UGD-0312 B

5.25 INCH FLEXIBLE DISK DRIVE

STANDARD SPECIFICATIONS

MF504A-347UA

MITSUBISHI ELECTRIC CORPORATION

CONTENTS

CHAPTER 1 INTRODUCTION

The Mitsubishi MF504A-3 Flexible Disk Drive is a high performance double side Disk Drive designed for use with standard 5.25 inch Diskettes. This device can perform read/write operation both with high density and normal density media.

1.1 General Description

1. Use of high density disk with the MF504A-3 Flexible Disk Drive allows for a formatted memory capacity exceeding 1Mb, a format compatible with an 8 inch floppy disk drive. It is also a magnetic disk drive which makes possible both read and write operations with normal density media used up to now. However, 48TPI normal density media can read and write, but only 96TPI drive can read the revised data.
2. Input pin 2 is used for switching between high density and normal density media. This allows the rotational speed to be switched between 360 rpm when high density is selected, and 300 rpm when normal density is selected. The READ/WRITE circuitry is also switched at the same time.

3. When normal density has been selected, the setting can be performed so that only the READ/WRITE circuit is switched, while the rotation remains at 360 rpm.

4. A wide variety of user options makes it possible for this device to be used in various operations.

5. Half height (41 mm) dimension of conventional model and two MF504A-3 units can be fit into the industry standard size for one 5-1/4 inch flexible disk drive.

6. The soft-toch, circular gimbal-supported magnetic head provides stable contact with the medium.

7. A high-precision stepping motor and steel bands are used in a combination for the magnetic head position mechanism to achieve a fast 3 ms access time between tracks.

8. Compact Brushless D.C. Motor gives maintenance free.

9. Stable media interchangeability by keeping enough window time margin at off-track in a wide range of ambient conditions.

10. Dynamic clamping function provides high reliability of diskette centering in order to avoid possible mis-clamping.

11. Ejector for the diskette provides ease-of use in the handling the diskette.

1.2 Specifications

1.2.1 Performance specifications (Table 1-1)

				high density media		normal density media	
Encoding method				FM	MFM	FM	MFM
Transfer rate (Kbits/s)				250	500	(150)/125	(300)/250
Memory capacity	Unformatted		Track (K bytes)	5.208	10.416	3.125	6.25
			Disk (K bytes)	833	1666	500	1000
	Formatted	26 sectors/track	Sector (K bytes)	0.128	0.256		
			Track (K bytes)	3.328	6.656		
			Disk (K bytes)	532.48	1064.96		
		15 (16) sectors/track ( ) is normal density.	Sector (K bytes)	0.256	0.512	0.128	0.256
			Track (K bytes)	3.840	7.680	2.048	4.096
			Disk (K bytes)	614.40	1228.80	327.68	655.36
		8 sectors/track	Sector (K bytes)	0.512	1.024		
			Track (K bytes)	4.096	8.192		
			Disk (K bytes)	655.36	1310.72		
Recording density			BPI	4935	9870	2961	5922
Magnetic flux reversal density			FCI	9870	9870	5922	5922
Number of tracks				160		160/80	
Track density			TPI	96		96/48	
Number of cylinders				80		80/40	
Track radius	00 Track		Side 0	57.150 mm (2.2500 in)			
			Side 1	55.033 mm (2.1667 in)			
	79 Track		Side 0	36.248 mm (1.4271 in)			
			Side 1	34.131 mm (1.3438 in)			
Rotation speed				360 rpm		(360)/300 rpm	
Motor starting time				500msec or less		(500)/400msec or less	
Average latency time				83.3msec		(83.3)/100msec	
Rotation speed change time (360rpm ⇌ 300rpm)				400msec or less			
1 Track Access time				3msec			
Settling time				15msec or less			
Average Acess time				94msec			

Note: ( ) of normal density madia is 360 rpm selected.

1.2.2 Physical specifications (Table 1-2)

DC power requirements	
+5V	+5V + 5%, 0.5 A typical 0.7 A max
+12V	+12V ± 5%, 0.6 A typical (seeking) 1.0 A max (Spindle motor operating)
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)
Non-operating environmental conditions	
Ambient temperature	-20°C to 51°C (-4°F to 125°F)
Relative humidity	5% to 95%
Heat dissipation	9.7 Watts Continuous seek(typical) 5 Watts Standby (typical) 4 Watts Motor off (typical)
Physical dimensions	(Except for front panel)
Height	41 mm (1.62 in)
Width	146 mm (5.75 in)
Depth	195 mm (7.7 in)
Front panel dimensions	42 x 148.0 mm (1.65 x 5.83 in)
Weight	1.2 kg (2.9 lbs)

1.2.3 Reliability specifications (Table 1-3)

MTBF	10,000 POH or more
MTTR	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
Error rate	
Soft read error	10^{-9} bit (Two retries)
Hard read error	10^{-12} bit
Seek error	10^{-6} seek

Table 1-3. Table of reliability specification.

CHAPTER 2 OPERATION OF MAJOR COMPONENTS

2.1 System Operation

The MF504A-3 Flexible Disk Drive consists of a medium rotating mechanism, two read/write heads, an actuator to position the read/write heads on tracks, 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 360 rpm or 300 rpm. The positioning actuator moves the read/write head over the desired track of the medium. Then, read or write data.

2.2 Electronic Circuits

The electronic circuits to drive the individual mechanisms of the MF504A-3 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 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

The spindle motor driving circuit is within the PCB that is integrated with the motor. It consists of a rotation speed control servo circuit, motor driving circuit, speed detecting device, and hall detecting device.

