

# OEM Manual

Flexible Disk  
Storage Drive

## SA455

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**SECTION I**  
**INTRODUCTION**

**1.1 GENERAL DESCRIPTION**

The SA455 is a 1.625" High (1/2 Hight) double-sided double-density minifloppy diskette drive.

It contains a band actuator, a DC direct drive motor, biocompliant read/write head geometry, track 0 detector, index detector, write protect switch, R/W electronics and motor speed control electronics.

**Key Features**

- 0.5 Mbytes storage capacity (unformatted)
- 125/250 K bits/second data transfer rate
- DC drive motor that eliminates ac requirements

**1.2 SPECIFICATIONS SUMMARY**

**1.2.1 Performance Specifications**

Capacity (in bytes)	Single Density (FM)	Double Density (MFM)
Unformatted		
Per Disk	250,000	500,000
Per Surface	125,000	250,000
Per Track	3,125	6,250
Formatted (16 Records/Track)		
Per Disk	163,840	327,680
Per Track	2,048	4,096
Per Sector	128	256
Formatted (10 Records/Track)		
Per Disk	204,800	409,600
Per Track	2,560	5,120
Per Sector	256	512
Transfer Rate	125 kbits/sec	250 kbits/sec
Latency (avg.)	100 msec	100 msec
Access Time		
Track to Track	6 msec	6 msec
Average	93 msec	93 msec
Setting Time	15 msec	15 msec

### 1.2.2 Functional Specifications

	Single Density	Double Density
Typical Motor Start Time	300 msec	300 msec
Worst Case Motor Start Time	500 msec	500 msec
Rotational Speed	300 rpm	300 rpm
Recording Density	2938 bpi	5876 bpi
Flux Density	5876 fci.	5876 fci.
Track Density	48 tpi	48 tpi

### 1.2.3 Physical Specifications

Environmental Limits	Operating	Storage
Ambient Temperature	50 <sup>0</sup> to 115 <sup>0</sup> F (10.0 <sup>0</sup> to 46.1 <sup>0</sup> C)	-8 <sup>0</sup> to 117 <sup>0</sup> F (-22.2 <sup>0</sup> to 47.2 <sup>0</sup> C)
Relative Humidity	20 to 80%	1 to 95%
Maximum Wet Bulb	85 <sup>0</sup> F (29.4 <sup>0</sup> C)	No Condensation
Shock	0.5G 10 msec	30G 10 msec
Vibration	0.5G 5-55Hz	3G 5-55 Hz

#### DC Voltage Requirements

- +12 V  $\pm$ 10% @ 1.2A (max), 0.75 A (typ), 100 mV ripple
- +5 V  $\pm$  5% @ 0.9 A (max), 0.7 A (typ), 50mV ripple

#### Mechanical Dimensions (exclusive of front panel)

- Width = 5.75 inches (146.1 mm)
- Height = 1.64 inches (41.5 mm)
- Depth = 8.00 inches (203.2 mm)
- Weight = 3.3 lbs (1.5 kg)

Power Dissipation = 12 Watts (41.0 BTU) continuous typical  
4 Watts (13.7 BTU) standby

#### NOTE

Standby: Drive motor off, drive select off.

### 1.2.4 Reliability Specifications

MTBF: 10,000 POH under typical usage.

PM: Not required.

MTTR: 30 minutes.

#### Error Rates:

- Soft Read Errors: 1 per 10<sup>9</sup> bits read.
- Hard Read Errors: 1 per 10<sup>12</sup> bits read.
- Seek Errors: 1 per 10<sup>6</sup> seeks

#### Media Life:

- Passes per Track: 3.0 x 10<sup>6</sup>
- Insertions: 30,000 +

### **1.3 FUNCTIONAL CHARACTERISTICS**

The SA455 consists of read/write and control electronics, drive mechanism, read/write head, and precision track positioning mechanism. These components perform the following functions:

- a. Interpret and generate control signals.
- b. Move read/write heads to the desired track.
- c. Read and write data.

The interface signals and their relationship to the internal functions are shown in figure 1-1.

#### **1.3.1 Read/write and Control Electronics**

The electronics package contains:

- a. Index detector circuits
- b. Head position actuator driver
- c. Read/write amplifier and transition detector
- d. Write protect detector
- e. Drive select circuit
- f. Drive motor control

#### **1.3.2 Drive Mechanism**

The dc drive motor under servo speed control (using an integral tachometer) rotates the spindle at 300 rpm through a direct drive system. An expandable collet/spindle assembly provides precision media positioning to ensure data interchange.

#### **1.3.3 Positioning Mechanics**

The read/write head assembly is accurately positioned through the use of a band positioner which is attached to the head carriage assembly. Precise track location is accomplished as this positioner is rotated in discrete increments by a stepping motor.

#### **1.3.4 Read/Write Heads**

The proprietary heads are a single element ceramic read/write head with 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 ensures diskette interchangeability.

