

**SA410/460**  
**96TPI**  
**Single/Double-sided**  
**Minifloppy™ Diskette**  
**Storage Drives**

OEM Manual

 **Shugart**

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# TABLE OF CONTENTS

1.0	Introduction . . . . .	1
1.1	General Description . . . . .	1
1.2	Specification Summary . . . . .	1
1.2.1	Performance Specifications . . . . .	1
1.2.2	Functional Specifications . . . . .	2
1.2.3	Physical Specifications . . . . .	2
1.2.4	Reliability Specifications . . . . .	2
2.0	Functional Characteristics . . . . .	3
2.1	Electronics . . . . .	3
2.2	Drive Mechanism . . . . .	3
2.3	Positioning Mechanism . . . . .	3
2.4	Read/Write Head(s) . . . . .	3
2.5	Recording Formats . . . . .	3
3.0	Functional Operations . . . . .	4
3.1	Power Sequencing . . . . .	4
3.2	Drive Selection . . . . .	4
3.3	Motor On . . . . .	4
3.4	Track Accessing . . . . .	4
3.4.1	Step Out . . . . .	4
3.4.2	Step In . . . . .	5
3.5	Side Selection (SA460 Only) . . . . .	5
3.6	Read Operation . . . . .	5
3.7	Write Operation . . . . .	8
3.8	Sequence of Events . . . . .	8
4.0	Electrical Interface . . . . .	10
4.1	Signal Interface . . . . .	11
4.1.1	Input Lines . . . . .	11
4.1.1.1	Input Line Terminations . . . . .	12
4.1.1.2	Drive Select 1-4 . . . . .	12
4.1.1.3	Motor On . . . . .	12
4.1.1.4	Direction Select . . . . .	13
4.1.1.5	Step . . . . .	13
4.1.1.6	Write Gate . . . . .	13
4.1.1.7	Write Data . . . . .	13
4.1.1.8	Side Select (SA460 Only) . . . . .	14
4.1.1.9	In Use (Option) . . . . .	14
4.1.2	Output Lines . . . . .	14
4.1.2.1	Track 00 . . . . .	14
4.1.2.2	Index/Sector . . . . .	14
4.1.2.3	Read Data . . . . .	14
4.1.2.4	Write Protect . . . . .	15
4.1.2.5	Drive Status . . . . .	15
4.2	Power Interface . . . . .	16
4.2.1	Frame Ground . . . . .	16
5.0	Physical Interface . . . . .	17
5.1	J1/P1 Connector . . . . .	17
5.2	J2/P2 Connector . . . . .	18
5.3	Frame Grounding . . . . .	18
6.0	Drive Physical Specifications . . . . .	20
6.1	Mechanical Dimensions . . . . .	20
6.2	Mounting . . . . .	20

## TABLE OF CONTENTS (CON'T)

7.0	Recording Format	21
7.1	General	21
7.2	Byte	21
7.3	Formats	22
7.3.1	Soft Sectored Recording Format	22
7.3.1.1	Track Layout	23
7.3.1.2	Hard Sectored Recording Format	23
8.0	Customer Installable Options	25
8.1	Drive Select	27
8.2	The Door Lock Solenoid (Option)	28
8.3	Side Select	29
8.4	Drive Status	30
8.5	Write Protect	31
9.0	Operation Procedures	32
9.1	Minidiskette Loading	32
9.2	Minidiskette Handling	32
10.0	Installation of Packaging Materials	33

# LIST OF ILLUSTRATIONS

Figure	1. SA410/460 96 TPI Minifloppys	iv
	2. SA410/460 Functional Diagram	v
	3. Track Access Timing	5
	4. Read Initiate Timing	6
	5. Read Data Timing (FM)	6
	6. FM and MFM Code Comparisons	7
	7. Write Initiate Timing	7
	8. Write Data Timing (FM)	8
	9. General Control and Data Timing Requirements	9
	10. Interface Connections	10
	11. Interface Signal Driver/Receiver	12
	12. Step Timing	13
	13. Write Data Timing (FM Encoding)	14
	14. Index Timing (Soft Sector Media)	15
	15. Index/Sector Timing (SA115 or SA167 Media)	15
	16. Index/Sector Timing (SA117 or SA167 Media)	15
	17. Read Data Timing (FM)	15
	18. Interface Connectors-Physical Locations	17
	19. J1 Connector Dimensions	18
	20. J2 Connector	18
	21. Physical Dimensions	19
	22. Recommended Mounting	20
	23. Byte (FM Encoding)	21
	24. Data Bytes	21
	25. Recommended Soft Sector Single Density (FM) (Even Boundaries)	22
	26. MFM Recommended Format - 256 Bytes/16 Records Per Track (IBM Type)	22
	27. Recommended Hard Sector FM and MFM Formats	24
	28. Component Locations	26
	29. Drive Select, Motor On and In Use	27
	30. Door Lock From In Use or Drive Select	28
	31. Side Select, Using Direction Select	29
	32. Drive Status	30
	33. Write Protect	31
	34. Carriage Stop	33
	35. Door Retainer	34
	36. Drive Container	35
	37. Shipping Container	36

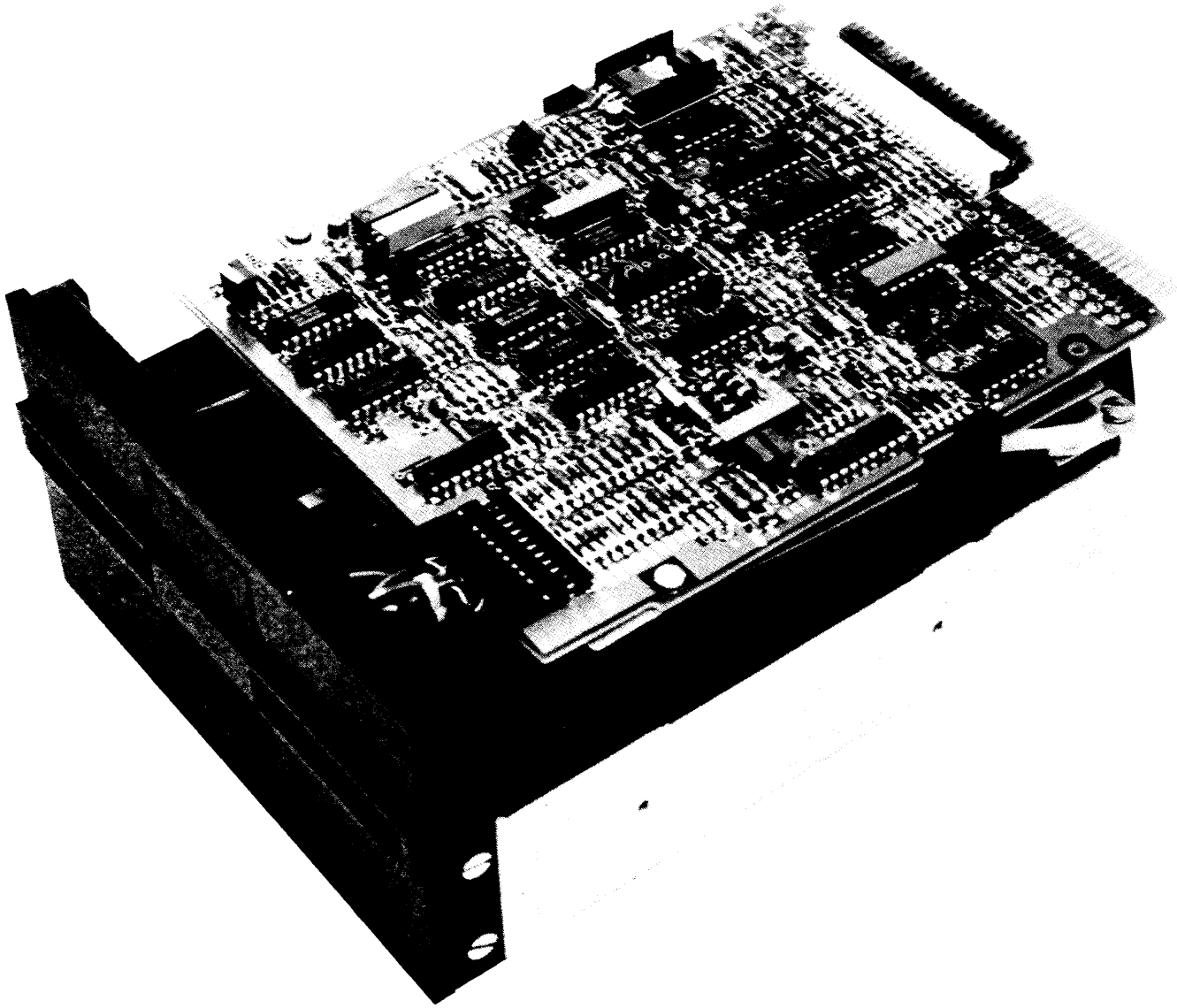
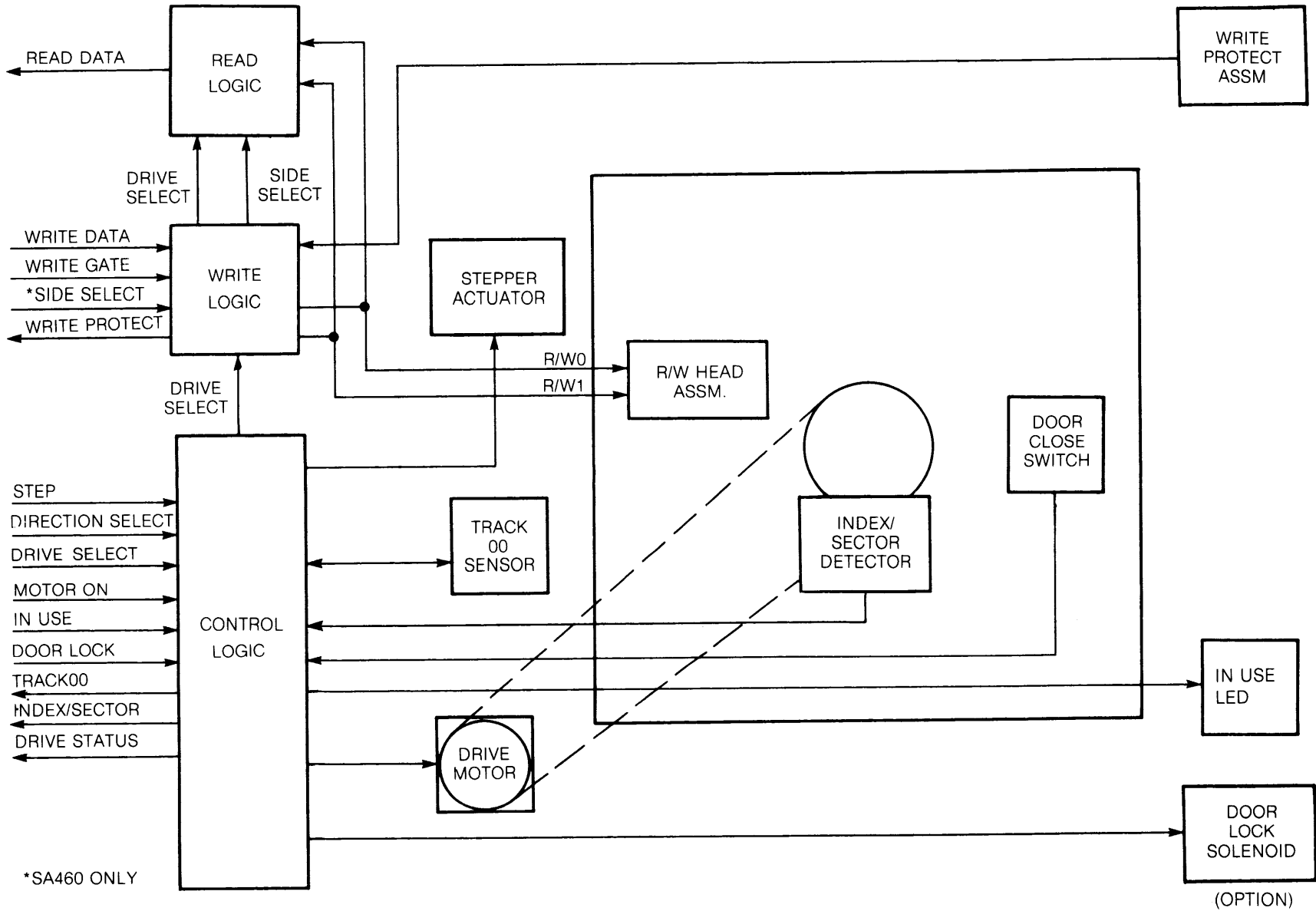


FIGURE 1. SA410/460 96 TPI MINIFLOPPYS



**FIGURE 2. SA410/460 FUNCTIONAL DIAGRAM**

## 1.0 INTRODUCTION

### 1.1 General Description

The compact SA410 single-sided and SA460 double-sided, 96 TPI, Minifloppy™ disk drives offer a reliable, low cost, high performance solution for OEM data storage applications which require maximum capacity in a Minifloppy. The SA410/460 Minifloppy drives are less than one-half the size of Shugart's standard SA801 floppy disk drive, fit comfortably in the space allocated for most tape cassette units, and offer up to one megabyte of unformatted capacity.

SA410/460 Minifloppy drives have these standard features: compact size - just 3.25" high × 5.75" wide × 8.25" deep, and weight of three pounds; low heat dissipation; positive media insertion to keep door from closing on media; rapid start DC drive motor with precision servo speed control and integral tachometer; direct drive stepping motor actuator with precise HeliCam™ V-groove lead screw; ball bearing anti-backlash followers; read/write head assembly; internal write protect circuitry; activity light, and solid die cast chassis.

The SA410 and SA460 are your best choices for word processing systems, microprocessor based systems, 'intelligent' calculators, program storage, personal computer systems and other applications where low cost higher capacity random access data storage is required. The SA410/460 offers the most cost effective data storage of any flexible media disk drive.

