# *DF500*

## *Disk Array Subsystem*

# *Maintenance Manual*

## *~for Theory~*

## *REV.5*

| Read this manual carefully and keep it. |
|---|
| • Before starting operation, read the safety instructions carefully and fully understand them.<br>• After reading this manual, keep it at hand for your reference. |

HITACHI

# Preface

This manual explains the operation theory of the DF500 disk array subsystem for service personnel to make them understand the DF500.

# Cautionary Notes

On this manual

- Hitachi, Ltd. owns the copyrights of this manual. No part of this manual may be reused or reproduced without permission of Hitachi, Ltd.
- Hitachi, Ltd. is not liable for any troubles or accidents which caused by operations not written in this manual.
- This manual may be revised without prior notice.
- The disk array is a “class 1 laser system” which emits no hazardous laser beam. Be sure to operate it according to this manual. Do not perform any operations other than those written in this manual. Otherwise, unexpected failures or accidents may be caused.

Trademarks

HP is a company name of Hewlett Packard Company, in the U.S.A.
IBM, AIX is a registered trademark of International Business Machines Corp. in the U.S.A.
IRIX is a product name of Sillicon Graphics, Inc. in the U.S.A.
Solaris is a product name of Sun Microsystems, Inc. in the U.S.A.
Sun is a registered trademark of Sun Microsystems, Inc. in the U.S.A.
Windows is a registered trademark of Microsoft Corp, Inc. in the U.S.A. and other countries.

Other company names and trade names described in this manual are trademarks or registered trademarks of each respective company.

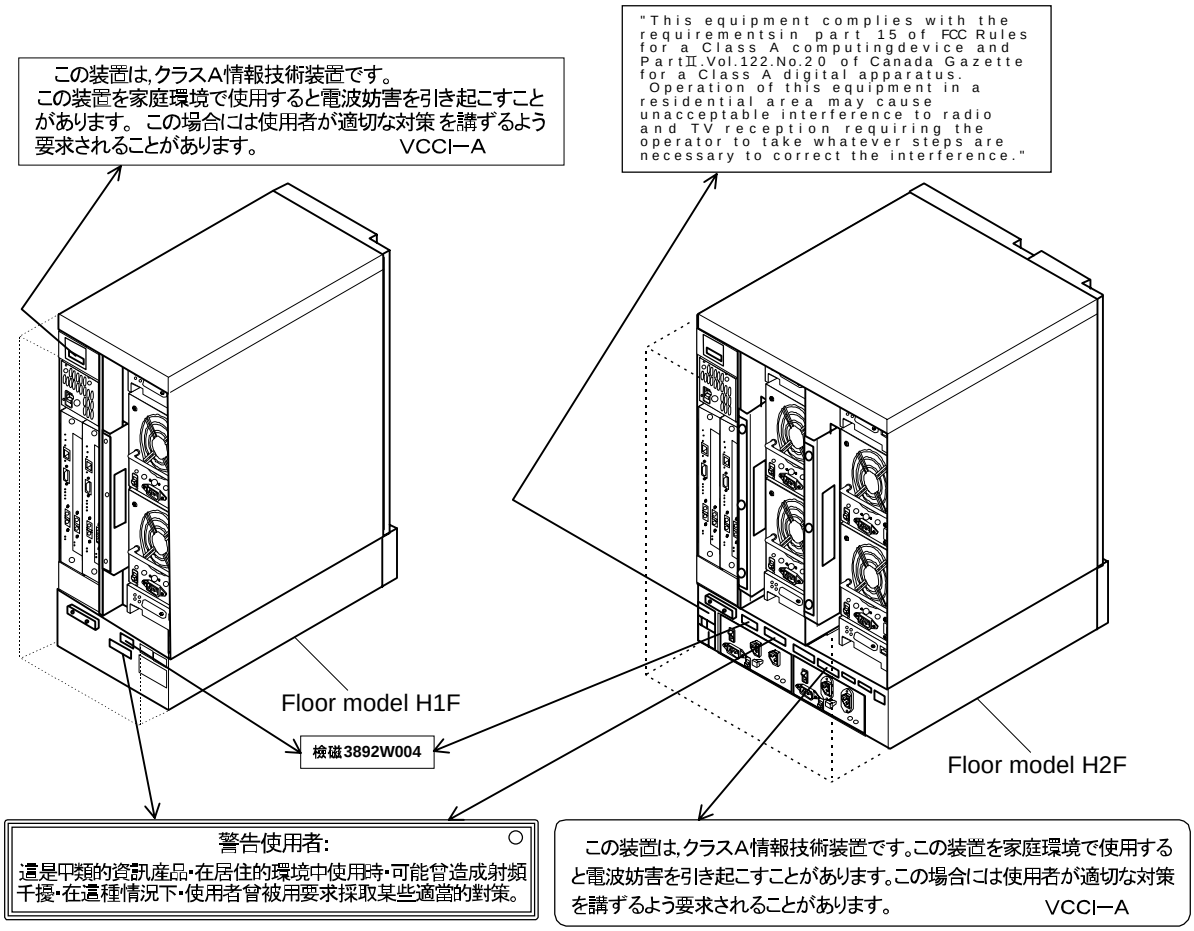
# Note

## EMI Regulation

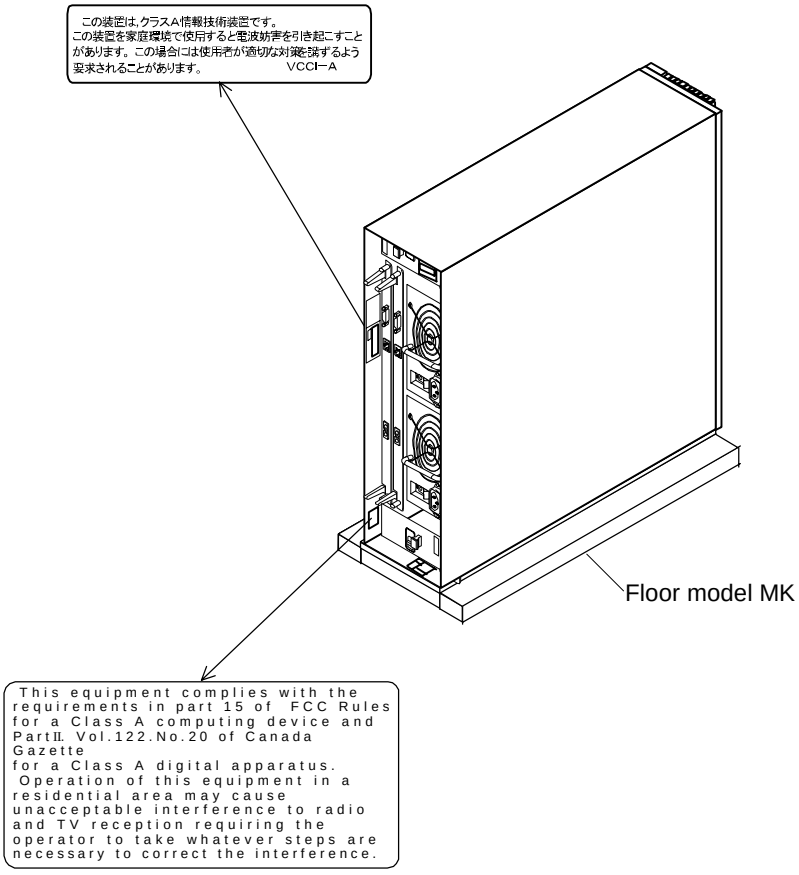
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference in which case the user will be required to correct the interference at his own expense. Testing was done with shielded cables. Therefore, in order to comply with the FCC regulations, you must use shielded cables with you installation.

## EMI Regulation Labels Affixed on the Subsystem.

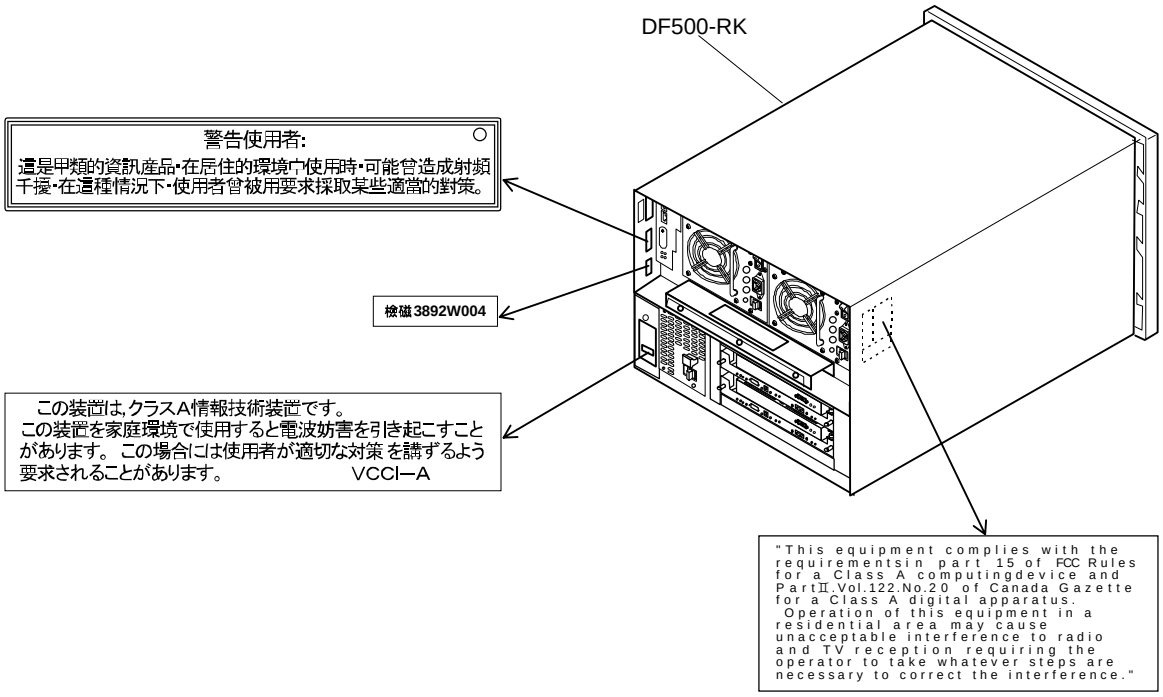
Floor model H1F/H2F

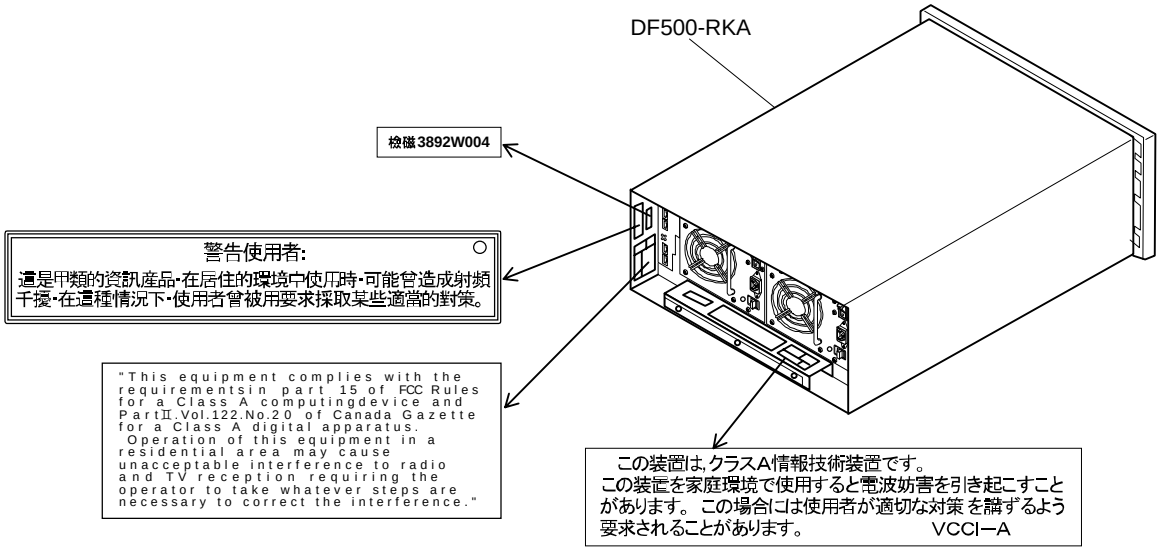


Floor model MK

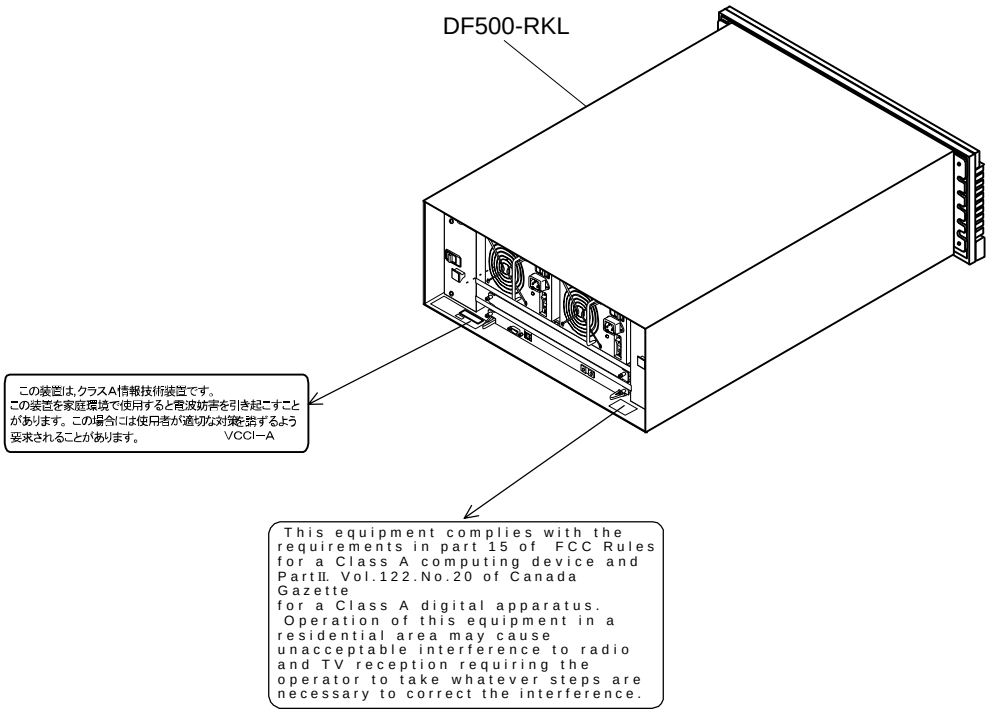


Rackmount model RK/RKA

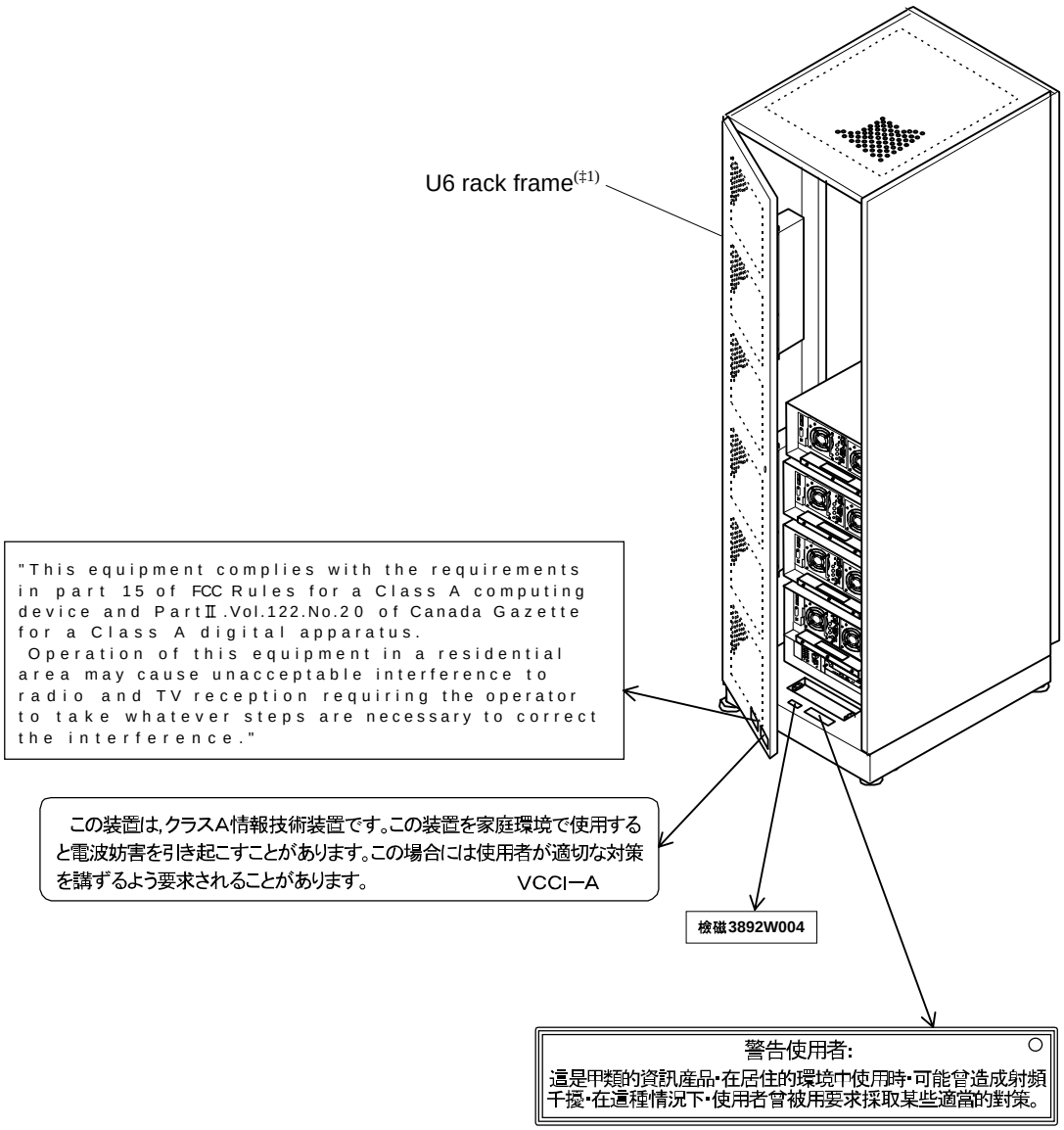


Rackmount model RKL



Rackmount model with U6 rack frame




‡1 : The illustration shows an example of the disk array subsystem in which the DF500-RK/RKA is installed.

# Contents

# ⚠ SAFETY SUMMARY

## 1. ⚠ General Safety Guidelines

Read the following safety guidelines carefully and follow them when you conduct maintenance of the machine.

Before starting maintenance

- Maintenance of the machine must be done only by trained and qualified engineers.
- Read and follow the safety guidelines and procedures in this manuals.
- In this manual and on the machine, hazard warnings are provided to aid you in preventing or reducing the risk of death, personal injury, or product damage. Understand and follow these hazard warnings fully.
- The hazard warning which appear on the warning labels on the machine or in the manual have one of the following alert signal words WARNING, or CAUTION.

| | |
|---|---|
| ⚠ **DANGER :** | Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
| ⚠ **WARNING :** | Indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury. |
| ⚠ **CAUTION :** | Indicates a potentially hazardous situation which, if not avoided, will or can result in minor or moderate injury, or serious damage of product. |
|  | The alert symbol shown left precedes every signal word for hazard warnings, and appears in safety related descriptions in the manual. |

The signal word ‘NOTICE’ is used to present warnings which are not directly related to personal injury hazards.

- When warning labels become dirty or start peeling off, replace them.
- Keep in mind that the hazard warnings in this manual or on the machine cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand.
  Be alert and use your common sense.
- This disk array is a “class 1 laser system” which emits no hazardous laser beam.
  Be sure to operate it according to this manual. Do not perform any operations other than those written in this manual. Otherwise, unexpected failures or accidents may be caused.

## ⚠ SAFETY SUMMARY (Continued)

During work

- For each procedure, follow the given method and sequence of steps.
- Use the spare, consumables, and materials for maintenance which are specified in the manual; otherwise, personal injury or damage of the machine, as well as deterioration of the product's quality, may result.
- Use the special tools and instruments specified for the work in the manual or commercially available tools and instruments which fit the purpose.
- Use measurement instruments and powered tools which are properly calibrated or periodically inspected.
- Keep the maintenance area neat and tidy.
- Always put away parts, materials, or tool when not in use.
- Wear an eye protector where liquid may splash or anything may fly about.
- When lifting anything heavy, lift it using your legs with your back kept erect, to prevent injury to your back or spine.
  When lifting anything, for the weight of which CAUTION is indicated, use a proper lifting tool or have somebody help you.
- Keep a soldering iron and its stand away from you to prevent accidental contact and burns.
- When using sharp objects or cutting tools, make sure that no part of your body lies in the path of the blade, or point.
- Before finishing your work, check if the subsystem is returned to its original state. (Make sure that all parts removed during maintenance have been in stalled back in their original positions in the machine. Make sure that no tool or foreign material left in the machine.)

## ⚠ SAFETY SUMMARY (Continued)

Prevention of electric shocks

- Before starting work, make sure that, unless otherwise specifically instructed, there is no potential electric hazard in the maintenance area such as insufficient grounding or a wet floor.
- Before starting work, note where the emergency power-off switches are located and make sure you know how to operate them.
- Unless otherwise specifically instructed, cut off all power sources to the machine before staring maintenance. Just switching off the machine power supplies is usually not enough.
  When power is fed from a wall or floor outlet, unplug the power supply cord, or turn off the switch on the power distribution panel or board. Attach a notice on the panel or board prohibiting the use of the switch.
  If the machine power has been already turned off, make sure yourself that these conditions are satisfied.
- Do not touch any uninsured conductor or surface, where so instructed, which remains charged for a limited time after the external power supply to the machine is disconnected.
- When working on a machine which has a grounding terminal, make sure that the terminals properly connected to the facility's ground.
- When working close to a hazardously energized part, do not work alone; work with another person who can immediately turn off the power in an emergency.
- Do not wear any metallic item such as a wrist watch with a metallic surface, or metallic accessories.
  If you wear eyeglasses with a metallic frame, take care not to let the frame touch an uninsured surface.
- Make sure that your hands and arms are dry.
- Unless otherwise specifically instructed, use only one hand when it is necessary to work near an exposed live electric circuit.
  This prevents the completion of the circuit through both hands even if you accidentally touch the circuit.
- Do not use a dental mirror near an exposed live electric circuit.
  The mirror surface is conductive and can become hazardous even if it is made of plastic.
- Unless otherwise specifically instructed, do not supply power to any subassembly such as a power supply unit or a motor while it is removed from the machine.

## ⚠ SAFETY SUMMARY (Continued)

Preventing being caught by rotating or moving parts

- Tuck in your tie, scarf, shirt, or any other loose clothing so that it will not be caught by a rotating or moving part.
- Tie up long hair.
- Unless otherwise specifically instructed, do not supply power to any device with rotating or moving parts which are not properly covered.
- When instructed to supply power to any device with rotating or moving parts whose covers have been removed, work with another person who can immediately turn off the power in an emergency.

Procedure in an emergency

For electric shock

- Do not panic. Do not become another victim through contact with the injured person.
- First, shut off the electric current passing through the victim.
  Use the emergency power-off switch, if there is one, or otherwise, a normal power-off switch. If this cannot be done, push the victim away from the source of the electric current by using a nonconductor object such as a dry wooden stick.
- Then, call an ambulance.
- If the victim is unconscious, artificial respiration may be necessary.
  A proper method for performing artificial respiration or resuscitation should be learned beforehand.
- If the victim's heart is not beating, cardiac resuscitation should be performed by a trained and qualified person.

For outbreak of fire

- First shut off all the power from the machine using the emergency power-off switch.
- If the fire continues burning after the power is shut off, take suitable actions including the use of a fire extinguisher or a call for the fire department.

## ⚠ SAFETY SUMMARY (Continued)

2. ⚠ Hazard Warning Statements

The following are the hazard warning statements contained in this manual.

2.1 ⚠ DANGER statements

No DANGER statement is contained.

2.2 ⚠ WARNING statements

No WARNING statement is contained.

2.3 ⚠ CAUTION statements

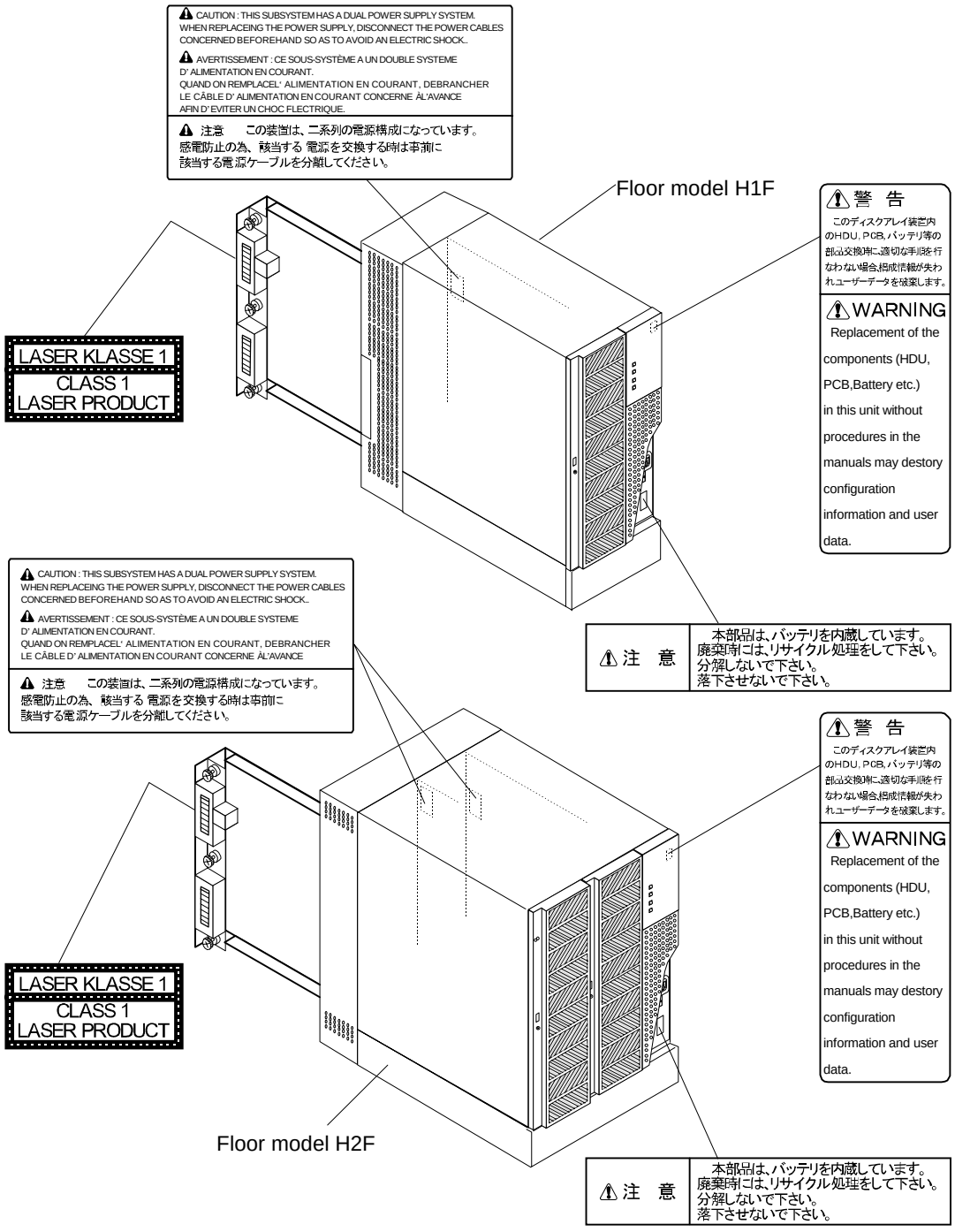
- Use of controls, adjustments, or performance of procedures other than those specified here in may result in hazardous radiation exposure.

(01-0030)

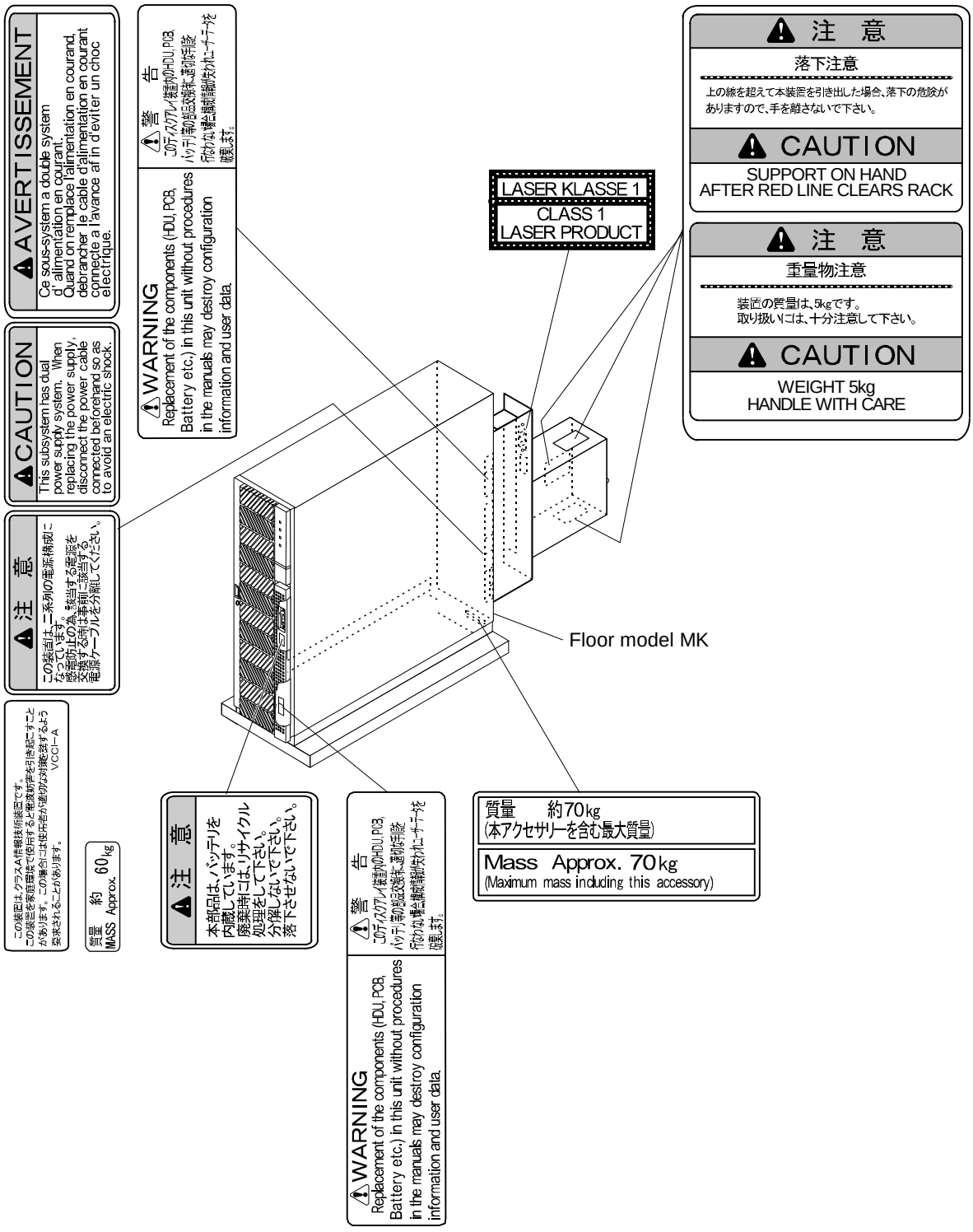
## ⚠ SAFETY SUMMARY (Continued)

3. ⚠ Warning Labels Affixed on the Subsystem

3.1 Floor model (H1F/H2F/MK)

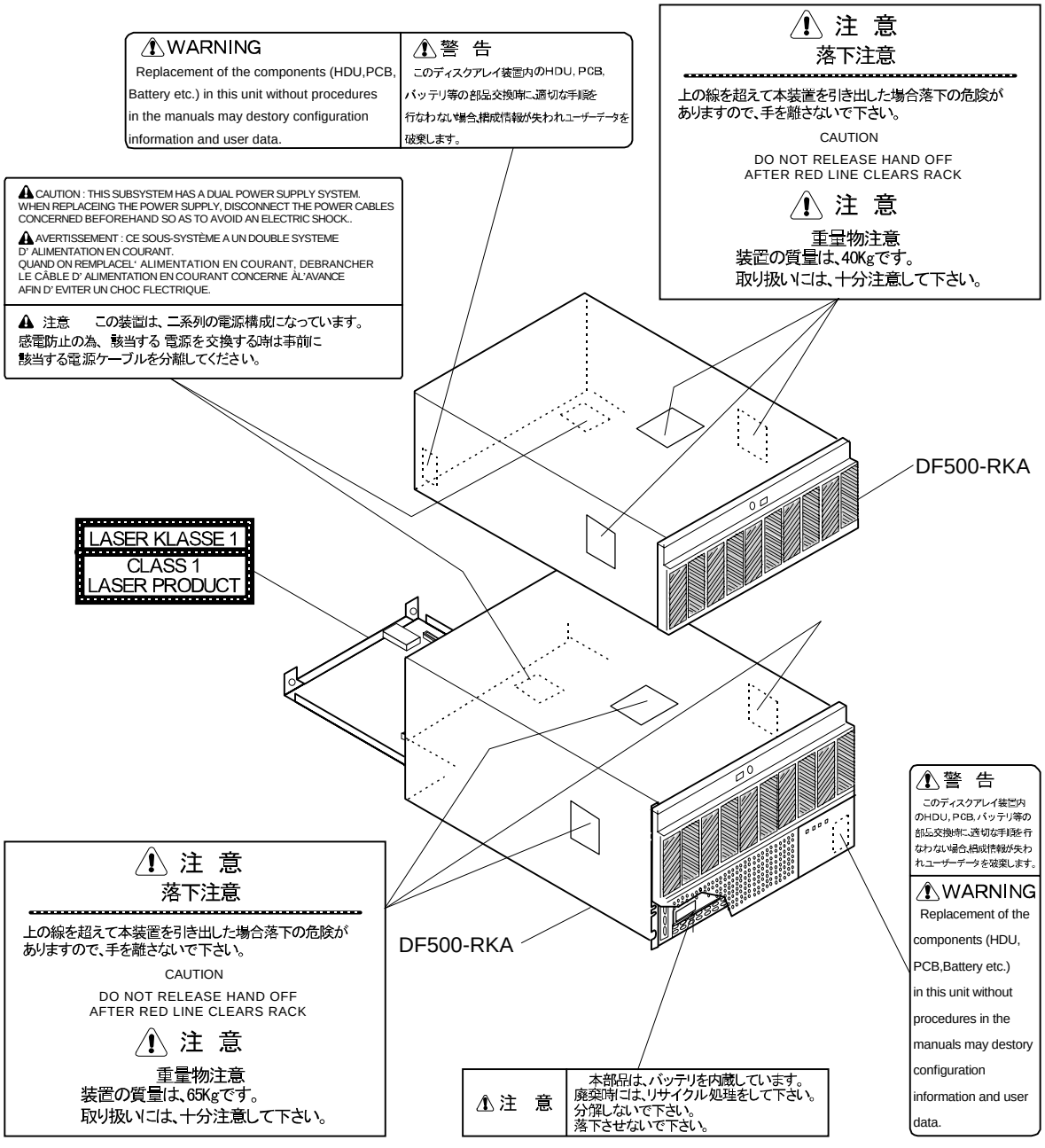


## ⚠ SAFETY SUMMARY (Continued)

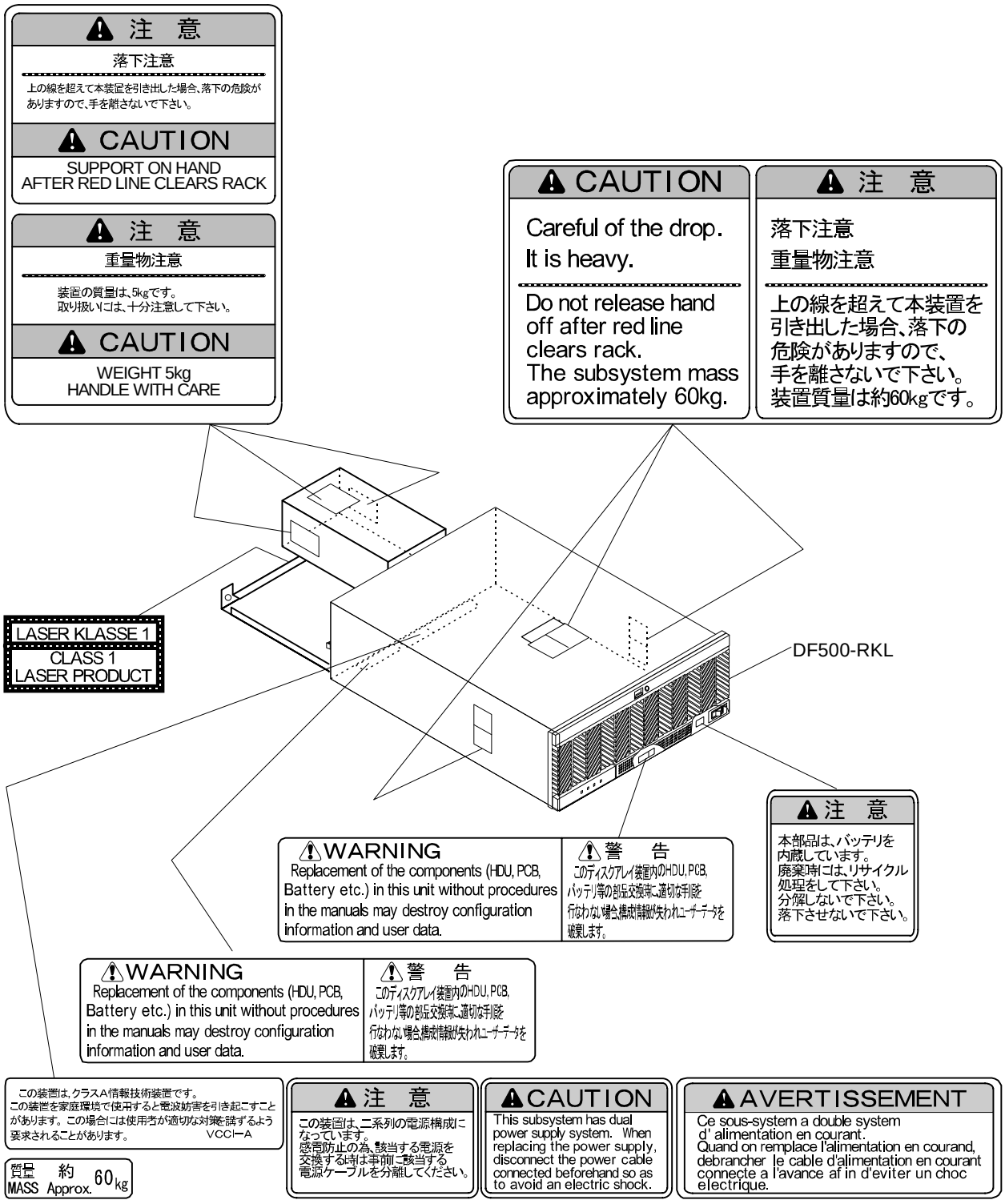


# ⚠ SAFETY SUMMARY (Continued)

## 3.2 Rackmount model (RK/RKA/RKL)

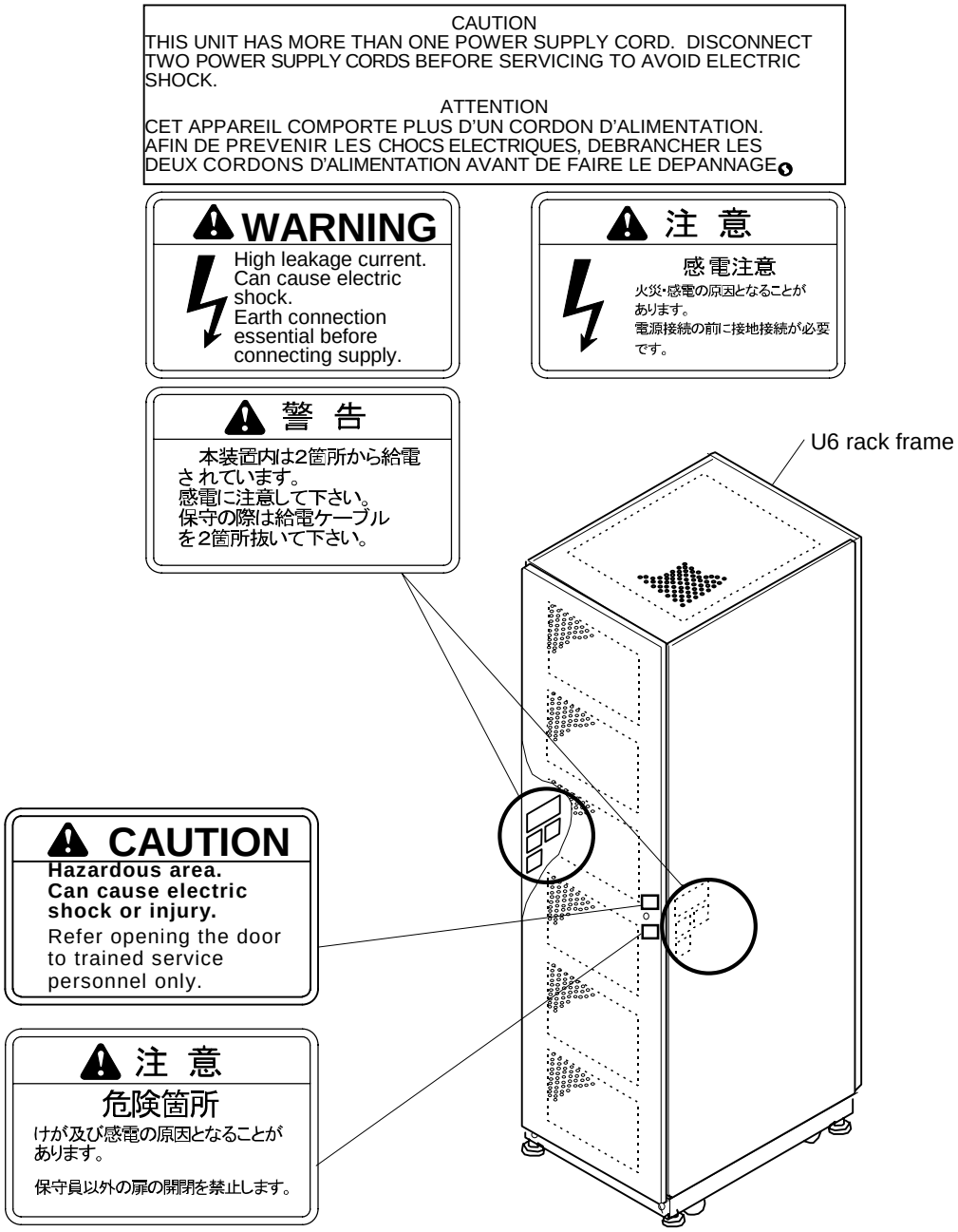


## ⚠ SAFETY SUMMARY (Continued)



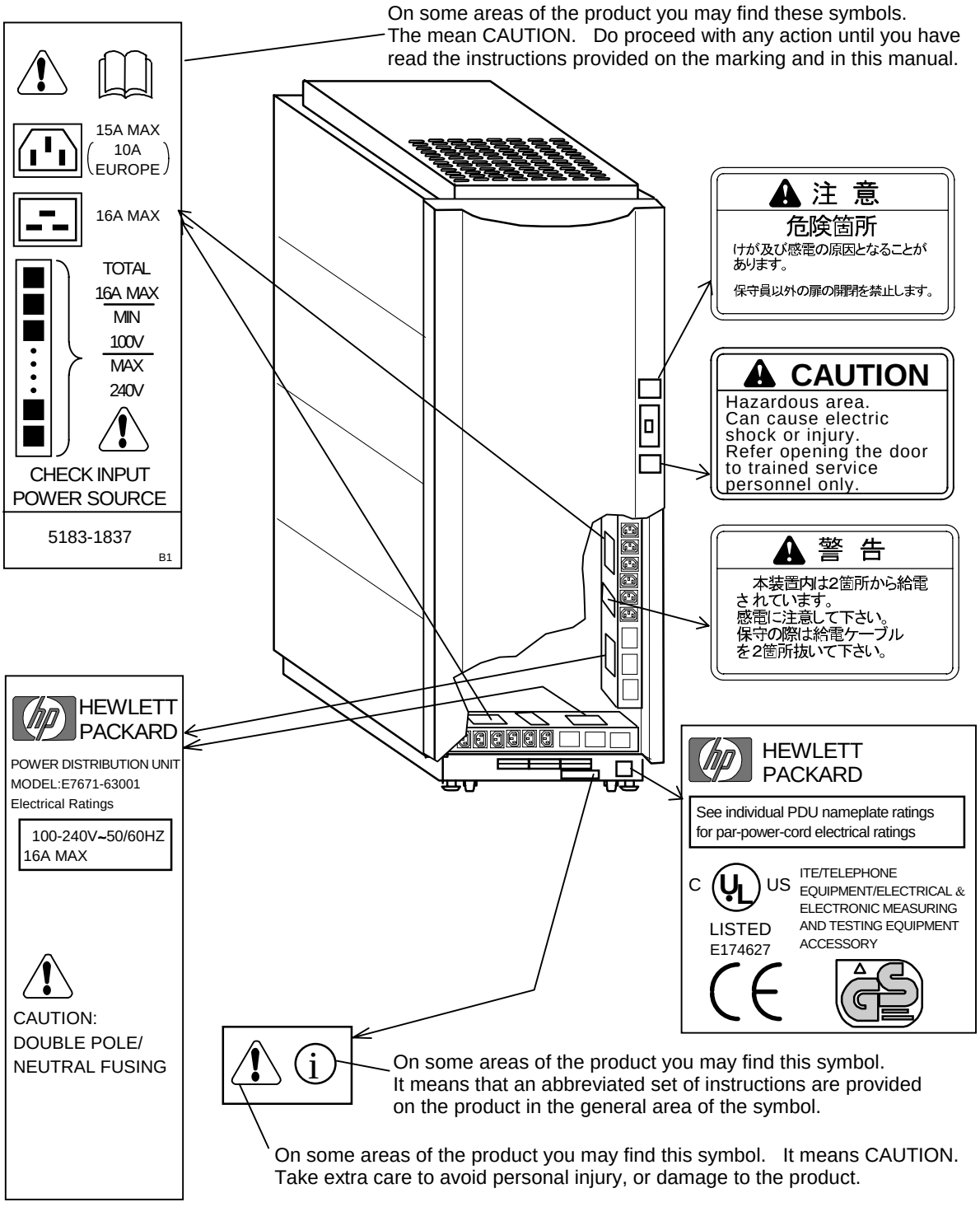
## ⚠ SAFETY SUMMARY (Continued)

3.3 Rackmount model with U6 rack frame



## ⚠ SAFETY SUMMARY (Continued)

3.4 Rackmount model with U4 rack frame



# Chapter 1. Before Starting Maintenance

This chapter contains information on items necessary to be studied before starting installation or maintenance of the disk array.

