

DRIVE (H)

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* 1.2 Meg. Floppy Disk Drive
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November 15, 1985

High Density 1.2 Meg. Mitsubishi M4854-3S and MF504A-3 drives

The Tandy 3000 uses the Mitsubishi M4854-3S and MF504A-3 flexible disk drives with a capacity of 1.2 Meg. These high performance double sided 5.25" drives can run normal density or high density media. These drives can be configured to run 300 rpm (40 or 80 cylinders, or 360 rpm high density 80 cylinders. The drives are normally run in the Tandy 3000 in the high density 96 tpi (80 cylinders) mode but can read or write to any compatible 5.25" diskette.

The following pages contain the specifications for your reference in maintenance, troubleshooting and repair of the drives.

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* 1.2 Meg. Floppy Disk Drive *
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* Section 1 *
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* Jumper settings *
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November 15, 1985

1.2 Meg Disk Drive Servo/Logic Board Jumper Settings

1. If the drive is a Mitsubishi Model 4854 be sure that HC, DC, MM, DS1, RR, UD, SB, TD and 11H on the drive servo/logic board are jumpered.

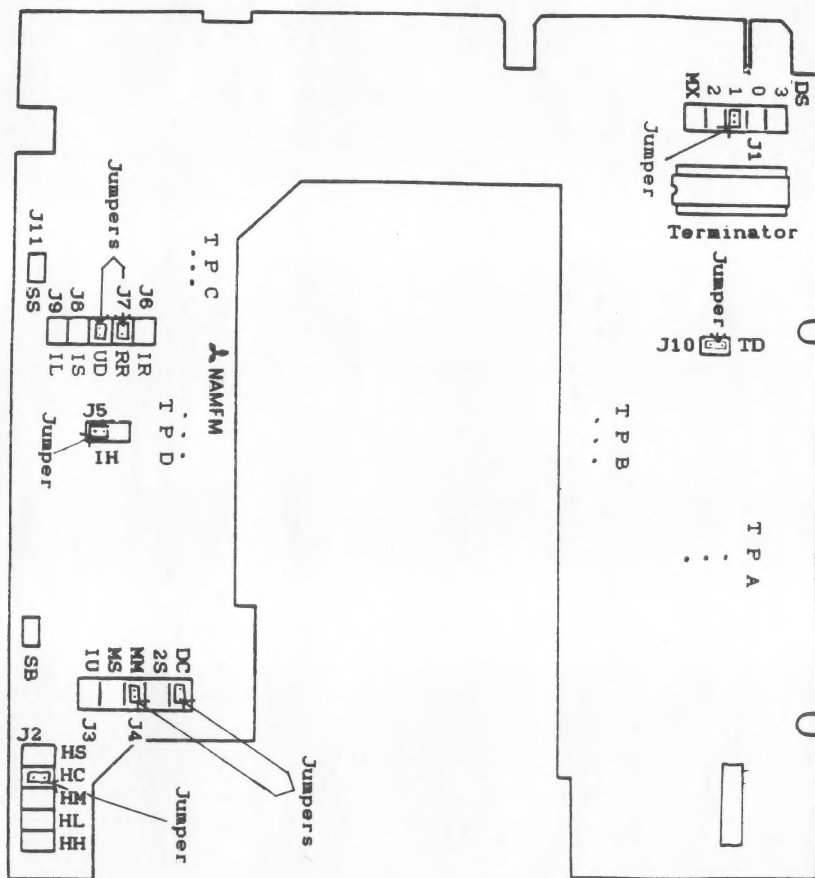


Figure 1
Drive logic board

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*   1.2 Meg. Floppy Disk Drive   *
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*   Section 2                     *
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*   Schematics & Component layout *
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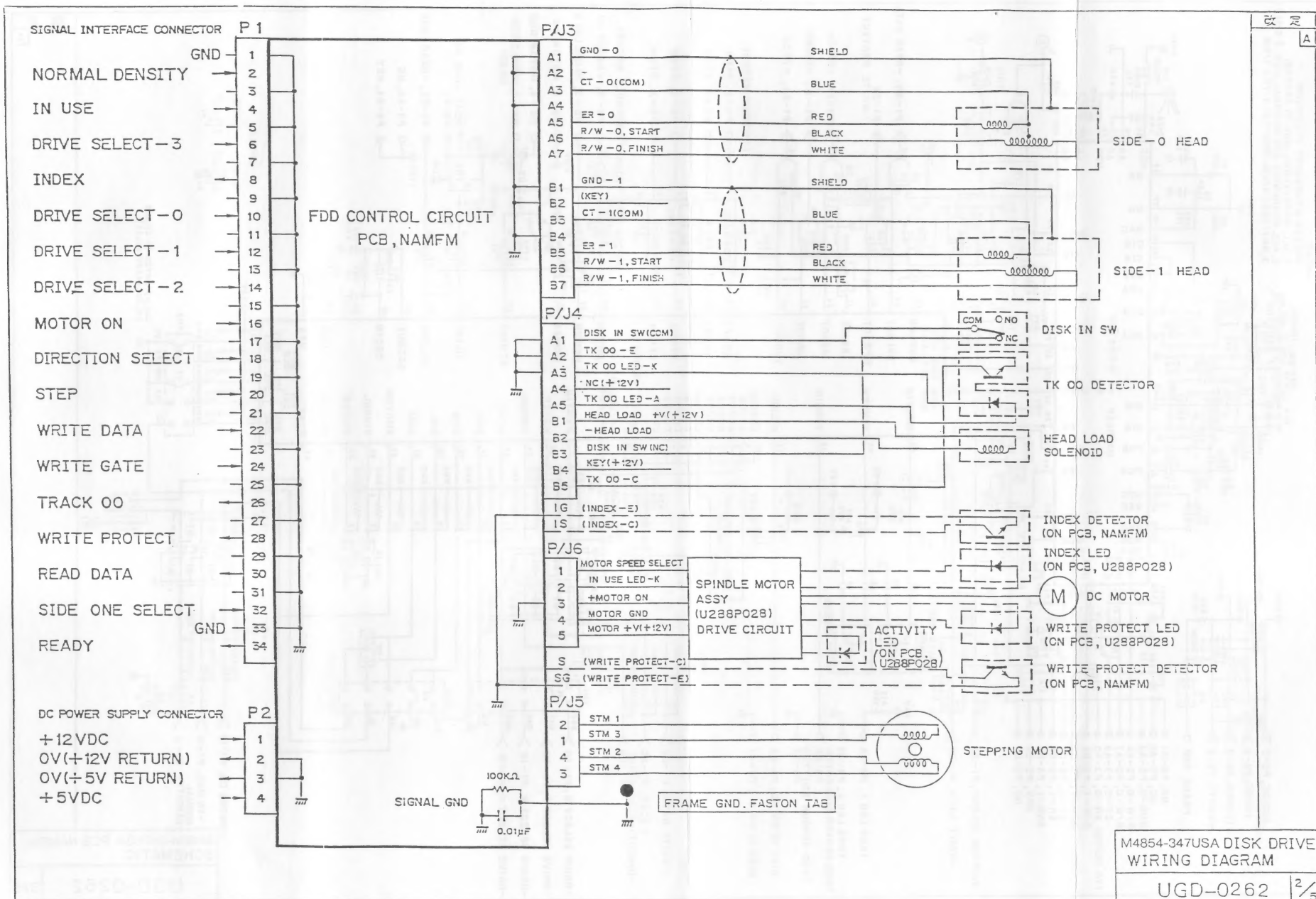
DISK DRIVE SCHEMATICS AND LOGIC MANUAL

M4854-347USA

<u>Sheet Title</u>	<u>Page</u>	<u>Revision</u>
M4854-347USA DISK DRIVE WIRING DIAGRAM.....	3/5	 A
M4854-347USA PCB NAMFM SCHEMATIC.....	3/5	 A
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M4854-347USA SPINDLE MOTOR ASSY SCHEMATIC.....	5/5	 B
(NAME : E2SLR94)		

 MITSUBISHI ELECTRIC CORPORATION

UGD-0262A



CHAPTER 2 OPERATION OF MAJOR COMPONENTS

2.1 System Operation

The M4854-3S 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 M4854-3S are located on a single printed-circuit board, which consists of the following circuits:

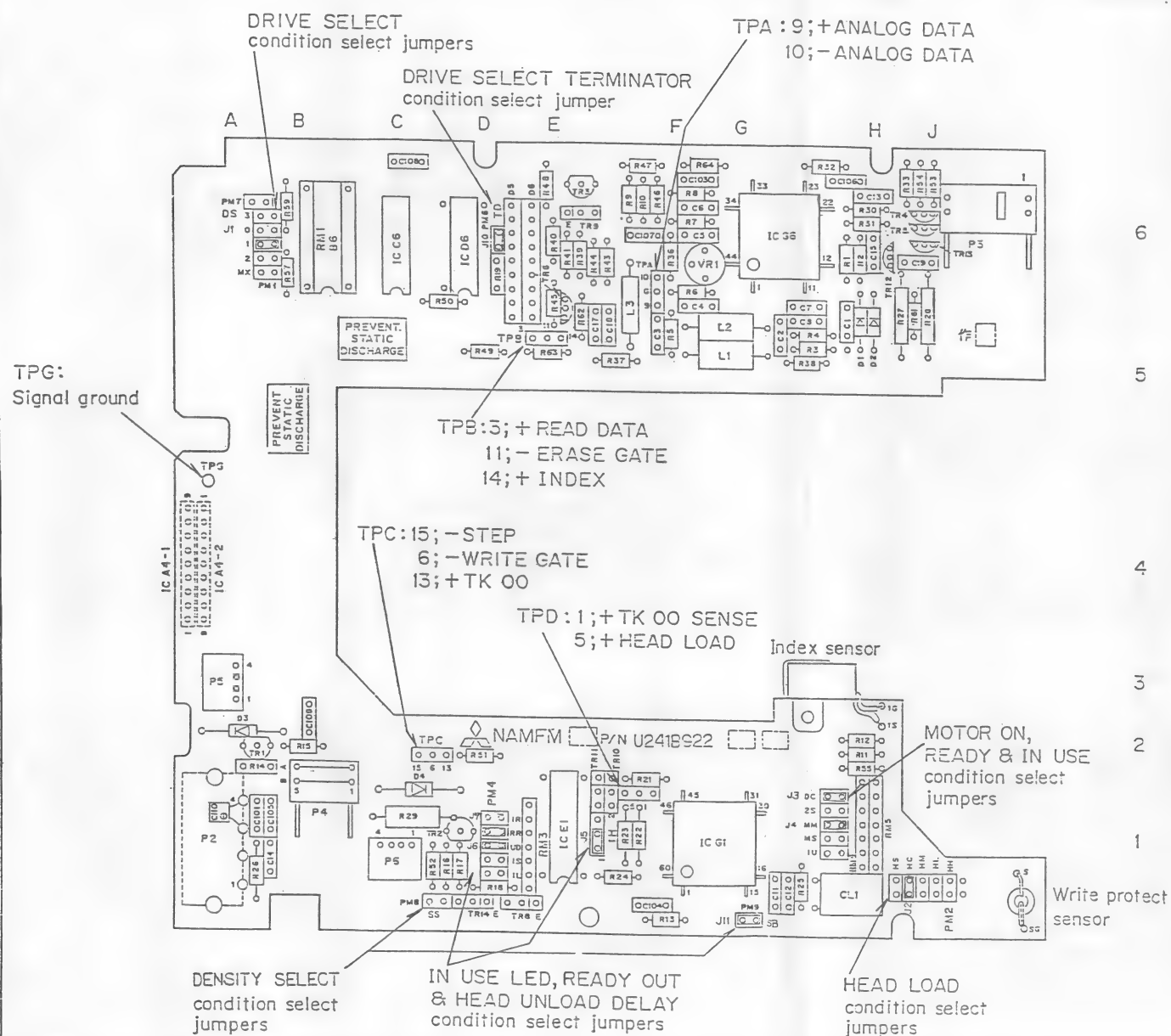
- o Line driver and receiver that exchange signals with the host system
- o Drive selection circuit
- o Index detection circuit
- o Head positioning actuator drive circuit
- o Head loading solenoid drive circuit
- o Read/write circuit
- o Write protect circuit
- o Track 00 detection circuit
- o Drive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

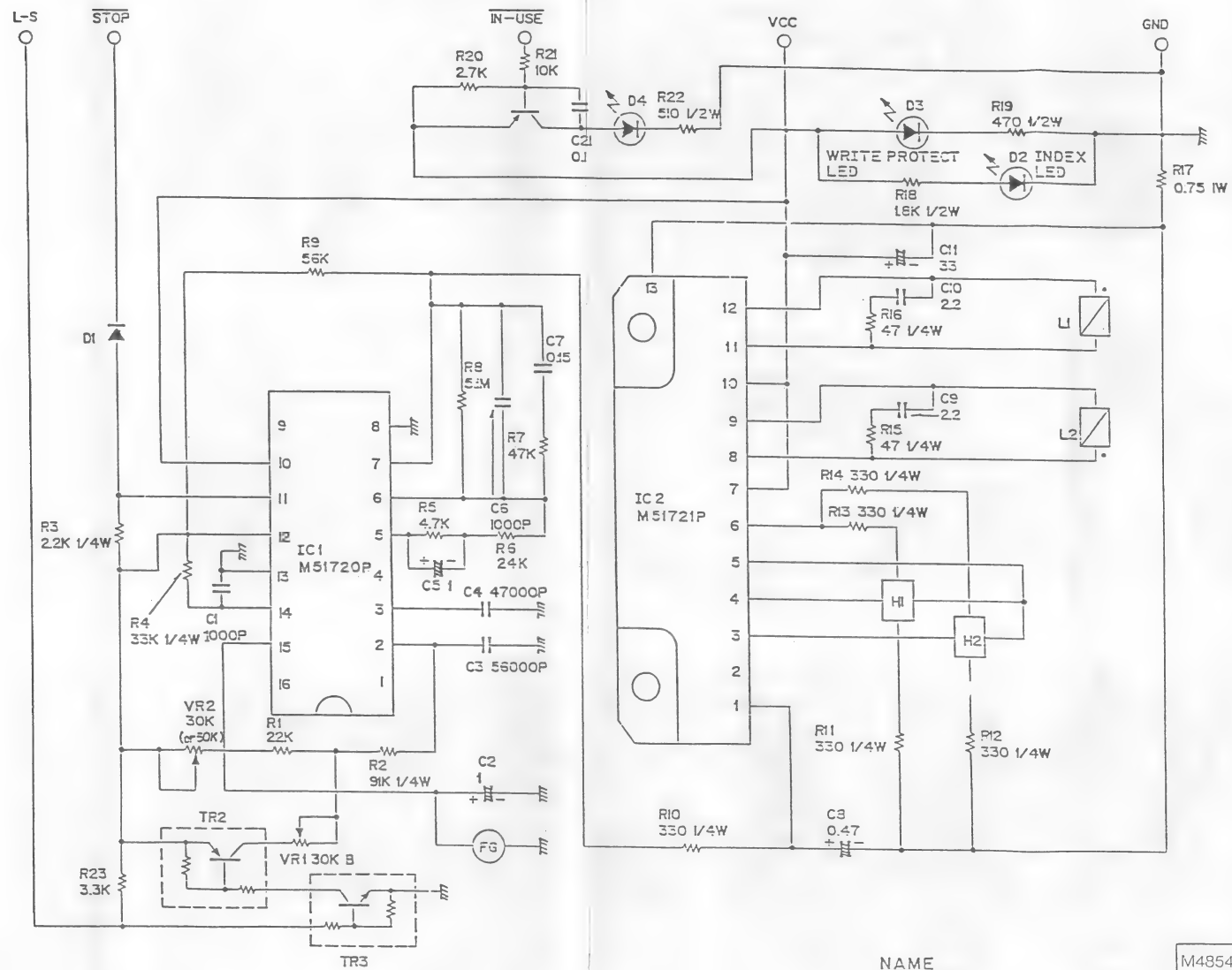
The spindle motor driving circuit is within the PCB that is integrated with the motor. It consists of a rotation speed control servo circuit, motor driving circuit, speed detecting device, and hall detecting device.

NOTES



3/5





NAME
E2SLRS4

M4854-347USA SPINDLE MOTOR
ASSY SCHEMATIC

UGD-0262

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*                                     *  
*      1.2 Meg. Floppy Disk Drive    *  
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*              Section 3              *  
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*      Maintenance manual             *  
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Maintenance Manual was not available at time of printing

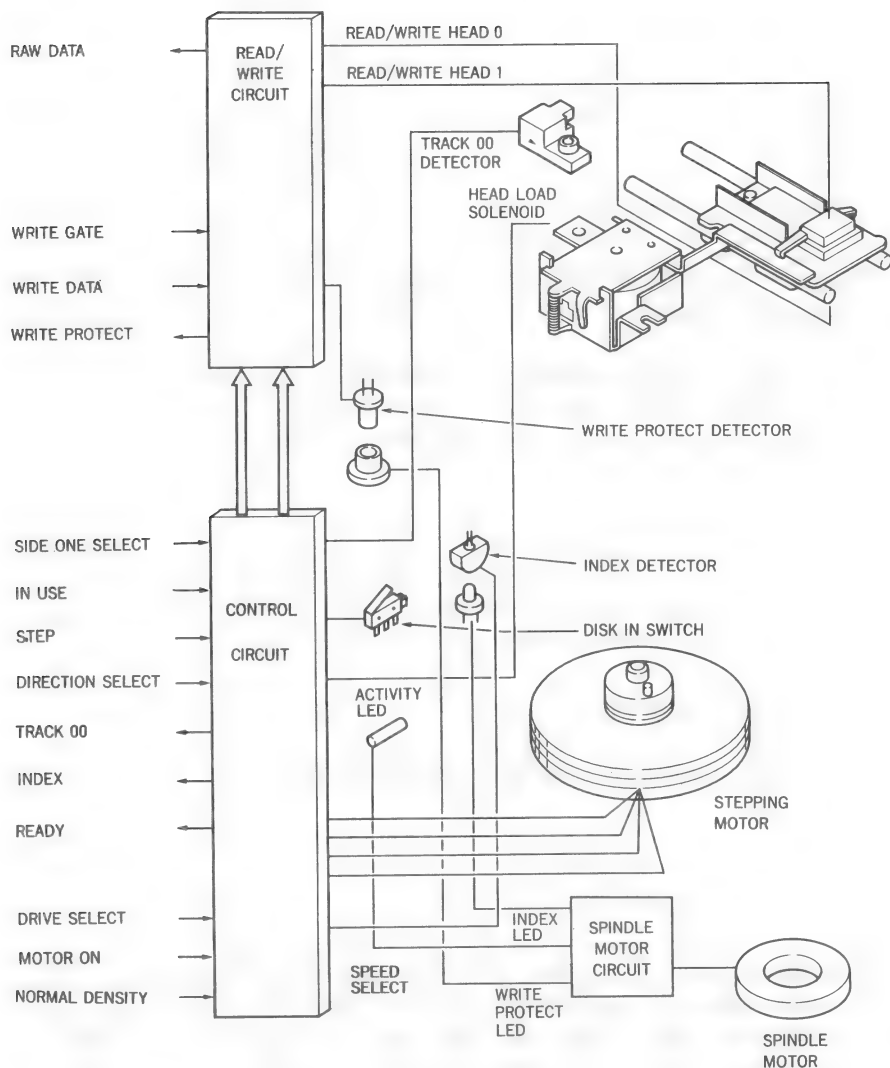


Fig. 1 Functional View

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*   1.2 Meg. Floppy Disk Drive   *
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*           Section 4             *
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*   Standard specifications       *
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November 15, 1985

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.

**5.25 INCH FLEXIBLE DISK DRIVE
STANDARD SPECIFICATIONS
M4854-347USA**

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CHAPTER 1 INTRODUCTION

The Mitsubishi M4854-3S 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 M4854-3S 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 circuit 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 M4854-3S units can be fit into the industry standard size for one 5-1/4 inch flexible disk drive.
6. Ejector for the diskette provides ease-of use in the handling the diskette.
7. The soft-toch, circular gimbal-supported magnetic head provides stable contact with the medium.

8. 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.
9. Compact Brushless D.C. Motor gives maintenance free.
10. Stable media interchangeability by keeping enough window time margin at off-track in a wide range of ambient conditions.
11. Low power consumption can be achieved by a diskette detection function.
12. Dynamic clamping function provides high reliability of diskette centering in order to avoid possible mis-clamping.

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
	Form- atted	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
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 Access time				94msec			

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

1.2.2 Physical specifications (Table 1-2)

DC power requirements +5V +12V	+5V + 5%, 0.5 A typical 0.7 A max +12V $\pm$ 5%, 0.7 A typical (seeking) 1.0 A max (Spindle motor operating)
Operating environmental conditions Ambient temperature Relative humidity	5°C to 43°C (41°F to 109.4°F) 20% to 80% (Maximum wet bulb temperature: 29°C (85°F))
Non-operating environmental conditions Ambient temperature Relative humidity	-20°C to 51°C (-4°F to 125°F) 5% to 95%
Heat dissipation	9.7 Watts Continuous seek (typical) 5 Watts Standby (typical) 4 Watts Motor off (typical)
Physical dimensions Height Width Depth	(Except for front panel) 41 mm (1.62 in) 146 mm (5.75 in) 195 mm (7.7 in)
Front panel dimensions	42 x 148.0 mm (1.65 x 5.83 in)
Weight	1.3 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 POH whichever comes first
Media life Rotational life	3.5×10^6 pass/track or more
Error rate Soft read error Hard read error Seel error	10^{-9} bit (Two retries) 10^{-12} bit 10^{-6} seek

Table 1-3. Table of reliability specification.

CHAPTER 2 OPERATION OF MAJOR COMPONENTS

2.1 System Operation

The M4854-3S 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 M4854-3S 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

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.

