

# DF300 Disk Subsystem

## Specification

### Rev. 0

This manual is preliminary version applied only for sample units of DF300-RKWH and related option features.

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K6601270	SHEET NO.	REV NO.	0
	1/60	'96.11.29	

DF300 Disk Subsystem Specifications  
Revision Control List

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

Rev.	Date	Revised by	Checked by	Approved by	Sheet No.	Description	Code
0	'96.11.29	M.Hori			All	First edition	

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 SAFETY SUMMARY





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1.  General Safety Guidelines

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

Before starting maintenance

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

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

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

- Keep in mind that the hazard warnings in this manual or on the machine cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand.  
Be alert and use your common sense.

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⚠ SAFETY SUMMARY (Continued)

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2. ⚠ Hazard Warning Statements

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

2.1 ⚠ DANGER statement

No DANGER statement

2.2 ⚠ WARNING Statement

No WARNING statement

2.3 ⚠ CAUTION statements

No CAUTION statement

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## 1. Overview

The DF300 series disk array subsystem connects minimum of five 3.5-inch compact hard disk drives (one row) or up to 21 drives (four rows plus one spare disk drive) and provide a large storage capacity, high-speed data transfer, and high reliability.

This subsystem consists of row(s) of compact hard disk drives (a row consists of five disk drives), and an array controller that controls the arrayed and interconnected compact hard disk drives. It uses a SCSI-2 interface as the host interface.

There are 4 types : desk top, mini-tower, cabinet, and rack-mount, and the rack-mount type is further divided into the RK type (DF300-RK) , RKH type (DF300-RKH) and RKWH type (DF300-RKWH).

### 1.1 Main Functions

The controller in this subsystem connects the disk array subsystem to the host using a Small Computer System Interface (SCSI).

#### (1) SCSI-2 interface

- The interface conforms to ANSI SCSI-2 (X3T9.2/86-109) which is a standard interface for small hard disk drives.

#### (2) High-speed data transfer

- The subsystem starts up multiple compact hard disk drives in parallel, and performs a read/write continuously at up to 10 MB/s in the synchronous mode.
- It also performs a read/write at up to 20 MB/s in the synchronous mode using a wide-SCSI-2 16-bit data bus.

#### (3) Large capacity

- The DF300 cabinet type or rack mount type is expandable as shown in Table 1.1.
- It can be used as single large capacity disk drive from viewpoint of the host, and it can be divided also logically up to eight portions.

Table 1.1 Number of Rows and Capacity of Disk Array

	Desktop			Mini-tower			Cabinet/Rackmount(RKWH)			Rack mount(RK/RKH)		
	Num-ber of rows	RAID	Capacity (GB)	Num-ber of rows	RAID	Capacity (GB)	Num-ber of rows	RAID	Capacity (GB)	Num-ber of rows	RAID	Capacity (GB)
Minimum configuration	1	0	2.3/4.1/8.3	1	0	2.3/4.1/8.3/17.4	1	0	2.3/4.1/8.3/17.4	1	0	2.3/4.1/8.3/17.4
		1	1.1/2.0/4.1		1	1.1/2.0/4.1/8.7		1	1.1/2.0/4.1/8.7			
		5	4.6/8.2/16.6		5	4.6/8.2/16.6/34.8		5	4.6/8.2/16.6/34.8			
Maximum configuration	1	0	5.8/10.3/20.8	1	0	5.8/10.3/20.8/43.5	4	0	23.3/41.3/83.2/174.2	2	0	11.6/20.6/41.6/87.1
		1	2.3/4.1/8.3		1	2.3/4.1/8.3/17.4		1	9.3/16.5/33.3/69.6		1	4.6/8.2/16.6/34.8
		5	4.6/8.2/16.6		5	4.6/8.2/16.6/34.8		5	18.6/33.0/66.6/139.3		5	9.3/16.5/33.3/69.6

Note: The capacity per row depends on the capacity of each disk drive to be mounted.

- The number of user blocks of the whole unit can be obtained using the following calculation formula. To convert the number of user blocks to the storage capacity, multiply it by 512.

① RAID5

No. of blocks =  $m * 4 * \text{No. of installed rows}$

② RAID1

No. of blocks =  $m * \text{int}(\text{No. of installed drives} / 2)^{*1}$

③ RAID0

No. of blocks =  $m * \text{No. of installed drives}^{*2}$

\*1 : Fraction of int shall be omitted.

\*2 : The number of installed drives is 2 or more.

For m, refer to the following table.

Model		DF-F300-			
		A2C1	A2C2	A2C4 A1C4 A2E4	A1E8
Capacity		1.1GB	2.0GB	4.1GB	8.7GB
Capacity per disk drive (user area)	Block Number(=m)	2,275,456	4,040,192	8,130,432	17,017,160
	Capacity[GB]	1.165	2.069	4.163	8.712

(4) High-availability of data

- If one disk drive fails in the RAID 5 configuration, the subsystem can read/write data without stopping the system because there is one parity disk drive per row.

(5) High-reliability of data

- The controller automatically creates and adds a unique 4-byte data assurance code to the data from the host, and it writes the code on the disk with the data.
- An automatic creation check for the data assurance code is performed on the data bus of the controller, which contributes to high reliability of data by means of data distribution and centralizing control which is peculiar to the disk array.

(6) Diagnostics and maintenance

- Diagnostics and maintenance of this equipment can be performed on the display panel of the DF300 subsystem.
- Diagnostics and maintenance of this subsystem can be done by a maintenance terminal (personal computer) or LAN connected to the RS-232C serial interface on the controller or on the host.
- Utility programs are also available.

1.2 Precautions for Operating

**Never fail to make backup data at regular intervals so that data lost by unexpected errors of hardware or software of Host system or array subsystem can be recovered.**

## 2. Configuration

### 2.1 Basic Configuration

The tables below show the basic configurations of each type of the DF300 disk subsystem.

#### (1) Basic composition

	Desktop	Mini-tower	Cabinet	Rack mount	
Model	DF300-DK	DF300-MK	DF300-CK	DF300-RK/-RKH	DF300-RKWH
Components	Frame, cover, controller, panel, FDD, battery, fan, In box, and power cable			Same as left, and power supplies	

#### (2) Disk drive (Select the disk drive(s) from the individual disk drives or the disk drive rows.)

Model	Individual disk drive (Note 1)				Disk drive row (Note 2)			
	A2C1	A2C2	A2C4 A2E4		E2C1	E2C2	E2C4 E2E4	
DF-F300-	-	-	A1C4 (Note 3)	A1E8 (Note 3)	-	-	E1C4 (Note 3)	E1E8 (Note 3)
Configuration	3.5" 1.1 GB (1 drive)	3.5" 2.0 GB (1 drive)	3.5" 4.1 GB (1 drive)	3.5" 8.7 GB (1 drive)	3.5" 1.1 GB (5 drives) RAID0 ... 5.8 GB RAID5 ... 4.6 GB	3.5" 2.0 GB (5 drives) RAID0 ... 10.3 GB RAID5 ... 8.2 GB	3.5" 4.1 GB (5 drives) RAID0 ... 20.8 GB RAID5 ... 16.6 GB	3.5" 8.7 GB (5 drives) RAID0 ... 43.5 GB RAID5 ... 34.8 GB

Note 1: Each disk drive capacity in one row must be the same.

Note 2: The number of rows per unit for each type is as follows:

Desktop and mini-tower: 1

Rack mount(RK/RKH): 1 to 2

Cabinet and Rack mount(RKWH): 1 to 4

Note 3: Cannot be used with the desk top type and rack mount RK type.

#### (3) Power supply for disk drives

	Desktop	Mini-tower, cabinet and rack mount(RK,RKH)
Model	DF-F300-B1D	DF-F300-B1M

Specify the number of power supplies required according to the number of disk drives to be mounted. (One power supply is needed for each five disk drives.)

#### (4) Cache memory (Standard capacity: Desktop type: 4 MB; mini-tower and other types: 8 MB)

Model	Desktop					Mini-tower, cabinet and rack mount				
	DF-F300-					DF-F300-				
	C14	C18D	C116D	C132D	C164	C18M	C116M	C132M	C164	C1128
Capacity	4MB	8MB	16MB	32MB	64MB	8MB	16MB	32MB	64MB	128MB

(5) Interface connector (Standard specification: W/D 68-pin screw type)

	Desktop			Mini-tower and cabinet			Rack mount(RK/RKH)		
Model	DF-F300-			DF-F300-			DF-F300-		
	DDWDS	DDNSL	DDWSS	DMWDS	DMNSL	DMWSS	DRWDS	DRNSL	DRWSS
Specifi- cation	W/D 68-pin screw type	N/S 50-pin latch type	W/S 68-pin screw type	W/D 68-pin screw type	N/S 50-pin latch type	W/S 68-pin screw type	W/D 68-pin screw type	N/S 50-pin latch type	W/S 68-pin screw type
Appendant	Terminating Resistor								

	Rack mount(RKWH)
Model	DF-F300-
Specifi- cation	DWWDS W/D 68-pin screw type
Appendant	Terminating Resistor

## 2.2 Optional Configuration

The tables below show the optional configuration of the DF300 disk subsystem.

- (1) Spare disk drive (for mini-tower, cabinet and rack mount types. One spare disk drive is mountable per unit.)

Model	DF-F300-A2C1	DF-F300-A2C2	DF-F300-A2C4 DF-F300-A2E4	
	-	-	DF-F300-A1C4(Note 3)	DF-F300-A1E8(Note 3)
Configuration	3.5" 1.1 GB (1 drive)	3.5" 2.0 GB (1 drive)	3.5" 4.1 GB (1 drive)	3.5" 8.7 GB (1 drive)

Mount a disk drive whose capacity is as large as the maximum one of data/parity disk drive in the unit.

Note 3: Cannot be used with the desk top type and rack mount RK type.

- (2) Dual controller
- for mini-tower, cabinet and rack mount RK/RKH types ... DF-F300-F2MC
  - for rack mount RKWH type ... DF-F300-F2WC

Select the cache memory with the same capacity as the one of the cache memory mounted on the basic controller.

	Cache memory for mini-tower, cabinet and rack mount				
Model	DF-F300-				
	C18M	C116M	C132M	C164	C1128
Capacity	8 MB	16 MB	32 MB	64 MB	128 MB

- (3) Redundant power supply (One redundant power supply is mountable per unit.)

	Desktop	Mini-tower, cabinet and rack mount (RK/RKH)
Model	DF-F300-B1D	DF-F300-B1M

- (4) LAN board

	Desktop	Mini-tower, cabinet and rack mount
Model	DF-F300-G1D	DF-F300-G1M

- (5) Utility program ..... P-2421-J001 (for all types)
- (6) Personal computers for maintenance ..... DF-F300-R1 (for all types)

An RS-232C cable is required to connect personal computers. For cables, see item (13).

(7) Additional disk drive(s) (Select the additional disk drive(s) from the individual disk drives or the disk drive rows shown below.)

Model	Individual disk drive (Note 1)				Disk drive row (Note 2)			
	A2C1	A2C2	A2C4 A2E4		E2C1	E2C2	E2C4 E2E4	
DF-F300-	-	-	A1C4 (Note 3)	A1E8 (Note 3)	-	-	E1C4 (Note 3)	E1E8 (Note 3)
Configuration	3.5" 1.1 GB (1 drive)	3.5" 2.0 GB (1 drive)	3.5" 4.1 GB (1 drive)	3.5" 8.7 GB (1 drive)	3.5" 1.1 GB (5 drives) RAID0 ... 5.8 GB RAID5 ... 4.6 GB	3.5" 2.0 GB (5 drives) RAID0 ... 10.3 GB RAID5 ... 8.2 GB	3.5" 4.1 GB (5 drives) RAID0 ... 20.8 GB RAID5 ... 16.6 GB	3.5" 8.7 GB (5 drives) RAID0 ... 43.5 GB RAID5 ... 34.8 GB

Note 1: Each disk drive capacity in one row must be the same.

Note 2: The number of rows per unit for each type is as follows:

Desktop and mini-tower: 1

Rack mount(RK/RKH): 1 to 2

Cabinet and Rack mount(RKWH): 1 to 4

Note 3: Cannot be used with the desk top type and rack mount RK type.

(8) Power supply for disk drives

	Desktop	Mini-tower, cabinet and rack mount(RK/RKH)
Model	DF-F300-B1D	DF-F300-B1M

Specify the number of power supplies required according to the number of disk drives to be mounted. (One power supply is needed for each five disk drives.)\*

\*Note : When 6 or more drives (the spare disk is excluded) are driven by one power supply, the power supply enters the overload state. Be sure to follow the above configuration.

(9) Additional cache memory (Mountable capacity for each types: Desktop: 4 to 64 MB; mini-tower and other types: 8 to 128 MB)

Model	Desktop					Mini-tower, cabinet and rack mount				
	DF-F300-					DF-F300-				
	C14	C18D	C116D	C132D	C164	C18M	C116M	C132M	C164	C1128
Capacity	4MB	8MB	16MB	32MB	64MB	8MB	16MB	32MB	64MB	128MB

(10) Rack frame cabinet

The U1 rack frame cabinet can mount up to 7 units of the DF300-RK rack-mount type and up to 6 units of the DF300-RKH rack-mount type. A centralized power distributor\* (for 200 V) for 7 units and a centralized power switch are provided. The interface may be selected for each rack mount drive independently. When disk arrays are mounted, rails as many as the units are required.

The U2 rack frame cabinet can mount up to 4 units of the DF300-RKWH rack-mount type. A centralized power distributor\* (for 200 V) for 4 units and a centralized power switch are provided. The interface may be selected for each rack mount drive independently.

	Rack frame cabinet	Rail
Model	DF-F300-U1	DF-F300-URHT
	DF-F300-U2	—

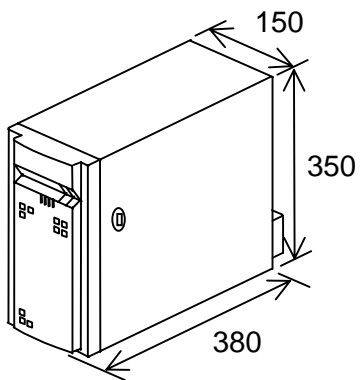


### 3. Appearance

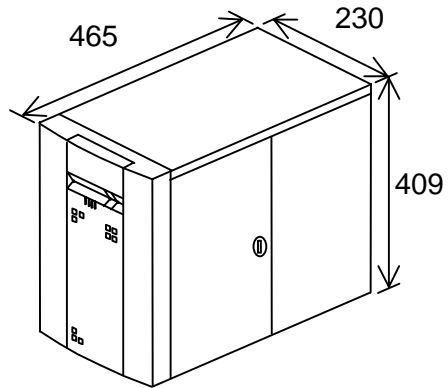
#### 3.1 Appearance of DF300 subsystem

Figure 3.1 shows the appearance of the DF300 subsystem.