## 1.1 Guarantee and Service

(1) Guarantee

- The term of guarantee is three years after the product is purchased. Within the period, periodic inspections and maintenance services against failures are executed free of charge.
- After one year has elapsed, the periodic inspections and maintenance services against failures are to be executed through making the upkeep maintenance contract.
- Above service expires eight years after shipment from the factory.
- Special maintenance is required to maintain quality of the subsystem when standard period of five years elapses.
- In the subsystem, periodic replacement parts and limited-life parts are used. Periodic part replacements are required to maintain quality of operation performance. The part whose usable has expired must not be used.

(2) Periodic replacement parts and limited-life parts

In the subsystem, periodical replacement parts and parts with limited lives are used. Periodical part replacement is required to maintain high-quality operation performance.

| Classification | Part name | Life | Treatment |
|---|---|---|---|
| Periodical replacement part | Battery unit | Two years | • Periodical replacement is required.<br>• When the maintenance service contract is made, the periodical replacement is performed as a part of maintenance service.<br>• If not, the periodical replacement must be performed basically by the user.<br>The genuine parts must be used.<br>• Follow the given procedure to dispose of the used battery. |
| Part with limited life | Disk drive | Five years (*1) | This part must be replaced through the special maintenance when its life is expires.<br>(After the time limit, possibility of failure occurrence will be higher and it is feared that data may be lost.)<br>Life of the subsystem main body is eight years after the shipping from the factory even though the special maintenance is performed. |
| *1 : The expected useful life of the Disk drive varies depending on the environment in which the customer uses it. For details, please consult us. | | | |

(3) Maintenance services

As the maintenance services, provided is services executed after introduction.

| Type of service | Contents | Treatment |
|---|---|---|
| Upkeep maintenance service | Periodical inspections, maintenance services against failures, and failure monitoring by means of the E-COM. | These services are offered according to contract or ordering. |
| Special maintenance (overhaul) | Overhaul executed when standard period of five years elapses after purchase of the product. When performing this maintenance, cache backup of user data is required beforehand. | |

## 1.2 LASER SAFETY COMPLIANCE

DF500 use a laser product. When you use DF500 then keep below.
The laser product module is an international Class 1 laser product under IEC825 and the US Department of Health and Human Services (DHHS) Radiation Performance Standard. The Center for Device and Radiological Health (CDRH) of the US Food and Drug Administration implemented regulation for laser products on August 2, 1996. Compliance is mandatory for products marketed in the United States.
The information shown below indicates compliance with the CDRH regulations.

This product conforms to the applicable requirements of 21 CFR Chapter 1, Sub Chapter J, Parts 1040.10 and CENELEC HD 482 SI using IEC825 standard.

This product is a Class 1 product, Laserklaseel 1, and complies with Par. 3 of the "Equipment Safety Law" of June 24, 1968.

The module has been approved by the following safety certification agencies:

- Underwriters Laboratories (UL) Recognized Product, File Number E157779. Applicable requirements: UL 1950.
- Canadian Standards Association (CSA), File Number LR 1018538. Applicable requirements: CAN/CSA C22.2 No.950.
- Center for Device and Radiological Health (CDRH), Accession Number 9622099.
- TÜV Essen of North America, License Number B 97 05 28026 003. Applicable requirements: EN60950 A3: 1995, EN60825-1: 1994 and All: 1996, EN60825-2: 1994.

**⚠ CAUTION**

**Use of controls, adjustments, or performance of procedures other than those specified here in may result in hazardous radiation exposure.**

# Chapter 2. Outline of Subsystem

This chapter explained about the outline of the subsystem which composes a disk array system.
In this chapter, it mechanical and power supplying system structures of each model are explained separately.

## 2.1 What is RAID

To put RAID to practical use, some techniques such as striping, mirroring, and parity disk are used.

- Striping

  It means to store data spreading it on several Disk drives. Since a datum is written on several Disk drives, time required to access each Disk drive is shortened and thus, time required for reading or writing is shortened.

- Mirroring

  It means to copy all the contents of one Disk drive to one or more Disk drives at the same time in order to enhance reliability.

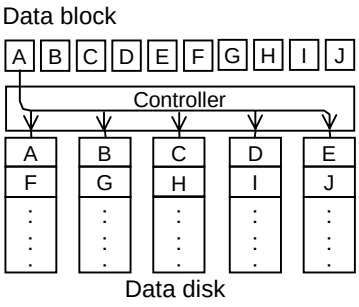
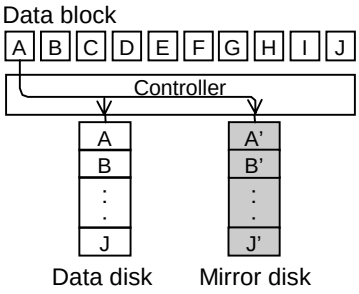
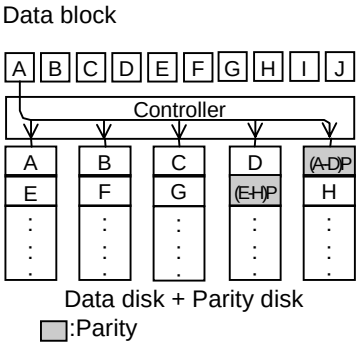
- Parity disk

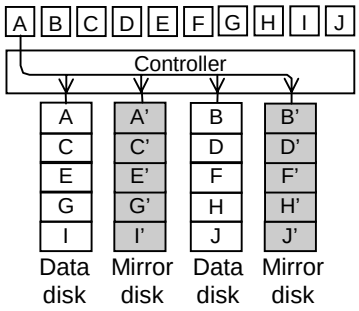
  It is a data writing method used when configure RAID with three or more Disk drives. Parity of data in the corresponding positions of two or more Disk drives is generated and stored on another Disk drive.

### 2.1.1 RAID levels

It is necessary to understand the characteristics of each RAID level to make the environment most suitable for the system you want to construct.
The RK and RKA subsystem supports RAID 0 (2D to 16D), RAID 1, RAID 5 (2D+1P to 15D+1P), RAID0+1 (2D+2P to 8D+8P). The RKL and MK subsystem supports RAID 0 (2D to 12D), RAID 1, RAID 5 (2D+1P to 11D+1P), RAID0+1 (2D+2P to 6D+6P). The outline and characteristics of each RAID level are explained in the following.

**Table 2.1.1 Outline of RAID Levels(*1)**

| Level | Configuration | | Characteristics |
|---|---|---|---|
| RAID 0 |  | Outline | RAID 0 stripes data across Disk drives (five Disk drives in the DF500) to attain higher throughput. |
| | | Advantages | Because Disk drives having redundant data is not needed, Disk drives can be used efficiently. |
| | | Disadvantage | Data is lost in any failure of the Disk drive. |
| RAID 1 |  | Outline | RAID 1 provides data redundancy by copying all the contents of two Disk drive to another (mirroring). Read/write performance is a little better than the individual Disk drive. |
| | | Advantages | Data is not lost even if a failure occurs in any Disk drive.<br>Performance is not lowered even when a Disk drive fails. |
| | | Disadvantage | RAID 1 is expensive because it requires twice the Disk capacity. |
| RAID 5 |  | Outline | RAID 5 consists of three or more Disk drives.<br>It uses one of them as a parity disk and writes divided data on the other Disk drives. Recovery from a failure of a data is possible by utilizing the parity data.<br>Since the parity data is stored on all the Disk drives, a bottleneck of the parity disk does not occur. |
| | | Advantages | When reading data, RAID 5 stripes data across Disk drives in the same way as that in RAID 0 to attain higher throughput. |
| | | Disadvantage | When writing data, since parity data is required to be updated, performance of writing small random data is lowered although there is no problem regarding writing of continuous data. The performance is also lowered when a Disk drive fails. |
| *1 : Only the RAID levels supported by DF500 are explained. | | | |

| Level | Configuration | | Characteristics |
|---|---|---|---|
| RAID 0+1 |  | Outline | RAID 0+1 provides data redundancy like RAID 1 by copying all the contents of two Disk drive to another. Different from RAID 1, data striping is performed over two to eight (6)(*1) sets of two Disk drives. |
| | | Advantages | Data is not lost even if any Disk drive fails.<br>Besides, since RAID 0+1 stripes data, it can make the performance of dealing with small size random accesses higher comparing with RAID 1.<br>Performance is not lowered even when a Disk drive fails. |
| | | Disadvantage | RAID 0+1 is expensive because it requires twice the disk capacity. |

*1 : RKL is six sets.

### 2.1.2 Application of RAID technology

When one I/O processing spans multiple Disk drive (when the stripe size is too small) during transaction processing in RAID 5, the performance cannot be exhibited sufficiently.
Therefore, thorough examination is required on the stripe size.

When using this subsystem, you can select the stripesize from 16, 32, and 64 k bytes. The default value is 64 bytes which was decided based on the actual result obtained through uses of up to the DF500.
Lump writing of data on the Disk drive and prereading of old data are performed by use of the cache memory so as prevent occurrence of write penalty as far as possible.

- Write penalty

  In the RAID 5 configuration, 3 to 16 (RKL and MK is 3 to 12) Disk drives constitute one parity group (RK and RKA is 2D+1P to 15D+1P, RKL and MK is 2D+1P to 11D+1P).
  Since parity data is generated from 2 to 15 (RKL and MK is 2 to 11) data disks in the group, when partial writing of one stripe in the group occurs in the transaction processing, it is necessary to generate the corresponding parity data in the group once again. Since parity data is calculated by the following calculation formula, “data before update”, “parity before update” and “data after update” are necessary to create the parity. Extra processing of reading “data before updating” and “parity before update” at this time is called write penalty.

  [New parity] = ([Data before update] EOR [Data after update]) EOR [Parity before update]

## 2.2 Outline of the Subsystem

### 2.2.1 Outline of functions

DF500 subsystem has two models: floor model and rackmouunt model.
There are three types of the floor model : one is a combination of the RK and the floor standing kit (hereafter referred to as floor model H1F) and one is a combination of the RK, the RKA, and the floor standing kit (hereafter, referred to as floor model H2F) and the other is a combination of the RKL and the floor standing kit (hereafter, referred to as floor model MK).
The rackmount model is a subsystem which is used in the form of a combination of the DF500-RK (hereafter, referred to as RK.) and the DF500-RKA (hereafter, referred to as RKA) and the DF500-RKL (hereafter, referred to as RKL).
Features of the subsystem are explained below.

- The floor model H1F mounts up to ten Disk drives and controls them as RAID by a Controller.
- The floor model H2F mounts up to twenty Disk drives and controls them as RAID by a Controller.
- The floor model MK mounts up to twelve Disk drives and controls them as RAID by a Controller.
- The RK mounts up to ten Disk drives and controls them as RAID by a Controller.
- The RKA mounts up to ten Disk drives and can be used being connected with the RK.
- The RKL mounts up to twelve Disk drives and controls them as RAID by a Controller.
- The subsystem uses either Fibre Channel (1 G bps/2 G bps, Non-OFC) or SCSI (LVD, Wide-differential, or Single-ended) as an interface with a host computer.
- The RK, RKA and RKL are models to be mounted on a 19-type rack frame, however, them can also be used as floor model when combined with the optional kit.
- Up to nine RKAs can be connected with a single RK using special cables so that you can configure a system with a set of 100 Disk drives using the Controller of the RK (‡1).
- A special rack frame (DF-F500-U6) is provided, which can mount a various combination of the RK(s) (6 EIA units high) and RKA(s) (3.5 EIA units high) up to a height of 38 EIA units.
- A special rack frame (DF-F500-U4) is provided, which can mount a various combination of the RK(s) and RKA(s) up to a height of 32 EIA units.
- Up to the nine and five(‡2) RKL(s) (4 EIA units high each) can be mounted on the rack frames for exclusive use, that is, DF-F500-U6 and DF-F500-U4, respectively.

‡1 : The two or more RKs cannot be connected to the one system.

‡2 : Up to the seven RKLs can be mounted through an addition of the UPDU (optional).

- The 2 G bps Fibre Channel interface board of DF500 (DF-F500-DF2G2) has downward compatibility with the 1 G bps Fibre Channel Interface board (DF-F500-DFMM5 or DF-F500-DFFM6).
- The 1 G bps Fibre Channel Interface board of DF500 (DF-F500-DFFM6) is an Interface board that supports the F-Port and has downward compatibility with the DF-F500-DFFM5.

(1) Scalability

- You can construct any system that meets wide variety of demands, from a system with ten Disk drives by using a single RK to a system with the maximum of 100 Disk drives expanded by connecting up to nine RKAs to the RK.
- By using the rack frame (U6/U4) exclusive to DF500, you can construct a system conforming to your demand by combining the RK and nine RKAs.
- Spare disk(s), up to five of which can be set up, can be mounted in any location(s).(‡1) You can use the system effectively by mounting each Spare disk in a Disk drive slot left unused as a result of a system construction.
- From the host computer, the subsystem can be used not only as a single large scale Disk drive but also as 64 logical disks (LUs) at the maximum.
- The subsystem enables you to construct a system which can connect up to 126 Fibre Channel devices by using the Fibre Channel interface and connecting the HUB and switch (hereafter, referred to as “SW”.).

(2) Multi-RAID configuration

- Four RAID levels, that is, RAID 0, RAID 1, RAID 5, and RAID 0+1 can be set up.
- Because RAID 1, RAID 5, and RAID 0+1 are provided with redundancy by virtue of mirror disk(s) and parity disk(s), they do not lose data even when a failure occurs in one of Disk drives, and moreover, data can be read/written from/onto them as if there existed no failure.
- With RAID 5 of DF500 (Floor model H1F/H2F and RK/RKA), you can construct a flexible system conforming to your demands from a system configured with two data disks (2D+1P) to that with 15 data disks (15D+1P).
- With RAID 5 of DF500 (Floor model MK and RKL), you can construct a flexible system conforming to your demands from a system configured with two data disks (2D+1P) to that with 15 data disks (11D+1P).

(3) High-speed data transfer

- The subsystem can read and write data at a high-speed by activating Disk drives in parallel.
- With the Fibre Channel connection, the subsystem can transfer data between the host computer and the subsystem at a maximum speed of 100 M bytes/s. Enough throughput can be got when connecting devices and making a multiple access.
- With the Ultra_2-Wide SCSI (LVD) connection, the subsystem can transfer data at a maximum speed of 80 M bytes/s.
- By using a non volatile large-capacity cache memory (256 M bytes to 2 G bytes/CTL, RKL and MK is 256 M bytes/CTL), speed-up of command execution at the time of read/write hit was achieved.

‡1 : Each of the Disk drives #0 and #1 cannot be set to the Spare disk.

(4) Large capacity
- The maximum capacity of 716 G bytes(‡1) can be realized with the system consisting of the only one RK.
- The maximum capacity of 7.1 T bytes(‡1) can be realized with the system consisting of the one RK connected with the nine RKAs.
- The maximum capacity of 859 G bytes(‡1) can be realized with the system consisting of the RKL or MK.

(5) High data availability
- With the redundant RAID configuration (RAID 1,RAID 5, or RAID 0+1), the subsystem can continuously read or write data without shutting down the subsystem by using the parity and/or mirror disks even when a Disk drive failed.

(6) High data reliability
- The Controller of the DF500 adds the original 8-byte data assurance codes to data from a host computer by automatically generating them, writes them in the Disk drive together with the data, and checks them when reading the data, and thus the data reliability is improved.
- On the data bus in the controller, the automatic generation of the data assurance codes and the check are executed to enhance data reliability in data distribution/concentration control which is peculiar to the disk array.

(7) Diagnostic and maintenance functions
- Diagnosis and maintenance of the subsystem can be done on a screen of a PC connected to the subsystem via a LAN.
- Status of the subsystem can be checked and a faulty part can be identified by the Disk Array management program.
- Diagnosis of the subsystem can be done from a distant place by using the remote maintenance function (SNMP).

‡1 : The Disk drive use of 71.6 G bytes. The time of RAID 0 configuration.

### 2.2.2 Differences between the DF500 and DF400

Differences between the subsystem and DF400 are explained below.

- Adoption of high-speed RISC processor

  The installed microprocessor was changed from POWER PC 603e (200 MHz) of the DF400 to POWER PC 750 (300 MHz) which has higher speed and higher performance.

- Widely enhanced performance of internal bus

  The bus performance between the cache memories on the controller was enhanced from 300 M byte/s (DF400) to 610 M byte/s (DF500) to achieve higher speed.

- Fibre Channel interface used as the standard host interface(RK/H1F/H2F)

  The DF400 uses Fibre Channel interface or SCSI depending on the selection, whereas the DF500-RK uses Fibre Channel interface as a standard configuration.

- Duplicated power supply

  In the DF400, the In Box for models RK, RKY, and RKL is duplicated but the AC/DC power supply is optionally duplicated depending on the configuration.
  Whereas, in the DF500, the new power supply which integrates functions of the IN BOX and the AC/DC power supply is duplicated as a standard configuration for both of the DF500.

- Up to five Spare disks installable

  The DF400 can install up to two Spare disks, whereas the DF500 can install up to five Spare disks in one system configuration so that the prevention of data loss owing to a failure is strengthened. Further, they can be set at in any locations depending on the data disk configuration.

- Adoption of Fibre Channel Disk drive

  The Disk drive installed in the DF400 uses SCSI, whereas, the DF500 adopts the Disk drive that uses the Fibre Channel interface. By virtue of this, DF500 can not only connect up to 100 Disk drives but also have more diverse RAID structures.

- Panelless system

  The information panel, which is used on the DF400 for key input and information check, has been eliminated, and instead operations are performed on the screen of a PC by the WEB function through LAN connection. Thereby the restriction on the number of characters, etc., has been removed, so the checking of a larger amount of information at a time has been made available.

## 2.3 Subsystem Structure

(1) RK, RKA, H1F, H2F

The subsystem can be composed of a combination of the RK (s) and RKA (s). The floor model has two types, that is, a type configured with a single RK and another type added with the RKA(s).

As for the rackmount model, a system with one RK and up to nine RKAs (with 100 Disk drives at the maximum) can be configured when using the U6 rack frame (DF-F500-U6).

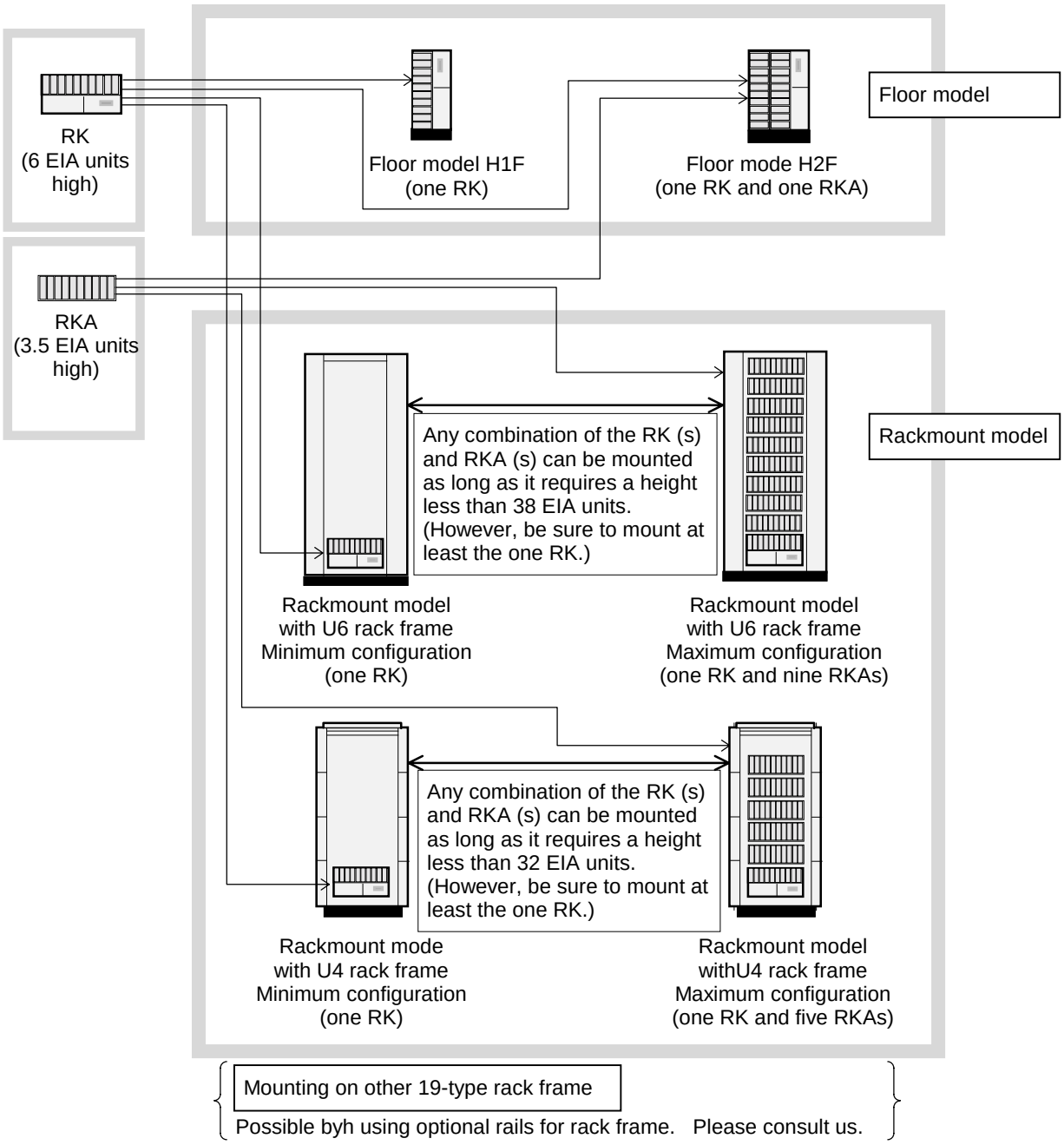



**Figure 2.3.1 Subsystem Configuration**

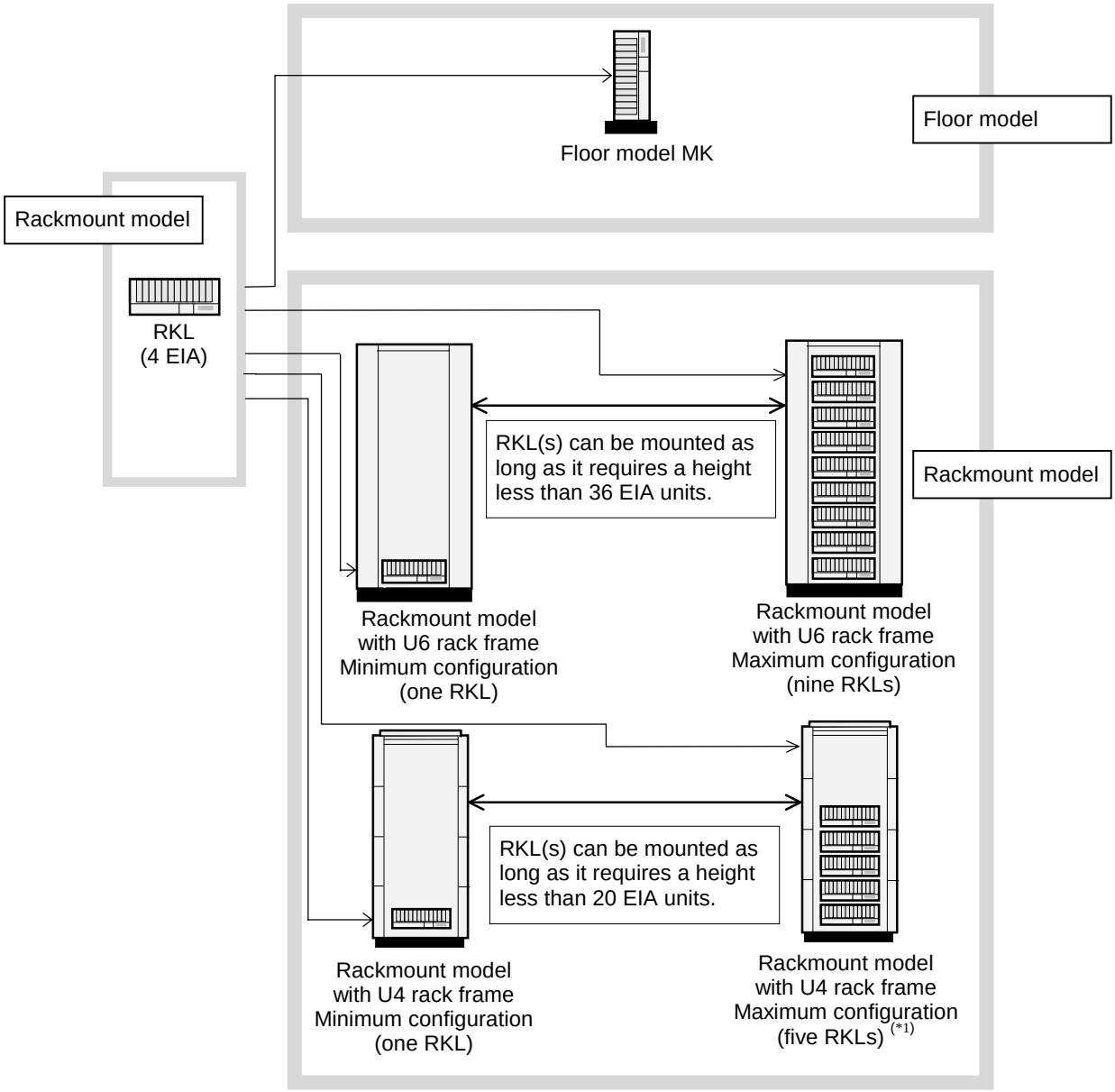
(2) RKL, MK

Each of the floor model MK and the rackmount model RKL has three types as shown below.

Floor model MK: MKF, MKS, and MKSD

Rackmount model RKL: RKLF, RKLS, and RKLSD

The rackmount model can mount up to nine RKLs when using the U6 rack frame (DF-F500-U6).




*1: Up to the seven RKLs can be mounted through an addition of the UPDU (optional).

Mounting on other 19-type rack frame

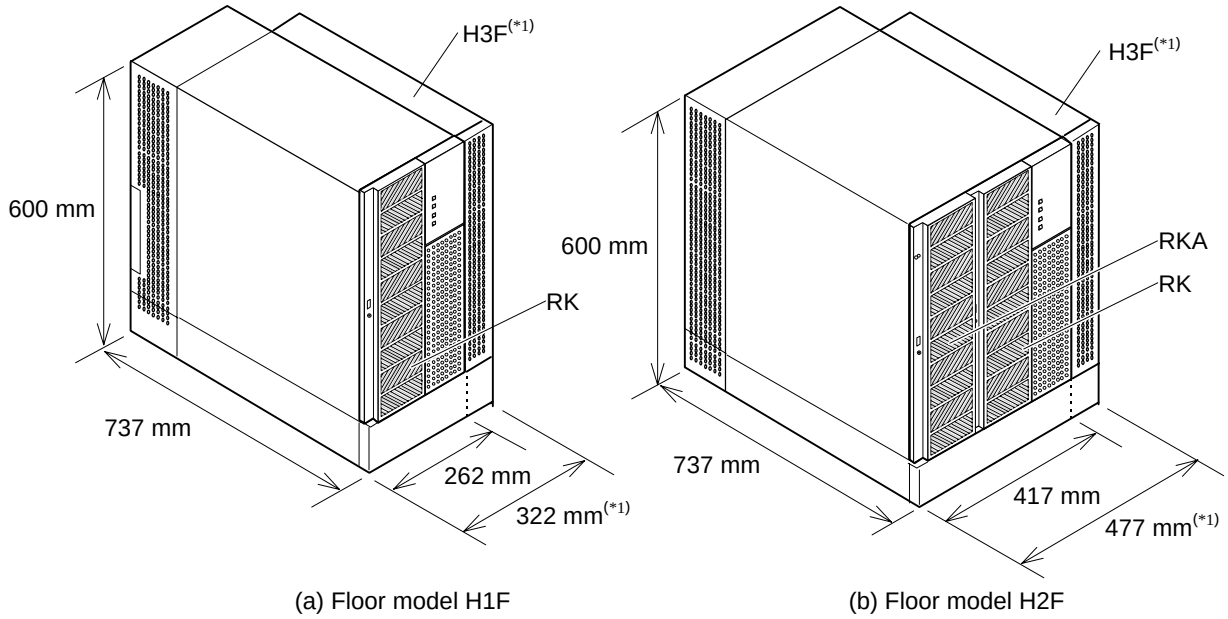
Possible by using optional rails for rack-mounting. Please consult us.

**Figure 2.3.2 Subsystem Configuration**

### 2.3.1 External appearances

(1) Appearances of H1F, H2F, RK, and RKA

(a) Floor model (H1F, H2F)




(a) Floor model H1F (b) Floor model H2F

*1 : The H3F is a frame kit which can be joined as an accessory.

**Figure 2.3.3 Appearances of the Floor Models**

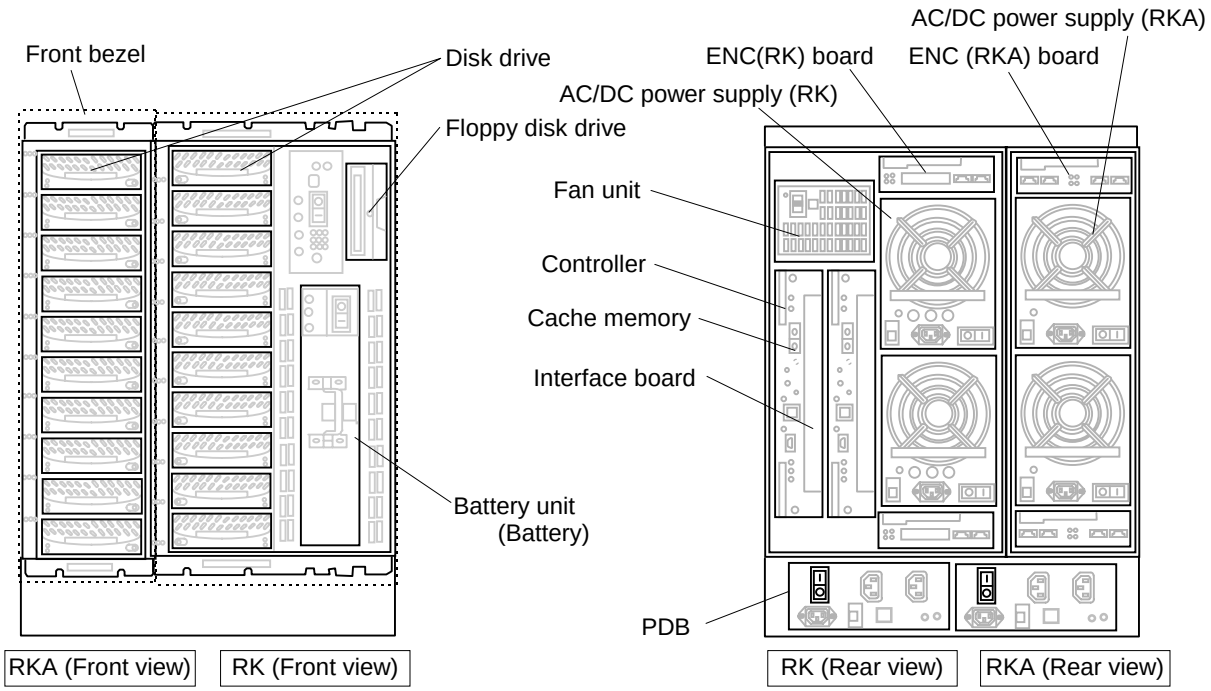



**Figure 2.3.4 Major Components of the Floor Model**

(b) Rackmount model (RK, RKA)

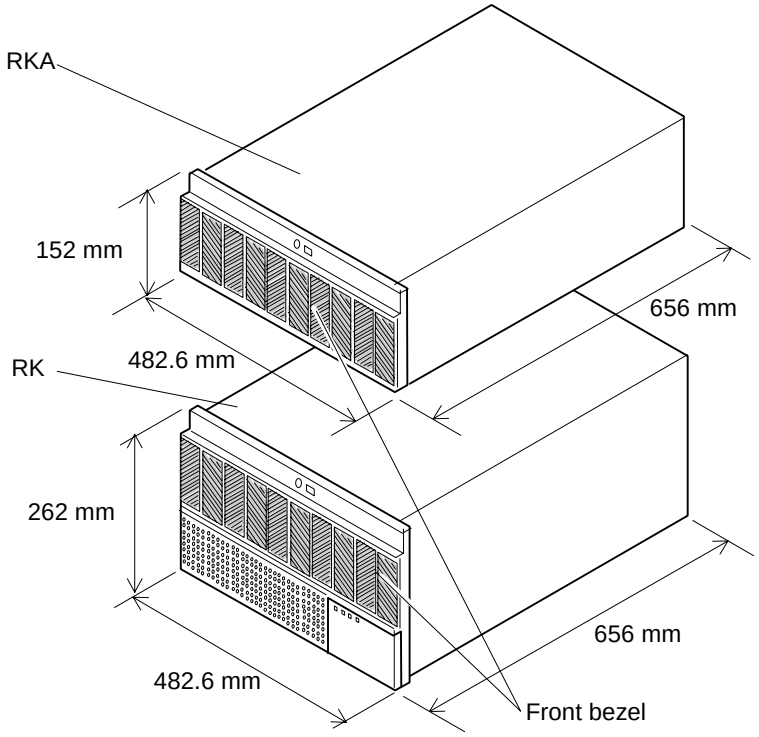



**Figure 2.3.5 Appearances of the RK and RKA**

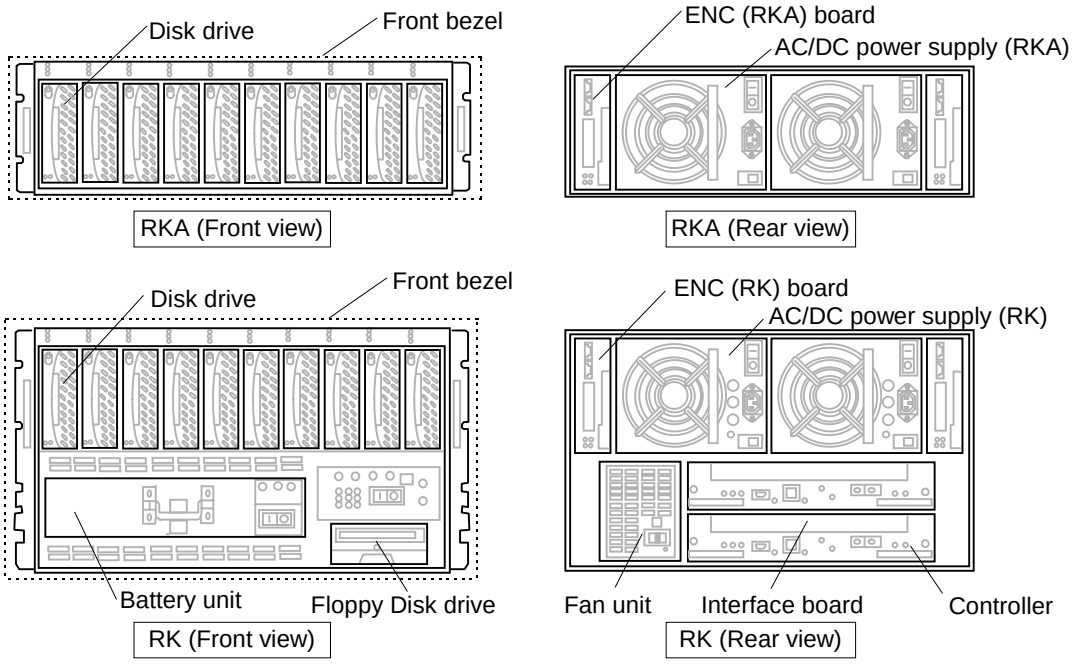
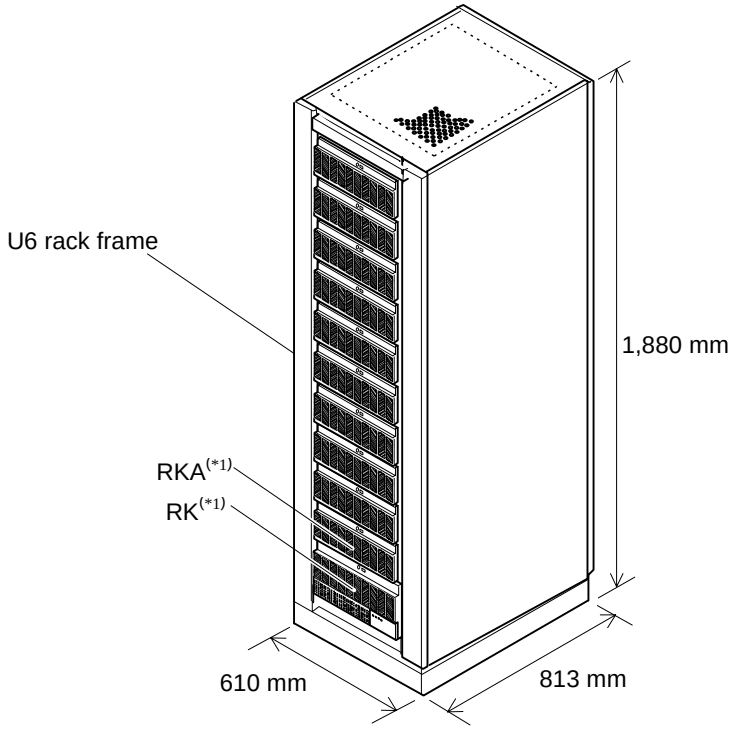



**Figure 2.3.6 Major Components of the RK and RKA**

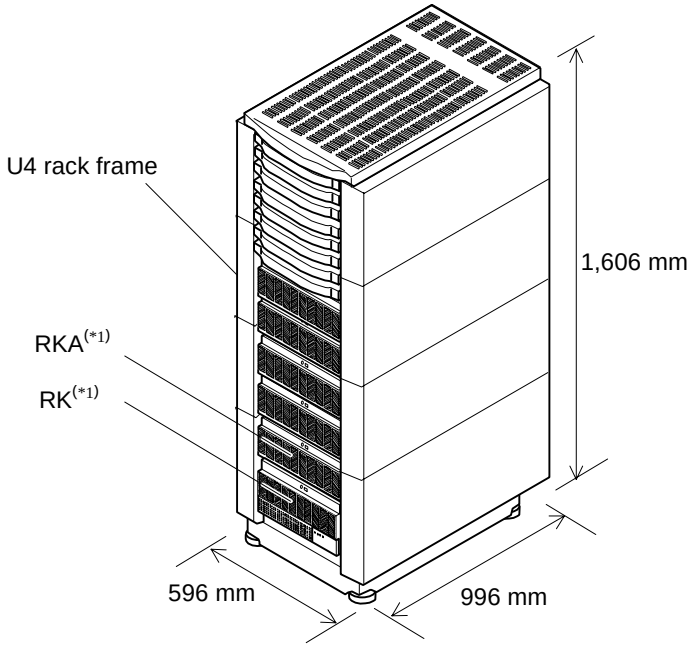
(c) Rackmount model with U6 rack frame




*1 : This figure shows an example of a subsystem with the one RK and nine RKAs.

**Figure 2.3.7 Appearances of the Rackmount Model with U6 Rack Frame**

(d) Rackmount model with U4 rack frame




*1 : This figure shows an example of a subsystem with the one RK and five RKAs.