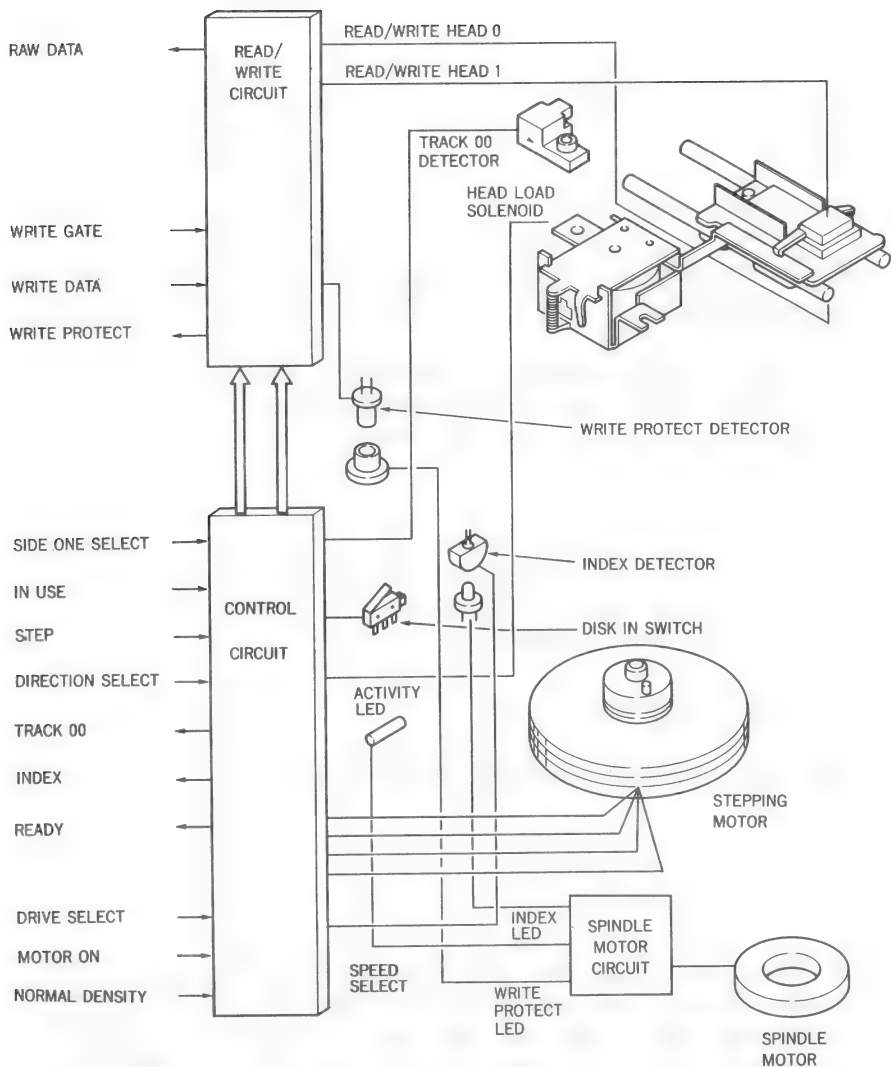


Fig. 1 Functional View

2.3 Rotation Mechanism

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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 M4854-3S 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 *2	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 *3	34	33

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

*2: The line can be used as HEAD LOAD instead of IN USE with the jumper plug setting on the PCB.

*3: This line can be used as HOLD READY and DISK CHANGE instead of READY with the jumper 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 drives.

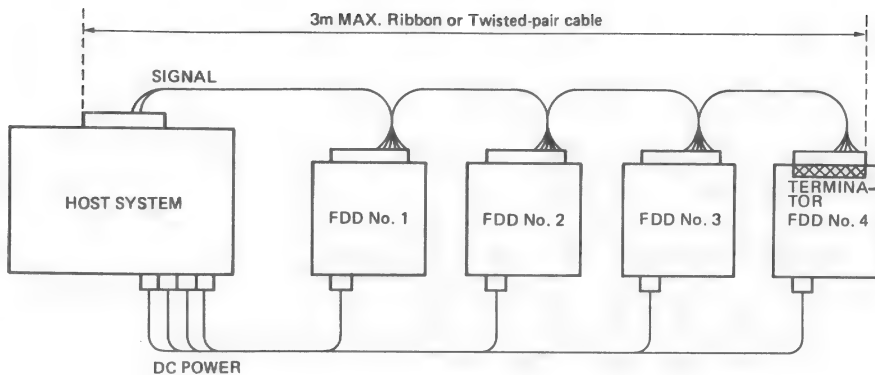


Fig. 3-1 Cabling Method (Sketch)

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.

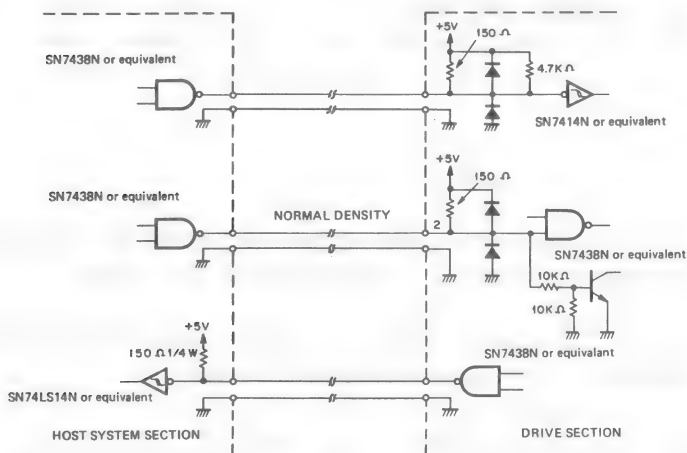


Fig. 3-2 Recommended Line Driver and Line Receiver Circuits

3.1.3 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 A6 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 D6 of PCB)

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) Head loading conditions selections HS, HM, HC, HL, (location J1 of PCB), & J2.

2.1) HS

In the case HS is short-circuited, the head will be loaded by DRIVE SELECT 0 - 3.

2.2) HM

In the case HM is short-circuited, the head will be loaded by the MOTOR ON signal.

2.3) HC

In the case Hc is short-circuited, the head will always be loaded regardless of the interface input signal.

2.4) HL

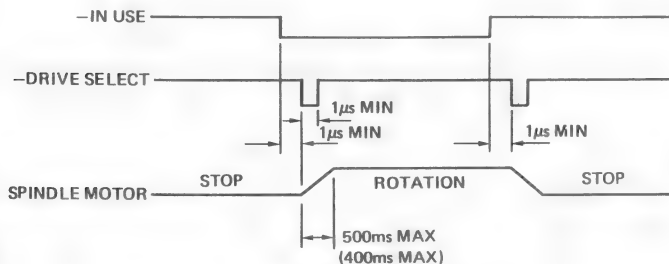
In the case HL is short-circuited, the IN USE input signal (Pin 4 of connector J1/P1) and the DRIVE SELECT signal of the head will be loaded a logical "0". The logical product for all of the conditions for the above is taken by the HOLD READY conditions listed later on and the head code will be controlled. HS is short-circuited at the factory before delivery.

- (3) Spindle MOTOR ON conditions selection MM, MS (location H1 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	3.1	Before delivery
short	open	3.2	
open	open	3.3	
short	short	3.4	

- 3.1) Power of the spindle motor is controlled by the MOTOR ON signal.
- 3.2) Power of the spindle motor is controlled by the drive select conditions that have been selected by DRIVE SELECT 0-3 signal.
- 3.3) Power of the spindle motor is controlled by the logic sum of the DRIVE SELECT 0-3 signals and MOTOR ON signal.
- 3.4) 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)

- (4) Ready transmission selection conditions DC, 2S
(location H1 of PCB) RR (location D1 of PCB)

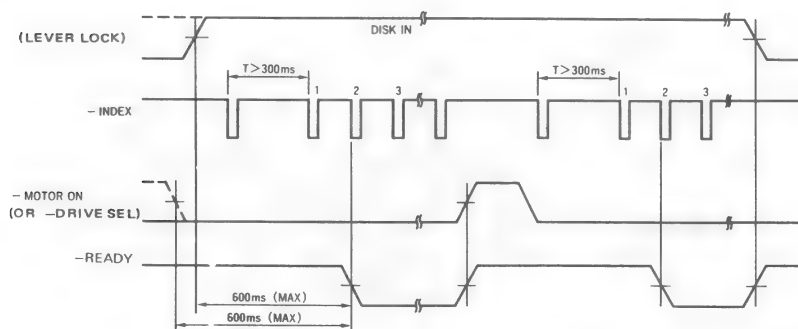
The ready transmission conditions below can be selected with the combination of opening and short-circuiting of DC and 2S.

Short plug		Refer to	Notes
DC	2S		
open	open	4.1	
open	short	4.2	
short	short	4.3	
short	open	4.4	Before delivery

4.1) Standard READY

With the standard READY signal, after detection for a disk rotation period of less than 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.



Standard READY timing

4.2) 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.

4.3) 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.

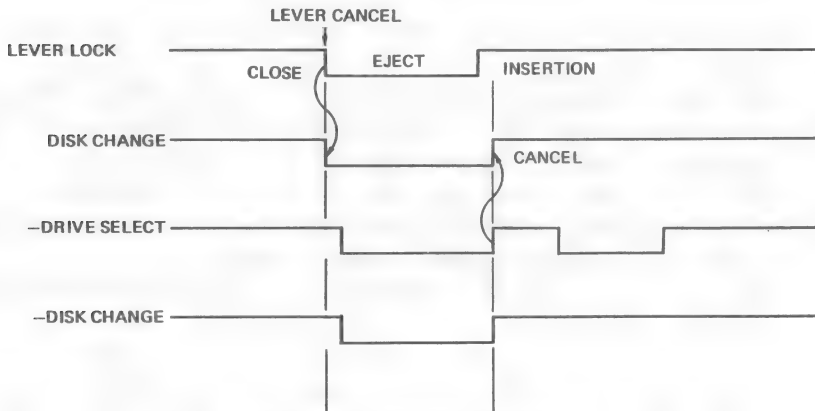


Fig. 6 Disk Change Timing

4.4) Diskette change

This signal becomes 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.

4.5) 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 out-putted regardlessly.

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

- (5) Head unloading conditions selection UD (location b1 of PCB). In the case UD is open, maintain the head loading mode until the disk rotates 3 to 4 times after the head loading signal becomes inactive. In the case UD is short-circuited, perform the head load operation that is synchronized with the head loading signals. UD is opened at the factory before delivery.
- (6) Panel indicator LED lighting conditions selection IU (location H1 of PCB) J3; IH (location E1 of PCB) J5; IR, IS, IL (location D1 of PCB) J6, J8, J9. Shown in Table 9.
- (7) Normal density condition selection SS (D1 on the PCB) J11; SB (G1 on the 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 circuitry 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 5	J 6	J 8	J 9	LED lighting conditions
I U Note 1	1 I H 2 Note 2	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 is active. 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 4) †This setting will be done at the factory before delivery.
I U	1 I H 2	I R	I S	I L	The READY conditions will be cancelled from the above lighting conditions.
I U	1 I H 2	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 delayed when IR is open. (The same is with the following.)
I U	1 I H 2	I R or I R	I S	I L	The LED will light with the logic sum of the DRIVE SELECT and IN USE signals.
I U	1 I H 2	I R or I R	I S	I L	The LED will light with the IN USE signal.
I U	1 I H 2	I R or I R	I S	I L Note 3	The LED will light with the DRIVE SELECT signal.
-	1 I H 2	-	-	-	The LED will light at head loading mode.
I U	1 I H 2	-	I S	-	The LED will not light.

- Note 1. The enclosed names are those shorted by jumper plugs. Those not enclosed are open.
2.

1 I H 2

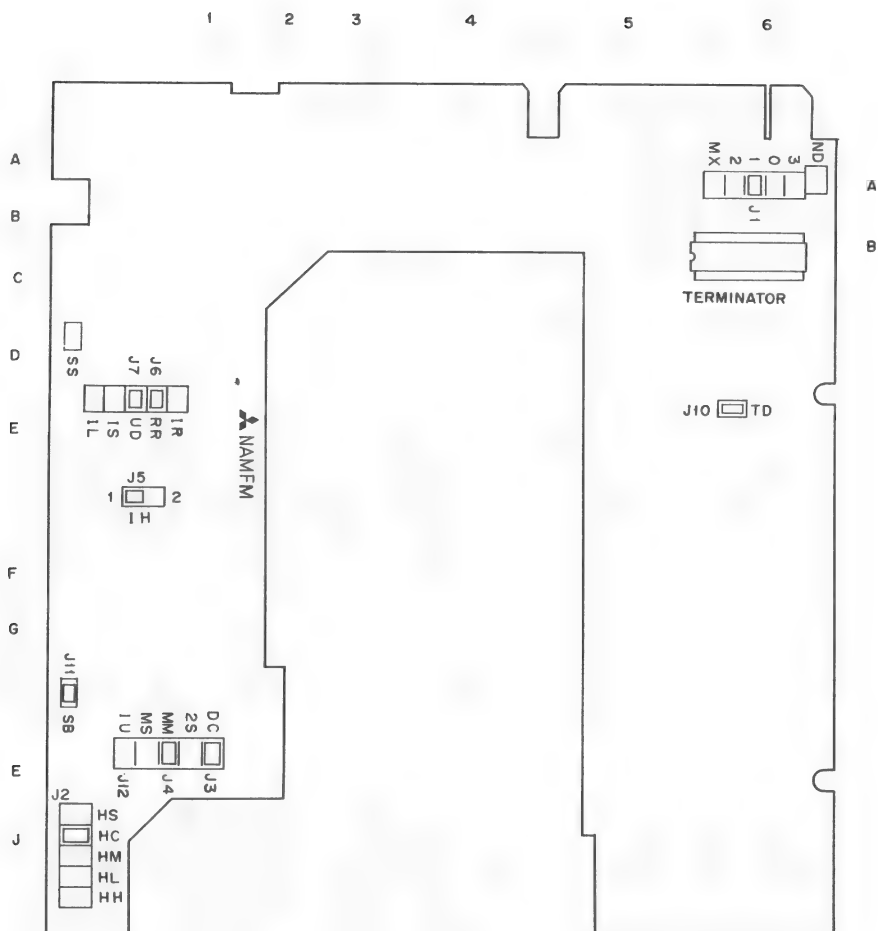
 indicates that side 1 is shorted by the insertion of a plug.

1 I H 2

 indicates that side 2 is shorted.
3. - indicates that the lighting conditions will not change whether open or short-circuited.
4. 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
Slection of drive select	☐ DS0	Drive select 0		J1
	☐ 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 head loading conditions	☐ HS	Head loading by the DRIVE SELECT signal		J2
	☐ HM	Head loading by the MOTOR ON signal		
	☐ HC	Normal head loading		
	☐ HL	Head loading by the IN USE signal		
	☐ HH	(not used)		
Selection of MOTOR ON conditions	☐ MM ☐ MS	Motor started by the MOTOR ON signal		J4
	☐ MM ☐ MS	Motor started by the DRIVE SELECT signal		J3
	☐ 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		
Selection of the signal transmitted from pin 34 of the interface (Connector P1)	DC ☐ 2S	STANDARD READY is sent		—
	DC ☐ 2S	HOLE READY is sent		
	DC ☐ 2S	DISK CHANGE is sent		
	DC ☐ 2S	(not used)		
Gate selection for the above transmission signal	☐ RR	Gated by DRIVE SELECT signal		J7
	RR	Transmitted as is		
Head unload condition 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/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 drive to be made active, corresponding to each of the DRIVE SELECT lines, and specify which of the drives is active.

* DS1 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 μ s before execution.

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

*1: The interval is 1000 μ s 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 μ s before the trailing edge of the step pulse.

(5) WRITE GATE

When this interface line goes to logical "0", the write drive 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 data logic is enabled. However, the protected read data is

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

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

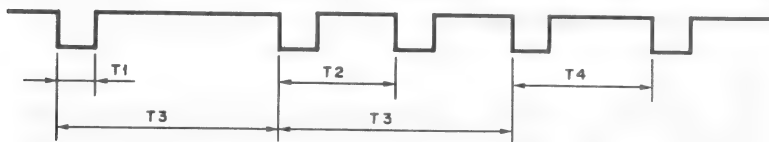
(6) WRITE DATA

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 μ s when normal density at 300 rpm is specified.)



	MFM			
	FM			T4
	T1	T2	T3	
High density, 360 rpm	150 to 1100ns	$2.00\mu\text{s} \pm 10\text{ns}$	$4.00\mu\text{s} \pm 20\text{ns}$	$3.00\mu\text{s} \pm 15\text{ns}$
Normal densiti, 300 rpm	150 to 2100ns	$4.00\mu\text{s} \pm 20\text{ns}$	$8.00\mu\text{s} \pm 40\text{ns}$	$6.00\mu\text{s} \pm 30\text{ns}$
Normal density, 360 rpm	150 to 1800ns	$3.33\mu\text{s} \pm 17\text{ns}$	$6.67\mu\text{s} \pm 33\text{ns}$	$5.00\mu\text{s} \pm 25\text{ns}$

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 ms 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 while 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.

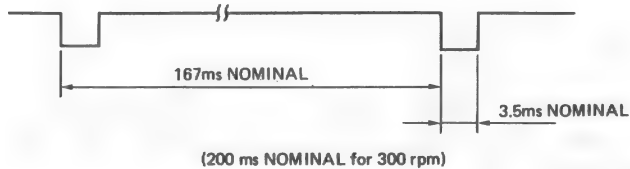


Fig. 3-4 Index Timing

(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.

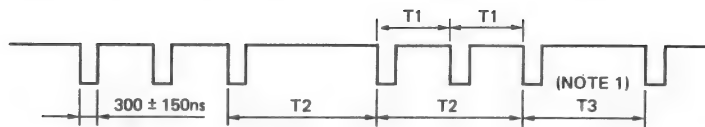
(3) READY

This interface line is logical "1" when the lever is cancelled. The line goes logical "0" (ready) if an index pulse 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		T3
	T1	T2	
High density, 360 rpm	$2.00\mu\text{s} \pm 400\text{ns}$	$4.00\mu\text{s} \pm 800\text{ns}$	$3.00\mu\text{s} \pm 600\text{ns}$
Normal density, 300 rpm	$4.00\mu\text{s} \pm 800\text{ns}$	$8.00\mu\text{s} \pm 1600\text{ns}$	$6.00\mu\text{s} \pm 1200\text{ns}$
Normal density, 360 rpm	$3.33\mu\text{s} \pm 667\text{ns}$	$6.67\mu\text{s} \pm 1333\text{ns}$	$5.00\mu\text{s} \pm 1000\text{ns}$

Note : Jitter caused by change in 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 ($\pm 5\%$)	0.7 A maximum 0.5 A typical	50 mV
+12 V DC	± 0.6 V ($\pm 5\%$)	1.3 A MAX (Spindle motor operating) 0.5 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 Fig. 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 Fig. 3-3 and 4-1.

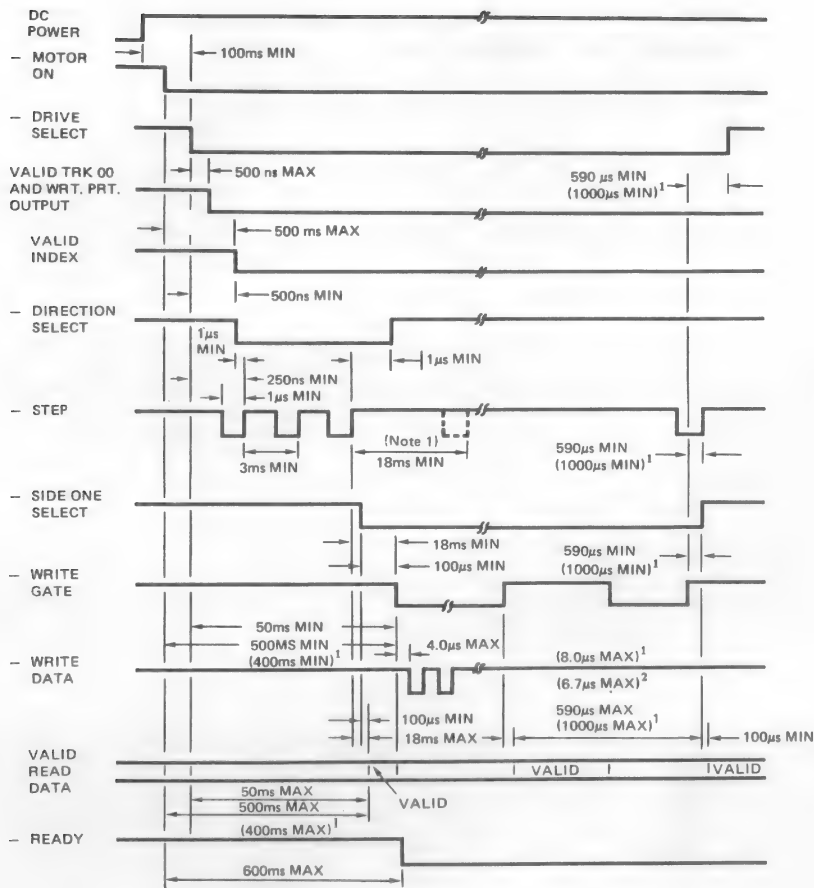
These timing specifications must be strictly observed to ensure an accurate write operation.

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 bit 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.

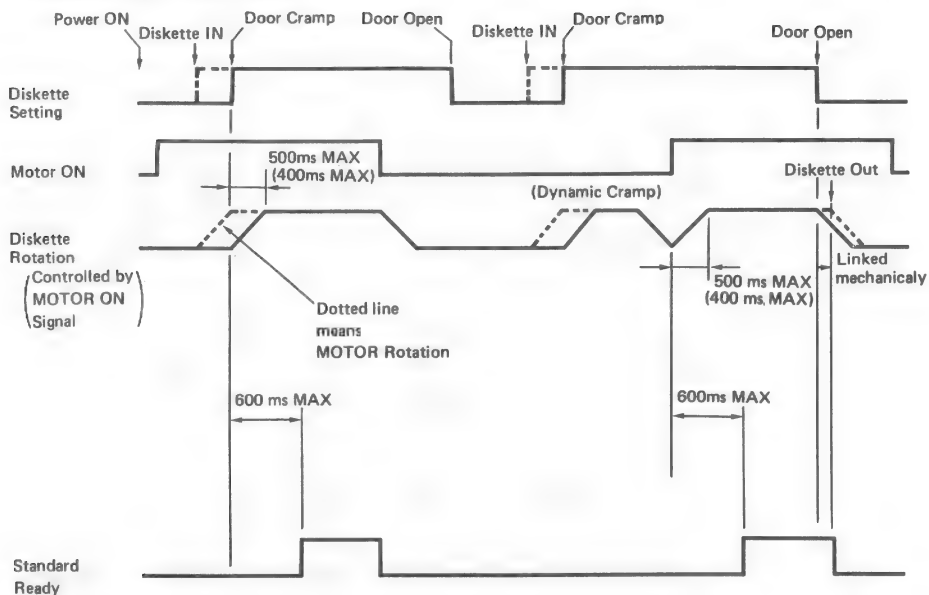


Note 1: When reversing direction, issue a next step pulse after more than 18 ms from the step pulse before inversion.

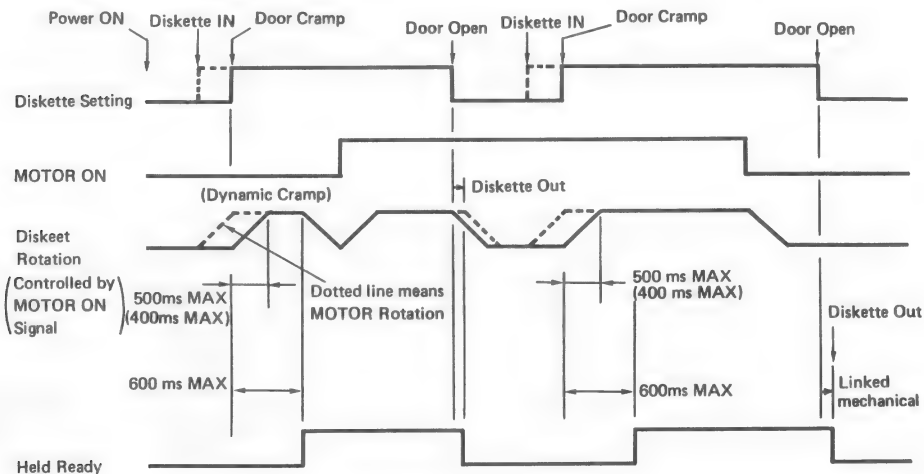
Note 2: The figures in bracketa (¹) are for when the unit is specified for normal density at 300 rpm.
The figures in brackets (²) are for when the unit is specified for normal density at 360 rpm.

