TEAC FD-35HFN-*Ad*

MICRO FLOPPY DISK DRIVE

SPECIFICATION

REV.A

TABLE OF CONTENTS

1. GENERAL

   This SPECIFICATION provides a description for the TEAC FD-35HFN-22, 3.5 inch, double sided, double densities, 135tpi, micro-floppy disk drive (hereinafter referred to as the FDD).

   The FDD is equipped with an input signal for switching high/normal densities on terminal No.2 of the signal interface connector.
   When the high density mode is designated from a host system, the FDD operates at 2.0M bytes-mode, while it operates like conventional 1M bytes-FDD when the normal density mode is designated. It can read and write data of conventional 3.5 inch, 135tpi, single/double sided disks, and it can also read the data of 3.5 inch, 67.5tpi, single/double sided disks.

   The following Table shows the summary of the FDD performance.

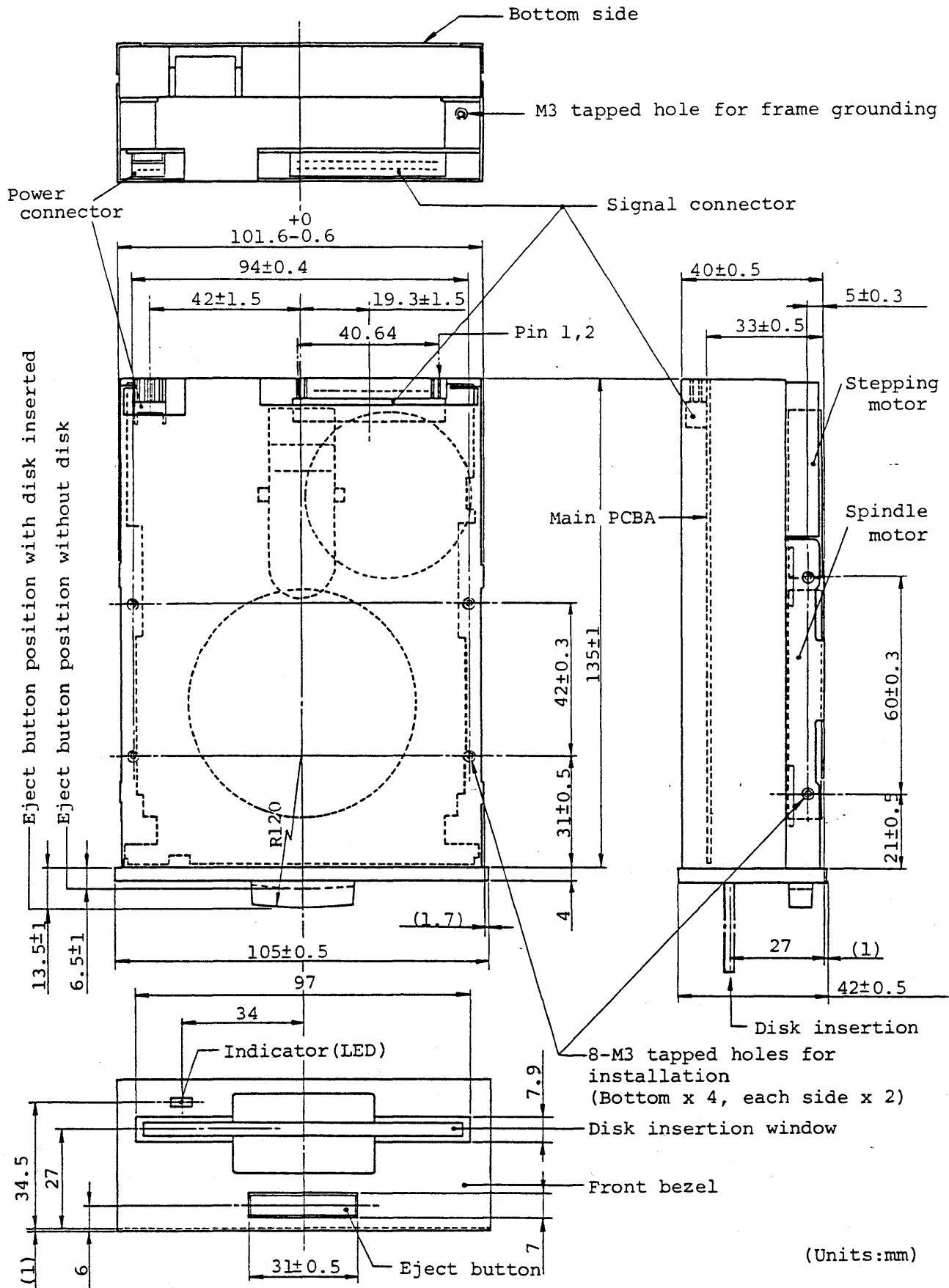 | Density mode | Unformatted data capacity | Track density | Disk rotation speed | Data transfer rate/sec |
   |---|---|---|---|---|
   | High | 2.0M bytes | 135tpi | 300rpm | 500K bits |
   | Normal | 1.0M bytes | 135tpi | 300rpm | 250K bits |

   (Table 0) Performance summary

2. DISK

   High density or normal density 3.5 inch micro floppy disks which are mutually agreed between the customer and TEAC.
   Since it is impossible for the FDD to identify which type of disks is installed, it is required for the host controller to provide some control such as detection of sector identifier or previous designation of the density.

3. PHYSICAL SPECIFICATION

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

(2) Height: 40mm (1.575 in), Nom.

(3) Depth: 135mm (5.315 in), NOm.

(4) Weight: 660g (1.46 lbs), Nom., 690g (1.52 lbs), Max.

(5) External view: See Fig.1

(6) Cooling: Natural air cooling

(7) Mounting: Mounting for the following directions are acceptable.

   (a) Front loading, mounted vertically.

   (b) Front loading, mounted horizontally with indicator up. Do not mount horizontally with spindle motor up.

   (c) Mounting angle in items (a) and (b) should be less than 15° with front bezel up.

  Note: As to the other mounting directions than the above will be considered separately.

(8) Installation: With installation holes on the side frame or on the bottom frame of the FDD (see Fig.1).

(9) Material, Frame: Aluminum diecast
                Front bezel and eject button: ABS or PPHOX (Zyron)

(10) Standard color, Indicator (LED): Amber
                  Front bezel and eject button: Black

Bottom side

M3 tapped hole for frame grounding

Power connector

Signal connector

+0
101.6-0.6

94±0.4

42±1.5   19.3±1.5

40.64

Pin 1,2

40±0.5

5±0.3

33±0.5

Eject button position with disk inserted

Eject button position without disk

Stepping motor

Main PCBA

Spindle motor

R120

42±0.3

135±1

60±0.3

31±0.5

21±0.5

4

(1.7)

27   (1)

105±0.5

42±0.5

13.5±1

6.5±1

Disk insertion

97

8-M3 tapped holes for installation
(Bottom x 4, each side x 2)

34

Indicator(LED)

7.9

Disk insertion window

34.5

27

Front bezel

(1)

6

7

31±0.5   Eject button

(Units:mm)

(Fig.1-1) External view

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Bottom side

M3 tapped hole for frame grounding

Power connector

Signal connector

101.6-0.6 +0

94±0.4

42±1.5   19.3±1.5

40.64

Pin 1,2

40±0.5

5±0.3

33±0.5

Stepping motor

Spindle motor

Main PCBA

Eject button position with disk inserted

Eject button position without disk.

135±1

42±0.3

31±0.5

60±0.3

21±0.5

0.5±0.5

7.5±1

(1.7)

4

105±0.5

27   (1)

42±0.5

Disk insertion

97

34

Disk insertion mark

Indicator (LED)

7.9

8-M3 tapped holes for installation (Bottom x 4, each side x2)

34.5

27

16.5

Disk insertion window

(1)

4.4

37.3

38±0.5

Eject button

Front bezel

(Units:mm)

Note: Flush type bezel requires special order.

