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Hitachi Virtual Storage Platform G1000, G1500, and Virtual Storage Platform F1500

Hardware Guide

Hitachi Data Systems

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Contents

Preface

This guide provides instructions and information about the Hitachi Virtual Storage Platform G1000 and G1500, and Hitachi Virtual Storage Platform F1500 storage systems.

Read this guide carefully to learn more about the storage systems and keep a copy to reference any information about the products.

Safety and environmental information

Note: Before operating or working on the Hitachi Virtual Storage Platform G1000 and G1500, and the Hitachi Virtual Storage Platform F1500 storage systems, read the safety and environmental information in Safety requirements on page 69 and Regulatory compliance on page 183.

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and authorized service providers who install, configure, and operate VSP G1000, VSP G1500, and VSP F1500 storage systems.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.
- The VSP G1000, VSP G1500, and VSP F1500 storage system and the *Product Overview*.
- The Hitachi Device Manager - Storage Navigator software and the *Hitachi Command Suite User Guide*.
- The concepts and functionality of storage provisioning operations in the use of Hitachi Dynamic Provisioning, Hitachi Dynamic Tiering software, Hitachi LUN Manager, and Hitachi Data Retention Utility.

Product version

This document revision applies to storage system microcode 80-05-0*x* or later.

Release notes

Read the release notes before installing and using this product. They may contain requirements or restrictions that are not fully described in this document or updates or corrections to this document. Release notes are available on Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

Changes in this revision

- Added Virtual Storage Platform G1500 and Virtual Storage Platform F1500 storage systems physical and operating specifications.
- Included a new Virtual Storage Director (VSD) equipped with new generation of Intel microprocessor.

- Added new 7 TB and 14 TB flash module drives.

Related documents

The documents below are referenced in this document or contain more information about the features described in this document.

Hitachi Virtual Storage Platform G1000 and G1500, and Hitachi Virtual Storage Platform F1500 documents:

- *Product Overview*, MK-92RD8051
- *Hitachi Command Suite Installation and Configuration Guide*, MK-90HC173
- *System Administrator Guide*, MK-92RD8016
- *Provisioning Guide for Mainframe Systems*, MK-92RD8013
- *Provisioning Guide for Open Systems*, MK-92RD8014
- *Hitachi Universal V2 Rack Reference Guide*, MK-94HM8035
- *Hitachi Command Suite User Guide*, MK-90HC172
- *Performance Guide*, MK-92RD8012
- *Mainframe Host Attachment and Operations Guide*, MK-96RD645
- *Open-Systems Host Attachment Guide*, MK-90RD7037
- *Hitachi SNMP Agent User Guide*, MK-92RD8015
- *Hitachi Volume Shredder User Guide*, MK-92RD8025

For a list of all documents related to the Hitachi Virtual Storage Platform G1000 and G1500 and Hitachi Virtual Storage Platform F1500 storage systems, see the *Product Overview*.

Document conventions

This document uses the following typographic conventions:

Convention	Description
Bold	• Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click **OK**. • Indicates emphasized words in list items.
Italic	• Indicates a document title or emphasized words in text. • Indicates a variable, which is a placeholder for actual text provided by the user or for output by the system. Example: `pairdisplay -g group` (For exceptions to this convention for variables, see the entry for angle brackets.)
`Monospace`	Indicates text that is displayed on screen or entered by the user. Example: `pairdisplay -g oradb`
< > angle brackets	Indicates variables in the following scenarios:

Convention	Description
	• Variables are not clearly separated from the surrounding text or from other variables. Example: `Status-<report-name><file-version>.csv` • Variables in headings.
[ ] 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.
| 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.

This document uses the following icons to draw attention to information:

Icon	Label	Description
	Note	Calls attention to important or additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Caution	Warns the user of adverse conditions and/or consequences (for example, disruptive operations, data loss, or a system crash).
	WARNING	Warns the user of a hazardous situation which, if not avoided, could result in death or serious injury.

Conventions for storage capacity values

Physical storage capacity values (for example, disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 kilobyte (KB)	1,000 (10^3) bytes
1 megabyte (MB)	1,000 KB or $1,000^2$ bytes
1 gigabyte (GB)	1,000 MB or $1,000^3$ bytes
1 terabyte (TB)	1,000 GB or $1,000^4$ bytes
1 petabyte (PB)	1,000 TB or $1,000^5$ bytes
1 exabyte (EB)	1,000 PB or $1,000^6$ bytes

Logical capacity values (for example, logical device capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 cylinder	Mainframe: 870 KB Open-systems: • OPEN-V: 960 KB • Others: 720 KB
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1,024^2$ bytes
1 GB	1,024 MB or $1,024^3$ bytes
1 TB	1,024 GB or $1,024^4$ bytes
1 PB	1,024 TB or $1,024^5$ bytes
1 EB	1,024 PB or $1,024^6$ bytes

Accessing product documentation

Product user documentation is available on Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents. Check this site for the most current documentation, including important updates that may have been made after the release of the product.

Getting help

Hitachi Data Systems Support Connect is the destination for technical support of products and solutions sold by Hitachi Data Systems. To contact technical support, log on to Hitachi Data Systems Support Connect for contact information: https://support.hds.com/en_us/contact-us.html.

Hitachi Data Systems Community is a global online community for HDS customers, partners, independent software vendors, employees, and prospects. It is the destination to get answers, discover insights, and make connections. **Join the conversation today!** Go to community.hds.com, register, and complete your profile.

Comments

Please send us your comments on this document to doc.comments@hds.com. Include the document title and number, including the revision level (for example, -07), and refer to specific sections and paragraphs whenever possible. All comments become the property of Hitachi Data Systems Corporation.

Thank you!

1

Introduction

This chapter describes the hardware components of the VSP G1000, VSP G1500, and VSP F1500 storage systems.

- System overview
- Hardware overview

System overview

The VSP G1000, VSP G1500, and VSP F1500 are high-capacity, high-performance, unified block and file enterprise storage systems that offer a wide range of storage and data services, software, logical partitioning and unified data replication across heterogeneous storage systems.

For information about availability of Virtual Storage Platform F1500, contact your HDS representative.

Features

The VSP G1000, VSP G1500, and VSP F1500 storage systems include state-of-the art advances in hardware technology that improve reliability, serviceability and accessibility to drives and other components when maintenance is required.

- Hitachi Accelerated Flash FMD DC2 storage offers a patented data-center-class design and rack-optimized form factor that delivers more than 8 PB per system. The FMD DC2 supports a sustained performance of 100,000 8K I/O per second, per device, with low and consistent response time.
- The latest 2.5-inch and 3.5-inch 6 Gb/sec SAS drives support lower power consumption and higher density per rack with up to 2,304 drives in six 19-inch standard racks. For more information about drive specifications, see Storage system specifications on page 122. For information about Hitachi racks, refer to the *Hitachi Universal V2 Rack Reference Guide*, MK-94HM8035.
- Hitachi NAS Platform hardware-accelerated network protocols support up to 2 GB/sec throughput for sequential workloads and up to 1.2 million NFS operations per second.
- Efficient caching makes up to 2 TB global cache dynamically accessible by all connected hosts and Hitachi NAS Platform nodes.
- The HNAS file module provides primary data deduplication using hardware-based SHA-256 calculation engines. This module achieves up to 90% capacity savings while maintaining high performance.
- When each controller is housed in a separate rack, the two controller racks can be placed up to 100 meters apart. In addition, the drive racks attached to a controller rack can be placed up to 100 meters from the controller rack. This enables maximum flexibility to optimize data center space usage and provides ease of access for operation and maintenance. See the detailed description of this feature and the cable diagrams in Long cable connections on page 97.
- The VSP G1500 and VSP F1500 are equipped with new Virtual Storage Directors (VSD). The VSD uses the latest generation of Intel Xenon 2.3GHz 8-core microprocessor to efficiently manage the front-end and back-end directors, PCI-Express interface, local memory and communication between the service processor.

For information about availability of Virtual Storage Platform F1500, contact your HDS representative.

- Expandable cache memory (up to 2 TB per 2-controller system).
- Nondisruptive migration is available as a service from Hitachi Data Systems authorized services representatives as well as by purchasing an optional software license for implementation by the customer. Because good planning is essential to smooth migration, we strongly recommend the nondisruptive migration planning service offered by Hitachi Data Systems Global Solution Services (GSS). See Nondisruptive service and upgrades on page 19.
- High temperature mode is a licensed feature that allows the storage system to operate at either standard temperature (60.8°F to 89.6°F / 16°C to 32°C) or higher temperatures (60.8°F to 104°F / 16°C to 40°C) in a data center, saving energy and cooling costs. See High temperature mode on page 19.

High performance

Hitachi offers the highest performance storage systems for the enterprise-class segment. The high-performance storage system enables consolidation and real-time applications, a wide range of storage and data services, software, logical partitioning, along with simplified and unified data replication across heterogeneous storage systems. Its large-scale, enterprise class virtualization layer, combined with Hitachi Dynamic Tiering and thin provisioning software, allows you to consolidate internal and external storage into one pool.

The storage system includes several features that improve system performance:

- Hitachi Accelerated Flash module drives that support ultra-high I/O rates and ultra-low latency
- Solid-state drives with high-speed response.
- Hitachi Command Suite, Device Manager - Storage Navigator, and Hitachi Storage Advisor provide integrated data and storage management to ensure high-speed data transfer between the back-end directors and small form-factor (SFF) or large form-factor (LFF) drives at 6 Gbps using a SAS interface.
- Ability to scale and upgrade system performance.
- Compression functionality reduces the size of stored data by encoding without reducing the amount of data.
- Deduplication functionality deletes the duplicated data while keeping the data in a single location when the same data is written to different addresses within the same pool.
- Disk drives operating at 7,200, 10,000, or 15,000 RPM.

Scalability

The storage system offers an entirely new type of scalable and adaptable integrated active-active architecture that supports integrated management. Hitachi Data Systems storage systems can be configured in numerous ways to meet performance and storage requirements.

Scalable system performance

System performance can be optimized according to the needs of the user and can be easily upgraded (in small or large increments) as storage needs increase. The following table shows the supported configurations.

Table 1 System performance configurations

Number of controllers	Number of VSD pairs / CPU cores[1]	Cache size[2]
1	min= 1 (16 cores) max=4 (64 cores)	min = 64 GB[3] max=1 TB
2	min= 2 (32 cores) max=8 (128 cores)	min = 64 GB per system (32 GB per controller)[3] max=2 TB

Notes:

1. A VSD pair consists of two VSD blades. Each VSD contains one 8-core processor.
2. Cache memory modules can be either 16 GB or 32 GB, but only one memory module size can be used in a system.
3. HDS minimum cache per system is 64 GB whether the system contains one or two controllers.

Scalable storage capacity

- The minimum configuration is a single rack with one controller chassis in a diskless configuration.
- A small system can be a single rack with one controller chassis and one or two drive chassis or flash drive chassis.
- A mid-sized system can be three racks with one controller chassis and a maximum of eight combined LFF or SFF drive chassis and up to two FMD chassis.
- For combined block and file storage systems, the maximum configuration depends on how many HNAS servers and switches are installed. Consult your authorized representative for examples of available configurations.
- Maximum storage capacity:
  - The storage system can be configured up to 65,280 logical volumes.
  - Configurable up to 2,304 SFF disk drives with a maximum physical disk capacity of approximately of 3.9 PB per storage system, or up to 1,152 LFF disk drives with a maximum physical disk capacity of approximately 6.8 PB per storage system.

- In a drive intermix configuration, it can be configured up to 576 flash module drives with a maximum physical capacity of 8.0 PB per storage system.

Flexible connectivity

Operating system support

The storage system supports IBM® mainframe operating systems as well as operating systems, including Microsoft Windows®, Oracle Solaris®, VMware®, IBM® AIX®, Linux®, HP-UX™, XenServer®, and OpenVMS™. For more information on supported operating systems, see https://support.hds.com/en_us/interoperability.html.

Host connectivity

The storage system supports connectivity to mainframe hosts via FICON front-end directors and to open servers via Fibre Channel, iSCSI and Fibre Channel over Ethernet (FCoE) front-end directors. The storage system can be configured with a combination of all of these front-end directors to support both mainframe hosts and open servers simultaneously.

High reliability

The storage system includes the following features to enhance reliability:

- **Multiple RAID configurations:** The system supports RAID6 (6D+2P and 14D+2P), RAID5 (3D+1P and 7D+1P), and RAID1 (2D+2D and 4D+4D).
- **Duplicate hardware:** Every module in the controller chassis and drive chassis are configured in redundant pairs so that if any module fails, the redundant module takes over until the failed component is replaced. The redundant hardware includes power supplies, VSD pairs, cache path controllers, front-end directors, back-end directors, and drives. If one of these hardware components fails, the storage system continues normal operation with zero data loss.
- **Protection from power failures:** The storage systems have dual-power feeds. In the event of a partial power loss on one of the feeds, the system operates normally on the alternate feed until full power is restored. In the event of a full power loss, the cache backup modules keep the cache contents active for 32 minutes while the system copies the system configuration information and all data in the cache to a cache flash drive (SSD).

High flexibility

The storage system is available in several configurations, from a small single rack, diskless system to a large six-rack system that includes two controller chassis, up to 2,304 SFF drives, up to 1,152 LFF drives, up to 384 SSD drives, up to 576 flash module drives, and a total of 2 TB cache. The system can be easily reconfigured for more storage capacity.

The system supports both block-or-file only and unified (block and file) configurations in open and mainframe environments. The unified systems contain Hitachi Network Attached Storage servers and switches in addition to the block controller and storage drives.

Typical system configurations

The storage system can be configured to a meet a variety of storage needs and typical configurations based on customer use-cases are described in the list.

- **Tiered storage:** : A storage system configured for tiered storage consists of multiple drive types, including: high-performance flash modules to fast data access, medium performance and capacity for most storage needs, and maximum capacity for data warehousing, all in one system. A tiered storage system can be configured with FMD (flash module) drives, SSD (solid state disk) drives, SAS drives (either SFF or LFF) and High capacity LFF drives. Software applications such as Dynamic Tiering allocate data to the appropriate drives based on frequency of access.
- **Maximum performance:** : A storage system configured with only flash module drives delivers maximum performance. This two-controller system can contain 12 FMD chassis with a total of 576 flash module drives. This system is designed for an on-line retail site where customers expect fast access to multiple images, or a hospital medical imaging system, where physicians need immediate access to 3D CAT or MRI images.
- **Maximum storage capacity:** : A storage system containing 12 LFF chassis with a total of 1152 LFF drives provides the maximum storage capacity. This system configuration with less priority for high-speed access is ideally suited for use as a data warehouse for medical or insurance records.

Software applications

The storage system provides the foundation for matching application requirements to different classes of storage and delivering critical services, including:

- Business continuity services
- Content management services (search, indexing)
- Thin provisioning
- Dynamic Tiering
- High availability
- Security services
- I/O load balancing
- Data classification
- File management services

Nondisruptive service and upgrades

The storage system is designed so that service and upgrades can be performed without interrupting normal operations.

- Main components can be "hot-swapped" (added, removed, or replaced without disruption) during normal operation. These include every module in the controller chassis and the drive chassis, such as power supplies, virtual storage directors, front-end directors, and back-end directors, cache and cache backup modules, SVPs, and drives.
- A service processor (SVP) mounted in the controller chassis monitors the operating condition of the storage system. Connecting the SVP with a service center allows authorized service personnel to manage the system remotely.
- Online non-disruptive upgrade of the Storage Virtualization Operating Systems (SVOS) can be performed during normal operation without shutting down or rebooting the storage system.
- Optional Hitachi Command Suite Migration Enablement Service (includes pilot migration) is available to jump-start self-service migration. For complex, large-scale, heterogeneous and remote replication data center environments, nondisruptive migration service from Hitachi Global Solution Services (GSS) are required. Contact your HDS authorized sales or service representative for more information.

High temperature mode

High temperature mode is a feature that allows the storage system to operate at standard temperature (60.8°F to 89.6°F / 16°C to 32°C) or higher temperatures (60.8°F to 104°F / 16°C to 40°C), saving energy and cooling costs. Temperature sensors at the air inlets in the primary microprocessor blades measure the ambient air temperature.

High temperature mode window

High temperature mode is set through the **Edit High Temperature Mode** window in the Device Manager - Storage Navigator GUI. The window also displays alerts when the ambient air temperature exceeds the preset limits.

- In standard temperature mode, a temperature alert (SIM) appears when the temperature in the storage system exceeds 89.6°F / 32°C.
- In high temperature mode, the temperature alert (SIM) appears when the temperature in the storage system exceeds 104°F / 40°C.

System life

The lifetime of the system is five years when operating in the standard temperature mode. This lifetime is reduced when operating the system in high temperature mode, even if you change the system to standard temperature mode later.

Cache Flash Memory battery life

When high temperature mode is enabled, the cache flash memory battery life will be reduced to two-thirds of the battery life that remains at the time when high temperature mode is enabled.

Example 1: A new cache flash memory battery has three years of usable life when operated in a standard temperature environment. If you enable high temperature mode when the battery is new, the battery life will be reduced to two years.

Example 2: The storage system is used for two years at normal temperature mode. The cache battery has one year of usable life remaining at that time. If you enable high temperature mode, the life of the battery will be reduced to eight months.

Cache Flash Memory battery date

When high temperature mode is enabled, the battery replacement notice displays one year earlier than when high temperature mode is disabled.

After high temperature mode is enabled, the date of the battery replacement notice cannot be changed back to normal, even if high temperature mode is disabled. When high temperature mode is enabled, a confirmation message is displayed.

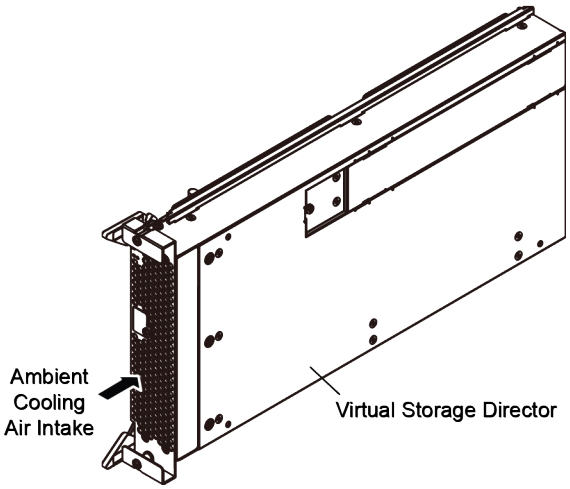
Caution: Important information about using high temperature mode.

See the *System Administrator Guide* for additional information.

- **Notify Technical Support:** Before enabling high temperature mode, contact Hitachi Data Systems Support at https://support.hds.com/en_us/contact-us.html for updates or additional information besides the following notes.
- **Guidelines for operating with flash module drives in high temperature mode:**
  - Do not enable high temperature mode if the system contains flash module drives (FMDs) from an earlier generation (prior to Hitachi Accelerated Flash FMD DC2 drives). The early generation FMDs are not designed to operate in high temperature mode. Only enable high temperature mode with Hitachi Accelerated Flash FMD DC2 drives.
  - Do not enable high temperature mode if the system contains a combination of early and current generation FMDs.
- **Operating altitude:** Because thinner air will not provide sufficient cooling, do not enable high temperature mode if the system is located above 4920 ft / 1,500 m. A storage system can operate up to 9842 ft / 3,000 m above sea level in standard temperature mode.
- **System noise:** When the storage system is used in a high temperature environment near 104°F / 40°C, the fans operate at high speed, increasing system noise. See for detailed information.

Temperature measurement

Ambient air temperature is measured by a sensor in the cooling air inlet on each module in the primary VSD pair on each controller.



Economical and quiet

The storage system is an ENERGY STAR® qualified product and meets the qualification specifications for data center storage. For more information, visit http://www.energystar.gov/productfinder/product/certified-data-center-storage/details/2252003.

The speed of the fans in the controller and drive chassis is controlled by sensors in the units that measure the temperature of the exhaust air and set the fans to the speed necessary to maintain the unit temperature within a preset range. When the system is less busy, it generates less heat and fan speed is reduced, saving energy and reducing the noise level.

Hardware overview

The following section describes the storage system components.

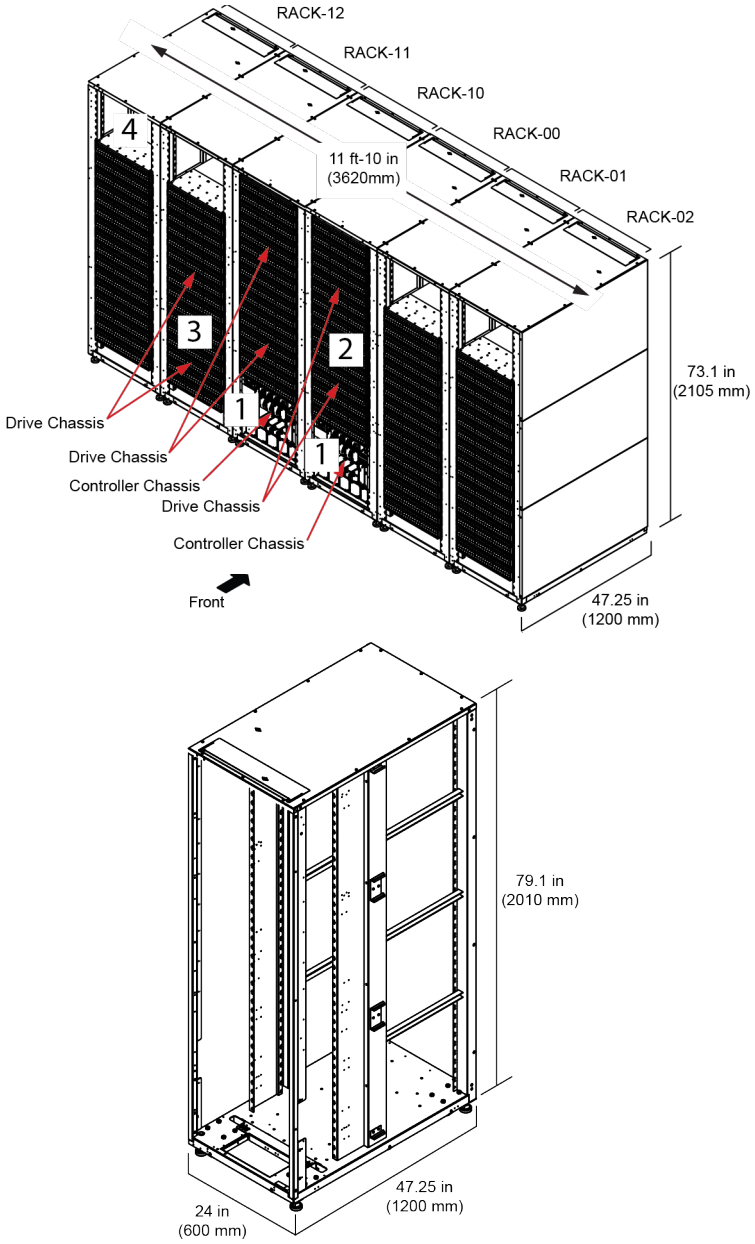


Figure 1 Storage System overview

Note: The illustration shown is only an example. The storage system provides flexibility for placing the controller and drive chassis within the racks. For more information about system configurations, contact your sales account representative.

Item	Description
1	10U controller chassis
2	(optional) maximum of 12 8U FMD drive chassis

Item	Description
3	16U SFF or LFF drive chassis
4	8U space

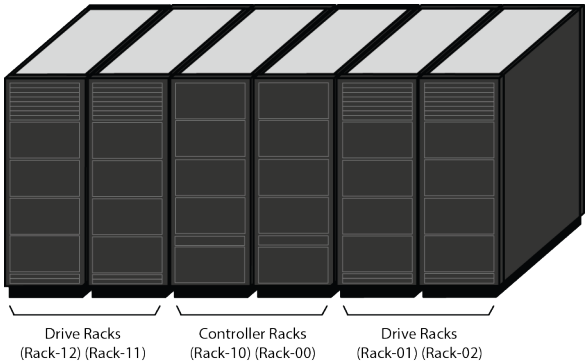


Figure 2 Rack numbers

Table 2 Supported block module components

Chassis	Description	Maximum chassis / drives per system	
		Single-controller system	Two-controller system
Controller	10U x 1 controller	1	2
SFF	16U x 192 2.5-inch HDD drives	6 / 1,152	12 / 2,304
LFF	16U x 96 3.5-inch HDD drives	6 / 576	12 / 1152
FMD	8U x 48 FMD drives	6 / 288	12 / 576
SFF / LFF	SSD drives	192 max	384 max

Table 3 Supported minimum configuration options

Number of VSD pairs	1	2 or 3	4	5	6 or 7	8
No. of controller chassis	1	1	1	2	2	2
Min cache memory (GB)	64	64	64	64	128	128
Cache Backup kit	1	1	1	1	2	2
front-end directors	1	1	1	1	1	1
back-end directors	0	0	0	0	0	0
Number of racks	1	1	1	1*	1*	1*
Drive chassis(SFF/LFF/ FMD)	Optional	Optional	Optional	Optional	Optional	Optional

*Assumes both controllers are housed in a single rack. Two separate racks are required if the controllers are separately housed.

Model Number List

The list provides the part description number for each storage system model.

For information about availability of Virtual Storage Platform F1500, contact your HDS representative.

Table 4 Model Number List

Model Name	Model Number			
	VSP G1000	VSP G1500 (Upgrade from VSP G1000 to G1500)	VSP G1500	VSP F1500
Primary Controller Chassis	DKC810I-CBXA/ DKC810I-CBXAC	DKC810I-CBXA/ DKC810I-CBXAC	DKC810I-CBXE	DKC810I-CBXE
Second Controller Chassis	DKC810I-CBXB	DKC810I-CBXB	DKC810I-CBXF	DKC810I-CBXF
Controller Chassis Bezel	DKC-F810I-BCH	DKC-F810I-BCH	DKC-F810I-BCH	DKC-F810I-BCH
Badge for bezel	5557156-001	N/A	5562191-001	5562488-001
DKC Power Cord Kit (USA)	DKC-F810I-PLUC	DKC-F810I-PLUC	DKC-F810I-PLUC	DKC-F810I-PLUC
DKC Power Cord Kit (EU)	DKC-F810I-PLEC	DKC-F810I-PLEC	DKC-F810I-PLEC	DKC-F810I-PLEC
DKC Power Cord Kit (China)	DKC-F810I-PLCC	DKC-F810I-PLCC	DKC-F810I-PLCC	DKC-F810I-PLCC
LFF Drive Chassis	DKC-F810I-UBX/ DKC-F810I-UBXC	DKC-F810I-UBX/ DKC-F810I-UBXC	DKC-F810I-UBXC	N/A
SFF Drive Chassis	DKC-F810I-SBX/ DKC-F810I-SBXC	DKC-F810I-SBX/ DKC-F810I-SBXC	DKC-F810I-SBXC	N/A
Drive Chassis Bezel	DKC-F810I-BUH	DKC-F810I-BUH	DKC-F810I-BUH	N/A
DKU Power Cord Kit (USA)	DKC-F810I-PHUC	DKC-F810I-PHUC	DKC-F810I-PHUC	N/A
DKU Power Cord Kit (EU)	DKC-F810I-PHEC	DKC-F810I-PHEC	DKC-F810I-PHEC	N/A
DKU Power Cord Kit (China)	DKC-F810I-PHCC	DKC-F810I-PHCC	DKC-F810I-PHCC	N/A
FMD Chassis	DKC-F810I-FBX	DKC-F810I-FBX	DKC-F810I-FBX	DKC-F810I-FBX
FMD Chassis Bezel	DKC-F810I-BFH	DKC-F810I-BFH	DKC-F810I-BFH	DKC-F810I-BFH

Model Name	Model Number			
	VSP G1000	VSP G1500 (Upgrade from VSP G1000 to G1500)	VSP G1500	VSP F1500
FBX Power Cord Kit (USA)	DKC-F810I-PFUC	DKC-F810I-PFUC	DKC-F810I-PFUC	DKC-F810I-PFUC
FBX Power Cord Kit (EU)	DKC-F810I-PFEC	DKC-F810I-PFEC	DKC-F810I-PFEC	DKC-F810I-PFEC
FBX Power Cord Kit (China)	DKC-F810I-PFCC	DKC-F810I-PFCC	DKC-F810I-PFCC	DKC-F810I-PFCC
Additional Service Processor	DKC-F810I-SVP/ DKC-F810I-SVPC	DKC-F810I-SVP/ DKC-F810I-SVPC	DKC-F810I-SVPC	DKC-F810I-SVPC
Additional Hub	DKC-F810I-HUB	DKC-F810I-HUB	DKC-F810I-HUB	DKC-F810I-HUB
Inter-Controller Connecting Kit	DKC-F810I-MOD5	DKC-F810I-MOD5	DKC-F810I-MOD5	DKC-F810I-MOD5
Inter-Controller Connecting Cable	DKC-F810I-MFC5	DKC-F810I-MFC5	DKC-F810I-MFC5	DKC-F810I-MFC5
Inter-Controller Connecting Kit	DKC-F810I-MOD30	DKC-F810I-MOD30	DKC-F810I-MOD30	DKC-F810I-MOD30
Inter-Controller Connecting Cable	DKC-F810I-MFC30	DKC-F810I-MFC30	DKC-F810I-MFC30	DKC-F810I-MFC30
Inter-Controller Connecting Kit	DKC-F810I-MOD1J	DKC-F810I-MOD1J	DKC-F810I-MOD1J	DKC-F810I-MOD1J
Inter-Controller Connecting Cable	DKC-F810I-MFC1J	DKC-F810I-MFC1J	DKC-F810I-MFC1J	DKC-F810I-MFC1J
Device Interface Cable CC1	DKC-F810I-CC1	DKC-F810I-CC1	DKC-F810I-CC1	DKC-F810I-CC1
Device Interface Cable CC2	DKC-F810I-CC2	DKC-F810I-CC2	DKC-F810I-CC2	DKC-F810I-CC2
Device Interface Cable CC4	DKC-F810I-CC4	DKC-F810I-CC4	DKC-F810I-CC4	DKC-F810I-CC4
Device Interface Cable FC5	DKC-F810I-FC5	DKC-F810I-FC5	DKC-F810I-FC5	DKC-F810I-FC5
Device Interface Cable FC30	DKC-F810I-FC30	DKC-F810I-FC30	DKC-F810I-FC30	DKC-F810I-FC30
Device Interface Cable FC1J	DKC-F810I-FC1J	DKC-F810I-FC1J	DKC-F810I-FC1J	DKC-F810I-FC1J

Model Name	Model Number			
	VSP G1000	VSP G1500 (Upgrade from VSP G1000 to G1500)	VSP G1500	VSP F1500
Fibre 16-port 8G Host Adapter	DKC-F810I-16FC8	DKC-F810I-16FC8	DKC-F810I-16FC8	DKC-F810I-16FC8
Fibre 8-port 16G Host Adapter	DKC-F810I-8FC16	DKC-F810I-8FC16	DKC-F810I-8FC16	DKC-F810I-8FC16
Fibre 16-port 16G Host Adapter	DKC-F810I-16FC16	DKC-F810I-16FC16	DKC-F810I-16FC16	DKC-F810I-16FC16
Mainframe Fibre 16-port 8G Host Adapter for Shortwave	DKC-F810I-16MS8	DKC-F810I-16MS8	DKC-F810I-16MS8	DKC-F810I-16MS8
Mainframe Fibre 16-port 8G Host Adapter for Longwave	DKC-F810I-16ML8	DKC-F810I-16ML8	DKC-F810I-16ML8	DKC-F810I-16ML8
Mainframe Fibre 16-port 16G Host Adapter for Shortwave	DKC-F810I-16MS16	DKC-F810I-16MS16	DKC-F810I-16MS16	DKC-F810I-16MS16
Mainframe Fibre 16-port 16G Host Adapter for Longwave	DKC-F810I-16ML16	DKC-F810I-16ML16	DKC-F810I-16ML16	DKC-F810I-16ML16
FCOE 16-port Host Adapter	DKC-F810I-16FE10	DKC-F810I-16FE10	DKC-F810I-16FE10	DKC-F810I-16FE10
iSCSI 8-port 10G Host Adapter	DKC-F810I-8IS10	DKC-F810I-8IS10	DKC-F810I-8IS10	DKC-F810I-8IS10
Additional Cache Path Control Adapter	DKC-F810I-CPEX	DKC-F810I-CPEX	DKC-F810I-CPEX	DKC-F810I-CPEX
Cache Memory (16GB)	DKC-F810I-CM16G	DKC-F810I-CM16G	DKC-F810I-CM16G	DKC-F810I-CM16G
Cache Memory (32GB)	DKC-F810I-CM32G	DKC-F810I-CM32G	DKC-F810I-CM32G	DKC-F810I-CM32G

Model Name	Model Number			
	VSP G1000	VSP G1500 (Upgrade from VSP G1000 to G1500)	VSP G1500	VSP F1500
Cache Backup Module Kit for Small Memory	DKC-F810I-BKMS	DKC-F810I-BKMS	DKC-F810I-BKMS	DKC-F810I-BKMS
Cache Backup Module Kit for Large Memory	DKC-F810I-BKML	DKC-F810I-BKML	DKC-F810I-BKML	DKC-F810I-BKML
Cache Flash Memory (128GB)	DKC-F810I-BMM128	DKC-F810I-BMM128	DKC-F810I-BMM128	DKC-F810I-BMM128
Cache Flash Memory (256GB)	DKC-F810I-BMM256	DKC-F810I-BMM256	DKC-F810I-BMM256	DKC-F810I-BMM256
Disk Adapter	DKC-F810I-SCA	DKC-F810I-SCA	DKC-F810I-SCA	DKC-F810I-SCA
Encryption Disk Adapter	DKC-F810I-ESCA	DKC-F810I-ESCA	DKC-F810I-ESCA	DKC-F810I-ESCA
FIPS140-2 Level2 Upgrade Toolkit	DKC-F810I-FIPS2	DKC-F810I-FIPS2	DKC-F810I-FIPS2	DKC-F810I-FIPS2
Additional Processor Blades	DKC-F810I-MP	N/A	N/A	N/A
MP2 Upgrade Kit	N/A	DKC-F810I-MP2UGH	N/A	N/A
Additional Processor Blades 2	N/A	DKC-F810I-MP2	DKC-F810I-MP2	DKC-F810I-MP2
SFF 300 GB Disk Drive 15k	DKC-F810I-300KCM/ DKC-F810I-300KCMC	DKC-F810I-300KCM/ DKC-F810I-300KCMC	DKC-F810I-300KCMC	N/A
SFF 600 GB Disk Drive 15k	DKC-F810I-600KGM	DKC-F810I-600KGM	DKC-F810I-600KGM	N/A
SFF 600 GB Disk Drive 10k	DKC-F810I-600JCM/ DKC-F810I-600JCMC	DKC-F810I-600JCM/ DKC-F810I-600JCMC	DKC-F810I-600JCMC	N/A
SFF 900 GB Disk Drive 10k	DKC-F810I-900JCM/	DKC-F810I-900JCM/	N/A	N/A

Model Name	Model Number			
	VSP G1000	VSP G1500 (Upgrade from VSP G1000 to G1500)	VSP G1500	VSP F1500
	DKC-F810I-900JCMC	DKC-F810I-900JCMC		
SFF 1.2 TB Disk Drive 10k	DKC-F810I-1R2JCM/ DKC-F810I-1R2JCMC	DKC-F810I-1R2JCM/ DKC-F810I-1R2JCMC	DKC-F810I-1R2JCMC	N/A
SFF 1.8 TB Disk Drive 10k	DKC-F810I-1R8JGM	DKC-F810I-1R8JGM	DKC-F810I-1R8JGM	N/A
SFF 400 GB SSD Drive	DKC-F810I-400MCM	DKC-F810I-400MCM	N/A	N/A
SFF 800 GB SSD Drive	DKC-F810I-800MCM	DKC-F810I-800MCM	N/A	N/A
LFF 4 TB Disk Drive 7.2k	DKC-F810I-4R0H3M/ DKC-F810I-4R0H3MC	DKC-F810I-4R0H3M/ DKC-F810I-4R0H3MC	DKC-F810I-4R0H3MC	N/A
LFF 6 TB Disk Drive 7.2k	DKC-F810I-6R0H9M	DKC-F810I-6R0H9M	DKC-F810I-6R0H9M	N/A
LFF 600 GB Disk Drive 10k	DKC-F810I-600J5M/ DKC-F810I-600J5MC	DKC-F810I-600J5M/ DKC-F810I-600J5MC	N/A	N/A
LFF 400 GB SSD Drive	DKC-F810I-400M5M	DKC-F810I-400M5M	N/A	N/A
1.75 TB Flash Module Drive	DKC-F810I-1R6FN	DKC-F810I-1R6FN	DKC-F810I-1R6FN	DKC-F810I-1R6FN
3.5 TB Flash Module Drive	DKC-F810I-3R2FN	DKC-F810I-3R2FN	DKC-F810I-3R2FN	DKC-F810I-3R2FN
7 TB Flash Module Drive	DKC-F810I-6R4FN	DKC-F810I-6R4FN	DKC-F810I-6R4FN	DKC-F810I-6R4FN
1.75 TB Flash Module Drive	DKC-F810I-1R6FM	DKC-F810I-1R6FM	N/A	N/A
	DKC-F710I-1R6FM	DKC-F710I-1R6FM	DKC-F710I-1R6FM	N/A
3.5 TB Flash Module Drive	DKC-F810I-3R2FM	DKC-F810I-3R2FM	N/A	N/A
	DKC-F710I-3R2FM	DKC-F710I-3R2FM	DKC-F710I-3R2FM	N/A

Model Name	Model Number			
	VSP G1000	VSP G1500 (Upgrade from VSP G1000 to G1500)	VSP G1500	VSP F1500
7 TB Flash Module Drive HD	DKC-F810I-7R0FP	DKC-F810I-7R0FP	DKC-F810I-7R0FP	DKC-F810I-7R0FP
14 TB Flash Module Drive HD	DKC-F810I-14RFP	DKC-F810I-14RFP	DKC-F810I-14RFP	DKC-F810I-14RFP

Controller chassis

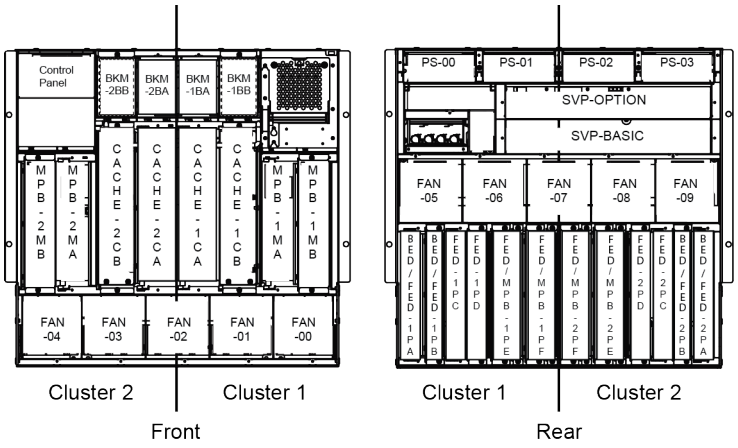
The controller provides system logic and control, memory, and monitoring, as well as the interfaces and connections to drives and host servers.

The 10U-high controller chassis consists of Virtual Storage Directors (microprocessors), cache path control adapters, cache backup module kits, front-end directors (host I/O modules), service processors (SVP), ten cooling fans, and up to four power supplies. In a system with drives, the controller also contains at least two back-end director pair. All components are installed in redundant pairs so that if any component fails, the mirrored component will handle the load and the system will continue to run. Any component, including the operating system running on the SVP, can be replaced or upgraded while the system is in operation.

Clusters

The controller is logically divided in the center. Each side of the controller is a cluster that works in parallel with the other cluster. The virtual storage directors, front-end directors and back-end directors, cache, and cache backup kits are installed symmetrically across the two clusters and work as one system.

The following figure shows the front and rear views of the clusters in a fully configured controller chassis.



Controller components

The following figures show the front and rear views of a controller chassis and the tables list the description of the components.

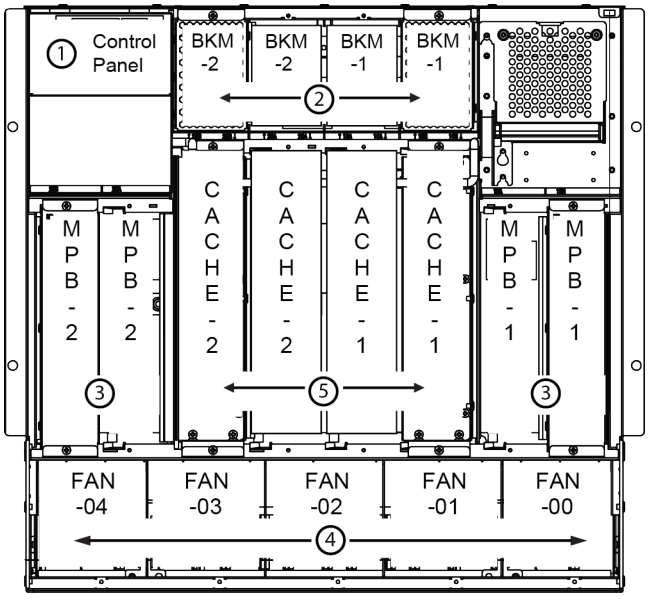


Figure 3 Controller, front view

Table 5 Controller components - front

Item	Name	Min	Max	Description
1	Control Panel	1	1	See Power control panel on page 108.
2	Cache Backup Module (BKM)	2	4	Backup memory modules are installed in pairs and referred to as a backup memory kit. Each module contains two batteries and either a 128 GB SSD flash drive (small kit) or a 256 GB SSD flash drive (large kit). If the power fails, the cache is protected from data loss by the backup batteries and the cache flash memory (SSD). The batteries keep the cache active up to 32 minutes while the data is copied to the SSD.

Item	Name	Min	Max	Description
3	• Virtual Storage Director (2.1GHz) • Virtual Storage Director (2.3Ghz)	2 (1 pair)	8 (4 pairs)	A VSD may contain either an Intel Xeon 2.1GHz or 2.3GHz 8-core microprocessor. The VSDs must be installed in pairs and the VSDs control the front-end directors, back-end directors, PCI-Express interface, local memory, and communication to the SVP. The VSDs are independent of the front-end directors and back-end directors, and can be shared across them.
4	Cooling fan (intake)	5	5	The five intake fans on the front of the controller pull air into the controller and distribute it across the controller components.
5	Cache Path Control Adapter (CPA)	1	4	The CPA uses the built in switch to connect the VSDs to the front-end directors, back-end directors, and the cache backup memory. It distributes data (data routing function) and sends hot-line signals to the VSD. The shared memory is located on the first CPA cache board in each cluster in the primary controller

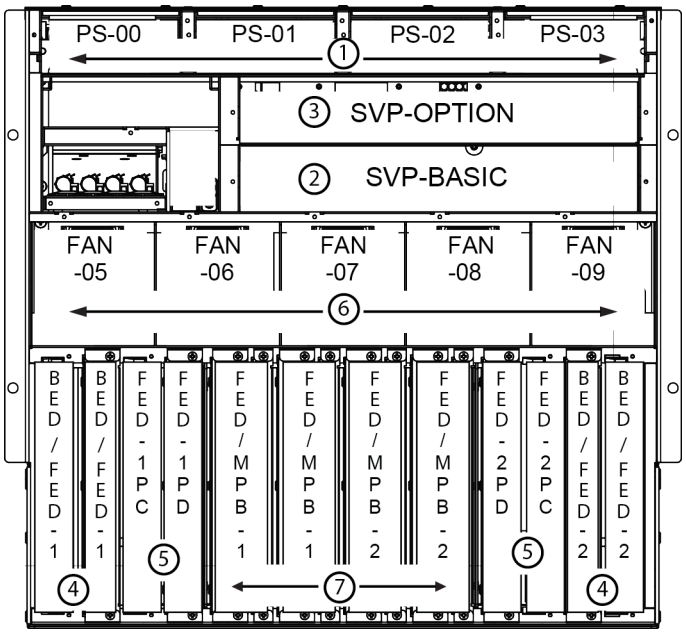


Figure 4 Controller, rear view

Table 6 Controller components - rear

Item	Name	Min	Max	Description
1	Power supply	2	4	200-240 VAC input. Provides power to the controller chassis in a redundant configuration. Each power supply contains two cooling fans to ensure constant cooling if one fan fails.
2	Service Processor (SVP)	1	2	A custom PC monitoring and controlling the storage system. It contains the Device Manager - Storage Navigator software used to configure and monitor the system. Connecting the SVP to a service center enables the storage system to be remotely monitored and maintained by the support team.

