MiniScribe

PRODUCT MANUAL

M6000 Series

MINISCRIBE VI

PRODUCT MANUAL

MODELS 6032, 6053, 6074, 6085

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A	70700	All	Initial Release, same as P5.	05/08/85

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1.0 INTRODUCTION

The MiniScribe 6000 series of disk drives are full height random access storage devices of 32, 53, 74 and 86 megabytes (unformatted storage capacity) containing up to five oxide 5 1/4 inch disks and utilizing Whitney Style flexure technology. With one disk surface dedicated to continuous servo data , each other surface employs a moveable head to service the data tracks.

High performance and high unit reliability are achieved by the utilization of microprocessor control, a linear voice coil, and a closed loop servo positioning system. The heads, disks, and actuator assemblies are within a sealed enclosure containing a recirculating and breather filter to supply clean air and equalized pressure to the head and disk environment. Quality mechanical construction with a sophisticated single printed circuit board allows for maintenance free operation throughout the life of the drive.

The 6000 series uses the industry standard compatible interface and has a 5 Megabit/second data transfer rate. The drive also features power up diagnostics, buffered seek, a brushless DC spin motor, dedicated shipping zone and automatic locking actuator.

The unit size and shock mountings are identical to the industry standard full height 5 1/4 inch mini floppy mounting dimensions, and it uses the same DC voltages and connector.

2.0 PRODUCT SPECIFICATIONS

2.1 MODEL SPECIFICATIONS

	MODEL			
STORAGE CAPACITIES:	6032	6053	6074	6085
Unformatted				
Per Drive (MB)	32.0	53.3	74.6	85.3
Per Track (Bytes)	10416	10416	10416	10416
Formatted				
Per Drive (MB)	26.7	44.5	62.4	71.3
Per Track (Bytes)	8704	8704	8704	8704
Per Sector (Bytes)	512	512	512	512
Sectors/Track	17	17	17	17
Number of Disks	2	3	4	5
Number of Recording Surfaces	3	5	7	8
Number of Cylinders	1024	1024	1024	1024
Data Tracks	3072	5120	7168	8192
Track Density (tpi)	1000	1000	1000	1000
Data Linear Density (ID/bpi)	9950	9950	9950	9950
Heads per Recording Surface	1	1	1	1
Number of Servo Surfaces	1	1	1	1

2.2 PERFORMANCE SPECIFICATIONS

Rotational Rate 3600 RPM ± 0.5 %
Data Transfer Rate 5.0 Mbits/second

Access Time (see Appendix A)
Seek Time (includes settling time, with a 6 us step rate)

Single Track	6 ms
Average (of all possible seeks)	28 ms
1/3 Stroke Seek Time	30 ms
Maximum	55 ms
Average Latency	8.33 ms

Start Time (Typical) 20 seconds from power on to -READY
Stop Time (Typical) 10 seconds from power removal

2.3 RELIABILITY AND MAINTENANCE

MTBF	15,000 hours (cont. operation)
MTTR	30 minutes
Preventative Maintenance	None
Component Design Life	5 years

Data reliability

1 recoverable error in 10^{10} bits read
1 permanent error in 10^{12} bits read
(not recoverable in 16 reads)
1 seek error in 10^{6} seeks

2.4 POWER REQUIREMENTS

DC Voltage Input

+12 Volts DC

Start Surge: 3.5 amps maximum during initial 6 seconds

Steady State: +5%, 0.8 amps typical, 1.8 amps maximum. Maximum Ripple allowed is 1% with equivalent resistive load.

+5 Volts DC

+ 5%, 0.9 amps typical
Maximum Ripple allowed is 2% with equivalent resistive load.

AC Input None Required

Power Dissipation: 14 Watts Track Following
26 Watts Maximum (Seeking)

2.5 PHYSICAL CHARACTERISTICS

Outline Dimensions	3.25"H x 5.75"W x 8.0"L
Mounting Dimensions	See Figure 2-1
Weight	6.0 pounds

2.6 ENVIRONMENTAL CHARACTERISTICS

Temperature:

Operating (Stabilized)	50° F (10° c) to 122° F (50° C)
Non Operating	-40° F(-40° C) to 140° F (60° C)
Thermal Gradient	18° F/hr. (10° C/hr.) max

Humidity:

Operating and Non operating	8% to 80% (non-condensing)
Maximum Wet Bulb	78° F (26° C)

Altitude (relative to sea level):

Operative	-200 to 10,000 feet
Non Operative	40,000 feet

2.7 SHOCK AND VIBRATION

Non Operational Shock: 35 G's, 14 ms pulse duratiuon, 1/2 sine wave

Non Operational Vibration: 2 to 200 Hz, .05 in. DA (peak to peak), 1.0 G

Operational Shock and Vibration:

Axis of Excitation	Vibration: Excitation Level	Vibration: Frequency Range	* Shock: Amplitude
Z	0.048 in. p-p	5- 17 Hz	5.0 G's
	0.73 G peak	17-150 Hz	
	0.33 G peak	200-500 Hz	
Y	0.048 in. p-p	5- 17 Hz	5.0 G's
	0.73 G peak	17-150 Hz	
	0.33 G peak	200-500 Hz	
X	0.036 in. p-p	5- 17 Hz	0.75 G
	0.25 G peak	17-500 Hz	

Refer to Figure 2-1 for X, Y and Z axis reference.

* Operational shock = 11 ms pulse duration, 1/2 sine wave

2.8 MAGNETIC FIELD

The externally induced magnetic flux density may not exceed 3 Gauss as measured at the disk surface.

2.9 ACCOUSTIC NOISE

0 - 5,000 Hz: 40 dBA maximum at 1 meter (on track mode)

50 dBA maximum at 1 meter (seeking mode)

2.10 SAFETY STANDARDS

The MiniScribe 6000 series of disk drives shall comply with relevant product safety standards such as UL and CSA.