Fig. 4-1 Control and Data Timing

(1) Standard Ready, Dynamic Cramp



(2) Held Ready, Dynamic Cramp



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

Fig. 4-2 Ready and Dynamic Cramp Timing.

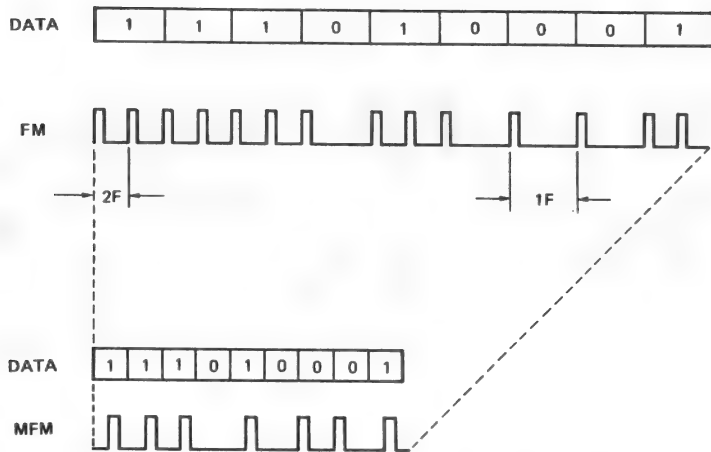


Fig. 4-3 Comparison of FM and MFM Encoding Systems

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.

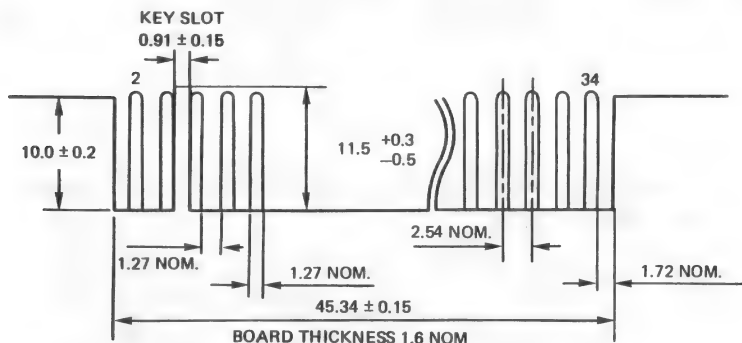


Fig. 5-1 Connector J1 Dimensions (mm) and Pin Numbers

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

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 (Pl)

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 AMP, 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	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 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.

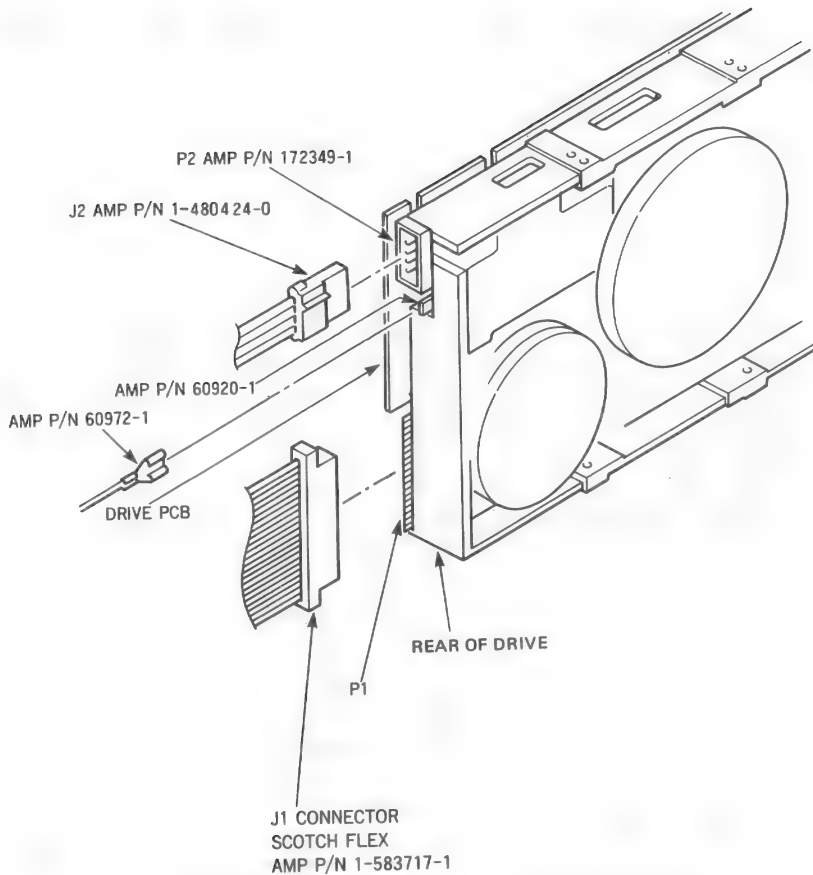


Fig. 5-3 Location of Interface Connectors

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.

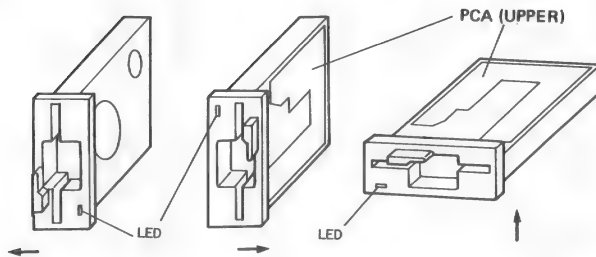


Fig. 6-1 Disk Drive Installation Directions

6.2 Dimensions of disk drive

See Fig. 6-2.

6.3 Dimensions of Front Panel

See Fig. 6-3.

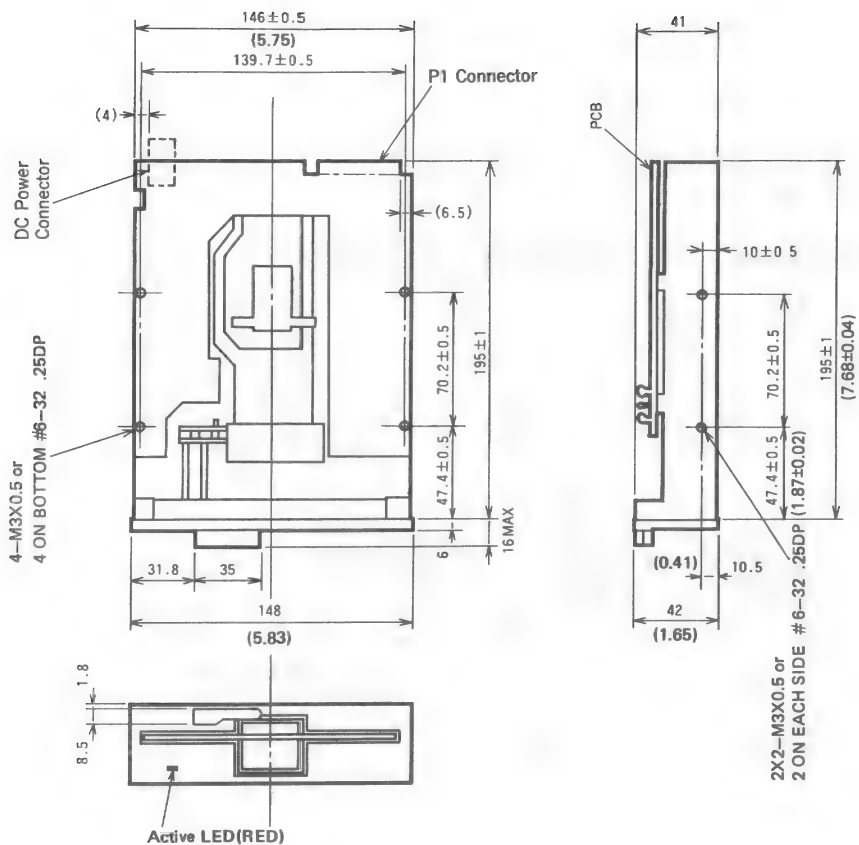


Fig. 6-2 Disk Drive Dimensions

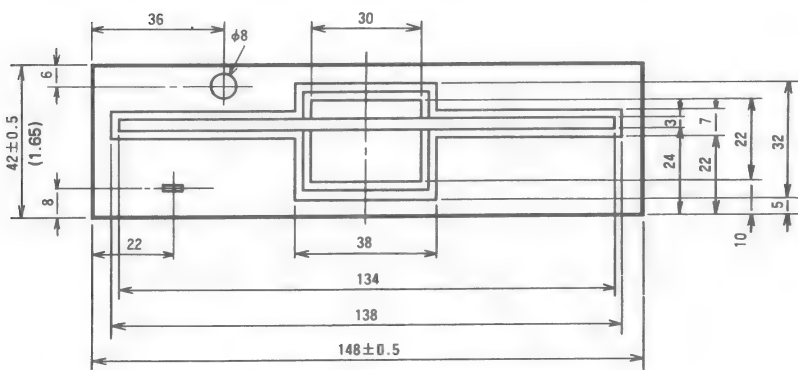


Fig. 6-3 Front Panel Dimensions

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:

- 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 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 damaged diskette surface.

- o Random electrical noise ranging in time from a few microseconds to a few milliseconds can also cause read errors. 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.
- 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 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 *1
Data Transfer Rate of MFM(FM)	500(250) Kbits/s only	250(125)Kbits/s, 300(150)Kbits/s selectable	50(125)Kbits/s, 300(150)Kbits/s selectable

*1 () indicates unformatted capacity.

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

```
*****
*
*
*      1.2 Meg. Floppy Disk Drive
*
*      Section 5
*
*      Parts list
*
*****
```

November 15, 1985

Disk Drive Subassembly

Item	Quan	Description	Part No.
1	1	Floppy Disk Drive	AXX-5106
2	1	Support, Disk Drive	
3	4	Grommet	AHC-0189
4	4	Screw, Shoulder	AHD-2751
5	1	Cable, Load (Floppy Drive Only)	
6	2	Heatshrink, 1 Inch	
7	1	Resistor, 20 Ohm 25W 1%	N-0077BWC
8	2	Screw, #6-32 x 5/16 PPHD HP Thread Form W/T.S.S	AHD-2746

Ejector Assembly
(Non-Repairable)

=====			
Item	Quan	Description	Part No.
=====			
1	1	Holder, Ejector A	
2	1	Ejector	
3	1	Shaft, Ejector	
4	1	Spring, Coil	
5	1	Switch (Micro-size)	
6	1	Screw, Pan HD., Washered	

Lever Assembly
(Non-Repairable)

=====			=====
Item	Quan	Description	Part No.
=====			=====
1	1	Lever	
2	1	Lever Holder	

Add In Floppy Disk Drive Kit

Item	Quan	Description	Part No.
1	1	Disk Drive	AXX-5106
2	4	Grommet	AHC-0189
3	4	Screw, Thumb	8569281

Front Panel Assembly
(Non-Repairable)

=====			
Item	Quan	Description	Part No.
=====			
1	1	Front Panel	
2	1	Indicator	

Chassis Front Assembly
(Non-Repairable)

Item	Quan	Description	Part No.
1	1	Chassis Front	
2	2	Washer	
3	1	Ring, E	
4	1	Washer	
5	1	Washer	
6	2	Ring, E	
7	1	Holder	
8	1	Spring, W	
9	1	Holder	
10	1	Shaft A	
11	1	Link B	
12	1	Pin A	
13	1	Ring	
14	1	Shaft	
15	1	Link A	
16	1	Pin B	

Collet Assembly
(Non-Repairable)

=====			
Item	Quan	Description	Part No.
=====			
1	1	Collet A	
2	1	Collet B	
3	1	Spring, Coil, B	
4	1	Shaft	
5	1	Bearing	
6	1	Ring, E	
7	1	Washer, Metal	

Bridge A Assembly
(Non-Repairable)

=====			=====		
Item	Quan	Description			Part No.
=====					
1	1	Stopper, Ejector			
2	2	Spacer A, Cartridge Guide			
3	1	Cushion Mold			
4	1	Cartridge Guide A			
5	1	Spring, Cartridge Guide			
6	2	Screw, Pan HD., Washered			

Carriage Assembly
(Non-Repairable)

Item	Quan	Description	Part No.
1	1	Carriage	
2	1	Arm	
3	1	Sub Frame	
4	1	Stay Spring	
5	1	Head Gimbals, S0	
6	1	Head Gimbals, S1	
7	2	Shield Plate	
8	1	Spring Coil	
9	1	Head Cable Assy	
10	1	Spring, P	
11	2	Rubber	
12	1	Rubber	
13	1	Holder, Arm	
14	1	Holder, Band C	
15	2	Screw Pan HD., Washered	
16	1	Bolt, Socket (Micro-size)	
17	3	Screw Tap-Tight	
18	1	Spacer	
19	1	Cover, Head S1	
20	1	Nut	
21	1	Cover, Head S0	
22	1	Washer	

Mechanism Assembly

Item	Quan	Description	Part No.
1	1	Carriage Assy	AZ-0073
2	1	Frame	AS-9098
3	1	Solenoid HLMG	ACS-0016
4	1	TK00 Sensor Assy	AM-4025
5	1	Spindle Motor Assy	AM-4016
6	1	Stepping Motor	ART-0188
7	1	Idler, Sub Assy	ART-0133
8	1	Holder, Idler C	ART-0134
9	1	Band A	ARB-6224
10	1	Spring, Coil, C	ART-0180
11	1	Holder, Band A	ART-0136
12	1	Holder, Band B	AHC-0159
13	2	Guide Rod	ARB-6226
14	2	Spring Coil	
15	1	Terminal	
16	1	Washer Plain	AHD-8020
17	12	Screw, M3X0.5X8 Pan HD., Washered.	AHD-2888
18	1	Screw, M2.5X4 Pan HD.	AHD-2886
19	3	Screw, Flat	
20	4	Screw, M3X0.5X8 Pan HD., Washered.	AHD-2888
21	1	Screw, M3X0.5X10 Pan HD., Washered	AHD-2896
22	2	Clamp	AHC-0115
23	2	Screw, Bind	
24	2	Washer, Plain	AHD-8021
25	1	Stopper Capstan	AHC-0158
26	1	Bolt, Socket (Micro-size)	
27	1	Bridge A Assy.	ART-0181
28	1	Colllet Assy	ART-0139
29	1	Spring, Leaf	ARB-5038
30	1	Ring, E	
31	3	Screw, M3X0.5X6 Pan HD., Washered	AHD-2885
32	1	Ejector Assy.	ART-0140
33	1	Front Panel Assy.	AZ-0083
34	1	Chassis Front Assy.	AZ-0075
35	1	Lever Assy.	ART-0182
36	1	PCB, NAMFM	

Tandy 3000 High Density Drive

Spindle Motor Assembly

Item	Quan	Description	Part No.
1	1	IC, M51720P Digital	MX-6360
2	1	IC, M51721L Linear	MX-6361
3	2	Pot 30K Ohm, Volume +20% 0.2W	AP-7010
4	1	Resistor, Carbon, 47K Ohm 1/6W +5%	N-0340ECC
5	1	Resistor, Carbon, 91K Ohm 1/4W +3%	N-0366DEC
6	1	Resistor, Carbon, 2.2K Ohm 1/4W +5%	N-0216EEC
7	1	Resistor, Carbon, 2.7K Ohm 1/6W +5%	N-0224ECC
8	1	Resistor, Carbon, 10K Ohm 1/6W +5%	N-0281ECC
9	1	Resistor, Carbon, 3.3K Ohm 1/6W +5%	N-0230ECC
10	1	Resistor, Carbon, 33K Ohm 1/4W +5%	N-0324EEC
11	1	Resistor, Carbon, 47K Ohm 1/6W +5%	(ABOVE)
12	1	Resistor, Carbon, 24K Ohm 1/6W +5%	N-0526ECC
13	1	Resistor, Carbon, 5.1M Ohm 1/6W +5%	N-0603ECC
14	1	Resistor, Carbon, 47K Ohm 1/6W +5%	(ABOVE)
15	5	Resistor, Carbon, 330 Ohm 1/4W +5%	N-0159EEC
16	1	Resistor, Carbon, 22K Ohm 1/6W +5%	N-0311ECC
17	1	Resistor, Metal, 1.8K Ohm 1/2W +5%	N-0210EFE
18	1	Resistor, Carbon, 470 Ohm 1/2W +5%	N-0169EFC
19	1	Resistor, Metal, 510 Ohm 1/2W +5%	N-0172BFE
20	2	Resistor, Carbon, 47 Ohm 1/4W +5%	N-0099EEC
21	1	Resistor, Metal, 0.75 Ohm 1W +5%	N-0637EGD
22	2	Capacitor, Rutiloon, 1000pF +20% 25V	(CF-1194)
23	2	Capacitor, Elec., 1uF +20% 50V	CC-F105MJNP
24	1	Capacitor, Poly, 0.056uF +5% 100V	CC-563JLGP
25	1	Capacitor, Poly, 0.047uF +5% 50V	CC-473JJGP
26	1	Capacitor, Elec., 0.15uF +20% 50V	CC-154MJGP
27	1	Capacitor, Elec., 0.47uF +20% 50V	CC-474MJNP
28	2	Capacitor, Elec., 2.2uF +20% 50V	CC-225MJAP
29	1	Capacitor, Elec., 33uF +20% 16V	CC-336MDNP
30	1	Capacitor, Elec., 0.1uF +20% 50V	CC-104MJNP
31	1	Diode, IS-1588	DX-0273
32	1	LED, GL-5AR2	AL-1005
33	1	LED, EL-1KL3	AL-1006
34	1	LED, EL-1CL3	AL-1007
35	2	Holl Element, H300A	MX-0087
36	1	Transistor, 2SA1115	2SA1115
37	1	Transistor, 2SC3402	2SC3402
38	1	Transistor, 2SA1348	2SA1348

PCB, NAMFM

Item	Quan	Description	Part No.
1	1	PWB, NAMFM	
2	1	Terminal	
3	4	Connector, male 3 pins	AJ-1072
4	1	Connector, male 4 pins	AJ-7585
5	1	Ornament	
6	1	Connector, male 14 pins	AJ-1073
7	3	Connector, male 10 pins	AJ-1074
8	11	Connector, female 2 pins	AJ-7588
9	1	Connector, male 4 pins	AJ-1075
10	1	Connector, male 10 pins	AJ-1076
11	3	Connector, male 2 pins	AJ-7592
12	1	Connector, male 3 pins	AJ-7584
13	1	Connector, male 2 pins	AJ-1085
14	1	Connector, male 5 pins	AJ-1086
15	1	Index Sensor U Assy	ACS-0018
16	1	Write Protect Sensor	ACS-0017
17	1	Holder, Write Protect Sensor	ART-0141
18	1	Bolt, Socket (FE)	AHD-5001
19	1	Socket, IC	AJ-1057
20	2	IC, M53238P Digital (D6)	MX-6364
21	1	IC, Digital (G1)	MX-5699
22	2	IC, M54542L Linear	MX-6365
23	1	IC, MC2870P Linear	MX-6892
24	1	IC, UPA20033C Linear	MX-6844
25	1	IC, Digital (G1) (Alternate)	
26	1	IC, Linear (G6) (Alternate)	
27	3	Capacitor, Ceramic, 0.01uF +10% 50V	CC-103KJCP
28	9	Capacitor, Ceramic, 1.5uF -20+80% 25V	(CC-155ZFCP)
29	2	Capacitor, Ceramic, 0.022uF +10% 50V	(CC-223KJCP)
30	2	Capacitor, Ceramic, 150pF +5% 50V	CC-151JJCP
31	1	Capacitor, Ceramic, 470pF +5% 50V	CC-471JJCP
32	1	Capacitor, Ceramic, 6800pF +10% 50V	CC-682KJCP
33	1	Capacitor, Ceramic, 3300pF +10% 50V	CC-332KJCP
34	1	Capacitor, Ceramic, 33pF +5% 50V	CC-330JJCP
35	1	Capacitor, Ceramic, 1500pF +10% 50V	CC-152KJCP
36	1	Capacitor, Ceramic, 680pF +10% 50V	CC-681KJCP
37	1	Capacitor, Ceramic, 330pF +10% 50V	WRONG # ?
38	1	Capacitor, Elec., 100uF +20% 16V	CC-107MDAP
39	1	Capacitor, Ceramic, 0.22uF +10% 50V	(CC-224KJCP)

PCB, NAMFM (con't)

Item	Quan	Description	Part No.
40	1	Resistor, Carbon, 10K Ohm +5% 1/6W	(N-0281ECC)
41	1	Resistor, Carbon, 3.3K Ohm +5% 1/6W	(N-0230ECC)
42	4	Resistor, Carbon, 4.7K Ohm +5% 1/6W	N-0247ECC
43	1	Resistor, Carbon, 1M Ohm +5% 1/6W	N-0445ECC
44	2	Resistor, Metal, 470 Ohm +2% 1/4W	N-0169CED
45	1	Resistor, Metal, 47K Ohm +2% 1/4W	N-0340CEE
46	2	Resistor, Carbon, 47 Ohm +5% 1/6W	N-0099ECC
47	2	Resistor, Carbon, 1.8K Ohm +5% 1/6W	N-0210ECC
48	1	Resistor, Metal, 150 Ohm +1% 1/4W	N-0142BED
49	1	Resistor, Carbon, 100K Ohm +5% 1/6W	N-0371ECC
50	2	Resistor, Carbon, 27K Ohm +5% 1/6W	N-0316ECC
51	1	Resistor, Carbon, 470K Ohm +5% 1/6W	N-0423ECC
52	1	Resistor, Carbon, 39 Ohm +5% 1/6W	N-0092ECC
53	1	Resistor, Carbon, 6.8K Ohm +5% 1/6W	N-0262ECC
54	1	Resistor, Carbon, 22K Ohm +5% 1/6W	(N-0311ECC)
55	2	Resistor, Carbon, 12K Ohm +5% 1/6W	N-0288ECC
56	1	Resistor, Carbon, 270 Ohm +5% 1/2W	N-0155EFC
57	1	Resistor, Carbon, 8.2K Ohm +5% 1/6W	N-0271ECC
58	1	Resistor, Metal, 27K Ohm +5% 1/4W	N-0316CED
59	3	Resistor, Carbon, 1.5K Ohm +5% 1/6W	N-0206ECC
60	3	Resistor, Carbon, 2.7K Ohm +5% 1/6W	(N-0244ECC)
61	1	Resistor, Metal, 10K Ohm +2% 1/4W	N-0281CED
62	2	Resistor, Carbon, 82K Ohm +5% 1/6W	N-0360ECC
63	1	Pot 50K Ohm Volume	AP-7389
64	2	Resistor, Carbon, 47K Ohm +5% 1/6W	(N-0340ECC)
65	2	Resistor, Carbon, 560 Ohm +5% 1/2W	N-0176EFC
66	1	Resistor, Metal, 1.5K Ohm +1% 1/4W	N-0206BED
67	1	Resistor, Carbon, 150 Ohm +5% 1/6W	M-0142ECC
68	1	Resistor, Carbon, 56 Ohm +5% 1/2W	N-0107EFC
69	1	Resistor, Metal, 150 Ohm x8 +5% 125mw	ARX-0040
70	4	Resistor, Metal, 4.7K Ohm x6 +5% 125mw	ARX-0041
71	1	Resistor, Carbon, 1.2K Ohm +5% 1/6W	N-0199ECC
72	2	Diode, 1S-953	DX-0762
73	2	Diode, 1SR35-100A-T	DX-0583
74	1	Ceramic, 400 KHZ	ACA-9001
75	2	Inductor, 330uH +5%	ACA-1018
76	1	Inductor, 100uH +10%	ACA-1017
77	2	Transistor	2SA-952
78	1	Transistor	2SK-68A
79	5	Transistor, DTC-114	MX-5700
80	3	Transistor	2SC-2603

```
*****
*
*      1.2 Meg. Floppy Disk Drive      *
*
*              Section 6                *
*
*              Jumper Settings          *
*
*****
```

1.2 Meg Disk Drive Servo/Logic Board Jumper Settings

If the drive is a Mitsubishi Model MF504A-3 be sure that DC, MM, DS1, RR, SB and TD on the drive servo/logic board are jumpered.

