

SA850/851
Bi-Compliant™
Double Sided
Diskette Storage Drive

OEM Manual



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1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION

The SA850/851 diskette storage drives are enhanced double-headed versions of the standard Shugart SA800/801 drives. SA850/851 drives provide up to four times the on-line storage capacity, faster access time, and lower heat dissipation along with improved reliability and maintainability.

SA850/851 drives read and write in single or double density on standard diskettes and on both sides of two-sided diskettes. The drives are exactly the same size as Shugart SA800/801 drives and are plug compatible. The SA850/851 drives are also media compatible with IBM 3740 and S/32 single-sided drives as well as IBM 4964 and 3600 series two-sided units.

The proprietary Fasflex™ actuator utilizes a flexible metal band for sure low friction head movement and a fast 3 ms track-to-track access time. In addition, Shugart's Bi-Compliant™ read/write head assembly provides superior compliance resulting in excellent data integrity.

Other valuable features include: programmable door lock and write protect plus dual index sensor to differentiate between single and two-sided diskettes.

The SA850/851 will prove highly cost-effective in applications such as: intelligent terminals, minicomputer/microcomputer systems, small business systems as well as word processing systems and intelligent calculators.

Key Features

- Storage capacity of up to four times that of SA800 and other standard floppy drives.
- Single or double density (standard).
- Same physical size as standard SA800/801 product family.
- SA800/801 I/O compatibility.
- Improved access time over standard drives - 3 ms track-to-track.
- Proprietary Fasflex™ actuator.
- Bi-Compliant read/write head assembly.
- Write protect and programmable door lock are standard for improved data security.
- Lower Heat dissipation.
- Improved AC connector.

1.2 SPECIFICATION SUMMARY

1.2.1 PERFORMANCE SPECIFICATIONS

Capacity	Single Density	Double Density
Unformatted		
Per Disk	800 kilobytes	1600 kilobytes
Per Surface	400 kilobytes	800 kilobytes
Per Track	5.2 kilobytes	10.4 kilobytes
IBM Format (128 byte sectors)		
Per Disk	500 kilobytes	1000 kilobytes
Per Surface	250 kilobytes	500 kilobytes
Per Track	3.3 kilobytes	6.66 kilobytes
Transfer Rate	250 kilobits/sec.	500 kilobits/sec.
Latency (Avg.)	83 ms	83 ms
Access Time		
Track to Track	3 ms	3 ms
Average (including settling)	91 ms	91 ms
Settling Time	15 ms	15 ms
Head Load Time	50 ms	50 ms

1.2.2 FUNCTIONAL SPECIFICATIONS

	Single Density	Double Density
Rotational Speed	360 rpm	360 rpm
Recording Density	3408 bpi	6816 bpi
(inside track)		
Flux Density	6816 fci	6816 fci
Track Density	48 tpi	48 tpi
Cylinders	77	77
Tracks	154	154
Heads	2	2
Physical Sectors		
SA850/R	0	0
SA851/R	32	32
Index	1	1
Encoding Method	FM	MFM/M ² FM
Media Requirements		
SA850	SA150/IBM Diskette 2D	SA150/IBM Diskette 2D
SA851	SA151	SA151
Alignment Diskette	SA122	SA122

1.2.3 PHYSICAL SPECIFICATIONS

	Operating	Shipping	Storage
Environment Limits			
Ambient Temperature	40° to 115°F	-40° to 144°F	-8° to 117°F
Relative Humidity	20 to 80%	1 to 95%	1 to 95%
Maximum Wet Bulb	85°F	No condensation	No condensation
AC Power Requirements			
50/60 Hz $\pm$ 0.5 Hz			
100/115 VAC Installations =	85 to 127V @ .35A Max.		
200/230 VAC Installations =	170 to 253V @ .25A Max.		
DC Voltage Requirements			
+ 24VDC $\pm$ 10% 1.0A Max.			
+ 5VDC $\pm$ 5% 1.1A Max.			
Mechanical Dimensions (exclusive of front panel)			
	SA850R/851R	SA850/851	
Height =	4.62 in. (117 mm)	4.62 in. (117 mm)	
Width =	8.55 in. (217 mm)	9.50 in. (241 mm)	
Depth =	14.25 in. (362 mm)	14.25 in. (362 mm)	
Heat Dissipation	Typical	Maximum	
BTU/Hr.	200	245	
Watts	60	72	

1.2.4 RELIABILITY SPECIFICATIONS

MTBF:	5000 POH under heavy usage. 8000 POH under typical usage.
MTTR:	30 minutes
Component Life:	15,000 POH
Error Rates:	
Soft Read Errors:	1 per 10^9 bits read.
Hard Read Errors:	1 per 10^{12} bits read.
Seek Errors:	1 per 10^6 seeks.
Media Life:	
Passes per Track	3.5×10^6
Insertions:	30,000 +

2.0 FUNCTIONAL CHARACTERISTICS

2.1 GENERAL OPERATION

SA850/851 Diskette Storage Drives consist of read/write and control electronics, drive mechanism, Bi-Compliant read/write heads and a track positioning mechanism. These components perform the following functions:

- Interpret and generate control signals.
- Move read/write heads to the selected track.
- Read and write data.

The Fasflex™ Head Positioning Actuator positions the read/write heads to the desired track on the diskette. The Head Load Solenoid loads the read/write heads against the diskette and data may then be recorded on or read from the diskette.

2.2 READ/WRITE AND CONTROL ELECTRONICS

The electronics are packaged on one PCB. The PCB contains:

1. Index Detector Circuits (Sector/Index for 851)
2. Head Position Actuator Driver.
3. Head Load Solenoid Driver.
4. Read/Write Amplifier and Transition Detector.
5. Data/Clock Separation Circuits (SA851 only).
6. Write Protect
7. Drive Ready Detector Circuit.
8. Drive Select Circuits.
9. Side Select Circuit.
10. In Use and Door Lock Circuits.
11. Write Current Switching/Read Compensation.

2.3 DRIVE MECHANISM

The Diskette drive motor rotates the spindle at 360 rpm through a belt-drive system. 50 or 60 Hz power is accommodated by changing the drive pulley and belt. A registration hub, centered on the face of the spindle, positions the Diskette. A clamp that moves in conjunction with the cartridge guide fixes the Diskette to the registration hub.

2.4 POSITIONING MECHANISM

The read/write heads are accurately positioned by Fasflex™ metal band/stepping motor actuator system. A precision stepping motor is used to precisely position the head/carriage assembly through the use of a unique metal band/capstan concept. Each 3.6° rotation of the stepping motor moves the read/write head one track in discrete increments.

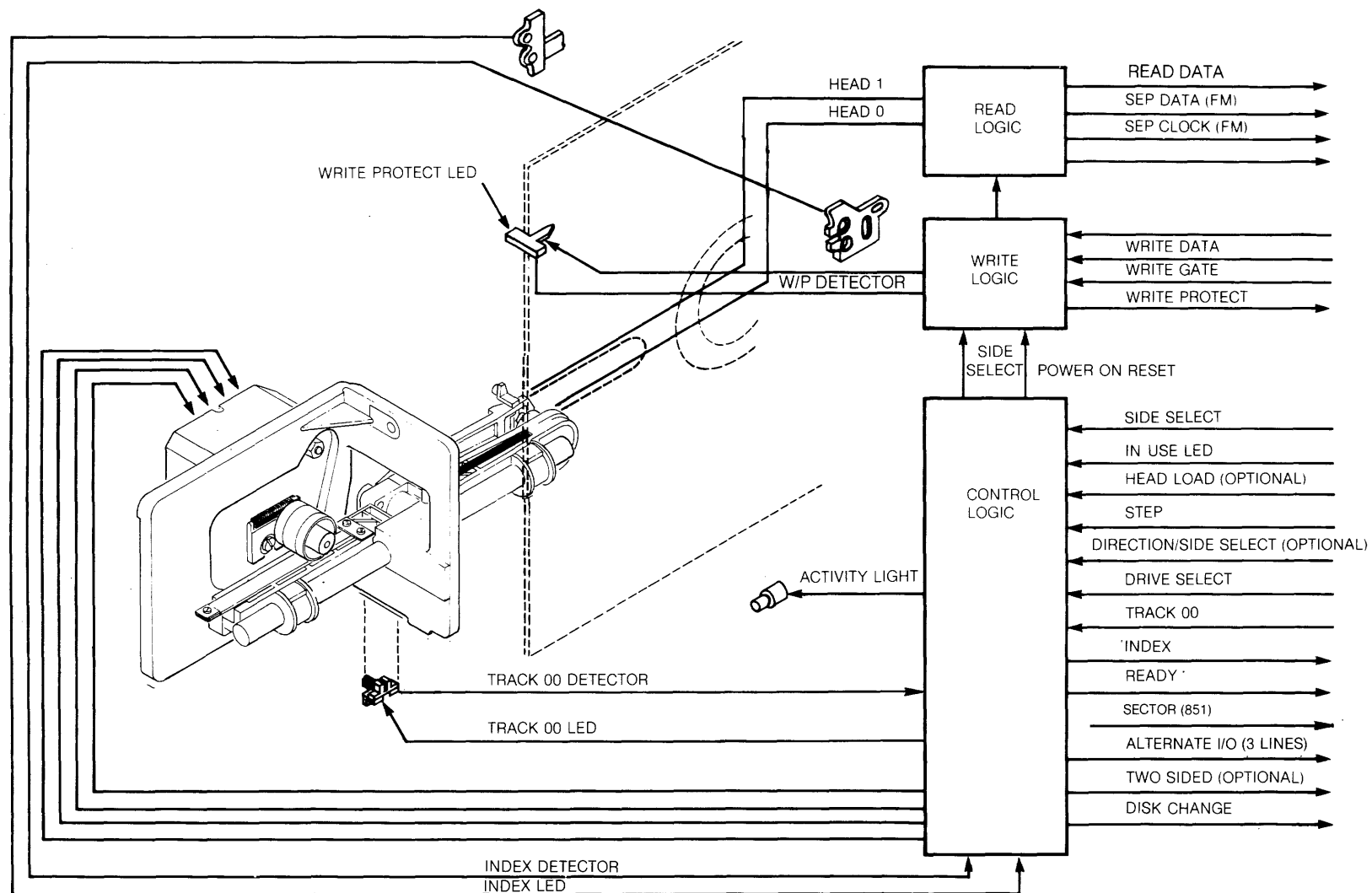


FIGURE 1. SA850/851 FUNCTIONAL DIAGRAM

2.5 READ/WRITE HEADS

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

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 flexure-mounted head is loaded against its rigidly mounted counterpart via the head load solenoid. 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.

3.0 FUNCTIONAL OPERATIONS

3.1 POWER SEQUENCING

Applying AC and DC power to the SA850/851 can be done in any sequence, however, once AC power has been applied, a 2 second delay must be introduced before any Read or Write operation is attempted. This delay is for stabilization of the Diskette rotational speed. Also, after application of DC power, a 90 millisecond delay must be introduced before a Read, Write, or Seek operation or before the control output signals are valid. After powering on, initial position of the read/write heads with respect to data tracks is indeterminate. In order to assure proper positioning of the read/write heads prior to any read/write operation after powering on, a Step Out operation should be performed until the Track 00 indicator becomes active.

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 will load the read/write head, apply power to the stepper motor, enable the input lines and output lines, light the Activity LED on the front of the drive and lock the door. Optional modes of drive selection are discussed in Section 7.

3.3 TRACK ACCESSING

Seeking the read/write head 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.

3.3.1 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 and the Direction Select line must have the timing characteristics shown in Figure 2.

3.3.2 STEP IN

With the Direction Select line at a 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 2.

