

Flexible Disk Drive

MITSUBISHI
M4852/4853 Specifications

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CHAPTER 1 INTRODUCTION

The Mitsubishi M4852/M4853 Flexible Disk Drives are high-performance, double-side, double bit and double track density flexible disk drive using a standard 5.25-inch diskette, that provides maximum customer satisfaction even to those who demand high reliability and long service life.

- Main Features -

- o Model M4852 is the standard size, and Model M4853 is half as high (41 mm) as the standard size.
- o Model M4853 includes a diskette ejector for easy diskette removal.
- o A new circular gimbal spring in the read/write head suspension mechanism greatly improves medium tracking performance.
- o The steel band drive system for positioning achieves the best inter-track access time in its class: just 3 ms.
- o The maintenance-free, DC, brushless, direct-drive motor obviates the belt replacement necessary for conventional counterparts.
- o Stable media interchangeability, wide off-track window time margin, and excellent performance are maintained over wide ambient temperature and relative humidity ranges.
- o The high-torque spindle motor permits control by switching on and off either the motor (starting time 250 ms) or the head load magnet (loading time less than 50 ms).

1.1 General Description

- o The M4853 Flexible Disk Drive is a twin-head, double-sided magnetic disk drive with a formatted memory capacity of more than 635 kilobytes for double-density recordings.
- o The M4853 reads and writes 5.25-inch, double-sided diskettes in double-density format.
- o The M4853 employs the unique Mitsubishi circular gimbal spring for holding and loading the magnetic heads to assure soft, steady contact with the medium. This means excellent read/write operation and a long service life for the medium. One of the outstanding features of this mechanism is reduction of the effects of jacket deformation and thickness variations, thereby stabilizing read/write performance and dispensing with the need for selecting products of a specific manufacturer.



1.2 Specifications

1.2.1 Performance specifications (Table 1-1)

Table 1-1 Performance Specifications

	Double Density
Memory capacity	
Unformatted	
Disk	1000 kilobytes
Per surface	500 kilobytes
Per track	6.25 kilobytes
Formatted	256 bytes/sector
Disk	655.4 kilobytes (including spare tracks)
Per surface	327.7 kilobytes (including spare tracks)
Per track	4096 bytes = 256 bytes x 16 sectors
Transfer rate	250 kilobits/second
Average latency time	100 ms
Access time	
Track to track	3 ms
Average	94 ms (including 3 ms step time and settling time)
Settling time	15 ms
Head loading time	50 ms
Motor starting time	250 ms

1.2.2 Functional specifications (Table 1-2)

Table 1-2 Functional Specifications

	Double Density
Recording density	5922, bits per inch
Magnetic flux inversion density	5922 FCI
Encoding method	MFM
Track density	96 tracks per inch
Number of cylinders	80
Number of tracks	160
Number of heads	2
Rotation speed	300 rpm
Rotation period	200 ms
Index	1
Media	Double-sided 96 TPI, standard 5.25-inches diskette

1.2.3 Physical Specifications (Table 1-3)

Table 1-3 Physical Specifications

DC power requirements	
+5 V	+5 V \pm 5%, 0.5 A typical
+12 V	+12 V \pm 5%, 0.7 A typical (Seeking)
Operating environmental conditions	
Ambient temperature	5°C to 43°C (41°F to 109.4°F)
Relative humidity	20% to 80% (Maximum wet bulb temperature: 29°C (85°F))



Table 1-3 (cont.)

Non-operating environmental conditions	
Ambient temperature	-20°C to 51°C (-4°F to 125°F)
Relative humidity	5% to 95%
Heat dissipation	11.4 Watts Continuous seek (typical) 9 Watts Standby (typical) 5.6 Watts Motor off (typical)
Physical dimensions	(Except for front panel)
	Model M4852 Model M4853
Height	82.6 mm (3.25 in) 41 mm (1.62 in)
Width	146 mm (5.75 in) 146 mm (5.75 in)
Depth	203.2 mm (8 in) 203.2 mm (8 in)
Front panel dimensions	
Model M4852	85.8 x 149.3 mm (3.38 x 5.88 in)
Model M4853	42 x 148.0 mm (1.65 x 5.83 in)
Weight	1.3 kg (2.9 lbs)

1.2.4 Reliability specifications (Table 1-4)

Table 1-4 Reliability Specifications

MTBF	10,000 POH or more
MTRR	30 minutes
Unit life	5 years or 20,000 energized hours, whichever comes first
Media life	
Insertion	3×10^4 or more
Rotational life	3.5×10^6 pass/track or more
Tap-tap	10^5 on the same spot of a track
Error rate	
Soft read error	10^{-9} bit
Hard read error	10^{-12} bit
Seek error	10^{-6} seek

CHAPTER 2 OPERATION OF MAJOR COMPONENTS

2.1 System Operation

The M4852/M4853 Flexible Disk Drive consists of a medium rotating mechanism, two read/write heads, an actuator to position the read/write heads on tracks, a solenoid to load the read/write heads on the medium, and electronic circuits to read and write data, and to drive these components.

The rotation mechanism clamps the medium inserted into the drive to the spindle, which is directly coupled to the DC brushless direct-drive motor, and rotates it at 300 rpm. The positioning actuator moves the read/write head over the desired track of the medium. Then, the head loading solenoid loads the read/write head on the medium to read or write data.

2.2 Electronic Circuits

The electronic circuits to drive the individual mechanisms of the M4852/M4853 are located on a single printed-circuit board, which consists of the following circuits:

- o Line driver and receiver that exchange signals with the host system
- o Drive selection circuit
- o Index detection circuit
- o Head positioning actuator drive circuit
- o Head loading solenoid drive circuit
- o Read/write circuit
- o Write protect circuit
- o Track 00 detection circuit
- o Drive ready detection circuit
- o Head selection circuit
- o In use and panel indicator LED drive circuit