(Unit :mm)



Desktop type

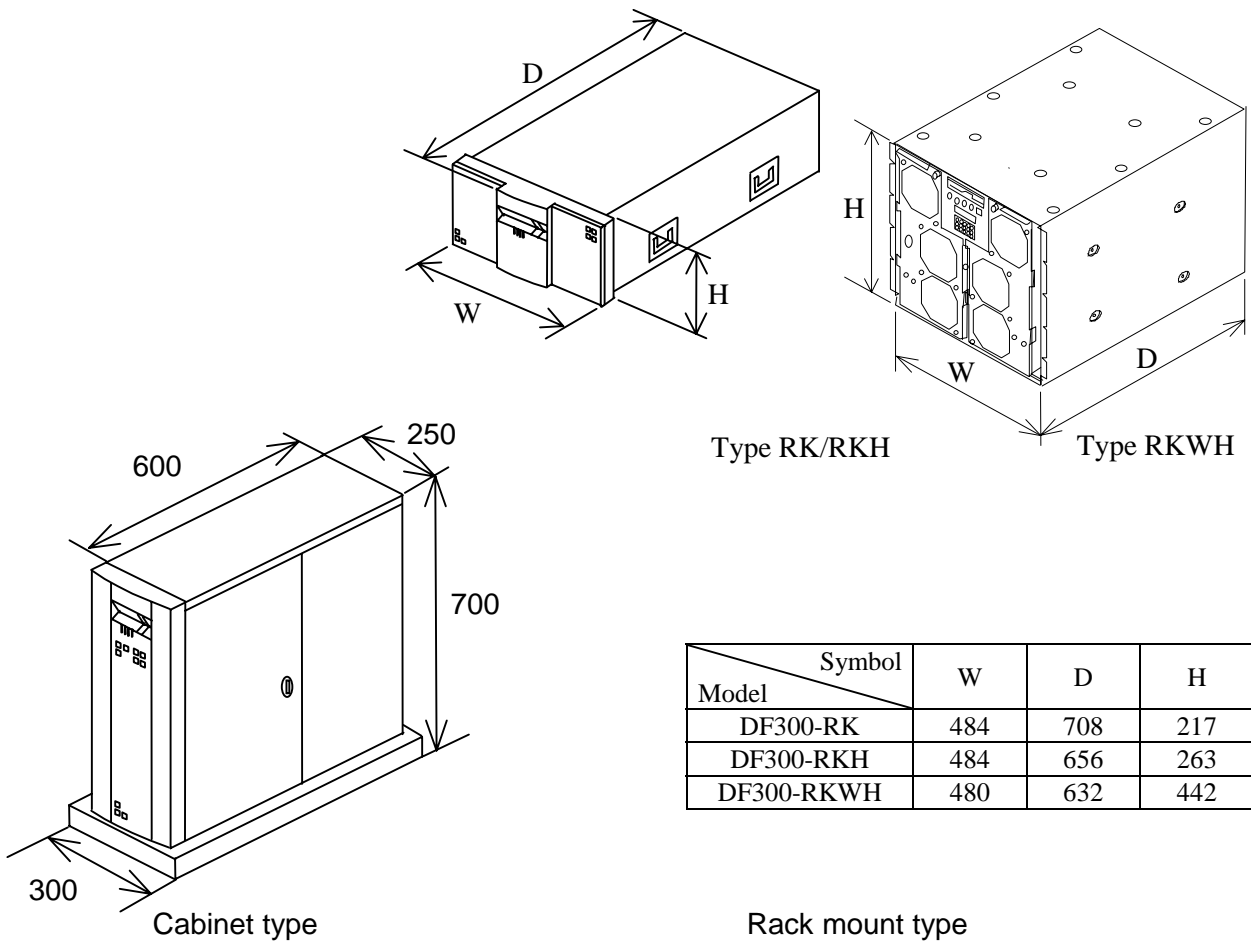


Mini-tower type

Name	Color
Front cover	Sandstone light(10Y 7.3/0.4)
Side cover	
Subsystem	

Fig. 3.1 Appearance of DF300 Subsystem

(Unit : mm)



Symbol Model	W	D	H
DF300-RK	484	708	217
DF300-RKH	484	656	263
DF300-RKWH	480	632	442

Name	Color		
	Cabinet	Rack mount(RK/RKH)	Rack mount(RKWH)
Front cover	Sandstone light (10Y 7.3/0.4)	Sandstone light (10Y 7.3/0.4)	Sandstone light (10Y 7.3/0.4) (option)
Side cover		Silver	Silver
Main body			
Anti-turnover skirt	Sandstone dark (10Y 5.3/0.4)	—	—

Fig. 3.1 Appearance of DF300 Subsystem (Cabinet and Rack Mount Types)

### 3.2 Maintenance Area

Figure 3.2 shows the maintenance area of the DF300 subsystem.

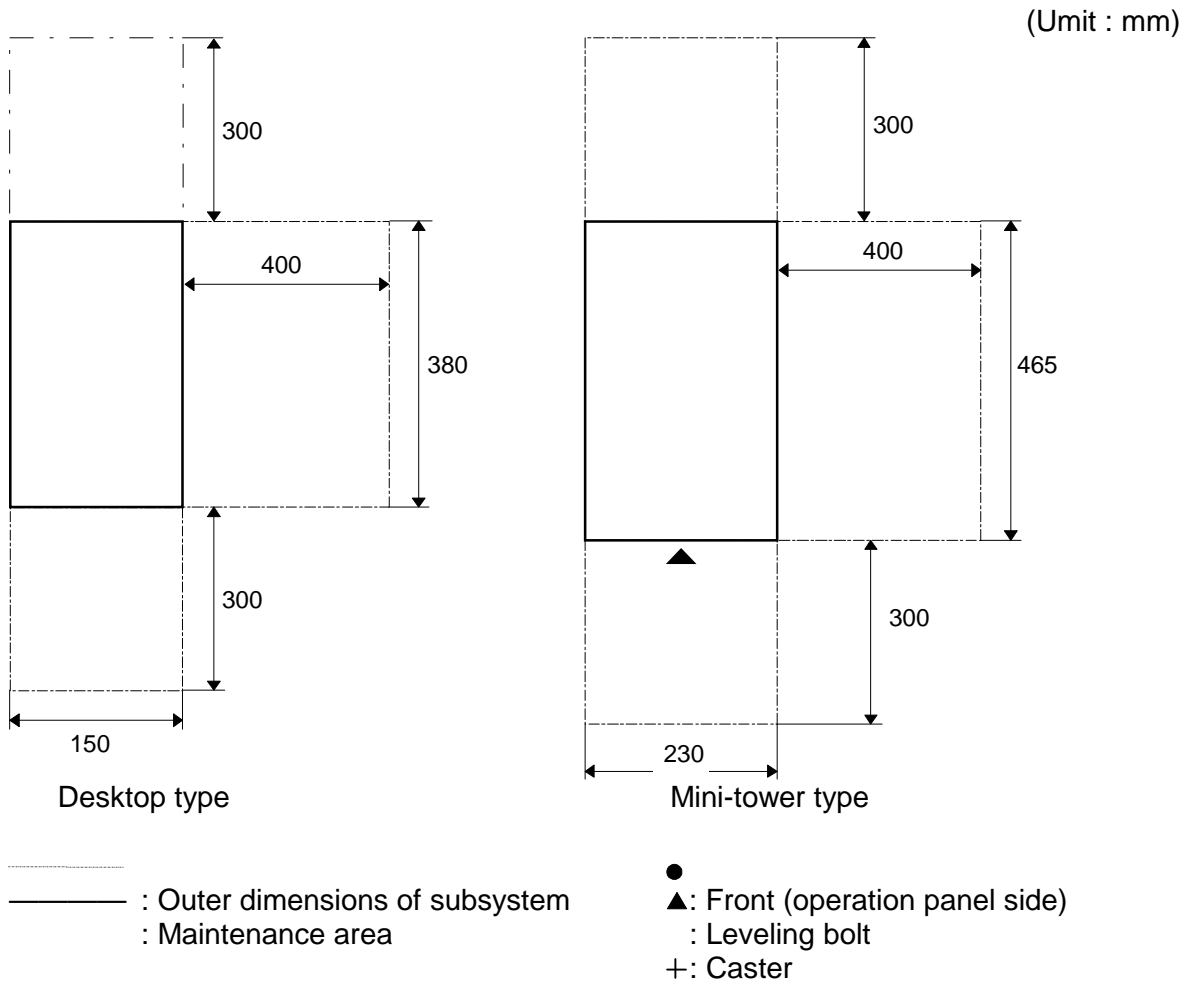
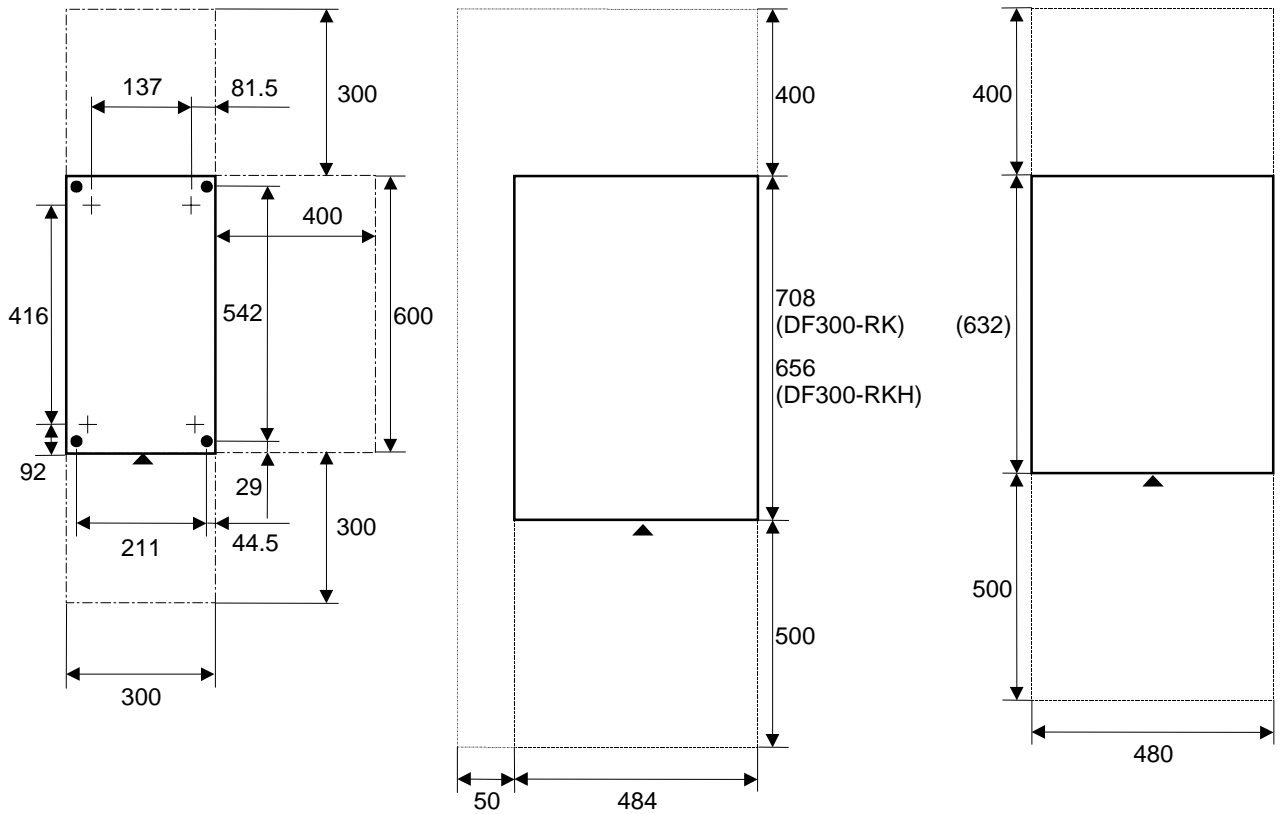


Fig. 3.2 Maintenance Area of DF300 Subsystem (Desktop and Mini-tower Types)

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(Unit :mm)



Cabinet type

Rack mount type(RK/RKH)

Rack mount type(RKWH)

- : Outer dimensions of subsystem
- : Maintenance area
- : Front (operation panel side)
- : Leveling bolt
- ▲ : Caster
- +

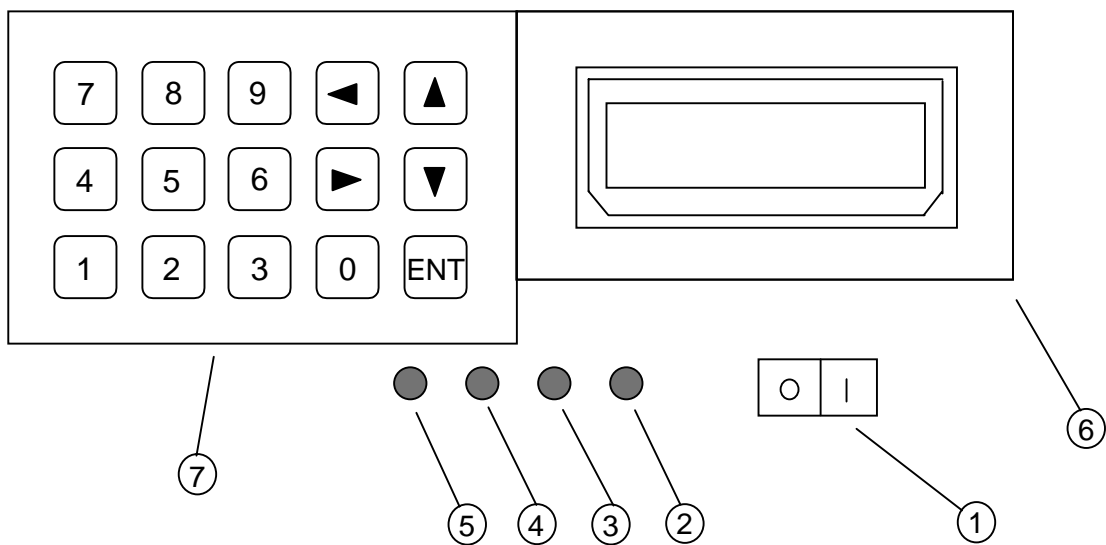
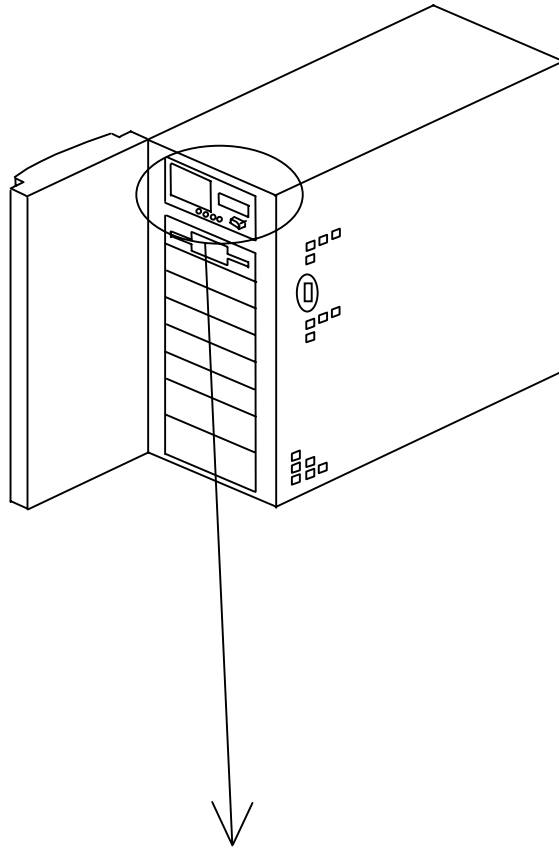
Fig. 3.2 Maintenance Area of DF300 Subsystem (Cabinet and Rack Mount Types)

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### 3.3 Operation Panel

(Desktop type)

For explanation on ① to ⑦, refer to Sheet 17.



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(Mini-tower and cabinet types)  
 For explanation on ① to ⑦, refer to Sheet 17.

