Introduction

This “Introduction” volume describes the cautionary/prohibited notes in the maintenance work, the outline of the array, and the configuration, etc.

Contents

Chapter 1. Outline

This chapter provides the outline of the array which composes a disk array system.
It covers the mechanical and power supplying system structures of each model.

1.1 What is RAID

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

- Striping
  It means to store data spreading it on several Drives. Since a datum is written on several Drives, time required to access each Drive is shortened and thus, time required for reading or writing is shortened.
- Mirroring
  It means to copy all the contents of one Drive to one or more Drives at the same time in order to enhance reliability.
- Parity drive
  It is a data writing method used when making a configuration such as RAID 5.
  Parity of data in the corresponding positions of two or more Drives is generated and stored on another Drive.

1.1.1 Application of RAID Technology

When one I/O processing spans multiple Drives (when the stripe size is too small) during transaction processing in RAID 5, the performance cannot be exhibited sufficiently.

Therefore, the stripe size of 256 k bytes is set as a default value in this array. When the Cache Partition Manager function of the priced option is used, the stripe size can be changed to 256 k bytes or 512 k bytes for each Volume.
Lump writing of data on the Drive and pre-reading 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 Drives compose one parity group (2D+1P to 15D+1P); in the RAID 6 configuration, 4 to 30 Drives compose one parity group (2D+2P to 28D+2P).
  Since parity data is generated from 2 to 15 data drives 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. For RAID 5, 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.

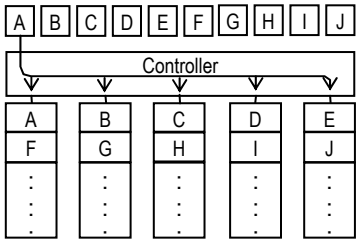
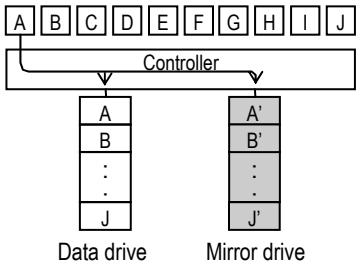
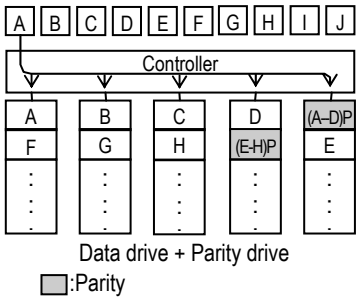
  RAID 5:
  [New parity] = ([Data before update] EOR [Data after update]) EOR [Parity before update]

  RAID 6:
  [New P parity] = ([Data before update] EOR [Data after update]) EOR [P parity before update]
  [New Q parity] = [Coefficient parity] AND ([Data before update] EOR [Data after update]) EOR [Q parity before update]

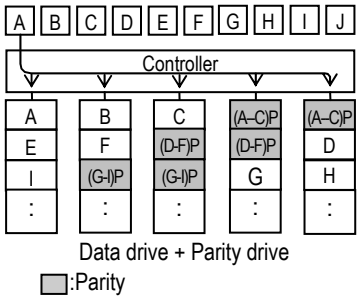
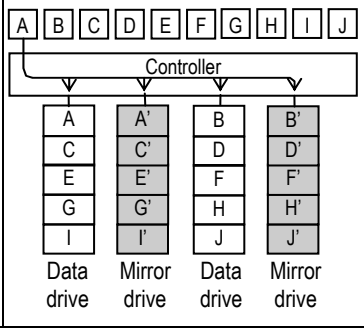
1.1.2 RAID Levels

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 HUS100 series support RAID 1, RAID 5 (2D+1P to 15D+1P), RAID 6 (2D+2P to 28D+2P) and RAID 1+0 (2D+2D to 8D+8D), and also support RAID 0 (2D to 16D) if the CBSL/CBSS/DBL/DBS/DBX/DBW is connected.

Table 1.1.1 Outline of RAID Levels

Level	Configuration	Characteristics	
RAID 0	Data block 	Outline	RAID 0 stripes data across Drives (five Drives in the DF850) to attain higher throughput.
		Advantages	Because Drives having redundant data is not needed, Drives can be used efficiently.
		Disadvantage	Data is lost in any failure of the Drive.
RAID 1	Data block 	Outline	RAID 1 provides data redundancy by copying all the contents of two Drive to another (mirroring). Read/write performance is a little better than the individual Drive.
		Advantages	Data is not lost even if a failure occurs in any Drive. Performance is not lowered even when a Drive fails.
		Disadvantage	RAID 1 is expensive because it requires twice the Drive capacity.
RAID 5	Data block 	Outline	RAID 5 consists of three or more Drives. It uses one of them as a parity drive and writes divided data on the other Drives. Recovery from a failure of a data is possible by utilizing the parity data. Since the parity data is stored on all the Drives, a bottleneck of the parity drive does not occur.
		Advantages	When reading data, RAID 5 stripes data across 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 Drive fails.

*1 : Only the RAID levels supported by DF850 are explained.

Level	Configuration	Characteristics	
RAID 6	Data block  	Outline	RAID 6 consists of four or more Drives. Two independent Drives of them are used as parity Drives and data is scattered and written to the rest of them. The parity data enables data to be restored even when the two Drives fail at the same time.
		Advantages	RAID 6 has ability to withstand failures that is superior to RAID 5 because one data block has two parities.
		Disadvantage	The performance is lowered because the number of Drives is increased by one in comparison with that of RAID 5. The performance is lowered when one or two Drives is/are failed.
RAID 1+0	Data block  	Outline	RAID 1+0 provides data redundancy like RAID 1 by copying all the contents of two Drives to another. Different from RAID 1, data striping is performed over two to eight sets of two Drives.
		Advantages	Data is not lost even if any Drive fails. Besides, since RAID 1+0 stripes data, it can make the performance of dealing with small size random accesses higher comparing with RAID 1. Performance is not lowered even when a Drive fails.
		Disadvantage	RAID 1+0 is expensive because it requires twice the drive capacity.

*1 : Only the RAID levels supported by DF850 are explained.

1.2 Overview of the DF850

1.2.1 Overview of Functions

- This array is used by combining the Controller Box (CBL/CBLE/CBSL/CBSS/CBXSL/CBXSS) with Drive Box (DBL/DBS/DBX/DBW) (‡1) (‡3).

[Controller Box]
- DF850-CBL (hereinafter called CBL.)
- DF850-CBLR1 (hereinafter called CBLE.)
- DF850-CBLD (hereinafter called CBLD.)
- DF850-CBSL + DF-F850-CTLS (hereinafter called CBSL.)
- DF850-CBSS + DF-F850-CTLS (hereinafter called CBSS.)
- DF850-CBSL + DF-F850-CTLXS (hereinafter called CBXSL.)
- DF850-CBSS + DF-F850-CTLXS (hereinafter called CBXSS.)

[Drive Box]
- DF-F850-DBL (hereinafter called DBL)
- DF-F850-DBLD (hereinafter called DBLD)
- DF-F850-DBS (hereinafter called DBS)
- DF-F850-DBSD (hereinafter called DBSD)
- DF-F850-DBF (hereinafter called DBF)
- DF-F850-DBX (hereinafter called DBX)
- DF-F850-DBW (hereinafter called DBW)

- The CBL is a CTU (Controller) in which Drives are not installed. The CBL is an array which configures a system by connecting the DBL/DBS/DBX/DBW/DBF(‡1) and performs RAID control for the Drives to be installed by the Controller. An array can contain up to 960 Drives (when connecting with DBSs or DBXs), and connect up to 40 DBLs, 40 DBSs, 20 DBXs, 12(‡2) DBWs or 40 DBF.
- The CBL, CBSL, CBSS, CBXSL, and CBXSS are models to be installed in a 19-type rack frame.
- There is a special rack frame (A-6516-RK40) that can install a various combination of the CBL (3U), the CBSL/CBSS/CBXSL/CBXSS (2U), the DBL/DBS/DBF (2U), and the DBW (5U) to the maximum of 40U (EIA standard).
- One DBL installs up to 12 Drives of 3.5-inch type (SAS7.2K Drive) and can be used being connected to the CBL, CBSL, CBSS, CBXSL or CBXSS.
- One DBS installs up to 24 Drives of 2.5-inch type (SAS Drive/Flash Drive (SSD) and can be used being connected to the CBL, CBSL, CBSS, CBXSL or CBXSS.
- One DBX installs up to 48 Drives of 3.5-inch type (SAS7.2K Drive) and can be used being connected to the CBL, CBSL or CBSS.
- One DBW installs up to 84 Drives of 3.5-inch type (SAS7.2K Drive) and can be used being connected to the CBL.
- One DBF installs up to 12 Drives of Flash Drive (FMD) and can be used being connected to the CBL.

‡1 : DBW can be connected with a CBL/CBSL/CBSS. When the firmware version is 0950/A or less, DBWs cannot be mixed with other Drive Boxes.

‡2 : When the firmware version is 0920/A or more and less than 0930/A: 4 DBWs.

- The Fibre Channel and iSCSI are adopted in the interface of the host computer.
- When the firmware version is 0937/A or more, the following array (‡1) can be established using the dedicated cable.
  One CBSL can connect the maximum of 19 DBLs, 14 DBSs, seven DBXs or four DBWs, and construct an array (‡1) making 360 Drives one set by the Controller of the CBSLs.
  One CBSS can connect the maximum of 19 DBLs, 14 DBSs, seven DBXs or four DBWs, and a set of 360 Drives is created by the CBSS Controller.
- When the firmware version is less than 0937/A, the following array (‡1) can be established using the dedicated cable.
  One CBSL can connect the maximum of 19 DBLs, nine DBS or five DBXs, and a set of 240 Drives (at the time of using DBX : 264 Drives) is created by the CBSL or CBSS Controller.
- One CBXSLs or CBXSS can be connected to the maximum of 9 DBL, or 4 DBSs by using the exclusive cables, and construct an array (‡1) making 120 Drives one set by the Controller of the CBXSLs or CBXSSs.
- The Fibre Channel and iSCSI are adopted in the host computer of HUS100 series. The Fibre Channel interface connection can be transferred between the hosts at the maximum of 800 Mbytes/s. The iSCSI interface connection can be transferred between the hosts at the maximum of 1,000 Mbytes/s.
- The host interface of the CBXSL/CBXSS installs the 4 ports/1 Controller onboard. Also, 2 ports/1 iSCSI Host I/O Board can be installed in the option.
- The host interface of the CBSL/CBSS installs the 4 ports/1 Controller onboard. Also, 4 ports/1 FC Host I/O Board or 2 ports/1 iSCSI Host I/O Board can be installed in the option.
- 4 ports/1 FC Host I/O Module or 2 ports/1 iSCSI Host I/O Module can be mounted up to two per controller on the host interface of the CBL.

‡1 : Two or more CBLs/CBSLs/CBSSs/CBXSLs/CBXSSs cannot be connected to one array.

The following describes the characteristic functions of this equipment.

(a) Scalability

- When the firmware version is 0937/A or more, the system responding to the wide range of needs can be established. (‡1) The CBSL solely has 12 Drives. The maximum of 19 DBLs is connected to the CBSL to install up to 240 Drives. The maximum of 14 DBSs or seven DBXs is connected to the CBSL to install up to 348 Drives. Furthermore, the maximum of four DBWs is connected to the CBSL to install up to 348 Drives.
- When the firmware version is less than 0937/A, the system responding to the wide range of needs can be established. (‡1) The CBSL solely has 12 Drives. The maximum of 19 DBLs is connected to the CBSL to install up to 240 Drives. The maximum of nine DBSs is connected to the CBSL to install up to 228 Drives. Furthermore, the maximum of five DBXs is connected to the CBSL to install up to 252 Drives.
- When the firmware version is 0937/A or more, the system responding to the wide range of needs can be established.(‡1) The CBSS solely has 24 Drives. The maximum of 19 DBLs is connected to the CBSS to install up to 252 Drives. The maximum of 14 DBSs or seven DBXs is connected to the CBSS to install up to 360 Drives. Furthermore, the maximum of four DBWs is connected to the CBSS to install up to 360 Drives.
- When the firmware version is less than 0937/A, the system responding to the wide range of needs can be established.(‡1) The CBSS solely has 24 Drives. The maximum of 17 DBLs is connected to the CBSS to install up to 228 Drives. The maximum of nine DBSs is connected to the CBSS to install up to 240 Drives. Furthermore, the maximum of five DBXs is connected to the CBSS to install up to 264 Drives.
- The system responding to the wide range of needs can be established.(‡1) The CBXSL solely has 12 Drives or the CBXSS solely has 24 Drives. Furthermore, the maximum of nine DBLs or four DBSs is connected to the CBXSL to install up to 120 Drives.
- The system responding to the wide range of needs can be established (‡1) by connecting the maximum of 40 DBLs or DBSs of the maximum of 20 DBXs to the CBL to install up to 960 Drives (up to 480 Drives when connecting the DBL only).
- Various systems that meet the wide range of needs can be constructed by using the maximum of 960(‡2) Drives by connecting up to 12(‡3) DBWs to the CBL(‡1).
- By using the exclusive rack frame (RK40), you can construct systems that meet needs.
- Spare drives can be set in one system, without selecting installation positions, up to 80 drives in the HUS150 (CBL), up to 30 drives in the HUS130 (CBSL/CBSS) and up to 15 drives in the HUS110 (CBXSL/CBXSS).
  You can use the system effectively by installing each Spare Drive in a Drive slot left unused as a result of the system configuration.
- From the host computer, the array can be used not only as a single large scale Drive but also as 4,096 (in case of the HUS150/130)/2,048 (in case of the HUS110) Volumes (VOL) at the maximum.

‡1 : Two or more CBLs/CBSLs/CBSSs/CBXSLs/CBXSSs cannot be connected to one array.

‡2 : When the firmware version is 0920/A or more and less than 0930/A: 336 Drives.

‡3 : When the firmware version is 0920/A or more and less than 0930/A: 4 DBWs.

- The flexible system, which the Fibre Channel connectors of SW become connectable for the number of the connectors, can be constructed for the Fibre Channel device including the host computer and the DF850 by connecting to the Fabric switch (hereinafter called SW).

(b) Multi-RAID configuration

- Five RAID levels of RAID 0, RAID 1, RAID 5, RAID 6 and RAID 1+0 can be set up.
- Since RAID 1, RAID 5 and RAID 1+0 have parity drives (mirror drives) with redundancy, even if a failure occurs in one of Drives, they do not lose data and can read/write the data as well as the time when there was no failure.
- Since RAID 6 has two parity drives and redundancy, it does not lose data even if up to two Drives fail at the same time and can read/write the data as well as the time when there was no failure.
- For the configuration with RAID 1+0, you can construct a flexible system meeting your needs from the configuration with four data drives (2D+2D) to the configuration with16 data drives (8D+8D).
- For the configuration with RAID 5, you can construct a flexible system meeting your needs from the configuration with 3 data drives (2D+1P) to the configuration with16 data drives (15D+P).
- For the configuration with RAID 6, you can construct a flexible system meeting your needs from the configuration with 4 data drives (2D+2P) to the configuration with 30 data drives (28D+2P).

(c) High-speed data transfer

- The array can read/write data at high speed by starting two or more Drives in parallel.
- With the Fibre Channel Connection, the array can transfer data between the host computer and the array at a maximum speed of 800 M bytes/s. Enough throughput can be acquired even when connecting two or more devices and making multiple access.
- Non-volatile large-capacity Cache memory (HUS150 is 16,384 M bytes/CTL, HUS130 is 16,384 M bytes/CTL, HUS110 is 4,096 M bytes/CTL) is adopted, and speed-up of command execution at the time of read/write hit is intended.

(d) Large capacity

- A maximum of 960 Drives can be connected, and a maximum Drive capacity of 3,758.4 T bytes (in case of RAID 0) can be achieved.

(e) High data availability

- In the redundant RAID configuration (RAID 1/1+0/5), the array can continuously read/write data without shutting down the system by using the parity drives or mirror drives for the failure occurred in one Drive.
- In the redundant RAID 6 configuration, the array can continuously read/write data without shutting down the system by using parity drives for the failure occurred in up to two Drives at the same time.

(f) High data reliability

- The Controller of the array adds the original data assurance codes (8 bytes) by automatic generation, and writes them in the Drive with the data. The data reliability is improved by checking the data at the time of reading.
- On the data bus in the Controller, the automatic generation of the data assurance codes and the check are executed, and the data reliability is improved by the data distribution and concentration control which is peculiar to the array.

(g) Diagnostic maintenance functions

- Diagnosis and maintenance of the array can be performed by using the WEB function of a PC connected to the DF850 via a LAN.
- The status of the array can be checked and a failed part can be identified by Hitachi Storage Navigator Modular 2.
- Diagnosis of the array can be performed from a distant place by using the remote maintenance function (SNMP).

(h) Maintainability

- The addition and maintenance of the array can be performed without powering off the system.
- All the parts of the maintenance target can be replaced without powering off the array.
- Connect only the regular parts defined in the maintenance manual for the maintenance parts.
- When the correction copy attributing to the blockade of the dynamic sparing or the data Drive is completed, if the capacity and the rotational speed are the same for the data Drive and the Spare Drive of the recovery destination and both of them are not the Drives of the DBL/DBS/DBX/DBW, the copy back does not operate even though the blocked Drive is replaced because the attributes of the data Drive and the Spare Drive are switched. Therefore, the influence to the customer's operation is suppressed because there is no deterioration of the host I/O performance by the copy back start after the Drive replacement, and the maintenance time is satisfied with the level of the replacement time of the Drive, and the maintenance cost can be reduced.
  In the following cases, the copy backless does not operate, and the copy back surely operates after the Drive replacement.
  - When the capacity or the rotational speed of the failed Drive and the Spare Drive which recovered the data differs
  - In the following four cases where the Power Saving/Power Saving Plus function is enabled (In the version of 0970/A or more, a Flash Drive operates according to the Spare Drive Operation Mode setting.)

License key status		Source data drive	Target Spare Drive			
			Less than 0940/A		0940/A or more	
			System drive	Non system drive	System drive	Non system drive
Power Saving/ Power Saving Plus	Enable	System drive	As specified	As specified	As specified	As specified
		Non system drive	As specified	As specified	As specified	As specified
	Disable	System drive	Copy back	As specified	As specified	Copy back
		Non system drive	Copy back	As specified	Copy back	As specified

* : System drives correspond to Drives #0 to #4 in CBSS/CBSL/CBSXS/CBXSL, Drives #0 to #4 of Unit ID#0 in DBS/DBL/DBW/DBF connected to CBL, or Drives #A0 to #A4 in DBX, Drives #0 to #4 of Unit ID#0 in DBSD/DBLD connected to CBLD.

(The copy-back operates for maintaining the power saving status that can be changed in the version less than 0940/A. The specification changed to remedy the problems such as the useless copy-back operation among system drives and the biased Spare Drives for the system drives.)

1.3 Structure

For an array, there are CBL/CBLD/CBSL/CBSS/CBXSL/CBXSS/DBL/DBLD/DBS/DBSD/DBF/DBX/DBW.
A rackmount model is made by combining these arrays.
CBL/CBSL/CBSS/CBXSL/CBXSS/DBL/DBS/DBF/DBX/DBW has a Power Unit power-supplied from AC power supply. CBLD/DBLD/DBSD has a Power Unit power-supplied from DC power supply.

When the firmware version is 0937/A or more, the model that the CBSL is the Controller Box can make the system configuration which connects the CBSL (one unit) and up to 14 DBSs (up to 348 Drives), or 19 DBLs (up to 240 Drives), to two racks when the RK40 rack frame is used.
The system can be configured by connecting up to 7 DBXs to one CBSL (up to 348 Drives).
The system can be also configured by connecting up to 4 DBWs to one CBSL (up to 348 Drives).
When installing Drive Boxes (DBSs, DBLs, DBXs, DBWs) together, the number of Drives to be installed depends on the combination of the Drive Boxes.
When the firmware version is 0950/A or less, DBWs cannot be mixed with other Drive Boxes.

When the firmware version is less than 0937/A, the model that the CBSL is the Controller Box can make the system configuration which connects the CBSL (one unit) and up to nine DBSs (up to 228 Drives), or five DBLs (up to 240 Drives), to two racks when the RK40 rack frame is used.
The system can be configured by connecting up to eight DBXs to one CBSL (up to 252 Drives).
When installing Drive Boxes (DBSs, DBLs, DBXs, DBWs) together, the number of Drives to be installed depends on the combination of the Drive Boxes.

When the firmware version is 0937/A or more, the model that the CBSS is the Controller Box can make the system configuration which connects the one CBSS and up to 14 DBSs (up to 360 Drives), or 19 DBLs (up to 252 Drives) to one rack when the RK40 rack frame is used.
The system can be configured by connecting up to 7 DBXs to one CBSL (up to 360 Drives).
The system can be also configured by connecting up to 4 DBWs to one CBSS (up to 360 Drives).
When installing the DBS/DBL and the DBX together, the number of Drives to be installed can be extended up to 360 depending on the combination.
When the firmware version is 0950/A or less, DBWs cannot be mixed with other Drive Boxes.

When the firmware version is less than 0937/A, the model that the CBSS is the Controller Box can make the system configuration which connects the CBSS (one unit) and up to nine DBSs (up to 240 Drives), or 17 DBLs (up to 228 Drives), to one rack when the RK40 rack frame is used.

The system can be configured by connecting up to five DBXs to one CBSL (up to 264 Drives).

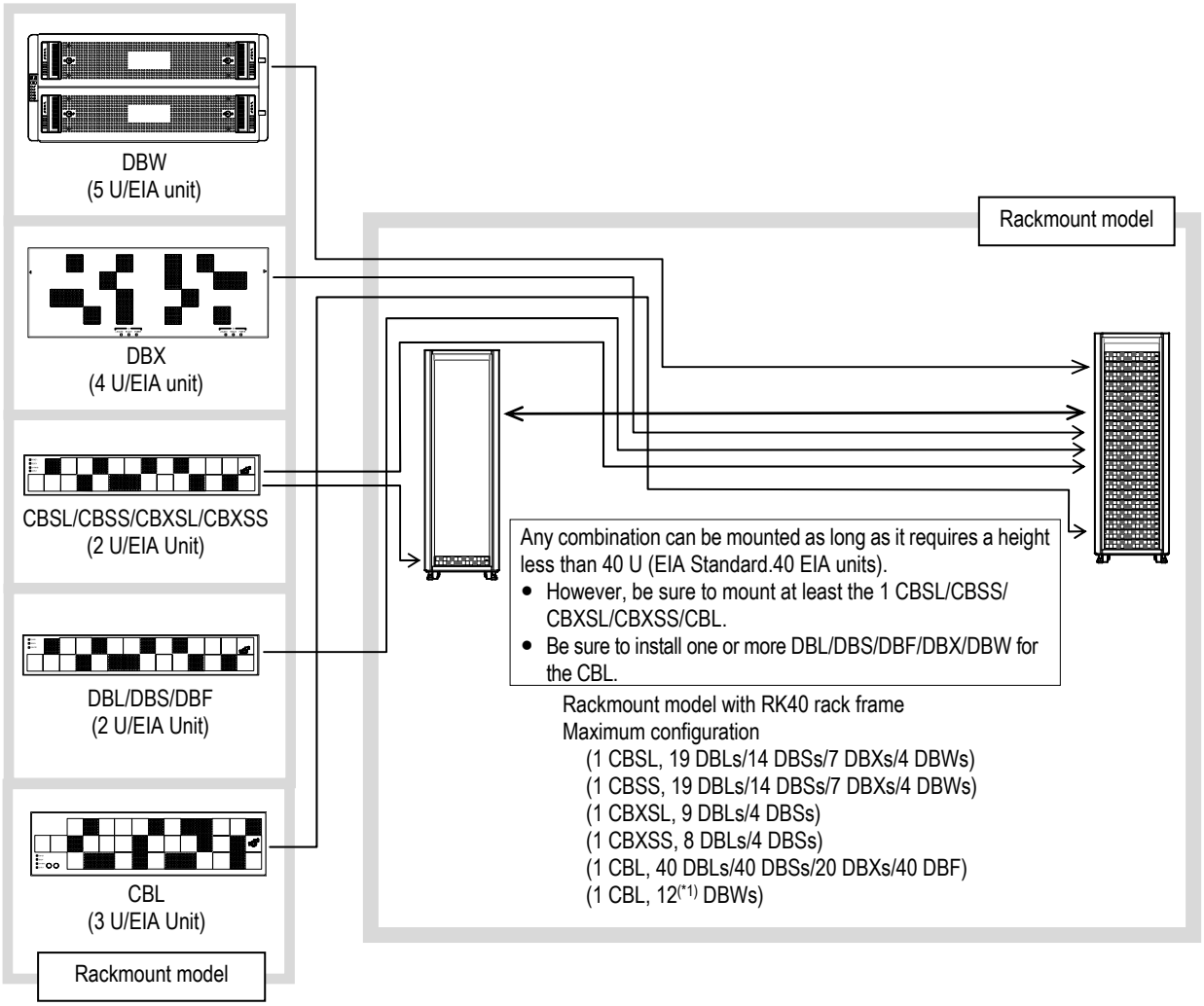
When mounting arrays mixing DBS/DBL and DBXs, the number of installed Drive count is extensible to 360 Drives with combination.

The model that the CBXSL is the Controller Box can make the system configuration which connects the one CBXSL and up to 4 DBSs (up to 108 Drives) or 9 DBLs (up to 120 Drives) to one rack, can be made.

The model that the CBXSS is the Controller Box can make the system configuration which connects the one CBXSS and up to 4 DBSs (up to 120 Drives) or 8 DBLs (up to 120 Drives) to one rack, can be made.
The CBXSL/CBXSS cannot be connected to the DBX.

A model which has a CBL as a controller box, if an RK40 rack frame is used, the system configuration (a maximum of 960 Drives (when connecting with DBSs or DBXs), a maximum of 480 Drives (when connecting DBLs or DBFs)) which connects one CBL and a maximum of 40 DBSs to 3 racks, a maximum of 40 DBLs to 3 racks, a maximum of 40 DBFs to 3 racks, and a maximum of 20 DBXs to 4 racks can be created.
However, when installing Drive Boxes (DBSs, DBLs, DBXs, DBFs, DBWs) together, the number of drives to be installed depends on the combination of the Drive Boxes.

A model which has a CBL as a controller box, if an RK40 rack frame is used, the system configuration (a maximum of 960(‡1) Drives) which connects one CBL and a maximum of 12(‡2) DBWs to one rack can be created.
However, when the firmware version is 0920/A or more and less than 0930/A, DBS/DBL and DBX cannot be installed in the configuration connecting CBL and DBWs.



*1 : When the firmware version is 0920/A or more and less than 0930/A: 4 DBWs.

Figure 1.3.1 Array Configuration

‡1 : When the firmware version is 0920/A or more and less than 0930/A: 336 Drives.
‡2 : When the firmware version is 0920/A or more and less than 0930/A: 4 DBWs.

1.3.1 Appearances

(1) Rackmount model (CBL/CBLD, CBSL/CBSS, CBXSL/CBXSS, DBL/DBLD/DBS/DBSD, DBF, DBX, DBW)

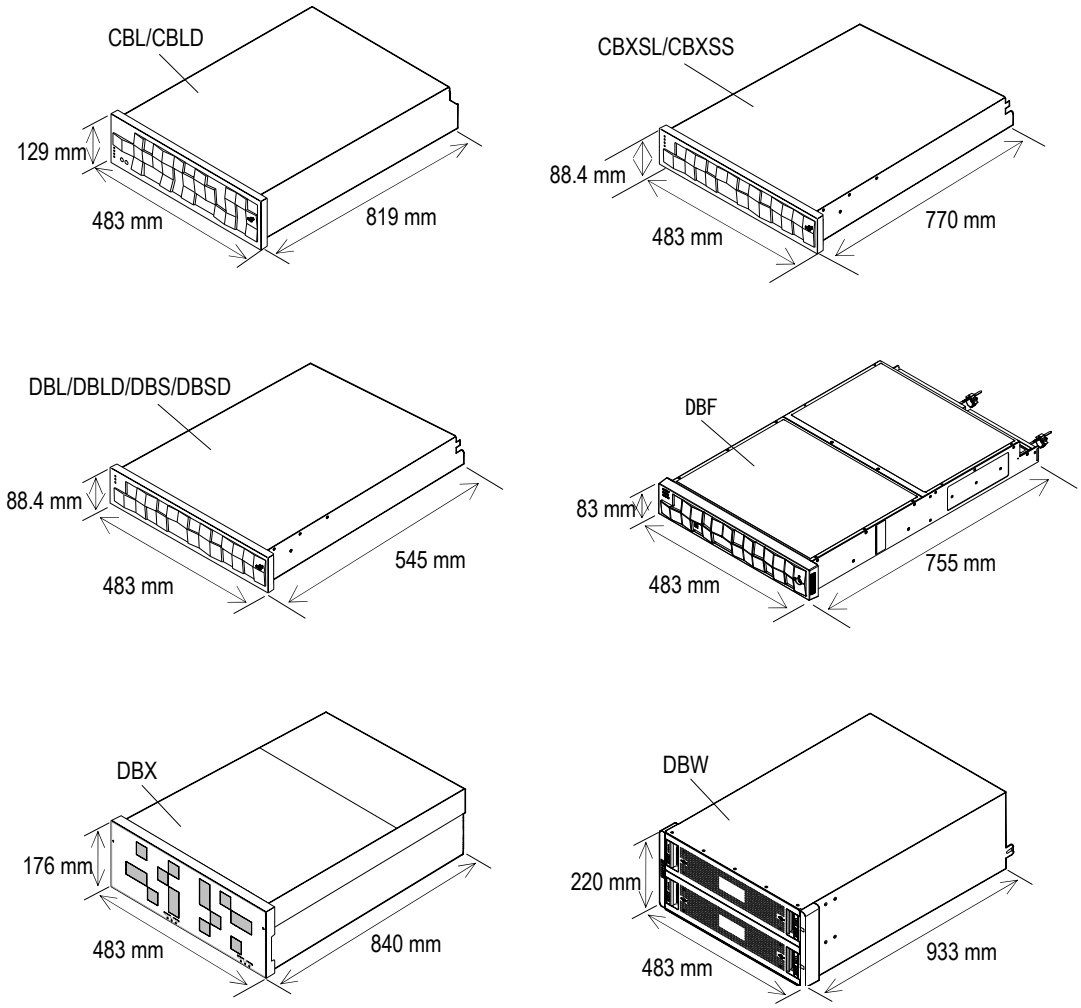


Figure 1.3.2 Appearances of the CBL/CBLD, CBSL/CBSS, CBXSL/CBXSS, DBL/DBLD/DBS/DBSD, DBF, DBX, DBW

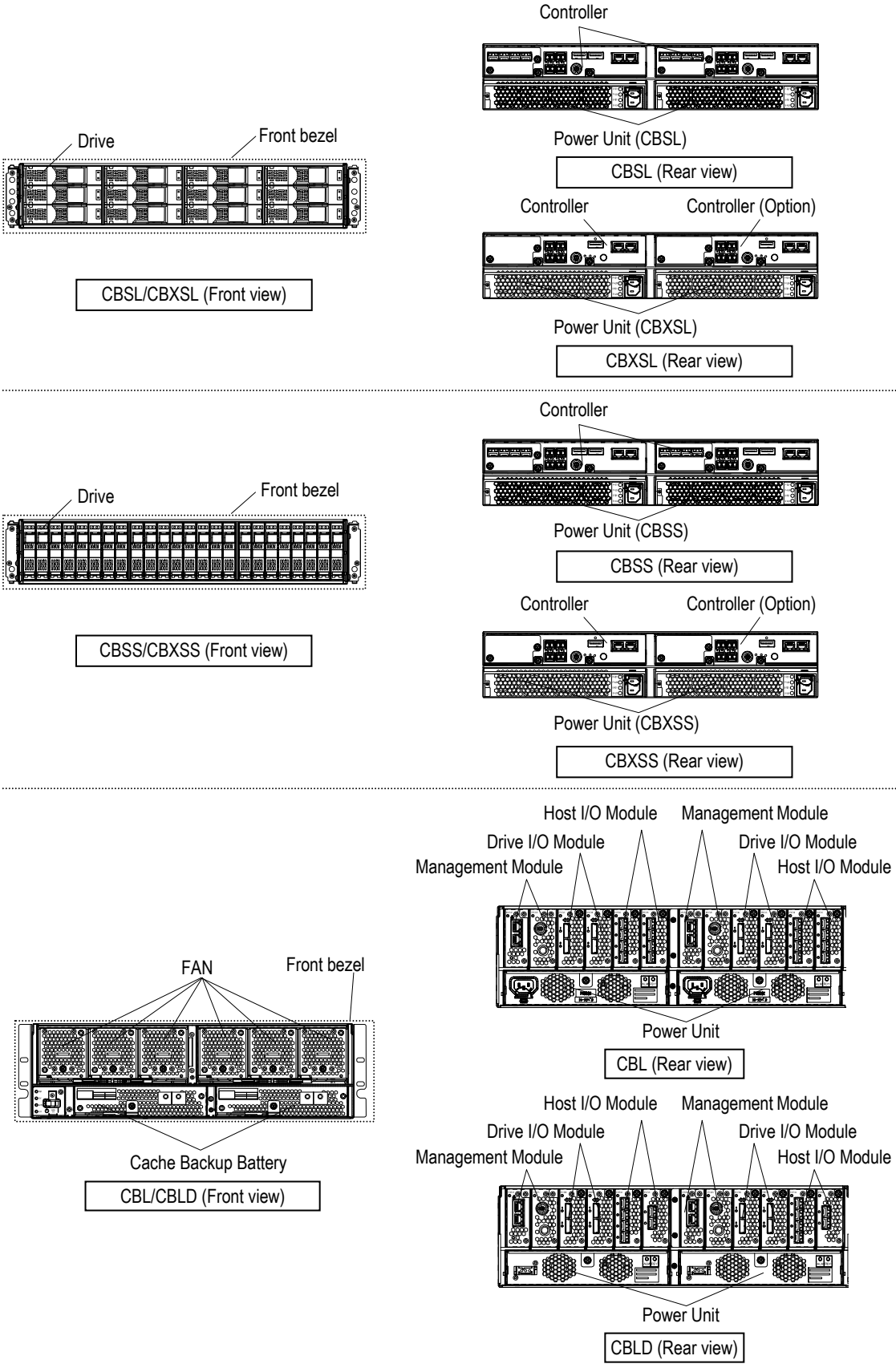


Figure 1.3.3 Major Components of the Controller Box

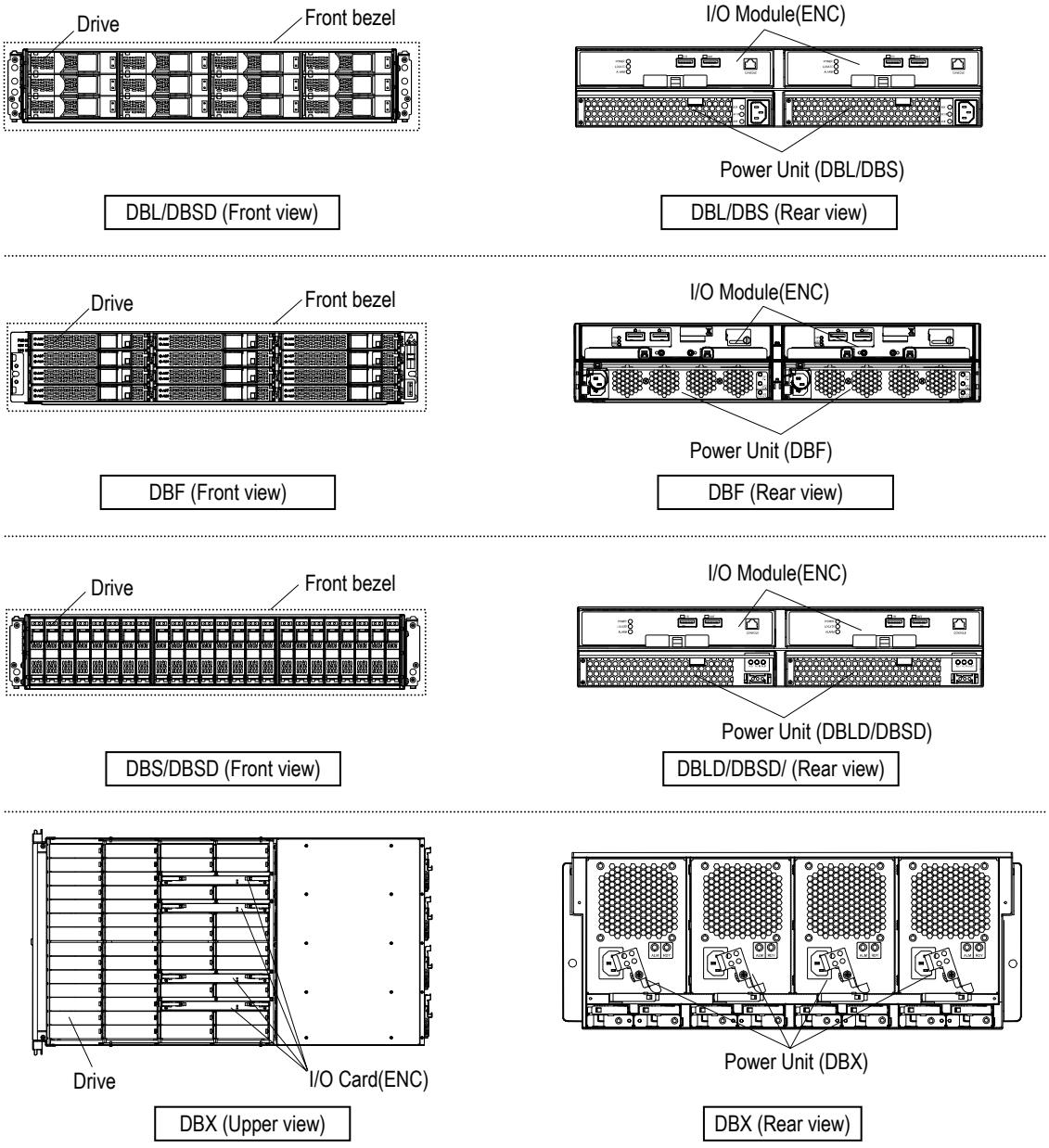


Figure 1.3.4 Major Components of the Drive Box

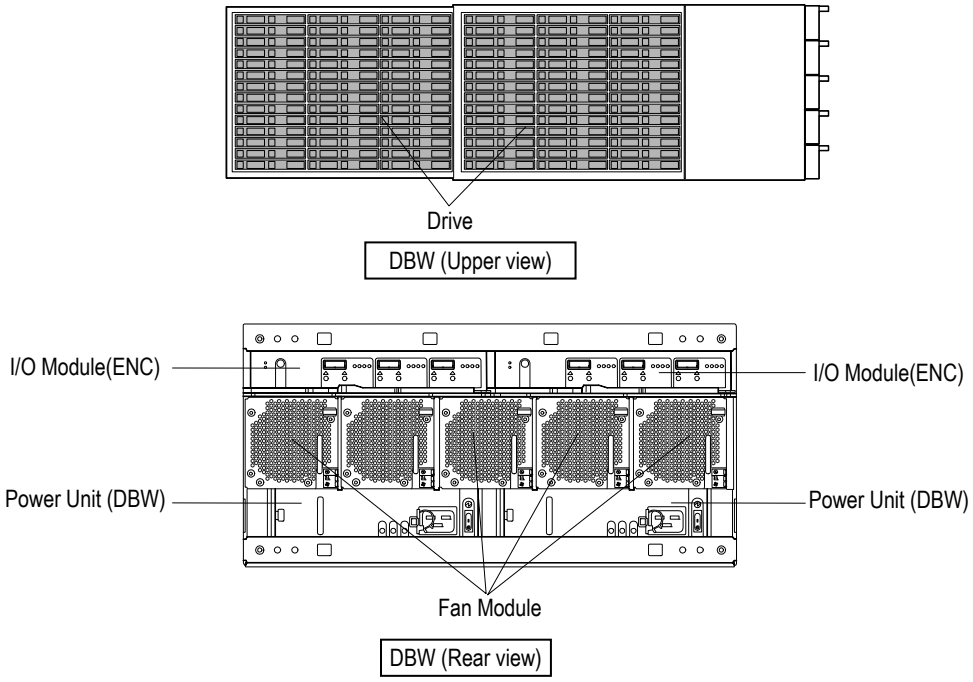
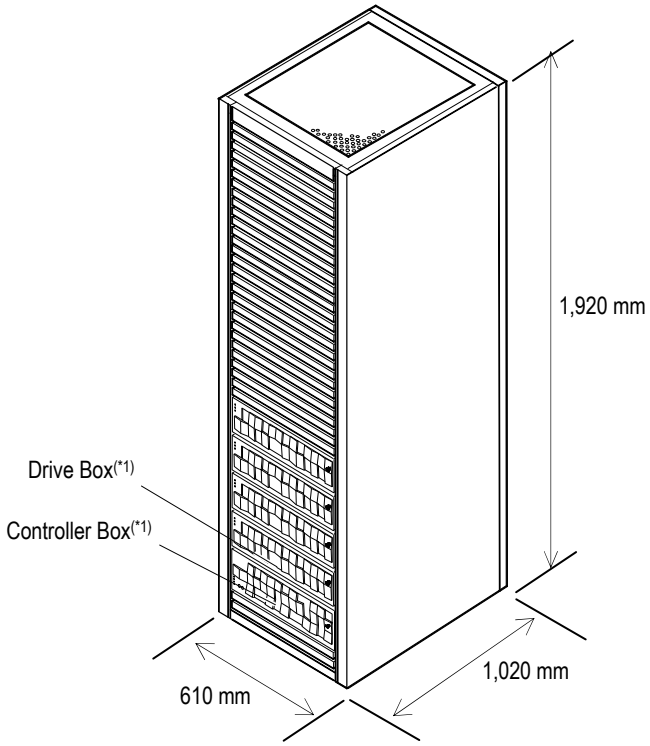


Figure 1.3.4.1 Major Components of the Drive Box

(2) Rackmount model with RK40 rack frame



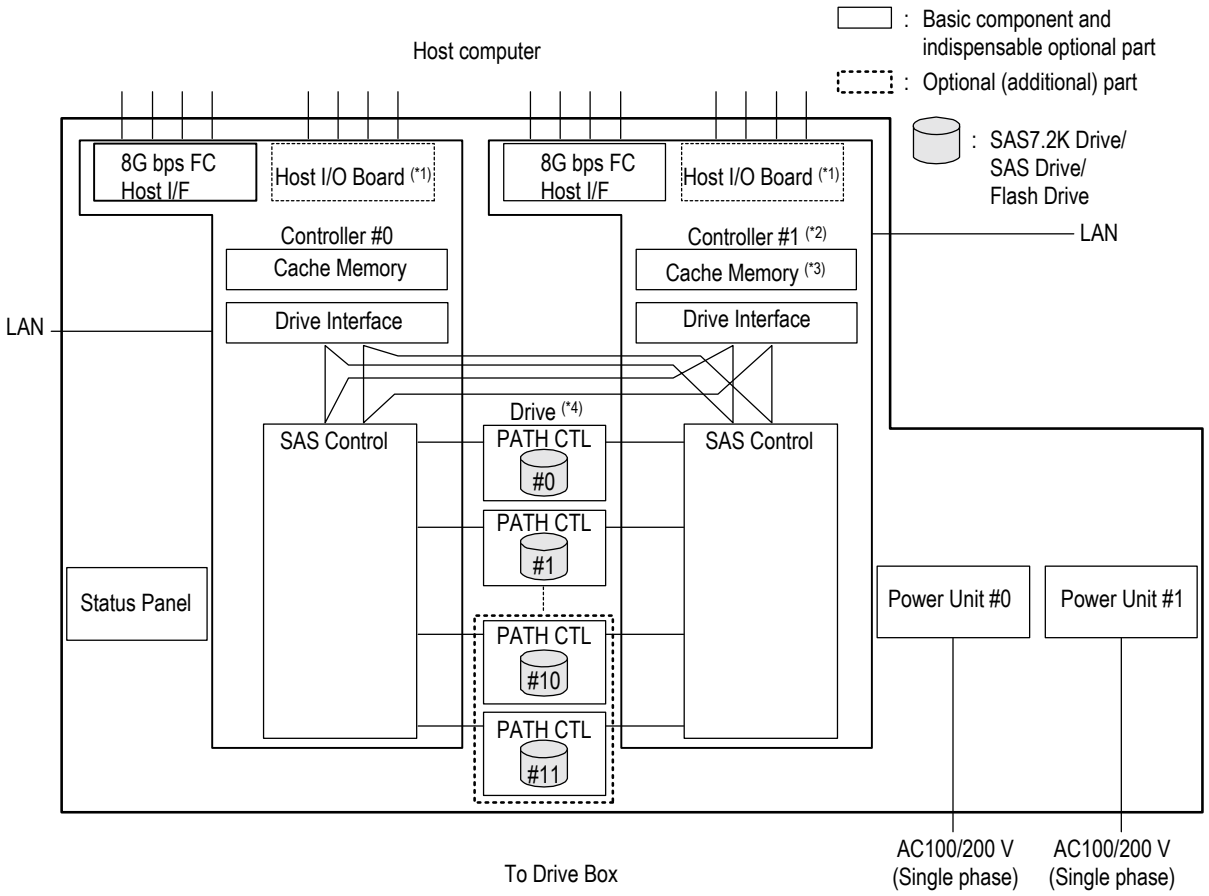
*1 : This figure shows an example of a rack mounting one CBL and four DBLs.

Figure 1.3.5 Appearances of the Rackmount Model with RK40 Rack Frame

1.3.2 System Configuration of the Rackmount Model

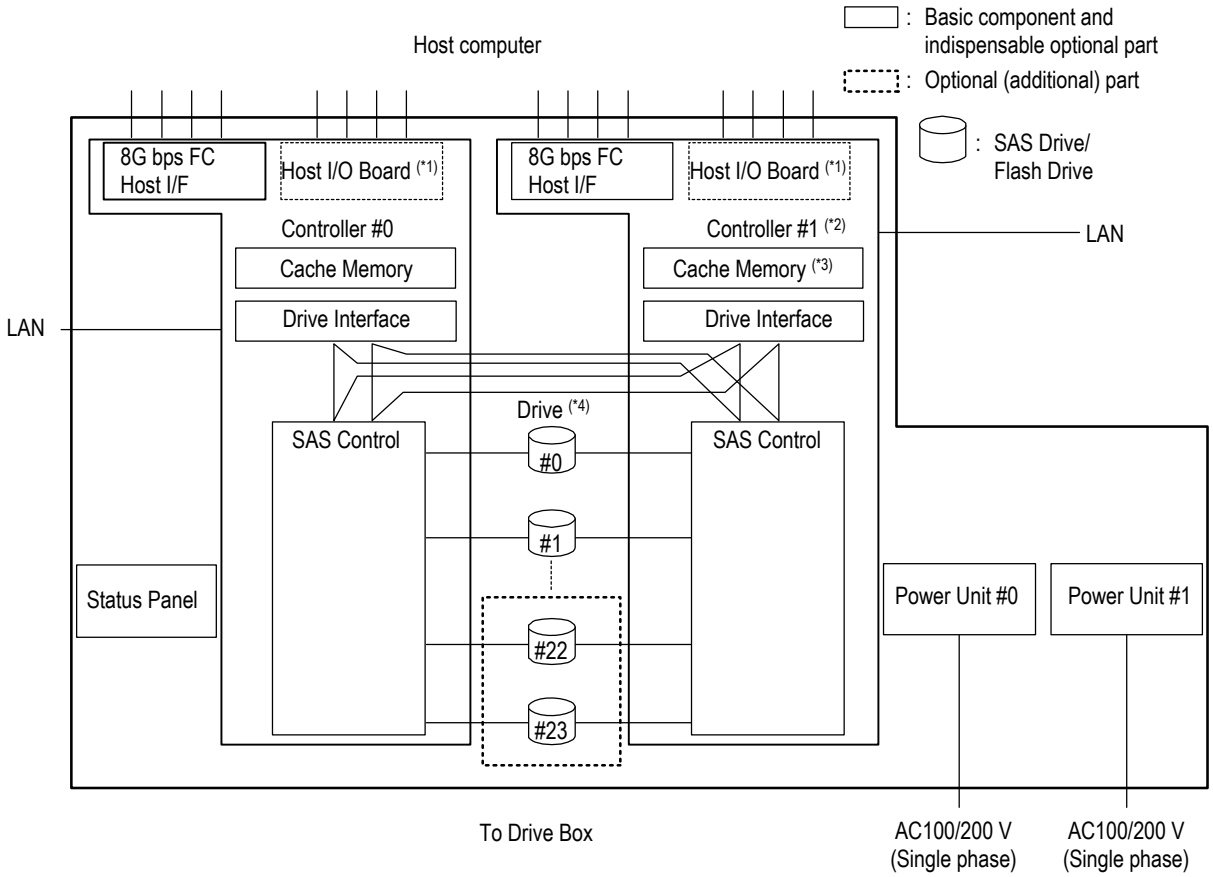
(1) System configuration of the rackmount model
Figure 1.3.6 to Figure 1.3.15.1 shows the block configurations.

No.	System configuration	Figure number	Refer page
1	CBSL	Figure 1.3.6	INTR 01-0160
2	CBSS	Figure 1.3.7	INTR 01-0170
3	CBXSL	Figure 1.3.8	INTR 01-0180
4	CBXSS	Figure 1.3.9	INTR 01-0190
5	DBL	Figure 1.3.10	INTR 01-0200
6	DBLD	Figure 1.3.10.1	INTR 01-0201
7	DBS	Figure 1.3.11	INTR 01-0210
8	DBSD	Figure 1.3.11.1	INTR 01-0211
9	DBF	Figure 1.3.11.2	INTR 01-0212
10	DBX	Figure 1.3.12	INTR 01-0220
11	DBW	Figure 1.3.12.1	INTR 01-0221
12	CBL (CBL + DBL)	Figure 1.3.13	INTR 01-0230
13	CBLD (CBLD + DBLD)	Figure 1.3.13.1	INTR 01-0231
14	CBL (CBL + DBS)	Figure 1.3.14	INTR 01-0240
15	CBLD (CBLD + DBSD)	Figure 1.3.14.1	INTR 01-0241
16	CBL (CBL + DBX)	Figure 1.3.15	INTR 01-0250
17	CBL (CBL + DBW)	Figure 1.3.15.1	INTR 01-0251



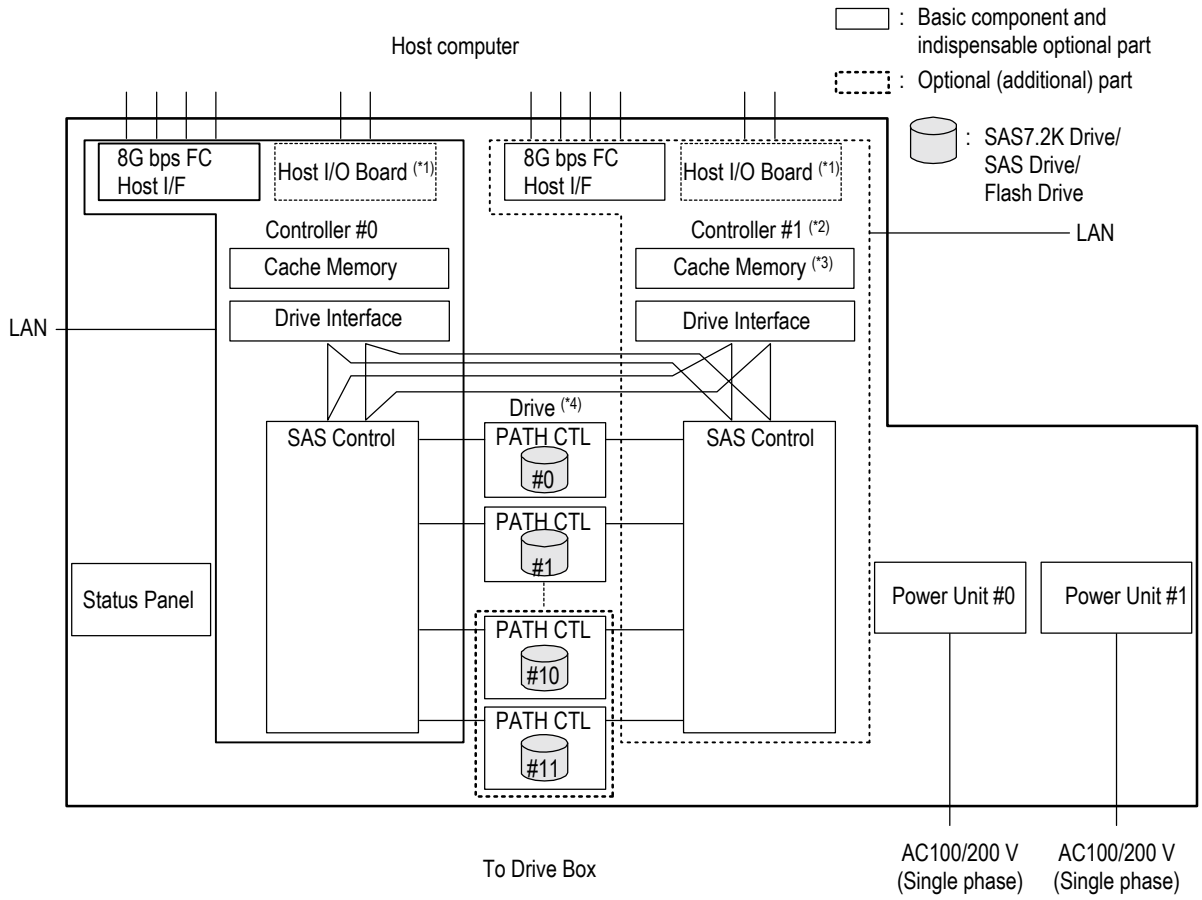
*1 : Host I/O Board :
DF-F850-HBF84
DF-F850-HBS102, DF-F850-HBS12
*2 : Controller :
DF-F850-CTLS
*3 : Cache Memory :
DF-F850-CMM4, DF-F850-CMM8
*4 : Drive :
DF-F850-2TNL, DF-F850-3TNL, DF-F850-4TNL,
DF-F850-2HGDML, DF-F850-4HGDML, DF-F850-8HGDML, DF-F850-3HGSLH, DF-F850-9HGSL

Figure 1.3.6 System Configuration Block Diagrams of the CBSL



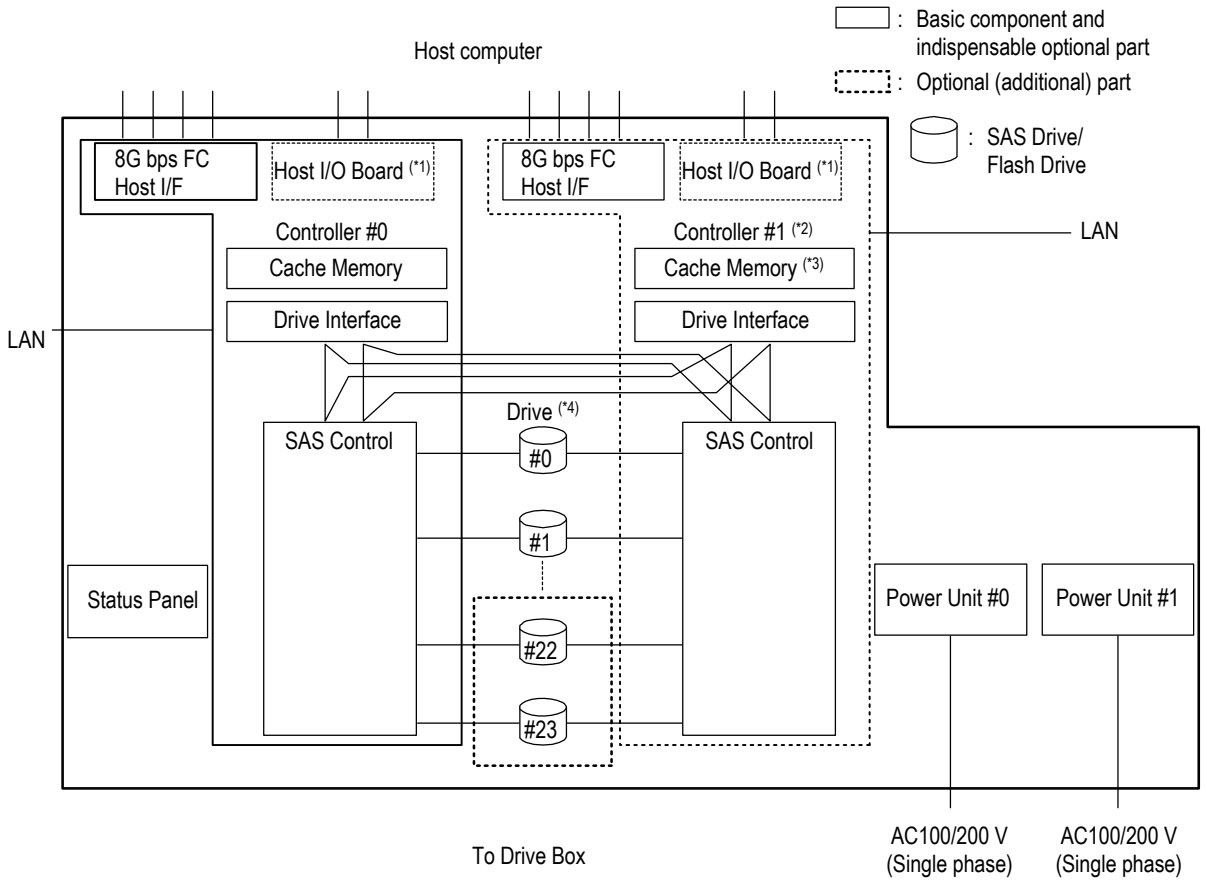
*1 : Host I/O Board :
DF-F850-HBF84
DF-F850-HBS102, DF-F850-HBS12
*2 : Controller :
DF-F850-CTLS
*3 : Cache Memory :
DF-F850-CMM4, DF-F850-CMM8
*4 : Drive :
DF-F850-3HGSS, DF-F850-3HGSSH, DF-F850-6HGSS, DF-F850-9HGSS, DF-F850-2HGDM, DF-F850-4HGDM, DF-F850-8HGDM, DF-F850-12HGSS

Figure 1.3.7 System Configuration Block Diagrams of the CBSS



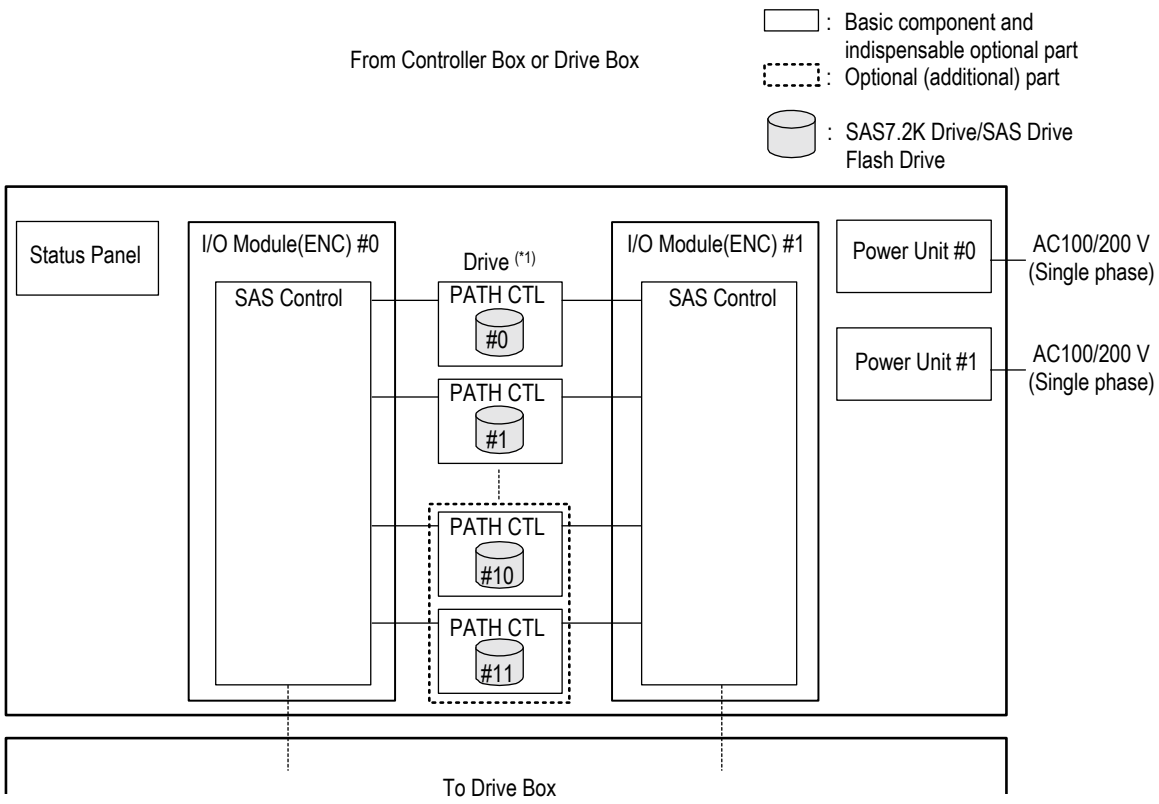
*1 : Host I/O Board :
DF-F850-HBS102, DF-F850-HBS12
*2 : Controller :
DF-F850-CTLXS
*3 : Cache Memory :
DF-F850-CMM4
*4 : Drive :
DF-F850-2TNL, DF-F850-3TNL, DF-F850-4TNL,
DF-F850-2HGDML, DF-F850-4HGDML, DF-F850-8HGDML, DF-F850-3HGSLH, DF-F850-9HGSL

Figure 1.3.8 System Configuration Block Diagrams of the CBXSL



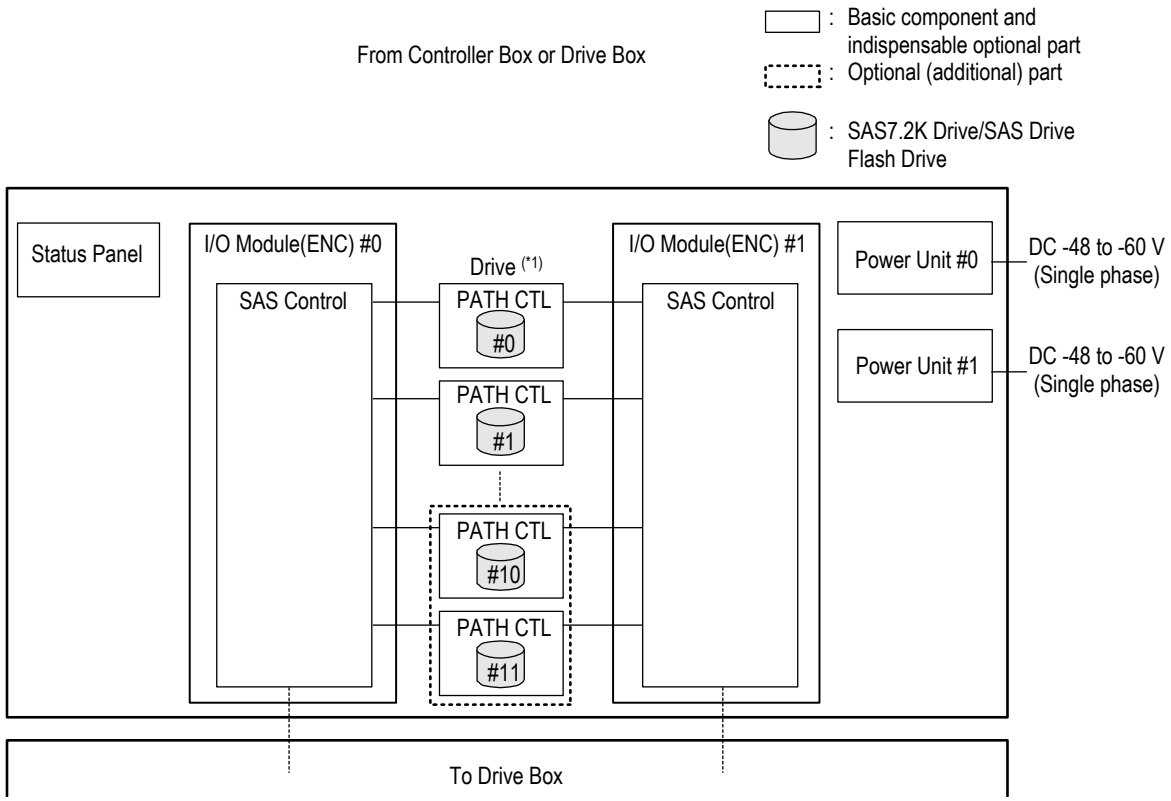
*1 : Host I/O Board :
DF-F850-HBS102, DF-F850-HBS12
*2 : Controller :
DF-F850-CTLXS
*3 : Cache Memory :
DF-F850-CMM4
*4 : Drive :
DF-F850-3HGSS, DF-F850-3HGSSH, DF-F850-6HGSS, DF-F850-9HGSS, DF-F850-2HGDM, DF-F850-4HGDM, DF-F850-8HGDM, DF-F850-12HGSS

Figure 1.3.9 System Configuration Block Diagrams of the CBXSS



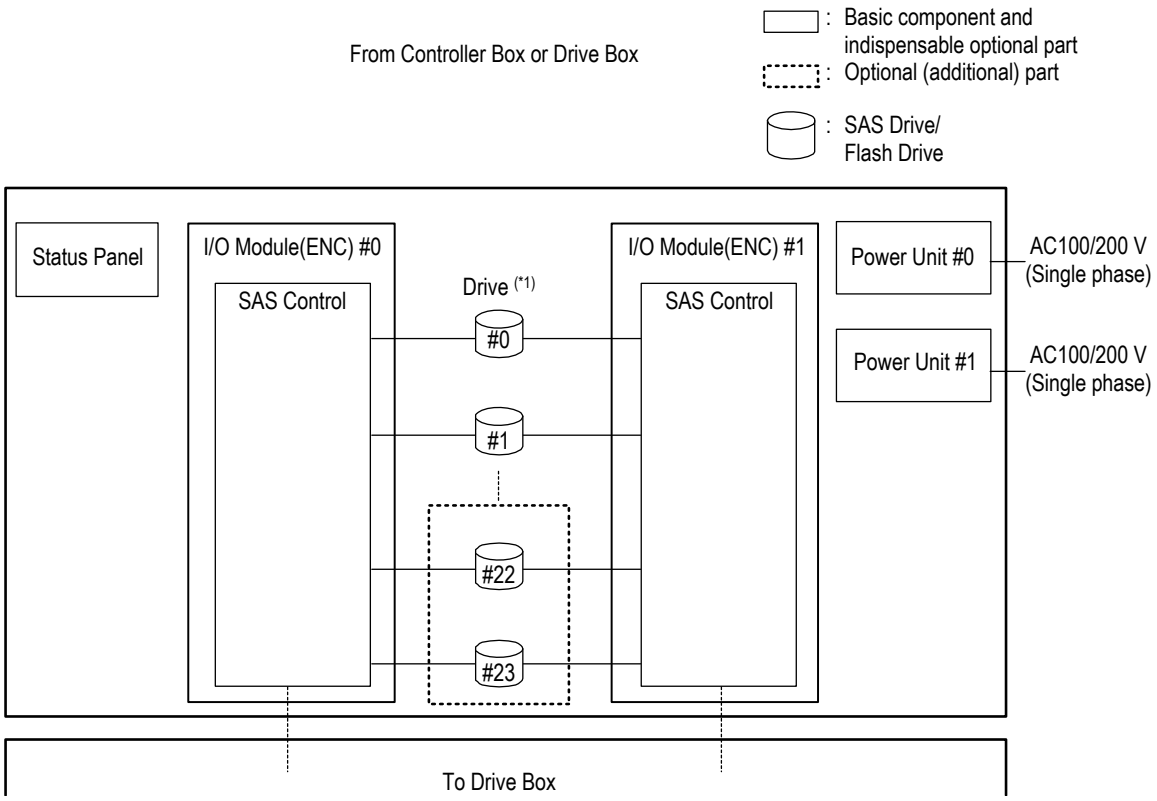
*1 : Drive :
DF-F850-2TNL, DF-F850-3TNL, DF-F850-4TNL,
DF-F850-2HGDML, DF-F850-4HGDML, DF-F850-8HGDML, DF-F850-3HGSLH, DF-F850-9HGSL

Figure 1.3.10 System Configuration Block Diagrams of the DBL



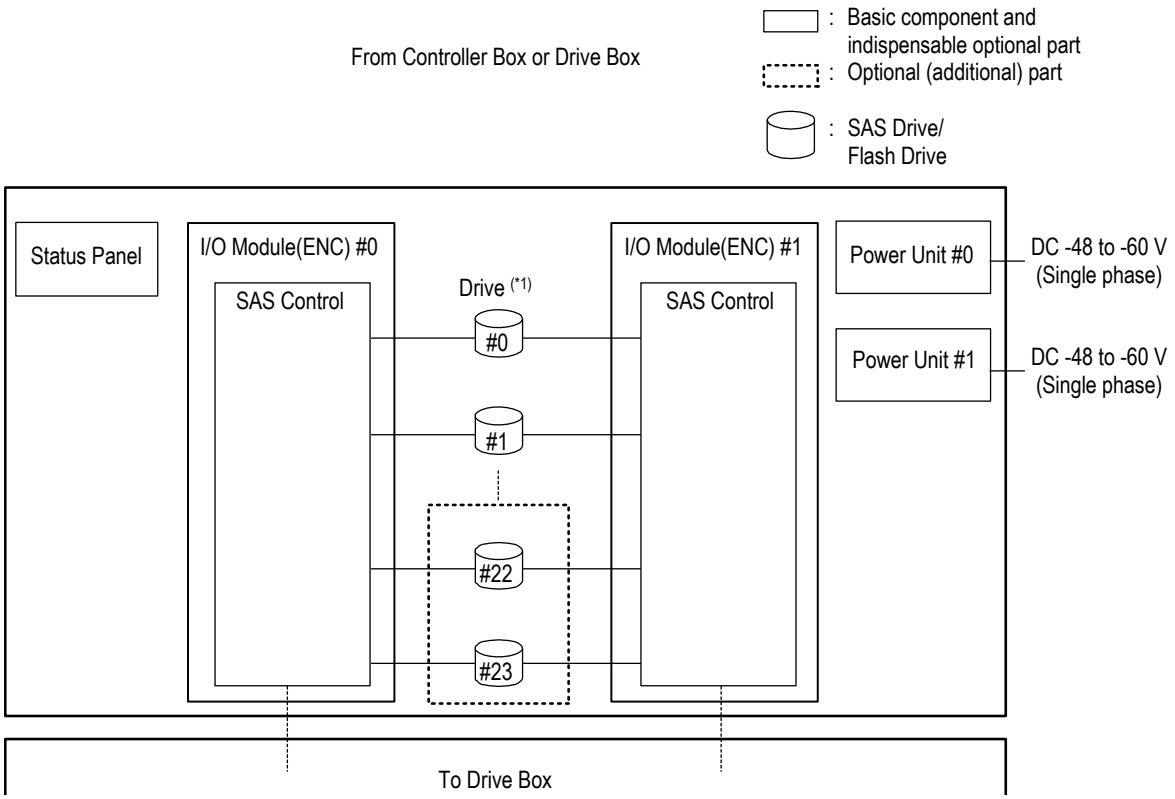
*1 : Drive :
DF-F850-2TNL, DF-F850-3TNL, DF-F850-4TNL
DF-F850-2HGDML, DF-F850-4HGDML, DF-F850-8HGDML, DF-F850-3HGSLH, HT-F4066-9HGSL

