WANG

INTERNATIONAL MEMORIES
INCORPORATED
5000H WINCHESTER

This is the first reprint of the IMI model 5000H maintenance manual. Updates and/or changes to this document will be published as Product Service Notices (PSN's) or subsequent editions.

CUSTOMER ENGINEERING

PRODUCT SERVICE NOTICE

DATE: 10/18/83

3110

PSN to 729 -1324

INTERNATIONAL MEMORIES INCORPORATED 5000H WINCHESTER

REASON FOR CHANGE:

To add the Schematics Appendix to the manual.

INSTRUCTIONS:

.

Add Appendix to the back of the International Memories Incorporated 5000H
Winchester Manual Reorder Number 729 - 1324.

This page is to be used as a permanent record of revisions; place it directly
following the title page.

INTERNATIONAL MEMORIES, INC.

OEM REFERENCE & MAINTENANCE MANUAL

5.25 INCH WINCHESTER

DISK DRIVES, MODELS

5006H, 5012H, 5018H

TABLE OF CONTENTS

Section

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

GENERAL DESCRIP- TION

SECTION 1

GENERAL DESCRIPTION

The International Memories, Inc. (IMI) advanced family of high reliability 5.25 inch Winchester disk drives offer such features as an isolated shock mounted head/disk assembly, ultra hard plated media, and enhanced thermal stability. The drives also provide up to 19.14 megabytes of unformatted storage, are ST506 compatible, and offer the latest in data integrity within a wide range of operating environments.

Other advanced and standard features of the drives include the following:

Data Integrity

o   Proven Winchester technology

o   Ultra-hard thin-film plated media lessens possibility of damage due to handling, lowering field service costs

o   Dedicated shipping zone provided for heads at inner diameter of disks

o   Automatic spindle brake acts as a restraint against spindle rotation

o   Manganese zinc recording heads for increased signal amplitude

o   Read preamplifiers located on head stack reduce EMI/RFI noise suscepti-bility, increasing data reliability

o   Magnetically shielded DC spin motor ensures data integrity

o   Optimized, automatic actuator position thermal compensation to provide minimal off-track error throughout temperature range

o   Short, sturdy head arms minimize resonance effects, improving data reliability

o   Head/disk assembly protected from handling damage by surrounding shock mounted frame

o   0.9° high torque stepper motor enables full-step positioning, minimi-zing positioning errors

o   Deeply ribbed base and top cover provide greater heat transfer area for cooling and transfer heat evenly and quickly, minimizing thermal off-track error

Component Reliability

o   Well proven, self aligning, 6 ball bearing linear actuator system low friction independent of position

o   Case-hardened actuator rails

o   Plated capstan to eliminate fretting corrosion

o   Elastomer carriage stop pads for controlled displacement and acceleration

.o   Unique patented band preload system minimizes stress concentrations in band, increasing life

o   0.9° stepper allows larger capstan size, further decreasing band stresses

o   High efficiency recirculating air filtration system for continuous air cleaning

o   HDA totally sealed from contaminated exterior air

      o   Stepper motor sealed
      o   Spindle motor sealed
      o   All mating surfaces gasketed

o   Forced air circulation system to cool electronics

General

o   Industry standard interfaces allow fast system integration

o   Drive requires no adjustments or preventive maintenance

o   DC power allows worldwide installation

o   5.0 Mbit/second data transfer rate

o   Crystal-controlled brushless DC spindle motor

o   Two piece HDA/frame shock mounted construction minimizes handling and in-service shock damage

1-1 DRIVE CHARACTERISTICS

The IMI 5000 series drive is a fixed disk, sealed environment drive with data recorded on storage surfaces using a modified frequency modulation (MFM) recording technique.

The drive's major components are shown in Figure 1-1. These include the spindle motor, disks (up to three), air filter, stepper motor, linear actuator, and heads (up to six) in a sealed head/disk assembly. The two printed circuit boards are mounted at the bottom of the drive chassis. These consist of one read/write and one motor control board.
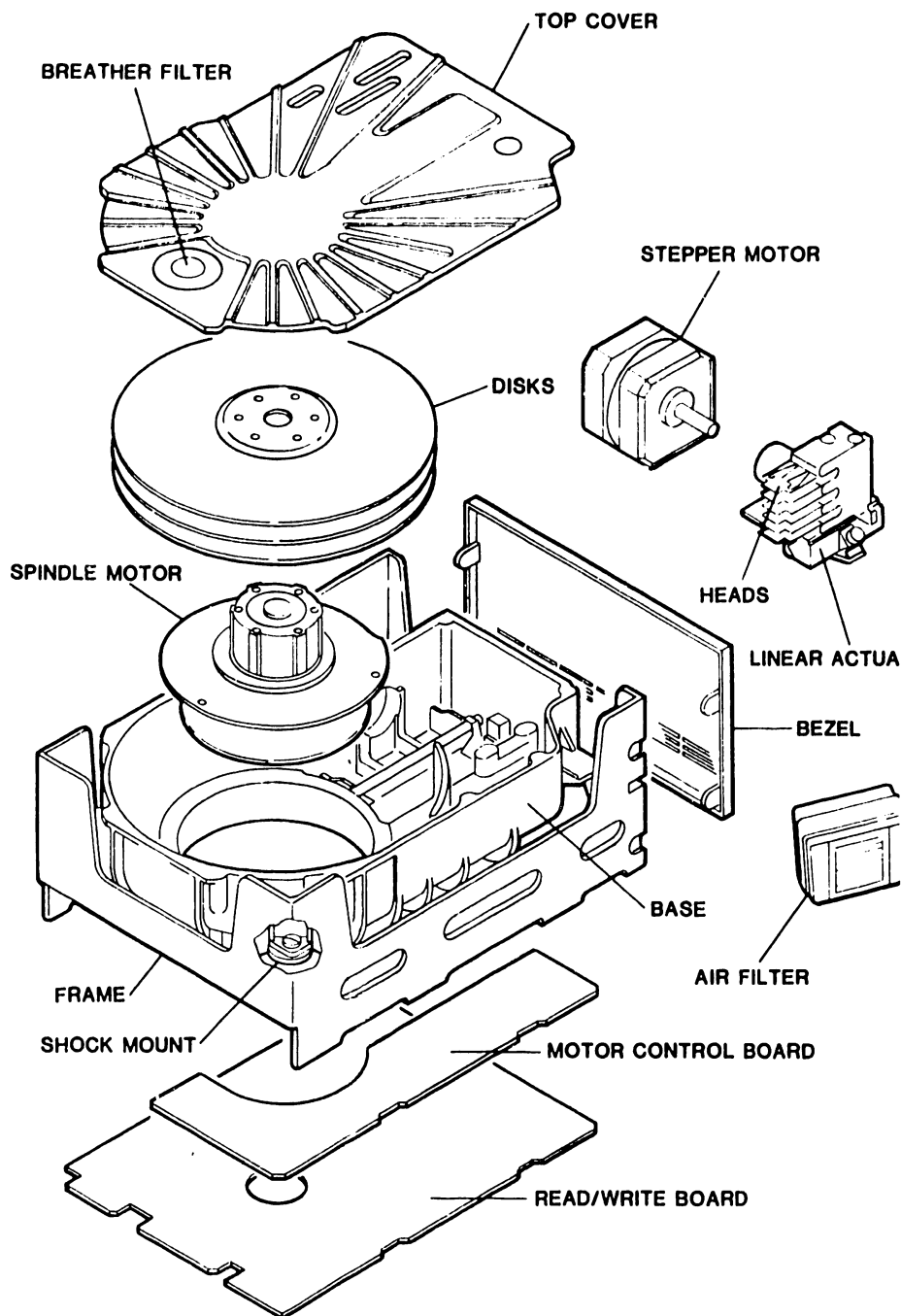
Figure 1-1. Drive Major Components

1.2 SPECIFICATIONS

FUNCTIONAL

Model Number	5018H	4012H	5006H
Capacity (unformatted)			
Drive (Mbytes)	19.125	12.75	6.375
Per surface (Mbytes)	3.1875	3.1875	3.1875
Per track (bytes)	10,417	10,417	10,417
Capacity (formatted)			
Drive (Mbytes)	15.03	10.02	5.01
Per surface (Mbytes)	2.506	2.506	2.506
Per track (bytes)	8,192	8,192	8,192
Sectors per track	32	32	32
Bytes per track	256	256	256
Recording density(BPI)	9706	9706	9706
Track density(TPI)	303	303	303
Recording surfaces	6	4	2
Heads per surface	1	1	1
Disks	3	2	1
Cylinders	306	306	306

PERFORMANCE

Start time	20 sec. typical
Stop time	15 sec. typical
Rotational Speed	3,600 RPM
	Accurate to $\pm$ 0.5%
	with $\pm$0.2% variation from
	nomimal speed
Transfer Rate	625 Kbytes/sec
Access Time (Maximum)	
Track to Track	3ms
Average	49ms
Maximum	99ms
Settling Time	19ms
Average Latency	8.3ms
Recording Code	MFM

1.2 Specifications (cont.)

PHYSICAL DIMENSIONS

Width	5.75 inches (14.61 cm)
Depth	8.0 inches (20.32 cm)
Height	3.25 inches (8.26 cm)
Weight	5 lbs (2.27 Kgm)

RELIABILITY

MTBF	10,000 POH
MTTR	<0.5 hour
Preventive Maintenance	None required
Service Life	>Five years

Error Rates

Soft	<1 in 10^{10} bits
Hard	<1 in 10^{12} bits
Seek	<1 in 10^{6} seeks

Media

Max Defects 5006H	8 defects maximum,
5012H	16 defects maximum,
5018H	24 defects maximum,
	cylinder 0 certified
	error-free

ENVIRONMENTAL

	Operating	Non-Operating
Temperature	39°F to 122°F (4°C to 50°C)	40°F to 140°F (-40°C to 60°C)
Relative Humidity	8% to 80%	8% to 80%
Altitude (max)	10,000 feet (3,048 meters)	50,000 feet (15,240 meters)
Shock, Vibration	Exceeds industry standards - Refer to "IMI 5000H Series Environmental Vibration Shock and Transportation Standard", Specification No. 706-02088-001.	
Temperature Variation	18°F/hour (10°C/hour) maximum	

1.2 Specifications (cont.)

HEAT DISSIPATION

    Watts   *20*

POWER REQUIREMENTS

    DC Operating Power   *+5 VDC $\pm$ 5%, 1.9 amps typical 2.5 (peak)*

                                           +12 VDC $\pm$ 5%, 1.1amps typical (4.0 amps surge during motor start).

SECTION
2
INSTAL-
LATION

SECTION 2

INSTALLATION

2.0 GENERAL INFORMATION

This section describes the procedures for unpacking, handling, installation, operation, and packing for reshipment of the IMI 5000H series drive. It is suggested that before attempting installation, please review this document to develop an overall understanding of the drive operation and technical features.

CAUTION

o   The drive must only be operated in the orientation described in the installation paragraph of this section.

o   The drive environment (operating and non-operating) must be maintained as described in Section 1 of this document.

o   The sealed head/disk assembly must not be opened for any reason.

o   The drive is a precision instrument and must be handled carefully.

2.1 UNPACKING AND INSPECTION

The IMI disk drive unit is shipped in a protective container, Figure 2-1, to prevent handling damage. Upon receipt of a unit from the shipper, carefully inspect the shipping container for damage. Report any damages to the carrier immediately. The warranty regarding reshipment of the unit requires that it be enclosed in the supplied container. Therefore, retain original packaging in case of later reshipment of the drive.

2.2 HANDLING

The disk drive contains a head landing/shipping zone designed to protect active data areas during periods of rough handling (shipping). The zone is located on the farthest inside track area (see Preparation for Reshipment). The drive also has a friction brake mechanism that stops the disk rotation at removal of power to the drive motor. This significantly reduces wear on the heads and the media, and acts as a shipping restraint to prevent disk rotation during shipping and handling. The position of the carriage is held against the inner carriage stop, with the heads in the shipping zone during shipping and handling by the orientation of the drive into shipping container (bezel up) and by the inherent magnetic detent of the stepping motor. (Extreme caution is recommended when handling).
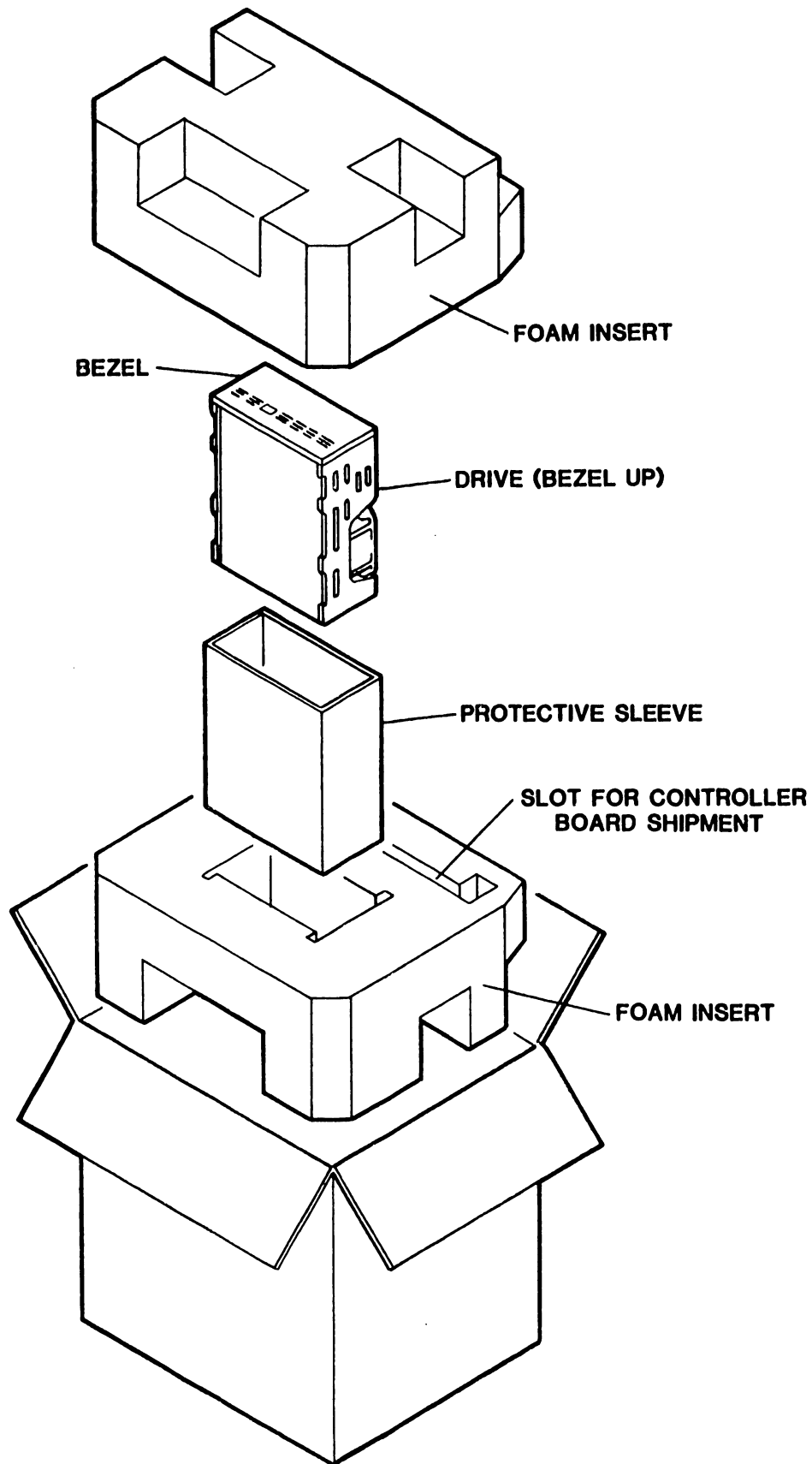
Figure 2-1. Shipping Container and Packaging