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

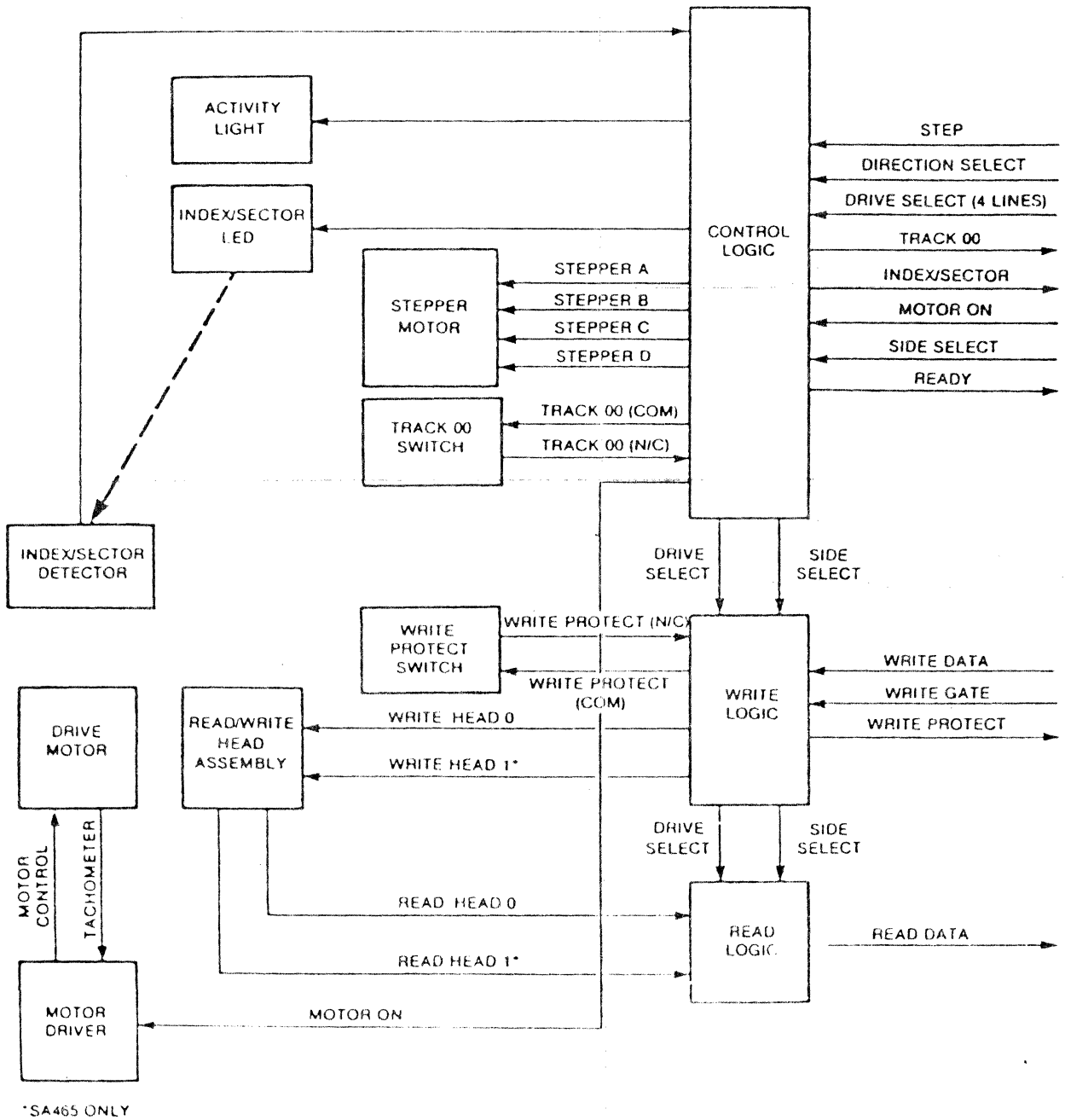


FIGURE 1-1. SA455 FUNCTIONAL DIAGRAM

## **1.4 FUNCTIONAL OPERATIONS**

### **1.4.1 Power Sequencing**

Applying dc power to the SA455 can be in any sequence. However, during power up, the Write Gate line must be held inactive or at a high level. This will prevent possible "glitching" of the media. After application of dc power, a SA455 delay should be introduced before any operation is performed. 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).

### **1.4.2 Drive Selection**

Drive selection occurs when the proper Drive Select line is activated. Only the drive with this line jumpered will respond to input lines or gate output lines.

### **1.4.3 Motor On**

In order for the host system to read or write data the dc drive motor must be turned on. This is accomplished by activating the line -MOTOR ON. A 500 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. The control electronics keep the motor active for 3 seconds after Motor On is deactivated. This allows reselecting during copy operations and will ensure maximum motor and media life.

### **1.4.4 Track Accessing**

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

- a. Activating the Drive Select line.
- b. Selecting desired direction using 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 (with direction valid) 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.

### **1.4.5 Step Out**

With the Direction Select line at a plus logic level (2.4 to 5.25 V), a pulse on the Step line will cause the read/write heads to move out track away from the center of the disk. The



pulse(s) applied to the Step line must have the timing characteristics shown in figures 1-2 and 1-3.

#### 1.4.6 Step In

With the Direction Select line at minus logic level (0 to 0.4 V), 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 figures 1-2 and 1-3.

#### 1.4.7 Side Selection

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 100  $\mu$ s delay is required after SIDE SELECT changes state before a read or write operation can be initiated. Figure 1-4 shows the use of SIDE SELECT prior to a read operation.

