

**SA700
5.25 Inch
Half-Height
Fixed Disk Drive
P/N 39252-1**

**Preliminary OEM
April 1983**

Shugart

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PUBLICATION CHANGE NOTICE

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Figure 4-1, page 4-1, of the above publication should be corrected to read as shown below.

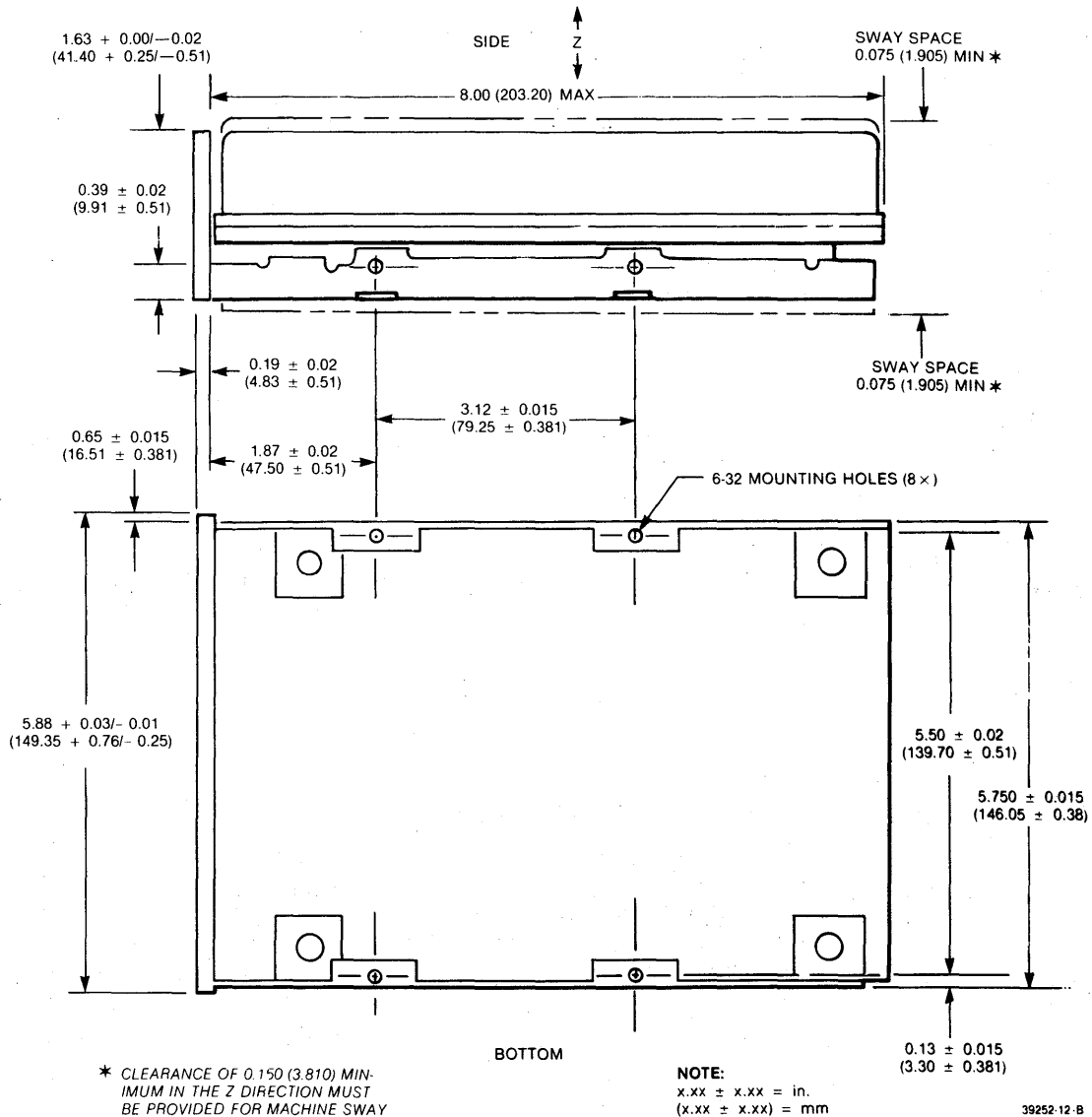


FIGURE 4-1. MOUNTING DIMENSIONS

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	1-1
1.2.1 Physical Specifications	1-1
1.2.2 Reliability Specifications	1-2
1.2.3 Performance Specifications	1-2
1.2.4 Functional Specifications	1-3
1.3 Functional Characteristics	1-3
1.3.1 General Operation	1-3
1.3.2 Read/Write and Control Electronics	1-3
1.3.3 Drive Mechanism	1-3
1.3.4 Air Filtration System	1-3
1.3.5 Positioning Mechanism	1-4
1.3.6 Read/Write Heads and Disk(s)	1-5
1.3.7 Spindle Lock	1-5
1.3.8 Read/Write Head Shipping Zone	1-5
1.4 Functional Operations	1-6
1.4.1 Power Sequencing	1-6
1.4.2 Drive Selection	1-6
1.4.3 Track Accessing	1-7
1.4.4 Head Selection	1-7
1.4.5 Read Operation	1-7
1.4.6 Write Operation	1-7
SECTION II ELECTRICAL INTERFACE	2-1
2.1 Electrical Interface	2-1
2.2 Signal Interface	2-1
2.3 Control Input Lines	2-2
2.3.1 Drive Selection 1—4	2-2
2.3.2 Direction In	2-2
2.3.3 Step	2-3
2.3.4 Head Select 2 ⁰ and 2 ¹	2-4
2.3.5 Write Gate	2-5
2.3.6 Reduced Write Current and Precompensation	2-5
2.4 Control Output Lines	2-5
2.4.1 Track 00	2-5
2.4.2 Index	2-6
2.4.3 Ready	2-6
2.4.4 Write Fault	2-6
2.4.5 Seek Complete	2-6
2.5 Data Transfer Lines	2-6
2.5.1 MFM Write Data	2-7
2.5.2 MFM Read Data	2-8
2.6 Select Status	2-8
2.7 General Timing Requirements	2-8
2.8 Power Interface	2-9

TABLE OF CONTENTS (CONT.)

SECTION III	PHYSICAL INTERFACE	3-1
	3.1 Physical Interface	3-1
	3.2 J1/P1 Connector	3-1
	3.3 J2/P2	3-1
	3.4 J6/P6	3-2
SECTION IV	PHYSICAL SPECIFICATIONS	4-1
	4.1 Mechanical Dimensions	4-1
	4.2 Mounting	4-2
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 SA700 Series 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
APPENDIX A	ORDERING INFORMATION	A-1

LIST OF FIGURES

Figure		Page
1-1	SA700 Half-Height Winchester Drive	1-0
1-2	Air Filtration System	1-4
1-3	Read/Write Head Positioning Mechanism	1-4
1-4	SA700 Actuator Lock	1-5
1-5	SA700 Shipping Zone	1-6
2-1	J1 Interface and J6 Power Connections	2-1
2-2	Control Input Driver/Receiver Combination	2-2
2-3	SA700 Jumper Locations	2-3
2-4	Normal Step Mode	2-3
2-5	Buffered Step Mode	2-4
2-6	Head Selection Timing	2-5
2-7	Control Output Driver/Receiver Combination	2-5
2-8	Index Timing	2-6
2-9	Data Transfer Line Driver/Receiver Combination	2-7
2-10	J2 Interface Connection	2-7
2-11	MFM Read/Write Data Timing	2-8
2-12	General Control Timing Requirement	2-9
3-1	Interface Connector Locations	3-1
3-2	J1 Connector Dimensions	3-2
3-3	J2 Connector Dimensions	3-2
3-4	J6 Connector	3-2
4-1	Mounting Dimensions	4-1
6-1	Track Format	6-1
8-1	Multiple Drive Configuration	8-1
9-1	SA700 Packaging	9-1

LIST OF TABLES

Table		Page
2-1	Head Select (1 = False, 0 = True)	2-4
2-2	DC Requirements	2-9
6-1	Write Precompensation	6-2
A-1	SA700 PSI	A-1

ABBREVIATIONS / MNEMONICS

AM Address Mark

BPI Bits Per Inch

CRC Cyclic Redundancy Check

FCI Flux Changes Per Inch

ID Identification

I_{in} In Line

PCB Printed Circuit Board

TPI Tracks Per Inch

TRK Track

ABOUT THIS MANUAL

This manual supersedes the SA700 Preliminary OEM (P/N 39252-0) dated 1/83.

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. Direct any comments to:

Shugart
Technical Publications, MS 3-14
475 Oakmead Parkway
Sunnyvale, CA 94086
(408) 733-0100



39252-01-A

FIGURE 1-1. SA700 HALF-HEIGHT WINCHESTER DRIVE

SECTION I INTRODUCTION

1.1 GENERAL DESCRIPTION

The SA700 Series Disk Drives are random access 5.25 inch half-height Winchester storage devices with one or two non-removable disks as storage media. Each disk surface employs one moveable head to service 306 data tracks.

Low cost and high reliability are achieved through the use of a unique rotary band actuator design, a self-contained microcomputer, and LSI circuitry.

The SA700 interface is ST506 compatible, allowing easy integration into existing systems.

Key Features

- a. Unformatted capacity of 6.4 or 12.7 megabytes.
- b. Winchester design reliability.
- c. Same physical size and identical mounting configuration as the SA455/465 series of half-height minifloppies.
- d. Uses the same dc voltages as the SA4XX minifloppies.
- e. Normal and buffered seek.
- f. Landing and shipping zone at cylinder 351.
- g. Brushless dc spindle motor.
- h. Microprocessor-based electronics.
- i. LSI read channel.
- j. Read/write pre-amp on head arm.
- k. 5 Mbits/second transfer rate.

1.2 SPECIFICATION SUMMARY

1.2.1 Physical Specifications

Environmental Limits:

Host Ambient Temperature:

Operating — 50° to 115°F (10° to 46°C)

Non-operating — 40° to +140°F (-40° to +60°C)

Temperature Gradient:

Operating — 10°F per 1/2 hr (5.5°C per 1/2 hr)

Non-operating — 212°F per hr (100°C/hr) non-condensing

Relative Humidity:

Operating — 8% to 80%

Non-operating — 1% to 95%

Maximum Wet Bulb — Operating - 78°F (25.6°C) non-condensing

Non-operating - Non-condensing

Elevation:

Operating — 0 to 6,000 ft. (0 to 1828 meters)

Non-operating — -1,000 to 12,000 ft. (-305 to 3656 meters)

Acoustical: Less than 55 dbA at 1m

Vibration:	Frequency	
Operating	2 - 23.3 Hz	0.018 in. Double Amplitude
	23.3 - 500 Hz	0.5 G's
Non-operating	To be furnished at a later date.	

