Application Note

Teac FC1 SCSI Floppy

100-0026-01

01/06/2023

Revision 2

Author Simon Rees

Created from 20-0047-2

Document History

Revision	Date	By	Description	Released
1	24/04/2023	SPR	First draft	28/04/2023
2	1/06/2023	JAH	Final Draft	01/06/2023

Notices

Definition

Solid State Disks, SSD and Reactive are trading names of Reactive Group Ltd, Creative House, Station Road, Theale, RG7 4PD, UK.

Confidentiality
The information contained in these documents is confidential, privileged and only for the information of the intended recipient. It may not be used, published or redistributed without the prior written consent of Reactive Group Ltd.

General
The information and opinions expressed herein are in good faith and while every care has been taken in preparing this document, Reactive Group Ltd makes no representations and gives no warranties of whatever nature in respect of the contents of this document, including but not limited to the accuracy or completeness of any information, facts and/or opinions contained therein. Reactive Group Ltd, its subsidiaries, the directors, employees and agents cannot be held liable for the use of and reliance on the information, opinions, estimates, forecasts and findings in this document. Users of this document should form their own judgement on the accuracy of the information and check with other sources, and no liability is accepted should the information prove to be inaccurate or opinions misleading.

Trademarks
SCSIFlash is a registered Trademark of Solid State Disk. All other Trademarks are the property of their respective owners

1 GENERAL

This is a guide to the TEAC FD-235HS, 3.5" double-sided 5.3 track/mm [135tpl] micro floppy disk drive known as the FC1 and how to configure a Solid State Disks Ltd SCSIFlash “SF” Disk emulator.

The FC1 has 3 data capacity modes 4MB, 2MB and 1MB although the 4MB mode was never used. Using Iwo types of disk SD and HD, this FC1 permits Iwo write/read modes with unformatted data capacities of 2M and 1M bytes. The interface with the hast system is SCSI. The FC1 has a switch for the detection of the high-density identification hole (HD hale) in the disk and straps for selecting the density mode system.

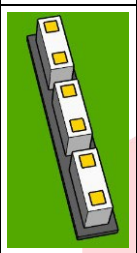
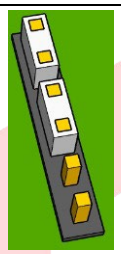
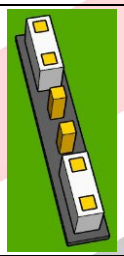
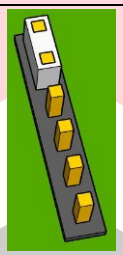
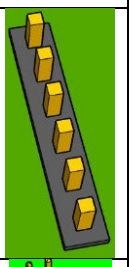
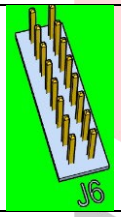
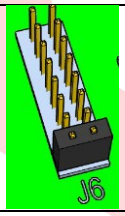
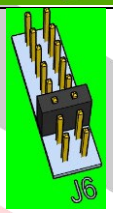
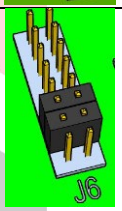
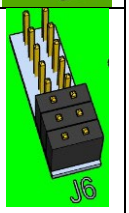
Identifying what floppy disk format is used in a given application can be quite difficult, making it hard to choose the correct emulation settings. This document is intended to guide you through that process.

2 Configuring a SCSIFlash to Emulate an FC1

2.1 Setting the SCSI ID

The SCSI ID jumpers of the TEAC drive have the opposite meaning to those on a SCSI Flash drive. The following table shows the jumper settings of both drives for each SCSI ID. Look at the jumpers on the FC1 and where one is fitted then remove one from the same place on the SCSI Flash. Where there is no jumper on the FC1 then fit one to the SCSI Flash.

TABLE 1, SCSI ID SETTING

SCSI ID	0	1	2	3	4	5	6	7
FC-1								
SF2								

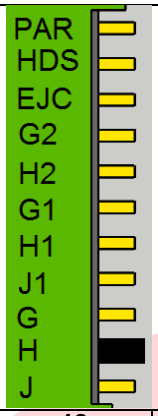
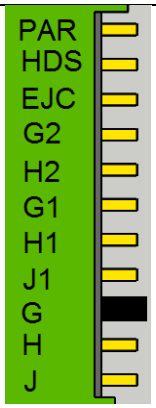
2.2 Choosing an Emulation

The SCSI Flash supports 12 fixed emulations and one variable emulation that can be configured by the host using the SCSI MODE SELECT command.