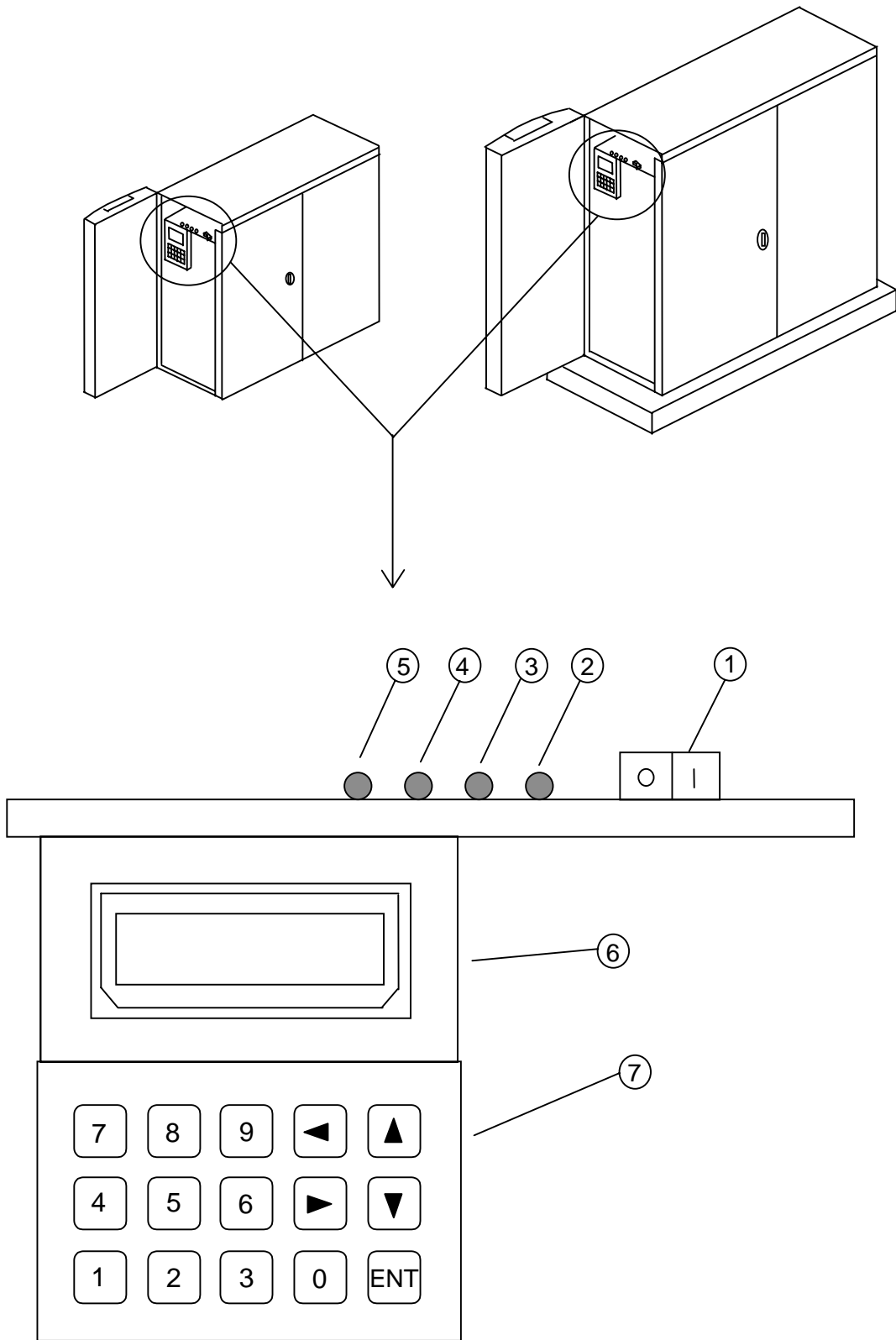
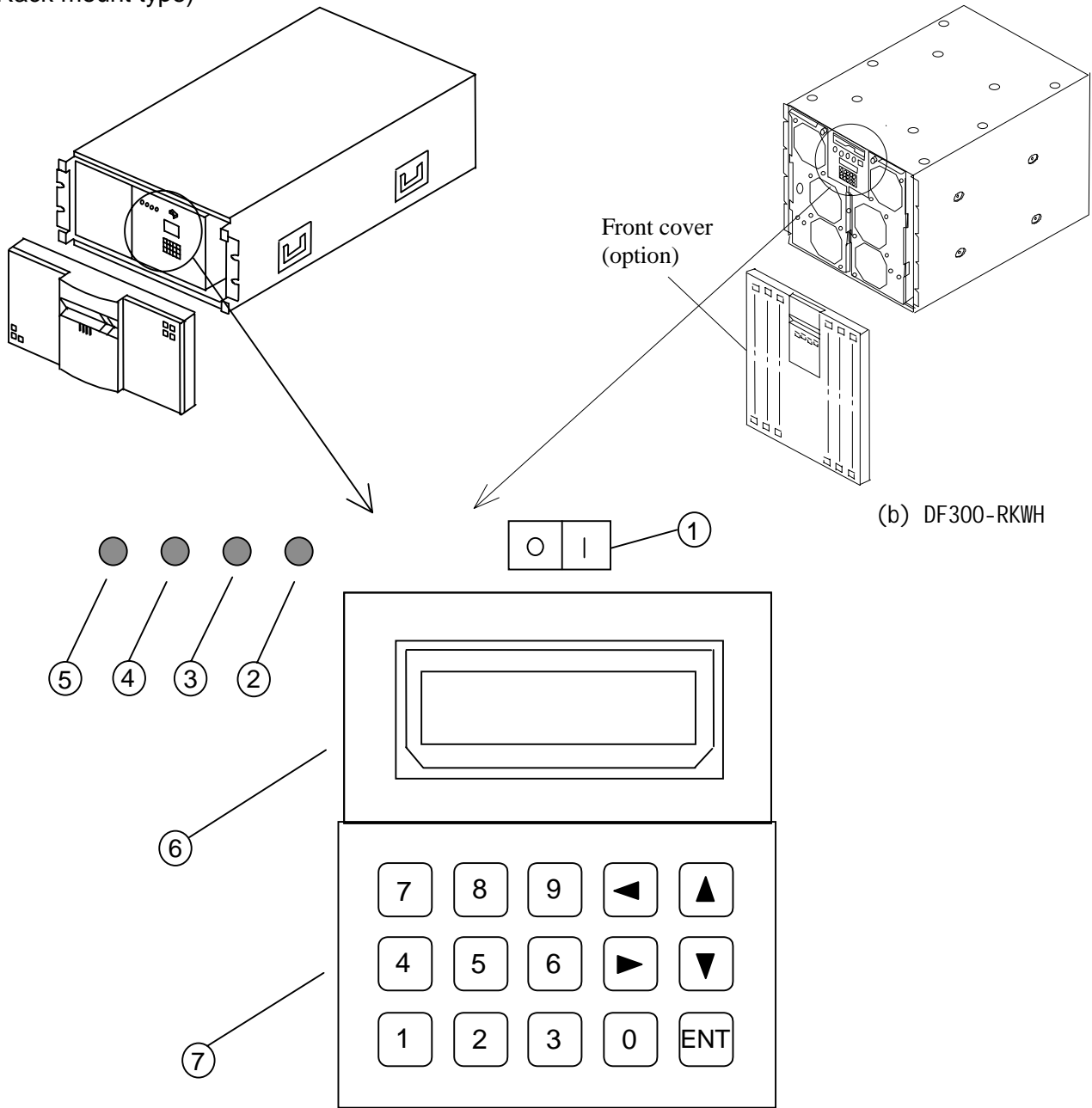


Fig. 3.3 Operation Panel

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(Rack mount type)



(b) DF300-RKWH

Fig. 3.3 Operation Panel

No.	Name	Category	Color	Function
1	POWER SW	Switch	-	Turns on/off the power.
2	POWER	LED	Green	Indicates that the power is turned on.
3	ALARM	LED	Red	Indicates the abnormal state in the subsystem.
4	WARNING	LED	Yellow	Indicates the operable abnormal state.
5	READY	LED	Green	Indicates that the subsystem is operable.
6	LCD	LCD	-	Displays the subsystem state and set parameters.
7	Numeric keypad	Keyboard	-	Sets parameters and selects a command.

## 4. Specifications

### 4.1 Major Specifications

Item		Type	Desktop	Mini-tower	Cabinet	Rack mount		
						DF300-RK	DF300-RKH	DF300-RKWH
Storage capacity (GB/unit)	RAID 0	2.3 to 20.8	2.3 to 43.5	2.3 to 174.2	2.3 to 41.6	2.3 to 87.1	2.3 to 174.2	
	RAID 1	1.1 to 8.3	1.1 to 17.4	1.1 to 69.6	1.1 to 16.6	1.1 to 34.8	1.1 to 69.6	
	RAID 5	4.6 to 16.6	4.6 to 34.8	4.6 to 139.3	4.6 to 33.3	4.6 to 69.6	4.6 to 139.3	
Number of rows		1		1 to 4	1 to 2		1 to 4	
Drives/row		5						
Cache capacity (MB)		4 to 64	8 to 128					
Cache backup time (h) (*1,*2,*3)		48(32MB)	150(64MB)					
RAID configuration		0, 1, 5						
Host interface		Narrow/Wide Single-ended or Narrow/Wide differential SCSI-2					SCSI-2(WD)	
Maximum data transfer rate(MB/s)		10 (fast) or 20 (fast wide)					20(Fast Wide)	
Number of host ports		1						
Redundancy	Spare disk	N	Y (optional)					
	Power supply	Y (optional)	Y (optional)					
	Hot-pluggable fan	N	Y					
Data block length		512 Byte						
Number of LUNs (logical unit numbers)		8 max.						
Startup time		TYP. 2 min. (*7)						
Outer dimensions WxDxH (mm)		150×380×35 0	230×465×40 9	300×600×70 0	484×708×21 7	484×656×26 3	480×632×44 2	
Weight (kg) min./max.		14/16kg	30/35kg	50/80kg	40/50Kg	50/65Kg	/105kg	
Power supply	Voltage (V) (Power supply voltages are switch-ed automatically.)	100 to 120 VAC+6%/-11% 200 to 240 VAC+6%/-11% (*4)					AC200~240 V +6%/-11%	
	Frequency (Hz)	50/60 ±1Hz						
	Rated current (A)	2.0A(100V) 1.2A(200V)	3.0A(100V) 1.5A(200V)	8A(100V) 4A(200V)	3.5A(100V) 2.0A(200V)	5A(100V) 2.5A(200V)	4.5A (200V)	
	Breaking current (A)	6.3	6.3	15	7.5		15	
	Apparent power, in steady state (VA)	240(*5)	300(*5)	800(*5)	400(*5)	500(*5)	900(*5)	
	Apparent power, at start (VA)	360(*5, *6)	450(*5, *6)	1100(*5, *6)	500(*5, *6)	620(*5, *6)	1200(*5, *6)	
	Heat dissipation in steady state (kCal)	210	260	700	350	440	790	
Insulation performance	Dielectric strength	1500 V (1 minute)						
	Insulation resistance	500 VDC 10 MΩ						
Energy consumption efficiency (W/MB)		0.011	0.007	0.005	0.010	0.006	0.005	

- \*1 : Indicates the value when the battery for memory back up is fully charged. Cache backup time depends on cache capacity. It takes the battery up to 24 hours to be fully charged. When the IN BOX switch is turned on and the 100 VAC(200) is supplied to the unit, the charging circuit of the battery is operable.
- \*2 : When the mode changes to the cache backup mode, the warning (yellow LED lights) may be arisen that shows the low voltage at the startup. This status shows that the rest of the battery capacity is running short, and the unit operates disabling the Write Cache automatically. When the battery charging is completed, the warning indication disappears, the Write Cache is enabled again automatically, and the job is continued.  
The warning indication is displayed for up to 24 hours. During the warning is indicated, the functions are guaranteed the normal operation though the performance of the unit may be lowered.
- \*3 : If the unit is not energized for more than a month, the over discharging of the battery occurs and it may be cause an unrecoverable damage. In this case, the battery must be energized more than 24 hours at least once a month, or store the unit with the switch of the battery off. Even when the switch is off, the battery discharges naturally. Therefore, turn on the switch of the battery and energize it for 24 hours every three months to charge it.
- \*4 : The setting of switching the voltage(100V/200V) is not required because the unit monitors the input voltage and switch it automatically.
- \*5 : The required power for the maximum configuration is shown. For installation planning of an uninterruptible power supply (UPS), use a power factor of 100% for calculation. (Example: 300 W = 300 VA) These are the specifications of 100V and 200V.
- \*6 : For several minutes after the power switch of the disk array is turned on (at the time of start), more power than that in the steady state is required to start the built-in disk drives.
- \*7 : When turning on the power within 30 seconds after turning off the power , sometime it takes more than two minutes to be ready.

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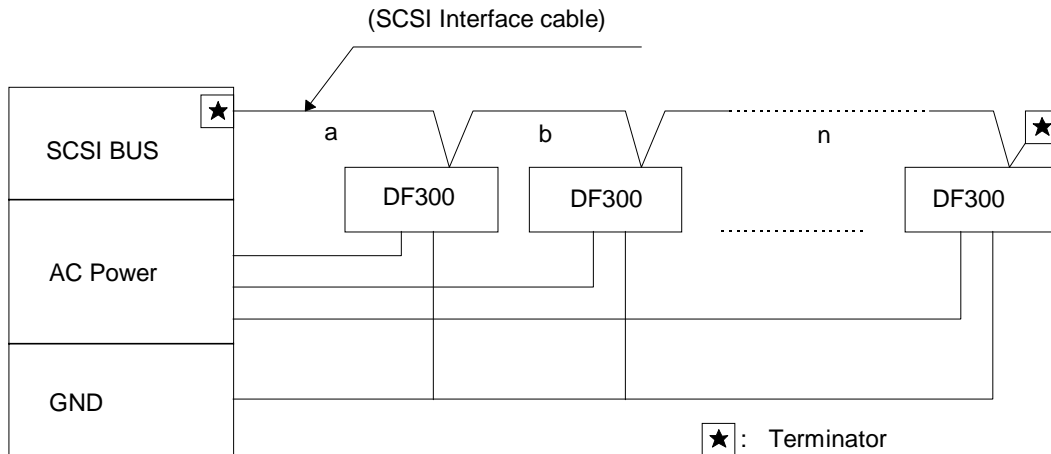
## 4.2 Environmental Specifications and Reliability

Item	Type	Desktop	Mini-tower	Cabinet	Rack mount	Remarks
	Temperature	Operating	10 to 40°C			
	Non-operating	-10 to 50°C				
	Transporting/storing	-30 to 60°C				
	Temperature change rate	10°C/h				
Humidity	Operating	8 to 80%				
	Non-operating	8 to 90%				
	Maximum wet bulb temperature	29°C				
Vibration	Operating	0.25G or less				
	Non-operating	0.5G or less				
	Transporting (packed)	0.5G or less				
Impact	Operating	2G or less				10ms half-sine wave
	Non-operating	5G or less				
	Transporting (packed)	8G or less				
Angle at which the equipment will turn over.		15 degrees or more				Measured when installed with leveling bolts
Atmosphere		No corrosive gas and salty air must be found.				
Acoustic noise		50 dB or less	55 dB or less (RKWH=57db or less)			Measured with the A scale, and at the position one meter away from the front end of the unit and one meter high.
MTBF		More than 50,000 hours are expected.				The case of the minimum construction.
MTBDA		$\left[ \frac{(\text{MTBF of the drives})^2}{n(n-1) \times \text{row numbers} \times \text{MTTR}} \right]$ <p>More than about 20 million hours</p>				<u>Mean Time Between Data Availability</u>
Drop in package (JIS Z0200)		No abnormality must be found at drop level IV (one end is dropped while another end is supported).				
Radio frequency radiation		Conforms to FCC Part 15B Class A				

## 5. Interface

### 5.1 Connection Specification

#### 5.1.1 Interface (daisy chain connection)



$a + b + \dots + n + \text{internal cable length} \leq 25 \text{ m (Differential)}$

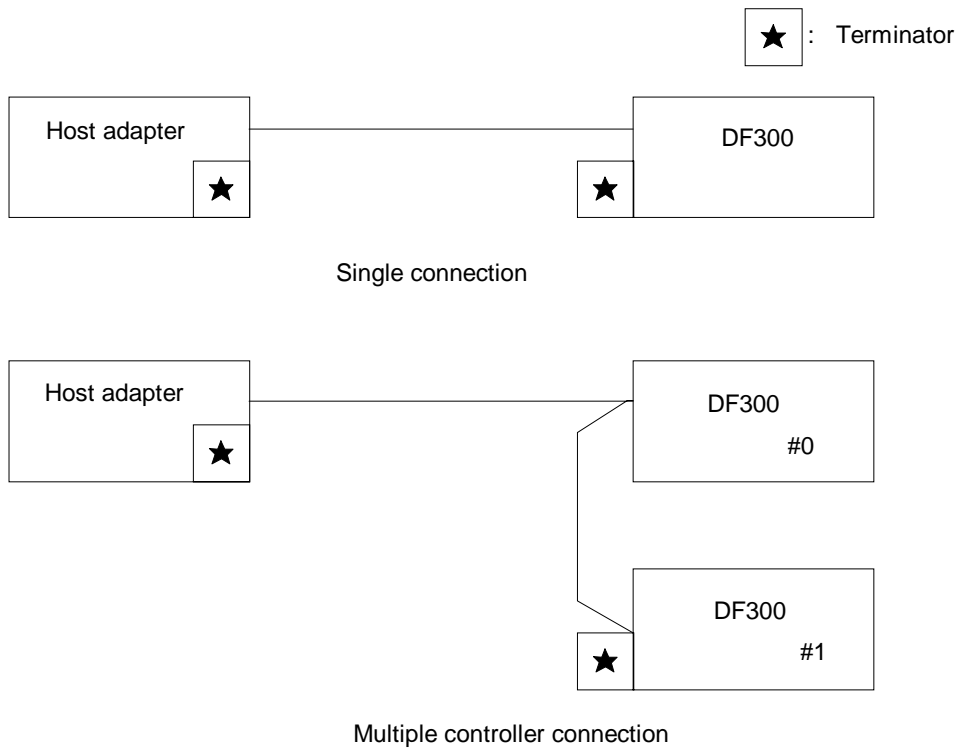
$a + b + \dots + n + \text{internal cable length} \leq 6 \text{ m (Single ended)}$

Notes:

- 1: The SCSI BUS cable can connect max. 8 units (16 units for wide SCSI) including the host, the DF300 and other units with SCSI interface, however, an internal cable length is max. 1.0 m in the DF300 system, therefore pay attention on the cable length when cable connecting.
- 2: The DF300 cannot perform the selection response to the commands issued by the host three seconds after startup. Start the host after checking that the initiator restricts issuing the commands during this time or that the DF300 becomes ready.  
Processing concerning to reading/writing can not be done until the unit becomes ready (see the startup time).
- 3: Turn off the DF300 after completion of the shut down procedure of the host.
- 4: The DF300 writes the entire reminding disk-non-reflective data on the cache memory of the disk (Destaging processing) when turning off the power using a power switch on the front (or when the SCSI terminator power switches to the low level in the remote mode.) This process takes several seconds to tens seconds, and then the power is turned off. If the power is directly turned off using a circuit breaker on the back of the equipment or one that supplies power with the equipment, the cache memory enters the battery backup mode since the de-staging cannot be performed. In this case, the data warranty time conforms to the cache backup time in Chapter 4. Normally turn off the power using a power switch on the front of the equipment (Switch the SCSI terminator power to the low level in the remote mode.), disconnect the circuit breaker after checking that Power LED is turned off. This procedure must be performed for replacement or maintenance of each component.