(Fig.1-2) Flush type external view

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4. OPERATIONAL CHARACTERISTICS

4.1 Data Capacity (High Density Mode)

Recording method			FM	MFM
Data transfer rate (K bits/sec)			250	500
Tracks/disk			160	160
Innermost track bit density (bpi)			8,717	17,434
Innermost track flux density (frpi)			17,434	17,434
Data capacity	Unformatted	K bytes/track	6.25	12.50
		K bytes/disk	1,000	2,000
	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
	Formatted — 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
	Formatted — 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 1-1) High density mode data capacity

4.2 Data Capacity (Normal Density Mode)

Recording method				FM	MFM
Data transfer rate (K bits/sec)				125	250
Tracks/disk				160	160
Innermost track bit density (bpi)				4,359	8,717
Innermost track flux density (frpi)				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 1-2) Data capacity

4.3 Disk Rotation Mechanism

(1) Spindle motor: Direct DC brushless motor

(2) Spindle motor speed: 300rpm

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

(4) Motor/spindle connection: Motor shaft direct

(5) Disk speed: 300rpm

   Long term speed variation (LSV): Less than ±1.5%

   Instantaneous speed variation (ISV): Less than ±2%

(6) Start time: Less than 400msec

(7) Average latency: 100msec

4.4 Index Detection

(1) Number of index: 1 per disk revolution

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

(3) Detection cycle: 200msec ±1.5%

(4) Index burst detection timing error: Less than ±500μsec with specified

test disk

4.5 Track Construction

(1) Track density: 135tpi

(2) Number of cylinders: 80 cylinders

(3) Number of tracks: 80 tracks/surface, 160 tracks/disk

(4) Outermost track radius (track 00): Side 0 39.500mm (1.5551 in)

Side 1 38.000mm (1.4961 in)

(5) Innermost track radius (track 79): Side 0 24.6875mm (0.9719 in)

Side 1 23.1875mm (0.9129 in)

(6) Positioning accuracy: Less than ±15μm, with specified test disk

(Track 40, 23±2°C, 45 ∿ 55%RH)

4.6 Magnetic Head

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

(2) Effective track width after trim erase:

0.115 ± 0.008 (0.0045 ± 0.0003 in)

(3) Read/write gap azimuth error: 0° ± 18', with specified test disk

4.7 Track Seek Mechanism

(1) Head positioning mechanism: Stepping motor and steel belt

(2) Stepping motor: 4-phase, 200 steps per revolution

(3) Stepping motor drive: 1 step per track

(4) Track 00 and innermost stopper: Mechanical moving stopper of head

carriage

(5) Track 00 detection method: LED and photo-transistor

(6) Track to track time: Use 3msec, Min.

(7) Settling time: 15msec, Max. (excludes track to track time)

(8) Average track access time: 94msec (includes settling time)

4.8 Window Margin and Others

(1) Window Margin (with specified test disk, MFM method, analogue PLO
                      separator, and recommended write pre-compensation)
      High density mode: More than 300nsec
      Normal density mode: More than 600nsec

(2) Recommendable write pre-compensation
      Track 00 ∿ 43, High and normal density modes: ±62.5nsec
      Track 44 ∿ 79, High and normal density modes: ±125nsec

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

(4) File protect mechanism: Detection of write inhibit hole by microswitch

(5) Disk detection mechanism: Detection of disk installation by microswitch

(6) Disk inserting force: 500gf, Max.

(7) Disk ejecting force: 1,500gf, Max.

(8) Acoustic noise at 1m: 50dBA, Max.

5. ENVIRONMENTAL CONDITIONS

(1) Ambient temperature

    (a) Operating   : 4°C ∿ 51.5°C (40°F ∿ 125°F)

    (b) Storage   : -22°C ∿ 60°C (-8°F ∿ 140°F)

    (c) Transportation: -40°C ∿ 65°C (-40°F ∿ 149°F)

(2) Temperature gradient

    (a) Operating   : Less than 15°C (27°F) per hour

    (b) Storage and transportation:

                 Less than 30°C (54°F) per hour

(3) Relative humidity

    (a) Operating   : 20% ∿ 80% (no condensation)

                 Maximum wet bulb temperature shall be 29°C (84°F)

    (b) Storage   : 10% ∿ 90% (no condensation)

                 Maximum wet bulb temperature shall be 40°C (104°F)

    (c) Transportation: 5% ∿ 95% (no condensation)

                 Maximum wet bulb temperature shall be 45°C (113°F)

(4) Vibration

    (a) Operating   : Less than 0.5G (less than 55Hz)

                 Less than 0.25G (55 ∿ 500Hz)

    (b) Storage and transportation:

                 Less than 2G (less than 100Hz)

(5) Shock

    (a) Operating   : Less than 5G peak (10msec, Max.)

    (b) Storage   : Less than 20G peak (10msec, Max.)

(c) Transportation: Less than 60G peak (10msec, Max.)

(6) Altitude (operating): Less than 5,000m (16,500 feet)

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

6. RELIABILITY

(1) MTBF: 10,000 power on hours or more (for typical usage)

(2) MTTR: 30 minutes

(3) Design component life: 5 years

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

(5) Disk insertion: 3×10^4 times or more

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

(7) Error rate

  (a) Soft read error: 1 per 10^9 bits

  (b) Hard read error: 1 per 10^{12} bits

  (c) Seek error: 1 per 10^6 seeks

(8) Safety standart: complying with UL, CSA

Warning: EMI/RFI countermeasure

This FDD generates and uses radio frequency energy. If the FDD (including the interface cable and connector) is used without shielding, it may cause interference to radio and television reception around it. Be sure to install this FDD in the equipment which is designed for effective EMI/RFI countermeasure.

This FDD installed in a specific equipment has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If the equipment with this FDD does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measure.

  a) Reorient the receiving antena.
  b) Relocate the equipment with respect to the receiver.
  c) More the equipment away from the receiver.
  d) Plug the equipment into a different outlet so that the equipment and the receiver are on different branch circuits.

7. POWER INTERFACE

7.1 Required Power

The following specifications are applicable at power connector of the FDD.

(1) DC+12V

(a) Voltage tolerance: ±10%

(b) Allowable ripple voltage: Less than 200mVp-p (including spike noise)

(c) Operating current consumption

Read operation: 75mA (Typ.), 110mA (Max.)
Write operation: 120mA (Typ.), 155mA (Max.)
Seek operation: 180mA (Typ.), 210mA (Max.)
Peak at spindle motor start: 200mA (Typ.), 240mA (Max.), within 400msec

(d) Stand-by current consumption
(at spindle motor off and seek stop): 0.2mA (Typ.), 0.5mA (Max.)

(2) DC+5V

(a) Voltage tolerance: ±5%

(b) Allowable ripple voltage: Less than 100mVp-p (including spike noise)

(c) Operating current consumption

Read operation: 180mA (Typ.), 210mA (Max.)
Write operation: 180mA (Typ.), 210mA (Max.)
Seek operation: 140mA (Typ.), 170mA (Max.)

Spindle motor start: 110mA (Typ.), 130mA (Max.)

(c) Stand-by current consumption

    (at spindle motor off and seek stop): 6mA (Typ.), 8.8mA (Max.)

(3) Power consumption

(a) Operating power consumption

    Read operation: 1.80W (Typ.), 2.37W (Max.)

    Write operation: 2.34W (Typ.), 2.91W (Max.)

    Seek operation: 2.86W (Typ.), 3.37W (Max.)

    Spindle motor start: 2.95W (Typ.), 3.53W (Max.)

(b) Stand-by power consumption

    (at spindle motor off and seek stop): 32mW (Typ.), 50mW (Max.)