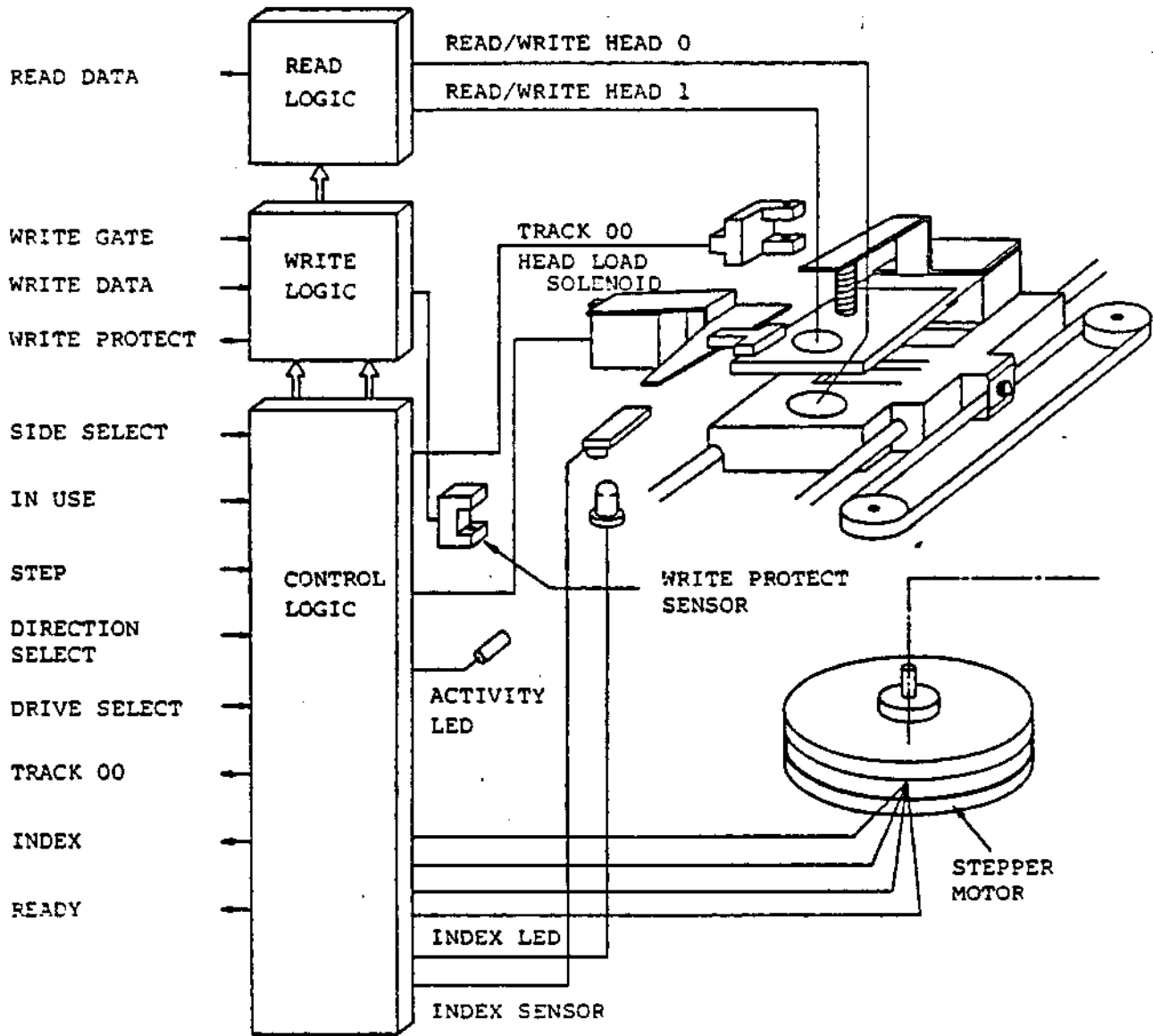


Fig. 2-1 M4853 Functional View

2.3 Rotation Mechanism

The diskette rotation mechanism uses the DC brushless direct-drive motor to directly rotate the spindle at 300 rpm.

2.4 Positioning Mechanism

The positioning mechanism positions the read/write heads as described below.

The head carriage assembly is fastened to the steel band secured around the capstan of a two-phase hybrid stepping motor; a 1.8° turn of the stepping motor moves the read/write head one track in the designated direction, thus positioning the read/write head.

This drive system is temperature compensated to minimize read/write head deviations from the disk tracks caused by ambient temperature change.

2.5 Read/Write Heads

The read/write heads are MnZn magnetic ferrite.

Each read/write head has three ferrite head cores, consisting read/write core and erase cores on both sides of the read/write core to erase the space between tracks (tunnel erase).

The two read/write heads, which are located face-to-face with a disk between them, are mounted on compliant, circular gimbal springs so that the heads track the disk with good contact to enable maximum reproduction of the signals from the disk. The high surface tracking ability of the circular gimbal keeps the disk free of stress, and thus improves diskette life.

CHAPTER 3 ELECTRICAL INTERFACE

There are two kinds of electrical interfaces: Signal interface and DC power interface.

The signal interface sends and receives control signals and read/write data between the M4853 and the host system via the J1/P1 connector.

The DC power interface drives the spindle drive motor of the M4853, and supplies power to the electronic circuits and the stepping motor which drives the read/write head positioning mechanism via the J2/P2 connector.

The signals and pin arrangement of these two types of interfaces are shown in Tables 3-1 and 3-2.

Table 3-1 DC Power Connector Pin Arrangement (J2/P2)

Source voltage	Pin number	Remarks
+12 V DC	1	
+12 V DC return	2	
+5 V DC return	3	
+5 V DC	4	

Table 3-2 Signal Connector Pin Arrangement (J1/P1)

Signal	Signal Pin Number	Ground Return Pin Number
SPARE	2	1
IN USE	4	3
DRIVE SELECT 3	6	5
INDEX	8	7
DRIVE SELECT 0	10	9
DRIVE SELECT 1	12	11
DRIVE SELECT 2	14	13
MOTOR ON	16	15
DIRECTION SELECT	18	17
STEP	20	19
WRITE DATA	22	21
WRITE GATE	24	23
TRACK 00	26	25
WRITE PROTECT	28	27
READ DATA	30	29
SIDE ONE SELECT	32	31
READY	34	33

3.1 Signal Interface

The signal interface is classified into control signals and data signals. These interface signal lines are all at TTL levels. The meanings and characteristics of the signal levels are as follows:

- o True = Logical "0" = VL 0 V to +0.4 V
Iin 40 mA maximum
- o False = Logical "1" = VH +2.5 V to +5.25 V
Iin 0 mA
- o Input impedance = 150 Ohms

3.1.1 Cabling method and input line termination

The M4853 uses a daisy chain system of cable connections. A single ribbon cable or twisted-pair cable may be fitted with multiple connectors to permit connection of up to four drives.

The connected drives are multiplex-controlled by drive select lines, and any one of the drives can be accessed.

The cabling method and input line termination are shown in Fig. 3-1. A maximum of seven input signal lines, plus the drive select lines, may be terminated at the M4852/M4853. Proper operation of the drives requires termination at or near the drive connected to the end of the interface cable farthest from the host system.

The M4852 has detachable resistor modules and M4853 has jumper plug terminators mounted on the printed-circuit board to terminate these input signal lines.

When a drive is shipped from the factory, its terminators are installed on the printed-circuit board.

Keep the terminators connected in the drive that is connected to the end of the interface cable, and disconnect the terminators in all the other drives.

