PRELIMINARY

MAY 1983

CM 4000 SERIES-HALF HEIGHT 5¼" WINCHESTER DISK DRIVE OEM MANUAL

COMPUTER MEMORIES Incorporated

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1.0 INTRODUCTION

1.1 General Description:

The CM 4000 Series of Half Height 5 1/4" Winchester Disk Drives are intended for mini and microcomputer applications which require high speed random access disk storage at low cost. The units incorporate one platter and utilize a Winchester type head/media technology similar to that used in IBM-3350 type disk drives. The platter has two data surfaces. Each data surface employs one movable head to service 640 data tracks.

The unit requires only DC voltages for operation. These voltages are compatible with those used by industry standard minifloppy disk drives.

Each unit consists of a drive mechanics assembly and a PCBA package which provides a standard 5 1/4" Winchester interface for attachment to a formatter/controller. The interface allows up to four drive units to be daisy chained to a single formatter/controller. All electronic components are located outside the head/disk assembly for ease of field serviceability.

Mechanical and contamination protection for the heads, actuator and disks are provided by an impact resistant aluminum enclosure. A self contained recirculating system supplies clean air through a 0.3 micron filter. A breather filter allows pressure equalization with ambient air without chance of contamination.

Key Features:

- Head parking zone
- Positioner locking mechanism
- Unformatted capacity 13.3 Mbytes; formatted 10.5 Mbytes
- 75 msec average access time
- Swing arm and metal band positioner
- Closed loop servo positioner
- Servo correction from disk
- Step pulse buffer
- 5.0 Megabit/sec transfer rate
- ST 506 interface
- Same DC voltages as minifloppies
- Same mounting as half height 5 1/4 inch floppies

1.2 Summary of Specifications:

1.2.1 Physical Specifications:

Environmental Limits:

Ambient Temperature:

Operating= 50 to 122 Deg F (10 to 50 Deg C)
Nonoperating= -40 to 140 Deg F (-40 to 60 Deg C)

Temperature Gradient:

Operating= 18 Deg F/hr (10 Deg C/hr)
Nonoperating= Below that which can cause condensation

Max. Wet Bulb= 78 Deg F (25.6 Deg C)

Elevation:

Operating= -100 to 6000 ft (-20 to 1828 meters)
Nonoperating= -1000 to 12,000 ft. (-305 to 3656 meters)

Vibration:

Operating= 1g
Nonoperating= 3 g

Shock:

Operating= 1g
Nonoperating= 20g

Ambient Magnetic Field 20 gauss

EMI Susceptability 1V/m 50 KHZ-300 MHZ

DC Voltage Requirement:

+ 12 VDC +/- 5% 2.2A peak during seeks and starts ups.
0.9A average during read and write
0.5 peak to peak maximum ripple

+5 VDC +/- 5% 0.9A typical (1.0A max.)
50mV peak to peak maximum ripple

Heat Dissipation= 55 BTU/hr (15.3 watts) Typical

Mechanical Dimensions:

Height = 1.65 inch (41 mm)
Width = 5.75 inch (146.1 mm)
Depth = 8.00 inch (203 mm)
Weight = less than 3 lbs.

Media:

Oxide coated disks (IBM 3350 technology)
Outside diameter: 130 mm
Inside diameter: 40 mm
Thickness: 0.075

1.2.2 Performance Specifications:

Capacity	CM4213
Unformatted	
Per Drive	13.34 Mbytes
Per Surface	6.67 Mbytes
Per track	10416 Bytes
Formatted	
Per Drive	10.5 Mbytes
Per Surface	5.248 Mbytes
Per Track	8.192 Kbytes
Per Sector	256 Bytes
Sector/Track	32
Transfer Rate	5.0 Mbits/sec
Average Latency	8.39 msec
Access Time (includes settle time)	
Track to track	13 msec
Average	75 msec
Maximum	110 Msec

1.2.3 Functional Specifications:

	CM4213
Rotational Speed	3573 rpm
Speed Variation	.1%
Recording Density	9275 bpi
Flux Density	9275 fci
Track Density	750 tpi
Cylinders	640
Tracks	1280
R/W Heads	2
Disks	1
Index	1
Encoding Method	MFM

1.2.4 Reliability Specifications

MTBF:	12000 power-on hours
PM:	None required
MTTR:	30 minutes
Component Life:	5 years

Error rates:

Soft read errors=	1 per 10E10	bits read
Head read errors=	1 per 10E10	bits read
Seek errors=	1 per 10E6	seeks

Defects:

No greater than 3 defects/surface. Defects* shall be no larger than 11 bits. Track 000 on each surface shall be defect-free.

*Defect is defined as an area during which the signal amplitude could fall below 55% of track average amplitude or pulses which are greater than 140% of track average amplitude.

2.0 FUNCTIONAL CHARACTERISTICS

2.1 General Description:

The CM 4000 series 5 1/4 " Winchester disk drive consists of Read/Write and control electronics, read/write heads, track positioning mechanism, media, and air filtration systems. These components perform the following functions:

1. Interpret and generate controls signals.
2. Position the heads over the desired track.
3. Read and write data.
4. Provide a contamination free environment.

2.2 Read/Write and Control Electronics

Electronics are packaged on two printed circuit boards. The primary board to which power, control and data signals are connected includes:

1. Index detection circuit
2. Positioner servo control circuits
3. Read/Write circuits
4. Head select circuit
5. Drive select circuit
6. Track 000 detector circuit
7. Positioner lock solenoid driver.

The primary board also includes a microprocessor which performs the following functions:

1. Controls both the spindle drive and positioner servo motor.
    a. Spindle speed controlled to .1%
    b. Controls spindle motor braking
    c. Controls spindle start-up current
    d. Senses motor failures, power losses, etc.
    e. Controls positioner velocity profile and position injection.
    f. Monitors servo burst on disk
    g. Corrects off track conditions, after servo burst decoding.
2. Controls lines on interface
3. Tracks position count
4. Reduces write current at a specific track
5. Prevents positioner over-travel
6. Restores head to Track 000 on power-up
7. Activates and deactivates positioner lock mechanism
8. Monitors write fault conditions
9. Gives fault indication on interface
10. Controls all internal timings
11. Generates seek complete

The second printed circuit board derives its power from the primary board and includes:

1. Spindle motor power amplifier
2. Positioner servo power amplifier

2.3 Drive Mechanism

A die cast base houses the recording heads, disks, and the head postioning mechanism as well as the spindle drive motor. Rotational drive for the disks is provided by a direct coupled brushless DC motor. No electronic parts are within the sealed area and electrical connections are made between the recording heads within this area and the electronics via a flexible circuit cable.

2.4 Air Filtration System (Figure 1)

The disks and read/write heads are fully enclosed in a module using an integral recirculation air system with an absolute recirculating filter which maintains a clean environment. A separate absolute breather filter permits pressure equalization with the ambient air without contamination.

CM 4000 AIR CIRCULATION SYSTEM
FIGURE 1.

2.5 Positioning Mechanism

The positioner is a swing arm mechanism supported on two preloaded ball bearings. The swing arm is connected via a connecting arm to a metal band/DC brushless servo motor actuator system. The positioner is controlled by a closed loop position and velocity servo systems. An optical encoder mounted on the motor shaft provides the required feedbacks. In addition a servo burst on the disk occuring just prior to index time provides fine position correction during thermal expansion of the drive. This correction is in addition to the mechanical compensation provided in the drive. The servo burst is transparent to the user and writing during this time is inhibited. Since the servo burst lasts for 128 micro seconds and since writing during this time is inhibited, it is necessary to control the spindle rotational speed to 3573 RPM, in order to maintain a track capacity of 10416 bytes and a data rate of 5.0 Mbits/sec. A solenoid actuator will lock the positioning system when power is removed. The lock mechanism is deactivated when power is applied to the drive and the spindle is at nominal speed.

