TEAC FD-05HGS-750

MICRO FLOPPY DISK DRIVE

HARDWARE SPECIFICATION

REV. A

1. GENERAL

This is the hardware specification of the TEAC FD-05HGS, 3.5" double-sided 135-tpi micro floppy disk drive (hereinafter referred to as SFD) with a data capacity of 2MB/1.6/1MB (3 modes) and a SCSI interface board (hereinafter referred to as FC-5).

For the specification of the software, refer to "FC-5-00 Software Specification".

The outline of this SFD is shown in Table 1-1.

Model name	FD-05HGS-750		
TEAC P/N	19307597-50		
ROM P/N	13703861-00		
Safety standard	UL, CSA & IEC950(CB)		
Operation modes	2MB mode, write/read	1.6MB mode, write/read	1MB mode, write/read
Disk used	High density (2HD)	High density (2HD)	Normal density (2DD)
Data transfer rate	500k bits/sec	500k bits/sec	250k bits/sec
Disk speed	300rpm	360rpm	300rpm
Track density	135tpi		
Required power	+5V single (4.75~5.25V)		
Front bezel & flap	Black		
Eject button	Black		
LED indicator color	Green		
Indicator lighting condition	DRIVE SELECT plus FDD ready state		
Signal interface	SCSI (Small Computer System Interface: ANSI standard X3.131-1986)		
Terminator	Provided (at factory), 220/330Ω ±5%, detachable		
Parity strap setting	ON (at factory), ON/OFF switchable		
SCSI ID setting	ID=0 (at factory), SCSI ID 0 to 7 switchable		
Logical Unit Number	LUN=0		
Internal data buffer capacity	31K bytes		
Other optical function	Not equipped		

(Table 1-1) Specification outline

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This SFD uses two disks and has three write and read modes with an unformatted data capacity of 2M bytes/1.6M bytes/1M bytes, and the interface with the host system is SCSI. This SFD has a switch for the detection of the high-density identification hole (HD hole) in the disk cartridge, and can identify the type of cartridge now loaded in the SFD.

2. BASIC SPECIFICATIONS

    (1) Signal interface   : Pursuant to the ANSI standard X3.131-1986

    (2) System configuration: Multiple initiators connectable

    (3) Reselection   : Available (LEVEL 2 compatible)

    (4) Electrical characteristics:
                              Single-end driver/receiver

    (5) Effective commands

TEST UNIT READY	RESERVE UNIT
REZERO UNIT	RELEASE UNIT
REQUEST SENSE	MODE SENSE
FORMAT UNIT	START/STOP UNIT
FORMAT TRACK	SEND DIAGNOSTIC
READ	READ CAPACITY
WRITE .	READ EXTEND
SEEK	WRITE EXTEND
INQUIRY	SEEK EXTEND
MODE SELECT	VERIFY
WRITE AND VERIFY	

    (6) Terminator power
        Provided with TERMPWR terminal to supply the interface with TERMPWR.

    (7) SCSI ID ADDRESS
        Setting 0 through 7 possible with the straps on the board. This is set to 0 at factory.

(8) Parity check

While parity check is always performed on output data from the SFD, whether the check to be done or not on input data can be selected with a strap on the board.

(9) Data transfer capacity: 640k bytes/sec (Asynchronous transfer)
However, this value is the average transfer speed in the case the host system responds in the shortest time.

3. SYSTEM CONFIGURATION

3.1 System Configuration

The following system configurations are available with the SCSI interface unit. When more than one SCSI device is connected, it is necessary to remove termination resistors except for that at the terminating SCSI device.
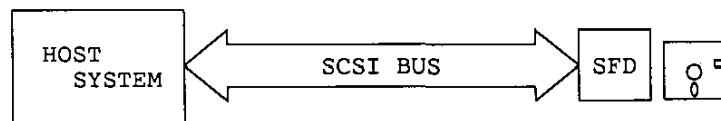
SINGLE INITIATOR, SINGLE TARGET

SINGLE INITIATOR, MULTI TARGET

MULTI INITIATOR, MULTI TARGET

(Fig.3-1) System configuration

3.2 Connection to the Host System

The SFD is either incorporated into the host system of the Work Station, IBM-PC-AT, IBM-PS/2, etc. to connect an independent SCSI device or used as part of a subsystem as shown below.
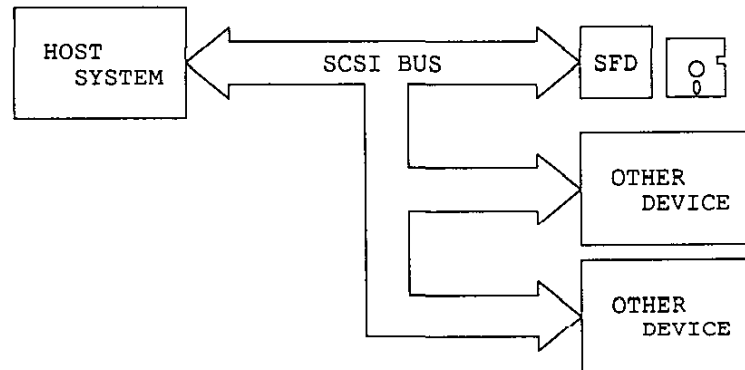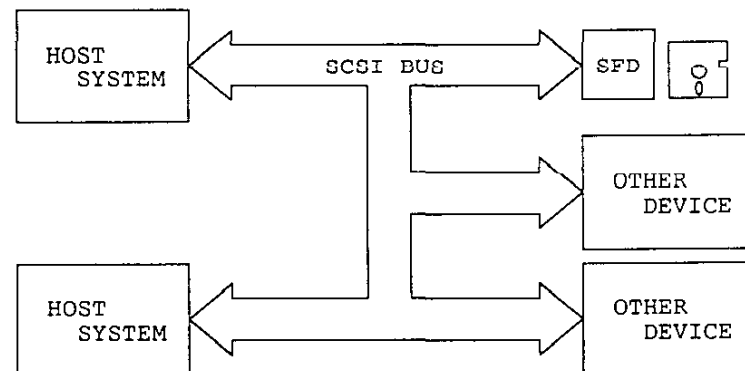
(1) When incorporating the SFD into the host system using daisychain connection, it is necessary to use an interface cable, the middle part of which is connected to the interface connector. (Refer to Fig.3-2)
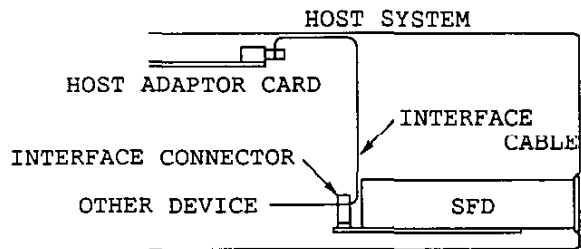
(Fig.3-2) Daisychain connection within the host system

(2) When constructing a subsystem, run the cable from the drive connector as shown in Fig.3-3, then install two sets of connectors onto the back panel of the subsystem. It is desirable that both of the two connectors are connected.
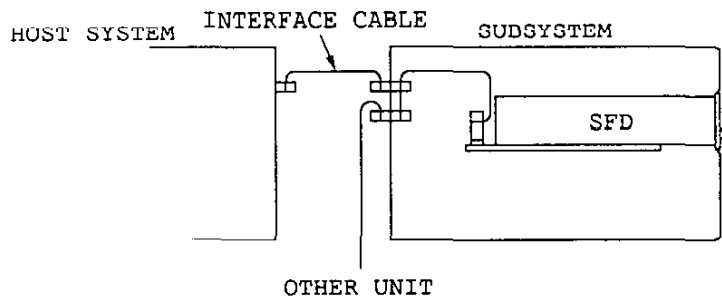
(Fig.3-3) Daisychain connection when incorporated into subsystem

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* IBM-PC-AT and IBM-PS/2 are trademarks of International Business Machines Corporation.

In each case, the total length of the interface cable(s) used shall not exceed 6m.

When the interface cable extends out of the system, use shielded cables and connectors which shall protect the signals from radiation noise.

4. DISK

3.5" micro floppy disks on Table 4-1 which are mutually agreed between the customer and TEAC.

Operation mode	Disk type	Magnetic powder	Magnetizing method
1MB	Normal density (DD)	$Co-\gamma-Fe_2O_3$	Surface recording
1.6MB	High density (HD)	$Co-\gamma-Fe_2O_3$	Surface recording
2MB	High density (HD)	$Co-\gamma-Fe_2O_3$	Surface recording

(Table 4-1) Disk used

5. PHYSICAL SPECIFICATIONS

5.1 Physical Specifications

  (1) Width   : 101.6mm (4.00 in), Max.

  (2) Height   : 25.4mm (1.00 in), Nom.

  (3) Depth   : 144.5mm (5.69 in), Nom. (excluding front bezel)

  (4) Weight   : 246g (0.542 lbs), Nom., 260g (0.573 lbs), Max.

  (5) External view : See Fig.5-1

  (6) Cooling   : Natural air cooling

  (7) Direction of installation: As described below.

    (a) The disk may be inserted vertically from the front.
    (b) The disk may be inserted horizontally from the front. However, the orientation with the PC board positioned on the upper side is not permitted.
    (c) In case of (a) and (b), the front flap side can be tilted to upward maximum 25 degrees.
   Note: As to the other mounting directions than the above will be considered separately.

  (8) Installation   : With installation holes on the bottom side or the both sides of the SFD. Refer to Fig.5-1

  (9) Material of frame (Base) : Aluminum diecast
      Meterial of SCSI bracket : A galvanized sheet iron

  (10) Material of front bezel : PPHOX

Bottom side

9.5 36.2

Pin1

Signal
connector

Power
connector

SCSI ID strap

5±0.3

5±0.3

Spindle
motor

Eject button position
5±1 (Disk inserted)
1±1 (Disk ejected)

90±0.2

60±0.2

21±0.4

17.5

Disk insertion

94±0.4

0
101.6-0.5

72±0.2

144.5±0.5

31±0.4

4

M3 tapped holes for installation
(Bottom x4,Each side x3)

90±0.2

60±0.2

21±0.4

0
25.4-0.4

90.6

46.8 (43.8)

Eject button

17.5

4.6

12

8.6

17

2.8

27.6 48.3

Indicator
(LED)

Front bezel

Disk insertion

(Fig.5-1) External view

(Units:mm)

− 8 −

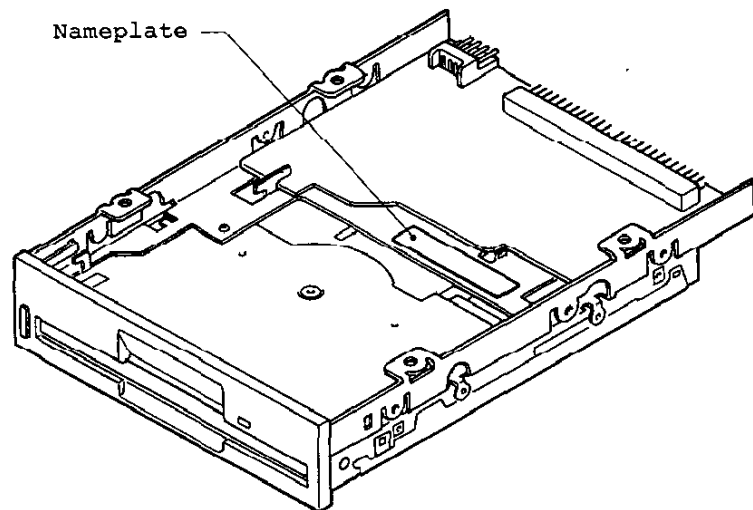## 5.2 Frame Grounding

(1) The SFD frame is electrically connected to DC 0V by a mounting screw on the PCB via chip jumper R2/9 on the main PCBA and chip jumper S10 on the FC-5 PCBA. (See Fig.5-2)
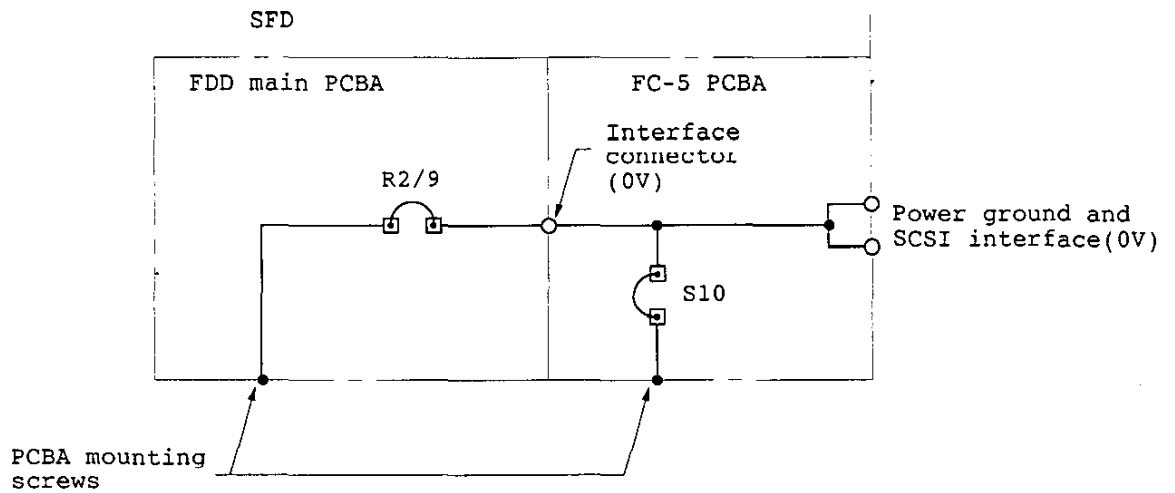
(Fig.5-2) Frame ground internal connection

5.3 Nameplate

The location where the nameplate is attached onto the SFD is shown in Fig. 5-3.

