

TABLE OF CONTENTS

	Page
TABLE OF CONTENTS	i
LIST OF FIGURES	iii
LIST OF TABLES	iii
ABBREVIATIONS/MNEMONICS	iv
SECTION I INTRODUCTION	1-1
1.1 General Description	1-1
1.2 Specification Summary	1-2
1.2.1 Performance Specifications	1-2
1.2.2 Functional Specifications	1-2
1.2.3 Physical Specifications	1-2
1.2.4 Reliability Specifications	1-3
1.3 Functional Characteristics	1-3
1.3.1 Read/Write and Control Electronics	1-3
1.3.2 Drive Mechanism	1-4
1.3.3 Air Filtration System	1-4
1.3.4 Positioning Mechanism	1-4
1.3.5 Read/Write Heads and Disk(s)	1-5
1.4 Functional Operations	1-5
1.4.1 Power Sequencing	1-5
1.4.2 Drive Selection	1-5
1.4.3 Track Accessing	1-6
1.4.4 Head Selection	1-6
1.4.5 Read Operation	1-6
1.4.6 Write Operation	1-6
SECTION II ELECTRICAL INTERFACE	2-1
2.1 Introduction	2-1
2.2 Signal Interface	2-1
2.2.1 Control Input Lines	2-1
2.2.2 Drive Select 1 — 4	2-3
2.2.3 Direction In	2-3
2.2.4 Step	2-3
2.2.5 Head Select 2^0 and 2^1	2-4
2.2.6 Write Gate	2-5
2.2.7 Reduced Write Current	2-5
2.2.8 Control Output Lines	2-5
2.2.9 Track 00	2-5
2.2.10 Index	2-5
2.2.11 Ready	2-6
2.2.12 Write Fault	2-6
2.2.13 Seek Complete	2-6
2.2.14 Data Transfer Lines	2-6
2.2.15 MFM Write Data	2-7
2.2.16 MFM Read Data	2-8
2.2.17 Timing Clock	2-8
2.2.18 Select Status	2-8
2.2.19 General Timing Requirements	2-8

TABLE OF CONTENTS (CONT.)

2.3	Power Interface	2-8
2.3.1	AC Power	2-8
2.3.2	DC Power	2-8
2.4	Frame Ground	2-9
SECTION III	PHYSICAL INTERFACE	3-1
3.1	Introduction	3-1
3.2	Connectors	3-2
3.2.1	J1/P1 Connector	3-2
3.2.2	J2/P2 Connector	3-2
3.2.3	J4/P4 Connector	3-2
3.2.4	J5/P5 Connector	3-2
3.3	Frame Grounding	3-3
3.3.1	Drive Ground	3-3
3.3.2	Logic Ground	3-3
SECTION IV	DRIVE PHYSICAL SPECIFICATIONS	4-1
4.1	General	4-1
4.2	Mechanical Dimensions	4-1
4.3	Mounting	4-1
SECTION V	MEDIA DEFECTS AND ERRORS	5-1
5.1	Error Mapping and Qualification	5-1
5.1.1	Causes of Errors	5-1
5.1.2	Error Definition	5-1
5.1.3	Media Defect Definition	5-1
5.1.4	Error Map	5-1
5.1.5	User Error Mapping	5-2
5.2	Error Acceptance Criteria	5-2
5.3	System Generated Errors	5-2
SECTION VI	RECORDING FORMAT	6-1
6.1	SA1000 Track Format	6-1
6.2	Gap Length Calculations	6-2
6.2.1	Gap 1	6-2
6.2.2	Gap 2	6-2
6.2.3	Gap 3	6-2
6.2.4	Gap 4	6-2
6.3	Write Precompensation	6-2
SECTION VII	CUSTOMER INSTALLABLE OPTIONS	7-1
SECTION VIII	DRIVE INTERCONNECT	8-1
SECTION IX	PACKAGING INSTRUCTIONS	9-1
9.1	SA1000 Unpackaging Instructions	9-1
9.2	Packing for Reshipping	9-2
APPENDIX A	ORDERING INFORMATION	A-1

LIST OF FIGURES

Figure Number	Title	Page
1-0	SA1000 Fixed Disk Drive	1-0
1-1	Air Filtration System	1-4
1-2	Positioning Mechanism	1-5
2-1	J1 Interface and Power Connection	2-2
2-2	Control Input Driver/Receiver Combination	2-3
2-3	Normal Step Mode	2-3
2-4	Buffered Step Mode	2-4
2-5	Head Selection Timing	2-5
2-6	Control Output Driver/Receiver Combination	2-5
2-7	Index Timing	2-6
2-8	Data Transfer Line Driver/Receiver Combination	2-6
2-9	J2 Interface Connection	2-7
2-10	MFM Read/Write Data Timing	2-7
2-11	General Control Timing Requirements	2-9
3-1	Connector Locations	3-1
3-2	J1 Connector Dimensions	3-2
3-3	J2 Connector Dimensions	3-2
3-4	J4 Connector	3-2
3-5	J5 Connector	3-2
4-1	Rack Mount Physical Dimensions	4-2
4-2	Standard Mount Physical Dimensions	4-3
6-1	Track Format	6-1
7-1	SA1000 Control PCB	7-1
8-1	Multiple Drive System Daisy Chain Connection	8-1
9-1	Proposed Spindle Lock	9-1
9-2	Current Spindle Lock	9-1
9-3	SA1000 Packaging	9-2

LIST OF TABLES

Table Number	Title	Page
2-1	Head Select	2-4
2-2	AC Power Requirements	2-10
2-3	DC Power Requirements	2-10
6-1	Write Precompensation	6-2
A-1	SA1000 PSI	A-1

ABBREVIATIONS / MNEMONICS

bpi	Bits Per Inch	MFM	Modified FM
CRC	Cyclic Redundancy Check	PCB	Printed Circuit Board
fci	Flux Changes Per Inch	R/W	Read/Write
FM	Frequency Modulation	tpi	Tracks Per Inch
ID	Identification	TBS	To Be Supplied

ABOUT THIS MANUAL

This manual (P/N 39010-3) supersedes all earlier manuals. This manual includes information contained in Publication Change Notice #1 (dated 10/1/81). All previous editions as well as the notice may be discarded.

While every effort has been made to ensure that the information provided herein is correct, please notify us in the event of an error or inconsistency. Write any comments on the form in the back of this manual and send to:

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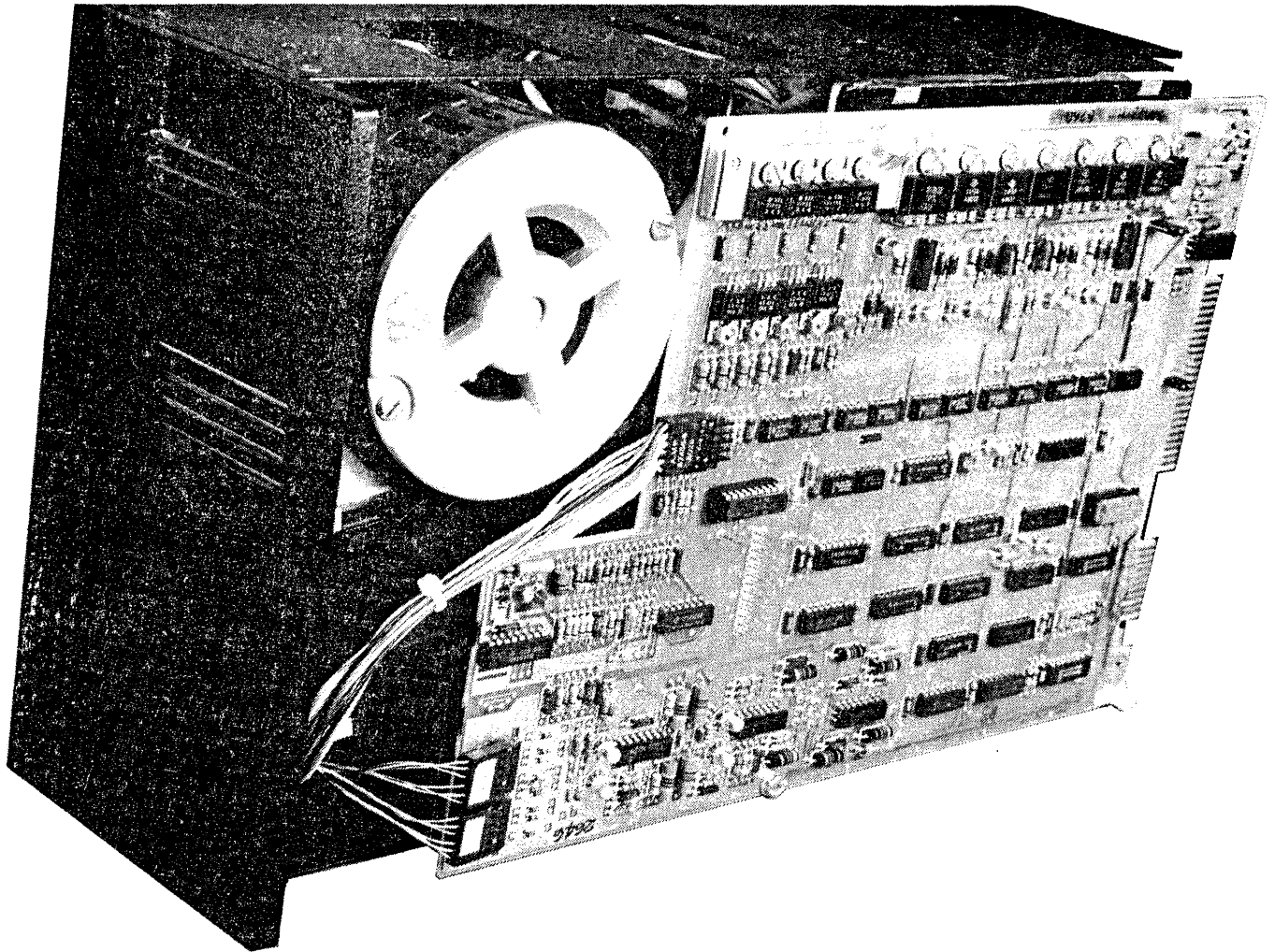


FIGURE 1-0. SA1000 FIXED DISK DRIVE

39010-01

SECTION I INTRODUCTION

1.1 GENERAL DESCRIPTION

The Shugart SA1000 series disk drive is a random access storage device. The SA1000 has one or two non-removable 8 inch disks as storage media. Each disk surface employs one movable head to service 256 data tracks. The two models of the SA1000 series are the 1002 and the 1004 with single and double disks respectively. The SA1002 provides 5 megabytes accessed by two movable heads. The SA1004 provides 10 megabytes accessed by four movable heads.

Low cost and unit reliability are achieved through the use of a unique band actuator design. The inherent simplicity of mechanical construction and electronic controls allows maintenance free operation throughout the life of the drive.

Mechanical and contamination protection for the head, actuator, and disks is provided by an impact resistant plastic and aluminum enclosure. A self contained recirculating system supplies clean air through a 0.3 micron filter. Another absolute filter allows pressure equalization with ambient air.

The optional SA1200 Data Separator PCB or equivalent circuitry is necessary to provide modified FM (MFM) encoding/decoding, write precompensation, a crystal write oscillator, and address mark writing and detection. These functions are also provided by the optional SA1400 controller.

The interface for the SA1000 is similar to the Shugart 8 inch family of floppy disk drives. Existing floppy controllers are not compatible with the SA1000 due to differences in the data transfer rates. The SA1000 is designed to fit into the same physical space as the 8 inch drives.

Key Features:

- a. Storage capacity of 5.33 or 10.67 megabytes.
- b. Winchester design reliability.
- c. Same physical size and identical mounting configuration as the SA800/850 drives.
- d. Uses the same dc voltages as the SA800/850 drives.
- e. Proprietary FasFlex III band actuator.
- f. 4.34 M bits/second transfer rate.
- g. Simple floppy type interface.
- h. Fully shock mounted package.

1.2 SPECIFICATION SUMMARY

1.2.1 Performance Specifications

	SA1002	SA1004
Capacity		
Unformatted		
Per Drive	5.33 M bytes	10.67 M bytes
Per Surface	2.67 M bytes	2.67 M bytes
Per Track	10.4 k bytes	10.4 k bytes
Formatted		
Per Drive	4.2 M bytes	8.4 M bytes
Per Surface	2.1 M bytes	2.1 M bytes
Per Track	8.2 k bytes	8.2 k bytes
Per Sector	256 bytes	256 bytes
Sectors/Track	32	32
Transfer Rate	4.34 M bits/sec.	4.34 M bits/sec.
Access Time		
Track to Track	1 ms	1 ms
Average	52 ms	52 ms
Maximum	132 ms	132 ms
Settling Time	18 ms	18 ms
Average Latency	9.6 ms	9.6 ms

1.2.2 Functional Specifications

Rotational Speed	3125 ± 3% rpm	3125 ± 3% rpm
Recording Density	6270 bpi	6270 bpi
Flux Density	6270 fci	6270 fci
Track Density	172 tpi	172 tpi
Cylinders	256	256
Tracks	512	1024
R/W Heads	2	4
Disks	1	2

1.2.3 Physical Specifications

Environmental Limits

Ambient Temperature =	50° to 115° F (10° to 46° C)
Relative Humidity =	8 to 80%
Maximum Wet Bulb =	78° non-condensing

AC Power Requirements

50/60 ± 0.5 Hz	
100/115 Vac Installations	= 90-127 V at 1.1 A typical
200/230 Vac Installations	= 180-253 V at 0.6 A typical

DC Voltage Requirements

DC Voltage	Ripple MV P-P	
+5 ± 0.25 V	50	2.0 amp typical 2.5 amp max.
-5 ± 0.25 V (-7 to -16 V optional)	50 (N/A)	0.20 amp typical 0.25 amp max.
±24 ± 2.4 V	1000	2.8 amp typical 3.3 amp max.