TABLE 2, SCSI FLASH EMULATION FORMAT DESCRIPTION

Emulation	Emulation Setdev I D	Sectors/Track	Block Size	Capacity	Total Size	Total Size K	Total Blocks	Heads	Cylinders
TEAC FC_1_128_32	219	32	128	650	655360	640	5120	2	80
TEAC FC_1_256_32	221	32	256	1.3	1310720	1280	5120	2	80
TEAC FC_1_256_18	222	18	256	720	737280	720	2880	2	80
TEAC FC_1_512_18	225	18	512	1.44	1474560	1440	2880	2	80
TEAC FC_1_512_10	226	10	512	800	819200	800	1600	2	80
TEAC FC_1_1024_10	229	10	1024	1.6	1638400	1600	1600	2	80
TEAC FC_1_128_16	220	16	128	320	327680	320	2560	2	80
TEAC FC_1_256_16	223	16	256	650	655360	640	2560	2	80
TEAC FC_1_256_9	224	9	256	360	368640	360	1440	2	80
TEAC FC_1_512_9	227	9	512	720	737280	720	1440	2	80
TEAC FC_1_512_5	228	5	512	400	409600	400	800	2	80
TEAC FC_1_1024_5	230	5	1024	800	819200	800	800	2	80

TABLE 3,CHOOSING AN EMULATION BY JUMPER SETTING

	Capacity Mode	2MB Mode			1.6MB Mode		
Disk Type	Jumper Setting						
	Sectors/Track	**32**	**18**	**10**	**16**	**9**	**5**
	Block Size	128	256	512	128	256	512
SD	Bytes/Disk	655.36K	737.28K	819.2K	327.68K	368.64K	409.6K
	Emulation	FC_1_128_32	FC_1_256_18	FC_1_512_10	FC_1_128_16	FC_1_256_9	FC_1_512_5
	Block Size	256	512	1024	256	512	1024
HD	Bytes/Disk	1310.72K	1474.56K	1638.4K	655.36K	737.28K	819.2K
	Emulation	FC_1_256_32	FC_1_512_18	FC_1_1024_10	FC_1_256_16	FC_1_512_9	FC_1_1024_5

Note: Block Size defaults to 512, other block sizes are selected by SCSI MODE SELECT command.

2.3 Setting the Parity Check

If the parity jumper is fitted to the FC1 then the Parity Disable jumper must be removed from the SCSIFlash.

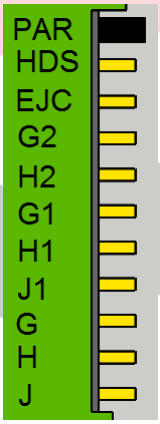


FIGURE 1, FC1 PARITY JUMPER LOCATION

2.4 Configuring Termination

If the terminator resistors are fitted to the FC1, see Figure 2, then fit jumper LK2 on the FC1.