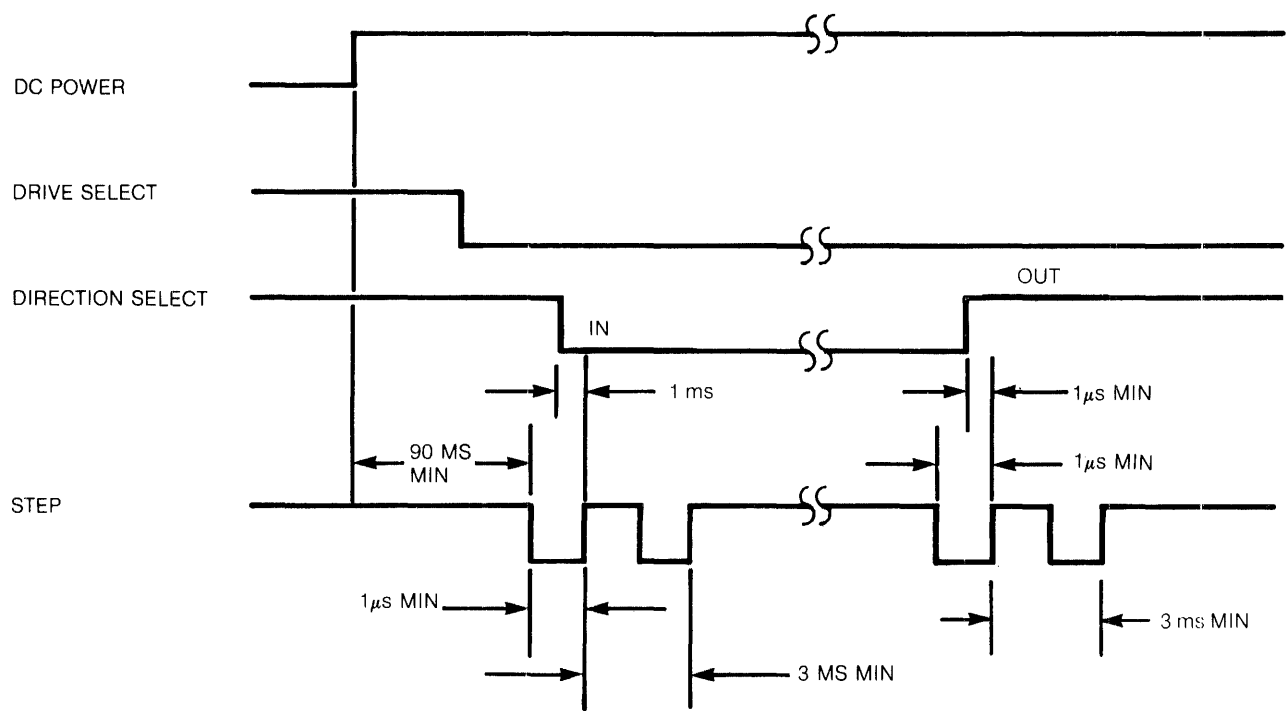
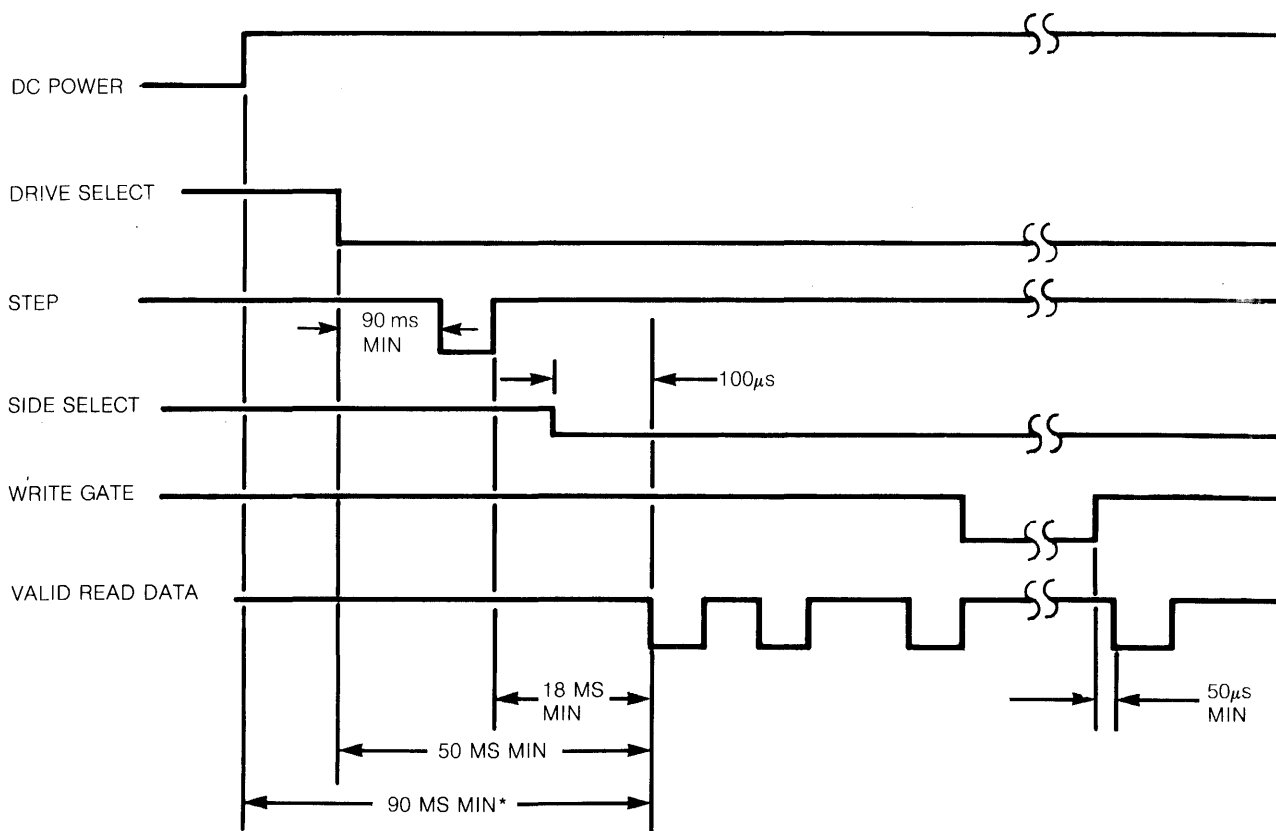


FIGURE 2. TRACK ACCESS TIMING

3.4 SIDE SELECTION

In the standard SA850/851, 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 $100\mu\text{s}$ delay is required after Side Select changes state before a read or write operation can be initiated. Figure 3 shows the use of Side Select prior to a read operation.

Two jumper-selectable Side Select options are also available. Either of these can be implemented to make use of existing controller and cable harness design. These options are described fully in Section 7.



*2 SECONDS IF AC AND DC POWER ARE APPLIED AT THE SAME TIME

FIGURE 3. READ INITATE TIMING

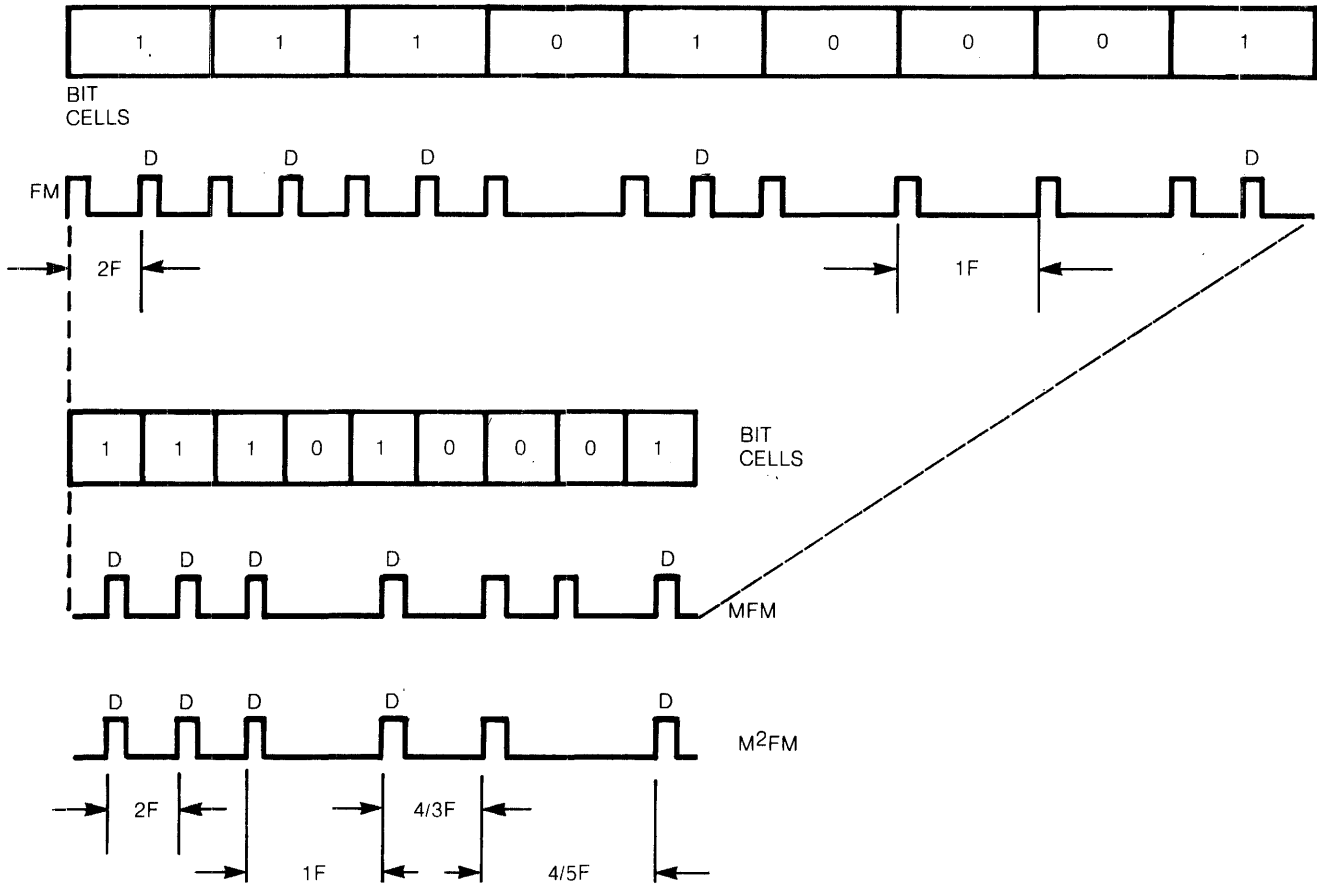


FIGURE 4. FM, MFM AND M2FM CODE COMPARISONS

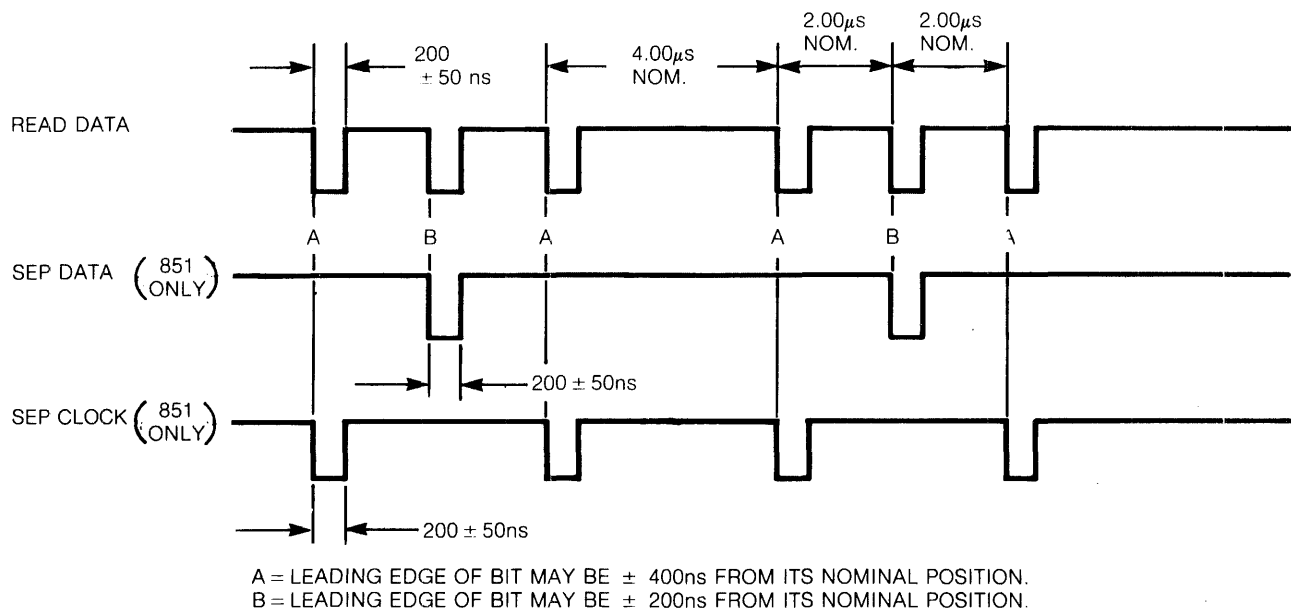


FIGURE 5. READ SIGNAL TIMING (FM ENCODING)

3.5 READ OPERATION

Reading data from the SA850/851 Diskette Storage drive 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 3. These timing specifications are required in order to guarantee that the read/write head position has stabilized prior to reading.

The coding scheme of the recorded data can be FM, MFM or M²FM. The first of these, FM, provides single-density recording. The superior efficiency of the other two codes permit their bit cell period to be ½ that of the FM code, thereby providing double-density recording. Differences among FM, MFM and M²FM encoding are concerned with the use of clock bits in the write data stream.

FM encoding rules specify a clock bit at the start of every bit cell. See Figure 4. MFM and M²FM encoding rules allow clock bits to be omitted from some bit cells, with the following prerequisites:

- a. MFM - 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 4.
- b. M²FM - The clock bit is omitted from the current bit cell if the preceding bit cell contained any bit (clock or data) or if the current bit cell contains a data bit. See Figure 4.

In all three of these encoding schemes, clock bits are written at the start of their respective bit cells and data bits at the center of their bit cells.

The timing of the read signals, Read Data, Separated Data and Separated Clock are shown in Figure 5 (FM encoding).

In the standard SA851, data separation of FM data is performed by the drive electronics. Data bits are presented to the controller on the Sep Data line and clock bits are presented on the Sep Clock line. In systems using the SA850 or when MFM/M²FM encoding is used, data separation is performed outside the drive. In such cases, the Read Data line carries both clock bits and data bits. Separation is MFM or M²FM encoded read data should be controlled by a phase-locked loop oscillator (PLO) circuit.

For additional information regarding the use of MFM and M²FM encoding with SA850/851 drives, refer to Shugart Associates' Double Density Design Guide.

3.6 WRITE OPERATION

Writing data to the SA850/851 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.
- e. Head Current switching.

The timing relationships required to initiate a write data sequence are shown in Figure 6. These timing specifications are required in order to guarantee that the read/write head position has stabilized prior to writing.

Write data encoding can be FM, MFM or M²FM. If either double-frequency encoding scheme is used (MFM or M²FM) the write data should be precompensated to counter the effects of bit shift. The amount and direction of compensation required for any given bit in the data stream depends on the pattern it forms with nearby bits.

For more details regarding data encoding and formatting for SA850/851 drives, refer to Shugart Associates' Double Density Design Guide.