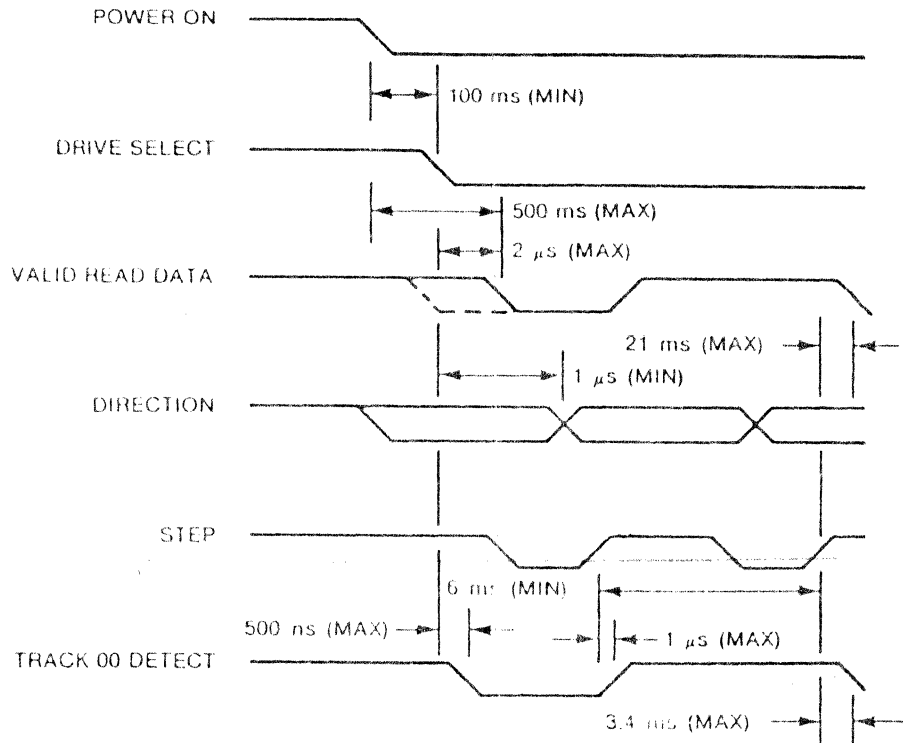


FIGURE 1-2. STEP TO READ

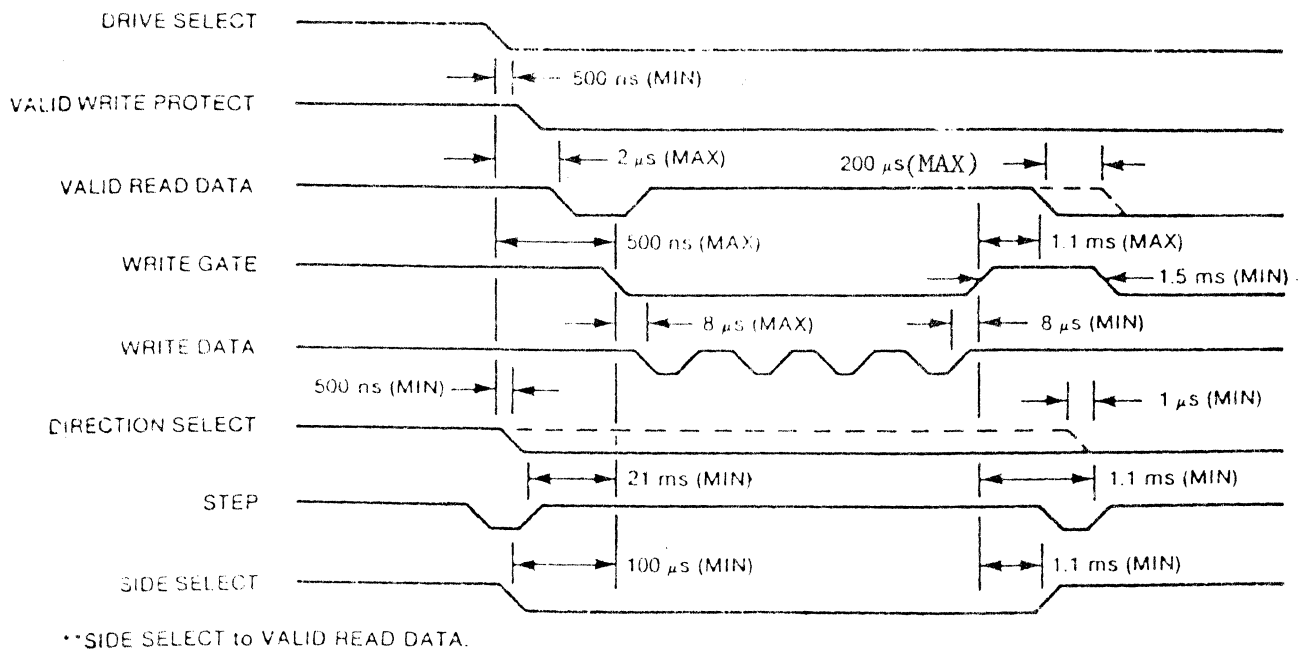


FIGURE 1-3. WRITE TO STEP

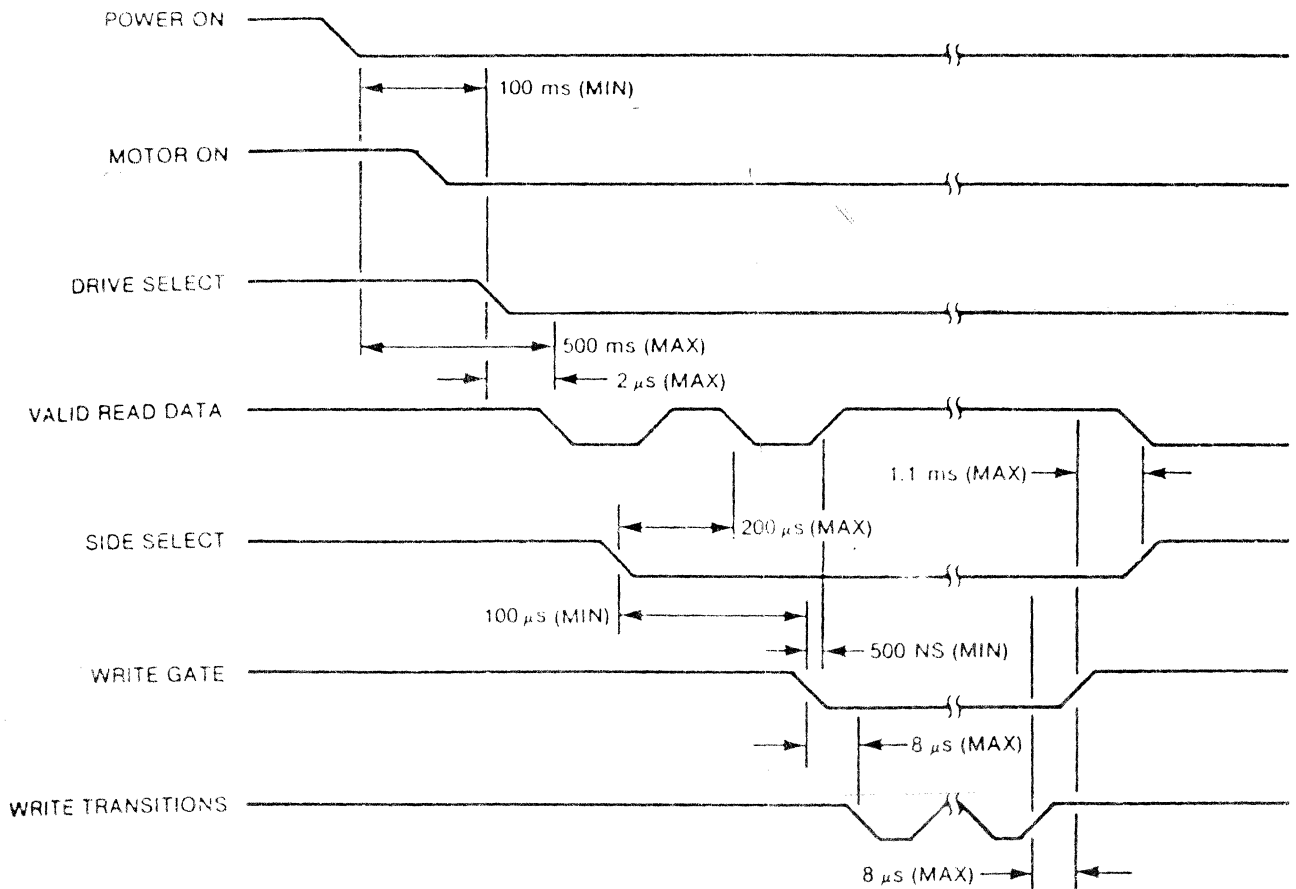


FIGURE 1-4. READ TO WRITE (FM)

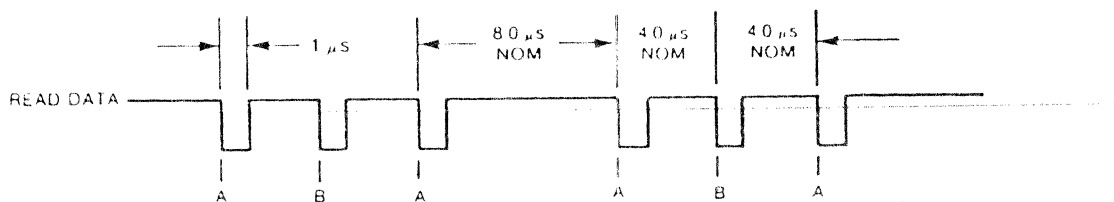
### 1.4.8 Read Operation

Reading data from the SA455 is accomplished by:

- a. Activating Drive Select line.
- b. Selecting head.
- c. Write Gate being inactive.

The timing relationships required to initiate a read sequence are shown in figure 1-4. These timing specifications are required in order to guarantee that the position of the read/write head has stabilized prior to reading.

The timing of Read Data (FM) is shown in figure 1-5.