2.3 INSTALLATION

The drive may be mounted horizontally (face up - circuit board down), or verti-
cally on either long side (so that the carriage moves horizontally). The drive
may be tilted +15° from the horizontal or vertical mounting positions shown in
Figure 2.2.   — The drive physical and mounting dimensions are shown in Figure
2.2. These diagrams illustrate all the necessary dimensions required for mount-
ing. The drive is secured to the mounting frame using 6-32 machine screws.
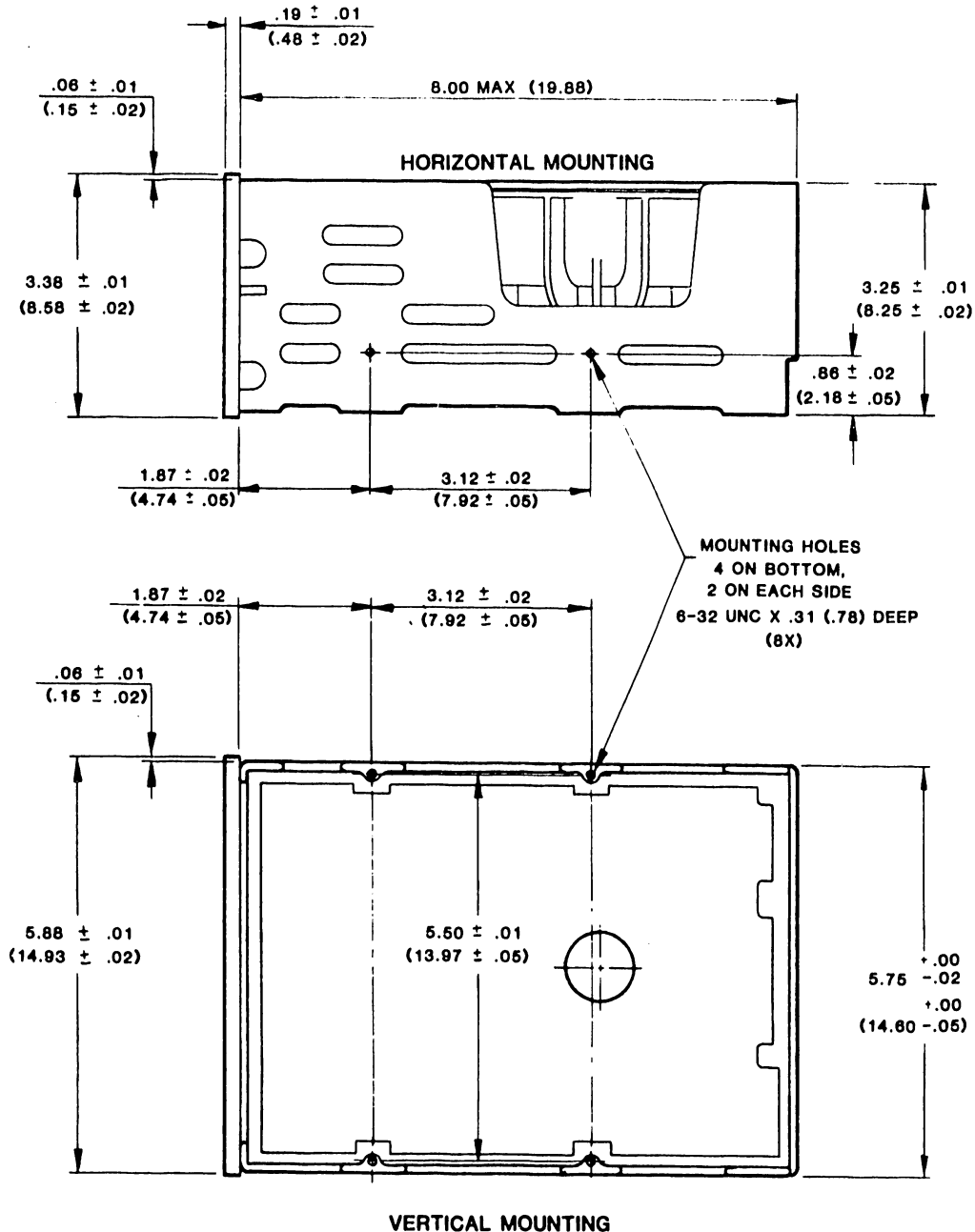
Figure 2-2. Disk Drive Physical and Mounting Dimension

Cooling for the circuit boards is provided by a centrifugal fan attached to the spin motor and by natural convection. Air is drawn into the fan through a hole in the PC board, and blown out through the gap formed by the underside of the PC board and the base of the drive as shown in Figure 2-3.

OUTPUT

CONVECTION

INPUT
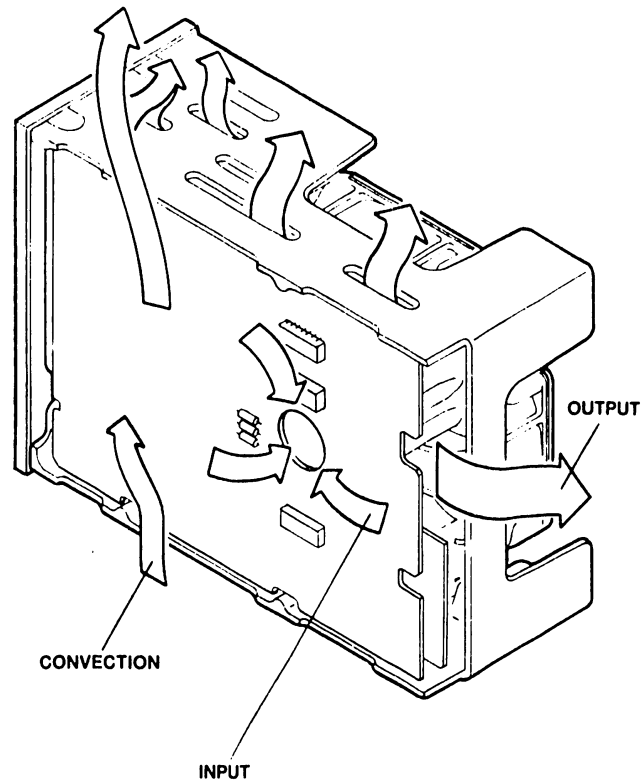
Figure 2-3. Cooling air Intake/Output Locations

It is recommended that clearance be allowed both above and below the protective frame as shown in Figure 2-4 to provide free air flow and clearance for shock mount deflection during severe shock conditions. A clearance of .125 inch is recommended.

.125 MIN.

.125 MIN.
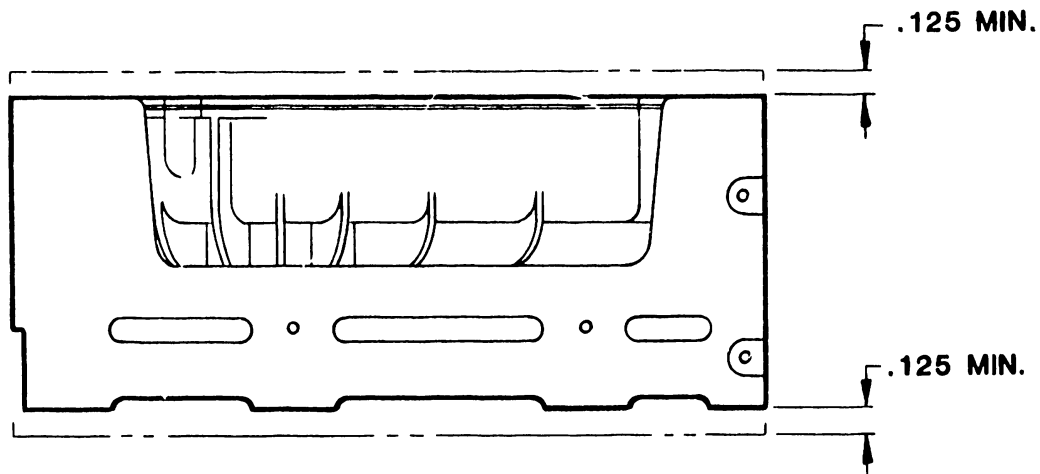
Figure 2-4. Recommended Mounting Clearance

2.3.1   Connecting Power

Connector locations for the following paragraphs are shown in Figure 2-9.

The drive requires only DC power for operation.   This is connected to the unit at four pin connector J-3 shown in Figure 2-5. The recommended mating connector for J3 is as follows:

J3/P3 - Amp	P/N 61314-4 (strip form)
	P/N 60617-4 (loose piece)
Socket housing	No. 1-480424-0
Recommended wire size	18 or 20 awg

J3
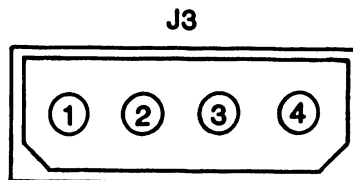
VOLTAGE		GROUND	
PIN 1	+12 VOLTS DC	PIN 2	+12 VOLT RETURN
PIN 4	+5 VOLTS DC	PIN 3	+5 VOLT RETURN

Figure 2-5. DC Power Connections

2.3.2   Connecting Signal Cable

The control   and status signals to and from the drive and host   controller are
transferred using connector J1.   The data communications (read/write) is over
connector J2.   Connection to J1 and J2 is via flat ribbon cable.   The physical
dimensions and pin locations for these connectors are shown in Figures 2-6 and
2-7 respectively (for specific signal information,   refer to ELECTRICAL INTER-
FACE, Section 3).   The recommended mating connectors for J1 and J2 are as
follows:

    J1/P1 - Amp ribbon connector P/N 88373-3 or 3M P/N 3463-

    0001, or equivalent, polarizing key 3M P/N 3439-0000.

    J2/P2 - Amp ribbon connector P/N 88373-6 or 3M P/N 3461-0001.

    Polarizing Key 3M P/N 3439-0000.

UNLESS OTHERWISE NOTED

    .XX = ±.03
  .XXX = ±.010

BOARD THICKNESS
    .062 ±.007

Figure 2-6. Control and Status (daisy chain) Connector J1

UNLESS OTHERWISE NOTED

.XX = ± .03
.XXX = ±.010

BOARD THICKNESS
.062±.007

Figure 2-7. Data Communications (head/write) Connector J2

For connector J1, odd numbered pins are grounds and even pins are for communica-
tion signals between the drive and host controller.   Key slots are provided for
both connectors between pins 4 and 6.

A typical system connection with a host controller and four drive units is shown
in Figure 2-8. Maximum cable length is 20 feet.

NOTE

Last drive installed must have a line
terminator installed. Refer to Figures
2-8 and 2-9.
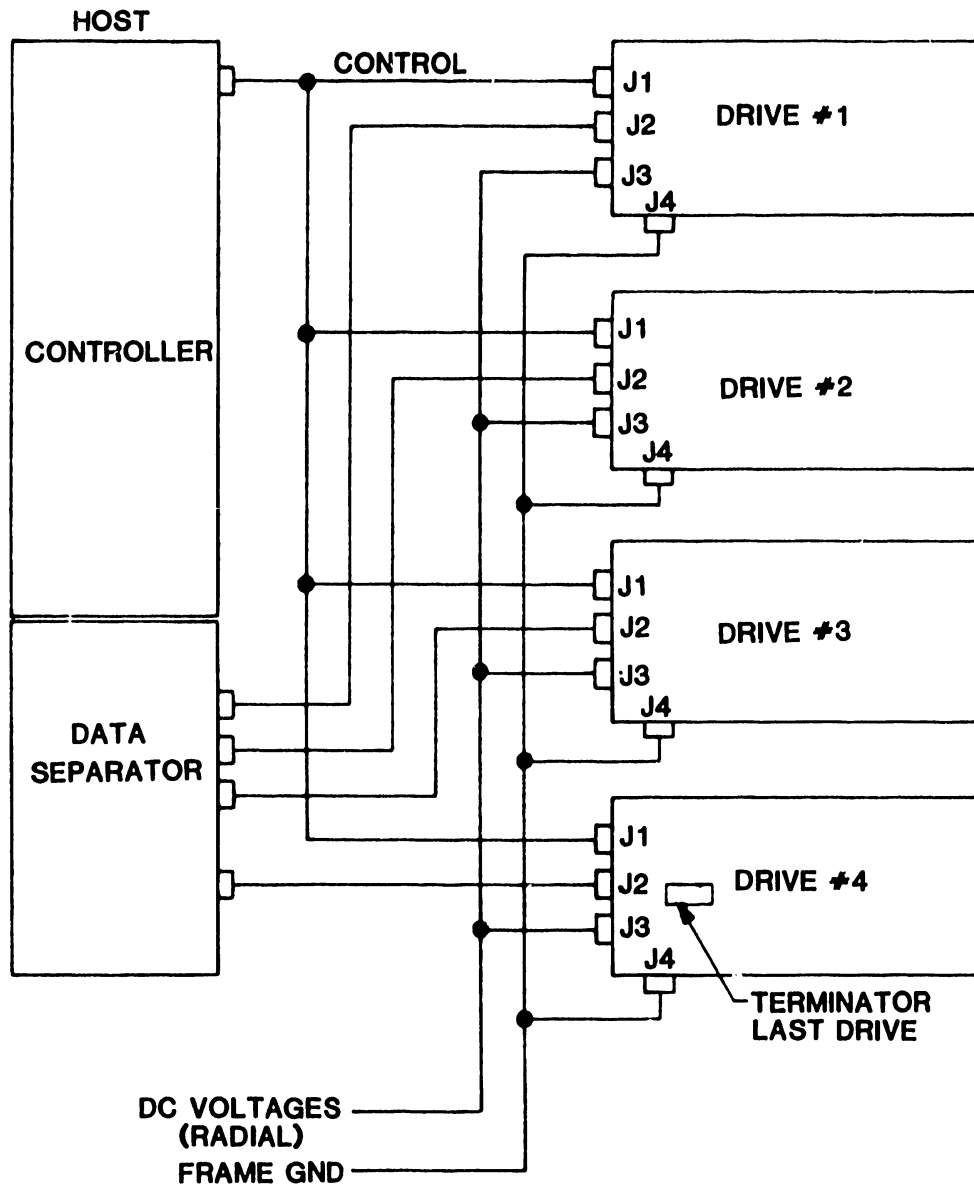
Figure 2-8. Typical Drive/Host Controller Connections (four drives)

2.3.3   Frame Ground

It is very important to supply a good ground between the disk unit and the host system. Failure to do so may result in drive noise susceptibility and random data errors.