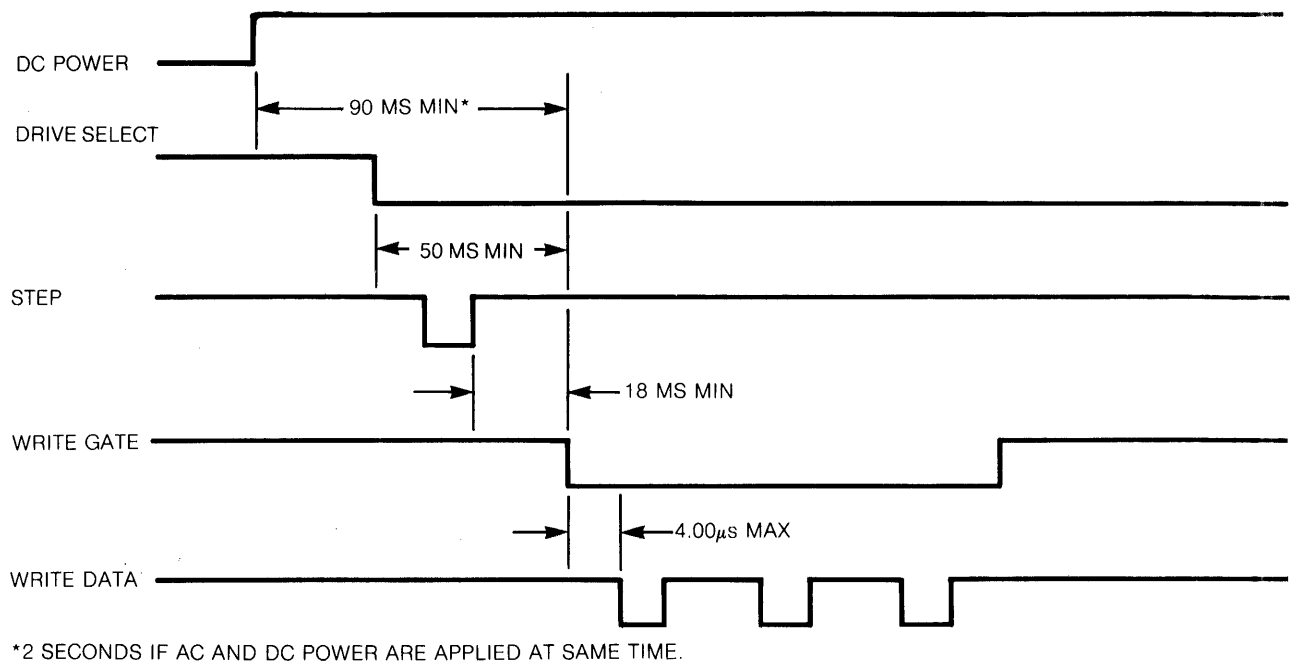


FIGURE 6. WRITE INITIATE TIMING

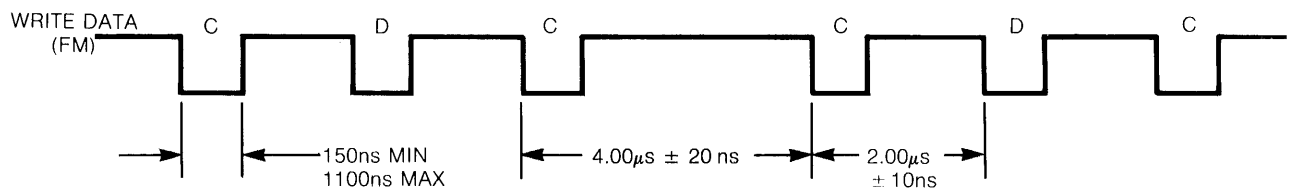
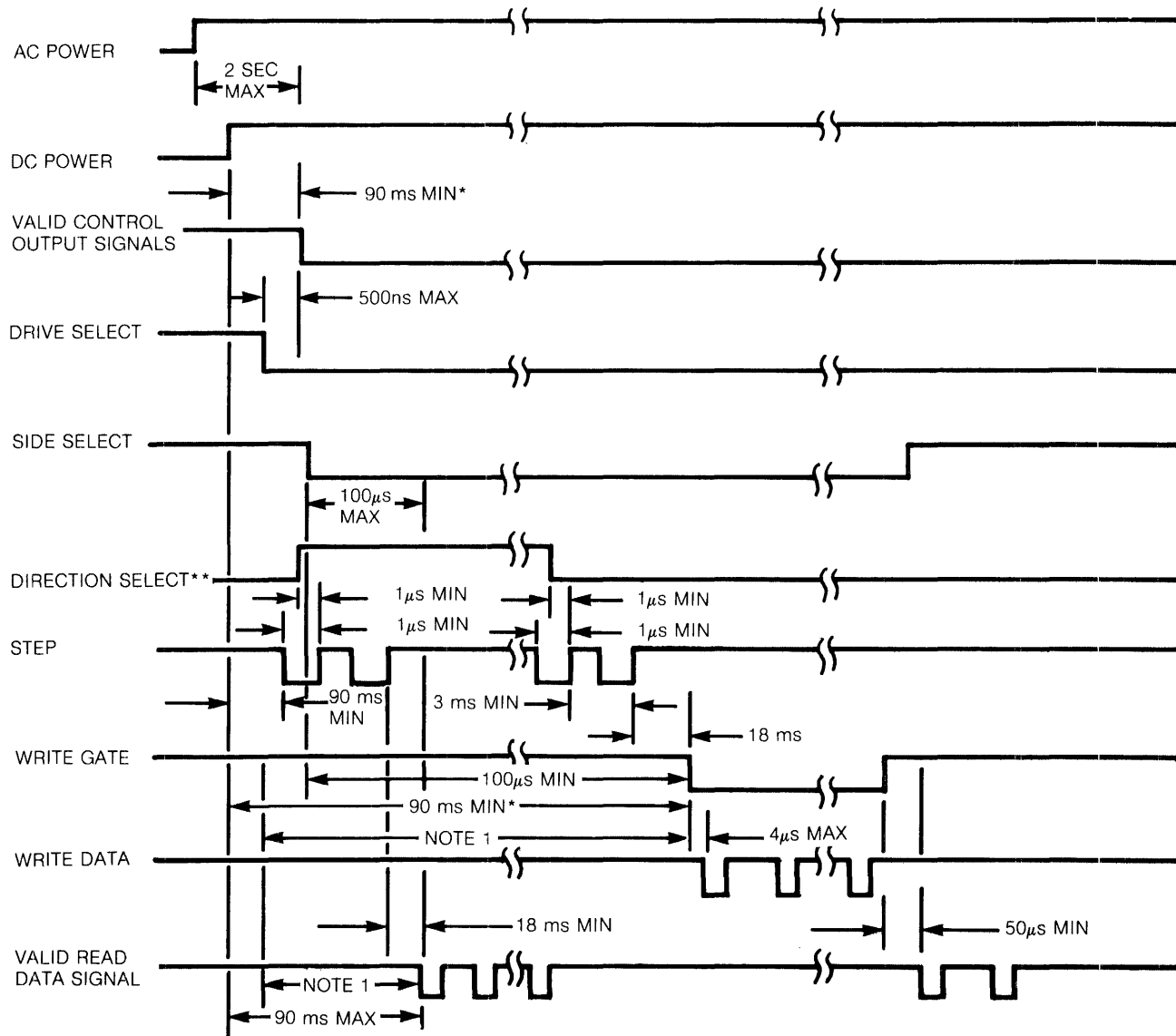


FIGURE 7. WRITE DATA TIMING (FM ENCODING)

3.7 SEQUENCE OF EVENTS

The timing diagram shown in Figure 8 shows the necessary sequence of events with associated timing restrictions for proper operation.

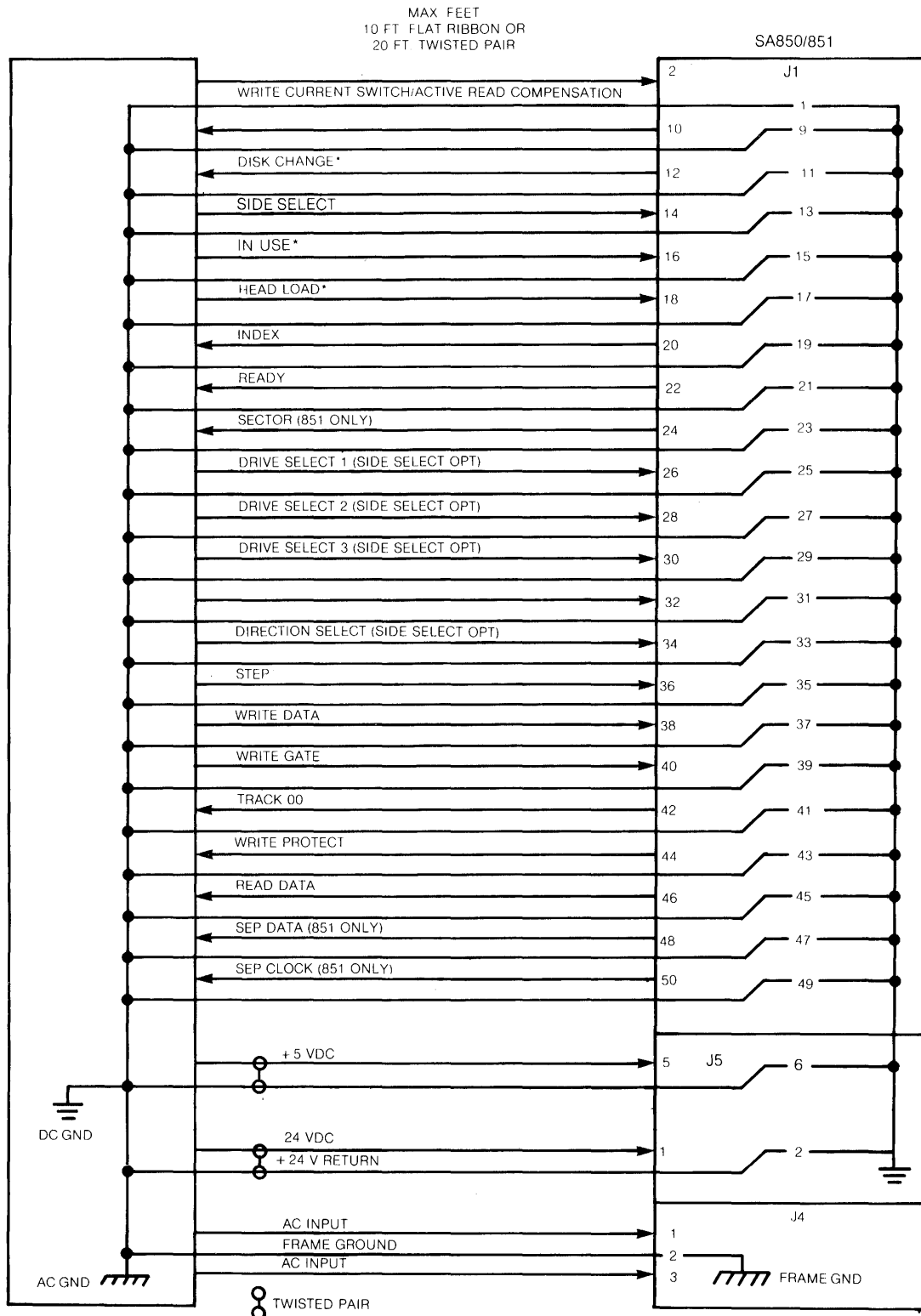


*2 SECONDS IF AC AND DC POWER ARE APPLIED AT SAME TIME.

**WHEN CHANGING DIRECTION ON THE HEAD A 15 MS DELAY MUST BE INTRODUCED.

NOTE 1 50 ms minimum delay must be introduced after Drive Select to allow for proper head load settling. If stepper power is to be applied independent of Head Load, then a 15 ms minimum delay must be introduced to allow for stepper settling. See section 7 on optional customer installable features.

FIGURE 8. GENERAL CONTROL AND DATA TIMING REQUIREMENTS



* These lines are alternate input/output lines and they are enabled by jumper plugs. Reference Section 7 for uses of these lines. Not shown are pins 4, 6 and 8 which are alternate I/O pins.

FIGURE 9. INTERFACE CONNECTIONS

4.0 ELECTRICAL INTERFACE

The interface of the SA850/851 Diskette drive can be divided into two categories:

1. Signal
2. Power

The following sections provide the electrical definition for each line.

Reference Figure 9 for all 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

There are thirteen (13) signal input lines, ten (10) are standard and three (3) are user installable options (reference section 7).

The input signals are of two types, those intended to be multiplexed in a multiple drive system and those which will perform the multiplexing. The input signals to be multiplexed are:

1. Direction Select
2. Step
3. Write Data
4. Write Gate
5. Side Select
6. Head Current Switch/Active Read Compensation
7. In Use
8. Head Load

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 input circuit lines have the following electrical specifications. Reference Figure 10 for the recommended circuit.

True = Logical zero = $V_{in} \pm 0.0V$ to $+0.4V$ @ $I_{in} = 40 \text{ ma (max)}$

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

Input Impedance = 150 ohms

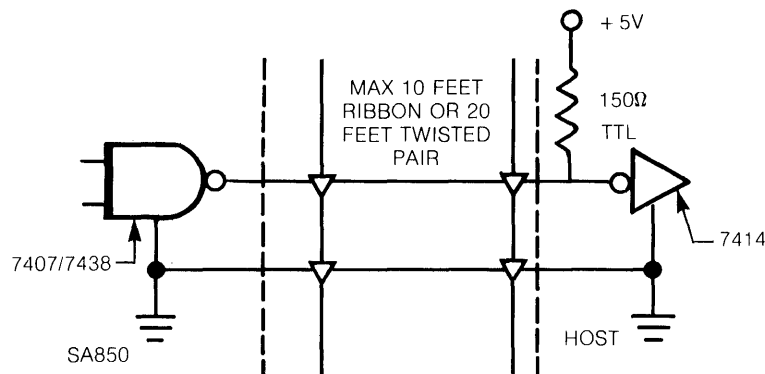


FIGURE 10. INTERFACE SIGNAL DRIVER/RECEIVER

4.1.1.1 INPUT LINE TERMINATION

The SA850/851 has been provided with a removable resistor pack for terminating the seven input lines that are to be multiplexed.