Nameplate ─

(Fig.5-3) Location where the nameplate is attached

6. FUNCTIONAL SPECIFICATIONS

6.1 2MB Mode Data Capacity

Recording method				FM	MFM
Data transfer rate between FC-5 - FDD (k bits/sec)				250	500
Tracks/disk				160	160
Innermost track bit density (bpi), Side 1				8,717	17,434
Innermost track flux density (frpi), Side 1				17,434	17,434
Data capacity	Unformatted		k bytes/track	6.25	12.50
			k bytes/disk	1,000	2,000
	F o r m a t t e d	32 sectors /track	k bytes/sector	0.128	0.256
			k bytes/track	4.096	8.192
			k bytes/disk	655.36	1,310.72
		18 sectors /track	k bytes/sector	0.256	0.512
			k bytes/track	4.608	9.216
			k bytes/disk	737.28	1,474.56
		10 sectors /track	k bytes/sector	0.512	1.024
			k bytes/track	5.12	10.24
			k bytes/disk	819.20	1,638.40

(Table 6-1) 2MB mode data capacity

6.2 1.6MB Mode Data Capacity

Recording method				FM	MFM
Data transfer rate between FC-5 - FDD (k bits/sec)				250	500
Tracks/disk				160	160
Innermost track bit density (bpi), Side 1				7,264	14,528
Innermost track flux density (frpi), Side 1				14,528	14,528
Data capacity	Unformatted		k bytes/track	5.208	10.416
			k bytes/disk	833.28	1,666.56
	F o r m a t t e d	26 sectors /track	k bytes/sector	0.128	0.256
			k bytes/track	3.328	6.656
			k bytes/disk	532.48	1,064.96
		15 sectors /track	k bytes/sector	0.256	0.512
			k bytes/track	3.840	7.680
			k bytes/disk	614.40	1,228.80
		8 sectors /track	k bytes/sector	0.512	1.024
			k bytes/track	4.096	8.192
			k bytes/disk	655.36	1,310.72

(Table 6-2) 1.6MB mode data capacity

6.3 1MB Mode Data Capacity

Recording method			FM	MFM
Data transfer rate between FC-5 - FDD (k bits/sec)			125	250
Tracks/disk			160	160
Innermost track bit density (bpi), Side 1			4,359	8,717
Innermost track flux density (frpi), Side 1			8,717	8,717
Data capacity	Unformatted	k bytes/track	3.125	6.250
		k bytes/disk	500	1,000
	Formatted / 16 sectors /track	k bytes/sector	0.128	0.256
		k bytes/track	2.048	4.096
		k bytes/disk	327.68	655.36
	9 sectors /track	k bytes/sector	0.256	0.512
		k bytes/track	2.304	4.608
		k bytes/disk	368.64	737.28
	5 sectors /track	k bytes/sector	0.512	1.024
		k bytes/track	2.560	5.120
		k bytes/disk	409.60	819.20

(Table 6-3) 1MB mode data capacity

6.4 Disk Rotation Mechanism

(1) Spindle motor   : Direct DC brushless motor

(2) Spindle motor speed
   2MB/1MB mode   : 300rpm
   1.6MB mode   : 360rpm

(3) Motor servo method   : Frequency servo by ceramic oscillator

(4) Motor/spindle connection: Motor shaft direct

(5) Disk speed   : The same as the spindle speed
   Long term speed variation (LSV):
                          ±1.5% or less
   Instantaneous speed variation (ISV):
                          ±3% or less

(6) Start time   : 500msec or less

(7) Average latency, 360rpm : 83.3msec
                    300rpm : 100msec

(8) Speed switching time   : 480msec or less (300rpm⇄360rpm)

6.5 Index Detection

(1) Number of index   : 1 per disk revolution

(2) Detection method   : Rotor revolution detection of the spindle
                               motor by Hall IC

(3) Detection cycle, 360rpm : 166.7msec ±1.5%
                    300rpm : 200msec ±1.5%

(4) Index burst detection timing error (with specified test disk)
                    360rpm : 340μsec or less
                    300rpm : 400μsec or less

6.6 Track Construction

(1) Track density (nominal): 135tpi (track pitch 187.5μm, nominal)

(2) Number of cylinders   : 80 cylinders

(3) Number of tracks   : 160 tracks/disk

(4) Outermost track radius (track 00): Side 0 39.500mm (1.5551 in)
                                       Side 1 38.000mm (1.4961 in)
    Innermost track radius (track 79): Side 0 24.6875mm (0.9719 in)
                                       Side 1 23.1875mm (0.9129 in)

(5) Positioning accuracy: ±15μm or less, with specified test disk.
                    (Track 40, 23 + 2°C, 45 ~ 55% Rh)

6.7 Magnetic Head

    (1) Magnetic head: Read/write head with erase gap, 2 sets

    (2) Effective track width after trim erase:
$$0.115 \pm 0.008mm \ (0.0045 \pm 0.0003 \ in)$$

    (3) Read/write gap azimuth error: $\pm18'$ or less, with specified test disk

6.8 Track Seek Mechanism

    (1) Head positioning mechanism: Stepping motor with lead screw

    (2) Stepping motor   : 4-phase, 20 steps per revolution

    (3) Stepping motor drive   : 2 steps per track

    (4) Track 00 detection method : Photo-interrupter

    (5) Track to track time   : 3msec

    (6) Settling time   : 15msec or less (excludes track to track time)

6.9 Others

    (1) Recommended write precompensation (all tracks): 2MB/1MB mode
                     2MB mode   : $\pm125nsec$
                     1.6MB/1MB mode: $0 \sim \pm125nsec$

    (2) Head loading mechanism: Not equipped
                              (The FDD becomes head loading condition whenever a disk is installed)

    (3) File protect mechanism: Write-inhibit hole is detected by a mechanical switch.

(4) Disk detection mechanism: Disk installation is detected by a mechanical
switch

(5) Disk inserting force: 700g or less at the center of the disk

(6) Disk ejecting force: 1,200g or less

(7) Acoustic noise (at a distance of 50cm):
45dBA or less (during a 3msec seek operation)

(8) Disk type identification mechanism: HD hole detection using a mechanical
switch.

7. ENVIRONMENTAL CONDITIONS

(1) Ambient temperature
    (a) Operating   : 4 ~ 51.7°C (39 ~ 125°F)
    (b) Storage   : -22 ~ 60°C (-8 ~ 140°F)
    (c) Transportation: -40 ~ 65°C (-40 ~ 149°F)

(2) Temperature gradient
    (a) Operating   : 20°C (27°F) hour or less (non-condensing)
    (b) Storage and transportation:
                      30°C (54°F) hour or less (non-condensing)

(3) Relative humidity
    (a) Operating   : 20 ~ 80% (non-condensing)
                      Maximum wet bulb temperature; 29.4°C (85°F)
    (b) Storage   : 5 ~ 90% (non-condensing)
                      Maximum wet bulb temperature; 40°C (104°F)
    (c) Transportation: 5 ~ 95% (non-condensing)
                      Maximum wet bulb temperature; 45°C (113°F)

(4) Vibration
    (a) Operating   : 1.5G or less (10 ~ 100Hz, 1oct/min. sweep rate)
                      0.5G or less (100 ~ 200Hz, 1oct/min. sweep rate)
                      0.25G or less (200 ~ 600Hz, 1oct/min. sweep rate)
    (b) Transportation: 2G or less (10 ~ 100Hz, 1/4oct/min. sweep rate)

(5) Shock
    (a) Operating
        Write & read : 5G (11msec, 1/2 sine wave) or less
        Read only   : 10G (11msec, 1/2 sine wave) or less
                      Soft errors are allowed if they are recoverable within
                      16 retries.
    (b) Transportation: 70G (11msec, 1/2 sine wave) or less
        (single shock)

(6) Altitude (operating): -300m (-980 feet) ~ 5,000m (16,400 feet)

Note: The above requirements are applied for the SFD without shipping box. When a long period is required for transportation such as by ship, storage environmental conditions should be applied.

8. RELIABILITY

(1) MTBF: 30,000 power on hours or more (for typical usage)

(2) MTTR: 30 minutes or less

(3) Design component life: 5 years

(4) Disk life: 3×10^6 passes/track or more

(5) Disk insertion: 1.5×10^4 times or more

(6) Seek operation life: 1×10^7 random seeks or more

(7) Preventive maintenance: Not required (for typical usage)

(8) Error rate

  (a) Soft read error: 1 or less per 10^9 bits read
                   (In the event of error, retry is performed up to 16 times automatically, including three recalibrations to track 00)

  (b) Hard read error: 1 or less per 10^{12} bits read
                   (In the event of error, retry is performed up to 16 times automatically, including three recalibrations to track 00)

  (c) Seek error   : 1 or less per 10^6 seeks
                   (In the event of error, retry is performed up to 16 times automatically, including three recalibrations to track 00)

(9) Safety standard: Approved by UL, CSA and IEC950(CB)

(10) Static withstand voltage: When a static voltage of 10kV (150pF, 330Ω)
                                    is applied to the operator accessible area in
                                    testing the SFD, the data written to the disk,

components in the SFD, and function of the
SCSI bus should be free from damage.

9. POWER INTERFACE

9.1 Required Power

The following specifications are applied at power interface connector of the SFD. Power is fed to the FDD via the signal interface FFC cable (1, 3, and 5 pins) between FC-5 and FDD.

(1) DC +12V: Not required

(2) DC +5V

    (a) Voltage tolerance: ±5% (4.75 ~ 5.25V)

    (b) Allowable ripple voltage: 100mVp-p or less (including spike noise)

    (c) Current and power consumption

Operating mode	Average current		Average power	
	Typ.	Max.	Typ.	Max.
Stand-by *1	60mA	80mA	0.3W	0.4W
Read Operation *1	0.29A	0.41A	1.45W	2.15W
Write Operation *1	0.29A	0.41A	1.45W	2.15W
Seek Operation *1	0.54A	0.66A	2.70W	3.47W
Motor start *1	0.70A	0.78A	3.50W	4.10W
Terminator current *2	0.16A	0.30A	0.80W	1.58W

Notes: 1. Values of Typ. current and power are specified at 5.0V, while the values of Max. are at 5.25V (+5%) with a disk of large running torque.

      2. The stand-by mode refers to when the SCSI bus is in the BUS FREE phase and when the spindle motor and seek stop.

      3. The maximum current consumption period while the spindle motor is operating is within 150msec.

      4. Maximum short-period peak current except for the surge current when power is switched on is 1.3A or less.

      5. For the example of current consumption time chart, refer to 10.6.2.

      6. The current values of items marked *1 indicate those without the terminator. The current values with the terminator will be those to which terminator current values marked *2 are added.