Item	Name	Min	Max	Description
3	Service Processor (SVP) or Hub	0	1	This space can be empty or can contain either a second SVP or a hub. When a second SVP is installed, the primary SVP is the active SVP, and the secondary SVP is the hot idle SVP with active Windows. A hub facilitates the transfer of information from the VSD pairs to the primary SVP.
4	back-end director or (optional) front-end director	0 if diskless 2 with drives	4	A back-end director (BED) provides connection to the HDDs, SSDs, and FMDs. It controls functions for data transfer between the drives and the cache. VSP G1000, VSP G1500, and VSP F1500 support two types of back-end directors: • Standard back-end director • Encrypting back-end director* Important: Each back-end director and front-end director consists of a set of two of blades. See Flexible front-end director installation on page 35 for details.
5	front-end director (host I/O module)	1	2 to 5 with drives 6 if diskless system	A front-end director (FED) provide ports that support connectivity to the open and mainframe systems belonging to the customer. In addition, some of the FEDs support virtualization of externally attached storage, remote replication between the VSP G1000, VSP G1500, and VSP F1500 and other storage systems, including communication between two Hitachi storage systems in a Global Active Device cluster. See Front-end director on page 32 for details.
6	Cooling fan (exhaust)	5	5	The five exhaust fans on the rear of the controller pull hot air away from the components and push it out the back of the rack.
7	FED or VSD slot	0	4	These four slots on the controller support both front-end directors and VSDs. Note that both FEDs and VSDs must be installed in pairs.

*Achieved FIPS 140-2 Level 1 certification.

Front-end director

A front-end director (FED) is a pair of blades that are installed in the controller. It connects the storage system to the host servers, processes channel commands from hosts, manages host access to the cache, and controls the transfer of data between the hosts and the controller cache.

Hitachi offers the following FEDs:

- iSCSI
- Fibre Channel
- FICON (shortwave and longwave)
- Fibre Channel over Ethernet (FCoE)

The Fibre Channel FED can be configured with either shortwave or longwave host connectors. The FICON FEDs are configured with either longwave or shortwave connectors that match the wavelength of the mainframe ports.

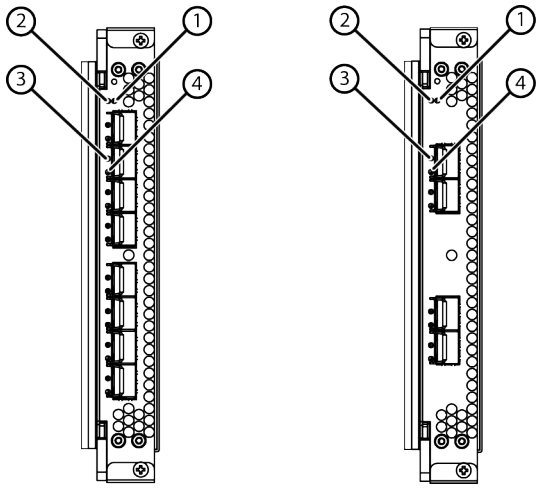


Figure 5 front-end director blade, Fibre Channel and iSCSI

Item	Name	Color	Description
1	Blade Status	Dark (off) Red (on)	OFF - Power is not supplied to the system; system is not operational. ON - Board failure. Blade can be replaced while system is running.
2	Power supply Status	Dark (off) Amber (on)	OFF - Power is not supplied to the system, or, if power is supplied to the system, power supply in this blade is operational. ON - Power supply failure, abnormal voltage in power supply.
3	Port Status (Fibre Channel)	Dark (off) Green (on)	OFF - If system power is off, port is not ready. OFF - If system power is on, port is ready. ON - Link is active.
4	Link Activity (Fibre Channel)	Dark (off) Green (on)	OFF - No link activity; three possible reasons: power is off, initialization not completed, and if system is operational, the port is not being accessed. ON (steady) Link is available & initialization complete, but connection to the host has not been established. Blinking - when port is being accessed and data is being transferred between the host and the cache.
3	Port Status (FICON)	Dark (off) Green (on)	OFF - If system power is off, port is not ready. ON - Link is available & initialization has completed, but connection to the host has not been established. ON - Link is active.
4	Link Activity (FICON)	Dark (off) Amber (on)	OFF - No link activity; three possible reasons: power is off, initialization not completed, and if system is operational, the port is not being accessed. ON (fast blink) - when port is being accessed and data is being transferred between the host and the cache.

Supported connections and protocols

Ports

Hitachi Data Systems offers a variety of FED blades. Some blades contain four ports while others have eight ports. Each port contains a host connector

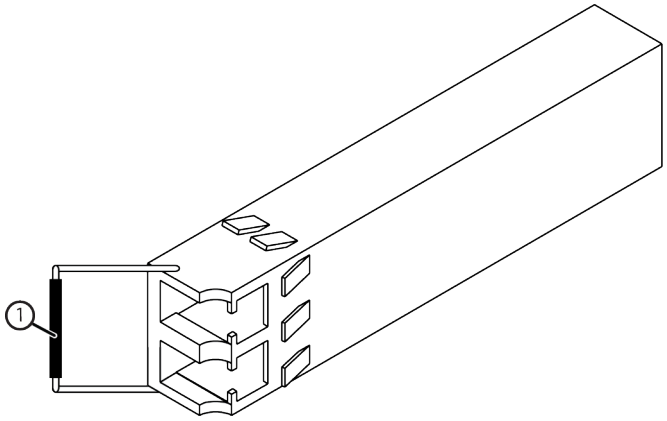
that sets the wavelength (short or long) and connects the adapter board to the fiber optic cables. A two-controller system supports the following maximum number of connections via the FEDs:

- 192 Fibre Channel ports (16 Gbps, 16-port)
- 192 Fibre Channel ports (8 Gbps, 16-port)
- 96 Fibre Channel ports (16 Gbps, 8-port)
- 176 FICON ports (16 Gbps, 16-port) available in longwave and shortwave versions
- 176 FICON ports (8 Gbps, 16-port) available in longwave and shortwave versions
- 192 FCoE ports (10 Gbps, 16-port)
- 88 iSCSI ports (10 Gbps, 8-port)

See Site preparation on page 73, for information on port configurations.

Host connectors

A host connector is an LC type optical transceiver that converts electrical signals from the FED to light pulses that are supported by the fiber optic cables. Host connectors are either shortwave or longwave. Fibre Channel FEDs are configured with shortwave host connectors by default. Longwave host connectors are available and may be substituted as needed.



Item	Description
1 - Host connector lock lever	Black lever = shortwave Blue lever = longwave

Protocols

An FED supports Fibre Channel for open systems and FICON for mainframe systems. For more information, see the following table

FED	System	Ports	Mode	Description
16-port, 16 Gbps Fibre Channel, shortwave and longwave adapter.	Open	16	Target and Initiator[1]	• Contains two 8-port channel boards. Each port contains an LC-type short wavelength, multi-mode host connector. These are installed by default.

FED	System	Ports	Mode	Description
		(8 per blade)		• A long wavelength host connector (-1PL8) for single mode can be used instead of the short wavelength host connector.
16-port, 8 Gbps Fibre Channel, shortwave and longwave adapter	Open	16 (8 per blade)	Target and Initiator[1]	• Contains two 8-port channel boards. Each port contains an LC-type short wavelength, multi-mode host connector. These are installed by default. • A long wavelength host connector (-1PL8) for single mode may be used instead of the short wavelength host connector.
8-port, 16 Gbps Fibre Channel ,shortwave and longwave adapter.	Open	8 (4 per blade)	Target and Initiator[1]	• Contains two 4-port channel boards. Each port contains an LC-type short wavelength, multi-mode host connector. These are installed by default. • A long wavelength host connector (-1PL16) for single mode may be used instead of the short wavelength host connector.
16-port, 8Gbps FICON shortwave adapter.	Mainframe	16 (8 per blade)	Target	• Contains two 8-port channel boards. Each port contains a short wavelength (multi-mode) host connector.
16-port, 8Gbps FICON longwave adapter.	Mainframe	16 (8 per blade)	Target	• Contains two 8-port channel boards. Each port contains an LC-type long wavelength (multi-mode) host connector.
16-port, 16 Gbps FICON shortwave adapter.	Mainframe	16 (8 per blade)	Target	• Contains two 8-port channel boards. Each port contains a short wavelength (multi-mode) host connector.
16-port, 16 Gbps FICON longwave adapter.	Mainframe	16 (8 per blade)	Target	• Contains two 8-port channel boards. Each port contains an LC-type long wavelength (multi-mode) host connector.
16-port, 10 Gbps Fibre Channel over Ethernet (FCoE)	Open	16 (8 per blade)	Target	• Contains two 8-port channel boards. Each port contains a short wavelength (multi-mode) host connector.
8-port, 10 Gbps iSCSI[2]	Open	8 (4 per blade)	Target and Initiator[1]	• Contains two 4-port channel boards. Each port contains a short wavelength (multi-mode) host connector. • For the diskless model, an additional set of this option can be installed in the CHA/DKA slot and a maximum of 48 ports are available for use.

Notes:

1. Supports remote replication, including TrueCopy, global-active device, Hitachi Universal Replicator and Hitachi Universal Volume Manager.
2. At least one is required for Hitachi Universal Volume Manager connection.

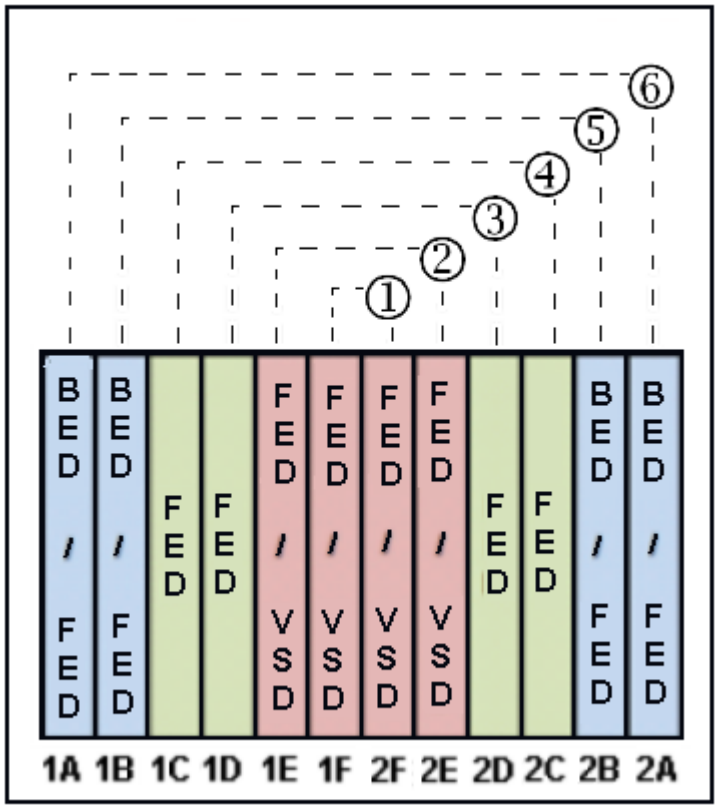
Flexible front-end director installation

The maximum number of FEDs that can be installed in the controller depends on the number of VSD pairs and back-end directors (BEDs) that are installed.

As shown in the following figure, the controller is built with 12 I/O slots, eight of which are dual-purpose. This provides a wide range of configuration flexibility.

Note: Each front-end director and back-end director consists of a set of two blades, as indicated by the numbers in the figure. A VSD, however, uses a single slot, but is sold and installed in pairs.

- 8 of 12 I/O slots support different types of devices.
- Slots 1C/2C and 1D/2D are reserved for the first two front-end directors
- Slots 1E/2E and 1F/2F support the installation of both front-end directors and VSDs
- Slots 1A/2A and 1B/2B support the installation of both back-end directors and VSDs



The following table shows the order of front-end director (FED) installation. If the storage system includes internal drives, the controller requires a minimum of a single pair of back-end directors and can be configured to support up to two back-end directors. The term "standard" describes a controller configured with a single back-end director, while "high performance" describes a controller configured with two back-end directors. A storage system that does not include any internal drives is referred to as a "diskless" configuration.

Table 7 VSP G1000 FED installation order

Installation order (see above figure)	Installation Slot Location					
	Diskless model		Standard model		High-performance model	
	DKC810I-CBXA/CBXAC	DKC-F810I-CBXB	DKC810I-CBXA/CBXAC	DKC-F810I-CBXB	DKC810I-CBXA/CBXAC	DKC-F810I-CBXB
1	1PC/2PC (CHA0)	1PJ/2PJ (CHA6)	1PC/2PC (CHA0)	1PJ/2PJ (CHA6)	1PC/2PC (CHA0)	1PJ/2PJ (CHA6)
2	1PD/2PD (CHA1)	1PK/2PK (CHA7)	1PD/2PD (CHA1)	1PK/2PK (CHA7)	1PD/2PD (CHA1)	1PK/2PK (CHA7)
3	1PE/2PE (CHA2/MPB3)	1PL/2PL (CHA8/MPB7)	1PE/2PE (CHA2/MPB3)	1PL/2PL (CHA8/MPB7)	1PE/2PE (CHA2/MPB3)	1PL/2PL (CHA8/MPB7)
4	1PF/2PF (CHA3/MPB2)	1PM/2PM (CHA9/MPB6)	1PF/2PF (CHA3/MPB2)	1PM/2PM (CHA9/MPB6)	1PF/2PF (CHA3/MPB2)	1PM/2PM (CHA9/MPB6)
5	1PB/2PB (DKA1/CHA4)	1PH/2PH (DKA3/CHA10)	1PB/2PB (DKA1/CHA4)	1PH/2PH (DKA3/CHA10)	—	—
6	1PA/2PA (DKA0/CHA5)	1PG/2PG (DKA2/CHA11)	—	1PG/2PG (DKA2/CHA11)	—	—

Table 8 VSP G1500 and VSP F1500 FED installation order

Installation order (see above figure)	Installation Slot Location					
	Diskless model		Standard model		High-performance model	
	DKC810I-CBXE	DKC810I-CBXF	DKC810I-CBXE	DKC810I-CBXF	DKC810I-CBXE	DKC810I-CBXF
1	1PC/2PC (CHA0)	1PJ/2PJ (CHA6)	1PC/2PC (CHA0)	1PJ/2PJ (CHA6)	1PC/2PC (CHA0)	1PJ/2PJ (CHA6)
2	1PD/2PD (CHA1)	1PK/2PK (CHA7)	1PD/2PD (CHA1)	1PK/2PK (CHA7)	1PD/2PD (CHA1)	1PK/2PK (CHA7)
3	1PE/2PE (CHA2/MPB3)	1PL/2PL (CHA8/MPB7)	1PE/2PE (CHA2/MPB3)	1PL/2PL (CHA8/MPB7)	1PE/2PE (CHA2/MPB3)	1PL/2PL (CHA8/MPB7)
4	1PF/2PF (CHA3/MPB2)	1PM/2PM (CHA9/MPB6)	1PF/2PF (CHA3/MPB2)	1PM/2PM (CHA9/MPB6)	1PF/2PF (CHA3/MPB2)	1PM/2PM (CHA9/MPB6)
5	1PB/2PB (DKA1/CHA4)	1PH/2PH (DKA3/CHA10)	1PB/2PB (DKA1/CHA4)	1PH/2PH (DKA3/CHA10)	—	—
6	1PA/2PA (DKA0/CHA5)	1PG/2PG (DKA2/CHA11)	—	1PG/2PG (DKA2/CHA11)	—	—

Note: Intermixing of DKC-F810I-MP and DKC-F810I-MP2 is not supported.

Supported speeds and cable lengths

The FEDs can be configured with either shortwave or longwave host connectors that match the cables connecting it to the host systems.

The following table lists the Fibre Channel cable length requirements for the front-end directors for the storage system.

Table 9 Maximum cable length (shortwave)

Data Transfer Rate	OM2 cable (50/125 um multi-mode fiber)	OM3 cable (50/125 um laser optimizedmulti-mode fiber)	OM4 cable (50/125 um laser optimizedmulti-mode fiber)
MB/s	feet / meters	feet / meters	feet / meters
200	984.3 / 300	1640.4 / 500	-
400	492.1 / 150	1246.7 / 380	1312.4 / 400
800	164 / 50	492.1 / 150	623.4 / 190
1600	118 / 35	328 / 100	410.1 / 125

Table 10 Maximum cable length (longwave)

Data Transfer Rate (MB/s)	Cable length (km) OM3 cable
200, 400, 800, 1600	10

Drive chassis

The VSP G1000 and G1500 support three different drive chassis. The VSP F1500 only supports the FMD chassis. All components in the drive chassis are configured with redundant pairs to prevent system failure. While the storage system is in operation, all components in the drive chassis can be added or replaced. For detailed information about the drives in each chassis, see Storage system specifications on page 122.

- SFF - a 16U group of eight 2U drive trays. Each holds up to 24 vertically positioned 2.5-inch HDD and SSD drives, for a total of 192 drives per chassis. Each drive tray also contains two redundant power supplies, and two ENC adapters that connect the drives to the controller. The connection to the controller may be direct, or it can be connected through other SFF drive trays. See Figure 19 SAS Connection Diagram of Rack-00 (SFF/LFF Standard Model) on page 94.
- LFF - a 16U group of eight 2U drive trays. Each holds up to 12 horizontally positioned 3.5-inch drives, for a total of 96 drives per chassis. Each drive tray also contains two redundant power supplies, and two adapters that are used to connect the drives to the controller. The connection to the controller may be direct, or it can be connected through other LFF drive trays. See Figure 19 SAS Connection Diagram of Rack-00 (SFF/LFF Standard Model) on page 94.
- FMD - an 8U group comprising four 2U drive trays, each holds up to 12 horizontally mounted drives, with a total of 48 FMDs per chassis. Each drive tray also contains two redundant power supplies and two adapters that connects the drives to the controller. The connection to the controller may be direct, or it can be connected through other FMD drive trays. See Figure 21 SAS Connection Diagram of Rack-00 (FBX Standard Model) on page 96.

The following illustrations show the front and rear panels of the three types of 2U drive trays, and the following tables describe the connectors and LEDs.

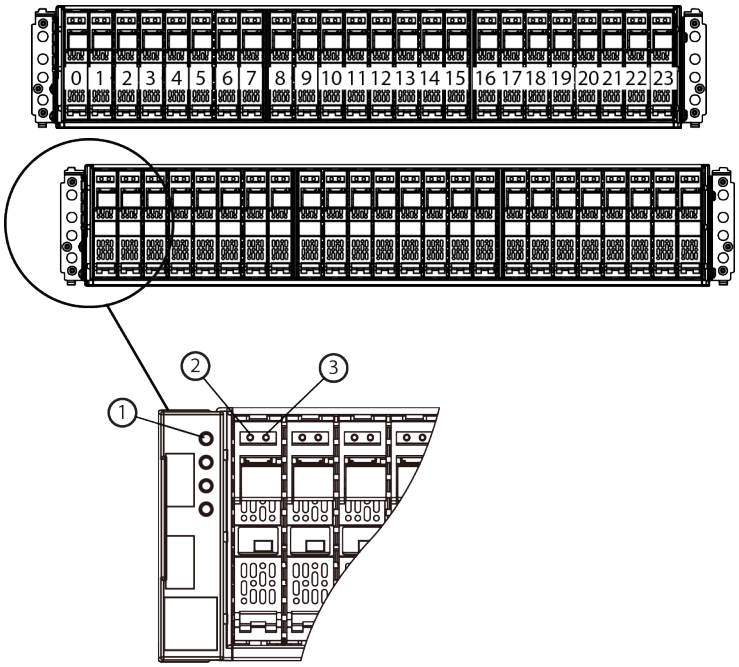


Figure 6 SFF 2U drive tray diagram and front view

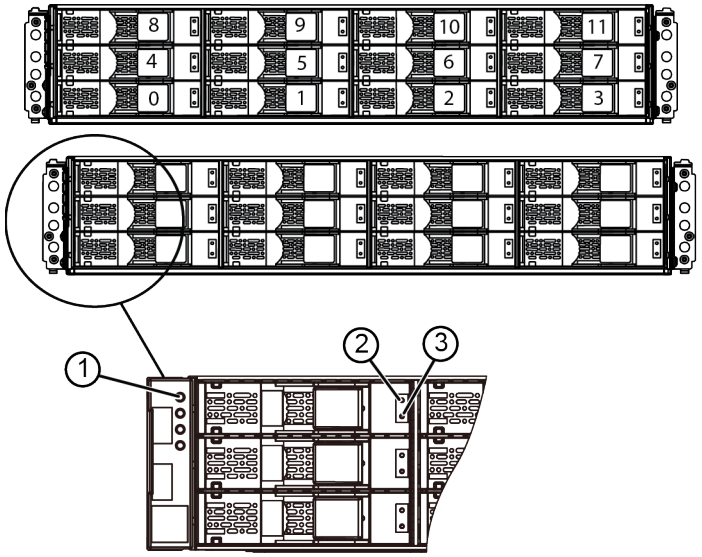


Figure 7 LFF 2U drive tray diagram and front view

Item	Name	Color	Description
1	POWER LED	Green	OFF - Power is not supplied to the system. ON - Power is supplied to the system.
	READY LED	Green	OFF - System is not operational.

Item	Name	Color	Description
			ON - Normal operation. Storage system is operational.Fast blink - internal processing. Storage system is operational. Slow blink - offline download processing completed (maintenance).
	LOCATE LED	Orange	OFF - Normal operation ON - Nonfatal error. Storage system can remain operating. Contact technical support. See *Getting Help* in the preface of this manual.
2	ALM LED (alarm)	Red	OFF - Normal operation ON - Fatal error. Contact technical support. See *Getting Help* in the preface of this manual.
3	ACT LED (Active)	Green	OFF - Drive is not being accessed. Blinking - Drive is being accessed.

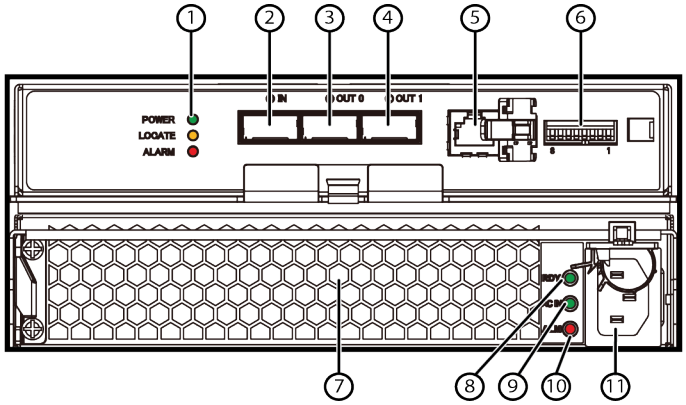


Figure 8 2U SFF and LFF drive tray, rear view

Item	Name	Color	Description
1	POWER LED	Green	OFF - No power is supplied to the system. ON - Power is supplied to the system.
	READY LED	Green	ON - Normal operation. Storage system is operational. Fast blink - Internal processing. Storage system is operational. Slow blink - Offline download processing completed (maintenance).
	LOCATE LED	Orange	ON - Nonfatal error. Storage system can continue operating. Contact technical support. See *Getting Help* in the preface of this manual.
2	ENC IN LED	Green	ON - Port is connected to an OUT port in the controller. This can be directly or via another drive box with daisy chained cables
3	ENC IN connector	-	Connects the drives to the ENC OUT port in the control chassis either directly or via another drive box with daisy chained cables.
4	ENC OUT connector	-	Connects the drives to the ENC IN port in the control chassis either directly, or via another drive box with daisy chained cables.

Item	Name	Color	Description
5	ENC OUT LED	Green	ON - Indicates that the port is connected to an IN port in the controller. This can be directly or indirectly, as described above.
6	Console port	-	RJ-45 connector (not used)
7	Power Supply	-	Converts 200 VAC to the DC voltages used by the drives and the ENC adapters.
8	RDY (Ready) LED	Green	OFF - No power is supplied to the system or the power supply has failed. ON - The power supply is operating normally.
9	AC IN LED	Green	ON - AC input is normal.
10	ALM (Alarm) LED	Red	Power supply has failed. Contact technical support. See *Getting Help* in the preface of this manual.
11	AC Socket	-	For IEC60320-C14 plug, 200 - 240 VAC +8% - 6% 50/60 Hz

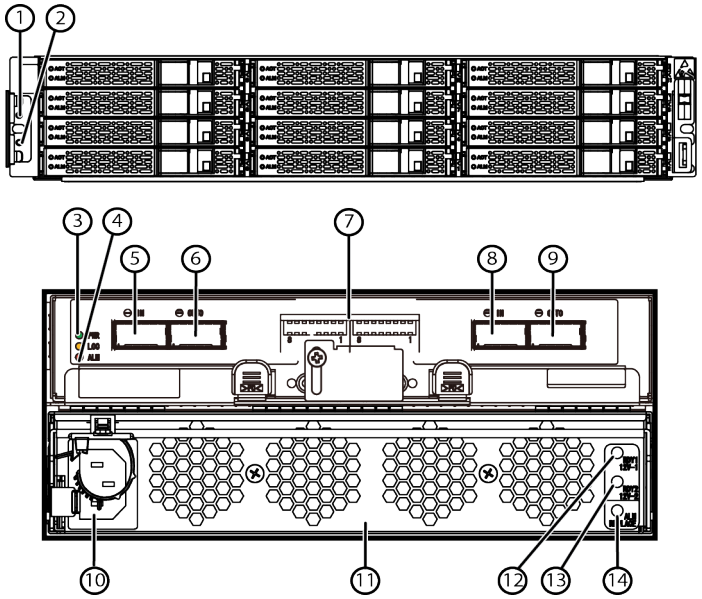


Figure 9 FMD drive tray

Item	Description
1	Flash module Active LED - Lights when the flash module is activated- Blinks at drive access.
2	Flash module Alarm LED - Lights when the flash module has an error and should be replaced.
3	SAS / ENC Module Power LED
4	SAS / ENC Module Alarm LED - Indicates fatal error condition.
5	SAS / ENC standard IN connector
6	SAS / ENC high performance IN connector
7	ENC adapter - Connects the flash modules to the BEDs in the controller via ENC cables.
8	SAS / ENC standard OUT connector

Item	Description
9	SAS / ENC high performance OUT connector
10	Power cord receptacle
11	Power Supply - 220 VAC input, draws approximately 265 watts.
12	Power Supply Ready 1 LED - Lights when 12 VDC power #1 is ready.
13	Power Supply Ready 2 LED - Lights when 12 VDC power #2 is ready.
14	Power Supply alarm LED - Lights when power supply has an error.

Cache memory

The VSP G1000, VSP G1500, and VSP F1500 can be configured with 64 GB to 1 TB of cache memory per controller. The cache memory is installed in one or two cache path control adapters (CPA). A CPA feature consists of a pair of redundant blades that are installed and work together to provide cache and shared memory for the system. The following figure shows two CPAs (2-3, and 1-4).

Cache memory modules (DIMMs) are available in either 16 GB or 32 GB sizes. The minimum memory required per controller is 64 GB, either two 16 GB DIMMs or one 32 GB DIMM must be installed in each CPA blade. The memory modules in a system must all be the same size.

The following table shows minimum and maximum cache capacities per controller. The figures are doubled for a two-controller system.

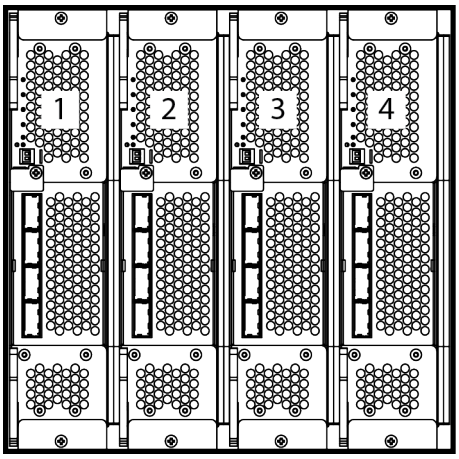
Table 11 Cache capacities per controller

# of controller chassis configuration	Capacity of cache memory module	Maximum cache capacity configurable based on the number of cache path control adapter pairs included:	
		1 cache path control adapter pair (Included with controller)	2 cache path control adapter pairs (One included with controller and an additional feature added)
VSP G1000, VSP G1500, and VSP F1500 including a Primary controller chassis only	16 GB	256 GB	512 GB
	32 GB	512 GB	1024 GB
VSP G1000, VSP G1500, and VSP F1500 including both a Primary and Secondary controller chassis	16 GB	512 GB	1024 GB
	32 GB	1024 GB	2048 GB

Notes:

1. One DIMM minimum, eight DIMMs maximum per board. Two blades/boards per CPA. One or 2 CPAs installed per controller.

# of controller chassis configuration	Capacity of cache memory module	Maximum cache capacity configurable based on the number of cache path control adapter pairs included:	
		1 cache path control adapter pair (Included with controller)	2 cache path control adapter pairs (One included with controller and an additional feature added)
2. HDS minimum cache per system is 64 GB whether configured with one or two controllers.			



Item	Description	Item	Description
2 & 3	Main (required) cache path control adapters	1 & 4	Optional cache path control adapters
1 & 2	Cluster 1	3 & 4	Cluster 0

Memory operation

The controller places all read and write data into the cache. The amount of fast-write data in cache is dynamically managed by the cache control algorithms to provide an optimum amount of read and write cache, depending on the workload read and write I/O characteristics.

Data protection

The VSP G1000, VSP G1500, and VSP F1500 storage systems are designed to protect the loss of data or configuration information stored in the cache when electrical power fails. The cache is kept active for up to 32 minutes by the cache backup batteries while the system configuration and data are copied to the cache flash memory in the cache backup modules. For more information, see Cache flash memory on page 48, and in Battery backup operations on page 112.

Cache capacity

The recommended amount of cache to install is determined by the RAID level, the number of drives installed in the system, and whether Hitachi Dynamic Provisioning (HDP), Hitachi Dynamic Tiering (HDT), Dynamic Cache Residency (DCR), and Universal Volume Manager (UVM) are applied or not. The recommended data cache capacity per Cache Logical Partition (CLPR) = (CLPR capacity) - (DCR Extent setting capacity per CLPR). When CLPR is not applied to DP/DT/DCR, install the recommended data cache capacity shown in the following table.

To configure a system for maximum performance, please contact your authorized Hitachi Data Systems representative. See *Getting Help* in the preface of this manual.

Table 12 Recommended data cache capacity when DP, DT, DCR, and UVM are not being used

Total logical capacity of external volumes + internal volumes per CLPR	Recommended data cache capacity per CLPR
Less than 2,900 GB	15 GB or more
less than 2,900 GB	15 GB or more
2,900 GB or more	16 GB or more
11,500 GB or more	22 GB or more
14,400 GB or more	24 GB or more
100,000 GB or more	30 GB or more
128,000 GB or more	32 GB or more
182,000 GB or more	40 GB or more
218,000 GB or more	48 GB or more
254,000 GB or more	56 GB or more
290,000 GB or more	64 GB or more
326,000 GB or more	72 GB or more

Shared memory

Shared memory holds storage system configuration information and it resides in the cache. The capacity of the shared memory + the capacity of the cache memory = the total capacity of the cache memory needed by the storage system.

The capacity overheads associated with the capacity saving function (deduplication and compression) include capacity consumed by metadata and capacity consumed by garbage (invalid) data. For more information, see the *Provisioning Guide for Open Systems*. The recommendation is to use 0.2% of active data size as cache size (200 GB of cache for every 100 TB of pool capacity to be reduced).

The following table shows the shared memory capacity needed depending on the kind of software applications installed in the system.

Number of CU	Determining factor of SM capacity									iSCSI	DC	SM capacity
	Software [1]					64KLDEV extension	DP/DT/AF/TI extension					
	SI/VM/NDM	DP/TI/FC	TPF	TC/UR/GAD	DT/AF		1	2	3			
1-64 (16k LDEV)	Apply	Apply	—	—	—	—	—	—	—	—	—	16 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	—	—	—	—	—	—	—	24 GB
1-64 (16k LDEV)	Apply	Apply	—	—	Apply	—	—	—	—	—	—	24 GB
1-64 (16k LDEV)	Apply	Apply	—	—	—	—	Apply	—	—	—	—	24 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	—	Apply	—	—	—	Apply	Apply	24 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	Apply	—	—	—	—	—	—	32 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	—	—	Apply	—	—	—	—	32 GB
1-64 (16k LDEV)	Apply	Apply	—	—	Apply	—	Apply	—	—	—	—	32 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	—	Apply	—	—	—	Apply	Apply	32 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	Apply	Apply	—	—	—	Apply	Apply	32 GB
1-255 (64k LDEV)	Apply	Apply	Apply		—	Apply	Apply	—	—	Apply	Apply	32 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	Apply	—	Apply	—	—	—	—	40 GB
1-64 (16k LDEV)	Apply	Apply	—	—	—	—	Apply	Apply	—	—	—	40 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	Apply	Apply	—	—	—	Apply	Apply	40 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	Apply	Apply	Apply	—	—	Apply	Apply	40 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	—	Apply	Apply	—	—	Apply	Apply	40 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	—	—	Apply	Apply	—	—	—	48 GB
1-64 (16k LDEV)	Apply	Apply	—	—	Apply	—	Apply	Apply	—	—	—	48 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	Apply	Apply	Apply	—	—	Apply	Apply	48 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	—	Apply	Apply	Apply	—	Apply	Apply	48 GB

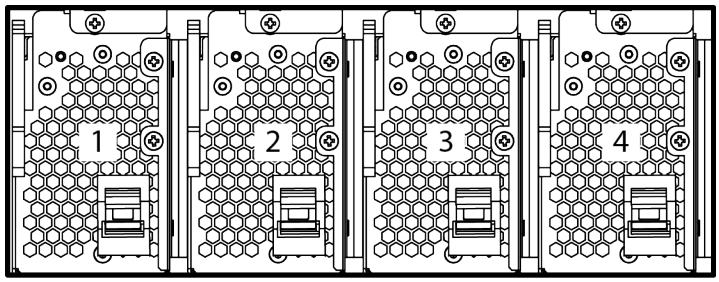
Number of CU	Determining factor of SM capacity									iSCSI	DC	SM capacity
	Software [1]					64KLDEV extension	DP/DT/AF/TI extension					
	SI/VM/NDM	DP/TI/FC	TPF	TC/UR/GAD	DT/AF		1	2	3			
1-64 (16k LDEV)	Apply	Apply	—	Apply	Apply	—	Apply	Apply	—	—	—	56 GB
1-64 (16k LDEV)	Apply	Apply	—	—	—	—	Apply	Apply	Apply	—	—	56 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	—	Apply	Apply	Apply	—	Apply	Apply	56 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	Apply	Apply	Apply	Apply	—	Apply	Apply	56 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	—	—	Apply	Apply	Apply	—	—	64 GB
1-64 (16k LDEV)	Apply	Apply	—	—	Apply	—	Apply	Apply	Apply	—	—	64 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	—	Apply	Apply	Apply	Apply	Apply	Apply	64 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	Apply	Apply	Apply	Apply	—	Apply	Apply	64 GB
1-64 (16k LDEV)	Apply	Apply	—	Apply	Apply	—	Apply	Apply	Apply	—	—	72 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	—	Apply	Apply	Apply	Apply	Apply	Apply	72 GB
1-255 (64k LDEV)	Apply	Apply	Apply	—	Apply	Apply	Apply	Apply	Apply	Apply	Apply	72 GB
1-255 (64k LDEV)	Apply	Apply	Apply	Apply	Apply	Apply	Apply	Apply	Apply	Apply	Apply	80 GB

1. Software includes the following applications:
- SI = ShadowImage
- HDP = Hitachi Dynamic Provisioning
- FC = Compatible FlashCopy® V2
- TC = TrueCopy
- HDT = Hitachi Dynamic Tiering
- NDM = nondisruptive migration
- VM = Volume Migration V2
- TI = Thin ImageVolume Migration V2
- TPF = Transaction Processing Facility
- UR = Universal Replicator
- GAD = global-active device
- DC = Deduplication and Compression

2. The required cache memory capacity is determined by the storage capacity and the number of Processor Blades.

Cache flash memory

The cache flash memory (CFM) is contained in the cache backup modules in the controller, along with the cache backup batteries. Like the cache memory, a CFM feature consists of a pair for redundancy purposes. They provide backup for the cache in case of power or component failure. The following figure shows two CPAs (2-3, and 1-4).



CFM operation

Each CFM blade connects directly to its corresponding CPA blade and backs up the data in that CPA blade if power fails. When data that is not stored on disk is written to the cache, it is written to one blade of the CPA and mirrored to the other. If one CFM fails, or one phase of the power fails, the other CFM backs up the mirrored data from its corresponding CPA blade, and no data is lost. In the unlikely event where a CFM has failed and a full power failure occurs, the other CFM backs up the mirrored data from the CPA without any loss of data.

Cache flash memory capacity

The recommended size of the installed cache flash memory depends on the size of the cache memory, and is automatically selected when defining the configuration for the system.

The following table shows CFM capacities per controller with both small and large cache memory backup assemblies.

Number of controllers	Number of CFM features (pairs of boxes)	Memory module size	CFM size[1]
1	1 CFM 2 boxes /SSDs	128 GB	256 GB
		256 GB	512 GB
	2 CFMs 4 boxes /SSDs	128 GB	512 GB
		256 GB	1 TB
2	1 CFM 2 boxes /SSDs	128 GB	512 GB
		256 GB	1 TB
	2 CFMs	128 GB	1 TB

Number of controllers	Number of CFM features (pairs of boxes)	Memory module size	CFM size[1]
	4 boxes /SSDs	256 GB	2 TB

Notes:

1. SDD sizes must be the same in all CFM. Cache must be distributed evenly across CFMs and controllers.

Note: The small CFM SSDs (128 GB) can be installed in the large cache backup, allowing for easier and less expensive upgrades.

2

Hardware architecture

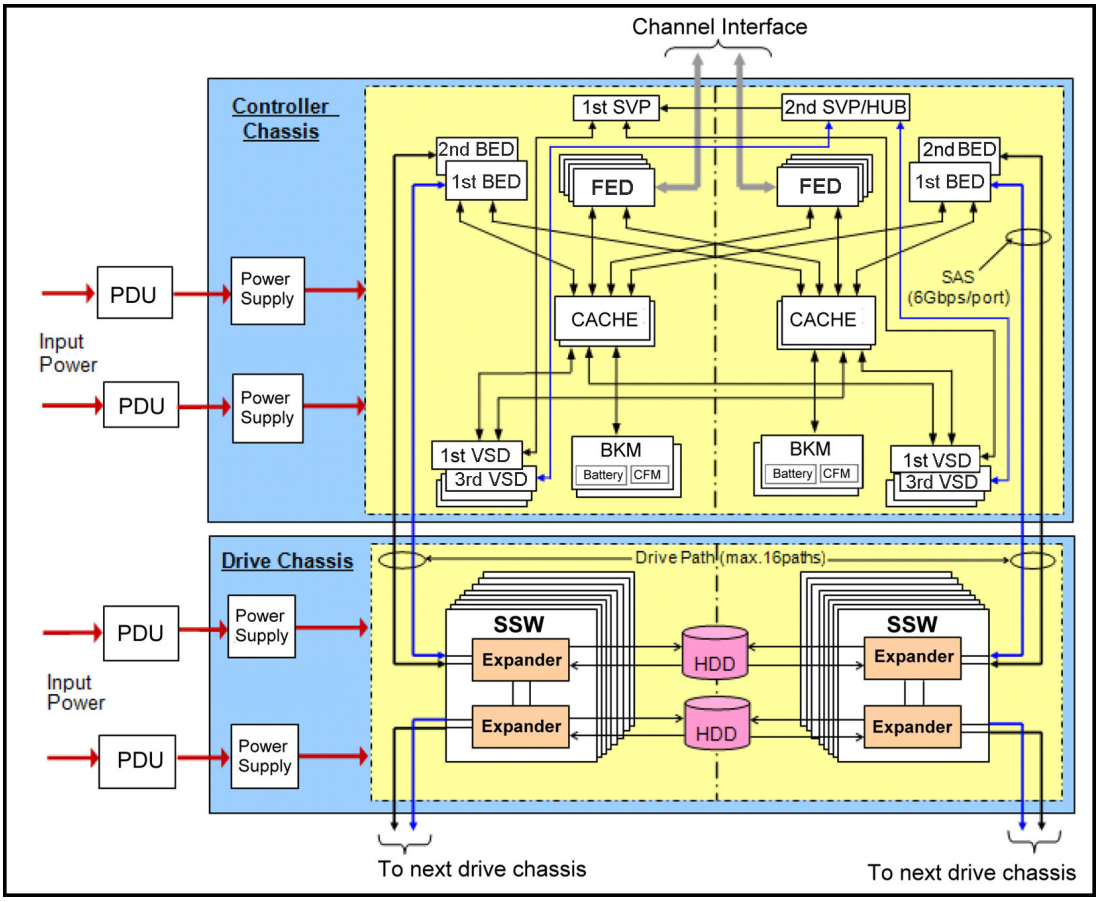
This chapter describes the VSP G1000, VSP G1500, and VSP F1500storage system architecture, including functional and operational specifications.

System architecture overview

The overview describes the architecture of the storage system.

Hardware architecture

The basic system architecture of a single controller is shown in the following diagram.



In this architecture, the virtual storage directors (microprocessors) are shared across the cache, front-end directors (host adapters), and back-end directors (disk adapters), providing processing power where and when it is needed, without wait time or interruption. This significantly increases the I/O throughput, up to three times the speed of the VSP system. The system provides a highly granular upgrade path, allowing the addition of drives to the drive chassis, and components such as virtual storage directors to the controller chassis as storage needs increase.

VSP G1000, VSP G1500, and VSP F1500 RAID implementation

The benefits of RAID technology are low cost, high reliability, and high I/O performance of data storage devices. To gain these benefits, this storage system supports RAID levels 1, 5 and 6. The features of the levels of RAID technologies are described below.

Array groups and RAID levels

An array group (also called parity group) is the basic unit of storage capacity for the storage system. In RAID 1, an array group is a set of four physical drives where one drive is installed in the same location in each of four contiguous disk trays in the same drive chassis. The following figure shows part of a SFF drive chassis where two RAID 1 array groups are set up. RAID group 1 consists of the drives highlighted by yellow rectangles. RAID group 2 is shown by the red rectangles.