Figure 5.1 DF300 Cable Connection Specification

## 5.1.2 System configuration



Notes:

1. The multiple controller connection can connect up to eight subsystem including a host adapter.
2. The final subsystem connected by the cable must have a terminator attached.

Figure 5.2 System Configuration

## 5.2 Physical Interface

### 5.2.1 Cable Connectors

Table 5.1 Cable Connectors

	Number of wires	Name	Manufacturer's type/model	Interface specification
SCSI interface connector	50	AMP Amplimite 050 series	Connector: 749621-5 Cover: 749193-2	Single ended SCSI
	68	AMP Amplimite 050 series	Connector: 749111-6 Cover: 750752-1	Differential SCSI Single ended wide SCSI Differential ended SCSI
AC power connector	–	Inlet connector single phase,3 wires	EN60320 STANDARD SHEET C13 10A,250V, Appliance Inlet For CLASS 1 Equipment For Cold Conditions	

### 5.2.2 Cables

	Number of wires	Cable type and rating
Control signal cable	50	Shielded cable 25P × 28 AWG made by Hitachi Cable or equivalent; cable impedance 90±1 Ω
	68	Shielded cable 34P × 30 AWG made by Hitachi Cable or equivalent; cable impedance 90±1 Ω
AC power cable	1.5A, 125 V	

5.2.3 Device connector (pin type)

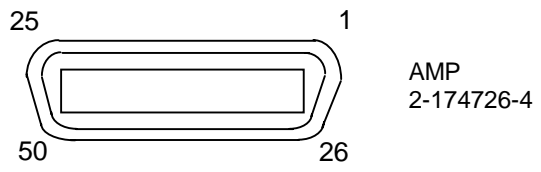


Figure 5.3 (a) SCSI Interface Device Connector

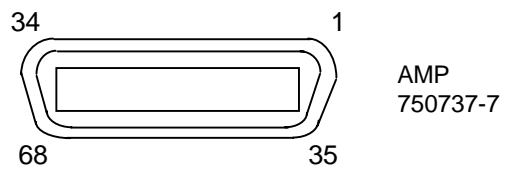


Figure 5.3 (b) Wide SCSI Interface Device Connector

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#### 5.2.4 Pin arrangement on the connector (for differential-wide SCSI and narrow SCSI)

01	+DB12	-DB12	35
02	+DB13	-DB13	36
03	+DB14	-DB14	37
04	+DB15	-DB15	38
05	+DBP1	-DBP1	39
06	GND	GND	40
07	+DB0	-DB0	41
08	+DB1	-DB1	42
09	+DB2	-DB2	43
10	+DB3	-DB3	44
11	+DB4	-DB4	45
12	+DB5	-DB5	46
13	+DB6	-DB6	47
14	+DB7	-DB7	48
15	+DBP	-DBP	49
16	DIFFSENS	GND	50
17	TERMPWR (Note 1,2)	TERMPWR (Note 1,2)	51
18	TERMPWR (Note 1)	TERMPWR (Note 1)	52
19	OPEN	OPEN	53
20	+ATN	-ATN	54
21	GND	GND	55
22	+BSY	-BSY	56
23	+ACK	-ACK	57
24	+RST	-RST	58
25	+MSG	-MSG	59
26	+SEL	-SEL	60
27	+C/D	-C/D	61
28	+REQ	-REQ	62
29	+I/O	-I/O	63
30	GND	GND	64
31	+DB8	-DB8	65
32	+DB9	-DB9	66
33	+DB10	-DB10	67
34	+DB11	-DB11	68

Note 1: If TERMPWR is not used, set OPEN (NOT USE).

Note 2: In the case of connecting the pins of No. 06 to 30 and No. 40 to 64 with the device for Narrow SCSI, be sure not to connect the pin of No. 17 with one of No. 51.

(For single-ended narrow SCSI)

01	GND	-DB0	26
02	GND	-DB1	27
03	GND	-DB2	28
04	GND	-DB3	29
05	GND	-DB4	30
06	GND	-DB5	31
07	GND	-DB6	32
08	GND	-DB7	33
09	GND	-DBP	34
10	GND	GND	35
11	GND	GND	36
12	OPEN	OPEN	37
13	OPEN	TERMPWR (Note)	38
14	OPEN	OPEN	39
15	GND	GND	40
16	GND	-ATN	41
17	GND	GND	42
18	GND	-BSY	43
19	GND	-ACK	44
20	GND	-RST	45
21	GND	-MSG	46
22	GND	-SEL	47
23	GND	-C/D	48
24	GND	-REQ	49
25	GND	-I/O	50

Note: If TERMPWR is not used, set OPEN (NOT USE).

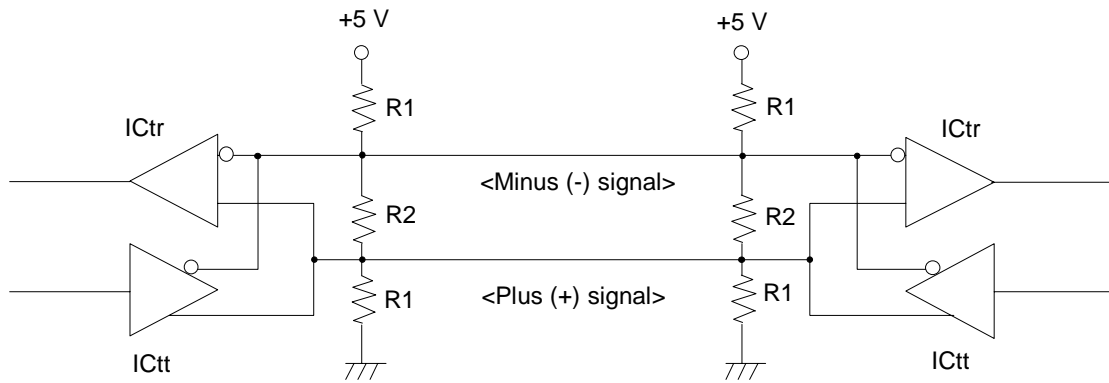
(For single-ended wide SCSI)

01	GND	-DB12	35
02	GND	-DB13	36
03	GND	-DB14	37
04	GND	-DB15	38
05	GND	-DBP1	39
06	GND	-DB0	40
07	GND	-DB1	41
08	GND	-DB2	42
09	GND	-DB3	43
10	GND	-DB4	44
11	GND	-DB5	45
12	GND	-DB6	46
13	GND	-DB7	47
14	GND	-DBP	48
15	GND	GND	49
16	GND	GND	50
17	TERMPWR (Note 1,2)	TERMPWR (Note1,2)	51
18	TERMPWR (Note 1)	TERMPWR (Note 1)	52
19	OPEN	OPEN	53
20	GND	GND	54
21	GND	-ATN	55
22	GND	GND	56
23	GND	-BSY	57
24	GND	-ACK	58
25	GND	-RST	59
26	GND	-MSG	60
27	GND	-SEL	61
28	GND	-C/D	62
29	GND	-REQ	63
30	GND	-I/O	64
31	GND	-DB8	65
32	GND	-DB9	66
33	GND	-DB10	67
34	GND	-DB11	68

Note 1: If TERMPWR is not used, set OPEN (NOT USE).

Note 2: In the case of connecting the pins of No. 06 to 30 and No.40 to64 with the device for Narrow SCSI, be sure not to connect the pin of No. 17 with one of No. 51.

### 5.2.5 Interface circuit (for differential-ended SCSI)



ICtt: EIA RS485 referenced

ICtr: EIA RS485 referenced

R1: 330  $\Omega$ ,  $\pm 5\%$

R2: 150  $\Omega$ ,  $\pm 5\%$

Figure 5.4 Interface Circuit

### 5.2.6 Interface characteristics (for differential-ended SCSI)

#### (1) Input characteristics

II (Input current for both plus (+) and minus (-) terminals)  $\pm 2.0$  mA or less

Max. input capacitor 25 pF or less

Note) Input voltage -7 to 12 VDC

#### (2) Output characteristics

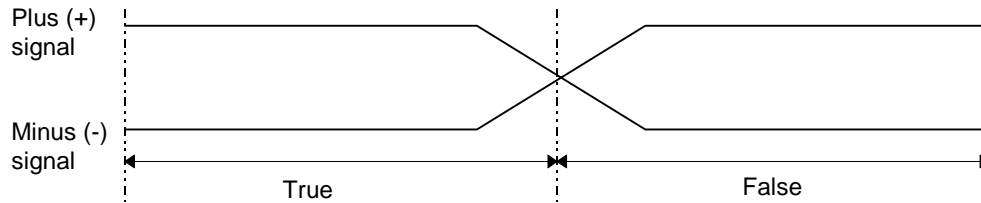
VOL (Low output voltage) 1.7 V or less (IOL = 55 mA)

VOH (High output voltage) 2.7 V or more (IOH = -55 mA)

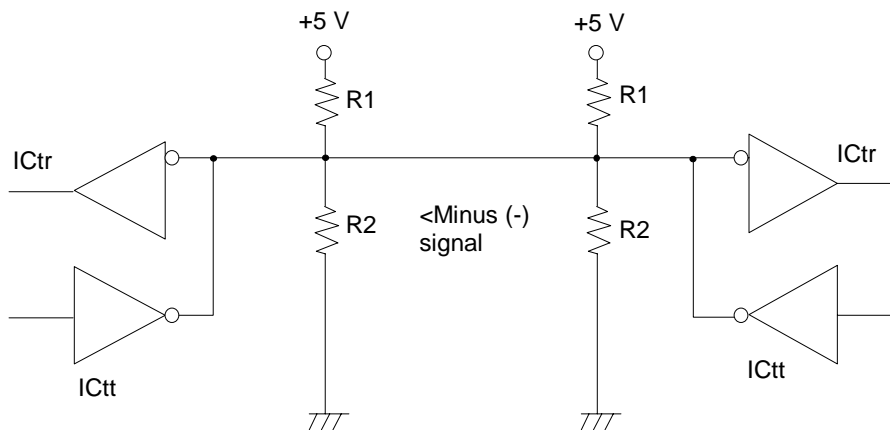
VOD (Operating voltage) 1.0 V or more (Same phase voltage = -7 to 12 V)

### (3) Logical truth and false

When plus (+) signal is higher than minus (-) signal, that defines true, on the other hand minus (-) signal is higher than plus (+) signal is false.



### 5.2.7 Interface circuit (for single-ended SCSI)



ICtt: SN438 or equivalent

ICtr: SN74CS240 or equivalent

R1: 220  $\Omega$ ,  $\pm 5\%$

R2: 330  $\Omega$ ,  $\pm 5\%$

Figure 5.5 Interface Circuit

### 5.2.8 Interface characteristics (for single-ended SCSI)

#### (1) Input characteristics

"L" level 0.0 to 0.8 VDC

"H" level 2.0 to 5.25 VDC

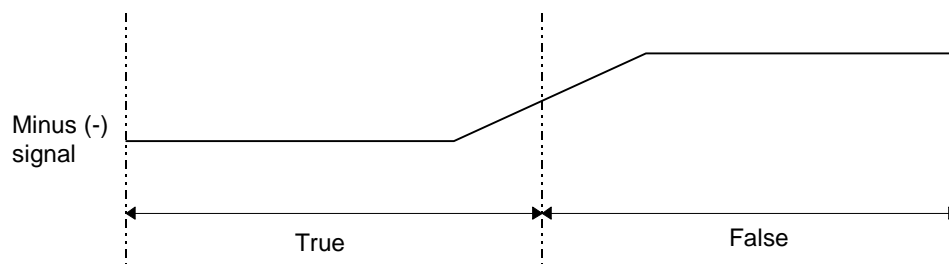
Input load (IIL) -0.4 mA max.

(2) Output characteristics

VOL (low output voltage)	0.0 to 0.4 VDC
VOH (high output voltage)	2.5 to 5.25 VDC
I <sub>OL</sub> (output current)	48 mA

(3) Logical true and false

All signals are active low (true = "L")



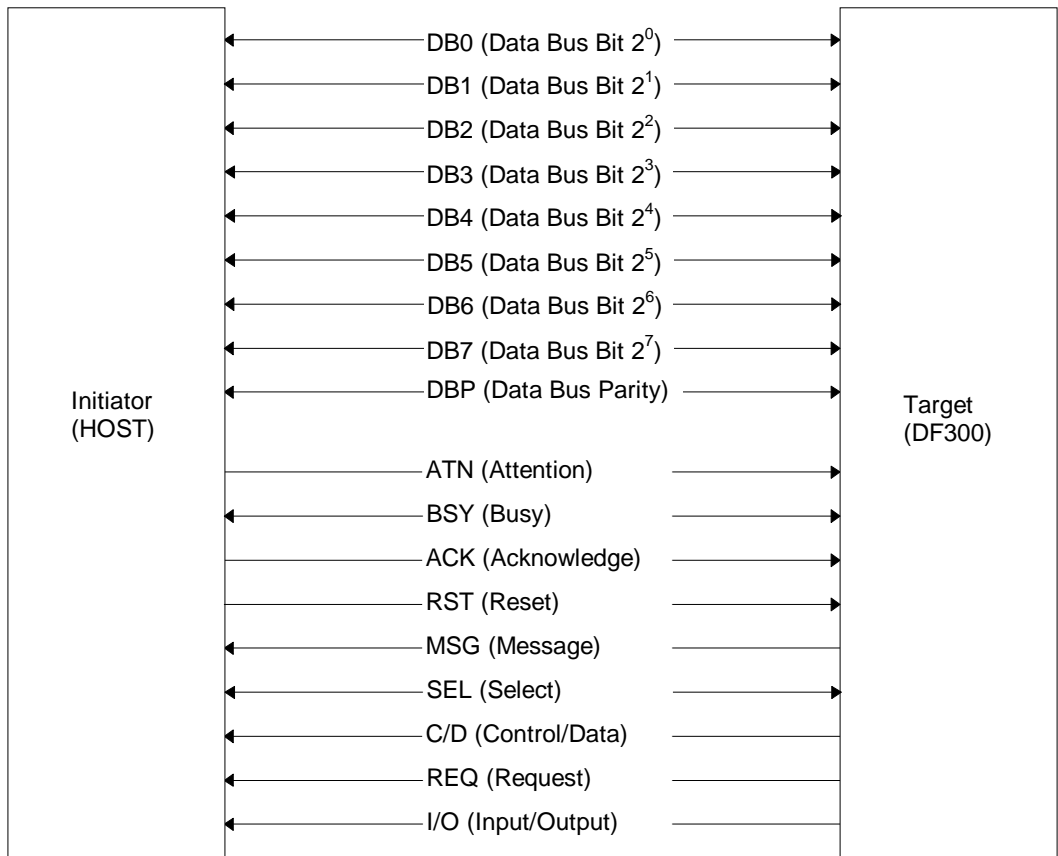
### 5.3 SCSI Bus

#### 5.3.1 SCSI bus signals

SCSI-2 bus interface (ANSI standard X3T9.2/86-109, REV. 10E) is used to connect between an Initiator and a Target.