(Table 9-1) Current and power consumption

(3) Power rise time, fall time: Arbitrary

9.2 Power Interface Connector and Cable

  (1) Power interface connector

    (a) SFD side connector: IRISO Electronics Co., LTD. P/N IMSA-6056B-04C
                                  (natural color) or equivalent
    (b) Pin numbers: 4 pins
    (c) Protection method for mis-connection:
                    Mechanical protection by the shape of connector housing.
    (d) Connector external view: See Fig.9-1
    (e) Connector location: See Fig.5-1
    (f) Power interface pin-assignment: See Table 9-2
    (g) Cable side matched connector: AMP, P/N 171822-4 (natural color)
                                  or equivalent
   matched pin: AMP, P/N 170204-2 (AWG #20 ~ 26, loose
                                  piece) or P/N 170262-2 (AWG #20 ~ 26,
                                  strip form) or equivalent
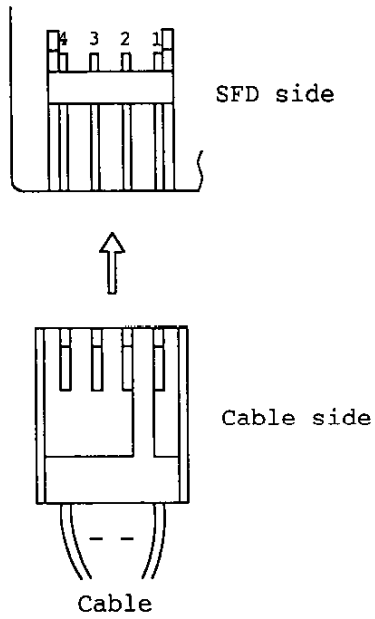
  (2) Power interface cable

    Any appropriate cables will be acceptable as long as the maximum power
    consumption of the SFD and voltage at the power connector are taken into
    consideration.

Power voltage	Pin numbers
DC +5V	1
0V	2
(0V)	3
(No connection)	4

(Table 9-2) Power interface pin-assignment

Power interface connector

Pin number

```
4  3  2  1
□  □  □  □
```

PCB

Rear view

```
4  3  2  1
```

SFD side

Cable side
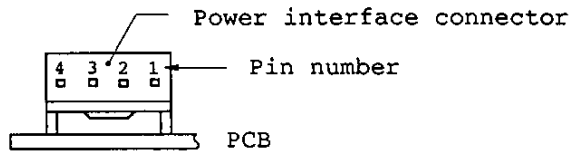
Cable

Top view

(Fig.9-1) Power interface connector external view

10. SIGNAL INTERFACE

10.1 Electrical Characteristics

Notes: 1. The specifications in items (2) are applicable at the SCSI connector.
2. Vcc indicates the +5V supply voltage to be fed to the SFD.

(1) I/O circuit: See Fig.10-1 ~ 10-3

(2) Electrical characteristics of I/O circuit
  (a) Input signal level
        logic "1" (TRUE) :   0 ~ 0.8V
        logic "0" (FALSE): 2.0 ~ 5.25V
        Hysteresis width : 0.2V, Min
  (b) Output signal level
        logic "1" (TRUE) :   0 ~ 0.4V
        logic "0" (FALSE): 2.5 ~ 5.25V
  (c) Maximum load current of receiver: -0.2mA (excl. terminator current)
  (d) Output driver sink current: 48mA (low level voltage: 0.4V)
  (e) Terminator: 220Ω ±5% (at DC +5V side)
                 330Ω ±5% (at 0V side)
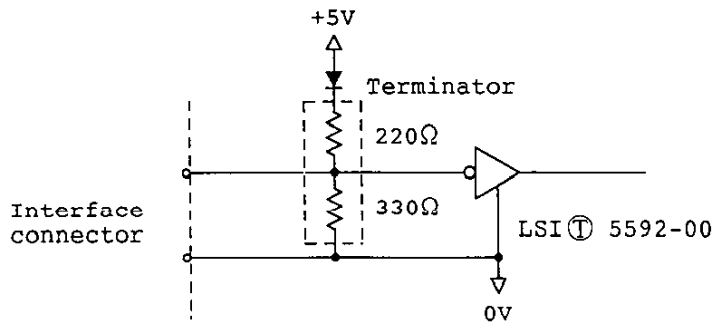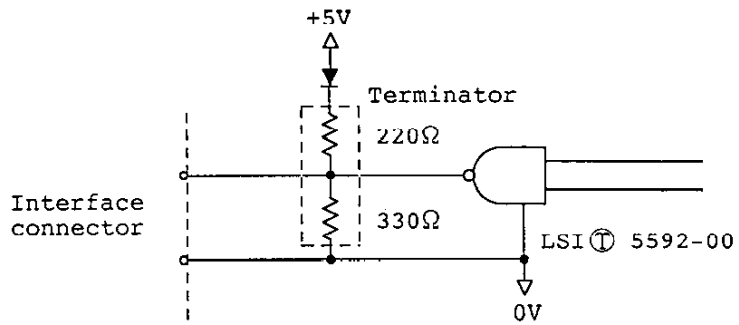   (Terminator is detachable)
  (f) TERMPWR output signal
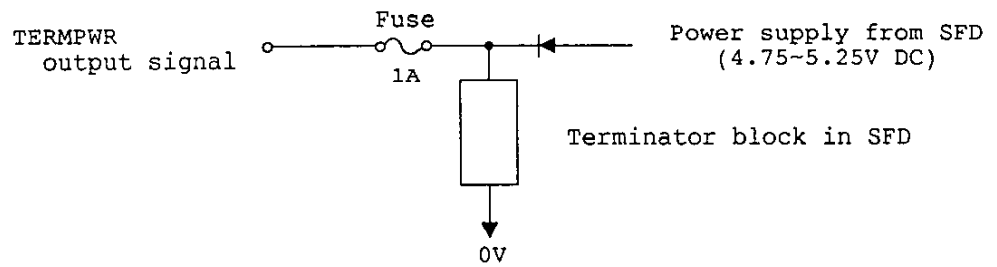   Output voltage: 4.2 ~ 5.25V
        Maximum output current: 1.0A
        Output current limitation: Fuse (1.0A)

+5V

Terminator

220Ω

330Ω

Interface
connector

LSI Ⓣ 5592-00

0V

(Fig.10-1) Input circuit

+5V

Terminator

220Ω

330Ω

Interface
connector

LSI Ⓣ 5592-00

0V

(Fig.10-2) Output circuit

TERMPWR
output signal

Fuse

1A

Power supply from SFD
(4.75~5.25V DC)

Terminator block in SFD

0V

(Fig.10-3) TERMPWR output circuit

10.2 Signal Interface Connector and Cable

(1) Signal interface connector
   (a) SFD side connector: IRISO Electronics Co., LTD. P/N IMSA-9022B-49Z53-
                           GT or equivalent
   (b) Pin numbers and pin pitch: 2 rows of 25 poles (50 poles), 2.54mm (0.1
                           in) pitch.
   (c) Interface connect or pin-assignment: See Table 10-1
   (d) Cable side matched connector: Fujitsu, P/N FCN-707J050-AU/0 or equiva-
                           lent.
   (e) Cable side mis-insertion protection key:
                           Fujitsu FCN-700A1 or equivalent
   (f) Connector location: See Fig.5-1
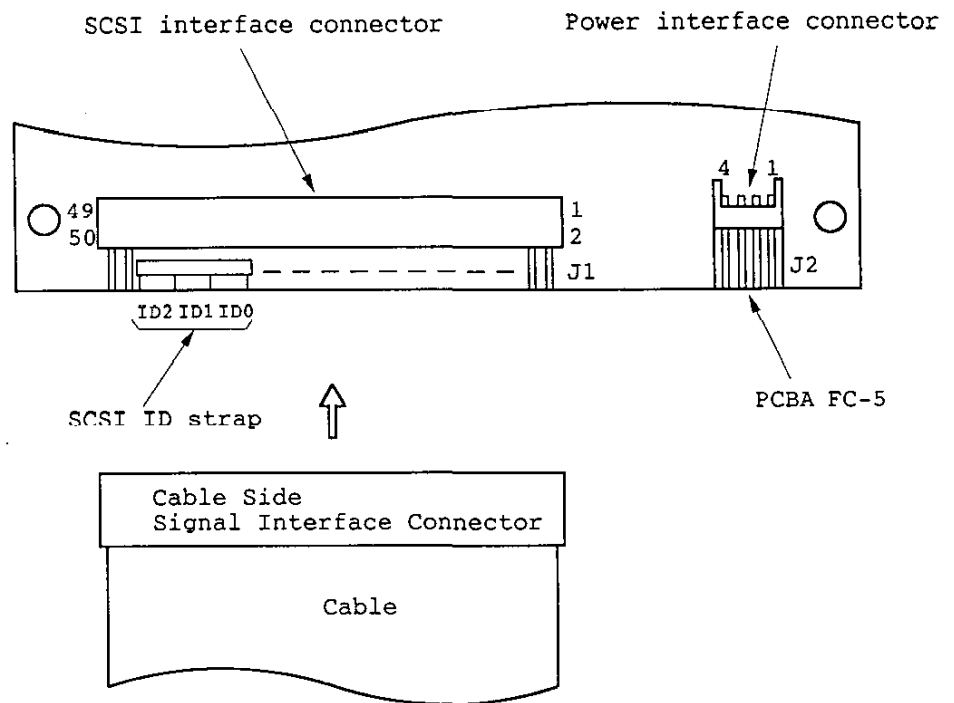
(2) Signal interface cable
   (a) Applicable cable: Sumitomo 3M, P/N 3365-50 or equivalent
   (b) Maximum cable length: 6m (20 feet)

| Pin No. | | Signal name | Symbol | Signal direction |
GND	DATA			
1	2	DATA BUS 0 (LSB)	-DB0	HOST ↔ FC-5
3	4	DATA BUS 1	-DB1	↔
5	6	DATA BUS 2	-DB2	↔
7	8	DATA BUS 3	-DB3	↔
9	10	DATA BUS 4	-DB4	↔
11	12	DATA BUS 5	-DB5	↔
13	14	DATA BUS 6	-DB6	↔
15	16	DATA BUS 7 (MSB)	-DB7	↔
17	18	DATA BUS PARITY	-DBP	↔
19	20	GND	GND	
21	22	GND	GND	
23	24	RESERVED	RES	
25(P.KEY)*	26	TERMINATOR POWER	TERMPWR	HOST ↔ FC-5
27	28	RESERVED	RES	
29	30	GND	GND	
31	32	ATTENTION	-ATN	HOST → FC-5
33	34	GND	GND	
35	36	BUSY	-BSY	HOST ↔ FC-5
37	38	ACKNOWLEDGE	-ACK	→
39	40	RESET	-RST	→
41	42	MESSAGE	-MSG	←
43	44	SELECT	-SEL	↔
45	46	CONTROL/DATA	-C/D	←
47	48	REQUEST	-REQ	←
49	50	INPUT/OUTPUT	-I/O	←

Notes: 1. Signals are all true at low level.

2. Terminals with odd numbers are all GND except for terminal No.25 (remove the pin to protect mis-insertion), No.23 and No.27 (Reserved).

(Table 10-1) Interface connector pin-assignment table

SCSI interface connector   Power interface connector

```
      49 |                    | 1
      50 |                    | 2
                               J1            J2
      ID2 ID1 ID0
```

SCSI ID strap   ⇧   PCBA FC-5

Cable Side
Signal Interface Connector

Cable

(Fig.10-5) Signal interface connector external view

10.3 Input and Output Signals

For the signals indicated below, an input signal represents a signal transmitted to FC-5 and an output signal, a signal transmitted from FC-5. Input/output signal represents a bidirectional signal. All the signals are true at low level.

(1) BUSY (-BSY): input/output signal
    This signal is used in the following three ways.

    (a) This signal goes true when the SCSI interface bus is in use.
    (b) If the FC-5 attempts to gain control of the SCSI bus in the ARBITRA-
        TION phase, this signal goes true.
    (c) This signal is a response signal to the -SEL signal from the host sys-
        tem or the SFD in the SELECTION phase and RESELECTION phase.

(2) SELECT (-SEL): input/output signal
    This is to select one out of the devices on the interface bus. The se-
    lected device responds with its -BSY signal turned to true. Device ad-
    dress information is delivered to -DB0 ~ -DB7 together with this signal.

(3) CONTROL/DATA (-C/D): output signal
    Indicates the type of information to be transferred through -DB0 ~ -DB7.
    Control information is transferred when this signal is true and data in-
    formation when it is false.

(4) INPUT/OUTPUT (-I/O): output signal
    Indicates direction of the information transferred through -DB0 ~ -DB7.
    Transfer takes place from FC-5 to the host system when this signal is
    true and from the host system to FC-5 when it is false.

(5) MESSAGE (-MSG): output signal
    This signal is turned to true in the MESSAGE phase where information is
    exchanged between the host system and FC-5. The direction of message
    transfer is indicated by the -I/O signal.

