MITSUBISHI

5 1/4" FLEXIBLE DISK DRIVE

MODEL M4853

OEM MANUAL

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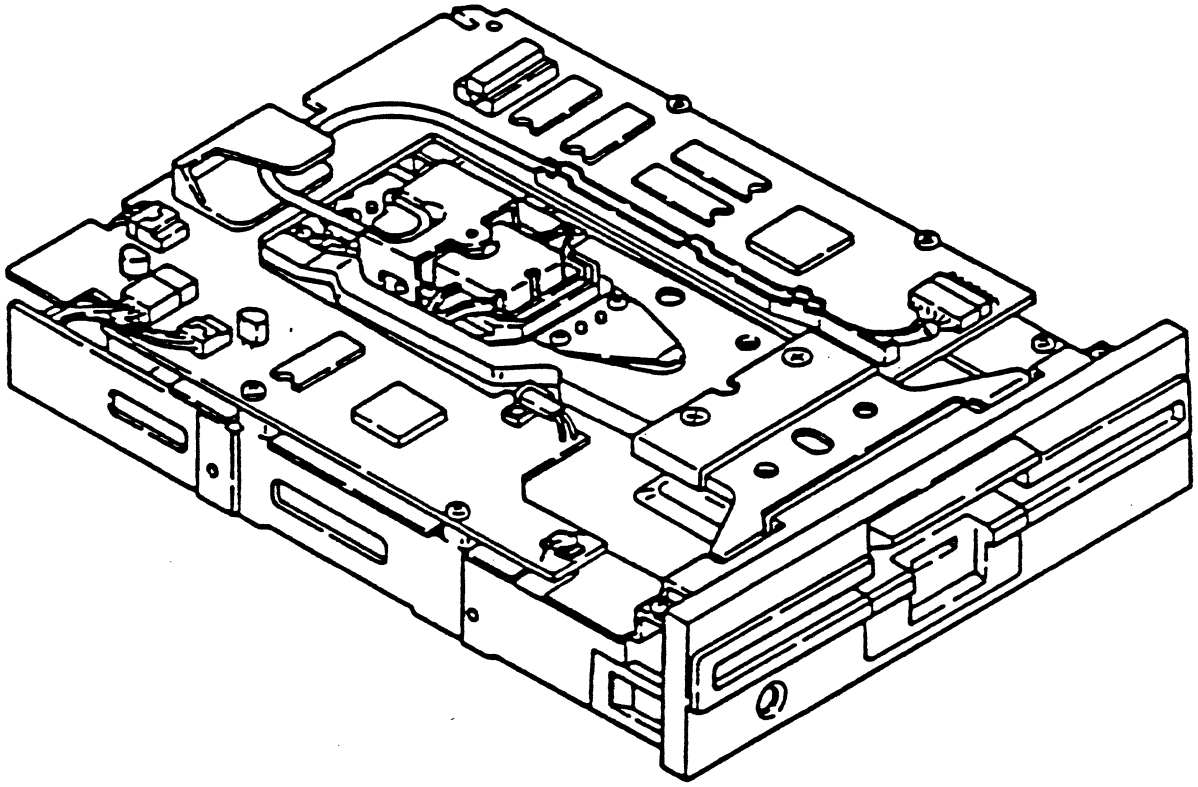


M4853-1 Flexible Disk Drive

M4B54-1S OEM MANUAL

TABLE OF CONTENTS

List of Figures

List of Tables

1. INTRODUCTION

The Mitsubishi M4854-1S is a high-performance, double-sided, double bit and double track density flexible disk drive using a high-density 5.25-inch diskette, that provides maximum customer satisfaction with high reliability and long service life.

- Main Features -

- o Has an unformatted capacity of 1.6 mega-byte, and a transfer rate of 500 kbit/sec.
- o Spindle speed can be selected from interface (360 RPM to 300 RPM). Changes disk capacity to 1.0 Megabyte.
- o Is compatible with the new IBM PC-AT (trademark of International Business Machines Corporation) "high capacity" floppy disk drive, either with a 300 or 250 Kbit/second transfer rate.
- o Is electrically compatible with 8" floppy disk drive controllers.
- o LSI ICs have been used to reduce the size of the drive and increase reliability.
- o Easily removed front panel allows packaging flexibility.
- o Includes a diskette ejector for easy diskette removal.
- o A circular gimbal spring in the read/write head suspension mechanism greatly improves medium tracking performance.
- o The steel band, flat stepping motor drive system for positioning achieves the best intertrack access time in its class: just 3 ms.
- o The maintenance-free, DC, brushless, direct-drive motor obviates the belt replacement necessary for conventional counterparts.
- o Excellent media interchangeability, wide off-track window time margin, and high performance are maintained over wide ambient temperature and relative humidity ranges.
- o The high-torque spindle motor permits control by switching on and off either the motor (starting time 500 ms) or the head load solenoid (loading time less than 50 ms).
- o Dynamic clamping insures correct disk seating with easy disk insertion.

1.1 GENERAL DESCRIPTION

- The M4854-1S Flexible Disk Drive is a twin-head, double-sided, magnetic disk drive with an unformated memory capacity of 1.6 megabyte (360 RPM), or 1.0 megabyte (300 RPM), for double-density recordings.

- For 1.6 Megabye operation the M4854-1S reads and writes 5.25-inch, double-sided high density diskettes in double-density format.

- The M4854-1S employs the unique Mitsubishi circular gimbal spring for holding and loading the magnetic heads to assure soft, steady contact with the medium. This means excellent read/write operation and a long service life for the medium. One of the outstanding features of this mechanism is reduction of the effects of jacket deformation and thickness variations, thereby stabilizing read/write performance.

- By changing the data transfer rate and/or the spindle speed, and translating track numbers given to the controller, three different types of disks may be accomodated:

  A) 96 TPI, high density disks may be read and written without restriction.

  B) 96 TPI, standard density disks may be read and written after changing either the transfer rate or the spindle speed.

  C) 48 TPI, standard density disks may be read and written on, after changing the transfer rate or the spindle speed. Once written upon by the M4854-1S, the disk cannot be reliably used in a 48 TPI disk drive again.

- The M4854-1S allows two methods of downward compatibility:

  A) 360 RPM operation, with either 500 or 300 Kbit/second transfer rates. A "low write current" input must be used to write on standard density media.

  B) The spindle speed may be lowered to 300 by use of an input to the drive. The transfer rate would be changed to 250 Kbit/second.

1.2 SPECIFICATIONS

1.2.1 Performance specifications (Table 1-1)

	360 RPM 1.6 MB	360 RPM 1.0 MB	300 RPM 1.0 MB
Memory capacity			
Unformatted			
Disk, kilobytes	1664	1000	1000
Per surface, kilobytes	832	500	500
Per track, kilobytes	10.4	6.25	6.25
Formatted			
Disk, kilobytes	1228.8	655.4	655.4
Per surface, kilobytes	614.4	327.7	327.7
Per track, bytes	7680	4096	4096
(bytes/sector)	(512)	(256)	(256)
(sectors/track)	(15)	(16)	(16)
Transfer rate, Kbits/sec	500	300	250
Average latency time	83	83	100
Motor starting time,nSec,max	500	500	400

Access time	
Track to track	3 mS maximum (unsettled)
Average	94 mS (including settling time)
Settling time	15 mS maximum
Head loading time	50 mS maximum (including settling)
Speed change time	400 nSec maximum

Table 1-1 Performance Specifications

1.2.2 Functional specifications (Table 1-2)

	360 RPM 1.6 MB	1.0 MB	300 RPM 1.0MB
Recording density	9870	5922	5922
Magnetic flux inversion density	9870 FCI	5922	5922
Encoding method	MFM	MFM	MFM
Track density	96	96	96
Number of cylinders	80	80	80
Number of tracks	160	160	160
Number of heads	2	2	2
Rotation period	166.7 ± 3.3 mSec		
Index	1		
Media	Double-sided 96 TPI, double density, high-density 5.25 inches diskette, soft sectored		
	Examples:		
	Brown Disk Mfgr.	UHR-2	
	Maxell	MD2-HD	
	Memorex	20-80-HD	
	BASF	HDFD	
	Dysan	UHR-2	

Table 1-2 Functional Specifications

1.2.3 Physical specifications (Table 1-3)

DC power requirements	
+5 V	+5 V 5%, 0.5 A typical (seeking)
+12 V	+12 V 5%, 0.5 A typical (seeking)
Heat dissipation	8.5 watts typical, seeking
	5.0 watts typical, reading in standby mode
	4.0 watts typical motor off
Physical dimensions	(Except for front panel)
Height	1.62 in (41 mm)
Width	5.75 in (146 mm)
Depth	7.68 in (195 mm)
Front panel dimensions	
Height	1.65 in (42.0 mm)
Width	5.83 in (148.0 mm)
Weight	2.9 lbs (1.3 kg)

Table 1-3 Physical Specifications

1.2.4 Environmental Specifications (Table 1-4)

Operating environmental conditions	
Ambient temperature	5 to 46 Deg. C (41 F tc 115 F)
Relative humidity	20% to 80% (Maximum wet bulb temperature: 29 C (85 F)
Shock	2.5 G Max (20 mSec)
Vibration	0.25 G Max (5-200 Hz.)
Altitude	-300 to 3000 meters
Non-operating environmental conditions	
Ambient temperature	-20 to 51 Deg. C (-4 F to 125 F)
Relative humidity	5% to 95%, non-condensing
Shock	30 G Max (20 mSec)
Vibration	3.0 G Max (5-200 Hz.)
Altitude	-300 to 3000 meters
Transportation environment conditions (max 72 hours)	
Ambient temperature	-40 to 62 Deg. C (-40 to 144 Deg. F)
Relative Humidity	1% to 95%, non-condensing

Table 1-4 Environmental Specifications

1.2.5 Reliability specifications (Table 1-5)

MTBF	10,000 POH (Power On Hours) minimum
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
Tap-tap	5×10^{4} on the same spot of a track
Error rate	
Soft read error	10^{-9} bit (2 retries)
Hard read error	10^{-12} bit (10 retries)
(Both hard and soft error rates assume a 100% open MFM data and clock window, and a correctly operating phase-lock loop data separator)	
Seek error	10^{-6} seek

Table 1-5 Reliability Specifications

2. GENERAL OPERATION

2.1 SYSTEM OPERATION

The M4854-1S Flexible Disk Drive consists of a medium rotating mechanism, two read/write heads, an actuator to position the read/write heads on tracks, a solenoid to load the read/write heads on the medium, 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 motor, and rotates it at 360 or 300 RPM. The positioning actuator moves the read/write to be head over the desired track of the medium. Then, the head loading solenoid loads the read/write head on the medium to read or write data.

2.2 ELECTRONIC CIRCUITS

The electronic circuits driving the individual mechanisms of the M4854-1S are located on a single printed-circuit board, which consists of the following circuits:

- Line driver and receiver that exchanges signals with the host system
- Drive selection circuit
- Index detection circuit
- Head positioning actuator drive circuit
- Head loading solenoid drive circuit
- Spindle motor control speed circuit
- Read/write circuit
- Write protect circuit
- Normal/low write current selection circuit
- Track 00 detection circuit
- Drive ready detection circuit
- Head selection circuit
- In use indicator LED drive circuit

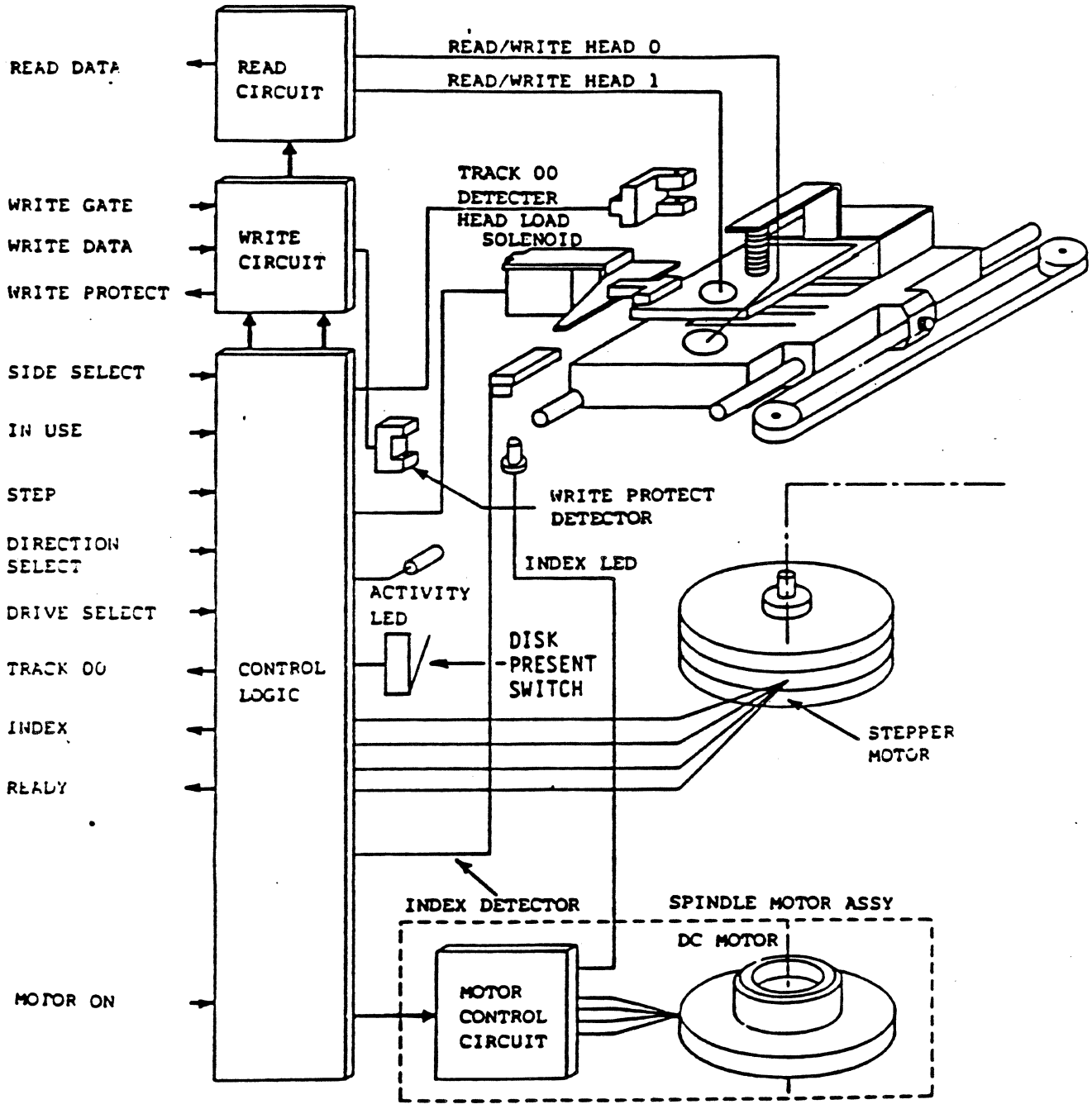


Figure 2-1 M4854-1S Functional Diagram

2.3 ROTATION MECHANISM

The diskette rotation mechanism uses a DC brushless direct-drive motor to directly rotate the spindle at 300 or 360 RPM.

2.4 POSITIONING MECHANISM

The positioning mechanism is a high-performance steel band type.

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

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

2.5 READ/WRITE HEADS

The read/write heads use MnZn magnetic ferrite.

Each read/write head has three ferrite cores, consisting of a 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 the disk between them, are mounted on compliant, circular gimbal springs so that the heads track the disk with good contact to enable maximum reproduction of the signals from the disk. The high surface tracking ability of the circular gimbal keeps the disk free of stress, and thus improves diskette life.

3. FUNCTIONAL OPERATION

3.1 POWER ON SEQUENCING

No operation may be performed for a period of 100 msec after the application of DC power to the drive.

The read/write head may be positioned on an incorrect track after switching the DC power on, so before starting a read/write operation, perform a step out operation until a track 00 signal is detected, thus correctly positioning the head at a known position.

3.2 DRIVE SELECTION

The M4854-1S daisy chain cabling system permits connection of multiple drives with a single cable.

These drives are selected when the drive select lines from the controller 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 drives 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 output signals of the drives.

3.3 POSITIONING OPERATION

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

Head movement occurs with the trailing edge of the step pulse.

It is allowable to read (and sometimes write) a 48 TPI disk in a 96 TPI disk drive. But the software must command the controller to move two "96 TPI" tracks for one 48 TPI track.

3.4 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.

3.5 READ OPERATION

Three modes of encoding, FM, MFM, or MMFM are used for the data stored on media. FM is used for single-density recording, and MFM or MMFM for double-density recording.

The required timing of operations for reading is described in Chapters 4 and 8.

A comparison of the FM and MFM encoding modes is shown in Fig. 3-1. See chapter 8 for a complete description of encoding methods.

3.6 WRITE OPERATIONS

Write data can be encoded by either FM, MFM, or MMFM. The M4854-1S 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). However, if it is desired precompensation of 150 nSec or smaller should be used on tracks 43 and above, and none should be used on lower numbered tracks.

When using the drive in a 300 or 250 K bit/second transfer rate mode no precompensation can be used. Doing so will only reduce the read data window margins.

The required timing of operations for reading is described in Chapters 4 and 8. See chapter 8 for a complete description of encoding methods. See Figure 3-2 for allowable read/write combinations between different types of drives.

3.7 DISK INSERTION

The sequence of events that occur with disk insertion are:

1) The user inserts the disk into the drive until audible "click" is heard. This indicates that the drive ejection mechanism has received the disk.

2) When the disk is fully inserted into the drive, a mechanical switch is actuated, and the spindle motor starts to rotate.

3) The user clamps the disk on to the rotating spindle using the bridge handle. The handle is moved until an audible click is heard.

4) The disk starts to rotate, and the index sensor begins to detect pulses of light from the index LED.

5) The index pulses are deteced in a minimum period of time, which switches the "held ready" logic to a true state. (If the disk is <u>not</u> properly seated, this will not occur because the index hole in the disk will never allow light to strike the presise location required to activate the photo-transistor that is the index pulse sensor.) The spindle motor is turned off.

6) Option jumper HC may be used to load the head on to the disk at this time. This is desirable if the user wishes to eliminate the head load and settling times associated with motor start/stop operation.

3.8 DISK REMOVAL

To remove the disk from the drive the user depresses the front panel door flap, which releases the bridge handle. The ejector mechanism then transports the disk out of the drive into the users fingers.

This action also resets the "held ready" status to a false condition, or the "disk change" status to a true condition, which can be detected by having the system controller poll the drive for its status.