A Faston tab is provided on the rear of the unit for this purpose. The mating connector is Amp P/N 60972-1. Recommended wire gauge is 16-18 AWG.

2.4   RESHIPMENT

Upon power-down before shipment, it is recommended that the host controller system command the unit to seek to cylinder 329. This location is dedicated as a shipment zone and is not intended for any other use.

Always pack the unit in its original shipping container with the BEZEL UP if it is to be moved any distance, Figure 2-1 unless it is installed in equipment that provides a protection which equals or exceeds that of the original container. The upper and lower foam inserts are identical and may be interchanged. No external restraints are required for shipment.

2.5   OPERATION

The paragraphs that follow describe the customer options as to the various configurations in which the drive can be connected, the drive address selection from a host controller, and a description of the power-up sequence with associated timing diagram.

2.5.1   Customer Options

The drive has an eight position jumper header to allow the customer to configure the drive for a particular need. The header is located along one side of the hole in the PCB. The jumpers currently operational are:

Force Select

> S8 - Jumpered, allows drive to be used in radial mode only. All output lines are active regardless of select status. Force select does not light the selected LED on the bezel.

> S4 - Drive Select 4

> S3 - Drive Select 3

> S2 - Drive Select 2

> S1 - Drive Select 1

2.5.2 Drive Address Selection

Drive select jumpers are shown in Figure 2-9. These jumpers select the proper drive for communications with the host controller when the jumpers match that of the drive select lines. To set the drive to the desired address place a jumper in the desired location as shown in section 2.4.1 above.
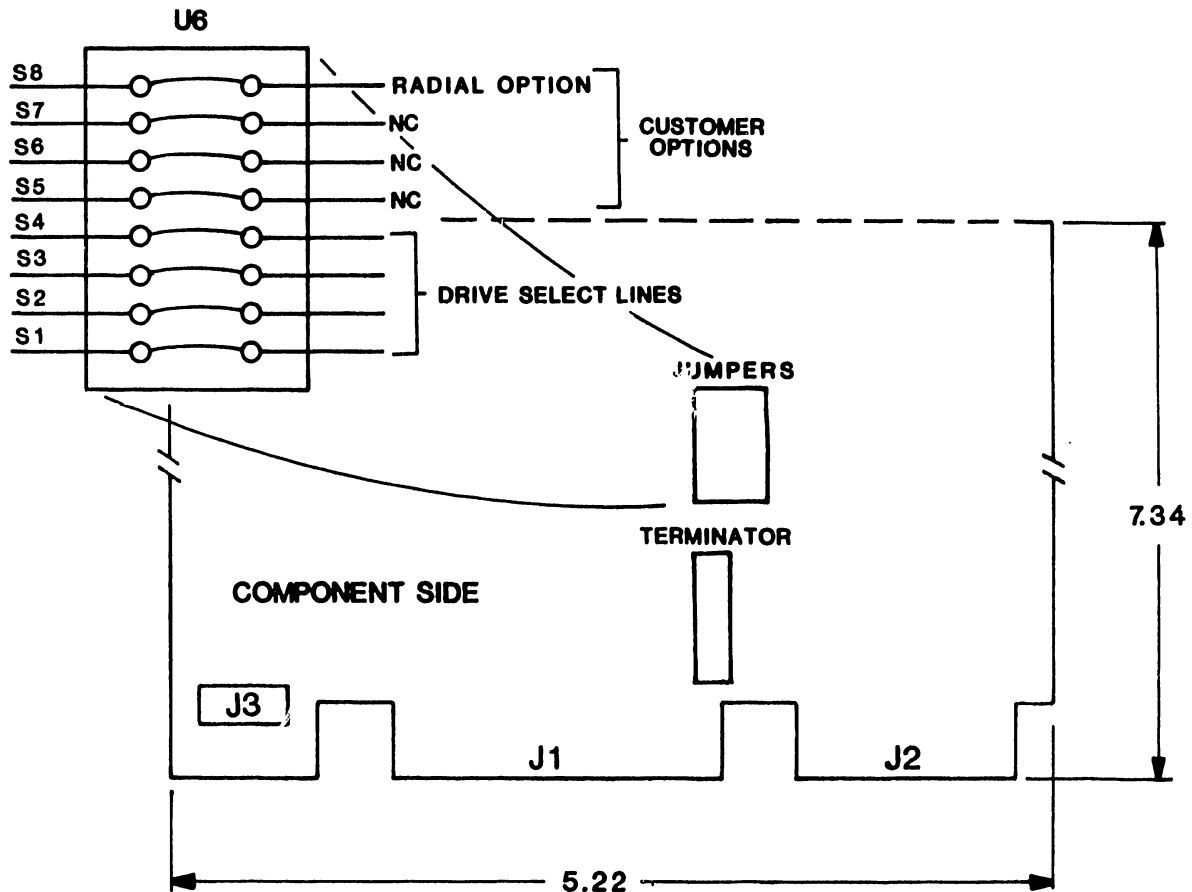
Figure 2-9. Read/Write Circuit Board Terminator, Switches, and Connector

2.5.3   Power-Up Sequence

DC power (+5 and +12) may be supplied in any order.   After a time of 30 seconds maximum the heads will automatically recalibrate to TRACK 000.   Upon a successful recalibrate, TRACK 000, READY and SEEK COMPLETE status signals will be true.   The unit will not perform any read/write or seek functions until READY is true (refer to ELECTRICAL INTERFACE, Section 3 for interface signal definitions).   A power up sequence timing diagram is shown in Figure 2-10.

DC ON

REVS=1000 approx.

DISK UP
TO SPEED

TRACK 000

AUTOMATIC RECALIBRATION
30 sec. MAX

READY

50 ms MAX

SEEK COMPLETE
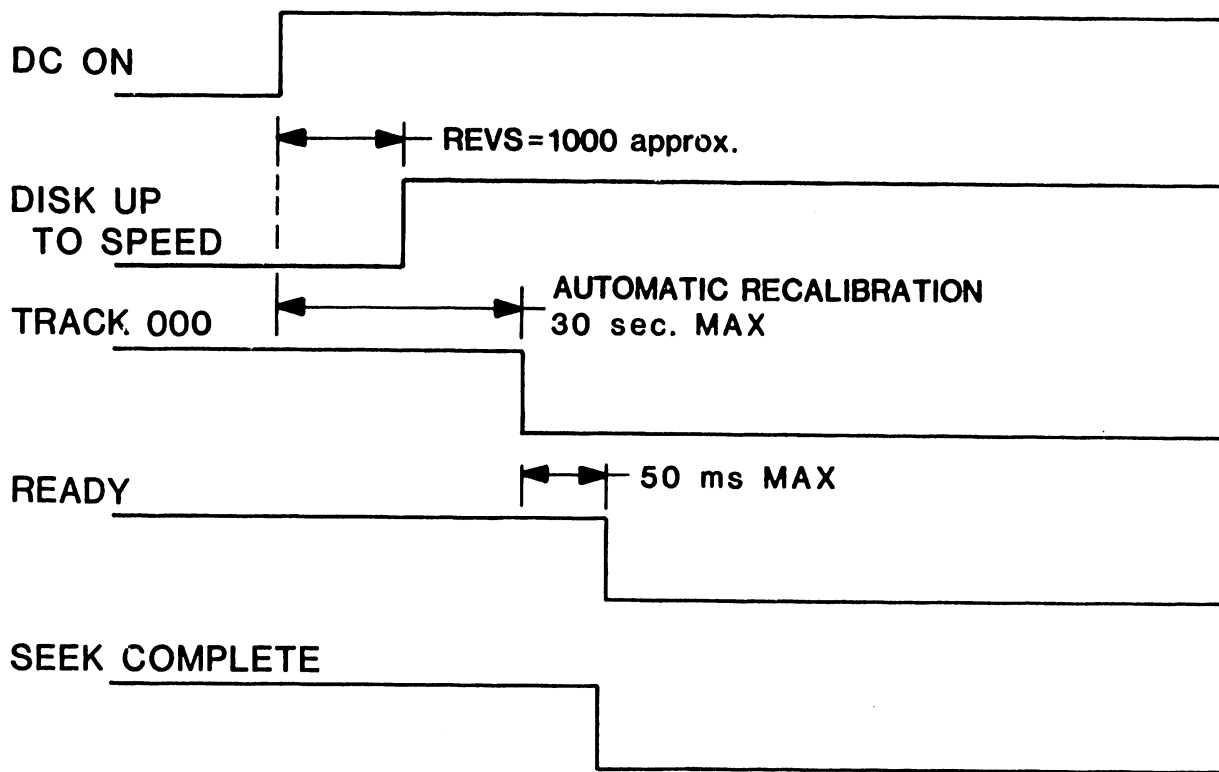
Figure 2-10.   Drive Power-Up Sequence Timing Diagram

SECTION
3
ELECT-
RICAL
INTER-
FACE

ELECTRICAL INTERFACE

3.0   INTRODUCTION

The electrical interface between the host controller and the IMI 5000H series disk drive is shown in Figures 3-1 and 3-2. The interface utilizes a control and status cable which connects between the host controller and connector J1 of the drive and a read/write circuit board located on the bottom of the drive (refer to Section 2).

The drive uses open collector TTL digital signals to provide communication between the host and drive connector J1. For the data cable, differential drivers and receivers are used for noise immunity purposes.
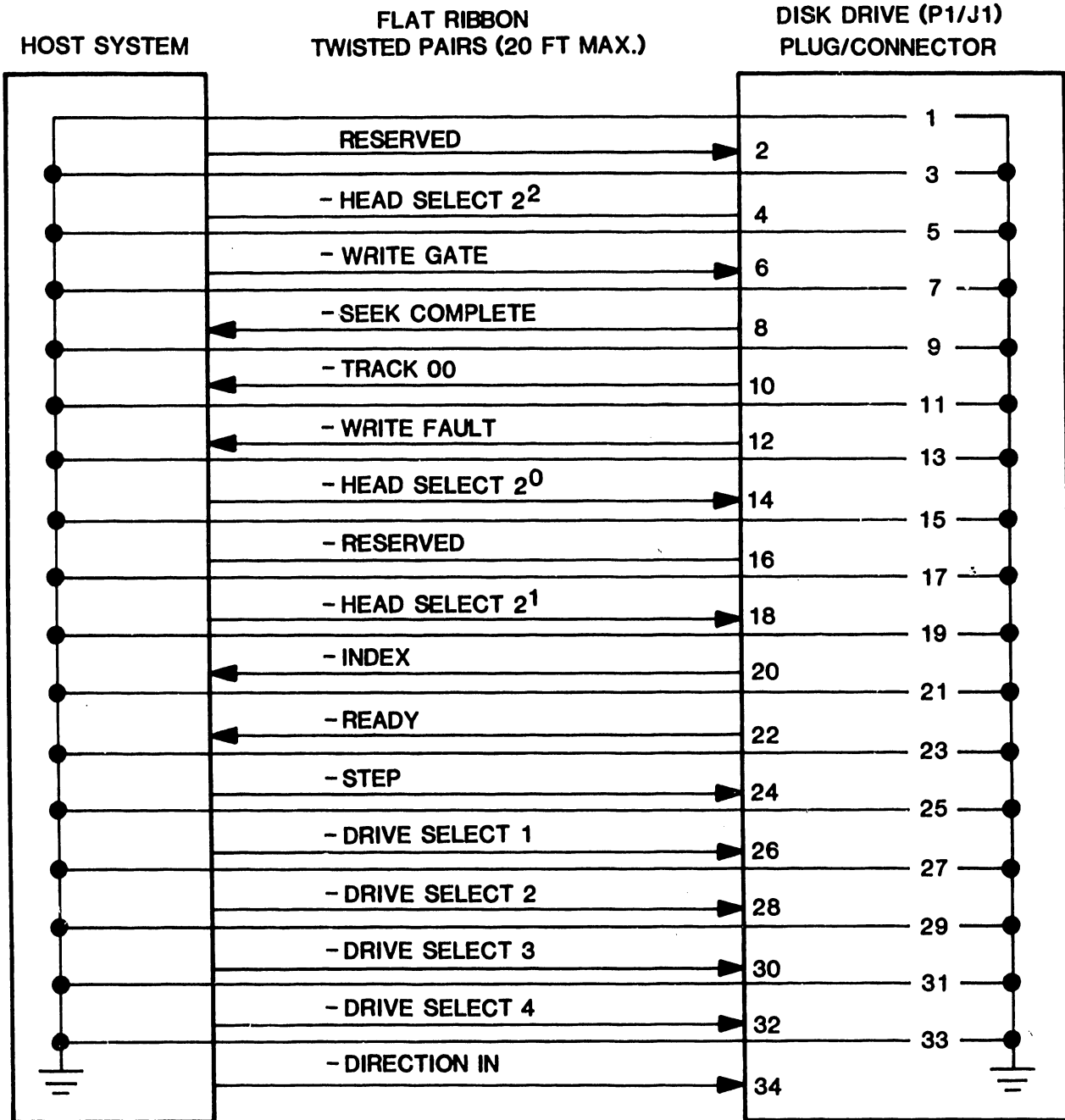
Figure 3-1.   Control and Status Interface Cable (P1/J1)
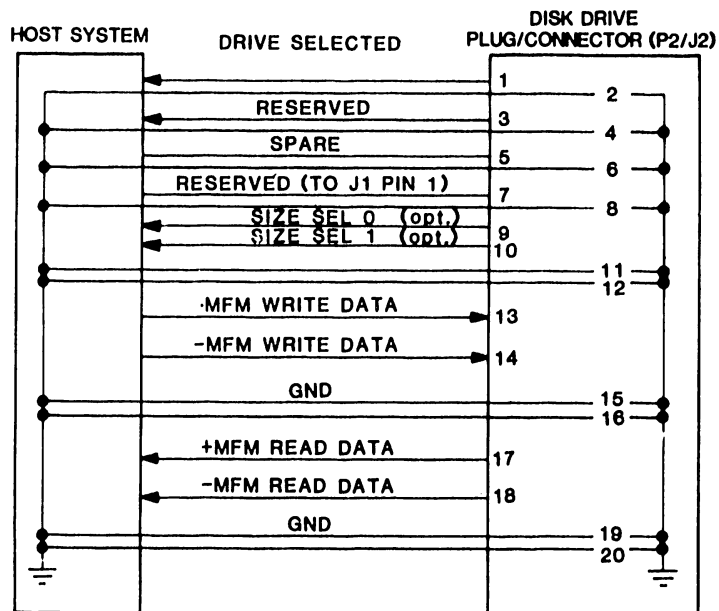
	DRIVE TYPE	PIN 9	PIN 10
OPTIONAL	5006	1	0
	5012	0	1
	5018	0	0

Figure 3-2. Control and Status Interface Drive/Receiver

3.1 CONTROL AND STATUS INTERFACE

The 34-pin flat ribbon interface cable relays control (STEP, DIRECTION and WRITE) and status (READY and SEEK COMPLETE) signals to and from the controller and the drive. These signals are multiplexed to the drive by the DRIVE SELECT signal. This selection also enables all output status signals to the controller. The true and false states of these lines are defined as follows:

Logic "O" (True) = 0.0 Vdc to 0.4 Vdc at -40 ma (max.)