### Key Features

- 96 Track per inch
- Precise HeliCam™ Actuator
- 0.5/1 MByte (unformatted) capacity
- SA400/450 I/O compatibility
- Same compact size and weight as the SA400/450 - similar to most tape cassette units
- 125/250 Kbits/second transfer rate
- Single and double density capability
- Low heat dissipation
- Positive media insertion to avoid media damage
- Rapid start DC drive motor (eliminates AC requirements)
- Shugart Bi-Compliant™ read/write head assembly on SA460
- Write protect circuitry
- Activity light
- Door Lock Solenoid
- Drive Status

### 1.2 Specification Summary

#### 1.2.1 Performance Specifications

	<b>SA410</b>	<b>SA460</b>
	Single/Double Density	Single/Double Density
Capacity		
Unformatted		
Per Disk	250/500 KBytes	0.5/1 MByte
Per Surface	250/500 KBytes	250/500 KBytes
Per Track	3.1/6.2 KBytes	3.1/6.2 KBytes
Formatted		
(10 Sector/Track)		
Per Disk	204.8/409.6 KBytes	409.6/819.2 KBytes
Per Surface	204.8/409.6 KBytes	204.8/409.6 KBytes
Per Track	2.56/5.12 KBytes	2.56/5.12 KBytes
Transfer Rate	125/250 Kbits/sec	125/250 Kbits/sec
Latency (avg.)	100 msec	100 msec
Access Time (w/o settling)		
Track to Track	6 msec	6 msec
Side to Side	--	0.2 msec
Average	158 msec	158 msec



	<b>SA410</b>	<b>SA460</b>
Settling Time	15 msec	15 msec
Motor Start Time	200 msec	200 msec

### 1.2.2 Functional Specifications

Rotational Speed	300 rpm	300 rpm
Recording Density (inside track)	2788/5576 bpi	2961/5922 bpi
Flux Density	5576 fci	5922 fci
Track Density	96 tpi	96 tpi
Tracks	80	80
Index	1	1
Encoding Method	FM/MFM	FM/MFM
Media Requirements		
soft sectored	SA114	SA164
16 sectors hard sectored	SA115	SA165
10 sectors hard sectored	SA117	SA167
Industry standard flexible diskette		
Oxide on 0.003 in. (0.08mm) Mylar		
5.25 in. (133.4mm) square jacket		

### 1.2.3 Physical Specifications

Environmental Limits	<b>Operating</b>	<b>Shipping</b>
Ambient Temperature =	40°F to 115°F (4.4°C to 46.1°C)	-40° to 144°F (-40°C to 62°C)
Relative Humidity =	20% to 80%	1% to 95%
Maximum Wet Bulb =	78°F (25.6°C)	no condensation

**Storage**  
-8°F to 117°F (-22°C to 47°C)  
1% to 95%  
no condensation

DC Voltage Requirements  
+ 12V ± 5% @ 1.3A typical, 2.2A MAX  
+ 5V ± 5% @ 0.5A typical, 0.7A MAX

Mechanical Dimensions (exclusive of front panel)  
Width = 5.75 in. (146.1mm)  
Height = 3.25 in. (82.6mm)  
Depth = 8.25 in. (205mm)  
Weight = 3 lbs. 3 ozs. (1.44 Kg) Nominal

Power Dissipation =  
18.2 watts (62.1 BTU/Hr) Continuous (typical)  
14.6 watts (49.8 BTU/Hr) Standby (typical)

### 1.2.4 Reliability Specifications

MTBF: 8000 POH under typical usage\*  
\*Assumes the duty cycle of the drive spindle motor to be 25%  
PM: Not required  
MTTR: 30 minutes  
Component Life: 5 years

Error Rates:		Media Life:
Soft Read Errors:	1 per 10 <sup>9</sup> bits read	Passes per Track: 3.0 × 10 <sup>6</sup>
Hard Read Errors:	1 per 10 <sup>12</sup> bits read	Insertions: 30,000 +
Seek Errors:	1 per 10 <sup>6</sup> seeks	

## **2.0 FUNCTIONAL CHARACTERISTICS**

The SA410/460 Minifloppy disk drives consist of:

1. Read/Write and Control Electronics
2. Drive Mechanism
3. Precision Track Positioning Mechanism
4. Read/Write Head(s)

### **2.1 Electronics**

The electronics are packaged on one PCB which contains:

1. Index Detector Circuits
2. Head Position Actuator Driver
3. Read/Write Amplifier and Transition Detector
4. Write Protect
5. Drive Select Circuits
6. Spindle Motor Control

The Head Positioning Actuator moves the read/write head(s) to the desired track on the diskette. The head(s) are loaded onto the diskette when the door is closed.

### **2.2 Drive Mechanism**

The DC drive motor under servo speed control (using an integral tachometer) rotates the spindle at 300 rpm through a belt-drive system. An expandable collet/spindle assembly provides precision media positioning to ensure data interchange. A mechanical interlock prevents door closure without proper media insertion, thus eliminating media damage.

### **2.3 Positioning Mechanism**

The read/write head assembly is accurately positioned through the use of a precision HeliCam V-groove lead screw with a ball follower which is attached to the head carriage assembly. Precise track location is accomplished as the lead screw is rotated in discrete increments by a stepping motor.

### **2.4 Read/Write Head(s)**

The glass bonded ceramic and ferrite read/write head(s) contain tunnel erase elements to provide erased areas between data tracks. Thus normal interchange tolerances between media and drives will not degrade the signal to noise ratio and diskette interchangeability is insured.

The read/write head(s) are mounted on a carriage which is located on precision carriage ways. The diskette is held in a plane perpendicular to the read/write head(s) by a platen located on the base casting. This precise registration assures perfect compliance with the read/write head(s). The read/write head(s) is in direct contact with the diskette. The head surfaces have been designed to obtain maximum signal transfer to and from the magnetic surface of the diskette with minimum head/diskette wear.

### **2.5 Recording Formats**

The format of the data recorded on the diskette is totally a function of the host system, and can be designed around the users application to take maximum advantage of the total available bits that can be written on any one track.

For a detailed discussion of the various recording formats refer to Section 7.0.

## 3.0 FUNCTIONAL OPERATIONS

### 3.1 Power Sequencing

Applying DC power to the SA410 or SA460 can be done in any sequence; however, during power up, the WRITE GATE line must be held inactive or at a high level. After application of DC power, a 100 ms delay should be introduced before any operation is performed. Also, after powering on, initial position of the read/write heads with respect to the data tracks on the media is indeterminant. In order to assure proper positioning of the read/write heads after power on, a Step Out operation should be performed until the Track 00 line becomes active (Recalibrate).

### 3.2 Drive Selection

Drive selection occurs when a drive's DRIVE SELECT line is activated. Only the drive with this line active will respond to input lines or gate output lines. Under normal operation, the DRIVE SELECT line enables the input and output lines and lights the Activity LED on the front of the drive.

### 3.3 Motor On

In order for the host system to read or write data the DC drive motor must be turned on. This may be accomplished by activating the line MOTOR ON. A 200 ms delay must be introduced after activating this line to allow the motor to come up to speed before reading or writing can be accomplished.

The motor must be turned off by the host system by deactivating the MOTOR ON line. This should be done if the drive has not received a new command within two (2) seconds (10 revolutions of diskette) after completing the execution of a command. This will insure maximum motor and media life. **Note:** All motors in a daisy chain configuration are turned on with MOTOR ON. Reference sections 4.1.1.2 and 4.1.1.3.

### 3.4 Track Accessing

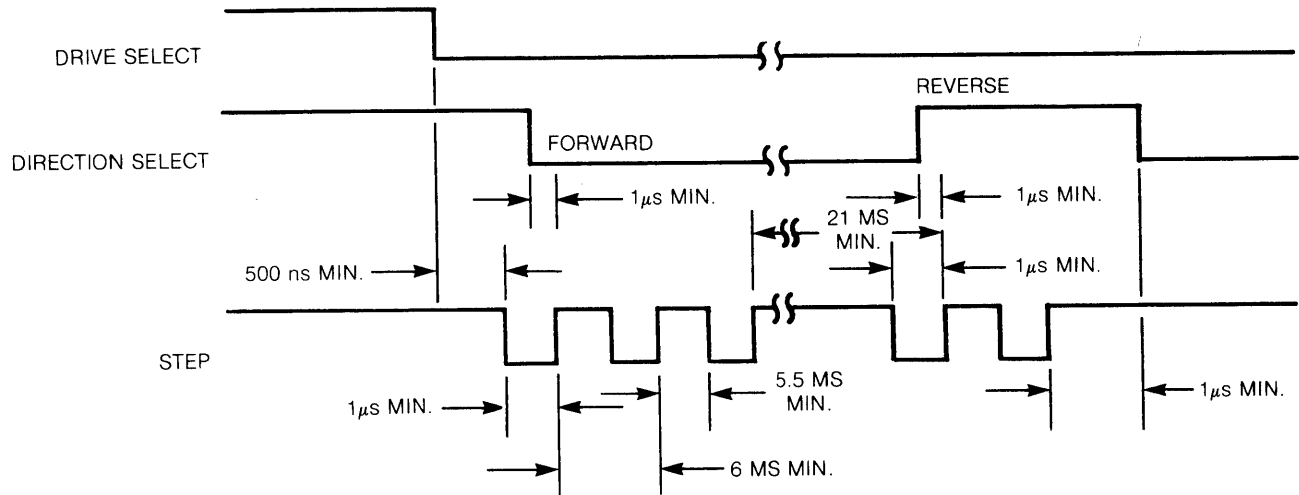
Seeking the read/write heads from one track to another is accomplished by:

- a. Activating DRIVE SELECT line.
- b. Selecting desired direction utilizing DIRECTION SELECT line.
- c. WRITE GATE being inactive.
- d. Pulsing the STEP line.

Multiple track accessing is accomplished by repeated pulsing of the STEP line until the desired track has been reached. Each pulse on the STEP line will cause the read/write heads to move one track either in or out depending on the DIRECTION SELECT line. Head movement is initiated on the trailing edge of the STEP pulse.

#### 3.4.1 Step Out

With the DIRECTION SELECT line at a plus logic level (2.5V to 5.25V) a pulse on the STEP line will cause the read/write heads to move one track away from the center of the disk. The pulse(s) applied to the STEP line must have the timing characteristics shown in Figure 3.



**FIGURE 3. TRACK ACCESS TIMING**

### 3.4.2 Step In

With the DIRECTION SELECT line at minus logic level (0V to .4V), a pulse on the STEP line will cause the read/write heads to move one track closer to the center of the disk. The pulse(s) applied to the STEP line must have the timing characteristics shown in Figure 3.

### 3.5 Side Selection (SA460 only)

Head Selection is controlled via the I/O signal line designated SIDE SELECT. A plus logic level on the SIDE SELECT line selects the read/write head on the side 0 surface of the diskette. A minus logic level selects the side 1 read/write head. When switching from one side to the other. A 200 μs delay is required after SIDE SELECT changes state before a read or write operation can be initiated. Side select should not change state for a minimum of 1.1 msec after write gate is terminated. Figure 4 shows the use of SIDE SELECT prior to a read operation.

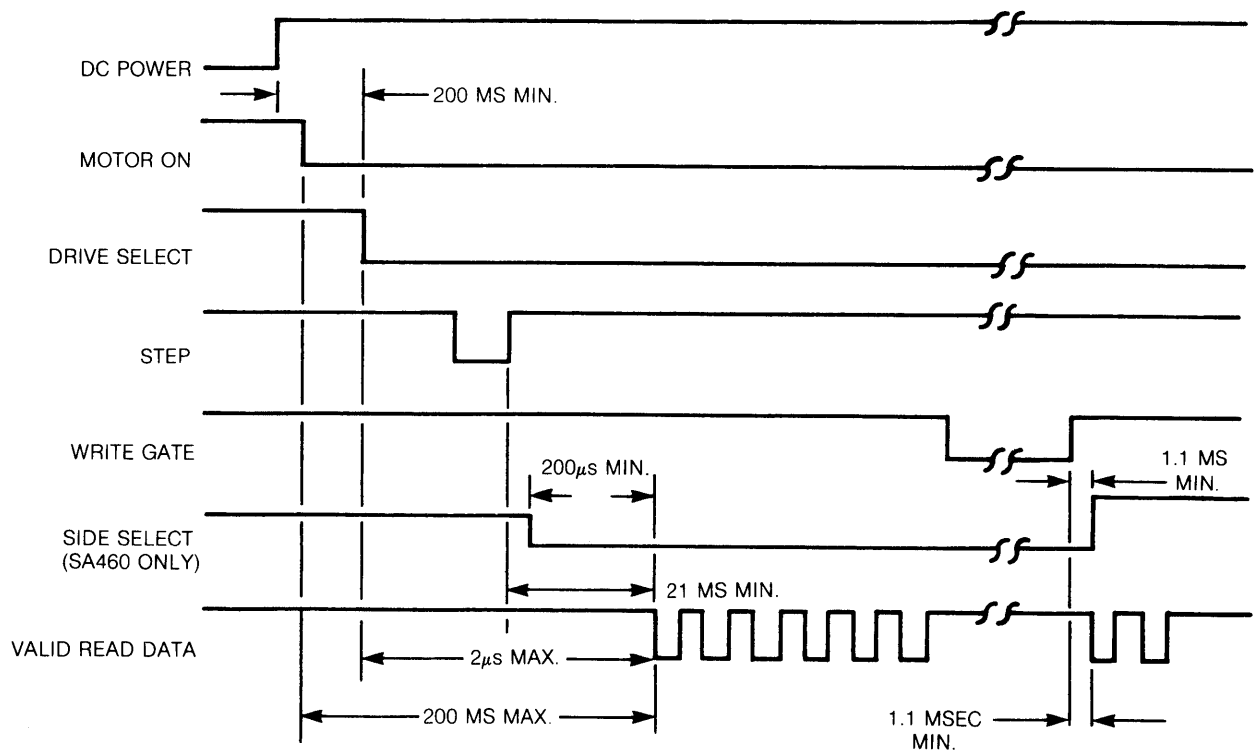
### 3.6 Read Operation

Reading data from the SA410/460 minifloppy drive is accomplished by:

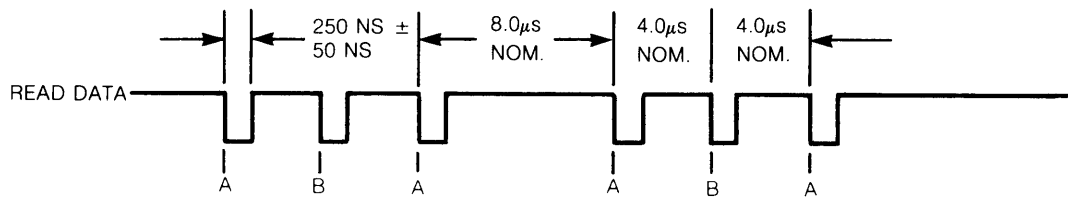
- a. Activating DRIVE SELECT line.
- b. Selecting Head (SA460 only).
- c. WRITE GATE being inactive.

The timing relationships required to initiate a read sequence are shown in Figure 4. These timing specifications are required in order to guarantee that the read/write heads position has stabilized prior to reading.

The timing of Read Data (FM) is shown in Figure 5.

