SERVICE MODULE

Winchester System

Z-100 PC Series Computers

585-70-01

860-45

ZENITH data systems

The purpose of this page is to make sure that all service bulletins are entered in this manual. When a service bulletin is received, annotate the manual and list the information in the record below.

Record of Service Bulletins

SERVICE BULLETIN NUMBER	DATE OF ISSUE	CHANGED PAGE(S)	PURPOSE OF SERVICE BULLETIN	INITIALS

Zenith Data Systems Corporation
St. Joseph, Michigan 49085

Contents

Record of Service Bulletins ii
Figures iii
Tables iii

Chapter 1 **Introduction**

Chapter 2 **Configuration and Installation**
Introduction 2.1
Winchester Controller Card Configuration 2.1
Winchester Installation 2.3
Preparing and Testing the Winchester Drive 2.7
The PREP Process 2.8

Chapter 3 **MiniScribe OEM Manual**

Chapter 4 **Parts List**
Introduction 4.1
Winchester Drive Option Parts List 4.1

Figures

2.1 Winchester Controller Card Configuration 2.2
2.2 Z-150 Exploded View 2.6
4.1 Winchester Option View 4.2

Tables

2.1 Switch S1 . . . . . 2.1

Chapter 1

Introduction

This manual provides information on the Winchester system. The OEM manual for the MiniScribe Winchester drive is included. **DO NOT** attempt repair on the Winchester drive.

Chapter 2

Configuration and Installation

Introduction

This chapter provides the information necessary to configure, install, test, and prepare the Winchester option.

Winchester Controller Card Configuration

Refer to Figure 2.1 for jumper and switch S1 location on the Winchester controller card.

The Winchester controller card has two jumpers:

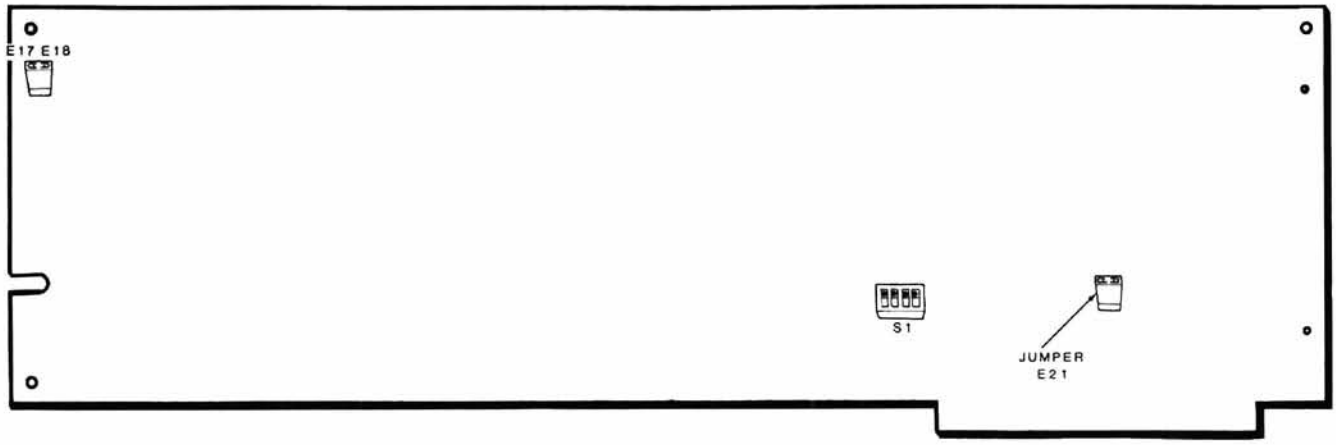
- The jumper between E17 and E18 is for testing purposes.
- The jumper on E21 is an addressing jumper.
  - Normal factory configuration is not jumpered for an address of C8000.
  - When E21 is jumpered, the address is F4000. This jumper is used when an optional bit-mapped graphics card is installed.

Switch S1 is a four-position switch representing binary numbers, where ON is a logic one (high) in the up position and OFF is a logic zero (low) in the down position. Refer to Table 2.1 for the switch description and settings. Refer to the particular Winchester OEM manual for the number of heads and cylinders.

Table 2.1. Switch S1

SWITCH POSITIONS				WINCHESTER CONFIGURATIONS		
1	2	3	4			
DRIVE 1		DRIVE 2		HEADS	CYLINDERS	
0	0	0	0	6	306	
0	1	0	1	4	480	
1	0	1	0	[illegible]	612	
1	1	1	1	4	306	Normal factory configuration
Command Port for Drive 0 is 320 Command Port for Drive 1 is 322						

Configuration and Installation



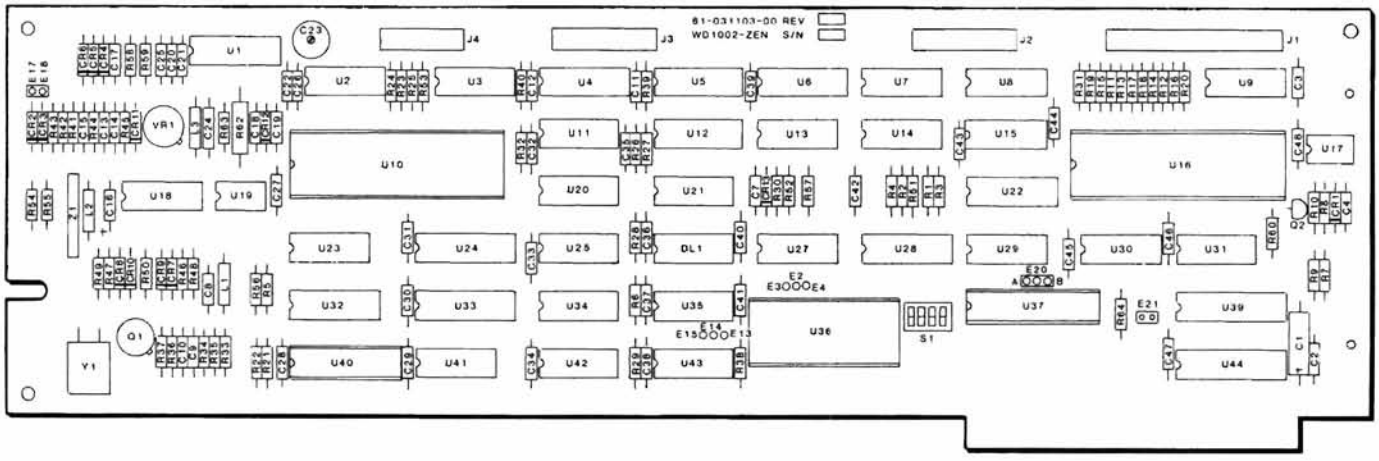


Figure 2.1. Winchester Controller Card Configuration

Winchester Installation

Refer to Figure 2.2 while reading the following.

- Remove seven screws (10) and top cover (5).
- Disconnect cable assembly (180) from floppy disk controller card (20).
- Disconnect any serial interface cables installed from floppy disk controller card (20).
- Remove screw (25) and floppy disk controller card (20).
- Disconnect the video display external cable from video/color/composite card (30).
- Remove screw (25) and video/color/composite card (30).
- Disconnect the keyboard from the system CPU card (35).
- Disconnect cable assembly (125) from the system CPU card (35).
- Remove screw (25) and system CPU card (35).
- Disconnect any exterior cables installed to the 128K memory card (40).
- Remove screw (25) and memory card (40).
- Remove two screws (25) and shipping bracket (166), if installed.
- Remove optional card(s), if installed.
- Disconnect power supply cable to backplane board (45).

- Disconnect power supply cables to the disk drive.
- Remove two screws (65) from rear of chassis.
- Remove four hex lock nuts (55) from the bottom of the chassis and power supply (50).
- Disconnect cable assembly (180).
- Remove six hex lock nuts (55) and disk drive chassis (75).
- Remove four screws (90) from the bottom drive and the bottom drive (85), if installed.
- Remove the four mounting support brackets (80), if installed.
- Remove Bezel if unit had only one drive installed.
- Mount the Winchester LED in the LED holder (225) on vented cover (100), and secure with the LED grommet (220).
- Route the vented cover (100) through the disk drive chassis (75), and snap into place.
- Install the Winchester disk drive (85) into the disk drive chassis (75), and secure with four screws (90).
- Install disk drive chassis (75), and secure with six hex lock nuts (55).
- Connect cable assemblies (205 and 210) to Winchester drive.
- Connect cable assembly (180).
- Install power supply (50), and connect the power cables to the disk drives (85) and backplane board (45).
- Secure the power supply (50) with two screws (65) and four hex lock nuts (55).
- Install cable strap (215) over cable assemblies (205 and 210), and secure with two hex lock nuts (220).

- Install Winchester controller card (200), and secure with screw (25).
- Connect cable assemblies (205 and 210) to Winchester controller card (200).
- Install optional cards, and secure with screw (25).
- Install memory card (40), and secure with screw (25).

If your customer wants his machine set for autoboot from the Winchester drive, refer to the *System CPU Card Service Module* and set the switches on that card.

- Install system CPU card (35), and secure with screw (25).
- Connect speaker/LED connector to the system CPU card (35).
- Install video/color/composite card (30), and secure with screw (25). Connect external video cables.
- Install floppy disk controller card (20), and secure with screw (25).
- Connect cable assembly (180) to floppy disk controller card (20).
- Install top cover (5), and secure with seven screws (10).