	Freq.	Operating	Non-Operating
Vibration	5-25 Hz 25-55 Hz 55-300 Hz	0.0014 inches DA* 0.0007 inches DA* 0.3 g's	0.008 inches DA* 0.004 inches DA* 2.0 g's
*Double Amplitude			
Shock	g's Pulse Width	1.0 max 10-20 ms	15.0 max 10-20 ms

Mechanical Dimensions

	Rack Mount	Standard Mount
Height =	4.62 in. (117.3 mm)	4.62 in. (117.3 mm)
Width =	8.55 in. (217.2 mm)	9.50 in. (241.3 mm)
Depth =	14.25 in. (362.0 mm)	14.25 in. (362.0 mm)
Weight =	17 lbs. (7.7 kg)	17 lbs. (7.7 kg)

Heat Dissipation = 321 BTU/hr. typical (94 watts)

1.2.4 Reliability Specifications

MTBF: 8,000 power on hours of typical usage

Preventive Maintenance: None Required

MTTR: 30 minutes

Component Life: 5 years

Error Rates:

Soft Read Errors: 1 per 10^{10} bits read

Hard Read Errors: 1 per 10^{12} bits read

Seek Errors: 1 per 10^6 seeks

1.3 FUNCTIONAL CHARACTERISTICS

The SA1000 consists of read/write and control electronics, read/write heads, track positioning mechanism, media, and air filtration system. These components perform the following functions:

- a. Interpret and generate control signals.
- b. Position the heads over the selected track.
- c. Read and write data.
- d. Provide a contamination free environment (class 100 or better).

1.3.1 Read/Write and Control Electronics

The standard electronics are packaged on a single printed circuit board containing the following circuits: (Early units have two printed circuit boards.)

- a. Index Detector circuit
- b. Head Position Actuator drivers
- c. Read/Write amplifiers
- d. Drive (Ready) Up to Speed circuit
- e. Drive Select circuit
- f. Write Fault Detection circuit

- g. Read/Write Head Select circuit
- h. Step Buffers with Ramped Stepper circuit
- i. Track 000 indicator

1.3.2 Drive Mechanism

The ac drive motor rotates the spindle at $3125 \pm 3\%$ rpm through a belt-drive system. Either 50 or 60 Hz power is accommodated by changing the drive pulley and belt.

1.3.3 Air Filtration System

The disk(s) and read/write heads are fully enclosed in a module using an integral recirculating air system with an absolute filter which maintains a clean environment. A separate absolute breather filter permits pressure equalization with the ambient air without contamination (see figure 1-1).

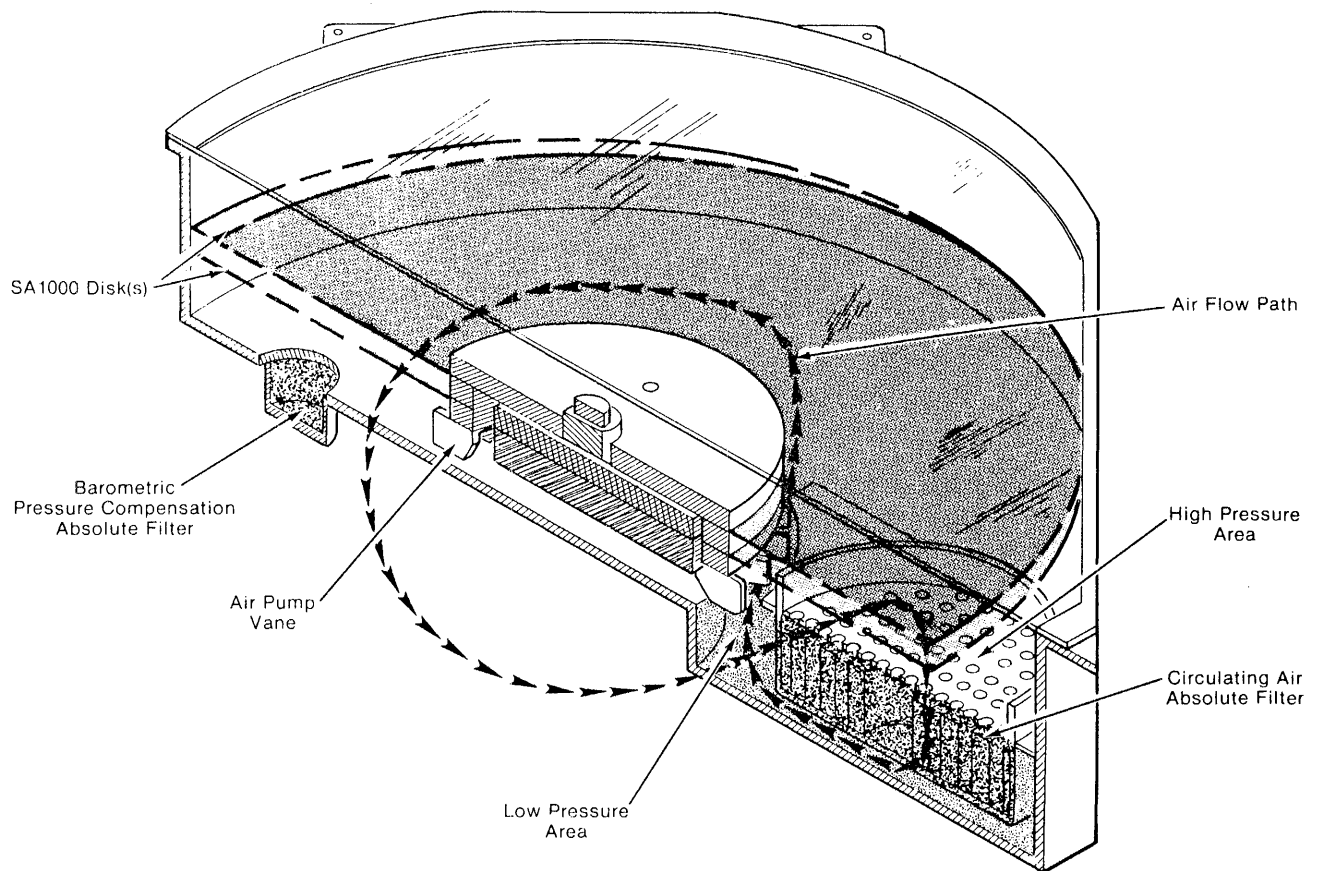


FIGURE 1-1. AIR FILTRATION SYSTEM

39010-02

1.3.4 Positioning Mechanism

The read/write heads are mounted on a ball bearing supported carriage which is positioned by the Fasflex III™ actuator. A stepper motor is used to precisely position the carriage assembly using a unique metal band/capstan concept (see figure 1-2).

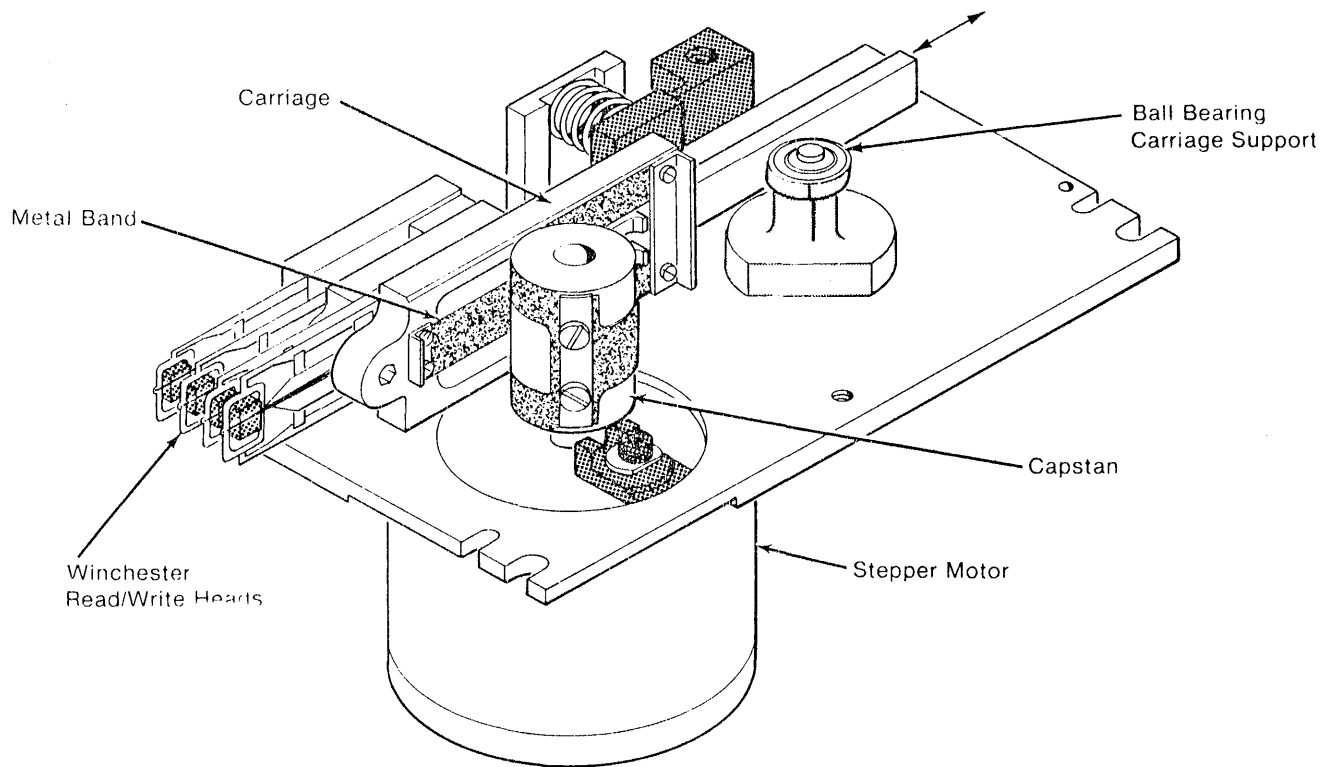


FIGURE 1-2. POSITIONING MECHANISM

39010-03

1.3.5 Read/Write Heads and Disk(s)

The recording media consists of a lubricated thin magnetic oxide coating on a 200 mm diameter aluminum substrate. This coating formulation, together with the low load force/low mass Winchester type flying heads, permits reliable contact start/stop operation.

Data on each disk surface is read by one read/write head. Each head accesses 256 tracks. The drive is available in two basic configurations: one disk with two read/write heads or two disks with four read/write heads.

1.4 · FUNCTIONAL OPERATIONS

1.4.1 Power Sequencing

Since the SA1000 has a speed sense circuit that prevents stepping until the disk is rotating at the proper speed, no power on sequence is required. A READY signal will be presented to the controller interface once the disk is up to 95% of its normal rotational speed. At READY time, after an initial power up, the drive will recalibrate itself to TK000. After an 18 msec head settle time, SEEK COMPLETE will go true. Normal seek and read/write functions can now begin.

NOTE

The radial cable must be connected and must be able to supply the 3.68 μ s Timing Clock. This is to ensure proper time out and recalibration.

1.4.2 Drive Selection

Drive selection occurs when one of the Drive Select lines is activated. Only the drive appropriately jumpered will respond to the activated Drive Select line.

1.4.3 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.

Stepping can occur at either the normal or buffered rate. During normal stepping, the heads are repositioned at the rate of incoming step pulses. In the case of buffered stepping, incoming step pulses are received at a high rate and are buffered into counters. When all of the steps have been received, they are issued at a ramped stepping rate to the stepper drivers.

Each pulse will cause the heads to move either one track in or one track out depending on the level of the Direction In line. A true on the Direction In line will cause an inward seek. A false on the Direction In line will result in an outward seek toward TK000.

1.4.4 Head Selection

Any of the four possible heads can be selected by placing the binary address for that head on the two Head Select lines.

1.4.5 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 that the drive is ready.
- d. Selecting the appropriate head.

1.4.6 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. Clearing any write fault conditions, if they exist, by reselecting the drive.
- d. Selecting the proper head.
- e. Activating Write Gate and placing data on the Write Data line.

SECTION II ELECTRICAL INTERFACE

2.1 INTRODUCTION

The interface of the SA1000 can be divided into two categories:

- a. Signal interface
- b. Power interface

The following paragraphs provide the electrical definition for each category.