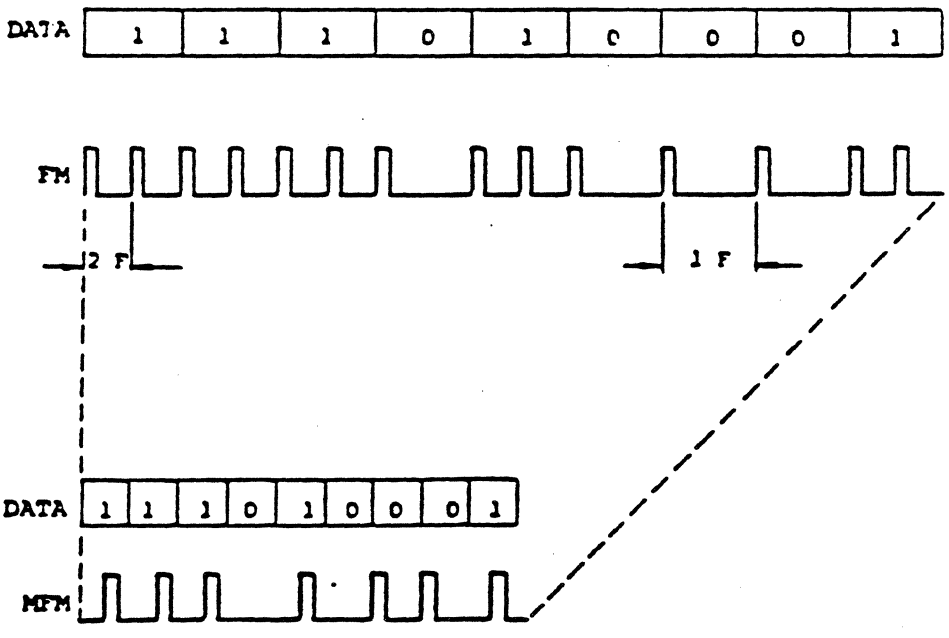


Figure 3-1 Comparison of FM and MFM Encoding

CAN DISKETTE BE READ BY THIS DRIVE/MODE	DISKETTE WRITTEN BY THIS DRIVE/MODE										
	M4851		M4853		M4854-1/3B			M4854-1/3S		
	0.5 MB 48 TPI 250 Kb/Sec 300 Oe Media	0.5 MB 48 TPI Note (1) 250 Kb/Sec 300 Oe Media	1.0 MB 96 TPI 250 Kb/Sec 300 Oe Media	0.5 MB 48 TPI Note (2) 300 Kb/Sec 300 Oe Media	1.0 MB 96 TPI Note (3) 300 Kb/Sec 300 Oe Media	1.6 MB 96 TPI 500 Kb/Sec 600 Oe Media	0.5 MB 48 TPI Note (4) 250 Kb/Sec 300 Oe Media	1.0 MB 96 TPI Note (5) 250 Kb/Sec 300 Oe Media	1.6 MB 96 TPI 500 Kb/Sec 600 Oe Media
M4851 0.5 MB 48 TPI 250 Kb/Sec 300 Oe Media	X	NO	NO	NO	NO	NO	NO	NO	NO
M4853 0.5 48 TPI Note (1) 250 Kb/Sec 300 Oe Media	YES	X	NO	YES	NO	NO	YES	NO	NO
M4853 1.0 MB 96 TPI 250 Kb/Sec 300 Oe Media	NO	NO	X	NO	YES	NO	NO	YES	NO
M4854-1/3B 0.5 MB 48 TPI Note (1) 300 Kb/Sec 300 Oe Media	YES	YES	NO	X	NO	NO	YES	NO	NO
M4854-1/3B 1.0 MB 96 TPI 300 Kb/Sec 300 Oe Media	NO	NO	YES	NO	X	NO	NO	YES	NO
M4854-1/3B 1.6 MB 96 TPI 500 Kb/Sec 600 Oe Media	NO	NO	NO	NO	NO	X	NO	NO	YES
M4854-1/3S 0.5 MB 48 TPI Note (4) 250 Kb/Sec 300 Oe Media	YES	YES	NO	YES	NO	NO	X	NO	NO
M4854-1/3S 1.0 MB 96 TPI Note (5) 250 Kb/Sec 300 Oe Media	NO	NO	YES	NO	YES	NO	NO	X	NO
M4854-1/3S 1.6 MB 96 TPI 500 Kb/Sec 600 Oe Media	NO	NO	NO	NO	NO	YES	NO	NO	X

NOTES

1. The 96 TPI head must be "double stepped" by controller
2. The 96 TPI head must be "double stepped" by controller. Write current must be reduced.
3. Write current must be reduced.
4. The 96 TPI head must be "double stepped" by controller. Speed reduced to 300 RPM.
5. Speed reduced to 300 RPM.

Figure 3-2 Read/Write Drive Compatibility

4. 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 M4854-1S and the host system via the J1/P1 connector.

The DC power interface drives the spindle drive motor of the M4854-1S, 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.

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

Table 4-1 DC Power Connector Pin Assignments (J2/P2)

Signal	Type	Signal Pin No.	Ground/Return Pin No.
LOW WRITE CURRENT(SB) LOW SPEED (SS) HEAD LOAD (HH)	Input	2	1
IN USE	Input	4	3
DRIVE SELECT 3	Input	6	5
INDEX	Output	8	7
DRIVE SELECT 0	Input	10	9
DRIVE SELECT 1	Input	12	11
DRIVE SELECT 2	Input	14	13
MOTOR ON	Input	16	15
DIRECTION SELECT	Input	18	17
STEP	Input	20	19
WRITE DATA	Input	22	21
WRITE GATE	Input	24	23
TRACK 00	Output	26	25
WRITE PROTECT	Output	28	27
READ DATA	Output	30	29
SIDE ONE SELECT	Input	32	31
READY/DISK CHANGE	Output	34	33

Table 4-2 Signal Connector Pin Arrangement (J1/P1)

4.1 SIGNAL INTERFACE

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

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

4.1.1 Cabling method and input line termination

The M4854-1S uses a daisy chain cabling system. 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. 4-1. A maximum of eight input signal lines, plus the drive select lines, may be terminated at the M4854-1S. 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 M4854-1S has a resistor pack in a socket 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 at the end of the interface cable, and disconnect the terminators in all the other drives.

4.1.2 Line Drivers and Receivers

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.

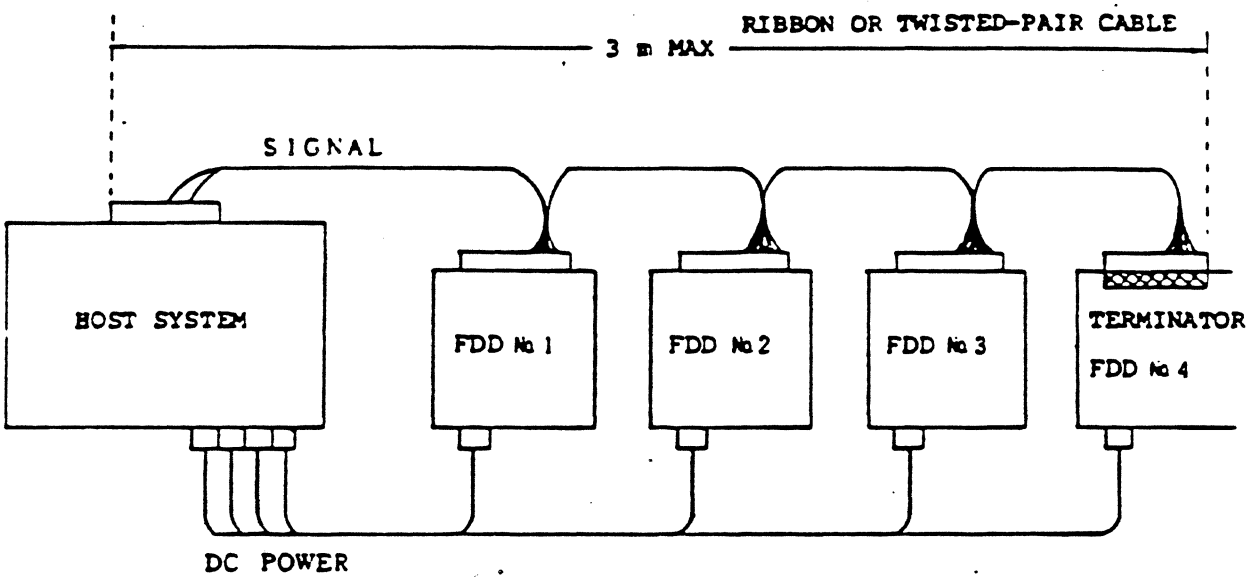


Figure 4-1 Cabling Method

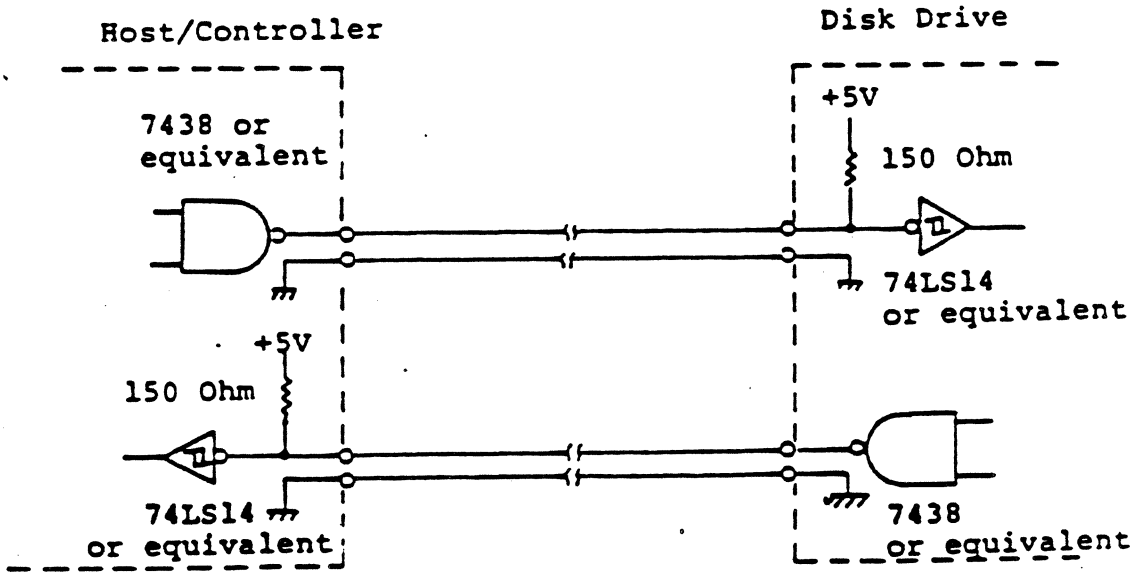


Figure 4-2 Recommended Line Driver and Receiver Circuit

4.1.3 Input Signal Lines

The M4854-1S 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:

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

4.1.3.1 Drive select 0 to drive select 3

When one of these drive select lines are at logical "0" level, the 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 multiplexing them. Jumper pins DS0, DS1, DS2, and DS3 on the printed-circuit board are used to select the drives to be made active,corresponding to drive select lines.

DS0 is shorted before shipment from the factory, so this setting must be changed when establishing other drive identifications are desired.

See figure 4-3 for timing details.

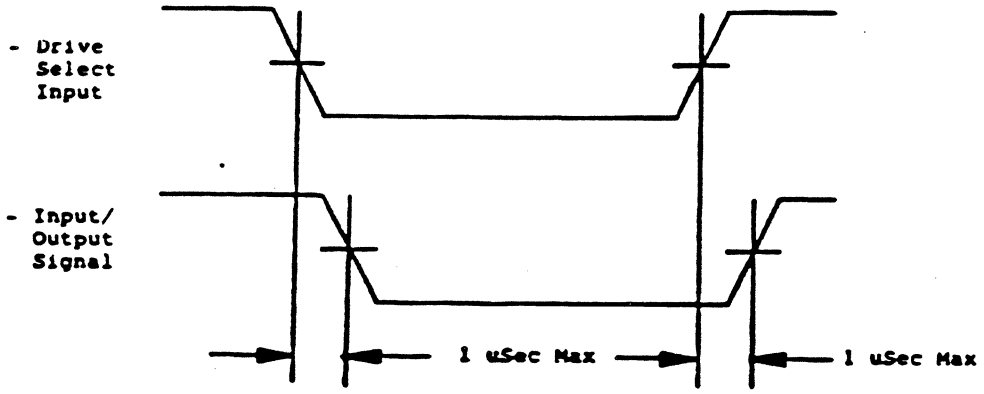


Figure 4-3 Drive Select Timing

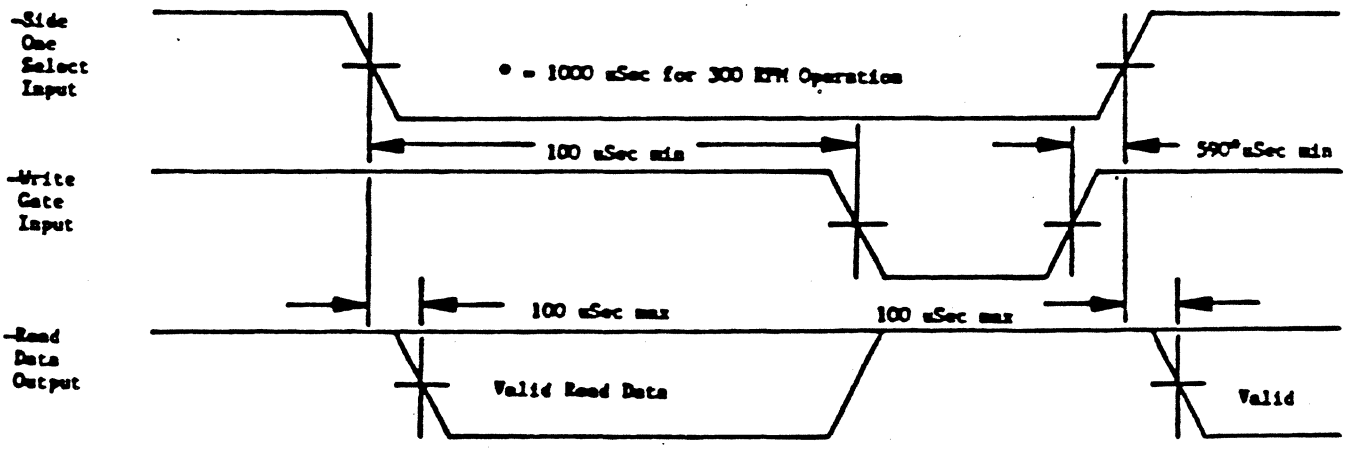


Figure 4-4 Side Select Timing

4.1.3.2 Side one select

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

Upon completion of a write operation, reverse the polarity of the side one select signal after a delay. The heads are tunnel erase type, with a physical gap deviation between the read/write head and the erase heads so with no delay non-erased areas would be generated on the diskette due to a timing difference between the write data area and the erase area during write operation. This is prevented by delaying the erase current cutoff time of a few hundred microseconds within the M4854-1S. Therefore, the head select must not be reversed during this delay time. Also, track access action is not permitted immediately after a write operation. See Figure 4-4 for details.

4.1.3.3 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. See Figure 4-5 for timing details.

4.1.3.4 Step

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

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

4.1.3.5 Write gate

When this interface line goes to logical "0", the write driver becomes active and the data given to the write data line is written on the selected side of the diskette. When the interface line goes to logical "1", the write driver becomes inactive to enable the read data logic. The verified read data is obtained sometime after the write driver becomes inactive. See figure 4-6 for timing details.

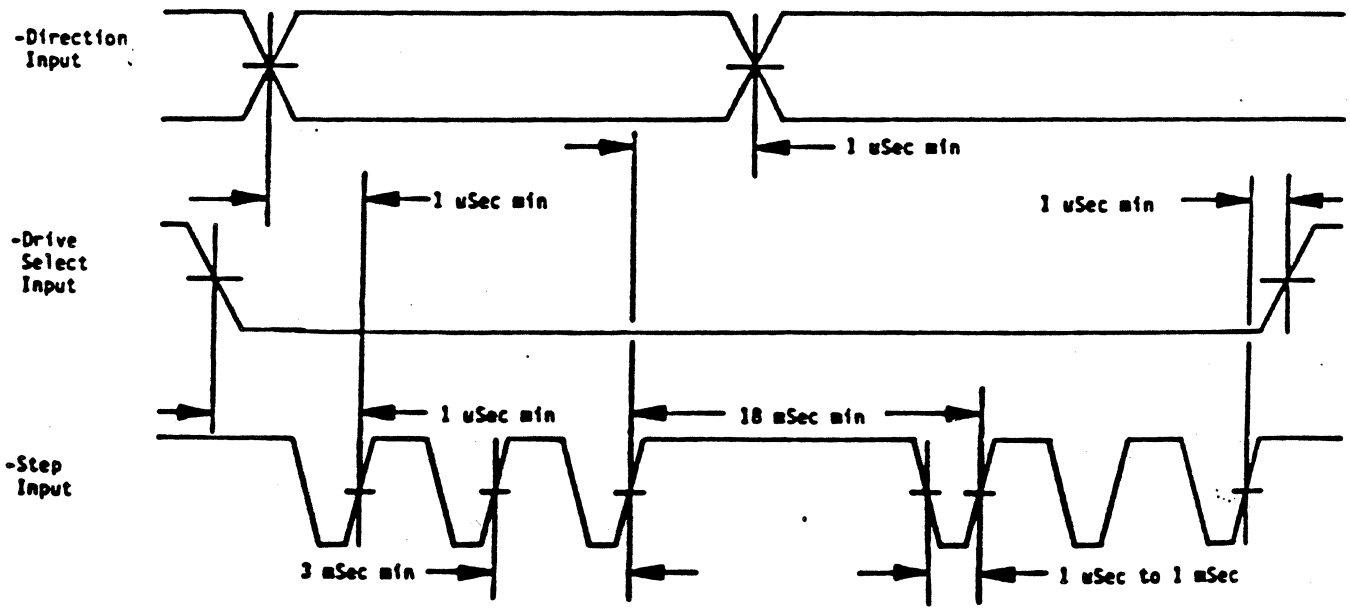


Figure 4-5 Step Timing

4.1.3.6 Write data

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

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

This line is enabled when the write gate is at logical "0", figure 4-6 shows the write data timing with to other signals. See Chapter 8 for data encoding specifics.