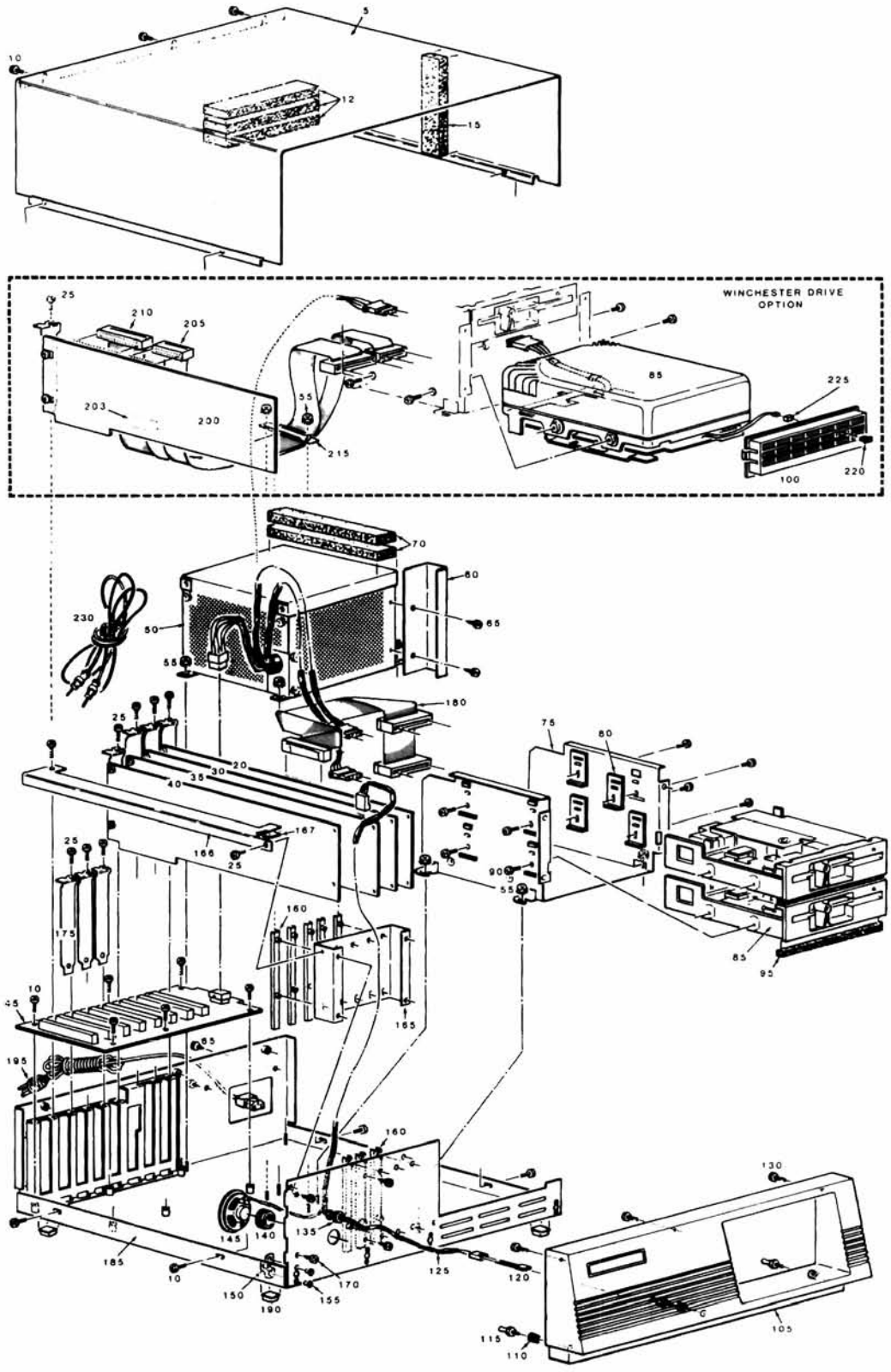


Figure 2.2. Z-150 Exploded View

Preparing and Testing the Winchester Drive

NOTE: Once the Winchester system is physically installed in the computer, you will need to run the PREP utility from MS-DOS Version 2 (or higher) to prepare the disk surface and test its data retention capabilities. This test will take about four hours to run.

NOTE: The CMI Winchester drive requires the FORMAT utility Version 2.5 (or higher).

Turn on the computer and boot from MS-DOS Distribution Disk I.

Enter the date and time (optional), press **RETURN**.

Replace MS-DOS Distribution Disk I with Disk II.

Enter **PREP** and press the **RETURN** key. You will see a message that explains the operation of PREP displayed on the computer's screen.

At the bottom of the message you will see:

```
Do you wish to proceed with PREP (Y/N)?
```

Press the **Y** key. You will see:

```
Type P to proceed
```

Press the **P** key. The reason for this double prompt is to prevent accidental operation of PREP by the customer. PREP will destroy any valid (or invalid) data stored on the Winchester disk. Next, you will see:

```
Winchester drive unit number (0-7):
```

PREP will support up to eight separate Winchester drives. Normally, you will never install more than one drive in any one computer system. If you are installing more than one drive, you will be involved in special addressing considerations (only one Winchester drive is supported at this time).

Enter **0**

If the installation was successfully made, the system will start the PREP process. Otherwise, you will see:

```
Can not communicate with Winchester controller.
```

If this message appears, software reset the system by pressing the CTRL, ALT, and DEL keys simultaneously, and repeat the Winchester preparation procedures.

The PREP Process

During the PREP process, the disk will be initialized and then tested for data retention six times. Each test takes about 30 minutes, so the total test takes approximately 3-½ hours.

Messages will be displayed during each phase of the test, and the LED access indicator for the Winchester disk will flicker slightly (it will be on most of the time).

When PREP has finished, you will hear an audible beep from the speaker. If there is **no** bad disk space, the screen will display `Completed` and the operating system prompt.

If there **is** some bad disk space, the display will indicate the amount. Some bad space may be expected and is normal in Winchester systems. If the bad surface area exceeds the amount allowed by the manufacturer's standards, you will be informed by an appropriate error message. Otherwise, you may assume that your customer has a good drive.

Finish securing the cabinet. The system is installed and tested.

Run the SHIP utility from MS-DOS Version 2 (or higher) before moving the system.

Chapter 3

MiniScribe OEM Manual

This manual is reprinted with the permission of:

MiniScribe Corporation
410 South Sunset
Longmont, Colorado 80501

MINISCRIBE II/IV

PRODUCT MANUAL

MiniScribe Corporation
410 South Sunset
Longmont, Colorado 80501

(303) 651-6000

TABLE OF CONTENTS

Revision No. 2

1.0 Introduction..... 1

2.0 Product Specifications..... 2
2.1 Model Specifications..... 2
2.2 Performance Specifications..... 2
2.3 Power Requirements..... 3
2.4 Physical Characteristics..... 3
2.5 Environmental Characteristics..... 3
2.6 Reliability and Maintenance..... 4
2.7 General Characteristics..... 4

3.0 Functional Description..... 6
3.1 Read/Write Control Electronics..... 6
3.2 Drive Mechanism..... 6
3.3 Air Filtration System..... 6
3.4 Head Positioning Mechanism..... 6
3.5 Read/Write Heads and Disks..... 7
3.6 Mechanically Isolated Mounting Points..... 7
3.7 Track 000 Detector..... 7

4.0 Operational Description..... 8
4.1 Power Sequencing..... 8
4.2 Drive Selection..... 9
4.3 Track Accessing..... 9
4.4 Head Selection..... 9
4.5 Read Operation..... 9
4.6 Write Operation.....10

5.0 Electrical Interface.....11
5.1 Control Input Signals.....11
5.2 Control Output Signals.....16
5.3 Data Transfer Signals.....18
5.4 Customer Options.....20
5.5 Terminators.....21
5.6 Error Messages.....21

6.0 Physical Interface.....22
6.1 J1/P1 Connector-Control Signals.....22
6.2 J2/P2 Connector-Data Signals.....22
6.3 J3/P3 Connector-DC Power.....23
6.4 J4/P4 Connector-Frame Ground.....23

7.0 Track Formatting Guidelines.....24

8.0 Installation.....25
8.1 Unpacking and Inspection.....25
8.2 Configuration.....26
8.3 Mounting.....26
8.4 Cabling.....26
8.5 Repacking.....27

9.0 Printed Circuit Card Replacements.....28

10.0 Diagnostic and Exerciser Routines.....30
10.1 General Description.....30
10.2 Message Readout.....30
10.3 Message Definitions.....31
10.4 Stepper Motor Phasing.....31
10.5 Shipping Zone.....32

Flow Charts.....33

LIST OF FIGURES

2-1 Outline and Mounting Dimensions 5

4-1 Power-on Timing..... 8

5-1 Cable Interconnection-4 Drive System..... 13

5-2 Control Signal Driver/Receiver..... 14

5-3 Seek Mode Timing..... 16

5-4 Data Signal Driver/Receiver.....18

5-5 Read/Write Timing.....19

5-6 Shunt Block..... 21

6-1 J1/J2 Connector.....22

6-2 J3 Connector..... 23

8-1 Unpacking/Packing..... 27

9-1 Board Replacement.....29

LIST OF TABLES

5-1 J1/J2/J3 Connector Pin Assignment..... 12

5-2 Write Pre-Compensation Rules..... 19

5-3 Drive Selection Configurator..... 20

1.Ø INTRODUCTION

The MiniScribe II and IV are random access 5-1/4 inch rigid media disk drives employing Winchester Technology. All models utilize rack and pinion actuators, microprocessor control, and open loop stepper head positioning. Unformatted capacity ranges from 6.4 MBytes to 2Ø MBytes depending upon the number of heads, disks, and tracks per inch.

All models feature power up diagnostics, head shipping zone, buffered seek, and 5 M bit transfer rate. DC voltages and physical form factor are the same as the 5-1/4 inch floppy drives.