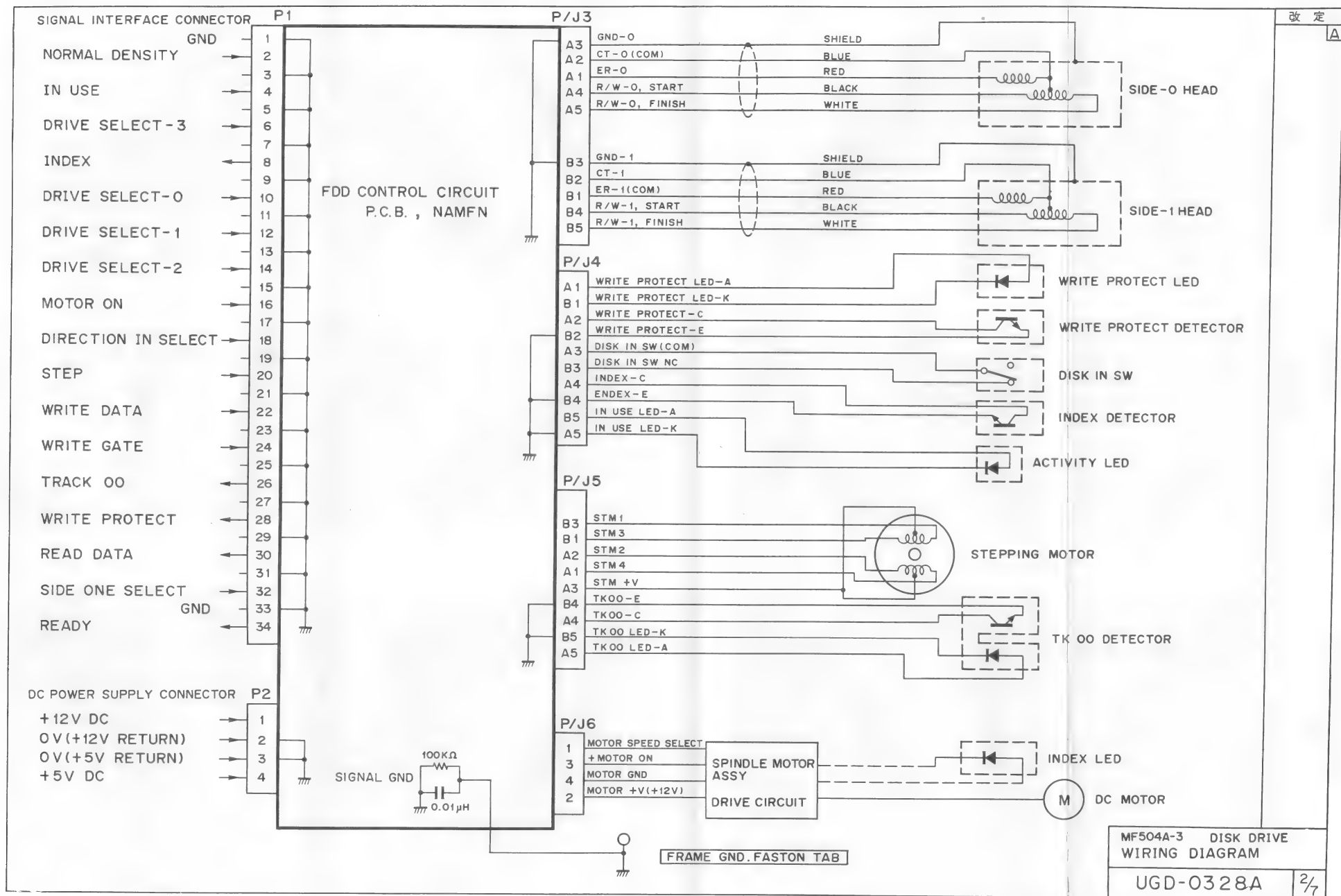
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* 1.2 Meg. Floppy Disk Drive *
*
* Section 7 *
*
* Schematics and Component Layout *
*

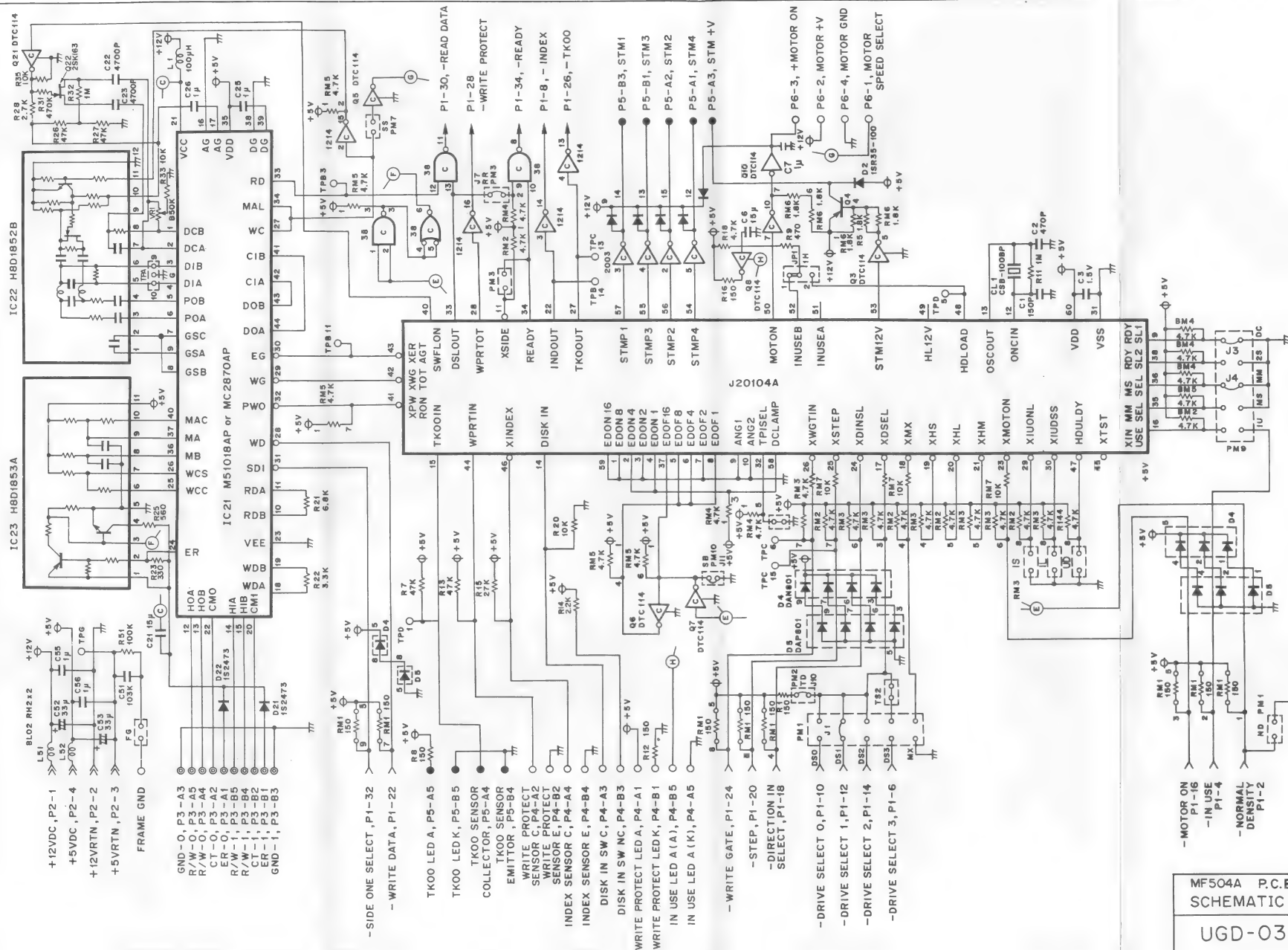
DISK DRIVE SCHEMATICS AND LOGIC MANUAL

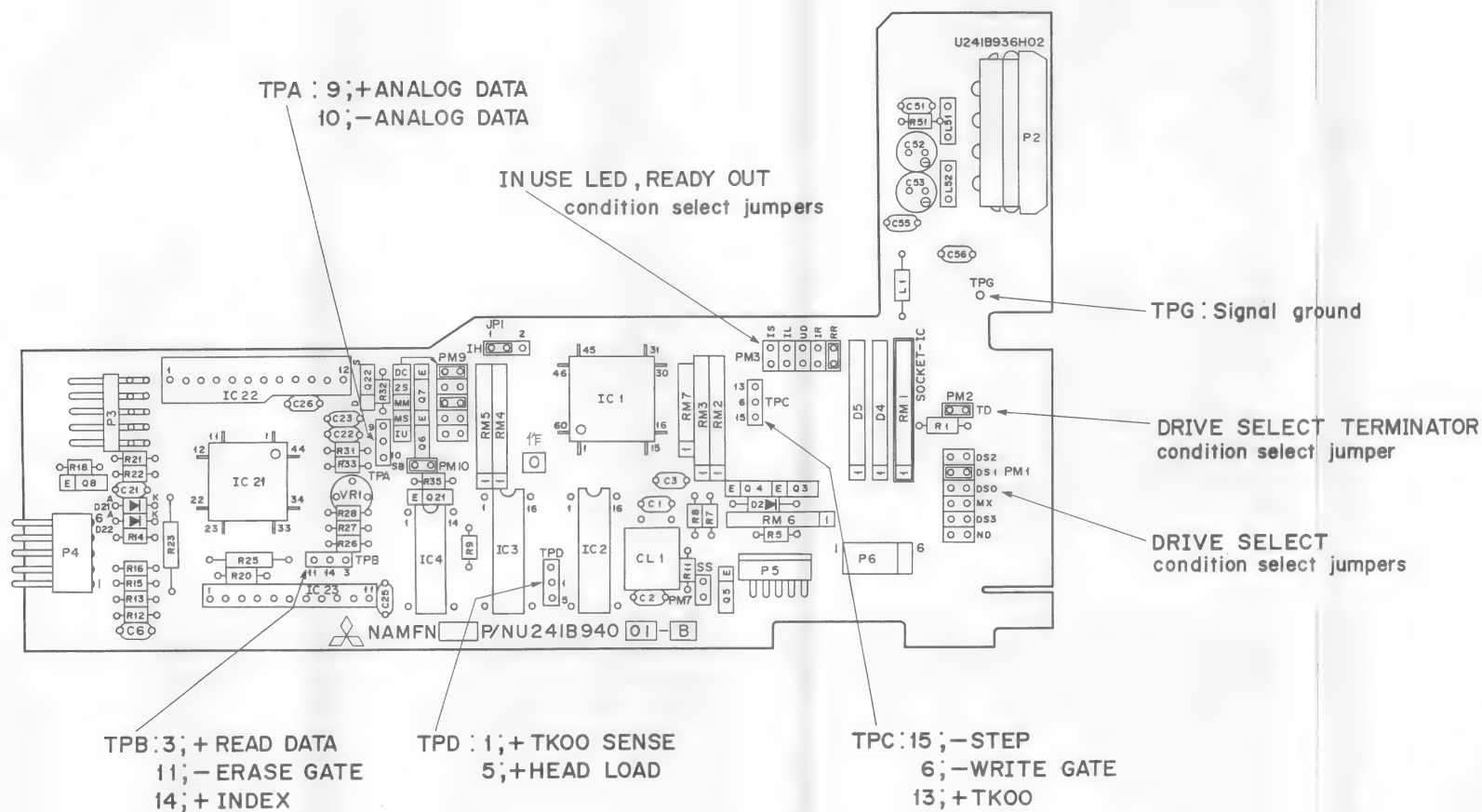
MF504A-347UA

<u>Sheet Title</u>	<u>Page</u>	<u>Revision</u>
MF504A-3 DISK DRIVE WIRING DIAGRAM	2/7	 A
MF504A-3 PCB NAMFN SCHEMATIC	3/7	 A
MF504A-3 PCB NAMFN PARTS LOCATION DIAGRAM	4/7 5/7	 A
MF504A-3 SPINDLE MOTOR ASSY SCHEMATIC	6/7 7/7	 A

(NAME : F2SMR05 or BDR-5BAB-GU3-DS)







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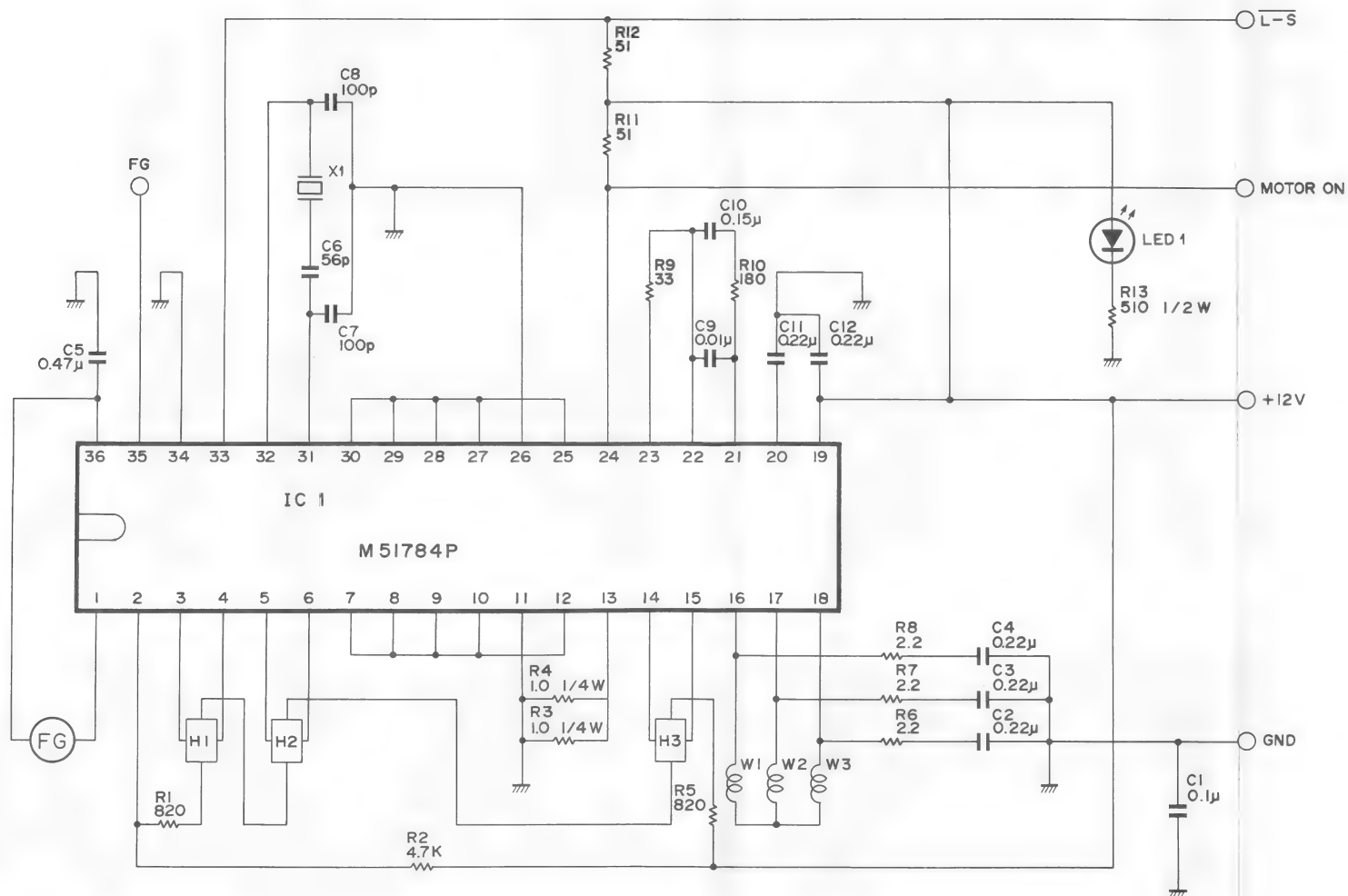
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MF504A P.C.B NAMFN
PAPTS LOCATION DIAGRAM

UGD-0328A

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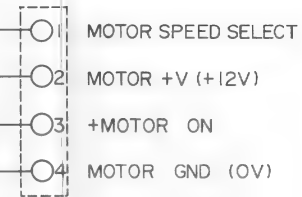


NAME
F2MSR05

MF504A SPINDLE MOTOR
ASSY SCHEMATICS

UGD-0328A

6/7



MF504A SPINDLE MOTOR
ASSY SCHEMATICS

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*
* 1.2 Meg. Floppy Disk Drive *
* *
* Section 8 *
* *
* Maintenance Manual *
*

UGD-0343A

**5.25 INCH FLEXIBLE DISK DRIVE
MAINTENANCE MANUAL
MF504A-3**

 **MITSUBISHI ELECTRIC CORPORATION**

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2. Related diagrams and references	2
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1. Introduction

This manual deals with the handling, maintenance, and adjustment of the MF504A-3 flexible disk unit.

2. Related diagrams and references

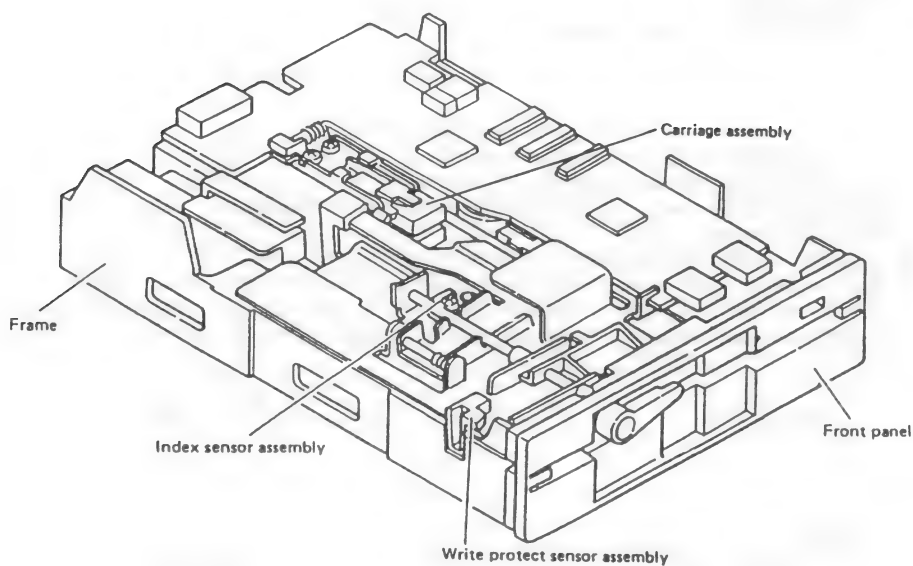
Standard specifications of MF-504A-3

Electrical diagram for maintenance of MF504A-3

Illustrated parts list

Packing instructions

3. Names of parts



4. Handling

4.1 Operating environment

No problems are likely occur when this unit is used under normal conditions. However damage to the unit or to disk is liable to occur if the unit is used under normal conditions outside the following:

- | | | |
|-------------------------------|--|---------------------------------|
| (1) Temperature and Humidity: | When in use | When not in use |
| Temperature range: | 5°C ~ 43°C | -10°C ~ 50°C |
| Humidity range: | 20% ~ 80% RH (non-condensating)
(Max. wet bulb 29.4%) | 20% ~ 80% RH (non-condensating) |
- (2) Vibration and Shock
When in use: less than 0.3 G (10 ~ 100 Hz)
When not in use: Continuous vibration less than 2 G (10 ~ 100 Hz)
- (3) Dust
Special caution should be taken regarding dust as it damages the magnetic head and recording surface of the disk.
- (4) Temperature drop
Less than 20°C/Hour (when unpacked)

4.2 Handling of disk cartridge (special caution should be taken regarding the following, see Diagram 1)

- (1) Do not place the unit near any device produces a magnetic field.
(For example, radios, TVs, motors, generators etc.)
- (2) Do not bring any magnetized objects near the cartridge.
(For example, rubber magnets, magnets for blackboards, screwdrivers etc.)
- (3) Do not bend the disk.
- (4) Place the disk cartridge into its paper case when it is transported or stored.
- (5) Do not touch the disk cartridge itself. Do not try to clean it with alcohol or similar liquids.
- (6) Do not place it in direct sunlight or in places which have high temperature or high dust levels.
- (7) Do not write anywhere but on the label. Use only a felttipped marker or similar pen.

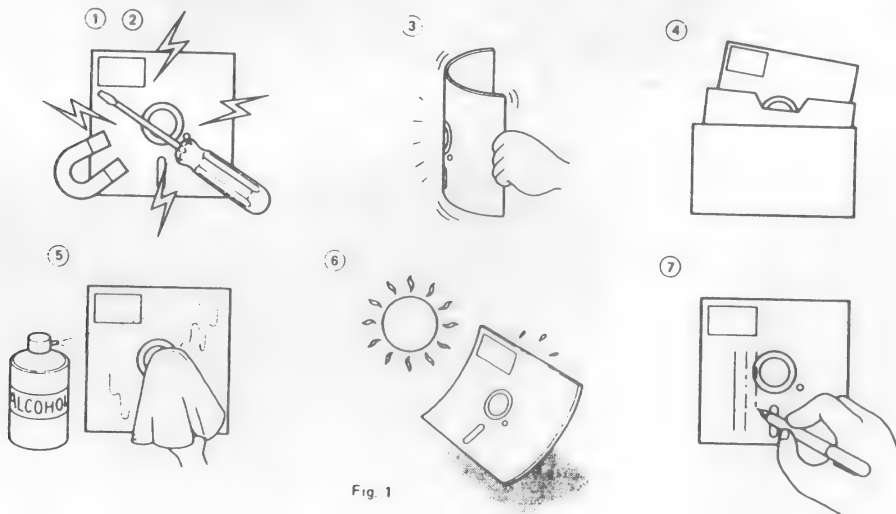


Fig. 1

5. Periodical maintenance

Periodical inspection, maintenance, cleaning, and replacement of worn-out parts is recommended to maintain the correct operation of this unit and to spot trouble quickly.

The time between periodical maintenance is calculated based on a 8 hour/day schedule. Thus, it may have to be adjusted if actual use is different. Based on usage of 8 hours/day under normal conditions, periodical maintenance should be once a year.

