1.0 GENERAL DESCRIPTION

1.1. Introduction

DMA Systems' fixed/removable 5.25-inch disk drive--the Micro-Magnum 5/5--combines proven technology with longterm reliability. The total capacity is 12.8 MBytes--6.42 MBytes removable and 6.42 MBytes fixed.

High reliability is achieved through the use of DMA Systems' patented magnetic recording head assembly, track following servo and linear motor positioning systems. The drive features a self-contained and self-sealing air recirculation system that cleans and cycles the air in a fast and effective manner.

The Micro-Magnum 5/5 drive interface is patterned after the standard 5.25-inch Winchester drive interface and data transfer rate. This provides system designers with the ability to interface existing 5.25-inch Winchester drive controllers easily, and enables the use of inexpensive controller chips.

1.2 Key Features

- Fixed/Removable Data Files.
- 6.42 MBytes removable, 6.42 MBytes fixed.
- Removable Micro-Magnum disk cartridge.
- Cartridge inserted from front for easy use.
- Self seals to maintain drive compartment cleanliness.
- 5 Mbits/second data transfer rate.
- Front panel form factored to minifloppy.
- No preventive maintenance.
- Convenient file copy, loading and backup.
- Fast access time.
- Embedded servo information provides reliable cartridge interchange and data integrity.

1.3 Reliability Features

1.3.1 Cooling Air

An external air intake vent is provided around the front panel bezel. In a user system with cooling fans exhausting air from the system cabinet, air flow will be ducted over the Micro-Magnum deck casting and PC Board components. This feature can be used by the system user to enhance reliability of drive operation by controlling operating temperature.

1.3.2 Front Door Latch

A front door latch mechanism is provided so that the front door is locked at any time the spindle is in operation. This feature prevents inadvertent attempts to remove the cartridge while the heads are in operation and the spindle is turning.

1.3.3 Cartridge Interlock

Proper seating of the disk cartridge is verified prior to spindle rotation or head load. Microswitches are positioned so as to verify the disk cartridge seating at the two alignment cones as well as in the area of the head door. This will verify presence of a disk cartridge and proper location of the cartridge plastics.

1.3.4 Front Door Interlock

When the RUN switch is turned on, if a cartridge is present and seated and the front door is closed, an interlock will be activated. This interlock will then prevent accidental opening of the front door while the disk is spinning. When the RUN switch is turned off, the interlock will not be deactiviated until the drive has been safely shutdown and the spindle is at full stop. In the event of loss of DC power, the front door interlock will be left on, locking the front door.

1.3.5 Door Interlock Light

At any time the front door interlock is activated (provided DC power is applied to the machine), the ready light will be on, either flashing or steady, so that door opening will not be attempted while the interlock is on. This interlock is in series with the cartridge interlock so that an improperly seated cartridge will be signalled by lack of proper door interlock indication.

1.3.6 Carriage Latch

A mechanical latching mechanism is positioned so as to latch the head carriage in its full retracted position. This is a precaution so that the carriage is not free to roll forward and load heads on a non-rotating disk (or no disk at all) during a normal office equipment move from one desk to another.

1.3.7 Carriage Home Switch

A switch is located so as to sense the presence of the carriage in its "Home" (fully retracted and latched) position. This switch is interrogated by the drive control processor to insure that the heads are "Home" (and safe) before the spindle drive is initiated. If not, the FAULT line will be brought to a true state and the start cycle terminated.

When the drive goes through its shut down sequence, the "Carriage Home" switch line must come true before spindle power is turned off, in order to protect the heads from landing on the disk.

1.3.8 Power Transistor Heat Sink

In order to limit drive temperature rise, it is desirable to isolate the high dissipation transistors from the main deck casting. A heat sink is mounted at the rear of the drive to carry the spindle and linear motor power drive transistors. The best available cooling air circulation is present at the rear of the machine and the separate heat sink is thermally isolated from the deck.

1.3.9 Embedded Servo Protection

Special precautions are taken to provide maximum protection possible for the embedded servo information that is recorded on the data surfaces.

Since the timing of all write operations is controlled from the sector mark signals derived from embedded servo information, a special timing circuit is provided to insure that the sector mark is occurring at the correct time with reference to previous timing marks. This check feature guards against instantaneous spindle speed change, external noise, and inability of the drive to decode the sector mark properly.

1.3.10 Speed Sensing

In order to provide redundant protection for the embedded servo data and customer data files, a speed checking signal is generated from the spindle motor commutation circuitry. If a speed-out-of-tolerance condition is detected, all write operations are inhibited.

1.3.11 Spindle Brake

Dynamic electrical braking is employed to decelerate the spindle from high speed so that the cartridge unload time is minimized.

1.3.12 Emergency Retract

Failure of any one of the DC voltages (+12, -12 or +5 VDC) will cause an emergency retract. Power for the retract will be derived from rectified back EMF from the rotating spindle. This feature provides for removal of heads from the disk surface in the event of a power failure that was not forwarned by the host system.

1.3.13 Shock Mounting

The main deck casting of the Micro-Magnum 5/5 is shock mounted as a protection against shock and vibration from the host system.

1.3.14 EMI Shielding

Sheilding is incorporated into the drive design to protect the sensitive drive electronics from host system interference such as CRT horizontal sweep. This shielding also facilitates compliance with FCC regulations.

1.3.15 Cleanliness Control

The Micro-Magnum 5/5 drive design includes several features aimed at protecting the disk/head interface environment.

1.3.15.1 Cartridge Door Control

A mechanism is coupled to the front door motion so as to open the cartridge door only after the cartridge is fully seated and sealed to the drive head compartments. By this means, the internal environment of the cartridge and drive are protected at all times from the contaminated environment of the cartridge receiver.

1.3.15.2 Drive Internal Door

The flying heads are fully retracted from the cartridge environment before the cartridge is inserted or removed.

A door is included in the drive that seals the head retract chamber before the cartridge is removed.

If the front door is closed with no cartridge present in the receiver, the internal head chamber door remains closed protecting the head environment. Only if a cartridge is present and coupled to the drive air system does closing the front door activate the head chamber and cartridge door open mechanism.

1.3.15.3 Clean Air System

A high flow rate closed clean air system is incorporated. An impeller is attached to the disk spindle shaft forcing pressurized air through an absolute filter and into the head/disk chamber. The disk cartridge is maintained at a positive pressure relative to ambient so that any leakage occuring at the door seals will not allow contamination entry.

1.3.16 Dynamic Head Load

A DMA proprietary head design allows for CushionAire loading of the flying heads to the disk surface. With this design, the Winchester type air bearing can be launched onto a disk surface rotating at full speed. This technique improves both convenience and reliability. At the end of the contamination purge cycle, heads may be launched onto the disk ready for immediate operation (no need for stopping the disk, setting heads on the media surface, and restarting the spindle).

3.0 PRODUCT SPECIFICATION

3.1 PERFORMANCE

Capacity

	Formatted	Unformatted
Per Drive	10 MB	12.8 MB
Removable	5 MB	6.4 MB
Fixed	5 MB	6.4 MB
Per Surface	2.5 MB	3.2 MB
Per Track	8192 B	10032 B
Per Sector	256 B	304 B
Sectors per Track	32+1 Spare	33

Transfer Rate 5.0 Mbit/sec

Access Time

Track to Track	3 ms Typical
Average	40 ms (Maximum 80 ms)
Settling	13 ms
Head to Head Switch	6 ms Max.

Latency, Average 8.7 ms

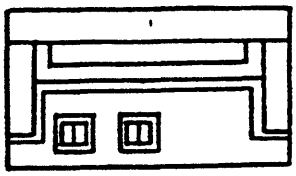
Package Size

Height	3.25 inches
Width	5.75 inches
Length	10.60 inches

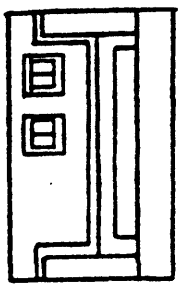
EMI Radiation Meets FCC Rules, Sub-part J of Part 15, Class B

Mounting Options

a.



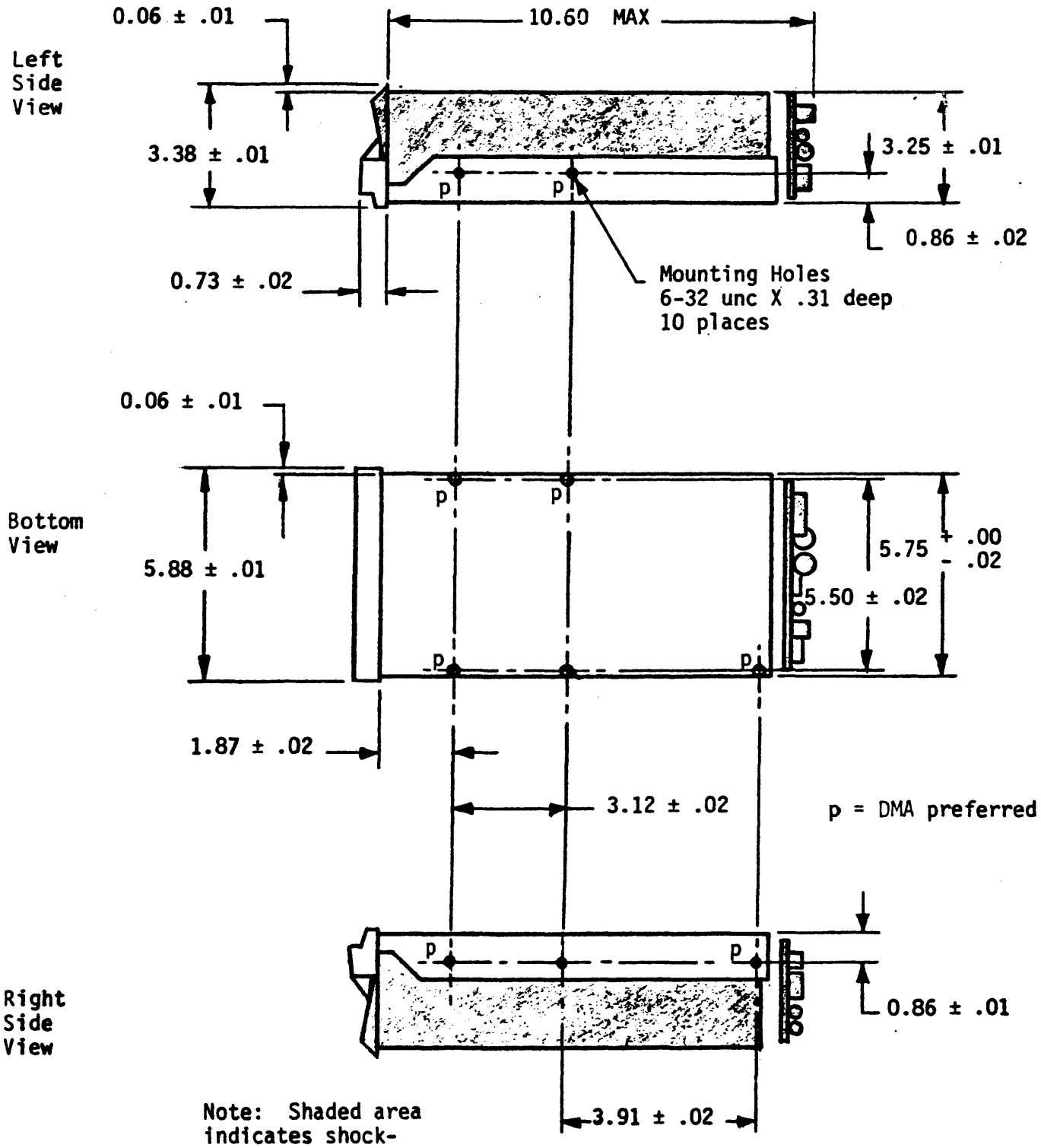
b.



ANGLE 10° max. from Horizontal

PHYSICAL MOUNTING DIMENSIONS & HOLE LOCATIONS

Figure 1



2.0 INSTALLATION

2.1 Introduction

This section describes the unpacking, inspection and mounting of the Micro-Magnum 5/5.

2.2 Unpacking And Inspection

The Micro-Magnum 5/5 is shipped in a sealed protective container which has been designed to protect the drive from humidity, vibration, and shock due to handling. Upon receipt of the unit from the carrier, inspect the container for damage. Open the container and unpack the drive. Report any damage to the carrier immediately. Save all packaging materials for reshipment should this be required.

2.3 Mounting

The Micro-Magnum 5/5 is capable of being mounted in two positions:

a. Horizontal (door handle up).

b. Vertical (door handle right).