2.0 PRODUCT SPECIFICATIONS

2.1 MODEL SPECIFICATIONS

	Model 2006	Model 2012
Storage Capacity-unfomatted		
Per Drive	6,374,592 bytes	12,749,184 bytes
Per Surface	3,187,296 bytes	3,187,296 bytes
Per Track	10,416 bytes	10,416 bytes
Per Cylinder	20,832 bytes	41,664 bytes
Disks	1	2
Recording Heads	2	4
Cylinders	306	306
Data Tracks	612	1224

	Model 4010	Model 4020
Storage Capacity-unformatted		
Per Drive	9,999,360 bytes	19,998,720 bytes
Per Surface	4,999,680 bytes	4,999,680 bytes
Per Track	10,416 bytes	10,416 bytes
Per Cylinder	20,832 bytes	41,664 bytes
Disks	1	2
Recording Heads	2	4
Cylinders	480	480
Data Tracks	960	1920

2.2 PERFORMANCE SPECIFICATIONS

Rotational Rate	3600 rpm ± 1%
Data Transfer Rate	5.0 Mbits per second ± 1%
Access Time	
Average Latency	8.33 milliseconds ± 1%
Settling Time	15 milliseconds
Seek Time	

	MiniScribe II	MiniScribe IV
Track-to-Track	3 milliseconds	3 milliseconds
Average*	85 milliseconds	120 milliseconds
Maximum*	205 milliseconds	310 milliseconds

* (Buffered including settling time)

2.3 POWER REQUIREMENTS

DC Input	+12 Volts DC Steady State: ± 5%, 1.5 amps maximum. Maximum ripple allowed is 1% with equivalent resistive load. Start Surge: ± 10%, 3.5 amps maximum. Less than 2 amps in 5 seconds (typical)
	+ 5 Volts DC ± 5%, 1.0 amps. Maximum ripple allowed is 2% with equivalent resistive load.
AC Input	None Required

2.4 PHYSICAL CHARACTERISTICS

Outline Dimensions	See Figure 2-1
Mounting Dimensions	See Figure 2-1
Weight	5.5 pounds
Heat Dissipation (maximum)	23 watts (78.5 BTU per hour)

2.5 ENVIRONMENTAL CHARACTERISTICS

Temperature	
Operating (stabilized)	40° F (4° C) to 115° F (46° C)
Non-Operating	-40° F (-40° C) to 135° F (57° C)
Humidity	
Operating & non-operating	8% to 80% Noncondensing
Maximum Wet Bulb	78° F (26 C)

2.6 RELIABLITY AND MAINTENANCE

MTBF	8,000 hours (continuous 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 rereads) 1 seek error in 10^{6} seeks
Media Defect Criteria (as shipped from MiniScribe)	
Model 2006 and 4010	10 defects maximum < 2 bytes in length Cylinder 000 defect free
Model 2012 and 4020	20 defects maximum < 2 bytes in length Cylinder 000 defect free

2.7 GENERAL CHARACTERISTICS

Start Time (typical)	20 seconds from power application to -READY
Stop Time (typical)	15 seconds from power removal

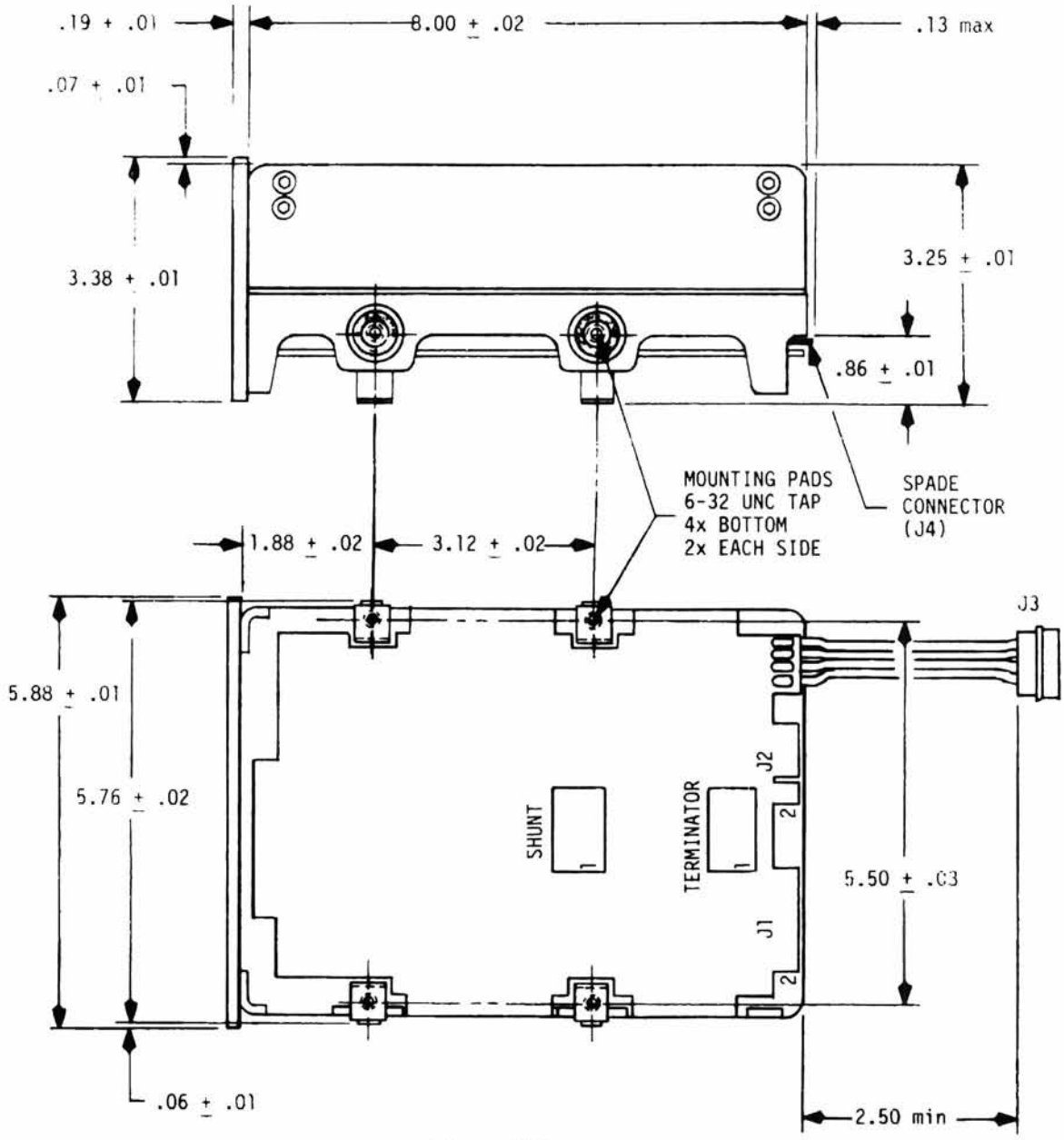


Figure 2-1

OUTLINE AND MOUNTING DIMENSIONS

3.0 FUNCTIONAL DESCRIPTION

The MiniScribe II and IV contain all necessary mechanical and electronic parts to interpret control signals, position the recording heads over the desired track, read and write data, and provide a contaminant free environment for the heads and disks.

3.1 READ/WRITE AND CONTROL ELECTRONICS

One integrated circuit is mounted within the sealed enclosure in close proximity to the read/write heads. Its function is to provide 1 of 2 or 1 of 4 head selection, read preamplification, and write drive circuitry.

The single microprocessor controlled circuit card provides the remaining electronic functions which include:

- Read/Write Circuitry
- Head Positioning
- Stepper Motor Drive
- Interface Control
- Index Detection
- Track 00 Detect
- Spin Speed Control
- Dynamic Breaking

3.2 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 coupled with a breather filter, provides over the drive life a clean, above atmospheric pressure environment to the heads and disks.

3.4 HEAD POSITIONING MECHANISM

Two or four read/write heads are supported by a carriage mechanism coupled to the stepper motor through a rack and pinion motion translator. The rack and pinion translator allows for the increased number of data tracks while retaining the full step holding torque and positioning repeatability characteristics of the stepper motor.

3.5 READ/WRITE HEADS AND DISKS

Data is recorded on 1 or 2 lubricated magnetic oxide coated 130mm diameter aluminum substrates (disks) through 2 or 4 low force, low mass Winchester type ferrite heads.

3.6 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.

3.7 TRACK 000 DETECTOR

The Track 000 Detector resides within the sealed enclosure. This optical sensor consists of a light source (activated only when a seek is initiated) and a receiver which when blocked by the positioner assembly indicates the logical/physical track 000.

4.0 OPERATIONAL DESCRIPTION

4.1 POWER SEQUENCING

+5 volts DC and +12 volts DC may be applied in any order. The +5VDC should be applied within 15 seconds of the +12VDC to insure proper automatic Track 000 calibration.

+12VDC powers the spindle drive motor. The microprocessor verifies that the disks are spinning at 3600 rpm and then activates the automatic Track 000 positioning. -TRACK 000, -SEEK COMPLETE, and -READY will become true upon completion of the Track 000 positioning sequence. Refer to Figure 4-1 for the Power-Up Sequencing.

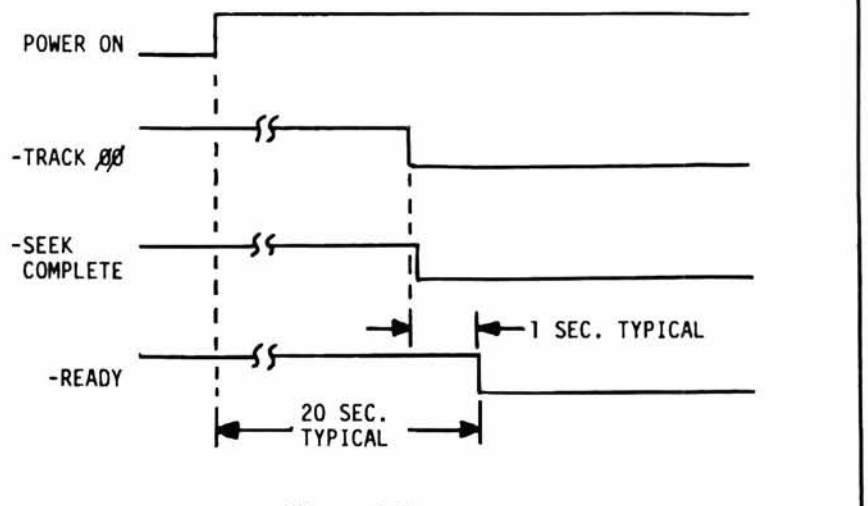


Figure 4-1

POWER ON TIMING

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 (see Paragraph 5.4.2 for the exception).

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 R/W heads to move either one track in or one track out, depending on the state of -DIRECTION IN. -DIRECTION IN true will cause the R/W head to move inward toward the spindle; -DIRECTION IN false will cause the R/W head to move outward toward TRACK 000. The drive will prevent any outward movement beyond Track 000 regardless of the -STEP pulses.