7.2 Power Interface Connector and Cable
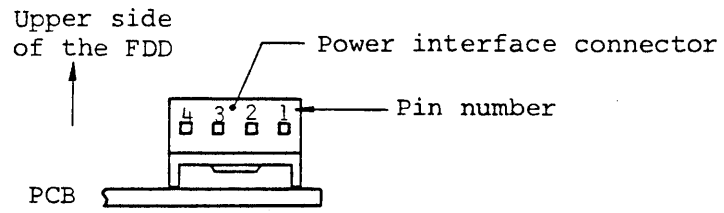

(1) Power interface connector

   (a) FDD side connector: AMP, P/N 171826-4 (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.2

   (e) Connector location: See Fig.1

   (f) Power interface connections: See Table 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)

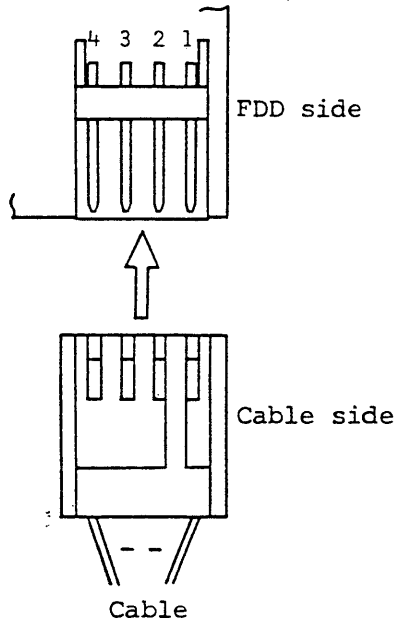   or equivalent

(2) Power interface cable

   Any appropriate cables taking the maximum power consumption of the FDD
   will be acceptable.

Power voltage	Pin numbers
DC +5V	1
0V	2
0V	3
DC+12V	4

(Table 2) Power interface connections

Upper side
of the FDD

Power interface connector

4 3 2 1

Pin number

PCB

Rear view

4 3 2 1

FDD side

Cable side

Cable

Top view

(Fig.2) Power interface connector external view

8. SIGNAL INTERFACE

Up to four FDDs, can be connected to one FDD controller by daisy chaining.

8.1 Electrical Characteristics

(1) Interface driver/receiver: See Fig.3

(2) Electrical characteristics

The following specifications are applicable at the signal connector of the FDD.

(a) Input signal (TTL level)

LOW level (TRUE): 0V $\sim$ 0.5V

Terminator current: -5.6mA, Max.

Receiver current: -0.4mA, Max.

HIGH level (FALSE): 2.5V $\sim$ 5.25V

(b) Output signal (Open collector driver)

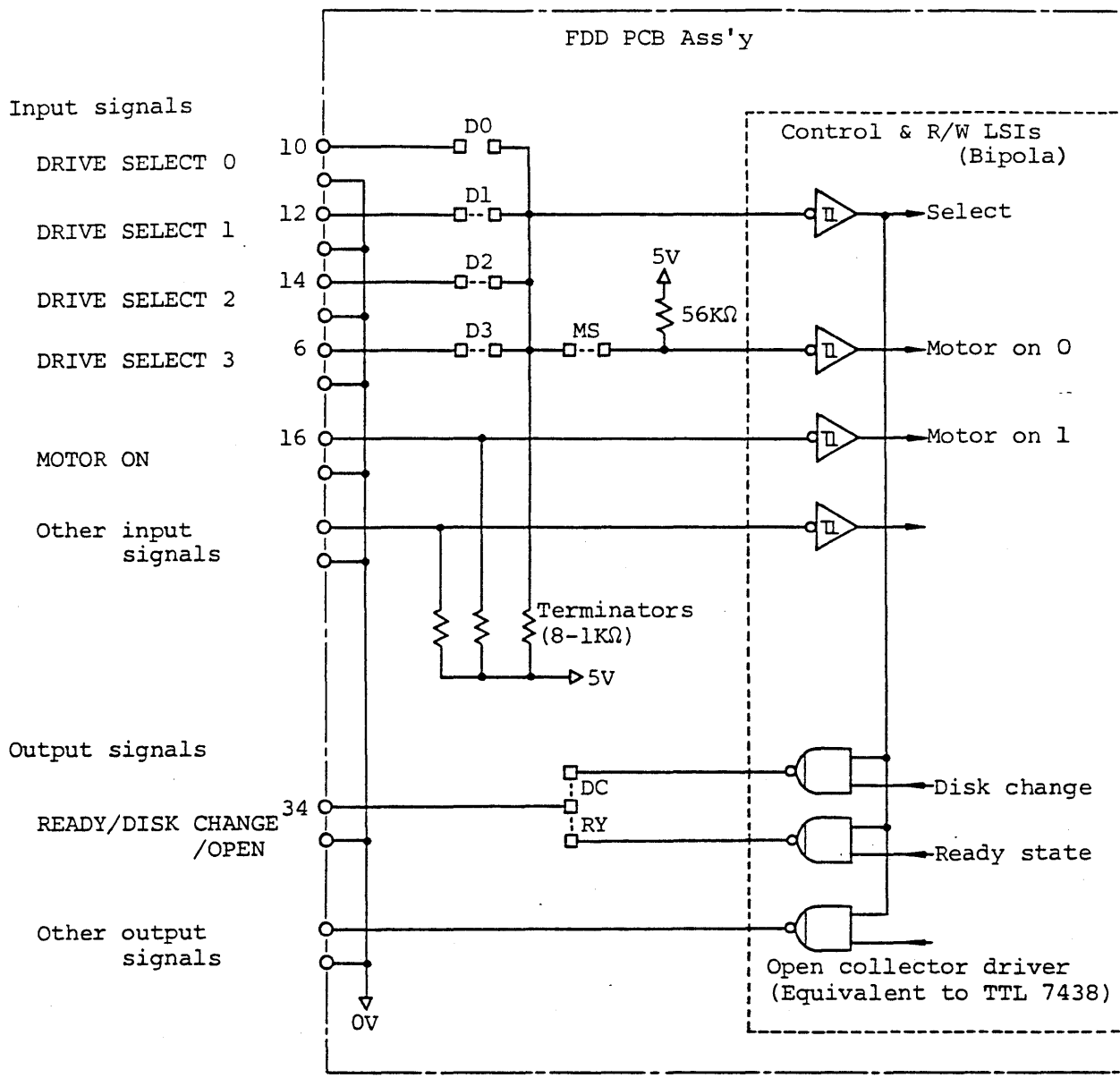LOW level (TRUE): 0V $\sim$ 0.4V

Driver sink current capability: 48mA, Max.

HIGH level (FALSE): 5.25V, Max.

(depending on host side terminator)

(3) Terminator resistor: 1KΩ ± 5%

Resistors are soldered to all the input signal lines of the FDD (not removable).

(4) Required sink current capability for host side driver in multiplex connection: -(5.6 + 0.4) x Number of FDDs connected

Input signals

DRIVE SELECT 0   10

DRIVE SELECT 1   12

DRIVE SELECT 2   14

DRIVE SELECT 3   6

MOTOR ON   16

Other input
signals

FDD PCB Ass'y

Control & R/W LSIs
(Bipola)

D0

D1

D2

D3   MS

5V

56KΩ

Select

Motor on 0

Motor on 1

Terminators
(8-1KΩ)

5V

Output signals

READY/DISK CHANGE 34
/OPEN

Other output
signals

DC

RY

Disk change

Ready state

Open collector driver
(Equivalent to TTL 7438)

0V

(Fig.3) FDD signal interface circuit

8.2 Signal Interface Connector and Cable

(1) Signal interface connector

   (a) FDD side connector: Fujitsu, P/N FCN-725P034-AU/0

                           or Japan Aviation Electronics,P/N PS-34PE-D4LT1-PN1

                           or equivalent

   (b) Pin numbers and pin pitch: 2.54mm (0.1 in) pitch, 34 pins block headder

                           (17 pins double rows, even number pins are

                           upper side of the FDD)

   (c) Connector external view: See Fig.4.

   (d) Connector location: See Fig.1

   (e) Interface connection: See Table 3

   (f) Host side (cable side) matched connector:

        Fujitsu, P/N FCN-747B034-AU/0 (closed end) or -AU/B(daisy chain)

        or Japan Aviation Electronics,P/N PS-34SEN-D4P1-1C (closed end)

                                 or -1D (daisy chain)

     or equivalent.

    Note: It is recommended to use a polarizing type connector with a

        projection on the center of the housing for a cable side to

        avoid wrong connection. (See Fig.4).