2.2 SIGNAL INTERFACE

The signal interface consists of three categories of lines:

- a. Control Input lines
- b. Control Output lines
- c. Data Transfer lines

All control lines are digital and provide signals to the drive (input) or provide signals to the disk controller (output) via the interface connector J1/P1. The data transfer signals are differential in nature, and provide data and clocking to or from the drive via J2/P2.

NOTE

In figure 2-1, signal lines marked SPARE are uncommitted. These lines may be used as alternate lines to carry SA1000 signals. Those signal lines marked N/A are uncommitted for the SA1000. They are assigned for the SA800/850. Therefore, these lines should not be used as alternate signal lines if a controller having an SA800/850 interface is used.

2.2.1 Control Input Lines

The control input signals are of two types: those to be multiplexed in a multiple drive system and those to control the multiplexing. The control input signals to be multiplexed are STEP, DIRECTION IN, HEAD SELECT 2⁰ and 2¹, WRITE GATE, and REDUCED WRITE CURRENT. The signals to do the multiplexing are DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3, and DRIVE SELECT 4.

The input lines have the following electrical specifications (see figure 2-2).

The 7438 has the following characteristics:

True = 0.0 to 0.4 Vdc @ I_{in} = 40 mA (max)

False = 2.5 to 5.25 Vdc @ I_{in} = 250 μA (open)

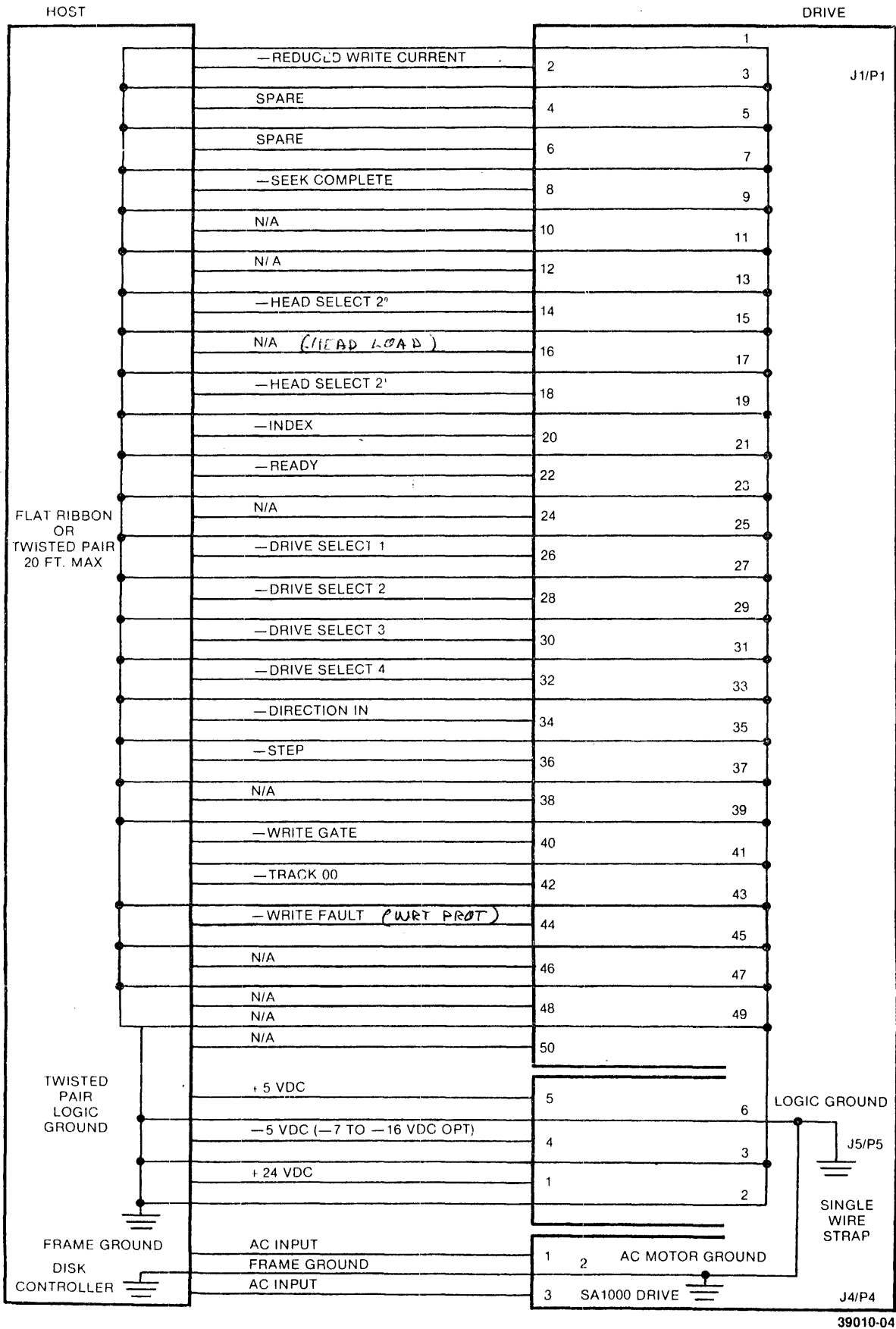
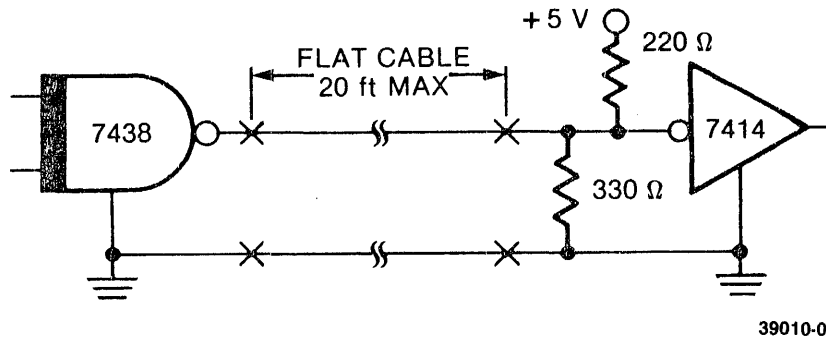


FIGURE 2-1. J1 INTERFACE AND POWER CONNECTION

Only one drive in the system should be terminated if floppy disks are daisy-chained together with SA1000 drives. A SA1000 should be physically located at the end of the cable and terminated at IC location 8C.

A 220/330 Ω resistor pack (IC location 8C) provides input line termination. If multiple drives are used the resistor pack must be on the last physical drive.



39010-05
FIGURE 2-2. CONTROL INPUT DRIVER/RECEIVER COMBINATION

2.2.2 Drive Select 1-4

DRIVE SELECT, when logically true, connects the drive to the control lines. Only one DRIVE SELECT line may be active at a time.

Jumper options DS1, DS2, DS3, and DS4 are used to select which drive select line will activate the interface for that unique drive.

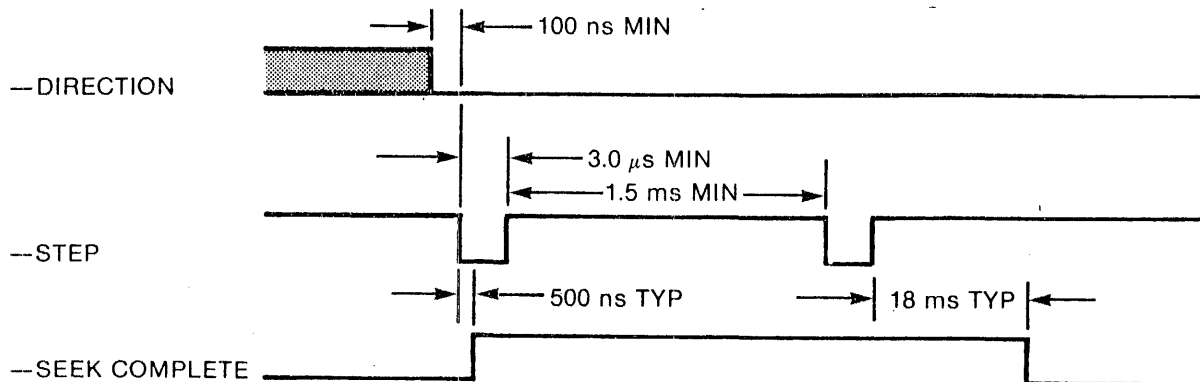
2.2.3 Direction In

This signal defines the direction of motion of the read/write heads when the Step line is pulsed. An open circuit or logical false, defines the direction as out. If a pulse is applied to the Step line, the read/write head will move away from the center of the disk. If the input is shorted to ground, or logical true, the direction of motion is defined as in. If a pulse is applied to the Step line, the read/write heads will move towards the center of the disk.

2.2.4 Step

The Step line causes the read/write heads to move in the direction as defined by the Direction In line. The motion is initiated at each logical true to false transition. Any change in the Direction In line must be made at least 100 ns before the trailing edge of the step pulse. Stepping can be performed in either the normal or buffered mode:

- a. Normal Step Mode. In this mode, the read/write heads will move at the rate of the incoming step pulses. The minimum time between successive steps is 1.5 ms with a minimum pulse width of 3.0 μ s (see figure 2-3).



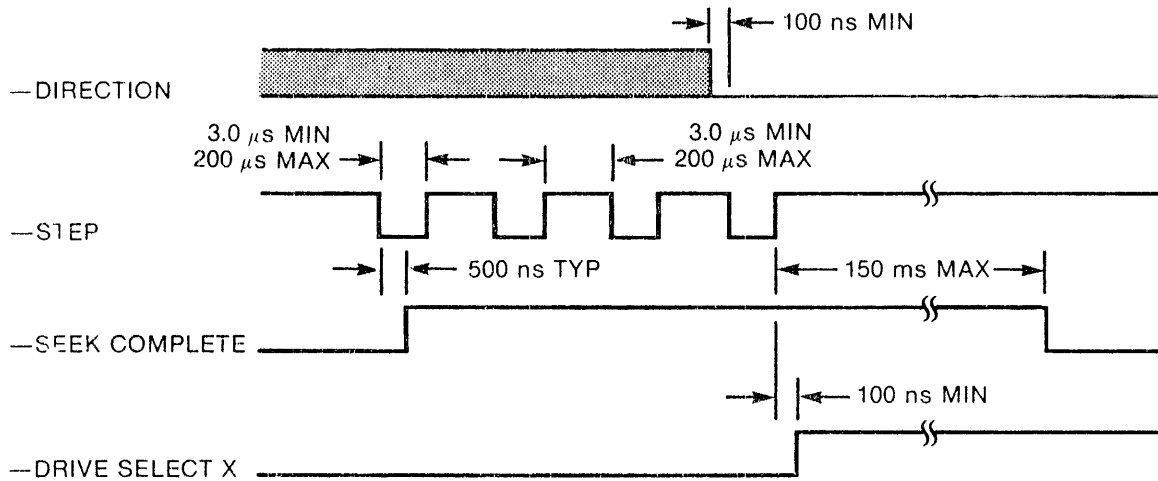
39010-06
FIGURE 2-3. NORMAL STEP MODE

- b. Buffered Step Mode. In this mode, the step pulses are received at a high rate and buffered into a counter. After the last Step pulse, the read/write heads will begin stepping the desired number of cylinders. SEEK COMPLETE (refer to paragraph 2.2.2) will go true after the read/write heads settle on the cylinder. This mode of operation is automatically selected when the time between Step pulses is equal to or less than 200 μ sec.

100 ns after the last step pulse has been sent to the drive, the Drive Select line may be dropped and a different drive selected. The maximum time between steps is 200 μ s with a minimum pulse width of 3.0 μ s (see figure 2-4).

NOTE

A high pitched noise may be present if ac and dc power are applied to an SA1000 with the data cable disconnected (no timing clock signal). This noise is caused by the stepper motor trying to return to track zero with no Step pulses present. While this will not damage the drive, this condition should be avoided.



NOTES: 1. Step pulses with periods between 200 μ s and 1.5 ms are not permitted. Seek accuracy is not guaranteed if this timing requirement is violated.

2. A 220/330 Ω resistor pack (IC location 8C) allows for Step line termination.

FIGURE 2-4. BUFFERED STEP MODE

39010-07

2.2.5 Head Select 2⁰ and 2¹

These two lines provide for the selection of each individual read/write head in a binary coded sequence. Head Select 2⁰ is the least significant line. When all Head Select lines are false, head zero will be selected. Table 2-1 shows the Head Select sequence and model variations for the Head Select lines (see figure 2-5).

A 220/330 Ω resistor pack (IC location 8C) allows for input line termination.