To facilitate mounting the drive in a sloping front panel, a front-to-rear tilt of up to 10° maximum is allowed.

The physical mounting dimensions and mounting hole locations are shown in Figure 1. Four (4) mounting options are provided:

a. Four point bottom mounting using industry standard 5¼" minifloppy pattern.

b. Four point side mounting using industry standard 5¼" minifloppy pattern.

c. DMA preferred four point bottom mounting pattern.

d. DMA preferred four point side mounting pattern.

In all cases, #6-32 screws of the appropriate lengths are required. Note that the maximum penetration depth is .31".

Allow .1" clearance around the shock mounted portion of the drive. Take care that no cables or other obstructions interfere with the running mechanism of the drive.

3.2 FUNCTIONAL

Rotational Speed	3443 RPM
Recording Density	8737 BPI
Flux Density	8737 FCI
Track Density	454 TPI
Cylinders	306 + 13 spares + 1CE = 320
Tracks	1224 + 52 spares + 4CE = 1280
R/W Heads	4
Disks - removable	1
- fixed	1

3.3 RELIABILITY

MTBF	8000 POH
Preventive Maintenance	None
MTTR	30 Min.
Component Life	5 Years
Error Rates:	
Soft	$1/10^{10}$ bits read
Hard	$1/10^{12}$ bits read
Seek	$1/10^{6}$ seeks

3.4 REQUIREMENTS

DC Voltage

+5V ± 5% (1.2A)

+12V ± 10%
- Startup: 1.6A for 20 sec.
- Head Load: 2.1A for 200 ms.
- Operating: 1.2A Avg., 1.5A Peak

-12V ± 10%
- Startup: 1.6A for 20 sec.
- Operating: 1.2A Avg., 1.5A Peak

AC Power: None

Environmental:

Temp (operational)	50°F - 115°F
Relative Humidity	8 - 80%
Wet Bulb, max	78°F, non-condensing
Altitude	6500 ft. operating

Heat Dissipation: 35 watts

4.0 DRIVE INTERFACE

4.1 Introduction

This section describes the physical and electrical interface with DMA Systems Corporation Micro-Magnum 5/5 Disk Drive.

4.2 General Description

The Micro-Magnum 5/5 interface to the host controller is accomplished through four cables which are:

4.2.1 J1

This is a 34 pin PCB edge connector for a flat cable which carries control signal lines. This cable may be connected directly to the controller or connected in a daisy chain configuration with other drives. All signals on this cable are multiplexed by the DRIVE SELECT lines on this cable.

4.2.2 J2

This is a 20 pin PCB edge connector for a flat cable which carries data line pairs and control line signals. This cable may not be daisy chained but must be a direct radial connection to the controller.

4.2.3 J3

This 7 pin connector provides DC power to the disk drive and a command pin per drive.

4.2.4 J4

Frame ground connection.

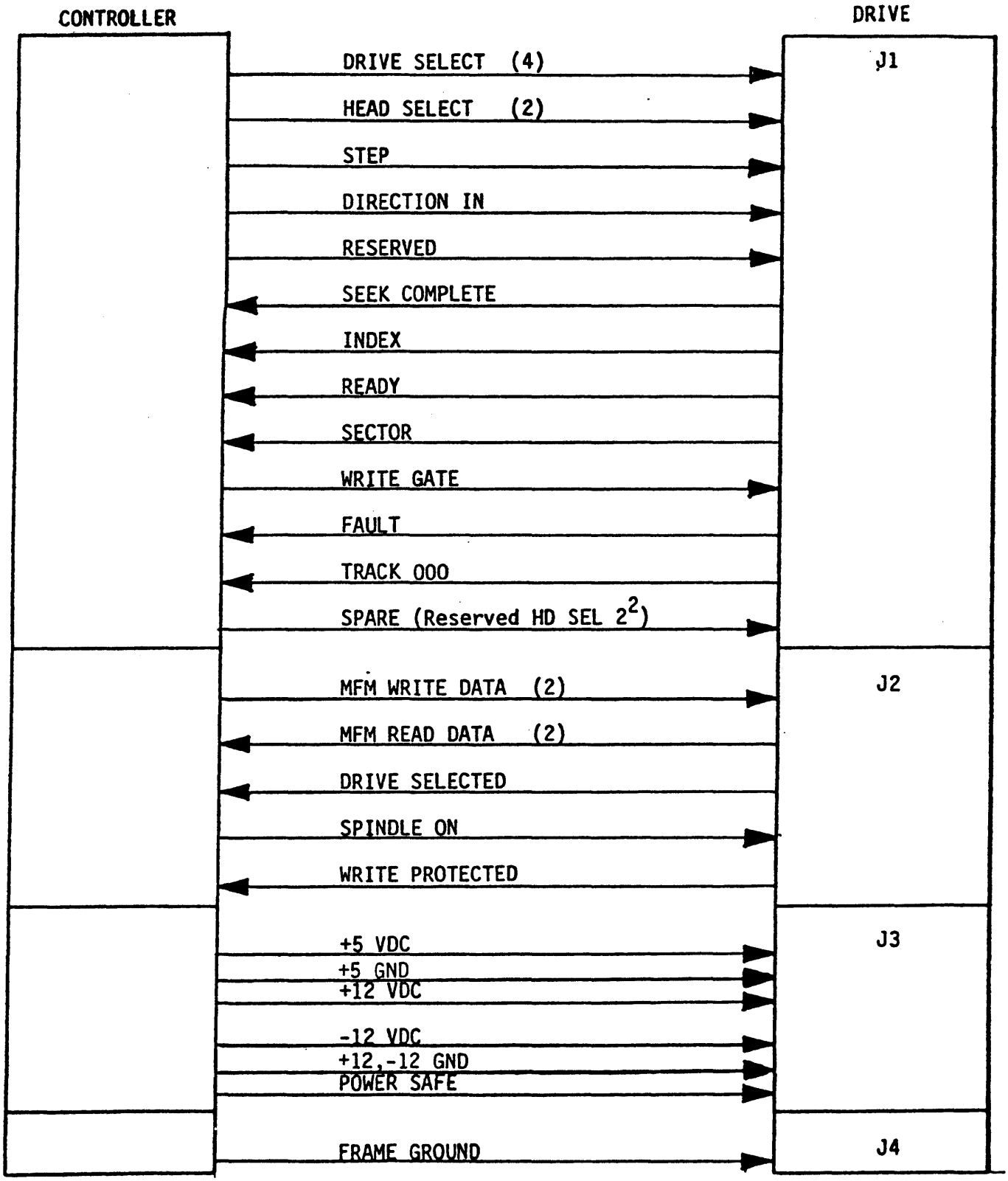
4.2.5 Single Drive Interface Diagram

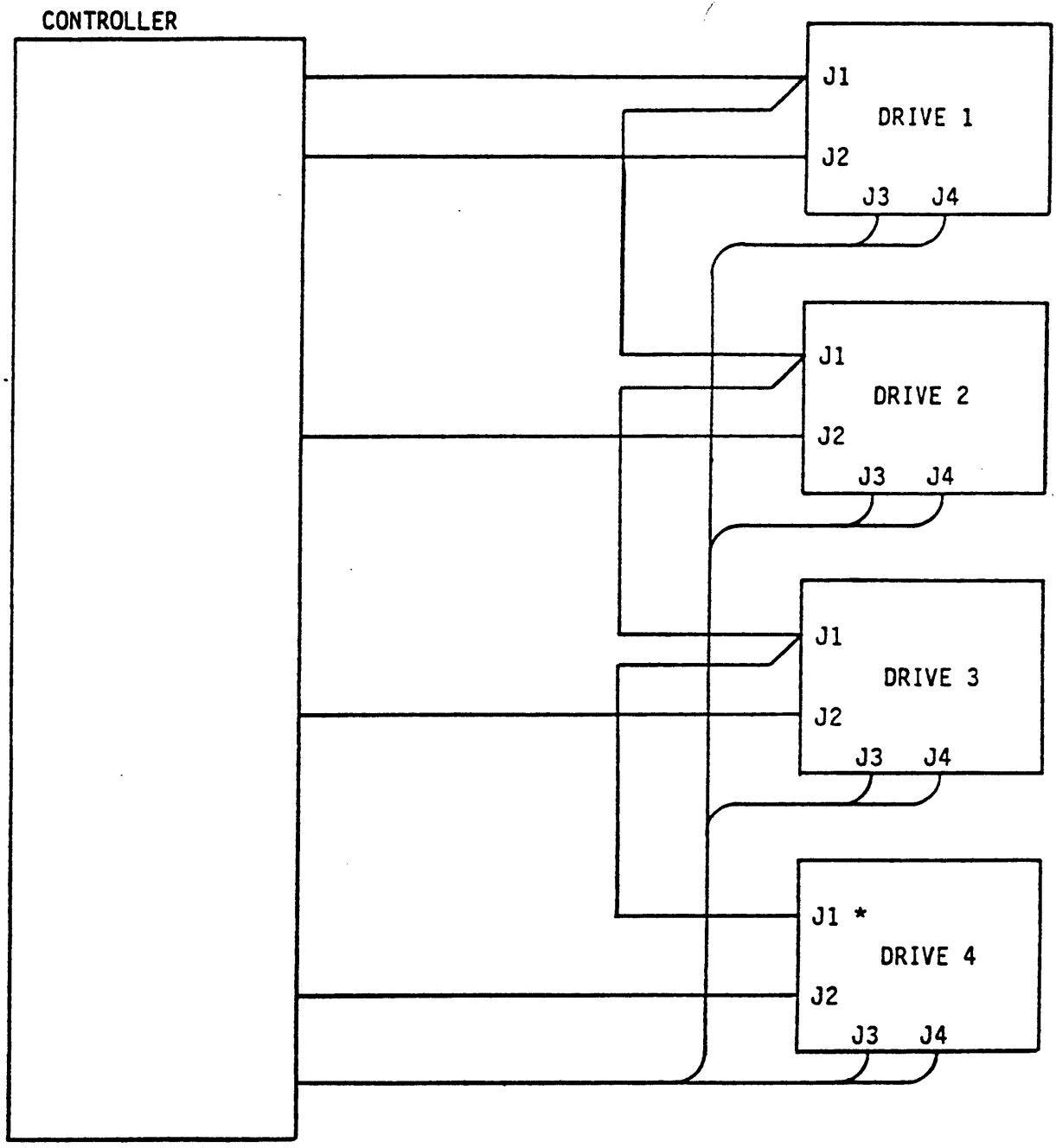
A generalized controller/drive interface diagram is included in Figure 2 showing a single drive to controller interconnection.