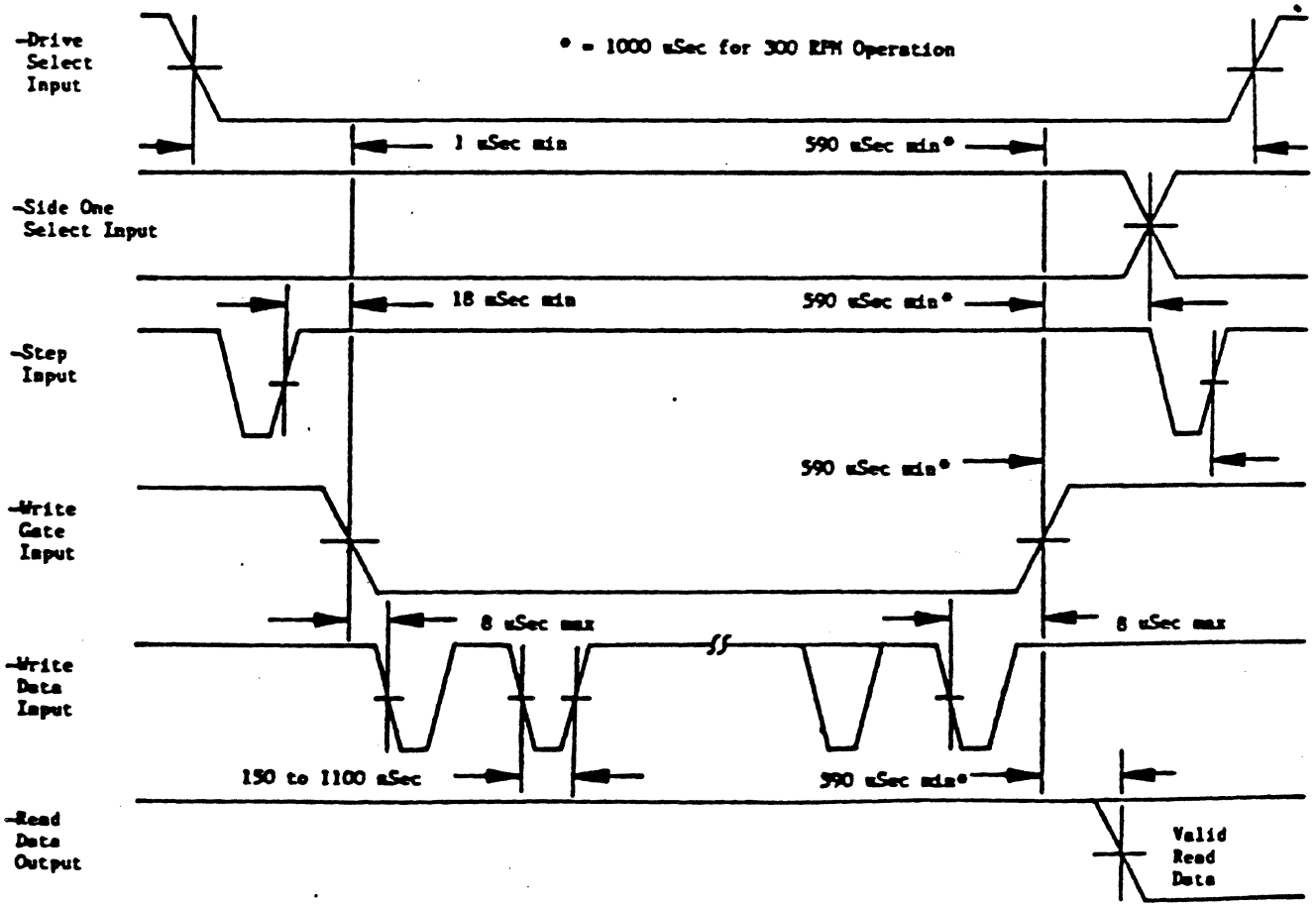


Figure 4-6 Write Gate Timing

4.1.3.7 In use

An LED indicator on the front panel lights when this interface line goes to logical "0". The LED can also be lit by drive select. See Section 7.0 for related options.

4.1.3.8 Motor on

This interface line starts the spindle motor when it goes to logical "0". See Chapter 7 for related options.

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

4.1.3.9 Low Write Current, Low Speed, Head Load

This input has three possible uses, depending on which options are selected on the main PCB. See Chapter 7 for the specific option settings.

Low Write Current:

This interface input is a logical "1" for high density disk operations. It is changed to a logical "0" only when writing on a low capacity disk. This is necessary to insure reliable read/write operation. The state of this input must be held constant for a minimum of 590 uSec after the Write Gate input goes to a logical "1", (high) level.

Low Speed:

Bringing this input to a "low" state causes the spindle motor to slow to 300 RPM. A transfer rate of 250 Kbit/sec must be used in this mode, along with narmal density media. The write current is also lowered by this selection.

Head Load:

It is possible to use pin 2 as a head load control input, but only if it is used exclusively in the 1.6 megabyte mode. See Chapter 7 for complete details.

4.1.4 Output signal lines

The M4854-1S has five standard output signal lines. All of them are multiplexed by the drive select lines. Until the unit is enabled by its drive select input, all of the outputs are in the "off" state.

4.1.4.1 Index

This interface line is normally logical "1" but sends a logical "0" output pulse 3 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 Figure 4-7.

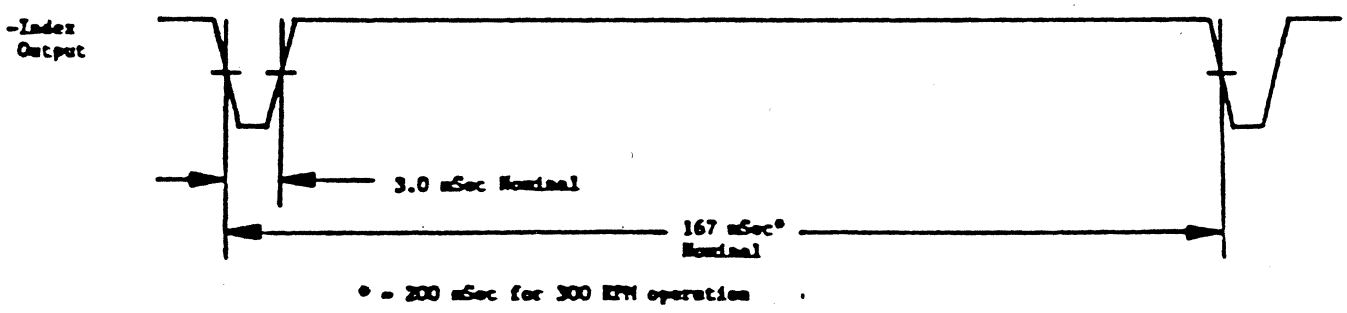


Figure 4-7 Index Output Timing

4.1.4.2 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. See Figure 4-8 for timing details.

4.1.4.3 Read data

This interface line transmits the data that is detected by the read/write head on the diskette.

The read data line is normally logical "1" but it sends a logical "0" (negative-going) output pulse during a read operation. Refer to Chapters 7 and 8 for timing details.

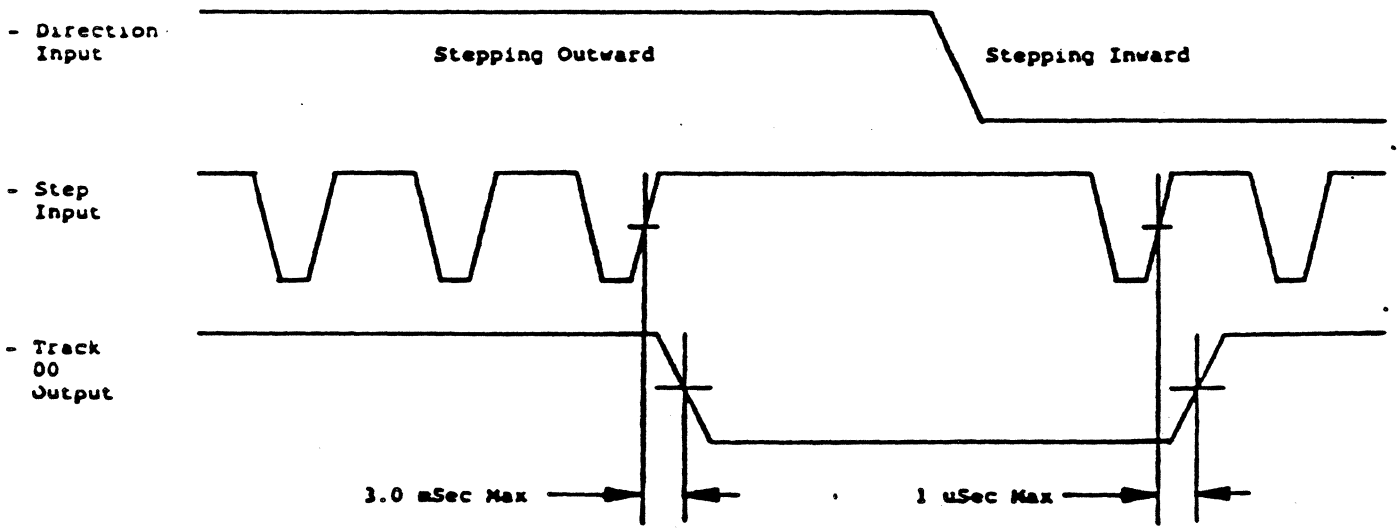


Figure 4-8 Track 00 Timing

4.1.4.4 Ready/Disk Change

This interface line is logical "1" when the door is open or no diskette is in the drive. The line goes logical "0" (ready) if an index pulse is detected twice or more, DC power (+5 V and +12 V) is within limits, and a diskette is inserted into the drive and the door is closed. See Chapter 7 for related options, and Figure 4-9 for timing details.

A "disk change" feature is also available on this output. This is used when knowledge of a disk change is the drive is necessary for software reasons.

4.1.4.5 Write protect

This interface signal notifies the host system of the insertion of a diskette without a write enable 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", writing on the diskette is inhibited even if the write gate line becomes active.

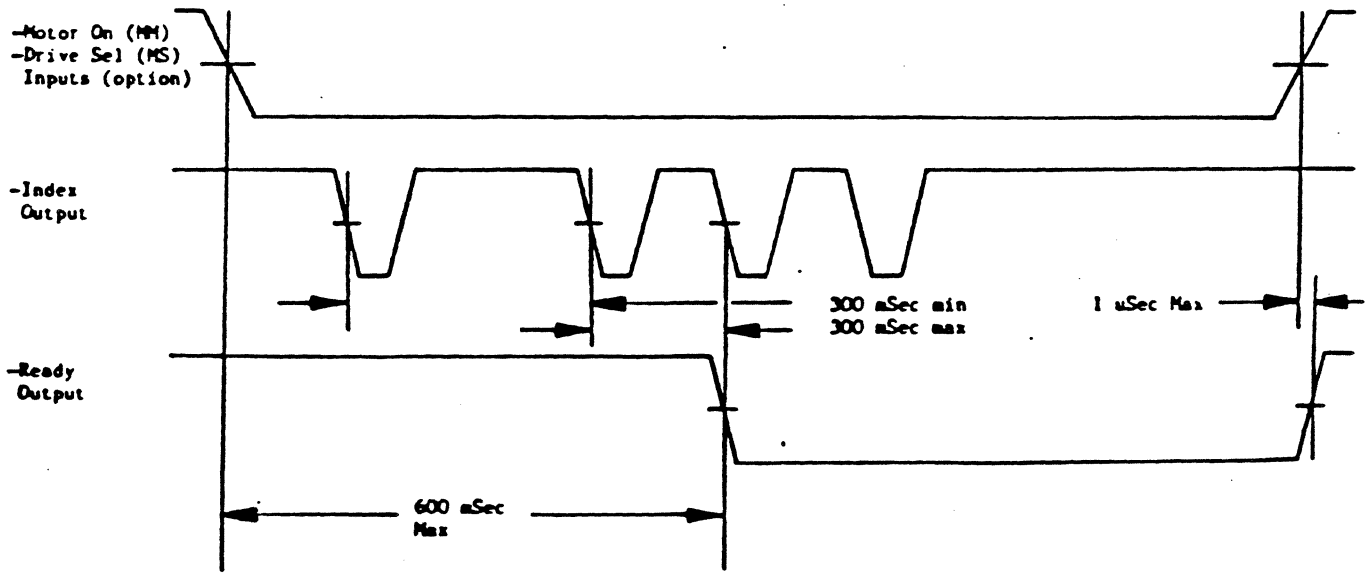


Figure 4-9 Basic Ready Timing

4.2 POWER INTERFACE

The M4854-1S requires two types of DC power supplies.

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

4.2.1 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 4-3. The pin arrangement of connector J2/P2 is shown in Table 4-1.

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

Table 4-3 DC Power Specifications

5. PHYSICAL INTERFACE

Electronic interfaces between the M4854-1S and the host system are accomplished with three connectors. Connector J1 is for the signal interfaces, connector J2 for the DC power supplies, and connector J5 for frame grounding. The connectors used for the M4854-1S and recommended mating connectors are described below.

5.1 SIGNAL CONNECTOR

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.

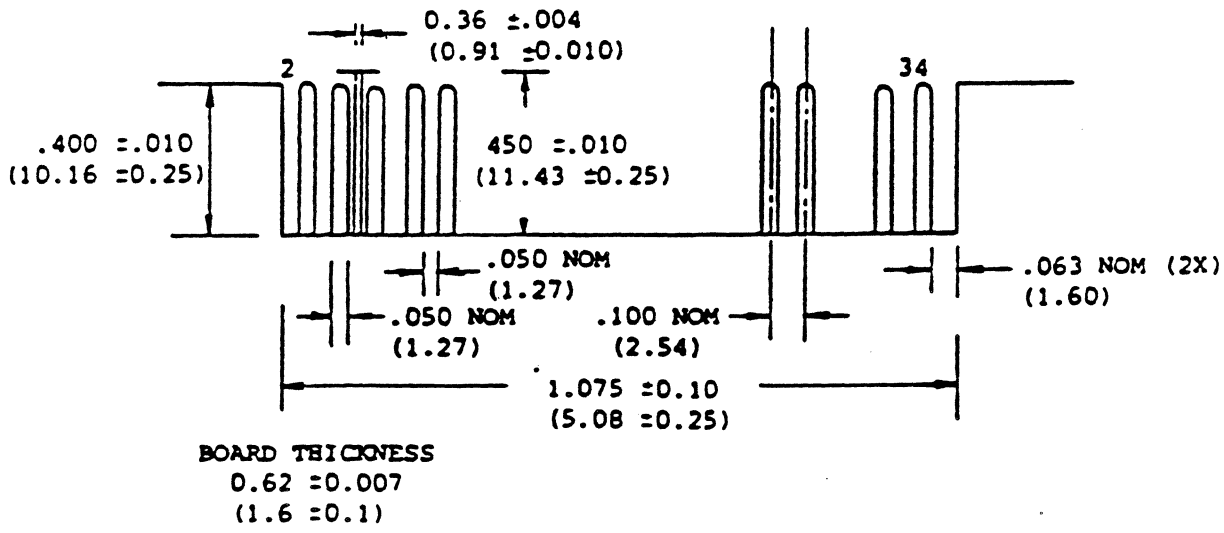


Fig. 5-1 Connector J1 Dimensions (mm) and Pin Numbers

Parts	Crimp type AMP P/N	Solder Type 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 maximum)	AWG 26	AWG 26

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

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

Table 5-2 Connector for Flat Cable (P1)

5.2 DC POWER CONNECTOR (J2/P2)

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

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

Parts	P2 (Cable Side) AMP P/N	J2 (Drive Side) 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	-

Table 5-3 DC Power Connectors

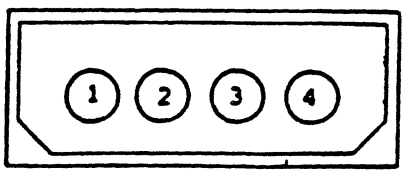


Figure 5-2 Connector J2

5.3 FRAME GROUND CONNECTOR (J5/P5)

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

5.4 INTERFACE CONNECTOR PHYSICAL LOCATION

Figure 5-3 shows the physical locations of the interface connectors used for the M4854-1S.

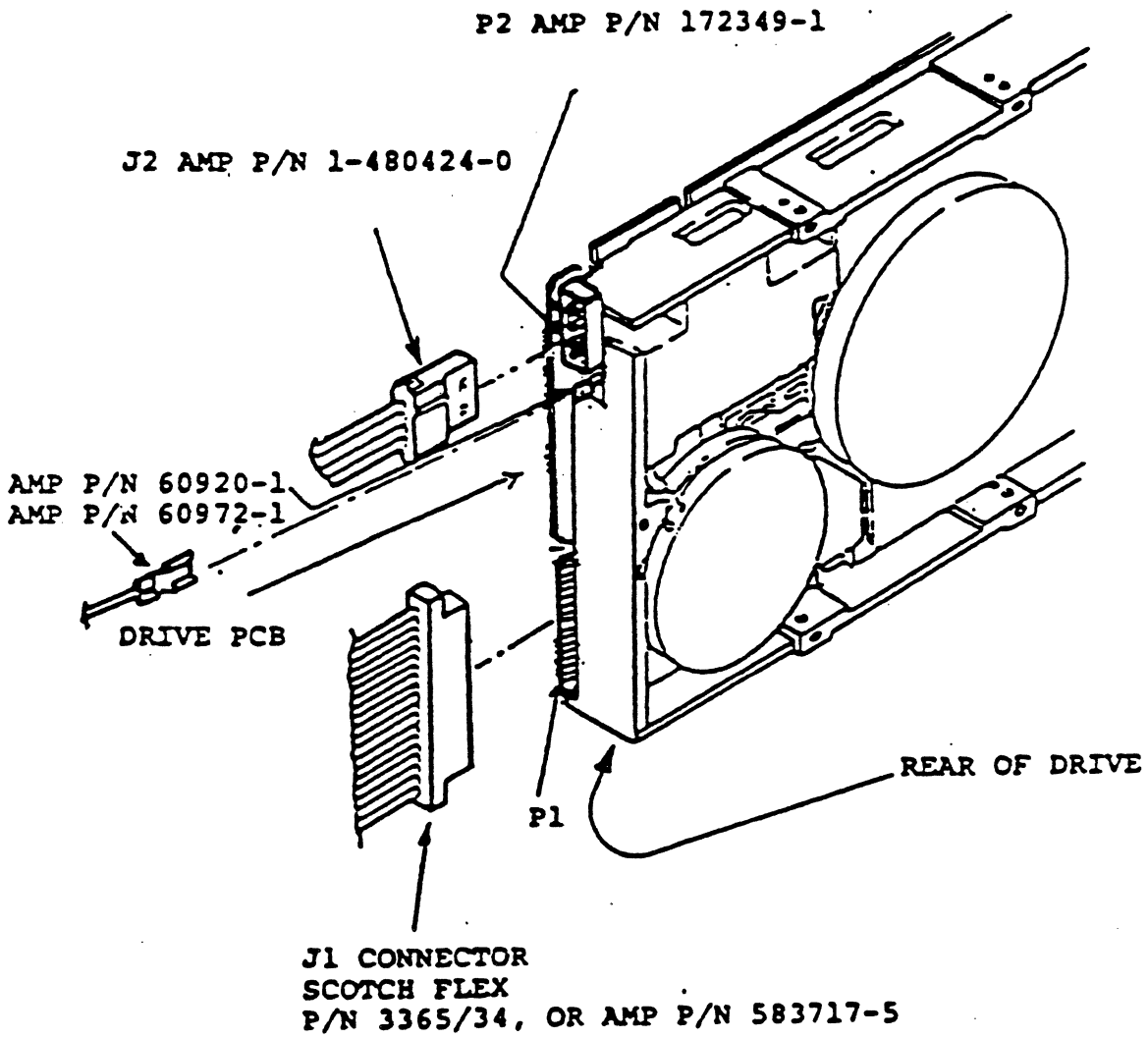


Figure 5-3 Connector Location Diagram (Rear View)

6. PHYSICAL SPECIFICATIONS

6.1 INSTALLATION DIRECTION

The M4854-1S disk drive shown in Fig. 6-1.