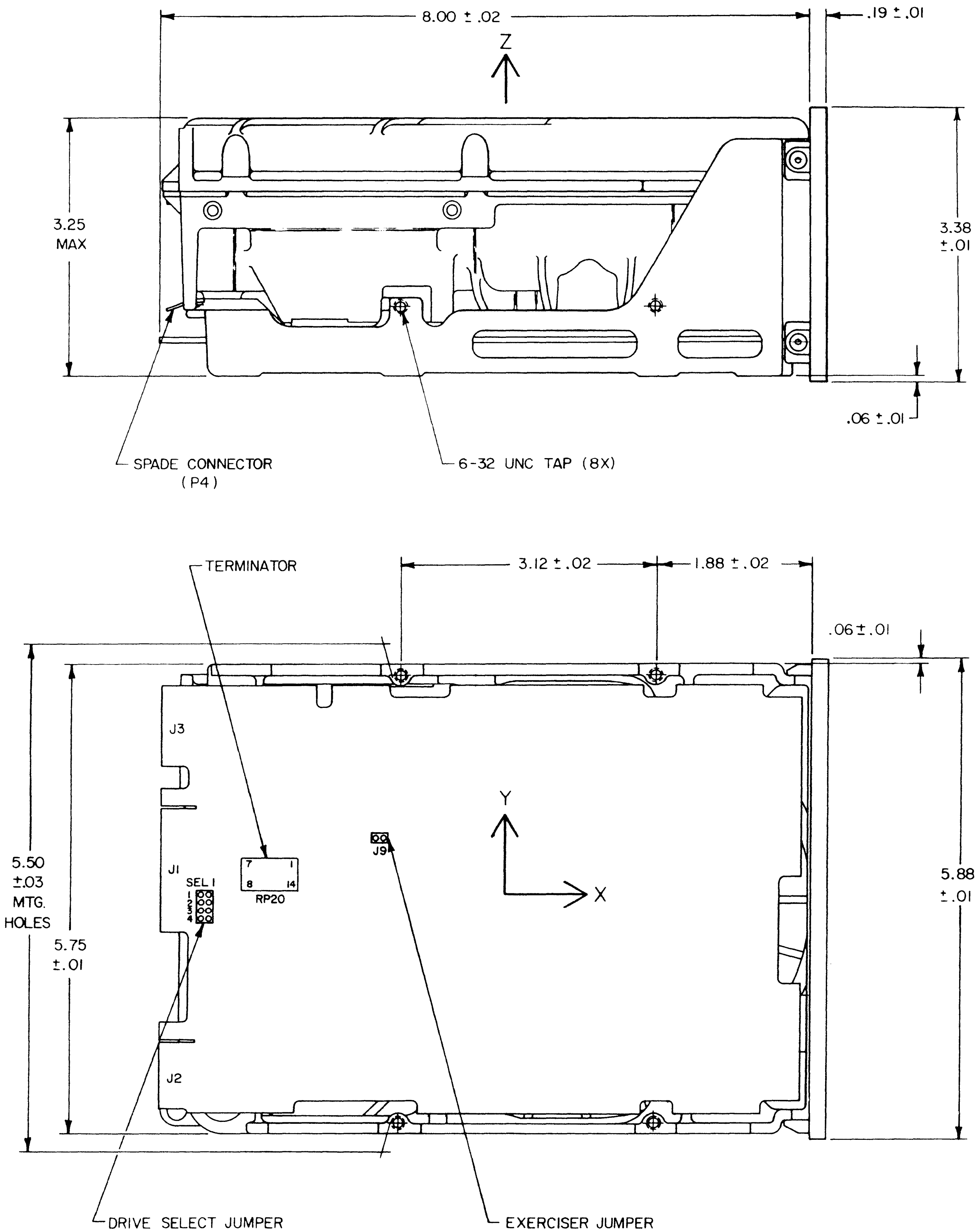


Figure 2-1
OUTLINE AND MOUNTING DIMENSIONS

3.0 FUNCTIONAL DESCRIPTION

The MiniScribe 6000 series of drives contain all necessary mechanical and electrical components to interpret control signals, position the recording heads over a desired track, read and write data, and provide a contaminant free environment for the heads and disks.

3.1 READ/WRITE AND CONTROL ELECTRONICS

Integrated circuits are mounted within the sealed enclosure of the head/disk assembly in close proximity to the read/write heads. Their functions are to provide head selection, read data preamplification, write drive circuitry and servo data preamplification.

The microprocessor controlled Printed Circuit Board contains the necessary electronic circuits to control the following functions:

- Read/Write Circuitry
- Head Positioning
- Interface Control
- Index Detection
- Track Zero Detect
- Spin Speed Control
- Dynamic Braking

3.2 SPINDLE DRIVE MECHANISM

A brushless DC direct drive motor rotates the spindle at 3600 rpm. The motor/spindle assembly is dynamically balanced to provide minimal mechanical runout to the disks. A dynamic brake is used to provide a fast stop to the spindle motor when power is removed.

3.3 AIR FILTRATION SYSTEM

Within the sealed enclosure, a 0.3 micron filter along with a breather filter provides a clean, equalized pressure environment to the HDA for the life of the drive.

3.4 HEAD POSITIONING SYSTEM

The Read/Write and servo data heads are mounted on a ball bearing supported linear carriage, positioned by a linear voice coil motor, and driven by a closed loop servo system. This design allows for an increase in the number of data tracks. Position reference is made to tracks recorded on the dedicated servo surface located on the bottom side of the bottom disk.

3.5 AUTOMATIC CARRIAGE RETRACT AND LOCKING

When power is removed from the drive, the carriage will automatically retract and be latched in a non data area located at the inner most portion of the disk.

3.6 FINE TRACK SAFETY SYSTEM

The drive utilizes a fine track safety system which inhibits write operations if an excessive offtrack condition occurs. This helps to enhance data reliability during extreme shock and vibration events that may exceed specified levels.

3.7 READ/WRITE HEADS AND DISKS

Data is recorded on as many as five 5 1/4 inch (130mm diameter) high coercivity oxide disks through up to eight Read/Write heads using 3380 Whitney style flexure and slider technology.

3.8 TRACK ZERO DETECTION

Track Zero detection utilizes data encoded at the factory on the servo disk, which is read by the servo head. The servo disk is the bottom surface of the first (lowest) disk.

3.9 MECHANICALLY ISOLATED MOUNTING POINTS

Four side mounting and four base mounting points are provided to the customer. Each mounting point is mechanically isolated from the drive. Additionally, four side mounting points are provided which are compatible with a full height floppy disk drive.

4.0 OPERATIONAL DESCRIPTION

4.1 POWER SEQUENCING

+5 volts DC and +12 volts DC may be applied in any order.

After power is applied, the microprocessor verifies that the disks are spinning at 3600 rpm, then activates the automatic Track Zero positioning sequence. -TRACK ZERO, -SEEK COMPLETE, and -READY will become true upon completion of this sequence. Refer to Figure 4-1 for Power Up Sequencing.

4.2 DRIVE SELECTION

Drive selection occurs when one of the drive select signals is true. Only the drive selected will respond to Control Input Signals, and only that drive's Control Output Signals will be gated to the interface.

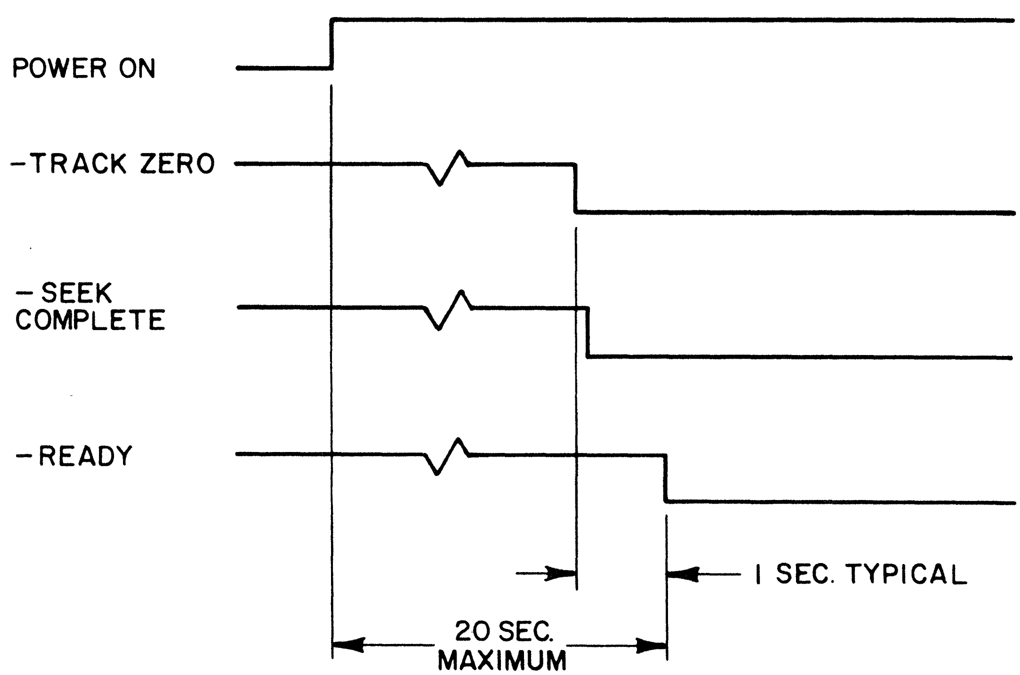


Figure 4-1
POWER-UP TIMING SEQUENCE

4.3 TRACK ACCESSING

Read/Write head positioning is accomplished by:

* Setting -WRITE GATE false
* Setting the appropriate -DRIVE SELECT true
* Selected drive having -READY and -SEEK COMPLETE true
* Setting the appropriate state of -DIRECTION IN
* Pulsing the -STEP

Each -STEP pulse will cause the read/write heads to move either one track in or one track out, depending on the state of -DIRECTION IN. -DIRECTION IN true will cause the head to move inward toward the spindle; -DIRECTION IN false will cause the head to move outward toward Track Zero. The drive will prevent any outward movement beyond Track Zero regardless of the step pulses.

