Galaxy Raid

Model A24F-R2224

FC-2G to SATA-II RAID Subsystem
Redundant Dual Controllers

Installation and Hardware

Reference Manual

Version 070106

RORKE DATA
A Subsidiary of BELL MICROPRODUCTS

Contact Information

Americas

Rorke Data Inc
9700 West 76th St
Eden Prairie, MN 55344
USA
Tel: +1-800 328 8147
Fax: +1-952 829 0988
sales@rorke.com
techsupport@rorke.com
http://www.rorke.com

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The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

WARNING:

Use only shielded cables to connect I/O devices to this equipment.

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

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This device meets the requirements of the CB standard for electrical equipment with regard to establishing a satisfactory level of safety for persons using the device and for the area surrounding the apparatus. This standard covers only safety aspects of the above apparatus; it does not cover other matters, such as style or performance.

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Safety Precautions

Precautions and Instructions

- Prior to powering on the subsystem, ensure that the correct power range is being used.
- This Galaxy subsystem comes with twenty-four (24) drive bays. Leaving any of these drive bays empty will greatly affect the efficiency of the airflow within the enclosure, and will consequently lead to the system overheating, which can cause irreparable damage.
- If a module fails, leave it in place until you have a replacement unit and you are ready to replace it.
- Airflow Consideration: The subsystem requires an airflow clearance, especially at the front and rear.
- Handle subsystem modules using the retention screws, extraction levers, and the metal frames/faceplates. Avoid touching PCB boards and connector pins.
- To comply with safety, emission, or thermal requirements, none of the covers or replaceable modules should be removed. Make sure that during operation, all enclosure modules and covers are securely in place.
- Be sure that the rack cabinet into which the subsystem chassis will be installed provides sufficient ventilation channels and airflow circulation around the subsystem.
- Provide a soft, clean surface to place your subsystem on before working on it. Servicing on a rough surface may damage the exterior of the chassis.
- If it is necessary to transport the subsystem, repackage all disk drives separately. If using the original package material, other replaceable modules can stay within the enclosure.
- Dual redundant controller models come with two controller modules that must be installed into the subsystem. Single controller models come with one controller module and a metal sheet is placed over the lower controller bay at the rear of the subsystem. Since single controller models cannot be upgraded, this metal sheet should NEVER be removed.

ESD Precautions

Observe all conventional anti-ESD methods while handling system modules. The use of a grounded wrist strap and an anti-static work pad is recommended. Avoid dust and debris or other static-accumulating materials in your work area.

About This Manual

This manual:

- Introduces the Galaxy A24F-R2224 subsystem series.
- Describes all the active components in the system.
- Provides recommendations and details about the hardware installation process of the subsystem.
- Briefly describes how to monitor the subsystem.
- Describes how to maintain the subsystem.

This manual does not:

- Describe components that are not user-serviceable.
- Describe the configuration options of firmware, management access through terminal emulation programs, LCD keypad panel, or the RAIDWatch GUI that came with your subsystem.
- Give a detailed description of the RAID controllers embedded within the subsystem.

Revision History

- Initial release

Who should read this manual?

This manual assumes that its readers are experienced with computer hardware installation and are familiar with storage enclosures.

Related Documentation

- ***Generic Operation Manual*** (firmware configuration accessed through terminal software and LCD keypad panel)
- ***RAIDWatch User's Manual***

These two documents can be found in the Product Utility CD included with your subsystem package.

Conventions

Naming

From this point on and throughout the rest of this manual, the Galaxy series is referred to as simply the "subsystem" or the "system" and Galaxy is frequently abbreviated as "Gal."

Lists

Bulleted Lists: Bulleted lists are statements of non-sequential facts. They can be read in any order. Each statement is preceded by a round black dot "•."

Numbered Lists: Numbered lists are used to describe sequential steps you should follow in order.

Important information that users should be aware of is indicated with the following icons:

NOTE:

These messages inform the reader of essential but non-critical information. These messages should be read carefully as any directions or instructions contained therein can help you avoid making mistakes.

CAUTION!

Cautionary messages should also be heeded to help you reduce the chance of losing data or damaging the system.

IMPORTANT!

The Important messages pertain to use the Galaxy subsystem introduced in this manual.

WARNING!

Warnings appear where overlooked details may cause damage to the equipment or result in personal injury. Warnings should be taken seriously.

Software and Firmware Updates

Please contact technical support for the latest software or firmware updates.

Problems that occur during the updating process may cause unrecoverable errors and system down time. Always consult technical personnel before proceeding with any firmware upgrade.

NOTE:

The firmware version installed on your system should provide the complete functionality listed in the specification sheet/user's manual. We provide special revisions for various application purposes. Therefore, DO NOT upgrade your firmware unless you fully understand what a firmware revision will do.

Chapter 1 Introduction

1.1. Product Overview

1.1.1 Product Introduction

This hardware manual briefly introduces the Galaxy A24F-R2224, 24-bay, 2Gbps Fibre to Serial ATA (SATA) RAID subsystem as shown in ***Figure 1-1***.

Figure 1-1: Galaxy 24-bay SATA RAID Subsystem

The Galaxy A24F-R2224 RAID subsystem is managed by dual-redundant Fibre-to-SATA RAID controllers. The subsystem has two (2) 2Gbps Fibre host channels that are interfaced through eight (8) separate SFP ports (four per channel). The additional SFP ports facilitate connection to cascaded enclosures, HBAs on the application servers, or Fibre Channel networking devices such as a switch. The onboard SATA chips provide twenty-four (24) 3Gbps SATA drive channels each dedicated to the connection of a SATA disk drive. Each controller board comes with a pre-installed 512MB DDR RAM DIMM module and can support memory modules with the capacities up to 2GB.

The controller module is accessed through the rear of the subsystem. Host channels from the dual-redundant controllers are routed through a common backplane to the eight (8) SFP ports on two (2) separate host I/O modules.

Two (2) RS-232C (audio jack) serial port connectors are located on the controller module faceplate on the rear of the subsystem. One serial port (COM1) enables serial communication between the controller and an external PC running terminal emulation software that can be used to configure and manage the RAID subsystem. The second serial port (COM2) can be used as signal lines to an uninterruptible power supply (UPS). (See ***Appendix B***) An RJ-45 Ethernet connector allows for

telnet access and web-based management of the subsystem using the included RAIDWatch Manager software.

I/O signals/commands transmitted between the RAID controller and the disk drives in the front section of the subsystem pass through a non-user-serviceable backplane. The passive backplane receives a maximum of twenty-four (24) hard drives that you purchase separately and install into the hot-swappable drive trays. The drive trays, which fit into drive bays, accommodate SATA II hard disk drives.

Two (2) redundant, hot-swappable, dual-fan cooling modules protect the RAID subsystem from overheating and three (3) redundant, hot-swappable, 1U 405W power supply unit (PSU) modules provide constant power to the RAID subsystem. The modular nature of the subsystem and the easy accessibility to all major components ensure that the Galaxy A24F can be easily and efficiently operated and maintained.

1.1.2 Enclosure Chassis

1.1.2.1 Chassis Overview

The Galaxy A24F subsystem enclosure is a 4U metal chassis. A back-end PCB is enclosed in thick gauge sheet metal that divides the enclosure internally into front and rear sections. (See ***Figure 1-2***) The front section accommodates twenty-four (24) drive trays (with their associated hard drives) and the rear section accommodates three (3) PSU modules, two (2) dual-fan cooling modules, and the dual-redundant RAID controller modules. The two (2) foldable handles on the front of the chassis enable you to easily insert/extract the chassis into/from a rack cabinet. The subsystem enclosure can be mounted into standard 19-inch rack cabinets using separately purchased slide rails.

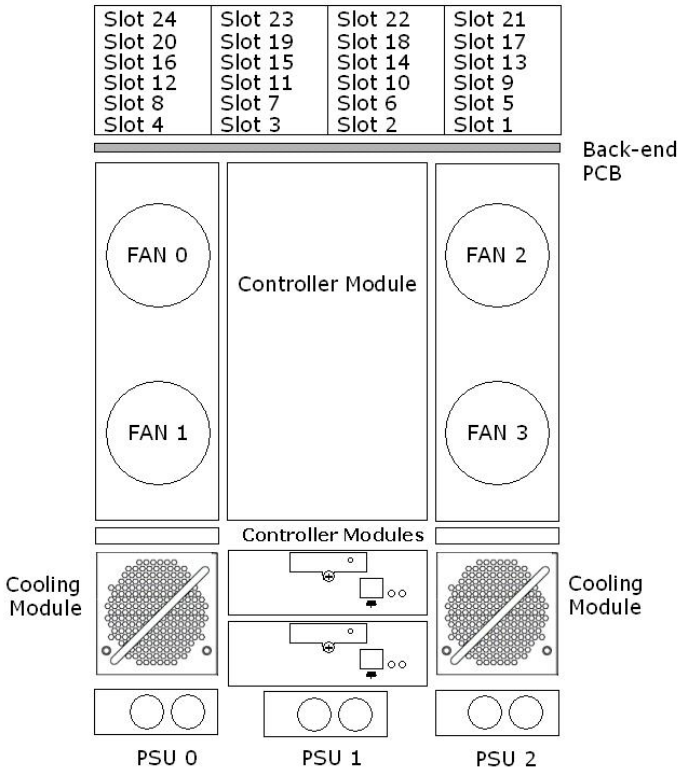

Figure 1-2: Galaxy 24-bay SATA RAID Subsystem Overview

CAUTION!

When working with the subsystem, it is important to use tools with extreme care. Do not place tools or other items on top of the enclosure to help avoid damaging the outward appearance of the chassis.

1.1.2.2 Physical Dimensions

The Galaxy A24F subsystem comes in a standard 4U chassis with the following dimensions:

- ***With forearm handles***: 482W x 174.4H x 514D mm (19 x 6.87 x 20.2 inches)
- ***Without forearm handles***: 445W x 174.4H x 498D mm (17.5 x 6.87 x 19.6 inches)

1.1.2.3 Front Panel Overview

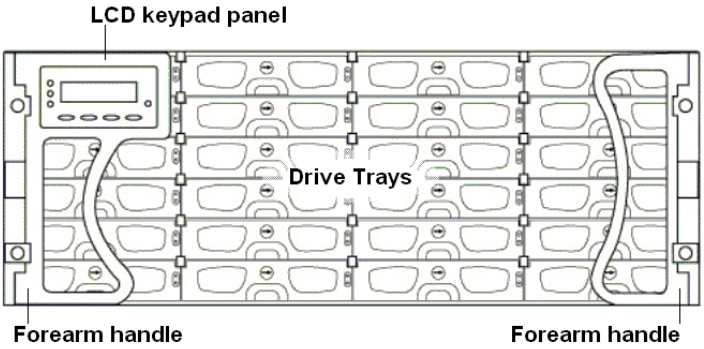

Figure 1-3: Galaxy A24F RAID Subsystem Front View

As shown in ***Figure 1-3***, the front of the subsystem features a 4-column by 6-row layout to accommodate twenty-four (24) drive trays that are designed to house standard 3.5-inch SATA drives. The front side of the subsystem also has two (2) foldable forearm handles (see ***Figure 1-3)*** that are conveniently placed on the sides to facilitate installation and removal of the enclosure within a rack. The left handle comes with a 16-character by 2-row LCD keypad panel with four (4) function buttons that can be used to configure, troubleshoot, and maintain the subsystem.

1.1.2.4 Drive Slot Numbering

The front section of the enclosure houses twenty-four (24) hard drives as shown in ***Figure 1-4***. When viewed from the front, the drive bays (slots) are numbered 1 to 24 from left to right, then from top to bottom.

Slot-1	Slot-2	Slot-3	Slot-4
Slot-5	Slot-6	Slot-7	Slot-8
Slot-9	Slot-10	Slot-11	Slot-12
Slot-13	Slot-14	Slot-15	Slot-16
Slot-17	Slot-18	Slot-19	Slot-20
Slot-21	Slot-22	Slot-23	Slot-24

Figure 1-4: Hard Drive Slot Numbering

1.1.2.5 Rear Panel Overview

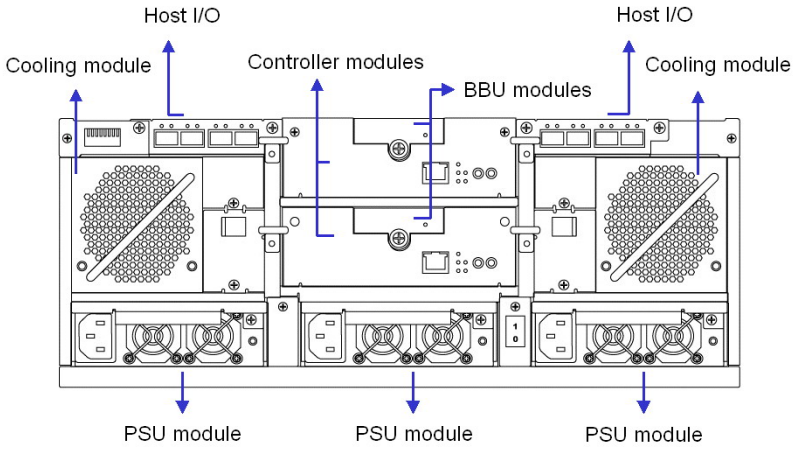

Figure 1-5: Galaxy A24F-R2224 RAID Subsystem Rear View

The rear panel of the A24F subsystem is shown in ***Figure 1-5***. The rear panel provides access to all the components located in the rear half of the RAID subsystem enclosure.

Three (3; N+1) redundant, hot-swappable 405W PSU modules connect the subsystem to the main power source. Two (2) redundant, hot-swappable dual-fan cooling modules are located above the PSU modules. One power switch on the chassis rear panel controls all PSU modules. Each PSU module contains two cooling fans.

Each RAID controller module comes with two (2) RS-232C (audio jack) serial ports, one (1) RJ-45 Ethernet connector, and status-indicating LEDs located on its rear-facing faceplate.

1.1.2.6 The Backplane Board

An integrated backplane board receives disk drives on the front end and connects the RAID controller, cooling, and PSU modules on the rear end. The PCB board provides logic level signals and low voltage power paths. It contains no active electronics and no user-serviceable components.

1.1.2.7 Subsystem Rack/Cabinet Installation

The A24F subsystem chassis has pre-drilled screw holes for slide rail mounting. Separately purchased, independently installed slide rails are available for rack or cabinet installation. Available slide rails are listed below:

The slide rails come with their own installation instructions.

1.2. Subsystem Components

1.2.1 LCD Keypad Panel

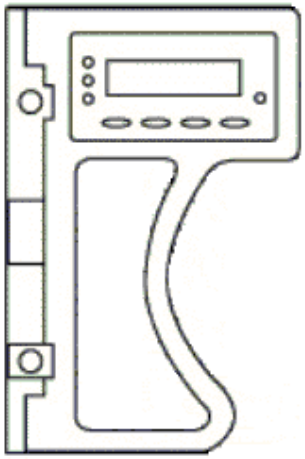

Figure 1-6: LCD Keypad Panel

The LCD keypad panel shown in ***Figure 1-6*** consists of an LCD display with push buttons and LEDs that indicate array status. The LCD panel provides full access to all RAID configurations and monitoring options. After powering up the subsystem, the initial screen will show the subsystem model name. A different name may be assigned for the system, host ports, or specific logical drives. This will enable ease of identification in a topology with numerous arrays.

1.2.2 Drive Trays

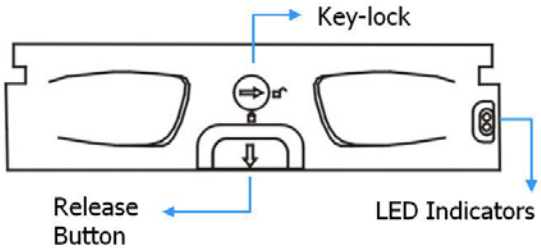

Figure 1-7: Drive Tray Front View

The subsystems' twenty-four (24) drive trays accommodate separately purchased, standard 1-inch pitch, 3.5-inch disk drives. The drive bays are accessed through the front of the enclosure. Two (2) LEDs on each tray bezel indicate the disk drive's operating status. A key-lock on each drive tray secures the hard drive in place, while a maize color release button ensures fast and efficient drive swapping.

WARNING!

Be careful not to warp, twist, or contort the drive tray in any way (e.g., by dropping it or resting heavy objects on it). The drive tray has been customized to fit into the

drive bays in the subsystem and if it is deformed or altered it may not fit into the drive bay.

NOTE:

The A24F-R2224 is shipped with twenty-four drive trays. Each of these drive trays has a multiplexer (MUX) kit attached on the rear of the tray. This MUX kit provides access routes for different RAID controllers. Do not use drive trays from different Galaxy models on the A24F-R2224. A correct drive tray for A24F-R2224 should have a maize color release button on the front panel.

1.2.3 RAID Controller Module

The RAID controller module contains a main circuit board and a daughter card providing management interface connectors, a dedicated drive-plane management interface, and a preinstalled 512MB DDR RAM DIMM. The subsystem comes with BBU protection for both of the RAID controllers. The BBU is installed in the module bay located at the top center of the controller module. The BBU can be independently inserted or removed. Please note: The controller module contains no user-serviceable components. Except when replacing a faulty unit or installing/upgrading the cache memory inside, the controller module should never be removed from the subsystem.

WARNING!

Although the RAID controller can be removed, the only time you should touch the controller itself is to install or replace memory modules. Unnecessary tampering with the RAID controller can damage the controller and make the system unusable.

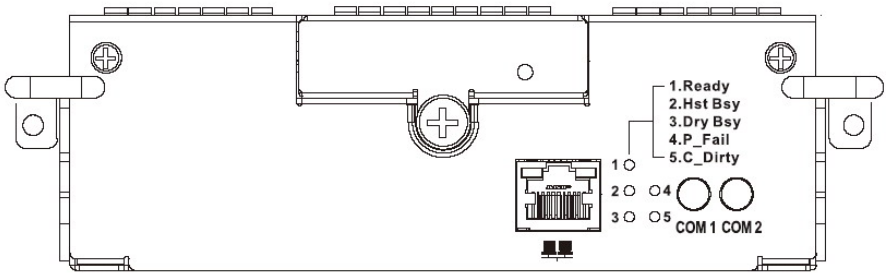

Figure 1-8: RAID Controller Module Faceplate

The controller module faceplate is shown in ***Figure 1-8*** and has two (2) RS-232C (audio jack) serial ports (labeled **COM1** and **COM2**); one (1) RJ-45 Ethernet connector and five (5) status-indicating LEDs (labeled from 1 to 5). The controller board is housed in a metal canister and can only be seen after the controller module has been removed from the subsystem enclosure. The controller canister has two (2) ejector levers that secure the controller module to the subsystem chassis. These levers are, in turn, secured to the enclosure chassis with two (2) retention screws.

1.2.4 Controller Module Interfaces

All management interfaces that connect to external devices are located on the controller module faceplate. The host I/O paths are routed through a common backplane to the host I/O modules. The interfaces are listed below.

- ***RS-232C (Audio Jack)***: All controller modules come with two (2) RS-232C (audio jack) serial ports. The serial ports can be used for terminal emulation and uninterruptible power supply (UPS) support.

- ***Ethernet port***: A single 10/100BaseT Ethernet port is used for remote management through a TCP/IP network.

- ***Disk Drive Channels***: All models come with twenty-four (24) SATA drive channels that are connected to the backplane through back-end connectors. (***NOTE:*** *Drive interfaces are not accessed through the controller module faceplate.*)

1.2.5 DIMM Module

Each controller module comes with a preinstalled 512MB DDR RAM DIMM module mounted on the controller board within a metal chassis. The controller module supports memory modules with sizes from 512MB to 2GB.

1.2.6 BBU Module

The Li-ION BBU module, shown in ***Figure 1-9***, comes standard on A24F-R2224. The BBU can sustain cached data for days during a power failure. The use of a BBU is highly recommended in order to ensure data integrity. If power outage occurs, the BBU supplies power to sustain the unfinished writes in cache memory.

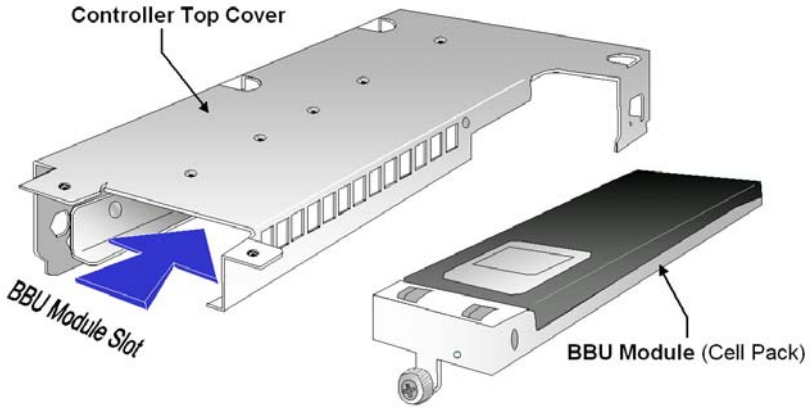

Figure 1-9: BBU Module, Controller Top Cover, and the Module Slot

The BBU consists of two major parts. One is the charger circuitry on the RAID controller. The other is an optional BBU module which contains several battery cells. By default, the dual-redundant controller subsystem comes with BBU modules. The BBU module is hot-swappable so it can be replaced while the subsystem is running.