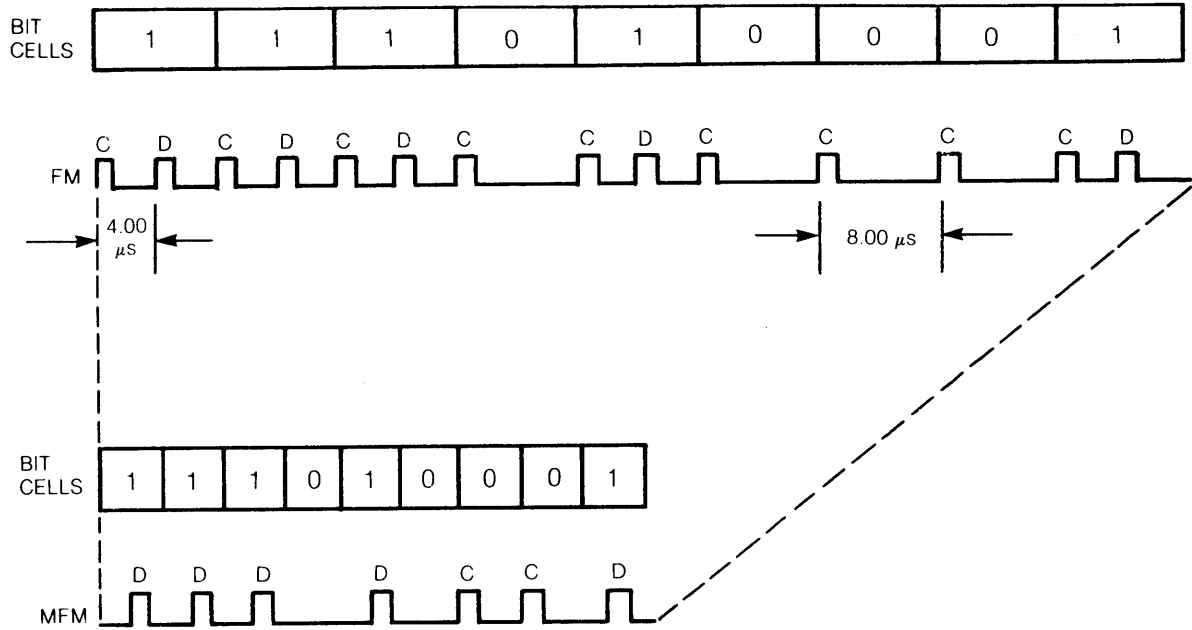


**FIGURE 4. READ INITIATE TIMING**

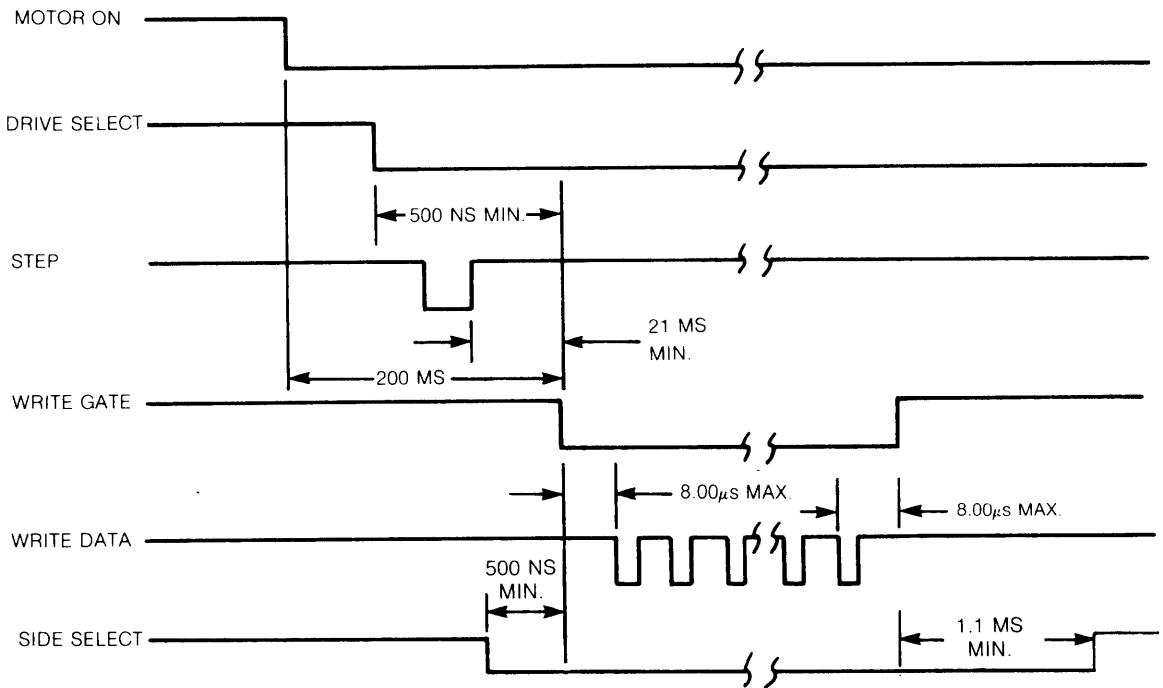


A = LEADING EDGE OF BIT MAY BE  $\pm 800$  ns FROM ITS NOMINAL POSITION  
 B = LEADING EDGE OF BIT MAY BE  $\pm 400$  ns FROM ITS NOMINAL POSITION

**FIGURE 5. READ DATA TIMING (FM)**



**FIGURE 6. FM AND MFM CODE COMPARISONS**



**FIGURE 7. WRITE INITIATE TIMING**

The encoding scheme of the recorded data can be either FM or MFM. FM encoding rules specify a clock bit at the start of every bit cell (Refer to Figure 6). MFM encoding rules allow clock bits to be omitted from some bit cells, with the following prerequisites:

The clock bit is omitted from the current bit cell if either the preceding bit cell or the current bit cell contains a data bit. See Figure 6.

In the above mentioned encoding schemes, clock bits are written at the start of their respective bits cells and data bits at the centers of their bit cells.

### 3.7 Write Operation

Writing data to the SA410/460 is accomplished by:

- a. Activating the DRIVE SELECT line.
- b. Selecting Head (SA460 only).
- c. Activating the WRITE GATE line.
- d. Pulsing the WRITE DATA line with the data to be written.

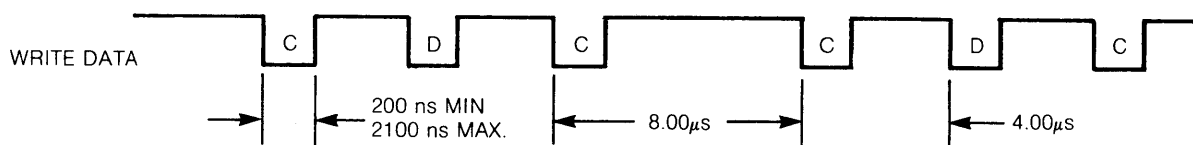
The timing relationships required to initiate a Write Data sequence are shown in Figure 7. These timing specifications are required in order to guarantee that the read/write head's position has stabilized prior to writing. Drive select, or side select (SA460), may not change nor a step command be issued for a minimum of 1.1 msec after write gate is returned to an inactive state (refer to paragraph 4.1.1.7).

The timing specifications for the Write Data pulses are shown in Figure 8.

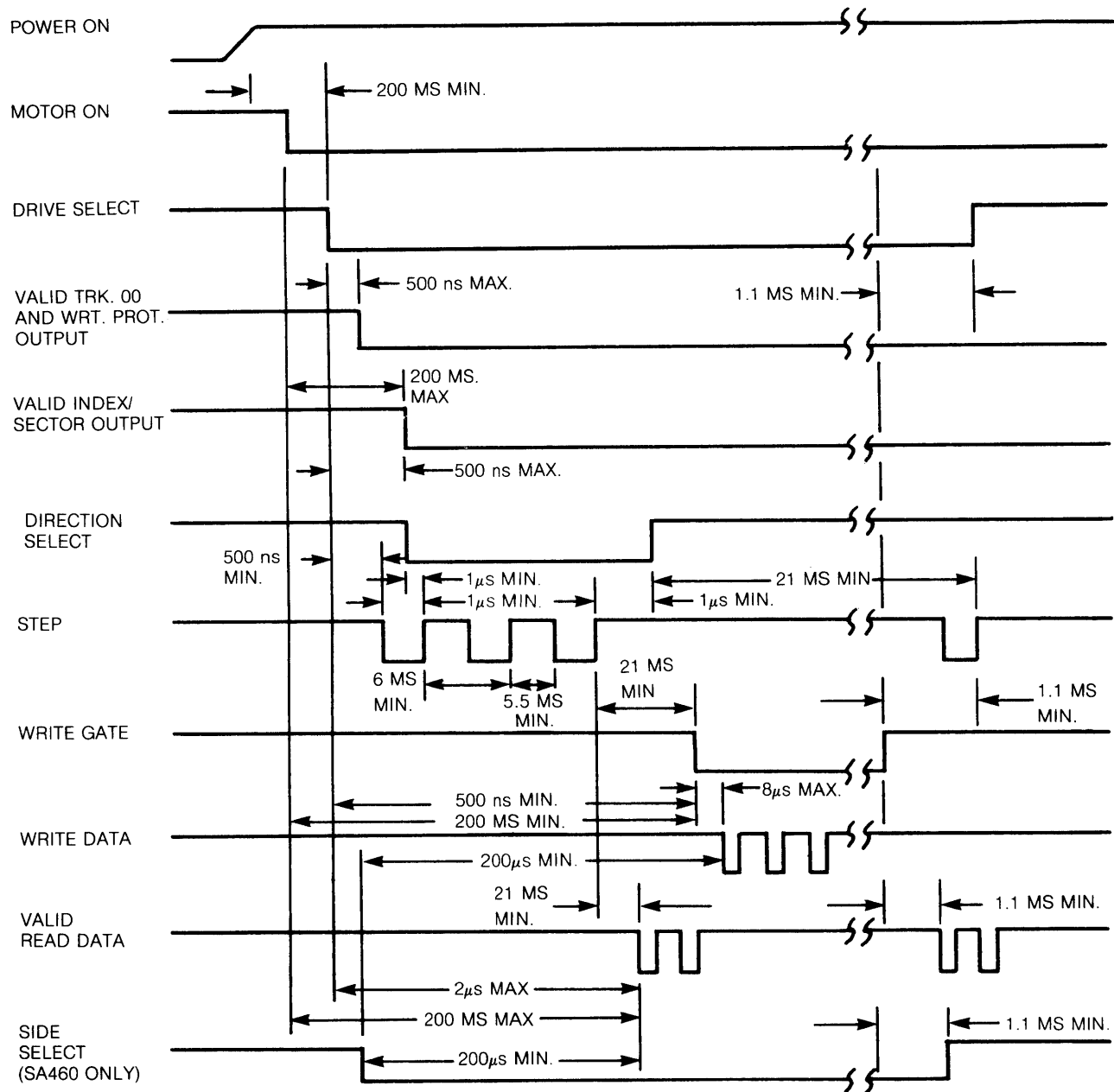
Write data encoding can be FM or MFM. The write data should be precompensated 100 ns on all tracks to counter the effects of bit shift. The direction of compensation required for any given bit in the data stream depends on the pattern it forms with nearby bits.

### 3.8 Sequence of Events

The timing diagram shown in Figure 9 shows the necessary sequence of events with associated timing restrictions for proper operation.



**FIGURE 8. WRITE DATA TIMING (FM)**



**FIGURE 9. GENERAL CONTROL AND DATA TIMING REQUIREMENTS**



## 4.0 ELECTRICAL INTERFACE

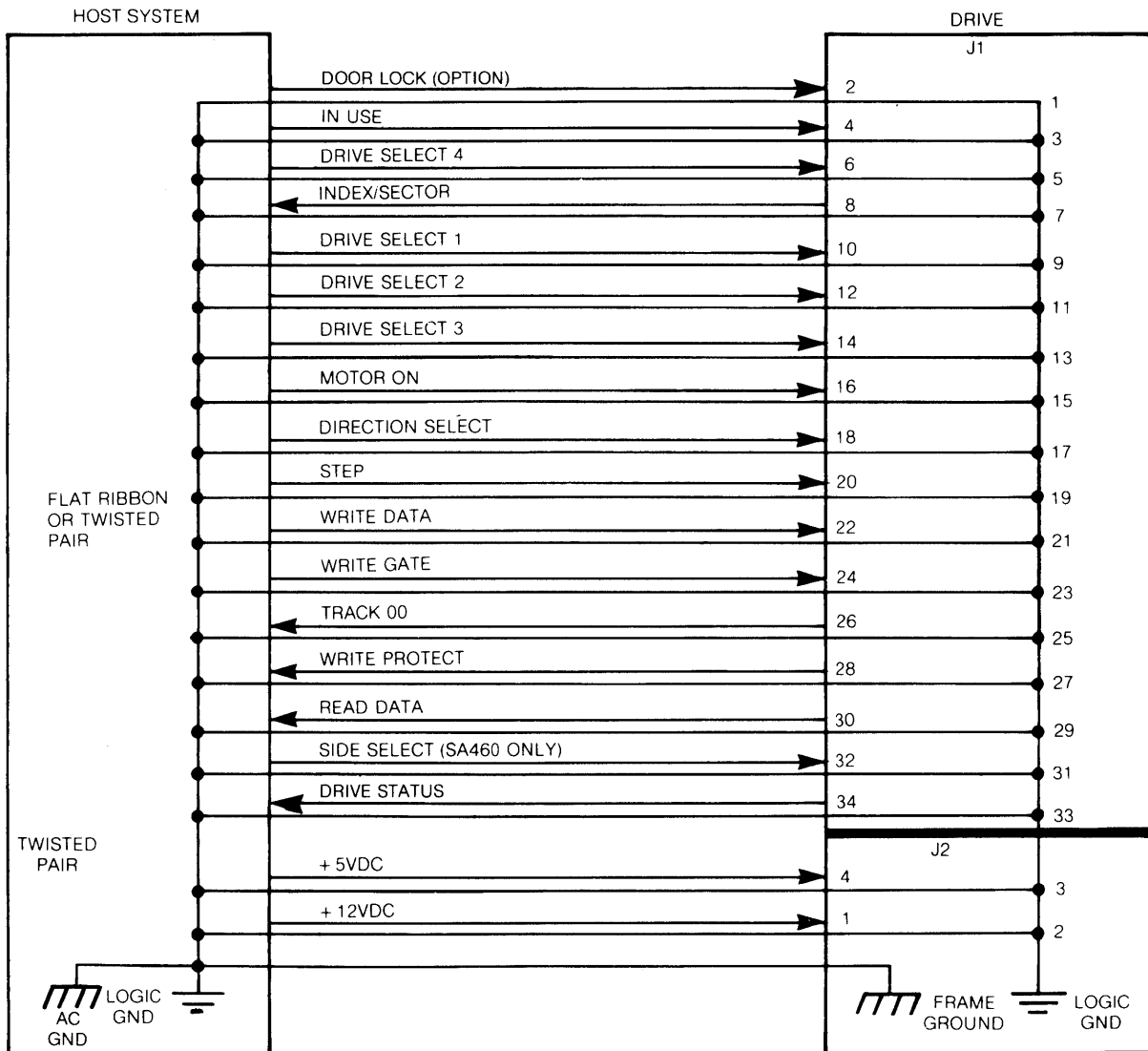
The interface of the SA410/460 minidiskette drives can be divided into two categories:

1. Signal
2. Power

The following sections provide the electrical definition for each line.

Refer to figure 10 for all interface connections.

Refer to section 8.0 for description of options.



**FIGURE 10. INTERFACE CONNECTIONS**

## 4.1 Signal Interface

The signal interface consists of two categories:

1. Control
2. Data Transfer

All lines in the signal interface are digital in nature and either provide signals to the drive (input), or provide signals to the host (output), via interface connector P1/J1.

### 4.1.1 Input Lines

The input signals are of 3 types, those intended to be multiplexed in a multiple drive system, those which will perform the multiplexing and those signals which are not multiplexed and affect all the drives in a daisy chain system.

The input signals to be multiplexed are:

1. DIRECTION SELECT
2. STEP
3. WRITE DATA
4. WRITE GATE
5. SIDE SELECT (SA460 only)

The input signals which are intended to do the multiplexing are:

1. DRIVE SELECT 1
2. DRIVE SELECT 2
3. DRIVE SELECT 3
4. DRIVE SELECT 4

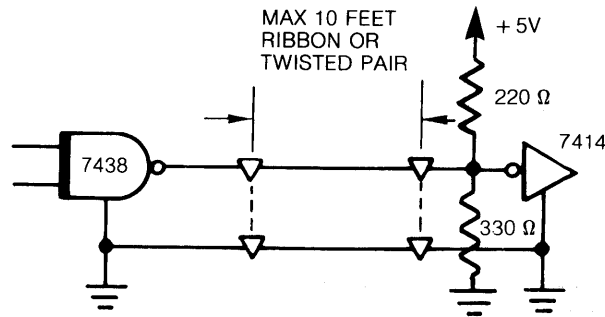
The signals which are not multiplexed are IN USE and MOTOR ON.

The input lines have the following electrical specifications. (See Figure 11 for the recommended circuit.)

True = Logical zero =  $V_{in}$  0.0V to +.04V @ 40 ma (max)

False = Logical one =  $V_{in}$  +2.5V to +5.25V @ 250 $\mu$ a (open)

Input impedance = 220/330ohms



**FIGURE 11. INTERFACE SIGNAL DRIVER/RECEIVER**

#### 4.1.1.1 Input Line Terminations

The SA410/460 has been provided with the capability of terminating the eight input lines listed below.

1. MOTOR ON
2. DIRECTION SELECT
3. STEP
4. WRITE DATA
5. WRITE GATE
6. SIDE SELECT (SA460 only)
7. DOOR LOCK
8. IN USE

These lines are terminated through a 220/330 ohm resistor pack installed in a dip socket.

In a single drive system this resistor pack should be kept in place to provide the proper terminations.

In a multiple drive system only the last drive on the interface is to be terminated. All other drives on the interface must have the resistor pack removed. External terminations may also be used, then the user must provide the terminations beyond the last drive and each of the eight lines must be terminated to +5VDC through a 220/330 ohm 1/4 watt resistor.

#### 4.1.1.2 DRIVE SELECT 1-4

The SA460 or SA410 is configured to operate with up to four drives in a multiplexed multiple drive system.