A seek to a higher cylinder than 1028 will cause a recalibration sequence in the drive and reposition the heads at Track Zero.

4.4 HEAD SELECTION

Any one of eight heads (max.) can be selected by placing the head's binary address on the -HEAD SELECT 2^2, 2^1, 2^0 lines.

4.5 READ OPERATION

Reading data from the drive is accomplished by:

* Setting -WRITE GATE false
* Setting the appropriate -DRIVE SELECT true
* Selected drive having -READY and -SEEK COMPLETE true
* Selecting the appropriate -HEAD SELECT binary address

4.6 WRITE OPERATION

Writing data to the drive is accomplished by:

* Setting the appropriate -DRIVE SELECT true
* Selected drive having -READY and -SEEK COMPLETE true
* Selecting the appropriate -HEAD SELECT binary address
* Assuring -WRITE FAULT is false
* Setting -WRITE GATE true and placing the data to be written on the MFM WRITE DATA lines.

5.0 ELECTRICAL INTERFACE

The interface to any MiniScribe 6000 can be divided into three sections, each of which is physically separated into Control Signals, Data Signals and DC Power.

All Control Signals are digital in nature (open collector TTL) and either provide signals to the drive (input) or signals to the controller (output). The Data Signals are differential in nature and provide data either to (write) or from (read) the drive.

Table 5-1 provides the connector pin assignments for P1 and P2. The interconnecting cables between the drive and controller may be flat ribbon or twisted pairs of a length not to exceed 20 feet. The signal return lines and ground lines for P1 and P2 should be grounded at the controller. Refer to Sections 6.1 and 6.2 for P1 and P2 specifications.

Table 5-1 also provides the connector pin assignments for P3. The voltage return lines of P3 should only be grounded at the power supply.

Connector P4 is a spade lug connector tied to frame ground.

The cable interconnection for a 4 drive system is defined in Figure 5-1.

5.1 CONTROL INPUT SIGNALS

The Control Input Signals are gated into the drive by the activation of the appropriate -DRIVE SELECT line. Refer to Figure 5-2 for the Driver/Receiver Equivalent Circuit and signal level specifications. Each Control Input Signal is terminated by a 220/330 ohm resister network in the drive.

5.1.1 -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.

Table 5-1
P1/P2/P3/P4 CONNECTOR PIN ASSIGNMENT

Signal	Ground Return	Signal Name
P1-2	P1-1	Reserved
P1-4	P1-3	-HEAD SELECT 2^2
P1-6	P1-5	-WRITE GATE
P1-8	P1-7	-SEEK COMPLETE
P1-10	P1-9	-TRACK ZERO
P1-12	P1-11	-WRITE FAULT
P1-14	P1-13	-HEAD SELECT 2^1
P1-16	P1-15	Reserved
P1-18	P1-17	-HEAD SELECT 2^0
P1-20	P1-19	-INDEX
P1-22	P1-21	-READY
P1-24	P1-23	-STEP
P1-26	P1-25	-DRIVE SELECT 1
P1-28	P1-27	-DRIVE SELECT 2
P1-30	P1-29	-DRIVE SELECT 3
P1-32	P1-31	-DRIVE SELECT 4
P1-34	P1-33	-DIRECTION IN
P2-1	P2-2	-SELECTED
P2-3	P2-4	Reserved
P2-5	P2-6	Spare
P2-7	P2-8	Reserved
P2-9		Spare
P2-10		Spare
P2-11	P2-12	Ground
P2-13		+MFM WRITE DATA
P2-14		-MFM WRITE DATA
P2-15	P2-16	Ground
P2-17		+MFM READ DATA
P2-18		-MFM READ DATA
P2-19	P2-20	Ground

		Suggested Wire Size
P3-1	+12 Volts DC	18 AWG
P3-2	+12 Volts DC Return	18 AWG
P3-3	+ 5 Volts DC Return	18 AWG
P3-4	+ 5 Volts DC	18 AWG