5.1 Precautions regarding maintenance

5.1.1 Precaution

- (1) Be sure that dust does not get inside the unit and that the head is not damaged.
- (2) Be sure that the power is off before beginning maintenance.
- (3) The DC power must be off when the connector is inserted or removed from the PC board. This is to prevent damage to the semiconductors.
- (4) Do not touch the surface of the disk or the magnetic head.
- (5) When this unit is used for playback (when CE disks etc. are being used), be careful of operations such as write protection for the protection of recorded data.
- (6) Do not touch or attempt to adjust the steel band.
- (7) Do not force or subject the head carriage assembly to shock of any sort as it was precision adjusted. Do not use screws or nuts other than those specified and do not attempt to re-adjust the assembly.

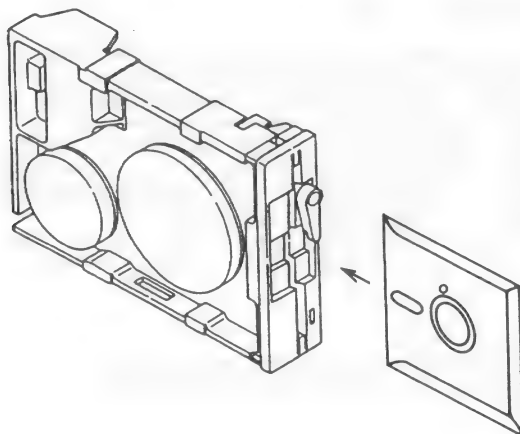
5.1.2 Disks which can be used

- (1) CE diskettes: 502-1D standard diskette made by DYMEK
- (2) Cleaning diskette: CFD-5W made by Nihon Micro Coating

5.2 Head Cleaning

Clean the head as dirt on the head can lead to read errors and damage to the disk. The head is cleaned by the following procedure:

- 1) Equipment
 - CE tester
 - Cleaning diskette



2) Cleaning method

- 2) —1 Connect the CE tester to the unit and turn the power on.
 - 2 Insert the cleaning diskette and start head loading.
 - 3 Remove the cleaning diskette after about 1 minute of cleaning.

3) Precautions

- 3) —1 Match the head to the track of the disk to improve cleaning efficiency.
 - 2 Clean the unit for about 1 minute.
 - 3 The cleaning diskette is good for 1 hour per track. Replace it after the expiration of this period.
 - 4 Do not clean the unit more than once at a single time or more than twice a month. This will prevent the head from being deformed.

5.3 Testing and adjustment

5.3.1 Adjustment of position of TK00 sensor

1) Equipment

CE tester

Blank diskette

Allen wrench (2.5 mm)

Oscilloscope

2) Adjustment

2) -1 Connect the CE tester to the unit, turn the power on and insert the diskette into the unit.

-2 Turn the motor on and start drive select operations.

-3 Perform repeat seeking on tracks 00 ~ 02. (step rate 3 ms)

-4 Monitor the TPC13 waveform (TK00) with the oscilloscope.

Trigger CH1—STEP (DC,—) (TPC15)

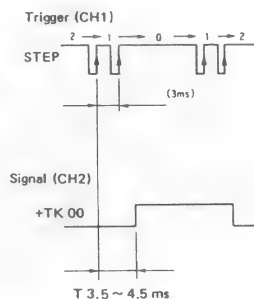
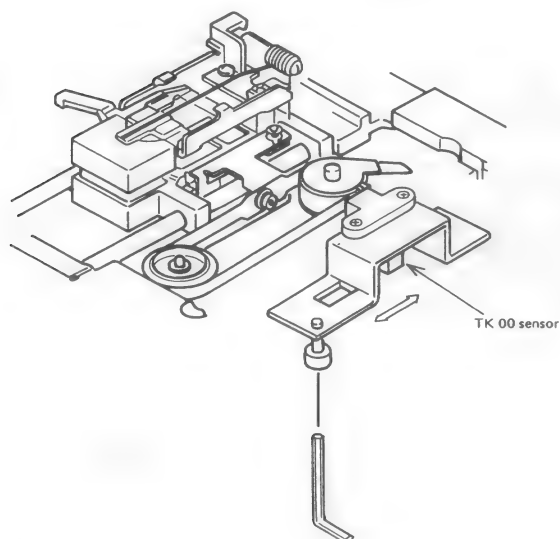
Signal CH2—+TK00 (DC —) (TPC13)

-5 Turn the installation screw until the time of T is 3.5 ~ 4.5 ms. This will move the TK00 sensor in the direction of the arrows for adjustment.

-6 Confirm that there are two STEP signals.

3) Checking

Check that seeking starts from track 00 and stops on track 02. Be sure the voltage of +TK 00 is 0 ~ 0.6V when the unit is stopped on track 02.



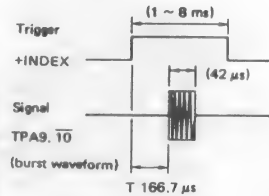
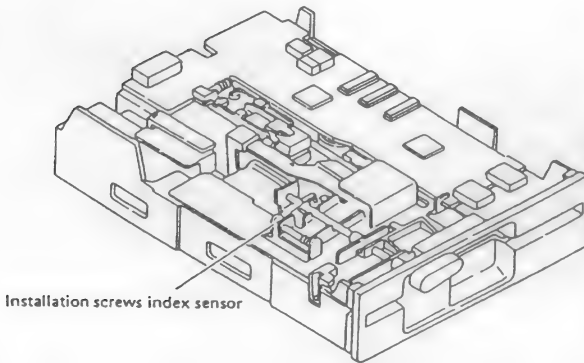
5.3.2 Testing of position of index sensor

- 1) Equipment
 - CE tester
 - CE diskette
 - No. 2 $\oplus$ screw driver
 - Oscilloscope

- 2) Testing

- 2) -1 Connect the CE tester to the unit, turn the power on and insert the diskette into the unit.
- 2 Turn the motor on and start drive select operations.
- 3 Set the unit to the read mode and monitor the TPA9 and TPA10 waveforms of track 02 with the oscilloscope.

Trigger	EXT—+INDEX (DC,+) (TPB14)		
Signal	CH1—output waveform (AC)	(TPA9)	
		ADD	
	CH2—output waveform (AC, INV)	(TPA10)	
Standard	Side 0	Side 1	
Testing	$166.7 \pm 100\mu\text{s}$	$166.7 \pm 150\mu\text{s}$	
Adjustment	$166.7 \pm 50\mu\text{s}$	$166.7 \pm 100\mu\text{s}$	



5.3.3 Adjustment of head alignment

1) Equipment

CE tester
CE diskette
Oscilloscope
Allen wrench (2mm)

2) Adjustment

- 2) -1 Connect the CE tester to the unit, turn the power on and insert the diskette into the unit.
- 2 Turn the motor on and start drive select operations.
- 3 Set the unit to the read mode and monitor the TPA9 and TPA10 waveforms, while the unit goes from track 00 to track 32, with the oscilloscope.

Trigger	EXT—+INDEX (DC,+)	(TPB14)
Signal	CH1— output waveform (AC)	} ADD (TPB9)
	CH2— output waveform (AC, INV)	

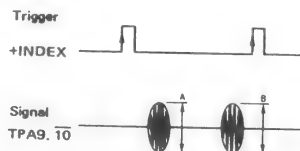
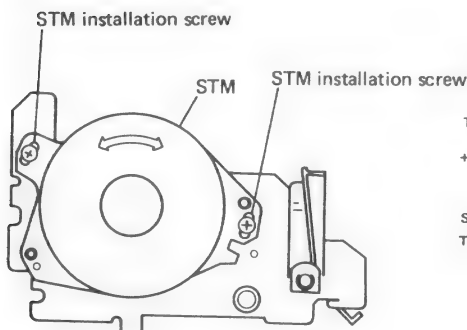
Standard	Testing	Adjustment
When $A > B$ B/A	0.57,	0.60
When $A < B$ A/B	0.57,	0.60

- 4 Adjust the carriage installation screws to obtain the above standards while the unit goes from track 00 to 32 or from track 9 to 32. This will move the carriage in the direction of the arrows for adjustment. (tighten the screws after adjustment)
- 5 Adjust both head 0 and head 1 until both are within the above specifications.

3) Precautions

Perform adjustment until the following conditions:

Temperature $23 \pm 2^{\circ}\text{C}$	} after waiting 2 hours
Humidity $50 \pm 5\text{RH}$	



5.3.4 Testing of head azimuth

1) Equipment

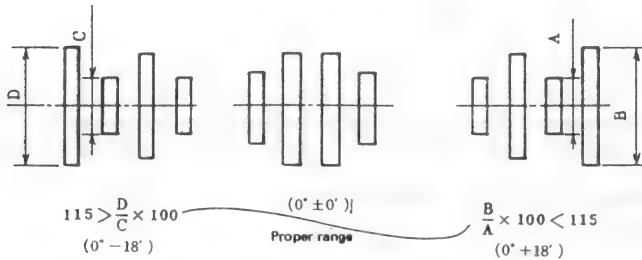
CE tester
CE diskette
Oscilloscope

2) Testing

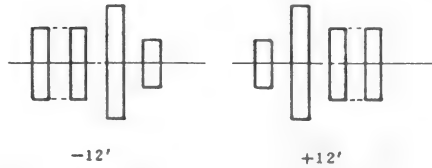
- 2) -1 Connect the CE tester to the unit and turn the power on.
- 2 Insert the diskette, turn the motor on, and start drive select operations.
- 3 Set the unit to the read mode, perform seek operations for track 68, and monitor the TPA9 and TPA10 waveforms with the oscilloscope.

Trigger	EXT—+INDEX (DC,+)	(TPB14)
Signal	CH1—output waveform (AC,)	ADD (TPA9
	CH2—output waveform (AC, INV)	TPA10)

- 4 The unit is operating correctly if the waveforms are within the following ranges.



Reference



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*****
*
*      1.2 Meg. Floppy Disk Drive      *
*
*      Section 9                        *
*
*      Technical Manual                *
*
*****
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**5.25 INCH FLEXIBLE DISK DRIVE
TECHNICAL MANUAL
MF504A-3**

CHAPTER 1 OUT LINE

1. This section deals with the mechanical parts and control circuits of the MF504A-3 flexible disk drive. MF504A-3 flexible disk unit with high density medium allows for more than 1MB formatted memory capacity. It is format compatible with a 8 inch flexible disk allowing the reading and writing of previously used normal density disks. However, normal density 48TPI medium can only be read. The rotational speed can be switched by an external signal for 360/300rpm for high and normal density respectively. The READ/WRITE circuitry is also automatically switched at the same time.
In addition, it is also possible to set the unit for normal density so that the rotational speed remains at 360rpm and only the READ/WRITE circuit is switched.

1.1 Composition of mechanism by Function

The mechanism can be divided by function as follows:

- (1) Lever mechanism and door sw mechanism
- (2) Disk rotation and clamp mechanism
- (3) Magnetic head positioning mechanism
- (4) Magnetic head/carriage mechanism
- (5) Sensors (index, write protect, track 00)

1.2 Composition of Electronic Circuitry by Function

The electronic circuits are installed on two printed-circuit boards and can be classified by function as follows: The spindle motor drive circuit constitutes an independent printed-circuit board which is built integrally with the motor.

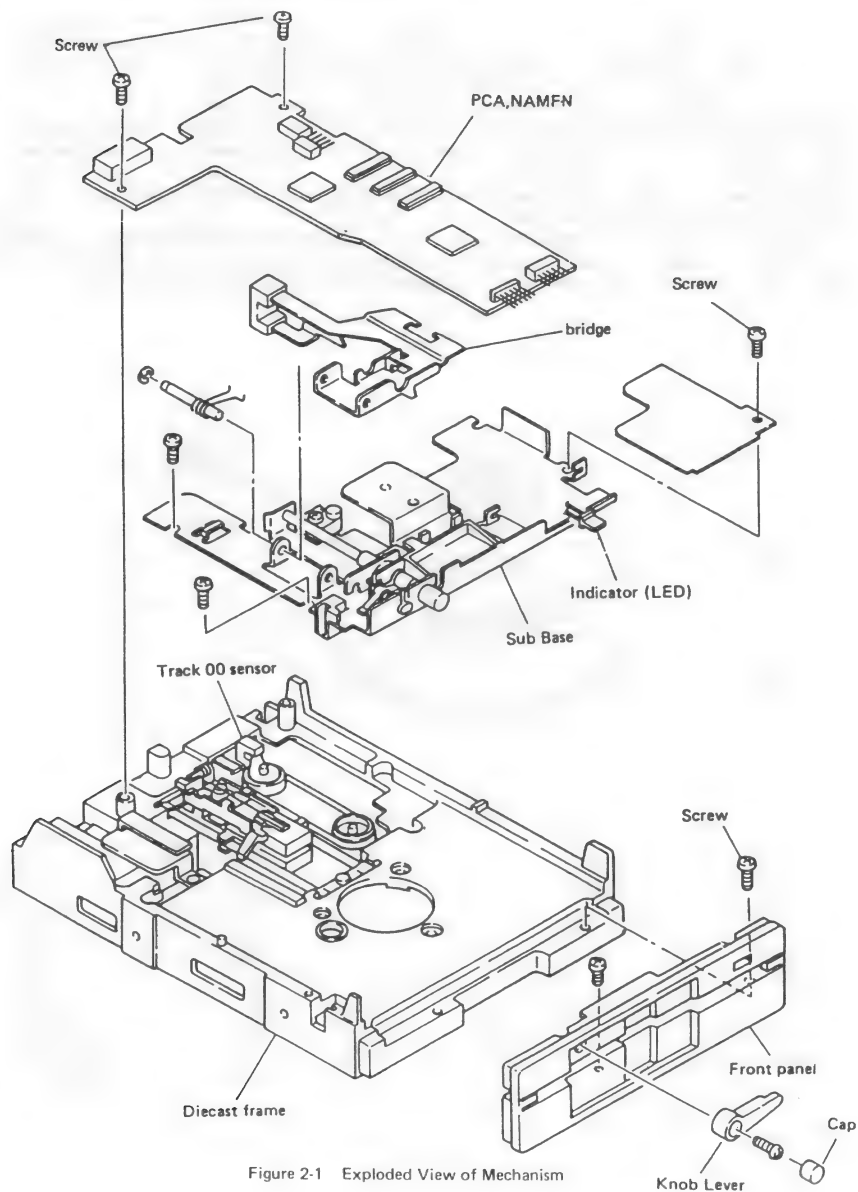
- (1) Signal interface circuit and drive select circuit
- (2) Power-on reset circuit
- (3) Panel indicator drive circuit
- (4) Index pulse generator circuit and ready circuit
- (5) Step motor drive circuit
- (6) Track 00 detection circuit
- (7) Side select circuit
- (8) Write/erase circuit
- (9) Write-protect circuit
- (10) Read circuit
- (11) Spindle motor drive circuit

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CHAPTER 2 DESCRIPTION OF MECHANISM OPERATION

Figure 2-1 shows an exploded view of the mechanism.



2.1 Disk Rotation Drive and Clamp Mechanism

The disk rotation drive motor is a flat DC servo motor. This motor has as long a life as an ordinary AC motor because it is a brushless type that uses a Hall element for coil phase-switching detection.

The motor does not use a belt, unlike conventional counterparts, but is a direct-drive type with the rotor and spindle directly connected to each other. This is another feature for prolonging motor life and assuring that the rotation mechanism is completely free of maintenance. The rotational speed of the spindle motor is 360rpm and 300rpm and this can be switched by the PCA, NAMFM signals from the main control circuit.

The frequency-generator coil detects the spindle motor speed and forms a servo circuit to control it.

The disk is clamped by the spindle cone on the motor side and by the collet on the door. The collet guides the disk to a position on the inner surface of the spindle cone. This assures compatibility between diskettes and the disk drives.

The collet is tapered to a specific angle to correct non-alignment of an inserted disk with the spindle cone.

Figure 2-2 shows the spindle motor and collet.

The printed-circuit board for the spindle motor servo circuit has an index sensor LED (light-emitting diode) for disk rotation detection, write protect sensor LED for write protect defection and indicator LED for driving signal. And a photo transistor for receiving its light is installed on another printed-circuit board (NAMFM).

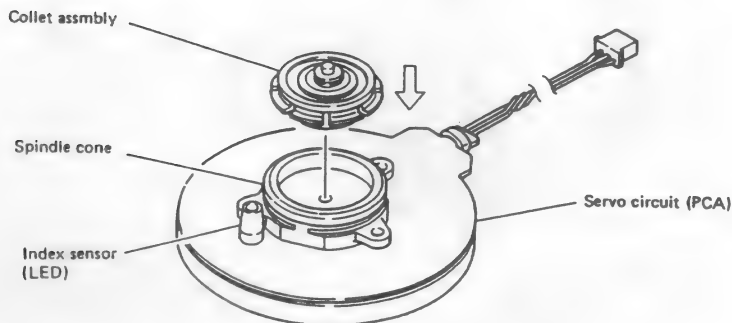


Figure 2-2 Spindle Motor and Collet

2.2 Magnetic Head Positioning Drive Mechanism

The flat step motor drives the magnetic head to each track (cylinder) in succession. The capstan mounted on the step motor shaft has a thin-loop steel band, which is pulled by the spring attached to the idler pulley located opposite the steel band to maintain a specific tension. The head/carriage assembly, supported by two guide rods, is fastened to the steel band so that a turn of the step motor by one step angle moves the head by a single track distance.

Figure 2-3 shows the positioning drive mechanism.

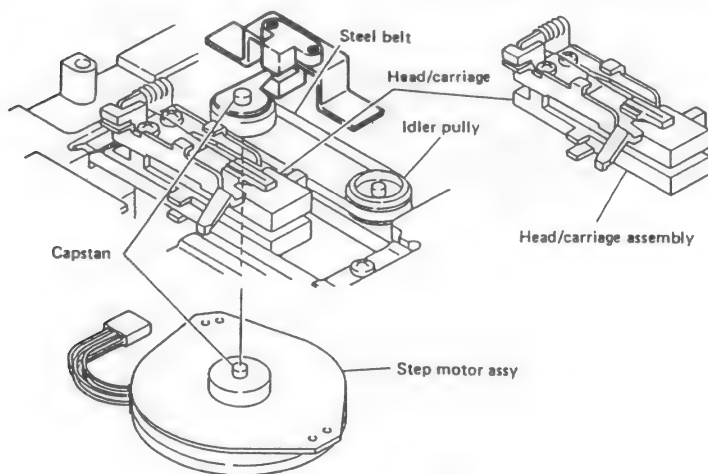


Figure 2-3 Magnetic-Head Positioning Mechanism

2.4 Sensors (Index, Write Protect, Track 00)

(1) Index sensor

The index sensor detects disk rotation. This sensor consists of an LED on the light-emitting side and a photo transistor on the light-receiving side. The LED is mounted on the servo circuit PCA for the spindle motor (Figure 2-2), and the photo transistor is mounted on the main control circuit PCA (NAMFM). Index sensor timing (position) can be adjusted by loosening the screws on the index sensor and removing index sensor.

Figure 2-6 shows where the photo-transistor for the index sensor is mounted.

(2) Write-protect sensor

The write-protect sensor detects the diskette's write-protect notch and inhibits write operation.

This sensor protects information stored on read-only disks from destruction by operation errors.

Disks with the diskette's notch covered with tape or a seal that does not transmit light are protected by this sensor. Remember that vinyl or cellophane tape that has a high percentage of light transmission will not protect the disk. The write-protect sensor is mounted on sub-base as shown in Figure 2-6. [Attached to the sub-base, this will transmit signals to PCA.]

(3) Track 00 sensor

The track 00 sensor detects that the head is on track 00.

The track 00 sensor detects the position of the light-shielding plate that projects from the head/carriage assembly. The sensor is screwed to the STM holder and can be adjusted in position by loosening the screw.

The track 00 sensor and head/carriage assembly are shown in Figure 2-7.

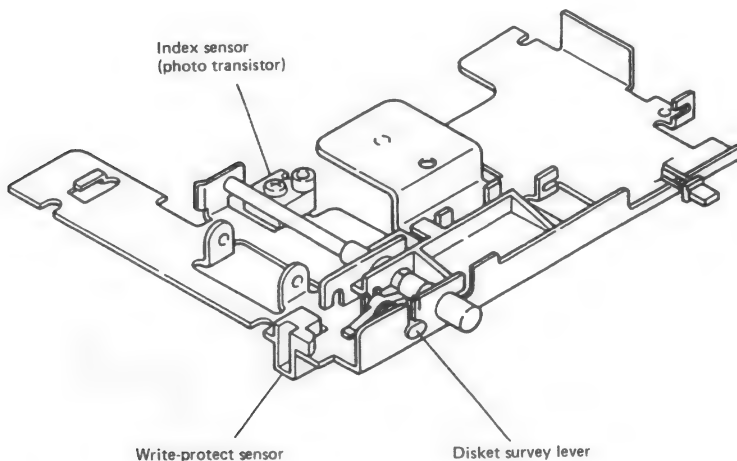


Figure 2-6 Index Sensor and Write-protect sensor

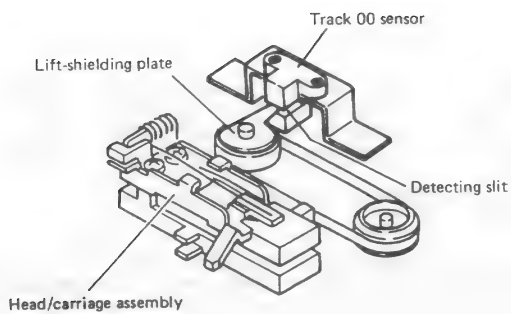


Figure 2-7 Track 00 Sensor and Head/Carriage Assembly

CHAPTER 3 DESCRIPTION OF ELECTRONIC CIRCUIT OPERATION

Figure 3-1 shows the electronic circuits and signal connections among these circuits.

The spindle motor drive circuit within the dotted lines constitutes the separate printed-circuit board that is built integrally with the motor.

The parts within the chain lines belong to the mechanism described in the previous pages.

