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Hitachi AMS 2500 Storage System
Hardware Guide

Hitachi Data Systems

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Preface

Congratulations on purchasing a new Hitachi AMS 2500 Storage System.

This guide can assist you in installing, configuring, and maintaining your Hitachi AMS 2500.

This preface includes the following information:

❑ Intended audience

❑ Product version

❑ Release notes and readme

❑ Document revision level

❑ Changes in this revision

❑ Document organization

❑ Document conventions

❑ Convention for storage capacity values

❑ Accessing product documentation

❑ Getting help

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and Authorized Service Providers who install, configure, and operate Hitachi Adaptable Modular System (AMS) 2000 family storage systems.

Product version

This document applies to Hitachi AMS 2000 Family firmware version 0890/A or later.

Release notes and readme

Read the release notes and readme file before installing and using this product. They may contain requirements or restrictions that are not fully described in this document and/or updates or corrections to this document.

Document revision level

Revision	Date	Description
MK-97DF8007-00	October 2008	Initial Release
MK-97DF8007-01	November 2008	Supersedes and replaces MK-97DF8007-00
MK-97DF8007-02	December 2008	Supersedes and replaces MK-97DF8007-01
MK-97DF8007-03	February 2009	Supersedes and replaces MK-97DF8007-02
MK-97DF8007-04	April 2009	Supersedes and replaces MK-97DF8007-03
MK-97DF8007-05	May 2009	Supersedes and replaces MK-97DF8007-04
MK-97DF8007-06	June 2009	Supersedes and replaces MK-97DF8007-05
MK-97DF8007-07	July 2009	Supersedes and replaces MK-97DF8007-06
MK-97DF8007-08	August 2009	Supersedes and replaces MK-97DF8007-07
MK-97DF8007-09	November 2009	Supersedes and replaces MK-97DF8007-08
MK-97DF8007-10	December 2009	Supersedes and replaces MK-97DF8007-09
MK-97DF8007-11	January 2010	Supersedes and replaces MK-97DF8007-10
MK-97DF8007-12	April 2010	Supersedes and replaces MK-97DF8007-11

Changes in this revision

The following information has been added for this release:

- Updated section "China RoHS" on page B-4
- Updated section "Required Parts," Table 2-5 on page 2-11
- Updated section "Optional Parts," Table 2-6 on page 2-12
- Updated Table 2-3 "Basic AMS 2500 Specifications" beginning on page 2-8.

Document organization

Thumbnail descriptions of the chapters are provided in the following table. Click the chapter title in the first column to go to that chapter. The first page of every chapter or appendix contains links to the contents.

Chapter/Appendix Title	Description
Chapter 1, Introduction	Provides a brief overview of the AMS 2500 storage system.
Chapter 2, Functional and operational characteristics	This chapter describes the basic features of the AMS 2500 storage system.
Chapter 3, Getting started	This chapter provides an overview of the tasks to install and configure an AMS 2500 storage system.
Chapter 4, Hardware components	Describes the hardware components of an AMS 2500 storage system.
Chapter 5, Installation	Explains the steps to prepare a site to install an AMS 2500 array and provides instructions to install the array.
Chapter 6, Power On/Off procedures	This chapter provides the procedures to apply power to and remove power from an AMS 2500 disk array storage system.
Chapter 7, Configuration	This chapter describes how to configure an AMS 2500 storage system.
Chapter 8, Troubleshooting	This chapter provides information to help you identify and resolve problems in the event that you encounter a problem with an AMS 2500 storage system.
Chapter 9, Upgrading the hardware	This chapter describes procedures for adding optional components and additional units to the AMS 2500 storage system.
Chapter 10, Upgrading the firmware	This chapter provides the procedures to Upgrade the firmware on the AMS 2500 storage system.
Appendix A, Specifications	This appendix provides the Mechanical, Electrical, Environmental, and other specifications for the AMS 2500. Complete specifications. are contained in the *Hitachi AMS 2000 Family Storage System Reference Guide*.
Appendix B, Regulatory information	This appendix provides information about the regulatory and compliance rules that govern the installation and operation of the AMS 2500 storage system.
Appendix C, DC-powered units	This appendix provides information about the DC-powered AMS 2500 storage system, including NEBS-3 and ETSI requirements, installation procedures, and specifications.
Glossary	Defines the acronyms and special terms used in this document.
Index	Provides a detailed and linked list of topics in this manual.

Document conventions

This document uses the following symbols to draw attention to important safety and operational information.

Symbol	Meaning	Description
	Tip	Tips provide helpful information, guidelines, or suggestions for performing tasks more effectively.
	Note	Notes emphasize or supplement important points of the main text.
	Caution	Cautions indicate that failure to take a specified action could result in damage to the software or hardware.
	WARNING	Warnings indicate that failure to take a specified action could result in loss of data or serious damage to the hardware.
	DANGER	The Danger symbol warns users of possible injury or death if instructions are not followed.
	ELECTRIC SHOCK HAZARD!	This symbol warns users of electric shock hazard. Failure to take appropriate precautions such as not opening or touching hazardous areas of the equipment could result in injury or death.
	Electrostatic Sensitive	The ESD symbol warns users that the equipment is sensitive to electrostatic discharge (ESD) and could be damaged if users do not take appropriate precautions such as using a grounded wrist strap when touching or handling the equipment.
	Burn Hazard	HOT SURFACE! Turn off power and allow to cool before touching.
	Sharp Edges or Corners	WARNING! Sharp edges or corners. Avoid touching or wear gloves.

The following typographic conventions are used in this document.

Convention	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. Example: Click **OK**.
Italic	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy *source-file target-file* Angled brackets (< >) are also used to indicate variables.
screen/code	Indicates text that is displayed on screen or entered by the user. Example: `# pairdisplay -g oradb`
< > angled brackets	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: `# pairdisplay -g <group>` Italic font is also used to indicate variables.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.

Convention	Description
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.
underline	Indicates the default value. Example: [<u>a</u> | b]

Convention for storage capacity values

Physical storage capacity values (e.g., disk drive capacity) are calculated based on the following values:

Physical capaciy unit	Value
1 KB	1,000 bytes
1 MB	1,000 KB or $1,000^2$ bytes
1 GB	1,000 MB or $1,000^3$ bytes
1 TB	1,000 GB or $1,000^4$ bytes
1 PB	1,000 TB or $1,000^5$ bytes
1 EB	1,000 PB or $1,000^6$ bytes

Logical storage capacity values (e.g., logical device capacity) are calculated based on the following values:

Logical capaciy unit	Value
1 block	512 bytes
1 KB	$1,024 (2^{10})$ bytes
1 MB	1,024 KB or 1024^2 bytes
1 GB	1,024 MB or 1024^3 bytes
1 TB	1,024 GB or 1024^4 bytes
1 PB	1,024 TB or 1024^5 bytes
1 EB	1,024 PB or 1024^6 bytes

Accessing product documentation

The AMS 2000 Family user documentation is available on the Hitachi Data Systems Portal: https://portal.hds.com. Please check this site for the most current documentation, including important updates that may have been made after the release of the product.

This documentation set consists of the following documents.

Release notes

- Adaptable Modular Storage System Release Notes
- Storage Navigator Modular 2 Release Notes

Please read the release notes before installing and/or using this product. They may contain requirements and/or restrictions not fully described in this document, along with updates and/or corrections to this document.

Installation and getting started

The following documents provide instructions for installing an AMS 2000 Family storage system. They include rack information, safety information, site-preparation instructions, getting-started guides for experienced users, and host connectivity information. The symbol ☞ identifies documents that contain initial configuration information about Hitachi AMS 2000 Family storage systems.

☞ **AMS2100/2300 Getting Started Guide**, MK-98DF8152

Provides quick-start instructions for getting an AMS 2100 or AMS 2300 storage system up and running as quickly as possible.

☞ **AMS2500 Getting Started Guide**, MK-97DF8032

Provides quick-start instructions for getting an AMS 2500 storage system up and running as quickly as possible.

AMS 2000 Family Site Preparation Guide, MK-98DF8149

Contains site planning and pre-installation information for AMS 2000 Family storage systems, expansion units, and high-density expansion units. This document also covers safety precautions, rack information, and product specifications.

AMS 2000 Family Fibre Channel Host Installation Guide, MK-08DF8189

Describes how to prepare Hitachi AMS 2000 Family Fibre Channel storage systems for use with host servers running supported operating systems.

AMS 2000 Family iSCSI Host Installation Guide, MK-08DF8188

Describes how to prepare Hitachi AMS 2000 Family iSCSI storage systems for use with host servers running supported operating systems.

Storage and replication features

The following documents describe how to use Storage Navigator Modular 2 (Navigator 2) to perform storage and replication activities.

Storage Navigator 2 Advanced Settings User's Guide, MK-97DF8039

Contains advanced information about launching and using Navigator 2 in various operating systems, IP addresses and port numbers, server certificates and private keys, boot and restore options, outputting configuration information to a file, and collecting diagnostic information.

Storage Navigator Modular 2 User's Guide, MK-99DF8208

Describes how to use Navigator 2 to configure and manage storage on an AMS 2000 Family storage system.

AMS 2000 Family Dynamic Provisioning Configuration Guide, MK-09DF8201

Describes how to use virtual storage capabilities to simplify storage additions and administration.

Storage Navigator 2 Storage Features Reference Guide for AMS, MK-97DF8148

Contains concepts, preparation, and specifications for Account Authentication, Audit Logging, Cache Partition Manager, Cache Residency Manager, Data Retention Utility, LUN Manager, Performance Monitor, SNMP Agent, and Modular Volume Migration.

AMS 2000 Family Copy-on-write SnapShot User Guide, MK-97DF8124

Describes how to create point-in-time copies of data volumes in AMS 2100, AMS 2300, and AMS 2500 storage systems, without impacting host service and performance levels. Snapshot copies are fully read/write compatible with other hosts and can be used for rapid data restores, application testing and development, data mining and warehousing, and nondisruptive backup and maintenance procedures.

AMS 2000 Family ShadowImage In-system Replication User Guide, MK-97DF8129

Describes how to perform high-speed nondisruptive local mirroring to create a copy of mission-critical data in AMS 2100, AMS 2300, and AMS 2500 storage systems. ShadowImage keeps data RAID-protected and fully recoverable, without affecting service or performance levels. Replicated data volumes can be split from host applications and used for system backups, application testing, and data mining applications while business continues to operate at full capacity.

AMS 2000 Family TrueCopy Remote Replication User Guide, MK-97DF8052

Describes how to create and maintain multiple duplicate copies of user data across multiple AMS 2000 Family storage systems to enhance your disaster recovery strategy.

AMS 2000 Family TrueCopy Extended Distance User Guide, MK-97DF8054

Describes how to perform bi-directional remote data protection that copies data over any distance without interrupting applications, and provides failover and recovery capabilities.

AMS 2000 Data Retention Utility User's Guide, MK-97DF8019

Describes how to lock disk volumes as read-only for a certain period of time to ensure authorized-only access and facilitate immutable, tamper-proof record retention for storage-compliant environments. After data is written, it can be retrieved and read only by authorized applications or users, and cannot be changed or deleted during the specified retention period.

Storage Navigator Modular 2 online help

Provides topic and context-sensitive help information accessed through the Navigator 2 software.

Hardware maintenance and operation

The following documents describe how to operate, maintain, and administer an AMS 2000 Family storage system. They also provide a wide range of technical information and specifications for the AMS 2000 Family storage systems. The symbol ☞ identifies documents that contain initial configuration information about Hitachi AMS 2000 Family storage systems.

☞ **AMS 2100/2300 Storage System Hardware Guide**, MK-97DF8010

Provides detailed information about installing, configuring, and maintaining an AMS 2100/2300 storage system.

☞ **AMS 2500 Storage System Hardware Guide**, MK-97DF8007 — this document

Provides detailed information about installing, configuring, and maintaining an AMS 2500 storage system.

☞ **AMS 2000 Family Storage System Reference Guide**, MK-97DF8008

Contains specifications and technical information about power cables, system parameters, interfaces, logical blocks, RAID levels and configurations, and regulatory information about AMS 2100, AMS 2300, and AMS 2500 storage systems. This document also contains remote adapter specifications and regulatory information.

AMS 2000 Family Storage System Service and Upgrade Guide, MK-97DF8009

Provides information about servicing and upgrading AMS 2100, AMS 2300, and AMS 2500 storage systems.

AMS 2000 Family Power Savings User Guide, MK-97DF8045

Describes how to spin down volumes in selected RAID groups when they are not being accessed by business applications to decrease energy consumption and significantly reduce the cost of storing and delivering information.

Command and Control (CCI)

The following documents describe how to install the Hitachi AMS 2000 Family Command Control Interface (CCI) and use it to perform TrueCopy and ShadowImage operations.

AMS 2000 Family Command Control Interface (CCI) Installation Guide, MK-97DF8122

Describes how to install CCI software on open-system hosts.

AMS 2000 Family Command Control Interface (CCI) Reference Guide, MK-97DF8121

Contains reference, troubleshooting, and maintenance information related to CCI operations on AMS 2100, AMS 2300, and AMS 2500 storage systems.

AMS 2000 Family Command Control Interface (CCI) User's Guide, MK-97DF8123

Describes how to use CCI to perform TrueCopy and ShadowImage operations on AMS 2100, AMS 2300, and AMS 2500 storage systems.

Command Line Interface (CLI)

The following documents describe how to use Hitachi Storage Navigator Modular 2 to perform management and replication activities from a command line.

Storage Navigator Modular 2 Command Line Interface (CLI) Unified Reference Guide, MK-97DF8089

Describes how to interact with all Navigator 2 bundled and optional software modules by typing commands at a command line.

Storage Navigator 2 Command Line Interface Replication Reference Guide for AMS, MK-97DF8153

Describes how to interact with Navigator 2 to perform replication activities by typing commands at a command line.

Dynamic Replicator documentation

The following documents describe how to install, configure, and use Hitachi Dynamic Replicator to provide AMS Family storage systems with continuous data protection, remote replication, and application failover in a single, easy-to-deploy and manage platform.

Dynamic Replicator - Scout Release Notes, RN-99DF8211

Dynamic Replicator - Scout Host Administration Guide, MK-98DF8212

Dynamic Replicator - Scout Installation and Configuration Guide, MK-98DF8213

Dynamic Replicator - Scout Quick Start Guide, MK-98DF8214

Dynamic Replicator - Scout Host Troubleshooting Guide, MK-98DF8215

Dynamic Replicator DR-Scout ICAT Utility Guide, MK-98DF8216

Dynamic Replicator - Scout RX Server Deployment Guide, MK-98DF8217

Dynamic Replicator VX Solution for Oracle (Solaris), MK-98DF8218

Dynamic Replicator - Scout Solution for SharePoint 2007, MK-98DF8219

Dynamic Replicator - Scout Solution for MySQL (Windows), MK-98DF8220

Protecting Citrix XenServer Using Hitachi Dynamic Replicator - Scout, MK-98DF8221

Dynamic Replicator Quick Install/Upgrade Guide, MK-98DF8222

Dynamic Replicator - Scout Protecting MS SQL Server, MK-98DF8223

Dynamic Replicator - Scout - Protecting Microsoft Exchange Server, MK-98DF8224

Dynamic Replicator - Scout File Server Solution, MK-98DF8225

Dynamic Replicator - Scout ESX - Protecting ESX Server (RCLI), MK-99DF8226

Getting help

If you need to contact the Hitachi Data Systems support center, please provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure.
- The exact content of any messages displayed on the host system(s).
- The exact content of any messages displayed on Storage Navigator Modular 2.
- The Storage Navigator Modular 2 configuration information. This information is used by service personnel for troubleshooting purposes.

The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week. If you need technical support, please log on to the Hitachi Data Systems Portal for contact information: https://portal.hds.com

Comments

Please send us your comments on this document: doc.comments@hds.com. Include the document title, number, and revision, and refer to specific section(s) and paragraph(s) whenever possible.

Thank you! (All comments become the property of Hitachi Data Systems.)

1

Introduction

This chapter provides an overview of the Hitachi AMS 2000 Family Storage System. It covers the following key topics:

❏ Array overview

❏ Features and benefits

❏ High capacity cache

❏ Performance reporting and monitoring

❏ Reliability, availability, and serviceability

❏ RAID implementations

❏ Open systems features and functions

❏ Data management features and functions

❏ Copy solution features and functions

❏ Performance management features and functions

❏ Failure monitoring features and functions

❏ Power saving features and functions

❏ Email notification

❏ Long term array storage

Array overview

The AMS 2500 consists of the following main components:

- A **base unit**, which includes two redundant power supplies, two controllers, four cache backup batteries, and two fan units. The base unit provides connection, control, and management of the array. The Hitachi factory designation is RKHE2.

- 1 - 32 optional **expansion units**. An expansion unit provides additional storage space and can connect the base unit to additional expansion units or high-density expansion units. The factory designation for the standard expansion unit is RKAK. An expansion unit contains two redundant power supplies, two ENC control units, and from two to 15 disk drives.

- 1 - 10 optional **high-density expansion units**. A high-density expansion unit provides additional storage space and can connect the base unit to additional expansion units or high-density expansion units. The same high-density expansion unit is used with both base unit models. The factory designation for the high-density expansion unit is RKAKX.

  A high-density expansion unit contains two independcent storage sections. Each section contains two redundant power supplies, two redundant ENC control units, and from 0 to 24 disk drives. The maximum number of drives that can be installed in a high-density unit is 48. These must all be SATA drives.

- One or two **battery expansion units**. Each battery unit contains its own charger which is powered by 100/200 VAC. A single battery can be connected to both control units. If two batteries are installed, each battery is connected separately to a different controller.

> **NOTE:** See Scalability on page 1-11 for details about combinations of expansion units and high-density expansion units.

Control unit configurations

The Hitachi Data Systems AMS 2500 base unit supports the following controller configurations. Numbers are total per base unit.

Table 1-1: AMS 2500 Control Unit Configurations

Host Interface	Number of Ports (total)	Cache (total)
Fibre Channel	16 Fibre Channel	16 GB
		32 GB
iSCSI	8 iSCSI	16 GB
		32 GB
Multi-Protocol	8 Fibre Channel and 4 iSCSI	16 GB
		32 GB

Figure 1-1 shows a basic illustration of a base unit, an expansion unit, and a high-density expansion unit. They are all described briefly in this chapter and in detail in Chapter 4, Hardware components.
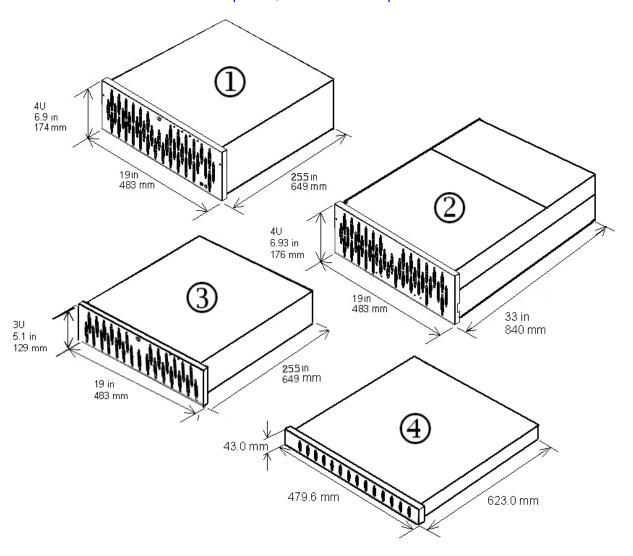
Figure 1-1: AMS 2500 System Units

Table 1-2: AMS 2500 System Units

Item	Description	Item	Description
①	AMS 2500 (base unit) RKHE2 and RKHE2D[1]	③	Expansion Unit RKAK and RKAKD
②	High Density Expansion Unit RKAKX	④	AMS2000 Battery Expansion Unit NR1K and NR1KD

1. Models that include the letter D are DC-powered. These are generally used in telephone applications. DC-powered models are covered in Appendix C, DC-powered units.

Power switch

The Power switch for turning the controllers and drives in a base unit on or off is also located on the front of the unit. Facing the front of the base unit, this switch is located at the lower right corner. Pressing on the right button turns the power on. Pressing on the left button turns the power off.
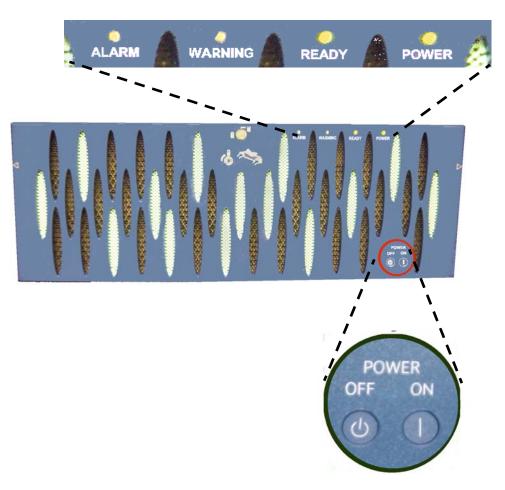
Figure 1-2: Front View of Base Unit

NOTE: The power ON/OFF buttons on the front bezel actuate the Main Switch on the front of the base unit (behind the front bezel). The Main Switch is actually a standby switch and controls power to all components in the base unit except the power supplies. The power supplies do not have a power switch and turn on as soon as the power cables are connected to them. They can deliver power to the rest of the unit after successful completion of their power on self test (POST). See Chapters 4 and 6 for details.

When the power switch is toggled to the OFF position, power is still applied to the power supplies. To completely remove the power from the unit, remove both power cables from the unit or disconnect them from the power source.

AMS 2500 base unit

The Hitachi AMS 2500 Adaptable Modular Storage disk array (factory designation RKHE2), hereafter referred to as AMS 2500, includes a base unit and from 1 to 32 expansion units or a mixture of expansion units and high-density expansion which can include up to 480 disk drives. The AMS 2500 base unit contains two redundant controllers, two redundant power supplies, two fan units, and four cache battery backup units.

Figure 1-3 shows the front (above) and rear (below) views of the AMS 2500 base unit. The center photo shows the Fibre Channel version. The lower photo shows the iSCSI version. The front bezel has been removed in this photo. See Appendix C, DC-powered units for information about the DC powered version of the AMS 2500.

Figure 1-3: AMS 2500 Base Unit Front and Rear Views

Expansion unit

The expansion unit (Models RKAK and RKAKD) contains two redundant power supplies, two ENC control units, and from two to fifteen disk drives, except for the first expansion unit, which requires a minimum of four disk drives. See Disk drive configurations in Chapter 4 for specifics. The ENC control units manage the drives and are also used to connect the expansion unit to the base unit and to other expansion units.

Figure 1-4 shows the front and rear view of the AC-powered expansion unit. The front bezel has been removed in this photo. Expanded views are shown in Chapter 4, Hardware components. See Appendix C, DC-powered units for information about the DC-powered expansion unit.
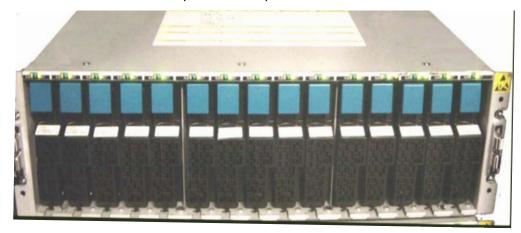
Figure 1-4: Hitachi AMS 2000 Family Expansion Unit Front and Rear Views

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High-density expansion unit

The AMS 2000 High-density Storage Expansion Unit (called high-density expansion unit) contains from 0 to 48 SATA disk drives, two pairs of redundant power supplies, and four ENC control units (cards). The control units manage the drives and are also used to connect the expansion unit to the base unit and to other expansion units. See Scalability on page 1-11 and Disk drive configurations on page 4-19 for detailed information about the number and type of disk drives that can be installed in a high-density expansion unit.

Figure 1-5 shows the front (top) and rear (bottom) views of the high-density expansion unit. The front bezel has been removed in this photo. Expanded views are shown in Chapter 4, Hardware components.
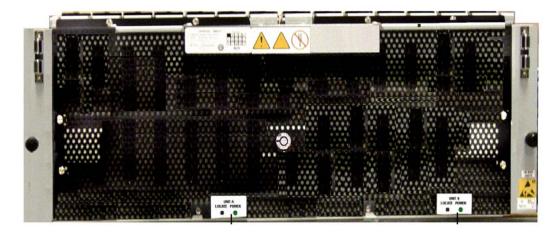
Figure 1-5: High Capacity Expansion Unit Front and Rear Views

> ⚠ **NOTE:**
>
> • The high-density expansion unit weighs 178 Lbs and requires a special rack with stabilizers on both sides and the front. It is shipped with rails and cables to fit the unit. See the *Hitachi AMS 2000 Site Preparation Guide* for information about the rack.
>
> • There is no DC-powered version of the high-density expansion unit.

Features and benefits

This section describes the main features and benefits of the AMS 2500 storage system.

Supported host operating systems

The AMS 2500 supports the following operating systems on host computers. Details for each operating system are described in *Hitachi AMS 2000 Family Fibre Channel Host Installation Guide* (MK-08DF8189). This manual is located on the product documentation CD with this users guide.

- Microsoft Windows 2008
- Microsoft Windows XP (Service Pack 2)
- Microsoft Windows 2003 and 2003 Server (Service Pack 1)
- Microsoft Windows 2000 (Service Pack 3/4)
- Sun™ Solaris™ v8, v9, and v10.
- HPUX
- Red Hat Linux
- SUSE Linux
- AIX
- Asianux
- Novell NetWare version 6.5 SP6, SP7 (for Fibre Channel only)
- Apple Macintosh OS10 (Fibre Channel only)

High data availability

The AMS 2500 is designed for high performance and protection of user data. See Reliability, availability, and serviceability on page 1-14 for further information on the reliability and availability features of the AMS 2500.

Connectivity

The AMS 2500 supports most open systems through standard Fibre Channel interfaces or standard iSCSI interfaces. The base unit can be configured with control units that have either Fibre Channel interface boards installed or iSCSI interface boards installed. Both control units must be configured with the same type of interface board.

Fibre channel interface

The array supports eight Fibre channel ports per controller. With the 8 Gbps Fibre Channel connection, the array can transfer data between the host computer and the array at a maximum speed of 800 MB/s for one port. Higher throughput can be obtained when accessing multiple devices connected on the same Fibre Channel loop.

The array supports open system operations and shortwave multimode optical cables. With these shortwave Fibre Channel cards, the AMS 2500 can be located up to 2821 feet (860 meters) from the open-system host.

Fibre Channel provides the capabilities listed in Table 1-3:

Table 1-3: Fibre Channel Features

Feature	Mode	Description
Supported Topologies	Fibre Channel	• Fibre Channel-AL • Point-to-Point • F-port
High-speed Data Transfer	Fibre Channel	With the 4 Gbps Fibre Channel connection, the array can transfer data between the host computer and the array at a maximum speed of 400 MB/sec on each port. The system provides sufficient throughput, even when accessing multiple devices connected on the same Fibre Channel loop. The AMS 2500 Fibre Channel interface is capable of operating at data transfer speeds of up to 400 MB/sec. The AMS 2500 supports shortwave multimode optical cables. With these shortwave Fibre Channel cards, the AMS 2500 can be located up to 500 meters from the open-system host.
Cable	Fibre Channel	See Table 1-4 on page 1-9.
Number of Connectable Devices	Fibre Channel	The array supports systems that can connect up to 128 Fibre Channel devices by using the Fibre Channel interface and connecting Fibre Channel-SW.
Security Function	Fibre Channel and Ethernet	When the system is configured to connect multiple hosts, a function is provided which rejects a boot by any host except a specified host. This function can prevent the access from an unauthorized host.

Fibre channel cable

The AMS 2500 supports shortwave multimode optical cables. With these shortwave Fibre Channel cards, the array can be located up to 300 meters from the open-system host. The array can use 50/125m, 62.5/125m multimode fibre cable as defined in Table 1-4, which lists the data transfer rates at specific distances.

Table 1-4: Fibre Channel Transfer Rates

Cable Type	Data Transfer Rate (MB/sec)	Maximum Cable Length (feet/meters)
Max 50/125 μm multimode (OM2)	100 200 400 800	1640 / 500 984 / 300 492 / 150 164 / 50
Max 62.5/125 μm multimode (OM1)	100 200 400 800	984 / 300 492 / 150 230 / 70 68 / 21
Max 50/125 μm multimode (OM3)	100 200 400 800	2821 / 860 1640 / 500 1246 / 380 492 / 150

⚠ **NOTE:** For more information on the Fibre Channel interface, refer to Chapter 4 in the *Hitachi AMS 2000 Family Reference Guide, MK-97DF8008.*

iSCSI interface

The AMS 2500 provides 4 iSCSI ports per controller (eight per unit) for the iSCSI configuration or two ports per controller (four per base unit) with the multi-protocol (mix of Fibre Channel and iSCSI) configuration. To convert a base unit from only Fibre Channel to only iSCSI or to a multi-protocol configuration, replace both controllers and install the firmware on them. The same firmware supports both fibre channel and iSCSI units. The part numbers for all three models of the controllers are listed in Chapter 2, Functional and operational characteristics.

High-speed data transfer

With the 1 Gbps Ethernet connection, the array provides high-speed data transfer to and from a host computer. The maximum transfer speed is 100 MB/s per port. Higher throughput can be obtained, even when accessing multiple devices connected to the same network.

The AMS 2500 supports iSCSI (1000 Base-T). With the HBA for iSCSI, generic NIC and software initiator, and network switch, the AMS 2500 can be located up to 100 meters from the host.

Table 1-5: iSCSI Features

Feature	Mode	Description
High-speed Data Transfer	iSCSI	The AMS 2500 supports iSCSI (1000Base-T). With a 1 Gbps Ethernet connection, the iSCSI interface is capable of operating at data transfer speed of up to 100 MB/sec per port. With the HBA for iSCSI, Generic NIC + Software initiator, and Network Switch, the AMS 2500 can be located up to 100 meters. Enough throughput can be obtained even when having multiple access to the multiple devices connected to the same network.
Cable	iSCSI	Category 6 Ethernet cable Maximum cable length: 325 ft. / 100 m
Number of Connectable Devices	iSCSI	The storage system supports systems that can connect up to 255 hosts for a physical port by using the switch. (When the TrueCopy remote replication function or TrueCopy Extended Distance function is installed and enabled, the maximum number of connectable hosts becomes 239.)
Security	iSCSI	When the system is configured to connect multiple hosts, a function is provided that rejects a boot by any host except a specified host. This function can prevent the access from an unauthorized host.
CHAP Authentication	iSCSI	User authentication is performed for each target.
iSNS client Function	iSCSI	The iSNS client function enabled to use iSCSI device discovery, state change notification on the network easily
Ping	iSCSI	You can ping the network to verify whether the device at a specified address and the AMS 2500 can communicate with IP network. This function specifies the address that Navigator 2 sends the ping from the iSCSI interface, and then displays a response. However, pinging an unreachable address might cause a delay and time-out of the host I/O processing on the controller. A warning message will be displayed before starting a Ping test. Hitachi Data Systems strongly recommends that you ping the network only when no host I/O exists on the controller.

Scalability

Using the components available, users can construct a variety of systems that meet a wide range of needs, as described here.

- You can configure a system by using one base unit and either one expansion unit or one high-density expansion unit.

- **Expansion unit intermix:** You can set up a complex system by using the maximum of 480 disk drives by connecting a mixture of expansion units and high-density expansion units to the AMS 2500 base unit. Details are shown in the following two tables.

Table 1-6: Minimum and Maximum HDS System Configurations

Base Unit			Expansion Unit					
	Disk Drives		Type	Units		Disk Drives		
	Min	Max		Min	Max	Min	Max	
AMS 2500	0	0	Expansion Unit (RKAK)	1	32	1st unit: 4 All other units: 2	15 per unit	
			High-density Expansion Unit (RKAKX)	1	10	2 in each section of the unit [1]	48 per unit	

1. Minimum supported HDS configuration is two disk drives installed in slots 0 and 1 in Unit A, and two drives installed in slots 0 and 1 in Unit B.

Using an AMS 2000 rack, you can construct a system that meets your needs by combining base units and expansion units, as shown in .

Table 1-7: AMS 2500 High-density Expansion Unit Intermix

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives
AMS 2500	0	10	480 [1]
	1	9	447
	2	9	462
	3	8	429
	4	8	444
	5	8	459
	6	8	474 [2]
	7	7	441
	8	7	456
	9	6	423
	10	6	438
	11	6	453
	12	6	468
	13	5	435

Table 1-7: AMS 2500 High-density Expansion Unit Intermix

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives
AMS 2500	14	5	450
	15	4	417
	16	4	432
	17	3	399
	18	3	414
	19	3	429
	20	3	444
	21	2	411
	22	2	426
	23	2	441
	24	2	456
	25	1	423
	26	1	438
	27	1	453
	28	1	468
	29	0	435
	30	0	450
	31	0	465
	32	0	480 [3]

1. Maximum number of disk drives using only high-density expansion units.
2. Maximum number of disk drives using intermix of expansion units and high-density expansion units.
3. Maximum number of disk drives using only expansion units.

Example: If 12 expansion units are installed, then no more than six high-density expansion units can be installed.

Table 1-8: AMS 2500 Hi-density Expansion Unit Intermix

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives	Total Number of SAS Disk Drives
AMS 2500	0	10	480 [1]	380
	2	9	462	372
	6	8	474 [2]	394
	8	7	456	386
	12	6	468	408
AMS 2500	14	5	450	400
	16	4	432	392
	20	3	444	414
	24	2	456	436
	28	1	468	458
	32	0	480 [3]	480

1. Maximum number of disk drives using only high-density expansion units.
2. Maximum number of disk drives using intermix of expansion units and high-density expansion units.
3. Maximum number of disk drives using only expansion units.

- You can configure a system with 15 disk drives by using a single expansion unit. You can set up a more complex system by using the maximum of 480 disk drives expanded by connecting up to 32 expansion units to the base unit.
- To use AMS 2500 systems efficiently, Hitachi Data Systems recommends that users mount a spare drive in each of the unused drive slots. Up to 30 spare disks can be set up in any location.
- From the host computer, the array can be used not only as a single-large scale Disk drive but also as 4096 logical disks (logical units) at the maximum.

High capacity cache

The AMS 2500 supports a maximum of 16 GB high capacity cache per control unit. This cache configuration supports immediate reporting to a host when data is written from the host to the cache. This is explained in detail in the next section.

Cache management

The cache management function works as described in the following process.

1. Data is stored in the cache when reading and writing. It is dynamically managed depending on the workload read and write I/O characteristics. The high percent cache hit rate is expected due to the transaction processing that the data is updated after referencing the data. The system throughput is increased by the reduced data writing time.

2. As soon as data is written onto the cache, it is reported to the host. The write operation onto the disk will be asynchronously performed later. Because the host does not have to wait for the data to be written to a disk drive, it can perform the next process immediately, significantly improving system performance.

⚠ **NOTE:** Even if there is an electric power failure during the write process, the data is saved because the cache is nonvolatile. The data is assured for 24 to 48 hours if the batteries in the standard configuration are fully charged when the power fails. See the following tables or details.

3. One specified logical unit from the host per controller can be resident in the cache. The high throughput can be realized for the specified logical unit since a 100% cache hit rate is expected when reading from the host and writing.

4. Optimum segment size can be specified by dividing cache memory into multiple partitions in accordance with applications, and then cache memory can be effectively used and tuned according to the user system by occupying cache memory by certain logical units.

Cache specifications

Table 1-9 shows the cache specifications.

Table 1-9:   Cache Specifications

Item	Base Unit	Expansion Array
Capacity (MB per controller)	8,192 / 16,384	-
Control method	Read LRU / Write After[1]	-
Battery backup	Provided	-
Backup duration (h)[2]	24 hrs when cache is 16,384 MB (4 x 4,096 MB per controller) 48 hrs when cache is 8,192 MB (4 x 2,048 MB per controller) 96 hrs when cache is 16,384 MB (4 x 4,096 MB per controller)[3] 168 hrs when cache is 8,192 MB (4 x 2,048 MB per controller)[3]	-

1. LRU = Least Recently Used. It is an algorithm that selects the oldest data in the cache, copies it to disk, and then deletes it from the cache to make room for new data.
2. Backup time in hours with four fully charged cache backup batteries.
3. Installing two battery expansion units is required.

Performance reporting and monitoring

The Navigator 2 storage management software provides the capability to either monitor the disk array in real-time or to collect historical data regarding the performance of the disk array.

Reliability, availability, and serviceability

Be aware of the following items concerning reliability, availability, and serviceability.

Dynamic load balancing

When connecting two or more hosts, the automatic load adjustment function operates between the Control Units supported by the "Dynamic Load Balance Controller." Therefore, it is not necessary to take into consideration which controller the hosts are connected to.

High reliability

The AMS 2500 array controller increases data reliability by adding original 8-byte data assurance codes to data from a host computer. It automatically generates the assurance codes across the data bus in the control unit assigned to the disk drive, and then writes them to the disk drive along with the data. In addition, it automatically checks the codes when reading the data. This significantly enhances data reliability in the data distribution/ concentration controller that is assigned to the disk array.

Spare disks

The AMS 2500 array monitors the disk drives for potential failure. The data copy operation can be automatically performed in the background before a failure actually occurs. In addition, the redundancy of the dynamic sparing feature enables the spare disk to be replaced while the system is running (excluding RAID 0 configuration) thereby increasing the reliability of the array even more.

The AMS 2500 can be specified up to 30 spare disks per storage system and monitors the disk drives for potential failure. The dynamic sparing feature enables the storage system to replace the spare disk due to the redundancy (excluding RAID 0 configuration) and provides high reliability.

To maintain system reliability, HDS recommends that you include at least one spare disk drive for each 15 disk drives in a array with SATA disk drives. Up to 30 spare disks can be specified per array.

Replacing a failed disk drive with a spare drive

A failed active disk drive can be replaced or "hot swapped" while the array is running. Data on the failed disk can be recovered and copied to the new disk drive.

Redundant power supplies

The AMS 2500 array includes two identical power supplies running in parallel. If either of these power supplies fails, the other can provide sufficient power to the system by itself. The array is designed to allow a failed power supply to be replaced (or hot swapped) while the array is running. The array monitors the power supplies for correct operation and provides an alert to the Navigator 2 storage management software if the voltages provided by the power supplies do not meet the system specifications.

RAID implementations

The AMS 2500 supports RAID 0, RAID 1+0, RAID 1, RAID 5, RAID6 or an intermix, as described in Table 1-10.

Table 1-10: RAID Implementations

RAID Level	Description
0	RAID 0 group stripes data across all disk drives in the group to attain higher throughput. There is no sparing disk drive function with this configuration. **Notes:** • When a failure occurs in a disk drive, data cannot be restored internally within the disk array because RAID 0 has no data redundancy. Therefore, although the host receives an error message, the data is left in its current state. • Unlike with an independent disk drive, error block management (assignment of alternative block for the independent disk drive with the Reassign Blocks command) is not done. Therefore, when a RAID 0 disk drive becomes inaccessible due to a failure, all the logical units in the RAID 0 configuration including the failed disk drive become inaccessible. Restoration of user data with backup data is essential after replacing the failed disk drive. • Do not allow RAID 0 to coexist with another RAID group. Do not form a group with two or more RAID 0 systems, for example (4D + 1P) × 2 + 2D. • Each time a failure occurs in a RAID 0 disk drive, data that cannot be written into the disk drive (pinned data) is accumulated in the cache. When the amount of accumulated data exceeds a certain value, a write I/O instructed to the other RAID group will not be accepted and the system will crash. In this case, restoration of user data and resynchronization of a file system using the backup data are required for the entire array. The recovery time for this procedure can be quite long. • Do not adopt the RAID 0 configuration to its fullest extent. Consider the above notes when building the configuration.
1+0[1]	RAID 1+0 groups provide data redundancy like RAID 1 by copying the contents of two disk drives to another pair. Different from RAID 1, data striping is performed for a maximum of 16 sets of two disk drives.
1	RAID 1 array groups consist of at least two disk drives in a mirrored configuration. Data is mirrored across the groups of two adjacent drives. The stripe consists of two data chunks.
5	RAID 5 uses from 2 to 15 data disks, and has a parity disk performing the data striping.
6	RAID 6 has two parity disks performing the data striping. Configuration with two parity disks provides the redundancy that can sustain two point failures.

1. RAID 0+1 is described in place of RAID 1+0 in some places, however, it has the same meaning as RAID 1+0.

The AMS 2500 RAID specifications are shown in Table 1-11.

Table 1-11: AMS 2500 RAID Specifications

RAID level	AMS 2500 Array
Configuration	SAS/Flash drives mounted: 0/1/5/6/1+0 SATA drives mounted: 1/5/6/1+0
RAID 0	SAS/Flash drives mounted: 2D to 16D
	SATA drives do not support RAID 0.
RAID 1	1D+1D
RAID 5	2D+1P to 15D+1P
RAID 6	2D+2P to 28D+2P
RAID 1+0	2D+2D to 8D+8D

Open systems features and functions

The AMS 2500 offers many features and functions specifically for the open-systems environment. The AMS 2500 also supports important open-system functions such as Fibre channel arbitrated-loop (Fibre Channel-AL) and fabric topologies, command tag queuing, multi-initiator I/O, and most industry-standard software and middleware products which provide host fail-over, I/O path fail-over, and logical volume management functions.

Open systems middleware

Open-system middleware products provide host failover capability, I/O path failover support, and logical volume management in the open systems environment. Middleware is not usually supplied as part of the array's basic operating system.

Logical unit mapping

Each logical unit can be assigned to multiple Fibre Channel ports or iSCSI ports to provide I/O path failover with the middleware support.

Data management features and functions

The AMS 2500 includes several high-performance features that implement easy and fast data management. These features are described in Table 1-12.

Table 1-12: Data Management Features and Functions

Feature	Description
Cache Residency Manager	The *Cache Residency Manager* feature makes data of specific logical units resident in a cache and makes all accesses to the LUs from the host cache hit without making any disk accesses occur. When the function is applied to a logic unit frequently accessed, it is expected that the throughput is increased because all data Read/Write can be performed as cache hits.
LUN Manager	The LUN Manager feature consists of two main functions for Fibre Channel and two for iSCSI: • The **fibre security control** function controls the access from specific hosts or specific commands. • The **host group** function (for Fibre Channel interface) enables also the array to make a suitable response to each host connected even within the same port by grouping connected hosts within a port and setting the logical unit mapping and the Host Connection mode for each host group. Up to 128 host groups can be set. • The **iSCSI security function** controls the access from specified hosts or specific commands.
LUN Expansion	The LUN Expansion feature is used to expand the size of logical unit (volume) to which a host computer accesses by combining multiple logical units (volumes) internally.
LUN Shrink and Grow	This feature is used to reduce or expand the size of a LUN.
Data Retention Utility	The Data Retention Utility feature prevents the logical unit (volume) from being accessed illegally by the host.
Password Protection	The Password Protection function restricts the number of Storage Navigator Modular users who are allowed to access a disk array, and prevents the simultaneous access from multiple users.
Account Authentication Function	The Account Authentication function authenticates login to the array unit based on the account information registered by the user, and controls the access to the array resource. This prevents the illegal operation by an unauthorized person.
Audit Logging Function	The Audit Logging function generates a syslog to audit the event when the user performs the setting operation for the disk array, and outputs the syslog to the external server.
Dynamic Provisioning	Dynamic provisioning is a function that improves the capacity efficiency of disk drives by assigning physical capacity On Demand at the time of the Write command receipt without assigning the physical capacity to logical units.

Copy solution features and functions

The AMS 2500 supports several copy solutions as described in Table 1-13.

Table 1-13: Copy Solution Features and Function

Feature	Description
TrueCopy Remote Replication	The TrueCopy remote replication function continuously synchronizes the data on two arrays connected by a Fibre Channel interface, ensuring that both arrays always contain the same data. In addition, this function significantly improves copying speed by transferring only differential data.
TrueCopy Extended Distance (TCED)	The TrueCopy Extended Distance (TCED) function. continuously synchronizes the data on two arrays connected by a Fibre Channel interface, ensuring that both arrays always contain the same data. TCED also increases copying speed by transferring only differential data.
TrueCopy Modular Distributed Function	The TrueCopy Modular Distributed Function extends the function which equalizes the data of both disk storage systems so that it can be used between multiple disk storage systems and one disk storage system. This function requires the TrueCopy remote replication function.
ShadowImage In-System Replication	The ShadowImage in-system replication function controls logical unit copying done within one and the same array. It can create a copy (secondary volume) of a logical unit within one and the same array keeping the redundancy that the source logical unit (primary volume) has.
Copy-on-write SnapShot	The Copy-on-write SnapShot feature enables you to maintain a logical copy of logical units (volumes) at a point in time within the same disk array.
Modular Volume Migration	The Modular Volume Migration function migrates the logical unit which receives the host operation to another RAID group within a disk array.

Performance management features and functions

The AMS 2500 supports several performance functions as described in Table 1-14.

Table 1-14: Performance Management Features and Functions

Feature	Description
Performance Monitor	This function acquires information on the performance of RAID groups and logical units, etc. in the array, and utilization rates of resources such as hard disk drives and processors. The information acquired is displayed with line graphs.
Cache Partition Manager	This function enhances system performance by cache area division, segment size specification, and assignment for separate logical units.

Failure monitoring features and functions

The AMS 2500 supports a failure monitoring feature called the SNMP Agent Support Function. The SNMP Agent Support Function reports network failures to the workstation monitoring the network via the SNMP (Simple Network Management Protocol) of the open platform.

The SNMP Agent Support Function does not support IPv6. When performing the failure monitoring, execute it by IPv4 or use the E-mail alert function.

Power saving features and functions

The AMS 2500 supports power saving solutions. The Power Saving Function reduces the electric power consumption of the AMS 2500 array by spinning down the disk drives in the expansion array which are included in a user-specified RAID group. The drives are still turned on, but the drive motors are stopped.

Email notification

When a failure occurs in an AMS 2500 and error monitoring is enabled, the Navigator 2 email alert feature sends email messages containing failure information to up to three previously registered email address when a failure has occurred in the array. The email alert feature detects failures at the instant they happen, and immediately sends failure notices to the designated recipients.

The email alert feature is explained in detail in the Navigator 2 online help system. Figure 1-6 shows an example of system construction of the email alert feature.
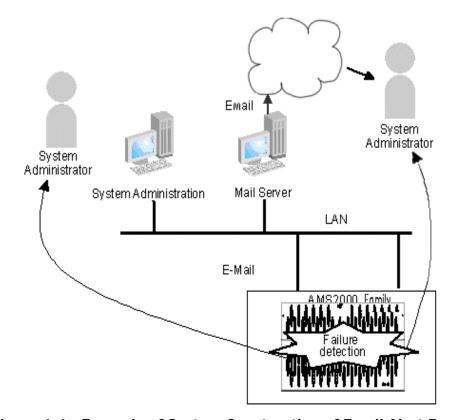
Figure 1-6: Example of System Construction of Email Alert Feature

Long term array storage

The cache backup batteries in an Hitachi AMS 2000 Family array cannot hold a charge indefinitely. If you do not use an AMS 2500 for six months or more, move the batteries to a system that is being used, or turn the array on for at least 24 hours once every six months.

> ⚠️ **CAUTION! If the AMS 2500 is not energized for more than 6 months, the battery will likely discharge completely. When the battery completely discharges, it may be damaged and you may not be able to recharge it.**

2

Functional and operational characteristics

This chapter describes the basic features of the AMS 2500. It contains the following key topics:

❒ Overview of the AMS 2500 storage system

❒ Array specifications

❒ Fibre channel interface

❒ iSCSI interface

❒ Multi-protocol interface

❒ Required parts

❒ Optional parts

❒ Accessory parts

Overview of the AMS 2500 storage system

The AMS2500 base unit is a versatile modular system that can be configured in several ways. Each of the two controllers can have size configurations, depending on which interface boards and cache units are installed. Both controllers must be configured the same way. See Table 1-1 on page 1-2 for details.

Each controller can support up to 240 disk drives in a RAID configuration (system total is 480 disk drives). The controllers support a mixture of SAS and SATA disk drives in the following sizes: 146 GB, 300 GB, 450 GB, 500 GB and 1 TB.

Architecture and components

The block diagrams in this section show the architecture of the base unit, expansion unit and high-density expansion unit.

AMS 2500 base unit architecture

This section describes the architecture of the three base unit host connection protocols.