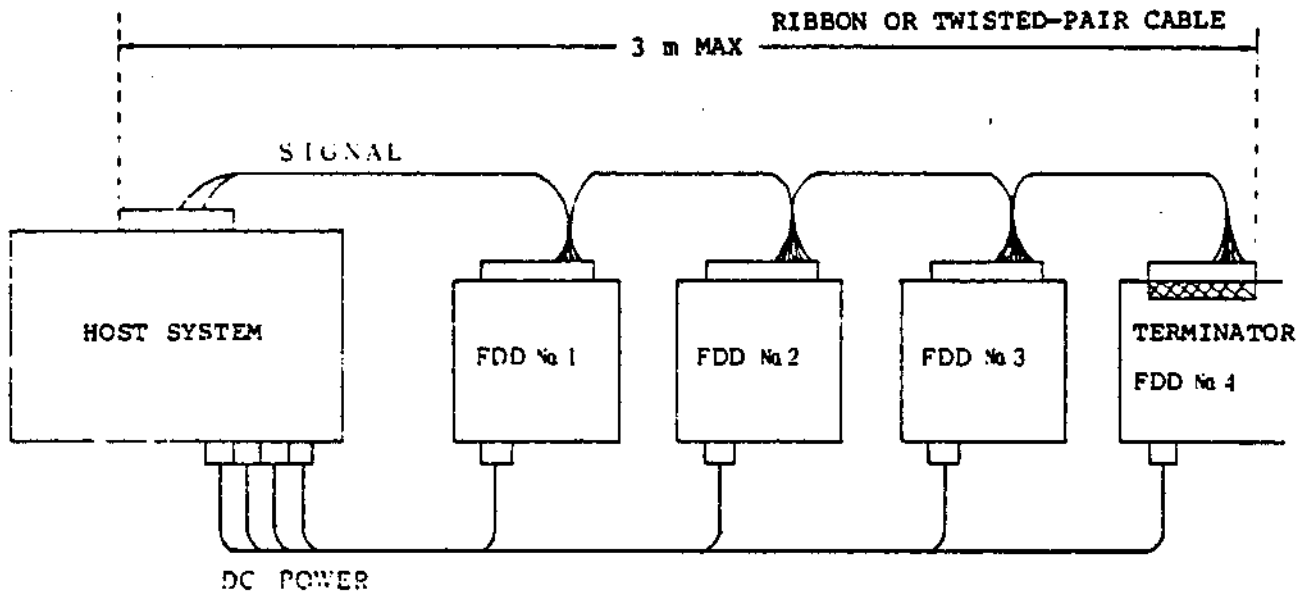


Fig. 3-1 Cabling Method (Sketch)

3.1.2 Line driver and line receiver

The recommended interface line driver and line receiver circuits for the host system and the drives are shown in Fig. 3-2.

It is suggested that a Schmitt trigger circuit with a hysteresis characteristic at the switching level be used for the line receiver to improve the noise resistance of the interface lines.

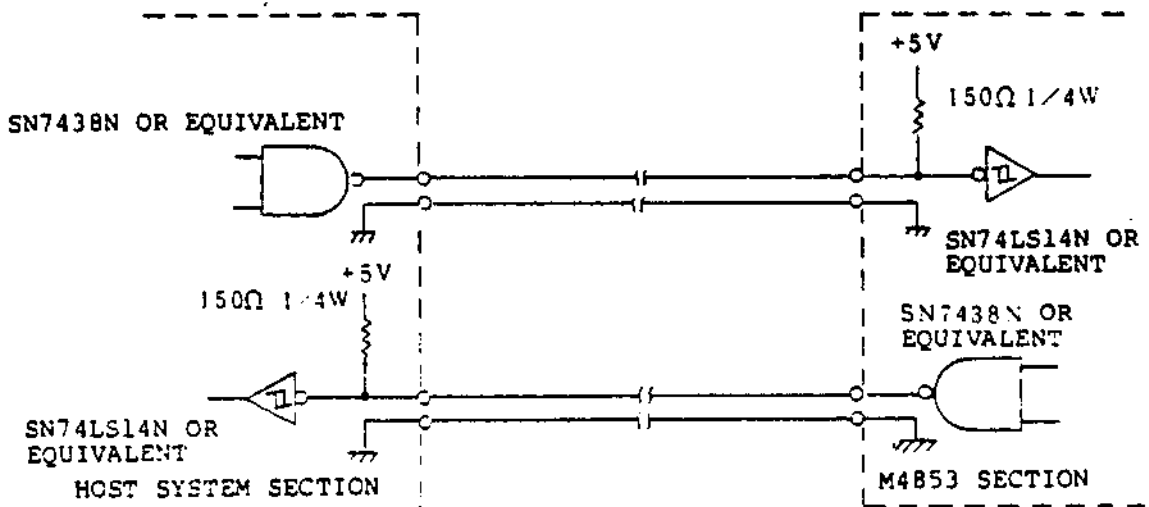


Fig. 3-2 Recommended Line Driver and Line Receiver Circuits

3.1.3 Jumpers

The jumpers on the printed-circuit board are used to set conditions for drive selection and head loading.

The uses of the individual jumper pins are as follows:

(1) MX

Jumper these pins when connecting only one FDD to the system.

The single drive then is always selected, permitting transmission and reception of input and output signals regardless of the conditions of drive select 0 to drive select 3.

Open these pins when connecting two or more FDDs.

(2) DS0 to DS3

When two or more FDDs are connected to the system, jumper one of DS0 to DS3 so that only the drive whose select line corresponds to the jumpered pin is selected by a logical "0" to permit transmission and reception of input and output signals.

For example, if DS0 is jumpered, its drive is selected when drive select 0 is at logical "0."

(3) HS and HM


These jumpers are used for setting head loading conditions.

If HS is jumpered, the heads are loaded by drive selection.

If HM is jumpered, the heads are loaded by turning the motor on.

Do not jumper HS and HM concurrently.

DS0 and HS are jumpered before shipment of the product from the factory. If different modes are desired, change the settings.



3.1.4 Input signal lines

The M4852/M4853 has 11 input signal lines. Input signals can be classified into two types: One is multiplexed in a multi-drive system; and the other performs a multiplex operation.

The multiplexing signals are as follows:

- o Drive select 0
- o Drive select 1
- o Drive select 2
- o Drive select 3

(1) Drive select 0 to drive select 3

When these drive select lines are at logical "0" level, a multiplexed I/O lines become active to enable read/write operation. These four separate input signal lines, drive select 0 to drive select 3, are provided for connecting four drives to one system and mutually multiplexing them. Jumper pins DS0, DS1, DS2, and DS3 on the printed-circuit board are used to select drives to be made active, corresponding to drive select lines.

DS0 is shorted before shipment from the factory, so this setting must be changed when establishing other select lines.

(2) Side one select

This interface line is used to select which of the two sides of the diskette should be read or written. When this line is at logical "1," the Side 0 head is selected; or when it is at logical "0," the Side 1 head is selected. If the polarity of the side one select signal is reversed, delay read/write operation by more than 100 μ s before execution.

Upon completion of a write operation, reverse the polarity of the side one select signal after a delay of 1000 μ s. The heads are tunnel erase type, with a physical core gap deviation between the read/write head and the erase heads so with no delay, non-erased areas would be generated on the diskette due to a timing difference between the write data area and the erase area during write operation. This is prevented by delaying the erase current cutoff time of a few hundred microseconds within the M4852/M4853. Therefore, the head select must not be reversed during this delay time. Also, the track access action must not be permitted for 1000 μ s.

(3) Direction select

This interface line controls the direction. (inward or outward) in which the read/write head should be moved when a step signal pulse is applied.

If the signal is at logical "1," the read/write head moves from the center of the diskette outward; if it is at logical "0," the head moves inward.