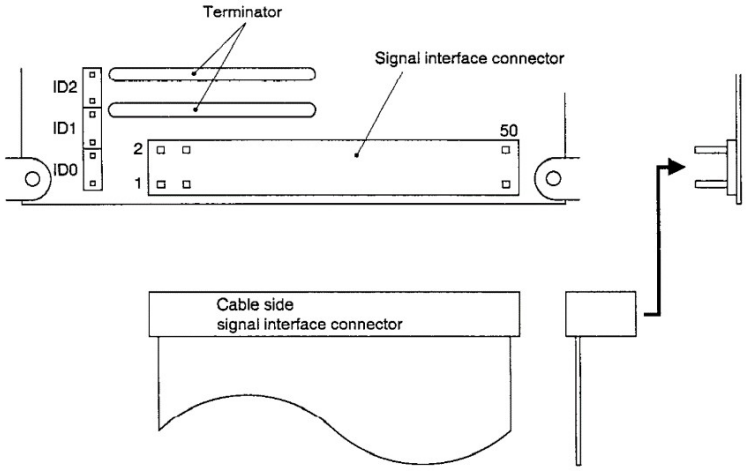
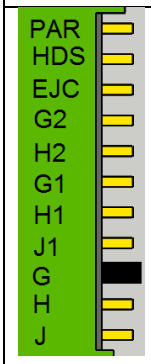
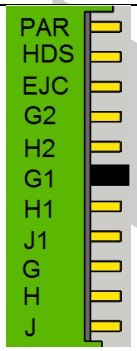
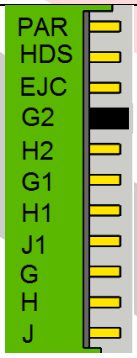
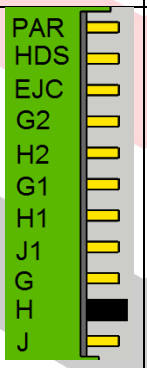
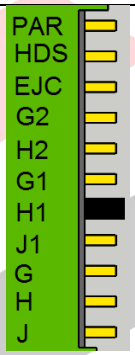
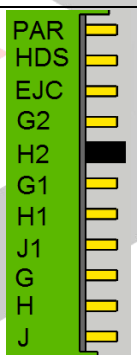
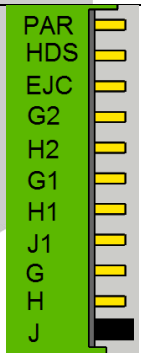
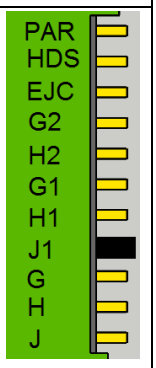


FIGURE 2, LOCATION OF FC1 TERMINATORS

2.5 Setting the Logical Unit Number (LUN)

The TEAC FC1 supports the ability to place the floppy drive on 1 of three possible logical unit numbers (LUNs).
Table 4 shows how the TEAC jumper settings select the drive capacity mode and LUN setting for each capacity mode. Only one capacity and one LUN combination can be set at any time.
The SCSI flash can only support LUN 0 so if the FC1 has jumpers set to LUN 1 or LUN 2 then the emulator is unlikely to work in place of the FC1.

TABLE 4, RELATION BETWEEN CAPACITY MODE AND LUN AND JUMPERS

1.6MB Mode			2MB Mode			4MB Mode	
LUN0	LUN1	LUN2	LUN0	LUN1	LUN2	LUN0	LUN1
							

3 TEAC FC1 SPECIFICATIONS

3.1 BASIC SPECIFICATIONS

(Table 1) Specification outline

Model name	**FD-235HS-1100**
TEAC PIN	19308111-00
ROM PIN	S002617-10
Safety standard	UL,CSA&TÜV
Operation modes	1MB mode, write/read 2MB mode, write/read
Disk used	Normal density (DO) High density (HO)
Data transfer rate	250k bits/s 500k bits/s
Disk speed	300rpm
Track density	5.3 track/mm [135tpi]
Required power	+5V single (4.75-5.25V)
Front bezel & flap	Black
Eject button	Black
LED indicator colour	Amber
Signal interface	SCSI (Small Computer System Interface: ANSI standard X3.1 31·1986)
Terminator	Provided (at factory), 220/33012 ±5%, detachable
Specification of parity	ON (at factory), ON/OFF switchable
Specification of SCSI	ID=0 (at factory), SCSI ID 0 to 7 switchable
Logical Unit Number	LUN=0 (at factory)
Internal data buffer capacity	31 K bytes

Using Iwo types of disk, this SCSIFlash Disk permits Iwo write/read modes with unformatted data capacities of 2M/1M bytes. The interface with the hast system is SCSI. The SCSIFlash Disk has a switch for the detection of the high-density identification hole (HD hale) in the disk and straps for selecting the density mode system (refer to 10.8).

3.1.1 SCSI Commands Supported

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

3.1.2 INQUIRY

Disk Fitted or Not Fitted

00 80 01 01 1f 00 00 00
54 45 41 43 20 20 20 20
46 43 2d 31 20 20 20 20 20 48 46 20 20 20 31 31
52 56 20 4a

Peripheral Qualifier = 0

Peripheral Device Type = 0
RMB = 80
Standard Version = 1
Flags3 = 1
Flags5 = 0
Flags6 = 0
Flags7 = 0
Manufacturer = TEAC
Model Name = FC-1 HF 11
Version = RV J

3.1.3 MODE SENSE (6)

For standard configuration data is identical for disks fitted or not fitted. Items that differ shown in red.