P4		Frame Ground

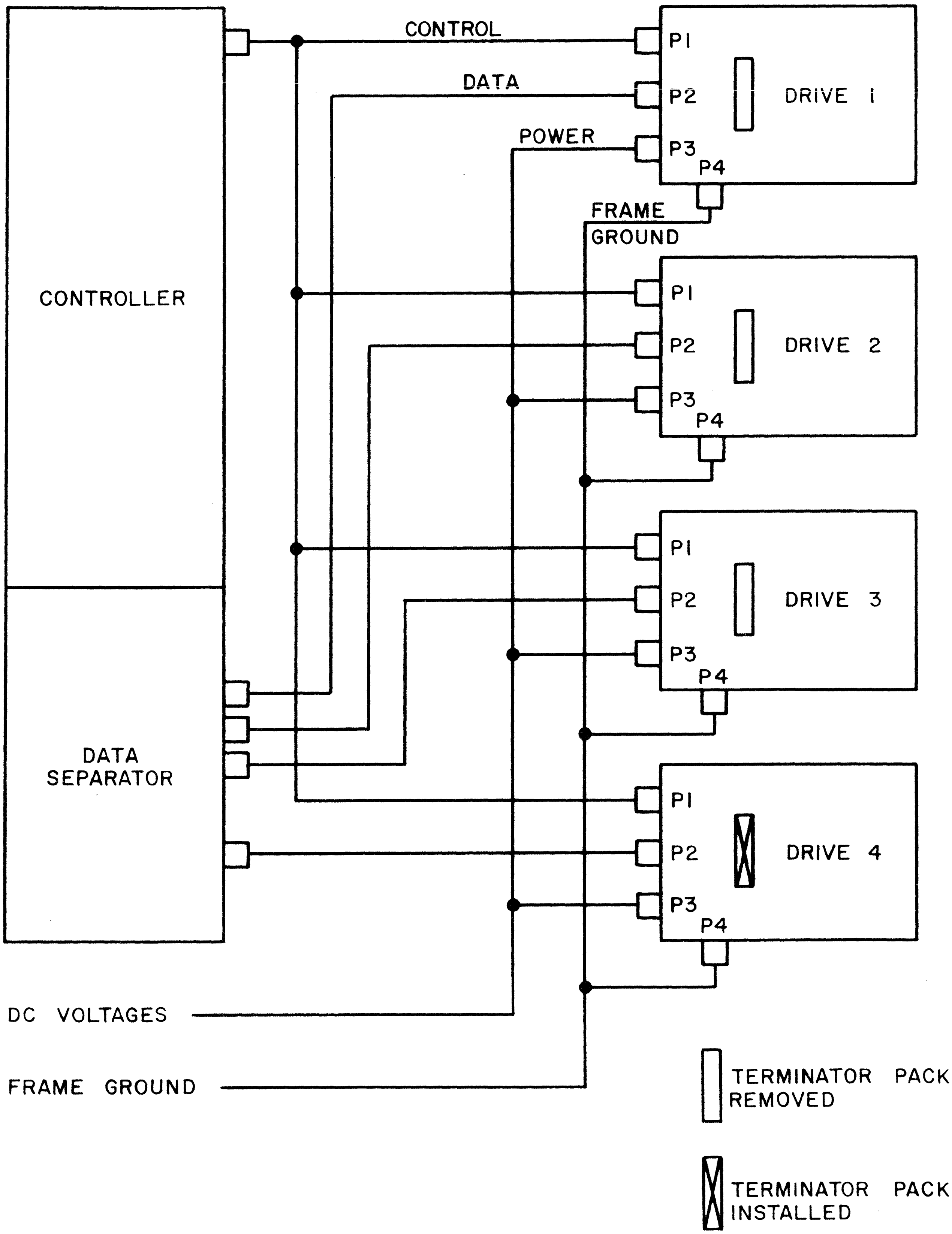


Figure 5-1
CABLE INTERCONNECTION - 4 DRIVE SYSTEM

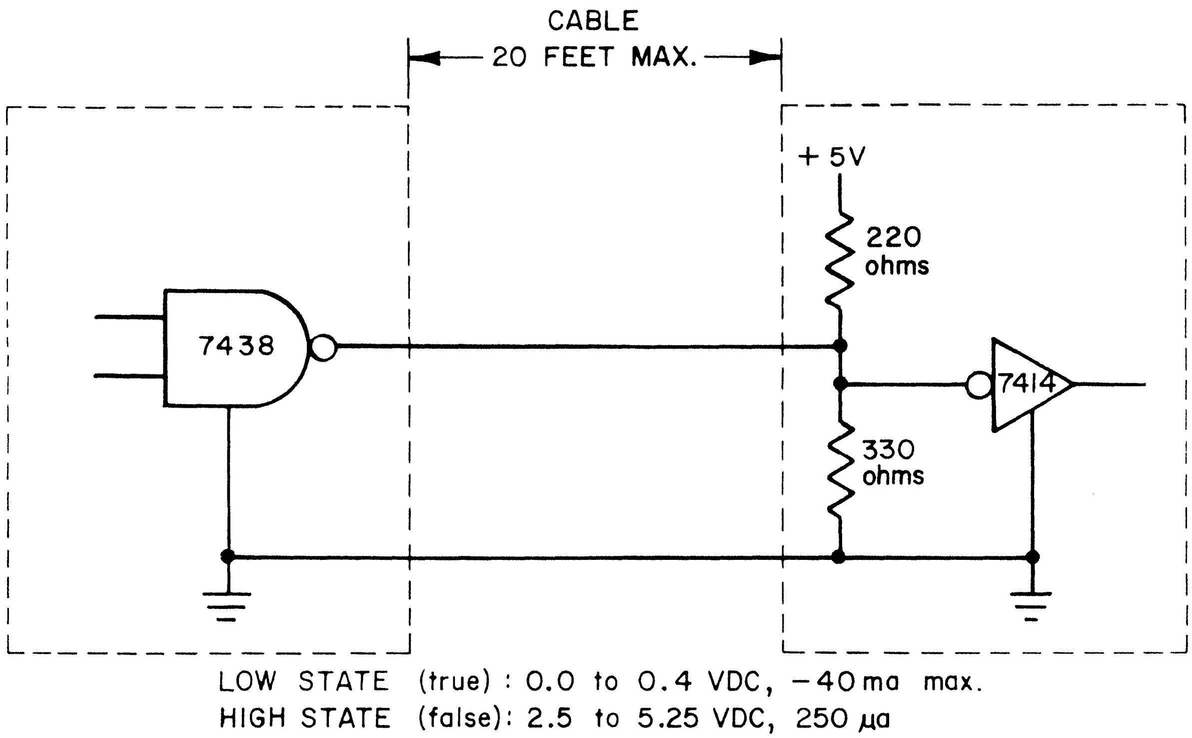


Figure 5-2
CONTROL SIGNAL DRIVER/RECEIVER EQUIVALENT CIRCUIT

5.1.2 -HEAD SELECT 2^2, 2^1, 2^0

These lines provide a means to select read/write heads in a binary coded sequence. Table 5-2 shows the head select sequence for the head select lines.

Table 5-2
HEAD SELECTION

Head Select Line 2^2	2^1	2^0	Data Head Selected
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

5.1.3 -DIRECTION IN

This signal defines the direction of motion of the read/write heads when the -STEP line is pulsed. A high level defines the direction as "out". At this time, when a pulse is applied to the -STEP line the heads will move away from the center of the disk. If this line is a low level, the direction of motion is defined as "in" and the step pulses will cause the read/write heads to move toward the center of the disk. Change in direction must meet the requirements shown in Figure 5-3.

5.1.4 -STEP

This control signal causes the read/write heads to move in the direction defined by the -DIRECTION IN line. The drive is able to accept step pulses in two modes, track-to-track and buffered. In the track-to-track mode, step pulses should be sent at a 3 ms rate or greater to access the desired track. In the buffered mode, step pulses must be sent at a 2 us to 200 us rate. Access motion is initiated upon receipt of the first step pulse. Step pulses are accumulated until no new pulses have been received for 200 us. An optimized seek algorithm is then executed to minimize access time. Pulses that occur after the 200 us period and prior to completion of the seek will be ignored. The drive automatically decides which mode to use based on the incoming step pulse rate. The direction line should be maintained at the desired level of 100 ns before the first step pulse and until 100 ns after the last step pulse has been issued. Refer to Figure 5-3 for the timing diagram.

5.1.5 -DRIVE SELECT 1, 2, 3 AND 4

-DRIVE SELECT, when low, connects the drive to the control lines. Placing a jumper across the appropriate pins on the PC Board (see Section 5.4.1) will determine which select line on the interface will activate the drive.

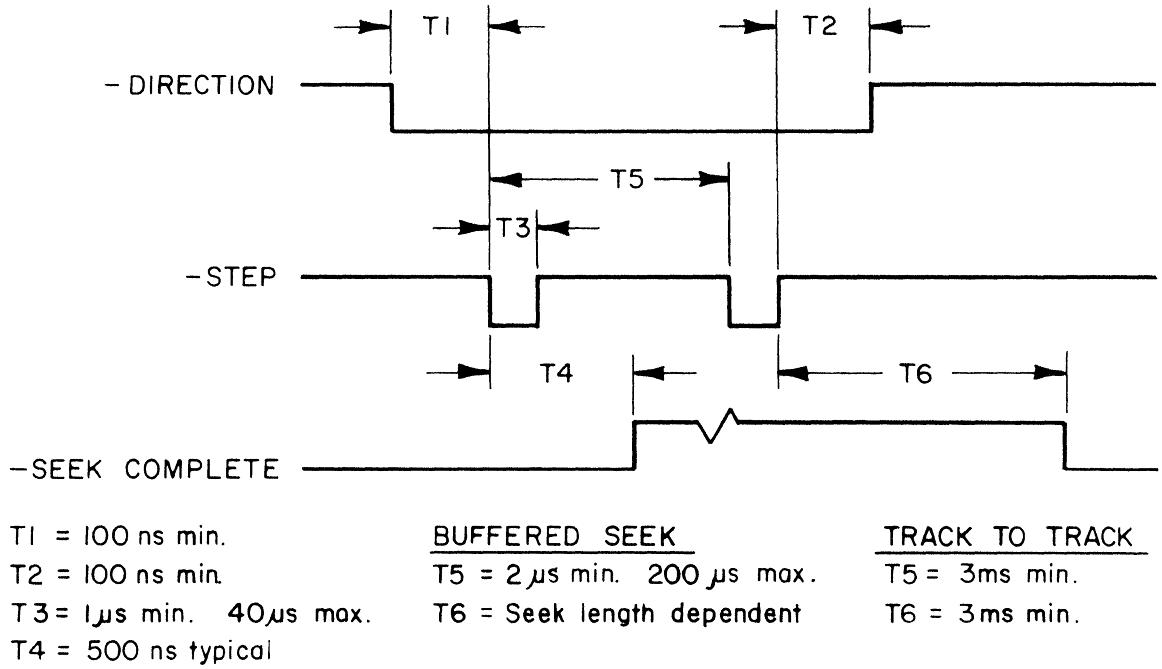


Figure 5-3
SEEK MODE TIMING

5.2 CONTROL OUTPUT SIGNALS

The Control Output Signals are gated from the drive by the activation of the appropriate -DRIVE SELECT line. Refer to Figure 5-2 for the driver/receiver equivalent circuit and signal level specifications. Each Control Output Signal should be terminated in the controller with a 220/330 ohm resistor network.