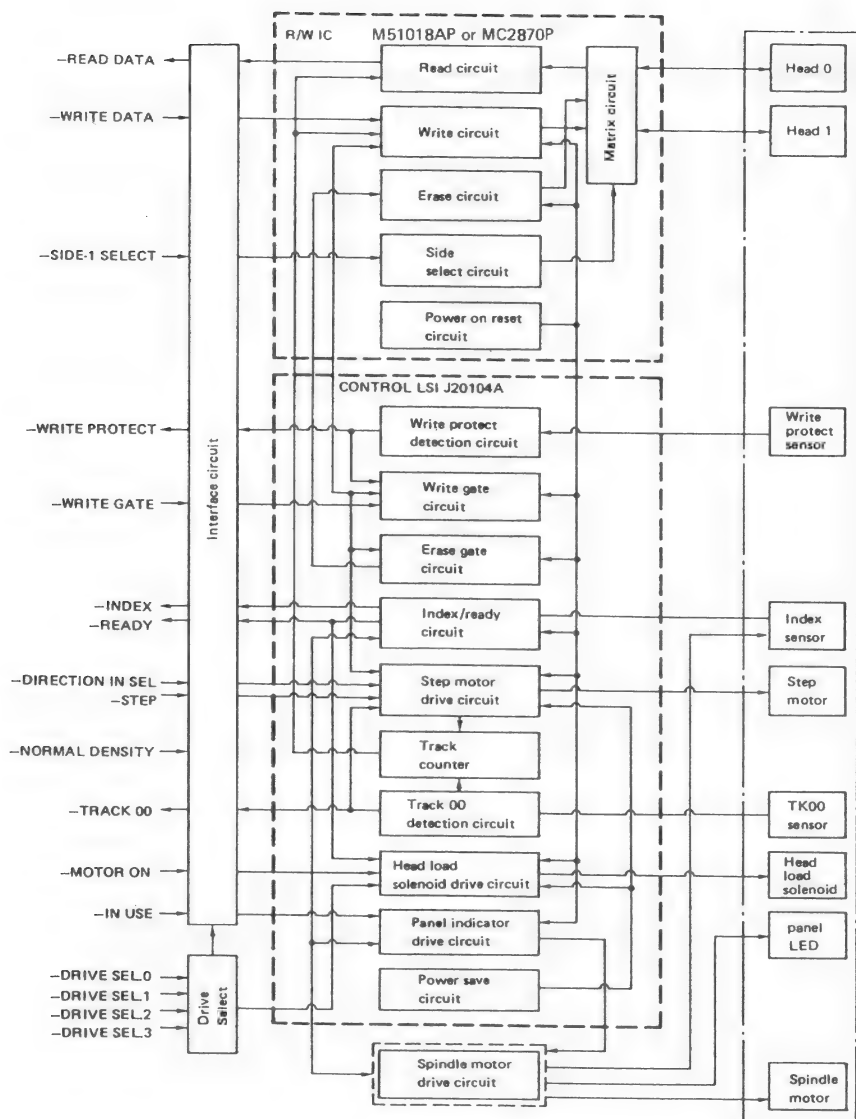


Figure 3-1 MF504A-3 Electronic Circuit

3.1 Interface and Drive Select Circuits

(1) Receive circuit

All the input terminals of the receiver that receives signals from the host controller are terminated at 150 ohms, pulling them up to +5 V. The host controller, therefore, must use driver elements with a drive capacity of 40 mA or more. Normally, an SN7438N or an equivalent open-collector drive is recommended. In connecting two or more disk drives (up to four) by a daisy-chain pattern, it is necessary to keep the cable end terminating resistor and remove the terminating resistors of the other disk drives.

(2) Transmit circuit

The disk drive line driver is an SN7438N or equivalent open-collector gate. It is necessary for the host controller to use a terminating resistor of 150 ohms or more.

All input signals to the line driver are gated by drive select signals. Thus, if two or more disk drives are connected in the daisy-chain pattern, the signals of only one selected disk drive are transmitted to the host controller.

(3) Drive select circuit

The drive select circuit selects one of the disk drives (four maximum) connected with the same cables through four interface lines (DS0 through DS3).

The four select lines correspond to the jumper plugs on the printedcircuit boards, one of which should be inserted to select the desired line. Never insert plugs into the same-numbered jacks on two or more disk drives that are connected with the same cable; interference between the output signals from such disk drives will cause errors.

The drive select signals also light the panel indicator LED.

In the case of a system requiring no drive selection, insert the jumper plug for the drive select line into the MX to maintain a selected condition.

3.2 Power-On Reset and Power Save Circuits

(1) Power-on reset circuit

The power-on reset circuit, a level-detection type reset circuit, initializes the control LSI, and that's used for preventing operation errors of the write circuit in switching power on, off.

(2) Power save circuit

The power save circuit controls current flowing to the step motor and head load solenoid according to their operating condition to reduce heat generation by unnecessary power consumption and thus to reduce temperature rise of the disk drive.

The step motor and head load solenoid share the same timer (mono-stablemultivibrator), which has a range of 30 ms.

Timing chart of the power save circuit is shown in figure 3-2.

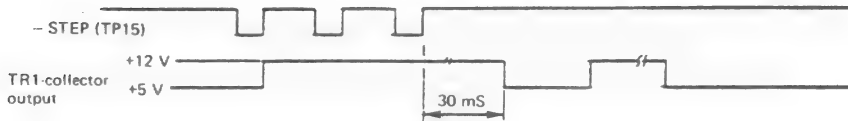


Figure 3-2 Power Save Circuit Timing Chart

3.3 Panel Indicator Circuit

The panel indicator is turned on by a drive select signal or by a drive select signal and in-use signal.

When no in-use signal is applied to the interface, the panel indicator is turned on by a drive select signal only. If the jumper plug for the drive select circuit is inserted into the MX, the panel indicator is turned on by an in-use signal only.

Regarding jumper plug combination and indicator conditions, refer to the detailed description in the Standard Specifications MF504A-3.

3.4 Index Sensor and Ready Circuits

The index sensor circuit detects the index holes in the disk with a sensor, and converts its signals into logic signals.

The ready circuit checks the index pulse intervals with a timer, and becomes ready when the intervals are less than 300 ms and the next index pulse is generated.

When the door opens and the disk stops rotating and the motor-on signal turns off and the disk stops rotating the ready signal is reset.

Figure 3.3 shows a timing chart.

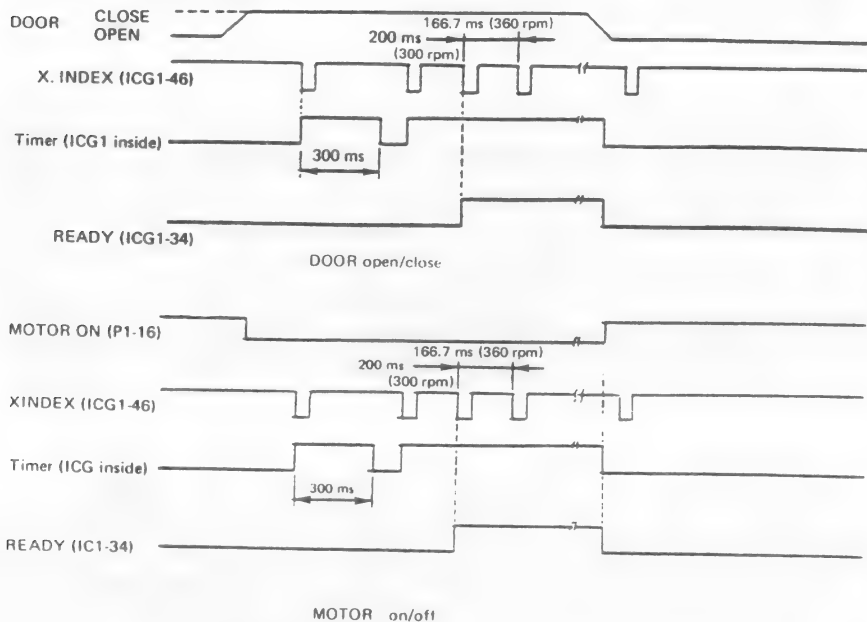


Figure 3-3 Index Sensor and Ready Circuit Timing Chart

3.5 Step Motor Drive Circuit

The step motor is a two-phase bipolar type and is driven to a step angle of 1.8° by feeding four mode currents, using two source/sink type drivers.

These four modes are generated by an up-down four-count counter that uses two flip-flops.

The step motor drive circuit switches the voltage supplied to the motor drive circuit to reduce power consumption during times other than seeking, when the motor is still.

In a seek operation, +12 V is supplied to the drive circuit, but if the next step pulse is not applied to the interface for 30 ms or more, +5 V is supplied.

Figure 3-4 shows a timing chart.

The step motor drive circuit blocks the step pulses with a write gate (except for the erase delay time) to prevent seeking during write operation. When the track 00 sensor output turns on, the circuit also blocks the step pulses to prevent further outward seek.

3.6 Track 00 Detection Circuit

The track 00 detection circuit detects the position of the light-shielding plate that projects from the head/carriage assembly, using a sensor. This output is ANDed with the step motor drive phase (TK00) to generate a track 00 signal. The circuit will not output a signal, therefore, unless the drive phase is at track 00 even if the sensor output is on.

For a timing chart, refer to figures 3-4.

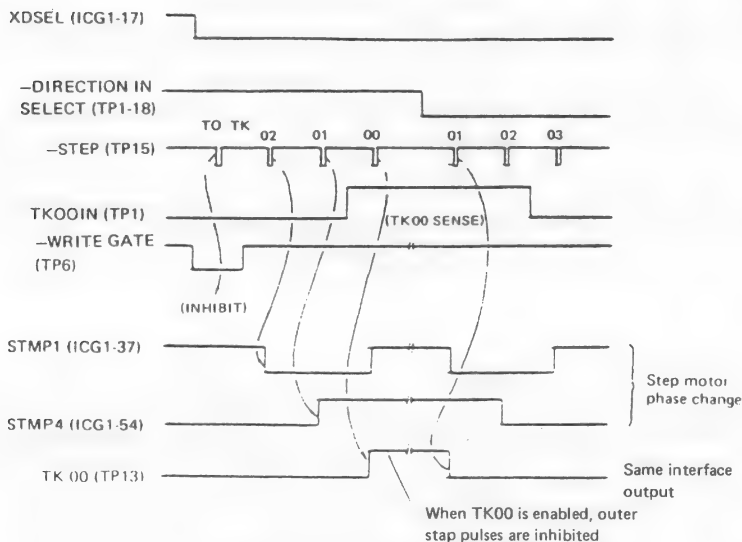


Figure 3-4 Step Motor Drive Circuit Timing Chart

3.7 Side Select Circuit

Side selection is made by switching the head center tap from about 0 V at off to about 11 V at on. This operation alternately feeds a write current from center tap CT-0 (CT-1) to H0A (H1A) and H0B (H1B), and an erase current from center tap CT-0 (CT-1) to ER-0 (ER-1) during write operation. In read operation a bias current is fed from CT-0 (CT-1) to H0A (H1A) and H0B (H1B) to induce a voltage between H0A (H1B) and H0B (H1B).

The host system selects side 1 through the interface line if – SIDE ONE SELECT is low, or side 0 through the same interface line if it is high.

Figure 3-5 shows a block diagram of the side select circuit.

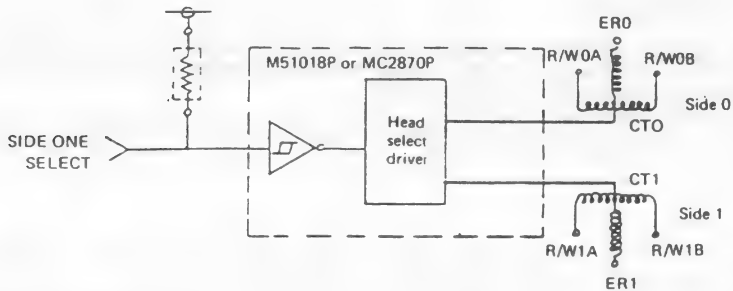


Figure 3-5 Side Select Circuit Block Diagram

3.8 Write/Erase Circuits

The write circuit is used for recording data on the disk. It starts writing when the write gate is opened for the selected head. If diskette write-protect status is detected, no write operation is performed.

The erase circuit erases the previous data written on both sides of the data by DC erasure. This function prevents old data from remaining on either side of newly written data due to a slight deviation of head position, and thus prevents old data crosstalk in reading the new data.

The write circuit consists of the following blocks:

- Write toggle flip-flop
- Write driver
- R/W matrix
- Write current source

When a write gate is input, the write toggle flip-flop, write driver and write current source are enabled to start a write operation. Write data is counted down to one half by the write toggle flip-flop, and a differential signal that changes synchronously with the write data is generated.

This differential signal switch the write driver.

The write driver is a switching circuit that feeds a current to the R/W head. This current is generated by the write current source and is sent to the write driver.

The R/W matrix feeds a current to the head selected by SIDE ONE SELECT as the write circuit gate is opened by a write gate.

Figure 3-6 shows the erase function and figure 3-7, a write circuit block diagram.

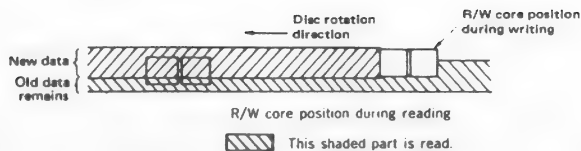
Current is alternately fed to the R/W head through two current routes, $CT \rightarrow R/WA$ and $CT \rightarrow R/WB$ as shown in the figure, according to the differential signal to invert its magnetization.

Erase operation starts with point E before write start point C and ends at point F after write end point D. The circumferential position deviation of the R/W core from the erase core is about 0.6 mm, and the erase core reaches a point that the R/W core gap has passed approx. $350\mu s$ at 360rpm (approx. $500\mu s$ at 300rpm) later (near TK 32). Therefore, the delay operation shown in figure 3-9 is required for the time from the opening of the write gate to the turning on of the erase driver and from the closing of the write gate to the turning off of the erase driver. It is for this purpose that the erase delay timer is provided to control the erase driver. Thus, for approx. $590\mu s$ at 360rpm (approx. $1000\mu s$ at 300rpm) after the closing of the write gate, the head must remain on the track and be kept selected.

The erase function erases data from the disk by always magnetizing it in one direction.

Figure 3-8 shows a conceptual diagram of write operation and figure 3-9, an erase delay operation timing chart.

(Without erase head)



(With erase head)

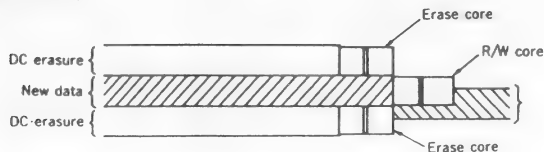


Figure 3-6 Erase Function

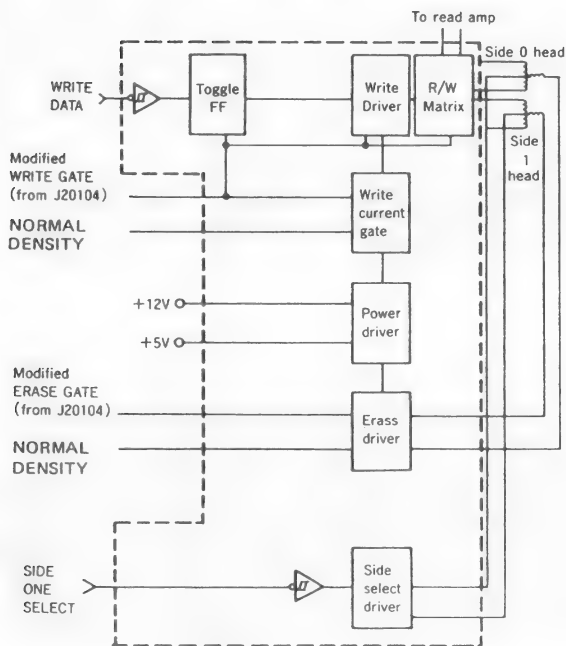


Figure 3-7 Write Circuit Block Diagram

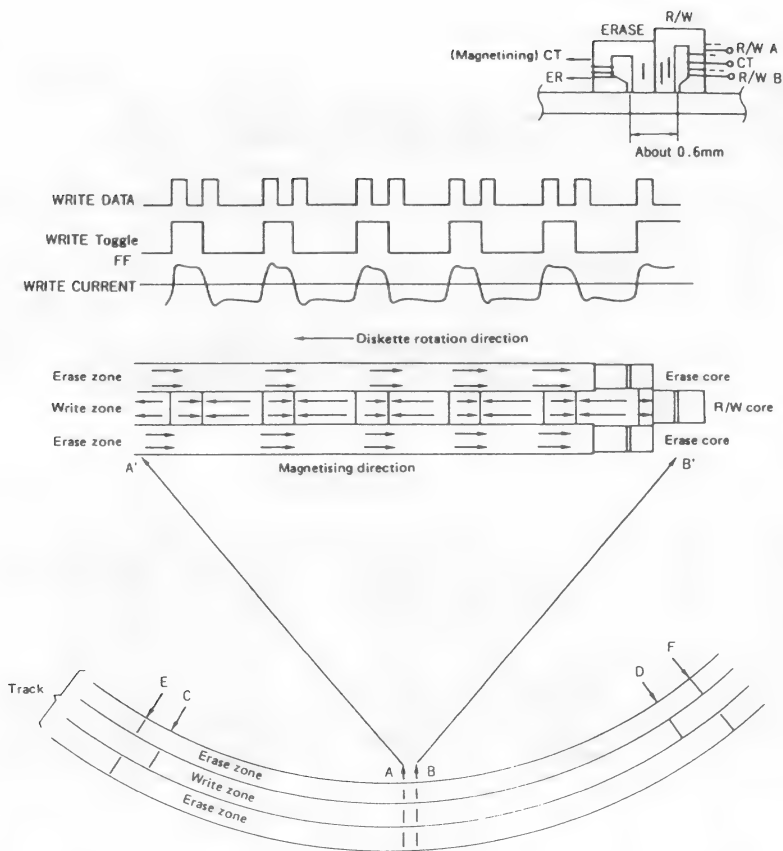


Figure 3-8 Write Operation Concept

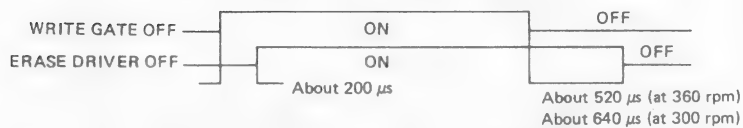


Figure 3-9 Erase Delay Operation Timing Chart

3.9 Write-Protect Circuit

The write-protect circuit detects the notch (cutout in the jacket) of the diskette with a sensor to inhibit write operation even if a write gate signal is received from the interface, and outputs a write-protect signal to the interface. Figure 3-16 shows a circuit diagram of the write-protect circuit.

3.10 Read Circuit

The diskette is read when the write gate and erase driver are closed.

The R/W core is on a track. If a head has been selected, the core reads the inversions of magnetization of the previously written data to induce a voltage between the two ends of the R/W coil (between R/WA and R/WB). This voltage is input to the read preamplifier via the R/W matrix.

The read preamplifier provides a gain about 200 times the level of a few millivolts induced in the head, and amplifies the input into a differential signal high enough for signal processing.

The read signal from the read preamplifier is fed through a low-pass filter that cuts out excess high frequencies. The low pass filter is constructed so that it is automatically switched for high/normal density. It is thus, matched for the optimum frequency of each of the two.

Because the position of inverting magnetization is expressed by a read signal peak, the read signal is fed to a peak-detection circuit to generate a read data pulse.

The peak-detection circuit consists of three blocks.

- Differentiator
- Comparator
- Time domain filter

The differentiator is a differentiating circuit to detect the peak point, and the detected peak point is converted to a zero-crossing point. The differentiated signal is routed to the comparator, where it is converted from an analog signal to a digital signal. The point of change of this digital signal actually becomes a data pulse. FM or MFM means frequency modulation. The frequency of magnetization inversion intervals used are in figure 3-10.

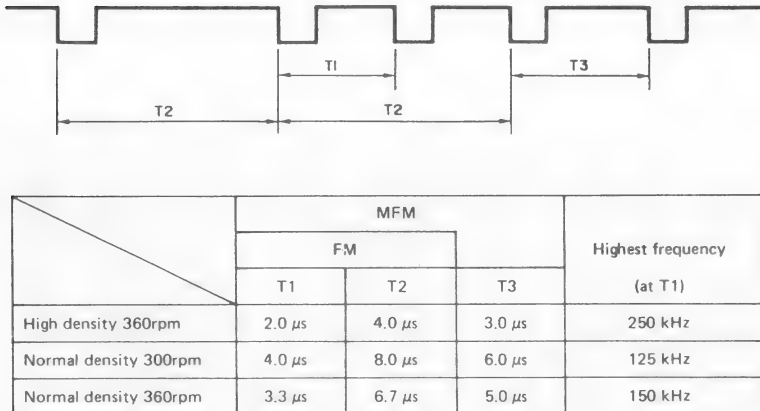


Figure 3-10 DATA Timing

Adjacent magnetization inversion waveforms interfere with the magnetization inversion waveform converted from magnetism to an electronic signal, so their combined waveform is read. If magnetization inversion intervals lengthen, however, the mutual interference decreases, resulting in generating a shoulder. When a shoulder is generated, the differentiated waveform zero-crosses so that the wrong data pulse is detected. A time domain filter is provided for removing the wrong data pulse. The time domain filter is constructed so that it is automatically switched for high/normal density. It is thus, set for the optimum frequency for each of the two.

If the comparator output maintains the level prior to the single operation ① following the zero crossover point for a specific amount of time, the time domain filter generates that output as real read data ②.

The read data thus generated is sent to the host system. Figure 3-11 shows a read circuit block diagram and figure 3-12, a read timing chart.

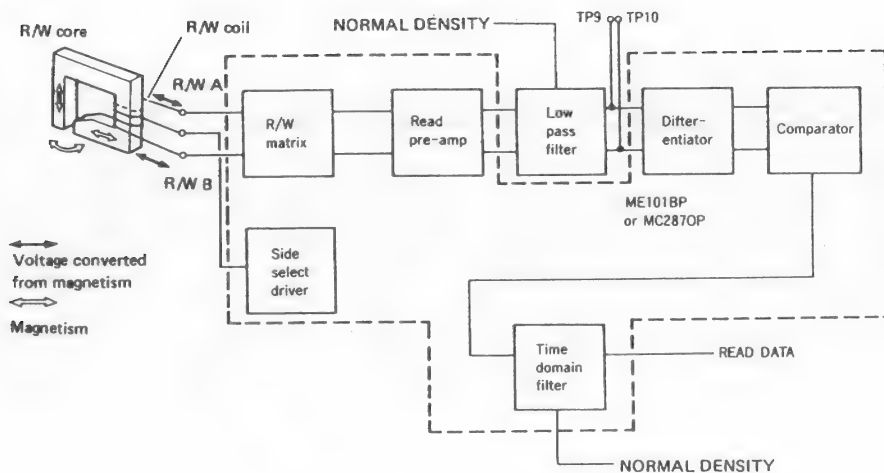


Figure 3-11 Read Circuit Block Diagram

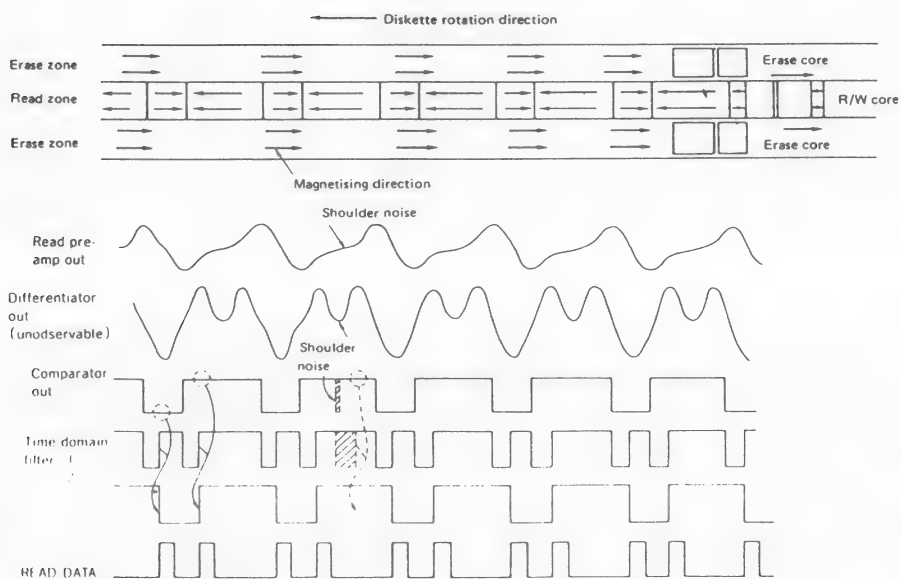


Figure 3-12 Read Timing Chart

3.11 Write current switch

The write is switched on this unit for the optimum recording current for both high and normal density disks.