No Disk Fitted

Raw 53 1a 80 08 00 00 05 00 00 00 02 00 81 06 20 10 00 00 00 00 85 1e 00 fa 02 08 02 00 00 50 00 50 00 50 00 28 00 01 18 04 46 60 01 00 00 00 20 00 00 00 00 00 a0 0a 00 00 00 00 00 00 00 00 00 a2 0e ff 0f 12 3f 00 00 00 00 00 00 00 00 00 00 80 02 00 00

MODE DATA LENGTH 53
MEDIUM TYPE 1A
DEVICE SPECIFIC_PARAM 80
BLOCK DESCRIPTOR LENGTH 8

DENSITY CODE 0
NUMBER OF BLOCKS 5
RESERVED 0
BLOCK LENGTH 2
53 1A 80 08
00 00 05 00 00 00 02 00
81 06 20 10 00 00 00 00
85 1E 00 FA 02 08 02 00 00 50 00 50 00 50 00 28
00 01 18 04 46 60 01 00 00 00 20 00 00 00 00 00

A0 0A 00 00 00 00 00 00 00 00 00 00
A2 0E FF 0F 12 3F 00 00 00 00 00 00 00 00 00 00

80 02 00 00

HD or SD Disk Fitted

Raw 53 1a 00 08 00 00 05 00 00 00 02 00 81 06 20 10 00 00 00 00 85 1e 00 fa 02 08 02 00 00 50 00 50 00 50 00 28 00 01 18 04 46 60 01 00 00 00 20 00 00 00 00 00 a0 0a 00 00 00 00 00 00 00 00 00 a2 0e ff 0f 12 3f 00 00 00 00 00 00 00 00 00 00 80 02 00 00

MODE DATA LENGTH 53
MEDIUM TYPE 1A
DEVICE SPECIFIC_PARAM 0
BLOCK DESCRIPTOR LENGTH 8

DENSITY CODE 0
NUMBER OF BLOCKS 5
RESERVED 0
BLOCK LENGTH 2
53 1A 00 08
00 00 05 00 00 00 02 00

81 06 20 10 00 00 00 00
85 1E 00 FA 02 08 02 00 00 50 00 50 00 50 00 28
00 01 18 04 46 60 01 00 00 00 20 00 00 00 00 00

A0 0A 00 00 00 00 00 00 00 00 00 00
A2 0E FF 0F 12 3F 00 00 00 00 00 00 00 00 00 00

80 02 00 00

3.2 2MB Mode Data Capacity

TABLE 5, 2MB MODE DATA CAPACITY

Encoding method			**FM**	**MFM**
Data transfer rate between FC-1 - FDD (k bits/s)			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
Data capacity Formatted	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		10.24
		k bytes/disk	819.20	1,638.40

3.3 1MB Mode Data Capacity

TABLE 6, 1MB MODE DATA CAPACITY

Encoding method			**FM**	**MFM**
Data transfer rate between FC-1 - FDD (k bits/s)			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
Unformatted		k bytes/track	3.125	6.250
		k bytes/disk	500	1,000
Data capacity 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

4 POWER INTERFACE

4.1 Required Power

The following specifications are applied at interface connector of the SFD. Power is fed to the FC-1 via the signal interface cable (7, 9 and 11 pins) between FC-1 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

(Table 14) Current and power consumption

Operating mode	Average current		Average power	
	Typ.	Max.	Typ.	Max.
Stand-by *1	85mA	105mA	0.43mW	0.55mW
Read operation *1	0.36A	0.46A	1.80W	2.42W
Write operation *1	0.36A	0.46A	1.80W	2.42W
Seek operation *1	0.54A	0.63A	2.70W	3.31W
Spindle motor start *1	0.70A	O.77A	3.50W	4.04W
Terminator Current *2	0.16A	0.30A	0.80W	1.58W

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.
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. Stand-by mode Is defined at the stop condition of spindle motor and seek operation.
3. Rush current flows within 150ms alter the motor start.
4. Short time peak current except tor power-on surge IS less than 1.3A.