Slant mounting should be within 10 degrees of perpendicular.

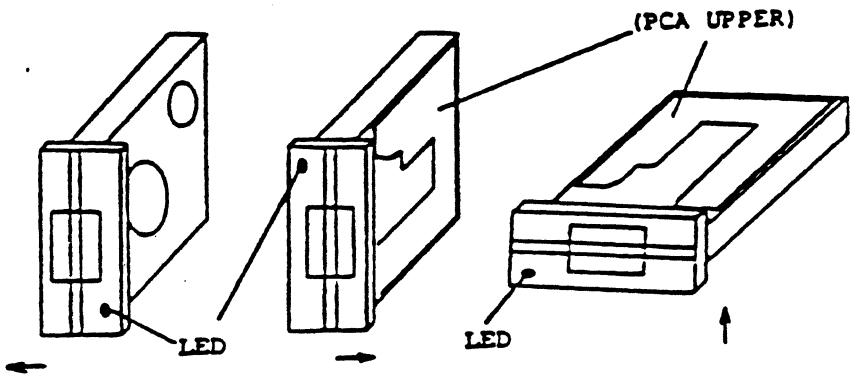
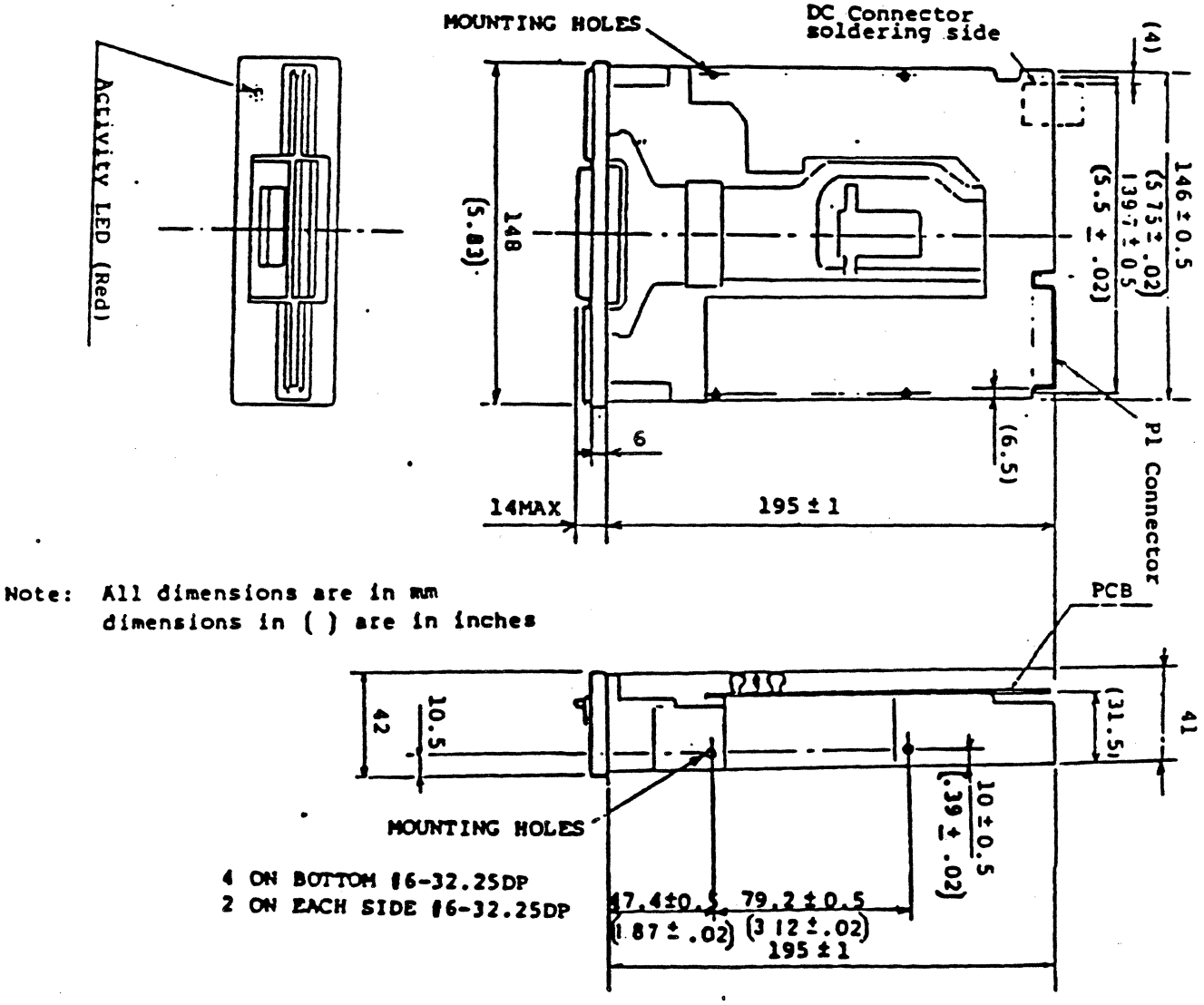


Fig. 6-1 Disk Drive Installation Directions

6.2 DIMENSIONS OF M4854-1S

See Fig. 6-2



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

Figure 6-2 Dimensions of M4854-1S

7. USER OPTIONS

Non-standard modes of operation are available to the customer by using option plugs, and some PCB cut and/or jumpers. When using a plug, installing the option plug on a pair of square pins is a "short" condition, and removing it is an "open". A trace or a soldered wire jumper between two pads is a "short", and none is a "open".

If necessary, these plug-on jumpers may be purchased from ELCO, with a part number of 00-8261-0282-00-878.

The specific options are explained below.

7.1 DRIVE SELECT OPTIONS

7.1.1 DS0 TO DS3

When two or more FDDs are connected to the system, jumper one of the four choices to allow the drive to be enabled when the particular select line is taken to a logical "0" condition.

Only one drive per system may be designated for each drive number. In other words, there can only be one drive "0", etc. in a system.

7.1.2 MX

If only one FDD is in a system, this option may be used to constantly select the drive. It causes the drive to ignore the status of the "DS" lines.

This jumper must be removed in multi-drive systems.

7.1.3 TD

This option allows the user to have the <u>same</u> DS line (DS0, DS1, DS2, DS3) used on more than one drive. Specifically, it disconnects the discrete terminating vesistor that is connected to the DS inputs. This would <u>only</u> be used for special test situations.

7.2 MOTOR CONTROL OPTIONS

Various ways of turning on the spindle motor are available to the user. The controller design and the timing requirements of the total system must be considered for this.

7.2.1 Motor On Input

MM = Short
MS = Open

This combination will cause the spindle motor to rotate if a logical "0" is present at the motor on input, and a disk is installed in the drive.

7.2.2 Drive Select Input

MM = Open
MS = Short

This combination will cause the spindle motor to rotate if one of the drive select inputs goes to a logical "0", and a disk is installed in the drive.

7.2.3 Motor On or Drive Select Inputs

MM = Open
MS = Open

This combination will cause the spindle motor to rotate if either the motor on or a drive select input goes to a logical "0" level, and a disk is installed in the drive.

7.2.4 In-Use Latched Input

MM = Short
MS = Short
IU = Short

This combination will cause the spindle motor to rotate if the in-use input and the drive select input are such that the in-use condition is latched, and a disk is installed in the drive. See Figure 7-1 for timing details.

7.2.5 Dual Speed Operation

SS = Short
SB = Open

This combination allows the drive to be used in a dual speed mode. Normally, the drive will be in 360 RPM, 500 Kbit/sec, mode. If pin 2 of P1/J1 is made "low", the drive changes to 300 RPM, 250 Kbit/second operation.

7.2.6 Single Speed Operation

SS = Open
SB = Short

This combination will cause the floppy disk to always rotate at 360 RPM. The transfer rate is 500 Kbit/sec for 1.6 Mbyte and 300 Kbit/sec for 1.0 and 0.5 Mbyte capacity. The "Low Write Current" input must be taken "low" to correctly record on a normal density floppy diskette.

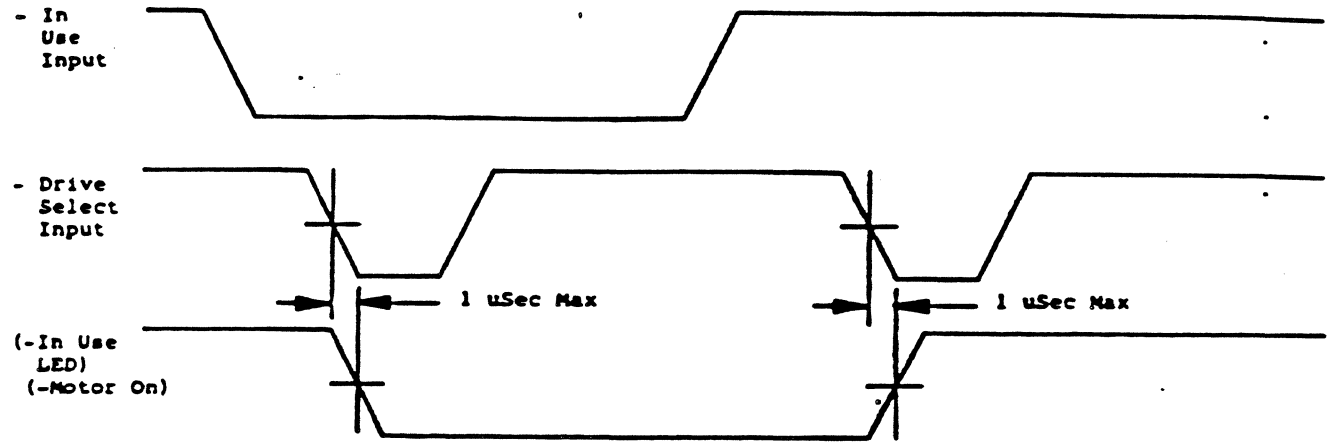


Figure 7-1 In-Use Latch Timing

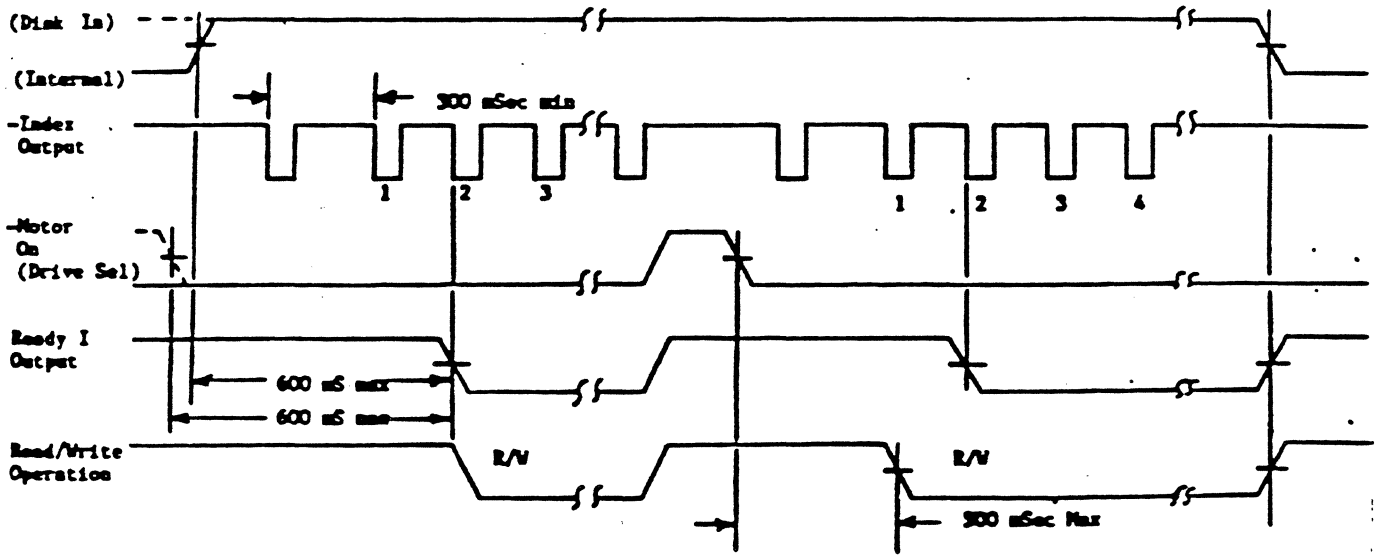


Figure 7-2 Current Ready (I) Timing

7.3 READY/DISK CHANGE OUTPUT OPTIONS

Depending on the controller design and the system timing requirements different ready output options may be selected.

7.3.1 Current Ready (I) Option

2S = Open
DC = Open

This combination will have the drive ready output follow the rotation of the disk. If the disk is not rotating the output will be a logical "1". If the disk is rotating and two index pulses have been sensed in the correct amount of time the output will be a logical "0". See Figure 7-2 for timing details.

7.3.2 Held Ready (II) Option

2S = Short
DC = Open

This combination will have the drive ready output go to a logical "0" state during the dynamic clamping sequence and stay at "0" until the disk is ejected from the drive. See Figure 7-3 for timing details.

7.3.3 Disk Change Option (Drive Select Reset)

2S = Short
DC = Short

This combination will cause the drive ready output to be a logical "1" whenever a disk is properly installed in the drive. (Note that the polarity of this is reversed from the previous options) As seen in Figure 7-4, this option is best used with a system controller that "polls" the disk drives for their status. This is because it is not the insertion of the disk that resets the "disk change" flip-flop, but the "low" to "high" transition of the drive select input. This means that after a disk is installed in the drive the correct status will be outputted on the second pulse.

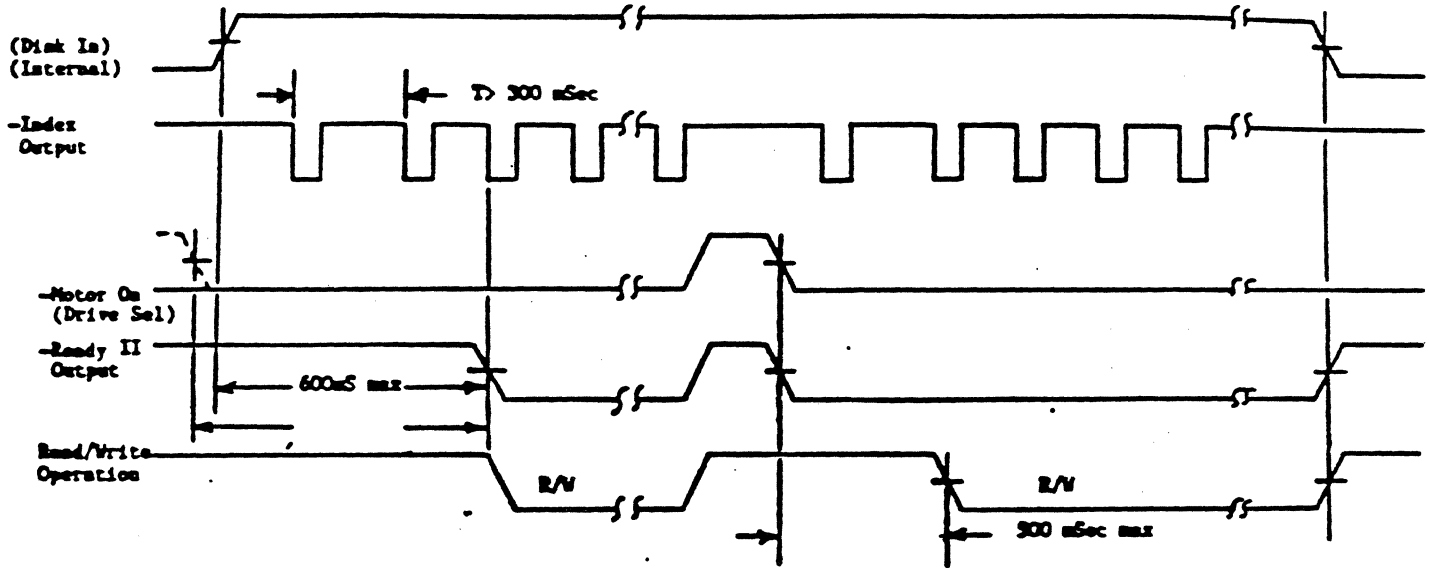


Figure 7-3 Held Ready (II) Timing

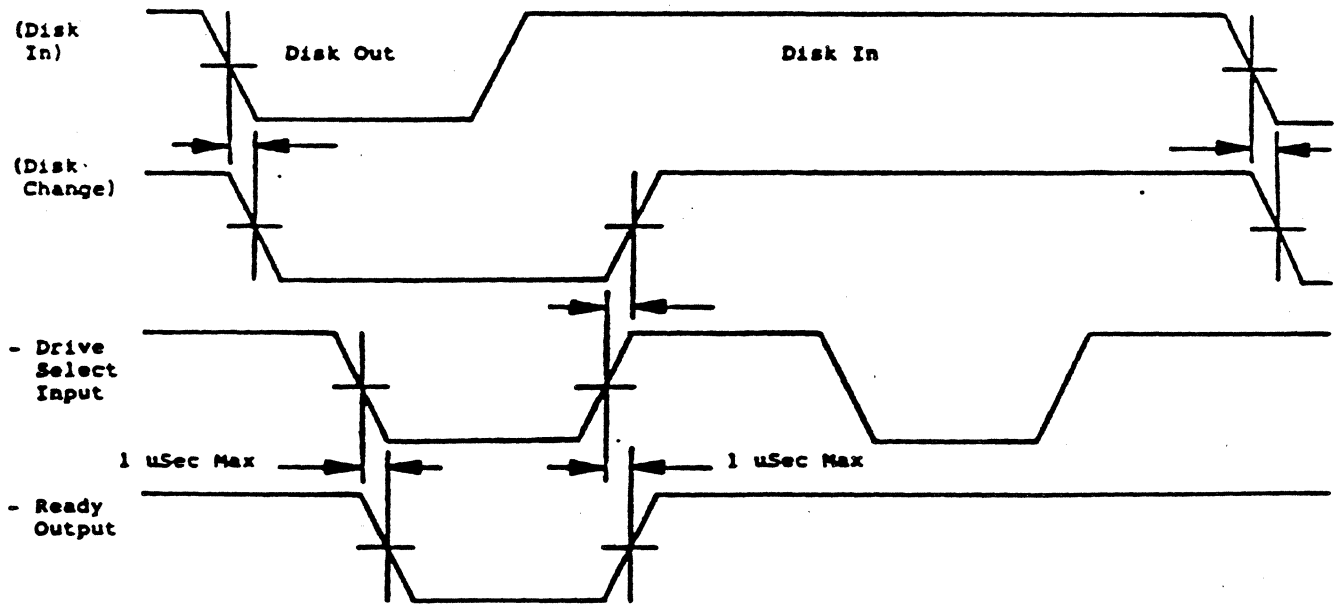


Figure 7-4 Disk Change (Drive Select Reset) Timing

7.3.4 Disk Change Option (Step Pulse Reset)

2S = Open
DC = Short

This option is the same as the preceeding one, except that the "high" to "low" transition of the stepping input resets the drive status.