Figure 1.3.10.1 System Configuration Block Diagrams of the DBLD



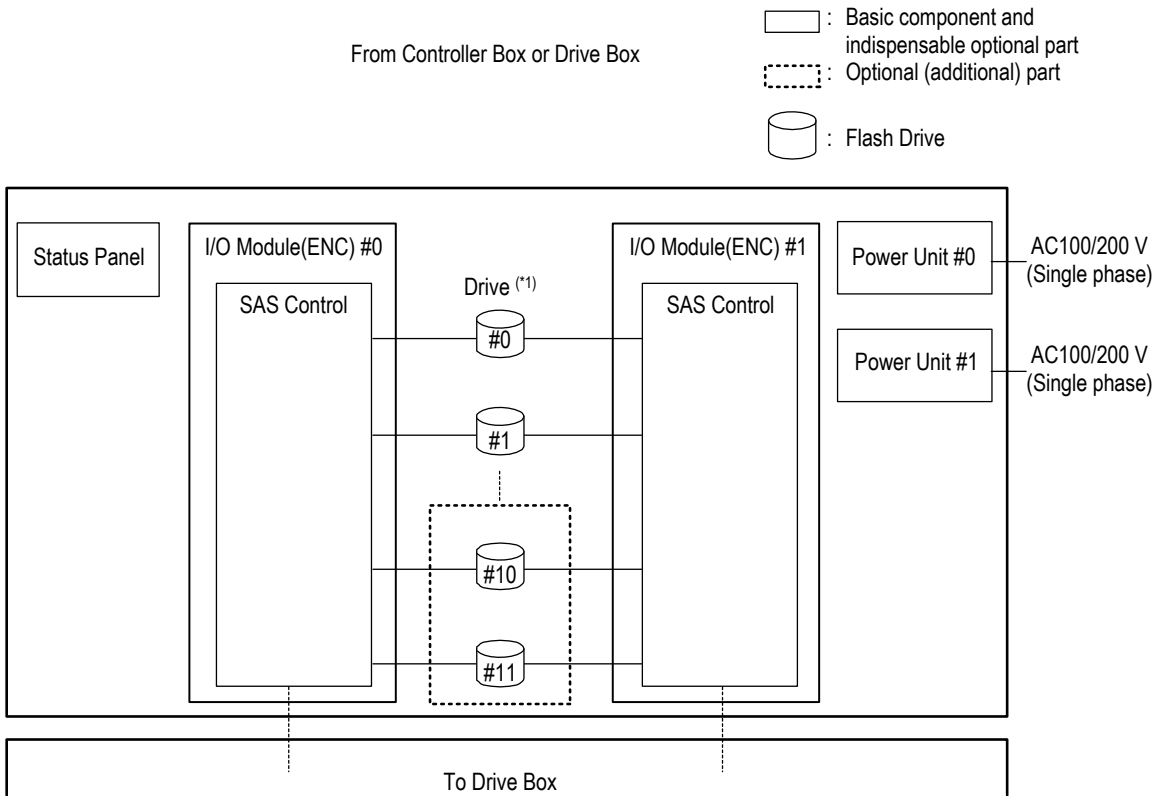
*1 : Drive :
DF-F850-3HGSS, DF-F850-3HGSSH, DF-F850-6HGSS, DF-F850-9HGSS, DF-F850-2HGDM, DF-F850-4HGDM, DF-F850-8HGDM, DF-F850-12HGSS

Figure 1.3.11 System Configuration Block Diagrams of the DBS



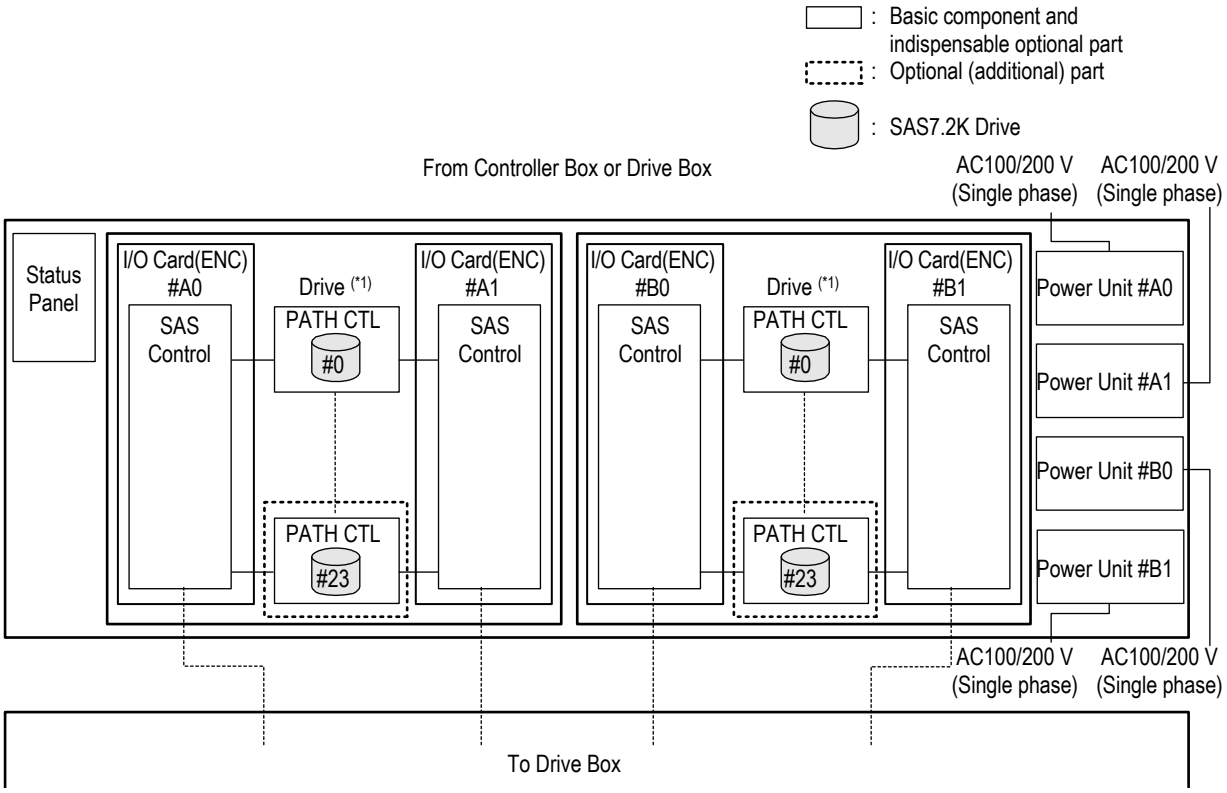
*1 : Drive :
DF-F850-3HGSS, DF-F850-3HGSSH, DF-F850-6HGSS, DF-F850-9HGSS, DF-F850-2HGDM, DF-F850-4HGDM, DF-F850-8HGDM, DF-F850-12HGSS

Figure 1.3.11.1 System Configuration Block Diagrams of the DBSD



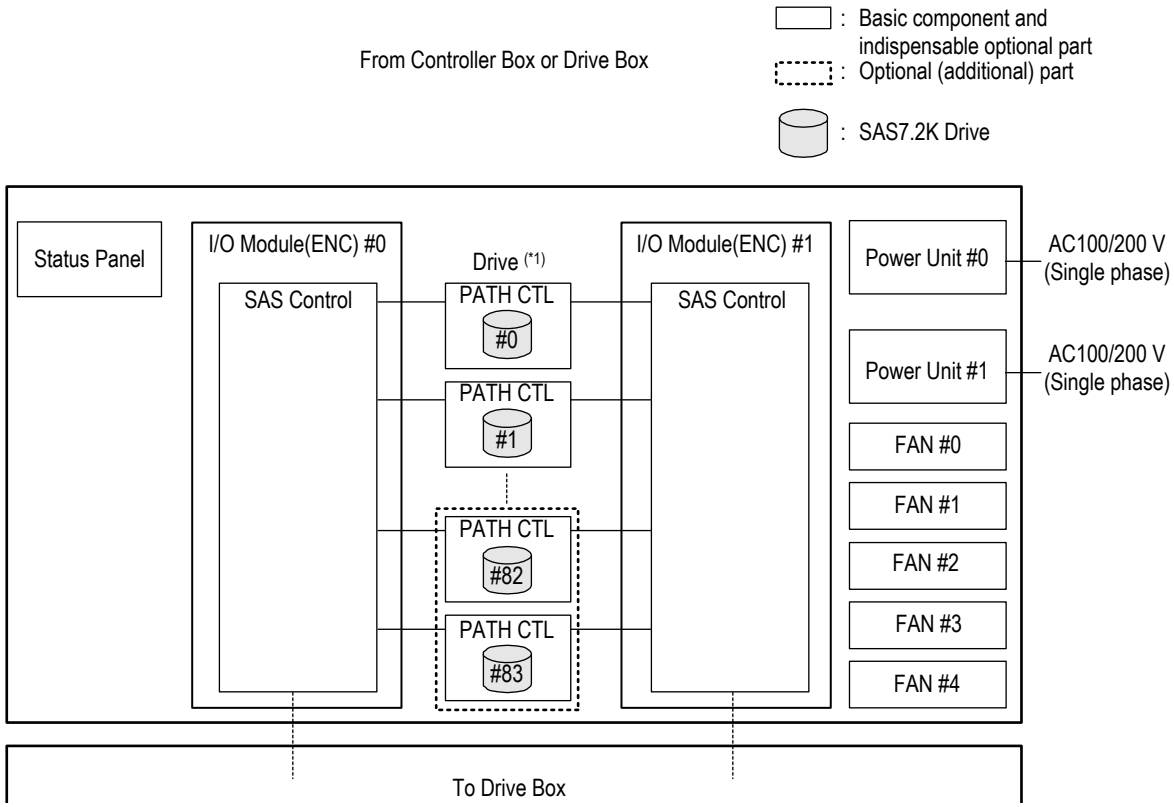
*1 : Drive :
DKC-F710I-1R6FM

Figure 1.3.11.2 System Configuration Block Diagrams of the DBF



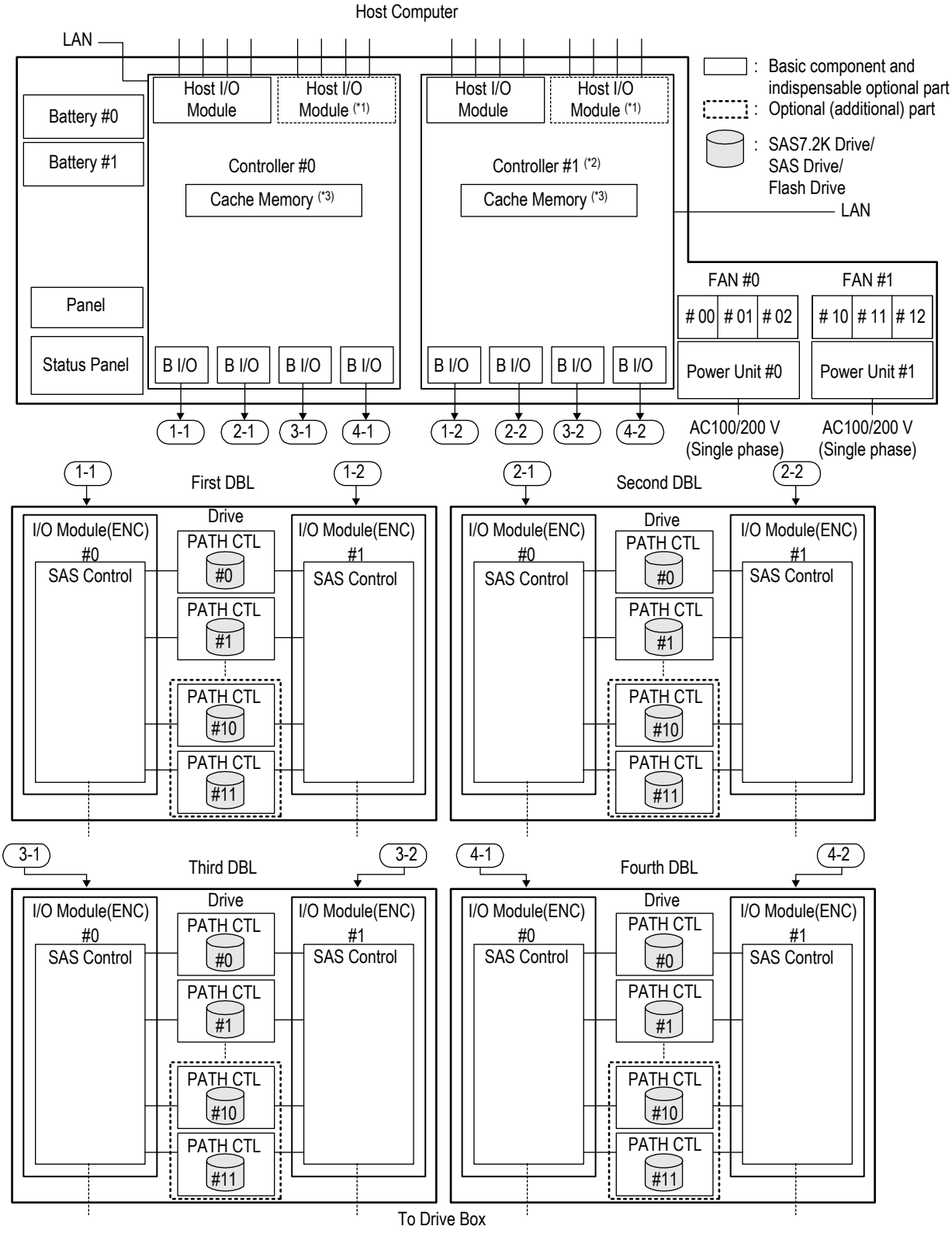
*1 : Drive :
DF-F850-2TNX, DF-F850-3TNX, DF-F850-4TNX

Figure 1.3.12 System Configuration Block Diagrams of the DBX



*1 : Drive :
DF-F850-3TNW, DF-F850-4TNW

Figure 1.3.12.1 System Configuration Block Diagrams of the DBW

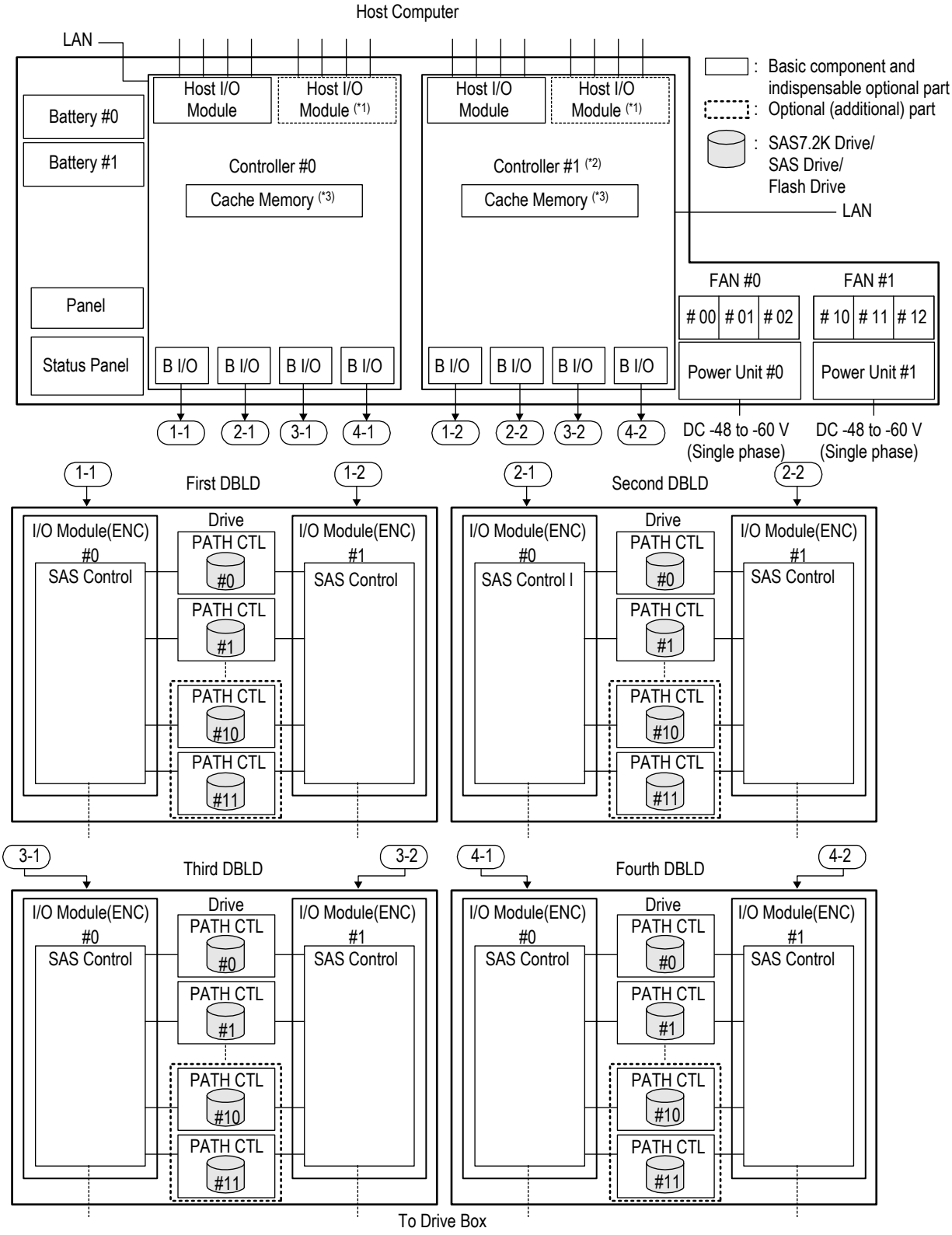


*1 : Host I/O Module : DF-F850-HF8G, DF-F850-HS10G

*2 : Controller : DF-F850-CTLL

*3 : Cache Memory : DF-F850-4GB, DF-F850-8GB

Figure 1.3.13 System Configuration Block Diagrams of the CBL (CBL+DBL)

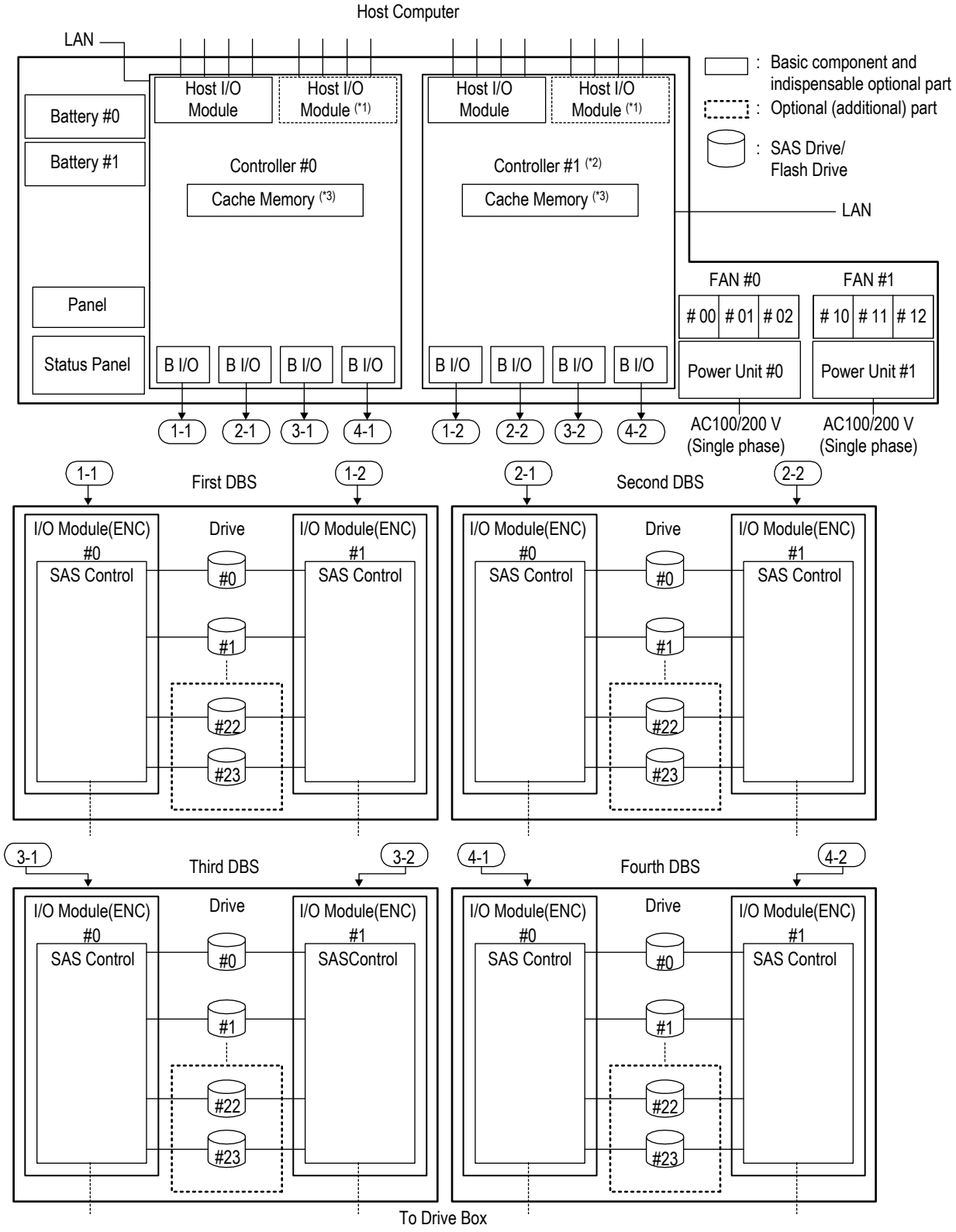


*1 : Host I/O Module : DF-F850-HF8G, DF-F850-HS10G

*2 : Controller : DF-F850-CTLL

*3 : Cache Memory : DF-F850-4GB, DF-F850-8GB

Figure 1.3.13.1 System Configuration Block Diagrams of the CBLD (CBLD+DBLD)

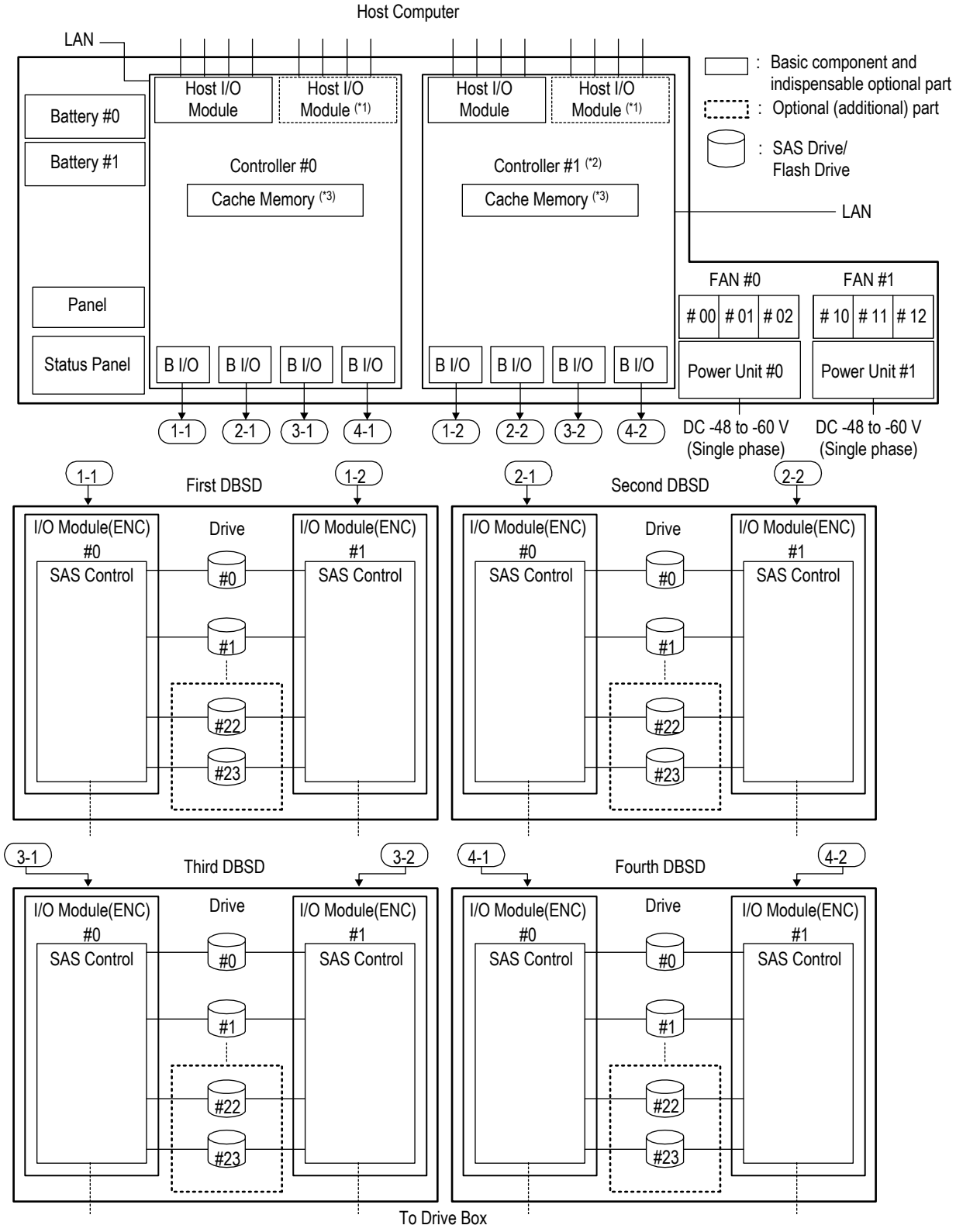


*1 : Host I/O Module : DF-F850-HF8G, DF-F850-HS10G

*2 : Controller : DF-F850-CTLL

*3 : Cache Memory : DF-F850-4GB, DF-F850-8GB

Figure 1.3.14 System Configuration Block Diagrams of the CBL (CBL+DBS)

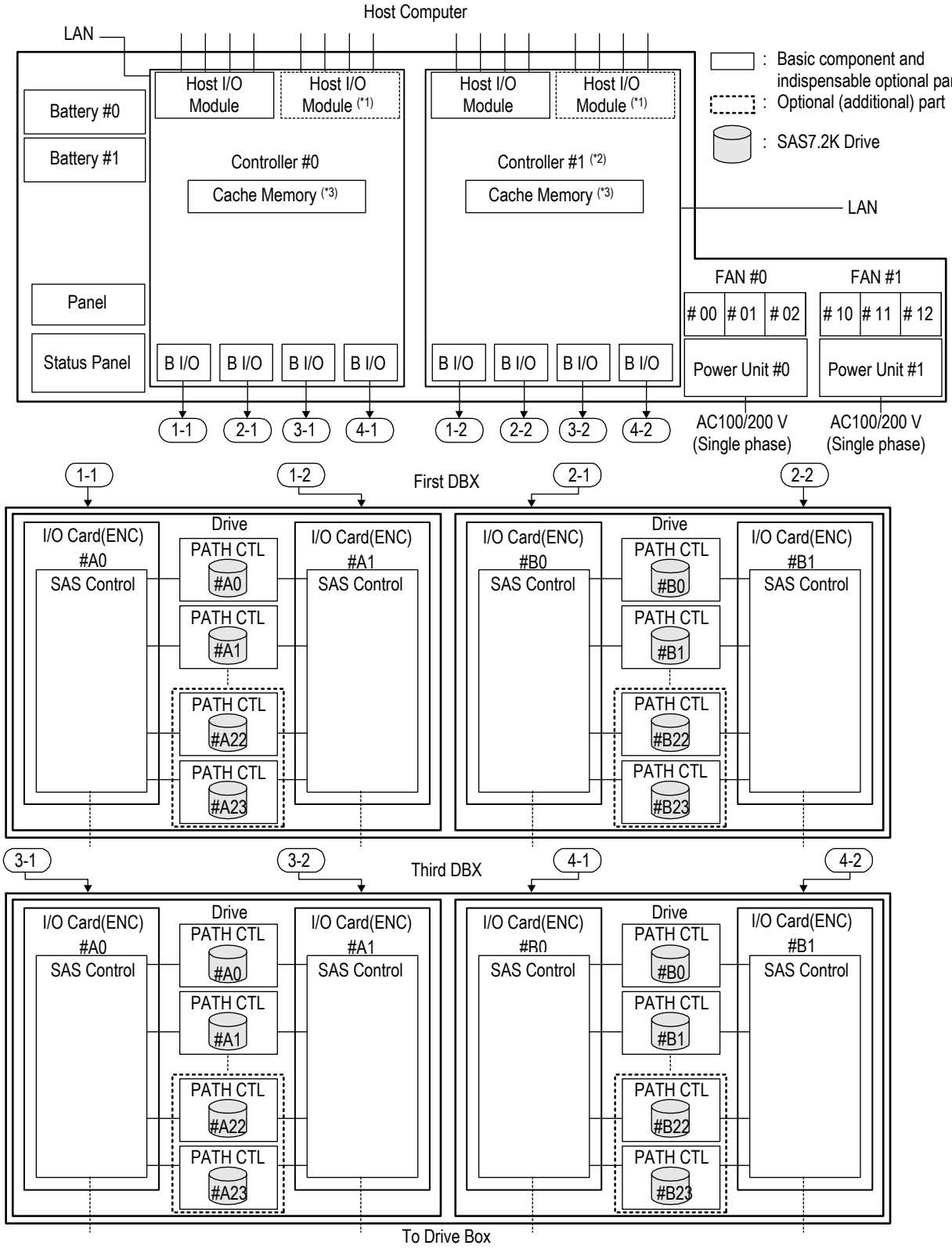


*1 : Host I/O Module : DF-F850-HF8G, DF-F850-HS10G

*2 : Controller : DF-F850-CTLL

*3 : Cache Memory : DF-F850-4GB, DF-F850-8GB

Figure 1.3.14.1 System Configuration Block Diagrams of the CBLD (CBLD+DBSD)

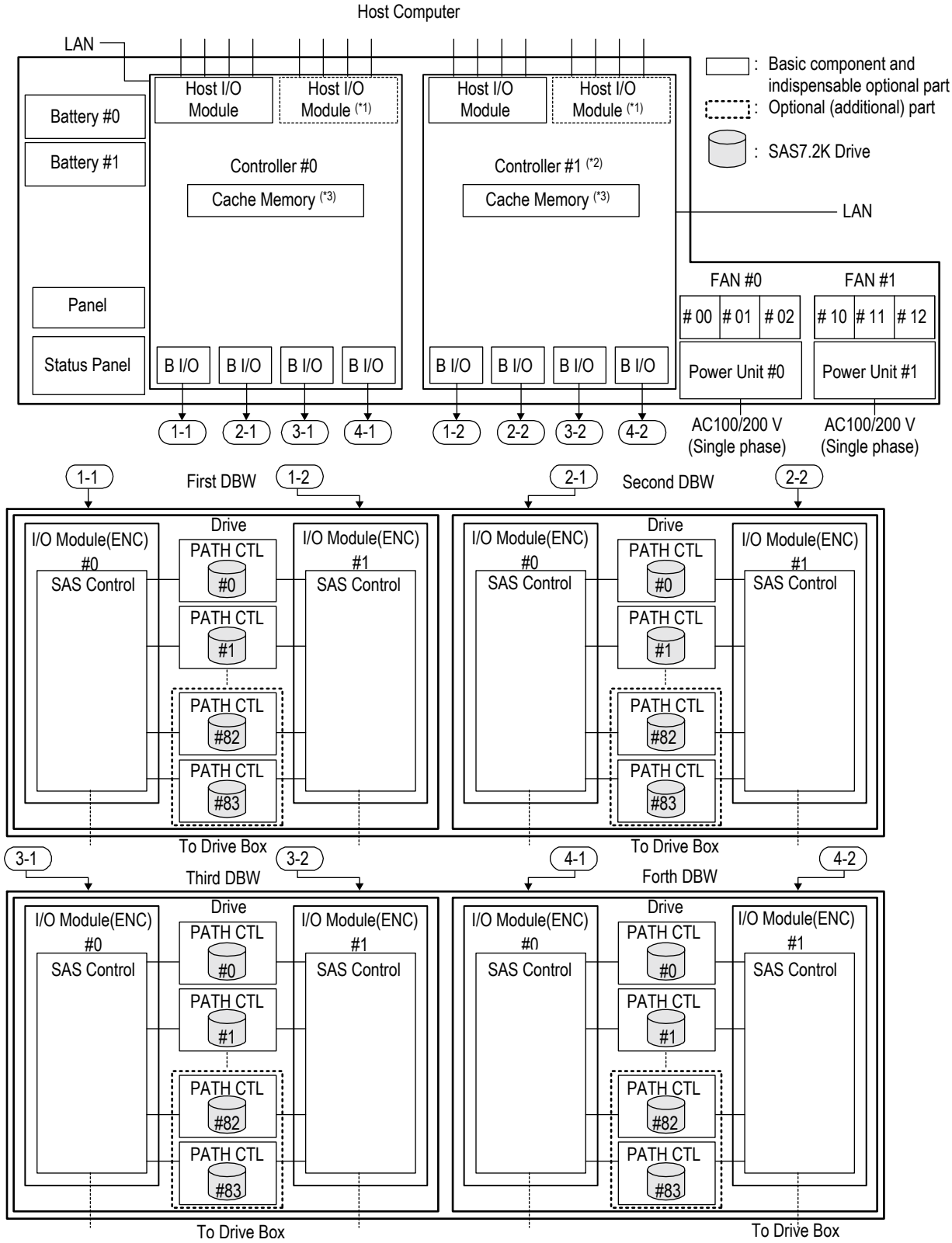


*1 : Host I/O Module : DF-F850-HF8G, DF-F850-HS10G

*2 : Controller : DF-F850-CTLL

*3 : Cache Memory : DF-F850-4GB, DF-F850-8GB

Figure 1.3.15 System Configuration Block Diagrams of the CBL (CBL+DBX)



*1 : Host I/O Module : DF-F850-HF8G, DF-F850-HS10G

*2 : Controller : DF-F850-CTLL

*3 : Cache Memory : DF-F850-4GB, DF-F850-8GB

Figure 1.3.15.1 System Configuration Block Diagrams of the CBL (CBL+DBW)

1.3.3 Configuration of Rackmount Model with RK40 Rack Frame

(1) Configuration of rackmount model with RK40 rack frame

A-6516-RK40 is mounting up to a height of 40 U (EIA Standard). (One CBL and seventeen DBLs) It consists of a rack frame main body and PDBs to be used to supply AC power to power supply units. The PDBs should be installed with a set of two PDBs to allow the power system to be duplicated.

Up to the seventeen DBLs can be mounted through an addition of the six PDU6s (option).

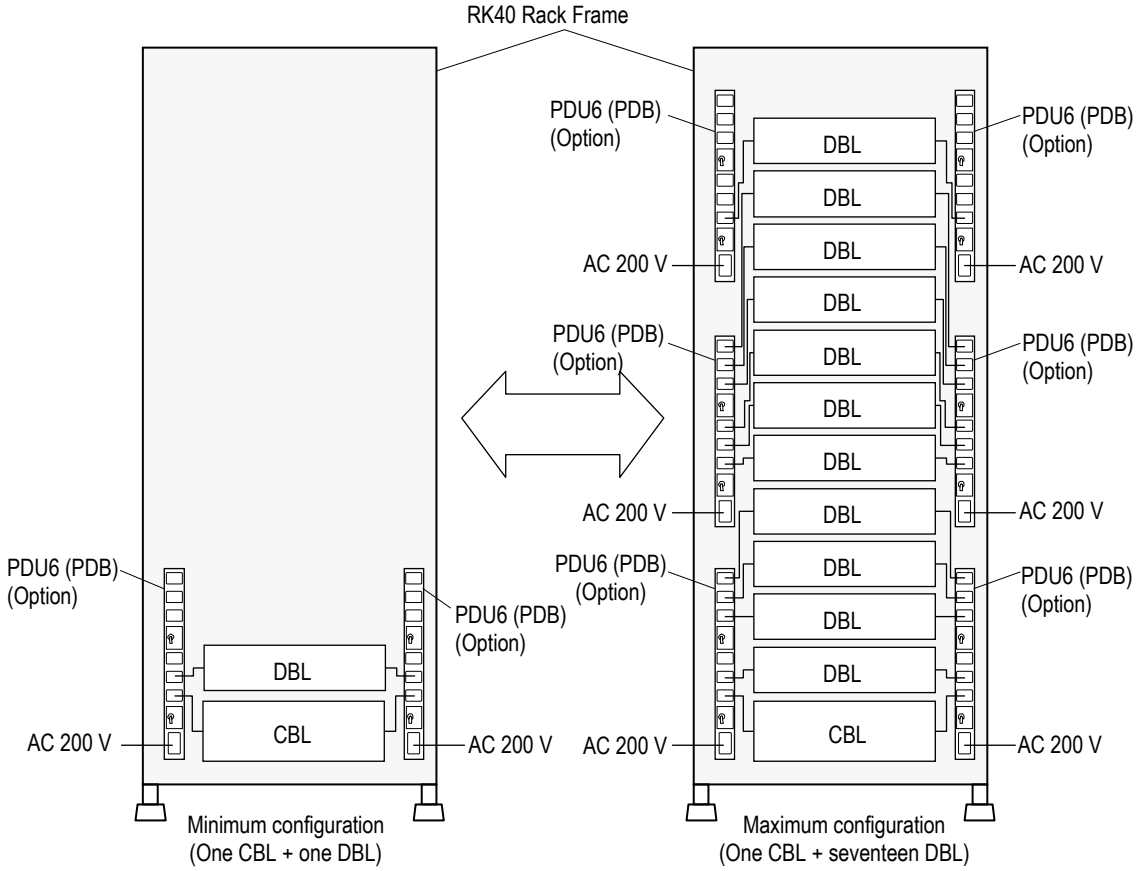


Figure 1.3.16 System Configuration of Rackmount Model with RK40 Rack Frame

1.3.4 Specification of the Drive Box Connection

(1) Rule of Drive Box connection ordering

Chassis connection has a rule that Drive boxes are connected in order of the Path #0 to Path #3 according to the order of installing the Controller Box and Drive Box from the bottom to the top of the rack (in order of unit ID number) (For DBX, connect DBX-A followed by DBX-B).

The followings show the connection examples in the configuration which follows the rule and which fails to follow the rule.

The figures show the logical relationship of the chassis connection.

(a) When following the rule

[Connecting the CBL and the DBL/DBS]

Connect the [1], [2] and [3] in the figure from left to right in the order shown by the arrow to keep Path connection from bottom to top in numerical order.

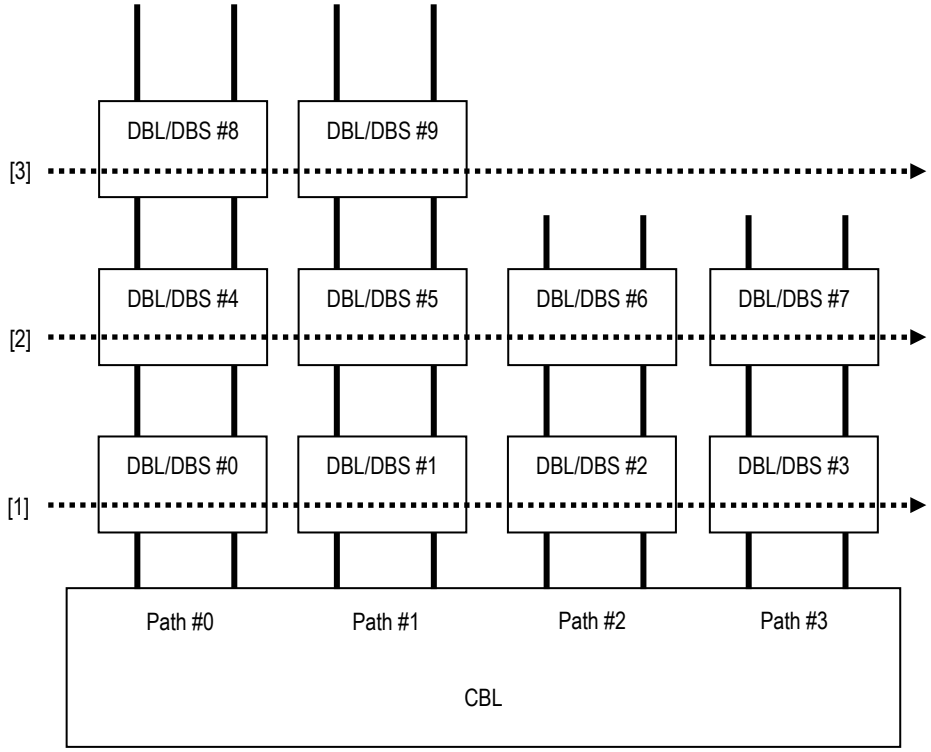


Figure 1.3.17 Connecting CBL and DBL/DBS by the rule

[Connecting the CBL and the DBW]
Connect the [1], [2] and [3] in the figure from left to right in the order shown by the arrow to keep Path connection from bottom to top in numerical order.

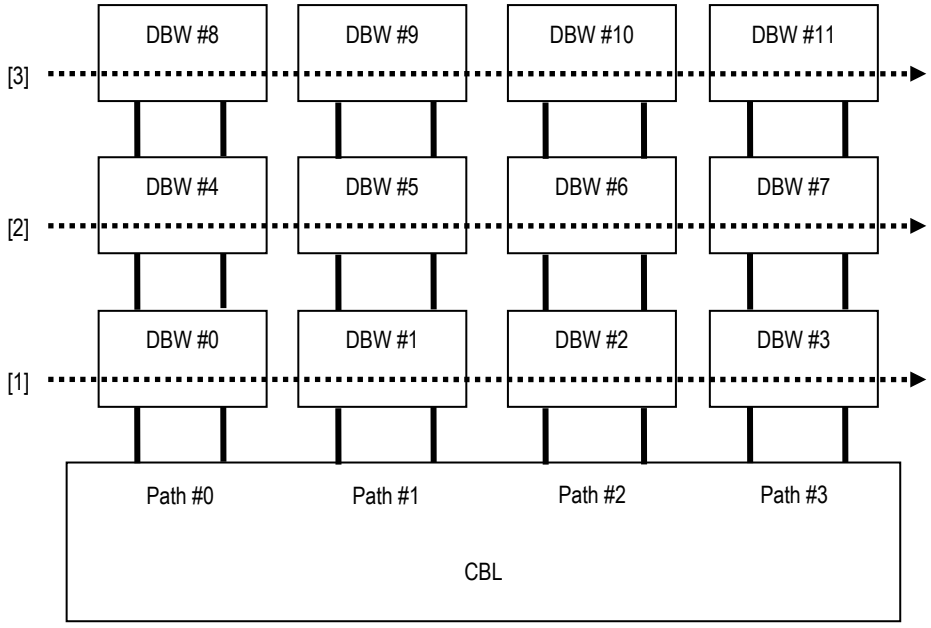


Figure 1.3.17.1 Connecting CBL and DBW by the rule

[Connecting the CBSL/CBSS and the DBL/DBS]
Connect the [1], [2] and [3] in the figure from left to right in the order shown by the arrow to keep Path connection from bottom to top in numerical order.

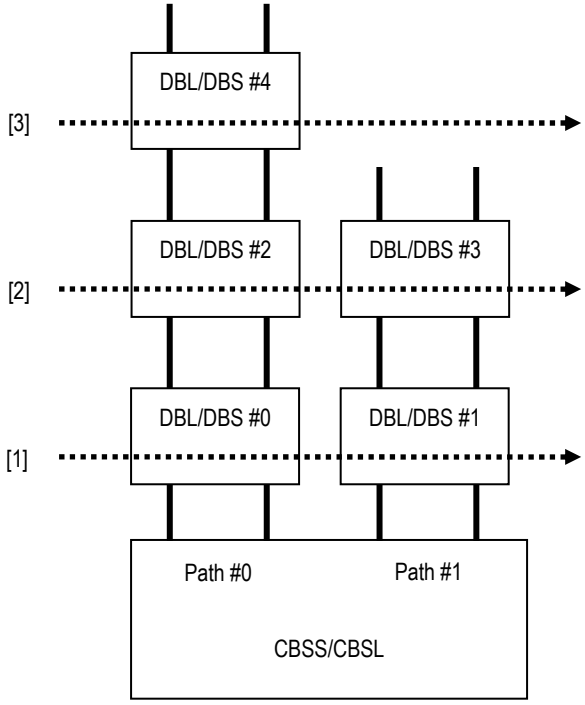


Figure 1.3.18 Connecting CBSS/CBSL and DBL/DBS by the rule

(b) When not following the rule

[Mixing CBL and DBL/DBS]

Example 1 Path #0 in the [3] row is skipped, and Path #1, Path2, and Path 3 are connected.

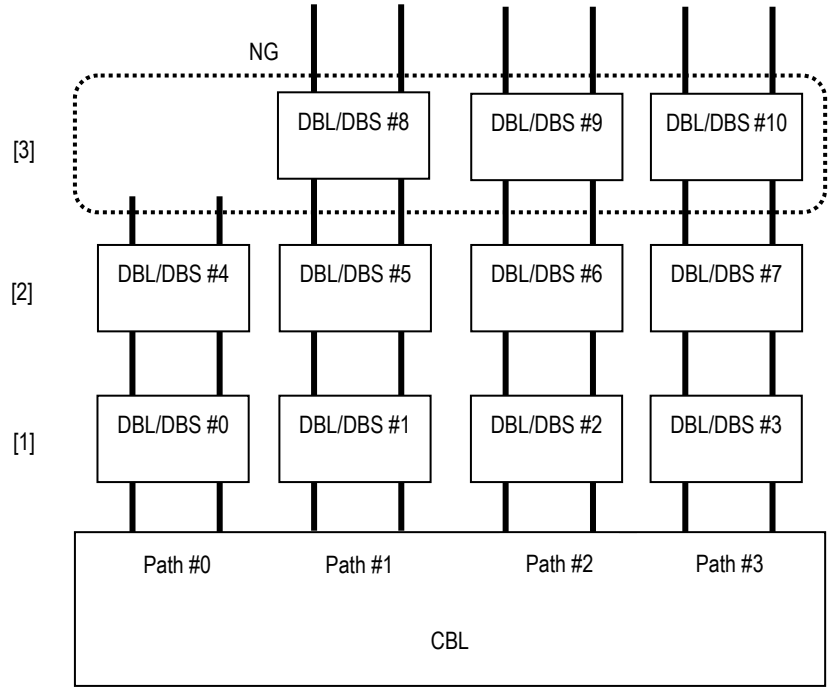


Figure 1.3.19 Connecting CBL and DBL/DBS without following the rule (Example 1)

Example 2 Path #2 and Path #3 in the [3] row are skipped, and Path #0 and Path #1 in the [4] row are connected.

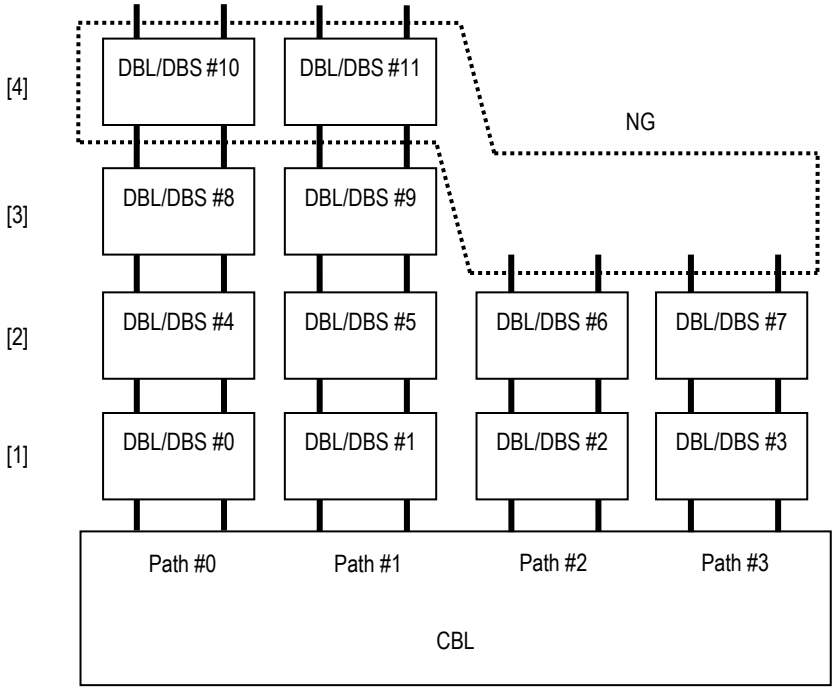


Figure 1.3.20 Connecting CBL and DBL/DBS without following the rule (Example 2)

[Mixing CBSL/CBSS and DBL/DBS]

Example 3 Path #0 in the [3] row is skipped, and Path #1 is connected.

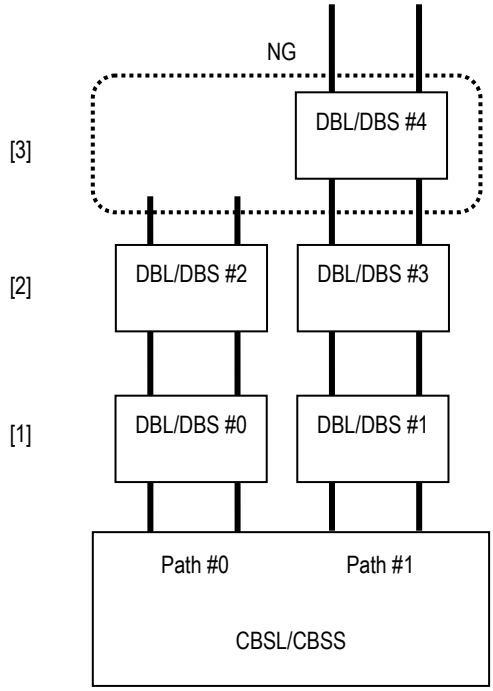


Figure 1.3.21 Connecting CBSL/CBSS and DBL/DBS without following the rule (Example 3)

Example 4 Path #1 in the [3] row is skipped, and Path #0 in the [4] row is connected.

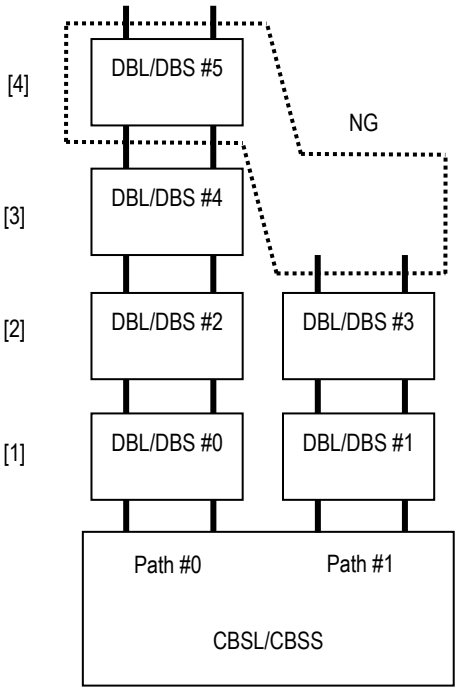


Figure 1.3.22 Connecting CBSL/CBSS and DBL/DBS without following the rule (Example 4)

[Mixing CBL and DBL/DBS/DBX]

Example 1 Path #2 and Path #3 in the [3] row are skipped, and Path #0 and Path #1 in the [4] row are connected.

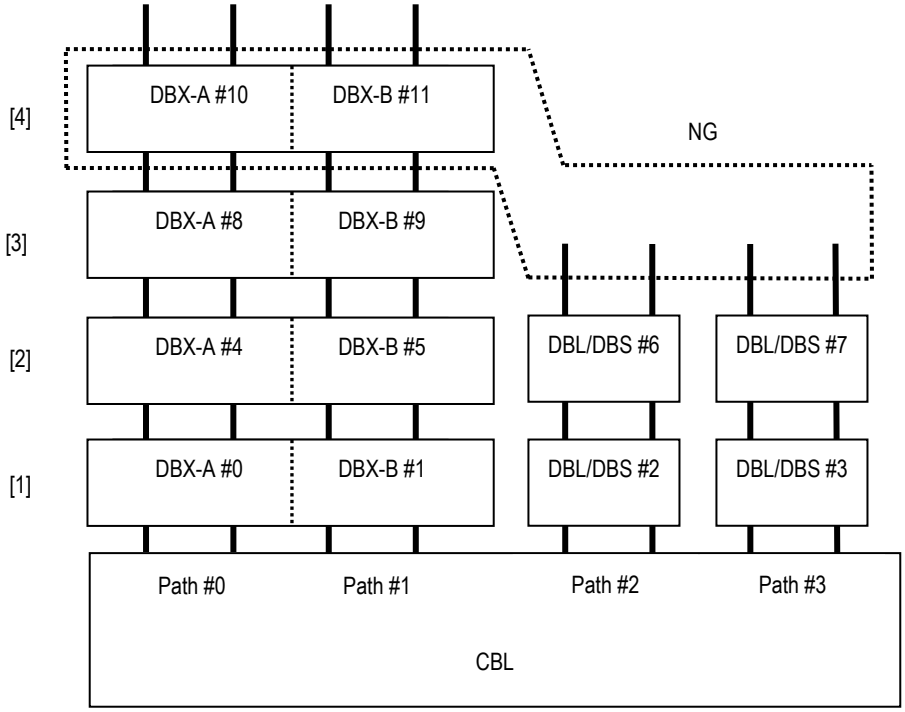


Figure 1.3.23 Connecting CBL and DBL/DBS/DBX without following the rule (Example 1)

Example 2 Path #0 and Path #1 in the [3] row are skipped, and Path #2 and Path #3 are connected.

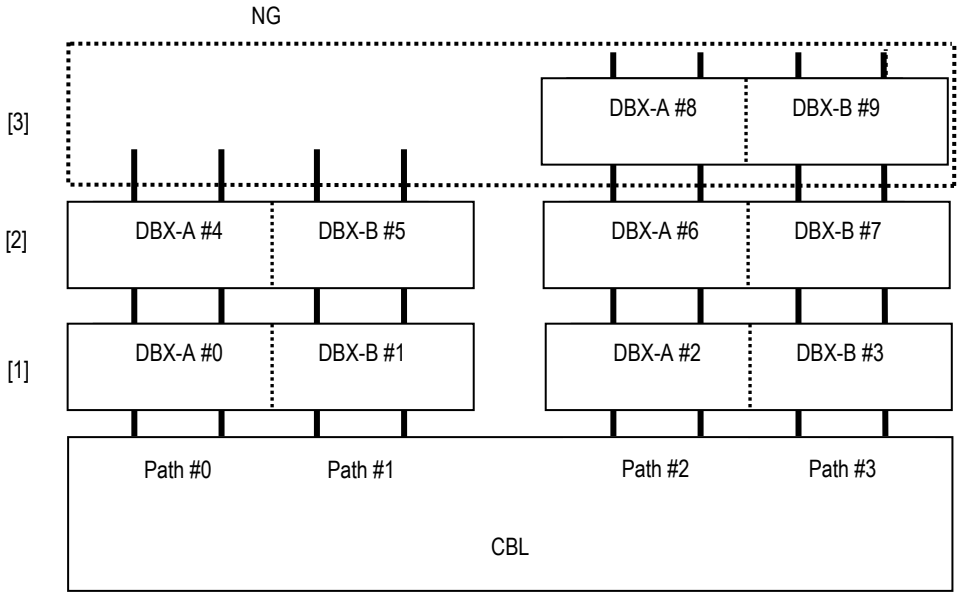


Figure 1.3.24 Connecting CBL and DBL/DBS/DBX without following the rule (Example 2)

(2) Mounted number of a mix of DBXs

When intermix of DBL/DBS and DBX is mounted, the mounted number of each Drive Box and the maximum number of Drives are shown in Table 1.3.1 and Table 1.3.1.1.

Table 1.3.1 Mounted Number of Drive Box and the Maximum Mountable Number of Drives (DBL/DBS and DBX) (When the firmware version is 0937/A or more)

Controller Box (one unit)	Number of mounted Drive Box(*1)		Maximum mountable number of Drives(*2)
	DBL/DBS	DBX	
CBSL	0/0	7	348
	1/0	7	360(DBL)/348(DBS)
	5/2	6	360(DBL)/348(DBS)
	9/4	5	360(DBL)/348(DBS)
	11/6	4	336(DBL)/348(DBS)
	13/8	3	312(DBL)/348(DBS)
	15/10	2	288(DBL)/348(DBS)
	17/12	1	264(DBL)/348(DBS)
	19/14	0	240(DBL)/348(DBS)
CBSS	0/0	7	360
	4/2	6	360(DBL)/360(DBS)
	8/4	5	360(DBL)/360(DBS)
	11/6	4	348(DBL)/360(DBS)
	13/8	3	324(DBL)/360(DBS)
	15/10	2	300(DBL)/360(DBS)
	17/12	1	276(DBL)/360(DBS)
	19/14	0	252(DBL)/360(DBS)
CBL	0/0	20	960
	2/2	19	936(DBL)/960(DBS)
	4/4	18	912(DBL)/960(DBS)
	6/6	17	888(DBL)/960(DBS)
	8/8	16	864(DBL)/960(DBS)
	10/10	15	840(DBL)/960(DBS)
	12/12	14	816(DBL)/960(DBS)
	14/14	13	792(DBL)/960(DBS)
	16/16	12	768(DBL)/960(DBS)
	18/18	11	744(DBL)/960(DBS)
	20/20	10	720(DBL)/960(DBS)
	22/22	9	696(DBL)/960(DBS)
	24/24	8	672(DBL)/960(DBS)
	26/26	7	648(DBL)/960(DBS)
	28/28	6	624(DBL)/960(DBS)
	30/30	5	600(DBL)/960(DBS)
	32/32	4	576(DBL)/960(DBS)
	34/34	3	552(DBL)/960(DBS)
	36/36	2	528(DBL)/960(DBS)
	38/38	1	504(DBL)/960(DBS)
	40/40	0	480(DBL)/960(DBS)

*1 : The maximum number of boxes that can be installed per PATH is 10. Note that the A side and the B side of the DBX are counted as one box respectively.
For the PATH #0, #1, #2, and #3 of the CBL, and the PATH #0 and #1 of the CBSL/CBSS, make the configuration where an equal number of Drives are connected in both the A side and the B side of the DBX.

*2 : The CBL/CBSL/CBSS can use up to 240 Drives per PATH.

Table 1.3.1.1 Mounted Number of Drive Box and the Maximum Mountable Number of Drives (DBL/DBS and DBX) (When the firmware version is less than 0937/A)

Controller Box (one unit)	Number of mounted Drive Box(*1)(*2)		Maximum mountable number of Drives
	DBL/DBS	DBX	
CBSL	0/0	5	252(*3)
	3/1	4	240(DBL)/228(DBS)
	7/3	3	240(DBL)/228(DBS)
	11/5	2	240(DBL)/228(DBS)
	15/7	1	240(DBL)/228(DBS)
	19/9	0	240(DBL)/228(DBS)
CBSS	0/0	5	264(*3)
	1/1	4	228(DBL)/240(DBS)
	5/3	3	228(DBL)/240(DBS)
	9/5	2	228(DBL)/240(DBS)
	13/7	1	228(DBL)/240(DBS)
	17/9	0	228(DBL)/240(DBS)
CBL	0/0	20	960
	2/2	19	936(DBL)/960(DBS)
	4/4	18	912(DBL)/960(DBS)
	6/6	17	888(DBL)/960(DBS)
	8/8	16	864(DBL)/960(DBS)
	10/10	15	840(DBL)/960(DBS)
	12/12	14	816(DBL)/960(DBS)
	14/14	13	792(DBL)/960(DBS)
	16/16	12	768(DBL)/960(DBS)
	18/18	11	744(DBL)/960(DBS)
	20/20	10	720(DBL)/960(DBS)
	22/22	9	696(DBL)/960(DBS)
	24/24	8	672(DBL)/960(DBS)
	26/26	7	648(DBL)/960(DBS)
	28/28	6	624(DBL)/960(DBS)
	30/30	5	600(DBL)/960(DBS)
	32/32	4	576(DBL)/960(DBS)
	34/34	3	552(DBL)/960(DBS)
	36/36	2	528(DBL)/960(DBS)
	38/38	1	504(DBL)/960(DBS)
	40/40	0	480(DBL)/960(DBS)

*1 : The CBL can use up to 240 Drives per PATH, the CBSL/CBSS can use up to 120 Drives per PATH, and the CBXSL/CBXSS can use up to 120 Drives per PATH.
For the PATH #0, #1, #2, and #3 of the CBL, and the PATH #0 and #1 of the CBSL/CBSS, make the configuration where an equal number of Drives are connected in both the A side and the B side of the DBX.

*2 : The maximum number of boxes that can be installed per PATH is 10. Note that the A side and the B side of the DBX are counted as one box respectively.

*3 : When configured of only the DBX, the CBSL can use up to 132 Drives per PATH, and the CBSS can use up to 144 Drives per PATH.

(3) DBX Drive installation specification

For the Drives to install in DBX, follow the specification described below.

Table 1.3.2 Drive Installation Specification

Item	Specification
Installable drive name (capacity)	•DF-F850-2TNX (2 T bytes) •DF-F850-3TNX (3 T bytes) •DF-F850-4TNX (4 T bytes)
Installable number of Drives	48 Drives
Installation position	#A0 to #A23, #B0 to #B23

(4) Restriction on DBX connection configuration and connection examples

For the mounted number of Drive Box, follow the description in "(2) Mounted number of a mix of DBX". This prevents the installed number of Drives in the array from exceeding the maximum number.

However, when the Controller Box is CBL, it may exceed 240 slots per Path depending on configuration. If Drive is inserted into the slot when the installed number of Drive exceeds 240 slots per Path, the Drive will be blocked. Therefore, connection configuration has to be made so that it does not exceed 240 slots per Path.

NOTE : Slot means a Drive insertion opening. DBL contains 12 slots, DBS contains 24 slots, and DBX-A or DBX-B contains 24 slots. When no Drive is inserted into slot, the number of slots is not changed.

(5) The number of Drive Boxes installed together with DBWs

Table 1.3.3 and Table 1.3.4 show the number of Drives to be installed in each Drive Box when installing DBLs/DBSs and DBWs or DBXs and DBWs together and the maximum number of Drives.

Table 1.3.3 Mounted Number of Drive Box and the Maximum Mountable Number of Drives (DBL/DBS and DBW) (When the firmware version is 0950/A or more)

Controller Box (one unit)	Number of mounted Drive Box(*1)(*2)		Maximum mountable number of Drives
	DBL/DBS	DBW	
CBSL	1/0	4	360(DBL)/348(DBS)
	7/4	3	348(DBL)/360(DBS)
	11/7	2	312(DBL)/348(DBS)
	15/11	1	276(DBL)/360(DBS)
CBSS	0/0	4	360(DBL)/960(DBS)
	7/3	3	360(DBL)/348(DBS)
	11/7	2	324(DBL)/360(DBS)
	15/10	1	288(DBL)/348(DBS)
CBL	0/0	12	936(DBL)/960(DBS)
	1/1	11	936(DBL)/948(DBS)
	2/2	10	864(DBL)/888(DBS)
	3/3	9	768(DBL)/948(DBS)
	24/12	8	960(DBL)/960(DBS)
	31/15	7	960(DBL)/948(DBS)
	34/19	6	812(DBL)/960(DBS)
	35/22	5	840(DBL)/948(DBS)
	36/26	4	768(DBL)/948(DBS)
	37/29	3	696(DBL)/948(DBS)
	38/33	2	624(DBL)/960(DBS)
	39/36	1	552(DBL)/948(DBS)

*1 : The maximum number of boxes that can be installed per PATH is 10. One box of the DBWs connected to a CBSL/CBSS counts as four boxes.

*2 : A CBL/CBSL/CBSS can use the maximum of 240 drives per PATH. Note that, only if connecting three DBW boxes per PATH for a CBL, the maximum number of 252 Drives can be used per PATH.

Table 1.3.4 Mounted Number of Drive Box and the Maximum Mountable Number of Drives (DBX and DBW) (When the firmware version is 0950/A or more)

Controller Box (one unit)	Number of mounted Drive Box(*1)		Maximum mountable number of Drives(*2)
	DBX	DBW	
CBSL	0	4	348
	2	3	312
	7	2	252
	5	1	216
CBSS	0	4	360
	1	3	324
	3	2	336
	5	1	348
CBL	0	12	960
	0	11	924
	1	10	888
	1	9	804
	6	8	960
	7	7	924
	9	6	936
	11	5	948
	13	4	960
	14	3	924
	16	2	936
	18	1	948

*1 : The maximum number of boxes that can be installed per PATH is 10. Note that the A side and the B side of the DBX count as one box, respectively.
For the PATH #0, #1, #2, and #3 of the CBL, and the PATH #0 and #1 of the CBSL/CBSS, make the configuration where an equal number of Drives are connected in both the A side and the B side of the DBX. Furthermore, one box of the DBW connected to the CBSL/CBSS counts as four boxes.

*2 : The CBL/CBSL/CBSS can use up to 240 Drives per PATH.
Note that, only if connecting three DBW boxes per PATH for a CBL, the maximum number of 252 Drives can be used per PATH.

(6) Restriction on DBW connection configuration

For the number of Drive Boxes to be installed, follow the description on "(5) The number of Drive Boxes installed together with DBWs" (INTR 01-0331).

Furthermore, in the same PATH, the number of Drive Boxes connected to under the DBW is limited to within two. Therefore, the number of installable Drive Boxes after installing the DBW is within 11 for a CBL and five for a CBSL/CBSS.

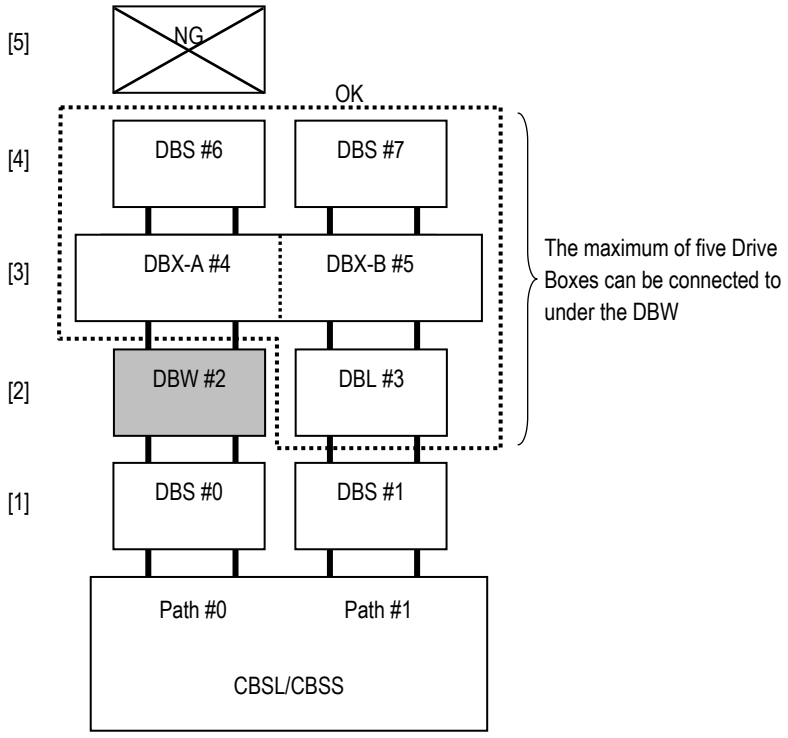


Figure 1.3.25 In case of the CBSL/CBSS

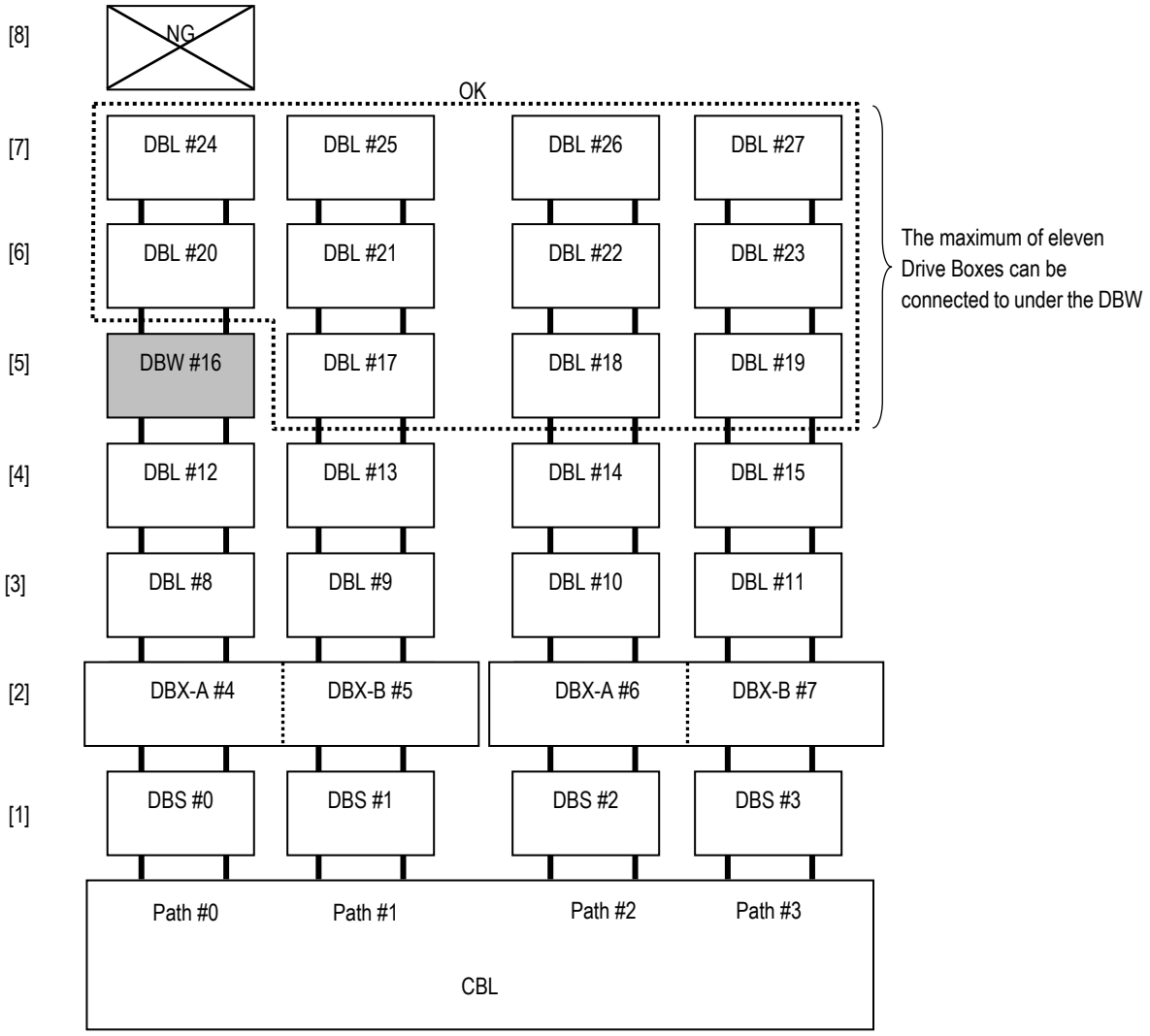


Figure 1.3.26 In case of the CBL

1.4 Configuration of Internal Power Supply System

For a single unit of rackmount models, there are CBL/CBSL/CBSS/CBXSL/CBXSS/DBL/DBS/DBF/DBX/DBW.
Rackmount models are configured by combining the single units.
The CBL/CBSL/CBSS/CBXSL/CBXSS/DBL/DBS/DBF/DBX/DBW has the Power Unit to receive AC as the external power supply.
The CBLD/DBLD/DBSD has the Power Unit to receive DC as the external power supply.

