HITACHI
DATA SYSTEMS

Hitachi Freedom Storage™ Thunder 9200™ User and Reference Guide

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 Data Systems Legal Department for any export compliance questions.

Document Revision Level

Revision	Date	Description
MK-90DF504-P	November, 2000	Rough Draft - only for 9200 Doc. Team
MK-90DF504-P1	November, 2000	Initial Draft
MK-90DF504-P2	November, 2000	Supersedes and replaces MK-90DF504-P1
MK-90DF504-0	January, 2001	Initial Release. Supersedes and replaces MK-90DF504-P2
MK-90DF504-1	January, 2001	Supersedes and replaces MK-90DF504-0
MK-90DF504-2	March, 2001	Supersedes and replaces MK-90DF504-1
MK-90DF504-3	March, 2001	Supersedes and replaces MK-90DF504-2
MK-90DF504-4	April, 2001	Supersedes and replaces MK-90DF504-3

Preface

The Hitachi Freedom 9200 User and Reference Guide describes the physical, functional, and operational characteristics of the 9200 subsystem, provides instructions for operating the 9200 subsystem, and details the installation and configuration planning information for the 9200 subsystem.

This User and Reference Guide assumes that:

- The user has a background in data processing and understands direct-access storage device subsystems and their basic functions,
- The user is familiar with the Hitachi Freedom Storage™ Thunder 9200™ array subsystem,
- The user is familiar with the Windows 95®, Windows 98®, or Windows NT® operating systems.

For further information on Hitachi Data Systems products and services, please contact your Hitachi Data Systems account team, or visit the Hitachi Data Systems worldwide web site at http://www.hds.com. For specific information on the supported host systems and platforms for the 9200, please refer to the user documentation for the product, or contact the vendor's customer support service.

Note: This document uses the term "9200" to refer to any 9200 subsystem.

Contents

Chapter 1 Safety Notices 1

1.1 Common Safety Precautions 1
1.1.1 Symbol Marks 1
1.1.2 Be Aware of Potential Hazards not Described in this Manual 1
1.1.3 Repair, Modification, and Disassembly 1
1.2 Precautions for Using the Equipment 2
1.2.1 Equipment 2
1.2.2 Cables 2
1.2.3 Air Vents 2
1.2.4 Battery Unit 3
1.2.5 Other 3
1.3 Precautions for Inspection and Cleaning 3
1.4 Emergency Precautions 4
1.4.1 Electric Shock 4
1.4.2 Fire 4
1.5 Warning Notices 5
1.5.1 CAUTION Statements 5
1.5.2 Locations of Warning Labels Pasted on the Equipment 6

Chapter 2 Overview of the Freedom 9200 Subsystem 7

2.1 Overview of the Hitachi Data Systems 9200 Subsystem 7
2.1.1 Differences between the 5800 and 9200 Disk Arrays 7
2.1.2 High Data Availability 8
2.1.3 Connectivity 8
2.1.4 Open Systems and Functionality 8
2.1.5 Enhanced Data Accessibility 9
2.1.6 Subsystem Scalability 9
2.1.7 Subsystem Performance Reporting and Monitoring 9
2.2 Reliability, Availability, and Serviceability 9

Chapter 3 Planning for Installation and Operation 11

3.1 User Responsibilities 12
3.2 Dimensions and Weight 12
3.3 Service Clearance Requirements 13
3.4 Floor Load Rating 14
3.4.1 Floor Load Rating for 9200 Controller with 1 Disk Array 14
3.4.2 Floor Load Rating for 9200 Controller with 9 additional RKA units. 14
3.5 Cable Requirements 14
3.6 Temperature and Humidity Requirements 15
3.7 General Specifications 16
3.8 Air Flow Requirements 17
3.9 Vibration and Shock Tolerances 17

Chapter 4 Subsystem Architecture and Components 19

4.1 Overview of the Rackmount (RK) Unit and the Rackmount Additional (RKA) Unit .19
4.2 Redundant Power Supplies 21
4.3 Fibre Channel 21
4.4 Array Frame 22
4.5 Disk Array Groups 23
4.6 Service Processor (SVP) 23

Chapter 5 Functional and Operational Characteristics 25

5.1 New 9200 Features and Capabilities 25
5.2 RAID Implementations 25
5.3 Cache Management 26
5.4 Logical Units (LUs) 26
5.5 Open Systems Features and Functions 26
5.5.1 Open Systems Middleware 26
5.5.2 LUN Management 27
5.6 Data Management Features and Functions 27
5.6.1 Overview of Flash Access 27
5.6.2 Overview of Password Protection 27
5.6.3 Overview of LUN Security 28

Chapter 6 Configuring the 9200 Subsystem 29

6.1 Overview of Configuration 29
6.1.1 Open Systems Configuration 30
6.1.2 Defining LUNs 30
6.1.3 Fibre Addressing and LUN Mapping 31
6.1.4 Alternate Pathing 32
6.2 Configuring the LAN Interfaces of the 9200 33
6.3 Configuring the 9200 Subsystem 34
6.4 Registering the 9200 for Control by Resource Manager 9200 34
6.5 Configure the 9200 for the Desired Application 34
6.6 General Configuration of the 9200 Subsystem 35
6.7 Starting the Parameter Wizard in Resource Manager 9200 35
6.8 Configuring the Basic Setup Parameters for the 9200. 35

Chapter 7 Configuring Storage on the 9200 Subsystem 37

7.1 Determining Space and RAID Level Requirements 37
7.2 Setting Aside Spare Disks 37
7.2.1 Setting a Spare Disk 38
7.3 Configuring RAID Groups 39
7.4 Configuring LUNs within a RAID group 40
7.5 Mapping the LUNs to Ports, Target Ids, and LUN Numbers 41
7.6 Transferring Configurations from One Array to Another 44
7.7 Storing Configuration Data 45
7.8 Applying Configuration Data to Another 9200 Subsystem 45

Chapter 8 Troubleshooting 47

8.1 Error and Failure Alerts 48
8.2 Calling the Hitachi Data Systems Support Center 48

Appendix A Glossary 49

Appendix B Unit Conversions 53

List of Figures

Figure 1.1 Positions and Contents of Labels Pasted on the Rack mount Model 6
Figure 4.1 RK Unit 20
Figure 4.2 RKA Unit 21
Figure 5.1 Logical Units 26
Figure 6.1 Fibre Port-to-LUN Addressing 31
Figure 6.2 Alternate Pathing 32
Figure 7.1 Manager Screen (70) 38
Figure 7.2 Manager Screen (71) 38
Figure 7.3 Manager Screen (72) 38
Figure 7.4 Manager Screen (22) 39

List of Tables

Table 1.1 CAUTION Statements 5
Table 3.1 9200 Dimensions and Weight 12
Table 3.2 Cable Requirements 14
Table 3.3 Environmental Specifications 15
Table 3.4 9200 Subsystem Power and Heat Output Specifications 16
Table 3.5 Vibration and Shock Tolerances 17
Table 4.1 Disk Array General Specifications 22
Table 5.1 Software Features and Resource Manager 9200 27
Table 6.1 Open System Configuration Guides for the 9200 30
Table 8.1 Troubleshooting 47
Table B.1 Unit Conversions for Standard (US) and Metric Measures 53

Chapter 1 Safety Notices

1.1 Common Safety Precautions

When using the 9200 disk array subsystem, follow these cautionary procedures:

- Perform operations in accordance with the instructions or procedures described in this manual.
- Follow the cautionary notes written on labels affixed to the equipment.
- Follow the cautionary notes written in this manual.

1.1.1 Symbol Marks

The ⚠ symbol followed by the word "CAUTION" in this manual indicates a potential safety hazard. When you see this symbol, observe the safety instructions that follow.

⚠ CAUTION	This symbol indicates the existence of a potential hazard which may cause a rather light injury or serious damage to the equipment if the written contents are not observed.

1.1.2 Be Aware of Potential Hazards not Described in this Manual

It is impossible to describe every hazard that may exist with this equipment. Please be aware of hazards not described in this manual. Work safely.

1.1.3 Repair, Modification, and Disassembly

Users must not repair, remodel, or disassemble the equipment. Such actions may cause hazardous conditions for the user and/or the equipment.

1.2 Precautions for Using the Equipment

Use special precautions for the following:

- Equipment
- Cables
- Air Vents
- Battery Unit
- Other

1.2.1 Equipment

- If you notice unusual heat generation, odors, or smoke emission, shut off the power feed to the equipment and contact the maintenance engineer. Leaving such conditions unattended may result in hazardous physical conditions and equipment failure.
- Avoid physical disruption to the equipment. This may result in hazardous physical conditions and equipment failure.
- Do not place heavy objects on top of the disk array. Avoid using the equipment for any use other than its original purpose; otherwise, an injury or equipment failure may result.

1.2.2 Cables

- Avoid obstructing walkways when routing cables.
- Do not allow heavy material to be placed on cables. Do not place cables near any apparatus that generates heat. Do not step on or subject cables or connectors to shearing or pulling forces; the cable jacket can be damaged and can break, resulting in an electric shock, fire, or loss of data.
- Make sure that electrical and signal cables are clean before connecting them. Any dirt on a connector should be removed before inserting the connector into a socket.

1.2.3 Air Vents

- Make certain that the air vents are free of obstruction. They should be inspected periodically.
- Do not place metallic material such as paper clips or any combustible material such as paper into or near the air vents. This may result in electric shock or fire.

1.2.4 Battery Unit

Observe the following when handling the battery:

- Do not disassemble or tamper with the battery.
- Do not allow the battery to be physically damaged. If the battery is physically damaged, have it replaced as soon as possible.
- Do not connect the two terminals of the battery directly to each other; this will create a short circuit.
- Do not tamper with cable insulation.
- Do not connect the battery to any equipment other than the Thunder 9200 disk array.
- Do not expose the battery to high temperatures.

1.2.5 Other

- When a failure occurs in the unit, take action according to the procedures recommended in this manual. If the difficulty does not correspond to the corrective measures documented in this manual, contact the maintenance engineer.

1.3 Precautions for Inspection and Cleaning

- If a maintenance activity requires that the unit be powered off, make sure that the power-off sequence described in the manual is performed before proceeding with maintenance.
- Do not work on the unit in a damp or flooded environment.
- Do not obstruct access to the unit with parts or tools.
- When performing the work with the door open, take off metal watches or jewelry to prevent electric shock. If you wear metal-frame glasses, do not touch the equipment.
- Ensure that loose clothing, jewelry or hair do not become tangled in moving components.
- There are high-voltage parts in the equipment. Observe the cautionary statements in the manual to make sure that high-voltage compoents are not touched during maintenance. Another person should be on alert so to shut off the power feed to the equipment.
- After the power feed to the equipment is shut off, electricity remains in the equipment for a period of time. Therefore, do not touch any components other than those indicated in this manual.
- The equipment can become extremely hot. Do not touch any part other than those indicated in this manual.
- When working with the door open, wear cotton gloves to prevent your hands from touching sharp objects.

1.4 Emergency Precautions

Follow these emergency precautions for the following:

- Electric Shock
- Fire

1.4.1 Electric Shock

- Do NOT immediately touch the person struck by electricity. You could be the second victim.
- To shut off the electric flow to a victim, disconnect the power feed cable of the equipment. In spite of this action, electricity may not be shut off. Separate the victim from the current source by using a non-conductive material such as dry wooden bar.
- Call an ambulance.
- When the victim has lost consciousness, practice artificial respiration on the victim. To prepare for such a case, learn how to practice artificial respiration.
- When the victim's heart has stopped, give a heart massage. This treatment should only be conducted by a person who has been trained and qualified.

1.4.2 Fire

- To shut off the electric flow to the equipment, pull out the power feed cable. This will terminate the power supply.
- If a fire cannot be extinguished when the electric flow has been shut off, use fire fighting procedures and contact the fire department.

1.5 Warning Notices

1.5.1 ⚠ CAUTION Statements

⚠ CAUTION statements described in this manual and the pages where they appear are listed below.