Fibre channel configuration

Figure 2-1 shows the configuration block diagrams of the AMS 2500 base unit with Fibre Channel interface boards installed in both slots in the controllers.
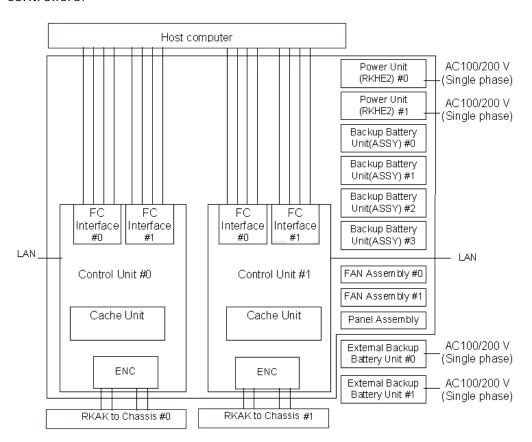
Figure 2-1: AMS 2500 Base Unit Fibre Channel Configuration Block Diagram (Fibre Channel Interface)

iSCSI configuration

shows the configuration block diagrams of the AMS 2500 base unit with iSCSI interface boards installed in both slots in the controllers.
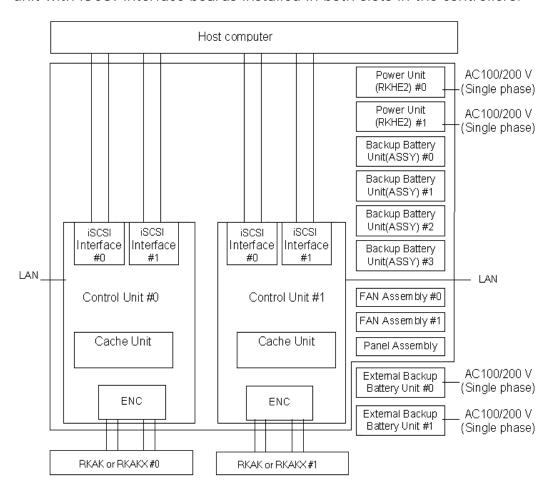
Figure 2-2: AMS 2500 Base Unit Configuration Block Diagram (iSCSI Interface)

DC-powered configuration

Figure 2-3 shows the configuration block diagrams of the AMS 2500 base unit with DC power supplies and Fibre Channel interface boards installed in both slots in the controllers. The DC-powered configuration is the same for the iSCSI configuration, except that the interface boards are iSCSI instead of Fibre Channel.
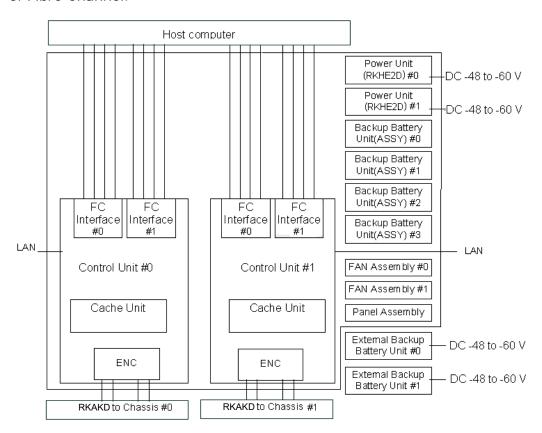
Figure 2-3: AMS 2500 Base Unit Configuration Block Diagram (Fibre Channel Interface)

Multi-protocol configuration

Figure 2-4 shows the configuration block diagrams of the AMS 2500 base unit with a Fibre Channel interface board installed in one slot in the controllers and an iSCSI interface board installed in the other slot.
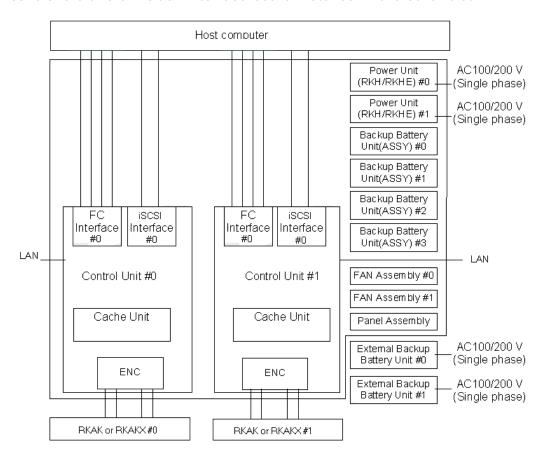
Figure 2-4: AMS 2500 Base Unit Configuration Block Diagram (Multi-protocol Interface)

Expansion unit architecture

The expansion units can include up to 15 disk drives each. These disk drives can be assigned to data disk(s), parity disk(s) (or mirror disks) depending on the RAID level. Up to 30 spare disks can be mounted in any location within the maximum configuration. The expansion unit supports a mixture of SAS and SATA disk drives in the following sizes: 146 GB, 300 GB, 450 GB, 500 GB, 1 TB and 2 TB.

Figure 2-5 shows the configuration block diagram of the expansion unit. The expansion unit can be AC-powered (RKAK) or DC-powered (RKAKD).
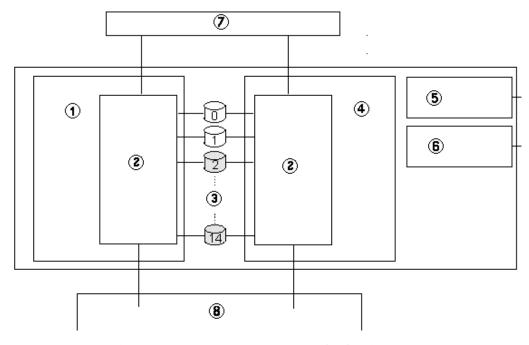
Figure 2-5: Expansion Unit Block Diagram

Table 2-1: Expansion Unit Block Diagram

Item	Description	Item	Description
①	ENC Unit 0	⑤	Power Supply 0 (120/240 VAC or −48 to −60 VDC)[1]
②	SAS / SATA Control	⑥	Power Supply 1 (AC or DC)
③	Disk Drives[2]	⑦	From Base or Expansion Unit
④	ENC Unit 1	⑧	To Expansion Unit

1. Both power supplies must be AC or both must be DC.
2. Supported disk drives: DF-F800-AKH146, DF-F800-AKH300, DF-F800-AKH450, DF-F800-AKF400, DF-F800-AVE500, DF-F800-AKH600, DF-F800-AVE1K, DF-F800-AVE2K, DF-F800-AKS200

High-density expansion unit architecture

Figure 2-6 shows the configuration block diagram of a high-density expansion unit. Table 2-2 provides a description of each numbered part.
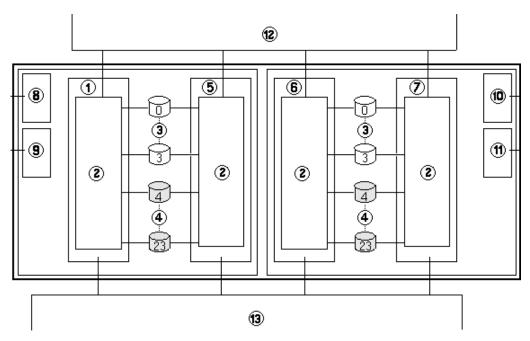
Figure 2-6: High-capacity Expansion Unit Block Diagram

Table 2-2: High-capacity Expansion Unit Block Diagram Descriptions

Item	Description	Item	Description
①	ENC Unit A0	⑧	Power Supply A0
②	SATA Control	⑨	Power Supply A1
③	Disk Drives [1] Drives 0 -3 are required. Drives 4 - 14 are optional	⑩	Power Supply B0
④	Disk Drives [1] Drives 4 - 14 are optional	⑪	Power Supply B1
⑤	ENC Unit A1	⑫	From Base Unit, Expansion Unit, or high-density Expansion Unit
⑥	ENC Unit B0	⑬	To Expansion Unit or high-density Expansion Unit
⑦	ENC Unit B1		

1.Supported disk drives: DF-F800-AVE1KX, DF-F800-AVE2KX, DF-F800-AKH450X, DF-F800-AKH600X

Array specifications

The AMS 2500 array can be configured with one AMS 2500 base unit and up to 32 expansion units for a total of 480 disk drives. This configuration provides a maximum of 881.8 TB storage space in a RAID5 (14D+1P) configuration using 2 TB disk drives. The expansion units contain the physical disk drives, including the disk array groups and the dynamic spare disk drives. See Scalability on page 1-11 for more details.

The basic specifications of the AMS 2500 are shown in Table 2-3.

Table 2-3: Basic AMS 2500 Specifications

Configuration		AMS 2500 base unit	Expansion unit	High Capacity Expansion Unit
Disk Drives	Disk drive size inches (mm)	n/a	Width: 101.6; Depth: 147.0 (Max.) Height: 26.1 (Max.)	
	Data capacity (GB) [1]	n/a	142.61/195.82/287.62/392.73/ 439.44/491.25/575.30/983.69/ 1968.52	439.44/ 575.30/ 983.69/ 1968.52
	Rotational speed (RPM)	n/a	• 15,000 RPM: 142.61/287.62/ 439.44/575.30 GB • 10,000 RPM: 392.73 GB • 7,200 RPM: 491.25/983.69/ 1968.52 GB • SSD (Flash) drive: 195.82 GB	• 15,000: 439.44/ 575.30 • 7,200: 983.69/ 1968.52
	Maximum mountable quantity per unit	0	15	38 (SAS) 48 (SATA)
Host Interface	Interface type	4 Gbps / 8 Gbps Fibre Channel Optical 1 Gbps iSCSI (1000Base-T)	n/a	n/a
	Data transfer speed (i.e. maximum speed for transfer to host)	800 MB/sec (Fibre Channel) 100 M bytes/s (iSCSI)		
	Number of host connectors (dual controllers)	**Fibre Channel** 8 per control unit, 16 total **iSCSI** 2 per control unit, 4 total iSCSI 4 per control unit, 8 total		
	Transferred block size (bytes)	512		

1. This values of storage capacity are calculated as 1 GB = 1,000,000,000 bytes. See the Preface of this manual for more information on storage capacity values.

Fibre channel interface

The AMS 2500 supports open system operations. It supports 8 Fibre Channel ports per controller (16 per base unit) when only Fibre Channel is used to connect to the host system. The AMS 2500 Fibre Channel interface uses shortwave multimode optical cables and operates at data transfer speeds up to 800 MB/sec. With these shortwave Fibre Channel cards, the AMS 2500 can be located up to 2821 feet (860 meters) from an open-system host.

> **NOTE:** For more information on the Fibre Channel interface, see Chapter 4, Interface, in t*he Hitachi /Hitachi AMS 2000 Family Storage System Reference Guide* MK-97DF8009.

Setting the transfer rate

Set the "Transfer Rate" of Fibre Channel corresponding to the transfer rate of devices connected directly with an array subsystem to each port according to the following table. When the AMS 2500 is connected directly and externally with the Hitachi Universal Storage Platform V/VM, set the port transfer rate of both the Hitachi Universal Storage Platform V/VM and the AMS 2500 to the fixed transfer rate (the same value for the Hitachi Universal Storage Platform V/VM and the AMS 2500 selecting any one of 1, 2, 4, or 8 Gbps).

Table 2-4: Fibre Channel Transfer Rates

Transfer Rate of Devices Connected with an Array Subsystem (Gigabits per second)	Transfer Rate of an Array Subsystem (Gigabits per second)
1	1
2	2
4	4
8	8
Auto (Maximum speed =8)	8
Auto (Maximum speed =4)	4
Auto (Maximum speed =2)	2

When the transfer rate of the Fibre Channel port on an AMS 2500 is set to "Auto," the transfer rate is automatically negotiated and set to the maximum rate possible. When you turn and AMS 2500 off and on or change the HBA, use Navigator 2 to check the transfer rate. If the transfer rate is not set at the maximum rate, disconnect and reconnect the Fibre Channel cable from the port you tested, or reset the transfer rate for that port with Navigator 2.

> **NOTE:** When connecting the AMS 2500 directly and externally with the Universal Storage Platform/Network Storage controller, set the topologies of both devices to "Loop."

iSCSI interface

The AMS 2500 provides 4 iSCSI ports per controller (8 total per base unit) when only iSCSI is used to connect to the host system. The iSCSI interface is capable of operating at data transfer speed of up to 100 MB/s. It supports iSCSI (1000Base-T). With the HBA for iSCSI, generic NIC + software initiator, and network switch, the array can be located up to 100 meters from the host computer.

Connect the switch based on the 1000BASE-T (full-duplex) to connect the AMS2500 and the host, directly. Moreover, use the switch complying with 1000BASE-T (full duplex) to connect the AMS2500 and the switch via the switch.

Use the LAN cable with the following types and shapes.

- Cable type: category 5e or category 6
- Connector: RJ-45

Do not set the spanning tree protocol function to ON when using a switch to connect a host to the iSCSI port of an AMS 2500. It may cause communications interference.

Setting iSCSI information

The following iSCSI information is set for iSCSI ports:

- iSCSI Port IP address
- iSNS Server
- Adding target
- Target option

When an iSCSI interface board is not added to the control unit, this information is not set for each host connector that connects the AMS 2500 Fibre Channel.

The host should log into the specified target of AMS2100/AMS2300 in iSCSI, unlike Fibre Channel. Refer to the HBA or iSCSI software initiator manuals for information about logging in to the target. In some initiators, the subsequent re-connection will be done automatically.

Multi-protocol interface

The AMS 2500 supports the use of both Fibre Channel and iSCSI protocols at the same time. In this configuration, one 4-port Fibre Channel interface board and one 2-port iSCSI interface board are installed in each of the two controllers. The system total is 8 Fibre Channel ports and four iSCSI ports. See the block diagram in .

Required parts

Table 2-5 describes the required parts for an AMS 2500 array.

Table 2-5: AMS 2500 Required Parts

Name	Factory Model and HDS Part Number	Components[1]
Base Unit	DF800-RKHE2 DF800-RKHE2D[2] DF800-RKEH2 DF800-RKEH2D	Frame (1), Control unit (2), Panel (1), Backup battery unit (4), AC cable J2H (2), Power unit (2)
Expansion Unit	DF-F800-RKAK DF-F800-RKAKD[2]	Frame (1), AC cable J2H (2), Power unit (RKAK) (2), ENC unit (2), ENC cable (4)
High-density Expansion Unit	DF-F800-RKAKX	Frame (1), AC cable J2H (4), Power unit (RKAKX) (4), ENC unit (4), ENC cable ((3m) 4)
Disk drive [3] [4] Required for expansion unit and high-density expansion unit.	DF-F800-AKH146	3.5-type Disk drive (142.61 GB) installed in a canister. 15,000 RPM
	DF-F800-AKH300	3.5-type Disk drive (287.62 GB) installed in a canister. 15,000 RPM
	DF-F800-AKH450 DF-F800-AKH450X	3.5-type Disk drive (439.44 GB) installed in a canister. 15,000 RPM. 450X is for the high-density expansion unit.
	DF-F800-AKF400	3.5-type Disk drive (392.73 GB) installed in a canister. 10,000 RPM
	DF-F800-AVE500	3.5-type Disk drive (491.25 GB) installed in a canister. 7,200 RPM
	DF-F800-AKH600 DF-F800-AKH600X	3.5-type Disk drive (575.30 GB) installed in a canister. 15,000 RPM. 450X is for the high-density expansion unit.
	DF-F800-AVE1K	3.5-type Disk drive (983.69 GB) installed in a canister. 7,200 RPM
	DF-F800-AVE1KX	3.5-type Disk drive (983.69 GB) installed in a canister. 7,200 RPM
	DF-F800-AVE2K	3.5-type Disk drive (1968.52 GB) installed in a canister. 7,200 RPM
	DF-F800-AVE2KX	3.5-type Disk drive (1968.52 GB) installed in a canister. 7,200 RPM
	DF-F800-AKS200	Flash Drive (195.82 G bytes) installed in a canister.
Storage Features[5]		Features bundle on the Navigator 2 installation CD. See Storage features on page 7-12 for the complete list of included and optional storage features. • Audit Logging • Account Authentication • LUN Manager • Cache Residency Manager • Cache Partition Manager • Modular Volume Migration • SNMP Agent Support • Performance Monitor
Navigator 2		Hitachi Navigator Modular 2 storage management software

1. Numbers in parentheses following component names show quantities of the components.
2. Model numbers ending in D are DC-powered.
3. This values of storage capacity are calculated as 1 GB = 1,000,000,000 bytes. See the Preface of this manual for more information on storage capacity values.
4. At least one type of drive in this list is required. A mix of drive types can be installed.
5. Basic Storage Features are installed in the AMS 2500 as standard.

Optional parts

describes the optional parts for an AMS 2500 array.

Table 2-6: AMS 2500 Optional Parts

Classification	Model	Name	Description[1]
Spare disk	-	Disk drive	Refer to the disk drive section.
Additional disk drive	-	Disk drive	Refer to the disk drive section.
Controller (2 required)	3282006-A	Controller, RKHE2.	Controller board (1) Cache memory 2,048 MB (4)
	3282006-B	Controller, RKHE2	Controller board (1) Cache memory 4,096 MB (4) [2]
Interface Board [2]	DF-F800-DKS12	iSCSI Interface board	1 Gbps iSCSI (1) [2]
	DF-F800-DKF44	FC Interface board	4 Gbps Fibre Interface (including Host connector) (1) [3]
	DF-F800-DKF84	FC Interface board	8 Gbps Fibre Interface (including Host connector) (1)
Cache Memory	DF-F800-C2GK DF-F800-C4GK	Cache Memory Cache Memory	2,048 MB DIMM 4,096 MB DIMM
Battery Expansion Unit	DF-F800-N1RK	AMS2000 Battery Expansion Unit	AMS2000 Battery Expansion Unit, AC (1)
	DF-F800-N1RKD	AMS2000 Battery Expansion Unit	AMS2000 Battery Expansion Unit, DC (1)
Remote Adapter	DF-F800-VR4A	Remote Adapter (Main unit)	Adapter for PS interlock control (Power cables for 100V and 200V each are standard equipment)
	DF-F800-VR4H	Remote adapter (Hub)	Hub for remote adapter (Power cables for 100V and 200V each are standard equipment)
Front bezel (RKHED)	DF-F800-UBKD	Front bezel	NEBS (Network Equipment-Building System) specification
Front bezel (RKAKD)	DF-F800-UBKAD	Front bezel	NEBS (Network Equipment-Building System) specification
Storage Features		Power Saving	Reduces power consumption by turning off the drive motors in a selected group of drives in the array.
		Data Retention Utility	Protects the disk array data and LUNs from input/output (I/O) operations performed by open-systems hosts.
		In-System Replication Suite	ShadowImage in-system replication Copy-on-write Snapshot
		ShadowImage	Makes a copy of a logical unit (volume) within an array unit.
		Copy-on-write Snapshot	Makes a point-in-time copy of a logical unit (volume) between arrays.
		TrueCopy Remote Replication	This feature equalizes data on secondary disk drives by continuously synchronizing data with the primary disk drive.
		TrueCopy Extended Distance	This feature equalizes data of disk array subsystems by continuously synchronizing their data asynchronously.

Table 2-6: AMS 2500 Optional Parts (Continued)

Classification	Model	Name	Description[1]
	P-002D-Jxxx	P-002D-Jxxx	The Dynamic Provisioning is a function to improve the capacity efficiency of disk drives by assigning physical capacity on demand at the time of the Write command receipt without assigning the physical capacity to logical units.
Rack Assembly	AMS 2000 Rack	AMS 2000 Rack	Extra-depth rack. See Hitachi AMS 2000 Site Preparation Guide.
	Hitachi Data Systems Seismic Rack	Seismic Rack	Used for DC-powered systems that meet NEBS requirements. See e Hitachi AMS 2000 Site Preparation Guide.

1. Numbers in parentheses following component names show quantities of the components.
2. Replaceable by HDS and HDS partner authorized service personnel only.
3. The number required depends on the controller model. See for details.

Accessory parts

Table 2-7: AMS 2500 Accessory Parts

Classification	Model	Name	Specification
Tray for remote adapter	DF-F800-HVR4	Tray for remote adapter	Rail kit for mounting the Remote adapter on the RK40 rack frame.
Power Cables	DF-F800-J1H	Power cable	2.5 m, 2-pole power cable with grounding terminal (AC 125 V, 13 A or 15 A)
	DF-F800-J2H	Power cable	2.5 m, 2-pole power cable with grounding terminal (AC 250 V, 13 A or 15 A)
	DF-F800-J2H5	Power cable	5.0 m, 2-pole power cable with grounding terminal (AC 200 V, 13 A or 15 A)
	DF-F800-J2H10	Power cable	10.0 m, 2-pole power cable with grounding terminal (AC 200 V, 13 or 15 A)
	A-F6516-P620	Power cable	Power cable for PDB (1)
	A-F6516-P630	Power cable	Power cable for PDB (1)
Cable Assembly	DF-F800-K1BS	ENC cable assembly	ENC cable 1m (2)
	DF-F800-K3BS	ENC cable assembly	ENC cable 3 m (2)
	DF-F800-K5BS	ENC cable assembly	ENC cable 5 m (2)
Remote Adapter Cable	DF-F800-VRC2	Remote adapter cable	For control of Remote adapter, 2 m
	DF-F800-VRC5	Remote adapter cable	For control of Remote adapter, 5 m
	DF-F800-VRC10	Remote adapter cable	For control of Remote adapter, 10 m
	DF-F800-VRC20	Remote adapter cable	For control of Remote adapter, 20 m
	DF-F800-VRC50	Remote adapter cable	For control of Remote adapter, 50 m

Table 2-7: AMS 2500 Accessory Parts (Continued)

Classification	Model	Name	Specification
	A-6515-GM5S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (5 m)
	A-6515-GM10S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (10 m)
	A-6515-GM20S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (20 m)
	A-6515-GM30S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (30 m)
	A-6515-GM50S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (50 m)
	A-6515-GM1JS	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (100 m)
	A-6515-HM2S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (2 m)
	A-6515-HM5S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (5 m)
	A-6515-HM10S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (10 m)
	A-6515-HM20S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (20 m)
	A-6515-HM30S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (30 m)
	A-6515-HM40S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (40 m)
	A-6515-HM50S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (50 m)
	A-6515-HM60S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (60 m)
	A-6515-HM70S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (70 m)
	A-6515-HM80S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (80 m)
	A-6515-HM90S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (90 m)
	A-6515-HM100S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (100 m)
	A-6515-HM150S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (150 m)
Fibre Channel Cables	A-6515-HM200S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (200 m)
	A-6515-HM300S	LC-SC Fibre I/F Cable	LC-SC Fibre I/F cable for Optical (300 m)
	A-6515-GM5L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (5 m)
	A-6515-GM10L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (10 m)
	A-6515-GM20L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (20 m)
	A-6515-GM30L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (30 m)
	A-6515-GM50L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (50 m)
	A-6515-GM1JL	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (100 m)
	A-6515-HM2L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (2 m)
	A-6515-HM5L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (5 m)
	A-6515-HM10L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (10 m)
	A-6515-HM20L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (20 m)
	A-6515-HM30L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (30 m)
	A-6515-HM40L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (40 m)
	A-6515-HM50L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (50 m)
	A-6515-HM60L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (60 m)
	A-6515-HM70L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (70 m)
	A-6515-HM80L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (80 m)
	A-6515-HM90L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (90 m)
	A-6515-HM100L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (100 m)

Table 2-7: AMS 2500 Accessory Parts (Continued)

Classification	Model	Name	Specification
	A-6515-HM150L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (150 m)
	A-6515-HM200L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (200 m)
	A-6515-HM300L	LC-LC Fibre I/F Cable	LC-LC Fibre I/F cable for Optical (300 m)
Control cable for External Backup Battery Unit	DF-F800-K1N	Control cable for External Backup Battery Unit	Interlocking control cable for the External Backup Battery Unit.

3

Getting started

This chapter provides an overview of the tasks to install and configure a Hitachi AMS 2000 Family Storage System. The following topic is discussed:

❐ Task roadmap

Task roadmap

Table 3-1 lists and describes the required and optional tasks that users can and should do to install, set up, configure, and manage an AMS 2500 array.

Table 3-1: Procedures for Installing and Configuring an AMS 2500 Array

Step	Task	Description
		Required Tasks
1	Unpack the array	Unpack and inspect the array components. See Chapter 5, Unpacking an array.
2	Mount the array in a rack	Install the rail kits and mount the base and expansion units. Connect power cables. See Chapter 5, Mounting the array in a rack.
3	Connect cables	Connect the Fibre Channel and ENC cables. See Chapter 5, Connecting cables.
4	Connect a management PC to the array	Connect the LAN cable. See Chapter 5, Connecting cables.
5	Attach the front bezel	See Chapter 5, Attaching a front bezel.
6	Turn the array on.	See Chapter 6, Power On/Off procedures.
7	Turning the array off	See Chapter 6, Power On/Off procedures.
8	Configuring the array - required configuration	See Chapter 7, Configuration.
9	Configuring host system and storage	Add arrays to Navigator 2 and configure them. See Chapter 7, Configuration.
		Optional Tasks
1	Configuring the array - optional Configuration	See Chapter 7, Configuration.
2	Upgrade the Hardware	Add Disk Drives. See Chapter 9, Upgrading the hardware.
3	Upgrade the Firmware	Download the firmware and install it. See Chapter 10, Upgrading the firmware.
4	Upgrade the Software	Install a new version of Navigator 2. See Chapter 7, Installing Navigator 2.

4

Hardware components

This chapter describes the components, controls, connectors and indicators of the AMS 2500. It covers the AMS 2500 base unit and Hitachi AMS 2000 Family expansion unit and the purpose of each.

This chapter discusses the following key topics:

❐ AMS 2500 base unit

❐ Expansion unit

❐ High-density expansion unit

⚠ **NOTE:** The DC-powered components (AMS 2500, expansion unit, and battery expansion unit) are described in Appendix C, DC-powered units.

AMS 2500 base unit

This section describes the base unit, its components, controls, and indicators.

Introduction

This section describes each of the components on the front of the base unit.

Base unit front panel

The following illustration shows the front of a base unit with the decorative bezel installed (upper photo) and removed in the lower photo, with the components on the front of the unit exposed. Close-up photos and detailed descriptions are included further on in this chapter.
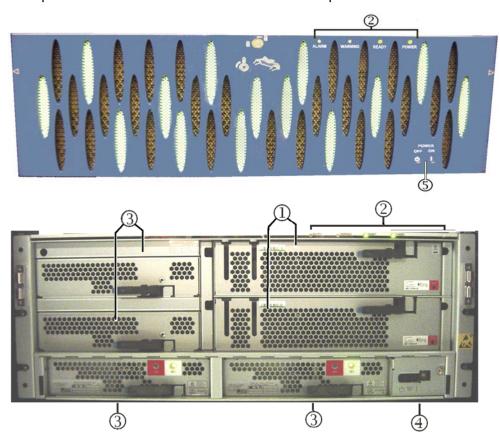
Figure 4-1: AMS 2500 Base Unit Front View

Table 4-1: AMS 2500 Base Unit Front View

Item	Description	Item	Description
①	Fan Units	④	Switch Panel (Power and Mode switches). See AMS 2500 base unit on page 1-5 and Switch panel on page 4-3 for details.
②	Base Unit Status LEDs See Base unit status LEDs on page 4-5 for details.	⑤	Power Switch. See Power switch on page 1-4.
③	Cache Backup Batteries. See Cache backup battery LEDs on page 4-6 for details.		

Switch panel

The base unit switch panel is located at the lower right corner of the front of the array. See #5 in Figure 4-1 above. The panel contains a power on-off switch and a mode switch, as shown in Figure 4-2.
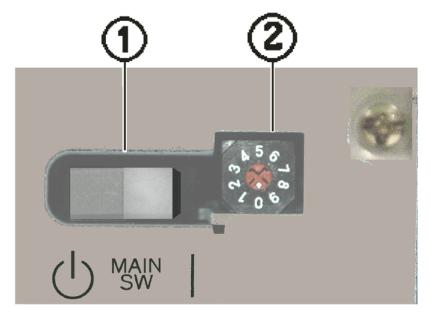
Figure 4-2: Base Unit Switch Panel

Table 4-2: Base Unit Switch Panel

Item	Description
①	**Power Switch (labeled Power ON on the front bezel and labeled Main SW on the switch panel).** Since the power supplies are on all the time, this is actually a power Standby/ON switch. • To turn the array power ON, press the right side of the switch (labeled |). • To turn the array power to STANDBY, press the left side of the switch.
②	**Mode Switch** Sets the Uninterruptable Power Supply (UPS) mode to either Local Mode or one of three remote modes. Leave this switch in the local mode (0) position.

⚠ **NOTE:** When you turn the power on, each component in the array (except for the power supplies which are already on) automatically runs a power on self test (POST). During this time, the Power LED is on and the Ready light blinks. The POST takes approximately four minutes under normal circumstances. When the POST is complete and the unit is ready for operation, the Ready light changes from blinking to ON.

Important! Read Chapter 6, Power On/Off procedures, before turning the array power on or off.

Base unit rear panel

Figure 4-3 shows the key hardware components on the rear panel of an AMS 2500 base unit. Close-up photos and detailed descriptions are included later in this chapter.
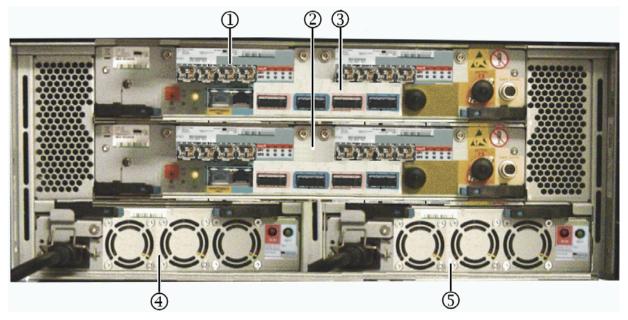
Figure 4-3: AMS 2500 Base Unit Rear Panel Components

Table 4-3: AMS 2500 Base Unit Rear Panel Components

Item	Part Name	Description
①	Host Connector	Host Connector (4 Gbps) See Fibre channel host connectors on page 4-11 for detailed information.
②③	Control Unit	Controller for AMS 2500 Includes Fibre Channel interface board and either 2 GB or 4 GB cache memory unit (RAM) See Expansion unit on page 4-17 for detailed information.
④⑤	Power Unit (RKHE2)	Power supply for RKHE2. See Base unit power supplies on page 4-13 for detailed information.

Base unit status LEDs

Front panel LEDs

The upper right edge of the front of the AMS 2500 base unit has four LEDs that indicate the status of the array. In addition, the Cache Backup battery has two status LEDS. Figure 4-4 and Table 4-4 describe the front panel status LEDs, their functions, and indications.
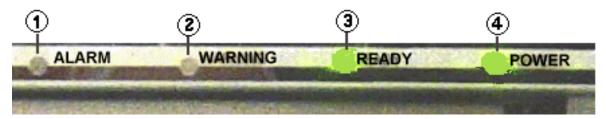
Figure 4-4: Base Unit Status LEDs (front panel)

Table 4-4: Base Unit Status LEDs (front panel)

Item	Name/Color	Status	Description
Unit Overall Status LEDs			
①	**Alarm** **RED**		The Alarm LED shows when an AMS 2500 array has encountered a serious error.
		OFF	Normal operation
		ON	A serious error has occurred in the array. Please contact Hitachi Data Systems Technical Support. See the Getting Help section in the Preface of this manual.
		Slow Blink (1 blink/sec)	A serious failure has occurred. Please contact Hitachi Data Systems Technical Support. See the Getting Help section in the Preface of this manual.
②	**Warning** **ORANGE**		The orange **Warning** LED shows when the base unit is operating normally, has encountered a nonserious error, or is upgrading the firmware.
		OFF	Normal operation
		ON or Slow Blink (1 blink/sec)	Nonserious error. The base unit can continue to operate. See the Alerts & Events window in Navigator 2 for information about the error.
		Fast Blink (8 blinks/sec)	The firmware is being updated (do not turn off the array).
③	**Ready** **GREEN**	**ON**	Normal operation. The array is fully operational.
		Slow Blink	Firmware download is complete. The array is fully operational.
		Fast Blink	Firmware is downloading (Do not turn off the array).
④	**Power** **GREEN**	**ON**	The base unit is turned on and receiving power.
		OFF	The base unit is not turned on.
Cache Backup Battery (see photo on page 4-6)			

Table 4-4: Base Unit Status LEDs (front panel) (Continued)

Item	Name/Color	Status	Description
②	Alarm LED **RED**	**ON**	Indicates that the battery has failed.
		OFF	Indicates that the battery status is normal.
③	Ready LED **GREEN** indicates battery condition	**ON**	Normal status
		Slow Blink	(1 blink per second): The battery is not fully charged.
		Off or Fast Blink	(8 blinks per second): Abnormal status

Fan unit LED

The AMS 2500 contains two fan units that are located at the front of the unit (see Figure 4-1 on page 4-2). Each fan unit contains an alarm LED that indicates when the unit has failed. Figure 4-5 shows a fan unit. Table 4-5 describes the components of the fan unit.
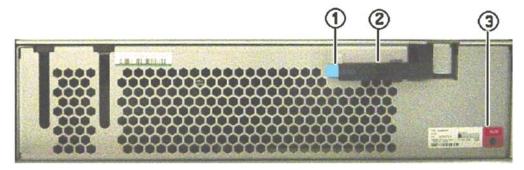
Figure 4-5: Fan Unit

Table 4-5: Fan Unit

Item	Description	Status
①	Lock Button	Push inward to unlock the Lock Lever.
②	Lock Lever	When the lock lever is closed and the blue button is fully extended, the fan unit is secured to the array.
③	**Alarm LED** **RED**	• When on, indicates that the fan unit has failed. • When off, indicates that the fan unit is wither operating normally or is turned off.

Cache backup battery LEDs

The front panel on the battery contains an Alarm LED and a Ready LED. See Cache backup batteries on page 4-14.

Rear panel LEDs

The rear panel of the AMS 2500 base unit has several LEDs that indicate the status of the power supplies and control units. These LEDs are explained as part of the descriptions of the Control unit on page 4-7 and the Base unit power supplies on page 4-13.

Control unit

The control unit is a multifunction device that provides connection and management functions for the array, including the following:

- Connects the base unit to a host computer
- Connects the base unit to an expansion unit
- Connects the base unit to a management console
- Manages the storage, replication, and security of data from the host computer to the disk drives
- Stores and supports the array firmware (operating system) and the Navigator 2 storage management software

The control unit and description of the controls, connectors, and LEDs are shown in Figure 4-6 and Table 4-6.

Figure 4-6 shows the control unit of an AMS 2500 base unit.
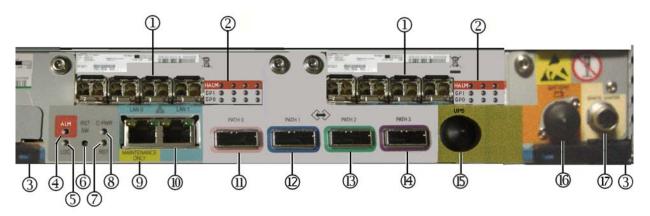
Figure 4-6: AMS 2500 Control Unit Switches, Connectors and LEDs

Table 4-6: AMS 2500 Control Unit Connectors and LEDs

Item	Description	Item	Description	Item	Description
①	Fibre channel host connectors (8 per controller)	⑥	RST (Rese)t Button Resets the control unit and performs a full dump.	⑫	ENC Connector Path 1 to ENC unit IN
②	Fibre Channel HALM (Host Alarm) - indicates that the host connector is abnormal. GP0 LED/GP1 LEDs (green) - indicate that the interface is normal.	⑦	Reset LED (Orange) Blinks while the control unit is resetting	⑬	ENC Connector Path 2 to ENC unit IN
		⑧	C- Power LED (Green) When on, indicates that cache memory is backed up.	⑭	ENC Connector Path 3 to ENC unit IN
③	Lock Lever (2 places)	⑨	**Maintenance Port (LAN 0)** ACT LED (yellow) indicates data is being transferred. LINK LED (green) When ON, indicates that the link status is normal.	⑮	Uninterruptable Power Supply Connector
④	Alarm LED (**Red**) Indicates that the control unit has failed.	⑩	10/100 Ethernet management port **(LAN 1)** ACT LED (yellow) indicates data is being transferred. LINK LED (green) When ON, indicates that the link status is normal.	⑯	Battery Expansion Unit Connector
⑤	LOC LED (**Orange**) See Table 4-8 on page 4-10.	⑪	ENC Connector Path 0 to ENC unit IN	⑰	Remote Adapter connector

AMS 2500 iSCSI control unit

The iSCSI AMS 2500 control unit is shown in Figure 4-7. The only difference between this control unit and the Fibre Channel control unit is the interface board and external ports.
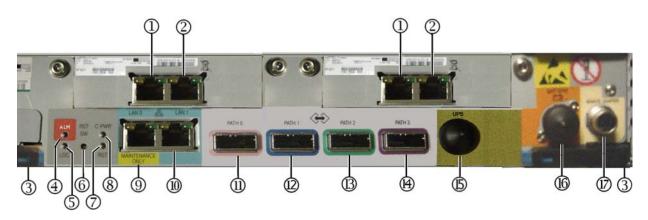
Figure 4-7: AMS 2500 iSCSI Control Unit Connectors and LEDs

Table 4-7: AMS 2500 iSCSI Control Unit Connectors and LEDs

Item	Description	Item	Description	Item	Description
1	iSCSI RJ45 Port #0 See item 9 for ACT and Link LED descriptions.	⑦	Reset LED (orange) Blinks while the control unit is resetting	⑬	ENC Connector Path 2 to ENC unit IN
② ①	iSCSI RJ45 Port #1 See item 9 for ACT and Link LED descriptions.	⑧	C- Power LED (**green**) When on, indicates that cache memory is backed up.	⑭	ENC Connector Path 3 to ENC unit IN
③	Lock Lever (2 places)	⑨	Maintenance Port (LAN 0) • ACT LED (yellow) indicates data is being transferred. • LINK LED (**green**) When ON, indicates that the link status is normal.	⑮	Uninterruptable Power Supply Connector
④	Alarm LED (red) Indicates that the control unit has failed.	⑩	10/100 Ethernet management port (**LAN 1**) • ACT LED (yellow) indicates data is being transferred. • LINK LED (**green**) When ON, indicates that the link status is normal.	⑯	Battery Expansion Unit Connector
⑤	LOC LED (**orange**) See Table 4-8 on page 4-10.	⑪	ENC Connector Path 0 to ENC unit IN	⑰	Remote Adapter connector
⑥	RST (Rese)t Button Resets the control unit and performs a full dump.	⑫	ENC Connector Path 1 to ENC unit IN		

LOC LED

The LOC LED in Table 4-8 indicates various controller conditions depending on the speed and number of blinks.

When adding a unit with the power turned on, the LOC LED indicates that an additional unit has been added (this is not an error).

Table 4-8: LOC LED

Number of blinks	Description
6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)
1 (fast)[1]	SRAM error.
2 (fast)	ENC hard error.
3 (fast)	Firmware error in flash memory.
4 (fast)	CUDG error in an ENC unit.
ON	Boot section error in the ENC firmware, a RAM error, or an ENC hard configuration error.

1. When blinking fast, the LED is on for 400 ms and off for 200 ms for each fast blink. After the number of fast blinks has completed, the LED ID goes off for one second.

Fibre channel host connectors
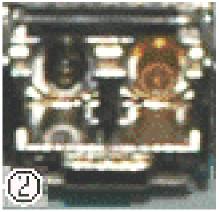
Each of the two AMS 2500 control units has eight Fibre Channel data ports (total of 16 ports per array). Each data port is part of a device called a host connector. A host connector is an SFP (Small Form Factor Pluggable) optical transceiver that connects the Fibre Channel interface board inside the control unit to the fibre optic cables.

The following illustrations show the four Fibre Channel data ports / Host Connectors on an AMS 2500 control unit.

*   Photograph ① shows the leftmost host connector with the lock opened and the unit ready for removal. The second connector is shown capped, as all of the host connectors are when the array is shipped. The third and fourth ports are shown connected. Note that two types of Fibre Channel cables and connectors are used in this photo.

*   Photograph ② shows a close up view of the two connectors in each data port.

*   Photograph ③ shows a host connector partially removed from the array.

*   Photograph ④ shows a host connector completely removed from the array. The front bezel key is included in the photo to show the relative size of a host connector.

See the Hitachi Hitachi AMS 2100/2300 Storage System Service Guide for information on removing and replacing a host connector.
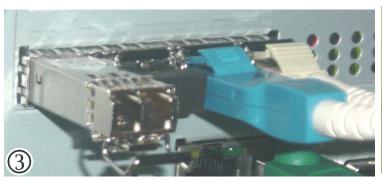
Figure 4-8: Fibre Channel Host Connectors

10/100 Ethernet management port

Each AMS 2500 controller has one 10/100BaseT Ethernet management port that is used to connect the control unit to a management console, usually a laptop PC. It an be connected directly or via a Local Area Network (LAN). The management port accepts either a cross-over cable for direct connections to the management port or a straight-through cable if connecting to the management port through a switch.

Using the management console, you can configure and manage an AMS 2500 array using the Navigator 2 storage management software on the CD that is supplied with the hardware. You can also use the storage features described under Features and benefits on page 1-8 to interact with an AMS 2500 array.

The management port accepts either a cross-over cable for direct connections to the management port or a straight-through cable if connecting to the management port through a switch. The port is a standard RJ45 connector that has an amber Port Activity LED on the left side of the port and a green Link LED on the right side. When an active LAN cable is plugged into the port, the Link light comes on steady. The Activity LED lights when data is being transferred to or from the port.

⚠️ **NOTE:** If you use Navigator 2 to configure an AMS 2500 array to send email alerts, be sure the management port can communicate via Ethernet with your mail server. For more information, refer to the Navigator 2 online help.

Figure 4-9 shows an example of how a laptop might be connected to a base unit that is installed in a rack.
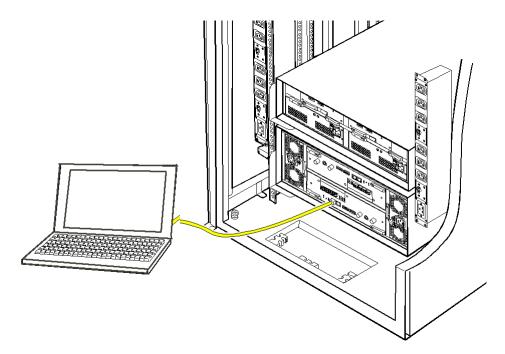
Figure 4-9: Connecting a Laptop to a Management Port

Base unit power supplies

As shown in Figure 4-3 on page 4-4, the AMS 2500 has two fully redundant power supplies. If one power supply fails, the other one can supply sufficient power and cooling to the array until the failed power supply is replaced.

> ⚠️ **NOTE:** This section describes the AC power supplies. See Appendix C, DC-powered units for information about the DC power supplies.

Power supply status

Each AC power supply has two LEDs on the panel near the power receptacle. These LEDs indicate the operational status of the power supply, as shown in Figure 4-10.

Figure 4-10: Base Unit AC Power Supply LEDs

Table 4-9: Base Unit AC Power Supply LEDs

Item	Description
①	**Ready LED (green)**. **OFF** when the power supply is not connected to power. **Blinks** when the corresponding power receptacle is connected to a working AC outlet, and is running the power on self test (POST). **ON** when the unit is operational, even if the AMS 2500 array is not turned on.
②	**Alarm LED (red)**. This LED indicates that the power supply has failed. Although the other power supply can supply sufficient power and cooling for the array, Hitachi Data Systems recommends that you replace the failed power supply as soon as possible. See the Hitachi Hitachi AMS 2100/2300 Storage System Service Guide for instructions.

Power receptacles

Each AC power supply contains a power receptacle that must be connected to a working AC power source using the supplied AC power cable.

> ⚠️ **NOTE:** Hitachi Data Systems recommends that each power supply in the base unit be connected to a different AC source in the rack. If one source fails, the other source continues to supply power to the other power supply. This keeps the array running until power is restored to the failed source.

Safety lock

The AC power supply includes a safety lock. It prevents the lock lever from being opened until the power cable is disconnected from the power supply. This prevents the power supply from being removed from the array with the power applied.

As shown in Figure 4-11, the AC power supply also includes a power cable retainer that can be used to ensure that the power cable is not accidentally disconnected from the power supply.

⚠ **NOTE:** Hitachi Data Systems recommends that you install the cable retainer to prevent the power cable from accidentally being disconnected from the power supply.
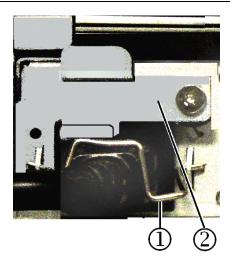
Figure 4-11: Base Unit Power Supply Safety Components

Table 4-10: Base Unit Power Supply Safety Components

Item	Description	Item	Description
①	Power Cable Retainer	②	Safety Lock

Cache backup batteries

The AMS 2500 base unit contains four internal cache backup batteries and can also use one or two Battery Expansion Units (external cache backup batteries). They are described in this section.

⚠ **NOTE:** This section describes the AC power supplies. See Appendix C, DC-powered units for information about the DC power supplies.

Internal backup batteries

In Figure 4-1 on page 4-2, item #3 shows the standard configuration of the AMS 2500 base unit, which includes four cache backup batteries. When fully charged, the four batteries can preserve the data in the cache for 24 to 48 hours, depending on the size of the cache and the amount of data in it. See Cache specifications on page 1-14 for details.

Figure 4-12 shows an internal backup battery. The front panel on the battery contains an Alarm LED and a Ready LED. The battery also includes a lock lever that keeps the battery securely installed in the array and is used to remove the battery when needed.
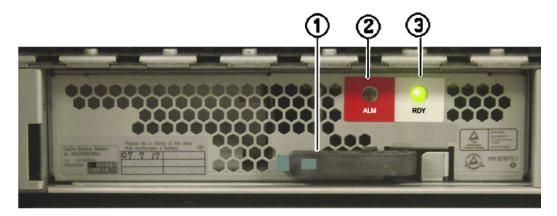
Figure 4-12: Internal Cache Backup Battery

Table 4-11: Internal Cache Backup Battery

Item	Description	Status
①	Lock Lever	When the lock lever is closed and the blue button is fully extended, the battery is secured to the array.
②	**Alarm LED** **RED**	• When on, indicates that the battery has failed. • When off, indicates that the battery status is normal.
③	**Ready LED** **GREEN**	This LED indicates the condition of the battery. • On: normal status • Low-speed blinking (1 blink per second): The battery is not fully charged. • Off or high-speed blinking (8 blinks per second): Abnormal status

Battery expansion units

The AMS 2500 can connect to one or two AMS 2000 Battery Expansion Units (external backup batteries) to extend the life of the data in the cache in case the power to the facility where the unit is installed fails for an extended period.

The battery expansion units contain the same batteries and have the same storage capacity as the internal batteries, but are housed in a rackmount unit that also contains a power supply to keep the battery charged. The power supply runs on 110VAC and is plugged into the rack PDB. The front panel on the battery expansion unit contains an Alarm LED and a Ready LED. Like the other components in the array, the status of the battery expansion unit is monitored by Navigator 2.

> **NOTE:** The AMS 2000 Battery Expansion Unit is supported only by the AMS 2500.

The AC-powered battery expansion unit is shown in Figure 4-13. See Appendix C, DC-powered units for information about the DC-powered unit.
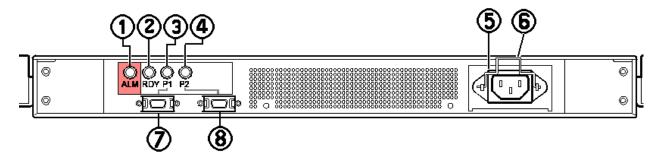
Figure 4-13: AMS 2000 Battery Expansion Unit LEDs and Connectors

Table 4-12: AMS 2000 Battery Expansion Unit LEDs and Connectors

Item	Description	Status
①	**Alarm LED** **RED**	**ON** - Lights when the battery charging or protection circuitry has failed or when the battery voltage is abnormal. **OFF** - During normal operation and when the unit is turned off. Also during backup.
②	**Ready LED** **GREEN**	This LED indicates the condition of the battery. **ON** • Charge is completed • Supplementation charge • Low-speed blinking (1 second blink every two seconds): The battery is not fully charged, and is charging • High-speed blinking (2 blinks per second): Abnormal status **OFF** - When the unit is turned off or the battery voltage is abnormal. Also when the status of the battery is abnormal. (See Alarm LED)
③	**Port 1 LED** **GREEN**	**ON**- When the port is connected and operating normally (can be during backup) **OFF** • When the port is not operating (for example, after sequential shutdown) • When the connector is not working correctly (not connected, etc.) • During backup
④	**Port 2 LED** **GREEN**	**ON** - When the port is connected and operating normally (can be during backup) **OFF** • When the port is not operating (for example, after sequential shutdown) • When the connector is not working correctly (not connected, etc.) • During backup
⑤	**Power Receptacle**	Connects the power cable to the backup battery charger. The unit is on when the power cable is connected to the PDU.
⑥	**Power Cable Retainer**	When locked onto the power cable, prevents the power cable from being accidentally unplugged from the power receptacle.
⑦	**Port 0**	Connects the battery cable from this port to the battery expansion unit connector on control unit #0.
⑧	**Port 1**	Connects the battery cable from this port to the battery expansion unit connector on control unit #1.

Expansion unit

An expansion unit provides additional storage capabilities for the base units. An expansion unit can hold up to 15 SATA or SAS drives, or a combination of the two. SATA and SAS drives can be mixed within the same unit, as long as the guidelines under Disk drive configurations on page 4-19 and RAID implementations on page 1-15 are followed. An AMS 2500 base unit supports up to 32 expansion units.

Drives are installed, removed, and replaced from the front of the expansion unit. No tools are required.

Figure 4-14 shows the front (above) and rear (below) views of the AMS 2500 expansion unit. The front bezel has been removed in this photo.
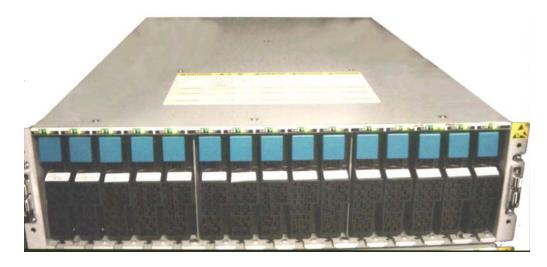
Figure 4-14: Expansion Unit Front and Rear Views

Expansion unit front panel

Figure 4-15 shows the front of an expansion unit (factory designation **RKAK**) with the decorative bezel installed.