In order for the drive to function properly, the last drive on the interface must have these seven lines terminated. Termination of these lines can be accomplished by either of two methods.

1. As shipped from the factory, the resistor pack is installed in location 5E. These packs can be removed from all drives except the last one on the Interface.
2. External termination may be used provided the terminator is beyond the last drive. Each of the five lines should be terminated by using a 150 ohm, $\frac{1}{4}$ watt resistor, pulled up to $+5VDC$.

The same removable resistor pack is also provided for terminating the optional input lines.

4.1.1.2 DRIVE SELECT 1 - 4

Drive Select when activated to a logical zero level, activates the multiplexed I/O lines and loads the read/write head. In this mode of operation only the drive with this line active will respond to the input lines and gate the output lines.

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 may be multiplexed together in a system and have separate Drive Select lines. Traces 'DS1', 'DS2', 'DS3', and 'DS4' have been provided to select which Drive Select line will activate the interface signals for a unique drive. As shipped from the factory, a shorting plug is installed on 'DS1'. To select another Drive Select line, this plug should be moved to the appropriate 'DS' pin.

4.1.1.3 SIDE SELECT

This interface line defines which side of a two-sided diskette is used for reading or writing. An open circuit, or logical one, selects the read/write head on the side 0 surface of the diskette. A short to ground, or logical zero, selects the read/write head on the diskette's side 1 surface. When switching from one head to the other, a 100 μ s delay is required before any read or write operation can be initiated.

Two optional methods of side selection are available and can be implemented by the user through appropriate jumper connections. These options are described in Sections 7.9 and 7.10.

4.1.1.4 DIRECTION SELECT

This interface line is a control signal which 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.

A jumper-selectable option is available, which allows the Direction Select line to be time shared for both the Direction Select and Side Select functions. That is, during head positioning operations, the Direction Select line controls direction of head motion and during read or write operations, the Direction Select line determines which head is selected. Details regarding the implementation of this option are provided in Section 7.9.

NOTE: A 15ms delay must be introduced when changing direction (i.e., the last step in pulse to first step out-pulse or vice versa).

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.

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 μ s before the trailing edge of the Step pulse. Refer to Figure 2 for these timings.

4.1.1.6 WRITE GATE

The active state of this signal (logical zero) enables Write Data to be written on the diskette. The inactive state (logical one) enables the read data logic (Separated Data, Separated Clock, and Read Data) and step-per logic. Refer to Figure 6 for Write Initiate timing information.

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 head to be reversed, thereby writing a data bit. This line is enabled by Write Gate being active. Refer to Figure 7 for timing information.

4.1.1.8 HEAD LOAD (ALTERNATE INPUT)

This customer installable option, when enabled by jumpering Trace "C" and activated to a logical zero level and the diskette access door is closed, will load the read/write heads against the diskette. Refer to section 7.15 for uses and method of installation.

4.1.1.9 IN USE (ALTERNATE INPUT)

This customer installable option, when enabled by jumpering Trace "D" and activated to a logical zero level will turn on the Activity LED in the door push button and will lock the door. This signal is an "OR" function with Drive Select. Refer to section 7.6 for uses and method of installation.

4.1.1.10 WRITE CURRENT SWITCH/ACTIVE READ COMPENSATION

Reference section 7.13

4.1.2 OUTPUT LINES

There are five standard output lines from the SA850, and eight standard output lines from the SA851. Also, there are two optional output lines and three alternate outputs available from either the SA850 or SA851. The output signals are driven with an open collector output stage capable of sinking a maximum of 40 ma at a logical zero level or true state with a maximum voltage of 0.4V measured at the driver. When the line driver is in a logical one or false state, the driver is off and the collector current is a maximum of 250 microamperes.

Refer to Figure 10 for the recommended circuit.

4.1.2.1 TRACK 00

The active state of this signal, or a logical zero indicates when the drive's read/write heads are positioned at track zero (the outermost track) and the access circuitry is driving current through phase one of the stepper motor. This signal is at a logical one level, or false state, when the selected drive's read/write heads are not at track 00.

4.1.2.2 INDEX

This interface signal is provided by the drive once each revolution of the diskette (166.67 ms) to indicate the beginning of the track. Normally this signal is a logical one and makes the transition to the logical zero level for a period of 1.8 ms (0.4 ms on SA851) once each revolution. The timing for this signal is shown in Figure 11.

To correctly detect Index at the control unit, Index should be false at Drive Select time; that is, the controller should see the transition from false to true after the drive has been selected.

For additional methods of detecting Index, refer to section 7.5.

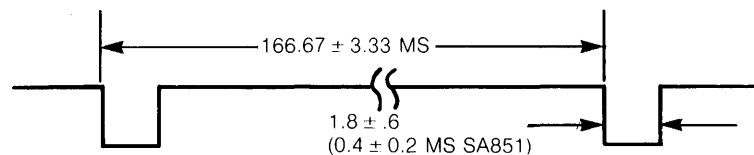


FIGURE 11. INDEX TIMING

4.1.2.3 SECTOR (SA851 only)

This interface signal is provided by the drive 32 times each revolution. Normally, this signal is a logical one and makes the transition to a logical zero for a period of 0.4 ms each time a sector hole on the Diskette is detected. Figure 12 shows the timing of this signal and its relationship to the Index pulse.

NOTE: Index/Sector pulses should not be used for loading the Read/Write heads as this may cause unusual media wear in one spot on the diskette.

4.1.2.4 READY

This interface signal indicates that two index holes have been sensed after properly inserting a diskette and closing the door, or that two index holes have been sensed following the application of + 5V power to the drive. Three holes have to be sensed for two sided diskettes.

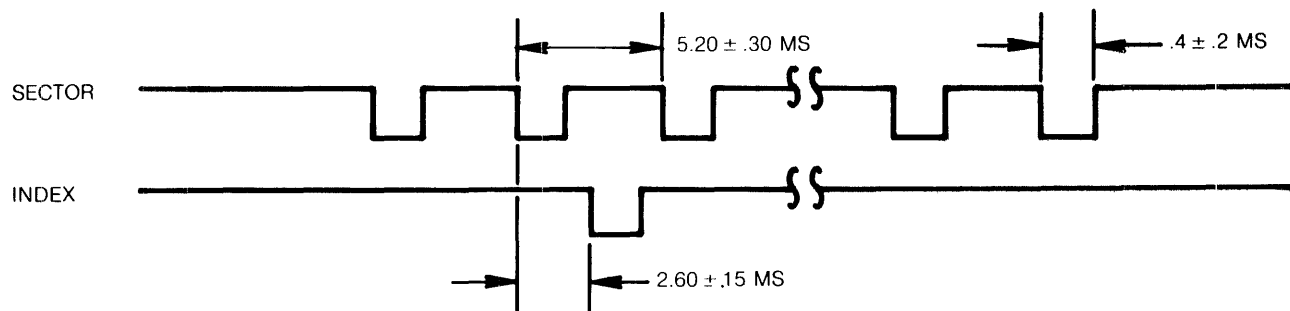


FIGURE 12. SECTOR TIMING

If a single sided diskette is installed, READY will be active (logical zero) if SIDE 0 is selected, but false (logical 1) if SIDE 1 is selected. Conversely, if a two-sided diskette is installed, READY will be active when either side of the diskette is selected.

For additional methods of using the Ready line, refer to section 7.4.

4.1.2.5 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. Reference Figure 5 for the timing and bit shift tolerance within normal media variations.

4.1.2.6 SEP DATA (SA851 only)

This interface line furnishes the data bits as separated from the "raw data" by use of the internal data separator. Normally, this signal is a logical one level and becomes a logical zero level for the active state. Reference Figure 5 for the timing

4.1.2.7 SEP CLOCK (SA851 only)

This interface line furnishes the clock bits as separated from the "raw data" by use of the internal data separator. Normally, this signal is a logical one level and becomes a logical zero level for the active state. Reference Figure 5 for the timing.

4.1.2.8 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 a 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.

For other methods of using Write Protect, refer to section 7.7

4.1.2.9 DISK CHANGE (OPTIONAL OUTPUT)

Reference section 7.8.

4.1.2.10 TWO SIDED (OPTIONAL OUTPUT)

Reference section 7.12.

4.1.3 ALTERNATE I/O PINS

These interface pins have been provided for use with customer installable options. Refer to section 7 for methods of use.

4.2 POWER INTERFACE

The SA850/851 Diskette Storage Drive requires both AC and DC power for operation. The AC power is used for the spindle drive motor and the DC power is used for the electronics and the stepper motor.

4.2.1 AC POWER

The AC power to the drive is via the connector P4/J4 located to the rear of the drive and below the AC motor capacitor. The P4/J4 pin designations are outlined in Table 1 for standard as well as optional AC power.

P4 PIN	60 Hz		50 Hz	
	115 V (Standard)	208/230 V	110V	220V
1	85-127 VAC	170-253 VAC	85-127 VAC	170-253 VAC
2	Frame Gnd	Frame Gnd	Frame Gnd	Frame Gnd
3	85-127 V Rtn	170-253 V Rtn	85-127 V Rtn	170-253 V Rtn
MAX CURRENT	0.35 Amps	0.25 Amps	0.35 Amps	0.25 Amps
FREQ TOLERANCE	± 0.5 Hz		± 0.5 Hz	

TABLE 1

4.2.2 DC POWER

DC power to the drive is via connector P5/J5 located on the non-component side of the PCB near the P4 connector. The two DC voltages and their specifications along with their P5/J5 pin designators, are outlined in Table 2.

P5 PIN	DC VOLTAGE	TOLERANCE	CURRENT	MAX RIPPLE (p to p)
1	+ 24 VDC	± 2.4 VDC	1.0A Max* 0.85A Typ	100 mv
2	+ 24 V Return			
6	+ 5 V Return			
5	+ 5 VDC	± 0.25 VDC	1.1A Max 1.0A Typ	50 mv

*If either customer installable option described in sections 7.1 and 7.3 are used, the current requirement for the +24-VDC is a multiple of the maximum +24V current times the number of drives on the line.

TABLE 2

5.0 PHYSICAL INTERFACE

The electrical interface between the SA850/851 and the host system is via three connectors. The first connector, J1, provides the signal interface; the second connector, J5, provides the DC power; and the third connector, J4, provides the AC power and frame ground.

This section describes the physical connectors used on the drive and the recommended connectors to be used with them. Refer to Figure 16 for connector locations.

5.1 J1/P1 CONNECTOR

Connection to J1 is through a 50 pin PCB edge card connector. The dimensions for this connector are shown in Figure 13. The pins are numbered 1 through 50 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 AC motor capacitor and is labeled 2. A key slot is provided between pins 4 and 6 for optional connector keying.

The recommended connectors for P1 are tabulated below.

TYPE OF CABLE	MANUFACTURER	CONNECTOR P/N	CONTACT P/N
Twisted Pair, #18 (crimp or solder)	AMP	1-583718-1	583616-5 (crimp) 583854-3 (solder)
Twisted Pair, #18 (solder term.)	VIKING	3VH25/1JN-5	NA
Flat Cable	3M "Scotchflex"	3415-0001	NA

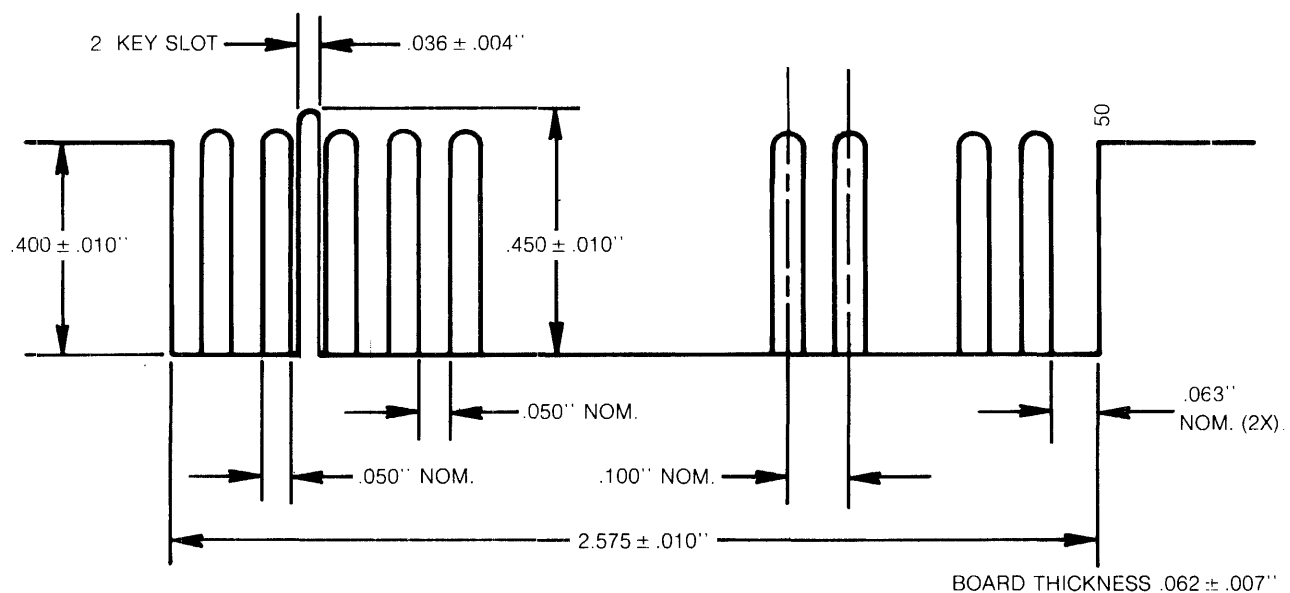


FIGURE 13. J1 CONNECTOR DIMENSIONS

5.2 J5/P5 CONNECTOR

The DC power connector, J5, is mounted on the non-component side of the PCB and is located below the AC motor capacitor. J5 is a 6 pin AMP Mate-N-Lok connector P/N 1-380999-0. The recommended mating connector (P5) is AMP P/N 1-480270-0 utilizing AMP pins P/N 60619-1. J5 pins are labeled on the component side of the PCB with pin 5 located nearest J1/P1. Figure 14 illustrates J5 connector as seen on the drive PCB from non-component side.