Table 1.1 ⚠ CAUTION Statements

Warning Statement	Corresponding Page
The weight of RK is 65 kg (145 lbs) and the weight of RKA is 40 kg (88 lbs). When lifting the equipment, be sure to lift it carefully with two or more workers or an appropriate lifting device.	12
Cooling fans rotate at a high speed. Keep body parts and loose clothing away from the cooling fans.	3
When performing cleaning, take care not to touch electrically charged parts, Electric shock may result from a failure to observe this precaution.	3, 4
Do not touch electrically charged components during parts replacement. Electric shock may result from a failure to observe this precaution.	4

1.5.2 Locations of Warning Labels Pasted on the Equipment

Warning labels are pasted on sections of equipment which require special care. They are shown in the following figure. Read the messages and observe the warning procedures.

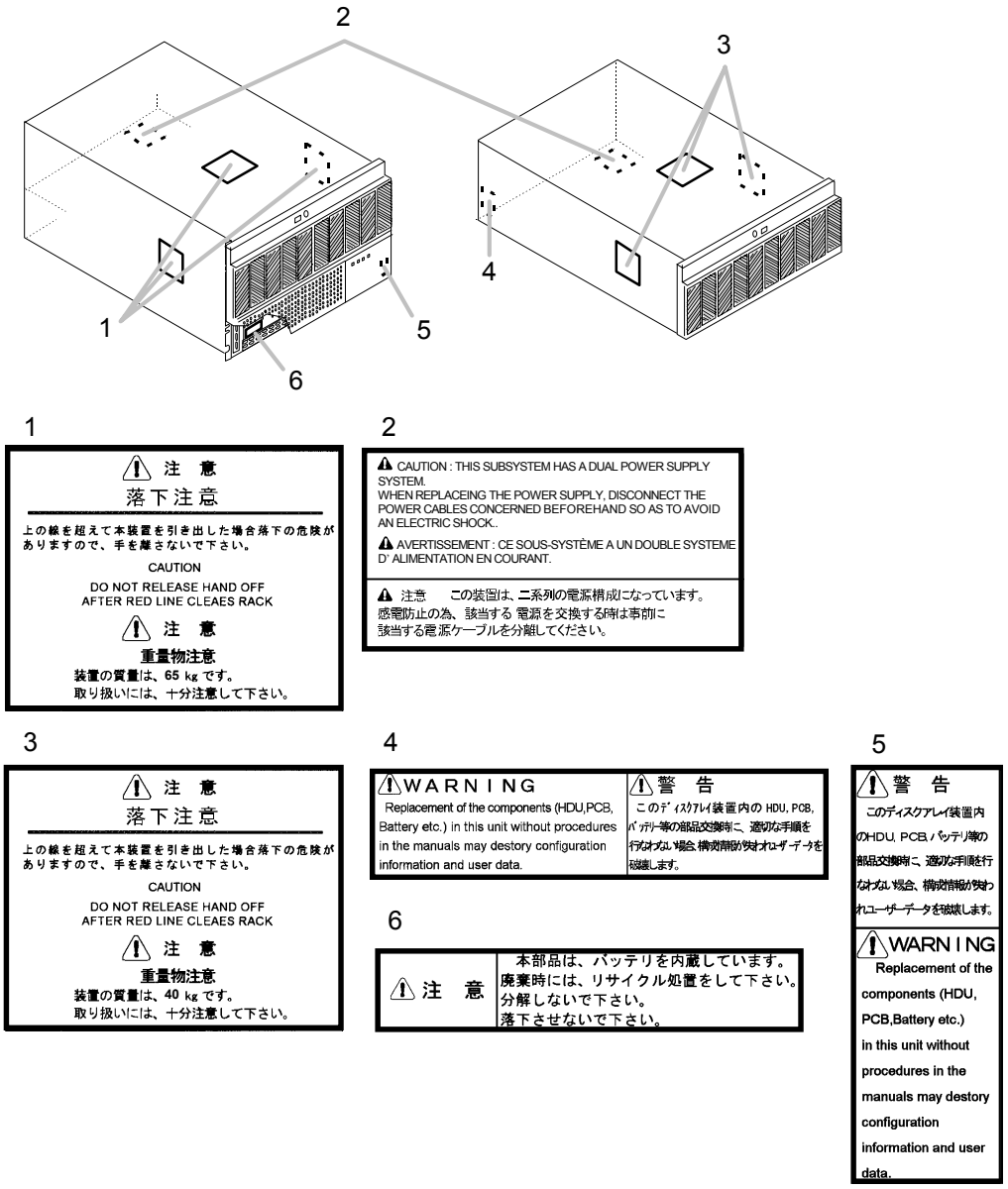


Figure 1.1 Positions and Contents of Labels Pasted on the Rack mount Model

Chapter 2 Overview of the Freedom 9200 Subsystem

2.1 Overview of the Hitachi Data Systems 9200 Subsystem

The Hitachi Freedom Storage™ Thunder 9200™ is a high-performance, medium-capacity storage array with added features designed to reduce the possibility of data loss due to the failure of any single component. Disk array installation and setup are simplified using the Resource Manager 9200 program included with the subsystem. Many parts are replaceable while the disk array is online. Cache memory has a battery backup to preserve cache contents in the event of a power failure.

2.1.1 Differences between the 5800 and 9200 Disk Arrays

- Enhanced performance of internal bus

  The bus performance between the cache memory on the controller was enhanced from 300 Mbyte/s (5800) to 805 Mbyte/s (9200) to achieve higher throughput.

- High clock speed RISC processor

  The installed microprocessor was changed from PowerPC 603e (200 MHz) of the 5800 to the high performance PowerPC 750 (300 MHz) 9200.

- Fibre Channel interface is used as the standard host interface

  The 5800 uses Fibre Channel interface or SCSI depending on the selection; the 9200 uses Fibre Channel interface as a standard configuration.

- Redundant power supplies

  In the 5800, the In Box for models RK and RKL is duplicated but the AC/DC power supply is optionally duplicated depending on the configuration.

  In the 9200, the new power supply which integrates functions of the IN BOX and the AC/DC power supply is duplicated as a standard configuration for both of the RK and RKA.

- Up to five spare disks

  The 5800 can install up to two spare disks; the 9200 can install up to five spare disks in one system configuration so that the possibility of data loss due to a failure is reduced. Unlike the 5800, there are no slots specifically identified for the spare disk. Depending on RAID group configuration, spare disks can be installed in any slot, with the exception of slot 0 and 1 of the RK unit.

- Fibre Channel Disk drive

  The 5800 disk drives use SCSI to connect to the backend; the 9200 disk drives use Fibre Channel. This enables the subsystem to connect up to 100 disk drives.

- Removal of the SVP panel

  For increased ease of use, the information panel, which is used on the 5800 for key input and information check, has been eliminated. Service operations for the 9200 are now performed by a PC web browser and HTTP connection to the array.

2.1.2 High Data Availability

The 9200 is designed for high performance and protection of user data. See section 1.2 for further information on the reliability and availability features of the Hitachi Freedom 9200 subsystem.

2.1.3 Connectivity

The Hitachi Freedom 9200 subsystem provides connectivity to most open systems through standard Fibre Channel and SCSI interfaces.

The 9200 subsystem can also be configured with up to 4 fibre-channel ports for connection to open-system hosts. The type of host platform determines the number of LUs that may be connected to each port. Fibre channel provides data transfer rates of up to 100 MB/sec. The 9200 supports fibre-channel arbitrated loop (FC-AL) and fabric Fibre Channel topologies. The 9200 supports short wavelength non-OFC (non-open fibre control) optical interfaces, and gigabit link modules (GLMs) as well as high-availability fibre-channel configurations using hubs and switches.

2.1.4 Open Systems and Functionality

The 9200 subsystem can be configured with multiple concurrent LU sizes and provides the following functionality in the open-system environment:

- Compatible with most popular open Host operating Systems
- Compatible with most popular open Middleware
- Compatible with most popular fibre Host Bus Adapters

2.1.5 Enhanced Data Accessibility

The 9200 supports command tag queuing, multi-initiator I/O, and most industry-standard middleware products providing host fail-over capability, I/O path fail-over support, and logical volume management. The 9200 also has many features that increase data accessibility and enable continuous user data access.

- Flash Access 9200 allows a LUN to reside in cache memory for fastest possible access.
- LUNs can be created to suit customer needs using Resource Manager 9200.
- LUN Security 9200 allows the 9200 to control host access to LUNs by host Worldwide Name. Up to 128 Worldwide Names per port can be supported.
- Up to 2 GBs (two pair of 512 MB DIMMs) of cache memory can be installed in each controller (or up to 4 GBs per subsystem) to improve I/O performance.

2.1.6 Subsystem Scalability

The architecture of the 9200 enables the user to scale the subsystem to meet a wide range of capacity and performance requirements. The storage capacity can be increased from a minimum of 72 GBs to a maximum of 7.2 TBs RAID0 of user data by adding additional disk drive bays (RKA units). The nonvolatile cache can also be configured in sizes from 256 MBs to 2 GBs per controller. All disk drive maintenance can be performed without interrupting user access to data and with minimal impact on subsystem performance.

2.1.7 Subsystem Performance Reporting and Monitoring

The Resource Manager 9200 program provides the capability to either monitor the disk array in real time or to collect historical data regarding the performance of the disk array.

2.2 Reliability, Availability, and Serviceability

The 9200 subsystem is not expected to fail in any way that would interrupt user access to data. The 9200 can sustain single component failures and still continue to provide full access to all stored user data.

Note: While access to user data will not normally be compromised, the failure of any single key component may degrade performance.

The reliability, availability, and serviceability features of the 9200 subsystem include:

- **High-Availability capability**. The 9200 subsystem provides high-availability capability for all critical components. The disk drives are protected against error and failure by enhanced RAID technologies as well as dynamic scrubbing and sparing. The 9200 uses component and function redundancy to provide high availability for many subsystem components. The 9200 subsystem is designed to provide nearly continuous access to all user data.
- **Redundant power supply systems**. Each 9200 unit has a set of two power supplies. Each power supply can provide power for the entire subsystem in the unlikely event of power supply failure. The power supplies of each set can be connected across power boundaries so that each set can continue to provide power if a power outage occurs. Each unit of the 9200 can sustain the loss of a single power supply and still continue operation.
- **Dynamic scrubbing and sparing for disk drives**. The 9200 uses special diagnostic techniques and dynamic scrubbing to detect and correct disk errors. Dynamic sparing is invoked automatically if needed. The 9200 can be configured with up to five spare disk drives, and any spare disk can back up any other disk of the same capacity.
- **Hi-Track® (optional).** The Hi-Track® maintenance support tool monitors the operation of the 9200 subsystem at all times, collects hardware status and error data, and transmits this to the local Hitachi Data Systems Support Center. The Hitachi Data Systems Support Center analyzes the data and implements corrective action, if necessary. In the unlikely event of a component failure, Hi-Track® contacts the Hitachi Data Systems Support Center immediately to report the failure. This automatic error/failure detection and reporting provided by Hi-Track® does not require any action on the part of the user. Hi-Track® enables some subsystem problems to be identified prior to actual failure, and the advanced redundancy features enable the subsystem to remain operational even if one or more components fail.

  Note: Hi-Track® is a service feature of HDS and consists of JAVA based software program/s developed by HDS to allow remote monitoring of HDS products. Hi-Track is installed on a users workstation or server, then attached to the 9200 Disk Sub system using TCP-IP over the customers LAN. The management server then can contact the local HDS Support Center using “FTP” of status and error information. Hi-Track monitors the 9200s that are registered every (1) minute for various conditions and will perform an FTP “put” command to the HDS Support Center if an error occurs.

  If no there is no error condition Hi-Track will report back once every 24 hours as a “health check”.
- **Error Reporting.** The Hitachi Freedom 9200 subsystem reports error messages to notify the user of errors and service requirements. The error messages are logged on the service processor (SVP) of the subsystem and are also visible using web access. Errors can also reported to the Hitachi Data Systems technical support center via the optional Hi-Track® product.

Chapter 3 Planning for Installation and Operation

This chapter provides information for planning and preparing a site before and during installation of the Hitachi Freedom 9200 array subsystem. Please read this chapter carefully before beginning your installation planning.

If you would like to use any of the 9200 features or products (e.g., LUN Security 9200, Flash Access 9200), please contact your Hitachi Data Systems account team to obtain the appropriate license(s) and software key files.

Note: The general information in this chapter is provided to assist in installation planning and is not intended to be complete. The internal 9200 installation and maintenance documents used by Hitachi Data Systems personnel contain complete specifications. The exact electrical power interfaces and requirements for each site must be determined and verified to meet the applicable local regulations. For further information on site preparation for 9200 installation, please contact your Hitachi Data Systems account team or the Hitachi Data Systems Support Center.