4.2.6 Typical four drive system connection - see Figure 3

SINGLE DRIVE INTERFACE

Figure 2





*Terminated (See Figure 6)

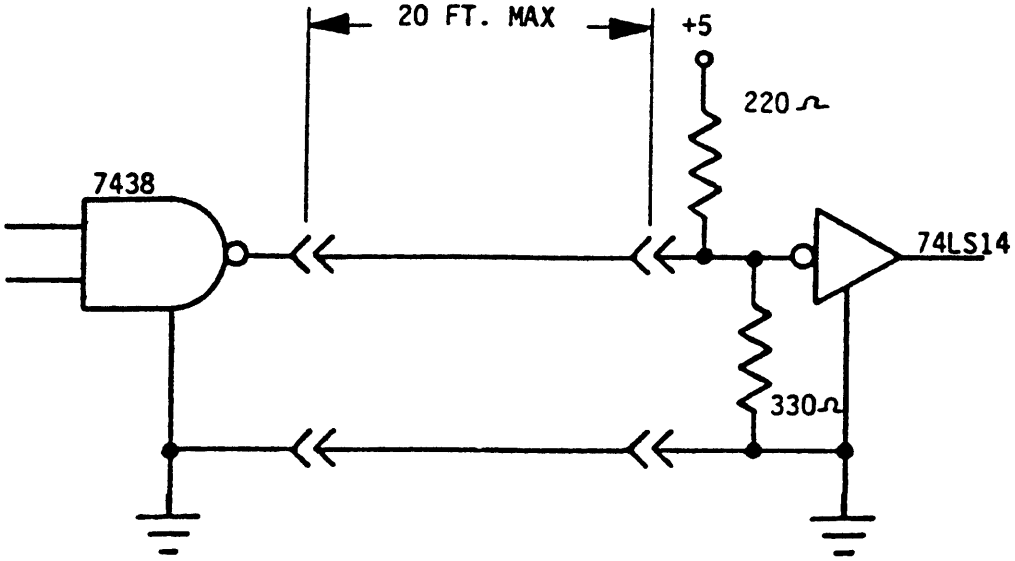
Figure 3

TYPICAL CONNECTION - 4 DRIVE SYSTEM

4.3 Electrical Interface Requirements

4.3.1 Control Signals

4.3.1.1 Driver/Receiver Circuit



CONTROL SIGNAL DRIVE RECEIVER CIRCUIT

Figure 4

4.3.1.2 Logical Control Signal Definition

True: 0.0V DC to 0.4V DC @ I = -40 ma (MAX)

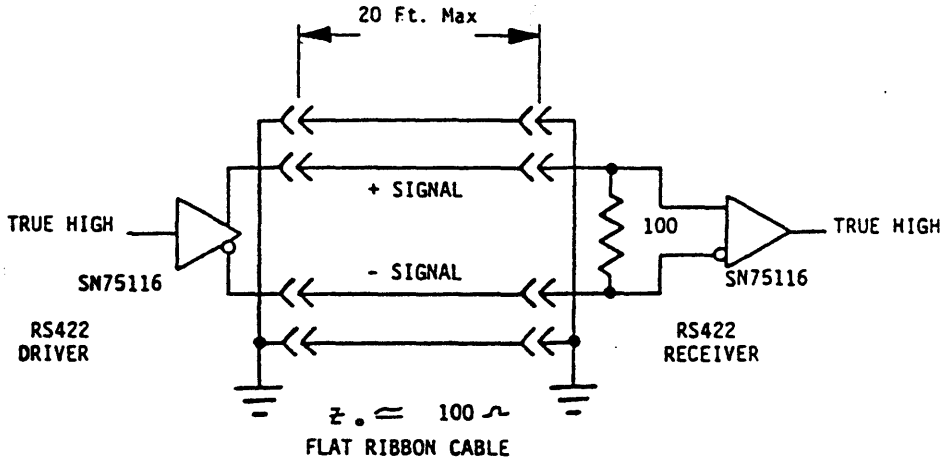
False: Open Collector I = 250 ua (MAX) @ 2.5V DC to 5.25V DC

4.3.1.3 Termination

Termination of the control signal lines is required at the end of a daisy chain only. A 220Ω/330Ω resistor pack is used for this function. The controller must terminate the transmission lines at receivers (see Figure 3 and Figure 6).

4.3.2 Data Lines

4.3.2.1 Driver/Receiver Circuit



DATA DRIVE/RECEIVER CIRCUIT

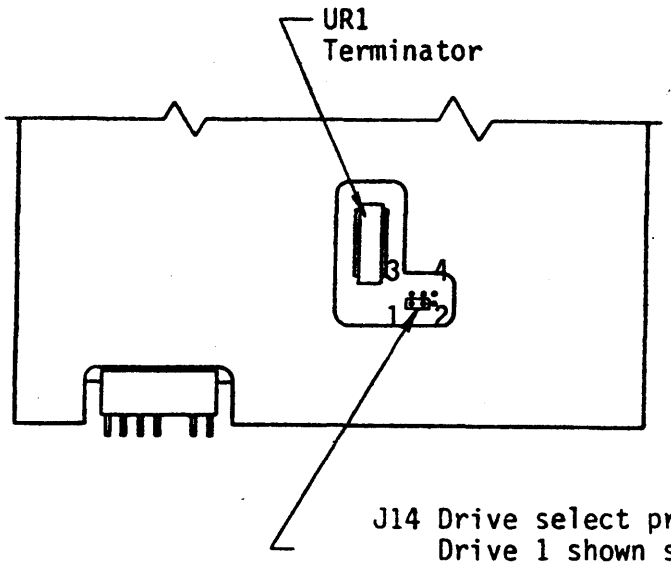
Figure 5

4.3.2.2 Logical Data Signal Definition

As shown in Figure 5 this type of line is a balanced differential transmission line. A logical "one" is defined on this line when the (+) line is more positive than the (-) line ("zero" definition (-) line (+) line). Since MFM data is being transmitted to and from the drive on these lines, a transition from "zero" to "one" will indicate a flux reversal either to be written or being read on the disk.

4.4 Physical Cable Interface

4.4.1 Connector Physical Locations

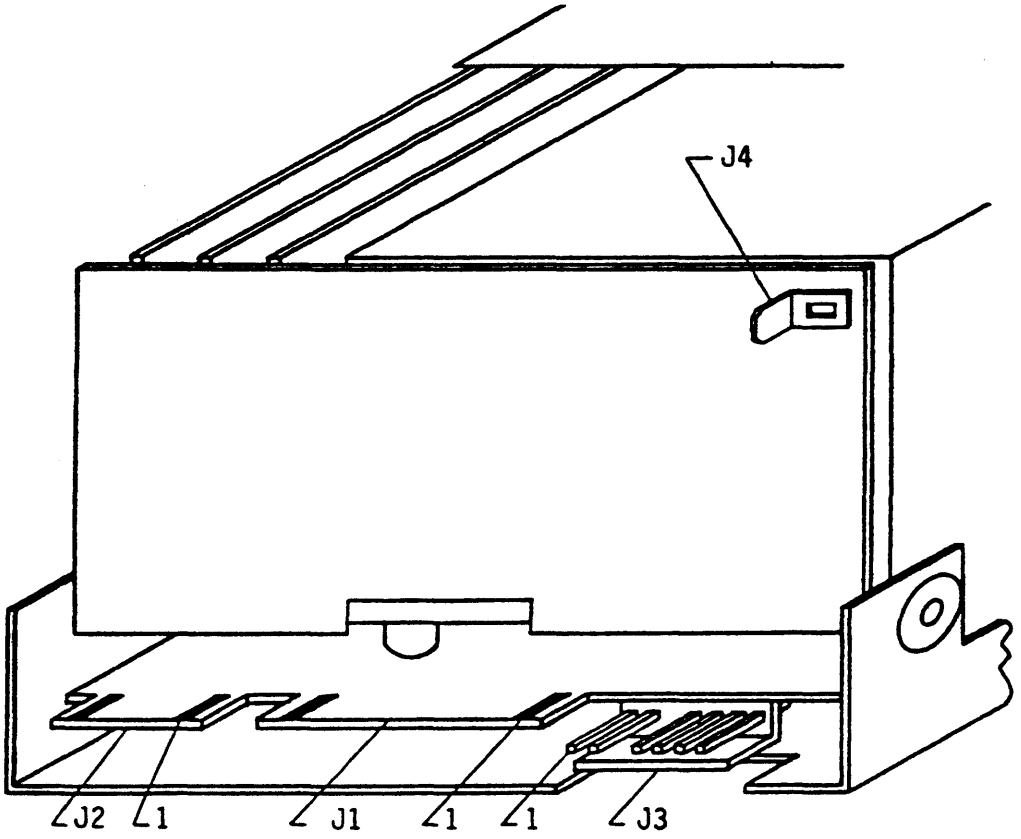


BOTTOM VIEW

MICRO-MAGNUM 5/5

Figure 6a

J14 Drive select programming
Drive 1 shown selected. (Use AMP 531220-2 Shunt)

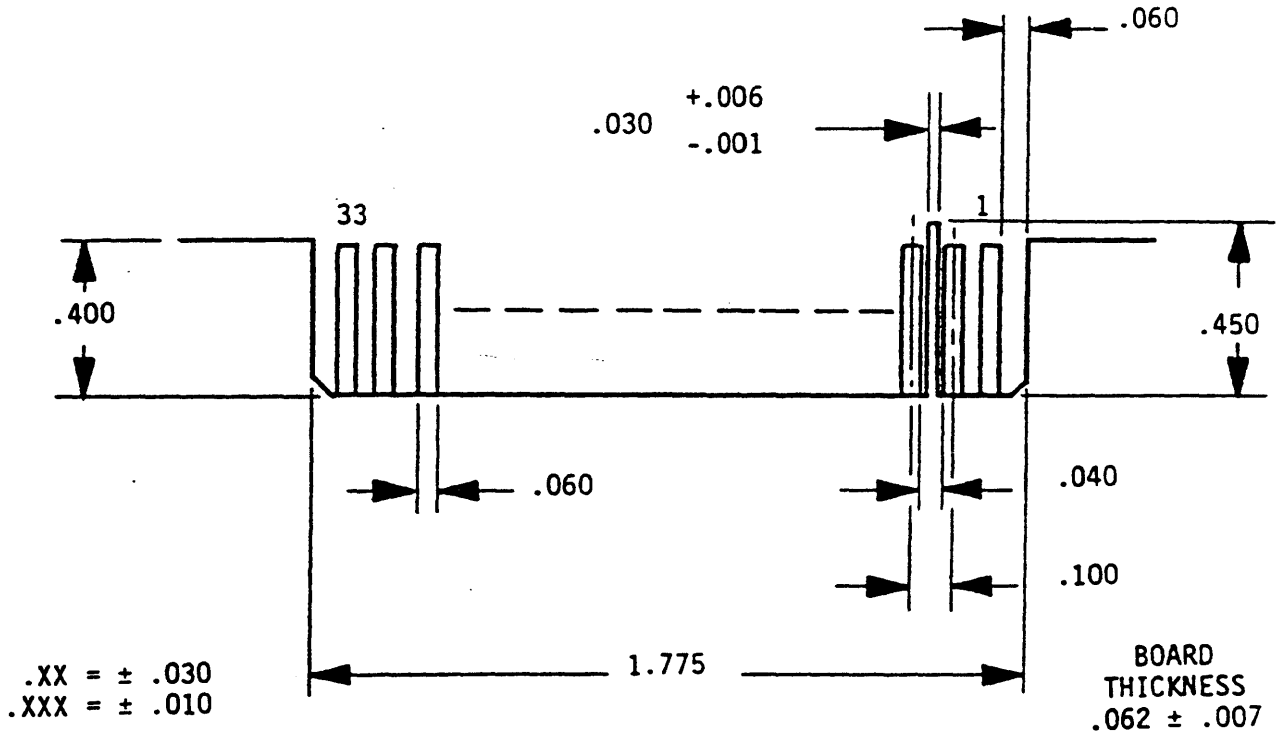


REAR VIEW

MICRO-MAGNUM 5/5 Figure 6b

4.4.2 J1 - Control Signals

Connection for J1 is through a 34 pin PCB edge connector. The dimensions for this connector are shown in Figure 7. The pins are numbered 1 through 34 with the even pins located on the component side of the PCB. A KEY SLOT is provided between pins 3 and 5. The recommended mating connector for P1 is AMP ribbon connector P/N 88373-3. All odd pins are ground.



J1 DIMENSIONS

Figure 7

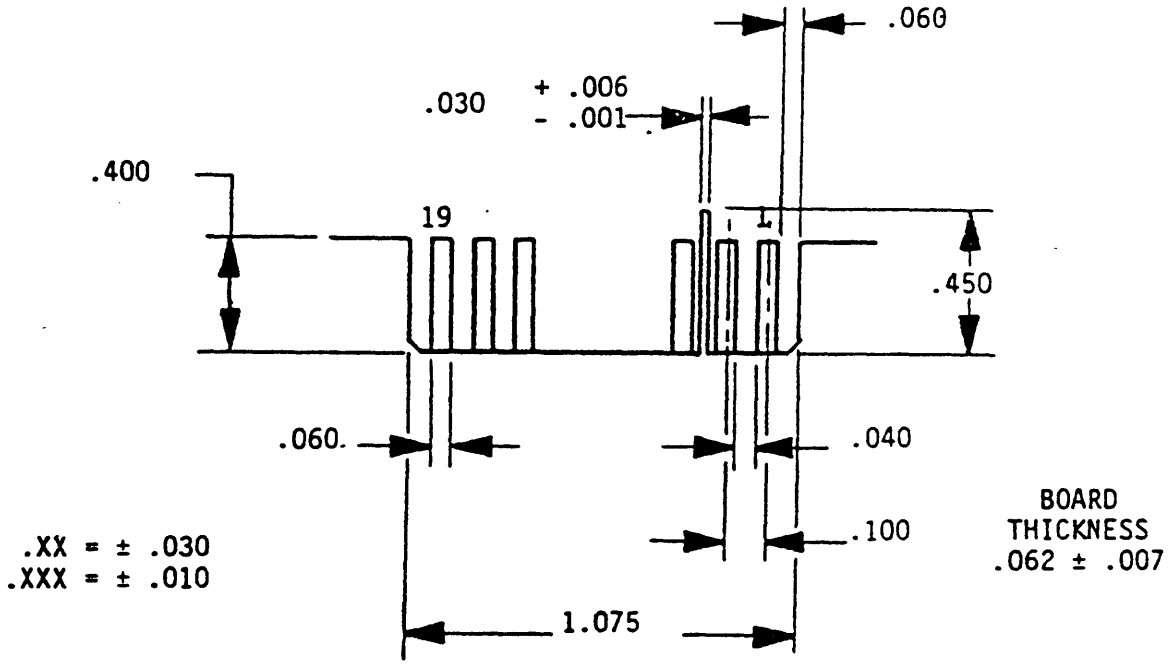
4.4.3 J1 - Pin Assignments

Signal Pin	Gnd Rtn Pin	Signal Name
2	1	Reserved (Open)
4	3	Reserved (Head 2^2) (Open)
6	5	Write Gate
8	7	Seek Complete
10	9	Track 000
12	11	Fault
14	13	Head Select 2°
16	15	Sector
18	17	Head Select 2^1
20	19	Index
22	21	Ready
24	23	Step
26	25	Drive Select 1
28	27	Drive Select 2
30	29	Drive Select 3
32	31	Drive Select 4
34	33	Direction In

4.4.4 J2 - Data Signals

Connection to J2 is through a 20 pin PCB edge connector. The dimensions for the connector are shown in Figure 8. The pins are numbered 1 through 20 with the even pins located on the component side of the PCB. The recommended mating connector for P2 is AMP ribbon connector P/N 88373-6

A key slot is provided between pins 3 and 5.