5.3 J4/P4 CONNECTOR

The AC power connector, J4, is mounted on the AC motor capacitor bracket and is located just below the capacitor. J4 connector is a 3 pin connector AMP P/N 1-480701-0 with pins P/N 350687-1, 2 EA. and 350654-1, 1 EA. The recommended mating connector (P4) is AMP P/N 1-480700-0 utilizing pins 350550-1. Figure 15 illustrates J4 connector as seen from the rear of the drive.

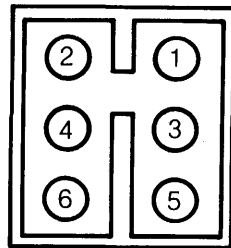


FIGURE 14. J5 CONNECTOR

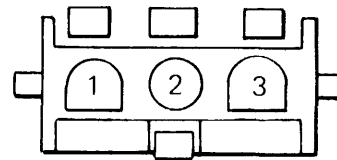


FIGURE 15. J4 CONNECTOR

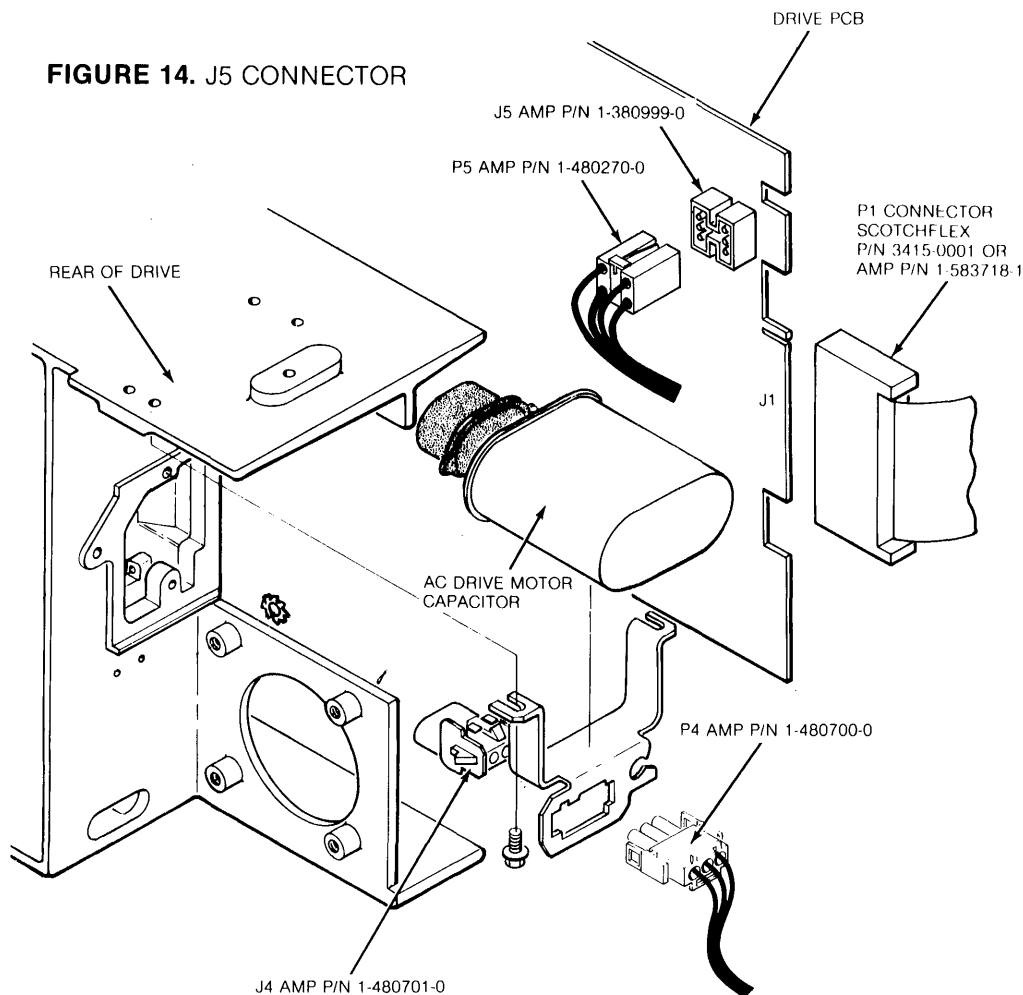


FIGURE 16. INTERFACE CONNECTOR-PHYSICAL LOCATION DIAGRAM

6.0 DRIVE PHYSICAL SPECIFICATIONS

This section describes the mechanical dimensions and mounting recommendations for the SA850/851.

6.1 DRIVE DIMENSIONS

Reference Figure 18 and 19 for dimensions of the SA850/851.

6.2 MOUNTING RECOMMENDATIONS

The SA850/851 is capable of being mounted in one of the following positions (refer to Figure 17):

1. Vertical - Door opening to the left or right.
2. Horizontal - Door opening up (PCB down).
3. Upright - To mount the drive in this position remove the spring hook attached to the eject mechanism and attach the eject spring to the post the spring hook was attached to.

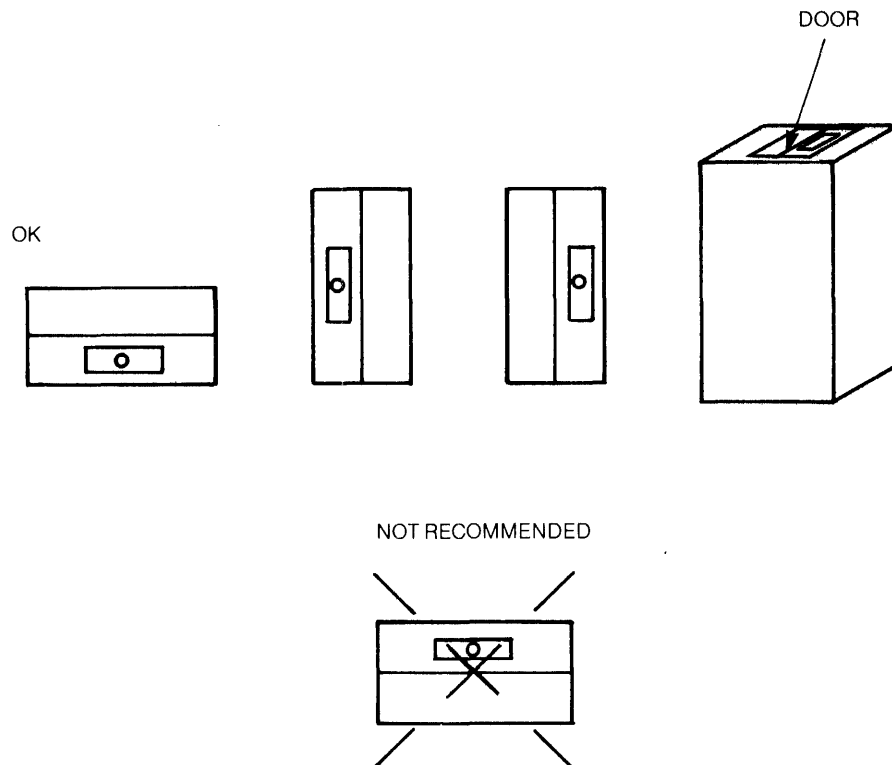
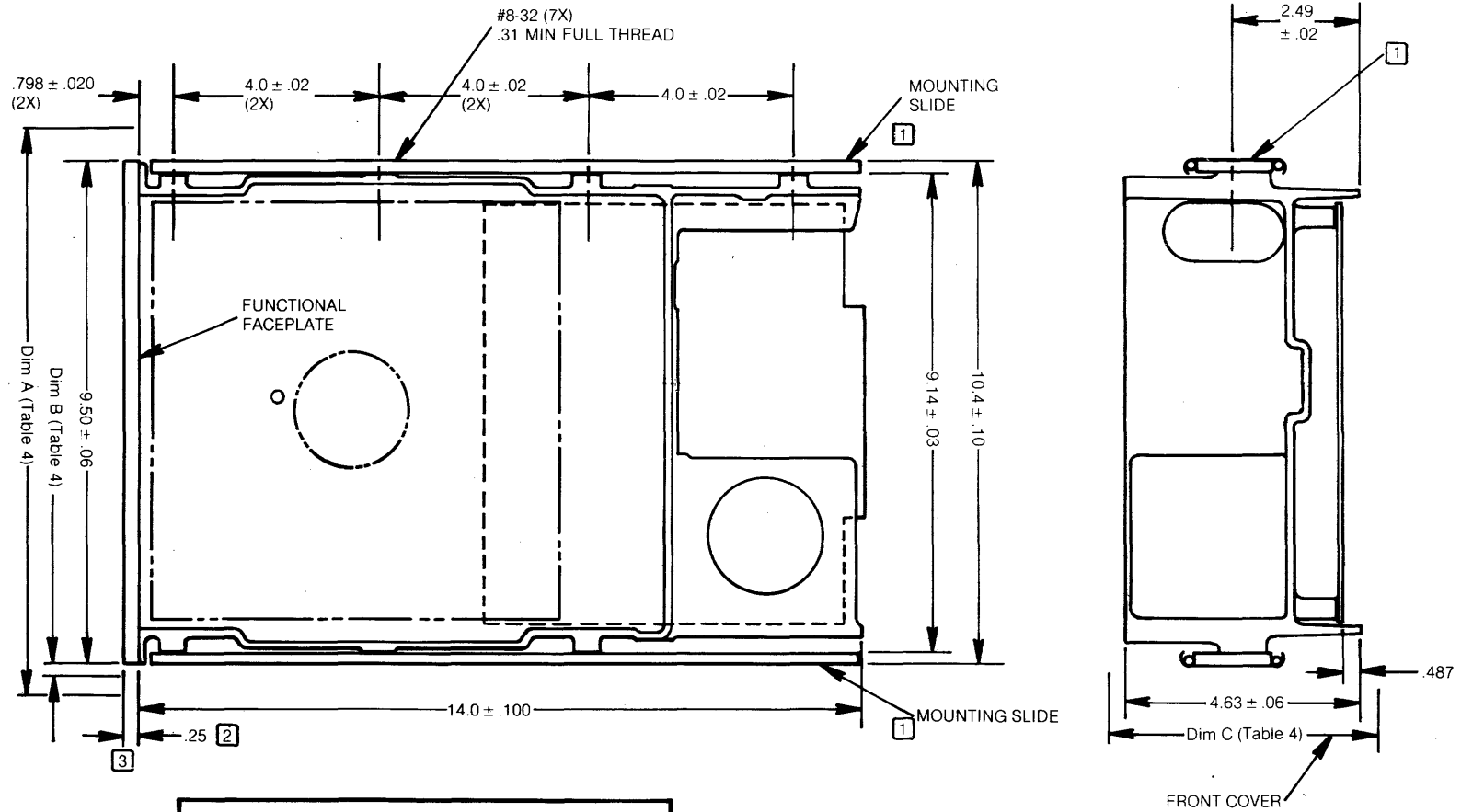


FIGURE 17. RECOMMENDED MOUNTING

FIGURE 18. SA850/851 DISKETTE STORAGE DRIVE DIMENSIONS



Decorative Cover Dimensions			
Cover Size	Dim A	Dim B	Dim C
4-5/8 × 10-1/2	10.50	.240	4.62
5-1/4 × 10	10.00	.240	5.25
5-1/4 × 11	11.00	.740	5.25
Tolerance	$\pm .03$	$\pm .030$	$\pm .03$

- 1 If drive is mounted on slides, drive will extend 14 inches from operating position for servicing.
- 2 With cosmetic cover this dimension is .38".
- 3 Handle extend .375" beyond faceplate.
- 4 All dimensions are in inches.

- 1 Dimension is from end of base casting.
- 2 Cosmetic front cover height.
- 3 Functional front plate height.
- 4 Cosmetic front cover width.

- 5 Functional front plate width.
- 6 Cosmetic front cover thickness.
- 7 Functional front plate thickness.
- 8 Cosmetic front cover color comes only in tan.