The front panel of the expansion unit includes Power and Locate status LEDs that show the status of the unit and identify the unit. The installation location should provide an unobstructed view of these LEDs.

In addition, each drive slot on the expansion unit has alarm and Active LEDs that show the status of the drive that is installed in the slot that is directly below the status LEDS. As shown in Figure 4-17 on page 4-19, these LEDs are visible when the front bezel is removed. A close up photo of the drive status LEDs is shown in Figure 4-17 on page 4-19.

There are no switches on an expansion unit. Power is turned on and off with a control signal that is routed from the base unit via the ENC cables that are connected to the ENC unit in the expansion unit.

Figure 4-15: Front View of an Expansion Unit

Table 4-13: Expansion Unit Front View

Item	Description	Item	Description
①	Locate LED - Indicates that a failure which does not stop operation occurred in unit. **Orange**	②	Power LED **Green**

Figure 4-16 shows the front of an expansion unit (factory designation **RKAK**) with the decorative bezel removed and the disk drives in the front of the array exposed.
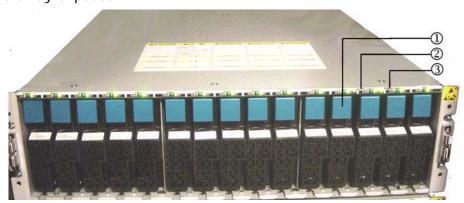
Figure 4-16: Expansion Unit Front View

Table 4-14: Expansion Unit Front View

Item	Description	Item	Description	Item	Description
①	Disk Drives, showing the status LEDs	②	Locate LED	③	Power LED

Disk drives

As shown Figure 4-16 above, an Hitachi AMS 2000 Family expansion unit has 15 drive slots in the front of the unit. Each slot can accommodate one SATA drive or one SAS drive.

Disk drive configurations

The following requirements are for the expansion unit.

- The minimum number of drives in the **first** expansion unit is four. These first four drives must all be either SAS drives or SATA drives. The minimum number of drives that must be installed in all other expansion units is two. These two drives must both be either SATA or SAS drives.

- After the minimum configuration is met, you can add two SAS or two SATA drives (which makes a RAID1 configuration) at a time, or other combinations of drives as required to meet the RAID configurations specified in Chapter 1.

Disk drive status LEDs

The expansion unit has two LEDs built into the unit chassis above each disk drive slot. These LEDS, shown in Figure 4-17, indicate the status of the drive that is installed in the slot below them. The slot number of the disk drive is on the blue triangle between the LEDs.
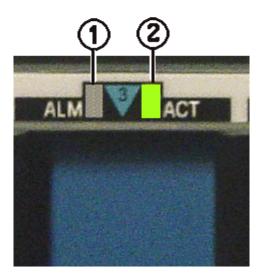
Figure 4-17: Disk Drive Status LEDs

Table 4-15: Disk Drive Status LEDs

Item	Description	Item	Description
①	**Alarm LED** (**(RED)** Lights when the drive has a serious Error.	②	**Active LED (GREEN)** Lights or flashes when the drive is operating and is being read from or written to. It indicates that the disk drive is operational.

Expansion unit status LEDs

The upper right edge of the front of the AMS 2500 expansion unit contains two LEDs that indicate unit status. Figure 4-18 and Table 4-16 describe the array status LEDs and their function.

Figure 4-18: Expansion Unit Status LEDs

Table 4-16: Base Unit Status LEDs

Item	Name/Color	Status	Description
①	**LOCATE** **ORANGE**		The Locate LED lights when an expansion unit has encountered a serious error.
		OFF	Normal operation
		ON	A serious error has occurred in the array. Please contact Hitachi Data Systems Technical Support. See the Getting Help section in the Preface of t his manual.
②	**POWER** **GREEN**	**ON**	Normal operation; the array is fully operational.
		Slow Blink	The firmware download is complete.
		Fast Blink	The firmware is downloading (do not turn off the array).

Expansion unit rear panel

This section describes the components on the rear Panel of the expansion unit. Figure 4-19 shows the key hardware components on the rear panel of an AMS 2500 expansion unit.
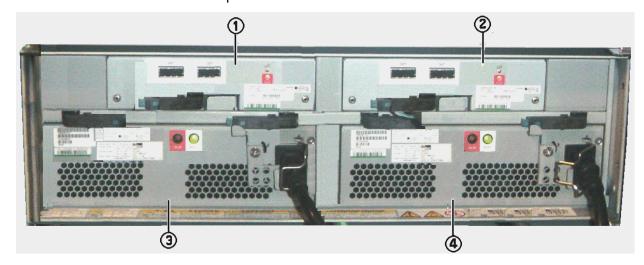
Figure 4-19: Expansion Unit Rear Panel Components

Table 4-17: Hitachi AMS 2000 Family Expansion Unit Rear Panel Components

Item	Description	Item	Description
①	ENC Unit 0	③	Power Supply 0
②	ENC Unit 1	④	Power Supply 1

The rear of the expansion unit provides the connectors used to daisy chain expansion units in the system. See Chapter 5, Installation for details. It also provides LEDs that show the status of the expansion unit and the power supplies that provide power to the expansion unit. Expanded views of the expansion unit and detailed descriptions are located on the following pages.
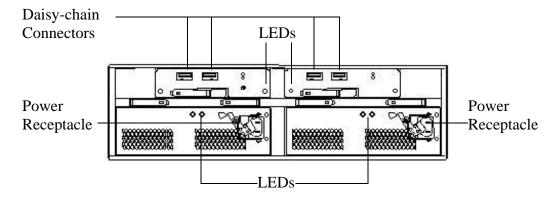
Figure 4-20: Rear View of the Expansion Unit

Expansion unit power supplies

> ⚠️ **NOTE:** This section describes the AC power supplies. See Appendix C, DC-powered units for information about the DC power supplies.

As shown in Figure 4-19, the AMS 2500 has two fully redundant power supplies. If one power supply fails, the other one can supply sufficient power and cooling to the array until the failed power supply is replaced.

Power supply status

Each AC power supply has two LEDs on the panel near the power receptacle. These LEDs indicate the operational status of the power supply, as shown in Figure 4-21 and Table 4-18.
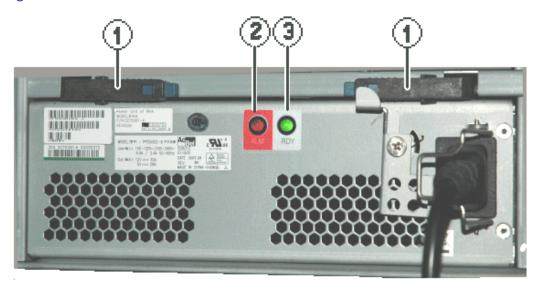
Figure 4-21: Power Supply Operational Status

Table 4-18: AMS 2500 Backup Battery Components

Item	Description
①	Lock Lever (2 places).
②	Alarm LED (red). This LED indicates that the power supply has failed. Although the other power supply can supply sufficient power and cooling for the array, Hitachi Data Systems recommends that you replace the failed power supply as soon as possible. See the Hitachi AMS 2500 Service Guide for instructions.
③	Ready LED (green). On each power supply blinks when the corresponding power receptacle is connected to a working AC outlet, even if an AMS 2500 array is not turned on; otherwise, the LED is OFF.

Power receptacles

Each AC power supply contains a power receptacle that must be connected to a working AC power source using the supplied AC power cable.

NOTE: Hitachi Data Systems recommends that each power supply in the base unit be connected to a different AC source in the rack. If one source fails, the other source continues to supply power to the other power supply. This keeps the array running until power is restored to the failed source.

Safety lock

Like the base unit, the expansion unit AC power supply includes a safety lock. It prevents the lock lever from being opened until the power cable is disconnected from the power supply. This prevents the power supply from being removed from the array with the power applied.

As shown in Figure 4-22, the power supply also includes a power cable retainer that can be used to ensure that the power cable is not accidentally disconnected from the power supply.

NOTE: Hitachi Data Systems recommends that you install the cable retainer to prevent the power cable from accidentally being disconnected from the power supply.
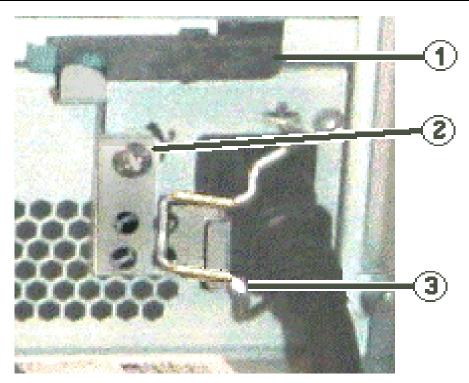
Figure 4-22: Expansion Unit Power Supply Safety Components

Table 4-19: Expansion Unit Power Supply Safety Components

Item	Description	Item	Description
①	Lock Lever	③	Power Cable Retainer
②	Safety Lock		

ENC unit

The ENC unit is mounted in the expansion unit. It is the interface between the expansion unit in which it is mounted and the controller in a base unit, or the ENC unit in another expansion unit. The ENC unit is shown in Figure 4-23.
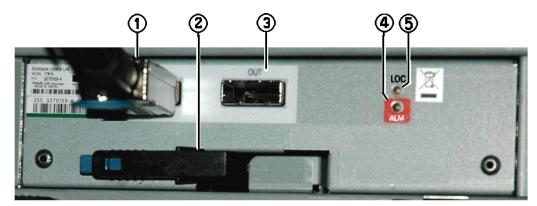
Figure 4-23: Expansion Unit ENC Unit

Table 4-20: Expansion Unit ENC Unit

Item	Description	Item	Description
①	ENC Port (IN) from either a base unit or an expansion unit or high-density expansion unit. Shown with an ENC cable connected to it.	④	Alarm LED **RED** This LED indicates that the ENC unit has failed.
②	Lock Lever	⑤	LOC LED **ORANGE** See Table 4-21.
③	ENC Port (OUT) to a base unit, expansion unit, or high-density expansion unit.		

Table 4-21: LOC LED Blink Descriptions

Number of blinks	Description
6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)
1 (fast)[1]	SRAM error.
2 (fast)	ENC hard error.
3 (fast)	Firmware error in flash memory.
4 (fast)	CUDG error in ENC.
ON	Boot section error in the ENC firmware, a RAM error, or ENC hard configuration error.

1. When blinking fast, the LED is on for 400 ms and off for 200 ms for each fast blink. After the number of fast blinks has completed, the LED goes off for one second.

High-density expansion unit

A high-density expansion storage unit (factory designation RKAKX) provides significant additional storage capabilities for the base units. It contains from 6 to 48 SATA disk drives, four redundant power supplies, and four ENC adapter units (cards). The ENC units manage the drives and are also used to connect the expansion unit to the base unit and other expansion units. See Disk drive configurations on page 4-19 and RAID implementations on page 1-15 for detailed information about the number and type of disk drives that can be installed in an expansion unit.

There are no switches on a high-density expansion unit. Power is turned on and off with a control signal that is routed from the base unit via the ENC cables that are connected to the ENC unit in the high-density expansion unit. An AMS 2500 base unit supports up to 10 high-density expansion units.

> **NOTE:** Disk drives are installed, removed, and replaced from the top of the high-density expansion unit. No tools are required to install or remove the disk drives, but the cover over the drives is locked and must be unlocked from the front panel of the unit (see Figure 4-25 on page 4-26).

High-density expansion unit front view

Figure 4-24 shows the front of a high-density expansion unit with the decorative front bezel installed.

The front panel of the high-density expansion unit includes two sets of Power and Locate status LEDs that show the status of each section (A and B) in the unit and identify the unit in case of a failure. The installation location should provide an unobstructed view of these LEDs.
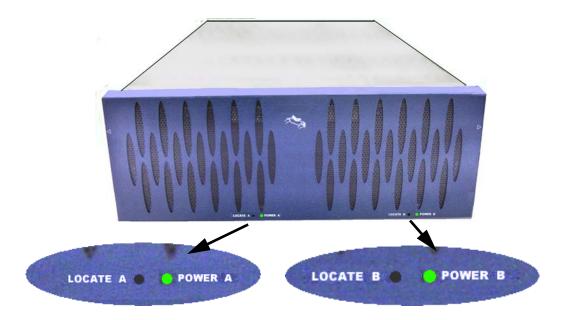
Figure 4-24: High-density Expansion Unit Front View

High-density expansion unit front panel

Figure 4-25 shows the front panel of a high-density expansion unit with the front bezel removed. The Locate and Power LEDS are visible with the front bezel off as sell as when it is installed.
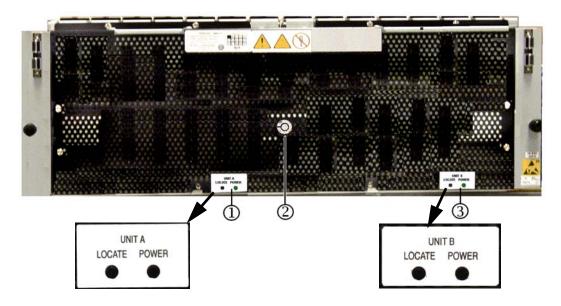
Figure 4-25: High-density Expansion Unit Front Panel

Table 4-22: High-density Expansion Unit Front Panel

Item	Description	Item	Description	Item	Description
①	Unit A Status LEDs	②	Drive Cover Lock	③	Unit B Status LEDs

High-density expansion unit status LEDs

Table 4-23 describes the array status LEDs and their functions.

Table 4-23: High-density Expansion Unit Status LEDs

Item	Name/Color	Status	Description
①	**LOCATE** **ORANGE**	OFF	Normal operation.
		ON	A serious error has occurred in the unit. Please contact Hitachi Data Systems Technical Support. See the Getting Help section in the Preface of this manual.
②	**POWER** **GREEN**	ON	Normal operation; the section is fully operational.
		Slow Blink	The firmware download is complete.
		Fast Blink	The firmware is downloading (do not turn off the array).

High-density expansion unit rear panel

The rear panel of a high-density expansion unit includes four power supplies, four ENC-IN ports, and four ENC-OUT ports. The ports provide the connections to daisy-chain high-density expansion units in the system. See Chapter 5, Installation for details. The rear panel also provides LEDs that show the status of the ENC units and the power supplies. Figure 4-26 shows the hardware components on the rear panel of a high-density expansion unit. Expanded views of the high-density expansion unit power supplies and ENC adapters and detailed descriptions are located on the following pages.
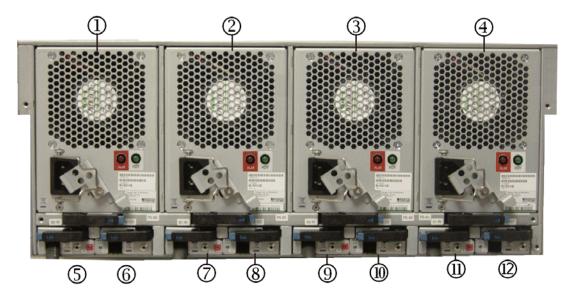
Figure 4-26: High-density Expansion Unit Rear Panel Components

Table 4-24: High-density Expansion Unit Rear Panel Components

Item	Description	Item	Description	Item	Description
①	Power Supply B0	⑤	ENC Unit B0 IN	⑨	ENC Unit A0 IN
②	Power Supply B1	⑥	ENC Unit B0 OUT	⑩	ENC Unit A0 OUT
③	Power Supply A0	⑦	ENC Unit B1 IN	⑪	ENC Unit A1 IN
④	Power Supply A1	⑧	ENC Unit B1 OUT	⑫	ENC Unit A1 OUT

High-density expansion unit power supply

As shown in Figure 4-26, the high-density expansion unit has two fully redundant power supplies for each section in the unit (total of four power supplies). If one power supply in a section fails, the other one can supply sufficient power and cooling to the section until the failed power supply is replaced.

Power supply status

Each power supply has two LEDs on the panel near the power receptacle. These LEDs indicate the operational status of the power supply, as shown in Figure 4-27.

Item	Description
①	**Alarm LED (red)**. This LED indicates that the power supply has failed. Although the other power supply can supply sufficient power and cooling for the array, Hitachi Data Systems recommends that you replace the failed power supply as soon as possible. Contact Hitachi Data SystemsTechnical Support for instructions.
②	**Ready LED (green)**. **OFF** when the power supply is not connected to power. **Blinks** when the corresponding power receptacle is connected to a working AC outlet, and is running the power on self test (POST). **ON** when the poser supply is operational, even if the AMS 2500 array is not turned on.
③	Power Receptacle (see next section).
④	Lock Lever.

Figure 4-27: High-density Expansion Unit Power Supply Components

Power receptacles

Each power supply contains a power receptacle that must be connected to a working AC power source using the supplied AC power cable.

> ⚠ **NOTE:** Hitachi Data Systems recommends that each power supply in the base unit be connected to a different AC source in the rack. If one source fails, the other source continues to supply power to the other power supply. This keeps the array running until power is restored to the failed source.

Safety lock

The high-density expansion unit power supply includes a safety lock that prevents the lock lever from being opened until the power cable is disconnected from the power supply. This prevents the power supply from being removed from the unit with the power applied.

As shown in Figure 4-28, the power supply also includes a power cable retainer that can be used to ensure that the power cable is not accidentally disconnected from the power supply.

> ⚠ **NOTE:** Hitachi Data Systems recommends that you install the cable retainer to prevent the power cable from accidentally being disconnected from the power supply.
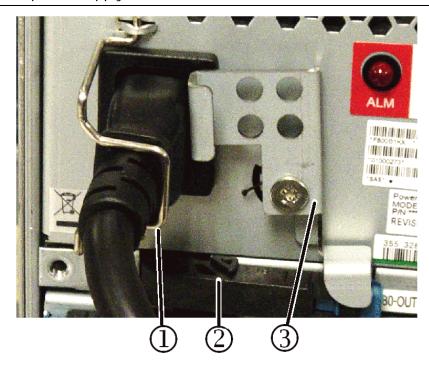
Figure 4-28: High-density Expansion Unit Power Supply Safety Components

Table 4-25: High-density Expansion Unit Power Supply Safety Components

Item	Description	Item	Description	Item	Description
①	Power Cable Retainer	②	Lock Lever	③	Safety Lock

High-density expansion unit ENC connectors

The ENC cards in the high-density expansion unit are mounted inside the unit and do not have direct access to the outside of the unit. Each ENC card is connected to two ENC connector extension units (IN and OUT) that connect the ENC cables to the ENC card. As shown in Figure 4-26 on page 4-27, the connector extensions are located below the power supplies.

The ENC IN connector includes an ALM (alarm) LED that turns on when the ENC card to which it is connected fails. This LED is shown in Figure 4-29.

Figure 4-29 shows the connectors removed from the high-density expansion unit and opened to show how the ENC cable is connected inside.
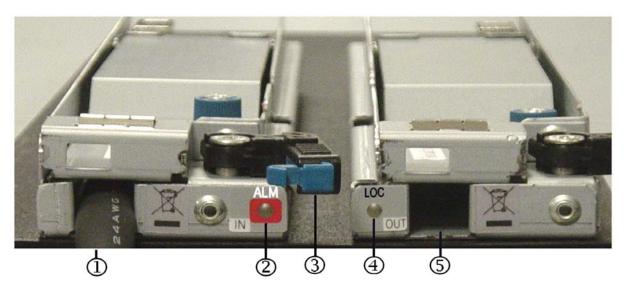
Figure 4-29: ENC Connectors

Table 4-26: ENC Connectors

Item	Description	Item	Description
①	ENC Port (IN). Connects to the OUT port on either the base unit controller the IN port on the ENC unit in an expansion unit or high-density expansion unit.	②	ALM (alarm) LED **RED** This LED indicates that the ENC unit has failed.
③	Lock Lever	④	LOC (locate) LED **ORANGE** See Table 4-21 on page 4-24.
⑤	ENC Port (OUT). Connects to IN on either the controller on a base unit or the IN port on the ENC unit in an expansion unit or high-density expansion unit.		

Hardware components

High-density expansion unit top view

Figure 4-30 shows the top view of high-density expansion unit with the drive cover removed. The disk drives and ENC cards can be seen along with the drive fillers where disk drives are not installed. These are required to prevent loss of cooling air to the drives.

Figure 4-30: High-density Expansion Unit Top View

Table 4-27: High-density Expansion Unit Top View

Item	Description	Item	Description
①	Power Supplies (4) 0	③	Disk Drive Filler (must be in all slots that do not have disk drives installed).
②	ENC Unit (four required)	④	Disk Drive. See Disk Drive Configurations following this table.

Disk drive configurations

As shown in Figure 4-30, a high-density expansion unit has 48 drive slots in the drive section of the unit. Each slot can accommodate one SATA drive or one drive filler. A drive filler is a solid but lightweight box that fills the slot to maintain airflow within the high-density expansion unit if 48 drives are not installed.

The following are requirements for the high-density expansion unit:

- All disk drives in this unit must be SATA drives.

- The Hitachi Data Systems minimum supported number of drives that must be installed in the high-density expansion unit is two in Unit A (slots 0-1) and two in Unit B (slots 0-1).

- After the minimum configuration is met, you can add up to two SATA drives in each unit (which makes a RAID 1 configuration) at a time, or other combinations of drives as required to meet the RAID configurations specified in Chapter 1.

Hardware components **4–31**

Disk drive status LEDs

Each disk drive in the high-density expansion unit has an ALM (alarm) LED on the top edge of the drive that shows the status of the disk drive. This LED, shown in Figure 4-31, indicates that the drive has failed.

Figure 4-31: Disk Drive Alarm LED

Table 4-28: Disk Drive Alarm LED

Item	Description
①	**Alarm LED (**(RED)**)** Lights when the drive has a serious error.

With the drive cover removed, the drives and any lighted alarm LEDs are visible, as shown in Figure 4-32.

Figure 4-32: Alarm LED Locations

High-density expansion unit ENC card

As shown in Figure 4-30 on page 4-31, four ENC units (cards) are mounted in the disk drive area of the high-density expansion unit. The ENC cards are the interfaces between the high-density expansion unit in which they are mounted and the controller in a base unit or the ENC unit in a standard expansion unit or another high-density expansion unit. Each ENC card has a LO (locate) LED and an ALM (alarm) LED. They are described in Table 4-29. The ENC card is shown in Figure 4-33. The upper photograph shows the top edge view of the ENC card, with an expanded view of the status LEDS.
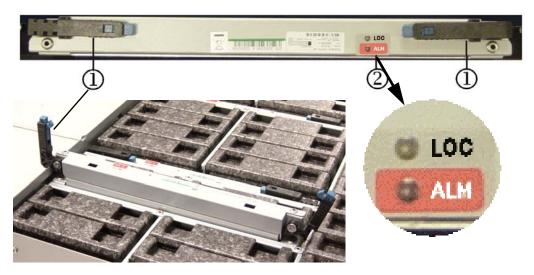
Figure 4-33: High-density Expansion Unit ENC Unit

Table 4-29: High-density Expansion Unit ENC Unit

Item		Description		
①	Lock Lever	Secures the ENC unit in the chassis.		
②	Status LEDs	Alarm **RED**	This LED indicates that the ENC unit has failed.	
		LOCATE **ORANGE**	**OFF**	Normal operation
			Blinking 6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)
			1 (fast)[1]	SRAM error.
			2 (fast)	ENC hard error.
			3 (fast)	Firmware error in flash memory.
			4 (fast)	CUDG error in ENC.
			6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)
			ON	Boot section error in the ENC firmware, a RAM error, or ENC hard configuration error.

1. When blinking fast, the LED is on for 400ms and off for 200 ms for each fast blink. After the number of fast blinks has completed, the LED goes off for one second.

5

Installation

This chapter describes the procedures for installing an AMS 2500. The installation procedures include instructions for connecting data, control, and power cables to the units, as well as references to information for installing additional components. The following key topics are discussed:

❑ Chapter overview and task list

❑ Safety considerations

❑ Preinstallation requirements

❑ Installing an AMS 2500

❑ Installing Storage Navigator Modular 2

Chapter overview and task list

Table 5-1 lists the main installation tasks. Click the page number to display the detailed instructions for each task.

<p style="text-align:center">Table 5-1: Installation Roadmap</p>

Step	Description	See Page
1	Review all safety considerations before you start the installation process.	5-2
2	Prepare the site where you intend to install the array.	5-8
3	Unpack the array. Ensure that all items on the packing list are accounted for and not damaged.	5-21
4	Obtain the required user-supplied items to perform the installation.	5-18
5	Install the array in a rack.	5-26
6	Configure and manage your storage.	7-9
7	Consult the Hitachi Series 2000 Host Installation Guide for your host operating system.	–

Safety considerations

Personal safety

Observe the following guidelines to ensure your safety. Failure to follow these guidelines could result in bodily injury and/or damage to the array or its components.

> **CAUTION! A fully populated AMS 2500 base unit weighs approximately 101 pounds 46 kg). Do not attempt to lift or move the unit alone. Use at least three people to lift and/or move the unit. Before lifting the unit, always turn off the power to the unit and unplug all data and power cables.**
> **An expansion unit weighs 88 lbs (40Kg). Use at least two people to unpack and install an expansion unit.**

Install the base unit at the bottom of the rack. If the array is mounted at the top of the rack, the rack may become unstable and fall.

CAUTION! Be sure to use at least three people to install the unit in a rack. Work carefully to prevent the unit from slipping or falling.

Be sure to install the base unit at the bottom of the rack and any expansion units above it to prevent the rack from falling. Lift the unit up to the height suitable for mounting. Adjust the position of the array so it is seated in the horizontal center of the rack. Slide the array onto the rails in the rack frame. When sliding the array onto the rails, move it gently all the way onto the rails.

WARNING!

- Do not wear loose clothing that could get caught in the chassis or mounting hardware.

- Wear safety glasses when working under conditions that are hazardous to your eyes.

- Do not perform any action that creates a potential hazard to people or makes the equipment or rack unsafe.

- Do not work on the equipment or disconnect cables during a thunderstorm, when wearing a wool sweater or other heavy wool clothing, or when power is applied.

- Disconnect all power before installation.

- Avoid hazards such as moist floor.

- Do not use ungrounded power extension cables.

Electrical safety guidelines

ELECTRIC SHOCK HAZARD!

- The power supplies and backup batteries can contain electricity even when the power is turned off and the units are disconnected from the electrical supply.

- Do not disassemble the power supplies or backup batteries.

- Do not touch the electrical connectors on the rear of the power supplies or backup batteries.

- When replacing power supplies or backup batteries, make certain that the replacement units are the same model number as the units being replaced.

- Do not install or remove any ENC or power cables with the power on (LAN and Fibre Channel cables can be installed or removed with the power on). The ENC cables carry a power control signal to the expansion units.

- When working close to a hazardously energized part, do not work alone. Work with another person who can immediately turn off the power in an emergency.

Handling of cables on the floor

- Protect cables which cannot be routed within a rack and are laid on the floor including across a doorway. Use a cable duct to prevent wear on the cable, tripping over, and walking on the cables, and thus laid on the floor or cables which cross a passage with cable ducts, etc.

- Do not route rack-to-rack cables in the air. Route them down the rack and under the floor if possible. Otherwise route the cables across the floor and use a cable duct to protect them.

Handling of under-floor cables

Use cables that have enough length so that the cables can be laid somewhat loosely on the floor under the computer room floor, and are not hanging or stretched between the racks or arrays. Tight cables can be damaged or broken if stretched beyond their specified limits, as could happen in an earthquake.

Equipment safety

The following safety instructions are designed to help protect the array from various types of physical and electrical damage.

- Moisture. Do not store or install the unit in a place where moisture exists or is likely to condense on the unit.

- Heat. Do not install the unit in a rack which has less than the specified cooling. The AMS 2500 has heat sensors which will cause the unit to shut down if the internal temperature exceeds the specifications. See the *Hitachi Hitachi AMS 2100/2300 Storage System Reference Guide* MK-97DF8008 for details.

- When the array is operating under normal conditions, close the rack doors if the rack has them. This helps to protect the array from electromagnetic interference.

Static-sensitive. Ground yourself before touching.

To avoid damage to the array or array components due to electrostatic discharge (ESD), wear an anti-static wrist strap when handling, installing, or removing any components from the array. Connect the clip to an unpainted part of the array chassis frame to safely channel any static electricity generated by your body to ground. If no wrist strap is available, ground yourself by touching an unpainted part of the array chassis frame.

Warning and safety labels

In this equipment, warning labels are pasted on areas requiring special care. Warnings written on them are primarily for service personnel. Table 5-2 shows symbols contained in warning labels.

Table 5-2: Warning Labels

Symbol	Meaning	Description
	Caution	Cautions indicate that failure to take a specified action could result in damage to the software or hardware.
	WARNING	Warnings indicate that failure to take a specified action could result in loss of data or serious damage to the hardware.
	DANGER	The Danger symbol warns users of possible injury or death if instructions are not followed.
	ELECTRIC SHOCK HAZARD!	This symbol warns users of electric shock hazard. Failure to take appropriate precautions such as not opening or touching hazardous areas of the equipment could result in injury or death.
	Electrostatic Sensitive	The ESD symbol warns users that the equipment is sensitive to electrostatic discharge (ESD) and could be damaged if users do not take appropriate precautions such as using a grounded wrist strap when touching or handling the equipment.
	Burn Hazard	HOT SURFACE! Turn off power and allow to cool before touching.
	No Screwdrivers	Do not disassemble the equipment.
	Heavy	Handle the heavy equipment carefully.
	Caught Fingers	Be careful that your fingers do not get caught in moving parts.
	Equipment Safety	Do not put anything on top of an array that is partially out of a rack

Base unit
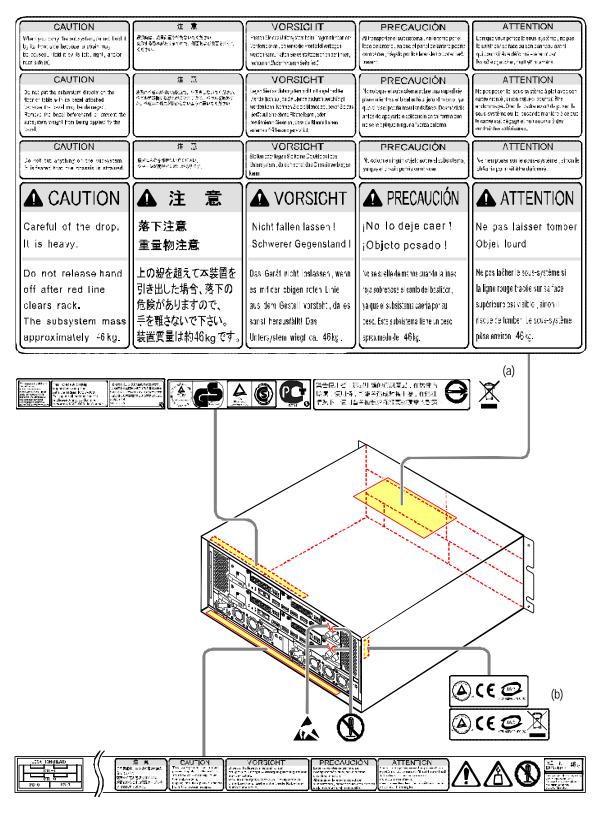
Figure 5-1: Warning and Safety Labels (Base Unit)

The ⊟ label is affixed at location (a) or (b).

Expansion unit

Figure 5-2 shows the location and content of the warning and safety labels on the expansion unit.
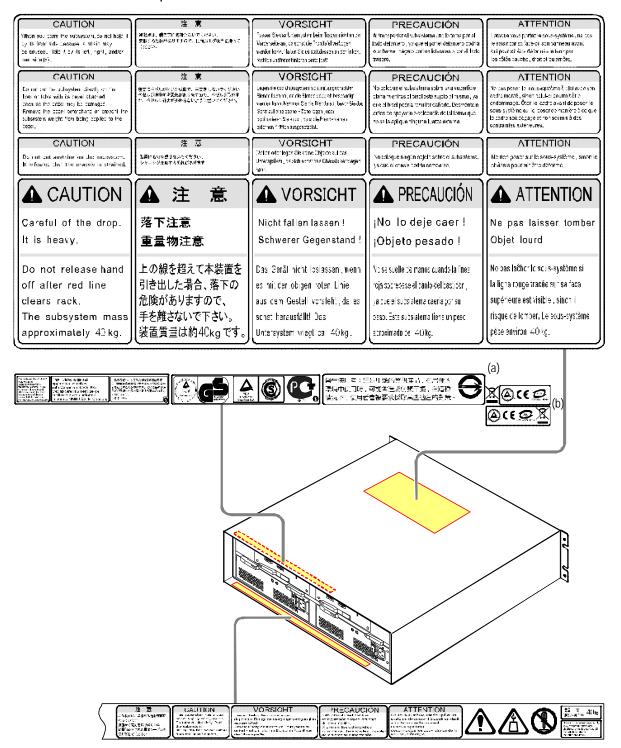
Figure 5-2: Warning and Safety Labels (Expansion Unit)

The ⌧ label is affixed at location (a) or (b).

High-density expansion unit

Figure 5-3 shows the location and content of the warning and safety labels on the high-density expansion unit.
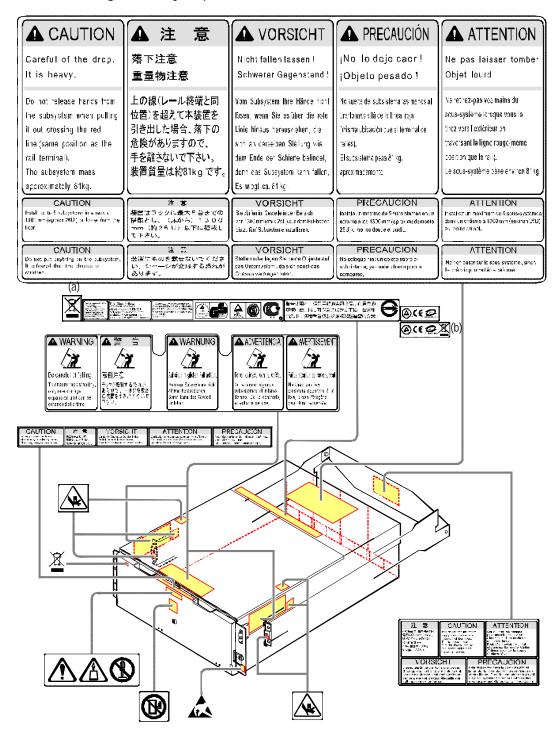
Figure 5-3: Warning and Safety Labels (high-density Expansion Unit)

The ⚠ label is affixed at location (a) or (b).

Battery expansion unit for AC

Figure 5-4 shows the location and content of the warning and safety labels on the Battery Expansion Unit.
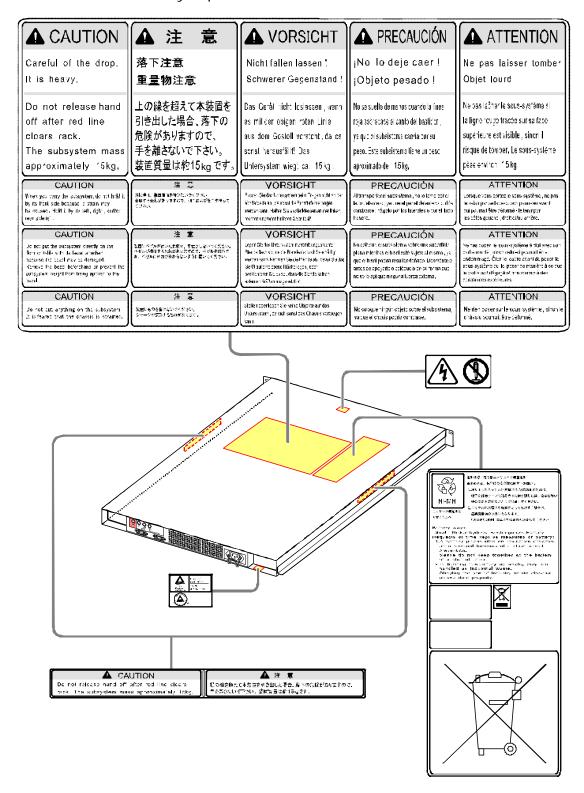
Figure 5-4: Warning and Safety Labels (Battery Expansion Unit)

Disk drives

Figure 5-5 shows the location of the label on the Expansion Unit disk drive.
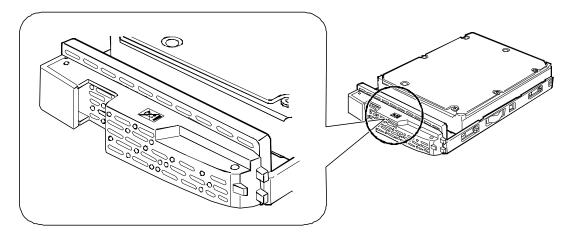
Figure 5-5: Expansion Unit Disk Drive

Figure 5-6 shows the location of the label on the High-density Expansion Unit disk drive.
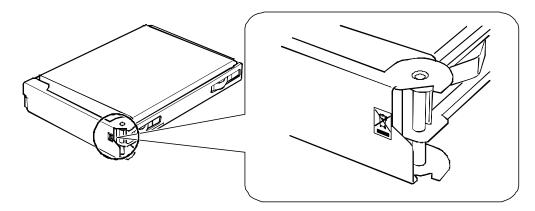
Figure 5-6: High-density Expansion Unit Disk Drive

Battery unit

Figure 5-7 shows the location of the label on the Battery Unit.
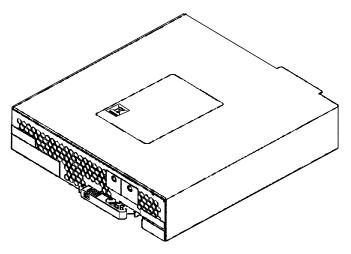
Figure 5-7: Battery Unit

Fan unit

Figure 5-8 shows the location (a) or (b) of the labels on the Fan Unit.
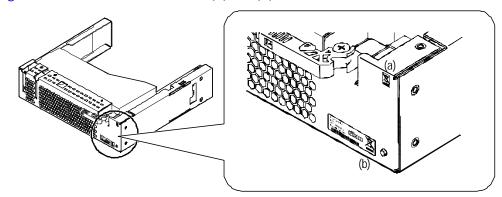
Figure 5-8: Fan Unit Label Locations

Power supply

Figure 5-9 shows the location of the label on the Power Supply for the Base Unit.
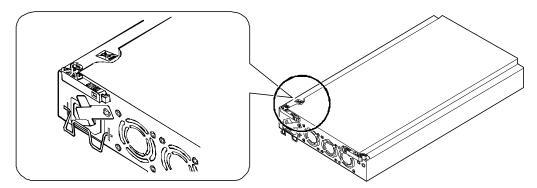
Figure 5-9: Power Supply Label Location for the Base Unit

shows the location of the label on the Power Supply for the Expansion Unit.

Figure 5-10: Power Supply Label Location for the Expansion Unit

shows the location of the label on the Power Supply for the High-density Expansion Unit.
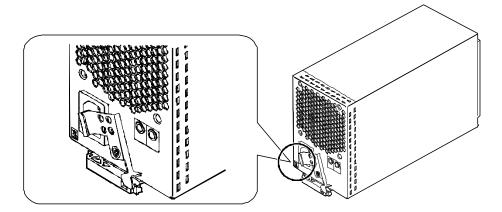
Figure 5-11: Power Supply Label Location for the High-density Expansion Unit

shows the location of the label on the DC Power Supply for the Base Unit.
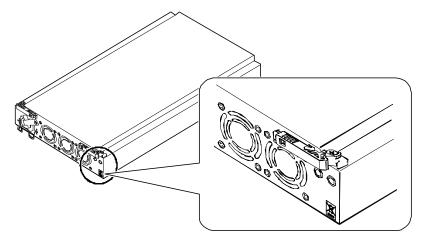
Figure 5-12: DC Power Supply Label Location for the Base Unit

Installation

Figure 5-13 shows the location of the label on the DC Power Supply for the Expansion Unit.
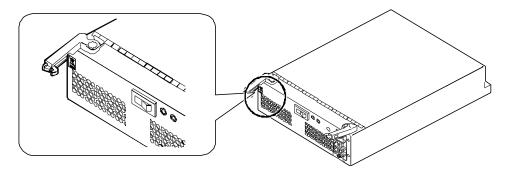
Figure 5-13: DC Power Supply Label Location for the Base Unit

Control unit

Figure 5-14 shows the location (a) or (b) of the labels on the Control Unit.
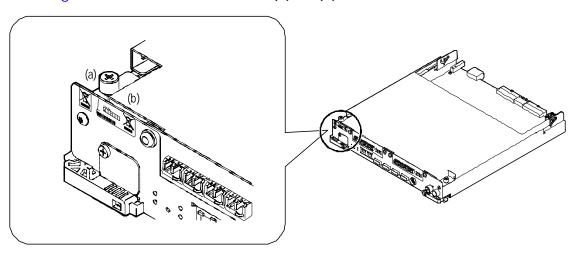
Figure 5-14: Control Unit Label Location

Cache memory

Figure 5-15 shows the location (a) or (b) of the labels on the Cache Memory module.
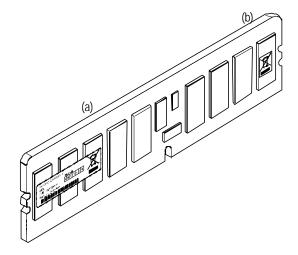
Figure 5-15: Cache Memory Label Location

Interface board

Figure 5-16 shows the location (a) or (b) of the labels on the FC Interface Board.
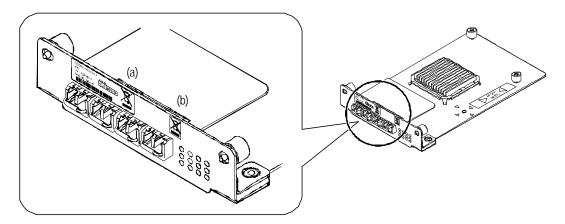
Figure 5-16: Fibre Channel Interface Board Label Location

Figure 5-17 shows the location of the label on the iSCSI Interface Board.
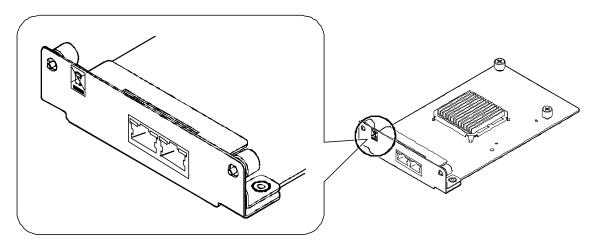
Figure 5-17: iSCSI Interface Board Label Location

Host connector

Figure 5-18 shows the location of the label on the Host Connector.
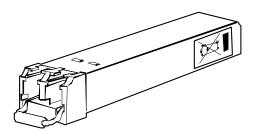
Figure 5-18: Host Connector Label Location

ENC unit

Figure 5-19 shows the location of the label on the ENC Unit of the Expansion Unit.
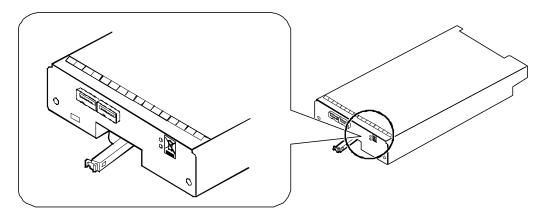
Figure 5-19: ENC Unit Label Location for the Expansion Unit

Figure 5-20 shows the location of the labels (a) or (b) on the ENC Unit of the High-density Expansion Unit.
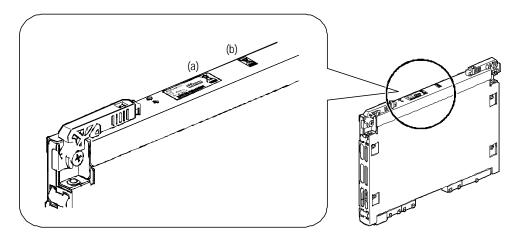
Figure 5-20: ENC Unit Label Location for the High-density Expansion Unit

ENC cable

Figure 5-21 shows the location of the label on the ENC Cable.
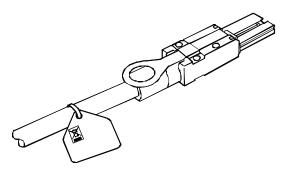
Figure 5-21: ENC Cable Label Location

Cable holder

Figure 5-22 shows the locations of the labels (a) or (b) on the Cable Holders.
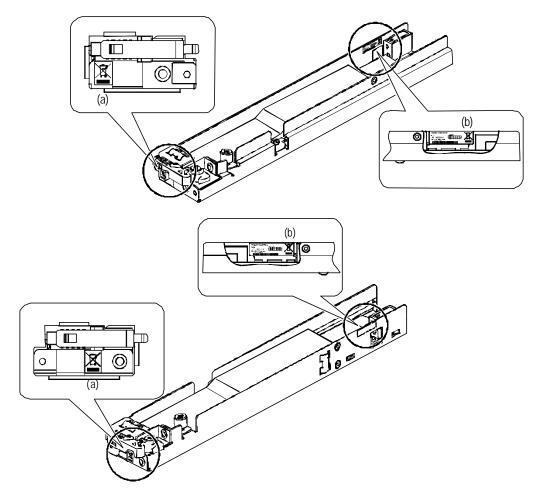
Figure 5-22: Cable Holder Label Locations

Preinstallation requirements

Ensure that the requirements in this section are completed before installing an array.

Site considerations

Ensure that the server room or other facility where the AMS 2500 is installed complies with the electrical specifications and environmental specifications listed in the *Hitachi AMS 2000 Family Storage Features Reference Guide for AMS* and also in the *Hitachi AMS 2000 Storage System Site Preparation Guide*.

User-provided items

Before the Hitachi AMS 2500 array arrives for installation, obtain the following items to ensure proper installation and configuration:

- Physical space necessary for proper array function and maintenance activity
- Electrical input power
- Connectors and receptacles
- Air conditioning
- Floor ventilation areas (recommended but not required)
- Cable access holes in the floor

Installation site

To maintain the Hitachi AMS 2500 performance, the Hitachi AMS 2500 must be installed in a proper environment.
For the environmental specification, refer to "Environmental Specifications" in the *Hitachi AMS 2000 Storage System Reference Guide.*

Do not install an AMS 2500 in any of the following places:

- Where the array would be exposed to direct sunlight
- Where the array would be exposed to variations in temperature and humidity
- Where the array would be near an apparatus that generates electric noise
- Where the array would be near an apparatus that generates a strong magnetic field
- Where the array would be exposed to a great deal of dust
- Where the array would be exposed to frequent vibrations
- Where the rack would be standing on inclined floor

⚠️ **CAUTION! Do not store or install the equipment in a high temperature environment of 40°C or more as this will shorten battery life.**

⚠️ **CAUTION! Ensure that the rack in which the units are mounted is electrically configured with two AC circuits and that the power supplies for each base and expansion unit are connected to separate circuits. This prevents unit failure in case one of the power circuits fails.**

Floor load rating

In the maximum configuration, the array can be configured with 1 AMS 2500 base unit and 32 expansion units. Before installing the base and expansion units in a rack, check the load-bearing specifications of the floor where you are placing the rack. To assure adequate load-bearing capacity, plan for the maximum configuration. See the following table. Be sure to include the weight of the rack when calculating the floor loading.

Table 5-3: Array and Rack Weights

Unit	Details	Approximate Weight (Lbs. / Kg.)
Base Unit	Base Unit	101 / 46
Expansion Unit	Expansion Unit with 15 disk drives	88 / 40
High-density Expansion Unit	High-density expansion Unit with 48 disk drives	178 / 81
Rack	Hitachi Data Systems AMS 2000 rack, including all preinstalled components (rack rails and PDUs)	341 / 155
Seismic Rack	Hitachi Data Systems Seismic Rack for DC power installations	570 / 259
AMS 2500	Base Unit +32 expansion units	2,917 / 1,326
	Base Unit + 32 expansion units + rack	3,258 / 1,481
	Base unit + 10 high-density expansion units + 3 racks (maximum configuration) + 2 battery expansion units	2,629 / 1,195
AMS 2500D	Seismic rack + 2 PDUs + AMS 2500D + 8 Expansion units + 2 battery expansion units	1,465 / 666

Installation area and service clearance

Please see the information and specifications in the *Hitachi AMS 2000 Site Preparation Guide* MK-97DF8149 before installing an AMS 2500 storage system.

Installation area refers to an area with sufficient air circulation. Service clearance refers to an area required to maintain the Hitachi AMS 2500. Be sure to install the equipment in a place to avoid problems; for example, do not install the array such that the cabinet door cannot be opened completely for maintenance work, or where the ventilation would be inadequate.

Notes on installation

- The array is provided with ventilating holes on external covers in order to prevent overheating. Therefore, be sure to leave at least 2 inches (5 cm) in front and rear of the array not block the ventilation holes. Otherwise, the array may overheat and fail.

- Use specified optional parts, cables, and connectors. Otherwise, a fire, a personal injury, or a failure of the array may be caused as well as the deterioration of the performance.

- If you detect an abnormal odor, generation of heat, or smoke, turn off the power to the array from the distribution panel immediately and contact your service personnel.

- Do not put anything heavy on top of an array. Otherwise, the array may fall and cause personal injury.

- Do not put containers that contain any type of liquids or metal articles on top of the array. If they spill and accidentally get into the array, they can cause a fire, an electric shock, or an array failure.

Installation configurations

The AMS 2500 is mounted in an AMS 2000 19-inch rack with extra depth.

Minimum configuration

The minimum configurations of the AMS 2500 is one base unit (does not contain disk drives) and either:

- One expansion unit containing four SAS or four SATA disk drives, or

- One high-density expansion unit containing six SATA disk drives in each section

You must connect at least one expansion unit, as the AMS 2500 base unit does not contain disk drives.