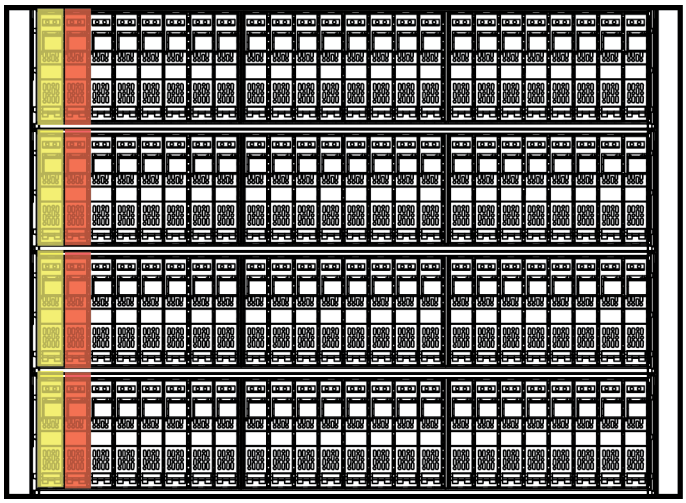


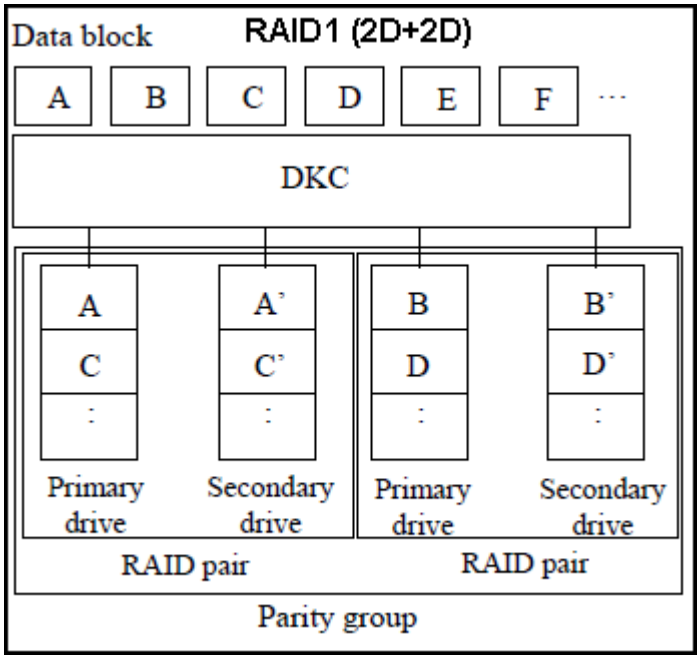
Figure 10 RAID group example

In the above figure, the drives with the red rectangles are unformatted physical drives so they are called an array group. The drives with the yellow rectangles have been formatted as a RAID level and have initial parity data on them, so they are called a parity group. Generally, this technical distinction is often lost, and the terms parity group and array group are often used interchangeably.

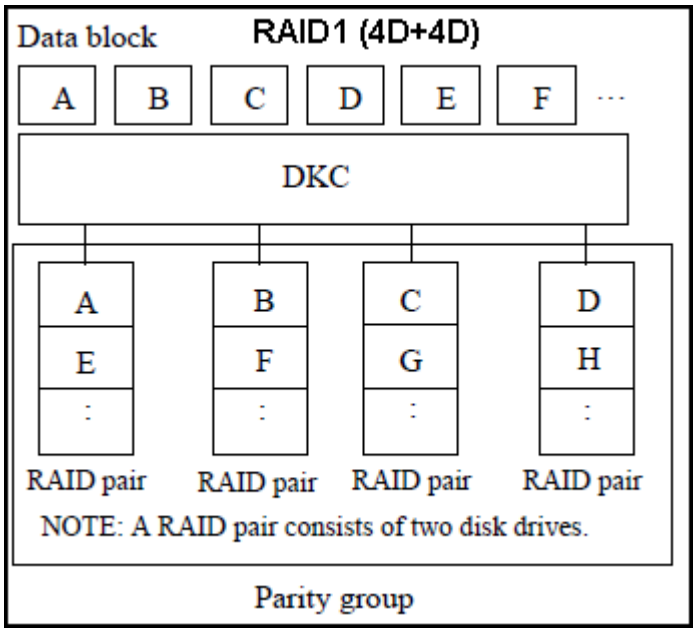
The storage system supports the following RAID levels: RAID 1, RAID 5, and RAID 6. When configured in four-drive RAID 5 parity groups (3D+1P), seventy-five percent of the raw capacity is available to store user data, and twenty-five percent of the raw capacity is used for parity data.

RAID 1

The following two figures illustrate the RAID 1 configurations. The tables following the figures describes each configuration.



Item	Description
Description	Mirror disks (duplicated writing). Two disk drives, primary and secondary disk drives, compose a RAID pair (mirroring pair) and the identical data is written to the primary and secondary disk drives. The data is distributed on the two RAID pairs.
Advantage	RAID 1 is highly usable and reliable because of the duplicated data. It has higher performance than ordinary RAID 1 (when it consists of two disk drives) because it consists of the two RAID pairs.
Disadvantage	Requires disk capacity twice as large as the user data.



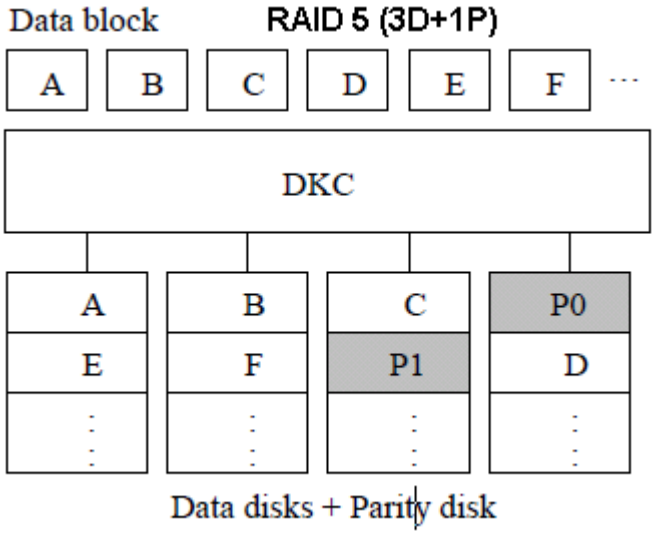
Item	Description
Description	Mirror disks (duplicated writing). The two parity groups of RAID 1(2D+2D) are concatenated and data is distributed on them. In the each RAID pair, data is written in duplicate.
Advantage	This configuration is highly usable and reliable because of the duplicated data. It has higher performance than the 2D+2D configuration because it consists of the four RAID pairs.
Disadvantage	Requires disk capacity twice as large as the user data.

RAID 5

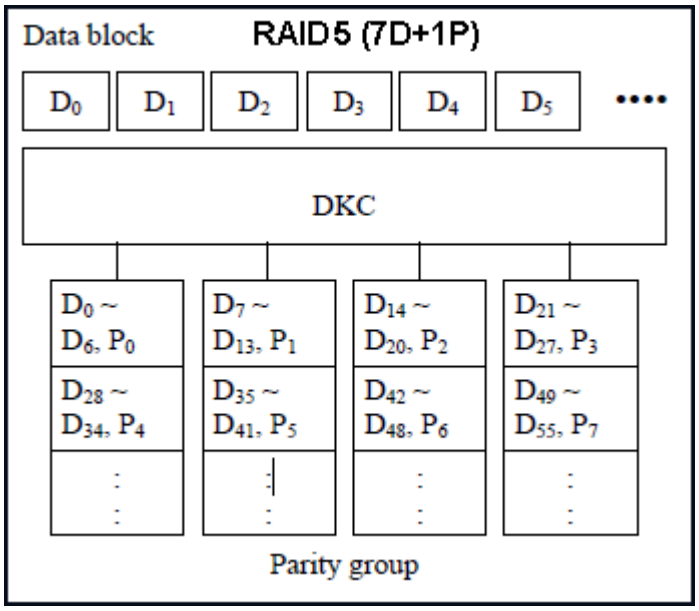
A RAID 5 array group consists of four or eight drives (3D+1P) or (7D+1P). The data is written across the four or eight drives in a stripe that has three or seven data chunks and one parity chunk. Each chunk contains either eight logical tracks (mainframe) or 768 logical blocks (open). This RAID 5 implementation minimizes the write penalty incurred by standard RAID 5 implementations by keeping write data in cache until the entire stripe can be built, and then writing the entire data stripe to the drives. The 7D+1P RAID 5 configuration increases usable capacity and improves performance.

The following two figures illustrate the RAID 5 configurations. The tables following the figures describes each configuration.

Note: There are two configurations of RAID 5: 3D+1P configuration (four disk drives) and 7D+1P configuration (eight disk drives). The following diagram shows the 3D+1P configuration. In the 7D+1P configuration, data is arranged in the same way.



Item	Description
Description	Data is written to multiple disks successively in units of block (or blocks). Parity data is generated from data of multiple blocks and written to disk.
Advantage	RAID 5 is well suited to support transaction operations that mainly use small size random access because each disk can receive I/O instructions independently. It can provide high reliability and usability at a comparatively low cost by virtue of the parity data.
Disadvantage	Write penalty of RAID 5 is larger than that of RAID 1 because pre-update data and pre-update parity data must be read internally as the parity data is updated when data is updated.



Item	Description
Description	In the case of RAID 5 (7D+1P), two or four parity groups (eight drives) are concatenated, and the data is distributed and arranged in 16 drives or 32 drives.
Advantage	If a RAID 5 (3D+1P) parity group becomes a performance bottleneck, you might achieve performance improvement through the added drives in a RAID5 (7D +1P) configuration.
Disadvantage	The impact when two drives are blocked is significant because twice or four times the numbers of LDEVs are arranged in the parity group when compared with RAID 5 (3D+1P). However, the chance that the read of the single block in the parity group cannot be performed due to failure is the same as that of RAID 5 (3D+1P).

Figure 11 Sample RAID 5 3D + 1P Layout (Data Plus Parity Stripe) on page 58 shows RAID 5 data stripes mapped across four physical drives. Data and parity are striped across each drive in the array group (hence the term "parity group"). The logical devices (LDEVs) are dispersed evenly in the array group, so that the performance of each LDEV within the array group is the same. This figure also shows the parity chunks that are the Exclusive OR (XOR) of the data chunks. The parity and data chunks rotate after each stripe. The total data in each stripe is 2304 blocks (768 blocks per chunk) for Open-systems data. Each of these array groups can be configured as either 3390-x or OPEN-x logical devices. All LDEVs in the array group must be the same format (3390-x or OPEN-x). For Open systems, each LDEV is mapped to an SCSI address, so that it has a track identifier (TID) and logical unit number (LUN).

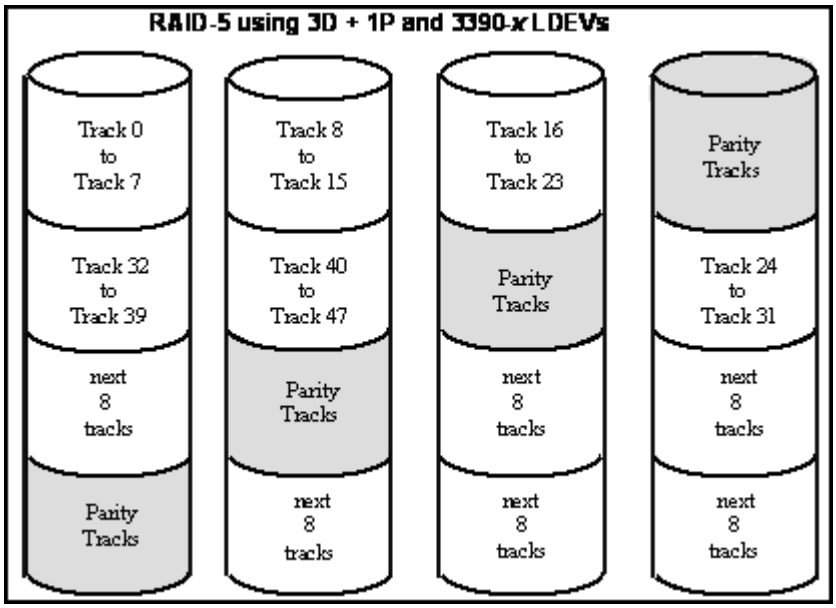


Figure 11 Sample RAID 5 3D + 1P Layout (Data Plus Parity Stripe)

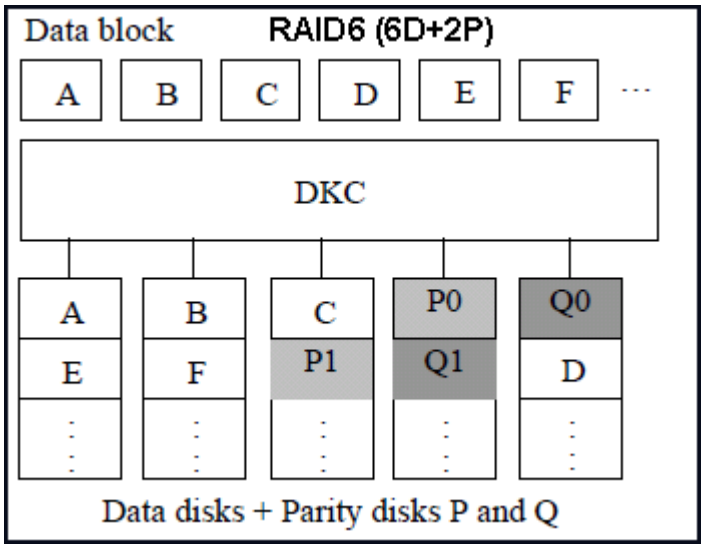
RAID 6

A RAID 6 array group consists of eight drives (6D+2P). The data is written across the eight drives in a stripe that has six data chunks and two parity chunks. Each chunk contains 768 logical blocks.

In RAID 6, data can be assured when up to two drives in an array group fail. Therefore, RAID 6 is the most reliable of the RAID levels.

The following figure illustrates the RAID 6 configuration and the table describes the configuration.

Note: There are two configurations of RAID 6: 6D+2P configuration (eight disk drives) and 14D+2P configuration (sixteen disk drives). The following diagram shows the 6D+2P configuration.



Item	Description
Description	Data blocks are scattered to multiple disks in the same way as RAID 5 and two parity disks, P and Q, are set in each row. Therefore, data can be assured even when failures occur in up to two disk drives in a parity group.
Advantage	RAID 6 is much more reliable than RAID 1 and RAID 5 because it can restore data even when failures occur in up to two disks in a parity group.
Disadvantage	The parity data P and Q must be updated when data is updated, RAID6 imposes a write heavier than that on RAID 5, performance of the random writing is lower than that of RAID 5 in the case where the number of drives makes a bottleneck.

LDEV striping across array groups

In addition to the conventional concatenation of RAID1 array groups (4D +4D), the storage system supports LDEV striping across multiple RAID5 array groups for improved logical unit performance in Open-system environments. The advantages of LDEV striping are:

- Improved performance, especially of an individual logical unit, due to an increase in the number of drives that constitute an array group.
- Superior workload distribution: If the workload of one array group is higher than another array group, you can distribute the workload by combining the array groups, thereby reducing the total workload concentrated on each specific array group.

The supported LDEV striping configurations are:

- LDEV striping across two RAID5 (7D+1P) array groups. The maximum number of LDEVs in this configuration is 1000. See the following figure.
- LDEV striping across four RAID5 (7D+1P) array groups. The maximum number of LDEVs in this configuration is 2000. See Figure 13 LDEV Striping Across 4 RAID5 (7D+1P) Array Groups on page 61.

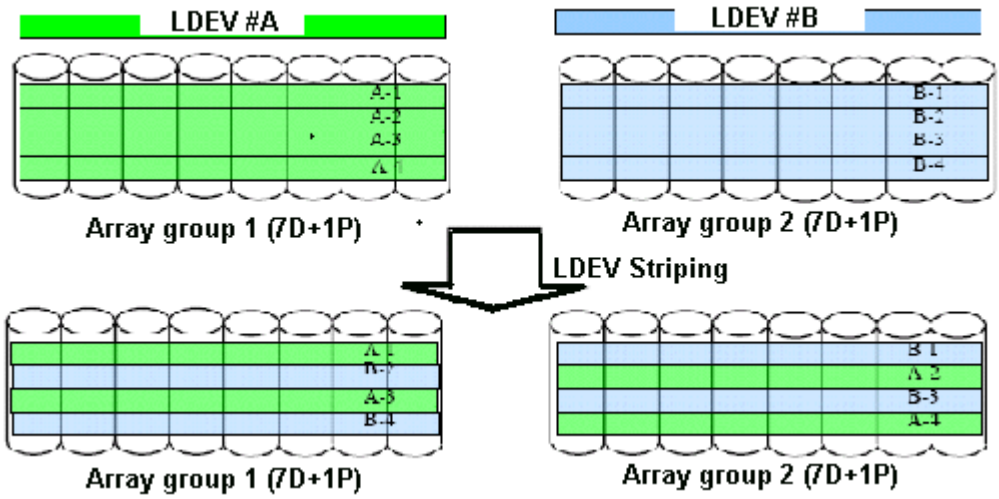


Figure 12 LDEV Striping Across 2 RAID5 (7D+1P) Array Groups

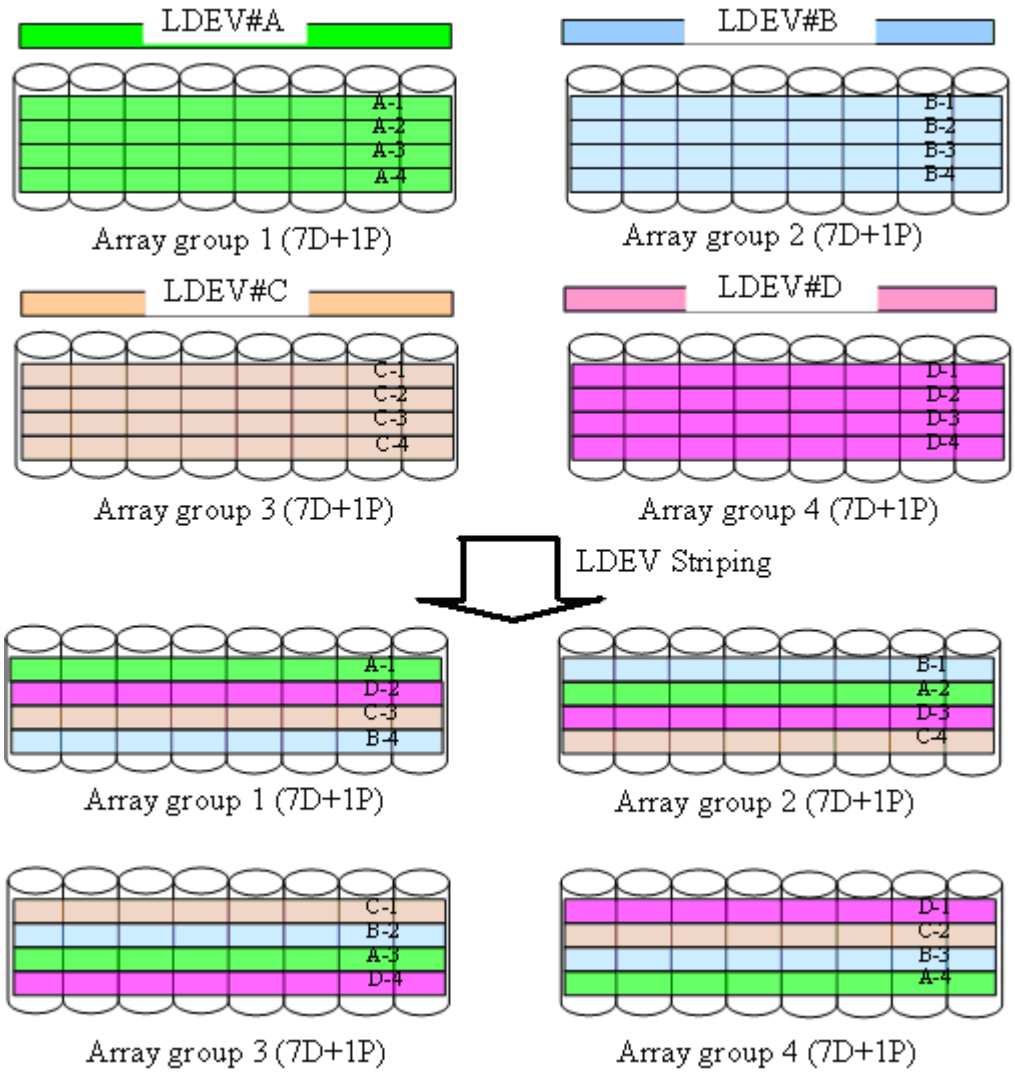


Figure 13 LDEV Striping Across 4 RAID5 (7D+1P) Array Groups

All drives and device emulation types are supported for LDEV striping. LDEV striping can be used with all storage system data management functions.

CU images, LVIs, and logical units

This section provides information about control unit images, logical volume images, and logical units.

CU images

The storage system is configured with one control unit image for each 256 devices (one SSID for each 64 or 256 LDEVs) and supports a maximum of 255 CU images in the primary logical disk controller (LDKC).

The storage system supports the following control unit (CU) emulation types:

- 3990-6, 3990 6E
- 2107

The mainframe data management features of the storage system may have restrictions on CU image compatibility.

For more information on CU image support, see the *Mainframe Host Attachment and Operations Guide*, or contact your Hitachi Data Systems account team.

Logical volume images

The VSP G1000, VSP G1500, and VSP F1500 support the following Mainframe LVI types:

- 3390-3, -3R, -9, L, and -M.
- The 3390-3 and 3390-3R LVIs cannot be intermixed in the same storage system.

The LVI configuration of the storage system depends on the RAID implementation and physical data drive capacities. The LDEVs are accessed using a combination of logical disk controller number (00), CU number (00-FE), and device number (00-FF). All control unit images can support an installed LVI range of 00 to FF.

For maximum flexibility in LVI configuration, the storage system provides the Virtual LVI feature. Using Virtual LVI, users can configure multiple LVIs under a single LDEV. For further information on Virtual LVI, see the *Provisioning Guide for Mainframe Systems*.

Logical units

The storage system is configured with OPEN-V logical unit types. The OPEN-V logical unit can vary in size from 48.1 MB to 4 TB. For information about other logical unit types, for example, OPEN-9, contact Hitachi Data Systems support.

For maximum flexibility in LU configuration, the storage system provides the Virtual LUN feature. Using Virtual LUN, users can configure multiple LUs under a single LDEV. For further information on Virtual LUN, see the *Provisioning Guide for Open Systems*.

Mainframe operations

This section provides high-level descriptions of Mainframe compatibility, support, and configurations.

Mainframe compatibility and functionality

In addition to full System Managed Storage (SMS) compatibility, the storage system provides the following functions and support in a Mainframe environment:

- Sequential data striping
- Cache fast write (CFW) and DASD fast write (DFW)
- Enhanced dynamic cache management
- Extended count key data (ECKD) commands
- Multiple Allegiance
- Concurrent Copy (CC)
- Peer-to-Peer Remote Copy (PPRC)
- Compatible FlashCopy® V2
- Parallel Access Volume (PAV)
- Enhanced CCW
- Priority I/O queuing
- Red Hat Linux for IBM S/390 and zSeries

Mainframe operating system support

The VSP G1000, VSP G1500, and VSP F1500 storage systems support most major IBM Mainframe operating systems. For more information about supported operating systems, see the Mainframe support matrix on https://support.hds.com/en_us/interoperability.html.

Mainframe configuration

After a storage system installation is complete, users can configure the storage system for Mainframe operations.

See the following user documents for information and instructions about configuring your storage system for Mainframe operations:

- The *Mainframe Host Attachment and Operations Guide*, describes and provides instructions for configuring the storage system for Mainframe operations, including FICON attachment, hardware definition, cache operations, and device operations.
  For detailed information about FICON connectivity, FICON or Open intermix configurations, and supported HBAs, switches, and directors for VSP G1000, VSP G1500, and VSP F1500, contact customer support.
- The *Hitachi Command Suite Installation and Configuration Guide* or *System Administrator Guide* provides instructions for installing, configuring, and using Device Manager - Storage Navigator to perform resource and data management operations on the storage systems.
- The *Provisioning Guide for Mainframe Systems* and *Hitachi Volume Shredder User Guide*, provide instructions for converting single volumes (LVIs) into multiple smaller volumes to improve data access performance.

Systems operations

This section provides high-level descriptions of compatibility, support, and configuration for storage systems.

Compatibility and functionality

The VSP G1000, VSP G1500, and VSP F1500 storage system supports many features and functions for the Open-systems environment, including:

- Multi-initiator I/O configurations with multiple host systems attached to the same Fibre Channel interface
- Fibre Channel Arbitrated Loop (FC-AL) and fabric topologies, supported on ports up to 8 Gbps

Note: When using 16 Gbps FC front-end director, the speed is limited to 8 Gbps.

- Command tag queuing
- Industry-standard failover and logical volume management software
- SNMP remote storage system management

The global cache feature in VSP G1000, VSP G1500, and VSP F1500 enables any Fibre Channel port to have access to any logical unit in the storage system. Each logical unit can be assigned to multiple Fibre Channel ports to provide I/O path failover and load balancing (with the appropriate middleware support, such as HGLM) without sacrificing cache coherency.

Users should plan for path failover (alternate pathing) to ensure the highest data availability. The logical units can be mapped for access from multiple ports or multiple target IDs. The number of connected hosts is limited only by the number of FC ports installed and the requirement for alternate pathing within each host. If possible, the primary path and alternate paths should be attached to different channel cards.

Systems host platform support

The VSP G1000, VSP G1500, and VSP F1500 storage systems support most major open-system operating systems, including Microsoft Windows, Oracle Solaris, IBM AIX, Linux, HP-UX, and VMware. For complete information about supported operating systems, visit https://support.hds.com/en_us/interoperability.html. The supported platforms are documented in the *Open-Systems Host Attachment Guide*.

For a complete list of the storage system user guides, including the host configuration guides, see the *Product Overview*.

System configuration

After physical installation of the storage system is complete, users can configure the storage system for open-systems operations with assistance from a Hitachi Data Systems representative, if necessary.

Refer to the following documents for information and instructions about configuring your storage system for open-systems operations:

- The host attachment guide provides information and instructions to configure the storage system and data storage devices for attachment to the open-systems hosts.

  Note: Queue depth and other parameters may need to be adjusted for the storage system. See the host attachment guide for queue depth and other requirements.

- The *Hitachi Command Suite Installation and Configuration Guide* or the *System Administrator Guide* provides instructions for installing, configuring, and using Device Manager - Storage Navigator to perform resource and data management operations on the storage system.
- The *Provisioning Guide for Open Systems* describes and provides instructions for configuring the storage system for host operations, including FC port configuration, LUN mapping, host groups, host modes and host mode options, and LUN security.
  Each Fibre Channel port on the storage system provides addressing capabilities for up to 2,048 LUNs across as many as 255 host groups, each with its own LUN 0, host mode, and host mode options. Multiple host groups are supported using LUN security.
- The *Hitachi SNMP Agent User Guide* describes the SNMP API interface for the storage systems and provides instructions for configuring and performing SNMP operations.
- The *Provisioning Guide for Open Systems* and *Hitachi Volume Shredder User Guide* provide instructions for configuring multiple custom volumes (logical units) under single LDEVs on the VSP G1000, G1500, and VSP F1500 . The *Provisioning Guide for Open Systems* also provides instructions for configuring size-expanded logical units by concatenating multiple logical units to form individual large logical units.

Host modes and host mode options

The VSP G1000, VSP G1500, and VSP F1500 support connection of multiple server hosts of different platforms to each of its ports. When your system is configured, the hosts connected to each port are grouped by host group or by target. For example, if Solaris and Microsoft Windows hosts are connected to separate Fibre Channel ports, or through a switch to a single Fibre Channel

port, a host group is created for the Solaris hosts and another host group is created for the Windows hosts. The appropriate host mode and host mode options are assigned to each host group. The host modes and host mode options provide enhanced compatibility with supported platforms and environments.

The host groups, host modes, and host mode options are configured by using Device Manager - Storage Navigator. For more information about host groups, host modes, and host mode options, refer to the *Provisioning Guide for Open Systems*.

Device Manager - Storage Navigator

Device Manager - Storage Navigator is the GUI that accesses the features in the firmware. The GUI is also used to set up and monitor the storage system. It can be installed on a PC, laptop, or workstation. It communicates via a LAN to the SVP in the storage system. The SVP obtains storage system configuration and status information and sends user-initiated commands to the storage system. The Device Manager - Storage Navigator displays detailed storage system information and allows users to configure and perform storage operations on the system.

Device Manager - Storage Navigator is provided as a Java® applet program that can be executed on any machine that supports a Java Virtual Machine (JVM). A PC hosting the Device Manager - Storage Navigator software is called a remote console. Each time a remote console accesses and logs into the SVP of the desired storage system, the Device Manager - Storage Navigator applet is downloaded from the SVP to the remote console. The following figure shows the remote console and SVP configuration for Device Manager - Storage Navigator.

For more information about Device Manager - Storage Navigator, see the *Hitachi Command Suite Installation and Configuration Guide* or the *System Administrator Guide*.

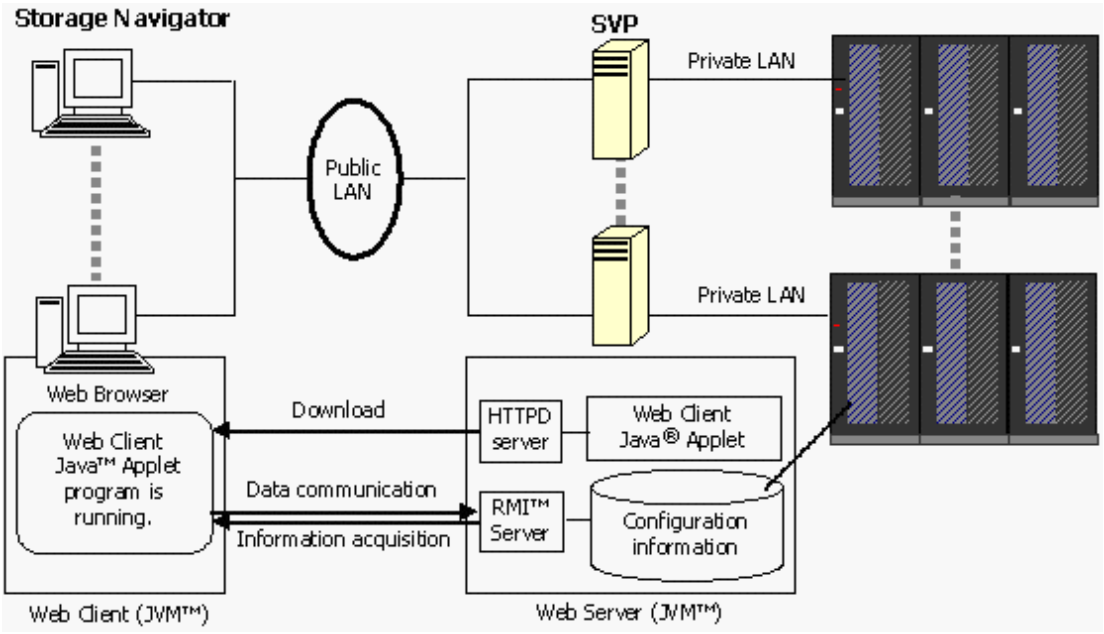


Figure 14 Device Manager - Storage Navigator and SVP Configuration

3

Safety requirements

Install Hitachi equipment in accordance with the local safety codes and regulations that apply to the facility. This chapter describes additional safety information that may apply to your facility. Read and follow the safety guidelines in this chapter before installing the equipment. The key sections in this chapter include:

- ☐ General safety guidelines
- ☐ Work safety guidelines

General safety guidelines

Observe the following general site guidelines:

- **General requirements:** The data center must comply with all applicable safety regulations, standards, and requirements for installing and operating industrial computer equipment similar to a storage system.
- **Fire protection:** The data center must have an operational fire protection system appropriate for use with computer and electrical equipment.
- **Hazards:** The data center must be free of hazards (for example, cables on the floor that can block access or cause people to trip).
- **Equipment modifications:** Do not make mechanical or electrical modifications to the equipment. Hitachi Data Systems is not responsible for regulatory compliance of a modified Hitachi Data Systems product.
- **Earthquake Safety:** To minimize personal injury in the event of an earthquake, securely fasten the control and drive chassis to a rigid structure extending from the floor to the ceiling or from the walls of the room in which the system is located.
- **Cabling:** Do not block walkways when routing cables. Do not place heavy materials on cables. Do not place cables near any possible source of heat.
- **Warning and safety labels:** Safety warnings, cautions, and instructions in various languages are attached to the storage system components. The safety warnings provide guidelines to follow when working with any equipment. Before working on the storage system, read all safety and warning labels attached to it. If the labels become dirty, damaged, unreadable, or peel off, contact the Hitachi Data Systems support center.
- **Authorized personnel:** Allow only qualified and authorized personnel (for example, a certified electrician) to perform hazardous tasks.

Work safety guidelines

Observe the following site guidelines:

- Do not wear loose clothing that could get caught in the equipment or mounting hardware. Fasten your tie or scarf and roll up your sleeves.
- 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.
- Keep walkways clear of tools, power cables, and parts to prevent them from being stepped on or causing people to trip and fall over them.
- 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.
- Keep floors dry to prevent slips and falls.
- Do not use ungrounded power cables.

- Keep the area clear and dust-free during and after installation.
- Do not block or cover equipment openings. Ensure that all equipment has adequate airflow. Failure to follow these guidelines can cause overheating and affect the system reliability.
- If you notice unusual heat generation, odors, or smoke emission, shut off the power feed to the equipment and contact a maintenance engineer. Leaving such conditions unattended may result in hazardous physical conditions and equipment failure.
- The rack is equipped with casters so that it can be moved short distances to position it for final installation. Use enough personnel (minimum of two) when moving a rack, especially on sloping loading docks and ramps to a raised computer room floor. Move the cabinet slowly and deliberately, and make sure that the floor is free from foreign objects and cables that the cabinet could roll over.

Warning: To avoid injury, wear protective footwear when moving equipment.

Warning about moving parts

Even though customers do not install or maintain equipment, these guidelines are provided to prevent possible injury when working with authorized service personnel. Observe the following warning related to moving parts:

- Tuck in any loose clothing so that it cannot be caught by a moving or rotating part such as a fan.
- Tie up long hair.
- Unless otherwise specifically instructed, do not supply power to any device that contains rotating or moving parts that are not properly covered.

Electrical safety guidelines

Even though customers do not install or maintain equipment, these guidelines are provided to prevent possible injury when working with authorized service personnel in the area where equipment is installed. Observe the following electrical safety guidelines:

- Disconnect all power before installation, deinstallation, or moving equipment.
- Ensure that the voltage and frequency of your power source match the voltage and frequency required by the system.
- All equipment should be properly grounded for proper operation and safety. To reduce the risk of electric shock or damage to equipment, follow proper grounding procedures.

Preventing electric shock

- Before starting work, note where the emergency power-off switches are located, and be sure you know how to operate them.

- Before starting work, be sure there are no potential electric hazards in the maintenance area such as insufficient grounding or a wet floor.

4

Site preparation

This chapter provides site and system requirements, and specifications to plan for an efficient storage system installation.

This chapter may not provide all the information for every installation. The installation and maintenance guides used by Hitachi Data Systems personnel contain complete information, including specifications for all possible installations. If you need additional information, contact customer support.

- ☐ Safety requirements
- ☐ Responsibilities
- ☐ Site preparation checklist
- ☐ General site requirements
- ☐ Data center requirements
- ☐ Operational requirements
- ☐ System specifications and requirements
- ☐ Power connection diagrams
- ☐ Data connection diagrams
- ☐ Long cable connections
- ☐ Port configurations

Safety requirements

Caution: Before operating or servicing the storage system, read the safety and environmental information in Safety requirements on page 69.

Responsibilities

The responsibilities for site planning and preparation are shared by the system users and Hitachi Data Systems support. The required installation planning tasks must be scheduled and completed to ensure a successful and efficient installation of the storage system.

Note: The storage system must be installed by trained Hitachi Data Systems personnel or trained authorized service providers. The storage system is not a customer-installable product.

User responsibilities

You are responsible for completing the following tasks and preparing your site for installation of the storage system.

- Understand the applicable safety requirements associated with installing a storage system.
- Understand the installation requirements for the storage system. You can use the information in this manual to determine the specific requirements for your installation. As needed, review the to familiarize yourself with the components, features, and functions of the storage system.
- Verify that the installation site meets all installation requirements. A checklist is included in this section to help you with this task.
- Provide electrical hardware, including cables, connectors and receptacles that are required to connect the storage system to site power.
- As needed, work with Hitachi Data Systems support to create an installation plan. Allow enough time to complete any changes to the plan, so your site is ready when the equipment arrives.

Hitachi Data Systems responsibilities

Hitachi Data Systems support is responsible for completing the following tasks:

- Provide proper assistance during the installation planning process for your specific site and operational configuration
- Coordinate Hitachi Data Systems resources to ensure a successful installation and configuration of the storage system.

Site preparation checklist

The following checklist can help you ensure that your site meets all requirements to install a storage system. You can make copies of this checklist for each installation you perform and check each step after it has been performed. Completing this checklist can help ensure smooth and efficient installation of a storage system.

Definition of terms

Equipment

The hardware delivered to the customer site that includes the storage system components. The system may be installed in a Hitachi rack when delivered or assembled on site. The delivered equipment may include only the system components if the customer supplies a standard 19-inch rack. Rack specifications are contained in the *Hitachi Universal V2 Rack Reference Guide*, MK-94HM8035.

Location

The specific location in the data center (area or "footprint" on the floor) where the storage system will be installed.

User Information	
Company	
Address	
Contact	
Phone	
Mobile	
Email	
Contact	
Phone	
Mobile	
Email	
Hitachi Data Systems Information	
Contact	
Phone	
Mobile	
Email	
Contact	
Phone	
Mobile	
Email	
Notes	

Preinstallation Checklist		Yes	No
Safety Requirements See Safety requirements on page 69.			
Does the data center provide appropriate fire protection for the storage systems?			
Is the data center free of hazards such as cables that obstruct access to the equipment?			
Delivery Requirements See General site requirements on page 77			
Is the receiving area adequate for equipment delivery, unloading, and unpacking?			
Are all doors, hallways, elevators, and ramps wide enough and high enough to allow the equipment to be moved from the receiving area to the installation area?			
Can the floors, elevators, and ramps support the weight of the equipment? See General site requirements on page 77.			
Storage Requirements See System storage requirements on page 78.			
If the equipment will be stored after delivery and prior to installation, does the storage location meet the environmental requirements for storing the storage system?			
Facilities Requirements See Data center requirements on page 78.			
Does the data center have a raised floor?			
Does the location meet the requirements for service clearance and cable routing (for example, floor cutouts)? See Equipment clearances on page 77.			
Does the installation site meet the floor load rating requirements?			
Power Requirements See Electrical specifications on page 81.			
Does the data center meet the AC input power requirements? See Electrical specifications on page 81, Power connection on page 82, and Electrical specifications on page 127.			
Does the data center meet the circuit breaker and plug requirements? See Data center requirements on page 78.			
Is the customer-supplied hardware such as connectors, receptacles, and cables ready for the installation?			
Environmental Requirements See general Environmental specifications on page 83 and detailed Environmental specifications on page 129.			
Does the data center meet the following operational environmental requirements for the storage system?			
	Temperature		
	Humidity		

Preinstallation Checklist		Yes	No
	Altitude		
	Air flow		
Does the data center provide adequate protection for a storage system from the following?			
	Electrostatic discharge		
	Electrical/radio frequency interference		
	Dust, pollution, and particulate contamination		
Does the data center provide adequate acoustic insulation to operate the storage system?			
Operational Requirements See Operational requirements on page 79.			
Does the data center provide a LAN for Device Manager - Storage Navigator?			
Does the location meet the cable length requirements for the front-end directors?			
Does the location meet the requirements for attaching external storage?			

General site requirements

The customer site must accommodate the delivery and movement of the equipment from the receiving dock to the installation location in the data center.

Equipment clearances

Receiving area

The receiving dock, storage area, and receiving area must be large enough to allow movement of and access to crated or packed equipment.

Other areas

The hallways, doorways, ramps and elevators must be wide enough to allow a single unpacked rack to be moved to the installation location. If there is insufficient space for unpacking, the storage systems are typically unpacked in the receiving area and the individual racks with pre-installed equipment are rolled into the data center. For information about rack dimensions, refer to the *Hitachi Universal V2 Rack Reference Guide*, MK-94HM8035.

Equipment weight

The floors, elevators, and ramps must be able to support the weight of the delivered equipment as it is moved to the installation location. Spreader

plates may be required to distribute the load and protect the floor as the equipment is moved from the receiving area to the installation location. Consult the system bill of materials to establish the approximate weight of the equipment. See the next paragraph for information about calculating the exact weight of the equipment.

The weight for a fully configured 2-controller, 6-rack storage system can reach 6,146 pounds / 2,917 kilograms. The exact weight of the equipment depends on the storage system configuration. The following table provides weights of typical system configurations.

Note: The data in the following table was taken from measurements of a system in a controlled environment. To calculate the power draw, current draw, and heat output of a specific system, see Component weight, heat, airflow, and power consumption on page 84 or (easier) use the power and weight calculator at the following URL: http://www.hds.com/go/weight-and-power-calculator.

Contact technical support if you need assistance using this tool.

System storage requirements

If the equipment must be stored after delivery and prior to installation, the storage location must meet the storage environmental requirements for the storage system. See Table 18 VSP G1000, VSP G1500, and VSP F1500 environmental specifications on page 83 for specifications.

Data center requirements

The data center must meet the following general requirements. Detailed mechanical, electrical, and environmental requirements are listed below.

Table 13 Data center requirements

Item	Description
General	The data center must provide appropriate power, air conditioning, cabling, and fire protection.
Temperature	The data center must maintain ambient temperature from 50º F (10ºC) to 95º F (35ºC).
Humidity	The data center must maintain ambient humidity from 20% to 80%, non-condensing.
ESD	The data center must provide adequate protection from electrostatic discharge (ESD).
Electrical interference	The data center must provide adequate protection from electrical/radio frequency interference.
Contamination	The data center must provide adequate protection from dust, pollution, and particulate contamination.

Item	Description
Acoustics	The data center must provide adequate acoustic insulation for operating the system.
User-supplied hardware	This includes cables, connectors, and power receptacles that must be available and ready when the system is installed.
User-supplied software	This includes storage system supported operating systems on the host and system management console

Operational requirements

The operational requirements for the storage system include:

- LAN for Device Manager - Storage Navigator
  Device Manager - Storage Navigator communicates with the storage system over a LAN to obtain system configuration and status information and send user commands to the storage system. Device Manager - Storage Navigator serves as the integrated interface for all resource manager components.
- Cable length for front-end directors
  The following table lists the cable length requirements for the front-end directors in the storage system.

Table 14 Maximum cable length (short wave)

DataTransferRate	OM2(50/125 f/m multi-mode fiber)	OM3(50/125 f/m laser optimizedmulti-mode fiber)	OM4(50/125 f/m laser optimizedmulti-mode fiber)
MB/s	feet / meters	feet / meters	feet / meters
200	984.3 / 300	1640.4 / 500	-
400	492.1 / 150	1246.7 / 380	1312.4 / 400
800	164 / 50	492.1 / 150	623.4 / 190
1600	118 / 36	328 / 100	410.1 / 125

- External data storage
  If you plan to attach external storage to the storage system, make sure to include the appropriate power and space requirements before attaching the external storage.

System specifications and requirements

This section describes the specifications of a VSP G1000, VSP G1500, and VSP F1500 storage systems.

For information about availability of Virtual Storage Platform F1500, contact your HDS representative.

Mechanical specifications

Basic system dimensions and main components of the VSP G1000, VSP G1500, and VSP F1500 storage system components are shown in the following illustration. Detailed specifications of the components are listed in the table.