(4) Step

This interface line is a pulse signal for moving the read/write head in the direction defined by the direction select line. The read/write head moves by one track each time a signal pulse is applied to the step line. The step line is normally logical "1," and the step operation starts with the trailing edge of a negative-going pulse (reversal from logical "0" to logical "1").

The direction select line must be reversed more than 1 μ s before the trailing edge of the step pulse.

(5) Write gate

When this interface line goes to logical "0," the write driver becomes active and the data given to the write data line is written on the selected side of the diskette. When the interface line goes to logical "1," the write driver becomes inactive to enable the read data logic. The verified read data is obtained 1000 μ s (maximum) after the write driver becomes inactive. Refer to CHAPTER 4 for the timing.

(6) Write data

Data to be written on the diskette is sent to this interface line.

This line is normally at logical "1," and reverses the write current at the leading edge of a negative-going data pulse (reversal from logical "1" to logical "0") to write data bits.

This line is enabled when the write gate is at logical "0," Fig. 3-3 shows the write data timing.

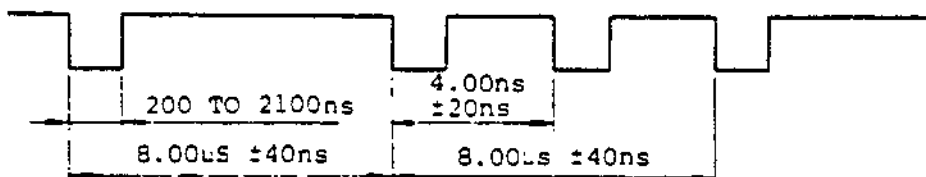


Fig. 3-3 Write Data Timing (FM Encoding)



(7) In use

An LED indicator on the front panel lights when this interface line goes to logical "0." The LED is also lit by the drive select.

(8) Motor on

This interface line starts the spindle motor when it goes to logical "0." The write gate does not go to logical "0" until more than 250 ms after the motor-on line goes logical "0."

The motor-on line goes logical "1" to stop the motor and keep it off while the drive is out of operation, thus prolonging motor life.

3.1.5 Output signal lines

The M4853 has five standard output signal lines.

(1) Index

This interface line is normally logical "1" but sends a logical "0" output pulse 4 ms wide each time the diskette makes one revolution (200 ms period).

This signal signifies the start of a track on the rotating diskette. The index signal timing is shown in Fig. 3-4.

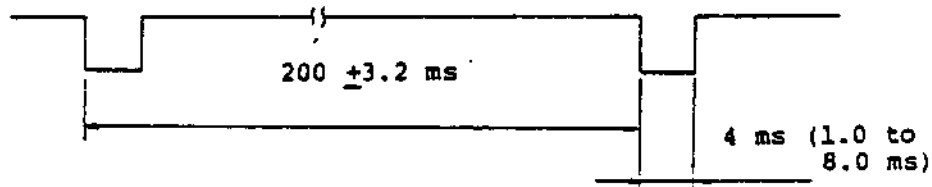


Fig. 3-4 Index Timing

(2) Track 00

When this interface line is at logical "0," it indicates that a read/write head of the selected drive is positioned on track 00. If the output of the selected drive is at logical "1," it indicates that the read/write head is positioned on a track other than track 00.

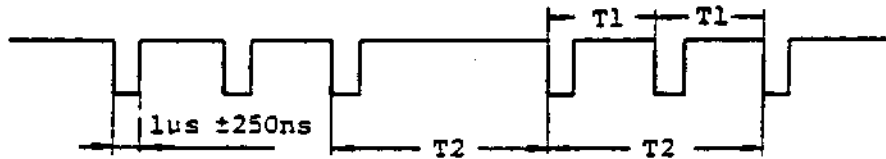
(3) Ready

This interface line is logical "1" when the door is open or no diskette is in the drive. The line goes logical "0" (ready) if an index pulse is detected twice or more when the index hole is correctly detected, and the DC power (+5 V and +12 V) supplied after a diskette is inserted into the drive and the door is closed.

(4) Read data

This interface line reads the data stored on the diskette with the read/write heads, and outputs raw data (combined clock and data signals) converted into pulse signals by an electronic circuit.

The read data line is normally logical "1" but it sends a logical "0" (negative-going) output pulse during a read operation. Fig. 3-5 shows allowable limits on timing variations with the usual diskette and bit shifts.



$T_1 = 4.00 \mu s \pm 800 \text{ ns}$ (Jitter due to rotation variation excluded)

$T_2 = 8.00 \mu s \pm 1.6 \mu s$ (Jitter due to rotation variation excluded)

Fig. 3-5 Read Data Timing (FM Encoding)

(5) Write protect

This interface signal notifies the host system of the insertion of a diskette with a write protect notch into the drive. The signal goes to logical "0" when a write-protected diskette is inserted into the drive. When the signal is at logical "0," write on the diskette is inhibited even if the write gate line becomes active.



3.2 Power Interface

The M4852/M4853 requires two types of DC power supplies.

One is +12 V DC, which drives the drive motor to rotate the diskette. It is supplied to the stepping motor and the read/write circuit. The other is +5 V DC, which is used for the logic circuit and the read/write circuit.

NOTE

The index LED is driven by the +12 V DC.

3.2.1 DC power

DC power is supplied via connector J2/P2 on the back of the printed-circuit board. The specifications of the two DC voltages are shown in Table 3-3. The pin arrangement of connector J2/P2 is shown in Table 3-1.

Table 3-3 DC Power Specifications

DC voltage	Voltage variation	Current	Maximum ripple voltage (peak-to-peak)
+5 V DC	± 0.25 V ($\pm 5\%$)	1.0 A maximum 0.5 A typical	50 mV
+12 V DC	± 0.6 V ($\pm 5\%$)	1.00 A maximum 0.7 A typical at seek	100 mV

CHAPTER 4 FUNCTIONAL OPERATION

4.1 Power On Sequencing

No read/write operation may be performed during the period of 200 ms or more from the start of DC power supply until the control signal stabilizes and the drive is ready.

The read/write head may have been positioned on an incorrect track after switching the DC power on, so before starting a read/write operation, be sure to perform the step out operation until a track 00 signal is output to the interface line, and thus correctly position the read/write head.

4.2 Drive Selection

The M4852/M4853 daisy chain cabling system permits connection of multiple drives to a single cable.

These drives are selected when the drive select lines on the drive side become active. Only the drive whose drive select line is active sends and receives signals to and from the host system. The select lines on the drive must have different numbers if two or more drives are connected. If the same number is assigned, an operation error occurs due to interference among the interface output signals of the drives themselves.

4.3 Positioning Operation

The seek operation which moves the read/write head to the desired track selects a direction, inward or outward, depending on the polarity of the direction select signal, and moves the head by the step signal. If access to a track two or more tracks away is required, step pulses are continuously sent until the head moves to the desired track.

Head movement starts with the trailing edge of the step pulse. Fig. 4-1 Shows the operation timing.

4.4 Side One Selection

The read/write heads located on both sides of the diskette are selected by the side one select signal. When the side one select line is high, the Side 0 head is selected. When it is low, the Side 1 head is selected.



