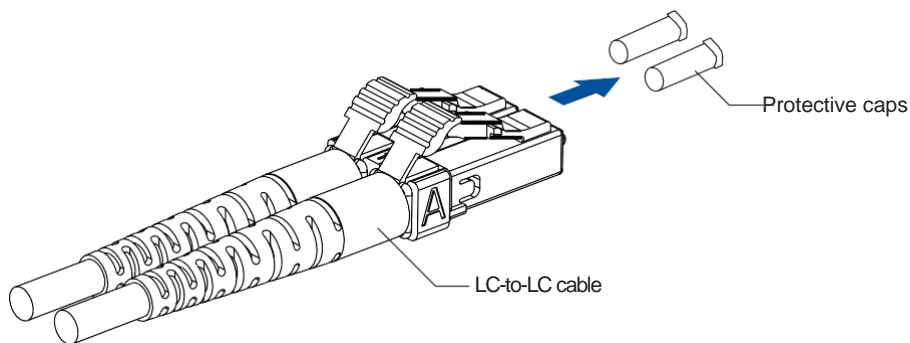
LC-to-LC cable

5. Insert the LC-to-LC cable to the SFP transceiver module already connected to the system. You can hear a clicking sound, securing the cable in place.
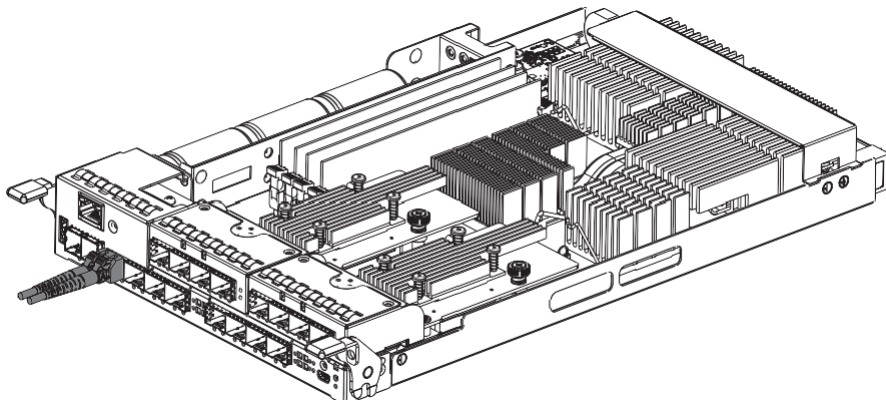
6. Remove the protective caps on the other end of the cable, then connect to an SFP transceiver module on a Fiber Channel switch port or a Fiber Channel HBA (host bus adapter) port.

Simple End-to-End Connection

This connection type shows a simple end-to-end connection, with each SFP port connected to a host adapter. Multiple logical drives, logical volumes, and logical partitions are created and each partition is mapped to a corresponding host channel ID/LUN combination.

Channels	Controller A	Controller B
Host	CH0, CH1, CH2, CH3	CH0, CH1, CH2, CH3
Configuration Information		
Number of Controllers	2	
Host Servers	2	
Data Path Connection	Fault-tolerant data paths	

NOTE: You need a multipathing software such as **MPIO** or **Linux Device Mapper** to control and optimize the access to logical drives via multiple data paths.
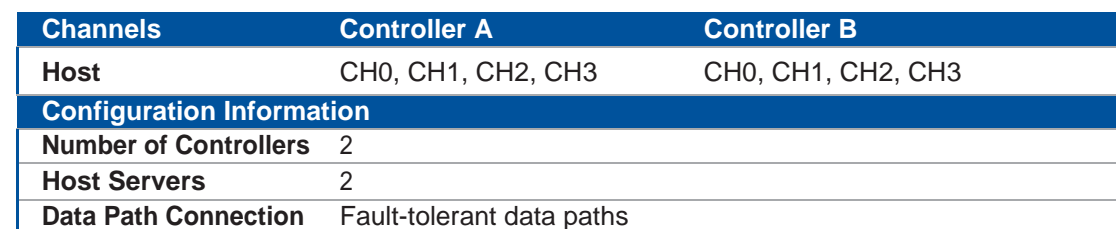
DAS (Direct-Attached Storage) Connection

This connection has more disk drives over SAS expansion links. With this connection, you can create more logical groups of drives. These logical drives use more host channel IDs or LUN numbers.

The two logical drives in the illustration below cannot equate the full power of the system. You can attach one or two more expansion enclosures to achieve more end-to-end performance.
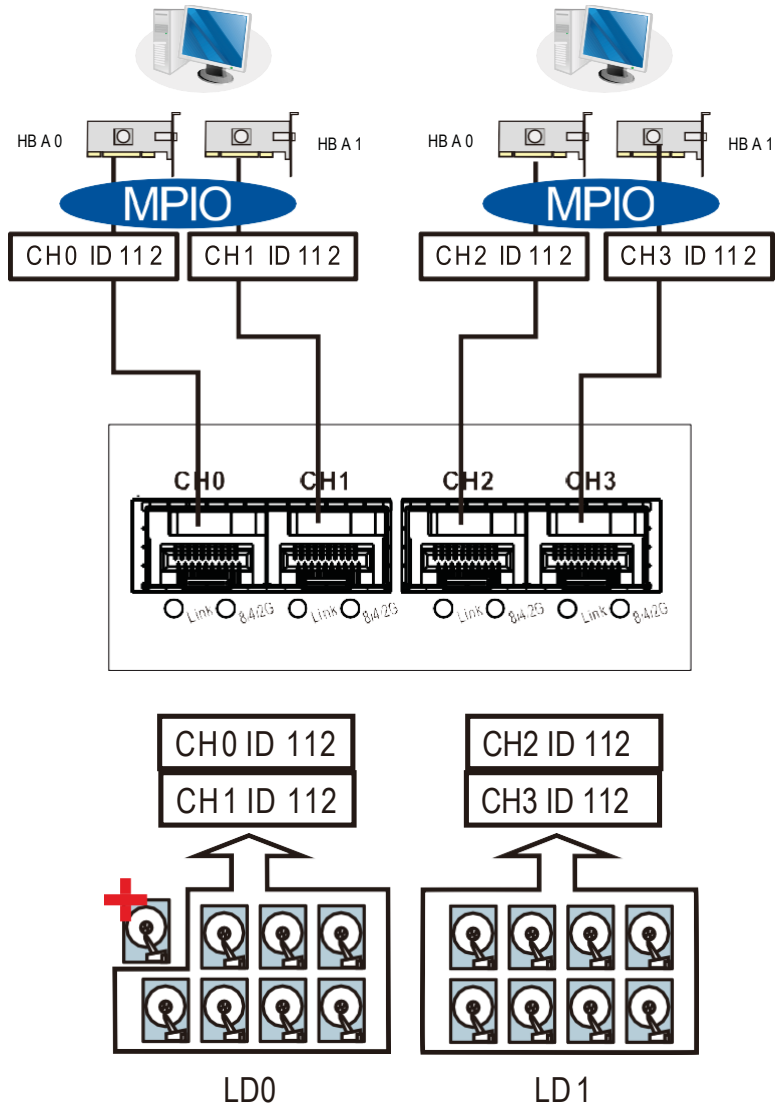
Channels	Controller A
Host	CH0, CH1, CH2, CH3
Configuration Information	
Number of Controllers	1
Host Servers	2
Data Path Connection	Simple end-to-end connections with fault-tolerant pairs

NOTE: If a server has multiple data paths to a SAN storage, a multipathing software such as MPIO, is needed.

Switched Fabric Connection in Dual Controller

In this type of connection, the channel link bypass is provided by external FC switches. Each application server shown in the illustration below is equipped with two HBAs with FC links, connecting via two FC switches to the SFP ports on individual controllers.
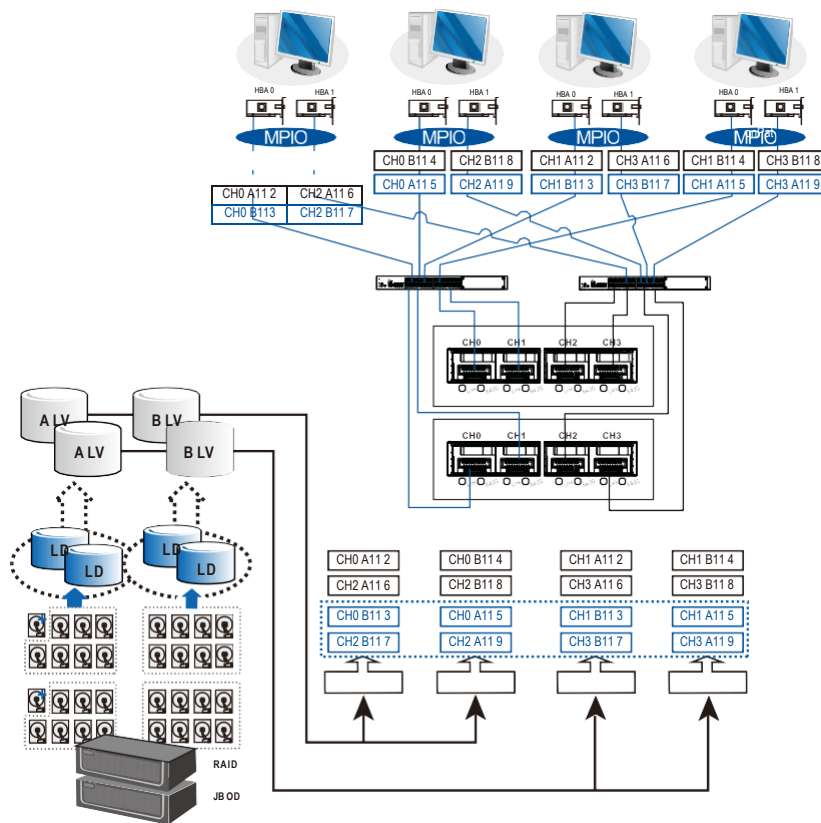
Channels	Controller A	Controller B
Host	CH0, CH1, CH2, CH3	CH0, CH1, CH2, CH3
Configuration Information		
Number of Controllers	2	
Host Servers	4 (or more via FC switches)	
FC Switches	2 (or 1 into 2 zones)	
Data Path Connection	Fault-tolerant data paths	

Each logical partition is redundantly mapped to multiple host channel IDs in an AAPP (Active-Active-Passive-Passive) configuration. Logical volumes are managed by either controller A or controller B. The passive IDs will only become functional when a single controller fails in the system.

The MPIO driver is needed on the application servers. This driver communicates with the system firmware and performs load balance and automated distribution of I/O's across the preferred paths (active IDs on data paths). TPGS (Target Port Group Service) is supported so that the I/O's are routed to the preferred paths.

Switched Fabric Connection in Single Controller

In this type of connection, each SFP port is connected to an FC switch then to the host board adapters. Each logical partition is mapped to a single host channel ID. If you prefer path redundancy, you can map a logical partition to IDs residing on two different channels.

LD 0   LD 1

Channels	Controller A
Host	CH0, CH1, CH2, CH3
Configuration Information	
Number of Controllers	1
Host Servers	4
Data Path Connection	The data paths are connected to one or more FC switches. The SAN management measures, such as switch zoning and port binding, must be taken to avoid multiple servers from accessing the same LUN.

If multiple servers detect a mapped volume, you have to avoid access contention using file locking software, port binding, or zoning feature of the FC switches, which limits the access from host to a specific LUN. If you have two servers in a clustered configuration, the clustering software will perform the access control.

IMPORTANT!

- We suggest you to use an enclosure-specific spare drive to prevent it from participating in the rebuild of a logical drive on another enclosure. You can refer to the ID tags on the host links to see the related LUN mapping and cable links routing paths.

- You need MPIO driver to manage the access via two different HBA ports. This driver communicates with the system firmware and performs load balance and automated distribution of I/O.

2.3.3   SAS-Host Connections

This section details about the connections between SAS and host using SAS cables. The SAS cables (8 pairs of 28 mm AWG) are characterized by the following:

- 100 Ohms

- Black color

- UL-approved, lead free, 50 cm, 120 cm, or 170 cm in length

- Connectors must be secured to the receptacle of the chassis using a latching mechanism.

WARNING! The SAS cables are sensitive and must be handled with care. To prevent interference within the rackmount, the cable routing path must be carefully planned and the cables must not be bent.

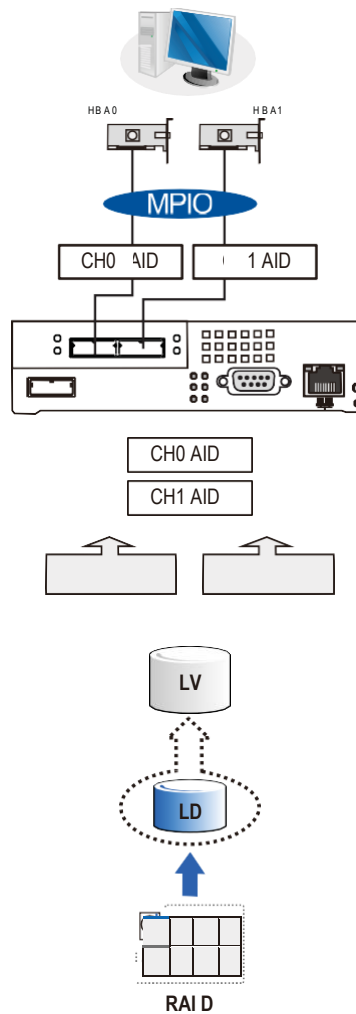## DAS (Direct-Attached Storage) Connection with Redundant Host Path

• **Dual Controller Models**
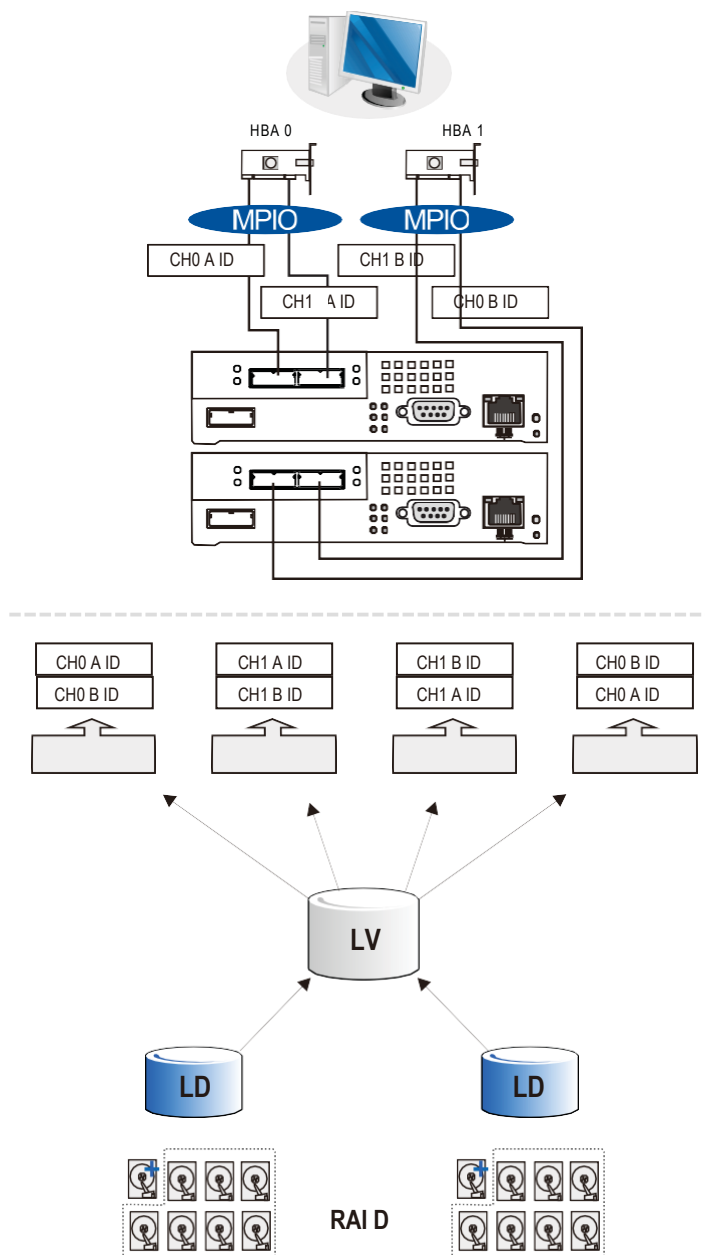
- **Single Controller Models**

NOTES:

- With more hard drives over SAS expansion links, you can create more logical groups of drives. Avail the logical partitions using more LUNs.
- If your operating system is Windows® 2003 server, you need a multipathing software such as **MPIO** or **Linux Device Mapper** to control and optimize the access to logical drives via multiple data paths.