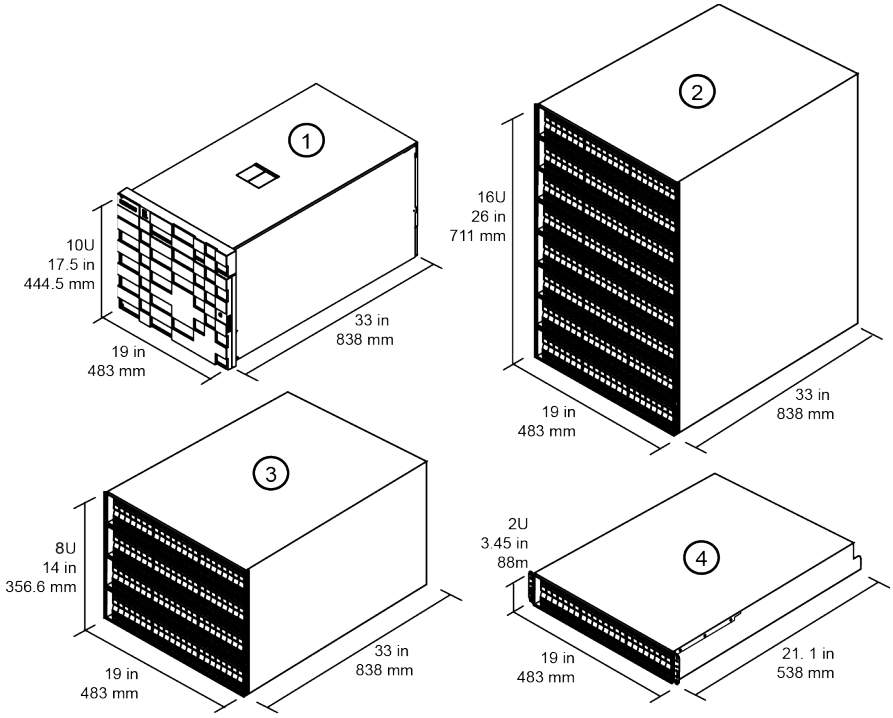


Table 15 VSP G1000, VSP G1500, and VSP F1500 storage system components

Item	Description	Dimension (L x W x H)	Weight (lb)
1	Controller Chassis Supports up to four pairs of VSD.	33 in (838 mm) x 19 in (483 mm) x 17.5 in (444.5 mm) Requires 10U of contiguous space in rack.	309 lb (140 kg) (empty) 377 lb (171 kg) (fully loaded)
2	SFF Drive chassis Supports up to eight 2U trays.	33 in (838 mm) x 19 in (483 mm) x 26 in (711.2 mm) Requires 16U of contiguous space in rack	315 lb (143 kg) (empty) 443 lb (201 kg) (fully loaded)
	LFF Drive Chassis Supports up to eight 2U trays.	33 in (838 mm) x 19 in (483 mm) x 26 in (711.2 mm) Requires 16U of contiguous space in rack	300 lb (136 kg) (empty) 459 lb (208 kg) (fully loaded)
3	FMD drive chassis (only supported with VSP F1500) Supports up to four 2U trays.	33 in (838 mm) x 19 in (483 mm) x 14 in (356.6 mm)	169 lb (77 kg) (empty)

Item	Description	Dimension (L x W x H)	Weight (lb)
		Requires 8U of contiguous space in rack	317 lb (144 kg) (fully loaded)
4	SFF drive tray Supports a maximum of 192 drives.	21.1 in (538 mm) x 19 in (483 mm) x 3.45 in (88 mm) 2U of space in drive chassis	39 lb (18 kg) (empty) 55 lb (25 kg) (fully loaded)
	LFF drive tray Supports a maximum of 96 drives.		38 lb (17 kg) (empty) 57 lb (26 kg) (fully loaded)
	FMD drive tray Supports a maximum of 48 drives.		42 lb (19 kg) (empty) 79 lb (36 kg) (fully loaded)

Table 16 VSP G1000, VSP G1500, and VSP F1500 storage system dimensions

Number of racks	Width (in / mm)	Depth (in / mm)	Height (in / mm)
1	23.5 / 600	47.25 / 1200	79.1 / 2010
2	47 / 1200	47.25 / 1200	79.1 / 2010
3	117.5 / 3000	47.25 / 1200	79.1 / 2010
4	94 / 2400	47.25 / 1200	79.1 / 2010
5	117.5 / 3000	47.25 / 1200	79.1 / 2010
6	141.0 / 3600	47.25 / 1200	79.1 / 2010

Electrical specifications

Note: The current and power specifications in the following tables were measured on the following VSP G1000, VSP G1500, and VSP F1500 storage systems in a controlled environment. To calculate the power draw, current draw, and heat output of a specific system, see Component weight, heat, airflow, and power consumption on page 84 or (easier) use the Power and Weight calculator at the following URL.

http://www.hds.com/go/weight-and-power-calculator/

Contact technical support if you need assistance using this tool.

The following table lists the electric power requirements of a standard VSP G1000, VSP G1500, and VSP F1500 storage systems. Detailed electrical specifications are listed in Specifications on page 121. For detailed voltage and power requirements, see Electrical specifications on page 127. For

system input power requirements, see PDU plugs, circuit breakers, and receptacles on page 82.

Table 17 Electric power requirements

Phase	Voltage	Frequency
AC, single phase 2 wire + ground	200 V -8% min 240 V +6% max	50 ±3 Hz 60 ±2 Hz
AC, three phase delta	208 V +5/-15%	50/60 Hz

Grounding

The site and site equipment must meet the following grounding requirements.

- An insulated grounding conductor that is identical in size and insulation material and thickness to the grounded and ungrounded branch-circuit supply conductors. It must be green, with or without yellow stripes, and must be installed as a part of the branch circuit that supplies the unit or system.
- The grounding conductor described above should be connected to earth ground at the service equipment or other acceptable building earth ground. For a high rise steel-frame structure, this can be the steel frame
- The receptacles in the vicinity of the unit or system must include a ground connection. The grounding conductors serving these receptacles must be connected to earth ground at the service equipment or other acceptable building earth ground.

Power connection

The AC power input for the storage system has a duplex PDU structure that allows the rack-installed equipment to remain powered on if power is removed from one of the two power distribution panels.

For more information, see Electrical specifications on page 127.

Note: Site power can be connected to the PDUs at either the top or bottom of the racks.

PDU plugs, circuit breakers, and receptacles

The PDU plugs must be appropriate for the power sources at the installation sites. The table below lists the plugs on the end of the PDU power cords. The power distribution panel at the installation site must have receptacles that match these plugs.

Required number of plugs in each PDU per chassis:

- Controller chassis: 4
- Drive chassis:
  - SFF: 16
  - LFF: 16
  - FMD: 8

Required number of PDUs per rack:

- Controller rack
  - Single phase: 4
  - Three phase: 2

- Drive rack:
  - Single phase: 4
  - Three phase: 2

Environmental specifications

The table lists the environmental specifications and requirements for the storage system.

Table 18 VSP G1000, VSP G1500, and VSP F1500 environmental specifications

Item	Operating[1]	Not Operating[2]	Shipping & Storage[3]
Standard Temperature (ºF / ºC)	61 to 90 / 16 to 32	-18 to 122 -10 to 35	-45 to 110 / -25 to 60
high temperature mode (ºF / ºC)	60.8 to 104 / 16 to 40		
Relative Humidity (%)[4]	20 to 80	8 to 90	5 to 95
Max. Wet Bulb (ºF / ºC)	78.8 / 26	80.6 / 27	84.2 / 29
Temperature deviation per hour (ºF / ºC)	50 / 10	50 / 10	68 / 20
Vibration[6]	5 to 10Hz: 0.25 mm10 to 300Hz: 0.49m/s2	5 to 10Hz: 2.5mm10 to 70Hz: 4.9m/s270 to 99Hz: 0.05mm99 to 300Hz: 9.8m/s2	Sine Vibration: 4.9m/s2, 5min.At the resonant frequency with the highest displacement found between 3 to 100Hz[7]
			Random Vibration: 0.147m2/s3, 30min, 5 to 100Hz[7]
Shock	No impact	78.4m/s^2(8.0G) 15ms	Horizontal: Incline Impact 1.22m/s [8]
			Vertical: Rotational Edge 0.15m[10]
Dust	Less than 0.15mg per cubic meter of air	-	-
Altitude	-60 m to 3,000 m		-

Item	Operating[1]	Not Operating[2]	Shipping & Storage[3]

Notes:

1. Environmental specification for operation should be met before the storage system is powered on. Maximum temperature of 90°F / 32°C should be strictly met at air system air inlet.
2. Non-operating condition includes both packing and unpacking conditions unless otherwise specified.
3. The system and components should be packed in factory packing for shipping and storing.
4. No condensation in and around the drive should be observed under any conditions.
5. The vibration specifications are applied to all three axes.
6. See ASTM D999-01 The Methods for Vibration Testing of Shipping Containers.
7. See ASTM D4728-01 Test Method for Random Vibration Testing of Shipping Containers.
8. See ASTM D5277-92 Test Method for Performing Programmed Horizontal Impacts Using an Inclined Impact Tester.
9. See ASTM D6055-96 Test Methods for Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates.
10. When FMDs (DKC-F810I-1R6FM/3R2FM) are installed.

Component weight, heat, airflow, and power consumption

The following table provides physical specifications of the individual VSP G1000, VSP G1500, and VSP F1500 system components.

Component Name	Component Model No.	Weight (lb/Kg)	Power Consumption (VA)	Heat Output	Airflow (m^3/min)
Primary controller	DKC810I-CBXA DKC810I-CBXAC[4] DKC810I-CBXE[4]	312 /142	508 [1]	483 [1]	16.7(32°C) 25.9(40°C)
Secondary controller	DKC-F810I-CBXB DKC-F810I-CBXF	308 / 140	435 [1]	413 [1]	16.7(32°C) 25.9(40°C)
SFF drive chassis	DKC-F810I-SBX DKC-F810I-SBXC[4]	315 / 143	674 [1]	640 [1]	9.4(32°C) 11.4(40°C)
LFF drive chassis	DKC-F810I-UBX DKC-F810I-UBXC[4]	299 / 136	674 [1]	640 [1]	6.2(32°C) 8.3(40°C)
FMD drive chassis	DKC-F810I-FBX	169 / 77	640 [1]	600 [1]	8.4
Service Processor	DKC-F810I-SVP DKC-F810I-SVPC[4]	8.8 / 4.0	75	Included in controller chassis specs	
Hub	DKC-F810I-HUB	5.1 / 2.3	10		
Virtual storage director pair (processor blades)	DKC-F810I-MP DKC-F810I-MP2 DKC-F810I-MP2UGH	6.0 / 2.7	179		
Cache path control adapter	DKC-F810I-CPEX	6.2 / 2.8	80		
Cache module (16GB)	DKC-F810I-CM16G	0.022	4		
Cache module (32GB)	DKC-F810I-CM32G	0.054	7		

Component Name	Component Model No.	Weight (lb/Kg)	Power Consumption (VA)	Heat Output	Airflow (m^3/min)
Small memory backup kit	DKC-F810I-BKMS	4.2 / 1.9	40[2]		
Large memory backup kit	DKC-F810I-BKML	4 / 1.8	50[2]		
Cache flash memory (SSD) (128GB)	DKC-F810I-BMM128	0.08	4[3]		
Cache flash memory (SSD) (256GB)	DKC-F810I-BMM256	0.07	4[3]		
300 GB, 15K rpm SAS SFF disk drive	DKC-F810I-300KCM DKC-F810I-300KCMC[4]	0.66 / 0.3	8.6[4]	Included in drive chassis specs	
600 GB, 15K rpm SAS SFF disk drive	DKC-F810I-600KGM	0.66 / 0.3	8.5[4]		
600 GB, 10K rpm SAS SFF disk drive	DKC-F810I-600JCM DKC-F810I-600JCMC[4]	0.66 / 0.3	8.0[4]		
900 GB, 10K rpm SAS SFF disk drive	DKC-F810I-900JCM DKC-F810I-900JCMC[4]	0.66 / 0.3	9.0[4]		
1.2TB, 10K rpm SAS SFF disk drive	DKC-F810I-1R2JCM DKC-F810I-1R2JCMC[4]	0.66/0.3	8.7[4]		
1.8TB, 10K rpm SFF	DKC-F810I-1R8JGM	0.3	8.5[4]		
4TB, 7.2K rpm SAS LFF disk drive	DKC-F810I-4R0H3M DKC-F810I-4R0H3MC[4]	0.83 / 0.83	14.8[4]		
600GB, 10K rpm disk drive in LFF canister	DKC-F810I-600J5M DKC-F810I-600J5MC[4]	0.66/0.3	14.8[4]		
6TB, 7.2K rpm SAS LFF disk drive	DKC-F810I-6R0H9M[4]	1.9/0.86	14.8[4]		
400GB MLC SSD in LFF canister	DKC-F810I-400M5M	0.66/0.3	7.1[4]		
400GB SFF MLC SSD	DKC-F810I-400MCM	0.29 / 0.13	6.7[4]		
800GB SFF MLC SSD	DKC-F810I-800MCM	0.29 / 0.13	6.7[4]		
Hitachi Accelerated Flash 1.75 TB FMD	DKC-F810I-1R6FM	3.08 / 1.4	18.0[4], [5]		
	DKC-F710I-1R6FM				
Hitachi Accelerated Flash 3.5 TB FMD	DKC-F810I-3R2FM	3.08 / 1.4	19.0[4], [5]		
	DKC-F710I-3R2FM				
Hitachi Accelerated Flash 1.75 TB FMD DC2	DKC-F810I-1R6FN	3.08 / 1.4	26.0[4], [5]	25.0[5]	
Hitachi Accelerated Flash 3.5 TB FMD DC2	DKC-F810I-3R2FN	3.08 / 1.4	26.0[4], [5]	25.0[5]	
Hitachi Accelerated Flash 7 TB FMD DC2	DKC-F810I-6R4FN	3.08 / 1.4	26.0[4], [5]	25.0[5]	
Hitachi Accelerated Flash 7 TB FMD DC2	DKC-F810I-7R0FP	3.08 / 1.4	26.0[4], [5]	25.0[5]	

Component Name	Component Model No.	Weight (lb/Kg)	Power Consumption (VA)	Heat Output	Airflow (m^3/min)
Hitachi Accelerated Flash 14 TB FMD DC2	DKC-F810I-14RFP	3.08 / 1.4	26.0[4], [5]	25.0[5]	
Back-end director (disk adapter)	DKC-F810I-SCA	4.2 / 1.9	100	105	—
Encrypting back-end director	DKC-F810I-ESCA	3.3 / 2.0	110	105	—
iSCSI 8-port 10G front-end director	DKC-F810I-8IS10	4.1 / 1.9	126	120	—
Fibre 16-port 16G front-end director	DKC-F810I-16FC16	4.6 / 2.1	116	110	—
Fibre 16-port 8G front-end director	DKC-F810I-16FC8	3.3 / 2.0	116	110	—
Fibre 8-port 16G front-end director	DKC-F810I-8FC16	5.3 / 2.4	116	110	—
Fibre Channel over Ethernet (FCoE) front-end director	DKC-F810I-16FE10	4.8 / 2.1	179	170	—
Mainframe Fibre 16-port 8G front-end director for Shortwave	DKC-F810I-16MS8	5.3 / 2.4	120	126	—
Mainframe Fibre 16-port 16G front-end director for Shortwave	DKC-F810I-16MS16	5.3 / 2.4	130	137	—
Mainframe Fibre 16-port 8G front-end director for Longwave	DKC-F810I-16ML8	5.3 / 2.4	120	126	—
Mainframe Fibre 16-port 16G front-end director for Longwave	DKC-F810I-16ML16	5.3 / 2.4	130	137	—
SFP for 8Gbps Longwave	DKC-F810I-1PL8	0.02	—	—	—
SFP for 8Gbps Shortwave	DKC-F810I-1PS8	0.02	—	—	—
SFP for 16Gbps Longwave	DKC-F810I-1PL16	0.02	—	—	—
SFP for 16Gbps Shortwave	DKC-F810I-1PS16	0.02	—	—	—
PDU 30A - single phase (Americas)	PDU-121112F10	10 / 4.5 kg	—	—	—
PDU 32 A - single phase (EMEA/APAC)	A3CR-123294-51	6 / 2.6	—	—	—
PDU 30A - three phase (Americas)	PDU-32C13800F10	18 / 8.0	—	—	—
PDU 32A - three phase (EMEA/APAC)	A3CK-243694-50	11 / 5.2	—	—	—
Controller chassis bezel	DKC-F810I-BCH	8.2 / 3.7	—	—	—
Drive chassis bezel	DKC-F810I-BUH	8.2 / 5.3	—	—	—
Flash module chassis bezel	DKC-F810I-BFH	6.2 / 2.8	—	—	—
Hitachi Universal "V2" Rack	A3BF-600-1200-V2	222 / 101	—	—	—

Component Name	Component Model No.	Weight (lb/Kg)	Power Consumption (VA)	Heat Output	Airflow (m^3/min)
Controller Rail Kit	A34V-700-800-CBX	7.4 / 3.4	—	—	—
Corner Guide Rail Kit (FBX)	A3BF-HK-GL-740-1	4.4 / 2	—	—	—
Corner Guide Rail Kit (SFF / LFF)	A3BF-HK-GL-740-1	4.4 / 2	—	—	—
Front Door	A3BF-DR-R800	50.6 / 23	—	—	—
Left side panel with Hitachi branding	A3BF-Z-PAN-BR-L	39.6 / 18	—	—	—
Right side panel w/ Hitachi branding	A3BF-Z-PAN-BR-R	39.6 / 18	—	—	—
Universal Rail Kit	A34V-600-850-UNI	6.2 / 2,8	—		
Power Cord Kit, CBX chassis, USA	DKC-F810I-PLUC	9.9 / 4.5	—	—	—
Power Cord Kit, SFF / LFF drive chassis, USA	DKC-F810I-PHUC	9.9 / 4.5	—	—	—
Power Cord Kit, FMD drive chassis, USA	DKC-F810I-PFUC	4.4 / 2.0	—	—	—
Power Cord Kit, controller chassis, EU	DKC-F810I-PLEC	2 / 0.7	—	—	—
Power Cord Kit, SFF / LFF drive chassis, EU	DKC-F810I-PHEC	6.8 / 3.1	—	—	—
Power Cord Kit, FMD drive chassis, EU	DKC-F810I-PFEC	3.1 / 1.4	—	—	—
Power Cord Kit, controller chassis, China	DKC-F810I-PLCC	1.5 / 0.7	—	—	—
Power Cord Kit, SFF / LFF drive chassis, China	DKC-F810I-PHCC	6.6 / 3.0	—	—	—
Power Cord Kit, FMD drive chassis, China	DKC-F810I-PFCC	2.9 / 1.3	—	—	—
Inter-Controller Connecting Kit, 5 m	DKC-F810I-MOD5	4.4 / 2.0	1	—	—
Inter-Controller Connecting Kit, 30 m	DKC-F810I-MOD30	7.7 / 3.5	1	—	—
Inter-Controller Connecting Kit	DKC-F810I-MOD1J	17.2 / 7.8	1	—	—
Inter-Controller Connecting Kit	DKC-F810I-MFC5	1.75 / 0.8	—	—	—
Inter-Controller Connecting Kit	DKC-F810I-MFC30	5.1 / 2.3	—	—	—
Inter-Controller Connecting Kit, not supported until V01+1.	DKC-F810I-MFC1J	14.3 / 6.5	—	—	—
Device Interface Cable (ENC), 1m	DKC-F810I-CC1	2.4 / 1.1	—	—	—

Component Name	Component Model No.	Weight (lb/Kg)	Power Consumption (VA)	Heat Output	Airflow (m^3/min)
Device Interface Cable (ENC), 2m	DKC-F810I-CC2	3.75 / 1.7	—	—	—
Device Interface Cable (ENC), 4m	DKC-F810I-CC4	6.4 2.9	—	—	—
Device Interface Cable (ENC), 5m	DKC-F810I-FC5	2.4/1.1	—	—	—
Device Interface Cable (ENC), 30m, not supported until V02	DKC-F810I-FC30	6.6/3.0	—	—	—
Device Interface Cable (ENC), 100m, not supported until V02	DKC-F810I-FC1J	18/8.2	—	—	—

Notes:

1. Maximum values with all fans running at maximum speed.
2. Power is consumed during the battery back-up time only. The idle power is included in DW700-CBX.
3. Actual values at a typical I/O condition. (Random Read and Write, 50 IOPs for HDD, 2500 IOPs for SSD, Data Length: 8k bytes) These values may increase for future compatible drives.
4. BNST-free part
5. Actual values at a typical I/O condition. (Random Read and Write, 50 IOPSs for HDD, 2500 IOPSs for SSD/FMD, Data Length: 8Kbytes)
   These values may increase for future compatible drives.

Airflow

The fans in both the control chassis and the drive trays circulate air through the units from front to back. Air flows in through the front bezel to the rear of the component and exits through the perforations in the rear door. The racks do not contain fans.

Equipment noise

The following table lists the maximum acoustic emission values loudness in dB for the VSP G1000, VSP G1500, and VSP F1500 storage system in standard and high-temperature modes.

Table 19 VSP G1000 and G1500

Operating	CBXA/CBXAC/CBXB/CBXE/CBXF	58 dB (24°C or less), 60 dB (32°C), 70 dB (40°C)
	SBX/SBXC/UBX/UBXC/FBX	61 dB (24°C or less), 64 dB (32°C), 70 dB (40°C) *2
Standby [1]	CBXA/CBXAC/CBXB /CBXE / CBXE	58 dB (24°C or less), 60 dB (32°C), 70dB (40°C)

	SBX/SBXC/UBX/UBXC/FBX	61 dB (24°C or less), 64 dB (32°C), 70 dB (40°C) [2]

Notes:
1. Measurement condition: The point 1m far from floor and surface of the product.
2. The DKC-F810I-1R6FM/3R2FM and DKC-F710I-1R6FM/3R2FM cannot be used at 40°C.

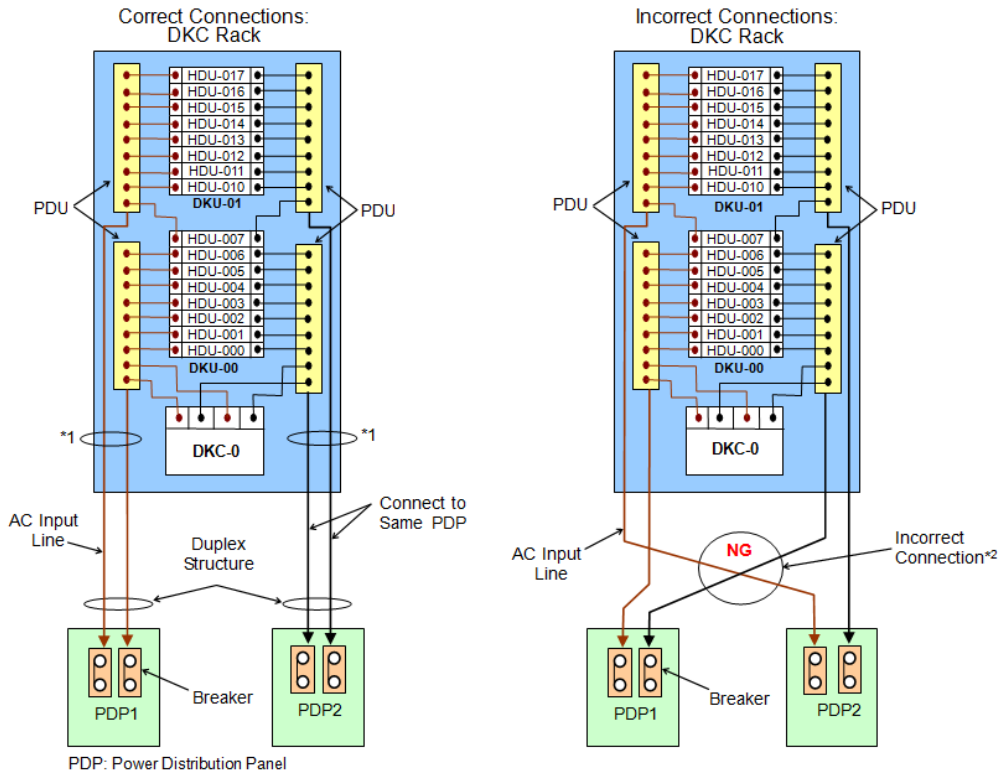
Table 20 VSP F1500

Operating	CBXE/CBXF	58 dB (24°C or less), 60 dB (32°C), 70 dB (40°C)
	FBX	TBD
Standby [3]	CBXE/CBXF	58 dB (24°C or less), 60 dB (32°C), 70dB (40°C)
	FBX	TBD

Notes:
1. Measurement condition: The point 1m far from floor and surface of the product.
2. The DKC-F810I-1R6FM/3R2FM and DKC-F710I-1R6FM/3R2FM cannot be used at 40°C.
3. Even if storage system is in a power-off state, the cooling fan continues to rotate in a standby mode.

Power connection diagrams

The following figures show the correct way to connect the power distribution units to the power distribution panels. When connected as shown, the system operates normally if either AC inputs fails. In the following figures, redundancy is provided through separate PDUs. These figures assume the separate power distribution units are attached to independent PDUs.



*1: When connected correctly, two of the four PDUs can supply power to the DKC rack.

*2: When connected incorrectly, two PDUs cannot supply power to the DKC rack, which causes a system failure.

Figure 15 Direct power connection

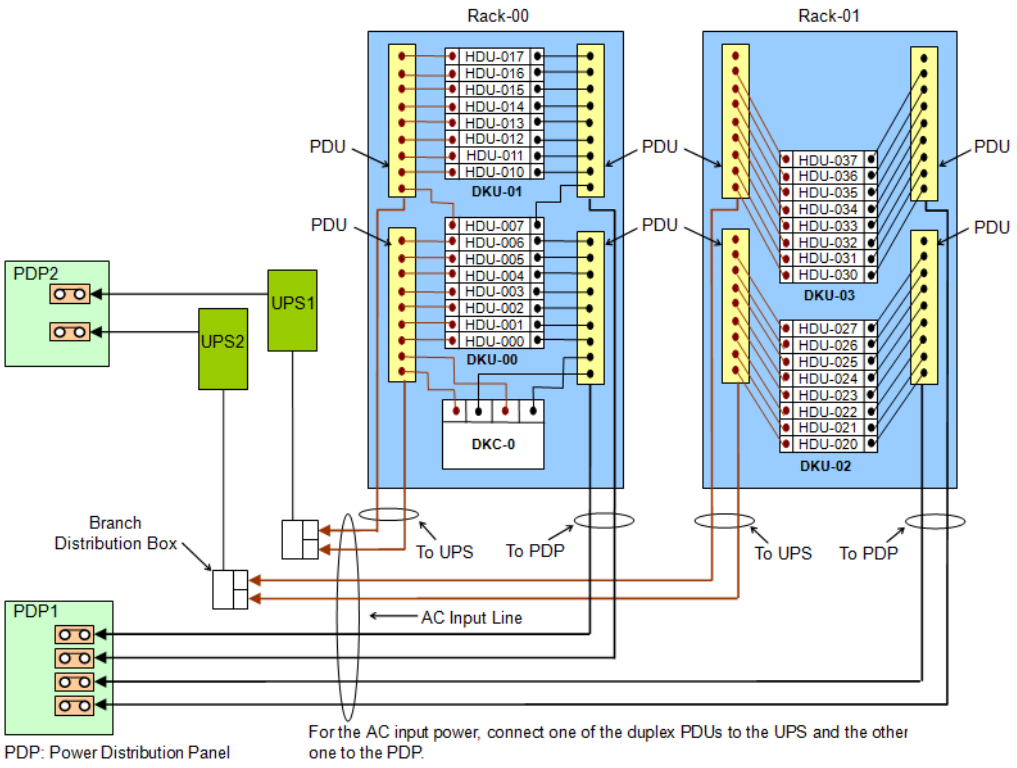


Figure 16 Power connection via UPS

Caution: When installing a system, do not cross-connect the AC cables as shown in the above illustration. Otherwise, a system failure can occur when either of the AC inputs is interrupted.

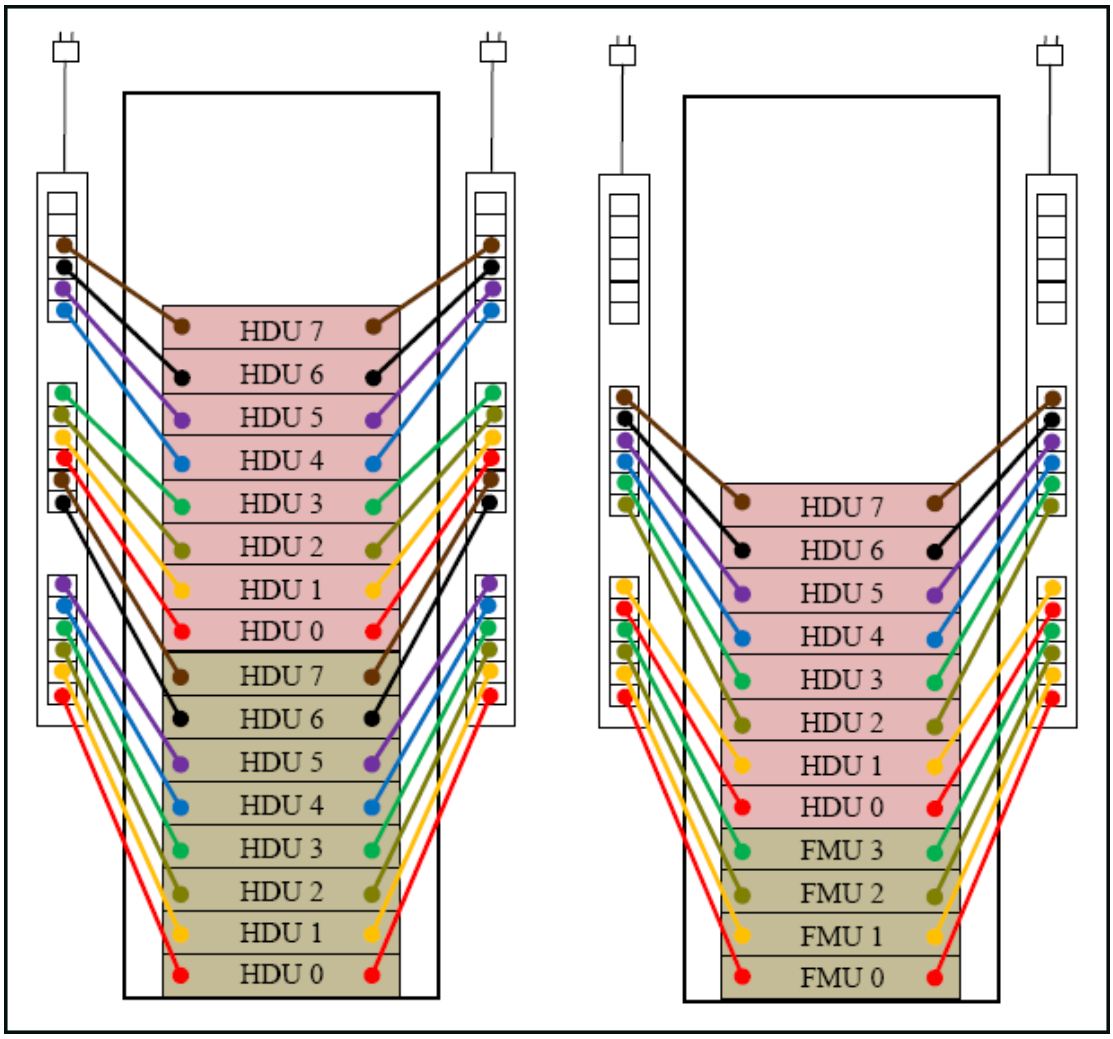


Figure 17 PDP breaker connections for the controller rack, three-phase

UPS power connection

The following figure shows the proper way to connect the PDUs to the PDP when an uninterruptible power supply is used.

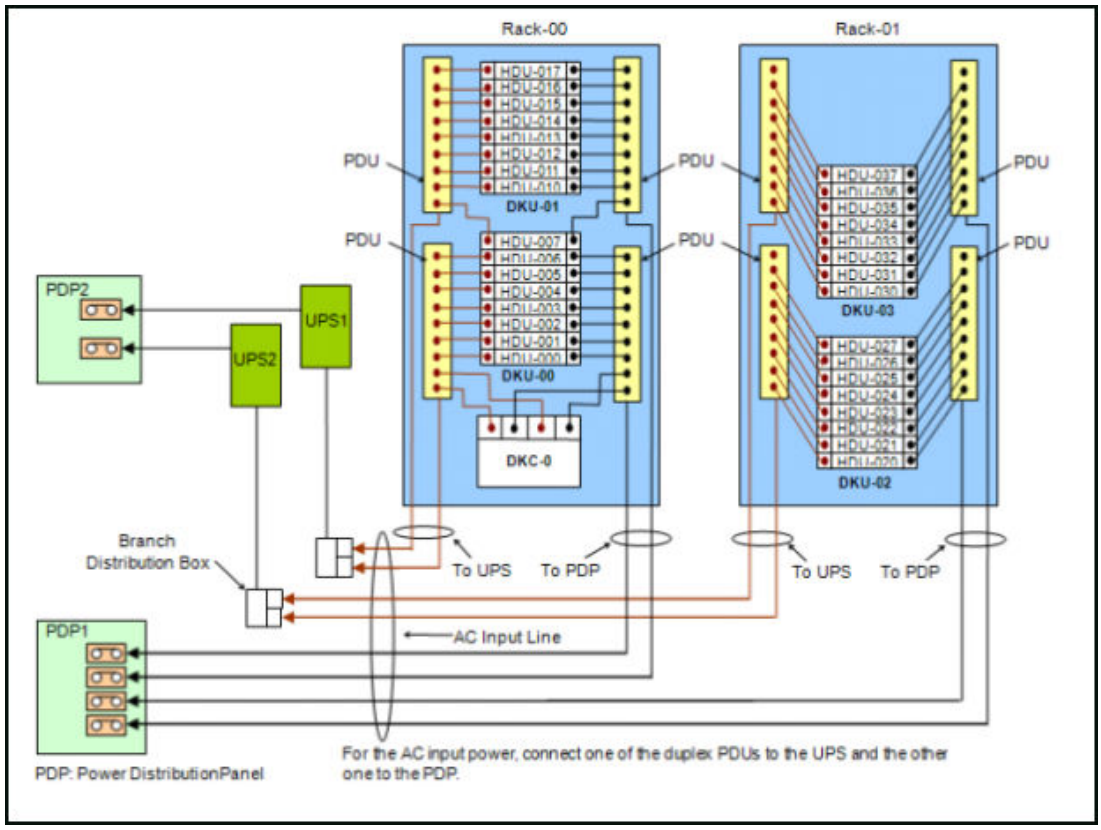


Figure 18 Breaker configurations when using a UPS

Data connection diagrams

This section provides basic cabling diagrams for connecting ENC (data and control) cables between the control chassis and the drive chassis in the block module, and between the controller and HNAS storage in the file module.

The following illustrations show the correct way to connect the drive chassis to the controller.

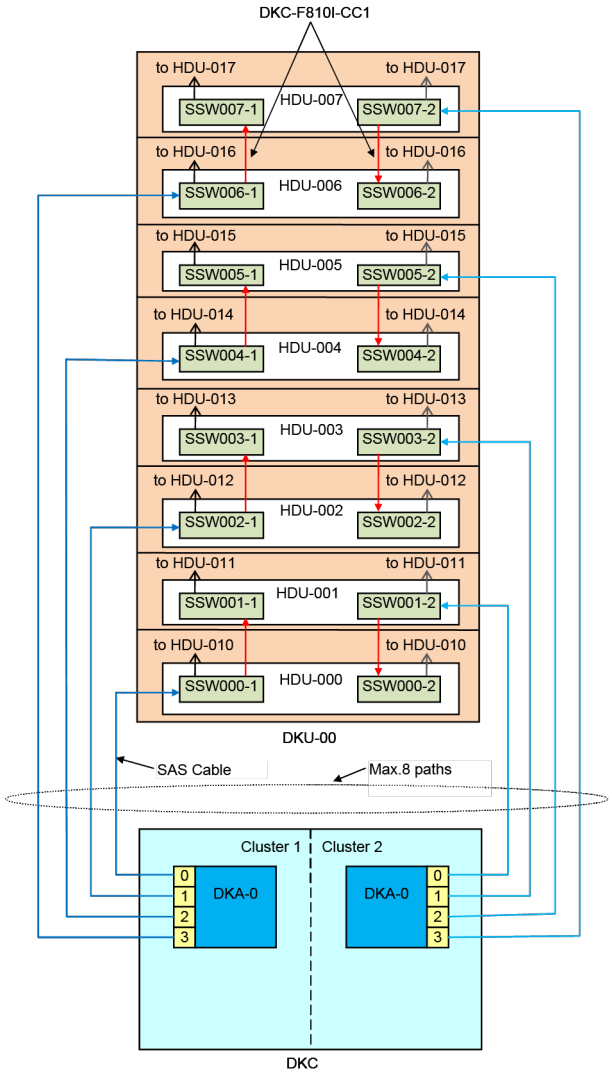


Figure 19 SAS Connection Diagram of Rack-00 (SFF/LFF Standard Model)

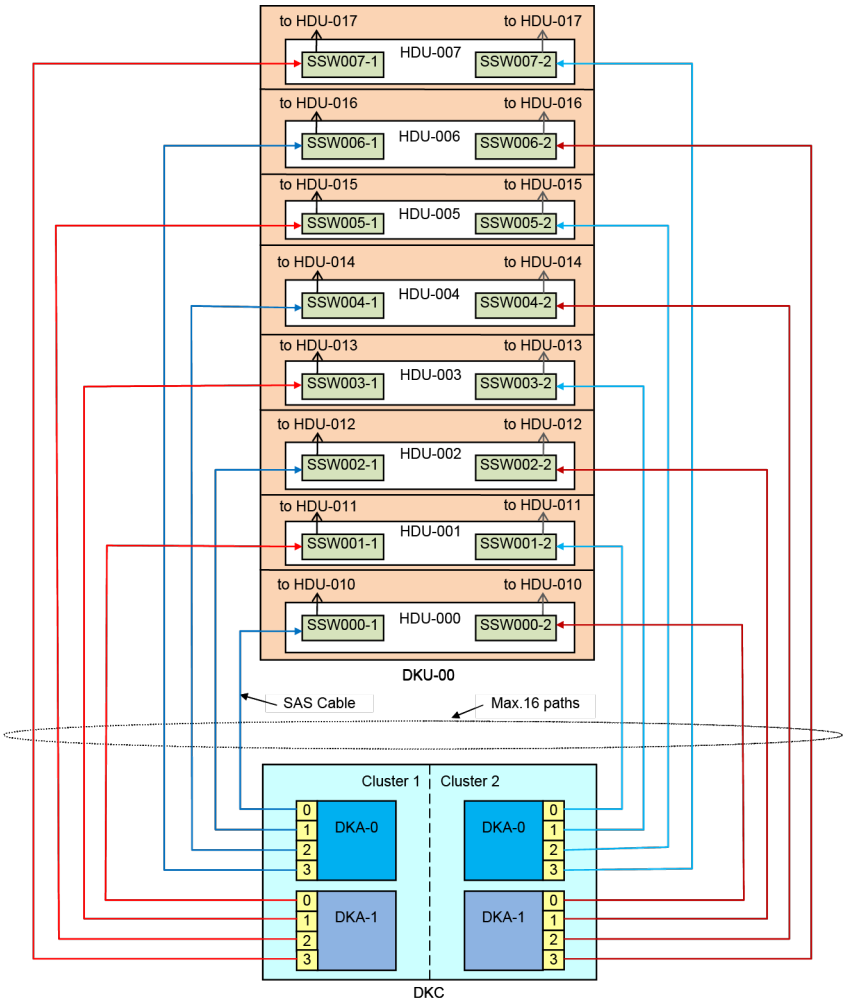


Figure 20 SAS Connection Diagram of Rack-00 (SFF/LFF High Performance Model)

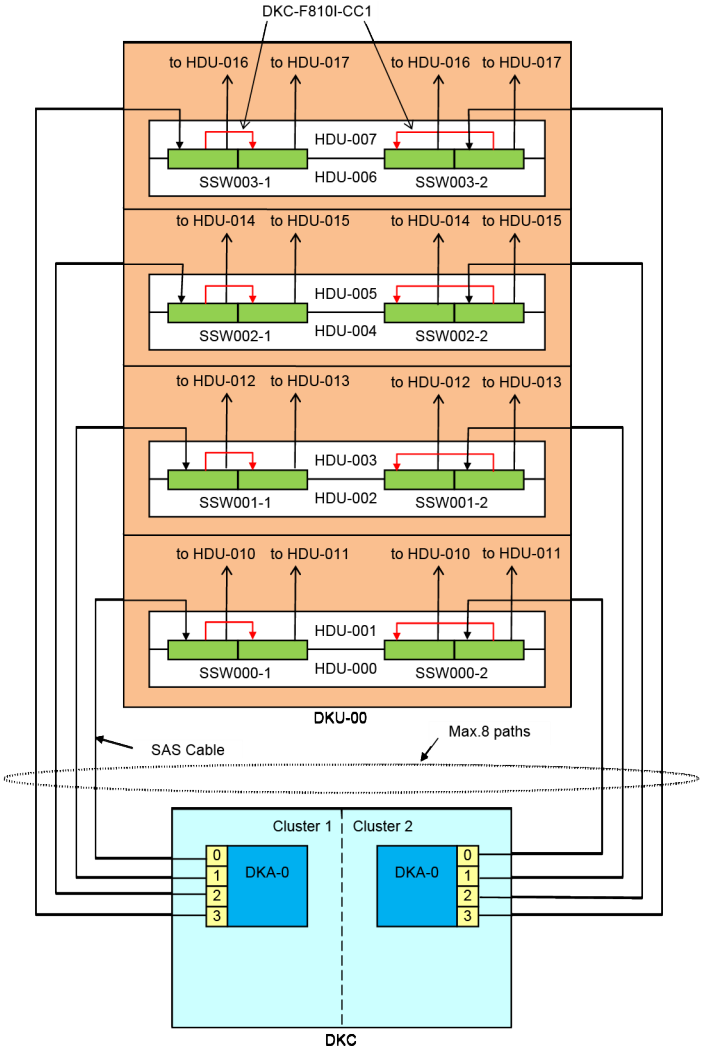


Figure 21 SAS Connection Diagram of Rack-00 (FBX Standard Model)

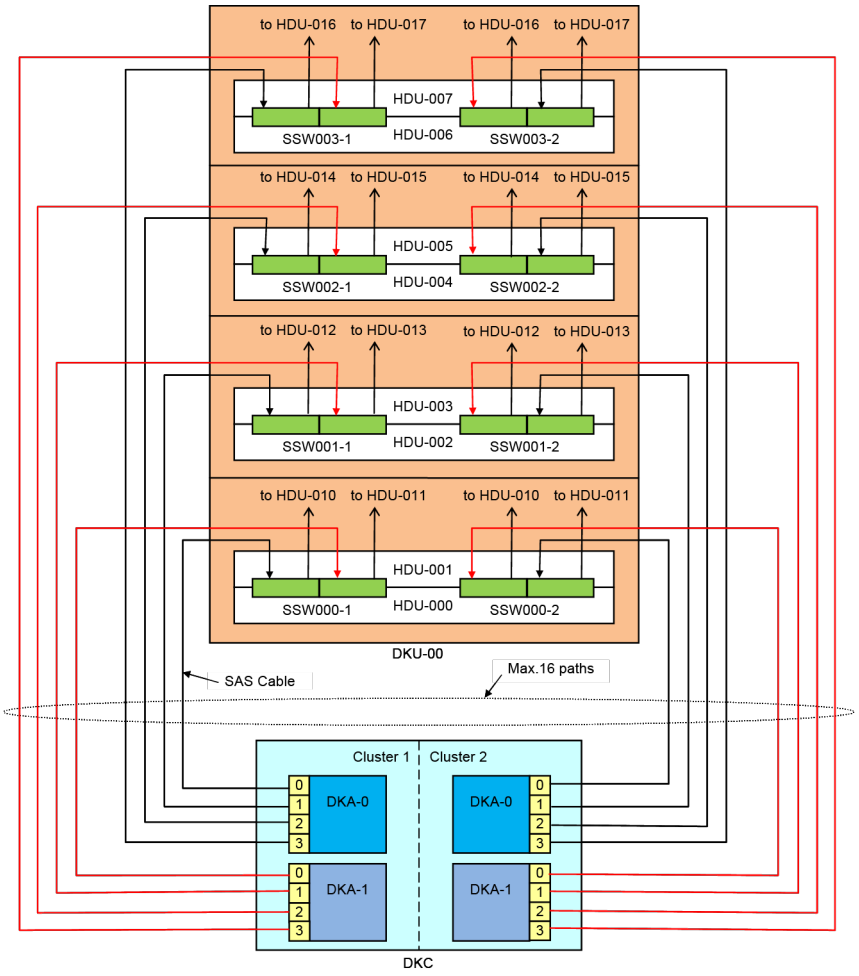


Figure 22 SAS Connection Diagram of Rack-00 (FBX High Performance Model)

Long cable connections

By default, all racks of a system installed in HDS-supplied racks are physically connected to each other. Two side panels are included to cover the sides of the outermost racks (see the figure below). Within the R1 "Extended Cabling" section are multiple options that can be selected to separate the racks to meet customer requirements. The following sections provide guidance about the available options and associated configuration rules.