4.2 9.2 Power Interface Connector and Cable

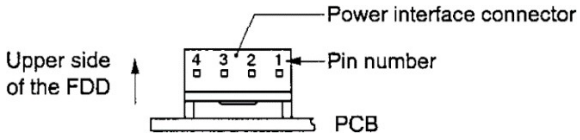
(1) Power interface connector
(Table 15) Power interface connector

3FD side connector	HONDA TSUSHIN KOCYO Co. Ltd., PIN Z-419E or equivalent
Pin numbers	4 pins
Protection method for mis-connection	Mechanical protection by the shape of connector housing
Connector external view	See Fig.7.
Connector location	See Fig.4.
Power interface connections	See Table 16.
Cable side matched connecter	AMP PIN 171822-4 (natural color) or equivalent
Cable side matched pin	AMP PIN 170204-2 (AWG#20-26, loose piece) or PIN 170262-2 (AWG#20-26, strip form) or equivalent

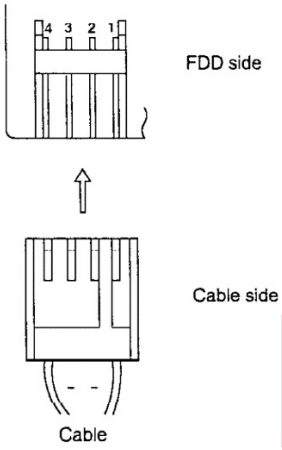
(2) Power interface cable — Any appropriate cables taking the maximum power consumption of the SFD will be acceptable.

(Table 16) Power interface pin-assignment

Powervoltage	Pinnumbers
DC+5V	1
0V	2
(0V)	3
(Noconnection)	4



Rear view



Top view

(Fig.7) Power interface connector external view

4.3 Setting the Mode for the SCSIFlash Disk

When setting the mode of this SCSIFlash Disk, mode can be selected by one of the following lwo methods by using the straps on the FC-1 board and FDD main board.

4.3.1 Method A

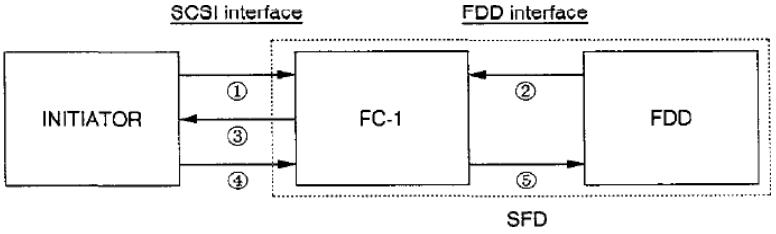
Method A indicates that the following operation is possible, and the unit is factory-preset by method A.

(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-1 can set two FDD density modes using the FDD interface signal (HD IN signal) shown in Table 21.

(Table 21) FDD density mode setting input/output signals

FDD interface signal	Signal direction	Meaning of the signal
HD IN signal	FC-1 ➔ FDD	2MB mode setting signal
HD OUT signal	FC-1 ← FDD	HD hole identification signal

(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 HO medium written in the 1MB mode is possible though reliability is low.
(4) Procedure



Procedures:

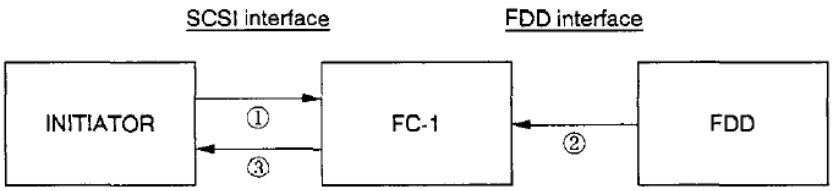
(1) The initiator executes the MODE SELECT command by making the Medium Type of the HEADER section 02h (Media identification code). (when in POWER ON, SCSI RESET or DISK CHANGE)

(2) The FC-1 sets the mode inside the FC-1 by referring to the media identification input signal (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 result of (3).
(5) The FC-1 sets the mode of the FDD (including the HO IN signal) by the MODE SELECT parameter of (4).

Note: If the initiator needs not detect the type of medium now loaded In the SFD, (1) to (2) above can be omitted.