4.5 Read Operation

The required timing for read operations is shown in Figs. 4-1 and 3-5. These timing specifications are necessary for accurate read operation.

Two modes of encoding, FM and MFM, are used for the data stored on media. FM is used for single-density read, and MFM for double-density read.

A comparison of the FM and MFM encoding modes is shown in Fig. 4-2.

4.6 Write Operation

The requiring timing for write operation is shown in Fig. 3-3.

These timing specifications must be strictly observed to ensure an accurate write operation.

Write data can be encoded by either FM or MFM. The M4852/M4853 has good contact stability of the read/write heads on the medium and employs high-performance read/write heads, so no precompensation is necessary for correcting the big shift effect when writing data in the MFM mode (double density).

In case of applying write precompensation, smaller compensation is recommended such as 7.5% or smaller.

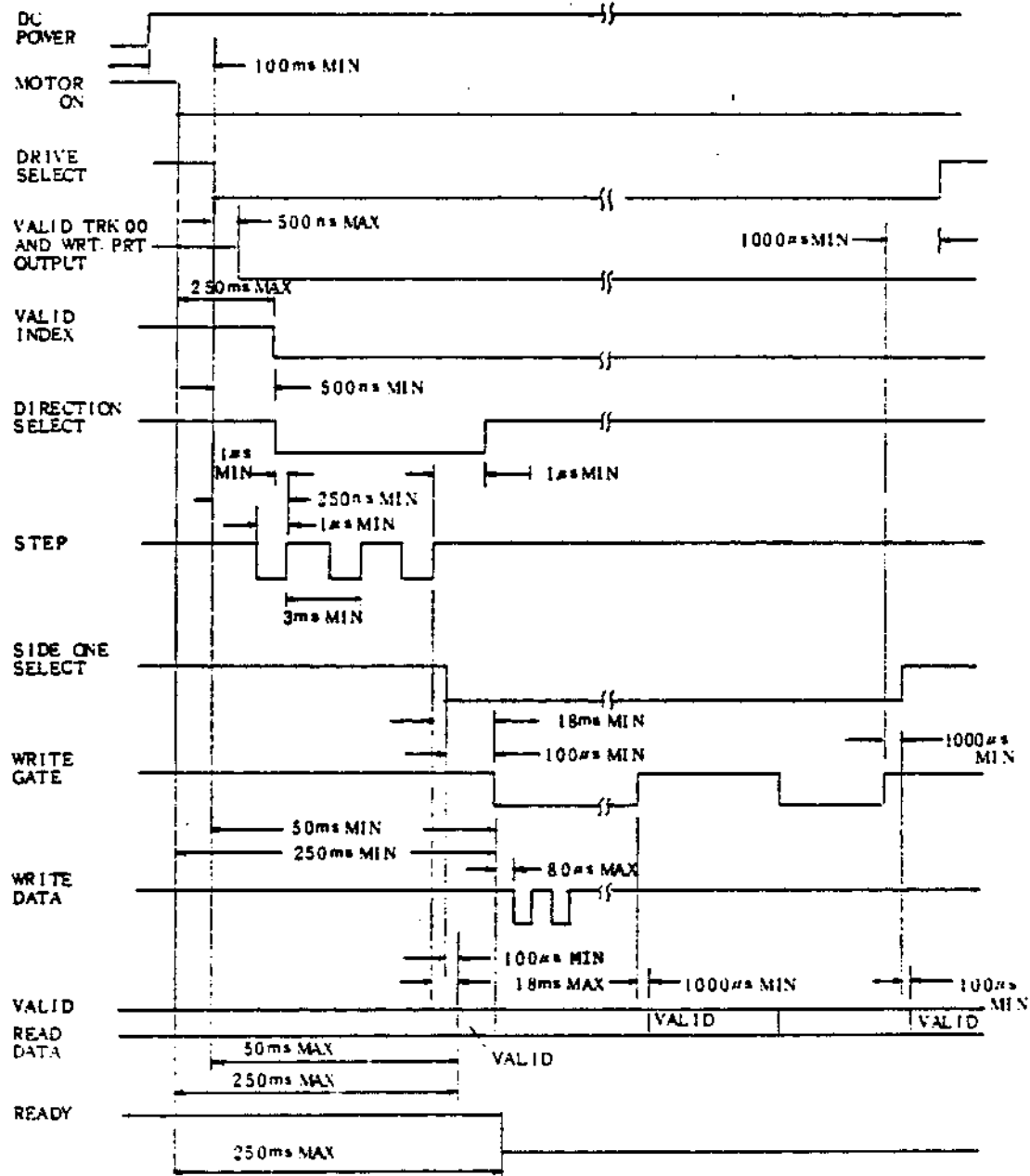


Fig. 4-1 Control and Data Timing

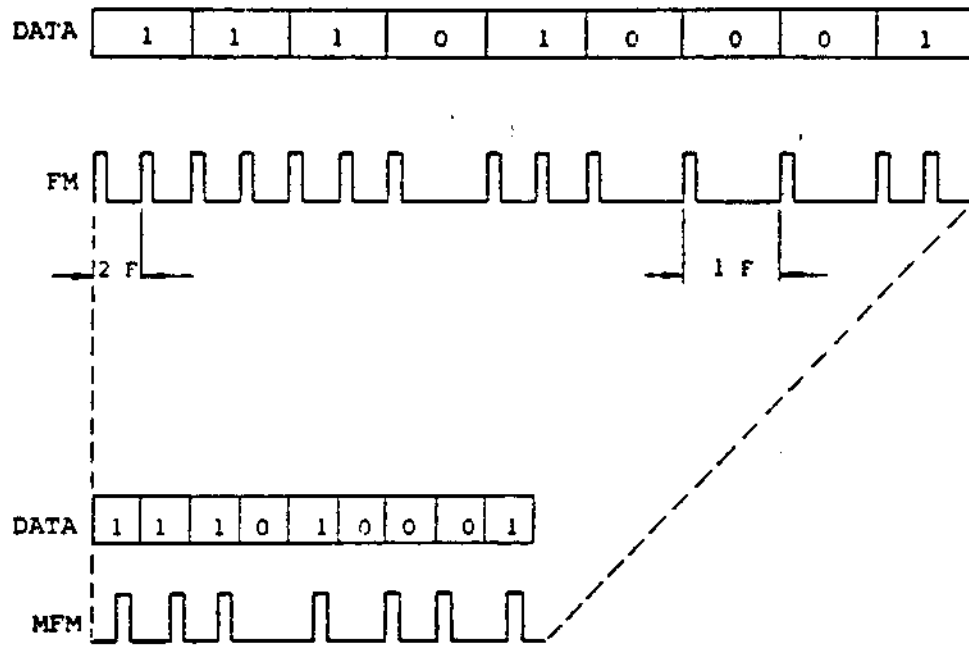


Fig. 4-2 Comparison of FM and MFM Encoding Systems

CHAPTER 5 PHYSICAL INTERFACE

Electronic interfaces between the M4852/M4853 and the host system are accomplished with three connectors. Connector J1 is for the signal interfaces, connector J2 for the DC power supplies, and connector J5 for frame grounding. The connectors used for the M4852/M4853, and recommended mating connectors are described below.