> ⚠️ **NOTE:** After the minimum configurations are met, the expansion units can be configured with a combination of SAS and SATA drives. The high-density expansion unit supports only SATA drives. See Disk drive configurations (page 4-19) for more information.

Maximum configurations

The maximum configurations of the AMS 2500 is one base unit (does not contain disk drives) and either:

- 32 expansion units containing 15 disk drives each, or

- 10 high-density expansion units containing 48 SATA disk drives each.

> ⚠️ **NOTE:** When mixing expansion units and high-density expansion units, the maximum configuration may not be possible. See Scalability (page 1-11) for information about combinations of expansion units and high-density expansion units.

Installing an AMS 2500

Installation road map

Table 5-4 lists the steps to install an AMS 2500 and provides links and page numbers where the detailed steps are located.

Table 5-4: Installation Tasks

Step	Description	Page
1	❐ Unpack the Array	5-21
2	❐ Remove the front bezel	5-24
3	❐ Mount the unit in rack	5-26
4	❐ Turn rack PDBs OFF	5-29
5	❐ Connect Fibre Channel host cables and LAN cable	5-40
6	❐ Connect power cables	5-40
7	❐ Install front bezel	5-49
8	❐ Turn rack PDBs on	5-40
9	❐ Turn array power on (front panel)	5-45
10	❐ Verify that array is ready (check LEDs)	6-4
11	❐ Close rack doors	5-4
12	❐ Install Navigator 2	7-13

Unpacking an array

Observe the following guidelines to ensure your safety. Failure to follow these guidelines could result in bodily injury or damage to the array chassis or components.

> ⚠️ **CAUTION! A fully populated AMS 2500 base unit weighs approximately 101 pounds (46 kg). Use at least three people to lift the array.**
>
> **A fully populated expansion unit weighs 88 lbs (40 kg). Use at least two people to unpack and install an expansion unit.**
>
> **A fully populated high-density expansion unit weighs 178 lbs (81 kg). Use at least three people to unpack and install an expansion unit.**
>
> **Before lifting or moving any unit, always turn off the unit and unplug all data and power cables.**

Install the base unit at the bottom of the rack. If the array is mounted at the top of the rack, the rack may become unstable and fall.

- Unpack the unit indoors. In particular, do not unpack it in areas of high dust, direct sunlight, or where rain or moisture is present.

- Unpack the unit in a place where rapid temperature change does not occur. Dew condensation may develop if it is unpacked in a place where a difference of temperature is extreme.

- Verify that the unpacking and installation of the rack frame are performed by service personnel.

The array contents and packaging are shown in Figure 5-23.

Complete the following steps to unpack an AMS 2500 array.

1. Remove the outer package and packing materials.
2. Take the array out of the polyethylene bag.
3. Remove any shipping tape, etc., that is present.
4. Remove the desiccating agent from the lower section of the array.
5. Check the exterior of the array visually for distortion or damage that happened while the array was being transported to your installation site.
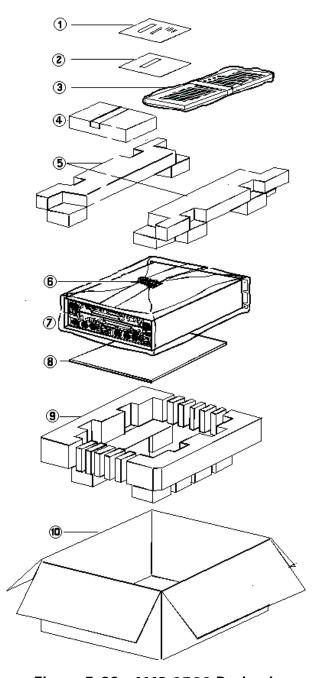
Figure 5-23: AMS 2500 Packaging

Table 5-5: AMS 2500 Packaging

Item	Description	Item	Description	Item	Description	Item	Description
①	Quick Installation Guide	④	Accessory Box	⑦	Base Unit or Expansion Unit	⑩	Shipping container
②	License Agreement	⑤	Buffer Pad (upper)	⑧	Pad		
③	Front Bezel	⑥	Desiccant	⑨	Buffer Pad (lower)		

Installation **5–23**

Checking the contents of the package

- Ensure that the model names, product serial numbers, and quantities of the items in the package agree with the information on the packing list shipped with the array. If any items are missing or damaged, contact the facility where you purchased the array.

- Be sure to keep the key for the front bezel supplied with the array. The key for the front bezel is used for security control and parts replacement. The same key fits all AMS 2500 base and expansion units.
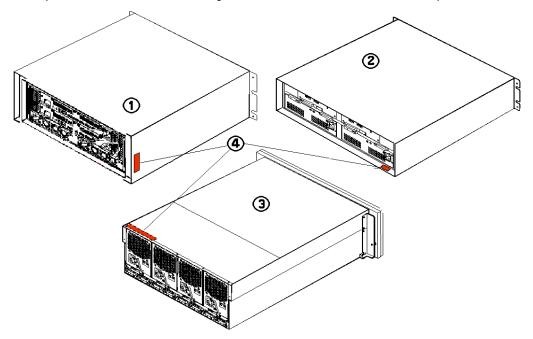
Figure 5-24: Locations of Array Serial Number Labels

Table 5-6: Locations of Array Serial Number Labels

Item	Description	Item	Description	Item	Description		
①	Base Unit	②	high-density Expansion Unit	③	Expansion Unit	④	Serial Number Location

Removing the front bezel

Complete the following steps to remove the front bezel.

> **CAUTION! Attach and remove the front bezel carefully. Otherwise, you may pinch your fingers between the bezel and the chassis as it snaps closed.**

> **NOTE:** When installing or removing the front bezel, be careful not to operate the main switch with the hook or the ON/OFF button of the front bezel.

1. Unlock the front bezel. The key will remain in the lock until the lock is locked again.

NOTE: Insert the key all the way into the lock before turning it. If the key is not inserted all the way, the key and/or the lock may be damaged when attempting to turn the key.

Figure 5-25: Front Bezel Key

2. Grasp the front bezel on both sides and above the center of the unit. Pull the front bezel toward you to disengage it from the ball catches.

3. Disengage the two hooks of the front bezel from the slots on the array chassis by shifting the bezel to the left and remove the bezel. See Figure 5-26. Also see the illustrations in Chapter 4 for details.
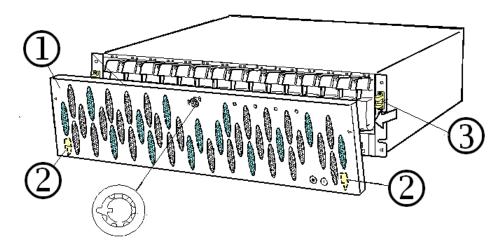
Figure 5-26: Removing the Front Bezel

Table 5-7: Removing the Front Bezel

Item	Description	Item	Description	Item	Description
①	Front Bezel	②	Hook	③	Ball Catches

Mounting the array in a rack

Attaching an EMI gasket

Complete the following steps to attach an EMI gasket, supplied with the rack rail, on the top of the base and expansion units.

1. Peel off the anti-adhesion sheet from the bottom surface of the EMI gasket.

2. Attach an EMI gasket at the front of the base unit, and at both the front and rear of the expansion unit(s), as shown in the following illustrations. Align the gaskets with the front and rear edges of the unit.
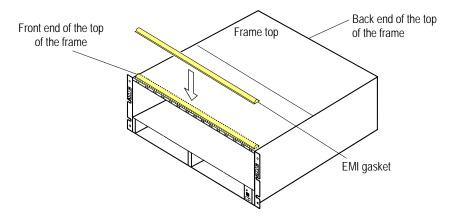
Figure 5-27: Position for Attaching EMI Gasket (Base Unit)
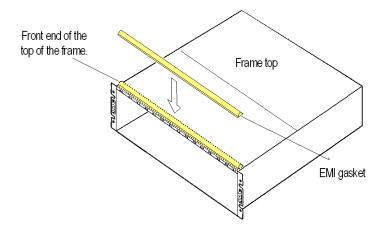
Figure 5-28: Position for Attaching EMI Gaskets (Expansion Unit)

Mounting the array

Please read all of the following safety information before mounting an array in a rack. More detailed safety instructions are included at the beginning of this chapter.

⚠️ **NOTE:** Rack rails should be installed in the rack by qualified personnel before installing the array.

⚠️ **CAUTION! Do not block the vent holes in the rack or any of the units. Without adequate cooling, the array may overheat or fail.** Install the array so that the air intakes and the air exhaust remain clear. See Installation area and service clearance (page 5-19) for details.

⚠️ **WARNING!**

- Be careful when lifting the array, especially if it is being installed high up in the rack. It could cause serious injury or damage if it falls.

- Hitachi Data Systems recommends using mechanical lifting equipment to help install the array. However, the equipment should be operated only by trained and qualified personnel.

- When using a mechanical lift to help install the array, do not move the lift away from the rack or lower the elevator until the red line on the label attached to the array is inside the rack. Otherwise, the array may fall.

- When lowering the elevator on a hydraulic lift, open the valve slowly. If you open the valve quickly, the elevator could drop rapidly and may cause personal injury.

- When a mechanical lift is not available, use at least three people to install the array into the rack.

- Work carefully when positioning, fastening, or doing any other operations on the array. The base unit weighs 125 lbs (55 kg) and the expansion unit weighs 88 lbs (40 kg).

- Whenever possible, install the base units near the bottom of the rack. This helps to prevent the rack from falling over.

To mount the array in a rack:

1. Lift the array only up to the height needed to mount it in the rack.

2. Adjust the position of the array so that it centered between the rack rails and vertically even with the rails onto which it will be mounted.

3. Gently slide the array onto the rails in the rack.

Fastening the array to the rack

Complete the following steps to fasten the array to the rack.

1. As shown in Figure 5-29, fasten the array to the rack rails with four M5×10 binding screws provided with the rack.
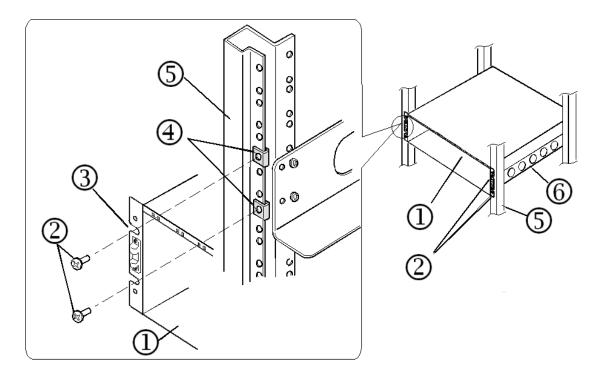
Figure 5-29: Fastening Front Side of the Array

Table 5-8: Fastening Front Side of the Array

Item	Description	Item	Description	Item	Description
①	Array	③	Mounting Slot	⑤	Rack Frame
②	Mounting Screw, M5-10	④	Nut	⑥	Rail

2. Fasten the rear side of the array to the rack rails, as shown in Figure 5-30.

3. Shift each of the two stoppers in the direction shown by the arrow and make it contact the frame.

4. Tighten the binding screws.

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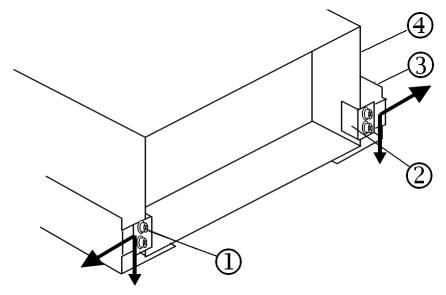
Figure 5-30: Securing Rear of the Array

Table 5-9: Securing Rear of the Array

Item	Description	Item	Description	Item	Description		
①	Binding Screw	②	Stopper	③	Rail	④	Frame

Connecting cables

⚠ **CAUTION! Be careful to connect cables correctly. Leave a service loop in each cable to facilitate maintenance and prevent it from being stretched or pulling on the connectors, and to leave some slack in case of an earthquake.**
Before connecting any cables to the array, make sure that the circuit breakers on the PDBs (power distribution busses) are turned OFF.

Connecting ENC cables

Use the ENC cables supplied with the expansion unit and high-density expansion unit to connect an ENC unit in an expansion unit to the base unit controller(s) and/or to other expansion units or high-density expansion units. Four ENC cables are supplied with each expansion unit.

⚠ **CAUTION! The connectors on the ends of an ENC cable are different. Check the label on the connectors of an ENC cable before plugging it in.**

As shown in Figure 5-31, the connector that plugs into the control unit on a base unit is stamped with a diamond. This connector can also plug into an OUT connector on an ENC unit. The connector that plugs into the IN connector on an ENC unit is stamped with a circle.

Hitachi AMS 2500 Storage System Hardware Guide
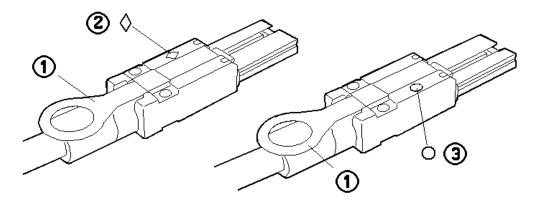
Figure 5-31: ENC Connectors

Table 5-10: ENC Connectors

Item	Description	Item	Description	Item	Description
①	Lock Tab (pull tab to unlock connector before unplugging it)	②	Diamond stamp on controller and ENC OUT end of cable	③	Circle stamp on ENC IN end of cable.

- When two or more expansion units are connected, both cables in ENC unit #0 and ENC unit #1 should be connected to the expansion unit.

- If it is necessary to bend an ENC cable to connect it, keep the bend radius as large as practical, and not less than 30 mm. This prevents excessive stress on the cable and the connector.

- The IN and OUT connectors on the ENC units have blue and green labels respectively.

Complete the following steps to install the ENC cables. Refer to Figure 5-32 (page 5-32) when installing ENC cables.

1. Remove the rubber cap from the ENC connector on the control unit.

2. Connect the ENC cable to the control unit.

3. Connect the ENC cable to the ENC unit of the expansion unit.

> ⚠ **NOTE:** Connect the control unit #0 of the base unit with the ENC unit #0 of the expansion unit and the control unit #1 of the base unit with the ENC unit #1 of the expansion unit.

4. Connect the cable marked in white from PATH#0 of base unit to the IN side of the ENC unit of expansion unit (Unit ID#1).

5. When three or more expansion units are mounted, connect the connector labeled OUT and the connector labeled IN on the ENC unit of the expansion units using the ENC cables.

   a. Remove the rubber cap of the ENC units in the locations where the ENC cables are to be connected.

   b. Connect each of the connectors the OUT side and the IN side of the ENC unit, from which the rubber cap was removed, with the ENC cables.

6. After connecting the ENC cable, roll up the excess part of the cable in a circle, tighten it lightly with the reusable cable tie.

> ⚠️ **CAUTION! To prevent electromagnetic interference from a power cable to the signals in an ENC cable, do not route power cables near an ENC cable.**
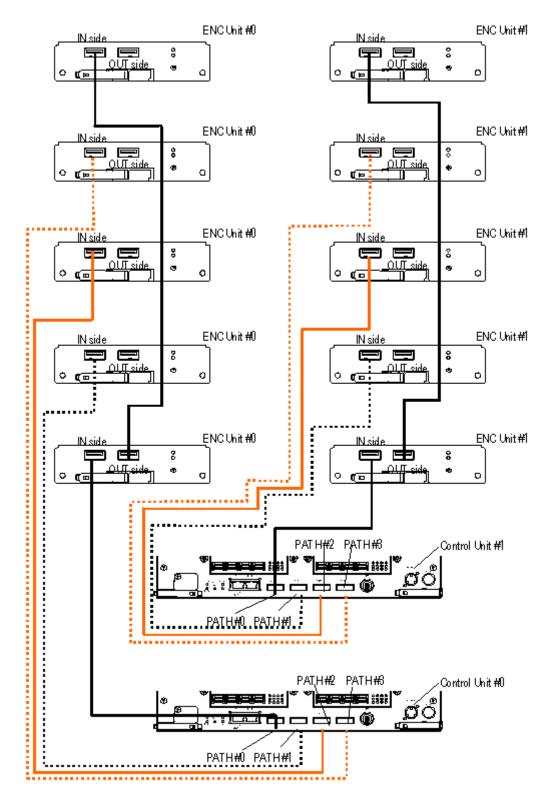
Figure 5-32: Connecting ENC Cables from an AMS 2500 to the Expansion Units
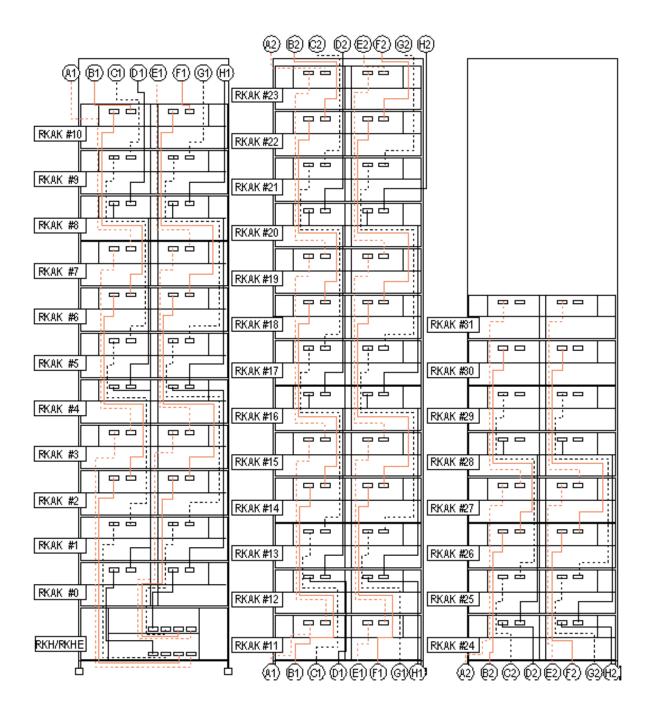
Figure 5-33: Connecting ENC Cables from an AMS 2500 to 32 Expansion Units

Connecting ENC cables (High-density expansion unit)

This section provides basic instructions to connect ENC cables to the high-density expansion unit. See the previous section for information to connect cables to a standard storage expansion unit.

⚠️ **NOTE:** The following information is provided for convenience to HDS service personnel and HDS partners who are authorized to perform these procedures. Complete instructions are located in the AMS 2000 Maintenance Manual.

Use the ENC cables supplied with the high-density expansion unit to connect an ENC unit in a high density expansion unit to the base unit controller(s) and/or to other expansion units or high-density expansion units. Two ENC cables are supplied with each high-density expansion unit.

⚠️ **CAUTION! The connectors on the ends of an ENC cable are different. Check the label on the connector before plugging it in. ENC connectors are designed to slide easily into the connector on the ENC unit. If a connector does not plug in easily, check the connector to make sure you have the correct end of the cable.**

As shown in Figure 5-34, the connector that plugs into the control unit on a base unit is stamped with a diamond. This connector can also plug into an OUT connector on an ENC unit. The connector that plugs into the IN connector on an ENC unit is stamped with a circle.
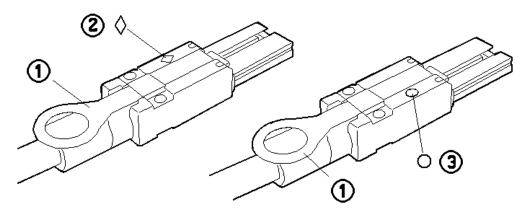
Figure 5-34: ENC Connectors

Table 5-11: ENC Connectors

Item	Description	Item	Description	Item	Description
①	Lock Tab (pull tab to unlock connector before unplugging it)	②	Diamond stamp on controller / ENC OUT end of cable	③	Circle stamp on ENC IN end of cable.

NOTE:

• When two or more expansion units are connected, both cables in ENC unit #0 and ENC unit #1 should be connected to the high-density expansion unit.

• If it is necessary to bend an ENC cable to connect it, keep the bend radius as large as practical, and not less than 30 mm. This prevents excessive stress on the cable and the connector.

• The IN and OUT connectors on the ENC units have blue and green labels, respectively.

Complete the following steps to install the ENC cables on a high-density expansion unit. Note that the ENC cable does not plug directly into the ENC unit in the high-density expansion unit.

1. Install the ENC cable in the high-density expansion unit cable holder, as shown in Figure 5-35.

Figure 5-35: ENC Cable Holder

2. Remove the rubber cap from the ENC connector on the control unit.

3. Connect the ENC cable to the control unit.

4. Route the cable through the cable routing bars to the appropriate high-density expansion unit. See Figure 5-36 and the diagrams in the installation chapter in the maintenance manual.

Figure 5-36: ENC Cable Routing on High-density Expansion Unit

5. Open the lock lever on the ENC cable holder and slide the cable holder into the appropriate slot on the high-density expansion unit, as shown in Figure 5-37.
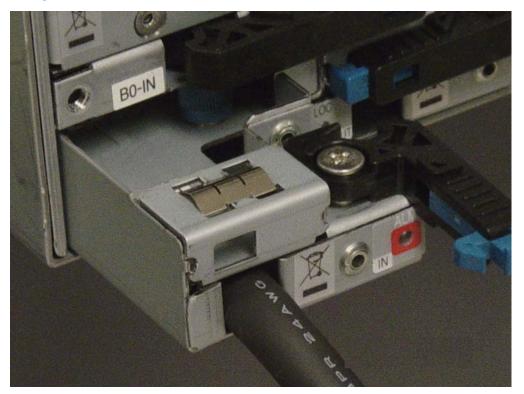
Figure 5-37: Connecting an ENC Cable to a High-density Expansion Unit

6. Slide the cable holder all the way into the high-density expansion unit. As you do so, the lock lever will close part way.

7. Push inward on the lock lever to close it. Ensure that the lock button snaps into place and locks the lever closed.

Cable routing diagrams

The following diagrams are examples of how to connect ENC cables from and AMS 2100/2300 to a variety of expansion unit and high-density expansion unit configurations.
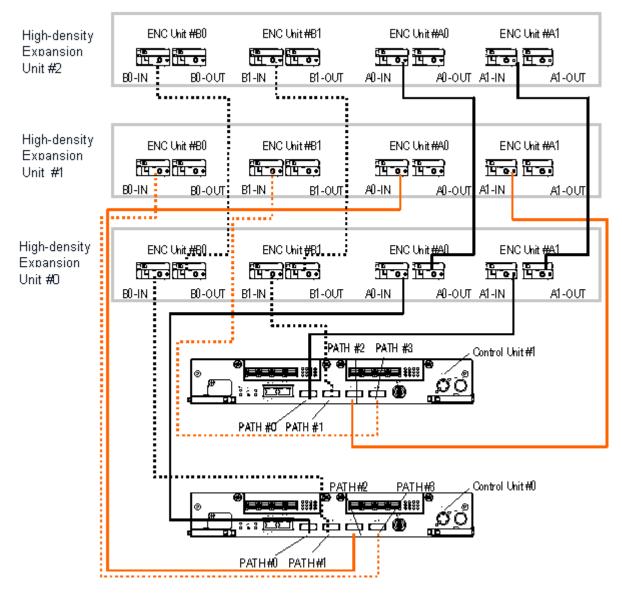
Figure 5-38: Connecting ENC Cables, AMS 2500 and Three High-density Expansion Units
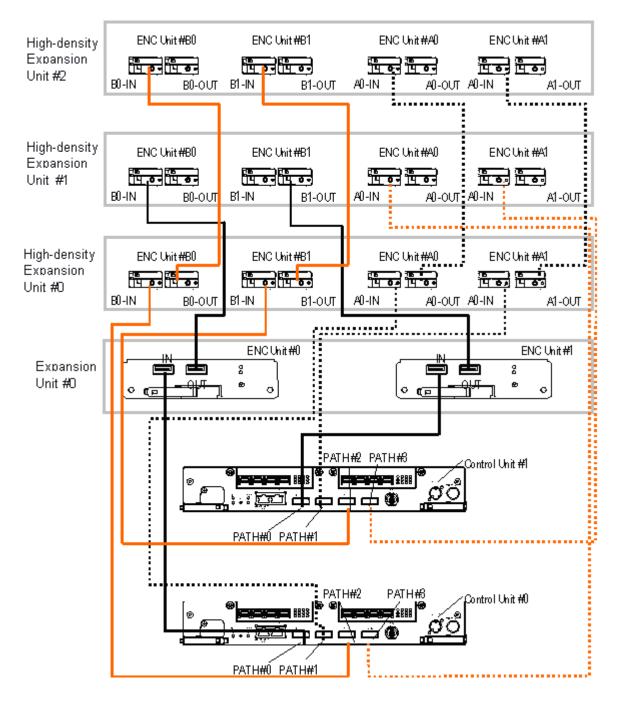
Figure 5-39: Connecting ENC Cables, AMS 2500, one Expansion Unit, and Three High-density Expansion Units
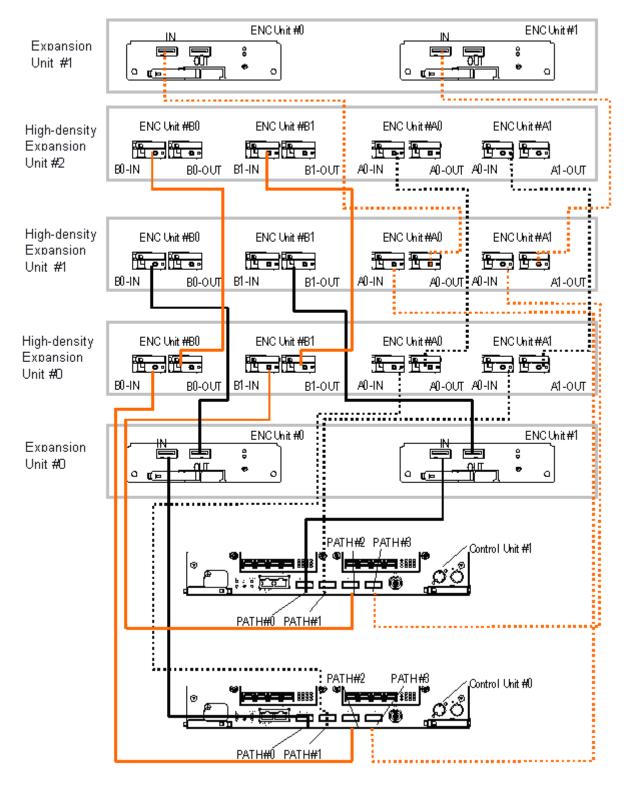
Figure 5-40: Connecting ENC Cables, AMS 2500, two Expansion Units, and three High-density Expansion Units

Connecting a LAN cable

Perform the following steps to connect a LAN cable.

1. Connect a (customer provided) CAT 5 or CAT 6 Ethernet LAN cable to the user LAN port on the control unit #0 or control unit #1 in the array.

2. Connect the other side of the LAN cable to a customer provided LAN-HUB or to the LAN port on the management PC.

- Use LAN cross cables when connecting to the LAN-HUB with 10/100BASE-T (Category 5 or 6). Use straight LAN cables when connecting the array directly to a management PC.

- The default IP address for the user LAN port on the control unit #0 is 192.168.0.16. The default IP address for the user LAN port on the control unit #1 is 192.168.0.17.
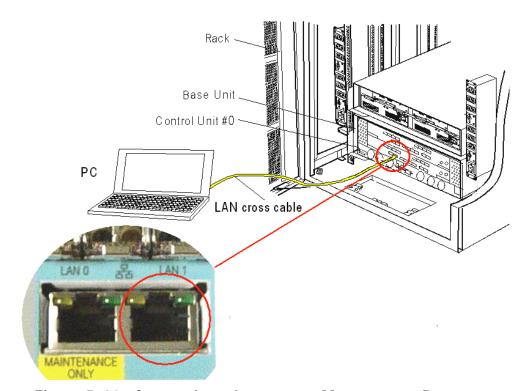
Figure 5-41: Connecting a Laptop to a Management Port

Connecting power cables

Complete the following steps to connect power cables to the rack PDB.

CAUTION! Check all power cables for cuts or cracks in the insulation before using them. Replace the cable as needed.

NOTE: Make sure that conductors shall be provided with 30 A overcurrent protection in accordance with Article 240 of the National Electrical Code, ANSI/NFPA 70, and the Canadian Electrical Code, Part 1, CSA C22.1, Section 14.

1. Make sure that the switch or breaker on each PDB in the rack has been turned off.

2. Insert the power cable plug into the receptacle on each power supply.

3. Slice the power cable retainers onto the power cables to prevent them from being pulled out of the receptacles accidentally.

4. Plug the power cable connected to power supply #0 into a PDB on the left side of the rack and plug the power cable from power supply #1 into the PDB on the other side of the rack. This ensures that the power supplies are connected to different AC sources and are therefore redundant.

⚠ **CAUTION! If both power supplies are connected to the same power source, both will fail if the AC power fails and the unit will also fail.**

- Do not plug any power cable other than a power cable from an array to an outlet on the PDB.

- Make sure that the total load on both of the PDBs in a rack does not exceed 16 amps.

- Limit the load on each PDB in the rack to 8 amps. Use the following values to calculate the load:

Table 5-12: AMS 2500 Power Requirements

Unit	Current at 100 - 120VAC
AMS 2500 base unit	2.2 Amps
Expansion Unit	2.4 Amps
high-density Expansion Unit	3.7 Amps x 2

5. After inserting a plug into a socket on a PDB, install the cable clamp to prevent it from accidentally becoming unplugged.

6. Route the power cables.

7. Recheck the power cable plug to make sure it is still secure in the PDB and that it has not become loosened during the cable routing process. See Figure 5-42.

Installation **5–41**
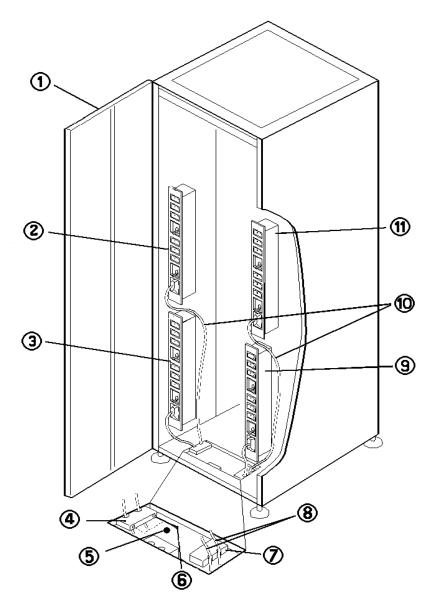
Figure 5-42: Connecting Power Cables (Rack PDB)

Table 5-13: Connecting Power Cables (Rack PDB)

Item	Description	Item	Description	Item	Description
①	Rear Door	⑤	Opening for cable	⑨	Power Distribution Bus #10
②	Power Distribution Bus #01	⑥	Hex nut, socket head	⑩	Power cable
③	Power Distribution Bus #00	⑦	PDB #10/11 side	⑪	Power Distribution Bus #11
④	Cable holder	⑧	Power Cable		

Connecting Fibre channel cables

Two types of Fibre Channel interface cables are provided to connect the base unit to the HBA (Host Bus Adapter on the host computer. Table 5-14 describes the connector shapes and cable types. Choose the applicable cables from the table for your installation.

Table 5-14: Connecting the Fibre Channel Interface Cables

Fibre Channel Interface Side (AMS 2500 side)			Host computer side (HBA (Host Bus Adapter), SW)	Types of Cables to be Connected	
Parts Name of Connected Cable Plug	Model	Connector Form	Connector Form	Cable Connector Shape	Model
Control Unit (including Fibre Channel Interface board)		LC	SC	LC-SC cable	A-6515-GMxS[1]
					A-6515-HMxS[1]
			LC	LC-LC cable	A-6515-GMxL[1]
					A-6515-HMxL[1]

1. "x" denotes a value (1 to 300) that shows a cable length

Complete the following steps to connect the Fibre Channel cables.

⚠ **NOTE:** When bending Fibre Channel cables, keep the radius of the bend to at least 1.2 inches (30 mm) to prevent cracking or breaking the fibre optic conductor.

1. Connect the Fibre channel cables from the host systems to the desired Fibre Channel ports (host connectors) on the AMS 2500 control unit. Insert the connectors on the cables until they are securely fastened to the host connectors, and the lock snaps into place. See Figure 5-43.
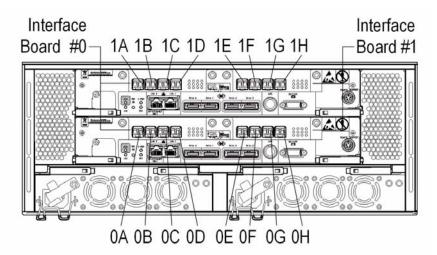
Figure 5-43: Fibre Channel Interface Cable Connection Ports

2. Pull all the Fibre Channel cables into the rack frame passing them through an opening for cables on the bottom plate of the rack frame.

3. Using the reusable cable ties provided, bind the cables together and fasten them securely to the rack at enough places to keep the cables close to the rack over their entire length. Leave extra length for each cable so that the connectors will not be pulled out of the sockets. See Figure 5-44.
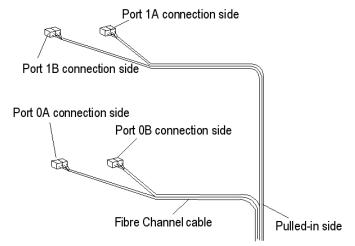
Figure 5-44: Binding Fibre Channel Cables Together

Connecting iSCSI cables

Complete the following steps to connect the iSCSI cables.

NOTE: When bending iSCSI cables, keep the radius of the bend to no less than 1.2 inches (30 mm) to prevent cracking or breaking the fibre optic conductor.

1. Connect the iSCSI cables from the host systems to the desired iSCSI ports on the AMS 2500 control unit. Insert the connectors until the lock snaps into place.
2. Pull all the iSCSI cables into the rack passing them through the opening for cables on the bottom plate of the rack.

(a) RKH (only iSCSI)

(b) RKH (iSCSI and Fibre Channel intermix)

(c) RKH (Fibre Channel and iSCSI intermix)
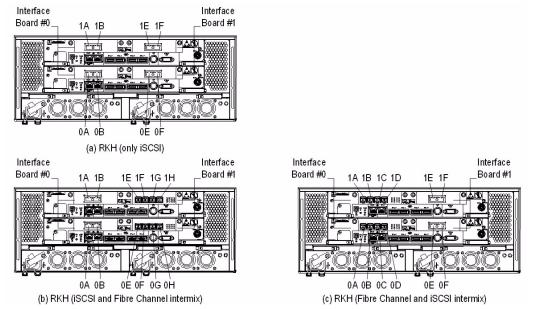
Figure 5-45: Connection Port for iSCSI Interface Cables

3. Using the reusable cable ties provided, bind the cables together and fasten them securely to the rack at enough places to keep the cables close to the rack over their entire length. Leave extra length for each cable so that the connectors will not be pulled out of the sockets. See Figure 5-46.

Port 1B connection side   Port 1A connection side

Port 0A connection side   Port 0B connection side

iSCSI cable   Pulled-in side
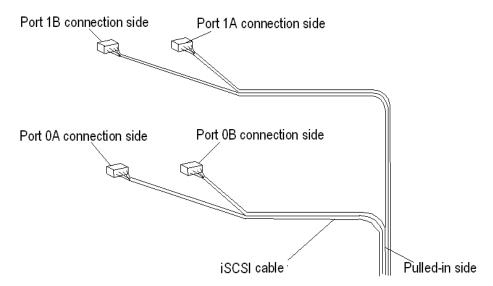
Figure 5-46: Binding iSCSI Cables Together

Turning the array ON

1. Turn the power switches or circuit breakers in the power distribution busses in the rack to ON.

2. Turn the array power ON. See the instructions in Chapter 6, Power On/ Off procedures.

Adding a disk drive

NOTE: Disk drives should be installed with the unit running and with the ready LED ON. Do not install a drive when any of the LEDs are blinking or when the Alarm LED is on.

Task overview

1. Remove only ONE dummy disk drive.

2. Within 10 minutes after you remove the dummy disk drive, install a new disk drive in the empty slot.

3. Repeat steps 1 and 2 for each drive you add to the array.

Installing a disk drive

Static-sensitive. Ground yourself before touching.

• To prevent part failures caused by an electrostatic discharge (ESD) from your body, wear an anti-static wrist strap any time you are handling unprotected parts, including while you are unpacking, removing, or installing them.

• When you install a component, support its metal frame with one hand and touch the metal frame with the hand that is wearing the wrist strap.

CAUTION! Remove only one component at a time from an operating array. Removing more than one component can cause too much cooling air to be lost from the array. After several minutes, this can cause the array to overheat or fail.

To add a disk drive to a unit:

1. Remove the dummy disk drive from the slot where you want to install a new drive.

2. Remove the new disk drive from its static-protective container.

3. Check the model number on the drive and make sure that it is the correct model, type (SAS/SATA), capacity, and speed for the array.

4. Insert the disk drive into the desired slot:

   a. Fit the disk drive in the guide rail of the RKS/RKM/RKAK and slide it in the direction shown by the arrow.

   b. Pull outward on the bottom of the lock tab to unlock the lock lever. Then pull outward on the top of the lock lever until that tab on the bottom is nearly horizontal.

   c. Push the drive into the slot until it reaches the position where the tab at the bottom of the of the lock lever can be entered into the slot at the lower part of the frame on the front side of the disk array unit.

   d. Push the lock lever inward toward the unit in which the drive is installed until the lock tab snaps closed. Push inward on the lock tab to make sure it is locked.

> ⚠️ **NOTE:** If the lock lever is closed too far when you insert the drive, the tab at the bottom of the lever will hit the edge of the unit frame when you try to install the drive. If this happens, open the lock lever enough to raise the tab and slide the drive inward until the tab can be inserted into the slot in the frame.

5. Pull the handle lightly to make sure that the disk drive cannot be accidentally pulled out of the unit.

6. Install a dummy disk drive in each disk drive slot in which no disk drive is installed. Insert it into the slot slowly so that the latch on the dummy disk drive is on the right side when the drive is installed.
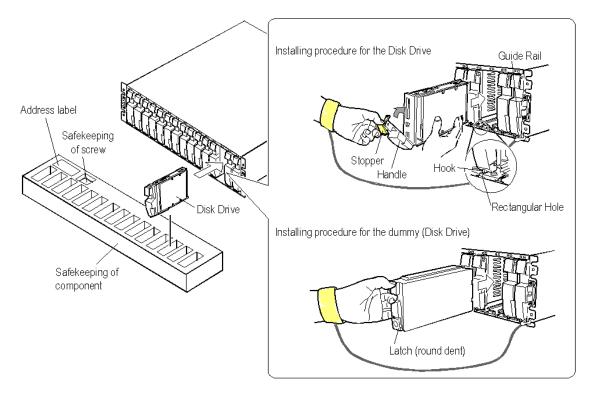
Figure 5-47: Installing the Disk Drive/Dummy disk drive
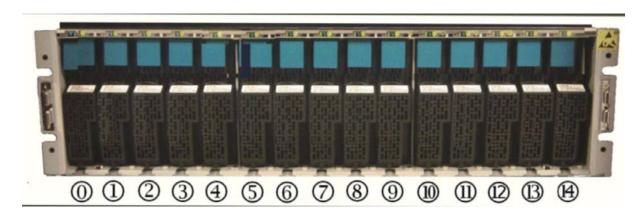
Figure 5-48: Disk Drive Mounting Locations

Removing a disk drive

When you install a disk drive or other component in the array, support its frame with your hand that has the wrist strap on it. You can discharge static electricity by touching the metal plate. See Figure 5-49.

> **Static-sensitive. Ground yourself before touching.** Be sure to put on a wrist strap that's connected to the chassis before starting work in order to protect the disk drives from electrostatic discharge, and do not take it off until you complete the procedure.
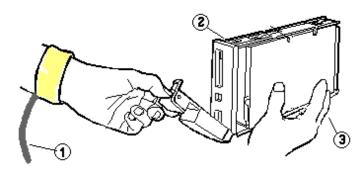
Figure 5-49: Installing a Disk Drive

Table 5-15: Installing a Disk Drive

Item	Description	Item	Description	Item	Description
①	Wrist Strap	②	Disk Drive	③	Touching the metal frame of the disk drive

To remove a disk drive:

1. Pull outward on the bottom of the lock tab to unlock the lock lever. Then pull outward on the top of the lock lever until that tab on the bottom is nearly horizontal.

2. Gently pull the drive out of the slot and close the lock lever.

3. Put the drive into an antistatic container.
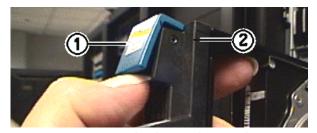
Figure 5-50: Unlocking the Lock Lever

Table 5-16: Unlocking the Lock Lever

Item	Description	Item	Description
①	Lock Tab	②	Lock Lever

Attaching a front bezel

Complete the following steps to attach the front bezel to the expansion unit.

> ⚠ **CAUTION! Attach and remove the front bezel carefully. Otherwise, you may pinch your fingers between the bezel and the chassis as it snaps closed.**

> ⚠ **NOTE:** When installing or removing the front bezel, be careful not to operate the main switch with the hook or the ON/OFF button of the front bezel.

> ⚠ **NOTE:** You must unlock the front bezel before you can install it. The key for the front bezel is required to unlock it.

1. Insert the key into the keyhole on the front bezel and release the lock.
2. Grasp the front bezel on both sides and above the center of the unit.
3. Engage the two hooks of the bottom of the front bezel into the slots on the expansion unit chassis, as shown in Figure 5-51.
4. Push the top of the front bezel toward the chassis to engage it into the ball catches.
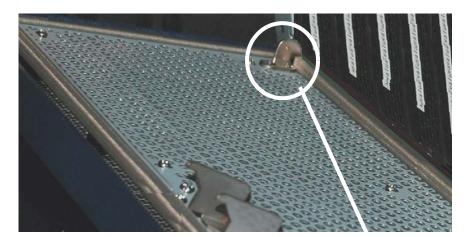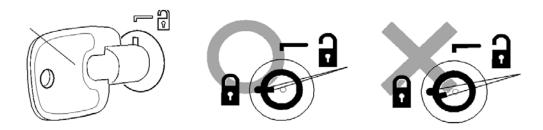
Figure 5-51: Installing a Front Bezel

NOTE: Insert the key all the way into the lock before turning it. If the key is not inserted all the way, the key or the lock may be damaged when attempting to turn the key.

5. Remove the key from the front bezel and store it in a safe place.

   • When removing the key after locking up the front bezel, be sure the key is aligned properly with the positioning mark on the lock.

   • When the key is pulled off in the state where the groove is not aligned with the positioning mark on the lock, damage to the lock might occur.

Installing Storage Navigator Modular 2

Detailed information about Navigator 2, including features, installation instructions, and operation is located in Chapter 7, Configuration. See Installing Navigator 2 (page 7-13).

6

Power On/Off procedures

This chapter provides the procedures to apply power to and remove power from an AMS 2500 Storage system. The following key topics are covered:

❑ Task list

❑ Prerequisites

❑ Storage system power on

❑ Storage system power off

❑ Recovering from a power outage

Task list

The process of applying power to the unit includes the following tasks:

- Ensure that all prerequisite tasks have been completed and that the electrical and environmental operating requirements have been met. See below and the specifications listed in the Hitachi AMS 2500 Reference Guide.

- Ensure that at least one expansion unit or high-density expansion unit is connected to the base unit and any other expansion units in the system. Ensure that they are plugged in and operating (there are no switches on expansion units).

⚠️ **NOTE:** Regarding the Expansion Unit Power, when the power supplies in the expansion unit are plugged in, the POST (power on self test) starts immediately and takes about 4 minutes to complete. When the test completes successfully, the expansion unit is in standby mode until the main power switch on the base unit is turned on. Power to the ENC unit and the drives is controlled from the base unit via the ENC cable. If only one power supply is plugged in, the fans in the other supply will run at high speed to ensure that the expansion unit has sufficient cooling.

Prerequisites

Verify that the following prerequisites are met before turning on the Main Switch on the base unit:

- Ensure that all prerequisites and requirements described in Chapter 5, Installation and Appendix A, Specifications, have been met.

- Ensure that the circuit breakers or switches in the PDBs (power distribution bus) are turned on and the PDBs are operational.

- Ensure that both power supplies on the base unit are plugged in and operating. The fans on both power supplies should be running at low speed.

Restarting a base unit

When a base unit is used as the remote unit in a TrueCopy remote replication/TrueCopy Extended Distance configuration, restarting the base unit can cause the following events:

- Both paths of TrueCopy remote replication/TrueCopy Extended Distance are blocked.

- At the time the path is blocked, Navigator 2 sends a failure notice to the users whose email addresses are configured in the Alerts and Events window in Navigator 2. The alert contains information regarding the SNMP Agent Support Function and TRAP. Follow the instructions in the email alert. After the remote unit has restarted, the path blockade automatically recovers the paths that are available for use.

- If the pair status of TrueCopy remote replication/TrueCopy Extended Distance is PAIR or COPY, the pair status changes to PSUE.

  When the base unit must be restarted, change the pair status of TrueCopy remote replication/TrueCopy Extended Distance to PSUS, and then restart the unit.

NOTE: When the Power Saving storage feature is used, if you restart the base unit while the spin-down is in progress, the spin-down may fail because it recognizes the host immediately after the unit starts.

After the spin-down has completed, check the RAID Groups and make sure that none of them are set to the "Normal (command monitoring)" power saving status. Then restart the unit. If the spin-down fails, start the spin-down again.

Storage system power on

Base unit

The power ON/OFF buttons on the front bezel actuate the Main Switch on the front of the base unit (behind the front bezel). The Main Switch is a rocker switch on the switch panel which is located in the lower right corner on the front panel of the base unit. See Figure 6-1 and the expanded view in Figure 6-2.
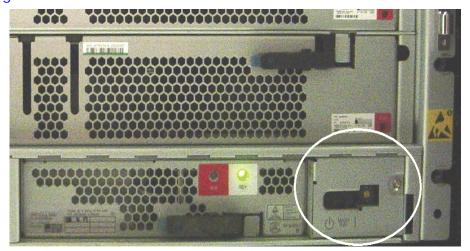
Figure 6-1: Base Unit Switch Panel Location

The Main Switch controls power to all components in the base unit except the power supplies. The power supplies do not have a power switch and turn on as soon as the power cables are connected to them. They can deliver power to the rest of the unit after successful completion of their power on self test (POST).

When only one power supply is plugged in, the multispeed fans on that power supply run at high speed to ensure that the base unit has sufficient cooling. As soon as the second power supply is plugged in, the fans on both power supplies run at low speed to cool the power supplies. When the base unit is running and both power supplies in the base unit are plugged in, the multispeed fans run at whatever speed is needed to ensure adequate cooling of all components in the base unit.

NOTE: When the Main switch is toggled to the Standby position, power is still applied to the power supplies. To completely remove the power from the unit, remove both power cables from the unit or disconnect them from the power source.
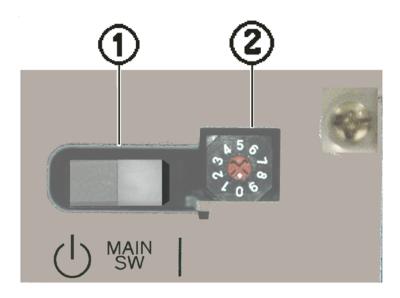
Figure 6-2: Base Unit Switch Panel

Table 6-1: Base Unit Switch Panel

Item	Description	Item	Description
①	**Main Switch** Applies power to and removes power from the controllers and disk drives in the base unit and the ENC unit and drives in any attached expansion units. The symbol ⏻ at the left side of the switch means **Standby.** (The power supplies remain on) The symbol │ at the right side of the switch means ON.	②	**Mode Switch** Sets the Uninterruptable Power Supply (UPS) mode to either Local Mode or one of three remote modes. **NOTE:** Uninterruptable Power Supplies are not supported by the AMS 2500. **Leave this switch in the Local Mode (0) position**.

To apply power to the base unit:

1. Press the right side of the Main Switch. As shown in Figure 6-2, the power ON side of the switch is labeled │ . This applies power to the control units and to the disk drives.

2. Verify that the READY LED (green) on the base unit lights steadily after four minutes. See Power ON Self Test below for more information.

Power on self test

When the Main Switch (shown above) is set to ON, each component in the array automatically runs a power on self test (POST). During this time, the array Power LED is on and the Ready light is blinking. The POST takes approximately four minutes under normal circumstances. When the POST is complete and the unit is ready for operation, the Ready light changes from blinking to steady ON.

The base unit automatically runs a POST (power on self test). The test takes about five minutes to complete. If the test completes successfully, the base unit is fully operational and ready for use.

Failures and workarounds

If the base unit does not turn on (the Ready LED stays off) after you turn on the main switch, or when the Ready LED does not stop blinking and light steadily after 4 minutes, see the instructions in Chapter 8, Troubleshooting.

Expansion units and high-density expansion units

Power to expansion units and high-density expansion units is controlled by the base unit via the ENC cable. When you turn the base unit ON or OFF, power to any expansion units connected to that base unit are also turned ON or OFF.

Storage system power off

Base unit

To remove power from the base unit:

1. Turn off the power.

   - With the front bezel installed, press the Power Off button ⏻
   - With the front bezel removed, press the left side of the Main Switch labeled ⏻.

   This turns off power to the control units and to the disk drives, but the power supplies will continue to run in standby mode.

2. Verify that the green LEDs above each power receptacle on the rear panel are OFF and that the green RDY LED on the front panel is OFF.