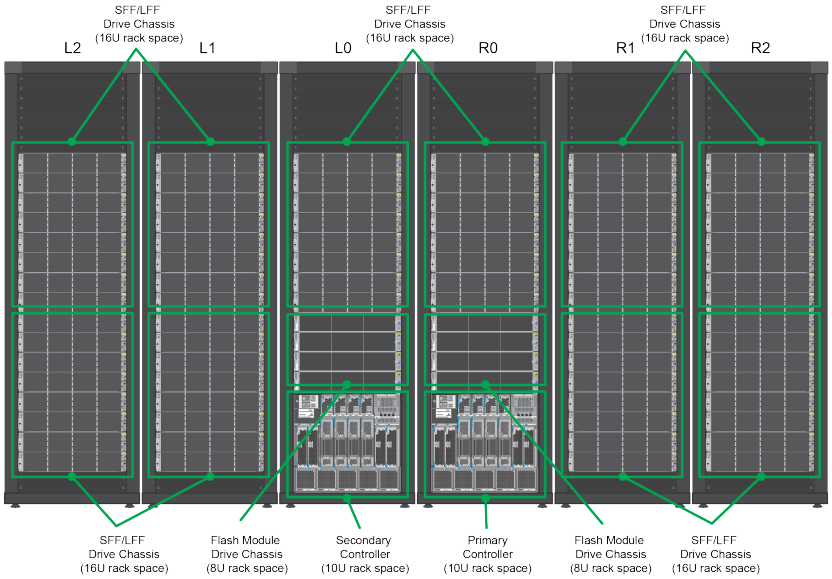


Figure 23 Default rack placement

Separated controller configuration

With most dual-controller configurations, the primary and secondary controllers are installed in separate racks. By default, these racks are connected to each other.

If desired, you can separate the two racks containing the primary and secondary controllers. By specifying the racks are not physically attached to each other, the Hitachi Configurator asks you to specify the length of cable for connecting the two controllers. Cable length options are 5 meters (which is the standard length), 30 meters, and 100 meters.

The following figure shows a dual-controller configuration, with extended cabling between the racks containing the two controllers. The Configurator includes additional side panels as required.

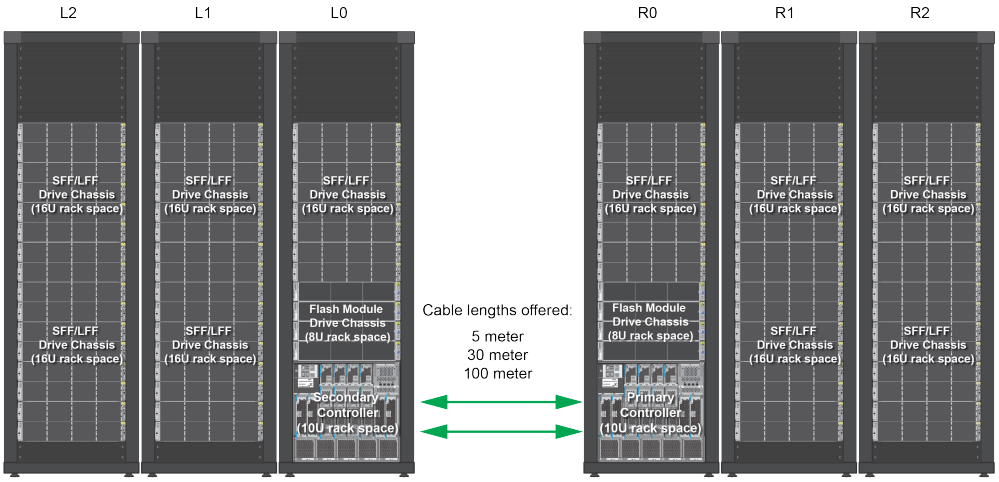


Figure 24 Example of a dual-controller configuration with extended cabling between racks

Separating drive-only racks

With either a single- or dual-controller configuration, you can separate the rack containing a controller from a rack with a drive chassis. You can also separate two racks containing only drive chassis. By specifying in the Configurator the racks are not physically attached to each other, the Configurator prompts you to specify the length of the SAS optical cable connecting the two racks.

SAS optical cable length options are:

- 5 meters (DKC-F810I-FC5)
- 30 meters (DKC-F810I-FC30)
- 100 meters (DKC-F810I-FC1J)

The following figure shows a single-controller configuration, with extended cabling between rack “R0” (containing the primary controller and two drive chassis) and rack “R1” (containing two drive chassis). In addition, extended cabling between racks “R1” and “R2" is available. The Configurator includes additional side panels as required.

While not shown in the following figure, extending the cabling between racks in a dual-controller configuration is also supported.

To avoid I/O latency issues, the sum of the length of all cables (controller-to-drive chassis cable and drive chassis-to-drive chassis cables) cannot exceed 125 meters. The Configurator prevents you from selecting cabling that exceeds this length.

The following example shows a configuration of a controller controlling six drive chassis, the maximum supported by a controller. The sum of the cables A + B + C + D + E + F must be less than or equal to 125 meters.

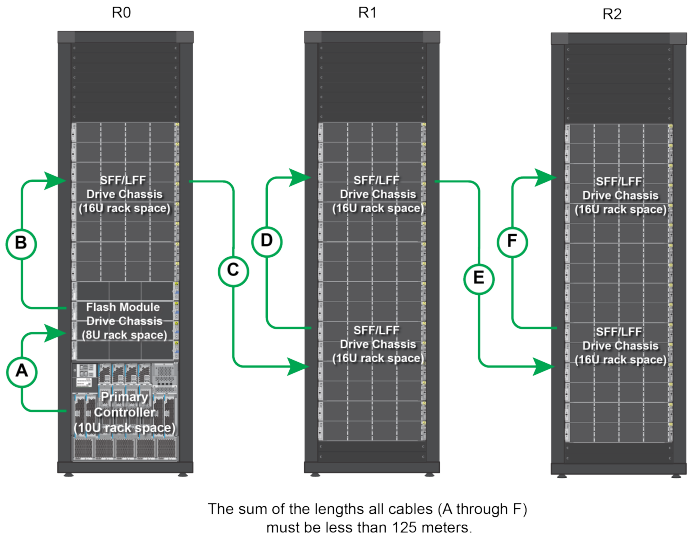


Figure 25 Example of separating drive-only racks

Separated rack configuration

In a dual-controller configuration, you can separate the rack that contains a controller from a rack that a contains drive chassis, as well as separate two racks that contain drive chassis only. This configuration combines both options described in the previous two examples.

The following figure shows a dual-controller configuration with extended SAS optical cabling between rack “R0” containing the primary controller and rack “R1” containing two drive chassis, as well as between rack “L0” containing the secondary controller and rack “L1” containing two drive chassis. The Configurator includes additional side panels as required.

While not shown in the following figure, the configuration can include an "R2" rack directly connected to, or separated from the "R1" rack. Similarly, the configuration can include an "L2" rack directly connecting to, or separating from, the "L1" rack.

To avoid I/O latency issues, the sum of the length of all cables (controller-to-drive chassis cable and drive chassis-to-drive chassis cables) may not exceed 125 meters. The Configurator prevents you from selecting cabling that exceeds this length.

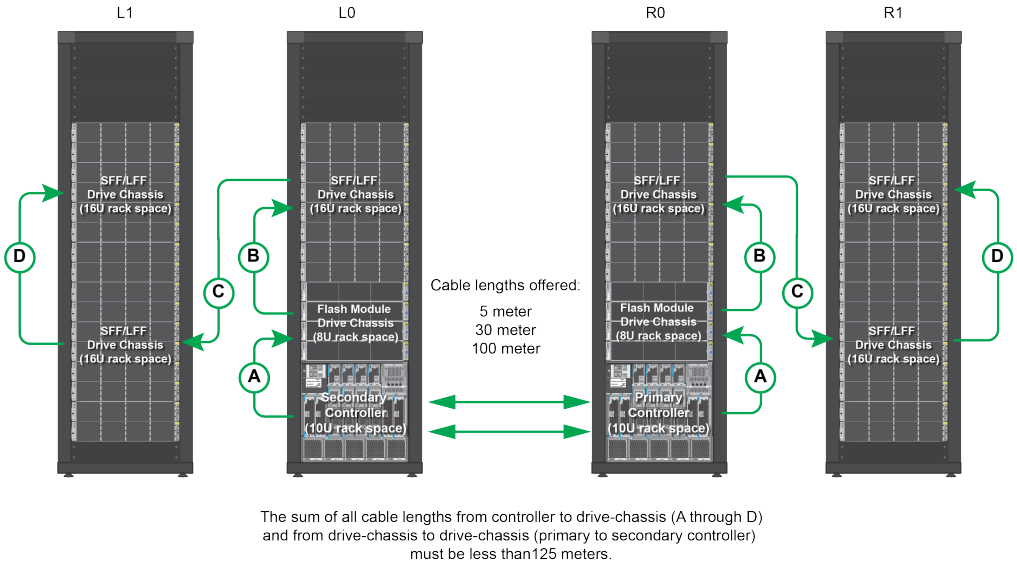


Figure 26 Example of a separated rack configuration

Additional guidelines

- You can implement extended cabling with a system installed in customer-supplied racks, so long as the racks are approved by HDS Customer Sales & Support (CSS) organization as meeting HDS specifications. Customers should be informed that HDS requires that customer-supplied racks housing HDS storage systems must have side panels installed on all exposed sides.
- The "High Temperature Mode" option can be implemented on systems that use extended cabling.
- The minimum microcode that must be installed on the to support the SAS optical cables is V02 (DKCMAIN 80-02-01-00/01) released October 20, 2014.
- You are strongly encouraged to keep your storage system microcode level current to ensure you have the most up-to-date enhancements and fixes. If your storage systems is using an earlier microcode release, contact your authorized service provider for assistance with planning, ordering, and installing a more current microcode release.

Dual controller in a single rack configuration

In a single rack, you can place both controller chassis to reduce the number of racks occupying floor space and minimize the operating expenses.

The following diagrams illustrate three configuration options:

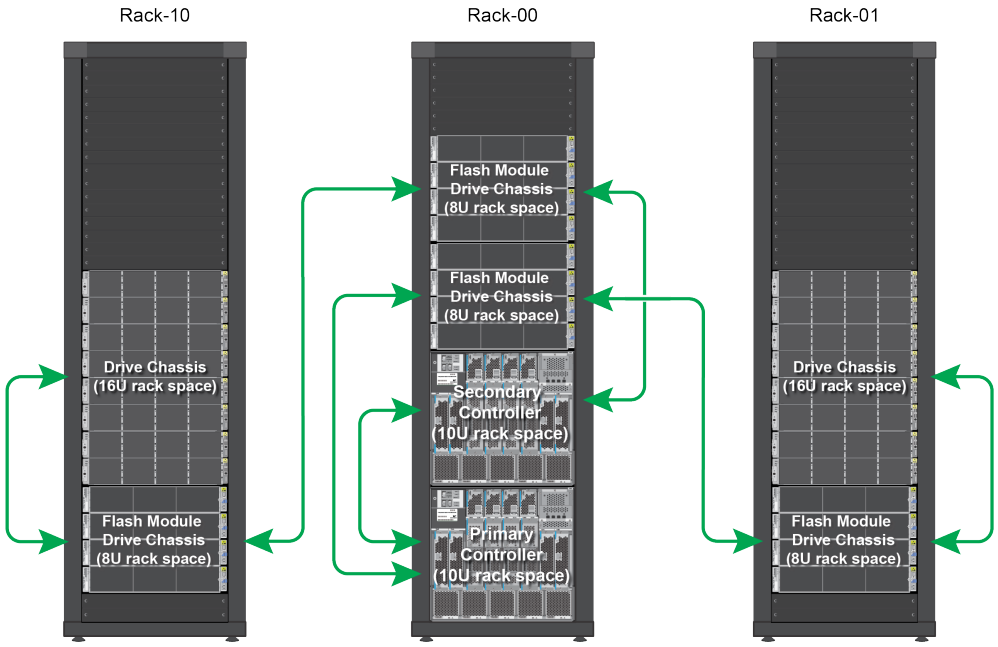
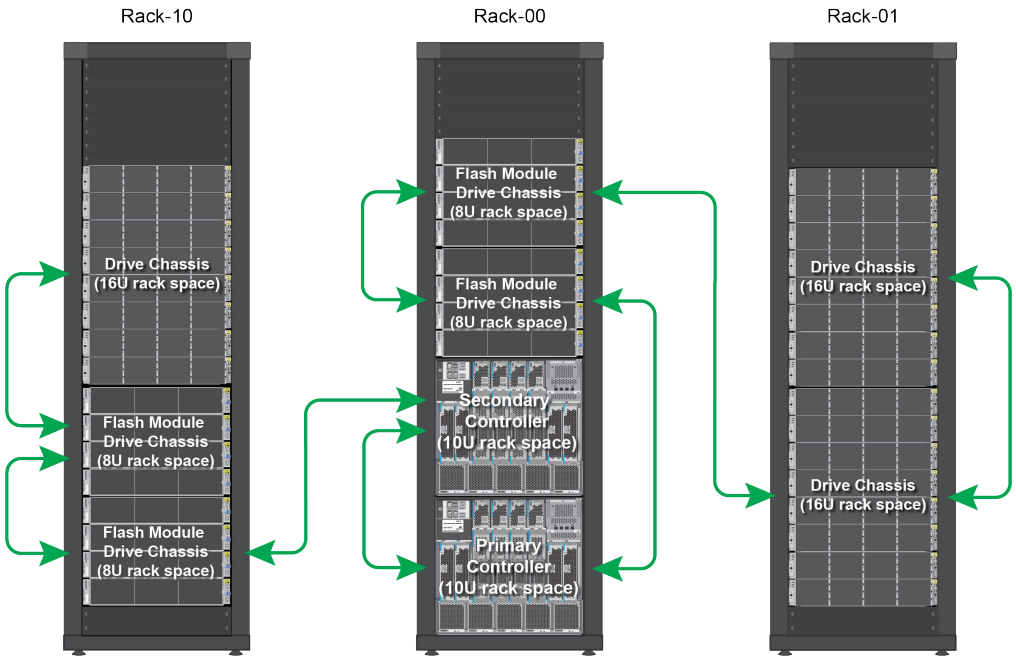


Figure 27 Example of a dual controller option 1 configuration in a single rack



Dual Controller and I/F Cable Configuration Option 2

Figure 28 Example of a dual controller option 2 configuration in a single rack

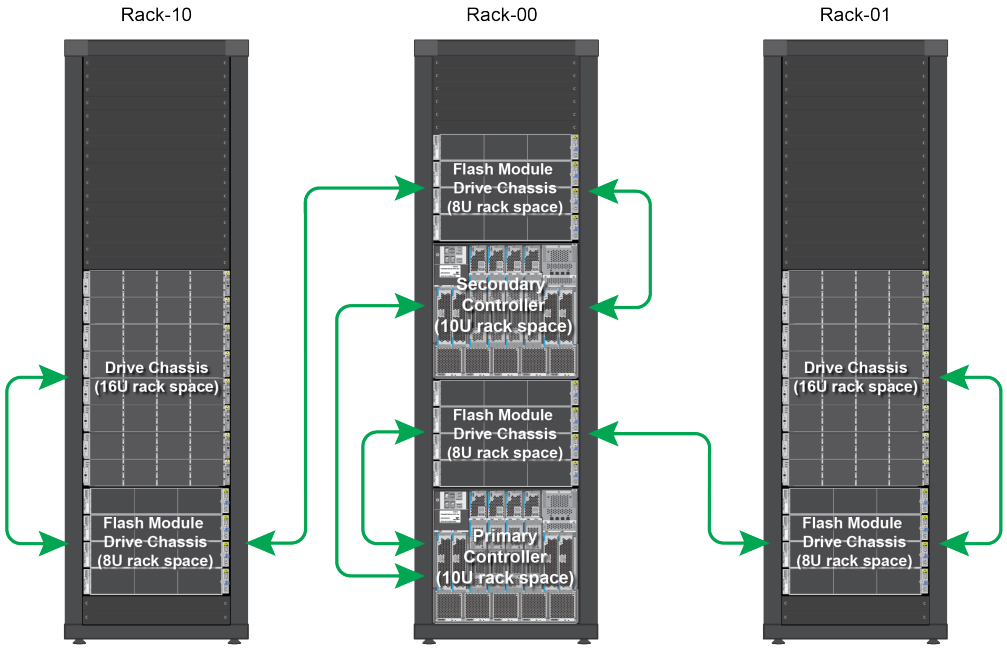


Figure 29 Example of a dual controller option 3 configuration in a single rack

Port configurations

The following figures show the front-end director port configurations.

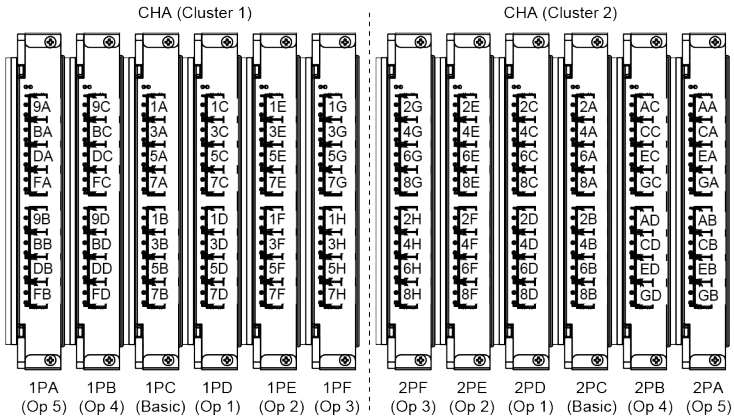


Figure 30 front-end director 16-port configuration

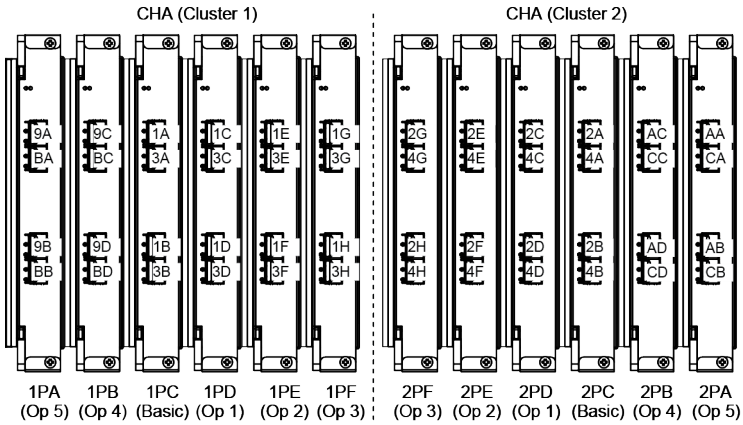


Figure 31 front-end director 8-port configuration

5

Power on/off procedures

This chapter describes the prerequisites and procedures to turn the power on and off to the storage system and provides the recommended procedures to use in the case of a power failure.

- ☐ Safety and environmental information
- ☐ Power control panel
- ☐ System idle mode
- ☐ Normal power on/off procedures
- ☐ Emergency power off/on procedures
- ☐ Battery backup operations

Safety and environmental information

Caution: Before operating or servicing the storage system, read about Safety requirements on page 69 and the environmental information in Regulatory compliance on page 183.

Power control panel

The power control panel is located in the top left corner of the controller. It is covered by a 2U-high bezel that can be removed separately from the 8U bezel that covers the rest of the controller.

The following illustration shows the switches and indicators on the control panel. The table following the figure explains the components and LED meanings. All LEDs are shown ON to demonstrate the color of the LED.

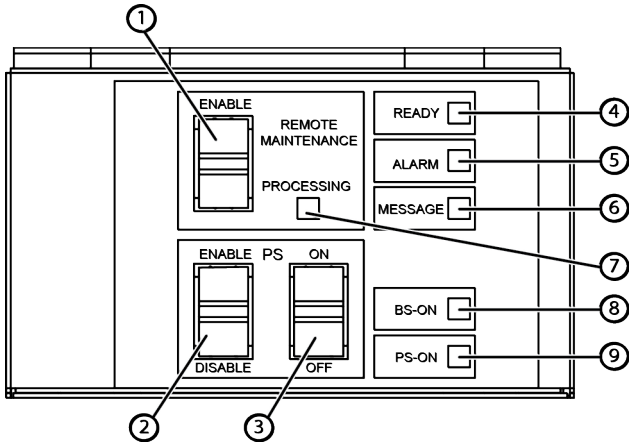


Figure 32 Storage system control panel

Table 21 Storage system power controls and status indicators

Item	Description
1	REMOTE MAINTENANCE switch • Set to ENABLE to allow remote maintenance. • Set to DISABLE to prevent remote maintenance.
2	ENABLE switch Used to enable the PS ON/PS OFF switch. See Power on procedures on page 110.
3	POWER switch. Move up or down to turn system power on or off. See Power on procedures on page 110.
4	READY LED - indicates the operational status of the system • Off when the channel interface is not operational. • Green Indicates that input/output operation on the channel interface is enabled.
5	ALARM LED • Off when the system is off or when the system is on and operational without failures . • Red when the SVP detects a component failure or other failure condition in the system

Item	Description
6	MESSAGE LED • Off when power is off, or when a system generated message is not in the queue, and the SVP has not failed. • Amber* On when a system information message (SIM) is generated by either of the clusters and has been sent to Device Manager - Storage Navigator and to the users that are set up in Device Manager - Storage Navigator to receive them. • Blinking when an SVP failure has occurred in a single SVP configuration, or of both SVPs have failed in a dual SVP configuration. Does not blink if only one SVP in a dual SVP configuration fails.
7	PROCESSING LED - indicates the status of remote processing • Off when power is off or when remote maintenance is not taking place. • Amber - ON when remote maintenance is taking place.
8	BS-ON LED - indicates the status of the AC power to the system (basic supply) • Off when AC power is applied to the system from the PDUs. • Amber - ON when AC power is applied to the system from the PDUs. The fans will be running.
9	PS-ON LED - indicates the status of the DC power to the system • Off when AC power is not applied to the system and when AC power is applied to the system, and the system is in idle mode. • Green when the power switch is ON, DC power is applied to the system, and the system is running.

System idle mode

When the storage system power cables are plugged into the PDUs and the PDU breakers are on, the storage system is in idle (basic supply only) mode. When the storage system is in idle mode:

- The amber Basic Supply (BS) LED on the control panel is on. This indicates that AC power is applied to the power supplies.
- The green READY LED is off. This indicates that the controller and drive chassis are not operational.
- The fans in both the controller and drive chassis are running.
- The cache backup batteries are being charged.
- The storage system consumes significantly less power than it does in operating mode. For example, a storage system that draws 100 amps while operating draws only 40 to 60 amps in idle mode, depending on the number of drives in the system. The more drives, the more power is saved. See Table 22 Maximum idle power per chassis on page 110 below and Table 27 Mechanical specifications on page 127.

To put the storage system into idle mode from the OFF condition:

1. Ensure power is available to the AC input boxes and PDUs in all racks.
2. Turn on all PDU power switches and circuit breakers.

To put the storage system into idle mode from a power on condition, perform the steps in Power off procedures on page 111.

To completely power down the storage system, perform the power off procedures in this chapter, then turn off all PDU circuit breakers.

Warning: Verify the storage system is powered off normally and in idle mode before turning off the PDU circuit breakers. Otherwise, turning off the PDU circuit breakers can leave the storage system in an abnormal condition.

Table 22 Maximum idle power per chassis

Chassis	Maximum idle power [VA]
Controller Chassis 0 or 1	500
SFF Drive Chassis	1,120
LFF Drive Chassis	720
FMD Drive Chassis	1,280

Normal power on/off procedures

This section provides general information about turning on and off the power to the storage system. If further assistance is required, contact customer support.

Power on procedures

Before you begin

- Confirm the storage system is in idle mode. See System idle mode on page 109.

Note: The control panel includes a safety feature to prevent the storage system power from being turned on or off accidentally. The PS power ON/OFF switch does not work unless the ENABLE switch is moved to and held in the ENABLE position while the power switch is moved to the ON or OFF position.

Perform the procedure to turn on the storage system. If applicable, refer to the figure of the control panel in Figure 32 Storage system control panel on page 108.

Procedure

1. On the control panel, check the amber BS LED and make sure it is lit. It indicates that the storage system is in idle mode.
2. In the PS area on the control panel, move the ENABLE switch to the ENABLE position and hold it there. While holding the switch in the ENABLE position, move the PS ON/OFF switch to the ON position. Then release both switches.
3. Wait for the storage system to complete its power-on self-test and boot up processes. Depending on the storage system configuration, this can take several minutes.

   The storage system will not go to the READY state until the cache backup batteries are charged to at least 50%. This can take 90 minutes if the

batteries are completely discharged. The storage system generates a SIM that provides the status of the battery charge. See Cache backup batteries on page 113 for information about the batteries.

4. When the system self-test is complete and all components are operating normally, the green READY LED turns ON and the storage system is ready for use.

   If the ALARM LED is also ON, or if the READY LED is not ON after 20 minutes, contact customer support for assistance.

Power off procedures

Before you begin

- Confirm all maintenance and software-specific shutdown procedures have been completed.
- Verify all I/O activity to the storage system has stopped. You can vary paths offline and shut down the attached hosts.
- Follow this procedure exactly when powering off the storage system.

Caution: Except in an emergency, do not turn off the PDU breakers before turning off the power to the system. The system reacts as a power failure occurred and uses the cache backup batteries to keep the cache active until the data in the cache are transferred to the cache backup flash memory. When the cache backup batteries discharge power, the power-on time may be prolonged by the amount of charge remaining in the batteries. Fully discharged batteries take 90 minutes to charge.

Note: The control panel includes a safety feature to prevent the storage system power from being turned on or off accidentally. The PS power ON/OFF switch does not work unless the ENABLE switch is moved to and held in the ENABLE position while the power switch is moved to the ON or OFF position.

Procedure

1. In the PS area on the control panel, move the ENABLE switch to the ENABLED position and hold it there. While holding the switch in the ENABLED position, move the PS ON/OFF switch to the OFF position. Then release both switches.
2. Wait for the storage system to complete its shutdown routines. Depending on the storage system configuration and certain MODE settings, it can take 20 minutes for the storage system to copy data from the cache to the cache flash drives and for the disk drives to spin down.

   If the READY and PS LEDs do not turn OFF after 20 minutes, contact customer support for assistance.

Emergency power off/on procedures

This section describes how to shut down the system in case of an emergency and bring it back up after an emergency shutdown.

Note: Observe the following guidelines when powering on or powering off PDUs.

- **Controllers:** Turn PDUs off first. Turn PDUs on last.
- **Drives:** Turn PDUs off last. Turn PDUs on first.

Emergency power off procedure

The storage system does not have an emergency power off switch. To turn off the system during an emergency, first, turn off the controllers and then the drive units.

Procedure

1. Open the back doors of both racks that contain control units.
2. Turn off the circuit breakers in the following order:
   a. Turn off the circuit breakers in both lower PDUs in both racks.
   b. Turn off the circuit breakers in both upper PDUs in both racks with control units.
3. Open the back doors of all racks containing only drive units and, in any order, turn off the circuit breakers to all the PDUs.

Power on procedure after emergency power off

To turn the power on to the storage system after an emergency shutdown, use the following instructions.

Procedure

1. In all system racks, turn on the circuit breakers in the PDUs supplying electrical power to the drive units.
2. In both controller racks, turn on the circuit breakers in the PDUs supplying electrical power to the controllers.
3. Follow the instructions in Normal power on/off procedures on page 110.

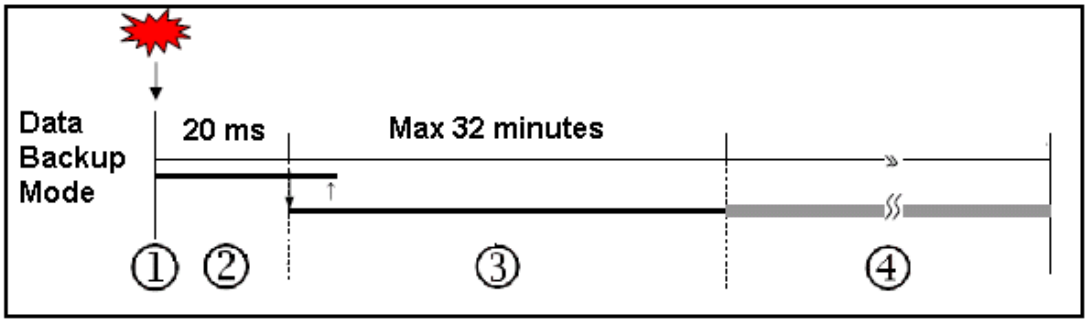
Battery backup operations

The storage system is designed not to lose data or configuration information when the power fails. The battery system is designed to provide sufficient power with fully charged batteries to completely back up all data in the cache if two consecutive power failures occur. If the batteries do not contain enough charge to provide sufficient time to back up the cache when a power failure

occurs, the cache operates in write-through mode and writes directly to the drives to prevent slow data throughput via the cache. When the battery charge is 50% or more, the cache write through mode is turned off and the system operates normally.

If a power failure occurs and continues for up to 20 milliseconds, the storage system continues normal operation. If the power failure exceeds 20 milliseconds, the storage system uses power from the batteries to keep the cache active while the system copies the storage system configuration and cached data to the cache flash memory in the cache backup modules. The process continues up to 32 minutes. The cache flash drives do not require power to retain the data.

The following illustration shows the timing if a power failure occurs.



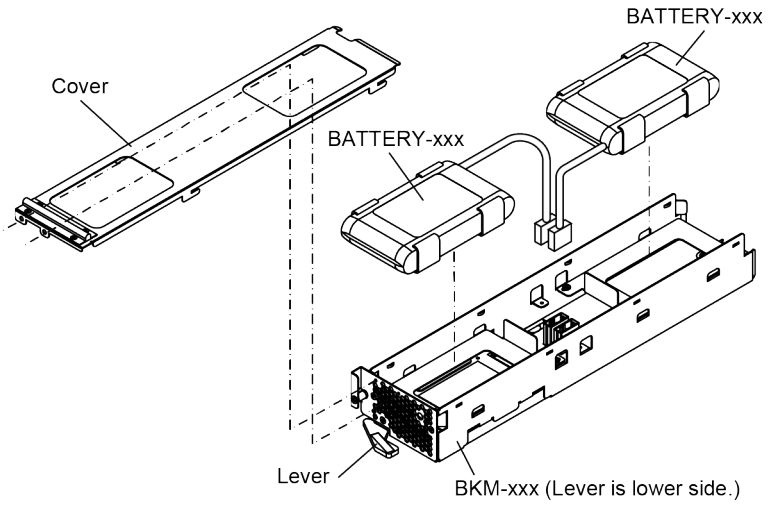
Item	Description
1	Power failure occurs.
2	The storage system continues to operate for 20 milliseconds and detects the power failure.
3	The cache memory data and storage system configuration are backed up to the cache flash memory in the cache backup assemblies. If power is restored during the backup, the backup stops unless the backup battery capacities are used less than 50%. In case, the system operates in write-through mode until the batteries are charged enough for a full backup.
4	Data is stored in the cache flash memory until power is restored, then it is written to the drives.

Cache backup batteries

If a power failure occurs, nickel metal-hydride batteries keep the cache memory active while the storage system configuration and data in the cache is copied to the flash memory in the cache backup modules. The batteries are located in the cache backup modules. They are fully charged at the distribution center where the storage system is assembled and tested. During

shipment, the batteries are disconnected automatically to prevent any discharging during shipping and storage until the system is installed. During installation, they are reconnected.

Note: When the system is running, it generates a SIM when the cache backup batteries are not connected.



Battery life

The batteries have a lifespan of three years and hold a charge for some time when disconnected. When the batteries are connected and power is on, they are continuously charging. This occurs during both normal system operation and while the system is in idle mode.

When the batteries are connected and the power is off, the batteries slowly discharge. The batteries have a charge of less than 50% after two weeks without power. When fully discharged, the batteries must be connected to power for three hours to fully recharge.

Note: The storage system generates a SIM when the cache backup batteries are not charged to at least 50%. The LEDs on the front panel of the cache backup kits also show the status of the batteries.

Storing the system

While connected, the cache backup batteries will completely discharge in two to three weeks without power applied. If you are not using the storage system for two weeks or more, contact customer support to move the batteries to an active storage system, or set the storage system to idle mode for at least 3 hours once every two weeks.

If you store the system for more than two weeks without disconnecting the cache backup batteries, the batteries need to charge for at least 90 minutes when you restart the system before the cache can be protected. To prevent

the batteries from discharging during long term storage, contact technical support and request a disconnection of the battery jumpers on the cache boards.

6

Troubleshooting

This chapter provides troubleshooting information for the storage system.

- Getting help
- Solving problems
- Service information messages (SIM)

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, contact Hitachi Data Systems Support at https://support.hds.com/en_us/contact-us.html.

Solving problems

The VSP G1000, VSP G1500, and VSP F1500 storage system is highly reliable and is not expected to fail in any way that would prevent access to user data.

The following table lists possible error conditions and recommends actions to resolve each condition. If you cannot resolve an error condition, contact your Hitachi Data Systems representative or contact customer support for assistance.

Table 23 Troubleshooting

Error Condition	Recommended Action
Error message displayed	Determine the type of error (refer to the SIM codes section). If possible, fix the cause of the error. If you cannot correct the error condition, contact customer support for assistance.
General power failure	Turn off all PDU switches and breakers. After the facility power is fully restored, turn on the switches and breakers and power on the system. See for instructions about turning on the power to the storage system. If necessary, contact customer support for assistance.
Fence message is displayed on the console	Determine whether there is a failed storage path. If a failed storage path occurred, toggle the RESTART switch and retry the operation. If the fence message displays again, contact customer support for assistance.
READY LED does not go on, or there is no power supplied	Contact customer support for assistance. WARNING: Do not open the storage system control frame/controller or touch any controls.
ALARM LED is on	If there is a temperature problem in the area, turn the power off to the storage system, lower the room temperature to the specified operating range, and then turn on the power to the storage system. If necessary, contact customer support for assistance with turning on the power to the storage system. If the area temperature is not the cause of the alarm, contact customer support for assistance.

Service information messages (SIM)

The VSP G1000, VSP G1500, and VSP F1500 generates SIMs to identify normal operations. For example, TrueCopy pair status change, as well as service requirements and errors or failures. For assistance with SIMs, contact customer support.

SIMs can be generated by the front-end directors, back-end directors, and the SVP. All SIMs generated by the storage system are stored on the SVP for use by Hitachi Data Systems personnel, displayed by the Device Manager - Storage Navigator software, and reported over SNMP to the open-system host. The SIM display on Storage Navigator enables users to remotely view the SIMs reported by the attached storage systems. Each time a SIM is generated, the amber Message LED on the control panel turns on. The Hi-Track remote maintenance tool also reports all SIMs to the support center.

SIMs are classified according to severity. There are four levels: service, moderate, serious, and acute. The service and moderate SIMs (lowest severity) do not require immediate attention and are addressed during routine maintenance. The serious and acute SIMs (highest severity) are reported to the host system once every eight hours.

Note: If a serious- or high-level SIM is reported, contact the support center immediately to ensure the problem is being addressed.

The following figure illustrates a typical 32-byte SIM from the storage system. The SIMs are displayed by reference code (RC) and severity. The six-digit RC comprises bytes 22, 23, and 13, identifies the possible error and determines the severity. The SIM type, located in byte 28, indicates which component experienced the error.

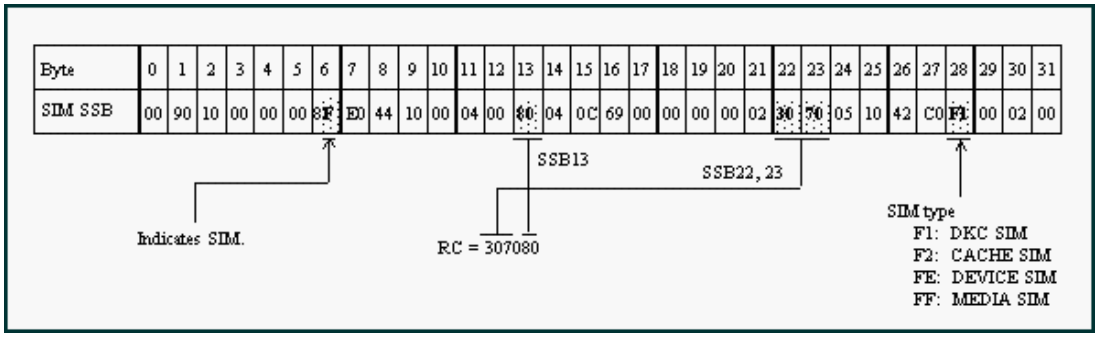


Figure 33 Service information message

A

Specifications

This appendix provides the mechanical, electrical, and environmental specifications for the VSP G1000, VSP G1500, and VSP F1500 storage systems.

Storage system specifications

The following table lists the technical specifications of the storage system.

Note: The current and power specifications of the storage system in the following tables were measured in a controlled environment. To calculate the power and current draw, and heat output of a specific system, see Component weight, heat, airflow, and power consumption on page 84 or use the Power and Weight calculator at the following URL.

http://www.hds.com/go/weight-and-power-calculator/

If you need assistance using this tool, contact Hitachi Data Systems Support at https://support.hds.com/en_us/contact-us.html.

Table 24 VSP G1000 and G1500 System Specifications

Item			Specification
System	Number of drives	Minimum	4 (disk-in model) / 0 (diskless model)
		Maximum	2,304 (SFF HDD) / 1,152 (LFF HDD)
	Maximum number of flash drives		384 *6
	Maximum number of flash module drives		576
	RAID level		RAID 6/RAID 5/RAID 1
	RAID Group Configuration	RAID 6	6D+2P, 14D+2P
		RAID 5	3D+1P, 7D+1P
		RAID 1	2D+2D, 4D+4D
	Maximum number of spare drives		96*1
	Maximum number of volumes		65,280
	Maximum storage system capacity (physical capacity)		• 3,984 TB (1.8 TB, 2.5-inch HDD used) • 6,767 TB (6 TB, 3.5-inch HDD used) • 8,106TB (14TB FMD used)
Internal Path	Architecture		Hierarchical Star Net
	Maximum bandwidth	Data path	768 GBps
		Control path	128 GBps
Memory	Cache memory capacity		32 GB to 2,048 GB
	Cache flash memory capacity		256 GB to 2,048 GB
Device I/F	DKC-DKU Interface		SAS/Dual Port
	Data Transfer Rate		Max. 6 Gbps

Item			Specification
	Maximum Number of Drive per SAS I/F (Under the SFF HDD Standard Model)		288
	Maximum Number of DKA		4
Channel I/F	Support channel type	Mainframe	2/4/8 Gbps Fibre channel: 16MS8/16ML8 4/8/16 Gbps Fibre channel: 16MS16/16ML16
		Open System	2/4/8 Gbps Fibre Short Wavelength[*2]: 16FC8 4/8/16 Gbps Fibre Short Wavelength[*3]: 8FC16/16FC16 10 Gbps FCoE/iSCSI Short Wavelength: 16FE10/8IS10
	Data transfer rate	MF Fibre Channel	200 / 400 / 800 / 1600 MBps
		Fibre Channel	200 / 400 / 800 / 1600 MBps
		FCoE/iSCSI	10 Gbps
	Maximum number of CHA		12
Power	AC Input	Single Phase	60Hz : 200V to 240V 50Hz : 200V to 240V
Acoustic Level [*4]	Operating	CBXA/CBXAC/CBXB/ CBXE/CBXF	58dB (24°C or less), 60dB (32°C), 70dB (40°C)
		SBX/SBXC/UBX/ UBXC/FBX	61dB (24°C or less), 64dB (32°C), 70dB (40°C) [*7]
	Standby[*5]	CBXA/CBXAC/CBXB/ CBXE/CBXF	58dB (24°C or less), 60dB (32°C), 70dB (40°C)
		SBX/SBXC/UBX/ UBXC/FBX	61dB (24°C or less), 64dB (32°C), 70dB (40°C) [*7]
Dimension	W x D x H (mm)	Single rack	610 x 1,115 x 2,006
		Six racks	3,610 x 1,115 x 2,006
Non-stop maintenance	Control PCB		Support
	Cache memory module		Support
	Cache flash memory		Support
	Power supply, fan		Support
	Microcode		Support
	Drive (HDD, SSD, FMD)		Support

[*1] Available as spare or data disks.

[*2] By the replacing SFP transceiver of the fibre port on the CHA to the DKC-F810I-1PL8, the port can be used for the long wavelength.

[*3] By the replacing SFP transceiver of the fibre port on the CHA to the DKC-F810I-1PL16, the port can be used for the long wavelength.

[*4] Measurement Condition: The point 1m far from floor and surface of the product.

Item	Specification
*5 Even if storage system is in a power-off state, the cooling fan continues to rotate in a standby mode. *6 Not includes the spare drive. *7 The DKC-F810I-1R6FM/3R2FM and DKC-F710I-1R6FM/3R2FM cannot be used at 40°C	

Table 25 VSP F1500 system specifications

Item			Specification
System	Number of flash modules	Minimum	8
		Maximum	576
	RAID level		RAID6/RAID5/RAID1
	RAID Group Configuration	RAID 6	6D+2P, 14D+2P
		RAID 5	3D+1P, 7D+1P*6
		RAID 1	2D+2D, 4D+4D
	Maximum number of spare drives		96*1
	Maximum number of volumes		65,280
	Maximum storage system capacity (physical capacity)		8,106 TB (14 TB FMD used)
Internal Path	Architecture		Hierarchical Star Net
	Maximum bandwidth	Data path	768 GBps
		Control path	128 GBps
Memory	Cache memory capacity		128 GB to 2,048 GB
	Cache flash memory capacity		256 GB to 2,048 GB
Device I/F	DKC-DKU Interface		SAS/Dual Port
	Data Transfer Rate		Max. 6 Gbps
	Maximum Number of Drive per SAS I/F (Under the FMD Standard Model)		72
	Maximum Number of DKA		4
Channel I/F	Support channel type	Mainframe	2/4/8 Gbps Fibre channel: 16MS8/16ML8 4/8/16 Gbps Fibre channel: 16MS16/16ML16
		Open System	2/4/8 Gbps Fibre Short Wavelength*2: 16FC8 4/8/16 Gbps Fibre Short Wavelength*3: 8FC16/16FC16 10 Gbps FCoE/iSCSI Short Wavelength: 16FE10/8IS10
	Data transfer rate	MF Fibre Channel	200 / 400 / 800 / 1600 MBps
		Fibre Channel	200 / 400 / 800 / 1600 MBps

Item			Specification
		FCoE/iSCSI	10 Gbps
	Maximum number of CHA		12
Power	AC Input	Single Phase	60Hz : 200V to 240V 50Hz : 200V to 240V
Acoustic Level *4	Operating	CBXE/CBXF	58dB (24°C or less), 60dB (32°C), 70dB (40°C)
		FBX	61dB (24°C or less), 64dB (32°C), 70dB (40°C)
	Standby*5	CBXE/CBXF	58dB (24°C or less), 60dB (32°C), 70dB (40°C)
		FBX	61dB (24°C or less), 64dB (32°C), 70dB (40°C)
Dimension	W x D x H (mm)	Single rack	610 x 1,115 x 2,006
		Six racks	3,610 x 1,115 x 2,006
Non-stop maintenance	Control PCB		Support
	Cache memory module		Support
	Cache flash memory		Support
	Power supply, fan		Support
	Microcode		Support
	Drive (HDD, SSD, FMD)		Support

*1 Available as spare or data disks.