DAS (Direct-Attached Storage) Connection to Two Servers

RAID
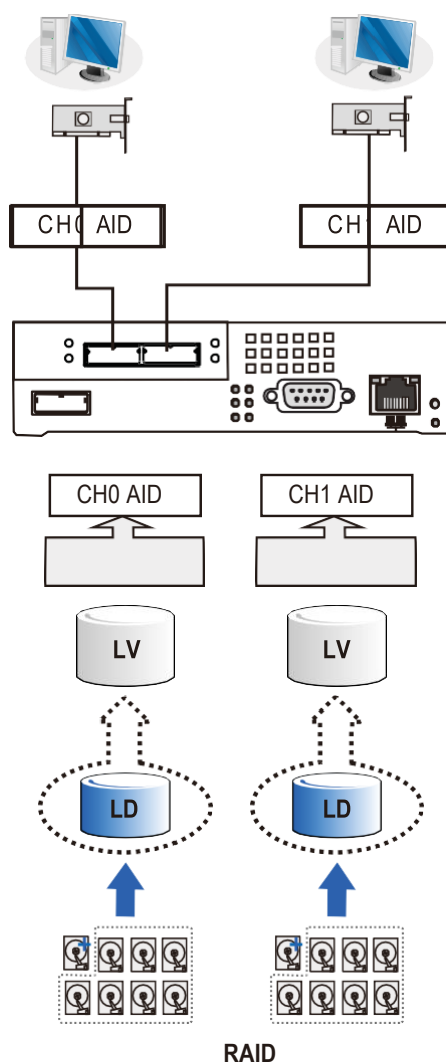
NOTE: If you want your LUN to be accessible by multiple hosts, use file locking or multipath access control.

Chapter 2: Hardware Installation

2.3.4   Ethernet-Host Connections

Before performing the connections between Ethernet and host, take note of the following requirements:

- Ethernet cables are user-supplied. We recommend using CAT5e shielded STP type network cables or cables with better performance types (important for meeting the requirements imposed by emission standards).

- Use of straight-through Ethernet cables with RJ-45 plugs.

- Use of cross-over cables. These cables are automatically detected and rerouted for a valid connection.

See below the list of connection types:

- Directly to iSCSI initiators (software or hardware) or via the Gigabit Ethernet switches.

- To servers equipped with iSCSI HBA, preferably a hardware TOE (TCP/IP Offload Engine) card, then to client stations with an Ethernet NIC or iSCSI HBA.

- The system presents its logical volumes via SCSI-like IDs and LUNs. These RAID volumes then appear as iSCSI targets via the network.

> **IMPORTANT!** Even though the iSCSI initiator software is a cost-effective way of building an iSCSI SAN, this software initiator adds additional workload to the server CPU. We recommend applying iSCSI HBAs that come with TCP/IP offload engines in order to reduce overhead.
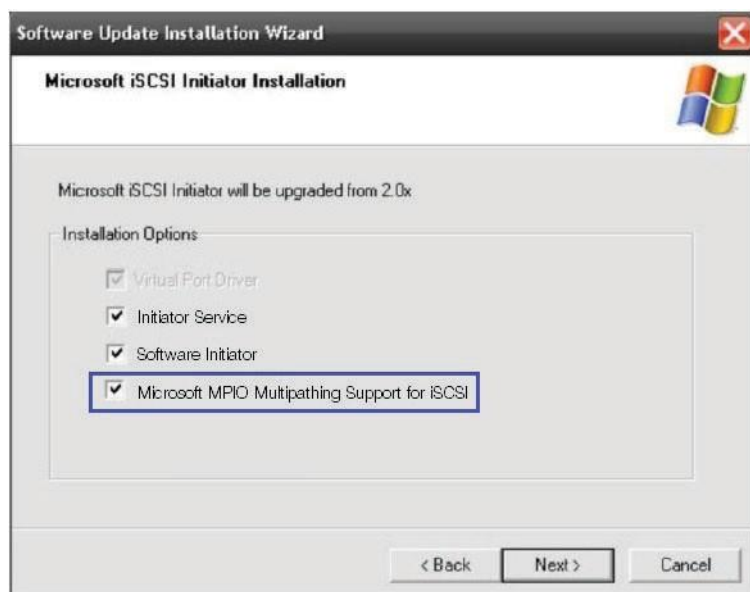
Network and Host Connection Topologies

The iSCSI host ports must be connected to Ethernet network devices and iSCSI initiators that comply with IETF iSCSI standard (RFC 3720). The network connection of the iSCSI ports is flexible. The use of network connecting devices, subnet, name servers, or iSCSI management software varies from case to case.
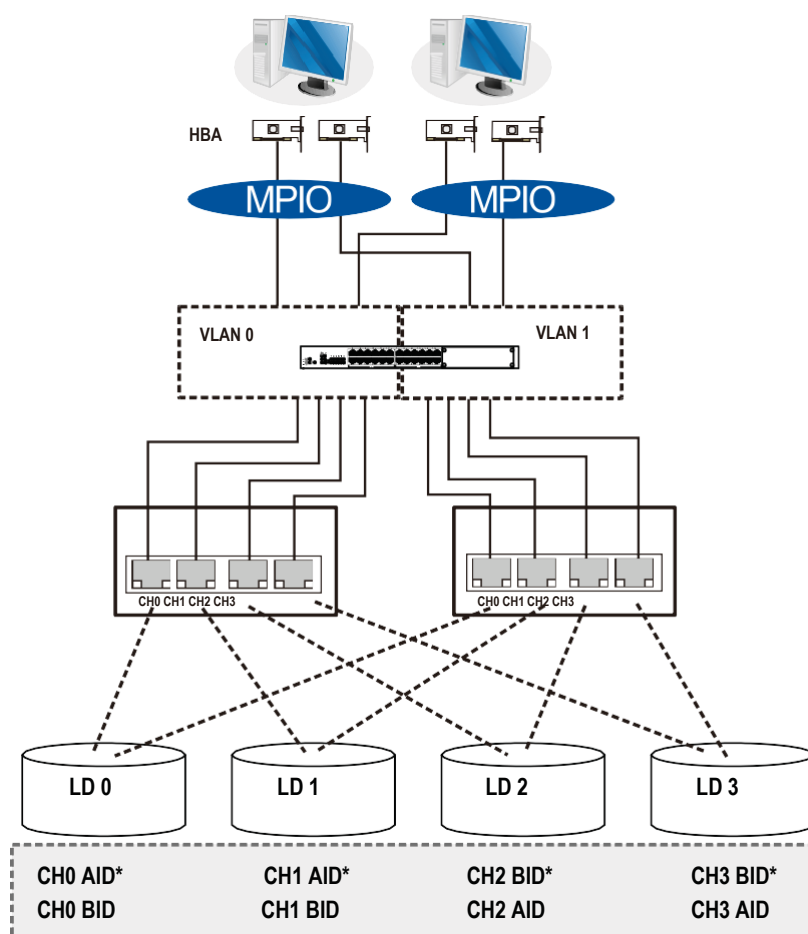
Note that the host NIC ports and the storage system's iSCSI host ports must be configured in the same subnet, and the following:

- Use the Ethernet management port for management purposes only such as PAC Management Software or telnet console. This port must not be used for I/O processes.

- Configurations such as subnet or virtual LAN can separate iSCSI host links, decrease overhead, and eliminate the impact of link failure.

- Multiple arrays or logical partitions can be created and made available separately via different IDs or LUNs on host ports. Usually, a RAID5 logical drive of 8 members sometimes brings optimal array performance.

IMPORTANT! If you are using Microsoft's software initiator, uncheck the embedded MPIO function when installing the software as the MPIO selection creates conflict with MPIO driver.
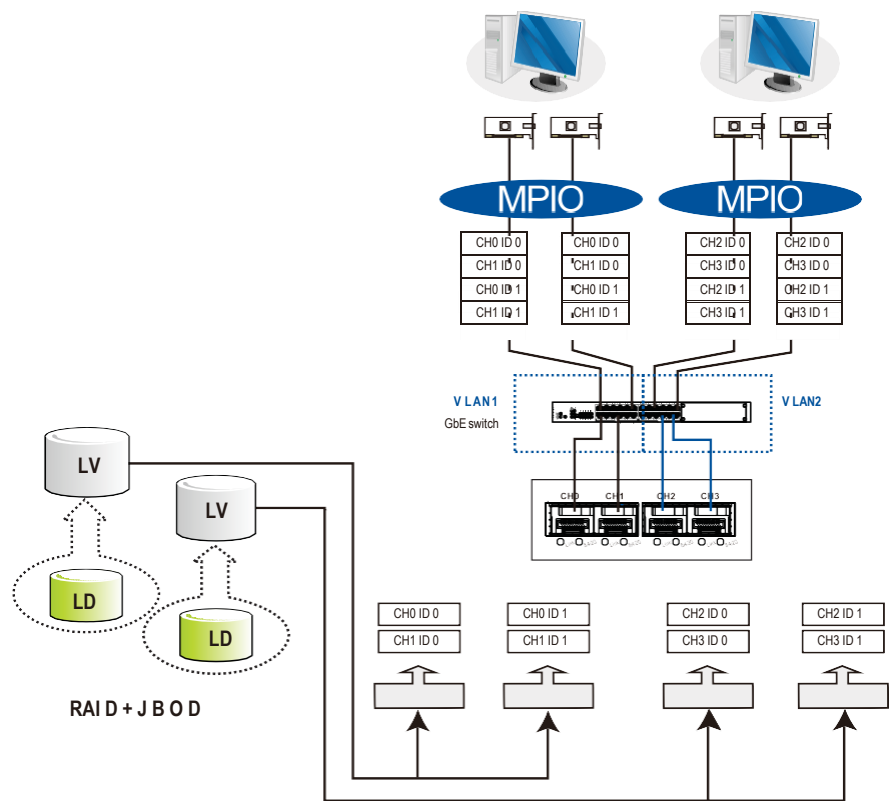

High Availability IP SAN with Redundant Controller

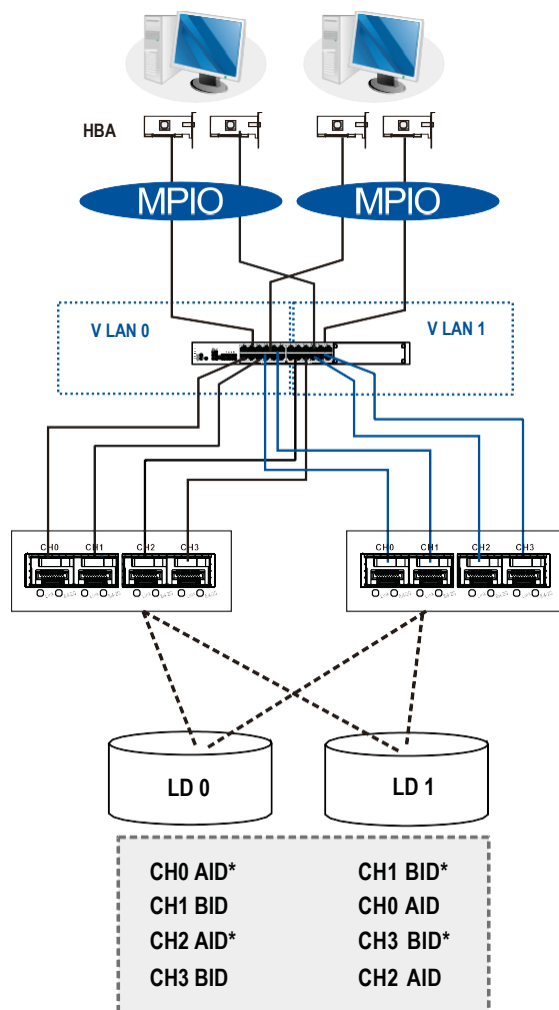| Component	Description
SAN Storage System	Redundant controllers with a total of 8 host ports
HBA	iSCSI initiators, preferably PCIe TOE (TCP/IP offload engine) capable cards
GbE Cables	GbE network cables
GbE Switch	Ports divided into 2 virtual LANs to separate access from host to targets
Software	MPIO to manage the fault-tolerant paths with failover/failback and load balance capabilities. Use MPIO multipathing software for the operating system to identify the alternative paths to the same logical drive.
RAID Configuration	• This configuration does not support remote replication functionality. To set up remote replication, refer to High Availability IP SAN (Recommended for Remote Replication) or High Availability IP SAN with Port Trunk (Remote Replication-Enabled). • Four logical drives (each logical drive has four member drives). You can include the drives from the expansion systems for better performance. • LD0 mapped to CH0 AID and CH0 BID; LD assigned to controller A • LD1 mapped to CH1 AID and CH1 BID; LD assigned to controller A • LD2 mapped to CH2 AID and CH2 BID; LD assigned to controller B • LD3 mapped to CH3 AID and CH3 BID; LD assigned to controller B
CH0 AID* **CH1 AID*** **CH2 BID*** **CH3 BID***	Logical drive assignment

IMPORTANT! In the event of single-controller failure, a logical drive is accessed via the host IDs managed by the alternate controller. The host IDs and port IPs do not failover to the remaining controller. In this case, MPIO driver is necessary for path redundancy and controller failover.

Single Controller with Fault-Tolerant Path

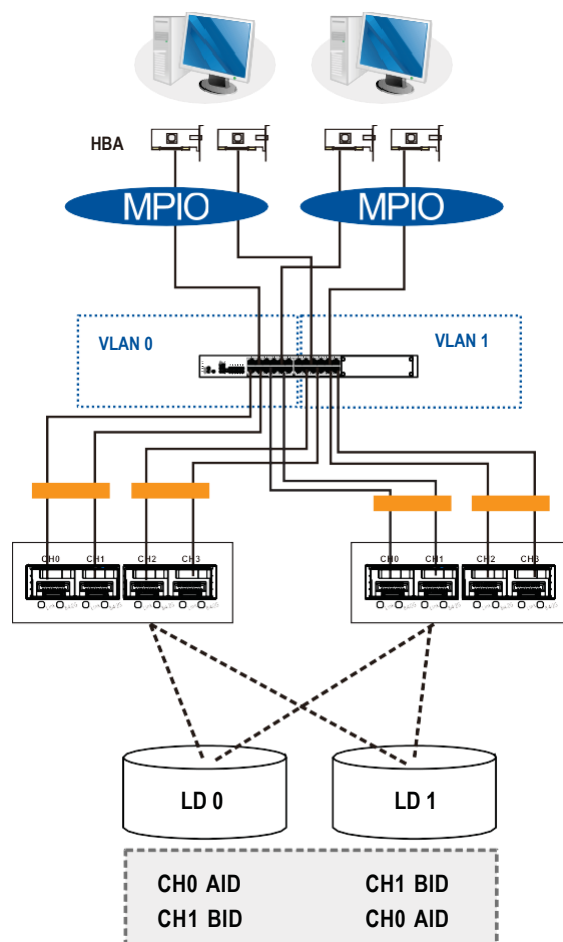| Component	Description
SAN Storage System	Single controller with 4 host ports
HBA or NIC	iSCSI initiators, preferably PCIe TOE (TCP/IP offload engine) capable cards
GbE Cables	GbE network cables
Software	MPIO to manage the fault-tolerant paths with failover/failback and load balance capabilities
RAID Configuration	• Four logical partitions (created from two logical volumes) • Two logical volumes (each contains a logical drive) • Two logical drives **NOTE:** Each logical partition appears on two different host links for fault tolerance. Use MPIO software so that your operating system can identify the alternate paths to the same logical drive.