Logic "1" (False) = 2.5 Vdc to 5.25 Vdc at 250 ua (max.)

A typical driver/receiver configuration for the control and status lines is shown in Figure 3-3. Each signal contained on the interface for the control and status cable is listed and the associated function described in table 3-1.
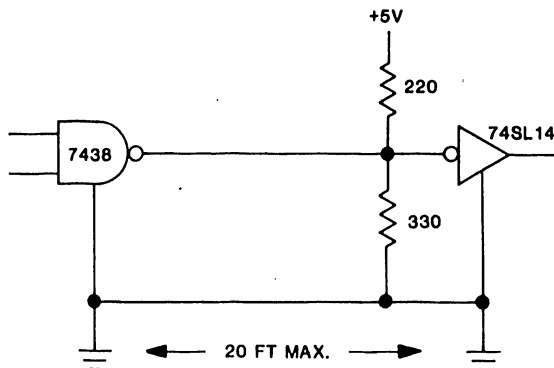
Figure 3-3. Control and Status Interface Drive/Receiver

Table 3-1. Control and Status Interface Signals	
SIGNAL	*FUNCTION*

DRIVE INPUT SIGNALS:

DRIVE SELECT 1-4	True line selects the corresponding drive for communication with the controller. The four select lines (S5, S6, S7, and S8) allow up to four drives to be daisy-chained to one controller.
DIRECTION IN	Determines direction of carriage movement and is used in conjunction with the STEP signal which moves the carriage one cylinder per STEP pulse. DIRECTION must not change state while STEP pulses are applied to the drive and must not change until 25ns after the last STEP pulse. Logic true = movement of carriage away from disk center.
STEP	Used with the DIRECTION signal to move the carriage away or towards the center of disk. Motion is initiated at the leading edge of the STEP pulse, logic one to zero transition. The micro-firmware clears SEEK COMPLETE by 500ns after the leading edge of the first STEP pulse high to low transition. The STEP pulse width is 1us minimum. The reoccurrence rate determines the seek mode. When STEP pulses are between 3us and 200us apart the drive is in BUFFERED STEP MODE. When STEP pulses are more than 3ms apart the drive is in SLOW SEEK STEP MODE. Any pulse train faster than 3us per pulse or between 200us and 3ms per pulse is illegal and may cause seek errors. Refer to Figure 3-4 for timing diagram of normal step mode.
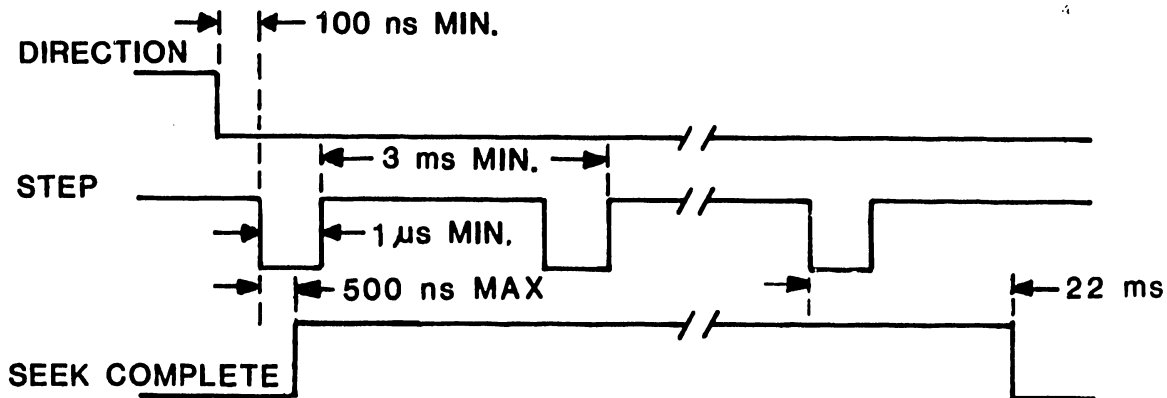
Figure 3-4. Normal Step Mode timing

Table 3-1. Control and Status Interface Signals (cont.)

BUFFERED STEP MODE — Offers reduced seek times for optimum performance. STEP pulses are between 3us and 200us apart. When the time between STEP pulses is decreased, the drive recognizes the pulse rate increase and responds by increasing the actuator speed to locate cylinders with an average access time of 49ms. The micro firmware counts all STEP pulses until:

    o 200usec of time expires since the last STEP

    o 305 STEP pulses have been counted

At this time the micro firmware steps the heads to the proper track using the optimum algorithm for the stepper motor.

Refer to Figure 3-5 for timing diagram of BUFFERED STEP MODE.
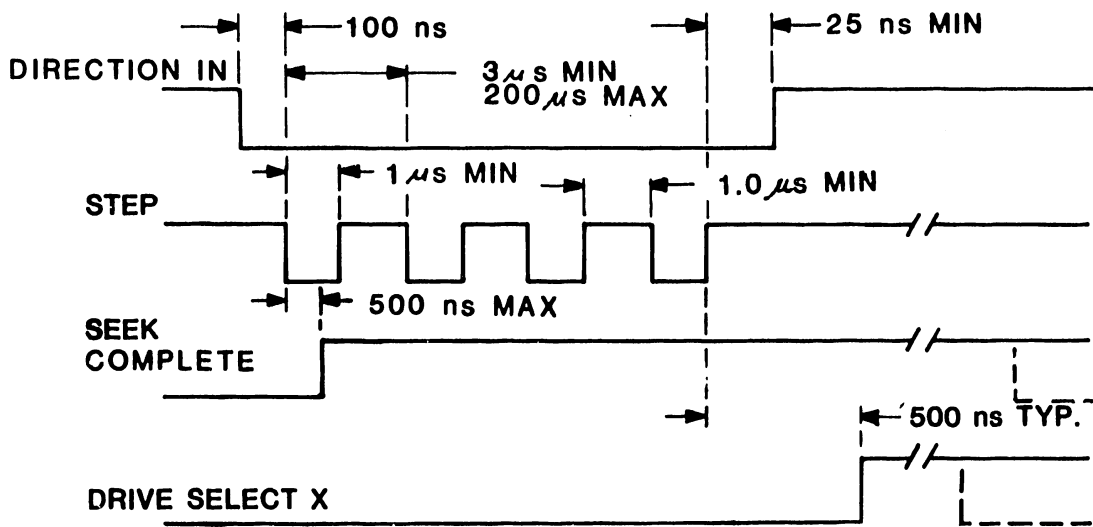
Figure 3-5. Buffered Step Mode Timing

HEAD SELECT $2^0, 2^1, 2^2$ — Three lines provide selection of one of the six (0-5) possible read/write heads available in the IMI 5000H series disks (depending on model number). Heads are addressed 0 through 5. The head selection for the three IMI models is as follows:

Head Select Lines   Heads Selected

                             IMI Models

2^2	2^1	2^0 (LSB)	5006H	5012H	5018H
1	1	1	0	0	0
1	1	0	1	1	1
1	0	1	–	2	2
1	0	0	–	3	3
0	1	1	–	–	4
0	1	0	–	–	5

Table 3-1 Control and Status Interface Signals (cont.)

WRITE GATE	When this line is true stepping is prohibited.

Writing data to the drive is accomplished as follows:

o   Drive Selection

o   Drive READY true

o   Selecting Required Track (Cylinder and Head)

o   No WRITE FAULT exists

o   SEEK COMPLETE true

o   Activating WRITE GATE

o   Transferring data on WRITE DATA lines

NOTE

The controller does not control REDUCED WRITE CURRENT because the onboard processor automatically decreases write current as necessary.

DRIVE OUPUT SIGNALS:

READY	Indicates drive is up to speed. READY together with SEEK COMPLETE, indicates drive is ready to SEEK, READ or WRITE and all I/O signals are valid. WRITE and SEEK commands are prohibited when READY is false. Typically the time for READY to go true after power-on is 30 seconds.
TRACK 000	When true, notifies the controller that the read-/write heads are positioned over cylinder zero.
SEEK COMPLETE	Notifies the controller that the read/write head has settled on a cylinder at the end of a seek. SEEK COMPLETE must be true before attempting to read or write. SEEK COMPLETE goes false under the following conditions:

o   At power on

o   500ns after the leading edge of a STEP pulse.

SEEK COMPLETE goes true when Heads are ready for R/W operations.

|	
INDEX	Occurs once every revolution to indicate the beginning of data track. A transition period from logical "one" (normal) to logical "zero" is used as INDEX time. A typical waveform of the INDEX timing is one TTL negative pulse 200us in length occuring every 16.67ms.
WRITE FAULT	This signal is used to indicate a condition exists at the drive that may cause improper writing on the disk. When this line is a low level or true, further writing and stepping is inhibited at the drive until the condition is corrected. WRITE FAULT cannot be reset via the interface.

Note: The controller should edge detect this signal.

3.2   READ/WRITE DATA INTERFACE

The data transfer to and from the controller is over the flat ribbon cable that connects to drive connector J2.

1. The data is transferred via differential drivers and receivers.

2. The DRIVE SELECTED line is a TTL open collector.

3. Two pairs of balanced signal lines are used for both the MFM WRITE AND READ DATA.

A typical example of these circuits is shown in Figure 3-6. Each signal on the cable and its associated function is listed and described in table 3-2.
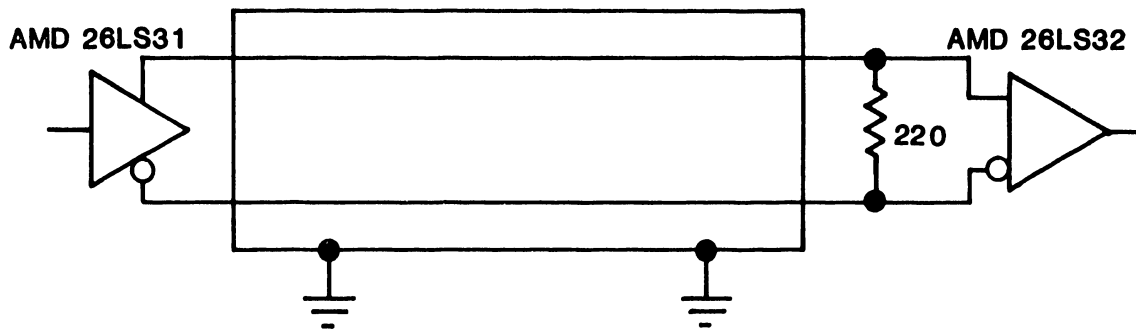
NOTES: 1. FLAT RIBBON OR TWISTED PAIR
MAXIMUM OF 12 FEET.

2. ANY RS422 DRIVE/RECEIVER PAIR
IS SUFFICIENT

Figure 3-6. Read/Write Data Interface Drivers and Receivers

Table 3-2. Read/Write Data Interface Signals	
SIGNAL	FUNCTION
+MFM WRITE DATA	The WRITE DATA differential pair is used to cause MFM data to be written on a track by flux reversals which are caused by the transition of the +MFM WRITE DATA line going more positive than the -MFM WRITE DATA line. During a read operation +MFM WRITE DATA must be held more negative than -MFM WRITE DATA by the controller.
+MFM READ DATA	The READ DATA line transmits MFM data from the drive to controller. A differential pair used for this purpose. The transition of the +MFM READ DATA line going more positive than the -MFM READ DATA line indicates the sensing of a flux transition on the disk surface.
-DRIVE SELECTED	TTL open collector circuit indicates to the controller that the drive has recognized and responded to its DRIVE SELECT address.

SECTION
4
THEORY
OF
OPERA-
TION

THEORY OF OPERATION

4.0 INTRODUCTION

This section describes the overall operation of the drive including functional descriptions of the major electrical and mechanical components that make up the drive, general timing, air cooling system, format recommendations and other important features of the disk drive system.

4.1 DRIVE FUNCTIONAL DESCRIPTION

A simplified block diagram of the drives's major components and related interfaces is shown in Figure 4-1. As shown, the drive system consists of spindle and stepper motors, control logic, read/write and head selection logic, and index and track detect sensors.

HEAD SELECT 2^0-2^2

READ LOGIC

MFM READ DATA

HEAD SECTION LOGIC

HUB BRACE

WRITE GATE

MFM WRITE DATA

WRITE LOGIC

REDUCE WRITE CURR

DC HUB MOTOR

MOTOR VELOCITY INFORM.

INDEX DET

READY

INDEX

WRITE FAULT

TRACK 000

SEEK COMPL.