**SINGLE DRIVE SYSTEM (MX shorting plug installed)**

With the MS shorting plug installed, DRIVE SELECT when activated to a logical zero level will turn the motor on. With MX shorted, the I/O lines are always enabled.

**MULTIPLE DRIVE SYSTEM (MX shorting plug not installed)**

Four separate input lines (DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3 and DRIVE SELECT 4) are provided so that up to four drives in a multiplexed system may have separate input pins. Only the drive with its unique DRIVE SELECT line active will turn its motor on, allow the drive to respond to multiplexed input lines and enable the outputs to drive their respective signal lines. A logic zero on the interface selects a unique drive select line for a drive.

#### 4.1.1.3 MOTOR ON

This input, when activated to a logical zero level, will turn on the drive motor allowing reading or writing on the drive. A 0.2 second delay after activating this line must be allowed before reading or writing. This line should be deactivated, for maximum motor life, if no commands have been issued to the drives within two seconds nominal (10 revolutions of the media) after completion of a previous command. This time may be varied by the host system to maximize system through-put and motor life depending on application.

As discussed in section 4.1.1.2, when MS is shorted the motor will turn on when the DRIVE SELECT line is activated or if the MOTOR ON line is activated. A user selectable option is available where by the motor will turn on only when the MOTOR ON line is activated.

#### 4.1.1.4 Direction Select

This interface line defines direction of motion the read/write heads will take when the STEP line is pulsed. An open circuit or logical one defines the direction as “out” and if a pulse is applied to the STEP line the read/write heads will move away from the center of the disk. Conversely, if this input is shorted to ground or a logical zero level, 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.

#### 4.1.1.5 Step

This interface line is a control signal which causes the read/write heads to move with the direction of motion as defined by the DIRECTION SELECT line. This signal must be a logical zero going pulse with a minimum pulse width of  $1\mu\text{s}$  and a logical one for 5.5 ms minimum between adjacent pulses. Each subsequent pulse must be delayed by 6 ms minimum from the preceding pulse.

The access motion is initiated on each logical zero to logical one transition, or the trailing edge of the signal pulse. Any change in the DIRECTION SELECT line must be made at least  $1\mu\text{s}$  before the trailing edge of the STEP pulse. The DIRECTION SELECT logic level must be maintained  $1\mu\text{s}$  after trailing edge of STEP pulse. Refer to Figure 12 for these timings.

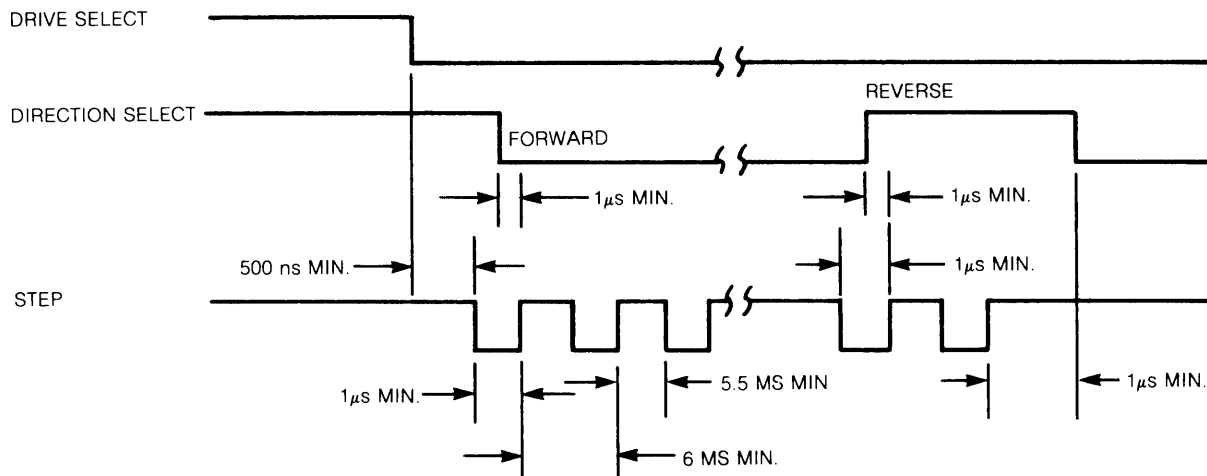


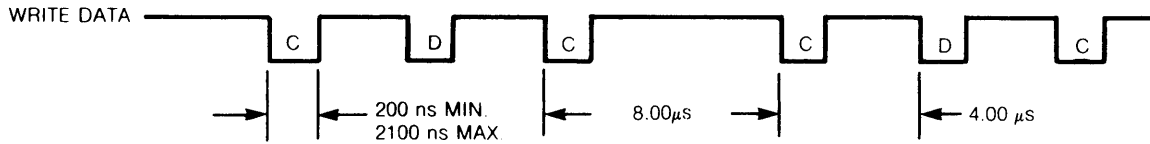
FIGURE 12. STEP TIMING

#### 4.1.1.6 Write Gate

The active state of this signal, or logical zero, enables Write Data to be written on the diskette. The inactive state or logical one, enables the read data logic and stepper logic. Refer to Figure 7 for timings.

#### 4.1.1.7 Write Data

This interface line provides the data to be written on the diskette. Each transition from a logical one level to a logical zero level, will cause the current through the read/write heads to be reversed thereby writing a data bit. This line is enabled by Write Gate being active. Write Data must be inactive during a read operation. Refer to Figure 13 for timings.



**FIGURE 13. WRITE DATA TIMING (FM ENCODING)**

#### 4.1.1.8 Side Select (SA460 only)

This signal defines which side of a two-sided diskette is to be written to or read from. A logical one selects the side 0 head. When switching from one side to the other a 200 μs delay is required before a read operation can be initiated. A delay of 1.1 ms is required after a write operation before changing the state of side select.

#### 4.1.1.9 In Use

Normally, the activity LED on the selected drive will turn on when the corresponding DRIVE SELECT signal is active. The IN USE input can alternately activate the LED on all the drives in a daisy chain or separately in a radial configuration.

#### 4.1.2 Output Lines

The output control lines have the following electrical specifications. Refer to Figure 11 for the recommended circuit.

True = Logical zero =  $V_{out} + 0.0V$  to  $+ 0.4V @ 40$  ma (max)

False = Logical one =  $V_{out} + 2.5V$  (open collector @ 250 μa max)

##### 4.1.2.1 Track 00

The active or logical zero state of this interface signal indicates when the drive's read/write heads are positioned at track zero (the outermost track) and the stepper is locked on track. This signal is at a logical one level, or inactive state, when the drive's read/write heads are not at track zero. When the drive's read/write heads are at track zero and an additional step out pulse is issued to the drive, a mechanical stop will keep the read/write heads at track zero.

##### 4.1.2.2 Index/Sector

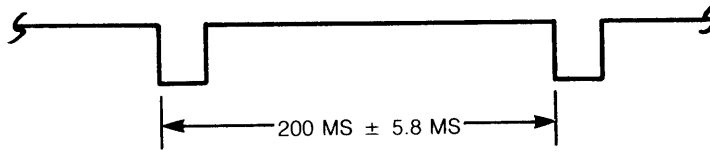
This interface signal is provided by the drive each time an index or sector hole is sensed at the Index/Sector photo detector. Normally, this signal is at a logical one level and makes the transition to the logical zero level each time a hole is sensed.

When using media Soft Sected, there will be one pulse on this interface signal per revolution of the diskette (200 ms). This pulse indicates the physical beginning of a track. Refer to Figure 14.

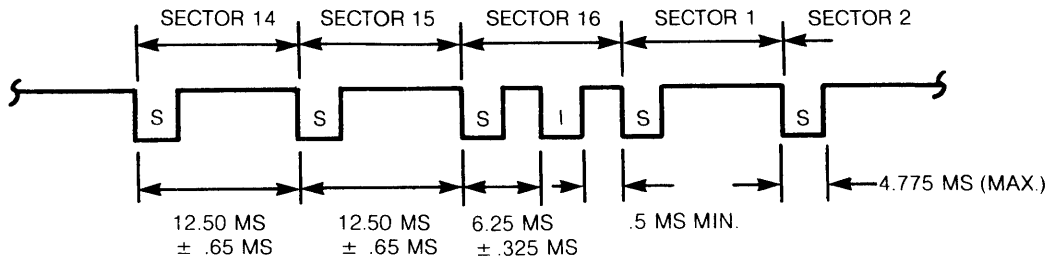
When using the Index/Sector signal, look for an edge or transition rather than a level for determining its status. With no diskette inserted, this signal remains active or at a logical zero level which is an erroneous status.

##### 4.1.2.3 Read Data

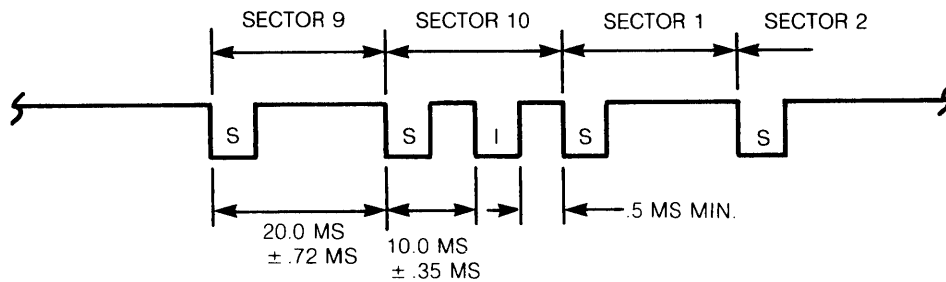
This interface line provides the "raw data" (clock and data together) as detected by the drive electronics. Normally, this signal is a logical one level and becomes a logical zero level for the active state. Refer to Figure 17 for the timing and bit shift tolerance within normal media variations.



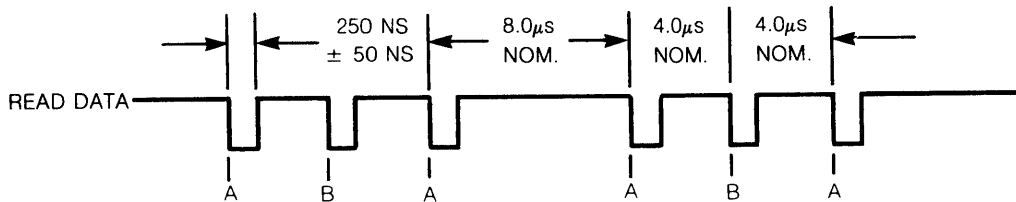
**FIGURE 14. INDEX TIMING (SOFT SECTORED MEDIA)**



**FIGURE 15. INDEX/SECTOR TIMING (SA115 OR SA165 MEDIA)**



**FIGURE 16. INDEX/SECTOR TIMING (SA117 OR SA167 MEDIA)**



A = LEADING EDGE OF BIT MAY BE  $\pm 800$  ns FROM ITS NOMINAL POSITION  
 B = LEADING EDGE OF BIT MAY BE  $\pm 400$  ns FROM ITS NOMINAL POSITION

**FIGURE 17. READ DATA TIMING (FM)**

#### 4.1.2.4 Write Protect

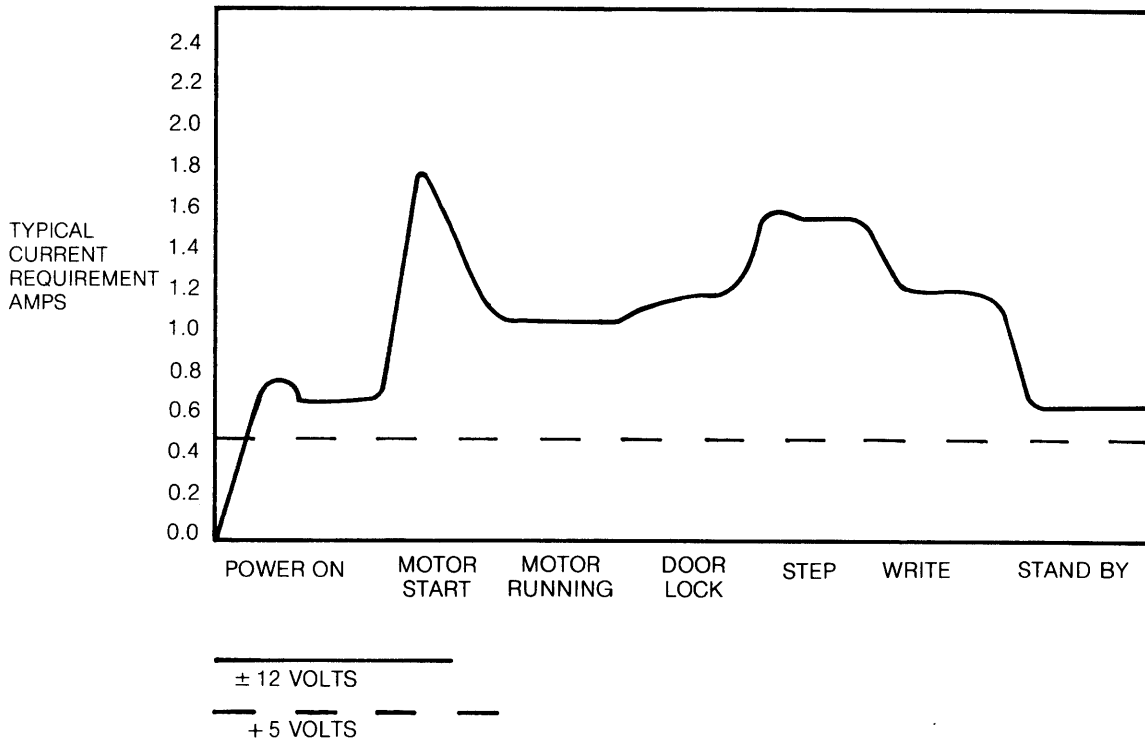
This interface signal is provided by the drive to give the user an indication when a Write Protected Diskette is installed. The signal is logical zero level when it is protected with label over notch. The drive will inhibit writing with a protected diskette installed in addition to notifying the interface (refer to paragraph 8.5).

#### 4.1.2.5 Drive Status (Refer to Paragraph 8.4)

## 4.2 Power Interface

The SA410 or SA460 requires only DC power for operation. DC power to the drive is provided via P2/J2 located on the component side of the PCB near the spindle drive motor. The two DC voltages, their specifications and their P2/J2 pin designators are outlined in table 1. The specifications outlined on current requirements are for one drive. For multiple drive systems the current requirements are a multiple of the maximum current times the number of drives in the system.

P2 PIN	DC VOLTAGE	TOLERANCE		MAX RIPPLE (p to p)
1	+ 12VDC	$\pm 0.6$ VDC	2.20 A MAX. 1.3 A TYP.	100 mV max allowable
2	+ 12 Return			
3	+ 5 Return			
4	+ 5VDC	$\pm 0.25$	.70A MAX .50A TYP.	