High Availability IP SAN (Recommended for Remote Replication)

Component	Description
SAN Storage System	Redundant controllers with eight host ports
HBA	iSCSI initiators, preferably PCIe TOE (TCP/IP offload engine) capable cards
GbE Cables	GbE network cables
GbE Switch	Ports divided into 2 virtual LANs. Both controllers are linked to both virtual LAN zones.
Software	MPIO to manage the fault-tolerant paths with failover/failback and load balance capabilities. Use MPIO multipathing software for the operating system to identify the alternative paths to the same logical drive.
RAID Configuration	• Two logical drives; each has eight member drives. You can create more logical drives from the drives in the expansion systems. • LD0 mapped to CH0 AID, CH1 BID, CH2 AID, and CH3 BID. LD must be assigned to controllers A and B to enable remote replication. • LD1 mapped to CH1 BID, CH0 AID, CH3 BID, and CH2 AID. LD must be assigned to controllers A and B to enable remote replication.

IMPORTANT! For systems operating in Windows® 2003 server, and in the event of single-controller failure, a logical drive is accessed via the host IDs managed by the alternate controller. The host IDs and port IPs do not failover to the remaining controller. In this case, MPIO driver is necessary for path redundancy and controller failover.

High Availability IP SAN with Port Trunk (Remote Replication-Enabled)

| Component	Description
SAN Storage System	Redundant controllers with eight host ports
HBA	iSCSI initiators, preferably PCIe TOE (TCP/IP offload engine) capable cards
GbE Cables	GbE network cables; port trunking marked in orange rectangles
GbE Switch	Ports divided into 2 virtual LANs. Both controllers are linked to both virtual LAN zones.
Software	MPIO to manage the fault-tolerant paths with failover/failback and load balance capabilities. Use MPIO multipathing software for the operating system to identify the alternative paths to the same logical drive.

Component	Description
RAID Configuration	• Two logical drives; each has eight member drives. You can create more logical drives from the drives in the expansion systems. • LD0 mapped to CH0 AID and CH1 BID. LD must be assigned to controllers A and B to enable remote replication. • LD1 mapped to CH1 BID and CH0 AID. LD must be assigned to controllers A and B to enable remote replication.

2.3.5 Hybrid Host Connections

For hybrid systems that feature two additional iSCSI ports, you can use these systems for remote replication or for host LUN mapping.

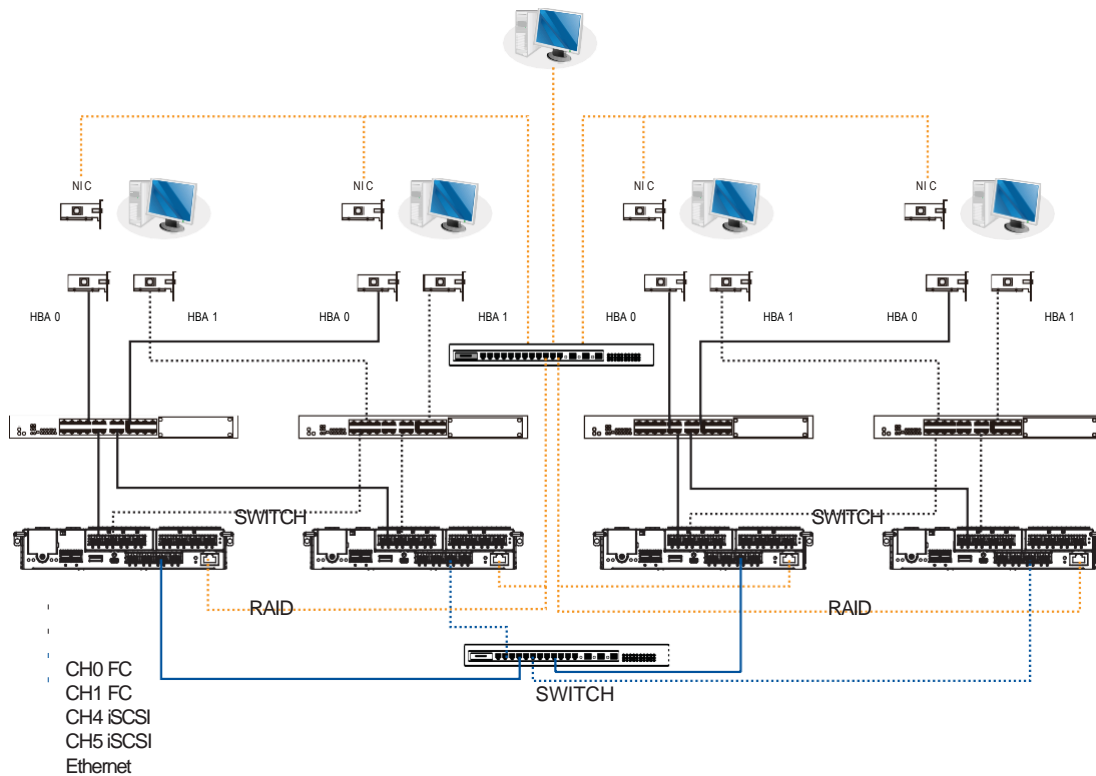### Single Hybrid Unit Connected to FC/iSCSI Hosts
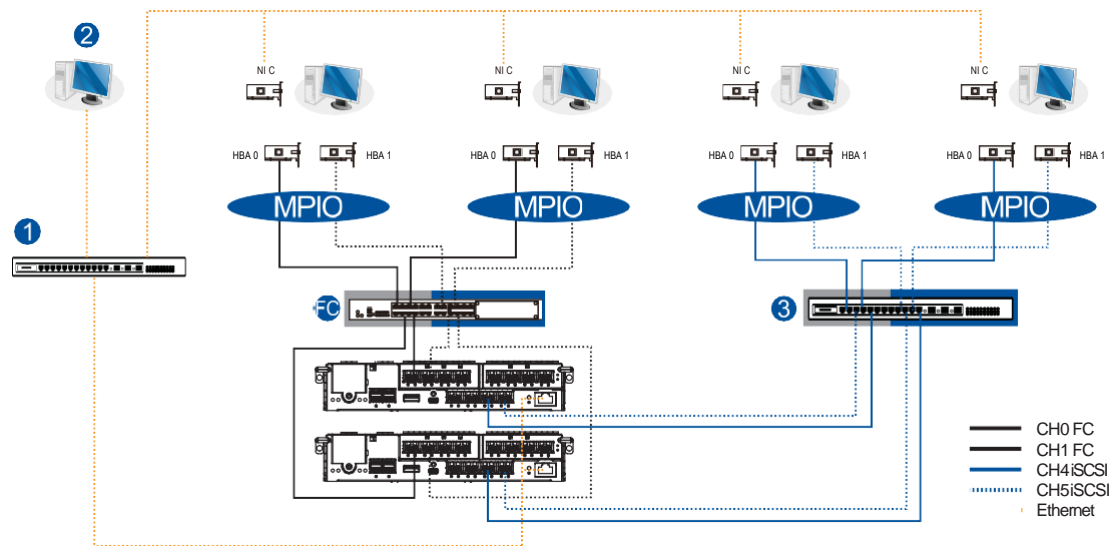
When connected to FC and iSCSI hosts, the connections are working in their respective speeds. This connection maximizes the number of connections while keeping the optimum performance gained by the high-speed FC link and FC switch.

NOTES:

- To gain optimum performance, ensure that the LAN switch **1** for the management station **2**, the LAN switch for the systems, and the iSCSI switch **3** for iSCSI host link are separated.

- If they are not separated, the host may consider that the iSCSI connection is a part of the host connection and might use it for data I/O, even if the iSCSI ports are not mapped to the host. As a result, the data transaction speed slows down to iSCSI connection's level and the fast FC connection bandwidth may be spent without use.

Utilizing Hybrid iSCSI Ports for Data Replication

NIC   NIC   NIC   NIC

HBA 0   HBA 1   HBA 0   HBA 1   HBA 0   HBA 1   HBA 0   HBA 1

SWITCH   SWITCH

RAID   RAID

CH0 FC
CH1 FC
CH4 iSCSI
CH5 iSCSI
Ethernet

SWITCH

The illustration above depicts the utilization of the iSCSI host ports for remote data replication.

Two hybrid systems, a source system and a target system, reside within the same virtual pool but are physically apart. You can create a volume copy/mirror pair for data protection without relying on slow management LAN cable connections. In such case, you can link the hybrid systems using iSCSI host ports. If the distances between systems are far, additional switches may be required.

2.3.6   Expansion Connections

A SAS host link cable is bundled per expansion package. If you need to purchase other cables, or if you need other cables of different lengths, contact your vendor.

Before configuring the expansions, you must take note of the following important points:

•   For a cleaner and clutter-free rack system, have a carefully planned routing paths when connecting between systems.

•   All SAS cables are sensitive and must be handled with care. DO NOT bend or twist the cables when connecting the systems installed to the rack.

Configuring the SAS Expansion

The SAS expansion port of the GS system connects to the expansion systems. For dual-controller systems, each expansion port connects to a controller of another expansion system, making a fault-tolerant linkage to different SAS domains.

The following principles apply to SAN storage and expansion system connections:

•   Dual-controller SAN storage connects to a dual-controller expansion system

•   Single-controller SAN storage connects to a single-controller expansion system

•   A longer cable is available in making expansion links with a dual-controller configuration. If you need to connect expansion systems from two opposite directions, you may need a longer cable. Routing between two different connections can avoid loss of data links if one expansion fails to operate.

Setting the Expansion IDs

Each expansion system must have a unique ID and you can configure the ID via the rotary ID switch. To set the expansion IDs, use a small flat blade screwdriver.

You must take note of the following when setting the IDs on the expansion system:

•   Set the IDs from 1 to 15. The order starts from the expansion enclosure that is closest to the managing PS enclosure.

•   Ensure to set a unique ID on each expansion enclosure so that the SAS WWN addresses of the disk drives are properly assigned. The SAN storage system firmware automatically manages these addresses.
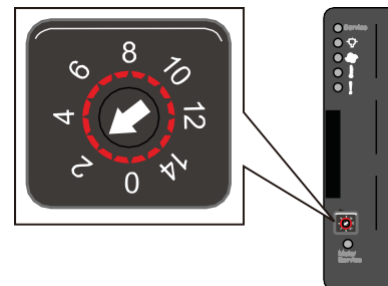
Configuration Rules

To connect the SAS interfaces across storage and expansion systems, you must take note of the following:

- **Fault-Tolerant Links in a Dual Controller Combination**

  Corresponding to the dual-port interfaces of the SAS drives, two physical links are available per disk drive, routed across the backplane board, then to a SAS expander, and interfaced via a 4x wide external SAS port.

- **With Data Paths via Separate SAS Domains**

  Access to disk drives can be continued in the event of a failure from a cable link or SAS expansion controller.
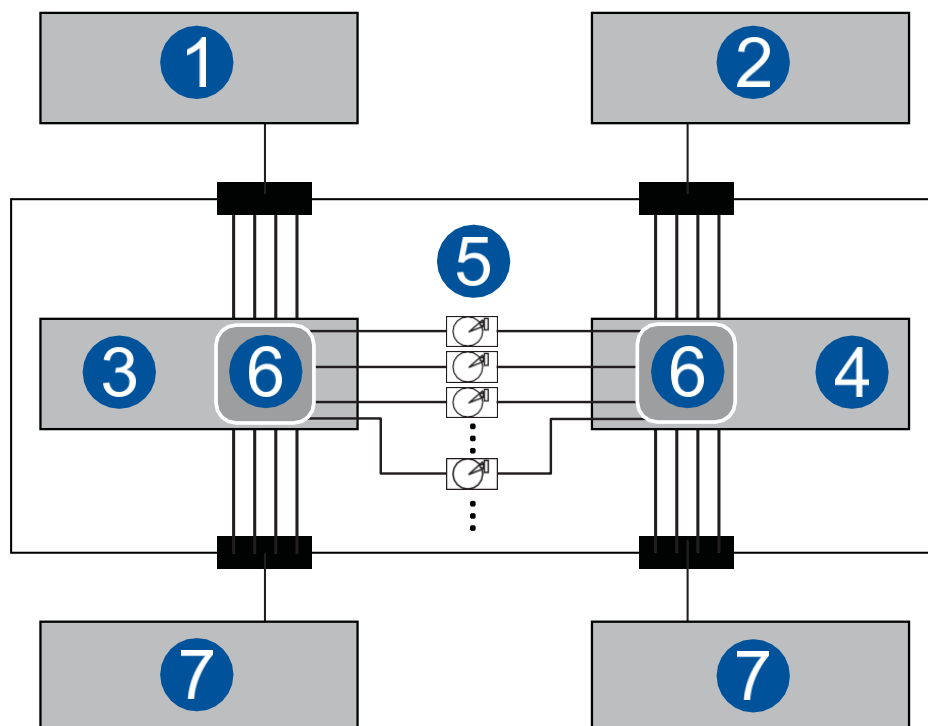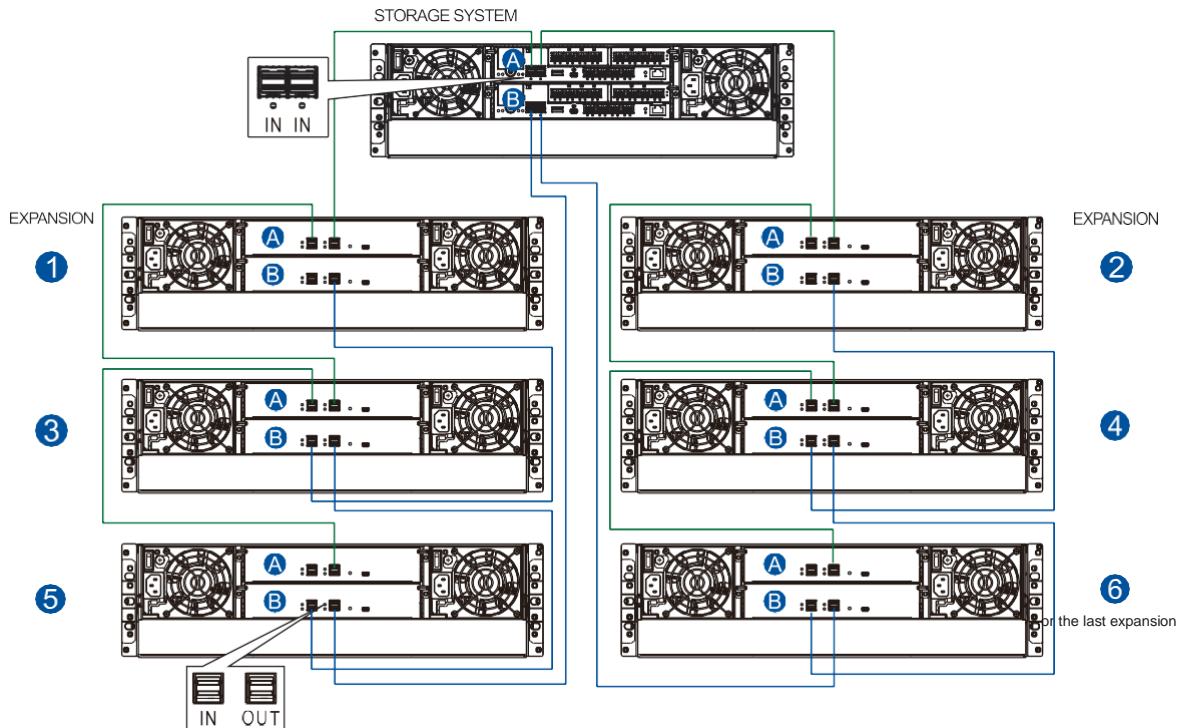
Number	Description
❶	RAID controller A
❷	RAID controller B
❸	Expansion system controller A
❹	Expansion system controller B
❺	Dual-port SAS drives
❻	Expander
❼	To another expansion system

- **Fault-Tolerant Links to SAS Disk Drives**

  - The SAS expansion cables are bundled with the expansion systems. Take note that if there are many expansion systems connected, a longer SAS external cable, approximately measured 120 cm, may be needed to connect an expansion system from the opposite direction for a higher redundancy.