TABLE 2-1. HEAD SELECT

HEAD SELECT LINE		HEAD # SELECTED	
2 ⁰	2 ¹	SA1002	SA1004
1	1	0	0
1	0	1	1
0	1	--	2
0	0	--	3
(1 = FALSE, 0 = TRUE)			

39010-08

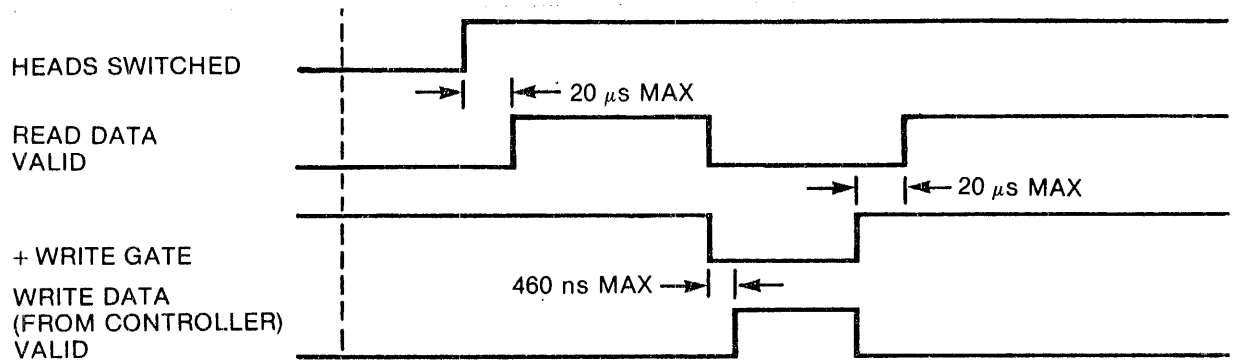


FIGURE 2-5. HEAD SELECTION TIMING

39010-09

2.2.6 Write Gate

The active state of this signal (logical zero level) enables WRITE DATA to be written onto the disk. The inactive state of this signal (logical one level) enables data to be transferred from the drive and enables Step pulses to reposition the head arm.

A 220/330 Ω resistor pack (IC location 8C) allows for termination of this line.

2.2.7 Reduced Write Current

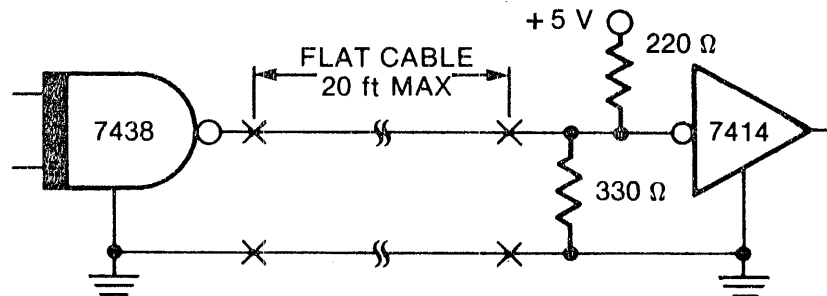
When this interface signal is low (true) the lower value of Write Current is selected (for writing on cylinders 128 through 255). When this signal is high (false), the higher value of Write Current is selected (for writing on cylinders 0 through 127). A 220/330 Ω resistor pack (IC location 8C) allows for line termination.

2.2.8 Control Output Lines

The control output signals are driven with an open collector output stage capable of sinking a maximum of 40 mA at logical zero (true) with a maximum voltage of 0.4 V measured at the driver. When the line driver is at logical one (false) the driver transistor is off and the collector cut off current is a maximum of 250 mA.

All J1 output lines are enabled by their respective Drive Select line.

Figure 2-6 shows the recommended control signal driver/receiver combination.



39010-05

FIGURE 2-6. CONTROL OUTPUT DRIVER/RECEIVER COMBINATION

2.2.9 Track 00

This interface signal indicates a true state (logical zero) only when the read/write heads of the selected drive are at track zero (outermost data track) and the access circuitry is driving current through phase one of the stepper motor. This signal is false (logical one) when the read/write head of the selected drive is not at track zero.

2.2.10 Index

The drive provides this interface signal once each revolution (19.2 ms) to indicate the beginning of the track. Normally, this signal is a logical one and makes the transition to logical zero for a period of approximately 10 μ s once each revolution (see figure 2-7).

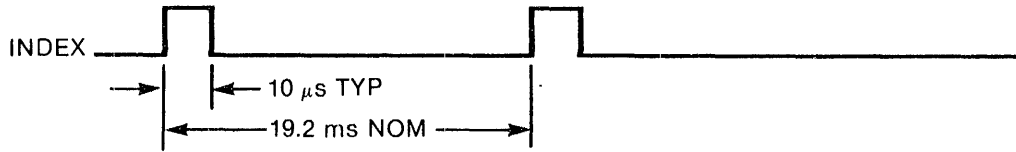


FIGURE 2-7. INDEX TIMING

39010-11

2.2.11 Ready

This interface signal, when true (logical zero), together with SEEK COMPLETE, indicates that the drive is ready to read, write, or seek and that the signals are valid. When this line is false (logical one), all writing to the disk and seeking is inhibited at the drive.

READY will be true after the drive is $95 \pm 2\%$ up to speed. The typical time for READY to become true after power on is 5 seconds.

2.2.12 Write Fault

This signal when active (logical zero) is used to indicate that a condition exists at the drive that could cause improper writing on the disk. A WRITE FAULT occurs whenever one of two conditions occur:

- a. WRITE CURRENT in the head without WRITE GATE active.
- b. Multiple heads selected.

To reset the Write Fault line, deselect the drive for at least 500 ns.

2.2.13 Seek Complete

SEEK COMPLETE will go true (logical zero) when the read/write heads have settled on the final track at the completion of a seek. Reading or writing should not be attempted until SEEK COMPLETE is true. SEEK COMPLETE will go false whenever one of two conditions occur:

- a. A recalibration sequence is initiated by the drive logic at power on when the read/write heads are not over track zero.
- b. 500 ns (typical) after the leading edge of a Step pulse or the first of a series of step pulses.

2.2.14 Data Transfer Lines

All lines associated with the transfer of data between the drive and the host are differential and may not be multiplexed. These three pairs of balanced signals are: MFM WRITE DATA, MFM READ DATA, and TIMING CLOCK. These signals are provided at the J2/P2 connectors on all drives. Figure 2-8 shows the driver/receiver combination and figure 2-9 shows the J2/P2 interface connections.

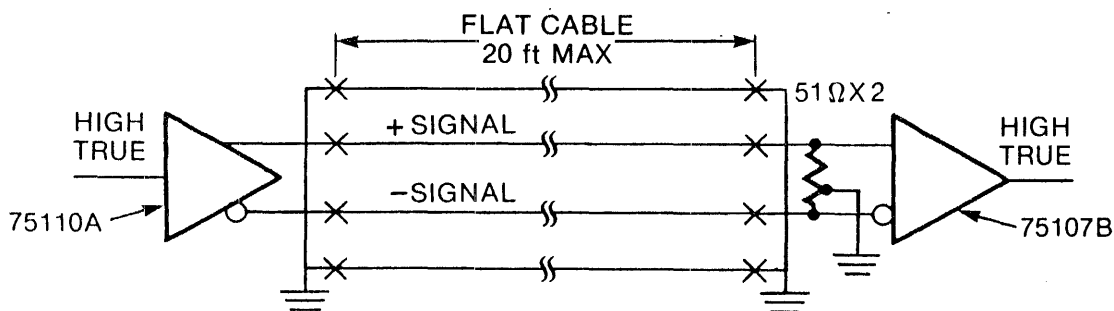


FIGURE 2-8. DATA TRANSFER LINE DRIVER/RECEIVER COMBINATION

39010-12

2.2.15 MFM Write Data

This pair of signals defines the transitions (bits) to be written on the disk. +MFM WRITE DATA going more positive than -MFM WRITE DATA will cause a flux reversal on the track under the selected head providing WRITE GATE is active. This signal must be driven to an inactive state (+MFM WRITE DATA more negative than -MFM WRITE DATA) by the host system when in the read mode. Figure 2-10 shows the timing for MFM WRITE DATA.

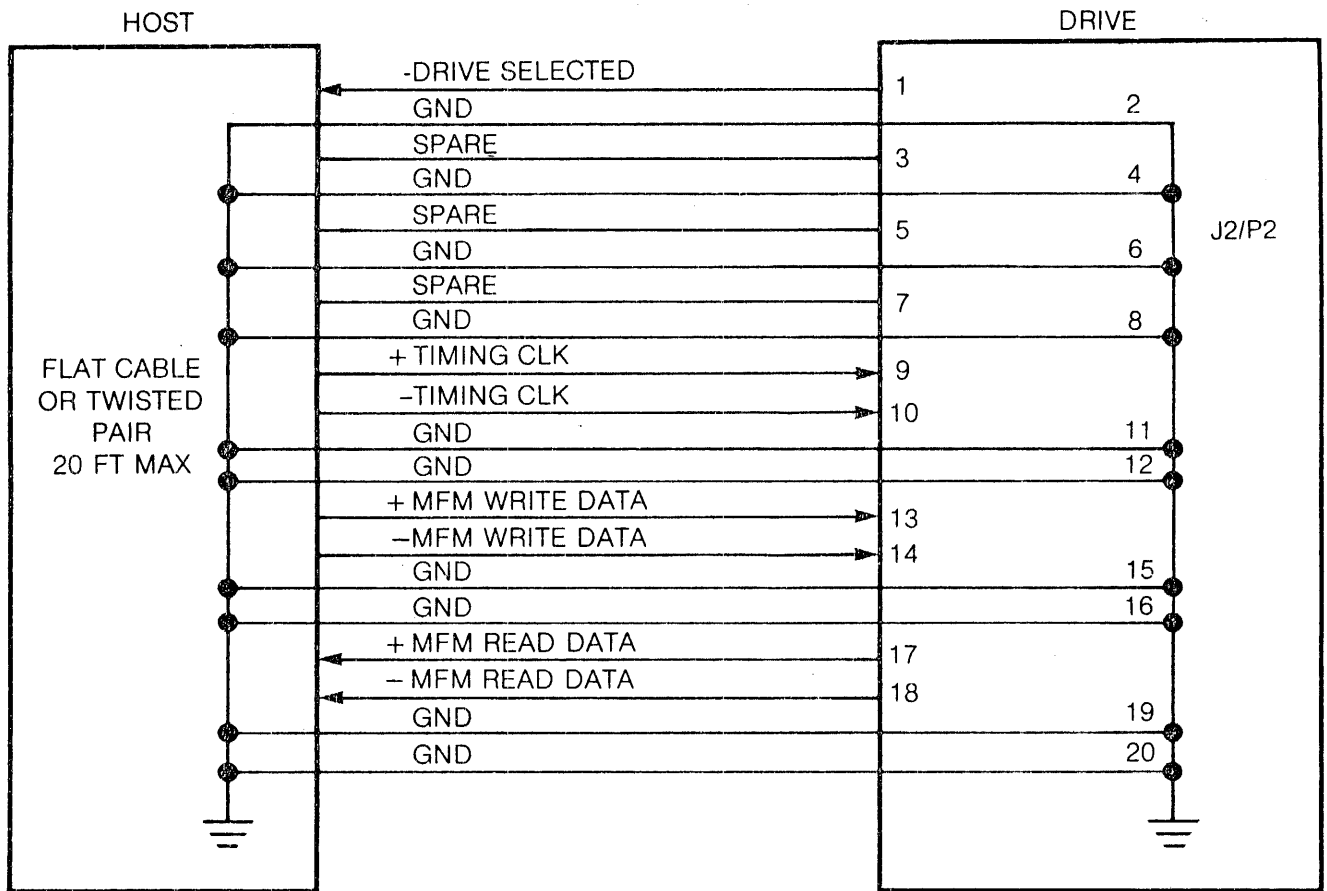


FIGURE 2-9. J2 INTERFACE CONNECTION

39010-13

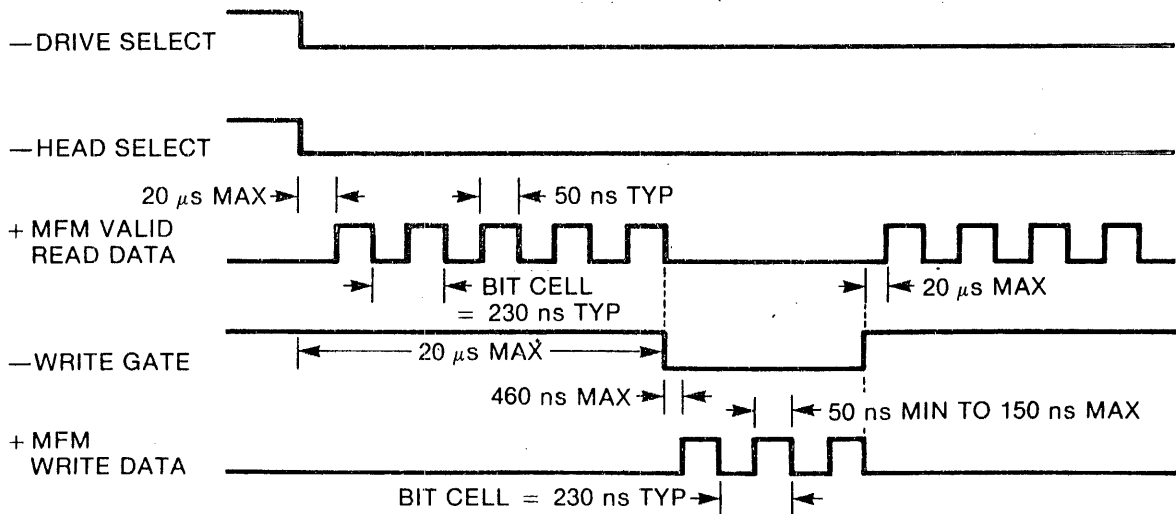


FIGURE 2-10. MFM READ/WRITE DATA TIMING

39010-14

2.2.16 MFM Read Data

The data recovered by reading a pre-recorded track is transmitted to the host system via the differential pair of MFM Read Data lines. This transition of the +MFM Read Data line going more positive than -MFM Read Data line represents a flux reversal on the track of the selected head while WRITE GATE is inactive (see figure 2-10).