1.2.7 Power Supply Units

The A24F subsystem is equipped with three (3) hot-swappable, 1U-profile, 405W PSU modules (see ***Figure 1-10***). The PSU modules are located on the rear panel of the subsystem.

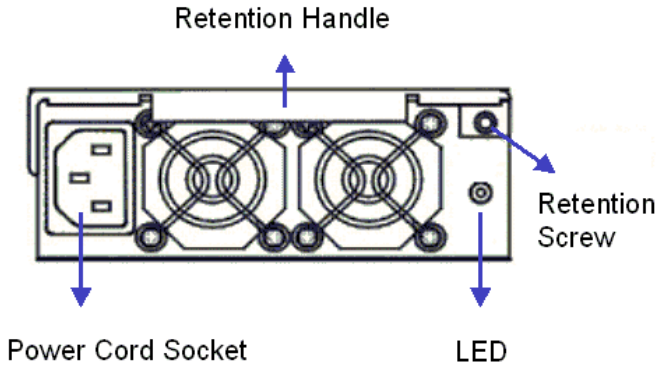

Figure 1-10: PSU Module

Each PSU module comes with a power socket for power cord plug-in. All three power supplies are turned on and off using a single power switch on the enclosure chassis. Each PSU also comes with two (2) embedded cooling fans to provide sufficient airflow across its heat-generating components and one (1) LED to indicate the PSU status. A handle at the back of the PSU makes it easier to install or remove the PSU from the subsystem. While a PSU may be removed while the system is still online, this should only be done if the PSU has failed and needs to be replaced.

A retention screw on the right side of the PSU module secures the PSU to the enclosure. If the PSU needs to be removed, the retention screw must be removed first. After installing a new PSU module, make sure that the retention screw has been firmly secured. The shipping package contains adjustable cable clamps that can be used to keep the power cords attached to the PSU in case the system experiences shock or vibration.

PSU specifications are shown in ***Appendix A***.

Power Supply Safety Restrictions

No. of Failed PSUs	Responses and Preventive Actions
1	1. Warning messages are issued. 2. Cached data is flushed to the hard drives (also depends on the Event Triggered configuration settings on the firmware). 3. If previously configured to the Write-back mode, the caching mode is automatically switched to the conservative Write-through mode.

2	1. Warning messages are issued. 2. The subsystem is temporarily held in an idle state. 3. The firmware forces the subsystem to stop serving host I/O requests. 4. After the failed PSUs are replaced, array administrators should manually turn the power switch off and then on. 5. If the subsystem is powered on with only one PSU, the firmware will start the initialization process but stays idle until at least one other PSU is added.

Table 1-1: Power Supply Safety Restrictions

1.2.8 Cooling Modules

The A24F subsystems come with two (2) hot-swappable, redundant, dual-fan cooling modules (shown in ***Figure 1-11***) preinstalled in the subsystem. Two (2) 8cm blowers are housed in each cooling module and provide ventilation airflow from the front to the rear of the subsystem, extracting the heat generated by the SATA hard drives and other components. The two (2) cooling fan modules are installed directly above the PSUs. (See ***Figure 1-5***)

Intelligent Dual Speed Operation

The fans in the cooling module operate with two rotation speeds. Under normal operating conditions, the cooling fans run at the low speed, which is sufficient for maintaining efficient airflow across components. Under the following conditions, the cooling fans automatically increase their rotation speed to increase the airflow:

1. Component Failure: if a cooling fan, PSU, or temperature sensor fails, the remaining cooling fan(s) automatically raises its rotation speed.

2. Elevated Temperature: if the temperature breaches the upper threshold set for any of the interior temperature sensors, the cooling fans automatically raises its rotation speed.

3. During the subsystem initialization stage, the cooling fans operate at the high speed and return to low speed once the initialization process is completed and no erroneous condition is detected.

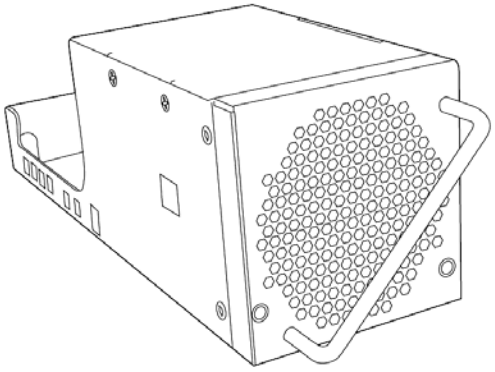

Figure 1-11: Cooling Module

NOTE:

There are two value sets for the upper temperature thresholds. One is set for event notification and the other triggers the higher fan rotation speed. The preset value for event notification can be changed using the firmware-embedded configuration utility, while the fan speed trigger is not a user's option. Please refer to the ***Generic Operation Manua****l for the options with event notification values.*

1.2.9 Host I/O Modules

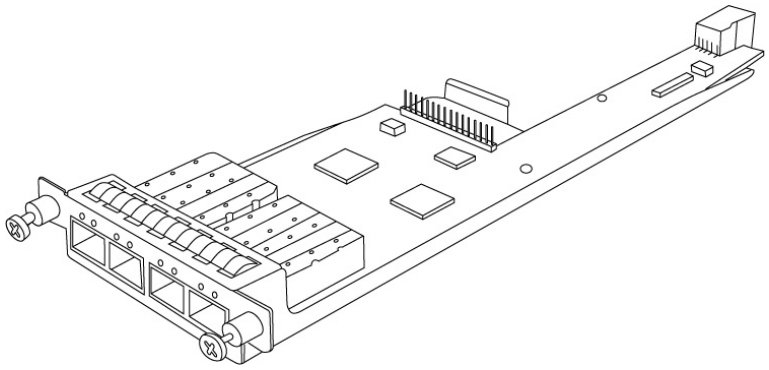

Figure 1-12: Host I/O Module

The hot-swappable host I/O modules are secured to the enclosure chassis with two (2) retention spring screws. Each I/O module connects to one host channel and is configured with four (4) 2Gbps Fibre Channel ports that receive 2Gb speed SFP transceivers. SFP transceivers are user-supplied items. You can order SFP transceivers from your subsystem vendor. Optical, short-wavelength cabling devices are recommended for connecting these host ports.

The I/O modules have bypass circuits which link the same channels (channels 0 and 1) on a controller pair together. The onboard bypass (hub) can also be disabled to allow the host channels from different RAID controllers to be separately connected.

The bypass circuits ensure loop integrity in a multi-host and multi-path configuration. In the event of RAID controller or FC link failure, application servers can access the array through the surviving link and to the surviving RAID controller. In a configuration of cascaded subsystems, the host ports can also be used to connect redundant data paths to withstand single link failure.

1.2.10 Enclosure DIP Switch

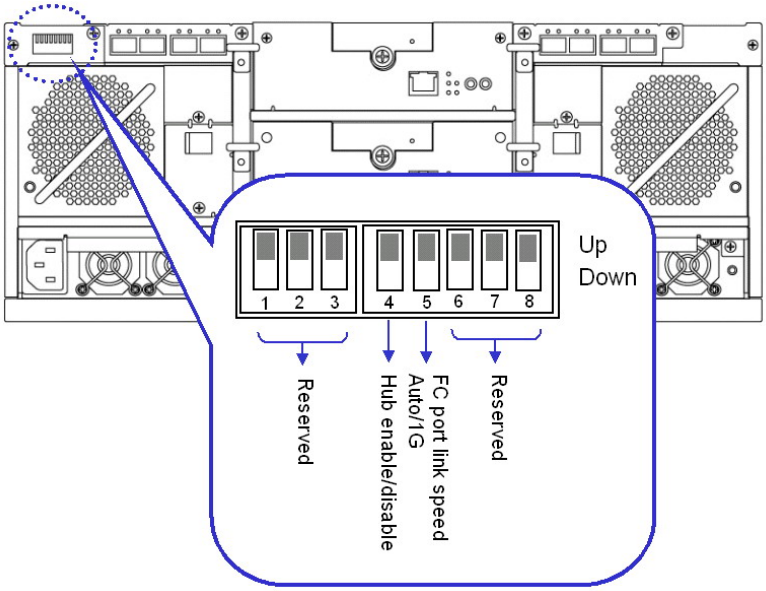

Figure 1-13: Enclosure DIP Switch

A DIP switch is located on the upper left corner of enclosure rear panel, above the cooling module. The six (6) switches marked from 1 to 3 and 6 to 8 are reserved. The switches marked 4 and 5 are for adjusting Fibre Channel link speeds and enabling/disabling the internal hub bypass functionality. The configuration options for setting the DIP switch is fully discussed in ***Section 4.3***.

1.3. Subsystem Monitoring

The A24F RAID subsystem comes with several monitoring methods to give you constant updates on the status of the system and its individual components. The following monitoring features are included in the subsystem.

1.3.1 I²C bus

The following subsystem elements interface to the RAID controller over a non-user-serviceable I^2C bus:

- Disk drives (drive failure output)
- PSU modules
- Cooling modules
- Temperature sensors

1.3.2 LED Indicators

The following active components all come with LEDs that indicate the status of the individual component:

- RAID controller (5 LEDs)
- LCD keypad panel (3 LEDs)
- Cooling module (2 LEDs)
- PSU module (1 LED)
- Drive tray (2 LEDs)
- BBU module (1 LED)

1.3.3 Firmware and RAIDWatch® GUI

Firmware: The firmware (FW) is pre-installed software that is used to configure the subsystem. The FW can be accessed through either the front panel LCD keypad or a terminal emulation program that is installed on an external computer/application server used as a management station.

RAIDWatch: RAIDWatch is a premier, web-based graphics user interface (GUI) that can be installed on a remote computer and accessed via standard TCP/IP.

1.3.4 Audible Alarm

The A24F subsystem comes with audible alarms that are triggered when certain active components fail or when certain controller or subsystem thresholds are exceeded. When you hear an audible alarm emitted from the subsystem, it is imperative that you determine the cause and rectify the problem immediately.

WARNING!

Failing to respond when an audible alarm is heard can lead to permanent subsystem damage. When an audible alarm is heard, rectify the problem as soon as possible.

1.4. Hot-swappable Components

1.4.1 Hot-swap Capabilities

The A24F subsystem comes with hot-swappable components that can be exchanged while the subsystem is still online without affecting the operational integrity of the subsystem. These components should only be removed from the subsystem when they are being replaced. At no other time should these components be removed from the subsystem.

1.4.2 Components

The following components are all hot-swappable:

- RAID controller modules
- PSU modules
- Host I/O modules
- Cooling modules
- Hard drives
- BBU modules

1.4.3 Normalized Airflow

Proper subsystem cooling is referred to as “normalized” airflow. Normalized airflow ensures the sufficient cooling of the subsystem and is only attained when all the components are properly installed. Therefore, a failed component should only be hot-swapped when a replacement is available. If a failed component is removed but not replaced, permanent damage to the subsystem can result.

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Chapter 2

Hardware Installation

2.1. Installation Overview

This chapter gives detailed instructions on how to install the Galaxy A24F subsystem. When installing the subsystem, it is necessary to install hard drives, drive trays, and cables. Installation into a rack or cabinet should occur before the hard drives or drive trays are installed into the subsystem. It is also advisable to confirm that all of the components listed on the printed Unpacking List that came with the subsystem were indeed included.

CAUTION!

For purposes of maintaining, viewing, and instructing the proper procedure for installing components in the Galaxy, the installation of components are included in this manual. Please note that the installation instructions described in this manual should be carefully followed in order to avoid damage to the subsystem.

2.2. Installation Pre-requisites

1. ***Static-free installation environment:*** The subsystem must be installed in a static-free environment to minimize the possibility of electrostatic discharge (ESD) damage. (See ***Section 2.3***)

2. ***Component check*****:** Before installing the subsystem, you should confirm that you have received all of the required components by checking the package contents against the Unpacking List.

3. ***Memory modules:*** If you wish to change the pre-installed memory modules, the separately purchased modules must be installed. (See ***Section 2.6.2***)

4. ***Hard drives:*** SATA hard drives have been integrated based on the size of drives you have purchased. Replacement drives may be installed. (See ***Section 2.7***)

5. ***Cabling:*** All optical FC cables and SFP transceivers are user-supplied. Contact Rorke sales to purchase these components. (See ***Section 4.2.1***)

6. ***Rack installation:*** The enclosure chassis can be installed into standard, 19-inch wide rack cabinet using self-purchased mounting rails or Galaxy slide rails.

2.3. Static-free Installation

Static electricity can damage the system's electronic components. Most of the subsystems that are returned for repair are the result of improper installation and ESD damage. To prevent ESD damage, follow these precautions before touching or handling any of the components:

- When installing the subsystem, you should wear an anti-static wrist band or touch a grounded metal surface to discharge any static electricity from your body.
- Avoid carpets, plastic, vinyl, and Styrofoam in the work area.
- Handle all components by holding their edges or metal frame. Avoid touching PCB boards or connector pins.

2.4. General Installation Procedure

Detailed, illustrated instructions for each step are given in the following sections.

CAUTION!

To ensure that the system is correctly installed, please follow the steps outlined below. If these steps are followed, the installation will be fast and efficient. If these steps are not followed, the hardware may accidentally be installed incorrectly.

Step 1. ***Unpack the subsystem***. Make sure that all the required subsystem components have indeed arrived.

Step 2. ***Change the DIMM module.*** Although a DIMM module comes with the controller board, if you wish to use a different DIMM module with a larger memory capacity, then the DIMM module exchange should be made first. (See ***Section 2.6.2***)

Step 3. ***Rack/Cabinet installation.*** The subsystem should be installed into a rack cabinetry prior to installing the hard drives. Installation into a rack cabinet requires separately purchased mounting rails. Rorke also provides rail kits for 32 or 36 inch deep racks. Installing the A24F into a rack or cabinet requires at least two or three people.

Step 4. ***Change the hard drives in the drive trays.*** Separately purchased SATA-II hard drives may be individually installed into the drive trays. (See ***Section 2.7***)

Step 5. ***Install the drive trays into the enclosure***. Note that the drive trays used in single- or redundant-controller subsystems are different. If you are working on both the single- (G2224) and redundant-controller (R2224) models, make sure not to mix the drive trays.

Step 6. ***Connect the cables.*** Use the supplied power cords to connect the subsystem to main power. It is recommended to connect power cords to separate and independent power sources for higher redundancy. Make sure your subsystem is electrically grounded.

It is also recommended to use the included cable clamps to prevent accidental disconnection of the power cords. Use separately purchased Fibre Channel optical cables and transceivers to connect the host ports to the host computers or expansion enclosures. (See ***Chapter 4***)

Step 7. ***Power up.*** Once all of the components have been properly installed and all the cables properly connected, the subsystem can be powered up and the RAID array configured. (See ***Chapter 4***)

2.4.1 Installation Procedure Flowchart

Figure** 2-1* shows a flowchart of the installation procedure. As you complete each step, check off the "Done***" box on the right. Please use this flowchart in conjunction with the instructions that follow.

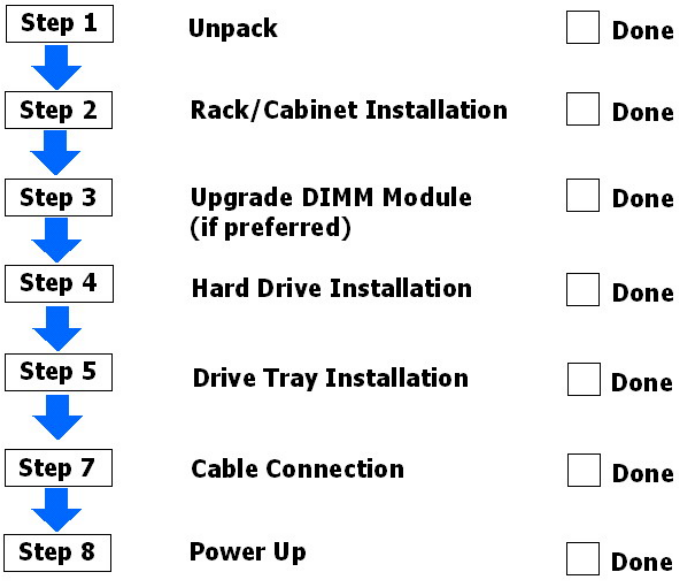

Figure 2-1: Installation Procedure Flowchart

2.5. Unpacking the Subsystem

The subsystem components are packed in several boxes.

WARNING!

For a detailed packing list, refer to the included Unpacking List. Do not rely on the non-definitive, summarized checklist shown below--it is for reference only.

The following items should be packed in individual boxes and are not pre-installed:

- Twenty four (24) drive and drive trays
- Accessory items

The enclosure chassis, with its pre-installed components, is located at the bottom of the package. The pre-installed components include:

- Two (2) controller modules
- Three (3) PSU modules
- Two (2) cooling modules
- Two (2) front handles
- One (1) LCD keypad panel on the left side foldable handle
- Back-end PCBs

2.6. Memory Module Installation

2.6.1 Memory Module Installation Overview

The subsystem comes with a pre-installed 512MB DDR RAM DIMM module on each controller. The controller supports memory modules with sizes up to 2GB. If memory modules with a different size need to be used, the pre-installed DIMM module can be removed and the new ones installed. Replacement and installation instructions are described fully below.

NOTE:

A DIMM of a different size can be ordered from your subsystem supplier. Using non-certified modules can cause unexpected results.

Considerations:

1. The DIMM module is located on the side of the main controller board. Prior to changing the DIMM module, the controller canister must first be removed from the enclosure chassis.

2. With a new subsystem, there may not be cached data in the DIMM module. If the subsystem has been operating and there is cached data, the BBU will discharge to support the cache contents. It is therefore recommended to make sure there is no BBU module installed before replacing the DIMM module. The BBU module is located right above the controller's rear-facing faceplate and can be removed simply by loosening its retention spring screw.

If you are replacing the memory modules, please refer to the installation procedure below. If the memory modules do not need to be changed, proceed to ***Section 2.7***.

WARNING!

- *The controller board in the controller module is a sensitive item. Please ensure that all anti-static precautions stipulated above are strictly adhered to. Only qualified engineers should replace the DIMM module.*

- *Removing the DIMM module while it contains cached data and when the BBU is still attached to the controller can damage the DIMM module. When the controller is removed from chassis, the BBU will start to discharge supplying power to memory. Removing the DIMM module while it is being powered by the BBU will damage the DIMM module.*

  Therefore, remove a BBU module before you replace a DIMM module if you prefer using a different DIMM module.

2.6.2 Selecting the Memory Modules

If the memory module on the A24F controller is going to be replaced, the following factors must be considered when purchasing replacement DIMM modules:

- ***Pre-installed DDR DIMM:*** The subsystem comes with a 512MB DDR RAM DIMM module pre-installed on the controller board. If you wish to change the size of the DIMM module, then a new, separately purchased DIMM must be installed.

- ***DDR DIMM modules supported***: The subsystem supports DDR RAM DIMM modules with memory capacities from 512MB to 2GB.

- ***Installation considerations:*** When installing the DIMM module, it is necessary to handle the controller module. The controller board is more susceptible to damage than the other components and must therefore be handled with extreme care. ALL anti-static precautions specified in ***Section 2.3*** must be strictly adhered to.

- ***Secure installation***: When replacing the DIMM module, make sure that the new DIMM module is firmly in place prior to installing the controller module. If the

DIMM module is not firmly in place, the subsystem will not run and the controller will need to be removed and the DIMM module correctly installed.

- ***Purchasing considerations***: When purchasing a DDR DIMM to install on the controller board, contact your system vendor for an adequate module.

2.6.3 DIMM Module Installation/Replacement

WARNING!

1. *Consult the technical support department of your reseller or distributor if you are not sure which memory module can be installed into the controller.*
2. *The installed BBU and controller module must be removed prior to installing a new memory modules. Do this with care. Sensitive components can be damaged during the process.*
3. *The BBU module is hot-swappable and can be independently swapped from the controller. However, as a safety precaution and just in case your memory still holds cached data, it is recommended to remove the BBU module before handling the DDR RAM module. If the BBU is supplying power to the memory when the DDR module is being removed, damage will occur.*

Step 1. Prepare an anti-static work pad for placing a removed controller. Use of an ESD grounding strap is highly recommended.