The configuration of internal power supply system is shown in the table below.

No.	System Configuration	Figure number	Refer page
1	CBXSL/CBSL	Figure 1.4.1	INTR 01-0350
2	CBXSS/CBSS	Figure 1.4.2	INTR 01-0360
3	CBL	Figure 1.4.3	INTR 01-0370
4	DBL	Figure 1.4.4	INTR 01-0380
5	DBF	Figure 1.4.4.1	INTR 01-0381
6	DBS	Figure 1.4.5	INTR 01-0390
7	DBX	Figure 1.4.6	INTR 01-0400
8	DBW (Back Board)	Figure 1.4.7	INTR 01-0401
9	DBW (Drive)	Figure 1.4.8	INTR 01-0402
10	CBLD	Figure 1.4.9	INTR 01-0403
11	DBLD	Figure 1.4.10	INTR 01-0404
12	DBSD	Figure 1.4.11	INTR 01-0405

(1) Internal power supply system configuration (CBSL/CBSS/CBXSL/CBXSS/CBL/DBL/DBS/DBF/DBX/DBW)
Input power to the CBSL/CBSS/CBXSL/CBXSS/CBL/DBL/DBS/DBF/DBX/DBW is supplied from the AC power supply. Even if the main switch is off, each voltage (BS) is supplied. For turning off the supply of each power voltage (BS), it is required to remove the power cables from the Power Units(‡1).
Two Power Units are installed as the standard to duplicate the power supply system. Accordingly, the array can continue its operation even when a failure occurs in one of the Power Unit or power cables. Further, part replacement can be done while the array is operating.
For at the time of the failure. Duplicate the power system prepare for the failure. Therefore, first the main switch off, next turning off the power supply when the need for turning off the one side power supply except failure.

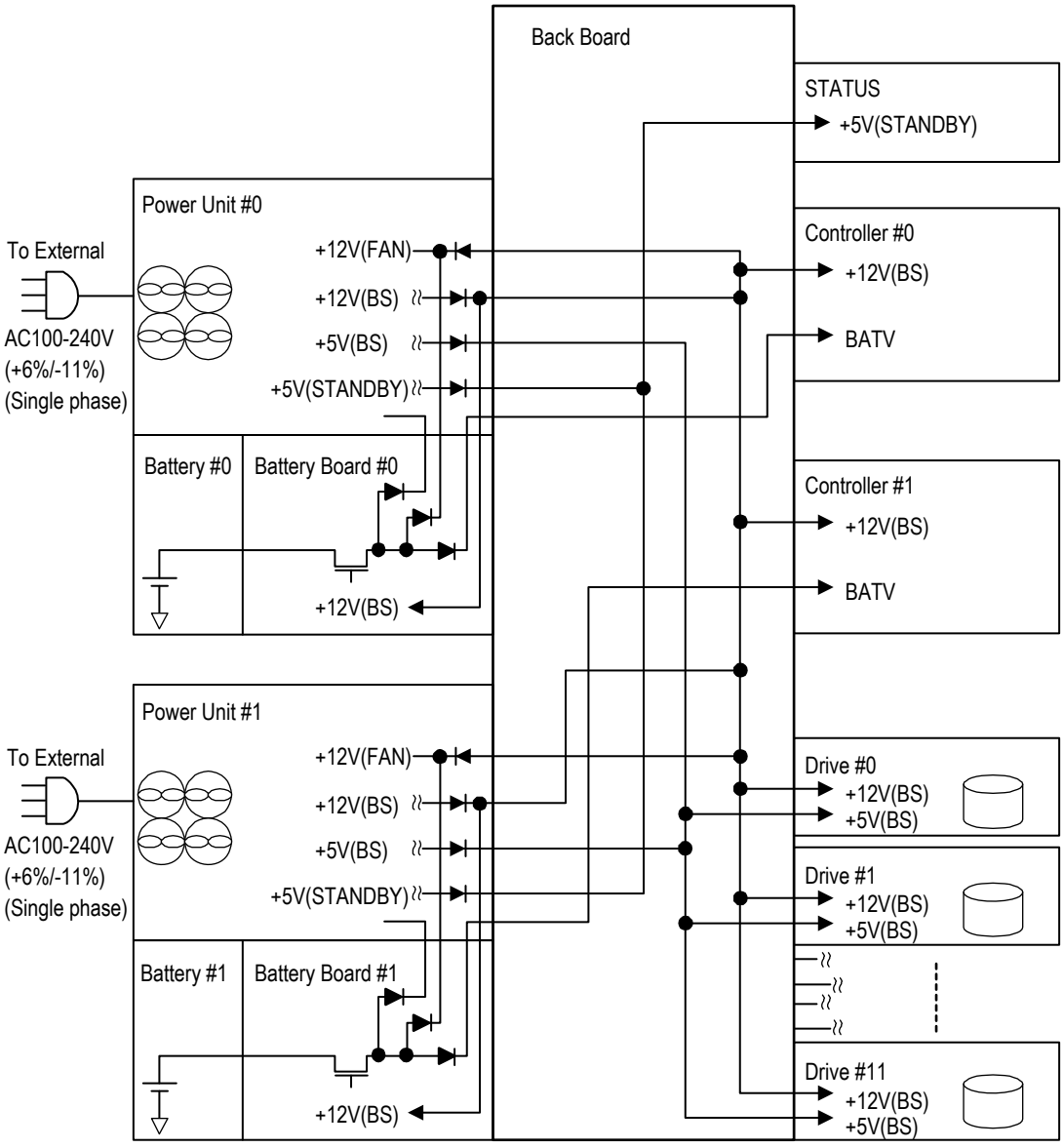


Figure 1.4.1 Connection Diagram of Power Supply System (CBXSL/CBSL)

‡1 : In the situation where the main switch is turned off, do not leave the components removed from the array for a long time. The power supply alarm can be given because of an abnormal alarm.

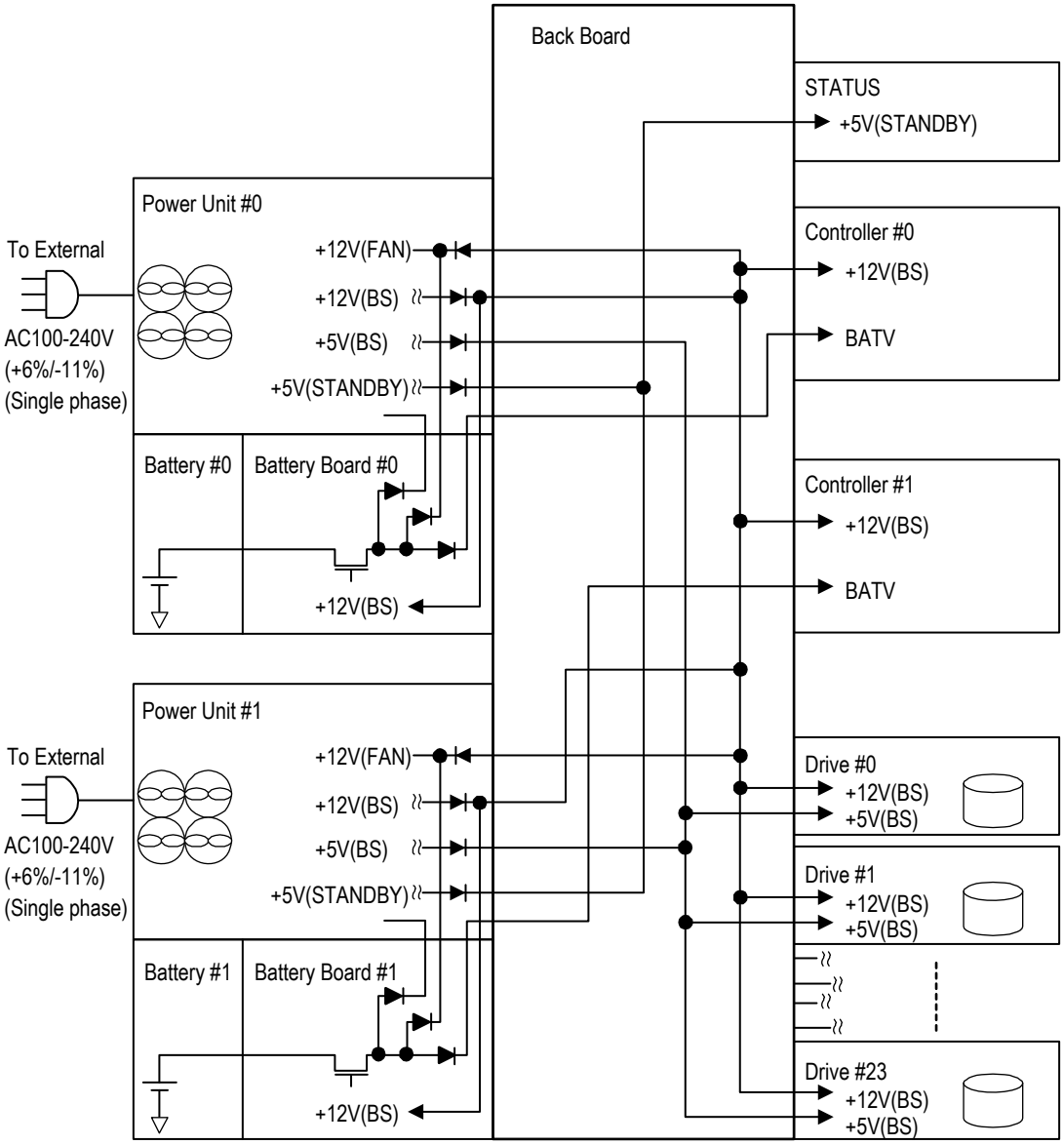


Figure 1.4.2 Connection Diagram of Power Supply System (CBXSS/CBSS)

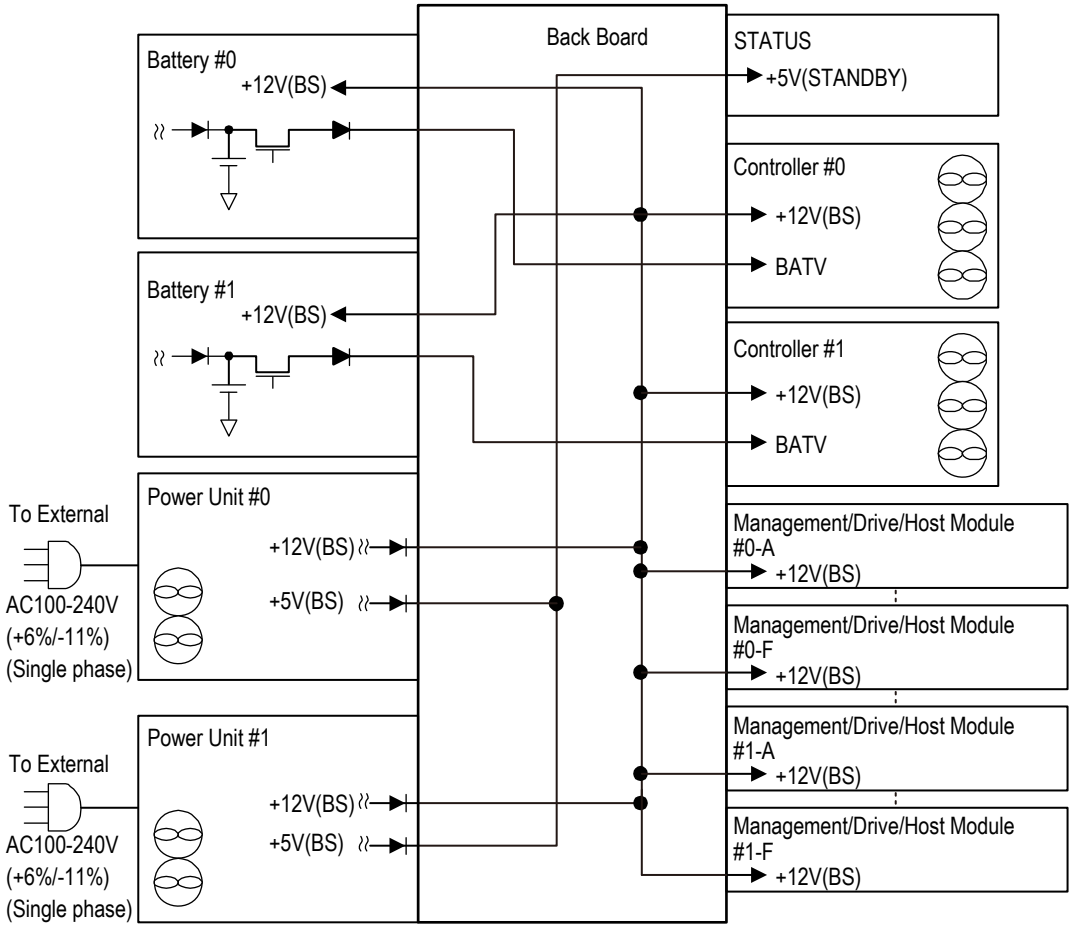


Figure 1.4.3 Connection Diagram of Power Supply System (CBL)

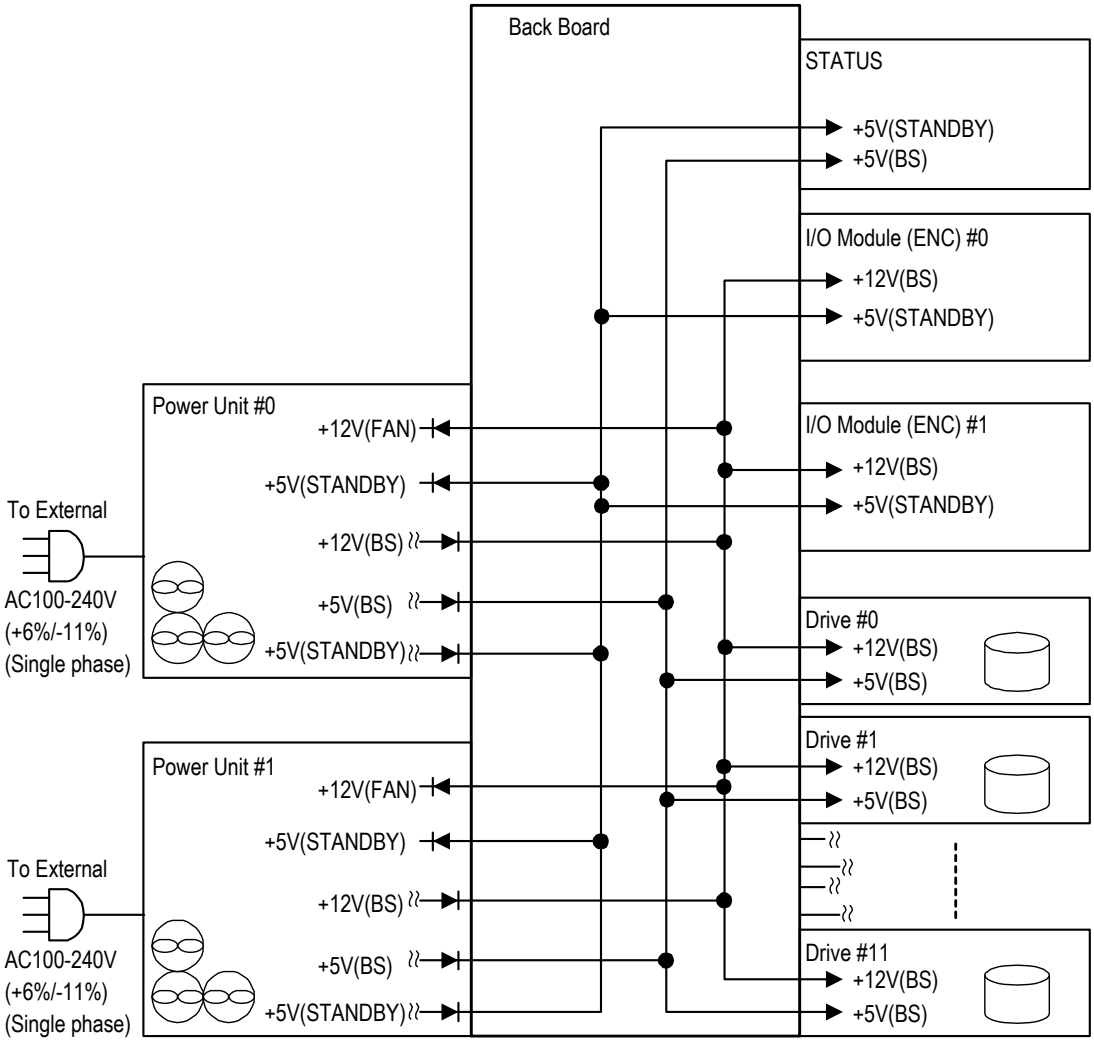


Figure 1.4.4 Connection Diagram of Power Supply System (DBL)

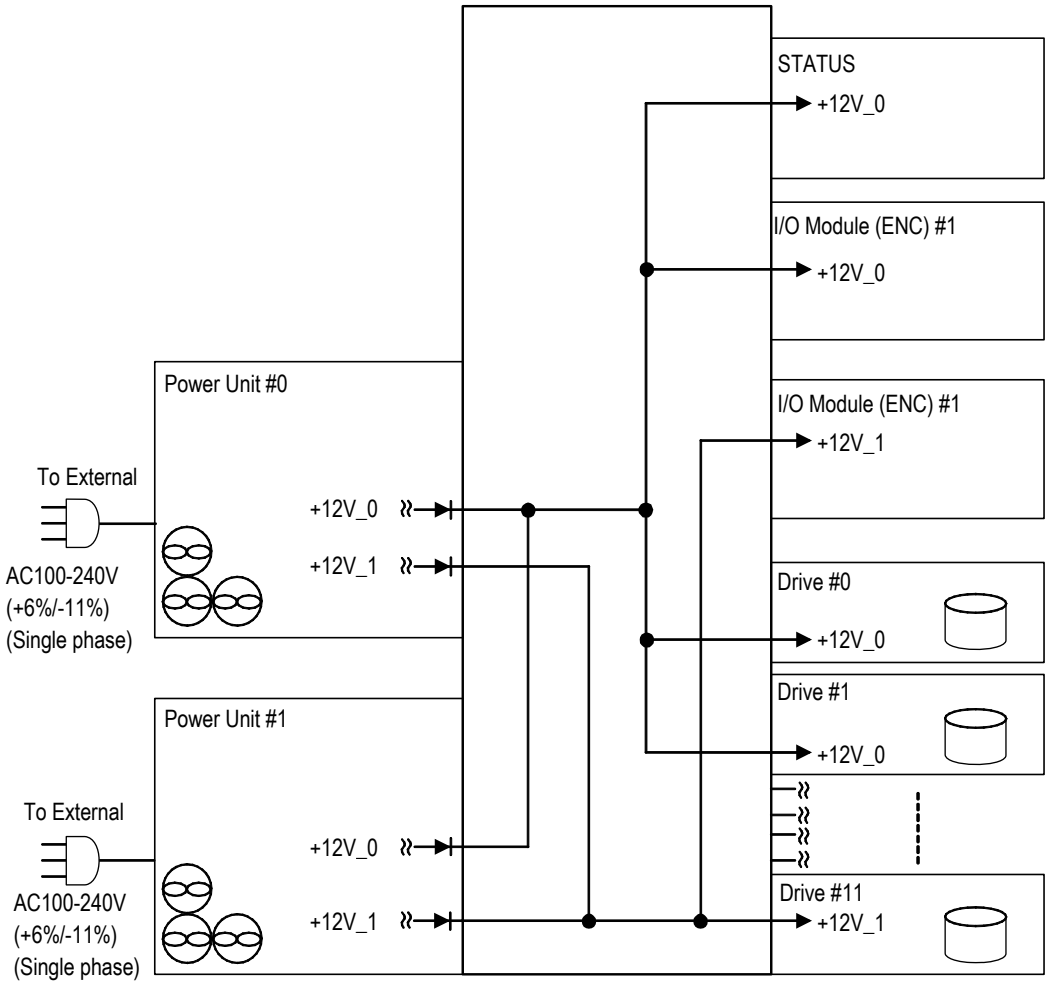


Figure 1.4.4.1 Connection Diagram of Power Supply System (DBF)

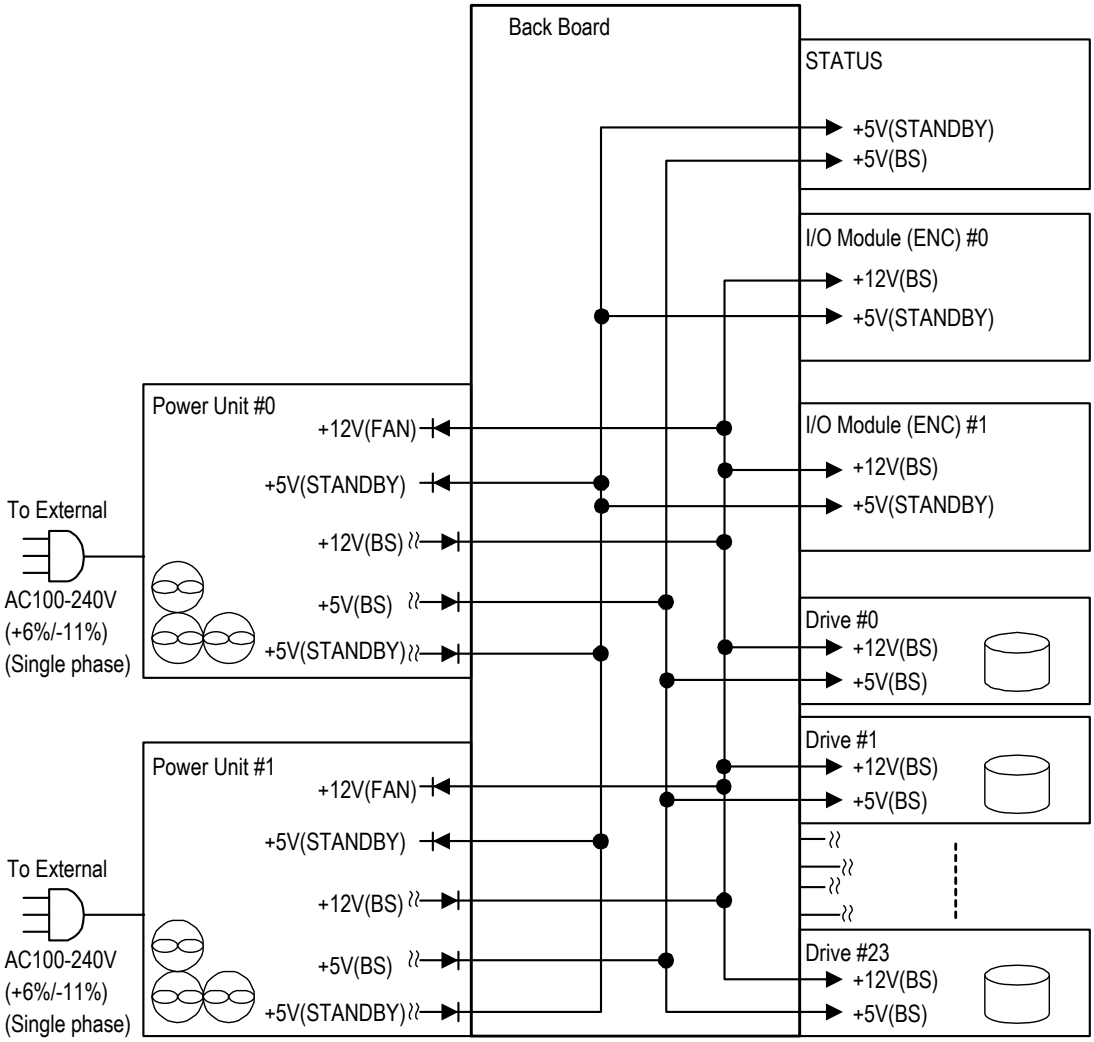


Figure 1.4.5 Connection Diagram of Power Supply System (DBS)

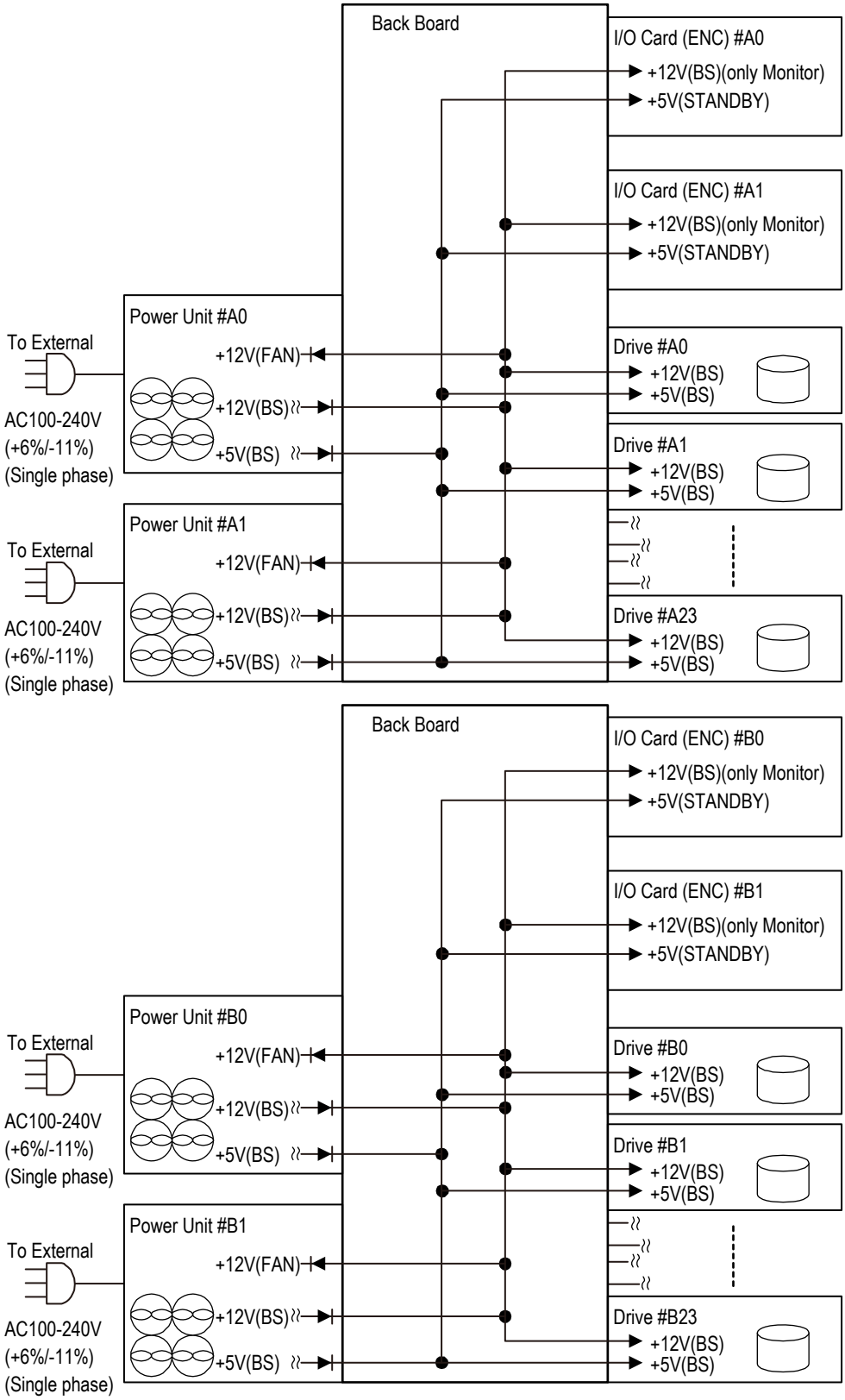
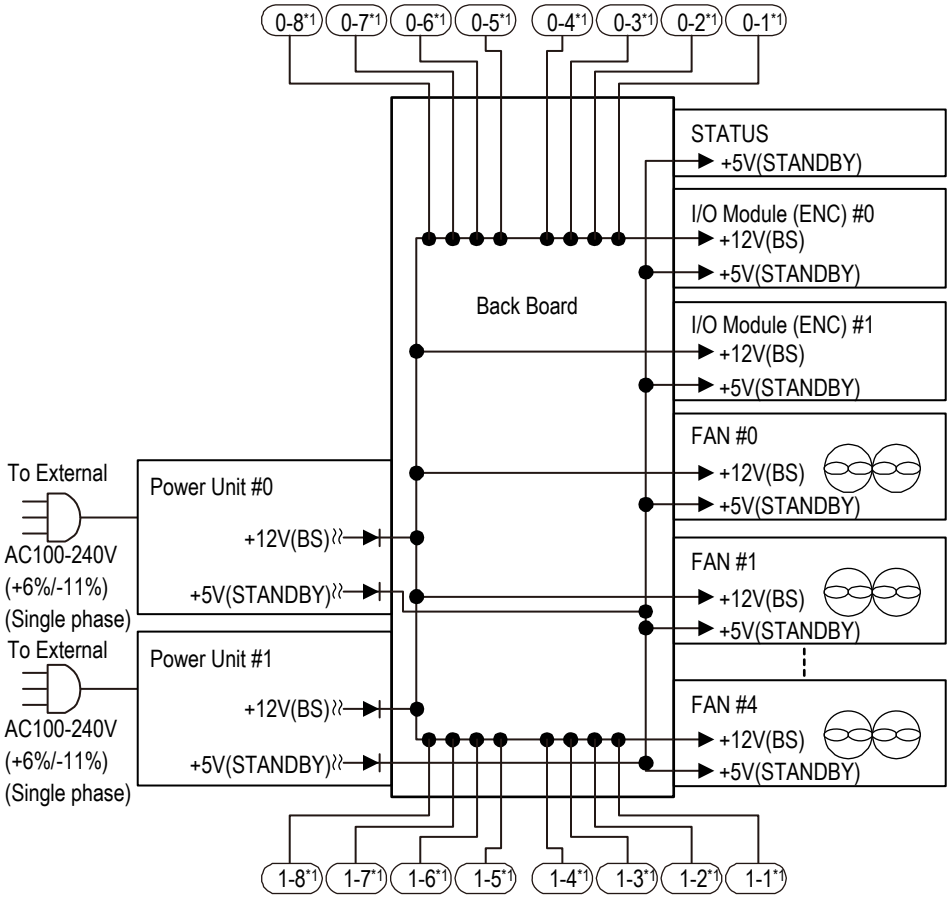
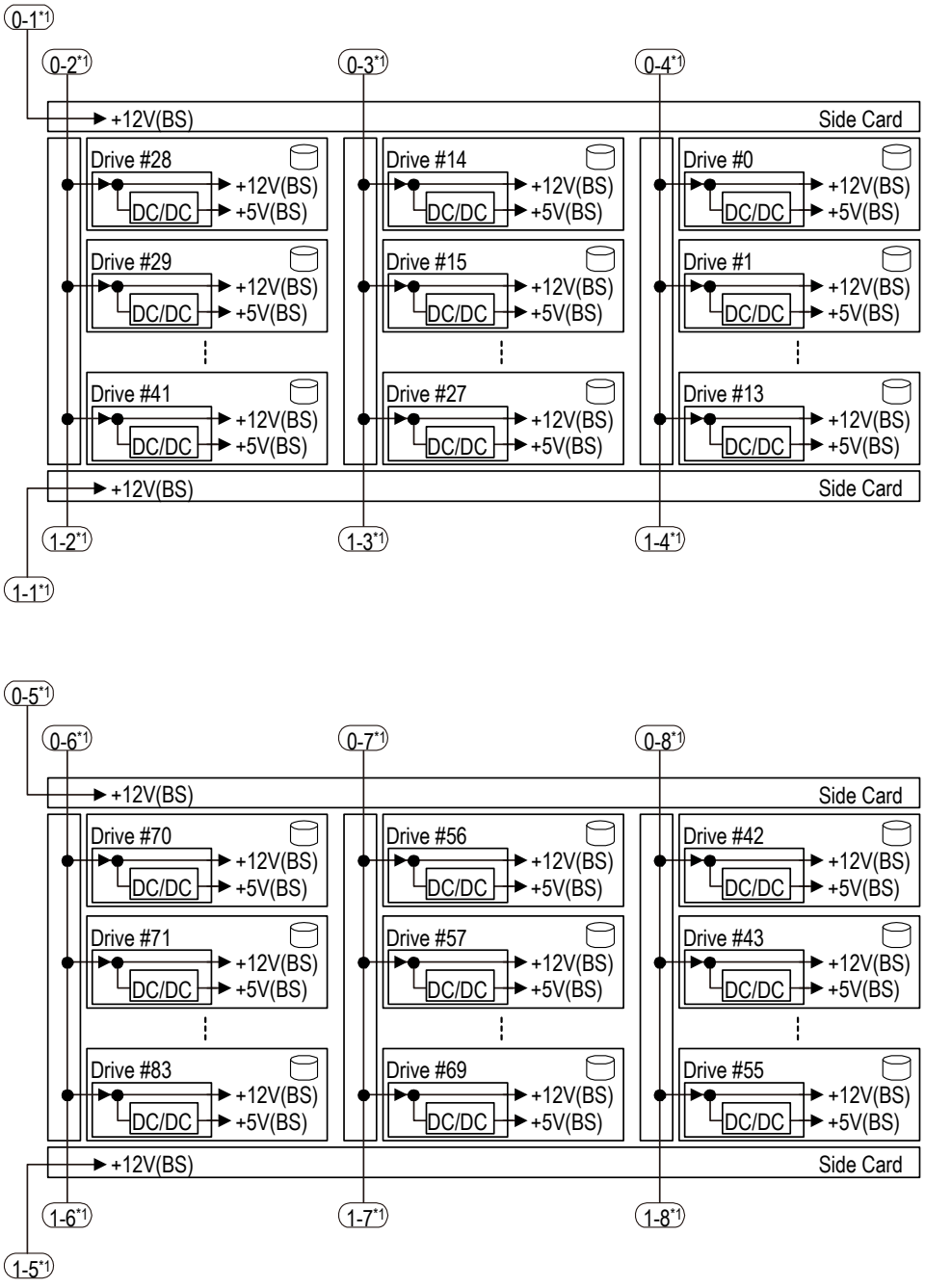


Figure 1.4.6 Connection Diagram of Power Supply System (DBX)



*1 : To Figure 1.4.8 Connection Diagram of Power Supply System (DBW-Drive) (INTR 01-0402).

Figure 1.4.7 Connection Diagram of Power Supply System (DBW-Back Board)



*1 : From Figure 1.4.8 Connection Diagram of Power Supply System (DBW-Back Board) (INTR 01-0401).

Figure 1.4.8 Connection Diagram of Power Supply System (DBW-Drive)

(2) Internal power supply system configuration (CBLD/DBLD/DBSD)

Input power to the CBLD/DBLD/DBSD is supplied from the DC power supply. Even if the main switch is off, each voltage (BS) is supplied. For turning off the supply of each power voltage (BS), it is required to remove the power cables from the Power Units(‡1).

Two Power Units are installed as the standard to duplicate the power supply system. Accordingly, the array can continue its operation even when a failure occurs in one of the Power Unit or power cables. Further, part replacement can be done while the array is operating.

For at the time of the failure. Duplicate the power system prepare for the failure. Therefore, first the main switch off, next turning off the power supply when the need for turning off the one side power supply except failure.

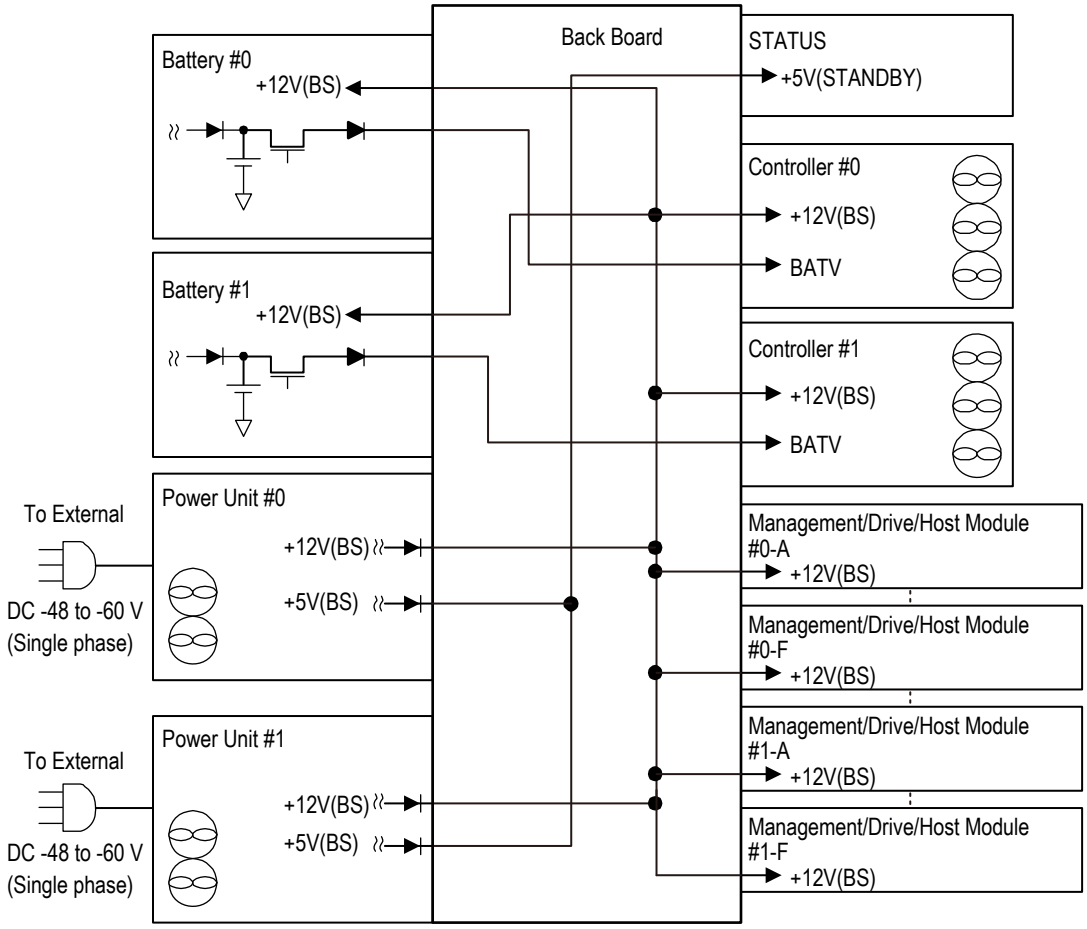


Figure 1.4.9 Connection Diagram of Power Supply System (CBLD)

‡1 : In the situation where the main switch is turned off, do not leave the components removed from the array for a long time. The power supply alarm can be given because of an abnormal alarm.

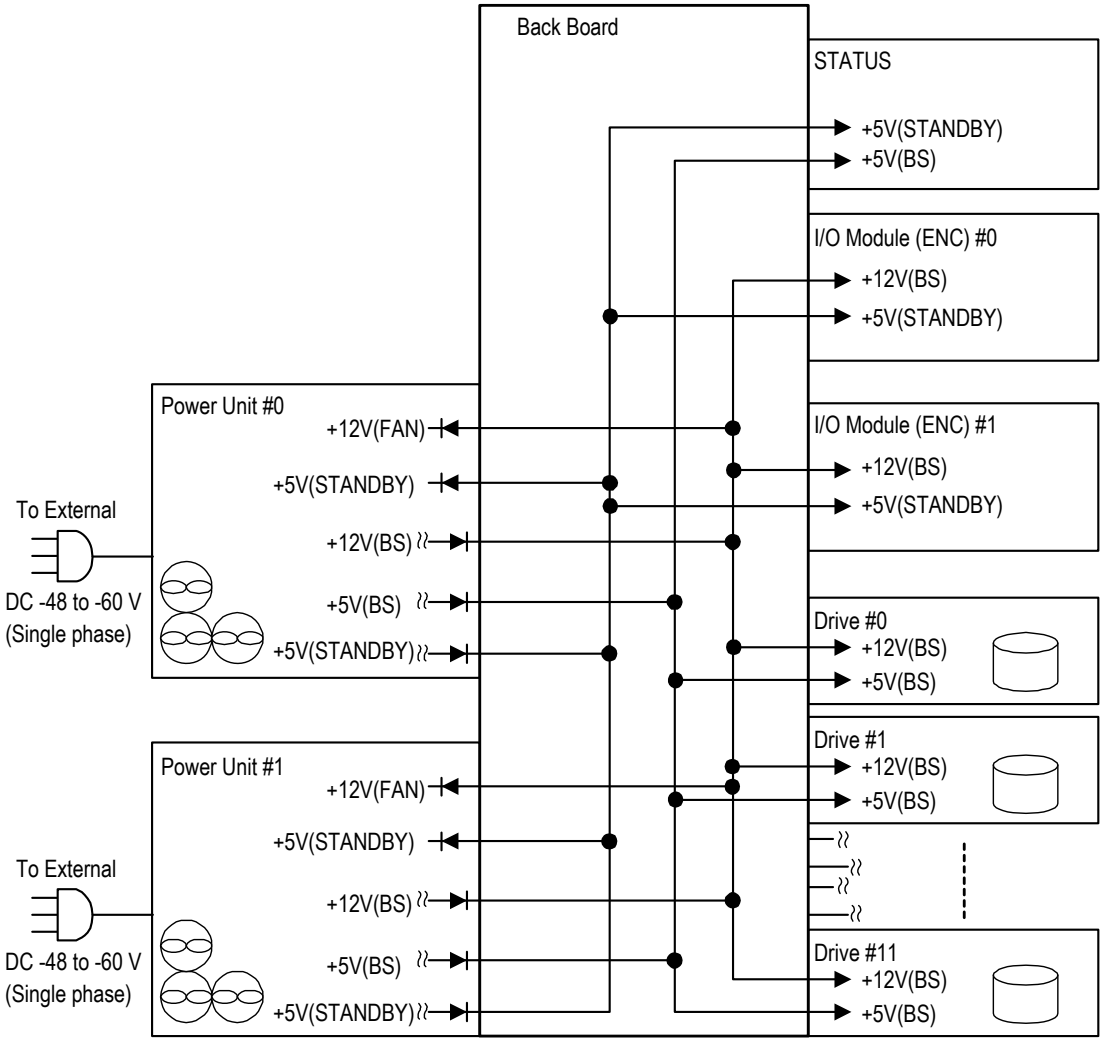


Figure 1.4.10 Connection Diagram of Power Supply System (DBLD)

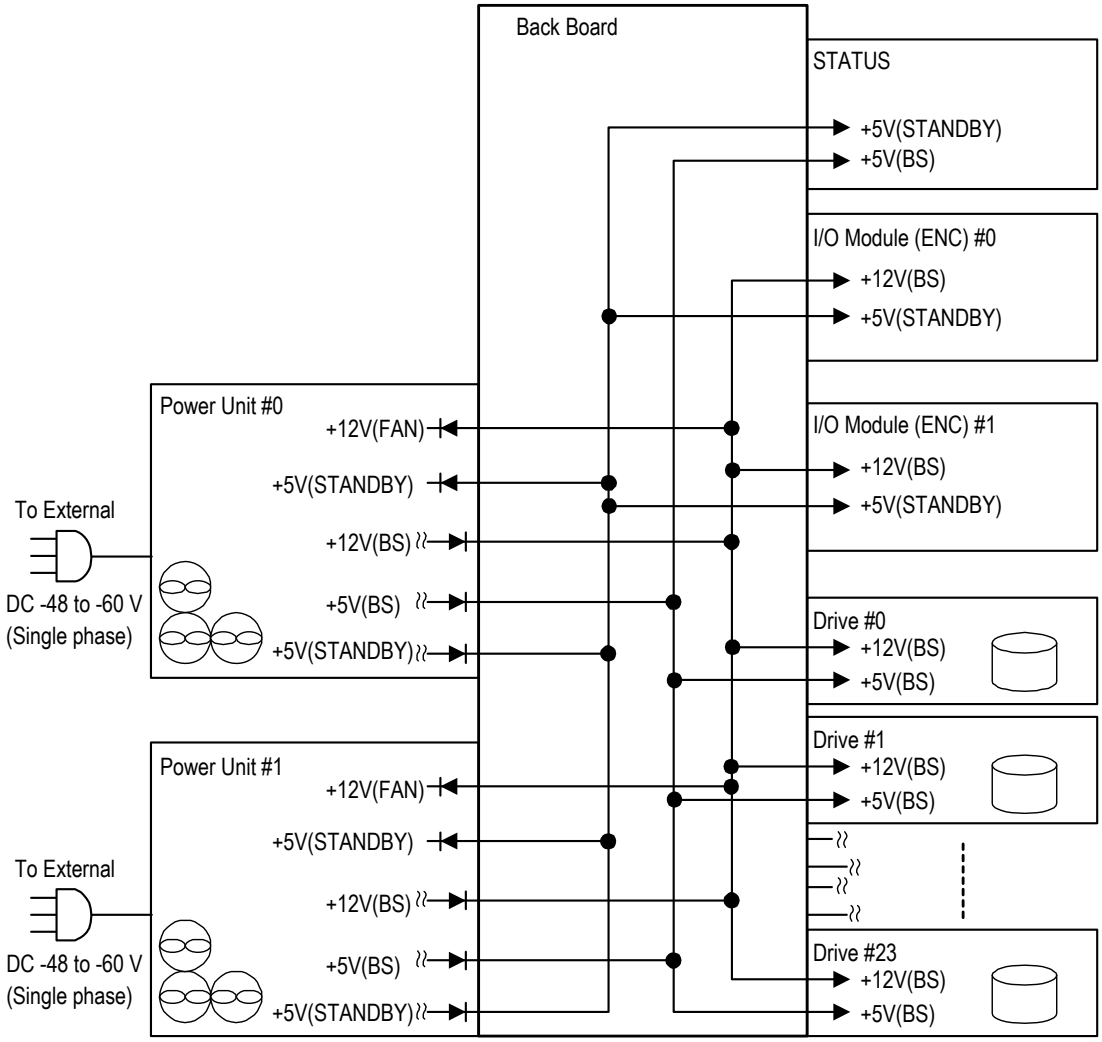


Figure 1.4.11 Connection Diagram of Power Supply System (DBSD)

1.5 Configuration of Internal Data System

Refer to table below for the configuration of Internal Data System.

No.	System Configuration	Figure number	Refer page
1	CBSL	Figure 1.5.1	INTR 01-0420
2	CBSS	Figure 1.5.2	INTR 01-0430
3	CBXSL	Figure 1.5.3	INTR 01-0440
4	CBXSS	Figure 1.5.4	INTR 01-0450
5	CBL/CBLD	Figure 1.5.5	INTR 01-0460
6	DBL/DBLD/DBF	Figure 1.5.6	INTR 01-0460
7	DBS/DBSD	Figure 1.5.7	INTR 01-0470
8	DBX	Figure 1.5.8	INTR 01-0470
9	DBW	Figure 1.5.8.1	INTR 01-0471
10	CBSL+DBL	Figure 1.5.9	INTR 01-0480
11	CBSL+DBL×2	Figure 1.5.10	INTR 01-0490
12	CBSL+DBS	Figure 1.5.11	INTR 01-0500
13	CBSL+DBS×2	Figure 1.5.12	INTR 01-0510
14	CBSL+DBX	Figure 1.5.13	INTR 01-0520
15	CBSL+DBX×2	Figure 1.5.14	INTR 01-0530
16	CBSL+DBW×2	Figure 1.5.14.1	INTR 01-0531
17	CBSS+DBL	Figure 1.5.15	INTR 01-0540
18	CBSS+DBL×2	Figure 1.5.16	INTR 01-0550
19	CBSS+DBS	Figure 1.5.17	INTR 01-0560
20	CBSS+DBS×2	Figure 1.5.18	INTR 01-0570
21	CBSS+DBX	Figure 1.5.19	INTR 01-0580
22	CBSS+DBX×2	Figure 1.5.20	INTR 01-0590
23	CBSS+DBW×2	Figure 1.5.20.1	INTR 01-0591
24	CBL+DBL×4/CBLD+DBLD×4 /CBL+DBF×4	Figure 1.5.21	INTR 01-0600
25	CBL+DBS×4/CBLD+DBSD×4	Figure 1.5.22	INTR 01-0610
26	CBL+DBX×2	Figure 1.5.23	INTR 01-0620
27	CBL+DBW	Figure 1.5.24	INTR 01-0621

(1) Host interface

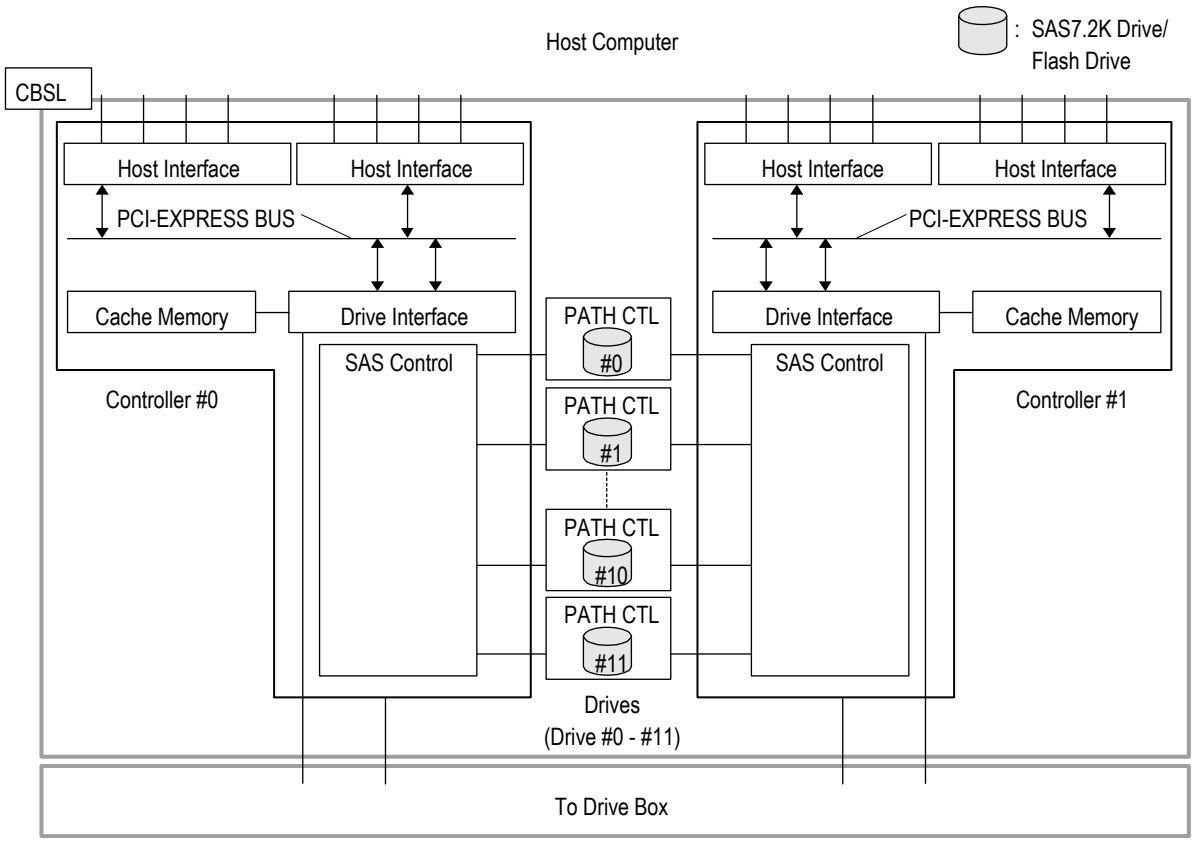
In the DF850, the PCI-Express bus is adopted for the connection between the host interface and the Controller, and the Fibre Channel interface or the iSCSI interface is supported as standard. With the Fibre Channel connection, one Controller can have up to two, four, or eight ports. Further, for the dual system, the array can have up to 16 Fibre Channel ports.
With iSCSI connection, one Controller can have up to two ports. For the dual system configuration, the array can have up to eight iSCSI ports.

(2) Cache memory data store

Even when a sudden power failure occurs, the Cache Memory stores the data in the Cache Memory to the back up device using a Battery.

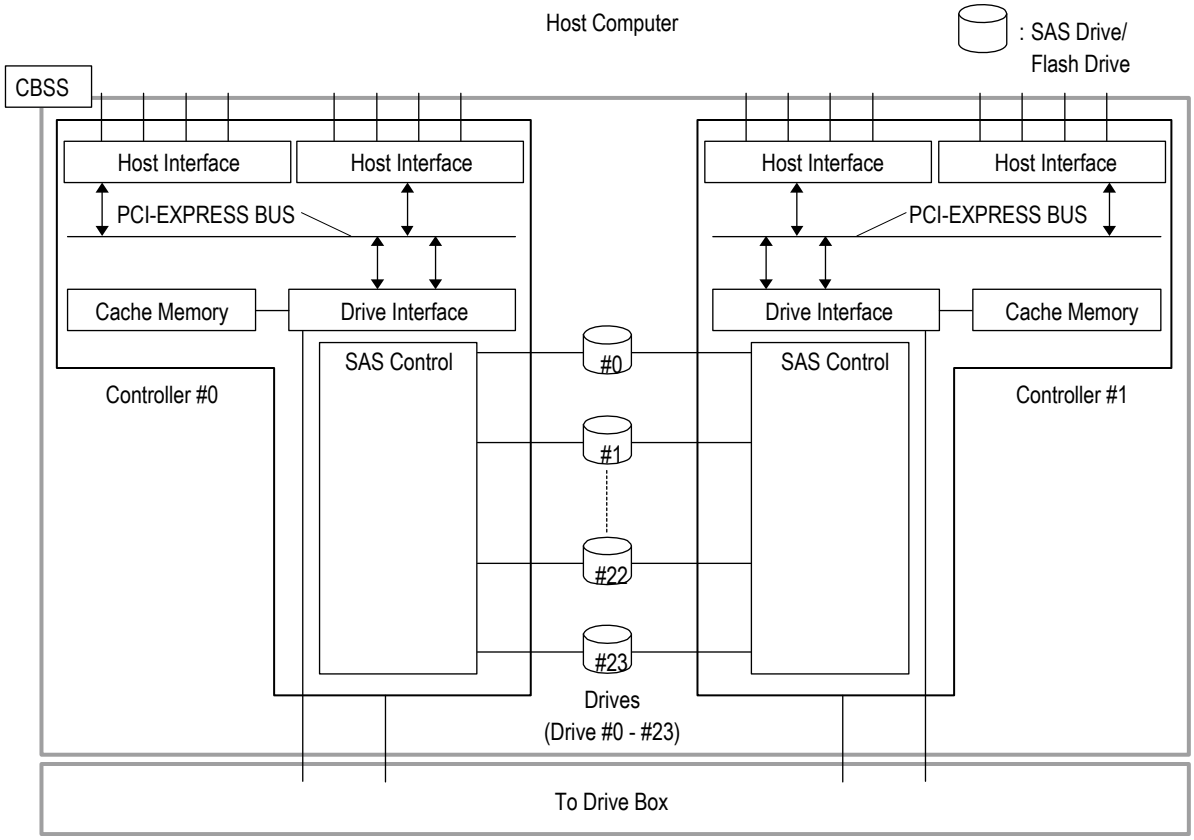
(3) Spare Drives

When a Spare Drive is set in a group of Drives, even if a failure occurs in the Drive, the same operation as before can be performed through reconstruction of data to the Spare Drive. Up to 80 (HUS130: up to 30, HUS110: up to 15) Spare Drives can be set.



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.1 Internal Data Connection of the CBSL



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.2 Internal Data Connection of the CBSS

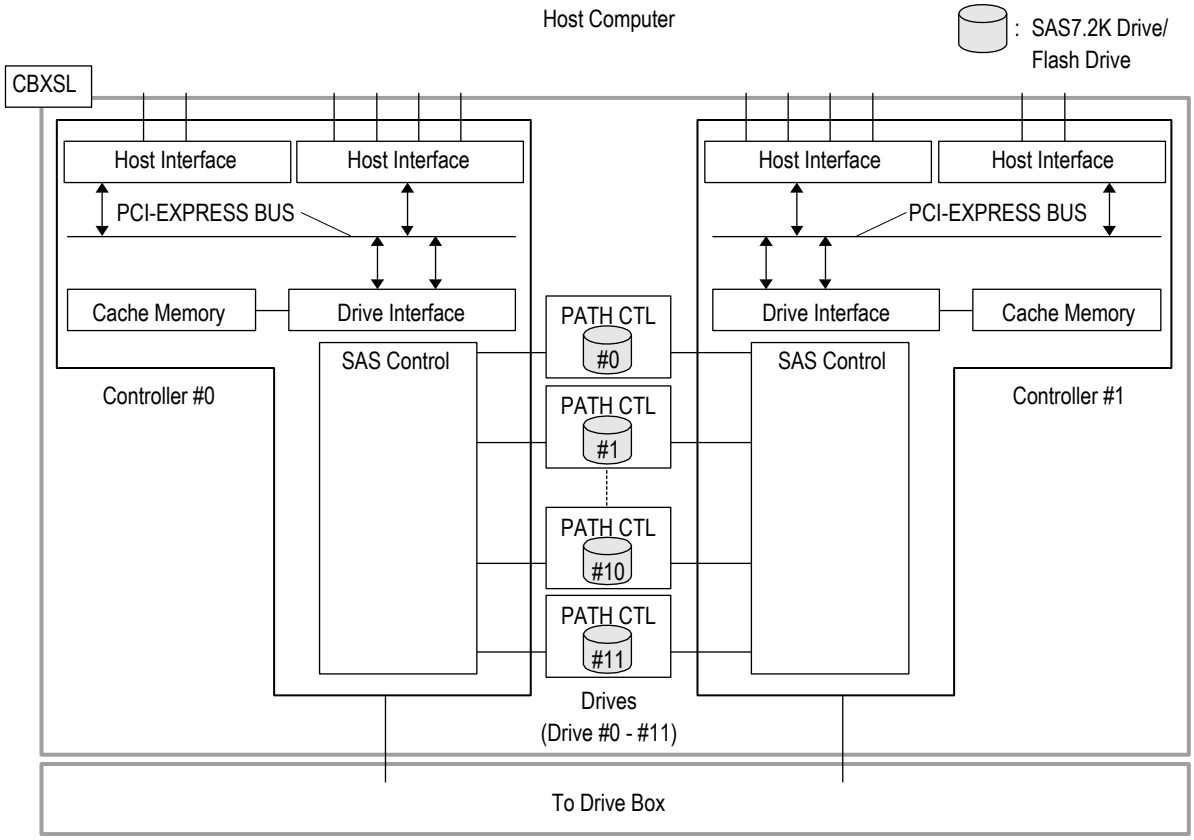


Figure 1.5.3 Internal Data Connection of the CBXSL

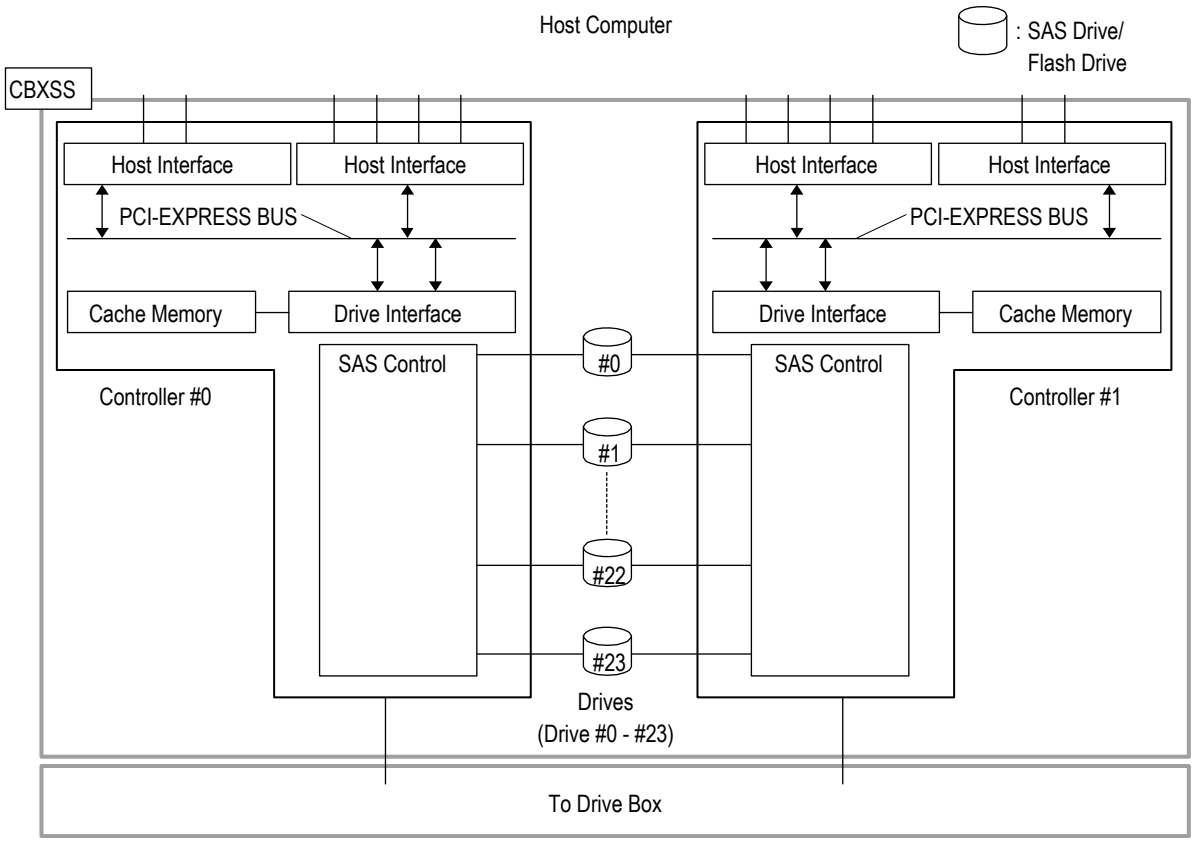
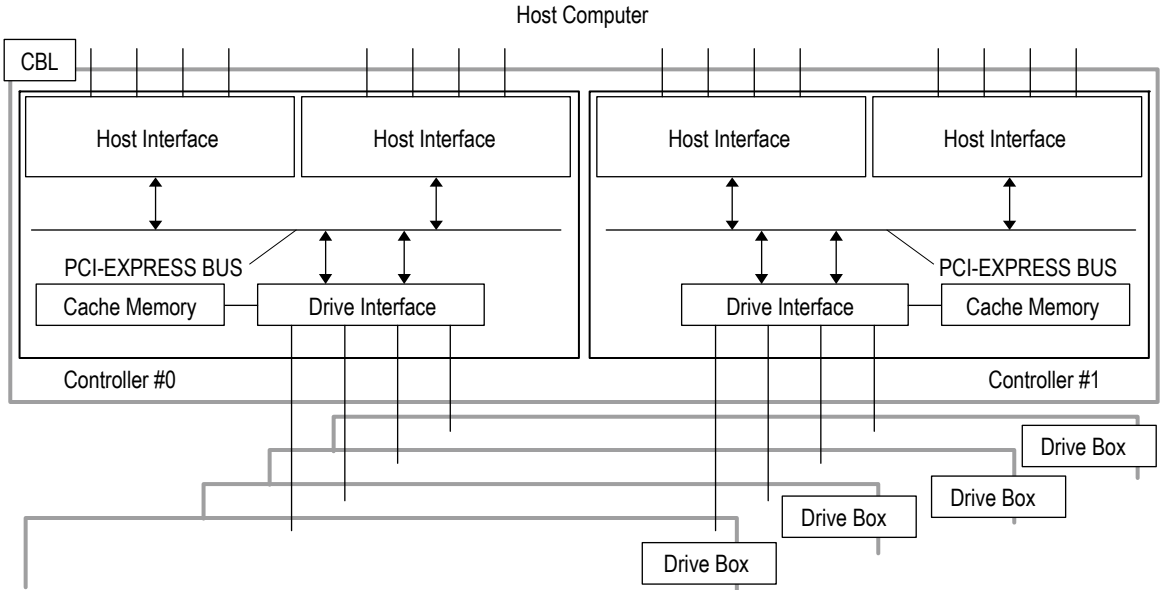
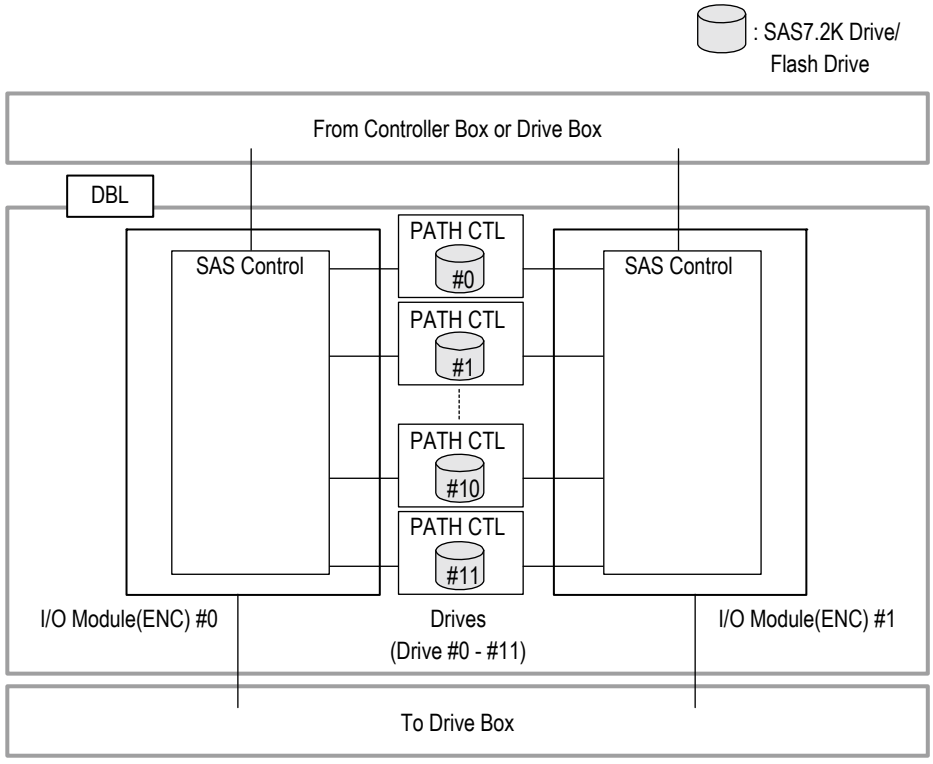


Figure 1.5.4 Internal Data Connection of the CBXSS



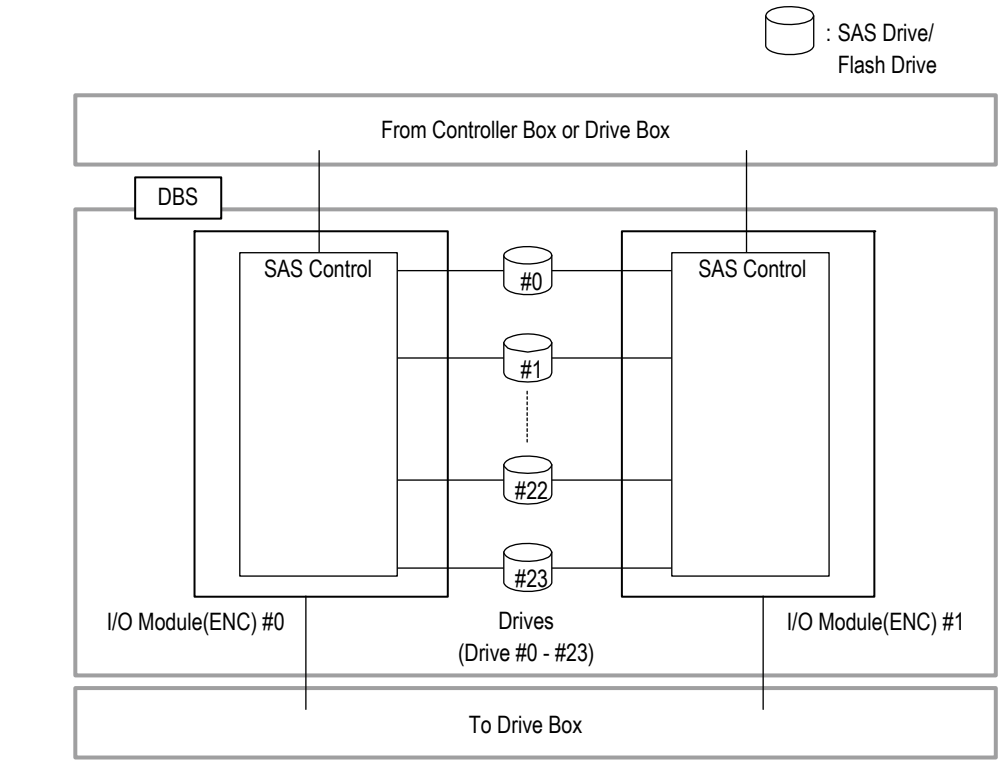
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.
*2 : The figure shows the CBL.