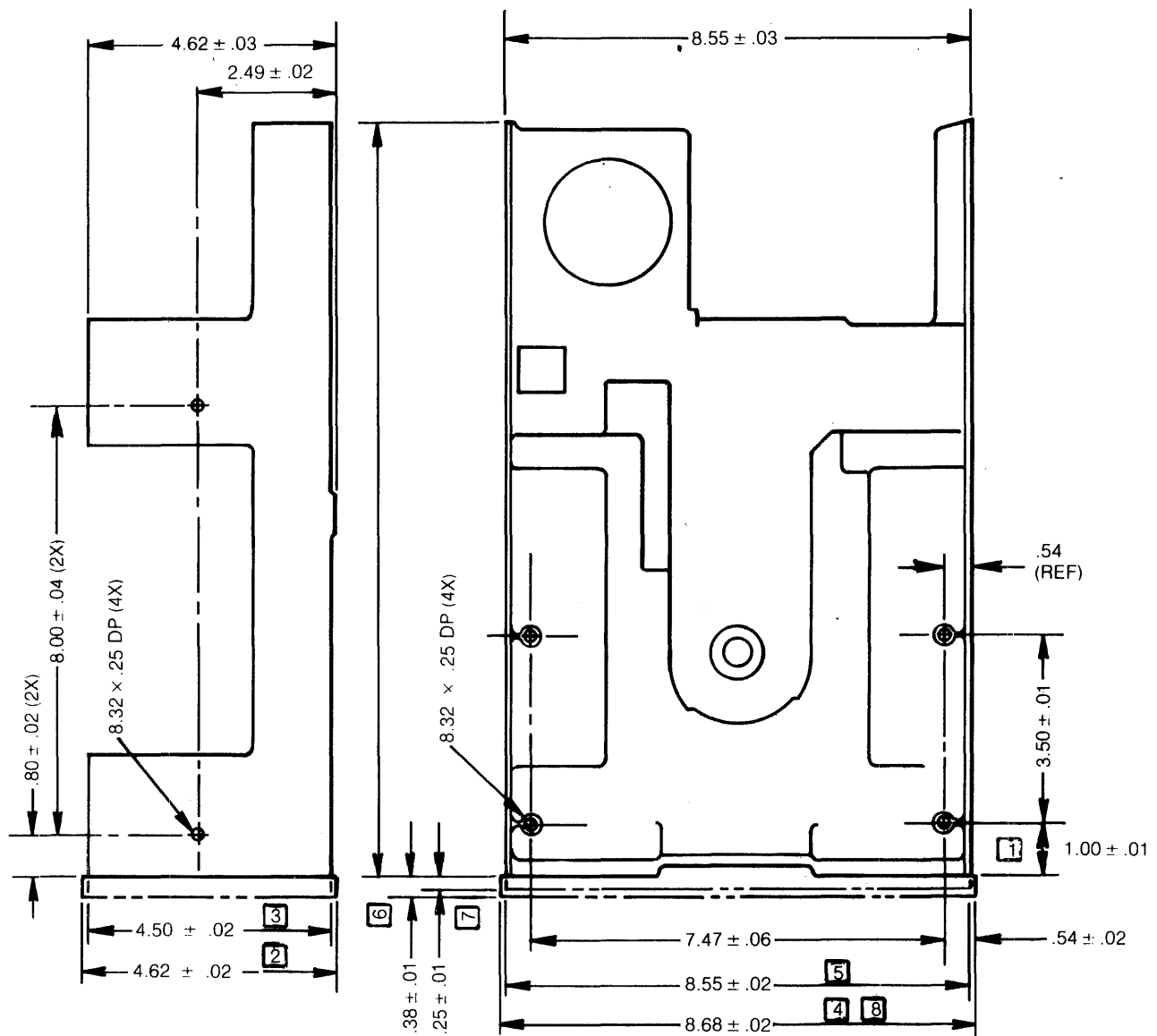
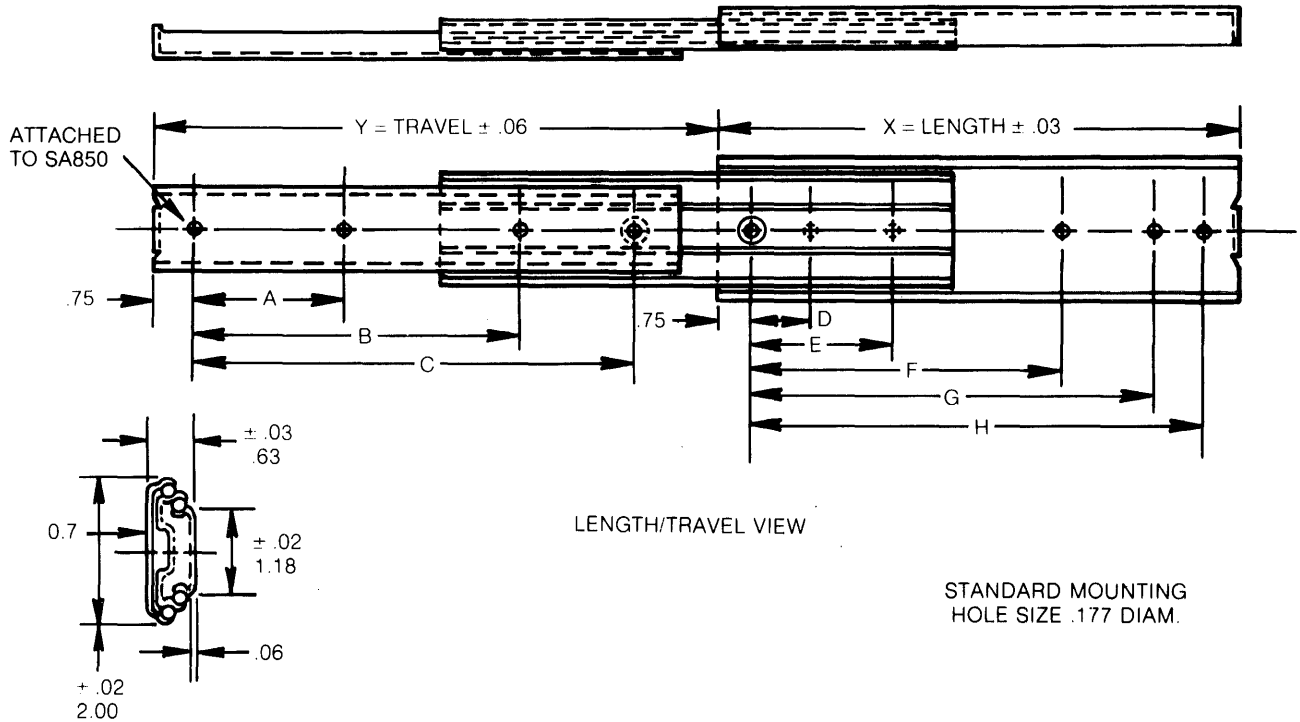


FIGURE 19. SA850/851R DIMENSIONS

6.3 CHASSIS SLIDE

Available as an optional accessory is a chassis slide kit P/N 50239. This kit contains two slides, one locking and one non-locking, and seven screws. Dimensions of the slide are shown in Figure 19.



X	Y	A	B	C	D	E	F	G	H
14	15	4.00	8.00	12.00	1.00	3.50	8.50	11.50	12.50

FIGURE 20. SLIDE MOUNTING DIMENSIONS

6.4 DECORATIVE FACE PLATE

The SA850/851 may be ordered with one of the following decorative face plates:

SIZE	COLOR
4 5/8 × 10 1/2	Tan
4 5/8 × 10 1/2	White
5 1/4 × 10	Tan
5 1/4 × 10	White
5 1/4 × 11	Tan
5 1/4 × 11	White
"R" Series-4 5/8 × 8 11/16	Tan

If another color is required to match the system's color scheme, the face plate may be painted. The following information should be utilized to avoid potential problems in the painting process.

1. The front cover is made from GE's LEXAN. Dimensional stability of LEXAN is from -60°F to +250°F. If the paint used requires baking, the temperature should not exceed +250°F, including any hot spots which can contact the cover.
2. LEXAN is a polycarbonate. Any paint to be used should be investigated to insure that it does not contain chemicals that are solvents to polycarbonates.

7.0 CUSTOMER INSTALLABLE OPTIONS

The SA850/851 can be modified by the user to function differently than the standard method as outlined in sections 3 and 4. These modifications can be implemented by adding or deleting connections and by use of the Alternate I/O pins. Some options are capable of being connected by use of a shorting plug, Shugart P/N 15648 or AMP P/N 53013-2. This section will discuss a few examples of modifications and how to install them. The examples are:

1. Select drive without loading head or enabling stepper.
2. Select drive and enable stepper without loading head.
3. Load head without selecting drive or enabling stepper.
4. Radial Ready.
5. Radial Index/Sector.
6. In Use (Activity LED) optional input.
7. Write Protect options.
8. Side selection.
9. Write Current Switch.
10. Ready Standard/Ready Modified.
11. Head Load Latch.
12. Active Read Compensation Filter.

CUSTOMER CUT/ADD TRACE OPTIONS

TRACE DESIGNATOR	DESCRIPTION	SHIPPED FROM FACTORY	
		OPEN	SHORT
5E	Terminations for Multiplexed Standard Inputs		Plugged
DS1	Drive Select 1 Input Pin		Plugged
DS2,3,4	Drive Select 2,3,4 Input Pins	X	
1B,2B,3B,4B	Side Select Option Using Drive Select	X	
RR	Radial Ready		X
RI	Radial Index and Sector		X
R (SHUNT 4F)*	Option Shunt for Ready Output		X
2S	Two-Sided Status Output	X	
850/851	Sector Option Enable	850	851
I (SHUNT 4F)*	Index Output		X
S (SHUNT 4F)*	Sector Output		X
DC	Disk Change Option	X	
HL (SHUNT 4F)*	Stepper Power From Head Load		X
DS	Stepper Power From Drive Select	X	
WP	Inhibit Write When Write Protected		X
NP	Allow Write When Write Protected	X	
D	Alternate Input-In Use	X	
M	Multi-Media Option		Plugged
DL	Door Lock Latch Option		X
A,B,X.(SHUNT 4F)*	Radial Head Load		X
C	Alternate Input-Head Load	X	
Z (SHUNT 4F)*	In Use From Drive Select		X
Y	In Use From Head Load	X	
S1	Side Select Option Using Direction Select	X	
S2	Standard Side Select Input		Plugged
S3	Side Select Option Using Drive Select	X	
TS, FS**	Data Separation Option Select	TS	FS Plugged
IW	Write Current Switch		Plugged***
RS	Ready Standard		Plugged
RM	Ready Modified	X	
HLL	Head Load Latch	X	
IT	In Use Terminator		Plugged
HI	Head Load or In Use to the In Use Circuit	X	
F****	Remove for MFM encoding install for M ² FM	X	
AF*****	Install for FM or MFM encoding		Plugged
NF*****	Install for M ² FM encoding.	X	

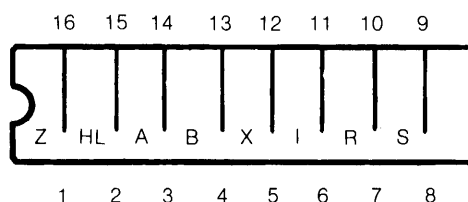
*A 16 pin programmable shunt Shugart P/N 15658 (location 4F) is provided for the eight most commonly used cut track options. These traces are usually shorted as shipped from the factory. The traces can be opened as follows:

1. Cut the trace using a Strap Cutter AMP P/N 435705.

**The SA851 offers a standard data separator, as in the SA801, and an optional data separator which properly separates data and clock bits through the soft-sectored IBM standard format and address mark area. Trace "FS" offers the standard separator and Trace "TS" offers the optional separator. Either separator may be selected through a shorting plug.

***Write current switch is plugged to the interface.

****MLC 10 ONLY.
*****MLC 11 ONLY.



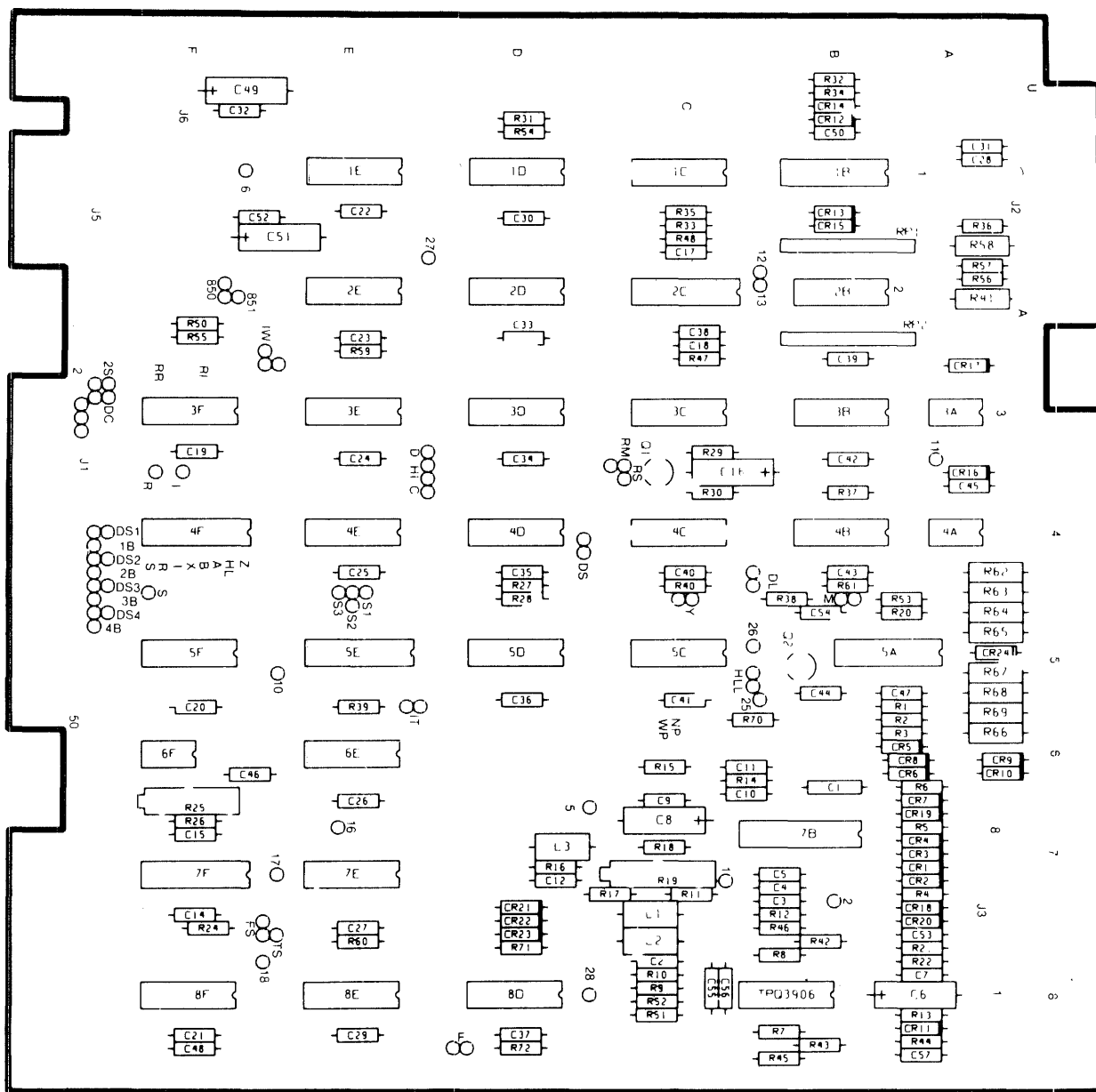


FIGURE 21. MLC 10 COMPONENT LOCATIONS (P/N 25188)