        In such a polarizing connector, ∇ mark of the connector housing

        may show pin number 34.
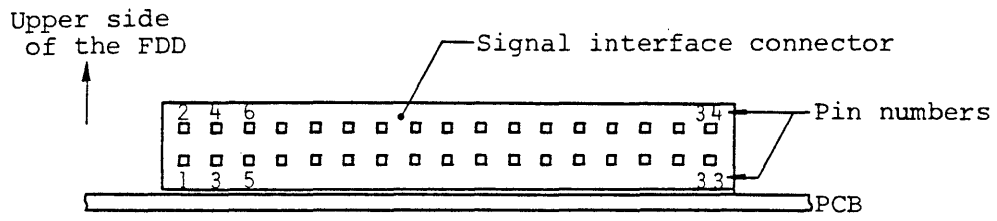

(2) Signal interface cable

  Maximum cable length: 1.5m (5 feet)

                    (For the multiplex connection by daisy chaining,

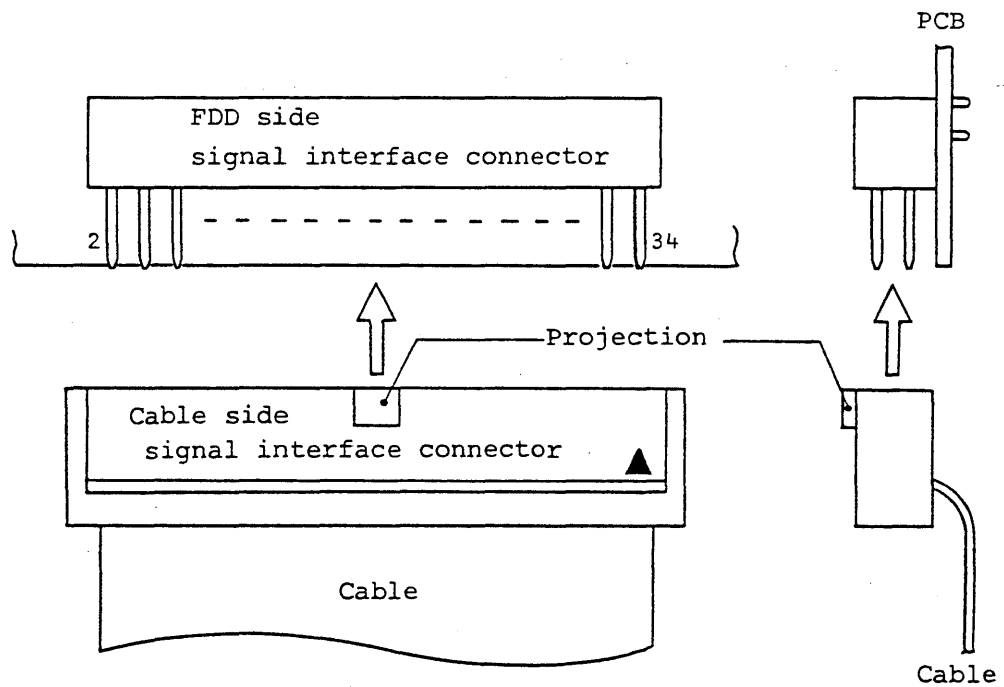   the total cable length should be less than 1.5m).

Signals	Directions	Terminal Nos.	
		Signals	0V
NORMAL DENSITY	Input	2	–
IN USE	Input	4	3
DRIVE SELECT 3	Input	6	5
INDEX	Output	8	7
DRIVE SELECT 0	Input	10	9
DRIVE SELECT 1	Input	12	11
DRIVE SELECT 2	Input	14	13
MOTOR ON	Input	16	15
DIRECTION SELECT	Input	18	17
STEP	Input	20	19
WRITE DATA	Input	22	21
WRITE GATE	Input	24	23
TRACK 00	Output	26	25
WRITE PROTECT	Output	28	27
READ DATA	Output	30	29
SIDE ONE SELECT	Input	32	31
READY / DISK CHANGE / OPEN	Output	34	33

Note: Refer to item 11.5 as to the output signal selection
      of terminal No.34.

(Table 3) Signal interface connection

Upper side
of the FDD

Signal interface connector

Pin numbers

```
2  4  6                              3 4
□  □  □  □  □  □  □  □  □  □  □  □  □  □  □  □  □
□  □  □  □  □  □  □  □  □  □  □  □  □  □  □  □  □
1  3  5                              3 3
```

PCB

Rear view

PCB

FDD side
signal interface connector

2   34

Projection

Cable side
signal interface connector ▲

Cable

Cable

Top view

Side view

(Fig.4) Signal interface connector external view

8.3 Input/Output Signals

In the following, input signals are those transmitted to the FDD while
output signals are those transmitted from the FDD.
LOW level of the signals is TRUE.

8.3.1 DRIVE SELECT 0 ∿ 3 input signals

(1) Signals of four lines to select a specific FDD for operation in
multiplex control by daisy chaining.

(2) Only the DRIVE SELECT signal of the same number as of on-state strap
among D0 ∿ D3 straps is effective.

(3) All the input/output signals except for the MOTOR ON, IN USE, and
NORMAL DENSITY are effective when this signal is effectively received.

(4) The time required to make each input or output signal effective after
the transmission of this signal is 0.5μsec, Max. including delay time
through the interface cable.

(5) Refer to item 12 as to turn-on condition of the front bezel indicator
and rotating condition of the spindle motor related to this signal.

8.3.2 MOTOR ON input signal

(1) Level signal to rotate the spindle motor.

(2) The spindle motor reaches to the rated rotational speed within 400msec
after this signal changes to TRUE.

(3) This signal is ineffective when no disk is inserted.

(4) Refer to item 12.2 as to rotating condition of the spindle motor by
other input signals.

8.3.3 DIRECTION SELECT input signal

(1) Level signal to define the moving direction of the head when the STEP
line is pulsed.

(2) Step-out (moving away from the center of the disk) is defined as HIGH level of this signal. Conversely, step-in (moving toward the center of the disk) is defined as LOW level of this signal.

(3) The signal shall maintain its level for 0.8μsec prior to the trailing edge of the STEP pulse. (Refer to Fig.11).

8.3.4 STEP input signal

(1) Negative pulse signal to move the head. The pulse width shall be more than 0.8μsec and the head moves one track space per one pulse.

(2) The access motion (head seek operation) is initiated at the trailing edge of the STEP pulse. For the subsequent motion in the same direction, the pulses should be input with the space of more than 3msec, while the pulses should be input with the space of more than 6msec for a direction change.

(3) This signal is ineffective when the WRITE PROTECT signal is FALSE and the WRITE GATE signal is TRUE.
Also this signal is ineffective when the TRACK 00 signal is TRUE and the DIRECTION SELECT signal is HIGH level (step-out).

8.3.5 WRITE GATE input signal

(1) Level signal to erase the written data and to enable the writing of new data.

(2) The FDD is set to write mode when the following logical expression is satisfied.
    WRITE GATE * DRIVE SELECT * $\overline{\text{WRITE PROTECT}}$

(3) This signal should be made TRUE after satisfying all of the following conditions.
  (a) The FDD is in ready state (refer to item 8.3.13).
     However, the host controller can ignore this item since the INDEX and the READ DATA pulses are output only when the FDD is in ready state.

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(b) More than 18msec after the effective receival of the final STEP pulse.

(c) More than 100μsec after the level change of the SIDE ONE SELECT signal.

(4) None of the following operations should be done for at least 650μsec after this signal is changed to FALSE.

(a) Stop the spindle motor.

(b) Make the DRIVE SELECT signal FALSE.

(c) Start the head seek operation by the STEP pulse.

(d) Change the level of the SIDE ONE SELECT signal.

(e) Change the level of the NORMAL DENSITY signal.

8.3.6 WRITE DATA input signal

(1) Negative pulse signal to designate the contents of data to be written on a disk. The pulse width should be 0.07μsec through 1.1μsec and the leading edge of the pulse is used.

(2) This signal is ineffective while either of the following condition is satisfied.

(a) The WRITE GATE signal is FALSE.

(b) The WRITE PROTECT signal is TRUE.

(3) This signal should be input according to the timing in Fig.6.