5.1 Signal Connectors

J1 is a card-edge type, 34-pin (for both sides, or 17 pins for a single side) connector with even-numbered pins (2, 4, to 34) on the parts side and odd-numbered pins (1, 3, to 33) on the soldered side.

A key slot is provided between pins 4 and 6 for the polarity reversal prevention.

The dimensions of J1 are shown in Fig. 5-1.

Recommended P1 connectors that mate with J1 are shown in Tables 5-1 and 5-2.

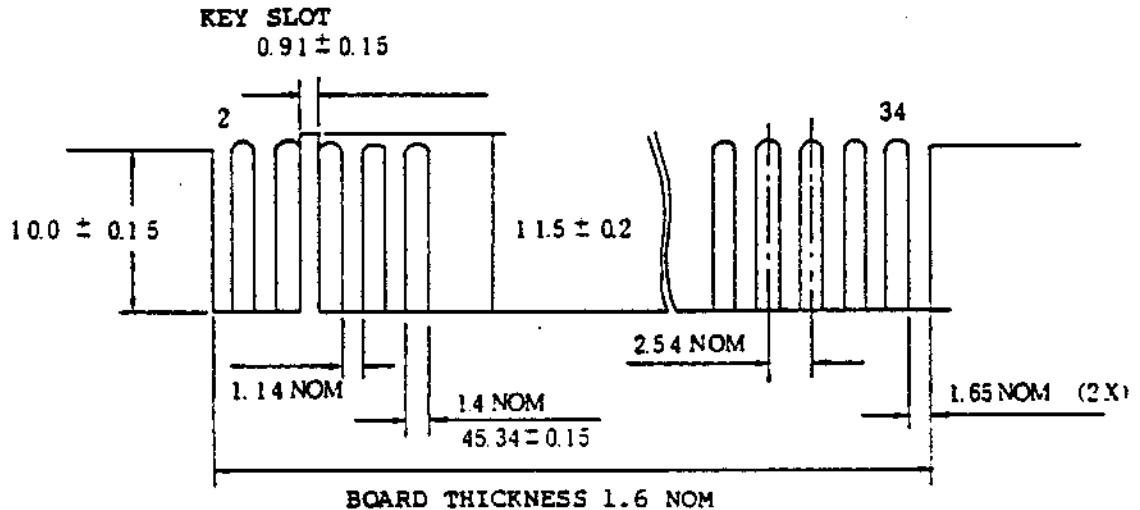


Fig. 5-1 Connector J1 Dimensions (mm) and Pin Numbers



Table 5-1 Connectors for Twisted-Pair Cable (P1)

Parts	Crimp Type	Solder Type
	AMP P/N	AMP P/N
Housing	583717-5	583717-5
Contact	1-583616-1	583854-3
Polarity key	583274-1	583274-1
Crimping tool	90268-1	-
Extraction tool	91073-1	91073-1
Twisted-pair cable (3 m max.)	AWG 26	AWG 26

Table 5-2 Connector for Flat Cable (P1)

Parts	3M P/N	
Connector	3463-0001	
Polarity key	3439-0000	
Crimping tools	Press	3440
	Locator press	3443-11
	Platen	3442-3
Flat cable (3 m max.)	3365/34	

5.2 DC Power Connector (J2/P2)

J2 is a four-pin DC power connector made by AMP, located on the back of the printed-circuit board. Pin 4 on connector J2 is located closest to J1/P1; the arrangement of the pins as viewed from the side is shown in Fig. 5-2. Pin numbers are shown on the parts side.

The connectors on the drive side and cable side are shown in Table 5-3.

Table 5-3 DC Power Connectors

Parts	P2 (Cable Side)	J2 (Drive Side)
	AMP P/N	AMP P/N
Housing	1-480424-0	172349-1
Contact (4 pins)	60619-1	-
Crimp tool	90124-2	-
Extraction tool	1-305183-2	-
Cable (3 m max.)	AWG 18	-

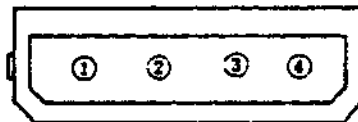


Fig. 5-2 Connector J2

5.3 Frame Ground Connector (J5/P5)

FASTON Terminal	Crimp Terminal
AMP P/N 60920-1	AMP P/N 60972-1



5.4 Interface Connector Physical Location

Fig. 5-3 shows the physical locations of the interface connectors used for the M4853.