5.2.1 -SEEK COMPLETE

This signal will go true when the read/write heads have settled on the desired track following a seek. A Read or Write operation should not be attempted when -SEEK COMPLETE is false. The following conditions will cause -SEEK COMPLETE to go false:

1. If the +5 or +12 volt line becomes unsafe or is momentarily lost.

2. If the drive attempts a seek retry after settling on a track.

3. If a step pulse greater than 1 us in width is sent.

4. When a recalibration sequence is initiated (by drive logic) at power on because the read/write heads are not at Track Zero.

5.2.2 -WRITE FAULT

This signal is used to indicate that a condition exists in the drive which will result in improper writing on the disk. When this signal is true, further writing is inhibited at the drive until the condition is corrected. Any of the following conditions may cause -WRITE FAULT to be true.

1. An open or shorted head in the drive.

2. No transitions on the MFM WRITE DATA line when -WRITE GATE is true.

3. DC voltages are out of tolerance with -WRITE GATE active.

4. More than one seek retry between seek commands from the controller.

5. Step pulses are received when -WRITE GATE is active.

6. An offtrack condition is detected while -WRITE GATE is active.

7. -WRITE GATE is active when write is disabled by the drive.

5.2.3 -TRACK ZERO

This interface signal indicates a true state only when the read/write heads are positioned at Track Zero.

5.2.4 -INDEX

This 30 microsecond (typical) interface pulse is provided by the drive once each revolution (16.67 ms nominal) to indicate the beginning of the track. Normally, this signal is a high level and makes the transition to the low level to indicate -INDEX. Only the transition from high to low is valid.

5.2.5 -READY

This interface signal, when true together with -SEEK COMPLETE, indicates that the drive is ready to read, write, or seek and that the I/O signals are valid. When this signal is false, all writing and seeking is inhibited. During drive operation, the following situations will cause -READY to go false.

1. At power up -READY will remain false until:

   a. Spindle speed is stable within 0.5% of nominal.
   b. Drive's wake up diagnostics are complete.
   c. Recalibration to Track Zero is complete.

2. -WRITE FAULT is true.

3. DC voltages are out of tolerance.

4. The spindle speed deviates from 0.5% nominal.

5.2.6 -DRIVE SELECTED

The -DRIVE SELECTED signal will go true only when the drive is configured as drive X (X being either 1,2,3, or 4) and the -DRIVE SELECT X line is activated by the controller.

5.3 DATA TRANSFER SIGNALS

All signals associated with the transfer of data between the drive and controller are differential in nature and are gated by -DRIVE SELECT.

Two pairs of balanced signals are used for the transfer of data: MFM WRITE DATA and MFM READ DATA. Figure 5-4 illustrates a typical driver/receiver equivalent circuit used for data transfer signals.

5.3.1 MFM WRITE DATA

This is a differential pair that defines the transitions to be written on the track. The transition of the +MFM WRITE DATA line going more positive than the -MFM WRITE DATA line will cause a flux reversal on the track provided -WRITE GATE is true. The timing of the write operation is illustrated in Figure 5-5.