J2 DIMENSIONS

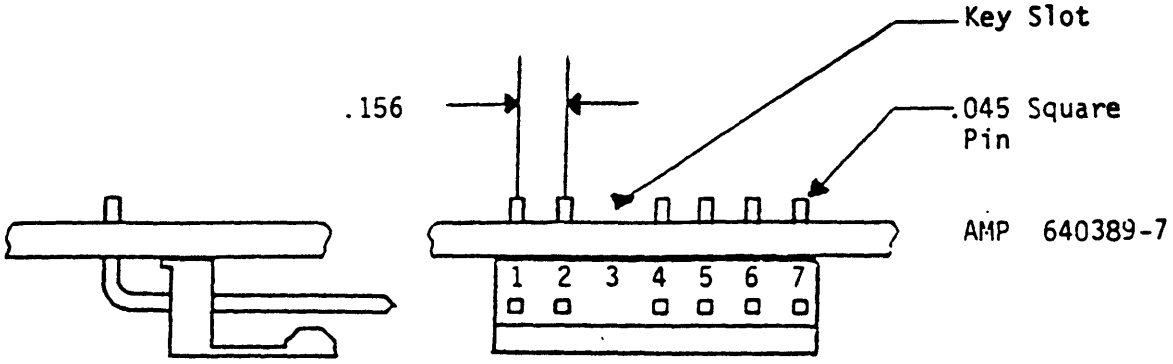
Figure 8

4.4.5 J2 - Pin Assignments

Signal Pin	Gnd Rtn Pin	Signal Name
1	2	Drive Selected
3	4	Spare (Open)
5	6	Write Protected
7	8	Spare (Open)
9	10	Spindle ON
11	12	GND
13		+ MFM Write Data
14		- MFM Write Data
15	16	GND
17		+ MFM Read Data
18		- MFM Read Data
19	20	GND

4.4.6 J3 - DC Power

The power connector J3 is a seven pin AMP 640389-7 connector. The mating plug is AMP 640426-7 with a polarity peg AMP 640629-1 in key slot (pin 3). See Figure 9 for illustration.



J3 DIMENSIONS

Figure 9

4.4.7 J3 - Pin Assignments

Pin	Signal
1	+ 5V DC
2	+ 5V Return
3	Key
4	+ 12V DC
5	(+ and -) 12V Return
6	- 12V DC
7	Power Safe

4.4.8 J4 - Frame Ground

A frame ground connection to the Micro-Magnum 5/5 is provided by an AMP Faston connector. The recommended mating connector is AMP 62187-1. Frame ground should be provided to the host system through a 20 gage or larger conductor.

4.5 Functional Signal Definitions

4.5.1 Control Input Lines

The control input signals are of two types: Those to be mutliplexed in a multiple drive sytem and those intended to do the multiplexing. The control input signals to be multiplexed are WRITE GATE GATE, HEAD SELECT 2^0, HEAD SELECT 2^1, STEP, and DIRECTION IN. The signals that do the multiplexing are DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3 and DRIVE SELECT 4. The circuit of section 4.3.1 is used for these signals.

4.5.1.1 Drive Select

Four DRIVE SELECT lines are present on J1 (DRIVE SELECT 1 thru 4). A drive may be assigned a unit number by positioning a programming shunt J14 (see Figure 6). When a true logic level is present on the DRIVE SELECT line corresponding to the pre-programmed unit number the drive will respond to commands on the J1 bus.

4.5.1.2 Write Gate

The true state of this signal enables write data to be written on the disk. The false state of this signal enables data to be transferred from the drive. Also, the false state of this signal enables the STEP and DIRECTION IN lines to command a seek operation or the HEAD SELECT lines to effect a head change.

4.5.1.3 Head Select 2^0 and 2^1

These two lines provide for the selection of each individual read/write head in a binary coded sequence. HEAD SELECT 2^0 is the least significant line. Heads are numbered 0 through 3. When all HEAD SELECT lines are false head 0 will be selected.

HD SELECT DECODE		HD #	SURFACE I.D.	
2^1	2^0			
1	1	3	TOP	CARTRIDGE
1	0	2	BOTTOM	
0	1	1	TOP	FIXED DISK
0	0	0	BOTTOM	

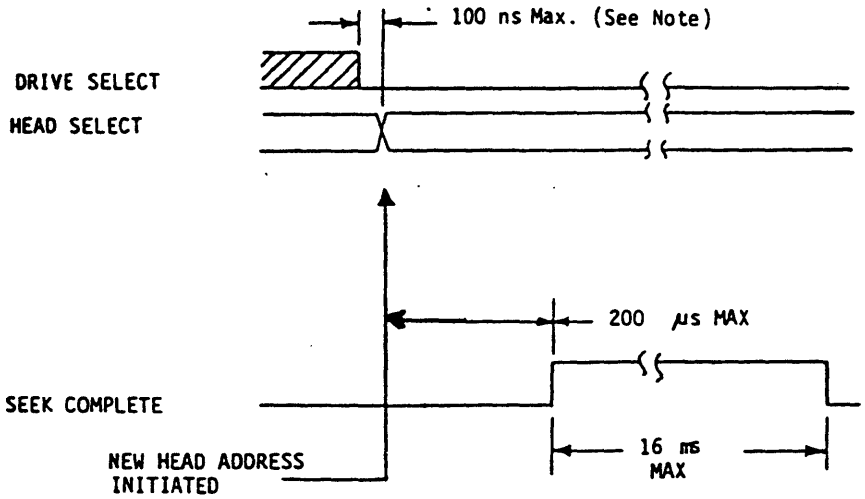
HEAD SELECT DECODE TABLE

Figure 10

Special consideration of the head select timing is required since the Micro-Magnum 5/5 used embedded servo technology (i.e.: final head carriage location depends on which head is selected). The Micro-Magnum 5/5 uses a buffered head select so that when the drive is deselected, it will remain on the cylinder and head last selected. (This feature is used during a buffered seek, see Section 4.5.1.4 STEP and DIRECTION IN). At any time the DRIVE SELECT line for a drive is true, and WRITE GATE is false, the HEAD SELECT lines are gated through to the buffers and head select changes may be initiated. A 200 µs acceptance delay is incorporated so that the drive may differentiate between a pure head change and a seek plus head change command (see Figure 12 Buffered Step Seek Timing). Since a pure head change involves head carriage repositioning, it may require up to 16 ms to regain track following and reassert SEEK COMPLETE. Timing for a head select change is shown in Figure 11.

4.5.1.3 Head Select 2^0 and 2^1 (Continued)

HEAD SELECT TIMING



NOTE: If a head switch is not desired when drive is reselected, head select lines must be returned to the correct address no later than 100 n-sec after drive is reselected.

Figure 11

4.5.1.4 Step And Direction In

The Micro-Magnum 5/5 incorporates a linear motor servo system to position the read/write heads. Control of the head position seeking is allowed through use of a buffered step pulse system. STEP and DIRECTION IN are used to define a seek, and will be accepted any time the DRIVE SELECT line is true and WRITE GATE is FALSE (indicating READ operation).

4.5.1.4.1 Direction In

This signal defines direction of motion of the R/W head when the STEP line is pulsed. A false state defines the direction as "out" and if a pulse is applied to the STEP line the R/W head will move away from the center of the disk.

Conversely, if this input is true, the direction of motion is defined as "in" and if a pulse is applied to STEP line, the R/W head will move toward the center of the disk.

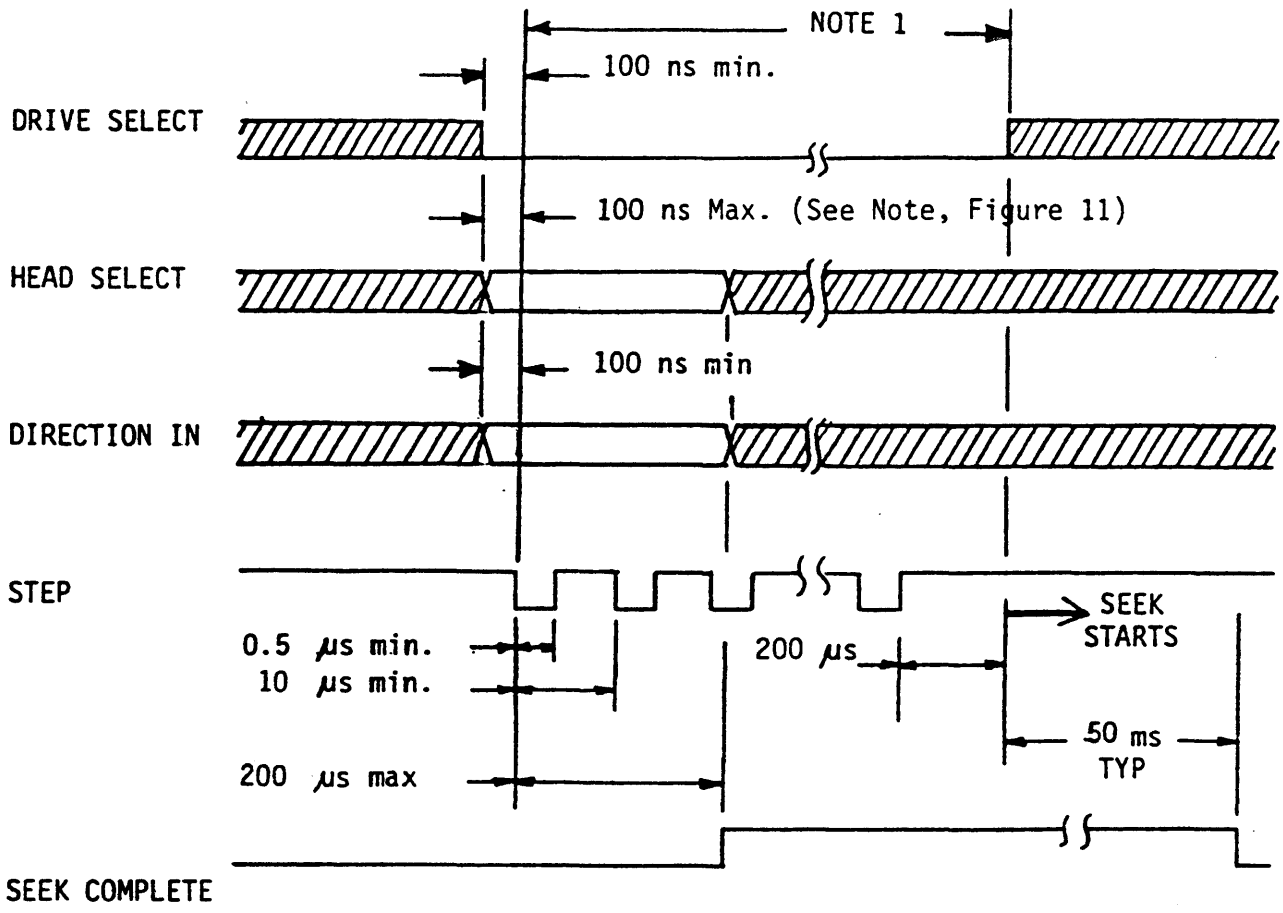
4.5.1.4.2 Step

In the buffered step pulse operation the step pulses are received at a high rate and buffered into a counter. Each STEP pulse transmitted represents a request for a single track move in the direction dictated by DIRECTION IN. When the end of the STEP pulse burst is detected, a seek operation will be initiated. SEEK COMPLETE will go false within 200 µs of the first STEP pulse, and go true after the R/W heads have settled at the demanded cylinder.