To completely power down a base unit:

1. Turn off the Main / Power switch and verify that the green Ready LED on the front panel is OFF.

2. Turn off the power switches or circuit breakers in the PDBs to which the base unit is connected.

3. Unplug the power cables from **both** power supplies in the base unit.

⚠️ **CAUTION! Residual power may remain in the power supplies for up to a minute after the power supplies are turned off.**

Expansion units

Power to the expansion units and high-density expansion units is controlled by the base unit via the ENC cable. When you turn the base unit ON or OFF, power to any expansion units connected to that base unit are also turned ON or OFF. As with the base unit, the power supplies in the expansion units will remain on standby and the fans will continue to run at low speed.

To completely power down an expansion unit:

1. Wait approximately 30 seconds after turning off the Main / Power switch on the base unit to which the expansion unit is attached.

2. Turn off the power switches or circuit breakers in the PDBs to which the expansion unit is connected.

3. Unplug the power cables from **both** power supplies in the expansion unit.

⚠️ **CAUTION! Residual power may remain in the power supplies for up to a minute after the power supplies are turned off.**

Recovering from a power outage

If your site experiences a power outage, the backup batteries preserve the contents in cache that have not yet been written to disk. Protection times vary depending on the size of the cache.

⚠️ **NOTE:** The backup batteries do not provide power to the array or act as an uninterupable power supply.

To restore power to the array after a power outage:

⚠️ **NOTE:** If possible, do this before the power to the site is restored.

1. Stop all host I/O to the array, if possible.

2. On the base unit front panel, set the Main switch to standby. ⏻

3. Remove the two power cables from the power receptacles on the array rear panel. To prevent possible damage from a power surge when the power comes back on, leave them disconnected until after the power is restored.

   Alternate method: Turn off the circuit breakers on the rack PDU.

4. When power returns, reconnect the power cables to the power receptacles on the array rear panel, then set the Main switch to the ON position. The green Power LED on the front panel should light at this time, and the array performs its Power On Self Test (POST), which takes about 4 minutes. At that time the green Ready LED on the front panel lights and the unit is ready for use.

⚠️ **NOTE:** If the Alarm or Warning LED on the front panel lights instead of the Ready LED, see Troubleshooting based on LED indications on page 8-12.

5. If host I/O activity was stopped, resume I/O activity to the array.

7

Configuration

This chapter describes how to configure an AMS 2500. Refer to the Host Configuration Guides for information about configuring the host system and for configuring storage on the host system.

❒ Configuration tasks

❒ Configuring an AMS 2500

❒ Installing Navigator 2

❒ Managing storage

❒ Using SSL

❒ Other storage management operations

❒ Uninstalling Navigator 2

Configuration tasks

This section describes the tasks required to configure an AMS 2500 to store and manage the data from a host system.

> **NOTE:**
> - The response performance mode is enabled only when the segment size is 16KB or less. Be careful when using it with Cache Partition Manager.
> - When changing from the response performance mode to the normal mode, if the I/O load is heavy, you may not change the setting. In this case, perform it after the host I/O stops according to the error message.
> - The processor operation rate becomes high while operating in the response performance mode compared to the rate in the normal mode. When replacing the firmware, it may not be replaced because the processor operation rate is high. If you cannot replace it, we recommend that you replace it again after changing the mode to normal.
> - Encrypt the User Management LAN by Using SSL (Secure Socket Layer)

Prerequisites

Before installing the Navigator 2 software and using it to configure the AMS 2500, ensure that the following perquisites have been met.

User supplied items

In addition to the items supplied with your AMS 2500, the following user-supplied items are required.

For the Hitachi AMS 2500

- If the controllers in the base unit are configured with Fibre Channel interface boards, a Fibre Channel cable is required for each Fibre Channel data port that will connect to a host.
- If the controllers in the base unit are configured with iSCSI interface boards, use a CAT-5 or CAT-6 Ethernet cable for each iSCSI data port that will connect to a host.
- A CAT-5 or CAT-6 Ethernet cable to connect the management console to the AMS 2500 is required.
- An IP address for each management port is required.

For the management console

> 💡 **TIP:** For the best Navigator 2 experience, Hitachi Data Systems recommends that you install Navigator 2 on a new or dedicated PC.

The computer that will be used as the management console must meet the requirements listed in Table 7-1.

Table 7-1: Prerequisites

Item	Description
Operating System[1]	• Microsoft Windows 2000 (Service Pack 3 or 4) • Windows XP (Service Pack 2 and 3, 32-bit only) • Windows Server 2003 (Service Pack 1 and 2) • Windows Server 2003 R2 (No Service Pack and SP2) • Windows Vista (Service Pack 1) • Windows Server 2008 (32 and 64-bit) (no Service Pack, SP2) • Windows 7 (x86, x64) (no Service Pack) • Windows Server 2008 R2 (x86) (no Service Pack)
Web browser[2]	• Internet Explorer 6.0, 7.0, or 8.0. (Windows 7 or Windows Server 2008 R2 supports only Internet Explorer 8.0.) • Mozilla Firefox v1.7 or higher
CPU	1 GHz Intel processor (2.4 GHz, Intel dual-processor recommended)
Memory	1 GB minimum, 2 GB recommended
Free disk space	1.5 GB minimum
Screen resolution	1024×768 or more recommended
Network	Must be connected to the array being managed via LAN

1. Navigator 2 may not run correctly if not running on a supported OS.
   Note: Navigator 2 does not support 64-bit OS.
2. Navigator 2 may not run correctly if not running on a supported web browser.

Supported network standards

The AMS 2500 user LAN port supports the following network standards.

Table 7-2: Supported Network Standards

Item	Standard and Functions	Note
Standard	IEEE 802.3 10BASE-T IEEE 802.3u 100BASE-TX IEEE 802.3 1000BASE-T	
Protocol	ARP, ICMP, ICMPv6, IPv4, IPv6, NDP, TCP, UDP	IPsec support is not scheduled.
Rooting	RIPv1, RIPv2	
RIPng	BGP and OSPF, etc., are unconfirmed.	
IP Address Resolution	DHCPv4 Router Advertisement	DHCPv6 support is not scheduled.

Table 7-2: Supported Network Standards (Continued)

Item	Standard and Functions	Note
Standard and function not affecting the use of the array	Port VLAN IEEE 802.1Q: Tag VLAN IEEE 802.1D: STP (Spanning Tree Protocol) IEEE 802.1w: Rapid STP (RSTP) IEEE 802.1s: Multiple Instances Spanning Tree Protocol (MISTP) IEEE 802.3ad: Link Aggregation	Note [1]
Communication Port	2000/tcp (Non Secure), 28355/tcp (Secure) The array uses the above TCP port for Navigator 2 communication.	Note [2] [3]

1. The array may not operate depending on the network environment. If it does not operate, consult the network administrator.

2. Cisco Skinny Client Control Protocol (SCCP) uses 2000/tcp. Therefore, when using Navigator 2 in the network environment in which SCCP is introduced, it is required to change the TCP port that Navigator 2 uses. Refer to the Hitachi Storage Navigator Modular 2 Command Line Interface (CLI) User's Guide for the change method. See Accessing product documentation in the Preface.

3. When obtaining the IPv6 address automatically, the Router Advertisement distribution server is required. If it is not set up, only the link local address (fe80::/10) is allocated as the array address, and communication is limited only in the same link not exceeding the router.

Precautions when using the IPv6 protocol SNMP agent support function

The SNMP Agent Support function does not support IPv6. When performing failure monitoring, use IPv4 or use the E-mail alert function.

Navigator 2 IPv6 support

Navigator 2 supports IPv6 in the following operating systems, as shown in Table 7-3.

Table 7-3: Navigator 2 IPv6 Support

Vendor	Operating System	Service Pack	IPv6 Support
Microsoft	Windows 2000	SP3/SP4	Not Supported [1]
	Windows XP	SP2	Not Supported [2]
	Windows Server 2003 (x86)	SP2	Supported
	Windows Server 2003 (x86)	SP1	Supported
	Windows Server 2003 R2 (x86)	SP1	Supported
	Windows Server 2003 R2 (x64)	SP1	Supported
	Windows Vista (x86)	SP1	Supported
	Windows Server 2008 (x86)	SP1	Supported
	Windows 7 (x86)	noSP	Supported
	Windows 7 (x64)	noSP	Supported
	Windows Server 2008 R2 (x64)	noSP	Supported
	Windows Server 2008 (x64)	SP1	Supported

1. IPv6 protocol is not supported.

2. Although the IPv6 protocol can be used by installing Microsoft TCP/IP version 6, Navigator 2 does not support it because the Web browser cannot use the IPv6 literal address (address in the colon(:)-delimited hexadecimal form).

IPv6 link local address

The IPv6 link local address is created automatically from the MAC address regardless of the availability of the IPv6 address. The array creates the interface ID which extends the MAC address (48 bits) to the EUI-64 format (64 bits) and has the address which adds fe80::/10 to the high 64 bits as the link local address.

Example

If the MAC address is "00:00:87:12:34:56"

1. Split the MAC address by 24 bits "000087" and "123456"

2. Insert `1111 1111 1111 1110 (0xFFFE)` between the split addresses

   `0000 87FF FE12 3456`

3. Reverse the 7th high bits `0200 87FF FE12 3456`

4. Add `fe80::/10` to high 64 bits to be the link local address.

   `fe80::0200:87FF:FE12:3456`

Setting the IPv6 address

Hitachi Data Systems recommends that you set the IPv6 address manually. If you obtain the IPv6 address automatically, since the IPv6 address is created based on the MAC address, the IPv6 address set to the array is changed automatically if the control unit is replaced due to a failure, etc. In this case, you would need to register the array again.

For the range of the IPv6 address set manually, use the global unicast address `2001::/16` for the IPv6 Internet.

Incorrect router advertisement

A router advertisement daemon (radvd) is run by Linux or BSD systems acting as IPv6 routers. It sends Router Advertisement messages, specified by RFC 2461, to a local Ethernet LAN periodically and when requested by a node sending a Router Solicitation message. These messages are required for IPv6 stateless autoconfiguration.

When changing the contents of the distributed Router Advertisement, perform the Router Advertisement (set router lifetime indicating the expiration date to 0) to disable the previous Router Advertisement from the Router Advertisement distribution server side. If the Router Advertisement distribution server side does not disable it, the new Router Advertisement is received by changing the IPv6 address of the array to the fixed setting once and changing it to the automatic setting again. When this operation is completed, since the IPv6 Advertisement of the array is changed, you must register the array and system again.

Temporary address

The temporary address specified by RFC3041 is enabled for Windows Vista. When connected by IPv6, many temporary addresses may be registered in the installed PC and the processing time may become long depending on your system environment. Check the temporary addresses and if many are set, disable them.

You can display the status of the temporary address by entering the following command from the command prompt.

```
C:\> netsh interface ipv6 show privacy
```

Enter the following command to disable the temporary address:
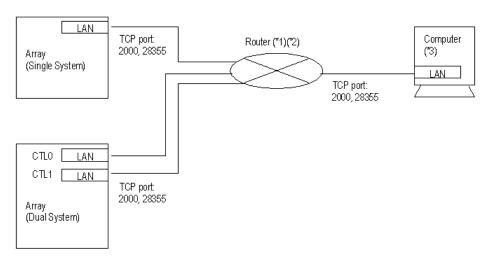
```
C:\> netsh interface ipv6 set privacy disable
```

Enter the following command to enable the temporary address:

```
c:\> netsh interface ipv6 set privacy enable
```

Connection method

The following illustration shows an example of a connection between the AMS 2500 and the computer in which Navigator 2 is installed on the host computer and not a separate management console.
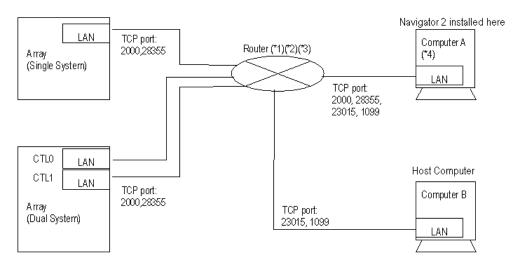
The following are notes regarding the above illustration:

1. The array uses 2000/tcp and 28355/tcp to communicate with Hitachi Storage Navigator Modular 2. When it can be connected directly but cannot communicate through the router, the router may have blocked ports. Set the router so that the two-way communication to ports is allowed.

2. The IPv6 multicast of the link local scope is used for the search array by the IPv6 address. When performing the search array, set up the array and the computer in which Hitachi Storage Navigator Modular 2 is installed in the same link.

3. When two or more LAN cards are inserted in the computer to install Hitachi Storage Navigator Modular 2 and each LAN is another segment, it can only access from the LAN card side specified by the installer.

The following illustration shows another example of a connection between the AMS 2500 and the computer in which Navigator 2 is installed on a separate management console.

The following are notes regarding the above illustration:

1. The array uses 2000/tcp and 28355/tcp to communicate with Navigator 2. If the array can communicate with the computer on which Navigator 2 is installed directly but not through the router, the router may have blocked ports. Set the router so that two-way communication to ports is allowed.

2. The computer in which Navigator 2 is installed (Computer A) uses 23015/tcp and 1099/tcp to communicate with the computer to the host (Computer B). When the computer on which Navigator 2 is installed can communicate if connected directly but cannot communicate through the router, the router may have blocked ports. Set the router so that the two-way communication to ports is allowed.

3. The IPv6 multicast of the link local scope is used for the search array by the IPv6 address. When performing the search array, set up the array and the computer in which Hitachi Storage Navigator Modular 2 is installed in the same link.

4. When two or more LAN cards are inserted in the computer to install Navigator 2 and each LAN is another segment, it can only access from the LAN card side specified by the installer.

Communication modes

When the communication settings between the array and the host and/or management console are not the same, they may not be able to communicate with each other. The communication mode for the array is set to "**Auto**" by default. Therefore, Hitachi Data Systems recommends that you set the host and any other storage devices on the LAN to **Auto**.

Table 7-4 shows the combination of settings for the array and the host and the settings that work.

Table 7-4: Communication Settings

	Auto	10 Mbps Half	10 Mbps Full	100 Mbps Half	100 Mbps Full	1000 Mbps Full
Auto (Default)	O	X	X	X	X	X
10 Mbps Half	X	O	X	X	X	X
10 Mbps Full	X	X	O	X	X	X
100 Mbps Half	X	X	X	O	X	X
100 Mbps Full	X	X	X	X	O	X
1000 Mbps Full	X	X	X	X	X	O
O: Communication possible			X: Communication not possible			

Configuring an AMS 2500

This section explains how to set up and configure an AMS 2500.

Prerequisites

Before using Navigator 2, please read the following notes and instructions:

- If you are using Windows®, disable Windows power management to prevent the PC from entering the low power mode suspension state.

- When connecting the array with Navigator 2 via a LAN, depending on the LAN environment, the array could be disconnected if there is a data transfer time-out. When Navigator 2 cannot connect with the array, verify that the connection is correct by using the ping command, etc. If the response to the ping command is normal, the LAN environment may affect the data transfer. The length of data to be transferred can be changed with the lanconf.inf file in the directory in which Navigator 2 is installed. The default setting is 32768. Change the setting to 16384 or 8192 in that order, or to a multiple of 1024, and then retry. The new setting becomes effective during the next operation (restarting Navigator 2 is not required). Navigator 2 operations may be very slow, depending on the setting. If the connection cannot be made after the settings are changed, review the LAN environment.

- Do not use the reserved words discrete for each OS or device names that indicate the input/output destinations as a file name when a file is output. Windows includes "con", "pm", "ax", etc. and UNIX® includes "/def*", etc. For example, when context is specified as an output file name, an error message is displayed in a window.

- If you connect Navigator 2 to an array via a LAN, set the TCP/IP port number to 1099. If you cannot connect, verify the TCP/IP port number.

Configuration roadmap

Table 7-5 lists the basic steps to configure an AMS 2500.

Table 7-5: Task List

Step	Task (Click the link to display detailed information)
1 [1]	Install the storage management software (See Installing Navigator 2 on page 7-13).
2	Power On the storage system (See Chapter 6, Power On/Off procedures).
3	Perform the Initial Setup (See First time storage configuration - required tasks on page 7-19).
4	Add an array to Navigator 2 (See Adding arrays to Navigator 2 on page 7-19).
5	Restore the storage management PC (See Restoring the management console on page 7-29).
6	Reregister the array (See Reregistering the array on page 7-30).
7	Set up the host ports (See Set up host ports on page 7-27).

1. If the storage management software has already been installed, this step is not required.

Introducing Navigator 2

Hitachi Navigator Modular 2 Navigator 2 (referred to as Navigator 2) is the storage management software application that is used to set up and configure a variety of Hitachi Data Systems storage products, including the AMS 2500. It consists of a GUI and underlying software that is used to accomplish many storage management configuration tasks.

Navigator 2 includes a set of easy-to-use wizards that are used for the initial setup of the array and that automate complex and/or repetitive tasks. They can help users quickly and easily configure, provision, and manage both simple and complex setups. Navigator 2 also includes a comprehensive set of utility functions (features) that are used to configure and manage the storage functions on the array. Although you can manage several models of Hitachi Data Systems storage arrays, this manual provides instructions for only the AMS 2000 series models.

NOTE: Navigator 2 does not support the window change function of a browser. The following procedures are for Internet Explorer to return to the previously displayed browser window. When the installation starts, follow the instructions in the screens that appear. During the installation, you will be asked to either accept the default destination directory where Navigator 2 will be installed or specify a different location.

- Press the Back Space key.
- Press the ← key while holding down the Alt key.
- Right click in the window and select "Back" in the drop down menu that is displayed.

If you perform any of the above on the displayed window by clicking Create or Edit with Navigator 2, the message "Now loading" is displayed and it may not close. In this case, Press the ✖ (Close) button at the top right of the window to close it, then open it again.

Navigator 2 features

Table 7-6 describes the main features of Navigator 2.

Table 7-6: Navigator 2 Features

Category	Function Name	Description	System Usable During Operation?
Configuration display	Component status display	Displays the status of a component such as drive and fan.	Yes
	Property display	Displays the status about system components of an array unit, RAID, logical units, etc.	Yes
Manage Logical Units	Create Logical Units	Used to add a logical unit. A new logical unit is added by specifying its capacity.	Yes
	Delete Logical Units	Deletes the defined logical unit. User data is deleted.	No
	Format Logical Units	Required to make a defined logical unit (LU) accessible by the host. Writes null data to the specified logical unit, and deletes user data.	No /Yes
Setting the Selection	Command Device	Sets up the command devices. This is only used for replication purposes.	
Configuration	Setting the Boot Option	Sets up the boot option. The array must be restarted to implement the setting	No
	Setup and Display iSCSI Information	Sets and displays the IP addresses and security information, etc.	No
	System Parameters	Sets up the system parameters.	Yes
	Port option	Configures the options on each port used by the array	Yes
	Setup and Display of RTC	Sets and displays the date and time.	Yes
	Firmware Upgrades	Downloads and updates the array microcode. You must reboot the array to implement the settings.	No /Yes
Error Monitoring	Report when a failure occurs and controller status display	Polls the array and displays the status. If an error is detected, it is output into a log file and sent by email. A specified application is started.	Yes

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Storage features

Table 7-7 lists the software that is already installed on the array and are ready for use, as well as software that is installed but must be enabled with a license key. Contact HDS Technical Support to obtain licenses for the optional software.

Table 7-7: Storage Features

Storage Feature	Type	Default State at startup	License Key Required
Firmware & Storage Feature Kit	Common License Key "A"		No
Base Firmware	Included	N/A	No
Audit Logging	Included	Enabled	No
Account Authentication	Included	Enabled	No
LUN Manager	Included	Enabled	No
Cache Residency Manager	Included	Disabled	No
Cache Partition Manager	Included	Disabled	No
Modular Volume Migration	Included	Disabled	No
SNMP Agent Support	Included	Enabled	No
Performance Monitor	Included	Enabled	No
Optional Storage Features			
Power Saving	Download	N/A	Yes
Data Retention Utility	Download	N/A	Yes
In-System Replication Suite	Download	N/A	Yes
ShadowImage	Download	N/A	Yes
Copy-on-write Snapshot	Download	N/A	Yes
TrueCopy Remote Replication	Download	N/A	Yes
TrueCopy Extended Distance	Download	N/A	Yes
Firmware & Storage Feature Kit	Common License Key "A"		No

⚠️ **NOTE:** For detailed information and instructions to use Navigator 2 to manage a variety of Hitachi Data Systems storage array models, see the Navigator 2 Online Help and the manuals listed in the Accessing product documentation section in the Preface of this manual. In the Navigator 2 main menu, click Help > Help to launch the online help, OR click the help button in and Navigator 2 window or dialog box.

Installing Navigator 2

This section describes the procedure to install the Navigator 2 software.

Changing the storage management PC IP address

To connect the array and the storage management PC to a network, the storage management PC IP Address must be changed temporarily.

⚠️ **NOTE:**

- This procedure is not necessary if you are connecting the array with IPv6 from the storage management PC.

- If you are connecting the management PC to the array with IPv4 or other cable, perform this procedure.

Complete the following steps to change the Storage Management PC IP Address:

1. Connect the 10/100 Ethernet Management Port on the array (controller #0) and the storage management PC with a CAT-5 Ethernet cable. See 10/100 Ethernet management port on page 4-12 for more details.

2. Open a command (DOS) window and use the command **ipconfig** to find out the IP address of the management console.

3. **Record this address** as you will need to reset the management console back to that address later.

4. The default IP addresses of the management ports on the AMS 2500 are:
   - Controller 0: `192.168.0.16`
   - Controller 1: `192.168.0.17`

5. If the IP address of the management console does not match the default subunit of the management ports, configure the management console to use an IP address that matches the default subnet ($192.168.0.x$) of the management port.

Navigator 2 installation procedure

This section explains how to install the Navigator 2 storage management software. Instructions to uninstall the software are located at the end of this chapter.

⚠️ **NOTE: IMPORTANT.** Before installing Navigator 2, disable pop-up blockers in your Web browser. Hitachi Data Systems also recommends that you disable anti-virus software and proxy settings on the management console before installing Navigator 2.

Complete the following steps to install the Navigator 2 storage management software. The installation process takes about 15 minutes.

⚠️ **NOTE:** During the installation, the progress indicator that is displayed may pause a few times for several seconds to a minute depending on the speed of the computer and any other processes that are running during the installation. This happens while the installer is unpacking and installing the files, and is normal. Do not cancel the installation during this time.

To install Navigator 2:

1. Insert the CD containing the Navigator 2 software into the CD-ROM drive on management console.

2. If the autorun program does not start, use Windows Explorer to browse the CD and double click the file

   `\program\hsnm2_win\HSNM2-`*`nnnn`*`-W-GUI.exe.`

   where *nnnn* is the Navigator 2 version number.

3. When the installation starts, follow the instructions in the installation wizard. During the installation, you will be asked to:

   - Accept the default destination directory where Navigator 2 will be installed or specify a different location.

   - Enter the IP address of the management system during the installation.

Installing Java

The Advanced Settings options in Navigator 2 are implemented through the Storage Navigator Modular management application that was used to manage the storage features in earlier versions of the Adaptable Modular Storage hardware.

To use this feature, you must have the proper Sun Java Runtime Environment (JRE) loaded and the Java Console set properly on your system. The requirements are as follows:

- JRE version required: v1.6.0

- From the Java Console on your PC, set the Java Runtime parameters to the following: **-Xmx192m**

⚠️ **NOTE:** Before accessing Advanced Settings in Navigator 2, check the memory setting in the Java Console on the browser PC. It should be set to -Xmx192m. Otherwise, Advanced Settings will fail, and you will be locked out and unable to access Advanced Settings until the login times out (20 minutes).

Clients running Microsoft Windows

If your client runs Microsoft Windows, perform the following procedure:

1. Click the Windows Start menu, point to Settings, and click Control Panel. The Windows Control Panel appears.

2. From the Windows Control Panel, double-click Java Control Panel. The Java Control Panel appears.

3. Click the Java tab. The Java tab is displayed, as shown in Figure 7-1.
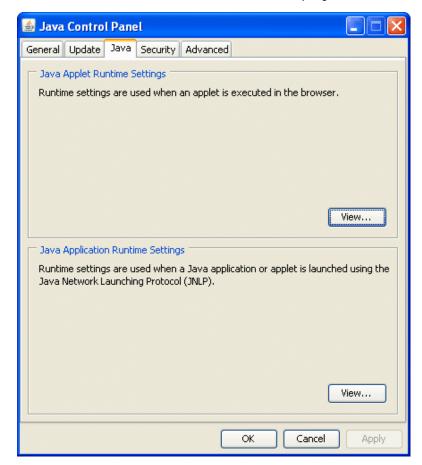
Figure 7-1: Java Tab

4. Click View in the Java Applet Runtime Settings section. The Java Runtime Settings dialog box appears, as shown in Figure 7-2.

5. In the Java Runtime Parameters field, type: **-Xmx192m**
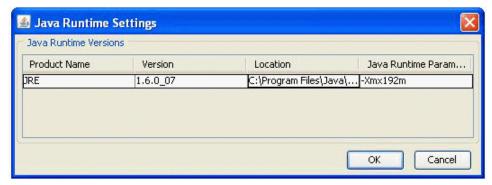
Figure 7-2: Java Runtime Settings Dialog Box

6. Click OK to exit the Java Runtime Settings dialog box.

7. Click OK in the Java tab to close the Java Control Panel dialog box.

8. Close the Windows Control Panel.

Clients running Solaris or Linux

If your client runs Solaris or Linux, perform the following procedure:

1. From an XWindows terminal, Enter the <JRE installed directory>/ bin/ jcontrol to run the Java Control Panel.

2. Click View in the Java Applet Runtime Settings section. The Java Runtime Settings dialog box appears.

3. In the Java Runtime Parameters field, type **-Xmx192m**.

4. Click OK to exit the Java Runtime Settings dialog box.

5. Click OK in the Java tab to close the Java Control Panel dialog box.

Installation problems

If you have problems with the installation, or if Navigator 2 does not install correctly or does not run after it is installed, please contact Hitachi Data Systems Technical Support. See Getting help in the Preface for contact information.

Starting Navigator 2

1. After the software is installed, launch a Web browser on the management console.

2. Enter the appropriate URL in the address field.

    -   If you are using http, enter the following URL in the address field:

        http://<IP address>:23015/StorageNavigatorModular/Login

        where *<IP address>* is the IPv4 or IPv6 address of the management console.

    -   <If you are using https, enter the following URL in the address field:
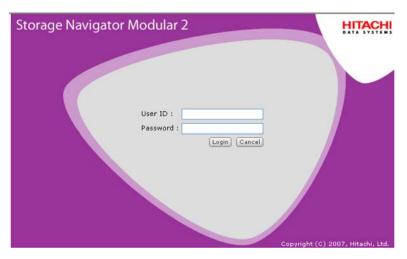
        https://<IP address>:23016/StorageNavigatorModular/Login

⚠️ **NOTE:** The https URL is invalid immediately after the installation. Refer to Using SSL on page 7-48.
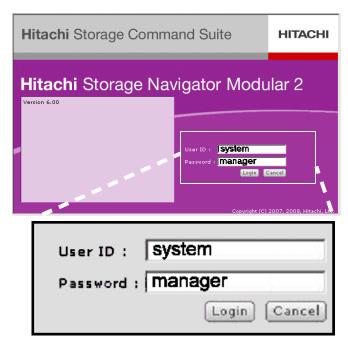
When you enter an IPv6 address, you must enclose the URL in brackets [] Example: http://[xxxx]:23015/StorageNavigatorModular/Login
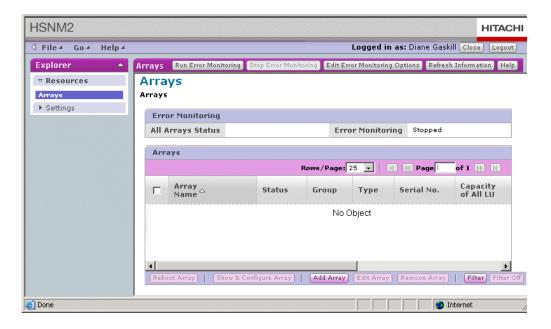
After a few seconds, the welcome screen is displayed, as shown below.

3. Click **Login** to display the login screen.

4. Enter the default administrator user ID and password.

5. Press Enter, or click **Login**. After several seconds Navigator 2 displays the Array List Window, as shown below.

> ⚠ **NOTE:** For security reasons, Hitachi Data Systems recommends that you change the password after logging in. The Navigator 2 online help contains a detailed procedure explaining how to do this. In Navigator 2, locate the main Help button and click **Help > Help** to launch the online help. In the Contents pane, select **Managing User Accounts > Change Your User Password**. Follow the instructions on this help page.

Managing storage

This section briefly explains how to use Navigator 2 to manage storage on a network. It contains the following topics:

- First time storage configuration - required tasks
- Additional storage configuration - optional tasks

First time storage configuration - required tasks

Setting up basic storage on an AMS 2500 array is actually very easy. Navigator 2 includes a set of wizards that guide you through the two initial tasks to add arrays and set them up. In addition, a set of simple dialog boxes is included to guide you through the procedure to map the storage on the array to a host so that the host can manage the storage assigned to it. These procedures are explained below.

Adding arrays to Navigator 2

Whenever Navigator 2 is launched, after you log in, Navigator 2 loads into memory (this may take several seconds). It then automatically searches the Navigator 2 database for any arrays listed there, and then displays the Arrays window (also called the Array List Window).

If there are arrays listed in the database, Navigator 2 displays them in the Array List window. If there are no arrays listed in the database, Navigator 2 automatically launches the **Add Array wizard**. Therefore, when Navigator 2 is first installed and launched, it automatically launches the Add Array wizard.

⚠️ **NOTE:** If the wizard does not launch, ensure that your browser's pop-up blockers are disabled. Then click **Add Array** at the bottom of the Array List window to launch the Add Array wizard.

Using the Add Array Wizard

The Add Array wizard guides you through the steps to discover existing arrays (within a range of IP addresses you set) on the storage network, and add the arrays you select from the list of arrays to the Navigator 2 database. It contains four screens, as described below. Click the links to see the detailed explanation of each page in the wizard.
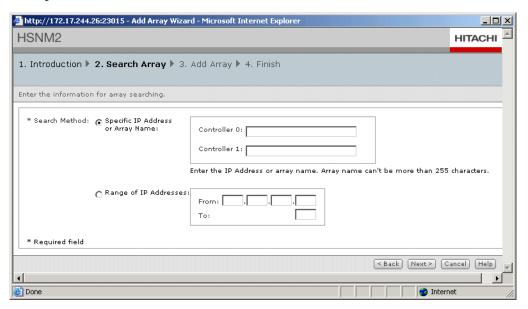
Introduction screen > Search array screen > Add array screen > Finish screen

Introduction screen

This screen explains the purpose of the wizard and sets up the criteria that is used when searching a storage network for arrays. Click **Next** to continue and open the Search Array screen.

Search array screen

This screen sets the criteria that is used when searching a storage network for arrays.

Adding a Specific Array (see next section for adding multiple arrays)

1. If you know the IP address of a specific array that you want to add, click either **Specific IP Address** or **Array Name to Search:** and enter the IP address of the array.

2. Click **Next** to continue and open the Add Array screen.

Adding Arrays Within a Range of IP Addresses

1. If you know the range of IP addresses that includes one or more arrays that you want to add, click **Range of IP Addresses to Search** and enter the low and high IP addresses of that range. The range of addresses must be located on a connected local area network (LAN).

2. Click **Next** to continue and open the Add Array screen.
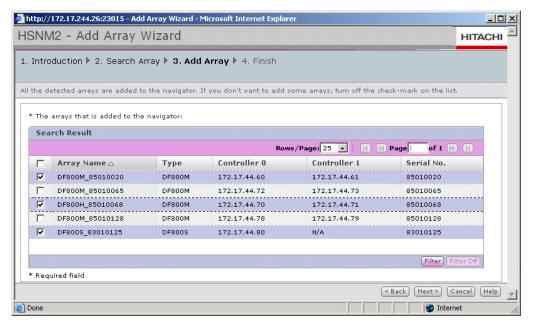
NOTE: if any of the IP addresses you entered is incorrect, when you click Next, Navigator displays the following message: *Failed to connect with the array. Confirm the array status and the LAN environment, and then try again.*

Add array screen

The Add Array Screen displays the results of the search that was specified in the Search Array screen. Use this screen to select the arrays you want to add to Navigator.

1. If you entered a specific IP address in the Search Array screen, that array is automatically registered in Navigator. Click **Next** to continue to the Finish screen. A message box confirming that the array has been added is displayed.

2. If you entered a range of IP addresses in the Search Array screen, all of the arrays within that range are displayed in this screen.

3. When the list of arrays is displayed, all the arrays in the list are automatically selected. Click the checkbox to the left of the array name to deselect the array.

4. Click **Next** to add the selected arrays to the Navigator 2 database and continue to the Finish screen.

Finish screen

This screen displays a message confirming that the arrays have been added to Navigator. Click **Finish** to acknowledge the message and close the Add Array wizard.

Navigator 2 now refreshes the Array List window and displays the arrays that you just added.

Managing a specific array
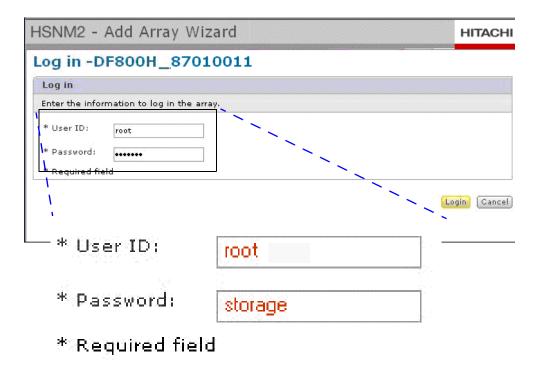
You can work with only one array at a time.

To select an array to manage, in the Array List window, click the **name** of the array that you want to configure. Navigator 2 queries the array and extracts data about the array, and stores it in memory. This may take a few seconds. When the Array Properties window opens, Navigator 2 displays the information there.

Array security

AMS 2500 arrays are configured with a security protocol called **Account Authentication (AA)**. When you select an array, Navigator 2 displays the AA login screen. You must log in to the array before Navigator 2 will display the Array Properties window.

1. **First time login**: Enter the default AA username (**root**) and password (**storage**) as shown in the following illustration. Note that this is a different username and password than is used to log in to Navigator 2.
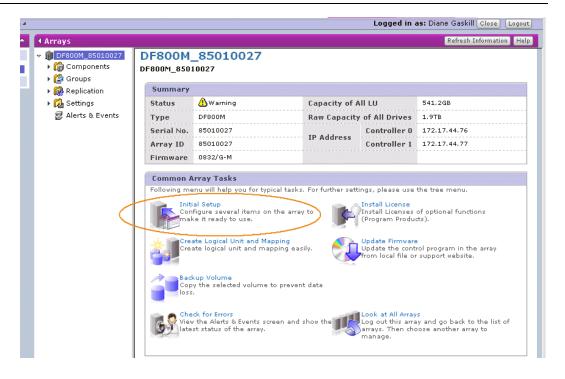
2. Click **Login**. If the username and password are valid, Navigator 2 displays the Array Properties window for the selected array as shown in the following illustration.

⚠️ **CAUTION! If you change the AA password, be sure to write the new password down and keep it in a safe place. Without a valid password, you cannot access the array without reinstalling the firmware. Hitachi Data Systems Technical Support cannot retrieve the password for you.**

Note: The user ID is not changeable.

For more information, see the Account Authentication chapter is the Navigator 2 *Storage Features Reference Guide*, MK-DF978148.

Initial array setup

This section describes the procedure to configure the basic settings of an array. The Array Setup wizard is used to do this.

Click **Initial Setup**. After a few seconds the **Array Setup wizard** launches. This wizard guides you through the following tasks. Each task listed here is a link to the detailed explanation that follows.

Introduction > Set up email alert > Set up management ports > Set up host ports > Set up spare drives > Set up date and time > Confirm > Finish

Introduction

The introduction page lists the tasks that can be completed by this wizard. Click **Next >** to continue to the next screen and begin the setup process.

> **NOTE: Important**! The settings you make on the screens in this wizard are not saved until you complete the wizard settings and select Confirm on the last screen in this wizard.

Set up email alert
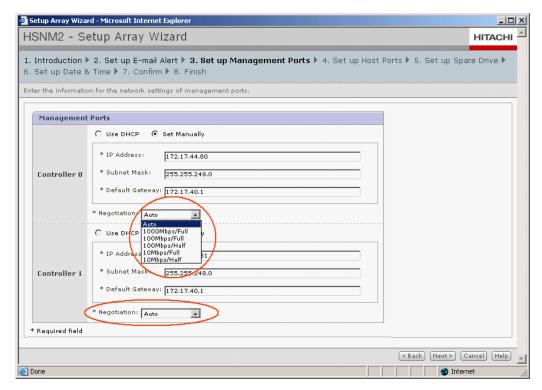
This dialog box sets up Navigator 2 so that if an error occurs in the array, it will send an email report describing the error to as many as three email addresses that are entered here. Perform the following steps to set up email notification:

1. Click **Enable**. The fields in this dialog box are now enabled and you can enter data in them.

2. Enter the domain name of the mail server. For example: hds.com.

3. Enter the IP address of the email server that will route the email messages to the email addresses listed in this dialog box.

4. Enter a From email address. This email address will appear on the distributed email messages. This enables the users who receive the reports to quickly identify the array from which the messages came.

5. Enter up to three email addresses of people to whom the alerts will be sent.

6. (Optional) Enter a Reply To email address.

7. Click **Next>** to exit this screen and open the Set up Management Ports screen.

Set up management ports

The management ports allow direct access to the controllers in the array. When this screen is displayed, Navigator checks the array and fills in the default values for the selected array. You can use these settings successfully, but you can also change the values if needed.

Table 7-8: Configuring Management Ports

Field	Description
Use DHCP	Configures the management port automatically, but requires a DHCP server. To let the system find and use any available IP address for the management port(s), click Use DHCP (Dynamic Host Configuration Protocol) on the controller(s) that you want to use that way.
Set Manually	Lets you complete the remaining fields to configure the management port manually. To use the default IP addresses, select Set Manually for the controller(s) that you want to use with a static IP address. To use other static IP addresses, select Set Manually for the controller(s) that you want to use with a static IP address and enter the IP Address, Subnet Mask, and Default Gateway.
IP Address	Internet Protocol address that client PCs use to access the base unit's management port.
Subnet Mask	Subnet mask that client PCs use to access the base unit's management port.
Default Gateway	Default gateway that client PCs use to access the base unit's management port.

Table 7-8: Configuring Management Ports (Continued)

Field	Description
Negotiation	As shown in the above illustration, to use the default negotiation between the controller and the host, leave the **Auto** setting as is. Otherwise select the speed and duplex mode that the controller will use to communicate with the host. The options are: • 1000Mbps, Full Duplex • 100 Mbps, Full Duplex • 100 Mbps, Half Duplex • 10Mbps, Full Duplex • 10Mbps, Full Duplex

If you know what the communication setting of the host is, you can optionally set the negotiation speed and mode of the management port(s) to match. If you do not know the communication setting on the host, leave the setting at **Auto** and let the controller query the host and set the port to the appropriate speed and duplex mode.
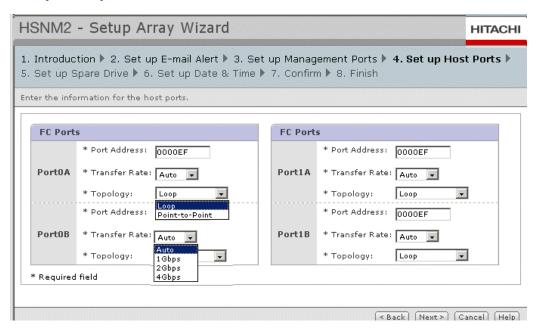
When you have completed the settings, click **Next>** to continue to the next screen. Note that the settings you have made are not saved until you complete the wizard settings and select **Confirm** on the last screen of the wizard.

NOTE:

• If the management console is directly connected to a management port on one controller, enter settings only for that controller (you will configure the management port settings for the other controller later).

• If the management console is connected via a switch or hub, you can enter settings for both management controllers now.
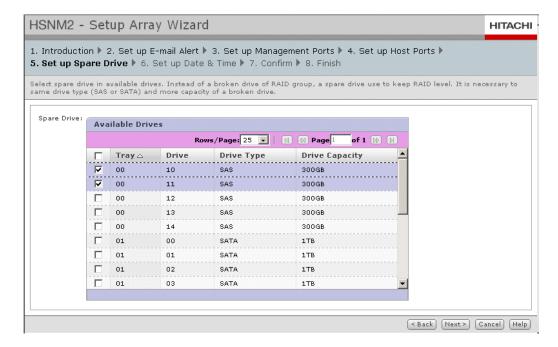
Set up host ports

As with the management ports, Navigator queries the host ports on the array and lists their current settings in the Setup Host Ports dialog box, as shown above.

1. To use the default settings, click **Next>** to continue to the Set Up Spare Drive screen.

2. To change the settings, use the pull-down menus for the Transfer Rate and/or Topology fields for each port as needed to match the settings on the host ports. Then click **Next>** to continue to the Set Up Spare Drive screen.

Set up spare drives
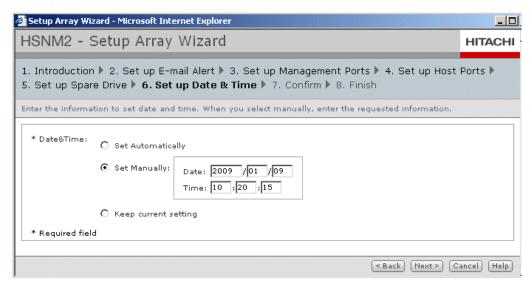
Configuration **7−27**

1. This screen shows the list of unused drives. Click the checkbox at the left end of the row that describes the drive(s) you want to designate as spare drives.

2. After making the selections, click Next> to open the Date & Time screen.

Set up date and time

The Set Up Date & Time page sets the real time clock (RTC) in the array. The date and time information is used to timestamp logs and events in the array.

3. Select the method of setting the date and time and enter the appropriate date and time for your location.

    -   Select **Set Automatically** to use the date and time settings from the server on which Navigator is installed.

    -   Select **Set Manually,** and enter the date and time for your location.

    -   Select **Do not setting** to use the date and time that is currently set in the array clock.

4. Click **Next>** to continue to the confirmation pages.

> ⚠ **NOTE:** You can also set Time Zone and NTP (Network Time Protocol) after finishing the Initial Setup Wizard. Both the NTP and the Edit Date and Time dialog boxes can be used to set the time. The setting made last from either dialog box is the setting that will used.

Confirm

The Confirm dialog box is divided into six pages, one for each of the settings dialog boxes described above. View the settings on each page and click **Next>** to view the next page or **<Back** to go back to the desired screen to change settings.

> ⚠️ **NOTE:** You cannot change settings on the confirmation screens. You must go back to the original screens to make changes.

After you have reviewed all of the confirmation pages, click **Confirm** on the four conformation page to save the settings. Depending on the communication speed and network activity, it make take several seconds to save the settings. When the settings are saved, the wizard displays the Finish screen.

Finish

This screen contains a message that the wizard has successfully completed the setup. Click OK to acknowledge the message and close the wizard.

Restoring the management console

Complete the following steps to restore the management console network environment.

1. Reset the IP address to its original setting. See the section titled Installing Navigator 2 on page 7-13.

2. Reconnect the LAN cable to the management port on the array.

Reregistering the array

Since the IP Address of the array was changed, as described in Initial array setup on page 7-24, you must register the array again. Otherwise, skip this procedure.

1. Log out of Navigator 2, and close the browser.

2. Restart the browser and launch Navigator 2.

3. Enter the appropriate URL in the address field.

- If you are using http, enter the following URL in the address field:

  http://< *IP address*>:23015/StorageNavigatorModular/Login/

  where *<IP address>* is the IPv4 or IPv6 address of the management console.

- If you are using https, enter the following URL in the address field:

  https://*<IP address>*:23016/StorageNavigatorModular/Login

  where *<IP address>* is the IPv4 or IPv6 address of the management console.

⚠️ **NOTE:** The https URL is invalid immediately after the installation. Refer to Using SSL on page 7-48.
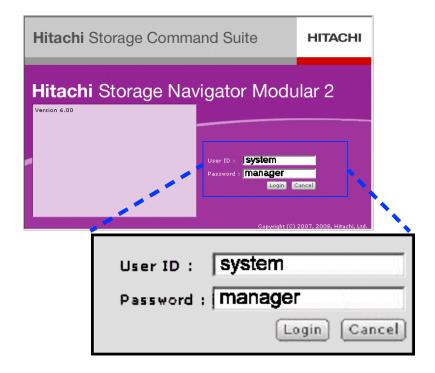
When you enter an IPv6 address, you must enclose the URL in brackets [] Example: http://[xxxx]:23015/StorageNavigatorModular
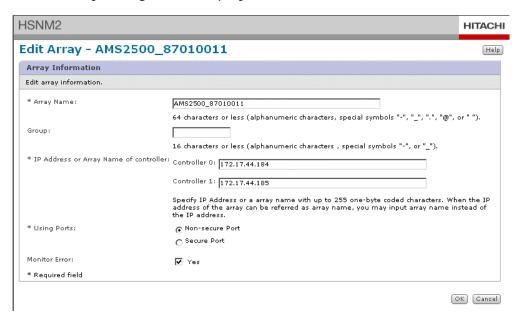
If you have the IPv6 address set to use DHCP and obtain an address automatically, simply delete the array from the Array List window and add it back in again.

After a few seconds, the login screen is displayed, as shown below.

4. Enter the default administrator user ID: **system** (all lower case).

5. If you changed the administrator password, **enter your current password**. Otherwise, enter the default administrator password: **manager**, as shown above. After a few seconds, the Array List window is displayed.

6. In the Array List window, click the checkbox to the left of the name of the array whose settings you just modified, and click **Edit Array**. The Edit Array dialog box is displayed.

7. In the Edit Array dialog box, enter the IP addresses for controller 0 and controller 1 that you set in the Set up management ports on page 7-25 screen in the Array Setup wizard.

> ⚠ **NOTE:** When setting the IPv6 address to Obtain an IP address automatically, the address sets automatically. Therefore after you remove the address from the Array List window, click Add Array and perform a search to register the address again.

Registering the array on the support site

This section describes the procedure for using Navigator 2 to register the array information on the Hitachi Data Systems Support site.

You must register the array information on the Hitachi Data Systems support site. This is required if you plan to download firmware, software, documentation updates, and for ordering any needed replacement parts.

> ⚠ **NOTE:** If the management console is not connected to Internet, write down the Information for registration and register it from a computer that is connected to the Internet.

To register an array on the support site:

1. Ensure that the management console has a connection to the internet.

2. Open a web browser and enter the following URL to access the Hitachi Data Systems Support site.

    https://extranet.hds.com/http://aim.hds.com/portal/dt.

> ⚠️ **NOTE:** If you encounter a problem registering your base unit, please contact Hitachi Data Systems Global Services at:
> - United States +1 866-371-7140
> - Europe / Middle East / Africa +44 (0) 1753 216053
> - All other Regions +1 858-621-7124
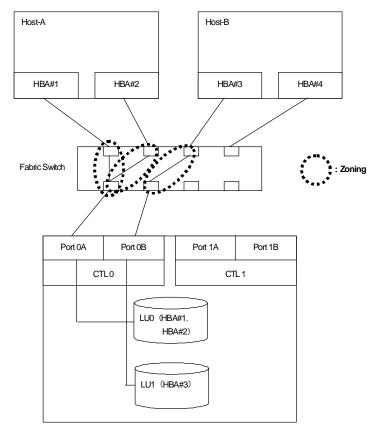
Cautionary note about system construction

This section offers a cautionary note about the system construction before connecting the AMS2500 to the host.

When using LUN manager on a Fabric switch connection

Observe the following when using LUN Manager on Fabric switch connection:

- When connecting to the servers (HBA) or exchanging the HBA, connect to the servers (HBA) that can access to Disk Array after the LUN Manager setting, including WWN registration, completes.

- Zoning on Fabric Switch must be set as shown below to redirect access from the HBA that cannot be accessed to Disk Array by LUN Manager.

Option setting for improving I/O response time in small-scale configuration
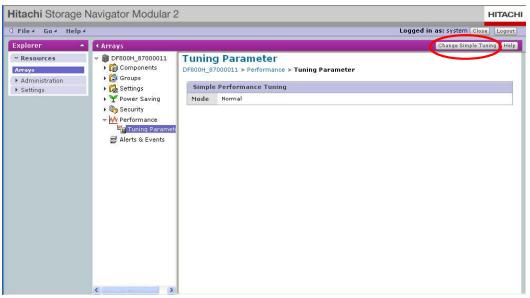
The number of RAID Groups can be expanded in the AMS2500 series. To realize this scalability, it is designed to keep the throughput on average even when the multiplicity of I/O is high. However, you can improve the I/O response time using the Cache preferentially in the case where the number of RAID Groups is small, about one to three in the configuration, and the Write I/O load is low, or the load only grows momentarily.

By setting this option, the write data is stored as much as possible in the Cache, and it changes to the operation that suppresses the I/O issue to the drive. The collision of the host I/O and drive I/O may be reduced by suppressing the I/O issue to the drive, so that you may improve the Write I/O response time.
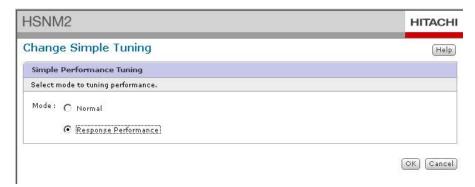
However, in the case of continuously writing the data volume greatly exceeding the cache memory size, the throughput may temporarily deteriorate. Therefore, you need to be careful when setting the option. We recommend you set this option with the environment in mind.