**TABLE 1. DC POWER REQUIREMENTS**

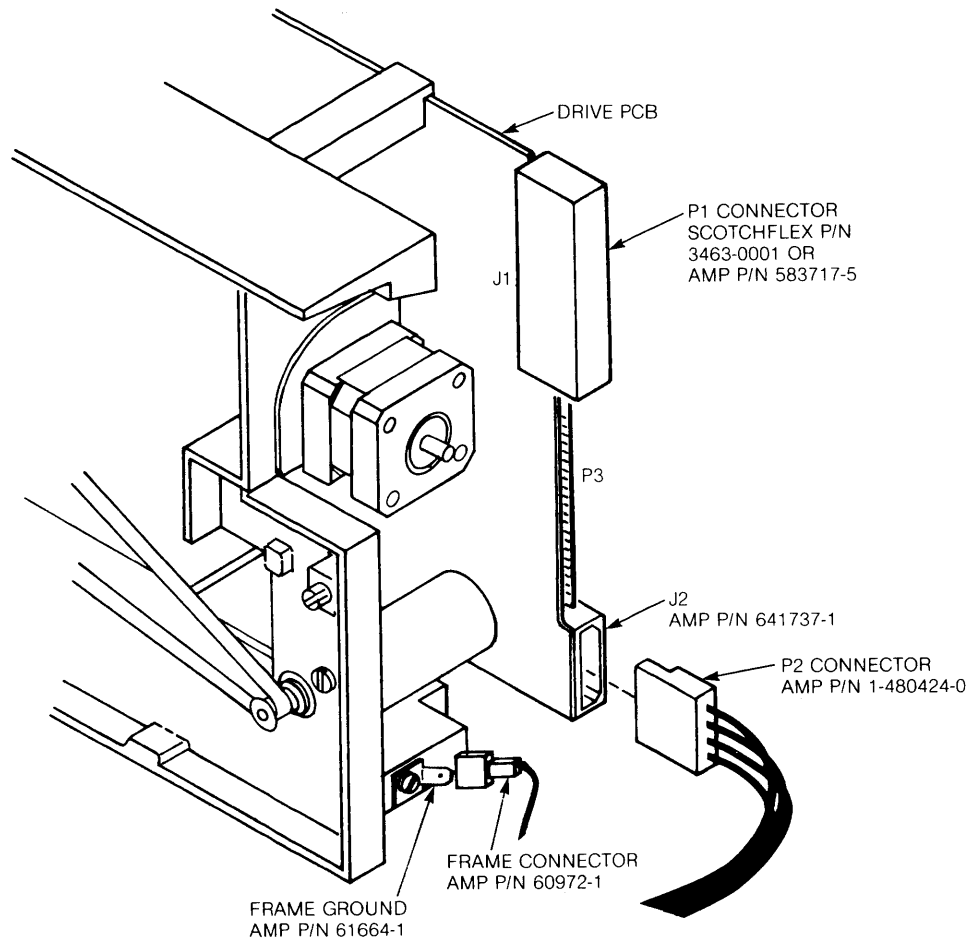
### 4.2.1 Frame Ground

It is important that the drive be frame grounded to the host system AC or frame ground. Failure to do so may result in drive noise susceptibility.

## 5.0 PHYSICAL INTERFACE

The electrical interface between the SA410 or SA460 and the host system is via two connectors. The first connector, J1, provides the signal interface and the second connector, J2, provides the DC power.

This section describes the physical connectors used on the drive and recommended connectors to be used with them. Refer to Figure 18 for connector locations.



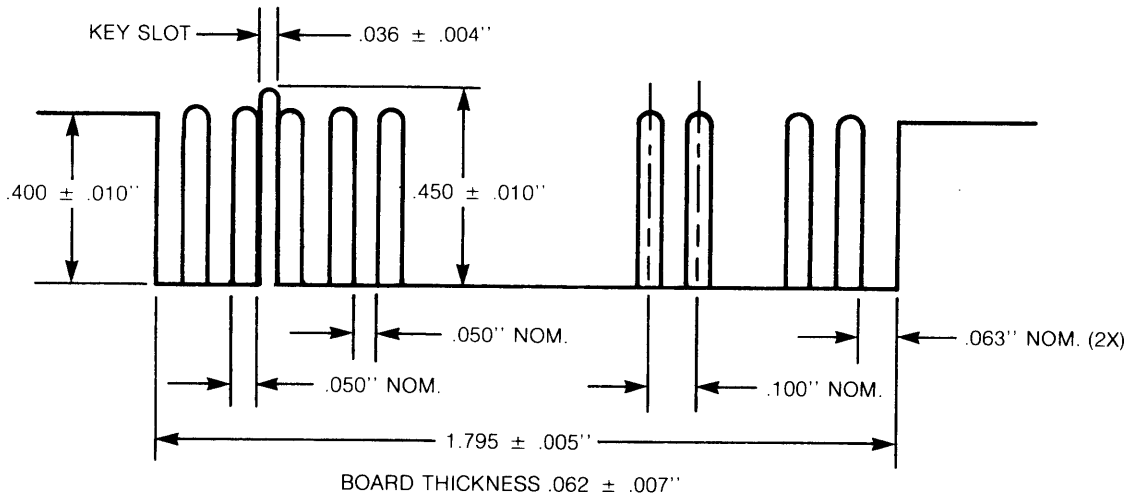
**FIGURE 18. INTERFACE CONNECTORS-PHYSICAL LOCATIONS**

### 5.1 J1/P1 Connector

Connection to J1 is through a 34 pin PCB edge connector. The dimensions for this connector are shown in Figure 19. The pins are numbered 1 through 34 with the even numbered pins on the component side of the PCB and the odd numbered pins on the non-component side. Pin 2 is located on the end of the PCB connector closest to the corner and is labeled 2. A key slot is provided between pins 4 and 6 for optional connector keying.

The recommended connectors for P1 are shown in Figure 18.

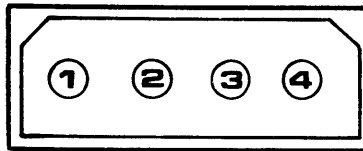




**FIGURE 19. J1 CONNECTOR DIMENSIONS**

### 5.2 J2/P2 Connector

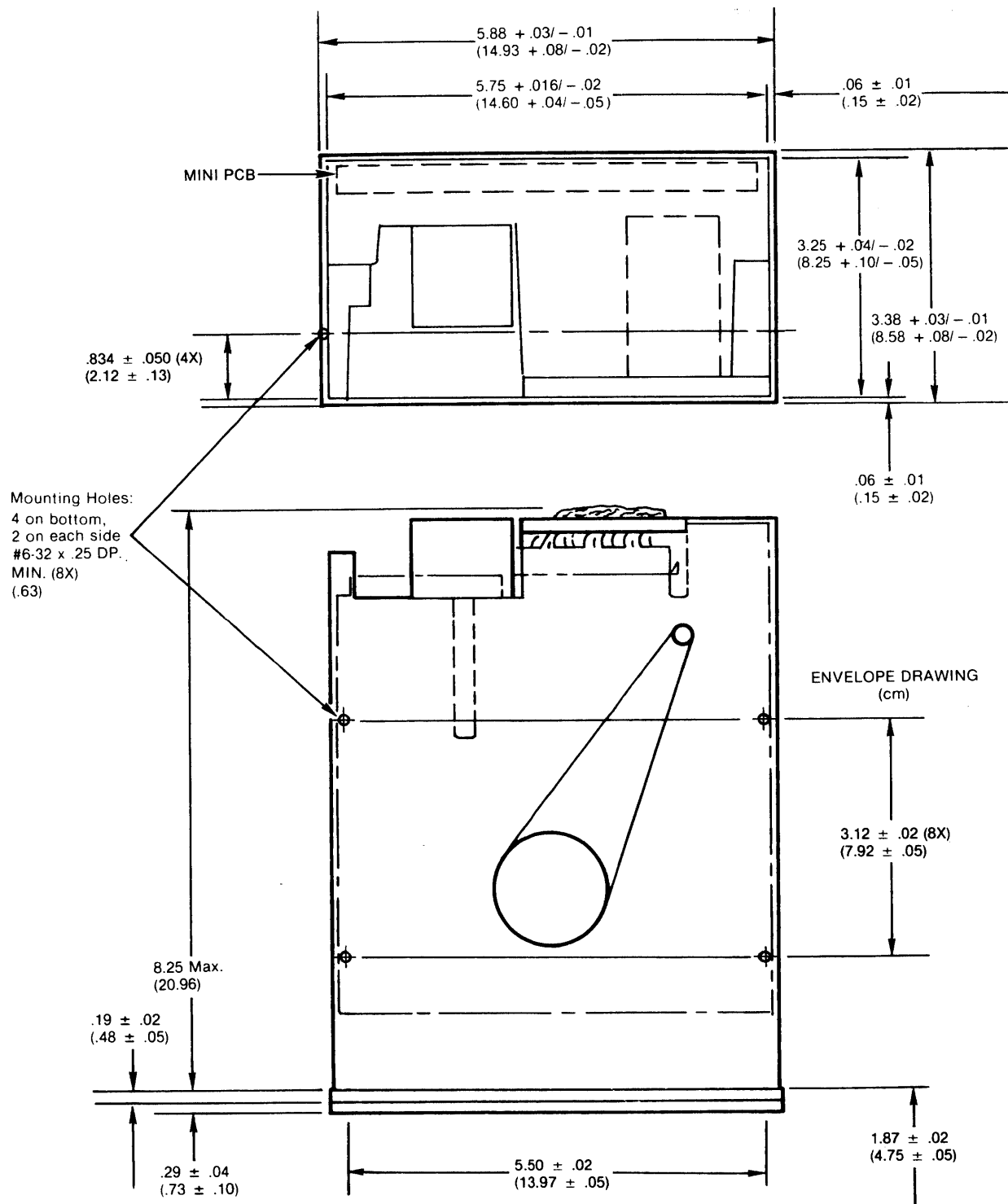
The DC power connector, J2, is mounted on the component side of the PCB and is located near the spindle drive motor. J2 is a 4 pin AMP Mate-N-Lok connector P/N 641737-1. The recommended mating connector (P2) is AMP P/N 1-480424-0 utilizing AMP pins P/N 61473-1. J2, pin 1, is labeled on the component side of the PCB. Wire used should be #18 AWG. Figure 20 illustrates J2 connector as seen on PCB from the rear of the drive.



**FIGURE 20. J2 CONNECTOR**

### 5.3 Frame Grounding

The drive must be frame grounded to the host system to insure 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. The tab is AMP P/N 61664-1 and its mating connector is AMP P/N 60972-1.



**FIGURE 21. PHYSICAL DIMENSIONS**

## 6.0 DRIVE PHYSICAL SPECIFICATIONS

This section contains the mechanical dimensions and mounting recommendations for the SA410 or SA460.

### 6.1 Mechanical Dimensions

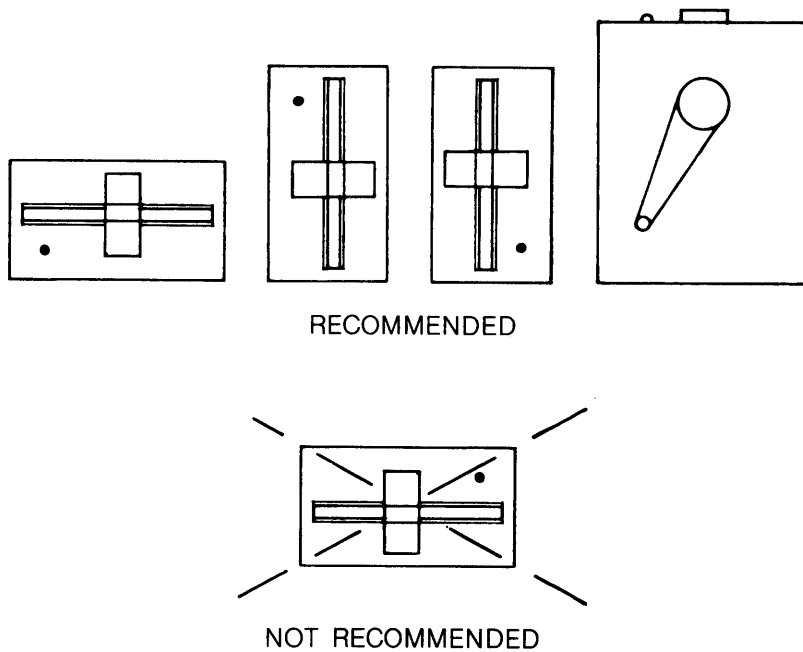
Refer to Figure 21 for dimensions of the SA410/460.

### 6.2 Mounting

As shipped from the factory, the drive is capable of being mounted in one of the following positions:

1. Top Loading -mounted upright.
2. Front Loading -mounted vertical with door opening left or right.

-mounted horizontal with PCB up. DO NOT HORIZONTAL MOUNT WITH PCB DOWN.



**FIGURE 22. RECOMMENDED MOUNTING**

## 7.0 RECORDING FORMAT

### 7.1 General

The format of the data recorded on the diskette is totally a function of the host system. As discussed in Section 3.6, data can be recorded on the diskette using FM or MFM encoding. In these encoding techniques, clock bits are written at the start of their respective bit cells and data bits at the centers of their bit cells.

### 7.2 Byte

A Byte, when referring to serial data (being written onto or read from the disk drive), is defined as eight (8) consecutive bit cells. The most significant bit cell is defined as bit cell 0 and the least significant bit cell is defined as bit cell 7. When reference is made to a specific data bit (i.e., data bit 3), it is with respect to the corresponding bit cell (bit cell 3).

During a write operation, bit cell 0 of each byte is transferred to the disk drive first with bit cell 7 being transferred last. Correspondingly, the most significant byte of data is transferred to the disk first and the least significant byte is transferred last.

When data is being read back from the drive, bit cell 0 of each byte will be transferred first with bit cell 7 last. As with reading, the most significant byte will be transferred first from the drive to the user.

Figure 23 illustrates the relationship of the bits within a byte and Figure 24 illustrates the relationship of the bytes for read and write data.

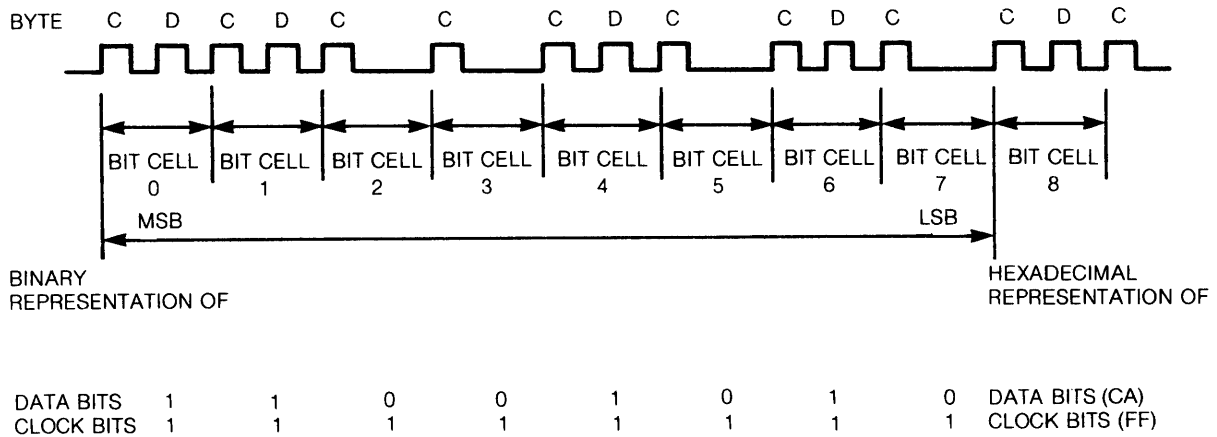


FIGURE 23. BYTE (FM ENCODING)

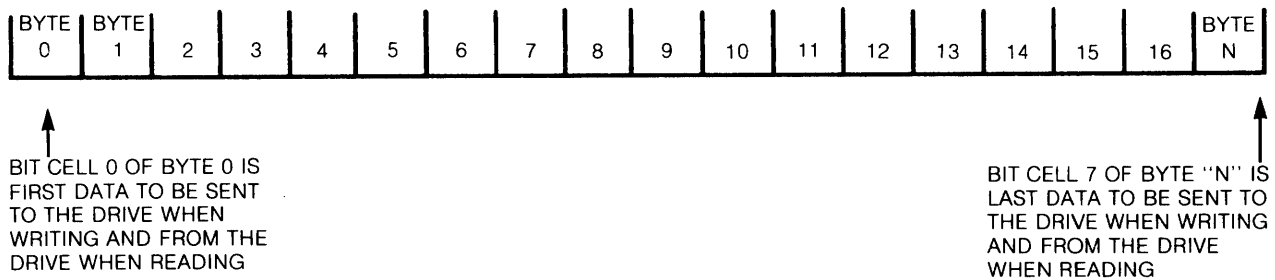


FIGURE 24. DATA BYTES

### 7.3 Formats

Tracks may be formatted in numerous ways and is dependent on the using system. The SA410 or SA460 can use either hard or soft sectored formats.