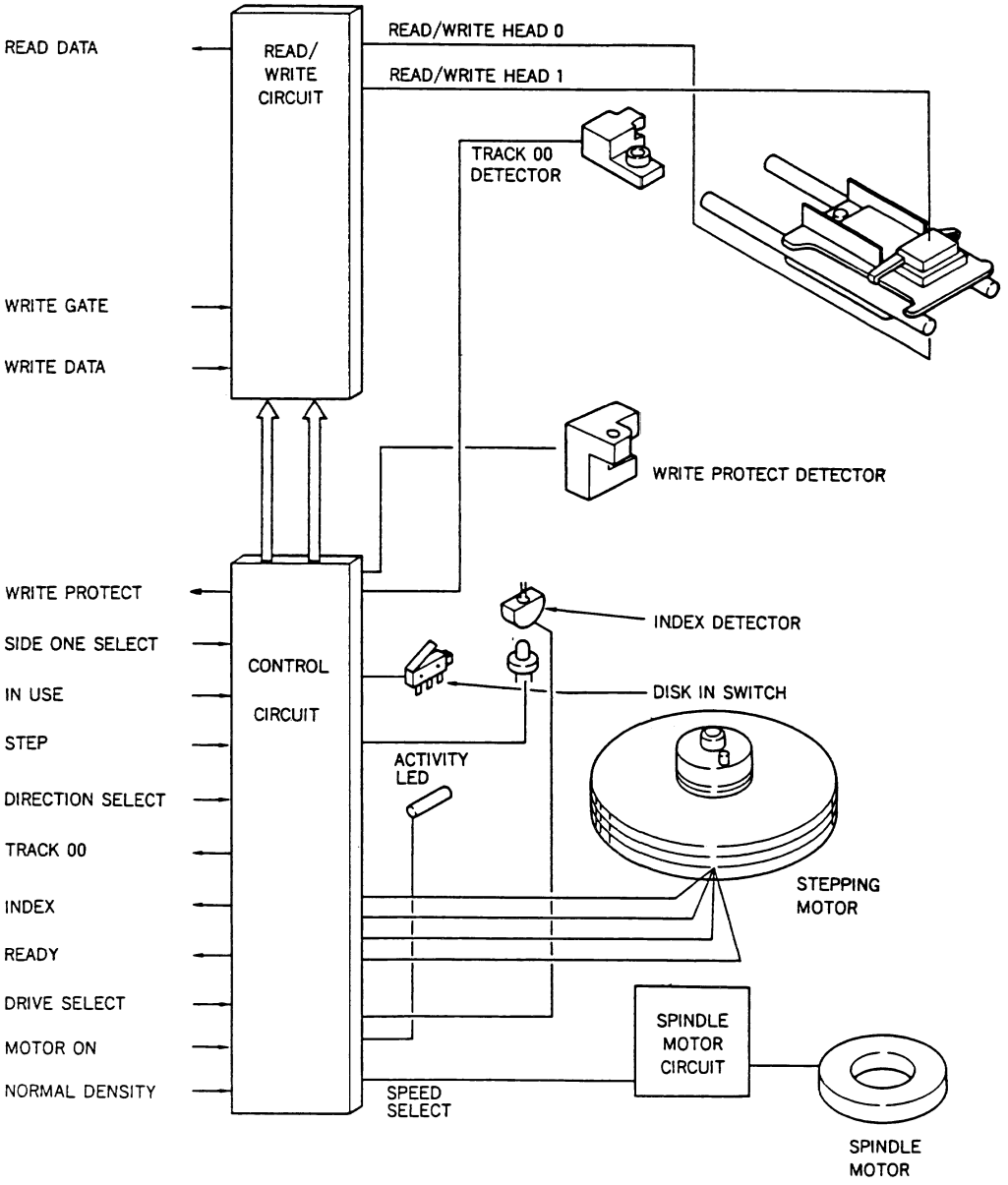


Fig. 1 Functional View

2.3 Rotation Mechanism

The diskette rotation mechanism used the DC brushless direct-drive motor to directly rotate the spindle at 360 rpm or 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 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, 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 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.

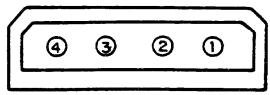
The signal interface sends and receives control signals and read/write data between the MF504A-3 and the host system via the J1/P1 connector.

The DC power interface drives the spindle drive motor of the disk drive, 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 return	3	
+5 V DC	4	



P2 connector

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

Signal	Signal Pin Number	Ground Return Pin Number
NORMAL DENSITY *1	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 *2	34	33

*1: This line is used for switching between high and normal density.

*2: Thisline can be used as HOLD READY and DISK CHANGE instead of READY with the short plug setting on the PCB.

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 +0.4V
  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 drive 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 eight input signal lines, plus the drive select lines, may be terminated at the disk drive 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 drive has detachable terminator modules 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 dirves.

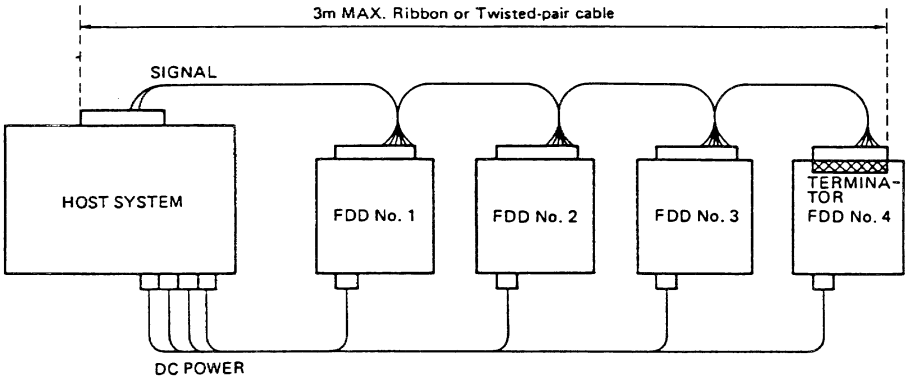


Fig. 3-1 Cabling Method (Sketch)

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.

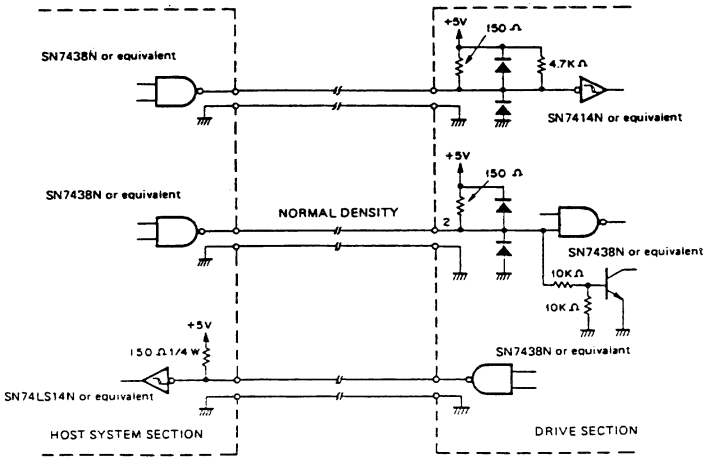


Fig. 3-2 Recommended Line Driver and Line Receiver Circuits

3.1.3 Short plug

The short plug sets the conditions for selecting the drive, starting the spindle motor, lighting the LED of the panel indicator and sending the ready signal.