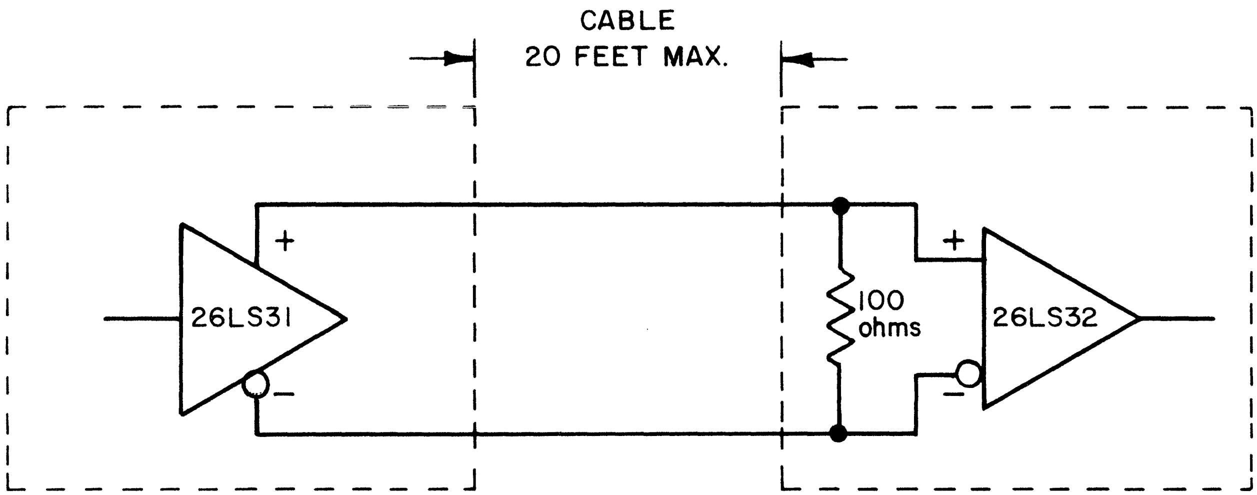


Figure 5-4
DATA SIGNAL DRIVER/RECEIVER EQUIVALENT CIRCUIT

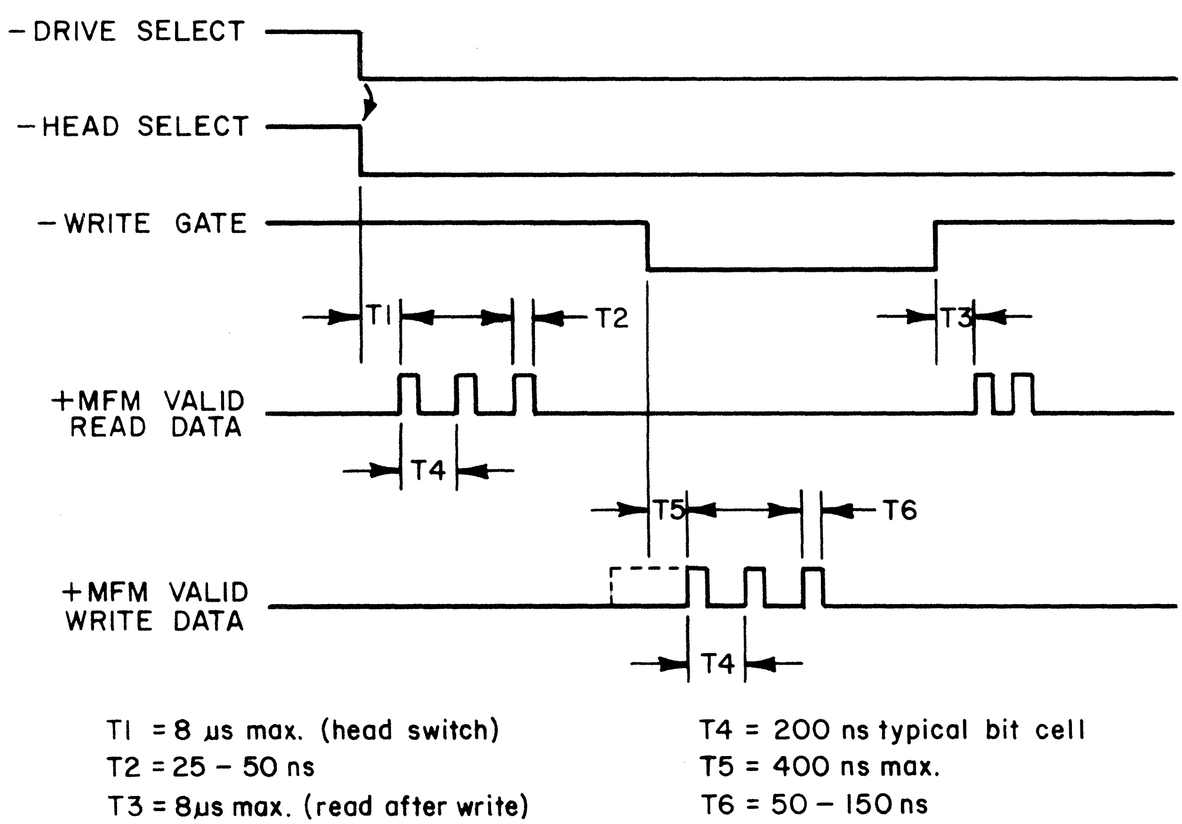


Figure 5-5
READ/WRITE TIMING

In MFM recording, to optimize data integrity and meet the error rate specified, the write data presented by the controller may be precompensated from Cylinder 512 and up. ± MFM Write Data pulses bounded on one side by a 200 ns period (1/2F) and bounded on the other side by 300 ns (1/1.5F) or 400 ns (1/F) period must be precompensated by 12 ns towards the side of the 200 ns (1/2F) period. The pre-compensation is illustrated in Table 5-3.

Table 5-3
WRITE PRE-COMPENSATION RULES

Bit 1	Bit 2	Bit 3	Bit 4	Compensation
1	0	0	0	12 ns late on first clock
0	0	0	1	12 ns early on second clock
0	1	1	x	12 ns late on first data
1	1	0	x	12 ns early on second data

5.3.2 MFM READ DATA

The data recovered by reading a pre-recorded track is transmitted to the controller 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. The timing of the read operation is illustrated in Figure 5-5.

5.4 CUSTOMER OPTIONS

Customer optional features are implemented via jumpers on the Printed Circuit Board. Refer to Figure 2-1 for the location of these jumpers and to Table 5-4 for the jumper configurations.

5.4.1 DRIVE SELECT

As shipped, the jumper is positioned for Drive Select 1 (pins 1 to 8 shorted). To select a different drive in a daisy-chain operation, refer to Table 5-4. Refer to Figure 2-1 for the location of the drive select jumper.

Table 5-4
DRIVE SELECT CONFIGURATIONS

Drive Select	1	2	3	4
Jumper Configurations	1------8	1-- --8	1-- --8	1-- --8
	2-- --7	2------7	2-- --7	2-- --7
	3-- --6	3-- --6	3------7	3-- --7
	4-- --5	4-- --5	4-- --5	4------5

5.4.2 DRIVE EXERCISE OPTION

As shipped, the Exerciser Mode jumper J9 is open for normal operation. When J9 is shorted with a jumper, the drive will be offline to the system and enter a seek exercise routine. Refer to Figure 2-1 for the Exercise Mode jumper location J9 and to Sections 9.0 through 9.3 for the drive Exercise Mode.

5.5 TERMINATORS

Each drive is shipped with a terminator pack RP 20 to provide the 220/330 ohm termination for the Controller Input Signals. If multiple drives are configured in a daisy chain configuration (see Figure 5-1) the terminator pack must be removed from all drives except the last unit on the daisy chain. Figure 2-1 shows the location of the terminator pack RP 20.

5.6 ERROR MESSAGES

The microprocessor performs wake up diagnostics on power up. Additionally, some operations are monitored during normal operations. If an error is detected, the microprocessor will flash an error code by blinking the activity LED. An explanation of the diagnostics and error codes is provided in Chapter 9.

6.0 PHYSICAL INTERFACE

The electrical interface between the disk drive, the host controller and the DC power supply is via four connectors: P1 - Control Signals, P2 - Data Signals, P3 - DC Power input and P4 - Frame Ground. (Refer to Figure 2-1 for connector locations).

6.1 P1 CONNECTOR - CONTROL SIGNALS

Connection to P1 is through a 34 pin PCB edge connector. The dimensions for this connector are shown in Figure 6-1. The pins are numbered 1 through 34 with the odd pins located on the component side of the Printed Circuit Board. A key slot is provided between pins 4 and 6.

The recommended mating connector (J1) is AMP Ribbon Connector P/N 88373-3.

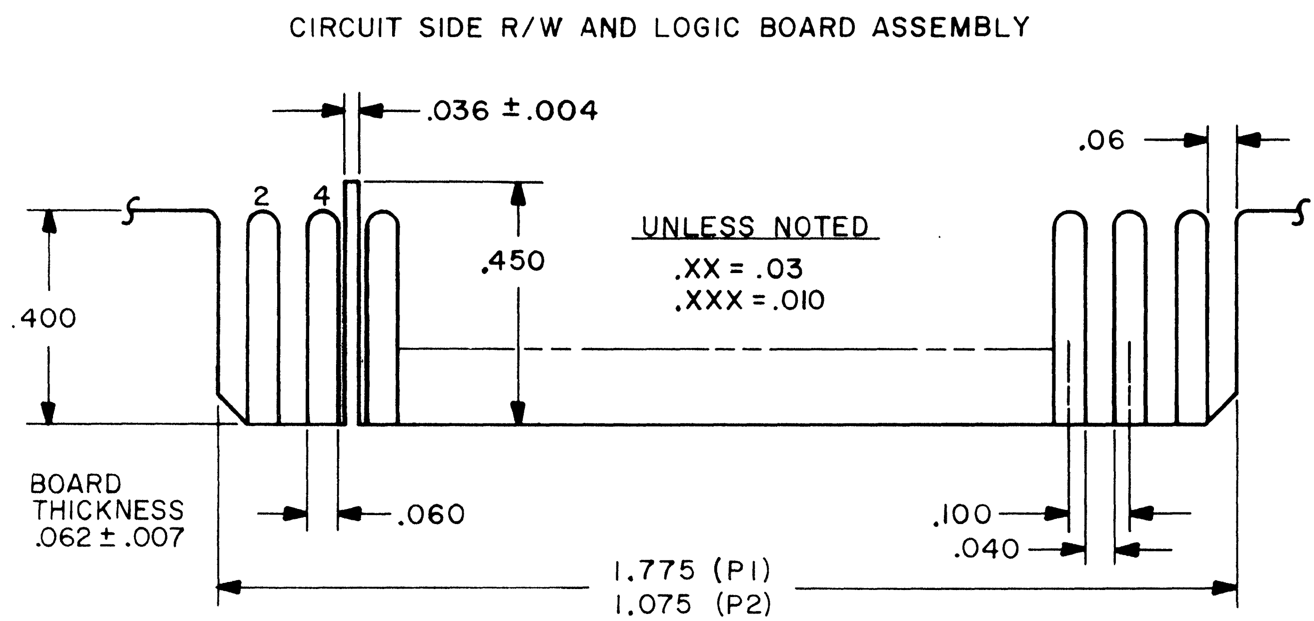


Figure 6-1
P1/P2 CONNECTORS

6.2 P2 CONNECTOR - DATA SIGNALS

Connection to P2 is through a 20 pin edge connector. The dimensions for the connector are shown in Figure 6-1. The pins are numbered 1 through 20 with the odd pins located on the component side of the Printed Circuit Board. A key slot is provided between pins 4 and 6.

The recommended mating connector (J2) is AMP Ribbon Connector P/N 88373-6.

6.3 P3 CONNECTOR - DC POWER

DC Power Connector (P3) is a 4 pin AMP Mate-N-Lock connector mounted on the PCB. P3 pins are numbered as shown in Figure 6-2.

The recommended mating connector (J3) is AMP P/N 1-480424-0 utilizing AMP pins P/N 350078-4.

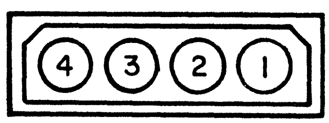
Suggested wire size: 18 AWG

6.4 P4 CONNECTOR - FRAME GROUND

Fasten AMP P/N 61761-2.