2.6 Read/Write Heads and Disks

The recording media consists of a lubricated thin magnetic oxide coating on a 130MM outside diameter aluminum substrate. This coating formulation, together with the low load force/low mass Winchester type flying heads, permit reliable contact start/stop operation. Data on each disk surface is read by one read/write head which accesses 640 tracks.

2.7 Head Parking Zone

During shipment the read/write heads are parked and locked in a zone near the disk hub. This parking area is not used for data storage so shipping cannot lead to loss of data or media damage.

3.0 FUNCTIONAL OPERATION

3.1 Power Sequencing

The DC voltages, +5v and + 12v, may be applied in any order. When the voltages are applied to the drive and the power sense circuit determines that all voltages are within limits, the initial load sequence occurs. This sequence consists of running the spindle up to operating speed, releasing the positioner lock mechanism and positioning the heads over Cylinder 000.

3.2 Drive Selection

Drive selection occurs when one of the drive select lines is activated. Only the drive appropriately jumpered will respond to the input signals, and that drive's output signals are then gated to the controller.

3.3 Track Accessing

Read/Write head positioning is accomplished by:

a) Deactivating Write Gate
b) Activating the appropriate Drive Select Line.
c) Being in the Ready condition with seek complete true.
d) Selecting the appropriate direction.
e) Pulsing the Step line.

Each step pulse will cause the heads to move either one track in or one track out depending on the status of the Direction Line. A true on the Direction Line will cause a seek inward toward the spindle; a false, outward toward track 000. Step pulses may be issued to the drive at time intervals equal to or exceeding 0.5 usec between pulses. The drive will accelerate to a speed of 17 tracks/msec (60 msec per track) before ramping down and settling on the track. Seek complete will go true when the R/W heads have settled on the final track at the end of the seek.

3.4 Head Selection

Any of the 2 possible heads can be selected by placing that head's binary address on the Head Select lines.

3.5 Read Operation

Reading data from the disk is accomplished by:

a) Deactivating the Write Gate line.
b) Activating the appropriate Drive Select line.
c) Assuring the drive is Ready.
d) Selecting the appropriate head.

3.6 Write Operation

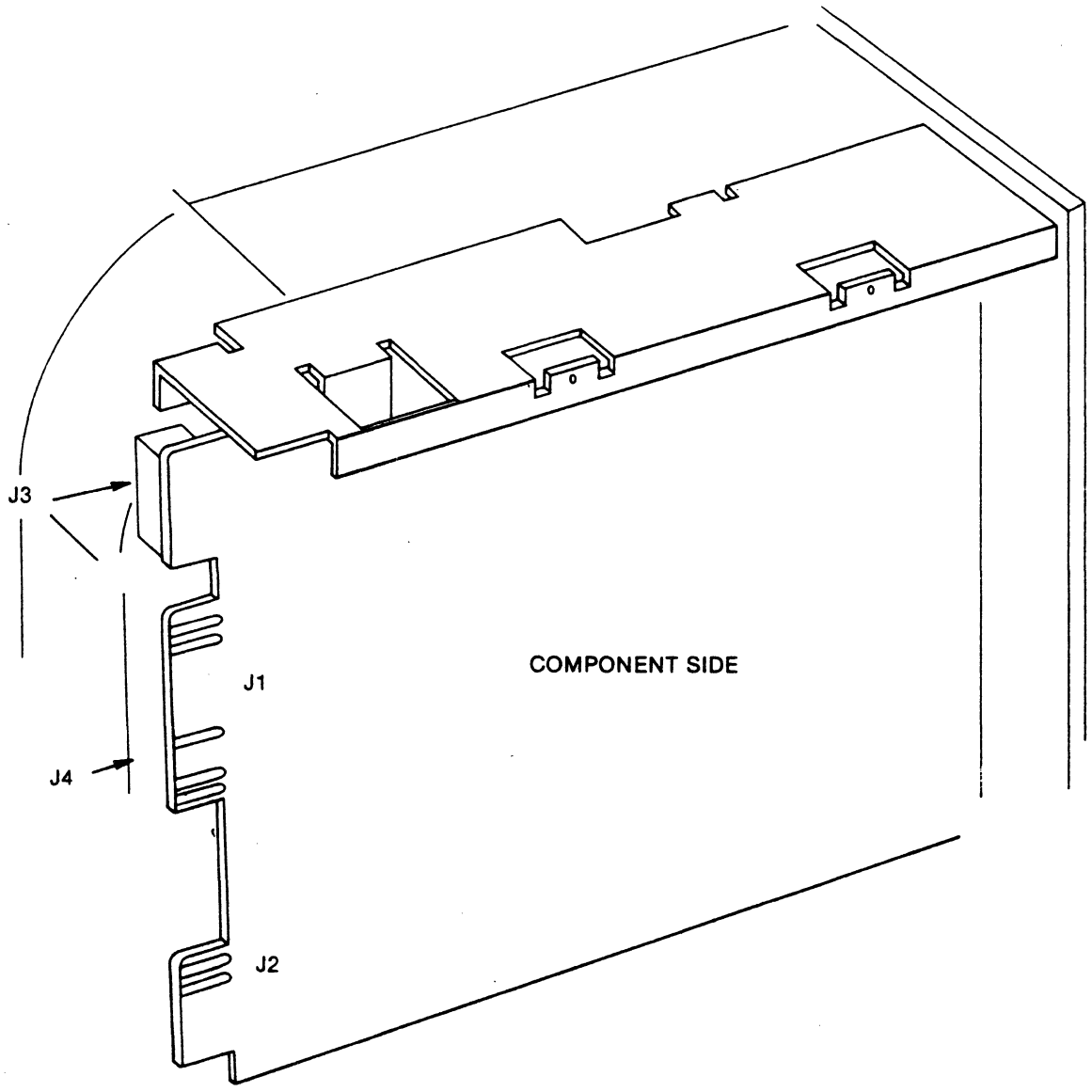
Writing data onto the disk is accomplished by:

a) Activating the appropriate Drive Select line.
b) Assuring that the drive is Ready.
c) Selecting the proper head.
d) Insuring no write fault conditions exist.
e) Activating Write Gate and placing data on the Write Data line.

4.0 ELECTRICAL INTERFACE

4.1 Physical Interface

The interface of the drive can be divided into three categories: Control, Signal and DC power. Table I, II and III define the pin assignments for these interface lines. Tables IV and V show the recommended cable type and the grounding configuration at the drive and at the host system. Figure 3 indicates the physical location of the connectors. Figure 4 indicates a typical connection for a four drive system.



INTERFACE CONNECTOR PHYSICAL LOCATION

FIGURE 3.

TABLE 1 J1/P1 CONNECTOR PIN ASSIGNMENT

GND RTN PIN	SIGNAL PIN	SIGNAL NAME
1	2	-NOT USED
3	4	-RESERVED
5	6	-WRITE GATE
7	8	-SEEK COMPLETE
9	10	-TRACK 000
11	12	-WRITE FAULT
13	14	-HEAD SELECT 2(0)
15	16	RESERVED (TO J2 PIN 7)
17	18	-RESERVED
19	20	-INDEX
21	22	-READY
23	24	-STEP
25	26	-DRIVE SELECT 1
27	28	-DRIVE SELECT 2
29	30	-DRIVE SELECT 3
31	32	-DRIVE SELECT 4
33	34	-DIRECTION IN

TABLE II J2/P2 CONNECTOR PIN ASSIGNMENT

GND RTN PIN	SIGNAL PIN	SIGNAL NAME
2	1	-DRIVE SELECTED
4	3	RESERVED
6	5	-WRITE PROTECT
8	7	RESERVED
10	9	SPARE
12	11	GND
	13	+ MFM WRITE DATA
	14	- MFM WRITE DATA
16	15	GND
	17	+ MFM READ DATA
	18	- MFM READ DATA
20	19	GND