Shock:
 Operating - 1g max
 Non-operating - 30g max

The following specifications will be furnished at a later date:
 Ambient Magnetic Field
 Electro-magnetic Interference Susceptibility

DC Voltage Requirements:
 +12 Vdc \pm 5% 1.1 A typical (3.7 A max starting for 10 sec)
 +5 Vdc \pm 5% 1.4 A typical (1.4 A max)

Heat Dissipation = 86 BTU/hr typical (25 watts)

Mechanical Dimensions without Faceplate (Nominal):
 Height = 1.63 in. (41.4 mm)
 Width = 5.75 in. (146.1 mm)
 Depth = 8.00 in. (203.2 mm)
 Weight = 3.3 lbs (1.5 kg)

1.2.2 Reliability Specifications

Mean Time Between Failure: 12,000 power on hours typical usage
 Preventive Maintenance: None required
 Mean Time to Repair: 12 minutes
 Component Life: 5 years

Error Rates:
 Soft Read Errors: 1 per 10¹⁰ bits read
 Hard Read Errors: 1 per 10¹² bits read
 Seek Errors: 1 per 10⁶ seeks

1.2.3 Performance Specifications

Capacity	SA706	SA712
Unformatted		
Per Drive	6.4 Mbytes	12.7 Mbytes
Per Surface	3.2 Mbytes	3.2 Mbytes
Per Track	10,416 bytes	10,416 bytes
Formatted (33 sectors/track)		
Per Drive	5.2 Mbytes	10.4 Mbytes
Per Surface	2.6 Mbytes	2.6 Mbytes
Per Track	8.45 kbytes	8.45 kbytes
Per Sector	256 bytes	256 bytes
Formatted (32 sectors/track)		
Per Drive	5.0 Mbytes	10.3 Mbytes
Per Surface	2.5 Mbytes	2.5 Mbytes
Per Track	8.19 bytes	8.19 bytes
Per Sector	256 bytes	256 bytes
Transfer Rate	5.0 Mbits/sec	5.0 Mbits/sec

Access Time (includes settling time)		
Track to Track	16.4 msec	16.4 msec
Average	99 msec	99 msec
Maximum	199 msec	199 msec
Average Latency	8.37 msec	8.37 msec
Start Up Time (Typical)	12 sec	12 sec

1.2.4 Functional Specifications

Rotational Speed	3,600 (+3,-35) rpm	3,600 (+3,-35) rpm
Recording Density	9,036 bpi	9,036 bpi
Flux Density	9,036 fci	9,036 fci
Track Density	360 tpi	360 tpi
Cylinders	*306	*306
Data Tracks	**612	†1,224
Read/Write Heads	2	4
Disks	1	2
Index/Revolution	1	1

*Shipping zone at cylinder 351.

**28 additional data tracks available for RL-01 compatibility (DEC trademark).

†56 additional data tracks available for RL-02 compatibility (DEC trademark).

1.3 FUNCTIONAL CHARACTERISTICS

1.3.1 General Operation

The SA700 fixed disk drives consist 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.

1.3.2 Read/Write and Control Electronics

The standard microprocessor and electronics are packaged on one printed circuit board containing the following circuits:

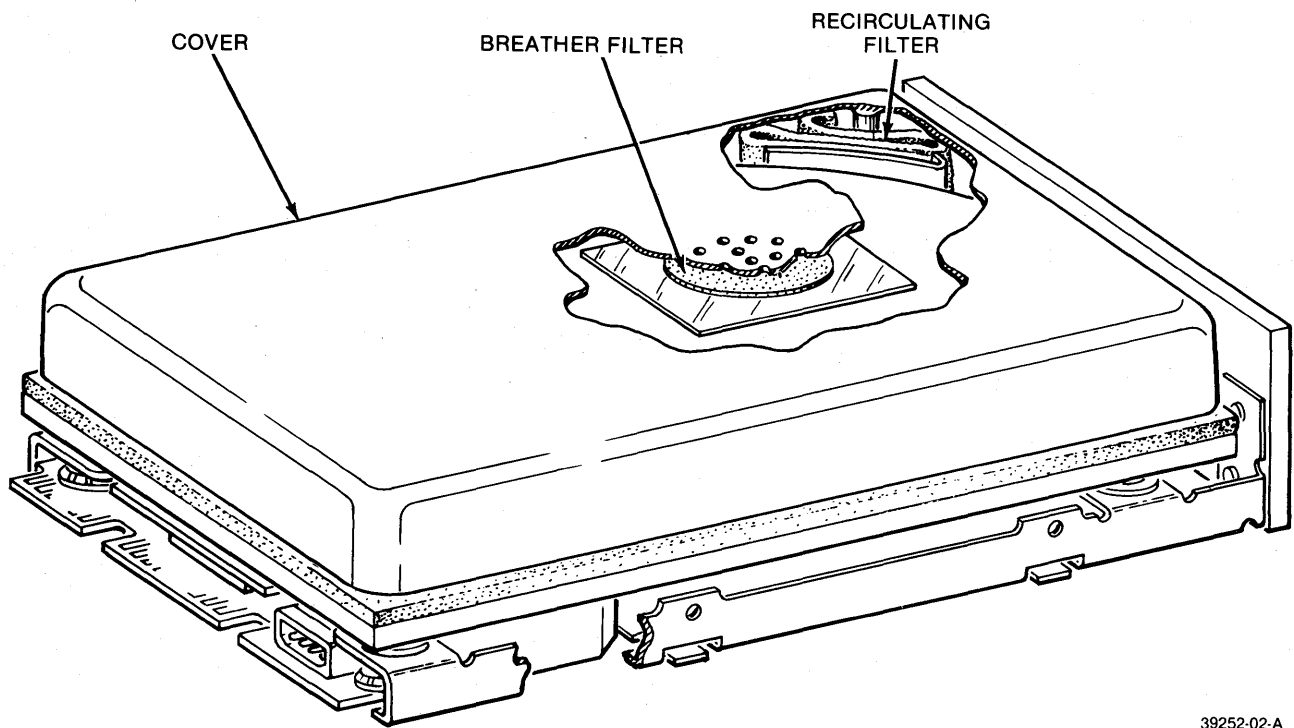
- a. Index Generator Circuit
- b. Head Position Actuator Drivers
- c. Read/Write Amplifiers
- d. Drive (READY) up to Speed Circuit
- e. Drive Select Circuit
- f. Write Fault Detection Circuit
- g. Read/Write Head Select Circuit
- h. Ramped (Buffered) Stepper Circuit
- i. Track 00 Indicator
- j. Brushless Spindle Motor Control Circuits

1.3.3 Drive Mechanism

The brushless dc drive motor rotates the spindle at 3,600 (+3,-35) rpm.

1.3.4 Air Filtration System

The disk(s) and read/write heads are fully enclosed in a module using an integral recirculating air system with a recirculating filter which maintains a clean environment. A separate absolute breather filter permits pressure equalization with the ambient air without contamination. See figure 1-2.

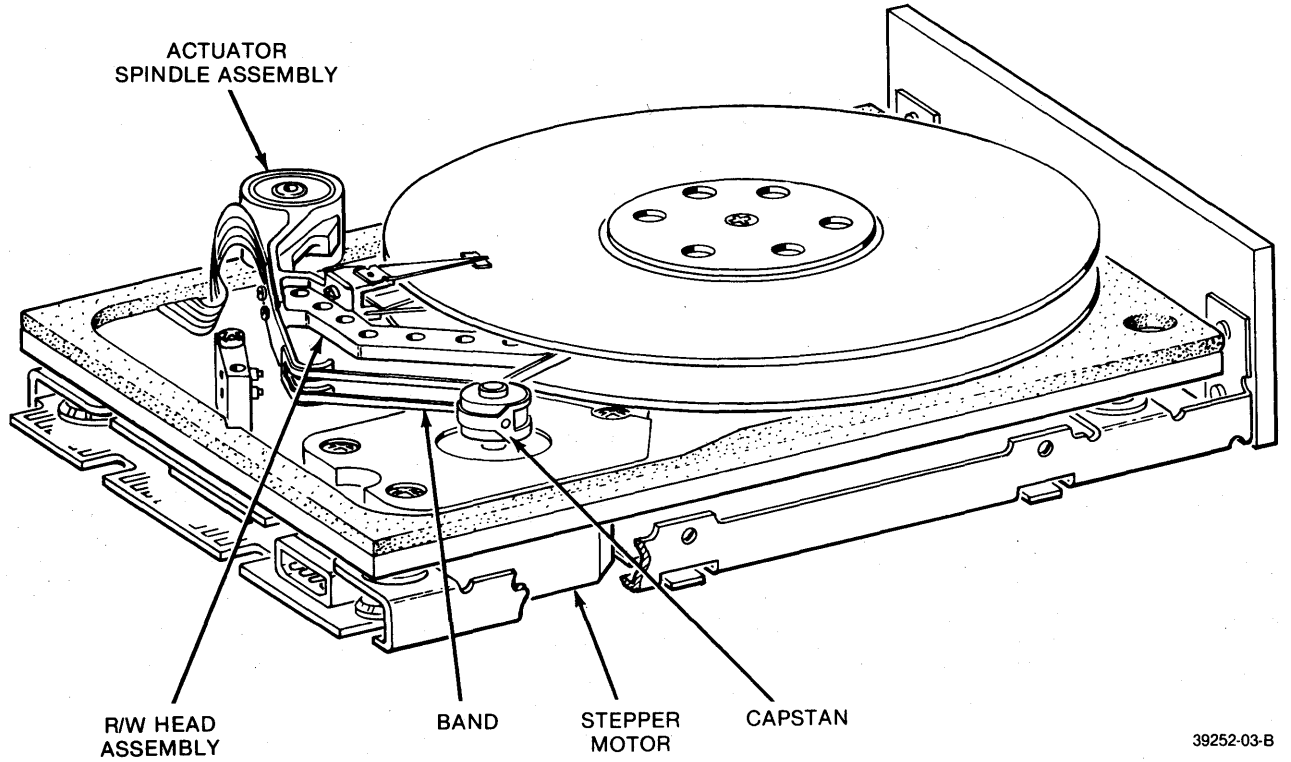


39252-02-A

FIGURE 1-2. AIR FILTRATION SYSTEM

1.3.5 Positioning Mechanism

The read/write heads are mounted on an arm which is positioned by the Fasflex IV™ rotary actuator. A stepper motor is used to precisely position the rotary actuator utilizing a unique metal band/capstan concept. Figure 1-3 illustrates the read/write head positioning mechanism.