8.3.7 SIDE ONE SELECT input signal

(1) Level signal to designate which side of a double sided disk is used for reading or writing.

(2) When this signal is HIGH level, the magnetic head on the side 0 surface (lower side) of the disk is selected, while the magnetic head on the side 1 surface (upper side) is selected when this signal is LOW level.

(3) The READ DATA pulse on a selected surface is valid more than 100μsec after the change of this signal level.

(4) Write operation (the WRITE GATE signal is TRUE) on a selected surface shall be started more than 100μsec after the change of this signal level.

(5) When the other side of a disk is selected after the completion of a write operation, the level of this signal shall be switched more than 650μsec after making the WRITE GATE signal FALSE.

8.3.8 IN USE input signal

(1) Level signal to indicate that all of the daisy chained FDDs are in use condition under the control of the host system.
(2) The front bezel indicator turns on while this signal is TRUE.

8.3.9 TRACK 00 output signal

(1) Level signal to indicate that the head is on track 00 (the outermost track).

(2) This signal is valid more than 2.8msec, after the effective receival of the STEP pulse.

8.3.10 INDEX output signal

(1) Negative pulse signal to indicate the start point of a track and one index pulse per one disk revolution is output.

(2) INDEX pulse is output when the following logical expression is satisfied.
    Index detection * DRIVE SELECT * Ready state

(3) Fig.5 shows the timing of this signal. Pulse width is 1msec through 5.5msec and the leading edge of the pulse shall be used as the reference.

8.3.11 READ DATA output signal

(1) Negative pulse signal for the read data from a disk composing clock bits and data bits together.

(2) Fig.7 shows the timing of this signal. Pulse width is 0.15μsec through 1.0μsec and the leading edge of the pulse shall be used as the reference.

(3) READ DATA pulse is output when the following logical expression is satisfied.
    Read data detection * DRIVE SELECT * Ready state * $\overline{\text{Write operation}}$
    Note: $\overline{\text{Write operation}}$ is the state while the WRITE GATE input signal is FALSE and 650μsec has been passed after the WRITE GATE signal changed to FALSE.

(4) Output pulse is valid while both of the following conditions are satisfied.
    (a) More than 18msec after the effective receival of the final STEP pulse. However, practical read operation can be executed more than 6msec after the final STEP pulse.
    (b) More than 100μsec after the level change of the SIDE ONE SELECT signal.

8.3.12 WRITE PROTECT output signal

  (1) Level signal which indicates that the write inhibit hole of the disk
      is not covered.
  (2) When this signal is TRUE, the data on the disk are protected from
      erasing and writing of new data is inhibited.

8.3.13 READY output signal

  (1) Level signal to indicate that the FDD is in ready state.
  (2) The FDD goes to ready state when all of the following conditions are
      satisfied.
    (a) The FDD is powered on.
    (b) A disk is installed and the auto-chucking operation (refer to item
        9.2) completes.
    (c) A motor-on command is TRUE and 400msec has been passed.
    (d) The spindle motor rotates at more than 80% of the rated speed and
        two INDEX pulses have been counted.
  (3) Required time for this signal to be TRUE after the start of the spindle
      motor is less than 800msec (510msec in average).
  (4) If a motor-on command is made FALSE, this signal is also changed to
      FALSE within 0.3msec.
  (5) INDEX and READ DATA output signals maintain FALSE while the FDD is not
      in the ready state.
  (6) Refer to Table 3 and item 11.5 as to the output selection of this signal.

8.3.14 DISK CHANGE output signal

  (1) Level signal to indicate that a disk in the FDD is ejected.
  (2) This signal changes to TRUE when either of the following condition is
      satisfied.
    (a) Power on.
    (b) Disk is removed.

(3) This signal returns to FALSE when both of the following conditions
    are satisfied. Refer to Fig.8.
  (a) Disk is installed.
  (b) A STEP pulse is received when the DRIVE SELECT signal (selected by
      D0 ∿ D3 strap) is TRUE.
(4) Refer to Table 3 and item 11.5 as to the output selection of this signal.

8.3.15 NORMAL DENSITY input signal
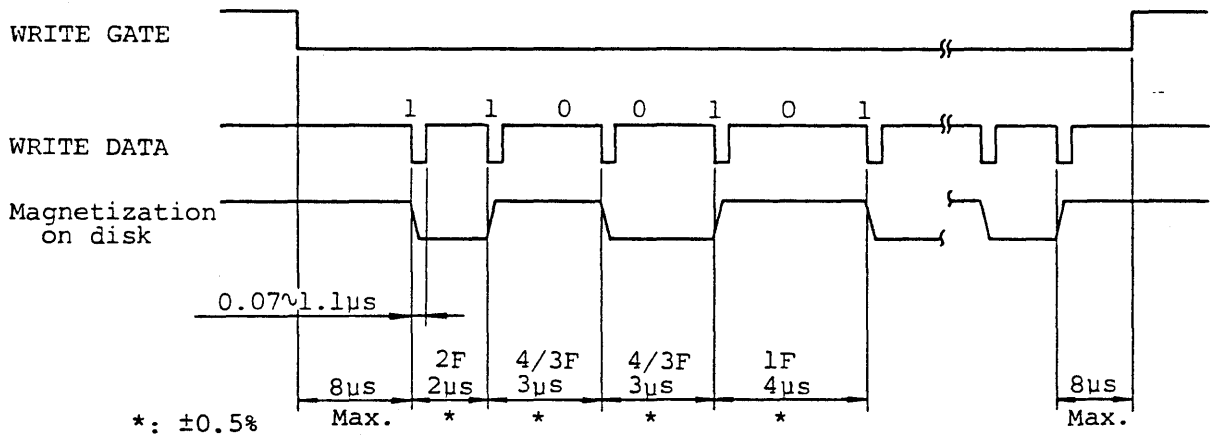

(1) Level signal to switch the operation mode (high or normal density) of
    the FDD.
(2) The HIGH level of this signal designates the high density mode, while
    the LOW level designates the normal density mode.

8.3.16 Treatment of not-used signals

    If some of the provided input/output signals are not necessary for
    your application, keep them open or connect appropriate pull-up
    resistor (more than 150Ω for an FDD output signal) at the host side.

INDEX

1∿5.5ms

200±3ms

(Fig.5) INDEX timing

WRITE GATE

WRITE DATA   1   1   0   0   1   0   1

Magnetization
  on disk

0.07∿1.1μs

	2F	4/3F	4/3F	1F		8μs
8μs	2μs	3μs	3μs	4μs		
Max.	*	*	*	*		Max.

*: ±0.5%
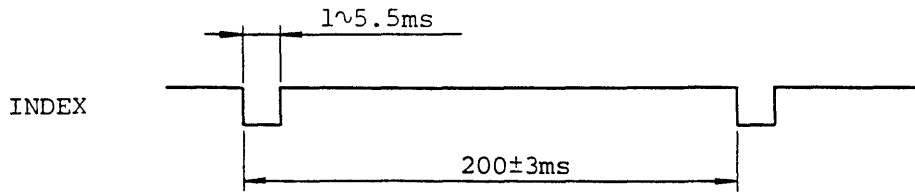
Note: Above WRITE DATA intervals are doubled at normal density mode.