MTR POWER

CONTROL LOGIC

STEPPER A
STEPPER B
STEPPER C
STEPPER D

STEPPER MOTOR (ACTUATOR)

TRACK 000 DETECT

DIRECTION IN

STEP

DRIVE SEL.1

2
3
4

SELECTED

INDEX

TRACK 000
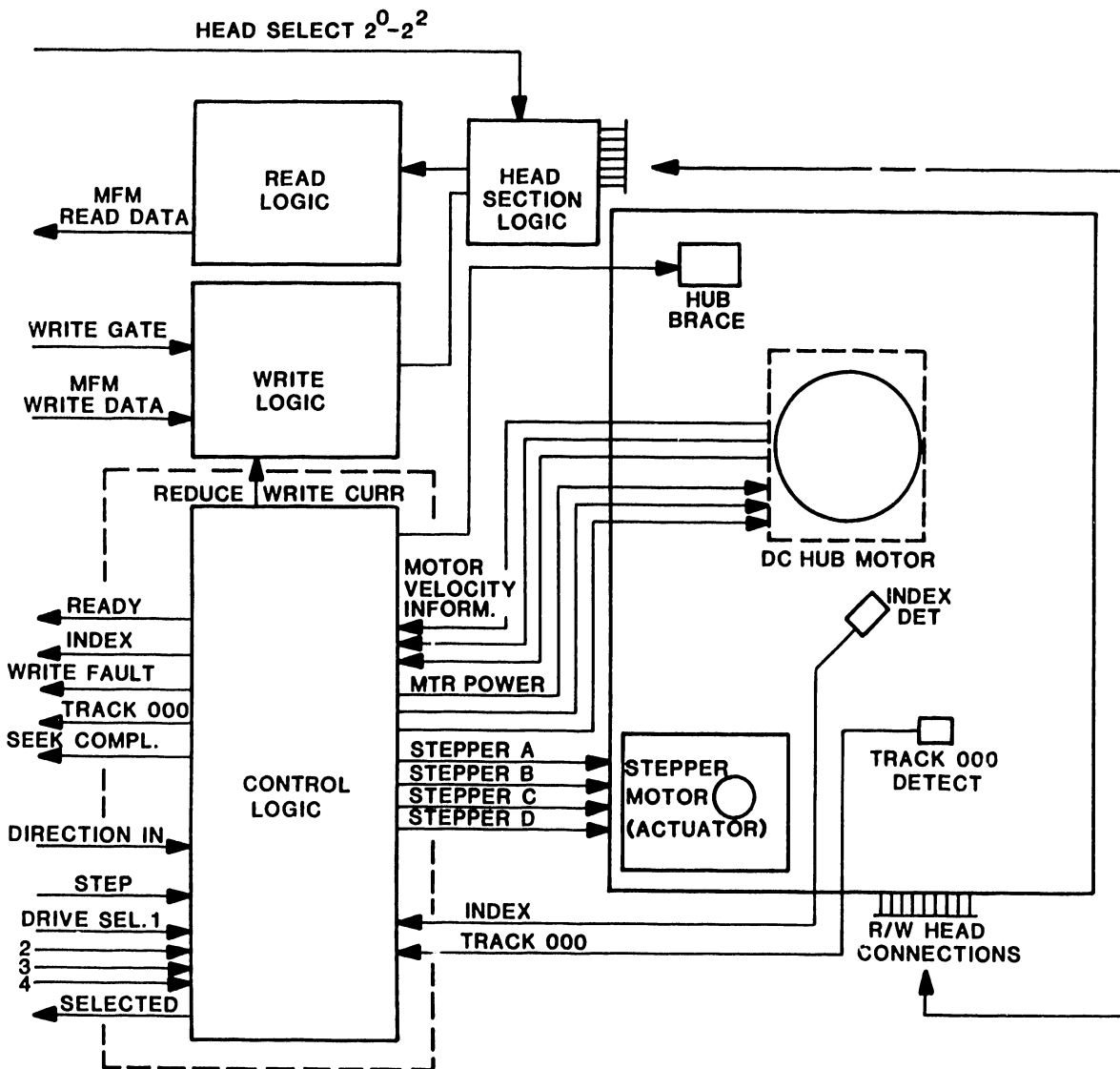
R/W HEAD CONNECTIONS

Figure 4-1. IMI 5000H Series Disk Drive Functional Block Diagram

4-1

4.1.1 Control Electronics

The control logic consists of two circuit boards. These include the read/write and motor control boards. The read/write board detects the drive status and in turn issues the necessary control signals to operate the drive. The general board functions include the following:

- o Read/write head positioning

    - Stepper motor control

    - Track 000 detect

- o Write fault detection

- o Head selection

The read and write data are fed directly to the media with the data transfer rate directly related to spindle speed.

The motor control board is mounted to the baseplate above the read/write board. This board obtains its operating power from the read/write board and provides power and speed control to the spindle drive motor.

4.1.2 General Timing Sequence

The general timing for an overall operating sequence of events is shown in Figure 4-2. The diagram shows the timing for a seek and a read/write operation and represents a six-track seek (0-5), a read, then a write.
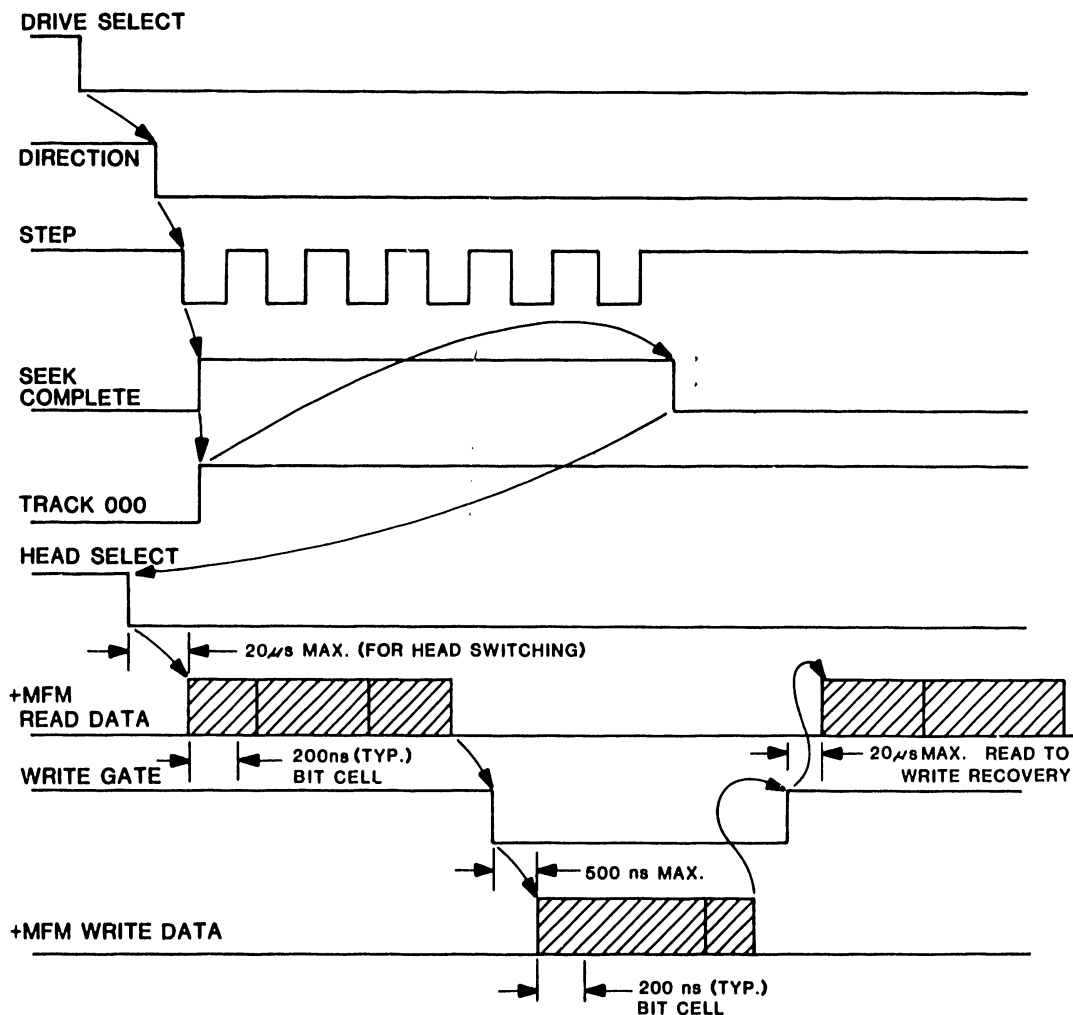

Figure 4-2. General Timing Sequence

4.1.3   Write Precompensation

The controller is responsible for encoding, decoding, address mark construction and detection, and write precompensation. Figure 4-3 shows examples of patterns to be compensated. The optimum amount of precompensation is 12ns for both early and late written bits. All other patterns are written "on time". Writing should occur out of a shift register which is used to observe the pattern. "On time" represents a nominal delay. Early and late represent less or more delay respectively. Precompensation is required while writing on cylinders 256 through 305.
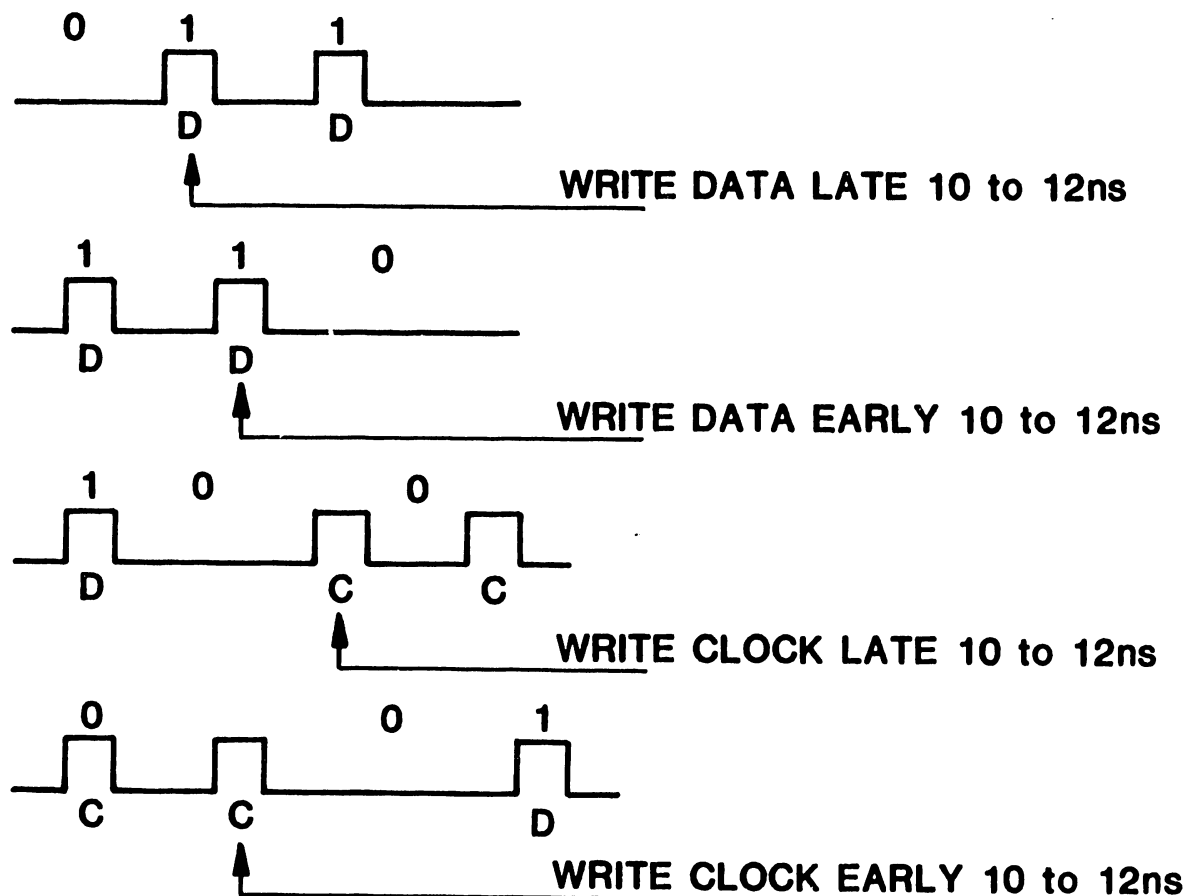
Figure 4-3. Write Precompensation Patterns

4.1.4   Read/Write Data Operation

Examples of both the read and write timing are shown in Figure 4-4. The data is recovered by reading a pre-recorded track on the disk. Aligned magnetized domains generated beneath the head cause a flux reversal on the track for a selected head. The timing diagram shows related timing for MFM data and standardized NRZ data required at the interface. Note where the MFM transitions occur in relation to the NRZ data within a bit cell.

During a write data operation, the controller supplies information to be written on the disk.

Data is written on the disk by passing a current through the read/write head, which generates a flux field across the head gap. This magnetizes the film particles directly beneath the head with an orientation (polarity) related to the direction of the current flow through the head.

Figure 4-4. Read/Write Data Timing Diagram
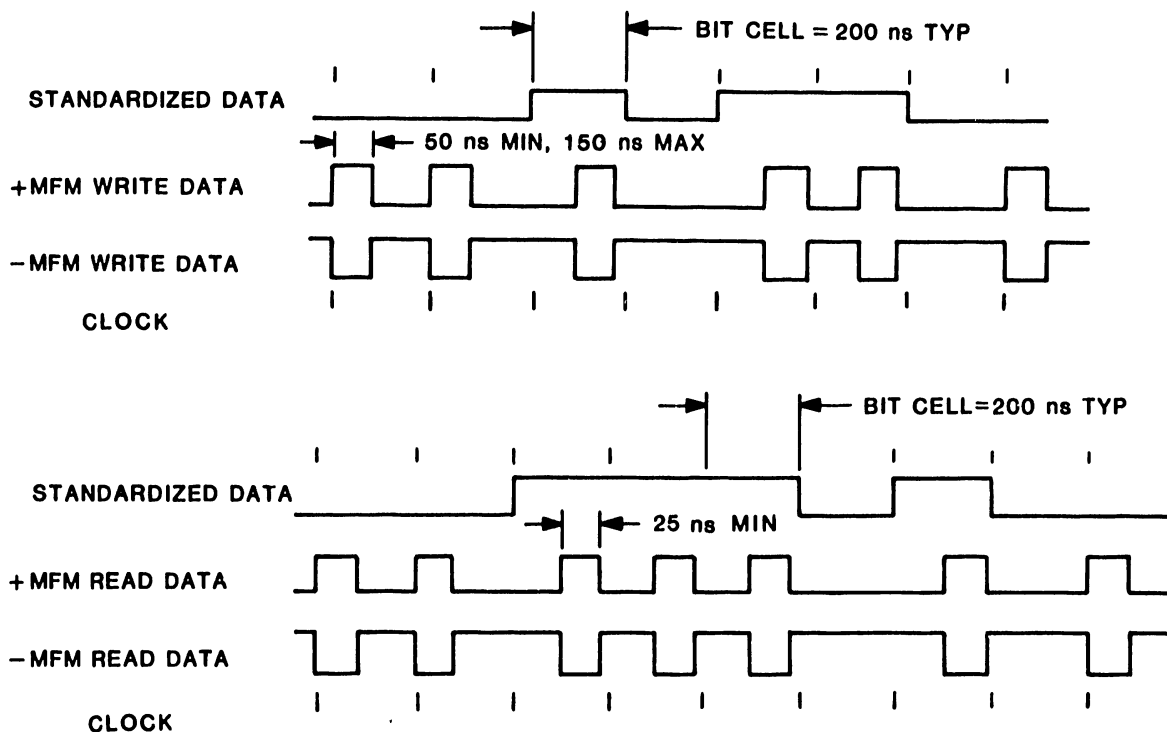
Because of changes in bit shift due to differences in head-to-disk reaction at inner or outer tracks, certain write data patterns must be pre-compensated by the controller to ensure specified data integrity. This is described in the previous paragraph along with examples of data pattern.