39252-03-B

FIGURE 1-3. READ/WRITE HEAD POSITIONING MECHANISM

1.3.6 Read/Write Heads and Disk(s)

The recording media consists of a thin, lubricated, magnetic oxide coating on a 130 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 of which accesses 306 data tracks. The drive is available in two basic configurations: one disk with two read/write heads or two disks with four read/write heads. The heads should be positioned at cylinder 351 via software prior to power down in order to minimize the potential for damage to the recorded data on portable systems. Refer to paragraph 1.3.8.

1.3.7 Spindle Lock

The SA700's are provided with an integral fail-safe spindle lock. This solenoid operated, mechanical brake is actuated when dc power is applied to the drive allowing the spindle to rotate. When the drive is powered off, the solenoid is de-activated allowing the brake to engage the spindle. This prevents the possibility of disk movement during shipping or movement of the drive. See figure 1-4.

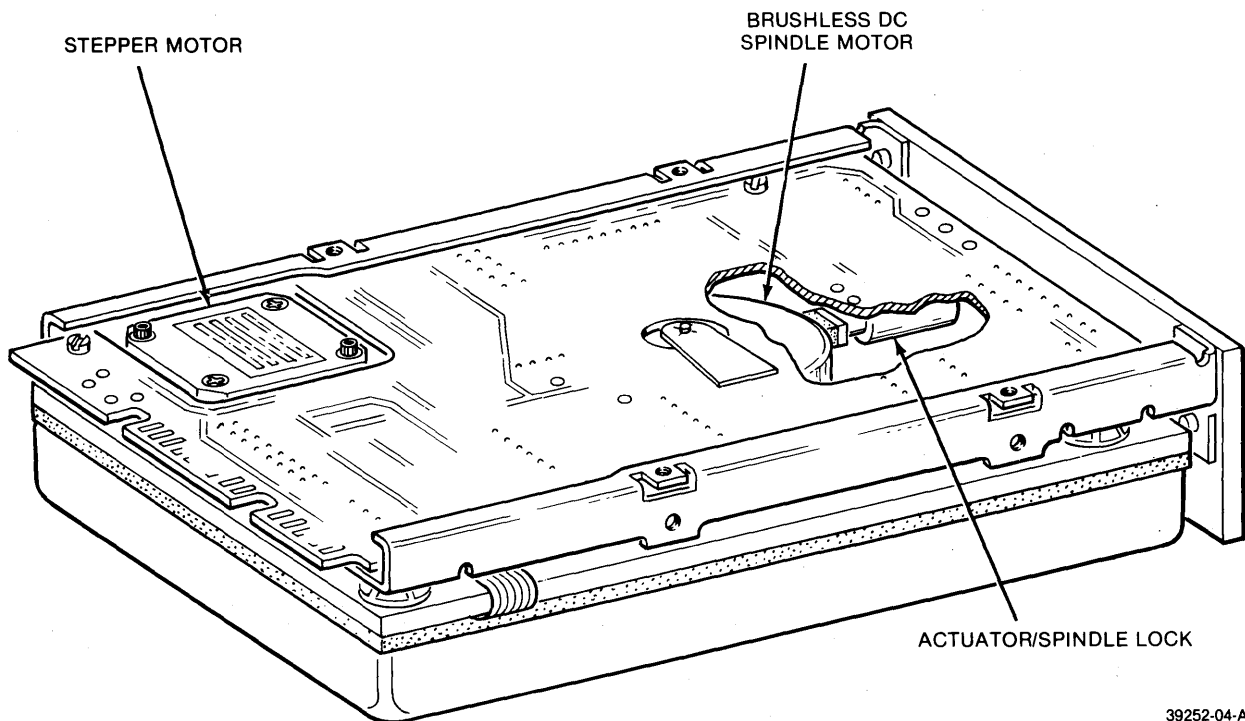


FIGURE 1-4. SA700 ACTUATOR LOCK

1.3.8 Read/Write Head Shipping Zone

The unused area of the disk surface, inside the data bands, is designated as a "shipping zone." The heads should be positioned to this area via software before the drive is powered off, prior to moving or shipping the drive. This ensures that if the drive is exposed to severe handling (shock), the data storage area of the disk surface will not be damaged by the heads bouncing on the disks. See figure 1-5.

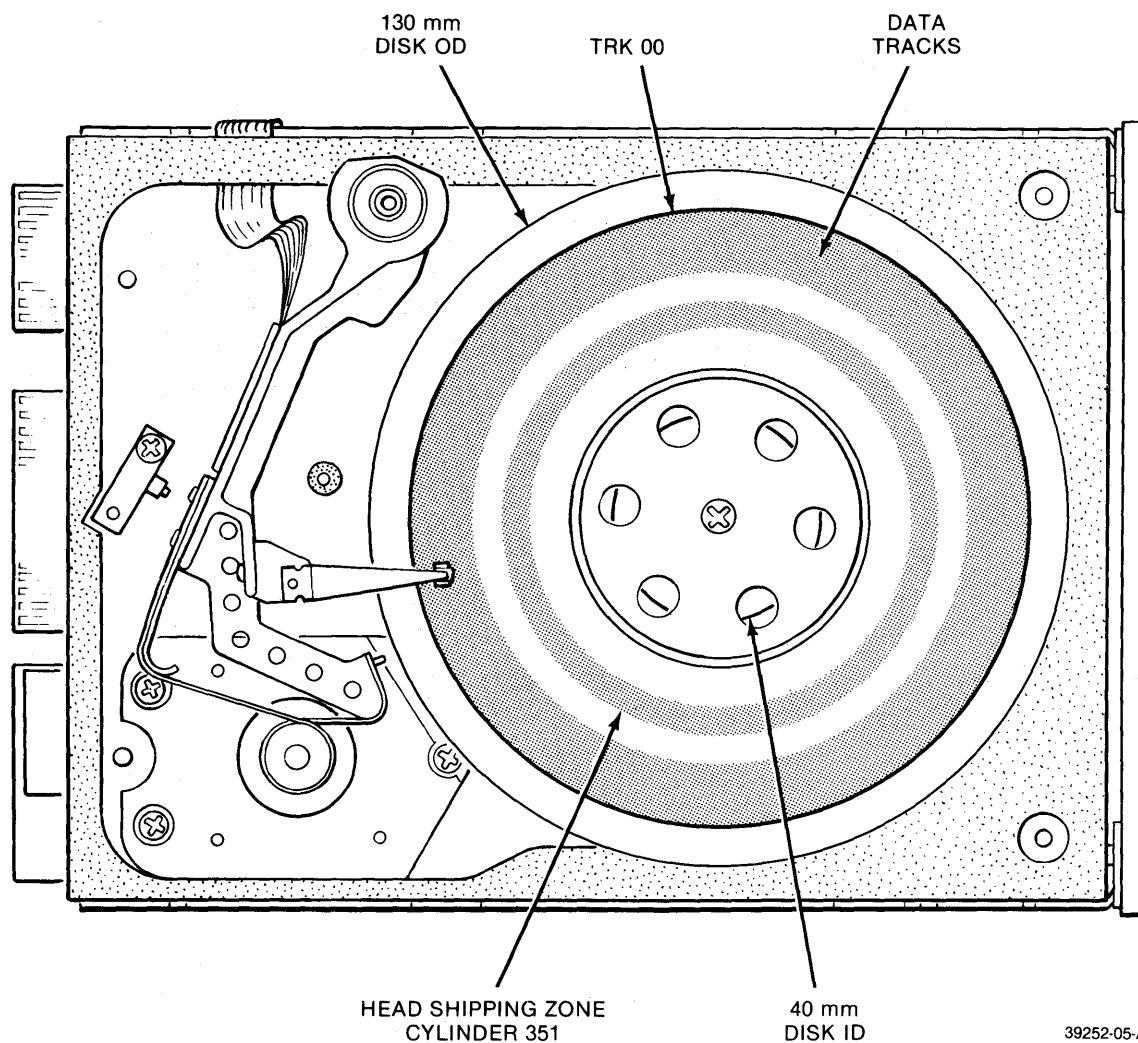


FIGURE 1-5. SA700 SHIPPING ZONE

1.4 FUNCTIONAL OPERATIONS

1.4.1 Power Sequencing

Since the SA700's have a speed sense circuit to prevent stepping until the disk is rotating at the proper speed (3,600 rpm), no power-on sequence is required. A READY signal will be presented to the controller interface once the disk is up to its normal rotational speed (3,600 rpm) plus or minus 2% for 2 seconds. At READY time, after an initial power up, the drive will recalibrate itself to track 00. When the recalibrate procedure is complete, SEEK COMPLETE will go true. Normal seek and read functions can now begin. Refer to paragraph 2.7.

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 input signals, and the output signals of that drive are then gated to the controller.

1.4.3 Track Accessing

Read/write head positioning is accomplished by:

- a. Deactivating WRITE GATE.
- b. Activating appropriate DRIVE SELECT line.
- c. Being in READY condition with SEEK COMPLETE true.
- d. Selecting appropriate direction.
- e. Pulsing STEP line.
- f. Checking for edge of -SEEK COMPLETE line (changing from false to true).

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 to the stepper drivers at a ramped stepping rate.

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 track 00.