7.3.5 Radial Ready

RR = Open

This option will cause the ready output to always be enables; the drive select input will have no effect on the ready output. The logic of the ready output (2S, DC options) is <u>not</u> affected by RR.

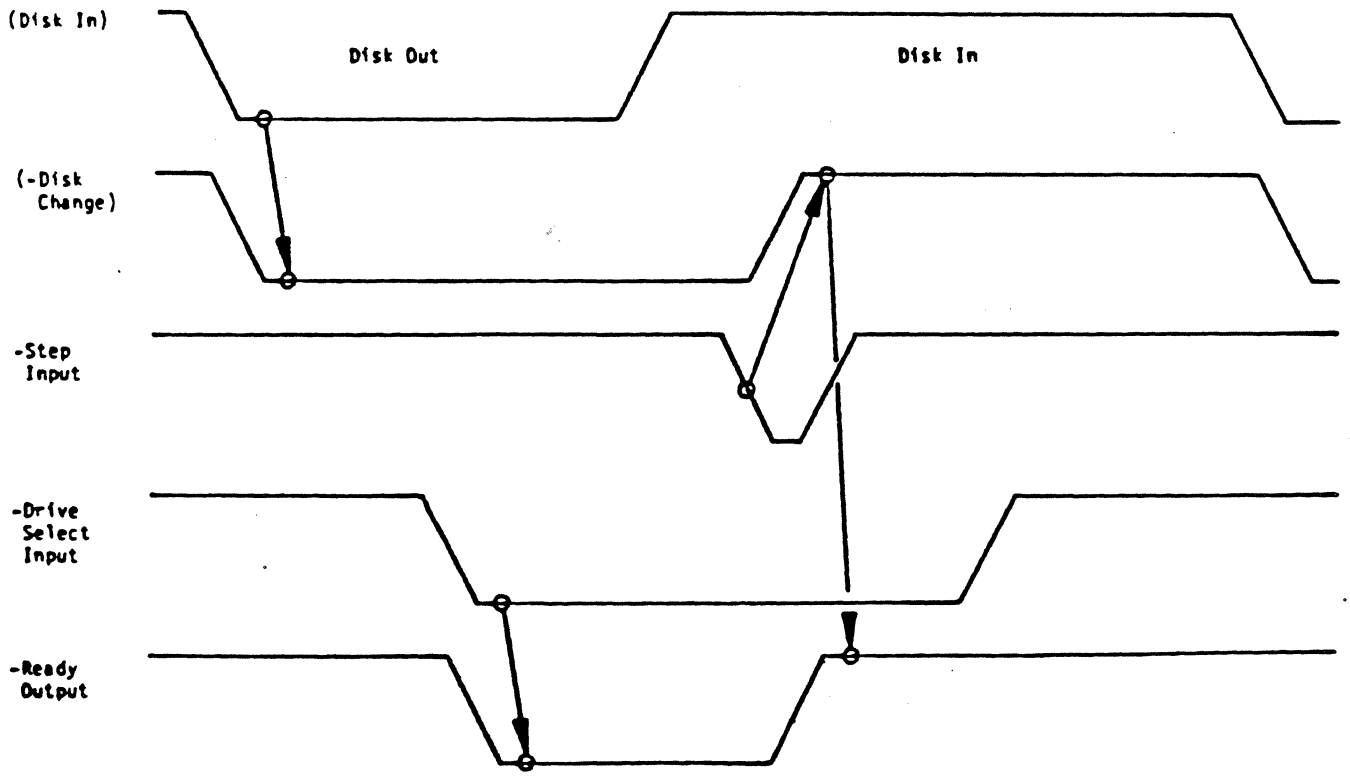


Figure 7-5 Disk Change (Step Reset) Timing

7.4 HEAD LOAD OPTIONS

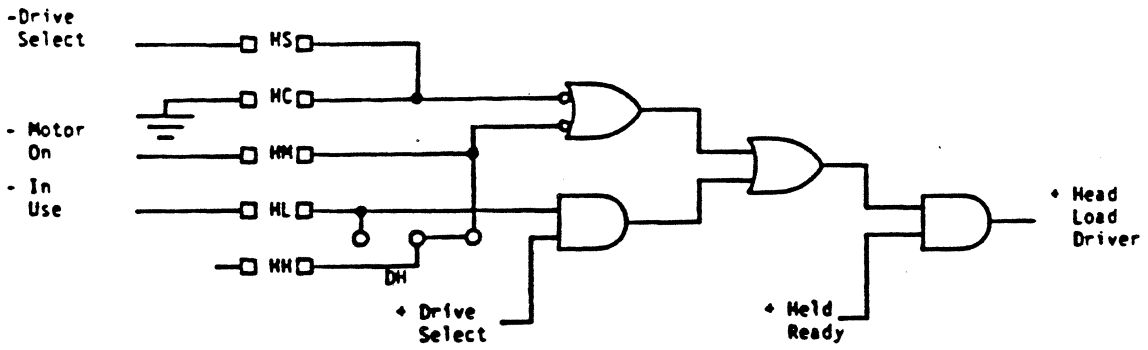
Many alternatives are available to the user on how to cause the read/write head to load onto the disk. To prolong disk life, the head should be unloaded as much as possible. Also, increased throughput can be realized by keeping the spindle motor turning, and then loading the head whenever disk access is required, because head loading is much quicker than starting the motor. But, this may not be a factor if single, long accesses are preformed.

7.4.1 Head Loading with Drive Select

HS = Short

Installing this plug will cause the head to load when the drive is selected by DS0 through DS3. This occurs only if a disk is installed in the drive with the door closed. See figure 7-5 for a schematic of this and other head load options.

Note: As seen in Figure 7-6, HS, HM, and HL can be used at the same time, but HH must not be used at the same time as the option it is connected to through option DH.



(Pull-up Resistors Omitted For Clarity)

Figure 7-6 Head Load and Spare Input Options Schematic

7.4.2 Constant Head Loading

HC = Short

This option will cause the head to always be loaded after the door is closed on a disk.

7.4.3 Head Loading with Motor On

HM = Short

This option will cause the head to load if the motor on input goes "low", and the door is closed on a disk.

7.4.4 Head Loading with In Use

HL = Short

This option will cause the head to load if the in-use input goes "low", and the door is closed on a disk.

7.4.5 Head Loading with Spare

HH = Short
SP = Short

This option will cause the head to load if the spare input goes "low", and the door is closed on a disk. DH may be used to qualify this action with the Drive Select inputs. The HH option cannot be used if pin 2 on P1/J1 (Low Speed, Low Write Current is being utilized.

7.4.6 Head Unload Delay

UD = Open

In order to eliminate unwanted oscillation of the head load solenoid, a delay may be introduced after whatever head load signal being used is made "false". This delay is 4 index pulses, which equals a time delay of 600 to 800 mSec.

7.5 LED OPTIONS

A front panel LED (also called the "In-Use" LED) is provided in the M4854-1S. Its purpose in most cases is to alert the user that the drive is being used, and that the disk should not be removed. It can also act as an indicator of program execution status. Many different modes of operation are available, which are detailed below.

7.5.1 In-Use Input or Drive Select

IU = Short

This combination will cause the LED to be on if either the In-Use or drive select inputs are made active.

7.5.2 Drive Select

IU = Open

This combination will cause the LED to light only if the drive is selected.

7.5.3 In-Use

IU = Short
IS = Short

This combination will light the LED when the In-Use input is input is active.

7.5.4 In-Use Latched By Drive Select

IU = Short
IS = Short
IL = Short

This combination latches the state of the In-Use input on the "high" to "low" transition of the drive select input. See figure 7-1 for timing details.

7.5.5 Head Load

IH = Cut PCB Trace
= Short Open Pads

This combination causes the LED to light whenever the read/write head is loaded. It totally ignores all In-Use circuitry and other jumpers.

7.5.6 Ready Qualifier

IR = Short

Shorting IR causes the In-Use LED to be qualified by the ready status (Disk Change options cannot be used). If used with "held ready" this has the effect of lighting the LED only if a disk is in the drive and the door is closed.

7.6 INPUT TERMINATIONS

All input lines to the drive are terminated (see section 4.1.1). The resistor pack should be removed on drives in multi-drive systems, with the exception of the drive the farthest electrical distance from the system controller.

7.7 FRAME GROUND

Normally the frame of the drive is connected to the logic ground through a resistor-capacitor network. If this is not desired it can be disconnected by cutting the FG trace. See Figure 7-7.

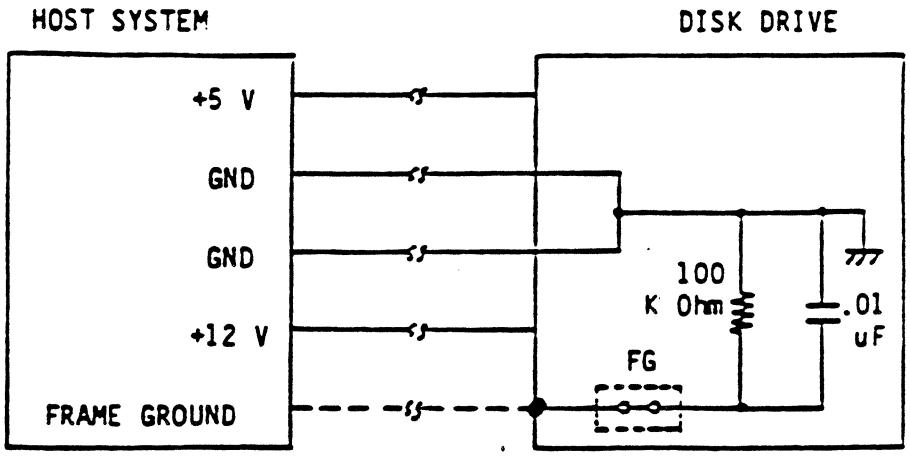


Figure 7-7 Frame Ground Circuit

7.8 OPTIONS SUMMARY (Table 7-1)

Name	Description	Type	Factory Shipment Open	Factory Shipment Short
DS0	Drive Select - 0	Plug		X
DS1	" " - 1	"	X	
DS2	" " - 2	"	X	
DS3	" " - 3	"	X	
MX	" " - Continuous	"	X	
TD	" " - Termination	"		X
HS	Head Load - Drive Select	Plug		X
HC	" " - Constant	"	X	
HM	" " - Motor On	"	X	
HL	" " - In Use	"	X	
HH	" " - Spare	"	X	
UD	" " - Unload Delay	"	X	
SP	Spare Input - Enable	Trace	X	
DH (HM)	" " - HM Route	"		X
DH (HL)	" " - HL Route	"	X	
IU	In Use - In Use Input	Plug		X
IS	" " - No Drive Select	"		X
IL	" " - Latched	"		X
IR	" " - Ready Qualified	"		X
IH-1	" " - Normal	"		X
IH-2	" " - Head Load	"	X	
2S	Ready - Held Ready	Plug	X	
DC	" - Disk Change	"	X	
RR	" - Radial Output	"		X
MM	Motor On - Motor On	Plug		X
MS	" " - Drive Select	"	X	
SS	Motor Speed - Dual Speed	"		X
SB	" " - Single Speed	"	X	
FG	Frame Grounding	Trace		X

Table 7-1 Option Summary

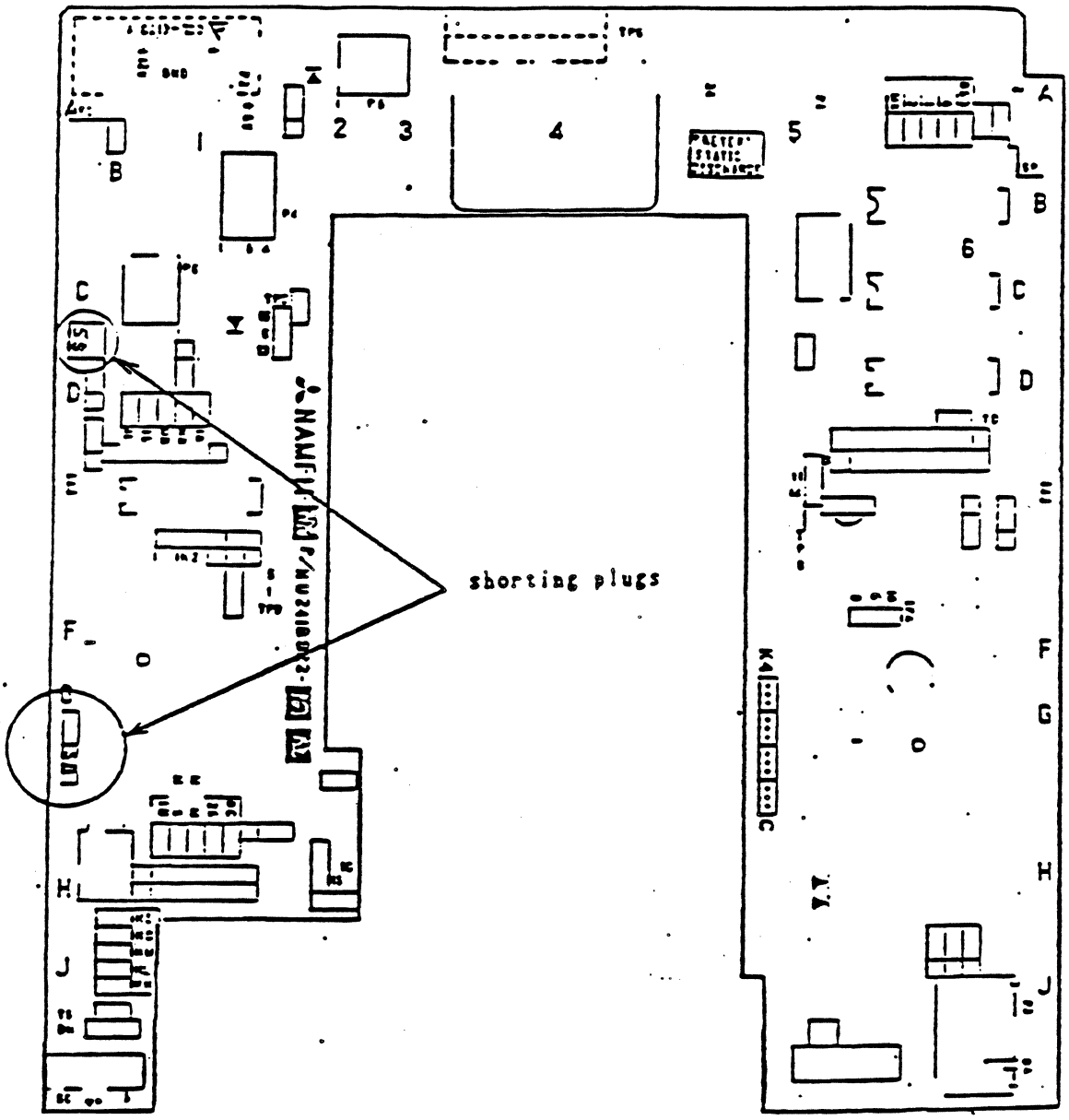


Figure 7-8 PCB Option Locations

8. RECORDING FORMAT

Data to be recorded on the floppy disk is grouped in various blocks.

There are bits, bytes, sectors, tracks, and sides. The bits are encoded onto the disk by three possible means: FM, MFM, or MMFM techniques. These bits are collected together in a certain number of bytes per sector to define the actual recording format used. All of this is defined by the host system; the disk drive just records and detects flux reversals on the disk.

8.1 BIT ENCODING

As stated before, there are three main methods of encoding bits on a floppy disk. All have some advantages and disadvantages, but the generally accepted standard is MFM (also called Double Density).

8.1.1 FM Encoding

FM (Frequency Modulation) encoding is shown in Figure 8-1. It is the simplest form of encoding, and may be decoded by use of inexpensive one-shot multivibrators. It can do this because each data pulse is between two clock pulses, thereby defining the "read window" very precisely. Values shown are for a 500 Kbit/second transfer rate. Multiply all values by 1.666 for a 300 kbit/second transfer rate, and by 2 for a 250 Kbit/second transfer rate.