This chapter includes the following:

- User Responsibilities
- Dimensions and Weight
- Service Clearance Requirements
- Floor Load Rating
- Cable Requirements
- Temperature and Humidity Requirements
- General specifications
- Air Flow Requirements
- Vibration and Shock Tolerances

3.1 User Responsibilities

Before the 9200 subsystem arrives for installation, the user must provide the following items to ensure proper installation and configuration.

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

3.2 Dimensions and Weight

The following table illustrates the dimensions and weight of the 9200 RK and RKA.

Table 3.1 9200 Dimensions and Weight

Item \ Model		Rackmount Model	
		RK	RKA
Physical Specifications	Chassis size (W×D×H) (mm)	482.6x656x262	482.6x656x152
	Mass (kg)(*4)	150 or less	40 or less
	Acoustic noise (dB)	65 or less	40 or less
	Required height (EIA unit)(*5) (*6)	6	3.5

*1: D : Data disk
P : Parity disk

*2: For the details of the available minimum or maximum storage capacity, refer to Appendix A, "List of Storage Capacities Corresponding to RAID Levels and Configurations (7000)".

*3: Although the subsystem with a configuration of RAID 5, RAID 1, or RAID 0+1 provides data reliability enhanced by means of redundancy, a possibility remains that user data is lost owing to an unexpected failure of a host computer or hardware/software of the subsystem itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

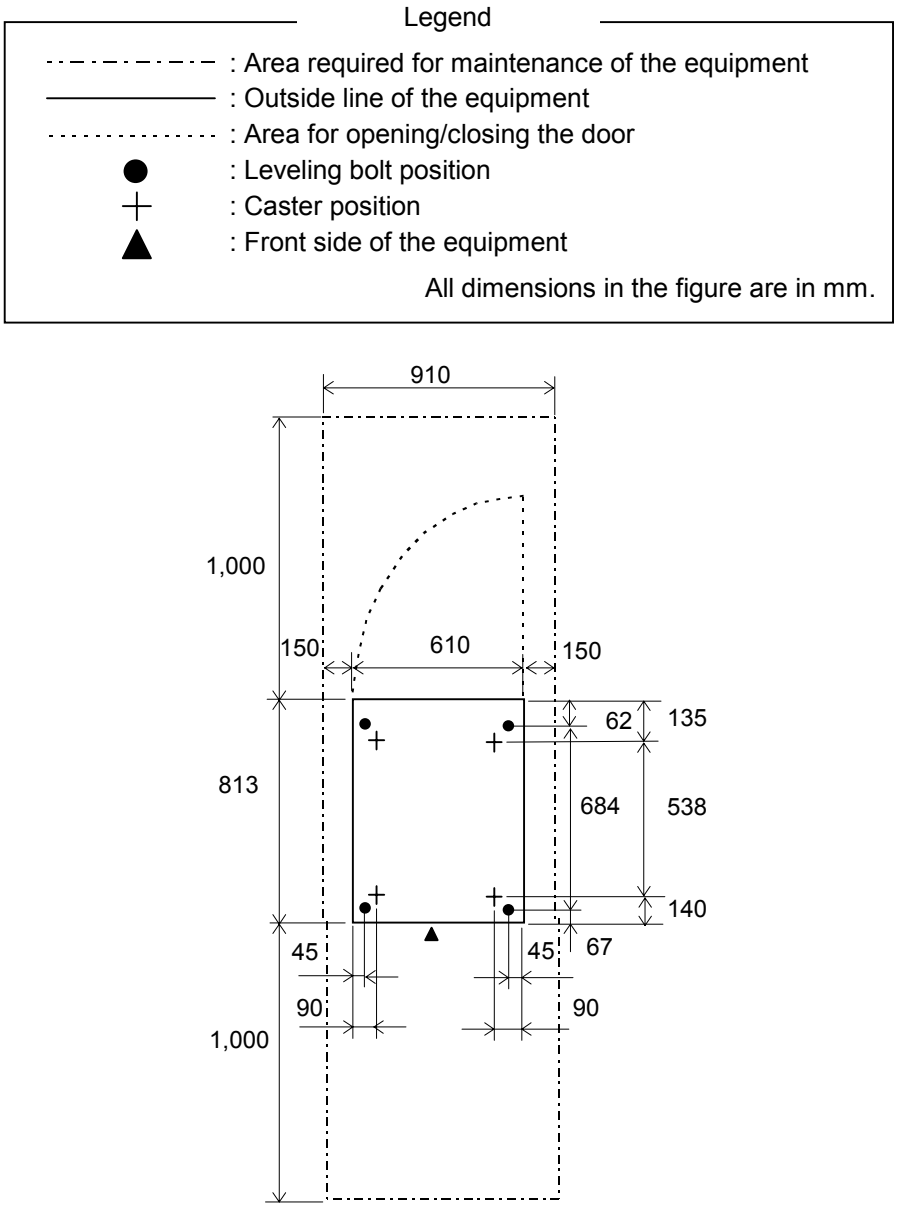
*4: Value of maximum configuration (in the case where all the mountable Disk drives and Controller are mounted).

*5: Can be mounted on the Hitachi special rack frame (U6). For the mounting, special rails for the rack frame and decoration panel(s) are required separately, depending on the number of the mounted subsystem(s).

*6: Can be mounted on the Hitachi special rack frame (U4). For the mounting, special rails for the rack frame are required separately, depending on the number of the mounted subsystem(s).

3.3 Service Clearance Requirements

The following figure shows the floor area required for installing the equipment. Be sure to install the equipment in a place with the area shown in the figure so as to avoid problems such as inadequate service clearance or insufficient ventilation. All distances in the following figure are stated in millimeters (mm).



3.4 Floor Load Rating

This section includes:

- Floor Load Rating for the 9200 Controller with 1 Disk Array
- Floor Load Rating for the 9200 Controller with 9 Additional RKA Units

3.4.1 Floor Load Rating for 9200 Controller with 1 Disk Array

The basic 9200 RKA unit will always contain at least one controller and the minimum number (2) of disks necessary to operate the disk array. The RK unit can contain a maximum of two controllers and 10 disk drives. To assure adequate load-bearing capacity, plan for the maximum configuration of the RK unit. In the maximum configuration the RK unit will weigh 70 kg (155 lbs.)

Each RKA disk cabinet can add a maximum of 40 kg (88 lbs) to the weight of the disk array subsystem.

3.4.2 Floor Load Rating for 9200 Controller with 9 additional RKA units.

The maximum configuration of the 9200 disk array includes one RK unit and 9 RKA units. The total weight of the subsystem in this configuration is 430 kg (950 lbs)

3.5 Cable Requirements

The following table lists the cables required for the 9200 control frame. ESCON® and fibre-channel cables are available from Hitachi Data Systems.

Table 3.2 Cable Requirements

Cable	Function
Fibre Cables	Connects Open Systems to 9200 ports. Fibre cable type is 50 micron multimode.
RS232 Null-Modem Cable - DB9-DB9	Resource Manager 9200 (crossover cable for direct connect to 9200)
Crossover LAN Cable – RJ45	UTP Unshielded Twisted Pair – RJ45 (crossover cable)

3.6 Temperature and Humidity Requirements

Table 3.3 lists the temperature and humidity requirements for the 9200 subsystem. The recommended operational room temperature is 70–75°F (21–24°C). The recommended operational relative humidity is 50 to 55 percent.

Table 3.3 Environmental Specifications

Item	Condition					
	Operating *1		Non-operating *2		Shipping & Storage *3	
	Low	High	Low	High	Low	High
Temperature °F(°C)	50(10)	104(40)	14(-10)	122(50)	-22(-30)	140(60)
Relative Humidity (%) *4	8 - 80		8 - 90		8-90	
Max. Wet Bulb °F (°C)	84(29)		84(29)		84(29)	

*1. Environmental specification for operating condition should be satisfied before the disk subsystem is powered on. The maximum temperature of 90°F (32°C) should be strictly satisfied at the air inlet portion of the subsystem. The recommended temperature range is 70-75°F (21-24°C).
*2. This includes both packing and unpacking conditions unless otherwise specified.
*3. During shipping or storage, the product should be packed with factory packing.
*4. No condensation in and around the drive should be observed under any conditions.

3.7 General Specifications

The following table lists the general specifications for the 9200 disk array components. These data generally apply to both 60-Hz and 50-Hz subsystems.

Table 3.4 9200 Subsystem Power and Heat Output Specifications

Item \ Model		Rackmount model		
		RK		RKA
Input power specifications	Input voltage (V)	AC 100/200 (89 to 127/178 to 254)		
	Frequency (Hz)	50/60 ± 1		
	Number of phases, cabling	Single-phase with protective grounding		
	Steady-state current (*1) (A)	3.5×2/1.8×2 (When the one power supply is connected : (5.8/2.9))		2.8×2/1.4×2 (When the one power supply is connected : (4.4/2.2))
	Breaking current (A)	20.0		15.0
	Required power (*2)	Steady state (VA)	700 (When the one power supply is connected : (580))	550 (When the one power supply is connected : (450))
		Starting state (VA)	800 (When the one power supply is connected : (700))	650 (When the one power supply is connected : (550))
Heat Output		700W/2388 BTU		550W/1877 BTU
Cache specifications	Capacity (M bytes/CTL)	256 to 2,048 2x128 → 2x512/CTL		
	Control method	Read LRU /Write after		—
	Battery backup	Provided		—
	Backup duration (*3) (h)	48 h (When cache of 4,096 M bytes/subsystem is installed)		—

*1 : For the both systems, plan the facilities for supplying power to the subsystem according to the specifications for the single power supply because when a failure occurs, only the one power supply operates.

*2 : 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.

*3 :
- Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Disk drives by turning off the power normally, and prevents the battery charge from being wasted.
- When the subsustem enters the Cache Backup mode, a warning (lighting of the orange LED) informing of a voltage drop of the battery may be issued when the subsustem is started. It shows that the remaining capacity of the battery is not sufficient, and in this state, the subsustem operates disabling the Write Cache function automatically.
  When the battery is charged, the warning indication disappears, and the subsustem continues the operation enabling the Write Cache function.

The warning indication disappears within 24 hours at the latest. Even when the warning is being indicated, normal functional operation is assured although the operation is performed in the Write-Through mode and the R/W performance is lowered because the Write Cache function is disabled.

- If the subsustem is not energized for more than a month, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage. In this case, the battery must be energized more than 24 hours at least once a month, or store the subsustem with the switch of the battery turned off. Even when the switch is turned off, the battery discharges naturally. Even in this case, however, charge the battery once per three months for longer than 24 hours because spontaneous discharge is done.

3.8 Air Flow Requirements

The 9200 subsystem is air cooled. Air must enter the subsystem through the air flow intakes at the back of each RK/RKA unit and must be exhausted out of the front, so it is very important that the air intakes and outlets remain clear.

3.9 Vibration and Shock Tolerances

Table 3.5 lists the vibration and shock tolerance data for the 9200 subsystem. The 9200 can be subjected to vibration and shock up to these limits and still perform normally. The user should consider these requirements if installing the 9200 near large generators located on the floor above or below the 9200 subsystem. Generators or any other source of vibration, if not insulated or shock-mounted, can cause excessive vibration that may affect the subsystem.

Table 3.5 Vibration and Shock Tolerances

Condition	Operating	Nonoperating	Shipping or Storage
Vibration	.25G	.5 G	.5G
Shock	2G 10ms, half sine wave impact	5G 10ms, , half sine wave impact	8G 10ms, half sine wave impact

Chapter 4 Subsystem Architecture and Components

This chapter includes the following:

- Overview of the Rackmount (RK) and the Rackmount Additional (RKA) Unit
- Redundant Power Supplies
- Fibre Channel
- Array Frame
- Disk Array Groups
- Service Processor (SVP)

4.1 Overview of the Rackmount (RK) Unit and the Rackmount Additional (RKA) Unit

A configuration block diagram of the RK and RKA is shown below. Each of the RK and RKA can mount ten disk drives. The Disk drives can be assigned to data disk(s), parity disk(s) (mirror disk(s)) depending on the RAID level. The RK is equipped with a controller which allows the attachment of up to 9 additional RKA units for a total of 100 drives.

Up to five Spare disks can be mounted in any locations within the configuration. The following figures show the configuration block diagrams of the RK and RKA respectively.