**Figure 2.3.8 Appearances of the Rackmount Model with U4 Rack Frame**

(2) Appearances of MK, RKL
(a) Floor model (MK)

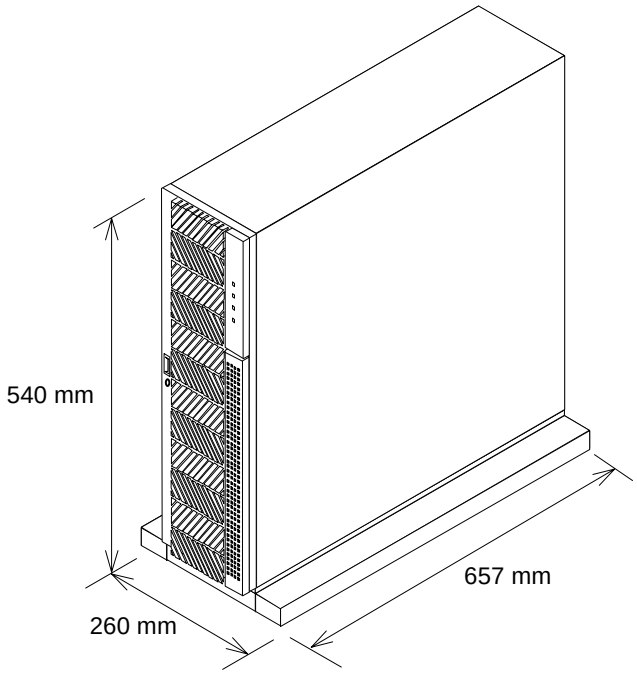



**Figure 2.3.9 Appearances of the Floor Model**

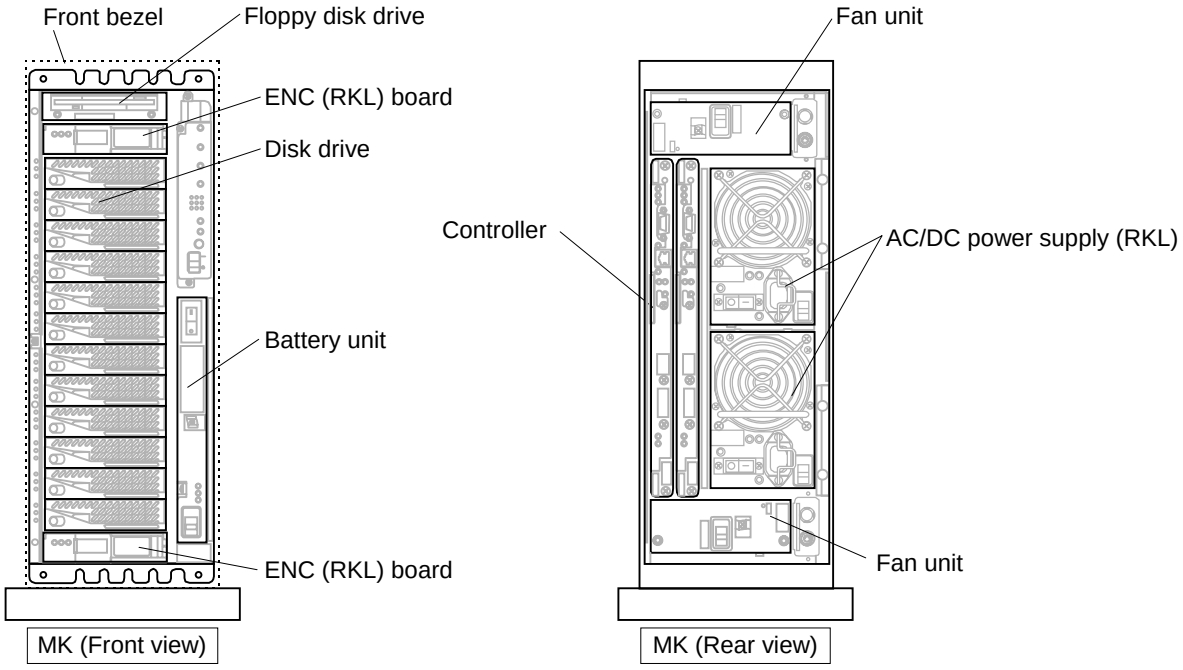



**Figure 2.3.10 Major Components of the Floor Model**

(b) Rackmount model (RKL)

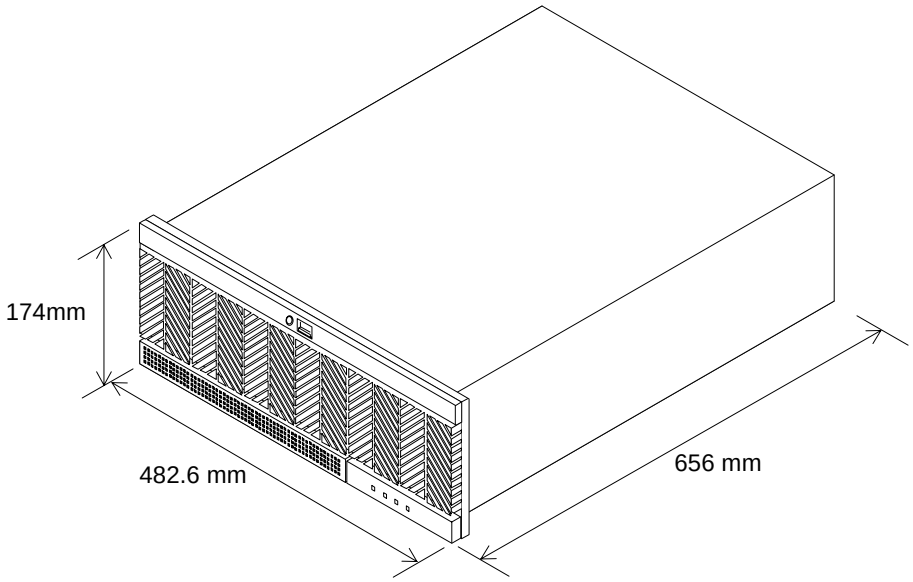



**Figure 2.3.11 Appearances of the RKL**

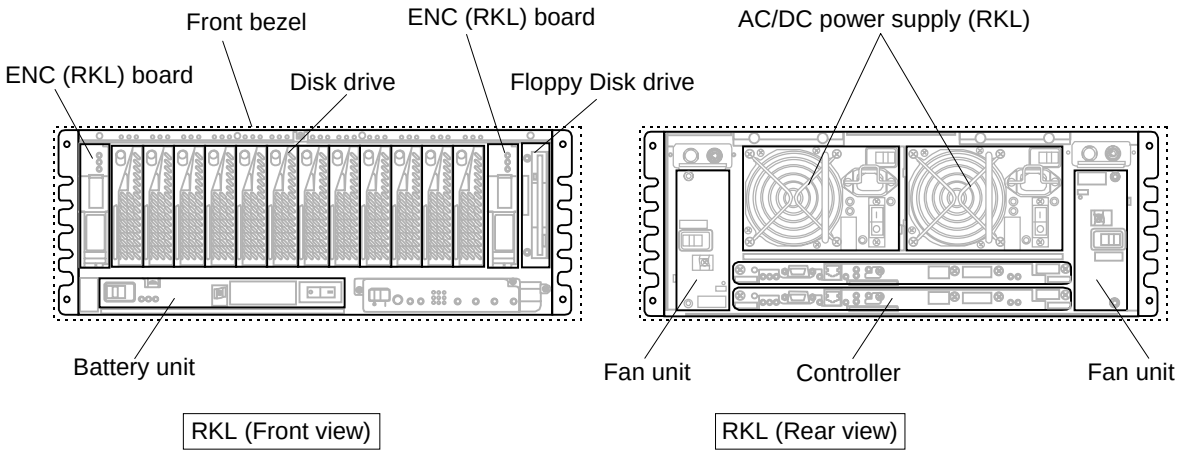



**Figure 2.3.12 Major Components of the RKL**

(c) Rackmount model with U6 rack frame

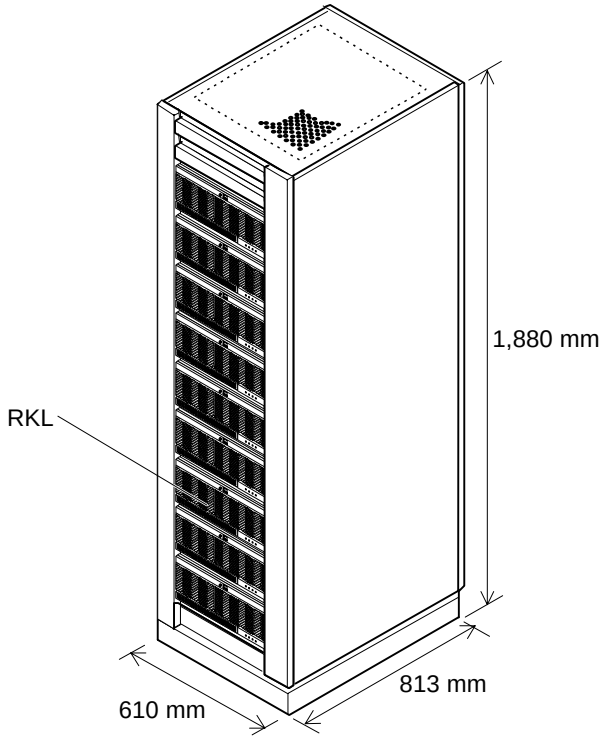



**Figure 2.3.13 Appearances of the Rackmount Model with U6 Rack Frame**

(d) Rackmount model with U4 rack frame

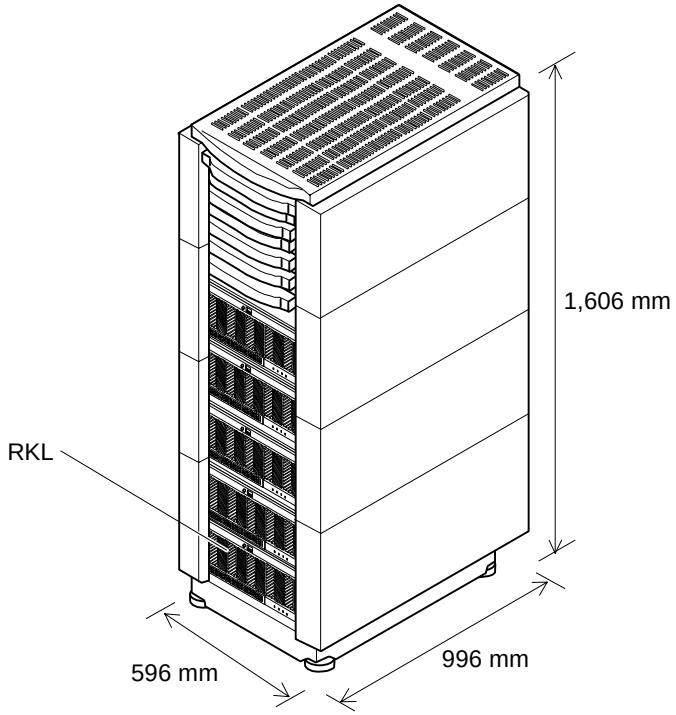



**Figure 2.3.14 Appearances of the Rackmount Model with U4 Rack Frame**

### 2.3.2 Configuration of floor model

(1) Floor model H1F

This model is produced by the combination of the RK and floor stand kit (DF-F500-H1F).

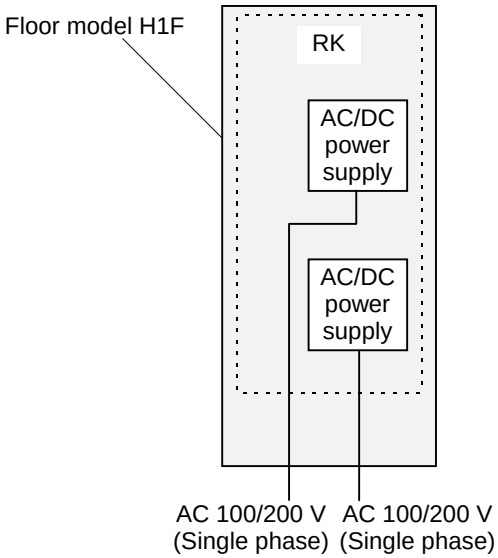



**Figure 2.3.15 System Configuration of Floor Model H1F**

(2) Floor model H2F

This model is produced by the combination of the RK, RKA, and floor stand kit (DF-F500-H2F).

The PDBs which supply AC power to the power supplies of the RK and RKA are added to the above configuration. The two PDBs are mounted to prepare for the dual power system.

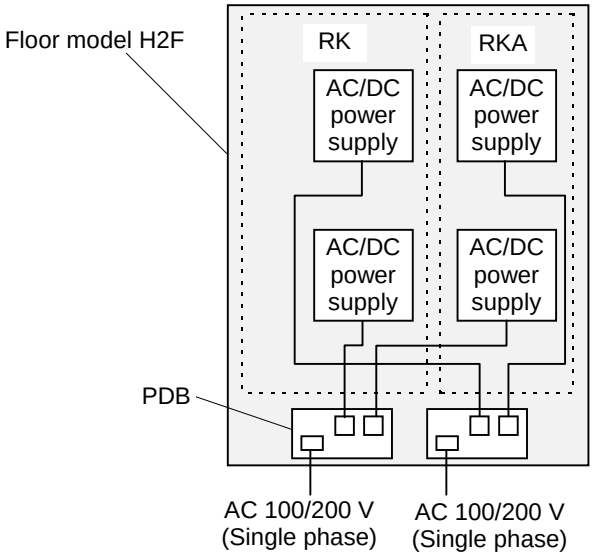



**Figure 2.3.16 System Configuration of Floor Model H2F**

(3) Floor model MK

This model is produced by the combination of the RKL and floor stand kit (DF-F500-H1FL).

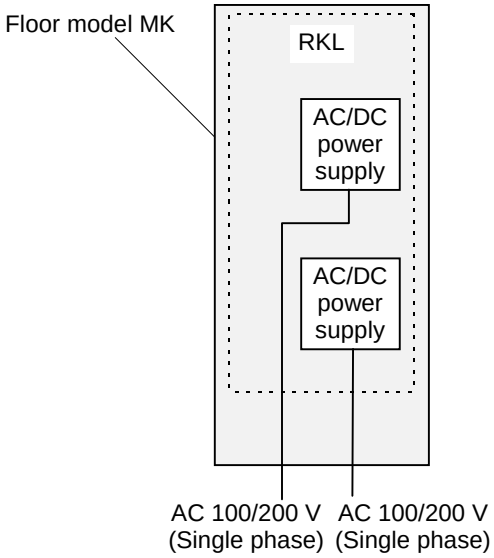
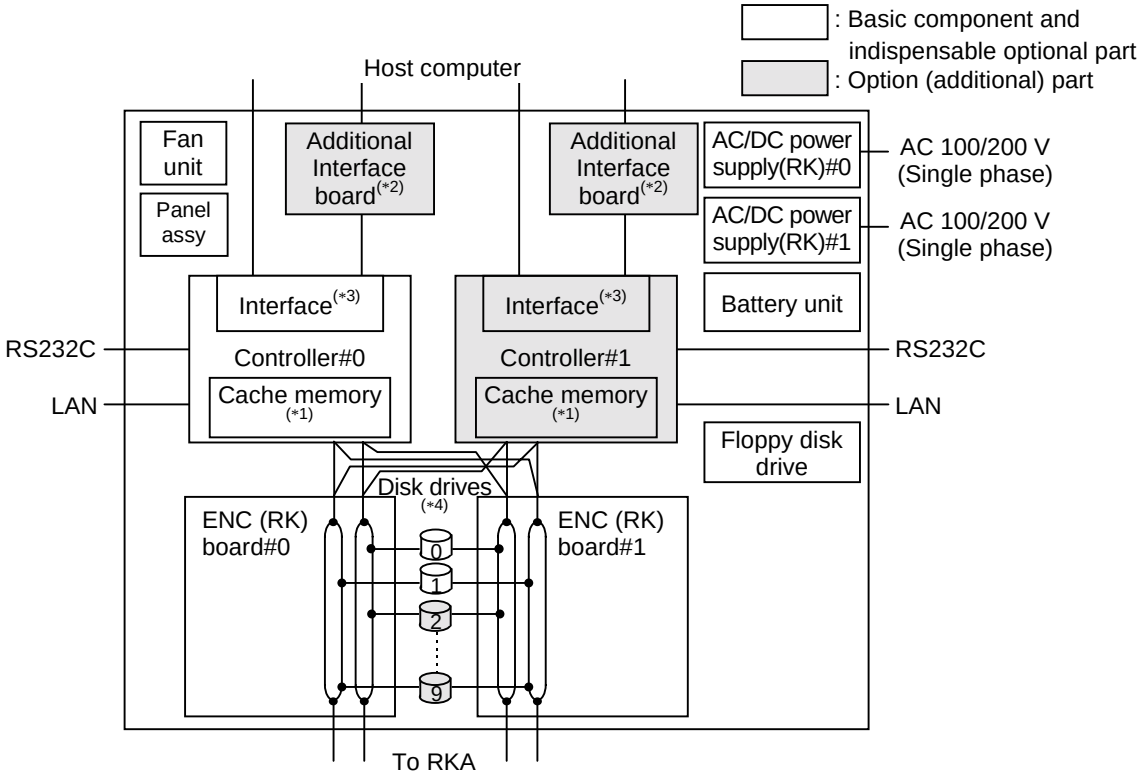



**Figure 2.3.17 System Configuration of Floor Model MK**

### 2.3.3 System configuration of the rackmount model

Configuration block diagram of the RK, RKA, and RKL is shown below. Each of the RK and RKA can mount ten Disk drives. Each of the RKL can mount twelve Disk drives. (The RK has a Controller which can control up to 100 Disk drives configured as RAID. The RKL has a Controller which can control up to twelve Disk drives configured as RAID.)
The Disk drives can be assigned to data disk(s), parity disk(s) (mirror disk(s)) depending on the RAID level.
Up to five Spare disks can be mounted in any locations within the configuration.(‡1)
Figure 2.3.18 and 2.3.19 shows configuration block diagrams of the RK and RKA respectively. Figure 2.3.20 shows configuration block diagrams of the RKL respectively.

(1) Configuration of RK and RKA




*1 : Cache memory :
DF-F500-C256, DF-F500-C512, or DF-F500-C1G

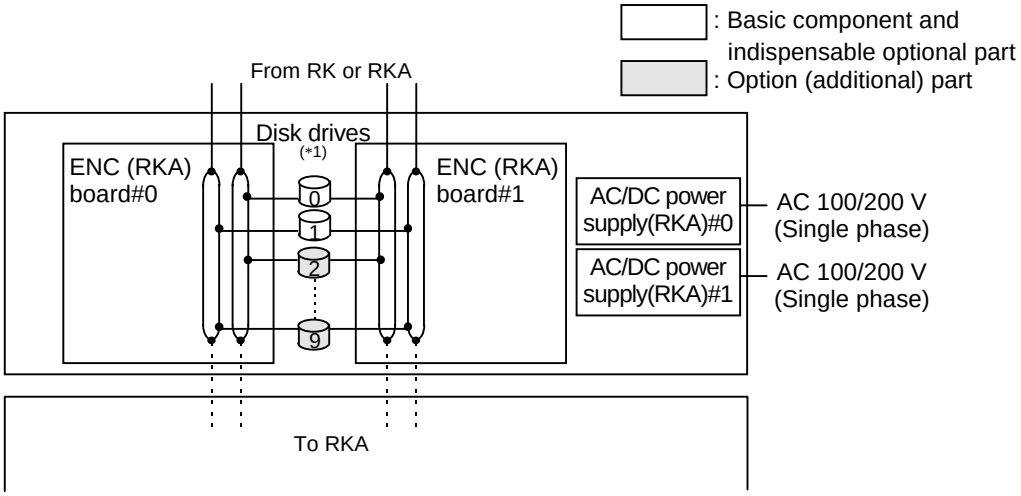
*2 : Interface board (for extension) :
DF-F500-DFFM5, DF-F500-DFFM6, DF-F500-DF2G2, DF-F500-DFUDS, or DF-F500-DFU2S

*3 : Interface (mounted in the controller) : 1 G bps Fibre Channel (Non-OFC)
However, when the DF-F500-DF2G2, DF-F500-DFUDS or DF-F500-DFU2S board are selected for an additional Interface board, the 1 G bps Fibre Channel cannot be used.

*4 : Disk drive :
DF-F500-AAF8, DF-F500-AAF18, DF-F500-AAH18, DF-F500-AAF36, or DF-F500-AAF72

**Figure 2.3.18 System Configuration Block Diagrams of the RK**

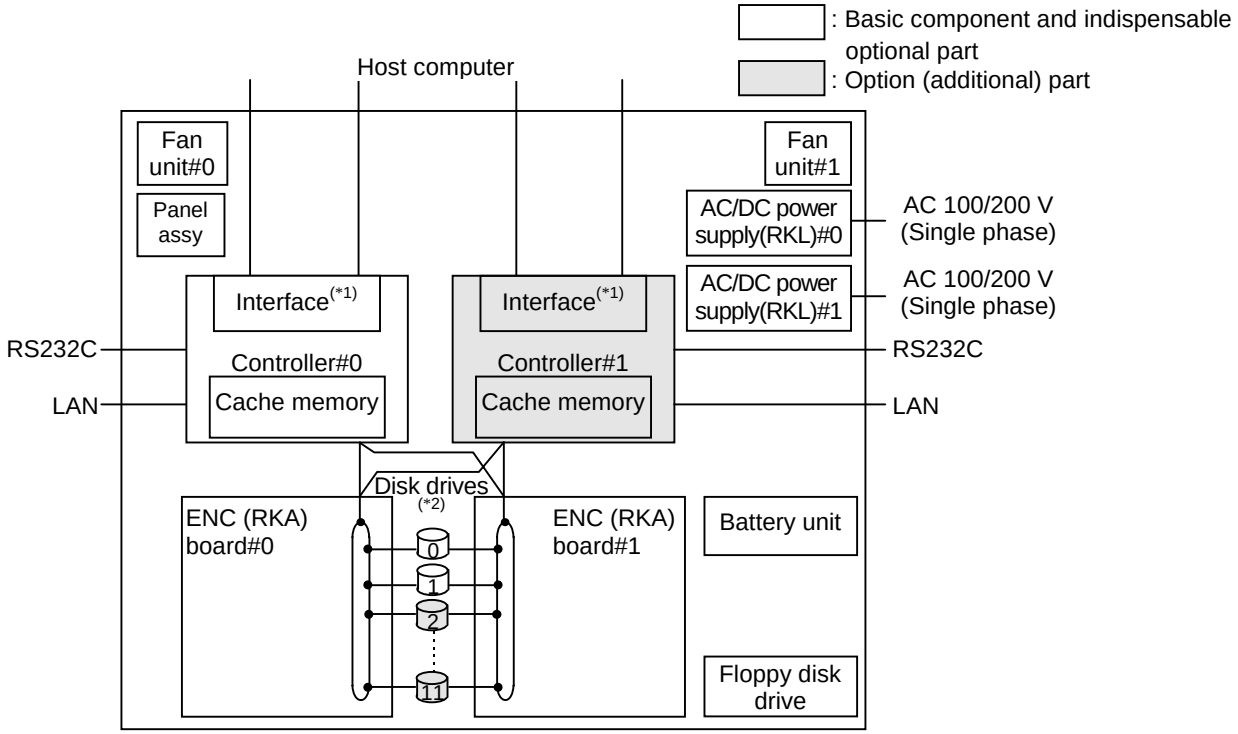
‡1 : No Spare disk can be set for the Disk drives #0 and #1 of the RK, RKA, and RKL.




*1 : Disk drive :
DF-F500-AAF8, DF-F500-AAF18, DF-F500-AAH18, DF-F500-AAF36, or DF-F500-AAF72

**Figure 2.3.19 System Configuration Block Diagrams of the RKA**

(2) Configuration of RKL




*1 : Interface (mounted in the Controller) : Fibre Channel (Non-OFC) or SCSI (LVD/single-end, HVD)

*2 : Disk drive :

DF-F500-ACF8, DF-F500-ACH18, DF-F500-ACF36, or DF-F500-ACF72

**Figure 2.3.20 System Configuration Block Diagrams of the MK/RKL**

### 2.3.4 Configuration of rackmount model with U6 rack frame

The DF-F500-U6 is an exclusive rack frame for mounting a combination of the RK (6 EIA units high) and the RKA(s) (3.5 EIA units high each) up to a height of 38 EIA units(‡1, ‡2). It can mount up to nine RKLs (4 EIA units high each), that is, up to a height of 36 EIA units.
It consists of a rack frame main body and PDBs to be used to supply AC power to power supply units of the mounted RK(s), RKA(s), and RKL(s). The four PDBs are installed to allow the power system to be duplicated.

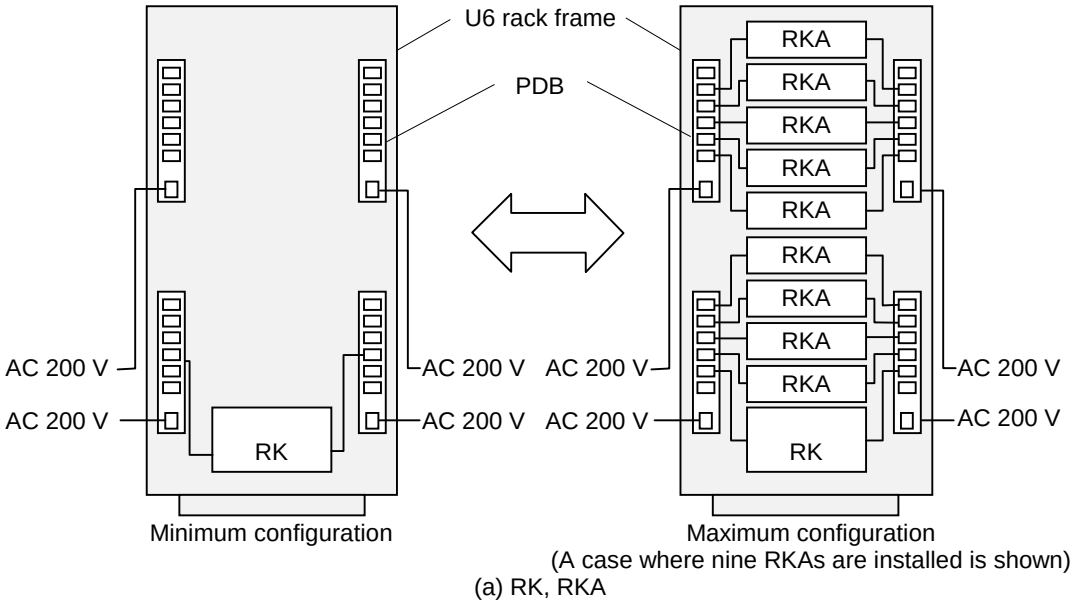



**Figure 2.3.21 System Configuration of Rackmount Model with U6 Rack Frame**

‡1 : At least one RK is required per system.

‡2 : The RK is to be mounted in the lowermost position of the rack frame. When connecting the RKA(s), mount it (them) above the RK, all adjacently to each other.

### 2.3.5 Configuration of rackmount model with U4 rack frame

The DF-F500-U4 is an exclusive rack frame for mounting a combination of the RK (6 EIA units high) and the RKA(s) (3.5 EIA units high each) up to a height of 32 EIA units(‡1, ‡2). It can mount up to five(‡3) RKLs (4 EIA units high each), that is, up to a height of 20 EIA units.
It consists of a rack frame main body and PDBs to be used to supply AC power to power supply units of the mounted RK(s) and RKA(s). The two PDUs are installed to allow the power system to be duplicated.

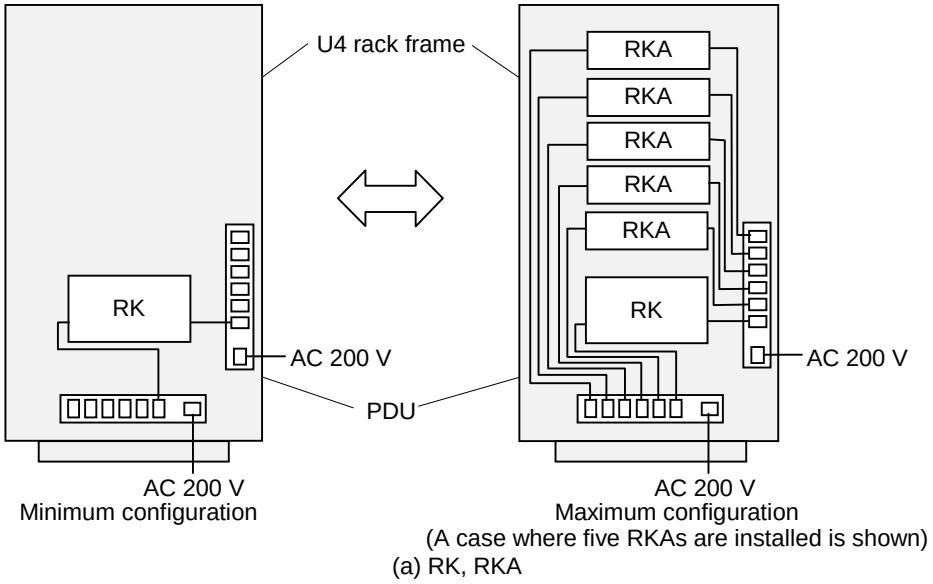



**Figure 2.3.22 System Configuration of Rackmount Model with U4 Rack Frame**

‡1 : At least one RK is required per system.

‡2 : The RK is to be mounted in the lowermost position of the rack frame. When connecting the RKA(s), mount it (them) above the RK, all adjacently to each other.

‡3 : Up to the seven RKLs can be mounted through an addition of the UPDU (optional).

## 2.4 Indications and their Functions

### 2.4.1 Indications and their functions of the RK/RKA and RKL

Figures 2.4.1 to 2.4.3 show locations of indications on the front bezel and those of functional components of the floor model H1F/H2F, RK and RKA respectively. Concerning the fllor model MK and RKL, locations of indication on the front bezel and those of functional components are shown in Figures 2.4.4 and 2.4.5 respectively. Further, functions of the indication are explained in Table 2.4.1.

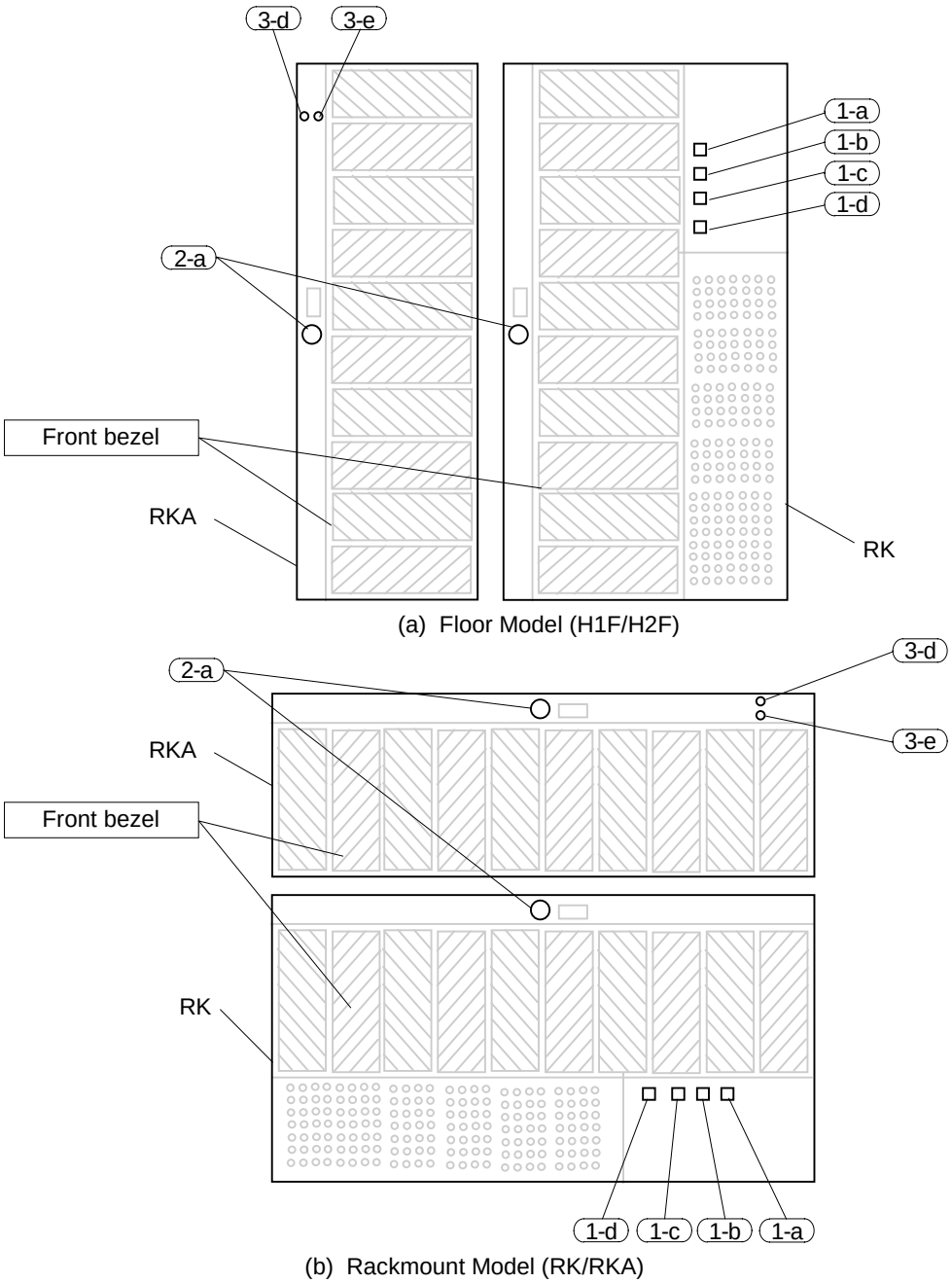



**Figure 2.4.1 Indication Locations of Front Bezel (H1F/H2F/RK/RKA)**

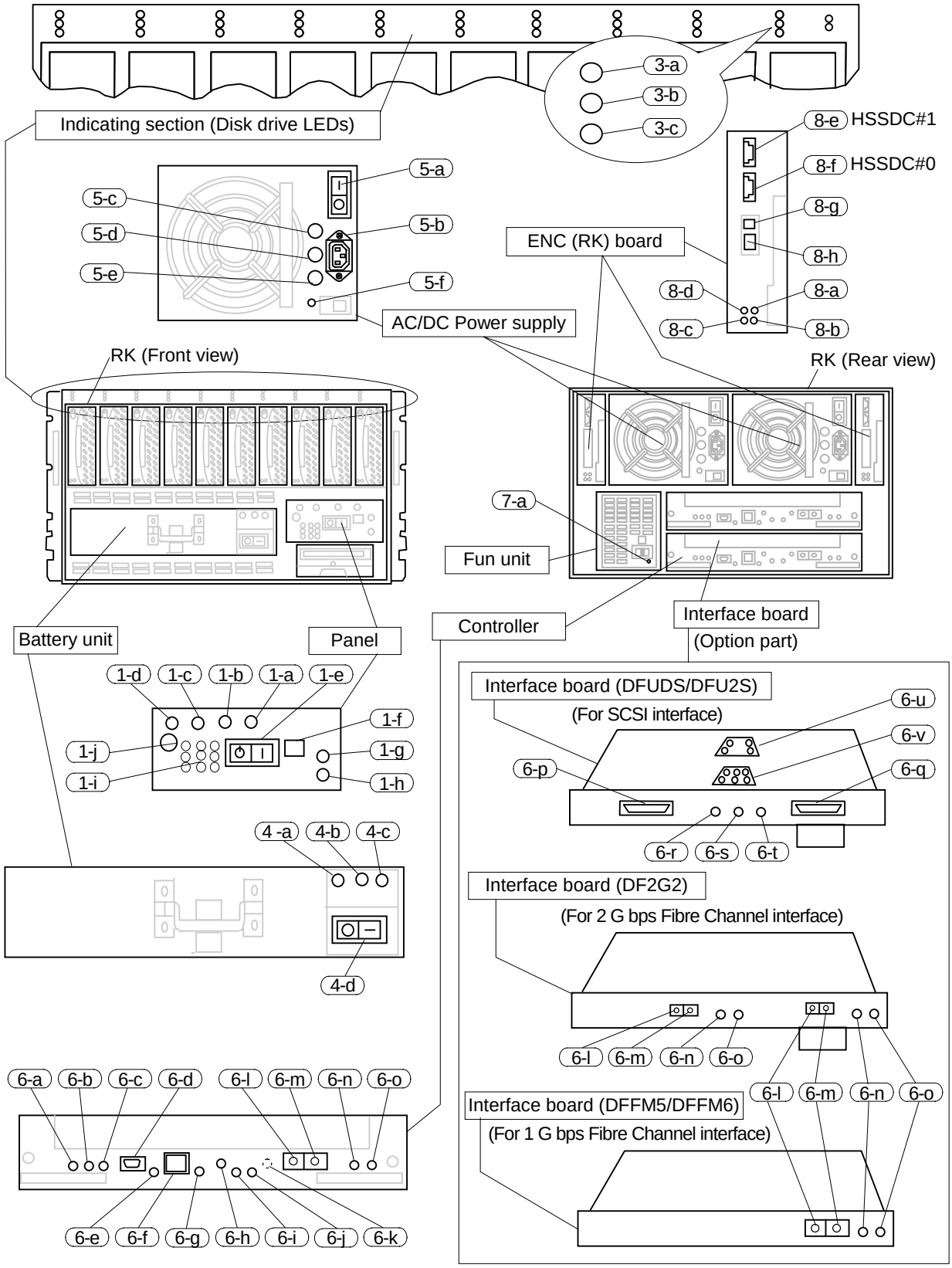



**Figure 2.4.2 Indication Locations of Functional Components (RK)**

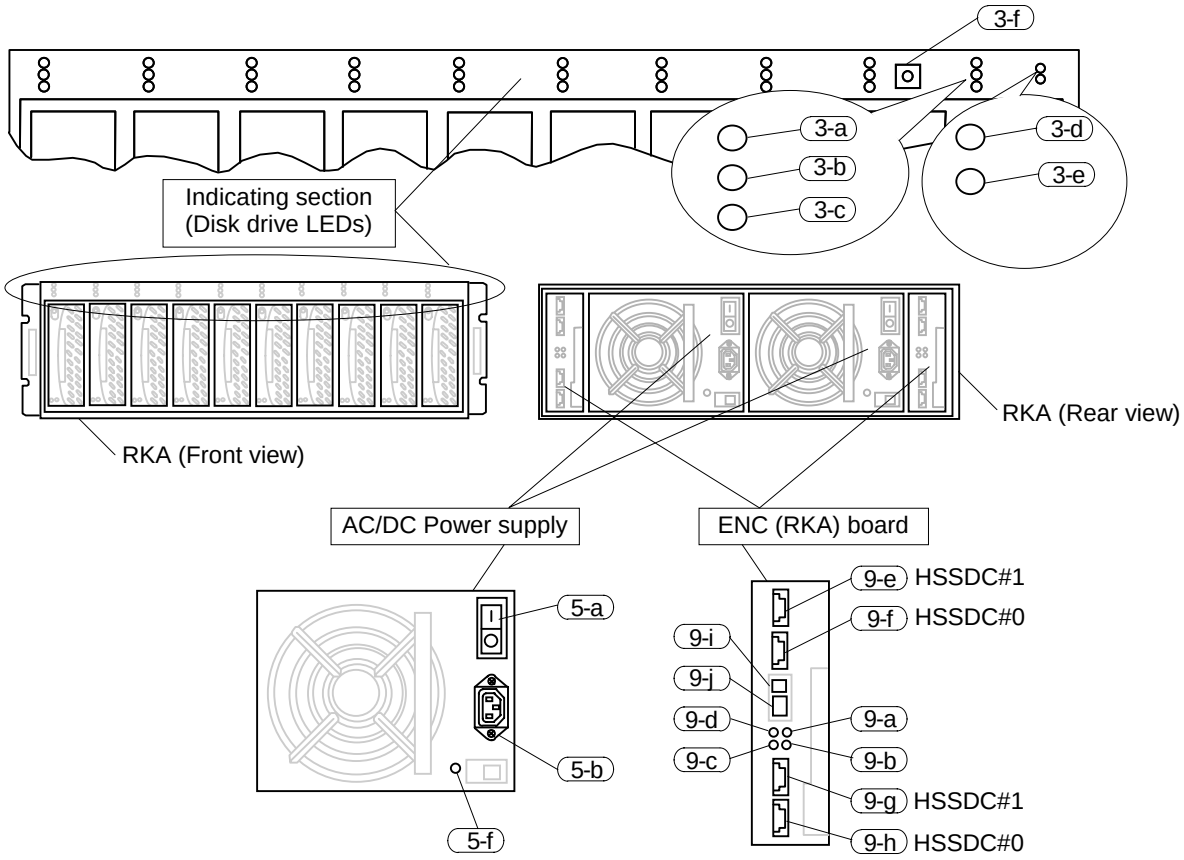
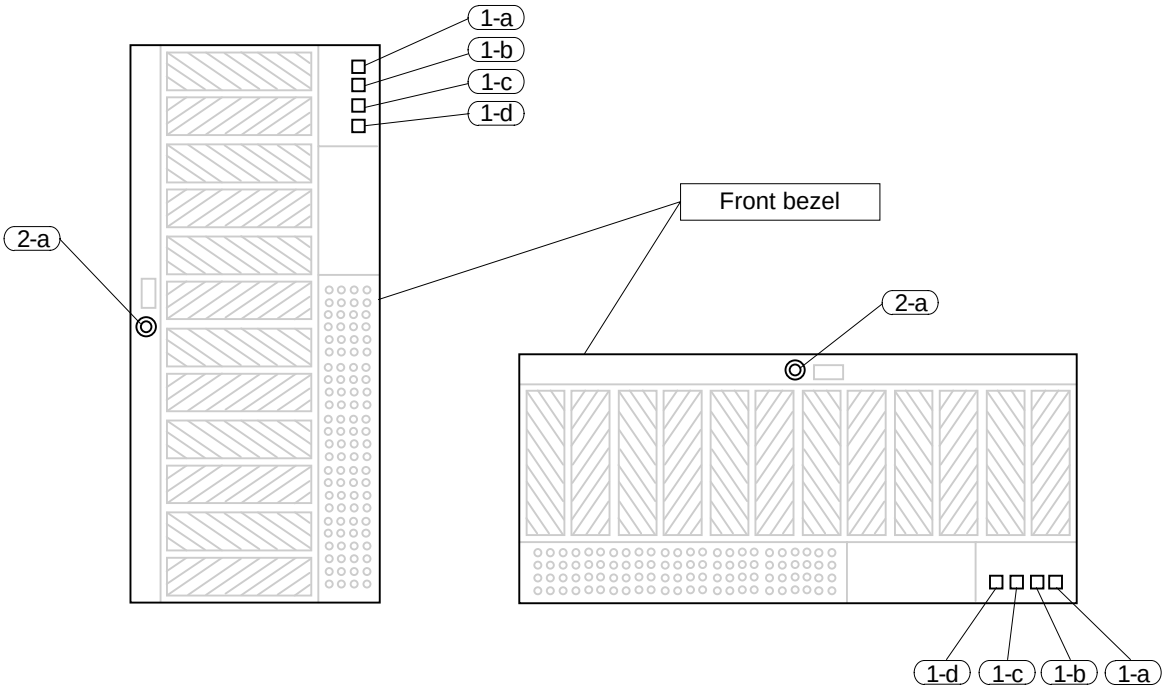



**Figure 2.4.3 Indication Locations of Functional Components (RKA)**




(a) Floor Model (MK) (b) Rackmount Model (RKL)

**Figure 2.4.4 Indication Locations of Front Bezel (MK/RKL)**

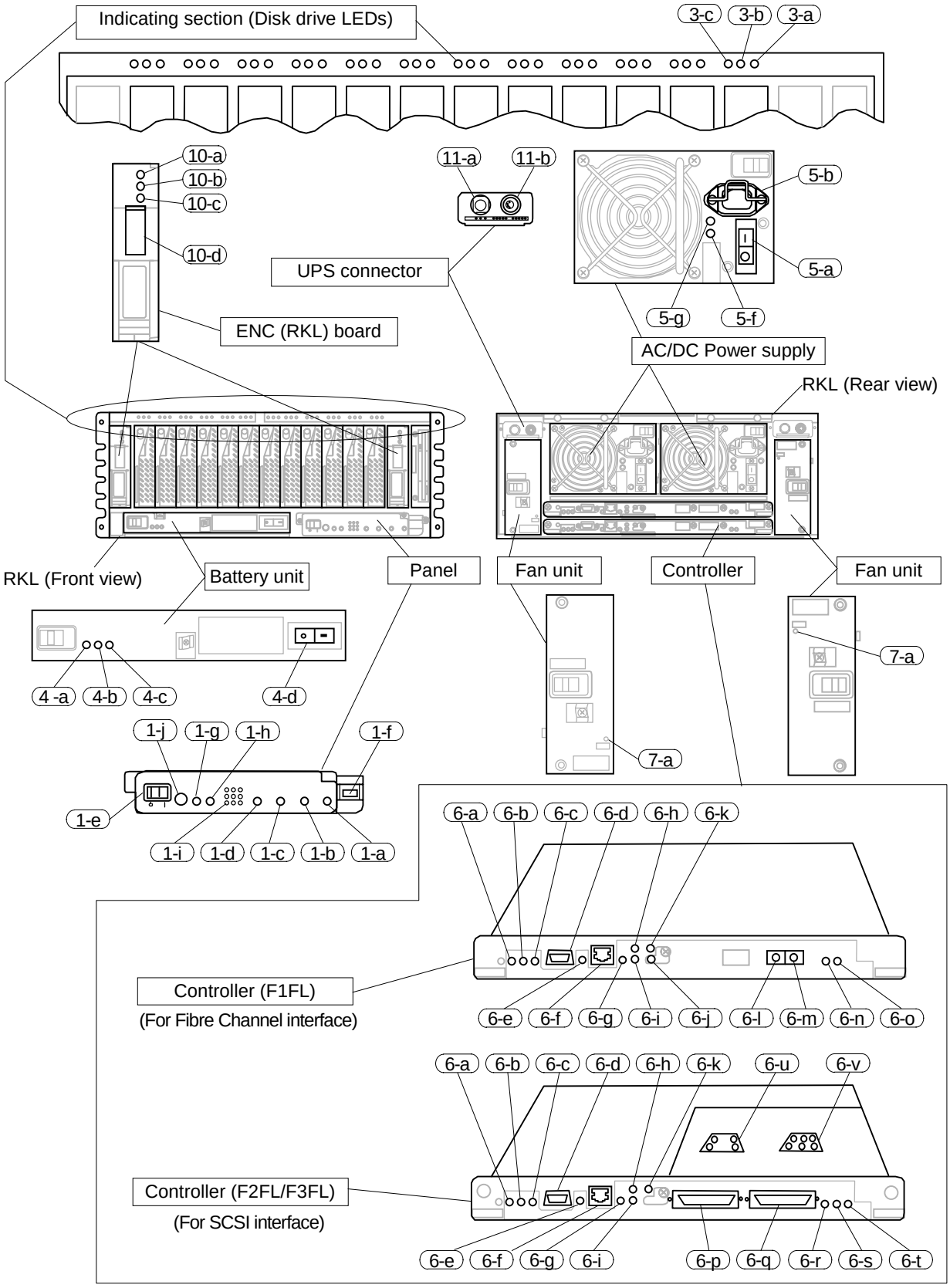
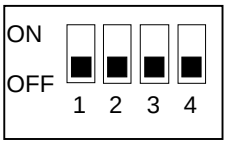