A seek operation is initiated by the leading edge of the first STEP pulse. As indicated in Figure 12, the DRIVE SELECT line must be true at least 100 ns prior to the leading edge of the first STEP pulse and must remain true until 100 µs after the last STEP pulse or until SEEK COMPLETE goes false, whichever occurs last. DIRECTION IN and HEAD SELECT must be static from 100 ns before the leading edge of the first STEP pulse until SEEK COMPLETE goes false. Note that the STEP pulses must begin not more than 200 µs, after any change in state of HEAD SELECT; if not, the drive will assume a head change only (per Figure 11) and ignore the late arriving STEP pulses.

The end of a step pulse burst is defined as a 200 µs period with no step pulses occuring. The drive starts the actual seek move at this time, and may be deselected during the time required to complete the seek. Both demand cylinder addresss and the selected head are buffered during seek time.

Note that timing restrictions are placed on the head select lines. Since the Micro-Magnum 5/5 incorporates embedded servo information on all surfaces, the final head position information can be derived only from the head addressed in the seek command information. In order to allow the drive to be deselected during the time period while the drive is performing the seek, a head select address buffer is incorporated.



NOTE 1: DRIVE SELECT must remain true until all step pulses are received or until SEEK COMPLETE goes false, whichever occurs last.

BUFFERED STEP SEEK TIMING

Figure 12

4.5.1.4.2 Step (Continued)

Once the controller initiates a seek or a head change, the HEAD SELECT (2^0 and 2^1) lines and DIRECTION IN must remain static until SEEK COMPLETE goes false. If the drive is deselected during seek time, the HEAD SELECT (2^0 and 2^1) lines must be returned to the proper select combination before the drive is reselected; otherwise, a new head change will be initiated.

4.5.2 Output Lines

Output control lines, also multiplexed by DRIVE SELECT 1-4, are: SEEK COMPLETE, TRACK 000, FAULT, INDEX, SECTOR and READY.

The circuit of Section 4.3.1 is used for these signals.

4.5.2.1 Seek Complete

This line will go true when the R/W heads have settled on the final track at the end of a seek or head switch. Reading or writing should not be attempted when SEEK COMPLETE is false. Seek or head switch commands will be ignored while SEEK COMPLETE is false.

SEEK COMPLETE will go false in four cases:

a. A drive initialization sequence is initiated (by drive logic) at power ON.

b. 200 μs (Max) after the leading edge of the first step pulse in a series of step pulses.

c. 200 μs (Max) after a HEAD SELECT change.

d. At any time a FAULT condition exists in the drive.

4.5.2.2 Track 000 ("Rezero")

The Track 000 line is used in conjunction with a "Rezero" sequence. The head carriage may be repositioned to Track 000 by issuing a string of single step seek commands in the "out" direction. When the carriage arrives at Track 000 the TRACK 000 signal will go true. At any time TRACK 000 is true, seek commands in the "out" direction will be ignored.

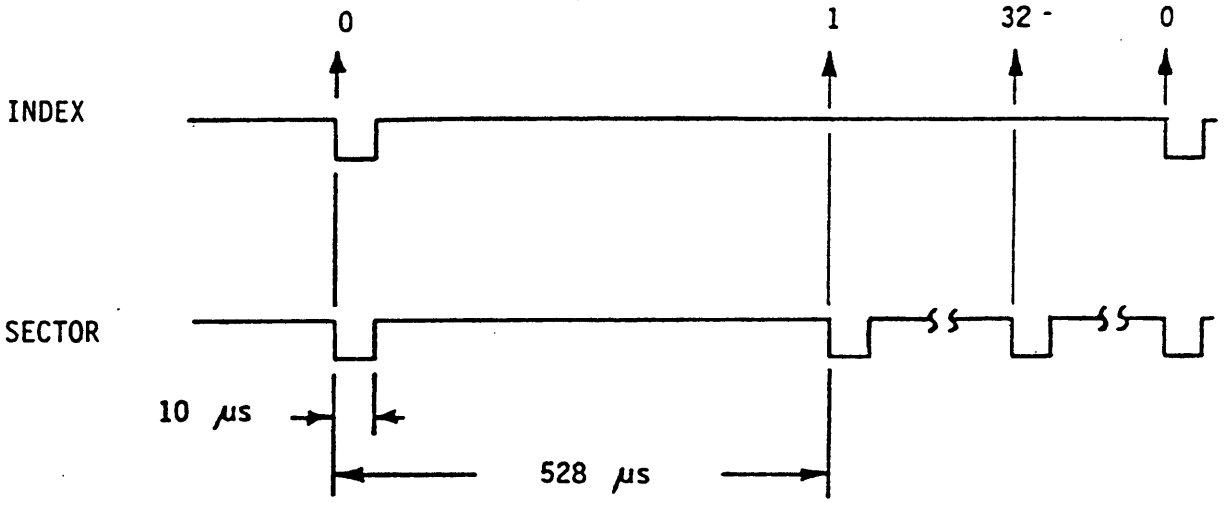
An alternate "Rezero" command is to issue a buffered seek of greater than 321 Tracks in the "Out" direction.

4.5.2.3 Index

A 10 μs index pulse is provided by the drive once, each revolution of the disk. Presence of this pulse indicates that the embedded servo field for sector zero is under the selected read/write head. See Figure 13 for timing of INDEX.

4.5.2.4 Sector

The drive provides a 10 μs sector pulse at the beginning of each sector. This sector pulse is derived from the embedded servo field recorded at the beginning of each sector. Figure 13 indicates timing for these pulses.



INDEX/SECTOR TIMING

Figure 13

4.5.2.5 Fault

This signal is used to indicate that a condition exists at the drive that may cause improper writing on the disk. When this line is true, further writing is inhibited at the drive until the condition is corrected.

At any time a FAULT condition is detected by the drive, the read/write heads will be retracted from the disk surface to the carriage "Home" position or returned to track 000.

4.5.2.5 Fault (Continued)

There are two classes of fault conditions detected by the Micro-Magnum 5/5: CLASS I and CLASS II. (See Section 5.3.3)

4.5.2.5.1 Fault Clearance

Class I FAULT clearance may be attempted by deselecting the drive for 50 μs minimum. Upon reappearance of SELECT the drive will reset the FAULT signal for a Class I FAULT within 2 seconds (provided the fault condition has been corrected) and return the head carriage to Track 000 under control of the head selected. At the end of this sequence TRACK 000, SEEK COMPLETE and READY will come true.

Class II FAULTS are of a serious nature indicating a possible hardware failure inside the disk drive. Repositioning the heads onto the disk surface by using the deselect sequence may cause destruction of data or recorded servo information. The deselect sequence described above will not reset a Class II FAULT.

It is required that deliberate consideration be given the risk to recorded information in order to reset a Class II FAULT condition. This may be done either by the operator from the RUN switch or under software control by use of the SPINDLE ON control line. In either case the drive spindle must be shut down and then reinitialized to the READY state (provided the FAULT has been cleared) by a RUN power-up sequence.

4.5.2.6 Ready

This interface signal when true together with SEEK COMPLETE, indicates that the drive is ready to read, write, seek or change heads. At any time this line is false, all writing and seeking is inhibited. (See Section 5.3.2)

4.5.3 Data Transfer Line

All lines associated with this transfer of data between the drive and the host system are differential in nature and may not be multiplexed. These lines are provided at the J2 connectors on all drives.

Two pairs of balanced signals are used for the transfer of data: MFM WRITE DATA and MFM READ DATA. The circuit of Section 4.3.2 is used for data transfer lines.

4.5.3.1 MFM Write Data

This is a differential pair that defines the transitions to be written on the track. The transition of +MFM WRITE DATA line going more positive than the -MFM WRITE DATA will cause a flux reversal on the track provided WRITE GATE is active. This signal must be driven to an inactive state (+MFM WRITE DATA more negative than -MFM WRITE DATA) by the host system when in a read mode. A ±12 ns write precompensation is required by the Micro-Magnum 5/5 disk drive in order to maintain data integrity on tracks 157 through 320.

The Micro-Magnum 5/5 provides internal protection of the embedded servo regardless of MFM WRITE DATA and WRITE GATE.

4.5.3.2 MFM Read Data

The data recovered by reading a pre-recorded track is transmitted to the host system via the differential pair of MFM READ DATA lines. The transition of the +MFM READ DATA line going more positive than the -MFM READ DATA line represents a flux reversal on the track of the selected head.

This data channel is gated to its active state by WRITE GATE and DRIVE SELECTED. Also an internal servo field inhibit function is provided. During embedded servo fields, the MFM READ DATA lines transmit a crystal derived AAA....pattern.

4.5.4 Radial Command Lines

These command lines are not multiplexed by the DRIVE SELECT lines but must be connected in the radial configuration directly to the controller. The circuit of Section 4.3.1 is used.

4.5.4.1 Spindle On

This command line is used by the controller to start and stop the spindle motor of the Micro-Magnum 5/5. A true state demands spindle on.

This line should not be multiplexed by DRIVE SELECT since the spindle should be left on at all times (during system operation) except when a cartridge change is necessary.

At any time when SPINDLE ON is true, the front panel RUN switch can control spindle operation. However, if SPINDLE ON is false, the RUN switch cannot command spindle operation

4.5.4.1 Spindle On (Continued)

During a normal power up cycle, the DC voltages (+5 and ±12V DC) must be brought up to their specified values before SPINDLE ON is brought true. The SPINDLE ON command will initiate power to the spindle motor. A 60 second clean air purge cycle will time out before heads are loaded and initialized to TRACK 000. The READY signal will come true after SEEK COMPLETE goes true. The drive will come up on head 0 by default.

A normal power off sequence requires that SPINDLE ON go false or the RUN switch be set to stop so that the heads can be retracted safely before DC power is removed.

At any time the controller senses an imminent power failure, SPINDLE ON should immediately be brought false in order to retract heads before spindle power is lost. (See alternate method: Section 4.5.6.1 POWER SAFE).

4.5.5 Radial Output Line

4.5.5.1 Write Protected

A write lockout function may be invoked on the removable cartridge by removing a tab on the cartridge itself. The fixed disk may be write protected from the front panel.

If the HEAD SELECT 2^0 and 2^1 lines address a protected volume, the WRITE PROTECTED line will be activated to a true level.

4.5.5.2 Drive Selected

A status line is provided at the J2 connector to inform the host system of the selection status of the drive.

This signal will go true only when the drive is programmed as drive X (X=1,2,3 or 4) by programming the shunt on the drive and when the DRIVE SELECT X line at J1 is activated by the host system.

4.5.6 DC Power Cable

4.5.6.1 Power Safe

A POWER SAFE control input is provided so that the power supply board may provide power supply status to the Micro-Magnum 5/5. This line is to be used in a manner similar to the SPINDLE ON line from the controller. At any time POWER SAFE goes false, the drive will interrupt any operation in progress and retract the heads from the disk surface. This line can be used to protect the drive when DC voltages are not within specified tolerance. In a normal power down sequence, this line, if used, should go false a minimum of 1 sec. prior to loss of DC power. Notice that in normal operation, this line is LOGICALLY FALSE, i.e. a high voltage, NOT pulled to ground. (See section 4.3.1.2, Logical Control Signal Definition)

4.6 Micro-Magnum 5/5 Track Format

The Micro-Magnum 5/5 incorporates embedded servo information between the sectors of data. Recording of servo data forms a fixed sector size for the drive. Sectors are organized so as to allow thirty-three (33) sectors of 256 bytes of data each. The total unrecorded capacity of each track is 10890 bytes (8 bits). Servo information requires 26 bytes per sector leaving a total of 48 bytes for use as format information with each sector. Use of the 48 byte format area is a customer option; however, the DMA standard Format is shown in Figure 14. Write data is to be generated at 5 Mbits/sec from a (±.01%) crystal resident in the controller.

4.6.1 Notes to DMA Standard Format

4.6.1.1 Embedded Servo

The embedded servo field consists of 26 bytes. The information recorded in this field is used exclusively by the internal control circuitry of the Micro-Magnum 5/5 and is not made available on the data bus. During read operations, a continuous string of AAA...is derived from a crystal and transmitted on the Read Data lines during the embedded servo field.