TABLE III P3-DC CONNECTOR PIN ASSIGNMENT

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

TABLE IV SINGLE DRIVE SYSTEM J2/P2 NOT SHOWN

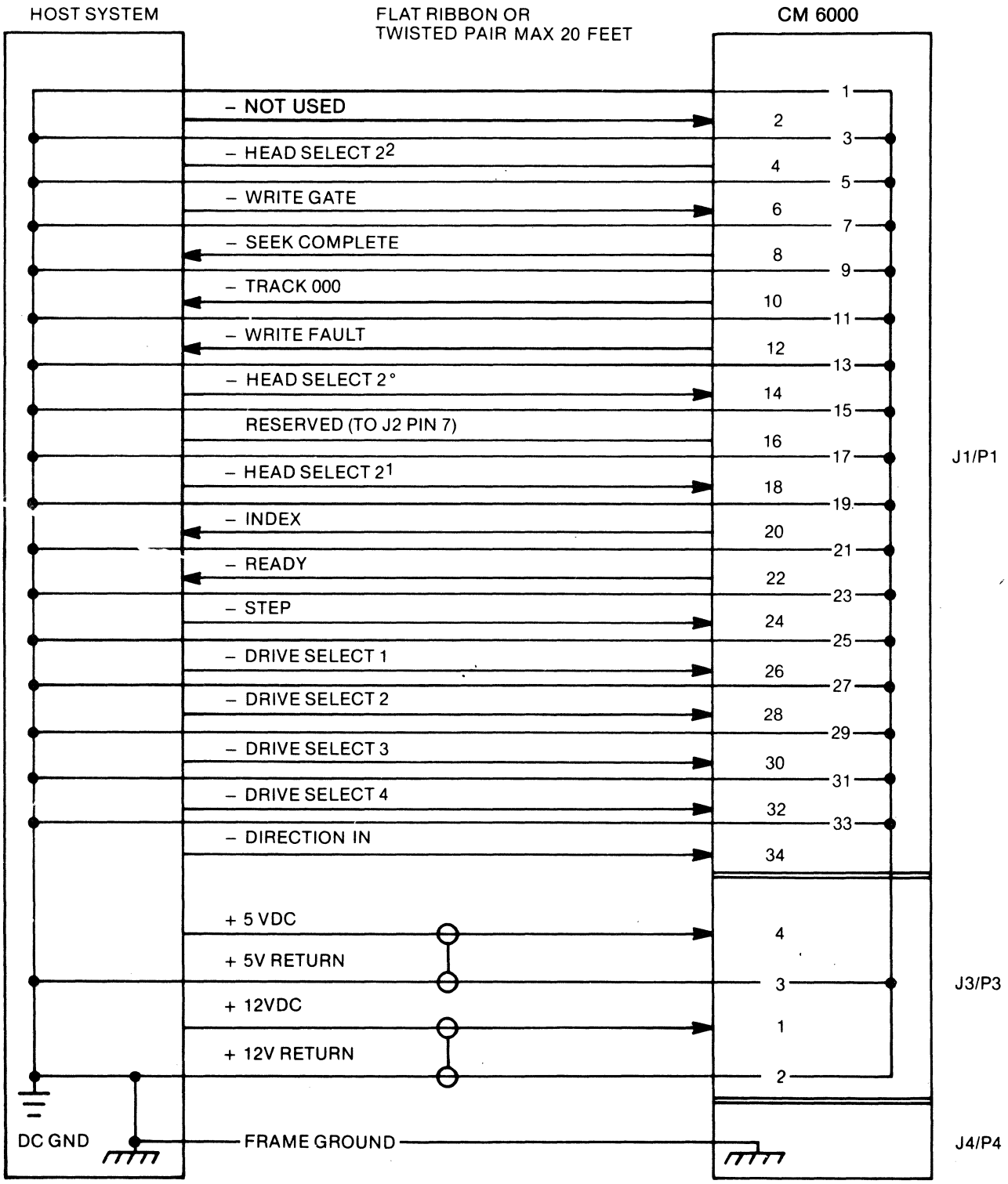
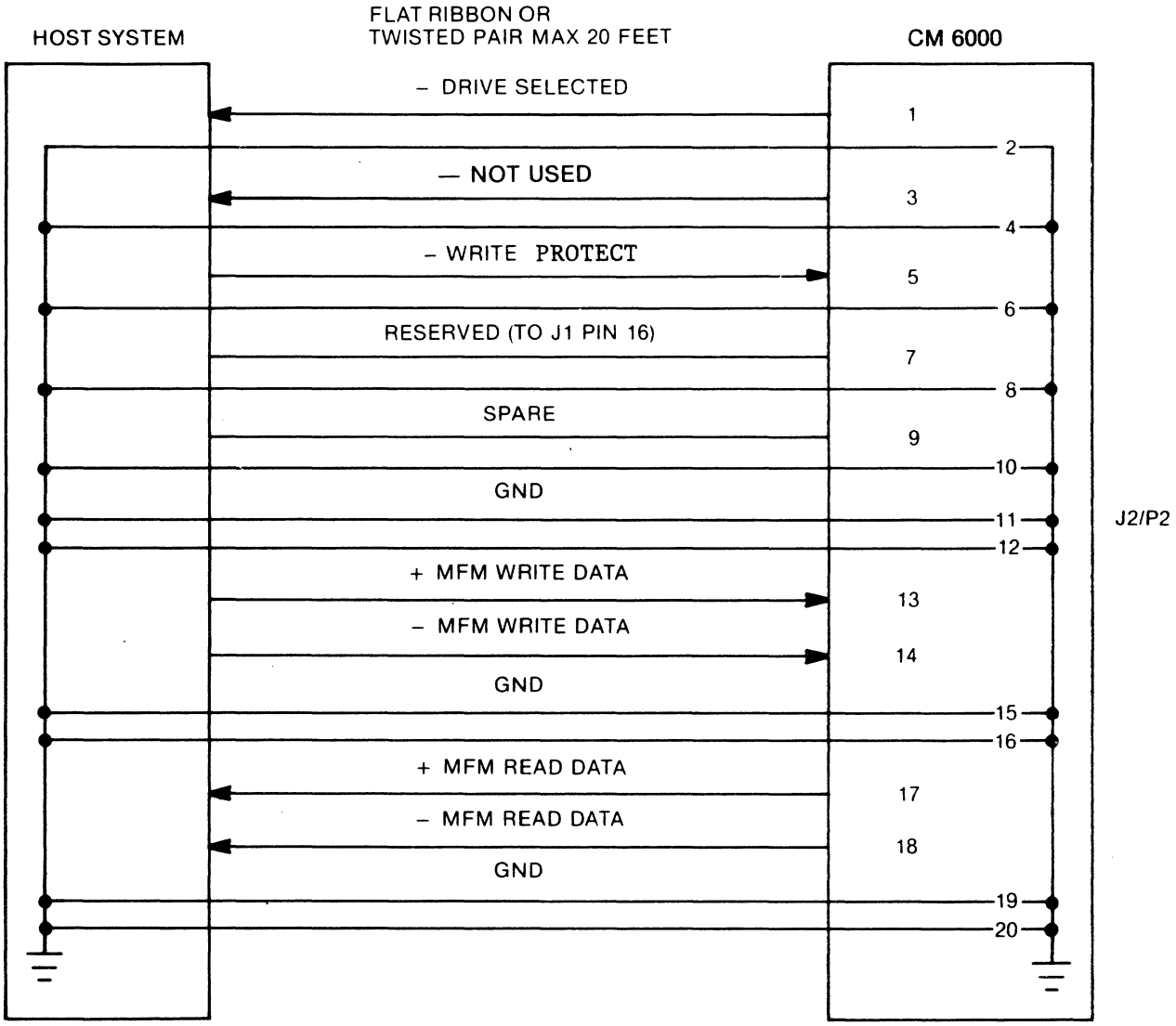