Figure 1.5.5 Internal Data Connection of the CBL/CBLD



*1 : The figure shows the DBL.

Figure 1.5.6 Internal Data Connection of the DBL/DBLD/DBF



*1 : The figure shows the DBS.

Figure 1.5.7 Internal Data Connection of the DBS/DBSD

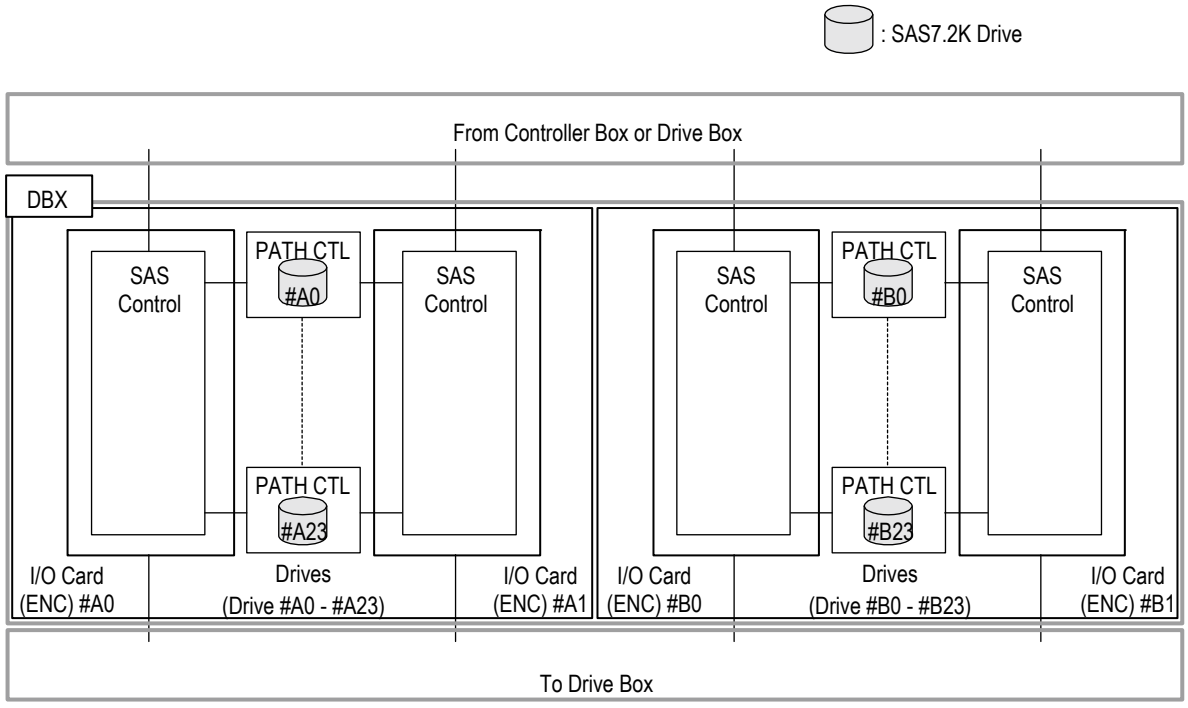


Figure 1.5.8 Internal Data Connection of the DBX

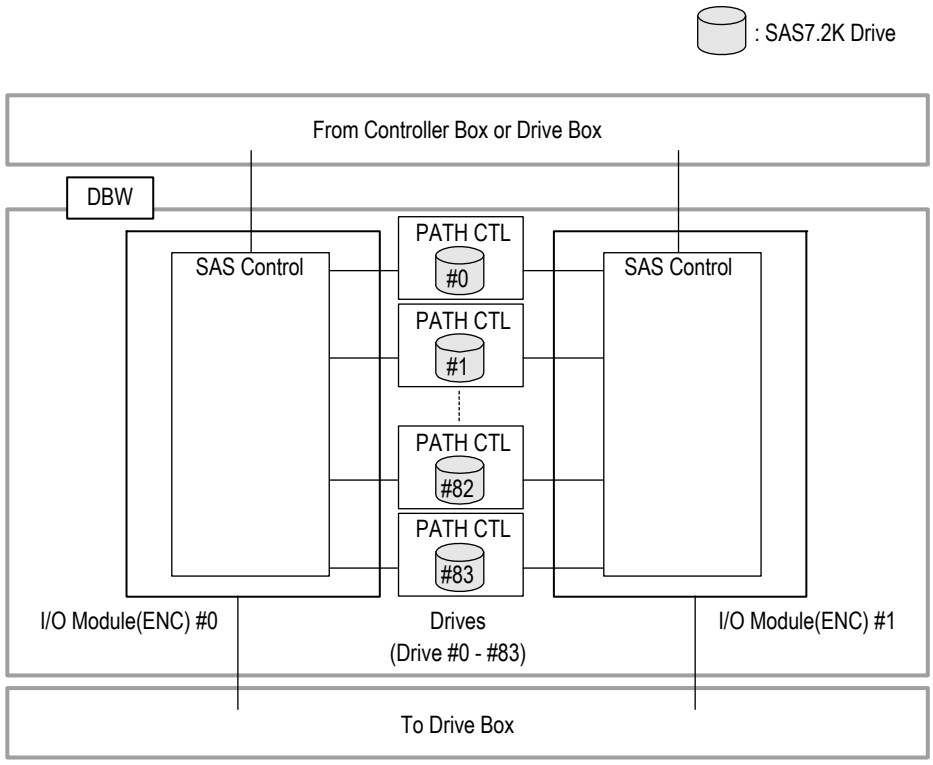
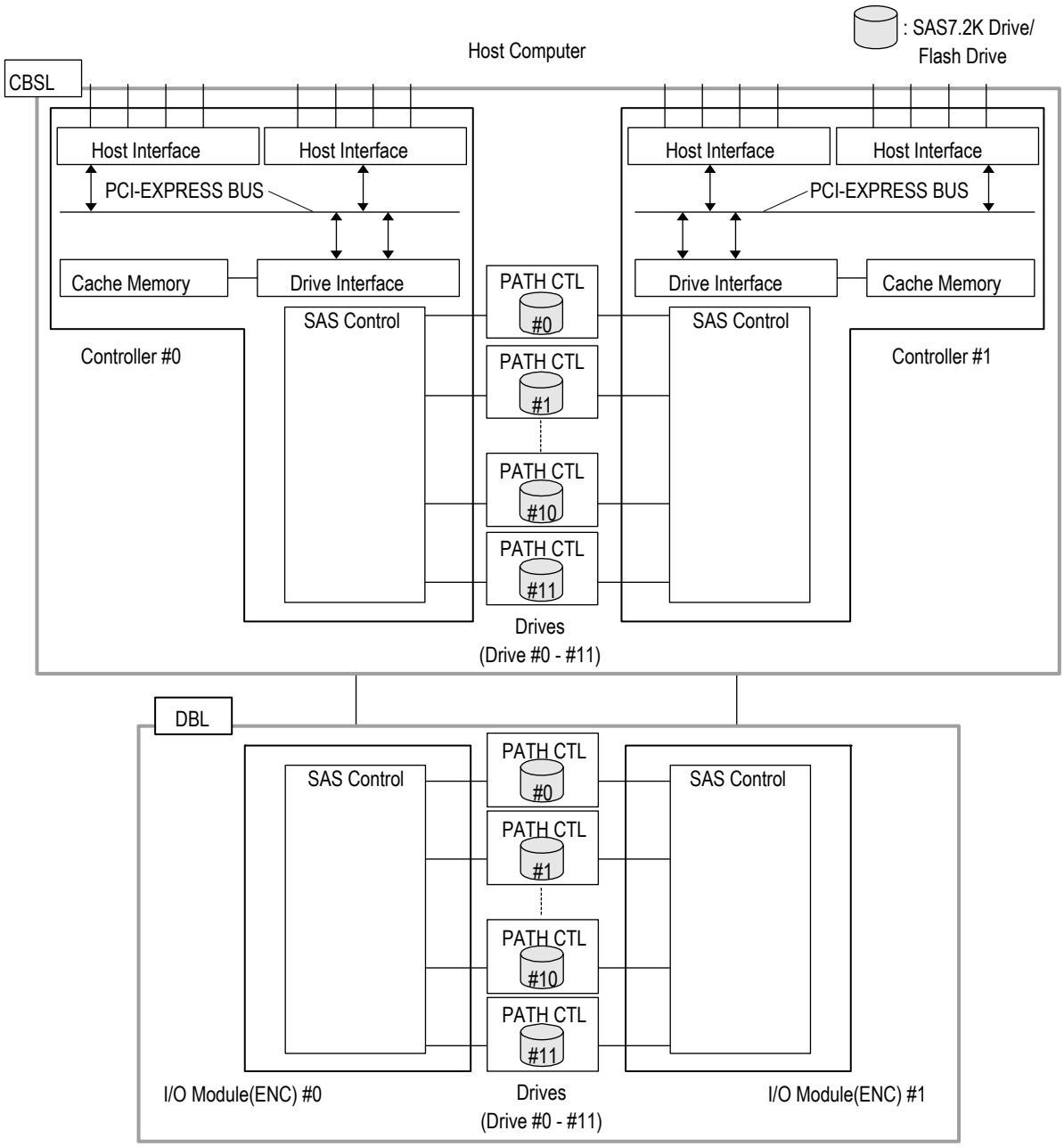
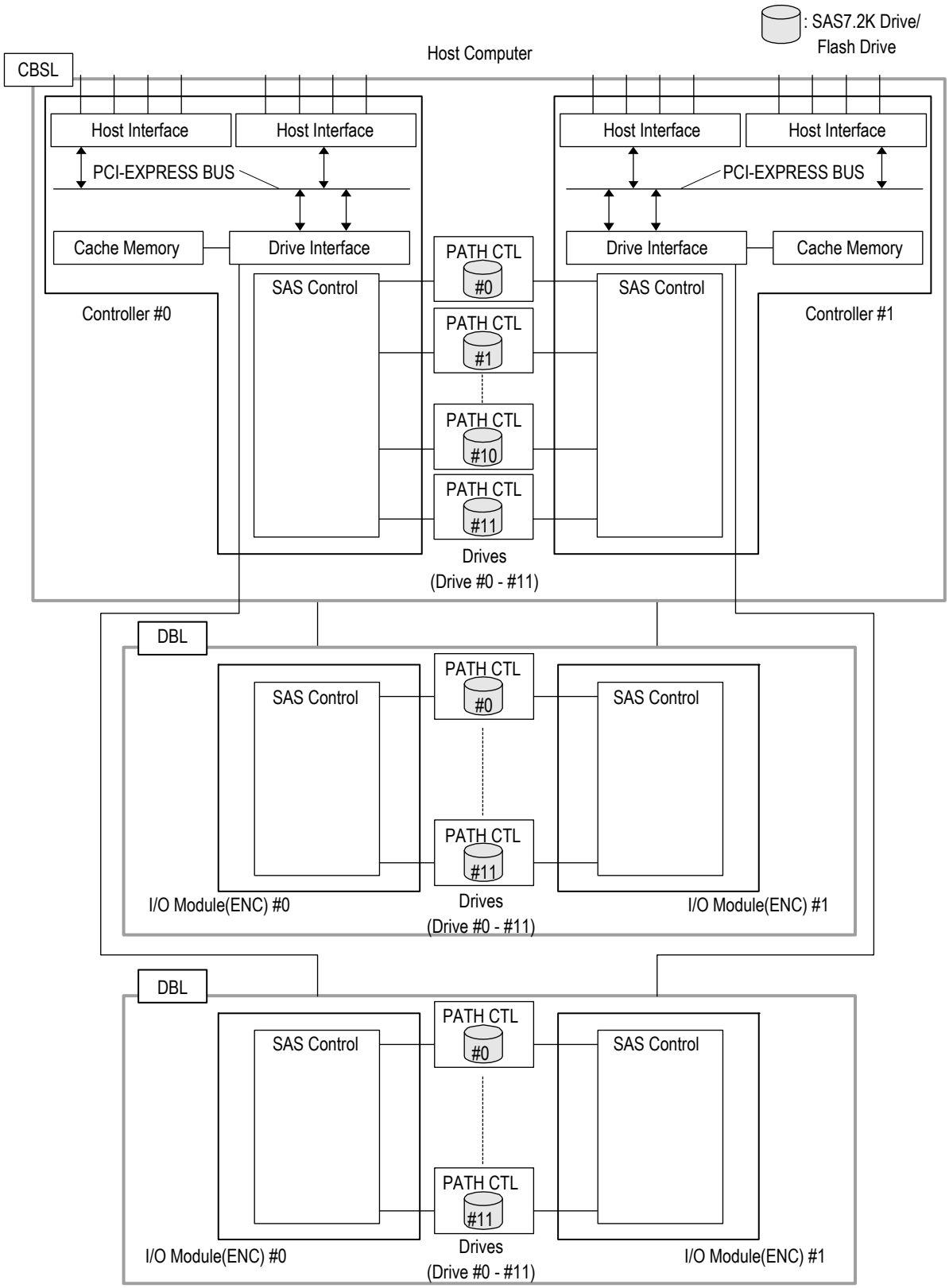


Figure 1.5.8.1 Internal Data Connection of the DBW



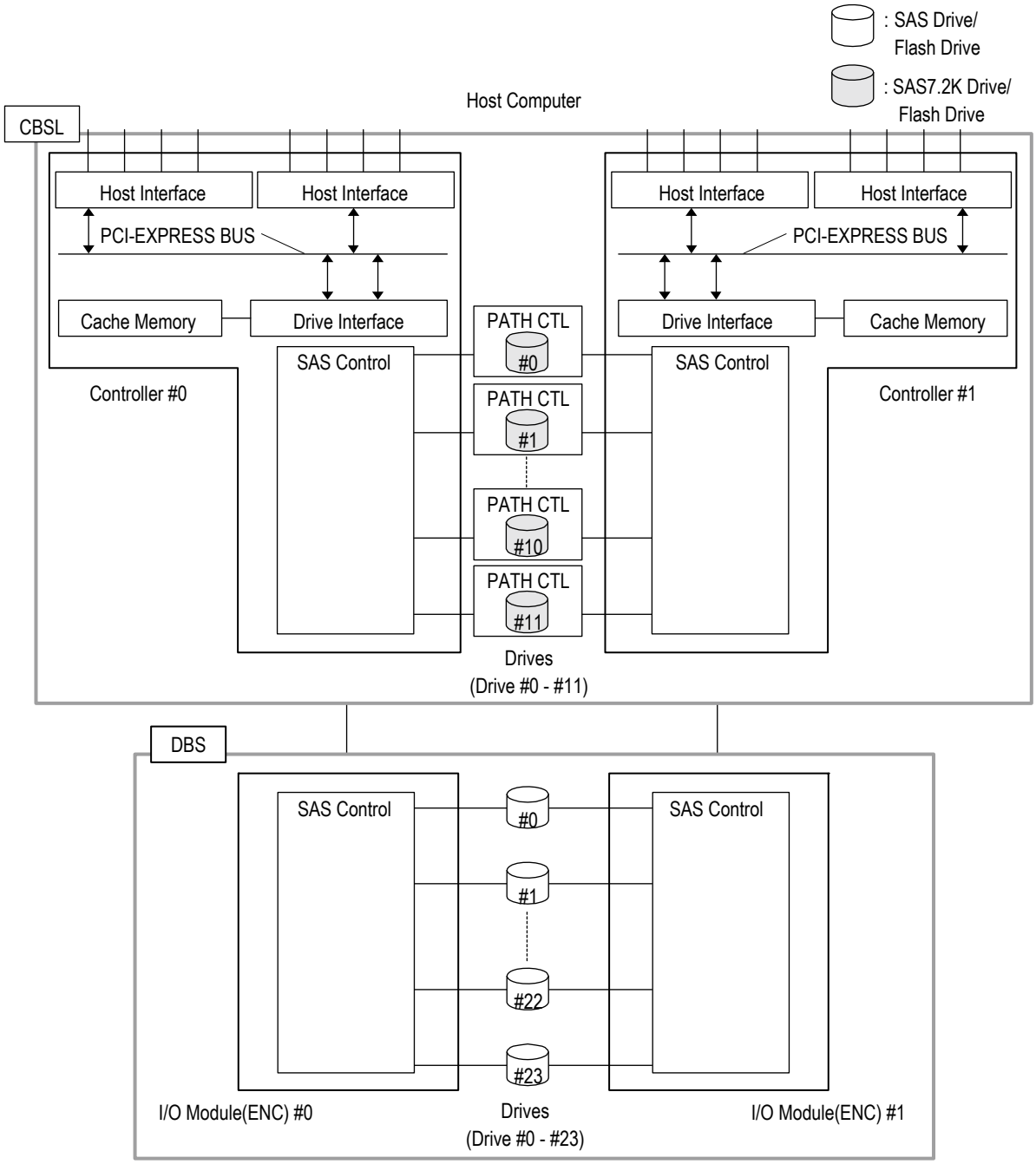
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.9 Internal Data Connection of the CBSL+DBL



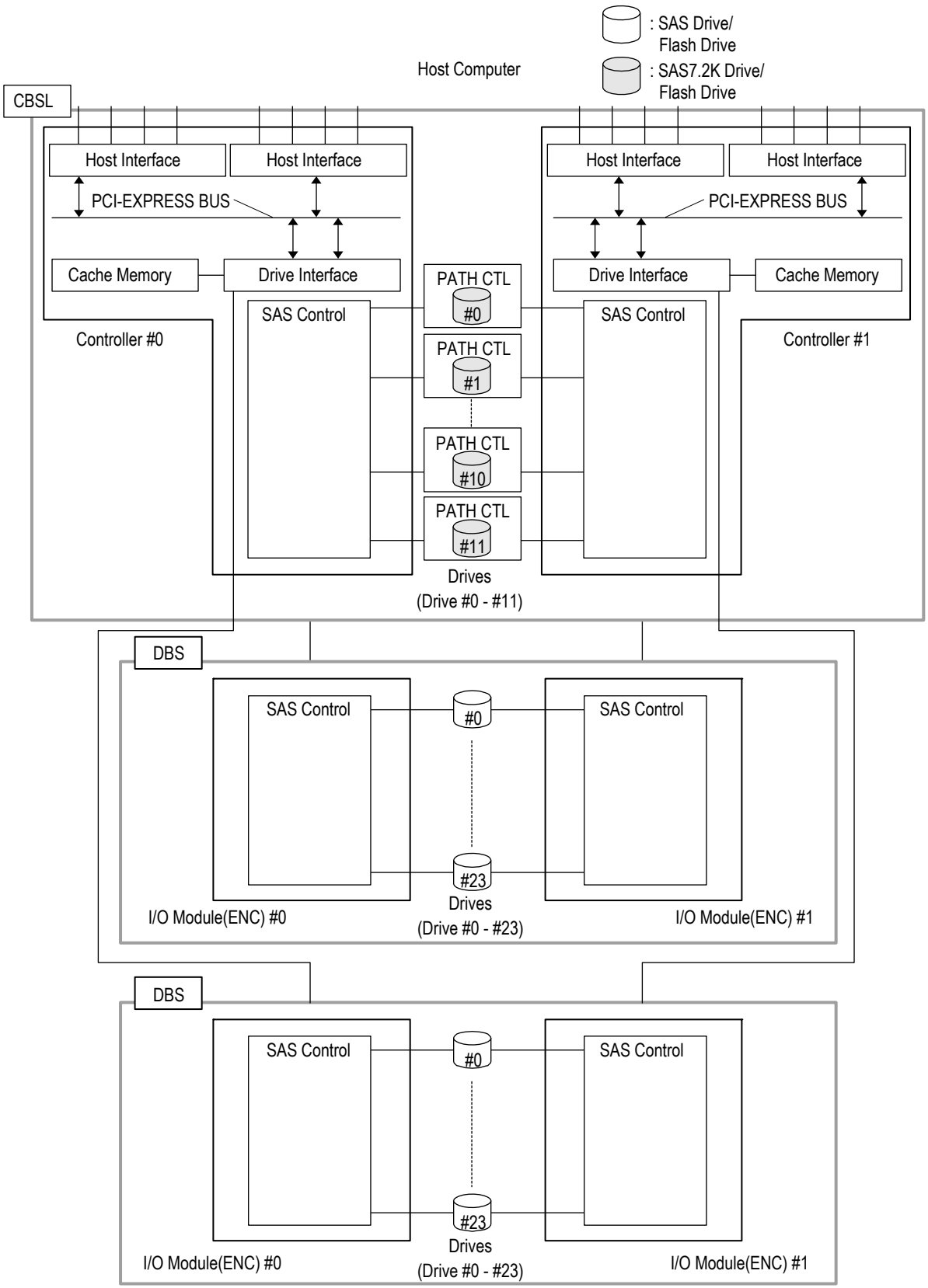
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.10 Internal Data Connection of the CBSL+DBL×2



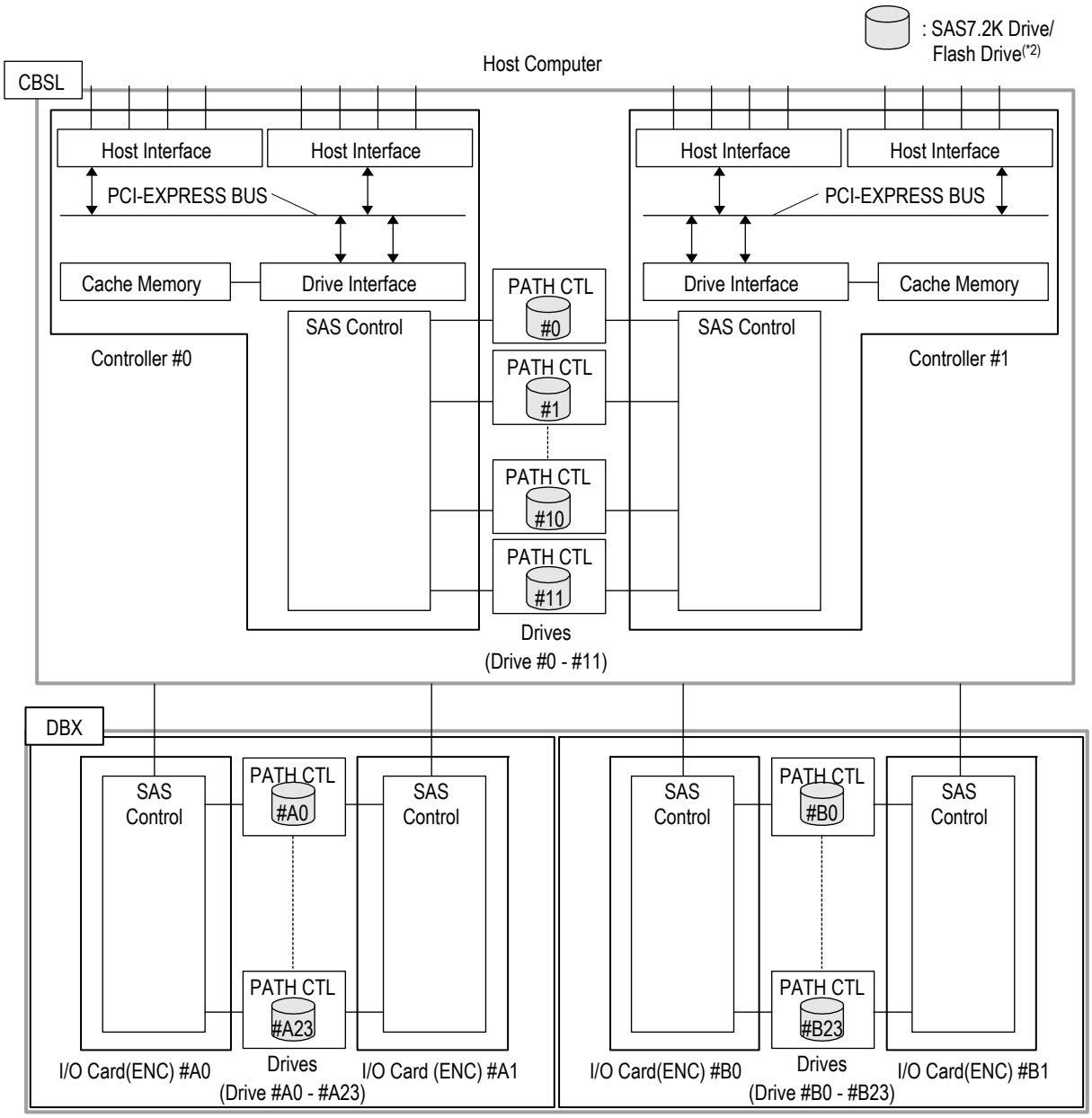
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.11 Internal Data Connection of the CBSL+DBS



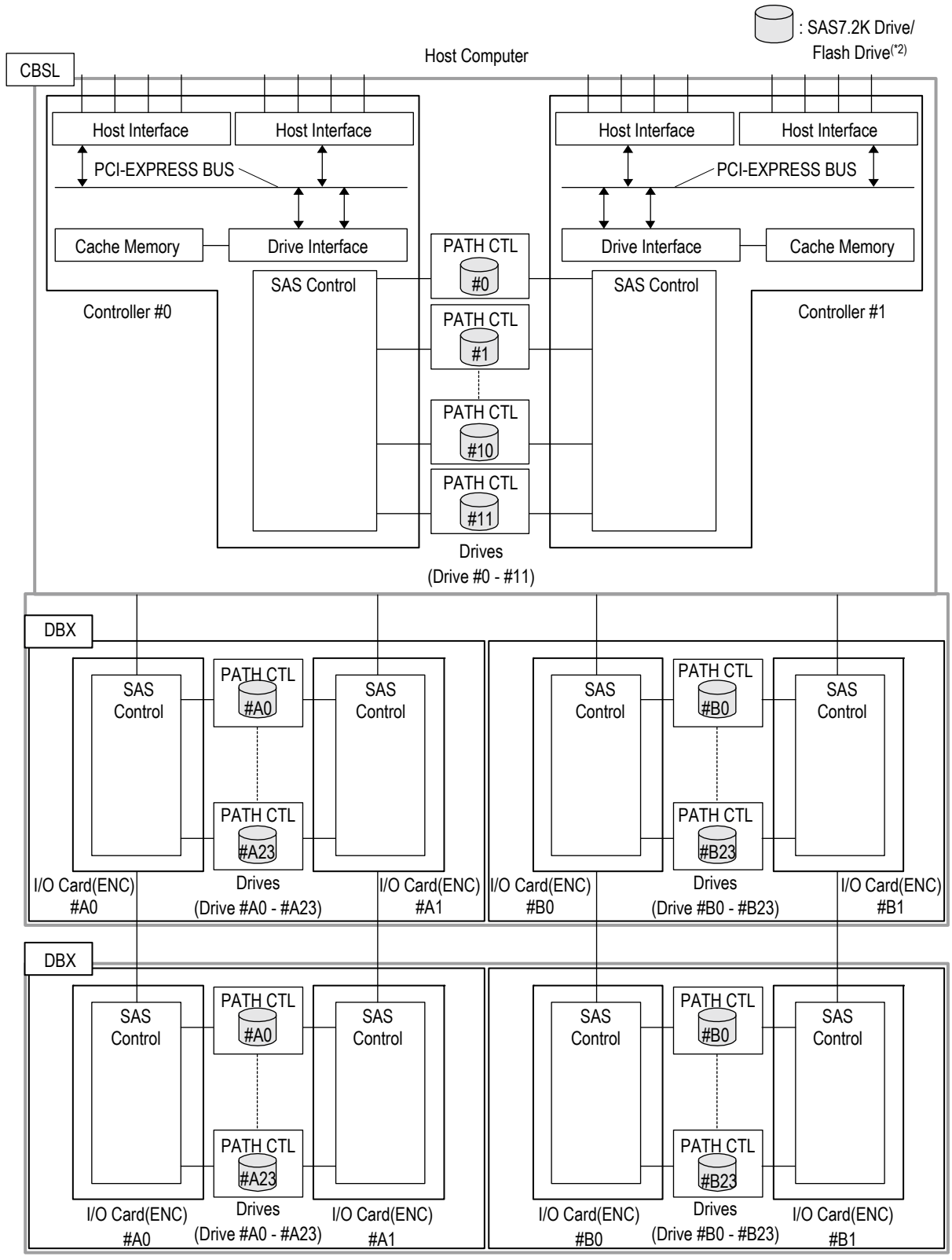
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.12 Internal Data Connection of the CBSL+DBS×2



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.
*2 : Flash Drive is not installed in the DBX.

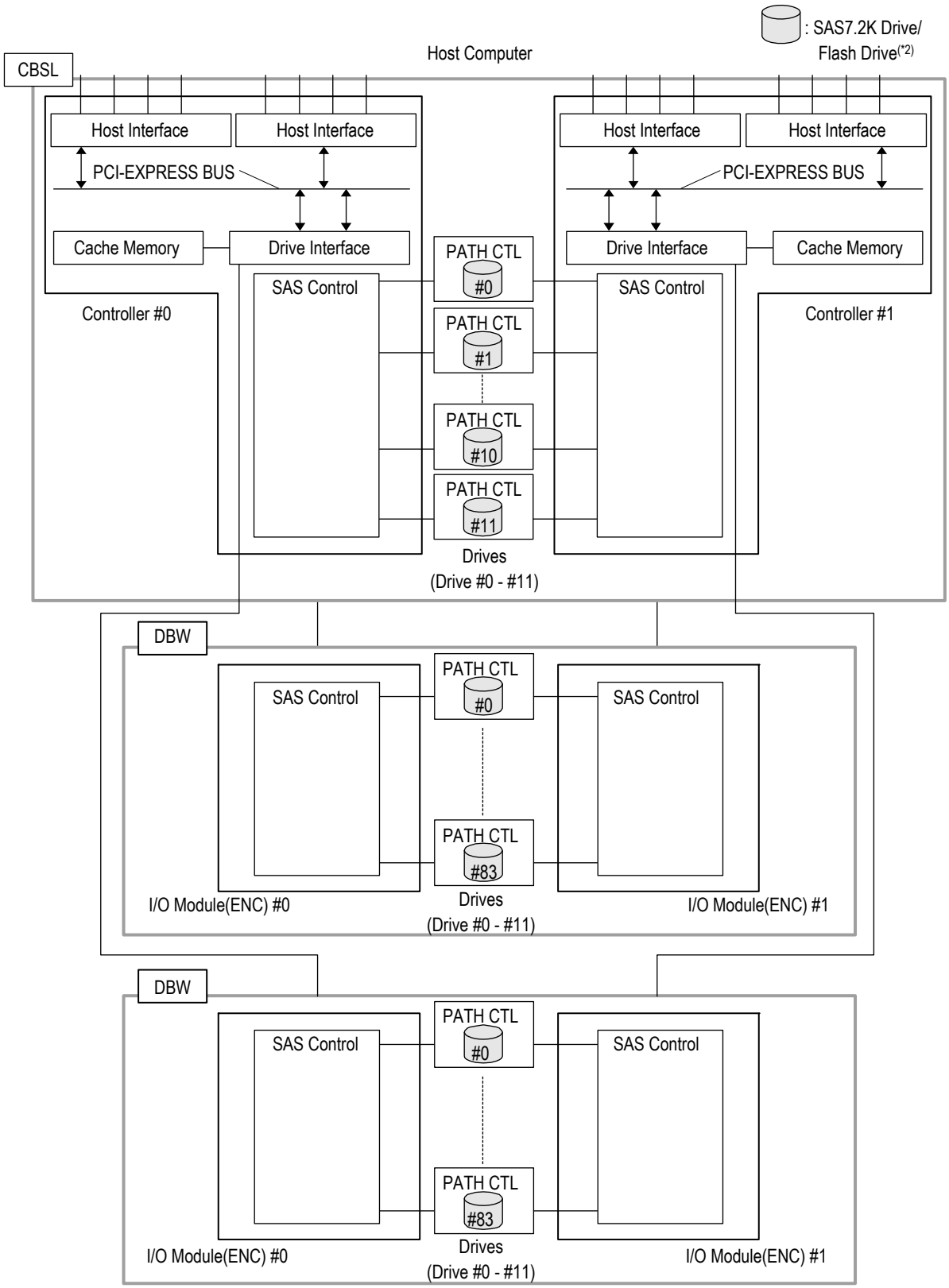
Figure 1.5.13 Internal Data Connection of the CBSL+DBX



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

*2 : Flash Drive is not installed in the DBX.

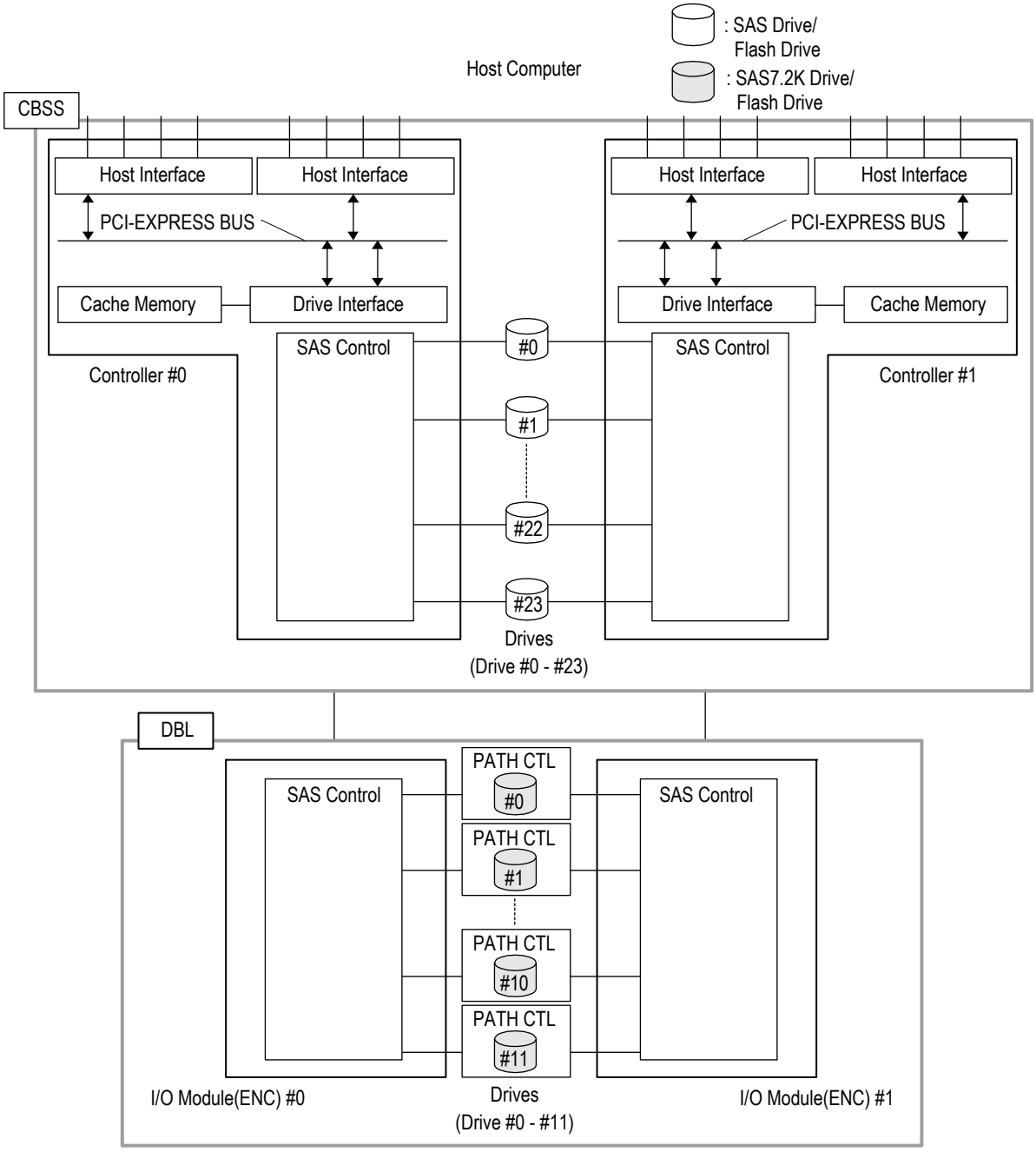
Figure 1.5.14 Internal Data Connection of the CBSL+DBX×2



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

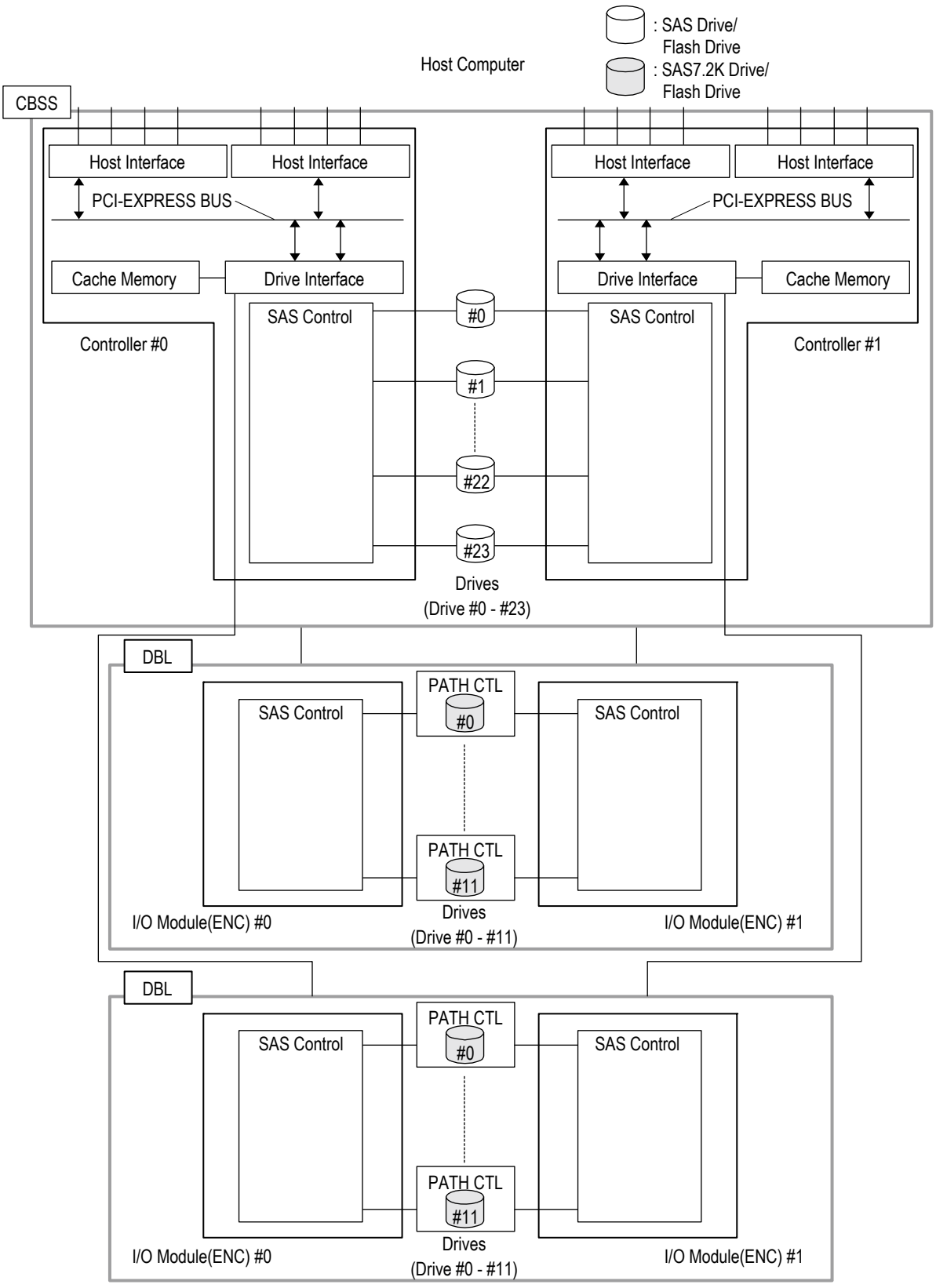
*2 : Flash Drive is not installed in the DBW.

Figure 1.5.14.1 Internal Data Connection of the CBSL+DBW×2



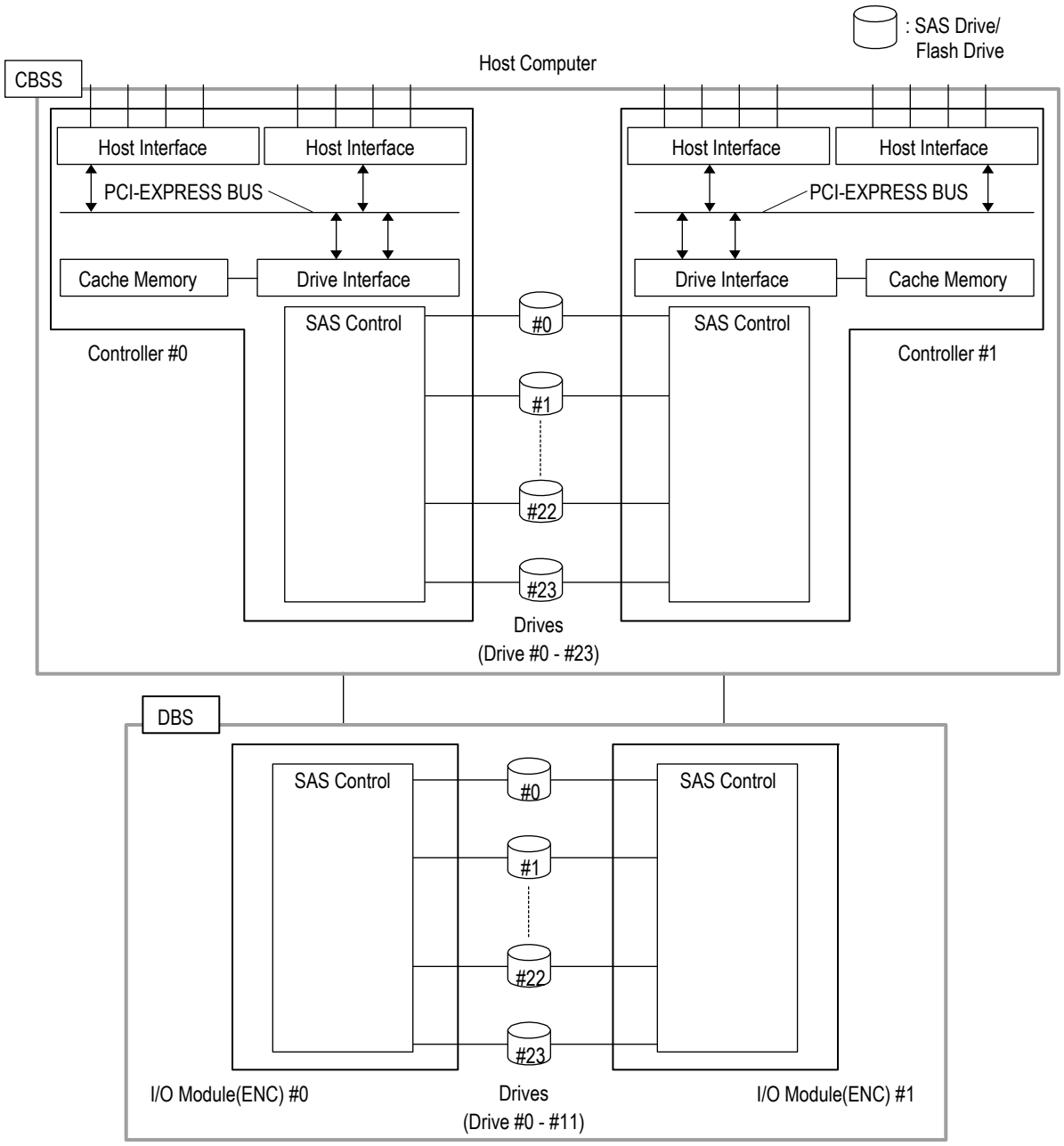
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.15 Internal Data Connection of the CBSS+DBL



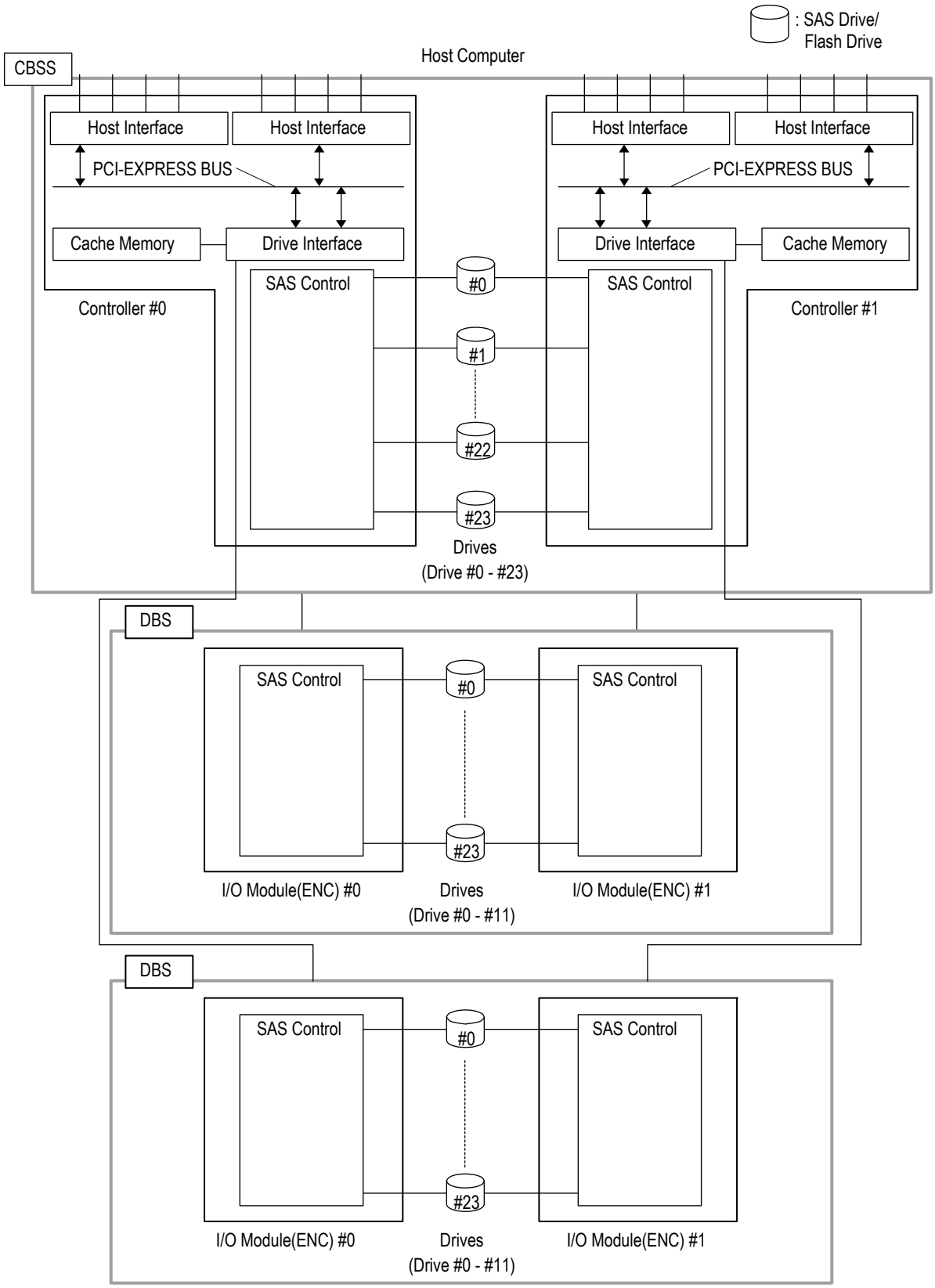
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.16 Internal Data Connection of the CBSS+DBL×2



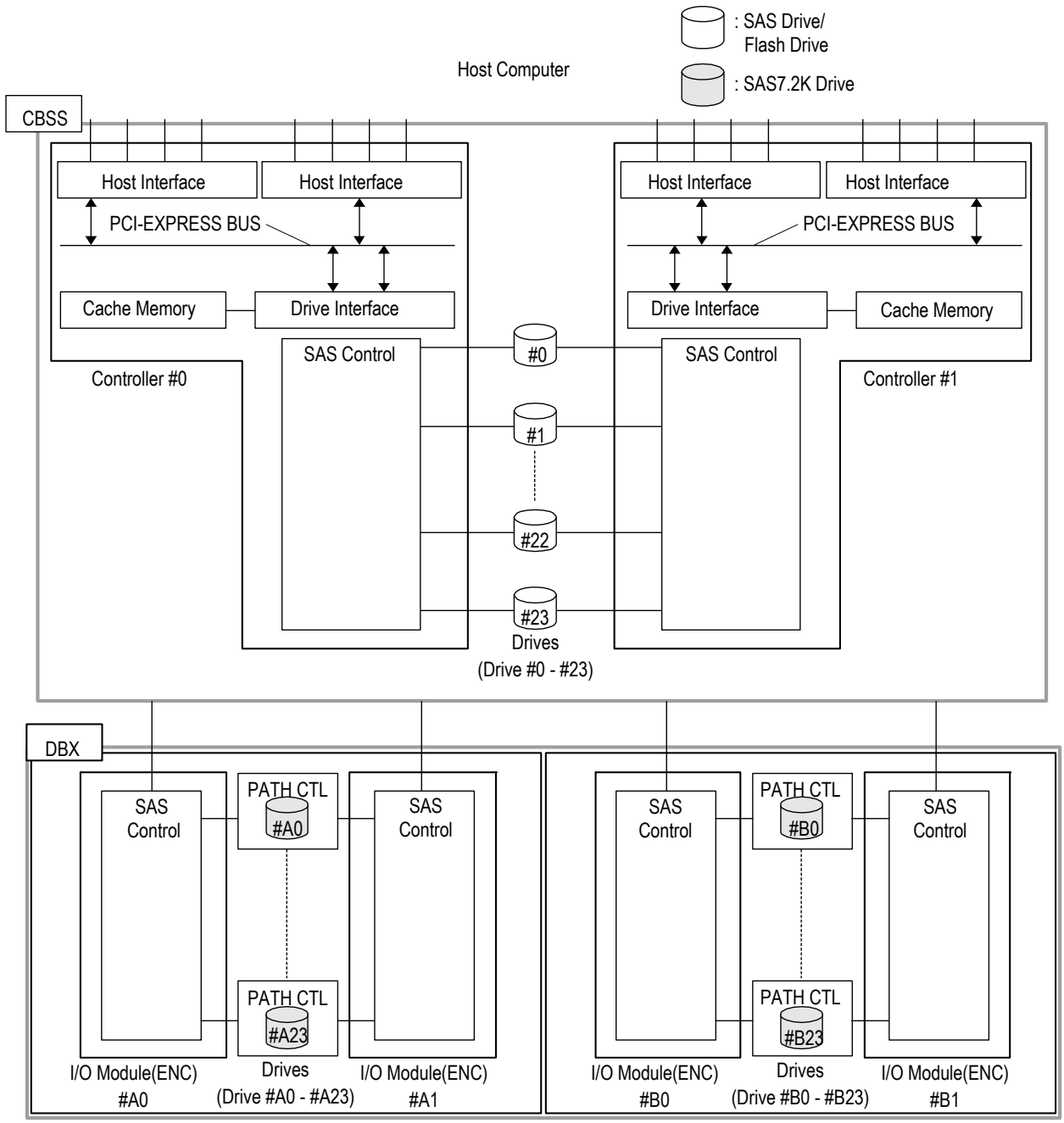
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.17 Internal Data Connection of the CBSS+DBS



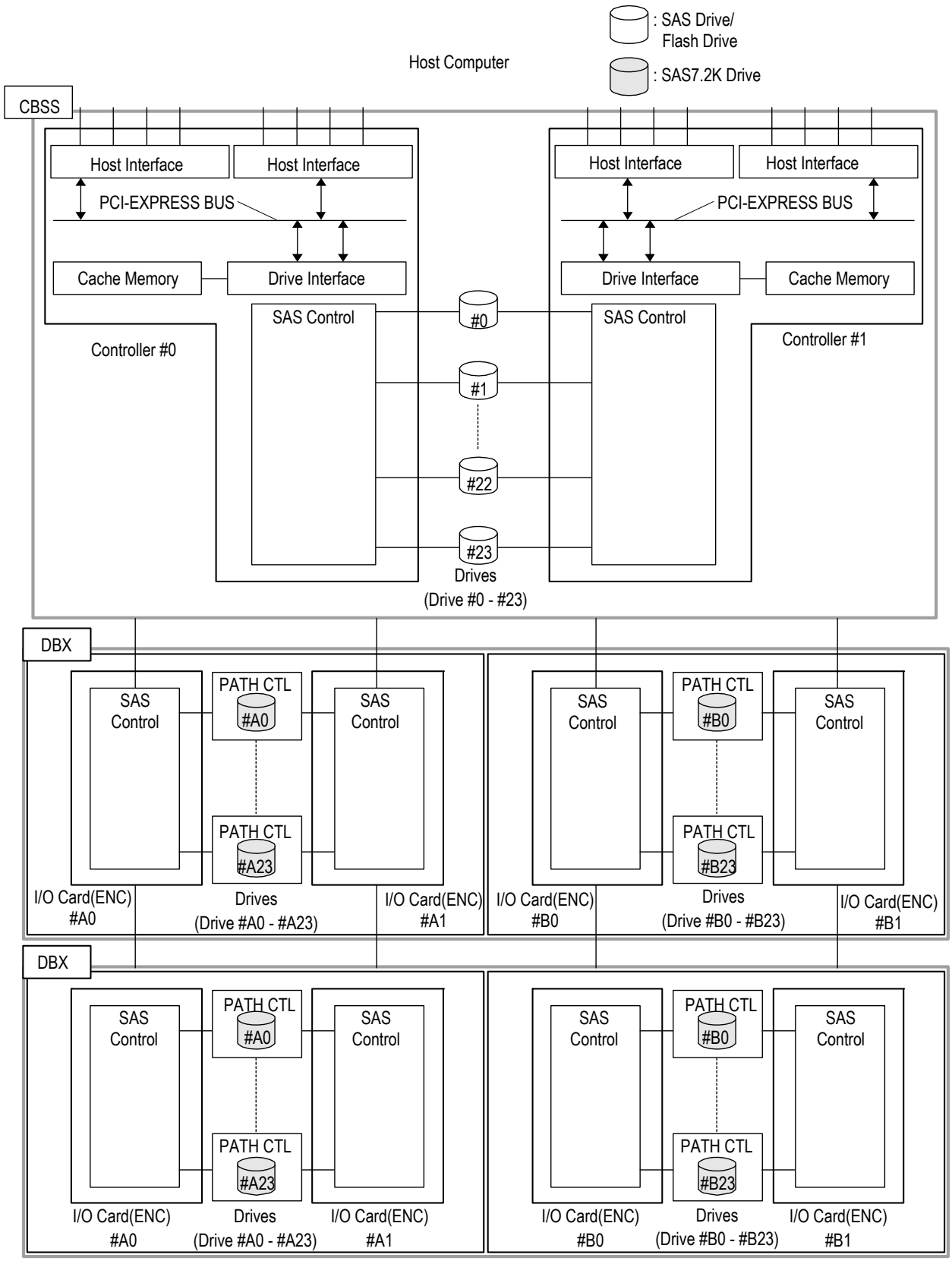
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.18 Internal Data Connection of the CBSS+DBS×2



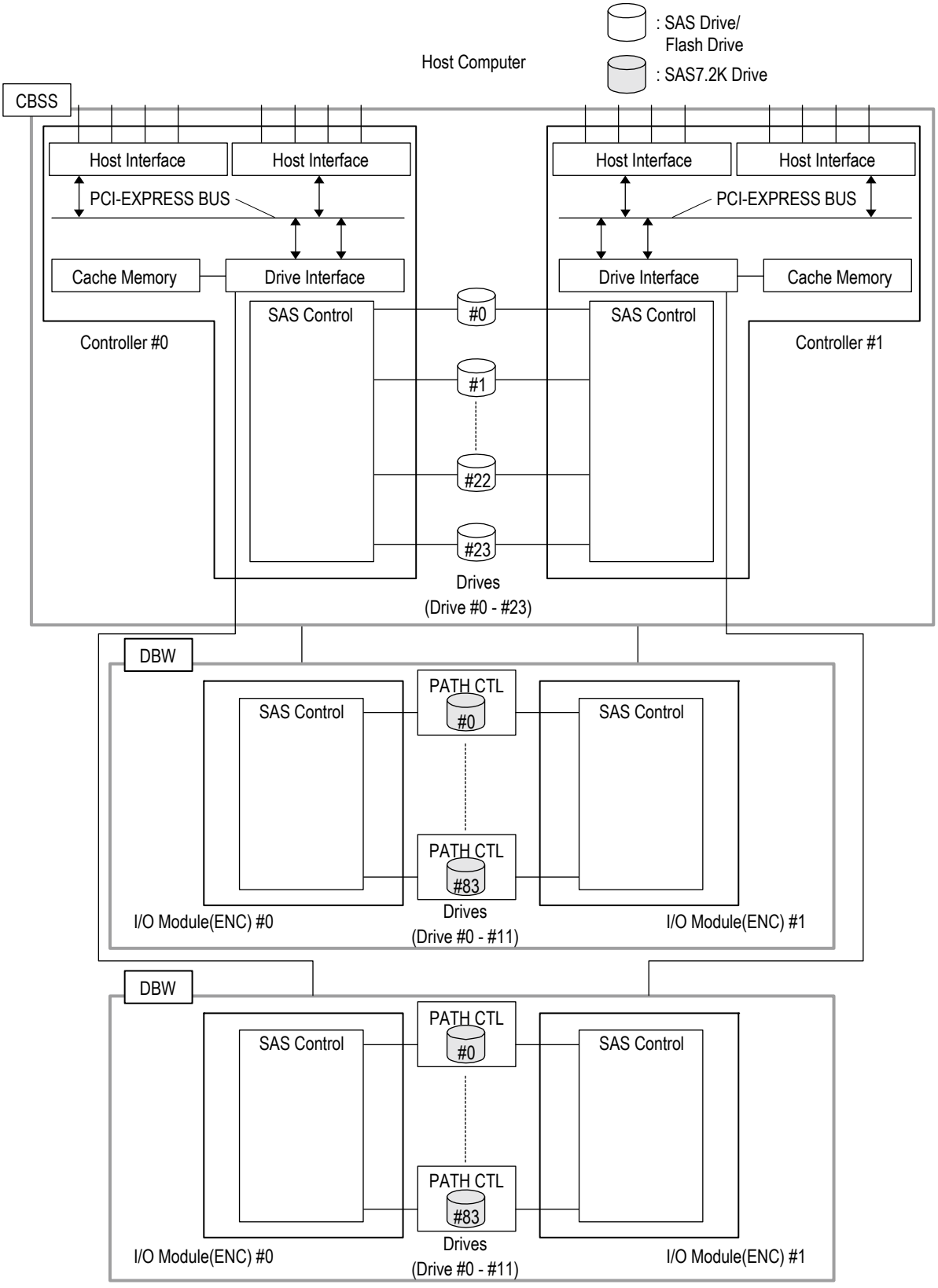
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.19 Internal Data Connection of the CBSS+DBX



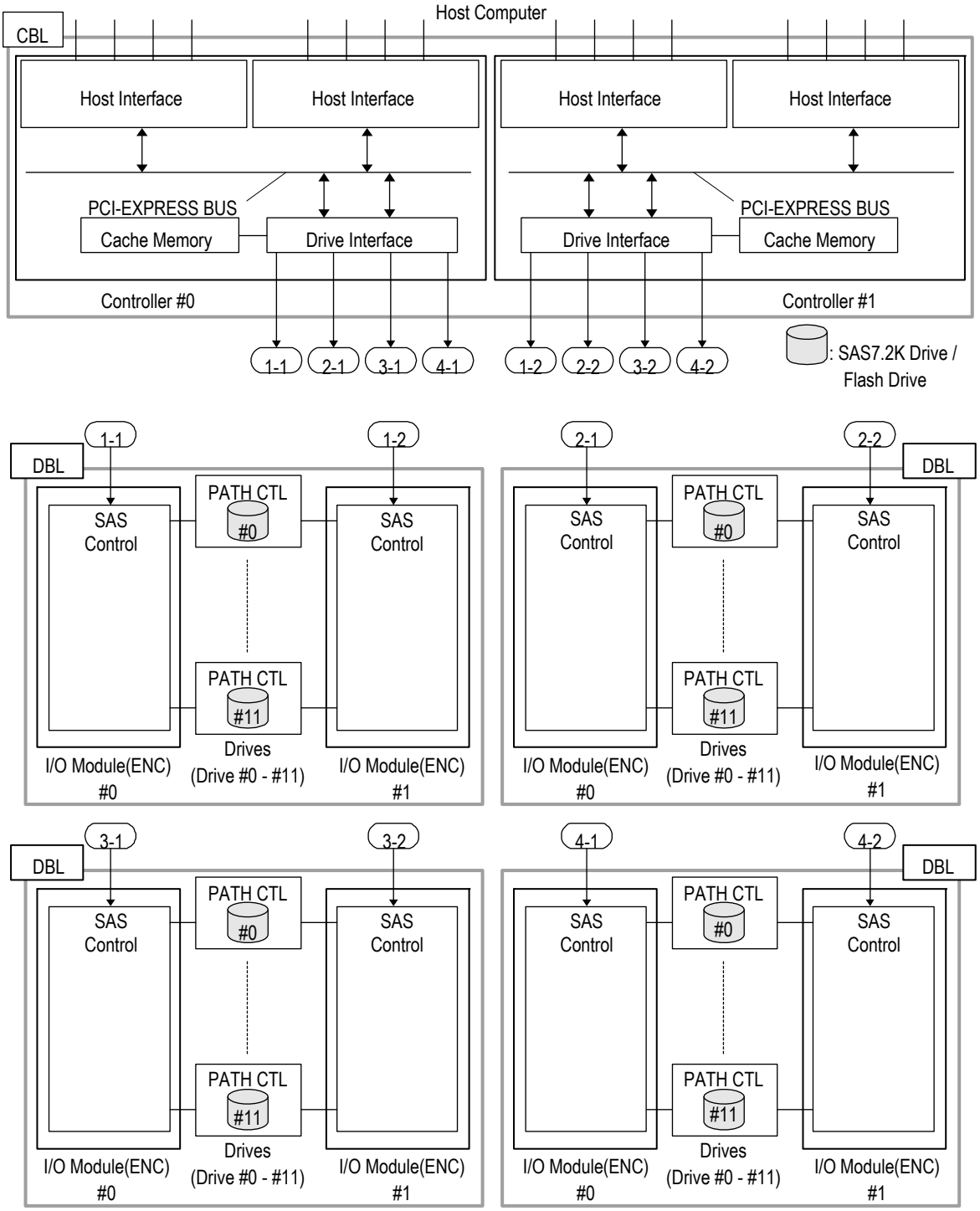
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.20 Internal Data Connection of the CBSS+DBX×2



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

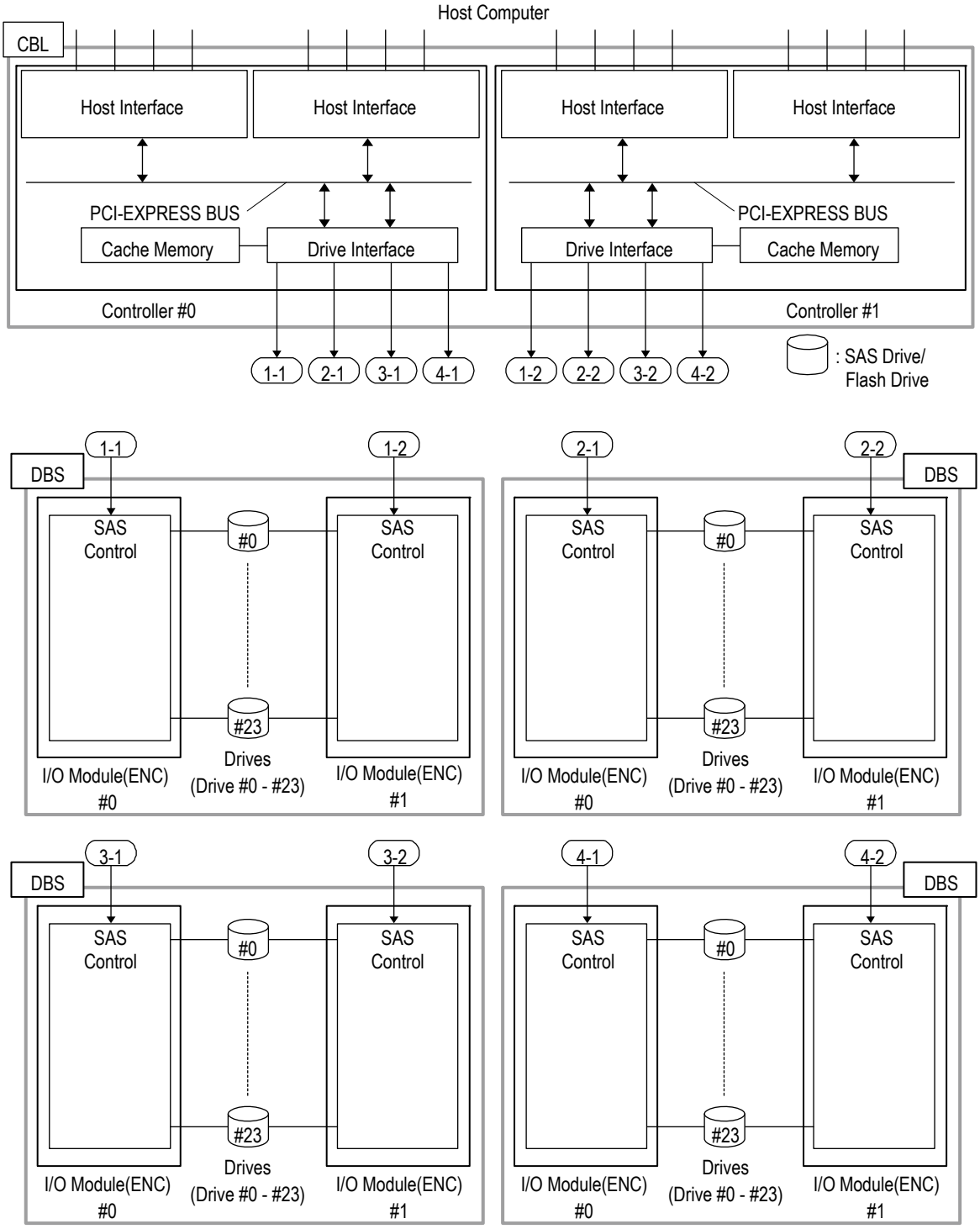
Figure 1.5.20.1 Internal Data Connection of the CBSS+DBW×2



*1: The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

*2: The figure shows the CBL+DBL×4.