(6) REQUEST (-REQ): output signal

Controls transfer timing at which the information is transferred through -DB0 ~ -DB7 (for handshake control) and is a data transfer request signal.

(7) ACKNOWLEDGE (-ACK): input signal

Controls transfer timing at which the information is transferred through -DB0 ~ -DB7 (for handshake control) and is a response signal to the -REQ signal.

(8) ATTENTION (-ATN): input signal

Requests reception of a message sent from the host system. MESSAGE OUT phase is executed when FC-5 receives this signal.

(9) RESET (-RST): input signal

Restores the initial state of FC-5. This signal must have a 25μs or more pulse width. Within 800ns after this signal becomes TRUE, the FC-5 enters BUS FREE phase. However, the response time (point ⓑ onward in Fig. 10-18) to the FC-5 initiator selection will be after the following operation is over and 1,100ms after this signal becomes TRUE.

(a) While WRITE/READ-related commands are in execution, the duration lasts until the WRITE/READ processing of all blocks in the cylinder currently in execution is over.

(b) The initial state operation of the FC-5 after (a) is over.

Therefore, if the total number of blocks in the cylinder are exceeded in WRITE-related commands, or the blocks that overflow to the adjacent cylinder are specified and the RESET signal becomes true during processing, part of the data may not be processed.

(10) DATA BUS 0-7 (-DB0 ~ -DB7): input/output signal

8-bit bidirectional bus for mutural transfer of control and data information. -DB7 is the MSB (Most Significant Bit) and -DB0 the LSB (Least Significant Bit).

(11) DATA BUS PARITY (-DBP): input/output signal

   Parity signal for -DB0 ~ -DB7 signals. When information is sent from FC-5, it is set up as odd parity and output with the same timing as -DB0 ~ -DB7.

   When FC-5 receives information, whether parity checking (odd parity) should be done or not can be selected by setting a switch in FC-5.
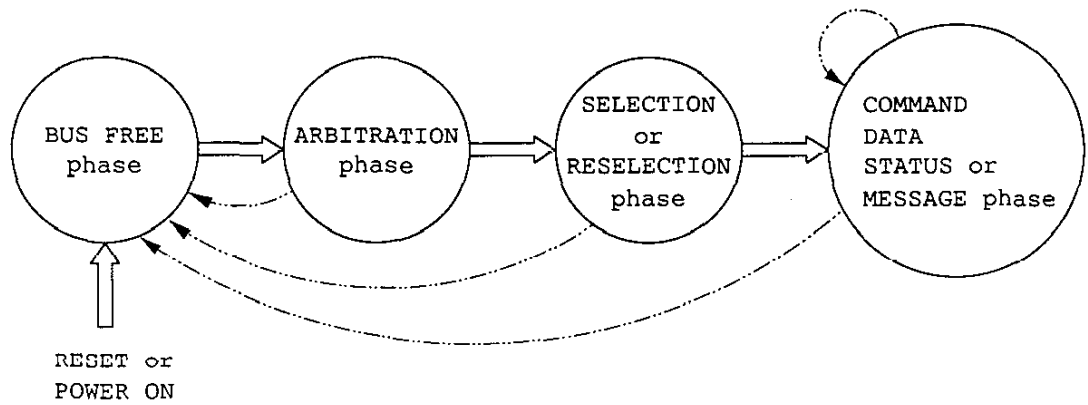
10.4 Phase Sequence

   This interface consists of the following operation phases.

   (a) BUS FREE phase
   (b) ARBITRATION phase
   (c) SELECTION phase
   (d) RESELECTION phase
   (e) COMMAND phase
   (f) DATA phase
   (g) STATUS phase
   (h) MESSAGE phase

   The phase sequences are shown in Fig.10-6. There are sequences with and without ARBITRATION. The commands for FC-5 are executed with the sequences shown in Fig.10-6, though DATA phase may not be available for some commands. Even for a command with data transfer, DATA phase may not be available or may be discontinued depending on error information.
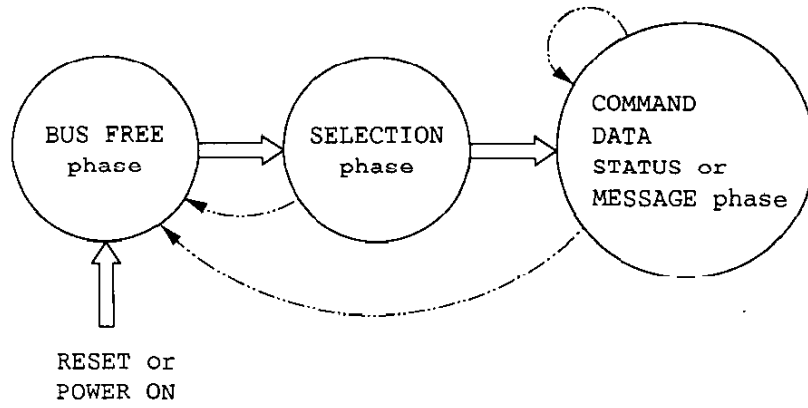
Host system without ARBITRATION


Host system with ARBITRATION

(Fig.10-6) Phase sequence

10.5 Interface Timing

The following specifications are all applied to the ends of the FC-5 interface connectors.

(1) RESET timing   : Fig.10-7
(2) BUS FREE phase timing   : Fig.10-8
(3) ARBITRATION phase timing: Fig.10-9
(4) SELECTION phase timing   : Fig.10-10
(5) RESELECTION phase timing: Fig.10-11
(6) COMMAND phase timing   : Fig.10-12
(7) DATA IN phase timing   : Fig.10-13
(8) DATA OUT phase timing   : Fig.10-14
(9) STATUS phase timing   : Fig.10-15
(10) MESSAGE IN phase timing : Fig.10-16
(11) MESSAGE OUT phase timing: Fig.10-17

In Fig.10-7 to Fig.10-17, 'H' denotes high level (logic '0' false) and 'L', low level (logic '1' true).
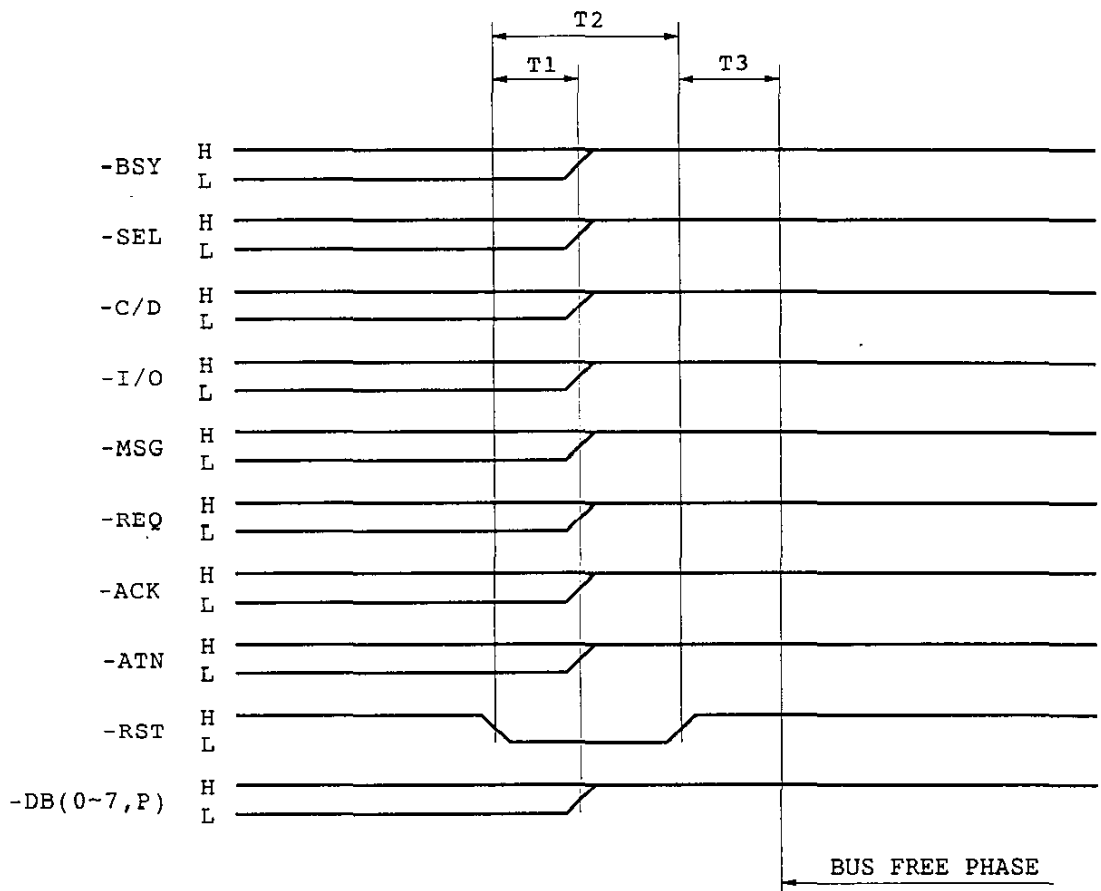
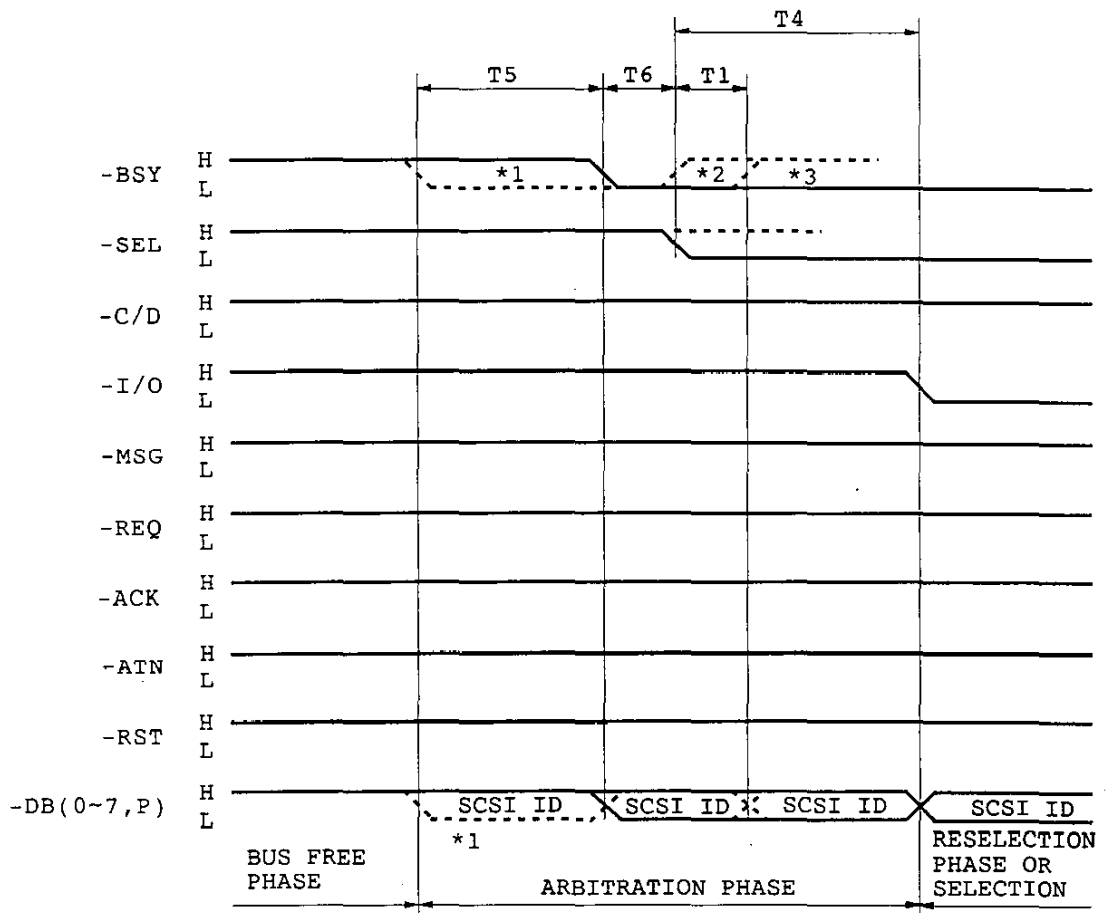| Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T1	BUS CLEAR DELAY			800	ns
T2	RESET HOLD	25			μs
T3	BUS SETTLE DELAY	400			ns