  - One expansion link connects the expansion system from a storage system with HBA/RAID card to the nearest expansion system, then to the most distant expansion system. Another expansion link connects to the most distant expansion system, from the opposite direction to the first expansion system from the storage system.

  - Each expander controller on the SAS expansion system controls a *SAS Domain* that connects to one of the alternative interfaces of the disk drives in the enclosure. For example, one expander unit controls Domain A while the other expander controls Domain B. In a fault-tolerant topology, the SAS external links always connect to the SAS ports of the same SAS domain.

  - Identify the SAS domains by the location of the expanders: the left controller is controller A, the right is controller B.

  - On a storage system, each controller is considered as managing a separate SAS domain. With the help of the port selector mechanism on the MUX boards, the idea of SAS domain applies even when SATA drives are used in a dual-controller expansion system.
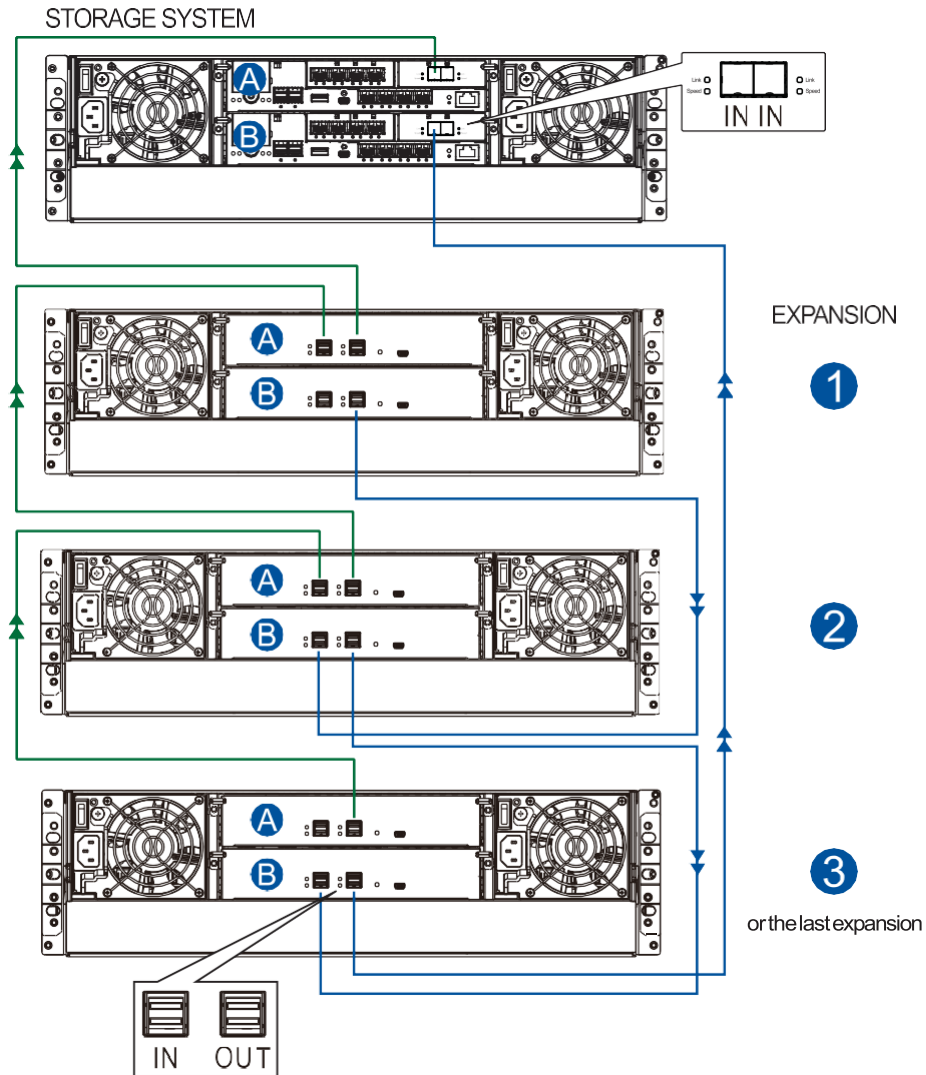
Connecting Expansion Systems

- **Connecting Dual Controller Expansions Using the Onboard SAS Expansion Ports**
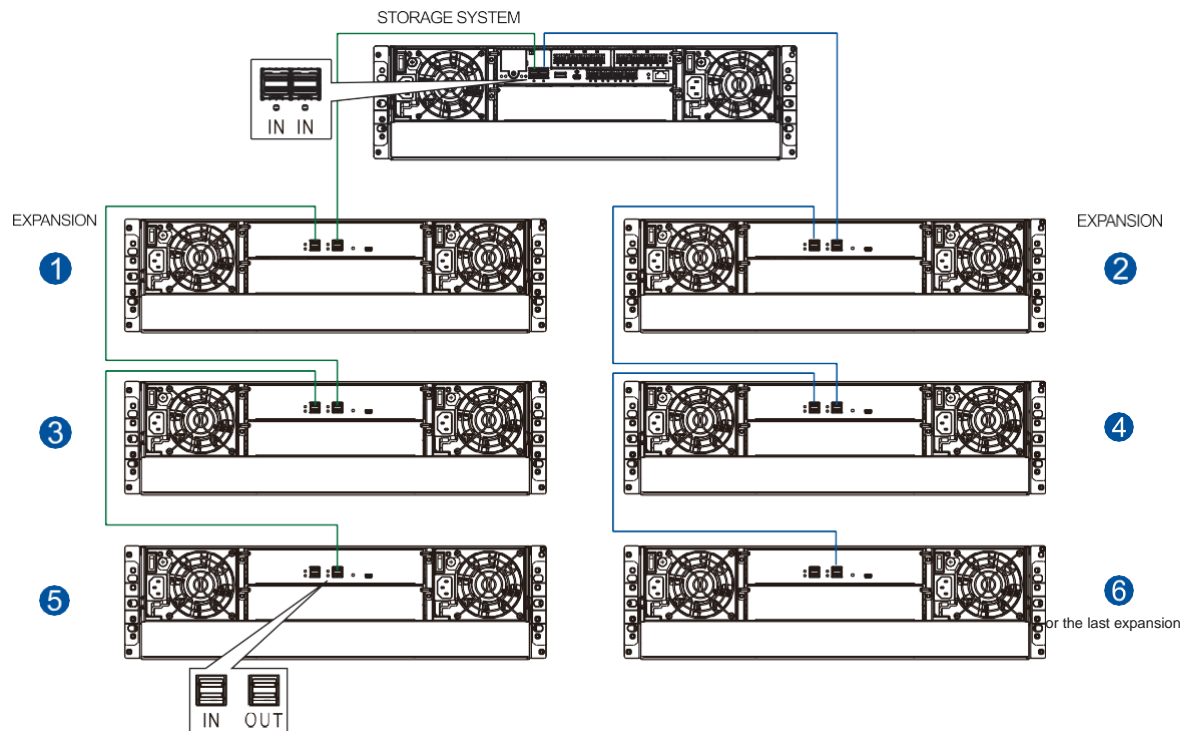

- Storage controller **Ⓐ**: left SAS port **IN** ➡ Expansion **❶**, controller **Ⓐ**: SAS port **OUT**
- Expansion **❶**, controller **Ⓐ**: SAS port **IN** ➡ Expansion **❸**, controller **Ⓐ**: SAS port **OUT**
- Expansion **❸**, controller **Ⓐ**: SAS port **IN** ➡ Expansion **❺**, controller **Ⓐ**: SAS port **OUT**
- Storage controller **Ⓐ**: right SAS port **IN** ➡ Expansion **❷**, controller **Ⓐ**: SAS port **OUT**
- Expansion **❷**, controller **Ⓐ**: SAS port **IN** ➡ Expansion **❹**, controller **Ⓐ**: SAS port **OUT**
- Expansion **❹**, controller **Ⓐ**: SAS port **IN** ➡ Expansion **❻** or last, controller **Ⓐ**: SAS port **OUT**

- Storage controller **Ⓑ**: left SAS port **IN** ➡ Expansion **❺**, controller **Ⓑ**: SAS port **OUT**
- Expansion **❺**, controller **Ⓑ**: SAS port **IN**   Expansion   , controller **Ⓑ**: SAS port **OUT**
- Expansion **❸**, controller **Ⓑ**: SAS port **IN**   Expansion   , controller **Ⓑ**: SAS port **OUT**
- Storage controller **Ⓑ**: right SAS port **IN** ➡ Expansion **❻** or last, controller **Ⓑ**: SAS port **OUT**
- Expansion **❻** or last, controller **Ⓑ**: SAS port **IN** ➡ Expansion **❹**, controller **Ⓑ**: SAS port **OUT**
- Expansion **❹**, controller **Ⓑ**: SAS port **IN** ➡ Expansion **❷**, controller **Ⓑ**: SAS port **OUT**
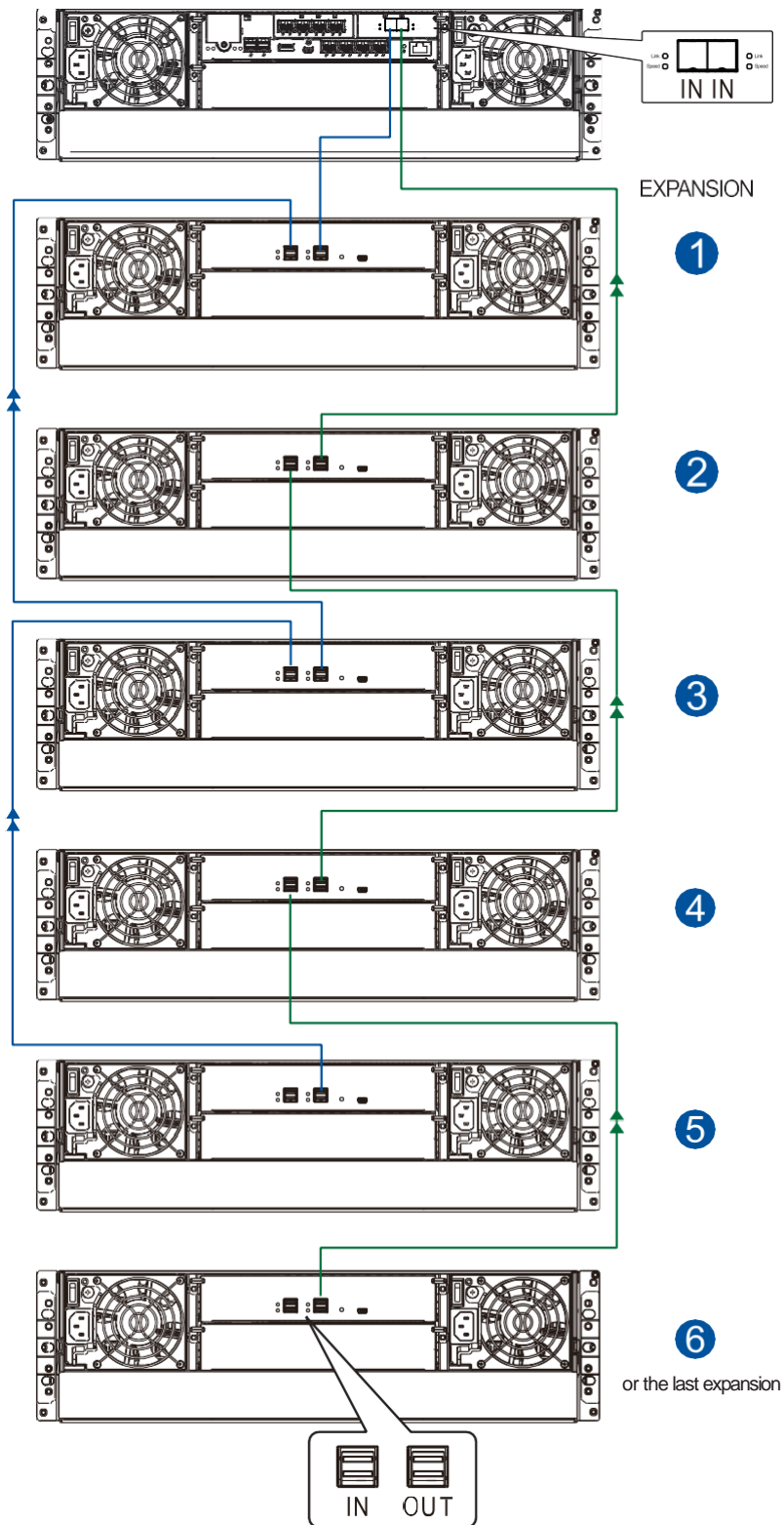
• **Connecting Dual Controller Expansions Using the Host Board's SAS Expansion Ports**

• Storage controller Ⓐ: host board SAS port **IN**➡ Expansion ❶, controller Ⓐ: SAS port **OUT**

• Expansion ❶, controller Ⓐ: SAS port **IN**➡ Expansion ❷, controller Ⓐ: SAS port **OUT**

• Expansion ❷, controller Ⓐ: SAS port **IN**➡ Expansion ❸ or last, controller Ⓐ: SAS port **OUT**

• Storage controller Ⓑ: host board SAS port **IN**➡ Expansion ❸ or last, controller Ⓑ: SAS port **OUT**

• Expansion ❸ or last, controller Ⓑ: SAS port **IN**➡ Expansion ❷, controller Ⓑ: SAS port **OUT**

• Expansion ❷, controller Ⓑ: SAS port **IN**➡ Expansion ❶, controller Ⓑ: SAS port **OUT**

• **Connecting Single Controller Expansions Using the Onboard SAS Expansion Ports**

STORAGE SYSTEM

IN IN

EXPANSION

① ② ③ ④ ⑤ ⑥

EXPANSION

or the last expansion

IN OUT

- • Storage controller: left SAS port **IN** ➡ Expansion ①: SAS port **OUT**

- • Expansion ①: SAS port **IN** ➡ Expansion ③: SAS port **OUT**

- • Expansion ③: SAS port **IN** ➡ Expansion ⑤: SAS port **OUT**

- • Storage controller: right SAS port **IN** ➡ Expansion ②: SAS port **OUT**

- • Expansion ②: SAS port **IN** ➡ Expansion ④: SAS port **OUT**

- • Expansion ④: SAS port **IN** ➡ Expansion ⑥ or last: SAS port **OUT**

• **Connecting Single Controller Expansions Using the Host Board's SAS Expansion Ports**

STORAGE SYSTEM

IN IN

EXPANSION

1

2

3

4

5

6

or the last expansion

IN   OUT

- Storage controller: host board SAS port **IN** Expansion **1**: SAS port **OUT**

- Expansion **1**: SAS port **IN** Expansion **3**: SAS port **OUT**

- Expansion **3**: SAS port **IN** Expansion **5**: SAS port **OUT**

- Storage controller: host board SAS port **IN** Expansion **2**: SAS port **OUT**

- Expansion **2**: SAS port **IN** Expansion **4**: SAS port **OUT**

- Expansion **4**: SAS port **IN** Expansion **6** or last: SAS port **OUT**

2.3.7 Management Console Connections

To connect your SAN storage to external consoles, you need the following:

- DB9 female to mini USB cable (bundled with the package)

- CAT5e LAN cable (user supplied)

Connecting SAN Storage to External Consoles
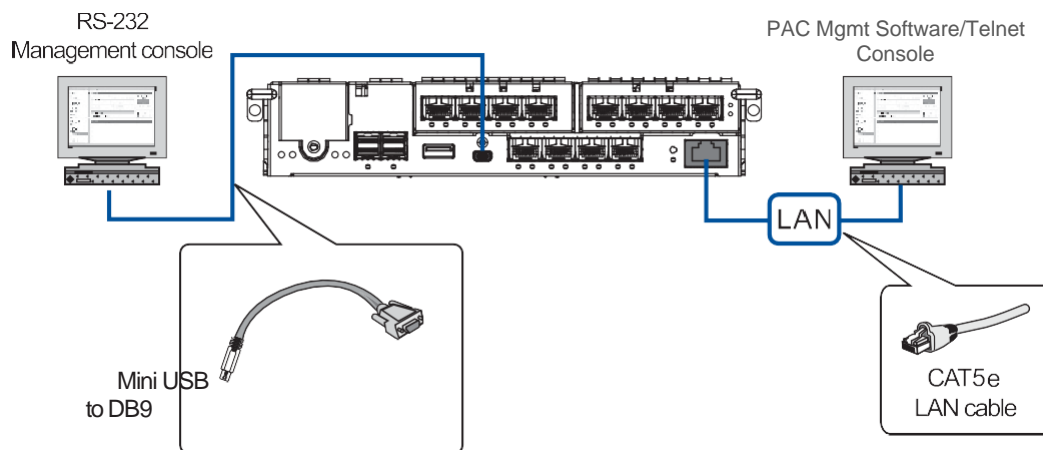
See below table for the list of default values of the serial port.