2.2.17 Timing Clock

This is a differential pair of clock signals (provided by the host) having a 50% (nominal) duty cycle and a $3.6866 \mu\text{s} \pm 0.1\%$ period. The frequency of this clock is exactly 1/16 the bit frequency for the standardized write data. Phase relationship between TIMING CLOCK and MFM WRITE DATA need not be maintained by the host for the SA1000 interface. The TIMING CLOCK is used by the drive logic for clocking and timing purposes.

2.2.18 Select Status

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

The Drive Selected line is driven by a TTL open collector driven as shown in figure 2-6. This signal will go active only when the following conditions are met:

- a. The drive is programmed as drive X (X = 1, 2, 3, and 4) by proper placement of the shorting plug in the vicinity of J1.
- b. Drive Select X line at J1/P1 is activated by the host system.

2.2.19 General Timing Requirements

The timing diagram as shown in figure 2-11 shows the necessary sequence of events (with associated timing restrictions) for proper operation of the drive.

NOTE

A recalibrate to track zero sequence is initiated automatically at every dc power on. For this auto-recal sequence to function, the following conditions must be met:

- a. TIMING CLOCK is supplied to the drive via J2/P2.
- b. STEP input at J1/P1 is held inactive.
- c. Spindle is spinning at regular speed. (If ac and dc are switched on at the same time, stepping action will not occur until disk is up to speed.)

2.3 POWER INTERFACE

The SA1000 requires both ac and dc power for operation. The ac power is used for the drive motor. The dc power is used for the electronics and the stepper motor.

2.3.1 AC Power

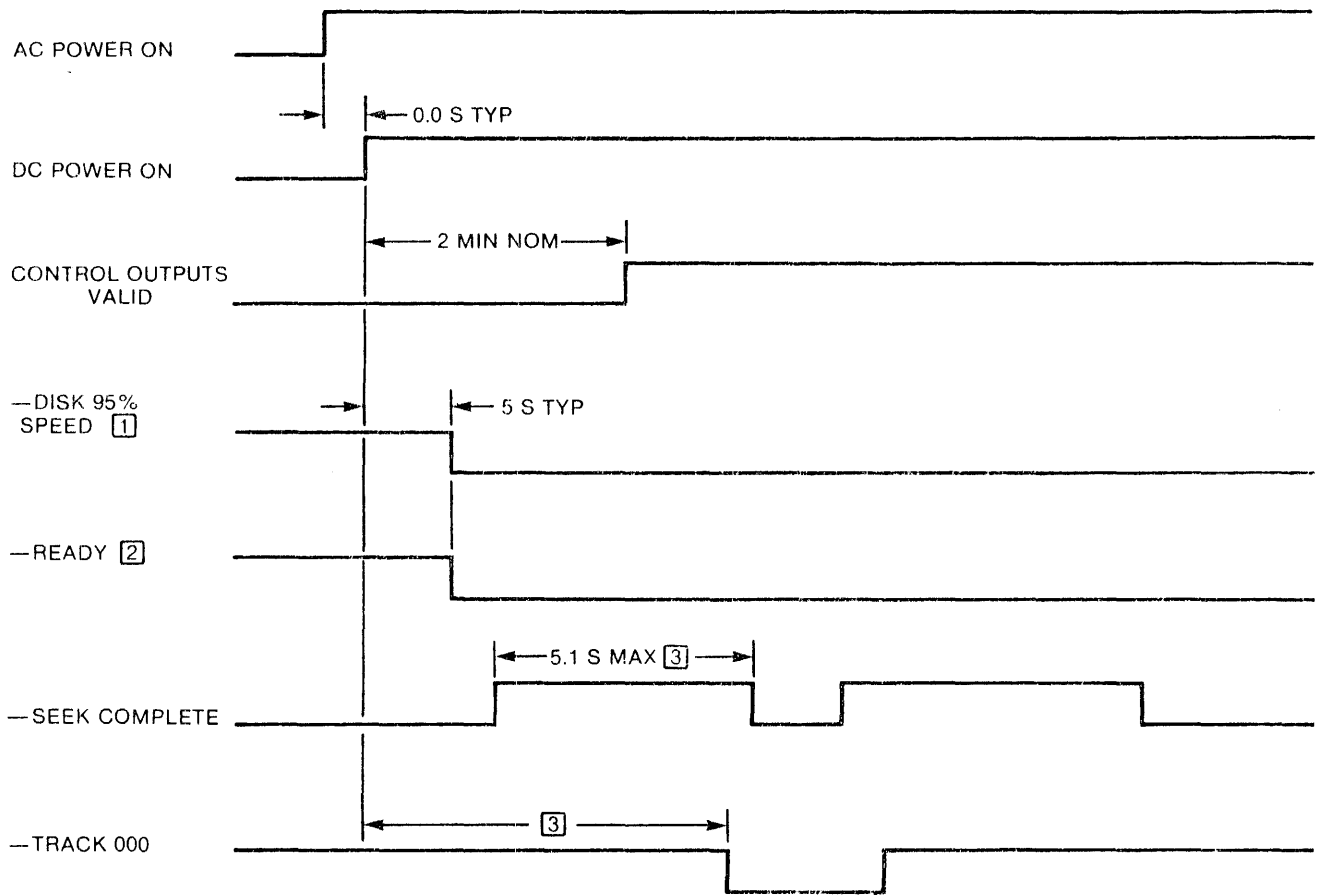
The ac power is via the connector J4 mounted at the center rear of the drive. Table 2-2 shows a listing of the ac power requirements.

2.3.2 DC Power

DC power to the drive is via connector J5/P5 located on the solder side of the PCB. The three dc voltages and their specifications along with their J5/P5 pin designations are outlined in table 2-3.

NOTE

The SA1000 is shipped with dc (base casting) and ac ground (drive motor) connected together with a ground strap located on the drive motor. If the system configuration requires the separation of these grounds, remove the strap.



- NOTES:**
- 1 Disk up to speed signal does not connect to the drive interface cable.
 - 2 The drive will bring READY active as soon as the disk is rotating at 95% of normal speed. It is now safe to seek the drive but an additional 2 minutes should be allowed for thermal expansion to stabilize.
 - 3 Time for recalibration is dependent on position of R/W heads at ac and dc power on.

FIGURE 2-11. GENERAL CONTROL TIMING REQUIREMENTS.

39010-14-A

2.4 FRAME GROUND

It is important that the drive be frame grounded to the ac ground or frame ground of the host system. Failure to do so may result in drive noise susceptibility. Refer to paragraph 3.3 for the procedure.

TABLE 2-2. AC POWER REQUIREMENTS

P4 CONNECTOR	60 HZ		50 HZ	
	110 V (STANDARD)	203/230 V	110 V	220 V
1	90 - 127 V	180 - 253 V	90 - 127 V	180 - 253 V
2	FRAME GND	FRAME GND	FRAME GND	FRAME GND
3	90 - 127 V RTN	180 - 253 V	90 - 127 V RETURN	180 - 253 V
MAX INRUSH CURRENT (3 SEC)	4.0 A	TBS	TBS	TBS
MAX RUN CURRENT	1.0 A	0.5 A	1.1 A	0.6 A
FREQ TOLERANCE	± 0.5 HZ		± 0.5 HZ	

39010-16

TABLE 2-3. DC POWER REQUIREMENTS

P5 CONNECTOR	CURRENT			
	STEADY STATE		STEPPING	
	MAX	TYP	MAX	TYP
+ 24 ± 2.4 V 1 V P-P MAX RIPPLE	3.3 A	2.8 A	3.3 A	2.8 A
+ 5 ± 0.25 V 50 mV P-P MAX RIPPLE	4.1 A	3.6 A	2.5 A	2.0 A
(- 7 TO - 16 V OPT) - 5 ± 0.25 V 50 mV P-P MAX RIPPLE	0.25 A	0.20 A	0.25 A	0.20 A

39010-17

SECTION III PHYSICAL INTERFACE

3.1 INTRODUCTION

The electrical interface between the SA1000 and the host system is via four connectors. The first connector, J1, provides control signals for the drive. The second connector, J2, provides for the radial connection of the read/write signals. The third connector, J5, provides dc power. The fourth connector, J4, provides ac power and frame ground. See figure 3-1 for connector locations.

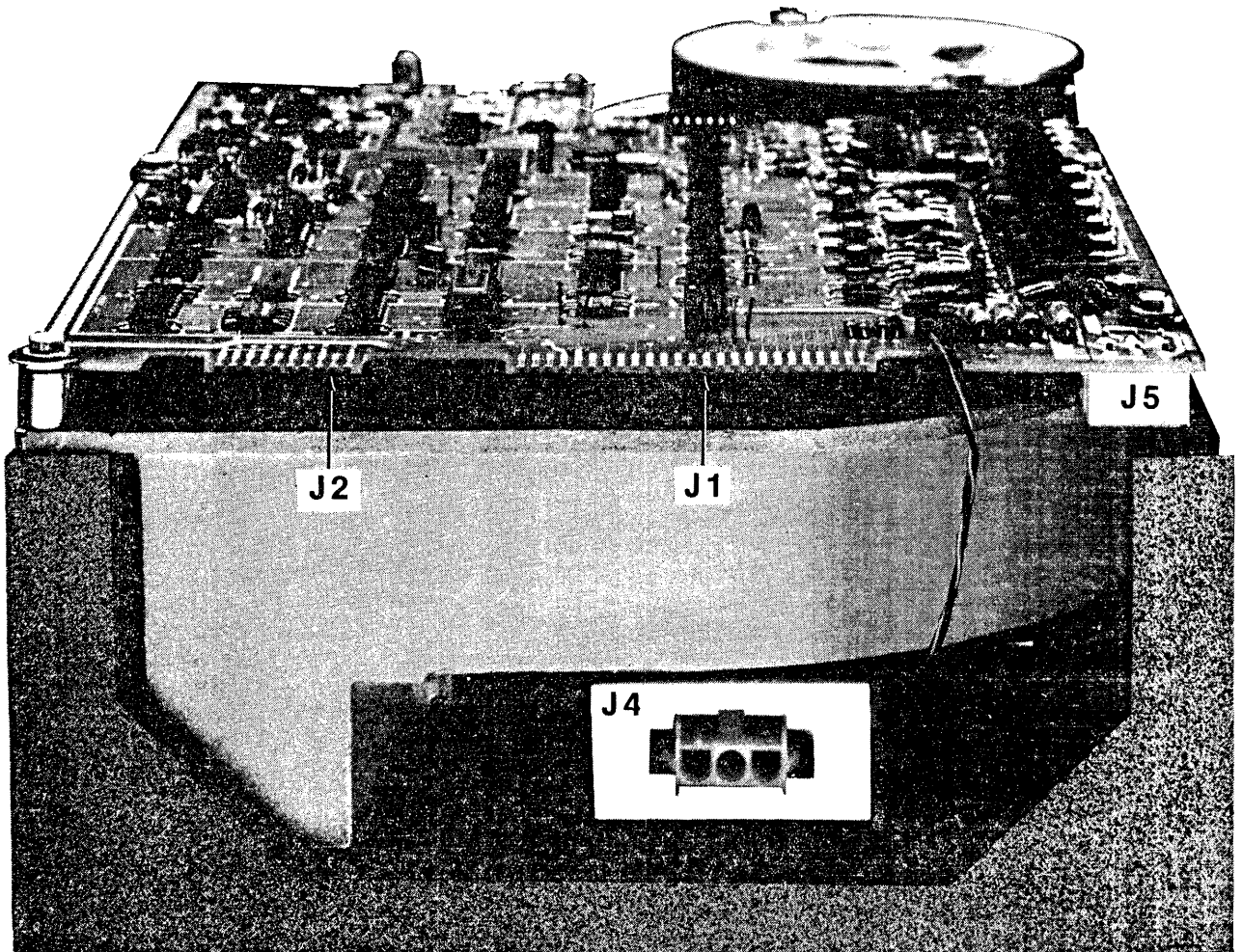


FIGURE 3-1. CONNECTOR LOCATIONS

39010-18

3.2 CONNECTORS

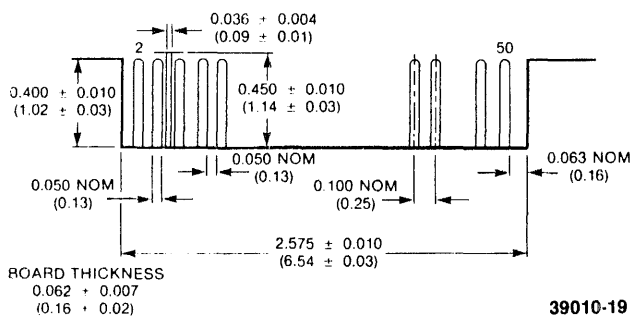
3.2.1 J1/P1 Connector

Connection to J1 is through a 50 pin PCB edge connector. The dimensions for this connector are shown in figure 3-2. The pins are numbered 1 through 50 with the even numbered pins located on the component side of the PCB. Odd pins are located on the non-component side of the PCB. Pin 2 is located on the end of the PCB connector closest to the J2 connector and is labeled. A key slot is provided between pins 4 and 6. The recommended mating connector for P1 is a Scotchflex ribbon connector (P/N 3415-0001).