Figure 5.6 (a) shows SCSI bus signal lines, Figure 5.6 (b) shows wide SCSI bus signal lines and meaning of each signal is shown in Table 5.2.

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→ : Signals issued from the initiator to the target.

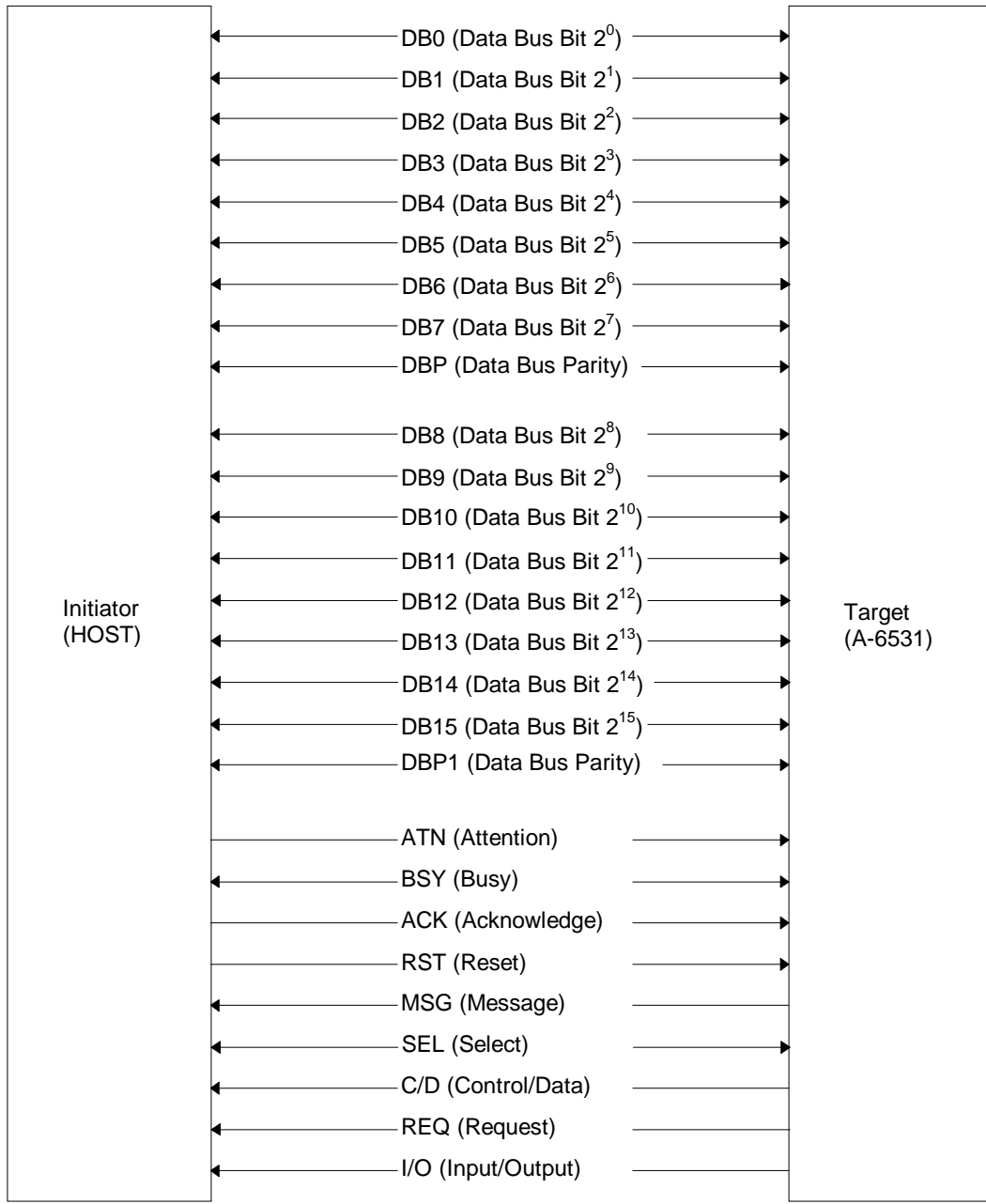
← : Signals issued from the target to the initiator.

↔ : Bi-directional signals

Figure 5.6 (a) SCSI Bus Signals

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# Wide SCSI Bus Signals



- : Signals issued from the Initiator to the Target.
- ← : Signals issued from the Target to the Initiator.
- ↔ : Bi-directional signals

Figure 5.6 (b) Wide SCSI Bus Signals

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Table 5.2 SCSI Bus Signal Sources

Classify	Signal name	Description
Signals controlled by the Target	I/O (Input/Output)	<ul style="list-style-type: none"> <li>Denotes a direction of information flow on the data bus.                             <ul style="list-style-type: none"> <li>I/O = 1: Target to Initiator</li> <li>I/O = 0: Initiator to Target</li> </ul> </li> <li>The Target distinguishes the Initiator                             <ul style="list-style-type: none"> <li>I/O = 1: Reselection (The Target reconnects with the Initiator.)</li> <li>I/O = 0: Selection (The Initiator selects the Target)</li> </ul> </li> </ul>
	C/D (Control/Data)	<ul style="list-style-type: none"> <li>Denotes sorts of information on the data bus.                             <ul style="list-style-type: none"> <li>C/D = 1: Command, Status and Message</li> <li>C/D = 0: Data</li> </ul> </li> </ul>
	MSG (Message)	<ul style="list-style-type: none"> <li>When MSG=1 means that the SCSI bus is in message phase.</li> </ul>
Signals controlled by the Initiator and the Target	BSY (Busy)	<ul style="list-style-type: none"> <li>When BSY=1 means that the SCSI bus is busy.</li> </ul>
	SEL (Select)	<ul style="list-style-type: none"> <li>Is a control signal to select Selection or Reselection.</li> </ul>
Hand shake signals between the Initiator and the Target	REQ (Request)	<ul style="list-style-type: none"> <li>Is used to transfer the information on the data bus accompanied with ACK.</li> <li>The Target renders REQ=1 each data byte so that the data transfer is carried out between the Initiator.</li> </ul>
	ACK (Acknowledge)	<ul style="list-style-type: none"> <li>Is used to transfer the information on the data bus accompanied with REQ.</li> <li>The Initiator renders ACK=1 in response to REQ when getting ready to data sending out or receiving.</li> <li>The Initiator is required to render ACK=0 in response to REQ=0 in order to completing the hand-shaking.</li> </ul>
Signals controlled by the Initiator	RST (Reset)	<ul style="list-style-type: none"> <li>Is Target reset signal, when setting RST=1 the Target will become an initial status.</li> </ul>
	ATN (Attention)	<ul style="list-style-type: none"> <li>When ATN=1 means that the Initiator has a message to send to the Target.</li> </ul>

Table 5.2 SCSI Bus Signal Sources (continued)

Classify	Signal name	Description
Data bus signals	DB7 to DB0 (Data Bus Bit 2 <sup>7</sup> )     (Data Bus Bit 2 <sup>0</sup> )	(SCSI bus)  <ul style="list-style-type: none"> <li>8 bits data bus</li> <li>These become SCSI ID bits to determine priority order at arbitration.</li> </ul> <p>The priority order of ID bits is depending upon the order of bit number ascending. (DB7=MSB, DB0=LSB)</p>
	DBP (Data Bus parity)	(SCSI bus)  <ul style="list-style-type: none"> <li>Data bus parity bit</li> <li>Odd parity</li> </ul>
	DB15 to DB0 (Data Bus Bit 2 <sup>15</sup> )     (Data Bus Bit 2 <sup>0</sup> )	(WIDE SCSI bus)  <ul style="list-style-type: none"> <li>8 bits data bus</li> <li>There become SCSI ID bits to determine priority order at arbitration.</li> </ul> <p>The priority order of ID bits is depending upon the order of bit number ascending. (DB15=MSB, DB0=LSB)</p>
	DBP, DBP1 (Data Bus Parity)	(WIDE SCSI bus)  <ul style="list-style-type: none"> <li>Data bus parity bit</li> <li>Odd parity</li> </ul>

### 5.3.2 Bus phases

The status on the SCSI bus operation between the Initiator and the Target can be classified into following eight phases.

#### (1) Bus Free phase

This phase stands for the SCSI bus in free then the Initiator is able to start up a new action and also the Target is able to reconnect with the Initiator. All signals are "0" status on the SCSI bus in the Bus Free phase.

#### (2) Arbitration phase

This phase is that the Initiator or the Target acquire the right to use the SCSI bus.

(3) Selection phase

This phase is that the Initiator selects the Target.

(4) Reselection phase

This phase is that the Target reconnect with the Initiator.

(5) Command phase

This phase is that the Target receives a command through the data bus from the Initiator.

(6) Data Transmission phase

This phase is to transmit the data to the Initiator through the data bus.

This phase is skipped at the command with no data transmission.

(7) Status phase

This phase is to transmit status bytes through the data bus after executing of the command from the Target to the Initiator.

(8) Message phase

This phase is to transmit message bytes through the data bus from the Target to the Initiator or reverse direction.

Through the eight phases described successively, a command is executed.

The Target informs the current phase which to be in by means of combination of three kinds of signals such as I/O, C/D and MSG to the Initiator regarding to the phases which transmit information such as command, data transmission, status and message phases.

The combination of I/O, C/D and MSG signals and each phase accommodation are described in Table 5.3.

Table 5.3 Information Transfer Phase

Signal name			Phase
MSG	C/D	I/O	
0	0	0	· Data phase (Sending out the data from the Initiator to the Target.)
0	0	1	· Data phase (Sending out the data from the Target to the Initiator.)
0	1	0	· Command phase (Receiving the command from the Initiator.)
0	1	1	· Status phase (Sending out the status from the Initiator.)
1	0	0	· Not used
1	0	1	· Not used
1	1	0	· Message Phase (Sending out the message from the Initiator to the Target.)
1	1	1	· Message phase (Sending out the message from the Target to the Initiator.)



### 5.3.3 SCSI bus timing

#### (1) Bus Free Phase

This phase is the phase in which the SCSI Bus is not busy, in no Arbitration system the phase is possible status to cause a new action (enter the selection phase), and also in Arbitration system it is possible status to enter the arbitration phase for the Initiator or the Target to get the right to use the Bus.

Time chart of the phase is shown in Figure 5.8, but the Bus Free phase begins at 400 ns later with "0" about SEL and BSY signals simultaneously.

Every Initiator or Target connected to the SCSI Bus needs to release entire interface signal within 800 ns from Bus Free phase beginning.

#### (2) Arbitration phase

This phase is to get the right to use the Bus line for the Initiator or the Target. The system can select the phase to present or not.

Time chart of the phase is shown in Figure 5.9 and explained as follows.

Explanation of the operation

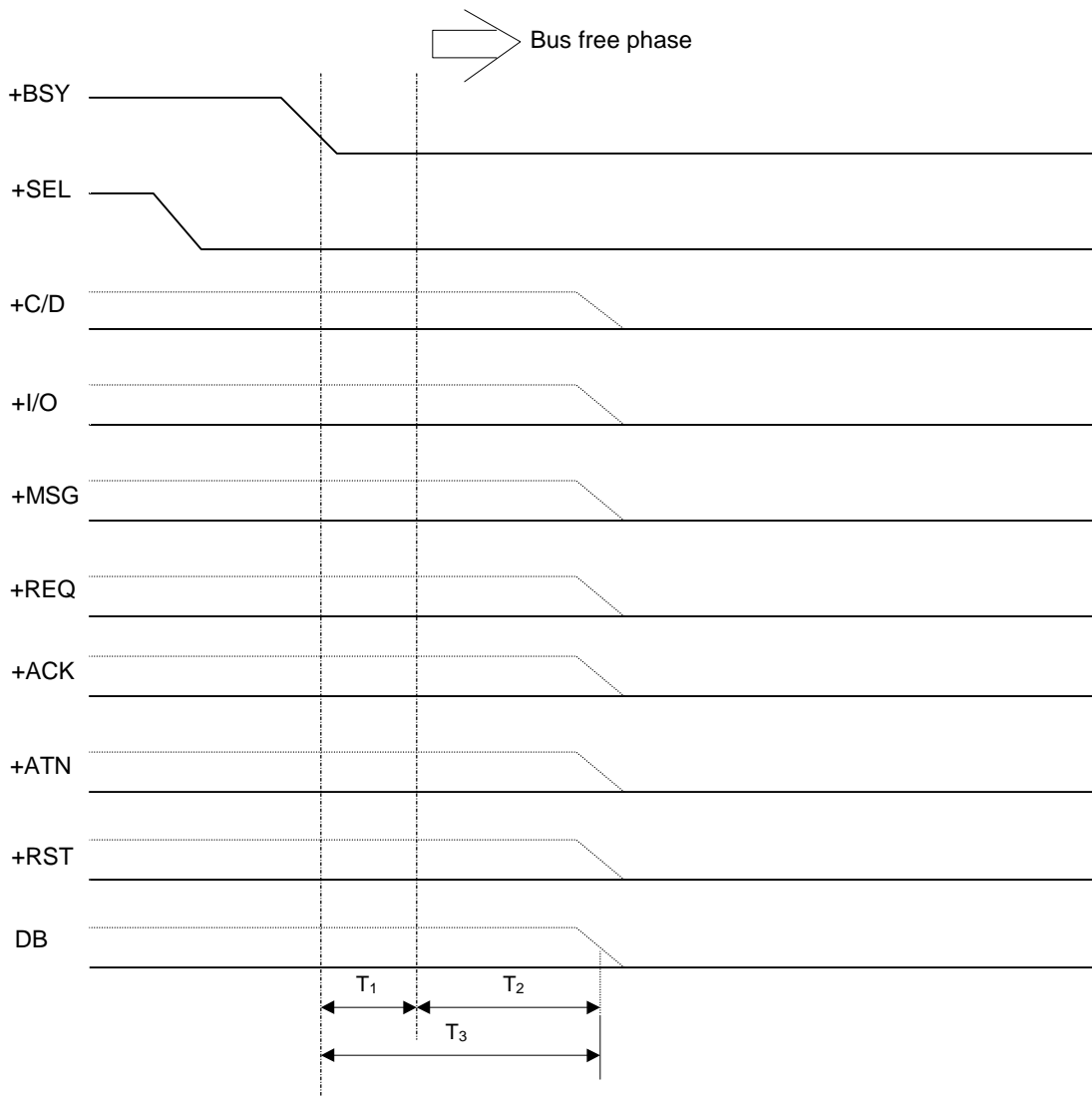
- ① Firstly the Initiator or the Target makes sure that the Bus is in Bus Free phase in order to get the right to use it.
- ② If the Bus Free Phase is detected, the Initiator or the Target raises BSY signal during 800 ns more later up to 1.8  $\mu$ s then sets its own address bits on the Data Bus.
- ③ When 2.4  $\mu$ s more time (SCSI-2 specification, 2.3  $\mu$ s more in SCSI-1) passed after BSY signal raising, the Initiator or the Target checks whether the address bit established on the data bus has higher priority than theirs or not.

Bit 7 has the highest priority and the priority descends in order toward bit 0. If the address bit which has higher priority than theirs is established, eventually it couldn't get the right to use the Bus therefore it should wait for next opportunity.

On the other hand no address bit with higher priority than its own address bit then it has gotten the right to use the BUS, the Initiator or the Target should raise SEL signal to show the passage.

When SEL signal is raised, another Initiator or Target which couldn't get the BUS must fall down entire signals in 800 ns.

Sub sequentially to the phase, proceeding to Selection phase or Reselection phase.