TABLE V SINGLE DRIVE SYSTEM J2/P2



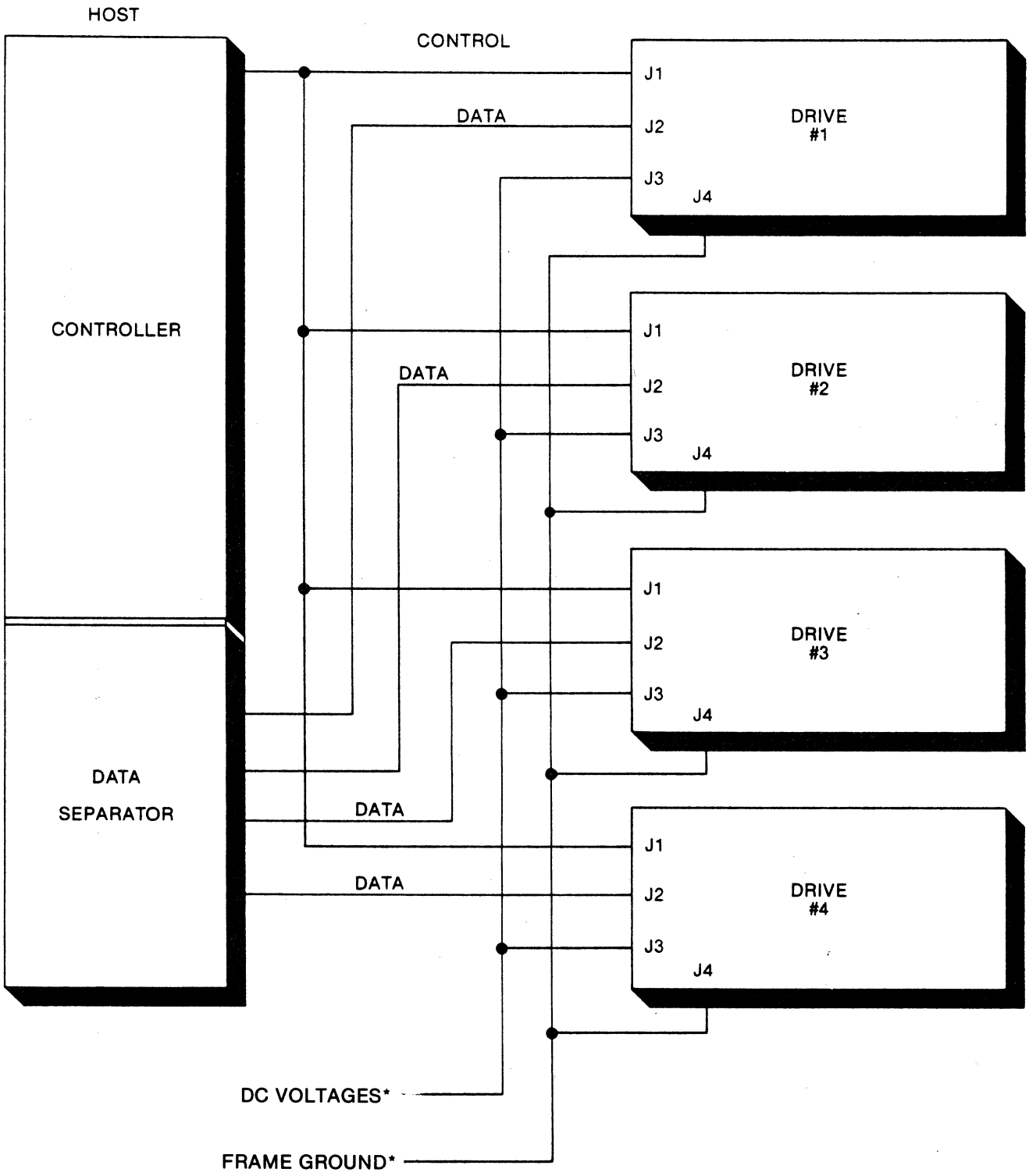


FIGURE 4.

*Note: Each drive should have its own DC voltages and frame ground connections to the power supplies.

4.1.1 J1/P1 Connector

Connection to J1 is via a 34 pin PCB edge connector. The dimensions for this connector are shown in Figure 5. The pins are numbered 1 through 34 with the even pins located on the component side of the PCB. Pin 2 is located on the end of the PCB connector closest to the DC power connector J3/P3. A key slot is provided between pins 4 and 6. The recommended mating connector for P1 is AMP ribbon connector P/N 88373-3.

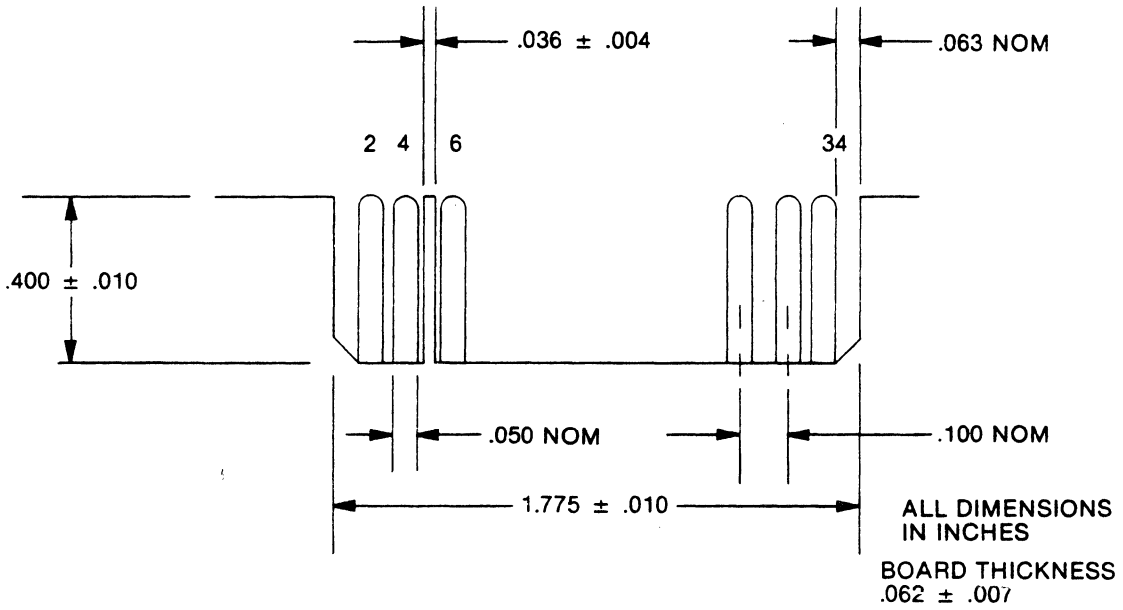


FIGURE 5. J1 CONNECTOR DIMENSIONS

4.1.2 J2/P2 Connector

Connection to J2 is via a 20 pin PCB edge connector. The dimensions for the connector are shown in Figure 6. 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 4 and 6.

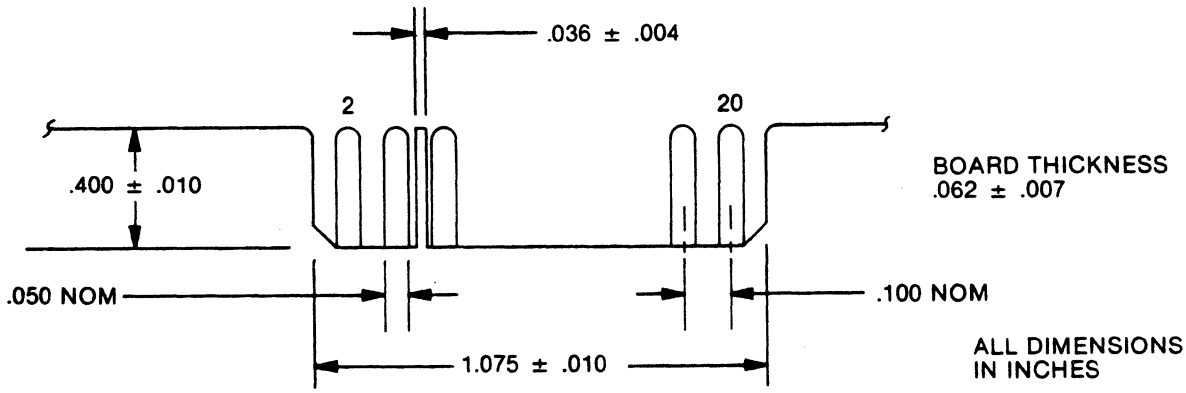


FIGURE 6. CONNECTOR DIMENSIONS

4.1.3 J3/P3 Connector

The DC Power connector (J3), Figure 7, is a 4 pin AMP MATE-N-LOK connector P/N 350211-1 mounted on the solder side of the PCB. The recommended mating connector (P3) is AMP P/N 1-480424-0 utilizing AMP pins P/N 350078-4.