A seek to cylinder 336 on the MiniScribe II will position the heads over the shipping zone; for the MiniScribe IV, seek to cylinder 522.

A seek to a higher cylinder on either model will cause a recalibration sequence in the drive.

4.4 HEAD SELECTION

Any of the 2 or 4 heads can be selected by placing the heads binary address on the two -HEAD SELECT input lines. Note that -HEAD SELECT 2^1 is only used for the Model 2012 and 4020.

4.5 READ OPERATION

Reading the 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 the MiniScribe II and IV can be divided into three categories each of which are physically separated: 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 J1 and J2. The interconnect cable 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 J1 and J2 should be grounded at the controller.

Table 5-1 also provides the connector pin assignments for J3. The voltage return lines of J3 should only be grounded at the power supply.

Connector J4/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. (See Paragraph 5.4.2 for exception). Refer to Figure 5-2 for the driver/receiver circuit and signal level specification. Each Control Input Signal is terminated by a 220/330 ohm resistor network in the drive.

5.1.1 -REDUCED WRITE CURRENT

This line is non-functional on the MiniScribe II and IV. Write current is controlled by the internal microprocessor.

Table 5-1
J1/J2/J3 CONNECTOR PIN ASSIGNMENT

Signal	Ground Return	Signal Name
J1-2	J1-1	-REDUCED WRITE CURRENT
J1-4	J1-3	Reserved
J1-6	J1-5	-WRITE GATE
J1-8	J1-7	-SEEK COMPLETE
J1-10	J1-9	-TRACK 000
J1-12	J1-11	-WRITE FAULT
J1-14	J1-13	-HEAD SELECT 2^0
J1-16	J1-15	Reserved
J1-18	J1-17	-HEAD SELECT 2^1
J1-20	J1-19	-INDEX
J1-22	J1-21	-READY
J1-24	J1-23	-STEP
J1-26	J1-25	-DRIVE SELECT 1
J1-28	J1-27	-DRIVE SELECT 2
J1-30	J1-29	-DRIVE SELECT 3
J1-32	J1-31	-DRIVE SELECT 4
J1-34	J1-33	-DIRECTION IN
J2-1	J2-2	-DRIVE SELECTED
J2-3	J2-4	Reserved
J2-5	J2-6	Spare
J2-7	J2-8	Reserved
J2-9		Spare
J2-10		Spare
J2-11	J2-12	GROUND
J2-13		+MFM WRITE DATA
J2-14		-MFM WRITE DATA
J2-15	J2-16	GROUND
J2-17		+MFM READ DATA
J2-18		-MFM READ DATA
J2-19	J2-20	GROUND
J3-1		+12 volts DC
J3-2		+12 volts DC return
J3-3		+5 volts DC return
J3-4		+5 volts DC

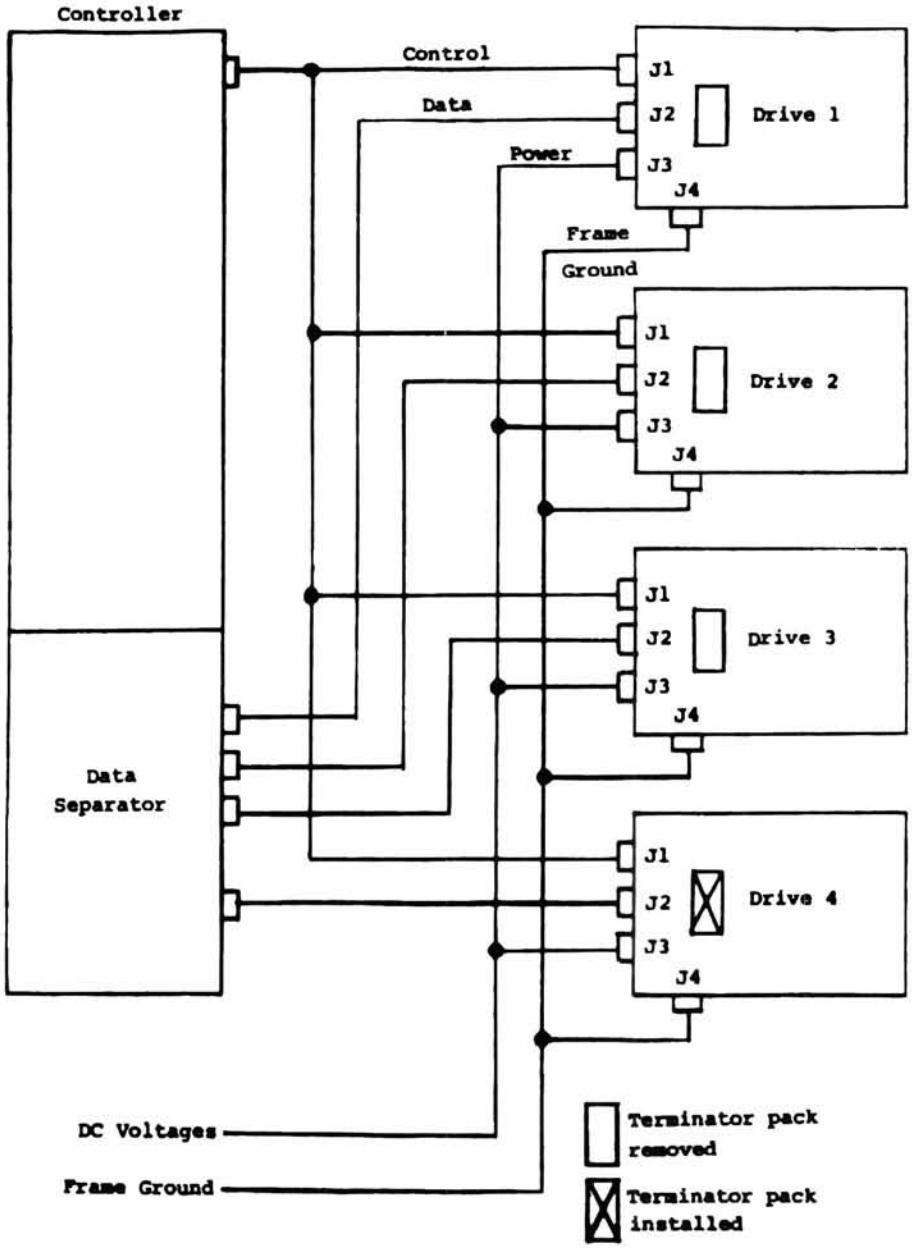


Figure 5-1

CABLE INTERCONNECTION - 4 DRIVE SYSTEM

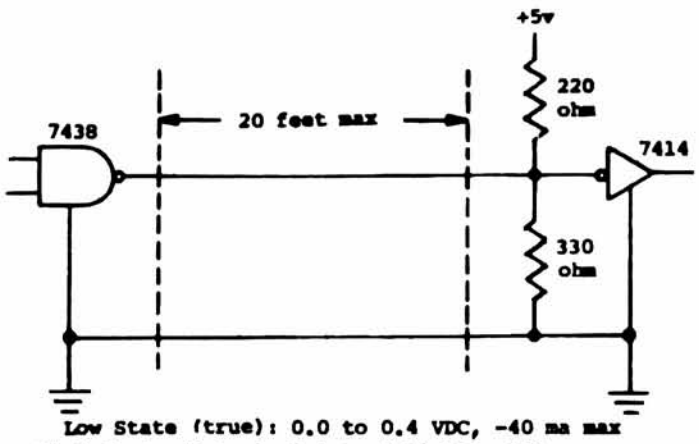


Figure 5-2
CONTROL SIGNAL DRIVER/RECEIVER

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 .

5.1.3 -HEAD SELECT 2^0 AND 2^1

These two signals provide for the selection of each individual read/write head in a binary coded sequence. HEAD SELECT 2^0 is the least significant signal. Heads are numbered 0 through 3. When both HEAD SELECT lines are false Head 0 will be selected. -HEAD SELECT 2^1 is used with the Model 2012 and 4020. If -HEAD SELECT 2^1 is set true on a Model 2006 and 4010 during write -WRITE FAULT will become true and during read only amplified noise will be presented to the interface.

5.1.4 -DIRECTION IN

This signal defines direction of motion of the R/W head when the -STEP line is pulsed. A high level defines the direction as "out" and if a pulse is applied to the -STEP line the R/W 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 R/W heads to move toward the center of the disk. Change in direction must meet the requirements shown in Figure 5-3.

5.1.5 -STEP

This control signal causes the R/W head to move with the direction of motion 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 6 us to 220 us rate. In this mode, pulses are accumulated until no new pulses have been received for 220 us. At this point access motion is initiated, and an optimized seek algorothim executed to minimize access time. Pulses that occur after this time 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 100 ns before the first step pulse until 100 ns after the last step pulse has been issued. See Figure 5.3 for timing diagram.

5.1.6 -DRIVE SELECT 1,2,3 AND 4

-DRIVE SELECT, when low, connects the drive to the control lines. Cutting the appropriate shunts on the Printed Circuit Card (See Paragraph 5.4.1) will determine which select line on the interface will activate that drive. (See Paragraph 5.4.2 for the exception.)

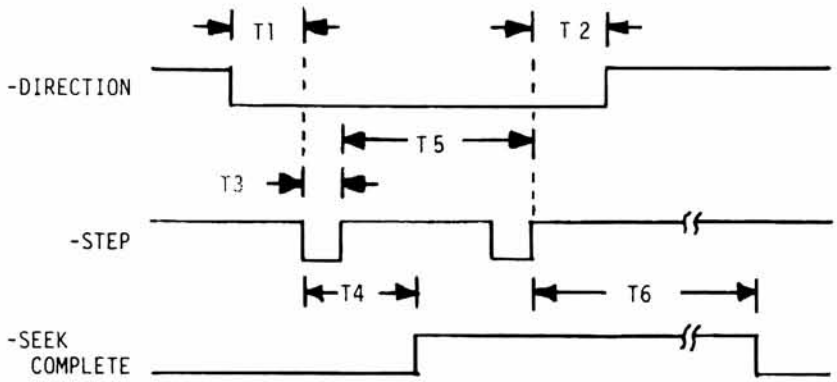


Figure 5-3

SEEK MODE TIMING

T1=100NS MIN
T2=100NS MIN
T3=1US MIN 40US MAX
T4=500NS TYPICAL

5.2 CONTROL OUTPUT SIGNALS

The Control Output Signals are gated from the drive by the activation of the appropriate -DRIVE SELECT line. (See Paragraph 5.4.2 for the exception.) Refer to Figure 5-2 for the driver/receiver 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 R/W heads have settled on the final track at the end of a seek. Reading or writing should not be attempted when -SEEK COMPLETE is false.