(Fig.10-7) RESET timing
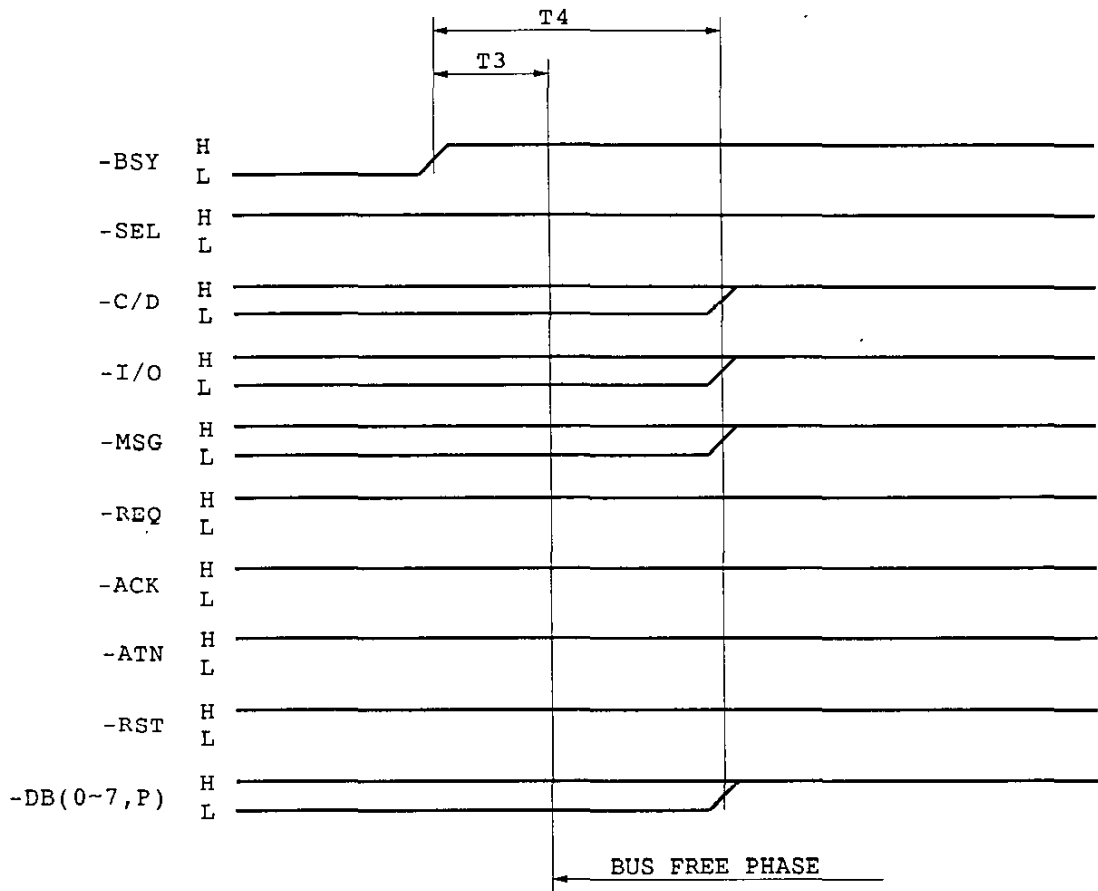
Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T3	BUS SETTLE DELAY	400			ns
T4	T3 + BUS CLEAR DELAY			1.2	μs

(Fig.10-8) BUS FREE phase timing

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T1	BUS CLEAR DELAY			800	ns
T4	BUS SETTLE + BUS CLEAR	1.2			μs
T5	BUS FREE DELAY	800		1800	ns
T6	ARBITRATION DELAY	2.2			μs

Notes: 1. Broken line *1 indicates the case in which a -BSY sig-
nal from another SCSI device, and the ID bit of that
device have already been asserted on the data bus.

2. Broken line *2 indicates the case in which an ID bit
with higher order than this SFD ID is sent to the data
bus. The SFD releases the data bus at the same time.

3. T1 and the broken line *3 indicate the case in which
the SEL signal has been asserted from another SCSI
device before this FC-5 checks -DB0~7 in the ARBITRA-
TION phase. In this case, the FC-5 releases the data
bus at the same time.
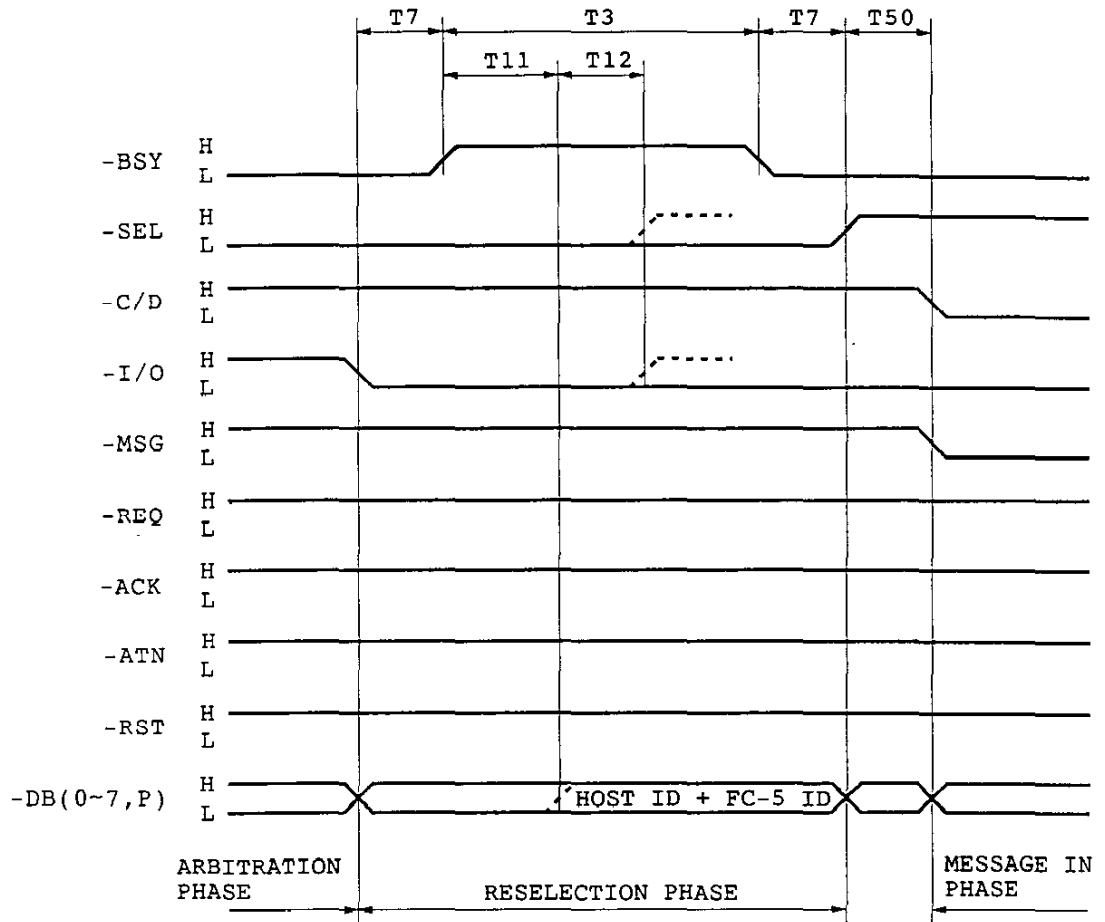
(Fig.10-9) ARBITRATION phase timing
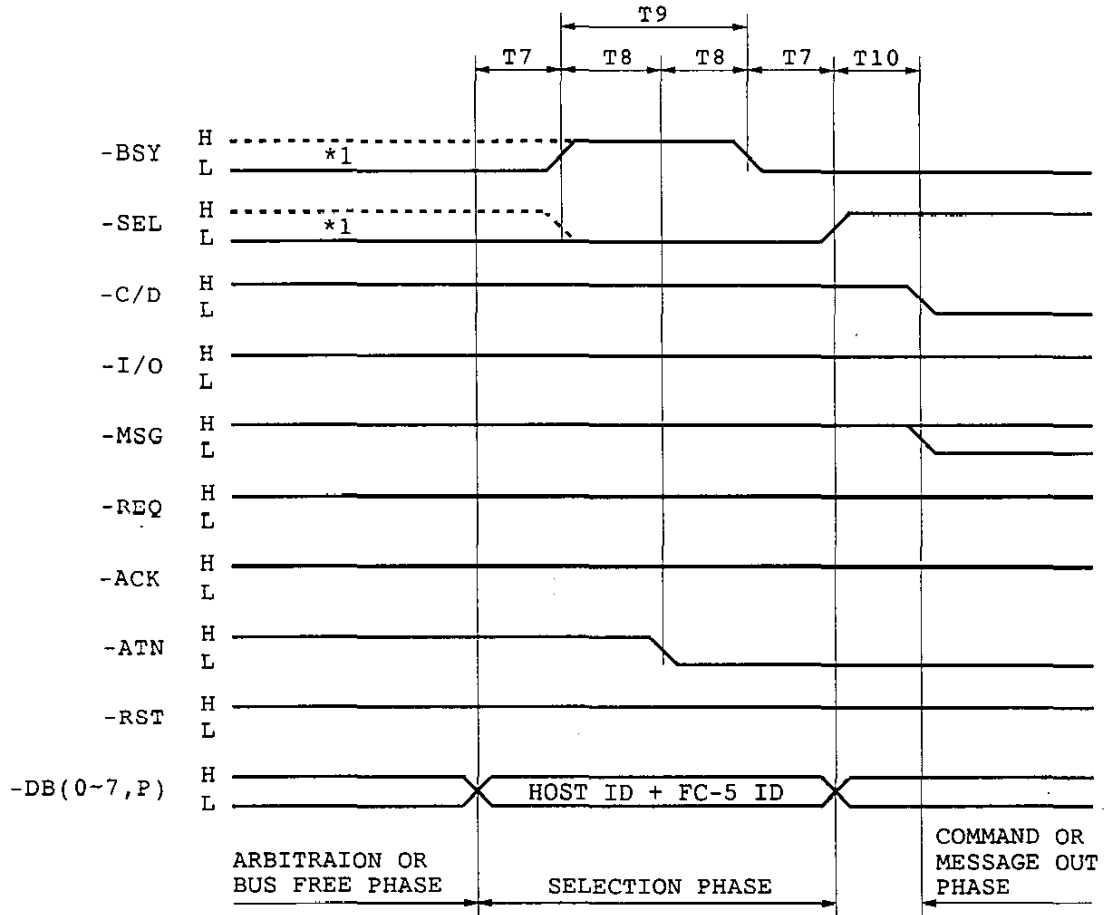
Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit	
T7	(DESKEW DELAY) × 2	90			ns	
T8		0			ns	
T9	BUS SETTLE DELAY	0.4		200	μs	*2
T10		25			μs	

Notes: 1. Broken line *1 indicates the case in which the phase changes from BUS FREE phase (without ARBITRATION).