The recommended mating connector is AMP P/N 62187-1.

If used, the hole in P4 will accommodate a wire size of 18 AWG maximum.



P3-1 = +12 VOLTS DC
P3-2 = +12V GROUND RETURN
P3-3 = +5V GROUND RETURN
P3-4 = +5 VOLTS DC

Figure 6-2
P3 CONNECTOR

7.0 DATA ORGANIZATION

7.1 TRACK FORMATTING GUIDELINES

Track format organizes data tracks into smaller, sequentially numbered blocks of data called sectors. The drive is a soft-sectored device allowing the customer to define the sector format. Information is encoded on the disk to define the beginning of each sector. This information is referred to as the identification field (ID) of the sector and typically contains the address mark, cylinder address, head address, and sector address. Additional information, such as flags for defect handling, may also be included. When establishing the track format, certain rules should be observed to accomodate the physical timing relationships within the drive.

7.1.1 GAP 1

If head switching occurs at index time, to reliably read the content of the first sector, Gap 1 must be provided to allow the read amplifier to stabilize. The minimum length of Gap 1 is 12 bytes.

7.1.2 SYNC

A sync field precedes each addressable record (ID or record) and should be of a length to accommodate the "lock up" characteristics of the phase-lock-loop within the data separator portion of the host controller.

7.1.3 GAP 2

Following each sector, it is recommended that a gap be placed to accommodate spindle speed variations between write operations on the same track to insure that overwrite will not occur on adjacent recorded data. To accommodate the $\pm$ 0.5% speed tolerance of the disk drive, Gap 2 should be a minimum of 1 byte for each 32 bytes of data within the sector.

7.1.4 GAP 3

This gap is a speed tolerance buffer for the entire track to insure that the last sector does not overflow beyond the index. Gap 3 precedes index and should be of a length to accommodate spin speed variations relative to the controller generated MFM WRITE DATA signals.

7.2 MEDIA DEFECTS

Media defects are physical characteristics of the recording media resulting in repetative read errors when a functional drive is operated within its specified operating conditions.

A single defect is defined as being less than two bytes in length. A multiple defect is defined as up to three contiguous single defects.

During the manufacture/test process, a certification test, consisting of a media verification, evaluates each drive and identifies the location of each media defect. These defects are labled on the drives flaw map by head and cylinder address, and number of bytes from index.

Media defects as shipped from MiniScribe:

	6032	6053	6074	6085
Maximum defects per drive:	32	53	74	85

These defects may be a combination of single or multiple type defects.

Cylinder zero shall be defect free.

8.0 INSTALLATION

CAUTION/WARNING

THE MINISCRIBE DRIVE IS A PRECISION PRODUCT. DURING HANDLING, THE PRODUCT MUST NOT BE DROPPED, JARRED OR BUMPED. OTHERWISE DAMAGE TO THE HEADS AND DISKS MAY OCCUR. WHEN THE DRIVE IS REMOVED FROM THE MINISCRIBE SHIPPING CONTAINER AND NOT IMMEDIATELY SECURED WITHIN A CHASSIS THROUGH ITS SHOCK MOUNTS, IT MUST BE STORED ON A SOFT PADDED CONDUCTIVE (ANTISTATIC) SURFACE.

FAILURE TO COMPLY WITH THE ABOVE PROCEDURE WILL RENDER NULL AND VOID ALL WARRANTIES.

8.1 UNPACKING AND INSPECTION

8.1.1 SINGLE PACK

Retain the packing materials for reuse. Refer to Figure 8-1 for the following steps:

Step 1: Inspect the shipping container for evidence of damage in transit. If damage is evident, notify the carrier immediately.

Step 2: Open the outer carton by carefully cutting the tape on the top of the carton.

Step 3: Lift the inner carton out of the outer carton and remove the outer end foam cushions.

Step 4: Open the inner carton by carefully cutting the tape on the top of the carton.

Step 5: Lift the drive from the inner carton and remove the inner end foam cushions and cardboard wrap.

Step 6: Place the pair of end cushions, the cardboard wrap, and the inner carton within the outer carton and store for subsequent reuse.

Step 7: Inspect the drive for shipping damage, loose screws or components and correct if possible. If damage is evident without noticeable damage to the shipping cartons, notify Miniscribe immediately for drive disposition.

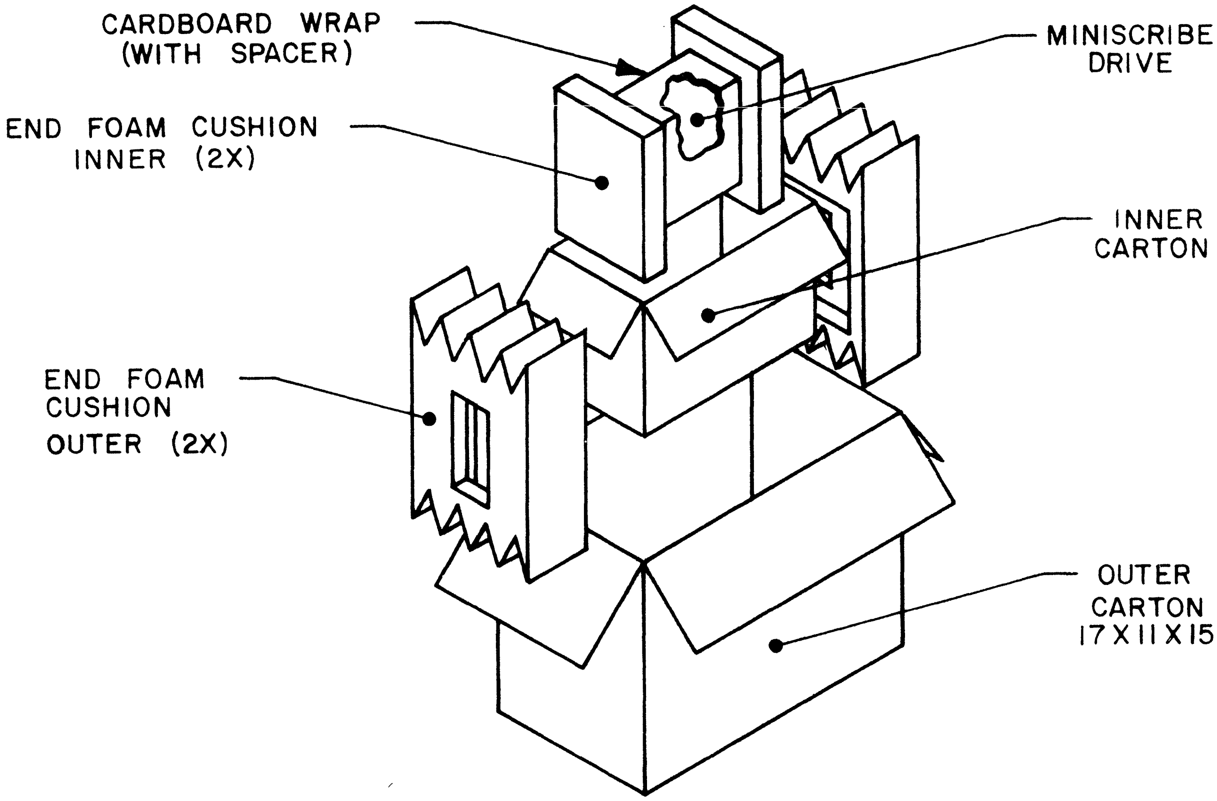


Figure 8-1
SINGLE PACK SHIPPING CONTAINER

8.1.2 MULTIPACK

Retain the packing materials for reuse.

Step 1: Inspect the shipping container for evidence of damage in transit. If damage is evident, notify the carrier immediately.

Step 2: Lift off outer carton.

Step 3: Lift off upper foam cushion. This will expose the drives in their cardboard wrap.