(1) Write current switch

Write current for high density disks is set when the interface line is logical "1".

Write current for normal density disks is set when the interface line is logical "0".

3.12 Spindle Motor Drive Circuit

The spindle motor is a DC, direct, brushless motor for which a feedback servo circuit is employed to maintain the correct speed at all times. This circuit is installed on a separate printed-circuit board that is built integrally with the motor.

It is connected to the main control circuit with four signal lines: +12 V DC, 0 V, motor-on signal, and IN USE LED.

This feedback servo circuit employs Hall elements for position feedback and a frequency generator, or tachometer generator, for speed feedback to constitute a secondary system to stabilize motor rotation.

Spindle rotating position is detected by the Hall elements located symmetrically from the rotating spindle, and the information is fed to the predriver to alternately switch driver 1 and driver 2.

The speed signal output by the frequency generator for speed control is rectified and integrated into a speed voltage, which is compared with the reference speed voltage to feed back the level of current to be supplied to the coil. The rotational speed of the motor is switched by changing the reference speed value.

Figure 3-13 shows a spindle motor drive circuit block diagram and figure 3-14, a conceptual diagram of the spindle motor drive circuit waveforms.

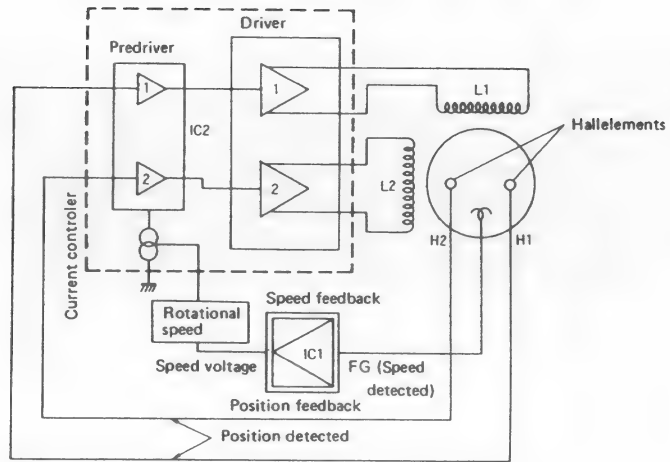


Fig. 3-13 Spindle motor drive circuit block diagram

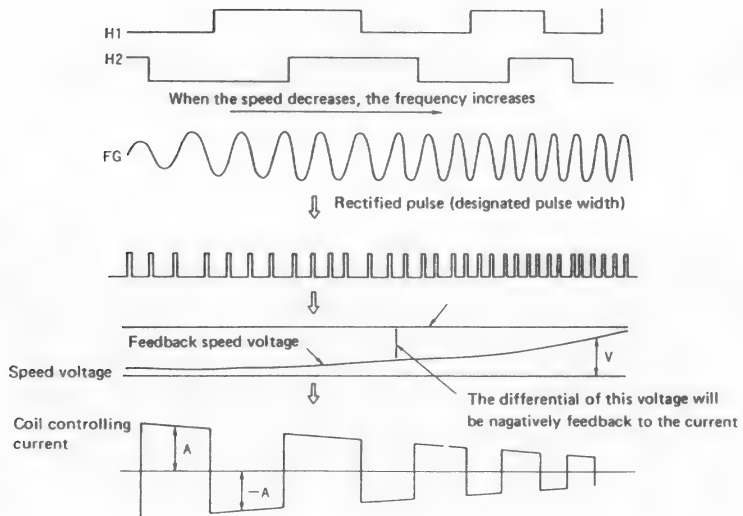


Fig. 3-14 Spindle motor drive current waveform configuration

*
* 1.2 Meg. Floppy Disk Drive *
*
* Section 10 *
*
* MF504A-3 Standard Specifications *
*

UGD-0312 B

**5.25 INCH FLEXIBLE DISK DRIVE
STANDARD SPECIFICATIONS
MF504A-347UA**

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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
	Form- atted	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
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 Access time				94msec			

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

1.2.2 Physical specifications (Table 1-2)

DC power requirements +5V +12V	+5V + 5%, 0.5 A typical 0.7 A max +12V $\pm$ 5%, 0.6 A typical (seeking) 1.0 A max (Spindle motor operating)
Operating environmental conditions Ambient temperature Relative humidity	5°C to 43°C (41°F to 109.4°F) 20% to 80% (Maximum wet bulb temperature: 29°C (85°F))
Non-operating environmental conditions Ambient temperature Relative humidity	-20°C to 51°C (-4°F to 125°F) 5% to 95%
Heat dissipation	9.7 Watts Continuous seek (typical) 5 Watts Standby (typical) 4 Watts Motor off (typical)
Physical dimensions Height Width Depth	(Except for front panel) 41 mm (1.62 in) 146 mm (5.75 in) 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.

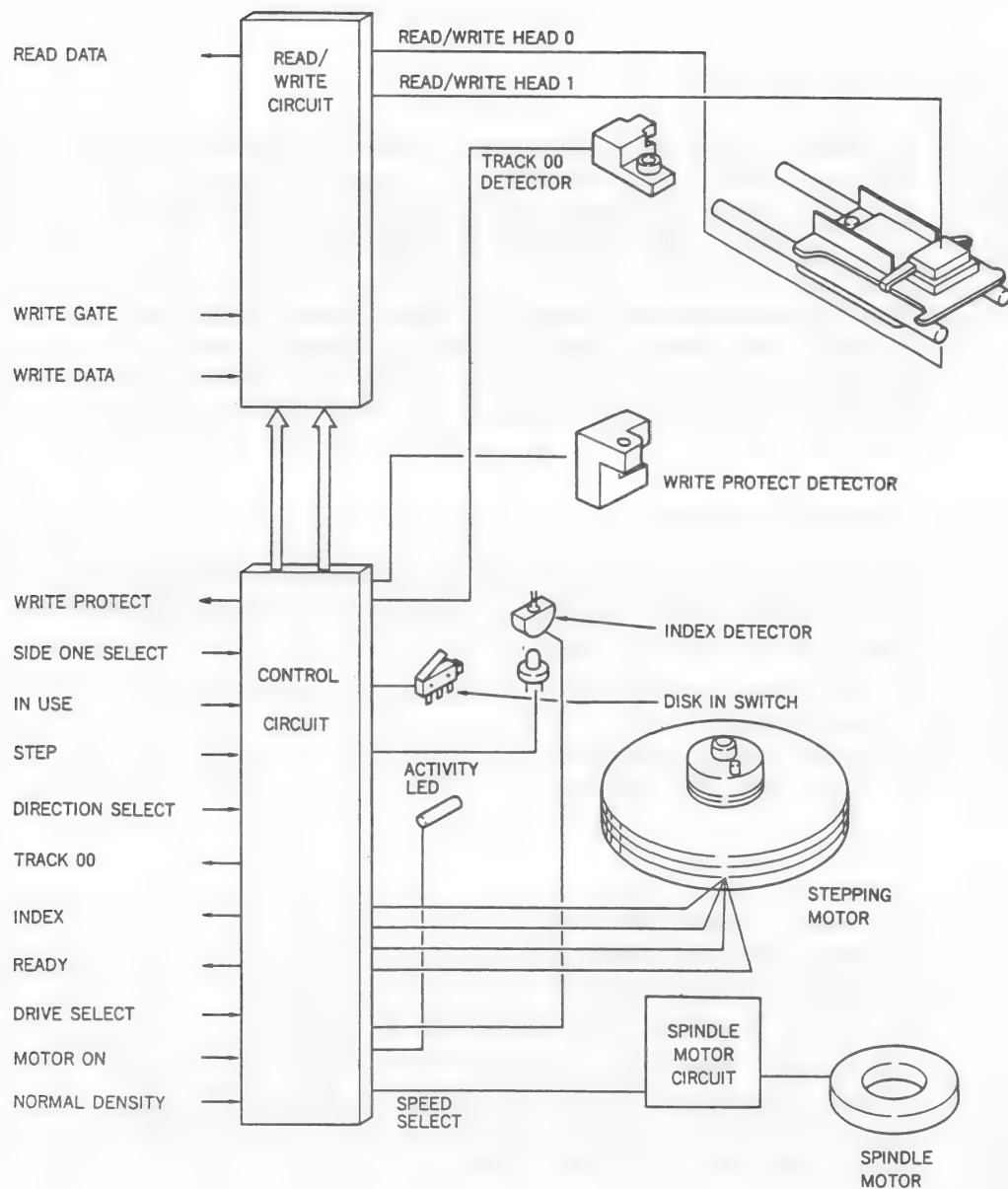


Fig. 1 Functional View

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: This line 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 drives.

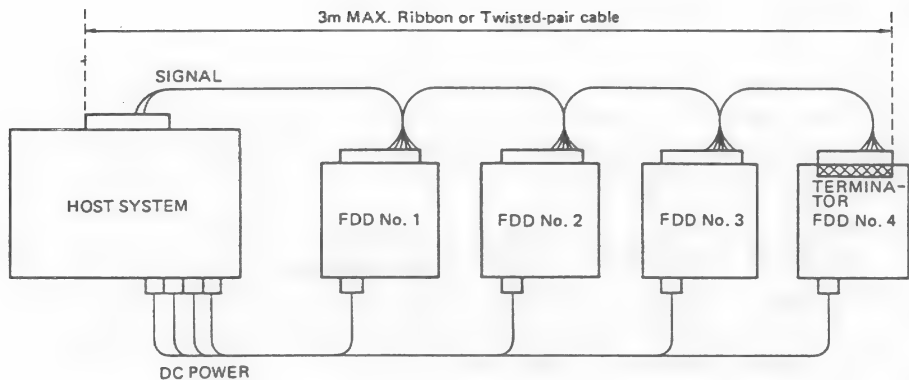


Fig. 3-1 Cabling Method (Sketch)

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.

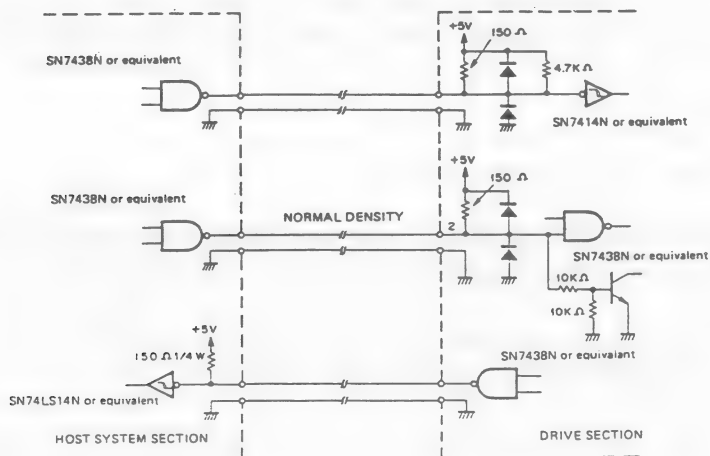


Fig. 3-2 Recommended Line Driver and Line Receiver Circuits

3.1.3 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.

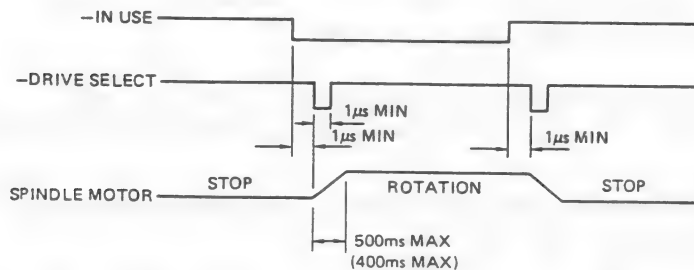
* TD is shorted when the unit is shipped from the factory.

- (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)

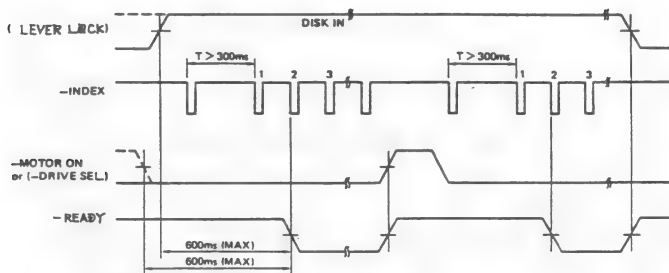
The ready transmission conditions below can be selected with the combination of opening and short-circuiting of DC and 2S.

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 than 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.

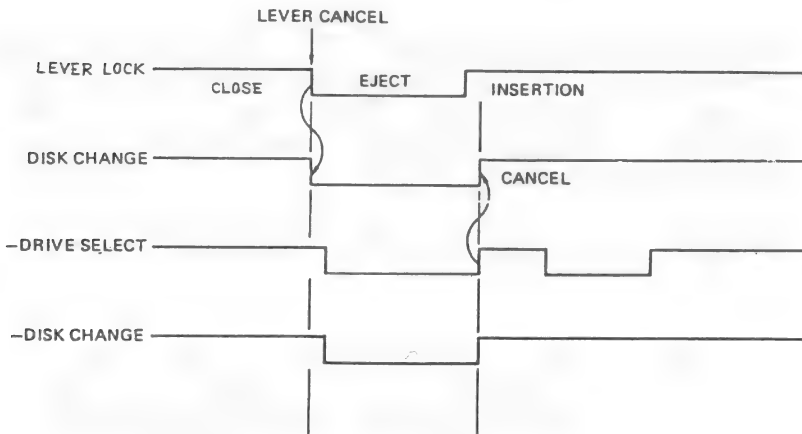


Fig. 6 Disk Change Timing

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 circuitry 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	 DS2  DS1  DS0  MX  DS3	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	 TD	J10
Selection of MOTOR ON conditions	 MM MS	Motor started by the MOTOR ON signal	 DC 2S  MM MS  IU	J4 J3
	 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		
Selection of the signal transmitted from pin 34 of the interface (Connector P1)	DC 2S	STANDARD READY is sent	 DC 2S  DC 2S  DC 2S  DC 2S	
	 DC 2S	HOLD READY is sent		
	 DC 2S	DISK CHANGE is sent		
	 DC 2S	(not used)		
Gate selection for the above transmission signal	 RR	Gated by DRIVE SELECT signal	 RR	J7
	RR	Transmitted as is		
~~Head unload condition selection~~	~~ UD~~	~~Head unload delay released~~	~~ UD~~	~~-~~
	~~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	 SS SB	J11
	 SS SB	360 rpm for both high and normal density		

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

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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/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 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 μ s before execution.

Upon completion of a write operation, reverse the polarity of the side one select signal after a delay of 590 μ s (*1). The heads are tunnel types, 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 within the disk drive. Therefore, the head select must not be reversed during this delay time. Also, the track access action must not be permitted for 590 μ s.
(*1)

*1: The interval is 1000 μ s 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 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 it becomes Logical "1," the write drive becomes inactive and the read data 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.

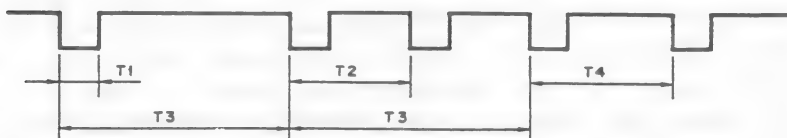
(6) WRITE DATA

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			T4
	T1	T2	T3	
High density, 360 rpm	150 to 1100ns	$2.00\mu\text{s} \pm 10\text{ns}$	$4.00\mu\text{s} \pm 20\text{ns}$	$3.00\mu\text{s} \pm 15\text{ns}$
Normal densiti, 300 rpm	150 to 2100ns	$4.00\mu\text{s} \pm 20\text{ns}$	$8.00\mu\text{s} \pm 40\text{ns}$	$6.00\mu\text{s} \pm 30\text{ns}$
Normal density, 360 rpm	150 to 1800ns	$3.33\mu\text{s} \pm 17\text{ns}$	$6.67\mu\text{s} \pm 33\text{ns}$	$5.00\mu\text{s} \pm 25\text{ns}$

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 μ s 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 while 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.

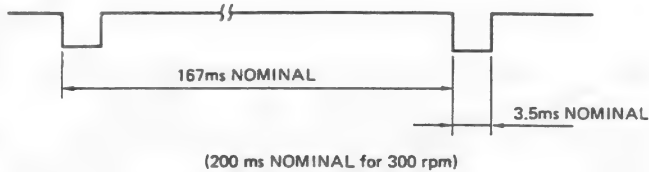


Fig. 3-4 Index Timing

(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.

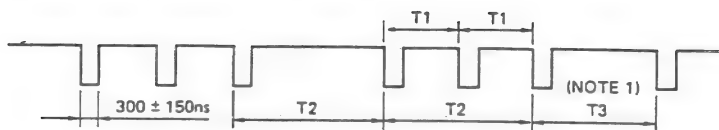
(3) **READY**

This interface line is logical "1" when the lever is cancelled. The line goes logical "0" (ready) if an index pulse 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		T3
	T1	T2	
High density, 360 rpm	$2.00\mu\text{s} \pm 400\text{ns}$	$4.00\mu\text{s} \pm 800\text{ns}$	$3.00\mu\text{s} \pm 600\text{ns}$
Normal density, 300 rpm	$4.00\mu\text{s} \pm 800\text{ns}$	$8.00\mu\text{s} \pm 1600\text{ns}$	$6.00\mu\text{s} \pm 1200\text{ns}$
Normal density, 360 rpm	$3.33\mu\text{s} \pm 667\text{ns}$	$6.67\mu\text{s} \pm 1333\text{ns}$	$5.00\mu\text{s} \pm 1000\text{ns}$

Note : Jitter caused by change in 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 ($\pm 5\%$)	0.7 A maximum 0.5 A typical	50 mV
+12 V DC	± 0.6 V ($\pm 5\%$)	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.

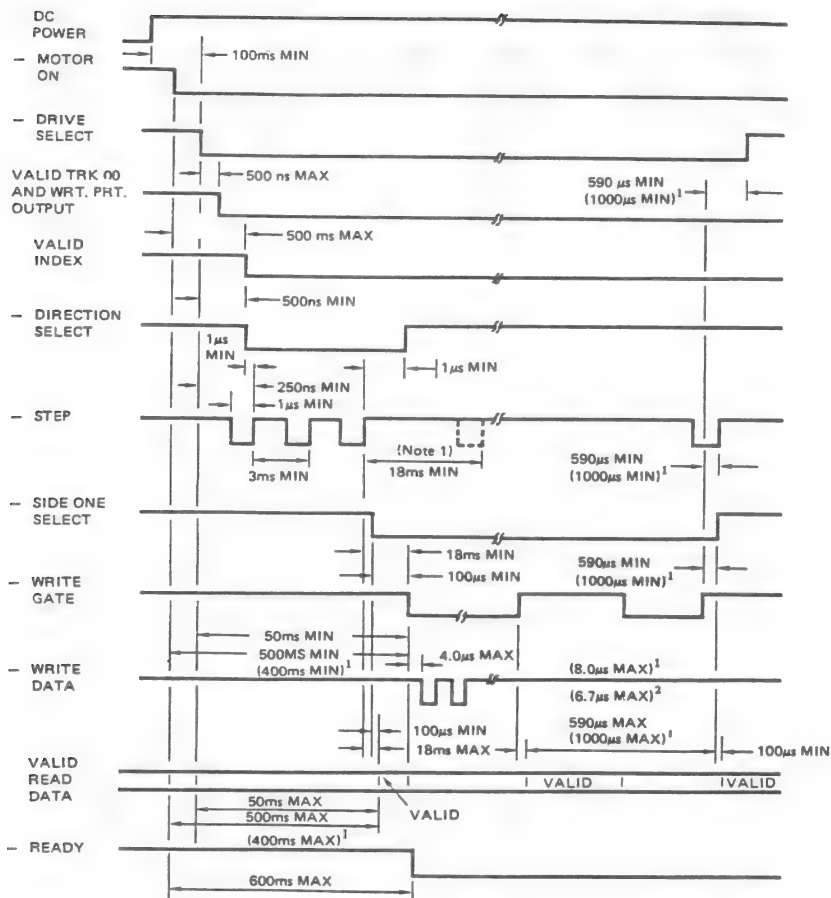
These timing specifications must be strictly observed to ensure an accurate write operation.

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.

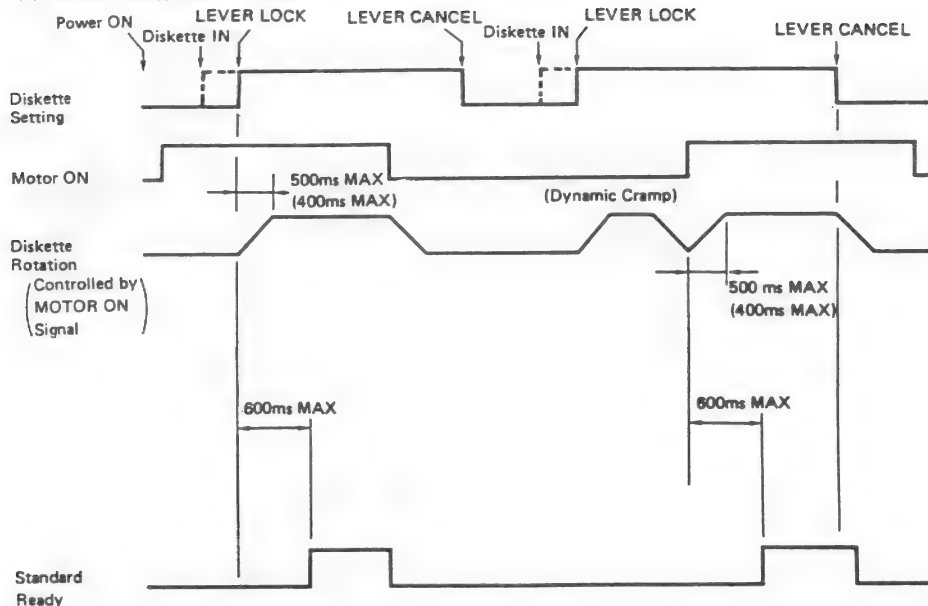


Note 1: When reversing direction, issue a next step pulse after more than 18 ms from the step pulse before inversion.

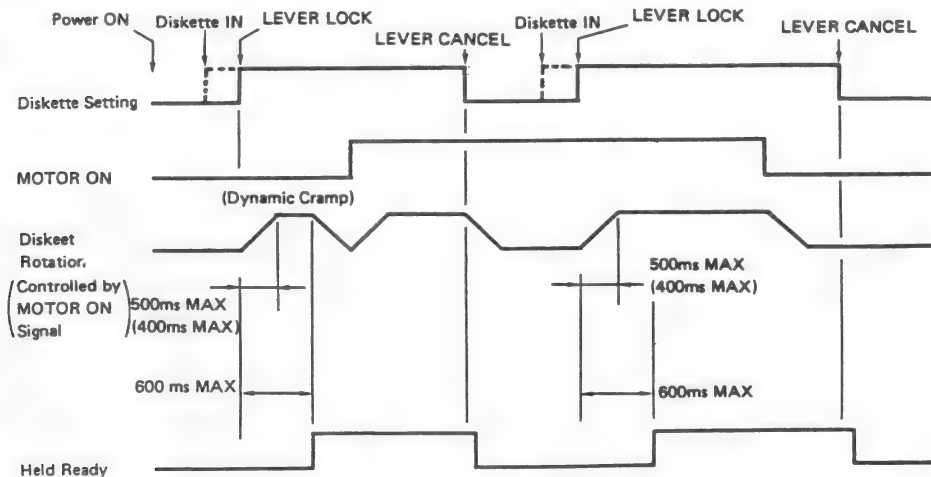
Note 2: The figures in brackets (¹) are for when the unit is specified for normal density at 300 rpm.
The figures in brackets (²) are for when the unit is specified for normal density at 360 rpm.