Baud Rate	38400
Data Bit	8
Parity	None
Stop Bit	1
Flow Control	Hardware

IMPORTANT! Always connect to the primary controller.

NOTES:

- A null modem may be required if you are using a 3rd party cable.

- For TCP/IP connection and firewall configuration, refer to your management software's online help, or user manual. If your network is not running the DHCP server protocols, you can use the default IP **10.10.1.1** if you are accessing for the first time.

2.3.8 Power Connection

Before connecting to a power source, ensure that all components are properly installed and the management interfaces are properly connected.

Take a look at the list below and check the following:

- The hard drives are correctly installed to the drive trays.

- All drive trays are installed to the system, whether or not they contain a hard drive.

- The system is connected to host computers, management computers, or external networking devices with the correct cables.

> **IMPORTANT!** Ensure to use the power cables with at least 1.2 meters in length. DO NOT use extension cables as the power cables are designed to connect **ONLY and DIRECTLY** to relocatable power taps (RPTs) on server cabinets.

- Ensure that the ambient temperature is not more than 35°C (with CBM).

Connecting to Power Source

Use the bundled power cables and connect them to the power sockets for both PSUs.
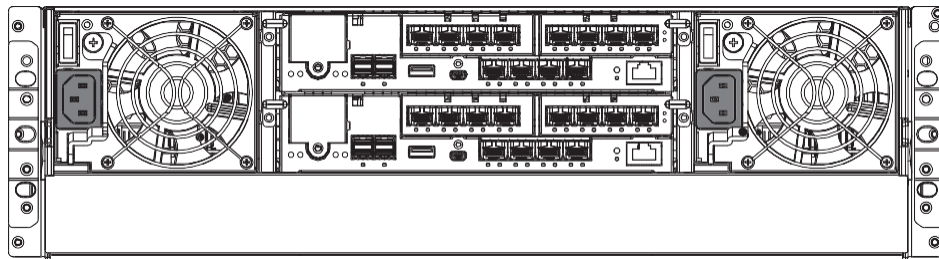
Turning the System On

Before turning on the PS system, you must turn on the expansion enclosures first if your network configuration consists of multiple arrays.

To turn on the system:

1. Turn on the networking devices.

2. Turn on the JBOD/expansion systems.

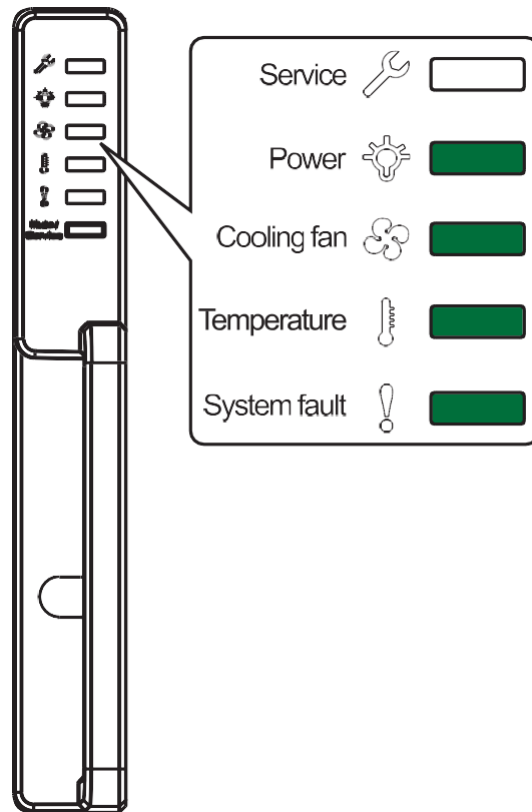3. Press the power switches located at the PSUs, from left to right order.
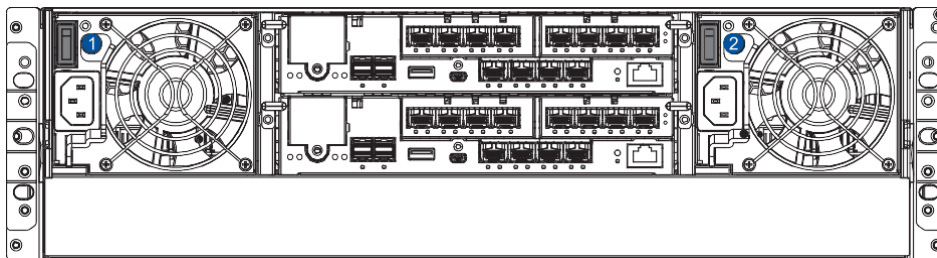
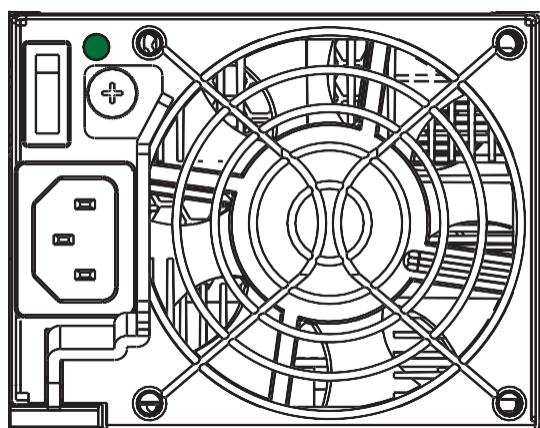4. Turn on the application servers.

Checking the Power Status

Once the system is on, no LEDs should light up in red or amber, nor should you hear an alarm from the system. Start verifying the system status via the following interfaces:
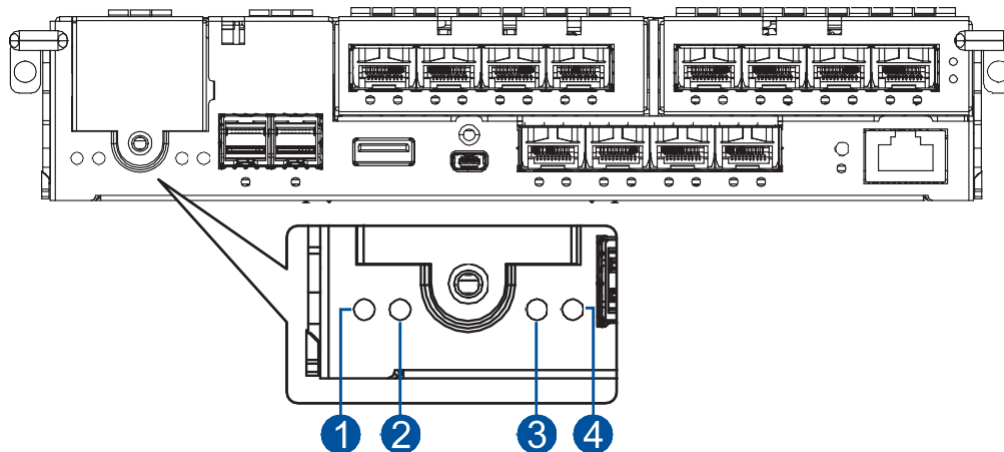
- **Front Panel LEDs**

- **PSU LED**

- **Controller Module LEDs**

Number	LED Name	Status
1	Control Status	**ON**
2	CBM Status	**ON/OFF**
3	Cache Dirty	**OFF**
4	Host Busy	**OFF**

NOTE: Refer to chapter **System Monitoring** for more information regarding the LED description.

2.3.9 Turning Off the System

Before turning off the system, ensure that no processes are taking place such as **Regenerate Logical Drive Parity** or **Media Scan**.

To turn off the system:

1. Close all applications to stop the I/O access to the system.

2. Flush the cache to clear the DRAM data. If the DRAM contains cached data, the Cache Dirty LED lights up in amber.

3. Flush all cached data using the controller's shutdown function to prepare the RAID system for a safe power shutdown. Refer to PAC Management Software manual for details.

4. Once the cache is flushed, switch off the system.

System Monitoring

3

This chapter details the monitoring features and the status of PS4000 Gen2 Series systems.

3.1 Monitoring Features

A PS 4000 Gen2 system is equipped with self-monitoring features that help you keep track of the system's operating status.

You can monitor your system's status with the following features:

- **Firmware**

  The firmware manages the controllers of the system, which is accessible in a terminal program via the serial port. For more details, see the firmware manual in the bundled CD.

- **PAC Management Software**

  PAC Management Software is a browser-based GUI (graphical user interface) software that you can install into a local or remote computer and access via the network.

- **LEDs**

  The LEDs are indicators that notify you of the system status, events, and errors or failed operations. The LEDs are located on both front and rear panels of the chassis.

- **Audible Alarms**

  The audible alarms are triggered in case of system failures.

3.1.1 LEDs

This section details the system LEDs and their descriptions.

- **Front Panel LEDs**

| 2U systems | 3U system | 4U system |
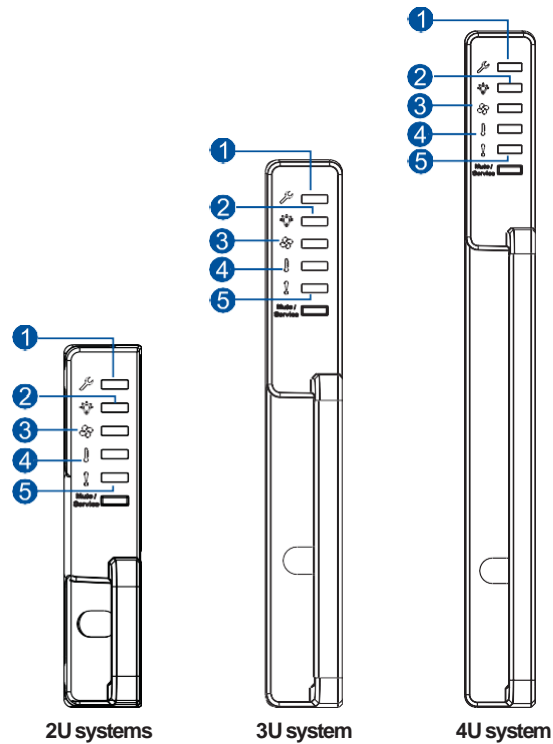
Number	LED Name	Color/ Status	Description
❶	Service	⚪	The system is being serviced or is requiring services.
		OFF	The system is not being serviced or does not require a service.
❷	Power	🟢	The system is powered properly.
		🟠	A power failure occurred in the system.
❸	Cooling Module Status	🟢	The cooling fan built with the PSU is running normally.
		🟠	A fan failure occurred.
❹	Temperature Status	🟢	The internal temperature is normal and within the safety threshold.
		🟠	The internal temperature exceeds the safety threshold.
❺	System	🟢	The system is operating normally.
		🟠	The system encounters abnormal conditions.

IMPORTANT! If the cooling module status LED lights up in 🟠, check the fan built with the PSU.

- **Drive Tray LEDs**

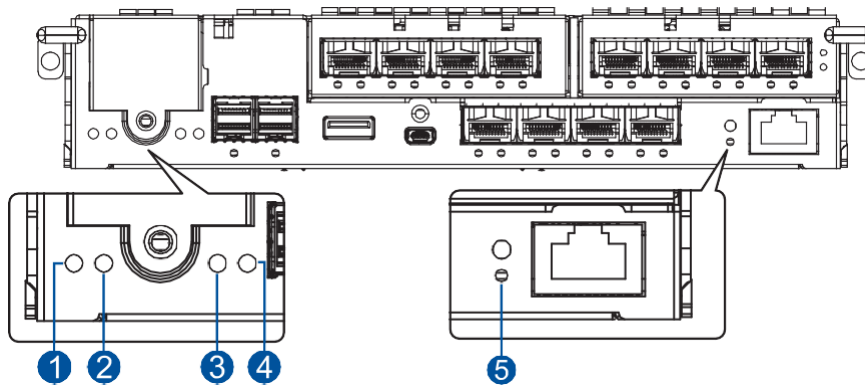**PS 4012 Gen2, PS 4016 Gen2, and PS 4024 Gen2**   **PS 4025 Gen2**
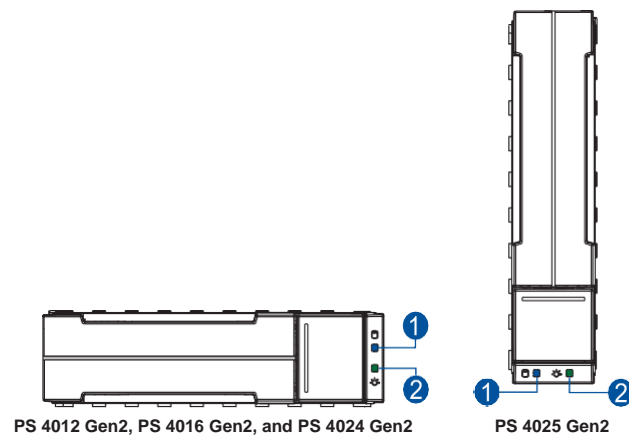
There are two LEDs on the tray that indicate the status of your drives. When you get notified by a drive failure message, you must check the drive tray LEDs to find the correct location of the failed drive.

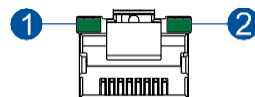| Number	LED Name	Color	Description
❶	Drive Busy	⚡	Data is being written or read from the drive. The drive is busy.
		🔵	The hard drive is plugged in but there is no activity going on.
❷	Power Status	🟢	The drive bay is occupied and working normally.
		🔴	Disk drive failed or connection problem occurred.

Rear Panel LEDs

- **Controller Status LEDs**

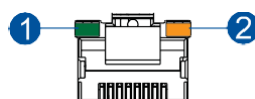| Number	LED Name	Color/Status	Description
1	Control Status	🟢	A controller is operating normally.
		🟠	• A component has failed or inappropriate RAID configurations cause system faults. • The controller is initializing.
2	CBM Status	🟢	• Supercapacitor and flash modules are installed in the system. • The CBM is ready for operation.
		🟠	• The CBM failed in operating, either the supercapacitor or flash module. • Either the supercapacitor and flash module is missing.
		⚡	The supercapacitor is charging.
3	Cache Dirty	🟠	• Cache memory is dirty. • Data in flash backup module is flushed to the cache. • Errors occurred with cache memory (ECC errors). • Data is flushed from flash backup module to drive when the power is restored. • The supercapacitor temperature reading is abnormal (out of 0 to 35°C range). • The supercapacitor is not present.
		⚡	The cached data is being transferred to the flash module after a power outage. Once the transfer is done, all LEDs will turn off. This signal is local to each controller.
		OFF	The cache is clean and the supercapacitor can sustain the memory in case of power loss.
4	Host Busy	🟢	Traffic is going on the host bus.
5	Restore Default	🟢	Successfully reset the controller after pressing and holding the restore default button.