The following is the explanation of features of the short plug.

(1) Drive selection conditions DS0-3, MX (location A4 of PCB)

1.1) DS0-3

If multiple connection is made with the system and the drive, by short-circuiting one of the DS0-3, the corresponding DRIVE SELECT line will select the drive with the logical "0" only, and input signals can be received.

For example, the drive that has had its DS0-3 short-circuited, will be selected when DRIVE SELECT 0 line is at logical "0".

1.2) MX

When all of DS0-3 has been opened and MX short-circuited, the drive will always be selected regardless of the DRIVE SELECT line of the interface. However, in this case the control of the panel indicator LED can only be done with the IN USE signal. Furthermore, the power of the spindle motor cannot be controlled by DRIVE SELECT 0-3. Therefore it is necessary to revise the conditions to another.

* DS1 is short-circuited at the factory before delivery. Resetting is necessary in order to use another drive number.

1.3) The terminator of the DRIVE SELECT line conditions selection TD (Location A3 of PCB) J10

When TD is open, the terminator of the DRIVE SELECT line can be separated.

* TD is shorted when the unit is shipped from the factory.

(2) Spindle MOTOR ON conditions selection MM, MS (location E3 of PCB)

The conditions for Spindle MOTOR ON conditions are selected by the combination of opening and short-circuiting of MM and MS.

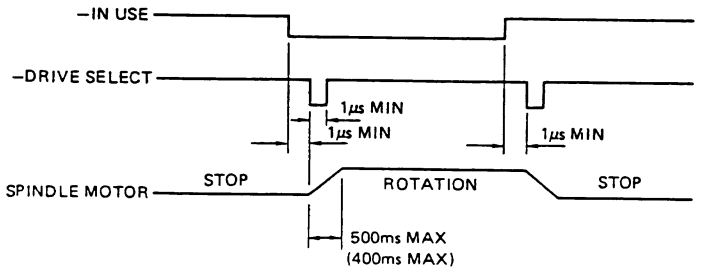
Short plug		Refer to	Notes
MS	MM		
open	short	2.1	Before delivery
short	open	2.2	
open	open	2.3	
short	short	2.4	

2.1) Power of the spindle motor is controlled by the MOTOR ON signal.

2.2) Power of the spindle motor is controlled by the drive select conditions that have been selected by DRIVE SELECT 0-3 signal.

2.3) Power of the spindle motor is controlled by the logic sum of the DRIVE SELECT 0-3 signals and MOTOR ON signal.

2.4) Power of the spindle motor is controlled by latching the IN USE signal with the reading edge of the DRIVE SELECT signal. At this time, the short plug IU will be short-circuited.



(Note) : The figures in brackets ( ) are for when the unit is at 300 rpm.

Fig. 5 Spindle motor on/off timing (IN USE latching)

(3) Ready transmission selection conditions DC, 2S (location E3 of PCB) RR (location B3 of PCB)

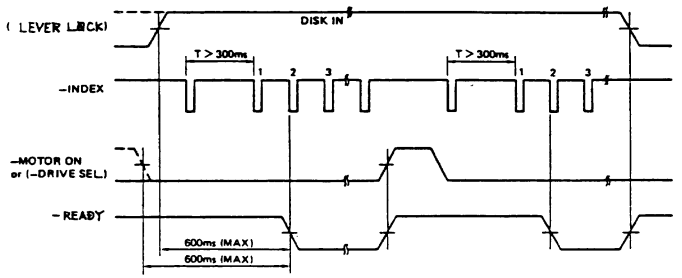
The ready transmission conditions below can be selected with the combination of opening and short-circuiting of DC and 2S.

Short plug		Refer to	Notes
DC	2S		
open	open	3.1	
open	short	3.2	
short	short	3.3	
short	open	3.4	Before delivery

3.1) Standard READY

With the standard READY signal, after detection for a disk rotation period of less then 300 ms, the INDEX signal is detected by two pulses and a READY signal is sent to the interface. A maximum of 600 ms is required for the output of the READY signal.

The READY signal interrupts disk rotation and renders it NOT READY for all conditions.



3.2) Hold ready

Indicates that the diskette is inserted and the lever is locked. This ready is set within 600 ms from when the lever is locked. When the lever is cancelled, reset starts. In order to perform read/write operations, since ready will be held even if the Spindle motor is turned off, a minimum of 500 ms should be allowed to pass after the spindle MOTOR ON signal (DRIVE SELECT signal in the case when spindle MOTOR ON is done with DRIVE SELECT 0-3) is sent.

3.3) Disk change

Indicates that the lever is cancelled immediately after POWER ON.

After the lever has been locked, this signal will be cancelled with the trailing edge of the first DRIVE SELECT signal and will not change with any DRIVE SELECT signal afterwards.

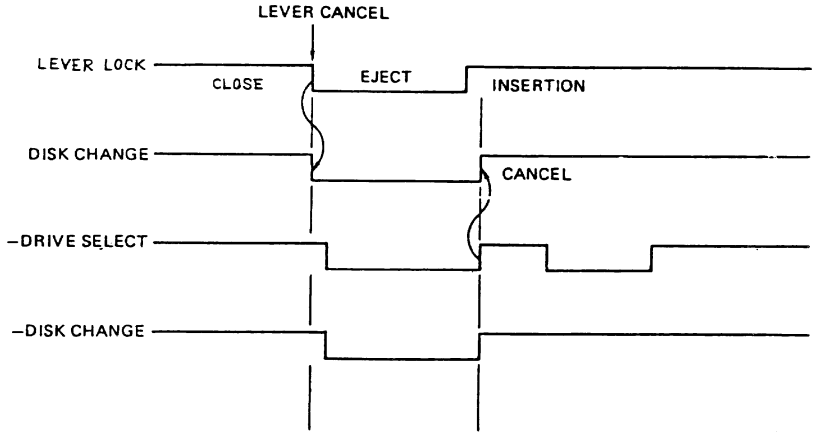


Fig. 6 Disk Change Timing

3.4) Diskette change

This signal become active or logic low (logical "0") when the drive door has been disturbed (opened) and reset to the inactive state when the door is closed and a step pulse has been received by the drive.