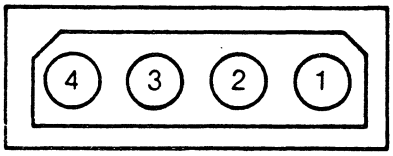


FIGURE 7 J3 CONNECTOR (DRIVE PCB SOLDER SIDE)

The required voltages and current levels on connector J3/P3 are shown below.

4.1.4 J4/P4 Frame Ground Connector

FASTON AMP P/N 62275-1

* NOTE: Each drive should have its own DC voltages and frame ground connections to the power supplies.

4.2 Interface Lines and Pin Assignment

4.2.1 Control Input Lines

The control input signals are of two types: those to be multiplexed in a multiple drive system and those intended to do the multiplexing. The control input signals to be multiplexed are, WRITE GATE, HEAD SELECT 2(0), STEP and DIRECTION IN. The signal to do the multiplexing is DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3, or DRIVE SELECT 4.

The input lines have the following electrical specifications. Refer to figure 8 for the recommended circuit.

TRUE: 0.0VDC TO 0.4 VDC @ I= -40mA (Max)

FALSE; 2.5VDC to 5.25 VDC @ I= 0mA (open)

Each control input line is terminated by 220/330 resistor pack as shown in figure 5.

4.2.1.1 Drive Select 1,2,3, and 4.

The Drive Select lines, when true, enable the input lines of the correspondingly programmed drive(s). Only one Drive Select line should be true at any time.

4.2.1.2 Head Select

This line provide for the selection of each individual read/write head in a binary coded sequence. Heads are numbered 0 and 1 on the CM 4213.

4.2.1.3 Write Gate

The active (true) state of this signal enables write data to be written on the selected disk of the selected drive provided that READY and SEEK COMPLETE are true, WRITE DISABLE is false and no WRITE FAULT exists on the selected drive. The inactive state of WRITE GATE permits the STEP pulses to step the R/W actuator on the selected and READY drive or it enables data to be transferred from that drive if SEEK COMPLETE is true.

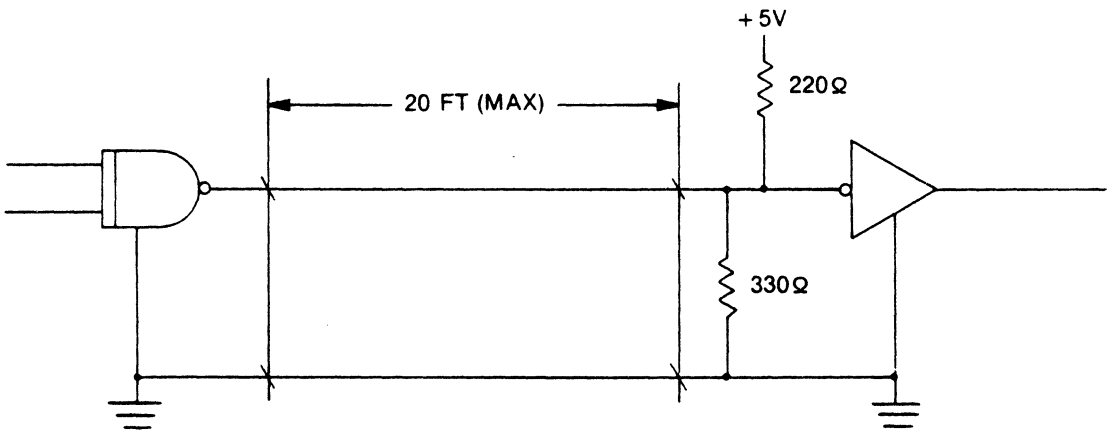


FIGURE 8. CONTROL SIGNAL DRIVER/RECEIVER COMBINATION

4.2.1.4 Step

This is a control signal which causes the R/W head to move in the direction of motion defined by the Direction In line. In the seeking mode the head moves one track for each STEP pulse.

Motion is initiated by the leading edge (i.e. false to true) of the STEP pulse. Any change in the DIRECTION line must be made at least 100nS before the leading edge of the STEP pulse.

STEP pulses may be issued at any time interval equal to or exceeding 0.5 micro seconds. The minimum pulse width is 0.1uS.

See figure 9 for STEP pulse timing. In a restore (recalibration) operation the minimum interval between successive STEP pulses should be 3.0 mS.

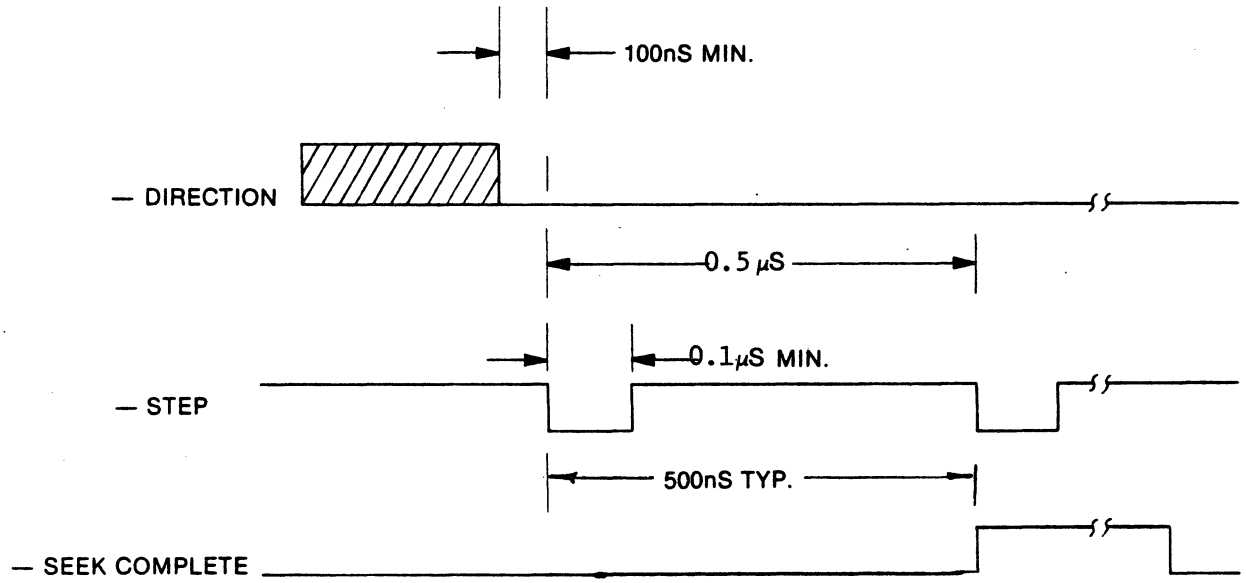


FIGURE 9. STEP PULSE TIMING

4.2.1.5 Direction In

This signal defines the direction of motion of the R/W head when the STEP line is pulsed. When the signal is false the direction is defined as "out" and a STEP pulse casues the R/W heads to move away from the center of the disk. When this line is true the direction is defined as "in" and the heads will move toward the center of the disk. The tracks are numbered 000 through 639 and track 000 is the outermost track. If an attempt is made to seek out beyond track 000 or in beyond track 639 the actuator will stop when one of these extremes is reached.