Step 2. ***Remove the pre-installed BBU module.*** Use a Phillips screwdriver to loosen the retention screw that secures the BBU module to the enclosure chassis and carefully remove the module. Carefully place the module for it contains Li-ION batteries. Do not drop it to the floor or place it near any heat source or fire. (See ***Figure 2-2***)

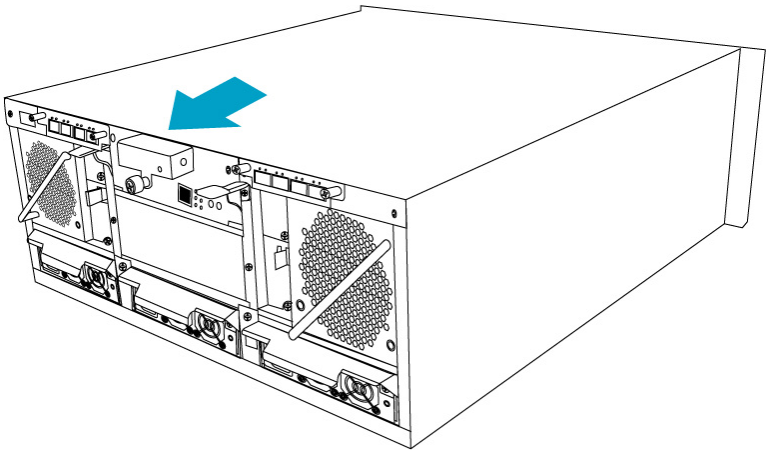

Figure 2-2: Removing the BBU Module

Step 3. ***Remove the controller module.*** Remove the retention screws securing the controller's ejection levers using a Phillips screwdriver. Using both hands, simultaneously press the ejection levers downward until the controller is removed from enclosure chassis. (See ***Figure 2-3***)

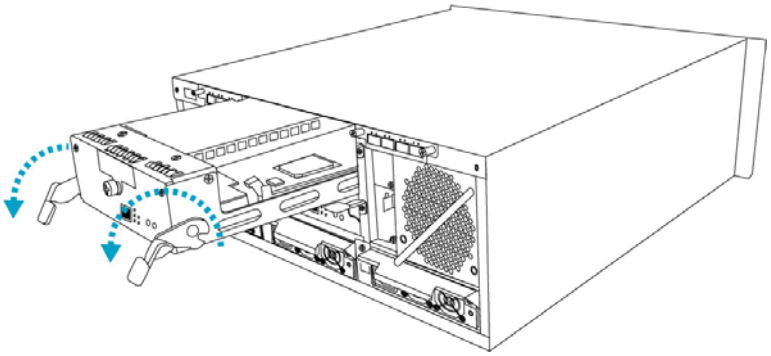

Figure 2-3: Removing the Controller Module

Step 4. ***Remove the DDR DIMM module.*** You can access the DIMM module from the opening on the right side of the controller canister.

To remove the DIMM module, press the white, plastic ejectors (clips) on the sides of the DIMM socket. Grasp the DIMM module by its edges and pull it out of the socket without touching the electrical components nearby. Place the module in an anti-static bag.

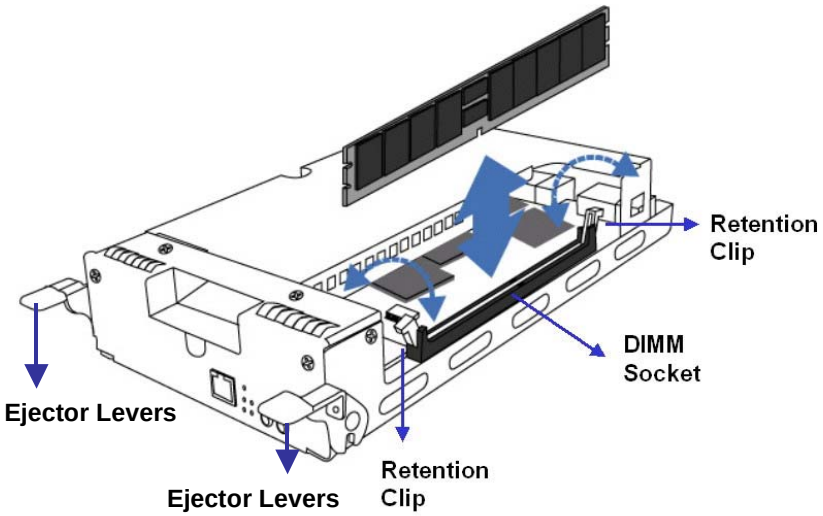

Figure 2-4: Accessing a DIMM Module

Step 5. ***Install the replacement DIMM module.*** Carefully remove the replacement module from its anti-static bag. Grasp the module by edges. Make sure the white, plastic ejectors on the sides of DIMM socket are open. Carefully align the DIMM module to the socket. Pressing firmly on both ends, push the module into the socket until the ejectors return to the closed position.

Step 6. ***Install the controller and the BBU module (if installed).*** Proceed with the following to install the controller:

1. Insert the controller into the respective module slot with the ejector levers at the lowest position.

2. Push the controller in until you feel contact resistance with its back-end connectors.

3. Use the ejector levers on the sides to secure the controller into the chassis slot. Make sure the squared notch of the ejector levers locks onto the metal groove on the interior sides of the module slot. Once in place, pull the ejector levers in an upward motion to secure the controller.

4. Insert and fasten the retention screws underneath each ejector lever to secure the modules. After the controller is properly installed, install the BBU module and secure it with the spring screw.

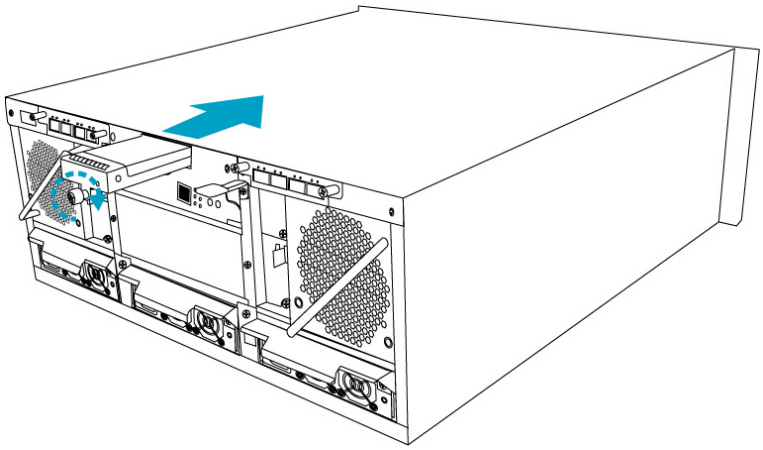

Figure 2-5: Installing a BBU Module

2.7. Rackmounting the Subsystem

2.7.1 Package Contents

The slide rail kit (32- or 36-inch versions) includes the following components. You should check to ensure that the slide rail kit you received contains the items listed below.

NOTE:

Except for the different length of mounting brackets, the 32- and 36-inch versions use the same mounting screws and mounting holes on rack posts.

Item	32-inch/812.8mm; 36-inch/914.4mm	Quantity
1	Mounting bracket assembly, left	1
2	Mounting bracket assembly, right	1
3	End bracket, left	1
4	End bracket, right	1
5	Screw, cross recess round head, M5x35, rev.: 1.0	4
6	Screw, M5x5mm, position screws for square racks, free cutting steel, rev.: 1.0	8
7	Screw, crosshead flat head, #6-32x8mm, rev.: 1.0	6
8	Screw, M5 cage nuts, rev.: 1.0	4
9	Screw, crosshead round screws, P+6#-32x6mm, rev.: 1.0	4
10	4U spacer behind forearm handle	2

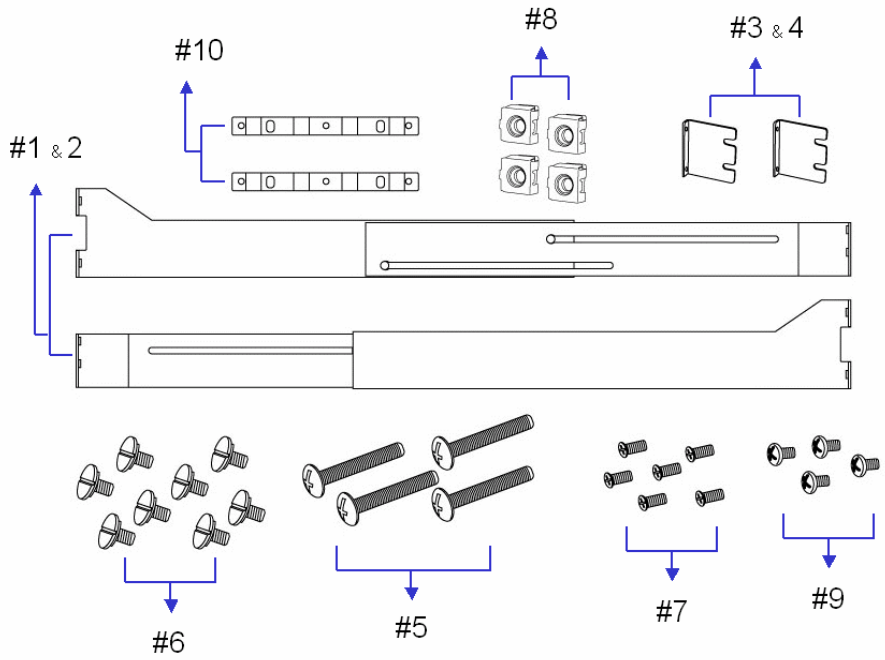

Figure 2-6: Package Contents (Excluding the Packing Materials)

The slide rails secure the Galaxy 4U chassis to standard 19-inch wide, four-post cabinets or racks that are between 23 and 36 inches deep. These heavy duty slide rails allow for easy, safe access to the subsystems as well as provide a solid support.

Prepare the tools needed to install the enclosure into rack. The following should be necessary:

- a medium-sized and a small-sized Phillips screwdrivers.
- a medium-sized flathead screw driver.

2.7.2 Installation Steps

Step 1. Determine the exact position where you want to install the Galaxy enclosure in the rack, and then measure the position.

Step 2. The mounting kit comes with M5 cage nuts that can be used with racks that have square, unthreaded holes. Align the front side of a support bracket and adjust spacing so that the front and rear sides of the bracket fit the vertical rack posts.

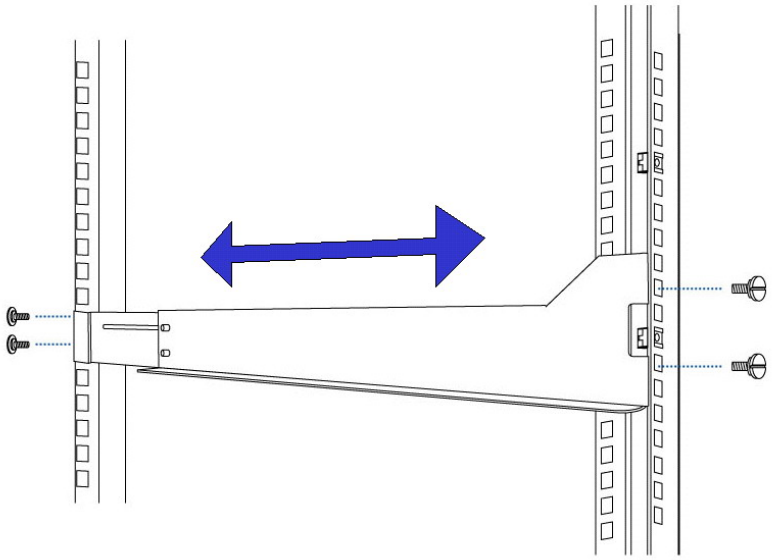

Figure 2-7: Fitting a Support Bracket to Rack Posts

Step 3. Determine where in the rack the subsystem is going to be installed. Attach four (4) M5 flathead screws (#6 in the packing list) to secure the bracket to the front and the rear rack posts. See the drawing above. Note that the lower part of the L-shaped brackets should always face inward.

Step 4. Attach two (2) M5 cage nuts (#8 in the packing list) onto each front rack post. The first cage nut is inserted through the hole right above the M5 screw on the bottom. Cage nuts should be attached from the inside of the rack facing outward. Leave six holes between the two cage nuts on each rack post. These cage nuts allow you to secure the enclosure from the front of the chassis through the mounting holes on forearm handles.

Repeat the process to install another support bracket on the left.

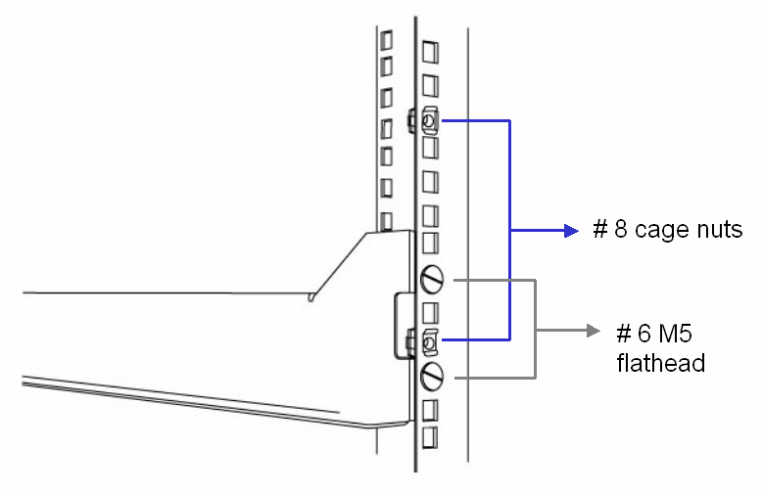

Figure 2-8: Attaching M5 Cage Nuts to Rack Posts

CAUTION!

The mounting positions on the rack posts must be carefully measured so that rails are mounted parallel to each other. Also pay attention to the clearance between the rack-mounted units.

Step 5. Attach a spacer (#10 in the packing list) to the back of each enclosure forearm handle using three (3) included flathead screws (#7 in the packing list).

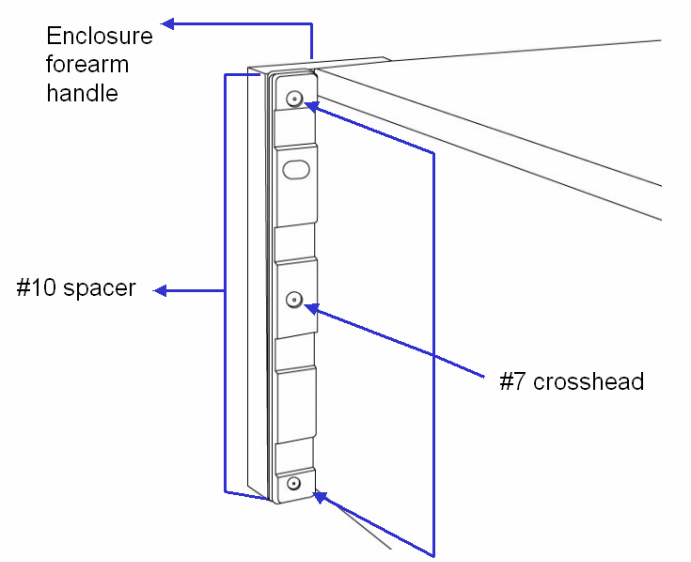

Figure 2-9: Attaching Spacers to the Back of Enclosure Forearm Handles

Step 6. Use the included crosshead round screws (#9 in the packing list) to secure two (2) end brackets (#3 or #4) to the back of the subsystem.

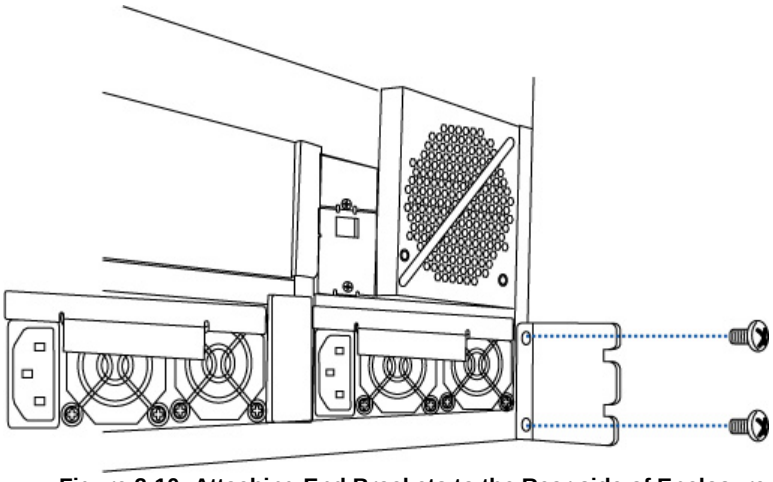

Figure 2-10: Attaching End Brackets to the Rear side of Enclosure

Step 7. Gently slide the subsystem into the rack by aligning the tips of the end brackets with the support brackets. Carefully rest the tips of the end brackets onto the support brackets and slide the chassis forward.

Step 8. When the chassis is inserted towards the end of the rack, the recessed parts of end brackets should engage the two rivets on the support brackets. Once the enclosure reaches the end, proceed with securing the chassis through the front mounting holes.

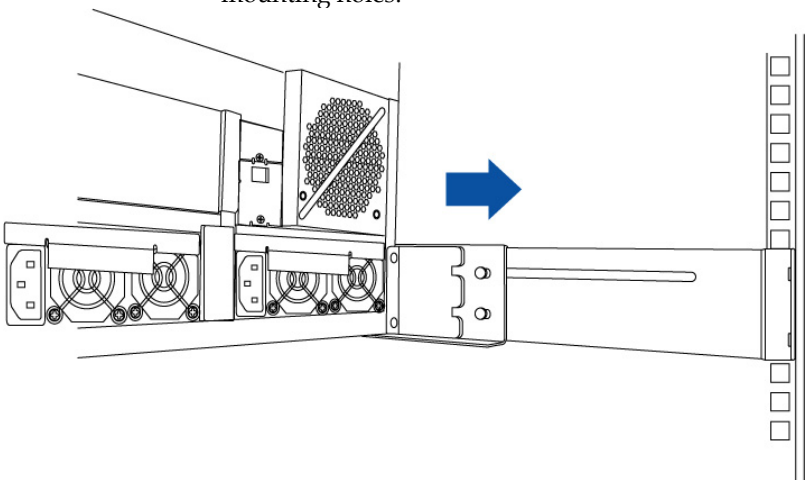

Figure 2-11: Installing Enclosure

Step 9. Slide the subsystem in as far as it will go, then secure the system using four (4) pan head screws (see #5 in the packing list) through the holes on the left- and right-side handles to both of the front rack posts.

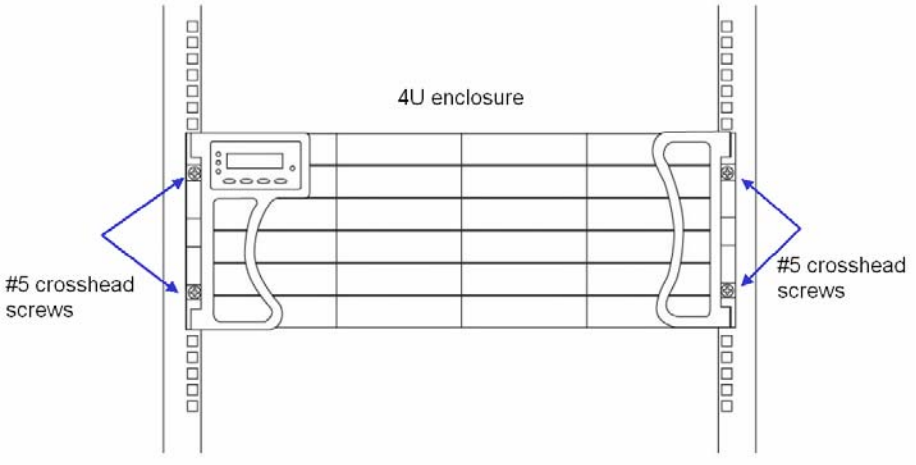

Figure 2-12: Securing Enclosure through the Front

Step 10. You are done with installing the rack mounting kit and subsystem enclosure.

2.8. Hard Drive Installation

NOTE:

Your hard drives have been preintegrated in drive trays and replacement hard drives will come preintegrated as well. The following procedures apply to the cases where you may have to replace or sway hard drives for troubleshooting purposes. Always replace hard drives with the exact size and model of the original drive.

2.8.1 Hard Drive Installation Overview

WARNING!

1. *Handle hard drives with extreme care. Hard drives are very delicate. Dropping a drive onto a hard surface (even from a short distance) and hitting or touching the circuits on the drives with your tools may all cause damage to drives.*
2. *Observe all ESD prevention methods when handling hard drives.*
3. *Only use screws supplied with the drive canisters. Longer screws may damage the disk drives.*

2.8.2 Hard Drive Installation Pre-requisites

CAUTION!

The hard drives and drive trays should only be installed into the subsystem after the subsystem has been mounted into a rack cabinet. If the hard drives are installed first, the subsystem will be too heavy to lift into position and the possible impact during installation may damage your drives.