As previously mentioned, data is fed directly to the media with the data transfer rate controlled by the spindle speed.

4.1.5   Media Defects

IMI performs media analysis on each unit to identify any media problem areas. During this testing, each problem area is logged on a "Defect Table" that is included with every drive. The table lists any unusable bit locations with reference to cylinder head. Maximum defects allowed are 8 for 5006, 16 for 5012 and 24 for 5018 with cylinder 000 certified as defect-free.

4.1.6   Drive Mechanism

The brushless direct driven DC drive motor rotates the spindle at 3600 rpm. The motor is thermally isolated from the baseplate to minimize temperature rise in the sealed chamber containing the heads and disks. The motor and spindle are dynamically balanced to ensure a low vibration level. An automatic friction brake is used to provide a fast stop to the spindle motor upon power-down.

4.1.7   Position Mechanism

The position mechanism including the stepper motor, carriage and associated devices are shown in Figure 4-5. The stepper motor is thermally isolated from the baseplate to minimize temperature rise in the sealed chamber containing the heads and disks. The read/write heads are attached to a precision ball bearing, 3 point self aligning carriage. A highly polished stainless steel band connects the actuator to the stepper motor. A large diameter capstan aids in increased band life.
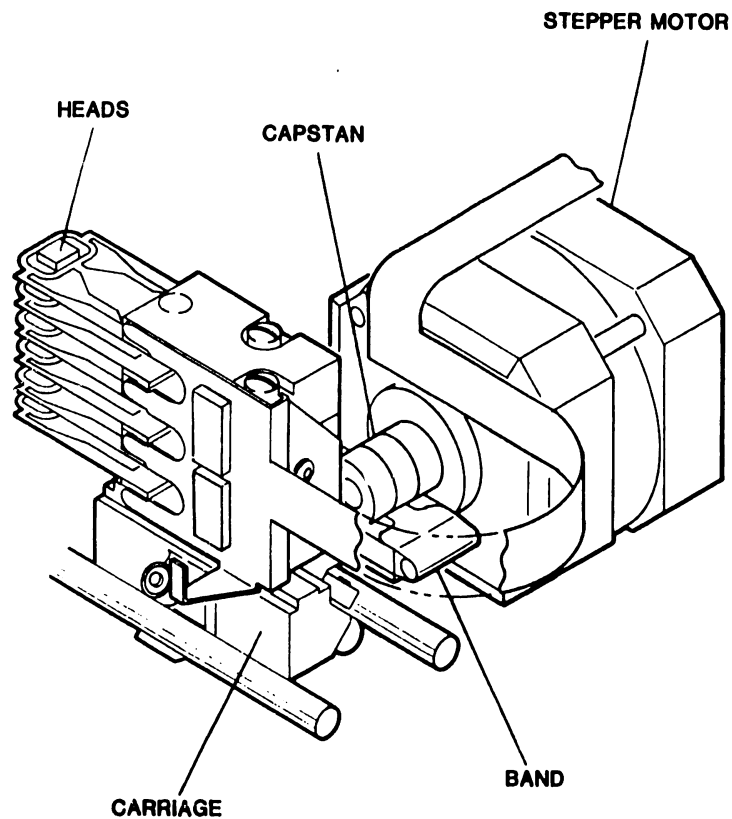
Figure 4-5. Position Mechanism

4.1.8 Air Flow and Filtration

The air flow and filtration system is shown in Figure 4-6. The disks and read/write heads are enclosed in a sealed module having an integral recirculation air system with an absolute filter which maintains a clean environment. The filter system provides better than a Class 100 environment to provide the increased reliability required in Winchester product lines.

A breather filter, located on the head/disk assembly top cover, permits continual ambient to internal pressure equalization without contaminate entry.

Figure 4-6. Air Flow and Filtration System

SECTION
5
TRACK FORMAT RECOMMENDA-
TIONS

TRACK FORMAT RECOMMENDATIONS

5.0 INTRODUCTION

This section describes the general format recommendations, for the IMI 5000 series drives.

5.1 GENERAL REQUIREMENTS

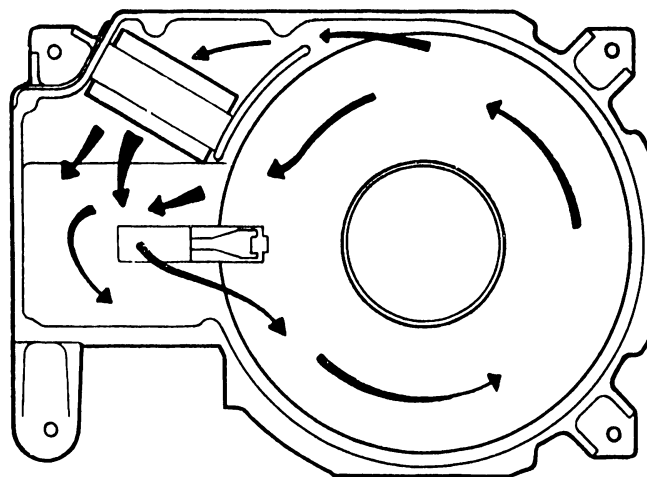The purpose of formatting or arranging a data track is to provide maximum use of the media. The format used with the IMI 5000H series disk drive may vary for customer requirements so long as required basic timing requirements are met.

This model of the IMI disk drive is a soft sectored device which means that the controller must read the track and sector heads to determine the location of the heads relative to the rotational position of the disk.

BIT POSITION

0	1	2	3	4	5	6	7
C D	C D	C D	C D	C D	C D	C D	C D

	0	1	2	3	4	5	6	7
A1 DATA BITS	1	0	1	0	0	0	0	1
A1 CLOCK BITS	0	0	0	0	1	0	1	0

ENCODED PATTERN WITH DROPPED CLOCK

NORMAL ENCODED PATTERN WITHOUT DROPPED CLOCK
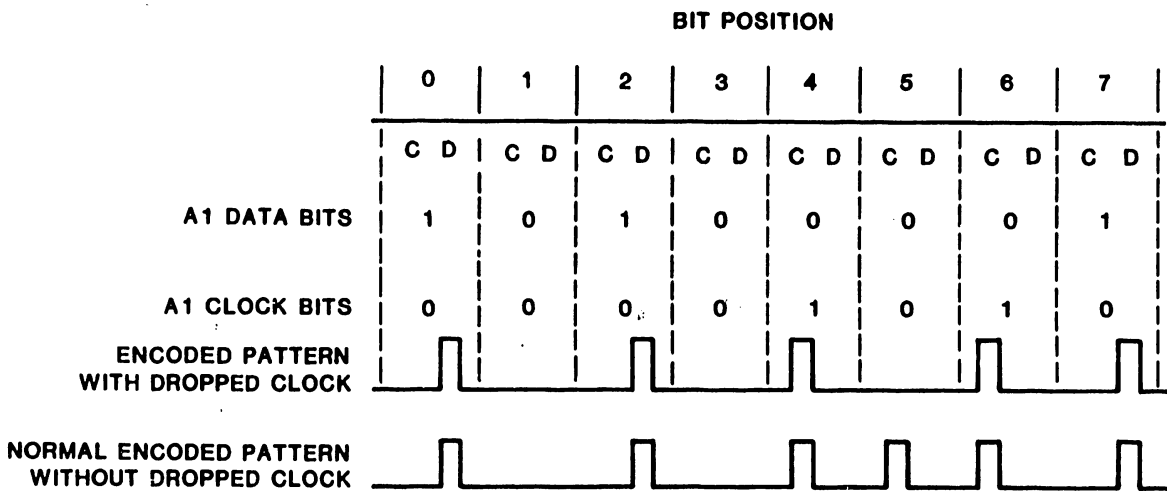
Figure 5-1. Address Mark Data Pattern

5.2 RECOMMENDED DATA FORMAT

The data format shown in Figure 5-2 illustrates and explains the most commonly used format in the industry. It consists of 32 equally divided sectors per track. Considering all tolerance gaps and required sync fields, this format provides 256-bytes of data space per sector, 8192-bytes per track, and 2.506-megabytes per surface. The A1 pattern shown in Figure 5-1 is created by dropping one clock bit normally required in MFM coding to create a unique recognizable pattern for an address mark.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
VFO FIELD (000)	AM (A1)	ID (FE)	C Y L	H E A D	S E C T O R	CHECK SUM (ECC CRC)	G A P	VFO SYNC FIELD (000)	AM (A1)	ID (F8)	DATA FIELD (256 BYTES)	CHECK SUM (ECC CRC)	G A P	INTER-RECORD GAP (4E)

TIME ⟶
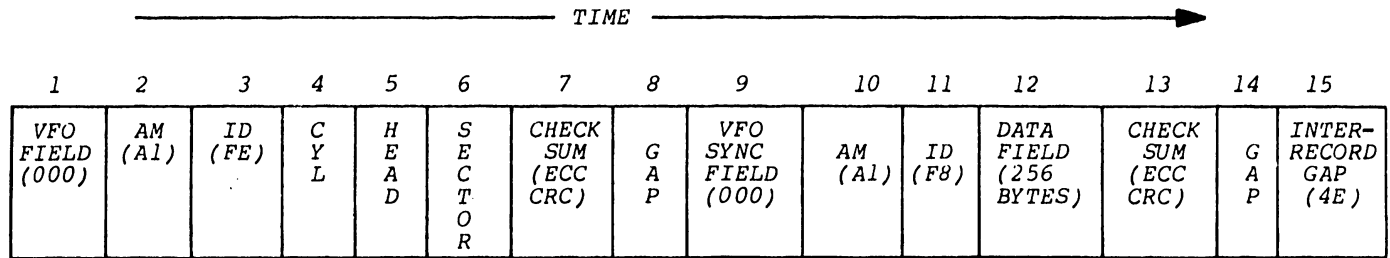
1) VFO Sync Field - Recommended 13-bytes long, all zeros, to provide VFO lock-on prior to data retrieval. Minimum number of bytes dependent on VFO lock-up performance of host data separator.

2) Address Mark -Hex pattern "A1", 1-byte long, identifies beginning of sector or data field.

3) Address Mark ID Field Identifier - Hex pattern "FE",1-byte long, identifies with previous address mark the beginning of ID field.

4) Cylinder Address - 1-byte long, part of header indicating cylinder address 00 - FF Hex.

5) Head Address - 1-byte long, part of header indicating head number 00-07 Hex. Bit 7 of this byte commonly used to identify defective sector.

6) Sector Address - 1-byte long, part of header indicating sector number 00 - FF Hex.

7) Check Sum - 3-bytes long, available for ECC or CRC for ID field verification.

8) Write splice (GAP) - 2-bytes long, all zeros, to allow time for a write turn-on for an update write routing (read header then write data field).

9) VFO Sync Field - Recommended all zeros, 13-bytes long, to provide VFO lock-on prior to data retrieval. Minimum number of bytes dependent on VFO lock-up performance of host data separator.

10) Address Mark - Hex pattern "A1" 1-byte long, idenfifies beginning of sector or data field.

11) Address Mark Data Field Indentifier - Hex patter "F8",1-byte long, identifies with previous address mark the beginning of data field.

12) Data Field - 256-bytes with 32-sector format.

13) Check Sum - 3-bytes long, available for ECC or CRC for data field verification.

14) Write Turn Off Gap - 2-bytes long, all zeros, to provide write turn-off time before next sector.

15) Inter Record Gap -Hex pattern "4E", 15-kbytes long. Tolerance gap to allow for spindle speed variations. 15-bytes allows for approximately +3% variation. For 32-sectors, minimum gap is 8-bytes long.

Figure 5-2. Recommended Data Format (32 Sectors)

5.3 INDEX GAP

A gap is required at the beginning of INDEX to allow for head switching recovery. This is because sequential sectors may be read without losing a complete disk revolution. Minimum length is 12-bytes, hex pattern "4E". Normal recommendations are 16-bytes lengths.

5.4 SPEED TOLERANCE GAP

A tolerance gap is required at the end of the last physical sector (before INDEX) to provide a spindle speed tolerance buffer for the entire track. A full track format routine begins and ends with detection of INDEX. For this example, the gap consists of 353-bytes of hex pattern "4E", but the actual number depends on media speed during the format operation.

5.5 SECTOR INTERLEAVING

This variation in format enhances data throughput of typical read/write operations by allowing multiple sector transfer during a single revolution. The process involves renaming sector addresses, which produces time between sequential sectors.

Interleaving factor numbers equal the number of sequential sectors on any given track. An example of interleaving factors for a 32-sector format is shown in Figure 5-3.

1 TO 1 INTERLEAVE

Physical	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Logical	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

7 TO 1 INTERLEAVE

Physical	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Logical	0	7	14	21	28	3	10	17	24	31	6	13	20	27	2	9	16	23	30	5	12	19	26	1	8	15	22	29	4	11	18	25

Figure 5-3. Sector Interleaving

SECTION 6
MAIN-
TENANCE

SECTION 6

MAINTENANCE

6.0   INTRODUCTION

The following paragraphs describe the services that may be performed on the IMI 5000H series disk drive outside of the manufacturer's facilities. Included are a list of tools required for performance of the services, procedures for removal and replacement of the particular item being serviced, and recommended spare parts for reducing maintenance turnaround time and extra shipping expenses. The assemblies that can be replaced by the user include the following:

      o   Read/Write Circuit Board

      o   Motor Control Circuit Board

      o   Brake Assembly

      o   Index Sensor

      o   HDA Ground Strap

6.1   PREVENTIVE MAINTENANCE

Preventive maintenance is not required to maintain drive operational status.