(Fig.6) WRITE DATA timing (MFM method)

Magnetization
  on disk

READ DATA   1   1   0   0   1   0   1

0.15∿1.0μs

2F	4/3F	4/3F	1F
2μs	3μs, Nom.	3μs, Nom.	4μs, Nom.
Nom.			
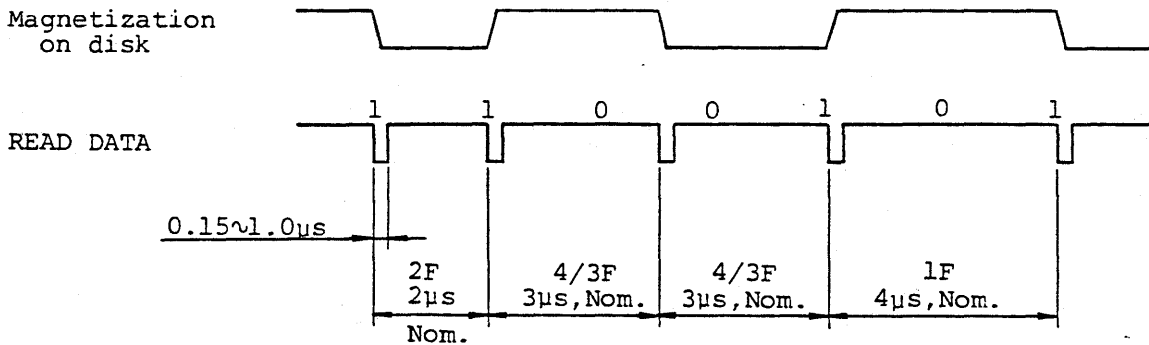
Notes: 1. Above READ DATA intervals are doubled at normal density mode.
       2. The displacement of any bit position does not exceed ±350nsec
          (high density mode) or ±700nsec (normal density mode) from its
          nominal position. (When PLO separator is used with recommended
          write pre-compensation.)

(Fig.7) READ DATA timing (MFM method)

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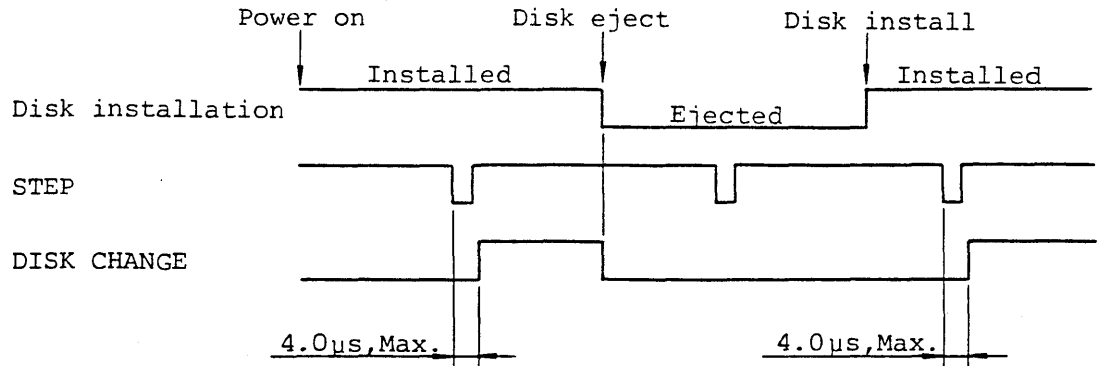
Note: To simplify the timing chart, the DRIVE SELECT signal
in the above figure is assumed always TRUE.

(Fig.8) DISK CHANGE signal timing

9. CONTROL SEQUENCE

9.1 Power-on Sequence

(1) Power on sequence: Not specified

(2) Protection against power on and off

   (a) In the transient period when the +5V power is lower than 3.5V, the
       FDD is protected against miswriting and miserasing whatever the state
       of input signals are.
   (b) Except for the condition of item (a), the FDD is protected against
       miswriting and miserasing as long as the WRITE GATE input signal does
       not change to TRUE.

(3) Power reset time in FDD: Less than 100msec
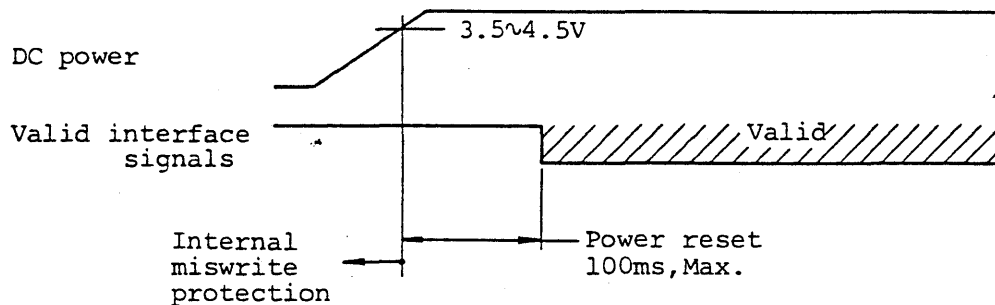
(Fig.9) Power on sequence

9.2 Disk Installation

(1) When a disk is installed during power on, the spindle motor automatically
    starts rotation for auto-chucking of the disk hub.
(2) Auto-chucking operation completes within 750msec. All of the interface
    signals are effective during the auto-chucking.
(3) The FDD ignores a motor-on command after the disk is ejected. Refer to
    Fig.8 as to the DISK CHANGE signal.
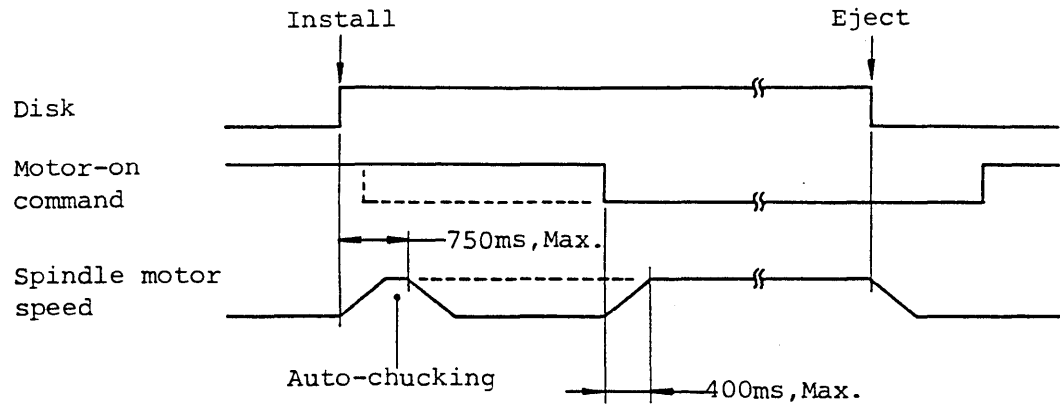
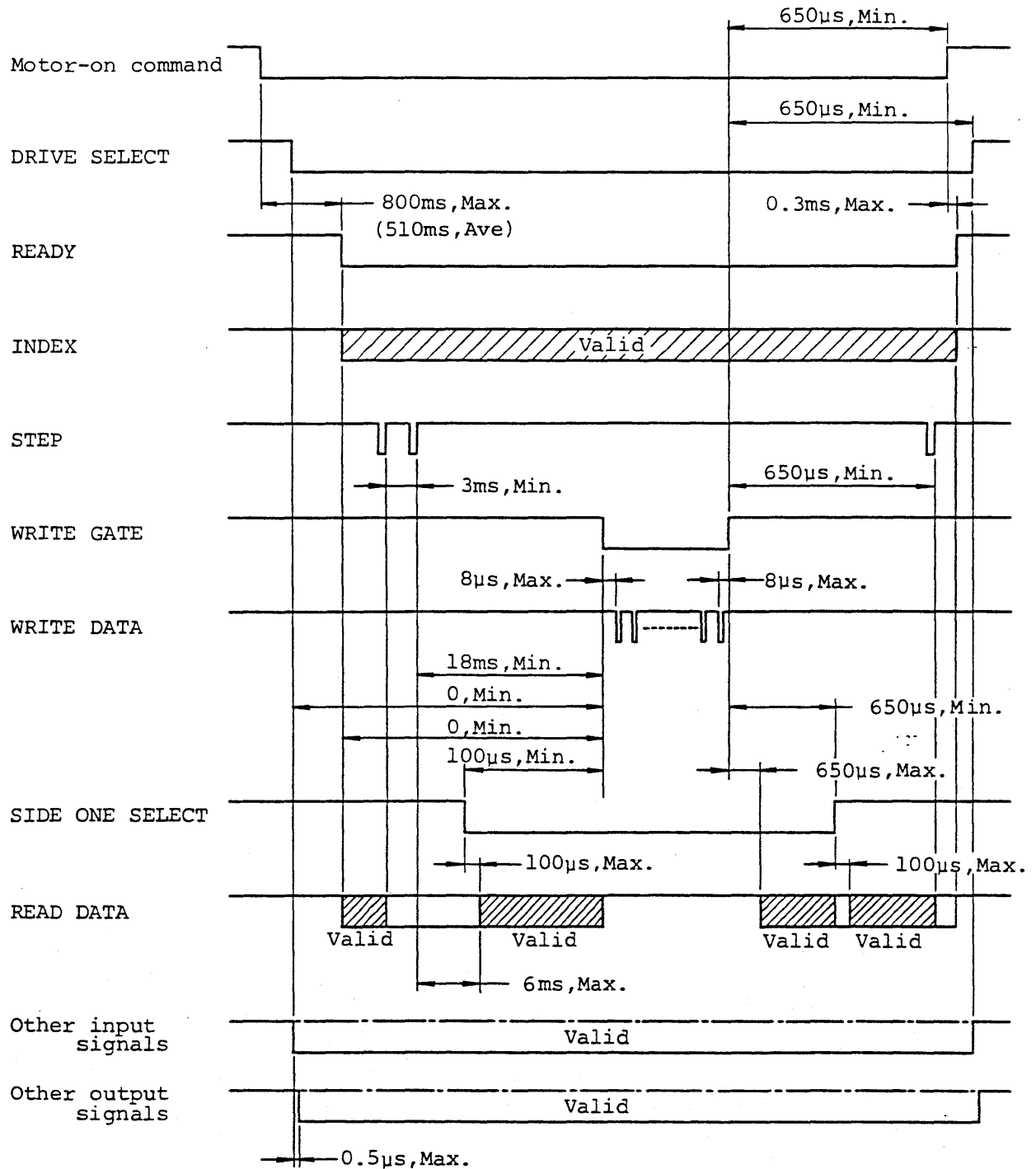(Fig.10) Disk installation and motor rotation