Hard drives for the subsystem must be purchased separately. When purchasing the hard drives, the following factors should be considered:

- ***Capacity (MB/GB):*** Use drives with the same capacity. RAID arrays use a "least-common-denominator" approach meaning the maximum capacity of each drive in the array is the maximum capacity of the smallest drive.
- ***Profile:*** The drive trays and bays of the system are designed for 3.5-inch wide x 1-inch high hard drives.
- ***Drive type:*** The A24F subsystem can use either SATA-II or SATA-I interface hard drives.

2.8.3 Drive Installation

Step 1. ***Place the SATA hard drive into the drive tray.*** (See ***Figure*** *2-13*) Make sure the hard drive is oriented in such a way that the drive's SATA connector is facing the back of the drive tray.

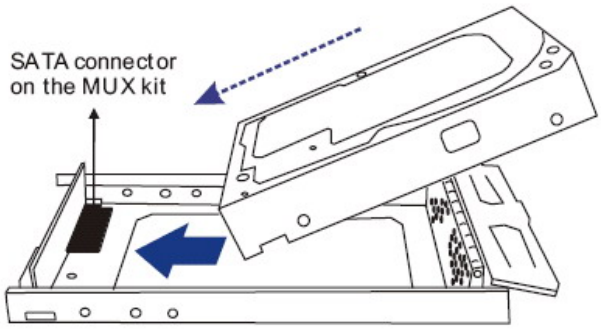

Figure 2-13: Installing a SATA Hard Drive

Step 2. ***Adjust the drive's location*** until the mounting holes in the drive canister are aligned with those on the hard drive. Secure the drive with four (4) supplied 6/32 flathead screws. (See ***Figure*** *2-13*)

WARNING! *Only use screws supplied with the drive canisters. Longer screws may damage the hard drives.*

2.9. Drive Tray Installation

Before drive tray installation, you need to access the drive bays on the left- and right-side columns:

To access drive bays on the left- or right-side column, first flip the retention latches on the enclosure front handles, and then swing the handles to the left and right-hand sides. To close the handles, see ***Figure** 2-14***,** first swing the handles towards the center to reveal the retention latch, flip the latch, and then proceed with closing the handles.

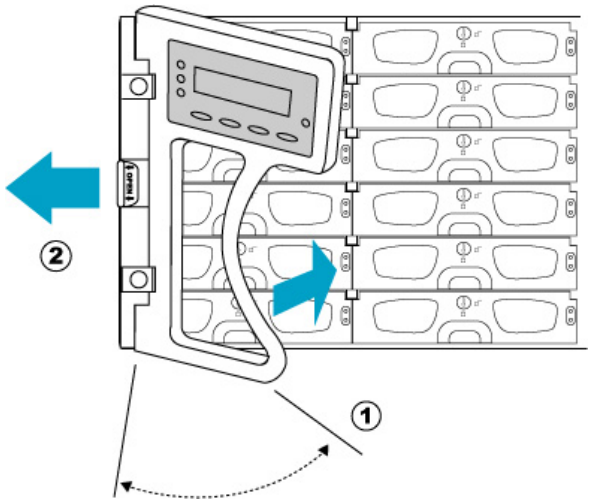

Figure 2-14: Closing the front handles

Install the drive trays into the subsystem once the hard drives have been installed in the drive trays.

Step 1. ***Make sure the key-lock is in the unlocked position***, i.e., the groove on its face is in a horizontal orientation. If the groove is in a vertical position, as shown in ***Figure** 2-15***,** then the key-lock is locked and the front flap on the drive tray cannot be opened.

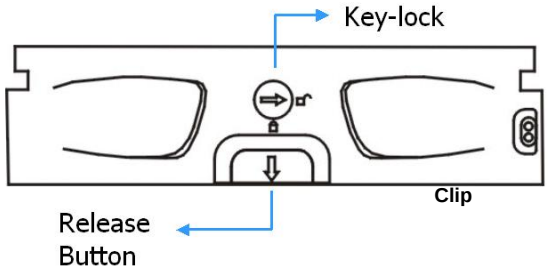

Figure 2-15: Front View of an Individual Drive Tray

Step 2. ***Open the front flap on the drive tray*** (See ***Figure** 2-16*) by pushing the release button (shown in ***Figure** 2-15*) on the front of the drive tray. The button is easy to access and lift.

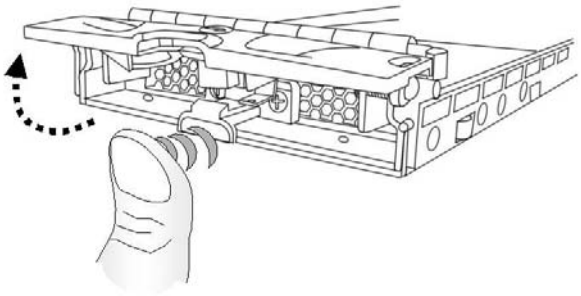

Figure 2-16: Drive Tray Front Flap

Step 3. ***Line the drive tray up with the slot*** in which you wish to insert it. Make sure that it is resting on the rails inside the enclosure. Once the drive tray is lined up with the slot, gently slide it in. This should be done smoothly and gently.

Step 4. ***Close the front flap on the drive tray***. Make sure the front flap is closed properly to ensure that the connector at the back of the drive tray is firmly connected to the corresponding connector on the backplane. If the front flap is not closed properly, the connection between the hard drive and the subsystem will not be secure.

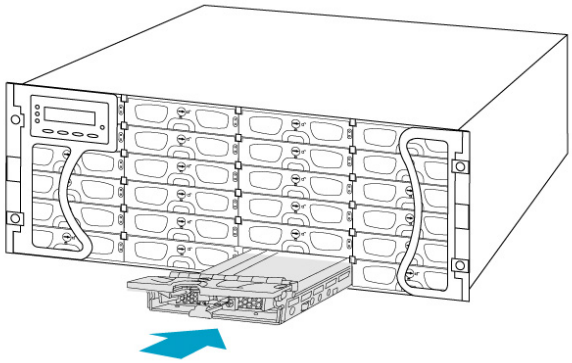

Figure 2-17: Installing a Drive Tray

Step 5. ***Lock the flap into place.*** Use a flathead screwdriver to turn the key-lock until the groove on its face is in a vertical orientation. (See ***Figure*** *2-18*)

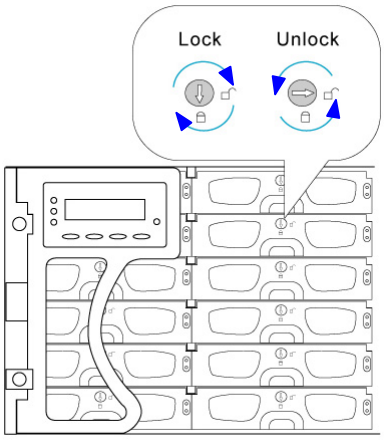

Figure 2-18: Drive Tray Key-lock Rotation

WARNING!

All the drive trays must be installed into the enclosure even if they currently do not contain a hard drive. If the drive trays are not installed, then the ventilation required for cooling will not be normalized and the subsystem will be damaged.

2.10. Power Cord Cable Clamp Installation

Several cable clamp assemblies are included in the accessories boxes in the A24F shipping package. When installing the subsystem, it is recommended to secure all power cords using these cable clamps to help prevent accidental disconnection of power cords that could result in costly down time.

2.10.1 Component Description

Each cable clamp consists of the following:

1. A cable strap with a “push barb” anchor mount

2. An adjustable cable clamp

The cable strap is secured to the chassis by inserting the barb anchor into the pre-drilled hole located under each power supply module. The cable clamp is then secured to the cable strap and is wrapped around the power cord to hold the subsystem’s power plug in place to ensure that the power cord connection can withstand shock, vibration and accidental impact.

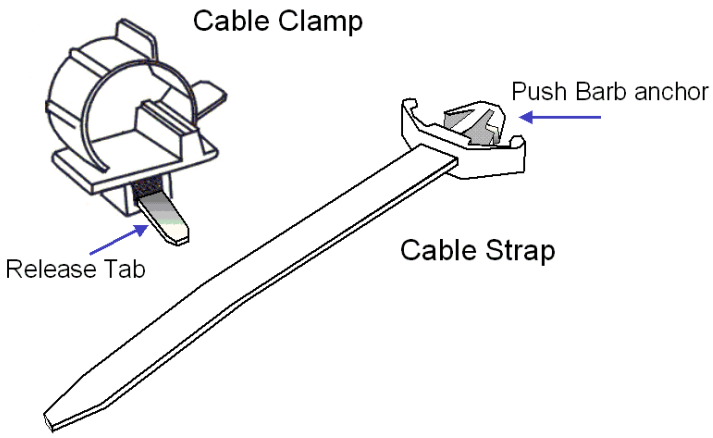

Figure 2-19: Cable Clamp and Cable Strap (Cable Mount)

2.10.2 Cable Clamp Installation

Step 1. Connect a power cord to a subsystem power socket so that you can determine the correct position of the cable clamp along the cable strap. The diagram below shows the relative positions of a power cord, cable clamp, and cable strap.

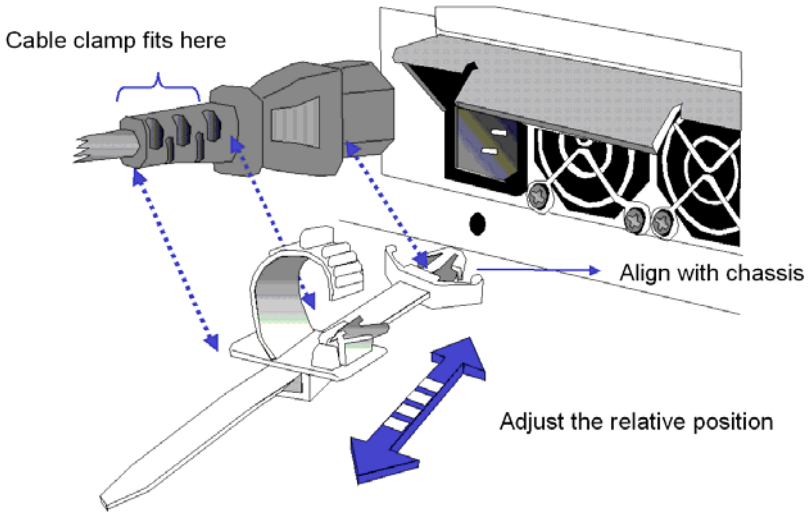

Figure 2-20: Power Cord, Cable Clamp and Cable Strap Positions

Step 2. ***Connect the cable clamp to the cable strap.*** Insert the flat angled end of the cable strap through the small opening (the tie head) underneath the cable clamp with the smooth side of the strap facing up and the ribbed side facing down and the release tab at the end. Press down the release tab to adjust the position of the cable clamp along the strap. See the diagram below.

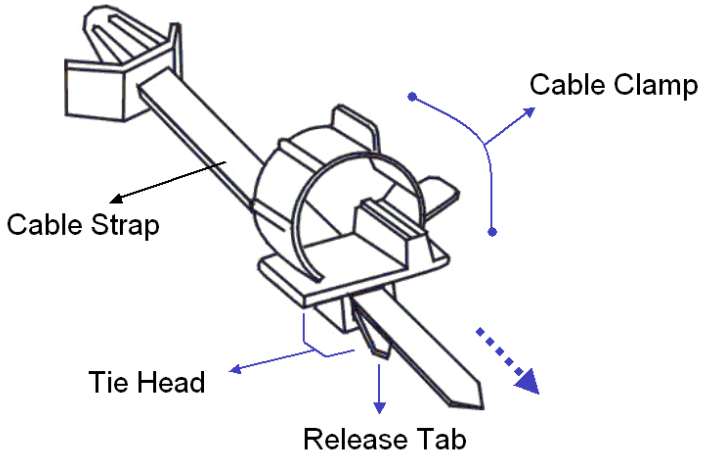

Figure 2-21: Inserting Cable Strap into Cable Clamp

Step 3. ***Mount the cable strap to the chassis by*** inserting the push-in barb anchor into the pre-drilled hole underneath the power supply.

Step 4. ***Secure the power cord with the cable clamp.*** Flip open the cable clamp and wrap it around the power plug. If necessary, use the release tab to adjust the location of the clamp so it aligns with the base of the power cord as shown below. Press the clip lock on the side of the clamp until it snaps into position. Now the power cord connection is secured.

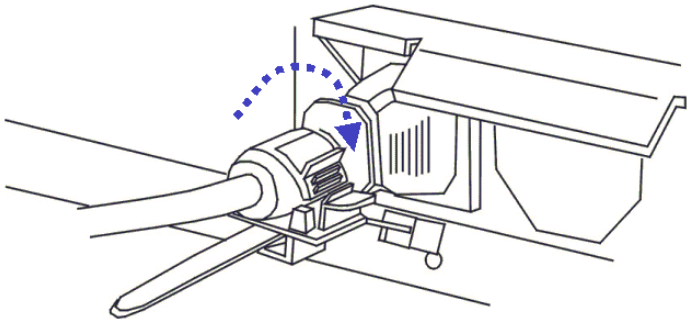

Figure 2-22: Power Cord Locked into Position

Step 5. Repeat the process to secure every power cords to the subsystem.

Chapter 3
Subsystem Monitoring

3.1. Subsystem Monitoring Overview

The Galaxy A24F-R2224 subsystems are equipped with a variety of self-monitoring features that keep you informed of the subsystem's operational status. These monitoring features provide vital feedback to help you maintain the operational integrity of the subsystem. Prompt response to warnings and component failure notifications will help ensure data integrity and the longevity of the RAID subsystem.

Self-monitoring features include:

- ***Management firmware (FW)***: The firmware manages the array, provides device status information, and is preinstalled in the subsystem controller. You can access the FW using either the LCD keypad panel or a PC running a terminal emulation program connected to a PC running terminal software through the system's **COM 1** RS-232C (audio jack) serial port. The firmware is fully described in the ***Generic Operation Manual*** that came with the subsystem. Please refer to this manual for further details.

- ***RAIDWatch***: RAIDWatch is a Java-based program that came with the subsystem and can be used to monitor and manage the subsystem locally or remotely over TCP/IP. You can use the powerful ***Configuration Client*** or ***Notification Process Center*** (NPC) sub-modules to keep you informed over a variety of communications methods such as fax, pager, email, etc. For further details on the installation and operation of RAIDWatch, please refer to the ***RAIDWatch User's Manual***.

- ***LEDs***: Device-status-indicating LEDs are placed on all of the active components to inform users of the integrity of a given component. You should become familiar with the different LEDs and be aware of their functions.

- ***Audible alarm***: The audible alarm on the subsystem controller board will be triggered if any of a number of threatening events occurs. These events usually jeopardize the functional and operational integrity of the controller board and must be heeded at all times. Events such as a breach of the temperature threshold will trigger the alarm and if an onsite subsystem manager is present, the manager should use either the LCD keypad panel or a PC running terminal

software to determine the cause of the alarm and take the appropriate corrective measures.

- ***I²C:*** The I²C bus monitors the operational integrity of the cooling fan, temperature sensors, and PSU modules (present/not present, ready/failed, etc.).

Subsystem monitoring is a necessary part of subsystem management. When failure events or other disruptive events are detected and reported, the subsystem manager must take appropriate actions to rectify the problem. Failure to act in a properly specified manner to a system event (such as overheating) can cause severe and permanent subsystem damage.

3.2. Status-indicating LEDs

3.2.1 Brief Overview of the LEDs

All FRUs (Field Replaceable Units) have status-indicating LEDs that show the operational status and integrity of the subsystem components. The list in ***Table 3-1*** shows the number of LEDs assigned to each component.

Component	LEDs per Module	Total LEDs	Definition
Controller Modules	5	10	See ***Section 3.2.2***
Ethernet Ports	2	4	See ***Section 3.2.3***
LCD Panel	3	3	See ***Section 3.2.4***
Drive Trays	2	48	See ***Section 3.2.5***
BBU Modules	1	2	See ***Section 3.2.6***
PSU Modules	1	3	See ***Section 3.2.7***
Cooling Modules	2	4	See ***Section 3.2.8***
FC Ports (Host I/O Modules	8	8	See ***Section 3.2.9***

Table 3-1: LED Distribution

3.2.2 Controller Module LEDs

The controller module faceplate is shown in ***Figure 3-1*** below. The LEDs are numbered from **1** to **5** and their definitions are shown in ***Table 3-2*** below.

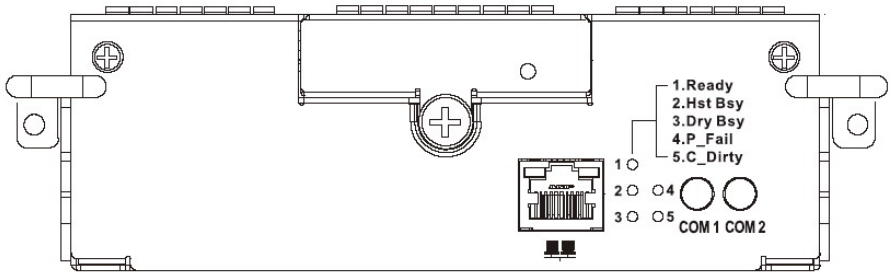

Figure 3-1: Galaxy A24F-R2224 Controller Faceplate

LED	Name	Color	Status
1	**Ready**	Green	**ON** indicates that the controller has successfully booted, is active, and is operating properly. **OFF** indicates that the controller is not ready for operation.
2	**Host Busy**	Green	**ON** indicates that the host ports are carrying data traffic, i.e., the host ports are busy. **OFF** indicates that there are no activities on the host ports, i.e., no data is being transmitted over the host buses.
3	**Drive Busy**	Green	**ON** indicates active I/Os on the drive side. **OFF** indicates that there are no activities on the drive side.
4	**Partner Failed**	Amber	**ON** indicates the partner controller has failed. This LED is only functional on the A24F-R2224 dual-controller configuration. **OFF** indicates that the dual-controller configuration is operating normally.
5	**Cache Dirty**	Amber	**ON** indicates that data is currently cached in memory or is being held up by the BBU during a system power loss.

Table 3-2: Controller Module LED Definitions

3.2.3 LAN Port LEDs

The LAN port comes with two (2) LEDs. As shown in ***Figure 3-2***, one LED indicates the online status and the other indicates LAN activity. The LED definitions are shown in ***Table 3-3***.

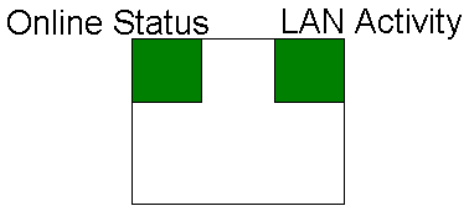

Figure 3-2: LAN Port LEDs

LED Name	Color	Status
Online Status	Green	**ON** indicates currently connected to LAN.
LAN Activity	Green	**BLINKING** indicates active transmission.

Table 3-3: LAN Connector LED Definitions

3.2.4 LCD Keypad Panel

The LCD keypad panel comes with three (3) status-indicating LEDs marked, from top to bottom, **PWR**, **BUSY**, and **ATTEN**, as shown in ***Figure 3-3*** below. The definitions of these LEDs are shown in ***Table 3-5***.

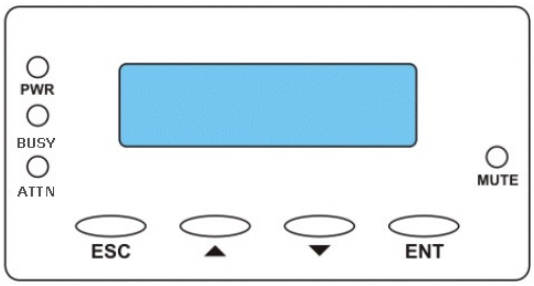

Figure 3-3: LCD Panel LEDs

LED Name	Color	Status
PWR	**Blue**	**ON** indicates that power is being supplied to the subsystem. **OFF** indicates that no power is being supplied to the subsystem or the subsystem/RAID controller has failed.
BUSY	**White**	**ON** indicates that there is active traffic on the host/drive channels. **OFF** indicates that there are no activities on the host/drive channels.
ATTEN	**Red**	**ON** indicates that a component failure/status event has occurred. **OFF** indicates that the subsystem and all its components are operating correctly.

Table 3-4: LCD Panel LED Definitions

NOTE:

During the power up process, the LCD panel ATTEN LED will be turned on. If the subsystem boots up correctly, then the ATTEN LED will be turned off after the boot up procedure is complete.

3.2.5 Drive Tray LEDs

The drive trays come with two (2) status-indicating LEDs, one that indicates power and the other that indicates hard drive activities. The LEDs are shown in ***Figure 3-4*** and their definitions in ***Table 3-5***.