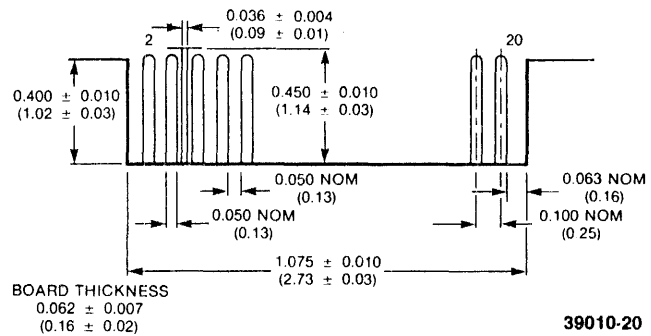
3.2.2 J2/P2 Connector

Connection to J2 is through a 20 pin PCB edge connector. The pins are numbered 1 through 20 with the even numbered pins located on the component side of the PCB. The recommended mating connector for P2 is a Scotchflex ribbon connector (P/N 3461-0001). A key slot is provided between pins 4 and 6. Figure 3-3 shows the dimensions for the connector.

NOTE: Top nos. in inches. (Bottom nos.) in cm.



39010-19



39010-20

FIGURE 3-2. J1 CONNECTOR DIMENSIONS

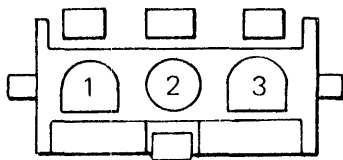
FIGURE 3-3. J2 CONNECTOR DIMENSIONS

3.2.3 J4/P4 Connector

AC power and frame ground are interfaced through a 3 pin connector, J4, located on the end of the drive. The AMP part number for J4 is 1-480701-0 with pins AMP P/N 350687-1 and 350654-1 (ground pin). The recommended mating connector, P4, is AMP socket P/N 1-480700-0 with AMP P/N 350536-1. See figure 3-4.

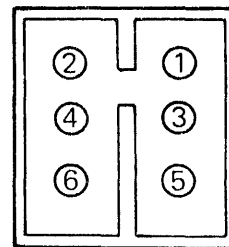
3.2.4 J5/P5 Connector

The dc power connector, J5, is a 6-pin AMP Mate-N-Lok connector (P/N 1-380999-0) mounted on the non-component side of the Control PCB. The recommended mating connector, P5, is an AMP P/N 1-480270-0 using AMP pins (P/N 60619-1). The J5 pins are labeled on the connector (see figure 3-5).



39010-21

FIGURE 3-4. J4 CONNECTOR



39010-22

FIGURE 3-5. J5 CONNECTOR

3.3 FRAME GROUNDING

The drive must be frame grounded to the host to ensure proper operation. If the frame of the drive is not fastened directly to the frame of the host system with a good ac ground, a wire from the system ac frame ground must be connected to the drive. For this purpose, a faston tab is provided on the drive where a faston connector can be attached or soldered.

3.3.1 Drive Ground

The drive is shipped with dc ground (base casting) and ac ground (drive motor) connected together with a ground strap located on the drive motor. If system configuration requires the separation of these grounds, remove the ground strap.

3.3.2 Logic Ground

All PCB logic ground planes are connected to the drive base casting through the PCB mounting screws.

SECTION IV DRIVE PHYSICAL SPECIFICATIONS

4.1 GENERAL

This section describes the mechanical dimensions and mounting recommendations for the SA1000.

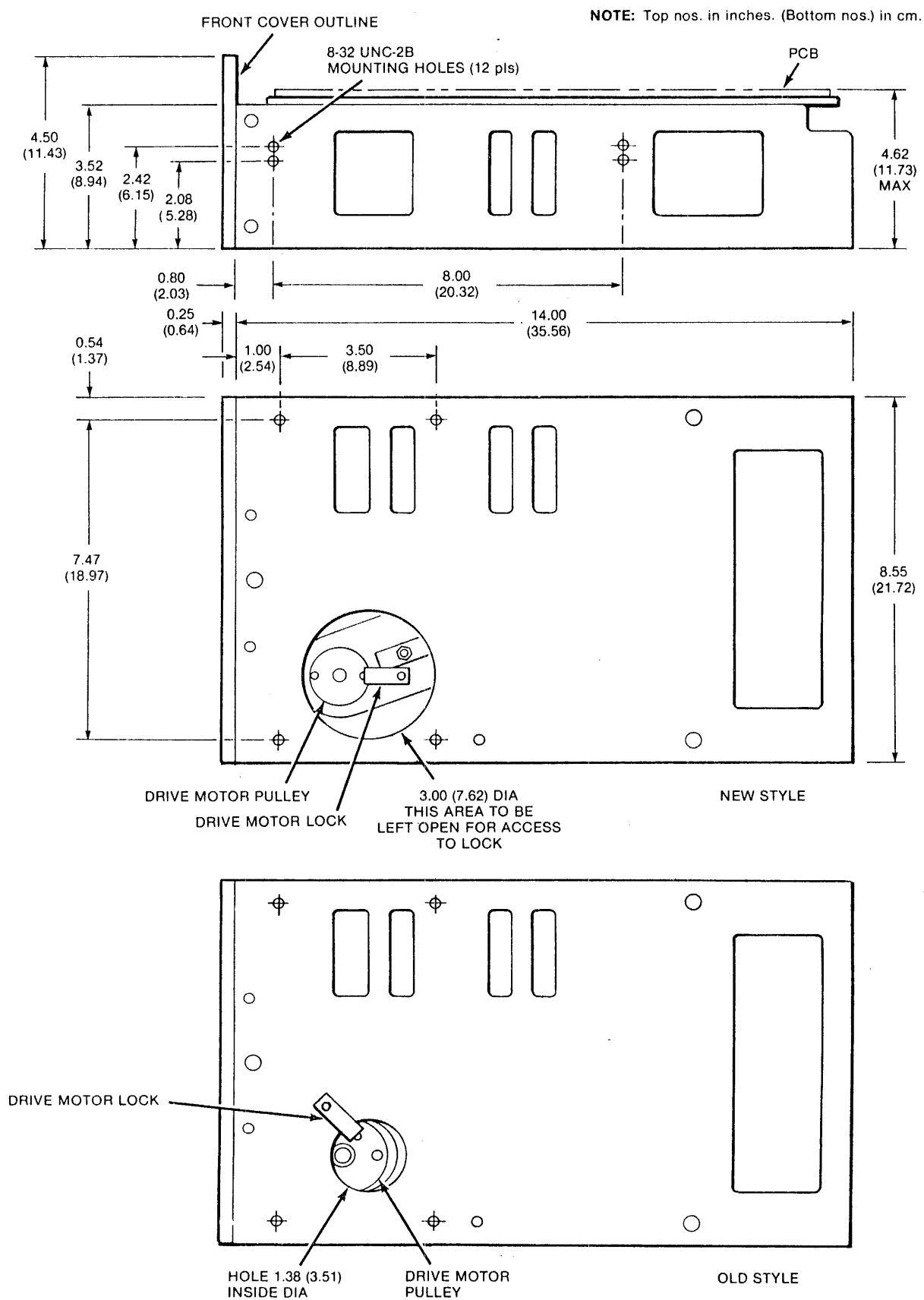
4.2 MECHANICAL DIMENSIONS

See figures 4-1 and 4-2 for the dimensions of the SA1000.

4.3 MOUNTING

The SA1000 is capable of being mounted in either one of the following positions:

- a. Vertical — on either side.
- b. Horizontal — PCB up.
- c. Upright — Front panel up or down.



39010-23

FIGURE 4-1. RACK MOUNT PHYSICAL DIMENSIONS

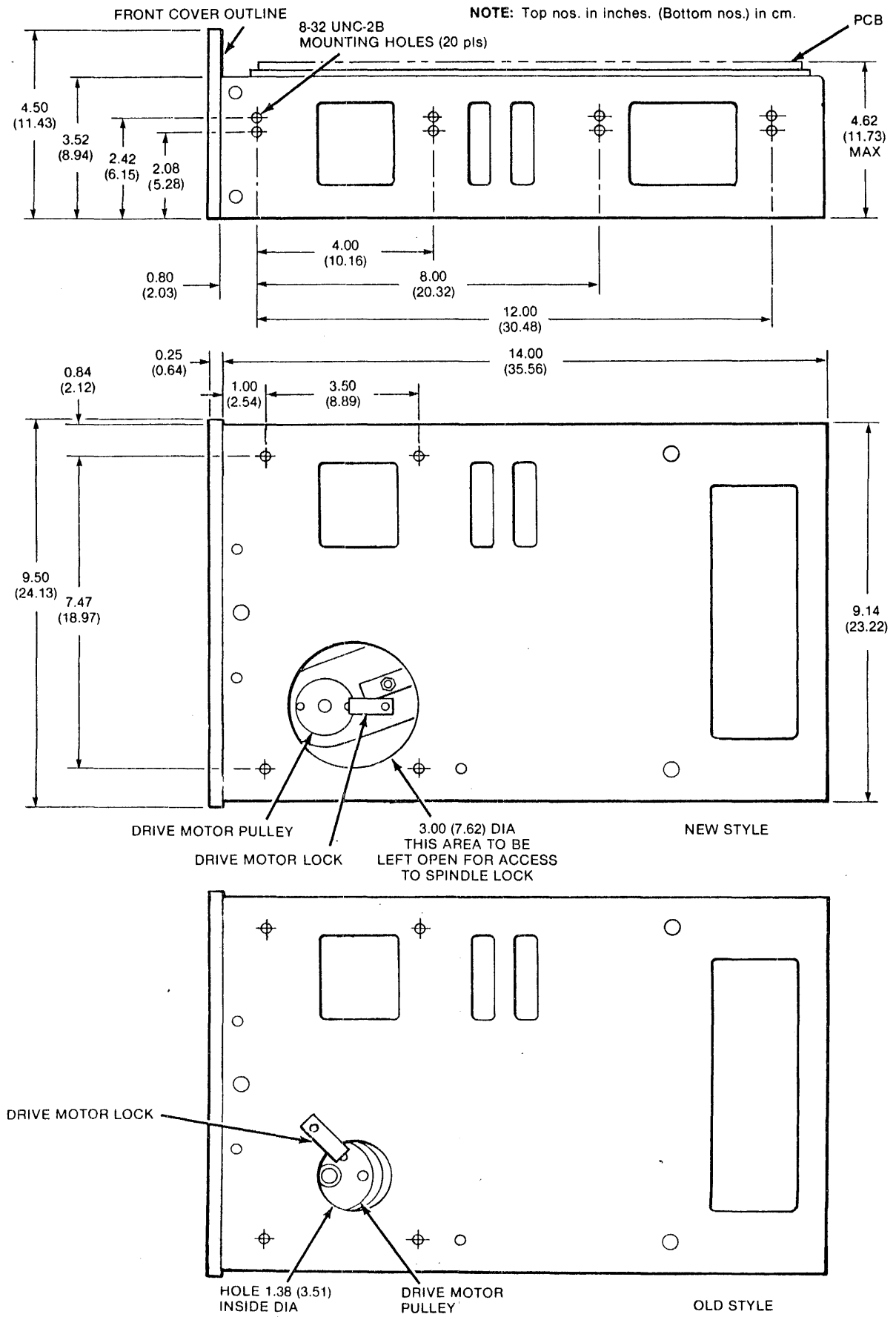


FIGURE 4-2. STANDARD MOUNT PHYSICAL DIMENSIONS

39010-24

SECTION V

MEDIA DEFECTS AND ERRORS

5.1 ERROR MAPPING AND QUALIFICATION

In high density digital recording storage systems it is necessary to increase the reliability and improve the operational performance. This is done by providing an error detection and correction scheme. For disk storage systems, the predominant error pattern is a burst of errors occurring in one or more tracks. These errors are drop outs (absent bits), drop ins (added bits), or bits shifted from their nominal position beyond the tolerance of the data separator.

5.1.1 Causes of Errors

The following conditions may result in errors:

- a. Marginal signal-to-noise ratio of read/write circuits.
- b. Marginal noise and phase characteristics of the media and read/write heads.
- c. Mispositioning of read/write heads on the disk during read operation.
- d. Minute defects or imperfections in the disk media.

5.1.2 Error Definition

An error is a discrepancy between recovered data and the true correct recorded data. There can be an extra bit or a missing bit. For example, a zero can be transformed into a one or a one can be changed to a zero. Bits can also be shifted from their nominal positions in the data stream due to pulse superposition, disk speed variation, or random noise.