Once a move has been initiated no attempt should be made to reverse the direction of seeking while the SEEK COMPLETE Line is false.

4.2.2 Control Output Lines

The output control lines are driven with an open collector output stage capable of sinking a maximum of 40mA at the true or active state with a maximum voltage of 0.4V measured at the driver. In the false or inactive state the output transistor is off and the maximum collector cutoff current is 250uA.

The output control lines are enabled by the programmed DRIVE SELECT Line.

The recommended circuit is shown in figure 8.

4.2.2.1 Seek Complete

This line will go true when the R/W heads have settled on the final track at the end of a seek.

The SEEK COMPLETE Line will go false at the following times:

a) During the power on sequence while the drive logic is in the process of restoring the R/W heads to track 000.

b) Approximately 500nsec after the leading edge of the first in any series of STEP pulses.

The minimum duration which this line will remain in the false state is approximately 10.0ms.

Writing is inhibited when SEEK COMPLETE is false. Any attempt to write during this period will generate a WRITE FAULT. When false SEEK COMPLETE also inhibits the transmission of MFM READ DATA.

No attempt should be made to reverse the direction of stepping when SEEK COMPLETE is false.

4.2.2.2 Track 000

The true state of this line is generated when the R/W heads are on their last step approaching track 000, i.e., when they are moving from track 001 to Track 000. It remains true as long as the heads are positioned at track 000. Track 000 is the outermost track.

4.2.2.3 Write Fault

This signal is used to indicate that a condition exists in the drive which causes improper writing on the disk(s). When this line is true, further writing is inhibited at the drive until the condition is corrected.

The following conditions are detected:

a) Write current in a head without WRITE GATE active
b) No write current in a head with WRITE GATE active and DRIVE SELECTED
c) WRITE GATE active when WRITE DISABLE is true
d) The DC voltages are grossly out of tolerance.

WRITE FAULT may be cleared by de-selecting the drive for a period exceeding 50 usecs, otherwise the condition will automatically clear 2 msecs after the conditions generating the fault have been removed.

Writing is inhibited internally during seeking or if WRITE GATE is true at the time SEEK COMPLETE going true.

4.2.2.4 Index

The leading edge (i.e. false to true) of this pulse indicates the beginning of each track. The pulse occurs once per revolution of the disk (16.8 mS nom.). Index width is 128uS.

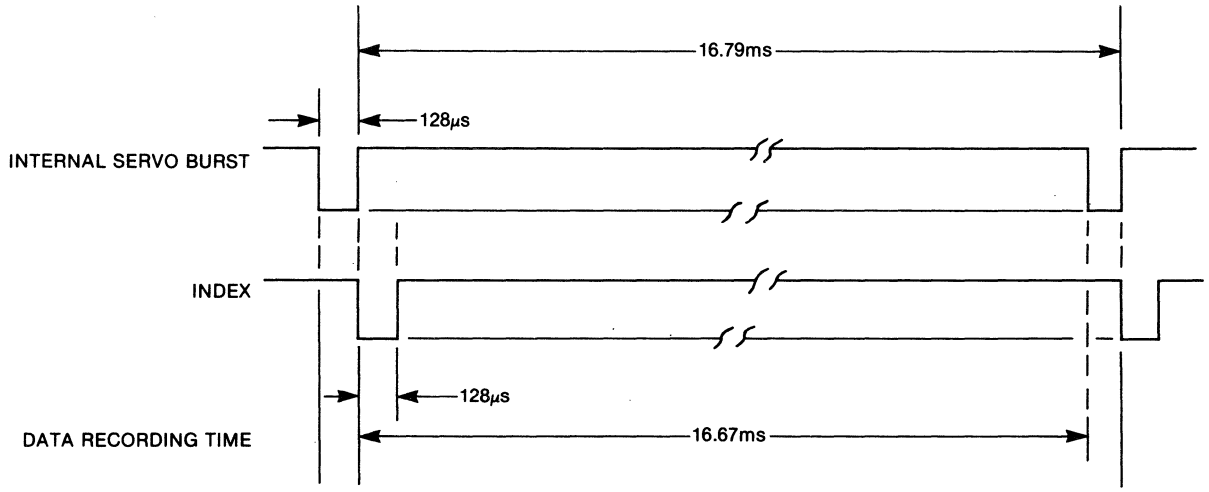


FIGURE 10

4.2.2.5 Ready

When the READY line is true together with SEEK COMPLETE the drive is ready to seek or read and if in addition the heads are not offtrack it is also ready to write. When this line is false the I/O signals are not valid, also, writing, seeking and the transmission of read data are inhibited.

At power on the READY line goes true when the DC voltages are within tolerance, the disks are rotating at the correct speed and the heads are positioned at track 000.

The READY Line will go false when the DC voltages are out of tolerance and/or the disks fail to maintain regulated speed.

4.3 Data Transfer Lines

The data transfer lines are provided at the J2/P2 connector. They are differential in nature and may not be multiplexed.

Two pairs of balanced signals are used for the transfer of data, one pair each for MFM WRITE DATA and MFM READ DATA. Figure 11 illustrates the driver/receiver combination used in the drive for data transfer signals.

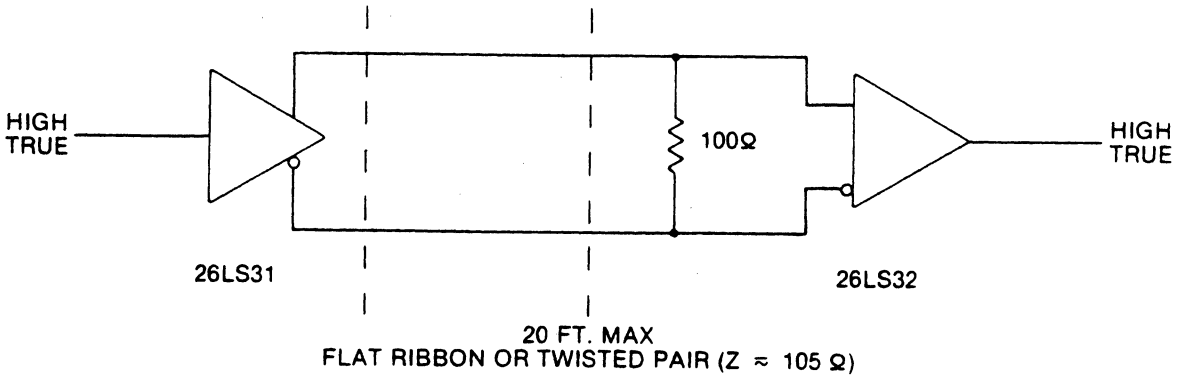


FIGURE 11. DATA LINE DRIVER/RECEIVER

4.3.1 MFM Write Data

This is a differential pair that defines the transitions to be written on the track. When WRITE GATE is active the transition of the signal + MFM WRITE DATA going more positive than-MFM WRITE DATA causes a flux reversal to be recorded on the track. When WRITE GATE is inactive the host system must hold + MFM WRITE DATA more negative than-MFM WRITE DATA.

The standard MFM write data transmission rate is 5,000 Mbits/sec. The write data timing is shown in Figure 12. The actual occurence of the flux reversals may differ due to write precompensation.