3.5) RR

In the case RR is short-circuited, the ready signal will be output after the logic product and the DRIVE SELECT signal will be taken.

In the case RR is open, this logic product will be deleted and the DRIVE SELECT signal and ready signal will be outputted regardlessly.

* RR is shorted when the unit is shipped from the factory.

4) Panel indicator LED lighting conditions selection IU (location E3 of PCB) IR, IS, IL (location B3 of PCB)

Shown in Table 9.

5) Normal density condition selection SS (location C5 of PCB) SB (location F4 of PCB)

When SS is shorted and SB is open, the rpm of motor is set to 360 rpm by logical "1" of the NORMAL DENSITY signal, and the read/write circuitry is set for the use of high density media. The rpm of the motor is set to 300 rpm by logical "0" of the NORMAL DENSITY signal, and the read/write circuity is set for the use of normal density media.

When SS is open and SB is shorted, the rpm is not changed by the NORMAL DENSITY signal, but the read/write circuitry is adjusted as above. Logical "0" of the NORMAL DENSITY signal allows the use of normal density media with a transfer speed of 300 kb/sec.

SS is shorted and SB is open when the unit is shipped from the factory.

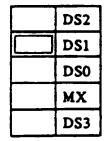
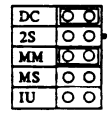
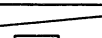
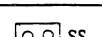
Table 9 Panel Indicator LED Lighting Conditions

J 3	J 6	J 8	J 9	LED lighting conditions
[I U] Note 1	[I R]	[I S]	[I L]	If the IN USE signal is active, latching and lighting will be initiated with the reading edge of the DRIVE SELECT signal. Afterwards the LED will remain lighted even after the DRIVE SELECT signal inactive. By inputting the DRIVE SELECT signal once again when the IN USE signal is inactive, the latching will be cancelled and the LED will go out with this reading edge. Furthermore, these lighting conditions become effective only when the drive is READY. (Note 3) This setting will be done at the factory before delivery.
[I U]	I R	[I S]	[I L]	The READY conditions will be cancelled from the above lighting conditions.
[I U]	[I R] or I R	I S	[I L]	LED will light with the logic sum of the DRIVE SELECT signal and the lighting conditions by the latching listed above. When the IR is short-circuited, the LED will light at the READY mode and logic product and will be delated when IR is open. (The same is with the following.)
[I U]	[I R] or I R	I R I S	I L	The LED will light with the logic sum of the DRIVE SELECT and IN USE signals.
[I U]	[I R] or I R	[I S]	I L	The LED will light with the IN USE signal.
I U	[I R] or I R	I S	– Note 2	The LED will light with the DRIVE SELECT signal.
I U	–	[I S]	–	The LED will not light.

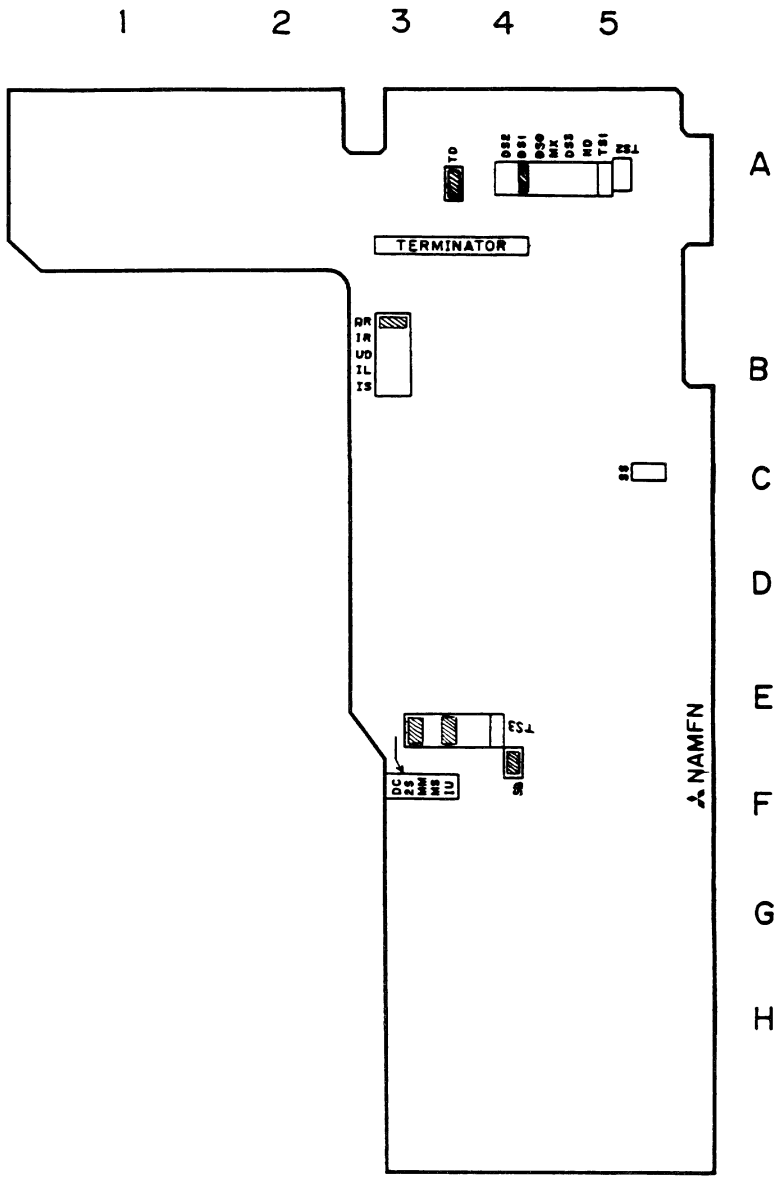
Note 1. The enclosed names are those shorted by jumper plugs. Those not enclosed are open.

2. - indicates that the lighting conditions will not change whether open or short-circuited.

3. When the lighting conditions are included in the ready conditions, stand-by or hold ready transmission conditions are to be used.