*2 By the replacing SFP transceiver of the fibre port on the CHA to the DKC-F810I-1PL8, the port can be used for the long wavelength.

*3 By the replacing SFP transceiver of the fibre port on the CHA to the DKC-F810I-1PL16, the port can be used for the long wavelength.

*4 Measurement Condition: The point 1m far from floor and surface of the product.

*5 Even if storage system is in a power-off state, the cooling fan continues to rotate in a standby mode.

*6 For VSP F1500 with FMDs installed, a minimum of 8 FMDs (min. capacity of 49 TB) are required for this specific configuration.

Drive specifications and guidelines

Table 26 Drive specifications

Drive Type	Size (inches)[1]	Drive Capacity	Speed (RPM)	Transfer Rate (Gbps)
HDD (SAS)	3.5	4.0 TB, 6.0 TB[6]	7,200	-
		600 GB	10,000	-
	2.5	300 GB, 600 GB	15,000	-
	2.5	600 GB, 900 GB, 1.2 TB, 1.8 TB	10,000	-

Drive Type	Size (inches)[1]	Drive Capacity	Speed (RPM)	Transfer Rate (Gbps)
SSD (MLC SAS) 2	2.5	400 GB, 800 GB	-	6
	3.5	400 GB	-	6
Flash Module (MLC)	-	1.75 TB, 3.5 TB, 7 TB, 14 TB	-	6

Drive Installation Guidelines

- A minimum of 4 drives must be installed for VSP G1000 and G1500. For VSP F1500, a minimum of 8 drives must be installed.
- Drives must be added in groups of 4, 8, or 16 at a time to create RAID groups, unless they are spare drives.
- Use the same generation drive type and capacity size when configuring RAID setting.
- Add or replace a drive with another drive of the same generation.
  - The spare drives associated with an array group consisting of first generation Flash Module Drives (FMD) must also be a first generation FMD. The spare drives must have the same or larger capacity as the FMD drives in the array group.
  - The spare drives associated with an array group consisting of Flash Module Drives (FMD) DC2 drives must also be an FMD DC2 of the same generation. The spare drives must have the same or larger capacity as the FMD DC2 drives in the array groups.

  Follow the listed examples:
  - Array group consisting of 1.6 TB FMD requires the same generation 1.6 TB FMD drive as a spare.
  - Array group consisting of 3.2 TB FMD requires the same generation 3.2 TB FMD drive as a spare.
  - Array group consisting of 1.6 TB FMD DC2 requires the same generation 1.6 TB FMD DC2 drive as a spare.
  - Array group consisting of 3.2 TB FMD DC2 requires the same generation 3.2 TB FMD DC2 drive as a spare.
  - Array group consisting of 6.4 TB FMD DC2 requires the same generation 6.4 TB FMD DC2 drive as a spare.

Maximum Number of Drives

Drive type (inches)	Drive chassis	Max per drive chassis	Max per 2-controller system
HDD, 2.5	SFF	192	2,304
HDD, 3.5	LFF	96	1.152
FMD, 5.25[3]	FMD	48	576
SSD, 2.5	SFF	192	384[4]
Spare drives[5]	-	48	96

Notes:

1. The LFF drive chassis uses 3.5-inch drives. The SFF drive chassis uses 2.5-inch drives.
2. SFF SSD drives can be mounted all in one SFF drive chassis or spread out among all of the SFF drive chassis in the storage system.
3. Guidelines for operating with flash module drives in high temperature mode:
   - Do not enable high temperature mode if the system contains FMDs from an earlier generation (prior to Hitachi Accelerated Flash FMD DC2 drives). The early generation FMDs are not designed to operate in high temperature mode. Only enable high temperature mode with Hitachi Accelerated Flash FMD DC2 drives.
   - Do not enable high temperature mode if the system contains a mixture of early and current generation FMDs.
4. Recommended maximum number.
5. Recommended number of spare drives: one spare HDD drive per set of 32 HDDs and one spare SSD per set of 32 SSDs.
6. Recommended number of spare drives for 6 TB LFF drive only: one spare drive per set of 16.

Mechanical specifications

The following tables list the mechanical specifications of the storage system.

Table 27 Mechanical specifications

Dimension	Single Rack	Single Controller (3 racks)	Dual Controller (6 racks)
Width (inches / mm)	21.6 / 600	70.9 / 1,800	141.7 / 3,600
Depth (inches / mm)	47.2 / 1,200	47.2 / 1,200	47.2 / 1,200
Height (inches / mm)	79.1 / 2,010	79.1 / 2,010	79.1 / 2,010
System Weight	**Single Rack**	**Single Controller (3 racks)**	**Dual Controller (6 racks)**
(lbs / kg)	Diskless 1 controller 638 / 290 2 controllers 983 / 446	-	-
Maximum (lbs / kg)	1,301 / 591 384 SFF drives	3,214 / 1,461 1,152 SFF drives	6,418 /2,917 2,304 SFF drives
Maximum (lbs / kg)	1,268 / 578 192 LFF drives	3,181 / 1,446 576 LFF drives	6,362 / 2,892 1,152 LFF drives

Electrical specifications

The VSP G1000, VSP G1500, and VSP F1500 storage system PDUs support both single-phase or three-phase AC power. The system components use single phase 220 VAC.

Table 28 Input power specifications

Item	Input Power to PDUs	Input Current [1]	Steady Current [2]	Leakage Current	Inrush Current		
					1st (0-p)	2nd (0-p)	1st (0-p) Time (-25%)
DKC PS	AC, single phase 2 pole + ground 200 V -8% min 240 V +6% max[3]	7.18A	3.59A	0.28 mA	20A	15A	80ms
UBX PS		2.07A	1.04A	1.75mA	25A	20A	150ms
SBX PS		2.61A	1.31A	1.75mA	25A	20A	150ms
FBX PS		0.28A	1.42A	28mA	20A	10A	80ms

Notes:

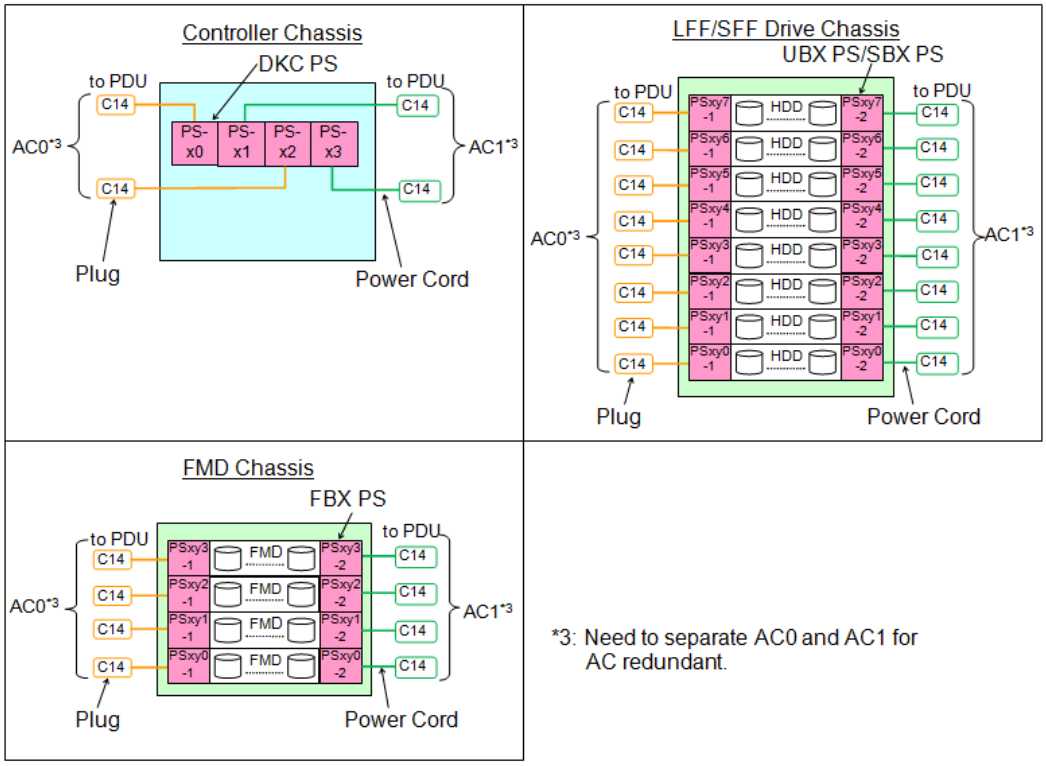
1. The maximum current in case AC input is not a redundant configuration (in case of 184V [200V -8%]).

Item	Input Power to PDUs	Input Current [1]	Steady Current [2]	Leakage Current	Inrush Current		
					1st (0-p)	2nd (0-p)	1st (0-p) Time (-25%)

2. The maximum current in case AC input is a redundant configuration (in case of 184V [200V -8%]).

3. 110/120 VAC system is not supported.

Power Supply Locations



Note: Depending on the configuration, the storage system may draw considerably less power than the rating of the PDU plugs. Use the weight and power calculator to determine the power draw for a specific system. See the note under Electrical specifications on page 81.

Table 29 PDU plugs, circuit breakers, and receptacles

Phase	Location	PDU Plug	Operating / Max Voltage Rating	Max Current Rating	No. of CB per PDU	Breaker Rating
Single See note 2	Americas PDU-12111 2F10	NEMA L6 30P twistlock 2 pole, 3 wire A + B + gnd	208 VAC	30 A	2 UL489	16 A, 20 A trip
	EMEA, APAC A3CR-1232 94-51	IEC 309, blue 2 pole, 3 wire A + B + gnd	230 VAC / 250 VAC	32 A	2 UL489	16 A, 20 A trip
Three See note 3	Americas PDU-32C13 800F10	NEMA L15 30P 3 pole, 4 wire A + B + C + gnd	208 VAC / 240 VAC	30 A per phase	3 UL489	15 A 2 pole
	EMEA, APAC A3CK-2436 94-50	IEC 309, red 4 pole, 5 wire A + B + C + Neut + gnd	400 VAC	32 A per phase	3 UL489	16 A 2 pole

Notes:

1. The numbers in this table were taken from the PDU manufacturer's specifications. Detailed PDU specifications are located in Appendix C. See PDU specifications on page 131.
2. Americas: Single phase, 30 Amp PDU, (12) IEC C13
   EMEA/APAC: Single phase, 32 Amp PDU, (12) IEC C13; (2) IEC C19
3. Americas: Methode three phase, 30 Amp PDU, (24) IEC C13; (6) IEC C19
   EMEA/APAC: Minkels three phase, 32 Amp PDU, (24) IEC C13; (6) IEC C19

Environmental specifications

The following table lists the specifications of the environmental conditions for the VSP G1000, VSP G1500, and VSP F1500 storage systems. The differences between standard and high temperature modes are indicated when applicable.

Table 30 Environmental specifications

Item	Condition		
	Operating[1]	Not Operating[2]	Shipping & Storage[3]
Standard temperature mode (ºF / ºC)	60.8 to 89.6 / 16 to 32	-14 to 109.4 / -10 to 43 -14 to 95 / -10 to 35[10]	-13 to 140 / -25 to 60

Item	Condition		
	Operating[1]	Not Operating[2]	Shipping & Storage[3]
high temperature mode (ºF / ºC)	60.8 to 104 / 16 to 40	-14 to 109.4 / -10 to 43	-13 to 140 / -25 to 60
Relative Humidity (%)[4]	20 to 80	8 to 90	5 to 95
Max. Wet Bulb (ºF / ºC)	78.8 / 26	80.6 / 27	84.2 / 29
Temperature deviation per hour) (ºF / ºC)	50 / 10	50 / 10	68 / 20
Gaseous contaminants[11]	G1 classification levels		
Altitude Standard temperature mode	-200 ft. / -60 m to 9842 ft. / 3,000 m		-
Altitude high temperature mode	-200 ft. / -60 m to 4920 ft. / 1,500 m		-
Vibration[5]	5 to 10Hz: 0.25 mm 10 to 300Hz: 0.49m/s^2	5 to 10Hz: 2.5mm 10 to 70Hz: 4.9m/s^2 270 to 99Hz: 0.05 mm 99 to 300Hz: 9.8m/s^2	Sine Vibration: 4.9m/s^2, 5min. At the resonant frequency with the highest displacement found between 3 to 100Hz[6] Random Vibration: 0.147m2/s3, 30min, 5 to 100Hz[7]
Shock	No impact	78.4m/s^2(8.0G) 15ms	Horizontal: Incline Impact 1.22m/s [8] Vertical: Rotational Edge 0.15m[9]
Dust	Less than 0.15 mg per cubic meter of air	-	-

Notes:

1. Environmental specification for operation should be met before the storage system is powered on. Maximum temperature of 90°F / 32°C at air system air inlet should be strictly met.
2. Unless otherwise specified, non-operating condition includes both packing and unpacking conditions.
3. The system and components should be packed in factory packing for shipping and storing.
4. No condensation in and around the drives should be observed under any conditions.
5. Vibration specifications are applied to all three axes.
6. See ASTM D999-01 The Methods for Vibration Testing of Shipping Containers.
7. See ASTM D4728-01 Test Method for Random Vibration Testing of Shipping Containers.
8. See ASTM D5277-92 Test Method for Performing Programmed Horizontal Impacts Using an Inclined Impact Tester.
9. See ASTM D6055-96 Test Methods for Mechanical Handling of Unitized Loads and Large Shipping Cases and Crates.
10. Applies only when flash module drives are installed.
11. See ANSI/ISA-71.04-2013 Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.

Table 31 System noise levels

Item	Noise levels (controller chassis)		
	Temperature (ºF / ºC)	Fan speed (RPM)	Noise level (dB)
Standard temperature mode	60.8 to 77 / 16 to 25	4200	57.4
	77 to 89.6 / 25 to 32	4700	59.5
high temperature mode (ºF / ºC)	89.6 to 104 / 32 to 40	7400	69.3

PDU specifications

For information about PDUs, refer to the *Hitachi Universal V2 Rack Reference Guide*.

B

System option modes

This appendix lists and describes the public system option modes.

System option modes

For greater flexibility, the VSP G1000, VSP G1500, and VSP F1500 storage systems can be configured with available system option modes to meet specific customer operating requirements. At installation, the modes are set to their default values, as shown in the following table. Discuss these settings with your Hitachi Data Systems team if you think changes should be made. Only a Hitachi Data Systems representative can change the system options modes.

The following tables provide information about system option modes and SVP operations:

- Table 32 System option modes on page 135 lists the public system option mode information for VSP G1000, VSP G1500, and VSP F1500 storage systems. These can be used if applicable.
- Table 33 SOM 15 functions on page 176 specifies the details of mode 15.
- Table 34 SOM 122 pairsplit operations on page 177
- Table 35 SOM 122 pairresync operations on page 177
- Table 36 SOM 269: SVP operations on page 179 specifies the details of mode 269 for SVP operations.
- Table 39 SOM 784 operational specifications on page 180
- Table 38 SOM 729 behavior on page 179
- Table 39 SOM 784 operational specifications on page 180
- Table 40 SOM 803 behavior on page 180
- Table 41 SOM 855 behavior with SOM 467 on page 180
- Table 42 Relations among SOM897, SOM898, and SOM901 on page 180
- Table 43 Relations between SOM930, SOM755 and SOM859 on page 181

Note: The following tables were up to date at the time this manual was published. However, the system option mode information may change in firmware releases that may happen before the next release of this manual. Contact Hitachi Data Systems support for the latest information on the VSP G1000, VSP G1500, and VSP F1500 system option modes.

The system option mode information includes:

- **Mode:** Specifies the system option mode number.
- **Category:** Indicates the functions to which the mode applies.
- **Description:** Describes the action or function that the mode provides.
- **Default:** Specifies the default setting (ON or OFF) for the mode.
- **MCU/RCU:** For remote functions, indicates whether the mode applies to the main control unit (MCU) and/or the remote control unit (RCU).

Table 32 System option modes

Mode	Category	Description	Default	MCU/RCU
15	Common	This mode can reduce the host response time from 15 seconds to 6 seconds or less. **Notes:** **1.** This mode is used on a storage system where slow or delayed drive response may affect business operations. **2.** When Dynamic Sparing or Auto Correction Mode is used, I/O watching time is 30 sec even when the mode is set to ON. This is because host I/Os conflict with copy processing, **3.** Do not use this mode when SATA HDDs are used in VSP G1000 and VSP G1500 systems. **4.** When SOM771 or SOM797 supported by RAID600, HM700, and later models is set to ON, the setting of SOM771/797 is prioritized for the read I/O watching time. **5.** For relations with other system option modes, see the SOM 015 sheet. **6.** When this mode is applied, SOM142 is disabled.	OFF	-
20	Public (Optional)	R-VOL read only function.	OFF	MCU
22	Common	Regarding the correction copy or the drive copy, in case ECCs/LRC PINs are set on the track of copy source HDD, mode 22 can be used to interrupt the copy processing (default) or to create ECCs/LRC PINs on the track of copy target HDD to continue the processing. **Mode 22 = ON:** If ECCs/LRC PINs (up to 16[1]) have been set on the track of copy source HDD, ECCs/LRC PINs (up to 16[1]) will be created on the track of copy target HDD so that the copy processing will continue. If 17 or more ECCs/LRC PINs are created, the corresponding copy processing will be interrupted. **Note:** 1: The maximum number of ECCs/LRC PINs is as follows. All versions: 64 **Mode 22 = OFF (default)** If ECCs/LRC PINs have been set on the track of copy source HDD, the copy processing will be interrupted. (first recover ECCs/LRC PINs by using the PIN recovery flow, and then perform the correction copy or the drive copy again). One of the controlling option for correction/drive copy.	OFF	None
36	HRC	Sets default function (CRIT=Y) option for SVP panel (HRC).	OFF	MCU
64	TrueCopy for Mainframe	**Mode 64 = ON:**		

Mode	Category	Description	Default	MCU/RCU
		• When receiving the Freeze command, in the subsystem, pair volumes that fulfill the conditions below are suspended and the status change pending (SCP) that holds write I/Os from the host is set. The path between MCU and RCU is not deleted. Query is displayed only but unusable. • When receiving the RUN command, the SCP status of the pairs that fulfill the conditions below is released. • When a Failure Suspend occurs when Freeze Option Enable is set, except the pair in which the Failure Suspend occurs, other pairs that fulfill conditions below go into SCP state:- TrueCopy Sync M-VOL- Mainframe Volume- Pair status: Duplex/Pending **Mode 64 = OFF (default):** • When receiving the Freeze command, pairs that fulfill the conditions below are suspended and the SCP is set. In the case of CU emulation type 2105/2017, the path between MCU and RCU is deleted, while the path is not deleted but unusable with Query displayed only in the case of CU emulation type 3990. • When receiving the RUN command, the SCP status of the pairs that fulfill the conditions below is released. • When a Failure Suspend occurs while the Freeze Option Enable is set, except the pair in which the Failure Suspend occurs, other pairs that fulfill the conditions below go into SCP state. Conditions: • TrueCopy Sync M-VOL • Mainframe Volume • Pair status: Duplex/Pending • A pair whose RCU# is identical to the RCU for which the Freeze command is specified. **Notes:** **1.** When all the following conditions are met, set Mode 64=ON. **2.** When all the following conditions are met, set Mode 64=ON. - Customer requests to stop the update I/O operation to the RCU of a TrueCopy for Mainframe pair for the whole subsystem. - Disaster Recovery function such as GDPS, HyperSwap, or Fail Over/ Fail Back, which requires compatibility with IBM storage, is not used as this Mode 64 operates without having compatibility with IBM storage. - Only Peer-to-Peer-Remote-Copy operation. (Do not use it in combination with Business Continuity Manager.) **3.** Even though the Failover command is not an applicable criterion, when executing the Failover command while Mode 114 is ON, since ports are not automatically switched, the Failover command fails. **4.** With increase of Sync pairs in subsystem, the time period to report the completion of Freeze command		

Mode	Category	Description	Default	MCU/RCU
		and RUN command gets longer (estimate of time to report completion: 1 second per 1000 pairs), and MIH may occur.		
80	ShadowImage	• For RAID 300/400/450 (SI for OPEN or Mainframe) In response to the Restore instruction from the host or Storage Navigator, the following operation is performed regardless of specifying Quick or Normal. • For RAID 500/600/700 (SI for OPEN) In response to the Restore instruction from the host, if neither Quick nor Normal is specified, the following operation is performed **Mode 80 = ON:** Normal Restore / Reverse Copy is performed. **Mode 80 = OFF:** Quick Restore is performed. **Notes:** **1.** This mode is applied when the specification for Restore of SI is switched between Quick (default) and Normal. **2.** The performance of Restore differs depending on the Normal or Quick specification.	OFF	-
87	ShadowImage	Determines whether NormalCopy or QuickResync, if not specified, is performed at the execution of pairresync by CCI. **Mode 87 = ON:** QuickResync is performed. **Mode 87 = OFF:** NormalCopy is performed.	OFF	-
104	HRC	Changes the default CGROUP Freeze option.	OFF	MCU
114	HRC	This mode enables or disables the LCP/RCP port to be automatically switched over when the PPRC command ESTPATH/DELPATH is executed. **Mode 114 = ON:** Automatic port switching during ESTPATH/DELPATH is enabled. **Mode 114 = OFF (default):** Automatic port switching during ESTPATH/DELPATH is disabled. **Notes:** **1.** If you select an incorrect port while the mode is set to ON, and if ESTPATH is executed when no logic path exists, the port is switched to RCP. **2.** Set this mode to OFF before using TPC-R (IBM software for disaster recovery).	OFF	MCU

Mode	Category	Description	Default	MCU/RCU
122	ShadowImage	For Split or Resync request from the Mainframe host and Storage Navigator, **Mode 122 = ON:** • By specifying Split or Resync, Steady/Quick Split or Normal/Quick Resync is respectively executed in accordance with Normal/Quick setting **Mode 122 = OFF (default):** • By specifying Split or Resync, Steady/Quick Split or Normal/Quick Resync is respectively executed in accordance with Normal/Quick setting. For details, see "SOM 122" sheet **Notes:** **1.** For RAID500 and later models, this mode is applied to use scripts etc that are used on RAID400 and 450 **2.** In the case of RAID500 and later models, executing the pairresync command from RAID Manager may be related to the SOM 087 setting. **3.** When performing At-Time Split from RAID Manager • Set this mode to OFF in the case of RAID450 • Set this mode to OFF or specify the environment variable HORCC_SPLT for Quick in the case of RAID500 and later. Otherwise, Pairsplit may turn timeout. **4.** The mode becomes effective after specifying Split/Resync following the mode setting. The mode function does not work if it is set during the Split/Resync operation.	OFF	-
187	Common	Yellow Light Option (only for XP product)	OFF	-
190	HRC	TCz – Allows you to update the VOLSER and VTOC of the R-VOL while the pair is suspended if both mode 20 and 190 are ON	OFF	RCU
269	Common	High Speed Format for CVS (Available for all dku emulation type) **1.** High Speed Format support When redefining all LDEVs included in an ECC group using Volume Initialize or Make Volume on CVS setting panel, LDEV format, as the last process, will be performed in high speed. **2.** Make Volume feature enhancement In addition, with supporting the feature, the Make Volume feature (recreating new CVs after deleting all volumes in a VDEV), which so far was supported for OPEN-V only, is available for all emulation types. **Mode 269 = ON:** The High Speed format is available when performing CVS operations on Storage Navigator or performing LDEV formats on the **Maintenance** window of the SVP for all LDEVs in a parity group. **Mode 269 = OFF (default):**	OFF	MCU/RCU

Mode	Category	Description	Default	MCU/RCU
		As usual, only the low speed format is available when performing CVS operations on Storage Navigator. In addition, the LDEV specifying format on the **Maintenance** window of the SVP is in low speed as well. **Notes:** **1.** For more details about mode 269, see worksheet "Mode269 detail for RAID700". **2.** Mode 269 is effective only when using the SVP to format the CVS.		
292	HRC	Issuing OLS when Switching Port In case the mainframe host (FICON) is connected with the CNT-made FC switch (FC9000 etc.), and is using along with the TrueCopy S/390 with Open Fibre connection, the occurrence of Link Incident Report for the mainframe host from the FC switch will be deterred when switching the CHT port attribute (including automatic switching when executing CESTPATH and CDELPATH in case of Mode 114=ON). **Mode 292=ON:** When switching the port attribute, issue the OLS (100ms) first, and then reset the Chip. **Mode 292=OFF (default):** When switching the port attribute, reset the Chip without issuing the OLS.	OFF	MCU/RCU
305	Mainframe	This mode enables the pre-label function (creation of VTOC including VOLSER). **Mode 305 = ON:** Pre-label function is enabled **Notes:** **1.** Set SOM 305 to ON before performing LDEV Format for a mainframe volume if you want to perform OS IPL (volume online) without fully initializing the volume after the LDEV Format. However, full initialization is required in actual operation. **2.** Processing time of LDEV format increases by as much as full initialization takes. **3.** The following functions and conditions are not supported. • Quick format • 3390-A (Dynamic Provisioning attribute) • Volume Shredder **4.** Full initialization is required in actual operation.	OFF	MCU/RCU
308	TrueCopy for Mainframe Universal Replicator for Mainframe	**SIM RC=2180 option** SIM RC=2180 (RIO path failure between MCU and RCU) was not reported to host. DKC reports SSB with F/M=F5 instead of reporting SIM RC=2180 in the case. Micro-program has been modified to report SIM RC=2180 with	OFF	MCU

Mode	Category	Description	Default	MCU/RCU
		newly assigned system option Mode as individual function for specific customer. **Mode 308 = ON** SIM RC 2180 is reported which is compatible with older Hitachi specification **Mode 308 = OFF** Reporting is compatible with IBM - Sense Status report of F5.		
310	Common	**Mode 310 = ON:** The monitoring timer for MP hang-up is 6 seconds and returning a response to the host within 8 is guaranteed. **Mode 310 = OFF (default):** The monitoring timer for MP hang-up remains 15 seconds (RAID500/RAID600) or 8 seconds (RAID700/RAID800/HM700). **Notes:** **1.** This mode applies to a site where strict host response performance is required. **2.** If a hardware failure occurs when the mode is set to ON, the time until MPB blockage is determined is shorter than usual.	OFF	
448	Universal Replicator Universal Replicator for Mainframe	**Mode 448 = ON: (Enabled)** If the SVP detects a blocked path, the SVP assumes that an error occurred, and then immediately splits (suspends) the mirror. **Mode 448 = OFF: (Disabled)** If the SVP detects a blocked path and the path does not recover within the specified period of time, the SVP assumes that an error occurred, and then splits (suspends) the mirror. **Note:** The mode 448 setting takes effect only when mode 449 is set to OFF.	OFF	
449	Universal Replicator Universal Replicator for Mainframe	Detecting and monitoring path blockade between MCU and RCU of Universal Replicator/Universal Replicator for z/OS **Mode 449 = ON:** Detecting and monitoring of path blockade will NOT be performed. **Mode 449 OFF (default):** Detecting and monitoring of the path blockade will be performed. * Newly shipped DKC will have Mode 449 = ON as default.		

Mode	Category	Description	Default	MCU/RCU
		Note: The mode status will not be changed by the microcode exchange.		
454	Virtual Partition Manager	CLPR (Function of Virtual Partition Manager) partitions the cache memory in the disk subsystem into multiple virtual cache and assigns the partitioned virtual cache for each use. If a large amount of cache is required for a specific use, it can minimize the impact on other uses. The CLPR function works as follows depending on whether SOM 454 is set to ON or OFF. **Mode 454 = OFF (default):** The amount of the entire destage processing is periodically determined by using the highest workload of all CLPRs (*a). (The larger the workload is, the larger the amount of the entire destage processing becomes.) *a: (Write Pending capacity of CLPR#x) ÷ (Cache capacity of CLPR#x), x=0 to 31 CLPR whose value above is the highest of all CLPRs Because the destage processing would be accelerated depending on CLPR with high workload, when the workload in a specific CLPR increases, the risk of host I/O halt would be reduced. Therefore, set Mode 454 to OFF in most cases. **Mode 454 = ON:** The amount of the entire destage processing is periodically determined by using the workload of the entire system (*b). (The larger the workload is, the larger the amount of the entire destage processing becomes.) *b: (Write Pending capacity of the entire system) ÷ (Cache capacity of the entire system) Because the destage processing would not be accelerated even if CLPR has high workload, when the workload in a specific CLPR increases, the risk of host I/O halt would be increased. Therefore, it is limited to set Mode 454 to ON only when a CLPR has constant high workload and it gives priority to I/O	OFF	
457	Universal Volume Manager	This SOM has two purposes: **Mode 457 = ON:** **1.** It activates high speed LDEV Format for External Volumes The high speed LDEV format for external volumes is available by setting system option mode 457 to ON. When SOM 457 is ON, if you select an external volume group and perform an LDEV format, any write processing on the external logical units will be skipped. However, if the emulation type of the external LDEV is a mainframe system, the write	OFF	MCU/RCU

Mode	Category	Description	Default	MCU/RCU
		processing for mainframe control information only will be performed after the write skip. **2.** It provides support for Mainframe Control Block Write. The high speed LDEV format for external volumes is supported. Control Block Write of the external LDEVs in mainframe emulation is supported by Device Manager - Storage Navigator (GUI). **Notes:** **1.** If the LDEV is not written with data "0" before performing the function, the LDEV format may fail. **2.** After the format processing, make sure to set system option mode 457 to OFF.		
459	ShadowImage for Mainframe, ShadowImage	When the secondary volume of an SI/SIz pair is an external volume, the transaction to change the status from SP-PEND to SPLIT is as follows: **Mode 459 = ON:** When creating an SI/SIz pair: The copy data is created in cache memory. When the write processing on the external storage completes and the data is fixed, the pair status will change to SPLIT. **Mode 459 = OFF:** When creating an SI/SIz pair Once the copy data has been created in cache memory, the pair status will change to SPLIT. The external storage data is not fixed (current spec).	OFF	-
466	Universal Replicator, Universal Replicator for Mainframe	For UR/URz operations it is strongly recommended that the path between main and remote storage systems have a minimum data transfer speed of 100 Mbps. If the data transfer speed falls to 10 Mbps or lower, UR operations cannot be properly processed. As a result, many retries occur and UR pairs may be suspended. Mode 466 is provided to ensure proper system operation for data transfer speeds of at least 10 Mbps. **Mode 466 = ON:** Data transfer speeds of 10 Mbps and higher are supported. The JNL read is performed with 4-multiplexed read size of 256 KB. **Mode 466 = OFF:** For conventional operations. Data transfer speeds of 100 Mbps and higher are supported. The JNL read is performed with 32-multiplexed read size of 1 MB by default. **Note:** The data transfer speed can be changed using the Change JNL Group options.	OFF	
467	ShadowImage, ShadowImage for Mainframe,Comp	For the following features, the current copy processing slows down when the percentage of "dirty" data is 60% or higher, and it stops when the percentage is 75% or higher. Mode 467 is provided to prevent the percentage from	ON	

Mode	Category	Description	Default	MCU/RCU
	atible FlashCopy® V2, Snapshot, Volume Migration, Universal Volume Manager	exceeding 60%, so that the host performance is not affected. ShadowImage, ShadowImage for Mainframe, Compatible FlashCopy® V2, Snapshot, Volume Migration, Universal Volume Manager **Mode 467 = ON:** Copy overload prevention. Copy processing stops when the percentage of "dirty" data reaches 60% or higher. When the percentage falls below 60%, copy processing restarts. **Mode 467 = OFF:** Normal operation. The copy processing slows down if the dirty percentage is 60% or larger, and it stops if the dirty percentage is 75% or larger. **Caution:** This mode must always be set to ON when using an external volume as the secondary volume of any of the above-mentioned replication products. **Note:** It takes longer to finish the copy processing because it stops for prioritizing the host I/O performance.		
471	Copy-on-Write Snapshot (Earlier than 70-05-0x-00/00) Copy-on-Write Snapshot, Hitachi Thin Image (70-05-0x-00/00 or higher)	Since the SIM-RC 601xxx that are generated when the usage rate of Pool used by Snapshot exceeds the threshold value can be resolved by users, basically they are not reported to the maintenance personnel. This option is used to inform maintenance personnel of these SIMs that are basically not reported to maintenance personnel in case these SIMs must be reported to them. SIMs reported by setting the mode to ON are: • SIM-RC 601xxx (Pool utilization threshold excess) (Earlier than 70-05-0x-00/00) • SIM-RC 601xxx (Pool utilization threshold excess)/ 603000 (SM Space Warning) (70-05-0x-00/00 or higher) **Mode 471 = ON:** This kind of SIMs is reported to maintenance personnel. **Mode 471 = OFF (default):** This kind of SIMs is not reported to maintenance personnel. **Note:** Set this mode to ON when it is required to inform maintenance personnel of the SIM-RC (*) SIMs reported by setting the mode to ON are: • SIM-RC 601xxx (Pool utilization threshold excess) (Earlier than 70-05-0x-00/00)	OFF	

Mode	Category	Description	Default	MCU/RCU
		• SIM-RC 601xxx (Pool utilization threshold excess)/ 603000 (SM Space Warning) (70-05-0x-00/00 or higher)		
474	Universal Replicator, Universal Replicator for Mainframe	UR initial copy performance can be improved by issuing a command from Raid Manager/BC Manager to execute a dedicated script consists of UR initial copy (Nocopy), UR suspend, TC (Sync) initial copy, TC (Sync) delete, and UR resync. **Mode 474 = ON:** For a suspended UR pair, a TC-Sync pair can be created with the same P-VOL/S-VOL so that UR initial copy time can be reduced by using the dedicated script. **Mode 474 = OFF (default):** For a suspended UR pair, a TC-Sync pair cannot be created with the same P-VOL/S-VOL. For this, the dedicated script cannot be used. **Notes:** **1.** Set this mode for both MCU and RCU. **2.** When the mode is set to ON: • Execute all of pair operations from Raid Manager/ BCM. • Use a dedicated script. • Initial copy operation is prioritized over update I/O. Therefore, the processing speed of the update I/O slows down by about 15μs per command. **3.** If this mode is set to ON, the processing speed of update I/O slows down by about 15μs per command, version downgrade is disabled, and Take Over is not available. **4.** If the mode is not set to ON for both or either sides, the behavior is as follows. • Without setting on both sides: Normal UR initial copy performance. • With setting on MCU/without setting on RCU: TC Sync pair creation fails. • Without setting on MCU/with setting on RCU: The update data for P-VOL is copied to the S-VOL in synchronous manner. • While the mode is set to ON, micro-program downgrade is disabled. • While the mode is set to ON, Take Over function is disabled. • The mode cannot be applied to a UR pair that is the 2nd mirror in URxUR multi-target configuration or URxUR cascade configuration. If applied, TC pair creation is rejected with SSB=CBEE output. **5.** While the mode is set to ON, make sure not to perform micro-program downgrade to an unsupported version.	OFF	MCU/RCU

Mode	Category	Description	Default	MCU/RCU
		6. While the mode is set to ON, make sure not to perform the Take Over function. **7.** The mode cannot be applied to a UR pair that is the 2nd mirror in URxUR multi-target configuration or URxUR cascade configuration. If applied, TC pair creation is rejected with SSB=CBEE output. **8.** Before setting SOM474 to ON, make sure that SOM1091 is set to OFF. If SOM1091 is set to ON, set it to OFF and then set SOM474 to ON.		
484	TrueCopy for Mainframe ShadowImage for Mainframe	The IBM-compatible PPRC FC path interface has been supported with RAID500 50-06-11-00/00. As the specification of QUERY display using this interface (hereinafter called New Spec) is different from the current specification (hereinafter called Previous Spec), this mode enables to display the PPRC path QUERY with the New Spec or Previous Spec. **Mode 484 = ON:** PPRC path QUERY is displayed with the New Spec. **Mode 484 = OFF (default):** PPRC path QUERY is displayed with the Previous Spec (ESCON interface). **Notes:** **1.** Set this mode to ON when you want to maintain compatibility with the Previous Spec for PPRC path QUERY display under the environment where IBM host function (such as PPRC and GDPS) is used. **2.** When an old model or a RAID500 that doesn't support this mode is connected using TCz, set this mode to OFF. **3.** If the display specification is different between MCU and RCU, it may cause malfunction of host. **4.** When TPC-R is used, which is IBM software for disaster recovery, set this mode to ON.	OFF	MCU/RCU
495	NAS	Function: That the secondary volume where S-VOL Disable is set means the NAS file system information is imported in the secondary volume. If the user has to take a step to release the S-VOL Disable attribute in order to perform the restore operation, it is against the policy for the guard purpose and the guard logic to have the user uninvolved. In this case, in the NAS environment, Mode 495 can be used to enable the restore operation. **Mode 495 = ON:** The restore operation (Reverse Copy, Quick Restore) is allowed on the secondary volume where S-VOL Disable is set. **Mode 495 = OFF (default):**	OFF	

Mode	Category	Description	Default	MCU/RCU
		The restore operation (Reverse Copy, Quick Restore) is not allowed on the secondary volume where S-VOL Disable is set.		
506	Universal Replicator, Universal Replicator for Mainframe	This option is used to enable Delta Resync with no host update I/O by copying only differential JNL instead of copying all data. The HUR Differential Resync configuration is required. **Mode 506 = ON:** Without update I/O: Delta Resync is enabled. With update I/O: Delta Resync is enabled. **Mode 506 = OFF (default):** Without update I/O: Total data copy of Delta Resync is performed. With update I/O: Delta Resync is enabled. **Note:** Even when mode 506 is set to ON, the Delta Resync may fail and only the total data copy of the Delta Resync function is allowed if the necessary journal data does not exist on the primary subsystem used for the Delta Resync operation.	OFF	MCU/RCU
530	Universal Replicator for Mainframe	When a Universal Replicator for Mainframe pair is in the Duplex state, this option switches the display of Consistency Time (C/T) between the values at JNL restore completion and at JNL copy completion. **Mode 530 = ON:** - C/T displays the value of when JNL copy is completed. **Mode 530 = OFF (default):** C/T displays the value of when JNL restore is completed. **Note:** At the time of Purge suspend or RCU failure suspend, the C/T of Universal Replicator for Mainframe displayed by Business Continuity Manager or Storage Navigator may show earlier time than the time showed when the pair was in the Duplex state.	OFF	RCU
531	Open and Mainframe	When PIN data is generated, the SIM currently stored in SVP is reported to the host. **Mode 531 = ON:** The SIM for PIN data generation is stored in SVP and reported to the host. **Mode 531 = OFF:** The SIM for PIN data generation is stored in SVP only, not reported to the host, the same as the current specification.	OFF	MCU/RCU

Mode	Category	Description	Default	MCU/RCU
548	TrueCopy for Mainframe, Universal Replicator for Mainframe, or ShadowImage for Mainframe from BCM	This option prevents pair operations of TCz, URz, or SIz via Command Device online. **Mode 548 = ON:** Pair operations of TC for z/OS, UR for z/OS, or SI for z/OS via online Command Device are not available. SSB=0x64fb is output. **Mode 548 = OFF:** Pair operations of TC for z/OS, UR for z/OS, or SI for z/OS via online Command Device are available. SIM is output. **Notes:** **1.** When Command Device is used online, if a script containing an operation via Command Device has been executed, the script may stop if this option is set to ON. As described in the BCM user's guide, the script must be performed with Command Device offline. **2.** This option is applied to operations from BCM that is operated on MVS.		
556	Open	Prevents an error code from being set in the 8 - 11th bytes in the standard 16-byte sense byte. **Mode 556 = ON:** An error code is not set in the 8 - 11th bytes in the standard 16-byte sense byte. **Mode 556 = OFF (default):** An error code is set in the 8 - 11th bytes in the standard 16-byte sense byte.	OFF	MCU/RCU
561	ShadowImage, Universal Volume Manager	Allows Quick Restore for external volumes with different Cache Mode settings. **Mode 561 = ON:** Quick Restore for external volumes with different Cache Mode settings are prevented. **Mode 561 = OFF (default):** Quick Restore for external volumes with different Cache Mode settings are allowed.	OFF	MCU/RCU
573	TrueCopy for Mainframe ShadowImage for Mainframe	For the DKU emulation type 2105/2107, specifying the CASCADE option for the ICKDSF ESTPAIR command is allowed. **Mode 573 = ON:** The ESTPAIR CASCADE option is allowed. **Mode 573 = OFF (default):** The ESTPAIR CASCADE option is not allowed. (When specified, the option is rejected.)	OFF	MCU/RCU The unit where TCz and SIz in a cascading configuration use the same volume

Mode	Category	Description	Default	MCU/RCU
		Notes: **1.** When DKC emulation type is 2105/2107, this mode is applied in the case where pair creation in TCz – SIz cascading configuration in the ICKDSF environment fails with the following message output. Message: ICK30111I DEVICE SPECIFIED IS THE SECONDARY OF A DUPLEX OR PPRC PAIR **2.** The CASCADE option can be specified in the TSO environment also. **3.** Although the CASCADE option can be specified for the ESTPAIR command, the PPRC-XD function is not supported. **4.** Perform thorough pre-check for any influence on GDPS/PPRC. **5.** The SOM must be enabled only when the CASCADE option is specified for the ESTPAIR command for the DKC emulation type 2105/2107.		
589	Universal Volume Manager	Turning this option ON changes the frequency of progress updates when disconnecting an external volume. Improvement in destaging to the pool by achieving efficient HDD access. **Mode 589 = ON:** For each external volume, progress is updated only when the progress rate is 100%. **Mode 589 = OFF (default):** Progress is updated when the progress rate exceeds the previous level. **Notes:** **1.** Set this option to ON when disconnecting an external volume while the specific host IO operation is online and its performance requirement is severe. **2.** Whether the disconnecting status for each external volume is progressed or not cannot be confirmed on Device Manager - Storage Navigator (It indicates "-"until just before the completion and at the last it changes to 100%).	OFF	
598	Universal Replicator for Mainframe	This mode is used to report SIMs (RC=DCE0 to DCE3) to a Mainframe host to warn that a URz journal is full. **Mode 598 = ON:** SIMs (RC=DCE0 to DEC3) to warn that a JNL is full are reported to SVP and the host. **Mode 598= OFF (default):** SIMs (RC=DCE0 to DEC3) to warn that a JNL is full are reported to SVP only. **Notes:** **1.** This mode is applied if SIMs (RC=DCE0 to DCE3) need to be reported to a Mainframe host. **2.** The SIMs are not reported to the Open server.	ON	