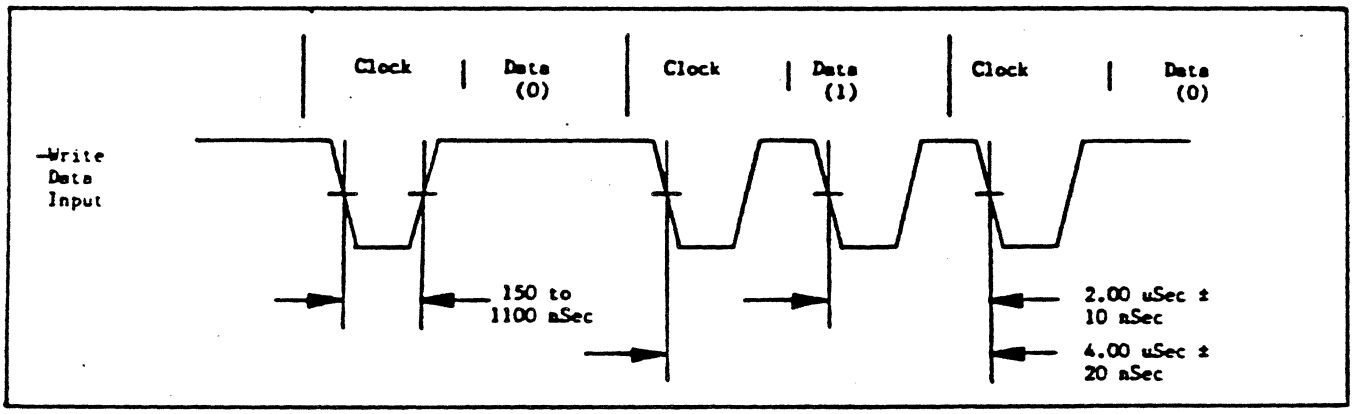


Figure 8-1 FM Write Timing

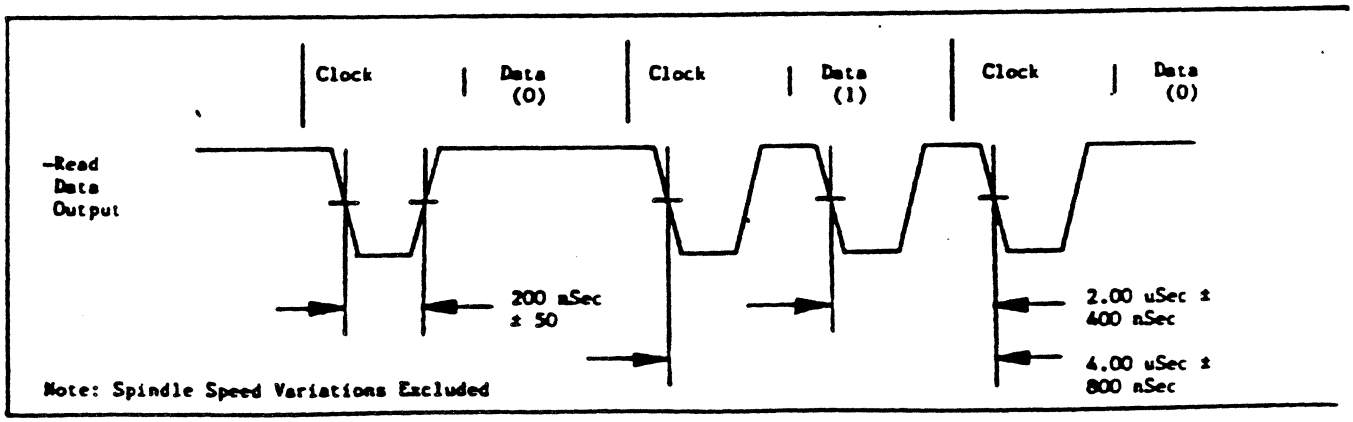


Figure 8-2 FM Read Timing

8.1.2 MFM Encoding

MFM (Modified Frequency Modulation) encoding records twice the number of bits per inch (linear recording density) as FM encoding, but has the same number of flux changes per inch. It does this by removing the clock pulses, and shrinking the bit cell space by 50%. See Figure 8-3 and 8-4 for specific details. Clock bits are always written at the leading edge of the cell only if no data bits are written in either the present or preceeding bit cells. Values shown are for a 500 Kbit/second transfer rate. Multiply all values by 1.666 for a 300 kbit/second transfer rate, and 2 for a 250 Kbit/second transfer rate.

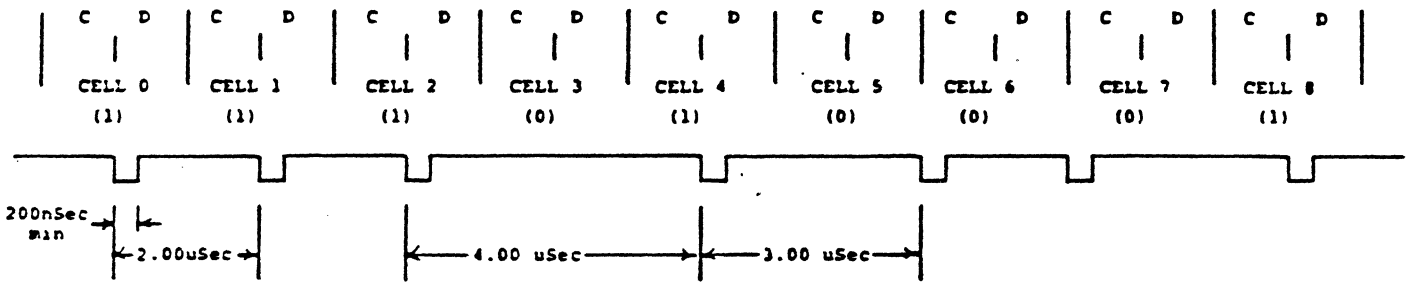


Figure 8-3 MFM Write Timing

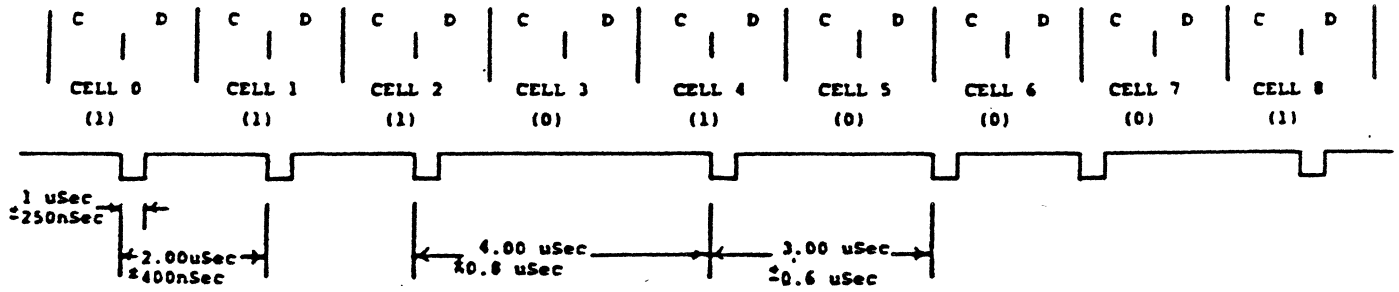


Figure 8-4 MFM Read Timing

8.1.3 MMFM Encoding

MMFM (Modified-Modified Frequency Modulation) is also a "double density" encoding method, but it further reduces the number of clock bits used to fill the empty spaces between data pulses.

It is not a standard encoding technique, and should probably be avoided for that reason. See Figure 8-5 and 8-6 for a description of MMFM. The data bits are written in the middle of the data cells, but a clock pulse is encoded only if no clock or data pulses were written in the previous bit cell, and no data bit is to be written in the present one. Values shown are for a 500 kbit/second transfer rate. Multiply all values by 1.666 for a 300 kbit/second transfer rate, and by 2 for a 250 Kbit/second transfer rate.

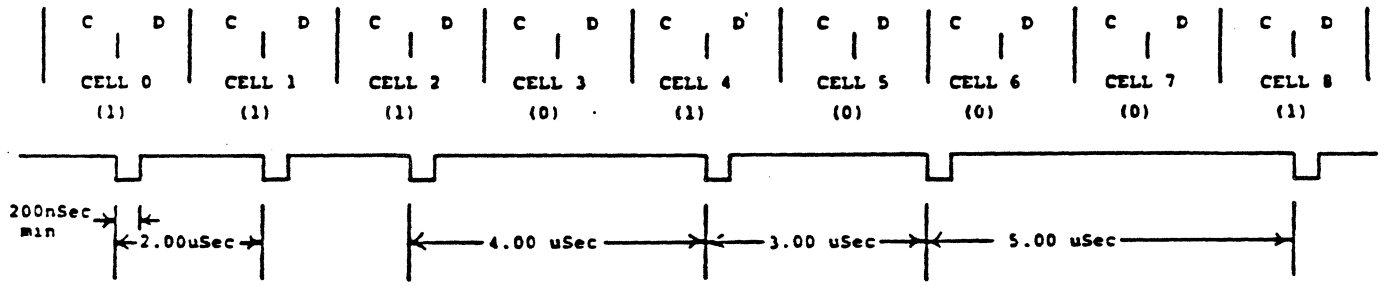


Figure 8-5 MMFM Write Timing

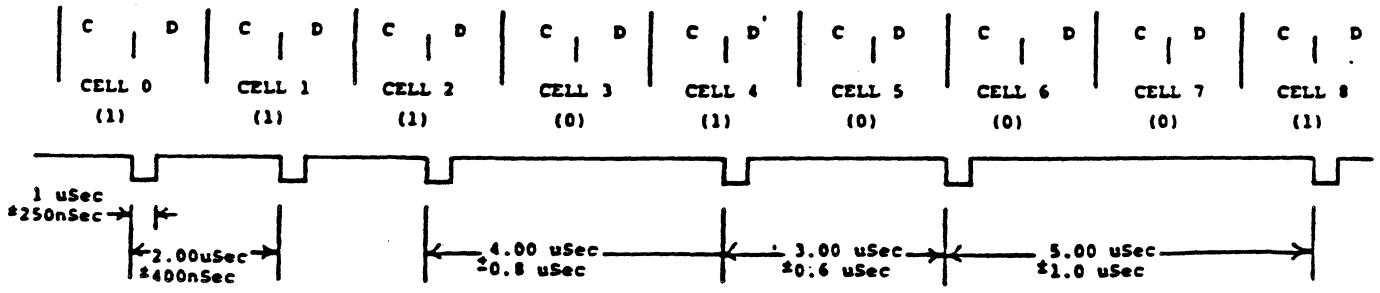


Figure 8-6 MMFM Read Timing

8.2 M4854-1S RECOMMENDED FORMATTINGS

M4854-1S 5 1/4-inch Flexible Disk Drives use industry standard Tunnel Erase type Read/Write Heads, and high accuracy direct-drive brushless motor for spindle rotation, guaranteed ±1.6% index interval and ±2% instantaneous speed.

The recommended formattings for data interchange between drives are shown in the following figures, including formatting and data re-write modes.

The drives allow for the following conditions on all tracks.

(1) The leading edge of a data block should be preceded by the erased area when re-written.

(2) The trailing edge of a data block should be covered by the erased area when re-written.

(3) The erased area should not overlap with Sector Identifiers.

(4) Read/Write gap should be before the next ID mark as the erase current is falling off when re-written with a fast rotation spindle on a slow formatted sector.

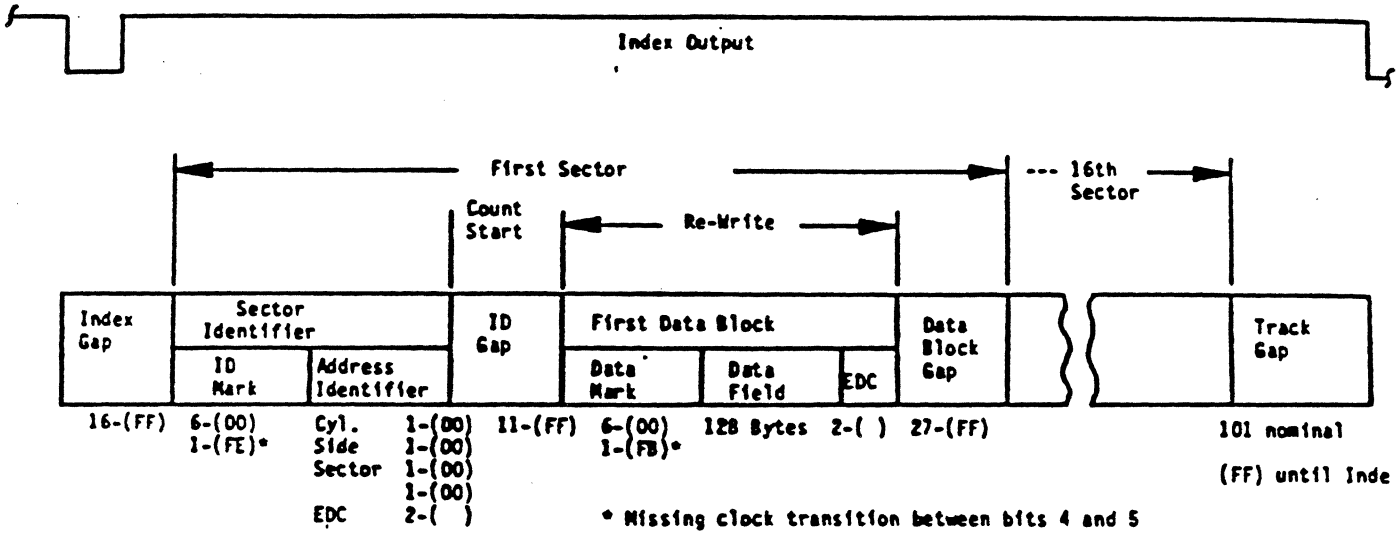


Figure 8-7 ISO-7487/2 Style, Track 00, Side 0 (FM)
250 or 300 Kbit/second Transfer Rate

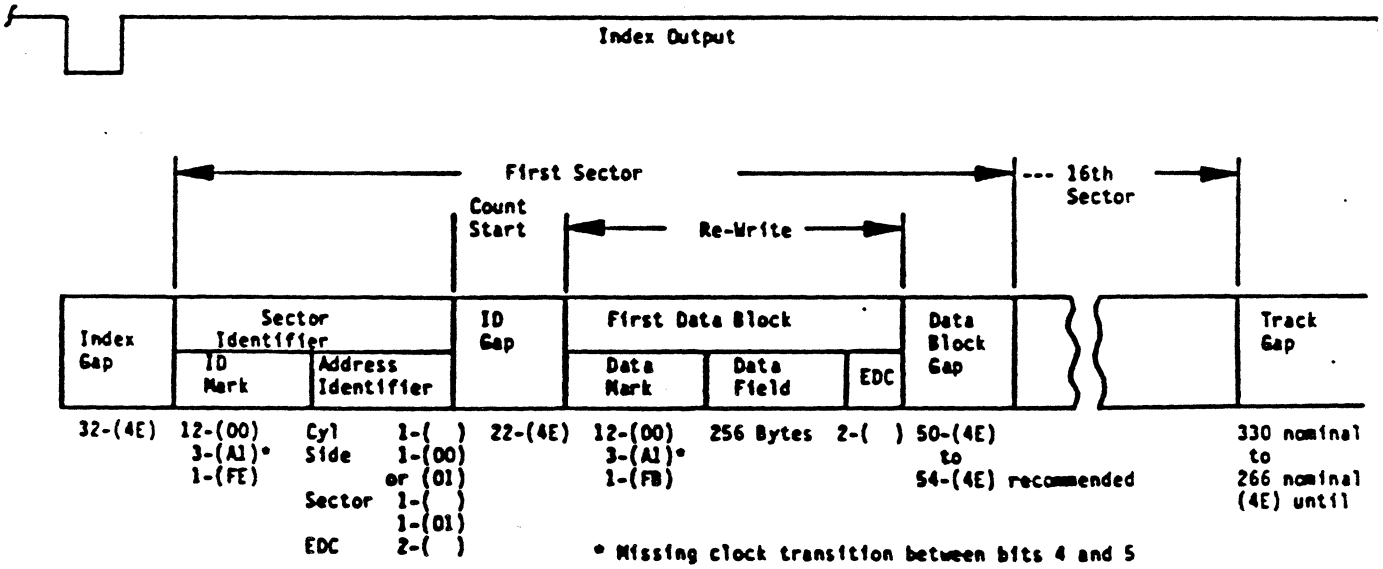


Figure 8-8 ISO-7487/2 Style, All Other Tracks (MFM)
250 or 300 Kbit/second Transfer Rate

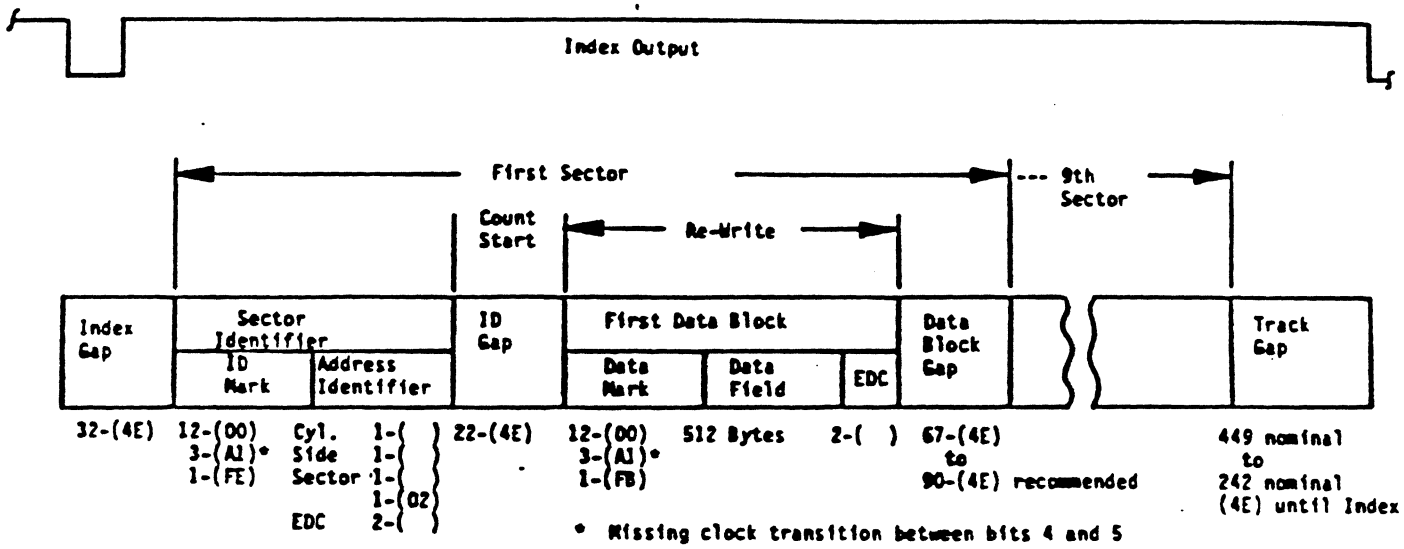


Figure 8-9 512 Bytes/Sector, Standard Format
250 or 300 Kbit/second Transfer Rate