4.6.1.2 PLO SYNC

Twelve bytes of 000...'s are transmitted for data separator synchronization.

4.6.1.3 ID and Data Adress Mark

The hex "A1" code, in the address mark, is made unique by omitting the clock transition between bits 4 and 5. A highly reliable address mark is thereby provided since no legal MFM code on the disk can contain this sequence. "FE" indentifies I.D. address mark while "F8" identifies the data address mark.

4.6.1.4 Cylinder-Head-Sector

The detail use of bits in these three bytes is outlined in Figure 14. Provision is made for 1024 cylinder, 8 head and 64 sectors. Special control flags are embedded in the HEAD BYTE.

4.6.1.5 Write Protect Sector Flag

A "1" set in this bit location indicates to the controller that this sector has been specially protected from being overwritten, by the host system. This feature is provided to enable the system to implement a software write protect function.

4.6.1.6 Bad Sector-Bad Track Flags

The use of these flags will be discussed in Section 4.7 FACTORY DEFECT MAPPING.

4.6.1.7 CRC

This two byte field is used to implement the CCITT CRC polynominal ($X^{16} + X^{12} + X^5 + 1$) for error detection in both the I.D. and data fields.

4.6.1.8 ECC

A three byte field is reserved for appending an error correction code to both the I.D. and data fields. A further discussion of this code can be found in DMA Application Note 2039.

4.6.1.9 Write Splice

This byte is provided between the I.D. field and the data field PLO SYNC for the purpose of write current turn on if data is to be recorded in the data field.

4.6.1.10 Data Pad

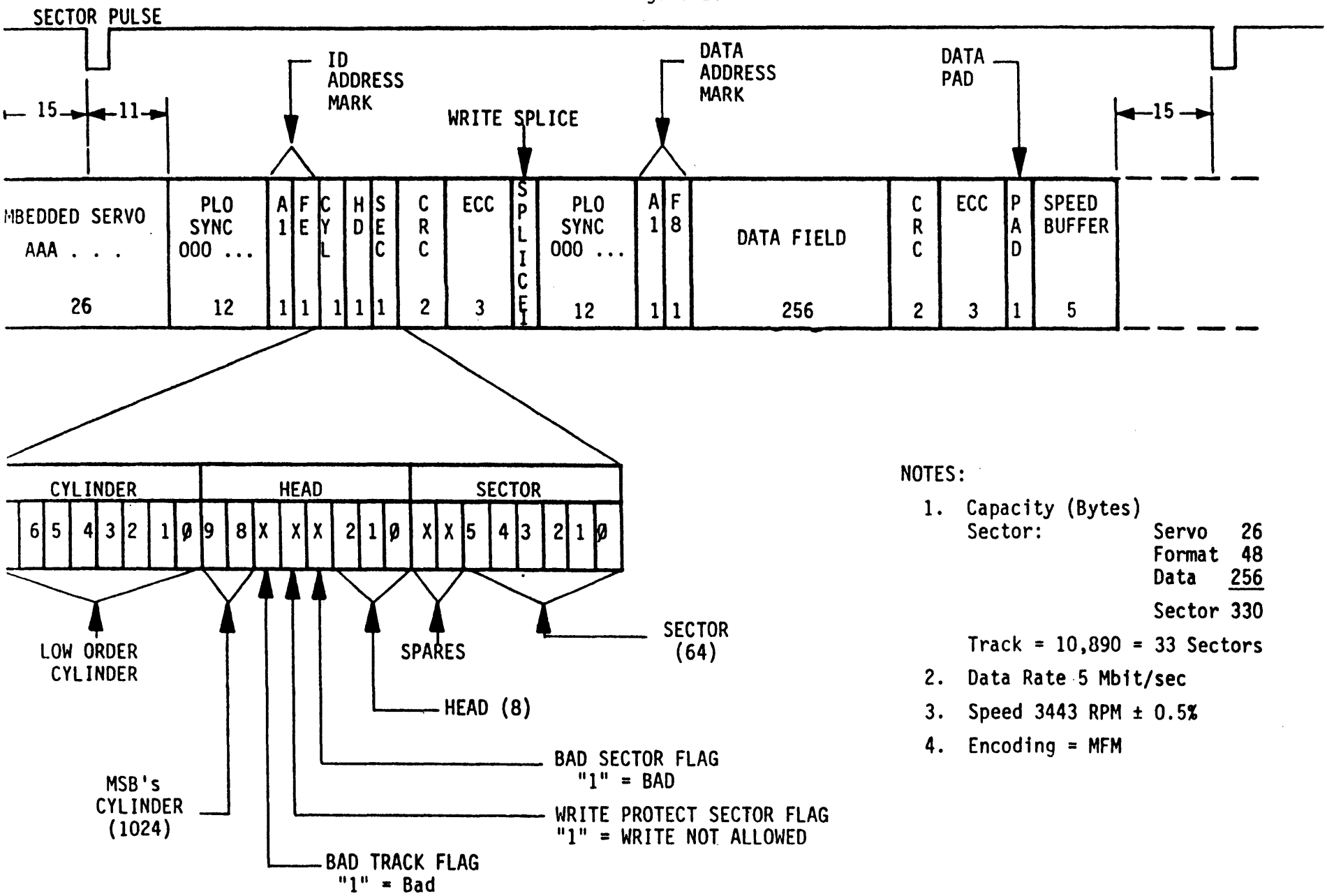
A one byte pad is provided between the final data ECC field and the speed buffer area in order to guarantee data integrity.

4.6.1.11 Speed Buffer

A five byte buffer area is provided at the end of the sector to accommodate spindle speed variations of up to ±0.75%. During write operations, the controller is required to write 000...s in the 5 byte Speed Buffer area.

DMA STANDARD FORMAT

Figure 14



NOTES:

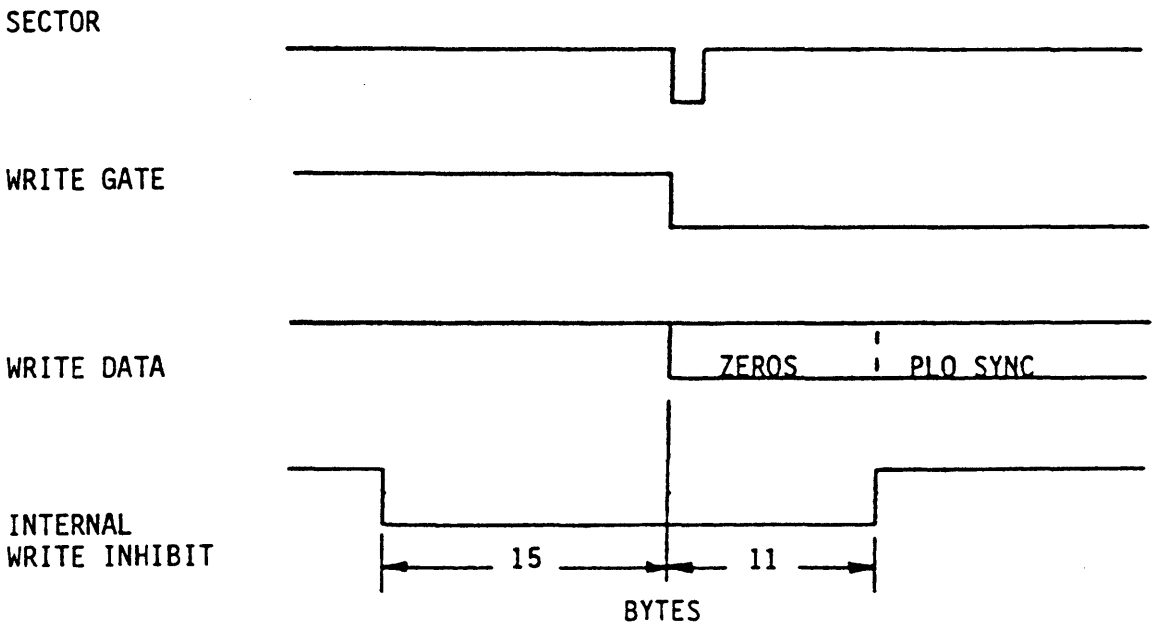
1. Capacity (Bytes)
   Sector: Servo 26
   Format 48
   Data 256
   Sector 330
   Track = 10,890 = 33 Sectors
2. Data Rate 5 Mbit/sec
3. Speed 3443 RPM ± 0.5%
4. Encoding = MFM

4.6.1.12 Sector Interleave

As recorded at the factory, a sector interleave factor of 4 will be applied to the sector I.D. fields. The sequence of sector I.D. fields is as follows: 0, 8, 16, 24, 1, 9, 17, 25, 2, 10 18, 26 etc.

4.6.2 Write Format Timing

All format write operations are timed from the sector pulses. WRITE GATE and WRITE DATA may be gated on with the SECTOR pulse or left on during the entire embedded servo area. The embedded servo areas are protected by the internal write inhibit function so that the beginning of actual recording on the disk will be controlled by the drive (11 bytes after leading edge of SECTOR).



WRITE FORMAT TIMING

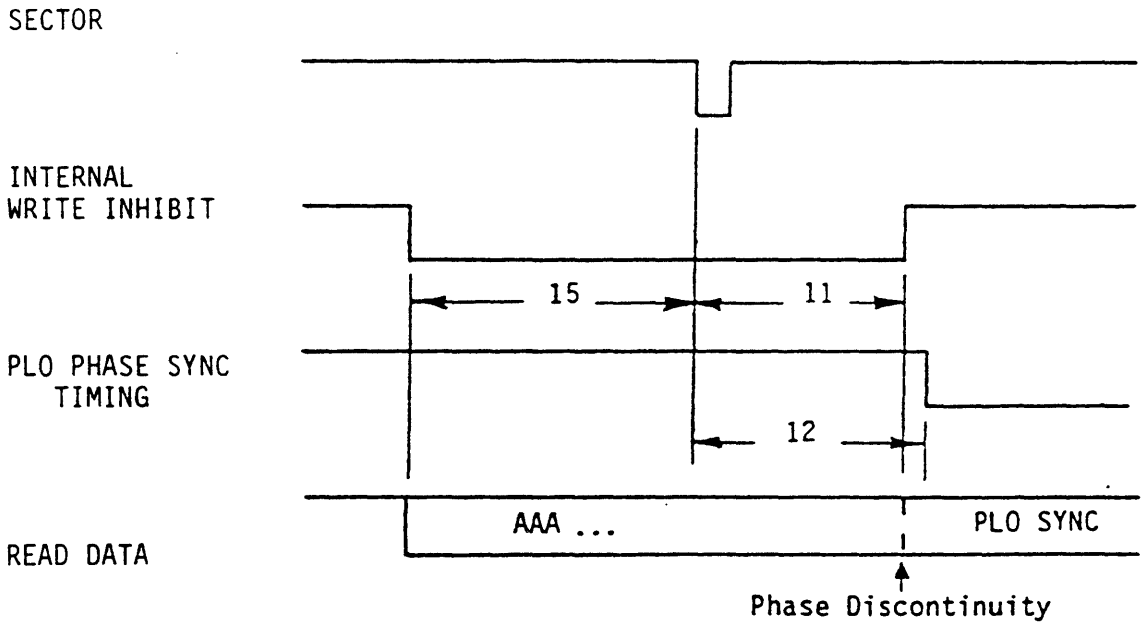
Figure 15

4.6.3 Read Format Timing

In order to avoid transient phase discontinuities, the PLO should be phase synchronized (forced into zero phase error) at 12 bytes after the leading edge of SECTOR

4.6.3 Read Format Timing (Continued)

The Micro-Magnum 5/5 drive will transmit an all A's pattern (101010 bit pattern) on the MFM READ DATA lines during the embedded servo write inhibit time. This all A's pattern will be derived from an internal crystal so that phase shifts will occur at the boundaries of the inhibit pulse.



READ FORMAT TIMING

Figure 16

4.7 Factory Defect Mapping

The cartridges and fixed disk drives will be defect mapped and formatted at the factory prior to shipment. This technique allows sophisticated test equipment to be utilized in finding defects and marginal areas. The following defect mapping algorithm will be employed:

4.7.1 For the first defective sector found on a track, the spare sector (Sector 32) will be used. In order to maintain efficient system operation, the defective sector will be assigned sector number 32 (with a bad sector flag) and the next physical sector will be assigned the number that should have been used for the defective sector. In this way, all following sectors will be moved down-track by one physical sector.