2. MAX. on *2 indicates a selection abort time.

(Fig.10-10) SELECTION phase timing

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T3	BUS SETTLE DELAY or SELECTION TIMEOUT	400ns		200μs	
T7	(DESKEW DELAY) × 2	90			ns
T50		65			μs
T11	SELECTION TIMEOUT	250			ms
T12	SELECTION ABORT TIME + (DESKEW DELAY) × 2	200.9			μs

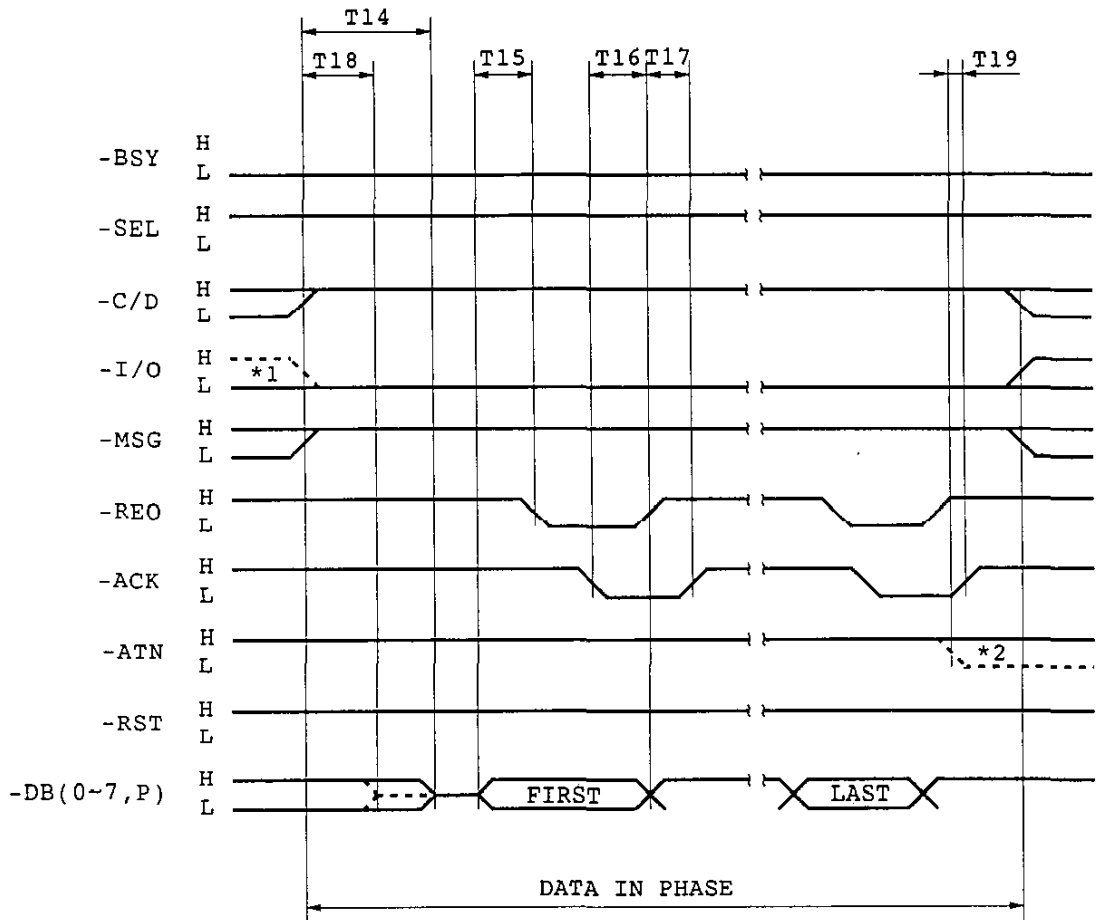Note: T11, T12 and the broken line indicate the case in which there is no -BSY response from the host (timeout).

(Fig.10-11) RESELECTION phase timing
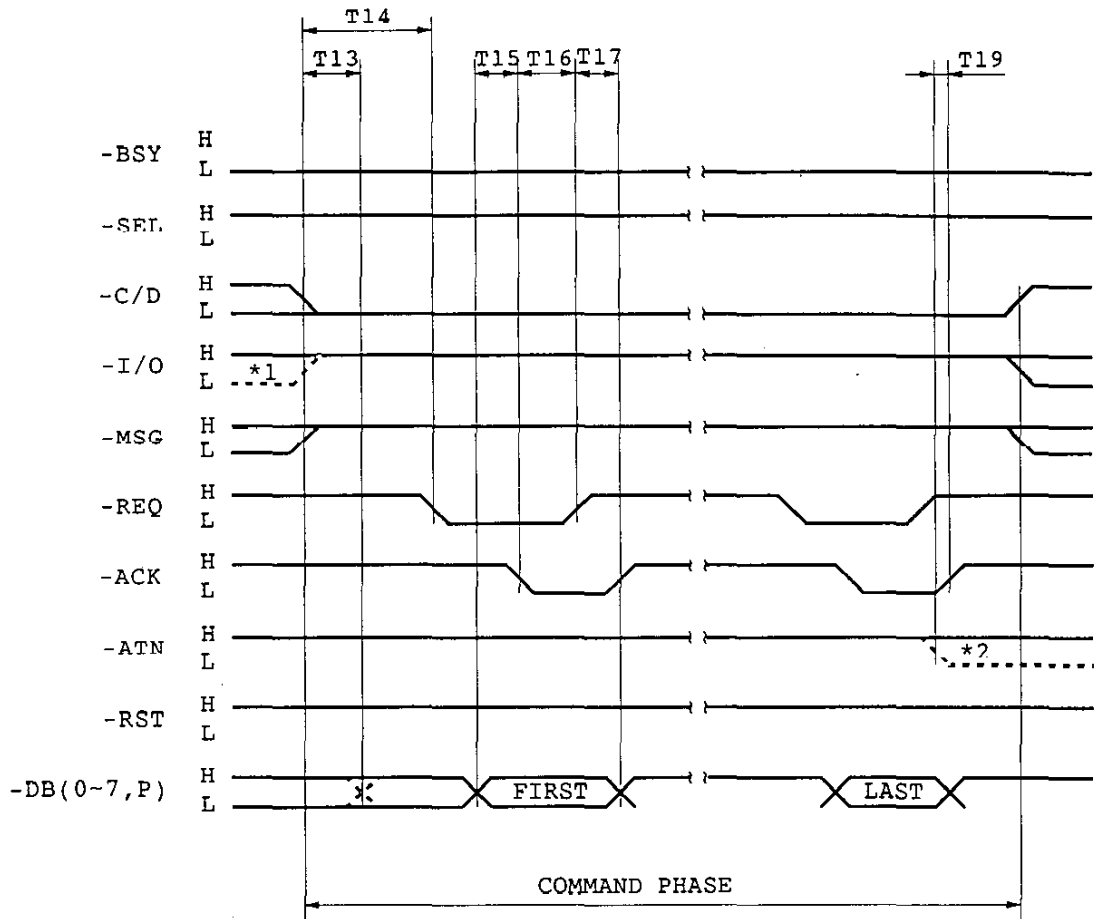
Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T13	DESKEW DELAY			45	ns
T14	BUS SETTLE DELAY + DATA RELEASE DELAY	800			ns
T15	DESKEW DELAY + CABLE SKEW	55			ns
T16		0			ns
T17		0			ns
T19		0			ns

Notes: 1. For the broken line *1, the FC-5 releases the data bus
          at the timing of T13.

       2. The broken line *2 indicates the timing at which the
          host transmits the -ATN signal in this phase.
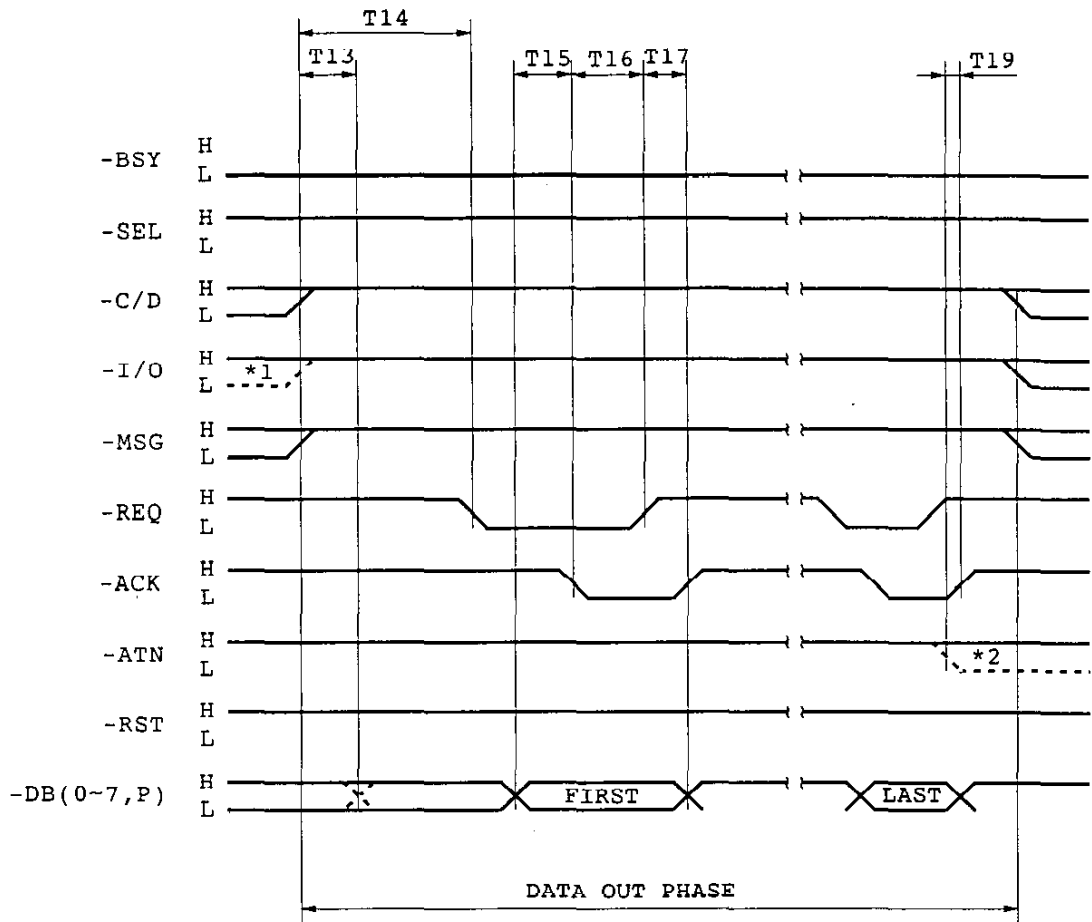
(Fig.10-12) COMMAND phase timing

(Fig.10-13) DATA IN phase timing

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T14	BUS SETTLE DELAY + DATA RELEASE DELAY	800			ns
T15	DESKEW DELAY + CABLE SKEW	55			ns
T16		0	70		ns
T17		0			ns
T18	DATA RELEASE DELAY			400	ns
T19		0			ns

Notes: 1. For the case of the broken line *1, the host must re-
          lease the data bus at the timing of T18. At this time,
          the FC-5 drives the data bus after (T18 or T14) +
          internal processing time.
       2. The broken line *2 indicates the timing at which the
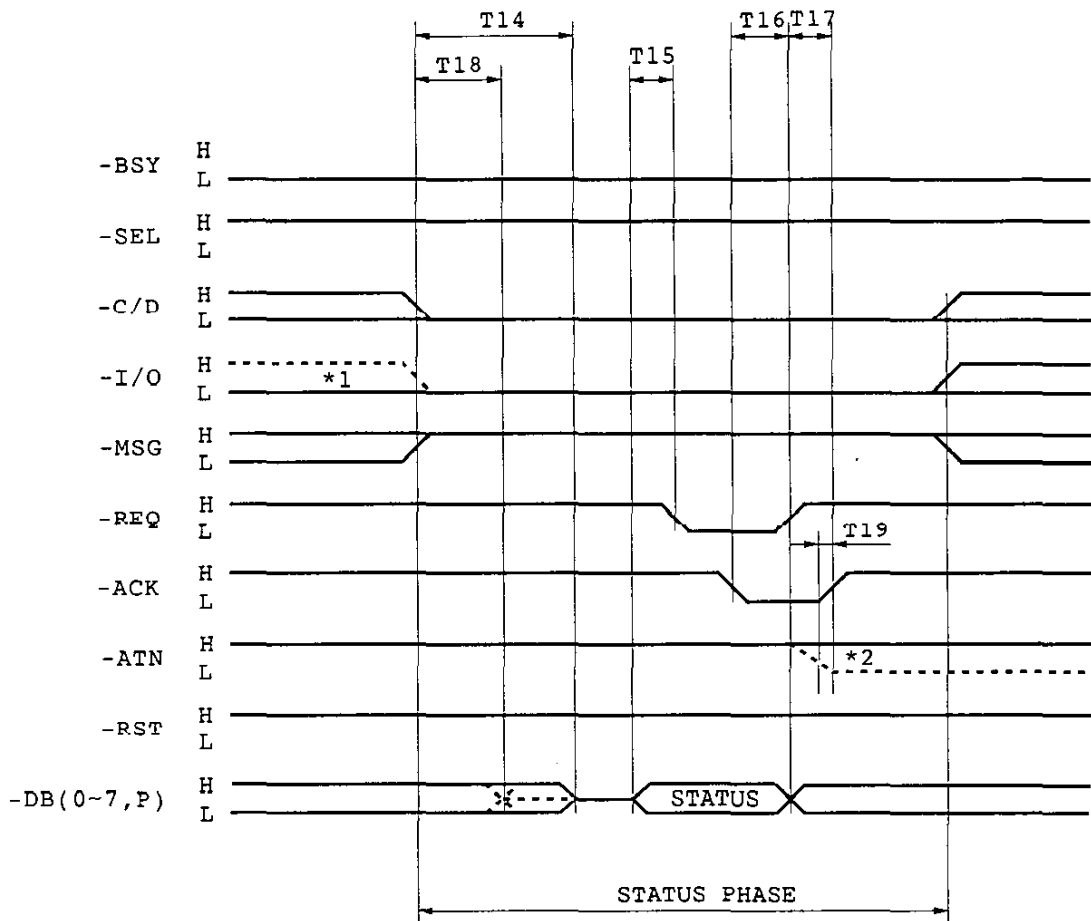   -ATN signal is transmitted at the end of this phase.