9.3 Seek operation

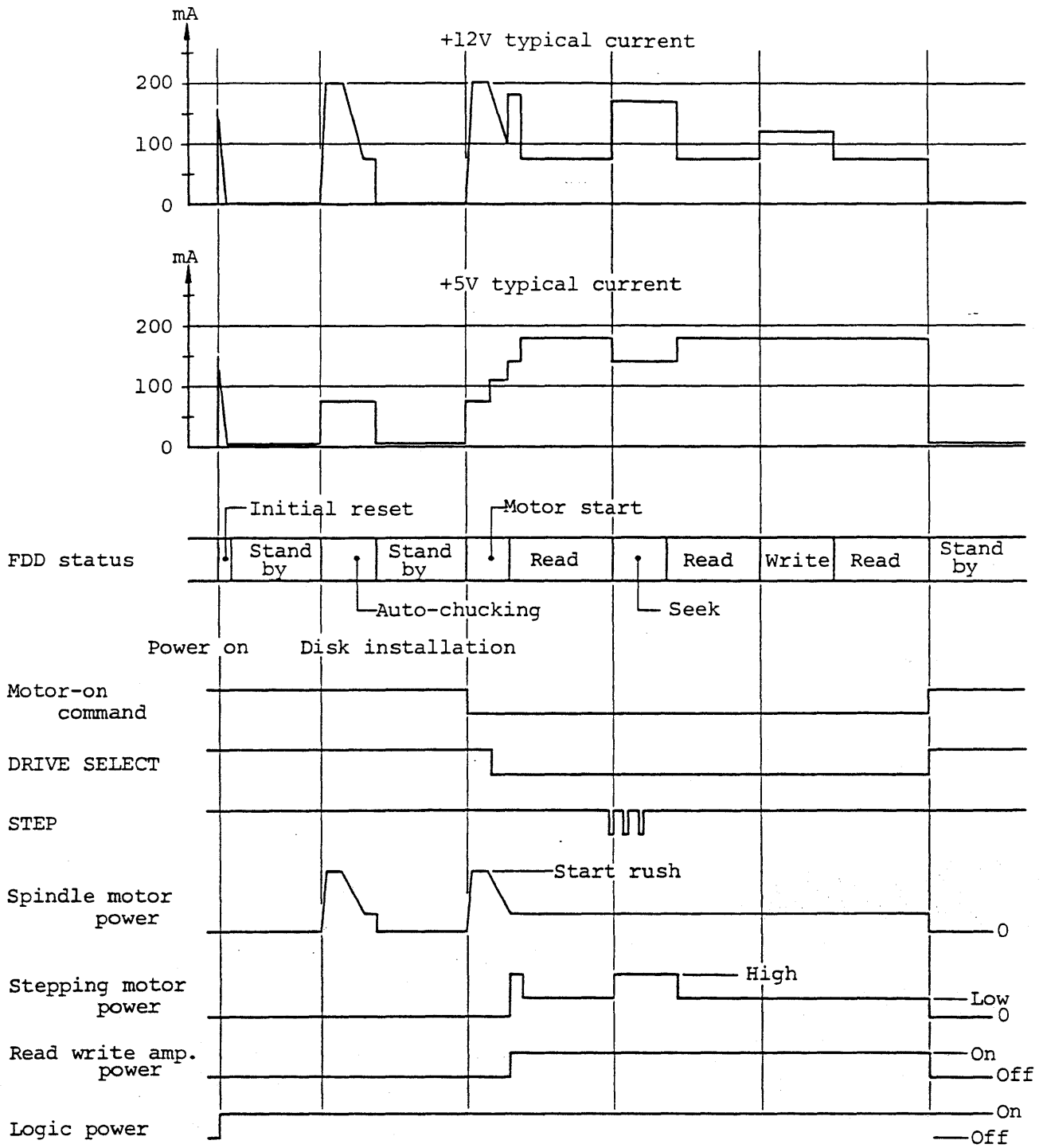Seek operation can be done independently of the spindle motor rotation.

t1,t2 $\geq$ 0.8μs   t3 $\geq$ 5μs
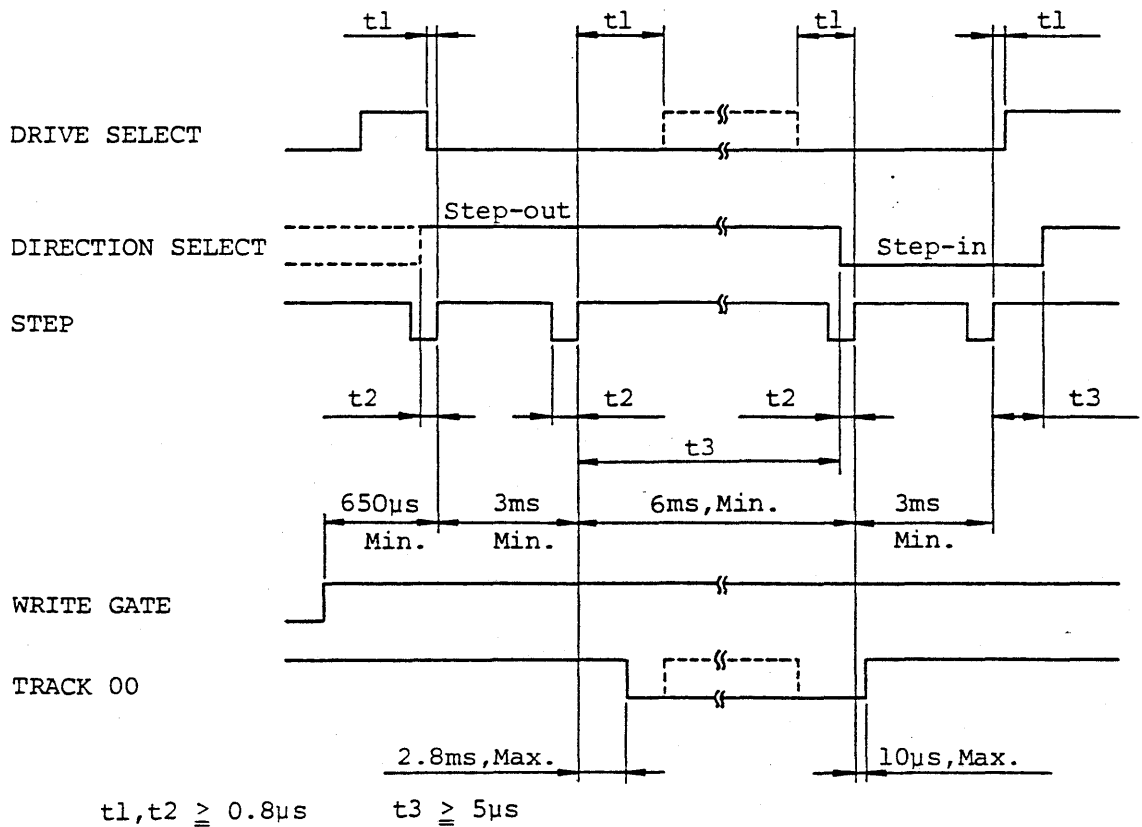
(Fig.11) Seek operation timing

9.4 Read Write Operation

(Fig.12) Read/write operation timing

9.5 Current Consumption Profile

(Fig.13) Current profile

(1) Stand-by mode

When both of the following conditions are satisfied, FDD goes to the
stand-by mode (low power consumption mode).