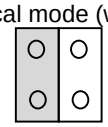

**Figure 2.4.5 Indication Locations of Functional Components (RKL)**

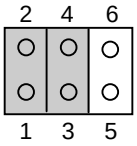
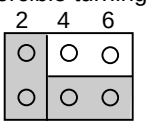
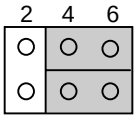
## Table 2.4.1 Functions of Indications

| No. | Section | Name | Classification | Color | Function |
|---|---|---|---|---|---|
| 1-a | Panel/ Front bezel | POWER | LED | Green | Indicates that the power is spplied to the subsystem. |
| 1-b | | READY | LED | Green | Indicates that the subsystem can be operated. |
| 1-c | | WARNING | LED | Orange | Indicates that a failure which allows the subsystem operation occurred. |
| 1-d | | ALARM | LED | Red | Indicates that a failure occurred which makes the subsystem unable to operate. |
| 1-e | | Main switch | Switch | — | Turns on/off the power.<br>\| : Power on<br>⏻ : Power off |
| 1-f | | DIP switch 1 | Switch | — | Sets the local/remote mode by the combination of turning on and off of the four mode switches.<br>  <br><br>The details of each local/remote mode and corresponding operation mode are shown in Table 2.4.2. |
| 1-g | | TRACE | LED | Orange | Lights while a trace is being executed. |
| 1-h | | FDD | LED | Orange | Lights while the Floppy disk drive is operating. |
| 1-i | | Buzzer | Buzzer | — | Sounds alarm beep when a failure occurs, an alarm sound is emitted. |
| 1-j | | TRACE SW / BUZZER OFF SW | Switch | — | Pressing of this switch while the buzzer sounds stops the beep.<br>Pressing of this switch in the statein which an Floppy disk drive is inserted in the starts a trace. |
| 2-a | Front bezel | KEY | Key | — | Locks the front bezel. |
| (1-a) | | POWER | LED | Green | Indicates that the power is spplied to the subsystem. |
| (1-b) | | READY | LED | Green | Indicates that the subsystem can be operated. |
| (1-c) | | WARNING | LED | Orange | Indicates that a failure which allows the subsystem operation occurred. |
| (1-d) | | ALARM | LED | Red | Indicates that a failure occurred which makes the subsystem unable to operate. |
| (3-d) | | POWER | LED | Green | Indicates that the power is applied to the RKA. |
| (3-e) | | WARNING | LED | Orange | Indicates that a failure which does not allow the RKA subsystem operation occurs. |

<table>
<tr><th>No.</th><th>Section</th><th>Name</th><th>Classification</th><th>Color</th><th>Function</th></tr>
<tr><td>3-a</td><td>Disk drive Panel</td><td>ACTIVE</td><td>LED</td><td>Green</td><td>
<table>
<tr><th>No.</th><th>LED status</th><th>Meaning</th></tr>
<tr><td>1</td><td>Blinking</td><td>Shows that the Disk drive is being accessed.</td></tr>
<tr><td>2</td><td>On</td><td>Spin up state.</td></tr>
<tr><td>3</td><td>Off</td><td>During seek on.</td></tr>
</table>
</td></tr>
<tr><td>3-b</td><td></td><td>SPARE</td><td>LED</td><td>Orange</td><td>Indicates that the corresponding Disk drive is assigned as a Spare disk.</td></tr>
<tr><td>3-c</td><td></td><td>FAIL</td><td>LED</td><td>Red</td><td>Indicates that a failure which makes the Disk drive unable to operate occurred.</td></tr>
<tr><td>3-d</td><td></td><td>POWER</td><td>LED</td><td>Green</td><td>Indicates that the power is applied to the RKA.</td></tr>
<tr><td>3-e</td><td></td><td>WARNING</td><td>LED</td><td>Orange</td><td>Indicates that a failure which allows the RKA operation occurred.</td></tr>
<tr><td>3-f</td><td></td><td>ID</td><td>Switch</td><td>—</td><td>Sets the device ID (1 to 9(*1)) of the RKA.</td></tr>
<tr><td>4-a</td><td>Battery unit</td><td>FAIL</td><td>LED</td><td>Red</td><td>Lights when the Battery unit is in trouble.<br>• The battery is not installed.<br>• The battery switch is turned off<br>• Battery boltage is lower than 5.7 V or higher than 7.0 V.<br>• Battery charging boltage is abnormal.<br>• Battery usable term may expired(*2).</td></tr>
<tr><td>4-b</td><td></td><td>CHARGE</td><td>LED</td><td>Orange</td><td>Shows that the battery is being charged (the LED is on) or the voltage level after a charge is being monitored (the LED blinks for 30 minutes.).</td></tr>
<tr><td>4-c</td><td></td><td>READY</td><td>LED</td><td>Green</td><td>Shows the state of the battery.<br>On : Normal<br>• Battery voltage is normal (6.0 V to 7.0 V).<br>Blinking : Warning of charged capacity<br>• Battery voltage is low (5.7 v to 6.0 V).<br>Off : Abnormal<br>• The battery switch is turned off.<br>• The battery is not installed.<br>• Battery voltage is abnormal (lower than 5.7 V or higher than 7.0).<br>• Battery usable term may expired(*2).</td></tr>
<tr><td>4-d</td><td></td><td>BATTERY Switch</td><td>Switch</td><td>—</td><td>Turns on/off of the battery power.<br>When this switch is set to the off, the WARNING LED comes on and the buzzer sounds.<br>| : Power on<br>○ : Power off</td></tr>
<tr><td colspan="6">*1 : “0” is used for the RK in default.<br>*2 : The battery voltage is not recovered after it has been recharged for 24 hours.</td></tr>
</table>

| No. | Section | Name | Classification | Color | Function |
|---|---|---|---|---|---|
| 5-a | AC/DC power supply | Breaker (CB1) | Switch | — | Controls the power applied to the subsystem.<br>\| : Power on<br>○ : Power off |
| 5-b | | Receptor (J1) | Connector | — | Connector on the subsystem side to connect the power cable. |
| 5-c | | Connector for connecting the UPS interlocking cable (J4) | Connector | — | Used to connect the UPS for the DF500. |
| 5-d | | Connector for connecting the Remote adapter (J2) | Connector | — | Used to connect the Remote adapter. |
| 5-e | | Connector for connecting the HITRACK (J3) | Connector | — | Used to connects the HITRACK. |
| 5-f | | PS RDY | LED | Green | Shows the operation state of the AC/DC power supply.<br>On : Normal operation<br>Off : Abnormal operation or out of operation |
| 5-g | | ALARM | LED | Red | Lights when the AC/DC power supply is in trouble. |
| 6-a | Controller/ Interface board | BACK UP | LED | Green | You can check whether the Cache memory is being backed up through indication of this LED. This LED is effective when the breaker is turned on<br>On : Indicates that the cache is being backed up. (The power is supplied from the battery to the Cache memory.)<br>Off : The Cache memory is not backed up. |
| 6-b | | FAIL | LED | Red | Indicates that a failure which makes in the Controller unable to operate occurred in it. |
| 6-c | | RESET | LED | Orange | Indicates that the Controller is being reset.<br>• During power-on reset<br>• During reset for doing a dump<br>• During reset for a reboot at the time of a microprogram down load |
| 6-d | | RS232C | Connector | — | Connects the RS232C cable. |
| 6-e | | LINK | LED | Green | Indicates that the link status of the LAN is normal. |
| 6-f | | LAN | Connector | — | Connects the LAN cable. |
| 6-g | | ACTIVE | LED | Green | Indicates that data is being transferred via a LAN. |
| 6-h | | SRST switch | Switch | — | Used to perform a memory dump. |
| 6-i | | SRST | LED | Red | Comes on when the SRST switch is pressed. |

| No. | Section | Name | Classification | Color | Function |
|---|---|---|---|---|---|
| 6-j | Controller/ | HRST | LED | Red | Comes on when the HRST switch is pressed. |
| 6-k | Interface board | HRST switch | Switch | — | Used when a memory dump cannot be done by the SRST switch. |
| 6-l | | Tx | Connector | — | Connector on the signal output side to connect the Fibre Channel interface cable. |
| 6-m | | Rx | Connector | — | Connector on the signal input side to connect the Fibre Channel interface cable. |
| 6-n | | GP1 | LED | Green | Shows status of the standard Interface board mounted on the Controller. |
| 6-o | | GP0 | LED | Green | Shows status of the standard Interface board mounted on the Controller. |
| 6-p | | SCSI IN | Connector | — | Connects the SCSI interface cable for input signals. |
| 6-q | | SCSI OUT | Connector | — | Connects the SCSI interface cable for output signals. |
| 6-r | | FAIL | LED | Red | This LED lights in red when an incorrect I/F type is connected.<br>It is off in a normal state. |
| 6-s | | TMP | LED | Green | This LED lights in green when the terminator power is being supplied.<br>If it is off when the power is internally supplied, it means that a failure has occurred.<br>When the power is supplied from outside, it shows a normal state even if the LED is off. |
| 6-t | | TM ON | LED | Green | This LED lights in green when the automatic terminating function operates. |
| 6-u | | Jumper JP1A | Jumper socket | — | Local mode (with self-supplied power):<br>  <br><br>Powering on/off of the subsystem is locally controlled (setting at the shipment from the factory).<br>+5V terminator power is supplied by the DF500 and a host computer. |
| | | | | | Remote mode (with externally supplied power):<br>  <br><br>Powering on/off of the subsystem is remotely controlled by means of the turning on/off of the terminator power.<br>+5V terminator power is supplied only from the power supply of a host computer. |

| No. | Section | Name | Classification | Color | Function |
|---|---|---|---|---|---|
| 6-v | Controller/ Interface board | Jumper JP2A | Jumper socket | — | Sets the mode of the terminator.<br>One of the following three modes can be set, that is, Automatic Switching mode, Forcible On mode, and Forcible Off mode. |
| | | | | | Automatic Switching mode (TM AUTO) : (default setting)<br>  <br><br>The terminator can be switched automatically. When a cable is connected to the half-pitch connector OUT (SCSI OUT), the terminator is turned off automatically. |
| | | | | | Forcible turning on mode (TM ON) :<br>  <br><br>Turns on the terminator forcibly irrespective of whether the cable is connected to the the half-pitch connector OUT (SCSI OUT) or not. |
| | | | | | Forcible turning off mode (TM OFF) :<br>  <br><br>Turns on the terminator forcibly irrespective of whether the cable is connected to the the half-pitch connector OUT (SCSI OUT) or not. |
| 7-a | Fan unit | FAIL | LED | Red | Shows the state of the Fan unit.<br>On : Abnormal<br>Off : Normal |

<table>
<tr><th>No.</th><th>Section</th><th>Name</th><th>Classification</th><th>Color</th><th>Function</th></tr>
<tr><td>8-a</td><td>ENC (RK) board</td><td>FAIL</td><td>LED</td><td>Red</td><td>Indicates that a failure that makes in the ENC (RK) board unable to operate occurred in it.</td></tr>
<tr><td>8-b</td><td></td><td>CHECK</td><td>LED</td><td>Red</td><td>Shows voltage error factors by means of a number of times of blinking.<br>Once : Logic +5 V voltage is abnormal.<br>Twice : Drive +12 V voltage is abnormal.<br>Three times : Logic +3.3 V voltage is abnormal.<br>Five times : Battery voltage is abnormal.<br>Six times : Voltage on the Controller is abnormal. (Reset of the Controller is not canceled.)</td></tr>
<tr><td>8-c</td><td></td><td>LINK 1</td><td>LED</td><td>Green</td><td>Indicates that the link status of the FC-AL (loop 1 side) is normal.</td></tr>
<tr><td>8-d</td><td></td><td>LINK 0</td><td>LED</td><td>Green</td><td>Indicates that the link status of the FC-AL (loop 0 side) is normal.</td></tr>
<tr><td>8-e</td><td></td><td>HSSDC 1</td><td>Connector</td><td>—</td><td>For RKA connects the FC-AL (loop 1 side). (Output)</td></tr>
<tr><td>8-f</td><td></td><td>HSSDC 0</td><td>Connector</td><td></td><td>For RKA connects the FC-AL (loop 0 side). (Output)</td></tr>
<tr><td>8-g</td><td></td><td>Jumper switch (JP1A)</td><td>Switch</td><td>—</td><td>8 ○ ○ 7<br>6 ○ ○ 5<br>4 ○ ○ 3<br>2 ○ ○ 1<br><table><tr><th colspan="2">Type</th><th>RK</th></tr><tr><th colspan="2">Pin No.</th><th>Meaning</th></tr><tr><td>1-2</td><td>-</td><td>Not used.</td></tr><tr><td>3-4</td><td>-</td><td>Not used.</td></tr><tr><td>5-6</td><td>Short circuit</td><td>Lowers all voltages output from the power supplies by 5%.</td></tr><tr><td>7-8</td><td>Short circuit</td><td>Raises all voltages output from the power supplies by 5%.</td></tr></table></td></tr>
<tr><td>8-h</td><td>ENC (RK) board</td><td>Output pin (J30)</td><td>Pin</td><td>—</td><td><table><tr><th>Pin No.</th><th>Meaning</th></tr><tr><td>1</td><td>BS+5 V</td></tr><tr><td>2</td><td>BS+12 V</td></tr><tr><td>3</td><td>Terminator voltage</td></tr><tr><td>4</td><td>—</td></tr><tr><td>5</td><td>Logic +3.3 V</td></tr><tr><td>6</td><td>—</td></tr><tr><td>7</td><td>Logic +5 V</td></tr><tr><td>8</td><td>—</td></tr><tr><td>9</td><td>—</td></tr><tr><td>10</td><td>—</td></tr><tr><td>11</td><td>Battery voltage</td></tr><tr><td>12</td><td>—</td></tr><tr><td>13</td><td>—</td></tr><tr><td>14</td><td>Drive +12 V</td></tr><tr><td>15</td><td>UPS +5 V (UPS voltage)</td></tr><tr><td>16</td><td>GND</td></tr></table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Section</th><th>Name</th><th>Classification</th><th>Color</th><th>Function</th></tr>
<tr><td>9-a</td><td>ENC (RKA) board</td><td>FAIL</td><td>LED</td><td>Red</td><td>Indicates that a failure that makes in the ENC (RKL) board unable to operate occurred in it.</td></tr>
<tr><td>9-b</td><td></td><td>CHECK</td><td>LED</td><td>Red</td><td>Shows voltage error factors by means of a number of times of blinking.<br>Once : Logic +5 V voltage is abnormal.<br>Twice : Drive +12 V voltage is abnormal.<br>Three times : Logic +3.3 V voltage is abnormal.<br>Five times : Battery voltage is abnormal.<br>Six times : Voltage on the Controller is abnormal. (Reset of the Controller is not canceled.)</td></tr>
<tr><td>9-c</td><td></td><td>LINK 1</td><td>LED</td><td>Green</td><td>Indicates that the link status of the FC-AL (loop 1 side) is normal.</td></tr>
<tr><td>9-d</td><td></td><td>LINK 0</td><td>LED</td><td>Green</td><td>Indicates that the link status of the FC-AL (loop 0 side) is normal.</td></tr>
<tr><td>9-e</td><td></td><td>HSSDC 1</td><td>Connector</td><td>—</td><td>For RKA connects the FC-AL (loop 1 side). (Input)</td></tr>
<tr><td>9-f</td><td></td><td>HSSDC 0</td><td>Connector</td><td></td><td>For RKA connects the FC-AL (loop 0 side). (Input)</td></tr>
<tr><td>9-g</td><td></td><td>HSSDC 1</td><td>Connector</td><td>—</td><td>For RK/RKA connects the FC-AL (loop 1 side). (Output)</td></tr>
<tr><td>9-h</td><td></td><td>HSSDC 0</td><td>Connector</td><td></td><td>For RK/RKA connects the FC-AL (loop 0 side). (Output)</td></tr>
<tr><td>9-i</td><td></td><td>Jumper switch (JP1)</td><td>Switch</td><td>—</td><td>4 ○ ○ 3<br>2 ○ ○ 1<br><table><tr><th colspan="2">Type</th><th>RKA</th></tr><tr><th colspan="2">Pin No.</th><th>Meaning</th></tr><tr><td>1-2</td><td>Short circuit</td><td>Lowers all voltages output from the power supplies by 5%.</td></tr><tr><td>3-4</td><td>Short circuit</td><td>Raises all voltages output from the power supplies by 5%.</td></tr></table></td></tr>
<tr><td>9-j</td><td></td><td>Output pin (J30)</td><td>Pin</td><td>—</td><td><table><tr><th>Pin No.</th><th>Meaning</th></tr><tr><td>1</td><td>Drive +5 V</td></tr><tr><td>2</td><td>Drive +12 V</td></tr><tr><td>3</td><td>—</td></tr><tr><td>4</td><td>—</td></tr><tr><td>5</td><td>Logic +3.3 V</td></tr><tr><td>6</td><td>—</td></tr><tr><td>7</td><td>Logic +2.5 V</td></tr><tr><td>8</td><td>GND</td></tr></table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Section</th><th>Name</th><th>Classification</th><th>Color</th><th>Function</th></tr>
<tr><td>10-a</td><td>ENC (RKL) board</td><td>LINK 1</td><td>LED</td><td>Green</td><td>Indicates that the link status of the FC-AL (loop 1 side) is normal.</td></tr>
<tr><td>10-b</td><td></td><td>FAIL</td><td>LED</td><td>Red</td><td>Indicates that a failure that makes in the ENC (RKA) board unable to operate occurred in it.</td></tr>
<tr><td>10-c</td><td></td><td>CHECK</td><td>LED</td><td>Red</td><td>Shows voltage error factors by means of a number of times of blinking.<br>Once : Logic +5 V voltage is abnormal.<br>Twice : Drive +12 V voltage is abnormal.<br>Three times : Logic +3.3 V voltage is abnormal.<br>Five times : Battery voltage is abnormal.<br>Six times : Voltage on the Controller is abnormal.<br>(Reset of the Controller is not canceled.)</td></tr>
<tr><td>10-d</td><td></td><td>Output pin<br>(J30)</td><td>Pin</td><td>—</td><td><table><tr><th>Pin No.</th><th>Meaning</th></tr><tr><td>1</td><td>Logic +12 V</td></tr><tr><td>2</td><td>BS +12 V</td></tr><tr><td>3</td><td>Logic +5 V</td></tr><tr><td>4</td><td>BS +5 V</td></tr><tr><td>5</td><td>Logic +3.3 V</td></tr><tr><td>6</td><td>Battery voltage</td></tr><tr><td>7</td><td>UPS +5 V (UPS voltage)</td></tr><tr><td>8</td><td>Terminator voltage (only SCSI)</td></tr><tr><td>9</td><td>—</td></tr><tr><td>10</td><td>GND</td></tr><tr><td>11</td><td>—</td></tr><tr><td>12</td><td>GND</td></tr><tr><td>13</td><td>Lowers all voltages in the power supply by 5% when a short-circuit occurs between the pins 13 and 14.</td></tr><tr><td>14</td><td>GND</td></tr><tr><td>15</td><td>Lowers all voltages in the power supply by 5% when a short-circuit occurs between the pins 15 and 17.</td></tr><tr><td>16</td><td>GND</td></tr></table></td></tr>
<tr><td>11-a</td><td>UPS connector</td><td>Connector for connecting the UPS interlocking cable</td><td>Connector</td><td>—</td><td>This connector is used when connecting the UPS for the DF500.</td></tr>
<tr><td>11-b</td><td></td><td>Connector for connecting the Remote adapter</td><td>Connector</td><td>—</td><td>This connector is used when connecting the remote adapter.</td></tr>
</table>

## Table 2.4.2 Power Control Mode Settings and Corresponding Operation Modes

| No. | Mode switch (4 bits) | | | | Operation mode name | Operation mode |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | | |
| 1 | OFF | OFF | OFF | OFF | LOCAL | Local mode |
| 2 | ON | OFF | OFF | OFF | SCSI Remote | Remote mode using the SCSI terminator power. |
| 3 | OFF | ON | OFF | OFF | Fibre Channel Remote | Remote mode using the HOST AC (using remote adapter) power. |
| 4 | ON | ON | - | - | - | No Setup (No Power On) |
| 5 | ON | ON | ON | OFF | UPS Interlock mode 1 | Interlock mode 1 with an UPS exclusive for the subsystem<br>To set the mode, connect AC#0 and AC#1 to the UPS and an external and an external AC power supply or the PDB (PDU) of the U6 (U4) rack frame respectively. |
| 6 | ON | OFF | OFF | ON | UPS Interlock mode 2 | Interlocking mode 2 with an UPS exclusive for the subsystem<br>To set the mode connect AC#0 and AC#1 to the one UPS. |
| 7 | OFF | OFF | ON | ON | UPS Interlock mode 3 | Interlocking mode 3 with an UPS exclusive for the subsystem<br>To set the mode, connect each of AC#0 and AC#1 to the different UPSs. |

: Do not make this setting when the UPS is not connected.

## 2.5 Structure of Internal Power Supplying System

### 2.5.1 Internal power supplying system configuration

Figure 2.5.1, Figure 2.5.2, and Figure 2.5.3 shows the connection diagrams of the internal power supplying system of the RK, RKA, and RKL respectively.
Input power to the RK, RKA and RKL is supplied from the AC/DC power supply.
The two AC/DC power supply are installed as the standard to duplicate the power supplying system. By virtue of this, the subsystem can continue its operation even when a failure occurs in one of the AC/DC power supply or power cables.
Further, part replacement can be done while the subsystem is operating.

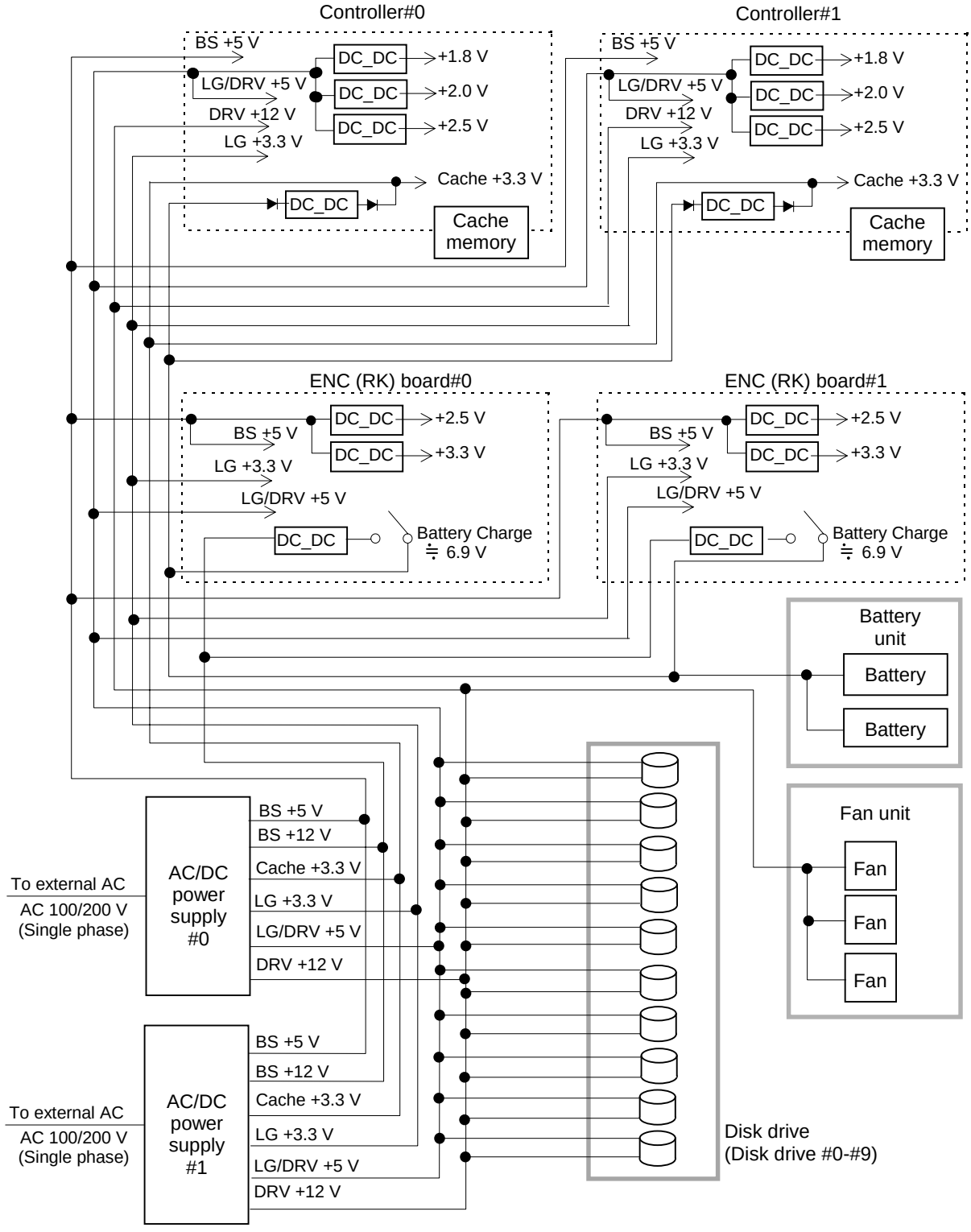



**Figure 2.5.1 Structure of Power Supplying System (RK)**

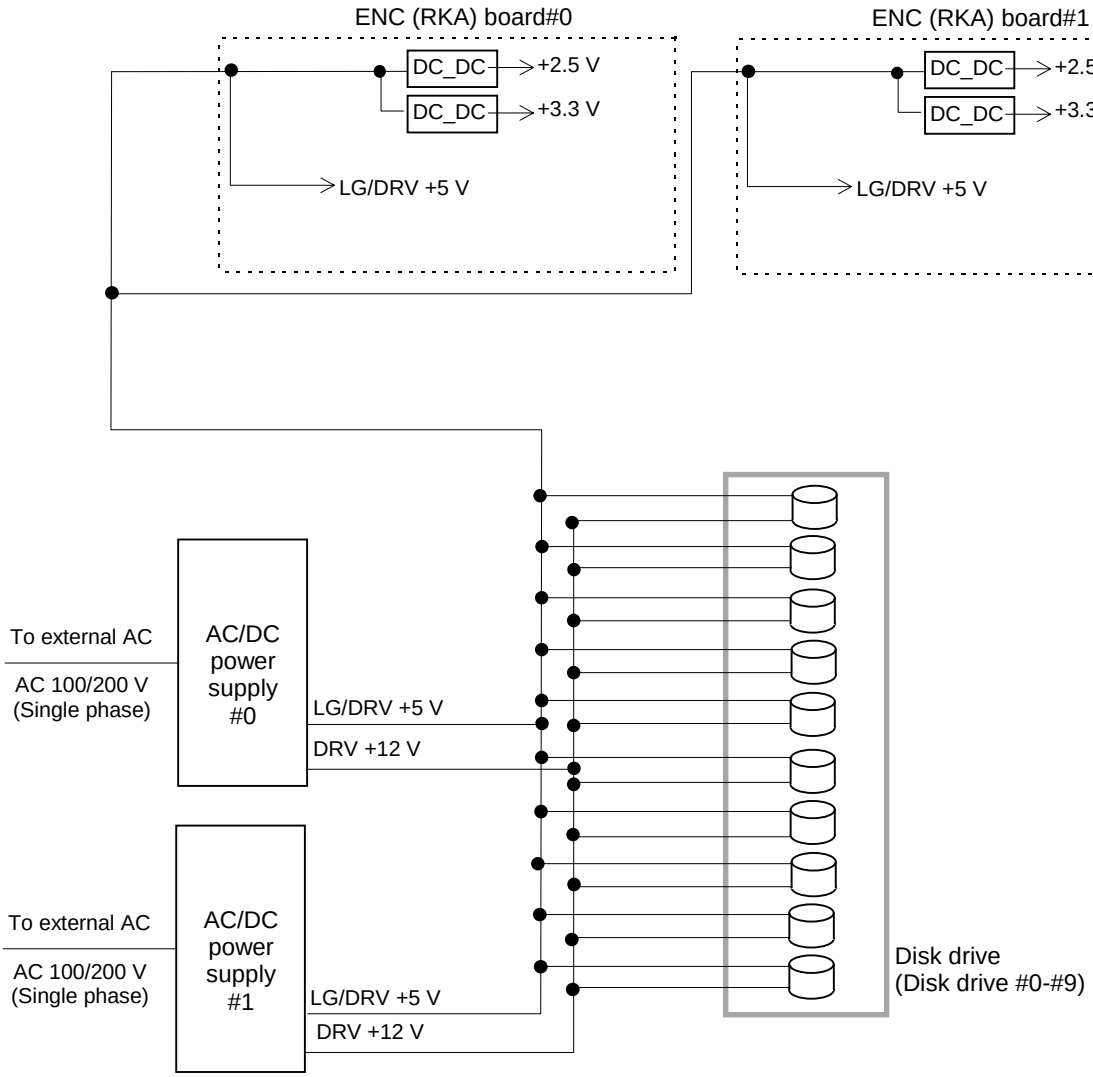



**Figure 2.5.2 Structure of Power Supplying System (RKA)**

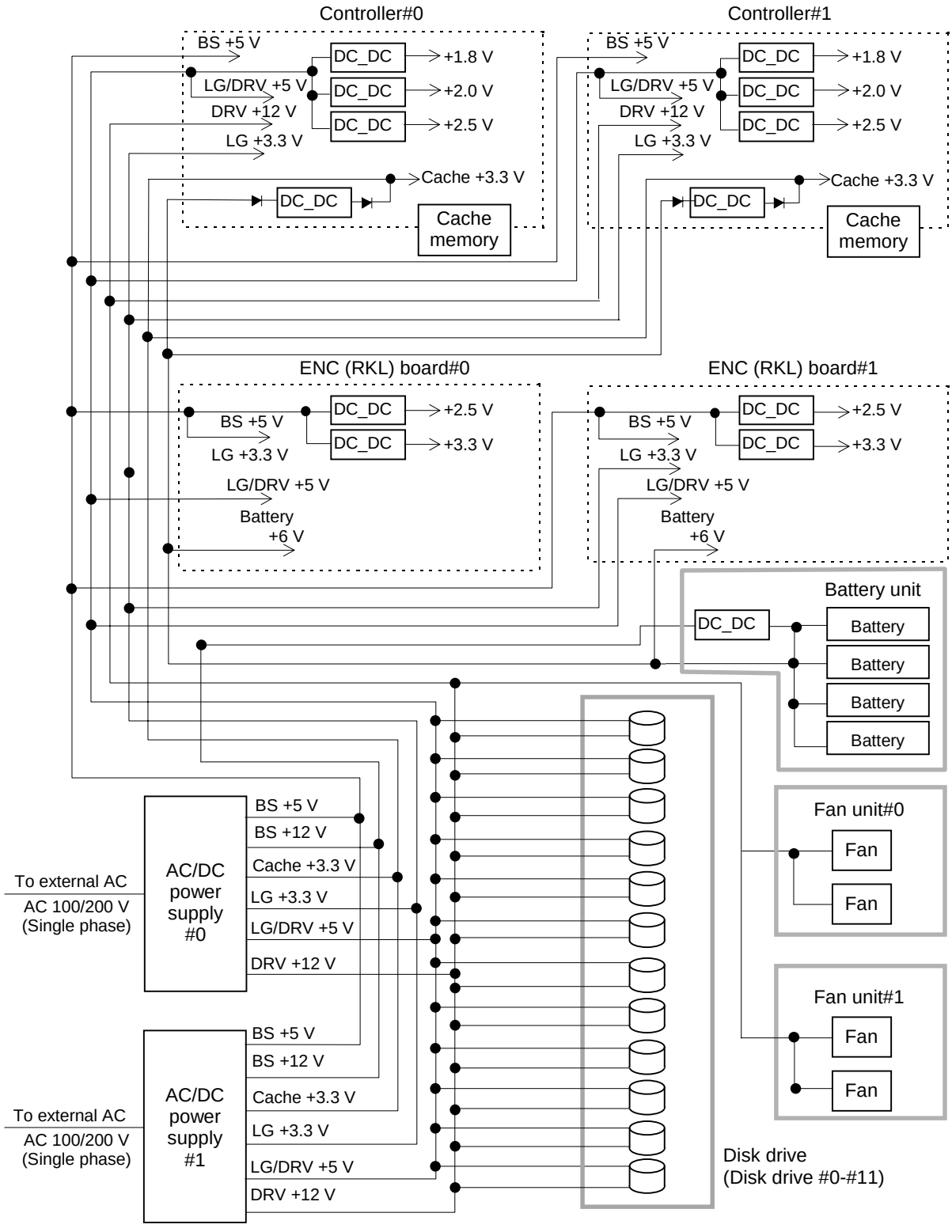



**Figure 2.5.3 Structure of Power Supplying System (RKL)**

## 2.6 Structure of Internal Data System

Figure 2.6.1, Figure 2.6.2, and Figure 2.6.3 shows the connection block diagram of the internal data system of the RK, RKA, and RKL respectively.

(1) Host interface

The RK and RKA subsystem adopts the PCI bus for its host interface and its Controller uses the Fibre Channel interface as the standard.

In the Fibre Channel configuration, the one Controller can have two ports. With the dual Controller configuration, the subsystem can have up to four Fibre Channel ports.

Besides, the subsystem can optionally have one port for the SCSI interface per Controller. It can be connected with up to the two ports when it is in the dual configuration.

A Controller is implemented in the RKL depending on the desired interface type.

A single Controller can be connected to one port.

(2) Cache memory backup

The Cache memory is backed up by the battery. Therefore, data in the Cache memory is maintained even when a sudden power failure or a power supply unit failure occurs.

(3) Spare disks

When an optional Spare disk(s) is set in the Disk drive group, the subsystem can continue the normal operation even when a Disk drive fails by restoring data on the Spare disk(s). Up to five Spare disks can be installed. In the case where the two or more Spare disks are set, the normal operation can be continued even when a Disk drive fails in addition to another Disk drive, thus high data reliability is assured.

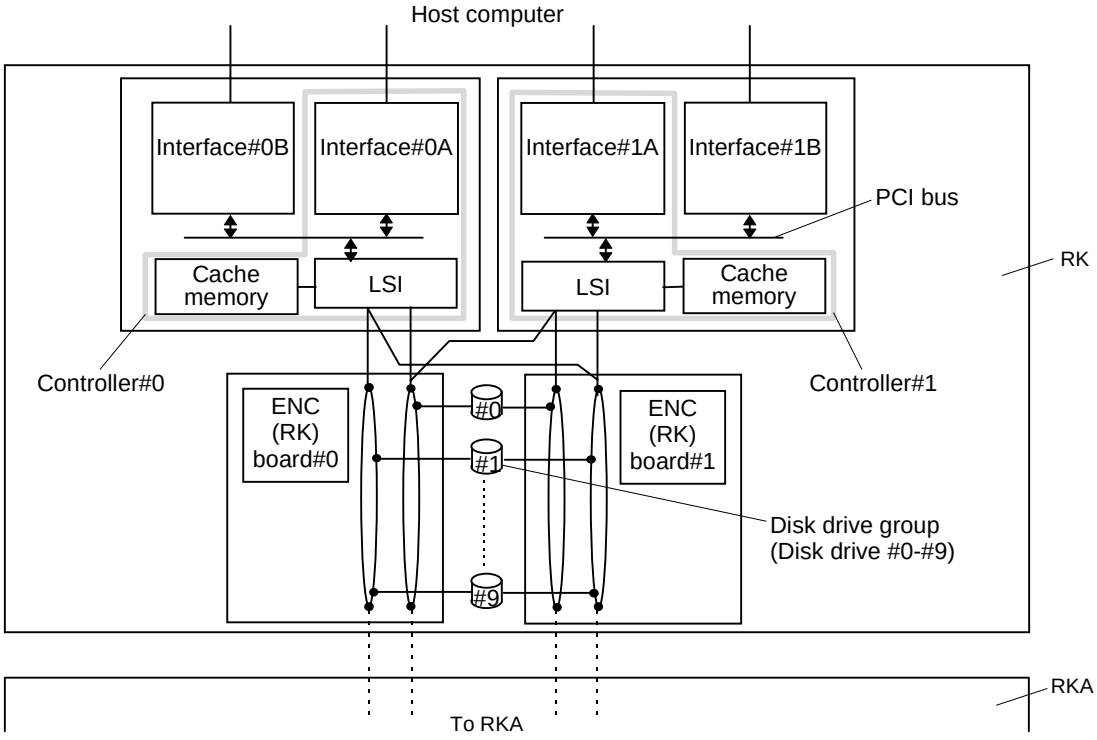



**Figure 2.6.1 Internal Data Connection of the RK**

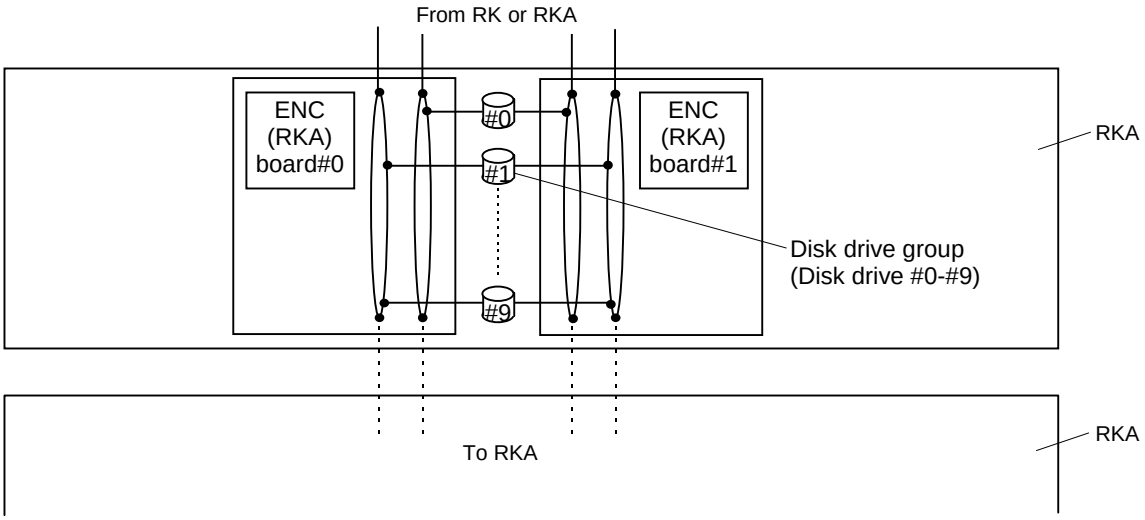



**Figure 2.6.2 Internal Data Connection of the RKA**

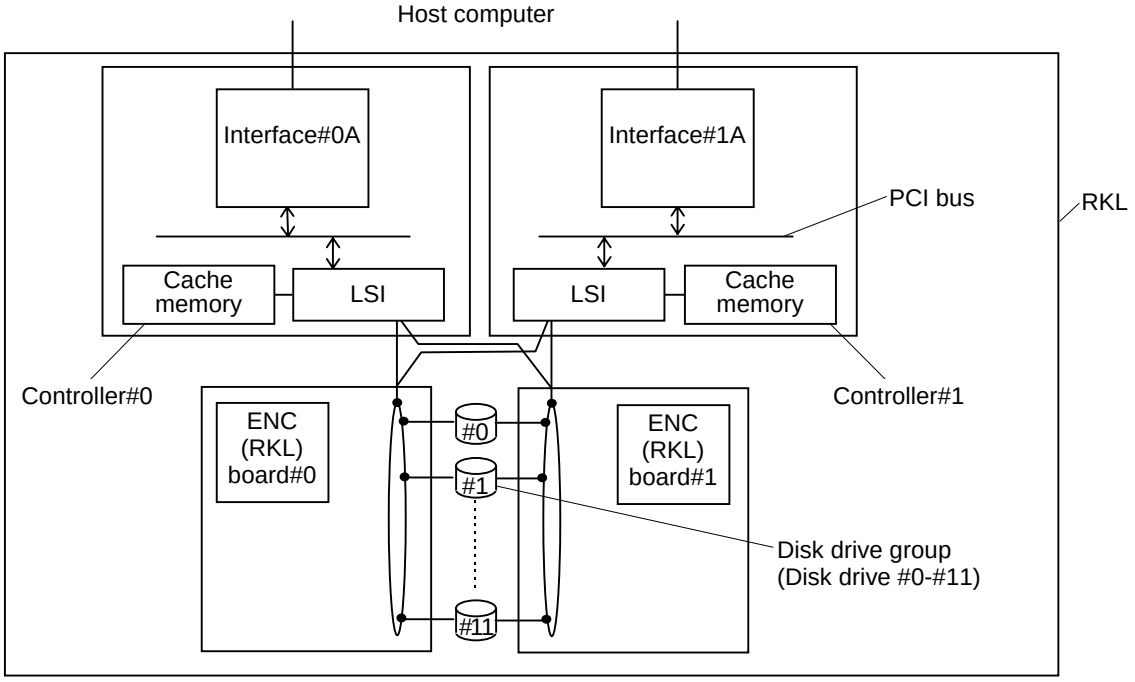
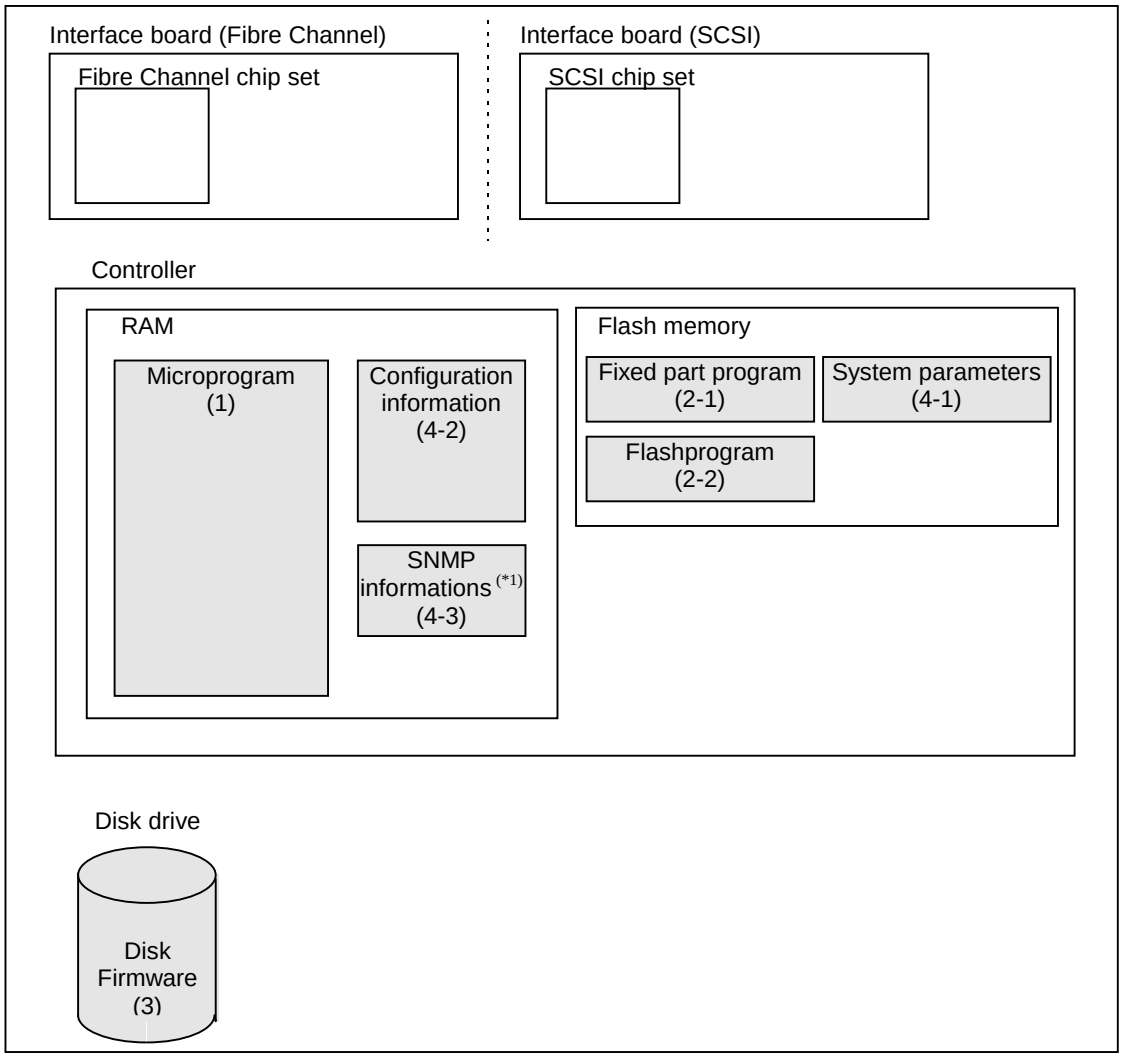



**Figure 2.6.3 Internal Data Connection of the RKL**

## 2.7 Structure of Software

### 2.7.1 Software structure list

The software structure is shown in Figure 2.7.1.
For the shaded portions in the figure, detailed explanations are given on the succeeding pages.




*1 : The SNMP information can be used when the SNMP function is validated by the DF-F500-WS.

**Figure 2.7.1 Software Structure**

(1) Microprograms
- These are programs that control.
- Their version numbers are controlled in the format of ××××/×.
- There are two types of microprograms shown below corresponding to as many usages.

| No. | Type of usage | Version | Supplying media |
|---|---|---|---|
| 1 | Fibre Channel | 055×/× (×:Optional) | Five FDs |
| 2 | SCSI | 050×/× (×:Optional) | Five FDs |

- "/×" in the version number may not be added or may be controlled by the other method.

(2) Flashprograms
- These are programs to start up the subsystem after powering on.

(2-1) Fixed part program

| No. | Name | Type |
|---|---|---|
| 1 | Fixed part program | A5F×/× (×:Optional) |

(2-2) Flashprogram

| No. | Name | Type |
|---|---|---|
| 1 | Flashprogram (Fibre Channel) (*1) | 055×/× (×:Optional) |
| 2 | Flashprogram (SCSI) (*1) | 050×/× (×:Optional) |
| *1 : This program and the microprogram are controlled unitarily. | | |

(3) Disk firmware
- You can also refer to even a version of firmware which the disk has independently. (You can do it by means of an online trace.)