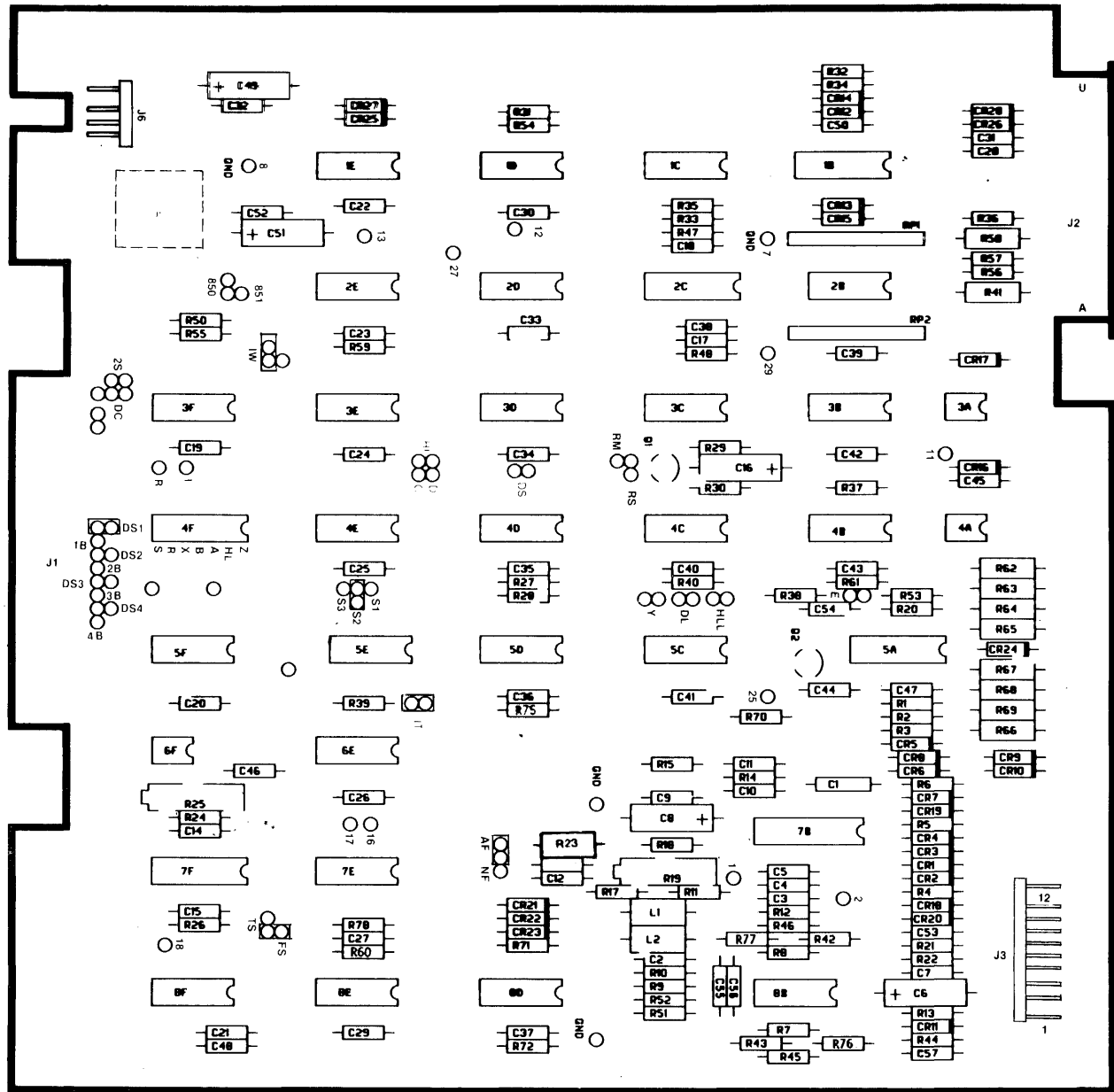


FIGURE 22. MLC 11 PCB COMPONENT LOCATIONS (P/N 25200)

7.1 SELECT DRIVE WITHOUT LOADING HEADS OR ENABLING STEPPER

This option would be advantageous to the user who requires a drive to be selected at all times. Normally, when a drive is selected, its heads are loaded and the stepper motor is energized. The advantage of this option would be that the output control signals could be monitored while the heads were unloaded thereby extending the head and media life. When the system requires the drive to perform a Read, Write, or Seek, the controller would activate the Head Load line (pin 18) which in turn would load the heads and energize the stepper motor. After the Head Load line is activated, a 50 ms delay must be introduced before Write Gate and Write Data may be applied or before Read Data is valid.

To install this option on a standard drive, the following traces should be deleted or added:

1. Cut trace 'X'.
2. Jumper trace 'C'.

7.2 SELECT DRIVE AND ENABLE STEPPER WITHOUT LOADING HEADS

This option is useful to the user who wishes to select a drive and perform a seek operation without the heads being loaded or with door open. An example use of this option is that at power on time, an automatic recalibrate (reverse seek to track zero) operation could be performed with the drive access door open. Normally for a seek to be performed, the door must be closed and the heads loaded. When a Read or Write operation is to be performed, the heads must be loaded. After the Head Load line is activated, a 50 ms delay must be introduced before Write Gate and Write Data may be applied or before Read Data is valid.

To install this option on a standard drive, the following traces should be deleted or added:

1. Cut trace 'B'.
2. Jumper trace 'DS'.
3. Cut trace 'HL'.
4. Jumper trace 'C'.

Figure 23 illustrates the circuitry.

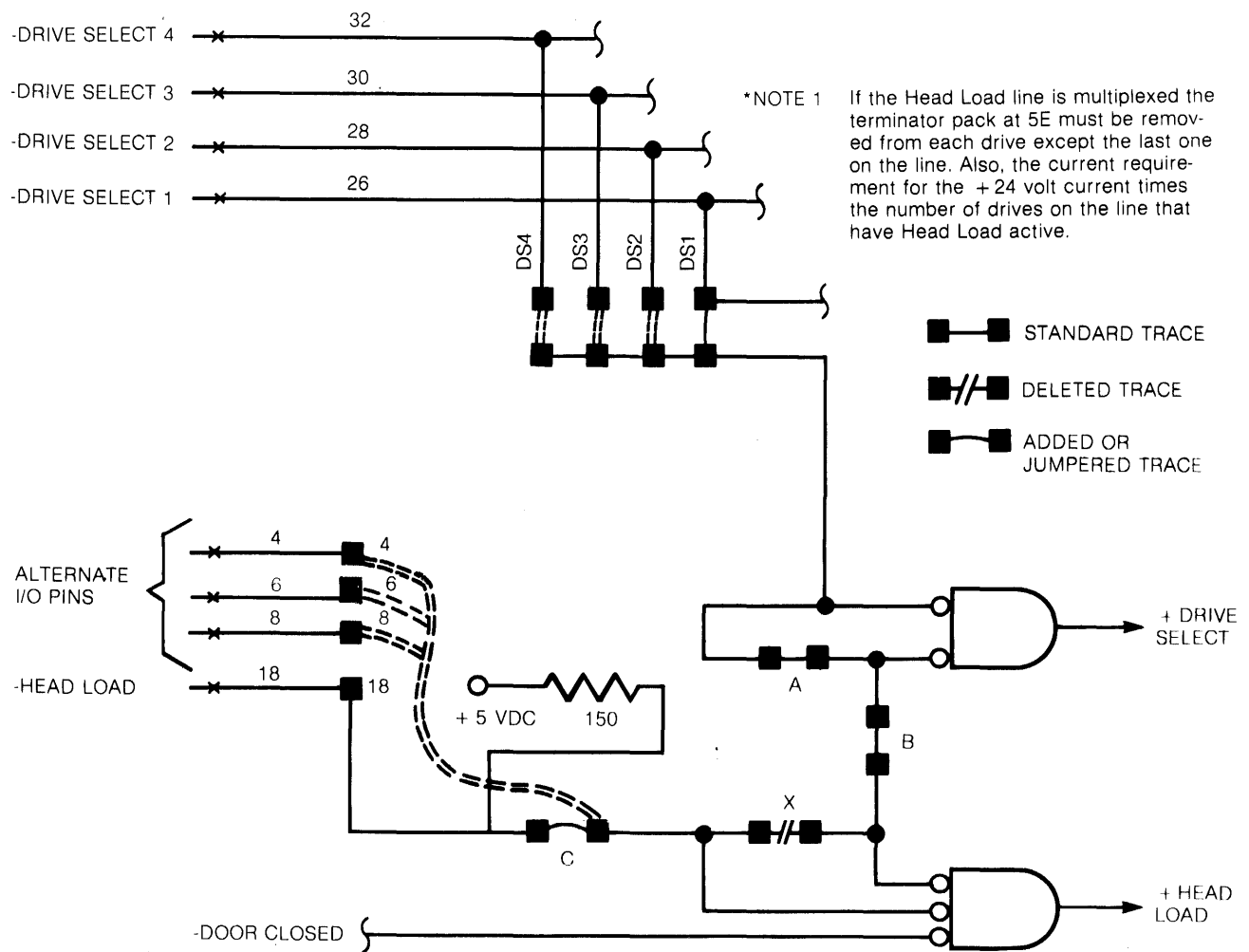


FIGURE 23. SELECT DRIVE WITHOUT LOADING HEAD CIRCUIT

7.3 LOADS HEADS WITHOUT SELECTING DRIVE OR ENABLING STEPPER

This option is useful in disk to disk copy operations. It allows the user to keep the heads loaded on all drives thereby eliminating the 50 ms head load time. The heads are kept loaded on each drive via an Alternate I/O pin. Each drive may have its own Head Load line (Radial or Simplex) or they may share the same line (Multiplexed). When the drive is selected, an 15 ms delay must be introduced before a Read or Write operation can be performed. This is to allow the read/write heads to settle after the stepper motor is energized. With this option installed, a drive can only be selected with both -Drive Select and -Head Load active.

To install this option on standard drive; the following traces should be deleted or added:

1. Cut trace 'A'.
2. Jumper trace 'DS'.
3. Cut trace 'HL'.
- *4. Jumper trace 'C'.

*If the -Head Load line is multiplexed, termination pack 5E jumper must be removed from each drive except the last one on the line.

Figures 24 and 25 illustrates the circuitry.