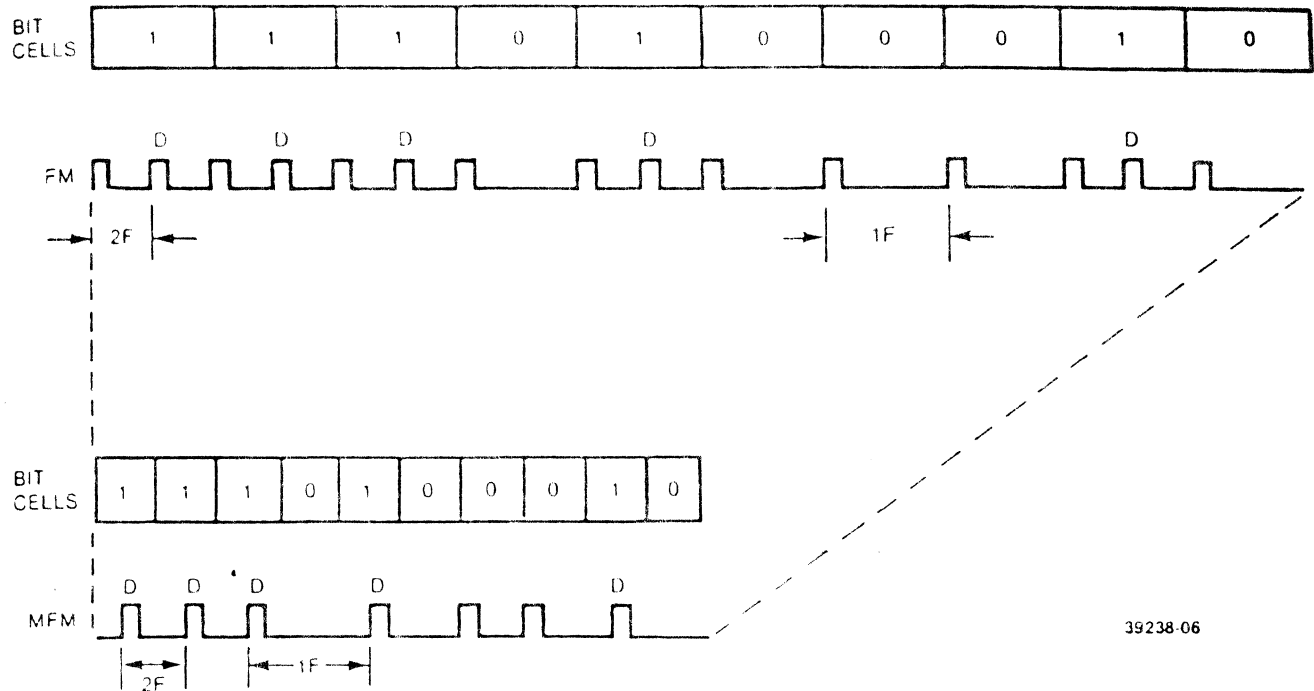


A = LEADING EDGE OF BIT MAY BE = 800 ns FROM ITS NOMINAL POSITION  
B = LEADING EDGE OF BIT MAY BE = 400 ns FROM ITS NOMINAL POSITION

FIGURE 1-5. READ DATA TIMING (FM)

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 and a data bit at the center of the bit cell if this cell contains a one data bit, (see figure 1-6). MFM encoding rules allow clock bits to be omitted from some bit cells with the following prerequisites:

- a. The clock bit is omitted from the current bit cell if either the preceding bit cell or the current bit cell contains a one data bit. See figure 1-6.
- b. 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.



39238-06

FIGURE 1-6. FM AND MFM CODE COMPARISONS

#### 1.4.9 Write Operation

Writing data to the SA455 is accomplished by:

- a. Activating the Drive Select line.
- b. Selecting head.
- 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 1-4. These timing specifications are required in order to guarantee that the position of the read/write heads has stabilized prior to writing.

The timing specifications for the Write Data pulses are shown in figure 1-7. Write data encoding can be FM or MFM.

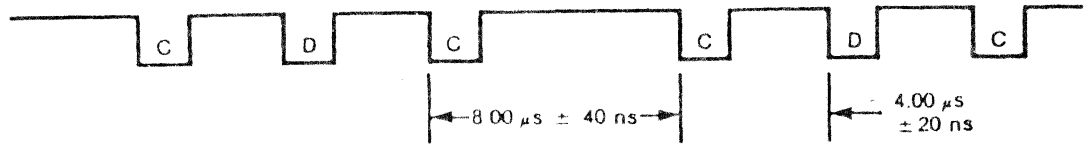


FIGURE 1-7. WRITE DATA TIMING (FM)

1.4.10 Sequence of Events

The timing diagrams shown in figures 1-2, 1-3, 1-4 and 1-8 show the necessary sequence of events with associated timing restrictions for proper operation.