(4) Parameter Information

The parameters are classified into the following three types for operating the subsystem.

(4-1) System parameters
- Parameters necessary for the subsystem start-up process from the turning on of the main switch to the coming on of the READY LED (green) are called system parameters. For the details of it, refer to the "for Installation Chapter 6 Parameter Setting" or "for Installation Chapter 9 Parameter Setting".
- The system parameters are stores in the flash memory. They can be backed up onto the backup FD. When the system parameter is changed, back it up onto the FD.

(4-2) Configuration information
- This is a piece of information on the configuration, such as the RAID configuration and LU capacity, for the subsystem to record user data.
- The configuration information exists on the Disk drives when the subsystem main switch is turned off, and is spread onto the RAM at the time when the main switch is turned on.
  When it is changed, that on the Disk drives are also changed.

(4-3) SNMP information

The SNMP information is a parameter for making the SNMP agent support function work effectively.

- When the SNMP information makes the SNMP agent support function effective, it edits the template on the SNMP EVA FD and registers the template with the subsystem.
  To update the information, edit the SNMP information on the SNMP EVA FD and register it with the subsystem.
  For the details of it, refer to the “SNMP Agent Support Function User’s Guide”.

## 2.7.2 Storages for parameter

The storages in which the parameters on the controller are stored are shown in Table 2.7.2.

**Table 2.7.2 Storages for Parameter**

| No. | Parameter | Storage | Description |
|---|---|---|---|
| 1 | • Fixed part program<br>• Flashprogram<br>• System parameters | Flash memory | • The parameters are stored in the flash memory. No provision of storage against a power shut off is required for the parameters because the flash memory can retain information even if a power is shut off.<br>• The parameters can be backed up to the following to provide against a trouble.<br>Fixed part program .....Cannot be backed up.<br>Flash program.....Automatically backed up to the system area.<br>System parameters.....Manually backed up to the backup FD. |
| 2 | • Microprogram<br>• Configuration information<br>• SNMP information | System area | • Generally, information in a RAM is erased when the main switch is turned off. Therefore, the subsystem also stores the parameters used on the RAM on the Disk drive. (An area is reserved in the Disk drive to store them. The area is called system area.)<br>• The system area is provided on the Disk drives #0 to #4 in the RK and RKL. Therefore, the system area has redundancy as far as the Disk drives #0 to #4 in the RK and RKL. |

# Chapter 3. Theory of Operation

This chapter explains the flow and format of data. It also explains the concrete data processing.

## 3.1 Power On/Off Sequence

### 3.1.1 IMPL sequence

The procedure for processing the IMPL executed when the subsystem is started is explained below. The IMPL sequence is broadly divided into four processes and they are executed sequentially.

(1) Boot loader
After the boot loader is booted from the flash memory, it executes the minimum CUDG and hardware initialization. Then, it loads the local memory loader from the flash memory to the local memory and transfers the control to the local memory loader.

(2) Local memory loader
The local memory loader performs the CUDG and hardware initialization which are necessary for loading the OS load module. It spins up all the installed Disk drives and loads the OS load module onto the local memory after it ascertains completion of the spin-up of the first group. After that, it transfers the control to the OS.

(3) OS
The OS initializes the table on the local memory for the communication between the tasks using the root task of the OS and generates the DF initialization task.

(4) DF initialization task
After completing initialization of the table and hardware of the DF, the DF initialization task generates the DF task. It executes the CUDG and loading of the take-over information using the DF task and performs the loop diagnosis on the Disk drive side and ascertains the completion of the spin-up of the Disk drives in the second and following groups.

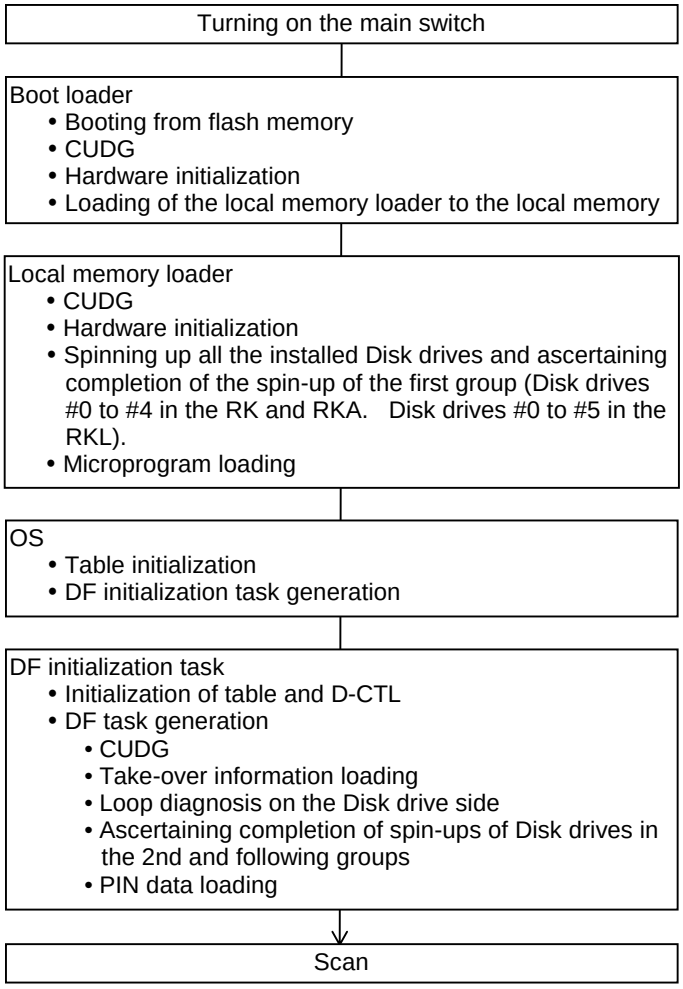



**Figure 3.1.1 IMPL Sequence**

### 3.1.2 Disk drive powering on sequence

If all the Disk drive motors are rotated at the same time an overcorrect may be caused. To avoid it, the drives are started in the following sequence.

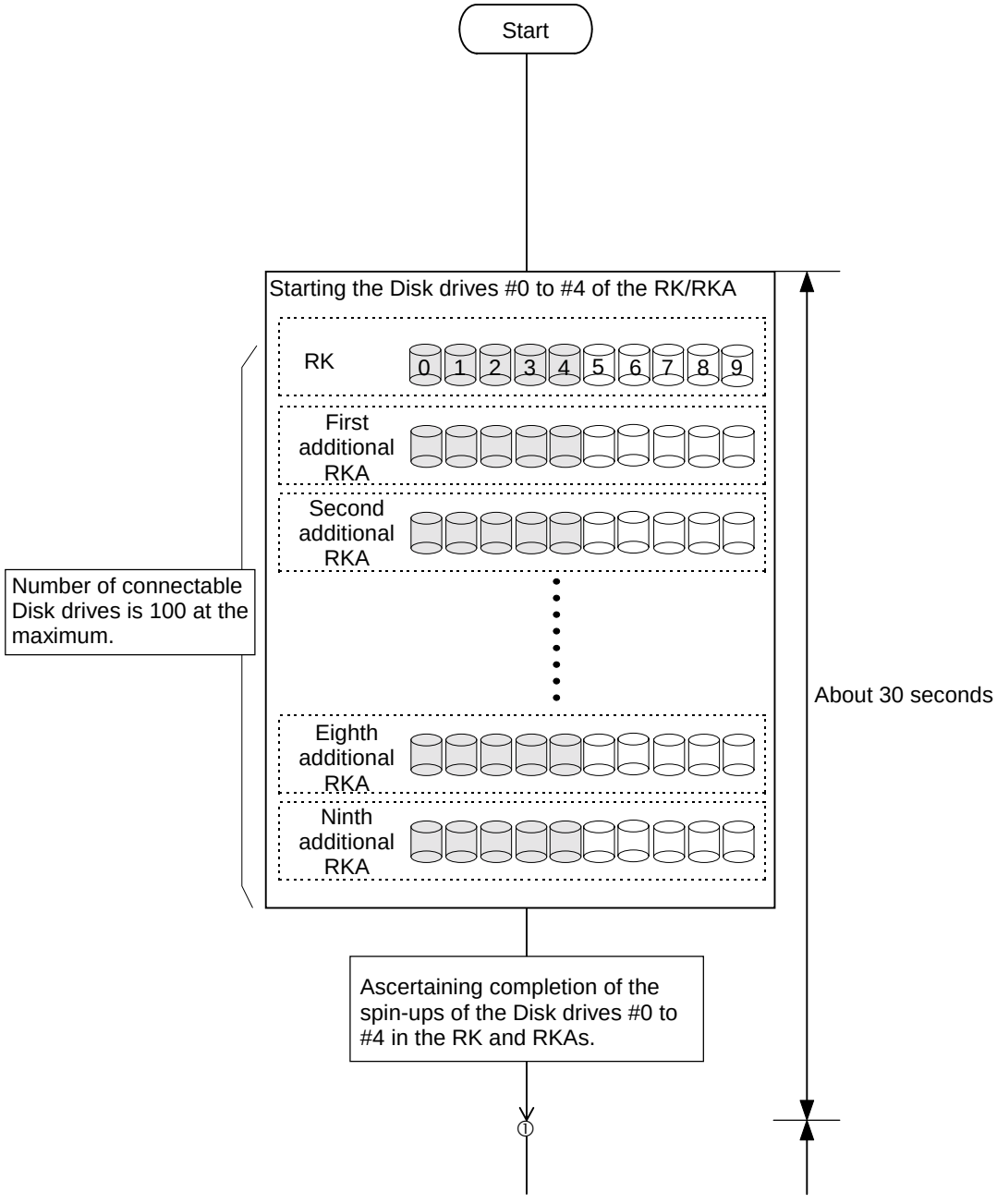



**Figure 3.1.2(1/2) Disk Drive Starting Sequence (RK/RKA)**

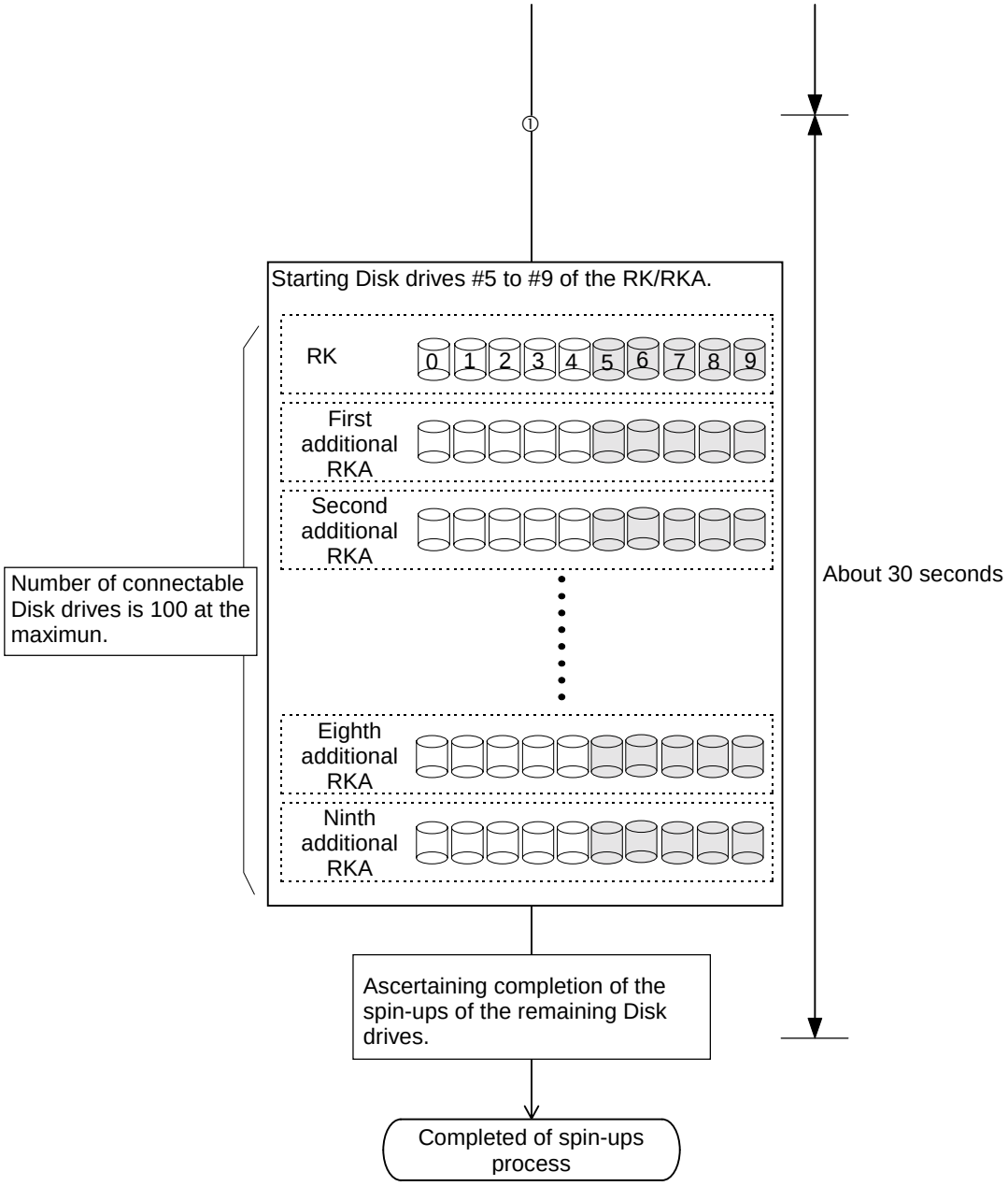



**Figure 3.1.2(2/2) Disk Drive Starting Sequence (RK/RKA)**

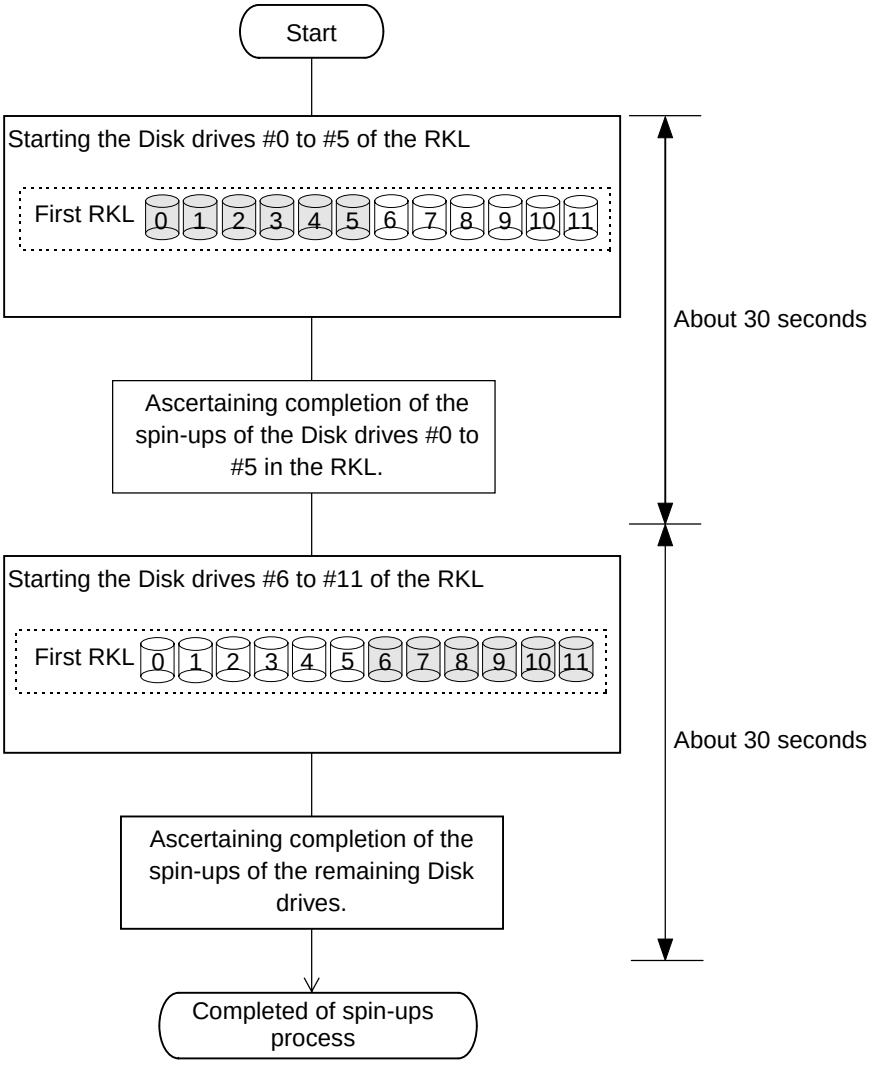



**Figure 3.1.2.1 Disk Drive Starting Sequence (RKL)**

### 3.1.3 Sequential shutdown

When the subsystem is instructed to shut it down because of the host computer powering off (remote control) or the main switch turning off (local control), it watches completion of processes being executed and not executed yet for all the logical devices.
After ascertaining completion of all of them, it executes the destaging.
When doing the above, if a track failed to be destaged (pinned data) occurs, it stores the Pin information in the system area on the system disk.
Then, after the take-over information is stored in the system area of the system disk and the power supplying from the battery unit is shut off, the subsystem is notified of the permission for powering off.
The breaker of the subsystem becomes able to be turned off after receiving the permission.

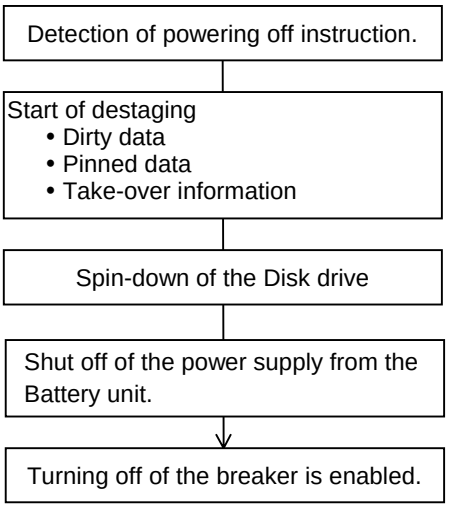



**Figure 3.1.3 Flow Chart of Sequential Shutdown**

## 3.2 Data Format

Figure 3.2.1 shows the data format.
To the sub-block, the check code the address assurance code (LA) and data assurance code (LRC) is added.
The physical format on the physical disk is that recorded in the data field in units of 520 bytes.

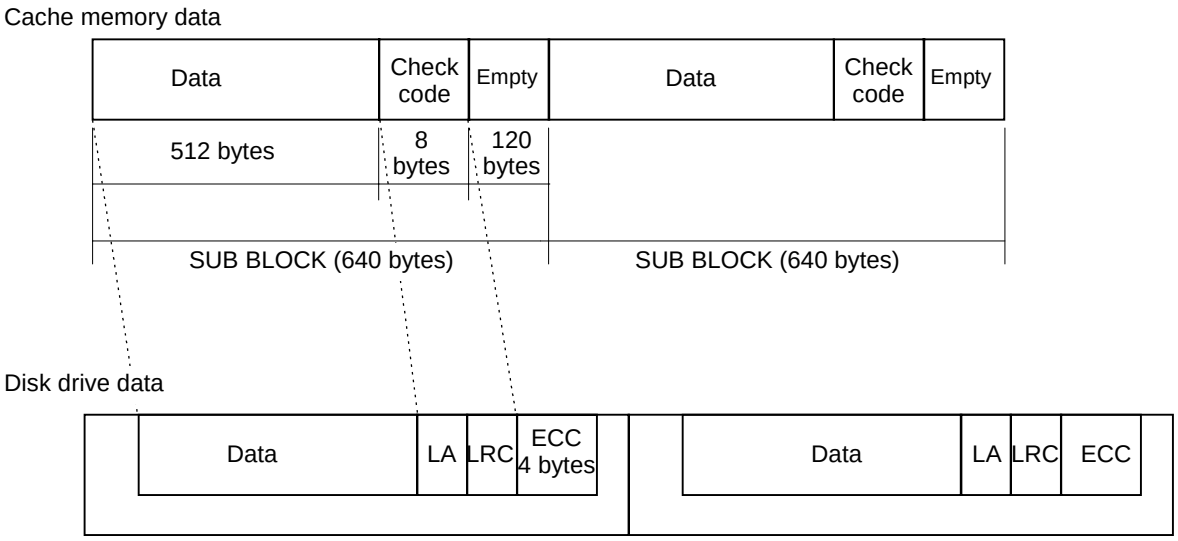



**Figure 3.2.1 Data Format**

## 3.3 Read/Write Operation

### 3.3.1 Command execution

In the subsystem, all R/W commands are executed via the Cache memory.

- When read data is in the Cache memory, the data in the Cache memory is transferred to the host computer (Read hit operation).
- Only when read data is not in the cache memory, the data is transferred to the host computer directly from the Disk drive (Read miss operation). The data is left in the Cache memory then, the read hit operation can be performed at the time of the next reading.
- To improve the responding performance of write operation, the write-after operation, in which a operation completion is reported to the host computer when a data writing into the Cache memory is completed, is performed. After that, the Controller generates the parity and writes the data on the Disk drive asynchronously.
- Data in the Cache memory is backed up by batteries. Thus, a data loss caused by a power failure, etc. can be prevented.

Data flows are shown in Figure 3.3.1.

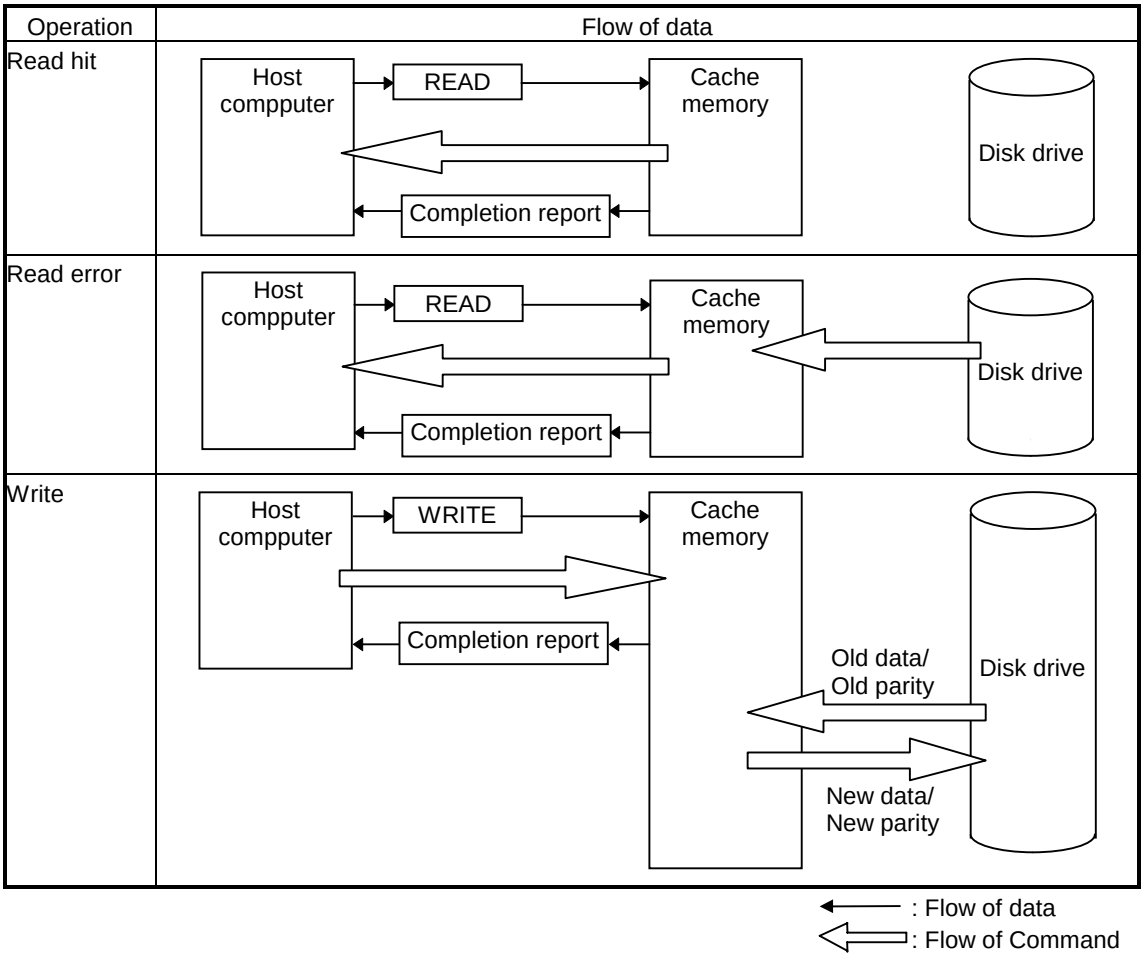



**Figure 3.3.1 Flow of Data**

### 3.3.2 Dual system configuration

(1) Feature of dual system

(a) The flexible system can be configured by virtue of the two Controllers installed. This allows the system configuration, which fits the host computer operation, to be provided. For details, refer to Item (2), "Dual system configuration".

(b) Data is duplicated and written on the Cache memories on the two Controllers respectively.
The duplication makes it possible to continue the operation and assure user data even when a Controller failure occurs.

(2) Dual system configuration

(a) Hot Standby mode
This is a system configuration in which the Controller is divided into the two, a main Controller and a standby Controller.

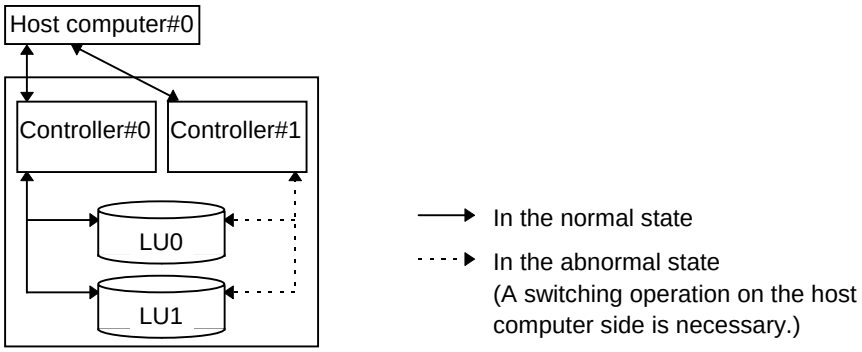



**Figure 3.3.2 System Configuration**

(b) ID take-over mode(*1)
When the Controller of the main system is blocked owing to a failure, the Controller of the stand-by system takes over the Controller ID of the main system (Fibre Channel: Port ID; SCSI: SCSI ID) and switches the path automatically.
When the Controller is switched, the standby Controller takes over the PORT ID, so that the host computer need not be conscious of the switching of the Controller.

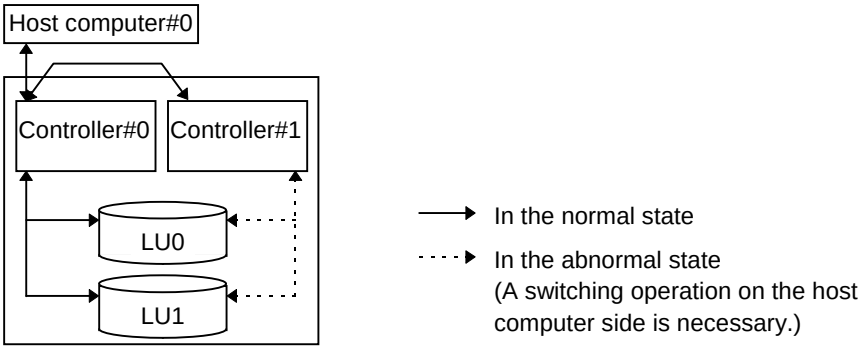


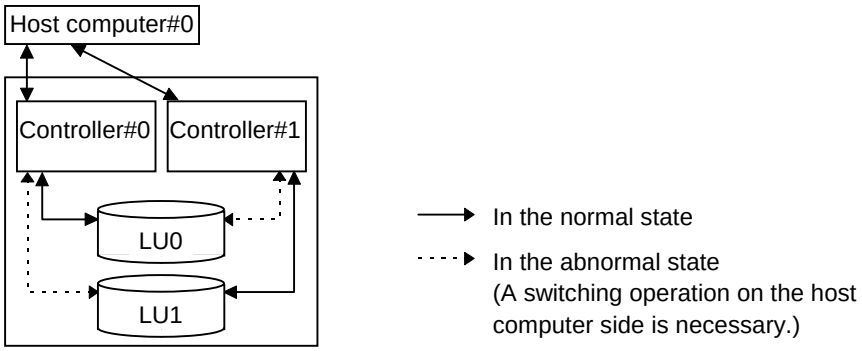

**Figure 3.3.3 System Configuration**

*1: In the ID Take-Over mode of the Fibre Channel connection, connect the host computer and the DF500 via the hub or a switch.

(c) Dual Active mode

This is a mode in which the two controllers operate in parallel. In this system configuration, LUs to which a controller accesses exclusively are allocated to each controller.

If an LU is accessed by a control which does not control it, the controlled LU is re-allocated, and then the access to it is started. This switching usually takes time, the access to an LU from the controller not controlling the LU causes a lowering of the performance.




*1 : The Controller#0 and Controller#1 control the LU0 and LU1 respectively.

**Figure 3.3.4 System Configuration**

(d) Data Sharing mode

This is a mode in which the two Controllers operate in parallel like the Dual Active mode.

In this system configuration, however, the controlled LU is not re-allocated when the LU is accessed by a Controller which does not control it. Therefore, the remarkable lowering of the performance such as that occurs in the case of Dual Active mode is not caused.

In the case of the Data Sharing mode, like the Dual Active mode, each Controller is allocated the LUs to be controlled by exclusively by a Controller are allocated to each Controller.

Aince accesses to the LU by a Controller which does not control it is internally entrusted to the Controller which controls it, the performance is lowerd.

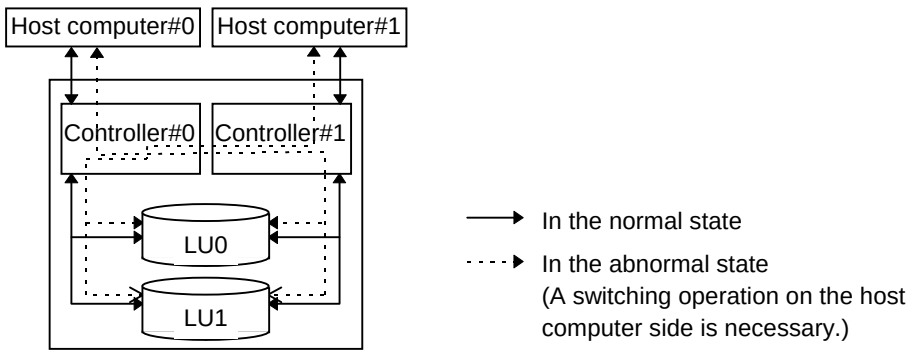



**Figure 3.3.5 System Configuration**

## 3.4 Cache Memory Control

### 3.4.1 Cache memory configuration

(1) Cache memory structure

The Cache memory consists of a directory section for controlling data and a data section for storing user data.

(2) Data

Data stored in the Cache memory is controlled in the state in which it is devided into segments with fixed length 16 k bytes. The minimum unit of data is a sub-block (Logical block) and one segment is equal to 32 sub-blocks. Data in the cache consists of staging data which came from the disk and dirty data which is not reflected on the disk. There are two types of dirty data : one is data without parity generated and the other is data with parity generated. Data has side attributes of the Read and Write sides so that the write penalty, which occurs at the time of the parity update and which is peculiar to the RAID, can be reduced. To prevent data loss occurs when the power is turned off, it is made to be non-volatile by means of the battery.

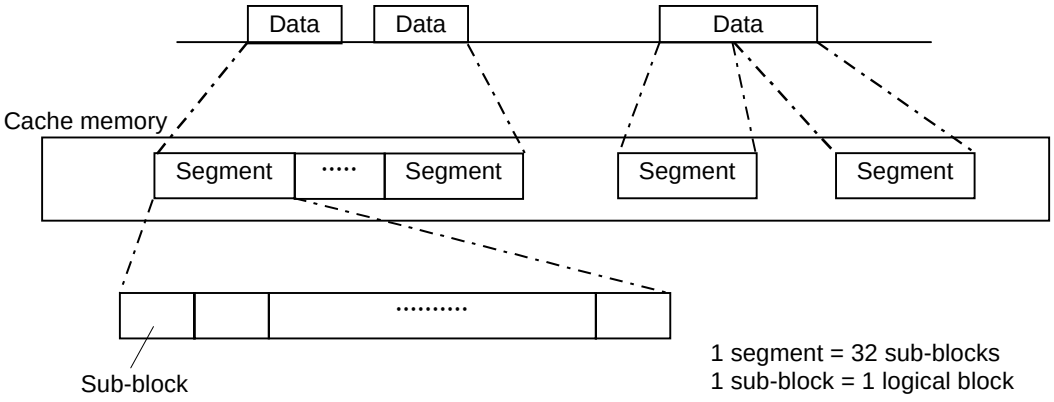



**Figure 3.4.1 Data Structure in Cache Memory**

(3) Directory

The directory consists of a hash table for deciding hit or miss and SGCBs for controlling the segments. The SGCB has a one-to-one correspondence with the segment and has a pointer to the segment concerned and information regarding the status of the segment concerned.

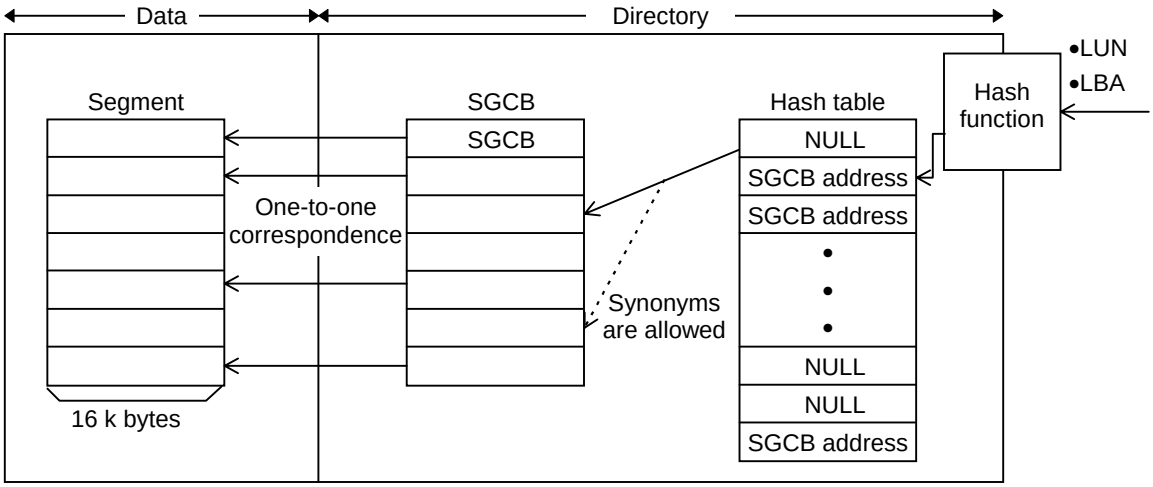



**Figure 3.4.2 Control Structure in Cache Memory**

(4) Hit/miss judgment

A hash table is used to increase the speed of data retrieval in the Cache memory. SGCB is entered in the hash table and hit or miss is judged by the use of the LUN and LBA (logical block address) as entry positions.

(5) Queue control

Data in the Cache memory is controlled by queues classified according to attributes. An SGCB is queued for each queue. The queues are controlled so as to perform processings such as segment assignment and destaging of dirty data according to the attributes.

(6) Dual system configuration

When the subsystem operates in the dual system configuration, write data in the directory is double-written on the Cache memory on the both Controller, so that no user data will be lost even if one Controller is blocked.

### 3.4.2 Optional function

(1) LU cache residence function

The subsystem provides the LU cache residence function as an optional function.
To use the LU cache residence function, the DF-F500-WLU is required separately.
The LU cache residence function makes data of specific LUs resident in a cache and makes all accesses to the LUs from the host cache hit without making any disk accesses occur.
When the function is applied to an LU frequently accessed, it is expected that the throughput is increased because all data R/W can be performed as cache hits.
(For details, refer to the manual supplied with the DF-F500-WLU.)

(2) LUN security function

The subsystem provides the LUN security function as an optional function. To use the LUN security function, the DF-F500-WSEC is required separately.
The LUN security function prevents data from being destroyed by illegal accesses by specifying hosts to be permitted to access an LUN optionally specified.
(For details, refer to the manual supplied with the DF-F500-WSEC.)

(3) Dual active ID take-over function

The subsystem provides the dual active ID take-over function as an optional function.
To use the dual active ID take-over function, the DF-F500-WD is required separately.
The dual active ID take-over function takes over the SCSI ID and Port ID in the Dual Active mode of the dual controller configuration.
Even when one of the two Controllers becomes inoperable owing to a failure, the path is automatically switched to the other Controller and the operation can be continued.
(For details, refer to the manual supplied with the DF-F500-WD.)

(4) SNMP agent support function

This subsystem provides the SNMP agent support function as an optional function.
To use the SNMP agent support function, the DF-F500-WS is required separately.
The SNMP agent support function reports occurrences of failure to the workstation for monitoring the network via the SNMP (Simple Network Management Protocol) of the open platform.
It reports conditions of command operation (such as a number of command receptions and number of cache hits) of the disk array subsystem.
It enables you to refer to the conditions of command operation depending on a type of access from a host and you can utilize it as information for tuning subsystem performance.
(For the details, refer to the manual supplied with the DF-F500-WS.)

(5) Password security protection function

The subsystem provides the password security protection function as an optional function. To use the password security protection function, the DF-F500-WSPS is required separately.

The password security protection function prevents any DF500 from being concurrently accessed by users by limiting users of Disk Array management program to be permitted to access the DF500.

(For details, refer to the manual supplied with the DF-F500-WSPS.)

(6) MRCF-Lite function

This subsystem provides the MRCF-Lite function as an optional function.

To use the MRCF-Lite function, the DF-F500-WCFL is required separately.

The MRCF-Lite function controls LU copying done within one and the same subsystem. It can create a copy (secondary volume) of an LU within one and the same subsystem keeping the redundancy that the source LU (primary volume) has.

(For the details refer to the manual supplied with the DF-F500-WCFL.)

## 3.5 Destaging Operation

Write data from the host computer is stored temporarily in the Cache memory, and then written on the Disk drive asynchronously.
This process to write data on the Disk drive asynchronously is called destaging.
There are two types of destaging method, that is, destaging of random data and destaging of sequential data.

(1) Destaging of random data
Data is processed in units of LBA. The old data and old parity of data to be destaged are staged from the disk. New parity is generated from the new data, old data, and old parity and the new data and new parity are destaged in units of LBAs.

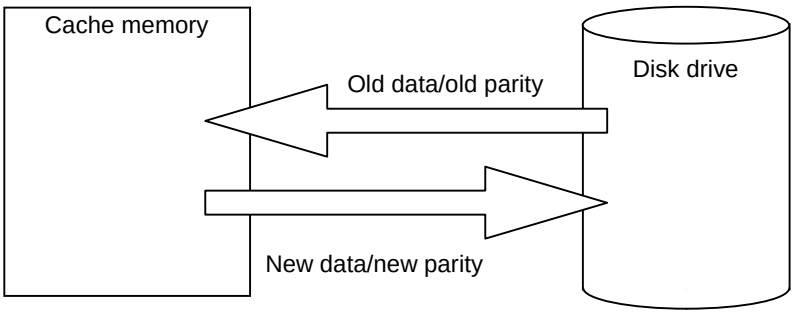



**Figure 3.5.1 Destaging of Random Data**

(2) Destaging of sequential data
Data is processed in units of stripe. New parity is generated from the write data and the new data and new parity are destaged in units of stripes.

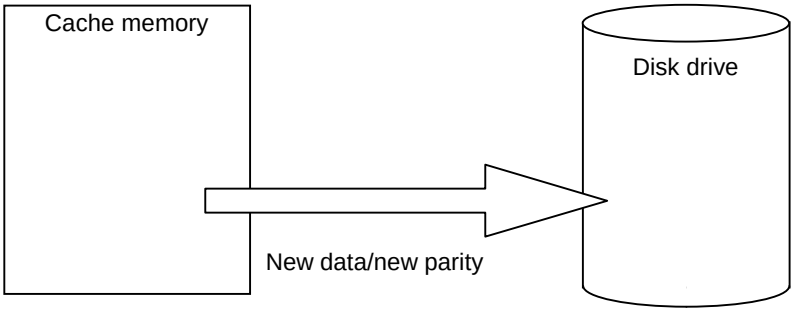



**Figure 3.5.2 Destaging of Sequential Data**

## 3.6 Operation Against Disk Failure Occurs

(1) I/O operation against Disk drive failure

In the subsystem with the RAID1, RAID5, or RAID0+1 configuration, even when a failure occurs in one Disk drive and data cannot be read from it, the target data can be recovered by means of using data on the other normal Disk drives.

In the case of RAID1 and RAID0+1, data on the mirror Disk drive is used, and in the case of RAID5, data on the other Disk drive on the same stripe is used. By means of these measures, even when a Disk drive failure occurs, reading /writing can be done as before. Figure 3.6.2 shows the outline of the data reading operation performed when a Disk drive failure occurs.