4.7.2 Tracks with more than one defective sector will be assigned one of the 26 alternate tracks available on the inner radius of the disk. Note that this may require a head change to the other side of the cartridge disk but must remain within the address volume of the cartridge. In this case, the bad track flag will be set in the I.D. field of every sector on the track and the assigned alternate track will be written in the data field of each sector. Format for recording alternate track address in the data field is shown in Figure 17.

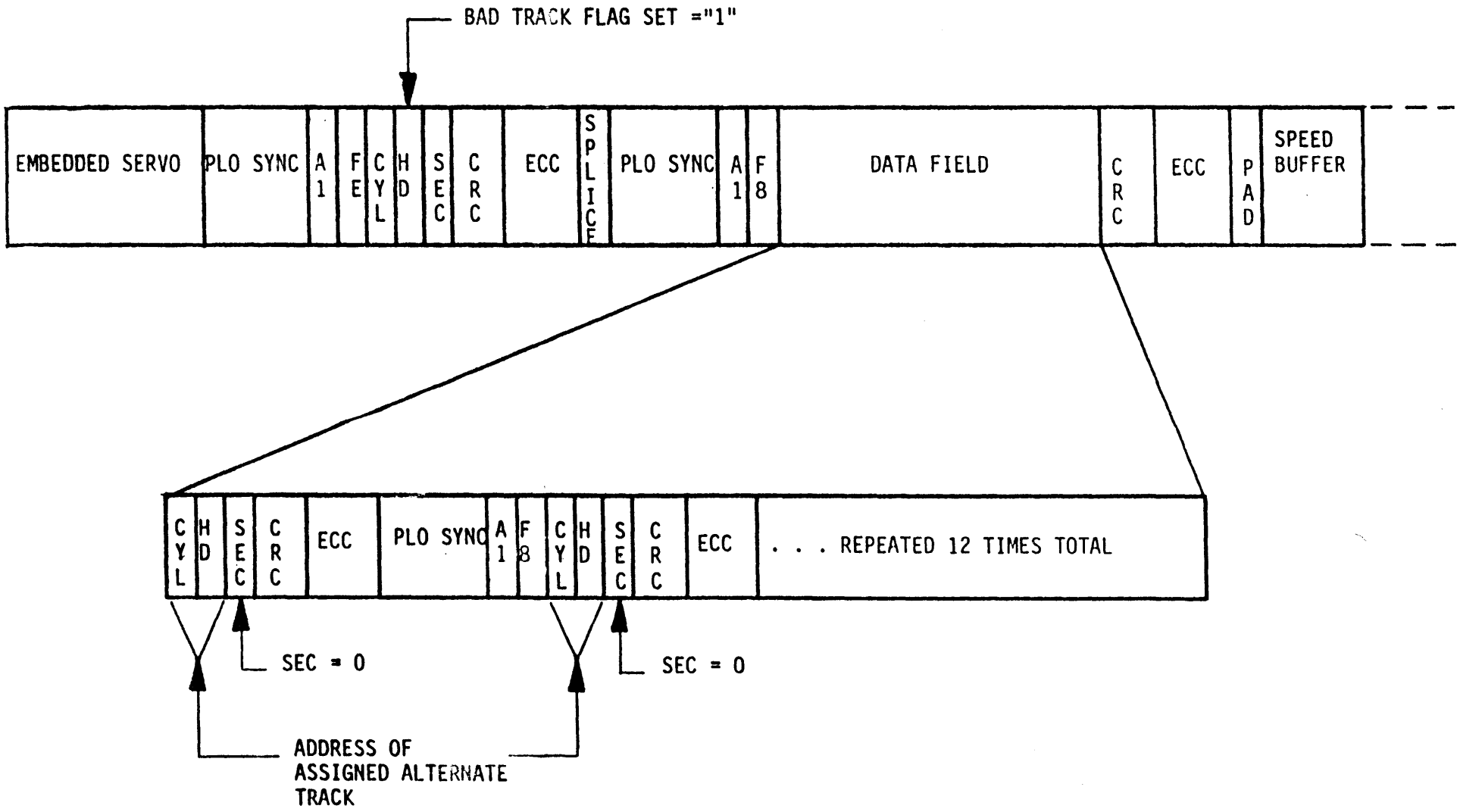
4.7.3 A catalog of alternate track assignments is recorded in sector 32 of track 0 head 2 (lower surface of cartridge) or head 0 (lower surface of fixed disk). Format for recording this information is shown in Figure 18.

4.7.4 A typed list of all defective sectors and alternate track assignments on the cartridge or drive will be supplied with the unit.

At the time of shipment, all embedded servo field, I.D. fields and data fields not spared, will be guaranteed 100% defect free. Track 000 on both sides of the disk (either cartridge or fixed disk) will be guaranteed 100% defect free (i.e.: no bad sectors will be spared out by sector #32 on track 0). No more than 25 tracks per surface will have defective sectors spared by sector #32 and no more than ten alternate tracks will have been assigned at the time of shipment.

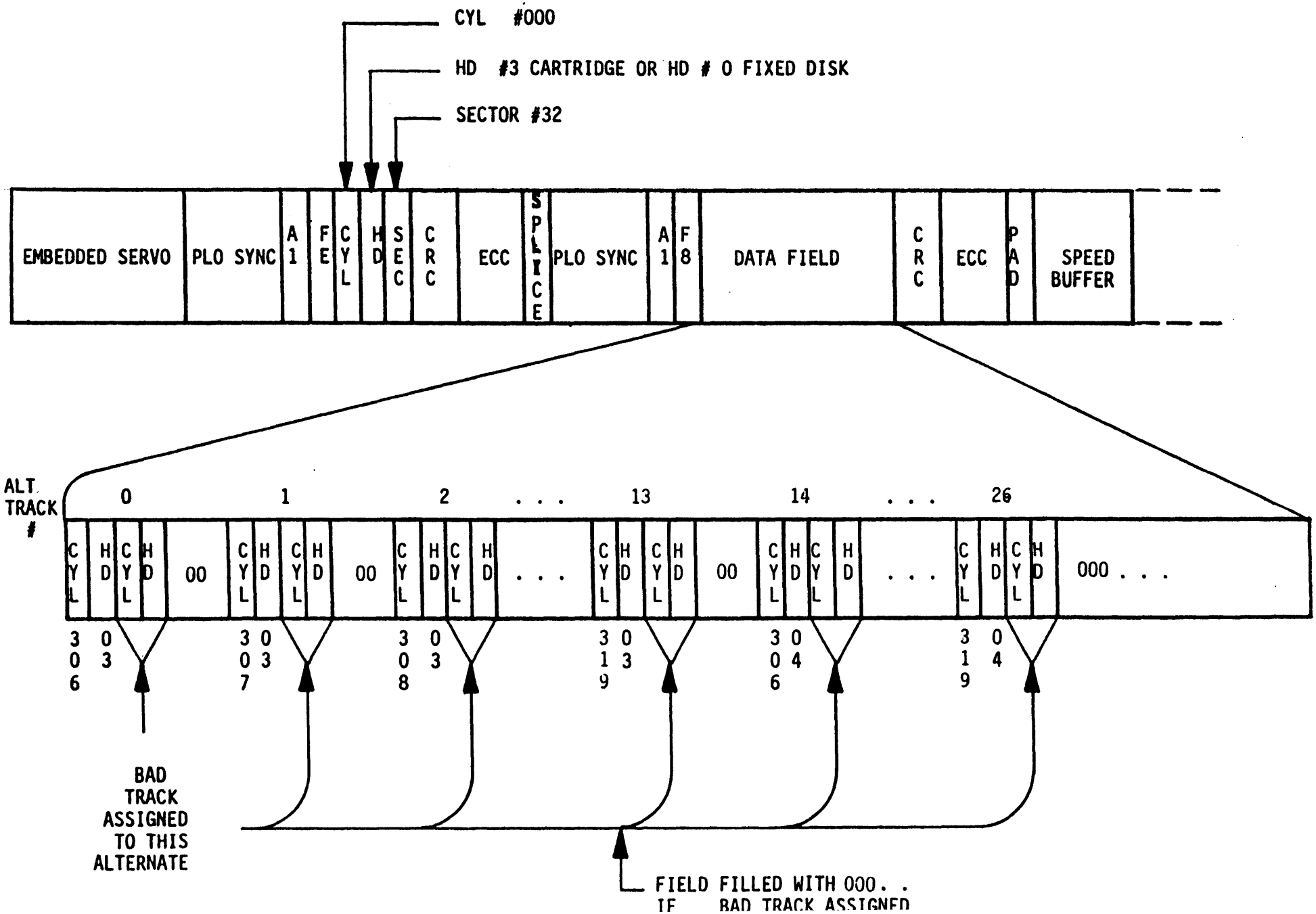
DATA FIELD FORMAT
for
DEFECTIVE TRACK WITH ASSIGNED ALTERNATE
(Repeated In Each Of 33 Sectors)

Figure 17



ALTERNATE TRACK CATALOG
FORMAT FOR DATA FIELD SECTOR 32 -TRACK 0

Figure 18



5.0 DRIVE OPERATION

5.1 Introduction

This section describes the front panel, control features and operation of the drive.

5.2 Front Panel Layout And Mechanics

Figure 19 is a full scale sketch of the front panel layout for horizontal installations. The same panel relabeled for vertical installation is shown in Figure 20.

5.2.1 Door Mechanism

A pivoted front door is used to gain access to the removable disk cartridge compartment. A mechanism attached to the door provides the proper seating and lifting action to the receiver so that reliable cartridge installation and removal can be accomplished. The door mechanism also has a door-open overtravel feature to activate a cartridge eject mechanism.

5.2.2 Door Latch

A solenoid operated door latch is incorporated into the MICRO-MAGNUM 5/5 so that the front door cannot be opened while the drive is operating. This latch is arranged so that in case of power failure the front door will remain latched.

5.2.3 Control Panel

A control panel extends across the bottom of the drive front panel. This panel contains two rocker switches, two LED indicators and a sticker location. Figures 19 and 20 show the front panel options.

5.3 Switch and Indicator Definitions

5.3.1 Run Switch

RUN is used by the operator to facilitate load and unload of the removable cartridge. After installing a cartridge, the spindle may be started by pushing RUN provided:

a. A cartridge is installed and properly seated.

b. The door is closed.

c. DC power is applied to the drive.

5.3.1 Run Switch (Continued)

d. The interface line SPINDLE ON is in its true state.

e. The power supply control line $\overline{\text{POWER SAFE}}$ is true.

If these conditions are met, the READY LED will be lighted with a flashing sequence and the drive will start its spin up cycle. A 60 second cycle is required to bring the spindle to speed, purge the contamination particles from the cartridge, load the heads and initialize the drive. At the end of this cycle, the READY light comes on steady and the interface READY line goes true indicating to the controller that the drive is ready for read, write or seek commands. When the drive initially comes up to the READY state, it will be positioned at track 000 under control of head 0.

To remove a cartridge the cycle may be initiated either by the controller dropping SPINDLE ON to a false condition or the operator deactivating RUN. At this point the ready light will go to its flash sequence, heads will be unloaded and the spindle will stop. When the spindle is fully stopped, the ready light goes off and the door may be opened for cartridge removal.

If a front panel initiated stop request occurs while WRITE GATE is true, the stop cycle will not be initiated until WRITE GATE goes false.

If a RUN sequence is commanded from the front panel and the door is ajar so that the door latch does not close or for some reason the cartridge is not properly seated, a fault condition will occur as indicated by the fault LED.

5.3.2 Ready LED

The READY LED is a green LED positioned next to the RUN switch.

A steady lighted READY indicator means that the drive is up to speed with heads loaded and is ready to accept commands at the interface. All interface commands are ignored until READY comes true.

During the spindle start or stop sequence, the READY light will flash indicating that opening of the cartridge door should not be attempted.

5.3.3 Fault LED

The FAULT LED is a Red LED positioned next to the RUN switch.

There are two classes of fault conditions indicated by the fault LED indicator:

5.3.3.1 Class I Faults

Indicated by a steady lighted FAULT indicator, these faults are of a noncritical nature and can be reset by the controller with the "Restore Sequence". (Section 4.5.2.5.1)

5.3.3.2 Class II Faults

These faults are of a more serious nature and indicate a condition that may destroy user data. This condition is indicated by a flashing FAULT indicator and can be reset only by a spindle shut down sequence. (Section 4.5.2.5.1)

Should a hardware failure occur where the heads cannot be extracted from the disk surface, the drive will stop the spindle allowing the heads to land on the disk surface, set both the READY and the FAULT LED's into a flashing sequence, and hold the front door in a locked condition. If removing power from the drive and reapplying power does not clear this indication, consult the factory.