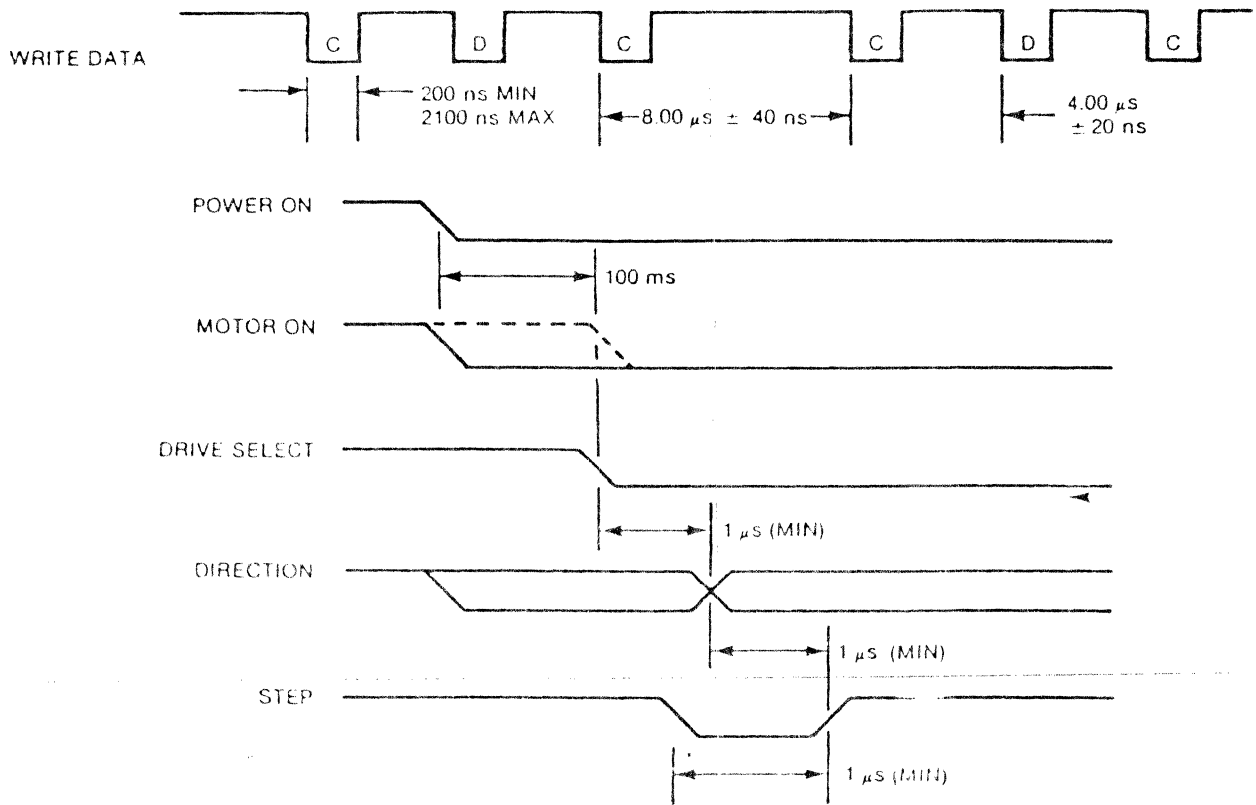


FIGURE 1-8. POWER ON TO STEP

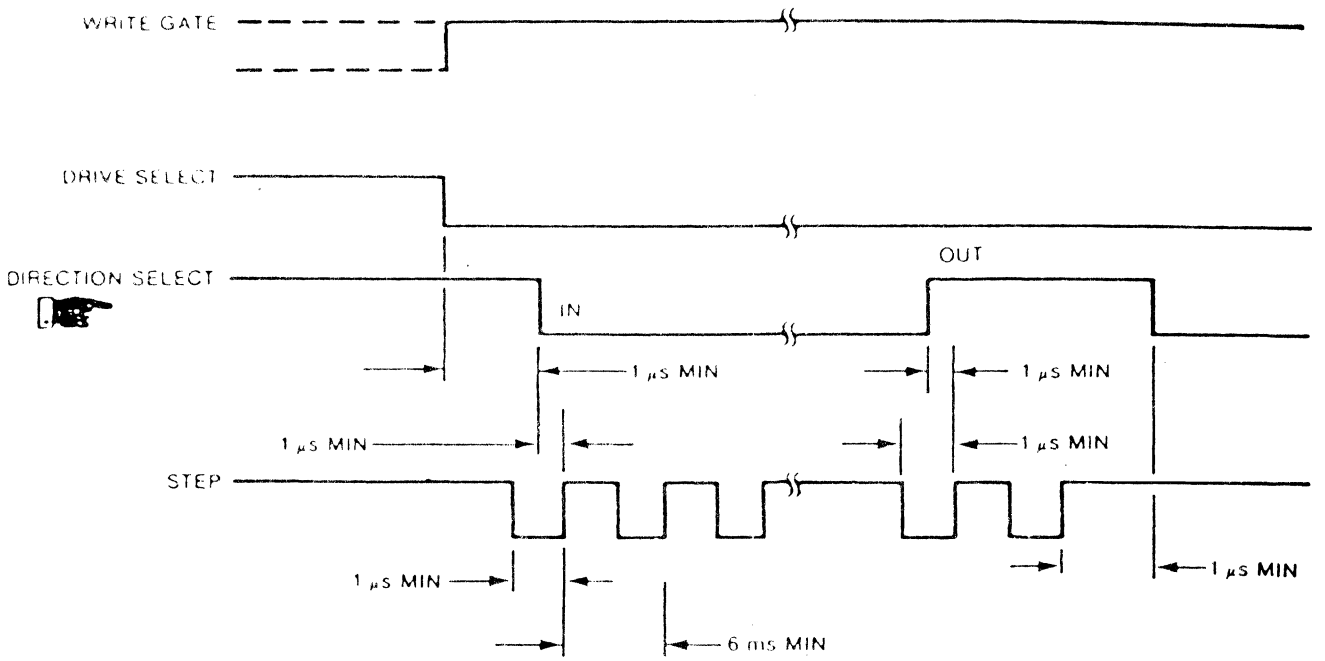


FIGURE 1-9. STEP TIMING

## SECTION II

### ELECTRICAL INTERFACE

#### 2.1 INTRODUCTION

The interface of the SA455 can be divided into two categories:

- a. Signal
- b. Power

The following sections provide the electrical definition for each line. See figure 2-1 for all interface connections.

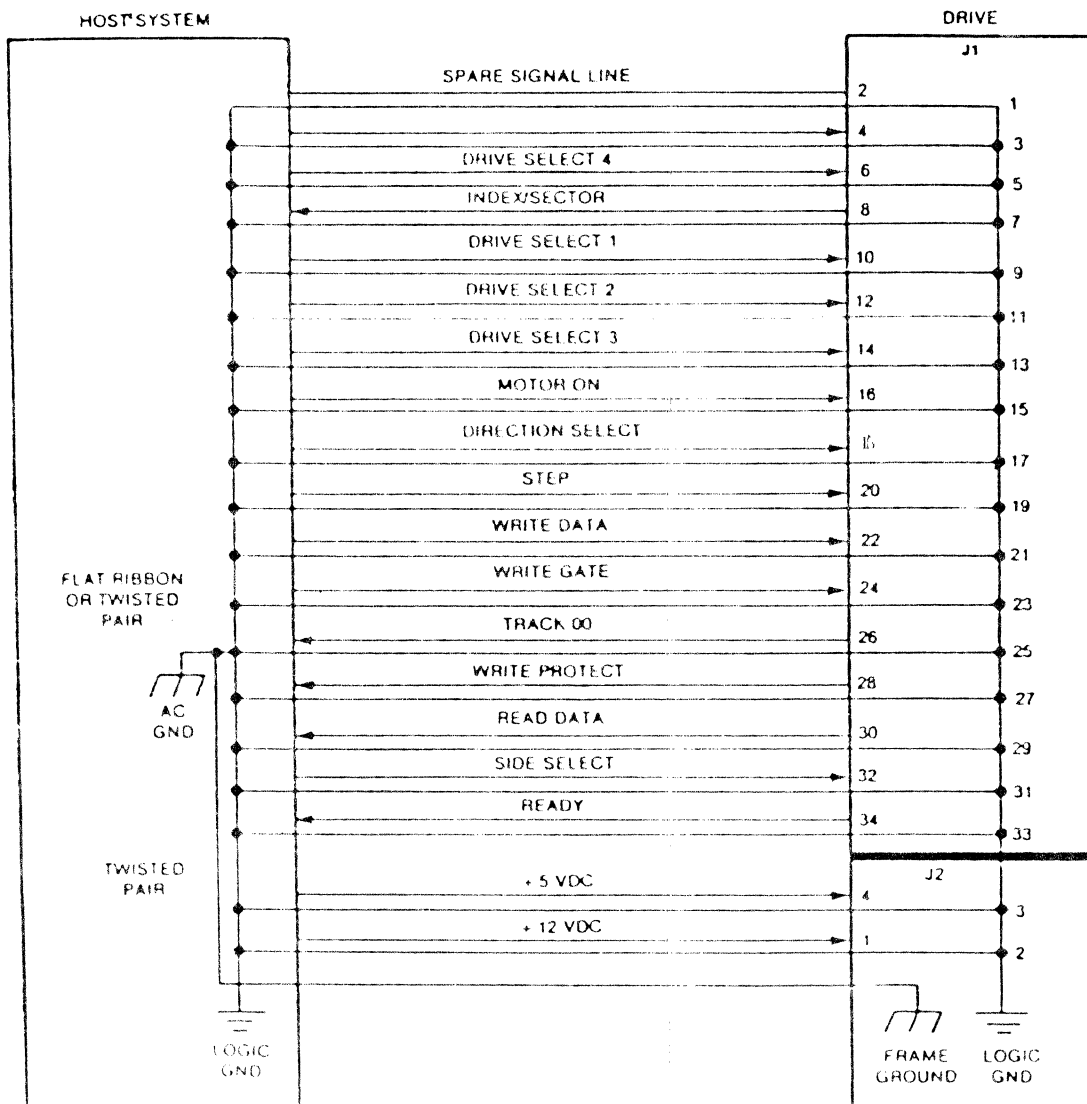


FIGURE 2-1. INTERFACE CONNECTIONS

## 2.2 SIGNAL INTERFACE

The signal interface consists of two categories:

- a. Control Lines
- b. Data Transfer Lines

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.