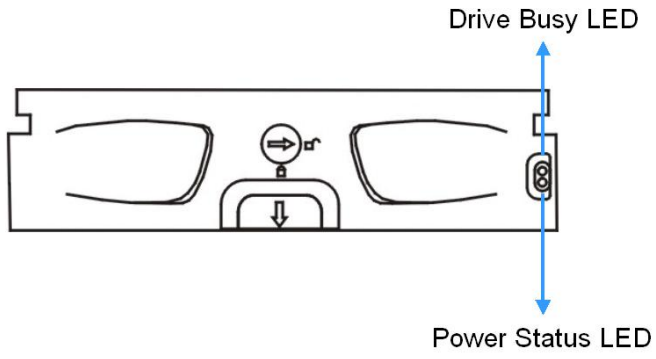

Figure 3-4: Drive Tray LEDs

LED Name	Color	Status
Drive Busy	**Blue**	**FLASHING** indicates there is read/write activity on the drive. **OFF** indicates there is no read/write activity on the drive.
Power Status	**Green/Red**	**GREEN** indicates that a drive is installed in the drive tray **RED** indicates that there is a drive failure.

Table 3-5: Drive Tray LED Definitions

3.2.6 BBU Module LED

The hot-swappable BBU module comes with an LED that indicates the status of the current battery charge, module failure, or when battery cells are being replenished.

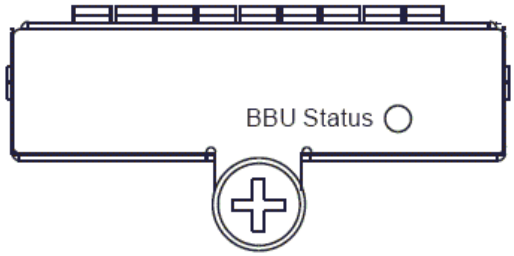

Figure 3-5: BBU Module LED

LED Name	Color	Status
BBU Status	Amber	**ON** indicates the BBU has failed and cannot sustain the cache memory. **OFF** indicates the BBU is sufficiently charged and can sustain cached data. **FLASHING** indicates the BBU is charging.

Table 3-6: BBU LED Definitions

IMPORTANT!

In addition to BBU failure itself and the charger failure, the subsystem may also light the BBU fault LED when the following occur:

1. *The temperature sensor embedded with the charger circuit reports a temperature reading exceeding 45 degree Celsius.*
2. *The BBU (battery cell pack) has been charged for over 7 hours. The BBU charger will enter a timer fault state.*

When the above conditions occur, the charger circuit will enter a low-power and self-protection state.

You may correct the faults when receiving a "BBU Thermal Shutdown/Enter Sleep-Mode!" *event message:*

1. *Check proper ventilation within the subsystem. You may also check the readings from other sensors within the enclosure. Airflow might have been disrupted by the absence of one or several major modules or the failure of a cooling fan. Once the thermal condition is improved, charging will resume automatically.*
2. *If a new battery module has been charged for over seven (7) hours and this event is issued, you may remove and re-install the battery module. An empty battery module may take more than 7 hours to be fully charged. There is a timer embedded with the charger, doing so can reset the timer. Charging will resume automatically.*

3.2.7 PSU Module LED

Each PSU module has one (1) LED located just above the power switch and just below the retention screw to indicate the operational status of the PSU module. (See ***Figure 3-6***) Please refer to ***Table 3-7*** for PSU LED definitions.

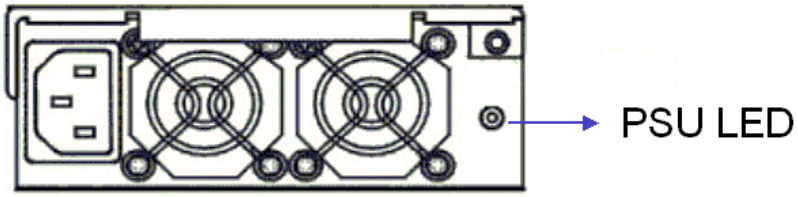

Figure 3-6: PSU Module Rear LED

Color	Status
Static Green	The PSU is operating normally and experiencing no problems
Static Red	The PSU has failed and is unable to continue providing power to the subsystem.
Blinking Green	The PSU is not turned on. This LED blinks green when the power cable has been plugged in but the power switch is not turned on.
OFF	The PSU is not turned on, no power is being supplied to the PSU or the power plug is not connected.

Table 3-7: PSU Module LED Definitions

3.2.8 Cooling Module LED

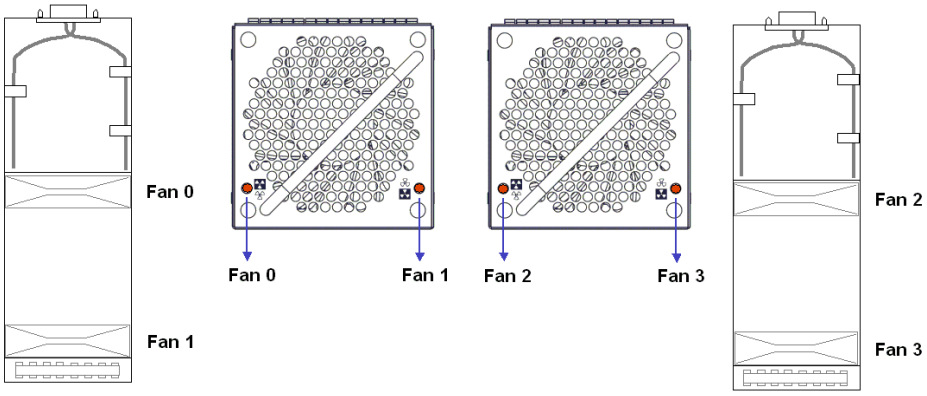

Figure 3-7: Cooling Fan Module LEDs and Cooling Fan Locations

Each cooling module has two (2) red LEDs. Each LED corresponds to a single cooling fan within the module. (See ***Figure 3-7***)

LED	Status
OFF	The respective cooling fan is operating normally.
ON	The respective cooling fan has failed and the module must be replaced.

Table 3-8: Cooling Fan Module LED Definitions

3.2.9 FC Ports LEDs

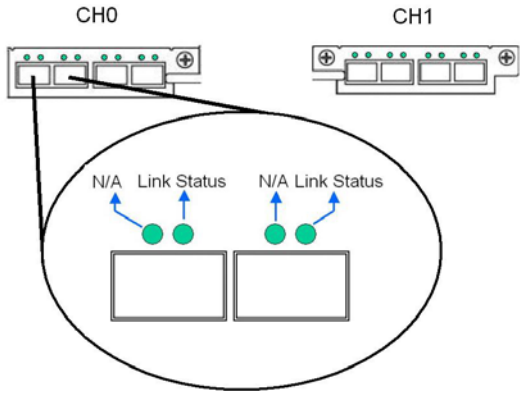

Figure 3-8: LEDs on FC Ports (SFP Cages)

Each FC port on the host I/O modules has two (2) green LEDs. The LED on the left is left undefined while the LED on the right indicates Fibre Channel link status. (See ***Figure 3-8***)

Green	Status	
Link Activity	Green	**ON** indicates the FC link is okay.
		OFF indicates the FC link is broken.

Table 3-9: FC Port LED Definitions

3.3. Audible Alarm

Different controller environmental and operational parameters (such as temperature, etc.) have been assigned a range of values between which they can fluctuate. If either the upper or lower thresholds are exceeded, an audible alarm will automatically be triggered. The alarm will also be triggered when an active component of the subsystem fails. If the subsystem manager is onsite and is alerted by the alarm, the manager needs to read the error message on the LCD screen or on the PC terminal to determine what has triggered the alarm and then take appropriate actions to rectify the problem.

WARNING!

Whenever an alarm is triggered, you must determine the problem. If the audible alarm is ignored or not taken seriously and the problem is not rectified, permanent damage to the system can result.

3.3.1 Default Threshold Values

Table 3-10 shows the default threshold values for the subsystem. If any of these values are surpassed, the alarm will sound:

Parameter	Upper Threshold	Lower Threshold
+3.3V	+3.6V	+2.9V
+5V	+5.5V	+4.5V
+12V	+13.2V	+10.8V
Enclosure Ambient	40ºC	0ºC
CPU Temperature	90ºC	5ºC
Board Temperature	80ºC	5ºC

Table 3-10: Default Threshold Values

The thresholds in ***Table 3-10*** are the default threshold values. To see how to change these values, please refer to the ***Generic Operation Manual*** that came with your system.

3.3.2 Failed Devices

If any of the following devices fail, the audible alarm will be triggered:

- RAID controller module
- Cooling modules
- PSU modules
- BBU modules
- Hard drives
- Temperature sensors

3.4. I^2C Monitoring

The PSUs, cooling modules, temperature sensors, and disk drive failure outputs are monitored through an I^2C serial bus. If any of these modules fails, you will be notified through the various methods described above.

Chapter 4

Subsystem Connection and Operation

This chapter outlines some basic rules you should follow when configuring a storage system and introduces basic information about how to connect the cabling and design a topology for the A24F subsystems. You can follow these sample topologies or use them as a guide for developing your own unique topologies. A complete description of the power on and power off procedures is also given in this chapter.

4.1 FC Host Connection Prerequisites

4.1.1 Choosing the Fibre Cables

The Fibre Channel standard allows for both copper and optical connections. Copper cable is cheaper but limited to lengths of less than 30m. Optical cable can be used over longer distances and have been shown to be more reliable. To meet the demands of high data transfer rates, short-wavelength optical cables are preferred for 2Gbps Fibre connectivity. Optical cables are also less susceptible to EMI.

Fibre cables need to be purchased separately. You may order Fibre cables from your Rorke. These cables have been tested and proved compatible with your A24F subsystems.

The Fibre host ports connect to Fibre Channel host adapters (HBA) that features a 2Gbps transfer rate, SFP interface, and support for full-duplex transfer, best capable of 64-bit/133MHz PCI-X operation.

WARNING!

All Fibre cables are sensitive and must be handled with care. To prevent interference within a rack system, the cable routing path must be carefully planned and the cables must not be bent.

4.1.2 FC Lasers

CAUTION!

Lasers can be hazardous and may cause permanent eye damage, and therefore must be treated with respect and used with caution. Never look at lasers without knowing that they are turned off.

Wavelengths: The lasers on fiber optic cables emit either short wave (SW) beams (770nm-860nm) or long wave (LW) (1270nm-1355nm) beams. Cables using either of these wavelengths can be used.

Laser types: Two (2) types of laser devices can be used in FC cables: Optical Fibre Control (OFC) and non-OFC lasers. The OFC lasers are high-powered and can be used over long distances.

Safety features: Due to their high power output, OFC lasers usually come with a safety mechanism that switches the laser off as soon as it is unplugged. Although non-OFC lasers are low power and do not come with this safety feature, they can still inflict damage.

4.1.3 FC Speed Auto-negotiation

Speed auto-negotiation is specified by the Fibre Channel standard. If a 1Gbps port is connected to a 2Gbps port, the 2Gps port will negotiate down and run at 1Gbps. If there are two 2Gbps ports on either end of the link, the link will be run at 2Gb.

NOTE:

1. *Fibre Channel transmission speed is also determined by cable length and other factors. Make sure your connection and device configuration meet the requirements specified by your cabling devices vendors.*
2. *If DIP Switch 5 on the back of the subsystem rear panel is manually selected to a specific transfer speed, the FC port auto-negotiation function will be disabled.*

4.1.4 SFP Transceivers

Once you have purchased your FC cables, it may be necessary to connect them to SFP transceivers. These transceivers should typically have at least 2Gbps bi-directional data links, a laser transmitter (for fiber optic cables), LC connector, and a metal enclosure to lower EMI.

NOTE:

LC connectors are small form-factor, fiber-optic connectors based on a 1.25-mm ceramic ferrule with the familiar latching mechanism of the RJ-45 modular plug and jack.

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

NOTE:

SFP transceiver modules must be purchased separately. You may also purchase the SFP transceivers from your Galaxy subsystem vendor/distributor.

4.2 Topology and Configuration Considerations

4.2.1 Basic Configuration Rules

When you are configuring your A24F-R2224, the following are some basic rules that should be followed.

NOTE:

Please adhere to these basic configuration rules. They are provided for your convenience to ensure that your storage system will run smoothly and effectively.

- When selecting the number of hard drives to be included in a logical configuration, the transfer rates of host ports and the mechanical performance of the hard disks should be considered.
- Follow all the Fibre Channel specifications when cabling. Pay attention to signal quality and avoid electronic noise from adjacent interfaces.
- The disk drives in the same logical array should have the same capacity, but it is preferred that all the drives have the same capacity.
- A spare drive should have a minimum capacity equivalent to the largest drive that it is expected to replace. If the capacity of the spare is less than the capacity of the drive it is expected to replace, then the controller will not proceed with the failed drive rebuild.

4.2.2 Fibre Channel Topologies

The Fibre Channel standard supports three (3) separate topologies: point-to-point, Fibre Channel Arbitrated Loop (FC-AL), and fabric switch.

- ***Point-to-Point:*** Point-to-point topology is the simplest topology that can be used. It is a direct connection between two (2) Fibre Channel devices.

- ***FC-AL:*** This is the most common topology currently in use. The Fibre Channel devices are all connected in a loop and each device is assigned an arbitrated loop physical address (AL_PA). FC-AL supports 124 devices in a single loop.

- ***Fabric:*** The fabric topology supports up to 2^{24} Fibre Channel devices. This topology allows many devices to communicate at the same time. A Fibre switch is required to implement this topology.

4.2.3 Host-side Topologies

In a configuration designed for high data availability, the primary concern for host-side topologies is to avoid points of failure. It is therefore recommended that the host side be connected to at least two (2) HBAs. It is also preferable to connect the RAID subsystems to the host computer(s) through a Fibre switch. The A24F subsystems come with onboard hub. In a directly attached application, this onboard hub feature saves you the cost of a FC switch.

NOTE:

To create dual-redundant data paths on the host side, it is necessary for third-party failover software to be installed on the host computer.

4.2.4 Drive-side Topologies

Each SATA drive is connected through a dedicated channel. Note that the FC host ports can be used to cascade other RAID subsystems but cannot connect to expansion enclosures (JBODs).

4.2.5 Internal Connections

The internal connections described here apply to the redundant controller subsystem, A24F-R2224. The two (2) RAID controllers are connected to each other internally through the common backplane board. This enables the controllers to synchronize cached contents and configuration data. When the internal hub is enabled by the enclosure DIP switch, the two (2) host channels are connected internally to both controllers. This provides access routes to a surviving controller in the event of single controller failure.

- Make sure you select the appropriate host port topology option through the firmware configuration utilities. The available options include:
  - Loop Only
  - Point-to-point
  - Loop preferred, otherwise Point-to-point
- If hub is enabled, the host IDs on the two (2) host channels are associated with the WWN node names and port names. If a controller fails, the surviving controller will avail itself using the original node names and port names.
- In the event of cable disconnection or RAID controller failure, a valid data link through the existing controller will continue data transfer that was previously served by the failed controller.

4.2.6 Unique Identifier

The unique identifier is a user-specified, 16-bit hexadecimal number that is used to generate FC ports' node names and port names. Each subsystem has a factory-assigned hexadecimal number.

4.2.7 ID/LUN Mapping

I/O load distribution between the dual-redundant RAID controllers (in the A24F-R2224) is determined by the host ID/LUN mapping, a process done by associating logical configurations of disk drives with host channel ID/LUN combinations. Different logical groups of drives can be mapped to channel IDs or the LUN numbers under a host ID. For a multi-path configuration, a logical drive configuration can be mapped to different ID/LUN combinations. In this case, the multi-path management software or file locking mechanism is required on the host side. ID/LUN mapping procedures are described fully in the ***Generic Operations Manual***.

4.3 Fibre Channels

4.3.1 Onboard Hub Settings

The A24F-R2224 subsystem comes with embedded hub on their host I/O modules. Channel bus and access routes configurations with different DIP switch settings are diagrammed below. The onboard hub helps avoid system down time caused by a single path failure.

4.3.2 Jumper Assignments

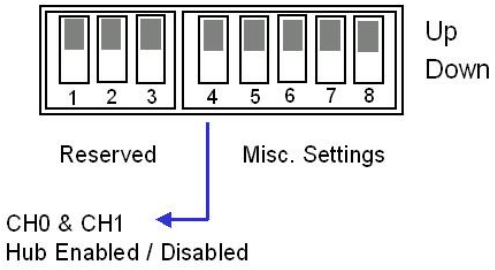

Figure 4-1: Location of the Onboard Hub Pin

- **UP:** hub enabled
- **Down:** hub disabled

Pin-4 on the DIP switch located on the upper left corner of the A24F subsystem rear panel controls the following:

DIP Switch Configurations and Host Port Connectivity:

- **Up**: The host channels of the partner controllers are connected together from the partner controllers, through a common backplane, host I/O modules, and to the host SFP ports.

  Every host I/O port connects to both of the RAID controllers.

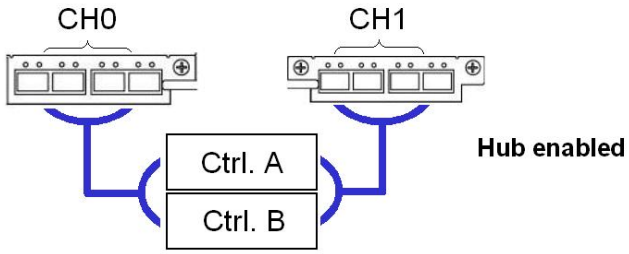

Figure 4-2: A24F-R2224 - Channel Buses When Hub is Enabled

- **Down:** Connection to a specific host port travels down to a specific RAID controller as diagrammed below.

  This applies to configurations where FC port hub can be provided externally, e.g., using a FC switch where specific FC ports are connected to switch ports. Path redundancy can also be achieved using redundant cable links.

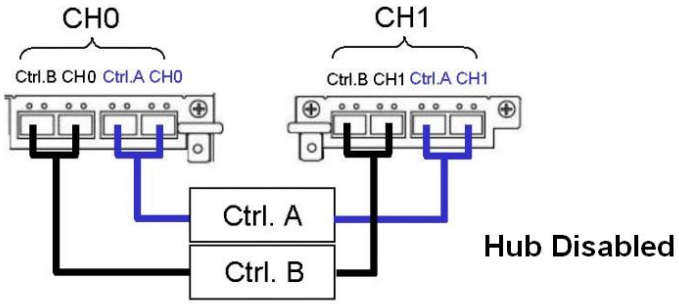

Figure 4-3: A24F-R2224 - Channel Buses When Hub is Disabled

4.3.3 Fibre Channel Speed Selection

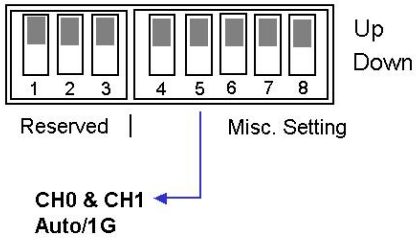

Figure 4-4: Pin 5 - Fibre Channel Speed Selection

- **UP:** Auto
- **Down:** 1Gbps

Speed auto-detection is a specified feature of the Fibre Channel standard. If one of the devices in the FC-AL loop is set to an auto setting, it will detect the available device and run at that speed. On the other hand, when you set the speed to 1G, it has the priority to run at that speed.

The Pin 5 default is set to Auto (the Up position) for the host port transfer speed. Flip this switch to the down position if the host ports need to run at 1Gbit per second. (See ***Figure** 4-4* for the location of the Pin 5 switch) Only Pins 4 and 5 are functional; leave the other pins in the UP position.

WARNING!

When the speed selection is manually switched for host channels to run at 1G speed, subsystem firmware must also be adjusted accordingly. You may access the firmware using the LCD in front of the subsystem, RS-232 hyper terminal screen, telnet and RAIDWatch management software. If the Fibre loop speed options are not coordinated with the firmware, the running speed may eventually slow down and cause system error.

NOTE:

To answer questions related to firmware configuration such as the channel speed selection, please refer to the ***Generic Operation Manual*** *that came with the Product Utility CD in your subsystem package.*

4.4 Host Connection Sample Topologies

4.4.1 Simple, Direct Connection to a Host Computer

The A24F-R2224 is directly connected to a host computer equipped with a dual-channel HBA.

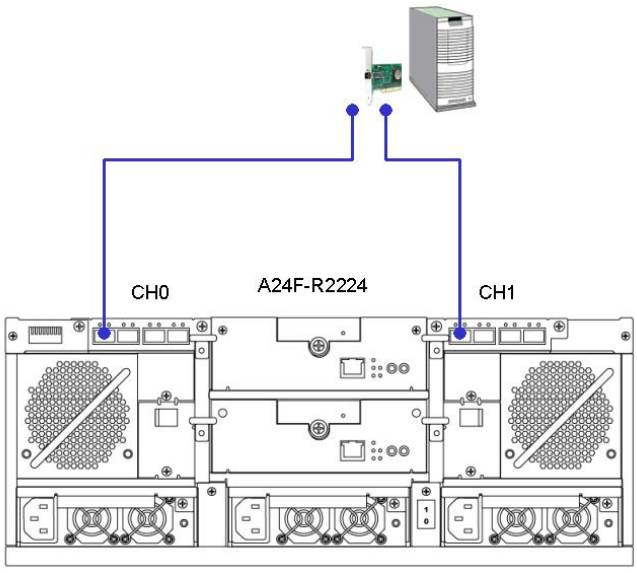

Figure 4-5: Direct Dual Hosts Connection

Channel Settings	
Host	CH0 and CH1
Drive	Via system bus, through the backplane
4th DIP Switch	Hub enabled

Configuration Information	
RAID Controllers	2
Host Servers	1
Data path Connection	Dual data paths
Host Channel Bandwidth	400 MBps
Max. Number of Drives	24

- This is a direct-attached configuration showing one (1) host connected to one (1) RAID subsystem. Drives in the enclosure can be configured into one or more arrays, and made available through individual host ports.
- Operating system(s) might boot from the array. Operating using a protected capacity decreases the chance of server downtime. The logical arrays can be associated with different host IDs on separate host channels so that if one cable link fails, the host can still access the arrays through another channel link. File locking or access management utilities will be necessary to avoid access conflicts.
- Depending on I/O characteristics, each configured array should be properly optimized either for Random or Sequential I/Os.
- Multiple logical drives or multiple partitions can be created and made available separately through different ID/LUNs on the host ports.