1.4.4 Head Selection

Any of the two to four possible heads can be selected by placing the binary address of that head on the three 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 ELECTRICAL INTERFACE

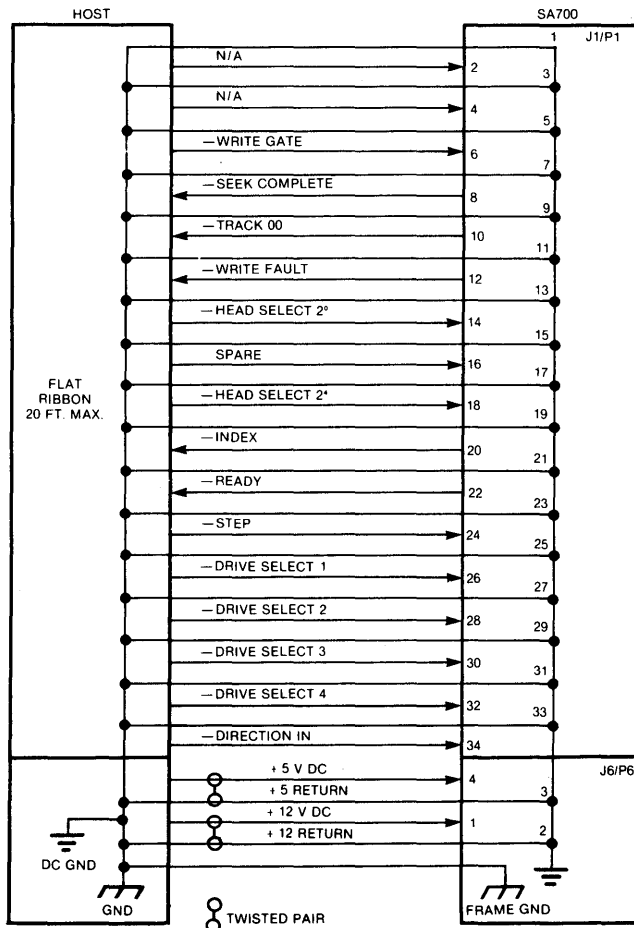
The interface of an SA700 drive can be divided into two categories:

- a. Signal Interface
- b. DC Power Interface

The following paragraphs provide the electrical definition for each line.

2.2 SIGNAL INTERFACE

The interface for an SA700 has drive control signal pin assignments per industry standards. See figure 2-1 for the pin assignments.



39252-08-A

FIGURE 2-1. J1 INTERFACE AND J6 POWER CONNECTIONS

The signal interface consists of three categories:

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

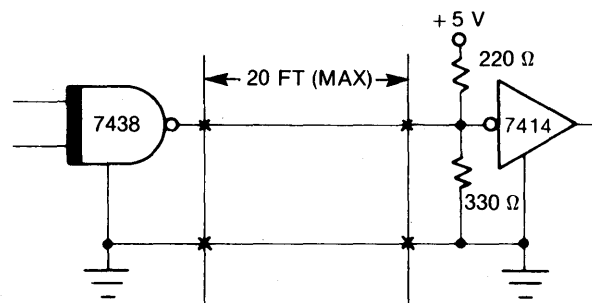
All control lines are digital in nature and either provide signals to the drive (input) or provide signals to the host (output) via the interface connector J1/P1. The data transfer signals are differential in nature. They provide data either to or from the drive, via J2/P2. See figure 2-10 for the J2/P2 pin assignments.

2.3 CONTROL INPUT LINES

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

The control input lines have the following electrical specifications. See figure 2-2 for the recommended circuit.

Only one drive in the system should be terminated. It should be physically located at the end of the cable and terminated by a 220/330 ohm resistor pack. This resistor pack can be disabled by removing the jumper block located near the P1 connector. See figure 2-3 for the jumper location.



True = 0.0 to 0.4 V dc @ $I_{in} = 40$ mA (max)
False = 2.5 to 5.25 V dc @ $I_{in} = 0$ mA (open)

39026-06

FIGURE 2-2. CONTROL INPUT DRIVER/RECEIVER COMBINATION

2.3.1 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. See figure 2-3 for the jumper location.

2.3.2 Direction In

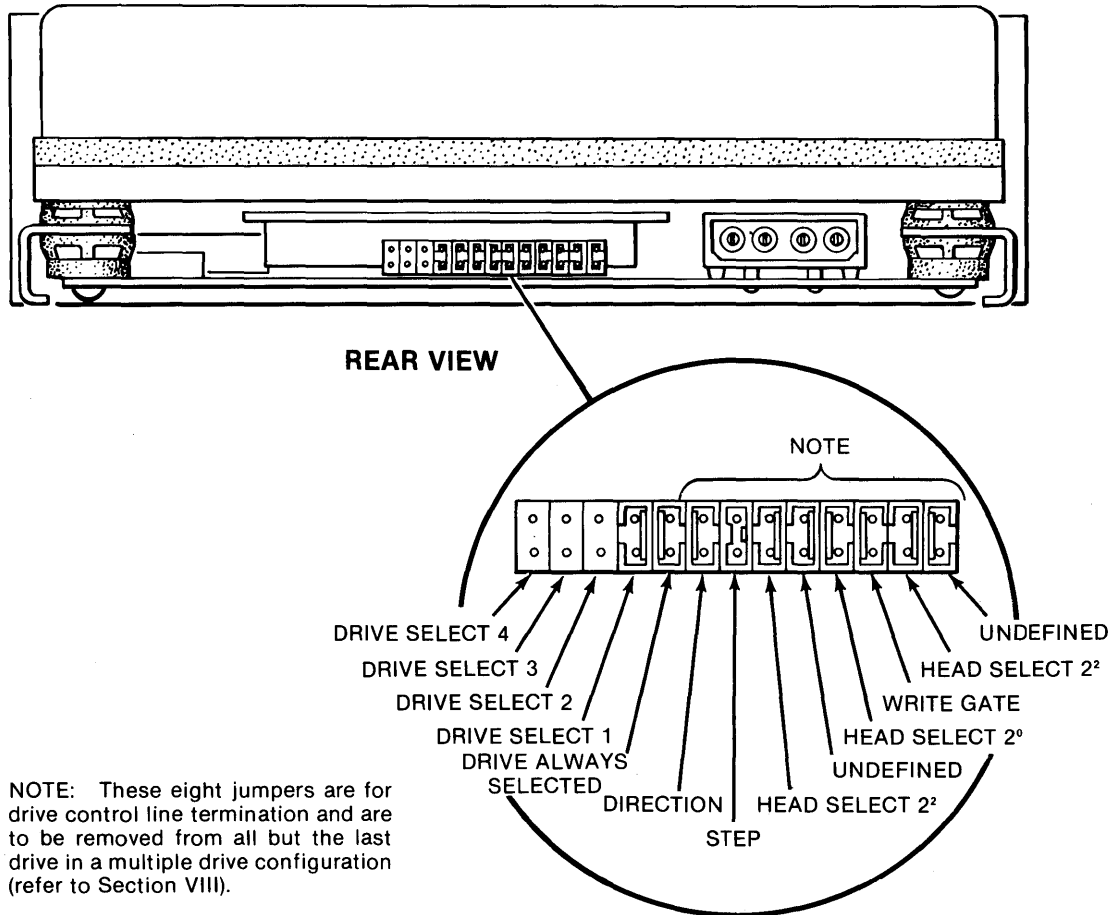
This signal defines the direction of motion of the read/write heads when the STEP line is pulsed. An open circuit, or logical false, defines the direction as "out" and if a pulse is applied to the STEP line, the read/write head will move away from the center of the disk. If the input is shorted to ground,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

2.3.3 Step

This line causes the read/write heads to move in the direction 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 before the leading edge of the step pulse. Stepping can be performed in either the normal or buffered mode:

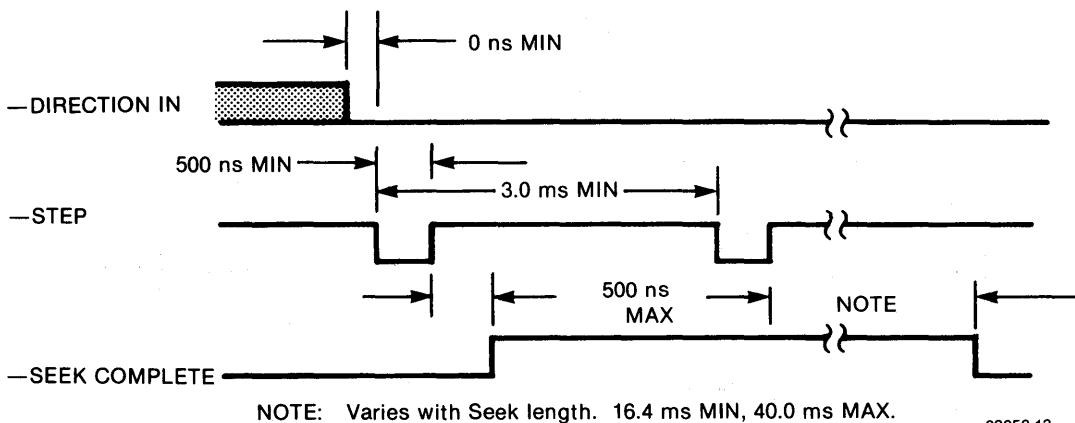
Normal Step Mode

In this mode, the read/write heads will move at the rate of the incoming step pulses. The minimum time between successive steps is 3.0 ms with a minimum pulse width of 500 ns. See figure 2-4.



39252-07

FIGURE 2-3. SA700 JUMPER LOCATIONS



39252-13

FIGURE 2-4. NORMAL STEP MODE

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 and SEEK COMPLETE (refer to paragraph 2.4.5) will go true after the read/write heads settle on the cylinders. This mode of operation is automatically selected when the time between step pulses is less than 200 μsec .

The DRIVE SELECT line may be dropped and a different drive selected 500 ns after the last step pulse has been sent to the drive.

The maximum time between steps is 200 μs with a minimum pulse width of 3.0 μs (see figure 2-5).

Shipping Zone

The read/write heads can be accessed to the shipping zone by doing a seek to cylinder 351.

NOTE

Step pulses with periods between 200 μs and 3.0 ms are not permitted. Seek accuracy is not guaranteed if this timing requirement is violated.