### 2.1.1 Input Lines

The input signals are of three 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:

- a. DIRECTION SELECT
- b. STEP
- c. WRITE DATA
- d. WRITE GATE
- e. SIDE SELECT

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

- a. DRIVE SELECT 1
- b. DRIVE SELECT 2
- c. DRIVE SELECT 3
- d. DRIVE SELECT 4

The signals which are not multiplexed are:

- a. IN USE
- b. MOTOR ON

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

True = Logical zero =  $V_{in} \pm 0.0$  to  $+4$  V @  $I_{in} = 40$  mA (max)

False = Logical one =  $V_{in} + 2.5$  to  $+ 5.25$  V @  $I_{in} = 250$  A (open)

Input impedance = 150 ohms

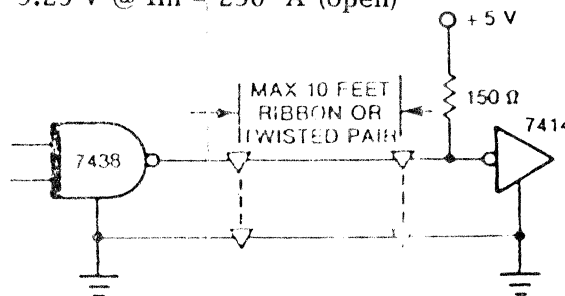


FIGURE 2-2. INTERFACE SIGNAL DRIVER/RECEIVER



### 2.2.2 Input Line Terminations

The SA455 has been provided with the capability of terminating all the ten input lines listed below.

- |                   |                     |
|-------------------|---------------------|
| 1. Drive Select 1 | 6. Direction Select |
| 2. Drive Select 2 | 7. Step             |
| 3. Drive Select 3 | 8. Write Data       |
| 4. Drive Select 4 | 9. Write Gate       |
| 5. Motor On       | 10. Side Select     |

These lines are terminated through a 150 ohm resistor pack. 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. However, the user must provide the terminations beyond the last drive and each of the ten lines must be terminated to +5 V dc through a 150 ohm, 1/4-watt resistor.

### 2.2.3 Drive Select 1-4 (J1 pins #10, 12, 14, and 6)

The SA455 as shipped from the factory, is configured to operate as the first drive in the system. The SA455 can be easily modified by the user to operate as either drive 2,3, or 4 in a multiple drive system.

In a multiple drive system the four input lines (Drive Select 1 through Drive Select 4) are provided so that the using system may select which drive on the interface is to be used. In this mode of operation, only the drive with its Drive Select line active will respond to the input lines and gate the output lines. However, in a single drive system, the MX jumper will allow any DRIVE SELECT line to activate the drive. Therefore, the MX jumper must be in the DS position whenever there are more than one drive.

### 2.2.4 Motor On (J1 pin #16)

This input, when activated to a logical zero level, will turn on the drive motor allowing reading or writing on the drive. A 500 ms 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 2 seconds (10 revolutions of the media) after completion of a previous command. Motor on may also be activated by Drive Select. This is achieved by moving the MM jumper to MS position.

### 2.2.5 Direction Select (J1 pin #18)

This interface line defines the 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. 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 . If a pulse is applied to the Step line, the read/write heads will move towards the center of the disk.

### **2.2.6 Step (J1 pin #20)**

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 low going pulse with a minimum pulse width of 1  $\mu$ s and then logically high for 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 at the trailing edge of the signal pulse. Any change in the Direction Select line must be made at least 1  $\mu$ s before the trailing edge of STEP pulse. The Direction Select logic level must be maintained 1  $\mu$ s after the trailing edge of STEP pulse. See figure 1-10 for these timings.

### **2.2.7 Write Gate (J1 pin #24)**

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. See figure 1-7 for timings.

### **2.2.8 Write Data (J1 pin #22)**

This interface line provides the data to be written on the diskette. Each transition from a logical one 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. A WRITE DATA clamp is provided on the PCB at the interface which holds the WRITE DATA line at a logical zero whenever WRITE GATE is inactive. See figure 1-7 for timings.

### **2.2.9 Side Select (J1 pin #32)**

This signal defines which side of a two-sided diskette is to be written on or read from. A logical one selects the side 0 head. When switching from one side to the other, 100  $\mu$ s delay is required before a read or write operation can be initiated.

## **2.3 OUTPUT LINES**

The SA455 drive output five active signal lines. Each output line is driven by a 7438 open collector output gate. Individual signal line characteristics are described below:

### **2.3.1 Track 00 (J1 pin #26)**

The active or logical zero state of this interface signal indicates when the read/write heads are positioned at track zero (the outermost track) and the access circuitry is driving current through phase A of the stepper motor. This signal is at a logical one level, or inactive state, when the read/write heads are not at track zero. When the 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. However, the TRACK 00 signal will go inactive. This is because the stepper motor will go to phase C and not phase A. One more step out pulse will put the stepper motor back into phase A and the TRACK 00 signal will go active again.

### 2.3.2 Index (J1 pin #8)

This interface signal is provided by the drive each time an index hole is sensed at the INDEX sensing photo transducer. Normally, this signal is a logical one level and makes the transition to the logical zero level each time a hole is sensed. There is one pulse on this interface signal per revolution of the diskette (200 ms). This pulse indicates the physical beginning of a track. The timing of this signal is shown in Figure 2-3.

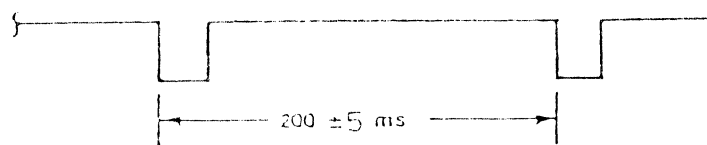


FIGURE 2-3. INDEX TIMING

### 2.3.3 Read Data (J1 pin #30)

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. See figure 1-4 for the timing and bit shift tolerance within normal media variations.

### 2.3.4 Write Protect (J1 pin #28)

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. Under normal operation, the drive will inhibit writing with a protected diskette installed in addition to notifying the interface.

### 2.3.5 Ready (J1 pin #34)

This interface signal is provided by the drive to be able to read or write. This signal is a logical one level when the drive is not ready for read or write operation and logical zero level when the drive counts two internal index pulses after drive motor gives normal speed.

## 2.4 POWER INTERFACE

The SA455 requires only dc power for operation. DC power to the drive is provided via P2/J2. The two dc voltages, their specifications, and their P2/J2 pin designators are outlined in table 2-1. 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.