4.4.2 Dual Path Redundant Connection

This is a high availability configuration centered around two (2) clustered host servers, each with two (2) single-ported HBAs for redundant path connections.

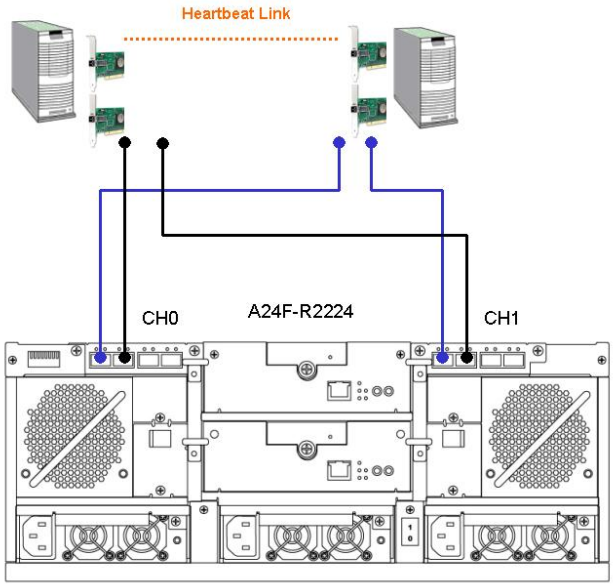

Figure 4-6: Clustered Servers with Redundant Paths

Channel Settings	
Host	CH0 and CH1
Drive	Via system bus, through the backplane
4th DIP Switch	Hub enabled

Configuration Information	
RAID Controllers	2
Host Servers	2
Data Path Connection	Dual data paths
Host Channel Bandwidth	400 MB/s
Max. Number of Drives	24

- This is a direct-attached configuration showing two (2) hosts sharing the capacity in one (1) RAID subsystem. Drives in the enclosure can be configured into one or more arrays, and made available through individual host ports.
- Each configured array (logical drive) is separately mapped (or associated) with more than one host ID/LUN. A logical configuration of drives may appear as two array volumes to the host, and the multi-path management software on the host should recognize one as active and the other as a standby. The management software should bring up the standby if the FC link connecting the active array fails.
- If a server in a clustered pair fails or a host bus is disconnected, the surviving server needs to access the arrays originally accessed by the

failed server. By associating an array with IDs on two host buses, every host bus has all mapped IDs. Most multi-pathing or access management software running on clustered servers should be able to manage the access to these IDs.

- If Controller A fails, Controller B will take over to eliminate any downtime for high-availability applications.
- Operating system(s) might boot from the array. Operating using a protected capacity decreases the chance of server downtime. Each server may use separate capacity volumes or share volumes using file locking or access management utilities.
- Depending on I/O characteristics, each configured array should be properly optimized either for Random or Sequential I/Os.
- You may also partition a logical capacity into two or more volumes and let each server access separate volumes.

4.4.3 Hub Disabled and Switched Fabric Connection

With hub disabled, the individual host channels from individual RAID controllers are connected to a switched fabric network. This can apply to applications using the RAID subsystem as a secondary storage where controller and path redundancy may not be the requirements.

More cable links can be used to connect redundant FC links from each controller to a switched fabric for ensured availability.

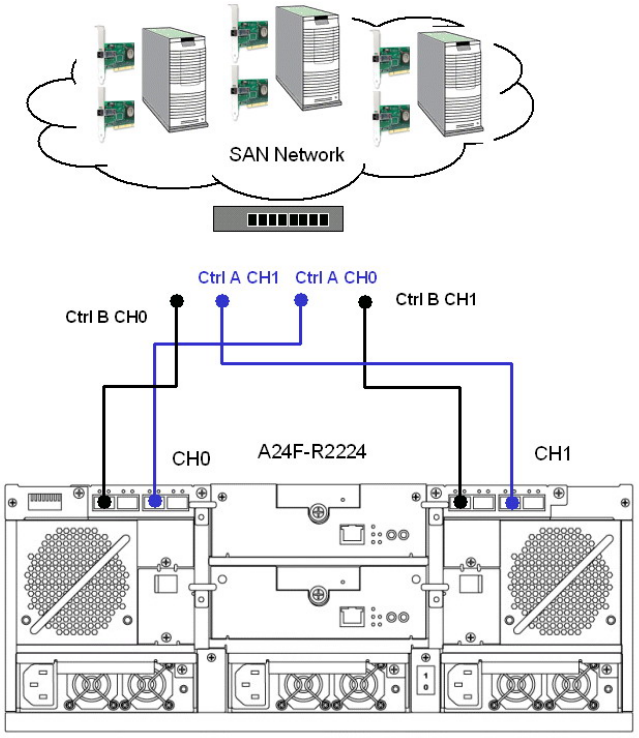

Figure 4-7: Hub Disabled and Switched Fabric

Please note, in the example shown in ***Figure 4-7,*** the channels are configured as follows:

Channel Settings	
Host	CH0 and CH1
Drive	Via system bus, through the backplane
4th DIP Switch	Hub disabled

Configuration Information	
RAID Controllers	2
Host Servers	Multiple through fabric links
Data Path Connection	Individual data paths
Host Channel Bandwidth	800 MB/s
Max. Number of Drives	24

The onboard hub can be disabled so that individual host ports connect to individual RAID controllers.

- This is a SAN storage application using two (2) host channels through four (4) separate FC links from individual RAID controllers.
- Path bypass redundancy is provided externally by a fabric switch.
- Depending on switch port configuration, change your FC host-side protocol through firmware utilities to suit the connection either to the N_ports or the NL_ports.
- Access management software can be implemented to direct data flow through an existing host link if one of the data paths fails. For the sake of simplicity, the diagram above only shows single FC links. More cables can be used to connect the rest of the host ports for path redundancy. The precondition is that an array should also be available through the host ID/LUNs on another host link.

4.4.4 Daisy Chaining

The subsystem is able to expand its storage capacity by daisy-chaining other A24F subsystems. The onboard hub enables the subsystem to withstand single link failure.

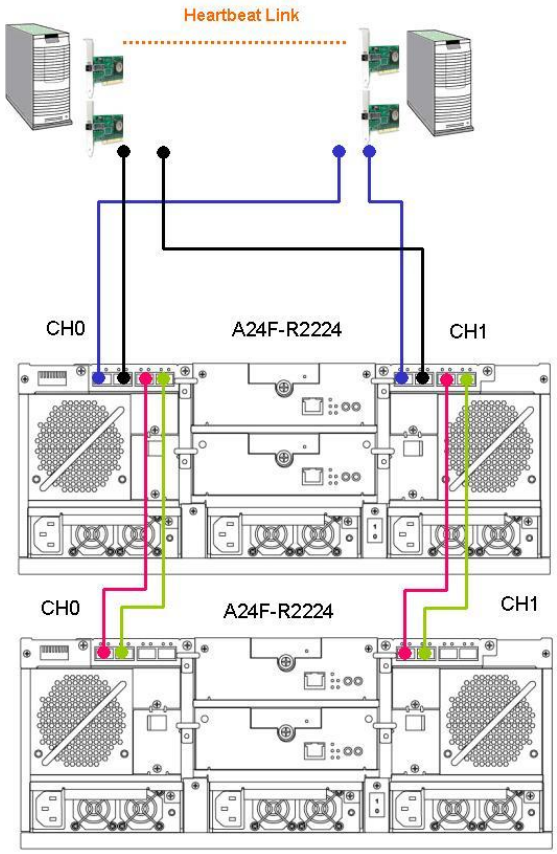

Figure 4-8: Daisy-Chaining A24F-R2224 Subsystems

Channel Settings	
Host	CH0, CH1
Drive	Via system bus, through the backplane
4th DIP Switch	Hub enabled

Configuration Information	
RAID Controllers	2
Host Servers	2
Data Path Connection	Dual-redundant data paths
Host Channel Bandwidth	400 MBps
Max. Number of Drives	48

- This is a daisy-chained configuration showing at least two (2) A24F-R2224 subsystems connected to two (2) clustered host computers.
- This configuration is suitable for applications that require storage expansion.

- Data paths connecting each host computer each has a failsafe counterpart. In the event of host link or server failure, data access can be continued through the redundant data path.
- Bypass is provided on the host I/O modules in this configuration.
- It is advised to connect the primary RAID subsystem to the secondary RAID subsystem using redundant data links.
- The array volumes in the two (2) cascaded RAID subsystems are separately configured but presented on the same FC channels (CH0 and CH1 of the two subsystems are connected) each using different host IDs.
- Depending on I/O characteristics, each configured array should be properly optimized either for Random or Sequential I/Os.

4.5 Power On

Once all of the components have been installed in the A24F-R2224 and the host channels have been connected, the subsystem can be powered on.

4.5.1 Check List

BEFORE powering on the A24F-R2224, please check the following:

- ***Memory module:*** Memory modules have been correctly installed on the controller boards.
- ***BBU:*** If being used, make sure the optional BBU has been installed correctly in the A24F-R2224.
- ***Hard drives:*** Hard drives have been correctly installed in the drive trays.
- ***Drive trays:*** All the drive trays, whether or not they contain a hard drive, have been installed into the subsystem.
- ***DIP switch settings:*** All the appropriate DIP switch settings have been made. The hub has been enabled/disabled (as required) and the speed of the host channel selected as automatically negotiated or fixed at 1Gbps.
- ***Cable connections:*** The subsystem has been correctly connected to host computer(s), external devices, and/or cascaded subsystems.
- ***Power cables:*** The power cords have been connected to the PSUs on the subsystem and plugged into the main power source.

- ***Ambient temperature:*** All the subsystem components have been acclimated to the surrounding temperature.

4.5.2 Power On Procedure

When powering on the A24F-R2224, please follow these steps:

Step 1. ***Power on the Fibre Channel connection devices.***

These devices include the FC switches and any other such device that have been connected to the subsystems. Please refer to the manual that came with your FC devices to see their power on procedure.

Step 2. ***Power on the subsystems that are not connected directly to the host computers, if applied.***

If you have cascaded RAID subsystems, power on those enclosures before powering on the A24F-R2224 subsystem that is connected directly to the host computer(s).

Step 3. ***Power on the A24F-R2224.***

The subsystems should be powered on before the host computers. To power on the subsystems please follow the description below.

- Using the power cords provided in the package, connect all power sockets on the subsystem rear panel to the main power source.
- Turn the power switch on. (See ***Figure*** *4-9*) One (1) power switch controls all PSUs.

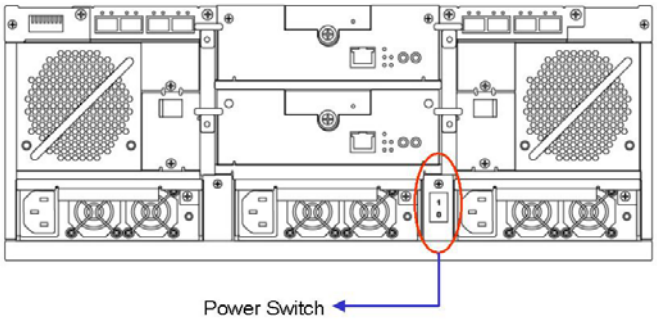

Figure 4-9: Power Sockets and Power Switch

CAUTION!

Although the PSUs are redundant and the subsystem can withstand a single PSU failure, it is advisable to replace a failed PSU immediately. The subsystem will be held in an idle state if two PSUs have already failed in the subsystem.

Step 4. ***Power on the host computers.***

The host computers are the last devices that are turned on. Please refer to the manual that came with your host computers to see their own power on procedures.

4.5.3 Power On Status Check

Once the subsystem has been powered on, the status of the entire subsystem should be checked to ensure that all components are receiving power and functioning without complications or malfunctions.

- ***Controller module LEDs*** – The *controller ready*, h*ost and drive ports active* LEDs should all flash green during the initialization stage.

- ***Drive tray LEDs –*** The blue LED for all the drive trays (that contain hard drives) should light up, showing that there is power.

- ***LCD panel LEDs –*** The blue LED on the LCD panel should come on, indicating that power is being supplied to the system.

- ***Firmware and RAIDWatch*** – The overall status of the system may be checked using the firmware or the RAIDWatch GUI.

- ***Audible alarm*** – If any errors occur during the initialization process, the onboard alarm will sound in a hastily repeated manner.

Drive tray LEDs should normally start flashing, indicating the RAID controller units are attempting to access the hard drives.

System firmware can be configured to support a delayed sequence for starting drives. Please consult your ***Generic Operation Manual*** for more details.

NOTE:

The subsystem has been designed to run continuously. If a component fails, the fault can be corrected online.

4.5.4 LCD Screen

When powering on the subsystem, the following messages should appear on the front panel LCD screen. Wait for the front panel LCD to show "**READY**" or "**No Host LUN**" before the host boots up.

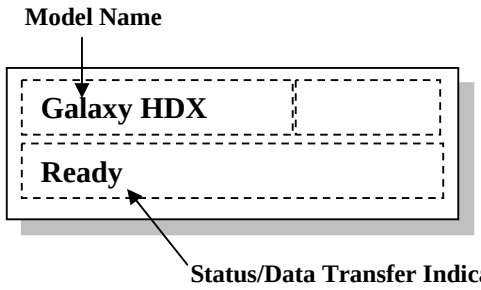

Figure 4-10: The LCD Start-up Screen

The LCD screen startup sequence is shown and described in the sequence below.

Initializing…. Please Wait...	This screen appears when the PSUs are turned on.
Power on Self Test, Please Wait…	This screen appears when the subsystem is testing the integrity of the firmware and hardware components.
Power on Self Test Completed	This screen appears after the self test is completed.
Galaxy HDX 512MB RAM, Wait…	This screen shows the memory size. If properly initialized, the subsystem should correctly indicate the memory size now.
Galaxy HDX No Host LUN	System is ready. You can now start to configure the subsystem.

4.6 Power Off Procedure

To power off the Galaxy subsystem, please follow these steps:

NOTE:

When powering off the Galaxy subsystem, please ensure that no time-consuming processes, like a "logical drive parity" check or a "Media Scan," are running.

Step 1. Stop I/O access to the system.

Use the software provided on the host computer to stop all I/O accesses to the Galaxy subsystem. Please refer to the documentation that came with your application servers and operating systems.

Some operating systems may require "unmounting" disk volumes (mapped LUNs) before powering off the array.

Step 2. Flush the cache.

Usually the cached writes will be distributed in a short time. You may also use the "Shutdown Controller" firmware function to flush all cached data. This prepares the RAID subsystem to be powered down.

Step 3. Turn off the power.

Turn off the power switch at the rear panel of the Galaxy RAID subsystem. Once the RAID subsystem has been powered off, other devices connected to the subsystem may be powered down.

Chapter 5
Subsystem Maintenance

5.1. Introducing Subsystem Maintenance and Upgrading

5.1.1 Maintenance

Constant monitoring and maintenance of your subsystem will minimize subsystem downtime and preserve the working integrity of the system for a longer period of time. If any of the subsystem components fail, they must be replaced as soon as possible.

WARNING!

Do not remove a failed component from the subsystem until you have a replacement on hand. If you remove a failed component without replacing it, the internal airflow will be disrupted and the system will overheat causing damage to the subsystem.

All of the following components can be replaced in case of failure:

1. RAID controller module – ***Section 5.2.3***
2. DIMM module – ***Section 5.2.4***
3. BBU module – ***Section 5.3***
4. PSU modules – ***Section 5.4***
5. Cooling modules – ***Section 5.5***
6. Hard drives – ***Section 5.6.2***
7. Host I/O modules **– *Section 5.7***

5.1.2 General Notes on Component Replacement

- All of the components on the subsystem, including the RAID controllers, PSU modules, cooling modules, and drive trays, are hot-swappable and can be changed while the subsystem is still in operation.

- Qualified engineers who are familiar with the subsystem should be the only ones who make component replacements. If you are not familiar with the subsystem and/or with RAID subsystem maintenance in general, it is strongly advised that you refer subsystem maintenance to a suitably qualified maintenance engineer.

- Normalized airflow is directly dependent upon the presence of all subsystem components. Even if a subsystem component fails, it should not be removed from the subsystem until a replacement is readily at hand and can be quickly installed. Removing a subsystem component without replacing it can lead to permanent subsystem damage.

- When replacing any hot-swappable component, caution should be taken to ensure that the components are handled in an appropriate manner. Rough or improper handling of components can lead to irreparable damage.

WARNING!

*When inserting a removable module, **DO NOT USE EXCESSIVE FORCE**! Forcing or slamming a module can damage the connector pins on the module or the backplane. Gently push the module in until it reaches the end of module slot. Once you feel the contact resistance, use slightly more pressure to ensure the module connectors are correctly mated. Use the extraction levers or retention screws to secure the module.*

5.2. Replacing Controller Module Components

5.2.1 Overview

The controller module consists of the components shown below:

Component	Maintenance Procedures
DIMM Module	The DIMM module can be replaced when it fails or if a larger capacity DIMM module is required.
BBU Module	The BBU can be installed after the initial installation procedure or replaced if a previously installed BBU module is faulty or fails to hold its charge.
Main Board	If the controller module in a single controller model fails, it is necessary to power the system down and replace the controller.

5.2.2 Notes on Controller Module Maintenance

- The controller module contains a DIMM module and a BBU module. When replacing the controller module, these components can be removed and used on the new controller module if they are functioning normally.

- When replacing the controller module, you must remember that the controller board is one of the most sensitive components in the subsystem. All previously stipulated safety precautions (see ***Chapter 2***) must be strictly adhered to. Failure to adhere to these precautions can result in permanent damage to the controller board, resulting in timely delays.

5.2.3 Removing the Controller Module

WARNING!

1. *Consult with your reseller's or distributor's technical support department to confirm which memory module can be installed into the controller module.*
2. *The installed BBU and controller module must be removed prior to installing new memory modules. Do this with care. Sensitive components can be damaged during the process.*
3. *The BBU is hot-swappable and can be independently swapped from the controller. However, as a safety precaution and in case your memory still holds cached data, it is recommended to remove the BBU before handling the DDR RAM module. If the BBU is supplying power to the memory when the DDR module is being removed, damage will occur!*

To remove the controller module:

Step 1. Prepare a clean, static-free work pad on which to place the controller that will be removed from the chassis.

Step 2. If working on the dual-controller A24F-R2224, the workload should have been taken over by the surviving RAID controller.

Step 3. Remove the BBU module if one has been installed. Loosen the BBU module's spring screw and then simply retrieve it from the chassis.

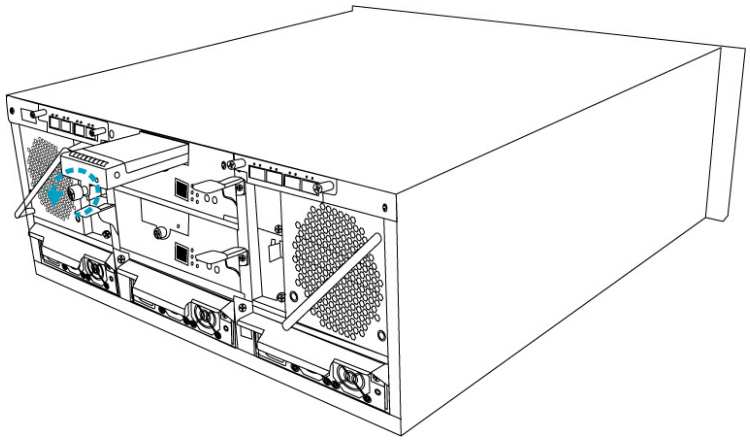

Figure 5-1: Removing the BBU Module

Step 4. ***Disconnect all cables*** that are connected to the controller module you wish to replace. These include the FC cables connecting to the host or cascaded enclosures, Ethernet cables connected to the LAN port, and any cables connected to the RS-232C audio jacks.