The setting procedure is as shown below.

1. Select the array from the Hitachi Storage Navigator Modular 2, and then select the **Tuning Parameter** icon in the Performance tree. The Tuning Parameter window is displayed.

2. Click the **Change Simple Tuning** button.

3. The Change Simple Tuning window is displayed. To improve the I/O response time, turn ON the Response Performance Mode.

4. Click the Close button.

NOTE:
- The **Response Performance** Mode is enabled only when the segment size is 16KB or less. Be careful when using it with CachePartitionManager.
- When changing from the **Response Performance** Mode to the normal mode, if the I/O load is heavy, you may not change the setting. In this case, perform it after the host I/O stops according to the error message.

The processor operation rate becomes high while operating in the **Response Performance** Mode compared to the rate in the normal mode. When replacing the firmware, it may not be replaced because the processor operation rate is high. If you cannot replace it, we recommend that you replace it again after changing the mode to normal.

Note on using Dynamic Disk

When using the Dynamic Disk on Windows Server 2008, you cannot use it while reducing the logical unit capacity.
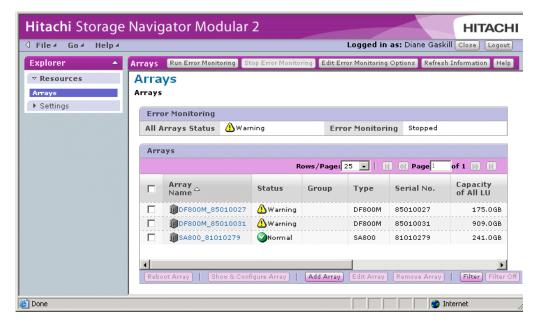
Additional storage configuration - optional tasks

Table 7-9 includes descriptions of the primary optional tasks to manage an array. These are explained in detail in the Navigator 2 online help and in the manuals listed in the Accessing product documentation section in the Preface of this manual.

Table 7-9: Additional Storage Tasks

Task	Description
Monitoring Alerts and Events	Most storage features that are preinstalled on the array have license keys installed with them. Some of the licenses are already enabled, but others are not. See Navigator 2 features on page 7-11 for details. You must enable the licenses before you can use the software. Optional software applications do not have the license keys installed. These keys must be installed on the array before the software can be used. The procedure to install a license key is described in the Navigator 2 **Install Licenses** help page.
Additional storage configuration - optional tasks on page 7-35	The Alerts and Events window displays information about errors and all events that have occurred in the array. It is a good idea to view this window on a regular basis to check for errors and whenever you receive an email or other alert that an error has occurred. It is also a good way to review all commands and actions that have been used to make changes to the array to help determine the cause of an error.
Checking the array status on page 7-36	The resources in an array include RAID groups (host groups). The procedures for managing these resources are explained in detail in the Managing Groups help page and other help pages that are linked from that page.
Managing replication on page 7-39	Replication is the process of copying data from one drive to another. See the Managing Replication help page for information and procedures for details and procedures to accomplish this task. Replication is done on the Simple Modular Storage System with a method called Copy On Write (Snapshot).

Checking the array status

Hitachi Data Systems strongly recommends that you periodically check the array status in the Array List window. When Navigator 2 is launched, it queries the arrays that are registered in its database and updates the information in the Array List window. You can also update the information by clicking on Refresh Information.

In addition, the Navigator 2 Alerts and Events window displays information about errors and all events that have occurred in the array. It is a good idea to view this window on a regular basis to check for errors and whenever you receive an email or other alert that an error has occurred. It is also a good way to review all commands and actions that have been used to make changes to the array to help determine the cause of an error. See the Error Monitoring help page in Navigator 2 for detailed information.

Managing resources

The resources in an AMS 2500 array include RAID groups and host groups.

Working with RAID groups

A RAID (Redundant Array of Independent Disk) group is a group of disk drives that constructs single or multiple parity groups. A RAID groups can be considered as the actual RAID container for data protection, and the parity group as a partition of the container. This way, multiple LUNs can be created from each RAID group, and ported out to the same or different servers (hosts). This allows granularity in LUN sizes being obtained from the RAID group.

A logical unit, generally referred to by its logical unit number (LUN), is created within a RAID group.
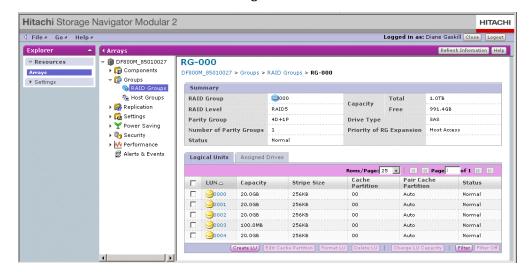
Hitachi AMS 2000 Series base and expansion units are preconfigured at the factory with a single RAID group. You can use this predefined RAID group, delete it, or create your own. The following procedures provide basic instructions for working with RAID groups. For detailed information, please see the Navigator 2 online help or the manuals listed in the Accessing product documentation section of the Preface.

Displaying RAID group properties

To display the properties of a RAID group:

1. Select an array to manage.
   a. If you are not working in the array you want to manage, click **Resources > Arrays** to display the Array List window. In this window, click the name of the array you want to manage.
   b. If you are already working with the array you want to manage, select the Array Properties window.

2. In the array tree, expand the **Groups** menu.

3. Select **RAID Groups**. The RAID Groups window is displayed. It shows the properties of the RAID group and lists all the LUNs that are assigned to that RAID group.
   - RAID level and parity group (example RAID6(2D+2P)
   - The total capacity of the drives in each RAID group
   - The total free space in each RAID group
   - The type of drive(s) assigned to this RAID group

To display detailed data for a single RAID group, in the RAID Groups window, click the name of the RAID group you are interested in. The properties window for the selected RAID group is displayed. The window should look similar to the following illustration.

The Summary section of the RAID Group Window provides the information listed in Table 7-10.

Table 7-10: RAID Group Properties
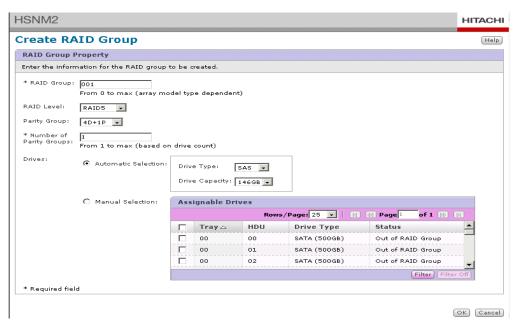
Feature	Description
RAID Group	This is the name of the displayed RAID group. The default name is RG-000. Note: The Simple Modular Storage System can have only one RAID group.
RAID level	This is the number of the RAID level (1-6) that has been assigned to the RAID group.
Parity Group	This is the name of the parity group that has been assigned.
Number of Parity Groups	This is the number of parity groups that have been assigned to the RAID group (min - 1).
Capacity	This field displays both the total capacity of the hard drive(s) in the RAID group and the free space left on the drive(s).
Drive Type	This field displays the type of drive(s) contained in the RAID group. It can be either SAS or SATA. Both types cannot be contained in the same RAID group.

Creating a RAID group

This procedure assumes that the RAID Groups window is already displayed. If needed, see the instructions in Displaying RAID group properties on page 7-37 to display the RAID Groups window.

To create a RAID group:

1. In the RAID Groups window, click Create RG. The Create RAID Group dialog box is displayed.

2. In the Create RAID Groups dialog box, enter appropriate information in the fields listed in Table 7-10. See the on-screen instructions in the dialog box.

3. Set the drive to either Automatic Selection or Manual Selection.

4. Click OK to save the settings, close the dialog box, and return to the RAID Groups window, or click Cancel to exit without creating a RAID group.

5. If you click OK in step 4, a message box is displayed, asking you to confirm that you want to create the RAID group. Click OK to confirm, or Cancel to close the window and exit without creating a RAID group.

6. When the RAID group has been created, another message box (not shown) is displayed, confirming that the RAID group has been created. Click Close to exit the window and go back to the RAID group window. You should now be able to see the new RAID group listed in the window.

Deleting a RAID group

To delete a RAID group:

1. Display the RAID groups window.

2. Click the checkbox(es) next to the name of the RAID group(s) you want to delete, then click Delete RG at the bottom of the window.

3. A confirmation dialog box is displayed. Click **OK** to confirm that you want to delete the RAID group or click Cancel to exit without deleting the selected RAID group.

4. If you click **OK**, a second confirmation dialog box is displayed. This dialog box explains that the data on the drives included in this RAID group(s) will be deleted. Click **OK** to delete the RAID group(s) anyway, or click Cancel to exit without deleting the RAID group(s).

If you click **OK**, SNM2 deletes the selected RAID groups and then displays a message confirming that the RAID groups have been deleted.

Managing replication

Navigator provides access to multiple methods of backing up data. They are divided between two primary types: local and remote replication, as described below.

Replication is the process of copying data from one volume (logical unit, LUN) to another. See the Managing Replication help page in the Navigator 2 Online Help system for information and procedures for details and procedures to accomplish this task. Replication can be accomplished via three different storage features including Copy On Write Snapshot, True Copy, and True Copy Extend Distance. Detailed information about each of these storage features is located in the *Hitachi Storage Navigator 2 Storage Features Reference Guide for AMS.* This manual is listed in the Accessing product documentation section in the Preface and is provided in PDF format on the documentation CD that accompanies the array.

In particular, see the *Hitachi Storage Navigator 2 Storage Features Reference Guide for AMS* that is included on the documentation CD that is shipped with the array. It explains the following storage features:

• Audit Logging

• Account Authentication

• Cache Partition Manager

• Cache Residency Manager

• Data Retention

• LUN Manager

- Performance Monitor
- SNMP Agent Support
- Volume Migration

Local replication

Local replication includes two methods of backing up information; ShadowImage and SnapShot. These methods create a copy of a volume (logical unit) in an array to another volume in the same array. You can create an actual copy of a volume by using ShadowImage and can create a virtual point-in-time copy of a volume by using SnapShot. ShadowImage and SnapShot treat the source volume, also called Primary Volume, and its copy, which is called the Secondary Volume, as a volume pair. For example, you can a copy by creating a pair. For detailed information and instructions, see the help page, Local Replication.

ShadowImage and SnapShot are optional storage features and require licenses to be installed and/or enabled before they can be used. See the introduction help page and the licenses help page for more information about setting up optional storage features.

Remote replication
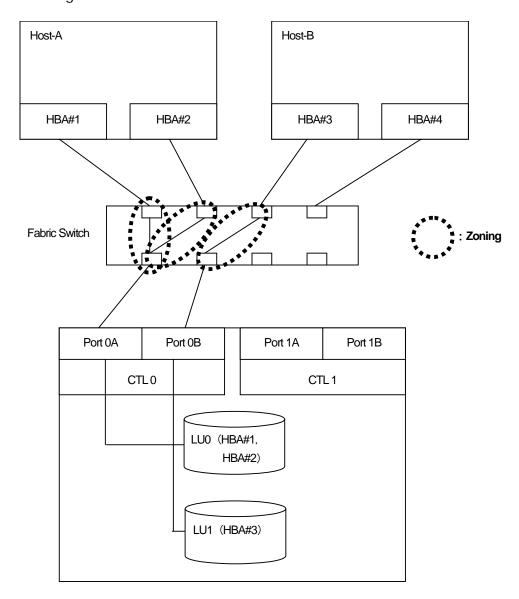
Remote replication includes two methods of backing up information; TrueCopy Remote Replication and TrueCopy Extended Distance. These methods allow you to create a copy of a volume (logical unit) in the array. TrueCopy remote replication allows the volumes to be synchronous at all times, while TrueCopy Extended Distance allows the volumes to be asynchronous. Both methods treat the source volume, also called Primary Volume, and its copy, which is called the Secondary Volume, as a volume pair. For example, you can a copy by creating a pair. For detailed information and instructions see the Remote Replication help page in Navigator 2.

TrueCopy remote replication and TrueCopy Extended Distance are optional storage features. See the Navigator 2 online help and the manuals listed in the Accessing product documentation in the Preface for more information about setting up these optional storage features.

Using the LUN Manager

Using LUN Manager on a Fabric switch connection

- When connecting to the servers (HBA) or exchanging the HBA, connect to the servers that can access the array after configuring the LUN Manager setting, including WWN registration.

• Zoning on a Fabric Switch must be set as shown below to change the access from HBA that cannot be accessed to Disk Array by LUN Manager.

Backing up your data

The AMS 2500 supports two types of backup operations:

- Local backup - copying LUNs to another drive in the same array

- Remote Backup - copying LUNs to a drive in another array.

Both of these operations are easy to accomplish using the wizards in Navigator 2. You can also copy data using the True Copy and Snapshot features in Navigator 2. See the Navigator 2 online help and the True Copy and Snapshot manuals that are included in the AMS 2500 documentation set for details.

Performance tuning in small-scale configurations

This section provides information to improve the I/O response time in small scale AMS 2500 configurations.

The number of RAID Groups can be expanded in the AMS 2500 array. To realize this scalability, the system is designed to keep the throughput on average even when the I/O is high. However, the I/O response time may create a delay in the configuration where the number of RAID Groups is small, for example one to three.

In this case, the I/O response time can be improved by setting this option. However, when continuously writing data to the cache, the amount of data can greatly exceed the cache memory size. This can temporarily cause the the throughput to deteriorate. Therefore, be careful when setting this option. Hitachi Data Systems recommends that you consider the traffic in the network environment before setting this option.

Setting the performance tuning option

1. In Navigator 2, display the **Array List window** and then select an array. The Array Properties window, and the explorer tree are displayed. If needed, see First time storage configuration - required tasks on page 7-19.

2. In the explorer tree, expand the **Performance** menu and select **Tuning Parameter**. The Tuning Parameter window is displayed.

3. Expand the Tuning Parameter menu to show the three options. These are described in Table 7-11.

Table 7-11: Tuning Parameters

Item	Description
Multi-Stream	Multi-Stream is a function that sets some parameters for multi-streaming for selected systems or logical units.
System Tuning	System Tuning is a function that sets some parameters for all systems.
LU Ownership	Logical Unit Ownership is a function that sets some parameters to logical unit ownership.
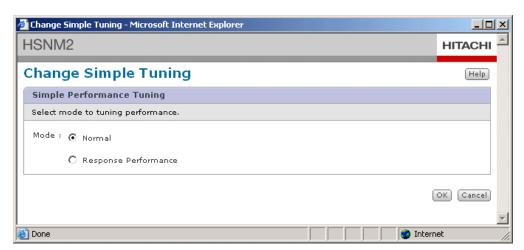
Viewing the tuning parameter mode

You can view the current Simple Tuning mode from the Summary portion of the Tuning Parameter window. There are two available modes, which may be set using the Change Simple Tuning button:

- Normal
- Response Performance

1. To change the Simple Tuning mode, click **Change Simple Tuning** (upper right corner of the window). The Change Simple Tuning window is displayed. Select **Response Performance** to improve the I/O response time only if the system meets the following conditions:

   - Dirty data are at 50%

   - The dirty data stop opportunity is 50%

   - The Multi-stream mode of the system is Read/Write

2. Click **OK**.

NOTE: The response performance mode is enabled only when the segment size is 16KB or less. Be careful when using it with Cache Partition Manager.

If you attempt to change the mode from response performance mode to the normal mode while the I/O load is heavy, the setting may not change and an error message is displayed. If this happens, follow the instructions in the error message, wait until after the host I/O stops, and change the setting again.
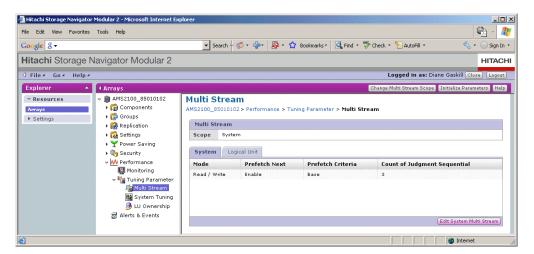
The processor operation rate becomes high while operating in the response performance mode compared to the rate in the normal mode. During this time, it may not be possible to replace the firmware. Hitachi Data Systems recommends that if you cannot replace the firmware while operating in the response performance mode, change the mode to normal and then replace the firmware.

If the mode setting is successful, a confirmation message is displayed. Click **Close** to exit the message box and return to the Tuning Parameters window, where you can confirm that the setting has changed.

Multi-stream configuration

Use the Multi Stream window to configure certain parameters that change the multi-stream scope, initialize parameter settings, and edit multi-stream options.
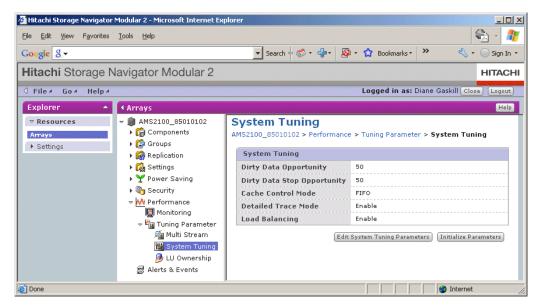
To display or set the multi-stream:

1. In the Array List window, select the array for which you want to display the multi stream and then click Show & Configure Array. The window and explorer tree for the selected array is displayed.

2. In the navigation tree, click Performance. The Performance window is displayed.

3. Click Tuning Parameter. The Tuning Parameter window is displayed.

4. Click Multi Stream. The Multi Stream window is displayed. The Multi Stream window displays the System tab by default.

5. You can view the current scope of the multi-stream feature from the Summary portion of the Multi Stream window. There are two available modes, which may be set using the Change Multi Stream Scope button:
    -   System
    -   Logical Unit

System tuning

You can set some parameters for system tuning and also initialize parameters from the System Tuning window.

To display or set the system tuning:

1. In the array window, select the array for which you want to display the system tuning and then click Show & Configure Array. The window and explorer tree for the selected array is displayed.

2. Click Performance. The Performance window is displayed.

3. Click Tuning Parameter. The Tuning Parameter window is displayed.

4. Click System Tuning. The System Tuning window is displayed. The System Tuning portion of the System Tuning Window provides the information in Table 7-12.
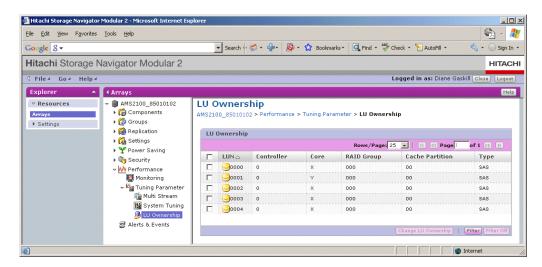
Table 7-12: System Tuning

Item	Description
Dirty Data Opportunity	Amount of dirty data opportunity.
Dirty Control Stop Opportunity	Number of dirty control stop opportunity.
Cache Control Mode	Selects the cache control mode.
Detailed Trace Mode	This is the mode of detailed trace.
Load Balancing	This is the type of load balancing.
Load Balancing Monitoring Time	A user-configurable value that sets the time to monitor load balancing. The default value is 3 minutes.

Logical unit ownership

In the Logical Unit Ownership window, you can change certain parameters of ownership to logical unit.

To display or to set the system tuning:

1. In the array window, select the array for which you want to view the system tuning and then click Show & Configure Array. The window and explorer tree for the selected array is displayed.

2. In the navigation tree, click **Performance**. The Performance window is displayed.

3. Click **Tuning Parameter**. The Tuning Parameter window is displayed.

4. Click **LU Ownership**. The LU Ownership window is displayed. The LU Ownership window provides the information shown in Table 7-13.

Table 7-13: Logical Unit Ownership

Item	Description
LUN	The LUN column in the table displays the name of the logical unit.
Controller	This column displays the controller number assigned to the LUN
Core	This column displays the core number assigned to the LUN. When core doesn't exist, this column displays "r;N/A".
RAID Group	This is the name of the displayed RAID group. The default name is RG-000.)
Cache Partition	This column displays the number of cache partitions assigned to the LUN (Range is 0 - nnn)
Type	This field displays the type of drive(s) contained in the RAID group. It can be either SAS or SATA. You cannot mix drive types within the same RAID group.

Using SSL

Hitachi Data Systems recommends that you use SSL (Secure Socket Layer) communication to encrypt data transferred via the user management LAN to manage the array. The general procedure for using SSL communication with the array is listed here and described in detail below.

1. Change the Server Certificate and Private key for array.

2. Change the Navigator 2 web server configuration.

3. Change the Navigator 2 Java applet configuration.

4. Manage the array through SSL communication.

Launching Navigator 2

When launching Navigator 2 specify the following URL:

https://xxxx:23016/StorageNavigatorModular/Login

where xxxx: is the IP Address that you used when returning the storage management when you returned the storage management PC network environment. See Restoring the management console on page 7-29.

For the URL, specify a host name or IP address of Navigator 2. Do not specify a loop back address such as localhost and 127.0.0.1 or [::1]. When you specify a loop back address such as localhost or 127.0.0.1, the Web screen is displays, but the Applet screen is not displays.
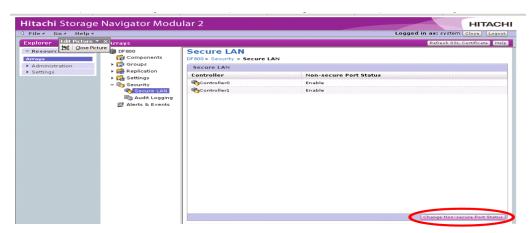
NOTE: When entering anIPv6 address in the address of the WEB browser, it is necessary to specify the URL that put xxxx of the URL in brackets ([]). `https://[xxxx]:23016/StorageNavigatorModular/Login`

Navigator 2 security settings

To set up SSL:

1. In the Array List window, select an array to manage.

2. When the Arrays window is displayed, expand the navigation tree to display the set of menu items.

3. Expand the Security menu item.

4. Click Secure LAN. The Secure LAN window is displayed, as shown below.

Changing the server certificate and private key

Complete the following easy steps to create a server certificate/private key using OpenSSL. After creating the server certificate/private key, update the server certificate/private key on the array.

> **NOTE:**
> - Only the x.509v3 certificate and RSA key are supported.
> - The certificate, private key and public key are read integrally up to the total of 8,192 Bytes.
> - The CRL (Certificate Revocation List) is unsupported.

1. Install OpenSSL and configure your environment that enable OpenSSL to use. Refer to OpenSSL Project (http://www.openssl.org).

2. Create a private key using the RSA algorithm. You can select a key length from 512, 1024 and 2048 bits.

> **NOTE:** You cannot use the private key encrypted by the Triple DES algorithm, etc. For example: With a 2048-bit key length, the command would be:

```
openssl genrsa -out privkey.pem 2048
```

3. Create an x.509 v3 server certificate. Use the certificate signed by the CA (Certificate Authority) or the certificate with your signature for the server certificate depending on the purpose.

   a. When using the server certificate signed by the CA (Certificate Authority), create a CSR (Certificate Signing Request). Submit the created CSR(Certificate Signing Request) ("csr.pem" in the example) to the CA (Certificate Authority) and obtain the signed server certificate. For example, when the expiration date is 365 days (one year), enter:

```
openssl req -new -days 365 -key privkey.pem -out csr.pem
```

   The obtained signed server certificate is described as "cacert.pem" hereinafter.

b. When using a self-signed certificate, create a certificate with your signature. Use the certificate only for the local environment or test. For example, when the validity period is 365 days (one year).

```
openssl req -new -x509 -key privkey.pem -out cacert.pem -days 365
```

4. Delete the path phrase (option). When you have generated the encrypted private key in step 1 or you use the existing encrypted private key, delete the path phrase in the following procedure. For example, delete the path phrase after copying the private key with another name (execution example with Unix) as follows:

```
cp -p privkey.pem privkey.pem.org
openssl rsa -in privkey.pem.org -out privkey.pem
```

5. Integrate the server certificate and private key. The array can read only the file (hereinafter called SSL certificate file) that integrates the server certificate and private key. Even if using the server certificate signed by the CA (Certificate Authority), create the file integrated with the private key in the following procedure. For example, when integrating the server certificate and private key as "server.pem" (execution example with Unix), enter:

```
cat cacert.pem privkey.pem > server.pem
```
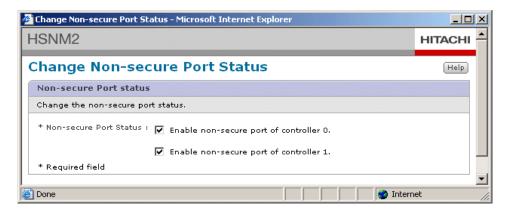
6. Use Navigator 2 to update the server certificate and private key. If you update the server certificate and private key when the normal port is invalid, you may not be able to connect it to the array when there is a problem on the server certificate or private key. Therefore, be sure to enable the normal port and update it.

   a. To enable the normal port, connect the port to the array from the secure port and select the secure LAN icon in the security tree. The secure LAN window is displayed.

   b. When the normal port status is invalid, click **Change Non-secure Port Status**. The Change Non Secure Port Status Dialog box is displayed.

c. As shown in the following figure, check **Enable non secure port of controller0** and **Controller1**. Then click **OK**. This enables the normal ports.

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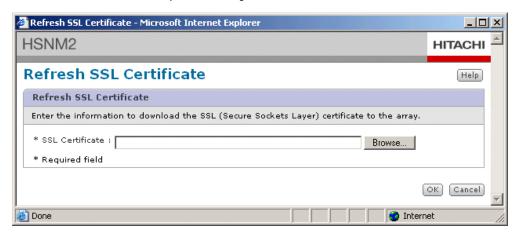
Updating the server certificate and private key

To update the server certificate and private key, perform the following steps.

1. Click the "Refresh SSL Certificate" button from the secure LAN window.

2. The SSL certificate update window is displayed. Specify the SSL certificate file created in step 3 in the above procedure and update the server certificate and private key.

Changing the Navigator 2 web server configuration

Follow the procedure below to change the Navigator 2 web server configuration.

1. Stop all Navigator 2 services.

   If you installed Navigator 2 in Windows, the HiCommand Suite Common Components and the SNM2 Server are registered in the OS as services. Because the services (daemon process) are registered when you start the OS, when you start the OS, the services (daemon processes) are automatically started.

   If you installed Navigator 2 in Linux and Solaris, the start and stop scripts of the process are created below /etc/init.d, and the HiCommand Suite Common Components and Navigator 2 Server are entered automatically as the daemon process when it starts.

Therefore, when you do any of the following operations, you must stop, start, or restart the services (daemon process) of HiCommand Suite Common Components and the Navigator 2 Server:

- Updating the Navigator 2 installation

- Uninstalling Navigator 2

- Installing other products to use HiCommand Suite Common Components

- Uninstalling other products to use HiCommand Suite Common Components

- Changing the setting files of Navigator 2

- It is always necessary to stop or start the service (daemon process) to use HiCommand Suite Common Components while another product is in use.

NOTE: When the service is stopped, the functions of Navigator 2 and other products using HiCommand Suite Common Components also stop and are not usable.

Stopping the SNM2 service

Prerequisites

Before stopping the Navigator 2 service, ensure that the following prerequisites are met:

- No users are logged on to Navigator 2.

- No problem is likely to occur while error monitoring is stopped.

- The firmware is not being updated.

- No problem is likely to occur while services (daemon process) of other products to use HiCommand Suite Common Components are stopped. (Refer to the manual of each product for the cautionary notes on stopping the services (daemon process) of other products.)

NOTE: You can restart the services (daemon process) by continuing each operation to stop or start the services (daemon process).

Procedure overview

To stop the services (daemon process):

1. Stop the SNM2 Server service (daemon process).

2. Stop the service (daemon process) for the HiCommand Suite Common Components.

> **NOTE:** Among the above procedures, if other products using HiCommand Suite Common Components are installed for the HiCommand Suit Common Components, it is not necessary for each product but it is entered only once. Besides, the operations other than the above may be required for each product when the services (daemon process) are stopped. Refer to the manual of each product for the details.

Windows

1. Stop the SNM2 Server service (daemon process). The service can be stopped either from the Control Panel or from the Command Prompt.

   Control Panel

   To stop the service from the Control Panel:

   a. In the Windows, select **Start > Settings > Control Panel**.

   b. In the Control Panel, select **Administrative Tools > Services**. The Services dialog box is displayed.

   c. In the Services (Local) list, select **SNM2 Server**.

   d. Select **Stop the service**.

   Command Prompt

   To stop the service from the command prompt:

   a. In Windows, select **Start > Run**, then enter **cmd** at the prompt. The command prompt (DOS) window is displayed.

   b. In the command prompt window, enter:

   ```
   C:\> net stop snm2server
   ```

   You can enter this command from any directory.

2. Stop the service (daemon process) for the HiCommand Suite Common Components.

> **CAUTION! Do not use the Services dialog box in the control panel to stop the service of HiCommand Suite Common Components. If you stop it directly, HiCommand Suite Common Components may become unusable.**

   a. In Windows, select **Start > Run**, then enter **Cmd** at the prompt. The command prompt (DOS) window is displayed.

   b. In the command prompt window, change directories to the directory where the HiCommand Suite Common Components have been installed. Enter:

   ```
   C:\> cd /D C:\Program Files\HiCommand\Base\bin
   ```

c. In the directory C:\Program Files\HiCommand\Base\bin, enter the following command:

```
C:\Program Files\HiCommand\Base\bin>hcmdssrv /stop
```

It may take several seconds to several minutes to stop the service.

d. To check the status of the service, enter the following command:

```
C:\Program Files\HiCommand\Base\bin>hcmdssrv /status
```

> ⚠️ **NOTE:** The part of the command, **C:\Program Files\HiCommand**, is the path of the directory in which HiCommand Base Common Components is installed.
>
> - It is necessary to replace this path according to the environment in which HiCommand Base Common Components is installed.
>
> - In an environment that does not include products that use HiCommand Suite Common Components other than Navigator 2, this directory is the same as the directory where Navigator 2 is installed.

e. If other products are also installed, specify a folder that was specified when the first product was installed.

Linux and Solaris

1. Stop the **SNM2 Server** daemon process. Ensure that you have root authority and then enter the following command.

```
/etc/init.d/snm2srv stop
```

You can enter this command from any directory.

2. Stop the service (daemon process) for the HiCommand Suite Common Components.

a. Ensure that you have root authority.

b. Enter the following command:

```
/opt/HiCommand/Base/bin/hcmdssrv -stop
```

You can enter this command from any directory.

It may take several seconds to several minutes to stop the daemon process.

c. Check that the daemon process is stopped by entering the following command.

```
/opt/HiCommand/Base/bin/hcmdssrv -status
```

> ⚠️ **NOTE:** The part of the command, **/opt/HiCommand,** is the path of the directory in which HiCommand Base Common Components is installed.

- • For Linux, it is necessary to replace the path according to the environment in which HiCommand Base Common Components are installed. In an environment that does not use any HiCommand Suite Common Components other than Navigator 2, this directory is:

      /opt/HiCommand

- • For Solaris, it is not necessary to replace the /opt/HiCommand.

   d. If other products are also installed, specify a directory that was specified when the first product was installed. Refer to the manual of each product for the details.

> ⚠️ **CAUTION! In the process of the HiCommand Suite Common Components, do not stop it by using the script /etc/init.d or by the kill command, etc. If you stop it by this method, the HiCommand Suite Common Components may become unusable.**

Creating a private key

After stopping the SNM2 server and HiCommand services (see above), create a private key. Use the hcmdssslc command to do this.

Windows

1. Create the directory that will hold the private key.
2. Select **Start > Run,** and in the Run field, enter **Cmd.** The command prompt (DOS) window is displayed.
3. In the command prompt window, change directories to the following directory:

       <Navigator 2 installation directory>\Base\bin

4. Enter the following command:

       hcmdssslc genrsa –out c:\ca\httpsdkey.pem <bit length of the key>

   where *<bit length of the key>* can be 512, 1024, or 2048.

Unix

1. Ensure that you have root authority.
1. Create the directory that will hold the private key.
2. Change directories to the directory:

       <Navigator 2 installation directory>/Base/httpd/sslc/bin

3. Enter the following command:

```
sslc genrsa –out /ca/httpsdkey.pem <bit length of the key>
```

where <bit length of the key> can be 512, 1024, or 2048.

Example

```
hcmdssslc genrsa -out c:\ca\httpsdkey.pem 2048
Loading 'entropy' into random state – unable to load 'random
state'
warning, not much extra random data, consider using the –rand
option
Generating 2 prime RSA private key, 2048 bit long modulus
.......................................................
..+++++
...........+++++
e is 65537 (0x10001)
```

Creating a CSR (Certificate Signing Request)

1. To create a CSR (Certificate Signing Request) enter the following command line:

Windows

```
hcmdssslc req –config "C:\Program
Files\HiCommand\Base\httpsd\sslc\bin\demoCA\sslc.cnf"
-new –key c:\ca\httpsdkey.pem –out c:\ca\httpsd.csr
```

Unix

```
./sslc req –config /opt/HiCommand/Base/httpsd/sslc/bin/
demoCA/sslc.cnf
-new –key ca/httpsdkey.pem –out /ca/httpsd.csr
```

Example

```
Using configuration from C:\Program
Files\HiCommand\Base\httpsd\sslc\bin\demoCA\
sslc.cnf
You will be prompted to enter information to incorporate
into the certificate request.
This information is called a Distinguished Name or a DN.
There are many fields however some can remain blank.
Some fields have default values.
Enter '.', to leave the field blank.
-----
Country Name (2 letter code) []:us
State or Province Name (full name) []:California
Locality Name (eg, city) []:San Jose
Organization Name (eg, company) []:Hitachi
Organizational Unit Name (eg, section) []:Hitachi
Common Name (eg, YOUR name) []:Hitachi
Email Address []:

Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:
An optional company name []:
```

2. Submit the created csr file ("httpsd.csr" in the above example) to the CA (Certificate Authority) and obtain the signed certificate.

   Even if you do not submit the csr file or obtain the signed certificate file from the CA (Certificate Authority), you can correspond to SSL by creating the certificate file with your signature using the hcmdssslc (sslc for Unix) command. In this case, however, the warning screen is displayed at the time of the initial screen display of Navigator 2, and when the applet launches.

3. Create a self-signed certificate file. Use the hcmdssslc (sslc for Unix) command.

   Windows

   Enter the following command line.

   ```
   hcmdssslc x509 -in c:\ca\httpsd.csr -out c:\ca\newcert.pem -
   reg -signkey
   c:\ca\httpsdkey.pem -days 365

   c:\ca\httpsd.csr:CSR to CA
   c:\ca\newcert.pem:self-signed certificate
   c:\ca\httpsdkey.pem:key file
   ```

   Unix

   Enter the following command line.

   ```
   ./sslc x509 -in /ca/httpsd.csr -out /ca/newcert.pem -reg -
   signkey
    /ca/httpsdkey.pem -days 365
   ```

Editing the httpsd.conf file

After creating the CSR, edit the configuration file as follows:

Open the httpsd.conf file stored in `<installation directory>\Base\httpsd\conf`. The contents of the file are shown below.

```
SSLSessionCacheSize 0
#Listen 23016
#Listen [::]:23016
#<VirtualHost s1j-orca2xp:23016>
#   ServerName s1j-orca2xp
#   SSLEnable
#   SSLProtocol SSLv3 TLSv1
#   SSLRequireSSL
#   SSLCertificateFile "C:/ca/httpsd.pem"
#   SSLCertificateKeyFile "C:/ca/httpsdkey.pem"
#   SSLCACertificateFile "C:/Program #Files/HiCommand/Base/
httpsd/conf/ssl/cacert/anycert.pem"
#   SSLSessionCacheTimeout 3600
#</VirtualHost>
```

4. Remove the comment mark `#` from each line in the file. These are commented out by default.

5. Change the values of `SSLCertificateFile` and SSLCertificateKeyFile. Specify the signed certificate file obtained from the CA for `SSLCertificateFile` and the full path of the private key file created in step 2 for `SSLCertificateKeyFile`.

6. Save the file. The contents of the edited file are shown below. The bold text indicates where text will be changed to the values you provide.

```
SSLSessionCacheSize 0
Listen 23016
Listen [::]:23016
<VirtualHost s1j-orca2xp:23016>
ServerName s1j-orca2xp
SSLEnable
SSLProtocol SSLv3 TLSv1
SSLRequireSSL
SSLCertificateFile "C:/ca/httpsd.pem"
SSLCertificateKeyFile "C:/ca/httpsdkey.pem"
SSLCACertificateFile "C:/Program #Files/HiCommand/Base/
httpsd/conf/ssl/cacert/anycert.pem"
SSLSessionCacheTimeout 3600
</VirtualHost>
```

Starting the Navigator 2 services

Procedure overview

To start the services (daemon processes):

1. Start the service for the HiCommand Suite Common Components.

2. Start the SNM2 Server service.

> **NOTE:** In the above procedure, if other products that use HiCommand Suite Common Components are installed for the HiCommand Suit Common Components, it is not necessary to stop the service for each product because only one service is used for the products. In addition, the operations other than the above may be required for each product when the services are stopped. Refer to the manual of each product for the details.

Windows

1. Use the Windows command prompt to start the HiCommand Suite Common Components service.

> **CAUTION! Do not use the Services dialog box in the control panel to start the service of HiCommand Suite Common Components. If you start it directly, HiCommand Suite Common Components may become unusable.**

   a. Select **Start > Run,** and in the Run field, enter **Cmd.** The command prompt (DOS) window is displayed.

   b. In the command prompt window, change directories to the directory where the HiCommand Suite Common Components have been installed.

   ```
   C:\> cd /D C:\Program Files\HiCommand\Base\bin
   ```

   c. The directory in which the commands of HiCommand Suite Common Components have been installed, enter:

   ```
   C:\Program Files\HiCommand\Base\bin>hcmdssrv /start
   ```

   It may take several seconds to several minutes for the service to start.

   d. Check that the service is started by entering the following command.

   ```
   C:\Program Files\HiCommand\Base\bin>hcmdssrv /status
   ```

> **NOTE:** The part of the command, **C:\Program Files\HiCommand**, is a path of the folder in which HiCommand Base Common Components is installed. It is required to replace it according to the environment in which HiCommand Base Common Components are installed.

2. Start the SNM2 Server service. The service can be started either from the Control Panel or from the Command Prompt.

Control Panel

To start the service from the Control Panel:

a. In Windows, select **Start > Settings > Control Panel.**

b. In the Control Panel, select **Administrative Tools > Services.** The Services dialog box is displayed.

c. In the Services (Local) list, select **SNM2 Server**.

d. Select **Restart the service**.

Command Prompt

To start the service from the command prompt, perform the following:

a. In Windows select **Start > Run,** and in the Run field, enter **Cmd**. The command prompt (DOS) window is displayed.

b. In the command prompt window, enter:

```
C:\> net start snm2server
```

You can enter this command from any directory.

Linux and Solaris

1. Start the HiCommand Suite Common Components daemon process.

   a. Ensure that you have root authority.

   b. Enter the following command:

   ```
   /opt/HiCommand/Base/bin/hcmdssrv -start
   ```

   You can enter this command from any directory.

   It may take several seconds to several minutes to start the daemon process.

   c. Check that the daemon process is started by executing the following command.

   ```
   /opt/HiCommand/Base/bin/hcmdssrv -status
   ```

⚠️ **NOTE:** The part of the command, **/opt/HiCommand,** is the path of the directory in which HiCommand Base Common Components is installed.

- For Linux, it is necessary to replace the path according to the environment in which HiCommand Base Common Components is installed. In an environment that does not use any HiCommand Suite Common Components other than Navigator 2, this directory is:

  ```
  /opt/HiCommand
  ```

- For Solaris, it is not necessary to replace the /opt/HiCommand.

---

d. If other products are also installed, specify a directory that was specified when the first product was installed. Refer to the manual of each product for details.

> ⚠️ **CAUTION! Do not start the HiCommand Suite Common Components process by using the script below /etc/init.d or by sending a signal with the kill command, etc. If you stop it this way, the HiCommand Suite Common Components may be come unusable.**

2. Start the SNM2 Server.

   To start the **SNM2 Server** daemon process:

   a. Ensure that you have root authority.

   b. Enter the following command.

   ```
   /etc/init.d/snm2srv start
   ```

   You can enter the command from any directory.

Changing the Navigator 2 Java applet configuration

The setting is required to use the Advanced Settings features in Navigator 2.

The applet screen can connect with either a normal port or secure port.

1. Stop the Navigator 2 services. See the instructions in Changing the Navigator 2 web server configuration on page 7-52.

2. Change the setting with the executable file that is already installed, as follows:

   - **Windows**: Change directories to *<Navigator 2 installation directory>*\StorageNavigatorModular\bin and run the batch file **snmkey.bat**.

   - **Unix**: Change directories to *<Navigator 2 installation directory>*\StorageNavigatorModular\bin and run the shell script **snmkey.sh**.

3. **Example** (Windows)
   If you have already created a keystore file and a certification file for client installation, enter **y** at the `continue` prompt.

```
cd "C:\Program Files\HiCommand\StorageNavigatorModular\bin"
c:
snmkey.bat
A keystore file or certification file already exists. If
you change the setting to use the secure port, this file
will be overwritten.
Are you sure you want to continue? (y/n)[n]:y
```

4. If the HiCommand Suite Common Components services or the RMI server service being used is running, the following message appears. Enter **y** at the `continue` prompt.

```
This setting stops the HiCommand Suite Common
Components services and the RMI server service.
Do you want to continue processing? (y/n)[n]:y
Stopping the HiCommand Suite Common Components
services...success
Stopping the RMI server service...success
```

```
Current RMI normal port number:1099

Input the normal port number(Input "unset" to unset)
[1099]:unset
```

5. Enter the port number that you want to set the normal port. If you enter **unset**, the normal port is not available.

```
Current RMI normal port number:1099

Input the normal port number(Input "unset" to unset)
[1099]:unset
```

6. Enter the port number for the secure port. If you enter unset, the secure port is not available.

NOTE: You cannot set the same port number to both the normal and secure ports.

7. Enter the alias name and password of the keystore file for using SSL. If the process completes successfully, the certification file path for the client is displayed.

```
Input the alias name of keystore file [snm2rmi]:mysnm2rmi

Input the new password of keystore file:abcdefg

Creating keystore...success

Signing to keystore...success

Creating certification file...success

Updating certification file...success

RMI security settings have been set successfully.

Certification file have been output to the following path.

<C:\Program
Files\HiCommand\StorageNavigatorModular\security\
snm2rmi.cert>
```

If the processing completed successfully, the HiCommand Suite Common Components services and RMI server service start automatically and the command prompt (terminal console for Unix) screen closes.

```
Starting the RMI server service...success

Starting the HiCommand Suite Common Components
services...success

All process completed.
```

8. Complete the following steps to install the client side. This procedure uses the client certificate file that you created in the previous step. When a client and server are different, copy the file to a client.

    a. Open a command prompt window (terminal console for Unix) and change directories to the following directory:

        <JRE >installation directory>\bin

    b. Enter the following command:

        **keytool -import
        -keystore "<*JRE installation directory*> \lib\security\cacerts" -
        <*alias <alias name*> -file <*client certificate file*>**

See the following example.

```
keytool –import
 –keystore "C:\Program Files\Java\server\jre1.6.0_05\lib\security\cacerts"
 -alias snm2rmi –file C:\key\snm2rmi.cert
Enter keystore password: changeit
Owner: CN=Hitachi, OU=Hitachi, O=Hitachi, L=San Jose,
ST=California, C=us
Issuer: CN=Hitachi,OU=Hitachi,O=Hitachi,L=San
Jose,ST=California, C=us
Serial number: 47b429aa
Valid from: Thu Feb 14 20:44:42 PDT 2008 until: Wed May 14
20:44:42 PDT 2008
Certificate fingerprints:
     MD5:  D8:C3:CC:59:93:68:DA:68:8A:6F:0A:87:78:E8:74:32
     SHA1:
C4:2D:49:2E:1E:AF:CC:AF:F5:1D:B2:A3:1C:44:DE:90:72:32:67:1
3
Trust this certificate? [no]: yes
Certificate was added to keystore
```

Managing an array with SSL communication
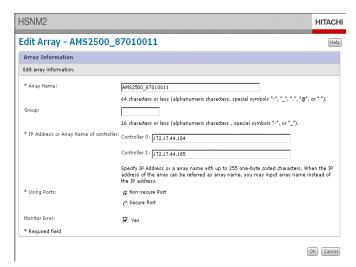
To manage an array using SSL:

1. Start Navigator 2 and log in. If needed, see .

⚠️ **NOTE:** Use the IP address and port number of the host computer, not a loop back address such as localhost or 127.0.0.1. If you specify a loop back address, the login screen is displayed, but Navigator 2 will not display.

2. Log into a selected an array. If needed, see .

3. Edit the array information to enable a secure port. Select an array (check the box next to the name, do not click the array name).

4. Click **Edit Array**. The Edit Array dialog box is displayed.

HSNM2   HITACHI

Edit Array - AMS2500_87010011   Help

Array Information

Edit array information.

* Array Name: AMS2500_87010011

64 characters or less (alphanumeric characters, special symbols "-", "_", ".", "@", or " ").

Group:

16 characters or less (alphanumeric characters , special symbols "-", or "_").

* IP Address or Array Name of controller: Controller 0: 172.17.44.184

Controller 1: 172.17.44.185

Specify IP Address or a array name with up to 255 one-byte coded characters. When the IP address of the array can be referred as array name, you may input array name instead of the IP address.

* Using Ports: ⦿ Non-secure Port
                            ○ Secure Port

Monitor Error: ☑ Yes

* Required field

                                                           OK   Cancel

c. Change **Using port** from **Non-secure** to **Secure**.

d. Click **OK**. If the change is made successfully, a confirmation message is displayed.

e. Click **Close** to exit the message box and return to the Array List window.

Edit Array - DF800M_85010031   [Help]

Array Information

Edit array information.

* Array Name: [DF800M_85010031   ]

64 characters or less (alphanumeric characters, special symbols "-", "_", ".", "@", or " ").

Group: [   ]

16 characters or less (alphanumeric characters , special symbols "-", or "_").

* IP Address or Array Name of controller: Controller 0: [172.17.44.74   ]

Controller 1: [   ]

Specify IP Address or a array name with up to 255 one-byte coded characters. When the IP address of the array can be referred as array name, you may input array name instead of the IP address.

* Using Ports: ○ Non-secure Port
                            ● Secure Port

Monitor Error: ☑ Yes

* Required field

[OK] [Cancel]

Disabling the normal port (optional)

You can optionally disable the normal port so that there is no unsecure access to the array.

1. Ensure that the secure port is working correctly.

2. Close the normal port as needed. In the Array List window, click Edit Array.

⚠ **NOTE:** To switch valid/invalid of the normal port, connect to the array by the secure port.

Other storage management operations

Other storage management operations include creating, deleting, and managing host groups, logical units (LUNs) and data pools, LUN expansion, See Navigator 2 features on page 7-11 and Storage features on page 7-12 for a complete list of the features supported on an AMS 2500.

These operations are described in detail in the *Hitachi Navigator Modular 2 (SNM2) Storage Features Consolidated User's Guide* that is included on the documentation CD that is shipped with the array. In addition, the Navigator 2 online help included detailed procedures to use these features.

Uninstalling Navigator 2

If you need to reinstall or upgrade the software, you must first uninstall the currently installed software. See the following instructions.

To uninstall Navigator 2:

1. Close all Navigator 2 windows, including any help windows that are open.

2. Stop all Navigator 2-related services.

    a. Locate the file \.....HiCommand\Base\bin\hcmdssrv.exe. The default location is:

       c:\Program Files\HiCommand\Base\bin\hcmdssrv.exe

    b. In a command (DOS) window that is started from the above directory, enter the following command:

       hcmdssrv /stop

3. When the services stop, select Start > Settings > Control Panel > Add/Remove Programs.

4. Wait until the list is populated (this can take several minutes, depending on the number of installed applications).

5. Select Hitachi Storage Navigator Modular 2.

6. Click Remove Program.

⚠️ **NOTE:** The removal process can take several minutes. During this time, the progress indicator may appear to stop for a minute or more. Please let the program run to completion.

Notes on advanced settings

Please note the following issues with using the Advanced Settings:

1. You must install JRE 1.6.0 (6.0) on the client machine (where the browser is launched). You can download the JRE from http://java.com/en/download.

2. You should have installed SNM2 with the default port settings of 1099.

3. You must configure the Java Runtime Parameters manually to include –Xmx912m.

For Windows

1. In the Windows Start menu, choose Settings, Control Panel.
2. From the Control Panel, select the Java icon.
3. Select the Java tab and click the **View…** button.
4. Enter "-Xmx192m" to the Java Runtime Parameters field.

⚠️ **NOTE:** It is necessary to set the Java Runtime Parameters to display the Applet screen.

5. Click **OK**.
6. Click **OK** in the **Java** tab.
7. Close the **Control Panel**.

For Linux and Solaris

1. Run the Java Control Panel from XWindow terminal executing the <JRE installed directory>/bin/jcontrol.
2. Select the Java tab and click the **View…** button.
3. Enter **-Xmx192m** to the Java Runtime Parameters field.
4. Click **OK**.

⚠️ **NOTE:** It is necessary to set the Java Runtime Parameters to display the Applet screen.

5. Click **OK** in the **Java** tab.
6. Click **Close** right of the dialog to close the window.
7. If you close the dialog using the "X" button, the session will remain open and you will not be able to use Advanced Settings until 30 minutes have passed.