Object	Name	Contents	Setting when shipped from the factory	Plug number
Selection of drive select	[DS0]	Drive select 0		J11
	[DS1]	Drive select 1		
	[DS2]	Drive select 2		
	[DS3]	Drive select 3		
	[MX]	The drive select which is usually set		
	[TD]	Connection to the terminator resistance of the DRIVE SELECT signal		J10
Selection of MOTOR ON conditions	[MM] MS	Motor started by the MOTOR ON signal		J4
	MM [MS]	Motor started by the DRIVE SELECT signal		
	MM MS	Motor started by the MOTOR ON signal or DRIVE SELECT signal		
	[MM] [MS] [IU]	Motor started by the IN USE signal latched by DRIVE SELECT signal		J3
Selection of the signal transmitted from pin 34 of the interface (Connector P1)	DC 2S	STANDARD READY is sent		
	DC [2S]	HOLD READY is sent		
	[DC] [2S]	DISK CHANGE is sent		
	[DC] 2S	(not used)		
Gate selection for the above trans mission signal	[RR]	Gated by DRIVE SELECT signal		J7
	RR	Transmitted as is		
Head unload cod-dition selection	~~[UD]~~	Head unload delay released		–
	~~UD~~	Head load mode is kept for 3 – revolutions		
Normal density condition selection	[SS] SB	360 rpm when high density is specified 300 rpm when normal density is specified		J11
	SS [SB]	360 rpm for both high and normal density		

Note 1 : [ ] means the plug position when shipped from factory.



Printed-Circuit Board Trace Location

3.1.4 Input signal lines

The disk drive has 12 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/0 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 drive to be made active, corresponding to each of the DRIVE SELECT lines, and specify which of the drives is active.

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 deskette should be read/write operations. 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 μs before execution.

Upon completion of a write operation, reverse the polarity of the side one select signal after a delay of 590 μs (*1). The heads are tunnel typs, 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 ON/OFF time of a few hundred microseconds with in the disk drive. There fore, the head select must not be reversed during this delay time. Also, the track access action must not be permitted for 590 μs. (*1)

*1: The interval is 1000 μs when normal density at 300 rpm is specified.

(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 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 μs 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 it becomes Logical "1," the write drive becomes inactive and the read ata logic is enabled. However, the protected read data is

output 590 μs(*1) after the write drive become inactive. Refer to CHAPTER 4 for the timing.

*1; The interval is 1000 μs when normal density at 300 rpm is specified.

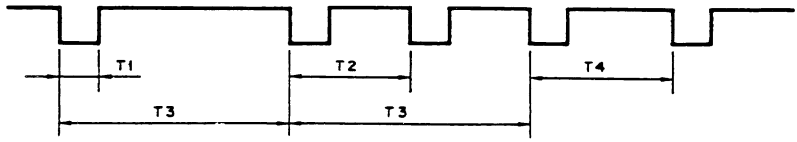
(6) WRITE DATA

Data to 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 goes to logical "0". Fig. 3-3 shows the write data timing.

(Note: The interval is 1000 μs when normal density at 300 rpm is specified.)



	MFM			
	FM			
	T1	T2	T3	T4
High density, 360 rpm	150 to 1100ns	2.00μs ± 10ns	4.00μs ± 20ns	3.00μs ± 15ns
Normal densiti, 300 rpm	150 to 2100ns	4.00μs ± 20ns	8.00μs ± 40ns	6.00μs ± 30ns
Normal density, 360 rpm	150 to 1800ns	3.33μs ± 17ns	6.67μs ± 33ns	5.00μs ± 25ns

Fig. 3-3 Write Data Timing (FM, MFM 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 500 ms (the interval is 400 μs for 300 rpm) after the motor-on line goes logical "0".

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

(9) NORMAL DENSITY

This interface line selects whether read/write operations are set for high density or normal density media. Logical "1" corresponds to high density, and logical "0" corresponds to normal density.

When the normal density condition selection plugs SS (shorted) and SB (open) are used to switch the rpm, read/write operations are performed after a wait of more than 400 ms after transmission of this NORMAL DENSITY signal, during which time the rpm is stabilized. When the rpm is switched, write operations always begin after the read/write head moves to track 00. This erase power delay of a few hundred microseconds, which is generated within the drive, is necessary for switching when the head is moved to track 00 or when the power is turned on. When the normal density condition selection plug SS is open and SB is closed, the rpm is always 360 rpm, and there is no waiting, and no need to move the head to track 00.

3.1.5 Output signal lines

The drive has five standard output signal lines.

(1) INDEX

This interface line is normally logical "1" but sends a logical "0" output pulse 3.5 ms wide each time the diskette makes one revolution.

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

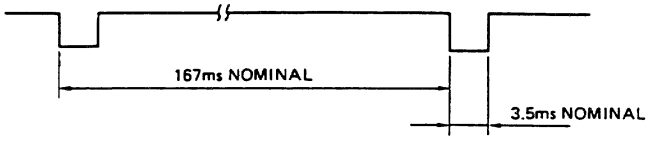


Fig. 3-4 Index Timing

(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.

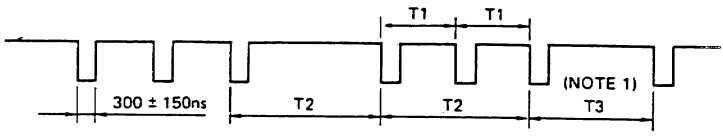
(3) **READY**

This interface line is logical "1" when the lever is cancelled. The line goes logical "0" (ready) if an index pluse is detected twice or more when the index hole is correctly detected, and the DC power (+5V and +12V) supplied after a diskette is inserted into the drive and the lever is locked.

(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.



	MFM / FM		
	T1	T2	T3
High density, 360 rpm	2.00μs ± 400ns	4.00μs ± 800ns	3.00μs ± 600ns
Normal density, 300 rpm	4.00μs ± 800ns	8.00μs ± 1600ns	6.00μs ± 1200ns
Normal density, 360 rpm	3.33μs ± 667ns	6.67μs ± 1333ns	5.00μs ± 1000ns

Note : Jitter caused by change is revolution speed are not considered in the above.

Fig. 3-5 Read Data Timing (FM, MFM 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 disk drive requires two types of DC power supplies.

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

NOTE

The index LED is driven by the +12V 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 (±5%)	0.7 A maximum 0.5 A typical	50 mV
+12 V DC	±0.6 V (±5%)	1.0 A MAX (Spindle motor operating) 0.6 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 100 ms or more from the start of DC power supply until the control signal stabilizes. And after the period of 600 ms from the Motor On, the drive comes to 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 disk drive 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 signal 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. 4-3.