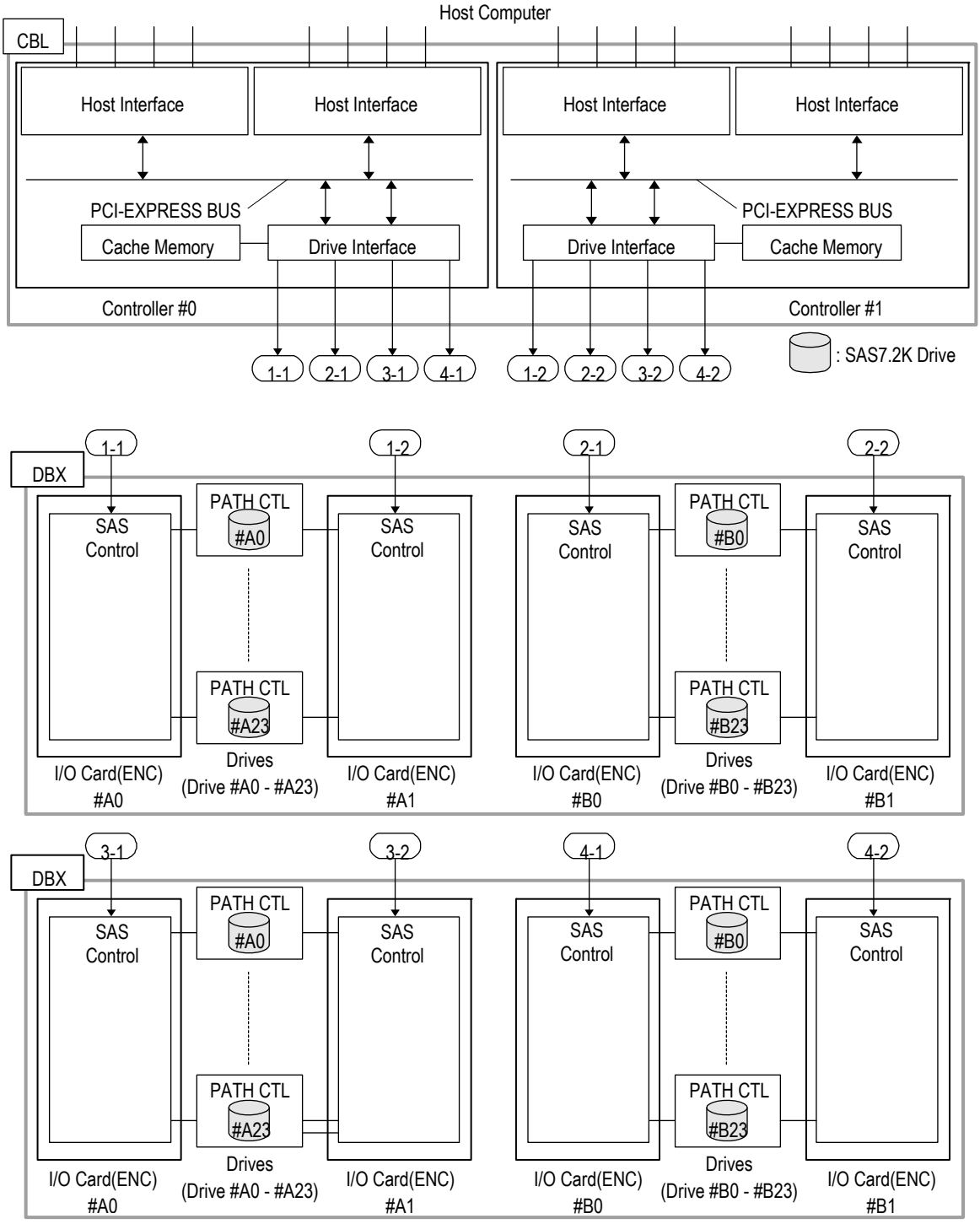
Figure 1.5.21 Internal Data Connection of the CBL+DBL×4/CBLD+DBLD×4/CBL+DBF×4



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

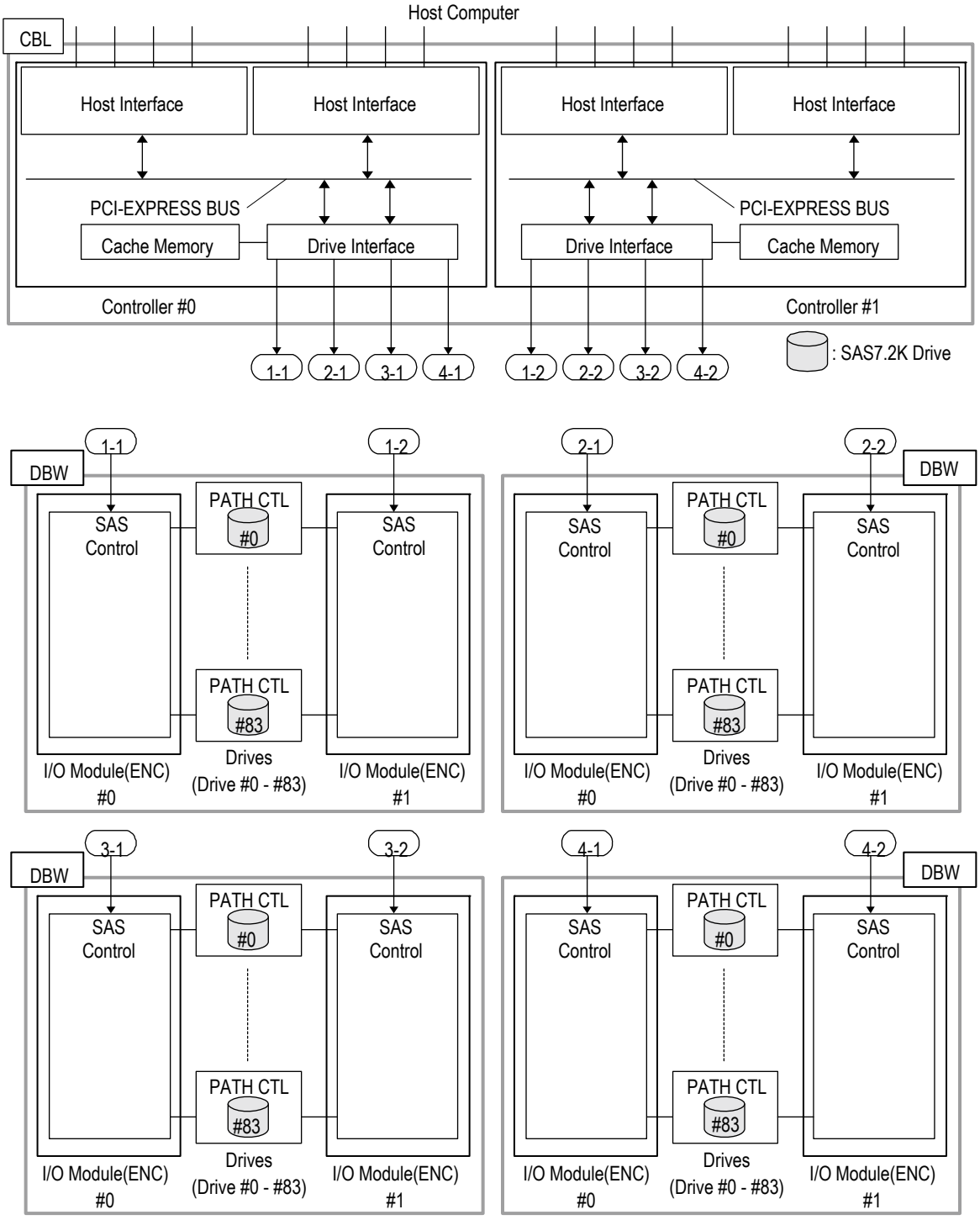
*2 : The figure shows the CBL+DBS×4.

Figure 1.5.22 Internal Data Connection of the CBL+DBS×4/CBLD+DBSD×4



*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.23 Internal Data Connection of the CBL+DBX×2



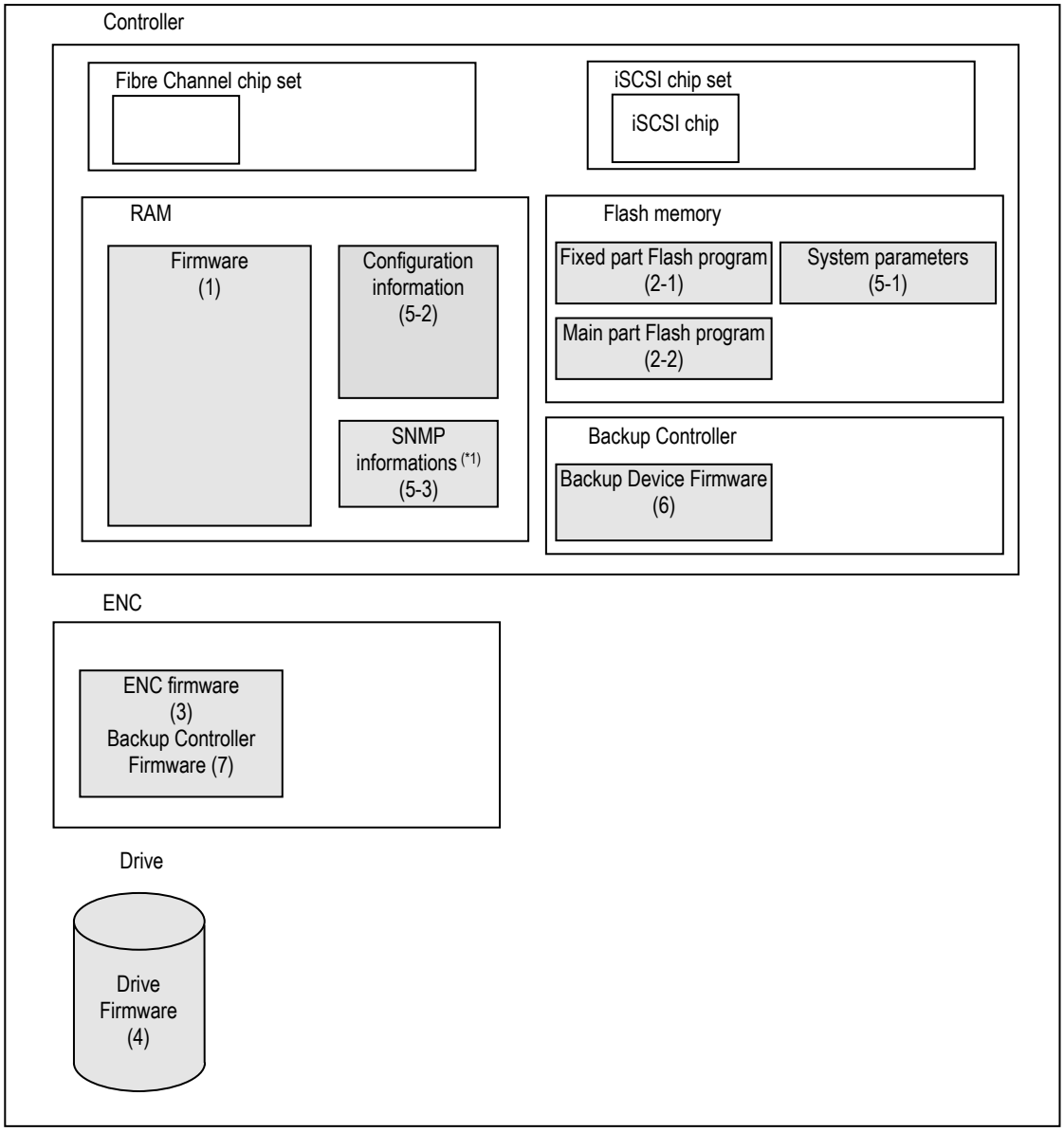
*1 : The Fibre Channel Interface is used as an example for the Host Interface of the Internal Data Connection.

Figure 1.5.24 Internal Data Connection of the CBL+DBW

1.6 Configuration of Built-in Software

1.6.1 Block Diagram of Built-in Software Configuration

The built-in software configuration is shown in Figure 1.6.1.
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 P-002D-J503.

Figure 1.6.1 Software Structure

(1) Firmware

- The firmware is a program for control.
- Their version numbers are controlled in the format of 09xxxxxx.
- The firmware has the following types.

No.	Type of usage	Version	Supplying media
1	Fibre Channel, iSCSI	09xxxxxx (×:Optional)	One DVD

- "/xx" 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 array after powering on.

(2-1) Fixed part Flash program

No.	Name	Type
1	Fixed part Flash program	09xxxxxx (×:Optional)

(2-2) Main part Flash program

No.	Name	Type
1	Main part Flash program (Fibre Channel) (*1)	09xxxxxx (×:Optional)

*1 : This program and the Firmware are controlled unitarily.

(3) ENC firmware

- The version of the firmware can be see using Hitachi Storage Navigator Modular 2 or through the WEB. (It is also collectable with the simple trace)
- This firmware controls the CBSL/CBSS/CBXSL/CBXSS/CBL/DBL/DBF/DBS/DBX/DBW.

(4) Drive firmware

- You can also refer to the version with Hitachi Storage Navigator Modular 2 or WEB for the firmware owned uniquely by the Drive (it is also collectable with the simple trace).

(5) Parameter Information

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

(5-1) System parameters

- Parameters necessary for the array start-up process from the main switch power-on to the lighting-up of the READY LED (green) are called system parameters.
  For details on each parameter, refer to the System Parameter "Chapter 1. Setting (Hitachi Storage Navigator Modular 2)" (SYSPR 01-0000).
- The system parameters are stores in the flash memory.
  System parameters are automatically backed up to the drive in the changing opportunity.

(5-2) Configuration information

- This is a piece of information on the configuration, such as the RAID configuration and Volume capacity, for the array to record user data.
- The configuration information exists on the Drives when the array main switch is turned off, and is spread onto the RAM at the time when the main switch is turned on.
  When the configuration information is changed, the information on the Drives is also changed.

(5-3) 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 array.
  To update the information, edit the SNMP information on the SNMP EVA FD and register it with the array.
  For details, refer to the "SNMP Agent Support Function User's Guide".

(6) Backup Device Firmware

- You can also refer to the firmware version by WEB. (It is also collectable with the simple trace)
- This firmware controls the Backup Device.

(7) Backup Controller Firmware

- You can also refer to the firmware version by WEB. (It is also collectable with the simple trace)
- This firmware controls the CBSL/CBSS/CBXSL/CBXSS/CBL.

1.6.2 Storages for Parameters

The storages in which the parameters on the controller are stored are shown in Table 1.6.1.

Table 1.6.1 Storages for Parameter

No.	Parameter	Storage	Description
1	• Fixed part Flash program • Main part Flash program • 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. • The parameters can be backed up to the following to provide against a trouble. Fixed part Flash program..... Cannot be backed up. Main part Flash program..... Automatically backed up to the system area. System parameters..... Automatically backed up to the system area.
2	• Firmware • Configuration information • SNMP information	System area	• Generally, information in a RAM is erased when the main switch is turned off. Therefore, the array also stores the parameters used on the RAM on the Drive. (An area is reserved in the Drive to store them. The area is called system area.)

Chapter 2. Major Specifications

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

(1) When the array configuration of the Fibre Channel interface (Rackmount model)

(a) HUS110 (CBXSL/CBXSS, DBL/DBS)

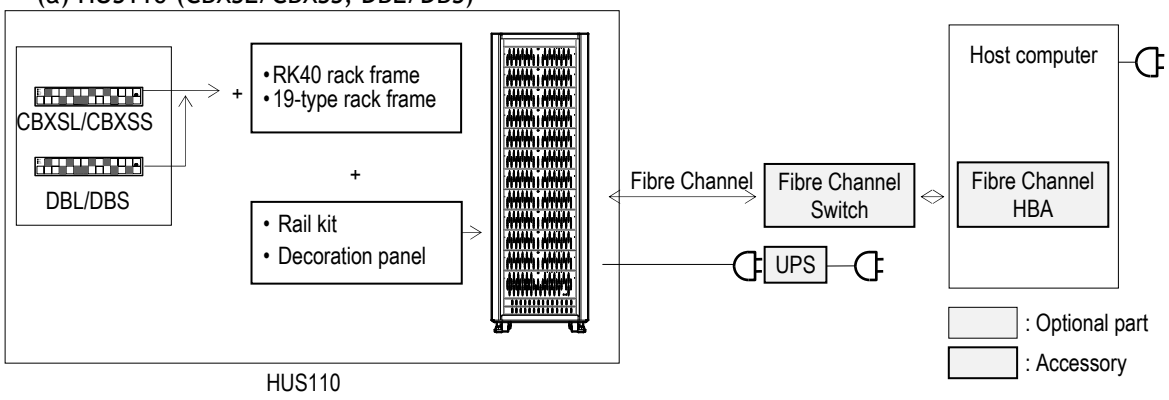


Figure 2.1 System Outline of HUS110 (CBXSL/CBXSS, DBL/DBS)

(b) HUS130 (CBSL/CBSS, DBL/DBS/DBX/DBW)

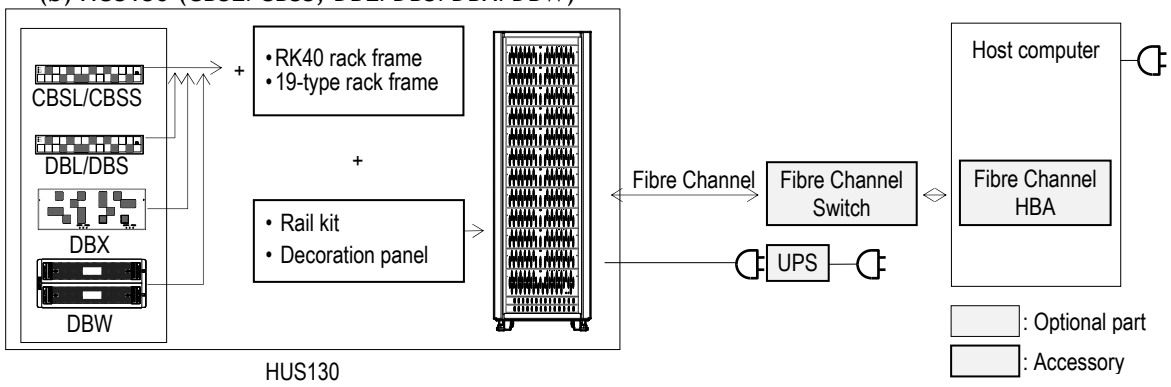


Figure 2.2 System Outline of HUS130 (CBSL/CBSS, DBL/DBS/DBX)

(c) HUS150 (CBL, DBL/DBS/DBX/DBW/DBF)

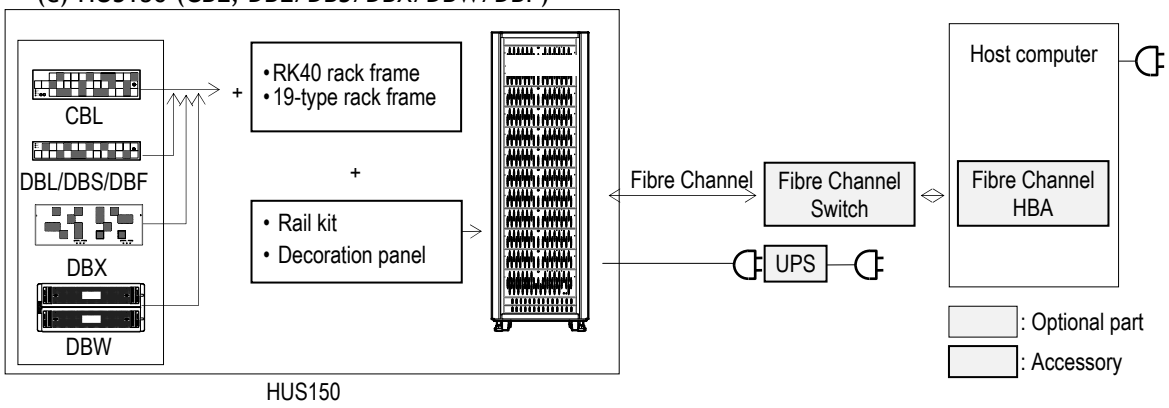


Figure 2.3 System Outline of HUS150 (CBL, DBL/DBS/DBX/DBW/DBF)

(2) When the array configuration of the iSCSI interface

(a) HUS110 (CBXSL/CBXSS, DBL/DBS)

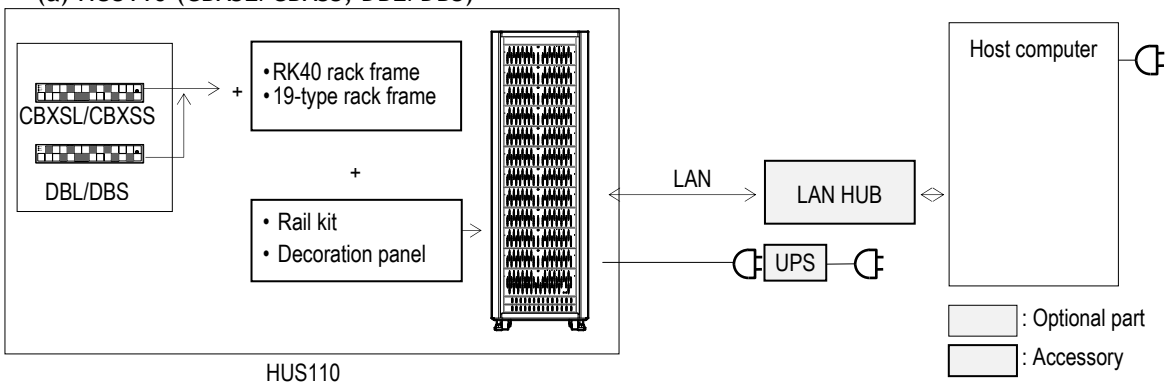


Figure 2.4 System Outline of HUS110 (CBXSL/CBXSS, DBL/DBS)

(b) HUS130 (CBSL/CBSS, DBL/DBS/DBX/DBW)

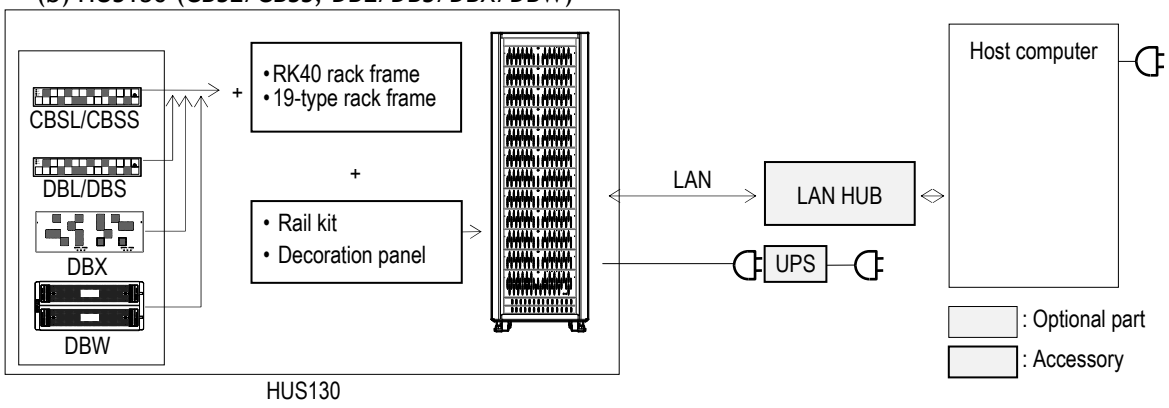


Figure 2.5 System Outline of HUS130 (CBSL/CBSS, DBL/DBS/DBX)

(c) HUS150 (CBL, DBL/DBS/DBX/DBW/DBF)

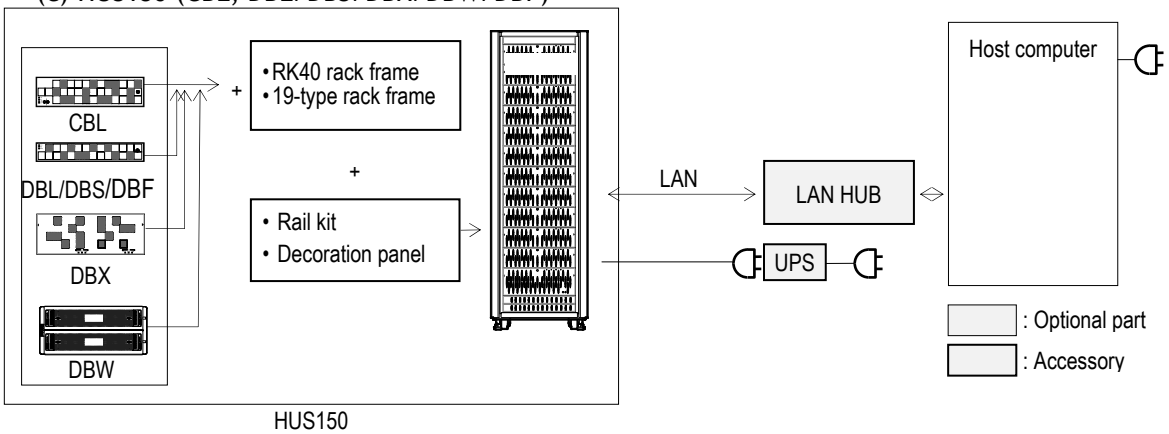


Figure 2.6 System Outline of HUS150 (CBL, DBL/DBS/DBX/DBW/DBF)

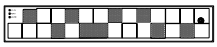
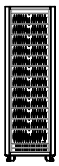
2.1 Basic Specifications

Refer to table below for the basic specifications of system configuration.

No.	System Configuration	Figure number	Refer page
1	HUS110 (CBXSL+DBL)	Figure 2.1.1	INTR 02-0021
2	HUS110 (CBXSL+DBS)	Figure 2.1.2	INTR 02-0050
3	HUS110 (CBXSS+DBL)	Figure 2.1.3	INTR 02-0080
4	HUS110 (CBXSS+DBS)	Figure 2.1.4	INTR 02-0110
5	HUS130 (CBSL+DBL)	Figure 2.1.5	INTR 02-0140
6	HUS130 (CBSL+DBS)	Figure 2.1.6	INTR 02-0170
7	HUS130 (CBSL+DBX)	Figure 2.1.7	INTR 02-0200
8	HUS130 (CBSL+DBW)	Figure 2.1.7.1	INTR 02-0221
9	HUS130 (CBSS+DBL)	Figure 2.1.8	INTR 02-0230
10	HUS130 (CBSS+DBS)	Figure 2.1.9	INTR 02-0260
11	HUS130 (CBSS+DBX)	Figure 2.1.10	INTR 02-0290
12	HUS130 (CBSS+DBW)	Figure 2.1.10.1	INTR 02-0311
13	HUS150 (CBL+DBL)	Figure 2.1.11	INTR 02-0320
14	HUS150 (CBLD+DBLD)	Figure 2.1.12	INTR 02-0341
15	HUS150 (CBL+DBS)	Figure 2.1.13	INTR 02-0350
16	HUS150 (CBLD+DBSD)	Figure 2.1.14	INTR 02-0371
17	HUS150 (CBL+DBX)	Figure 2.1.15	INTR 02-0380
18	HUS150 (CBL+DBW)	Figure 2.1.16	INTR 02-0401
19	HUS150 (CBL+DBF)	Figure 2.1.17	INTR 02-0404

(1) HUS110 (CBXSL+DBL)

Table 2.1.1 Basic Specifications

Item \ Model			Rackmount model		
			CBXSL	DBL	CBXSL + DBL + RK40 rack frame One rack
Configuration	Configuration		1 CBXSL	1 DBL	1 CBXSL + DBL (9 units) (Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		101.6×147.0×26.1 : 3.5 inch Type		
	Data capacity (*1) (G byte)		195.8 / 287.6/ 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 G byte		
	Rotational speed (min^{-1})		195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 879.9 G byte (3.5 inch Type) : 10,000 287.6 G byte (3.5 inch Type) : 15,000		
	Maximum mountable quantity (*2) (unit)		12		120
Host interface	Type	Fibre Channe	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10Gbps [Optical]	–	1Gbps iSCSI [1000Base-T]/ 10Gbps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1000 M bytes/s	–	100 M bytes/s or 1000 M bytes/s
	Number of host connector	Single controller	Fibre Channel : 4	–	Fibre Channel : 4
			Fibre Channel : 4 + iSCSI : 2	–	Fibre Channel : 4 + iSCSI : 2
		Dual controller	Fibre Channel : 4×2	–	Fibre Channel : 4×2
			Fibre Channel : 4×2 + iSCSI : 2×2	–	Fibre Channel : 4×2 + iSCSI : 2×2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item			Model: Rackmount model — CBXSL	DBL	CBXSL + DBL + RK40 rack frame (One rack)
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 12D	2D to 16D	
		RAID 1	1D+1D		
		RAID 5	2D+1P to 11D+1P	2D+1P to 15D+1P	
		RAID 6	2D+2P to 10D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 6D+6D	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Single Core)
	Control memory			–	• Flash memory : 32 M bytes • L3 Cache memory : 2 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 7 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483×545×88.4)	(610×1,020×1,920)
	Mass (*4) (kg)		43 approx.	27 approx.	536 approx.
	EIA Standard for unit (U) (*5)		2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		3.5x2/1.8x2	1.9x2/1.0x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		700/650 or less	380/350 or less	4,120/3,800 or less
	Power consumption (*8) (VA/W)		540/500 or less	280/260 or less	3,060/2,840 or less
	Heat value (normal) (kJ/h)		2,340 or less	1,260 or less	13,680 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 9 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item \ Model		Rackmount model		
		CBXSL	DBL	CBXSL + DBL + RK40 rack frame One rack
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	4,096
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBXSL) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBL) •I/O Module(ENC) (DBL)	•Controller •Drive •Power Unit (CBXSL / DBL) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

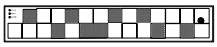
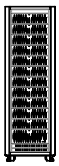
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(2) HUS110 (CBXSL+DBS)

Table 2.1.2 Basic Specifications

Item \ Model			Rackmount model		
			CBXSL	DBS	CBXSL + DBS + RK40 rack frame One rack
Configuration	Configuration		1 CBXSL	1 DBS	1 CBXSL + DBS (4 units) (Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		101.6×147.0×26.1 : 3.5 inch Type (CBXSL) 81.6×205.7×18.7 : 2.5 inch Type (DBS)		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 : 3.5 inch Type 195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1,173.7 : 2.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1,173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 879.9 G byte (3.5 inch Type) : 10,000 287.6 G byte (3.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive 195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		12	24	108
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1 G bps iSCSI [1000Base-T] / 10 G bps [Optical]	–	1 G bps iSCSI [1000Base-T] / 10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s (Fibre Channel)/100 M bytes/s or 1000 M bytes/s (iSCSI)(*4)
		iSCSI(*3)	100 M bytes/s / 1,000 M bytes/s	–	100 M bytes/s / 1,000 M bytes/s
	Number of host connector	Single controller	Fibre Channel : 4	–	Fibre Channel : 4
			Fibre Channel : 4 + iSCSI: 2		Fibre Channel : 4 + iSCSI : 2
		Dual controller	Fibre Channel : 4×2	–	Fibre Channel : 4×2
			Fibre Channel : 4×2 + iSCSI : 2 × 2		Fibre Channel : 4× 2 + iSCSI : 2×2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item			Model: Rackmount model — CBXSL	DBS	CBXSL + DBS + RK40 rack frame: One rack
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 12D	2D to 16D	
		RAID 1	1D+1D		
		RAID 5	2D+1P to 11D+1P	2D+1P to 15D+1P	
		RAID 6	2D+2P to 10D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 6D+ 6D	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Single Core)
	Control memory			–	• Flash memory : 32 M bytes • L3 Cache memory : 2 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 7 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483×545×88.4)	(610×1,020×1,920)
	Mass (*4) (kg)		43 approx.	23 approx.	359 approx.
	EIA Standard for unit (U) (*5)		2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		3.5x2/1.8x2	2.4x2/1.2x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		700/650 or less	480/460 or less	2,620/2,490 or less
	Power consumption (*8) (VA/W)		540/500 or less	320/310 or less	1,820/1,740 or less
	Heat value (normal) (kJ/h)		2,340 or less	1,660 or less	8,970 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 4 Drive Boxes, which is the maximum configuration, will be 5 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item	Model	Rackmount model		
		CBXSL	DBS	CBXSL + DBS + RK40 rack frame One rack
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	4,096
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive (3.5 inch Type) •Power Unit (CBXSL) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector	•Drive (2.5 inch Type) •Power Unit (DBS) •I/O Module(ENC) (DBS)	•Controller •Drive •Power Unit (CBXSL / DBS) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 15 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

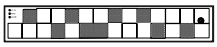
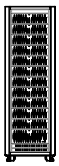
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(3) HUS110 (CBXSS+DBL)

Table 2.1.3 Basic Specifications

Item \ Model			Rackmount model		
			CBXSS	DBL	CBXSS + DBL + RK40 rack frame One rack
Configuration	Configuration		1 CBXSS	1 DBL	1 CBXSS+ DBL (8 units) (Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		81.6×205.7×18.7 : 2.5 inch Type (CBXSS) 101.6×147.0×26.1 : 3.5 inch Type (DBL)		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1,173.7 : 2.5 inch Type 195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 : 3.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1,173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 879.9 (3.5 inch Type) : 10,000 287.6 (3.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive 195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		24	12	120
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1 G bps iSCSI [1000Base-T] / 10 G bps [Optical]	–	1 G bps iSCSI [1000Base-T] / 10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s / 1,000 M bytes/s	–	100 M bytes/s / 1,000 M bytes/s
	Number of host connector	Single controller	Fibre Channel : 4	–	Fibre Channel : 4
			Fibre Channel : 4 + iSCSI : 2		Fibre Channel : 4 + iSCSI : 2
		Dual controller	Fibre Channel : 4×2	–	Fibre Channel : 4×2
			Fibre Channel : 4×2 + iSCSI : 2×2		Fibre Channel : 4×2 + iSCSI : 2×2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item			Model	Rackmount model		
				CBXSS	DBL	CBXSS + DBL + RK40 rack frame One rack
RAID specifications (*1)	RAID level (*2)			0/1/5/6/1+0		
	RAID configuration	RAID 0		2D to 16D	2D to 16D	
		RAID 1		1D+1D		
		RAID 5		2D+1P to 15D+1P		
		RAID 6		2D+2P to 22D+2P	2D+2P to 28D+2P	
		RAID 1+0		2D+2D to 8D+8D		
Internal logic specifications	Control CPU			It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Single Core)
	Control memory				–	• Flash memory : 32 M bytes • L3 Cache memory : 2 M bytes • SDRAM : 1 G bytes
	Data assurance method				–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)			Standard : 5 to 7(*3)		
	Chassis size (W×D×H) (mm)			(483×770×88.4)	(483×545×88.4)	(610×1,020×1,920)
	Mass(*4) (kg)			40 approx.	27 approx.	501 approx.
	EIA Standard for unit (U) (*5)			2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)			AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)			50/60 ± 1		
	Number of phases, cabling			Single-phase with protective grounding		
	Steady-state current(*6) (*7) (*8) AC 100/200 (A)			4.1x2/2.1x2	1.9x2/1.0x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)			16.0	16.0	8.0
	Steady-state power(*8) (*9) (VA/W)			820/770 or less	380/350 or less	3,860/3,570 or less
	Power consumption(*8) (VA/W)			590/550 or less	280/260 or less	2,830/2,630 or less
	Heat value (normal) (kJ/h)			2,780 or less	1,260 or less	12,860 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 8 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model — CBXSS	DBL	CBXSS + DBL + RK40 rack frame: One rack
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	4,096
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBXSS) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBL) •I/O Module(ENC) (DBL)	•Controller •Drive •Power Unit (CBXSS / DBL) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 15 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

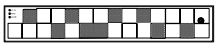
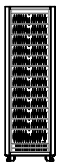
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(4) HUS110 (CBXSS+DBS)

Table 2.1.4 Basic Specifications

Item \ Model			Rackmount model		
			CBXSS	DBS	CBXSS + DBS + RK40 rack frame One rack
Configuration	Configuration		1 CBXSS	1 DBS	1 CBXSS+ DBS (4 units)(Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		81.6×205.7×18.7 : 2.5 inch Type		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1,173.7 : 2.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1,173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		24		120
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1 G bps iSCSI [1000Base-T] / 10 G bps [Optical]	–	1 G bps iSCSI [1000Base-T] / 10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s / 1,000 M bytes/s	–	100 M bytes/s / 1,000 M bytes/s
	Number of host connector	Single controller	Fibre Channel : 4	–	Fibre Channel : 4
			Fibre Channel : 4 + iSCSI : 2	–	Fibre Channel : 4 + iSCSI: 2
		Dual controller	Fibre Channel : 4×2	–	Fibre Channel : 4×2
			Fibre Channel : 4×2 + iSCSI : 2×2	–	Fibre Channel : 4×2 + iSCSI : 2×2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item			Model: Rackmount model — CBXSS	DBS	CBXSS + DBS + RK40 rack frame: One rack
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 16D		
		RAID 1	1D+1D		
		RAID 5	2D+1P to 15D+1P		
		RAID 6	2D+2P to 22D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Single Core)
	Control memory			–	• Flash memory : 32 M bytes • L3 Cache memory : 2 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 7(*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483×545×88.4)	(610×1,020×1,920)
	Mass(*4) (kg)		40 approx.	23 approx.	355 approx.
	EIA Standard for unit (U) (*5)		2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current(*6) (*7) (*8) AC 100/200 (A)		4.1x2/2.1x2	2.4x2/1.2x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power(*8) (*9) (VA/W)		820/770 or less	480/460 or less	2,740/2,610 or less
	Power consumption(*8) (VA/W)		590/550 or less	320/310 or less	1,870/1,790 or less
	Heat value (normal) (kJ/h)		2,780 or less	1,660 or less	9,400 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 4 Drive Boxes, which is the maximum configuration, will be 5 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item	Model	Rackmount model		
		CBXSS	DBS	CBXSS + DBS + RK40 rack frame One rack
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	4,096
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive (3.5 inch Type) •Power Unit (CBXSS) •Cache Memory •Cache Backup Battery(*3) • Host I/O Board (FC/iSCSI) and Host Connector	•Drive (2.5 inch Type) •Power Unit (DBS) •I/O Module(ENC) (DBS)	•Controller •Drive •Power Unit (CBXSS / DBS) •Cache Memory •Cache Backup Battery(*3) • Host I/O Board (FC/iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 15 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

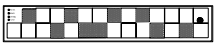
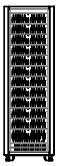
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(5) HUS130 (CBSL+DBL)

Table 2.1.5 Basic Specifications

Item \ Model			Rackmount model		
			CBSL	DBL	CBSL + DBL + RK40 rack frame Two racks
Configuration	Configuration		1 CBSL	1 DBL	1 CBSL+ DBL (19 units)(Maximum configuration) + RK40 rack frame (2 units)
	Appearance				
Drive used	Drive size (W×D×H) (mm)		101.6×147.0×26.1 : 3.5 inch Type		
	Data capacity (*1) (G byte)		195.8 / 287.6/ 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 G byte		
	Rotational speed (min^{-1})		195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 879.9 G byte (3.5 inch Type) : 10,000 287.6 G byte (3.5 inch Type) : 15,000		
	Maximum mountable quantity (*2) (unit)		12		240
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of host connector	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4 × 2 + iSCSI : 2 × 2	–	Fibre Channel : 4 × 2 + iSCSI : 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item \ Model			Rackmount model		
			CBSL	DBL	CBSL + DBL + RK40 rack frame Two racks
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 12D	2D to 16D	
		RAID 1	1D+1D		
		RAID 5	2D+1P to 11D+1P	2D+1P to 15D+1P	
		RAID 6	2D+2P to 10D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 6D+6D	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory			–	• Flash memory : 32 M bytes • L3 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(480.8×545×88.4)	(610×1,020×1,920)
	Mass (*4) (kg)		43 approx.	27 approx.	1,065 approx.
	EIA Standard for unit (U) (*5)		2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		3.5x2/1.8x2	1.9x2/1.0x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		700/650 or less	380/350 or less	7,920/7,300 or less
	Power consumption (*8) (VA/W)		570/530 or less	280/260 or less	5,890/5,470 or less
	Heat value (normal) (kJ/h)		2,340 or less	1,260 or less	26,280 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 19 Drive Boxes, which is the maximum configuration, will be 8 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model		
		CBSL	DBL	CBSL + DBL + RK40 rack frame Two racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBSL) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBL) •I/O Module(ENC) (DBL)	•Controller •Drive •Power Unit (CBSL/DBL) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

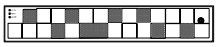
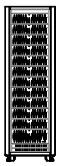
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(6) HUS130 (CBSL+DBS)

Table 2.1.6 Basic Specifications

Item \ Model			Rackmount model		
			CBSL	DBS	CBSL + DBS + RK40 rack frame One rack
Configuration	Configuration		1 CBSL	1 DBS	1 CBSL+ DBS (14 units)(Maximum configuration) + RK40 rack frame (1 Units)
	Appearance				
Drive used	Drive size (W×D×H) (mm)		101.6×147.0×26.1 : 3.5 inch Type (CBSL) 81.6×205.7×18.7 : 2.5 inch Type (DBS)		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 : 3.5 inch Type 195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1,173.7 : 2.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1,173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 879.9 G byte (3.5 inch Type) : 10,000 287.6 G byte (3.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive 195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		12	24	348
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of host connector	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2		Fibre Channel : 4× 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item			Model: Rackmount model — CBSL	DBS	CBSL + DBS + RK40 rack frame: One rack
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 12D	2D to 16D	
		RAID 1	1D+1D		
		RAID 5	2D+1P to 11D+1P	2D+1P to 15D+1P	
		RAID 6	2D+2P to 10D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 6D+6D	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory			–	• Flash memory : 32 M bytes • L3 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483.8×545×88.4)	(610×1,020×1,920)
	Mass (*4) (kg)		43 approx.	23 approx.	654 approx.
	EIA Standard for unit (U) (*5)		2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		3.5x2/1.8x2	2.4x2/1.2x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		700/650 or less	480/460 or less	7,420/7,090 or less
	Power consumption (*8) (VA/W)		570/530 or less	320/310 or less	5,050/4,870 or less
	Heat value (normal) (kJ/h)		2,340 or less	1,660 or less	25,530 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 9 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model — CBSL	DBS	CBSL + DBS + RK40 rack frame (One rack)
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive (3.5 inch Type) •Power Unit (CBSL) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector	•Drive (2.5 inch Type) •Power Unit (DBS) •I/O Module(ENC) (DBS)	•Controller •Drive •Power Unit (CBSL/DBS) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

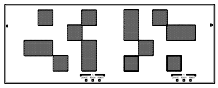
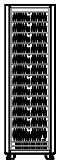
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(7) HUS130 (CBSL+DBX)

Table 2.1.7 Basic Specifications

Item \ Model			Rackmount model		
			CBSL	DBX	CBSL + DBX + RK40 rack frame One rack
Configuration	Configuration		1 CBSL	1 DBX	1 CBSL+ DBX (7 units)(Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		101.6×147.0×26.1 : 3.5 inch Type		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 G byte		
	Rotational speed (min-1)		1956.9 / 2935.9 / 3915.0 G byte : 7,200 879.9 G byte : 10,000 287.6 G byte : 15,000 195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		12	48	348
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of Host connector	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2	–	Fibre Channel : 4× 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3: It indicates the value of when the iSCSI I Host I/O Board is added to the Controller.

Item			Model: Rackmount model — CBSL	DBX	CBSL + DBX + RK40 rack frame (One rack)
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 12D	2D to 16D	
		RAID 1	1D+1D		
		RAID 5	2D+1P to 11D+1P	2D+1P to 15D+1P	
		RAID 6	2D+2P to 10D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 6D+6D	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483×840×176)	(610×1,020×1,920)
	Mass (*4) (kg)		43 approx.	85 approx.	574 approx.
	EIA Standard for unit (U) (*5)		2	4	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		3.5x2/1.8x2	3.7x4/1.9x4	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		700/650 or less	1,480/1,450 or less	11,060/10,800 or less
	Power consumption (*8) (VA/W)		570/530 or less	1,000/980 or less	7,570/7,390 or less
	Heat value (normal) (kJ/h)		2,340 or less	5,220 or less	38,880 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 5 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item \ Model		Rackmount model		
		CBSL	DBX	CBSL + DBX + RK40 rack frame One rack
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBSL) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBX) •I/O Module(ENC)	•Controller •Drive •Power Unit (CBSL/DBX) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

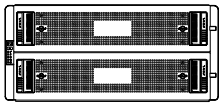
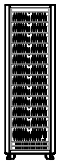
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(8) HUS130 (CBSL+DBW)

Table 2.1.7.1 Basic Specifications

Item \ Model			Rackmount model		
			CBSL	DBW	CBSL + DBW + RK40 rack frame One rack
Configuration	Configuration		1 CBSL	1 DBW	1 CBSL+ DBW (4 units)(Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		101.6×147.0×26.1 : 3.5 inch Type		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 G byte		
	Rotational speed (min^{-1})		1956.9 / 2935.9 / 3915.0 G byte : 7,200 (CBSL) 195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive (CBSL) 879.9 G byte (3.5 inch Type) : 10,000 287.6 G byte (3.5 inch Type) : 15,000 2935.9 / 3915.0 G byte : 7,200 (DBW)		
	Maximum mountable quantity (*2) (unit)		12	84	348
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of Host connector	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2	–	Fibre Channel : 4× 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3: It indicates the value of when the iSCSI I Host I/O Board is added to the Controller.

Item			Model: Rackmount model — CBSL	DBW	CBSL + DBW + RK40 rack frame (One rack)
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 12D	2D to 16D	
		RAID 1	1D+1D		
		RAID 5	2D+1P to 11D+1P	2D+1P to 15D+1P	
		RAID 6	2D+2P to 10D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 6D+6D	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483×933×220)	(610×1,020×1,920)
	Mass (*4) (kg)		43 approx.	128 approx.	797 approx.
	EIA Standard for unit (U) (*5)		2	5	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		3.5x2/1.8x2	-/8x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		700/650 or less	3,200/2,880 or less	13,500/12,170 or less
	Power consumption (*8) (VA/W)		570/530 or less	1,400/1,330 or less	6,170/5,850 or less
	Heat value (normal) (kJ/h)		2,340 or less	10,370 or less	43,820 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 5 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model — CBSL	DBW	CBSL + DBW + RK40 rack frame (One rack)
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBSL) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector	•Drive (3.5 inch Type) •Power Unit (DBL) •I/O Module(ENC)	•Controller •Drive •Power Unit (CBSL) •Power Unit (DBW) •Cache Memory •FAN •Cache Backup Battery (*3) • Host I/O Board (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

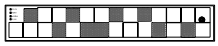
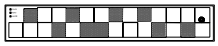
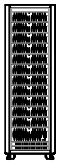
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(9) HUS130 (CBSS+DBL)

Table 2.1.8 Basic Specifications

Item \ Model			Rackmount model		
			CBSS	DBL	CBSS + DBL + RK40 rack frame Two racks
Configuration	Configuration		1 CBSS	1 DBL	1 CBSS+ DBL (19 units)(Maximum configuration) + RK40 rack frame (2 units)
	Appearance				
Drive used	Drive size (W×D×H) (mm)		81.6×205.7×18.7 : 2.5 inch Type (CBSS) 101.6×147.0×26.1 : 3.5 inch Type (DBL)		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1,173.7 : 2.5 inch Type 195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9 / 3915.0 : 3.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1,173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 879.9 G byte (3.5 inch Type) : 10,000 287.6 G byte (3.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive 195.8 / 392.7 / 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		24	12	252
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of host connector	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2		Fibre Channel : 4 × 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3: It indicates the value of when the iSCSI Host I/O Board is added to the Controller.

Item			Model	Rackmount model		
				CBSS	DBL	CBSS + DBL + RK40 rack frame Two racks
RAID specifications (*1)	RAID level (*2)			0/1/5/6/1+0		
	RAID configuration	RAID 0		2D to 16D	2D to 16D	
		RAID 1		1D+1D		
		RAID 5		2D+1P to 15D+1P		
		RAID 6		2D+2P to 22D+2P	2D+2P to 28D+2P	
		RAID 1+0		2D+2D to 8D+8D		
Internal logic specifications	Control CPU			It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory				–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method				–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)			Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)			(483×770×88.4)	(483×545×88.4)	(610×1,020×1,920)
	Mass (*4) (kg)			40 approx.	27 approx.	1,045 approx.
	EIA Standard for unit (U) (*5)			2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)			AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)			50/60 ± 1		
	Number of phases, cabling			Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)			4.1x2/2.1x2	1.9x2/1.0x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)			16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)			820/770 or less	380/350 or less	8,040/7,420 or less
	Power consumption (*8) (VA/W)			620/580 or less	280/260 or less	5,940/5,520 or less
	Heat value (normal) (kJ/h)			2,780 or less	1,260 or less	26,720 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 17 Drive Boxes, which is the maximum configuration, will be 8 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item \ Model		Rackmount model		
		CBSS	DBL	CBSS + DBL + RK40 rack frame Two racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBSS) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBL) •I/O Module(ENC)	•Controller •Drive •Power Unit (CBSS/DBL) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

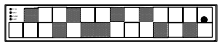
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(10) HUS130 (CBSS+DBS)

Table 2.1.9 Basic Specifications

Item \ Model			Rackmount model		
			CBSS	DBS	CBSS + DBS + RK40 rack frame One rack
Configuration	Configuration		1 CBSS	1 DBS	1 CBSS+ DBS (14 units)(Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		81.6×205.7×18.7 : 2.5 inch Type		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1,173.7 : 2.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1,173.7 G byte : 10,000 (2.5 inch Type) 287.6 G byte : 15,000 (2.5 inch Type) 195.8 / 392.7 / 786.5 G byte : Flash Drive (2.5 inch Type)		
	Maximum mountable quantity (*2) (unit)		24		360
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of Host connectors	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2	–	Fibre Channel : 4× 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3: It indicates the value of when the iSCSI Host I/O Board is added to the Controller.

Item \ Model			Rackmount model		
			CBSS	DBS	CBSS + DBS + RK40 rack frame One rack
RAID specifications (*1)	RAID level (*2)		0/1/5/6/1+0		
	RAID configuration	RAID 0	2D to 16D		
		RAID 1	1D+1D		
		RAID 5	2D+1P to 15D+1P		
		RAID 6	2D+2P to 22D+2P	2D+2P to 28D+2P	
		RAID 1+0	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)		(483×770×88.4)	(483×545×88.4)	(610×1,020×1,920)
	Mass (*4) (kg)		40 approx.	23 approx.	657 approx.
	EIA Standard for unit (U) (*5)		2	2	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		4.1x2/2.1x2	2.4x2/1.2x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)		820/770 or less	480/460 or less	7,540/7,210 or less
	Power consumption (*8) (VA/W)		620/580 or less	320/310 or less	5,100/4,920 or less
	Heat value (normal) (kJ/h)		2,780 or less	1,660 or less	25,960 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 9 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model — CBSS	DBS	CBSS + DBS + RK40 rack frame (One rack)
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive (3.5 inch Type) •Power Unit (CBSS) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/iSCSI) and Host Connector	•Drive (2.5 inch Type) •Power Unit (DBS) •I/O Module(ENC) (DBS)	•Controller •Drive •Power Unit (CBSS/DBS) •Cache Memory •Cache Backup Battery (*3) •Host I/O Board (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

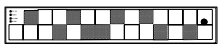
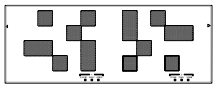
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(11) HUS130 (CBSS+DBX)

Table 2.1.10 Basic Specifications

Item \ Model			Rackmount model		
			CBSS	DBX	CBSS + DBX + RK40 rack frame One rack
Configuration	Configuration		1 CBSS	1 DBX	1 CBSS+ DBX (7 units)(Maximum configuration) + RK40 rack frame (2 units)
	Appearance				
Drive used	Drive size (W×D×H) (mm)		81.6×205.7×18.7 : 2.5 inch Type (CBSS) 101.6×147.0×26.1 : 3.5 inch Type (DBX)		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1173.7 : 2.5 inch Type 1956.9 / 2935.9 / 3915.0 : 3.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 1956.9 / 2935.9 / 3915.0 G byte (3.5 inch Type) : 7,200 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*2) (unit)		24	48	360
Host interface	Type	Fibre Channel	8 G G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of Host connectors	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2		Fibre Channel : 4× 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3: It indicates the value of when the iSCSI Host I/O Board is added to the Controller.

Item			Model	Rackmount model		
				CBSS	DBX	CBSS + DBX + RK40 rack frame One rack
RAID specifications (*1)	RAID level (*2)			0/1/5/6/1+0		
	RAID configuration	RAID 0		2D to 16D	2D to 16D	
		RAID 1		1D+1D		
		RAID 5		2D+1P to 15D+1P		
		RAID 6		2D+2P to 22D+2P	2D+2P to 28D+2P	
		RAID 1+0		2D+2D to 8D+8D		
Internal logic specifications	Control CPU			It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory				–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method				–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)			Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)			(483×770×88.4)	(483×840×176)	(610×1,020×1,920)
	Mass (*4) (kg)			40 approx.	85 approx.	1,146 approx.
	EIA Standard for unit (U) (*5)			2	4	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)			AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)			50/60 ± 1		
	Number of phases, cabling			Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)			4.1x2/2.1x2	3.7x4/1.9x4	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)			16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)			820/770 or less	1,480/1,450 or less	11,180/10,920 or less
	Power consumption (*8) (VA/W)			620/580 or less	1,000/980 or less	7,620/7,440 or less
	Heat value (normal) (kJ/h)			2,780 or less	5,220 or less	39,320 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 5 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item \ Model		Rackmount model		
		CBSS	DBX	CBSS + DBX + RK40 rack frame One rack
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBSS) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBX) •I/O Card(ENC) (DBX)	•Controller •Drive •Power Unit (CBSS/DBX) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/ iSCSI) and Host Connector •I/O Card(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory / Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

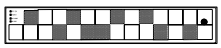
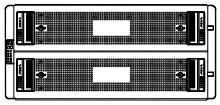
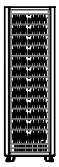
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(12) HUS130 (CBSS+DBW)

Table 2.1.10.1 Basic Specifications

Item \ Model			Rackmount model		
			CBSS	DBW	CBSS + DBW + RK40 rack frame One rack
Configuration	Configuration		1 CBSS	1 DBW	1 CBSS+ DBW (4 units)(Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		81.6×205.7×18.7 : 2.5 inch Type (CBSS) 101.6×147.0×26.1 : 3.5 inch Type (DBW)		
	Data capacity (*1) (G byte)		195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1173.7 : 2.5 inch Type 1956.9 / 2935.9 / 3915.0 : 3.5 inch Type		
	Rotational speed (min^{-1})		287.6 / 575.3 / 879.9 / 1173.7 G byte : 10,000 (2.5 inch Type) 287.6 G byte : 15,000 (2.5 inch Type) 1956.9 / 2935.9 / 3915.0 G byte : 7,200 (3.5 inch Type) 195.8 / 392.7 / 786.5 : Flash Drive (2.5 inch Type)		
	Maximum mountable quantity (*2) (unit)		24	84	360
Host interface	Type	Fibre Channel	8 G G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10 G bps [Optical]	–	1Gbps iSCSI [1000Base-T]/10 G bps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1,000 M bytes/s	–	100 M bytes/s or 1,000 M bytes/s
	Number of Host connectors	Dual controller	Fibre Channel : 8 × 2	–	Fibre Channel : 8 × 2
			Fibre Channel : 4× 2 + iSCSI: 2 × 2		Fibre Channel : 4× 2 + iSCSI: 2 × 2
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3: It indicates the value of when the iSCSI Host I/O Board is added to the Controller.

Item			Model	Rackmount model		
				CBSS	DBW	CBSS + DBW + RK40 rack frame One rack
RAID specifications (*1)	RAID level (*2)			0/1/5/6/1+0		
	RAID configuration	RAID 0		2D to 16D	2D to 16D	
		RAID 1		1D+1D		
		RAID 5		2D+1P to 15D+1P		
		RAID 6		2D+2P to 22D+2P	2D+2P to 28D+2P	
		RAID 1+0		2D+2D to 8D+8D		
Internal logic specifications	Control CPU			It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)
	Control memory				–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method				–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)			Standard : 5 to 8 (*3)		
	Chassis size (W×D×H) (mm)			(483×770×88.4)	(483×933×220)	(610×1,020×1,920)
	Mass (*4) (kg)			40 approx.	128 approx.	794 approx.
	EIA Standard for unit (U) (*5)			2	5	Max. 40
Input power specifications	Input voltage (Operable voltage range) (V)			AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)			50/60 ± 1		
	Number of phases, cabling			Single-phase with protective grounding		
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)			4.1x2/2.1x2	-/8x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)			16.0	16.0	8.0
	Steady-state power (*8) (*9) (VA/W)			820/770 or less	3,200/2,880 or less	13,620/12,290 or less
	Power consumption (*8) (VA/W)			620/580 or less	1,400/1,330 or less	6,220/5,900 or less
	Heat value (normal) (kJ/h)			2,780 or less	10,370 or less	44,250 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 5 Drive Boxes, which is the maximum configuration, will be 7 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model — CBSS	DBW	CBSS + DBW + RK40 rack frame (One rack)
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384
	Control method		–	Read LRU/Write after
	Battery backup		–	Provided
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CBSS) •Cache Memory •Cache Backup Battery (*3) • Host I/O Board (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBW) •I/O Card(ENC) (DBW)	•Controller •Drive •Power Unit (CBSS) •Power Unit (DBW) •Cache Memory •FAN •Cache Backup Battery (*3) • Host I/O Board (FC/ iSCSI) and Host Connector •I/O Card(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory / Drive (resident)
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)
	Spare Drive	Up to 30 of mounted Drives can be set to Spare Drives		
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)
	Insulation resistance	DC 500 V, 10 MΩ or more		

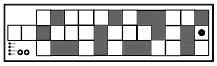
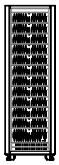
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(13) HUS150 (CBL+DBL)

Table 2.1.11 Basic Specifications

Item \ Model			Rackmount model			
			CBL	DBL	CBL + DBL + RK40 rack frame	
					One rack	Three racks
Configuration	Configuration		1 CBL	1 DBL	1 CBL + DBL (13 units) (Maximum configuration)(*1) + RK40 rack frame	1 CBL + DBL (40 units) (Maximum configuration) (*1) + RK40 rack frame (3 units)
	Appearance					
Drive used	Drive size (W×D×H) (mm)		–	101.6×147.0×26.1 : 3.5 inch Type		
	Data capacity (*2) (G byte)		–	195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9		
	Rotational speed (min^{-1})		–	1956.9 / 2935.9 G byte : 7,200 879.9 G byte : 10,000 287.6 G byte : 15,000 195.8 / 392.7/ 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*3) (unit)		–	12	132	480
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]	
		iSCSI(*4)	10 G bps [Optical]	–	10 G bps [Optical]	
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes	–	800 M bytes	
		iSCSI(*4)	1,000 M bytes	–	1,000 M bytes	
	Number of host connector	Dual controller	Fibre Channel : 16/ iSCSI: 8(*4)	–	Fibre Channel : 16/ iSCSI: 8(*4)	
	Transferred block size (bytes)		512			

*1 : When nine or more mounted on RK40 rack, optional PDB is necessary.

*2 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*3 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*4: It indicates the value of when the iSCSI Host I/O Module is added to the Controller.

Item			Model: Rackmount model — CBL	DBL	CBL + DBL + RK40 rack frame: One rack	CBL + DBL + RK40 rack frame: Three racks
RAID specifications (*1)	RAID level (*2)		–	0/1/5/6/1+0		
	RAID configuration	RAID 0	–	2D to 16D		
		RAID 1	–	1D+1D		
		RAID 5	–	2D+1P to 15D+1P		
		RAID 6	–	2D+2P to 28D+2P		
		RAID 1+0	–	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)	
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes	
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code	
Physical specifications	Start-up time (min)		Standard : 5 to 10 (*3)			
	Chassis size (W×D×H) (mm)		(483×819×129)	(483×545×88.4)	(610×1,020×1,920)	(610×3) ×1,020×1,920)
	Mass (*4) (kg)		47 approx.	27 approx.	675 approx.	1,922 approx.
	EIA Standard for unit (U) (*5)		3	2	Max. 40	Max. 120
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%	
	Frequency (Hz)		50/60 ± 1			
	Number of phases, cabling		Single-phase with protective grounding			
	Steady-state current (*6) (*7) (*8) AC 100/200 (A)		2.5x2/1.3x2	1.9x2/1.0x2	-/16.0 (One PDB)	
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0	
	Steady-state power (*8) (*9) (VA/W)		500/450 or less	380/350 or less	5,440/5,000 or less	15,700/14,450 or less
	Power consumption (*8) (VA/W)		410/370 or less	280/260 or less	4,050/3,750 or less	11,610/10,770 or less
	Heat value (normal) (kJ/h)		1,620 or less	1,260 or less	18,000 or less	52,020 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 0 Controller Boxes + 40 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item	Model	Rackmount model			
		CBL	DBL	CBL + DBL + RK40 rack frame	
				One rack	Three racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384	
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Power Unit (CBL) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBL) •I/O Module(ENC)	•Controller •Drive •Power Unit (CBL/DBL) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Board (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB	•Controller •Drive •Power Unit (CBL/DBL) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)	
	Insulation resistance	DC 500 V, 10 MΩ or more			

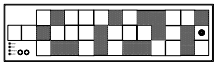
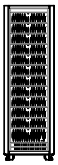
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(14) HUS150 (CBLD+DBLD)

Table 2.1.12 Basic Specifications

Item \ Model			Rackmount model			
			CBLD	DBLD	CBLD+ DBLD+ RK40 rack frame	
					One rack	Three racks
Configuration	Configuration		1 CBLD	1 DBLD	1 CBLD+ DBLD(13 units) (Maximum configuration)(*1) + RK40 rack frame	1 CBLD+ DBLD(40 units) (Maximum configuration) (*1) + RK40 rack frame (3 units)
	Appearance					
Drive used	Drive size (W×D×H) (mm)		–	101.6×147.0×26.1 : 3.5 inch Type		
	Data capacity (*2) (G byte)		–	195.8 / 287.6 / 392.7 / 786.5 / 879.9 / 1956.9 / 2935.9		
	Rotational speed (min^{-1})		–	1956.9 / 2935.9 G byte : 7,200 879.9 G byte : 10,000 287.6 G byte : 15,000 195.8 / 392.7/ 786.5 G byte (3.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*3) (unit)		–	12	132	480
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]	
		iSCSI(*4)	10 G bps [Optical]	–	10 G bps [Optical]	
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes	–	800 M bytes	
		iSCSI(*4)	1,000 M bytes	–	1,000 M bytes	
	Number of host connector	Dual controller	Fibre Channel : 16/ iSCSI: 8(*4)	–	Fibre Channel : 16/ iSCSI: 8(*4)	
	Transferred block size (bytes)		512			

*1 : When nine or more mounted on RK40 rack, optional PDB is necessary.

*2 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*3 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*4: It indicates the value of when the iSCSI Host I/O Module is added to the Controller.

Item			Model: Rackmount model — CBLD	DBLD	CBLD + DBLD + RK40 rack frame: One rack	CBLD + DBLD + RK40 rack frame: Three racks
RAID specifications (*1)	RAID level (*2)		–	0/1/5/6/1+0		
	RAID configuration	RAID 0	–	2D to 16D		
		RAID 1	–	1D+1D		
		RAID 5	–	2D+1P to 15D+1P		
		RAID 6	–	2D+2P to 28D+2P		
		RAID 1+0	–	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)	
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes	
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code	
Physical specifications	Start-up time (min)		Standard : 5 to 10 (*3)			
	Chassis size (W×D×H) (mm)		(483×819×129)	(483×545×88.4)	(610×1,020×1,920)	(610×3) ×1,020×1,920)
	Mass (*4) (kg)		47 approx.	27 approx.	675 approx.	1,922 approx.
	EIA Standard for unit (U) (*5)		3	2	Max. 40	Max. 120
Input power specifications (*6)	Input voltage (Operable voltage range) (V)		DC -48 to -60 (-40 to -72)		–	
	Steady-state current (*7) (*8) (*9) (A)		4.7x2	4.8x2	–	
	Current rating of Breaker/ Fuse (A)		16.0	16.0	–	
	Heat value (normal) (kJ/h)		1,620 or less	1,260 or less	18,000 or less	52,020 or less
	Steady-state power (*9) (VA/W)		450/450 or less	350/350 or less	5,000/5,000 or less	14,450/14,450 or less
	Power consumption (*9) (VA/W)		370/370 or less	260/260 or less	3,750/3,750 or less	10,770/10,770 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 0 Controller Boxes + 40 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : The power current of N×2 described in this table is required for operation by a single Power Unit.

*7 : When one of the two Power Units fails, another Power Unit requires electric current for the two Power Units. Therefore, plan the power supply facility in which the current carrying capacity of one of the Power Units is a total capacity of the two Power Units.
Power requirement in the case of the maximum configuration is shown.
Value at -48 V is shown. The actual required power may exceed the value shown in the table when the tolerance is included.

*8 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*9 : This rating is based on the EN60950-1.

Item		Model: Rackmount model — CBLD	DBLD	CBLD + DBLD + RK40 rack frame: One rack	CBLD + DBLD + RK40 rack frame: Three racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384	
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Power Unit (CBLD) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBLD) •I/O Module(ENC)	•Controller •Drive •Power Unit (CBLD/DBLD) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Board (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB	•Controller •Drive •Power Unit (CBLD/DBLD) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • LED of maintenance part			
Insulation performance	Insulation withstand voltage	DC 1,000 V (10 mA, 1 min)		AC 1,500 V (100 mA, 1 min)	
	Insulation resistance	DC 500 V, 10 MΩ or more			

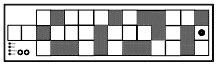
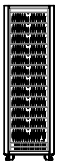
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(15) HUS150 (CBL+DBS)

Table 2.1.13 Basic Specifications

Item \ Model			Rackmount model			
			CBL	DBS	CBL + DBS + RK40 rack frame	
					One rack	Three racks
Configuration	Configuration		1 CBL	1 DBS	1 CBL + DBS (13 units) (Maximum configuration) (*1) + RK40 rack frame	1 CBL + DBS (40 units) (Maximum configuration) (*1) + RK40 rack frame (3 units)
	Appearance					
Drive used	Drive size (W×D×H) (mm)		–	81.6×205.7×18.7 : 2.5 inch Type (DBS)		
	Data capacity (*2) (G byte)		–	195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1173.7		
	Rotational speed (min-1)		–	287.6 / 575.3 / 879.9 / 1173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*3) (unit)		–	24	216	960
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]	
		iSCSI(*4)	10 G bps [Optical]	–	10 G bps [Optical]	
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s	
		iSCSI(*4)	1,000 M bytes/s	–	1,000 M bytes/s	
	Number of host connector	Dual controller	Fibre Channel : 16/ iSCSI: 8(*4)	–	Fibre Channel : 16/ iSCSI: 8(*4)	
	Transferred block size (bytes)		512			

*1 : When nine or more mounted on RK40 rack, optional PDB is necessary.

*2 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*3 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*4 : It indicates the value of when the iSCSI Host I/O Module is added to the Controller.

Item			Model	Rackmount model			
				CBL	DBS	CBL + DBS + RK40 rack frame	
						One rack	Three racks
RAID specifications (*1)	RAID level (*2)			–	0/1/5/6/1+0		
	RAID configuration	RAID 0		–	2D to 16D		
		RAID 1		–	1D+1D		
		RAID 5		–	2D+1P to 15D+1P		
		RAID 6		–	2D+2P to 28D+2P		
		RAID 1+0		–	2D+2D to 8D+8D		
Internal logic specifications	Control CPU			It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)	
	Control memory				–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes	
	Data assurance method				–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code	
Physical specifications	Start-up time (min)			Standard : 5 to 10(*3)			
	Chassis size (W×D×H) (mm)			(483×819×129)	(483×545×88.4)	(610×1,020×1,920)	((610×3)×1,020×1,920)
	Mass(*4) (kg)			47 approx.	23 approx.	625 approx.	1,822 approx.
	EIA Standard for unit (U) (*5)			3	2	Max. 40	Max. 120
Input power specifications	Input voltage (Operable voltage range) (V)			AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%	
	Frequency (Hz)			50/60 ± 1			
	Number of phases, cabling			Single-phase with protective grounding			
	Steady-state current(*6) (*7) (*8) AC 100/200 (A)			2.5x2/1.3x2	2.4x2/1.2x2	-/16.0 (One PDB)	
	Current rating of Breaker/ Fuse (A)			16.0	16.0	8.0	
	Steady-state power(*8) (*9) (VA/W)			500/450 or less	480/460 or less	6,740/6,430 or less	19,700/18,850 or less
	Power consumption(*8) (VA/W)			410/370 or less	320/310 or less	4,570/4,400 or less	13,210/12,770 or less
	Heat value (normal) (kJ/h)			1,620 or less	1,660 or less	23,150 or less	67,860 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 0 Controller Boxes + 40 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item	Model	Rackmount model			
		CBL	DBS	CBL + DBS + RK40 rack frame	
				One rack	Three racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384	
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Power Unit (CBL) •Cache Memory •Fan Module •Cache Backup Battery (*3) • Host I/O Module (FC/iSCSI) and Host Connector	•Drive (2.5 inch Type) •Power Unit (DBS) •I/O Module(ENC) (DBS)	•Controller •Drive •Power Unit (CBL/DBS) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB	•Controller •Drive •Power Unit (CBL/DBS) •Cache Memory •Fan Module •Cache Backup Battery (*3) • Host I/O Module (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)	
	Insulation resistance	DC 500 V, 10 MΩ or more			

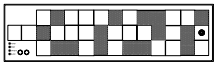
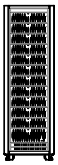
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(16) HUS150 (CBLD+DBSD)

Table 2.1.14 Basic Specifications

Item \ Model			Rackmount model			
			CBLD	DBSD	CBLD + DBSD + RK40 rack frame	
					One rack	Three racks
Configuration	Configuration		1 CBLD	1 DBSD	1 CBLD + DBSD (13 units) (Maximum configuration) (*1) + RK40 rack frame	1 CBLD + DBSD (40 units) (Maximum configuration) (*1) + RK40 rack frame (3 units)
	Appearance					
Drive used	Drive size (W×D×H) (mm)		–	81.6×205.7×18.7 : 2.5 inch Type (DBS)		
	Data capacity (*2) (G byte)		–	195.8 / 287.6 / 392.7 / 575.3 / 786.5 / 879.9 / 1173.7		
	Rotational speed (min^{-1})		–	287.6 / 575.3 / 879.9 / 1173.7 G byte (2.5 inch Type) : 10,000 287.6 G byte (2.5 inch Type) : 15,000 195.8 / 392.7 / 786.5 G byte (2.5 inch Type) : Flash Drive		
	Maximum mountable quantity (*3) (unit)		–	24	216	960
Host interface	Type	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]	
		iSCSI(*4)	10 G bps [Optical]	–	10 G bps [Optical]	
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s	
		iSCSI(*4)	1,000 M bytes/s	–	1,000 M bytes/s	
	Number of host connector	Dual controller	Fibre Channel : 16/ iSCSI: 8(*4)	–	Fibre Channel : 16/ iSCSI: 8(*4)	
	Transferred block size (bytes)		512			

*1 : When nine or more mounted on RK40 rack, optional PDB is necessary.

*2 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*3 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*4 : It indicates the value of when the iSCSI Host I/O Module is added to the Controller.

Item			Model: Rackmount model — CBLD	DBSD	CBLD + DBSD + RK40 rack frame: One rack	CBLD + DBSD + RK40 rack frame: Three racks
RAID specifications (*1)	RAID level (*2)		–	0/1/5/6/1+0		
	RAID configuration	RAID 0	–	2D to 16D		
		RAID 1	–	1D+1D		
		RAID 5	–	2D+1P to 15D+1P		
		RAID 6	–	2D+2P to 28D+2P		
		RAID 1+0	–	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)	
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes	
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code	
Physical specifications	Start-up time (min)		Standard : 5 to 10 (*3)			
	Chassis size (W×D×H) (mm)		(483×819×129)	(483×545×88.4)	(610×1,020×1,920)	((610×3)×1,020×1,920)
	Mass (*4) (kg)		47 approx.	23 approx.	625 approx.	1,822 approx.
	EIA Standard for unit (U) (*5)		3	2	Max. 40	Max. 120
Input power specifications (*6)	Input voltage (Operable voltage range) (V)		DC -48 to -60 (-40 to -72)		–	
	Steady-state current (*7) (*8) (*9) (A)		4.7x2	3.7x2	–	
	Current rating of Breaker/ Fuse (A)		16.0	16.0	–	
	Heat value (normal) (kJ/h)		1,620 or less	1,660 or less	23,200 or less	68,020 or less
	Steady-state power (*9) (VA/W)		450/450 or less	460/460 or less	6,430/6,430 or less	18,850/18,850 or less
	Power consumption (*9) (VA/W)		370/370 or less	310/310 or less	4,400/4,400 or less	12,770/12,770 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 0 Controller Boxes + 40 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : The power current of N×2 described in this table is required for operation by a single Power Unit.

*7 : When one of the two Power Units fails, another Power Unit requires electric current for the two Power Units. Therefore, plan the power supply facility in which the current carrying capacity of one of the Power Units is a total capacity of the two Power Units.
Power requirement in the case of the maximum configuration is shown.
Value at -48 V is shown. The actual required power may exceed the value shown in the table when the tolerance is included.