(Fig.10-13) DATA IN phase timing

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T13	DESKEW DELAY			45	ns
T14	BUS SETTLE DELAY + DATA RELEASE DELAY	800			ns
T15	DESKEW DELAY + CABLE SKEW	55			ns
T16		0	70		ns
T17		0			ns
T19		0			ns

Notes: 1. For the case of the broken line *1, the FC-5 releases the data bus at the timing of T13.

2. The broken line *2 indicates the timing at which the -ATN signal is transmitted in this phase.
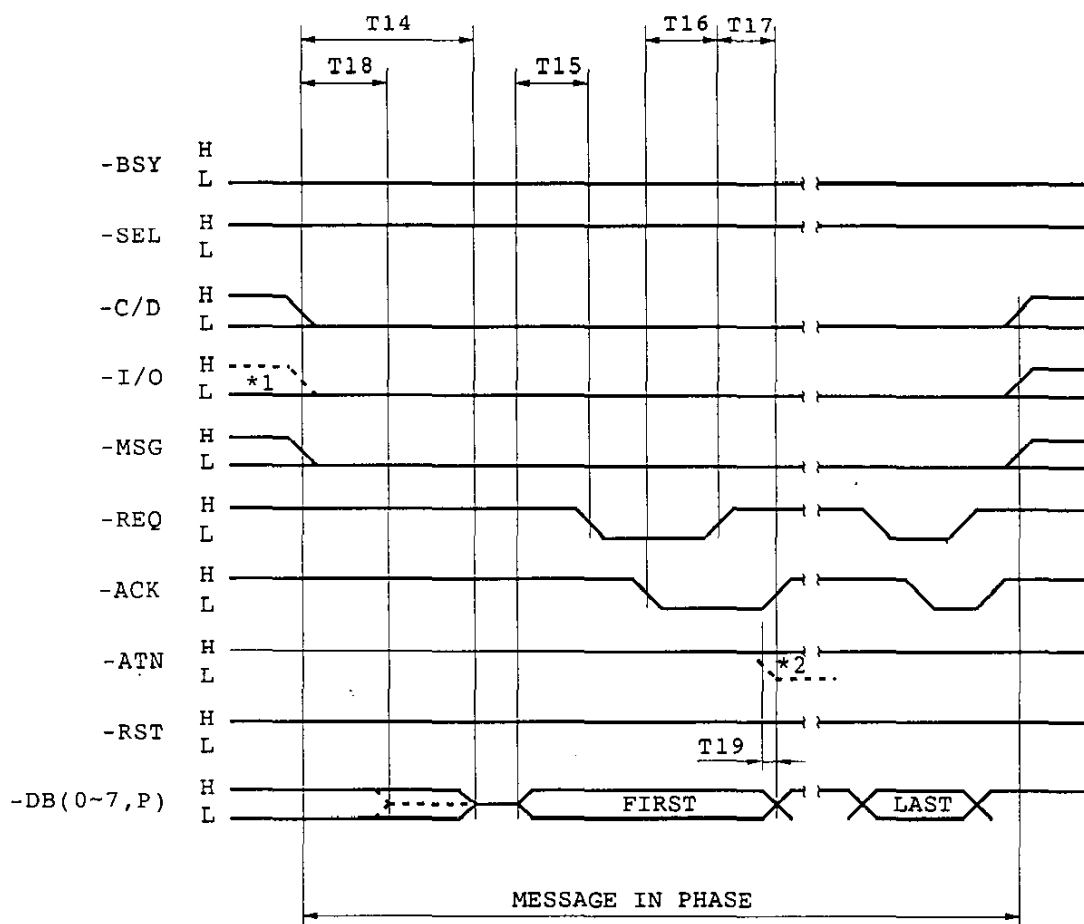
(Fig.10-14) DATA OUT phase timing

Timing diagram with signals: -BSY, -SEL, -C/D, -I/O, -MSG, -REQ, -ACK, -ATN, -RST, -DB(0~7,P), each with H/L levels. Intervals labeled T14, T18, T15, T16, T17, T19. DB shows STATUS. Overall period labeled STATUS PHASE. Notes *1 and *2 on -I/O and -ATN respectively.

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T14	BUS SETTLE DELAY + DATA RELEASE DELAY	800			ns
T15	DESKEW DELAY + CABLE SKEW	55			ns
T16		0	70		ns
T17		0			ns
T18	DATA RELEASE DELAY			400	ns
T19		0			ns

Notes: 1. For the case of the broken line *1, the host must re-
lease the data bus at the timing of T18. At this time,
the FC-5 drives the data bus after (T14 or T18) +
internal processing time.

2. The broken line *2 indicates the timing at which the
-ATN signal is transmitted at the end of this phase.
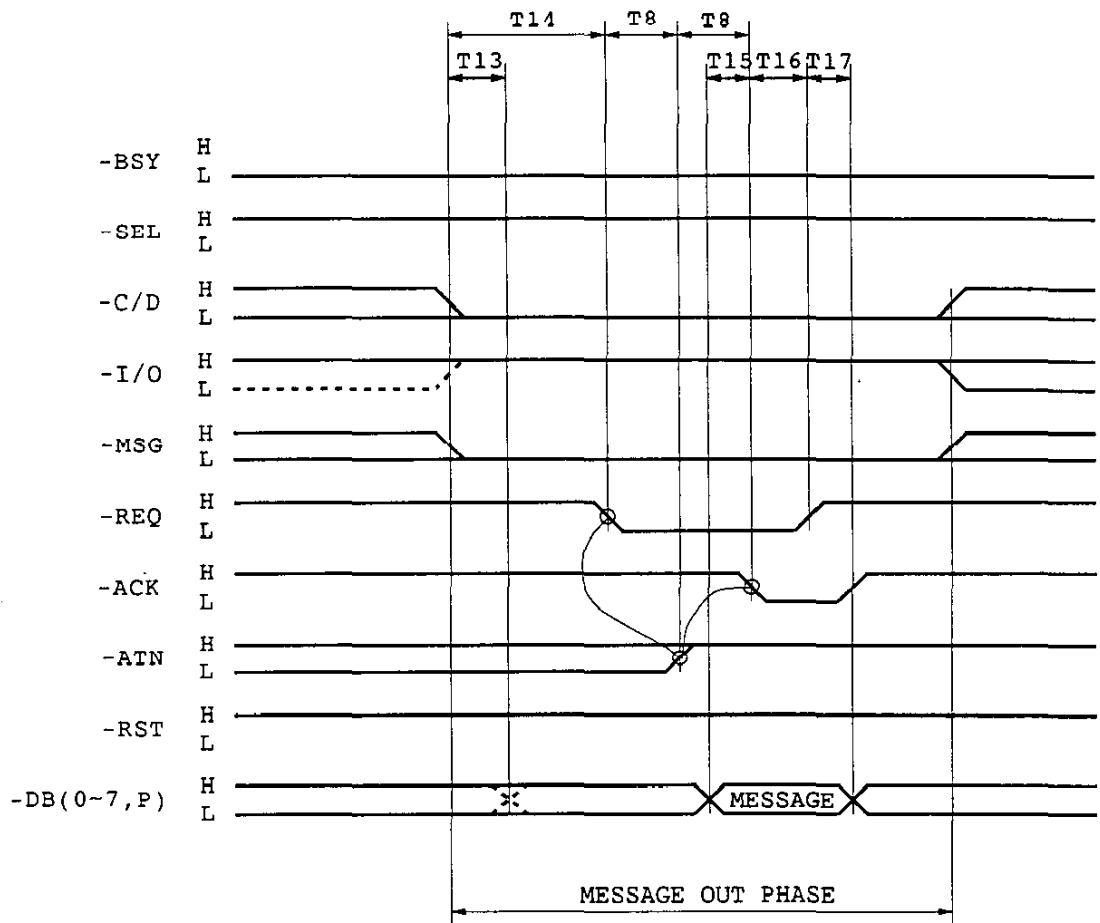
(Fig.10-15) STATUS phase timing

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T14	BUS SETTLE DELAY + DATA RELEASE DELAY	800			ns
T15	DESKEW DELAY + CABLE SKEW	55			ns
T16		0	70		ns
T17		0			ns
T18	DATA RELEASE DELAY			400	ns
T19		0			ns

Notes: 1. For the case of the broken line *1, the host must re-
          lease the data bus at the timing of T18. At this time,
          the FC-5 drives the data bus after (T18 or T14) +
          internal processing time.

       2. The broken line *2 indicates the timing at which an
          -ATN signal is transmitted when the host requests re-
          transfer of the MESSAGE.

(Fig.10-16) MESSAGE IN phase timing

Symbol	Description of symbol	MIN.	TYP.	MAX.	Unit
T8		0			ns
T13	DESKEW DELAY			45	ns
T14	BUS SETTLE DELAY + DATA RELEASE DELAY	800			ns
T15	DESKEW DELAY + CABLE SKEW	55			ns
T16		0	70		ns
T17		0			ns

Note: For the case of the broken line, the FC-5 releases the data
bus at the timing of T13.

(Fig.10-17) MESSAGE OUT phase timing

10.6 Control Sequence

10.6.1 Initialized state when the power is switched on or reset

(1) Protection of written data

In the transient period when the +5V power is lower than 3.5V, the SFD
is protected against miswriting and miserasing whatever the state of in-
put signals are.

(2) Auto-recalibration

Auto-recalibration is executed (head moves to track 00) immediately
after the power-on or reset.

(3) Motor starting state

The moment the unit is bootstrapped, the motor turns ON. However, it
stops five seconds later.

(4) Self-diagnosis

The moment the power is switched on or reset, the following items are
checked. In the event of an abnormality, HARDWARE ERROR (ADDITIONAL
SENSE CODE = A0 ~ A2h) is issued in response to the command given first,
terminating in a check condition. If control is continued disregarding
this, operation is not guaranteed.
 (a) Read/write check of the buffer RAM and I/O port
 (b) Specified check of straps
 (c) Check of whether or not terminator power is supplied

(5) Mode select state

In the initialized state, the 2MB mode is set.
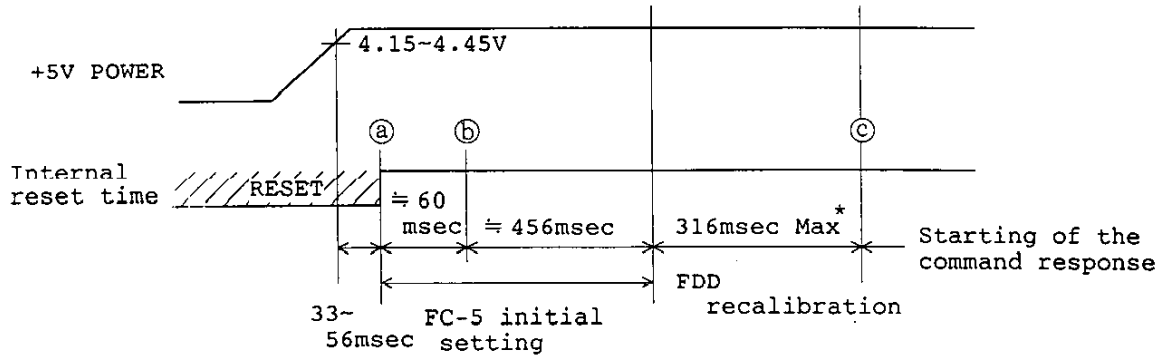 Operation mode   : 2MB
 No. of sectors   : 18 sectors/track
 Block length   : 512 bytes/sector
 Recording method: MFM
If operation is to be done with the above setting, there is no need to
issue a new mode select command.

(6) FC-5 reset sequence after the power is switched ON.

(Fig.10-18) Internal reset time

Notes: 1. Response is impossible for selection occurring between ⓐ and ⓑ.
2. The selection occurring between ⓑ and ⓒ shifts phases in the order STATUS (BUSY) → MESSAGE IN (COMMAND COMPLETE) → BUS FREE.
When the RESET signal of SCSI turned to true at ⓐ, the shift is the same.
3. *: When the head position of the SFD is at track 79.

(7) As sudden power switching applies an undue burden to the SFD, it is desirable to allow 5 seconds or more between switching.