#### 7.3.1 Soft Sectored Recording Format

In this format, the using system may record one long record or several smaller records. Each track is started by physical index pulse and then each record is preceded by a unique recorded identifier. This type of recording is called soft sectoring. Figure 25 illustrates the recommended single density (FM) formats. Figures 26 shows the recommended double density (MFM) formats.

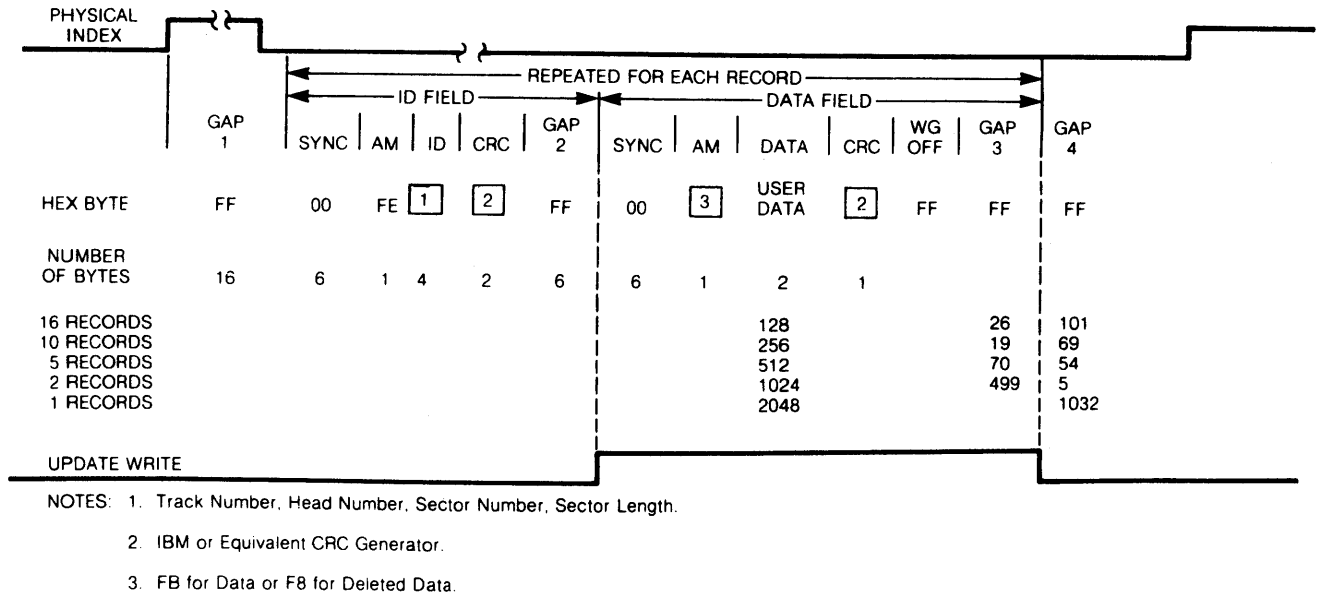


FIGURE 25. RECOMMENDED SOFT SECTOR SINGLE DENSITY (FM) (EVEN BOUNDARIES)

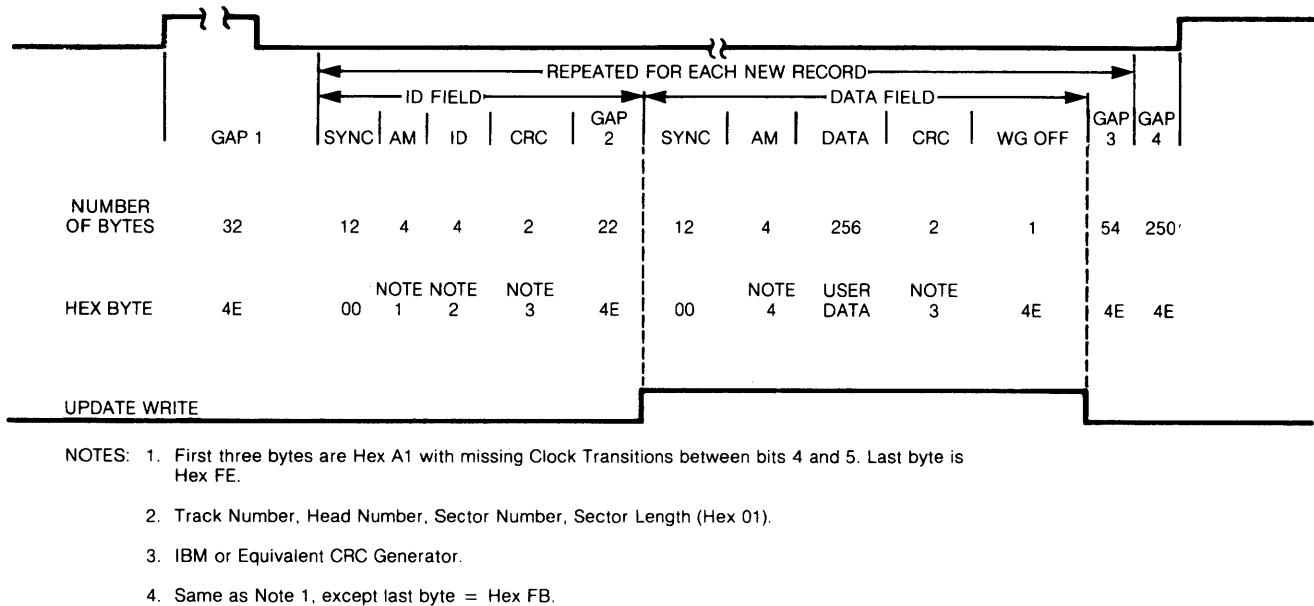


FIGURE 26. MFM RECOMMENDED FORMAT - 256 BYTES/16 RECORDS PER TRACK (IBM TYPE)

### 7.3.1.1 Track Layout

Index is the physical detector indicating one revolution of the media and is used to initiate format operations, generate the Ready signal in the storage device, insure one complete revolution of the media has been searched, and for a deselect storage device signal after a certain number of revolutions.

Gap 1-**G1** is from the physical index mark to the ID field address mark sync and allows for physical index variation, speed variation and interchange between storage devices.

ID Field-**Sync** is a fixed number of bytes for Separator synchronization prior to AM. Includes a minimum of two bytes plus worst case Separator sync up requirements.

**ID Pre Address Mark** (MFM)-Three bytes of A1 with unique clock bits not written per encode rules.

**ID Address Mark** (FM)-is a unique byte to identify the ID field and not written per the encode rules.

**ID Address Mark** (MFM)-is one byte of FE and it is written per the encode rules.

**ID**-if a four byte address containing track number, head number, record number, and record length.

**CRC**-is two bytes for cyclic redundancy check.

Gap 2-**Gap** from ID CRC to data AM sync and allows for speed variation, oscillator variation and erase core clearance of ID CRC bytes prior to write gate turn on for an update write.

Data Field-**Sync** is a fixed number of bytes for Separator synchronization prior to the AM. Includes a minimum of two bytes plus worst case separator sync up requirements.

**Pre Data Address Mark** (MFM)-Three bytes of A1 with unique clock bits not written per the encode rules.

**Data Address Mark** (FM)-is a unique byte to identify the Data Field and it is not written per the encode rules.

**Data Address Mark** (MFM)-is one byte of FB or F8 and it is written per the encode rules.

**Data**-is the area for user data.

**CRC**-is two bytes for cyclic redundancy check.

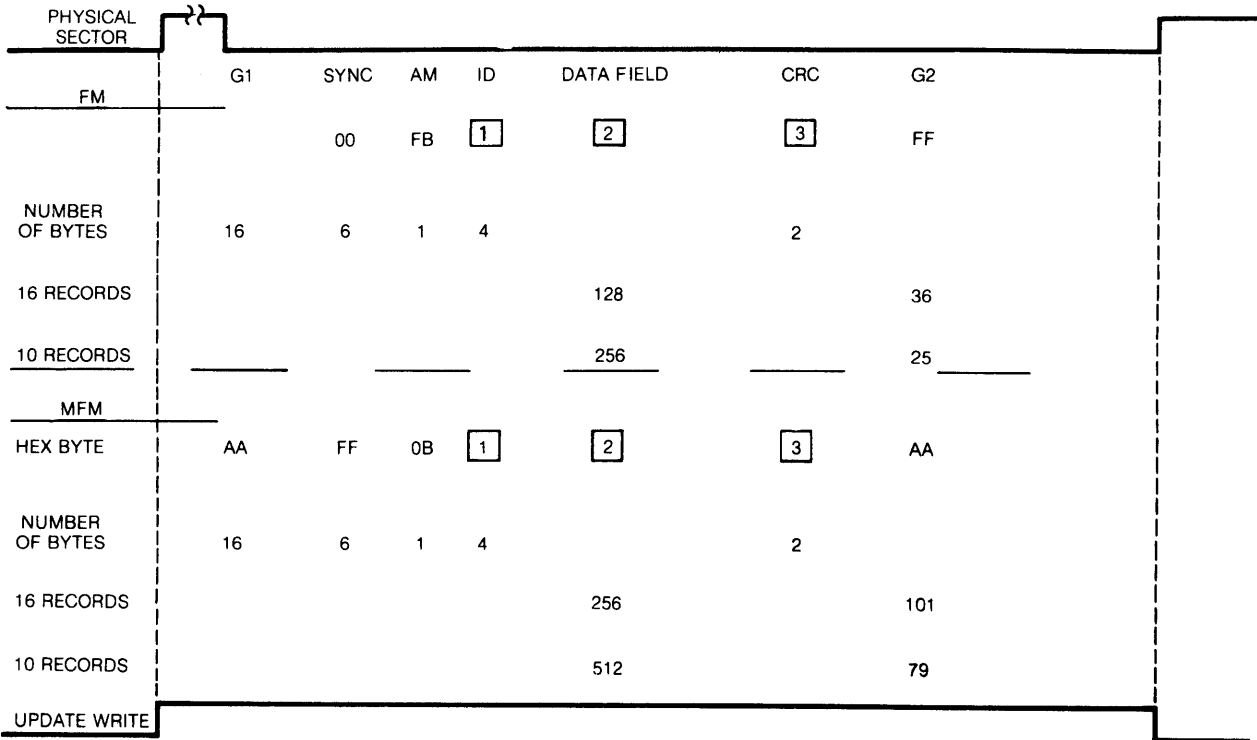
**WG OFF** (Write Gate Off)-is one byte to allow for Write Gate turn off after an update write.

Gap 3-**Gap** from WG OFF to next ID AM sync and allows for erase core to clear the Data Field CRC bytes, speed and write oscillator variation, read preamplifier recovery time and system turn around time to read the following ID Field.

Gap 4-**G4** is the last gap prior to physical index and allows for speed and write oscillator variation during a format write and physical index variation.

### 7.3.1.2 Hard Sector Recording Format

In this format, the using system may record up to 16 or 10 sectors (records) per track. Each track is started by a physical index pulse and each sector is started by a physical sector pulse. This type of recording is called hard sectoring. Figure 27 illustrates the hard sectored formats. All drive tolerances have been taken into account in developing these formats.



- NOTES: 1. Track Number, Head Number, Record Number, Record Length.  
 2. User Data.  
 3. Generated by CRC Generator (IBM or Equivalent).

**FIGURE 27. RECOMMENDED HARD SECTOR FM AND MFM FORMATS**

## 8.0 CUSTOMER INSTALLABLE OPTIONS

The SA410/460 can be modified by the user to function differently than the standard method. These modifications can be implemented by adding or deleting connections. Options can be selected by use of a shorting plug or a cut trace. This section discusses examples of modifications and how to install them. The examples are:

1. DRIVE SELECT, MOTOR ON and IN USE
2. DOOR LOCK from IN USE or DRIVE SELECT
3. SIDE SELECT, using DIRECTION SELECT
4. DRIVE STATUS
5. WRITE PROTECT

TRACE DESIGNATOR	DESCRIPTION	SHIPPED FROM FACTORY	
		OPEN	SHORT
U3	Terminations for Multiplexed Standard Inputs		plugged
DS1	DRIVE SELECT 1 input line		plugged
DS2,3,4	DRIVE SELECT 2,3,4 input lines	X	
MX	DRIVE SELECT Enabled Single Drive System	X	
MS	MOTOR ON From DRIVE SELECT	X	
SS	Standard SIDE SELECT		plugged
SD	SIDE SELECT Option using DIRECTION SELECT	X	
DD	DOOR DISTURB		plugged
DO	DOOR OPEN		
RI	READY INDEX		plugged
RD	READY DOOR	X	
DA	DOOR LOCK From DRIVE SELECT	X	