- **1GbE Management Port LED**
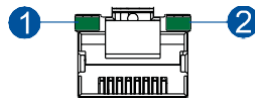
Number	LED Name	Status	Description
1	Speed	ON	1Gb connection is established.
		OFF	• 10/100Mb connection is established. • No connection is established.
2	Link/Active	ON	A connection is established.
		Flashing	Data I/O is ongoing.
		OFF	No connection is established.

- **10GbE Port (SFP+) LED**

Number	LED Name	Color/Status	Description
1	Speed	🟢	10Gb connection is established.
		OFF	10/100Mb connection is established.
2	Link/Active	🟢	A connection is established.
		⚡	Data I/O is ongoing.
		OFF	No connection is established.

- **10GbE Port (RJ-45) LED**

Number	LED Name	Color/Status	Description
1	Speed	🟢	10Gb connection is established.
		🟠	1Gb connection is established.
		OFF	10/100Mb connection is established.
2	Link/Active	ON	A connection is established.
		Flashing	Data I/O is ongoing.
		OFF	No connection is established.

• **25GbE Port (SFP28) LEDs**
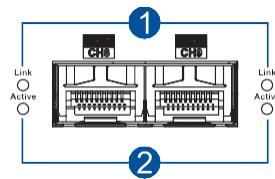
LED Name	Status	Description
Link/Speed	🟢	A connection is established.
	OFF	No connection is established.
Active	🟠	Data I/O is ongoing.
	OFF	No Data I/O.

• **12Gb/s SAS Expansion Port LED**
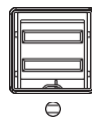
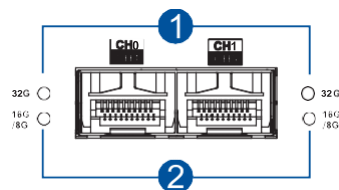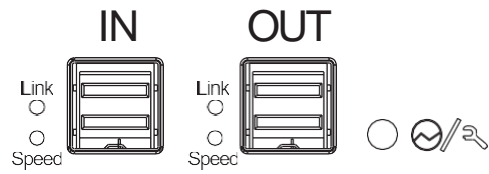| LED Name	Status	Description
Link/Active	🟢	All 4 PHY links are validly linked.
	⚡	Less than 4 PHY links are connected (at least one of the PHYs has failed).
	OFF	All 4 PHY links are offline.

- **16Gb/s Fiber Channel Port LEDs**
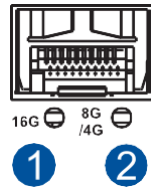
Number	LED Name	Color/Status	Description
❶	16Gb/s Speed	🟢	A connection is established.
		⚡ (fast)	Data I/O is ongoing.
		⚡ (slow)	No link/connection is established.
❷	8Gb/s Speed	🟢	A connection is established.
		⚡ (fast)	Data I/O is ongoing.
		⚡ (slow)	No link/connection is established.
	4Gb/s Speed	🟠	A connection is established.
		⚡ (fast)	Data I/O is ongoing.
		⚡ (slow)	No link/connection is established.

- **32Gb/s Fiber Channel Port LEDs**

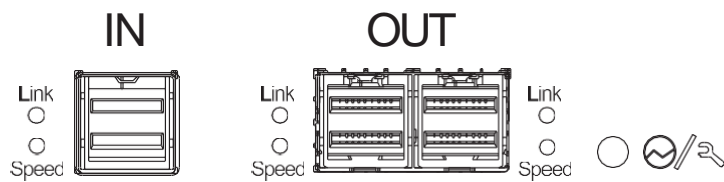| Number	LED Name	Color/Status	Description
❶	32Gb/s Speed	🟢	A connection is established.
		⚡ (fast)	Data I/O is ongoing.
		⚡ (slow)	No link/connection is established.
❷	16Gb/s Speed	🟢	A connection is established.
		⚡	Data I/O is ongoing.
		OFF	No link/connection is established.
	8Gb/s Speed	🟠	A connection is established.
		⚡	Data I/O is ongoing.
		OFF	No link/connection is established.

- **12Gb/s SAS Expansion Controller LEDs**

IN   OUT

Link   Link

Speed   Speed

PS12J2, PS16J3, PS24J2, and PS25J2

IN   OUT 1   OUT 2

Link   Link   Link

Speed   Speed   Speed

PS60J4 Series

IN   OUT

Link   Link   Link

Speed   Speed   Speed
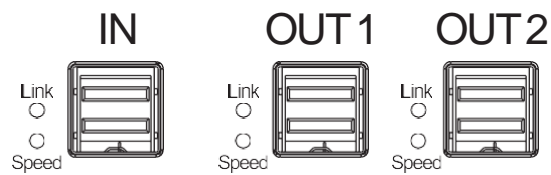
PS60J4 Series (Drawer Type)

LED Name	Status	Description
Link/Active	ON	All PHYs are validly linked.
	Flashing	One of the PHYs has failed.
	OFF	All PHYs are offline.
Speed	🟢	12Gb/s link speed
	🟠	6Gb/s or 3Gb/s link speed
	OFF	No connection
○ ⊘/🔧	🟢	The controller is operating normally.
	🟠	• A component failure occurred. • Initialization is ongoing.

• **PSU LED**
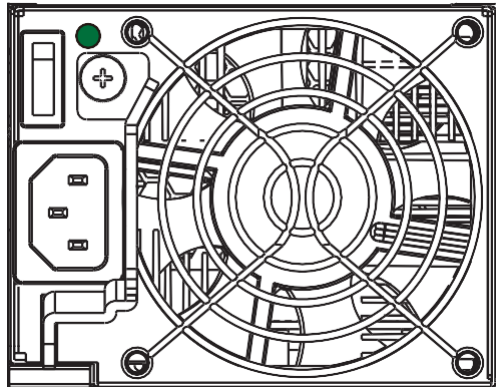
Color	Description
⚡	The system is connected to the power source but the system is not turned on.
🟢	The PSU is operating normally.
🔴	The PSU is faulty.

The PSU LED alerts you of the current status of your PSU. When this component fails, you must replace the PSU immediately.

> **WARNING!** Keep your fingers away from moving parts of the system to prevent technical mishaps and physical injuries.

> **NOTE:** For more details, see section **4.1.1 Replacing the PSU/Cooling Module**.

3.1.2 Alarms and I²C Bus

This section details the system alarms and I²C bus.

Audible Alarms

You will hear an audible alarm if any of the following components fails:

- Cooling modules

- PSU modules

- Hard disk drives

- Sensors or presence detection circuitries

If you hear an audible alarm, ensure to read the error message on the terminal or PAC Mgmt. Software screen to determine the cause of the alarm. Take appropriate actions to solve the problem. You can turn off the alarm using the mute button on the front panel.

> **NOTE:** When the temperature exceeds the preset threshold, the controller's charger circuits stop charging. You will receive a message that says *Thermal Shutdown/Enter Sleep Mode*. When the temperature falls back to normal range, the super capacitor resumes charging.

I²C bus

The operating status of the PSU and cooling modules are collected via the I²C serial bus. If either of the modules fails, the system detects the failure and you will be notified via the same methods stated in audible alarms.

System Maintenance

4

This chapter provides maintenance and replacement procedures of replaceable components of your PS 4000 Gen2 Series systems.

4.1   Replaceable Components

Your PS 4000 Gen2 system is comprised of replaceable components:

*   PSU/cooling module

*   Controller module

*   Memory module

*   Host board

*   CBM

*   Hard disk drive

WARNING!

*   DO NOT remove a defective component from the system until you have the replacement on hand. Doing so may disrupt the internal airflow.

*   Consult with the qualified engineers who are familiar with the system to recommend you of the component replacements.

*   DO NOT use excessive force when installing a replaceable module. Forced installation of the module can damage the connector pins of the system, the module, or the internal backplane.


4.1.1   Replacing the PSU/Cooling Module

Replace the defective PSU/cooling module immediately, but only if you have the replacement.

> **WARNING!** Although the system can still operate with a defective PSU, it is not recommended to use it for an extended period of time.

> **IMPORTANT!** For single-controller systems, you must shut down your system before replacing the PSU/cooling module.

To replace the PSU/cooling module:

1.   Shut down the system, turn off the PSU, then unplug the power cord.

2.   Loosen the retention screw that secures the extraction lever to the chassis.
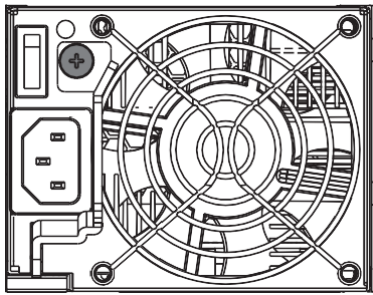
3.   Pull down the extraction lever to dislodge the PSU/cooling module from the backplane connectors, then gently pull the PSU/cooling module from the system. If the system is mounted to the rackmount, carefully support its weight with the rack while removing the module.
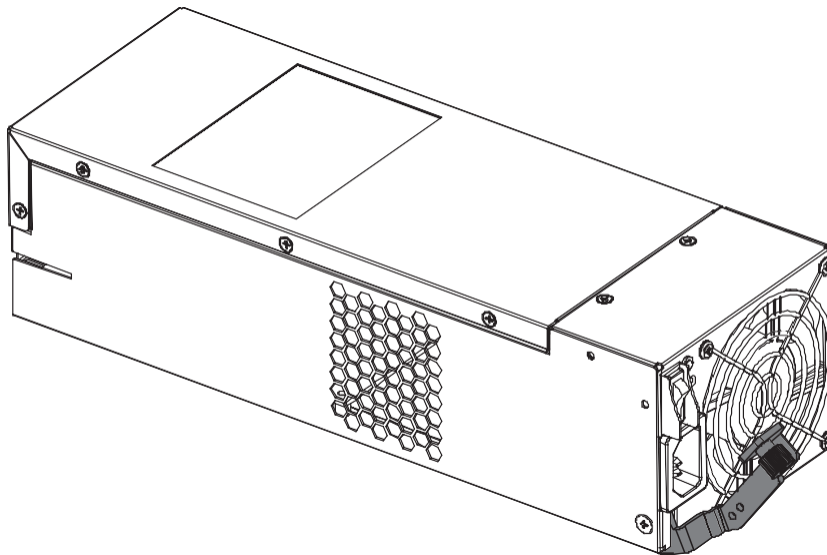
4. Insert the replacement PSU/cooling module with the extraction lever pointing outwards, then push into the chassis. When you feel a resistance, push the extraction lever to lodge the PSU/cooling module to the backend connectors.
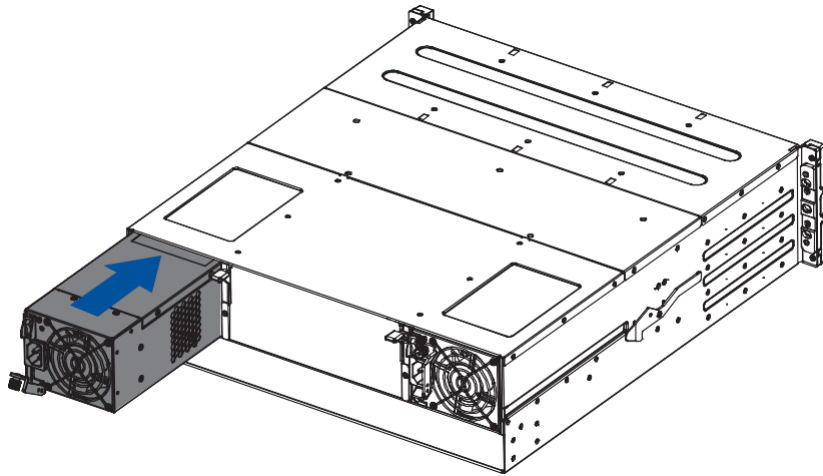
5. Fasten the retention screw.

6. Reconnect the power cord.

7. Power on the PSU module.

4.1.2   Replacing the Controller Module

When replacing a controller in a dual-controller system, ensure that the replacement controller's firmware matches with the controller that you want to get replaced. The replacement provided to you has the firmware version on the label of the packaging.

Use PAC Mgmt. Software to find out the firmware version of the present controller. From PAC Mgmt GUI, go to **Storage Manager** > **Information** > **Enclosure View**.

WARNING! DO NOT use the controller modules from different models. Each controller module has a unique ID which is applied to the host port names. If you insist on using other models' controller modules, you may encounter SAN problems on multiple systems.
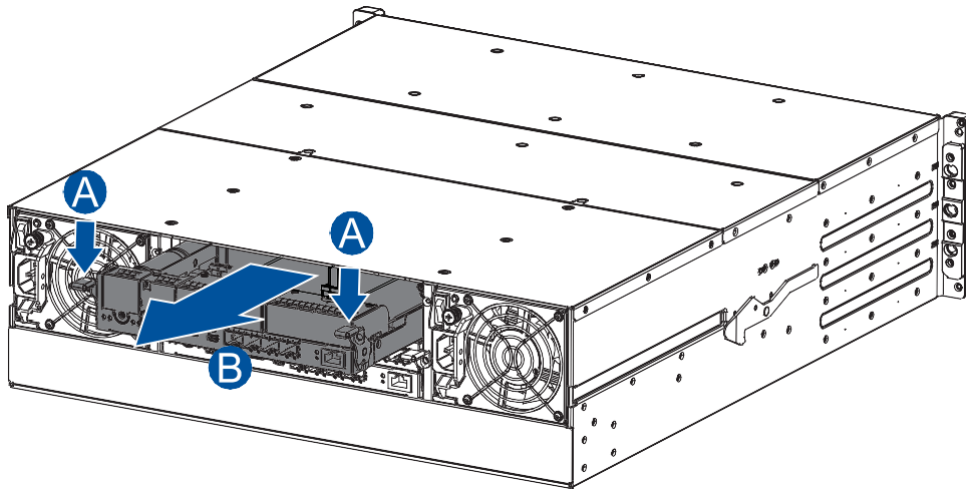

IMPORTANT! When removing/installing a controller in a single-controller system or both controllers simultaneously in a dual-controller system, ensure that you shut down the applications and the system.
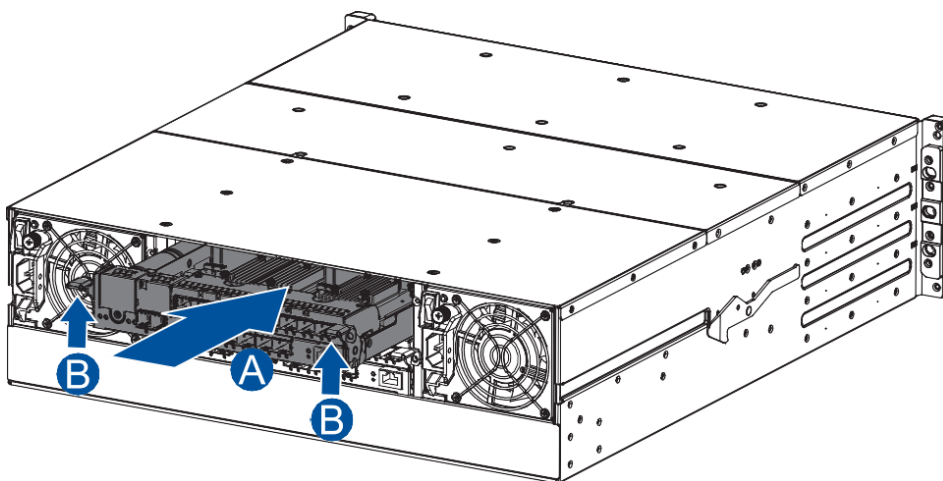

To replace the controller:

1. Prepare a clean, static-free work pad or container to place the controller.

2. For replacing a controller in a single-controller system or both controllers simultaneously in a dual-controller system, shut the system down. Stop all I/O access to the system and ensure all cached writes have been distributed to disk drives using firmware's **Main Menu** > **System Functions** > **Shutdown controller function**. Power off the system and turn off the power switches and unplug the power cords from PSUs.