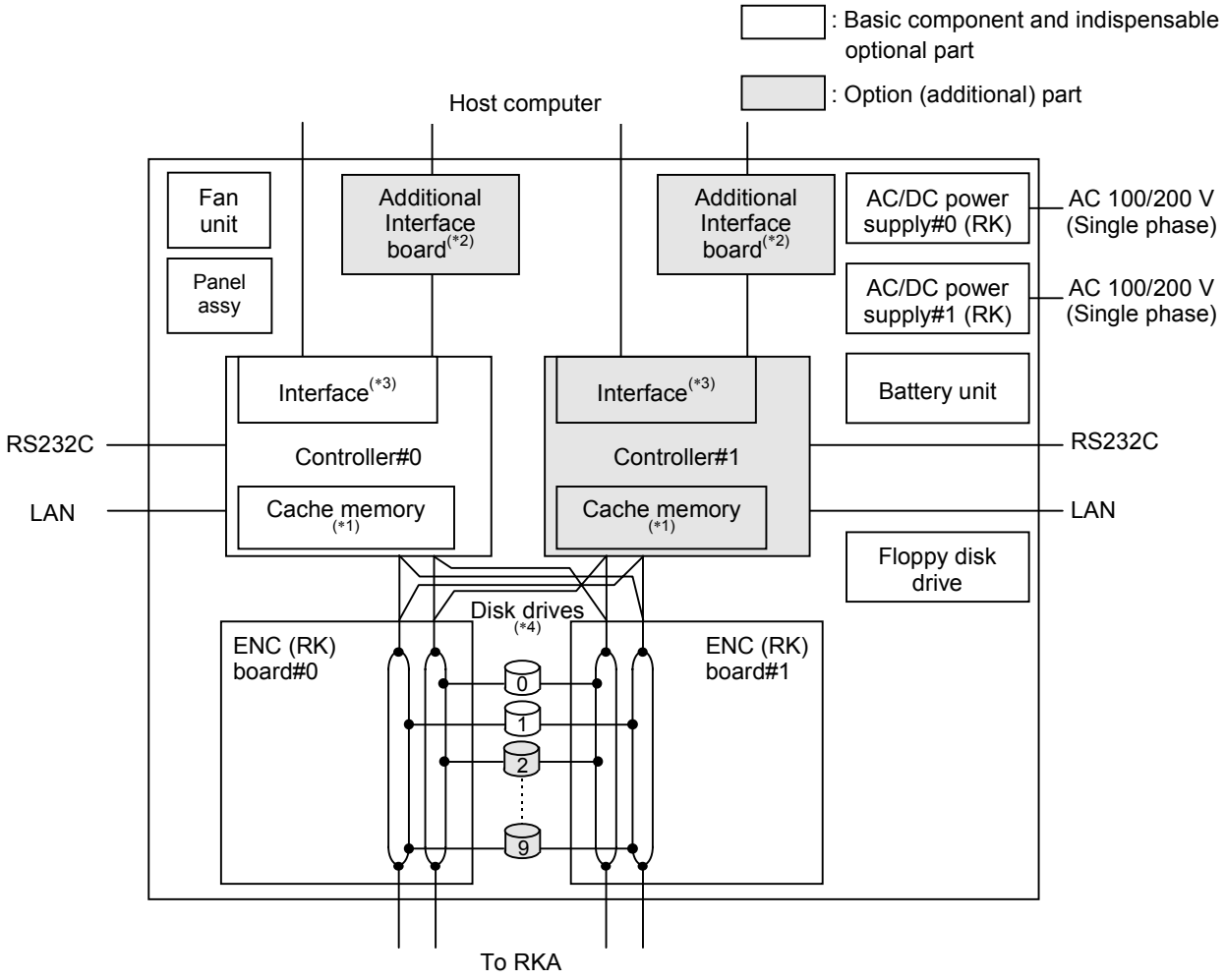


Figure 4.1 RK Unit

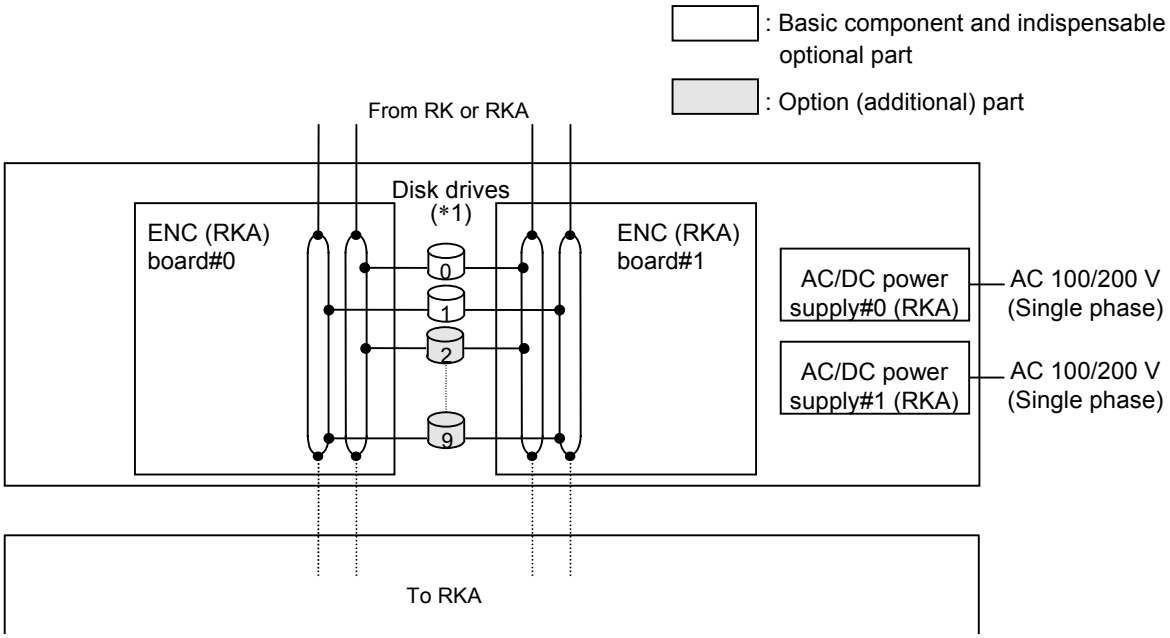


Figure 4.2 RKA Unit

4.2 Redundant Power Supplies

Each 9200 unit is powered by its own set of redundant power supplies, and each power supply is able to provide power for the entire RK or RKA unit, should it become necessary. Because of this redundancy, the 9200 subsystem can sustain the loss of multiple power supplies and still continue operation. To make use of this capability, the two power supplies of each 9200 unit should be connected either to dual power sources or to different power panels, so if there is a power failure on one of the sources, the 9200 can continue full operations using power from the alternate source.

4.3 Fibre Channel

The 9200 supports open system operations and offers Fibre Channel connectivity. The 9200 supports up to 4 fibre-channel ports. The 9200 Fibre Channel interface is capable of operating at data transfer speeds of up to 100 MB/sec. The 9200 supports shortwave multimode optical cables. With these shortwave fibre cards, the 9200 subsystem can be located up to 500 meters (2750 feet) from the open-system host.

4.4 Array Frame

Each RK or RKA unit contains the physical disk drives, including the disk array groups and the dynamic spare disk drives. Each array frame has dual AC power plugs, which should be attached to two different power sources or power panels. The 9200 can be configured with 1 RK and up to 9 RKA units for a total of 100 disk drives at a maximum of 7.2 TBs RAID0.

Each disk drive can be replaced nondisruptively on site. The 9200 uses diagnostic techniques and background dynamic scrubbing that detect and correct disk errors. Dynamic sparing is invoked automatically if needed. For both RAID-5 and RAID-1 array groups, any spare disk drive can back up any other disk drive of the same capacity or smaller anywhere in the subsystem. The 9200 can be configured with a minimum of one and a maximum of five spare disk drives. (Contact your Hitachi Data Systems representative to determine your maximum allowable configuration) The Hi-Track® monitoring and reporting tool detects failed disk drives and notifies the Hitachi Data Systems Support Center automatically so that a service representative can be sent to replace the disk drive.

Note: The spare disk drives are used only as replacements and are not included in the storage capacity ratings of the subsystem.

Table 4.1 Disk Array General Specifications

Item \ Model			Rackmount model	
			RK	RKA
Confi-guration	Configuration		1 RK	1 RKA
	Subsystem appearance			
Disk drive used	Disk drive size (W×D×H) (mm)		Thin type: 101.6×146.1×25.4 Thick type: 101.6×146.1×41.5	
	Disk dia. (mm)		90	
	Data capacity (G byte)		35.7/71.6	
	Rotational speed (min^{-1})		10,000	
	Maximum mountable quantity (unit)		10	10
Host interface	Interface type		•Fibre Channel Optical (Non-OFC, 100-M5-SN-I) •Ultra-Wide single-ended/differential SCSI •Ultra_2-Wide low voltage differential (LVD) SCSI	
	Data transfer speed (i.e. maximum speed for transfer to host)		•100 M bytes/s (Fibre Channel) • 80 M bytes/s (Ultra_2-Wide SCSI) • 40 M bytes/s (Ultra-Wide SCSI)	
	Number of ports	Single controller	Fibre Channel :1 to 2 SCSI : 1	
		Dual controller	Fibre Channel : 2 to 4 SCSI : 2	
	Transferred block size (bytes)		512	

4.5 Disk Array Groups

The RAID group is the basic unit of storage capacity for the 9200. All disk drives in an RAID group must have the same logical capacity. The 9200 supports several different RAID levels.

A RAID-1 array group consists 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. The primary and secondary stripes are toggled back and forth across the physical disk drives for high performance.

4.6 Service Processor (SVP)

The 9200 is controlled by the service processor (SVP). The SVP is integrated into the controller frame and is accessed through the Resource Manager 9200 program and service utilities. The SVP enables Hitachi Data Systems representatives to configure, maintain, and upgrade the 9200 subsystem.

Note: The SVP does not have access to any user data stored on the 9200 subsystem.

Chapter 5 Functional and Operational Characteristics

This chapter includes a description of the following:

- New 9200 Features and Capabilities
- RAID Implementations
- Cache Management
- Logical Units
- Open System Features and Functions
- Data Management Features and Functions

5.1 New 9200 Features and Capabilities

The Hitachi Freedom 9200 subsystem offers the following new or improved features and capabilities, which distinguish the 9200 subsystem from the 5800 subsystem:

- Internal redundant Fibre Channel loops.
- 64 LUNs maximum/20 RAID groups.
- 36-GB and 72-GB Disk Drives.
- Up to 4 GB Cache/Subsystem Dual Controller.

5.2 RAID Implementations

RAID technology provides full fault-tolerance capability for the disk drives of the 9200 subsystem. The 9200 supports either RAID0, RAID1, RAID5 or an intermix. The cache management algorithms enable the 9200 to stage up to one full RAID stripe of data into cache ahead of the current access to allow subsequent access to be satisfied from cache at host channel transfer speeds.

- RAID5. A RAID5 array group normally consists of five disk drives (4D + 1P). Normally the enhanced RAID5 implementation in the 9200 subsystem will attempt to keep write data in cache until an entire stripe can be built, then writes the entire data stripe to the disk drives to minimize the write penalty incurred by standard RAID5 implementations.
- Three different RAID levels are available. RAID0 (striping), RAID0+1 (striped and mirrored and RAID5 (striping with parity). The 9200 currently allows RAID5 groups of from 2D + 1P to 15D + 1 P.

5.3 Cache Management

The 9200 subsystem places all read and write data in cache, and 100% of cache memory is available for read operations. The amount of fast-write data in cache is dynamically managed by the cache control algorithms to provide the optimum amount of read and write cache, depending on the workload read and write I/O characteristics.

5.4 Logical Units (LUs)

The 9200 supports up to 64 LUNs. Each LU is identified by fibre-channel port ID and LUN number.