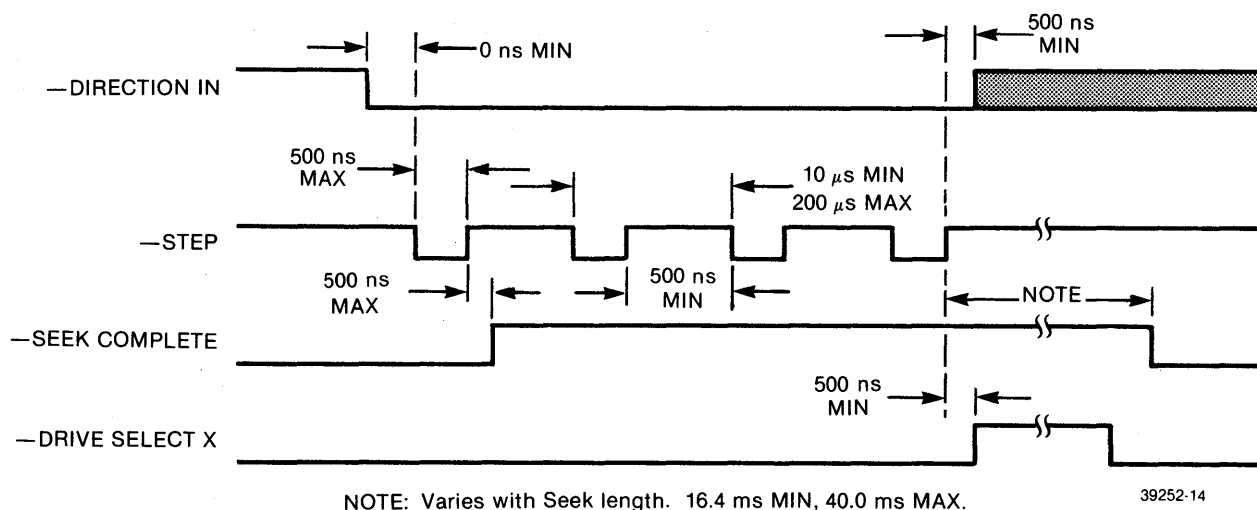


FIGURE 2-5. BUFFERED STEP MODE

2.3.4 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 0 will be selected. Table 2-1 shows the HEAD SELECT sequence and model variations for the HEAD SELECT lines. See figure 2-6 for the timing sequences.

TABLE 2-1. HEAD SELECT (1 = FALSE, 0 = TRUE)

HEAD SELECT LINE		HEAD SELECTED	HEAD SELECTED
2 ⁰	2 ¹	SA706	SA712
1	1	0	0
0	1	1	1
1	0	IMPROPER SELECT	2
0	0	IMPROPER SELECT	3

39252-06-A

2.3.5 Write Gate

The active state of this signal (logical 0 level) enables WRITE DATA to be written onto the disk. The inactive state of the signal (logical 1 level) enables data to be transferred from the drive and enables STEP pulses to reposition the head arm. See figure 2-6 for the timing sequences.

2.3.6 Reduced Write Current and Precompensation

The SA706/SA712 provides for automatic reduced write current switching. Optimum precompensation is 12 ns and should be used on cylinders 200 through 320.

2.4 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 0 (true), with a maximum voltage of 0.4 V measured at the driver. When the line driver is at logical 1 (false), the driver transistor is off and the collector cut off current is a maximum of 250 μA .

All J1 output lines are enabled by their respective DRIVE SELECT lines.

Figure 2-7 shows the recommended control signal driver/receiver combination.

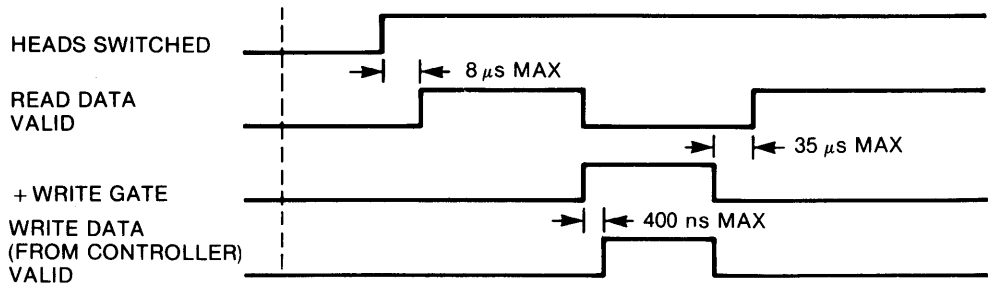
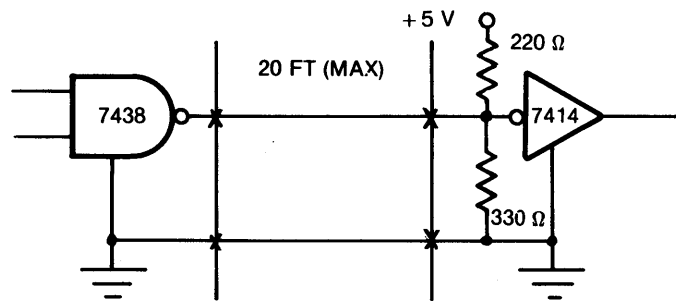


FIGURE 2-6. HEAD SELECTION TIMING

39026-10-A



39026-11

FIGURE 2-7. CONTROL OUTPUT DRIVER/RECEIVER COMBINATION

2.4.1 Track 00

This interface signal indicates a true state (logical 0) only when the read/write heads of the selected drive are at track 00 (the outermost track) and the access circuitry is driving current through phase one of the stepper motor. This signal is false (logical 1) when the read/write heads of the selected drive are not at track 00. The state of this line is undefined when SEEK COMPLETE is false.

2.4.2 Index

The drive provides this interface signal once each revolution (16.74 ms typical) to indicate the beginning of the track. Normally, this signal is a logical 1 (false) and makes the transition to logical 0 (true) for a period of approximately 200 μ s once each revolution (see figure 2-8).

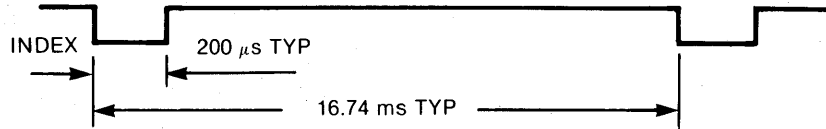


FIGURE 2-8. INDEX TIMING

39252-15

2.4.3 Ready

This interface signal when true (logical 0), 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 1), all seeking and writing to the disk is inhibited at the drive.

READY will be true after the drive is plus or minus 2% up to speed for 2 seconds. The typical time for READY to become true after power on is 12 seconds. After the automatic actuator recalibration process, which typically lasts 6 seconds, SEEK COMPLETE will also become true. It is now safe to seek the drive, but an additional 2 minutes should be allowed for thermal expansion to stabilize before any write operations are performed.

2.4.4 Write Fault

This signal, when active (logical 0), is issued to indicate that a condition exists at the drive that could cause improper writing on the disk. A WRITE FAULT occurs whenever one of four conditions occurs:

- WRITE CURRENT in the head without WRITE GATE active.
- Read/write heads improperly selected.
- DC voltage greater than 25% out of tolerance.
- Actuator or spindle control system fault.

To reset the WRITE FAULT line, deselect the drive for at least 500 ns.

NOTE

The WRITE FAULT line will not reset if the fault condition still exists after deselecting the drive.

2.4.5 Seek Complete

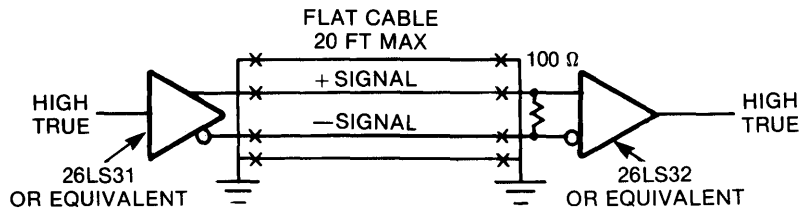
SEEK COMPLETE will go true (logical 0) when the read/write heads have settled on the final track at the completion of a seek. Reading or writing should not be attempted until SEEK COMPLETE is true.

SEEK COMPLETE will go false in two cases:

- A recalibration sequence is initiated (by the drive logic) at power-on if the read/write heads are not over track 00. Refer to paragraph 2.7.
- 500 ns typical, after the trailing edge of a STEP pulse (or the first of a series of step pulses).

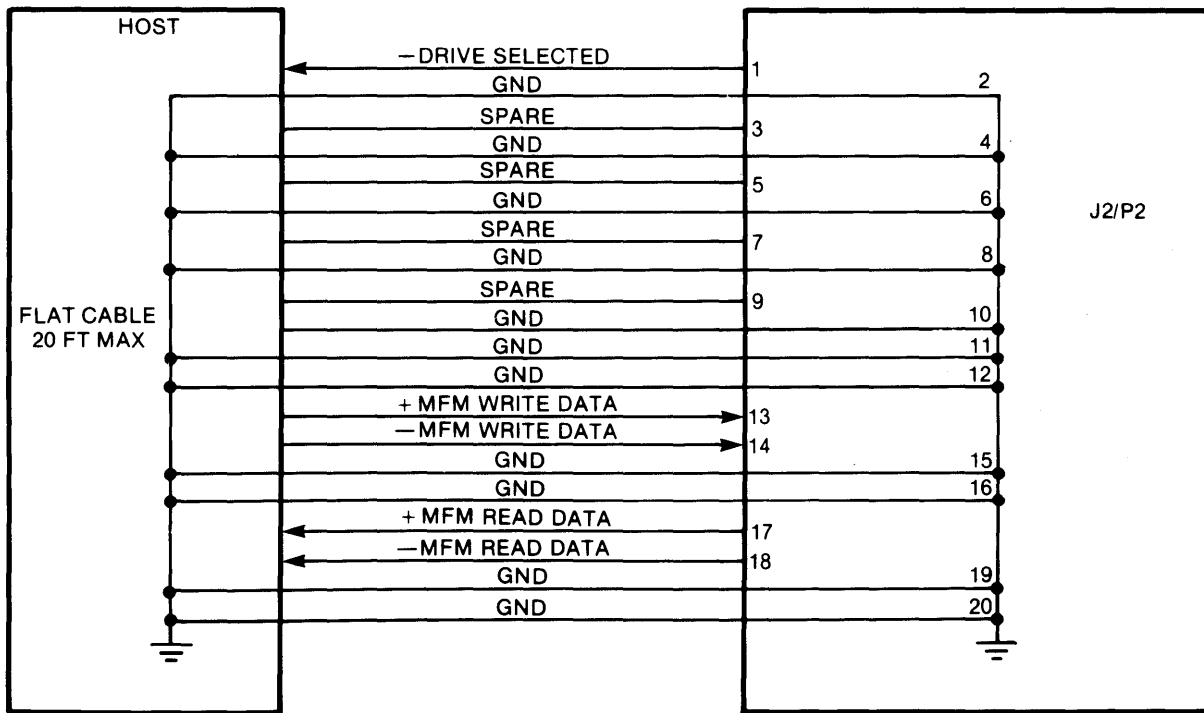
2.5 DATA TRANSFER LINES

All lines associated with the transfer of data between the drive and the host are differential in nature and may not be multiplexed. These two pairs of balanced signals are: MFM WRITE DATA and MFM READ DATA, and are provided at the J2/P2 connector on all drives. Figure 2-9 illustrates the driver/receiver combination. Refer to figure 2-10 for the J2/P2 interface connection.