Data B reading request

(a) Data B read request

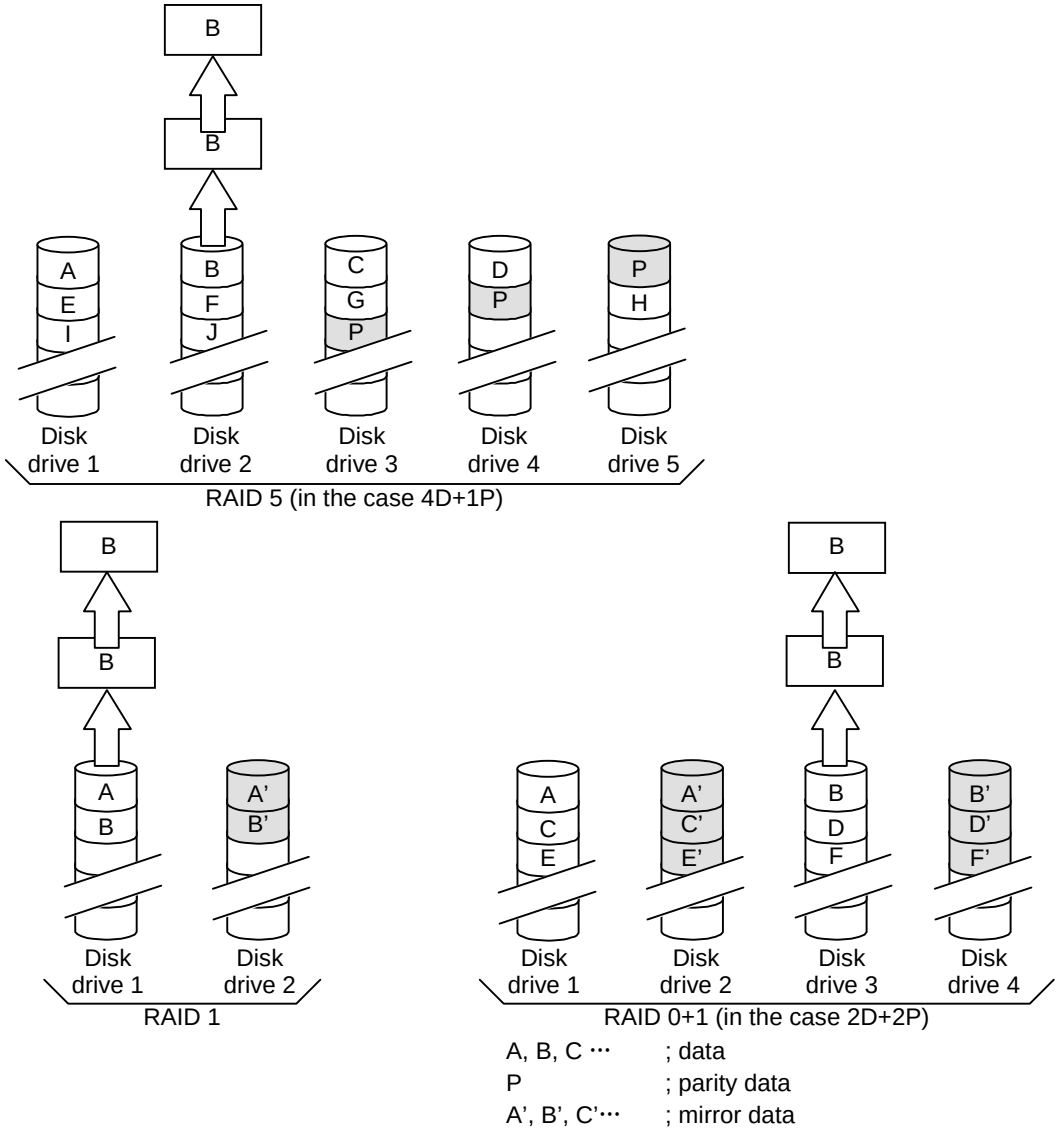
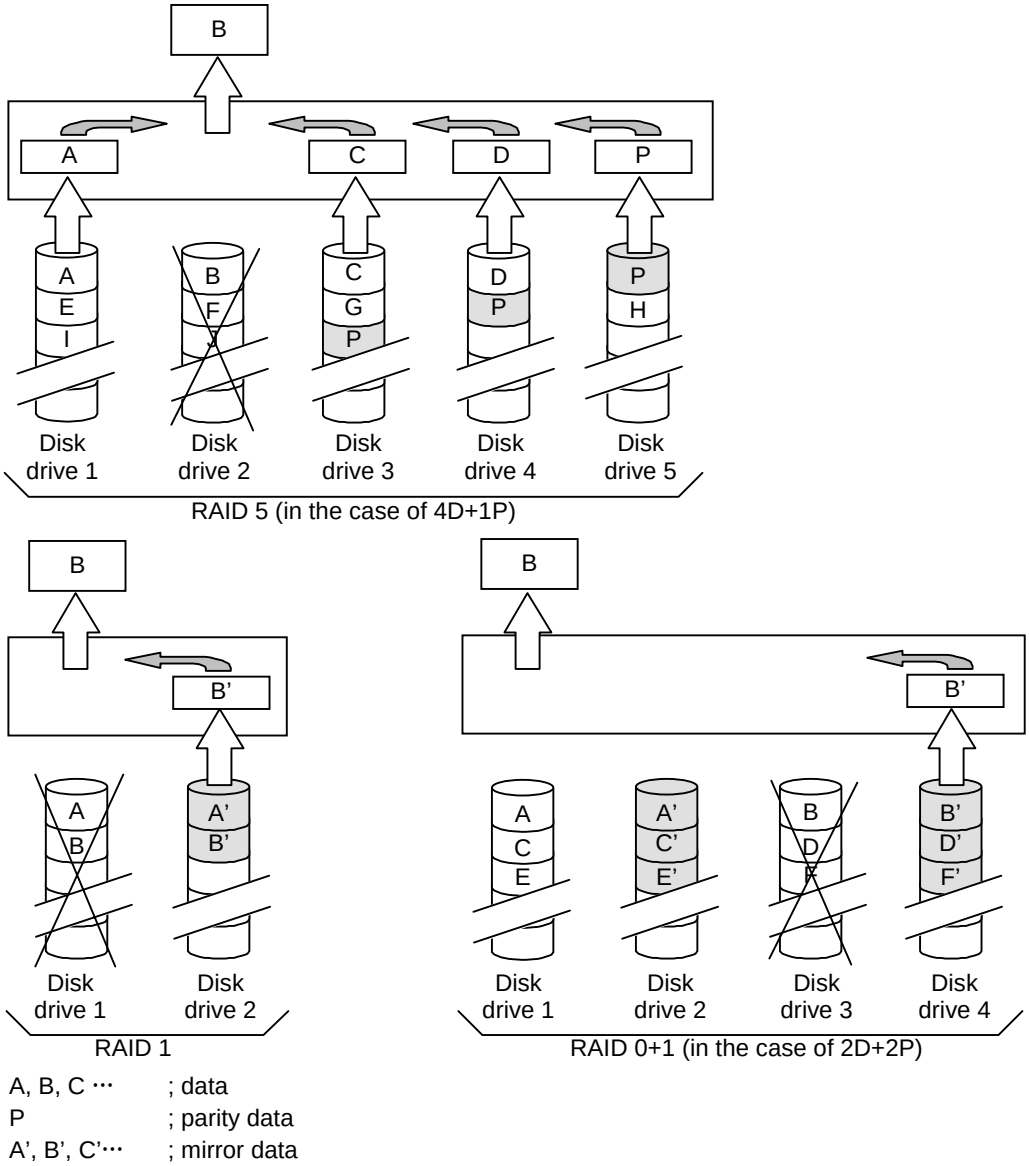



**Figure 3.6.1 Data Reading Operation When Disk Drive is Normal**

(b) When a Disk drive failure occurs




A, B, C ⋯ ; data
P ; parity data
A', B', C'⋯ ; mirror data

**Figure 3.6.2 Data Reading Operation When a Disk Drive Failure Occurs**

(2) Data assurance when a disk failure occurs

The subsystem can have a Spare disk (s) optionally. Data on a Disk drive which is blocked owing to its failure or a Disk drive in which a number of error occurrence has exceeded the specified value is automatically reconstructed on the Spare disk.
This operation is performed in the background without making the host computer conscious of it, so that I/O request can be accepted continuously. When the failed Disk drive is replaced, the data saved on the Spare disk is copied to the new Disk drive.

(a) Dynamic sparing

Errors which occur during ordinary reading/writing operation are controlled for each Disk drive. When a number of error occurrences of a Disk drive exceeds the specified value, data on the Disk drive is automatically copied onto the Spare disk because it is determined that there exists a risk that a failure (an uncorrectable error) will occur in the Disk drive. This function is called a dynamic sparing function.

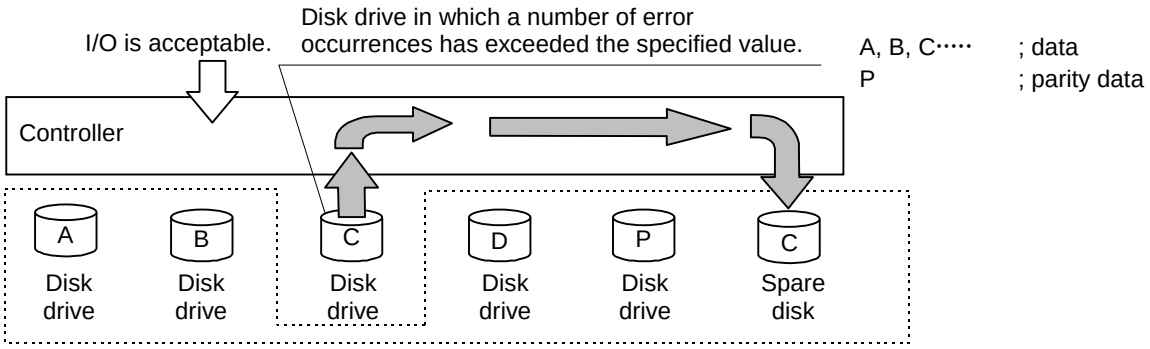



**Figure 3.6.3 Dynamic Sparing**

(b) Correction copy

In the subsystem with the RAID 5 configuration, when a failure occurs in a Disk drive and data reading/writing from/on it cannot be done, the data on the failed Disk drive is restored using those on the other data disk drives and the parity disk drive, and then copied onto the Spare disk. In the subsystem with the RAID 1 or RAID 0+1 configuration, when the same situation as above occurs, data on the mirror disk drive is copied onto the Spare disk. In the RAID 0 configuration, the correction copy cannot be done.

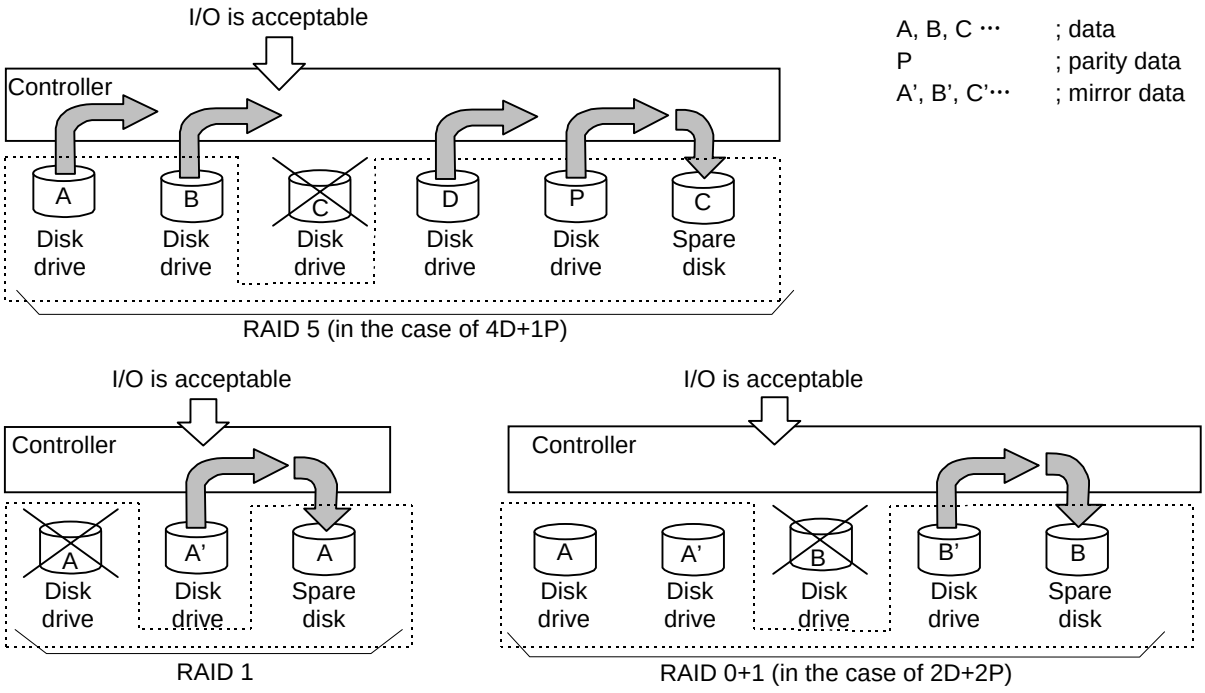



**Figure 3.6.4 Correction Copy**

## 3.7 Setting RAID Group

You can set the RAID group and RAID level shown below by using the setting function.

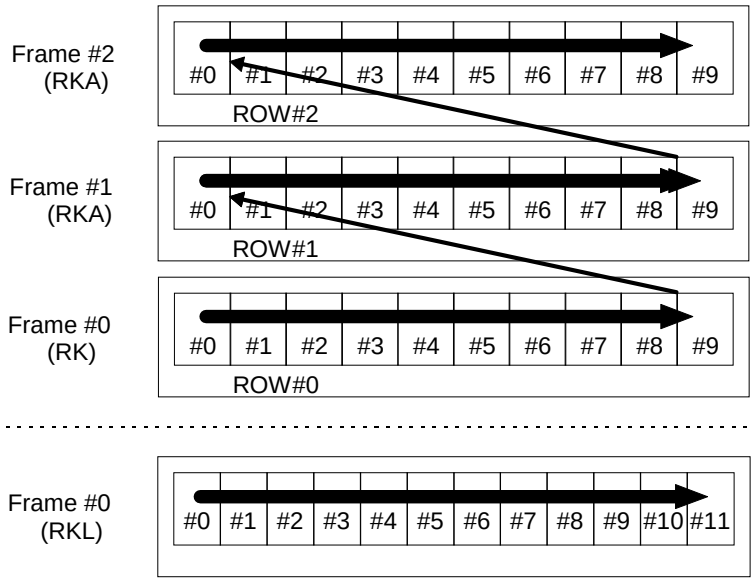
(1) RAID level
The range of the RAID levels supported by the DF500 is shown in the table below.

**Table 3.7.1 Range of Supported RAID Levels**

| No. | RAID level | Supported range | | Remarks |
|---|---|---|---|---|
| | | 0552/* | 05×3/* | |
| 1 | RAID 0 | 5D | 2D to 16D | (*1) (*2) |
| 2 | RAID 1 | 1D+1P | | |
| 3 | RAID 5 | 2D+1P to 4D+1P | 2D+1P to 15D+1P | (*2) |
| 4 | RAID 0+1 | 2D+2P | 2D+2P to 8D+8P | (*1) (*2) |

*1: The supported striping size for RAID 0 and RAID 0+1 is 64 k bytes only.
*2: In the case of RKL, 2D to 12D (RAID 0) , 2D+1P to 11D+1P (RAID 5) , 2D+2D to 6D+6P (RAID 0+1 ) supported.

(2) Disk drives of a RAID group are allocated as follows because of the full mapping. They are allocated in numerical order (in ascending order) starting from the top Disk drive (the Disk drive #0 in the frame #0) and in order of the frame No., up to the number calculated as multiplying the RAID width (number of Disk drives in the parity group) by the depth (number of parity groups).



(3) User data area

All the Disk drives allocated to a RAID group are managed as those having the same capacity because of the full mapping.

The size of the user data in one Disk drive is the specified Disk drive capacity from which the system area capacity is subtracted and rounded with 0x80.

Expression:

User data size = ((LAST LBA + 1) - Data portion beginning LBA) & 0xFFFFFF80

When the capacity of the Disk drives installed within the range where the RAID group is allocated is smaller than the specified Disk drive capacity, the RAID group cannot be defined.

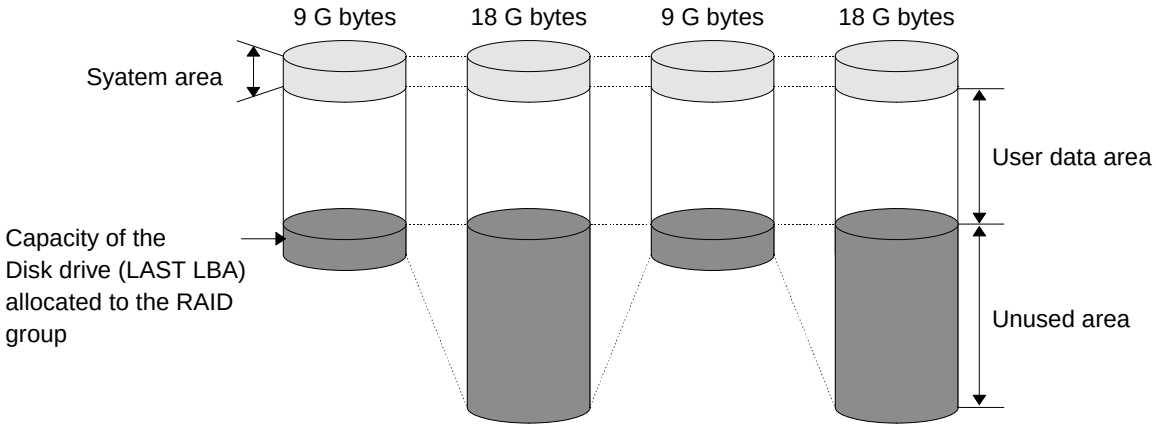
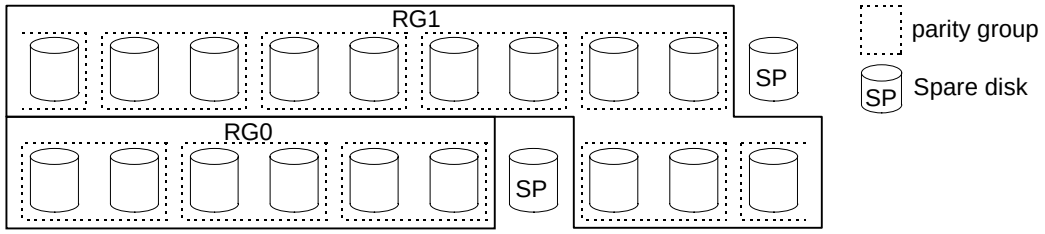



**Figure 3.7.1 User Data Area**

(4) Image of RAID group definition for each RAID level (RK/RKA)

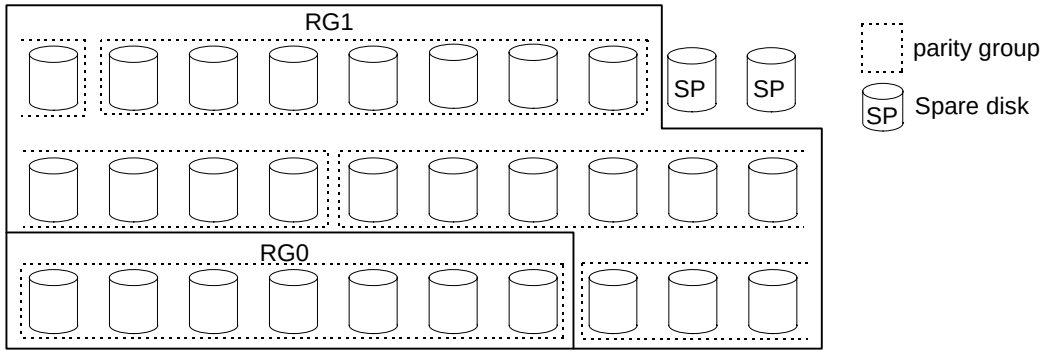
(a) RAID 0

• In the case of 2D



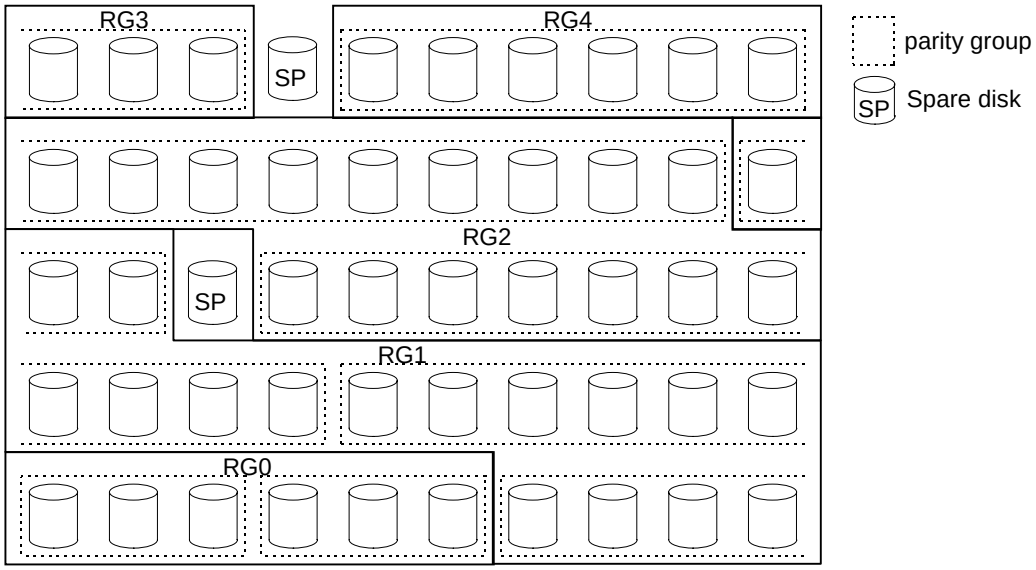

RG0 : Number of the Disk drive in the parity group = 2
Number of parity groups = 3
RG1 : Number of the Disk drive in the parity group = 2
Number of parity groups = 6

• In the case of 7D



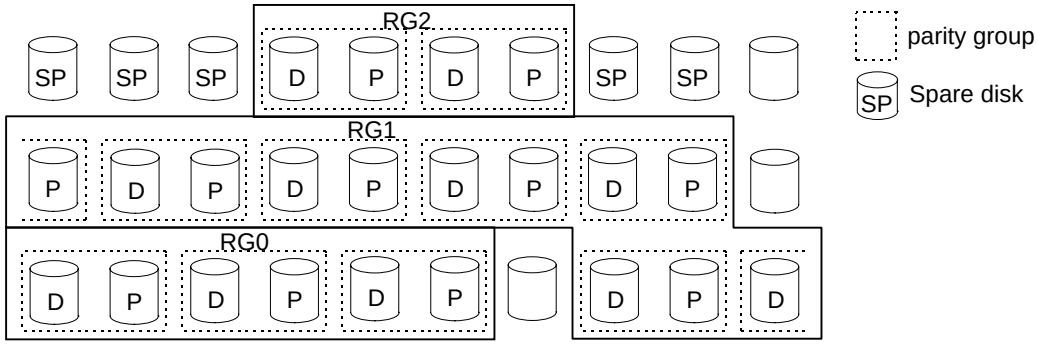

RG0 : Number of the Disk drive in the parity group = 7
Number of parity groups = 1
RG1 : Number of the Disk drive in the parity group = 7
Number of parity groups = 3

- In the case of 2D to16D




RG0 : 3D Number of the Disk drive in the parity group = 3
Number of parity groups = 2
RG1 : 8D Number of the Disk drive in the parity group = 8
Number of parity groups = 2
RG2 : 16D Number of the Disk drive in the parity group = 16
Number of parity groups = 1
RG3 : 4D Number of the Disk drive in the parity group = 4
Number of parity groups = 1
RG4 : 6D Number of the Disk drive in the parity group = 6
Number of parity groups = 1

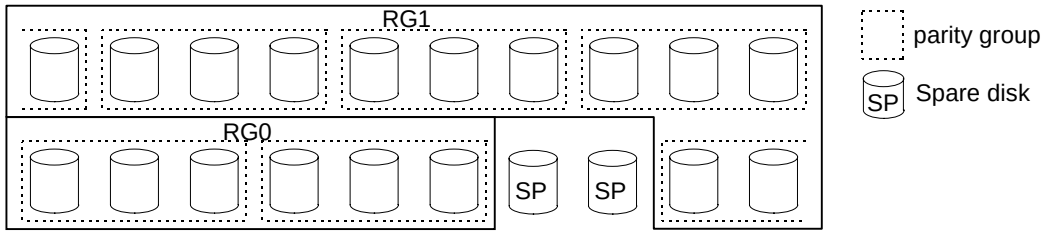
(b) RAID 1




RG0 : Number of the Disk drive in the parity group = 2
Number of parity groups = 3
RG1 : Number of the Disk drive in the parity group = 2
Number of parity groups = 6
RG2 : Number of the Disk drive in the parity group = 2
Number of parity groups = 2

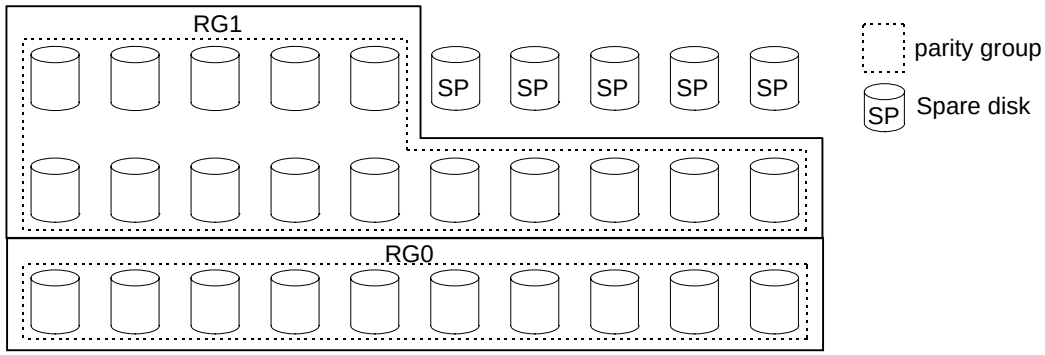
(c) RAID 5

- In the case of 2D + 1P



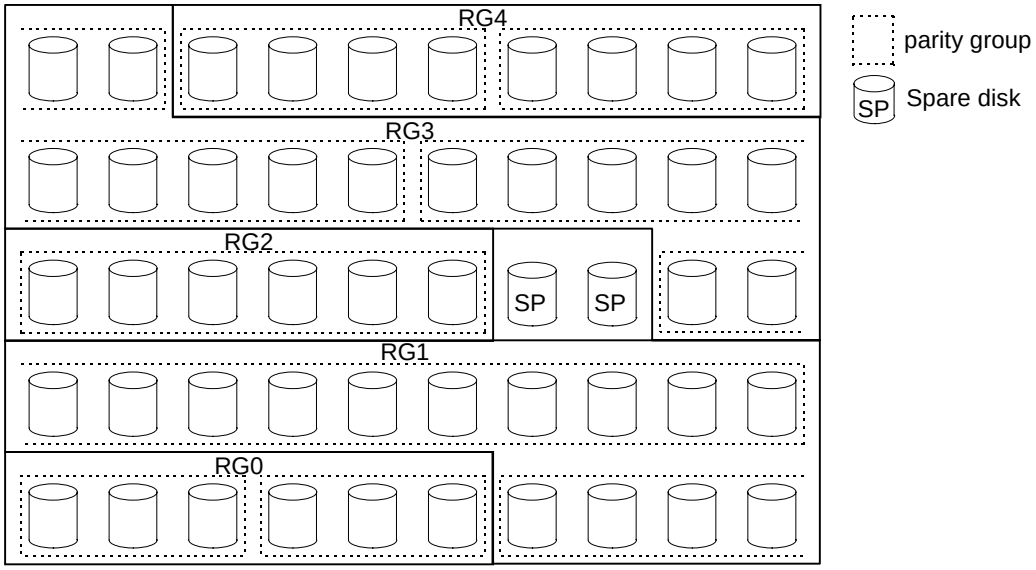

RG0 : Number of the Disk drive in the parity group = 3
Number of parity groups = 2
RG1 : Number of the Disk drive in the parity group = 3
Number of parity groups = 4

- In the case of 4D + 1P




RG0 : Number of the Disk drive in the parity group = 5
Number of parity groups = 2
RG1 : Number of the Disk drive in the parity group = 5
Number of parity groups = 3

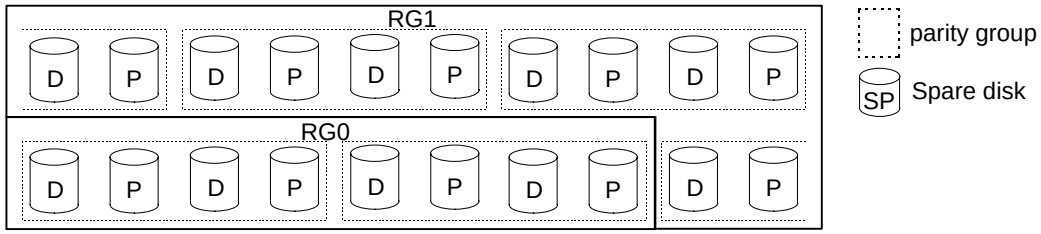
- In the case of 2D + 1P to 15D + 1P




RG0 : 2D + 1P Number of the Disk drive in the parity group = 3
Number of parity groups = 2
RG1:13D + 1P Number of the Disk drive in the parity group = 14
Number of parity groups =1
RG2: 5D + 1P Number of the Disk drive in the parity group = 6
Number of parity groups = 1
RG3: 6D + 1P Number of the Disk drive in the parity group = 7
Number of parity groups = 2
RG4: 3D + 1P Number of the Disk drive in the parity group = 4
Number of parity groups = 2

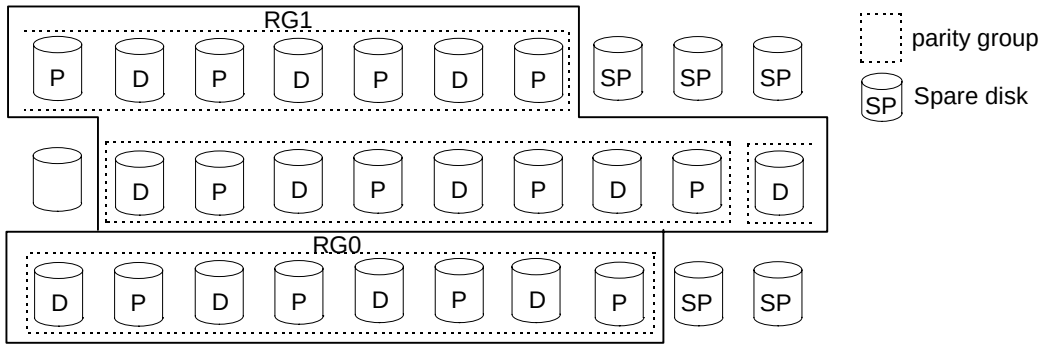
(d) RAID 0+1 (RAID A)

- In the case of 2D + 2P



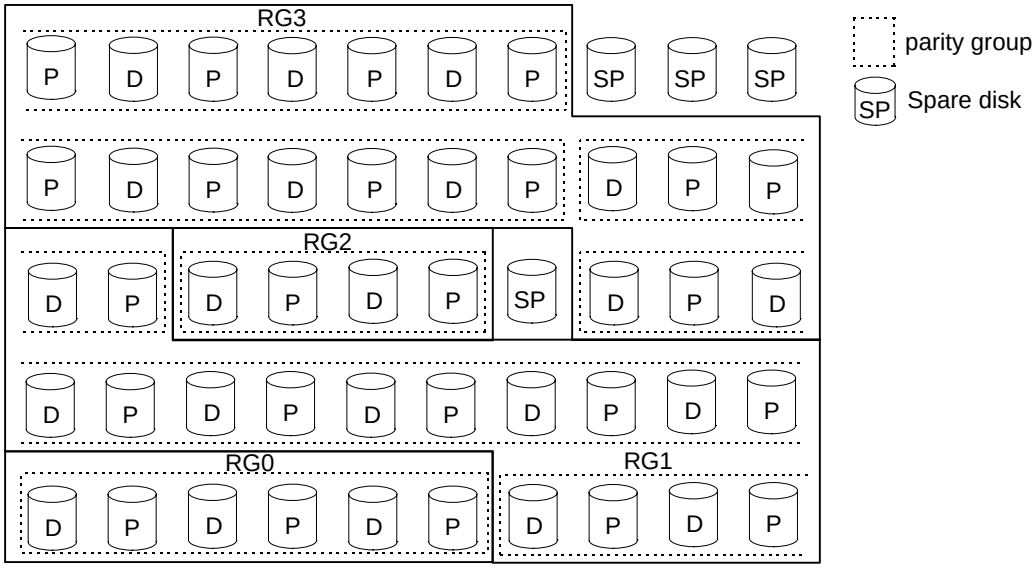

RG0 : Number of the Disk drive in the parity group = 4
Number of parity groups = 2
RG1 : Number of the Disk drive in the parity group = 4
Number of parity groups = 3

- In the case of 4D + 4P



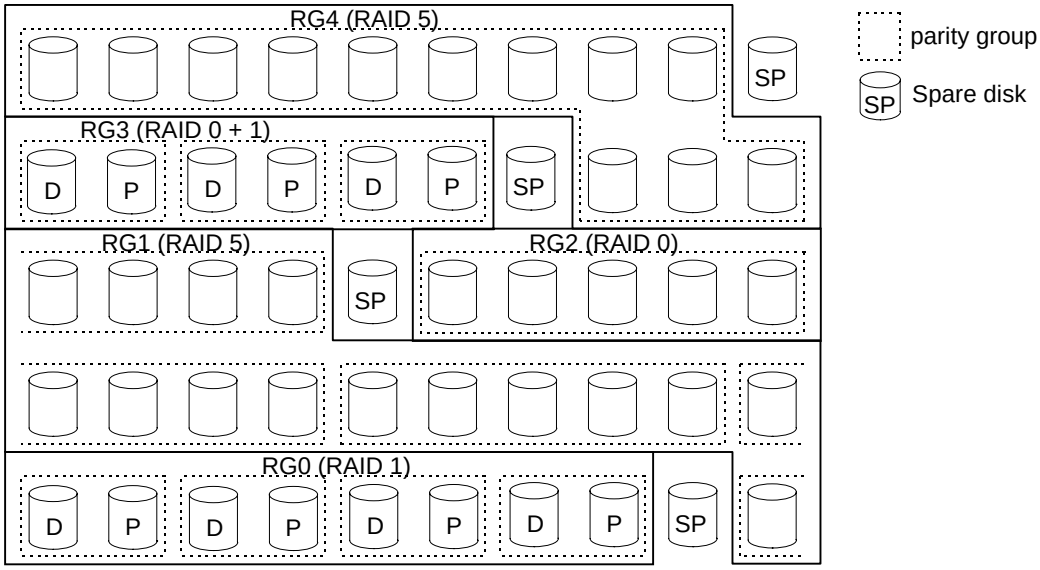

RG0 : Number of the Disk drive in the parity group = 8
Number of parity groups = 1
RG1 : Number of the Disk drive in the parity group = 8
Number of parity groups = 2

• In the case of 2D + 2P to 8D + 8P




RG0 : 3D + 3P Number of the Disk drive in the parity group = 6
Number of parity groups = 1
RG1 : 8D + 8P Number of the Disk drive in the parity group = 16
Number of parity groups = 1
RG2 : 2D + 2P Number of the Disk drive in the parity group = 4
Number of parity groups = 1
RG3 : 5D + 5P Number of the Disk drive in the parity group = 10
Number of parity groups = 2

(e) In the case where RAID levels coexist

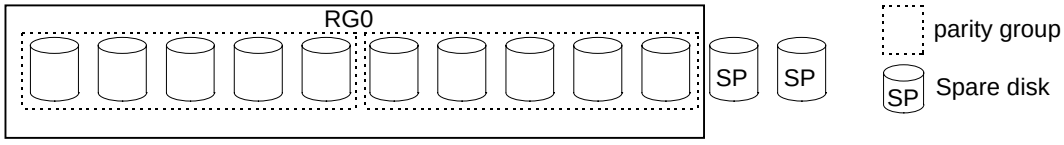



RG0(RAID 1) : Number of the Disk drive in the parity group = 2
Number of parity groups = 4
RG1(RAID 5) : 4D + 1P
Number of the Disk drive in the parity group = 5
Number of parity groups = 3
RG2(RAID 0) : 5D
Number of the Disk drive in the parity group = 5
Number of parity groups = 1
RG3(RAID 0 + 1) : 3D + 3P
Number of the Disk drive in the parity group = 2
Number of parity groups = 3
RG4(RAID 5) : 11D + 1P
Number of the Disk drive in the parity group = 12
Number of parity groups = 1

(5) Image of RAID group definition for each RAID level (RKL)

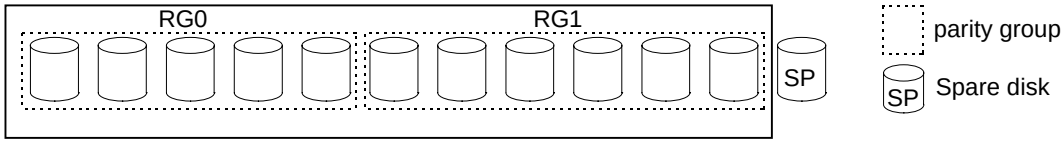
(a) RAID 0

• In the case of 5D



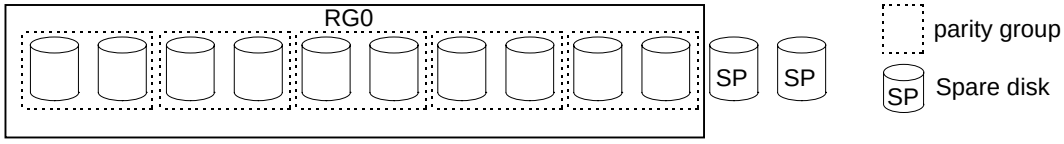

RG0 : Number of the Disk drive in the parity group = 5
Number of parity groups = 2

• In the case where 5D and 6D coexist




RG0 : Number of the Disk drive in the parity group = 5
Number of parity groups = 1
RG1 : Number of the Disk drive in the parity group = 6
Number of parity groups = 1

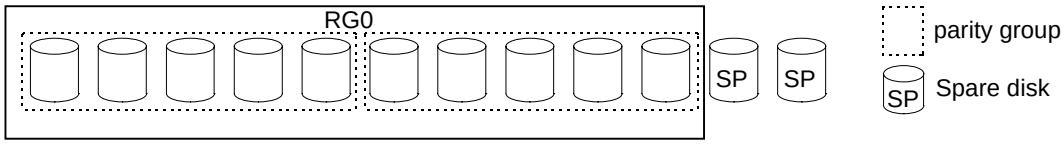
(b) RAID 1




RG0 : Number of the Disk drive in the parity group = 2
Number of parity groups = 5

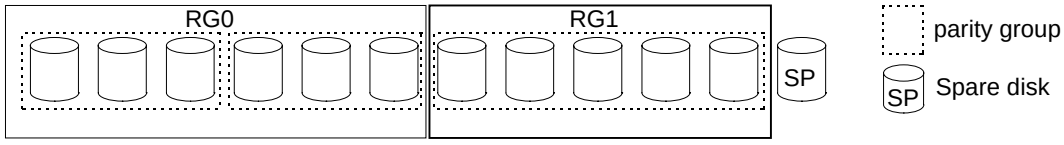
(c) RAID 5

• In the case of 4D + 1P




RG0 : Number of the Disk drive in the parity group = 5
Number of parity groups = 2

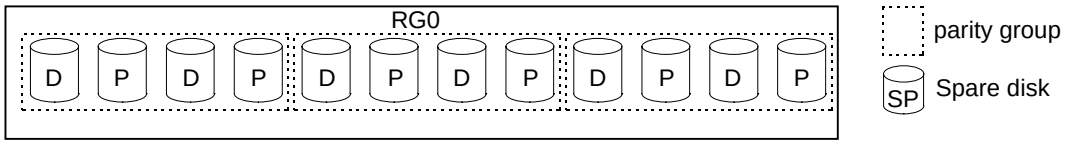
• In the case where 2D + 1P and 4D + 1P coexist




RG0 : Number of the Disk drive in the parity group = 3
Number of parity groups = 2
RG1 : Number of the Disk drive in the parity group = 5
Number of parity groups = 1

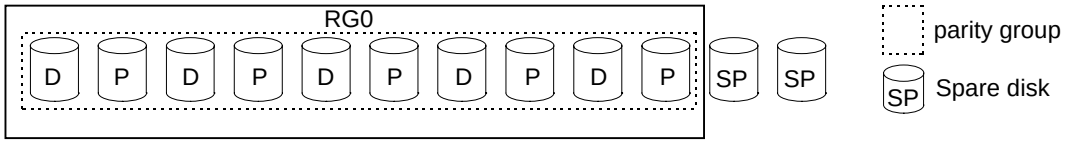
(d) RAID 0+1 (RAID A)

- In the case of 2D + 2P




RG0 : Number of the Disk drive in the parity group = 4
Number of parity groups = 3

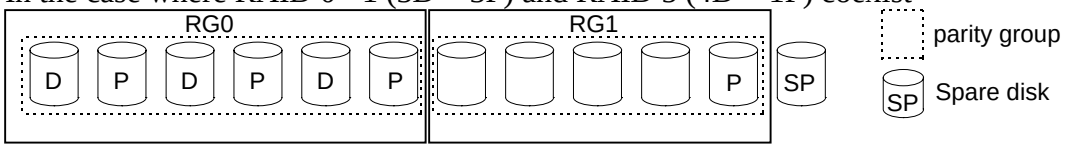
- In the case of 5D + 5P




RG0 : Number of the Disk drive in the parity group = 10
Number of parity groups = 1

(e) In the case where RAID 0 coexist

- In the case where RAID 0 +1 (3D + 3P) and RAID 5 (4D + 1P) coexist

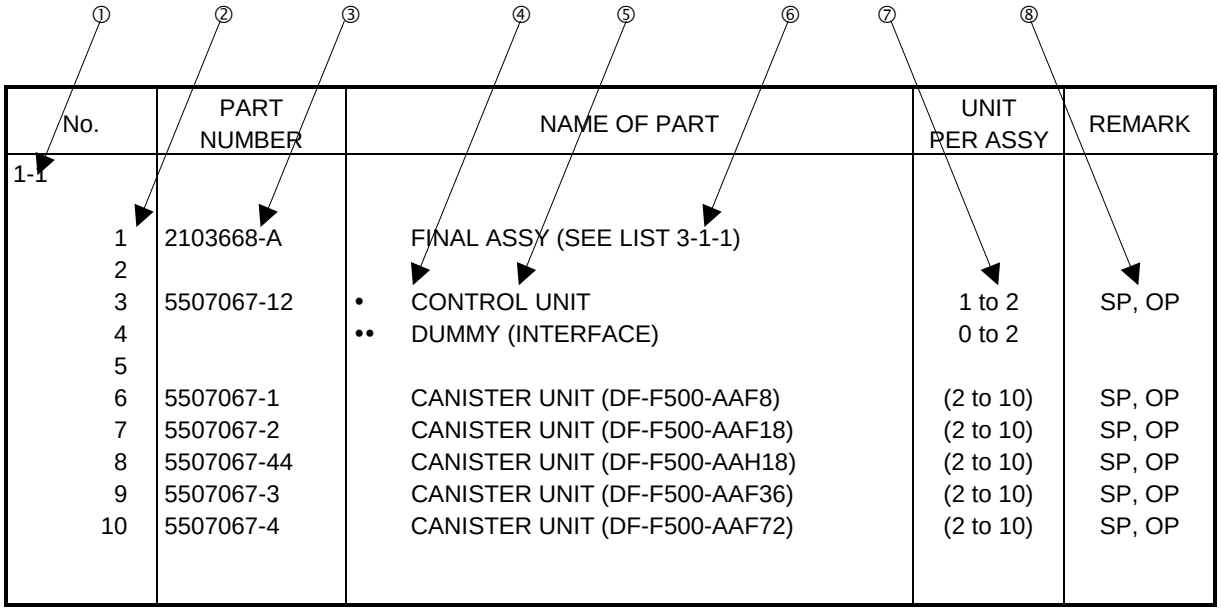



RG0 : Number of the Disk drive in the parity group = 6
Number of parity groups = 1
RG1 : Number of the Disk drive in the parity group = 5
Number of parity groups = 1

# Chapter 4. Parts Catalog

This chapter contains catalogs of the parts of the subsystem and the devices composing the system.
Names and installation locations of parts are shown for the each model and the device.
In addition, classification of parts (into maintenance parts and optional parts) is also contained.

## 4.1 How to Use this Parts Catalog




| No. | PART NUMBER | | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|---|
| 1-1 | | | | | |
| 1 | 2103668-A | | FINAL ASSY (SEE LIST 3-1-1) | | |
| 2 | | | | | |
| 3 | 5507067-12 | • | CONTROL UNIT | 1 to 2 | SP, OP |
| 4 | | •• | DUMMY (INTERFACE) | 0 to 2 | |
| 5 | | | | | |
| 6 | 5507067-1 | | CANISTER UNIT (DF-F500-AAF8) | (2 to 10) | SP, OP |
| 7 | 5507067-2 | | CANISTER UNIT (DF-F500-AAF18) | (2 to 10) | SP, OP |
| 8 | 5507067-44 | | CANISTER UNIT (DF-F500-AAH18) | (2 to 10) | SP, OP |
| 9 | 5507067-3 | | CANISTER UNIT (DF-F500-AAF36) | (2 to 10) | SP, OP |
| 10 | 5507067-4 | | CANISTER UNIT (DF-F500-AAF72) | (2 to 10) | SP, OP |

① : Indicates a list number of an assembly which is a broad division of the subsystem.

② : Indicates a serial number of a part listed in the above list.

③ : Indicates a part number (drawing number).

④ : Indicates relationship of parts as follows.

No dots: Main assembly

• : Detail part of a main assembly

•• : Detail part of a one-dot subassembly

••• : Detail part of a two-dot subassembly

⑤ : Indicates a part name

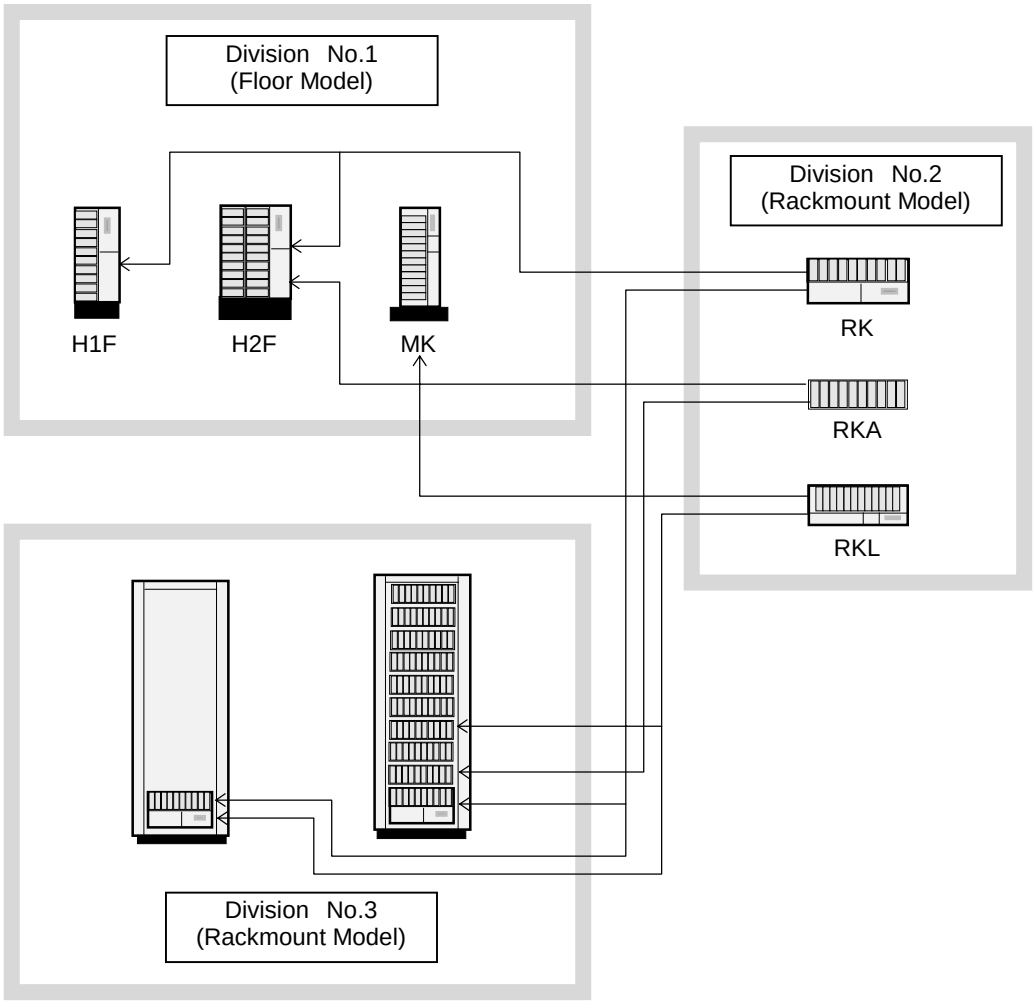
⑥ : Indicates a number of a detailed list when it exists. (Ex.: See No. 3-1-1.)