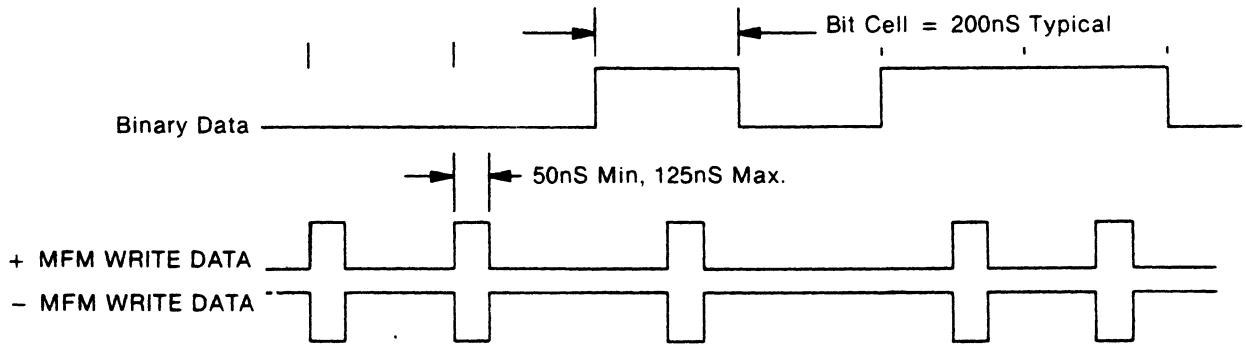


FIGURE 12. MFM WRITE DATA TIMING.

4.3.2 MFM Read Data

Data recovered from a pre-recorded track is transmitted to the host system via a 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.

Read data is suppressed during writing and seeking operations and also when the drive is not selected. Following a write operations and/or HEAD SELECT change the read data will not be valid for a period of up to 20uS. If the drive is already selected at the end of a seek operation, read data will appear immediately upon SEEK COMPLETE. When the drive has been deselected, read data will not reappear for a period of up to 100uS after it is reselected.

Typical MFM read data timing is shown in figure 13.

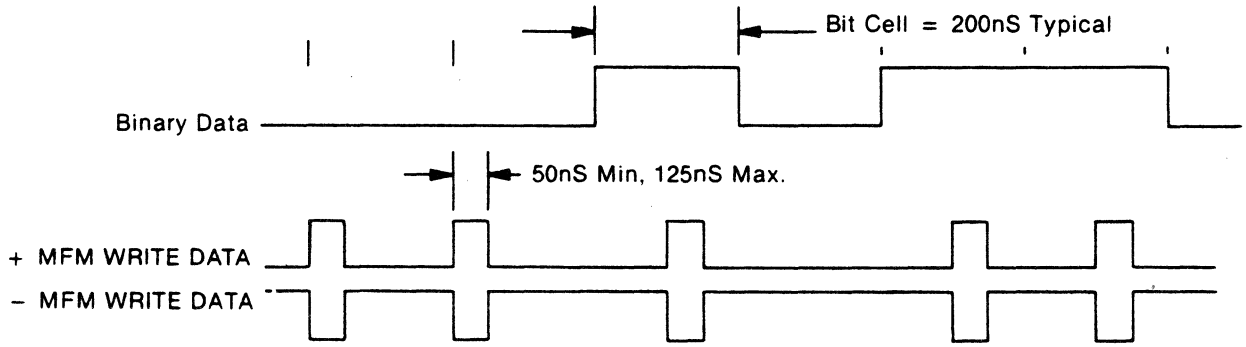


FIGURE 12. MFM WRITE DATA TIMING.

4.3.3 Write Protect

Writing to the disk is inhibited when WRITE PROTECT is active irrespective of the condition of WRITE GATE. If WRITE GATE and WRITE PROTECT are both active simultaneously then WRITE FAULT is set.

4.3.4 Drive Select

This status line is provided at the J2/P2 connector to inform the host system of the selection status of the drive.

The DRIVE SELECT Line is driven by a TTL open collector driver as shown in figure 8. When the appropriate DRIVE SELECT line at J1/P1 is activated by the host system this signal will go active on the correspondingly programmed drive.

4.4 General Timing Requirements

Figure 14 is a timing diagram showing the necessary sequence of events and associated timing restrictions for proper operation of the drive.

Note that an automatic recalibration to track zero occurs at DC power on. At DC power off the disks are brought to a complete stop in approximately 20 Secs.

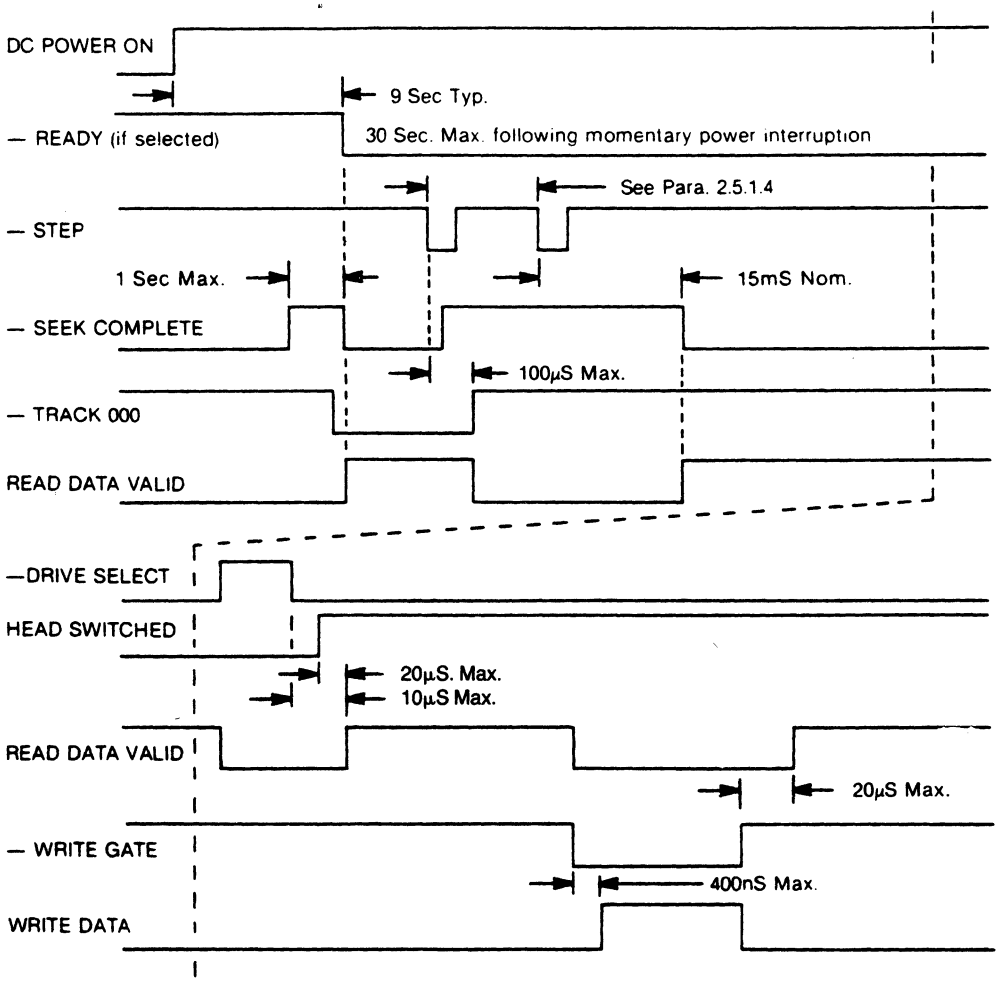
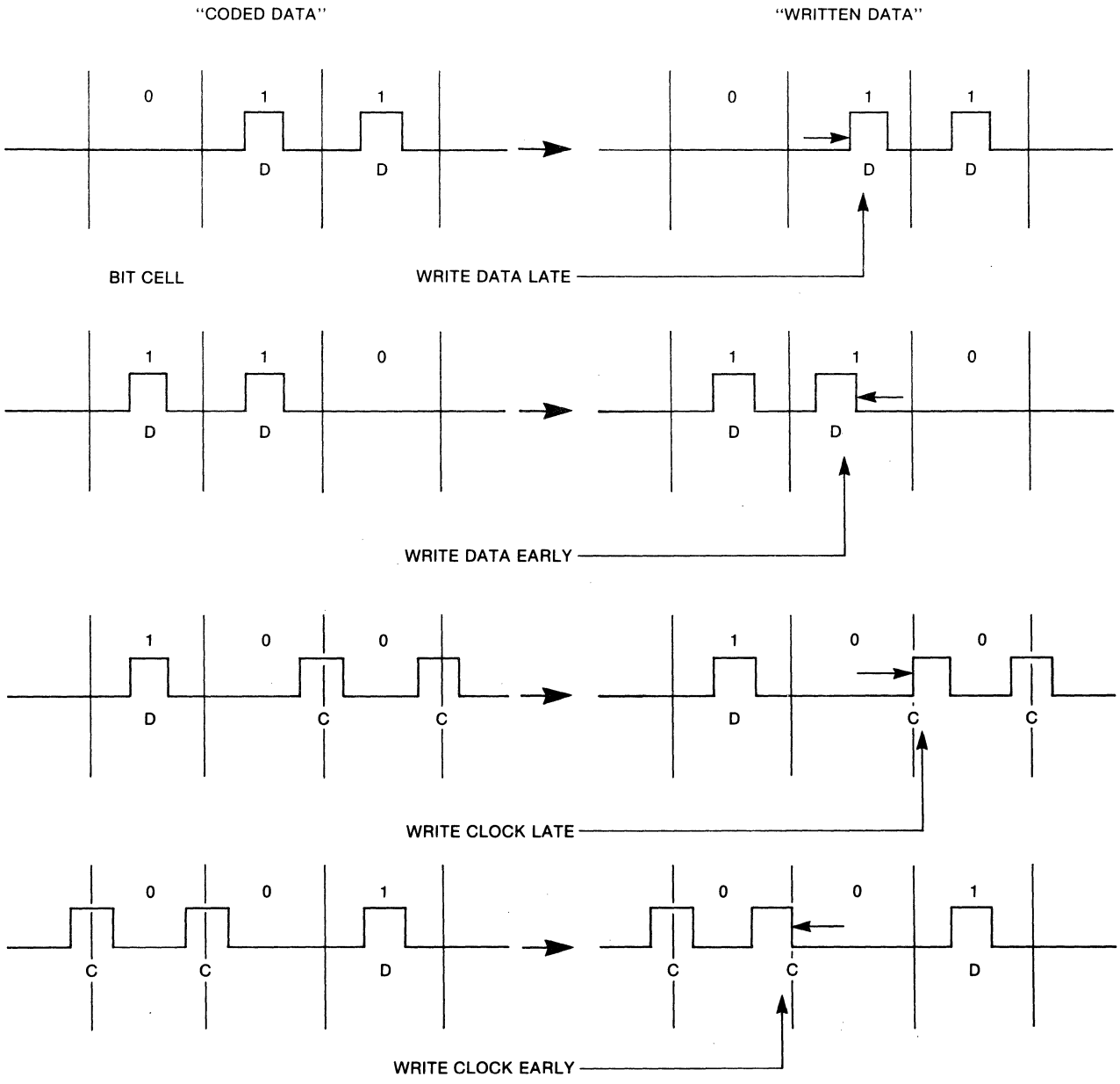