(a) The spindle motor stops.
(b) Not in seek operation (including settling time).

Note: In the stand-by mode, the FDD can immediately respond to a command
from the host side with no restriction.
If the polling operation of the DRIVE SELECT line is done in
stand-by mode, current flows into the front bezel indicator (when
US0 and US1 straps are off), and the terminator intermittently,
and in result +5V current increases.

(2) Simultaneous operation of motor start and seek

If a seek operation is done during the start up of the spindle motor,
+12V peak current increases by 100mA, approx. from the value in item
7.1 (1)-(c).

10. FRAME GROUNDING

(1) The FDD frame is electrically connected to DC 0V by FG strap on the main PCBA. (See Fig.14).

(2) The FDD is shipped with the FG strap set to on-state.

(3) Insulation resistance between the frame and DC 0V is more than 150KΩ at DC 150V, if the FG strap is set to off-state.

(4) If frame grounding by other cabling method is required, use M3 tapped hole at the rear side of the FDD. (Refer to Fig.1).
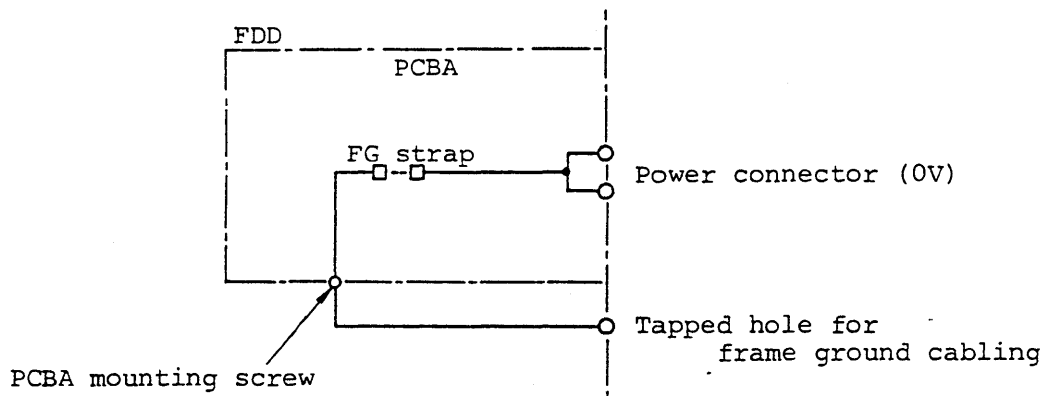
(Fig.14) Frame ground internal connection

11. CUSTOMER SELECTABLE STRAPS

The FDD is equipped with selectable straps at the customer side.
All the straps are mounted on the main PCBA of the FDD. Insertion of a
short bar onto the post pin is defined as the on-state of the strap.

```
□ □ US1
□ □ US0
□ □ RE
□ □ RY
□ □ DC
□ □ MS
□ □ D3
□ □ D2
□ □ D1
□ □ D0
□ □ FG
```

(Fig.15) Assignment of straps

11.1 Strap Setting at Shipment

The FDD is shipped with the following straps set to on-state:

D1, DC, FG

11.2 D0 ∿ D3 Straps

(1) In the multiplex control by daisy chaining, these straps designate
the address of the FDD.

(2) By the combination with the DRIVE SELECT 0 ∿ 3 signals (refer to
Fig.3 and item 8.3.1, four addresses of 0 through 3 can be designated.
Never designate more than 2 FDDs to a same address.

(3) Refer to item 12 as to the relation between these straps and the
turn-on condition of the front bezel indicator or the rotating
condition of the spindle motor.

11.3 MS Strap

(1) Strap to rotate the spindle motor by a DRIVE SELECT signal only for a
    designated FDD. Refer to item 12.2.
(2) If the MS strap is off-state, the motor rotates only while the MOTOR ON
    signal is TRUE like a conventional FDD.
(3) If the MS strap is on-state, the motor rotates by ORed condition of a
    DRIVE SELECT signal and the MOTOR ON signal.

11.4 DC and RY Straps

(1) Straps to select the output signal function on interface terminal
    No.34. Refer to Fig.3 in item 8.1.
(2) If the DC strap is on-state, DISK CHANGE signal is output.
(3) If the RY strap is on-state, READY signal is output.
(4) If the both straps are off-state, the terminal No.34 is open condition.
(5) Do not set the both straps to on-state.

11.5 RE Strap

(1) Strap to make the head recalibrate automatically to track 00 after power
    on.
(2) IF the RE strap is off-state, no auto-recalibration is executed.
(3) If the RE strap is on-state, auto-recalibration starts after power on
    and it completes within 255msec (if the head was on the innermost track).
    The FDD maintains not-ready state and STEP command is ignored during
    the operation.

11.6 USO and US1 Straps

(1) Straps to designate the turn-on condition of the front bezel indicator.

(2) Refer to item 12.1 as to the details of the indicator turn-on condition.
Four turn-on condition in Table 4 are offered for selection using
these two straps.

11.7 FG Strap

(1) Strap to connect the FDD frame electrically to DC 0V.

(2) Refer to item 10 as to the details.

12. TURN ON CONDITION OF INDICATOR AND SPINDLE MOTOR

12.1 Front Bezel Indicator

Four turn-on conditions in Table 4 are offered for selection using two straps of US0 and US1.

Selection	Straps		Turn-on conditions
	US0	US1	
1	-	-	DRIVE SELECT + IN USE
2	ON	-	IN USE
3	-	ON	Spindle motor rotating condition + IN USE
4	ON	ON	DRIVE SELECT * READY + IN USE

Note: "-" mark indicates the off-state of the strap.

(Table 4) Indicator turn-on conditions

(1) Selection No.1

While the DRIVE SELECT signal (selected by D0 ∿ D3 straps) is TRUE, or while the IN USE signal is TRUE, the indicator turns on.

(2) Selection No.2

While the IN USE signal is TRUE, the indicator turns on.

(3) Selection No.3

The indicator turns on in the same condition of the spindle motor rotating condition in item 12.2 or while the IN USE signal is TRUE. The indicator also turns on in the period from disk insertion to the completion of the auto-chucking of the disk hub.

(4) Selection No.4

While the DRIVE SELECT signal is TRUE and the FDD is in ready state
(refer to item 8.3.13), or while the IN USE signal is TRUE, the
indicator turns on.

12.2 Spindle Motor

Two rotating conditions in Table 5 are offered for selection using MS strap.

While no disk is installed, the spindle motor will not rotate at any condition. When a disk is installed, the auto-chucking of the disk hub will be executed by an internal command of the FDD in both conditions. (Refer to item 9.2).

Selection Nos.	MS strap	Rotating condition
1	-	MOTOR ON * Disk in
2	ON	(MOTOR ON + DRIVE SELECT) * Disk in

(Table 5) Spindle motor rotating condition

(1) Selection No.1

While a disk is installed and the MOTOR ON signal is TRUE, the spindle motor rotates.

(2) Selection No.2

While a disk is installed and the MOTOR ON or DRIVE SELECT signal is TRUE, the spindle motor rotates.