*8 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*9 : This rating is based on the EN60950-1.

Item		Model: Rackmount model — CBLD	DBSD	CBLD + DBSD + RK40 rack frame: One rack	CBLD + DBSD + RK40 rack frame: Three racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384	
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Power Unit (CBLD) •Cache Memory •Fan Module •Cache Backup Battery (*3) • Host I/O Module (FC/iSCSI) and Host Connector	•Drive (2.5 inch Type) •Power Unit (DBSD) •I/O Module(ENC) (DBSD)	•Controller •Drive •Power Unit (CBLD/DBSD) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB	•Controller •Drive •Power Unit (CBLD/DBSD) •Cache Memory •Fan Module •Cache Backup Battery (*3) • Host I/O Module (FC/ iSCSI) and Host Connector •I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • LED of maintenance part			
Insulation performance	Insulation withstand voltage	DC 1,000 V (10 mA, 1 min)		AC 1,500 V (100 mA, 1 min)	
	Insulation resistance	DC 500 V, 10 MΩ or more			

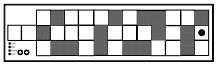
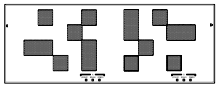
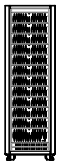
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(17) HUS150 (CBL+DBX)

Table 2.1.15 Basic Specifications

Item \ Model			Rackmount model			
			CBL	DBX	CBL + DBX + RK40 rack frame	
					One rack	Four racks
Configuration	Configuration		1 CBL	1 DBX	1 CBL + DBX (5 units) (Maximum configuration) + RK40 rack frame	1 CBL + DBX (20 units) (Maximum configuration) + RK40 rack frame (4 units)
	Appearance					
Drive used	Drive size (W×D×H) (mm)		–	101.6×147×26.1 : 3.5 inch Type (DBX)		
	Data capacity (*1) (G byte)		–	1956.9 / 2935.9 / 3915.0		
	Rotational speed (min^{-1})		–	1956.9 / 2935.9 / 3915.0 G byte : 7,200		
	Maximum mountable quantity (*2) (unit)		–	48	240	960
Host interface	Host interface	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]	
		iSCSI (*3)	10 G bps [Optical]	–	10 G bps [Optical]	
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s	
		iSCSI (*3)	1,000 M bytes/s	–	1,000 M bytes/s	
	Number of Host connector	Dual controller	Fibre Channel : 16/ iSCSI: 8(*3)	–	Fibre Channel : 16/ iSCSI: 8(*3)	
	Transferred block size (bytes)		512			

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Module is added to the Controller.

Item			Model: Rackmount model			
			CBL	DBX	CBL + DBX + RK40 rack frame	
					One rack	Four racks
RAID specifications (*1)	RAID level (*2)		–	0/1/5/6/1+0		
	RAID configuration	RAID 0	–	2D+16D		
		RAID 1	–	1D+1D		
		RAID 5	–	2D+1P to 15D+1P		
		RAID 6	–	2D+2P to 28D+2P		
		RAID 1+0	–	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)	
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes	
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code	
Physical specifications	Start-up time (min)		Standard : 5 to 10(*3)			
	Chassis size (W×D×H) (mm)		(483×819×129)	(483×840×176)	(610×1,020×1,920)	(610×4)×1,020×1,920)
	Mass(*4) (kg)		47 approx.	85 approx.	730 approx.	2,766 approx.
	EIA Standard for unit (U) (*5)		3	4	Max. 40	Max. 160
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%	
	Frequency (Hz)		50/60 ± 1			
	Number of phases, cabling		Single-phase with protective grounding			
	Steady-state current(*6) (*7) (*8) AC 100/200 (A)		2.5x2/1.3x2	3.7x4/1.9x4	-/16.0 (One PDB)	
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0	
	Steady-state power(*8) (*9) (VA/W)		500/450 or less	1,480/1,450 or less	7,900/7,700 or less	30,100/29,450 or less
	Power consumption(*8) (VA/W)		410/370 or less	1,000/980 or less	5,410/5,270 or less	20,410/19,970 or less
	Heat value (normal) (kJ/h)		1,620 or less	5,220 or less	27,720 or less	106,020 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 0 Controller Boxes + 20 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item	Model	Rackmount model			
		CBL	DBX	CBL + DBX + RK40 rack frame	
				One rack	Four racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384	
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Power Unit (CBL) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBX) •I/O Card(ENC) (DBX)	• Controller • Drive •Power Unit (CBL/DBX) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/iSCSI) and Host Connector • I/O Card(ENC) •PDB	• Controller • Drive •Power Unit (CBL/DBX) •Cache Memory •Fan Module •Cache Backup Battery (*3) •Host I/O Module (FC/iSCSI) and Host Connector • I/O Card(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)	
	Insulation resistance	DC 500 V, 10 MΩ or more			

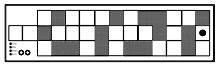
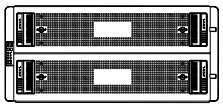
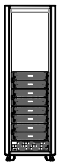
*1 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(18) HUS150 (CBL+DBW)

Table 2.1.16 Basic Specifications

Item \ Model			Rackmount model			
			CBL	DBW	CBL + DBW + RK40 rack frame(*1)	
					One rack	Three racks
Configuration	Configuration		1 CBL	1 DBW	1 CBL + DBW (4 units) (Maximum configuration) + RK40 rack frame	1 CBL + DBW (12 units) (Maximum configuration) + RK40 rack frame (3 units)
	Appearance					
Drive used	Drive size (W×D×H) (mm)		–	101.6×147×26.1 : 3.5 inch Type (DBW)		
	Data capacity (*2) (G byte)		–	2935.9 / 3915.0		
	Rotational speed (min^{-1})		–	2935.9 / 3915.0 G bytes : 7,200		
	Maximum mountable quantity (*3) (unit)		–	84	336	960
Host interface	Host interface	Fibre Channel	8 G bps [Optical]	–	8 G bps [Optical]	
		iSCSI (*4)	10 G bps [Optical]	–	10 G bps [Optical]	
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s	
		iSCSI (*4)	1,000 M bytes/s	–	1,000 M bytes/s	
	Number of Host connector	Dual controller	Fibre Channel : 16/ iSCSI: 8(*4)	–	Fibre Channel : 16/ iSCSI: 8(*4)	
	Transferred block size (bytes)		512			

*1 : When the firmware version is less than 0930/A, maximum configuration is 4 DBWs.

*2: The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*3: Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*4 : It indicates the value of when the iSCSI Host I/O Module is added to the Controller.

Item			Model: Rackmount model — CBL	DBW	CBL + DBW + RK40 rack frame(*1) — One rack	CBL + DBW + RK40 rack frame(*1) — Three racks
RAID specifications (*2)	RAID level (*3)		–	0/1/5/6/1+0		
	RAID configuration	RAID 0	–	2D+16D		
		RAID 1	–	1D+1D		
		RAID 5	–	2D+1P to 15D+1P		
		RAID 6	–	2D+2P to 28D+2P		
		RAID 1+0	–	2D+2D to 8D+8D		
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Dual Core)	
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes	
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code	
Physical specifications	Start-up time (min)		Standard : 5 to 10(*4)			
	Chassis size (W×D×H) (mm)		(483×819×129)	(483×933×220)	(610×1,020×1,920)	(610×3)×1,020×1,920)
	Mass(*5) (kg)		47 approx.	128 approx.	730 approx.	2,280 approx.
	EIA Standard for unit (U) (*6)		3	5	Max. 40	Max. 120
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%	AC 200-240 +6%/-11%	AC 200-240V +6%/-11%	
	Frequency (Hz)		50/60 ± 1			
	Number of phases, cabling		Single-phase with protective grounding			
	Steady-state current(*7) (*8) (*9) AC 100/200 (A)		2.5x2/1.3x2	--/8x2	-/16.0 (One PDB)	
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0	
	Steady-state power(*9) (*10) (VA/W)		500/450 or less	3,200/2,880 or less	13,300/11,970 or less	38,900/35,010 or less
	Power consumption(*9) (VA/W)		410/370 or less	1,400/1,330 or less	6,010/5,690 or less	17,210/16,330 or less
	Heat value (normal) (kJ/h)		1,620 or less	10,370 or less	43,100 or less	126,040 or less

*1 : When the firmware version is less than 0930/A, maximum configuration is 4 DBWs.

*2 : D : Data drive
P : Parity drive

*3 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*4 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 0 Controller Box + 4 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

*5 : Value of maximum configuration (in the case where all the mountable Drives and Controller are mounted).

*6 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*7 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*8 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*9 : This rating is based on the EN60950-1.

*10 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown. The actual required power may exceed the value shown in the table when the tolerance is included.

Item		Model: Rackmount model — CBL	DBW	CBL + DBW + RK40 rack frame(*1) — One rack	CBL + DBW + RK40 rack frame(*1) — Three racks
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192 / 16,384	
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*2)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*3)	•Controller •Power Unit (CBL) •Cache Memory •Fan Module •Cache Backup Battery (*4) •Host I/O Module (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBW) •I/O Module(ENC) (DBW)	• Controller • Drive •Power Unit (CBL/DBW) •Cache Memory •Fan Module •Cache Backup Battery (*4) •Host I/O Module (FC/iSCSI) and Host Connector • I/O Module(ENC) •PDB	• Controller • Drive •Power Unit (CBL) •Power Unit (DBW) •Cache Memory •Fan Module (CBL) •Fan Module (DBW) •Cache Backup Battery (*4) •Host I/O Module (FC/iSCSI) and Host Connector • I/O Module(ENC) •PDB
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling Firmware patching • Drive controlling Firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)	
	Insulation resistance	DC 500 V, 10 MΩ or more			

*1 : When the firmware version is less than 0930/A, maximum configuration is 4 DBWs.

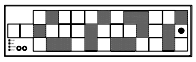
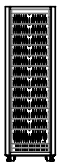
*2 : • Non-volatility of data in the cache memory is ensured against power trouble such as a sudden power failure. It transfers data in the Cache memory to Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

(19) HUS150 (CBL+DBF)

Table 2.1.17 Basic Specifications

Item \ Model			Rackmount model		
			CBL	DBF	CBL + DBF + RK40 rack frame Three racks
Configuration	Configuration		1 CBL	1 DBF	1 CBL + DBF (40 units) (Maximum configuration) + RK40 rack frame
	Appearance				
Drive used	Drive size (W×D×H) (mm)		–	145×366.8×19.8 : Flash Drive (FMD)	
	Data capacity (*1) (G byte)		–	1758.1 G byte	
	Rotational speed (min^{-1})		–	Flash Drive (FMD) : 1758.1 G byte	
	Maximum mountable quantity (*2) (unit)		–	12	480
Host interface	Type	Fibre Channe	8 G bps [Optical]	–	8 G bps [Optical]
		iSCSI(*3)	1Gbps iSCSI [1000Base-T]/ 10Gbps [Optical]	–	10Gbps [Optical]
	Data transfer speed (i.e. maximum speed for transfer to host)	Fibre Channel	800 M bytes/s	–	800 M bytes/s
		iSCSI(*3)	100 M bytes/s or 1000 M bytes/s	–	100 M bytes/s or 1000 M bytes/s
	Number of host connector	Dual controller	Fibre Channel :16 (Max.) + iSCSI :8 (*3)	–	Fibre Channel :16 (Max.) + iSCSI :8 (*3)
	Transferred block size (bytes)		512		

*1 : The drive capacity values are calculated as 1 G byte =1,000,000,000 bytes. This definition is different from that calculated as 1 k byte =1,024 bytes, which are actually displayed on PCs that you are using.
The RAID group capacity values displayed in the Hitachi Storage Navigator Modular 2 are calculated as 1 k byte =1,024 bytes.

*2 : Can be mounted on the Hitachi special rack frame (RK40). For the mounting, special rails for the rack frame and decoration panel(s) are required separately depending on the number of the mounted array(s).

*3 : It indicates the value of when the iSCSI Host I/O Board is mounted to the Controller.

Item			Model: Rackmount model — CBL	DBF	CBL + DBF + RK40 rack frame: Three racks
RAID specifications (*1)	RAID level (*2)		–	1/5/6/1+0	
	RAID configuration	RAID 0	–	–	
		RAID 1	–	1D+1D	
		RAID 5	–	2D+1P to 15D+1P	
		RAID 6	–	2D+2P to 28D+2P	
		RAID 1+0	–	2D+2D to 8D+8D	
Internal logic specifications	Control CPU		It is the same as 'With RK40 rack frame'	–	Jasper Forest 1.73 GHz (Single Core)
	Control memory			–	• Flash memory : 32 M bytes • L2 Cache memory : 4 M bytes • SDRAM : 1 G bytes
	Data assurance method			–	• Data bus : Parity • Cache memory :ECC (1 bit for correction, 2 bits for detection) • Drive : Data assurance code
Physical specifications	Start-up time (min)		Standard : 5 to 10 (*3)		
	Chassis size (W×D×H) (mm)		(483×819×129)	(483×755×87)	(610×1,020×1,920)
	Mass(*4) (kg)		47 approx.	38 approx.	715 approx.
	EIA Standard for unit (U) (*5)		3	2	Max. 11
Input power specifications	Input voltage (Operable voltage range) (V)		AC 100-120/200-240 +6%/-11%		AC 200-240 +6%/-11%
	Frequency (Hz)		50/60 ± 1		
	Number of phases, cabling		Single-phase with protective grounding		
	Steady-state current(*6) (*7) (*8) AC 100/200 (A)		2.5x2/1.3x2	2.6x2/1.3x2	-/16.0 (One PDB)
	Current rating of Breaker/ Fuse (A)		16.0	16.0	8.0
	Steady-state power(*8) (*9) (VA/W)		500/450 or less	520/470 or less	21,300/19,250 or less
	Power consumption(*8) (VA/W)		410/370 or less	450/410 or less	18,410/16,770 or less
	Heat value (normal) (kJ/h)		1,620 or less	1,700 or less	69,300 or less

*1 : D : Data drive
P : Parity drive

*2 : Although the array with a configuration of RAID 6, RAID 5, RAID 1, or RAID 1+0 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 array itself.
Therefore, users are requested to back up all data for restoration in case where the original data is lost.

*3 : Power on time will be long in proportion to the number of connected Drive Boxes. (The case of 1 Controller Box + 20 Drive Boxes, which is the maximum configuration, will be 10 minutes.)

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

*5 : Racks height are measured in meters, EIA units, and "U". 1EIA unit equals 1U, which equals 44.45 mm.

*6 : When a failure occurs, a single Power Unit operates. Therefore, plan the power supply facility according to the specification in the operation by a single Power Unit for both units.

*7 : The current value in the operation by a single Power Unit is same as that in the operation by both Power Units.

*8 : This rating is based on the EN60950-1.

*9 : Power requirement in the case of the maximum configuration is shown. Value at 100 V/200 V is shown.
The actual required power may exceed the value shown in the table when the tolerance is included.

Item	Model	Rackmount model			
		CBL	DBF	CBL + DBF + RK40 rack frame	
				Three racks	
Cache specifications	Capacity (M bytes/CTL)	It is the same as 'With RK40 rack frame'	–	8,192	16,384
	Control method		–	Read LRU/Write after	
	Battery backup		–	Provided	
	Backup duration(*1)		–	Unrestricted (Saving to a nonvolatile memory)	
Maintenance specifications /anti-fault specifications	Parts to which hot replacement is applicable (*2)	•Controller •Drive •Power Unit (CSL) •Cache Memory •FAN •Cache Backup Battery (*3) •Host I/O Module (FC/iSCSI) and Host Connector	•Drive •Power Unit (DBF) •I/O Card(ENC) (DBF)	•Controller •Drive •Power Unit (CBL / DBF) •Cache Memory •FAN •Cache Backup Battery (*3) • Host I/O Module (FC/iSCSI) and Host Connector •I/O Card(ENC) •PDB	
	Firmware installation method	It is the same as 'With RK40 rack frame'	–	Flash memory/Drive (resident)	
	SVP (built-in exclusive tool) function	It is the same as 'With RK40 rack frame'	–	• Failure information logging/Power control • Controlling firmware patching • Drive controlling firmware down loading • Configuration information change • Drive recovery initiating process (This process is automatically executed when Drive is replaced.)	
	Spare Drive	Up to 80 of mounted Drives can be set to Spare Drives			
	Collection of trace and dump	It is the same as 'With RK40 rack frame'	–	Download the trace and dump through LAN on the maintenance PC.	
	Display function	• Status LEDs (POWER, READY, WARNING, and ALARM) • 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)	
	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 Drives by turning off the power normally, and prevents the battery charge from being wasted.
• Since battery is subject to effect of environmental temperature, avoid using a battery in unnecessarily continuous operation at high temperature.
• If the array is not energized for more than six months, the over discharging of the battery occurs and it may cause the battery an unrecoverable damage.
In this case, charge the battery once per six months for longer than three hours.
• To minimize the deterioration of battery, use and keep a battery at the lowest temperature possible.

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

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

2.2 Environmental Specifications

To maintain the Hitachi Unified Storage 100 Series performance, the Hitachi Unified Storage 100 Series must be installed in a proper environment.
Do not install the array in such places as shown below because the equipment life will be shortened or the equipment will result in a failure.

- Place exposed to direct sunlight.
- Place where the temperature and humidity varies much.
- Place near an apparatus that generates electric noise.
- Place near an apparatus that generates a strong magnetic field.
- Very dusty place.
- Place exposed to frequent vibrations.
- Place such as inclined floor.

The environmental specifications for the HUS 130/150 are shown in the Table 2.2.1, for the HUS 150 (CBLD/DBLD/DBSD) is shown in Table 2.2.2, and that for the HUS 110 is shown in Table 2.2.3.

Table 2.2.1 Environmental specifications (HUS130/150)

Item \ Model		Rackmount model						Notes
		CBSS/ CBSL/ CBL	DBL/DBS	DBX	DBW	DBF	RK40 rack	
Temperature	In operation (°C)	10 to 40		10 to 35			10 to 40(*1)	–
	In non-operation (°C)	-10 to 50				-10 to 35	-10 to 50	–
	In transport/storage (°C)	-30 to 60				-30 to 50	-30 to 60	–
	Temperature change rate (°C/h)	10 or less						–
Humidity	In operation (%)	8 to 80						–
	In non-operation (%)	8 to 90						–
	Maximum wet bulb temperature (°C)	29						Non-condensing
Vibration	In operation (m/s2)	2.5 or less						Within 5 seconds (Resonance point:10Hz or less)
	In non-operation (m/s2)	5.0 or less						–
	In transport (packed) (m/s2)	5.0 or less						–
Impact	In operation (m/s2)	20 or less						–
	In non-operation (m/s2)	50 or less						10 ms, half sine wave
	In transport (packed) (m/s2)	80 or less						–
Angle at which the array will turn over (°)		15 or more						To be measured when installed on leveling bolts.
Altitude	In operation (m)	-60 to 3,000 (Ambient temperature:10°C to 40°C)						–
	In non-operation (m)	-60 to 12,000						–
Atmosphere		No corrosive gas and salty air must be found.						–
Acoustic noise (dB)		60 (Environmental temperature: 32°C or less)(*2)		65 (Environmental temperature: 32°C or less)(*2)	75 (Environmental temperature: 28°C or less)(*2) (*3)	60 (Environmental temperature: 32°C or less) (*2)	72 (*4) (Environmental temperature: 32°C or less) (*2)	Measured at the position one meter away from the array and at a height of one meter.

*1 : 10°C to 35°C when DBW is mounted.

*2 : It may exceed this standard value when the maximum load continues under high-temperature environment or when a failure occurs in one part of the system because the internal temperature of the system controls the rotating speed of the FAN.

*3 : In case of one DBW, 80 dB at the temperature of 32°C, the maximum level is 85 dB.
Do not work behind DBW for a long time.

*4 : 79dB (environmental temperature is 28°C or less) when DBW is mounted.

Table 2.2.2 Environmental specifications (HUS150 (CBLD/DBLD/DBSD))

Item \ Model		Rackmount model			Notes
		CBLD	DBLD/DBSD	RK40 rack	
Temperature	In operation (°C)	5 to 40		10 to 40	–
	In transport/storage (°C)	-30 to 60			–
Humidity	In operation (%)	5 to 85			Non-condensing
	In storage (%)	5 to 100			Non-condensing
Altitude	In operation (m)	-60m to 3000 m (Ambient temperature:5°C to 40°C)			–
	In non-operation (m)	-60m to 12000m			–

Table 2.2.3 Environmental specifications (HUS110)

Item \ Model		Rackmount model			Notes
		CBXSL/CBXSS	DBL/DBS	RK40 rack	
Temperature	In operation (°C)	10 to 40			–
	In non-operation (°C)	-10 to 50			–
	In transport/storage (°C)	-30 to 60			–
	Temperature change rate (°C/h)	10 or less			–
Humidity	In operation (%)	8 to 80			–
	In non-operation (%)	8 to 90			–
	Maximum wet bulb temperature (°C)	29			Non-condensing
Vibration	In operation (m/s2)	2.5 or less			Within 5 seconds (Resonance point:10Hz or less)
	In non-operation (m/s2)	5.0 or less			–
	In transport (packed) (m/s2)	5.0 or less			–
Impact	In operation (m/s2)	20 or less			–
	In non-operation (m/s2)	50 or less			10 ms, half sine wave
	In transport (packed) (m/s2)	80 or less			–
Angle at which the array will turn over (°)		15 or more			To be measured when installed on leveling bolts.
Altitude	In operation (m)	-60 to 3,000 (Ambient temperature:10°C to 40°C)			–
	In non-operation (m)	-60 to 12,000			–
Atmosphere		No corrosive gas and salty air must be found.			–
Acoustic noise (dB)		60 (Environmental temperature: 32°C or less)(*1)		72 (Environmental temperature: 32°C or less) (*1)	Measured at the position one meter away from the array and at a height of one meter.

*1 : It may exceed this standard value when the maximum load continues under high-temperature environment or when a failure occurs in one part of the system because the internal temperature of the system controls the rotating speed of the FAN.

2.3 Basic Specifications of the Drive

Table 2.3.1 SAS Drive (300 GB)

Item \ Mode		DF-F850-3HGSS				DF-F850-3HGSSH
Drive Model Name	Seagate	-	ST9300605SS (DKS5D-J300SS)	-	ST300MM0006 (DKS5E-J300SS)	-
	HGST	HUC106030CSS600 (DKR5C-J300SS)	-	HUC109030CSS600 (DKR5D-J300SS)	-	HUC156030CSS204 (DKR5C-K300SS)
Capacity (G bytes)		287.62	287.62	287.62	287.62	287.62
Number of Heads	Seagate	-	2	-	2	-
	HGST	3	-	2	-	3
Number of Drives	Seagate	-	1	-	1	-
	HGST	2	-	1	-	2
Seek Time (ms) (Read/Write)	minimum	-	0.2/0.4	-	-	-
	average	3.7/4.2	3.4/3.8	3.8/4.2	-	2.9/3.1
	maximum	8.6/9.4	7.1/7.4	8.6/9.4	-	5.9/6.2
Average latency time (ms)		3.0	3.0	3.0	3.0	2.0
Rotational speed (min^{-1})		10,000	10,000	10,000	10,000	15,000
Interface data transfer rate (MB/S)		600	600	600	600	600
Internal data transfer rate (MB/S)		153 to 253	125 to 238	165 to 279	180 to 293	187 to 267
Interface		SAS	SAS	SAS	SAS	SAS

Item \ Mode		DF-F850-3HGSSH/ DF-F850-3HGSLH
Drive Model Name	Seagate	ST9300653SS (DKS5C-K300SS)
	HGST	-
Capacity (G bytes)		287.62
Number of Heads	Seagate	4
	HGST	-
Number of Drives	Seagate	2
	HGST	-
Seek Time (ms) (Read/Write)	minimum	0.2/0.4
	average	2.7/3.1
	maximum	5.1/5.5
Average latency time (ms)		2.0
Rotational speed (min^{-1})		15,000
Interface data transfer rate (MB/S)		600
Internal data transfer rate (MB/S)		194 to 283
Interface		SAS

Table 2.3.2 SAS Drive (600 GB)

Item \ Mode		DF-F850-6HGSS			
Drive Model Name	Seagate	-	ST9600205SS (DKS5D-J600SS)	-	ST600MM0006 (DKS5E-J600SS)
	HGST	HUC106060CSS600 (DKR5C-J600SS)	-	HUC109060CSS600 (DKR5D-J600SS)	-
Capacity (G bytes)		575.30	575.30	575.30	575.30
Number of Heads	Seagate	-	4	-	4
	HGST	6	-	4	-
Number of Drives	Seagate	-	2	-	2
	HGST	3	-	2	-
Seek Time (ms) (Read/Write)	minimum	-	0.2/0.4	-	-
	average	3.7/4.2	3.4/3.8	3.8/4.2	-
	maximum	8.6/9.4	7.1/7.4	8.6/9.4	-
Average latency time (ms)		3.0	3.0	3.0	3.0
Rotational speed (min^{-1})		10,000	10,000	10,000	10,000
Interface data transfer rate (MB/S)		600	600	600	600
Internal data transfer rate (MB/S)		153 to 253	125 to 238	165 to 279	180 to 293
Interface		SAS	SAS	SAS	SAS

Table 2.3.3 SAS Drive (900 GB)

Item \ Mode		DF-F850-9HGSS/DF-F850-9HGSL		
Drive Model Name	Seagate	ST9900805SS (DKS5D-J900SS)	-	ST900MM0006 (DKS5E-J900SS)
	HGST	-	HUC109090CSS600 (DKR5D-J900SS)	-
Capacity (G bytes)		879.98	879.98	879.98
Number of Heads	Seagate	6	-	6
	HGST	-	6	-
Number of Drives	Seagate	3	-	3
	HGST	-	3	-
Seek Time (ms) (Read/Write)	minimum	0.2/0.4	-	-
	average	3.7/4.1	3.9/4.2	-
	maximum	7.7/8.1	8.6/9.4	-
Average latency time (ms)		3.0	3.0	3.0
Rotational speed (min^{-1})		10,000	10,000	10,000
Interface data transfer rate (MB/S)		600	600	600
Internal data transfer rate (MB/S)		125 to 238	165 to 279	180 to 293
Interface		SAS	SAS	SAS

Table 2.3.3.1 SAS Drive (1200 GB)

Item \ Mode		DF-F850-12HGSS	
Drive Model Name	Seagate	-	ST1200MM0007 (DKS5F-J1R2SS)
	HGST	HUC101212CSS600 (DKR5E-J1R2SS)	-
Capacity (G bytes)		1,173.71	1,173.71
Number of Heads	Seagate	-	8
	HGST	8	-
Number of Drives	Seagate	-	4
	HGST	4	-
Seek Time (ms) (Read/Write)	minimum	-	-
	average	4.6/5.0	-
	maximum	12.6/12.9	-
Average latency time (ms)		3.0	3.0
Rotational speed (min^{-1})		10,000	10,000
Interface data transfer rate (MB/S)		600	600
Internal data transfer rate (MB/S)		161 to 279	180 to 293
Interface		SAS	SAS

Table 2.3.4 SAS7.2K Drive (2,000 GB)

Item \ Mode			DF-F850-2TNL/DF-F850-2TNX			
Drive Model Name		Seagate	ST33000650SS (DKS2D-H3R0SS)	ST2000NM0001 (DKS2P-H2R0SS)	ST32000645SS (DKS2D-H2R0SS)	ST2000NM0023 (DKS2E-H2R0SS)
		HGST	HUS723020ALS640 (DKR2D-H2R0SS)	-	-	HUS724020ALS640 (DKR2E-H2R0SS)
Capacity (G bytes)			1,956.94	1,956.94	1,956.94	1,956.94
Number of Heads		Seagate	10	8	7 or 8	5
		HGST	7	-	-	6
Number of Drives		Seagate	5	4	4	3
		HGST	4	-	-	4
Seek Time (ms) (Read/Write)	minimum	Seagate	0.5/0.5	0.5/0.8	0.5/0.5	-
		HGST	-	-	-	-
	average	Seagate	8.1/8.8	8.3/9.3	8.3/9.3	-
		HGST	7.6/8.0	-	-	8.2/8.2
	maximum	Seagate	15.5/16.2	18/19	15.5/16.2	-
		HGST	14.5/15.0	-	-	14.5/14.5
Average latency time (ms)			4.16	4.16	4.16	4.16
Rotational speed (min^{-1})			7,200	7,200	7,200	7,200
Interface data transfer rate (MB/S)			600	600	600	600
Internal data transfer rate (MB/S)		Seagate	113 to 239	95 to 212	113 to 239	-
		HGST	-	-	-	-
Interface			SAS	SAS	SAS	SAS

Table 2.3.5 SAS7.2K Drive (3,000 GB)

Item \ Mode			DF-F850-3TNL/DF-F850-3TNX/DF-F850-3TNW	
Drive Model Name	Seagate		ST33000650SS (DKS2D-H3R0SS)	ST3000NM0023 (DKS2E-H3R0SS)
	HGST		HUS723030ALS640 (DKR2D-H3R0SS)	HUS724030ALS640 (DKR2E-H3R0SS)
Capacity (G bytes)			2,935.96	2,935.96
Number of Heads	Seagate		10	8
	HGST		10	8
Number of Drives	Seagate		5	4
	HGST		5	4
Seek Time (ms) (Read/Write)	minimum	Seagate	0.5/0.5	-
		HGST	-	-
	average	Seagate	8.1/8.8	-
		HGST	7.6/8.0	8.2/8.2
	maximum	Seagate	15.5/16.2	-
		HGST	14.5/15.0	14.5/14.5
Average latency time (ms)			4.16	4.16
Rotational speed (min^{-1})			7,200	7,200
Interface data transfer rate (MB/S)			600	600
Internal data transfer rate (MB/S)	Seagate		113 to 239	-
	HGST		-	-
Interface			SAS	SAS

Table 2.3.5.1 SAS7.2K Drive (4,000 GB)

Item \ Mode			DF-F850-4TNL/ DF-F850-4TNX/ DF-F850-4TNW
Drive Model Name	Seagate		ST4000NM0023 (DKS2E-H4R0SS)
	HGST		HUS724040ALS640 (DKR2E-H4R0SS)
Capacity (G bytes)			3,915.01
Number of Heads	Seagate		10
	HGST		10
Number of Drives	Seagate		5
	HGST		5
Seek Time (ms) (Read/Write)	minimum	Seagate	-
		HGST	-
	average	Seagate	-
		HGST	8.2/8.2
	maximum	Seagate	-
		HGST	14.5/14.5
Average latency time (ms)			4.16
Rotational speed (min^{-1})			7,200
Interface data transfer rate (MB/S)			600
Internal data transfer rate (MB/S)	Seagate		-
	HGST		-
Interface			SAS

Table 2.3.6 Flash Drive (200 GB / 400 GB / 800 GB)

Item \ Mode		DF-F850-2HGDM/ DF-F850-2HGDML	DF-F850-4HGDM/ DF-F850-4HGDML	DF-F850-8HGDM/ DF-F850-8HGDML
Drive Model Name	HGST	HUSML4020ASS600 (SLR5B-M200SS)	HUSML4040ASS600 (SLR5B-M400SS)	-
	TOSHIBA	PX02SMF020 (SLB5A-M200SS)	PX02SMF040 (SLB5A-M400SS)	PX02SMF080 (SLB5A-M800SS)
Capacity (G bytes)		195.82	392.73	786.59
Average time of access(μs)		100	100	100
Interface data transfer rate (MB/S)		600	600	600

Table 2.3.6.1 Flash Drive (FMD) (1,600 GB)

Item \ Mode	DKC-F710I-1R6FM
Drive Model Name : HITACHI	NFH1A-P1R6SS / NFH1C-P1R6SS
Capacity (G bytes)	1758.12
Average time of access(μs)	-
Interface data transfer rate (MB/S)	600

Cautionary Notes for life span of Flash Drive

(1) The maximum number of writing capacity (Endurance)

- Flash Drive is a life-span part which is determined with whichever comes first, either the elapse of time or writing times.
- Information message for replacement is displayed to recommend when writing capacity of Flash Drive reaches 90 % of its life-span.
  Hitachi Storage Navigator Modular 2 Ver. 25.50 or more can set the write capacity life threshold value for Flash Drives (FMDs).
  Hitachi Storage Navigator Modular 2 Ver. 22.00 or more can set the write capacity life threshold value for Flash Drives (SSDs).
  For the setting procedure, refer to System Parameter “11.2 Setting the Flash Drive Write Endurance Threshold” (SYSPR 11-0050).
  And 95 % to 98 %, the message is displayed every increase of 1 %.
  Example:
  When the write endurance threshold is set, the message will be displayed when the following endurance rate is reached.

Threshold	Write endurance rate at which the information message is notified.
50 %	50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 96, 97, 98
83 %	83, 85, 90, 95, 96, 97, 98
90 %	90, 95, 96, 97, 98
97 %	97, 98

- The Dynamic sparing operates and copies the data to the Spare Drive when it reaches 99%.

(2) Flash Drive (FMD) battery life

Flash Drives (FMDs) have batteries built-in. The battery life is affected by the array specification environment.

If the Flash Drive (FMD) life reaches 90 %, the notice to promote replacement is issued.

Hitachi Storage Navigator Modular 2 Ver. 25.50 or more can set the battery life threshold value for Flash Drives (FMDs).

For the setting procedure, refer to System Parameter "11.2 Setting the Flash Drive Write Endurance Threshold" (SYSPR 11-0050).

And 95 % to 98 %, the message is displayed every increase of 1 %.

Example:

When the write endurance threshold is set, the message will be displayed when the following endurance rate is reached.

Threshold	Write endurance rate at which the information message is notified.
50 %	50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 96, 97, 98, 99, 100
83 %	83, 85, 90, 95, 96, 97, 98, 99, 100
90 %	90, 95, 96, 97, 98, 99, 100
97 %	97, 98, 99, 100
98 %	99, 100
99 %	100

(3) Retention period of power off data (Retention)

- The more number of writing capacity increases, the shorter the data retention period during power off (power down of Controller Box/Drive Box with Flash Drive installed and/or Controller Box/Drive Box without Flash Drive) is.
- Flash Drive must be energized with the Array power on at least once every three months.
- When using a Flash Drive (FMD) or DBF not in use for a long period, power on the DBF and charge the Flash Drive (FMD) battery.
  When battery charge is required, the ACT LED (green) on the Flash Drive (FMD) blinks and it goes out after completing the charge.

Chapter 3. Introduction of Operation

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

3.1 Power On/Off Sequence

3.1.1 IMPL Sequence

The procedure for processing the IMPL (Initial Microprogram Load) executed when the array is started is explained below. The IMPL sequence is broadly divided into four processes and they are executed sequentially.

(1) Boot loader
After the flash memory is booted, the BIOS executes the minimum necessary CUDG and the hardware initial setting. After that, BIOS develops the local memory loader from the flash memory to the local memory and transfers the control.

(2) Local memory loader
The local memory loader performs the CUDG and hardware initialization which are necessary for loading the OS load module. It loads the OS load module in the local memory after the spin-up of the first five Drives of the Controller Box. 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 making the initial setting of the hardware and the DF table, DF initialization task generates DF task. The load of the CUDG and the takeover information is executed in the DF task, and the diagnosis on the Drive side and the load of the PIN data are performed. After that, all Drives of the Controller Box and the Drive Box are spun up.

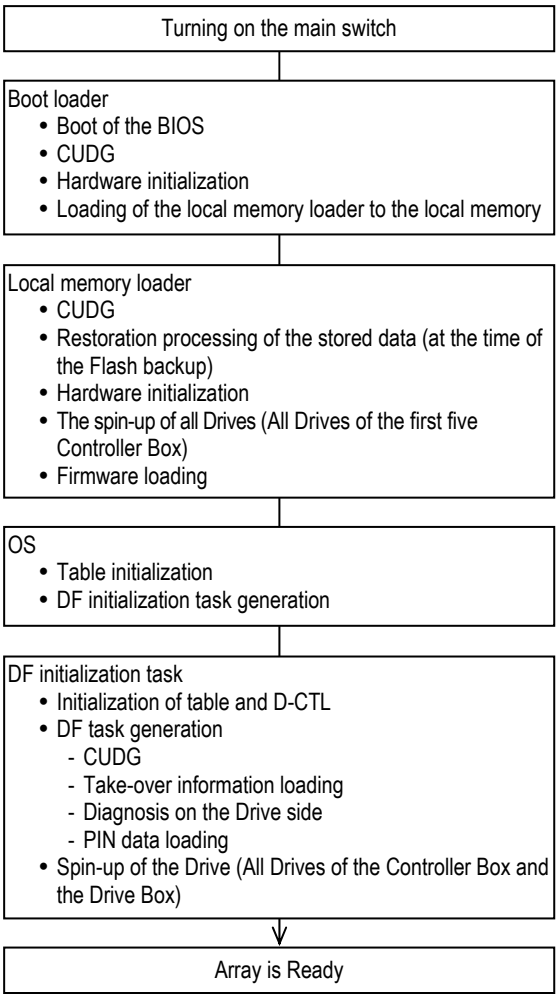
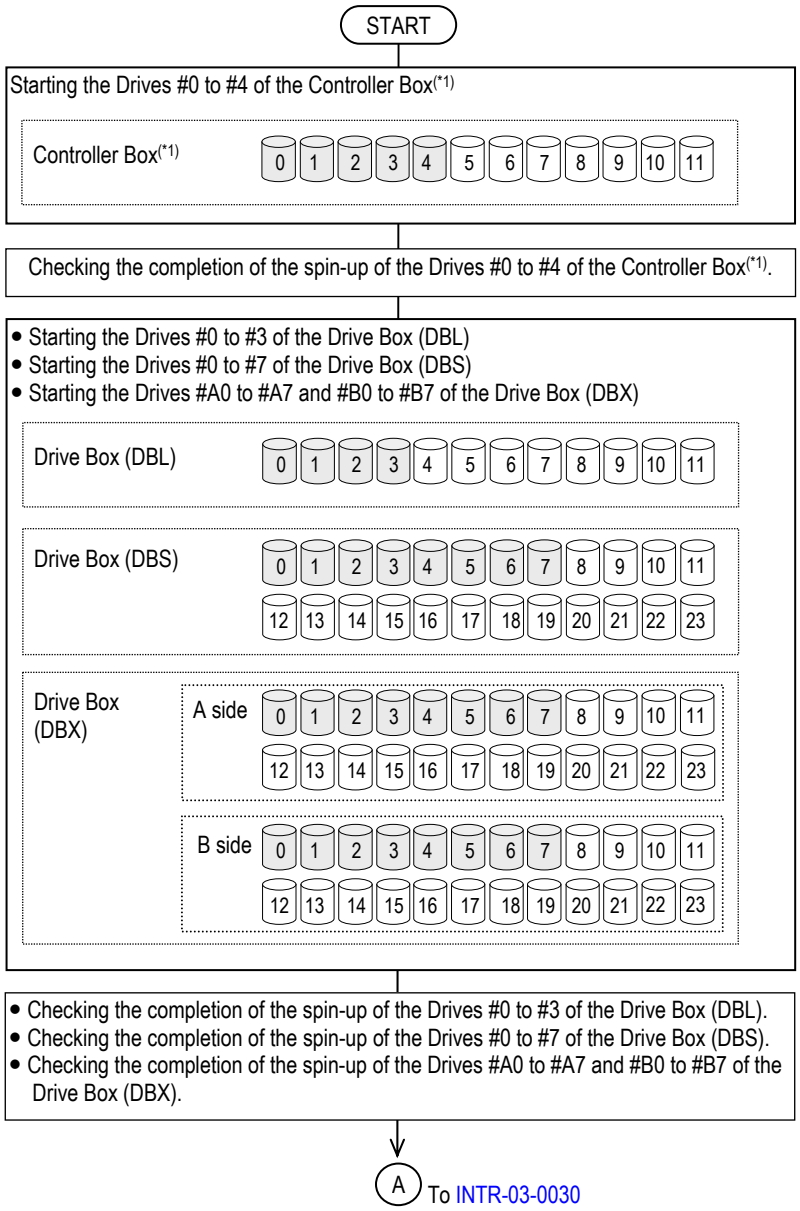


Figure 3.1.1 IMPL Sequence

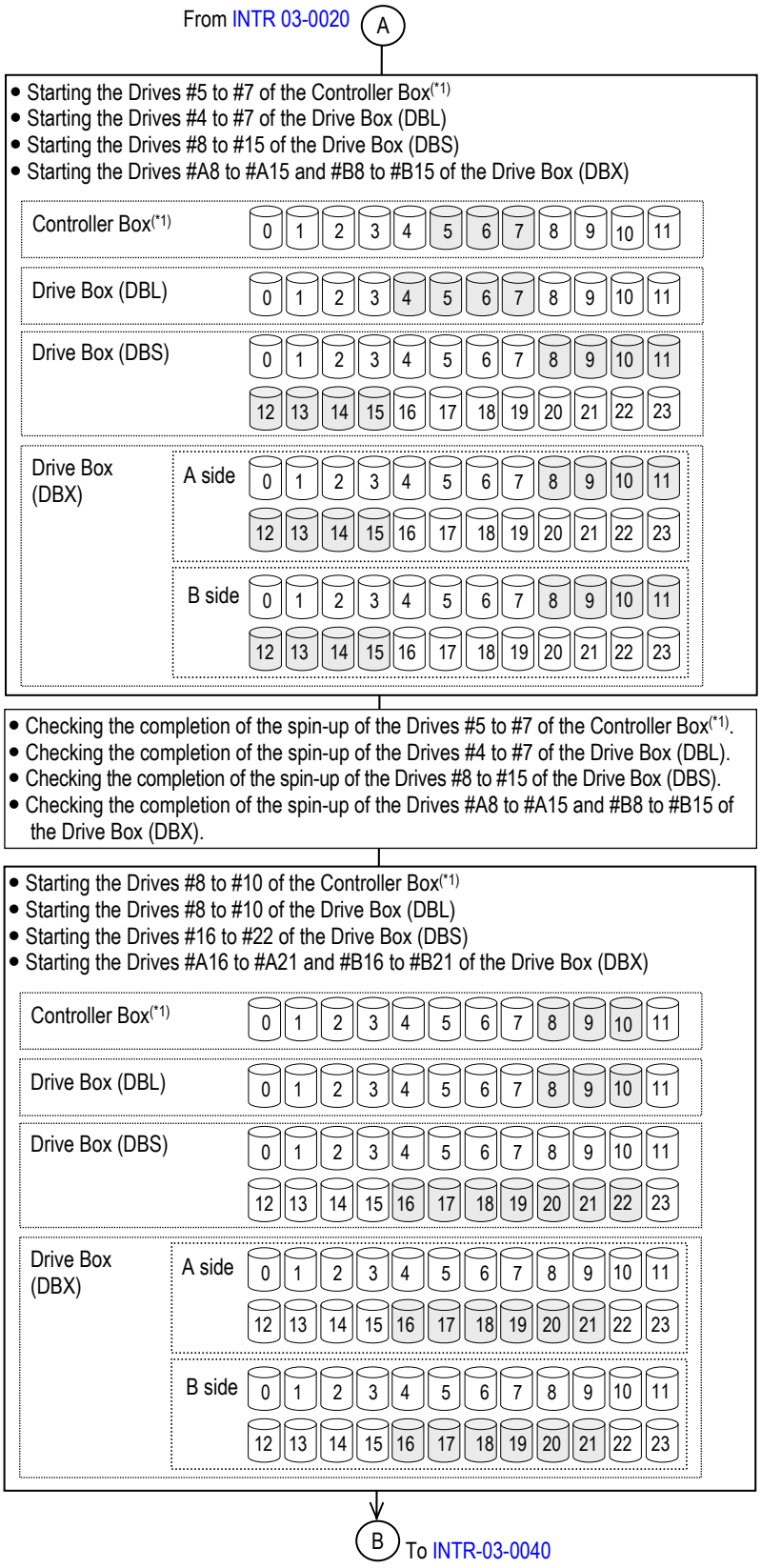
3.1.2 Drive Powering On Sequence

If all the Drives are rotated at the same time, an overcurrent may be caused.
To avoid it, the drives are started in the following sequence.

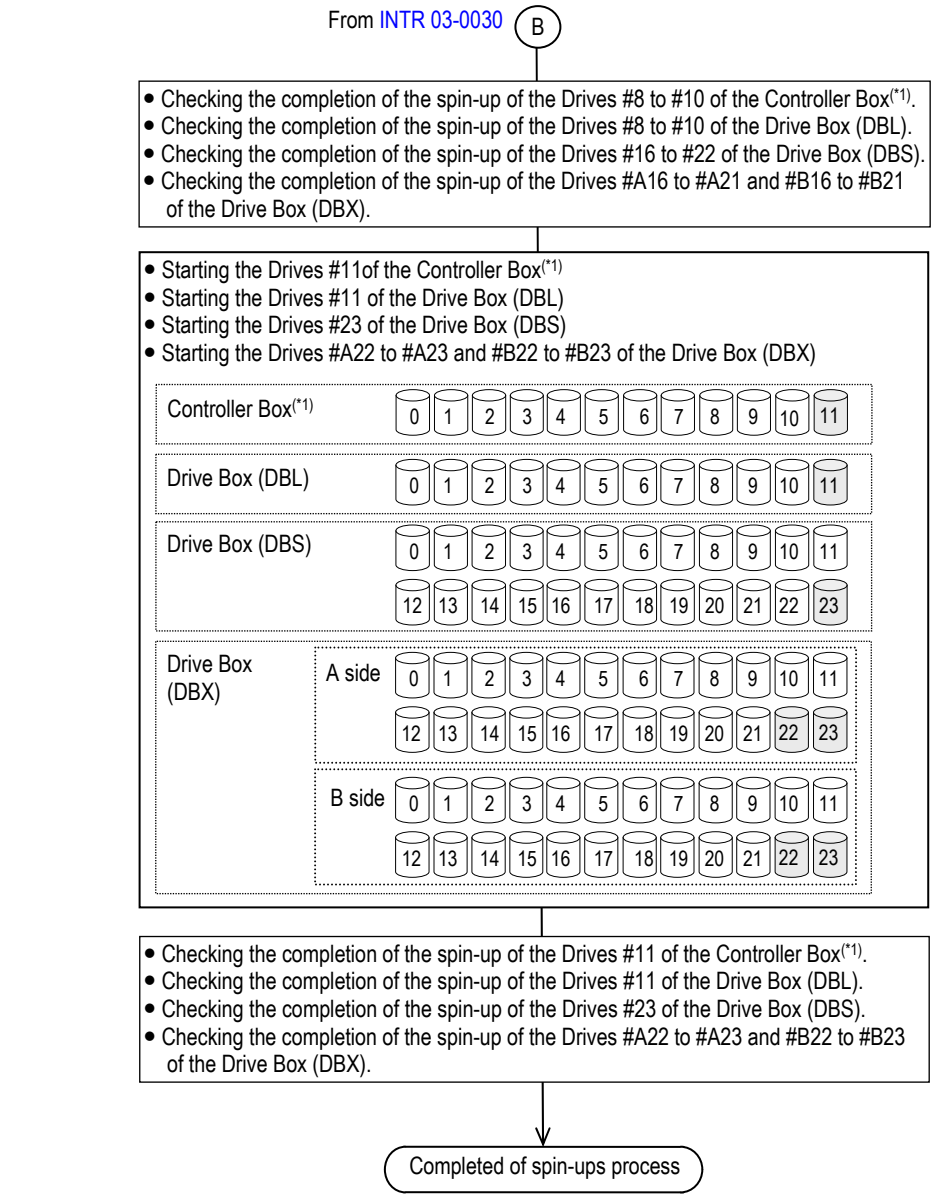
(1) When Controller Box is CBSL/CBXSL, or when Drive Box of the unit#0 connected to CBL is DBL



*1 : Controller Box (CBSL/CBXSL), or Drive Box (DBL) of the Unit #0 connected to CBL.

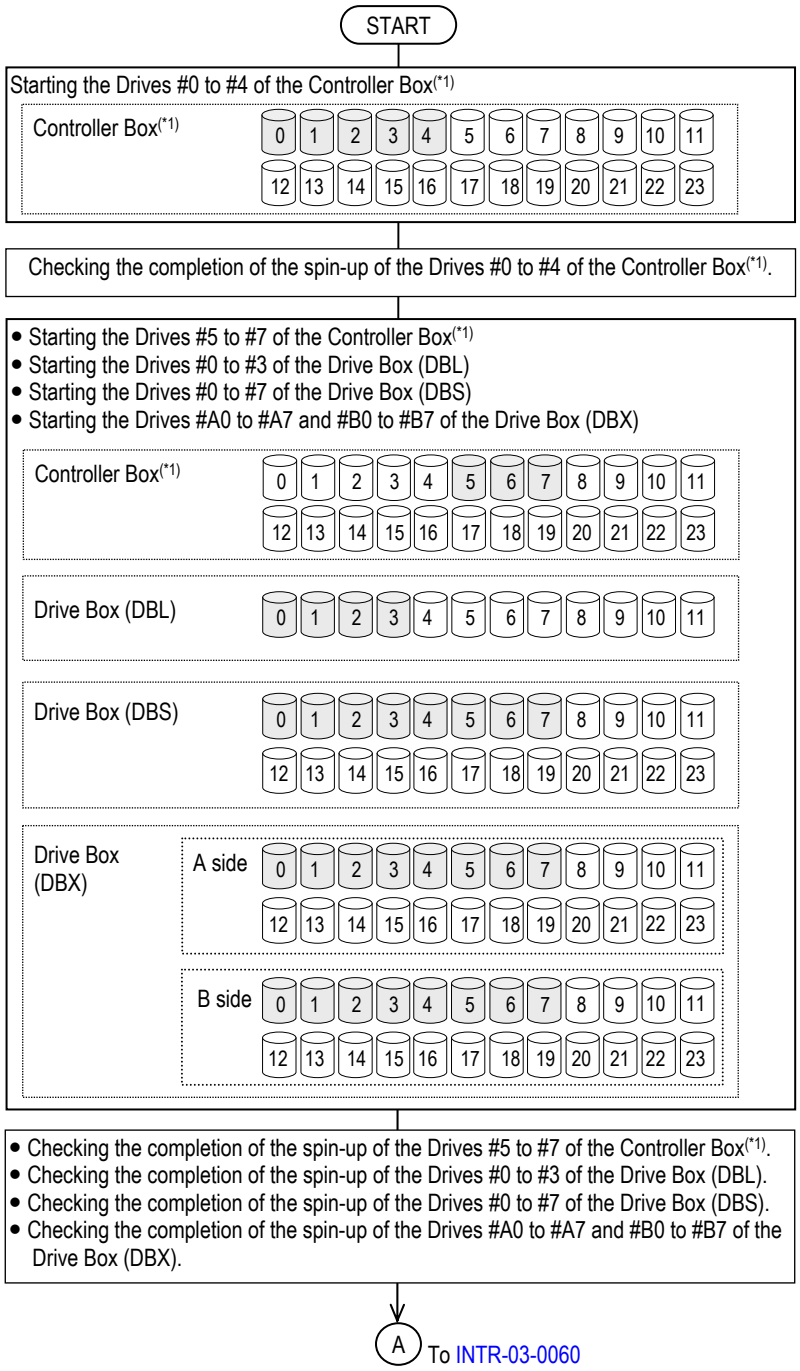


*1 : Controller Box (CBSL/CBXSL), or Drive Box (DBL) of the Unit #0 connected to CBL.

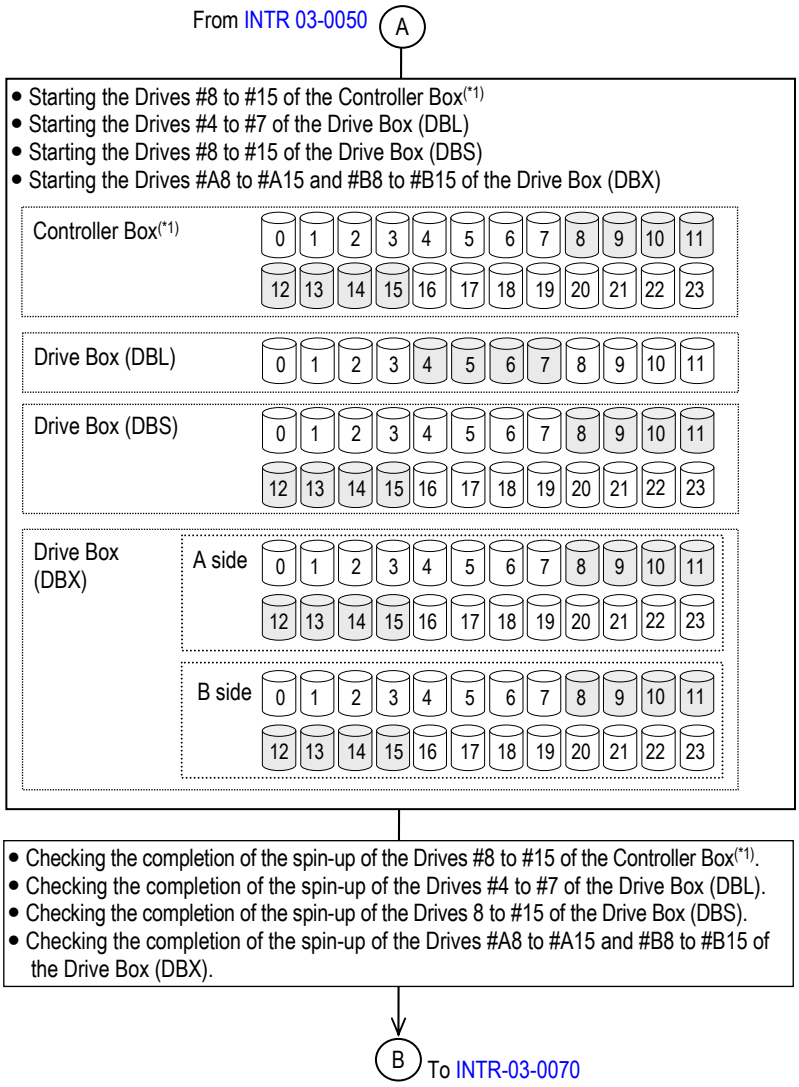


*1 : Controller Box (CBSL/CBXSL), or Drive Box (DBL) of the Unit #0 connected to CBL.

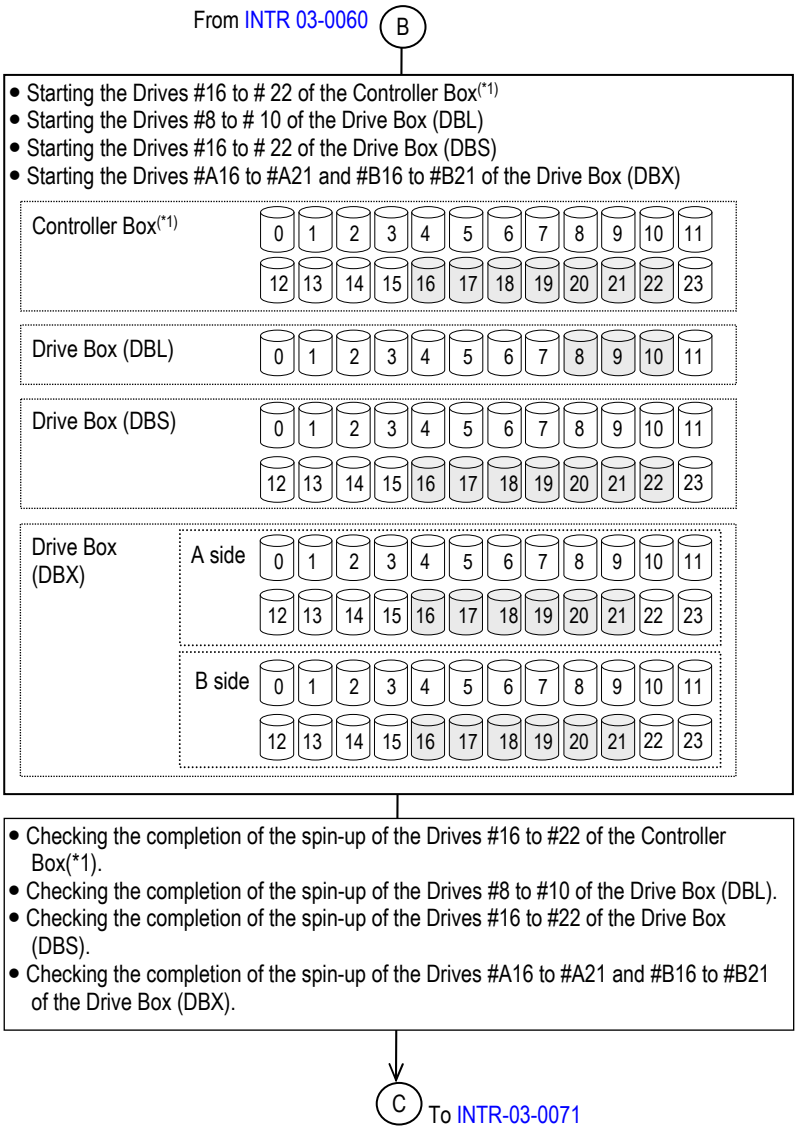
(2) When Controller Box is CBSS/CBXSS, or when Drive Box of the unit#0 connected to CBL is DBS



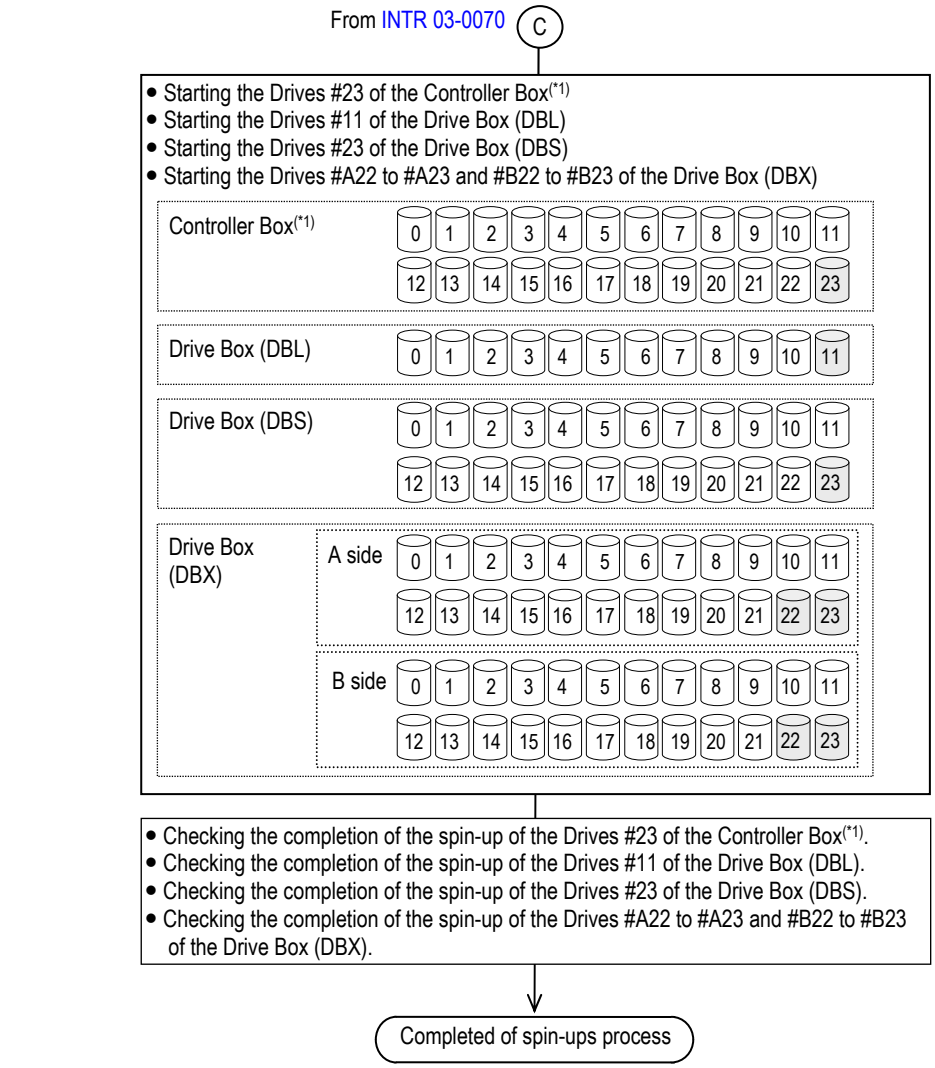
*1 : Controller Box (CBSS/CBXSS), or Drive Box (DBS) of the Unit #0 connected to CBL.



*1 : Controller Box (CBSS/CBXSS), or Drive Box (DBS) of the Unit #0 connected to CBL.

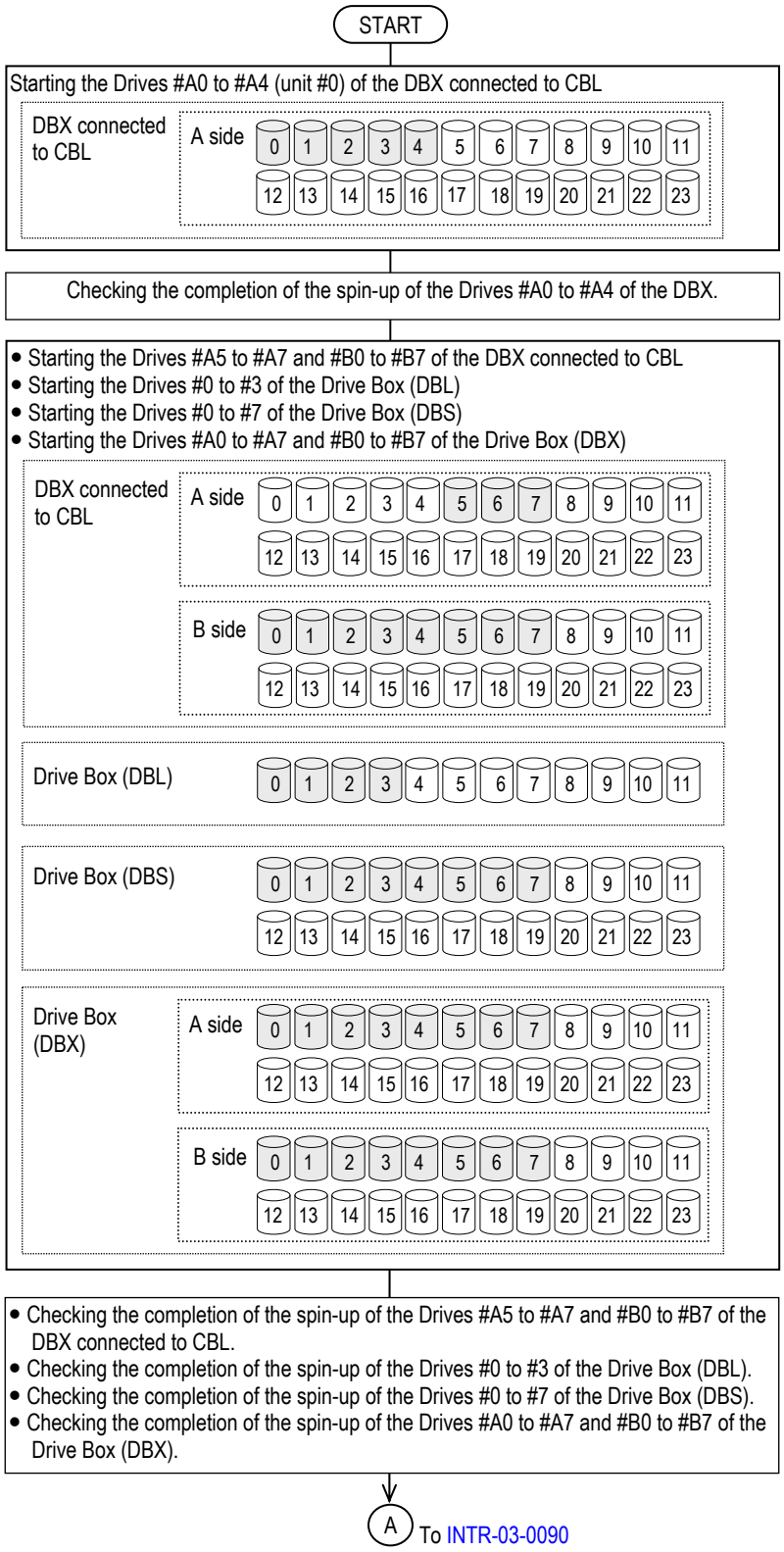


*1 : Controller Box (CBSS/CBXSS), or Drive Box (DBS) of the Unit #0 connected to CBL.



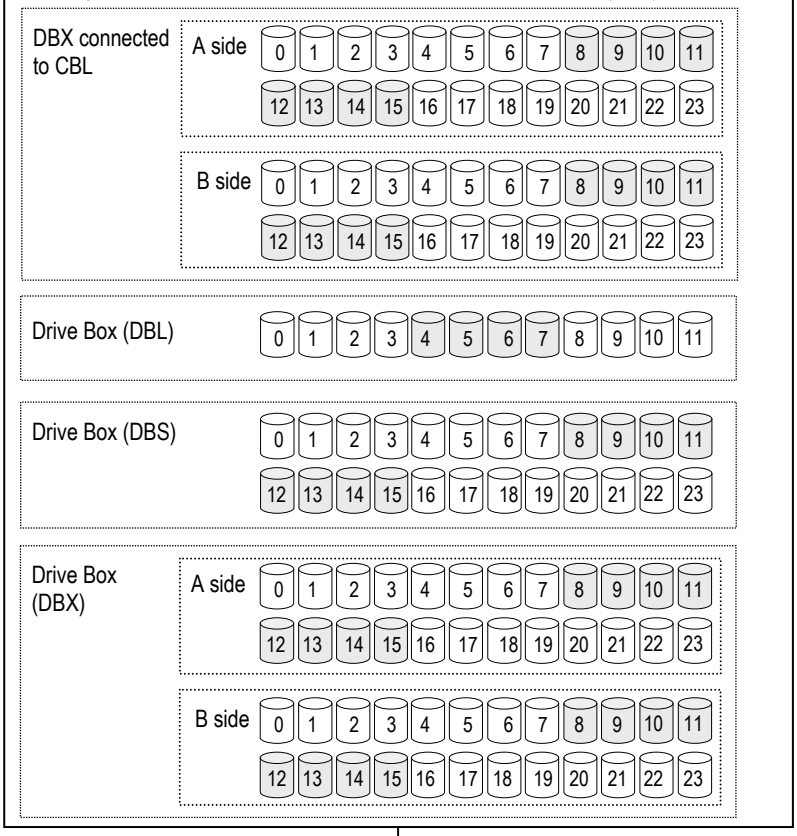
*1 : Controller Box (CBSS/CBXSS), or Drive Box (DBS) of the Unit #0 connected to CBL.

(3) When Drive Box of the unit#0 connected to Controller Box CBL is DBX



From INTR 03-0080 (A)

- Starting the Drives #A8 to #A15 and #B8 to #B15 of the DBX connected to CBL
- Starting the Drives #4 to #7 of the Drive Box (DBL)
- Starting the Drives #8 to #15 of the Drive Box (DBS)
- Starting the Drives #A8 to #A15 and #B8 to #B15 of the Drive Box (DBX)

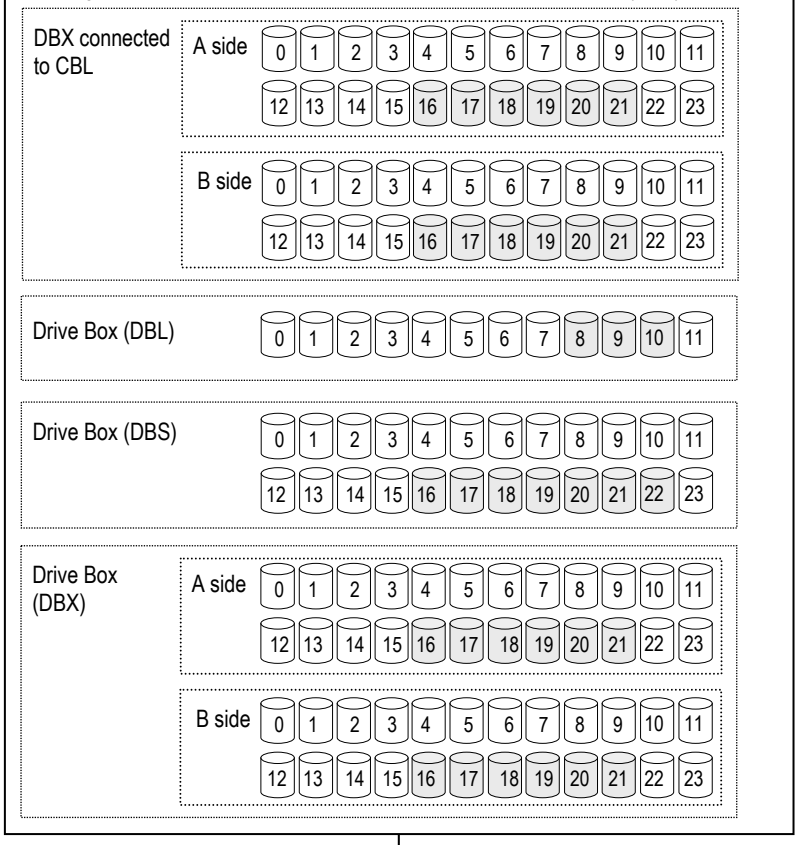


- Checking the completion of the spin-up of the Drives #A8 to #A15 and #B8 to #B15 of the DBX connected to CBL.
- Checking the completion of the spin-up of the Drives #4 to #7 of the Drive Box (DBL).
- Checking the completion of the spin-up of the Drives #8 to #15 of the Drive Box (DBS).
- Checking the completion of the spin-up of the Drives #A8 to #A15 and #B8 to #B15 of the Drive Box (DBX).