4.6 Write Operation

The requiring timing for write operation is shown in Figs. 3-3 and 4-1.

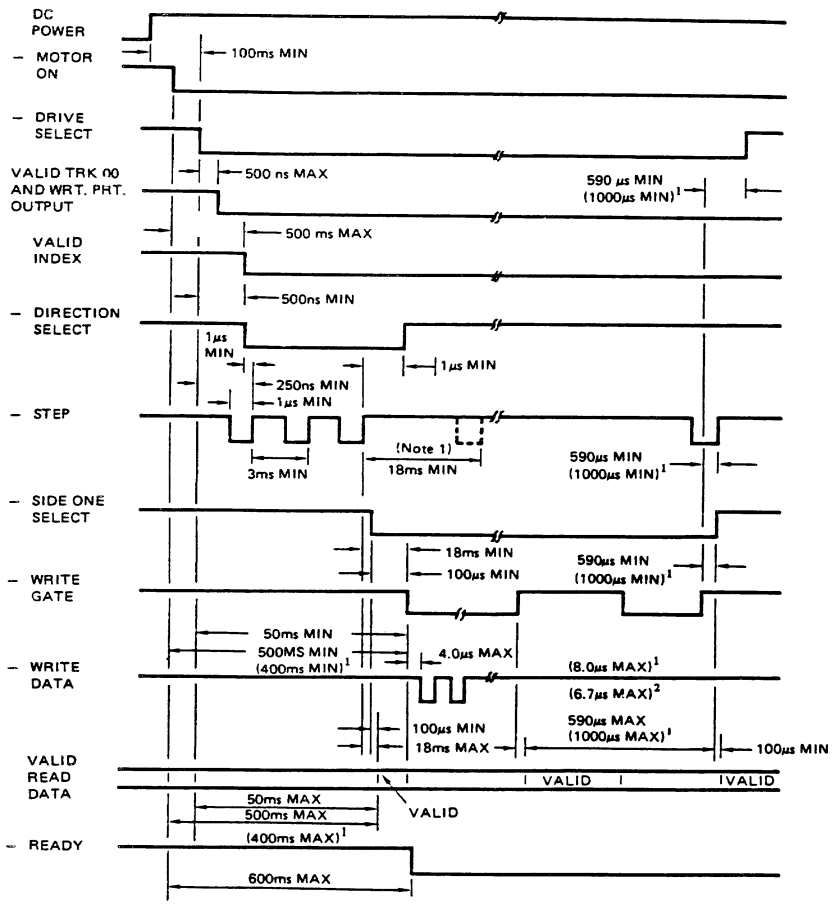
These timing specifications must be strictly observed to ensure an accurate write operation.

Write data can be encoded by either FM or MFM. The disk drive 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 peak shift effect when writing data in the MFM mode (double density).

In case of applying write precompensation, smaller compensation is recommended such as 150ns or smaller.

4.7 READY and dynamic clamp functions

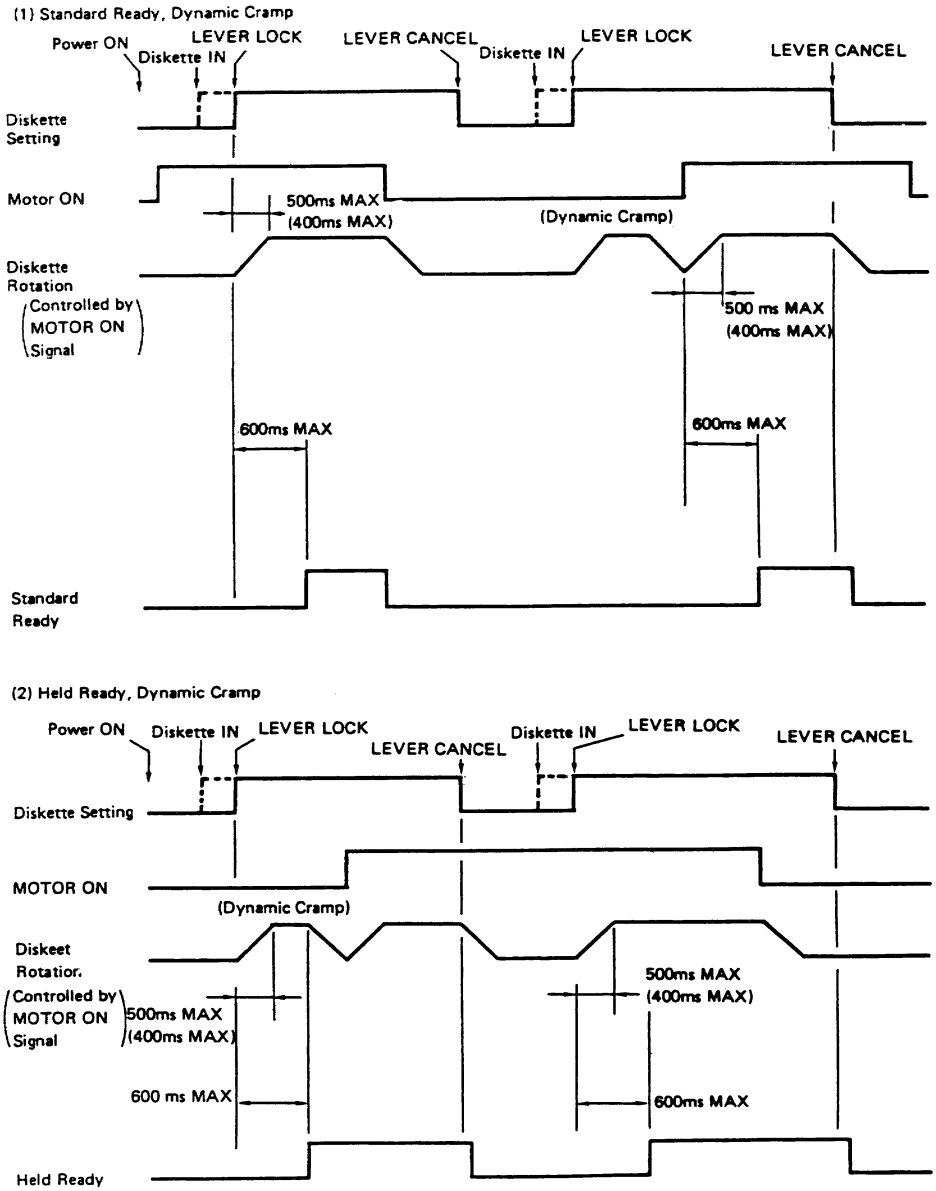
Refer to Fig. 4-2 for standard ready, hold ready, and the timing of the dynamic clamp.