**TABLE 2-1. DC POWER REQUIREMENTS**

P2 PIN	DC VOLTAGE	TOLERANCE	CURRENT	MAX RIPPLE (p to p)
1	+ 12 V DC	$\pm 10\%$	1.2 A MAX 0.75 A TYP	100 mV MAX ALLOWABLE
2	+12 RETURN			
3	+5 RETURN			
4	+5 VDC	$\pm 5\%$	0.9 A MAX 0.7 A TYP	50 mV MAX ALLOWABLE

## 2.5 FRAME GROUNDING

### CAUTION

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

## SECTION III

### CUSTOMER INSTALLABLE OPTIONS

#### 3.1 CUT/ADD TRACE OPTIONS

The SA455 can be modified by the user to function differently to suit individual needs. These modifications can be implemented by adding or deleting connections. These options can be accomplished by use of a shorting plug or by cutting a trace (refer to table 3-1). This Section discusses examples of modifications and how to implement them.

These examples are:

1. DRIVE SELECT, MOTOR ON
2. READY

**TABLE 3-1. CUSTOMER CUT/ADD TRACE OPTIONS**

TRACE DESIGNATOR	DESCRIPTION	SHIPPED FROM FACTORY	
		OPEN	SHORT
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	
RY	READY or DOOR DISTURB SWITCH		plugged
DR	READY From DRIVE SELECT Only		plugged
RR	READY irrespective of DRIVE SELECT	X	

### 3.2 JUMPER OPTION

#### 3.2.1 DS/IS JUMPER

DS	IS	IN USE LED
OPEN	CLOSED	In use LED is a direct function of "IN USE" line only of J1 I/O.
CLOSED	OPEN	In use LED is a direct function of "DRIVE SELECT" line only of I/O.

Note 1: DS/IS: Solder jumper option.

#### 3.2.2 MS/MM JUMPER

MS	MM	SPINDLE MOTOR
OPEN	CLOSED	Spindle motor is a function of "MOTOR ON" line of J1 I/O. Motor is turned on when there is logical "Low" on "MOTOR ON" signal.
CLOSED	OPEN	Spindle motor is not a function of "MOTOR ON" line, instead the motor is turned on when the drive is settled.

Note 1: MS/MM: Shorted plug installed option.

#### 3.2.3 MX/DS JUMPER

MX	DS	DRIVE SELECTION
OPEN	CLOSED	Drive is selected, when "DRIVE SELECT" line of J1 I/O interface is low.
CLOSED	OPEN	Drive is always selected irrespective of any logic level on "DRIVE SELECT" line of J1 I/O interface.

Note 1: MX/DS: Shorted plug installed option.

### 3.2.4 +WP JUMPER

+WP	WRITE PROTECT
CLOSED	An active low level on this signal line (J1 #28) indicated that write protected diskette has been installed.
OPEN	An active high level on this signal line (J1 #28) indicated that write protected diskette has been installed.

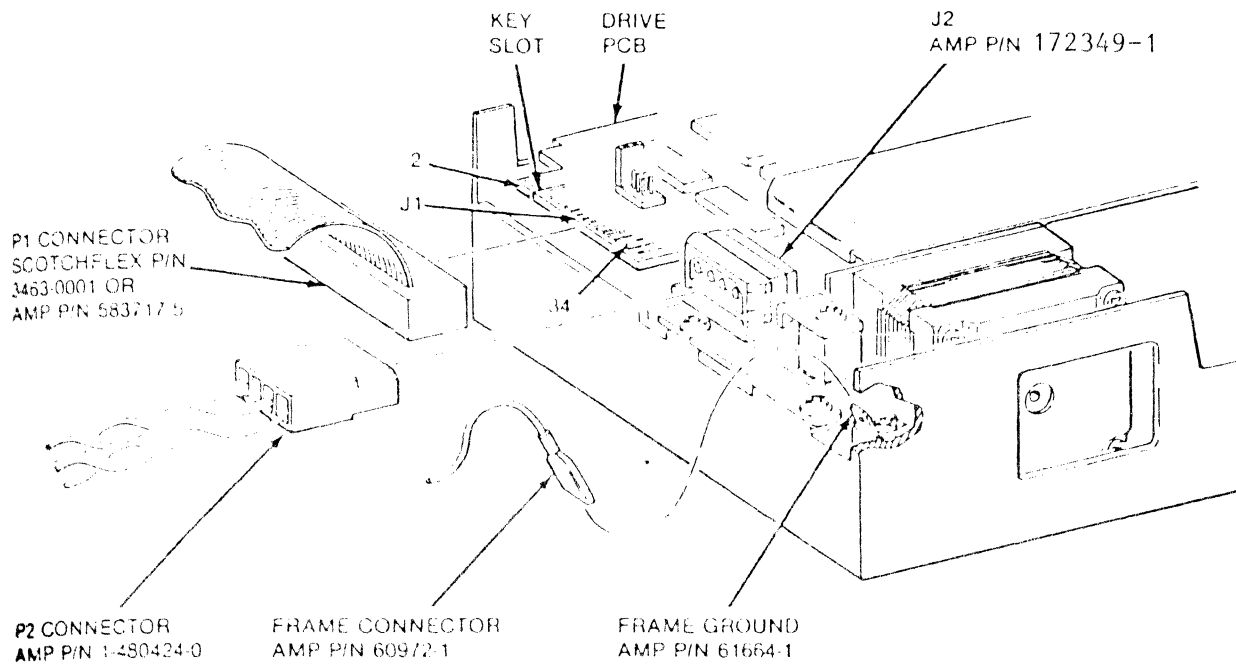
Note 1: +WP: Solder jumper option.

SECTION IV  
PHYSICAL INTERFACE

**4.1 INTRODUCTION**

The electrical interface between the SA455 and the host system is via two connectors. The first connector, J1, provides the signal interface. 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. See figure 4-1 for connector locations.



**FIGURE 4-1. INTERFACE CONNECTORS PHYSICAL LOCATIONS**

**4.1.1 J1/P1 Connector**

Connection to J1 is through a 34 pin PCB edge connector. The dimensions for this connector are shown in figure 4-2. The pins are numbered 1 through 34 with the even numbered pins on the component side of the PCB. The odd numbered pins are 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.



### 4.1.2 J2/P2 Connector

The dc power connector, J2, is a 4 pin AMP Mate-N-Loc connector (P/N 172349-1). The recommended mating connector, P2, is AMP P/N 1-480424-0 using 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 4-3 illustrates J2 connector as seen on the drive PCB from the non-component side.