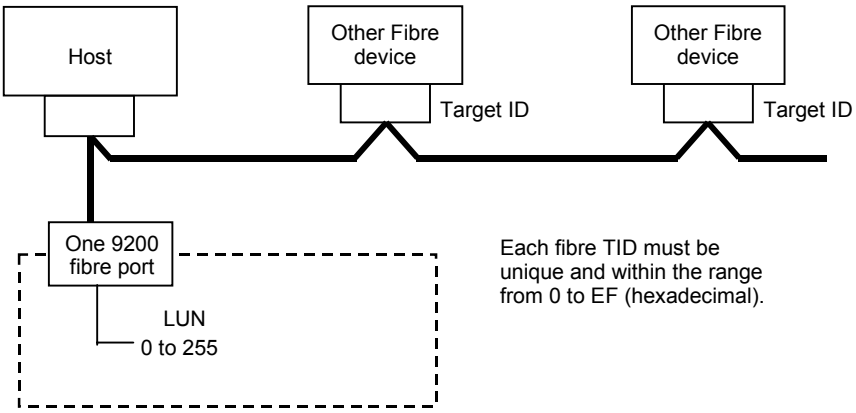


Figure 5.1 Logical Units

5.5 Open Systems Features and Functions

The 9200 subsystem offers many features and functions specifically for the open-systems environment. The 9200 subsystem also supports important open-system functions such as fibre-channel arbitrated-loop (FC-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.

5.5.1 Open Systems Middleware

Open-system middleware products provide host fail-over capability, I/O path fail-over support, and logical volume management in the open-systems environment. Middleware is not usually supplied as part of the basic operating system. Open-system vendors usually supply middleware as add-ons or value-added packages. For the latest information on middleware releases, availability, and compatibility, please contact your Hitachi Data Systems account team.

5.5.2 LUN Management

In the 9200, each LUN can be assigned to multiple fibre-channel ports to provide I/O path fail-over with the appropriate middleware support. The LUN mapping can be performed by the user using the Resource Manager 9200 array utility, or can be performed by Hitachi Data Systems Customer Service as a fee-based service.

5.6 Data Management Features and Functions

The 9200 subsystem provides features and functions, which increase data availability and improve data management. The following table lists the data management features that are available for the 9200. Please review the appropriate user's guide for more details.

Table 5.1 Software Features and Resource Manager 9200

Feature Name	Licensed Software Product	User's Guide
Flash Access	DF-F500-WLU	MK-90DF507
LUN Security	DF-F500-WSEC	MK-90DF508
Resource Manager 9200	0044-100190-01	MK-90DF506
Password Protection	DF-F500-WSEC (Included with 0044-100190-01)	MK-90DF528 (Included with MK-90DF506)

5.6.1 Overview of Flash Access

LUN cache residence is available with Resource Manager 9200. Product DF-F500-WLU provides the LUN cache residence (Flash Access) feature. Data stored on a cache-resident LUN is read into cache the first time it is accessed after a power cycle and remains in the 9200's onboard cache, available for rapid access. The data is only written back to magnetic storage when the disk array is turned off. In the event of an unexpected power failure, the cache battery will maintain the cache-resident LUN's integrity for up to 48 hours.

5.6.2 Overview of Password Protection

Password protection is available with the Resource Manager 9200 program. The DF-F500-WSPS product prevents users other than those authorized by the customer to access the management functions of the 9200. Protection is provided by passwords stored on the disk array itself. Up to 20 users and passwords are supported. For additional information, see the Password Protection User's Manual (MK-90DF528).

5.6.3 Overview of LUN Security

The optional LUN Security feature of the 9200 storage subsystem allows you to restrict LU accessibility to an open-systems host using the host's World Wide Name (WWN). You can set a LUN to communicate only with one or more (up to 128) specified WWNs, allowing you to limit access to that LUN to specified open-system host(s). This feature prevents other open-systems hosts from either seeing the secured LU or accessing the data contained on it. The Resource Manager 9200 management program provides the user interface to the optional LUN Security feature.

LUN Security can be activated on any installed Fibre Channel port and be turned on or off at the port level. If you disable LUN Security on a particular port, that LU will not be restricted to a particular host or group of hosts. If you enable LUN Security on a particular port, that port will be restricted to a particular host or group of hosts. You can assign a port to be accessible to up to 128 different WWNs and you can assign more than one WWN to each port. You can also change the WWN access for any port without disrupting the settings of that port.

Chapter 6 Configuring the 9200 Subsystem

This chapter includes the following:

- Overview of Configuration
- Configuring the LAN Interface of the 9200
- Configuring the 9200 Subsystem
- Registering the 9200 for Control by Resource Manager 9200
- Configure the 9200 for the Desired Application
- General Configuration of the 9200
- Starting the Parameter Wizard in Resource Manager 9200
- Configuring the Basic Setup Parameters for the 9200

6.1 Overview of Configuration

This section includes the following information on configuration:

- Open Systems Configuration
- Defining LUNs
- Fibre Addressing and LUN Mapping
- Alternate Pathing

6.1.1 Open Systems Configuration

After physical installation of the 9200 subsystem has been completed, the user configures the 9200 subsystem for open-system operations with assistance as needed from the Hitachi Data Systems Customer Service representative. For specific information and instructions on configuring the 9200 devices for open-system operations, please refer to the 9200 configuration guide for the specific open-system platform, as shown in the following table.

Table 6.1 Open System Configuration Guides for the 9200

Title	Document Number
AIX Configuration Guide	MK-90DF513
SGI IRIX Configuration Guide	MK-90DF517
HP-UX Configuration Guide	MK-90DF516
Novell NetWare Configuration Guide	MK-90DF518
SUN Solaris Configuration Guide	MK-90DF514
Windows NT Configuration Guide	MK-90DF521
Windows 2000 Configuration Guide	MK-90DF515
Sequent Dynix/PTX Configuration Guide	MK-90DF518

6.1.2 Defining LUNs

The Resource Manager 9200 software enables the user to define the LUN mapping for each device and reconfigure the mapping at any time. Using LUN Manager, the user can also set each fibre port to the correct host mode for the connected platform. If desired, Hitachi Data Systems Customer Service can configure the LUN mapping as a fee-based service. For further information on Resource Manager 9200, please refer to the 9200 Resource Manager 9200 User's Guide (MK-90DF506), or contact your Hitachi Data Systems account team.

6.1.3 Fibre Addressing and LUN Mapping

The 9200 subsystem supports a maximum of 4 fibre-channel ports. Each fibre-channel port is assigned a unique target ID number (from 0 to EF). The 9200 can address up to 64 LUNs per port. The following figure illustrates fibre port-to-LUN addressing.

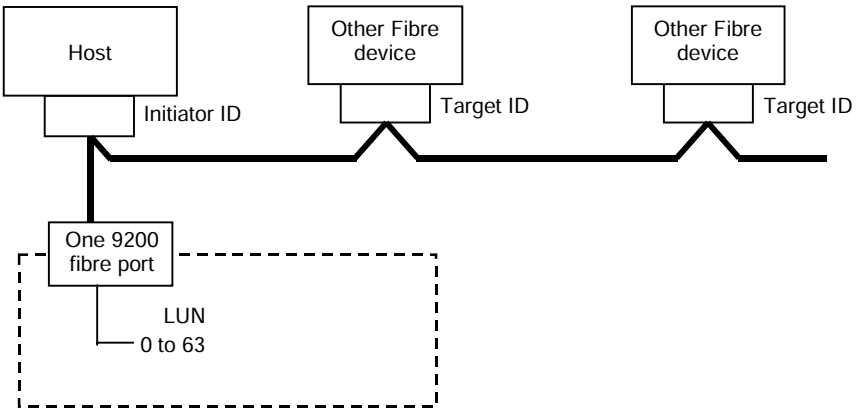


Figure 6.1 Fibre Port-to-LUN Addressing

6.1.4 Alternate Pathing

The user should plan for alternate pathing to ensure the highest data availability. In the open-system environment, alternate pathing can be achieved by host fail-over and/or I/O path fail-over middleware. The 9200 provides up to 4 Fibre ports or 2 SCSI ports to accommodate alternate pathing for host attachment. The following figure shows a sample of alternate pathing. The LUNs can be mapped for access from multiple ports and/or multiple target IDs. The number of connected hosts is limited only by the number of fibre-channel ports installed and the requirement for alternate pathing within each host. The 9200 supports many industry-standard host fail-over and I/O path fail-over middleware products. If possible attach the alternate path(s) to different controllers than the primary path.

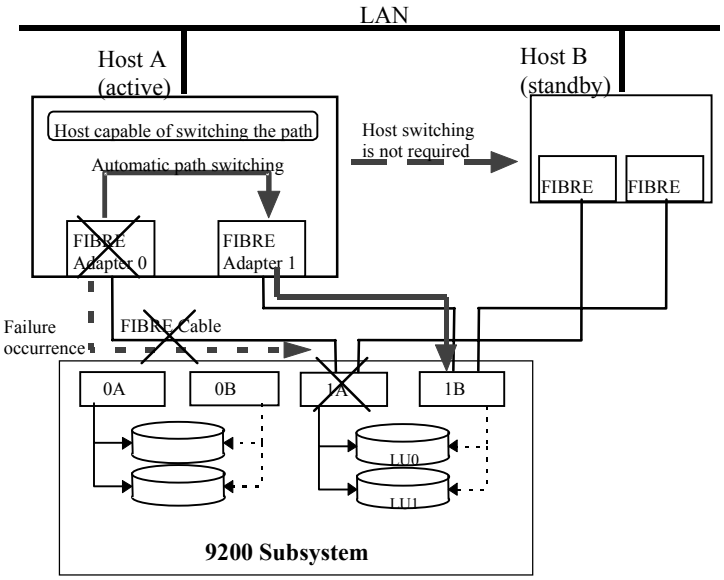


Figure 6.2 Alternate Pathing

6.2 Configuring the LAN Interfaces of the 9200

Set the IP Address by using a combination of the arp and ping commands built into Windows 95, 98 and NT. Each controller is shipped with a default IP address of 192.168.0.16 and netmask of 255.255.255.0. The IP address can be set to the customer's preferred value either through the use of the Resource Manager 9200 program or by changing the network interfaces address resolution protocol response using the following procedure.

If you wish to use Resource Manager 9200 to configure the IP addresses, refer to the Resource Manager 9200 manual (MK-90DF506).

Note: Do this work after an array unit becomes Ready.

- Only the IP Address can be set using this procedure. All other network parameters must be set using Resource Manager 9200.
- The IP Address can only be set using this procedure when the IP Address of the device is set to the factory default value (192.168.0.16) to prevent unauthorized changes of IP address.
- This procedure will only work from a PC that is located on the same LAN segment as the disk array. No device with it's own ARP table (router, etc) can be located between the PC and the disk array.

1. Execute the command below following the MS-DOS prompt of the Windows PC connected to the same network segment to which the subsystem is connected:

```
arp  -s  IP address  Physical address
ping  IP address
```

- IP address = The IP Address that the interface should be set to.
- Physical address = The physical address of the controller's ethernet interface is on a white label next to the ethernet port on the 9200's controller labeled "ETHER ADDRESS." The physical address is a string of 6 two-digit pairs of numbers separated by colons. The Windows environment substitutes hyphens (-) for the colon character when configuring the ARP cache.

Example : To set a controller with a Physical Address of 00:00:87:12:34:56 to the IP Address 192.168.15.64, use the following command.

```
arp  -s  192.168.15.64  00-00-87-12-34-56
ping  192.168.15.64
```

2. If the message such as "Reply from 192.168.15.64····" comes back from the device, the IP Address has been set up successfully.
3. Once the IP address is set, power-cycle the disk array to make the change permanent.

6.3 Configuring the 9200 Subsystem

Once the 9200 is correctly configured on the LAN, the disk array must be configured to best conform to the customer's installation. The following steps must be performed to configure the disk array.

1. Install Resource Manager 9200 on the system that will be used as the management PC/Server.
2. See the Resource Manager 9200 User's Guide section titled "Installing Resource Manager 9200" for instructions on how to install the program.
3. Register the disk array for control by Resource Manager 9200.
4. Configure the 9200 for the desired application.
5. Reboot the disk array to complete the configuration.

6.4 Registering the 9200 for Control by Resource Manager 9200

1. Start Resource Manager 9200.
2. Press the "Add" button on the Resource Manager 9200 panel.
3. Assign a unique name for the array and type it into the "Name" field of the "Array Unit Registry" window.
4. Select the type of array that is being registered (i.e. "9200 dual").
5. If connecting through a LAN, leave the "Connection Mode" set to "LAN".
6. Set the appropriate IP addresses for each controller in the "IP Address" boxes at the bottom of the "Array Unit Registry" window.
7. Click OK to register the disk array for management by Resource Manager 9200.