-SEEK COMPLETE will go false if a recalibration sequence is initiated (by drive logic) at power-on, or 500nS (typical) after the leading edge of a step pulse.

5.2.2 -TRACK 000

This interface signal indicates a true state only when the drive's R/W heads are positioned at Track 000 (the outermost data track).

5.2.3 -WRITE FAULT

This signal is used to indicate a condition exists in the drive which will result in improper writing on the disk. When this signal is true, further writing and stepping is inhibited at the drive until the condition is corrected. Once corrected the controller can reset this line by deselecting the drive. Any of the following four conditions could cause -WRITE FAULT to be true.

1. No write current sensed in the head with -WRITE GATE active and -DRIVE SELECTED.

2. An open head in the drive.

3. No transitions on MFM WRITE DATA line when -WRITE GATE true.

4. DC voltages are out of tolerance.

5.2.4 -INDEX

This 150 microsecond (typical) interface pulse is provided by the drive once each revolution (16.67MS 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 are inhibited.

The typical time after power on for -READY to be true is 20 seconds.

5.2.6 -DRIVE SELECTED

The -DRIVE SELECTED signal will go true only when the drive is programmed as drive X (X=1,2,3, or 4) and the -DRIVE SELECT X line is activated by the controller. (See Paragraph 5.4.2 for the exception.)

5.3 DATA TRANSFER SIGNALS

All signals associated with the transfer of data between the drive and the controller are differential in nature and are gated by -DRIVE SELECT except in the radial mode (See Paragraph 5.4.2).

Two pairs of balanced signals are used for the transfer of data: MFM WRITE DATA and MFM READ DATA. Figure 5-4 illustrates the driver/receiver combination used in the MiniScribe II and IV for data transfer signals.

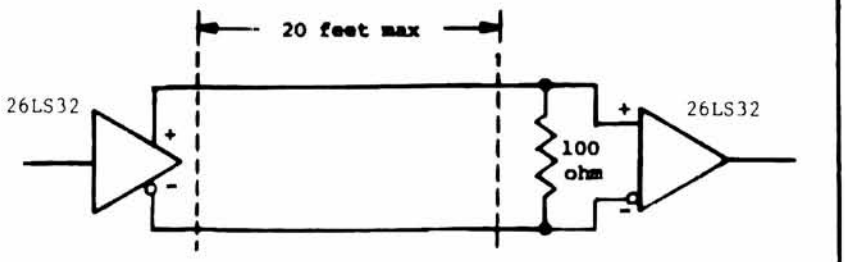


Figure 5-4

DATA SIGNAL DRIVER/RECEIVER

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 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.

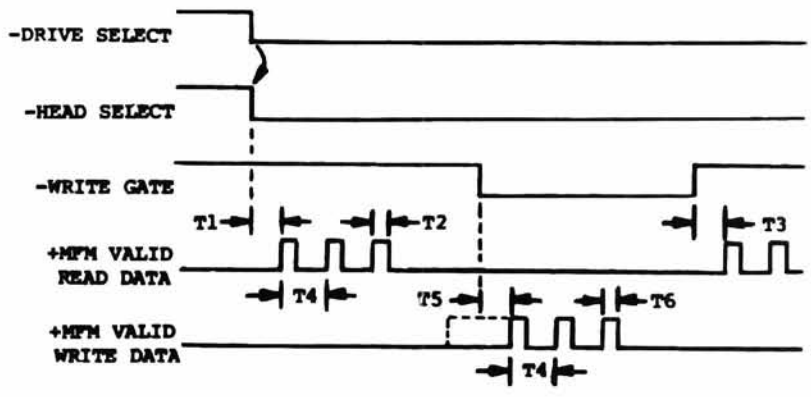
In MFM recoding, to optimize data integrity and meet the error rate specified, the write data presented by the controller must be pre-compensated on all tracks. ± MFM Write Data pulses bounded on one side by a 200ns period (1/2F) and bounded on the other side by a 300ns (1/1.5F) or 400ns (1/F) period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

Table 5-2
WRITE PRE-COMPENSATION RULES

Bit 1	Bit 2	Bit 3	Bit 4	Compensation
1	Ø	Ø	Ø	12nsec late on first clock
Ø	Ø	Ø	1	12nsec early on second clock
Ø	1	1	x	12nsec late on first data
1	1	Ø	x	12nsec 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.



T1 = 20 us max (head switch)
T2 = 25 - 50 ns
T3 = 20 us max (read after write)
T4 = 200 ns typical bit cell
T5 = 400 ns max
T6 = 50 - 150 ns

Figure 5-5

READ/WRITE TIMING

5.4 CUSTOMER OPTIONS

Customer optional features are implemented via a shunt block on the Printed Circuit Card. See Figure 2-1 for the location of the shunt block and the position of pin 1. See Figure 5-6 for the layout of the shunt block.

5.4.1 -DRIVE SELECT

As shipped, the 16-pin shunt block has all pin pairs shorted with the "Radial" option selected (see Paragraph 5.4.2). To select the desired drive number in a daisy-chain operation, refer to Table 5-3.

Table 5-3
DRIVE SELECTION CONFIGURATION

	DRIVE SELECT NUMBER			
Pin Pair	1	2	3	4
8 - 9	short	open	open	open
7 - 10	open	short	open	open
6 - 11	open	open	short	open
5 - 12	open	open	open	short
1 - 16	open	open	open	open

5.4.2 "RADIAL" OPTION

As shipped, the 16-pin shunt block has pin pair 1/16 shorted resulting in a radial operation. In this case, all input and output signals are enabled, even if the drive is not selected. However, the front panel LED will not be on. -DRIVE SELECT must be active to light the LED. When pin pair 1/16 is open the drive is in a daisy chain mode where input and output signals are enabled when the appropriate -DRIVE SELECT line is activated.

5.4.3 Drive Exercise Option

As shipped, the 16-pin shunt block has pin pair 2/15 shorted. This shunt is used to initiate drive exercise routines. (Refer to Chapter 10.)

5.4.4 Track Zero Phasing

Pin pair 3/14 and 4/13 are set at the factory and should not require changing. They establish information about the track zero sensor and stepper motor phasing relationship. (Refer to Chapter 10.)

5.5 TERMINATORS

Each drive is shipped with a terminator pack providing the 220/330 ohm termination for the Control 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.

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 a warning by blinking the activity LED. An explanation of the diagnostics and error codes is defined in Chapter 10.

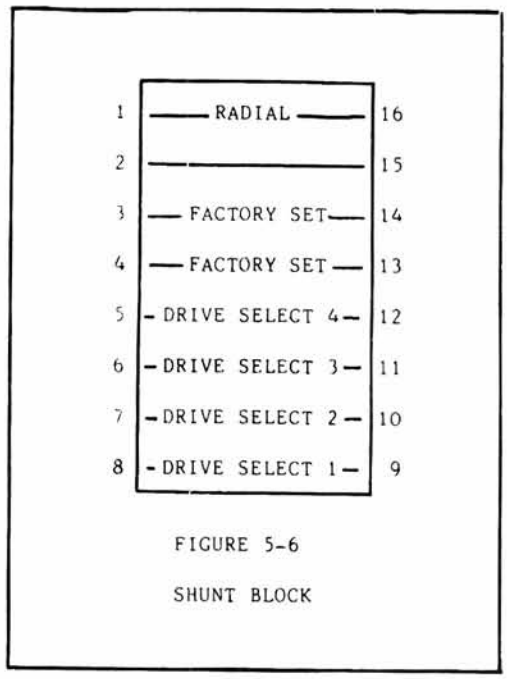


FIGURE 5-6

SHUNT BLOCK

6.0 PHYSICAL INTERFACE

The electrical interface between the disk drive and the host controller and DC power supply is via four connectors: J1 - Control Signals, J2 - Read/Write Signals, J3 - DC Power input and J4 - Frame Ground.

Refer to Figure 2-1 for connector locations.

6.1 J1/P1 CONNECTOR - CONTROL SIGNALS

Connection to J1 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 even pins located on the component side of the Printed Circuit Card. A key slot is provided between pins 4 and 6.

The recommended mating connector (P1) is AMP Ribbon Connector P/N 88373-3.

6.2 J2/P2 CONNECTOR - DATA SIGNALS

Connection to J2 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 even pins located on the component side of the Printed Circuit Card. A key slot is provided between pins 4 and 6.

The recommended mating connector (P2) is AMP Ribbon Connector P/N 88373-6.