5.3.4 Write Protect

5.3.4.1 Write Protect Cartridge

The Micro-Magnum disk cartridge is equipped with a removable tab so that the cartridge can be protected from all write operations. When this tab is removed from the cartridge, the cartridge activates a switch when inserted into the drive, so that the internal write enable signal is inhibited when the cartridge volume is addressed.

5.3.4.2 Fixed Disk Write Protect Switch

The fixed disk volume may be write protected from the front panel by moving the FIXED WRITE PROTECT SWITCH to its protected position.

5.4 Cartridge Installation And Removal

5.4.1 Installation

In order to install a cartridge, DC power must be present on the Micro-Magnum 5/5. DC power is required so that the door unlatch solenoid can be activated.

When the drive is ready to accept a cartridge, no indicator LED will be lit. In this case, the front door may be opened to its door-open detent position and a cartridge inserted into the cartridge receiver. The cartridge should be pushed into the receiver against a soft spring force until a spring latch detent is felt that allows the cartridge to remain fully inserted into the receiver. (Note: The cartridge eject spring will push the cartridge out of the receiver unless the spring latch detent is achieved. Eject spring latch detent will be impossible if the cartridge is accidentally inserted upside down).

The front door may now be closed. This should be done slowly so as to allow the cartridge to assume final location alignment and seating in the cartridge receiver. This entire door closing operation should be smooth and non-binding. Never force the door aginst hard resistance. When the front door is fully closed, a door closed detent should be in effect that holds the door securely closed.

With the cartridge fully seated and the door closed, the RUN switch may now be activated to sequence the drive up to a READY state. If no cartridge is present, the cartridge is not properly seated, or the door is not securely closed, the drive will indicate a FAULT situation by flashing the FAULT LED (red). This condition can be reset by switching the RUN switch off, correcting the cause of the fault and reactivating the RUN switch.

If the drive accepts the RUN command, the READY LED (green) will flash at one second intervals until the drive spindle is up to speed, heads have been loaded, and drive initialization has been completed. At this time, the READY LED will come on steady green indicating the READY state.

5.4.2 Removal

To remove a cartridge from a running drive, the RUN switch is switched off. The READY LED assumes the 1/2 second flashing mode until the spindle is brought to a complete stop. At this time, all front panel LED's will go out indicating that the door may be opened.

5.4.2 Removal (Continued)

The door may be opened with a smooth gentle force. This action removes the disk cartridge from the magnetic spindle chuck and lifts the receiver to its upper position. A momentary motion of the door past its door-open detent position will release the cartridge eject spring and allow the cartridge to be ejected approximately one inch out of the receiver for removal.

If a new cartridge is not inserted immediately, the front door should be closed as a precaution against entry of dust and dirt into the cartridge receiver.

5.5 Cleanliness, Care And Handling

The Micro-Magnum 5/5 disk drive and the Micro-Magnum cartridge have been designed for maximum reliability and long operating life; however, improper control of the operating environment or mishandling of the cartridge or drive can cause damage to the drive and/or cartridge and may cause loss of customer data. The following practices are recommended:

a. Use the drive in normal office environment. It is not intended for use in a harsh environment involving high dust and dirt concentrations.

b. Always keep the drive door closed when not in process of cartridge installation or removal.

c. Never tamper with the inside portion of the drive.

d. Always install the cartridge into its protective sleeve when not in use.

e. Never tamper with the cartridge mechanism and try to open the cartridge hub or door while it is outside the drive.

f. Avoid exposure of the drive or cartridge to oily or sticky substances.

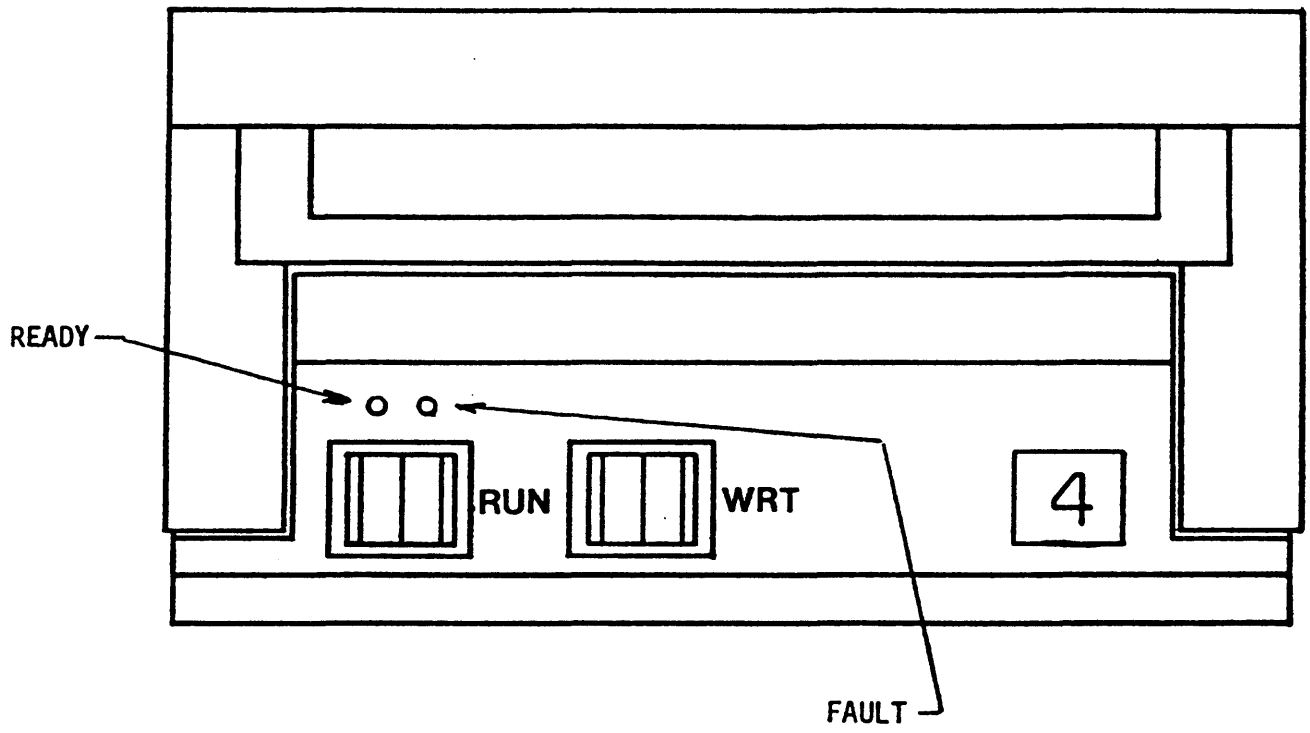
g. Never install a cartridge that has been contaminated, tampered with, or dropped. Permanent damage to the drive may result.

h. Avoid exposure to magnetic fields.

i. Use stick-on label at designated location only.

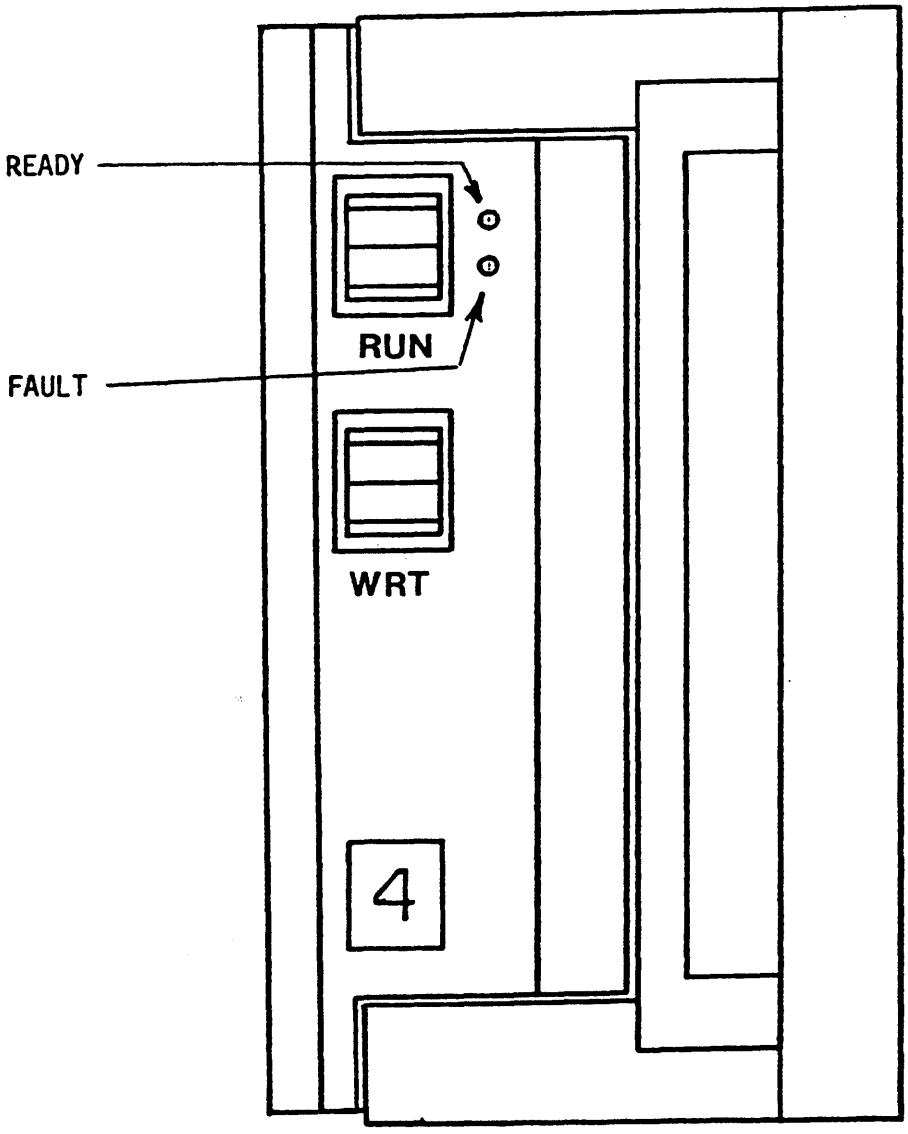
FRONT PANEL
HORIZONTAL

Figure 19



FRONT PANEL
VERTICAL

Figure 20



6.0 DMA DISK CARTRIDGE

6.1 Introduction

This section describes the DMA Removable Disk Cartridge and Supplier Specification on the product.

6.2 General Description

The Micro-Magnum removable disk cartridge is used with the Micro-Magnum 5/5 disk drive and both are designed to be used in a normal office environment. The cartridge consists of a standard 5.25-inch oxide disk (130mm ANSI proposed standard) clamped to a hub and enclosed in a plastic housing.

The industry standard mechanical interface (ANSI proposed standard) is provided. The interaction between the precision alignment of the cartridge plastics and the disk hub defines the mechanical interface. The cartridge is intended for front load applications and is dimensioned so as to preclude improper cartridge loading.

Both disk surfaces are available for data storage. Pre-recorded embedded servo information provides for cartridge interchange and track positioning. No CE alignment disk or head alignment is required.

When the Micro-Magnum cartridge is inserted into the drive, the door actuator mechanisms opens the head access and air filtration ports. When the cartridge is removed, the door automatically closes protecting the internal compartment of the cartridge from contamination.

6.3 Performance

	Formatted	Unformatted
Capacity	5 MB	6.4 MB
Per Surface	2.5 MB	3.2 MB
Per Track	8192 B	10032 B
Per Sector	256 B	304 B
Sector Per Track	32+1 Spare	33
Transfer Rate	5.0 Mbit/Sec.	

6.4 Functional

	Formatted
Rotational Speed	3443 RPM
Recording Density	8737 BPI
Flux Density	8737 BPI
Track Density	454 TPI
Cylinders	306 + 13 Spare + 1CE = 320
Tracks	640
Write Protect File	

6.5 Physical Characteristics

Thickness	0.748 inches (19mm)
Length	5.551 inches (141mm)
Width	5.394 inches (137mm)
Weight	11 oz.

6.6 Environmental

Temperature Range, Operating	60°F to 135°F (16°C to 57°C)
Temperature Range, Non-Operating	-40°F to 150°F (-40°C to 66°C)
Relative Humidity	8 to 80% R.H.
Wet Bulb, Maximum	79°F (26°C), Noncondensing