Errors fall into two categories: Hard or Soft. Hard errors are the result of media defects and will be repeatable for six consecutive retries. Soft errors are caused by items a through c under paragraph 5.1.1, and will not be repeatable for six retries.

Some hard errors may be ignored if they reside in an unused area of the format. For those areas that contain media defects, alternate track/sector areas must be allocated or the area simply avoided. Media defects are addressed per level controller and software sophistication, i.e., skips and/or reassignment of bad sector(s), or skip and/or reassignment of bad track(s). Refer to paragraph 5.1.5 below.

5.1.3 Media Defect Definition

Most errors resulting from media defects are classified as hard errors. They are attributable to small imperfections in the oxide coating of the disk. Examples are such as an impurity within the oxide itself or a microscopic scratch on the surface of the oxide coating.

As the storage size and density of information increases, these defects become more apparent to the system. Winchester technology uses a higher bit packing ratio (5000 to 8000 bpi) than older types of drives and is therefore generally more susceptible to this type of error.

5.1.4 Error Map

All drives will be scanned by a special scanning device during the manufacturing process. This device will test the drive in extreme marginal conditions by measuring the amplitude of a unique signal recorded on every track of

every disk surface. All hard errors (media defects) will be logged and an error map attached to each drive. Each defect will be listed on the error map and will contain the following information:

- a. Track number
- b. Head number
- c. Byte count (Indicates the defective bytes as a location from physical index.)
- d. Length of defect in bits.

The error map accompanying each drive will typically provide the locations of more hard errors than will be detected by the user system. There are situations, however, where a magnetic anomaly or extra defects caused by improper handling in the disk coating may cause a bit shift. This shift is unique to a particular format or bit pattern. The bit shift will present itself as a hard error in addition to those reported on the error map. In the event that this situation occurs, it is recommended that this defect be added to the error map and mapped out. If the original error map is lost or missing, a copy may be obtained from Shugart Tech Support.

5.1.5 User Error Mapping

The user system should be capable of mapping the defects as listed on the error map. These include any additional hard errors found during the user's functional test. The recommended method of mapping is to create a defect directory, either at cylinder 00 or at the optional fixed heads. These heads are guaranteed to be error free. This directory would contain the locations of all defective areas as well as alternate sector/track assignments for those areas.

5.2 ERROR ACCEPTANCE CRITERIA

No head surface will have more than 12 defective tracks. Of these 12 tracks, no more than four will contain multiple defects. Additionally, track 00 of all heads is guaranteed to be error free.

A single defect is defined as an error less than two bytes long. A multiple defect is defined as an error greater than two bytes long or more than one single defect on a track. As the defects are recorded on an unformatted drive, the defected location may fall on an unused area when formatted by the customer.

5.3 SYSTEM GENERATED ERRORS

It should be noted that errors, in addition to those which are drive related, may be present as a result of system electrical noise. This noise may be due to marginal timing conditions, ground loops in the dc power distribution cables, or faulty controller power sequencing.

SECTION VI RECORDING FORMAT

6.1 SA1000 TRACK FORMAT

The purpose of a format is to organize a data track into smaller, sequentially numbered, blocks of data called sectors. The SA1000 format is a soft sector type. This means that the beginning of each sector is defined by a prewritten identification (ID) field. The ID field contains the physical sector address plus cylinder and head information. The ID field is followed by a user data field.

The soft sector format is a slightly modified version of the I.B.M. System 34 double density which is commonly used on 8 inch floppy disk drives. The encoding method used here is MFM.

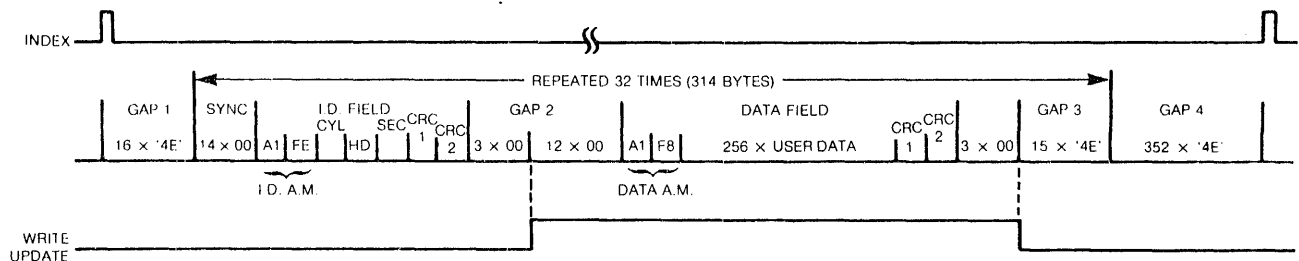
In the example shown (see figure 6-1), each track is divided into 32 sectors. Each sector has a data field of 256 bytes in length. The beginnings of both the ID field and the data field are flagged by unique characters called address marks.

An address mark is two bytes in length. The first byte is always an A1 data pattern. This is followed by an FE or an F8 pattern. FE is used to define an ID address mark. F8 is a data address mark pattern.

The A1 pattern is made unique by violating the encode rules of MFM. This is done by omitting one clock bit. The resultant address mark pattern is unique when compared to any other serial bit combination.

Each ID and data field is followed by a 16 bit cyclic redundancy check (CRC) character used for data verification. Each CRC polynomial is unique for a particular data pattern.

Surrounding the ID and data fields are gaps called Interrecord gaps.



NOTES:

1. NOMINAL TRACK CAPACITY - 10416 BYTES.
2. MINIMUM TRACK CAPACITY - (NOMINAL - 3% SPEED VARIANCE) 10102 BYTES.
3. WRITE TO READ RECOVERY TIME = 20 MICROSECONDS.
4. HEAD SWITCHING TIME = 20 MICROSECONDS.

39010-25

FIGURE 6-1. TRACK FORMAT

6.2 GAP LENGTH CALCULATIONS

6.2.1 Gap 1

The purpose of gap 1 is to provide a head switching recovery period. This is needed so that when switching from one track to another, sequential sectors may be read without waiting the rotational latency time. Gap 1 should be at least 11 bytes long which corresponds to the head switching time of 20 microseconds. Gap 1 is immediately followed by a sync field for the ID field of the first sector.

6.2.2 Gap 2

Following the ID field, and separating the ID field from the data field is gap 2. Gap 2 provides a known area for the data field write update splice to occur. The remainder of this gap also serves as the sync-up area for the data field address mark. The length of gap 2 is determined by the data separator lock up performance.

6.2.3 Gap 3

Gap 3, following the data field, is a speed variation tolerance area. Power line variations can create variations in rotational speed. This can result in a track being formatted while the disk is rotating at a 3% slower speed or write at a 3% faster speed. Gap 3 allows for this variation. Gap 3 should be at least 15 bytes long.

6.2.4 Gap 4

Gap 4 is a speed tolerance buffer for the entire track. This allows the disk to rotate at least 3% faster than normal without overflowing the track during the format operation. The format operation which writes the ID fields, begins with the first encountered index and continues to the next index.

6.3 WRITE PRECOMPENSATION

Whenever two bits are written in close proximity to each other, a phenomenon called pulse superposition occurs. Pulse superposition tends to cause the two bits to move away from each other. This is a large factor of bit shift. Other phenomenon such as random noise and speed variation will also cause bit shift but to a lesser degree.

The effect of bit shift can be reduced by a technique called precompensation. This technique detects which bits will occur early and which will occur late. The bits are then written in the opposite direction of the expected shift. Bit shift is more apparent on the innermost data tracks due to pulse crowding. Therefore, precompensation should only be at a track number greater than 128. The optimum amount of pre-compensation for the SA1000 is 12 nanoseconds for both early and late written bits. Table 6-1 shows various bit patterns for pre-compensation.

Precompensation Pattern Detection bits are shifted through a four bit shift register. The bit is written out of the the third position.

TABLE 6-1. WRITE PRECOMPENSATION

WRITE POSITION	DIRECTION OF SHIFT
0 0 0 0	= On Time Clock
0 0 0 1	= Late Clock
0 0 1 0	= On Time Data
0 0 1 1	= Early Data
0 1 0 0	-----
0 1 0 1	-----
0 1 1 0	= Late Data
0 1 1 1	= On Time Data
1 0 0 0	= Early Clock
1 0 0 1	= On Time Clock
1 0 1 0	= On Time Data
1 0 1 1	= Early Data
1 1 0 0	-----
1 1 0 1	-----
1 1 1 0	= Late Data
1 1 1 1	= On Time Data

39214-24

SECTION VII CUSTOMER INSTALLABLE OPTIONS

The following jumper options are located on the control PCB (P/N 26050 and 26073). P/N 26073 replaces P/N 26050. However, jumper locations remain the same as shown in figure 7-1.

Jumper	Function
Fault	When jumpered, this option disables the fault detection circuitry.
Ready	When jumpered, this option enables an active READY signal at the interface.
Drive Select (DS1 - 4)	When jumpered, this option selects the designated drive.
-5, -15 Volts	When jumpered in the -5 volt configuration, this option bypasses the regulator chip. The -5 volts is used when the input voltage is rated at -5 volts. When jumpered in the -15 volt configuration, this option allows a -15 volt input to be regulated to -5 volts.

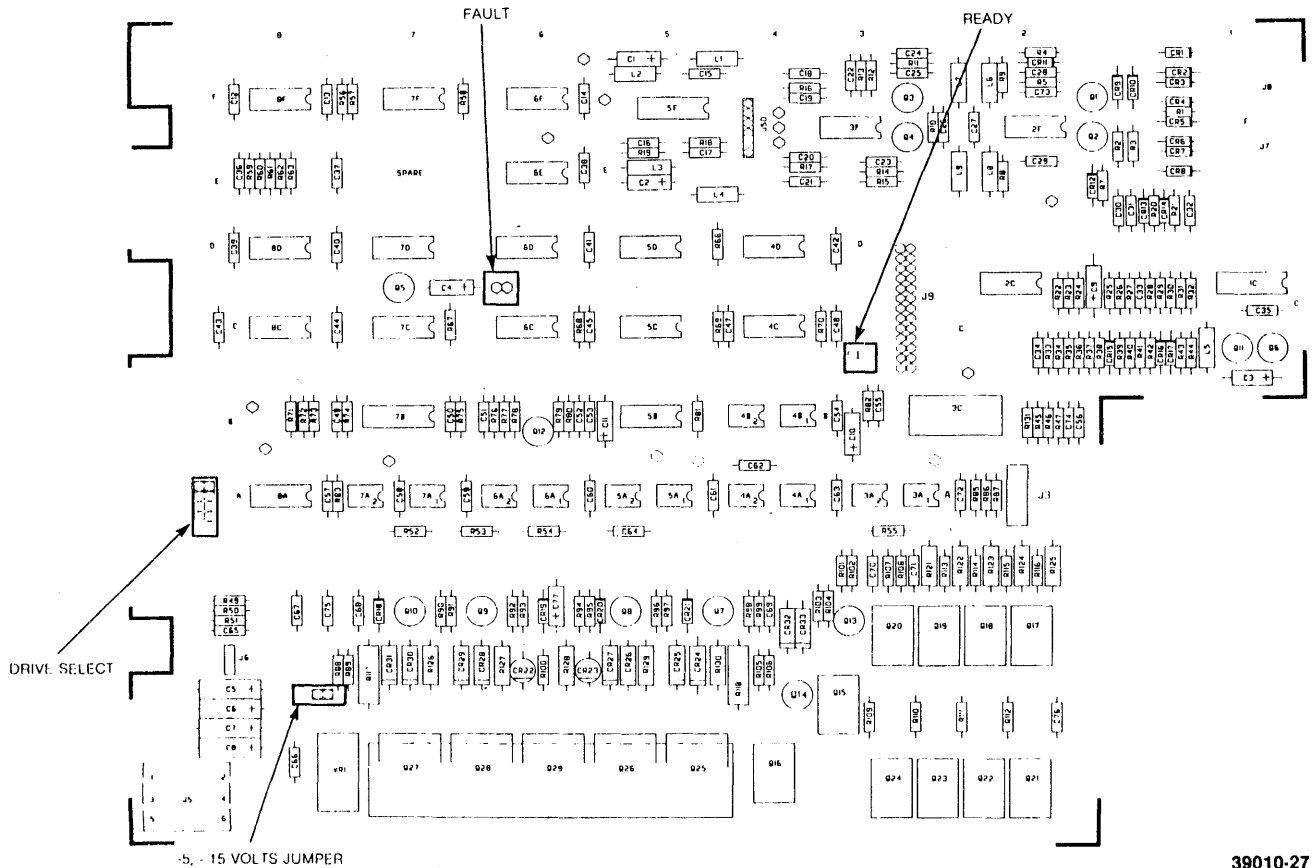
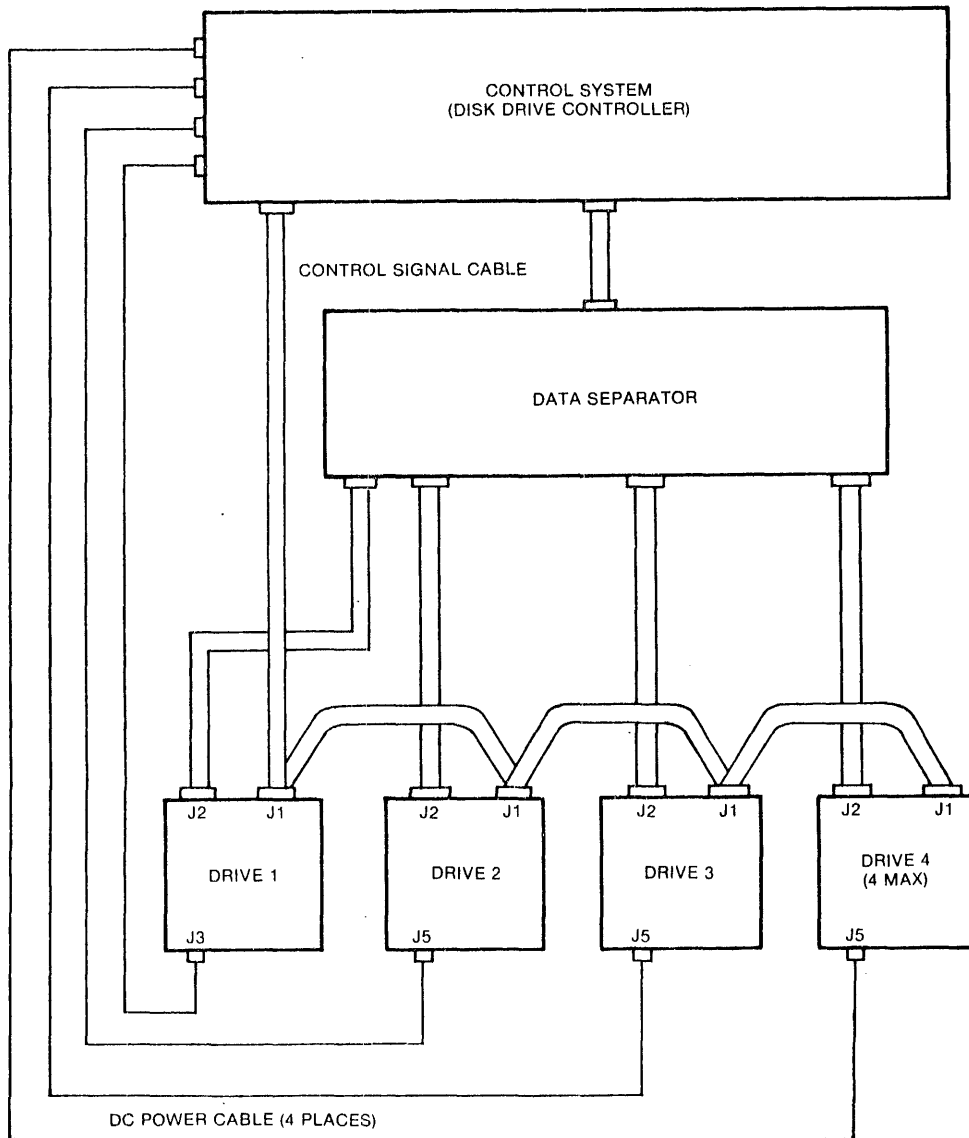