6.2   TOOLS REQUIRED

The following tools (or equivalent) are required to perform the maintenance procedures described in this section.

      o   Screwdriver, 1/4 inch flat blade

      o   Socket Driver, 3/16 inch hex

      o   Gauges, .015 + .001 inch, .010 + .001 inch

      o   Torque driver, 5/64 inch hex, 8 inch pounds torque

6.3   REPLACEMENT PROCEDURES

The following procedures give step-by-step instructions for removing, adjusting, and replacing the assemblies listed in paragraph 6.0. Prior to performing any of the procedures, please perform the pre-maintenance procedure steps listed in the following paragraph.

6.3.1   Pre-Maintenance Requirements (Figure 6-1)

1. Before drive power-down, position drive to cylinder 329.

2. Remove power from drive.

3. Remove screw (4) securing drive unit to mounting surface.

4. Slide drive away from mounting to expose attached cables.

5. Disconnect power cable J3, control and status cable J1, and read/write cable J2 from drive.

6. Disconnect HDA DC ground cable from Faston tab.

7. Observe the following caution:

CAUTION

Extreme care must be exercised in
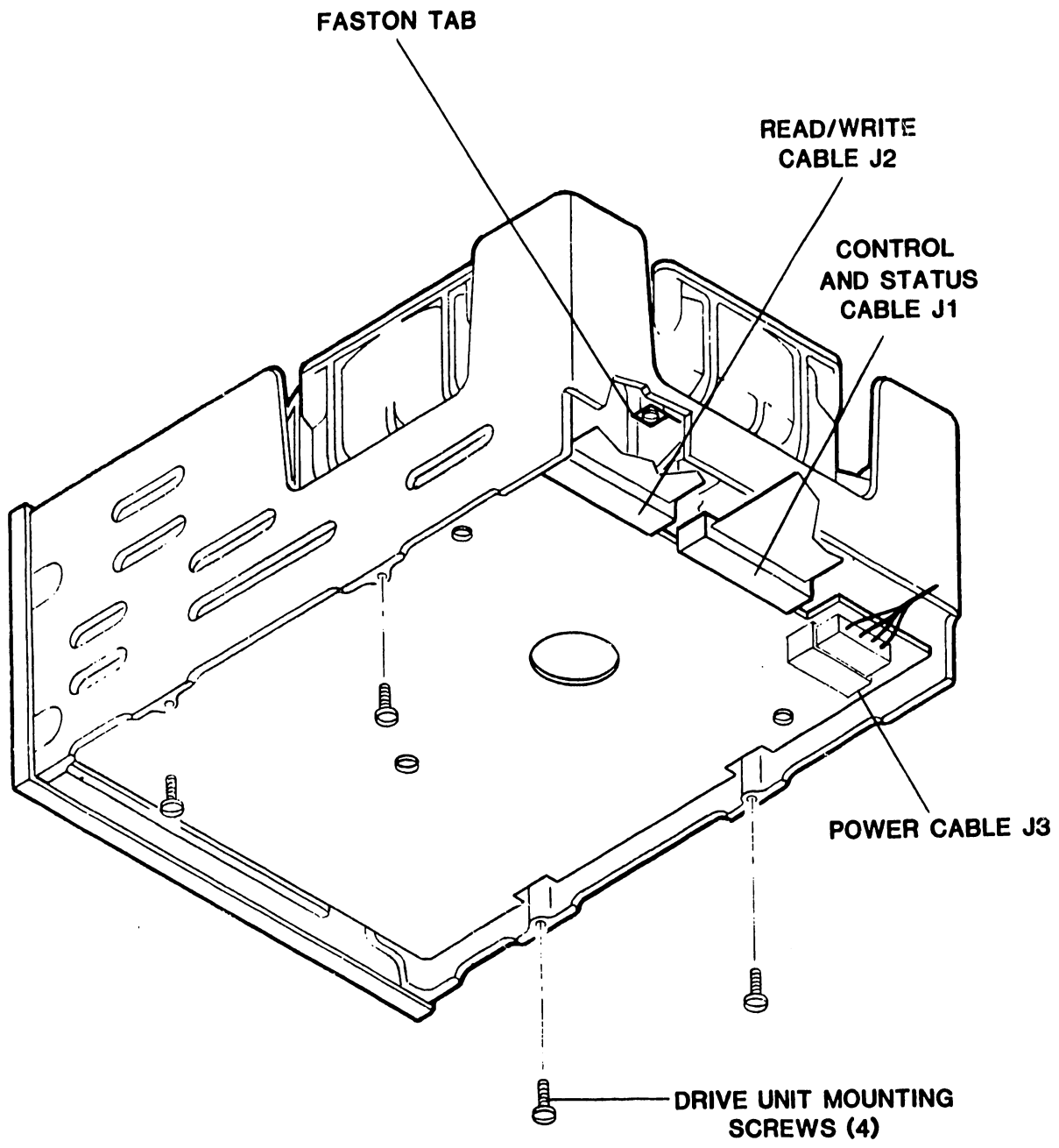removing the electronics PCB to
prevent possible ribbon cable damage.

FASTON TAB

READ/WRITE
CABLE J2

CONTROL
AND STATUS
CABLE J1

POWER CABLE J3

DRIVE UNIT MOUNTING
SCREWS (4)

Figure 6-1. Drive Unit and Cabling Removal and Replacement

6.3.2 Read/Write Board Removal and Replacement (Figure 6-2)

1. Disconnect LED cable.

2. Separate R/W connector from board using flat bladed screwdriver while board is still attached to base. Remove three screws securing R/W board to base. Lift board away from motor control board connector and tilt board away from unit frame.

3. Disconnect stepper motor cable from read/write board.

4. To reinstall, connect the stepper motor cable. Guide the R/W connector loosely onto the board connector pins as board is moved into position on the base. Attach the three screws using a flat bladed screwdriver, completely mate the connector after the board is attached to the base. This technique is required to prevent damaging the flat cable to connector contacts.
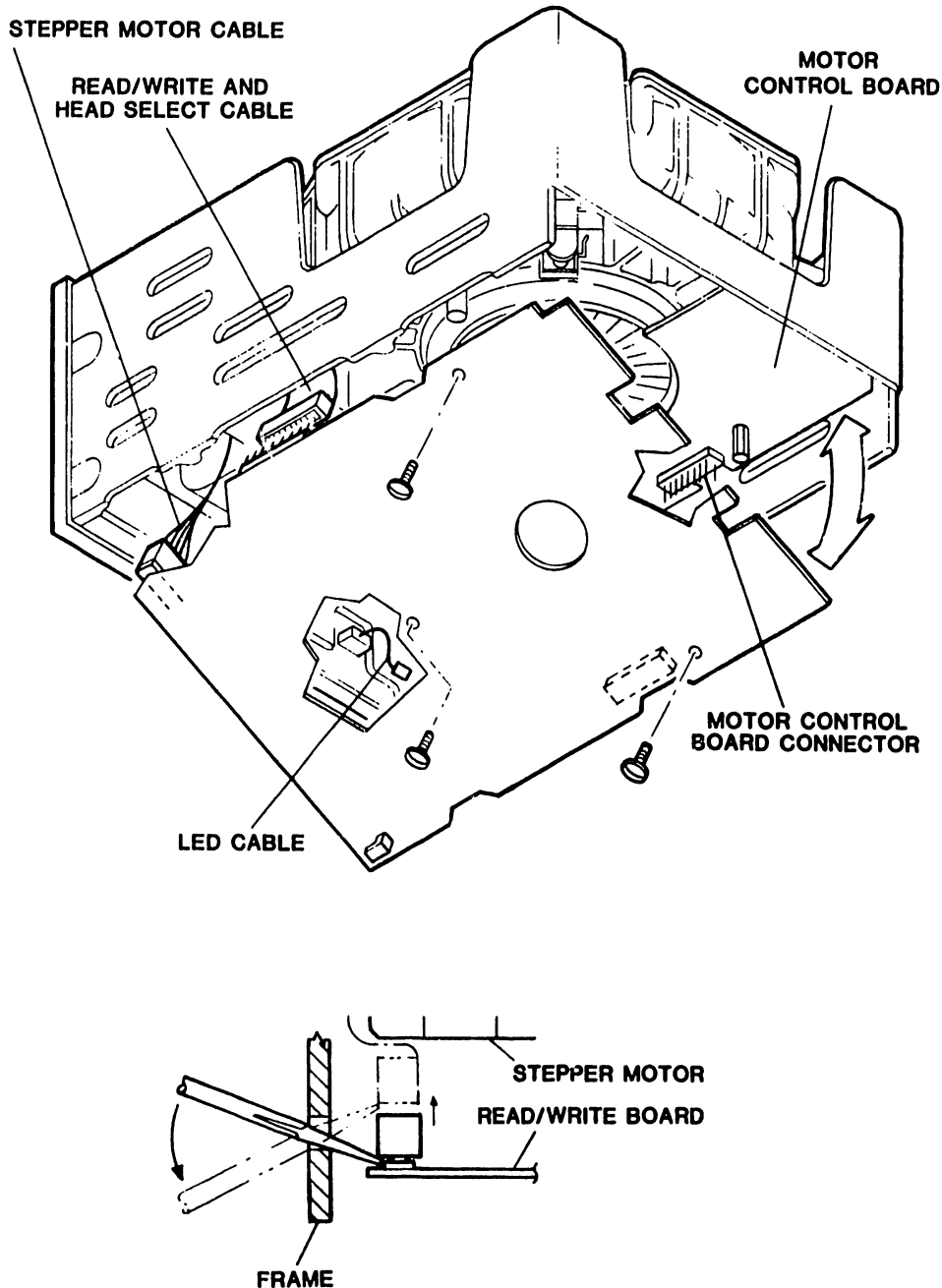
Figure 6-2. Read/Write Board Removal and Replacement

6.3.3 Motor Control Board Removal and Replacement (Figure 6-3)

1. Perform paragraph 6.3.2, steps 1 through 3.

2. Disconnect zero track sensor cable.

3. Disconnect index sensor.

4. Disconnect spindle motor and brake cable.

5. Remove two screws and standoff securing board to unit frame.

6. Reinstall new board by reversing steps 1 through 5.

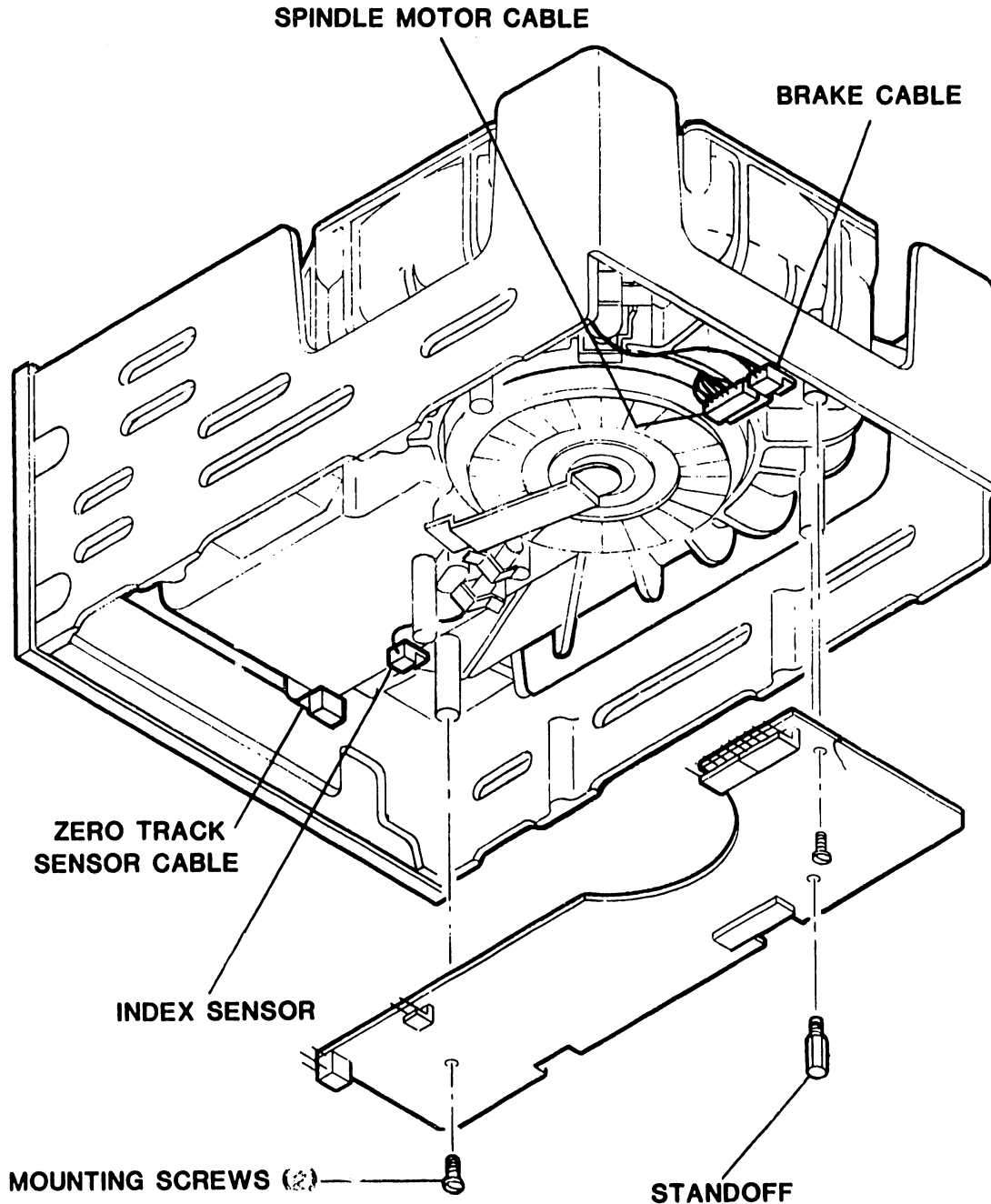7. Reinstall read/write board by performing paragraph 6.3.2, step 4.