T<sub>1</sub>: Min. 400 ns (bus settle delay)

T<sub>2</sub>: Max. 800 ns (bus clear delay)

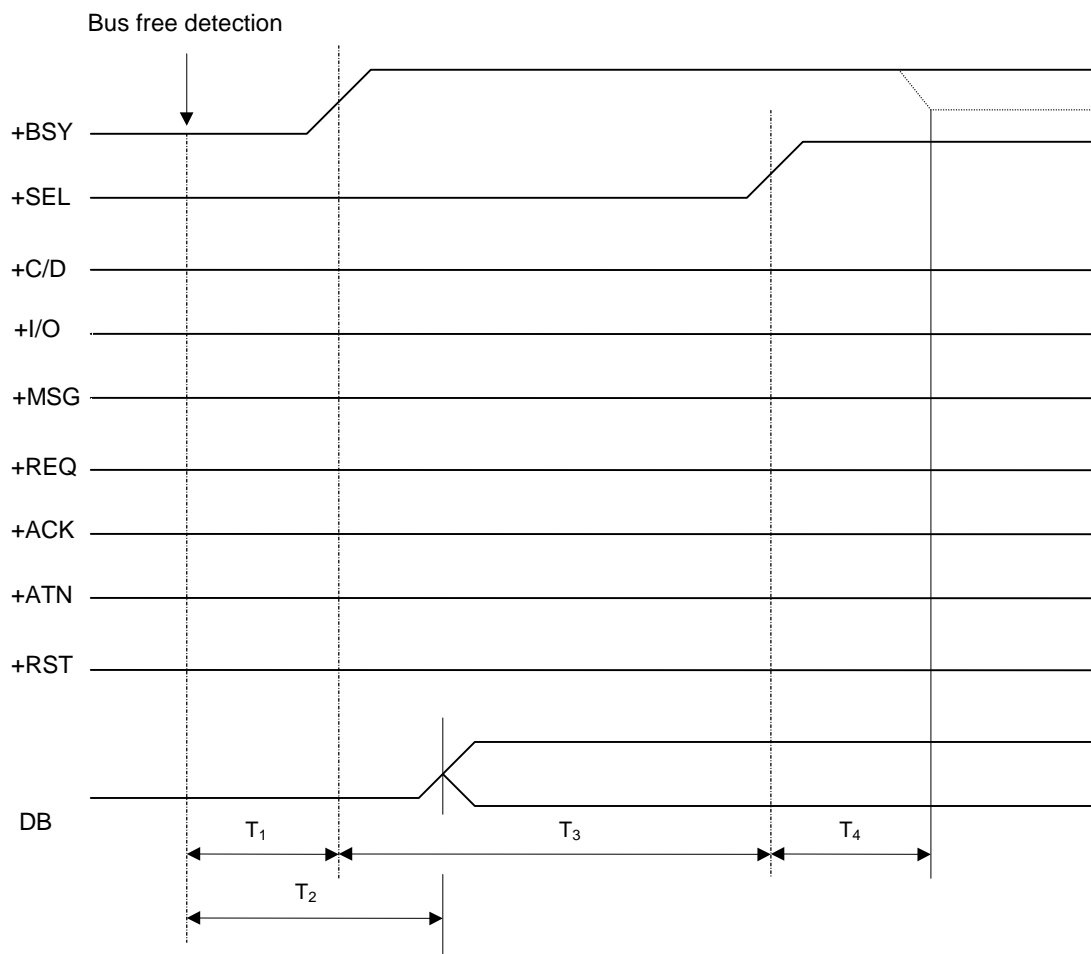
T<sub>3</sub>: Max. 1.2 μs (bus settle delay + bus clear delay)

Note: Every signal line should be released within 800 ns when the bus phase is changed to bus free phase.

This figure is drawn assuming that signals are active high (true = "H").

Figure 5.8 Bus Free Phase Time Chart

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$T_1, T_2$ : Min. 800 ns (Bus Free Delay) and Max. 1.8  $\mu$ s (Bus Set Delay)

$T_3$ : Min. 2.2  $\mu$ s (Arbitration Delay)

$T_4$ : Max. 800 ns (Bus Clear Delay)

Note: Arbitration Delay is the time to wait for that the BUS Devices take in bus data for purpose of participating in arbitration and determination then the bus data is checked and the Bus Device which won the arbitration should raise SEL signal.

This is drawn assuming that signals are active high (true = "H").

Figure 5.9 Arbitration Phase Time Chart

### (3) Selection Phase

Selection phase is the phase which follows Bus Free phase (in case of no arbitration system) or Arbitration phase.

It is the phase for the Initiator to select the Target.

Figure 5.10 shows the time chart for the Selection phase in the system with arbitration. The Selection phase operation is described as follows.

Explanation of the operation

- ① In the arbitration phase, the Initiator which got the right to use the Bus should set its own address bit and the Target's address bit on the data bus after 1.2  $\mu$ s more later from raising SEL signal. (Correct parity bit should have been added in the system which supports the parity on the data bus.)

In addition to, it renders BSY=0 after 90 ns more passed.

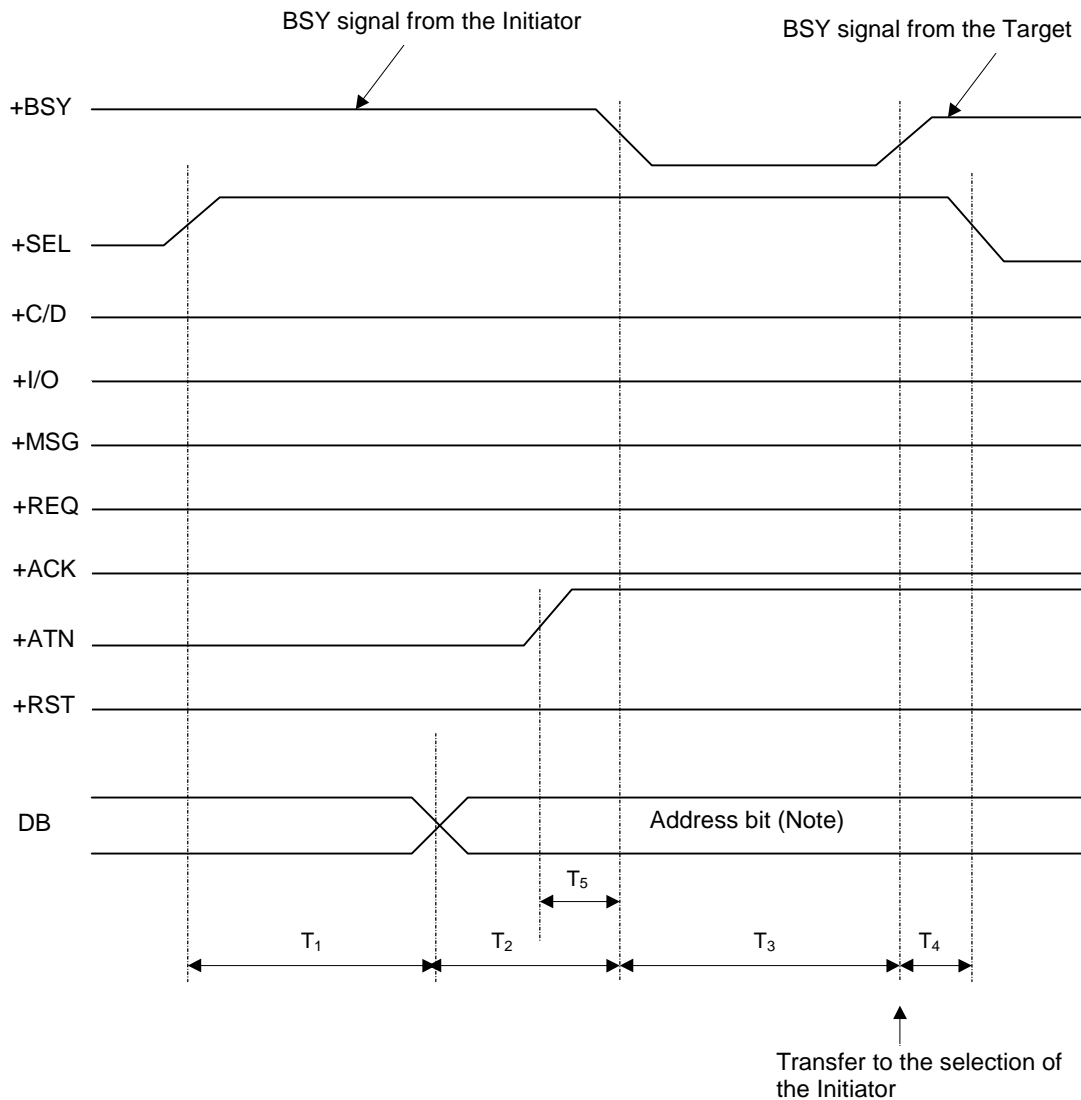
- ② When the Target detects above situation, it sets BSY=1 and responses this.

As to SEL signal, the Initiator renders SEL=0 after 90 ns more later from detecting of BSY=1 by the Target.

The Target cannot enter next operation unless detection of SEL=0 consequently the Initiator must render SEL=0.

ATN signal shown in the time chart should be raised prior to SEL=1 and BSY=0 when the Initiator shows the Target to support a message except COMMAND COMPLETE message.

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T<sub>1</sub>: Min. 1.2 μs (Bus Clear Delay + Bus Settle Delay)

T<sub>2</sub>: Min. 90 ns (Deskew Delay × 2)

T<sub>3</sub>: Min. 0 ns to Max. 250 ms (Selection Timeout Delay)

T<sub>4</sub>: Min. 90 ns (Deskew Delay × 2)

T<sub>5</sub>: Min. 0 ns

Note: The address bit of the Initiator and the address bit of the Target are usually set.

The address bit of the Target is only set at Signal Initiator Option selected.

This figure is drawn assuming that signals are active high (true = "H").

Figure 5.10 Selection Phase Time Chart

#### (4) Reselection Phase

Reselection phase is the phase which follows the Arbitration phase and also the Target select the Initiator in order to recovering the Bus interface with the Initiator when the Target disconnects the BUS on the way of Command execution.

Time chart of the Reselection phase is shown in Figure 5.11 and the Reselection phase is described as follows.

Explanation of the operation

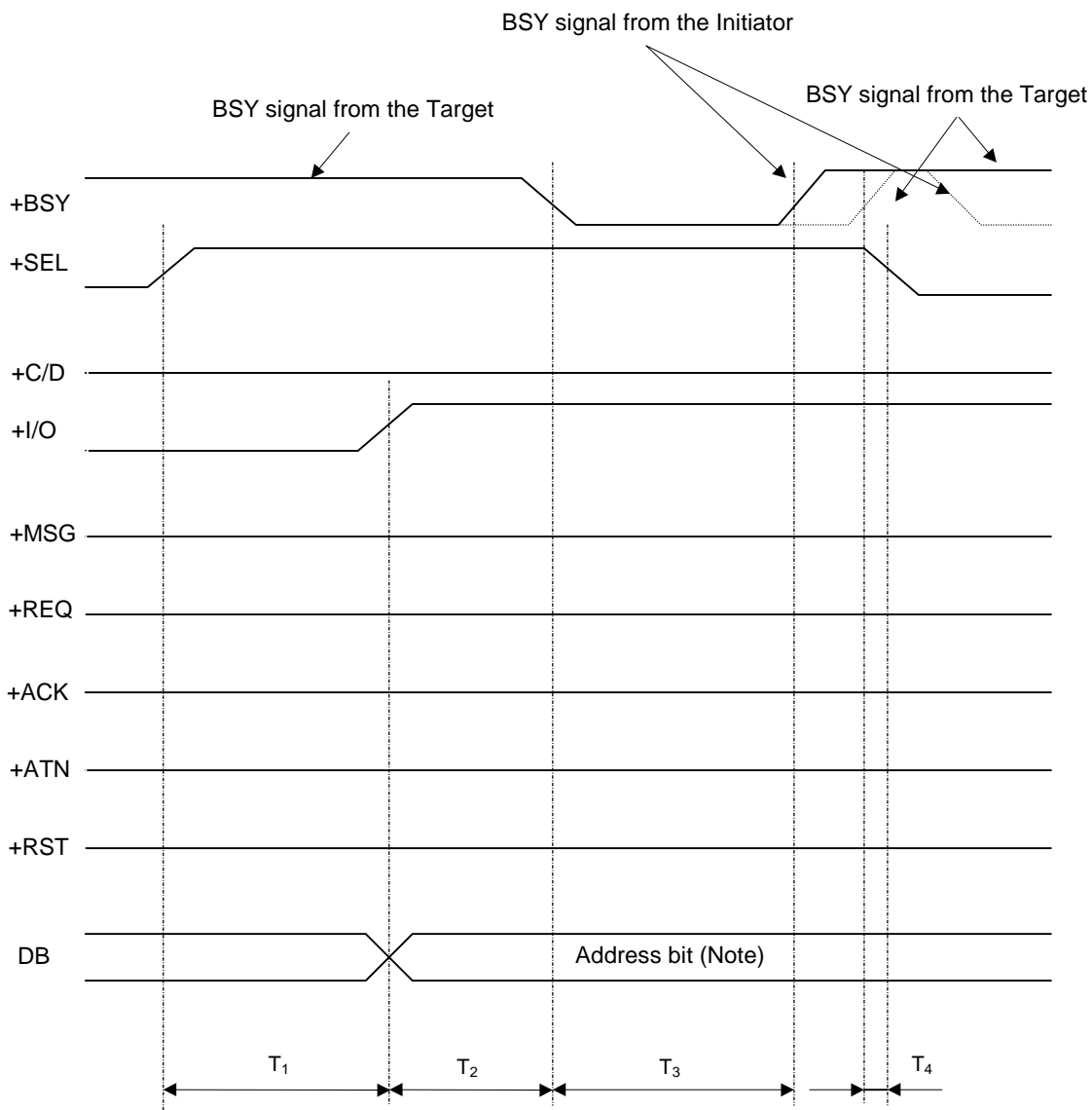
- ① In the arbitration phase, the Target which got the right to use the BUS should set its own address bit and the Initiator's address bit with parity bit added on the data bus and raise I/O signal after 1.2  $\mu$ s more later from rendering SEL=1.

In addition to, it renders BSY=0 after 90 ns or more passed.

- ② When the Initiator detects above situation, it sets BSY=1 as response.
- ③ When BSY signal from the Initiator is detected then the Target also renders BSY=1 itself and 90 ns more later it renders SEL=0.
- ④ The Initiator detects SEL=0 then sets own BSY signal to "0".

The Target waits for BSY signal response for 250 ms from the Initiator at the Reselection, even though no response, it releases the Bus and clears current command executing.

The Initiator must render BSY=1 in 200  $\mu$ s from identification of the Reselection (reference of the address bit on the Bus) by the Target.



T<sub>1</sub>: Min. 1.2 μs (Bus Clear Delay + Bus Settle Delay)

T<sub>2</sub>: Min. 90 ns (Deskew Delay × 2)

T<sub>3</sub>: Min. 400 ns (Bus Settle Delay) to Max. 250 ms (Selection Timeout Delay)

T<sub>4</sub>: Min. 90 ns (Deskew Delay × 2)

Note: Addresses of the Initiator and the Target are set.

This figure is drawn assuming that signals are active high (true = "H").

Figure 5.11 Reselection Phase Time Chart

## (5) Information transfer phase

This phase carries out to transmit information such as commands, data, status and messages between the Initiator and the Target.

The information transmission phase can be classified into an information receiving phase (Target to Initiator) and an information transmitting phase (Initiator to Target) based on transfer direction.

Time chart of the information receiving phase is shown in Figure 5.12 and that of the information transmitting phase is shown in Figure 5.13. The information transmission phase is described as follows.

### Explanation of the operation

In the information transmission phase, control signals such as C/D, I/O and MSG must be established prior to REQ rising in first handshake 400 ns more before, and also they must succeed to have been establishing till ACK in the last handshake falling down.

#### (A) Information receiving phase (data read, status read and message in)

① The Target makes C/D=0, I/O=1 and MSG=0/1.

(Refer to Table 5.2 Information transmission phase about values of C/D and MSG)

② In next step, the Target sets transmitting data on the data bus then it renders REQ=1 55 ns passed later.

The data is ensured until detecting response ACK=1 of the Initiator.

③ When the Initiator detects REQ=1, it reads data on the data bus then makes ACK=1.

④ When the Target detects ACK=1 then makes REQ=0.

⑤ When detecting REQ=0, the Initiator renders ACK=0.

Above ② to ⑤ hand shaking steps should repeat as necessary when multiple bytes are transmitted at a time to the Initiator.

(B) Information transmitting (data write, command and message out)

① The Target makes C/D=0/1, I/O=0 and MSG=0/1.

(Refer to Table 5.2 Information transmitting phase about values of C/D and MSG)

② In next step, the Target renders REQ=1.

③ When the Initiator detects REQ=1, it sets data on the data bus then it renders ACK=1 55 ns passed later.

The data is ensured until detecting response REQ=0 of the Target.