Note 1: When reversing direction, issue a next step pulse after more than 18 ms from the step pulse before inversion.

Note 2: The figures in bracketa ( )[1] are for when the unit is specified for normal density at 300 rpm. The figures in brackets ( )[2] are for when the unit is specified for normal density at 360 rpm.

Fig. 4-1 Control and Data Timing



Note 1: The figures in brackes ( ) are for when the unit is specified for 300 rpm.

Fig. 4-2 Ready and Dynamic Cramp Timing

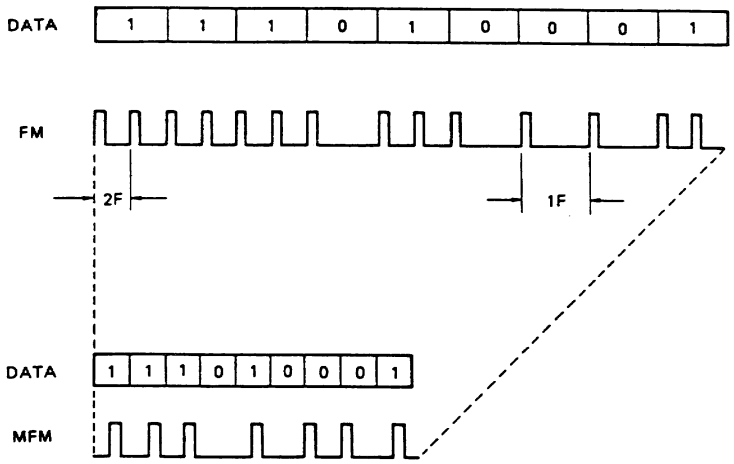


Fig. 4-3 Comparison of FM and MFM Encoding Systems

CHAPTER 5 PHYSICAL INTERFACE

Electronic interfaces between the disk drive 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 J7 for frame grounding. The connectors used for the disk drive 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.

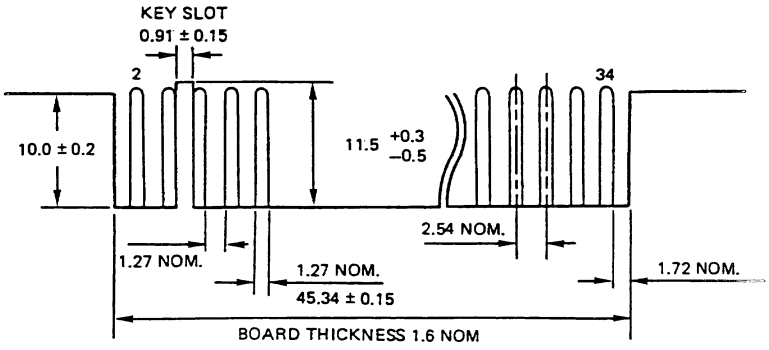


Fig. 5-1 Connector J1 Dimensions (mm) and Pin Numbers

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 plate	3443-11
	Platen	3442-3
Flat cable (3 m max.)		3365/34

Items that can be used in conjunction with a connector for the flat cable.

Parts	HIROSE P/N
Connector	HIF5D-34DA-2.54R
Polarity key	CR7C-GPIN

(Items such as a fusing tool. For details refer to the manufacturers of the connector.)

5.2 DC Power Connector (J2/P2)

P2 is a four-pin DC power connector made by JST, located on the back of the printed-circuit board. Pin 4 on connector P2 is located closest to J1/P1; the arrangement of the pins as viewed from the side is shown in Fig. 5-2.

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

Table 5-3 DC Power Connectors

Parts	J2 (Cable Side)	P2 (Drive Side)
	AMP P/N	JST P/N
Housing	1-480424-0	LC-04A
Contact (4 pins)	60619-1	-
Crimp tool	90124-2	-
Extraction tool	1-305183-2	-
Cable (3 m MAX.)	AWG 18	-

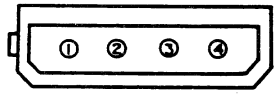


Fig. 5-2 Connector P2

5.3 Frame Ground Connector (J7/P7)

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.

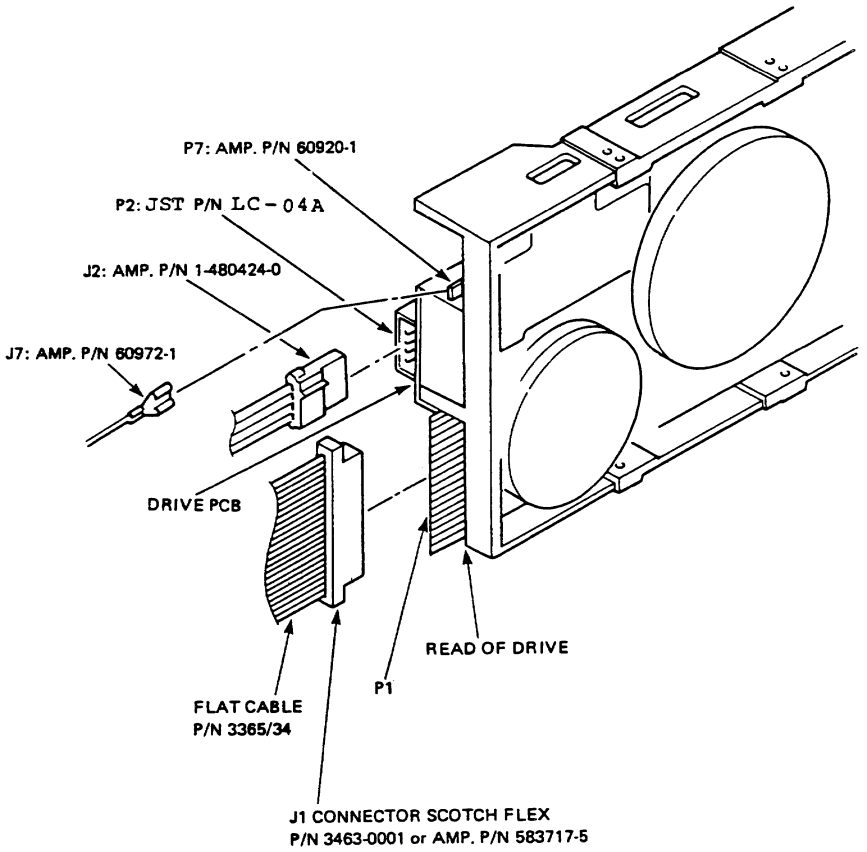


Fig. 5-3 Location of Interface Connectors

CHAPTER 6 DRIVE PHYSICAL SPECIFICATIONS

6.1 Installation Direction

Install the Mini Flexible disk drive in the directions shown in Fig. 6-1.