Mode	Category	Description	Default	MCU/RCU
		3. SIMs for JNL full (RC=DCE0 and DCE1) on MCU are reported to the host connected with MCU. **4.** SIMs for JNL full (RC=DCE2 and DCE3) on RCU are reported to the host connected with RCU.		
689	TrueCopy for Mainframe ShadowImage for Mainframe	This option is used to slow down the initial copy and resync copy operations when the Write Pending rate on RCU exceeds 60%. **Mode 689 = ON:** The initial copy and resync copy operations are slowed when the Write Pending rate on RCU exceeds 60%. * From RAID700, if the CLPR write pending rate where the initial copy target secondary volume belongs to is not over 60% but that of MP PCB where the S-VOL belongs to is over 60%, the initial copy operation is slowed down. **Mode 689 = OFF (default):** The initial copy and resync copy operations are not slowed down when the Write Pending rate on RCU exceeds 60% (the same as before). **Notes:** **1.** This mode can be set online. **2.** The micro-programs on both MCU and RCU must support this mode. **3.** This mode should be set per customer's requests. **4.** If the Write Pending status long keeps 60% or more on RCU, it takes extra time for the initial copy and resync copy to be completed by making up for the slowed down copy operation. **5.** From RAID700, if the Write Pending rate of CLPR where the initial copy target secondary volume belongs to is not over 60% but that of MP PCB where the S-VOL belongs to is over 60%, the initial copy operation is slowed down.	OFF	
690	Universal Replicator, Universal Replicator for Mainframe	This option is used to prevent Read JNL or JNL Restore when the Write Pending rate on RCU exceeds 60% as follows: • When CLPR of JNL-Volume exceeds 60%, Read JNL is prevented. • When CLPR of Data (secondary)-Volume exceeds 60%, JNL Restore is prevented. **Mode 690 = ON:** Read JNL or JNL Restore is prevented when the Write Pending rate on RCU exceeds 60%. **Mode 690 = OFF (default):** Read JNL or JNL Restore is not prevented when the Write Pending rate on RCU exceeds 60% (the same as before). **Notes:** **1.** This mode can be set online. **2.** This mode should be set per customer's requests.	OFF	

Mode	Category	Description	Default	MCU/RCU
		3. If the Write Pending status long keeps 60% or more on RCU, it takes extra time for the initial copy to be completed by making up for the prevented copy operation. **4.** If the Write Pending status long keeps 60% or more on RCU, the pair status may become Suspend due to the JNL-Vol being full.		
696	Open	This mode is available to enable or disable the QoS function. **Mode 696 = ON:** QoS is enabled. (In accordance with the Share value set to SM, I/Os are scheduled. The Share value setting from RMLIB is accepted) **Mode 696 = OFF (default):** QoS is disabled. (The Share value set to SM is cleared. I/O scheduling is stopped. The Share value setting from host is rejected) **Note:** Set this mode to ON when you want to enable the QoS function.	OFF	
701	Universal Volume Manager	Issues the Read command at the logical unit discovery operation using UVM. **Mode 701 = ON:** The Read command is issued at the logical unit discovery operation. **Mode 701 = OFF:** The Read command is not issued at the logical unit discovery operation. **Notes:** **1.** When the Open LDEV Guard attribute (VMA) is defined on an external device, set the system option to ON. **2.** When this option is set to ON, it takes longer time to complete the logical unit discovery. The amount of time depends on external storages. **3.** With this system option OFF, if searching for external devices with VMA set, the VMA information cannot be read. **4.** When the mode is set to ON while the following conditions are met, the external volume is blocked. a. RAID700 70-03-3x-00/00 or higher version is used on the storage system. b. An external volume to which Nondisruptive Migration (NDM) attribute is set exists. c. The external volume is reserved by the host **5.** As the VMA information is USP/NSC specific, this mode does not need to be ON when the external storage is other than USP/NSC.	OFF	

Mode	Category	Description	Default	MCU/RCU
		6. Set the mode to OFF when the following conditions are met. a. RAID700 70-03-3x-00/00 or higher version is used on the storage system b. An external volume to which Nondisruptive Migration (NDM) attribute is set exists.		
704	Open and Mainframe	To reduce the chance of MIH, this option can reduce the priority of SI, VM, CoW Snapshot, Flash Copy or Resync copy internal IO requests so that host IO has a higher priority. This mode creates new work queues where these jobs can be assigned with a lower priority. **Mode 704 = ON:** Copy processing requested is registered into a newly created queue so that the processing is scheduled with lower priority than host I/O. **Mode 704 = OFF: (Default)** Copy processing requested is not registered into a newly created queue. Only the existing queue is used. **Note:** If the PDEV is highly loaded, the priority of Read/Write processing made by SI, VM, Snapshot, Compatible FlashCopy® V2 or Resync may become lower. As a consequence the copy speed may be slower.	OFF	
721	Open and Mainframe	When a parity group is uninsulated or installed, the following operation is performed according to the setting of mode 721. **Mode 721 = ON:** When a parity group is uninstalled or installed, the LED of the drive for uninstallation is not illuminated, and the instruction message for removing the drive does not appear. Also, the windows other than that of parity group, such as DKA or DKU, are unavailable to select. **Mode 721 = OFF (default):** When a parity group is uninstalled or installed, the operation is as before: the LED of the drive is illuminated, and the drive must be unmounted and remounted. **Notes:** **1.** When the RAID level or emulation type is changed for the existing parity group, this option should be applied only if the drive mounted position remains the same at the time of the parity group uninstallation or installation. **2.** After the operation using this option is completed, the mode must be set back to OFF; otherwise, the LED of the drive to be removed will not be illuminated at subsequent parity group uninstalling operations.	OFF	

Mode	Category	Description	Default	MCU/RCU
725	Universal Volume Manager	This option determines the action that will be taken when the status of an external volume is Not Ready **Mode 725 = ON:** When Not Ready is returned, the external path is blocked and the path status can be automatically recovered (Not Ready blockade). Note that the two behaviors, automatic recovery and block, may be repeated. For version 60-05-06-00/00 and later, when the status of a device is Not Ready blockade, Device Health Check is executed after 30 seconds. **Mode 725 = OFF (default):** When Not Ready is returned three times in three minutes, the path is blocked and the path status cannot be automatically recovered (Response error blockade). **Notes:** **1.** For R700 70-01-62-00/00 and lower (within 70-01-xx range) • Applying this SOM is prohibited when USP V/VM is used as an external subsystem and its external volume is DP-VOL. • Applying this SOM is recommended when the above condition (1) is not met and SUN storage is used as an external storage. • Applying this SOM is recommended if the above condition (1) is not met and a maintenance operation such as firmware update causing controller reboot is executed on the external storage side while a storage system other than Hitachi product is used as an external subsystem. **2.** For R700 70-02-xx-00/00 and higher, or later models. • Applying this SOM is prohibited when USP V/VM is used as an external subsystem and its external volume is DP-VOL. • Applying this SOM is recommended when the above condition (1) is not met and SUN storage is used as an external storage. • Applying this SOM is recommended when the above condition (1) is not met and EMC CX series or Fujitsu Fibre CAT CX series is used as an external storage. • Applying this SOM is recommended if the above condition (1) is not met and a maintenance operation such as firmware update causing controller reboot is executed on the external storage side while a storage system other than Hitachi product is used as an external subsystem. (Continued below) **3.** While USP V/VM is used as an external subsystem and its volume is DP-VOL, if SOM e Pool-VOLs constituting the DP-VOL are blocked, external path blockade and recovery occurs repeatedly.	OFF	

Mode	Category	Description	Default	MCU/RCU
		4. When a virtual volume mapped by UVM is set to pool-VOL and used as DP-VOL in local subsystem, this SOM can be applied without problem.		
729	Dynamic Provisioning Data Retention Utility	To set the Protect attribute for the target DP-VOL using Data Retention Utility (DRU), when any write operation is requested to the area where the page allocation is not provided at a time when the HDP Pool is full. **Mode 729 = ON:** To set the Protect attribute for the target DP-VOL using DRU, when any write operation is requested to the area where the page allocation is not provided at a time when the HDP pool is full. (Not to set in the case of Read request.) **Mode 729 = OFF (default):** Not to set the Protect attribute for the target DP-VOL using DRU, when any write operation is requested to the area where the page allocation is not provided at a time when HDP pool is full. **Notes:** **1.** This SOM is applied when: • The threshold of pool is high (for example. 95%) and the pool may be full. • File system is used. • Data Retention Utility is installed. **2.** Since the Protect attribute is set for V-VOL, the Read operation cannot be allowed as well. **3.** When Data Retention Utility is not installed, the desired effect is not achieved. **4.** Protect attribute can be released from the **Data Retention** window of Device Manager - Storage Navigator after releasing the full status of the pool by adding a Pool-VOL. **5.** With RAID800 V02 and later versions, do not change the mode setting when the pool is full. Instead, use the virtual volume protection function to change the setting. **6.** With R800 V02+2 and later, when HMO63 or 73 is set to ON, the setting of the HMO takes precedence over the setting of SOM 729. SOM 729 acts as if it were turned OFF, even if it is actually turned ON.	OFF	
733	Volume Migration V2, ShadowImage, ShadowImage for Mainframe	This option enables to suspend Volume Migration or Quick Restore operation during LDEV-related maintenance. **Mode 733 = ON:** Volume Migration V2 or Quick Restore operation during LDEV-related maintenance is not suspended **Mode 733 = OFF (default):** Volume Migration V2 or Quick Restore operation during LDEV-related maintenance is suspended **Notes:**	OFF	

Mode	Category	Description	Default	MCU/RCU
		1. (USP V/VM) This option is recommended as functional improvement to avoid maintenance failures. In some cases of a failure in LDEV-related maintenance without setting the option, Storage Navigator operations may be unavailable. **2.** (USP V/VM) There is the potential for LDEV-related maintenance activities to fail when Volume Migration V2 and Quick Restore is active without setting the option. **3.** Note that behavior when the mode is set to ON and OFF is reversed between USP V/VM and VSP and later/HUS VM and later. **4.** (USP V/VM) This option should be applied when Volume Migration or Quick Restore operation can be suspended during LDEV-related maintenance. **5.** (USP V/VM) If virtual volume capacity expansion operation conflicts with Volume Migration V2 or Quick Restore operation, the virtual volume capacity expansion operation may fail. **6.** (VSP and later/HUS VM and later) This mode should be applied to perform Volume Migration or Quick Restore during maintenance operation. **7.** (VSP and later/HUS VM and later) Set mode 733 to ON if you want to prioritize the Volume Migration or Quick Restore operation over maintenance activities. In this case, maintenance activities may fail when the Volume Migration or Quick Restore operation works during the maintenance activities. **8.** (VSP and later/HUS VM and later) An LDEV-related maintenance operation such as LDEV installation/ removal may fail when Volume Migration or Quick Restore takes place.		
734	Microcode version V02 and lower: Dynamic Provisioning Microcode version V02 +1 and higher: Dynamic Provisioning Dynamic Provisioning for Mainframe	When exceeding the pool threshold, the SIM is reported as follows: **Mode 734 = ON:** The SIM is reported at the time when exceeding the pool threshold. If the pool usage rate continues to exceed the pool threshold, the SIM is repeatedly reported every eight (8) hours. Once the pool usage rate falls below the pool threshold, and then exceeds again, the SIM is reported. **Mode 734 = OFF (default):** The SIM is reported at the time when exceeding the pool threshold. The SIM is not reported while the pool usage rate continues to exceed the pool threshold. Once the pool usage rate falls below the pool threshold and then exceeds again, the SIM is reported. **Notes:** **1.** This option is turned ON to prevent the write I/O operation from being unavailable due to pool full. **2.** If the exceeding pool threshold SIM occurs frequently, other SIMs may not be reported. **3.** Though turning on this option can increase the warning effect, if measures such as adding a pool fail	OFF	

Mode	Category	Description	Default	MCU/RCU
		to be done in time so that the pool becomes full, MODE 729 can be used to prevent file systems from being destroyed. **4.** Turning on MODE 741 can provide the SIM report to not only the users but also the service personnel.		
741	Microcode version V02 and lower: Dynamic Provisioning Microcode version V02 +1 and higher: Dynamic Provisioning, Dynamic Provisioning for Mainframe	The option enables to switch over whether to report the following SIM for users to the service personnel: SIM-RC 625000 (HDP pool usage rate continues to exceed the threshold) **Mode 741 = ON:** SIM is reported to the service personnel **Mode 741 = OFF (default):** SIM is not reported to the service personnel **Notes:** **1.** This option is set to ON to have SIM for users reported to the service personnel: • For the system where SNMP and E-mail notification are not set. • If Device Manager - Storage Navigator is not periodically activated. **2.** When MODE 734 is turned OFF, SIM-RC625000 is not reported; accordingly the SIM is not reported to the service personnel even though this option is ON.	OFF	-
745	Universal Volume Manager	Enables to change the area where the information is obtained as the Characteristic1 item from SYMMETRIX. **Mode 745 = ON:** • The area where the information is obtained as the Characteristic1 item from SYMMETRIX is changed. • When CheckPaths or Device Health Check (1/hour) is performed, the information of an already-mapped external volume is updated to the one after change. **Mode 745 = OFF (default):** • The area where the information is obtained as the Characteristic1 item from SYMMTRIX is set to the default. • When CheckPaths or Device Health Check (1/hour) is performed, the information of an already-mapped external volume is updated to the default. **Notes:** **1.** This option is applied when the Characteristic1 item is displayed in symbols while the EMC SYMMETRIX is connected using UVM. **2.** Enable the setting of EMC SCSI Flag SC3 for the port of the SYMMETRIX connected with Virtual Storage Platform. If the setting of EMC SCSI Flag SC3 is not enabled, the effect of this mode may not be achieved. **3.** If you want to enable this mode immediately after setting, perform Check Paths on each path one by	OFF	-

Mode	Category	Description	Default	MCU/RCU
		one for all the external ports connected to the SYMMETRIX. Without doing Check Paths, the display of Characteristic1 can be changed automatically by the Device Health Check performed once per hour. If SSB=AD02 occurs and a path is blocked, perform Check Paths on this path again. **4.** If Check Paths is performed while ShadowImage for Mainframe pair and Compatible FlashCopy® V2 Mirror pair are defined in the specified volume, the Check Paths operation is rejected with a message "605 2518". If ShadowImage for Mainframe pair and Compatible FlashCopy® V2 Mirror pair are defined in the specified volume, do not perform Check Paths and wait until the display is automatically changed.		
749	Microcode version V02 and lower: Dynamic Provisioning, Dynamic Tiering Microcode version V02_ICS or V02+1: Dynamic Provisioning Dynamic Provisioning for Mainframe Dynamic Tiering Microcode version V03 and higher: Dynamic Provisioning Dynamic Provisioning for Mainframe Dynamic Tiering Dynamic Tiering for Mainframe Thin Image	Disables the Dynamic Provisioning Rebalance function that allows the HDDs of all ECC Groups in the pool to share the load. **Mode 749 = ON:** The Dynamic Provisioning Rebalance function is disabled. **Mode 749 = OFF (default):** The Dynamic Provisioning Rebalance function is activated. **Notes:** **1.** This option is applied when no change in performance characteristic is desired. **2.** All HDP pools are subject to the HDP Rebalance function. **3.** When a pool is newly installed, the load may be concentrated on the installed pool volumes. **4.** When 0 data discarding is executed, load may be unbalanced among pool volumes.	OFF	
757	Open and Mainframe	Enables/disables output of in-band audit logs. **Mode 757 = ON:** Output is disabled. **Mode 757 = OFF (default):**	OFF	MCU/RCU

Mode	Category	Description	Default	MCU/RCU
		Output is enabled. **Notes:** **1.** Mode 757 applies to the sites where outputting the In-band audit logs is not needed. **2.** When this option is set to ON • There is no access to SM for the In-band audit logs, which can avoid the corresponding performance degradation. • SM is not used for the In-band audit logs. **3.** If outputting the In-band audit log is desired, set this mode to OFF.		
762	Universal Replicator for Mainframe	This mode enables to settle the data to RCU according to the time stamp specified in the command when a Flush suspension for an EXCTG is performed from BCM. **Mode 762 = ON:** The data is settled to RCU according to the time stamp specified in the command. **Mode 762 = OFF (default):** The data is settled to RCU according to the time stamp that RCU has received. **Notes:** **1.** This mode is applied under the following conditions. • Universal Replicator for Mainframe. • EXCTG configuration. • Flush suspension with an EXCTG specified is executed. • BCM is installed on the host where the time stamping function is available. • (In the case of multiple-host configuration, SYSPLEX timer is available on the system) **2.** If this mode is set to ON while the BCM does not exist in the environment where the time stamping function is available (In the case of multiple-host configuration, SYSPLEX timer is available on the system), the pair status may not become Suspend after Flush suspension for an EXCTG. **3.** Do not set this mode to ON if the BCM does not exist in the environment where the time stamping function is available (In the case of multiple-host configuration, SYSPLEX timer is available on the system).	OFF	RCU (On RCU side, consideration in Takeover is required for setting)
769	TrueCopy TrueCopy for Mainframe Universal Replicator Universal Replicator for Mainframe	This mode controls whether the retry operation is executed or not when a path creation operation is executed. (The function applies to both of CU FREE path and CU single path for Open and Mainframe). **Mode 769 = ON:** The retry operation is disabled when the path creation operation is executed (retry operation is not executed).	OFF	MCU and RCU

Mode	Category	Description	Default	MCU/RCU
		Mode 769 = OFF (default): The retry operation is enabled when the path creation operation is executed (retry operation is executed). **Notes:** **1.** This mode is applied when the three conditions below are met: • SOM 114 is set to OFF (operation of automatically switching the port is disabled). • HMO 49 and HMO 50 are set to OFF (70-02-31-00/00 and higher). • TPC-R is used (it is not applied in normal operation). **2.** When SOM 769 is set to ON, SOM 114, HMO 49 and HMO 50 must not be set to ON. **3.** In either of the following cases, the path creating operation may fail after automatic port switching is executed. • SOM 114 is set to ON. • HMO 49 and HMO 50 are set to ON.		
776	TrueCopy for Mainframe, Business Continuity Manager	This mode enables/disables to output the F/M=FB message to the host when the status of P-VOL changes to Suspend during a TC/TCA S-VOL pair suspend or deletion operation from BCM. **Mode 776 = ON:** When the status of P-VOL changes to Suspend during a TC/TCA S-VOL pair suspend or deletion operation from BCM, the F/M=FB message is not output to the host. **Mode 776 = OFF (default):** When the status of P-VOL changes to Suspend during a TC/TCA S-VOL pair suspend or deletion operation from BCM, the F/M=FB message is output to the host. **Notes:** **1.** Set this mode to ON in the environment where TC/TCA for z/OS is used from BCM and the MCU host does not need the F/M=FB message output during an S-VOL pair suspend or deletion operation from BCM. **2.** If this mode is set to ON, the F/M=FB message is not output to the host when the status of P-VOL changes to Suspend during a TC/TCA S-VOL pair suspend or deletion operation from BCM **3.** If the PPRC item of CU option is set to NO, the F/M=FB message is not output to the host regardless of setting of this mode. **4.** If the function switch#07 is set to "enable", the F/M=FB message is not output to the host regardless of setting of this mode.	OFF	
784	TrueCopy global-active device'	This mode can reduce the MIH watch time of RI/O for a TrueCopy for Mainframe or global-active device pair internally so that update I/Os can continue by using an alternate path without MIH or time-out occurrence in the environment where Mainframe host MIH is set to 15	OFF	MCU/RCU

Mode	Category	Description	Default	MCU/RCU
		seconds, or Open host time-out time is short (15 seconds or less). The mode is effective at initial pair creation or Resync operation for Hitachi TrueCopy® for Mainframe or global-active device. It is not effective by just setting this mode to ON. **Mode 784 = OFF (default):** The operation is processed in accordance with the TC Sync for z/OS, TC Sync or global-active device specification. Mode 784 = ON This mode reduces the internal MIH time of RI/Os so that when a path failure occurs between controllers on which the host MIH time is set to 15 seconds, update I/Os can be quickly processed by using an alternate path. This lowers the possibility of host MIH occurrence. **Notes:** **1.** This mode is used when the MIH time on a mainframe host is set to 15 seconds, or the timeout time on an open system host is set to 15 seconds or less. **2.** The purpose of this mode is to reduce the RI/O MIH time to 5 seconds. **3.** This function is available for all the TC Sync for mainframe, TC Sync, and GAD pairs on the subsystem, unable to specify the pairs that are using this function or not. **4.** To apply the mode to TC Sync, the firmware must be the supported version on both sides. **5.** For a TC Sync or TC Sync pair with the mode effective (RI/O MIH time is 5 seconds), the setting of RI/O MIH time made at RCU registration (default is 15 seconds, which can be changed within range from 10 to 100 seconds) is invalid. However, RI/O MIH time displayed on Device Manager - Storage Navigator and CCI is not "5 seconds" but is what set at RI/O registration. **6.** For a TC Sync for z/OS TC Sync, or GAD pair with the mode effective (RI/O MIH time is 5 seconds), the setting of RI/O MIH time made at RCU registration (default is 15 seconds, which can be changed within range from 10 to 100 seconds) is invalid. However, RI/O MIH time displayed on Storage Navigator and CCI is not "5 seconds" but is what set at RI/O registration **7.** If a failure occurs on the switched path between controllers, mainframe host MIH or open server time-out may occur. **8.** If a VSD to which the path between controllers belongs is overloaded, switching to an alternate path delays and host MIH or time-out may occur. **9.** If an RI/O retry occurs due to other factors than RI/O MIH (5 sec), such as a check condition report issued from RCU to MCU, the RI/O retry is performed on the same path instead of an alternate path. If a response		

Mode	Category	Description	Default	MCU/RCU
		delay to the RI/O occurs constantly on this path due to path failure or link delay, host MIH or time-out may occur due to response time accumulation for each RI/O retried within 5 seconds. **10.** Even though the mode is set to ON, if Mainframe host MIH time or Open host time-out time is set to 10 seconds or less, host MIH or time-out may occur due to a path failure between controllers. **11.** Operation commands are not available for quickly switching to an alternate path. **12.** The mode works for the pair on which an initial pair creation or Resync operation is executed. **13.** Micro-program downgrade to an unsupported version cannot be executed unless all the TC Sync for z/OS or TC Sync pairs are suspended or deleted. **14.** For GAD pairs, the mode is effective if the firmware is in a version that supports GAD. **15.** For GAD pairs, the mode is effective if the microcode is in a version that supports GAD. **16.** The mode does not support paths between DKCs using iSCSI. When iSCSI is used for paths between DKCs, the time to switch to an alternate path cannot be reduced. For this, if a failure occurs on a path between DKCs in an environment where host time-out time is short, a time-out may occur on the host side. A time-out may also occur on the host side when a failure occurs on an iSCSI path between DKCs if DKC paths of Fibre and iSCSI coexist in an environment where host time-out time is short so that the configuration where DKC paths of Fibre and iSCSI coexist is not supported too.		
787	Compatible FlashCopy(R) V2	This mode enables the batch prefetch copy. **Mode 787 = ON:** The batch prefetch copy is executed for an FCv2 pair and a Preserve Mirror pair **Mode 787 = OFF (default):** The batch prefetch copy is not executed. **Notes:** **1.** When the mode is set to ON, the performance characteristic regarding sequential I/Os to the FCv2target VOL changes. **2.** The mode is applied only when SOM 577 is set to OFF **3.** The mode is applied if response performance for a host I/O issued to the FCv2 target VOL is prioritized	OFF	
803	Dynamic Provisioning, Data Retention Utility	While a HDP pool VOL is blocked, if a read or write I/O is issued to the blocked pool VOL, this mode can enable the Protect attribute of DRU for the target DP-VOL. **Mode 803 = ON:** While a HDP pool VOL is blocked, if a read or write I/O is issued to the blocked pool VOL, the DRU attribute is set to Protect.	OFF	

Mode	Category	Description	Default	MCU/RCU
		Mode 803 = OFF (default): While a HDP pool VOL is blocked, if a read or write I/O is issued to the blocked pool VOL, the DRU attribute is not set to Protect. **Notes:** **1.** This mode is applied when • a file system using HDP pool VOLs is used. • Data Retention Utility is installed. **2.** Because the DRU attribute is set to Protect for the V-VOL, a read I/O is also disabled. **3.** If Data Retention Utility is not installed, the expected effect cannot be achieved. **4.** The Protect attribute of DRU for the HDP V-VOL can be released on the **Data Retention** window of Device Manager - Storage Navigator after recovering the blocked pool VOL.		
855	ShadowImage, ShadowImage for Mainframe, Volume Migration V2	By switching the mode to ON/OFF when ShadowImage is used with SOM 467 set to ON, copy processing is continued or stopped as follows. **Mode 855 = ON:** When the amount of dirty data is within the range from 58% to 63%, the next copy processing is continued after the dirty data created in the previous copy is cleared to prevent the amount of dirty data from increasing (copy after destaging). If the amount of dirty data exceeds 63%, the copy processing is stopped. **Mode 855 = OFF (default):** The copy processing is stopped when the amount of dirty data is over 60%. **Notes:** **1.** This mode is applied when all the following conditions are met • ShadowImage is used with SOM 467 set to ON. • Write pending rate of an MP blade that has LDEV ownership of the copy target is high • Usage rate of a parity group to which the copy target LDEV belongs is low. • ShadowImage copy progress is delayed. **2.** This mode is available only when SOM 467 is set to ON. **3.** If the workload of the copy target parity group is high, the copy processing may not be improved even if this mode is set to ON		
857	Open and Mainframe	This mode enables or disables to limit the cache allocation capacity per MPB to within 128 GB except for cache residency. **Mode 857 = ON:** The cache allocation capacity is limited to within 128 GB.	OFF	-

Mode	Category	Description	Default	MCU/RCU
		Mode 857 = OFF (default): The cache allocation capacity is not limited to within 128 GB. **Note:** This mode is used with VSP microcode version -04 (70-04-0x-00/00) and earlier. It is also applied when downgrading the microprogram from V02 (70-02-02-00/00) or higher to a version earlier than V02 (70-02-02-00/00) while over 128 GB is allocated.		
867	Dynamic Provisioning	All-page reclamation (discarding all mapping information between HDP pool and HDP volumes) is executed in DP-VOL LDEV format. This new method is enabled or disabled by setting the mode to ON or OFF. **Mode 867 = ON:** LDEV format of the DP-VOL is performed with page reclamation. **Mode 867 = OFF (default):** LDEV format of the HDP-VOL is performed with 0 data writing. **Notes:** **1.** This mode is applied at recovery after a pool failure. **2.** The mode is applied from factory shipment. **3.** Do not change the setting of the mode during DP-VOL format. **4.** If the setting of the mode is changed during DP-VOL format, the change is not reflected to the format of the DP-VOL being executed but the format continues in the same method.	OFF	
872	Universal Volume Manager	When the mode is applied, the order of data transfer slots is guaranteed at the destaging from P9500 to an external storage. **Mode 872 = ON** (default for 80-03-31 and later): The order of data transfer slots from VSP to an external storage is guaranteed. **Mode 872 = OFF** (default for earlier than 80-03-31): The order of data transfer slots from VSP to an external storage is not guaranteed. In V03 and later versions, the mode is set to ON before shipment. If the micro-program is exchanged to a supported version (V03 or later), the setting is OFF as default and needs to be set to ON manually. **Note:**	ON (default for 80-03-31 and later)	

Mode	Category	Description	Default	MCU/RCU
		This mode is applied when performance improvement at sequential write in UVM configuration is required.		
895	TrueCopy for Mainframe	Setting the mode to ON or OFF, the link type with transfer speed of 8 GBps or 4 GBps is reported respectively. **Mode 895 = ON:** When the FICON/FC link up speed is 8 GBps, the link type with transfer speed of 8 GBps is reported. **Mode 895 = OFF (default):** The link type with transfer speed of up to 4 GBps is reported , even when the actual transfer speed is 8 GBps. **Notes:** **1.** To apply the mode, set the RMF version of mainframe to be connected to 1.12 or higher. **2.** If the OS does not use a supported version, the transfer speed cannot be displayed correctly.	OFF	
896	Dynamic Provisioning Dynamic Provisioning for Mainframe, Dynamic Tiering Dynamic Tiering for Mainframe, Hitachi Thin Image	The mode enables or disables the background format function performed on an unformatted area of a HDP/HDT pool. For information regarding operating conditions, refer to Provisioning Guide for Open Systems or Provisioning Guide for Mainframe Systems. **Mode 896 = ON (default)** The background format function is enabled. **Mode 896 = OFF** The background format function is disabled. **Notes:** **1.** The mode is applied when a customer requires the background format for a HDP/HDT pool in the environment where new page allocation (for example, when system files are created from a host for newly created multiple HDP VOLs), frequently occurs and the write performance degrades because of an increase in write pending rate. **2.** When the mode is set to ON, because up to 42MB/s of ECCG performance is used, local copy performance may degrade by about 10%. Therefore, confirm whether the 10% performance degradation is acceptable or not before setting the mode to ON. **3.** When a Dynamic Provisioning VOL that is used as an external VOL is used as a pool VOL, if the external pool becomes full due to the background format, the external VOL may be blocked. If the external pool capacity is smaller than the external VOL (Dynamic Provisioning VOL), do not set the mode to ON.	ON	
897	Dynamic Tiering, Dynamic Tiering for Mainframe	By the combination of SOM 897 and 898 setting, the expansion width of Tier Range upper I/O value (IOPH) can be changed as follows.	OFF	

Mode	Category	Description	Default	MCU/RCU
		Mode 897 = ON: • SOM 898 is OFF: 110%+0IO • SOM 898 is ON: 110%+2IO **Mode 897 = OFF (Default)** • SOM 898 is OFF: 110%+5IO (Default) • SOM 898 is ON: 110%+1IO By setting the SOM s to ON to lower the upper limit for each tier, the gray zone between other tiers becomes narrow and the frequency of page allocation increases. **Notes:** **1.** Apply the mode when the usage of upper tier is low and that of lower tier is high. **2.** The mode must be used with SOM 898. **3.** Narrowing the gray zone increases the number of pages to migrate between tiers per relocation. **4.** When Tier1 is SSD while SOM 901 is set to ON, the effect of SOM 897 and 898 to the gray zone of Tire1 and Tier2 is disabled and the SOM 901 setting is enabled instead. In addition, the settings of SOM 897 and 898 are effective for Tire2 and Tier3. Please also see spreadsheet "SOM 897_898_901" for more details about the relations between SOM 897, 898 and 901.		
898	Dynamic Tiering, Dynamic Tiering for Mainframe	I/O value (IOPH) can be changed as follows. **Mode 898 = ON:** • SOM 897 is OFF: 110%+1IO • SOM 897 is ON: 110%+2IO **Mode 898 = OFF (default):** • SOM 897 is OFF: 110%+5IO (Default) • SOM 897 is ON: 110%+0IO By setting the SOM s to ON to lower the upper limit for each tier, the gray zone between other tiers becomes narrow and the frequency of page allocation increases. **Notes:** **1.** Apply the mode when the usage of upper tier is low and that of lower tier is high. **2.** The mode must be used with SOM 897. **3.** Narrowing the gray zone increases the number of pages to migrate between tiers per relocation. **4.** When Tier1 is SSD while SOM 901 is set to ON, the effect of SOM 897 and 898 to the gray zone of Tire1 and Tier2 is disabled and the SOM 901 setting is enabled instead. In addition, the settings of SOM 897 and 898 are effective for Tire2 and Tier3. Please also see spreadsheet "SOM 897_898_901" for more details about the relations between SOM 897, 898 and 901.	OFF	

Mode	Category	Description	Default	MCU/RCU
899	Volume Migration	In combination with the SOM 900 setting, whether to execute and when to start the I/O synchronous copy change as follows. **Mode 899 = ON:** • SOM 900 is ON: I/O synchronous copy starts without retrying Volume Migration. • SOM 900 is OFF: I/O synchronous copy starts when the threshold of Volume Migration retry is exceeded. (Recommended) **Mode 899 = OFF (default):** • SOM 900 is ON: I/O synchronous copy starts when the number of retries reaches half of the threshold of Volume Migration retry. • SOM 900 is OFF: Volume Migration is retired and I/O synchronous copy is not executed. **Notes:** **1.** This mode is applied when improvement of Volume Migration success rate is desired under the condition that there are many updates to a migration source volume of Volume Migration. **2.** During I/O synchronous copy, host I/O performance degrades.	OFF	
900	Volume Migration	In combination with SOM899 setting, whether to execute and when to start the I/O synchronous copy change as follows. **Mode 900 = ON:** • SOM899 is ON: I/O synchronous copy starts when the threshold of Volume Migration retry is exceeded. • SOM899 is OFF: I/O synchronous copy starts when the number of retries reaches half of the threshold of Volume Migration retry. **Mode 900 = OFF (default):** • SOM899 is ON: I/O synchronous copy starts when the threshold of Volume Migration retry is exceeded. (Recommended) • SOM899 is OFF: Volume Migration is retired and I/O synchronous copy is not executed. **Notes:** **1.** This mode is applied when improvement of Volume Migration success rate is desired under the condition that there are many updates to a migration source volume of Volume Migration. **2.** During I/O synchronous copy, host I/O performance degrades.	OFF	
901	Dynamic Tiering Dynamic Tiering for Mainframe	By setting the mode to ON or OFF, the page allocation method of Tier Level ALL when the drive type of tier1 is SSD changes as follows. **Mode 901 = ON:** For tier1 (drive type is SSD), pages are allocated until the capacity reaches the limit. Without consideration of	OFF	

Mode	Category	Description	Default	MCU/RCU
		performance limitation exceedance, allocation is done from highly loaded pages until reaching the capacity limit When the capacity of the tier1 reaches the threshold value, the minimum value of the tier range is set to the starting value of the lower IOPH zone, and the maximum value of the lower tier range is set to the boundary value. **Mode 901 = OFF (default):** For tier1 (drive type is SSD), page allocation is performed based on performance potential limitation. With consideration of performance limitation exceedance, allocation is done from highly loaded pages but at the point when the performance limitation is reached, pages are not allocated any more even there is free space. When the capacity of the tier1 reaches the threshold value, the minimum value of the tier range is set to the boundary value, and the maximum value of the lower tier range is set to a value of boundary value x 110% + 5 [IOPH]. **Notes:** **1.** 1. This mode is applied when pages with the maximum capacity need to be allocated to tier1 (drive type is SSD) with Dynamic Tiering or Dynamic Tiering for Mainframe. **2.** 2. When Tier1 is SSD while SOM901 is set to ON, the effect of SOM897 and 898 to the gray zone of Tire1 and Tier2 is disabled and the SOM901 setting is enabled instead. In addition, the settings of SOM897 and 898 are effective for Tire2 and Tier3. **3.** The following is recommended when applying SOM901. The actual I/O value (total number of I/Os of all tiering policies) < the performance potential value of Tier 1*1 x 0.6 *1: The performance potential value of Tier 1 displayed on Monitor information by using Dx-ray. Please also see spreadsheet "SOM897_898_901" for more details about the relations between SOM897, 898 and 901		
904	Dynamic Tiering Dynamic Tiering for Mainframe	By setting the mode to ON or OFF, the number of pages to be migrated per unit time at tier relocation is changed. **Mode 904 = ON:** The number of pages to be migrated at tier relocation is set to up to one page per second. Mode 904 = OFF (default): No restriction on the number of pages to be migrated at tier relocation (existing specification). **Notes:** **1.** This mode is applied when: • Dynamic Tiering for Mainframe is used (including multi-platform configurations).	OFF	

Mode	Category	Description	Default	MCU/RCU
		• the requirement for response time is severe. **2.** The number of pages to be migrated per unit time at tier relocation decreases.		
908	Universal Replicator Universal Replicator for Mainframe	The mode can change CM capacity allocated to MPBs with different workloads. **Mode 908 = ON:** The difference in CM allocation capacity among MPBs with different workload is large. **Mode 908 = OFF (default):** The difference in CM allocation capacity among MPBs with different workload is small (existing operation) **Notes:** **1.** 1. The mode is applied to a CLPR only used for UR JNLGs. **2.** 2. Since CM capacity allocated to MPBs with low load is small, the performance is affected by a sudden increase in load.	OFF	
930	Dynamic Provisioning Hitachi Thin Image	When the mode is set to ON, all of the zero data page reclamation operations in processing are stopped. (Also the zero data page reclamation cannot be started.) * Zero data page reclamation by WriteSame and UNMAP functions, and IO synchronous page reclamation are not disabled. **Mode 930 = ON:** All of the zero data page reclamation operations in processing are stopped at once. (Also the zero data reclamation cannot be newly started.) **Mode 930 = OFF (default):** The zero data page reclamation is performed. See sheet "SOM 930" for relationship with SOM 755 and SOM 859. **Notes:** **1.** The mode is applied when stopping or disabling zero data page reclamation by user request is required. **2.** When the mode is set to ON, the zero data page reclamation does not work at all. • Zero data page reclamation by Write Same and UNMAP, and IO synchronous page reclamation can work. **3.** When downgrading micro-program to a version that does not support the mode while the mode is set to ON, set the mode to OFF after the downgrade • Because the zero data page reclamation does not work at all while the mode is set to ON. **4.** The mode is related to SOM 755 and SOM 859.	OFF	
937	Dynamic Provisioning	By setting the mode to ON, HDT monitoring data is collected even if the pool is a HDP pool.	OFF	

Mode	Category	Description	Default	MCU/RCU
	Dynamic Provisioning for Mainframe Dynamic Tiering Dynamic Tiering for Mainframe	**Mode 937 = ON:** HDT monitoring data is collected even if the pool is a HDP pool. Only Manual execution mode and Period mode are supported. **Mode 937 = OFF (default):** HDT monitoring data is not collected if the pool is a HDP pool **Notes:** **1.** The mode is applied when HDT monitoring data collection is required in HDP environment. **2.** When HDT is already used, do not set the mode to ON. **3.** For HDT monitoring data collection, shared memory for HDT must be installed. **4.** If monitoring data collection is performed without shared memory for HDT installed, an error is reported and the monitoring data collection fails. **5.** Before removing the shared memory for HDT, set the mode to OFF and wait for 30 minutes. **6.** Tier relocation with monitoring data collected when the mode is set to ON is disabled. **7.** When HDP is converted into HDT (after purchase of PP license), the collected monitoring data is discarded.		
1017	Universal Replicator	This mode can be used to advance arbitration processing of an extended consistency group and restore journal data on DKCs on the secondary site even when a Mainframe host continues to issue I/Os with invalid time stamps. Mode 1017 = ON: When Mainframe host I/Os with invalid time stamp continue, the time stamp is replaced with the latest time stamp in those of journal data that DKCs at secondary site in a consistency group receive, so that the arbitration processing makes progress and journal data in DKCs at secondary site can be restored. **Mode 1017= OFF (default):** The above function does not work. **Note:** **1.** When a Mainframe host issues I/Os with invalid time stamps, SSB=4874 and SSB=CD58 are logged on DKCs at primary and secondary sites respectively. In this case, verify that the LDEV# of the primary volume reported in SSB=4874 and the LDEV# of the secondary volume reported in SSB=CD58 are the primary and secondary volumes of a pair respectively. If the	Inactive	RCU

Mode	Category	Description	Default	MCU/RCU
		combination of the reported volumes matches the exact pair, apply the mode to all DKCs at secondary site so as to advance the arbitration processing and to restore journal data on DKCs at secondary site. **2.** The mode works only when the timer type of journal option on MCU and RCU is system. **3.** Set the SOM to ON for all DKCs at secondary site in Universal Replicator for Mainframe MxN configuration (EXCTG). **4.** To use the SOM, DKCMAIN must be the support version and the SOM is set to ON for all DKCs at secondary site. To fail over, DKCMAIN must be the support version and the SOM is set to ON for all DKCs at primary site too. **5.** The function is applied to time stamps that DKCs at secondary site receive after setting the SOM. **6.** If a Mainframe host issues I/Os with invalid time stamps, SSB=CD58 is logged on the target DKC at secondary site. If the SOM is set to ON, SSB=CD57 is logged on the target DKC at secondary site.		
1021	Universal Volume Manager	The mode can enable or disable the auto-recovery for external volumes of an EMC storage system. **Mode 0121 = ON**: An external volume that is blocked due to Not Ready status can be recovered automatically regardless of the type of external storage system. **Mode 1021 = OFF (default)**: An external volume that is blocked due to Not Ready status might not be recovered automatically depending on the type of external storage system. Note: (1) The mode is applied when the auto-recovery of external volumes that are blocked due to Not Ready status is desired in UVM connection using an ECM storage system as an external storage system. (2) When the mode is set to ON and the connected external storage system is not in stable status (such as failure and recovery from failure), a blockage due to Not Ready status and auto-recovery may occur repeatedly.	Inactive	
1050	Universal Replicator TrueCopy global-active device	This mode enables creation of pairs using user capacity in excess of 1.8 PB per system by managing differential BMP in hierarchical memory for pair volumes whose capacity is 4 TB (open) or 262,668 Cyl (mainframe) or less. Mode 1050 = ON:	OFF	Both

Mode	Category	Description	Default	MCU/RCU
		For pair volumes of 4 TB (open)/262,668 Cyl (mainframe) or less, differential BMP is managed in hierarchical memory that performs caching to CM/PM using HDD as a master and enables creation of pairs using user capacity in excess of 1.8 PB per system. **Mode 1050= OFF (default):** For pair volumes of 4TB (OPEN)/262,668 Cyl (Mainframe) or less, differential BMP is managed in SM as usual so that the user capacity to create pairs is limited to 1.8 PB per system. Also, differential MPB management can be switched from the hierarchical memory to SM by performing a resync operation for pairs whose volume capacity is 4 TB (open)/ 262,668 Cyl (mainframe) or less. Notes. **1.** This mode is related to SOM 1058. **2.** The hierarchical memory is used for volumes over 4 TB (open)/262,668 Cyl (mainframe) even when the mode is set to OFF. **3.** When the mode is turned OFF after operating with the mode set to ON, if resynchronizing pairs whose volume capacity is 4TB (open)/262,668Cyl (Mainframe) or less managed in the hierarchical memory, the pair resync operation may fail due to lack of the SM capacity. **4.** If a pair resync operation fails, the pairs exceeding 1.8 PB of user capacity need to be deleted. **5.** Open non-DP VOLs do not support hierarchical memory differential management so that the mode cannot be applied. **6.** To downgrade the microcode, the procedure described in Maintenance Manual (Function ID 01:03 described in 03 MICRO-FC) is required. Refer to the manual before applying the mode. **7.** The mode is applied when pair creation using user capacity exceeding 1.8 PG per system is desired. **8.** Depending on the I/O pattern, I/O response might be affected. **9.** Depending on the condition, initial copy time might be affected **10.** The differential BMP managed in hierarchical memory does not use the shared memory, but the differential data is managed in a pool with which the volumes are associated. For the pool capacity necessary for the differential data management, refer to "Differential Data" in the Hitachi TrueCopy® User Guide, Hitachi TrueCopy® for Mainframe User Guide, Hitachi Universal Replicator User Guide, Hitachi Universal Replicator for Mainframe User Guide, and the Global-Active Device User Guide. **11.** Before using this SOM to increase pair volumes on the storage system, check the resources on the storage system to make sure all performance requirements are met.		