8

Troubleshooting

This chapter provides information to help you identify and resolve problems that you may encounter with an AMS 2500. This chapter includes the following key topics:

❐ Getting help

❐ Troubleshooting tables

❐ Troubleshooting flowcharts

❐ Recovering from failures

❐ Troubleshooting based on LED indications

Getting help

If you have difficulty with any of the procedures included in this chapter, or if a procedure does not provide the answer or results you expect, please contact the Hitachi Data Systems Customer Support team. See the Getting help section in the Preface for information about accessing the support portal.

Troubleshooting tables

Table 8-1 lists common problems and their solutions. Detailed solutions are described further in this chapter. The solutions include flowcharts and other instructions to assist you in solving these problems.

Table 8-1: Problems and Solutions

Symptom	Possible Cause	Action
Missing or damaged parts	• Packing error • Shipping damage	If any of the contents listed on the packing list that is included with the unit are missing or damaged, contact your place of purchase.
A failure other than an array failure occurs	No power to host and/or array	• Check that the host and the array are turned on. • Ensure that power cables to the equipment are connected. • Ensure that the power source is operational.
	Communication failure with host	• Verify that the port activity LEDs on the Fibre Channel data ports being used are is ON. If not, try a different Fibre Channel data port. • Check the LUN Manager, mapping and LUN settings.
Array or part has failed	Array or part has failed	1. Start Navigator 2. If it fails to start, see Navigator 2 does not start on page 8-3, below. 2. Go to the Explorer pane and select Resources > Arrays. 3. In the Array List window, check for a failed array. If you find one, select Components > Trays. 4. From the Alerts screen, click **Details** to check for additional failed parts. 5. Read any detailed information about the failed part. 6. If the failed component is a drive, order a replacement drive from the Web Portal at http://support.hds.com.
An unidentified failure has occurred	Software failure	1. If using preinstalled software (see Features and benefits on page 1-8), refer to the documentation for that product. 2. Turn off the AMS 2500 array. Verify that the front panel Power LED goes OFF. If the Power LED is ON, disconnect both power cables and verify that the front panel Power LED is OFF. 3. Turn on The AMS 2500 array and verify that the Ready LED goes ON. 4. If these steps do not resolve the problem, see Array or part has failed, above.

Table 8-1: Problems and Solutions

Symptom	Possible Cause	Action
Navigator 2 does not start	Communication failure with host or management console	• Check and reset communications settings • Check and reconnect LAN cables. Replace if needed. • Check LEDs and take appropriate action. See the LEDs section in this table. • Check and restore power to equipment as needed. • Be sure the computer acting as the management console meets the minimum requirements described in Prerequisites on page 7-9. • Check the settings of your Web browser. • Verify that the correct IP address was entered in the Web browser address field. • Verify that the Navigator 2 server is working. • Verify that the host has Java Runtime Environment (JRE) version 1.6 (update 2) installed. This is a free download from http://java.sun.com/javase/downloads/index.jsp. • If these steps do not fix the problem, you may need to reinstall the Navigator 2 software.
	Corrupt Navigator 2 installation	Reinstall Navigator 2. See Chapter 7, Configuration.
Navigator 2 does not run	Incorrect communication setting: Negotiation	Check the negotiations settings on the management console, and array. Make sure they are the same. The default value for the negotiation is **Auto**.
	Incorrect value set for the IP Address, subnet mask, or default gateway of array	Set a suitable value for the customer's environment for the IP address, subnet mask, and default gateway of array. [IPv4 default value] controller #0: IP address: 192.168.0.16 Subnet Mask: 255.255.255.0 Default Gateway: 0.0.0.0 controller #1: IP address: 192.168.0.17 Subnet Mask: 255.255.255.0 Default Gateway: 0.0.0.0 [IPv6 default value] controller #0: IP Address: Auto controller #1: IP Address: Auto
	Communication failure with host or management console	1. Check and reset communications settings. 2. See next section in this table.

Table 8-1: Problems and Solutions

Symptom	Possible Cause	Action
Navigator 2 cannot communicate with the array In addition to this table, see the flowchart Figure 8-2: Flowchart - Navigator 2 Cannot Connect to an Array on page 8-9	iSCSI LAN cables are broken or not properly connected	If using iSCSI connections, connect a category 5e or category 6 LAN cable to the RJ-45 connector marked **LAN** and the management console
	One or more units are powered off or do not have power.	1. Check the array power cables, power sources, power switch, and power LED. 2. Check whether other devices in your network, such as a router or switch, are the cause of the problem. 3. Turn off the array. Verify that the front panel Power LED goes OFF. If the Power LED stays ON, disconnect both power cables and verify that the front panel Power LED is OFF. 4. Turn on the array, wait about 4 minutes for the POST to complete, and verify that the Ready LED goes ON. 5. If these steps do not resolve the problem, see Array or part has failed, above.
	Communication failure: the array is set to use the DHCPv4 server	• When the array is set to use the DHCPv4 server, connect with the IP address assigned by the DHCPv4 server. When using the DHCPv4 server, it is recommended that the array be set to statically (Static) assign IP address. • If the IP address is not assigned from the DHCPv4 server to the array when the array is set to use the DHCPv4 server, Navigator 2 cannot be connected to the array. Consult with your network administrator, and review the DHCPv4 server settings. • The default value is DHCPv4: Off (uses a Static IP address)
	Communication failure: an incorrect value set for the IP address, subnet mask, or default gateway of array	Set a suitable value for the customer's environment for the IP address, subnet mask, and default gateway of array. [default value] controller #0: IP address: 192.168.0.16 default gateway: 0.0.0.0 Subnet Mask: 255.255.255.0 controller #1: IP address: 192.168.0.17 default gateway: 0.0.0.0 subnet mask: 255.255.255.0
	Communication failure: the array is set to use the same IP address as other arrays or hosts.	When the same IP address as the other arrays or hosts is set for the array, Navigator 2 cannot be connected correctly to the array. Set the array IP address to one that is not used by any other array or hosts on the LAN.
	TCP/UDP port filtering is being performed on the network switch.	• The standard default TCP port number for Navigator 2 is 2000. The secure port is 28355. Set a suitable value for the customer's environment. • Be sure to change the port number in the environment using the Cisco SIP Phone.

Table 8-1: Problems and Solutions

Symptom	Possible Cause	Action
	Is the Search Array being performed across the IPv6 routers?	The Auto Search Array of IPv6 uses link-local scope multicast. The IPv6 router is unable to transfer this multicast to other local link, so the IPv6 router is unable to search array across the IPv6 router. In case of between different local links, register the array by the static address search.
Host cannot access storage	Communication failure with host or management console.	1. If you are using Fibre Channel, verify that the port activity LED on the used Fibre Channel data ports is ON or flashing. 2. Check that all Fibre Channel cables are connected securely at both ends. 3. If you are using iSCSI, ping the array from the host. If the ping fails, verify that the host is communicating with the array at the appropriate IP address. 4. Check whether other devices (routers, switches, etc.) in your network) are the cause of the problem. 5. If these steps do not fix the problem, contact Technical Support. See Getting help in the Preface of this manual.

Table 8-2: LED Failure Indications

Unit	Symptom	Possible Cause	Action
In addition to this table, also see Troubleshooting based on LED indications on page 8-12.			
Base Unit	Power LED OFF	1. Array power switch OFF. 2. Power supplies not plugged in. 3. PDB switch or breaker OFF. 4. No electric supply to rack.	1. Ensure that the array power switch is ON. 2. Check that the power cable connections to the array and the PDB are secure. 3. Ensure that the PDB switches are ON. 4. Verify electricity supply to the rack. Work with facility administrator to restore power. 5. If these steps do not fix the problem, contact Technical Support. See Getting help in the Preface of this manual.
	Ready LED OFF	Array failure	Please contact Hitachi Data Systems Technical Support. See the Getting help section in the Preface of this manual.
	Ready LED OFF	Array failure	Please contact Hitachi Data Systems Technical Support. See the Getting help section in the Preface of this manual.
	Ready LED slow blink	Not a failure. Firmware download is complete. The array is fully operational.	Use the array normally.
	Ready LED fast blink	Not a failure. The firmware is being updated (do not turn off the array).	Wait until the light is ON steady before attempting to replace parts or use the array.
	Warning LED ON	Nonserious error. The base unit can continue to operate.	See the Alerts & Events window in Navigator 2 for information about the error.
Disk Drive	Alarm LED ON	A serious error has occurred in the array.	Please contact Hitachi Data Systems Technical Support. See the Getting Help section in the Preface of this manual.
Backup Battery	Alarm LED	The drive has failed.	Back up data and replace the drive.
	Ready LED blinking slowly (1 blink per second)	Not a failure. The battery is not fully charged.	Allow battery to charge fully.
Power Supply	Ready LED OFF	No power to power supply.	1. Ensure that power cables to the equipment are connected. 2. Ensure that the power source is operational.
	Ready LED blinking	Not a failure. Means that power is connected to the power supply.	Use normally.
	Alarm LED ON	The power supply has failed.	Replace the power supply.

Table 8-2: LED Failure Indications (Continued)

Unit	Symptom		Possible Cause	Action
Controller	C-Power LED ON		The cache memory is backed up.	
	RST LED blinking		Not a failure. Blinks while the base unit is resetting.	Wait until reset completes before using the base unit.
	Link LED OFF		Link status is abnormal.	Check LAN cable connections and communications settings. See Navigator 2 cannot communicate with the array in Table 8-1.
	ACT LED OFF		No data is being transferred.	
	LCT LED blinking	6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)	Replace the controller.
		1 (fast)[a]	SRAM error.	
		2 (fast)	ENC hard error.	
		3 (fast)	Firmware error in flash memory.	
		4 (fast)	CUDG error in ENC.	
	LCT LED ON		Boot section error in the ENC firmware, a RAM error, or ENC hard configuration error.	
Expansion Unit	Power LED OFF		1. Array power switch OFF. 2. Power supplies not plugged in. 3. PDB switch or breaker OFF. 4. No electric supply to rack.	1. Ensure that the ENC cables are connected from the base unit to the expansion unit and that Ensure that the array power switch is ON 2. Check that the power cable connections to the expansion unit and the PDB are secure. 3. Ensure that the PDB switches in the rack are ON. 4. Verify electricity supply to the rack. Work with facility administrator to restore power. If these steps do not fix the problem, contact Technical Support. See Getting help in the Preface of this manual.
	Locate LED ON		Indicates that a non-fatal failure in the expansion unit, but which does not stop the unit from operating. Indicates that the expansion unit has been added to the array with the power turned on (this is not an error).	

a.When blinking fast, the LED is on for 400ms and off for 200ms for each fast blink. After the number of fast blinks has completed, the LED id goes off for one second.

Troubleshooting flowcharts

The following section provides step-by-step flowcharts that can assist you in solving two common problems with Navigator 2.

Navigator 2 does not start

Follow these flowchart steps in Figure 8-1 if Navigator 2 does not start when you enter the login URL in your web browser. Communication failure with the host or a corrupt installation are the main things to look for.

Figure 8-1: Flowchart - Navigator 2 Does Not Start

Navigator 2 cannot connect to an array

The flowchart in Figure 8-2 provides a series of troubleshooting steps to follow if Navigator 2 runs but cannot connect to an array.

Navigator 2 does not connect to any array. The status is --------.

Check the Power LED on the array and make sure that the array is turned on.

Power LED is OFF → Check the power cables and connect them if needed. Verify that the rack has power and the distribution busses are turned on.

Turn on the Power switch and wait for the Ready LED to come on.

Ready LED is ON → End

Ready LED is OFF

Power LED is ON

Check the Alarm LED on the selected array.

Alarm LED is ON → Cycle the power switch, wait for the Ready LED to come on, and check the Alarm LED. Repeat three times.

Alarm LED is ON

Alarm LED is OFF

Check the Ready LED on the selected array and verify that it is ON.

Ready LED is ON → Check the LAN cable between the management console and the array. Check for a communications failure between Navigator 2 and the array. See Table 8.1

See "Recovering from Failures" in this chapter.

Yes → End

No → Contact Network Admin

Ready LED is OFF

Turn the power switch OFF and check the Power LED.

Power LED goes off OR it stays on for more than 20 minutes, even with the power switch off.

Unplug the power cables from both power supplies in the base unit, then reconnect them.

Turn on the Power switch and verify that the Power LED is ON. Wait at least four minutes and check the Ready LED. (1)

Ready LED is OFF

Ready LED is ON

Recheck the power on/off operation. Turn the Power switch OFF and check the Power LED. (2)

Power LED is ON

Power LED is OFF

Turn on the Power switch, wait at least four minutes and check the Ready LED. (1) (2)

Ready LED is OFF

Ready LED is ON

End

Contact HDS Support. See "Getting Help" in this chapter.

Notes:
(1) The Ready LED normally lights about four minutes after the power is turned on but can take as long as 20 minutes depending on the array status. If the Ready LED does not light within 20 minutes, check the Power LED and verify that it is ON. If it is not ON, check the power cables and the power to the rack.
(2) If the Power LED stays on when the Power switch is turned OFF, the array may not have powered off correctly. Turn the power on and back off again, then recheck the Power LED.

Figure 8-2: Flowchart - Navigator 2 Cannot Connect to an Array

Recovering from failures

An array failure may have occurred if one or more of the following occurs:

- The AMS 2500 array sends an email alerting you to a failure.
- The **Alarm** or **Warning** LED on the front panel is ON.
- The **Ready** LED on the front panel is OFF.
- You experience performance deterioration with the AMS 2500 array.
- A LUN cannot be recognized.
- A host cannot see a Fibre Channel data port on The AMS 2500 array.

If one or more of these actions occurs, perform the following steps to recover from the failure:

1. Log in to Navigator 2. Enter the following URL in the address field in the web browser:

   `http://<IP address of management console PC>:23015/ StorageNavigatorModular/Login`

2. The Array List window is displayed.
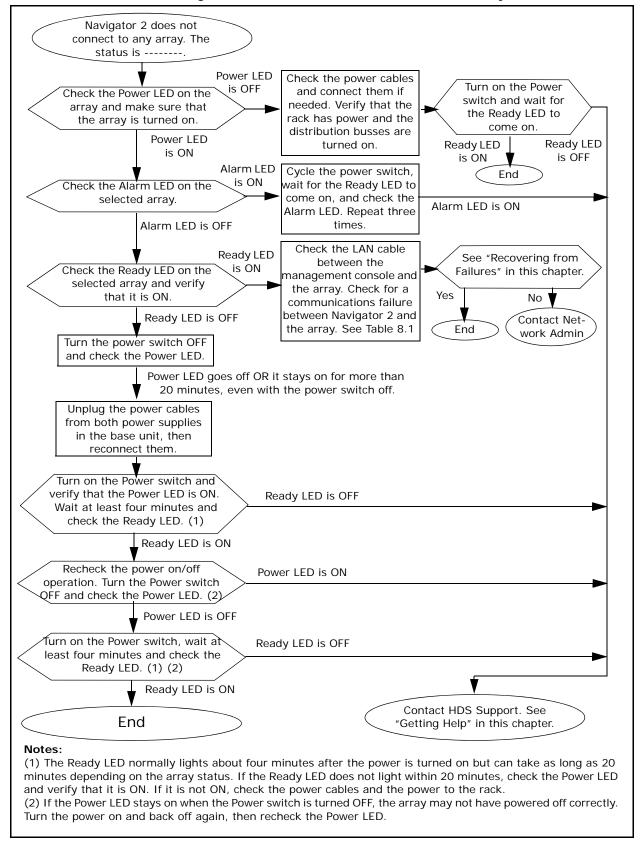
> ⚠️ **NOTE:** If Navigator 2 does not start, a communication failure with the Navigator 2 server may have occurred or the Navigator 2 server may not be started normally. See "Navigator 2 does not start" in Table 8-1: Problems and Solutions, on page 8-2 and Figure 8-1: LED Failure Indications, on page 8-8.

3. In the **Arrays** area, check the status and serial number of the array where the failure occurred (see Figure 8-3 on page 8-10).
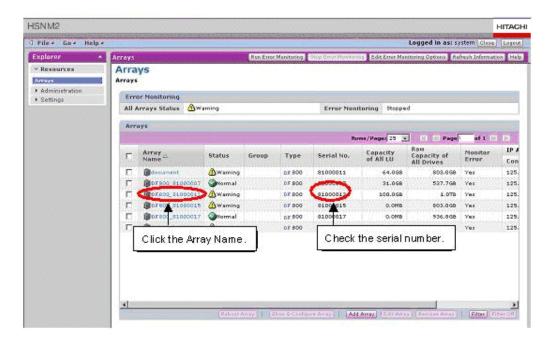

Figure 8-3: Locating the Array Name and Serial Number

> ⚠️ **NOTE:** If Navigator 2 cannot access The AMS 2500 array, the array may be turned off or there may be a network failure between Navigator 2 and the array. See Table 8-1 on page 8-2 for more information.

4. If you received an email about the failure, or used SNMP to detect the failure, check that the hardware serial number in the email/SNMP matches the one on The AMS 2500 array (see Figure 8-3 on page 8-10).

5. Check the status column of the system that matches the hardware serial number checked in the previous step.

   • **Normal** = The AMS 2500 array is operating normally. The fault may have occurred between the array and the host. See "A failure other than an array failure occurs" in Table 8-1:Problems and Solutions, on page 8-2.

   • **---** = Navigator 2 cannot access The AMS 2500 array. The **MAIN SW** switch may be set to the OFF position or a network failure may have occurred between the host and the array. See "Navigator 2 cannot communicate with the array" in Table 8-1:Problems and Solutions, on page 8-2.

6. From the Arrays area shown in Figure 8-3, click the name of the array. When the next screen appears, click either **Alerts & Events** in the Array List window or **Check for Errors** in the Common Array Tasks area. In the **Alert Parts** tab, check for the failed part, such as a disk drive (see Figure 8-4 on page 8-11).

   • If a disk drive is shown, replace the drive. See Adding a disk drive on page 9-3.

   • If The AMS 2500 array is shown, the array is faulty and should be replaced.

   • If neither appears in the failure list window, a software failure may have occurred. See "Unidentified failure has occurred" in Table 8-1:Problems and Solutions, on page 8-2.
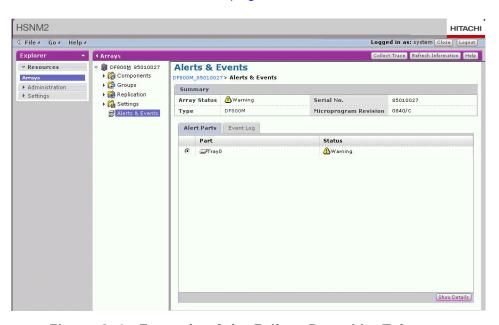

Figure 8-4: Example of the Failure Parts List Tab

7. If an entry appears in the failure parts list window, click **Show Details** in the lower right corner of the screen for detailed information (see Figure 8-5 on page 8-12). To remove the information, click **Close**.
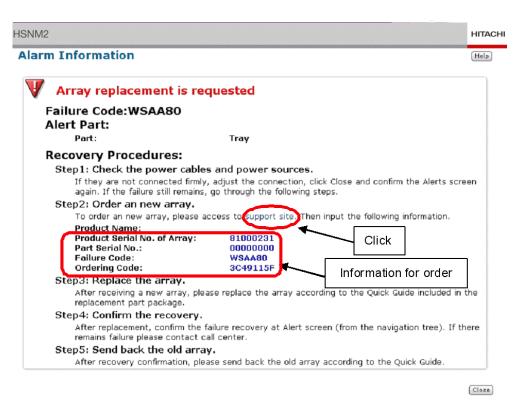
Alarm Information   Help

⚠ **Array replacement is requested**

Failure Code:WSAA80
Alert Part:
    Part: Tray
Recovery Procedures:
    Step1: Check the power cables and power sources.
        If they are not connected firmly, adjust the connection, click Close and confirm the Alerts screen
        again. If the failure still remains, go through the following steps.
    Step2: Order an new array.
        To order an new array, please access to support site. Then input the following information.
        Product Name:
        Product Serial No. of Array: 81000231   Click
        Part Serial No.:   00000000
        Failure Code: WSAA80   Information for order
        Ordering Code: 3C49115F
    Step3: Replace the array.
        After receiving a new array, please replace the array according to the Quick Guide included in the
        replacement part package.
    Step4: Confirm the recovery.
        After replacement, confirm the failure recovery at Alert screen (from the navigation tree). If there
        remains failure please contact call center.
    Step5: Send back the old array.
        After recovery confirmation, please send back the old array according to the Quick Guide.

                                                              Close

Figure 8-5: Example of an Alarm Information Window

Troubleshooting based on LED indications

This section provides step-by-step procedures to help determine the cause
of failures that are indicated by the LEDs on the array. This section is
intended to be used along with Table 8-2:LED Failure Indications, on
page 8-6.

Verify that a failure is recovered after taking the appropriate actions for the
following LED indications.

NOTE: When a base unit is used as the remote unit in a TrueCopy remote replication/TrueCopy Extended Distance configuration, restarting the base unit can cause the following events:

- Both paths of TrueCopy remote replication/TrueCopy Extended Distance are blocked.

- At the time the path is blocked, Navigator 2 sends a failure notice to the users whose email addresses are configured in the Alerts and Events window in Navigator 2. The alert contains information regarding the Email Alert and SNMP Agent Support features, and TRAP. Follow the instructions in the email alert. After the remote unit has restarted, the path blockade automatically recovers and the paths are available for use.

- If the pair status of TrueCopy remote replication/TrueCopy Extended Distance is PAIR or COPY, the pair status changes to PSUE.

- When the base unit must be restarted, change the pair status of TrueCopy remote replication/TrueCopy Extended Distance to PSUS, and then restart the unit.

NOTE: When the Power Saving storage feature is used, if you restart the base unit while the spin-down is in progress, the spin-down may fail because it recognizes the host immediately after the unit starts.

After the spin-down has completed, check the RAID Groups and make sure that none of them are set to the "Normal (command monitoring)" power saving status. Then restart the unit. If the spin-down fails, start the spin-down again.

The Power LED does not turn on

1. Set the main switch to On.

2. Is the POWER LED on the base unit on?
   Yes: Go to step 10.
   No: Power on the host computer.

3. Is the POWER LED on the base unit on?
   Yes: Go to step 10.
   No: Set the main switch to Off.

4. Check the PDB to verify that electricity is being supplied to the unit.

5. Verify that the AC cable is correctly connected to the power supply socket and the equipment.

6. Set the main switch to On.

7. Is the POWER LED on the base unit on?
   Yes: Go to step 10.
   No: Set the main switch to Off.

8. Call your maintenance engineer. Go to step 10.

9. Is the READY LED on?
   Yes: Continue to use the equipment in its current operational state. If the READY LED (green) blinks at a high pace, the download of the ENC firmware is executed. Even when the READY LED (green) blinks, the storage system is operational.
   No: Refer to (3); READY LED does not turn on or READY LED has turned on once and then turned off.

10. End of procedure.

The Power LED has turned off

1. Is electricity supplied to the equipment?
   Yes: Go to step 2.
   No: Supply electricity to the unit, and then restart the unit. Go to step 2.

2. Set the main switch to Off.

3. After waiting for more than one minute, set the main switch to On.

4. Is the POWER LED on the base unit on?
   Yes: go to step 5.
   No: Set the main switch to Off.

5. Call your maintenance engineer. Go to step 7.

6. Is the READY LED on the base unit on?
   Yes: Continue to use the equipment in its current operational state. If the READY LED (green) blinks at a high pace, the download of the ENC firmware is executed. Even when the READY LED (green) blinks, the storage system is operational.
   No: Refer to READY LED does not turn off (below).

7. End of procedure.

Ready LED does not turn on or off

This procedure is also used when the Ready LED has turned on once and then turns off.

1. Is the Power LED on the base unit on?
   Yes: Go to step 2.
   No: Go to step 4 if The Power LED does not turn on.

2. Is the Alarm LED on the base unit on?
   Yes: Refer to Alarm LED has turned on.
   No: Go to step 3.

3. Does the Ready LED (green) on the base unit blink at high speed?
   Yes: Wait for up to 30 to 50 minutes until the Ready LED (green) on the base unit lights because the automatic download of the ENC firmware is in progress. Even when the Ready LED (green) blinks, the storage system is operational.
   No:

4. Does the Warning LED (orange) blink at high speed?
   Yes: Wait until the Warning LED (orange) on the base unit is off, and the Ready LED (green) on the base unit lights because the update of the flash program is executed.
   No: Go to step 5.

5. Turn off the Power switch.

6. After waiting for more than one minute, turn on the Power switch.

9

Upgrading the hardware

This chapter describes procedures for adding optional components and additional units to a Hitachi AMS 2000 Family Storage System. It includes the following key topics:

❏ Prerequisites

❏ Adding a disk drive

❏ Recognizing a new logical unit

Prerequisites

Please read this entire section before beginning any work on an array.

> ⚠️ **CAUTION! Back up your data before adding or replacing hardware components.** If a part is installed incorrectly, it may be possible that data can be lost. Hitachi Data Systems strongly recommends that you back up your data to a remote array before beginning hardware upgrades or replacements.

> ⚠️ **CAUTION! When adding or replacing a disk drive with the array power on, be sure to complete the installation within ten minutes after removing the dummy disk drive. The reason for this is that an open slot in the array can let enough cooling air out of the array that after ten minutes, it might overheat and shut down.**

In addition to these prerequisites, also see the safety instructions at the beginning of Chapter 5, Installation.

Before adding or replacing any hardware components in either the base unit or the expansion unit, protect your data from accidental loss. The following items provide important information that can help protect your array from accidental loss of data.

1. The procedure to add an optional component varies depending on the component being added and the location where the component is to be installed.

2. **Before adding, removing, or replacing a part, read the entire procedure**. If you have any questions about the procedure, please call Hitachi Data Systems Technical Support before starting the procedure. It is a lot easier, faster, and less costly than fixing something afterward.

3. Determine whether the work must be done with the array power on or off.

   • The power on condition refers only to the array power and does not consider whether the host power is turned on or off.

   • The power off condition refers only to the array power and does not consider whether the host power is turned on or off.

4. When adding an optional component, change the settings of the array using a management console connected via a LAN. Do the following before starting the addition of an optional component.

   • Set up a management console on which Navigator 2 is installed.

   • Determine whether the array is operable via a LAN.

5. **Ready LED Status.** Do not add or replace any hardware components while the green Ready LED on the front of the base unit is blinking at high speed. When it is blinking at high-speed, the ENC firmware is being downloaded. Depending on the LAN connection and traffic on the LAN, this could take from 40 tor 60 minutes. Wait at least 30 seconds after the Ready LED lights steadily before making any changes to the hardware.

6. **Warning LED Status**. Do not add or replace any hardware components while the orange Warning LED on the front of the base unit is blinking at high speed. When it is blinking at high-speed, the flash program is being updated. This could take from 30 to 85 minutes. Wait at least 30 seconds after the Warning LED goes out and the Ready LED lights steadily before making any changes to the hardware.

Adding a disk drive

Before beginning the procedure to add or remove a disk drive, ensure the the prerequisites on the previous page have been met.

Locations and numbers of disk drives

As shown in Figure 9-1, the disk drive numbering in an expansion unit is #0 to #14 from the left to right viewed from the front of the array.

⚠️ **NOTE:** Disk drive slots use the same numbers whether they contain a drive or not.
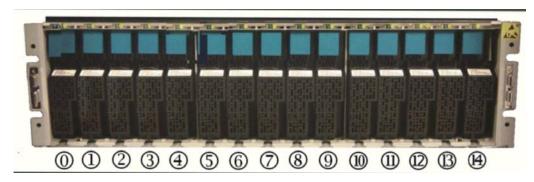

Figure 9-1: Expansion Unit Disk Drive Numbering

If no vacant slots are available

If you need to add more drives to the array than there are vacant slots, add an additional expansion unit. See Adding an Additional Storage Unit in this chapter for instructions to do this.

⚠️ **NOTE:**

• The minimum number of drives in the **first** expansion unit is four. These first four drives must all be either SAS drives or SATA drives. The minimum number of drives that must be installed in all other expansion units is two. These two drives must both be either SATA or SAS drives.

• After the minimum configuration is met, you can add two SAS or two SATA drives (which makes a RAID1 configuration), or other combinations of drives as required to meet the RAID configurations specified in Chapter 1.

Installation procedure

Complete the following steps to install a disk drive. Do not skip any steps.

> ⚠️ **CAUTION! disk drives are a precision electro-mechanical devices.** Be careful not to drop a disk drive or allow it to receive a mechanical shock or vibration.

> ♺ **Static-sensitive. Ground yourself before touching.** Before unpacking or handling disk drives and other static-sensitive components, wear a wrist strap and connect it to an unpainted metal part of the array chassis. When you insert a disk drive into the array, hold the disk drive with the hand on which you are wearing the wrist strap.

When you install a disk drive or other component in the array, support its frame with your hand that has the wrist strap on it. You can discharge static electricity by touching the metal plate.
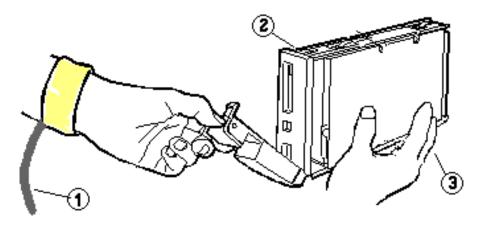

Figure 9-2: Handling a Disk Drive

Table 9-1: Handling a Disk Drive

Item	Description	Item	Description	Item	Description
①	Wrist Strap	②	Disk Drive	③	Touching the metal frame of the disk drive

1. Remove the front bezel. Grasp the front bezel at both upper corners and pull out and down. When the bezel is free of the catches at both ends, lift the bezel up and away from the unit. Put it aside. You will reinstall it at the end of this procedure.

> ⚠️ **NOTE:** If you are installing multiple drives, remove only one drive filler at a time and install a drive in the slot before removing the next drive filler.

2. If you have not already done so, put on an antistatic wrist strap. See the Prerequisites above for further information.

3. Unpack the new disk drive and put the drive on an antistatic mat.

CAUTION! Time Limit between steps.
Complete step 5 within 10 minutes after completing step 4. It is possible for the unit to overheat and shut down if enough cooling air is allowed to escape from the open drive slot.

4. Loosen the mounting screws and remove the filler ("dummy disk drive") from the slot where you want to install the new drive. You may note that cooling air is coming out of the open slot.

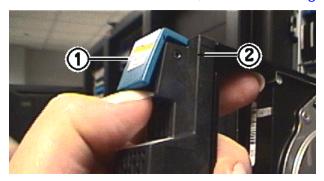5. Unlock the lock lever on the new drive, as shown in Figure 9-3.

Figure 9-3: Unlocking the Lock Lever

Table 9-2: Unlocking the Lock Lever

Item	Description	Item	Description
①	Lock Tab	②	Lock Lever

6. Gently slide the new disk drive into the open slot in the expansion unit, lining the lock tab up with the slot hole in the chassis.

7. Close the lock lever. As you do this, the disk drive is pulled into the chassis and the electrical connector is plugged into its socket.

8. Make sure that the disk drive is fully inserted and that the lock lever "clicks" when fully closed.

9. Verify that the drive begins to run (spins up) as soon as it is fully inserted into the slot and is connected electrically to the unit.

   If the drive is a replacement for a failed drive, as soon as the drive is operational, the system will begin copying data to it. The system copy is completed in approximately 1 minute 30 seconds for each disk drive.

10. Repeat steps 3 through 9 for each disk drive that you are installing.

11. When you have installed all the drives, replace the front bezel. Grasp the bezel at both sides engage the hooks at the bottom of the bezel with the lower edge of the unit chassis. Then rotate the top of the bezel inward and press in at the vertical center of both ends of the bezel to engage the catches.

Expanding storage capacity

To expand the storage capacity of an array with the power off, repeat steps 1 and 2 for each disk drive that you add to the array.

1. Remove the dummy disk drive. Press the round dent on the latch to unlock it and then open the latch. Pull outward on the latch to remove the dummy disk drive from the base or expansion unit. Store the dummy drive so that it can be used to replace a disk drive if you remove one.

2. Install the disk drive to be added taking care not to apply any shock to it.

    a. Fit the disk drive in the guide rail of the chassis and slide it in the direction shown by the arrow.

    b. Push it in until it reaches the position where the tab on the bottom of the lock lever on of the handle can be entered into the rectangular hole at the lower part of a frame on the front side of the unit.

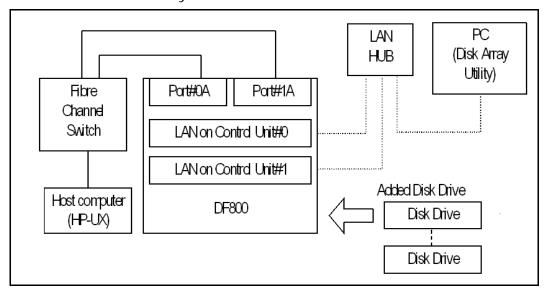   c. Push the lock lever inward until the lock button clicks.

⚠️ **NOTE:** If the lock lever is closed or nearly closed when you slide the disk into the slot, the tab on the bottom will catch on the front of the unit and cannot be inserted into the slot in the chassis. Be sure the lock lever is open far enough when you slide the disk in so that the tab can be inserted into the slot.

⚠️ **NOTE:** When the disk drive has been added while the array power is on, the Alarm LED on the disk drive will go out a few minutes after the disk drive has been inserted. Make sure that the LED goes out.

Recognizing a new logical unit

The following example shows how to make a host computer that is running HPUX recognize a Logical Unit while the array power is on. As shown in the following illustration, the management PC on which Navigator 2 is installed is connected to the array via a LAN cable.

Complete the following steps to make the host computer recognize a newly created logical unit.

1. Make sure the host computer and the DF800 are in the Ready status. (I/Os host computer can be continued.)

2. Install the disk drives to be added in the DF800.

3. Create a new RAID group for the installed disk drives.

4. Create one or more new logical units for the RAID group.

5. Format the logical units.

6. From the host, issue the Fibre Channel disk command **ioscan -n** to verify that the array has been recognized by the host computer. However, the status of the newly added logical unit is displayed as NO-NW.

7. Issue the **insf -e** command from the host to create a device file of the logical unit(s) which have just been added.

8. From the host, issue the Fibre Channel disk command **ioscan -n** to verify that the array has been recognized by the host computer. The status of the newly added logic unit is displayed as CLAIMED.

9. Create a file system by creating the volume group and logical volume for the newly added logical unit from the host computer.

Logical units created according to the above procedure are usable by the host computer.

Upgrading the firmware

The Hitachi AMS 2000 Family Storage System can use newer versions of its firmware as they become available. This chapter describes how to upgrade the firmware on an AMS 2500 storage array. This procedure requires the use of the Upgrade Firmware wizard in the Navigator 2 storage management software.

This chapter includes the following key topics:

❑ Overview

❑ Prerequisites

❑ Upgrading the firmware

Overview

The instructions in this chapter assume that the AMS 2500 system is operating normally.

The procedure to upgrade the firmware on an AMS 2500 includes using the Upgrade Firmware wizard that is part of the Navigator 2 storage management software. See Chapter 7, Configuration for basic information on using the Navigator 2 software. See the Navigator 2 online help system for detailed information. To access the help system, click **Help** in any window in Navigator 2.

While the firmware is being upgraded, the host I/O may be focused in one of the two control units. Therefore, Hitachi Data Systems recommends that this work be performed during a period when the host I/O load is low.

Prerequisites

- Ensure that there is a good LAN connection between the AMS 2500 and the host computer, whether they are connected directly or connected via switch.

- Ensure that other applications such as JP1/HiCommand Device Manager, or other Hitachi applications are not currently accessing the AMS 2500, either directly or via the LAN.

- Ensure that all hardware components of the array are working and that no parts have been removed.
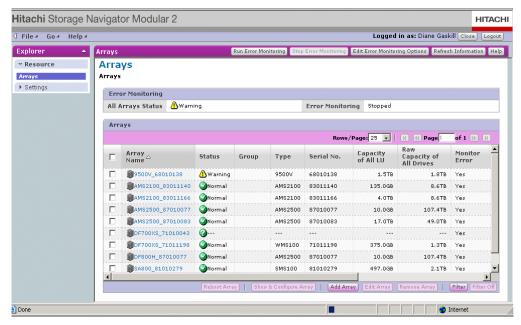
Upgrading the firmware

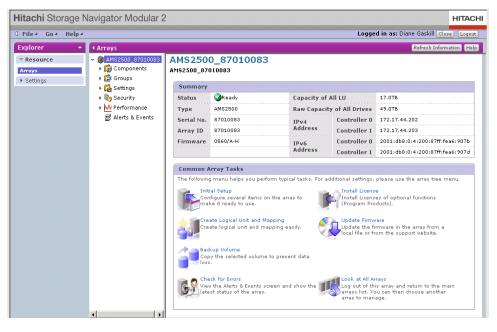Use the following procedure to upgrade the firmware.

⚠️ **CAUTION! Do not remove or replace any hardware components in the array while the firmware is being downloaded or installed. Wait at least 30 seconds after download and/or installation is completed before beginning any hardware replacement procedures.**
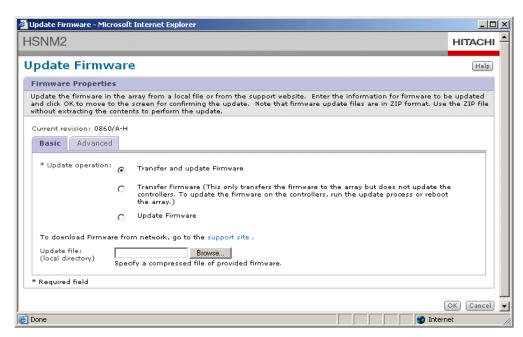
1. Download the latest firmware from the Hitachi Data Systems Support Portal. See the Getting help section in the Preface for information about accessing the support portal.

2. Launch a web browser and log in to Navigator 2 at the following URL:

   http://*<IP address of management console PC>*:23015/ StorageNavigatorModular

   If needed, see Chapter 7, Configuration for information on starting and using Navigator 2.

3. Log in to Navigator 2. After a few seconds, the Navigator 2 Array List window is displayed. The table in the window displays the names and descriptions of the arrays currently listed in the Navigator 2 database.

4. As shown in the following illustration, in the Array List window, either click the name of the array whose firmware you want to update, or click the checkbox and then click Show and Configure Array.
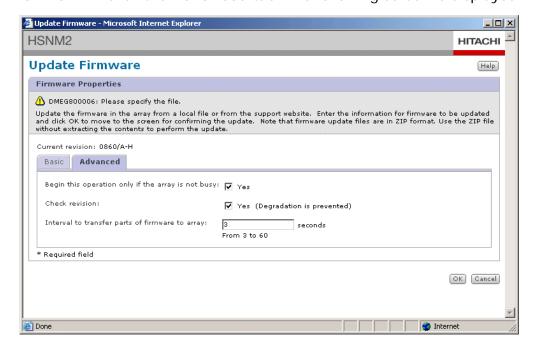
5. The Array Window (shown below) is displayed. In the Common Array Tasks section of the Array window, click **Update Firmware**.

For detailed instructions and further information, see the help page in the Navigator 2 online help system. Click **Help** on any screen in the wizard to access the help for the wizard.
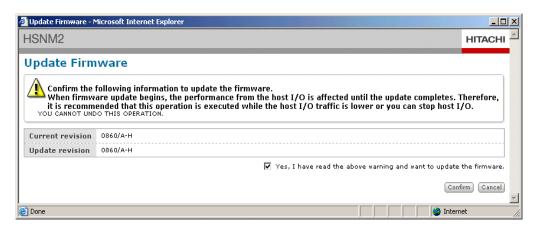
6. Select one of the three options:

   - Transfer and update Firmware - this option downloads the firmware from the Support portal and installs the firmware on the control unit.

   - Transfer Firmware - this option downloads the firmware to the array but does not install it. To update the firmware on the controllers, run the update process or reboot the array.

   - Update Firmware - this option installs firmware that has already been downloaded but not installed.

7. OPTIONAL: Click the **Advanced** tab. The following screen is displayed.

8. Review the default settings and change as needed.

9. To return to the Basic tab, click Basic. Make any changes to the settings as needed. Otherwise click OK. Skip to step 12.

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10. Next to **Update file**, click **Browse**. Then navigate to the location where the firmware file resides, click the file, and click the **Open** button. The path and filename appear in the **Browse** field.

11. In the Update Firmware dialog box, click **OK**. The following confirmation window appears.

12. Read the information in the window. Then click the checkbox **Yes, I have read the above warning and agree to update the Microprogram**.

13. Click the **Confirm** button to proceed. A window similar to the following appears as the firmware is updated. The window shows the approximate time required to update the firmware.

⚠️ **CAUTION! Do not cancel the upgrade procedure or have the AMS 2500 perform I/O operations while the firmware is being upgraded.**

14. After the firmware has been updated, a message informs you that the operation has been completed successfully. Click **Close** to confirm the message and close the message box. You can then return to normal operation.

A

Specifications

This appendix includes a comprehensive set of specifications for the AMS 2500 described in this manual. It includes the following key topics:

- ❑ Mechanical specifications
- ❑ Electrical specifications (AC)
- ❑ Environmental specifications
- ❑ Ethernet specifications
- ❑ Cache specifications

Mechanical specifications

Table A-1 describes the mechanical specifications for the AMS 2500.

Table A-1 Mechanical Specifications

Dimension	Size (English, metric)			
	AMS 2500 Base Unit (RKHE2)	**Expansion Unit (RKAK)**	**High-density Expansion Unit (RKAKX)**	**Battery Expansion Unit**
Height	6.9 inches (174 mm) / 4U	5.08 inches (129 mm) / 3U	6.93 inches (176 mm) / 4U	1.7 inches (43 mm) / 1U
Width	19 inches (483 mm)	19 inches (483 mm)	19 inches (483 mm)	18.9 inches 479.6 mm
Depth	25.6 inches (649 mm)	25.6 inches (649 mm)	33 inches (840 mm)	24/5 inches (623 mm)
Weight	101.2 Lbs (46 Kg)	88 Lbs (40 Kg)	178 Lbs (81 Kg)	33 Lbs (approx) 15 kg

Electrical specifications (AC)

Table A-2 describes the AC electrical specifications for the AMS 2500. See Appendix C, DC-powered units for DC electrical specifications.

Table A-2 AC Electrical Specifications

Item		Base Unit	Expansion Unit	High-density Expansion Unit
Volts AC		100/200 (100 to 120/200 to 240)		
Frequency (Hz)		50/60		
Number of Phases, Cabling		Single phase plus ground (3 wire)		
Steady-state Current (amps)[2]		2.2 x 2 / 1.1 x 2	2.4 x 2 /1.2 x 2	3.7 x 4/1.9 x 4
Breaking Current (A)		16	16	16
Heat Value (kJ/h)		1,440 or less	1,660 or less	5,190 or less
Required Power[1]	Steady State Current (VA/W)[2][3]	440/400 or less	480/460 or less	1,480 /1,440 or less
	Starting state (VA/W)	440/400 or less	480/460 or less	1,480 /1,440 or less
Electrical Insulation Performance	Insulation Withstands Voltage	AC 1,500 V (10 mA, 1 min)		
	Insulation Resistance	DC 500 V, 10 MΩ or more		

1. Power requirement in the case of the maximum configuration is shown. When planning facilities such as the uninterrupted power supply (UPS), specify the power factor as 100% for calculation. Value at 100 V/200 V is shown. (Example: 300 W=300 VA)
The actual required power may exceed the value shown in the table when the tolerance is included (Example: 300 W=300 VA). The actual required power may exceed the value shown in the table when the tolerance is included.
2. The power current of N x 2 described in this table is required for operation by a single power supply unit.
3. When one of the two power supply units fails, the other power supply provides the total power to the unit that the two supplies together did before the failure. The operating power supply therefore draws the same current as the two supplies did before the failure. To make sure that either power supply can operate in this manner, ensure that the PDUs in the rack can supply twice the normal power of the units plugged into it.

Table A-3 Battery Expansion Unit Electrical Specifications (AC)

Item	Specification
Volts AC	100/200 (100 to 120/200 to 240)
Frequency (Hz)	50/60
Number of Phases, Cabling	Single phase plus ground (3 wire)
Steady-state Current (amps)	1.0/0.5
Power Consumption	100/100
Heat Value (kJ/h)	360
Time to fully charge battery	24 hrs or less, depending on the amount of discharge

Environmental specifications

Table A-4 describes the environmental specifications for the AMS 2500.

Table A-4 Environmental Specifications

Parameter	Specification
Temperature, Operating	50° to 104°F (10° to 40° C)
Temperature, Storage	14° to 122°F (−10° to 50° C)
Temperature, Transporting	−22° to 140°F (−30° to 60° C)
Temperature Change Rate	50°F (10°C) per hour
Humidity, Operating	46° to 176°F (8° to 80° C)
Humidity, Storage	46° to 194°F (8° to 90° C)
Maximum Wet Bulb Temperature	84°F (29°C) noncondensing
Vibration, Operating (m/s2)	2.5 or less (5 to 300 Hz) (within 5 seconds)
Vibration, Storage (m/s2)	5.0 or less (5 to 300 Hz)
Vibration, Transporting (m/s2)	5.0 or less
Impact, Operating (m/s2)	20 or less (10 ms, half sine wave impact)
Impact, Storage (m/s2)	50 or less (10 ms, half sine wave impact)
Impact, Transporting (m/s2)	80 or less (10 ms, half sine wave impact)
Altitude, Operating	−984.25 to 9842 feet (−300 to 3,000 m)
Altitude, Storage	−300 to 12,000
Acoustic Noise	60 dB (environmental temperature: 32°C or less)

Ethernet specifications

Table A-5 describes the Ethernet specifications for the AMS 2500.

Table A-5 Ethernet Specifications

Parameter	Specification
Works with switches that comply to the following standards:	IEEE 802.1D STP IEEE 802.1w RSTP IEEE 802.3 CSMA/CD IEEE 802.3u Fast Ethernet IEEE 802.3z 1000BaseX IEEE 802.1Q Virtual LANs IEEE 802.3ad Dynamic LACP
	RFibre Channel 768 UDP RFibre Channel 783 TFTP RFibre Channel 791 IP RFibre Channel 793 TCP RFibre Channel 1157 SNMP v1 RFibre Channel 1213 MIB II RFibre Channel 1757 RMON RFibre Channel 1901 SNMP v2
Cable Type	RJ-45 1000BASE-TX UTP or STP (STP is recommended)

Cache specifications

The Cache specification is shown in Table A-6.

Table A-6 AMS 2500 Specification (base unit)

Item	Base Unit
Capacity (MB per controller)	8,192 / 16,384
Control method	Read LRU / Write After[1]
Battery backup	Provided
Backup duration (h)[2]	24 hrs when cache is 16,384 MB (4 x 4,096 MB per controller) 48 hrs when cache is 8,192 MB (4 x 2,048 MB per controller) 96 hrs when cache is 16,384 MB (4 x 4,096 MB per controller) 168 hrs when cache is 8,192 MB (4 x 2,048 MB per controller)[3]

1. LRU = Least Recently Used. It is an algorithm that selects the oldest data in the cache, copies it to disk, and then deletes it from the cache to make room for new data.
2. Backup time in hours with four full charged cache backup batteries.
3. Installing the two Battery Expansion Units is required.

B

Regulatory information

This appendix includes a comprehensive set of regulatory requirements for the products described in this manual. It includes the following key topics:

❒ Regulatory compliance

❒ US FCC notice and/or Declaration of Conformity

❒ Canadian DoC notice

❒ European Declaration of Conformity

❒ Notice of export controls

❒ China RoHS

❒ Disposal

❒ Recycling

Regulatory compliance

This equipment has been tested and certificated for the following standards.

Table B-1: Regulatory Compliance

Standard	Specification	Mark on the product	Country
Electronic emission control	FCC Part 15 Subpart B Class A	Yes (FCC)	U.S.A
Radio inteference voluntary control	VCCI Class A	Yes (VCCI)	Japan
Limits for harmonic current emissions	JIS C61000-3-2	None	Japan
Electronic emission control	ICES-003 Class A	Yes (ICES-003)	Canada
Electronic emission control	AS/NZS 3548:1995,A1,A2	None	Australia
Electronic emissions certification	EN 50022:1998/A1:2000/A2:2003	Yes (CEmarking)	EU
	EN 61000-3-2:2000/A1:2001/A2:2005		
	EN 61000-3-3:1995/A1:2001		
	EN 55024:1998/A1:2001/A2:2003		
	EN 61000-4-2:1995/A1:1998/A2:2001		
	EN 61000-4-3:2002/A2:2002		
	EN 61000-4-4:1995/A1:2001/A2:2003		
	EN 61000-4-5:1995A1:2001		
	EN 61000-4-6:1996/A1:2001		
	EN 61000-4-8:1993/A1:2001		
	EN 61000-4-11:1994/A1:2001		
Electronic emission control	CNS 13438 Class A	Yes (BSMI)	Taiwan
Electronic emission control	KN22	Yes (RRL)	Korea
	KN6100-4		
Safety certification	UL 60950-1	Yes (TUV)	EU/U.S.A
	CAN/CSA-C22.2		
Safety certification	EN 60950-1	Yes (GS)	EU
Safety certification	GOST R60950-2002	Yes (GOST)	Russia
	GOST R51318.22–99		
	GOST R51318.24-99		
	GOST R51317.3.2-99		
	GOST R51317.3.3-99		
Safety certification	IEC 60950-1	Yes(IRAM)	Argentina

US FCC notice and/or Declaration of Conformity

FCC Notice

Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

Testing was done with shielded cables. Therefore, in order to comply with the FCC regulations, you must use shielded cables with your installation.