   If the registration is successful, the display will show that the operation completed successfully and the main panel of Resource Manager 9200 will now contain an icon for the 9200 that was just added.

6.5 Configure the 9200 for the Desired Application

Make sure that you have a copy of the Host Install Guide for the platform that will be using the 9200 and the Resource Manager 9200 User's Manual (HDS part no. MK-90DF506)

Before configuring the 9200 make sure that you know the following:

- The required RAID level
- The number and size of LUNs you wish to create
- The controller path you wish to use to access the data on the LUNs

If there are any special options that need to be set that are specific to the host platform being used. These will be detailed in the Host Installation Manual for the host platform being used.

6.6 General Configuration of the 9200 Subsystem

Activating Management mode in Resource Manager 9200 will enable you to do a general configuration of the 9200 subsystem. Before it is possible to configure the 9200, management mode must be enabled in Resource Manager 9200. Otherwise, it is only possible to monitor the status of the 9200.

To enable Management mode:

1. Set a password for management mode in Resource Manager 9200.
2. Press the “password” button. A dialogue will open to allow the setting of a Management-mode password. Set and confirm a password, then close the dialogue.
3. To activate Management mode, press the “Change Mode” button on the Resource Manager 9200 panel and enter the password. The “Mode” indicator in Resource Manager 9200 should change to “Management.”

6.7 Starting the Parameter Wizard in Resource Manager 9200

1. Before setting the 9200’s parameters, insert a blank, DOS-Formatted diskette into the floppy drive of the 9200 subsystem. This diskette will be used to store the parameter settings for the 9200.
2. Highlight the icon for the 9200 storage system in the main panel.
3. Click the “Open” button on the Resource Manager 9200 main panel. The Manager Screen for the 9200 should open within 30 seconds.
4. From the Manager Screen, click the "Param Wizard" button. The Parameter Wizard should open withing 30 seconds.

6.8 Configuring the Basic Setup Parameters for the 9200.

Most of the references to the parameter wizard refer to a “Window number” – the window number will always be displayed in the upper right-hand corner of the Parameter Wizard window. In any window of the Resource Manager 9200 Parameter Wizard, if you are not sure what a parameter means, contact the HDS Global Support Center for clarification.

To configure the basic setup parameters for the 9200, follow these procedures:

1. Select “Standard Setup” in the introductory panel of the Parameter Wizard and continue to the next panel.
2. In window 1 of the Parameter Wizard “Controller 0/1 Common”, set the number of controllers and port options required for the host platform by the Host Install Guide. After these options are set, click “next” to continue.

3. In the next window, Window 3, also titled “Controller 0/1 Common” and subtitled “Option 1”, set any options required by the Host Install Guide and continue to the next window.
4. The next window, Window 4, also titled “Controller 0/1 Common” and subtitled “Option 2”, set any options required by the Host Install Guide and continue to the next window.
5. The next window, Window 5, configures LUN mapping for controller 0. At this point in the configuration process there are no LUNs to map, so continue to the next window.
6. Window 6 configures LUN mapping for controller 1, if controller 1 is present. At this point in the configuration process there are no LUNs to map. Click OK to finish the parameter setting and exit the Parameter Wizard. The disk array will reboot upon exiting the Parameter Wizard after writing the new parameters to nonvolatile storage.

Note: If no changes are made, cancel out of the Parameter Wizard. The 9200 subsystem does not reboot.

Chapter 7 Configuring Storage on the 9200 Subsystem

The process of configuring storage on the 9200 subsystem involves the following sub-processes:

- Determining Space and RAID Level Requirements
- Setting Aside Spare Disks
- Configuring RAID Groups
- Configuring LUNs Within a RAID Group
- Mapping the LUNs to Ports, Target IDs, and LUN Numbers (Optional)
- Transferring Configurations from One Array to Another (Optional)
- Storing Configuration Data
- Applying Configuration Data to Another 9200 Subsystem

7.1 Determining Space and RAID Level Requirements

This process will depend on the customer requirements, however Hitachi Data Systems recommends certain configuration guidelines that will provide good performance and adequate protection of data integrity in most circumstances.

Note: RAID groups should normally be configured as RAID level 5 and be spread across as many disks as possible per RK/RKA Unit, leaving room for at least one spare. One or two LUNs per RAID group is usually optimal. If more LUNs are required, bear in mind that the 9200 supports a maximum of 64 LUNs per subsystem.

7.2 Setting Aside Spare Disks

Choose up to 5 disks per subsystem to use as spare disks. In normal circumstances, one or two spare disks per subsystem will be sufficient. Since RAID groups must be made up of consecutive disks, spare disks must not be placed between two disks that are in the same RAID group.

Once a disk is selected to be used as a spare, use Resource Manager 9200 to set the disk as a spare.

7.2.1 Setting a Spare Disk

1. Click the [Parameters] button of the unit window. Subsequently, click the [Spare Drive] tab.
2. Click the disk drive set for a spare disk.
3. When a confirmation window of spare disk setting appears. Click the [OK] button.
4. On the unit window, click the [Device Configuration] button. Subsequently, a spare disk can be checked when the [Spare Drive] tab is in the clicked state.

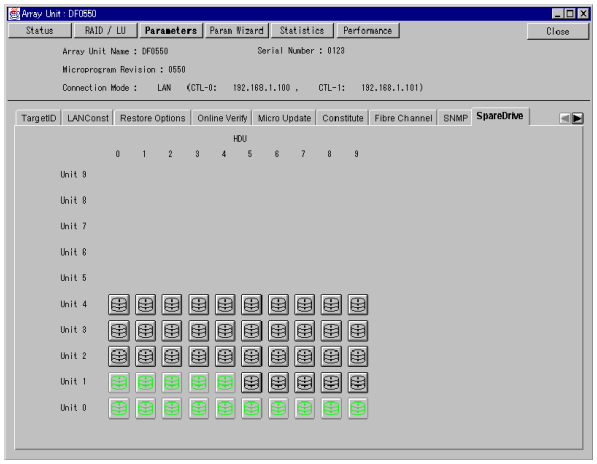


Figure 7.1 Manager Screen (70)

Figure 7.2 Manager Screen (71)

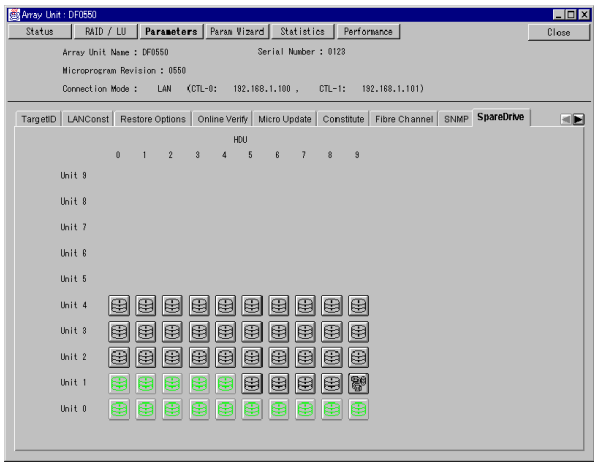


Figure 7.3 Manager Screen (72)

7.3 Configuring RAID Groups

To set the RAID group, follow these procedures:

1. Click “RAID/LU” button and select the “RG Configuration” tab.
2. Click and hold the icon that represents the disk that will be the first unit in the new RAID group to be set from the menu. The icon will be highlighted in white.
3. Drag the highlighted icon to the icon representing the last disk to be included in the RAID group.
4. The range of selected disk drives will be displayed in a rectangular box.
5. Click the “Create RG” button.
6. Configure the RAID group for the selected range of disks. Select a RAID level, and set the number of Disk drives within a parity group and the number of parity groups. Finally, click the “OK” button.
7. When the confirmation window for the RAID setting appears. Click the “OK” button.
8. The new RAID group will be added to the displayed RAID groups.

   If a RAID group is found to be incorrectly configured, delete it and create a new one. See the Resource Manager 9200 user’s guide.

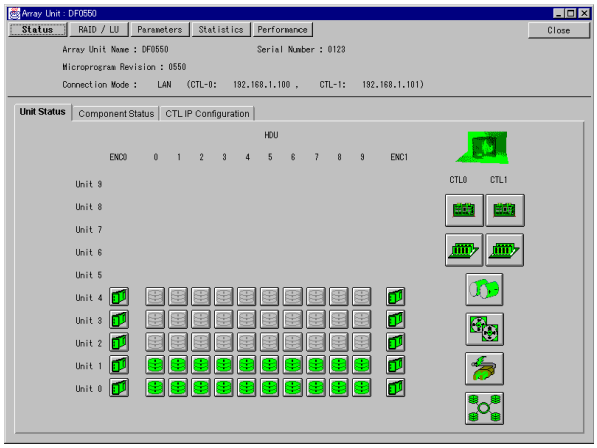


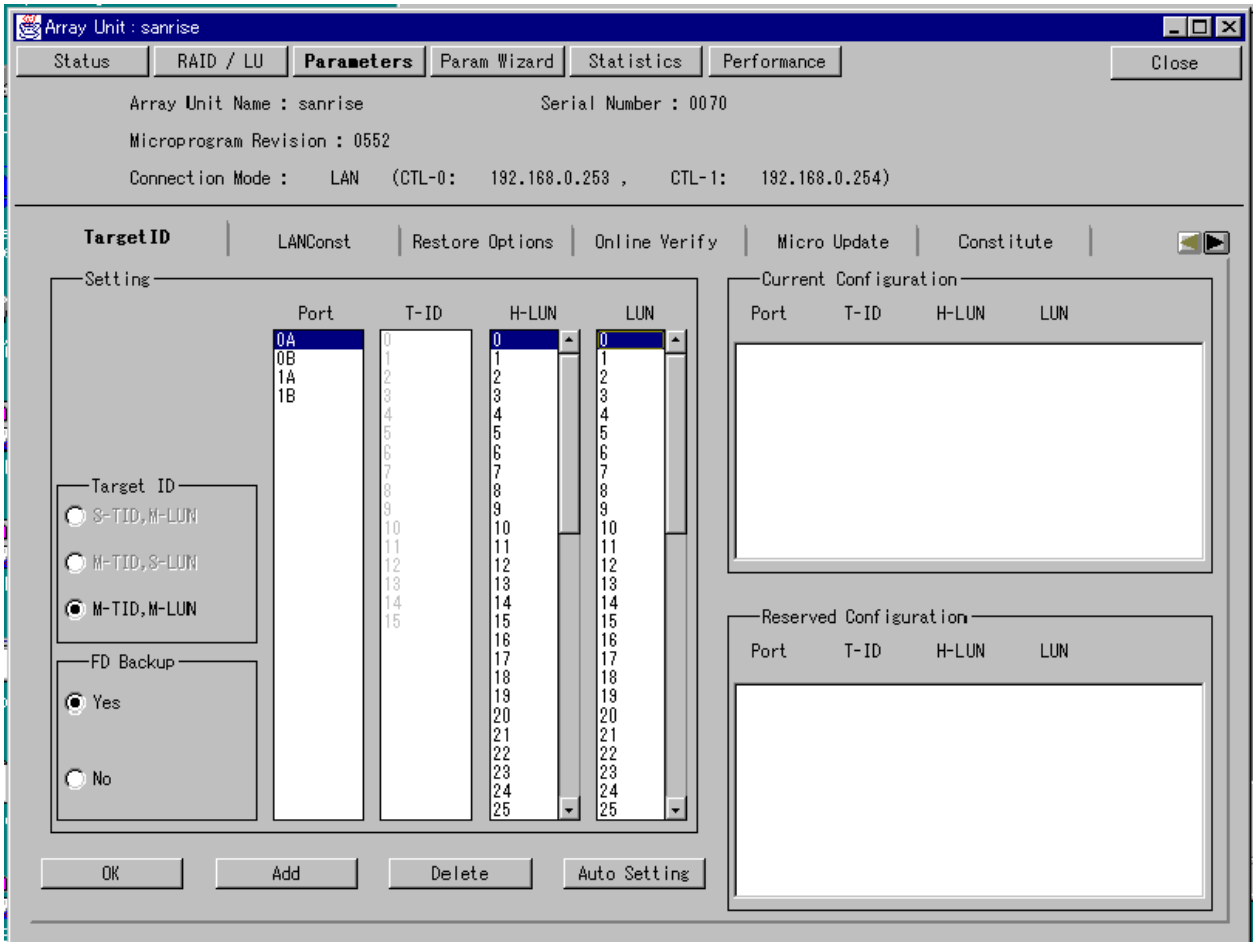
Figure 7.4 Manager Screen (22)