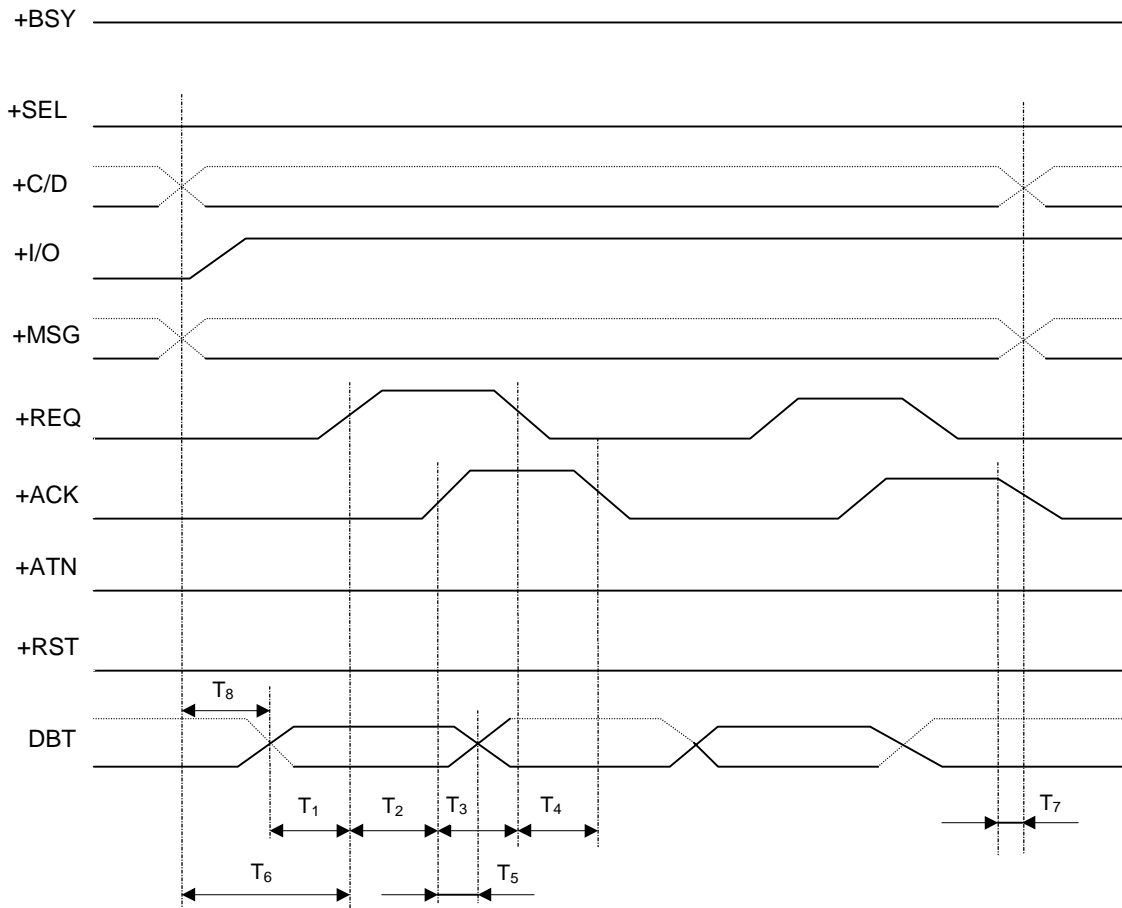
④ When detecting ACK=1, the Initiator reads data on the bus data then makes REQ=0.

⑤ When detecting REQ=0, the Initiator makes ACK=0.

Above ② to ⑤ hand shaking steps should repeat at necessary when multiple bytes are receiving at a time by the Target.

The Initiator should set ATN signal off between REQ=1 and ACK=0 in the last REQ/ACK signal handshaking in the MESSAGE OUT phase.

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T<sub>1</sub>: Min. 55 ns (Deskew Delay + Cable Skew Delay)

T<sub>2</sub>: Min. 0 ns

T<sub>3</sub>: Min. 0 ns

T<sub>4</sub>: Min. 0 ns

T<sub>5</sub>: Min. 0 ns

T<sub>6</sub>: Min. 400 ns (Bus Settle Delay)

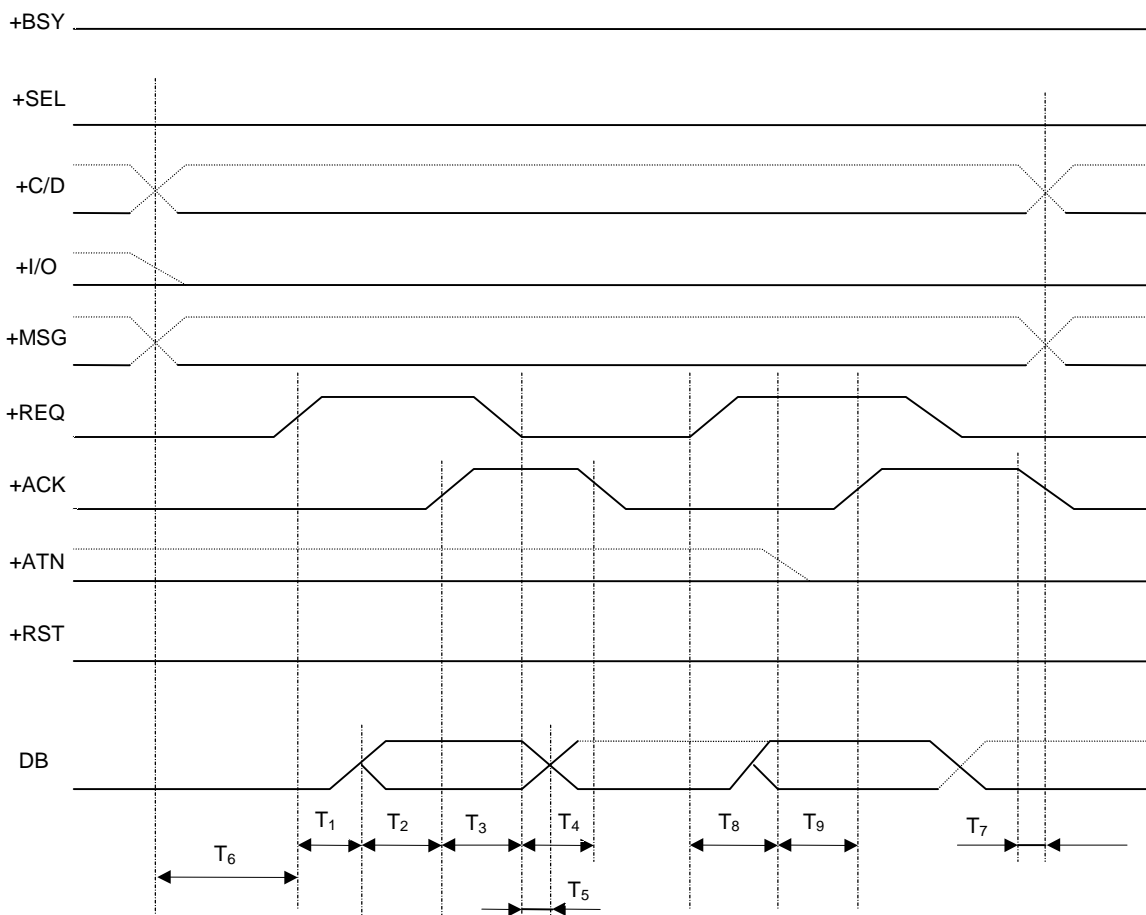
T<sub>7</sub>: Min. 0 ns

T<sub>8</sub>: Min. 0 ns

Note: This figure is drawn assuming that signals are active high (true = "H").

Figure 5.12 Information Receiving Phase Time Chart  
(Data Read, Status Read and Message In)

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T<sub>1</sub>: Min. 0 ns

T<sub>2</sub>: Min. 55 ns (Deskew Delay + Cable Skew Delay)

T<sub>3</sub>: Min. 0 ns

T<sub>4</sub>: Min. 0 ns

T<sub>5</sub>: Min. 0 ns

T<sub>6</sub>: Min. 400 ns (Bus Settle Delay)

T<sub>7</sub>: Min. 0 ns

T<sub>8</sub>: Min. 0 ns

T<sub>9</sub>: Min. 0 ns

Note: This figure is drawn assuming that signals are active high (true = "H").

Figure 5.13 Information Transmitting Phase Time Chart  
(Data Write, Command and Message Out)

(6) Synchronous data transmission (FAST Synchronous data transmission)

Synchronous data transmission is only applied to data phase

It is required to set up REQ/ACK offset and transmission period to perform it by synchronous message protocol.

Refer to "Hitachi small size disk unit SCSI interface specifications" for details. The REQ/ACK offset stipulates the lowest value of REQ pulses that the Target can transmit beyond the number of ACK pulses received from the Initiator.

When the number of REQ pulses is over the REQ/ACK offset value plus the number of ACK pulses then the Target quits to transmit until it receives next ACK pulses.

The number of REQ pulses and ACK's need to coincide in order to complete the data transmission correctly.

The Synchronous data receiving phase is shown in Figure 5.14 and the Synchronous data transmission in Figure 5.15.

The Operation of them are described as follows.

Explanation of the operation

Uses of REQ and ACK are specified as follows.

- 1) Time for "1" More than 30 ns
- 2) Time for "0" More than 30 ns
- 3) Pulse period More than data transmission time specified in the Message protocol.

(A) Data receiving phase (transmit to the Initiator)

- ① The Target makes C/D=0, I/O=1 and MSG=0.
- ② The Target sets data to transmit on the data bus then 55 ns more (25 ns more at Fast) later, it issues REQ pulse.

In addition the data is held on for 100 ns (min. 35 ns at Fast) from REQ+1.

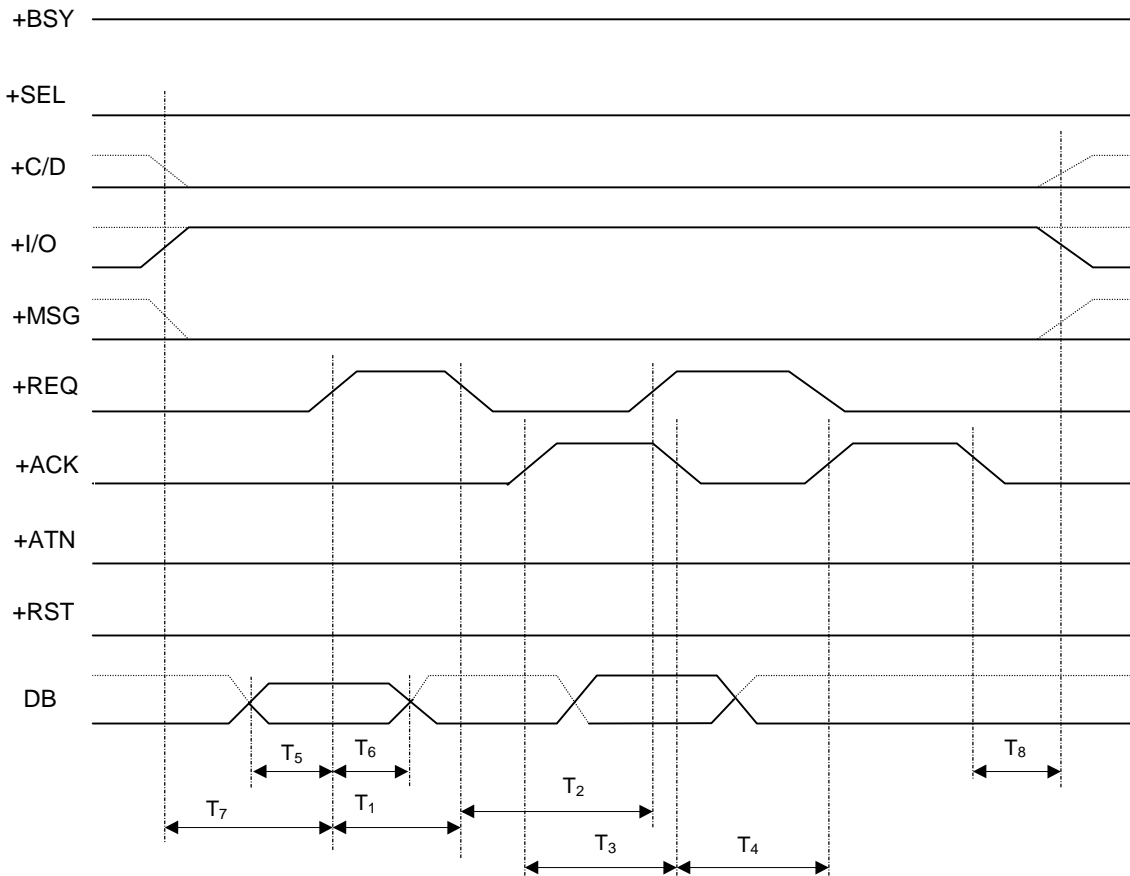
The Target also issues REQ pulses up to maximum REQ/ACK offset value without response of ACK pulse.

- ③ The Initiator receives contents of the data bus within 45 ns (within 10 ns at Fast) each REQ pulse receiving from REQ=1 setting then responds with ACK pulse.
- ④ After the Target issued REQ pulses for the number of data transmission intended and then it waits for ACK pulse response, the data transmission completes when the number of pulses coincide.

(B) Data phase (transmission from the Initiator)

- ① The Target makes C/D=0, I/O=0 and MSG=0.
- ② In next step, the Target issues REQ pulses up to maximum REQ/ACK offset values.
- ③ The Initiator transmits one byte data each REQ pulse receiving. After receiving REQ pulses, the Initiator sets data on the data bus then 55 ns more (25 ns more at Fast) later, it issues ACK pulse. The data must be held on for 100 ns more (35 ns at Fast).
- ④ After the Target issued REQ pulses for the number of data transmission intended and then it waits for ACK pulse response, the data transmission completes when the number of pulses coincide.

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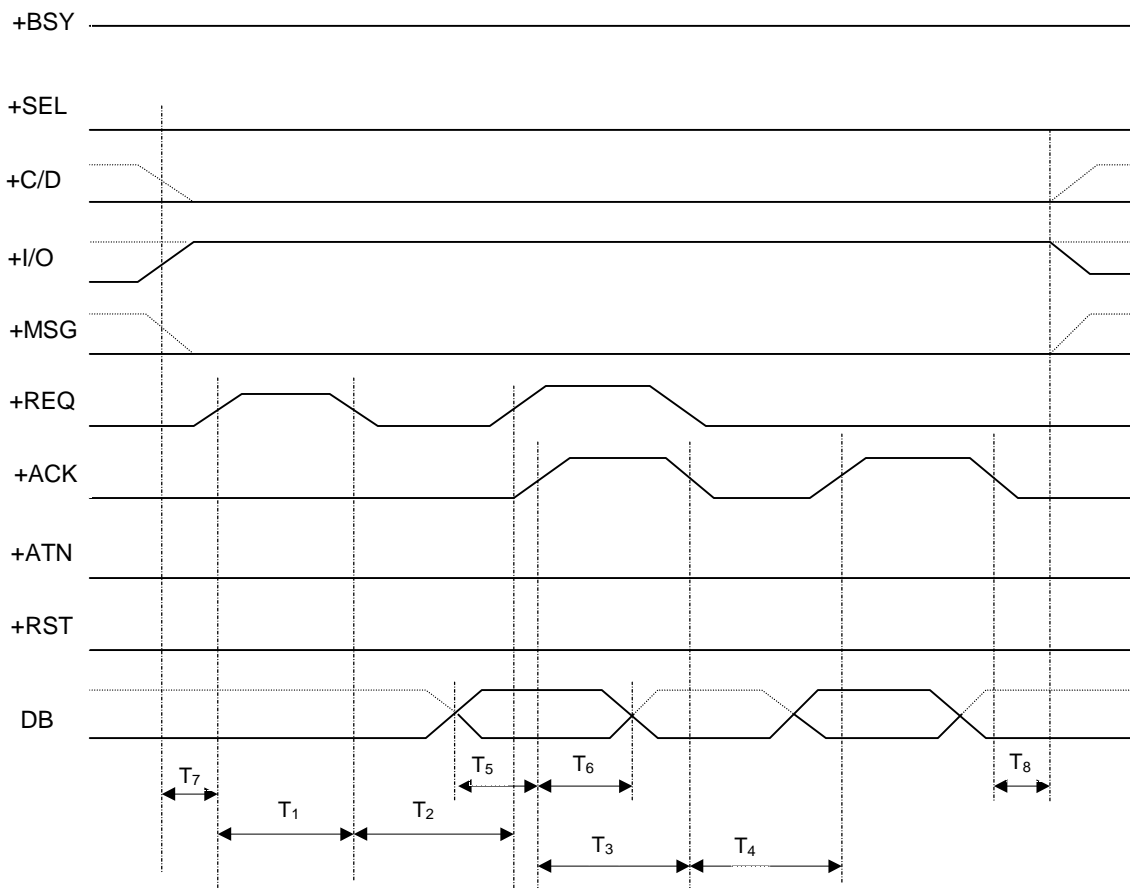


(At Fast)

- |  |                               |
|--|-------------------------------|
| T <sub>1</sub> : Min. 90 ns (Assertion Delay)                              | T <sub>1</sub> : Min. 30 ns   |
| T <sub>2</sub> : Min. 90 ns (Negation Delay)                               | T <sub>2</sub> : Min. 30 ns   |
| T <sub>3</sub> : Min. 90 ns (Assertion Delay)                              | T <sub>3</sub> : Min. 30 ns   |
| T <sub>4</sub> : Min. 90 ns (Negation Delay)                               | T <sub>4</sub> : Min. 30 ns   |
| T <sub>5</sub> : Min. 55 ns (Deskew Delay + Cable Skew Delay)              | T <sub>5</sub> : Min. 25 ns   |
| T <sub>6</sub> : Min. 100 ns (Deskew Delay + Cable Skew Delay + Hold Time) | T <sub>6</sub> : Min. 35 ns   |
| T <sub>7</sub> : Min. 400 ns (Bus Settle Delay)                            | T <sub>7</sub> : Same as left |
| T <sub>8</sub> : Min. 0 ns   | T <sub>8</sub> : Same as left |

Note: This figure is drawn assuming that signals are active high (true = "H").