FIGURE 7-1. SA1000 CONTROL PCB

SECTION VIII DRIVE INTERCONNECT

The electrical connection between the SA1000 and the control system is shown in figure 8-1. For daisy-chain configuration, the last drive in the chain requires terminating resistors. The terminating resistor network is shown in figure 2-6. A 220/330 ohms resistor pack is used for signal cable line termination.



NOTE: THE LAST DRIVE IN DAISY-CHAIN REQUIRES TERMINATING RESISTOR NETWORK.

39214-20

FIGURE 8-1. MULTIPLE DRIVE SYSTEM DAISY CHAIN CONNECTION

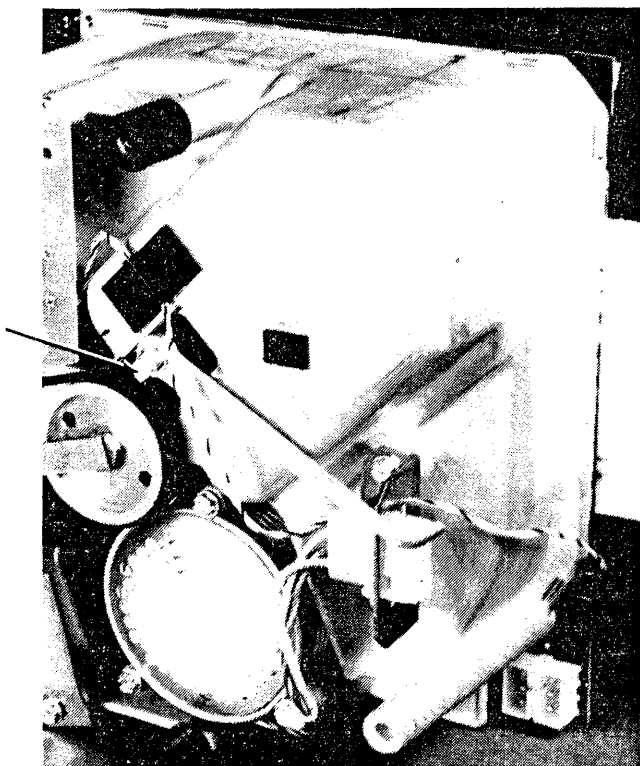
SECTION IX PACKAGING INSTRUCTIONS

9.1 SA1000 UNPACKAGING INSTRUCTIONS

CAUTION

These instructions must be carefully followed to ensure proper operation of the drive.

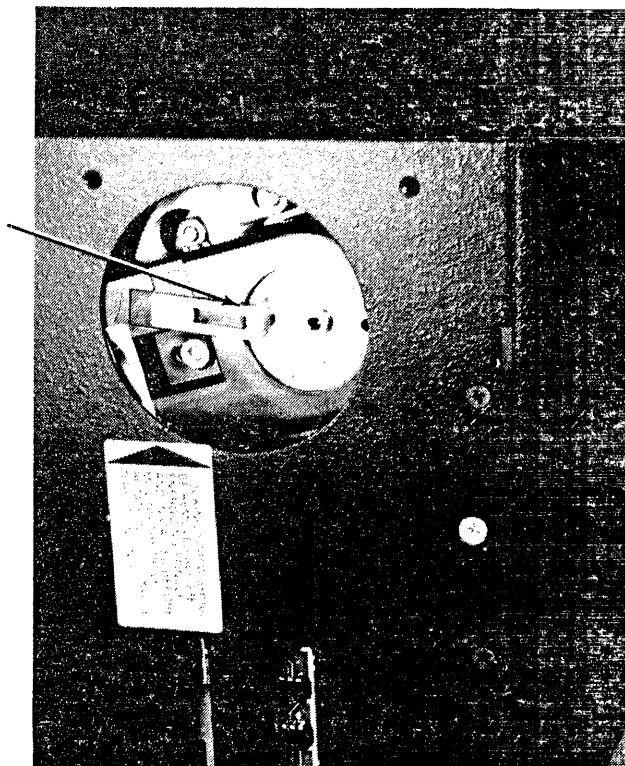
- a. The spindle lock (P/N 60464) must be removed before applying ac power to the drive (see figures 9-1 and 9-2). Retain the lock for reinstallation prior to transporting the drive.
- b. To prevent possible damage to the heads and media, rotate the spindle in a clockwise direction only.
- c. To isolate the ac ground from logic ground, remove the motor ground strap (P/N 60060).



(Shown in locked position)

39010-28

FIGURE 9-1. PROPOSED SPINDLE LOCK



39010-29

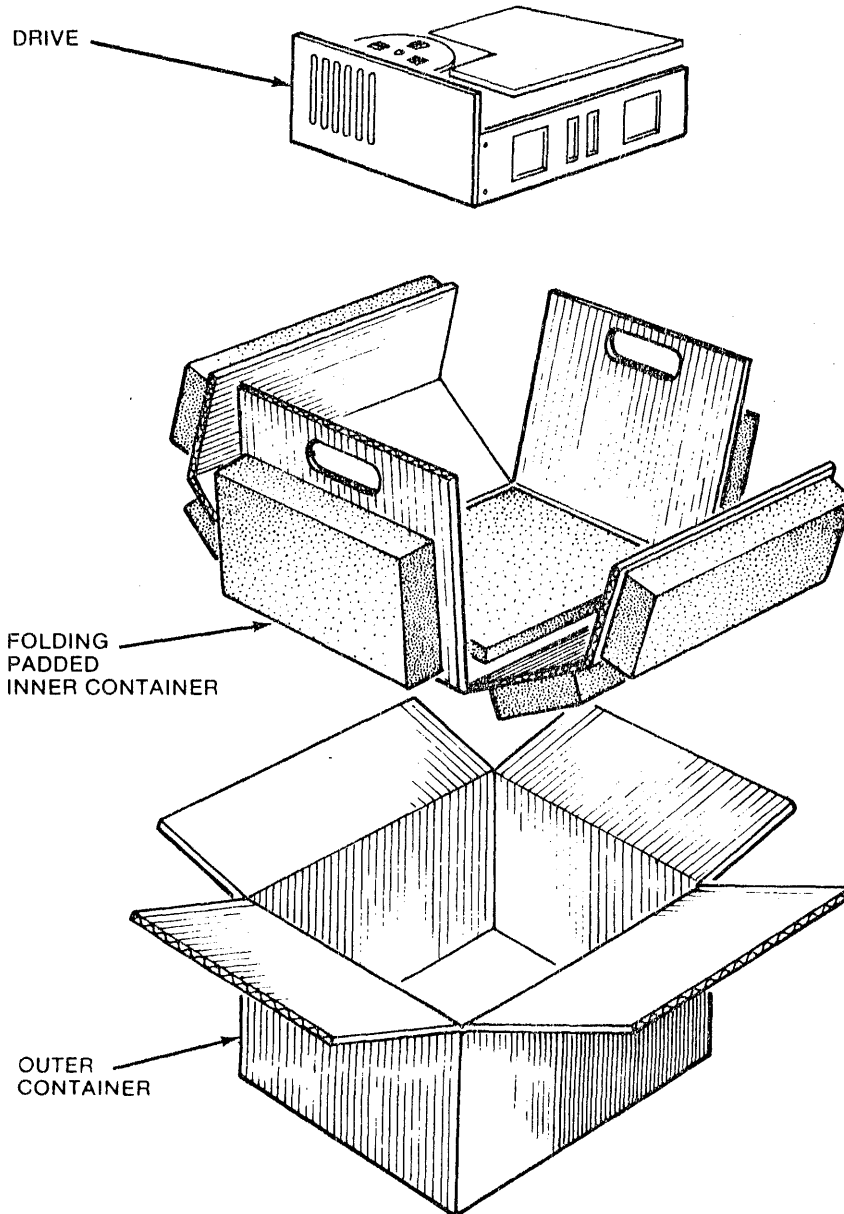
FIGURE 9-2. CURRENT SPINDLE LOCK

9.2 PACKING FOR RESHIPPING

It is suggested that packing material be kept in case the unit must be returned to Shugart for repair. Regardless, the unit must be individually packaged in comparable packing as shipped to preclude damage in shipping and handling (see figure 9-3). **Damage to the unit as a result of inadequate packaging will void the warranty on the unit.**

CAUTION

Heads should be on or past track 225 and spindle lock must be installed whenever drive is shipped. Damage to magnetic heads, disks, or both may occur if spindle is not locked during shipment.



39010-30

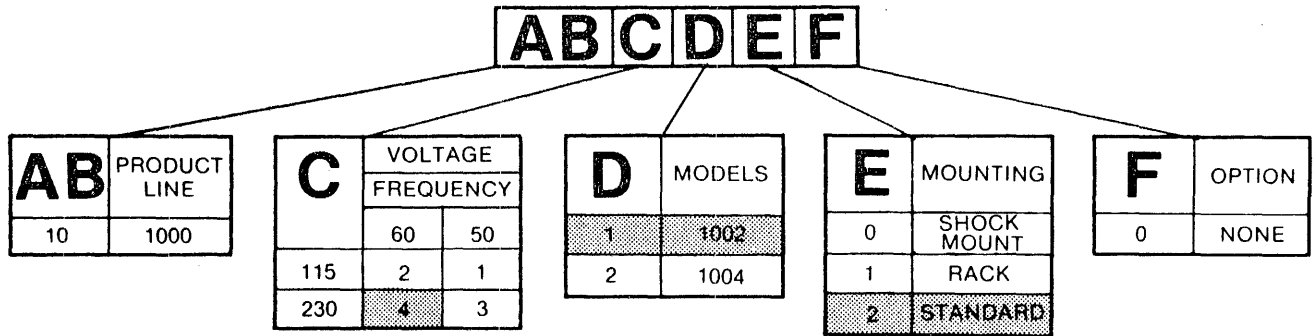
FIGURE 9-3. SA1000 PACKAGING

APPENDIX A ORDERING INFORMATION

The table below can be used to construct a part number for a unique drive configuration.

TABLE A-1. SA1000 PSI

SA1000



39224-12-A

NOTE: Shaded area = non-preferred drive configurations.