Fig. 4-1 Control and Data Timing

(1) Standard Ready, Dynamic Cramp



(2) Held Ready, Dynamic Cramp



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

Fig. 4-2 Ready and Dynamic Cramp Timing

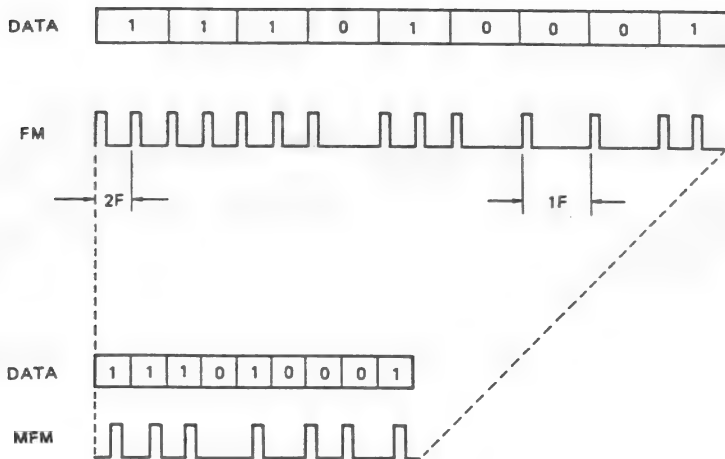


Fig. 4-3 Comparison of FM and MFM Encoding Systems

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.

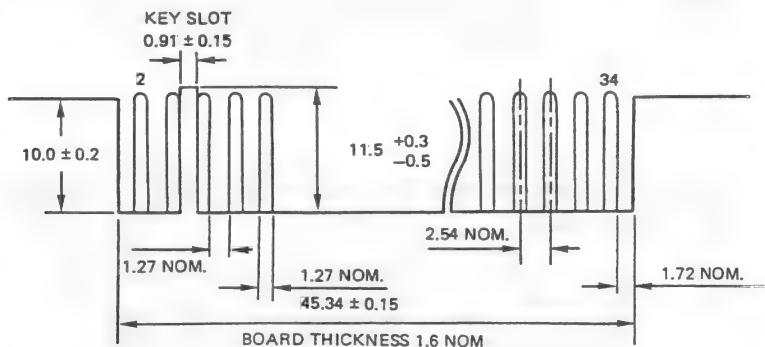


Fig. 5-1 Connector J1 Dimensions (mm) and Pin Numbers

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.

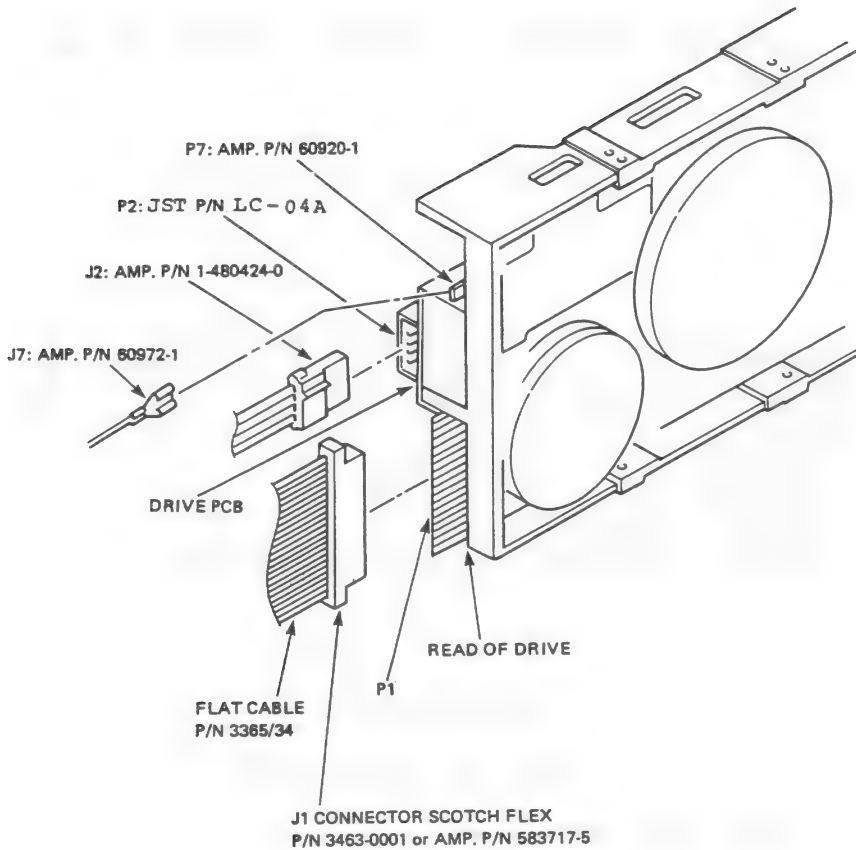


Fig. 5-3 Location of Interface Connectors

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.

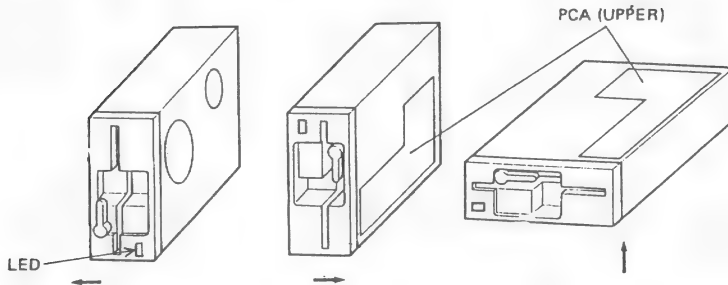


Fig. 6-1 Disk Drive Installation Directions

6.2 Dimensions of disk drive

See Fig. 6-2.

6.3 Dimensions of Front Panel

See Fig. 6-3.

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:

- 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 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 damaged diskette surface.

- o Random electrical noise ranging in time from a few microseconds to a few milliseconds can also cause read errors. 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.
- 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 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 () indicates unformatted capacity.

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

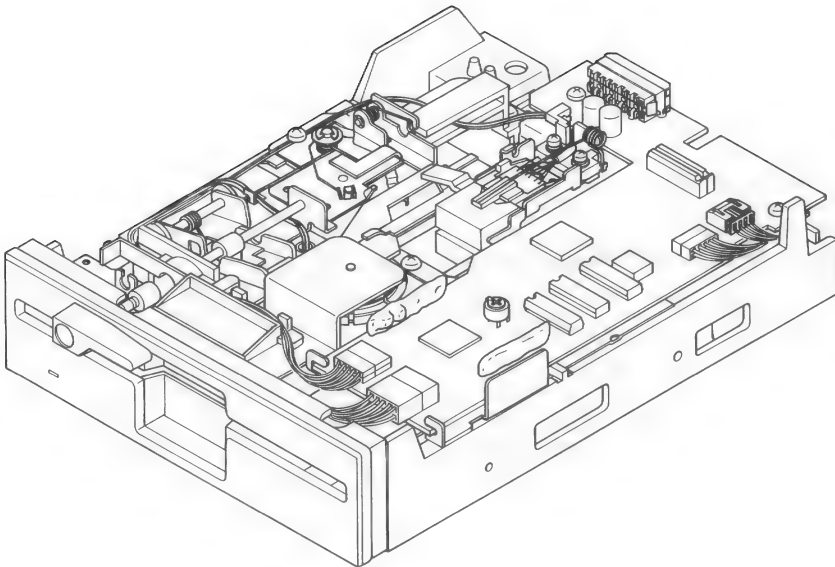
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*****
*
*      1.2 Meg. Floppy Disk Drive      *
*
*      Section 11                       *
*
*      Parts List                       *
*
*****
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UED-0135A

**5.25 INCH FLEXIBLE DISK DRIVE
ILLUSTRATED PARTS LIST
MF504A-347UA**

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MF504A-34UA Flexible Disk Drive

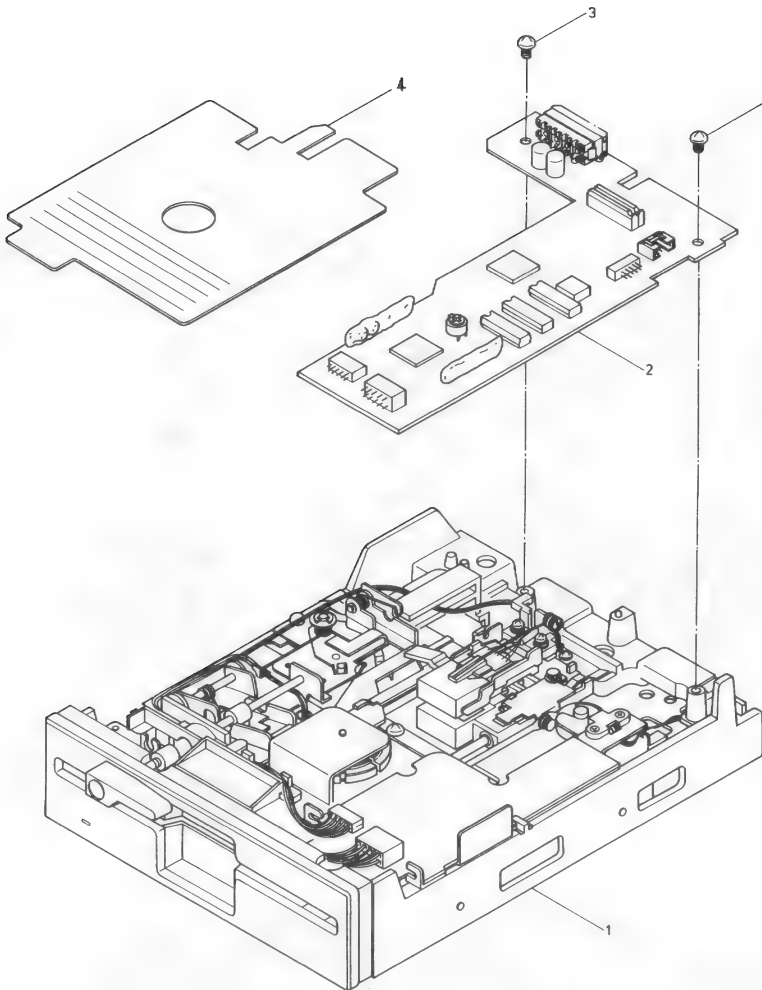


Fig. 1 Flexible Disk Drive

Fig. & Index Number	Part Number	Description	Q'ty
Fig. 1		Flexible Disk Drive	1
1	U951B016G09	Mechanism Ass'y	(1)
2	U241D506G04	PCA-NAMFN3	(1)
3	U650S063H19	Screw-B M3 x 6	(2)
4	U803C166H01	Head Protect Sheet	(1)

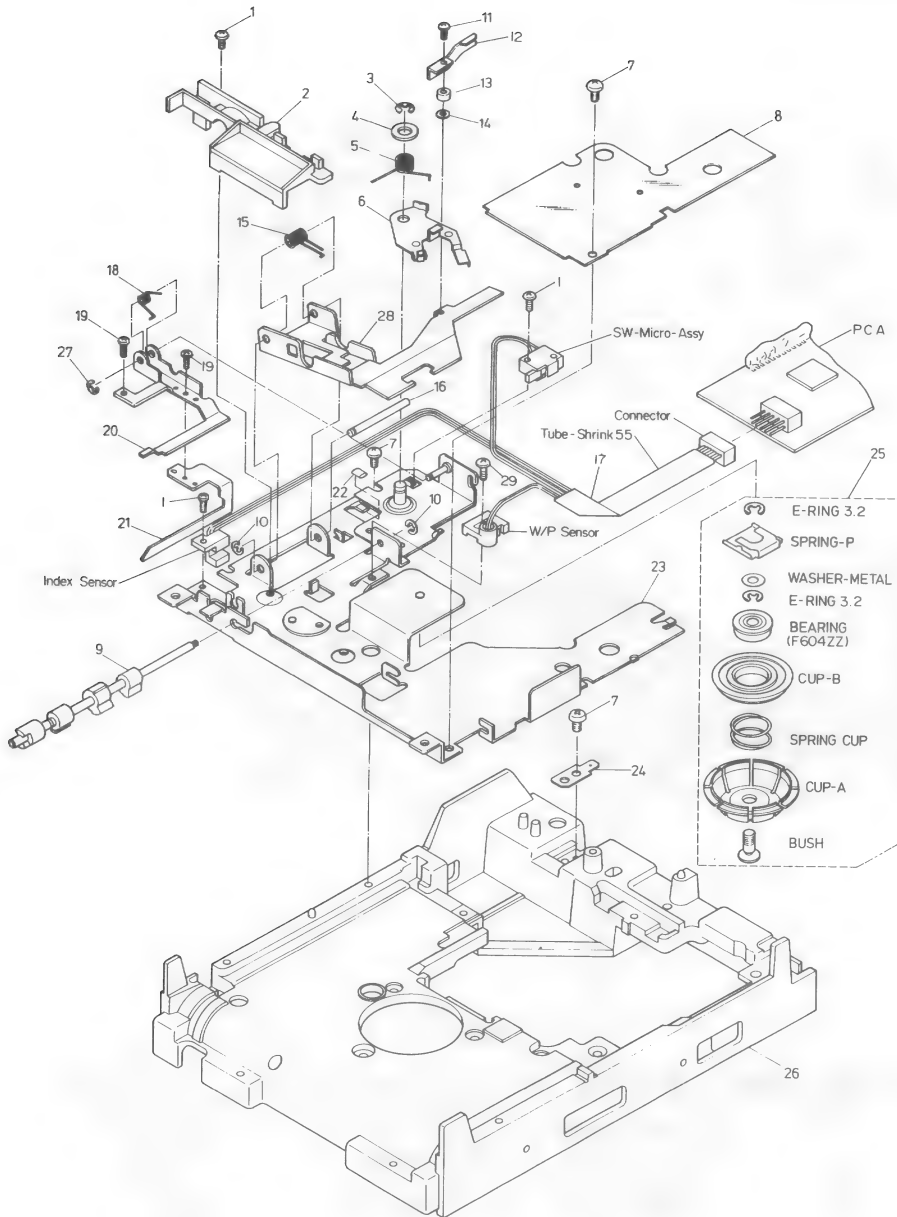


Fig. 2 Mechanism Ass'y (1)

Fig. & Index Number	Part Number	Description	Q'ty
Fig. 2			
1	U650D506H01	Mechanism Ass'y (1)	1
2	U541C058H05	Screw-B M2 x 6.5	(4)
3	U685S100H05	Holder	(1)
4	U680S100H02	E-Ring 3	(1)
5	U573D074H02	Washer-CU	(1)
6	U525C053H02	Spring-W	(1)
7	U650S063H19	Lever	(1)
8	U236D005H04	Screw-B M3 x 6	(4)
9	U536D078G01	Spacer-PVC	(1)
10	U685S100H01	Cam Ass'y	(1)
11	U650S063H02	E-Ring 2	(2)
12	U572D074H02	Screw-B M2 x 5	(1)
13	U550D834H01	Spring-P	(1)
14	U683D084H20	Spacer-Metal	(1)
15	U571D094H02	Washer	(1) or (2)
16	U531D421H01	Spring-W	(1)
17	U268C011G05	Shaft	(1)
18	U573D075H01	Sensor Ass'y	(1)
19	U650S063H77	Spring-W	(1)
20	U525C042H03	Screw-B M2 x 3	(2)
21	U546D514H03	Lever	(1)
22	U073S733H03	Holder-L	(1)
23	U580C088G07	Tube-Shrink 8 x 1	(1)
24	U442D164H01	Base Ass'y	(1)
25	U567C003G01	Terminal	(1)
26	U581A010H26	Cup Ass'y	(1)
27	U685S100H14	Frame	(1)
28	U525C045H01	E-Ring 1.5	(1)
29	U650S065H86	Lever	(1)
		Screw-B M2.6 x 4	(1)

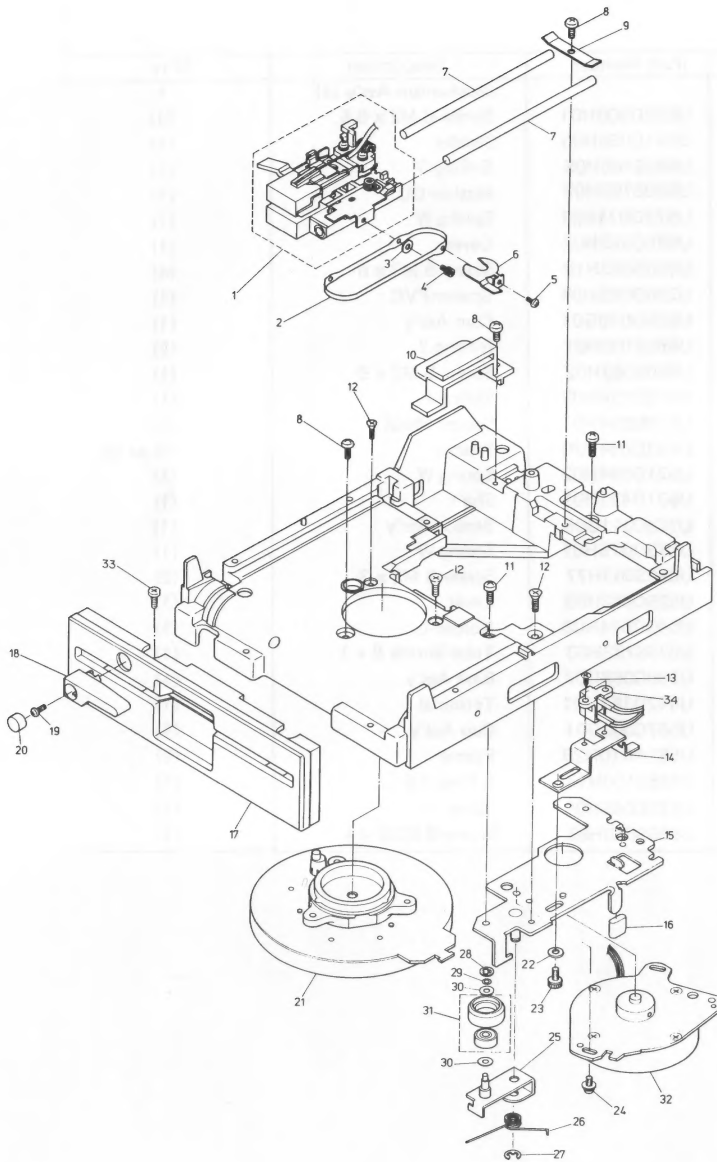


Fig. 3 Mechanism Ass'y (2)

Fig. & Index Number	Part Number	Description	Q'ty
Fig. 3		Mechanism Ass'y	1
1	U587B024G01	Carriage Ass'y	(1)
2	U521C507H03	Band	(1)
3	U680S157H02	Washer-BS 2.6	(1)
4	U667S013H01	Bolt M2.5 x 4	(1)
5	U650W021H03	Pan-FE M2.5 x 4	(1)
6	U541C071H01	Holder	(1)
7	U531D423H02	Shaft	(2)
8	U650S063H19	Screw-B M3 x 6	(4)
9	U572D055H01	Spring-P	(2)
10	U541D370H04	Holder	(1)
11	U650S063H20	Screw-B M3 x 8	(2)
12	U650S033H17	Screw-F M3 x 8	(3)
13	U650S033H02	Screw-F M2 x 6	(2)
14	U541D381H01	Holder	(1)
15	U544D197G05	Holder-F Ass'y	(1)
16	U073S733H06	Tube Shrink 13 x 2	(2)
17	U702D062G01	Panel-Front Ass'y	(1)
18	U714C014H01	Knob-Lever	(1)
19	U650S063H03	Screw-B M2 x 6	(1)
20	U567D333H14	Cap	(1)
21	U288Y026H01	Spindle Motor Ass'y	(1)
22	U680S033H03	Washer-3	(1)
23	U667S013H23	Bolt M3 x 6	(1)
24	U669S030H11	Screw-P M3 x 5	(2)
25	U525D897G03	Lever Ass'y	(1)
26	U571D093H01	Spring-W	(1)
27	U685S100H05	E-Ring-3	(1)
28	U685S140H01	CS-Ring 2	(1)
29	U680S033H01	Washer-2	(1)
30	U683S021H07	Washer-PL	(2)
31	U522D523G01	Idler Ass'y	(1)
32	U288Y030H02	Stepping-Motor	(1)
33	U650S063H20	Screw-B M3 x 8	(2)
34	U268D117G03	TK00 Sensor Ass'y	(1)

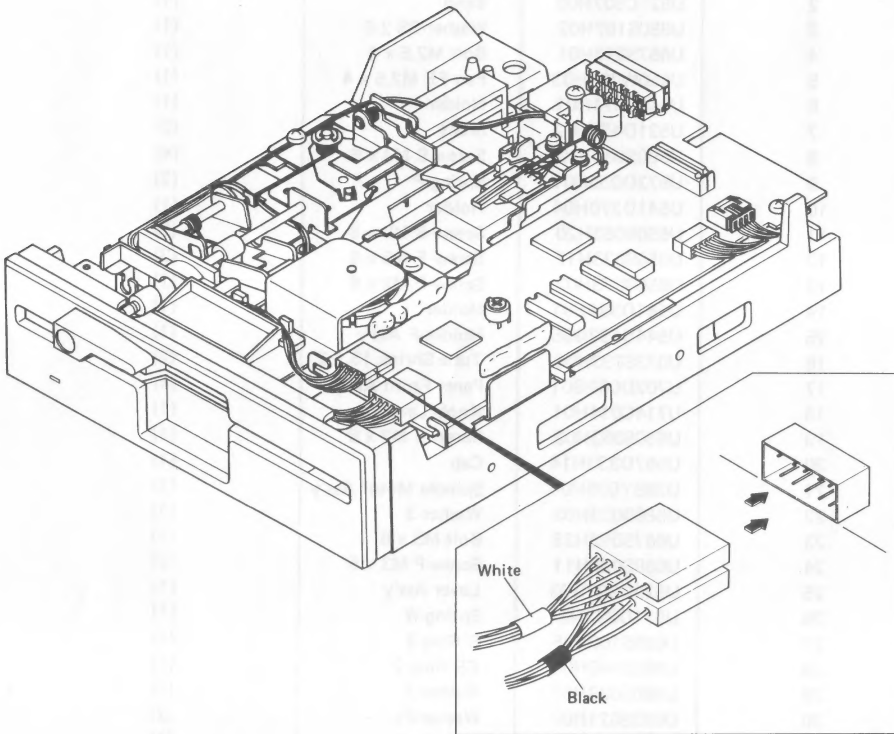


Fig. 4 Flexible Disk Drive Wiring Diagram