Step 5. ***Loosen the retention screws*** that secure the controller's ejector levers to the enclosure chassis. (See ***Figure*** *5-2*)

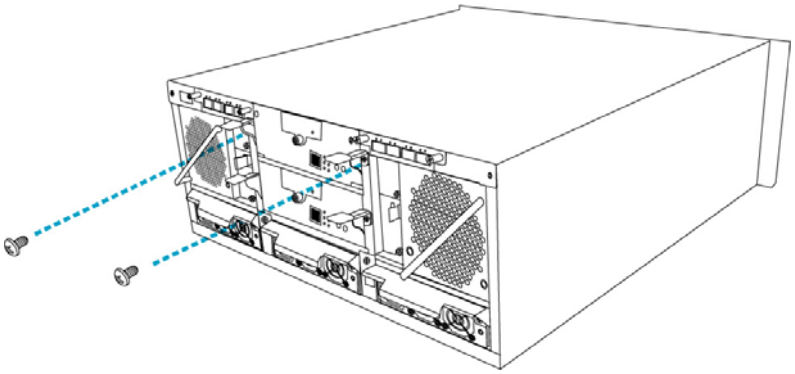

Figure 5-2: Removing the Retention Screws

Step 6. ***Gently press both of the ejector levers in a downward motion*** at the same time to disconnect the controller from the back-end PCB. When the ejector levers are at their lowest positions, the controller module will automatically be eased out of the controller module bay in the subsystem. (See ***Figure*** *5-3***)**

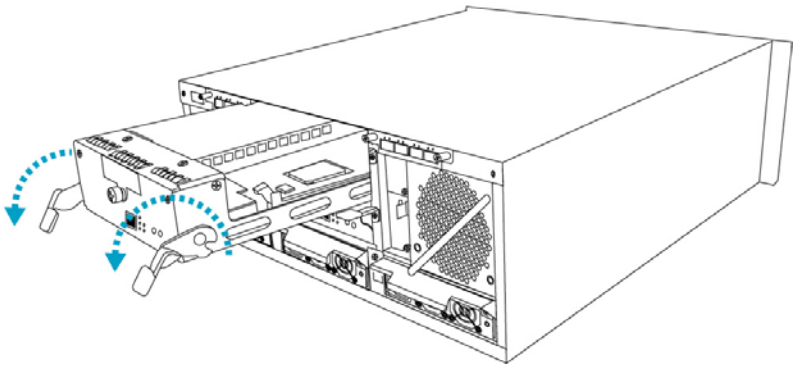

Figure 5-3: Removing the Controller Module

Step 7. ***Carefully pull the controller module out of the subsystem chassis*** keeping one hand underneath to support the weight of the module.

5.2.4 DIMM Module Replacement

If a DIMM module fails or a DIMM module with a higher memory capacity is required, the onboard DIMM module must be replaced.

- ***DIMM module replacement***: When replacing DIMM module, make sure that the subsystem is correctly powered down and disconnect all the cables connected to the controller prior to removing the controller module.

- ***Procedures on replacing the DIMM module:*** For complete illustrated instructions on how to replace a DIMM module, refer to ***Chapter 2***, ***Section 2.6***.

5.2.5 Replacing the Controller Module

If the controller module has failed, it must be replaced. To replace a failed controller module:

Step 1. Remove the BBU module (if it was installed, see ***Section 5.3.1***), the controller module, and then the DIMM module from the Galaxy subsystem. (See ***Section 5.2.4***)

Step 2. ***Install the DIMM module and the BBU module*** onto the new controller module.

Step 3. ***Install the new controller module*** into the subsystem. (See ***Section 2.7***)

Step 4. ***Re-attach all the cables*** that were removed. These include the FC cables that connect to the host or the expansion enclosures, the

Ethernet cable that was previously attached to the LAN port, and any cables that were attached to the RS-232C audio jacks.

Step 5. ***Power up*** the system following the correct power up sequence that is described below.

5.3. Replacing a Failed BBU Component

5.3.1 Replacing the BBU Module

NOTE:

When replacing a BBU in a single controller model, the whole subsystem needs to be powered down. Therefore, when replacing a failed BBU, you should carefully select the time at which the replacement will be made to minimize the overall disruption to the service.

CAUTION!

- *Install or replace the BBU with BBUs supplied by your subsystem vendors only. Use of battery cells from another source will void our warranty.*
- *Always dispose of discharged or used batteries in an ecologically responsible manner. Dispose of used BBUs at authorized disposal sites only.*
- *Do not use nor leave the BBU near a heat source. Heat can melt the insulation and damage other safety features of battery cells, possibly causing it to leak acid and result in flames or explosion.*
- *Do not immerse the BBU in water nor allow it to get wet. Its protective features can be damaged and abnormal chemical reactions may occur, possibly causing functional defects, acid leak, and other hazardous results.*
- *Do not disassemble or modify the BBU. If disassembled, the BBU could leak acid, overheat, emit smoke, burst and/or ignite.*
- *Do not pierce the BBU with a sharp object, strike it with a hammer, step on it, or throw it against a hard surface. These actions could damage or deform it and internal short-circuiting can occur, possibly causing functional defects, acid leak, and other hazardous results.*
- *If a BBU leaks, gives off a bad odor, generates heat, becomes discolored or deformed, or in any way appears abnormal during use, recharging or storage, immediately remove it from the subsystem and stop using it. If this is discovered when you first use the BBU, return it .*

BBU failure can result from the following:

1. A BBU (battery cell pack) has lost its ability to hold electrical charge. This may be the case after the battery cells have been recharged for many times regardless of how long the module has been used. Therefore, a stable power source is important for system operation.

2. The charger circuitry mounted underneath the controller top cover has failed.

There are other conditions that might trigger the BBU fault events and light the BBU fault LED:

1. The temperature sensor embedded with the subsystem's charger circuit reports a temperature reading exceeding 45 degree Celsius. The charger circuits will enter a low-power and self-protection state.

2. A BBU module has been charged for over seven (7) hours. A timer is embedded with the charger. When this occurs, the charger will enter a timer fault state. The fault condition usually occurs with a brand new BBU or with a totally discharged BBU. Charging will resume automatically if you remove and re-install the BBU module.

To replace a BBU module, please follow these steps:

Step 1. ***Remove the BBU module from the subsystem*** by loosening its spring screw, and then gently removing the module from the chassis.

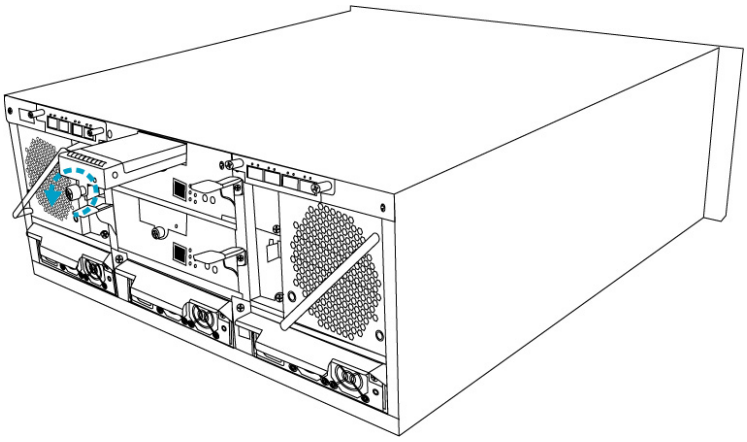

Figure 5-4: Removing the BBU Module

Step 2. ***Re-install the new BBU.*** To do this, insert the BBU into the module slot, and fasten the spring screw to secure the BBU.

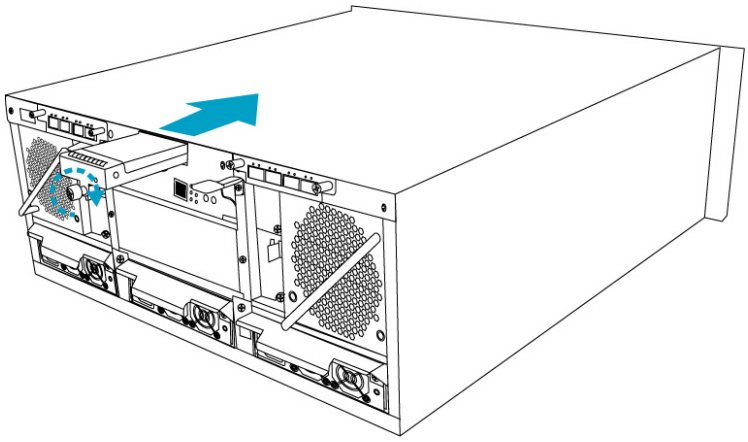

Figure 5-5: Installing a BBU Module

NOTE:

The chance of BBU charger failure is comparatively low. If the cause of a failure cannot be determined even after a BBU module is replaced, contact your system vendor for a replacement controller and return the controller module through the standard RMA procedure.

5.4. Replacing a Failed PSU Module

5.4.1 Notes on PSU Module Maintenance

- ***Redundant (N+1) PSU modules***: The subsystem comes with three fully redundant, hot-swappable PSU modules. These modules are accessed through the rear of the subsystem.

- ***Immediate replacement***: When a PSU fails, it should ideally be replaced immediately. Do not remove a PSU module unless a replacement is readily available. Removing a PSU without a replacement will cause severe disruptions to the internal airflow and the subsystem will overheat, possibly causing irreparable damage to some of the subsystem components.

WARNING!

Although the PSU modules are fully redundant, it is not advisable to run the Galaxy subsystem with any failed PSU module for a long period of time. If a second PSU module fails, the subsystem will enter an idle state.

5.4.2 Replacing a PSU Module

To replace a PSU, please follow these steps:

Step 1. ***Flip open the cable clamp (if used) and remove the power cord*** connecting the failed module to the main power. If the provided cable clamps are used, remove them.

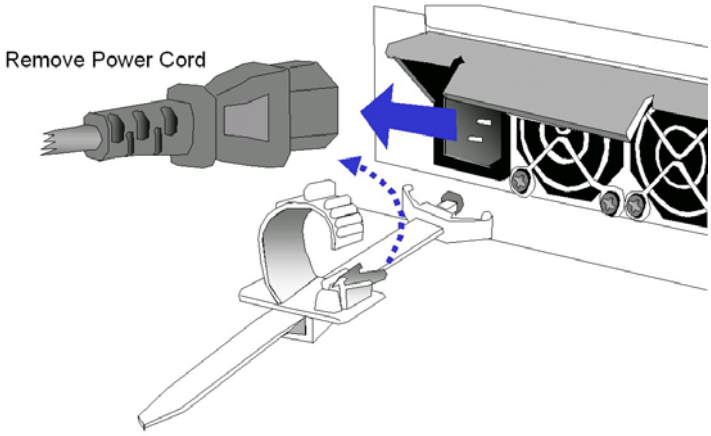

Figure 5-6: Removing the Power Cord

Step 2. ***Remove the retention screw*** located on the right side of the PSU. (See ***Figure*** *5-7***)**

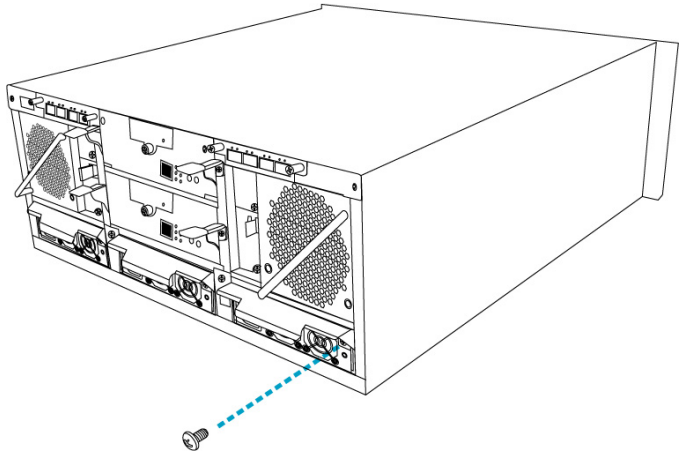

Figure 5-7: Removing the PSU Retention Screw

Step 3. ***Remove the failed module*** by pressing the retention handle down until the PSU is released from the enclosure chassis. (See ***Figure 5-8***)

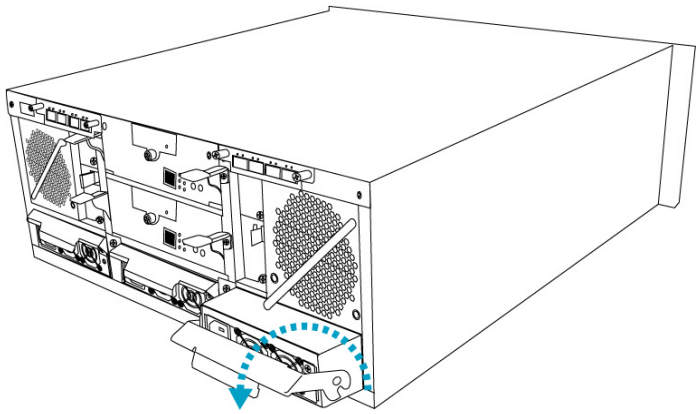

Figure 5-8: Dislodging the PSU

Step 4. ***Gently pull the PSU module out of the chassis*** using the retention handle.

Step 5. ***Insert the new PSU module*** into the slot with the retention handle at its lowest position. Push the PSU in until you feel the contact resistance with its back-end connectors. Do not use force or slam the module into place. Doing so can damage the back-end connectors or enclosure backplane.

Secure the PSU into the chassis slot. Make sure the squared notches of the retention handle lock onto the metal groove on the interior sides of the module slot. Once in place, pull the retention handle in an upward motion to secure the module.

Step 6. ***Insert and fasten the retention screw*** underneath the handle to secure the module.

Step 7. ***Install the cable clamp assembly (if used).***

5.5. Cooling Module Maintenance

5.5.1 Notes on Cooling Module Maintenance

- ***Two redundant cooling modules***: The subsystem is equipped with two redundant, hot-swappable, dual-fan cooling modules located above the PSU modules. These cooling modules control the internal operating temperature of the subsystem and therefore their working integrity should be maintained at all times.

- ***Detecting a failed cooling fan module***: If a cooling module fails, you can choose to be notified of the failure by the LEDs located at the back of the module, an audible alarm, the firmware terminal access, the RAIDWatch Panel View, or the various event notification methods.

- ***Replacing a cooling module***: When you are notified that a cooling module has failed, it should be replaced as soon as possible. A failed cooling module should only be removed from the subsystem when you have a replacement module that can be installed as soon as the failed cooling module has been removed.

WARNING!

Although the cooling fan modules are fully redundant, it is not advisable to run the Galaxy subsystem with a single cooling module for a long period of time. If the second cooling module fails, the system is at risk of sustaining irreparable damage.

5.5.2 Replacing a Cooling Module

To replace a cooling module, please follow these instructions:

Step 1. ***Remove the cooling module*** by pressing the slide lock on the side of the module towards the center of the chassis and then pulling the module out of the chassis. (See ***Figure*** *5-9*)

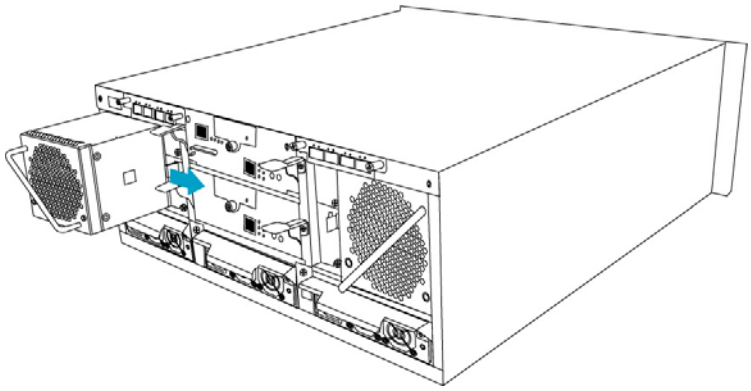

Figure 5-9: Removing the Cooling Module

 Step 2. Gently slide the new cooling module into the chassis. Do not use force or slam the module. The slide lock will hold the module in place.

5.6. Drive Tray Maintenance

5.6.1 Notes on Hard Drive Maintenance

- ***Hot-swappable drive trays***: The drive trays are all hot-swappable. If a hard drive fails, it can be replaced while the subsystem is still running.

- ***Remove drives slowly***: When removing a drive tray, withdraw it from the enclosure slowly. If the drive tray is removed too quickly a drive I/O timeout may occur.

- ***Open flap***: Once the flap on the drive tray has been opened, the drive tray must be removed from the subsystem. Failure to remove the drive tray from the subsystem after the flap has been opened may result in signal glitches and Data Compare Errors.

- ***Replacement on-hand***: Before removing a failed hard drive from the subsystem, make sure you have a replacement hard drive readily available. Do not leave the drive tray slot open for an extended period of time. Otherwise, the normalized airflow will be disrupted and subsystem components will overheat and may become permanently damaged.

5.6.2 Hard Drive Replacement

When a hard drives fails, it needs to be replaced. To replace a hard drive, please follow these steps:

 Step 1. ***Remove the drive tray*** from the enclosure. First unlock the key-lock on the front of the drive tray using a flat-head screwdriver to turn the key-lock until the groove on its face is in a horizontal orientation.

 Step 2. ***Open the front flap*** by pressing the release button to lift up the latch at the front of the drive tray. This will dislodge the hard drive from the enclosure and the hard drive can be carefully withdrawn.

 Step 3. ***Remove the retention screws*** on the sides of the drive tray and then remove the hard-drive from the drive tray.

 Step 4. ***Install the new hard drive.*** Please refer to the complete hard drive installation procedure in ***Chapter 2***.

5.7. Replacing a Host I/O Module

All host I/O modules on the A24F are hot-swappable. If any of these modules failed, the whole module can be replaced online. To install or replace an I/O module, please follow these steps:

NOTE:

The following instructions are showing only the host I/O module on the right-hand side. You may follow the same procedures to work on the module on the other side.

Step 1. ***Disconnect the SFP transceiver(s) that are connected to the host I/O module*** by pressing the latch on the bottom of the transceiver. Then pull out the transceiver module along with the Fibre cables attached to it.

NOTE:

The procedure for disconnecting the standard SFP transceiver sent with the Galaxy Raid. If you are using a different SFP transceiver, please refer to the instructions provided with the module.

Step 2. ***Use a screwdriver to loosen the retention screws.*** (See ***Figure 5-10***)

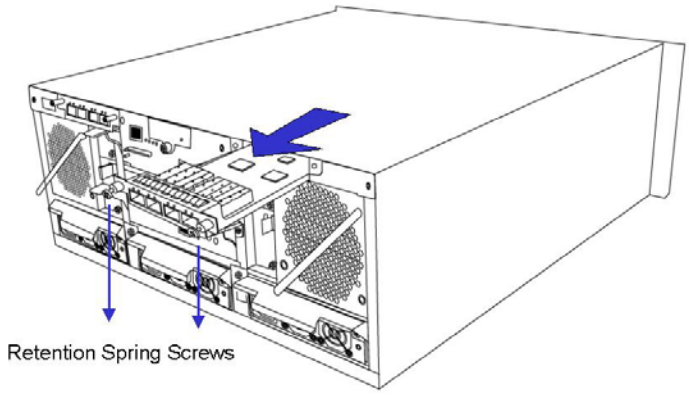

Figure 5-10: Removing the Host I/O Module

Step 3. ***Remove the module by pulling the spring-screws.***

Step 4. ***Align the replacement module with the slot and gently insert it*** until the back of the module reaches the end of the slot.

Step 5. ***Secure the replacement module to the chassis*** by fastening the retention screw on the module.

Step 6. Re-insert the SFP transceiver(s) and cabling that were previously removed.