(B) To INTR-03-0100

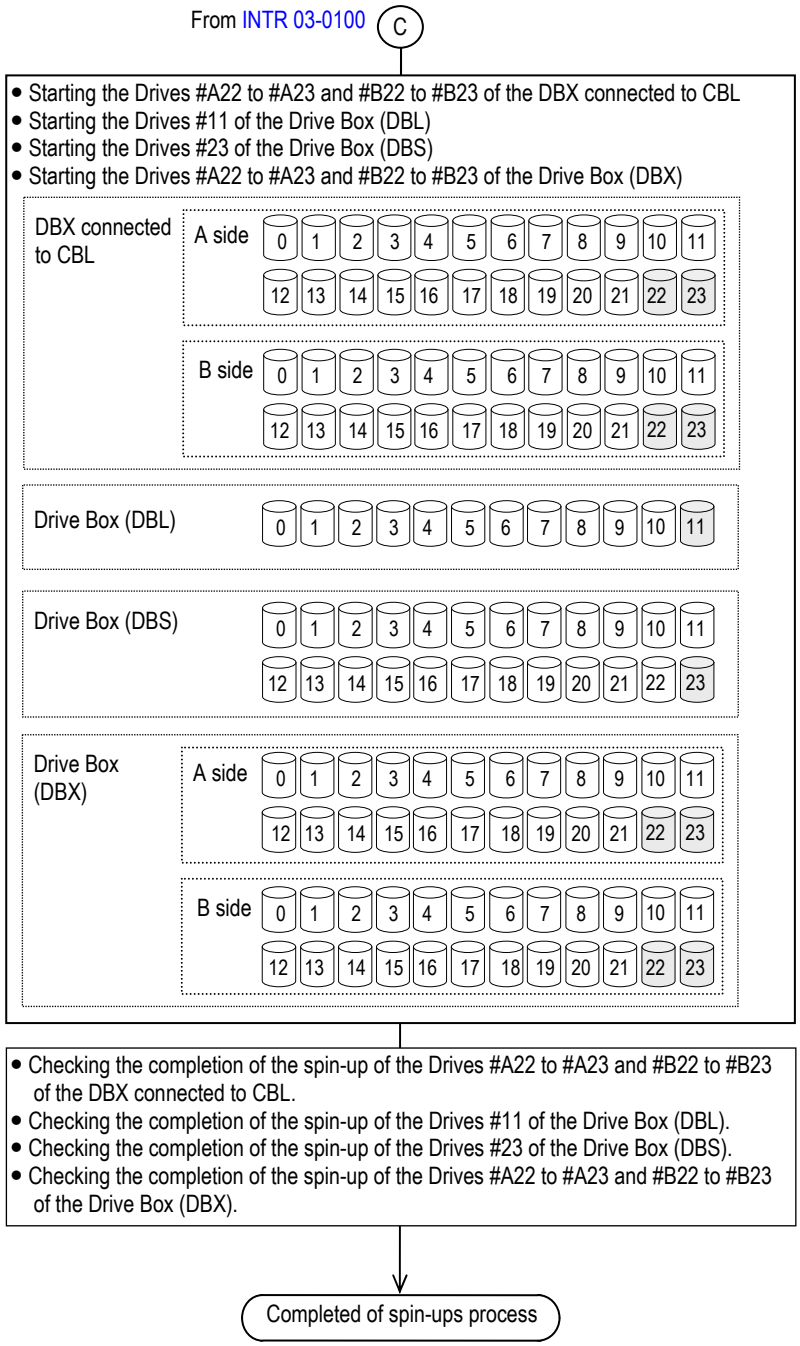
From INTR 03-0090 (B)

- Starting the Drives #A16 to #A21 and #B16 to #B21 of the DBX connected to CBL
- Starting the Drives #8 to #10 of the Drive Box (DBL)
- Starting the Drives #16 to #22 of the Drive Box (DBS)
- Starting the Drives #A16 to #A21 and #B16 to #B21 of the Drive Box (DBX)

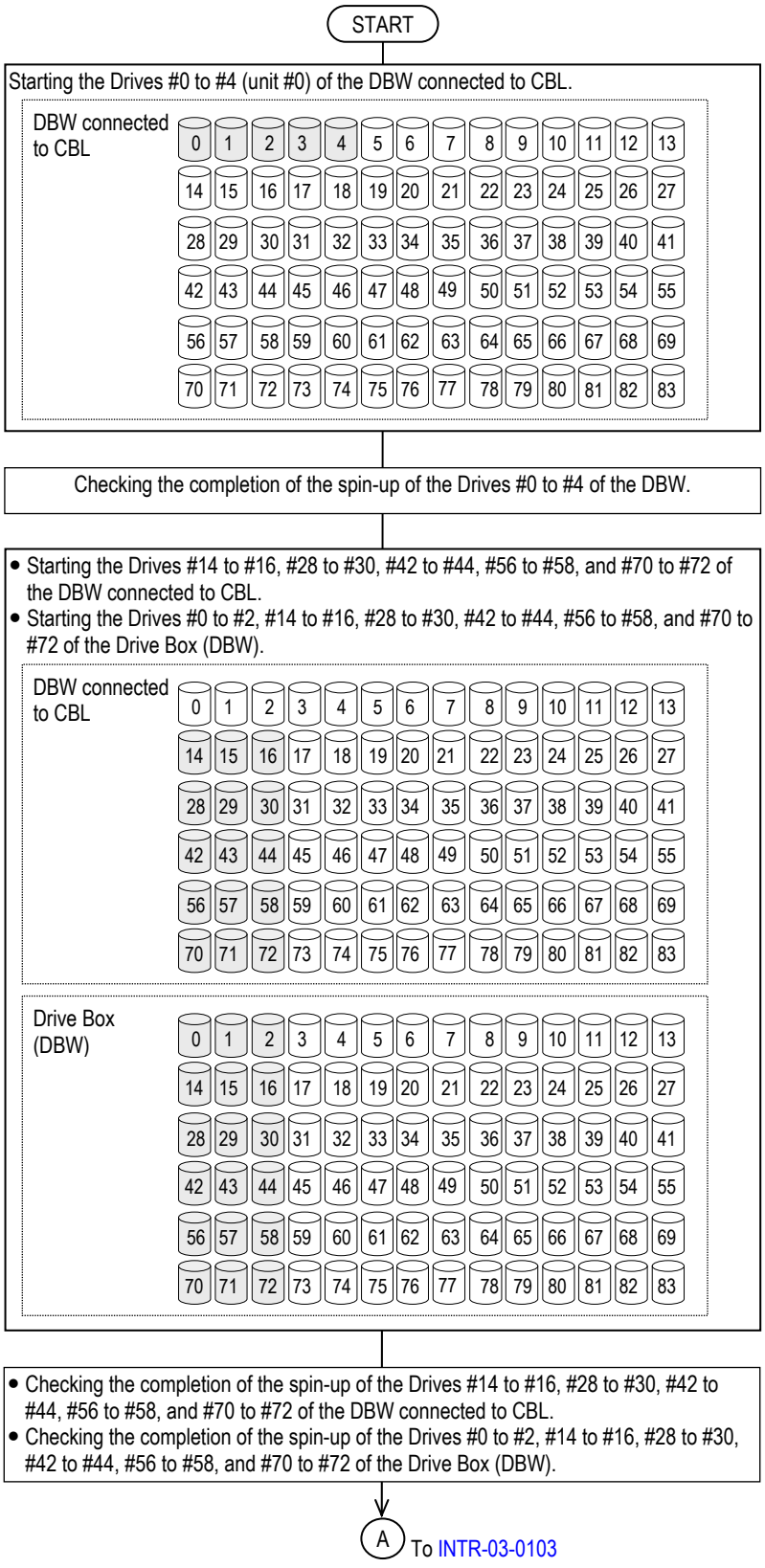


- Checking the completion of the spin-up of the Drives #A16 to #A21 and #B16 to #B21 of the DBX connected to CBL.
- Checking the completion of the spin-up of the Drives #8 to #10 of the Drive Box (DBL).
- Checking the completion of the spin-up of the Drives #16 to #22 of the Drive Box (DBS).
- Checking the completion of the spin-up of the Drives #A16 to #A21 and #B16 to #B21 of the Drive Box (DBX).

(C) To INTR-03-0101

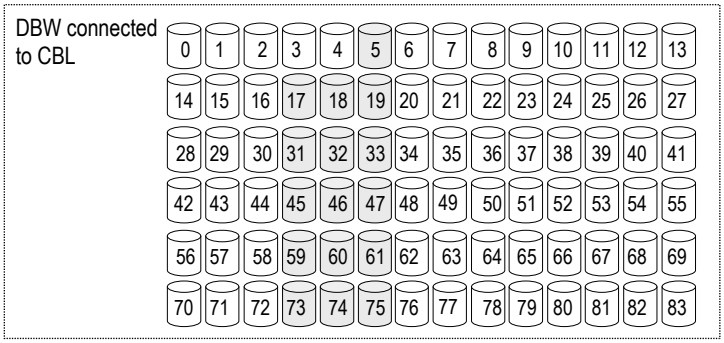


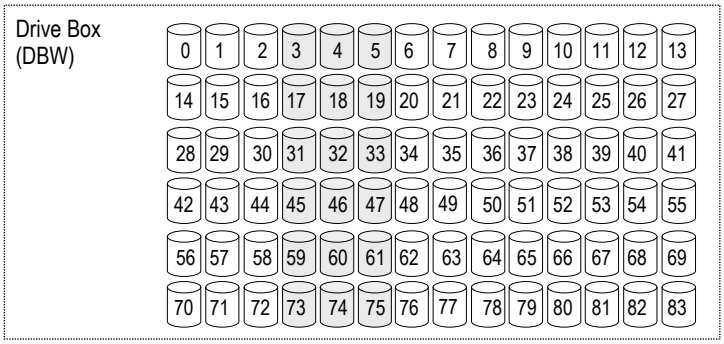
(4) When Drive Box of the unit#0 connected to Controller Box CBL is DBW



From INTR 03-0102 (A)

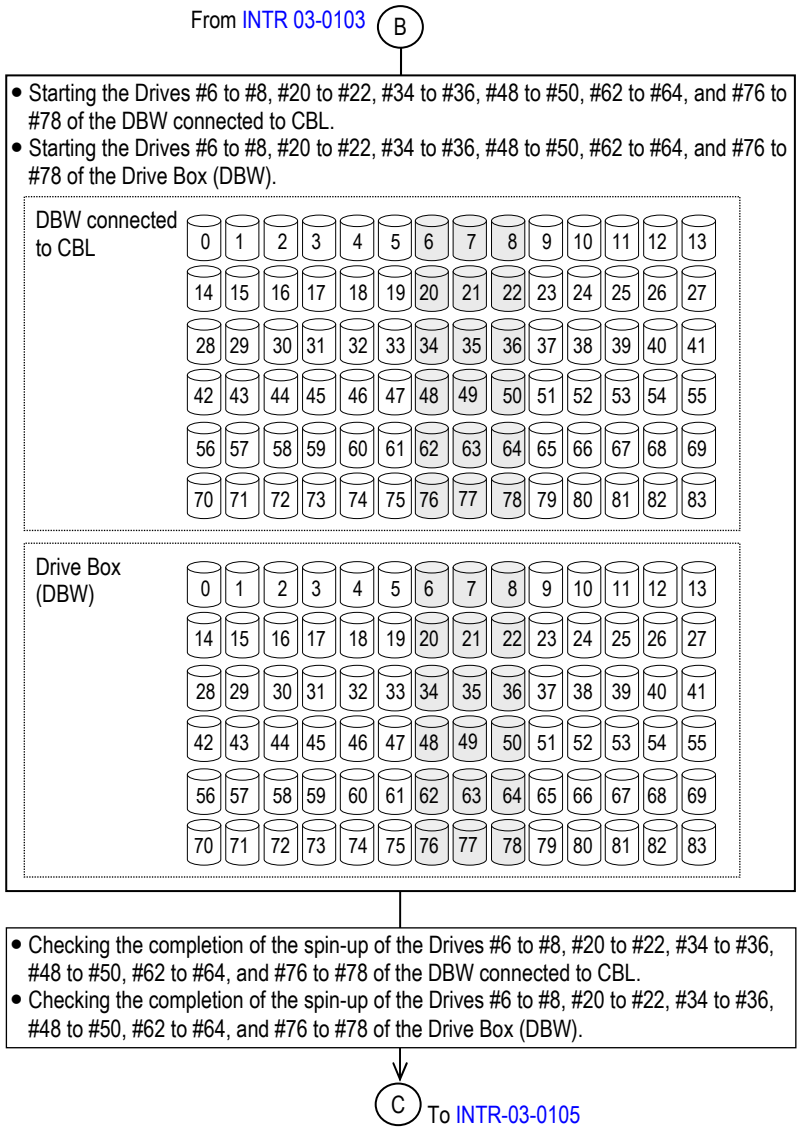
- Starting the Drives #5, #17 to #19, #31 to #33, #45 to #47, #59 to #61, and #73 to #75 of the DBW connected to CBL.
- Starting the Drives #3 to #5, #17 to #19, #31 to #33, #45 to #47, #59 to #61, and #73 to #75 of the Drive Box (DBW).





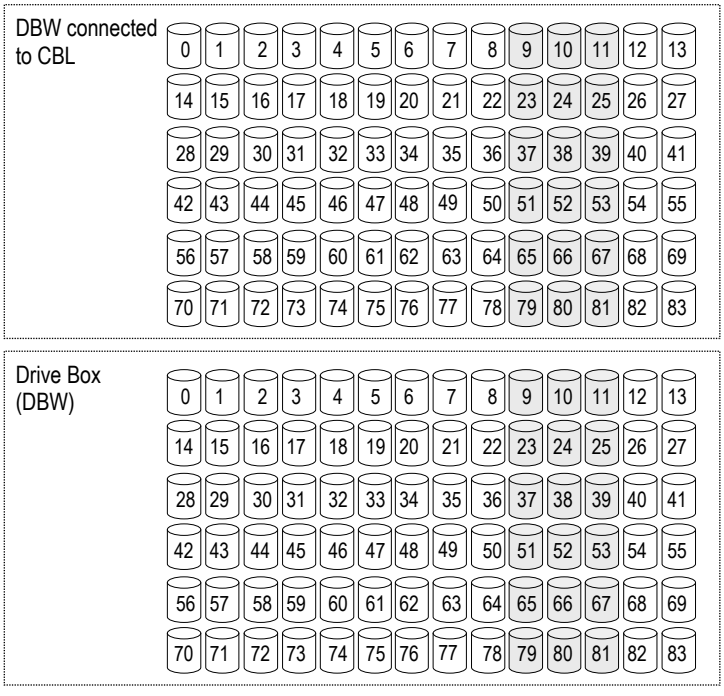
- Checking the completion of the spin-up of the Drives #5, #17 to #19, #31 to #33, #45 to #47, #59 to #61, and #73 to #75 of the DBW connected to CBL.
- Checking the completion of the spin-up of the Drives #3 to #5, #17 to #19, #31 to #33, #45 to #47, #59 to #61, and #73 to #75 of the Drive Box (DBW).

(B) To INTR-03-0104



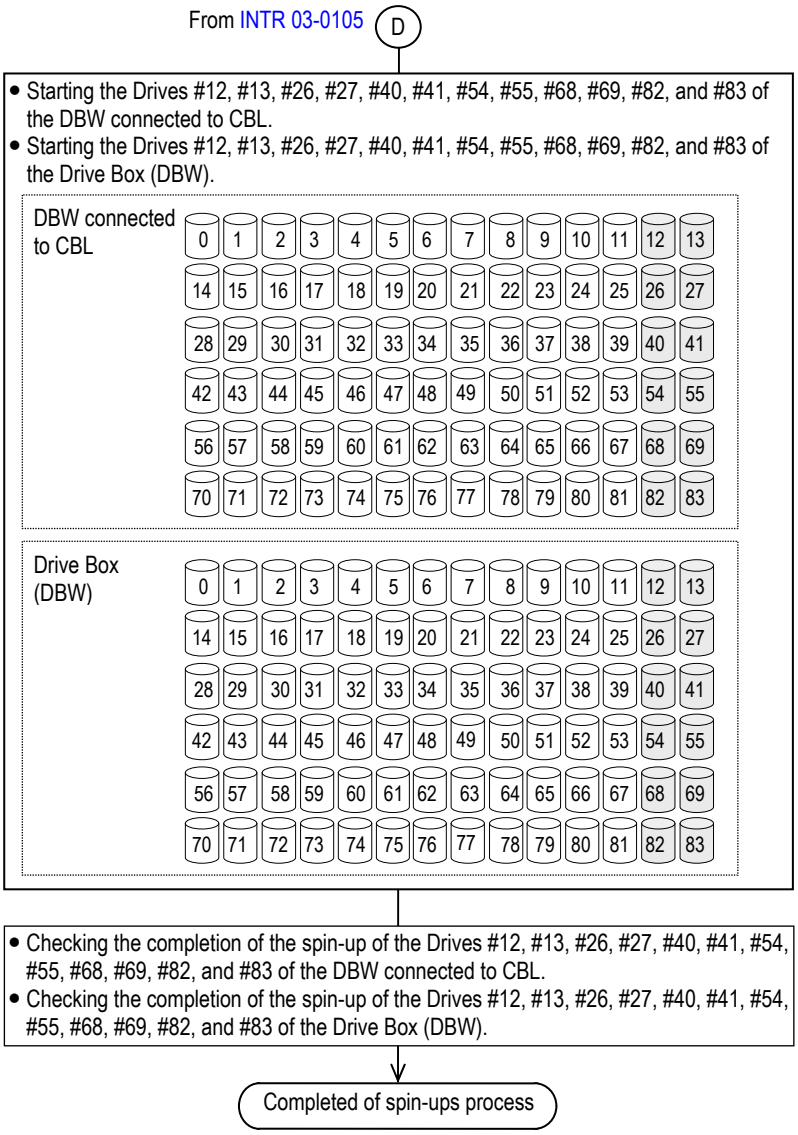
From INTR 03-0104 (C)

- Starting the Drives #9 to #11, #23 to #25, #37 to #39, #51 to #53, #65 to #67, and #79 to #81 of the DBW connected to CBL.
- Starting the Drives #9 to #11, #23 to #25, #37 to #39, #51 to #53, #65 to #67, and #79 to #81 of the Drive Box (DBW).



- Checking the completion of the spin-up of the Drives #9 to #11, #23 to #25, #37 to #39, #51 to #53, #65 to #67, and #79 to #81 of the DBW connected to CBL.
- Checking the completion of the spin-up of the Drives #9 to #11, #23 to #25, #37 to #39, #51 to #53, #65 to #67, and #79 to #81 of the Drive Box (DBW).

(D) To INTR-03-0106



3.1.3 Sequential Shutdown

If the array receives instructions of a stop (remote control) by powering off the host computer and a stop (local control) by turning off the main switch, the destaging operation is performed after confirming the completion of all of them.
At this time, if a track failed to be destaged (pinned data) occurs, the Pin information is stored in the system area on the system drive.
Then, after the take-over information is stored in the system area of the system drive and the power supply from the Cache Backup Battery is shut off, the array is notified of the permission for powering off.
For the array, the power cables can be removed from the Power Units after permitting the power supply turning off.

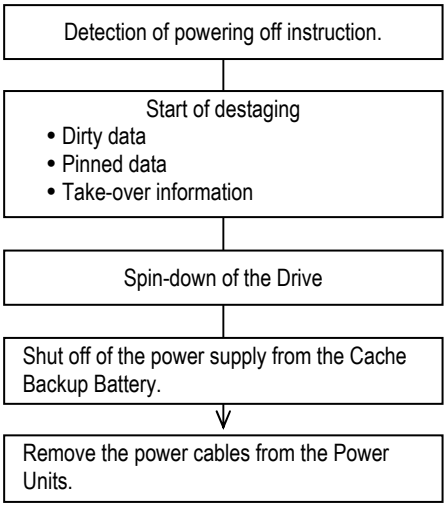


Figure 3.1.2 Flow Chart of Sequential Shutdown

3.2 Data Format

Figure 3.2.1 shows the data format.

To the sub-block, the check codes such as the address assurance code (LA), write sequence (WR_SEQ), reserve (RSV) and data assurance code (LRC) are added.

The physical format on the physical drive is recorded in the data field in units of 520 bytes.

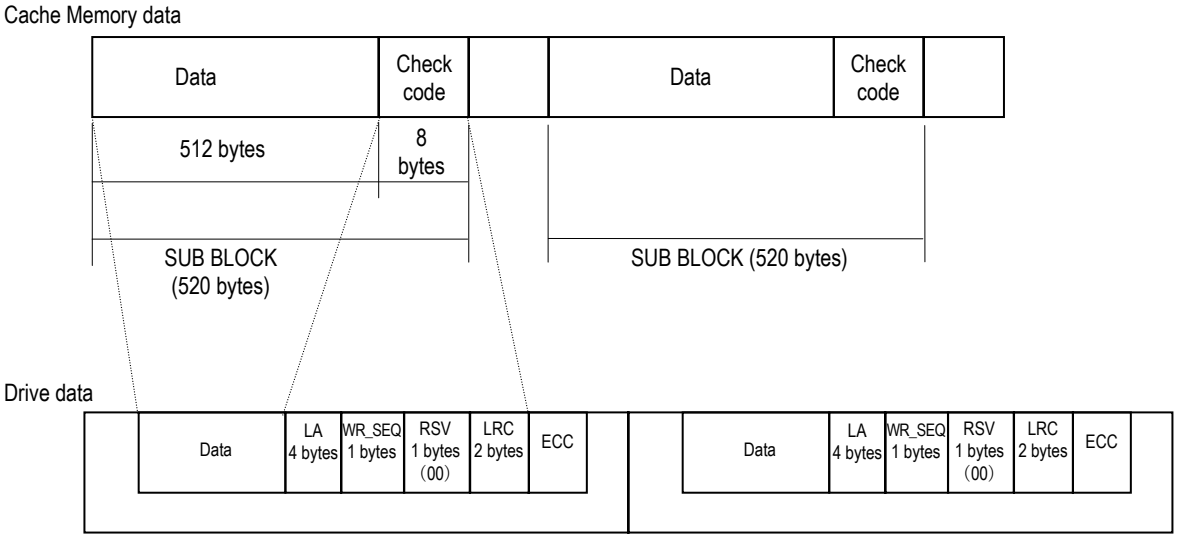


Figure 3.2.1 Data Format

3.3 Read/Write Operation

3.3.1 Command Execution

In the array, all R/W commands are executed via the Cache Memory.

- When the data is on the Cache Memory at reading, the data on the Cache Memory is transferred to the host computer (Read hit processing).
- Only when the data is not on the Cache Memory at reading, the data is transferred to the host computer directly from the Drive (Read miss processing). 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 the write processing, the write-after processing that returns the completion report to the host computer when the data writing to the Cache Memory is completed is performed.
  After that, the Controller generates the parity and writes the data on the Drive asynchronously.
- Even when a sudden power failure occurs, the Cache Memory stores the data in the Cache Memory to the back up device using a Battery. Battery prevents data loss by providing the power supply until the data store is completed.
- Write-Through is an operation responding to a host computer after writing write data to Drives when the array receives the write data from the host computer. Therefore, the response time of the command to the host computer delays when the array executes the Write-Through.
  The conditions that the array executes the Write-Through are as follows.
  - When the Turbo LU Warning of the system parameter is disable (default) and the array receives the write data in the PIN area
  - When the Write Unique Response Mode of the system parameter is enable (However, the write command for the Volumes of RAID 1 and RAID 1+0 are excluded.)
  - When the forced write through mode of the system parameter is valid and a blockade of the Controller (it is not this condition in the single controller configuration) or a power unit failure occurred
  - When the Cache Backup Battery that can operate normally is lost
  - When a failure occurs in the battery backup circuit (except when the Controller is blocked)
  - When the Battery Charging Write Command in the system parameter is set to Write Through and the Battery capacity is insufficient.

Data flows are shown in Figure 3.3.1.

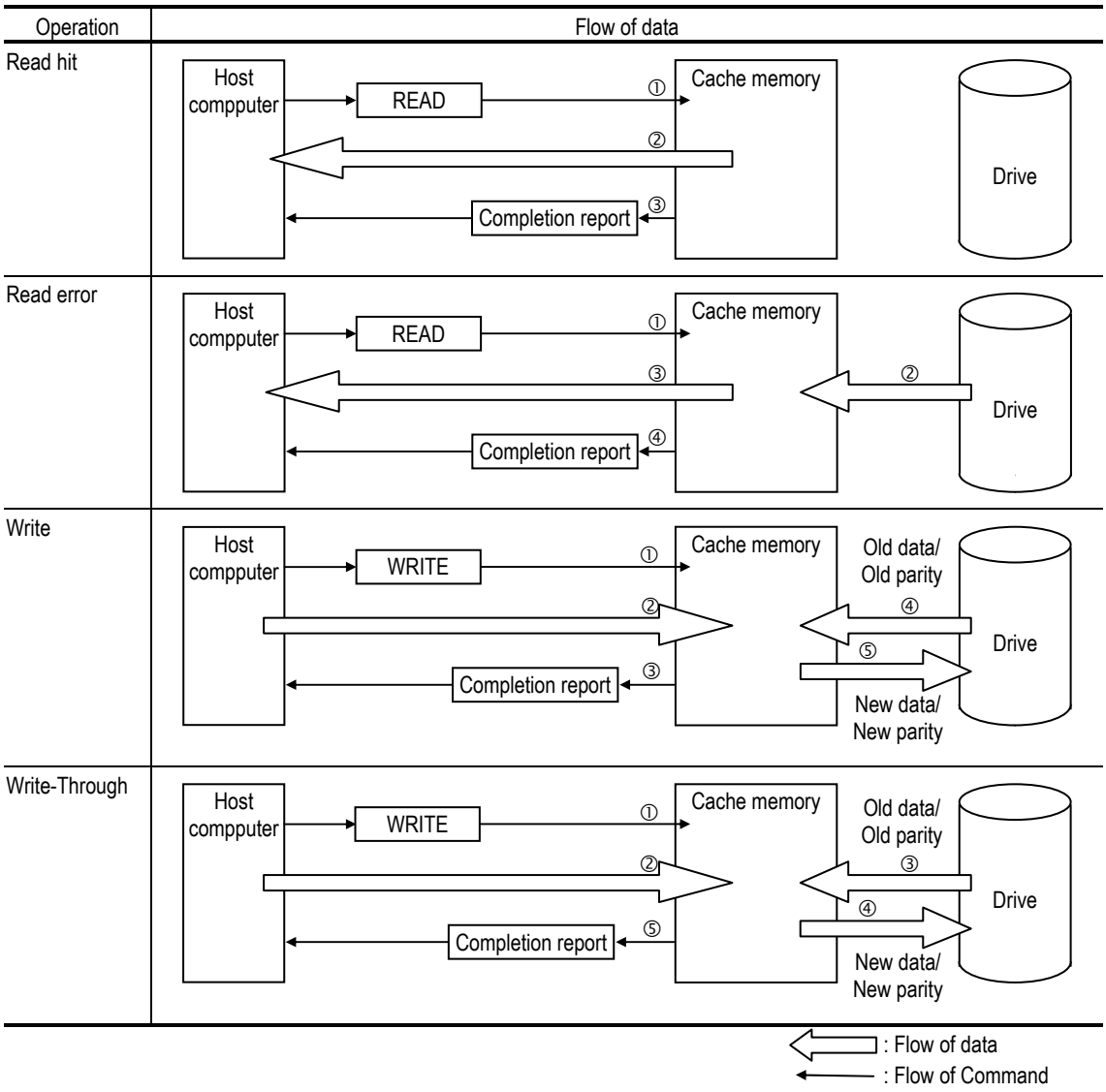


Figure 3.3.1 Flow of Data

3.3.2 Dual System Configuration

(1) Feature of dual system

(a) The flexible system can be configured by installing the two Controllers.
This allows the system configuration tailored to the 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

The Dual Active mode makes the two controllers operate in parallel.
In this system configuration, it internally allocates the Volume in charge to each Controller. However, since the performance is equivalent in the cases where the Controller accesses the Volume not in charge or accesses the Volume in charge, it is usually unnecessary to be conscious of the Controller in charge.
Also, the CPU that executes the processing of the access from the host computer becomes a Controller of which the Volume takes charge. Therefore, the load of the CPU of both Controllers is monitored regularly and when the imbalance occurs, reallocation of the Volume in charge is automatically executed and the imbalance of the CPU load is resolved.

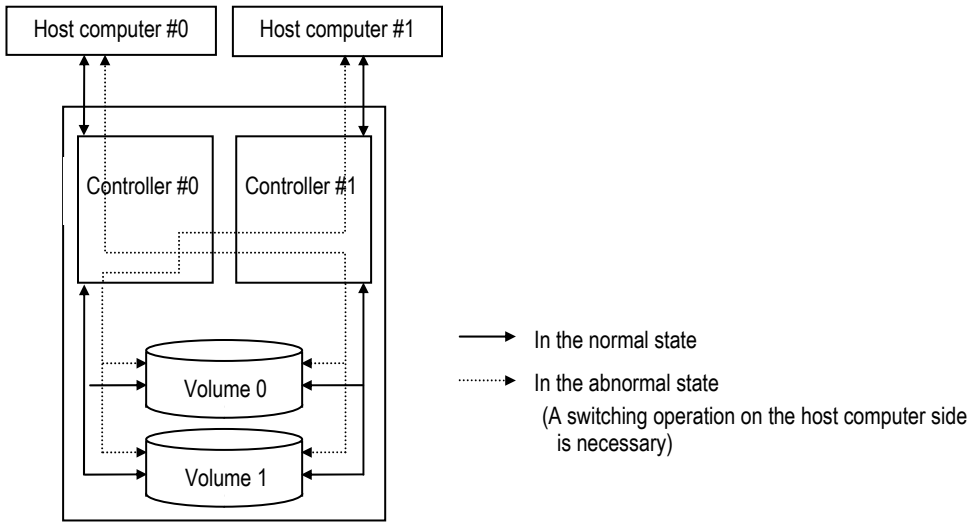


Figure 3.3.2 System Configuration

3.4 Cache Memory Control

3.4.1 Purpose of Cache Memory

(1) Mitigation of the write penalty (overheads for generating the parity which is unique to RAID) that accompanies the write-after operation
The write data received here is nonvolatile with the batteries to prevent the data loss due to the power failure before it is written in the Drive. Also, the write data is double written in the Cache memories of both Controllers, and the data loss can be prevented at the time of a Controller failure by becoming the dual controller configuration (optional).

(2) Speed-up of sequential reading operation by means of pre-fetch
The reading performance is enhanced as follows. The array studies the received commands and when it perceives that it is receiving read commands to read data from continuous addresses, it executes the pre-fetch operation to read the next read data from a Drive before receiving the next read command. Thus the array makes it possible to read from the cache memory when it receives the read command from a host.

(3) Faster sequential write operation
Performance of the sequential write operation is improved through impounding some amount of write data in the Cache memory at the sequential access and destaging it out to an HDD at once.

(4) Achieving the complete Cache read hit by the Cache Residency Manager function
One-hundred percent Cache hit can be realized by the Cache Residency Manager function.
(Refer to "4.1 (7) Cache Residency Manager" (INTR 04-0010).)

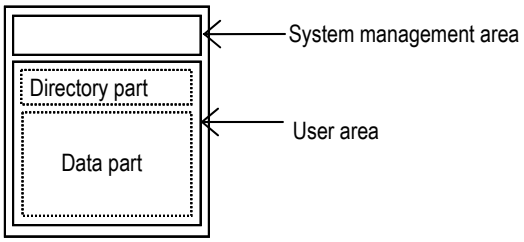
3.4.2 Cache Memory Configuration

The cache memory consists of the following components.

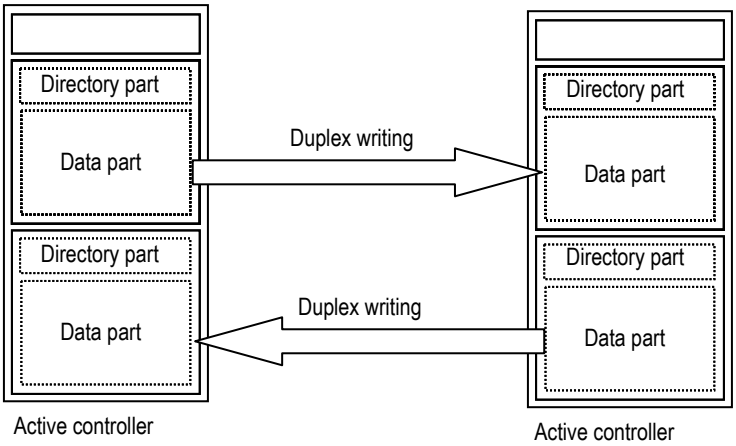
- System management area
- Directory part
- Data part

The Cache Memory configuration corresponding is shown below.

a. For the single controller configuration



b. For the dual controller configuration (in the Dual Active mode)



3.4.3 Cache Memory Structure

(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 part

The data in the Cache memory is controlled by dividing it into the segments with the fixed length of 16 k bytes (a default value). However, when the Cache Partition Manager function is used, the segment length can be changed to 4 k bytes, 8 k bytes, 64 k bytes, 256 k bytes or 512 k bytes.

The minimum unit of data is sub-block (logical block of 512 bytes). When the segment length is 16 k bytes, one segment is 32 sub-blocks. Data storage is done in units of sub-block.

When a command to write data of one logical block (512 bytes) is received, for example, a segment is secured and the received write data is stored in one of the sub-blocks in the segment. The data area is also used as a work area while of the parity generation.

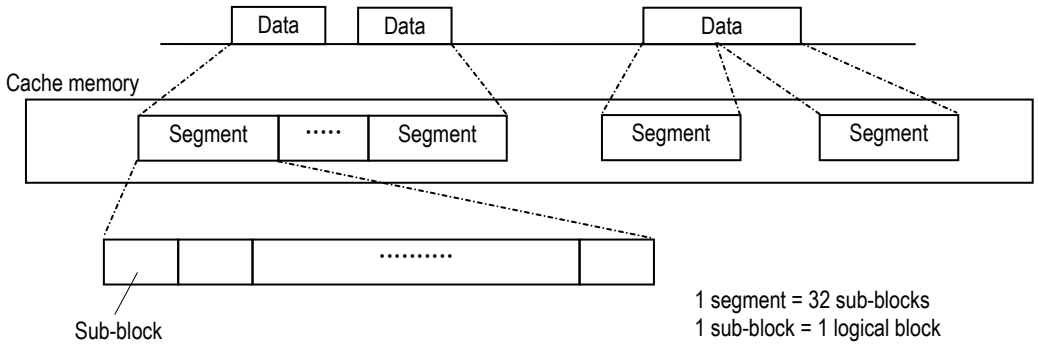


Figure 3.4.1 Data Structure in Cache Memory

(3) Directory part

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.
The hash table stores the segment management information addresses.
When the segment management information is NULL, an error occurs.

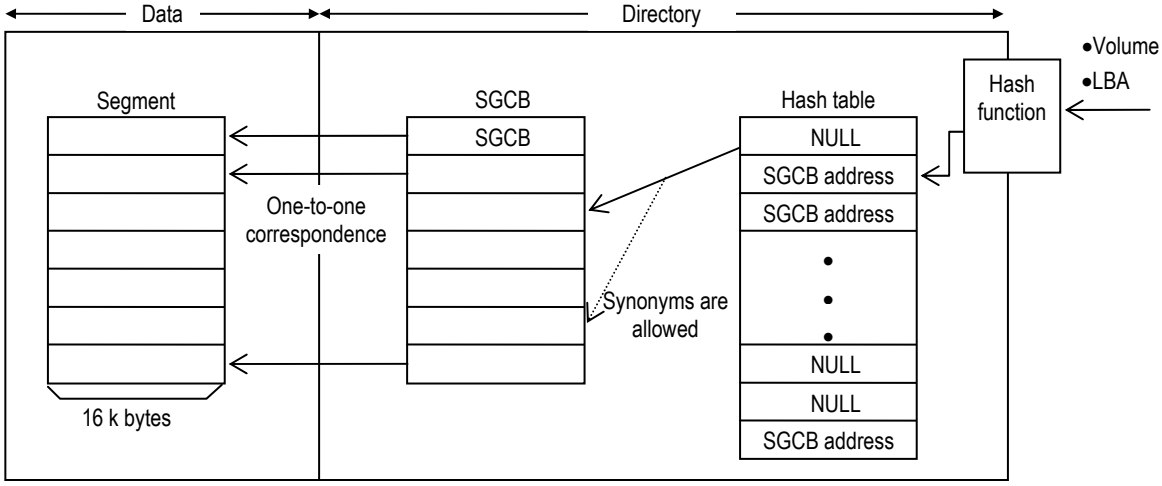
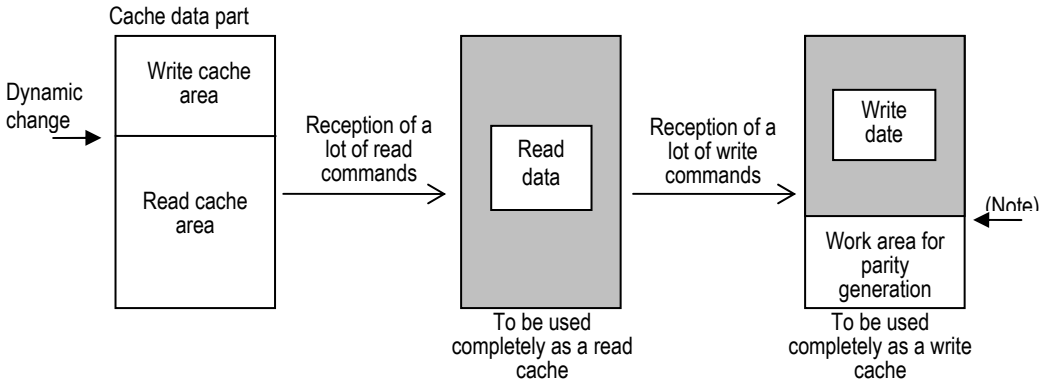


Figure 3.4.2 Control Structure in Cache Memory

3.4.4 Basic Operation of Cache Control

The following dynamic optimizing operation is performed in the cache control.

(1) Dynamic optimization of read/write cache area assignment
The read and write cache areas are not fixed but dynamically assigned according to an I/O instruction from a host.



NOTE : No wider write cache data area than the threshold value is assigned in order to secure the area for parity generation.

(2) Dynamic optimization of destaging algorithm
The optimum destaging algorithm is selected automatically according to a writing pattern given by a host computer. (Refer to Subsection "3.4.5 Destaging Operation" (INTR 03-0210).)

(3) Dynamic optimization of staging algorithm
The optimum staging algorithm is selected automatically through a study of a read command issued by a host computer. (Refer to Subsection "3.4.6 Staging Operation (Writing to the Cache Memory)" (INTR 03-0220).)

3.4.5 Destaging Operation

Write data transferred from a host computer is stored in the cache memory and written to a Drive asynchronously. This operation to write data to a Drive asynchronously is called destaging operation.

In the destaging operation, random and sequential accesses are discriminated and written to a Drive in a way optimum for each of them.

(1) Destaging of random data

Data is destaged in units of LBA. Old data and its parity to be destaged are staged from a Drive.

A new parity is generated from new data, the old data, and the old parity and then the new data and new parity are destaged in units of LBA.

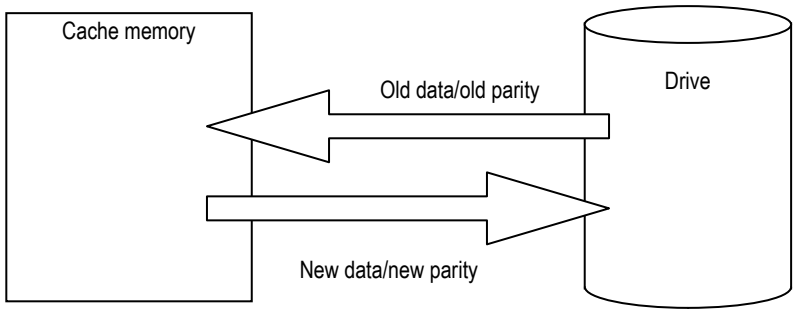


Figure 3.4.3 Destaging of Random Data

(2) Destaging of sequential data

Data is destaged in units of stripe. A new parity is generated from write data, and then new data and the new parity are destaged in units of stripe.

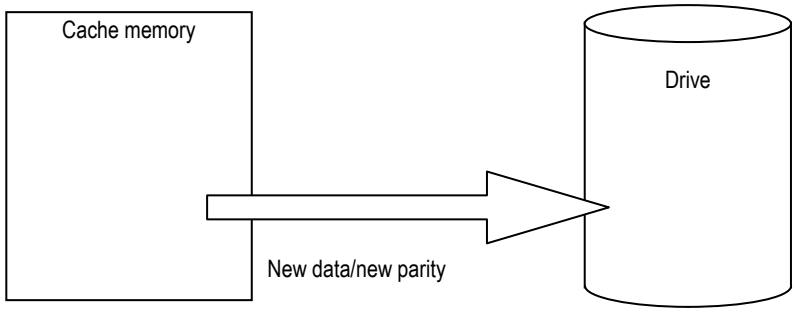


Figure 3.4.4 Destaging of Sequential Data

3.4.6 Staging Operation (Writing to the Cache Memory)

(1) Random reading

For allocating the Cache memory, FIFO (First In First Out) and LRU (Least Recently Used) are selectable, and the most appropriate allocation is performed according to the access pattern to improve the hit rate.

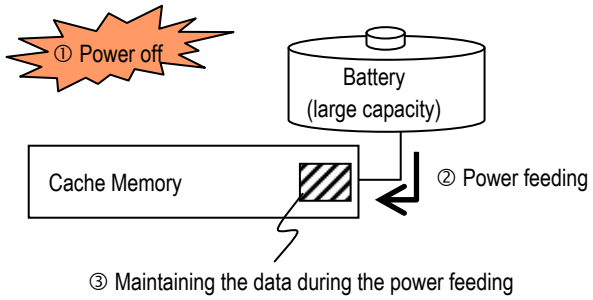
(2) Sequential reading

According to the learning of received commands, in case of a command to read back data from consecutive addresses is received, a pre-fetch read data from the next area of the HDD is performed prior to the following read command. When the following read command is received, the data is read back from the Cache memory, so that the read performance is improved.

3.4.7 Flash Backup Function

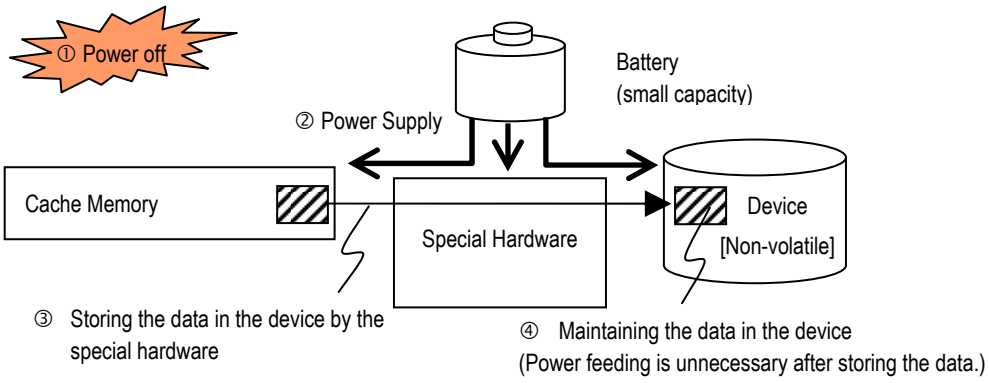
As for the way to protect the data in the Cache Memory during power off, in a new way of flash backup function, the power supply by battery allows to save the data from the volatile Cache Memory to non-volatile backup device and to make the time for data protection almost unlimited.

In the conventional way, after the power has gone off, to maintain the data in the Cache Memory, the power provided by the battery prevents the data volatilization.



The role of battery is for battery backup for Cache Memory and to supply the power so that the self-refresh operation is continuously performed to maintain the data in the Cache Memory.
Therefore, the backup time which can maintain the data is determined by the battery capacity.

In a new way, at the time of power off, storing the data from the Cache Memory to the backup device for store using a special hardware prevents the data volatilization.



The role of battery is to operate the special hardware for data store and supply the power to the special hardware, Cache Memory, and backup device, etc. during power off. After storing the data in the backup device, the power supply becomes unnecessary.
The data protection time is almost unlimited because the data is maintained in the non-volatile backup device.

3.5 E-mail Alert Function

3.5.1 Overview and Restriction

The E-mail alert is a function to send an E-mail of failure information to the previously registered mail address from the built-in Controller in the array when a failure occurs in the array. Since the array sends the E-mail stand-alone in this function, it cannot send the E-mail in the following cases. In the dual controller configuration, even if a failure is detected in both Controllers, the Controller that detects the failure first sends a failure mail and the other one does not send the same mail (deterring dual failure report).

- When the array goes down (Not Ready)
- When the Controller is blocked in the single controller configuration
- When a failure occurs while changing the E-mail setting information (parameter)
- When there is a problem on the communication path such as LAN cable
- When the array is starting/rebooting
- When the E-mail report is deterred (Disable E-mail alert)
- When the E-mail setting information (parameter) is incorrect
- When the DHCP function is enabled and the DHCP server goes down (or does not start)

NOTE :
- In the dual controller configuration, a Controller, which detects the failure first, executes the E-mail report, so that always insert the LAN cables to both Controllers and enable the E-mail alert function. Both Controller #0 and Controller #1 may send the mail.
- Use the Controller #0 side for the setting in the dual controller configuration.
- When many failures occur at the same time in the array, the array cannot send E-mail corresponding to all failures.
- If data loss happens with all data in the cache memory gone due to a problem such as system down and the combination of power outage and battery failure, the setting done from the start of the array to the occurrence of data loss will return to where it was before the start of the array. So it is necessary to check and reconfigure the E-mail Alert setting after maintenance work for a failure that leads to data loss.

3.5.2 Details of Sent Mails

(1) Examples of Sent Mails

The example of the full text of the sent mail is shown below.

The content of the mail consists of “From: header”, “To: header” and “mail text” same as usual mails.

The mail text consists of a failure message and Information Message. The failure message consists of the failure occurrence date, array name, customer’s specific information and failure message, etc. The Information Message displays the failure information and status information (up to 50) that the array detected by the time the mail was sent.

NOTE : When E-mail Alert function becomes effective, the failure information that occurred before becoming effective may be notified.

- Example of mail

```
Tue, Jun. 21 15:44:35 2011/StorageSystem//ARRAY Controller Detached.
Tue, Jun. 21 15:44:35 2011/StorageSystem//ARRAY DeviceType 01.

Timezone : (GMT+09:00) Osaka/ Sapporo/ Tokyo
Hardware serial number : 92000030
Micro program version : Controller 0 = 1910/A-H, Controller 1 = 1910/A-H
Hardware serial number for controller/tray : 92000030
Failed part revision : --
Failed Drive information : --
Drive operation time : --
Drive failed factor information : --
--------------------------------------------------------------------------------
This information is automatically generated.
--------------------------------------------------------------------------------
Array Warning occurred. Please confirm the Alerts window of Hitachi Storage Navigator Modular 2.
The followings are WEB information messages.
--------------------------------------------------------------------------------
06/21/2011 15:44:35 10 W01100 CTL alarm (CTL-0)                          :CTL   /CTRC
```

(2) Details of the Sent Mail Format

The details of the header and text format, which configure the mail, are shown below.

No.	Item	Description	Purpose
1	Automatic processing information	Mail transmission time (day, month, date, hour, minute, second, year)	For running customer information and failure information
2		Model of array (“StorageSystem” fixed)	
3		Additional mail information (settable (settable only in Hitachi Storage Navigator Modular 2” maintenance mode) (63 alphanumeric numbers or less)	
4		Details failure message	
5	Time zone	Time zone set in array	
6	Array serial number	Array serial number	
7	The version downgrade of the firmware	Firmware version of each Controller	
8	Serial number of the failed tray	Serial number of the failed tray	
9	Revision of failed part	ENC firmware revision or drive firmware revision	
10	Failed drive information	Manufacturer name, product ID, firmware revision, drive serial number	
11	Drive operation time	Total time of drive operation	
12	Cause information of drive failure	64-byte information from internal trace data	Failure analysis
13	Fix message to end users	Message to press end users to refer to the HSMN2 alert window	Same as left-mentioned
14	Web messages	Most recent Web messages (50)	Failure analysis

(3) List of Failure Report Messages

No.	Failure factor	Failure message(*1) (△: One-byte space, ↓: Linefeed code)	Remarks
1	Controller failure	ARRAY△Controller△Detached.↓ ARRAY△DeviceType△ZZ.	–
2	Battery failure	ARRAY△Battery△Alarm.↓ ARRAY△DeviceType△ZZ.	–
3	FAN failure	ARRAY△Fan△Alarm.↓ ARRAY△DeviceType△ZZ.	–
4	Power Unit failure	ARRAY△ACDC△Power△Supply△△Failure.↓ ARRAY△Unit△No.XX△Box△No.YY.↓ ARRAY△Power△Supply△Type△V.↓ ARRAY△DeviceType△ZZ.	XX : Unit # (“00”-“27”) (*2) YY : Power Unit # (“00”-“01”) (XX is displayed with a hexadecimal number of 2 digits) V : Power Unit type 0:AC 1:DC
5	Drive failure	ARRAY△Drive△Detached.↓ ARRAY△Detached△Drive△Position△Unit△No.XX△HDU△No.YY.↓ ARRAY△Drive△Type△WW.↓ ARRAY△DeviceType△ZZ.	XX : Unit # (“00”-“27”) YY : Drive # (“00”-“53”) (XX and YY are displayed with a hexadecimal number of 2 digits) WW : Drive type (3HGSS, 3HGSSH, 6HGSS, 9HGSS, 2TNL, 3TNL, 2TNX, 3TNX, 3TNW, 4TNL, 4TNX, 4TNW, 2HGDM, 4HGDM, 8HGDM, 2HGDML, 4HGDML, 8HGDML, 3HGSLH, 9HGSL, 12HGSS)
6	Spare Drive failure	ARRAY△Drive△Detached.↓ ARRAY△Detached△Drive△Position△Unit△No.XX△HDU△No.YY.↓ ARRAY△Drive△Type△WW.↓ ARRAY△DeviceType△ZZ.	XX : Unit # (“00”-“27”) YY : Drive # (“00”-“53”) (XX and YY are displayed with a hexadecimal number of 2 digits) WW : Drive type (3HGSS, 3HGSSH, 6HGSS, 9HGSS, 2TNL, 3TNL, 2TNX, 3TNX, 3TNW, 4TNL, 4TNX, 4TNW, 2HGDM, 4HGDM, 8HGDM, 2HGDML, 4HGDML, 8HGDML, 3HGSLH, 9HGSL, 12HGSS)
7	I/O Module(ENC) or I/O Card(ENC) failure	ARRAY△ENC△Alarm.↓ ARRAY△Unit△No.XX△ENC△No.YY.↓ ARRAY△ENCType△W.↓ ARRAY△DeviceType△ZZ.	XX :Unit # (“00”-“27”) YY : I/O module (ENC) or I/O card (XX is displayed with a hexadecimal number of 2 digits) (ENC) # (“00”-“01”) W : ENC type 0 : ENC for DBS and DBL 1 : ENC for DBX 2 : ENC for DBW 3 : ENC for DBF Z :ENC is unknown

*1 : ZZ : CBL : “01”, CBSS : “02”, CBSL : “03”, CBXSS : “04”, CBXSL : “05”, DBS : “0A”, DBL : “0B”, DBX : “0C”, DBW : “0D”, DBF : “0E”, When array types are unknown : “0F”

*2 : In case of failure of CBL, the unit # is shown as “FF”

No.	Failure factor	Failure message (△: One-byte space, ↓: Linefeed code)	Remarks
8	UPS failure	ARRAY△UPS△Failure.↓ ARRAY△DeviceType△ZZ.	–
9	Host Connector failure	ARRAY△HostConnector△Alarm.↓ ARRAY△DeviceType△ZZ.	–
10	Cache Memory failure	ARRAY△Cache△Memory△Alarm.↓ ARRAY△Memory△Type△Y.↓ ARRAY△DeviceType△ZZ.	Y : Memory type (4GB, 8GB)
11	Host I/O Board failure	ARRAY△Interface△Board△Alarm.↓ ARRAY△InterfaceType△YY.↓ ARRAY△DeviceType△ZZ.	YY : Host I/O Board type 00 : Not installed 40 : FC 8G – 4 ports 22 : 10G-iSCSI 12 : 1G-iSCSI
12	Host I/O Module failure	ARRAY△Host△IO△Module△Alarm.↓ ARRAY△Host△IO△Module△Type△YY.↓ ARRAY△DeviceType△ZZ.	YY : Host I/O Module type 20 : FC 4 ports 02 : iSCSI 2 ports 03 : FCoE 2 ports 99 : Collection by types is impossible 00 : None
13	Drive I/O Module failure	ARRAY△Drive△IO△Module△Alarm.↓ ARRAY△Drive△IO△Module△Type△YY.↓ ARRAY△DeviceType△ZZ.	YY : Drive I/O Module type 05 : Drive I/O module (SAS6G) 2 ports 99 : Collection by types is impossible 00 : None
14	Management Module failure	ARRAY△Management△Module△Alarm.↓ ARRAY△Management△Module△Type△YY.↓ ARRAY△DeviceType△ZZ.	YY : Management Module type 04 : LAN 2 ports 99 : Collection by types is impossible 00 : None
15	Side Card blockade	ARRAY△Side△Card△Alarm. ARRAY△Unit△No.XX△Side△Card△Y. ARRAY△DeviceType△ZZ	XX :Unit # (“00”-“04”) (XX is displayed with a hexadecimal number of 2 digits) YY : Side card type/Installation location (Y is displayed with a hexadecimal number of 1 digit) 0 : Side Card-A-U 1 : Side Card-B-U 2 : Side Card-A-L 3 : Side Card-B-L F :Type is unknown
16	Controller pseudo blockade (The controller concerned becomes inaccessible from the host and the management program because the controller operation stops.)	ARRAY△CTL△failure△by△related△parts△alarm.↓ ARRAY△DeviceType△ZZ.	–

ZZ : CBL : “01”, CBSS : “02”, CBSL : “03”, CBXSS : “04”, CBXSL : “05”, DBS : “0A”, DBL : “0B”, DBX : “0C”, DBW : “0D”, DBF : “0E”, When array types are unknown : “0F”

No.	Failure factor	Failure message (△: One-byte space, ↓: Linefeed code)	Remarks
17	A path blockade failure between the arrays	ARRAY△Path△Alarm.↓ ARRAY△RemoteArray△UUUUUUUU.↓ ARRAY△DeviceType△ZZ.	UUUUUUUU : Logical Array Serial Number
18	Arrays Warning	ARRAY△Warning.↓ ARRAY△DeviceType△ZZ.	–
19	Over threshold value of HDP pool early alert	ARRAY△Pool△Consumed△Capacity△Early△Alert△Pool△number△XX.↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
20	Over threshold value of HDP pool depletion alert	ARRAY△Pool△Consumed△Capacity△Depletion△Alert△Pool△number△XX.↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
21	HDP Pool deletion	ARRAY△Pool△Consumed△Capacity△Over△Pool△number△XX.↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
22	Over threshold value of over provisioning ratio forewarning	ARRAY△Pool△Over△Provisioning△Warning△Pool△number△XX.↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
23	Over threshold value of over provisioning ratio overwarning	ARRAY△Pool△Over△Provisioning△Limit△Pool△number△XX.↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
24	Capture port error count alert for CTL0	ARRAY△Port△Error△Threshold△Over.↓ ARRAY△DeviceType△ZZ.	–
25	Capture port error count alert for CTL1	ARRAY△Port△Error△Threshold△Over.↓ ARRAY△DeviceType△ZZ.	–
26	Cycle time threshold value over failure	ARRAY△TrueCopy△Extended△Distance△Cycle△Time△Threshold△Over.↓ ARRAY△DeviceType△ZZ.	–
27	Replication depletion alert	ARRAY△Replication△Depletion△Alert△Pool△number△XX.↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
28	Replication data open	ARRAY△Replication△Data△Released△Pool△number△XX. ↓ ARRAY△DeviceType△ZZ.	XX : DP Pool # (00-63) (XX is displayed with a decimal number of 2 digits)
29	The write count of the Flash Drive (SSD) reached the threshold value of the endurance count	ARRAY△SSD△Write△Count△Early△Alert.↓ ARRAY△DeviceType△ZZ.↓	–
30	Power Unit (DC) Filter Replacement Request	ARRAY△Please△replace△the△Air△Filter△of△Bezel. ARRAY△DeviceType△ZZ.	–
31	Report test	Test△message	–
32	Tray power saving PDU connection error alert	ARRAY△Tray△Power△Saving△PDU△connection△error.↓ ARRAY△DeviceType△ZZ.	ZZ : Tray type
33	CTL0 Tray power saving health check error alert	ARRAY△Tray△Power△Saving△health△check△error△CTL△No.0.↓ ARRAY△DeviceType△ZZ.	ZZ : Tray type
34	CTL1 Tray power saving health check error alert	ARRAY△Tray△Power△Saving△health△check△error△CTL△No.1.↓ ARRAY△DeviceType△ZZ.	ZZ : Tray type

ZZ : CBL : “01”, CBSS : “02”, CBSL : “03”, CBXSS : “04”, CBXSL : “05”, DBS : “0A”, DBL : “0B”, DBX : “0C”, DBW : “0D”, DBF : “0E”, When array types are unknown : “0F”

No.	Failure factor	Failure message (△: One-byte space, ↓: Linefeed code)	Remarks
35	The Drive mounting location error has occurred in the DBW	ARRAY△HDU△Mounting△Alarm. ↓ ARRAY△Unit△No.XX. ↓ ARRAY△DeviceType△ZZ.	XX and ZZ are displayed with a hexadecimal number of 2 digits.
36	HDT page relocation failure warning	ARRAY△Page△Relocation△Failed. ↓ ARRAY△DeviceType△ZZ. ↓	–
37	The write count of the Flash Drive (FMD) reached the threshold value of the endurance count.	ARRAY△FMD△Write△Count△Early△Alert. ↓ ARRAY△DeviceType△ZZ.	–
38	The battery life ratio of the Flash Drive (FMD) reached the threshold value of the battery life ratio.	ARRAY△FMD△battery△Early△Alert.△ ↓ ARRAY△DeviceType△ZZ.	–

ZZ : CBL : “01”, CBSS : “02”, CBSL : “03”, CBXSS : “04”, CBXSL : “05”, DBS : “0A”, DBL : “0B”, DBX : “0C”, DBW : “0D”, DBF : “0E”, When array types are unknown : “0F”

3.6 Operation against Drive Failure

(1) I/O operation against Drive failure

In the array with the RAID1, RAID5, or RAID1+0 configuration, even when a failure occurs in one Drive and data cannot be read from it, the target data can be recovered by means of using data on the other normal Drives.

In the case of RAID1 and RAID1+0, data on the mirror Drive is used, and in the case of RAID5, data on the other Drive on the same stripe is used. By means of these measures, even when a Drive failure occurs, reading/writing can be done as before.

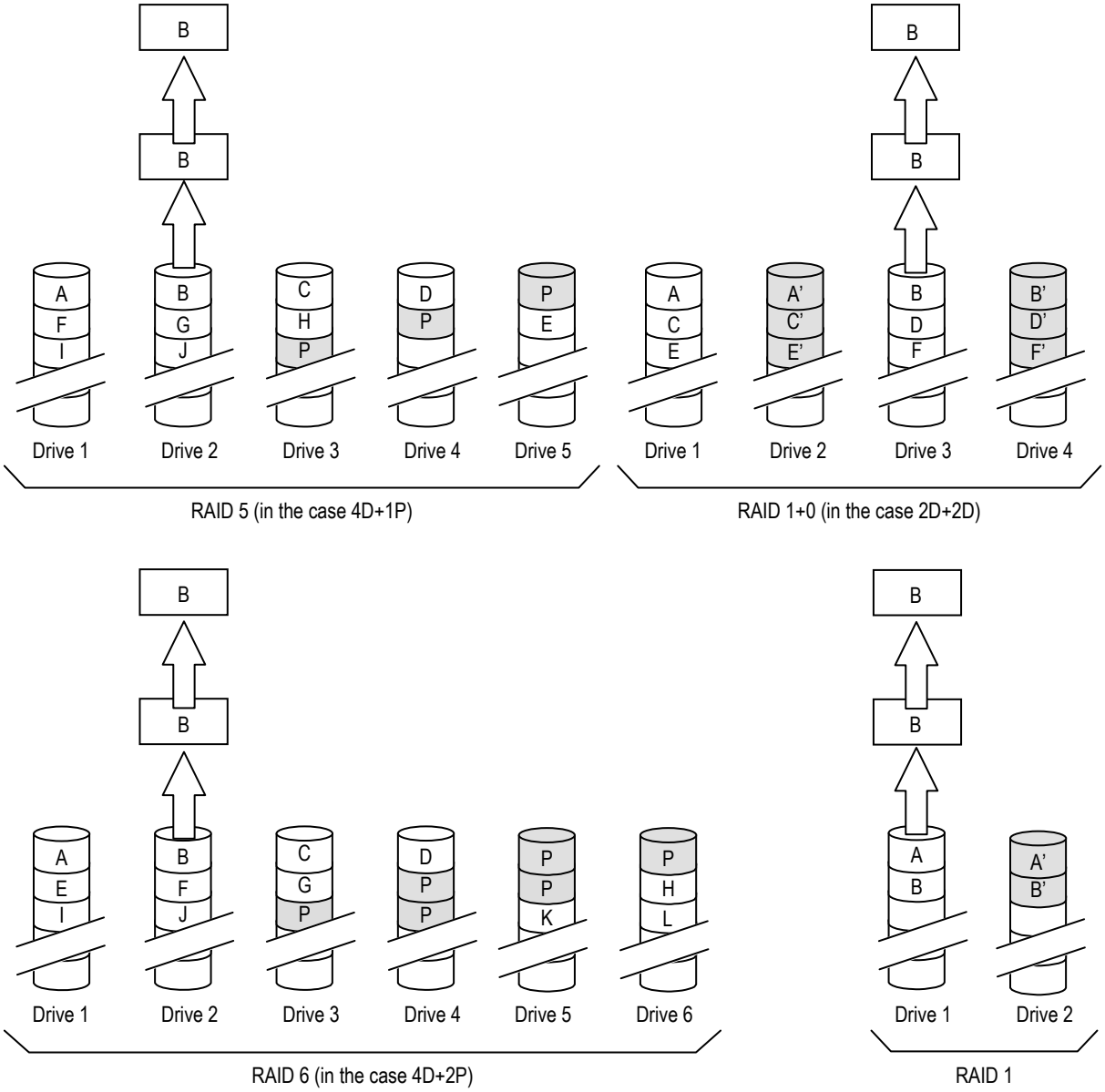
Even when failures occur in two Drives at the same time and reading from them becomes impossible, the RAID 6 configuration can restore the data concerned utilizing data stored in normal Drives.

In the RAID 6 configuration, each Drive utilizes data in the other Drives in the same stripe. If failures occur in two Drives, reading/writing can be done in the same way as before the failures by virtue of the above.

Figure 3.6.2 shows the outline of the data reading operation performed when a Drive failure occurs.

Data B reading request

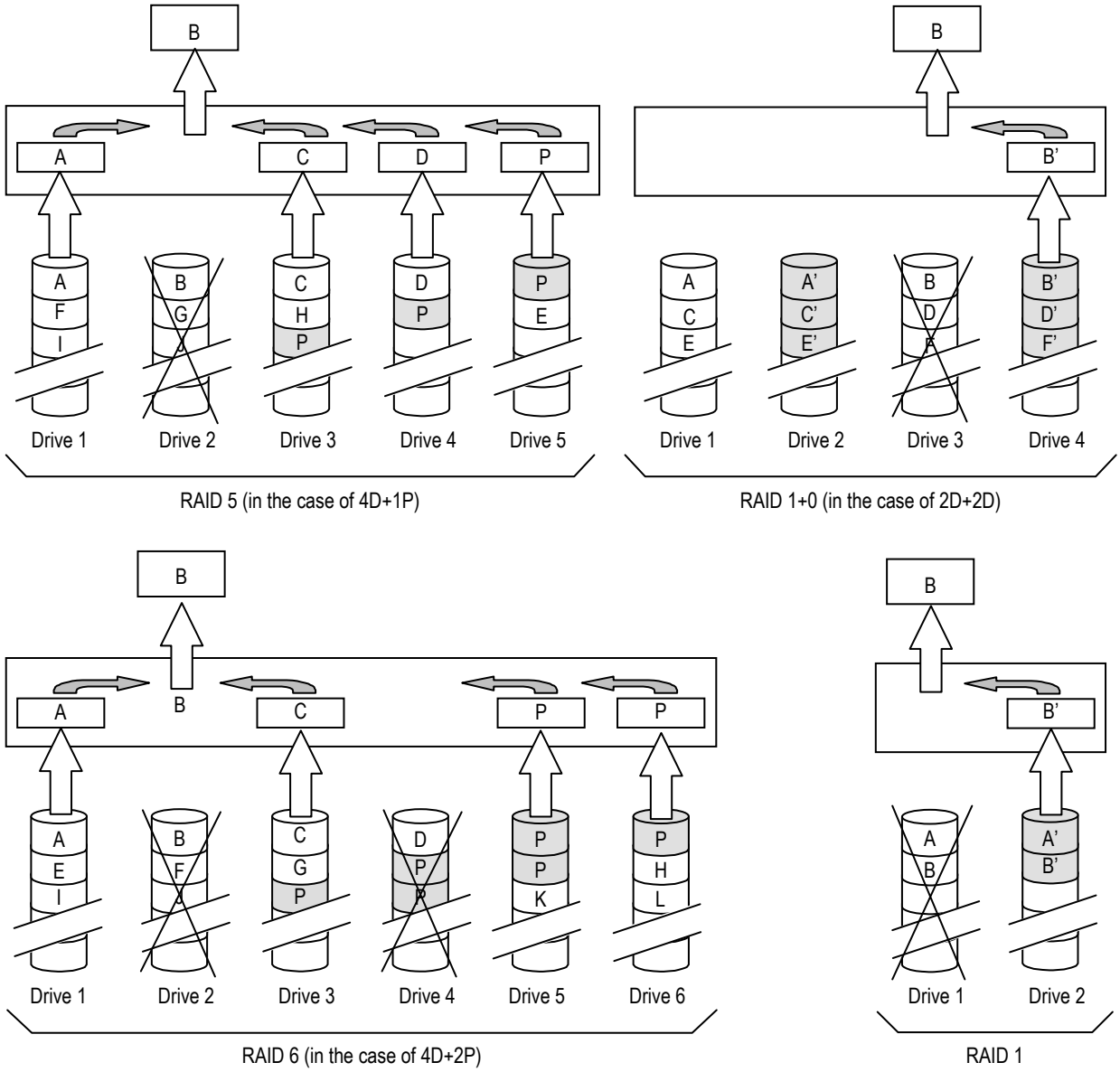
(a) Data B read request



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

Figure 3.6.1 Data Reading Operation when Drive is Normal

(b) When a Drive failure occurs



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

Figure 3.6.2 Data Reading Operation when a Drive Failure Occurs

(2) Data assurance when a Drive failure occurs

The array can have a Spare Drive (s) optionally. Data on a Drive which is blocked owing to its failure or a Drive in which the number of error occurrences has exceeded the specified value is automatically reconstructed on the Spare Drive.

The data to be copied on the Drive to restructure data in the Spare Drive is the data on the Volume which a Volume format is already completed.

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 Drive is replaced, the data saved on the Spare Drive is copied to the new Drive.

The data recovery processing to the Drive of the Dynamic sparing function, Correction copy function and Copy back function operates to one Drive. After the data recovery to one Drive is completed, the data recovery is started to another Drive. Also, these three functions do not operate at the same time but operate in the order of ① Correction copy function, ② Copy back function, and ③ Dynamic sparing function. For example, when two Drives are blocked in the RAID Group with the RAID level 6, the Correction copy function does not recover the data of the two failed drives at the same time, but recovers one Drive at a time.

(a) Dynamic sparing

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

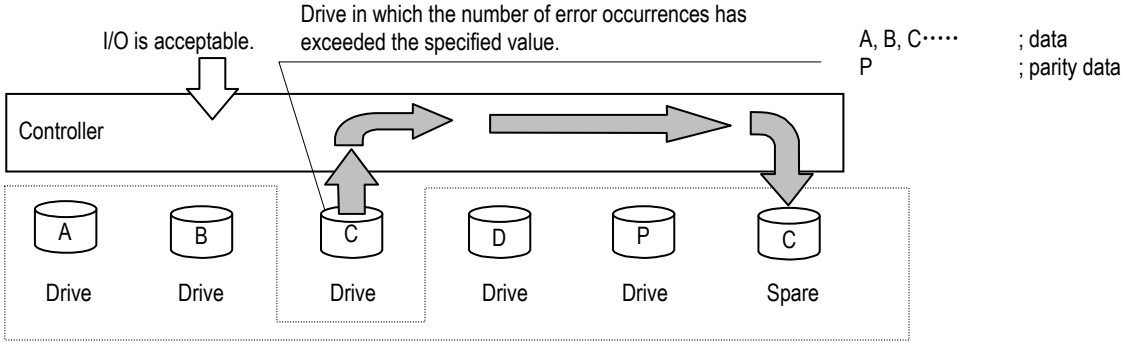


Figure 3.6.3 Dynamic Sparing

(b) Correction copy

In the array with the RAID 5 and RAID 6 configuration, when a failure occurs in a Drive and data reading/writing from on it cannot be done, the data on the failed Drive is restored using those on the other data Drives and the parity Drive, and then copied onto the Spare Drive. In the array with the RAID 1 or RAID 1+0 configuration, when the same situation as above occurs, data on the mirror Drive is copied onto the Spare Drive. In the RAID 0 configuration, the correction copy cannot be done.