Figure 6-3. Motor control Board Removal and Replacement

6.3.4 Brake Assembly Removal and Replacement (Figure 6-4)

1. Perform paragraph 6.3.2, steps 1 through 3.

2. Disconnect brake cable from motor control board.

3. Remove two screws securing brake assembly to unit base.

4. Reinstall new brake assembly by reversing steps 2 and 3 (do not tighten mounting screws at this time).

5. Perform brake adjustment as follow:

   With mounting screws loosened, grip brake assembly with thumb, fore and middle fingers as shown in Figure 6-4. Squeeze assembly together and slide forward and against lateral location bosses. At the same time place .010 gauge between spindle motor and brake. Tighten and torque brake assembly mounting screws to eight inch pounds. Following torqueing of screws, check to ensure that the brake pad is spaced .010 from the braking surface when the plunger is fully retracted .010 +.003.
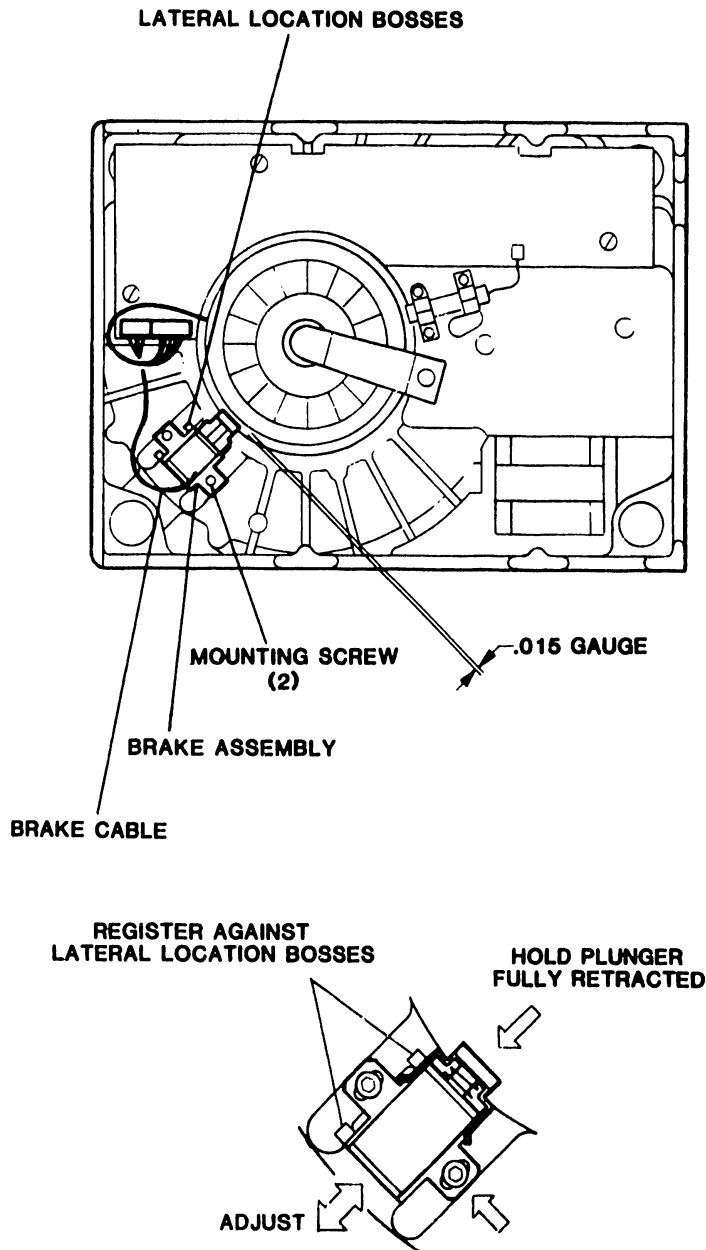
LATERAL LOCATION BOSSES

MOUNTING SCREW (2)

.015 GAUGE

BRAKE ASSEMBLY

BRAKE CABLE

REGISTER AGAINST LATERAL LOCATION BOSSES

HOLD PLUNGER FULLY RETRACTED

ADJUST

Figure 6-4. Brake Assembly Removal and Replacement

6.3.4 (cont.)

    6. Reinstall read/write board by performing paragraph 6.3.2, step 4.

6.3.5 Index Sensor Removal and Replacement (Figure 6-5)

    1. Perform paragraph 6.3.2, steps 1 through 3.

    2. Disconnect index sensor cable from motor board.

    3. Remove two mounting screws securing index sensor to unit base.

    4. Remove two retaining clips.

    5. Place new sensor into mount. Attach clips and mounting screws (do not tighten).

    6. Rotate motor until index timing tab lines up with index.

    7. Place .015 gauge between sensor and tab. Slide sensor forward against gauge and flange. Tighten and torque screws to eight inch pounds.

    8. Connect index sensor cable connector to motor control board.

    9. Reinstall read/write board by performing procedure described in paragraph 6.3.2, step 4.
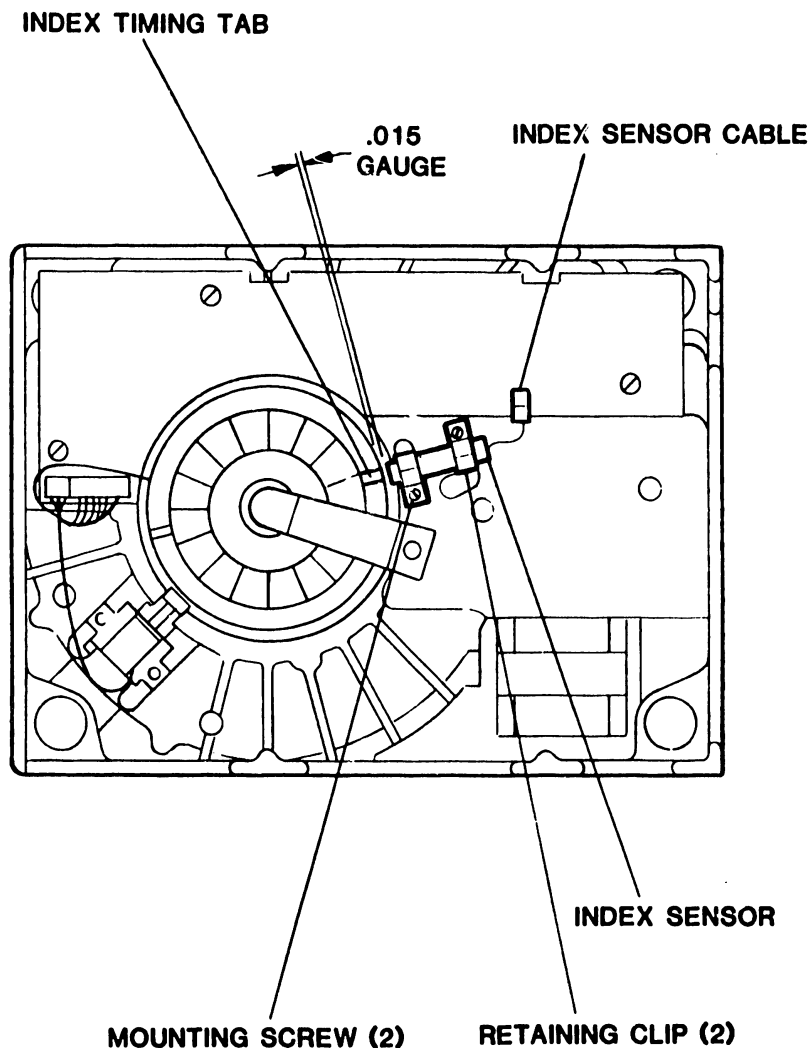
Figure 6-5. Index Sensor Removal and Replacement

6.3.6 HDA Ground Strap (Figure 6-6)

1. Perform paragraph 6.3.2, steps 1 through 3.

2. Remove screw and lockwasher securing ground strap to unit base.

3. To reinstall, position strap against three locating bosses and install and tighten screw and lockwasher. Torque screw to 8 inch pounds.

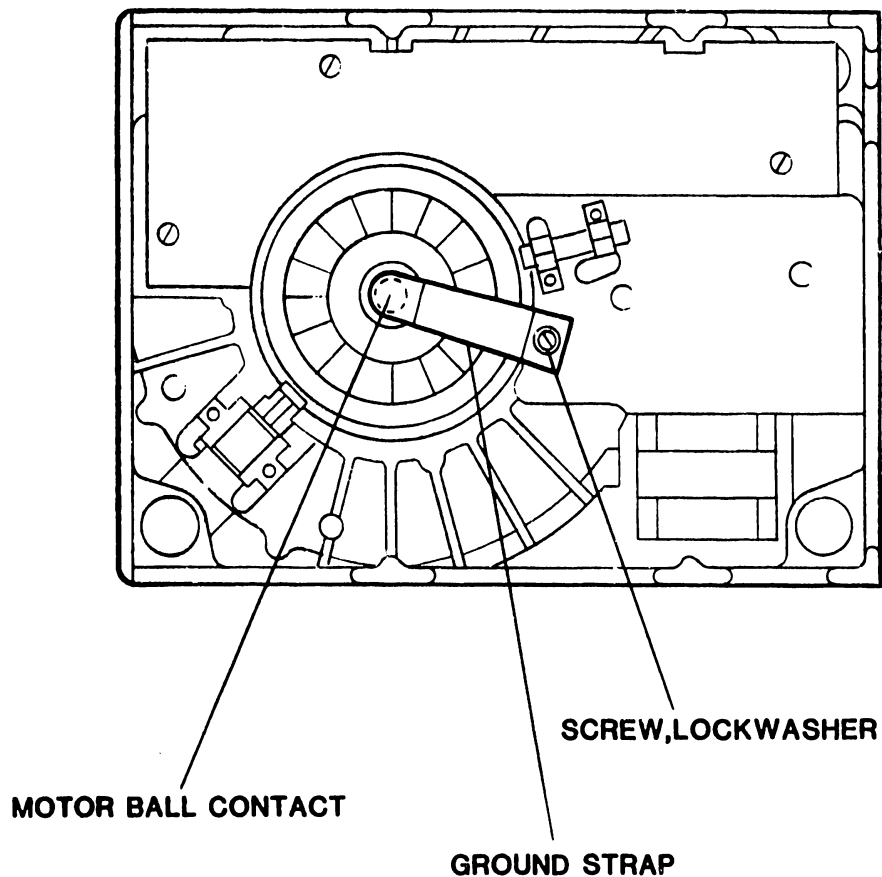4. Reinstall read/write board by performing procedure described in paragraph 6.3.2, step 4.

SCREW,LOCKWASHER

MOTOR BALL CONTACT

GROUND STRAP

Figure 6-6. HDA Ground Strap Removal and Replacement

APPENDIX A

THE SCHEMATICS, WHEN AVAILABLE, ARE ON THE LAST FICHE IN THIS SET.

APPENDIX

A

APPENDIX A

SCHEMATICS

REV	DATE	EC NO		REV	DATE	EC NO		263-02410-001
AA	11.17.82	460						
BB	1.26.83	491						NEXT ASSEMBLY	USED ON
CC	5.5.83	549						
DD		644						

J25-1 MAG, PICK UP
J25-2 -MAG, PICK UP

C5 10pF
R11 4.7K
R9 4.7K
R13 18K
R12 4.7K
+6.2V
R23 1.2K
R10 4.7K
U1 1/2 LM392
TP-1
360μs
-INDEX SH-2

R37, 1.2K +6.2V
+5V
R19 1.2K
U8 LS14
R17 1.2K
+6.2V
R18 1.2K
U9 LS14
R39 1.2K
C3 .1μF

J22-1 MOTOR TAC

U2 ULN 2074B
R5 33Ω
C5 1μF
C11 1μF
COIL 1 J22-5
COIL 2 J22-6

R22 4.7K
R21 1.2K
Q1 PN2907
R9 1.2K
R1 100K
+6.2V
U1 1/2 LM392
R3 2.7MEG
C2 .1μF
C1 .22μF
R7 1.2K
R8 4.7K
+6.2V
R4 1.2K
R20 1.2K
Q2 PN2222
R2 4.7K
CR2 1N414B
CR1 1N414B
CR5 1N414B
CR6 1N414B

R6 1Ω 4.0W

+12V
R15 8.2Ω 2.5W, 5%
BRAKE J22-7
CR4 1N4001
BRAKE RET J22-?
C4 10μF
MOTOR +12V J22-?
MOTOR RET J22-2
+5V
MOTOR J22-3

-DEC SPEED
INC SPEED

256μs

+5V
U3 1MHz
U10 LS02
U11 CD4020
256μs

MOTOR

J24-15
J24-16
+5V
U8 LS14
U9 LS175
U10 LS02
U12 LS30
U8 LS14
R34 4.30K
C14 10μF
U13 339
J24-7
J24-8
+12V
C6 10μF
C7,8 100nF
J24-14
J24-11
J24-12

U10 LS02
HP5082-2835 (REWORK)
R96 8.2K
R35 27K
+12V

1 MHz CLK SH-2
1 MHz CLK J24-4
U7 LS02
U8 LS14
-CPU RESET J24-9

MATERIAL		SCALE NONE	IMI INTERNATIONAL MEMORIES INCORPORATED
		DRAWN M. LIFF 9-10-82	MOTOR CONTROL 5000H
FINISH		CHKD	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES		APPROVED	D 263-02410-001 DD
DECIMAL XX± .XXX±	FRACTIONAL ± ANGULAR ±	RELEASED	SHEET 1 OF 2 REV

263-02410-001

+5V
R39 4.7K
N

U6 LS163   U5 LS163   U4 LS163

U7 LS02

SH-1 1 MHz CLK

U8 LS14   U7 LS02

SECTOR J24-2

SH-1 +INDEX

500µS

U9 1/2 LS175

U7 LS02

INDEX CLK J24-5

INDEX J24-6

SND

TP-3 GND

J23-4 DIODE 1   R32 220Ω   +5V
J23-9 AMP RET
J23-2 DIODE RET

+12V
R28 220Ω
R27 23.7K 1%
R33 17.8K 1%
CR3 1N5234 6.2V 2%
R25 4.7K
+5V
U13 339
C10 0.1µF

R30 8.87K 1%

SPARE J24-10,13

+6.2V SH-1

SH-1

R29 23.7K 1%
U13 339
+5V

-POWER LOSS J24-1

TP-2 CYL ØØ

+12V
R31 270K
+5V
R24 4.7K
J23-1 Ø SENSE
U13 339
+5V

CYL Ø J24-3

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTORS ARE IN OHMS (Ω), 1/4W, 5%.

2. ALL CAPACITORS ARE MICROFARADS (µF).

3. NOT USED: C9, R16

263-02410-001

READ/WRITE LOGIC 5000H
263-02381-301
SHEET 1 OF 5

R/W LOGIC

263-02381-301

SHEET 2 OF 3

R/W LOGIC

D 263-02381-301 BB

SHEET 3 OF 3

263-02381-301

END