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Appendix A

Subsystem Specifications

A.1. Technical Specifications

Environmental Specifications	
Humidity	5% to 95% (non condensing – operating and non-operating)
Temperature	*Operating*: 0º to 40ºC *Non-operating*: -20º to 60ºC
Altitude	*Operating*: sea level to 12,000 ft *Non-operating*: sea level to 20,000 ft

Power Requirements	
Input Voltage	90VAC @ 8AC 264VAC @ 4AC with PFC (auto-switching)
Frequency	47 to 63Hz
Power Consumption	405W

Dimensions		
	With Forearm Handles	**Without Forearm Handles**
Height	174.4mm (6.86 inches)	174.4mm (6.86 inches)
Width	482mm (19 inches)	445mm (17.5 inches)
Length	514mm (20.2 inches)	498mm (19.6 inches)

EMI/EMC
• FCC Class-A • CE • CB

Safety Requirements
• UL60950 / IEC 60950

Shock	
Half-sine	*Operating:* 5G peak, 11ms duration *Non-operating:* 10G peak, 11ms duration

Vibration	
Operating	5 to 500Hz, 0.2G, 0.5oct/min
Non-operating	5 to 500Hz, 1.0G, 0.5oct/min

Warning Alarms
• Audible alarms • System LEDs • LCD screen • Terminal screen • Event notification via the RAIDWatch Manager

A.2. Controller Specifications

A.2.1 Configuration

Specification	
RAID Levels	0, 1(0 + 1), 3, 5, 10, 30, 50, JBOD, and non-RAID disk spanning
Host O/S Compatibility	Host O/S independent; supports all major platforms
Host Interface	2 2Gbps Fibre channels via independent host I/O modules and SFP ports
Host Channels	2 pre-configured 2Gbps host channels
Drive Interface	Supports up to 24 channels of 3Gbps SATA II drives, backward compatible to SATA I
Drive Channels	All drive channels are pre-configured, routed through a back-end PCB and cannot be changed
Cache Mode	Write-through and write-back
Cache Memory	Pre-installed 512MB DDR RAM DIMM, supports up to 2GB DDR RAM with ECC, registered
Number of LUNs	Up to 32 per ID; up to a total of 1024, configurable depending on the size of installed DDR memory
Multiple Target IDs/Host Channel	Yes
Aliases for Target IDs	Yes
Firmware on Flash Memory	Yes
Drive Hot-swapping	Yes
Controller Hot-swapping	Yes (redundant controller models only)

A.2.2 Architecture

Specification	
CPU	600MHz PowerPC 750FX
Host Channel Processor	QLogic 2Gbps FC processors
DIMM Slot	One 184-pin DDR DIMM module
PC-133 Support	Yes
ASIC	64-bit chipset (ASIC266)
Flash ROM	64Mbit (8MB)
NVRAM	32Kb with RTC (Real-time Clock)
Hardware XOR	Yes
I/O Channel Bandwidth	1 to 2Gbps
Real-time Clock	For event messages with time record tracking and scheduled maintenance tasks, e.g., Media Scan.

A.3. Drive Tray Specifications

Specification	
Height	28mm (1.1inch)
Width	110mm (4.3 inches)
Depth	218.92mm (8.6 inches)
Key-lock	Yes

A.4. Power Supply Specifications

Specification	
Nominal Power	405W
DC Output	+3.3V: 3.20V to 3.465V; min. 0.5A, max. 20A +5V: 4.80V to 5.25V; min. 2.5A, max. 36A +12V: 11.52V to 12.60V; min. 1A, max. 24A +5V SB: 4.85V to 5.25V; min. 0A, max. 0.5A
Input Frequency	47 to 63Hz
AC Input	90VAC @ 8AC – 264VAC @ 4AC with PFC
Power Factor Correction	Yes
Hold-up Time	At least 20ms at 115/230VAC full load after a loss of AC input
I^2C	Through backplane to controller
Over-temperature Protection	Lost cooling or excessive ambient temperature
Cooling Fans	Two fans inside each PSU

A.5. Cooling Module Specifications

Specification	
Speed	High (6300rpm) or low (4600rpm) rotation speeds controlled by firmware (measurements by one cooling fan)
Max. Airflow (per module)	High speed: 48.12 CFM (A24F-R2224)
Operating Voltage	Rated Voltage ± 10% (10.8V DC to 13.2V DC)
Rated Current	1.1A@12V DC (high speed); 0.55A@12V (low speed)
Rated Voltage	DC 12V
Temperature	Operating: -10° to 70°C

A.6. RAID Management

Specification	
Configuration	• LCD keypad panel • Text-based firmware-embedded utility over RS-232C connection through the included audio jack-to-DB-9 serial cable • RAIDWatch Manager using an Ethernet link • Telnet access through an Ethernet link
Performance Monitoring	Yes
Remote Control and Monitoring	Yes
Event Notification	Yes (via RAIDWatch's sub-modules, Configuration Client and NPC)
Management Connection	In-band over Fibre or out-of-band over Ethernet or RS-232C
Configuration on Disk	Configuration data stored on disks for logical drive assemblies to exist after controller replacement or hardware failure; basic settings, e.g., channel model settings, are stored on NVRAM
Failure Indicator	Via audible alarm, LCD keypad panel, RAIDWatch Manager session, event notifications, or event prompts on terminal emulation

A.7. Fault Tolerance Management

Specification	
SATA Drive S.M.A.R.T Support	Yes
Battery Backup Option	Yes, comes standard on A24F-R2224
ISEMS via I^2C Interface	Yes
Automatic Drive Failure Detection	Yes
Automatic Rebuild on Spare Drives	Yes
Regenerate Logical Drive Parity	Yes
Bad Block Reassignment	Yes
Automatic Rebuild upon Failed Drive Replacement	Yes
Manual Clone of Suspected Failed Drive	Yes
Concurrent Rebuild on Multiple Drives in a RAID (0 + 1) Logical Drive	Yes
Salvage the 2nd Temporary Failed Drive in a RAID 1, 3 or 5 Logical Drive	Yes
Salvage the 1st Temporary Failed Drive in a RAID 0 Logical Drive	Yes

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Appendix B
Uninterruptible Power Supply

B.1. Uninterruptible Power Supply Overview

An uninterruptible power supply (UPS) is a separately purchased battery backup unit that can be connected to an Galaxy subsystem. If the UPS is sufficiently charged, it can power the whole subsystem in the event of an AC power failure allowing the RAID subsystem to safely distribute ongoing I/O processes onto the hard drives.

B.2. Compatible UPS Supplies

The APC SMART UPS series is compatible with the Galaxy subsystems.

B.3. Serial Communication Cables

The customized audio-jack-to-DB9 serial communication cable for UPS monitoring should be purchased separately. This cable is used to connect the controller module(s) on a subsystem to a UPS. If you wish to use a UPS with your subsystem, use an included audio jack-to-DB9 serial communication cables (see ***Figure B-1***).

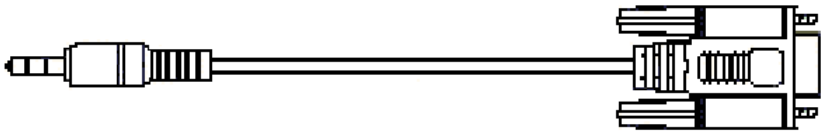

Figure B-1: Audio-Jack-to-DB9 Serial Communication Cable

CAUTION!

The pinouts on the audio- jack-to-DB9 serial cable used to connect to the UPS are different from the pinouts on the serial cables used to connect a PC running a terminal program. When connecting the UPS device, please be sure to use the correct cable.

B.4. Connecting the UPS to the Subsystem

B.4.1 Connect the PSU Module Power Cords

The three (3) power cords shipped with the subsystem must be plugged into the power cord sockets in the rear of the PSU modules. The plug at the other end of the power cord must be inserted into a socket on the UPS. Please refer to the documentation that came with your UPS device to determine the location of these sockets. The UPS must then be connected to main power.

B.4.2 Set the Baud Rate

The default baud rate for the COM2 serial port is 38400 and must be changed to 2400 or other rate as specified by the UPS specifications. To see how to change the baud rate, please refer to the ***Generic Operation Manual*** that came with the subsystem.

B.4.3 Connect COM2

The separate audio-jack-to-DB9 serial cable connects the COM2 ports on the controller modules to the UPS directly. The cable transmits UPS status updates to the controller modules and will in turn determine the write policy of the controller module. To connect the serial communication cable to the subsystem controller, insert the audio jack connector on one end of the cable into the COM2 port on the controller module. To see how to connect the DB9 connector to the UPS, please refer to the documentation that came with your UPS.

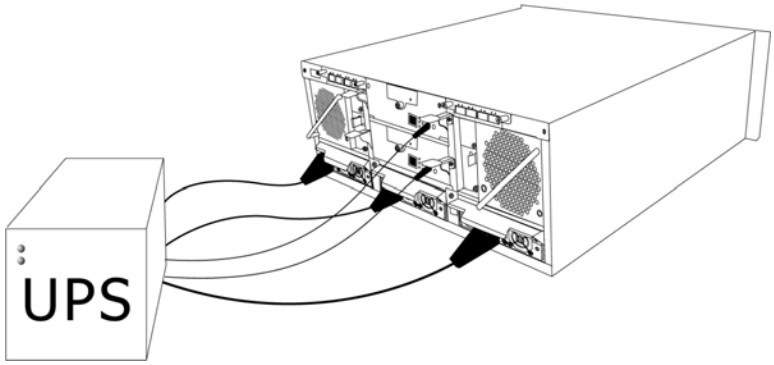

Figure B-2: Connecting the UPS to the Subsystem

B.5. Power On

When powering on the subsystem, the UPS must be powered on before the subsystem. To see how to power on the UPS, please refer to the documentation that came with your UPS. Note that the power on sequence described in ***Chapter 4*** will be altered. The power on sequence when a UPS is connected is shown below:

 Step 1. Power on the network connection devices (including FC switches). Bypass this step if you are using a SCSI host subsystem.

 Step 2. Power on any expansion/cascaded enclosures connected to the subsystem.

 Step 3. Power on the UPS.

 Step 4. Power on the subsystem.

 Step 5. Power on the application servers.

 Step 6. The subsystem firmware should detect the UPS. To see how to do this please, refer to the ***Generic Operation Manual*** that came with the subsystem.

 **NOTE:**

A UPS can be connected to the subsystem after the subsystem has been powered on, but you will have to trigger the firmware to allow the subsystem to detect the UPS.

B.6. UPS Status Monitoring

If a UPS is correctly connected to the subsystem, the status of the UPS will be constantly monitored by the controller through the COM2 (audio jack) serial port. The status of the UPS will determine the controller's write policy, and messages that appear on the LCD panel and other monitoring devices will keep you informed of the UPS status.

B.6.1 Normal Operational Status

If the UPS is connected to main power and the UPS battery power level is above 50%, then no status messages will appear and the "Write-back" write policy will be applicable.

B.6.2 UPS Messages

The following messages may appear on the LCD screen:

Message 1: "*UPS connection is absent*"

This message appears when COM2 has not been connected to the UPS or an established link is lost.

Message 2: "*UPS connection detected*"

This message appears when the COM2 port link to a UPS has just been established.

Message 3: "*Warning: UPS AC Power-Loss detected*"

This message appears when the UPS battery power level remains above 50% but its connection to the AC power source has been disrupted.

Message 4: "*Warning: UPS Battery Low 50%. Please shut down to protect data loss*"

This message appears when the UPS battery power level has dipped below 50% of its charge capacity and the UPS has either been disconnected from the AC power source or the AC power source has been disrupted. If the event triggered configuration has been enabled, arrays using write-back caching will be forced to adopt the write-through mode. When the UPS battery is restored to its full charge, the original array operating mode will be restored.

Message 5: "*Warning: UPS Battery Low 50%*"

This message appears when the UPS battery power level has dipped below 50% of its capacity. The default write policy will be changed from the default write-back to write-through.

Message 6: "*UPS Battery restored to safe level*"

This message appears when the UPS battery power level has been restored to above 50% of its capacity. The original array write policy will be restored.

Message 7: "*UPS AC Power Restored*"

This message appears when AC power to the UPS has been restored. If the UPS battery power level is below 50%, the write policy will remain as write-through. If the battery power level is above 50%, the write policy will change from write-through to write-back.

B.6.3 UPS Message Summary

Table B-1 below summarizes the UPS messages described above. It is important that you become familiar with these messages and their meanings to help maintain the integrity of the data running through your subsystem.

Message	AC Power	Battery Power Level (BPL)	Write Policy Status
UPS connection is absent	N/A	N/A	Write back
UPS connection detected	N/A	N/A	Write back
Warning: UPS AC Power-Loss detected	Disconnected	BPL > 50%	Write through
Warning: UPS Battery Low 50%. Please shut down to protect data loss	Disconnected	BPL < 50%	Write through
Warning: UPS Battery Low 50%.	Connected	BPL < 50%	Write through
UPS AC Power Restored	Reconnected	BPL > 50%	Write back
UPS AC Power Restored	Reconnected	BPL < 50%	Write through
UPS Battery restored to safe level	Reconnected	BPL > 50%	Write back

Table B-1: UPS Status Messages

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Appendix C
Spare Parts and Accessories

C.1. Spare Parts

Spare parts that come with the subsystem are listed in ***Table C-1***.

Model Name	Description
GAL-84AF22RD24C	Fibre to SATA RAID controller module, for ES A24F-G/R2224 subsystem, no FC-2G SFP host connectors
GAL-9274CDTray (tray without MUX board)	Drive tray, Type-III bezel and Type-II LED lightpipe
GAL-9274ADT2S1S	Drive tray (Type-III bezel and Type-II LED lightpipe), 2-to-1 SATA (SATA-I) MUX conversion, power MOS switch embedded, dual-controller subsystems
GAL-9274AN2S1S	HDD dongle board, 2-to-1 SATA (SATA-I) MUX conversion, power MOS switch embedded, dual-controller subsystems
GAL-9274CPSU	Power supply module, for ES 4U/24-bay subsystems, 405W (N+1) capacity
GAL-9274CFanMod	Cooling fan module, for ES 4U/24-bay subsystems
GAL-9274CF2HIO4L	Fibre channel (FC-2G) IO board, Left-hand side, for ES 4U/24-bay subsystem, 4 x SFP ports w/ on-board host hub
GAL-9274CF2HIO4R	Fibre channel (FC-2G) IO board, Right-hand side, for ES 4U/24-bay subsystem, 4 x SFP ports w/ on-board host hub
GAL-9274HandLLCD	Left-side forearm handle, for ES 4U/24-bay subsystems, LCD panel included

GAL-9274CHandR	Right-side forearm handle, for ES 4U/24-bay subsystems
GAL-9274CBT-C	Battery cell pack, Li-Ion, for ES 4U/24-bay subsystems

Table C-1: Spare Parts Shipped with the Subsystem

C.2. Accessories and Optional Items

Accessories that come with the subsystem are listed in ***Table C-2.***

Model Name	Description
GAL-9011	Null Modem, DB9 female to DB9 male, wires swapped
GAL-9270AYCab (A24F-R2224 dual controllers)	Serial port Y-cable for dual-controller subsystems, 2 audio jacks -to- 1 DB-9; maintenance-free during controller failover/failback

Table C-2: Accessories Shipped with the Subsystem

Accessories that must be purchased separately are listed in ***Table C-2.***

Model Name	Description
GAL-9270CUPSCab	RS-232C serial cable and audio-jack-to-DB9 cable for UPS status monitoring
9270ASCab	RS-232C serial cable, audio-jack to DB9
GAL-9270CSFP2GA01	Agilent Fibre Channel 2.125 / 1.0625 GBd Small Form Pluggable Optical Transceiver, LC, wave-length 850nm, multi-mode
GAL-9270CFCCab01	Optical FC cable, LC-LC, MM-62.5/125, Duplex, LSZH, O.D.=1.8mmx2, 1 Meter
GAL-9270CFCCab02	Optical FC cable, LC-LC, MM-62.5/125, Duplex, LSZH, O.D.=1.8mmx2, 5 Meters
GAL-9270CFCCab03	Optical FC cable, LC-LC, MM-62.5/125, Duplex, LSZH, O.D.=1.8mmx2, 10 Meters

GAL-9274A2DT2S1S-0030	Drive tray (Type-III bezel and Type-II LED lightpipe), 2-to-1 SATA (SATA-II) MUX conversion, power MOS switch embedded, dual-controller subsystems
GAL-9272CDTrayDmy	Dummy drive tray, Type-II bezel
GAL-9274Cslider32	Slide rails for 24" to 32" deep racks
GAL-9274Cslider36	Slide rails for 24" to 32" deep racks

Table C-3: Separately Purchased Accessories

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Appendix D
Pinouts

D.1. SFP Connector Pinouts

Each of the SFP host or expansion ports is comprised of a case bottom, an EMI case, and a 20-pin host connector. These port sockets receive Small-Form-Factor Pluggable (SFP) fiber optic and copper-based transceivers. Contact Rorke's technical support department for an updated list of SFP transceiver modules that have been tested to comply with the sockets. The pinouts are shown in ***Figure D-1*** and their definitions are shown in ***Table D-1***.

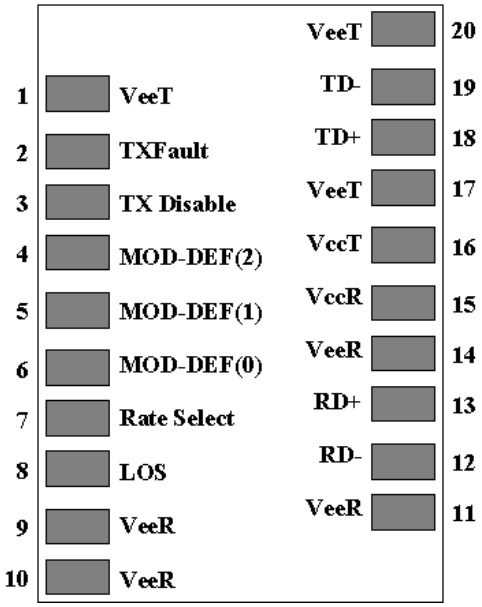


Figure D-1: SFP Connector Pinouts

Pin	Pin Name	Pin Description
1	V_{EET}	Transmitter ground (common with receiver ground)
2	T_{FAULT}	Transmitter fault; not supported
3	T_{DIS}	Transmitter disable; laser output disabled on high or open
4	MOD_DEF(2)	Module definition 2; data line for serial ID
5	MOD_DEF(1)	Module definition 1; clock line for serial ID
6	MOD_DEF(0)	Module definition 0; grounded within the module
7	Rate Select	No connection required
8	LOS	Indicates loss of signal; logic 0 indicates normal operation
9	V_{EER}	Receiver ground (common with transmitter ground)
10	V_{EER}	Receiver ground (common with transmitter ground)
11	V_{EER}	Receiver ground (common with transmitter ground)
12	RD-	Receiver inverted DATA out; AC coupled
13	RD+	Receiver non-inverted DATA out; AC coupled
14	V_{EER}	Receiver ground (common with transmitter ground)
15	V_{CCR}	Receiver power supply
16	V_{CCT}	Transmitter power supply
17	V_{EET}	Transmitter ground (common with receiver ground)
18	TD+	Transmitter non-Inverted DATA in 100 ohm termination between TD+ and TD-; AC coupled thereafter
19	TD-	Transmitter inverted DATA in. See TD+
20	V_{EET}	Transmitter ground (common with receiver ground)

Table D-1: SFP Pin Out Definitions

D.2. DB9 Audio Jack Pinouts

D.2.1 COM1 Serial Port Cable

Part Number:GAL-9270AYCab

Figure D-2: RS-232C (Audio Jack) Pinouts

The COM1 Y-cable connects the two COM1 ports on redundant RAID controllers to a PC running terminal emulation program.

CN1 Pin Number	Pin Name
1	Ground
2	TXD
3	RXD

CN2 Pin Number	Pin Name
1	NC
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	NC
♦ Pin 4 and Pin 6 are shorted ♦ Pin 7 and Pin 8 are shorted	

Table D-2: RS-232C (Audio Jack) Pinouts Definitions

D.2.2 COM2 Serial Port Cable to UPS

COM2 Cable: Use this cable to connect the COM2 port to a UPS.

Part Number: GAL-9270CUPSCab

Figure D-3: COM2 Cable CN1 and CN2 Connectors

CN1 Pin Number	Pin Name
1	Ground
2	TXD
3	RXD

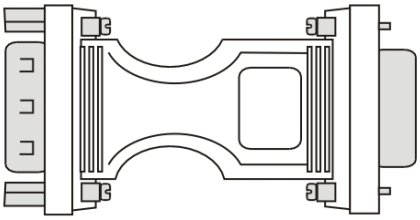
CN2 Pin Number	Pin Name
1	TXD
2	RXD
3	NA
4	NA
5	NA
6	NA
7	NA
8	NA
9	Ground

Table D-3: COM2 Cable CN1 and CN2 Pinouts Definitions

D.3. Null Modem

A null modem is used for wire-swap and is necessary for connecting COM1 CN2 to a PC serial port.

PN: GAL-9011



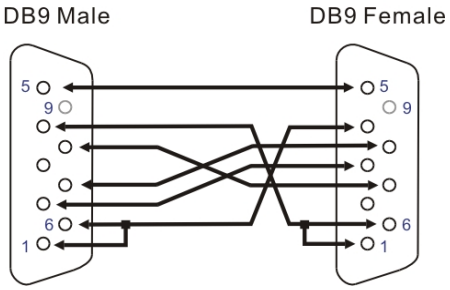


Figure D-4: Null Modem Pin Outs

Swap pin 2 and pin 3
Swap pin 4 and pin 6
Swap pin 7 and pin 8

Table D-4: Null Modem Pin Outs

D.4. Ethernet Port Pinouts

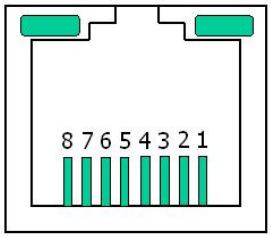


Figure D-5: Ethernet Port Pinouts

Pin	Pin Name	Pin	Pin Name
1	LAN_TXP	**5**	N2
2	LAN_TXN	**6**	LAN_RXN
3	LAN_RXP	**7**	N1
4	N2	**8**	N1

Table D-5: Ethernet Port Pinouts

D.5. Main Power

IEC-type receptacle.