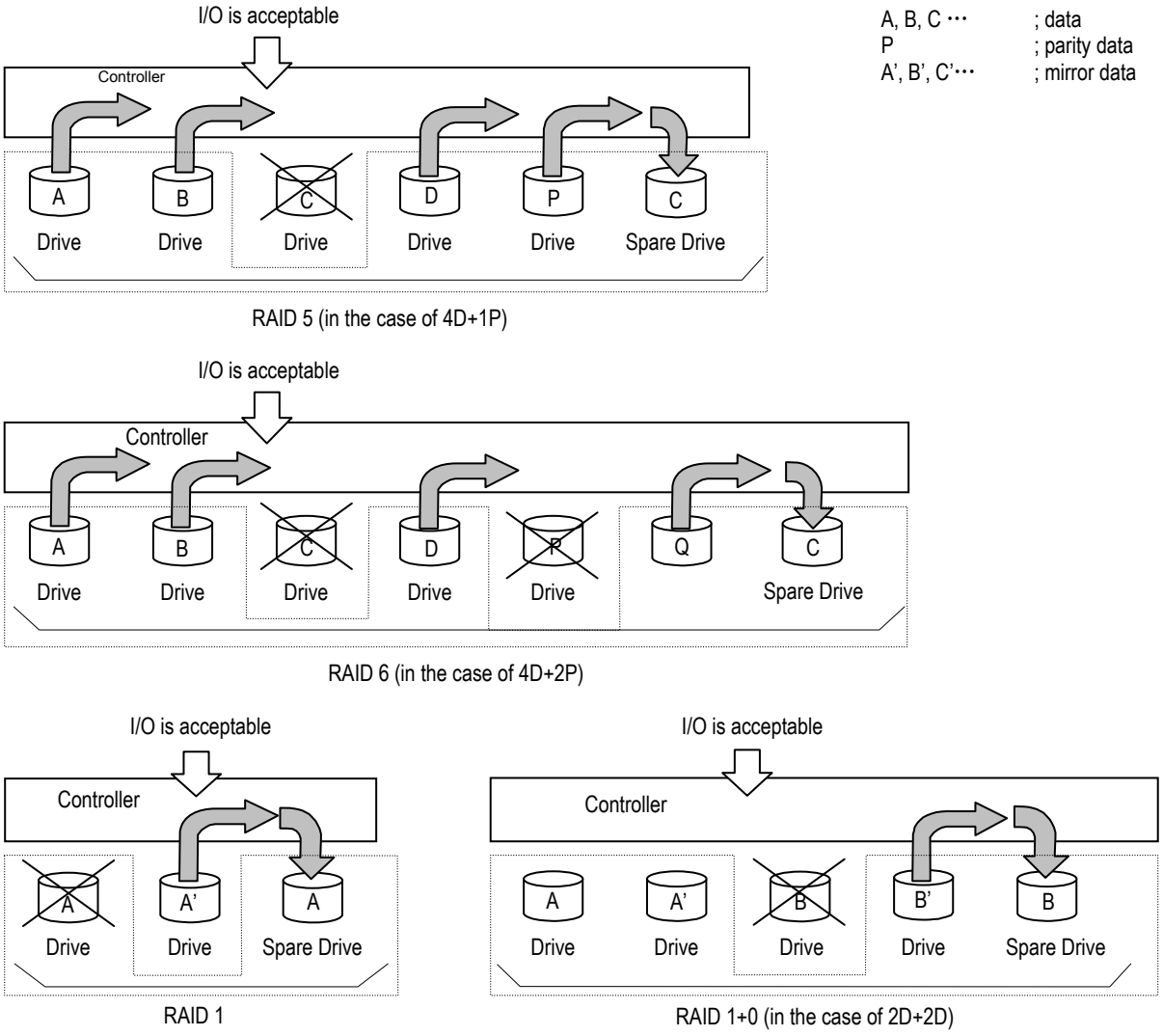


Figure 3.6.4 Correction Copy

(3) Operation after replacing the failed Drive

Copy back is the processing returned to the original status by copying the data in the Spare Drive to the replaced Drive after replacing the failed Drive when the data is reconstructed in the Spare Drive by the dynamic sparing or the correction copy.

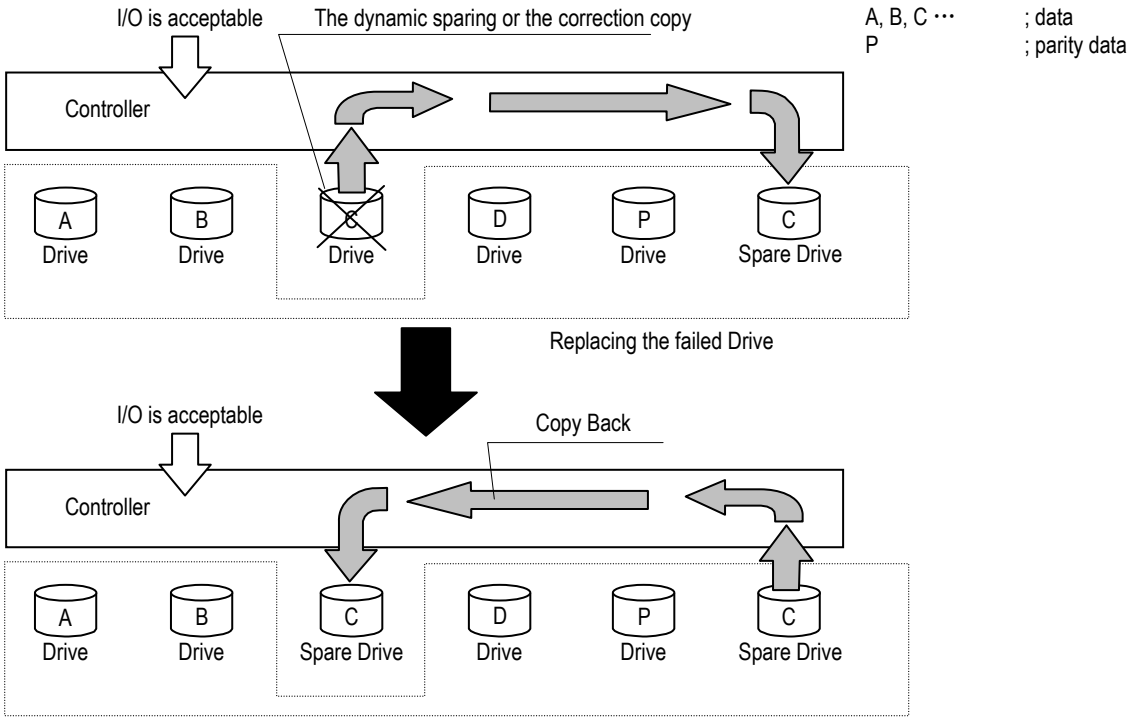


Figure 3.6.5 Copy Back

The Copy back may or may not operate depending on the relationship among the setting value of “Spare Drive Operation Mode”, the Spare Drive which recovered the data, and the failed Drive.

The setting value of “Spare Drive Operation Mode” and the operation specification are shown in Table 3.6.1.

Table 3.6.1 Setting of "Spare Drive Operation Mode" and the Operation Specification (SAS Drive)

The first parameter (Spare Drive Operation Mode)	Operation specification
Fixing (Fixed)	If the failed Drive is replaced, the data saved in the Spare Drive is copied back to the replaced Drive. (Refer to Figure 3.6.6.) The location of the Drive which configures the RAID Group never changes from the time of creating the RAID Group. Therefore, this parameter is set when fixing the location of the Drive which configures the RAID Group.
Variable (Variable) (*1) (*2) (*3) (This is set in default.)	Although the dynamic sparing or the correction copy is completed, the data saved in the Spare Drive is not copied to the replaced Drive if the capacity and the rotational speed of the failed Drive and the Spare Drive which recovered the data are the same. The copy backless operates because the replaced Drive becomes a new Spare Drive. (Refer to Figure 3.6.7.) In the following case, the copy backless does not operate, and the copy back surely operates after replacing the failed Drive. •- When the capacity or the rotational speed of the failed Drive and the Spare Drive which recovered the data differs

*1 : If the Power Saving function is enabled, copy back is performed in the following four cases even if Spare Drive Operation Mode has been set to the default mode, which is copy back less.
Furthermore, the operation differs depending on whether the firmware version is more than or equal to 0940/A or less than 0940/A. (In the version of 0970/A or more, a Flash Drive operates according to the Spare Drive Operation Mode setting.)

License key status			Target Spare Drive			
		Source data drive	Less than 0940/A		0940/A or more	
			System drive	Non system drive	System drive	Non system drive
Power Saving/ Power Saving Plus	Enable	System drive	As specified	As specified	As specified	As specified
		Non system drive	As specified	As specified	As specified	As specified
	Disable	System drive	Copy back	As specified	As specified	Copy back
		Non system drive	Copy back	As specified	Copy back	As specified

* : System drives correspond to Drives #0 to #4 in CBSS/CBSL/CBSXS/CBXSL, Drives #0 to #4 of Unit ID#0 in DBS/DBL/DBW/DBF connected to CBL, or Drives #A0 to #A4 in DBX, Drives #0 to #4 of Unit ID#0 in DBSD/DBLD connected to CBLD.

(The copy-back operates for maintaining the power saving status that can be changed in the version less than 0940/A. The specification changed to remedy the problems such as the useless copy-back operation among system drives and the biased Spare Drives for the system drives.)

*2 : If operated by the copy-back-less setting, the Drive positions which configure the RAID group are replaced due to the Drive failure restoration. In the Power Saving/Power Saving Plus functions, depending on the Drive positions which configure the RAID group, even if the RAID groups have the same RAID level and the number of Drives, the spinup time from the power saving status may differ. Therefore, if the RAID group is configured considering the spinup time from the power saving status, it is recommended to set it to the copy-back mode.

*3 : If the Drive restoration to the Spare Drive operates between the Drives of CBSL/DBL/DBX and DBW at the time of the Drive failure restoration of the RAID group executes the power saving instruction of the I/O interlock enables, the copy-back-less function does not operate and the copy-back function operates surely after replacing the Drives. (In case the firmware version is 0940/A or more.)

(3-1) When "Spare Drive Operation Mode" is fixed

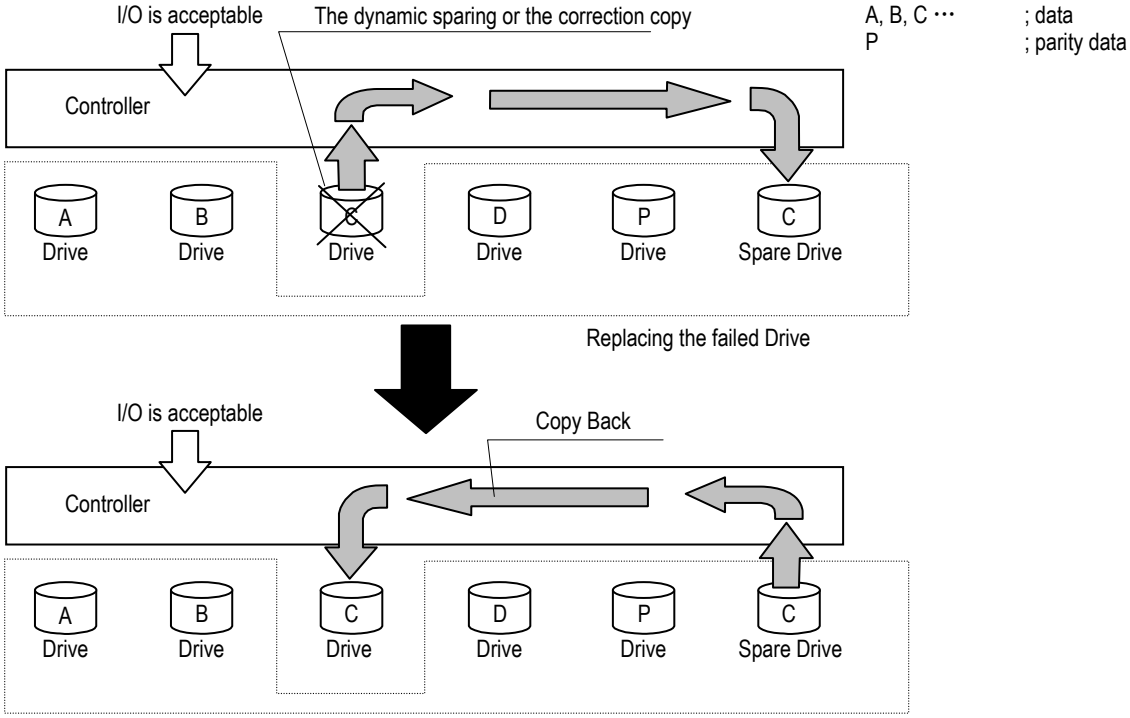


Figure 3.6.6 Copy Back

(3-2) When "Spare Drive Operation Mode" is variable

(a) When the rotational speed and the capacity of the failed Drive and the Spare Drive are the same, if the Drive restoration (dynamic sparing or correction copy) is completed, the copy backless operates.

The copy back does not operate even if the failed Drive is replaced.

NOTE : • If the Power Saving function is enabled, copy back is performed in the following four cases even if Spare Drive Operation Mode has been set to the default mode, which is copy back less.

Furthermore, the operation differs depending on whether the firmware version is more than or equal to 0940/A or less than 0940/A. (In the version of 0970/A or more, a Flash Drive operates according to the Spare Drive Operation Mode setting.)

License key status			Target Spare Drive			
		Source data drive	Less than 0940/A		0940/A or more	
			System drive	Non system drive	System drive	Non system drive
Power Saving/ Power Saving Plus	Enable	System drive	As specified	As specified	As specified	As specified
		Non system drive	As specified	As specified	As specified	As specified
	Disable	System drive	Copy back	As specified	As specified	Copy back
		Non system drive	Copy back	As specified	Copy back	As specified

* : System drives correspond to Drives #0 to #4 in CBSS/CBSL/CBSXS/CBXSL, Drives #0 to #4 of Unit ID#0 in DBS/DBL/DBW/DBF connected to CBL, or Drives #A0 to #A4 in DBX, Drives #0 to #4 of Unit ID#0 in DBSD/DBLD connected to CBLD.

(The copy-back operates for maintaining the power saving status that can be changed in the version less than 0940/A. The specification changed to remedy the problems such as the useless copy-back operation among system drives and the biased Spare Drives for the system drives.)

- If operated by the copy-back-less setting, the Drive positions which configure the RAID group are replaced due to the Drive failure restoration. In the Power Saving/Power Saving Plus functions, depending on the Drive positions which configure the RAID group, even if the RAID groups have the same RAID level and the number of Drives, the spinup time from the power saving status may differ. Therefore, if the RAID group is configured considering the spinup time from the power saving status, it is recommended to set it to the copy-back mode.
- If the Drive restoration to the Spare Drive operates between the Drives of DBW and DBL at the time of the Drive failure restoration of the RAID group executes the power saving instruction of the I/O interlock enables, the copy-back-less function does not operate and the copy-back function operates surely after replacing the Drives. (In case the firmware version is 0940/A or more.)

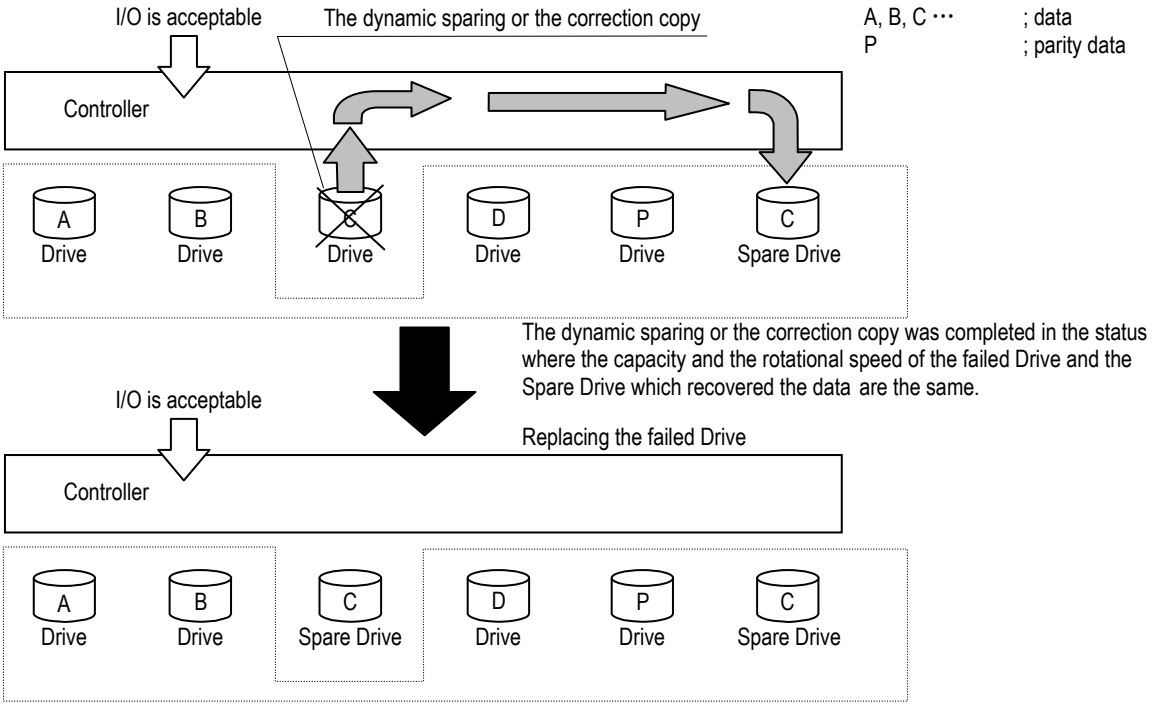


Figure 3.6.7 Copy Backless

(b) When the rotational speed and the capacity of the failed Drive and the Spare Drive differ, the copy backless does not operate at the time of completing the Drive restoration (dynamic sparing or correction copy), and the copy back operates after replacing the failed Drive.

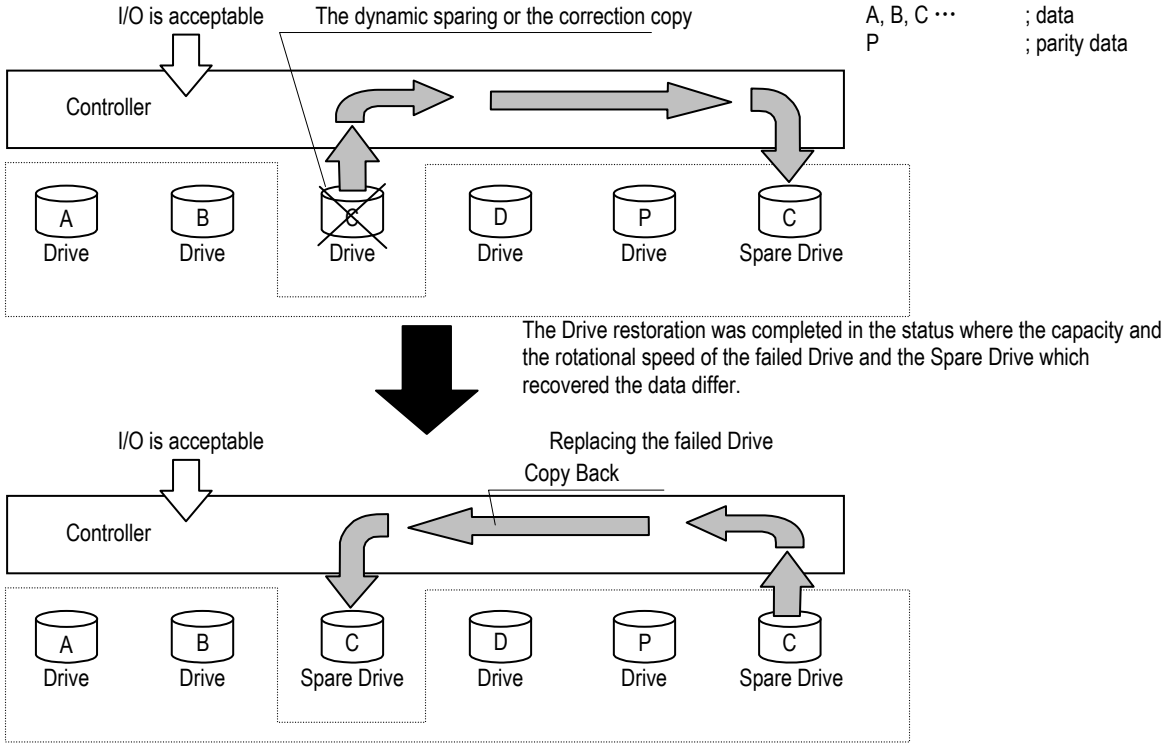


Figure 3.6.8 Copy Back

(c) The combination of the failed Drive and Spare Drive which causes the copy backless

The Copy backless operates depending on the types of the failed Drive and Spare Drive, the relation between the rotational speed and capacity of the failed Drive and Spare Drive. The relation between the failed Drive and Spare Drive is shown in Table 3.6.2, Table 3.6.3 and Table 3.6.3.1.

Table 3.6.2 Availability of the Copy Backless Operation between the SAS Drives of the CBSS/DBS

Attribute				Spare Drive		
	Array			CBSS/DBS		
Failed Drive (SAS)	CBSS/DBS	Capacity [G bytes]		300	600	900
			Rotational speed [min^{-1}]	10,000/ 15,000	10,000	10,000
		300	10,000/15,000	○	×	×
		600	10,000	–	○	×
		900	10,000	–	–	○

○ : Copy backless
× : Copy back
– : The Drive restoration does not operate.

Table 3.6.3 Availability of the Copy Backless Operation between the SAS7.2K Drives of the CBSL/DBL/DBX/DBW

Attribute				Spare Drive (SAS7.2K)		
	Array			CBSL/DBL/DBX/DBW		
Failed Drive (SAS7.2K)	CBSL/DBL/DBX/ DBW	Capacity [G bytes]		2,000	3,000	4,000
			Rotational speed [min^{-1}]	7,200	7,200	7,200
		2,000	7,200	○	×	×
		3,000	7,200	–	○	×
		4,000	7,200	–	–	○

○ : Copy backless
× : Copy back
– : The Drive restoration does not operate.

Table 3.6.3.1 Availability of the Copy Backless Operation between the Flash Drives of the CBSS/DBS

Attribute			Spare Drive		
	Array		CBSS/DBS		
Failed Drive (Flash Drive)	CBSS/DBS	Capacity [G bytes]	200	400	800
		200	○	×	×
		400	–	○	×
		800	–	–	○

○ : Copy backless
× : Copy back
– : The Drive restoration does not operate.

(4) Method for selecting a Spare Drive

When data is restored to a Spare Drive in the case where two or more Spare Drives are installed, the Spare Drive is selected according to priorities of the following items.

Table 3.6.4 Priorities of the restoration to a Spare Drive

Priority item	Description	Degree of priority
Drive type	It is judged which Drive type the Drive that requires restoration is of SAS, S-ATA, SAS7.2K or Flash Drive and only a drive of the same type is used.	High ↑
Model name	A Spare Drive with the same model name as the Drive to be restored is used preferentially.	↑
Drive capacity	A Spare Drive with the same capacity as a RAID group to be restored is used preferentially. When a Drive with the same capacity does not exist, a Drive with the most approximate and larger capacity is selected preferentially. (If the capacity of the Spare Drive is less than that of the target Drive, the Spare Drive cannot be used.)	↑
Rotational number	A Spare Drive with the same rotation number as the Drive that requires restoration is used preferentially.	↑
Drive reliability	A Spare Drive with the same reliability as the Drive to be restored (operation hour per month assured by the vendor (330 hours per month, 720 hours per month)) is used preferentially.	↑
Other than system drive(*1)	When the Power Saving/Power Saving Plus is enabled, use the Spare Drive other than the system drive(*1) preferentially. (In the version of 0970/A or more, when the recovery target Drive is a Flash Drive, it is outside the above operation target.)	↑
Backend path	A Spare Drive in the same backend path as the Drive to be restored is used preferentially.	↓ Low
The order of definition	A Spare Drive is used preferentially in the order Spare Drives were defined.	-

*1 : System drives correspond to Drives #0 to #4 in CBSS/CBSL/CBSXS/CBXSL, Drives #0 to #4 of Unit ID#0 in DBS/DBL/DBW/DBF connected to CBL, or Drives #A0 to #A4 in DBX, Drives #0 to #4 of Unit ID#0 in DBSD/DBLD connected to CBLD.

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 DF850 is shown in the table below.

Table 3.7.1 Range of Supported RAID Levels

No.	RAID level	Supported range			Remarks
		CBXSL/CBXSS+DBL/DBS	CBSL/CBSS + DBL/DBS	CBL + DBL/DBS	
1	RAID 0	2D to 16D	2D to 16D	2D to 16D	The stripe size is 256 k bytes in default. It can be changed to 64 k bytes or 512 k bytes.
2	RAID 1	1D+1D	1D+1D	1D+1D	
3	RAID 5	2D+1P to 15D+1P	2D+1P to 15D+1P	2D+1P to 15D+1P	
4	RAID 6	2D+2P to 28D+2P	2D+2P to 28D+2P	2D+2P to 28D+2P	
5	RAID 1+0	2D+2D to 8D+8D	2D+2D to 8D+8D	2D+2D to 8D+8D	

(2) Selection of Drives

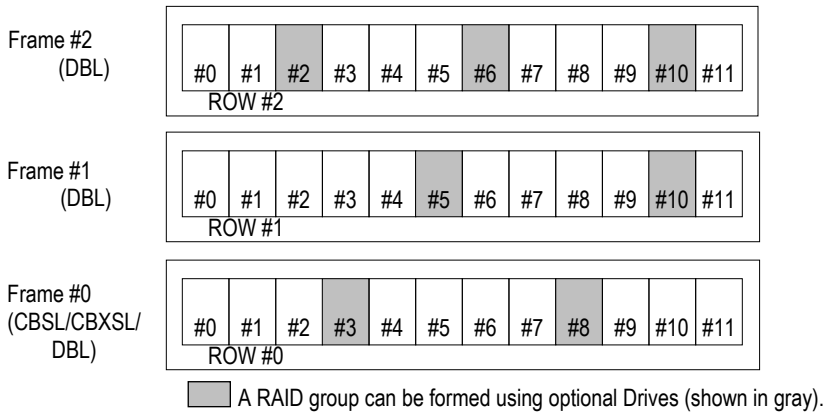
Drives for a RAID group

RAID Group can be created by selecting either a SAS, a SAS7.2K or a Flash Drive which is not set to Spare Drive or RAID Group and not blocked.

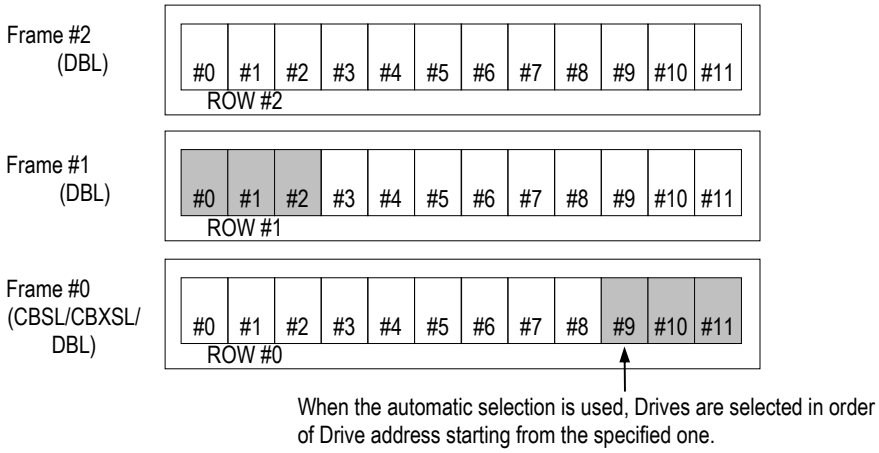
When selecting Drives that configure RAID Group manually, it is recommended to continuously select a Drive (either a SAS, a SAS7.2K or a Flash Drive which is not set to RAID Group or Spare Drive and not blocked) in the Controller Box or Drive Box by Hitachi Storage Navigator Modular 2.

When using the automatic selection, the Drives for the RAID width (number of Drives in the parity group) × depth (number of parity groups) are allocated from the specified first Drive by the numerical order (in ascending order) in device # order as the RAID Group configuration.

(2-1) Selection of optional Drives



(2-2) Automatic selection



(3) User data area

All the 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 Drive is the specified Drive capacity from which the system area capacity is subtracted and rounded with 0x0800.

Expression:

User data size = ((LAST LBA + 1) - Data portion beginning LBA) & 0xFFFFF800

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

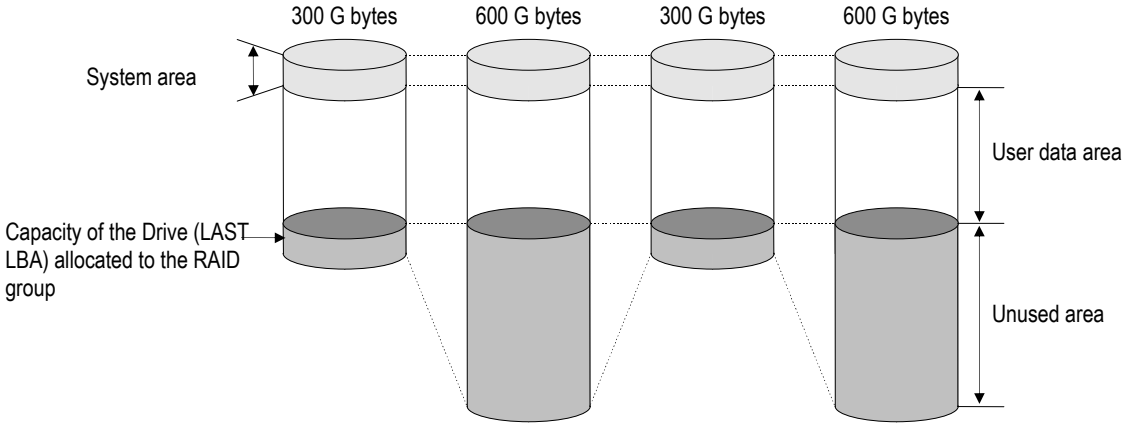
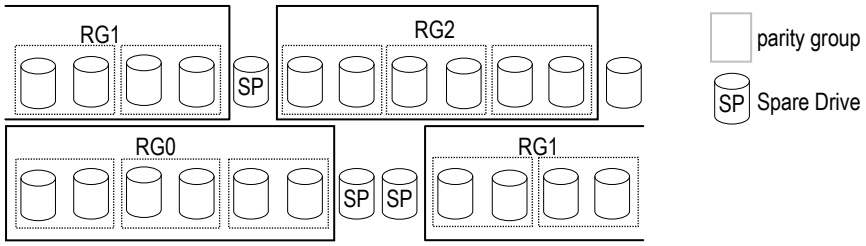


Figure 3.7.1 User Data Area

(4) Image of RAID group definition for each RAID level

(a) RAID 0

• In the case of 2D

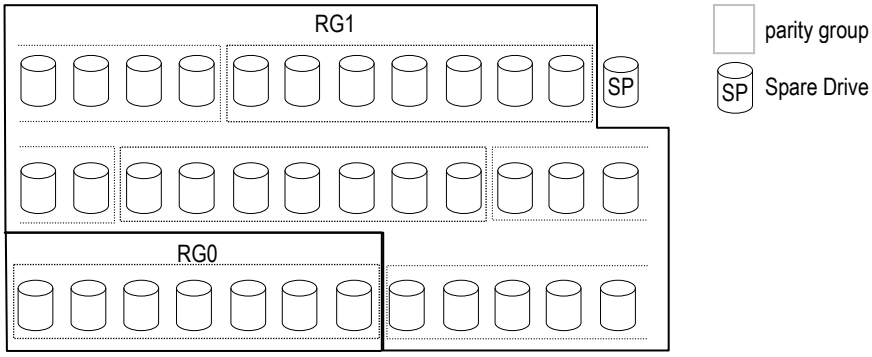


RG0 : Number of the Drive in the parity group = 2
Number of parity groups = 3

RG1 : Number of the Drive in the parity group = 2
Number of parity groups = 4

RG2 : Number of the Drive in the parity group = 2
Number of parity groups = 5

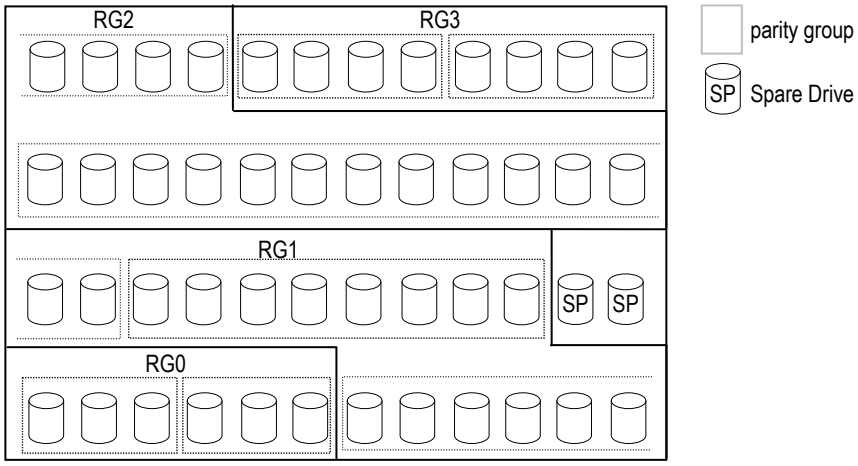
• In the case of 7D



RG0 : Number of the Drive in the parity group = 7
Number of parity groups = 1

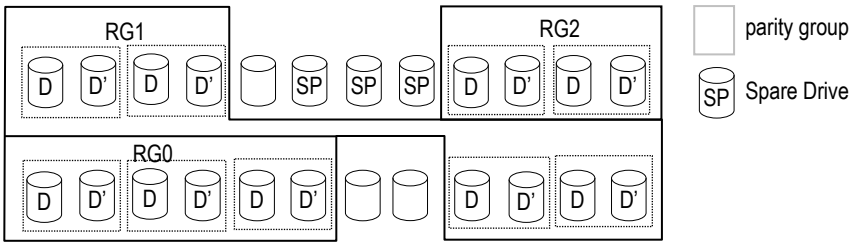
RG1 : Number of the Drive in the parity group = 7
Number of parity groups = 4

• In the case of 2D to16D



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

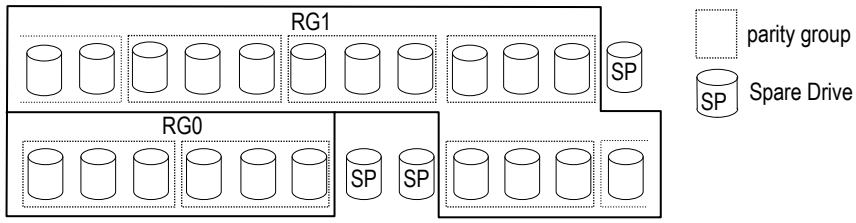
(b) RAID 1



RG0 : Number of the Drive in the parity group = 2
Number of parity groups = 3
RG1 : Number of the Drive in the parity group = 2
Number of parity groups = 4
RG2 : Number of the Drive in the parity group = 2
Number of parity groups = 2

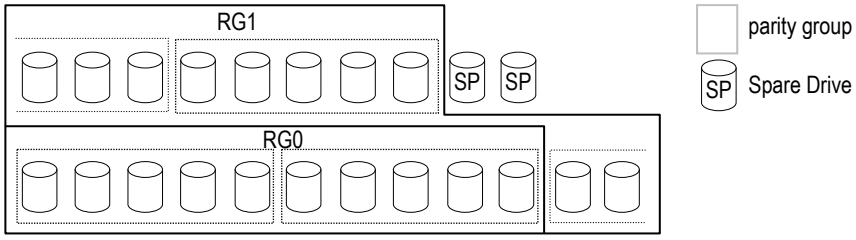
(c) RAID 5

- In the case of 2D + 1P



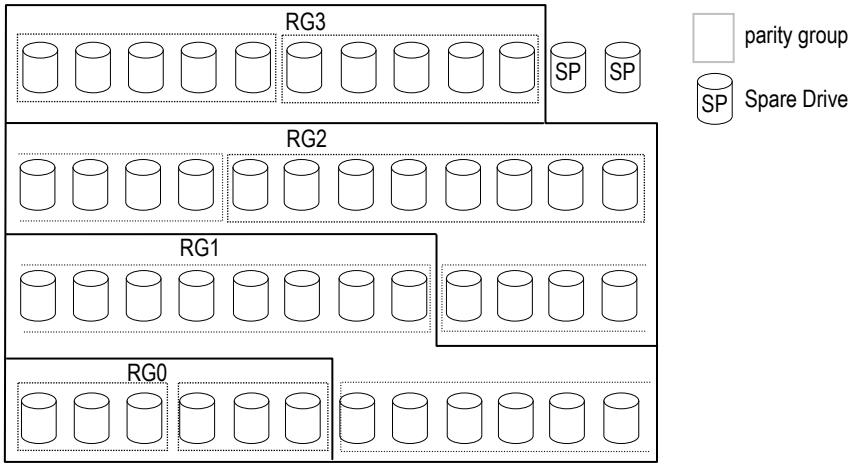
RG0 : Number of the Drive in the parity group = 3
Number of parity groups = 2
RG1 : Number of the Drive in the parity group = 3
Number of parity groups = 5

- In the case of 4D + 1P



RG0 : Number of the Drive in the parity group = 5
Number of parity groups = 2
RG1 : Number of the Drive in the parity group = 5
Number of parity groups = 2

• In the case of 2D + 1P to 15D + 1P



RG0 : 2D + 1P Number of the Drive in the parity group = 3
Number of parity groups = 2

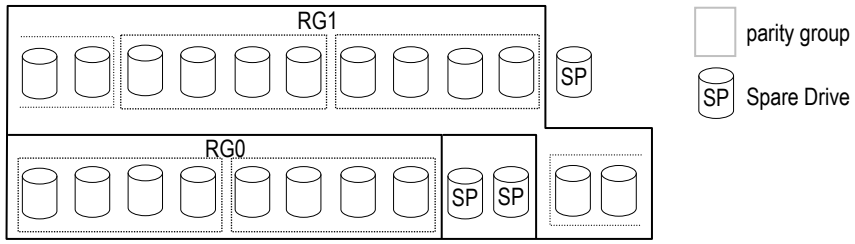
RG1:13D + 1P Number of the Drive in the parity group = 14
Number of parity groups =1

RG2: 7D + 1P Number of the Drive in the parity group = 8
Number of parity groups = 2

RG3: 4D + 1P Number of the Drive in the parity group = 5
Number of parity groups = 2

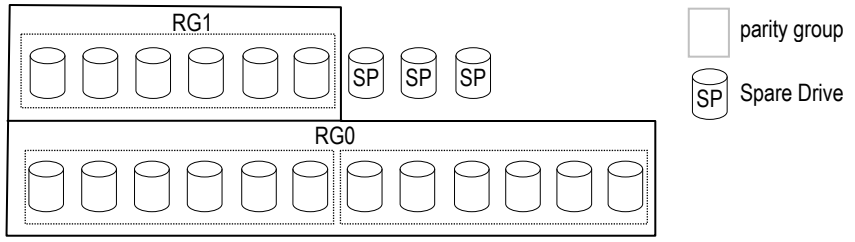
(d) RAID 6

- In the case of 2D + 2P



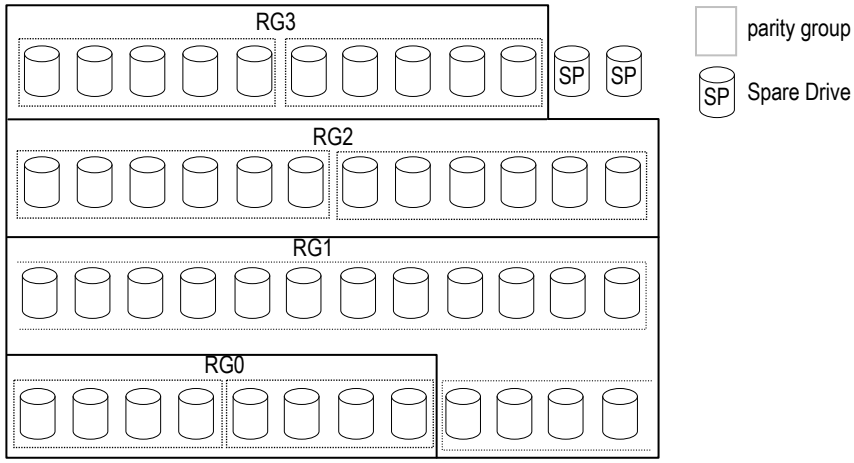
RG0 : Number of the Drive in the parity group = 4
Number of parity groups = 2
RG1 : Number of the Drive in the parity group = 4
Number of parity groups = 3

- In the case of 4D + 2P



RG0 : Number of the Drive in the parity group = 6
Number of parity groups = 2
RG1 : Number of the Drive in the parity group = 6
Number of parity groups = 1

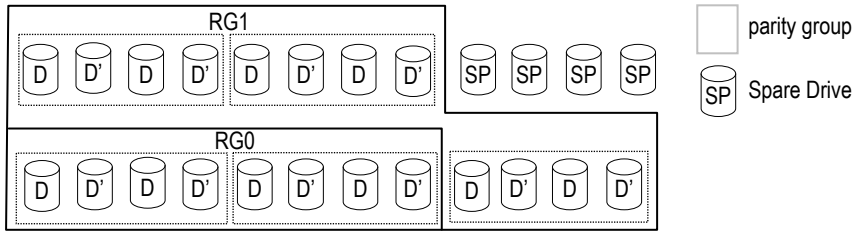
- In the case of 2D + 2P to 28D + 2P



RG0 : 2D + 2P Number of the Drive in the parity group = 4
Number of parity groups = 2
RG1:14D + 2P Number of the Drive in the parity group = 16
Number of parity groups =1
RG2: 4D + 2P Number of the Drive in the parity group = 6
Number of parity groups = 2
RG3: 3D + 2P Number of the Drive in the parity group = 5
Number of parity groups = 2

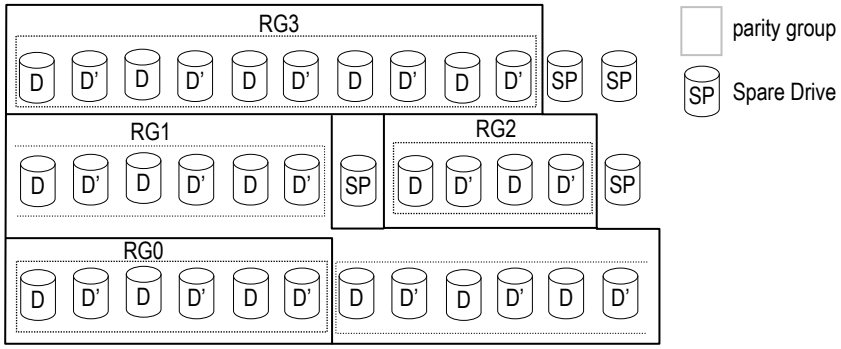
(e) RAID 1+0

- In the case of 2D + 2D



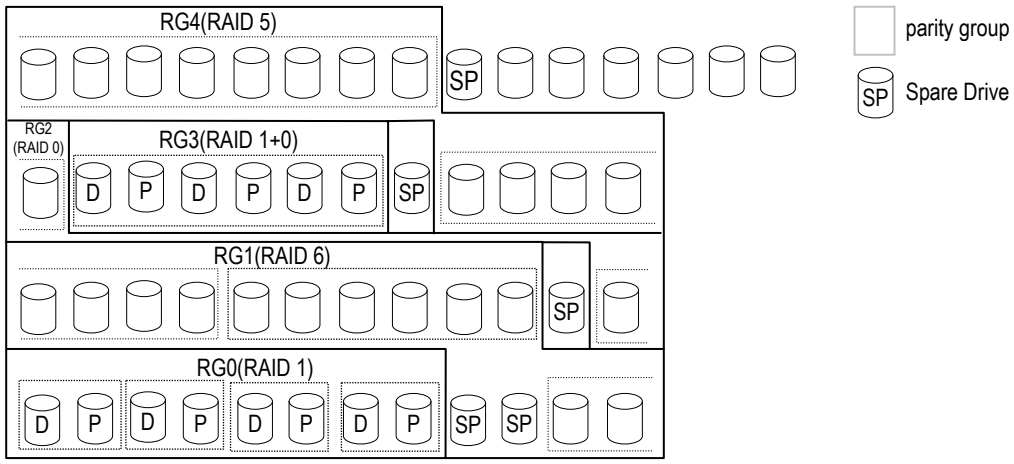
RG0 : Number of the Drive in the parity group = 4
Number of parity groups = 2
RG1 : Number of the Drive in the parity group = 4
Number of parity groups = 3

- In the case of 2D + 2D to 8D + 8D



RG0 : 3D + 3D Number of the Drive in the parity group = 6
Number of parity groups = 1
RG1 : 6D + 6D Number of the Drive in the parity group = 12
Number of parity groups = 1
RG2 : 2D + 2D Number of the Drive in the parity group = 4
Number of parity groups = 1
RG3 : 5D + 5D Number of the Drive in the parity group = 10
Number of parity groups = 1

(f) In the case where RAID levels coexist



RG0 (RAID 1) :1D+1D Number of the Drive in the parity group = 2
Number of parity groups = 4

RG1 (RAID 6) : 4D + 2P
Number of the Drive in the parity group = 6
Number of parity groups = 2

RG2 (RAID 0) : 2D
Number of the Drive in the parity group = 2
Number of parity groups = 1

RG3 (RAID 1+0) : 3D + 3D
Number of the Drive in the parity group = 6
Number of parity groups = 1

RG4 (RAID 5) : 11D + 1P
Number of the Drive in the parity group = 12
Number of parity groups = 1

3.8 Online Verify

(1) Outline of Function

The online verify function executes verification of the Drive medium surface, detects a Drive medium fault, and recovers the data by reassignment to prevent an occurrence of data loss caused by a Drive medium fault.

(2) Online Verify Specification

Check results of the online verify for each state of the check object and action against error are shown in Table 3.8.1.

Table 3.8.1 Check Results and Action Against the Error According to the State of the Check Object (1/2)

Check object	Volume state		Check results	Retry	Action against error
RAID-0	Volume undefined		Correctable error, uncorrectable error	Yes (*1)	The alternate sector is assigned.
			Hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.)
	Volume defined	Unformatted	Correctable error, uncorrectable error	Yes (*1)	The alternate sector is assigned.
			Hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.)
		Normal/ blocked	Correctable error	Yes (*2)	The alternate sector is assigned, and the writing is performed. (*3)
			Uncorrectable error, hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.)

*1 : Retry one time by the VERIFY command.

*2 : When there is staging data or no data on the cache, retry two times by the READ command. When there is dirty data, pin data, or write incomplete data on the cache, retry two times by the VERIFY command. When errors occur in both retries, recover the data. If there is no error in both retries, it is treated as normal.

*3 : (a) If the data recovery fails, ignore the faulty sector and go to the next LBA.
(b) Even if the alternate sector assignment fails, execute the recovery data write & verify function. When returned due to sector exhaustion, block the corresponding drive and go to the next drive.
(c) If the write & verify of the recovered data fails, leave the recovered data as dirty data and go to the next LBA.

Table 3.8.1 Check Results and Action against the Error According to the State of the Check Object (2/2)

Check object	Volume state		Check results	Retry	Action against error
RAID 1/1+0/ 5/6	Volume undefined		Correctable error, uncorrectable error	Yes (*1)	The alternate sector is assigned.
			Hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.) (*4)
	Volume defined	Unformatted	Correctable error, uncorrectable error	Yes (*1)	The alternate sector is assigned.
			Hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.)(*4)
		Normal/ blocked	Correctable error, uncorrectable error	Yes (*2)	The data is restored, the alternate sector is assigned, and the writing is performed. (*3)
			Hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.) (*4)
RAID undefined	Volume undefined		Correctable error, uncorrectable error	Yes (*1)	The alternate sector is assigned.
			Hardware error, other errors	None	Ignore the error and continue the processing. (The test is continued from the next LBA. At this time, the Drive is not blocked.) (*4)
System area	–		Correctable error, uncorrectable error, hardware error, other errors	None	Blocked system area. Immediately after the blockade, the system area is recovered by the automatic operation of the system copy.

*1 : Retry one time by the VERIFY command.

*2 : When there is staging data or no data on the cache, retry two times by the READ command. When there is dirty data, pin data, or write incomplete data on the cache, retry two times by the VERIFY command. When errors occur in both retries, recover the data. If there is no error in both retries, it is treated as normal.

*3 : (a) If the data recovery fails, ignore the faulty sector and go to the next LBA.
(b) Even if the alternate sector assignment fails, execute the recovery data write & verify function. When returned due to sector exhaustion, block the corresponding drive and go to the next drive.
(c) If the write & verify of the recovered data fails, leave the recovered data as dirty data and go to the next LBA.

*4 : Error count is managed. (When this error occurs at a Drive twice within 24 hours, the Drive is blockaded in case of redundant composition.)

(3) Online Verify Starting Timing

The online verify function is active from becoming ready to scheduled stop. The online verification execution position is managed per drive and the start of the online verification after being READY is resumed from the position when the planned shutdown was normally performed last time. When the online verify is completed to the last LBA of the Drive, the online verify is resumed from the Drive head LBA. The operation of the online verification can be set to disable or enable by the Hitachi Storage Navigator Modular 2.

However, the online verify does not work during the copy operation of ShadowImage in-system replication or TrueCopy remote replication whose Copy pace is set to the "Fast".

(4) Online Verify by Dual Controller

In the dual controller configuration, the controller 0 takes charge of the even number Chassis (Controller Box, Drive Box #2, 4, 6 …), and the controller 1 takes charge of the odd number Chassis (Drive Box #1, 3, 5 …).

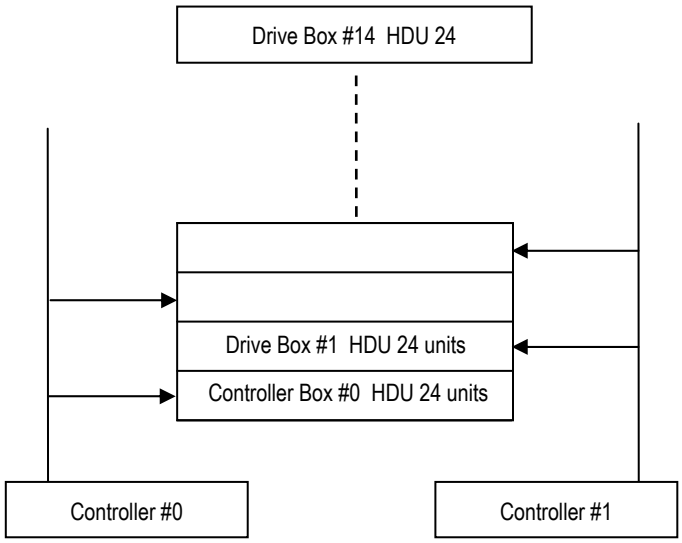


Figure 3.8.1 Online Verify by Dual Controller

(5) Online verification time of Drives

Table 3.8.2 shows the standard of time required for the online verification from the head LBA to the last LBA of the support Drives.

Table 3.8.2 Standard of Time Required for Online Verification of Support Drives

Drive type	Capacity	Online verification time
Flash Drive	200 GB	35 hours
	400 GB	70 hours
	800 GB	140 hours
SAS	300 GB	52 hours
	600 GB	104 hours
	900 GB	156 hours
SAS7.2K	2 TB	346 hours
	3 TB	519 hours

3.9 Setting of LAN Interface

LAN interface and the setting on DF850 are shown below.

(1) Type of LAN interface

The array installs following LAN interfaces;

Parts	Name of LAN port	Use
Controller	Maintenance port	For maintenance operation
	User management port	For customer
iSCSI Host I/O	iSCSI port	For customer

(2) Setting item of LAN interface

When you use LAN interface of array, following setting should be correct between array and device connected to the array.

○ : Setting item of array
✧ : Setting item of device connected to the array
× : Not required

Setting item		IP address	Subnet mask,	Default gateway	Negotiation	LAN port number	MTU(*2)
Maintenance port of controller	Using WEB	○	×	×	✧ (Auto negotiation)	×	✧ (1500)
	Using SNM(*1)	○	×	×	✧ (Auto negotiation)	○	✧ (1500)
User management port of controller	Using WEB	○	○	○	○	×	✧ (1500)
	Using SNM(*1)	○	○	○	○	○	✧ (1500)
iSCSI port		○	○	○	✧ (1000Mbps/ Full duplex)	○	✧ (1500(default)/4500/9000)

*1 : Hitachi Storage Navigator Modular 2

*2 : Maximum Transmission Unit

NOTE : For a Maintenance port, subnet mask and default gateway cannot be set. Thus a Maintenance port does not support the network including routers.

(a) Setting of IP address, length of subnet mask/ subnet prefix and default gateway

Set IP address, length of subnet mask/ subnet prefix and default gateway to each LAN port.

(a-1) Setting of the array shipped from the factory

Setting item			IP address	Length of subnet mask/ subnet prefix	Default gateway
Maintenance port of controller	IPv4	CTL0	10.0.0.16	255.255.255.0	0.0.0.0
		CTL1	10.0.0.17		
	IPv6	CTL0	fe80::16	64	::
		CTL1	fe80::17		
User management port of controller	IPv4	CTL0	192.168.0.16	255.255.255.0	0.0.0.0
		CTL1	192.168.0.17		
	IPv6	CTL0	Automatic	64	::
		CTL1	Automatic		
iSCSI port	IPv4	Port 0A	192.168.0.200	255.255.255.0	0.0.0.0
		Port 0B	192.168.0.201		
		Port 0E	192.168.0.204		
		Port 0F	192.168.0.205		
		Port 1A	192.168.0.208		
		Port 1B	192.168.0.209		
		Port 1E	192.168.0.212		
		Port 1F	192.168.0.213		
	IPv6	Port 0A	Automatic	64	::
		Port 0B			
		Port 0E			
		Port 0F			
		Port 1A			
		Port 1B			
		Port 1E			
		Port 1F			

(a-2) Notes on Setting

(a-2-1) When using it in the IPv4 environment

For user management port, IP address, subnet mask and default gateway can be automatically assigned by making the DHCP function enabled. In this case, these parameters cannot be set by manual.

When you set these parameters, be careful about the followings.

(i) For the head value of IP address, '0', '127' and '255' cannot be specified. You cannot set 0.xxx.xxx.xxx, 127.xxx.xxx.xxx and 255.xxx.xxx.xxx.

(ii) Set a correct subnet mask. You cannot use discontinuous one-bit IP address for example 255.0.255.0.

(iii) Set a host address of IP address and default gateway address different from the network address and the broadcast address. When the broadcast address is being displayed on binary data, the addresses that won't be masked by the subnet mask are the ones that become all "1"

Example 1: When the network address is 192.168.0.0 and the subnet mask is 255.255.255.0, set the address of the user management port and the default gateway between 192.168.0.1 and 192.168.0.254. In this case it's not possible to set the network address as 192.168.0.0 neither the broadcast address as 192.168.0.255.

Subnet mask	Base 10	255	255	255	0
	Base 2	11111111	11111111	11111111	00000000
Network address	Base 10	192	168	0	0
	Base 2	11000000	10101000	00000000	00000000
Broadcast address	Base 10	192	168	0	255
	Base 2	11000000	10101000	00000000	11111111
IP address	Base 10	192	168	0	?
	Base 2	11000000	10101000	00000000	????????

The range masked by the subnet mask (111..111). The same value is applied for the same network

The range not masked by the subnet mask (on binary 00000000 is the network address, 11111111 is the broadcast address. Any value apart from these can be applied.

Example 1: When the network address is 192.168.0.0 and the subnet mask is 255.255.255.248, set the address of the user management port and the default gateway between 192.168.0.1 and 192.168.0.6. In this case it's not possible to set the network address as 192.168.0.0 neither the broadcast address as 192.168.0.7.

Subnet mask	Base 10	255	255	255	248
	Base 2	11111111	11111111	11111111	11111000
Network address	Base 10	192	168	0	0
	Base 2	11000000	10101000	00000000	00000000
Broadcast address	Base 10	192	168	0	7
	Base 2	11000000	10101000	00000000	00000111
IP address	Base 10	192	168	0	?
	Base 2	11000000	10101000	00000000	00000???

The range masked by the subnet mask (111..111). The same value is applied for the same network

The range not masked by the subnet mask (on binary 00000000 is the network address, 11111111 is the broadcast address. Any value apart from these can be applied.

(iv) Set the same network address for IP address and default gateway.
If no default gateway address for management port is specified or iSCSI port, set "0.0.0.0".
For example, when subnet mask is 255.255.255.0 and IP address is 192.168.0.16, you cannot set 192.168.1.1 for default gateway.

(v) When you set following IP address, you cannot set same network address.
Set individual network address for each IP address.
• Maintenance port of controller / User management port of controller
For example, when subnet mask is 255.255.255.0 and IP address of maintenance port is 10.0.0.16, you cannot set 10.0.0.xxx for user port.

(vi) When the network address of the LAN device, which is connected via the Gateway in the extension of the user management port, is the same as that of the Maintenance port, the communication cannot be made normally because of the conflict between them. Therefore, use a value other than the network address set to the maintenance port for the LAN device connected to the port for the user management via Gateway. (Refer to System Parameter "7.1 Setting Maintenance LAN" (SYSPR 07-0000).) Or change the IP address of the maintenance port to a value other than the network address of the LAN device connected via Gateway by Using Hitachi Storage Navigator Modular 2. (Refer to System Parameter "7.1 Setting Maintenance LAN" (SYSPR 07-0000).)

(a-2-2) When using it in the IPv6 environment

The user management port can set these setting automatically by RA (Router advertisement). In that case, the IP address, length of subnet prefix and default gateway cannot be set manually.

Be careful of the following when setting the IP address, length of subnet prefix and default gateway.

(i) Set the IP address other than the multicast address (fe00::/8), loopback address (::1) and unset (::). Do not set the link local address (fe80::/10) because it may duplicate the link local address that the array automatically generates.

(ii) Set the correct length of subnet prefix. The standard length is 64.

(iii) Set the IP address and default gateway address as the same network address.
If not using the gateway address, do not enter anything.

(iv) When setting the IP address of the following port, you cannot set the same IP address. Set the IP address so that the network address does not duplicate.

- Maintenance port and user management port
  For the maintenance port, fe80::16, fe80::17, fe80::f6 or fe80::f7 is used.

(v) By extension of the user management port, when the network address of the LAN device connected through Gateway becomes the same as the network address of the maintenance port, they both compete and communication is not performed normally.
Therefore, use an address other than the network address set to the maintenance port for the LAN device connected to the user maintenance port through Gateway (refer to System Parameter "7.2 Setting LAN' (SYSPR 07-0040)"). Or, change the IP address of the maintenance port to a value other than the network address of the LAN device connected through Gateway by Using Hitachi Storage Navigator Modular 2 (System Parameter "7.1 Setting Maintenance LAN' (SYSPR 07-0000)").

(a-3) Method of setting

- User management port of controller
  Refer to System Parameter "7.2 Setting LAN" (SYSPR 07-0040).
- Maintenance port of controller
  Refer to System Parameter "7.1 Setting Maintenance LAN" (SYSPR 07-0000).
- iSCSI port
  Refer to Hitachi Storage Navigator Modular 2 Help "iSCSI Settings".

(b) Setting of negotiation

Set negotiation to each LAN port.

(b-1) Setting of the array shipped from the factory

Setting item	Negotiation
Maintenance port of controller	Auto negotiation (10M/100Mbps, Half/Full duplex)
User management port of controller	Auto negotiation (10M/100Mbps, Half/Full duplex)
iSCSI port	1000Mbps, Full duplex

(b-2) Firmware revision and Hitachi Storage Navigator Modular 2 for Setting

The setting availability of the negotiation is shown below.

○ : Settable, × : Not settable

Maintenance port of controller	× (Auto negotiation (10M/100Mbps, Half/Full duplex))
User management port of controller	○
iSCSI port	× (1000Mbps, Full duplex fixed)

(b-3) Notes on Setting

Conform the negotiation of array to the negotiation of the device connected to LAN port.

If the negotiation of array is different from the negotiation of the device connected to LAN port, the throughput or response performance of network communication may decrease and the Controller may not communicate the destination device across a network.

(b-4) Method of setting

- User management port of controller

  Refer to System Parameter “7.2 Setting LAN” (SYSPR 07-0040).

(c) Setting of LAN port number

Set LAN port number to use when connecting.

(c-1) Setting of the array shipped from the factory

Setting item	LAN port number
Maintenance port of controller	2000
User management port of controller	
iSCSI port	3260

(c-2) Firmware revision and Hitachi Storage Navigator Modular 2 for Setting

The setting availability of the LAN port number is shown below.

○ : Settable, × : Not settable

Maintenance port of controller	(Same as LAN port number of User management port of controller)
User management port of controller	○
iSCSI port	○

(c-3) Notes on Setting

(i) When you set LAN port number, confirm that the LAN port number is not used.
If you set the LAN port number that has been already used, the array cannot communicate.

(ii) If you change LAN port number, you have to change setting of LAN port number on your PC.
In case of User management port of controller, edit "Service" file on PC using Hitachi Storage Navigator Modular 2.
In case of iSCSI port, change the setting of LAN port number on iSCSI initiator.

(c-4) Method of setting

- User management port of controller
  Refer to System Parameter "7.2 Setting LAN" (SYSPR 07-0040).
- iSCSI port
  Refer to Hitachi Storage Navigator Modular 2 Help "iSCSI Settings".

(d) Setting of MTU

Set packet size of sending (Maximum Transmission Unit) to each LAN port.

(d-1) Setting of the array shipped from the factory

Setting item	Negotiation
Maintenance port of controller	1500
User management port of controller	
iSCSI port	1500/4500/9000

(d-2) Firmware revision and Hitachi Storage Navigator Modular 2 for Setting

○ : Settable, × : Not settable

Maintenance port of controller	× (1500 fixed)
User management port of controller	
iSCSI port	× (1500(default)/4500/9000)

(d-3) Notes on Setting

Conform the MTU of array to the MTU of the device connected to LAN port.
If the MTU of array is different from the MTU of the device connected to LAN port, the Controller may not communicate with the destination device across a network.

Chapter 4. Outline of P.P.

4.1 Optional Functions

(1) ShadowImage in-system replication

This array provides the ShadowImage in-system replication function as an optional function.
To use the ShadowImage in-system replication, the P-002D-J511 is required separately.
The ShadowImage in-system replication controls Volume copying done within one and the same arrays.
It can create a copy (secondary volume) of a Volume within one and the same arrays keeping the redundancy that the source Volume (primary volume) has. (For the details, refer to the manual supplied with the P-002D-J511 or the P-002D-J511W.)

(2) TrueCopy remote replication

The array provides the TrueCopy remote replication as an optional function. To use the TrueCopy remote replication, the P-002D-J512 is required separately.
The TrueCopy remote replication supports the mode, in which data of arrays connected via the Fibre Channel interface are equalized, by always synchronizing their data. Besides, the function makes the copying speed higher by transferring differential data only.
(For the details, refer to the manual supplied with the P-002D-J512 or the P-002D-J512W.)

(3) TrueCopy Extended Distance

The array provides the TrueCopy Extended Distance as an optional function. To use the TrueCopy Extended Distance, the P-002D-J515 is required separately.
TrueCopy Extended Distance supports the mode, in which data of arrays connected via the Fibre Channel interface are equalized, by always synchronizing their data periodically.
Besides, the function makes the copying speed higher by transferring differential data only.
(For the details, refer to the manual supplied with the P-002D-J515 or the P-002D-J515W.)

(4) Copy-on-write SnapShot

This array provides the Copy-on-write SnapShot as an optional function.
To use the Copy-on-write SnapShot, the P-002D-J510 is required separately.
Copy-on-write SnapShot is a function to internally retain a logical duplication of the primary volume data at the time of the command instruction.
Copy-on-write SnapShot can create up to 15 duplication volumes per primary volume and manage data in two or more generations within the arrays. (For the details, refer to the manual supplied with the P-002D-J510 or the P-002D-J510W.)

(5) Data Retention Utility

This array provides the Data Retention Utility as an optional function.
To use the Data Retention Utility, the P-002D-J509 is required separately.
Data Retention Utility is an option for protecting a Volume (VOL) against an illegal access from a host computer by setting an access attribute to Volume. (For the details, refer to the manual supplied with the P-002D-J509 or the P-002D-J509W.)

(6) LUN Manager

The array provides the LUN Manager as an optional function.
To use the LUN Manager, the P-002D-J508 is required separately.
The LUN Manager enables the array to make a suitable response to each connected host even within the same port by grouping the connected hosts within a port and setting the volume mapping and the Host Connection mode for each host group. (For the details, refer to the manual supplied with the P-002D-J508 or the P-002D-J508W.)

(7) Cache Residency Manager

This array provides the Cache Residency Manager as an optional function.
To use the Cache Residency Manager, the P-002D-J505 is required separately.
The Cache Residency Manager to make the data of the specified Volume resident in the Cache memory installed in the Controller, and to execute all the accesses from the server related to the Volume concerned by cache hit without generating any access of the Drive. (For the details, refer to the manual supplied with the P-002D-J505.)

(8) SNMP Agent Support Function

This array provides the SNMP Agent Support Function as an optional function.
To use the SNMP Agent Support Function, the P-002D-J503 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 system.
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 array performance. (For the details, refer to the manual supplied with the P-002D-J503.)

(9) Password Protection

The array provides the Password Protection as an optional function.
To use the Password Protection, the P-002D-J502 is required separately.
The Password Protection prevents any DF850 from being concurrently accessed by users by limiting users of Hitachi Storage Navigator Modular 2 to be permitted to access the DF850. It can suspend the information provided from the DF850 to the user who has no access authority, and avoid the case that two or more users update the configuration information at the same time. (For the details, refer to the manual supplied with the P-002D-J502.)

(10) Performance Monitor

This array provides the Performance Monitor as an optional function.

To use the Performance Monitor, the P-002D-J506 is required separately. Performance Monitor acquires information on performance of the array and utilization rates of resources. Further, the information acquired is displayed with line graphs in the Monitor. (Refer to the attached manual of P-002D-J506 for more details).

(11) Cache Partition Manager

The array provides the Cache Partition Manager as an optional function. To use the Cache Partition Manager, the P-002D-J507 is required separately.

Cache Partition Manager is a function to tune the cache memory and has the following functions. (For the details, refer to the manual supplied with the P-002D-J507.)

- A function to partition the cache memory and to make each Volume's domain exclusive
- A function to be able to change the segment length for each partition from 16 k bytes of a default value to 4 k bytes, 8 k bytes, 64 k bytes, 256 k bytes and 512 k bytes for the partitions other than the master partition.

(12) Modular Volume Migration

This array prepares Modular Volume Migration as an optional function.

P-002D-J516 is separately required to use Modular Volume Migration.

Modular Volume Migration is a function to transfer the Volume to other RAID groups in the disk array system with the Read operation and the Write operation from the host continued. (Refer to the attached manual of P-002D-J516 or the P-002D-J516W for more details).

(13) Account Authentication

This array prepares Account Authentication as an optional function.

P-002D-J517 is separately required to use Account Authentication.

Account Authentication controls the login authentication to the array and the access to the array resource by using the account information that the user registered beforehand. The user ID, the password, and the information on the roll classification are included in the account information, and the login authentication is performed with the user ID and the password, and right or wrong of the update setting and the information reference to each resource of the array is decided by the roll classification.

Therefore, the illegal access to the DF850 can be prevented. (Refer to the attached manual of P-002D-J517 for more details.)

(14) Audit Logging

This array prepared Audit Logging as an optional function.
P-002D-J518 is separately required to use Audit Logging.
Audit Logging is a function to generate the log of the event when the user performs the setting operation, configuration change, etc. for the DF850.
The log is generated in the syslog form, and it is immediately output to the server for syslog that the user set (Refer to the attached manual of P-002D-J518 for more details).

(15) Power Saving

This array prepares Power Saving as an optional function.
P-002D-J519 is separately required to use Power Saving.
Power Saving is the function to reduce the electric power consumption of the DF850 by spinning down (stopping the rotation of the Drives) the Drives which configure the RAID Group that the user specified. (Refer to the manual attached to P-002D-J519 for the details.)

(16) Power Saving Plus

This array prepares Power Saving Plus as an optional function.
P-002D-J530 is separately required to use Power Saving Plus.
Power Saving Plus is a function to reduce the power consumption of HT-4066/HT-4017 by spinning down the Drives (stopping the rotation of the Drives) or drive power OFF (stopping drive power feeding) which configure the RAID group specified by the user.
It is possible to perform the power saving interlocking with the I/O in addition to the power saving function not interlocking with the I/O of Power Saving in the step (15). (For the details, refer to the manual supplied with the P-002D-J530.)

(17) Dynamic Provisioning

The array provides the Dynamic Provisioning as an optional function.
To use the Dynamic Provisioning, the P-002D-J523 is required separately.
Dynamic Provisioning is a function to improve the capacity efficiency of Drives by assigning physical capacity On Demand at the time of the Write command receipt without assigning the physical capacity to Volumes. (For the details, refer to the manual supplied with the P-002D-J523 or P-002D-J423W.)

(18) Dynamic Tiering

The array provides the Dynamic Tiering as an optional function.
To use the Dynamic Tiering, the P-002D-J528 is required separately.
Dynamic Tiering is a function which can configure the volume with multiple different media and reduce the storage cost of the performance excess by using it in the environment where Dynamic Provisioning is used. (For the details, refer to the manual supplied with the P-002D-J528 or P-002D-J528W.)

(19) Fibre Channel Option

CBXSL/CBXSS provides the Fibre Channel Option as an optional function.
To use the Fibre Channel Option, the P-002D-J529 is required separately.
Fibre Channel Option is a function that enables the Fibre Channel Interface environment after purchasing the iSCSI model of the CBXSL/CBXSS. (For the details, refer to the manual supplied with the P-002D-J529.)

(20) TrueCopy Modular Distributed

The array provides the TrueCopy Modular Distributed as an optional function.
TrueCopy Modular Distributed is a program product that expands TrueCopy remote replication or TrueCopy Extended Distance.
If you would like to use TrueCopy Modular Distributed with TrueCopy remote replication, P-002D-J512N is required. (Customer who owns TrueCopy remote replication needs the P-002D-J522N.)
If you would like to use TrueCopy Modular Distributed with TrueCopy Extended Distance, P-002D-J512M is required. (Customer who owns TrueCopy Extended Distance needs the P-002D-J522.)
TrueCopy Modular Distributed extends the function which equalizes the data of both arrays so that it can be used between multiple arrays and one array.
(For the details, refer to the manual supplied with the P-002D-J522N, J522, J512N, J512NW, J512M or J512MW.)

(21) Data At Rest Encryption

CBL prepares Data At Rest Encryption as an optional function.
To use Data At Rest Encryption, P-002D-J527 is required separately.
Data At Rest Encryption is a function to prevent drives from being stolen or taken out and information at the time of replacement from being leaked out by encrypting the data to be stored in the array. (For the details, refer to the manual supplied with the P-002D-J527.)

(22) Tray Power Saving

CBL prepares Tray power Saving as an optional function.
To use Data At Rest Encryption, P-002D-J521 is required separately.
Tray Power Saving reduces power consumption in the array by working with the PDU (PX2-5198J-E2N1) from Raritan to turn OFF when all of its drives are turned OFF (no power is supplied). (For the details, refer to the manual supplied with the P-002D-J5212.)