Figure 5.14 Synchronous Data Receiving Phase



(At Fast)

T<sub>1</sub>: Min. 90 ns (Assertion Delay)

T<sub>2</sub>: Min. 90 ns (Negation Delay)

T<sub>3</sub>: Min. 90 ns (Assertion Delay)

T<sub>4</sub>: Min. 90 ns (Negation Delay)

T<sub>5</sub>: Min. 55 ns (Deskew Delay + Cable Skew Delay)

T<sub>6</sub>: Min. 100 ns (Deskew Delay + Cable Skew Delay + Hold Time)

T<sub>7</sub>: Min. 400 ns (Bus Settle Delay)

T<sub>8</sub>: Min. 0 ns

T<sub>1</sub>: Min. 30 ns

T<sub>2</sub>: Min. 30 ns

T<sub>3</sub>: Min. 30 ns

T<sub>4</sub>: Min. 30 ns

T<sub>5</sub>: Min. 25 ns

T<sub>6</sub>: Min. 35 ns

T<sub>7</sub>: Same as left

T<sub>8</sub>: Same as left

Note: This figure is drawn assuming that signals are active high (true = "H").

Figure 5.15 Synchronous Data Transmission Phase

## 5.4 Reset Condition

This controller becomes an initial status as same as a status at power-on by rendering RST=1 (holding on for min. 25  $\mu$ s).

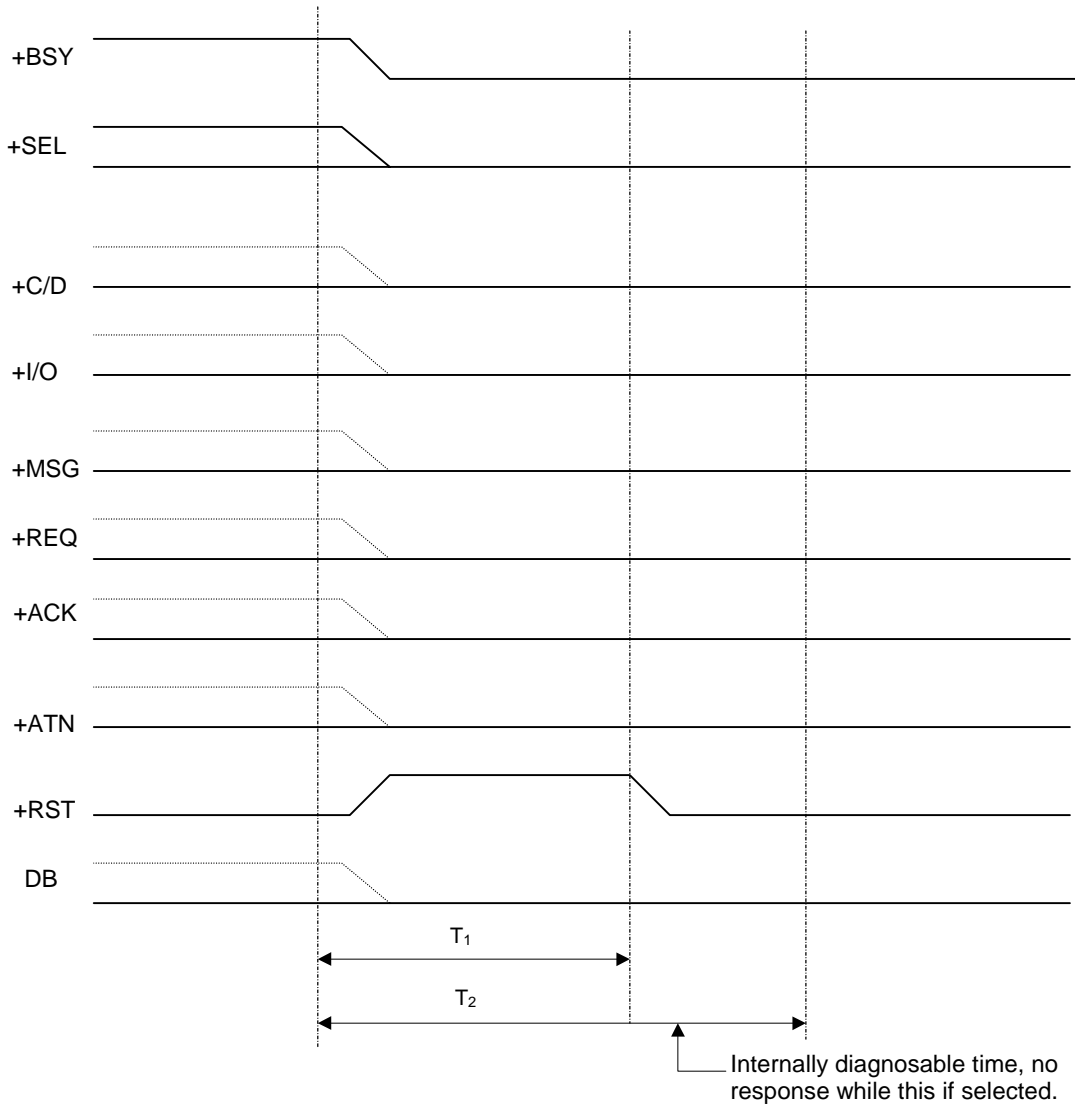
Becoming RST=1 makes the controller released entire SCSI Bus signal except RST signal and starts to internally diagnose. The controller does not respond for the while (250 ms) to selection from the Initiation.

Though the Host can set RST=1 at optional timing;

- (1) Entire uncompleted commands (including not only an executing command connected with the Initiator but also a cuing command) should be cleared.
- (2) Reserved status of the drive by RESERVE (16)H is released.
- (3) Parameters by MODE SELECT (15)H become an initial value at power-on time (when saving completes, it goes to saved value.).

Figure 5.16 shows Time chart regarding to Reset.

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T<sub>1</sub>: Min. 25 μs

T<sub>2</sub>: Max. 250 ms

Note: This figure is drawn assuming that signals are active high (true = "H").

Figure 5.16 Reset Time Chart

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## 5.5 Overview of Software

### 5.5.1 Supported command

The controller supports the commands of groups 0 to 2 as shown in Table 3.7.

Table 3.7 Supported Commands (1/4)

Operation Code	Group 0 Command Name
00 <sub>H</sub>	TEST UNIT READY
01 <sub>H</sub>	REZERO UNIT
03 <sub>H</sub>	REQUEST SENSE
04 <sub>H</sub>	FORMAT UNIT
07 <sub>H</sub>	REASSIGN BLOCKS
08 <sub>H</sub>	READ
0A <sub>H</sub>	WRITE
0B <sub>H</sub>	SEEK
12 <sub>H</sub>	INQUIRY
15 <sub>H</sub>	MODE SELECT
16 <sub>H</sub>	RESERVE
17 <sub>H</sub>	RELEASE
1A <sub>H</sub>	MODE SENSE
1B <sub>H</sub>	START/STOP UNIT
1C <sub>H</sub>	RECEIVE DIAGNOSTIC RESULTS
1D <sub>H</sub>	SEND DIAGNOSTIC

Table 3.7 Supported Commands (2/4)

Operation Code	Group 1 Command Name
25 <sub>H</sub>	READ CAPACITY
28 <sub>H</sub>	READ (EXTEND)
2A <sub>H</sub>	WRITE (EXTEND)
2B <sub>H</sub>	SEEK (EXTEND)
2E <sub>H</sub>	WRITE AND VERIFY
2F <sub>H</sub>	VERIFY
35 <sub>H</sub>	SYNCHRONIZE CACHE
37 <sub>H</sub>	READ DEFECT DATA
3B <sub>H</sub>	WRITE BUFFER
3C <sub>H</sub>	READ BUFFER

Table 3.7 Supported Commands (3/4)

Operation Code	Group 2 Command Name
55 <sub>H</sub>	MODE SELECT (10)
5A <sub>H</sub>	MODE SENSE (10)

Table 3.7 Supported Commands (4/4)

Operation Code	Group 7 Command Name
E8 <sub>H</sub>	READ WITH SKIP MASK
EA <sub>H</sub>	WRITE WITH SKIP MASK

Table 3.8 shows the commands not supported by this controller for the direct access devices defined in the ANSI SCSI standards.

Table 3.8 Unsupported Commands

Operation Code	Command Name (alphabetical order)	Remarks
40 <sub>H</sub>	CHANGE DEFINITION	
39 <sub>H</sub>	COMPARE	
18 <sub>H</sub>	COPY	
3A <sub>H</sub>	COPY AND VERIFY	
36 <sub>H</sub>	LOCK-UNLOCK-CACHE	
4C <sub>H</sub>	LOG SELECT	Support is being examined as enhancements.
4D <sub>H</sub>	LOG SENSE	Support is being examined as enhancements.
34 <sub>H</sub>	PRE-FETCH	
1E <sub>H</sub>	PREVENT-ALLOW MEDIUM REMOVAL	
3E <sub>H</sub>	READ LONG	
31 <sub>H</sub>	SEARCH DATA EQUAL	
30 <sub>H</sub>	SEARCH DATA HIGH	
32 <sub>H</sub>	SEARCH DATA LOW	
33 <sub>H</sub>	SET LIMITS	
3F <sub>H</sub>	WRITE LONG	
41 <sub>H</sub>	WRITE SAME	Support is being examined as enhancements.

## 5.5.2 Message

Table 4.1 shows the messages supported by a controller.

Table 4.1 Message Code

Code	Description	Direction	Remarks
00 <sub>H</sub>	COMMAND COMPLETE	In	
01 <sub>H</sub>	EXTENDED MESSAGE	In Out	
02 <sub>H</sub>	SAVE DATA POINTER	In	
03 <sub>H</sub>	RESTORE POINTERS	In	
04 <sub>H</sub>	DISCONNECT	In	
05 <sub>H</sub>	INITIATOR DETECTED ERROR	Out	
06 <sub>H</sub>	ABORT	Out	
07 <sub>H</sub>	MESSAGE REJECT	In Out	
08 <sub>H</sub>	NOOPERATION	Out	
09 <sub>H</sub>	MESSAGE PARITY ERROR	Out	
0A <sub>H</sub>	LINKED COMMAND COMPLETE	In	
0B <sub>H</sub>	LINKED COMMAND COMPLETE (WITH FLAG)	In	
0C <sub>H</sub>	BUS DEVICE RESET	Out	
0D <sub>H</sub>	ABORT TAG	Out	
0E <sub>H</sub>	CLEAR QUEUE	Out	
0F <sub>H</sub> -1F <sub>H</sub>	RESERVED CODES		
20 <sub>H</sub>	SIMPLE QUEUE TAG	In Out	2-byte message
21 <sub>H</sub>	HEAD OF QUEUE TAG	Out	2-byte message
22 <sub>H</sub>	ORDERED QUEUE TAG	Out	2-byte message
23 <sub>H</sub>	IGNORE WIDE RESIDUE	In	2-byte message
24 <sub>H</sub> -7F <sub>H</sub>	Reserved Code		
80 <sub>H</sub> -FF <sub>H</sub>	IDENTIFY	In Out	

In: Controller to Host

Out: Host to Controller

### 5.5.3 Status

The status byte is defined as shown in Tables 4.6 and 4.7. When each command terminates, this status byte will be reported from the controller to the host in the STATUS phase. If the command is cleared by the ABORT message, the ABORT TAG message, CLEAR QUEUE message, BUS DEVICE RESET message, or the RESET status (including POWER ON RESET), reporting will not be made.

Table 4.6 Status Byte

Bit	7	6	5	4	3	2	1	0
Byte								
0	R 0	R 0	Status Byte Code					R 0

R: Reserved

Table 4.7 Status Byte Code

Bit of Status Byte					Status
5	4	3	2	1	
0	0	0	0	0	GOOD
0	0	0	0	1	CHECK CONDITION
0	0	1	0	0	BUSY
0	1	0	0	0	INTERMEDIATE/GOOD
0	1	1	0	0	RESERVATION CONFLICT
1	0	1	0	0	QUEUE FULL

Shown below is the definition of the byte code statuses:

GOOD:

Indicates that the controller terminates a command normally.

## CHECK CONDITION

Indicates that a command terminates abnormally due to the error that sets sense data, the exception status, or the abnormal status. After reporting this status, the host can obtain detailed error information by issuing the REQUEST SENSE command.

The REQUEST SENSE command must always be issued until the CHECK CONDITION status is returned and the REQUEST SENSE command is issued since the startup from another host may enter the BUSY status.

Note: If a command terminates in the CHECK CONDITION status, the REQUEST SENSE command without a tag must always be issued. For the REQUEST SENSE command with a tag, an error may not be reported correctly.

## BUSY

Indicates that the controller is busy. The controller reports this status if a command from the host cannot be accepted.

## INTERMEDIATE/GOOD

Indicates that the command (except for the last command) being linked has terminated normally. If this status is not reported, the linked command chain will be cut off.

## RESERVATION CONFLICT

This status is reported when the host tries to access the logical unit reserved by another host. The status cannot be reported by the RELEASE command. (The controller executes the RELEASE command.)

## QUEUE FULL

Indicates that a command from the host cannot be accepted since the command queue is full.

## 6. Ways of Handling

Keep the subsystem away from vibration or dust.

Carefully handle the subsystem not to apply static electricity or excessive force to it.

### 6.1 Packing

For packing the DF300 subsystem, perform moisture-proof packing by following the Packing Specifications.

- (1) Use the same inner and outer cases and cushions as used at the shipping from the factory, or pack the DF300 with cushion materials suitable to absorb the direct impact.
- (2) Indicate the UP mark on the outer case with cautions not to turn over the subsystem and to handle it carefully.

### 6.2 Transportation

Take care not to apply impact or vibration exceeding the specifications to the subsystem during transportation.

### 6.3 Storage

Store the subsystem within the anti-moisture packing.

### 6.4 Environmental conditions

The DF300 disk subsystem needs the proper environment and handling to use it for a long time without adversely affecting its functions. Keep the unit away from the places that reduce service life or cause failures. Place the unit where:

- Direct sunlight does not strikes.
- The temperature and humidity do not vary greatly such as near an air conditioner or a heater.
- Electric noise is not generated by an ungrounded motor of an air conditioner or a washing machine.
- Electromagnetic fields are not generated by a device. (Do not bring a magnet close to the unit.)
- It is not dusty.
- Vibration does not occur.

### 6.5 Installation conditions

#### (1) Weight

Neither sit on the DF300 nor place heavy items on it.

#### (2) Ventilation

Do not place anything in front of the vents since the DF300 takes in air from the front louver and lets it out through the rear vents. However, in the case of the rack mount type, air is ejected from the slit on the left side of the cabinet as viewed from the front of the unit, so that care should be taken not to cover the vent holes on the side also.

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