39026-13

FIGURE 2-9. DATA TRANSFER LINE DRIVER/RECEIVER COMBINATION



39026-14

FIGURE 2-10. J2 INTERFACE CONNECTION

2.5.1 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 2-11 shows the timing for MFM WRITE DATA.

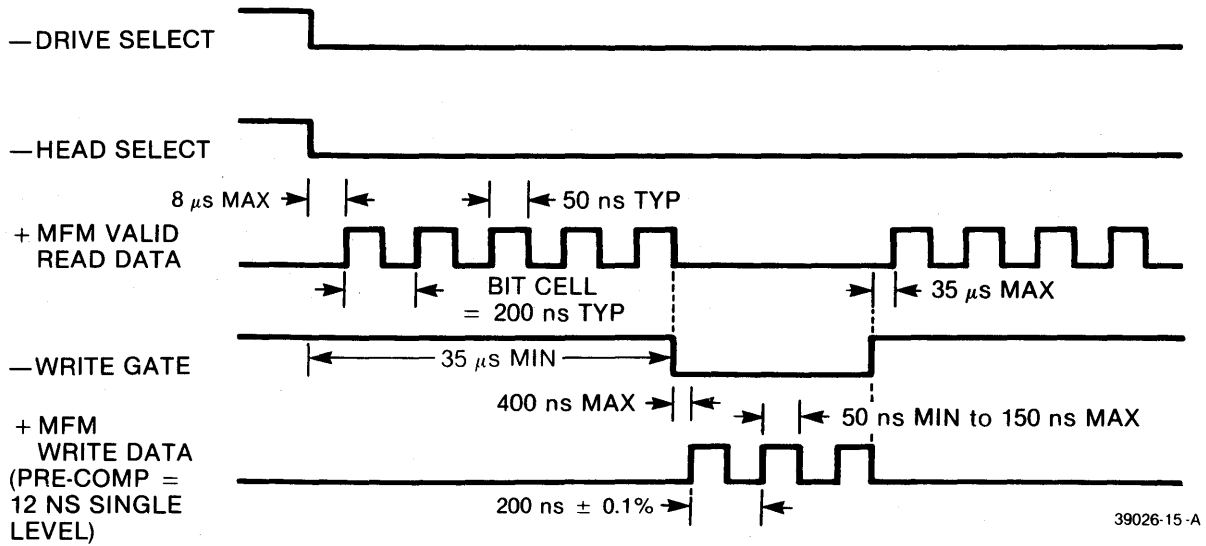


FIGURE 2-11. MFM READ/WRITE DATA TIMING

2.5.2 MFM Read Data

The data recovered by reading a pre-recorded track is transmitted to the host system via the differential pair of MFM READ DATA lines. This transition of the +MFM READ DATA line going more positive than -MFM READ DATA lines represents a flux reversal on the track of the selected head while WRITE GATE is inactive. Refer to figure 2-11.

2.6 SELECT STATUS

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

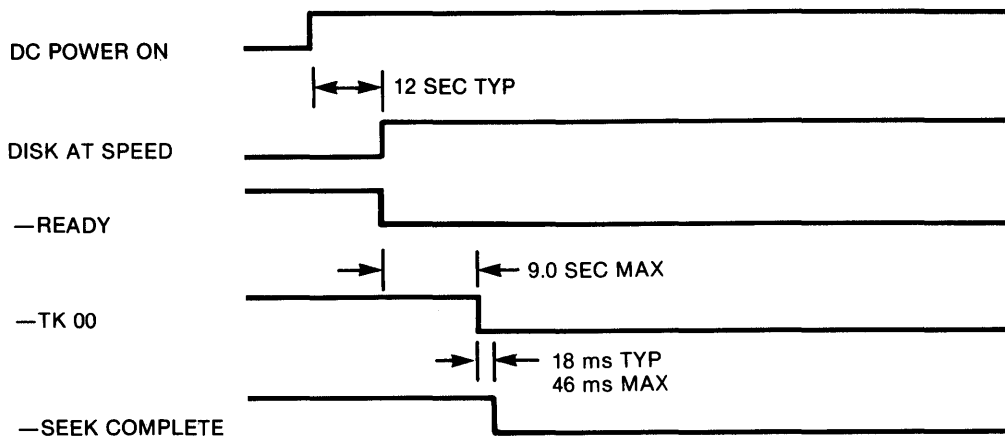
The DRIVE SELECT line is driven by a TTL open collector driver as shown in figure 2-7. This signal will go active only when the drive is programmed as drive X (X = 1, 2, 3, and 4) by proper placement of the shorting plug in the vicinity of J1, and DRIVE SELECT X line at J1/P1 is activated by the host system. See figure 2-3 for the jumper location.

2.7 GENERAL TIMING REQUIREMENTS

The timing diagram shown in figure 2-12 illustrates the necessary sequence of events (with associated timing restrictions) for proper operation of the drive.

Note that a recalibrate to track 00 sequence is initiated automatically at every dc power on. For this auto-recall sequence to function, the following conditions must be met:

- a. STEP input at J1/P1 is held inactive.
- b. Spindle is spinning at regular speed.



39026-16-B

FIGURE 2-12. GENERAL CONTROL TIMING REQUIREMENT

2.8 POWER INTERFACE

The SA700's require only dc power for operation.

DC power to an SA700 drive is via connector J6/P6 located on the solder side of the PCB. The two dc voltages and their specifications along with their J6/P6 pin designations, are outlined in table 2-2.

TABLE 2-2. DC REQUIREMENTS

P6 PIN	DC VOLTAGE	TOLERANCE	CURRENT	MAX RIPPLE (P TO P)
1	+ 12 VDC	± 0.6 VDC ± 1.2 V STARTING*	1.1 A TYPICAL 3.7 A STARTING*	100 mV MAX ALLOWABLE
2	+ 12 RETURN			
3	+ 5 RETURN			
4	+ 5 VDC	± 0.25 VDC	1.4 A TYPICAL 1.4 A MAX	50 mV MAX ALLOWABLE

*10 SEC MAX.

39252-10

SECTION III PHYSICAL INTERFACE

3.1 PHYSICAL INTERFACE

The electrical interface between an SA700 and the host system is via three 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; and the third connector, J6, provides dc power. Refer to figure 3-1 for the connector locations.

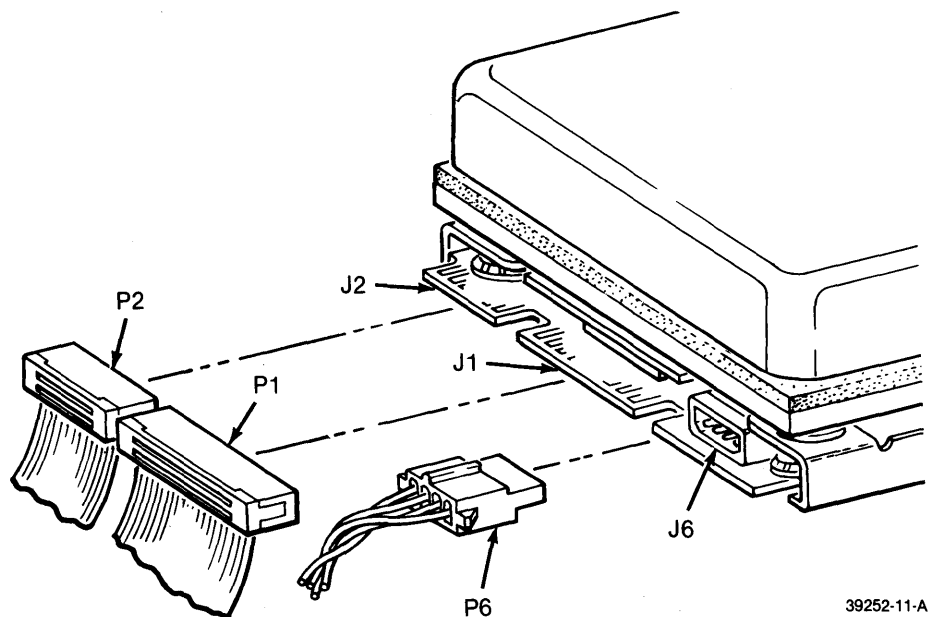


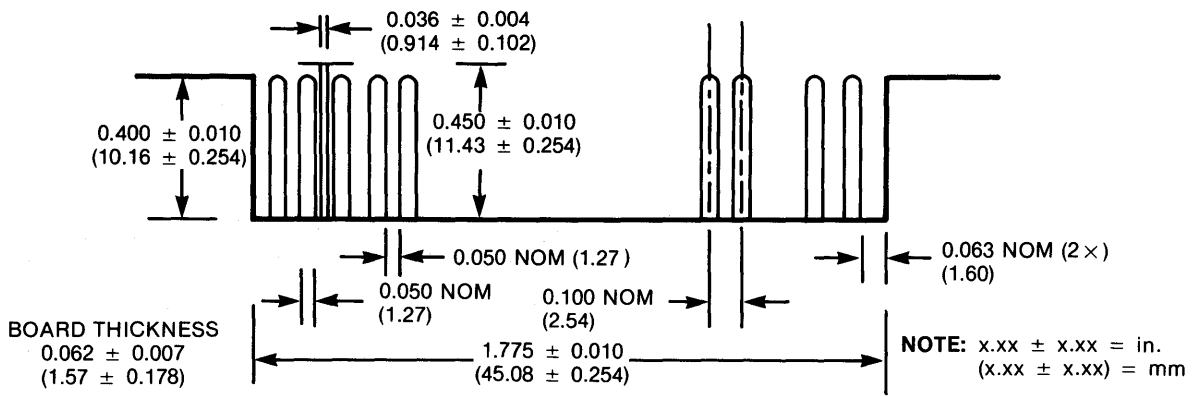
FIGURE 3-1. INTERFACE CONNECTOR LOCATIONS

3.2 J1/P1 CONNECTOR

Connection to J1 is through a 34 pin PCB edge connector. The dimensions for this connector are shown in figure 3-2. The pins are numbered 1 through 34 with the even numbered pins located on the component side of the PCB and odd pins located on the non-component side of the PCB. Pin 2 is located at 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 3463-0001.