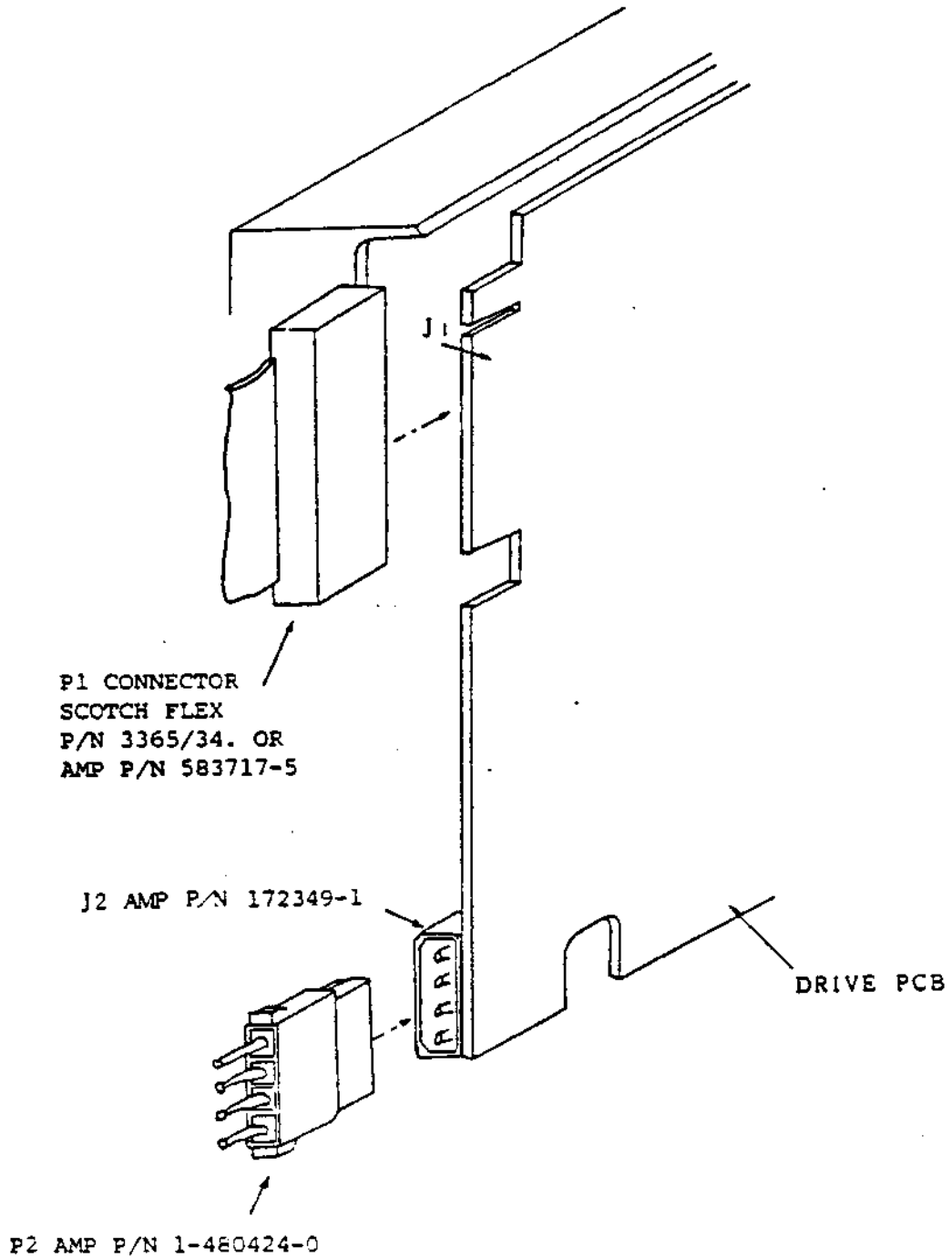


Fig. 5-3 Connector Location Diagram (Rear View)

CHAPTER 6 DRIVE PHYSICAL SPECIFICATIONS

6.1 Installation Direction

Install the M4852/M4853 disk drive in the directions shown in Fig. 6-1.

The slant mount should be within 10 degrees.

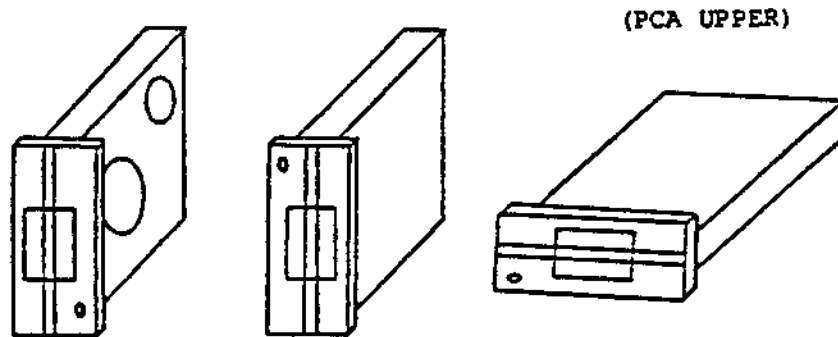


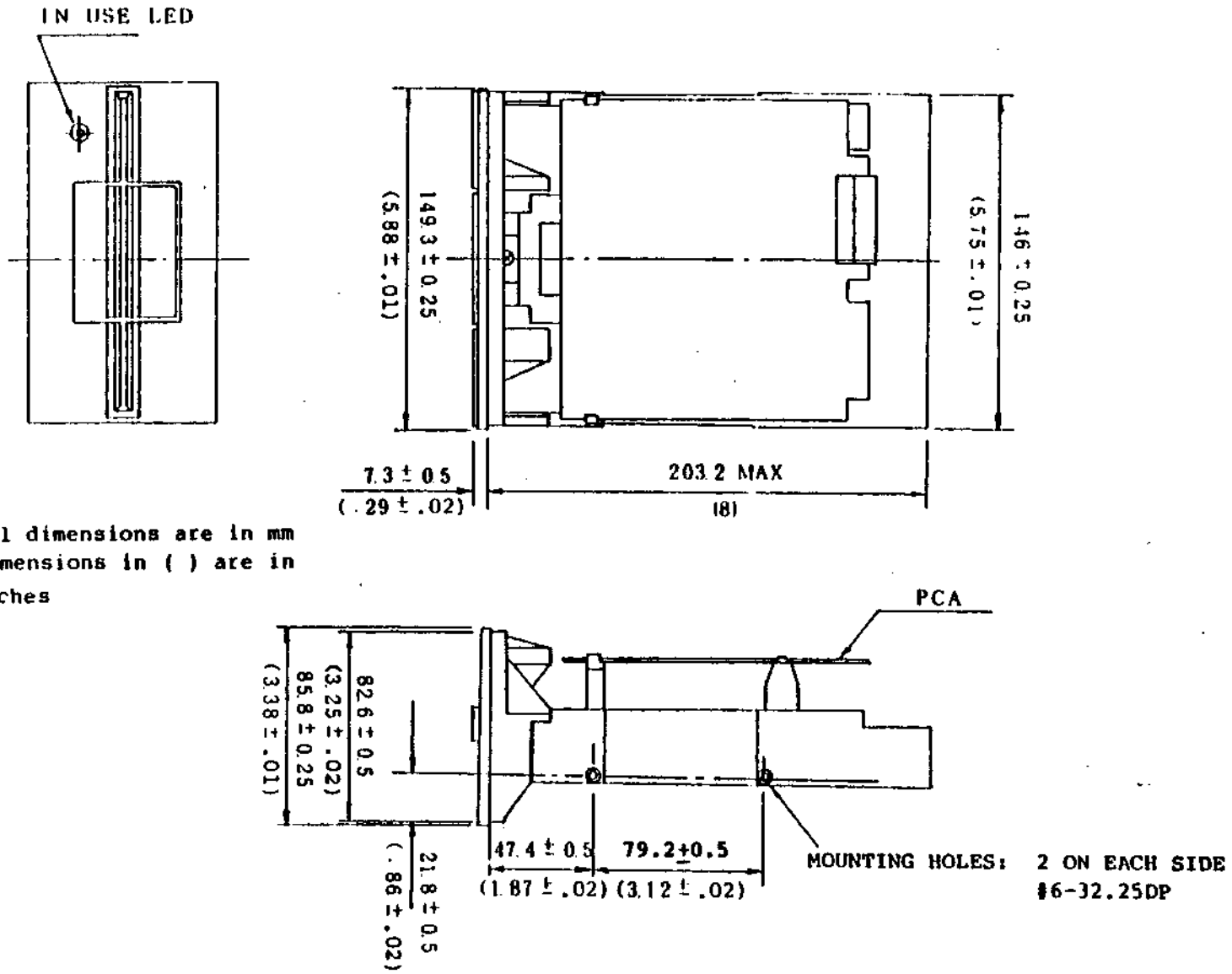
Fig. 6-1 Disk Drive Installation Directions

6.2 Dimensions of M4852

See Fig. 6-2.