4.3.2 Method B

Method B indicates the following operations are possible.
(1) The initiator can detect the medium type (DD/HD) now loaded in the SFD.
(2) By identifying whether or not there is a HD hole on the disk loaded, the SFD automatically sets the 1MB (DD) or 2MB (HD) mode.
The initiator can only set mode for the SFD with respect to the PAGE parameter.
(3) The initiator cannot rescue in a special case where a disk loaded is written with the inherently wrong density.
(4) Procedure



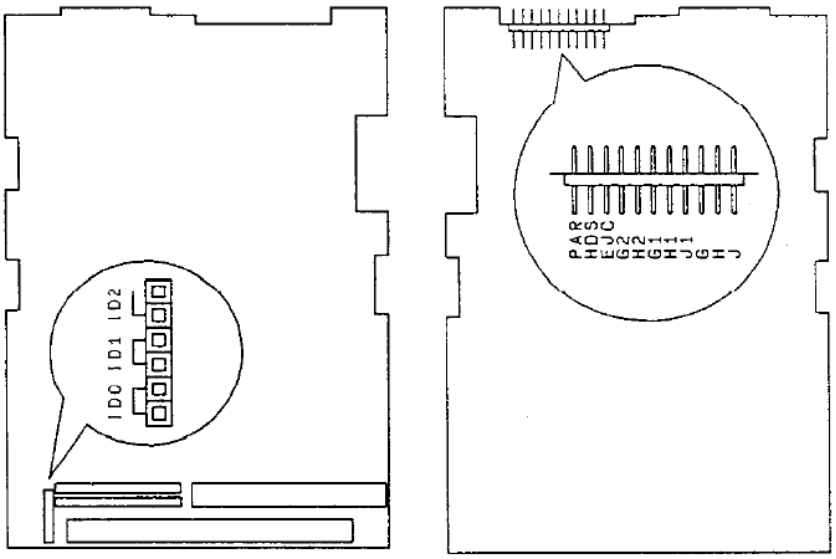
Procedures:
(1) The initiator executes the command in the DISK LOAD status (excluding the INOUIRY and REQUEST SENSE commands).
(2) The FC·1 sets the mode inside the FC-1 referring to the media identification input signals (HD OUT signal) from the FDD and executes the command (1) based on it.
(3) The initiator can detect the MODE setting status (including the medium loaded in the FDD) of the current FC-1 from the MODE SENSE command. The HEADER section of the MODE SENSE data (Current rate). Medium Type is as follows.
HD media: 88h, DD media: 80h.

Note: To set mode including the PAGE 5 parameter, the initiator executes the MODE SELECT command by making the Medium type of the HEADER section 00h or 02h.

4.4 Customer Selectable Straps

4.4.1 Straps setting on the FC-1 board

There are straps on the FC-1 board as shown in Fig.28 and the state where the shorting bar is inserted is the on state. Their functions are described below.
Factory-set is follows.



(Shown when viewed from the chip side)

(Fig.20) Straps arrangement

(1) ID Straps Setting
Performs SCSI ID setting with "ID0", "ID1", and "ID2" the PCBA. The relation between "ID0 ~ ID2" settings and the SCSI ID addresses are shown in Table 22.

"ID0 - 1D2" are all factory-set to "ON" (device address = 0).

(Table 22) SCSI ID setting

SCSI ID ADDRESS	ID2	101	100
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

(2) SCSI Parity strap
"PAR" on the PCBA is the parity strap. When "PAR" is ON, the FC-1 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) J/H/G/J1/H1/G1/H2/G2 straps
These straps indicate an FDD type as shown in Table 10-4 and the LUN 0 FDD type is set by J/H/G straps, the LUN 1 FDD. type by J1/H1/G1 straps or the LUN 2 FDD type by H2/G2 straps.
Here, the 1MB mode is valid at all times irrespective of the LUN number.
Strap "H" is factory-preset to ON.

(Table 23) Setting the FDD type

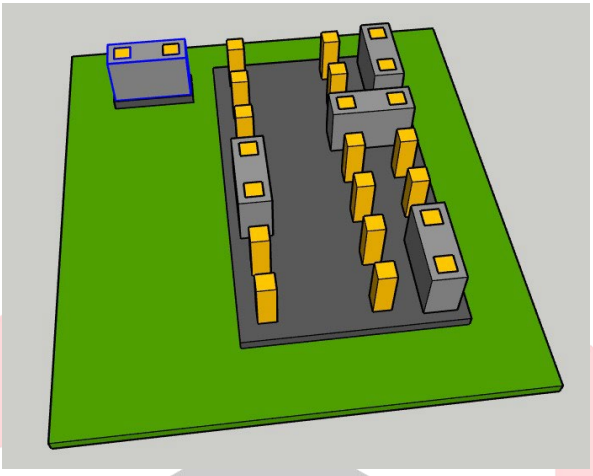
Strap	G/G1/G2	H/H1/H2	J/J1
Mode	1.6MB mode	2MB mode	4MB mode

(4) HDS strap
Sets the initial state whether or not the mode auto setting function according to the disk type loaded in the SCSIFlash Disk is valid using the HDS strap. If the HDS strap is ON, It Is necessary to set the H1/H2 straps.
The strap is factory-preset to OFF.