7.4 Configuring LUNs within a RAID group

1. Click the “RAID/LU” button in the status display of the 9200. Make sure that the Resource Manager 9200 program is in “Management” mode before attempting to create LUNs.
2. Select the “LU Configuration” tab
3. On the left-hand side of the screen there will be a list of all the RAID groups configured on the subsystem. Select one by clicking the mouse on the name of the RAID group you wish to install new LUNs to. The name of the RAID group will be highlighted in blue.
4. Click the “Create” button. The “LU Creation” dialog box will open.
5. In the “Number of Blocks Allocated” field, specify either a number of blocks or that the LU to be created should take up the remainder of the RAID group. (2 blocks = 1024 bytes). If you wish to use the remainder of the space in the RAID group, select “All Data to the Extent of the RAID Group.” The number of blocks remaining unallocated in the RAID group will be displayed in the “RG Rest Capacity” field.
6. Select whether the LUN is to be owned by Controller 0 or Controller 1. A LUN should normally be accessed through the controller that owns it. For more details on the LUN ownership model and for assistance in planning multi-path access schemes (Path or Host Failover) contact the HDS Global Support Center.
7. After selecting the parameters for the LUN, click on OK in the “LU Creation” dialog box, then confirm that you wish to create the LUN.
8. The new LUN will appear in the “LU Configuration” panel with its status set to Unformatted. Before the LUN can be used it must be formatted.
9. To format the new LUN, highlight the LUN in the selection click “Format (Multiple)” button and confirm that you wish to format the LUN.
10. When the format is complete, there will be a dialogue box displayed showing the the format has terminated. Click OK, verify that the format terminated successfully in the “Result” box, then click OK to close the results box.
11. The LUN is now ready for use.

7.5 Mapping the LUNs to Ports, Target Ids, and LUN Numbers

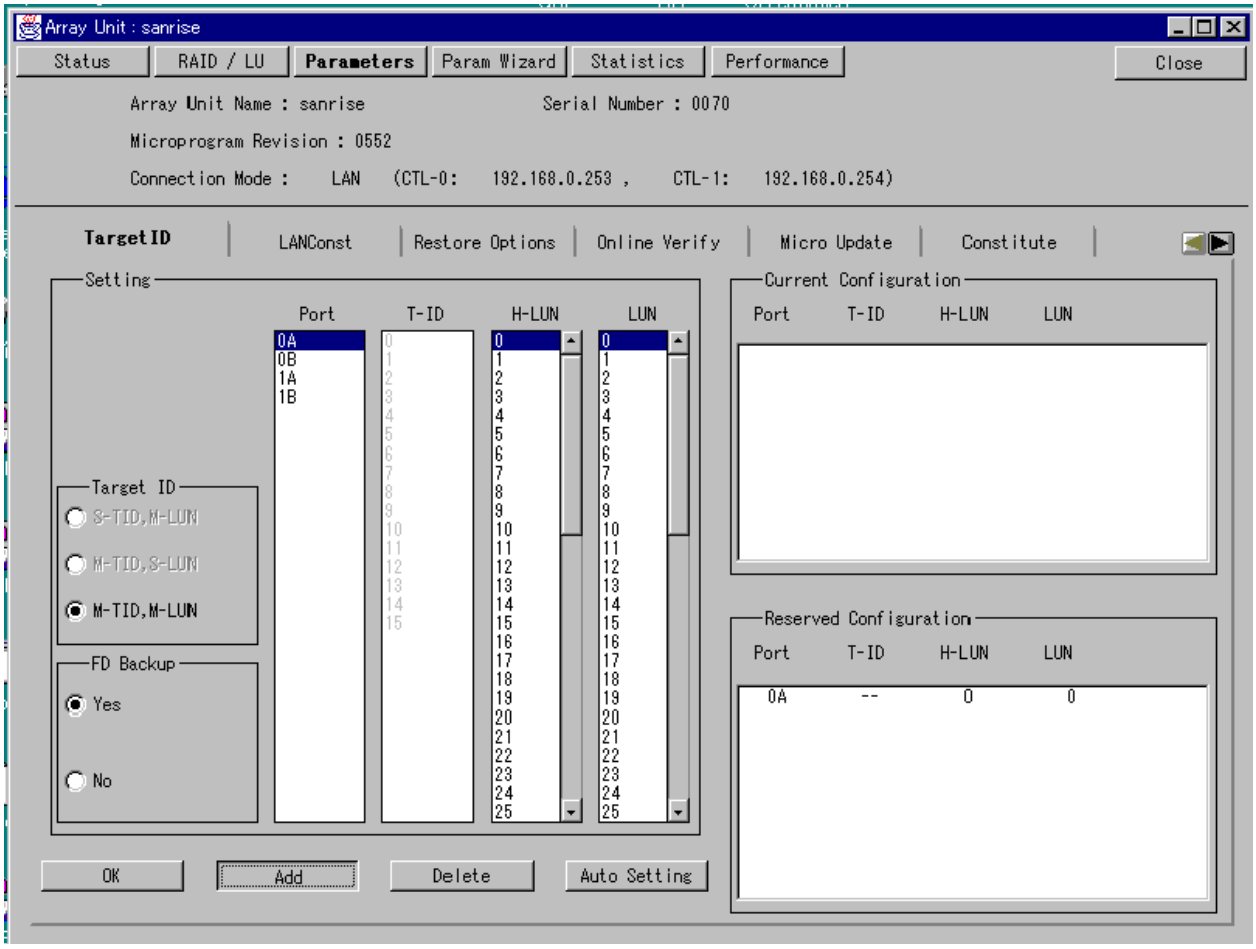
If the array will be configured so that all LUNs are not visible through all ports, the LUN mapping feature is required. LUN mapping allows the user to make LUNs accessible through an arbitrarily assigned port, using a user-selectable LUN number. This process must take place in management mode and must be performed using Resource Manager 9200.



To begin the process of mapping a LUN:

1. Click the “Parameters” button from the management screen of Resource Manager 9200.
2. Select the “Target ID” tab.
3. Select the “M-TID, M-LUN” radio button in the “Target ID” box.

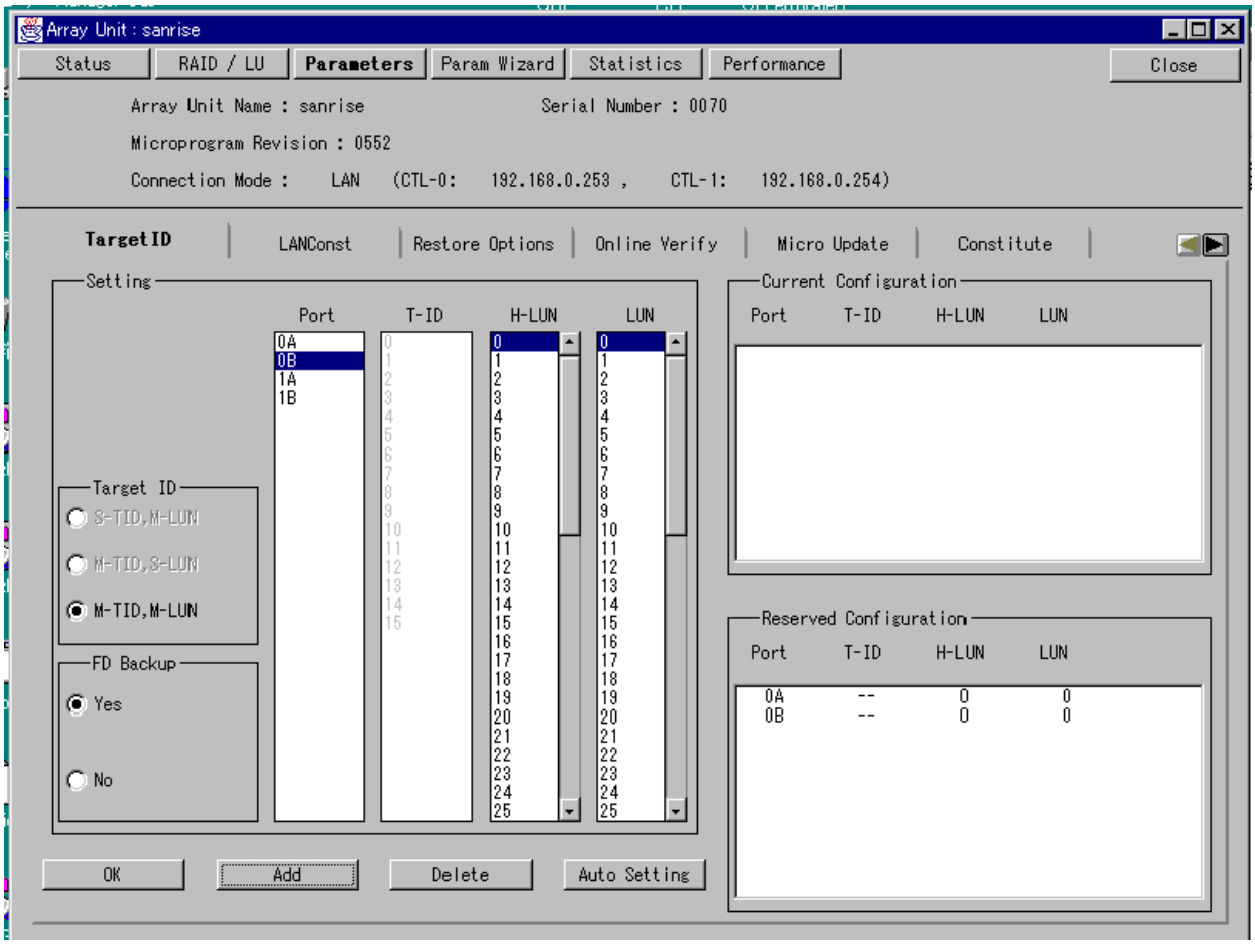
   Once LUN mapping is enabled for a 9200 subsystem, only LUNs that have been mapped will be accessible. Insert a floppy disk to back up the data that will be changed in this process.



4. Select a LUN to be mapped and which a port that the LUN should be presented through.

   The LUN number is the LUN number inside the 9200. The H-LUN number is the LUN number that the host will see at the Host Bus Adapter. When configuring H-LUN numbers, be sure to consult the appropriate Host Install Guide. Many host platforms have limitations on LUN numbering and sequencing that must be observed while configuring LUN mapping.

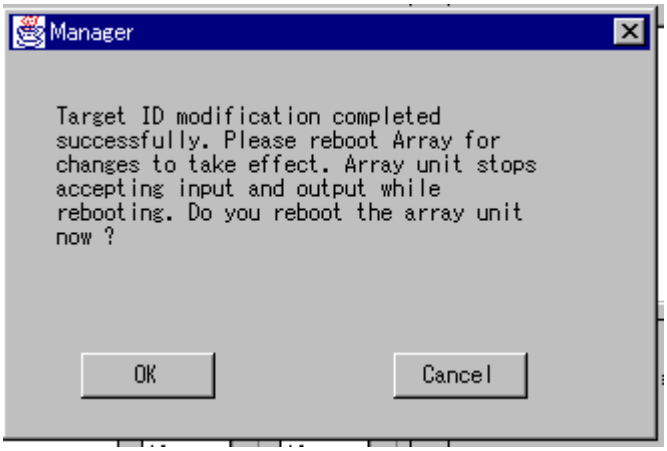
Any LUN can be configured to be visible through more than one port. The following example shows how to map LUN 0 to an additional port.



LUN 0, which in the previous example was configured only to interface 0A, can now also be accessed through interface 0B. Through both interfaces, it is seen as LUN 0, though any other LUN number could have been selected from the “H-LUN” column.

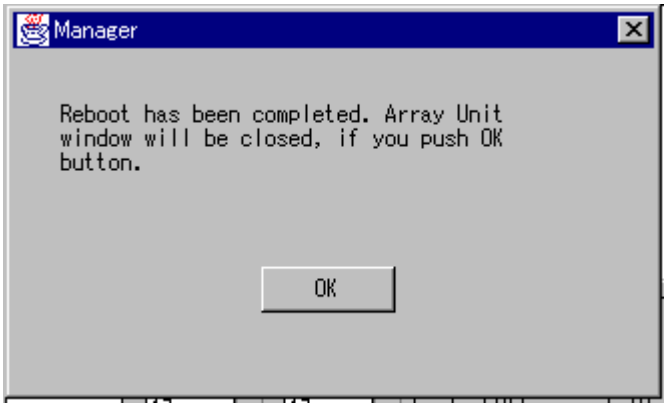
5. In order to permanently install the mappings into the 9200, click the “OK” button after selecting all the desired LUN mappings.