3. Disconnect all cables from the controller that you want to be replaced.

4. Loosen the screws that secure the controller's ejection levers to the chassis.
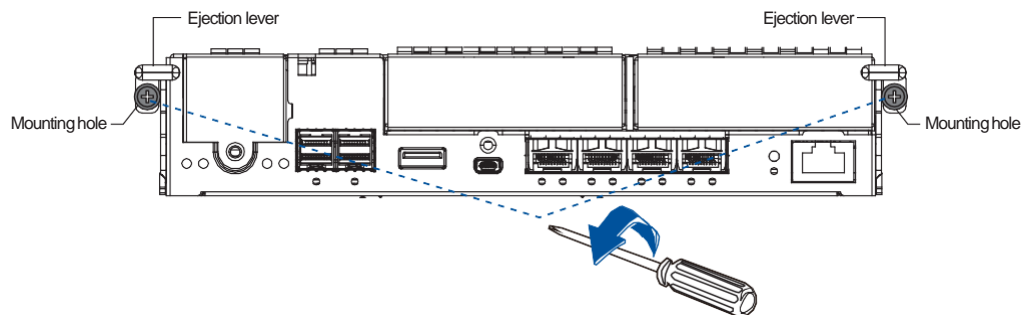
3. Push the ejection levers downwards to dislodge the controller from the system (A), then pull to remove from the enclosure (B).

4. Insert the replacement controller carefully into the controller module slot (A). When you feel a contact resistance, use a small but careful force and push the ejection levers upwards to secure the controller to the enclosure (B).

5. To secure the controller to the chassis, fasten two retention screws to the controller's mounting holes under the ejection levers.
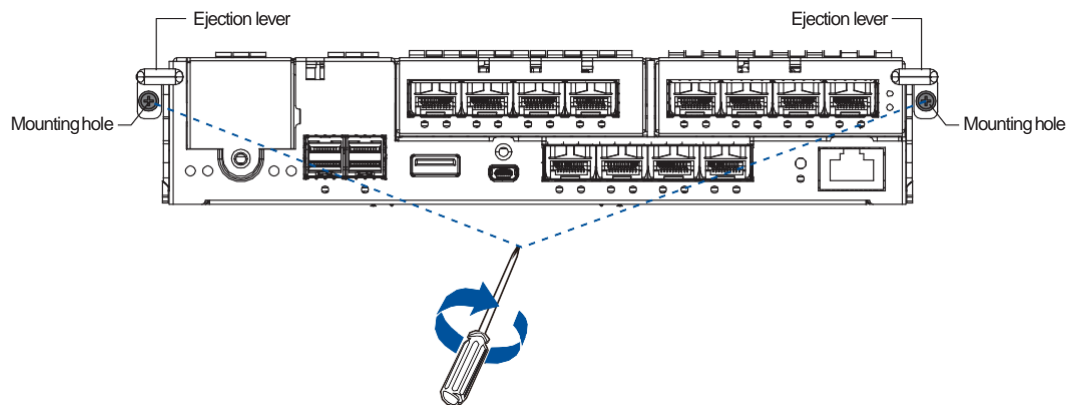
6. Reconnect the cables to the controller's ports.

7. For replacing a controller in a single-controller system or both controllers simultaneously in a dual-controller system, power up the system. Check the messages on the system's LCD panel, PAC Mgmt., or firmware utility. The power LEDs turn on when the system is successfully initiated online.

8. For replacing a controller in a single-controller system or both controllers simultaneously in a dual-controller system, restore NVRAM data. From your firmware, look for **Restore NVRAM from Disks** or **Restore NVRAM from Files** to restore your previous ID/LUN mapping configuration.

4.1.3   Replacing the Memory Module

The controller comes with a pre-installed DRAM module(s). You can upgrade or replace it when the bundled module malfunctions.

IMPORTANT!

- We strongly recommend you to NOT use the removed DRAM module from a failed controller of a different storage system.

- Contact your system vendor to help you purchase the compatible DRAM modules.

- When removing/installing a memory module in a single-controller system, ensure that you shut down the applications and the system.
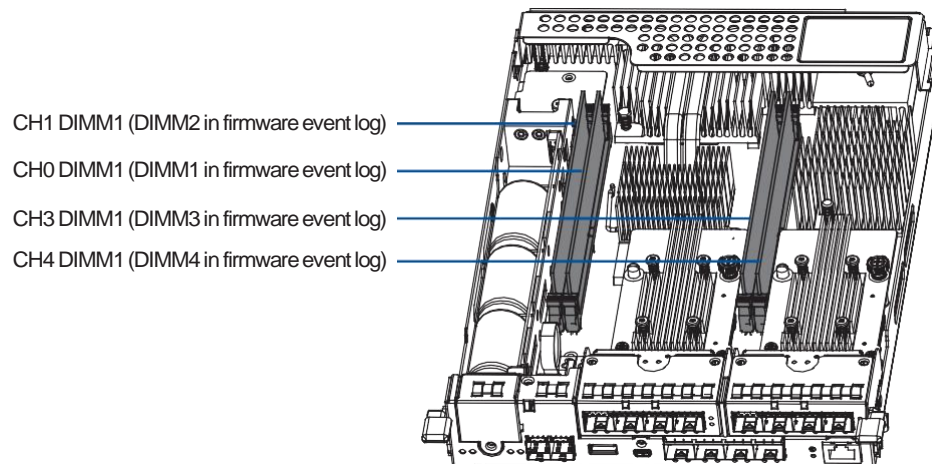

NOTE: Refer to section **ESD Precautions** for safety information.

To replace the memory module:

1.   Remove the controller that contains the memory module you want to replace.

**NOTE:** See section **4.1.2 Replacing the Controller Module** for details.

---

2.   Look for the DIMM slots in the controller.

CH1 DIMM1 (DIMM2 in firmware event log)
CH0 DIMM1 (DIMM1 in firmware event log)
CH3 DIMM1 (DIMM3 in firmware event log)
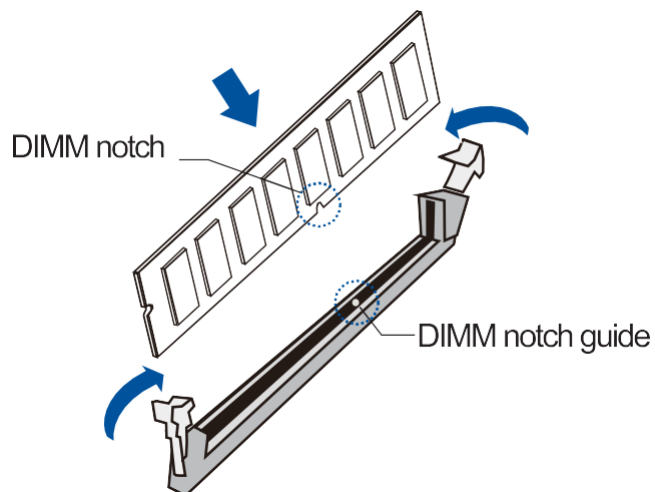CH4 DIMM1 (DIMM4 in firmware event log)

IMPORTANT! When installing memory modules, please fill CH0 DIMM1 and CH3 DIMM1 slots first.

3. Push down the clips to release the DRAM module from the DIMM socket.
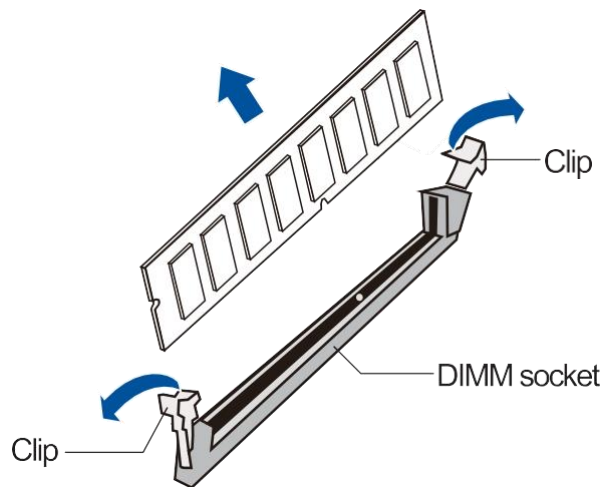
4. Insert the replacement DIMM carefully into the DIMM socket, with the DIMM's notch aligned to the DIMM socket's notch guide.

5. Reinstall the controller back to the enclosure.

4.1.4 Replacing the Host Board

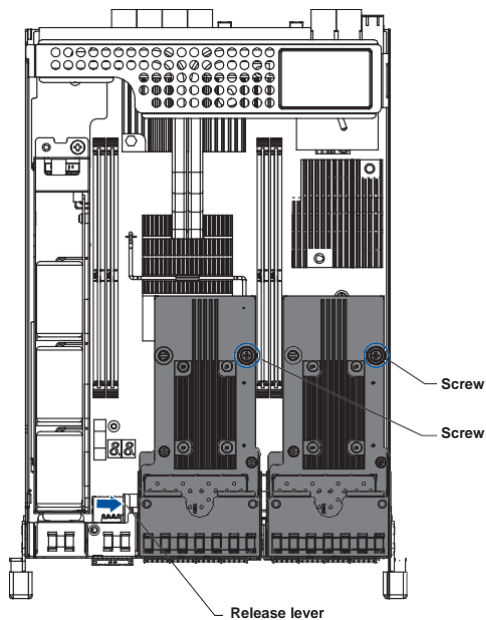Before replacing the host board to the controller, you must take note of the following considerations:

- A controller/host board downtime may occur if you replace a host board for an upgrade.

- The firmware automatically restores the system to its factory settings when adding or replacing a host board.

To replace the host board:

1. Remove the controller that contains the host board you want to replace.

   NOTE: See section **4.1.2 Replacing the Controller Module** for details.

2. Loosen the screw that secure the host board to the controller, push the release lever, then lift to remove the host board.

Screw

Screw

Release lever

3. Use the guide pin to position the new host board to the host board slot, place it carefully (A), then tighten the thumb screws to secure the host board in place (B).

Guide pin

Host board 2

Host board 1
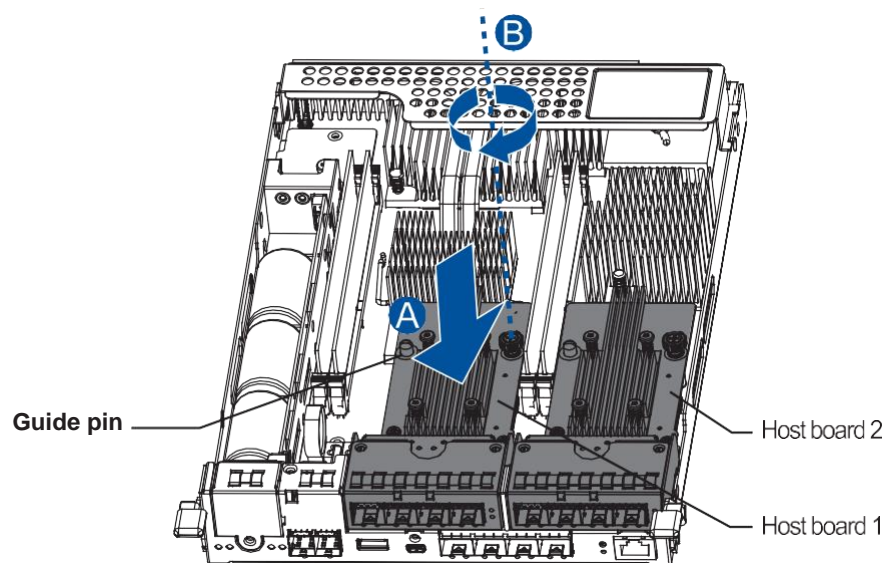
4. Reinstall the controller back to the enclosure.

4.1.5 Replacing the CBM (Cache Backup Module) Components

The CBM is comprised of a super capacitor and the FBM (flash backup module). The super capacitor allows your controller to provide more power during a power outage, supporting the controller to save the data to the FBM.

WARNING! Ensure that you have the replacement on hand before replacing your current CBM.

Super Capacitor Fault Conditions and Precautions

If a super capacitor leaks, gives off bad odor, generates abnormal amount of heat, becomes discolored or deformed, or appears abnormal when charging or storing, remove it from the system immediately.

These issues may be due to the following:

- The temperature sensor on the system's charger circuit reports a temperature that exceeds the preset threshold. The charger circuit enters to a low power and self-protection state.
- A super capacitor module has been charged for more than 10 minutes. When this occurs, the charger enters a timer fault state. Charging resumes automatically after you remove or reinstall the super capacitor, or after you reset the system.

When reinstalling/replacing the super capacitor, remember these precautions:

- ONLY use a replacement super capacitor supplied by an authorized distributor. Use of other capacitors voids your system's warranty.
- ONLY dispose your used/defective super capacitor at an authorized battery disposal site.
- DO NOT place the super capacitor near a heat source.
- DO NOT immerse/submerge the super capacitor in water or other liquids.
- DO NOT disassemble or modify the super capacitor.
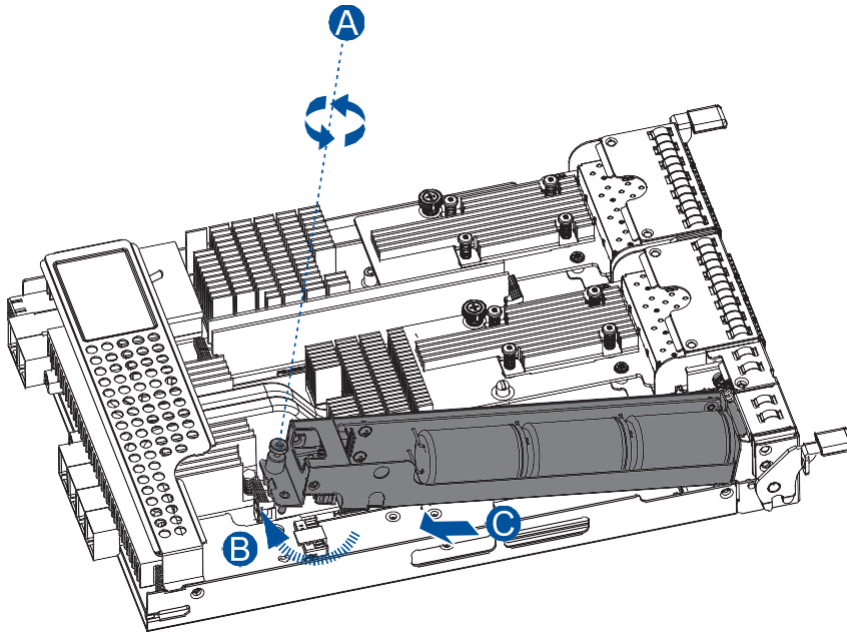- DO NOT pierce, strike, throw, or exert pressure on the super capacitor.

Replacing the Super Capacitor

To replace the super capacitor:

1.   Remove the controller that contains the super capacitor you want to replace.

   NOTE: See section **4.1.2 Replacing the Controller Module** for details.

2.   Loosen the screw that secures the super capacitor to the controller (A), lift its side to a 45° angle (B), then pull to remove from the controller (C).