**TABLE 2. CUSTOMER CUT/ADD TRACE OPTIONS**



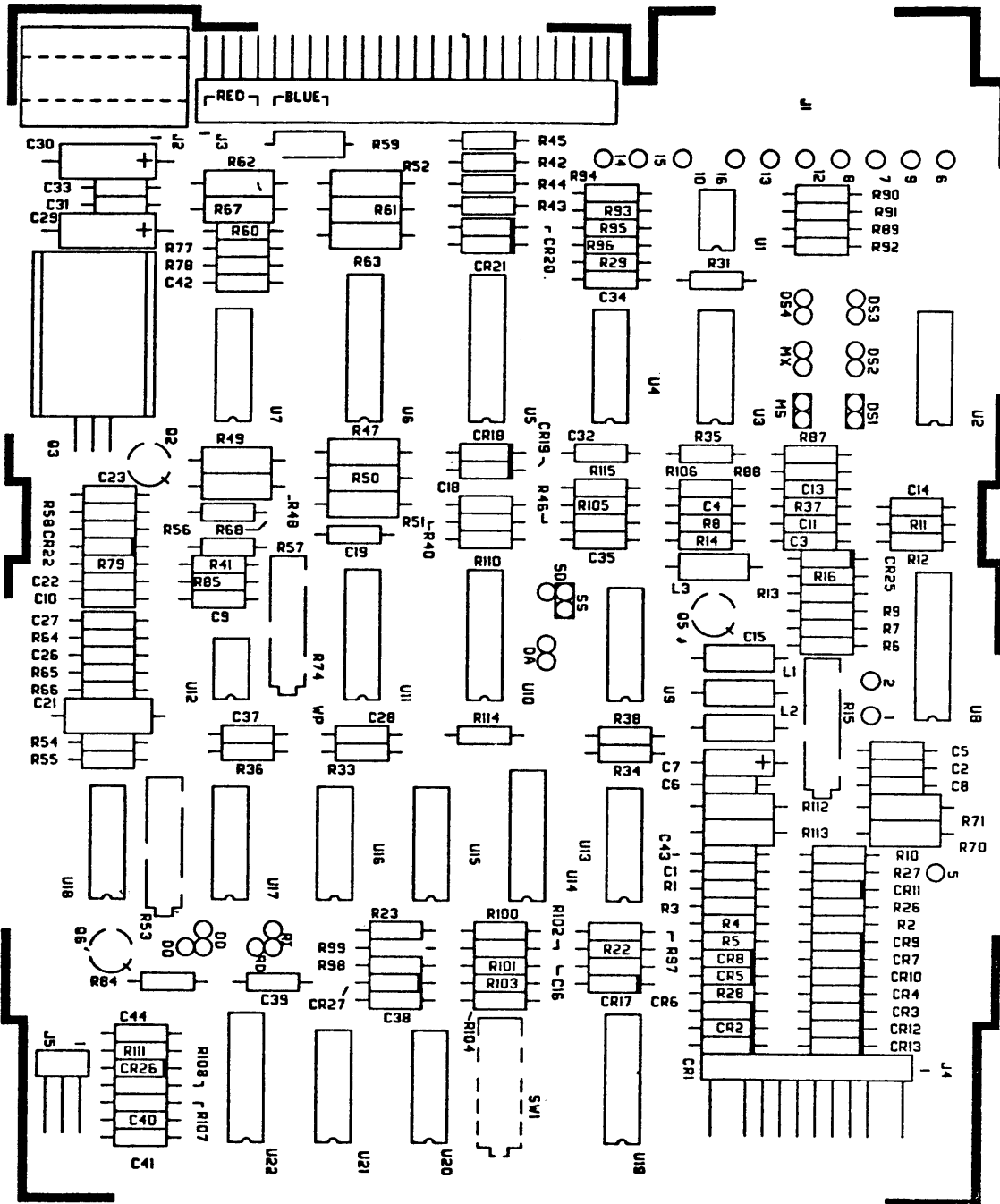
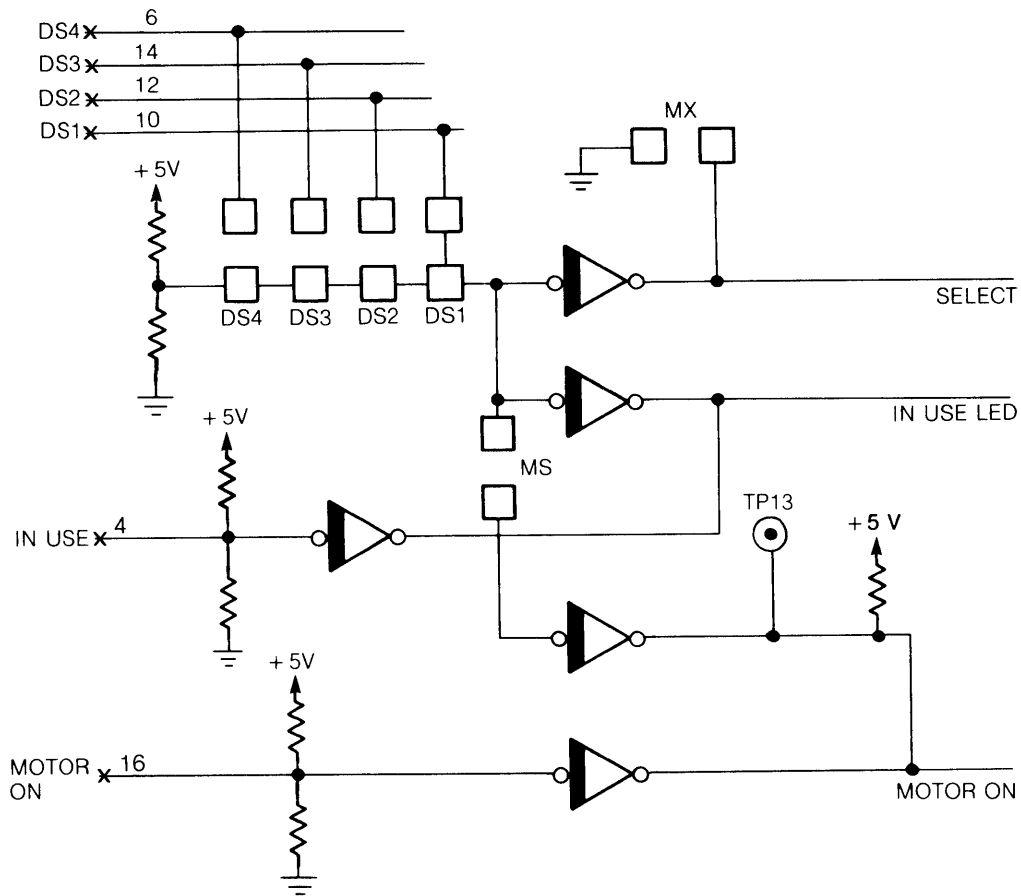


FIGURE 28 COMPONENT LOCATIONS



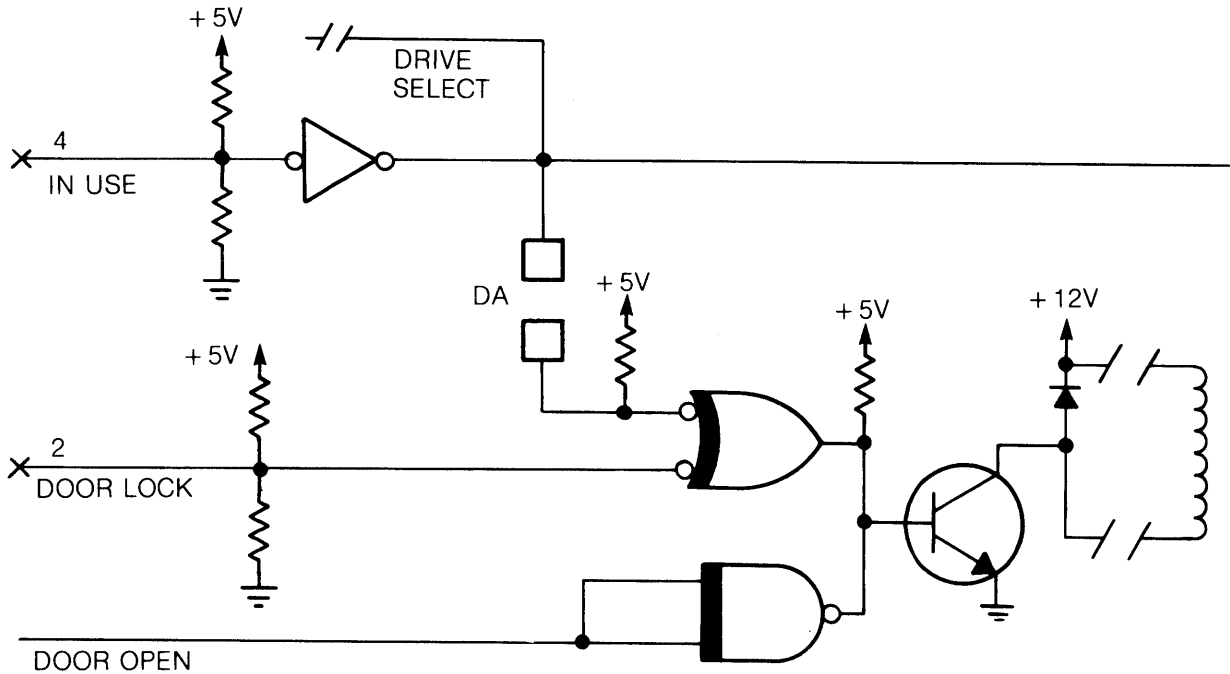
**FIGURE 29.** DRIVE SELECT, MOTOR ON AND IN USE

## 8.1 Drive Select

The DRIVE SELECT Jumper (DS1,2,3,4) as the drive is shipped is in position DS1. The SA410/460 is configured to operate alone in a single drive system. It can be easily modified to operate with other drives in a daisy chained, multiplexed multiple drive system. This is done by selecting specific drive address and jumpering the appropriate DRIVE SELECT line.

The MX option is used for single drive systems. By shorting MX the I/O lines are always enabled.

The MS option allows the motor to be enabled from DRIVE SELECT.

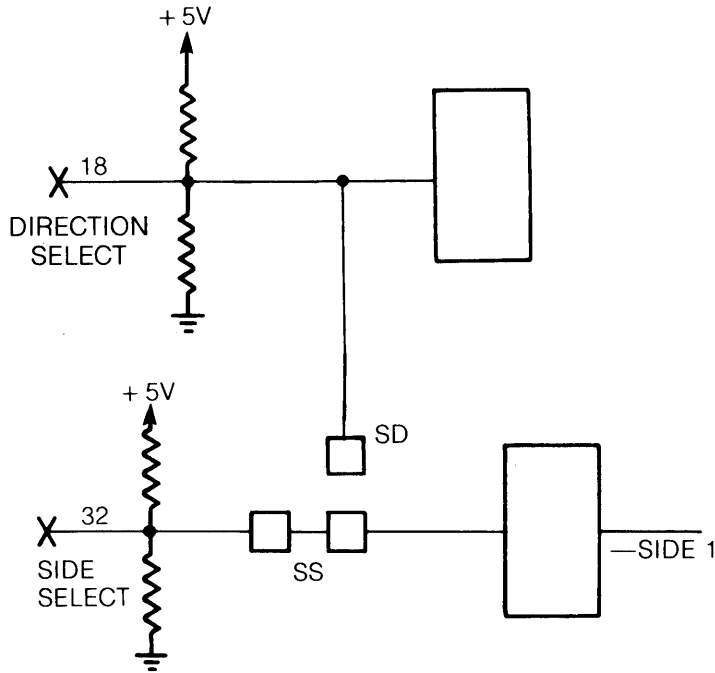


**FIGURE 30. DOOR LOCK FROM IN USE OR DRIVE SELECT**

## 8.2 The Door Lock Solenoid (Option)

The Door Lock Solenoid can be activated by the interface line provided on PIN 2.

The DA option allows the Door Lock Solenoid to be activated when the IN USE or DRIVE SELECT Signal has been asserted to a logic zero.



**FIGURE 31.** SIDE SELECT, USING DIRECTION SELECT

### 8.3 Side Select

The SIDE SELECT function can be controlled via the DIRECTION SELECT line, if desired. With this option, the DIRECTION SELECT line controls the direction of head motion during stepping operations and controls side (head) selection during read/write operations. To implement this option, simply move jumper SS to location SD.

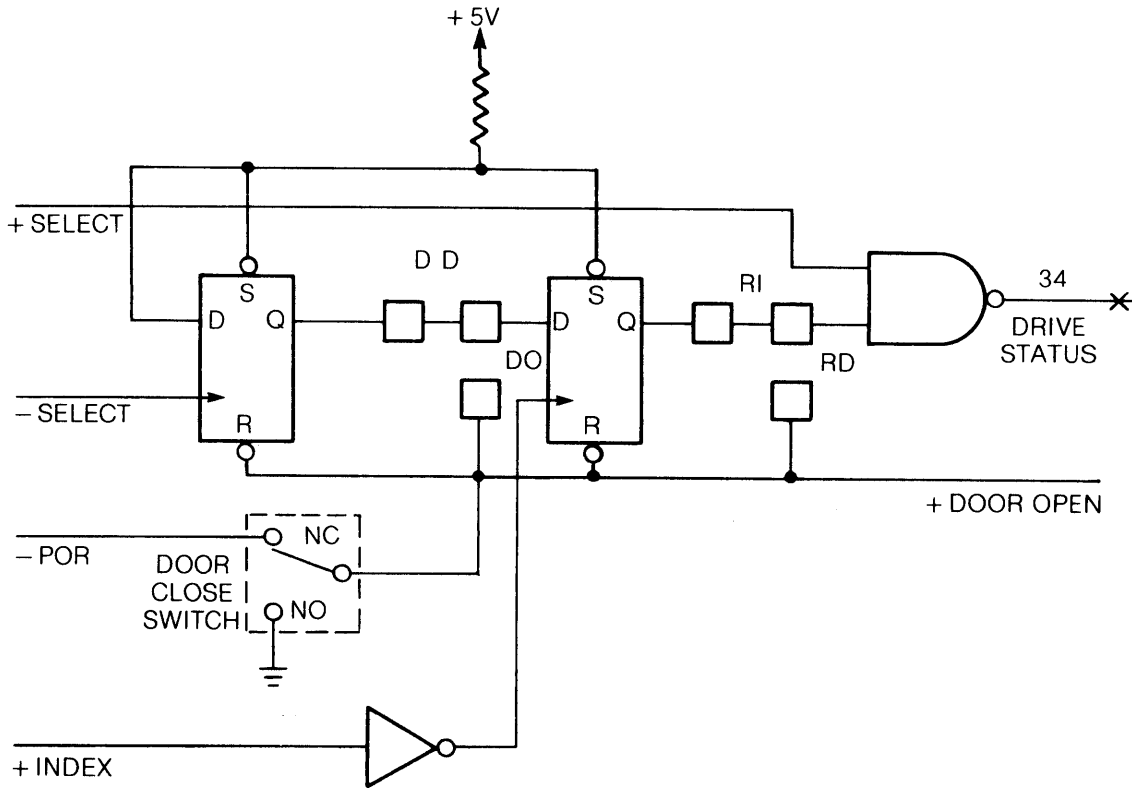


FIGURE 32. DRIVE STATUS

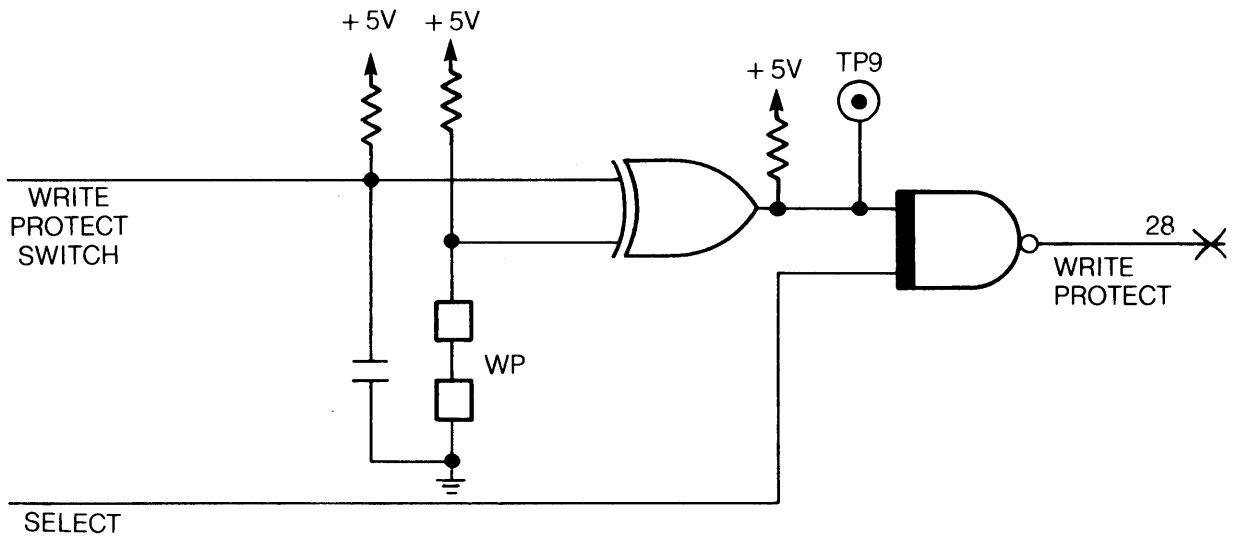
#### 8.4 Drive Status

This interface signal gives the user an indication that a diskette is inserted correctly in the drive and the door is closed. The DRIVE STATUS signal is active, at a logic zero level, when the following conditions are met:

- (a) the door is closed
- (b) the door has not been opened since the drive was last deselected; and
- (c) an INDEX/SECTOR pulse has been sensed since the previous conditions were met.

If the DRIVE STATUS signal is inactive, the user may deselect and then select the drive to test DRIVE STATUS again: if the door had previously been disturbed (condition (b) was not met) but is now closed, DRIVE STATUS WILL ACTIVATE upon sensing an INDEX/SECTOR pulse.

Condition (b) may optionally be eliminated by cutting trace DD and shorting trace DO. Conditions (b) and (c) may optionally be eliminated by cutting trace RI and shorting trace RD. One of these two options must be implemented if MX is shorted (see Figure 29), since condition (b) will not be met.



**FIGURE 33. WRITE PROTECT**

### 8.5 Write Protect

This interface signal is provided by the drive to give the user an indication when a Write Protected Diskette is installed. The signal is logical zero level when it is protected with label over notch. Under normal operation, the drive will inhibit writing with a protected diskette installed in addition to notifying the interface. If the "WP" trace is cut, writing to the diskette is inhibited unless a label is installed over the notch.