Mode	Category	Description	Default	MCU/RCU
1058	Universal Replicator TrueCopy global-active device	This mode can change differential BMP management from SM to hierarchical memory so that the number of pairs to be created on a system and user capacity used for pairs increase. • For mainframe systems, all pairs can be managed in hierarchical memory so that pairs can be created by all LDEVs. • For open systems, pairs that can only be managed in SM use SM so that the number of pairs that can be created using non-DP VOLs increases. **Mode 1058 = ON:** • SOM1050 is set to ON • SOM1050 is set to OFF **Mode 1058 = OFF (default):** • SOM1050 is set to ON • SOM1050 is set to OFF **Notes:** **1.** Depending on the I/O pattern, I/O response might be affected. **2.** Depending on the condition, initial copy time might be affected. **3.** The mode is related to SOM1050. **4.** OPEN non-DP VOLs do not support hierarchical memory differential management so that the mode cannot be applied. **5.** To downgrade the microcode, the procedure described in Maintenance Manual Function ID 01:03 described in 03 MICRO-FC. is required. Refer to the manual before applying the mode. **6.** The mode is applied when increasing the number of pairs that can be created on a system or the user capacity for pairs is desired. **7.** The differential BMP managed in hierarchical memory does not use the shared memory, but the differential data is managed in a pool with which the volumes are associated. For the pool capacity necessary for the differential data management, refer to "Differential Data" in the Hitachi TrueCopy® User Guide, Hitachi TrueCopy® for Mainframe User Guide, Hitachi Universal Replicator User Guide, Hitachi Universal Replicator for Mainframe User Guide, and the Global-Active Device User Guide **8.** Before using this SOM to increase pair volumes on the storage system, reexamine the resource on the storage system to make sure all performance requirements are met.	OFF	Both
1070	global-active device	The mode changes the processing for a group operation with GAD consistency group. Mode 1070 = ON: The status change of all pairs in a consistency group is performed for 50 msec.	OFF	Both

Mode	Category	Description	Default	MCU/RCU
		Mode 1070 = OFF (default): The status change of all pairs in a consistency group is performed for 1 msec. **Notes:** **1.** The mode is applied when reducing the time to complete status change of all pairs in a consistency group at a group operation (suspension and resync operation) with the GAD CTG function. In a system configuration where host I/O performance is prioritized, do not use the mode because setting the mode may affect the host I/O performance. **2.** The VSD usage rate increases during status change of all pairs in a consistency group. For approximate percentage increase in MP usage rate, see sheet "SOM1070".		
1079	Dynamic Provisioning Dynamic Tiering	This mode is set not to run the Proprietary ANCHOR command during microcode downgrade from a version that supports the Proprietary ANCHOR command to a version that does not support the command. Mode 1079 = ON: The Proprietary ANCHOR command is unavailable. Mode 1079 = OFF (default): The Proprietary ANCHOR command is available. **Note:** **1.** The mode is applied when downgrading the microcode from a version that supports the Proprietary ANCHOR command to a version that does not support the command. **2.** Whether the Proprietary ANCHOR command can be run or not varies depending on the setting combination of SOM1079 and HMO097 as follows: **a.** SOM1097 setting ON/HMO097 setting ON --> Proprietary ANCHOR command Unavailable **b.** SOM1097 setting ON/HMO097 setting OFF --> Proprietary ANCHOR command Unavailable **c.** SOM1097 setting OFF/HMO097 setting ON --> Proprietary ANCHOR command Available **d.** SOM1097 setting OFF/HMO097 setting OFF --> Proprietary ANCHOR command Unavailable	Inactive	-
1080	global-active device Universal Volume Manager	The mode is intended for a case that multiple external connection paths are connected to a Target port on an external system with a quorum disk and there is a path whose performance degrades. For such a case, the mode can eliminate impacts on commands run for other external	Inactive	-

Mode	Category	Description	Default	MCU/RCU
		devices that share the Target port with the quorum disk on the external system by setting the time to run a reset command for the Target port to be the same (15 seconds) as that to run other commands for the other external devices. Mode 1080 = ON: The time to run the reset command for the quorum disk on the external system is 15 seconds to eliminate the impacts on commands run for the other external devices that share the Target port with the quorum disk on the external system. If a response to ABTS is delayed for 12 seconds or longer, the quorum disk may be blocked. Mode 1080 = OFF (default): The time to run a reset command for the quorum disk when performance of a path degrades is 3 seconds so that a retry is performed by an alternate path to avoid quorum disk blockage. **Note:** **1.** The mode is applied if avoiding impacts on commands for other external devices sharing a Target port on an external system side with a quorum disk is prioritized over preventing quorum disk blockage when a response to ABTS is delayed. The delay is caused due to path performance degradation in a configuration where the Target port is shared between external devices and the quorum disk. **2.** When connection performance degradation occurs, the quorum disk blockage is more likely to occur.		
1083	Dynamic Provisioning Universal Volume Manager	The mode enable or disable DP-VOL deletion while an external volume associated with the DP-VOL with data direct mapping attribute is not disconnected. Mode 1083 = ON: DP-VOL deletion is enabled. Mode 1083 = OFF (default): DP-VOL deletion is disabled. **Note:** **1.** The mode is applied when the following conditions are met. • A DP-VOL with data direct mapping attribute is deleted.	Inactive	-

Mode	Category	Description	Default	MCU/RCU
		• The data of external volume with data direct mapping attribute associated with a deletion target DP-VOL with data direct mapping attribute will not be used again. **2.** When SOM 1083 is set to ON, the data of external volumes cannot be guaranteed. **3.** When DP-VOL deletion is performed without disconnecting an external volume, the data of the external volume cannot be guaranteed.		
1091	TrueCopy Universal Replicator Compatible FlashCopy® V2	This mode enables or disables the zHyperWrite function. When the mode setting is changed to ON or OFF, SCI is reported to the host and the zHyperWrite function is enabled or disabled. **Mode 1091 = ON**: The zHyperWrite function is enabled. (ReadFeatureCode setting for the zHyperWrite function) **Mode 1091 = OFF (default)**: The zHyperWrite function is disabled. Note: (1) The mode is applied when storage system version 80-04-21-00/00 or higher that supports the zHyperWrite function is used. (2) To enable the zHyperWrite function, set the mode to ON to both MCU and RCU of TCz. (3) To downgrade the microcode to a version that does not support the zHyperWrite function, set the mode to OFF prior to downgrading the microcode. (4) Even though the mode is set to ON for a storage system in 3DC configuration, the zHyperWrite function does not work for volumes in 3DC configuration. (5) Do not set the mode to ON if SOM474 is set to ON. (6) Do not set the mode to ON if Preserve Mirror configuration is created. (7) Do not set the mode to ON if the TCz Function Switch 12 is set to ON. (8) To use the zHyperWrite function, a HyperSwap environment is required.	Inactive	Both
1093	Dynamic Provisioning Dynamic Tiering Hitachi Thin Image	This mode is used to disable background unmap during microcode downgrade from a version that supports pool reduction rate correction to a version that does not support the function. **Mode 1093 = ON**:	Inactive	-

Mode	Category	Description	Default	MCU/RCU
		Background unmap cannot work. **Mode 1093 = OFF (default)**: Background unmap can work. Note: The mode is applied when downgrading microcode from a version that supports pool reduction rate correction to a version that does not support the function is disabled		
1096	Universal Replicator	This mode disables read-journal frequency reduction. **Mode 1096 = ON**: The read-journal frequency reduction does not work. **Mode 1096 = OFF (default)**: The read-journal frequency reduction works. Note: (1) The mode is applied when a significant delay, which is about 200 msec or longer, occurs in the line between MCU and RCU. (2) When the mode is set to ON while round-trip delay time is small (about less than 20 msec), the usage rate of RCU Initiator increases by 10% x the number of journals. (3) Even though the mode is supposed to be applied to UR RCU, apply it to both MCU and RCU on the premise of DR operation. (4) The mode is effective for each CLPR, so that select the operation target LPRxx (xx=00 to 31), and then set the mode to ON/OFF. For example, when only CLPR0 is defined (CLPR1 to 31 are not defined), select LPR00 and then set the mode to ON/OFF. The mode is not effective for any CLPRs if "System" is selected even when the mode is set to ON.	Inactive	Both
1106	Dynamic Provisioning Dynamic Tiering	This mode is used to monitor the page usage rate of parity groups defined to a pool, and perform rebalance to balance the usage rate if the rate differs significantly among parity groups. **Mode 1106 = ON**: The usage rate is checked once a day and the rebalance works if the rate is not even. **Mode 1106 = OFF (default)**: The rebalance does not work even when the usage rate is not balanced. The pool usage rate is determined as unbalanced when there is 25% or more difference between the usage rate of each parity group in the pool and the average.	Inactive	-

Mode	Category	Description	Default	MCU/RCU
		Note: For DT pools (including those with active flash attribute), the average of parity group usage rates is calculated per tier. Examples: (1) In a DP pool, if the usage rates of PG1, PG2, and PG3 are 50%, 40%, and 30% respectively, it is not determined as unbalanced. Because the average parity group usage rate is (50%+ 40%+ 30%) / 3 = 40% and the difference in the rate between each parity group and the average is 10% at the maximum. (2) In a DP pool, if the usage rates of PG1, PG2, and `G3 are 80%, 40%, and 30% respectively, it is determined as unbalanced. Because the average parity group usage rate is (80%+ 40%+ 30%) / 3 = 50% and the difference in the rate between each parity group and the average is 30% at the maximum. (3) In a DT pool, if the usage rates of PG1, PG2, and PG3 are 80% (SSD), 40% (SAS15K) and 30% (SAS15K), it is not determined as unbalanced because: - the average parity group usage rate of Tier1 is (80%) / 1 = 80% and the difference in the rate between the parity group and the average is 0%. - the average parity group usage rate of Tier2 is (40%+ 30%) / 2 = 35% and the difference in the rate between the parity group and the average is 5% at the maximum. Note: (1) The mode is applied when balancing the usage rate is required at a customer site where the usage rate is not even.		

SOM details

This section provides detailed information for several of the SOMs described in the above table.

Details for SOM 15

Table 33 SOM 15 functions

Operation with Mode 15 ON	Operation with Mode 15 OFF
Upper limit for retry of drive is reduced from 2 sec to 0.5 sec.	Upper limit for retry of drive is 2 sec

Operation with Mode 15 ON	Operation with Mode 15 OFF
If a drive failure occurs in read processing, a correction read processing is executed immediately.	If a drive failure occurs in read processing, a retry processing corresponding to the type of failure is executed
I/O watching time is reduced from 6.5 sec to 4.5 sec.	I/O watching time is 6.5 sec.
Read or write processing is not retried for time-out failure.	Read or write processing is retried for time-out failure

Details for SOM 122

Table D-3 shows the results of the pairsplit/pairresync command from CCI.

Table 34 SOM 122 pairsplit operations

CCI setting			Controller setting	Split type
Command	-fq option	Environment variable HORCC_SPLT	System Option Mode122	
pairsplit	Normal	None	ON	Steady Split
			OFF	Steady Split
		Normal	ON	Steady Split
			OFF	Steady Split
		Quick	ON	Steady Split
			OFF	Steady Split
	Quick	None	ON	Quick Split
			OFF	Quick Split
		Normal	ON	Quick Split
			OFF	Quick Split
		Quick	ON	Quick Split
			OFF	Quick Split
	None	None	ON	Steady Split
			OFF	Quick Split
		Normal	ON	Steady Split
			OFF	Steady Split
		Quick	ON	Quick Split
			OFF	Quick Split

Table 35 SOM 122 pairresync operations

CCI setting			Controller setting		Split type
Command	-fq option	Environment variable HORCC_SPLT	System Option Mode87	System Option Mode122	
pairresync	Normal	None	ON	ON	Normal Resync

CCI setting			Controller setting		Split type
Command	-fq option	Environment variable HORCC_SPLT	System Option Mode87	System Option Mode122	
				OFF	Normal Resync
			Normal	ON	Normal Resync
				OFF	Normal Resync
		Normal	Quick	ON	Normal Resync
				OFF	Normal Resync
			None	ON	Normal Resync
				OFF	Normal Resync
		Quick	Normal	ON	Normal Resync
				OFF	Normal Resync
			Quick	ON	Normal Resync
				OFF	Normal Resync
	Quick	None	ON	ON	Quick Resync
				OFF	Quick Resync
			Normal	ON	Quick Resync
				OFF	Quick Resync
		Normal	Quick	ON	Quick Resync
				OFF	Quick Resync
			None	ON	Quick Resync
				OFF	Quick Resync
		Quick	Normal	ON	Quick Resync
				OFF	Quick Resync
			Quick	ON	Quick Resync
				OFF	Quick Resync
	None	None	ON	ON	Normal Resync
				OFF	Quick Resync
			Normal	ON	Normal Resync
				OFF	Normal Resync
		Normal	Quick	ON	Normal Resync
				OFF	Normal Resync
			None	ON	Normal Resync
				OFF	Normal Resync
		Quick	Normal	ON	Quick Resync
				OFF	Quick Resync
			Quick	ON	Quick Resync
				OFF	Quick Resync

Details for SOM 269

For Device Manager - Storage Navigator operations, only low speed format is available. See the following table for SVP operations

Table 36 SOM 269: SVP operations

Operation	Target of Operation	Mode 269 ON	Mode 269 OFF
PDEV Addition	-	High speed	High speed
VLL (CVS)	All LDEVs in a PG	High speed	Low speed
VLL (CVS)	Some LDEVs in a PG	Low speed	Low speed
Format	PG is specified	High speed	High speed
Format	All LDEVs in a PG	High speed	Low speed
Format	Some LDEVs in a PG	Low speed	Low speed

Details for SOM 467

Table 37 SOM 467 default setting

Storage system	Default setting
VSP G1000, VSP G1500, and VSP F1500	ON (all microcode levels)

Details for SOM 729

Table 38 SOM 729 behavior

SOM 729	Protect V-VOLs when I/O fails to Full Pool	Behavior
OFF	Disabled	DRU Protect attribute is not set
OFF	Enabled	DRU Protect attribute is set
ON	Disabled	DRU Protect attribute is not set
ON	Enabled	DRU Protect attribute is set

Details for SOM 784

The following table lists the operational specifications for each combination of MCU and RCU with TrueCopy for Mainframe and Continuous Access Synchronous.

Table 39 SOM 784 operational specifications

MCU and RCU			Operational specification	
Model	**Microprogram version**	**SOM 784 setting**	**Pair creation, resync**	**RI/O MIH time reduction**
VSP G1000, VSP G1500, and VSP F1500	All supported versions	OFF	Normal end	Disabled
VSP G1000, VSP G1500, and VSP F1500	All supported versions	ON	Normal end	Enabled

Details for SOM 803

Table 40 SOM 803 behavior

SOM 803	Protect V-VOLs when I/O fails to Blocked Pool VOL	Behavior
OFF	Disabled	DRU Protect attribute is not set
OFF	Enabled	DRU Protect attribute is set
ON	Disabled	DRU Protect attribute is not set
ON	Enabled	DRU Protect attribute is set

Details for SOM 855

Table 41 SOM 855 behavior with SOM 467

SOM 467	SOM 855	WP				
		To 57%	**58% to 60%**	**61% to 63%**	**64% to 75%**	**Over 76%**
ON	ON	Normal copy	Copy after destaging		Copy stops	
	OFF	Normal copy		Copy stops		
OFF	ON/OFF	Normal copy				Copy stops

Details for SOM 897, SOM 898, and SOM 901

Table 42 Relations among SOM897, SOM898, and SOM901

SOM 901	Type of Tier1	Tier1 and Tier2 gray zone	Tier2 and Tier3 gray zone
ON	SSD	SOM 901	Combination of SOM 897 &SOM 898
	Not SSD	Combination of SOM 897 & SOM 898	
OFF	SSD	Combination of SOM897 & SOM898	

Details for SOM 901

Table 43 Relations between SOM930, SOM755 and SOM859

SOM 930	SOM 755	SOM 859	I/O synchronous page discarding	VOL batch page discarding	Write Same	UNMAP
OFF	OFF	OFF	Enabled	Enabled	Enabled	Enabled
OFF	OFF	ON	Disabled	Enabled	Enabled	Enabled
OFF	ON	OFF	Disabled	Disabled	Disabled	Disabled
OFF	ON	ON	Disabled	Disabled	Disabled	Disabled
ON	OFF	OFF	Enabled	Disabled	Enabled	Enabled
ON	OFF	ON	Disabled	Disabled	Enabled	Enabled
ON	ON	OFF	Disabled	Disabled	Disabled	Disabled
ON	ON	ON	Disabled	Disabled	Disabled	Disabled

C

Regulatory compliance

This appendix provides regulatory compliance information for the storage system and includes tables with explanations of regulatory requirement statements from various countries.

Regulatory compliance

This equipment has been tested and is certified to meet the following certifications.

Table 44 VSP G1000, VSP G1500, and VSP F1500 certifications

Standard	Specification	Mark on the product	Country
Electronic emission control	FCC Part 15 Subpart B Class A	Yes (FCC)	U.S.A
Electronic emission control	FCC Part 15 Subpart B Class A:2010, Class A ICES-003 Issue 4 Class A	Yes (UL)	Japan
Safety certification	TUV Safety Report and TUV-NRTL Certification, FCC Verification Report	Yes (TUV)	EU, North America
Electronic emission certifications	TUV Safety Report, EMC Report, TUV GS License, EMC Certificate, CE Mark	Yes (CE Mark)	European Union
Electronic emission control	CB Report and Certificate	Yes (TUV)	Worldwide
Electronic emission control	Test Report for C-Tick Approval	Yes	Australia and New Zealand
VCCI Registration for Product and Accessories	VCCI Class A	Yes (VCCI)	Japan
Safety certification	GOST Certificate for Product and Accessories	Yes (GOST)	Russia
Electronic emission control	BSMI Approval for Product and Accessories	Yes (BSMI)	Taiwan
Electronic emission control	RRL Approval and KTL Safety Approval	Yes (RRL)	Korea
Safety certification	IRAM Approval	Yes	Argentina
Electronic emission control	CCC Approval for Switching Power Supply	Yes (IRAM)	China

Table 45 VSP G1000, VSP G1500, and VSP F1500 certifications by region

	Region	Regulatory	Standard	Certificate No. and Report No.	
Safety	Worldwide	CB	IEC60950-1:2005+A1	Certificate Numbers	JPTUV-053187-M2 JPTUV-053211-A1

	Region	Regulatory	Standard	Certificate No. and Report No.	
					PTUV-048773-M1
				Report Numbers	12030097 12030890 12028263
				Photo Documentation Numbers	12030097 12030890 12028263
	North America	cTUVus	UL60950-1:2007 CAN/CSA-C22.2 No. 60950-1-07+A1	Test Report No. Certificate Numbers	USA-JT 12030098 CU72133020 CU72133022 CU72120935
	European Union	TUV	+A11+A1+A12	Certificate Numbers	S1-50266086 S1-50266254 S1-50245594
	Argentina	IRAM	IEC60950-1:2005+A1	Certificate Numbers	RA3385104E,204E,205E RA3385103E,202E,203E RA3283003E
Safety EMC	Russia	EAC	TP TC 004/2011 TP TC 020/2011	Certificate Numbers	RA3283003E RU C-JP.AR46.B.60400 RU C-JP.AR46.B.60634
	North America	FCC	FCC Part15 Subpart B Class A EICES-003 Issue:2012 Class A	Test Report No.	10033930S-C 10057416S-C 10162445S-D
	European Union	EN	EEN55022:2010 EEN55024:2010 EEN61000-3-2:2006 +A1+A2 EEN61000-3-3:2008	Certificate No. Test Report Numbers	CJ50268193 12030583-001 12030583-003 12030583-004
EMC	Australia and New Zealand	C-Tick RCM	AS/NZS CISPR 22:2009+A1 Class A	Test Report Numbers	10033930S-B 10057416S-B 10162445S-C
	Taiwan	BSMI	CNS13429¥CNS14336-1	Declaration of Conformity	Declaration of Conformity
	South Korea	KCC	KN22KN24	Certificate No.	MSIP-REM-HTB-DKC810

	Region	Regulatory	Standard	Certificate No. and Report No.	
	Region	Regulatory	Standard	Model	Certificate No.
Safety EMC	China	CCC	GB4943-2011GB9254-2008GB17625.1-2003	SBX/ UBX_SWPSTDPS-600FB XX	2011010907455767
				FBX_SWPSPPD6001	2012010907575263

US FCC Notice

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.

Electronic emissions testing

EMI testing was conducted with shielded cables. To comply with the FCC regulations, you must use shielded cables with your installation.

The EMI tests were performed with the following configurations:

DKC810I-CBX+DKC+F810I-SBX

DKC810I-CBX+DKC+F810I-SBX+DKC-F810I-UBX

Copies of the Underwriters Laboratories EMI compliance certificates are located at the end of this chapter.

If trouble occurs in another configuration, a user may be requested to take appropriate preventive measures.

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.

"EINE LEICHT ZUGÄNGLICHE TRENN-VORRICHTUNG, MIT EINER KONTAKT-ÖFFNUNGSWEITE VON MINDESTENS 3mm IST IN DER UNMITTELBAREN NÄHE DER VERBRAUCHERANLAGE ANZUORDEN (4-POLIGE ABSCHALTUNG)."

Maschinen lärm informations verordnung 3. GSGV, 18.01.1991: Der "höchste" Schalldruckpegel beträt 70 db (A) oder weniger gemäß ISO 7779

CLASS 1 LASER PRODUCT

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Warning: Dies ist ein Produkt der Klasse A. In nichtgewerblichen Umgebungen können von dem Gerät Funkstörungen ausgehen, zu deren Beseitigung vom Benutzer geeignete Maßnahmen zu ergreifen sind.

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

This symbol displays requirements for controlling pollution caused by electronic information products.

Hazardous and toxic substances

Table 46 Hazardous and toxic substances

Toxic and Hazardous Substances and Elements						
Unit	Lead (PB)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chronium (Cr (VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Controller chassis	X	O	O	O	O	O
Drive chassis	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, 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. Recycle the battery instead. The mark posted on the battery unit is a three-arrow mark that means a recyclable part.

Electronic emissions certificates

Copies of the Underwriters Laboratories EMI compliance certificates are located on the following pages. If necessary, contact customer support for detailed information.

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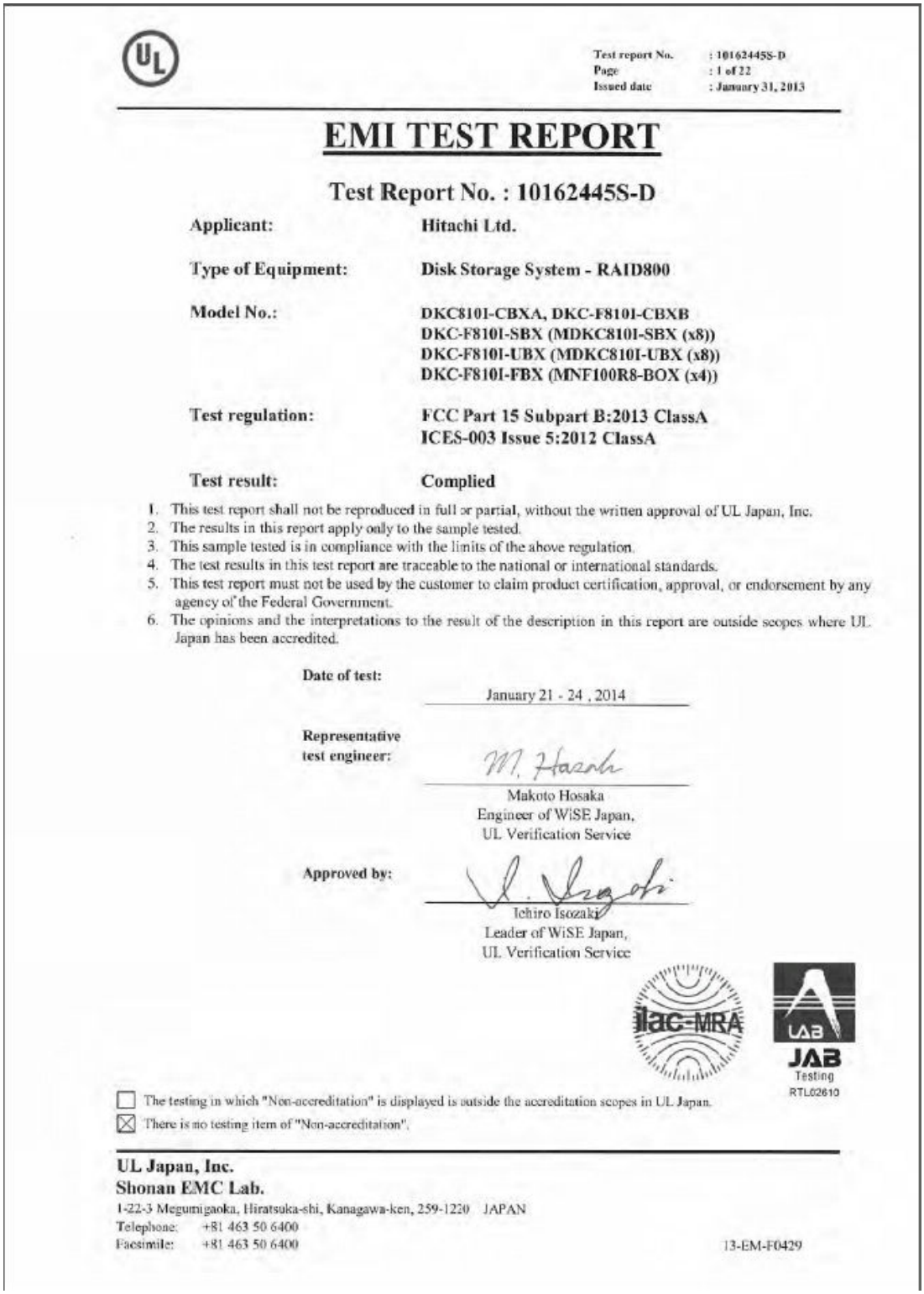

Test report No. : 10162445S-D
Page : 1 of 22
Issued date : January 31, 2013

EMI TEST REPORT

Test Report No. : 10162445S-D

Applicant: Hitachi Ltd.

Type of Equipment: Disk Storage System - RAID800

Model No.: DKC810I-CBXA, DKC-F810I-CBXB
DKC-F810I-SBX (MDKC810I-SBX (x8))
DKC-F810I-UBX (MDKC810I-UBX (x8))
DKC-F810I-FBX (MNF100R8-BOX (x4))

Test regulation: FCC Part 15 Subpart B:2013 ClassA
ICES-003 Issue 5:2012 ClassA

Test result: Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by any agency of the Federal Government.
6. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

Date of test: January 21 - 24 , 2014

Representative test engineer: Makoto Hosaka
Engineer of WiSE Japan,
UL Verification Service

Approved by: Ichiro Isozaki
Leader of WiSE Japan,
UL Verification Service

ilac-MRA
JAB Testing RTL02610

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

UL Japan, Inc.
Shonan EMC Lab.
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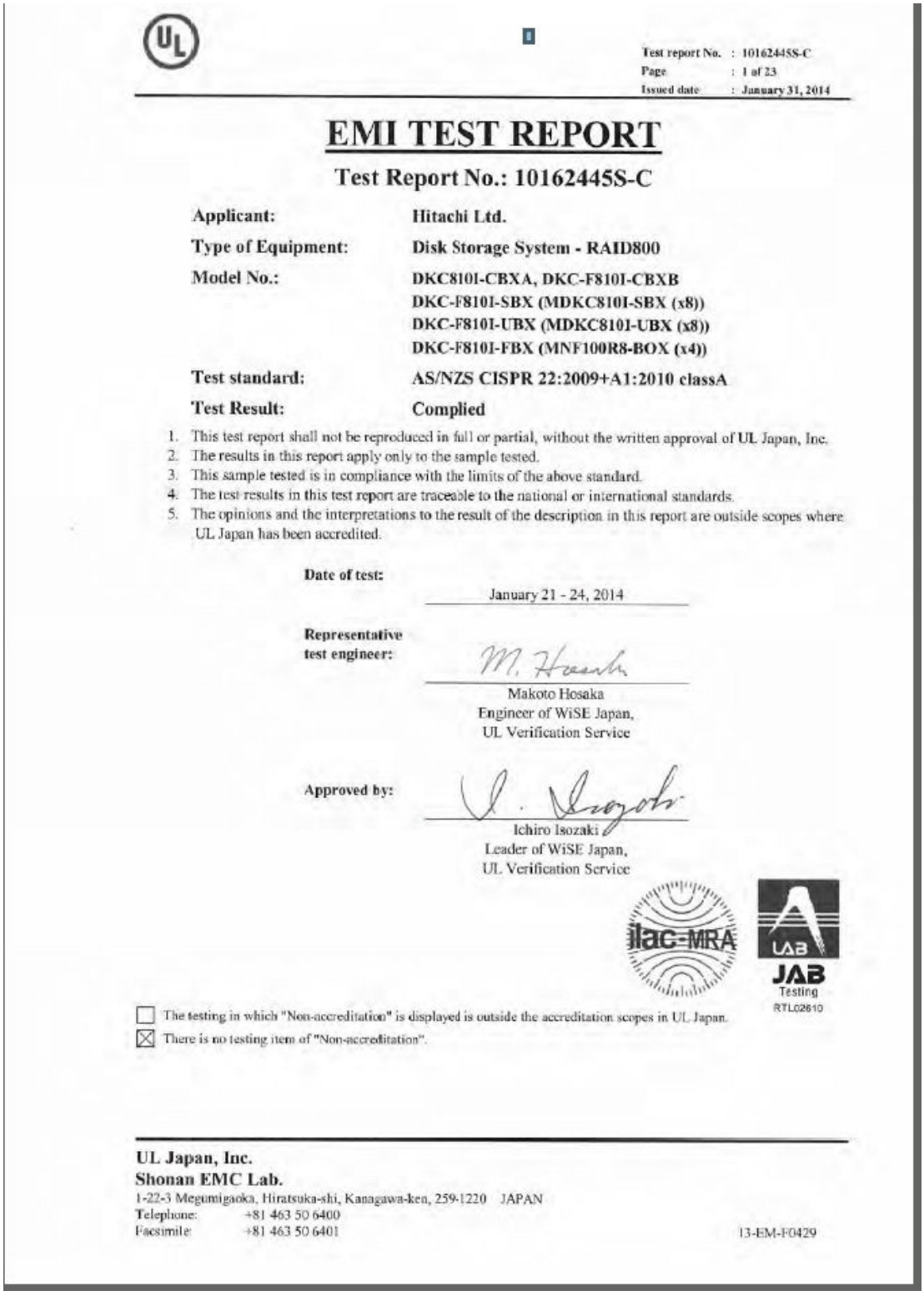
Telephone: +81 463 50 6400
Facsimile: +81 463 50 6400

13-EM-F0429

Figure 34 UL EMI compliance certificate (1 of 3)



Test report No. : 10162445S-C
Page : 1 of 23
Issued date : January 31, 2014

EMI TEST REPORT

Test Report No.: 10162445S-C

Applicant:	**Hitachi Ltd.**
Type of Equipment:	**Disk Storage System - RAID800**
Model No.:	**DKC810I-CBXA, DKC-F810I-CBXB** **DKC-F810I-SBX (MDKC810I-SBX (x8))** **DKC-F810I-UBX (MDKC810I-UBX (x8))** **DKC-F810I-FBX (MNF100R8-BOX (x4))**
Test standard:	**AS/NZS CISPR 22:2009+A1:2010 classA**
Test Result:	**Complied**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above standard.
4. The test results in this test report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

Date of test: January 21 - 24, 2014

Representative test engineer: M. Hosaka
Makoto Hosaka
Engineer of WiSE Japan,
UL Verification Service

Approved by: I. Isozaki
Ichiro Isozaki
Leader of WiSE Japan,
UL Verification Service

ilac-MRA

JAB Testing RTL02610

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☒ There is no testing item of "Non-accreditation".

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Facsimile: +81 463 50 6401

13-EM-F0429

Figure 35 Test certificate (2 of 3)

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

SYSTEME CEI D'ACCEPTATION MUTUELLE DE CERTIFICATS D ESSAIS DES EQUIPEMENTS ELECTRIQUES (IECEE) METHODE OC

Ref. Certif. No.
JPTUV-048773-M1

CB TEST CERTIFICATE

CERTIFICAT D'ESSAI OC

Product Produit	Flash Module Drive Box
Name and address of the applicant Nom et adresse du demandeur	Hitachi, Ltd. 322-2 Nakazato Odawara-shi, Kanagawa, 250-0872 JAPAN
Name and address of the manufacturer Nom et adresse du fabricant	Hitachi, Ltd. 322-2 Nakazato Odawara-shi, Kanagawa, 250-0872 JAPAN
Name and address of the factory Nom et adresse de l'usine	Hitachi, Ltd. 2880 Kozu Odawara-shi, Kanagawa, 256-8510 JAPAN
Ratings and principal characteristics Valeurs nominales et caractéristiques principales	1) AC 200-240V; 50/60Hz; 2 x 1.3A 2) AC 100-120/200-240V; 50/60Hz; 2x 2.6/1.3A Class I
Trademark (if any) Marque de fabrique (si elle existe)	HITACHI
Type of Manufacturer's Testing Laboratories used Type de programme du laboratoire d'essais constructeur	TMP
Model / Type Ref. Réf. de type	1) MNF100R-BQXxy, MNF100R8-BQXxxx (x, y = 0-9, A-Z or blank) 1) DW-F700-DBFxxx, HT-F405A-DBFxxx (x = A-Z or blank) 2) DF-F850-DBFxxx, HT-F4066-DBFxxx (x = 0-9, A-Z or blank)
Additional information (if necessary may also be reported on page 2) Les informations complémentaires (si nécessaire peuvent être indiquées sur la 2ème page)	For model differences, refer to the test report. Re-issue of JPTUV-048773 dated 28.12.2012, due to first modification
A sample of the product was tested and found to be in conformity with Un échantillon de ce produit a été essayé et a été considéré conforme à la	IEC 60950-1:2005+A1 National differences see test report
As shown in the Test Report Ref. No. which forms part of this Certificate Comme indiqué dans le Rapport d'essais numéro de référence qui constitue partie de ce Certificat	12028263 002

This CB Test Certificate is issued by the National Certification Body
Ce Certificat d'essai OC est établi par l'Organisme National de Certification

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Figure 36 Test certificate (3 of 3)

Glossary

#

10 Gb

10 gigabit Ethernet computer networking standard, with a nominal data rate of 10 Gbps, 10 times as fast as gigabit ethernet.

A

arbitrated loop (AL)

Arbitrated loop, also known as FC-AL, is a Fibre Channel topology in which devices are connected in a one-way loop fashion in a ring topology. Up to 127 devices may be attached in the loop, but only two can communicate at the same time. Arbitrated loop is an alternative to Fibre Channel switches.

array group

A set of drives in a storage system that have the same capacity and are treated as one RAID unit. An array group contains user data and parity information, which ensures user data integrity in the event of a disk drive failure in the array group.

B

bps

bits per second. The standard measure of data transmission speeds.

C

cache

A set of RAM (Random Access Memory) modules used to store data temporarily.

capacity

The amount of data storage space available on a physical storage device, generally measured in bytes (MB, GB, TB, and so on).

CCI

See Command Control Interface.

challenge handshake authentication protocol (CHAP)

An authentication technique for confirming the identity of one computer to another. Described in RFC 1994.

CHAP

See challenge handshake authentication protocol.

CLI

command line interface

cluster

Multiple storage servers working together to respond to multiple read and write requests.

cluster capacity

The total amount of disk space in a cluster, excluding the space required for system overhead and the operating system. Cluster capacity is the amount of space available for all archive data, including original file data, metadata, and redundant data.

Command Control Interface (CCI)

Software used to control volume replication functionality (such as TrueCopy or ShadowImage) by means of commands issued from a host to a storage system. A command device must be set up in the storage system to enable the storage system to receive commands from CCI.

In an open system, Replication Manager uses the CCI configuration definition files to modify copy pair configurations and to acquire configuration information. Copy pair modification processing, such as splitting and resynchronizing copy pairs, is executed on the storage system via CCI.

command device

A dedicated logical volume used to interface with the storage system. Can be shared by several hosts.

controller box

The enclosure that contains the storage system controller. For some models, disk drives may be included as well. Controller boxes come in 2U and 3U versions.

- **CBL:** AC-powered 3U controller box.
- **CBLE:** AC-powered 2U controller box with support for encryption.
- **CBLD:** DC-powered 3U controller box.
- **CBLE:** 3U controller box that supports encryption.
- **CBSL controller box:** A 3U controller box that can contain a maximum of 12 3.5-inch drives.
- **CBSS controller box:** A 2U controller box that can contain a maximum of 24 2.5-inch drives.
- **CBXSL controller box:** A 3U controller box that can contain a maximum of 12 3.5-inch drives.
- **CBXSS controller box:** A 2U controller box that can contain a maximum of 24 2.-5 inch drives.

CRC

See cyclic redundancy check.

cyclic redundancy check (CRC)

An error-correcting code designed to detect accidental changes to raw computer data.

D

differential management-logical unit

disaster recovery

A set of procedures to recover critical application data and processing after a disaster or other failure. Disaster recovery processes include fallover and fallback procedures.

DMLU

See differential management-logical unit.

drive box

Chassis for mounting drives that connect to the controller box.

- Drive boxes with AC power supply:
  - **DBS, DBL, DBF:** Drive box (2U)
  - **DBX:** Drive box (4U)
  - **DBW:** Drive box (5U)

- Drive boxes with DC power supply:
  - **DBSD:** Drive box (2U)
  - **DBLD:** Drive box (2U)

drive I/O module

I/O module for the controller box that has drive interfaces.

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 directions. 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.

E

ethernet

A computer networking technology for local-area networks.

extent

A contiguous area of storage in a computer file system that is reserved for writing or storing a file.

F

fabric

Hardware that connects workstations and servers to storage devices in a storage-area network (SAN)N. The SAN fabric enables any server to any storage device connectivity through the use of fibre channel switching technology.

failback

The process of restoring a system, component, or service in a state of failover back to its original state (before failure).

failover

Automatic switching to a redundant or standby computer server, system, hardware component, or network upon the failure or abnormal termination of the previously active application, server, system, hardware component, or network. Failover and switchover are essentially the same operation, except that failover is automatic and usually operates without warning, while switchover requires human intervention.

fault tolerance

A system with the ability to continue operating, possibly at a reduced level, rather than failing completely, when some part of the system fails.

FC

Fibre Channel

FC-AL

See arbitrated loop.

FCoE

Fibre Channel over Ethernet. An encapsulation of Fibre Channel frames over Ethernet networks. This allows Fibre Channel to use 10-gigabit Ethernet networks (or higher speeds) while preserving the Fibre Channel protocol.

Fibre Channel (FC)

A technology for transmitting data between computer devices at a data rate of up to 4 Gbps. It is especially suited for attaching computer servers to shared storage devices and for interconnecting storage controllers and drives.

firmware

Software embedded into a storage device. It may also be referred to as *microcode*.

flash module (FMD)

A high speed data storage device that includes a custom flash controller and several flash memory sub-modules on a single PCB.

full-duplex

Transmission of data in two directions simultaneously. For example, a telephone is a full-duplex device because both parties can talk at the same time.

G

Gbps

Gigabit per second.

gigabit ethernet

A version of ethernet that supports data transfer speeds of 1 gigabit per second. The cables and equipment are very similar to previous ethernet standards.

GUI

graphical user interface

H

HA

High availability.

half-duplex

Transmission of data in just one direction at a time. For example, a walkie-talkie is a half-duplex device because only one party can talk at a time.

HBA

See host bus adapter.

host

One or more host bus adapter (HBA) world wide names (WWN).

host bus adapter (HBA)

One or more dedicated adapter cards that are installed in a host, have unique WWN addresses, and provide Fibre Channel I/O connectivity to storage systems, typically through Fibre Channel switches. Unlike general-purpose Ethernet adapters, which handle a multitude of network protocols, host bus adapters are dedicated to high-speed block transfers for optimized I/O performance.

host I/O module

I/O module for the controller box . The host I/O module provides interface functions for the host.

I

I/O

input/output

I/O card

The I/O card (ENC) is installed in a DBX. It provides interface functions for the controller box or drive box.

I/O module

The I/O module (ENC) is installed in a DBS/DBSD/DBL/DBLD/DBF/DBW. It provides interface functions for the controller box or drive box.

IEEE

Institute of Electrical and Electronics Engineers. A non-profit professional association best known for developing standards for the computer and electronics industry. In particular, the IEEE 802 standards for local-area networks are widely followed.

IOPS

I/Os per second

iSCSI

Internet Small Computer Systems Interface

iSCSI initiator

iSCSI-specific software installed on the host server that controls communications between the host server and the storage system.

iSNS

Internet Storage Naming Service. An automated discovery, management, and configuration tool used by some iSCSI devices. iSNS eliminates the need to manually configure each individual storage system with a specific list of initiators and target IP addresses. Instead, iSNS automatically discovers, manages, and configures all iSCSI devices in your environment.

L

LAN

See local area network.

load

In UNIX computing, the system load is a measure of the amount of work that a computer system is doing.

local area network (LAN)

A computer network that spans a relatively small geographic area, such as a single building or group of buildings.

logical

Describes a user's view of the way data or systems are organized. The opposite of logical is physical, which refers to the real organization of a system. A logical description of a file that it is a quantity of data collected together in one place. The file appears this way to users. Physically, the elements of the file could live in segments across a disk.

M

microcode

The lowest-level instructions directly controlling a microprocessor. Microcode is generally hardwired and cannot be modified. It is also referred to as firmware embedded in a storage subsystem.

Microsoft Cluster Server

A clustering technology that supports clustering of two NT servers to provide a single fault-tolerant server.

P

pair

Two logical volumes in a replication relationship in which one volume contains original data to be copied and the other volume contains the copy of the original data. The copy operations can be synchronous or asynchronous, and the pair volumes can be located in the same storage system (in-system replication) or in different storage systems (remote replication).

pair status

Indicates the condition of a copy pair. A pair must have a specific status for specific operations. When a pair operation completes, the status of the pair changes to a different status determined by the type of operation.

parity

In computers, parity refers to a technique of checking whether data has been lost or written over when it is moved from one place in storage to another or when transmitted between computers.

Parity computations are used in RAID drive arrays for fault tolerance by calculating the data in two drives and storing the results on a third. The

parity is computed by XOR'ing a bit from drive 1 with a bit from drive 2 and storing the result on drive 3. After a failed drive is replaced, the RAID controller rebuilds the lost data from the other two drives. RAID systems often have a "hot" spare drive ready and waiting to replace a drive that fails.

parity group

See *RAID group*.

point-to-point

A topology where two points communicate.

port

An access point in a device where a link attaches.

primary site

The physical location of a storage system that contains original data to be replicated and that is connected to one or more storage systems at a remote or secondary site via remote copy connections. A primary site can also be called a “main site” or “local site”.

The term "primary site" is also used for host failover operations. In that case, the primary site is the location of the host on which the production applications are running, and the secondary site is the location of the host on which the backup applications that run when the applications at the primary site have failed.

R

RAID

redundant array of independent disks

A collection of two or more disk drives that presents the image of a single logical disk drive to the system. Part of the physical storage capacity is used to store redundant information about user data stored on the remainder of the storage capacity. In the event of a single device failure, the data can be read or regenerated from the other disk drives.

RAID employs the technique of disk striping, which involves partitioning each drive's storage space into units ranging from a sector (512 bytes) up to several megabytes. The stripes of all the disks are interleaved and addressed in order.

RAID group

A redundant array of inexpensive drives (RAID) that have the same capacity and are treated as one group for data storage and recovery. A RAID group contains both user data and parity information, which allows the user data to be accessed in the event that one or more of the drives within the RAID group are not available. The RAID level of a RAID group determines the number of data drives and parity drives and how the data is "striped" across the drives. For RAID1, user data is duplicated within the RAID group, so there is no parity data for RAID1 RAID groups.

A RAID group can also be called an array group or a parity group.

remote path

A route connecting identical ports on the local storage system and the remote storage system. Two remote paths must be set up for each storage system (one path for each of the two controllers built in the storage system).

S

SAN

See storage area network.

SAS

See Serial Attached SCSI.

SAS cable

Cable for connecting a controller box and drive box.

Secure Sockets Layer (SSL)

A common protocol for managing the security of message transmission over the Internet.

Two SSL-enabled peers use their private and public keys to establish a secure communication session, with each peer encrypting transmitted data with a randomly generated and agreed-upon symmetric key.

Serial Attached SCSI (SAS)

A replacement for Fibre Channel drives in high-performance applications. See also SCSI.

snapshot

A term used to denote a copy of the data and data-file organization on a node in a disk file system. A snapshot is a replica of the data as it existed at a particular point in time.

SNM2

See Storage Navigator Modular 2.

storage area network (SAN)

A network of shared storage devices that contain disks for storing data.

Storage Navigator Modular 2

A multi-featured scalable storage management application that is used to configure and manage the storage functions of Hitachi storage systems.

striping

A way of writing data across drive spindles.

T

target

The receiving end of an iSCSI conversation, typically a device such as a disk drive.

U

URL

Uniform Resource Locator

W

world wide name

A unique identifier that identifies a particular fibre channel target.

Z

zoning

A logical separation of traffic between host and resources. By breaking up into zones, processing activity is distributed evenly.

Index

S

T

V

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