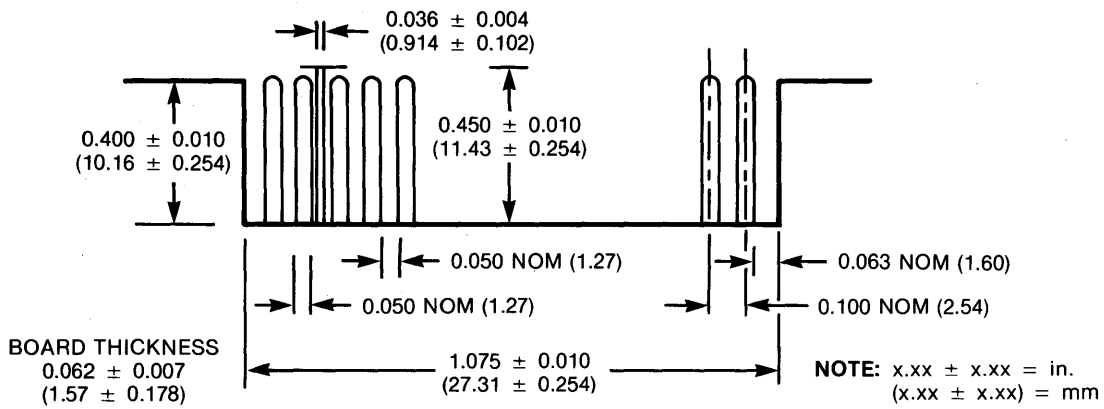
3.3 J2/P2

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.



39206-19

FIGURE 3-2. J1 CONNECTOR DIMENSIONS

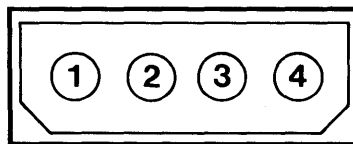


39026-20

FIGURE 3-3. J2 CONNECTOR DIMENSIONS

3.4 J6/P6

The dc power connector, J6, is mounted on the non-component side of the PCB. J6 is a 4 pin AMP Mate-N-Lok connector P/N 350211-1. The recommended mating connector is AMP P/N 1-480424-0 utilizing AMP pins P/N 61473-1. J6, pin 1, is labeled on the component side of the PCB. Wire used should be #18 AWG. Figure 3-4 illustrates the J6 connector as seen on the drive PCB from the non-component side.



39026-21

FIGURE 3-4. J6 CONNECTOR

SECTION IV PHYSICAL SPECIFICATIONS

4.1 MECHANICAL DIMENSIONS

See figure 4-1 for the dimensions of the SA700 series drives.

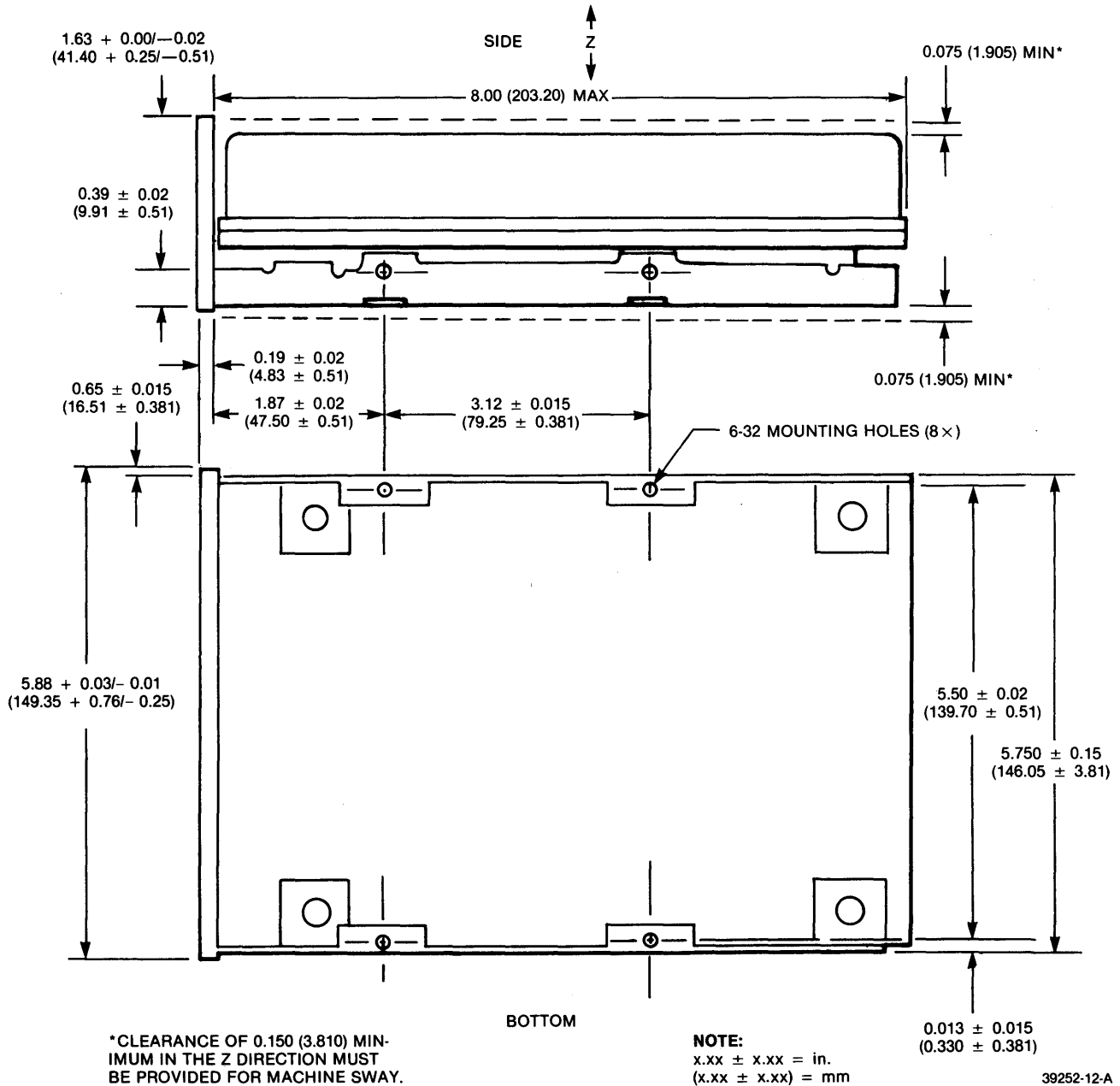


FIGURE 4-1. MOUNTING DIMENSIONS

4.2 MOUNTING

The SA700's are capable of being mounted in either of the following positions:

- a. Vertically on either 8-inch side.
- b. Horizontally with PCB up or down.

SECTION V

MEDIA DEFECTS AND ERRORS

5.1 ERROR MAPPING AND QUALIFICATION

In high density digital recording storage systems, it is necessary to increase reliability and improve 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 characteristics of the media and read/write heads
- c. Mispositioning of read/write heads on the disk
- d. Defects or imperfections in the disk media

5.1.2 Error Definition

An error is a discrepancy between recovered data and original data. There can be an extra bit or a missing bit, i.e., a "0" can be transformed into a "1" or a "1" can be changed to a "0."

Errors fall into two categories: "hard" or "soft." Hard errors are usually the result of media defects and will be repeatable. Soft errors are often caused by items (a) through (c) under paragraph 5.1.1 and will normally not be repeatable.

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, such as an impurity within the oxide itself, or a 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 utilizes a higher bit packing ratio than older types of drives and is therefore 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 - Accurate to \pm TBD bytes (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 may cause an error that is unique to a particular format or bit pattern. This flaw may 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.

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 at cylinder 00. This directory would contain the locations of all defective areas, as well as alternate track assignments for those areas.

Many mapped defects do not appear to cause errors. This is because the error map is generated from the linear data. The amplitude loss due to the defect may only reduce the signal to a marginal value which is still able to be read under most voltage and temperature conditions. In addition, some errors end up in areas unused by a given format.

5.2 ERROR ACCEPTANCE CRITERIA

The drive as received from the factory will meet the following error criteria:

- a. No head surface will have more than 10 defective tracks. Of these 10 tracks, no more than 3 will contain multiple defects. Additionally, track 00 of all heads is guaranteed to be error free.
- b. A single defect is defined as an error less than 10 bits long. A multiple defect is defined as an error greater than 10 bits long, or more than one defect location per track.

5.3 SYSTEM GENERATED ERRORS

It should be noted that errors may also be present as a result of system electrical noise, marginal timing conditions, ground loops in the dc power distribution cables, electro-magnetic interference, radio frequency interference, etc.

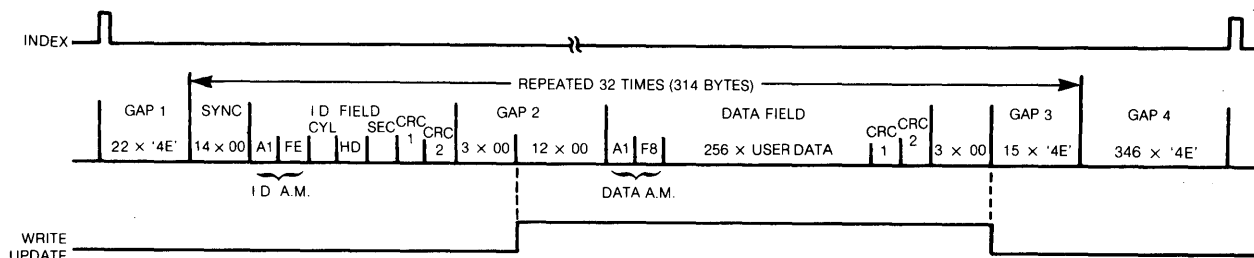
SECTION VI RECORDING FORMAT

6.1 SA700 SERIES TRACK FORMAT

The purpose of a format is to organize a data track into smaller, sequentially numbered blocks of data called sectors. The SA700 format is a soft sectored type, which means that the beginning of each sector is defined by a prewritten identification (ID) field which contains the physical sector address, plus cylinder and head information. The ID field is then followed by a user data field.