⑦ : Indicates a quantity per assembly.
Number in parentheses indicates the minimum and maximum quantities of the installed parts.

⑧ : SP and OP means maintenance part and optional part respectively.

## 4.2 System of Parts Catalog

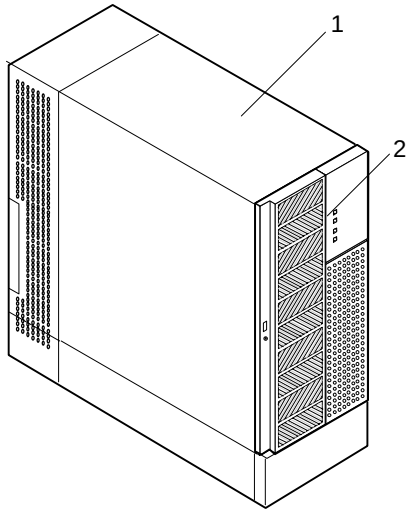
The parts and devices which composes the system are classified as shown below.




| Division | Classification | Name of Part | No. | Sheet No. |
|---|---|---|---|---|
| 1 | Floor Model | Floor model H1F | 1-1 | 04-0030 |
| | | Floor model H2F | 1-2 | 04-0040 |
| | | Floor model MK | 1-3 | 04-0051 |
| 2 | RK , RKA,RKL | DF500-RK | 2-1 | 04-0060 |
| | | DF500-RKA | 2-2 | 04-0090 |
| | | DF500-RKL | 2-3 | 04-0111 |
| 3 | Rackmount Model | U6 Rack frame | 3-1 | 04-0120 |
| | | U4 Rack frame | 3-2 | 04-0140 |

## 4.3 Parts Catalog

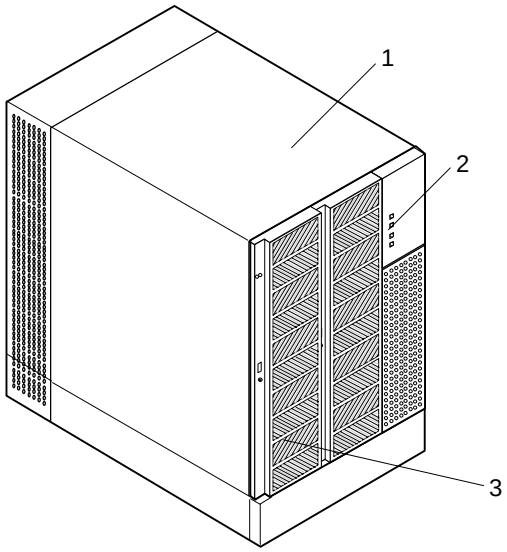
No. 1-1 Floor Model H1F




No.1-1 Floor model H1F

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 1-1 | | Floor model H1F | | |
| 1 | | FLOOR STAND KIT (DF-F500-H1F) | 1 | OP |
| 2 | | DF500-RK | 1 | No.2-1 |

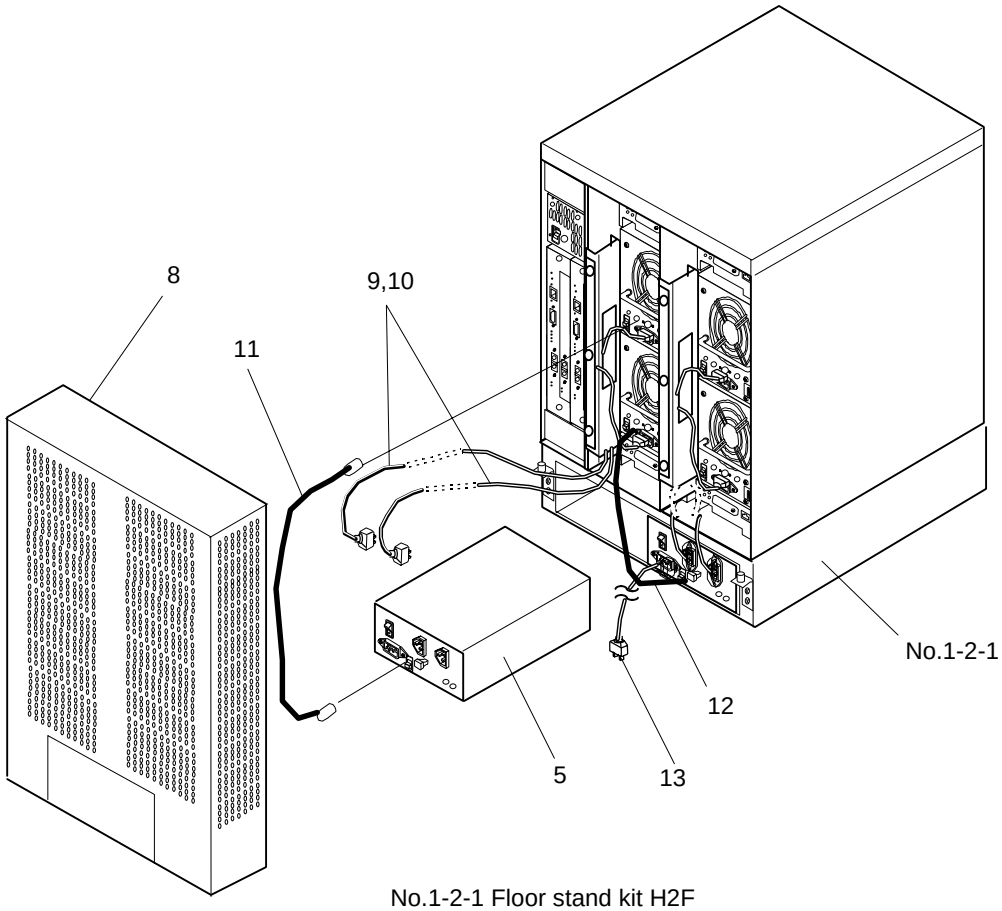
## No. 1-2 Floor Model H2F




No.1-2 Floor model H2F

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 1-2 | | Floor model H2F | | |
| 1 | | FLOOR STAND KIT (DF-F500-H2F) (SEE No.1-2-1) | 1 | OP |
| 2 | | DF500-RK | 1 | No.2-1 |
| 3 | | DF500-RKA | 1 | No.2-2 |

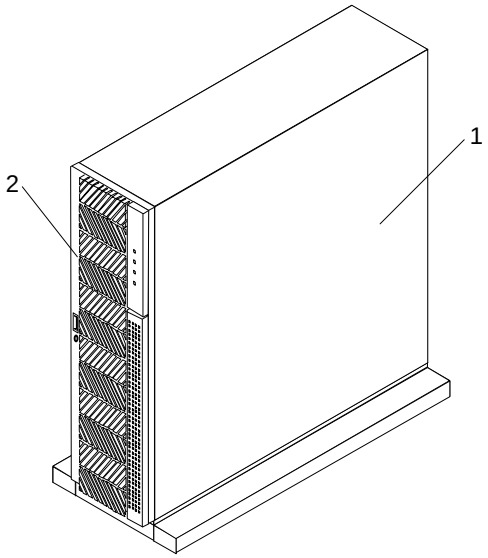
No. 1-2 Floor Model H2F




No.1-2-1 Floor stand kit H2F

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 1-2-1 | | FLOOR STAND KIT (DF-F500-H2F) | | |
| 1 | | | 1 | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | 5507067-24 | • PDB | 2 | SP |
| 6 | | | | |
| 7 | | | | |
| 8 | | • Rear cover | 1 | |
| 9 | 5507067-53 | • Power cable (white) | 2 | SP |
| 10 | 5507067-54 | • Power cable (yellow) | 2 | SP |
| 11 | 5507067-31 | • PDB Interlock cable (white) | 1 | SP |
| 12 | 5507067-52 | • PDB Interlock cable (yellow) | 1 | SP |
| 13 | 5507067-25 | • AC POWER CABLE (J1F) | 2 | SP |
| 14 | | | | |

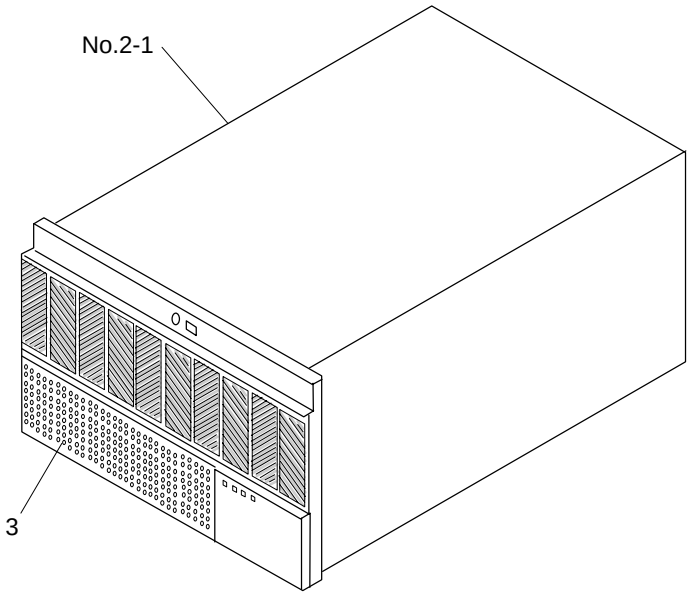
## No. 1-3 Floor Model MK




No.1-3 Floor model MK

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 1-3 | | Floor model MK | | |
| 1 | | FLOOR STAND KIT (DF-F500-H1FL) | 1 | OP |
| 2 | | DF500-RKL | 1 | No.2-3 |

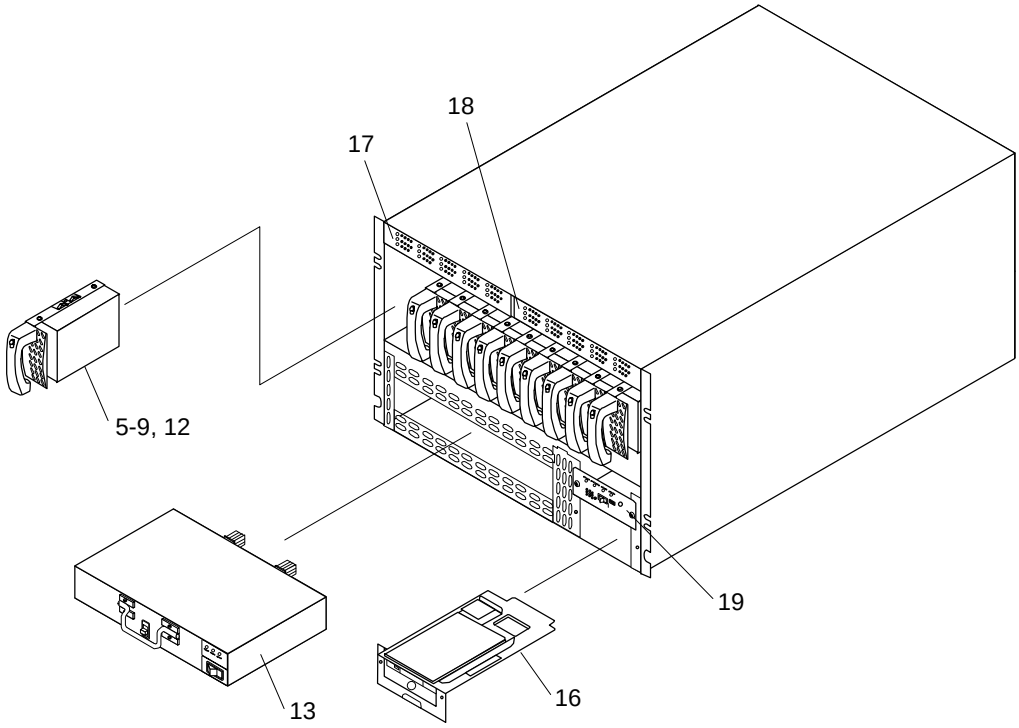
No. 2-1 DF500-RK




No.2-1 DF500-RK (1)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-1 | | DF500-RK | | |
| 1 | | | | |
| 2 | | | | |
| 3 | 2103786-A | • FRONT BEZEL | 1 | |
| 4 | | | | |

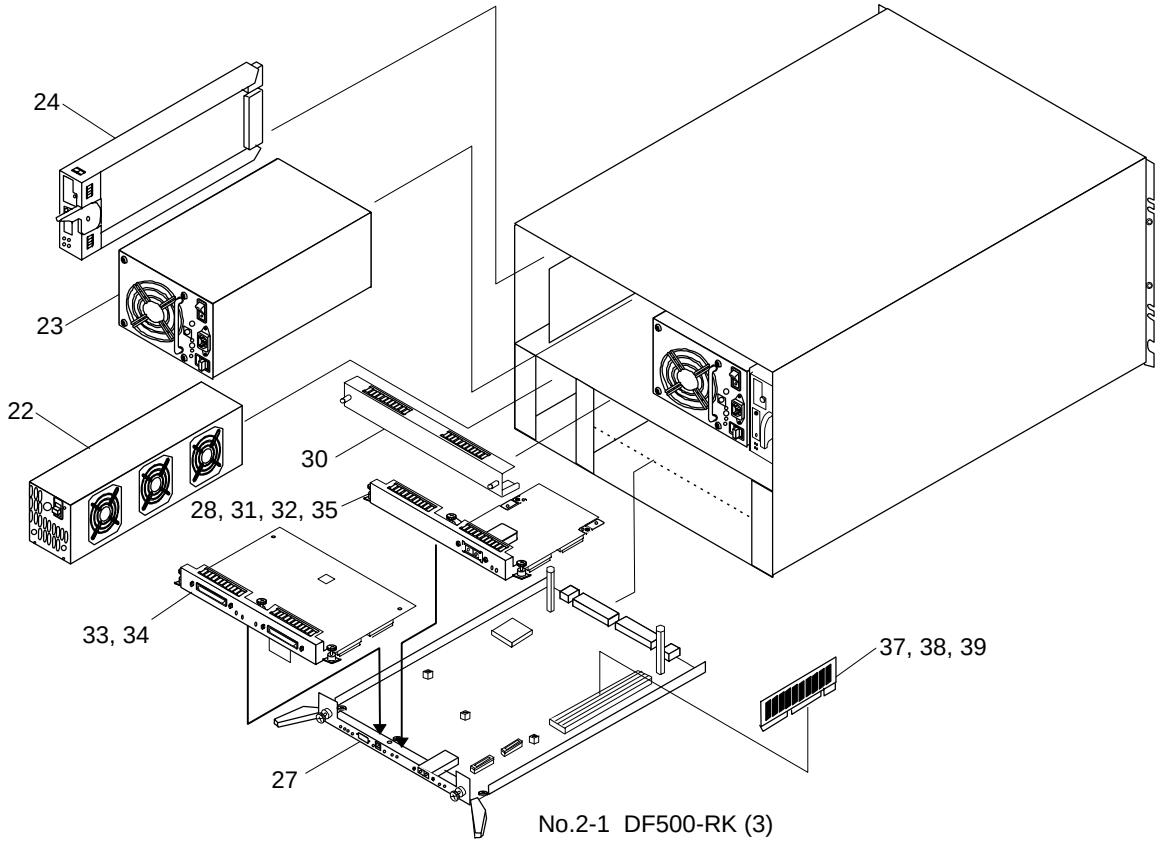
No. 2-1 DF500-RK




No.2-1 DF500-RK (2)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-1 | | | | |
| 5 | 5507067-1 | CANISTER UNIT (DF-F500-AAF8) | (2 to 10) | SP, OP |
| 6 | 5507067-2 | CANISTER UNIT (DF-F500-AAF18) | (2 to 10) | SP, OP |
| 7 | 5507067-44 | CANISTER UNIT (DF-F500-AAH18) | (2 to 10) | SP, OP |
| 8 | 5507067-3 | CANISTER UNIT (DF-F500-AAF36) | (2 to 10) | SP, OP |
| 9 | 5507067-4 | CANISTER UNIT (DF-F500-AAF72) | (2 to 10) | SP, OP |
| 10 | | | | |
| 11 | | | | |
| 12 | 3259090-A | • DUMMY (DISK DRIVE) | 0 to 8 | |
| 13 | 5507067-16 | • BATTERY UNIT | 1 | SP |
| 14 | | | | |
| 15 | | | | |
| 16 | 5507067-17 | • FLOPPY DISK DRIVE | 1 | SP |
| 17 | 3258283-A | • DISK DRIVE PANEL | 1 | |
| 18 | 3258284-A | • DISK DRIVE PANEL | 1 | |
| 19 | 2103718-A | • LED PANEL | 1 | |
| 20 | | | | |

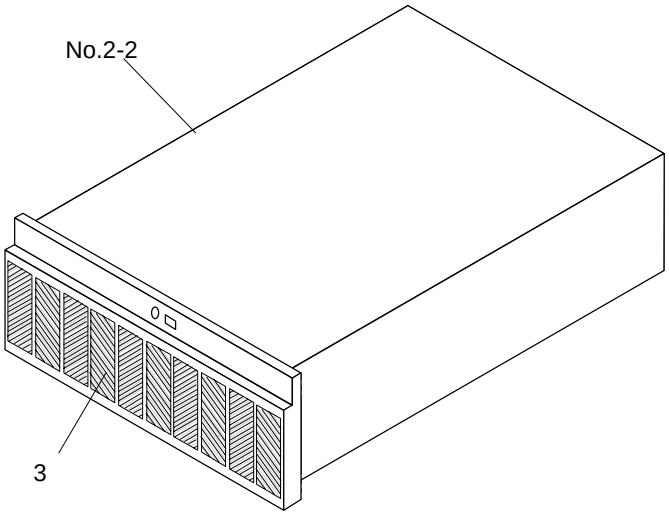
No. 2-1 DF500-RK




No.2-1 DF500-RK (3)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-1 | | | | |
| 21 | | | | |
| 22 | 5507067-18 | • FAN UNIT | 1 | SP |
| 23 | 5507067-5 | • AC/DC POWER SUPPLY (RK) | 2 | SP |
| 24 | 5507067-13 | • ENC (RK) BOARD | 2 | SP |
| 25 | | | | |
| 26 | | | | |
| 27 | 5507067-12 | • CONTROLLER (DF-F500-F1F) | 1 to 2 | SP, OP |
| 28 | 3258285-A | • DUMMY (INTERFACE) | 1 to 2 | |
| 29 | | | | |
| 30 | 3255474-A | • DUMMY (CONTROLLER) | 0 to 1 | |
| 31 | 5507067-76 | INTERFACE BOARD (DF-F500-DFFM6) | (0 to 2) | SP, OP |
| 32 | 5507067-11 | INTERFACE BOARD (DF-F500-DFFM5) | (0 to 2) | SP, OP |
| 33 | 5507067-9 | INTERFACE BOARD (DF-F500-DFUDS) | (0 to 2) | SP, OP |
| 34 | 5507067-10 | INTERFACE BOARD (DF-F500-DFU2S) | (0 to 2) | SP, OP |
| 35 | 5507067-61 | INTERFACE BOARD (DF-F500-DF2G2) | (0 to 2) | SP, OP |
| 36 | | | | |
| 37 | 5507067-7 | CACHE MEMORY (DF-F500-C256) | (1 to 4) | SP, OP |
| 38 | 5507067-22 | CACHE MEMORY (DF-F500-C512) | (1 to 4) | SP, OP |
| 39 | 5507067-8 | CACHE MEMORY (DF-F500-C1G) | (1 to 4) | SP, OP |

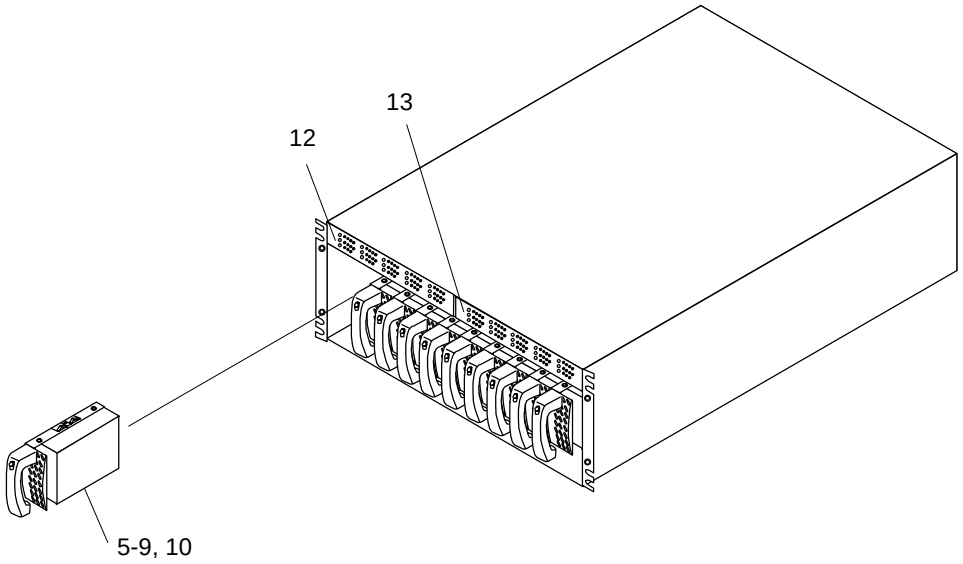
No. 2-2 DF500-RKA




No.2-2 DF500-RKA (1)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-2 | | DF500-RKA | | |
| 1 | | | | |
| 2 | | | | |
| 3 | 2104414-A | • FRONT BEZEL | 1 | |
| 4 | | | | |

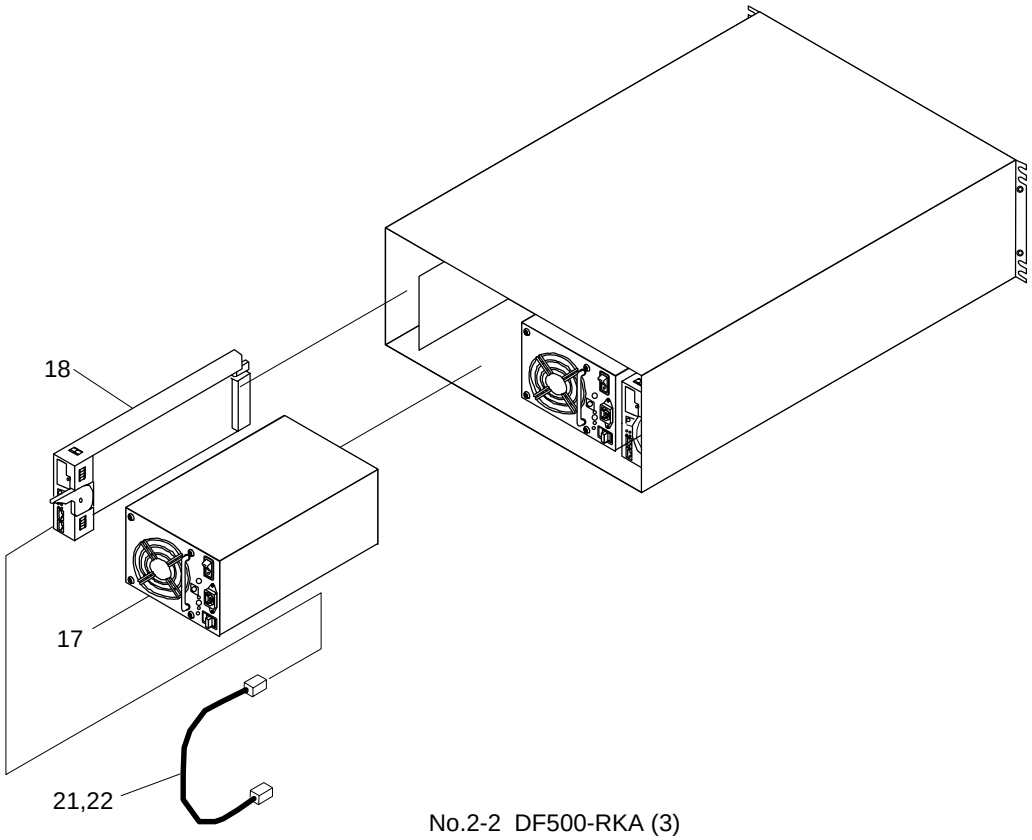
No. 2-2 DF500-RKA




No.2-2 DF500-RKA (2)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-2 | | | | |
| 5 | 5507067-1 | CANISTER UNIT (DF-F500-AAF8) | (2 to 10) | SP, OP |
| 6 | 5507067-2 | CANISTER UNIT (DF-F500-AAF18) | (2 to 10) | SP, OP |
| 7 | 5507067-44 | CANISTER UNIT (DF-F500-AAH18) | (2 to 10) | SP, OP |
| 8 | 5507067-3 | CANISTER UNIT (DF-F500-AAF36) | (2 to 10) | SP, OP |
| 9 | 5507067-4 | CANISTER UNIT (DF-F500-AAF72) | (2 to 10) | SP, OP |
| 10 | 3259090-A | • DUMMY (DISK DRIVE) | 0 to 8 | |
| 11 | | | | |
| 12 | 3258283-B | • DISK DRIVE PANEL | 1 | |
| 13 | 3258284-B | • DISK DRIVE PANEL | 1 | |
| 14 | | | | |
| 15 | | | | |

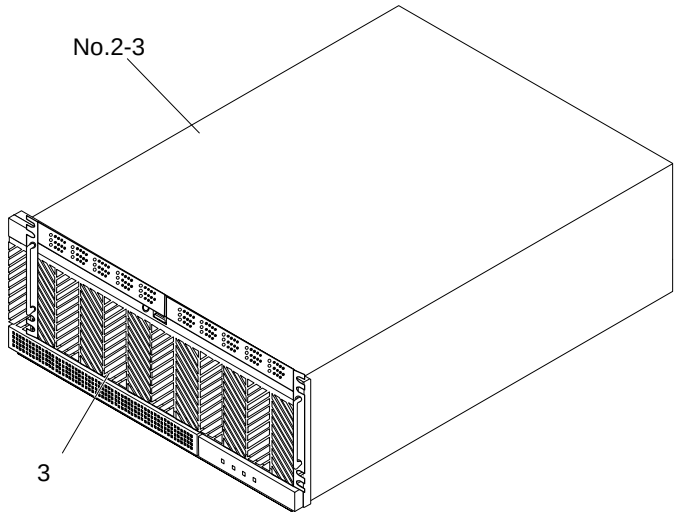
No. 2-2 DF500-RKA




No.2-2 DF500-RKA (3)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-2 | | | | |
| 16 | | | | |
| 17 | 5507067-6 | • AC/DC POWER SUPPLY (RKA) | 2 | SP |
| 18 | 5507067-14 | • ENC (RKA) BOARD | 2 | SP |
| 19 | | | | |
| 20 | | | | |
| 21 | 5507067-19 | • ENC CABLE (0.25 m) | 4 | SP |
| 22 | 5507067-77 | ENC CABLE (0.5 m × 2) | 0 to 2 | OP |
| 23 | | | | |

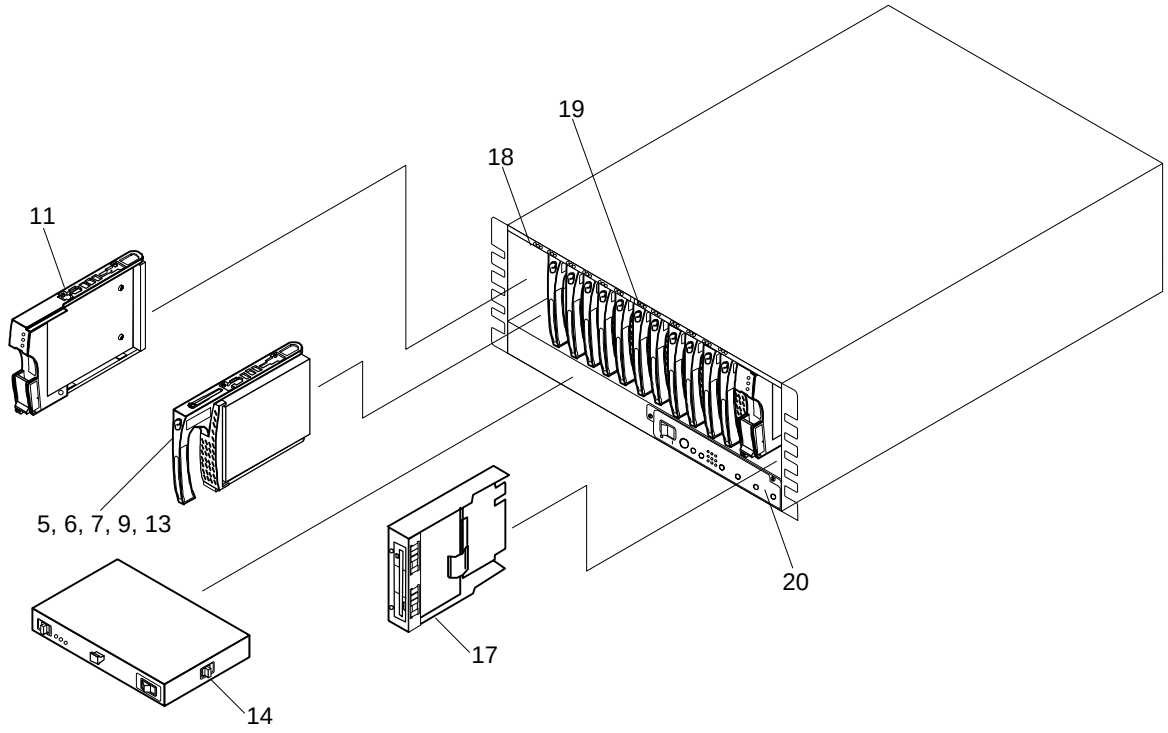
No. 2-3 DF500-RKL




No.2-3 DF500-RKL (1)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-3 | | DF500-RKL | | |
| 1 | | | | |
| 2 | | | | |
| 3 | 2105100-A | • FRONT BEZEL | 1 | |
| 4 | | | | |

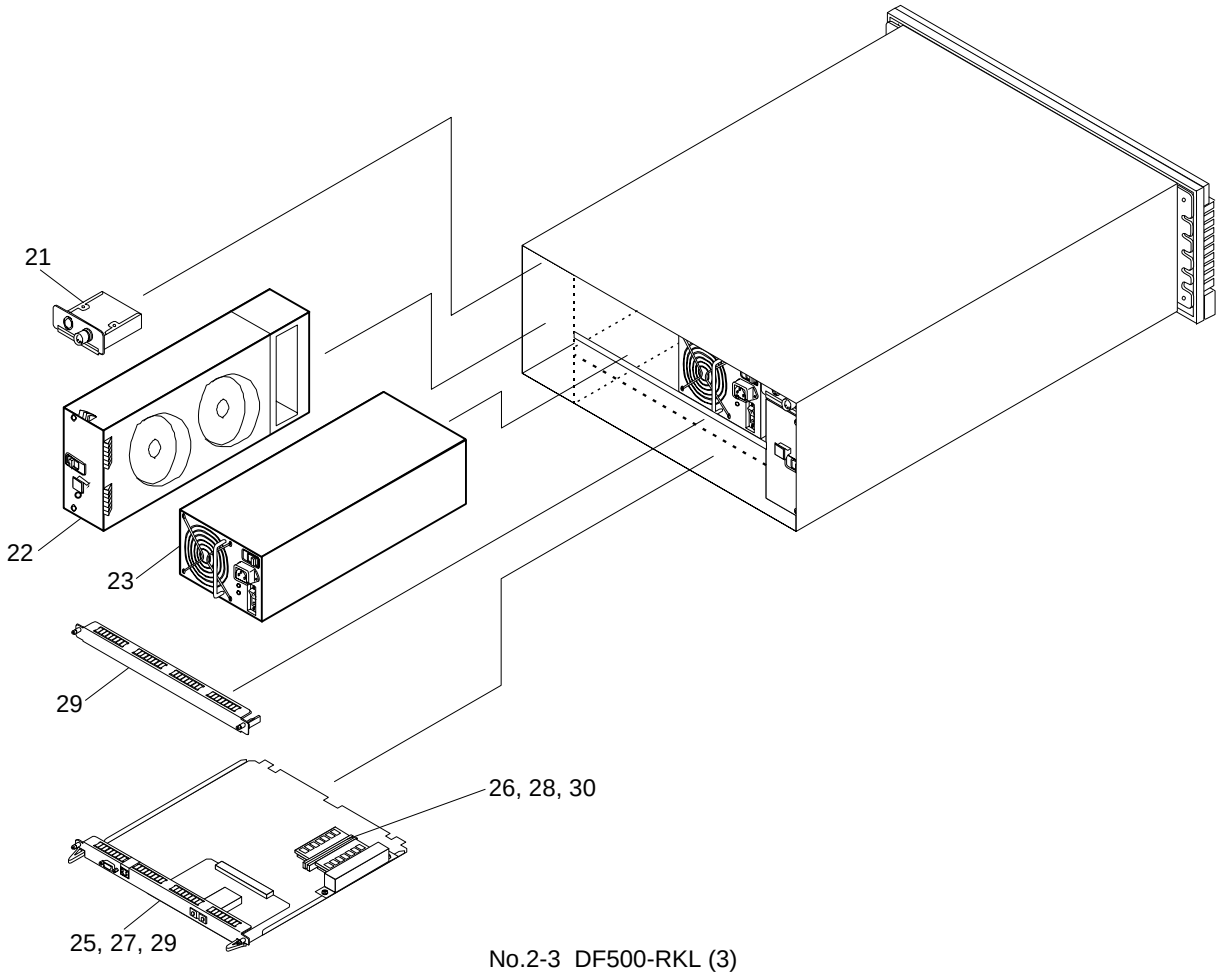
No. 2-3 DF500-RKL




No.2-3 DF500-RKL (2)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-3 | | | | |
| 5 | 5507067-81 | CANISTER UNIT (DF-F500-ACF18) | (2 to 12) | SP, OP |
| 6 | 5507067-93 | CANISTER UNIT (DF-F500-ACH18) | (2 to 12) | SP, OP |
| 7 | 5507067-82 | CANISTER UNIT (DF-F500-ACF36) | (2 to 12) | SP, OP |
| 8 | | | | |
| 9 | 5507067-83 | CANISTER UNIT (DF-F500-ACF72) | (2 to 12) | SP, OP |
| 10 | | | | |
| 11 | 5507067-87 | • ENC (RKL) BOARD | 2 | SP |
| 12 | | | | |
| 13 | 3259090-A | • DUMMY (DISK DRIVE) | 0 to 10 | |
| 14 | 5507067-88 | • BATTERY UNIT | 1 | |
| 15 | | | | |
| 16 | | | | |
| 17 | 5507067-89 | • FLOPPY DISK DRIVE | 1 | SP |
| 18 | 3258583-A | • DISK DRIVE PANEL | 1 | |
| 19 | 3258284-A | • DISK DRIVE PANEL | 1 | |
| 20 | 2103718-A | • LED PANEL | 1 | |

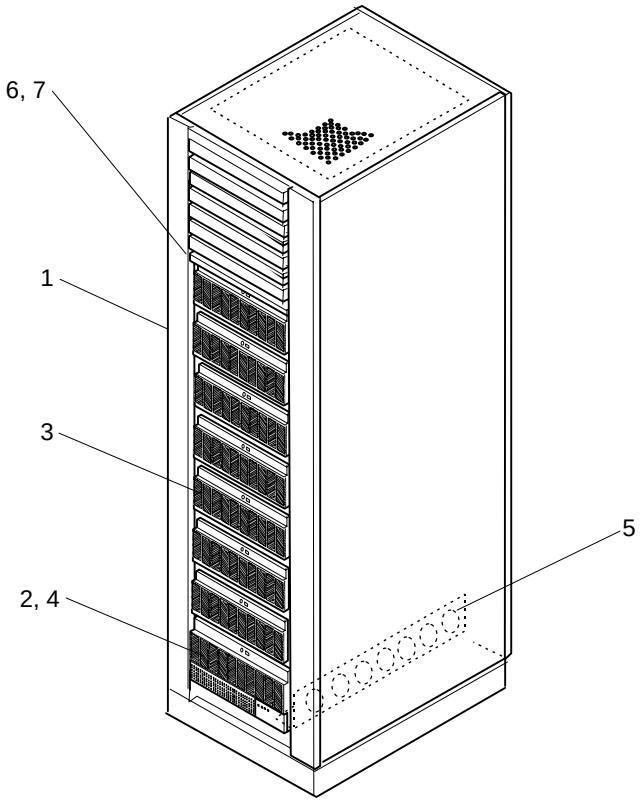
No. 2-3 DF500-RKL




No.2-3 DF500-RKL (3)

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 2-3 | | | | |
| 21 | 3261236-A | • UPS CONECTOR | 2 | |
| 22 | 5507067-90 | • FAN UNIT | 2 | SP |
| 23 | 5507067-84 | • AC/DC POWER SUPPLY (RKL) | 2 | SP |
| 24 | | | | |
| 25 | 5507067-85 | CONTROLLER (DF-F500-F1FL) | (1 to 2) | SP, OP |
| 26 | 5507067-91 | •• CACHE MEMORY | 1 | SP |
| 27 | 5507067-86 | CONTROLLER (DF-F500-F2FL) | (1 to 2) | SP, OP |
| 28 | 5507067-91 | •• CACHE MEMORY | 1 | SP |
| 29 | 5507067-92 | CONTROLLER (DF-F500-F3FL) | (1 to 2) | SP, OP |
| 30 | 5507067-91 | •• CACHE MEMORY | 1 | SP |
| 31 | | | | |
| 32 | 3258287-A | • DUMMY (CONTROLLER) | 0 to 1 | |
| 33 | | | | |
| 34 | | | | |
| 35 | | | | |

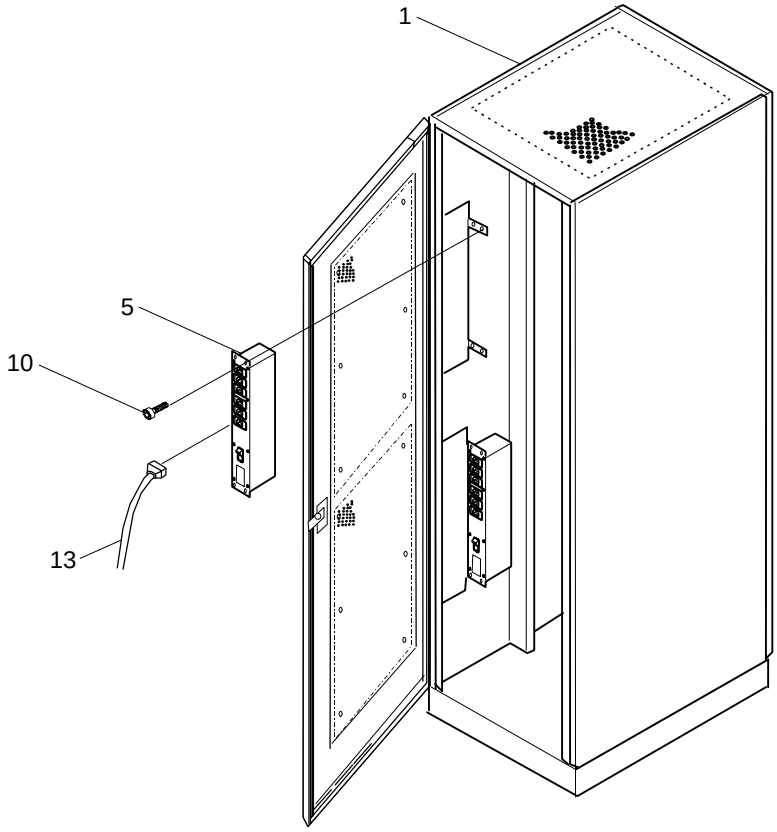
No. 3-1 Rackmount Model With U6 Rack Frame)




No.3-1 U6 Rack frame

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 3-1 | | U6 RACK FRAME | | |
| 1 | | DF-F500-U6 (SEE No. 3-1-1) | 1 | OP |
| 2 | | DF500-RK | (1 to 6) | No.2-1 |
| 3 | | DF500-RKA | (0 to 9) | No.2-2 |
| 4 | | DF500-RKL | (0 to 9) | No.2-3 |
| 5 | | RAIL KIT (DF-F500-URHT5) | (1-10) | OP |
| 6 | | DECORATION PANEL (1U) (DF-F500-U10D) | 0 to 34 | OP |
| 7 | | DECORATION PANEL (0.5U) (DF-F500-U05D) | 0 to 1 | OP |

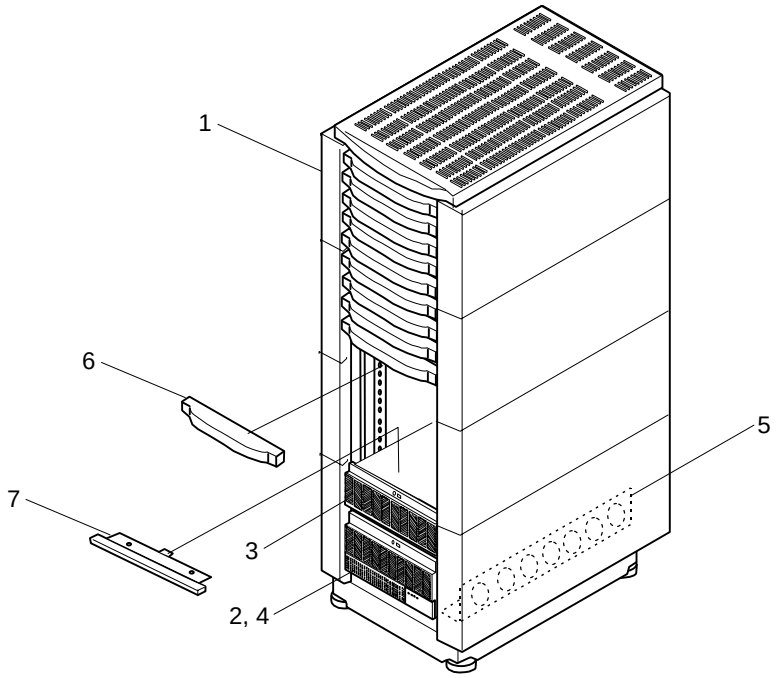
No. 3-1 Rackmount Model With U6 Rack Frame)




No.3-1-1 DF-F500-U6

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 3-1-1 | | DF-F500-U6 | | |
| 1 | 5510303-A | FINAL ASSY (U6) | 1 | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | 5507067-15 | • PDB | 4 | SP |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | BS508 | • Hexagon socket bolt (M5x8) | 16 | |
| 11 | | | | |
| 12 | | | | |
| 13 | 5507067-30 | • AC POWER CABLE | 4 | |
| 14 | | | | |

## No. 3-2 Rackmount Model With U4 Rack Frame

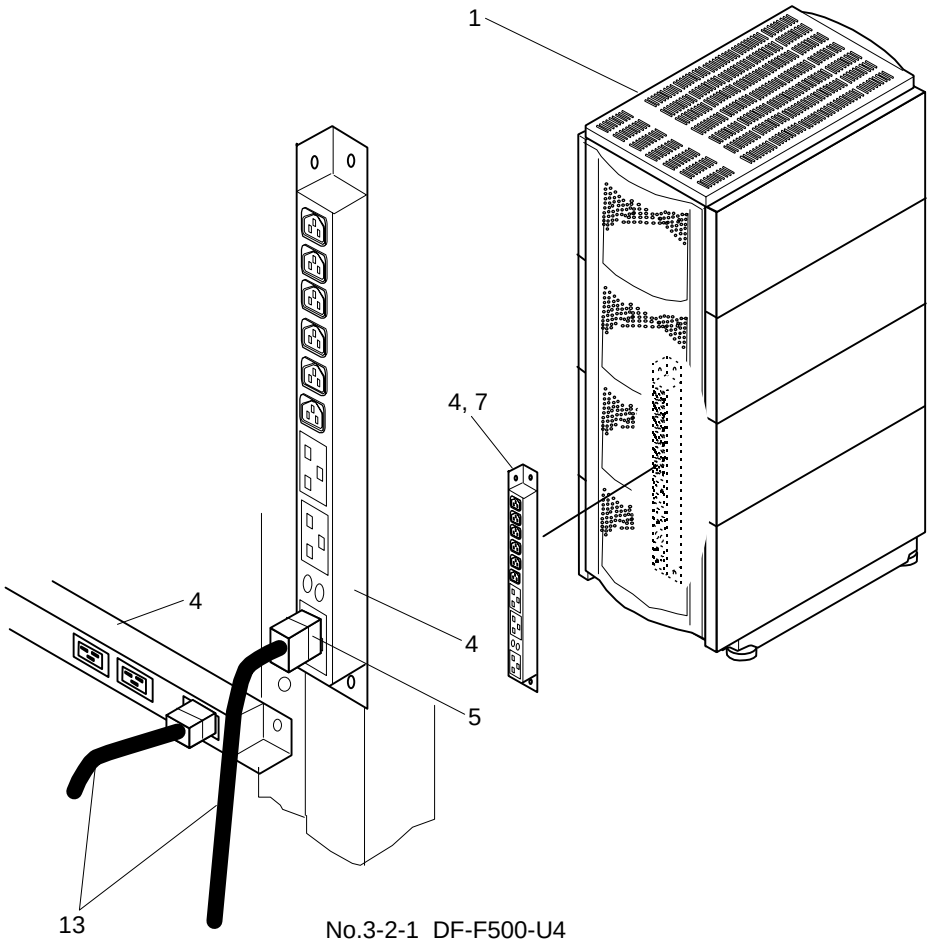



No.3-2 U4 Rack flame

| No. | PART NUMBER | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|
| 3-2 | | U4 RACK FRAME | | |
| 1 | | DF-F500-U4 (SEE No. 3-2-1) | 1 | OP |
| 2 | | DF500-RK | 1 to 5 | No.2-1 |
| 3 | | DF500-RKA | 0 to 7 | No.2-2 |
| 4 | | DF500-RKL | 1 to 5(*1) | No.2-3 |
| 5 | | RAIL KIT (DF-F500-URHP5) | 1 to 7 | OP |
| 6 | 5500750-14 | FILLER PANEL | 1 to 24 | |
| 7 | | DECORATION PANEL (0.5U) (DF-F500-UD05D) | 0 to 1 | OP |

*1 : Up to the seven RKLs can be mounted through an addition of the UPDU (optional).