3.   Install the replacement super capacitor to the controller, then tighten the screw to secure it in place.

4.   Reinstall the controller back to the enclosure.

Replacing the FBM (Flash Backup Module)

The FBM is located underneath the super capacitor. To replace the FBM, you need to remove the super capacitor from the controller.
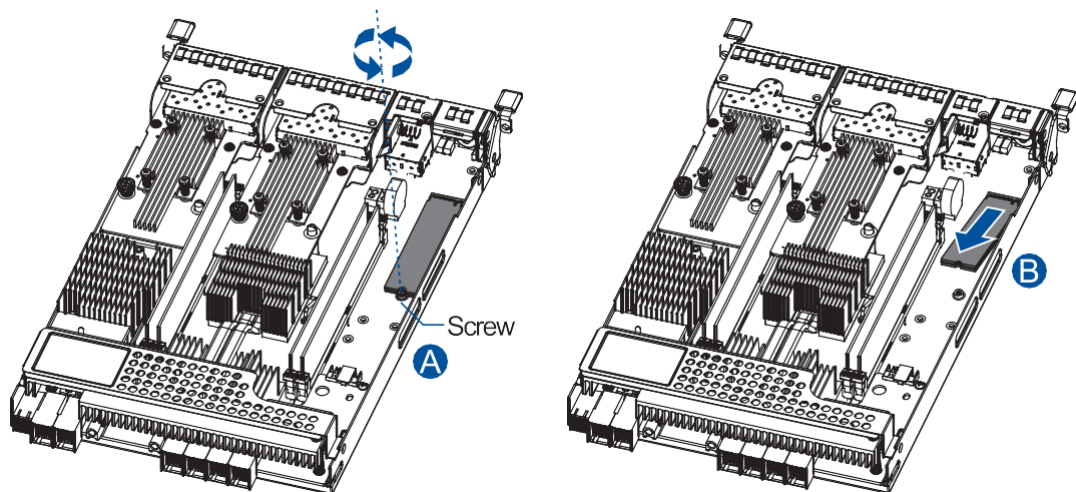
To replace the FBM:

1. Remove the controller that contains the FBM you want to replace.

    NOTE: See section **4.1.2 Replacing the Controller Module** for details.
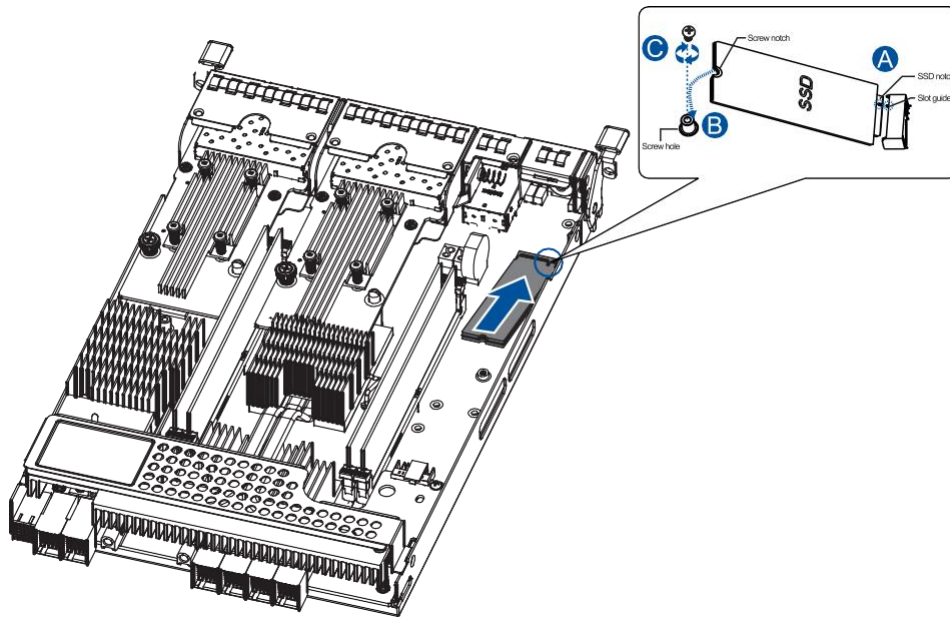
2. Remove the super capacitor from the controller.

    NOTE: See section **Replacing the Super Capacitor** for details.

3. Remove the screw that secures the FBM to the controller (A), then remove the FBM from the FBM module slot (B).

4. Orient and insert the replacement FBM's notch to the module slot's guide in a 45° angle (A), orient the screw notch on the screw hole (B), then secure the FBM to the board with a screw you removed in step 3 (C).

5. Install the super capacitor back to the controller.

6. Insert the controller back to the enclosure.

4.1.6   Replacing the Hard Drive

WARNING!

- Ensure to have the replacement ready before replacing the hard drive. DO NOT leave the drive tray open for long periods to prevent disruption of internal airflow.

- Handle the hard drives with extreme care. Hold them by the edges and avoid touching the circuits and interface connectors.

Replacing the Hard Drive into the Drive Bay and Enclosure (for PS 4012 Gen2, PS 4016 Gen2, and PS 4024 Gen2 Systems)

To replace the hard drive:

1. Identify the faulty hard drive using the PAC Mgmt. Software.

    NOTE: See section **Hard Drive Designation** for the order of the drive bays.

2. When the faulty hard drive is located, push the release button to eject the drive tray, wait for 30 seconds for the drive to spin down, then pull out the tray using the spring handle.
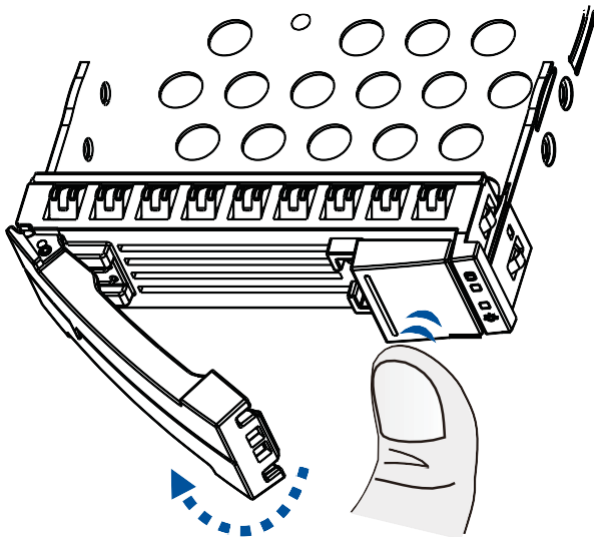
3. Remove the retention screws from the drive tray to dislodge the hard drive.

Screw hole location of 2.5-inch HDD/SSD on a 3.5-inch drive tray
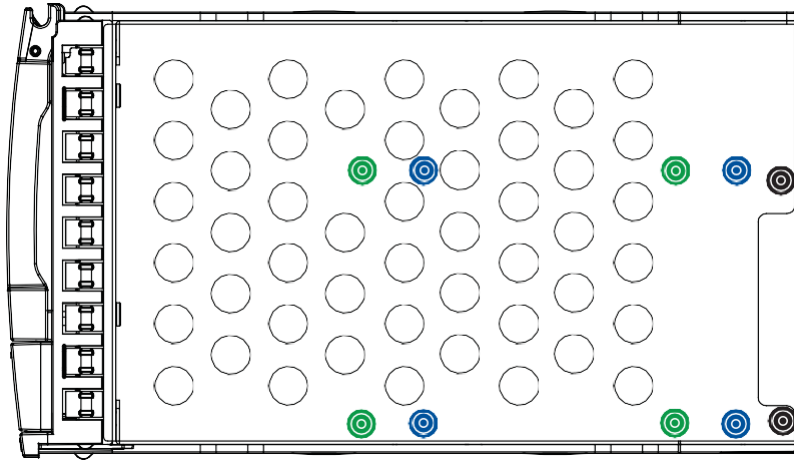
- ● HDD/SSD with MUX board
- ● HDD/SSD without MUX board
- ● MUX board screw holes
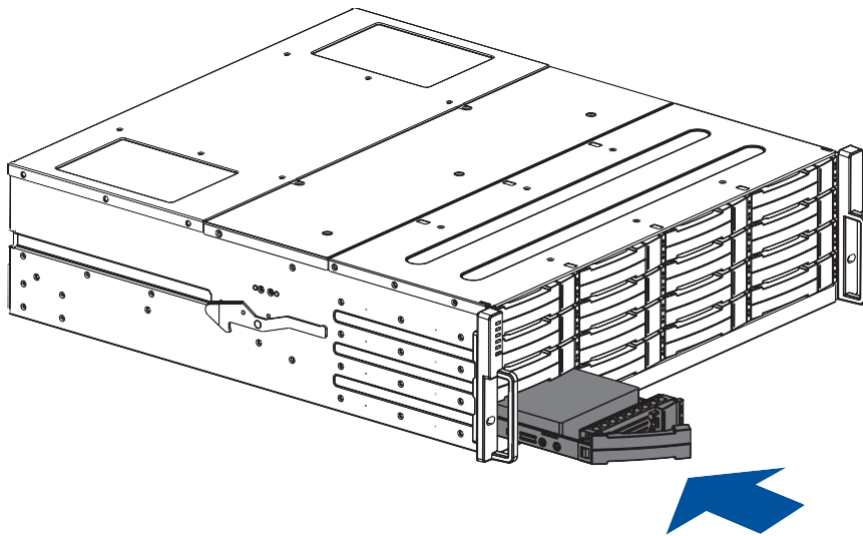
Screw holes of 3.5-inch SAS and SATA HDD

- ● HDD with MUX board
- ● HDD without MUX board

Screw holes of 2.5-inch SAS and SATA HDD

- ● HDD with MUX board
- ● HDD without MUX board

4. Install the replacement hard drive to the drive tray, then insert the assembled hard drive and drive tray to the bay with the spring handle open.

5. When the tray is fully inserted to the bay, close the spring handle.

> **IMPORTANT!** Ensure that there is no more drive error reported.

Replacing the Hard Drive into the Drive Bay and Enclosure (for PS 4025 Gen2 System only)
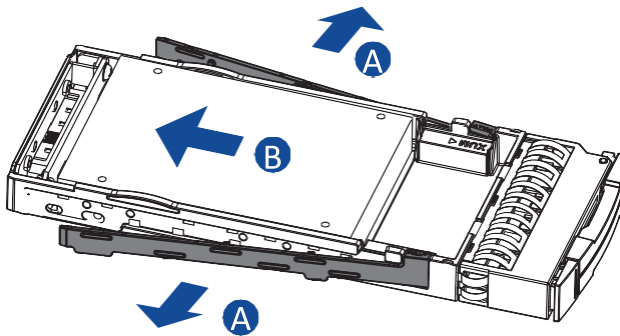
To replace the hard drive:

1. Identify the faulty hard drive using the PAC Mgmt. Software.

> **NOTE:** See section **Hard Drive Designation** for the order of the drive bays.

2. When the faulty hard drive is located, push the release button to eject the drive tray, wait for 30 seconds for the drive to spin down, then pull out the tray using the spring handle.
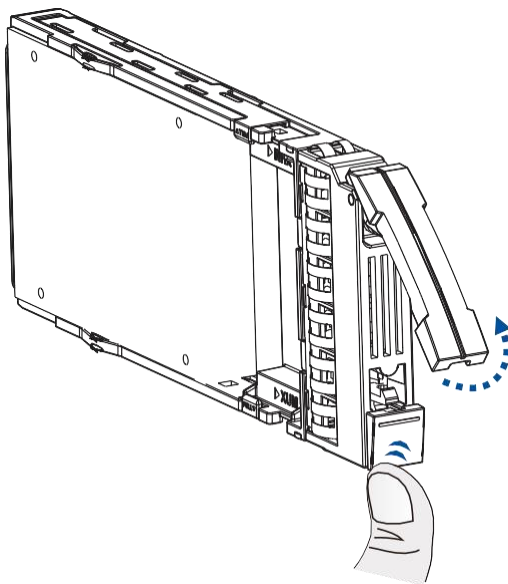
3. Remove the side clips from the tray (A) then remove the hard drive from the tray (B).

NOTE: If the installed hard drive has a MUX board, remove it from the hard drive's connectors.

4. Place the hard drive on the tray (A), then secure the clips to both sides of the tray (B).
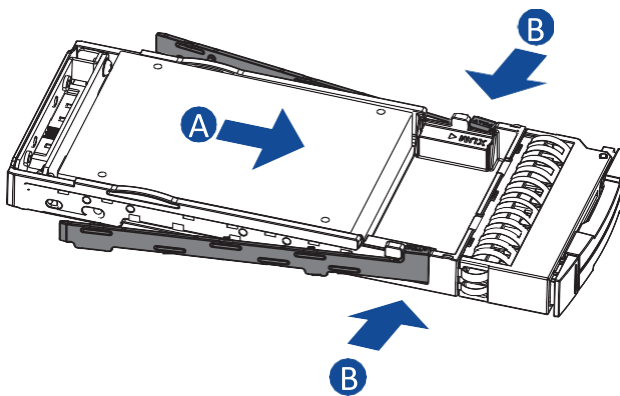
NOTE: If the hard drive requires a MUX board, attach it to the drive.

5. Insert the assembled hard drive and tray to the enclosure with the spring handle open, then close the spring handle when the drive is fully inserted to the bay.

4.2   Restoring Default System Settings

> **NOTE:** Restoring default settings is a last-resort function. All configurations such as parameters and host LUN mappings will be erased.

You may need to restore default settings in the following cases:

• When the firmware update procedure requires it.

• When you need to reset the password to access the storage system.

To restore the default settings, follow these steps:

1. Stop all host I/O's.

2. Save the current configuration using **Export NVRAM**.

3. You may also want to make a list of the existing ID/LUN mapping information because the default restoration will erase the ID/LUN mapping associations (i.e., which logical drive is associated with which host ID/LUN).

4. If your system is a dual-controller model, remove Controller B from the chassis. Please refer to **4.1.2 Replacing the Controller Module**.

5. Power off the storage system.

6. Insert a straightened paper clip to the Restore Default button on Controller A, then press and hold until the Restore Default LED lights up.

> **NOTE:** During restoration, the Restore Default LED lights up in 🟠. It lights up in 🟢 after the restoration process is complete.

7. In the firmware, use **Import NVRAM from reserved space** or **Restore NVRAM from files** to restore your previous settings. ID/LUN mapping configuration is restored after applying your previous settings. The single-controller system's restore default procedure is complete. For dual-controller system, please continue with the following procedures:

8. Power off the system.

9. Replace Controller A with Controller B (Insert Controller B into Controller A's slot). While leaving Controller B's slot empty with Controller B in slot A, perform the above steps 1 to 7 to restore Controller B to default settings.

10. Put both Controller A and Controller B into their original positions and power up the system.

Appendices

A

Certifications

Summary

Safety	UL 60950-1 second edition BSMI CNS 14336-1:99 *年版* CB IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013
EMC	CE EN 55032:2012 +AC:2013 / EN61000-3-2:2014 EN 61000-3-3: 2013 / EN 55024:2010+A1:2015 BSMI (CNS 13438) FCC (FCC Part 15, subpart B)
Environment	IEC 60068-2 MIL-STD-810E/883E ISTA ASTM-D3332 IPC-TM-650
Others	ISO7779/3744 RoHS Microsoft WHQL-Windows Server 2003

User Warning

This is Class A Information Technology product which may cause radio frequency interference when used in a residential area, in which case the user will be required to take certain appropriate measures/troubleshooting.

UL Caution, Safety, and Warning Markings

SAFETY STOP - DO NOT ALTER	DISPOSITIF DE SÛRETÉ – NE PAS MODIFIER
CAUTION: This product is combustible. A protective barrier or thermal barrier is required as specified in the appropriate building code	**ATTETNION:** Ce produit est combustible. Une barrière de protection ou une barrière thermique est exigée par le code du bâtiment en vigueur.
WARNING – Interconnection of more than one power supply source to a section of grid rail bus may present a fire hazard.	**AVERTISSEMENT** – Interconnexion de plus d'une source d'alimentation à une section de bus sur rail grille peut présenter un risqué d'incendie.
DANGER – RADIATION	**DANGER – RAYONNEMENT**