The final setting of the LUN mappings will require a reboot of the 9200. After clicking the "OK" button in the Target ID setting screen, this warning box will appear:



This warning is your last opportunity to avoid rebooting the array. If you click "OK" at this point, the LUN mapping operation will be finalized and the array will be rebooted. Click "Cancel" if you don't want this to happen.

If you click "OK", the 9200 will reboot. When it comes back up, click the "OK" button on this requester to close the manager screen for the 9200 :



7.6 Transferring Configurations from One Array to Another

Resource Manager 9200 offers the capability of saving the RAID group and LUN configuration from one 9200 disk array to a file and applying those configurations to another array. This may prove useful if the customer needs to set up multiple identically-configured disk arrays or needs to store disk array configurations in case they should ever need to be restored.

For more details on this process consult the Resource Manager 9200 User's Guide.

7.7 Storing Configuration Data

1. Starting from the management screen in Resource Manager 9200 for the 9200, click the "Parameter" button and select the "Constitute" tab. There are two radio buttons in this panel. Each represents a different type of configuration data. Both must be saved to completely move the configuration data from one disk array to another. The files must be saved one at a time.
2. For both types of parameters (System Parameters and RAID/LU configuration), select the type of parameters to be saved using the appropriate radio button.
3. Select the "File" button to bring up a file selector.
4. Pick a name for the configuration file and save the file to disk by clicking the "Export" button.

7.8 Applying Configuration Data to Another 9200 Subsystem

To apply configuration data to another 9200 subsystem:

1. From the management screen in Resource Manager 9200 for the 9200, click the "Parameter" button and select the "Constitute" tab. There are two radio buttons in this panel. Each represents a different type of configuration data. Both must be restored to completely move the configuration from one disk array to another. The files must be restored one at a time.

Note: System parameters should be restored first, if they are to be restored from another system. Please exercise caution when restoring system parameters.

1. For each type of parameter file that is to be restored, select the type of parameters to be restored using the appropriate radio button.
2. Click the "File" button to bring up a file selector to choose the parameter file that is to be restored.
3. Apply the parameter file to the target 9200 by clicking the "Import" button.

Ensure that the configuration is to be applied to the target disk array. This is the last opportunity to cancel this operation.

After confirming the RAID/LU settings, the disk array will automatically configure RAID groups and LUNs, format the LUNs, and set up target IDs and LUN mappings to match the settings of the 9200 that provided the settings file.

Chapter 8 Troubleshooting

The Hitachi Freedom Storage™ Thunder 9200™ subsystem provides high data availability and is not expected to fail in any way that would prevent access to user data. The READY and POWER LEDs on the 9200 control panel must be **ON** when the subsystem is operating online. If you are unable to resolve an error condition, please ask your Hitachi Data Systems Customer Service representative for help, or call the Hitachi Data Systems Support Center for assistance.

Table 8.1 Troubleshooting

Error Condition	Recommended Action
Warning light lit.	Check the status panel of Resource Manager 9200 to see if there are any parts displayed
General power failure.	Turn off power to rack that the subsystem(s) is/are mounted in to prevent damage caused by power surges when power is restored. After power has been restored and is no longer fluctuating, power on the 9200.
READY LED does not go on, or there is no power supplied.	Call the Hitachi Data Systems Support Center for assistance. ***WARNING***: Do not open the 9200 front cover or touch any of the controls unless instructed by the Hitachi Data Systems Support Center.
Emergency (fire, earthquake, flood, etc.)	Pull the emergency power-off (EPO) switch. You must call the Hitachi Data Systems Support Center to have the EPO switch reset.
ALARM LED is on.	Call the Hitachi Data Systems Support Center for assistance. Notify the support center that the alarm LED on the disk array is lit. Normally this means that data on the disk array is not accessible.

8.1 Error and Failure Alerts

The 9200 generates error messages which are visible in the Resource Manager 9200 program to notify the user of problems with components of the subsystem. When a error alert is generated, the amber warning LED on the front panel turns on as an additional alert for the user as well as sounding a high pitched whistle. The optional Hi-Track® remote maintenance tool also reports all error messages to the Hitachi Data Systems Support Center.

If the amber warning LED on the 9200 turns on, check the Resource Manager 9200 screen to determine which component of the 9200 is causing the alarm condition and notify the Hitachi Data Systems Support Center.

8.2 Calling the Hitachi Data Systems Support Center

If you need to call the Hitachi Data Systems Support Center, provide as much information about the problem as possible, including the circumstances surrounding the error or failure, the exact content of any messages displayed at the mainframe, and/or open-system host console, and the severity levels and reference codes. The worldwide Hitachi Data Systems Support Centers are:

- Hitachi Data Systems North America/Latin America
  San Diego, California, USA
  1-800-348-4357
- Hitachi Data Systems Europe
  Buckinghamshire, United Kingdom
  011-44-175-361-8000
- Hitachi Data Systems Asia Pacific
  North Ryde, Australia
  011-61-2-9325-3300

Appendix A Glossary

Cache backup :

Because a cache memory uses DRAM, information stored in it is lost when the subsystem power is shut off. To provide against unexpected power failure, the subsystem has an setup to maintain data in the cache memory by batteries. Cache backup is a state in which the data is protected by the batteries.

Canister :

A mechanical part for mounting disk drives in order to allow the disk drives to be installed/ removed in/from the subsystem easily.

CTL : Controller

CUDG : Control Unit Diagnosis

Destage:

To automatically write data in the cache memory, which has not been written on the disk drive yet, on the disk drive when the main switch is turned off.

ECC : Error Checking and Correcting

EIA : Electronic Industries Alliance

EIA standard 1 EIA unit = 44.45 mm

FC-AL : Fibre Channel Arbitrated Loop

Fibre Channel HBA : Fibre Channel Host bus Adapter

Fibre Channel HUB :

An apparatus to connect and relay Fibre Channel cables each connected to a Fibre Channel device in order to form an arbitrated loop of the Fibre Channel.

FC-SW : Fibre Channel-SWitch Topology

GBIC : GigaBit Interface Converter

Host computer :

A computer which manages devices. In the case of the disk array, a computer which makes the disk array store data is applicable to the term.

Hot replacement :

To replace an installed part with the subsystem power on. Usually, the major part is duplicated so that when one of the parts fails, the subsystem function is maintained by another part.

I/F : Interface

LA : Logical Address

LBA : Logical Block Address

LED : Light Emission Diode

LRC : Longitudinal Redundancy Check

LU : Logical Unit

LVD : Low Voltage Differential

Mirror disk :

This is a slave disk which contains an exact copy of a master disk in RAID1 configurations. When a failure occurs in the master disk drive, reading/writing is done from/on the mirror disk.

MTBF : Mean Time Between Failure

MTBDL : Mean Time Between Data Lost

PDB : Power Distribution Box

PDU : Power Distribution Unit

Rack frame:

A frame on which electronic equipment are mounted like a bookshelf using rails, etc. Most of them have a width of 19 inches, and called 19-inch rack frame. Height of the equipment to be mounted is regulated by the EIA standard (1 EIA unit = 44.45 mm). The rack frame has screw holes to fasten equipment with bolts, etc.

RAID : Redundant Array of Independent (Inexpensive) Disks

The RAID technology, which was proposed by a research group in the University of California at Berkeley in 1987, is to realize high-speed, large capacity, and highly reliable storage device by scattering accesses using several disk drives. RAID levels proposed by the University of California are classified into six levels, that is, RAID 0 to RAID 5, and they are selected according to user's demand taking their costs and speeds in consideration.

Remote maintenance function (SNMP) :

SNMP agents an occurrence of a failure to the workstation for monitoring the network via the SNMP of the open platform.

R/W : Read/Write

SGCB : Segment Control Block

SNMP : Simple Network Management Protocol

Spare disk :

A disk drive installed separately from disk drives used for usual reading and writing. When one of the latter disk drives fails, the subsystem keeps in service as before by copying data stored in the failed disk drive to the spare disk drive.

UPS : Uninterrupted Power Supply

Write cache :

When data is written from a host computer onto a disk array subsystem, it is not written directly on the disk drive but written on a cache memory. In this way, the disk array subsystem can return a writing completion report promptly. This writing method using a cache memory is called write cache.

Appendix B Unit Conversions

Table B.1 provides unit conversions for the standard (US) and metric measurement systems.

Table B.1 Unit Conversions for Standard (US) and Metric Measures

From	Multiply By:	To Get:
British thermal units (BTU)	0.251996	Kilocalories (kcal)
British thermal units (BTU)	0.000293018	Kilowatts (kW)
Inches (in)	2.54000508	Centimeters (cm)
Feet (ft)	0.3048006096	Meters (m)
Square feet (ft2)	0.09290341	Square meters (m2)
Cubic feet per minute (ft3/min)	0.028317016	Cubic meters per minute (m3/min)
Pound (lb)	0.4535924277	Kilogram (kg)
Kilocalories (kcal)	3.96832	British thermal units (BTU)
Kilocalories (kcal)	$1.16279 \times 10\text{-}3$	Kilowatts (kW)
Kilowatts (kW)	3412.08	British thermal units (BTU)
Kilowatts (kW)	859.828	Kilocalories (kcal)
Millimeters (mm)	0.03937	Inches (in)
Centimeters (cm)	0.3937	Inches (in)
Meters (m)	39.369996	Inches (in)
Meters (m)	3.280833	Feet (ft)
Square meters (m2)	10.76387	Square feet (ft2)
Cubic meters per minute (m3/min)	35.314445	Cubic feet per minute (ft3/min)
Kilograms (kg)	2.2046	Pounds (lb)
Ton (refrigerated)	12,000	BTUs per hour (BTU/hr)

Index

A

Air Flow Requirements, 17
Array Frame, 22

C

Cable Requirements, 14
Cache Management, 26
Channels, 21
Clearance Requirements, 13
command tag queuing, 26
Configuration
  Alternate Pathing, 32
  Defining LUNs, 30
  Fibre Addressing, 31
  LAN Interfaces, 33
  LUN Mapping, 31
  Open Systems, 30
  Setup Parameters, 35
  Storage, 37–45
Connectivity, 8

D

Data Accessibility, 9
Data Management, 27
Dimensions, 12
Disk Array Groups, 23

E

Emergency Precautions, 4
  Electric Shock, 4
  Fire, 4
Error Reporting, 10

F

Fibre Channel, 21
Flash Access, 27
Floor Load Rating, 13–14

G

Glossary, 49
GRAPH-Track, 11

H

Hitachi Data Systems Support Center, 48
Hi-Track, 10
HMDE, 11

I

Intermix, 25

L

Logical Units, 26
LUN Management, 27
LUN Manager, 27
LUN Security, 28
LUNs, 26, 30, 31
LUNs Within a RAID Group
  Configuring, 40

M

Mapping, 40–44
Middleware, 26

O

Open system
  Open system configuration manuals, 30
Open Systems, 8
  Configuration, 30
  Features and Functions, 26
  Middleware, 26

P

Password Protection, 27
Power Supplies, 21

R

Rackmount (RK) Unit, 20
Rackmount Additional (RKA) Unit, 19
Rackmount Additonal (RKA) Unit, 21
RAID Groups
  Configuring, 39
RAID Implementations, 25
RAID-5, 25

Resource Manager 9200, 34–36
General Configuration, 35
Installing Host Platforms, 34
Parameter Wizard, 35
Registering the 9200, 34

S

Safety Precautions, 1–6
Air Vents, 2
Battery Unit, 3
Cables, 2
Equipment, 2
Inspection and Cleaning, 3
Service Processor (SVP), 23
Spare Disk
Setting, 38
Storing Configuration Data, 45
Subsystem Scalability, 9

T

Temperature and Humidity Requirements, 15
Troubleshooting, 47
Error and Failure Alerts, 48

U

Unit Conversions, 53
Unit Conversions for Standard (US) and Metric Measures, 53

V

Vibration, 17

W

Warning Labels, 6
Weight, 12