10.6.2 Current consumption profile
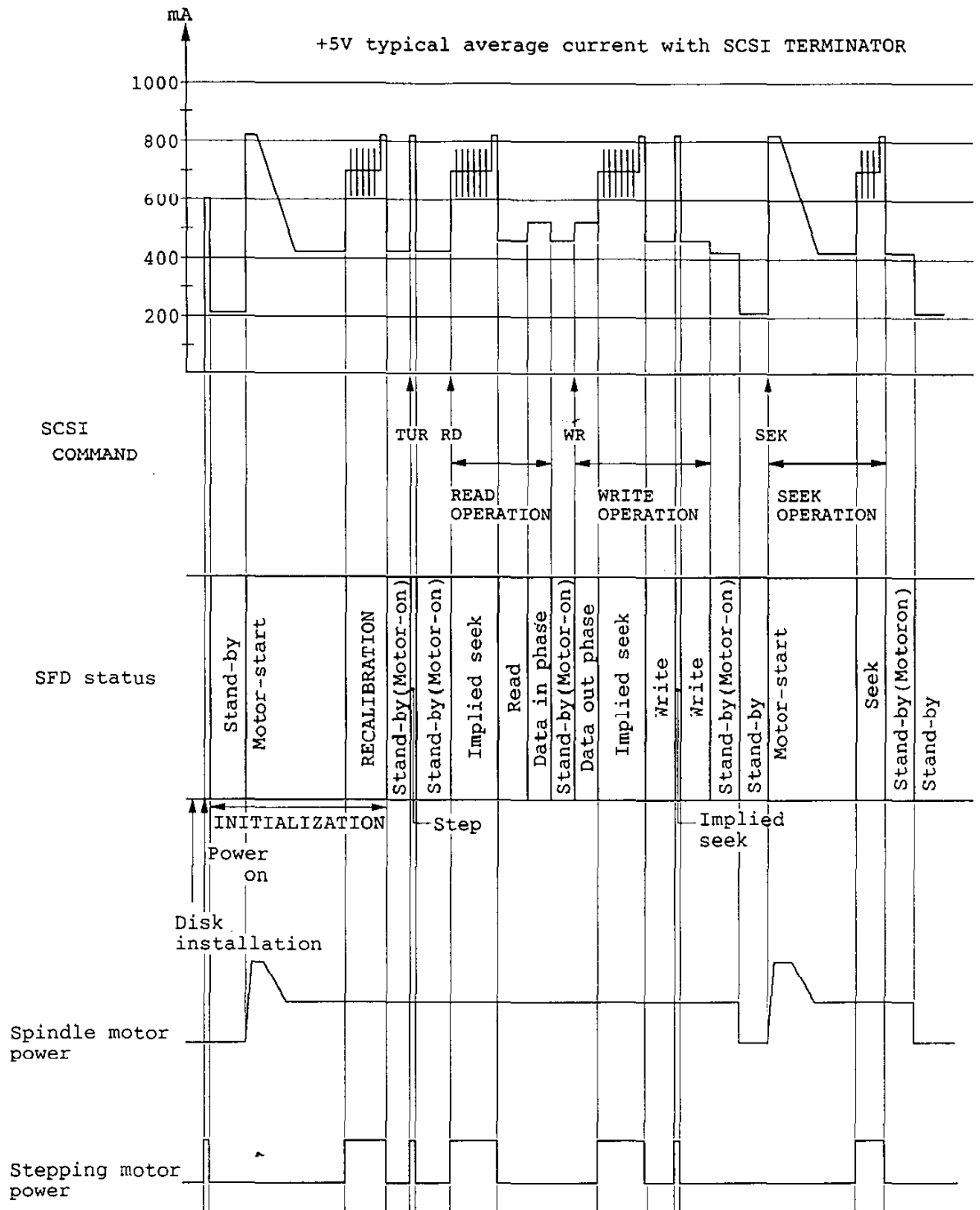
(Fig.10-19) Typical average current profile

10.7 Setting the Mode of the SFD

The mode of this SFD can be selected from among the following two methods.

(1) The initiator can detect the medium type (DD/HD) now loaded in the SFD.

(2) Based on the result of (1), the initiator can set the mode according to the type of medium loaded.

The FC-5, by referring to the Page 5 definition of the MODE SELECT data of the MODE SELECT command, controls the FDD density mode setting signal, and sets the three FDD density modes.
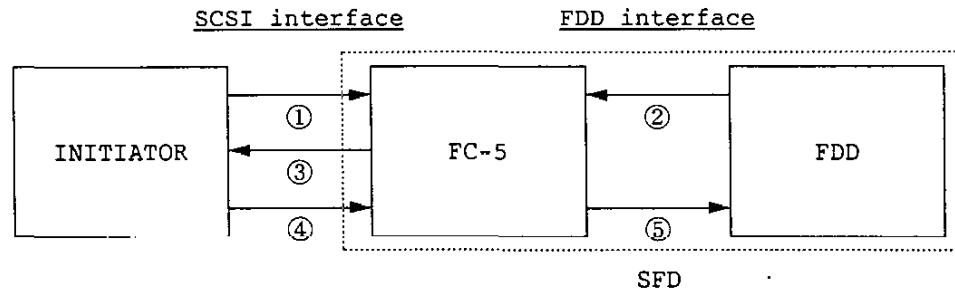
FDD interface FDD density mode setting signal	Page 5 definition of MODE SELECT data	Signal direction	1MB	1.6MB	2MB
Pin 11: HD IN signal	Byte 26 low-order 4 bit: DH	FC-5 → FDD	LOW	HIGH	HIGH
Pin 13: 1.6MB IN signal	Byte 27 low-order 4 bit: 3H	FC-5 → FDD	HIGH	LOW	HIGH
Pin 9: HD OUT signal*	Byte 27 high-order 4 bit: FH	FC-5 ← FDD	LOW	HIGH	HIGH

Note * Pin 9 (HD out signal) definition is applied to 02H (Media identification code) of the Medium Type of the HEADER section when executing the MODE SELECT command.
If bits other than 02H are specified to the Medium Type of the HEADER section, Byte 27 high-order 4 bit: 0H (OPEN) can be used.

(Table 10-2) FDD density mode setting input/output signals

(3) The initiator can recover in even a special case where a disk loaded is written with inherently the wrong density.

For example, read or write of HD medium written in the 1MB mode is possible though reliability is low.

(4) Procedure

```
            SCSI interface           FDD interface

 ┌───────────┐  ┌──────────┐       ┌──────────┐
 │           │    ①          │          │  ②          │          │
 │           │ ◄───          │          │ ◄───          │          │
 │ INITIATOR │    ③          │  FC-5    │               │   FDD    │
 │           │    ───►          │          │               │          │
 │           │    ④          │          │  ⑤          │          │
 │           │    ───►          │          │  ───►          │          │
 └───────────┘  └──────────┘       └──────────┘
                              SFD
```

Procedures: ① The initiator executes the MODE SELECT command by making
the Medium Type of the HEADER section 02h (Media identi-
fication code). (when in POWER ON, SCSI RESET or DISK
CHANGE)

② The FC-5 sets the mode inside the FC-5 by referring to
the media identification input signal (FDD interface Pin
9: HD OUT signal) from the FDD.

③ The initiator can detect the media loaded in the FDD
with the HEADER section of the MODE SENSE data, Medium
Type by executing the MODE SENSE command.
  HD media: 88h, DD media: 80h

④ The initiator executes the MODE SELECT command before
the next write or read action based on the execution re-
sult of ③.

⑤ The FC-5 sets the mode of the FDD (FDD interface Pin 11:
HD IN.signal, Pin 13: 1.6MB IN signal) by the MODE
SELECT data of ④.

Note: If the initiator needs not detect the type of medium
now loaded in the SFD, ① to ③ above can be omitted.

10.8 Customer Selectable Straps

10.8.1 Straps setting on the FC-5 board

There are straps on the FC-5 board as shown in Fig.10-20 and the state where the shorting bar is inserted is the ON state. Their functions are described below.

Factory-set is follows.

   H0, G0, H/G, PAR, ID0 ~ ID2: ON

(Shown when viewed from the chip side)

ID2 ID1 ID0

J0
H0
G0
EJC
HDS

EDC
ED1
H/G
PAR
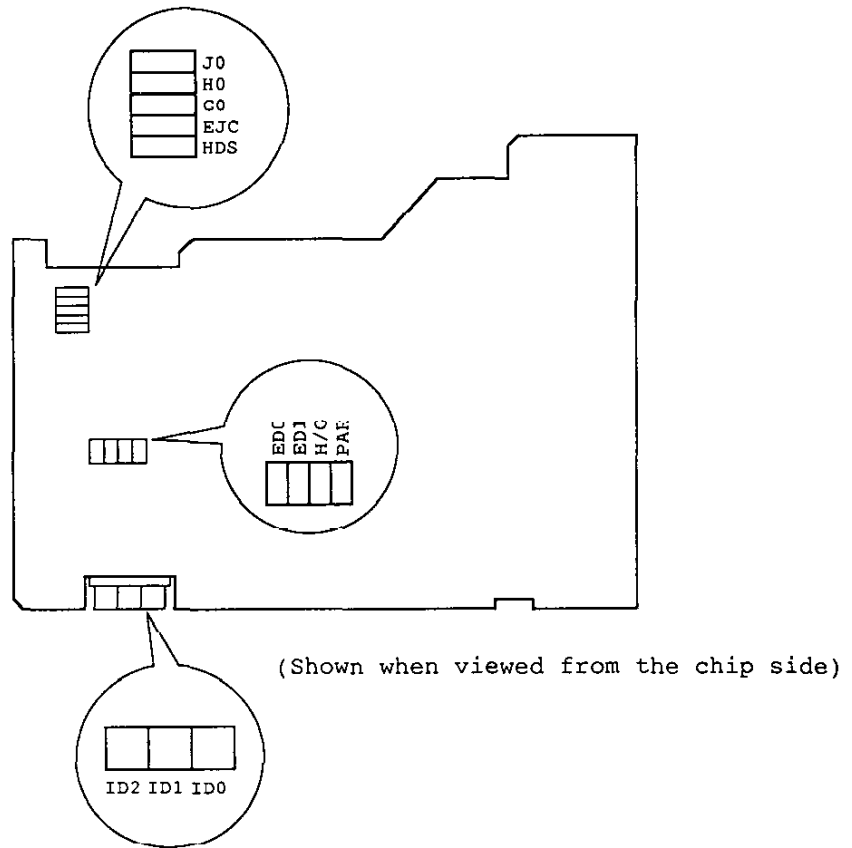
(Fig.10-20) Straps arrangement

(1) ID0/ID1/ID2 straps

Performs SCSI ID setting with "ID0", "ID1", and "ID2" on the PCBA. The relation between "ID0 ~ ID2" settings and the SCSI ID addresses is shown in Table 10-3.

"ID0 ~ ID2" are all factory-set to "ON" (device address = 0).

SCSI ID ADDRESS	ID2	ID1	ID0
0	ON	ON	ON
1	ON	ON	OFF
2	ON	OFF	ON
3	ON	OFF	OFF
4	OFF	ON	ON
5	OFF	ON	OFF
6	OFF	OFF	ON
7	OFF	OFF	OFF

(Table 10-3) SCSI ID setting

(2) PAR strap

"PAR" on the PCBA is the parity strap. When "PAR" is ON, the FC-5 performs parity checking (odd number) of input data (-DB0 ~ -DB7, -DBP). Parity checking does not take place when "PAR" is OFF.

It is factory-set to "ON".

(3) J0/H0/G0 straps

Set the FDD type shown in Table 10-4.
Strap "H0" "G0" are factor-set to ON, and these cannot be changed.
The 1MB mode is valid at all times.

Strap	J0	H0	G0
Mode	4MB mode	2MB mode	1.6MB mode

(Table 10-4) Setting the FDD type

(4) ED0, ED1, H/G straps

These are used to set the signals assigned to pin 11 (HF/GF/HGF type) or pin 21 (JHF/JGF type) in the interface between the FC-5 board and FDD. The H/G straps are factory-set to ON and define the HD IN signal (signal given from the FC-5 board to the FDD to set either the 1MB or 2MB mode) for pin 11.

These straps cannot be changed.

(5) HDS strap

Sets the initial state of the SFD mode auto switching to be valid or invalid according to the type of disk loaded in the SFD.

This is factory-set to OFF, and this cannot be changed.

"HDS": ON .... Valid

OFF .... Invalid

(6) EJC strap

Sets the media ejection function to valid or invalid. The factory setting is OFF.

"EJC": ON .... Valid

OFF .... Invalid

Note: To make this function valid, the eject mechanism must be supported.