The soft sectored format is a slightly modified version of the IBM system 34 double density format commonly used on 8-inch floppy disk drives. The encoding method used here is modified frequency modulation (MFM).

Figure 6-1 shows each track divided into 32 sectors. Each sector has a data field 256 bytes in length. However, if sector interleaving is used, Gap 4 can be reduced to 32 bytes minimum to accommodate 32 sectors per track. If sector interleaving is not used, Gap 3 is 25 bytes and Gap 4 becomes 26 bytes minimum.



NOTES:

1. MINIMUM TRACK CAPACITY — 10416 BYTES.
2. WRITE TO READ RECOVERY TIME = 35 MICROSECONDS.
3. HEAD SWITCHING TIME = 35 MICROSECONDS.

39026-23

FIGURE 6-1. TRACK FORMAT

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 either an "FE" pattern which is the pattern used to define an ID address mark, or an "F8" which is a data address mark pattern.

The "A1" pattern violates the encode rules of MFM by omitting one clock transition between bits 4 and 5. This makes the address mark pattern unique to any other serial bit combination.

All ID and data fields are 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.

6.2 GAP LENGTH CALCULATIONS

6.2.1 Gap 1

The purpose of gap 1 is to provide a head switching recovery period so that, when switching from one track to another, sequential sectors may be read without waiting the rotational latency time. In addition, gap 1 allows physical position "drift" of the index pulse as a function of drive temperature. Gap 1 should be at least 22 bytes (30 bytes recommended) long to correspond with the head switching time and index drift. 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. This allows for a situation where a track has been formatted while the disk is running 2% slower (3528 rpm), then write updated with the disk running at highest speed (3603 rpm).

Gap 3 should be at least 15 bytes in length (this includes 2 bytes for write turn off).

NOTE

To operate properly in non-interleaved formats, Gap 3 should be at least 25 bytes to allow for 35 μ s read recovery. In this format, a drive can only support 32 sectors per track.

6.2.4 Gap 4

Gap 4 is a speed tolerance buffer for the entire track. This allows the disk to rotate at the highest rated speed 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, which tends to cause the two bits to move away from each other. This is a large factor contributing to bit shift. Other phenomenon such as random noise, speed variation, etc., will also cause bit shift, but to a lesser degree.

The effect of bit shift can be reduced by a technique called precompensation, which, by detecting which bits will occur early and which bits will occur late, can effectively minimize the shift by writing these bits 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 track numbers greater than or equal to 128. The optimum amount of precompensation for an SA700 is 12 ns for both early and late written bits. Table 6-1 shows various bit patterns for precompensation. Precompensation pattern detection bits are shifted through a four bit shift register. The bit is written out of 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 1 0 0	= -----
1 1 0 1	= -----
1 1 1 0	= Late Data
1 1 1 1	= On Time Data

Bit is written out of third position

39026-24

SECTION VII CUSTOMER INSTALLABLE OPTIONS

The SA700 series drives have no customer installable options.

SECTION VIII DRIVE INTERCONNECT

The electrical connection between the SA700 and the control system is shown in figure 8-1. For daisy-chain configuration, the terminating network must be removed from the last drive in the chain.

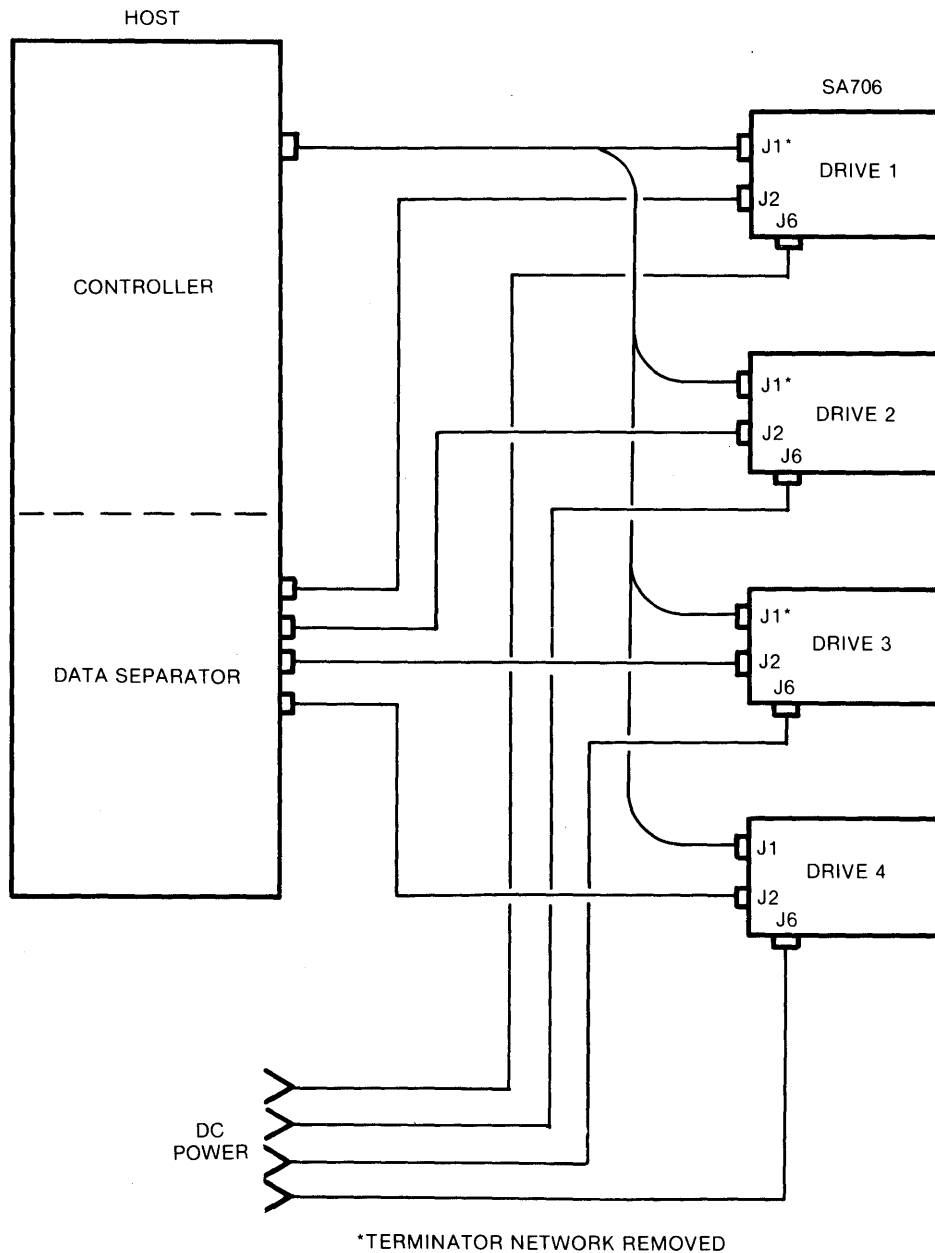


FIGURE 8-1. MULTIPLE DRIVE CONFIGURATION

39252-16

SECTION IX PACKAGING INSTRUCTIONS

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. **Damage to the unit as a result of inadequate packaging will void the warranty on the unit.**

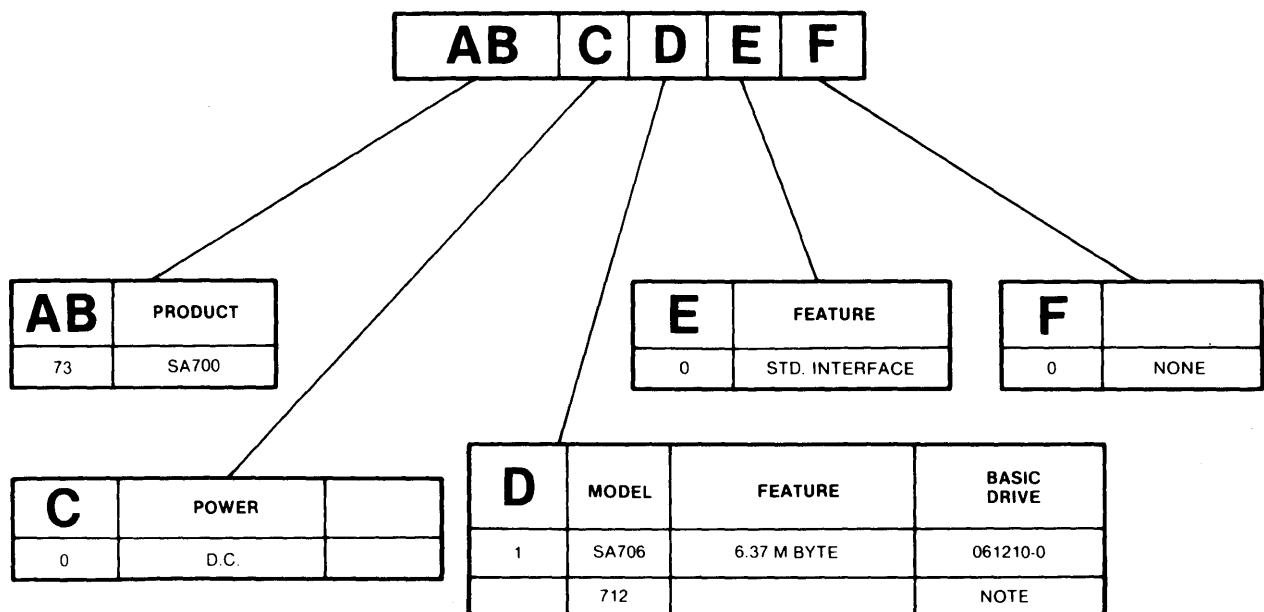
Figure 9-1 shows how to repackage the disk drive using the original shipping containers.

TO BE SUPPLIED

APPENDIX A ORDERING INFORMATION

Table A-1 can be used to construct a unique drive configuration.

TABLE A-1. SA700 PSI



NOTE
MODEL 712 NOT AVAILABLE AT PUBLISHING DATE.

39252-18