## No. 3-2 Rackmount Model With U4 Rack Frame




No.3-2-1 DF-F500-U4

| No. | PART NUMBER | | NAME OF PART | UNIT PER ASSY | REMARK |
|---|---|---|---|---|---|
| 3-2-1 | | | DF-F500-U4 | | |
| 1 | 2103208-A | | RACK CHANG ASSY | 1 | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | E7671A | • | PDU | 2 | SP |
| 5 | | •• | STRAIN RELLEF | 2 | |
| 6 | | | | | |
| 7 | | | PDU (DF-F500-UPDU) | 0 to 2 | OP |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | | | |
| 12 | | | | | |
| 13 | E7805A | • | AC POWER CABLE | 2 | SP |
| 14 | | | | | |

# Chapter 5. Maintenance Tools

## 5.1 Maintenance Tools for Hardware

Names and usages of maintenance tools to be used for installation and maintenance are shown below.

| No. | Tool name | Specification | Usage |
|---|---|---|---|
| 1 | Phillips screwdriver | No.2 | General use<br>For fastening RK , RKA or RKL (to rack frame) |
| 2 | Allen wrench | No.3 | For installing floor stand kit |
| 3 | Allen wrench | No.4 | For fastening of AC power cable. |
| 4 | Allen wrench | No.6 | For opening/closing doors (of rack frame) |
| 5 | Spanner | No.13 | For adjusting leveling bolt (of U4 rack frame) |
| 6 | Spanner | No.22 | For adjusting leveling bolt (of U6 rack frame) |

## 5.2 Maintenance Tools for Software

The maintenance tool includes the Disk Array management program or Disk Array management program 2, failure notification program, SNMP agent, and subsystem's built-in WEB.

Outline of the method of monitoring failures by the maintenance tool is shown below. For the constitution and setting of it, refer to the User's Guide of the each program.

(1) Disk Array management program or Disk Array management program 2
This program monitors the status of the subsystem with the polling performed at specified intervals using the failure monitoring function.
A failed section is displayed with red characters in the case of the GUI or with a message designating a failed section in the case of the CLI. For the details, refer to the following manuals.

For details, refer to the following manual.
<Disk Array management program>
- Disk Array management program (for GUI) User's Guide
- Disk Array management program (for CLI) User's Guide

<Disk Array management program2>
- Disk Array management program2 (for GUI) User's Guide
- Disk Array management program2 (for CLI) User's Guide

(2) Failure notification program
When a failure occurs in the subsystem, this program receives information on a failed section reported via the RS232C and outputs it to a log file.
For further details, refer to the "Failure Notification Program User's Guide".

(3) SNMP agent
The SNMP agent monitors failures with the TRAP and GET REQUEST.
When a failure occurs in the subsystem, the failed section is reported with the TRAP.
The GET REQUEST monitors the status of the subsystem with the polling performed at specified intervals.
For further details, refer to the "SNMP Agent Support Function User's Guide".

(4) Subsystem's built-in WEB
The status of the subsystem is monitored with the polling performed at intervals of five seconds when the Page Refresh mode of the WEB is turned on.
For further details, refer to the "Maintenance Manual for WEB".

Table 5.2.1 lists function of each maintenance tool.

## Table 5.2.1 List of Maintenance Tool Functions

| Function / Tool name | Sections in which failures are to be detected by the failure monitoring | | | | | | | | | | | Configuration reference and setting |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Warning (*1) | Disk drive | Fan unit | Battery unit | AC/DC power supply | Cache memory | Another controller | Battery charging circuit | ENC | LOOP | UPS | |
| Disk array management program or Disk Array management program2 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | × | • System parameters<br>• RAID definition<br>• LU definition<br>• Fibre channel information setting, etc. |
| Failure notification program | ○ | ○ | △ | △ | △ | △ | ○ | △ | △ | △ | ○ | None |
| SNMP agent | ○ | △ | △ | △ | △ | △ | □ | △ | △ | △ | ○ | None |
| Subsystem's built-in WEB | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | × | • System parameter (maintenance mode) setting, etc. |

*1: The warning means a case where a failed part is detected or the subsystem enters the status in which a warning is given.

○ : Supported
× : Does not support
△ : Supports but indicates no Disk drive location
□ : Supports matters concerning failures of the own Controller

Connection from of the maintenance tools are shown in Figure 5.2.1.

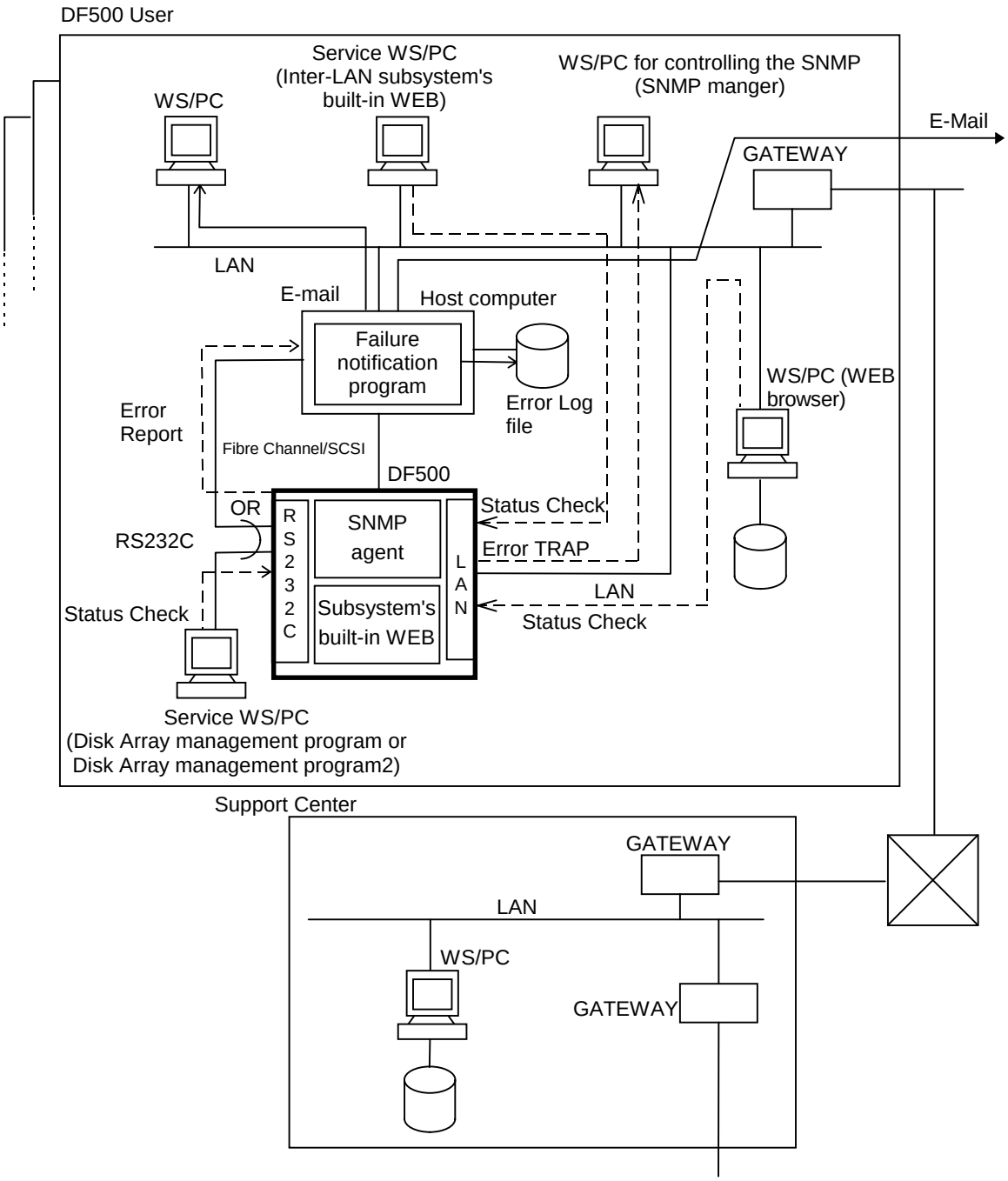



**Figure 5.2.1 Connecting Configuration of Maintenance Tools**

# Appendix

# Appendix A Glossary

Cache backup :

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

Canister :

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

CTL : Controller

CUDG : Control Unit Diagnosis

Destage:

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

ECC : Error Checking and Correcting

EIA : Electronic Industries Alliance

EIA standard 1 EIA unit = 44.45 mm

FC-AL : Fibre Channel Arbitrated Loop

Fibre Channel HBA : Figre Channel Host bus Adapter

Fibre Channel HUB :

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

FC-SW : Fibre Channel-SWitch Topology

GBIC : GigaBit Interface Converter

Host computer :

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

Hot replacement :

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

I/F : Interface

LA : Logical Address

LBA : Logical Block Address

LED : Light Emission Diode

LRC : Longitudinal Redundancy Check

LU : Logical Unit

LVD : Low Voltage Differential

LSI : Large-service Interface

Mirror disk :

A slave disk on which the same data as that on the master disk, which is used to read/write data, is written in the RAID 1 configuration. When a failure occurs in the master disk drive, reading/writing is done from/on the mirror disk.

MTBF : Mean Time Between Failure

MTBDL : Mean Time Between Data Lost

Parity disk :

When configuring RAID 5, one disk drive in a RAID group is designated as the parity disk and the other disk drives as data disks. On the parity disk, parity data calculated from those of data disks is stored. Even when one of the disk drives in a RAID group fails, the subsystem can be used with its data not damaged by virtue of the parity data.

PDB : Power Distribution Box

PDU : Power Distribution Unit

Rack frame:

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

RAID : Redundant Array of Independent (Inexpensive) Disks

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

Remote maintenance function (SNMP) :

SNMP agent support function reports an occurrence of a failure to the workstation for monitoring the network via the SNMP of the open platform.

R/W : Read/Write

SGCB : Segment Control Block

SNNP : Simple Network Management Protocol

Spare disk :

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

UPS : Uninterrupted Power Supply

Write cache :

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

# Appendix B Main Specifications of the Subsystem

Basic specifications of the subsystem and the optional devices which compose a disk array system are shown below.

(1) Floor model

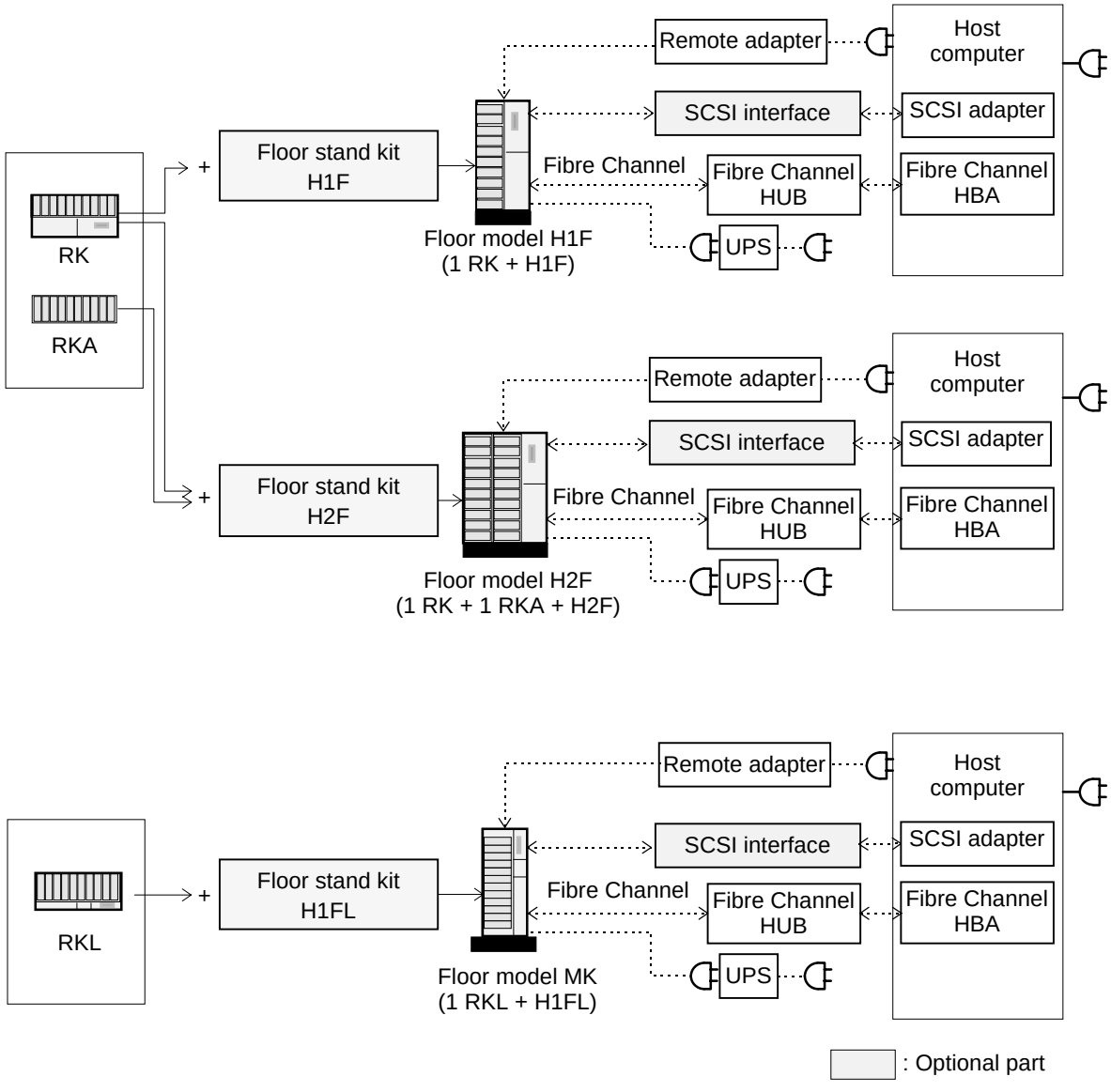



**Figure Appendix B.1 System Outline (Floor Model)**

(2) Rackmount model

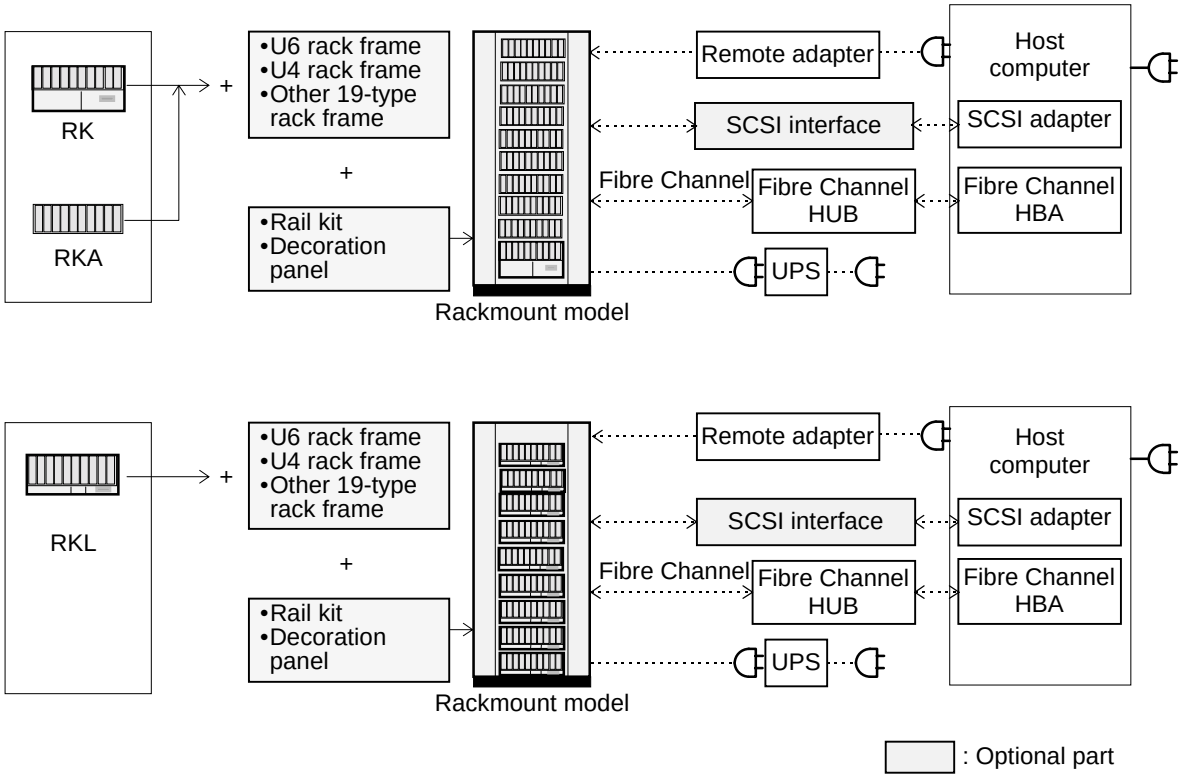
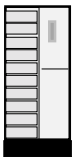
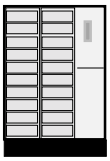
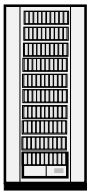
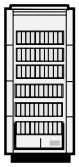



**Figure Appendix B.2 System Outline (Rackmount Model)**

## Appendix B.1 Basic Spcifications of the Subsystem

(1) RK/RKA/H1F/H2F

### Table B.1 Basic Spcifications

| Item \ Model | | Floor model | | Rackmount model | | | |
|---|---|---|---|---|---|---|---|
| | | Floor model H1F | Floor model H2F | RK | RKA | With U6 rack frame | With U4 rack frame |
| Confi-guration | Configuration | 1 RK + H1F Floor stand kit (Optional) | 1 RK + 1 RKA + H2F Floor stand kit (Optional) | 1 RK | 1 RKA | 1 RK + RKA (9units) (Maximum configuration) + U6 rack frame (Optional) | 1 RK + RKA (5units) (Maximum configuration) + U4 rack frame (Optional) |
| | Subsystem appearance |  |  |  |  |  |  |
| Disk drive used | Disk drive size (W×D×H) (mm) | Thin type : 101.6×146.1×25.4<br>Thick type : 101.6×146.1×41.5 | | | | | |
| | Data capacity (G byte) | 8.7/17.8/35.7/71.6 | | | | | |
| | Rotational speed ($min^{-1}$) | 10,000/15,000 | | | | | |
| | Maximum mountable quantity (unit) | 10 | 20 | 10 | 10 | 100 | 60 |
| Host interface | Host interface | •2 G bps Fibre Channel Optical (Non-OFC, 200-M5-SN-I)<br>•Fibre Channel Optical (Non-OFC, 100-M5-SN-I)<br>•Ultra_2-Wide SCSI Low Voltage Differential (LVD)<br>•Ultra-Wide SCSI Single-ended/Differential | | | — | •2 G bps Fibre Channel Optical (Non-OFC, 200-M5-SN-I)<br>•Fibre Channel Optical (Non-OFC, 100-M5-SN-I)<br>• Ultra_2-Wide SCSI Low Voltage Differential (LVD)<br>• Ultra-Wide SCSI Single-ended/ Differential | |
| | Data transfer speed (i.e. maximum speed for transfer to host) | •200 M bytes/s (Fibre Channel)<br>•100 M bytes/s (Fibre Channel)<br>• 80 M bytes/s (Ultra_2-Wide SCSI)<br>• 40 M bytes/s (Ultra-Wide SCSI) | | | — | •200 M bytes/s (Fibre Channel)<br>•100 M bytes/s (Fibre Channel)<br>•80 M bytes/s (Ultra_2-Wide SCSI)<br>•40 M bytes/s (Ultra-Wide SCSI) | |
| | Number of ports: Single controller | Fibre Channel :1 to 2<br>SCSI : 1 | | | — | Fibre Channel :1 to 2<br>SCSI : 1 | |
| | Number of ports: Dual controller | Fibre Channel : 2 to 4<br>SCSI : 2 | | | — | Fibre Channel : 2 to 4<br>SCSI : 2 | |
| | Transferred block size (bytes) | 512 | | | | | |

| Item \ Model | | | Floor model | | Rackmount model | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Floor model H1F | Floor model H2F | RK | RKA | With U6 rack frame | With U4 rack frame |
| RAID specifications(*1) | RAID level(*2) | | 0/1/5/0+1 | | | | | |
| | RAID configuration (unit of addition) | RAID 0 | 2D to 10D | 2D to 16D | 2D to 10D | — | 2D to 16D | |
| | | RAID 1 | 1D+1P | | | — | 1D+1P | |
| | | RAID 5 | 2D+1P to 9D+1P | 2D+1P to 15D+1P | 2D+1P to 9D+1P | — | 2D+1P to 15D+1P | |
| | | RAID 0+1 | 2D+2P to 5D+5P | 2D+2P to 8D+8P | 2D+2P to 5D+5P | — | 2D+2P to 8D+8P | |
| Internal logic specifications | Control CPU | | MPC750e (300 MHz) | | | — | MPC750e (300 MHz) | |
| | Control OS | | VxWorks | | | — | VxWorks | |
| | Control memory | | •Flash memory : 2 M bytes<br>•L2 Cache memory : 512 k bytes<br>•SRAM : 64 M bytes | | | — | •Flash memory : 2 M bytes<br>•L2 Cache memory : 512 k bytes<br>•SRAM : 64 M bytes | |
| | Data bus performance | | Cache access : 610 M bytes/s | | | — | Cache access : 610 M bytes/s | |
| | Data assurance method | | •Data bus : Through-parity<br>•Cache memory : ECC (1 bit for correction, 2 bits for detection)<br>•Disk drive : Data assurance code | | | — | •Data bus : Through-parity<br>•Cache memory : ECC (1 bit for correction, 2 bits for detection)<br>•Disk drive : Data assurance code | |
| Physical Specifications | Start-up time (min) | | Standard : 3(*7) | | | — | Standard : 3(*7) | |
| | Chassis size (W×D×H) (mm) | | 262×737×600 | 417×737×600 | 482.6×656×262 | 482.6×656×152 | 610×813×1,880 | 596×996×1,606 |
| | Mass(*3) (kg) | | 85 approx. | 140 approx. | 65 approx. | 40 approx. | 620 approx. | 400 approx. |
| | Acoustic noise(*4) (dB) | | 60 or less | 65 or less | 60 or less | | 65 or less | |
| | Required height(*5, *6) (EIA unit) | | — | | 6 | 3.5 | Max. 38 | Max. 32 |
| Input power specifications | Input voltage (V) | | AC 100/200 (89 to 127/178 to 254) | | | | AC 200 (178 to 254) | |
| | Frequency (Hz) | | 50/60 ± 1 | | | | | |
| | Number of phases, cabling | | Single-phase with protective grounding | | | | | |
| | Steady-state current(*8) (A) | | 3.5×2/1.8×2 (When the one power supply is connected : (5.8/2.9)) | 6.7×2/3.4×2 | 3.5×2/1.8×2 (When the one power supply is connected : (5.8/2.9)) | 2.8×2/1.4×2 (When the one power supply is connected : (5.8/2.9)) | -/16.0 (One PDB) | -/16.0 (One PDU) |

*1 : D : Data disk
P : Parity disk

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

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

*4 : A noise emitted at the time of start is not included.

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

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

*7 : The start-up time may be longer than three minutes depending on the configuration.

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

| Item | | | Model: Floor model — Floor model H1F | Floor model H2F | Rackmount model — RK | RKA | With U6 rack frame | With U4 rack frame |
|---|---|---|---|---|---|---|---|---|
| Input power specifications | Breaking current (A) | | 20.0 | | | 15.0 | 20.0 | |
| | Required power | Steady state (VA) | 700 (When the one power supply is connected : (580)) | 1,250 | 700 (When the one power supply is connected : (580)) | 550 (When the one power supply is connected : (450)) | 3,200 (One PDB) | 3,200 (One PDU) |
| | | Starting state(*1) (VA) | 800 (When the one power supply is connected : (700)) | 1,450 | 800 (When the one power supply is connected : (700)) | 650 (When the one power supply is connected : (550)) | 3,200 (One PDB) | 3,200 (One PDU) |
| Cache specifications | Capacity (M bytes/CTL) | | 256 to 2,048 | | | — | 256 to 2,048 | |
| | Control method | | Read LRU/Write after | | | — | Read LRU/Write after | |
| | Battery backup | | Provided | | | — | Provided | |
| | Backup duration(*2) (h) | | 48 (When cache of 4,096 M bytes /subsystem is installed) | | | — | 48 (When cache of 4,096 M bytes/subsystem is installed) | |
| Maintenance specifications/ anti-fault specifications | Parts to which hot replacement is applicable(*3) | | •Controller •Disk drive •AC/DC power supply (RK) •Interface board •Cache memory •Fan unit •Battery unit(*4) •ENC (RK) board | •Controller •Disk drive •AC/DC power supply (RK) •AC/DC power supply (RKA) •Interface board •Cache memory •Fan unit •Battery unit(*4) •ENC (RK) board •ENC (RKA) board •PDB | •Controller •Disk drive •AC/DC power supply (RK) •Interface board •Cache memory •Fan unit •Battery unit(*4) •ENC (RK) board | •Disk drive •AC/DC power supply (RKA) •ENC (RKA) board | •Controller •Disk drive •AC/DC power supply (RK) •AC/DC power supply (RKA) •Interface board •Cache memory •Fan unit •Battery unit(*4) •ENC (RK) board •ENC (RKA) board •PDB | •Controller •Disk drive •AC/DC power supply (RK) •AC/DC power supply (RKA) •Interface board •Cache memory •Fan unit •Battery unit(*4) •ENC (RK) board •ENC (RKA) board •PDU |

*1 : Power requirement in the case of the maximum configuration is shown. When planning facilities such as the uninterrupted power supply (UPS), specify the power factor as 100% for calculation. Value at 100 V/200 V is shown.
(Example : 300 W=300 VA)
The actual required power may exceed the value shown in the table when the tolerance is included.

*2 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Disk drives by turning off the power normally, and prevents the battery charge from being wasted.

• When the subsustem enters the Cache Backup mode, a warning (lighting of the orange LED) informing of a voltage drop of the battery may be issued when the subsustem is started. It shows that the remaining capacity of the battery is not sufficient, and in this state, the subsustem operates disabling the Write Cache function automatically.
When the battery is charged, the warning indication disappears, and the subsustem continues the operation enabling the Write Cache function.
The warning indication disappears within 24 hours at the latest. Even when the warning is being indicated, normal functional operation is assured although the operation is performed in the Write-Through mode and the R/W performance is lowered because the Write Cache function is disabled.

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

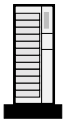
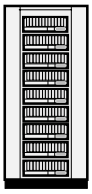
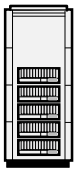
*3 : Only the trained service personnel can perform a hot replacement.

*4 : The battery in the Battery unit is a part to be recycled.

| Item | | Model | Floor model | | Rackmount model | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Floor model H1F | Floor model H2F | RK | RKA | With U6 rack frame | With U4 rack frame |
| Maintenance specifications/ anti-fault specifications | Microprogram installation method | | Flash memory/Disk drive (resident) | | | — | Flash memory/ Disk drive (resident) | |
| | SVP (built-in exclusive tool) function | | •Failure information logging/Power control<br>•Controlling microprogram patching<br>•Disk drive controlling microprogram down loading<br>•Configuration information change<br>•Disk drive recovery initiating process<br>(This process is automatically executed when disk drive is replaced.) | | | — | •Failure information logging/Power control<br>•Controlling microprogram patching<br>•Disk drive controlling microprogram down loading<br>•Configuration information change<br>•Disk drive recovery initiating process<br>(This process is automatically executed when disk drive is replaced.) | |
| | Spare disk | | Up to five of mounted Disk drives can be set to spare disks | | | | | |
| | Floppy disk drive | | •Failure and statistics information logging<br>•Controlling program patching/Disk drive down loading | | | — | •Failure and statistics information logging<br>•Controlling program patching/Disk drive down loading | |
| | Display function | | •Status LEDs (POWER, READY, WARNING, and ALARM)<br>•LED of maintenance part | | | | | |
| Insulation performance | Insulation withstand voltage | | AC 1,500 V (10 mA, 1 min) | AC 1,500 V (100 mA, 1 min) | AC 1,500 V (10 mA, 1 min) | | AC 1,500 V (100 mA, 1 min) | AC 1,500 V (10 mA, 1 min) |
| | Insulation resistance | | DC 500 V, 10 MΩ or more | | | | | |

(2) MK/RKL

## Table B.2 Basic Spcifications

| Item \ Model | | | Floor model | Rackmount model | | |
|---|---|---|---|---|---|---|
| | | | MK | RKL | With U6 rack frame | With U4 rack frame |
| Confi-guration | Configuration | | 1 RKL + H1FL Floor stand kit (Optional) | 1 RKL | RKL (1 to 9 units) + U6 rack frame (Optional) | RKL (1 to 5 units)(*1) + U4 rack frame (Optional) |
| | Subsystem appearance | |  |  |  |  |
| Disk drive used | Disk drive size (W×D×H) (mm) | | Thin type : 101.6×146.1×25.4 | | | |
| | Data capacity (G byte) | | 17.8/35.7/71.6 | | | |
| | Rotational speed ($min^{-1}$) | | 10,000/15,000 | | | |
| | Maximum mountable quantity (unit) | | 12 | 12 | 108 | 60 |
| Host interface | Interface type | | •Fibre Channel Optical (Non-OFC)<br>•Ultra_2-Wide low voltage differential (LVD) SCSI<br>•Ultra-Wide single-ended/differential SCSI | | | |
| | Data transfer speed (i.e. maximum speed for transfer to host) | | •100 M bytes/s (Fibre Channel)<br>• 80 M bytes/s (Ultra_2-Wide SCSI)<br>• 40 M bytes/s (Ultra-Wide SCSI) | | | |
| Host interface | Number of ports | Single controller | Fibre Channel : 1<br>SCSI : 1 | | | |
| | | Dual controller | Fibre Channel : 2<br>SCSI : 2 | | | |
| | Transferred block size (bytes) | | 512 | | | |
| RAID specifi-cations (*2) | RAID level(*3) | | 0/1/5/0+1 | | | |
| | RAID con-figuration (unit of addition) | RAID 0 | 2D to 12D | | | |
| | | RAID 1 | 1D+1P | | | |
| | | RAID 5 | 2D+1P to 11D+1P | | | |
| | | RAID 0+1 | 2D+2P to 6D+6P | | | |

*1 : Up to the seven RKLs can be mounted through an addition of the UPDU (optional).

*2 : D : Data disk
P : Parity disk

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

| Item \ Model | | | Floor model | Rackmount model | | |
|---|---|---|---|---|---|---|
| | | | MK | RKL | With U6 rack frame | With U4 rack frame |
| Internal logic specifi-cations | Control CPU | | MPC750e (300 MHz) | | | |
| | Control OS | | VxWorks | | | |
| | Control memory | | •Flash memory : 2 M bytes<br>•L2 Cache memory : 512 k bytes<br>•SRAM : 64 M bytes | | | |
| | Data bus performance | | Cache access : 610 M bytes/s | | | |
| | Data assurance method | | •Data bus : Through-parity<br>•Cache memory : ECC (1 bit for correction, 2 bits for detection)<br>•Disk drive : Data assurance code | | | |
| Physical Specifi-cations | Start-up time | | Standard : 3(*8) | | | |
| | Chassis size (W×D×H) (mm) | | 260×657×540 | 482.6×656×174 | 610×813×1,880 | 596×996×1,606 |
| | Mass(*1) (kg) | | 70 approx. | 60 approx. | 670 approx. | 400 approx.(*2) |
| | Acoustic noise(*3) (dB) | | 60 or less | | 65 or less | |
| | Required height(*4) (*5) (EIA unit) | | — | 4 | Max. 36 | Max. 20 |
| Input power specifi-cations | Input voltage (V) | | AC 100/200 (89 to 127/178 to 254) | | AC 200 (178 to 254) | |
| | Frequency (Hz) | | 50/60 ± 1 | | | |
| | Number of phases, cabling | | Single-phase with protective grounding | | | |
| | Steady-state current(*6) (A) | | 3.2×2/1.6×2 (When the one power supply is connected : (5.8/2.9)) | | -/16.0 (One PDB) | -/16.0 (One PDU) |
| | Breaking current (A) | | 15.0 | | 20.0 | |
| | Required power | Steady state (VA) | 640 (When the one power supply is connected : (500)) | | 3,200 (One PDB) | 3,200 (One PDU) |
| | | Starting state(*7) (VA) | 720 (When the one power supply is connected : (580)) | | 3,200 (One PDB) | 3,200 (One PDU) |

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

*2 : Approximately 510 kg when the seven RKLs are installed.

*3 : A noise emitted at the time of start is not included.

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

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

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

*7 : Power requirement in the case of the maximum configuration is shown. When planning facilities such as the uninterrupted power supply (UPS), specify the power factor as 100% for calculation. Value at 100 V/200 V is shown. (Example : 300 W=300 VA)
The actual required power may exceed the value shown in the table when the tolerance is included.

*8 : The start-up time may be longer than three minutes depending on the configuration.

| Item \ Model | | Floor model | Rackmount model | | |
|---|---|---|---|---|---|
| | | MK | RKL | With U6 rack frame | With U4 rack frame |
| Cache specifi-cations | Capacity (M bytes/CTL) | 256 | | | |
| | Control method | Read LRU/Write after | | | |
| | Battery backup | Provided | | | |
| | Backup duration(*1) (h) | 48 (When cache of 512 M bytes/subsystem is installed) | | | |
| Mainte-nance specifi-cations/ anti-fault specifi-cations | Parts to which hot replacement is applicable(*2) | •Controller<br>•Disk drive<br>•AC/DC power supply (RKL)<br>•Fan unit<br>•Battery unit(*3)<br>•ENC (RKL) board | | •Controller<br>•Disk drive<br>•AC/DC power supply (RKL)<br>•Fan unit<br>•Battery unit(*3)<br>•ENC (RKL) board<br>•PDB | •Controller<br>•Disk drive<br>•AC/DC power supply (RKL)<br>•Fan unit<br>•Battery unit(*3)<br>•ENC (RKL) board<br>•PDU |
| | Microprogram installation method | Flash memory/Disk drive (resident) | | | |
| | SVP (built-in exclusive tool) function | • Failure information logging/Power control<br>• Controlling microprogram patching<br>• Disk drive controlling microprogram down loading<br>• Configuration information change<br>• Disk drive recovery initiating process (This process is automatically executed when Disk drive is replaced.) | | | |
| | Spare disk | Up to five of mounted Disk drives can be set to spare disks | | | |
| | Floppy Disk drive | • Failure and statistics information logging<br>• Controlling program patching/Disk drive down loading | | | |
| | Display function | • Status LEDs (POWER, READY, WARNING, and ALARM)<br>• LED of maintenance part | | | |
| Insulation perfor-mance | Insulation withstand voltage | AC 1,500 V (10 mA, 1 min) | | AC 1,500 V (100 mA, 1 min) | AC 1,500 V (10 mA, 1 min) |
| | Insulation resistance | DC 500 V, 10 MΩ or more | | | |

*1 :• Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Disk drives by turning off the power normally, and prevents the battery charge from being wasted.

• When the subsystem enters the Cache Backup mode, a warning (lighting of the orange LED) informing of a voltage drop of the battery may be issued when the subsystem is started. It shows that the remaining capacity of the battery is not sufficient, and in this state, the subsystem operates disabling the Write Cache function automatically.

When the battery is charged, the warning indication disappears, and the subsystem continues the operation enabling the Write Cache function.

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

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

*2 : Only the trained service personnel can perform a hot replacement.

*3 : The battery in the Battery unit is a part to be recycled.

# Revision Control

Legend for revision codes : AD : Addition CH : Change CR : Correction DL : Deletion

| REV. | Date | DRW | CHKD | APPD | Sheet No. | Description | Code |
|---|---|---|---|---|---|---|---|
| 0 | Jul.31.2000 | A.Yamanashi | A.Yamanashi | M.Sato | All | Issued | - |
| 1 | Aug.25.2000 | K.Suzuki | K.Suzuki | Y.Takeuchi | All | Issued | - |
| 2 | Oct.10.2000 | K.Suzuki | K.Suzuki | Y.Takeuchi | 00-0000 | Rev.1 → Rev.2 | CH |
| | | | | | 00-0050 | "Powe" in the Subection 2.5 was corrected to "Power". | CR |
| | | | | | 00-0080 | "subsytem" was corrected to "subsystem". | CR |
| | | | | | 01-0010 | "Two years" was changed to "Three years". | CH |
| | | | | | 02-0050 | Description of the 2.2.2 was changed. | CH |
| | | | | | | Description of the SCSI was added to the 2.2.1. | AD |
| | | | | | | ‡2 was added. | AD |
| | | | | | 02-0060 | Description of the SCSI was added to the Item (2). | AD |
| | | | | | | Item (7) was moved to page 02-0061. | DL |
| | | | | | 02-0061 | This page was newly added. (Item (7) was moved to this page from page 02-0060.) | AD |
| | | | | | 02-0130 | SCSI specification was added as Note *2. DF-F500-AAH18 was added as Note *4. | AD |
| | | | | | 02-0140 | DF-F500-AAH18 was added | AD |
| | | | | | 02-0190 | "subsytem" in the Item 1-a was corrected to "subsystem". | CR |
| | | | | | 02-0230 | "anbormal" in the Item 7-b was corrected to "abnormal". | CR |
| | | | | | 02-0240 | "anbormal" in the Item 8-b was corrected to "abnormal". | CR |
| | | | | | 02-0250 | "neme" in the Item was corrected to "name". | CR |
| | | | | | 02-0260 | Item number was changed from (a) to (1). | CH |
| | | | | | 02-0261 | This page (containing "(2) SCSI Interface board") was newly added. | AD |
| | | | | | 02-0262 | This page was newly added. | AD |
| | | | | | 02-0300 | A description concerning SCSI was added to Item (1). | AD |
| | | | | | 02-0320 | Information on the SCSI interface was added to Figure 2.7.1. | AD |
| | | | | | 02-0330 | Some descriptions were added to Item (1). | AD |
| | | | | | 03-0080 | Some contents were added to Item (2) (b). | AD |
| | | | | | 03-0100 | "cache memry" in the (2) was corrected to "Cache memory". | CR |
| | | | | | 03-0110 | "Cache memry" in the (5) was corrected to "Cache memory". | CR |

Legend for revision codes : AD : Addition CH : Change CR : Correction DL : Deletion

| REV. | Date | DRW | CHKD | APPD | Sheet No. | Description | Code |
|---|---|---|---|---|---|---|---|
| | | | | | 03-0180 | The description of the next enhancement in Table 3.7.1 was changed to 05x3/*. | CH |
| | | | | | 03-0220 | Drawings for the cases of 4D+1P and 2D+1P to 15D+1P were modified. | CH |
| | | | | | 04-0000 | "DK500" in the No.2-1 and No.2-2 was corrected to "DF500". | CR |
| | | | | | 04-0010 | DF-F500-AAH18 and DF-F500-AAF72 were added in table. | AD |
| | | | | | 04-0070 | DF-F500-AAH18 was added in No.7. | AD |
| | | | | | 04-0080 | Parts of Nos. 33 and 34 were added. | AD |
| | | | | | 04-0100 | DF-F500-AAH18 was added in No.7. | AD |
| | | | | | 04-0110 | Form of the part of No. 18 was modified. | AD |
| | | | | | 05-0030 | "Battery uniut" in the Item was corrected to "Battery unit". | CR |
| | | | | | 70-0050 | Arrangement in the table was modified. (Pages 07-0060, 07-0070 and 07-0080 were changed by the same reason.) | CH |
| 3 | Dec.10.2000 | K.Suzuki | K.Suzuki | Y.Takeuchi | 00-0000 | Rev.2 → Rev.3 | CH |
| | | | | | 02-0210 | "Orange" in 5-c was corrected to "—". | CR |
| | | | | | 70-0060 | Corrected "Mass"and "Required power". | CR |
| 4 | Jan.10.2001 | K.Suzuki | K.Suzuki | Y.Takeuchi | All | A revision owing to a change of the page format. (Revision numbers of all pages were advanced to 4.) | CH |
| 5 | Mar.20.2001 | K.Suzuki | | | 00-0000 | Rev.4 → Rev.5 | CH |
| | | | | | 00-0050 | Subsection 2.4.2 in contents was deleted. | DL |
| | | | | | | "RK and RKA" in the Subection 2.4.1 was corrected to "RK/RKA and RKL". | CR |
| | | | | | 02-0010 | Description of text was changed. | CH |
| | | | | | 02-0051 | This page was newly added. | AD |
| | | | | | 02-0081 | Corrected Figure 2.3.2. | CR |
| | | | | | 02-0100 | Corrected Figure 2.3.5. | CR |
| | | | | | 02-0111 | Corrected Figure 2.3.10. | CR |
| | | | | | 02-0130 | ‡1 was added. DF-F500-DFFM6, DF-F500-DF2G2 was added to *2. | AD |
| | | | | | 02-0141 | Description of *1 and *2 were changed. | CH |
| | | | | | 02-0170 | Format in the Section 2.4 was modified. ( DF-F500-DF2G2 was added) (Pages 02-0180 to 02-0262 were changed by the same reason.) | CH |
| | | | | | 02-0241 | This page was deleted. | DL |
| | | | | | 02-0340 | RKL was added to Table 2.7.2. | AD |
| | | | | | 03-0020 | RKL was added to Figure 3.1.1. | AD |
| | | | | | 03-0030 | Corrected Figure 3.1.2(1/2).. | CR |
| | | | | | 03-0120 | (4) was added. ("SNMP agent ···") | AD |
| | | | | | | "(5) Password security ···" was moved to page 03-0121. | DL |
| | | | | | 03-0121 | This page was newly added. ((5), (6)) | AD |

Legend for revision codes : AD : Addition CH : Change CR : Correction DL : Deletion

| REV. | Date | DRW | CHKD | APPD | Sheet No. | Description | Code |
|---|---|---|---|---|---|---|---|
| | | | | | 04-0010 | Subsection 4.1 in contents was corrected. (Pages 04-0040, 04-0050, 04-0050, 04-0051, 04-0060, 04-0090, 04-0111, 04-0112, 04-0113, 04-0120, 04-0130, 04-0140 and 04-0150 were changed by the same reason.) | CR |
| | | | | | 04-0080 | No.35 (DF-F500-DF2G2) and No.36 (DF-F500-DFFM6) were added. | AD |
| | | | | | 04-0110 | No.22 was added. (ENC cable : 0.5 m) | AD |
| | | | | | 05-0020 | Description of Disk Array management program2 was added. | AD |
| | | | | | 70-0050 | “RAID spesifications” was moved to page 70-0060. | DL |
| | | | | | 70-0060 | “RAID spesifications” was added. | AD |
| | | | | | | Description of Physical Specifications was changed. (40 s→3min) | CH |
| | | | | | | *6 and *7 was added. | AD |
| | | | | | | *6 was changed to *8 and description was changed. | CH |
| | | | | | 70-0070 | Description of *1 was changed. | CH |
| | | | | | 70-0080 | “Spare disk” was corrected. | CR |
| | | | | | 70-0100 | *8 was added to “Start-up time”. | AD |