Step 4: Lift each drive out of the lower foam cushion individually and remove the cardboard wrap.

Step 5: Place the cardboard wraps in the lower foam cushion for reuse.

Step 6: Place the drive on a protective foam pad and inspect the drive for shipping damage, loose screws or components and correct if possible. If damage is evident without noticeable damage to the shipping carton, notify Miniscribe immediately for drive disposition.

Step 7: Once all the drives have been removed from the shipping carton and the cardboard wraps have been returned to the lower foam cushion, reassemble the carton and store for reuse.

8.2 REPACKING

Should the MiniScribe drive require shipment, repack the drive using the MiniScribe packing materials and follow the steps in Section 8.1.1 or 8.1.2 in reverse order.

NOTICE

The MiniScribe drive warranty is void if the drive is returned to MiniScribe in other than the standard MiniScribe shipping carton packed in accordance with the enclosed procedure.

8.3 DRIVE CONFIGURATIONS

The customer should determine the drive select number required and configure the jumper as defined in Section 5.4.

8.4 RECOMMENDED MOUNTING CONFIGURATION

The MiniScribe 6000 series of full height drives are designed to be used in applications where the unit may experience shock and vibrations at greater levels than larger and heavier disk drives.

The drive may be mounted in any attitude except on its ends and must not exceed an inclined pitch of five degrees.

The drive is mounted using 6-32 UNC screws, 1/4 inch maximum penetration. See Figure 2-1 for mounting dimensions. The customer should allow adequate ventilation to the drive to insure reliable drive operation over the operating temperature range.

8.5 CABLING

Attach interface cables with connectors P1, P2, P3 and P4 to J1, J2, J3 and J4 respectively. Insure that connectors P1 and P2 have keys installed as indicated in Figure 6-1. If multiple drives are to be interconnected, remove the terminator packs in all but the last drive in the daisy chain. Refer to Figure 2-1 for the terminator location and Figure 5-1 for cable interconnections for multiple drive systems.

9.0 EXERCISE MODE

This section covers the Exercise mode for the MiniScribe 6000 series of drives. Error identification and error message definitions are also included.

9.1 GENERAL DESCRIPTION

The microprocessor performs a series of "wake up" diagnostics upon application of power. If an error is detected, the microprocessor will flash an error code by blinking the activity LED. Some errors may not allow the drive to return to the program until power is cycled.

If no errors are detected, the microprocessor checks the configuration of the diagnostic jumper J9. If shorted, the drive enters a seek exercise routine. If open (normal operation) the drive will remain in an idle state waiting for control signals. If an error is detected during the exercise routine an error code will be flashed by blinking the activity LED. Refer to Table 9-1 for jumper configurations and Figure 2-1 for the jumper location.

Table 9-1
EXERCISER MODE AND JUMPER CONFIGURATION J9

J9 Jumper Configuration	Mode
Open	Normal Operation
Shorted	Seek Exercise

9.2 MESSAGE READOUT

Error codes are generated by the microprocessor to indicate hardware errors or warnings that are detected during power-up, exercise routines or normal operation. Error codes are displayed in a morse-code type manner, blinked out by the activity LED. Flashes, or "bits" may be interpreted and converted into hexadecimal error codes. "ZERO's" are indicated by a short (0.5 second) flashing mode. "ONE's" are indicated by a short (0.5 second) continuous ON mode. The LED remains off 0.5 seconds between bits flashed. Five bits make a binary "Word" and words are separated by a one second LED off time.

Zero = 0.5 second flashing mode
One = 0.5 second Continuous ON mode
Between Bits = 0.5 second off
Between Repeat Cycles (Words) = 1.0 second off

Listed below are the binary to hexadecimal conversion values:

0=00000	8=01000	10=10000	18=11000
1=00001	9=01001	11=10001	19=11001
2=00010	A=01010	12=10010	1A=11010
3=00011	B=01011	13=10011	1B=11011
4=00100	C=01100	14=10100	1C=11100
5=00101	D=01101	15=10101	1D=11101
6=00110	E=01110	16=10110	1E=11110
7=00111	F=01111	17=10111	1F=11111

Example: Code "1A" 11010

1	0.5 sec ON
	0.5 sec off
1	0.5 sec ON
	0.5 sec off
0	0.5 sec FLASHING
	0.5 sec off
1	0.5 sec ON
	0.5 sec off
0	0.5 sec FLASHING
	1.0 sec off

9.3 ERROR CODE DEFINITIONS

Code 00 = Microprocessor RAM error
Code 01 = Microprocessor ROM checksum error
Code 02 = Interface chip diagnostic error
Code 03 = -WRITE FAULT will not reset
Code 04 = Index pulse not detected or lost
Code 05 = Unable to maintain spin speed within 0.5%
Code 06 = Loss of +FINE TK during idle mode
Code 07 = More than one seek retry
Code 08 = Time out on +END DECEL signal
Code 09 = Time out on track crossing (-CYL PULSE)
Code 0A = Overshoot
Code 0B = Time out on +FINE TK
Code 0C = +TK0 signal not detected
Code 0D = Comparator mismatch
Code 0E = Reserved
Code 0F = Unexpected interrupt from microprocessor
Code 10 = Time out on GB pattern
Code 11 = Time out on GB1 pattern
Code 12 = Time out on GB2 Pattern
Code 13 = Reserved
Code 14 = Voltage unsafe with -WRTGATE inactive
Code 15 = Voltage unsafe with -WRTGATE active
Code 16 = Chip unsafe (-WRITE FAULT)
Code 17 = Step pulses received with -WRTGATE active
Code 18 = Time out on +END DECEL signal
Code 19 = Time out on track crossing (-CYL PULSE)
Code 1A = Overshoot
Code 1B = Time out on +FINE TK
Code 1C = +TK0 signal not detected
Code 1D = Comparator mismatch
Code 1E = Reserved
Code 1F = 6301 Trap

NOTE:

Codes: 08, 09 = During a seek

Codes: 0A, 0B, 0C, 0D = After a seek

Codes: 10, 11, 12, 18, 19, 1A = During a rezero

Codes: 1B, 1C, 1D = After a rezero

APPENDIX A
DEFINITION AND MEASUREMENT OF SEEK TIME

The measurement of seek time is important for understanding a disk drive's performance. Seek time is measured at the -SEEK COMPLETE interface signal. It is defined as the duration of time in which Seek Complete is false.

The seek time performance of a disk drive is often indicated by its average access or seek time. This is an average value of seek time during random activity and can be calculated. Using the seek time for each possible move length, the number of possibilities for each move length, and the total number of possible seeks, the following method can be used:

n = number of cylinders
m = seek length
T(m) = seek time for m length
Number of possible seeks of m length = 2(n-m)
Number of possible seeks (total) = n(n-1)

$$\text{Average Seek Time} = \frac{\sum_{m=1}^{n-1} 2(n-m)\,T(m)}{n(n-1)}$$

or

$$\text{Average Seek Time} = \frac{\text{Sum of seek times for all possible seeks}}{\text{Number of possible seeks}}$$

This method requires numerous measurements and is often replaced by the measurement of the one-third stroke seek time. The average distance travelled during random activity is one-third of the total number of cylinders. The seek time for this move is the same as the average seek time for constant velocity positioners. Due to the nonlinear nature of the velocity profile for high performance, closed-loop positioners, the one-third stroke seek time is usually longer than the average seek time. Although the average seek time method contains more information about system throughput, the shorter method is most often used on automatic test equipment throughout the industry.

Effect of Step Rate

Since seek time is measured from the receipt of the first step pulse, the rate of the incoming pulses will have an effect on seek time measurements. This effect is minimized in the 6000 series because motion begins immediately after the first step pulse is received. The velocity of this initial motion is still physically limited by the step rate, so a faster step rate will result in a faster seek time.

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