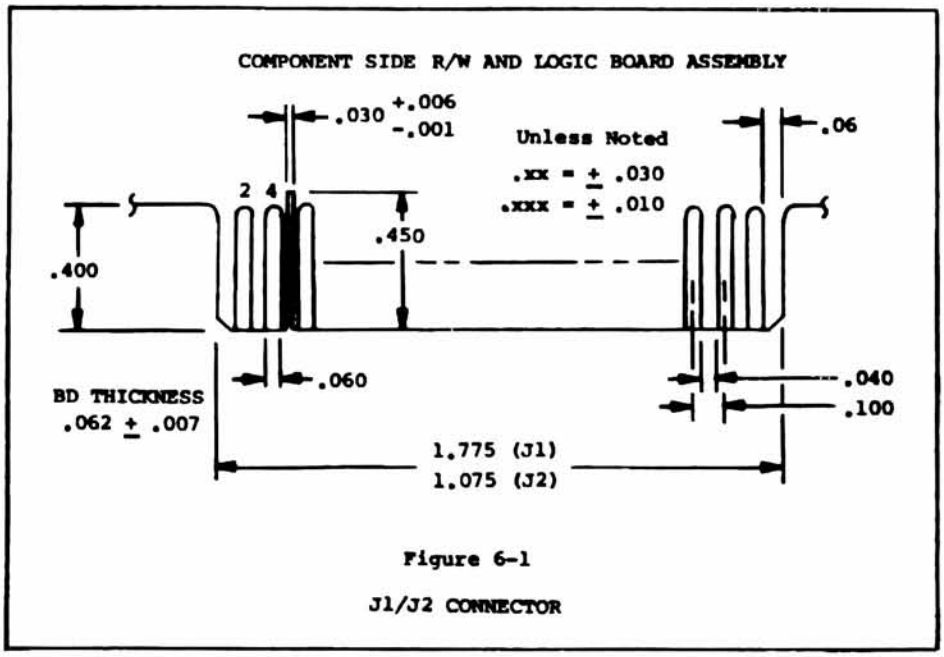


Figure 6-1

J1/J2 CONNECTOR

6.3 J3/P3 CONNECTOR - DC POWER

DC power connector (J3) is a 4 pin AMP Mate-N-Lok connector P/N 350211-1 mounted in a cable extended 4 inches from the drive. J3 pins are numbered as shown in Figure 6-2.

The recommended mating connector (P3) is AMP P/N 1-480424-0 utilizing AMP pins P/N 350078-4.

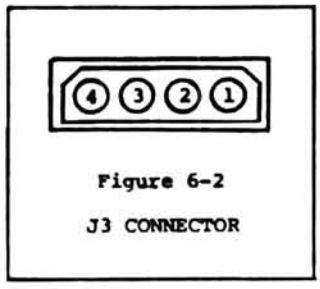


Figure 6-2

J3 CONNECTOR

6.4 J4/P4 CONNECTOR - FRAME GROUND

Faston AMP P/N 61761-2

Recommended mating connector is AMP 62187-1.

If used, the hole in J4 will accommodate a wire size of 18AWG max.

7.0 TRACK FORMATTING GUIDELINES

The purpose of a format is to organize a track into smaller addressable records called sectors. The MiniScribe II and IV are soft sectored devices allowing the customer to define the sector format. When establishing the track format certain rules should be observed to accommodate the physical timing relationships within the drive.

7.1 GAP 1

If head switching occurs at index time, then, 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.

7.2 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 customer's controller.

7.3 GAP 2

Following each sector it is recommended 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 $\pm$ 1% speed tolerance of the disk drive, Gap 2 should be a minimum of 1 byte for each 32 bytes of data within the sector. Additonally the customer should increase the gap to accommodate the spin speed-asynchronous frequency variation of the controller generated MFM WRITE DATA signals.

7.4 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 preceeds index and should be of a length to accommodate the spin speed variations of the disk drive ($\pm$ 1%) and the frequency variations of the controller generated MFM WRITE DATA signals.

8.0 INSTALLATION

CAUTION/WARNING

The MiniScribe II and IV are precision products weighing 5.5 lbs. During handling, the unit must not be dropped, jarred, or bumped. Otherwise damage to the heads and disks may occur.

8.1 UNPACKING AND INSPECTION

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

Step 1: Inspect the shipping container for evidence of intransit damage. 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 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 end foam cushions and the cardboard wrap.

Step 6:

Place the two pairs of end cushions, the cardboard wrap and the inner carton within the outer carton and store for subsequent use.

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.

8.2 CONFIGURATION

The customer should determine the drive select number required and the options desired and configure the 16-pin shunt as defined in Paragraph 5.4.

8.3 MOUNTING

The drive should be mounted to the customer frame through the mechanically isolated mounting points on the bottom or sides of the drive using 6-32 machine 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.

8.4 CABLING

Connect interface cables with connectors P1, P2, P3 and P4 to J1, J2, J3, and J4 respectively. Insure 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. See Figure 2-1 for the terminator pack location.

8.5 REPACKING

Should the MiniScribe Drive require shipment, repack the drive using the MiniScribe packing materials following Steps 1-5 of Paragraph 8.1 in reverse order.

The MiniScribe series contain shipping zones for protection of the data areas from periods of mishandling. Prior to power down for shipment, the host controller should access this zone (See Paragraph 4.3).

NOTICE

The MiniScribe Drive product 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.

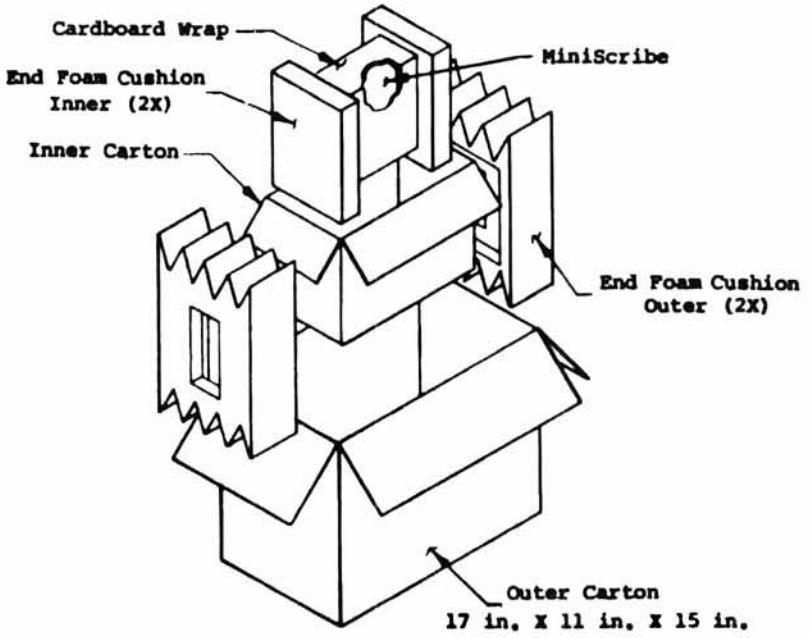


Figure 8-1
PACKING/UNPACKING

9.0 PRINTED CIRCUIT CARD REPLACEMENT (See Figure 9-1)

CAUTION!

The MiniScribe Drive is a precision product weighing 5.5 lbs. During handling the unit must not be dropped, jarred or bumped. Otherwise, damage to the heads and disk may occur. When the drive is not properly mounted, it is recommended that it be placed on a protective foam pad.

Step 1: Seek the heads to the shipping zone (See Paragraph 4.3). Disconnect the cables and remove the mounting screws. Move the disk to a convenient work station, and place on a foam pad with the Printed Circuit Card up.

Step 2: Carefully remove the flex lead connector. Do not pull on the flex lead, instead grasp the connector on the sides and slide it off the pins.

Step 3: Remove the four screws holding the card to the baseplate.

Step 4: Raise the card approximately one inch. Disconnect the rear connector and two front connectors noting their orientation for replacement.

Note: On some drives there are two rear connectors that must be disconnected.

Step 5: Install the new card by reversing the above steps. Ensure the connectors are properly mated and the cables are not touching the spin motor.

Step 6: Move the terminator (if installed) and the shunt block from the old card to the new one. Remount and cable the drive in the system.

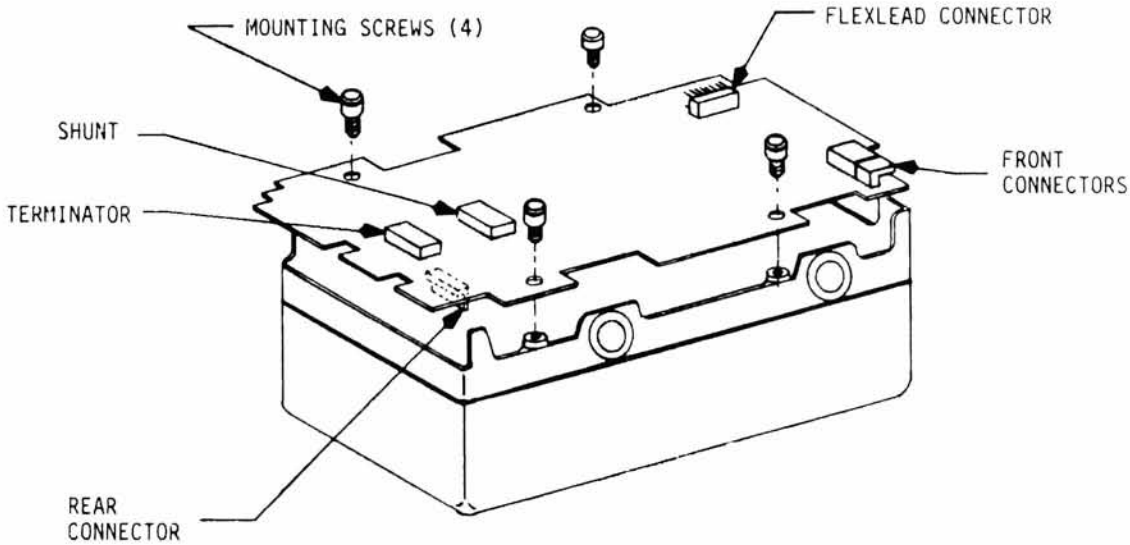


Figure 9-1
BOARD REPLACEMENT

10.0 Diagnostic and Exercise Routines

This section covers the diagnostic and exercise routines for the MiniScribe II and IV. A simplified flow chart is included to define the routines and the steps at which errors might occur. Error indications are explained as well as setting stepper motor phasing and a method for parking the heads at the shipping zone.

10.1 General Description

The microprocessor performs "wake up" diagnostics upon application of power. If an error is detected, the processor will flash a warning by blinking the Activity LED. Some errors are fatal in that they do not return to the program until power is cycled (refer to the Flow Chart).

If no errors are detected, the processor tests the shunt block to determine the state of pin pair 2/15 (drive exercise option).

If pin pair 2/15 is shorted, the drive will become ready. During normal operation, the drive will continue to monitor some functions such as spin speed and indicate an error if it occurs.