6.3 Dimensions of M4853

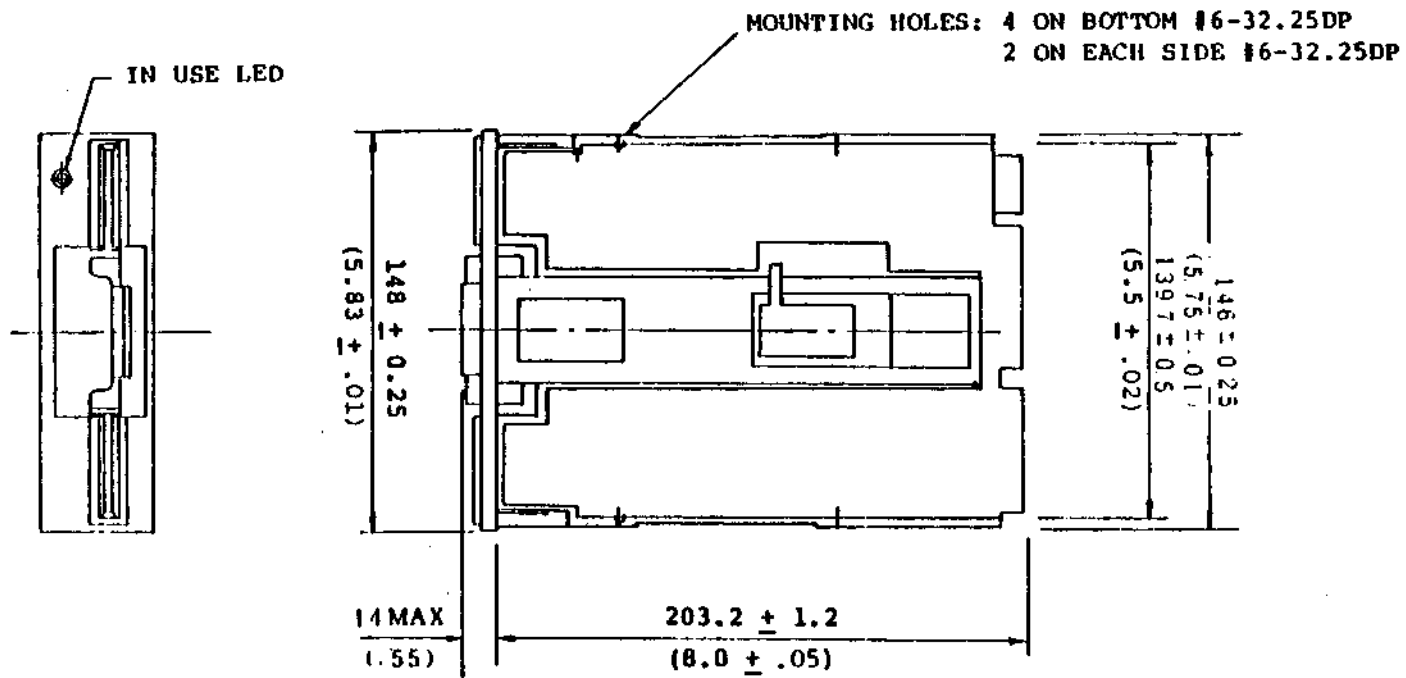
See Fig. 6-3.



Note: All dimensions are in mm
dimensions in () are in
inches

Fig. 6-2 Dimensions of M4852





Note: All dimensions are in mm
 dimensions in () are in inches

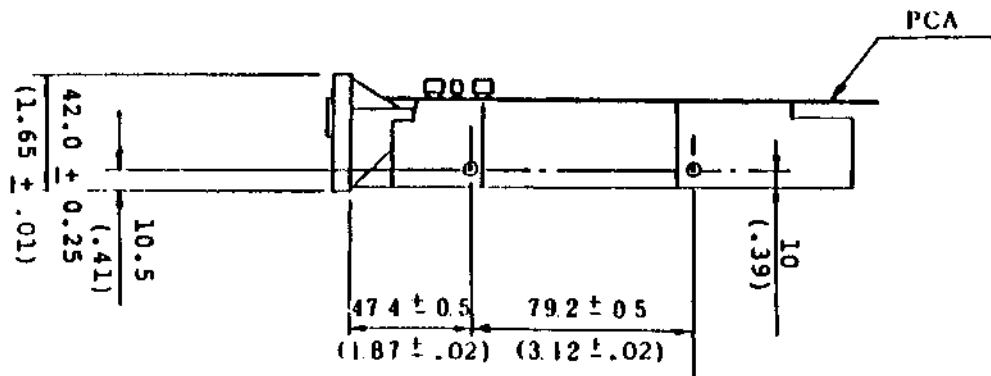


Fig. 6-3 Dimensions of M4053

CHAPTER 7 ERROR DETECTION AND CORRECTION

This chapter describes the general cause analysis and corrective procedures to be followed in the event that data errors occur.

7.1 Write Errors

If an error occurs during a write operation, it can be detected by performing a read operation on the diskette rotation immediately following the write operation. This is generally called a write check, which is an effective means of preventing write errors. It is recommended, therefore, that a write check be made without fail.

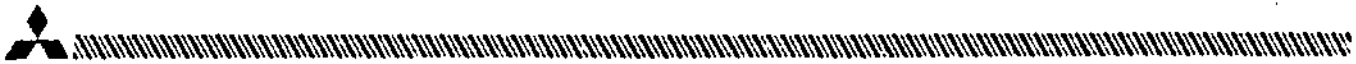
If a write error occurs, repeat the write operation and conduct a write check. If data cannot be correctly written even after the write operation is repeated about ten times, perform a read operation on another track to determine whether the data can be read correctly. If so, a specific track of the diskette is defective. If data cannot be correctly read on the other track, the drive is assumed to have some trouble. If the diskette is defective, replace it.

7.2 Read Errors

Most data errors that occur are soft errors. If a read error occurs, repeat the read operation to recover the data.

The following are possible main causes of soft errors:

- o Dust is caught between the read/write head and diskette causing a temporary fault in head contact. Such dust is generally removed by the self-cleaning wiper of the jacket, and the data is recovered by the next re-read operation. If read/write is continued for a long time in a very dusty environment, however, hard errors can result from a damaged diskette surface.
- o Random electrical noise ranging in time from a few microseconds to a few milliseconds can also cause read errors. Spike noise generated by a switching regulator, particularly one that has short switching intervals, deteriorates the signal-to-noise ratio, and increases the number of re-read operations for data recovery. It is necessary, therefore, to make an adequate check on the noise levels of the DC power supplies to the drive and frame grounding.
- o Written data or diskettes may have so small a defect as cannot be detected by a data check during write operation.
- o Fingerprints or other foreign matter on a written diskette can also cause a temporary error. If foreign matters is left on a



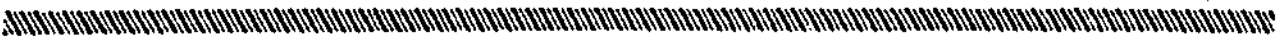
written diskette for a long time, it can adhere to the diskette, possibly causing a hard error.

It is recommended that the following read operations be performed to correct these soft errors:

- o Step 1: Repeat the read operation about ten times until the data is recovered.
- o Step 2: If the data cannot be recovered by Step 1, move the head to other track, the opposite direction of the previous track position before the designated track, and then return the head to the original position.
- o Step 3: Repeat an operation similar to Step 1.
- o Step 4: If the data cannot be recovered, take the error as a hard error.

CHAPTER 8 RESHIPMENT PRECAUTIONS

When reshipping the drive, make sure the protection sheet for transportation is in place in the drive, and close the door.



MEMO