## **9.0 OPERATION PROCEDURES**

The SA410 or SA460 was designed for ease of operator use to facilitate a wide range of operator oriented applications. The following section is a guide for the handling procedures on the minidiskette and minifloppy drive.

### **9.1 Minidiskette Loading**

To load the diskette, open the door on the front panel, insert the diskette with label towards the door handle and close handle. A mechanical interlock prevents door closure without proper media insertion, thus eliminating media damage.

### **9.2 Minidiskette Handling**

To protect the diskette, the same care and handling procedures specified for computer magnetic tape apply. These precautionary procedures are as follows:

1. Return the diskette to its storage envelope whenever it is removed from drive.
2. Do not bend or fold the diskette.
3. Store diskettes not for immediate use in their box.
4. Keep diskettes away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can distort recorded data on the disk.
5. Replace storage envelopes when they become worn, cracked or distorted. Envelopes are designed to protect the disk.
6. Place I.D. labels in the correct location, never use them in layers.
7. Do not write on the plastic jacket with a lead pencil or ball point pen. Use a felt tip pen.
8. Do not use erasers.
9. Heat and contamination from a carelessly dropped ash can damage the disk.
10. Do not expose diskette to heat or sunlight.

## 10.0 INSTALLATION OF PACKAGING MATERIALS

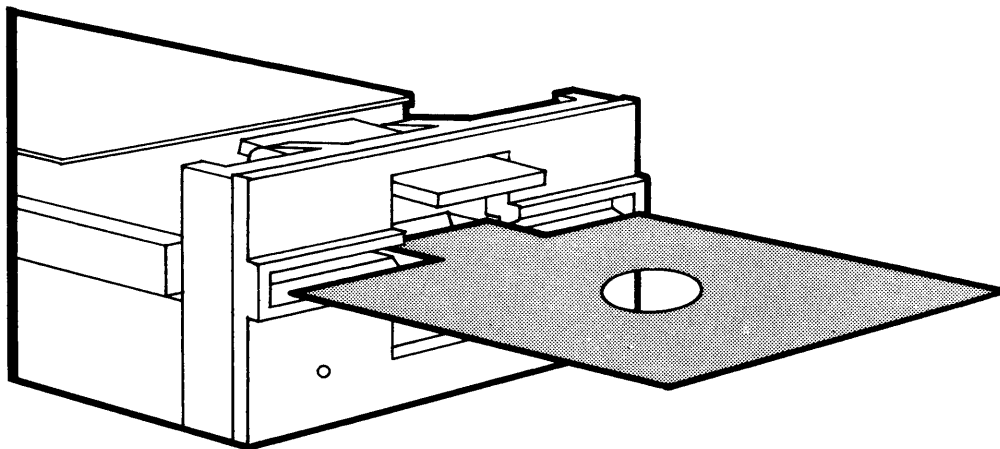
All 410's and 460's shipped from the factory and regional depots are equipped with carriage stops and door retainers. The carriage stop is designed to prevent head carriage movement while the drive is in transit. The door retainer eliminates the possibility of breakage resulting from the door opening during shipment.

Upon receipt of the drive, the door retainer and carriage stop should be removed and retained. They must be reinstalled prior to any further shipment of the drive.

To prepare a drive for shipment:

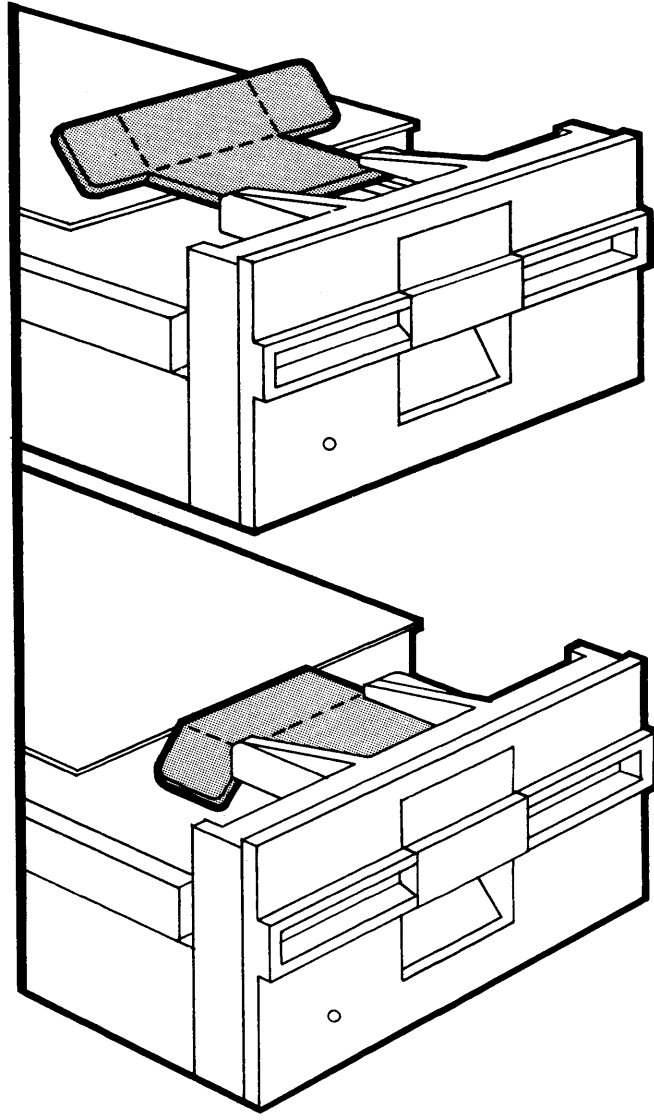
- A. Locate the head carriage at Track 00.
- B. Insert the carriage stop as you would a diskette, with the tab under the head carriage (see Figure 34).
- C. Install the door retainer by sliding the center section (with the tabs nearest the PCB), into the door pin slots and bending the tabs down over the hub frame (see Figure 35).
- D. Place the drive in its packing container (see Figure 36 and 37).

Failure to follow this procedure may result in damage to the drive.

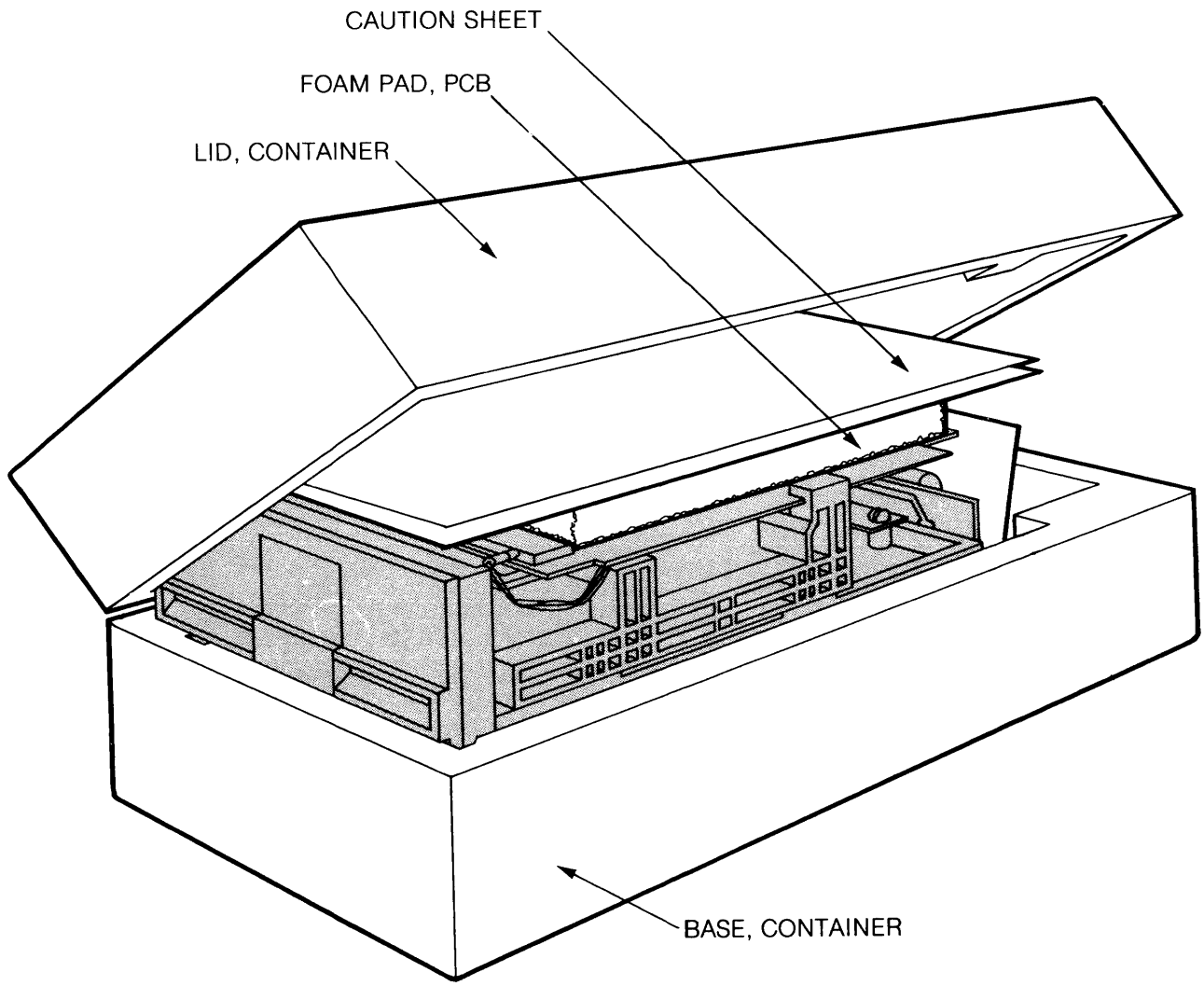


**FIGURE 34. CARRIAGE STOP**

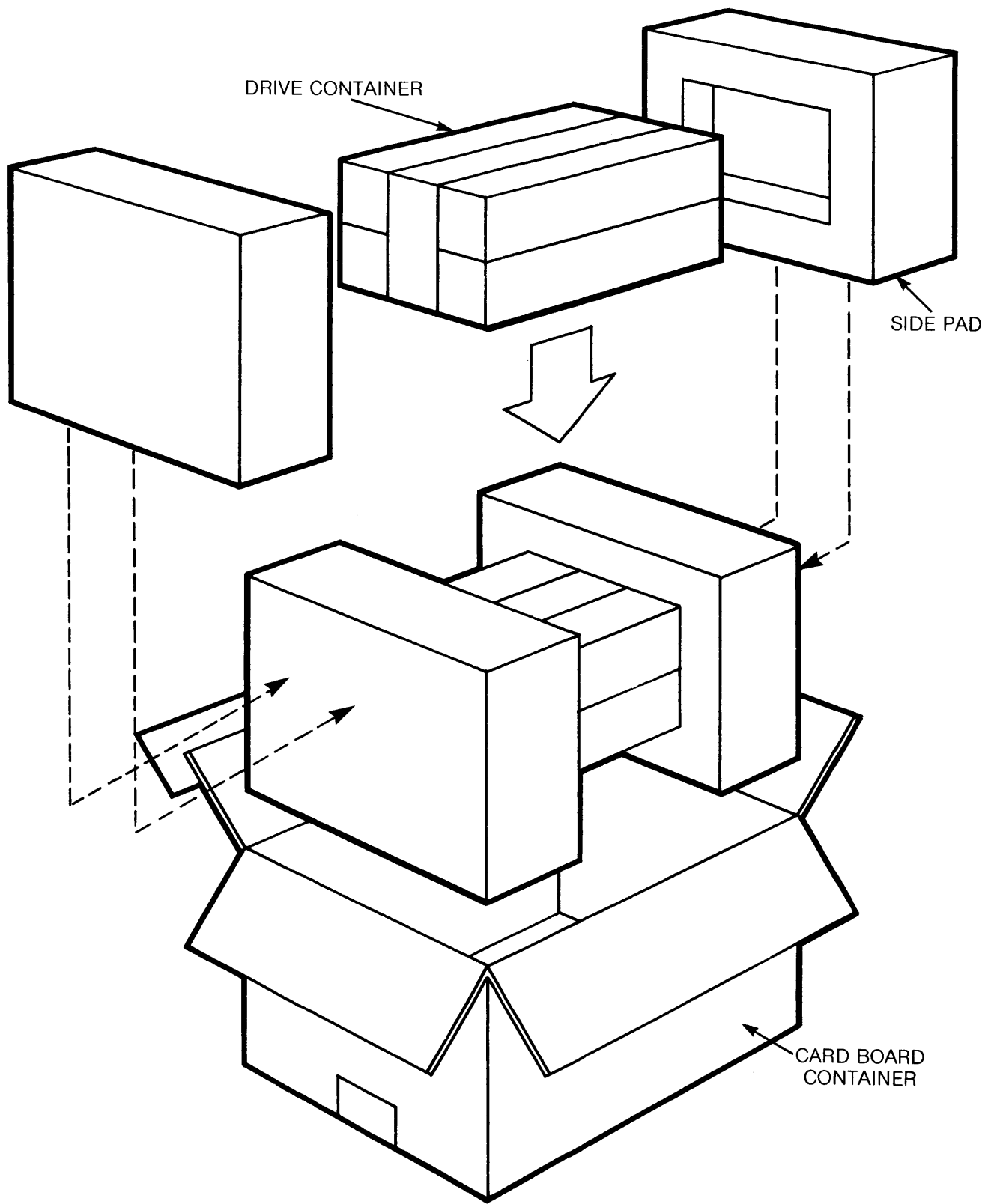




**FIGURE 35. DOOR RETAINER**



**FIGURE 36. DRIVE CONTAINER**



**FIGURE 37.** SHIPPING CONTAINER

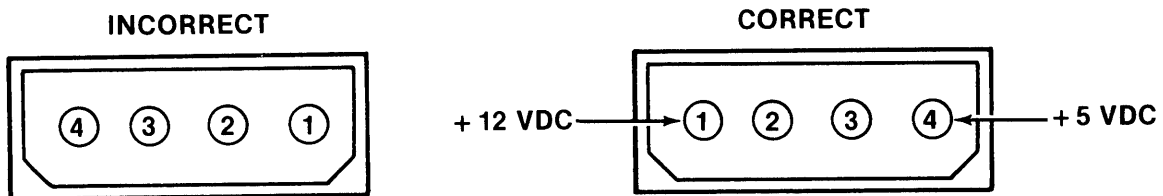
## PUBLICATION CHANGE NOTICE

**PN:** 39024-0 + -1     **Product:** SA410/460     **Date:** 10-29-81     **Errata: #** 1  
**Pub. Date:** 9/80 & 6/81     **Pub. Type:** OEM

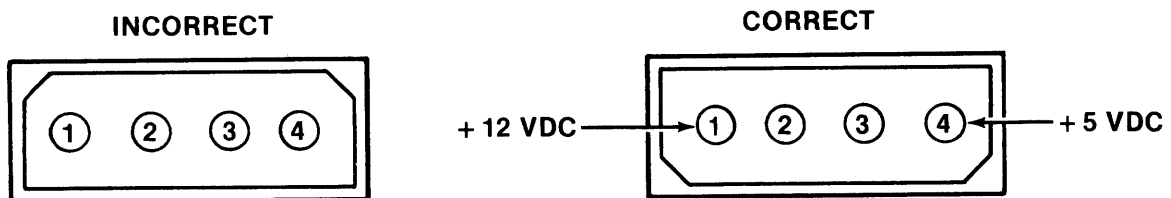
**Subject:** J2 pin designations

Figure 20 (page 20, P/N 39024-0 and page 18, P/N 39024-1) shows pin numbers in reverse order. Make ink corrections to the figures as follows:

Page 20, P/N 39024-0



Page 18, P/N 39024-1





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475 Oakmead Parkway Sunnyvale, California 94086  
Telephone: (408) 733-0100 TWX: 910 339 9355 SHUGART SUVL