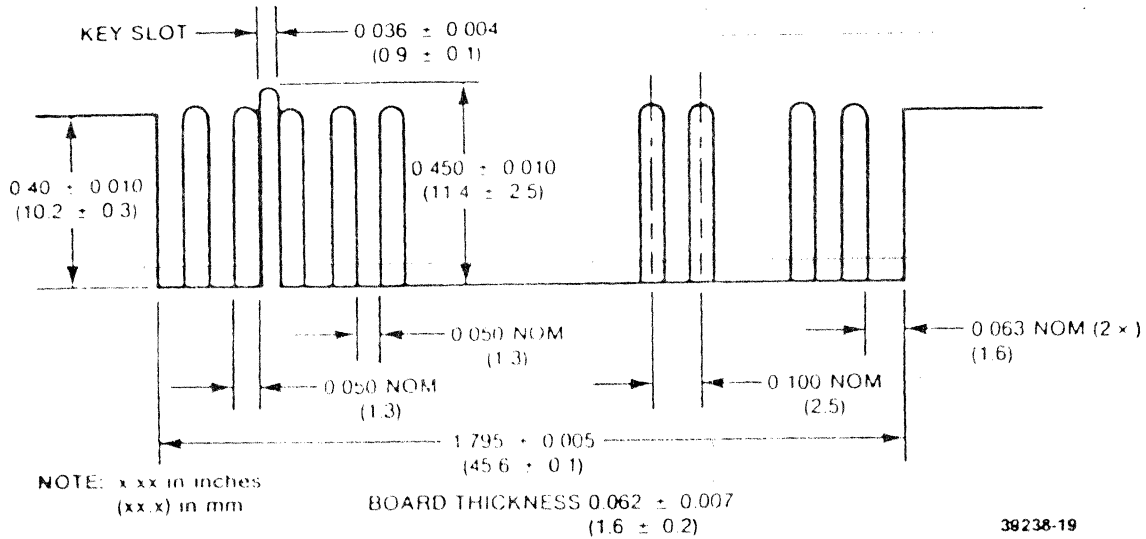


FIGURE 4-2. J1 CONNECTOR DIMENSIONS

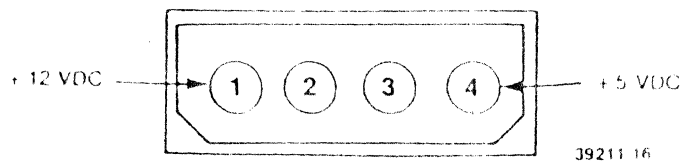


FIGURE 4-3. J2 CONNECTOR

### 4.1.3 FRAME GROUNDING

#### CAUTIONS

The SA455 must be frame grounded to the host system to ensure proper operation. If the frame of the drive is not fastened directly to the frame of the host system with a good ac ground, a wire from the system ac frame ground must be connected to the SA455. For this purpose, a faston tab is provided on the drive near the motor control PCB 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.

## SECTION V

### DRIVE PHYSICAL SPECIFICATIONS

#### 5.1 GENERAL

These paragraphs contain the mechanical dimensions and mounting recommendations for the SA455.

#### 5.2 MECHANICAL DIMENSIONS

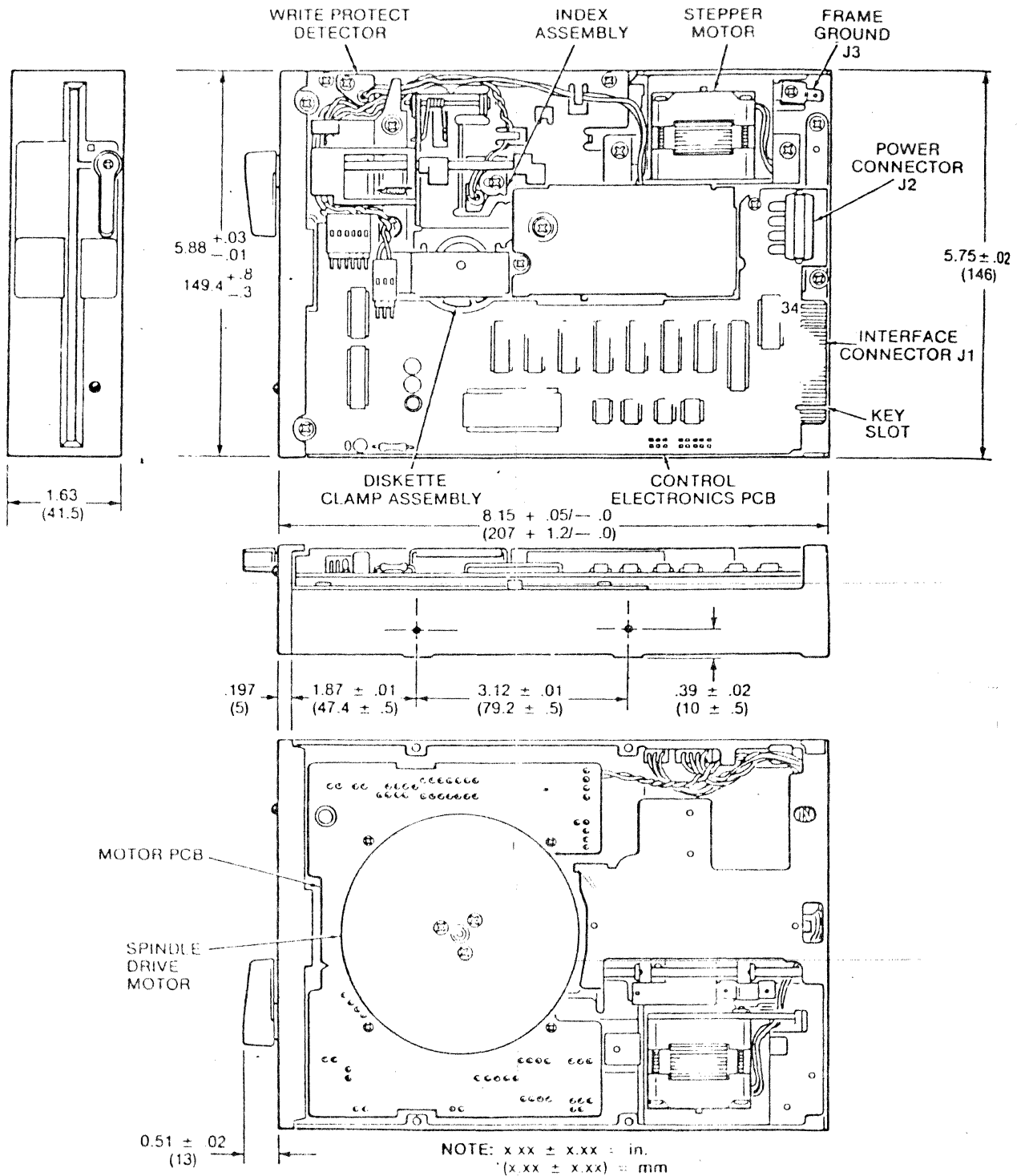
See figure 5-1 for dimensions of the SA455.

#### 5.3 MOUNTING

##### CAUTION

Do not mount horizontal with the PCB down. Failure to do so may damage the drive. The SA455 is capable of being mounted in one of the following positions.

1. Front Loading - mounted vertical with door opening left or right.  
- mounted horizontal with PCB up.
2. Mounting hardware for bottom and side holes is number 3 metric.



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FIGURE 5-1. SA455 PHYSICAL DIMENSIONS