The EMI test was done in the following configuration:

```
DF800-RKH2 + RKAK (4) + RK40
DF800-RKHE2 + RKAK (4) + N1RK + RK40
DF800-RKHE2 + RKAK (2) + RKAKX (2) + RK40
```

If a trouble occurs in another configuration, a user may be requested to take appropriate preventive measures.

Canadian DoC notice

DOC Notice

Canadian Department of Communications

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulation of the Canadian Department of Communications. Operation in a residential area may cause unacceptable interference to radio and TV reception requiring the owner or operator to take whatever steps are necessary to correct the interference.

Cet équipment ne dépasse pas les limites de Classe A d'émission de bruits radioélectriques pour les appareils numériques, telles que prescrites par le Règlement sur le brouillage radioélectrique établi par le Ministère des Communications du Canada. L'exploitation faite en milieu rèsidentiel peut entraîner le brouillage de réceptions radio et télé, ce qui obligerait le propriétaire ou l'opérateur à prenere les dispositions nécessaires pour en éliminer les causes.

European Declaration of Conformity

Warning This equipment complies with the requirements relating to electromagnetic compatibility, EN 55022 class A for ITE, the essential protection requirement of Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility.

Notice of export controls

Export of technical data contained in this document may require an export license from the United States government and/or the government of Japan. Contact the Hitachi Legal Department for any export compliance questions.

China RoHS

The indication is given based on the Requirements for Controlling Pollution Caused by Electronic Information Products Regulation.

Hazardous and toxic substances

Table B-2: Hazardous and Toxic Substances

Part Name	Toxic and Hazardous Substances and Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
RKH/RKHE/ RKEH/ RKHED/ RKEHD	X	O	O	O	O	O
RKAK/ RKAKD/ RKAKX	X	O	O	O	O	O

The Symbol **O** indicates that this toxic or hazardous substances contained in all of the homogeneous materials for this part is below this limit requirement in SJ/T 11363-2006.
The symbol **X** indicates that this toxic or hazardous substances contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T 11363-2006.

Disposal

NOTE: This symbol on the product or on its packaging means that your electrical and electronic equipment should be disposed at the end of life separately from household wastes.
There are separate collection systems for recycling EU and many cities in the USA. For more information, please contact the local authority or the dealer where you purchased the product.

Recycling

The cache backup battery unit includes a nickel-hydride battery. A nickel-hydride battery should be recycled when it is no longer usable. When you replace the battery unit, do not dispose of the old one in the trash. Please recycle the battery instead.
The mark posted on the battery unit is a three-arrow mark that means a recyclable part.

Ni-MH

C

DC-powered units

This appendix provides a detailed description of the DC-powered AMS 2500 storage system used in telecommunications installations, the NEBS-3 (Network Equipment Building System) requirements for installation, installation instructions, and specifications for the system.

This appendix includes the following key topics:

- ❐ Overview
- ❐ System components
- ❐ Installation prerequisites
- ❐ Installation
- ❐ Electrical specifications
- ❐ Regulatory compliance
- ❐ Certifications
- ❐ Drawings

Overview

The DC-powered AMS 2500 storage system consists of five main components, as shown in Figure C-1 and described in Table C-1. The additional item (#2 spacer) is part of the rack. Note that a system can be composed of several racks that include up to 480 disk drives. See Scalability on page 1-11 for the complete list of configurations.

The system is constructed, configured and tested in a DC environment at the Hitachi Distribution Center. For NEBS-3 installations, after testing is complete, the AMS 2500 components are removed from the rack, boxed separately, and shipped with the rack to the customer's site.

The DC-powered system is also available in an AMS 2000 Solutions rack for customers who do not require NEBS-3 or ETSI certification. For this configuration, the system is installed and tested at the Hitachi Data Systems distribution center, but the components can be left in the rack and the system shipped as a unit.

It is the customer's responsibility to place and anchor the rack, and then connect it to earth ground and the DC power grid. Once the rack is installed, Hitachi Data Systems personnel will install the AMS 2500 components in the rack, and will configure and test the system.

The following figure shows the front view of an assembled DC-powered AMS 2500 system installed in a seismic rack. The PDU is enlarged for clarity.
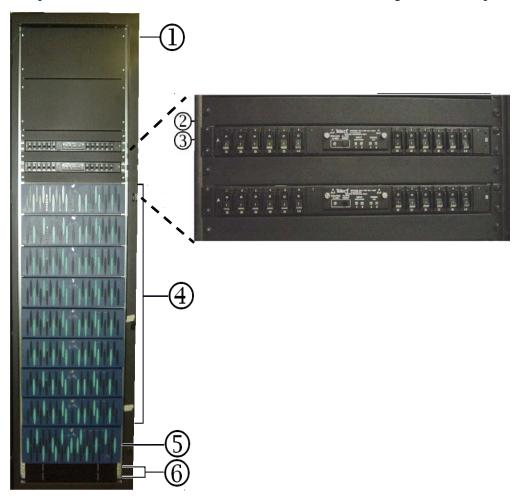

Figure C-1: AMS 2500 DC-powered Storage System

Table C-1: AMS 2500 DC-powered Storage System

Item	Name	Description	Item	Name	Description
①	Seismic Rack	Hitachi Data Systems Seismic Rack. Meets NEBS-3 requirements for construction, anchoring, and grounding.	④	Expansion Unit	Storage expansion unit, factory model RKAKD, is configured with two redundant DC-powered power supplies and two ENC adapter units
②	1U Spacer	1U spacer above and below both PDUs to allow room to connect the DC power cables. (up to 3 required)	⑤	AMS 2500DC	The base unit, factory model RKHE2D. Configured with two redundant DC-powered power supplies, two redundant controllers, two fan units, and four cache backup batteries.
③	Power Distribution Unit	Telect PDU 48VDC Circuit Breaker Panel with intelligent alarm system. (up to 2 per rack)	⑥	Battery Expansion Units (2)	DC-powered external cache backup batteries, factory model number N1RKD

System components

All components in the DC-powered AMS 2500 base and expansion units, except the power supplies and front bezels, are functionally and operationally the same as the components in the AC-powered units described in the rest of this manual. Therefore, the configuration, operation, and troubleshooting procedures for the DC-powered units described in this appendix are the same as the AC-powered units described in the other chapters and appendixes in this manual. Please refer to them as needed.

Seismic rack

The front view of the Hitachi Data Systems Seismic Rack is shown in Figure C-1. To meet NEBS-3 requirements, the seismic rack requires special procedures during construction. These are listed under NEBS-3 requirements (USA) on page C-10.

During installation, the seismic rack requires anchoring and grounding. These requirements are described in the installation section of this appendix.

Figure C-2 on the next page shows the rear view of the seismic rack with the DC power cables installed. The large green ground wire at the bottom connects the rack frame to the vertical rail that supports the rails that support the AMS 2500 components. The rack ground and DC power connections to the rack come in at the top of the rack and are not shown in this figure.

Figure C-2: Seismic Rack - Rear View

AMS 2500 base unit

The AMS 2500 base unit is described in detail in Chapters 1, 2, and 4. Figure C-3 shows the rear view of an AMS 2500 configured with DC-powered power supplies.

Figure C-3: DC-powered AMS 2500

AMS 2500 DC power supply

Figure C-4 shows the AMS 2500 power supply and the electrical connections. The + and − terminal labels are on the underside of the terminal block. Table C-2 describes the components on the power supply rear panel.
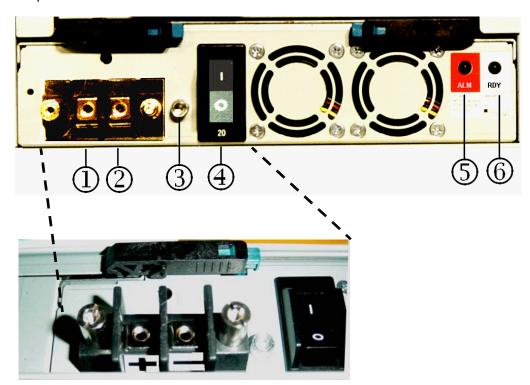
Figure C-4: AMS 2500 DC Power Supply, Rear and Lower Views

Table C-2: AMS 2500 DC-powered Storage System

Item	Description	Item	Description
①	DC Ground Connection	②	−40 to −72 VDC Connection (nominally −48 VCD)
③	Earth / Frame Ground Connection	④	Power Switch / 20 Amp circuit breaker
⑤	**Alarm LED (RED)**. This LED indicates that the power supply has failed. Although the other power supply can supply sufficient power and cooling for the array, Hitachi Data Systems recommends that you replace the failed power supply as soon as possible. See the Hitachi Hitachi AMS 2000 Family Storage System Service Guide for instructions.		
⑥	**Ready LED (GREEN)**. **OFF** when the power supply is not connected to power. **Blinks** when the power supply is connected to DC power and is running the power on self test (POST). **ON** when the unit is operational, even if the AMS 2500 array is not turned on.		

Expansion unit

The expansion unit is described in detail in Chapters 1, 2, and 4. Figure C-5 shows the rear view of a DC-powered expansion unit, model RKAKD, configured with DC-powered power supplies. Figure C-6 shows the DC power supply and its connections.

Figure C-5: DC-powered Expansion Unit

Expansion unit DC power supply

The following figures show the expansion unit power supply and the electrical connections. As shown in Figure C-6, the + and − labels are located on the right of the terminal block.
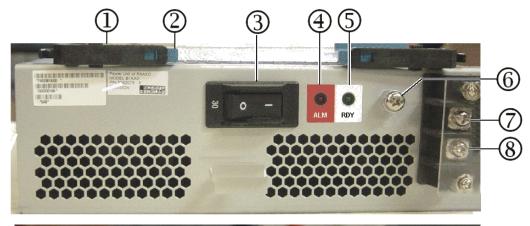
Figure C-6: Expansion Unit DC Power Supply, Rear and Side Views

Table C-3: Expansion Unit DC Power Supply, Rear and Side Views

Item	Description	Item	Description	Item	Description
①	Lock Lever (2 places)	②	Lock Button (2 places)	③	Power Switch / 30 Amp circuit breaker
④	**Alarm LED (red)**. This LED indicates that the power supply has failed. Although the other power supply can supply sufficient power and cooling for the array, Hitachi Data Systems recommends that you replace the failed power supply as soon as possible. See the Hitachi Hitachi AMS 2000 Family Storage System Service Guide for instructions.				
⑤	**Ready LED (green)**. **OFF** when the power supply is not connected to power. **Blinks** when the power supply is connected to DC power and is running the power on self test (POST). **ON** when the unit is operational.				
⑥	Earth / Frame Ground Connection	⑦	−40 to −72 VDC Connection (nominally −48 VCD)	⑧	DC Ground Connection

Battery expansion unit

Figure C-7 shows the front and rear views of the DC-powered battery expansion unit with the front bezel removed. Table C-4 describes the components and controls on the rear panel.
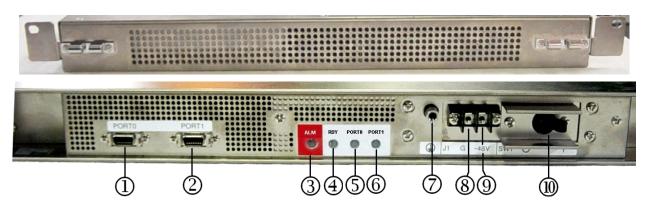
Figure C-7: DC-powered Battery Expansion Unit Controls and Connectors

Table C-4: AMS 2000 Battery Expansion Unit Controls and Connectors

Item	Description	Status
①	**Port 0**	Connects the battery cable from this port to the battery expansion unit connector on control unit #0.
②	**Port 1**	Connects the battery cable from this port to the battery expansion unit connector on control unit #1.
③	**Alarm LED (RED)**	**ON** - Lights when the battery charging or protection circuitry has failed or when the battery voltage is abnormal. **OFF** - During normal operation and when the unit is turned off. Also during backup.

Table C-4: AMS 2000 Battery Expansion Unit Controls and Connectors (Continued)

Item	Description	Status
④	**Ready LED** (GREEN)	This LED indicates the condition of the battery. **ON** - • Charge is completed. • Low-speed blinking (1 second blink every two seconds): The battery is not fully charged, and is charging. • High-speed blinking (2 blinks per second): Abnormal status **OFF** - When the unit is turned off or the battery voltage is abnormal. Also when the status of the battery is abnormal. (See Alarm LED)
⑤	**Port 1 LED** (GREEN)	**ON** - When the port is connected and operating normally (can be during backup) **OFF** - • When the port is not operating (for example, after sequential shutdown) • When the connector is not working correctly (not connected, etc.) • During backup.
⑥	**Port 2 LED** (GREEN)	**ON** - When the port is connected and operating normally (can be during backup) **OFF** - • When the port is not operating (for example, after sequential shutdown) • When the connector is not working correctly (not connected, etc.) • During backup.

Item	Description	Item	Description
⑦	Earth / Frame Ground Connection	⑧	DC Ground Connection
⑨	−40 to −72 VDC Connection (nominally −48 VCD)	⑩	Power Switch / 30 Amp circuit breaker

Front bezels

The front bezels on all AMS 2500DC components, including the expansion unit and battery expansion unit, contain filters to meet NEBS-3 requirements. These filters must be changed at least every six months to meet NEBS-3 requirements.

Figure C-8: Front Bezel with NEBS-3 Filter (rear view)

Power distribution unit

Figure C-9 shows the front view of the DC power distribution unit (PDU) that is used to route DC power to the AMS 2500 storage system in a seismic rack.

Figure C-9: DC Power Distribution Unit

Table C-5: Expansion Unit DC Power Supply, Rear and Side Views

Item	Description	Item	Description	Item	Description
①	Bank A Circuit Breakers. Five 20 Amp breakers protect the AMS 2500 storage system components and one five-amp circuit breaker protects one battery expansion unit.	②	Breaker Alarm LED (RED). This LED is on when any of the circuit breakers in either bank trip. It is OFF when the unit is operating normally.	③	Breaker Alarm Reset Button. After the breaker that tripped has been reset, press this button to reset the alarm and turn off the LED.
④	Input Breaker LEDs (A and B). RED. This alarm LED is ON when the input circuit breaker for the bank it represents has tripped.	⑤	Power on indicator LEDs (GREEN). These LEDs are on when the input circuit breaker is on and the PDU is connected to a −48 VDC source.	⑥	Bank B Circuit Breakers. Five 20 Amp breakers protect the AMS 2500 storage system components and one five-amp circuit breaker protects one battery expansion unit.

> **WARNING! If a breaker trips, do not turn the breaker back on until you have determined what tripped the breaker and fixed the problem.**

Specifications for the PDU are located in Table C-12 on page C-18. Please refer to the Telect installation manual, Dual 40/50/100A Configurable Breaker Panel Installation Guide that is shipped with the PDU for detailed specifications and installation information.

Installation prerequisites

Before installing the seismic rack or any components in it, please read the NEBS-3 requirements (or ETSI requirements if installing in Europe). It is imperative that you follow all the installation instructions exactly to meet the requirements.

NEBS-3 requirements (USA)

This section lists the NEBS requirements for installing a seismic rack and AMS 2500 components that will be used in a telecommunications facility. "NEBS Level 3" is a term from Bellcore special report, SR-3580, and means the equipment meets all of the requirements of GR-63-CORE and GR-1089-CORE. NEBS Level 3 has strict specifications for:

- Fire suppression
- Thermal margin testing
- Vibration resistance (earthquakes)
- Airflow patterns
- Acoustic limits
- Failover

It also includes partial operational requirements such as:

- Chassis fan failures
- Failure severity levels
- RF emissions and tolerances
- Testing/certification requirements

In addition to these operational requirements, NEBS-3 also requires that the equipment pass a set of non-operational tests. These consist of high and low temperatures, high humidity, drop, rain, and others. All of these tests were performed on the AMS 2500 equipment in its packaging. The equipment passed all the tests.

⚠️ **NOTE:** Verizon and AT&T do not follow NEBS Level 3 or SR-3580. They use their own NEBS checklists. Both accept the TCG checklist that can be found on their web sites.

Rack and assembly

This section complies with NEBS-3 Section 9.6 Equipment Unit Bonding and Grounding. NEBS-3 requires that you complete the following steps when building a rack:

1. Clean all parts to be joined before assembly.
2. Apply anti-oxidant compounds to the surfaces to be joined before assembly.
3. Fasten the internal rack structures together with thread forming screws and paint-piercing star lock washers, and apply antioxidants during assembly.

Anchoring the rack

The seismic rack must be anchored to the concrete floor with anchoring bolts that meet NEBS-3 specifications. See the anchoring kit specifications in the Installation section in this appendix for details.

Shelf level configuration

Use thread forming screws and paint piercing lock washers to mount all hardware in the rack. See the example in the Installation section of this appendix.

Bonding and grounding

This section complies with NEBS-3 Sections 9.9.2 and 9.9.3, Connectors, and Section 9.7.1, Connectors and Connection Methods for Equipment Unit Assemblies.

Main ground connection to the rack

- Each ground lead must be secured with its own bolt or thread-forming screw.

- Bolt assembly size and torque specifications for securing the two hole compression lugs to the rack must be followed when installing the rack. See the Installation section for this information.

- Procedures for cleaning and treating the surface areas surrounding the compression lugs during installation must followed when installing the rack. See the Installation section for this information.

Other grounding connectors

- Bare conductors must be cleaned and antioxidant materials applied before crimp connections during installation. See the Installation section for details.

- Install a crimp-type lug on each grounding conductor. Fasten the lug to the chassis or rack with a thread forming screw. Install paint-piercing star lock washers on both sides of the lug to ensure positive ground and thread locking.

- Each grounding conductor must be attached to the chassis or rack with a separate screw or bolt. Do not connect multiple ground wires to a chassis or to the rack with a single screw or bolt.

Wiring and cabling

> ⚠️ **WARNING!**
> **The intra-building port(s) of the equipment or subassembly is suitable for connection to intrabuilding or unexposed wiring or cabling only. The intra-building port(s) of the equipment or subassembly MUST NOT be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.**
>
> **To meet NEBS-3 requirements, you must use shielded, twisted-pair (STP) Ethernet cable. The shield must be grounded at both ends of the cable. This is a REQUIREMENT for installation.**

NEBS-3 testing

NEBS-3 testing was completed at the following facility:

MET Laboratories, Inc.
33439 Western Ave.
Union City, CA 94587
510-489-6300
http://www.metlabs.com

NEBS-3 test results and certification

The AMS 2500 DC-powered storage system, as described in this appendix, passed NEBS-3 test requirements and is certified for NEBS-3 installations, as of May 14, 2009.

The Certifications section in this appendix shows the certificates and test results.

ETSI requirements (Europe)

In addition to NEBS-3 testing, the DC-powered AMS 2500 system was also tested at MET Laboratories for compliance with the specifications set forth by the European Telecommunications Standards Institute (ETSI) for equipment installed in telecommunications facilities.

⚠ **NOTE:** The European Telecommunications Standards Institute is a non-profit organization that establishes telecommunications standards for Europe. ETSI guidelines are voluntary and almost always comply with standards produced by international bodies.

ETSI testing

ETSI testing was completed at the following facility:

MET Laboratories, Inc.
33439 Western Ave.
Union City, CA 94587
510-489-6300
http://www.metlabs.com

ETSI test results and certification

The AMS 2500 DC-powered storage system, as described in this appendix, passed NEBS-3 test requirements and is certified for ETSI installations, as of May 14, 2009.

The Certifications section in this appendix shows the certificates and test results.

Installation

This section describes the procedures to install a Hitachi Data Systems Seismic Rack and the DC-powered storage units into it.

⚠️ **CAUTION! Please read the installation prerequisites and requirements before beginning the installation.**

Installing a seismic rack

It is the customer's responsibility to place, anchor, ground, and connect the rack to the DC power grid. Hitachi Data Systems is not responsible for rack placement and anchoring.

Once the rack is installed, Hitachi Data Systems personnel will install the AMS 2500 components in the rack, and will configure and test the system.

Anchoring the rack

Rack anchoring must be completed by an experienced installer who is familiar with seismic installations that meet local building codes and can obtain the appropriate anchor bolts.

The seismic rack does not have leveling feet or casters. It must be moved about on a pallet. The Seismic Rack vendor, Mayville Products Corp., offers anchoring kits. These may be ordered from the vendor from the following pages on the vendor's website:

http://www.apwmayville.com/products product_detail.aspx?productID=2676

http://www.apwmayville.com/products/product_detail.aspx?productID=2677

Anchoring kit

Table C-6 lists the specifications of the anchoring kit.

Table C-6: Anchoring Kit Specifications

Item	Specification
Anchor length	7.5 inches (131 mm)
Approvals	ETA Option 1, Shock BZS, Fire IBMB, Fire Warrington Report, ICC-ES/ AC 193
Base materials	Concrete (cracked), Concrete block (solid), Stone (hard natural)
Environmental conditions	Inside dry
Min. thickness of base material	4 inches (160 mm)
Anchor type	Mechanical
Working principle	Torque controlled expansion
Type of fixing	Through-fastening
Effective embedment depth	3.15 inches (80 mm)
Baseplate clearance hole	0.79 inch (20 mm)
Drill bit diameter	46/64 inch (18 mm)

Table C-6: Anchoring Kit Specifications

Item	Specification
Hole depth (mm)	4.02 inches (105 mm)
Required tightening torque (Nm)	80
Wrench size (mm)	3/4 inch (19 mm)
Package quantity	20
Additional product information	The indicated load value applies to non-cracked concrete C20/25, no edge distance and spacing influence.
Max. thickness fastened	1 inch (25 mm)
Min. thickness of base material	4 inches (160 mm)

Grounding the rack components

As shown in Figure C-10, grounding cables between rack components are constructed with two-hole compression lugs at both ends of the cable.

Figure C-10: Seismic Rack Ground Connection

To connect the lug to the rack:

1. Remove any paint overspray from the area where the lug will attach to the rack.

2. Clean the rack surface where the ground lug will be attached and remove any residue and paint particles.

⚠ **NOTE:** IMPORTANT! To meet NEBS-3 requirements, the surface where the ground lug attaches to the rack must be cleaned and polished to a bright finish and anti-oxidant applied to the area before the ground lug is attached to the rack.

3. Clean the connector lug.

4. Apply anti-oxidant compound to both the area where the lug will attach to the rack and to the side of the connector lug that will contact the rack.

5. Fasten the grounding lug to the rack with two thread-forming screws or use captive bolts if they are installed in the rack. Install star lock washers above *and below* the compression lug. If the lug is installed with captive bolts (nominally 1/4 inch diameter, carbon steel) tighten the nuts as specified in Table C-7.

Table C-7: Ground Lug Torque Specifications

Bolt Size	Torque - foot lbs.
1/4-20	6
1/4-28	7
The torque values are for SAE Grade 5 (medium strength) steel bolts, dry lubricated, using SAE Grade 5 Nuts	

Mounting components in the rack

NEBS-3 requires that you use special fasteners and paint-piercing lock washers when installing storage components into the rack. They are described in this section.

Fasteners

To meet the NEBS-3 code, use screws that form their own threads in the rack frame, ensuring good electrical contact with the rack as well as a tight mechanical bond. These are sheet-metal screws and are shown in the following illustration and on the detailed drawings at the end of this appendix.

Paint piercing lock washers

In addition to the fasteners described above, use lock washers that pierce the paint or other finish (alodine, etc.) on the installed units and the rack to ensure that the units are securely grounded to the rack. A star washer usually fills this requirement. A star washer has internal or external teeth that lock the fastener to the unit as well as pierce the finish and contact the metal underneath. The fastener, in turn, is grounded to the rack via the threads in the rack frame. Table C-8 shows internal and external tooth star washers and an example of an installation.

Table C-8: Fasteners and Star Washers

Internal Tooth Star Washer		External Tooth Star Washer		Installed Fastener with Star Washer	
Captive 1/4-20 stud for ground terminals. See Table C-7 above.		Thread forming screw: 10-32 x 3/8 pan head philips drive steel zinc finish.			

Specifications

This section provides specifications for each unit in a DC-powered AMS 2500 Storage System.

Seismic rack

provides specifications for the Hitachi Data Systems seismic rack.

Table C-9: Specifications

Item	Specification
Rack Dimensions	84H x 24W x 36"D / 2133H x 610W x 914D mm
Weight	570 lb / 259 kg
Service Clearance, front and rear	40 inches / 1015 mm (See the illustration below)
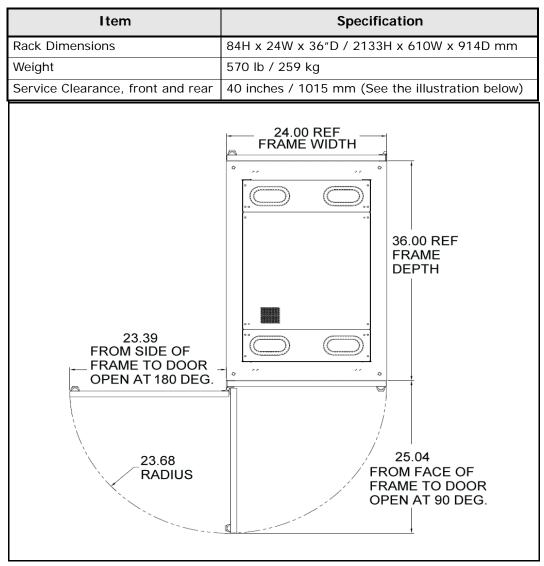
Figure C-11: Service Clearances

DC-powered units

Electrical specifications

Most specifications for the AMS 2500 storage systems are included in Appendix 1 in this manual. Only specifications for the DC-powered components are included here.

Grounding (battery return)

The DC-powered AMS 2500 employs an Isolated DC return (DC-I) for battery return. DC-I means that the DC return terminal or conductor is not connected to the equipment frame or the grounding means of the equipment. The DC-powered AMS 2500 does not have any solid connections within the equipment between the battery return and frame, or between the battery return and the grounding of the equipment.

Hitachi Data Systems seismic rack

See the Hitachi AMS 2000 Site Preparation Guide for complete seismic rack specifications. Also see the Certifications section in this appendix.

AMS 2500 and expansion unit

Table C-10 lists the electrical specifications for the AMS 2500 DC-powered power supply. Appendix A, Specifications for all other specifications for the AMS 2500 and expansion unit.

Table C-10 - AMS 2500 Electrical Specifications (DC)

Item		Base Unit RKHE2D	Expansion Unit RKAKD
Operating Range, VDC		–48 to –72	–48 to –72
Steady-state Current (amps)		4.2 x 2	4.6 x 2
Breaking Current (A)		20	30
Heat Value (kJ/h)		1,460 or less	1,605 or less
Required Power[1]	Steady State Current (VA/W)[2][3]	405	405
	Starting state (VA/W)	445	445
Electrical Insulation Performance	Insulation Resistance	DC 500 V, 10 MΩ or more	

1. The power current of N+2 described in this table is required for operation by a single power supply unit.
2. When one of the two power supply units fails, the remaining power supply unit compensates for the failed power supply unit by increasing its electric current output. Therefore, plan the power supply facility such that the current carrying capacity of one of the power supply units is capable of handling the load during failure of the other power supply unit.
3. Power requirement in the case of the maximum configuration is shown. When planning facilities such as the uninterrupted power supply (UPS), base your calculations on a power factor of 100%. Value at 100 V/200 V is shown. Example: 300 W = 300 VA. The actual required power may exceed the value shown in the table when the tolerance is included.

Battery expansion unit

Table C-11 lists the electrical specifications for the DC-powered battery expansion unit. See Appendix A, Specifications for all other battery expansion unit specifications.

Table C-11: Battery Expansion Unit Electrical Specifications (DC)

Item		Specification (N1RKD Battery)
DC Input power Specifications	Heat value	360 kJ/h
	Input voltage	−48 to −60 VDC
	Steady-state current (A)	to be supplied
	Maximum current (A)	to be supplied
	Heat value (kJ/h)	to be supplied

Power distribution unit

Table C-12 lists the specifications for the Power Distribution Unit, model T009-5030KKKKK50.

Table C-12: Power Distribution Unit Specifications

Item	Dimension	Specification
Mechanical	Width (inches / mm)	17.25 / 438.15
	Height (inches / mm)	1.75 / 44.45
	Depth (inches / mm)	8 / 203.20
	Weight (lbs / kg)	12 / 5.44
	Material	Cold-rolled steel
	Finish	Black powder coat
	Mounting (inches)	19 or 23
Electrical	Nominal voltage	±24V, −48V
	Input rating	100 A per bus
	Maximum input interrupt device	125 A
	Maximum output protection device	20 A
	Power dissipation (full load)	20 W per bus
Environmental	Temperature, operating	−10 to 55°C
	Temperature, storage	
	Humidity, operating	0 to 90%, non-condensing
	Humidity, storage	
Connections	Input terminals	2-hole compression lug, 5/8-inch center-to-center[1]
	Output terminals	Wire binding
	Chassis ground	Single or double-hole compression lug, 5/8-inch center-to-center
	Relay contact ratings	0.6 A at 60 VDC; 2 A at 30 VDC
Alarms	Alarm indicators	Power and breaker alarms
	Alarm type	Form C
	Alarm connector	Screw down, wire binding
Compliance	Agency compliance	NEBS 3, UL, CE

1. Part numbers T009-50005555AAA and T009-500033555AA feature screw-tight horizontal inputs.

Regulatory compliance

The DC-powered AMS 2500 equipment has been tested and certificated for the following standards.

Table C-13: Regulatory Compliance

Standard	Specification	Mark on the product	Country
Electronic emission control	FCC Part 15 Subpart B Class A	Yes (FCC)	U.S.A
Radio inteference voluntary control	VCCI Class A	Yes (VCCI)	Japan
Limits for harmonic current emissions	JIS C61000-3-2	None	Japan
Electronic emission control	ICES-003 Class A	Yes (ICES-003)	Canada
Electronic emission control	AS/NZS 3548:1995,A1,A2	None	Australia
Electronic emissions certification	EN 50022:1998/A1:2000/A2:2003	Yes (CEmarking)	EU
	EN 61000-3-2:2000/A1:2001/A2:2005		
	EN 61000-3-3:1995/A1:2001		
	EN 55024:1998/A1:2001/A2:2003		
	EN 61000-4-2:1995/A1:1998/A2:2001		
	EN 61000-4-3:2002/A2:2002		
	EN 61000-4-4:1995/A1:2001/A2:2003		
	EN 61000-4-5:1995A1:2001		
	EN 61000-4-6:1996/A1:2001		
	EN 61000-4-8:1993/A1:2001		
	EN 61000-4-11:1994/A1:2001		
Electronic emission control	CNS 13438 Class A	Yes (BSMI)	Taiwan
Electronic emission control	KN22	Yes (RRL)	Korea
	KN6100-4		
Safety certification	UL 60950-1	Yes (TUV)	EU/U.S.A
	CAN/CSA-C22.2		
Safety certification	EN 60950-1	Yes (GS)	EU
Safety certification	GOST R60950-2002	Yes (GOST)	Russia
	GOST R51318.22-99		
	GOST R51318.24-99		
	GOST R51317.3.2-99		
	GOST R51317.3.3-99		
Safety certification	IEC 60950-1	Yes(IRAM)	Argentina

Certifications

This section provides the NEBS-3 certifications that show that the AMS 2500 storage system has passed the NEBS-3 test requirements.

MET Laboratories, Inc.
Baltimore, MD   Union City, CA   Santa Clara, CA
410-354-3300   510-489-6300   408-748-3585   www.metlabs.com

May 14, 2009

Chuck Coleman
Hitachi Data Systems
750 Central Expressway
Santa Clara, CA 95050

Dear Mr. Coleman,

Congratulations! It is our pleasure to inform Hitachi Data Systems that the Hitachi Adaptable Modular Storage 2500 (Frame Level), as will be defined in the MET Laboratories' Test Report 81307A-NEBS, , has successfully completed and is compliant with the following Requirements and Objectives *except where noted*, for the following tests performed at MET Laboratories, Inc:

However, the overall compliance of the Hitachi Adaptable Modular Storage 2500 (Frame Level) has not been determined.

■ *GR-1089-CORE, Issue 4, June 2006* - Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment:

- Section 2.1 - Systems-Level Electrostatic Discharge (ESD)
- Section 2.2 – Electrical Fast Transients (EFT)
- Section 3.2.1.1 – Electric Fields Radiated Emission Criteria for Unintentional Radiators
  Note: Compliance excludes Objective O3-3.
- Section 3.2.1.3 – Magnetic Fields Radiated Emission
- Section 3.2.2.2 – Conducted Emission AC & DC Power Ports Current
- Section 3.2.3.1 – Conducted Emission for Signal Leads - Current
- Section 3.3.1 – Radiated Immunity Door / Covers Closed & Open
- Section 3.3.2 – Conducted Immunity for AC & DC Power Ports
- Section 3.3.3.1 – Conducted Immunity for Signal Leads
- Section 4.6.9 – First-Level Intra-Building Lightning Surge Tests
  Note: Requirement R4-16: Compliance TBD, Awaiting Customer Documentation
- Section 7 - Electrical Safety Criteria
- Section 9 - Bonding and Grounding
  Note: Requirements R9-2, R9-10, R9-12, R9-20, R9-21, R9-22, R9-25: Compliance TBD, Awaiting Customer Documentation
- Section 10 – Criteria for DC Power Port of Telecommunications Load Equipment

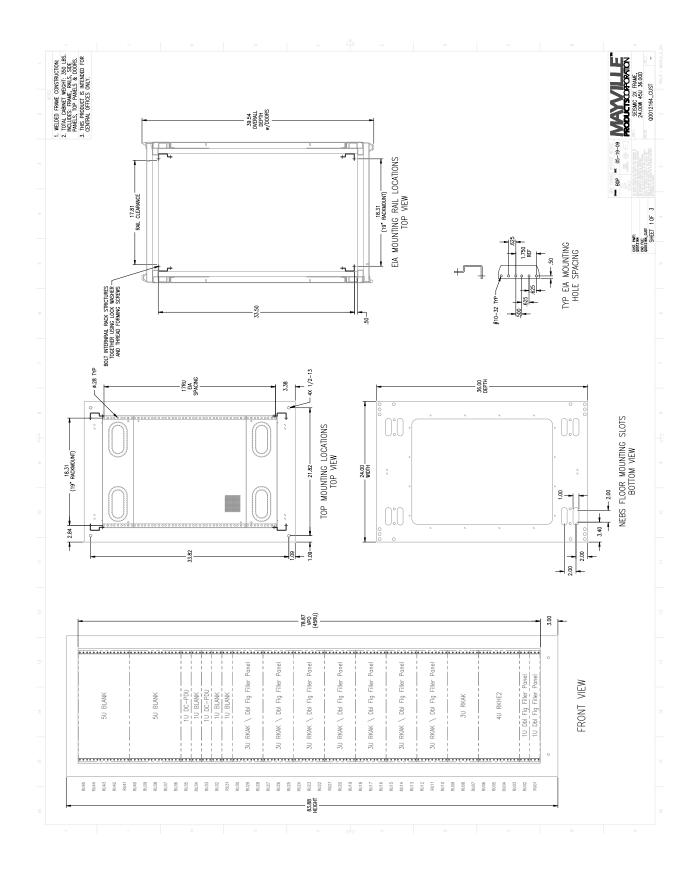*The Nation's First Nationally Recognized Testing Laboratory Licensed by OSHA*

Figure C-12: NEBS-3 Frame Level Certification

**MET Laboratories, Inc.**
Baltimore, MD Union City, CA Santa Clara, CA
410-354-3300   510-489-6300   408-748-3585   www.metlabs.com

May 14, 2009

Chuck Coleman
Hitachi Data Systems
750 Central Expressway
Santa Clara, CA 95050

Dear Mr. Coleman,

Congratulations! It is our pleasure to inform Hitachi Data Systems that the Hitachi Adaptable Modular Storage 2500 (Shelf Level), as will be defined in the MET Laboratories' Test Report 81307B-NEBS, , has successfully completed and is compliant with the following Requirements and Objectives *except where noted*, for the following tests performed at MET Laboratories, Inc:

However, the overall compliance of the Hitachi Adaptable Modular Storage 2500 (Shelf Level) has not been determined.

■ *GR-1089-CORE, Issue 4, June 2006* - Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment:

- Section 2.1 - Systems-Level Electrostatic Discharge (ESD)
- Section 2.2 – Electrical Fast Transients (EFT)❶
- Section 3.2.1.1 – Electric Fields Radiated Emission Criteria for Unintentional Radiators
  Note: Compliance excludes Requirement R3-2
- Section 3.2.1.3 – Magnetic Fields Radiated Emission
- Section 3.2.2.2 – Conducted Emission AC & DC Power Ports Current❶
- Section 3.2.3.1 – Conducted Emission for Signal Leads – Current❶
- Section 3.3.1 – Radiated Immunity Door / Covers Closed & Open
- Section 3.3.2 – Conducted Immunity for AC & DC Power Ports❶
- Section 3.3.3.1 – Conducted Immunity for Signal Leads❶
- Section 4.6.9 – First-Level Intra-Building Lightning Surge Tests
  Note: Requirement R4-16: Compliance TBD, Awaiting Customer Documentation
- Section 7 - Electrical Safety Criteria
- Section 9 - Bonding and Grounding
  Note: Requirements R9-7, R9-10, R9-20, R9-24: Compliance TBD, Awaiting Customer Documentation
- Section 10 – Criteria for DC Power Port of Telecommunications Load Equipment
  Note: Compliance excludes Requirements R10-8 and R10-10

❶ *This section was tested simultaneously with Frame Level and is deemed Compliant by Similarity*

The Nation's First Nationally Recognized Testing Laboratory Licensed by OSHA

Figure C-13: NEBS-3 Shelf Level Certification
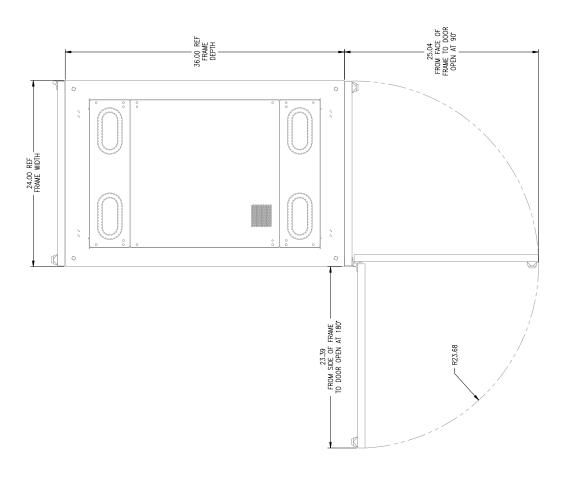
Drawings
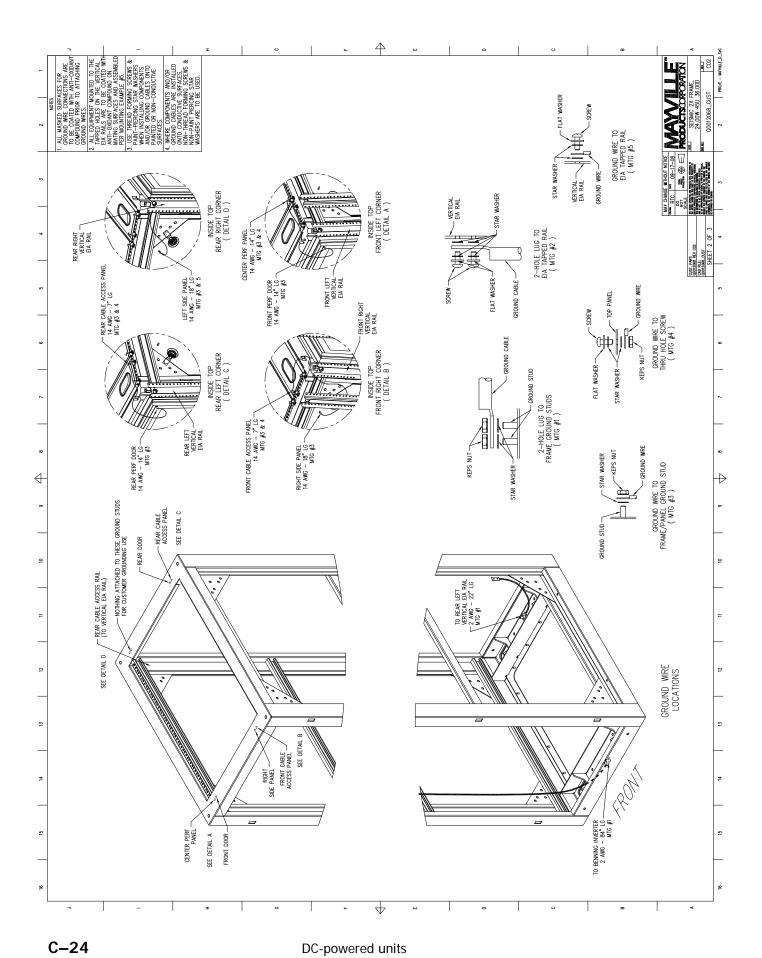
This section includes a set of manufacturers drawings of the seismic rack used to contain the components of the DC-powered AMS 2500. Please refer to the following drawing for details of the components and dimensions of the APWMayville Seismic x2 Frame (rack).

- Overall dimensions: Q0012068_CUST_C02_sht1of3.pdf

- Grounding system: Q0012068_CUST_C02_sht2of3.pdf

- Service clearance: Q0012068_CUST_C02_sht3of3.pdf

36.00 REF
FRAME DEPTH

24.00 REF
FRAME WIDTH

25.04
FROM FACE OF
FRAME TO DOOR
OPEN AT 90°

23.39
FROM SIDE OF FRAME
TO DOOR OPEN AT 180°

R23.68

MAYVILLE
PRODUCTS CORPORATION

SEISMIC 2X FRAME,
24.00W 45U 36.00D

Q00112164_CUST

CUST. PART:
Q00112164
CAD FILE:
Q00112164_CUST

SHEET 3 OF 3

DRAWN BDP   DATE 05-19-09

DC-powered units

C–23

Glossary

This glossary provides definitions of general storage networking terms as well as specific terms related to the technology that supports your Hitachi Simple Modular Storage 100 array. Click the letter of the glossary section to display that page.

# #

1000Base-T

A specification for Gigabit Ethernet over copper wire. The standard defines 1 Gbps data transfer over distances of up to 100 meters using four pairs of Category 5 balanced copper cabling and a 5-level coding scheme.

A

Array

A set of hard disks grouped logically together to function as one contiguous storage space.

ATA

Advanced Technology Attachment. A disk drive implementation that integrates the controller on the disk drive.

B

BIOS

Basic Input Output System. Built-in software code that determines the functions that a computing device can perform without accessing programs from a disk.

Bps

Bits per second, the standard measure of data transmission speeds.

C

Cache

A temporary, high-speed storage mechanism. It is a reserved section of main memory or an independent high-speed storage device. Two types of caching are found in computers: memory caching and disk caching. Memory caches are built into the architecture of microprocessors and often computers have external cache memory. Disk caching works like memory caching; however, it uses slower, conventional main memory that on some devices is called a memory buffer.

Capacity

The amount of information (usually expressed in gigabytes) that can be stored on a disk drive. It is the measure of the potential contents of a device; the volume it can contain or hold. In communications, capacity refers to the maximum possible data transfer rate of a communications channel under ideal conditions.

Glossary–2

Challenge Handshake Authentication Protocol

A security protocol that requires users to enter a secret for access.

CHAP

See Challenge Handshake Authentication Protocol.

CUDG:

Control Unit Diagnosis.

D

DHCPv4

Dynamic Host Configuration Protocol version 4 allows a computer to join an IP-based network without having a pre-configured IPv4 address. DHCPv4 is a protocol that assigns unique IP addresses to devices, then releases and renews these addresses as devices leave and re-join the network.

Duplex

The transmission of data in either one or two directions. Duplex modes are full-duplex and half-duplex. Full-duplex is the simultaneous transmission of data in two direction. For example, a telephone is a full-duplex device, because both parties can talk at once. In contrast, a walkie-talkie is a half-duplex device because only one party can transmit at a time.

F

Fabric

The hardware that connects workstations and servers to storage devices in a SAN. The SAN fabric enables any-server-to-any-storage device connectivity through the use of Fibre Channel switching technology.

Firmware

Software embedded into a storage device. It may also be referred to as Microcode.

Full-duplex

The concurrent transmission and reception of data on a single link.

G

Gbps

Gigabits per second.

Glossary–3

H

HBA

Host bus adapter. A circuit board and/or integrated circuit adapter installed in a workstation or server that provides input/output processing and physical connectivity between a server and a storage device. An iSCSI HBA implements the iSCSI and TCP/IP protocols in a combination of a software storage driver and hardware.

HDD

Hard disk drive.

I

Initiator

A system component that originates an I/O command over an I/O bus or network, such as an I/O adapters or network interface cards.

I/O

Input/output.

IP

Internet Protocol, specifies the format of packets and addressing scheme. Most networks combine IP with a higher-level protocol called Transmission Control Protocol (TCP), which establishes a virtual connection between a destination and a source.

IP address
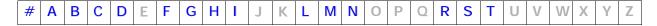
An identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255 (for example, 192.168.0.200). The current main address is IPv4 (Internet Protocol Address Version 4) and the next-generation address is IPv6 (Internet Protocol address Version 6).

IP-SAN

Block-level Storage Area Networks over TCP/IP using the iSCSI protocol.

iSCSI

Internet SCSI. An IP-based standard for connecting data storage devices over a network and transferring data using SCSI commands over IP networks. iSCSI enables a Storage Area Network to be deployed in a Local Area Network.

Glossary–4

iSNS

Internet Storage Name Service. A protocol that allows automated discovery, management and configuration of iSCSI devices on a TCP/IP network.

L

LAN

Local Area Network. A computer network that spans a relatively small area, such as a single building or group of buildings.

Loopback address

Loopback address is virtual address that means itself in network. In case of IPv4 uses "127.0.0.1", in case of IPv6 uses "::1". Also "local host" is used as the host name conventionally.

LU

Logical unit.

LUN

Logical unit number.

M

Middleware

Software that connects two otherwise separate applications. For example, a middleware product can be used to link a database system to a Web server. Using forms, users request data from the database; then, based on the users' requests and profile, the Web server returns dynamic Web pages to the user.

N

NIC

Network Interface Card. An expansion board in a computer that allows the computer to connect to a network

R

RAID

Redundant Array of Independent Disks. A disk array in which part of the physical storage capacity is used to store redundant information about user data stored on the remainder of the storage capacity. The redundant information enables regeneration of user data in the event that one of the array's member disks or the access path to it fails.

RAID 6

An extension of the RAID 5 array that allows for two simultaneous drive failures without downtime or data loss.

After a recovery operation, the recovery point objective (RPO) is the maximum desired time period, prior to a disaster, in which changes to data may be lost. This measure determines up to what point in time data should be recovered. Data changes preceding the disaster are preserved by recovery.

S

SAN

Storage Area Network. A network of shared storage devices that contain disks for storing data.

SAS

Serial Attached SCSI. An evolution of parallel SCSI into a point-to-point serial peripheral interface in which controllers are linked directly to disk drives. SAS delivers improved performance over traditional SCSI because SAS enables up to 128 devices of different sizes and types to be connected simultaneously.

SATA

Serial ATA is a computer bus technology primarily designed for the transfer of data to and from hard disks and optical drives. SATA is the evolution of the legacy Advanced Technology Attachment (ATA) interface from a parallel bus to serial connection architecture.

SCSI

Small Computer System Interface. A parallel interface standard that provides faster data transmission rates than standard serial and parallel ports.

Session

A series of communications or exchanges of data between two end points that occurs during the span of a single connection. The session begins when the connection is established at both ends, and terminates when the connection is ended. For some applications each session is related to a particular port. In this document a session is the exchange of data between groups of primary and secondary volumes.

SMTP

Simple Mail Transfer Protocol. A protocol used to receive and store email data directly from email servers.

Software initiator

A software application initiator communicates with a target device. A software initiator does not require specialized hardware because all processing is done in software using standard network adapters.

SSD

Solid State Disk (drive). A data storage device that uses solid-state memory to store persistent data. An SSD emulates a hard disk drive interface, thus easily replacing it in most applications.

Storage Navigator Modular 2

A multi-featured scalable storage management application that is used to configure and manage the storage functions of Hitachi arrays. Also referred to as "Navigator 2".

Subnet

In computer networks, a subnet or subnetwork is a range of logical addresses within the address space that is assigned to an organization. Subnetting is a hierarchical partitioning of the network address space of an organization (and of the network nodes of an autonomous system) into several subnets. Routers constitute borders between subnets. Communication to and from a subnet is mediated by one specific port of one specific router, at least momentarily. SNIA.

Switch

A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have internal bandwidth that is a multiple of link bandwidth, and the ability to rapidly switch node connections from one to another. A typical switch can accommodate several simultaneous full link bandwidth transmissions between different pairs of nodes. SNIA.

T

Target

Devices that receive iSCSI requests that originate from an iSCSI initiator.

TOE

A dedicated chip or adapter that handles much of the TCP/IP processing directly in hardware. TCP/IP transmission is inherently a CPU-intensive operation. Therefore, using dedicated hardware that can operate in parallel with the main processor allows for superior system performance. Although all iSCSI HBAs have a TOE, a generic TOE only implements TCP/IP, while an iSCSI HBA implements the iSCSI protocol in addition to TCP/IP.

Glossary–8

Index

Index-2

Hitachi Data Systems

MK-97DF8007EN-12