If pin pair 2/15 is open, the drive will enter the exerciser routine. Having checked the stepper motor phasing during diagnostics, the processor will flash the proper phasing via the Ativity LED. This code flashing sequence is repeated two times.

The drive then does a seek to the shipping zone and turns the LED on solid. The heads will remain at the shipping zone for 5 seconds during which time the drive can be powered down for shipment. At the end of the 5 second period the drive will initiate an actuator exercise routine which does a random seek for approximately 5 days.

10.2 Message Readout

The processor will display messages by flashing a "morse-code" type hexidecimal character via the Activity LED. The flashing sequence is a combination of long and short periods of LED ON cycles. The timing for each period is as follows:

Zero = 0.1 second ON
One = 0.6 second ON
Between Bits = 0.6 seconds OFF

Between Repeat Cycles = 2.0 seconds OFF

Below is listed the binary to hexidecimal conversion values:

0=0000	4=0100	8=1000	C=1100
1=0001	5=0101	9=1001	D=1101
2=0010	6=0110	A=1010	E=1110
3=0011	7=0111	B=1011	F=1111

Example: Code "E"

0.6 Sec ON
0.6 Sec OFF
0.6 Sec ON
0.6 Sec OFF
0.6 Sec ON
0.6 Sec OFF
0.1 Sec ON
2.0 Sec OFF

10.3 Message Definitions

Code 0 - Microprocessor RAM error
Code 1 - EPROM checksum error
Code 2 - Miscellaneous hardware error
Code 3 - Write Fault does not set
Code 4 - Write Fault does not reset
Code 5 - Unable to detect motor spinning
Code 6 - Spin motor failed margin test
Code 7 - Unable to maintain spin speed
Code 8 - Unable to uncover Track 00 sensor
Code 9 - Unable to cover Track 00 sensor
Code A - Incorrect phase selected
Code B - Step counter error
Code C - Correct phasing is both pin pairs open
Code D - Correct phasing is 3/14 open 4/13 shorted
Code E - Correct phasing is 3/14 shorted 4/13 open
Code F - Correct phasing is both pin pairs shorted

10.4 Stepper Motor Phasing

The proper stepper motor phase must be selected to insure correct operation of the Track 00 sensor. It is factory set and should not require attention as long as the original shunt block remains with the Head Disk Assembly. To set motor phasing, use the following procedure:

1. Initiate the exercise routine by removing the interface cables, removing the shunt block, and applying D.C. power.

2. Interpret the flashing code and set pin pairs 3/14 and 4/13 of the shunt block according to the explanations of Code C through F of paragraph 10.3.

3. Power drive off, reinstall the shunt block, and reconnect the interface cables.

   NOTE: The factory set code is recorded on a label on the top of the HDA.

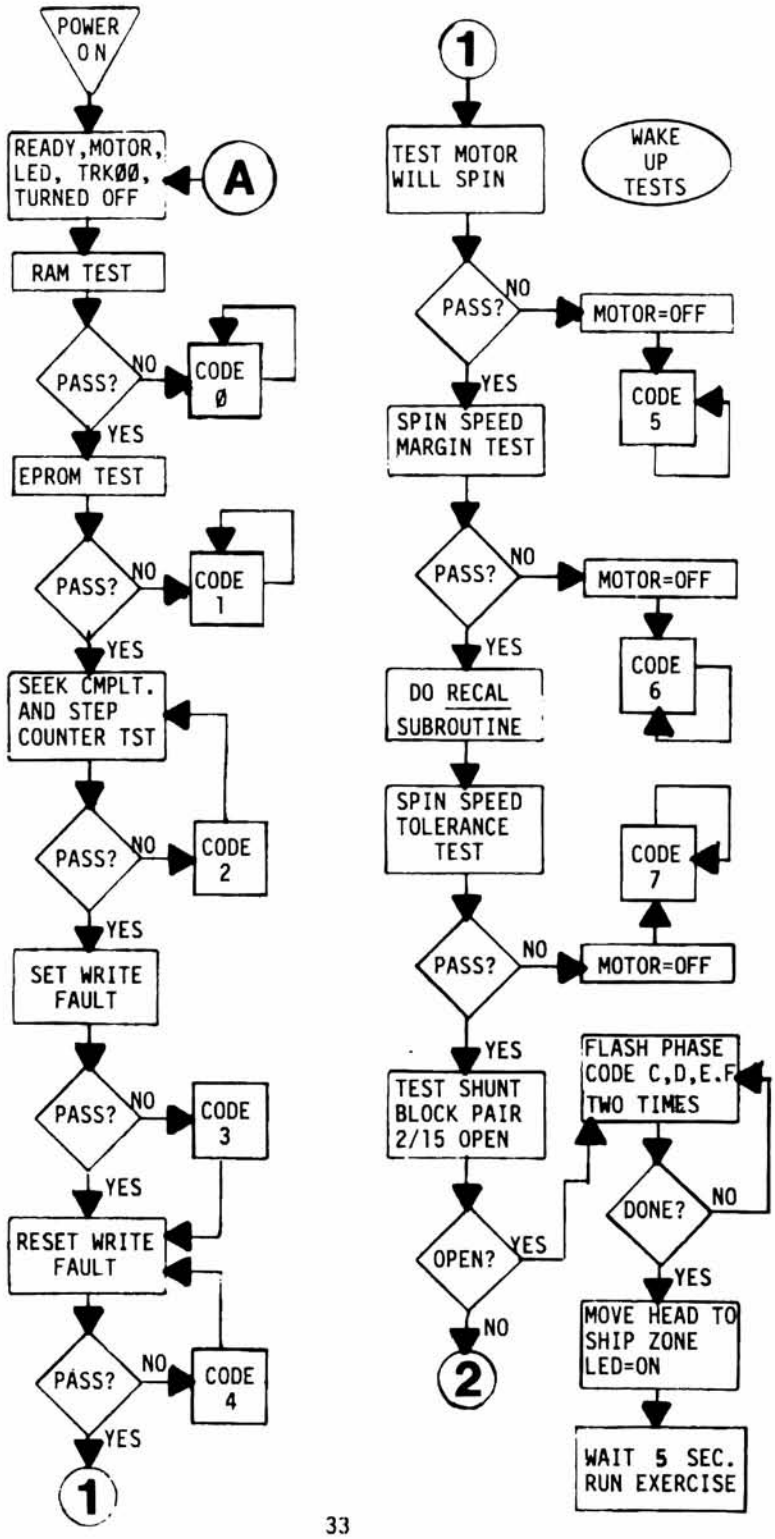
10.5 Shipping Zone

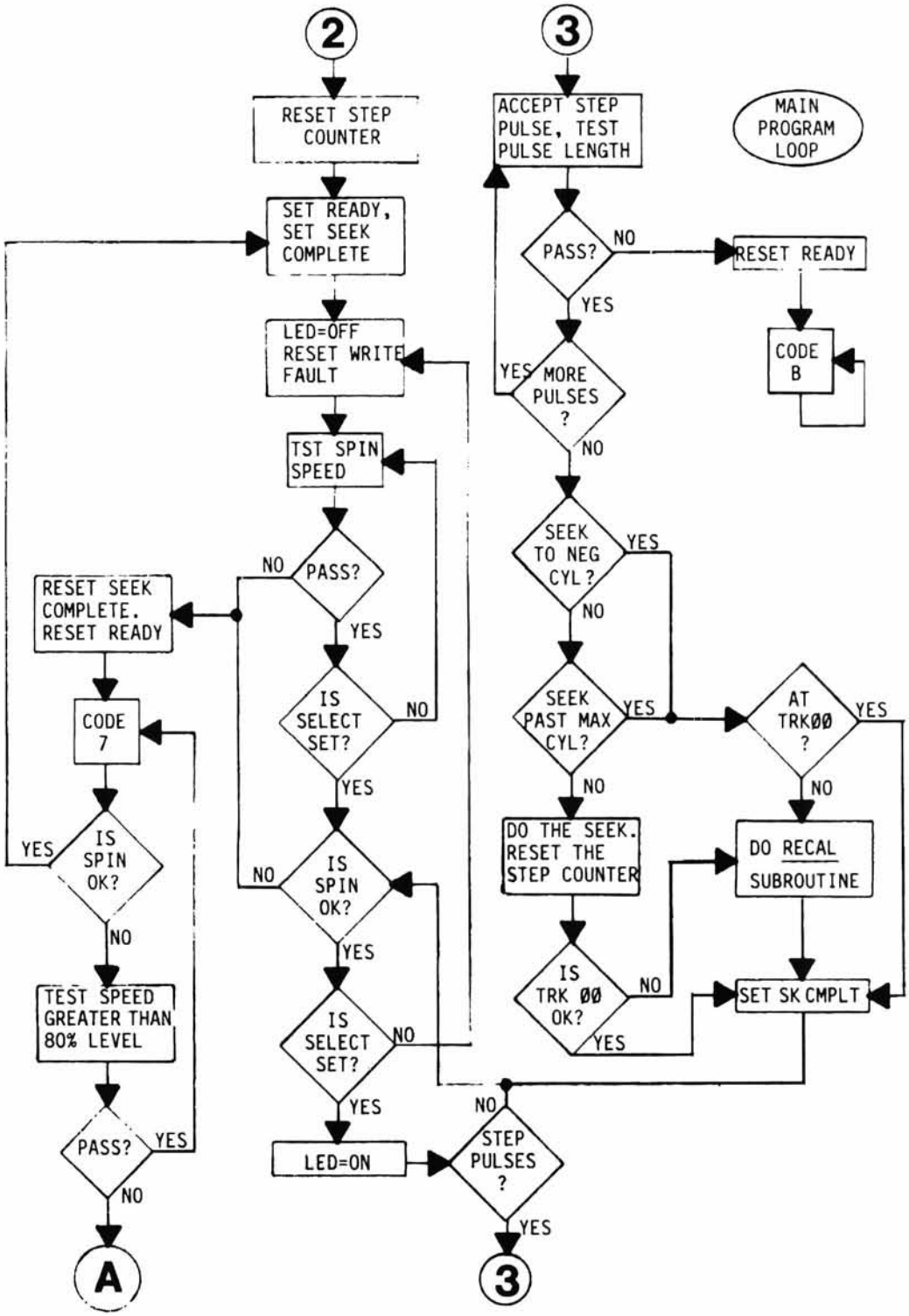
The shipping zone can be accessed by seeking to it (refer to paragraph 4.3) or by utilizing the following procedure:

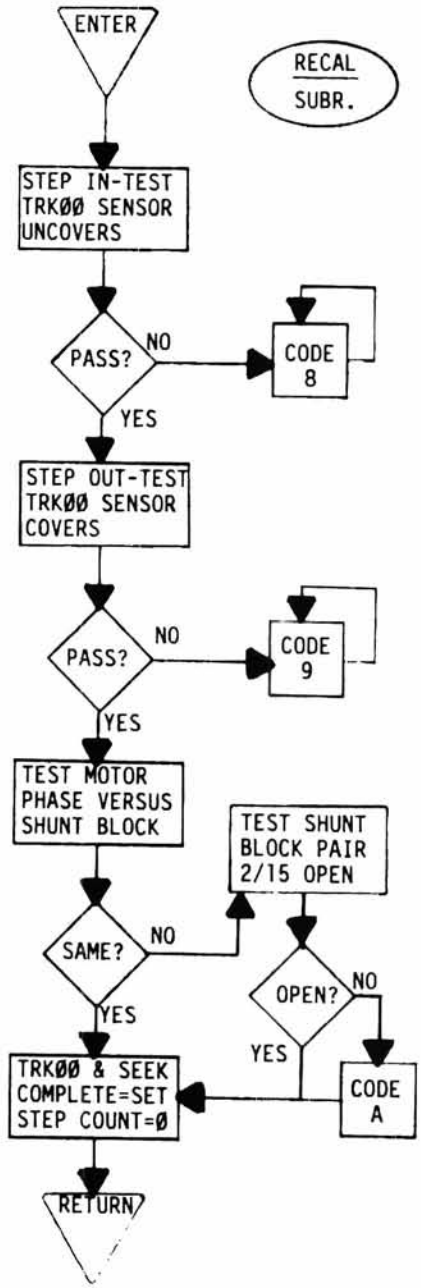
1. Initiate the exercise routine by removing the shunt block, and applying D.C. power.

2. After the processor has flashed the motor phase two times, the LED will turn on solid for 5 seconds. During the 5 second period remove D.C. power.

3. Reinstall the shunt block.


POWER ON
READY,MOTOR, LED, TRKØØ, TURNED OFF
A
RAM TEST
PASS?
NO
CODE Ø
YES
EPROM TEST
PASS?
NO
CODE 1
YES
SEEK CMPLT. AND STEP COUNTER TST
PASS?
NO
CODE 2
YES
SET WRITE FAULT
PASS?
NO
CODE 3
YES
RESET WRITE FAULT
PASS?
NO
CODE 4
YES
1
1
TEST MOTOR WILL SPIN
WAKE UP TESTS
PASS?
NO
MOTOR=OFF
CODE 5
YES
SPIN SPEED MARGIN TEST
PASS?
NO
MOTOR=OFF
CODE 6
YES
DO RECAL SUBROUTINE
SPIN SPEED TOLERANCE TEST
CODE 7
PASS?
NO
MOTOR=OFF
YES
TEST SHUNT BLOCK PAIR 2/15 OPEN
FLASH PHASE CODE C,D,E,F TWO TIMES
DONE?
NO
OPEN?
YES
YES
NO
2
MOVE HEAD TO SHIP ZONE LED=ON
WAIT 5 SEC. RUN EXERCISE


2
RESET STEP COUNTER
SET READY, SET SEEK COMPLETE
LED=OFF RESET WRITE FAULT
TST SPIN SPEED
PASS?
NO
YES
RESET SEEK COMPLETE, RESET READY
IS SELECT SET?
NO
YES
IS SPIN OK?
NO
YES
CODE 7
IS SPIN OK?
NO
YES
TEST SPEED GREATER THAN 80% LEVEL
PASS?
NO
YES
A
IS SELECT SET?
NO
YES
LED=ON
3
ACCEPT STEP PULSE, TEST PULSE LENGTH
PASS?
NO
YES
RESET READY
CODE B
MORE PULSES ?
YES
NO
SEEK TO NEG CYL ?
YES
NO
SEEK PAST MAX CYL?
YES
NO
AT TRKØØ ?
YES
NO
DO THE SEEK. RESET THE STEP COUNTER
DO RECAL SUBROUTINE
IS TRK ØØ OK?
NO
YES
SET SK CMPLT
STEP PULSES ?
NO
YES
3
MAIN PROGRAM LOOP


ENTER
RECAL
SUBR.
STEP IN-TEST
TRKØØ SENSOR
UNCOVERS
PASS?
NO
CODE
8
YES
STEP OUT-TEST
TRKØØ SENSOR
COVERS
PASS?
NO
CODE
9
YES
TEST MOTOR
PHASE VERSUS
SHUNT BLOCK
TEST SHUNT
BLOCK PAIR
2/15 OPEN
SAME?
NO
OPEN?
NO
YES
YES
TRKØØ & SEEK
COMPLETE=SET
STEP COUNT=Ø
CODE
A
RETURN

Chapter 4

Parts List

Introduction

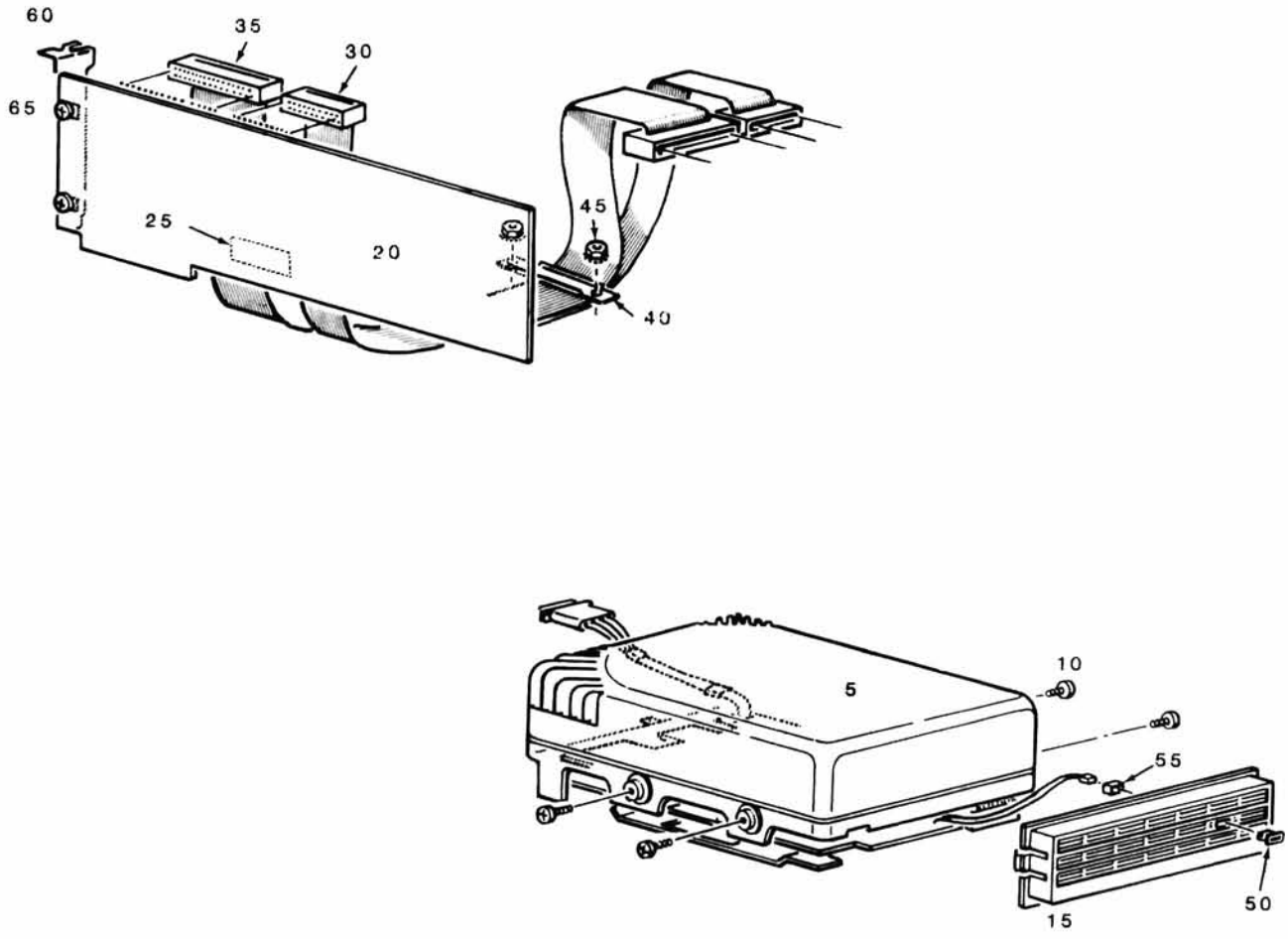
This chapter includes a view of the Winchester drive option to assist in the identification of replacement parts. Adjacent to the item number are the part number and description which must be supplied when ordering the replacement part.

Winchester Drive Option Parts List

Refer to Figure 4.1 for identification of replacement parts.

ITEM NUMBER	PART NUMBER	DESCRIPTION
5	HE 150-156	Winchester, MiniScribe
	or	
	HE 150-164	Winchester, CMI
	or	
	HE 150-167	Winchester, Seagate
10	HE 250-1325	Screw, 6-32 × .375
15	HE 203-2203	Vented cover
20	HE 150-177	Winchester controller card
25	HE 444-284-1	ROM
30	HE 134-1380	Cable assembly
35	HE 134-1381	Cable assembly
40	HE 267-25	Cable strap
45	HE 252-756	Nut, hex lock
50	HE 260-708-81	LED clip
55	HE 260-708-82	LED grommet
60	HE 204-2774	Bracket
65	HE 250-1411	Screw

Parts List



4.1. Winchester Option View