FIGURE 14. GENERAL TIMING REQUIREMENTS.

4.5 Write Precompensation

To assure data integrity, the write data presented by the host may be precompensated on tracks 256 through 639.

The optimum amount of pre compensation is 10nsec. Figure 18 shows the bit patterns to be compensated. All other patterns should be written "On time". "On Time" represents a nominal delay. Early and late represents less or more delay, respectively.



WRITE PRECOMPENSATION PATTERNS

FIGURE 15

5.0 PHYSICAL SPECIFICATIONS

This section describes mechanical and mounting recommendations.

5.1 Mounting Orientation

The CM 4000 may be mounted in any orientation. In the final mounting configuration, insure that operation of the four shock mounts which isolate the base casting from the frame is not restricted.

5.2 Mounting Holes

Eight mounting holes, four on bottom and two on each side are provided for mounting the drive into an enclosure. The size and location of these holes, shown in Figure 16, are identical to industry standard minifloppy drives.

5.3 Physical Dimensions

Overall height/width/depth and other key dimensions are shown in Figures 16 and 17.

6.0 MEDIA DEFECT AND ERRORS

Any defects on the media surface will be identified on a defect amp provided with each drive. This defect map will indicate the Head number, Track number, and number of bytes from index for each defect. The maximum number of defects/surface is three (3) with track 000 certified to be defect free on each surface. Each defect shall be no longer than 11 bits (a defect is defined as an area during which the signal amplitude could fall below 55% of track average amplitude or pulses which are greater than 140% of track average amplitude).

7.0 JUMPER OPTIONS

All jumper options are shown in Figure 18 and Table VI.

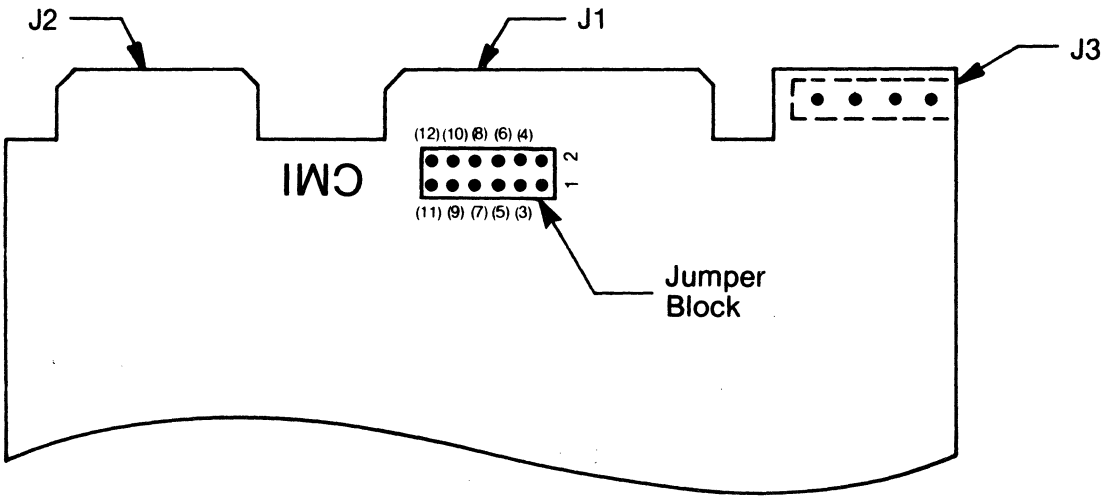


FIGURE 18.

Function	Jumper Block Pin Numbers
Drive Select 0	1, 2
Drive Select 1	3, 4
Drive Select 2	5, 6
Drive Select 3	7, 8
Reserved	9, 10
Reserved	11, 12

TABLE VI

8.0 WARRANTY AND SHIPPING INFORMATION

Should the disk drive fail to operate properly during the warranty period (12 months from original shipment from factory) return the drive to Computer Memories in accordance with the steps listed under Shipping Information.

8.1 USA Shipping Information

a) Call Computer Memories Inc. order entry department for a return material authorization (RMA) number.

   Phone number (213) 709-6445

b) Pack the disk drive in its original shipping container, or equivalent.

c) Send the disk drive to the Computer Memories repair facility at:

   9216 Eton Avenue
   Chatsworth, California 91311

8.2 European Shipping Information

Kode Services Limited is the approved repair facility in the United Kingdom, the Republic of Ireland and Europe. Customers in these areas should contact:

Kode Services Limited
Station Road, Calne
Wiltshire, SN11 OJR, England
Telephone Caine (0249) 813771.
Telex: 449335

Shipping costs to the factory are the customer's responsibility. Computer Memories Incorporated cannot assume any responsibility for loss or damage to shipments. For you protection, please send your disk insured. Computer Memories will return the repaired drive to the customer freight prepaid.

To reduce the risk of shipping damage, disk drives should, if possible be shipped in the original container. Containers can be purchased from the factory if you have discarded the original. Please pack securely to avoid shipping damage.

9216 Eton Avenue, Chatsworth, California 91311