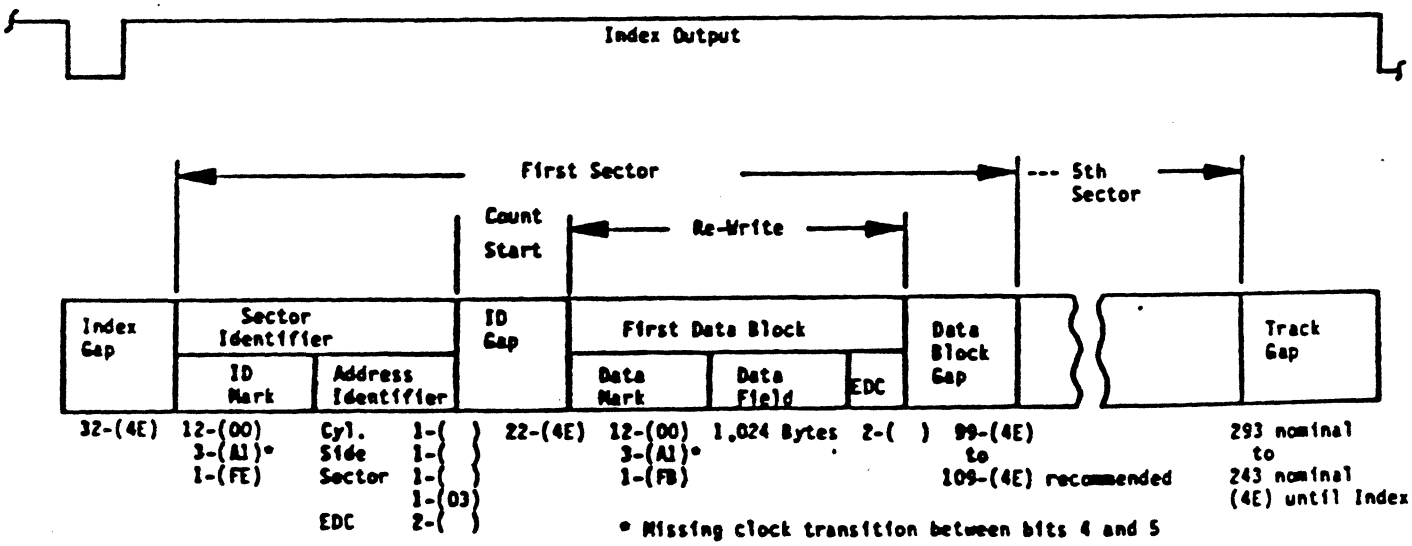


Figure 8-10 1,024 Bytes/Sector, Standard Format
250 or 300 Kbit/second Transfer Rate

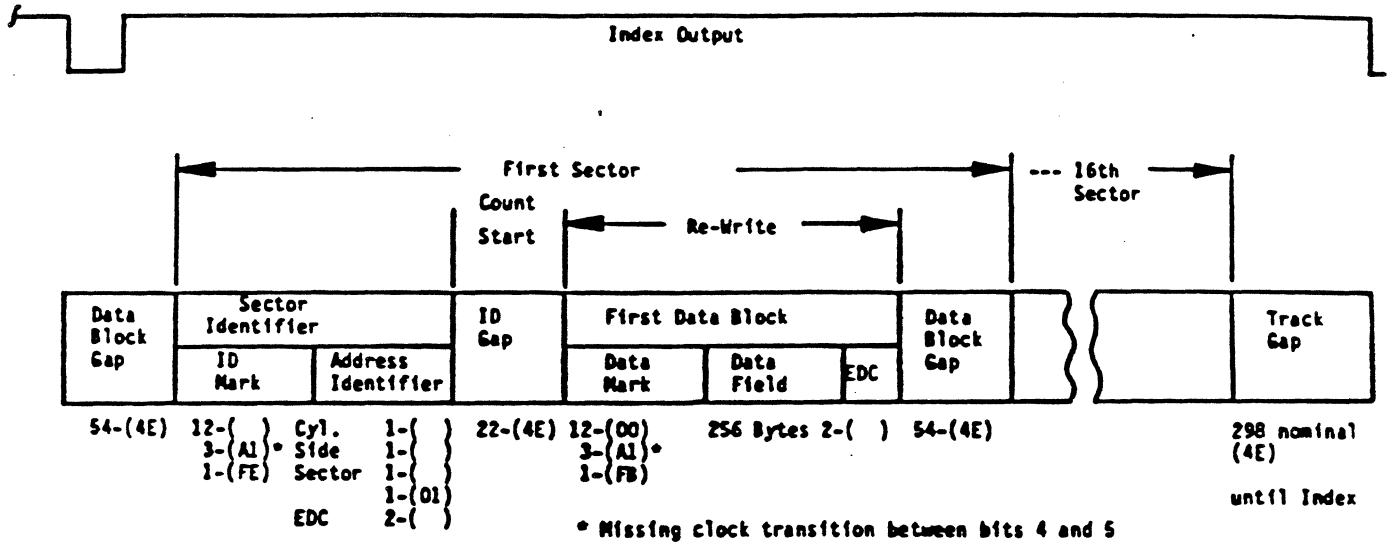


Figure 8-11 256 Bytes/Sector, Simplified Format
250 or 300 Kbit/second Transfer Rate

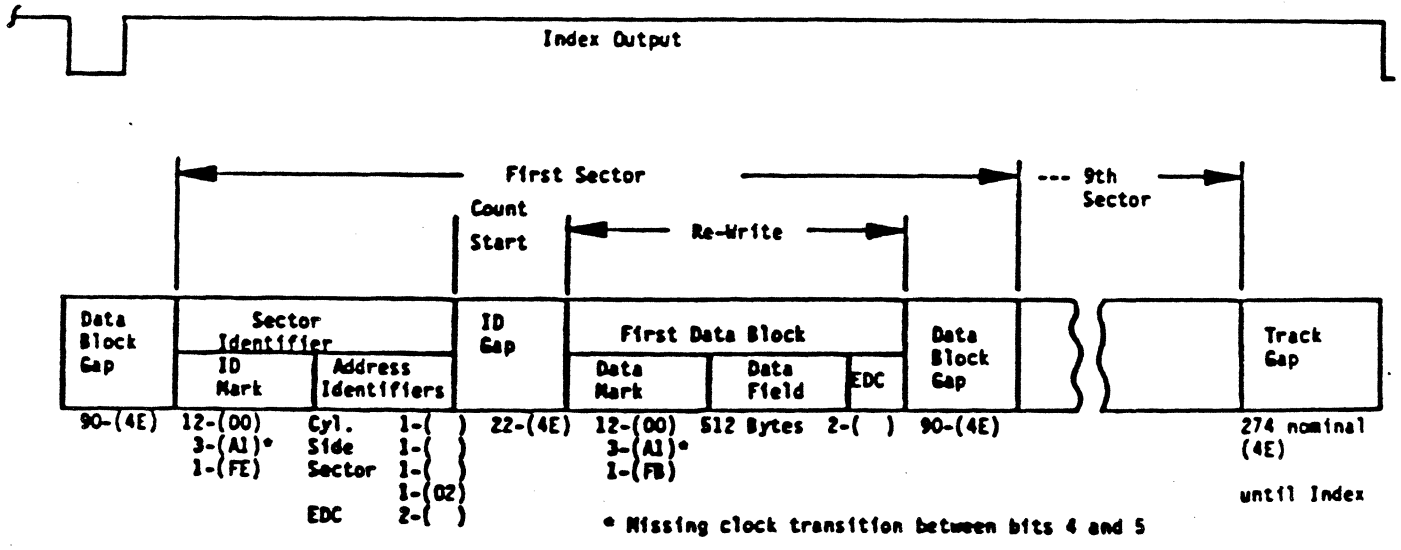


Figure 8-12 512 Bytes/Sector, Simplified Format
250 or 300 Kbit/second Transfer Rate

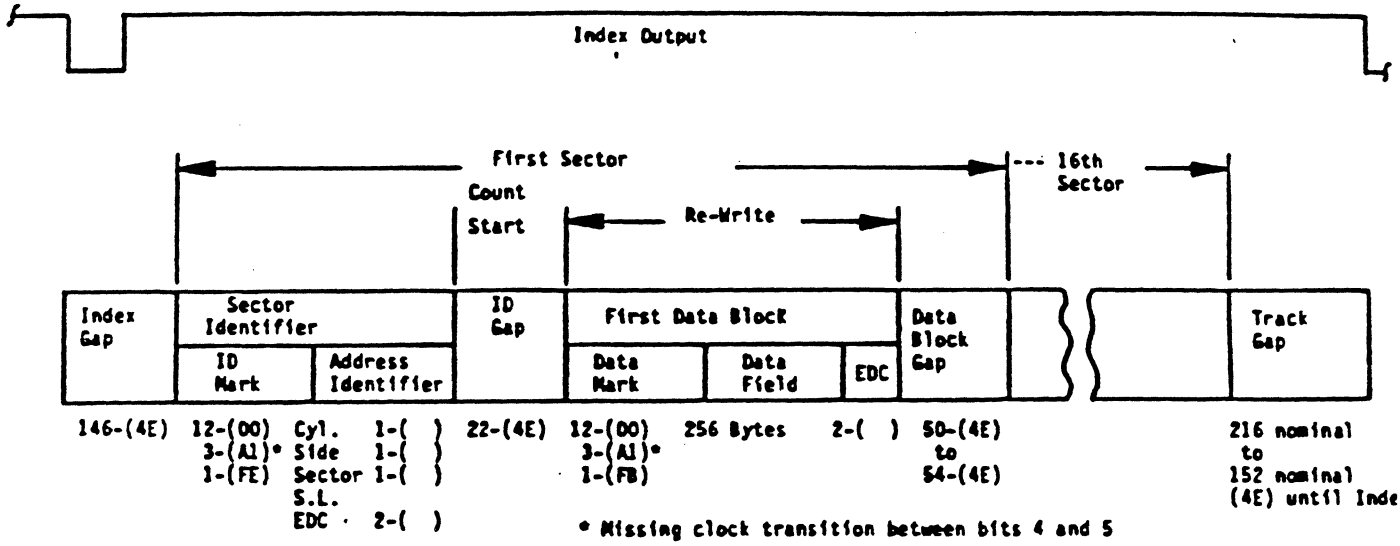


Figure 8-13 256 Bytes/Sector, NEC 765A Format
250 or 300 Kbit/second Transfer Rate

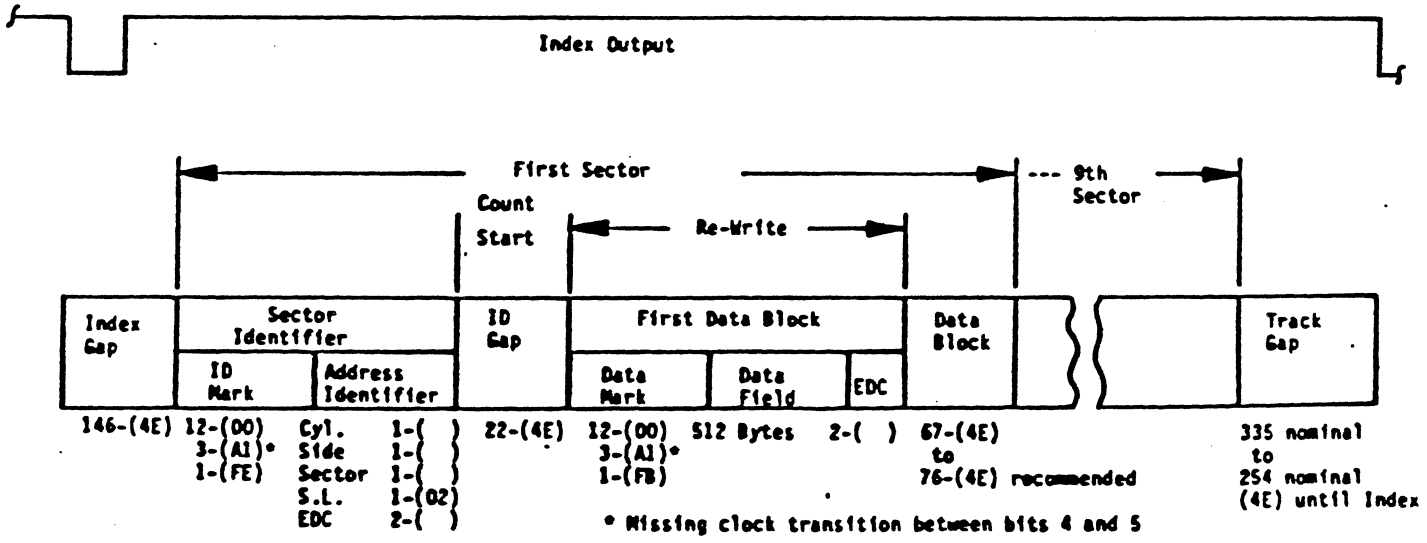


Figure 8-14 512 Bytes/Sector, NEC 765A Format
250 or 300 Kbit/second Transfer Rate

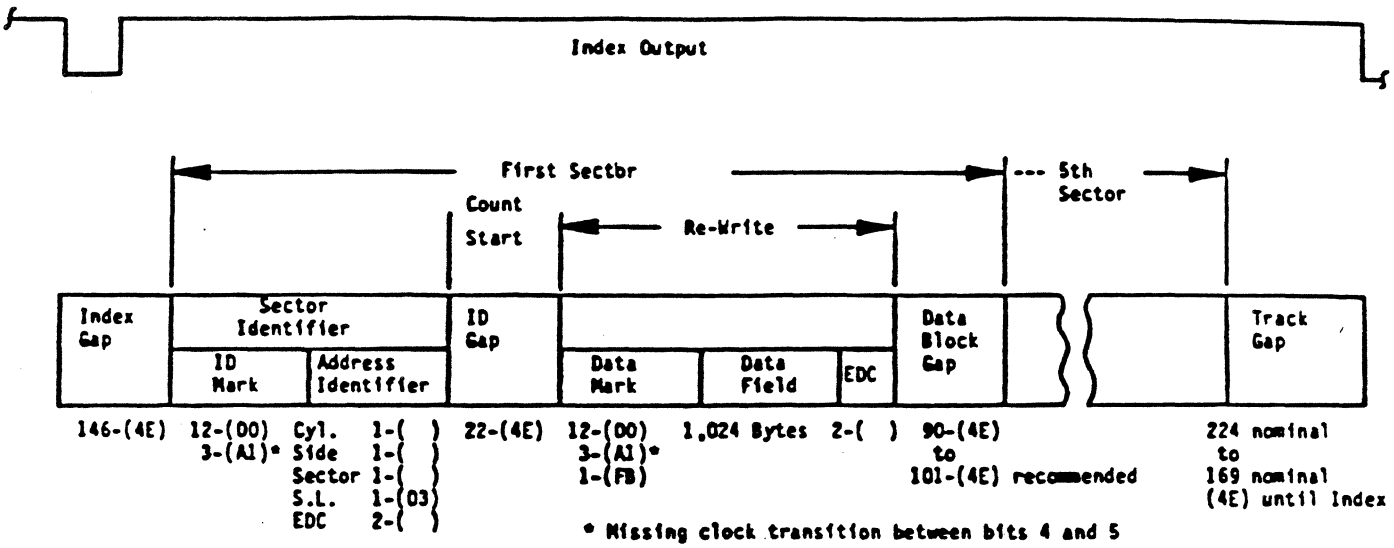


Figure 8-15 1,024 Bytes/Sector, NEC 765 A Format
250 or 300 Kbit/second Transfer Rate

Figure 8-16 512 Bytes/sector, 15 Sectors/track
500 Kbit/second Transfer Rate

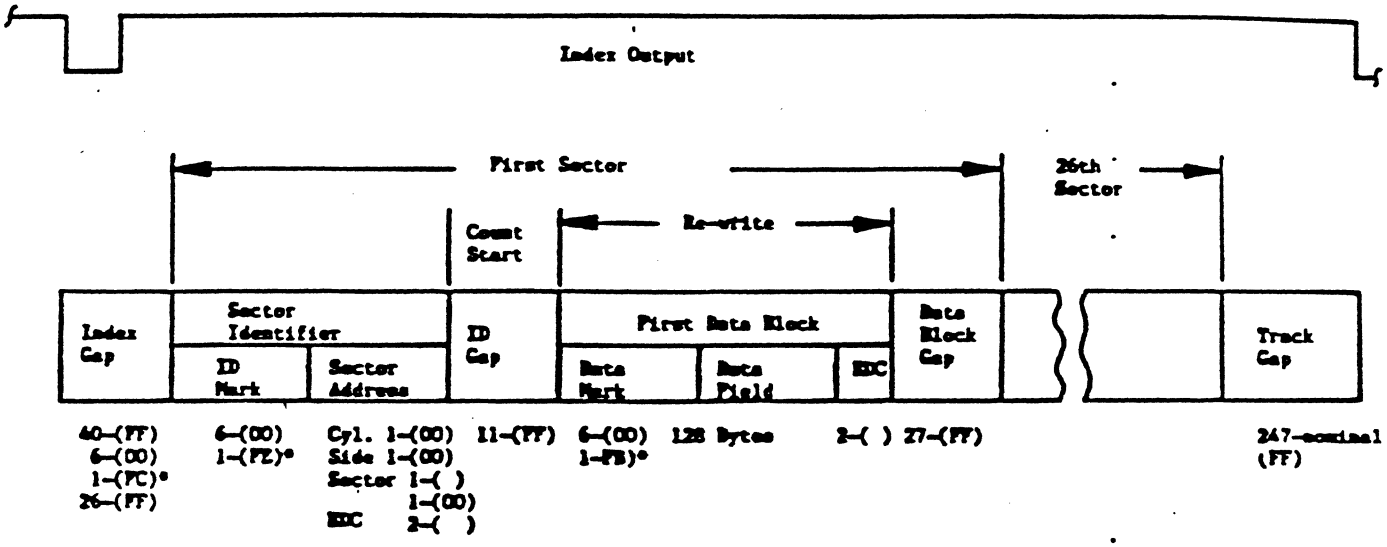


Figure 8-17 ISO-7065/2 Style, Track 00 Side 0 (FM)
500 Kbit/second Transfer Rate

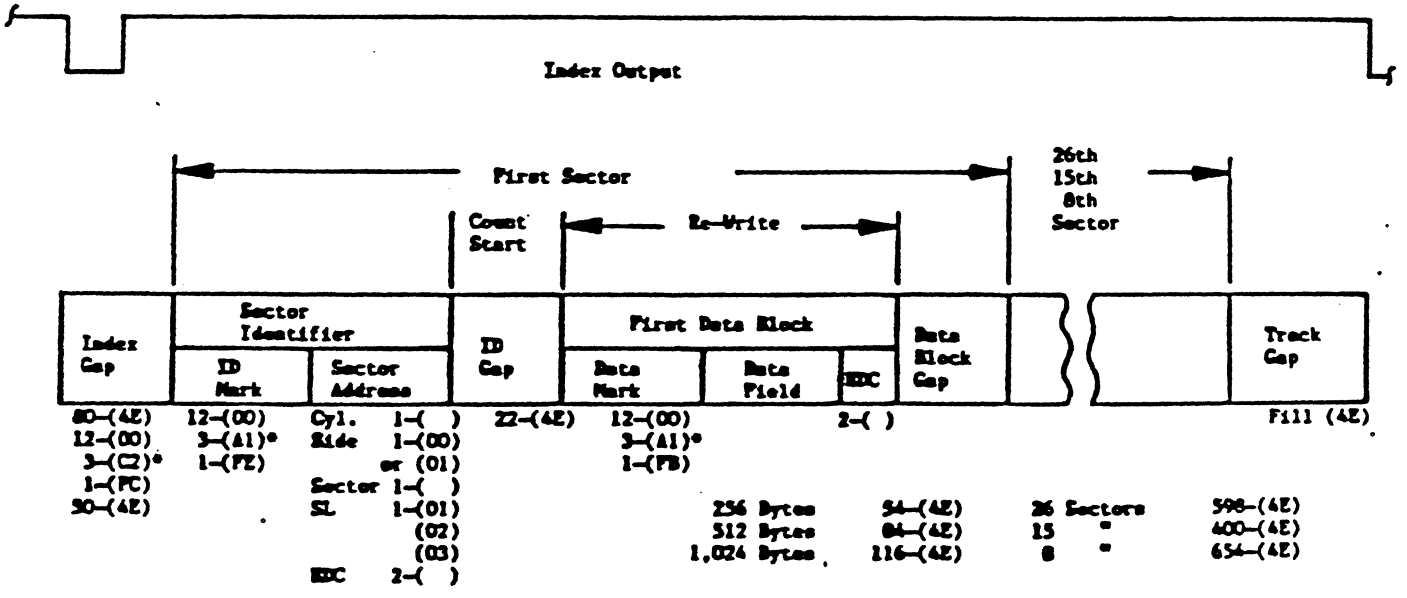


Figure 8-18 ISO-7065/2 Style, All Other Tracks (MFM)
500 Kbit/second Transfer Rate

8.3 ERROR DETECTION AND CORRECTION

8.3.1 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.