The slant mount should be within 10 degrees.

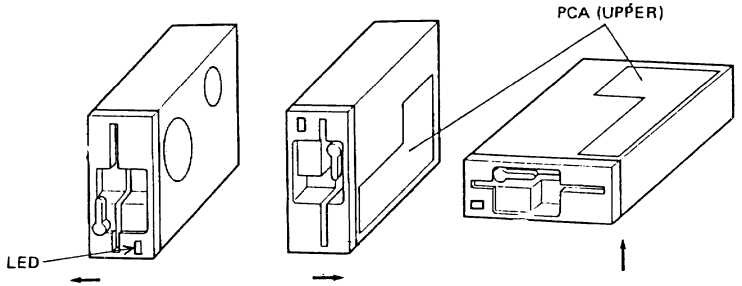


Fig. 6-1 Disk Drive Installation Directions

6.2 Dimensions of disk drive

See Fig. 6-2.

6.3 Dimensions of Front Panel

See Fig. 6-3.

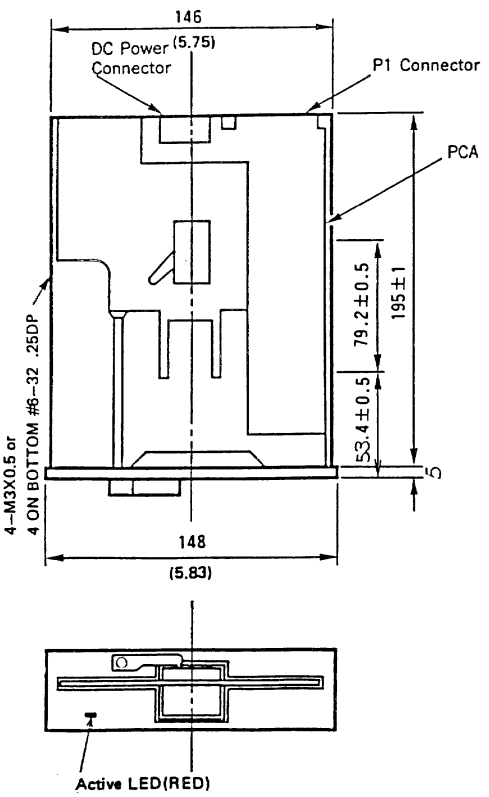


Fig. 6-2 Disk Drive Dimensions

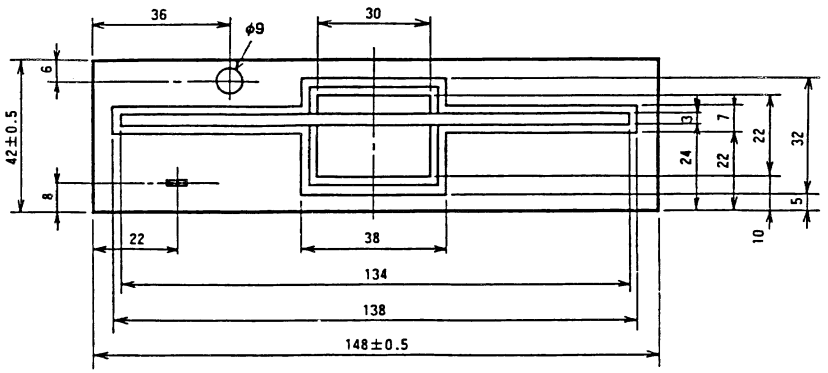


Fig. 6-3 Front Panel Dimensions

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 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:

- 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 wipet of the jacket, and the data is recovered by the next re-read operation. If read/write operations is continued for a long time in a very dusty environment, however, hard errors can result from a demaged diskette surface.

- Random electrical noise ranging in time from a few microseconds to a few milliseconds can also cause read erros. Spile 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.

- Written data or diskettes may have so small a defect as cannot be detected by a data check during write operation.

- 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:

- Step 1: Repeat the read operation about ten times until the data is recovered.
- 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.
- Step 3: Repeat an operation similar to Step 1.
- 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 open the door.

* Additional Specifications

This item describes motor speed and data transfer rate of the M4854-1/3S Flexible Disk Drives.

Fig. 1 Implementation of motor speed selection and data transfer rate selection.

Implementation						
	Short Plug Selection (on PCB)	SS : Short SB : Open		SS : Open SB : Short		See Note 1.
	Normal Density signal (controller output)	logical " 1 "	logical " 0 "	logical " 1 "	logical " 0 "	See Note 2.
Useable Media		High Density	Normal Density	High Density	Normal Density	
Motor Speed		360 rpm	300 rpm	360 rpm	360 rpm	
Data Transfer Rate		500 Kbits/s	250 Kbits/s	500 Kbits/s	300 Kbits/s	

Note 1. See 3.1.3 (7), page 20 in the Standard Specifications.

Note 2. See 3.1.4 (9), page 27 in the Standard Specifications.

Fig. 2 Relation to Formatted Media

Formatted Media	96 TPI High Density (1.6MB) *1	96 TPI Normal Density (1.0MB) *1	48 TPI Normal Density (0.5MB) *1
Read/ Write	Read and Write Possible	Read and Write possible	Read and Write possible *2
Data Transfer Rate of MFM(FM)	500(250) Kbits/s only	250(125)Kbits/s, 300(150)Kbits/s selectable	250(125)Kbits/s, 300(150)Kbits/s selectable

* 1 ( ) indecates unformatted capacity.

* 2 Only 96 TPI drive can read the revised data.