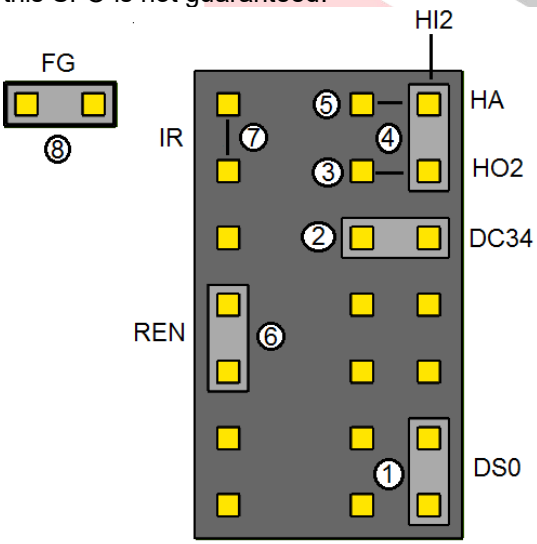
"HDS"; ON Valid
OFF Invalid

(5) EJC strap
(Setting the output signal at pin 4 in the FD IF)
Sets the initial state whether or not the media eject function is valid using the EJC strap.
The strap is factory-preset to OFF and it Is not possible to change this strap.
"EJC"; ON Valid
OFF Invalid

4.4.2 Strap setting on the FDD main board



The straps on the FDD main board and an outline of their functions are given in Table 24.
If the settings of straps other than HA/IR/FG on the FDD main board are changed, the operation of this SFO is not guaranteed.



Position	Name	Outline of functions
(1)	DS0	DRIVE SELECT 0 input
(2)	DC34	PIN 34: DISK CHANGE output
(3)	HO2	PIN 2: HD OUT output
(4)	HI2	PIN 2: HD IN input
(5)	HA	Sets FDD automatic density using the HD hole
(6)	REN	Auto-recalibration enable
(7)	IR	LED active condition: DRIVE SELECT * READY state
(8)	FG	Frame ground

Note: The shown positions are the factory pre-set positions.

(Table 24) Straps on the FDD main board and their functions

(1) HAIHI2/HO2 straps
By combining HA/HI2/H02 straps on the FDD main board with HDS strap on the FC-1 board, users can select the mode setting methods shown in Table 25. The factory pre-set mode setting method is A.
For details of how to set the method of the SCSIFlash Disk, refer to 10.7.

(Table 25) Strap setting when mode is selected.

Mode	Strap setting	Setting	FDD density mode	Medium identification

setting method					mode	setting signal level	signal level	
	FC-1	FDD				HD IN *(PIN 2)	HD OUT	
	HDS	HI2	HO2	HA			*(PIN 4)	*(PIN 2)
A	OFF	ON	OFF	OFF	1MB	LOW	LOW	---
					2.0MB	HIGH	HIGH	---
B	ON	OFF	ON	ON	1MB	---	---	LOW
					2.0MB	---	---	HIGH

Note: With PIN 2 and 4 (marked "*") of the FDD interface signal, the meaning and true level are defined by bytes 26 and 27 of PAGE code 5 of the MODE SELECT parameter.

(2) IR strap
With the IR strap, one of the following two front bezel indicator (LED) lighting conditions can be selected.
However, to prevent the lighting due 10 the polling operation of the DRIVE SELECT signal, the indicator does not light for 3.1ms immediately after the DRIVE SELECT signal is made true under any conditions.

(Table 26) Selecting the front bezel indicator lighting conditions.

IR strap	Front bezel indicator (LED) lighting conditions
----	DRIVE SELECT
ON	DRIVE SELECT * FDD READY slate

Note: Symbol of "---" Indicates the state when the strap = OFF.

(3) FG strap
Connects the FDD frame to OV DC. (For details, refer to 5.2)

(1) Mode select state
In the initialized state, the high-density mode is set.
Operation mode :H (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.