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

The following are possible main causes of soft errors:

- Dust is caught between the read/write head and diskette causing temporary fault in head contact. Such dust is generally removed by the self-cleaning wiper of the jacket, and the data is recovered by the next re-read operation. If read/write is continued for a long time in a very dusty environment, however, hard errors can result from a damaged diskette surface.

- Random electrical noise ranging in time from a few microseconds to a few milliseconds can also cause read errors. Spike noise generated by a switching regulator, particularly one that has short switching intervals, deteriorates the signal-to-noise ratio, and increases the number of re-read operations for data recovery. It is necessary, therefore, to make an adequate check on the noise levels of the DC power supplies to the drive and frame grounding.

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

- Fingerprints or other foreign matter on a written diskette can also cause a temporary error. If foreign matter is left on a written diskette for a long time, it can adhere to the diskette, possibly causing a hard error.

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

- Step 1: Repeat the read operation about ten times, or until the data is recovered.

- Step 2: If the data cannot be recovered by Step 1, move the head to another track, the opposite direction of the previous track position before the designated track, and then return the head to the original position.

- Step 3: Repeat an operation similar to Step 1.

- Step 4: If the data cannot be recovered, assume the error is a hard error.

9. RESHIPMENT PRECAUTIONS

When reshipping the drive, proper steps must be taken to prevent any damage to the drive.

9.1 SHIPPING DAMAGE

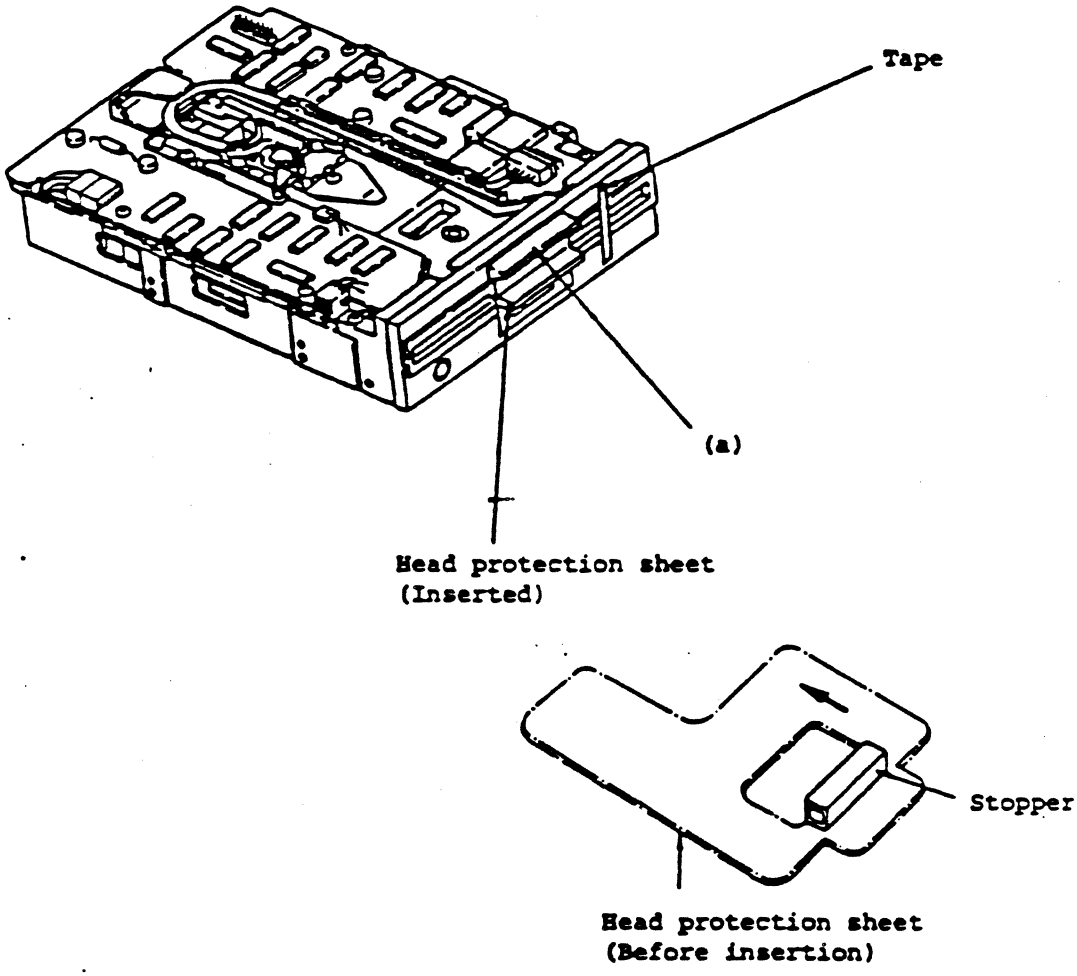
Any damage to the drive that occured during shipping is the responsibility of the carrier. Contact the carrier for any damage claims.

9.2 RESHIPPING

If it is necessary to return a drive for any reason, proper steps must be taken to prevent damage to the drive.

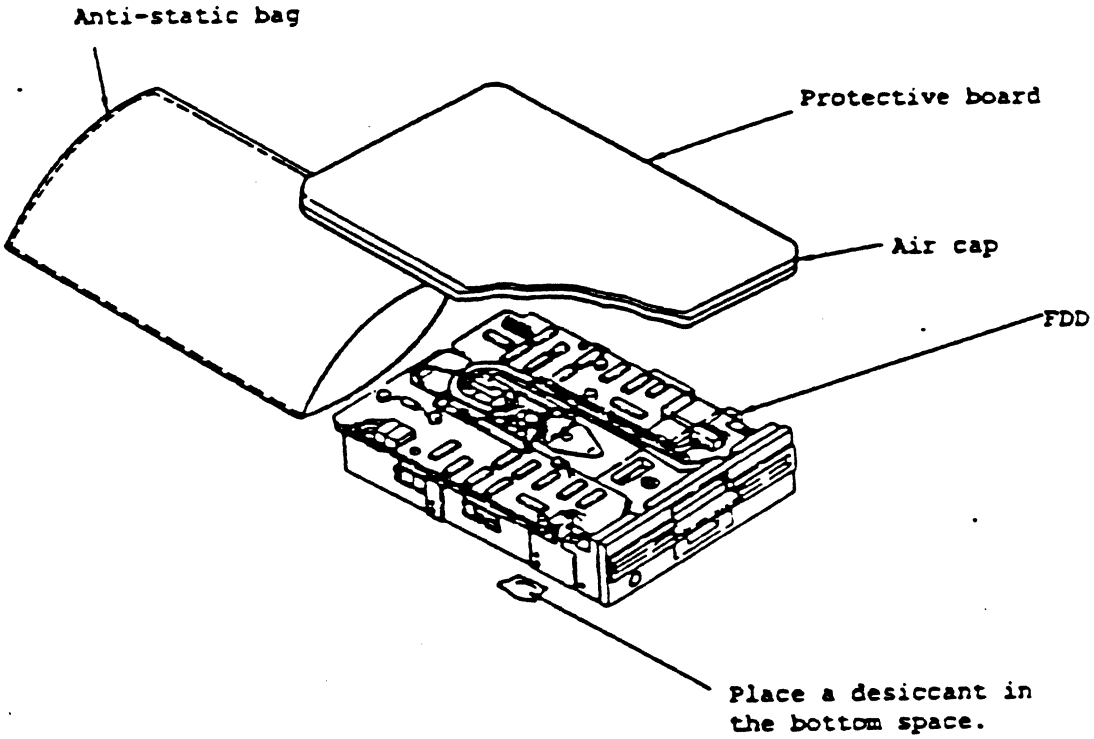
- Use all the packing materials that were received with the drive, if possible.
- Be sure to utilize the anti-static bag that came with the drive.
- The head protection sheet should be inserted into the drive (the door should not be closed).

Please refer to figures 9-1, 9-2, 9-3, and 9-4 for specific details of how to pack the drives for shipment.



NOTE: After inserting the head protection sheet, push the stopper in the arrow direction (a) until the sheet is securely in place.

Figure 9-1 Head Protection Sheet Installation



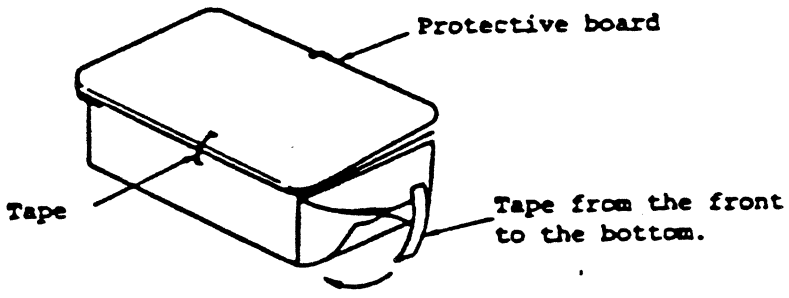


Figure 9-2 Bag and Board Assembly

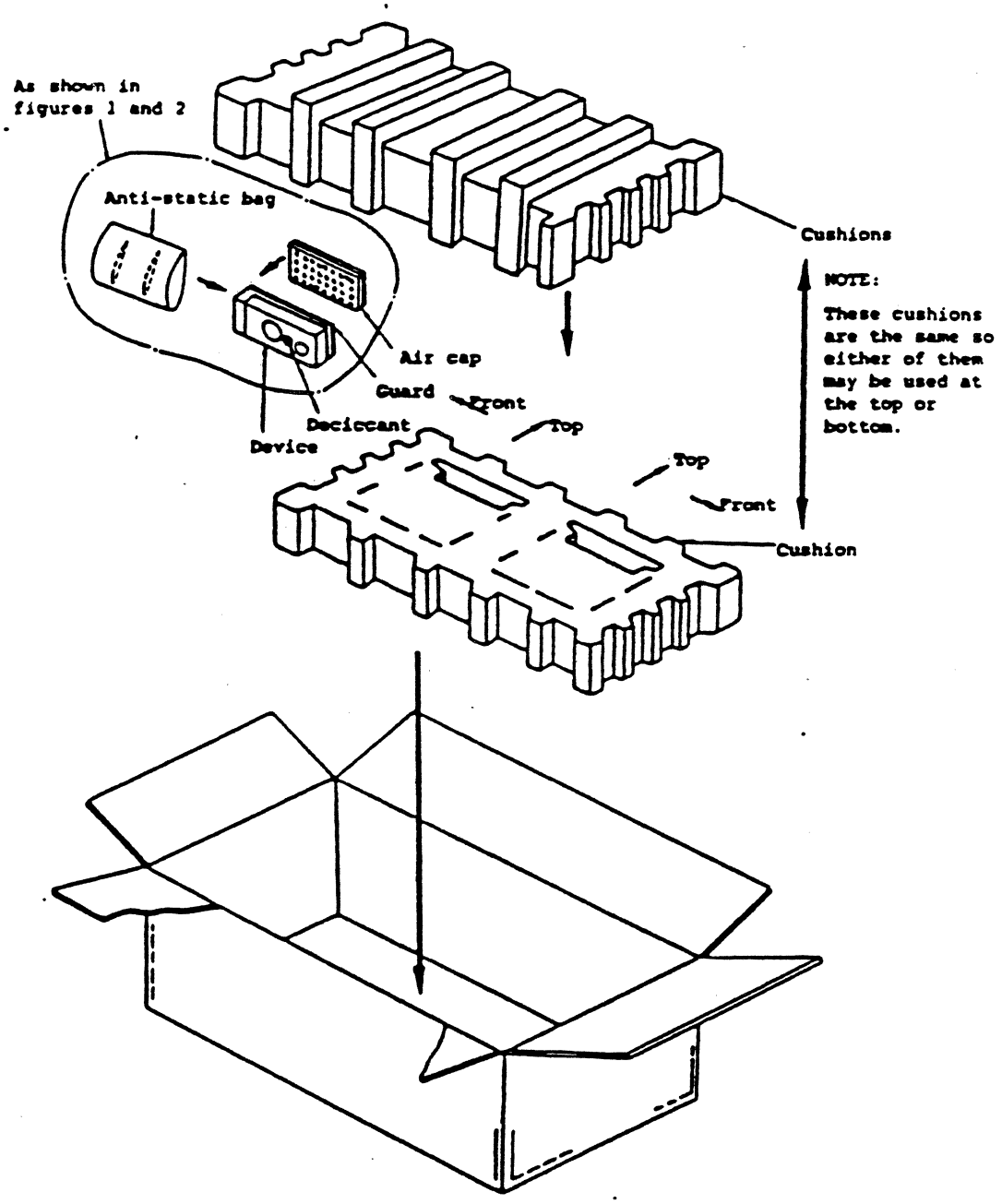


Figure 9-3 Ten-Pack Carton Assembly

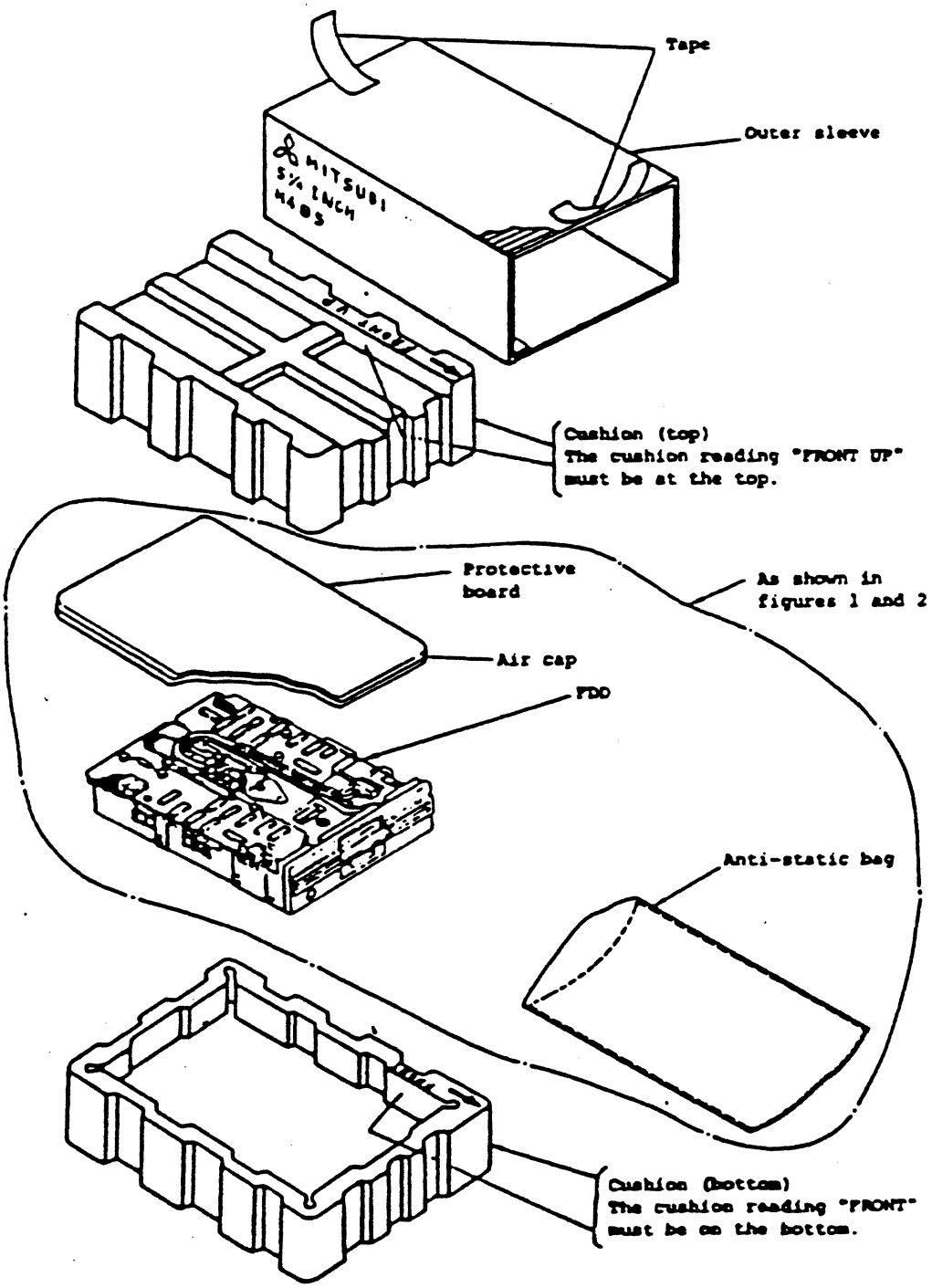


Figure 9-4 Single-Pack Carton Assembly