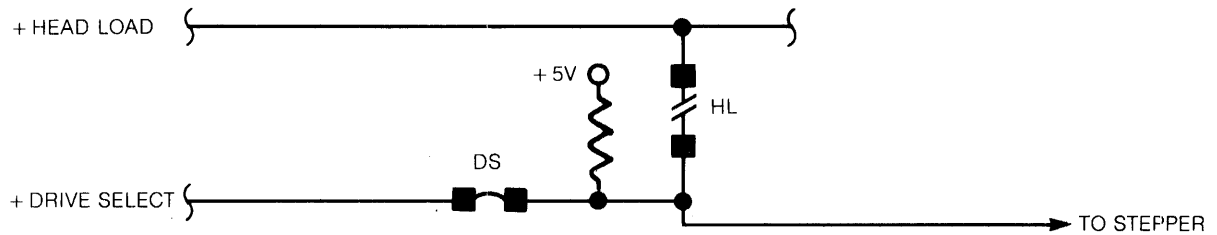
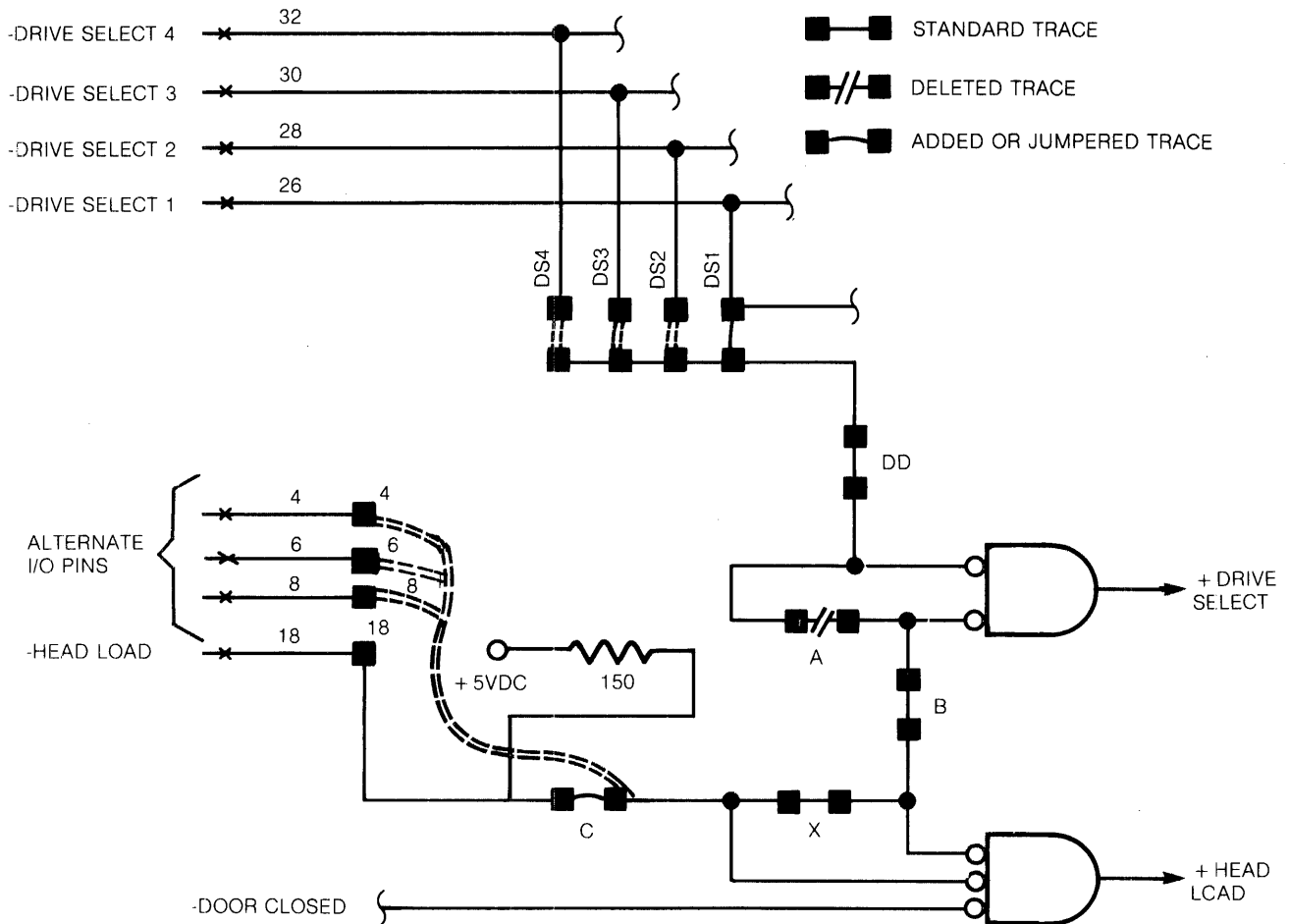


FIGURE 24. STEPPER MOTOR ENABLE CIRCUIT



*If the -Head Load line is multiplexed, termination pack 5E must be removed from each drive except the last one on the line.

FIGURE 25. LOAD HEAD WITHOUT SELECTING DRIVE OR ENABLING STEPPER CIRCUIT

7.4 RADIAL READY

This option enables the user to monitor the Ready line of each drive on the interface. This can be useful in detecting when an operator has removed or installed a Diskette in any drive. Normally, the Ready line from a drive is only available to the interface when it is selected.

To install this option on a standard drive, the following traces should be deleted or added:

1. Cut trace 'RR'.
- *2. Cut trace 'R'.
- *3. Add a wire from pad "R" to one of the Alternate I/O pins.

*One of the drives on the interface may use pin 22 as its Ready line, therefore steps 2 and 3 may be eliminated on this drive. All the other drives on the interface must have their own Ready line, therefore step 2 and 3 must be incorporated.

Figure 26 illustrates the circuitry.

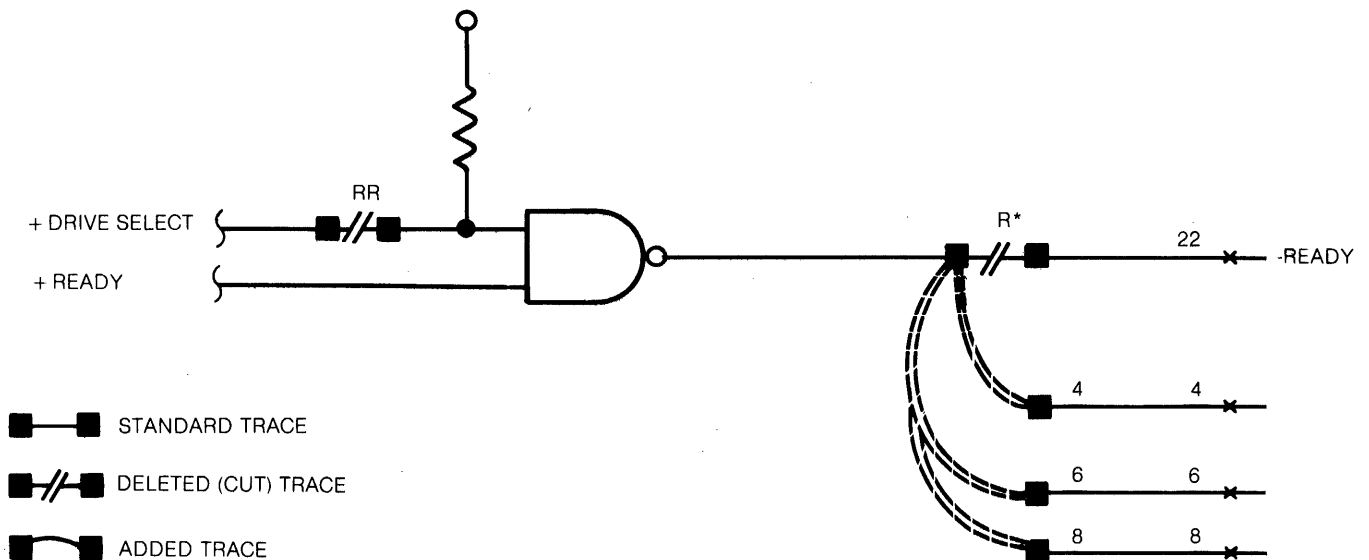


FIGURE 26. RADIAL READY CIRCUIT

7.5 RADIAL INDEX/SECTOR

This option enables the user to monitor the Index and Sector lines at all times so that the drive may be selected just prior to the sector that is to be processed. This option can be used to reduce average latency.

To install this option on a standard drive the following traces should be deleted or added:

1. Cut trace 'RI'.
- *2. Cut trace 'I'.
- *3. Cut trace 'S'.
- *4. Add a wire from trace 'I' to one of the Alternate I/O pins.
- *5. Add a wire from trace 'S' to one of the Alternate I/O pins.

*One of the drives on the interface may use pin 20 (-Index) and pin 24 (-Sector) as its Index and Sector lines, therefore steps 2 - 5 may be eliminated for this drive. All other drives on the interface must have their own Index and Sector lines, therefore, steps 2 - 5 must be incorporated.

Figure 27 illustrates the circuitry.

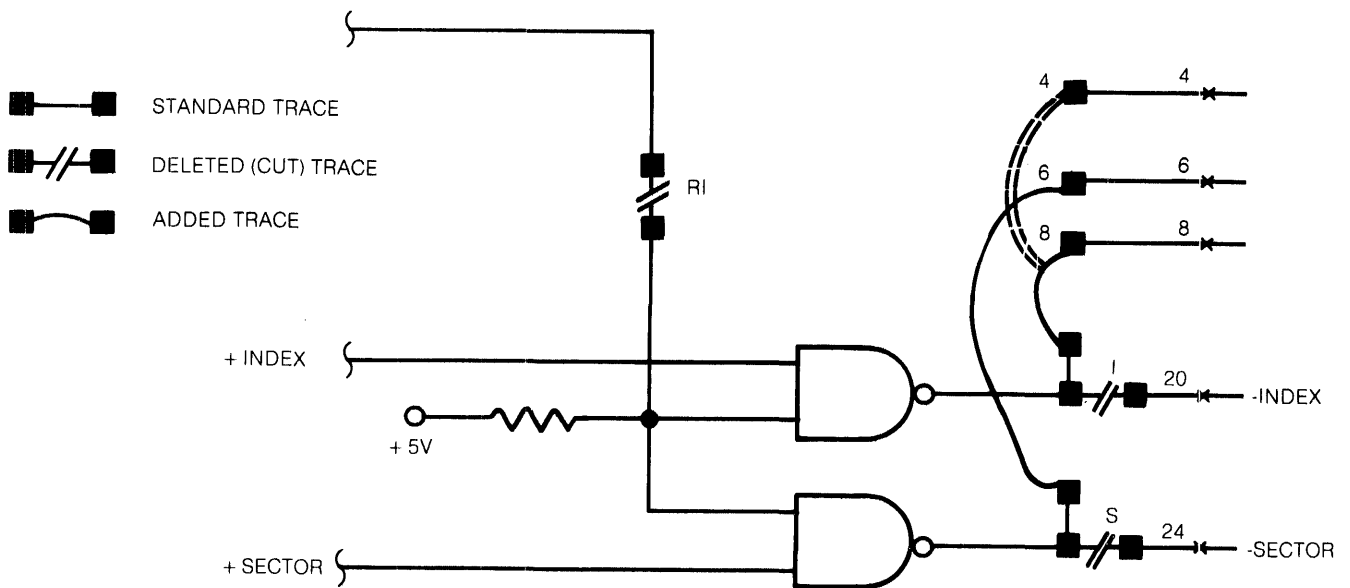


FIGURE 27. RADIAL INDEX/SECTOR CIRCUIT

7.6 IN USE ALTERNATE INPUT (ACTIVITY LED)

This alternate input, when activated to a logical zero level, will turn on the Activity LED mounted in the push bar on the front panel and locks the door of the drive.

To install this option on standard drive, jumper trace 'D' to trace 'HI' and activate the interface line pin 16.

This signal is an "OR" function with Drive Select or Head Load. Figure 28 illustrates the circuitry. For other uses, reference section 7.15.

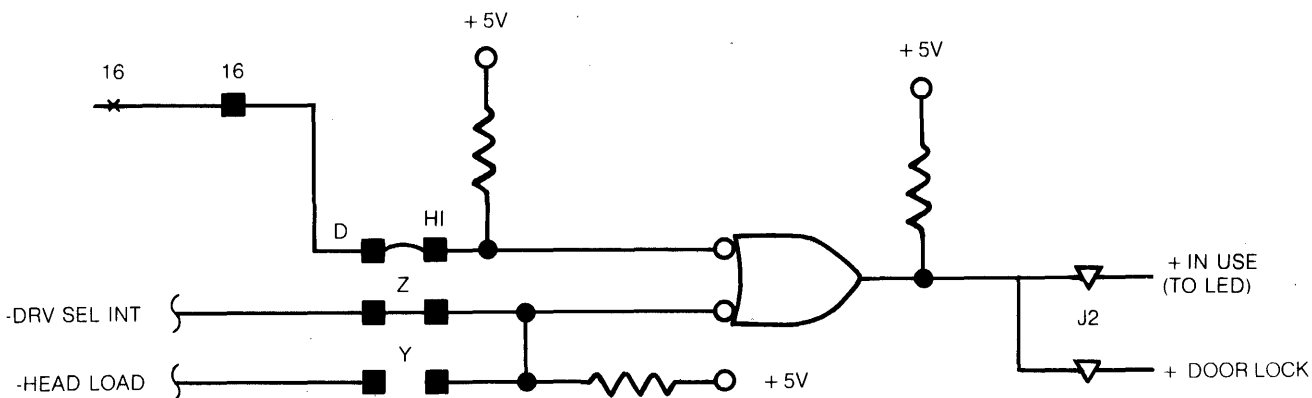


FIGURE 28. IN USE/ACTIVITY LED CIRCUIT

7.7 WRITE PROTECT OPTIONAL USE

As shipped from the factory, the optional Write Protect feature will internally inhibit writing when a Write Protected Diskette is installed. With this option installed, a Write Protected Diskette will not inhibit writing, but it will be reported to the interface. This option may be useful in identifying special use Diskettes.

To install this option on a drive with the Write Protect feature, the following traces should be added or deleted:

1. Cut trace 'WP'.
2. Connect trace 'NP'.

Figure 29 illustrates the circuitry.

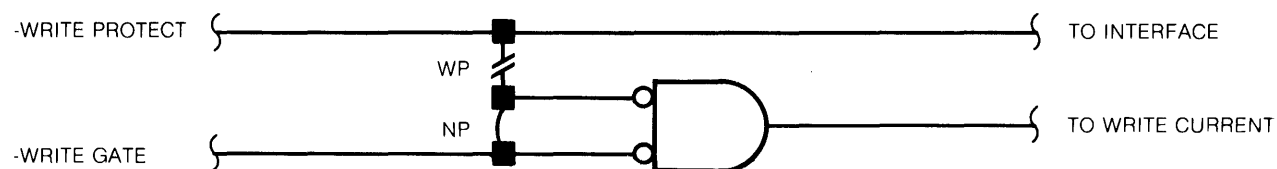


FIGURE 29. WRITE PROTECT CIRCUIT

This customer installable option is enabled by jumpering trace 'DC'. It will provide a true signal (logical zero) onto the interface (pin 12) when Drive Select is activated if while deselected the drive has gone from a Ready to a Not Ready (Door Open) condition. This line is reset on the true to false transition of Drive Select if the drive has gone Ready. Timing of this line is illustrated in Figure 30. The circuitry is illustrated in Figure 31.



7.9 SIDE SELECTION, USING DIRECTION 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 S2 to location S1.

Figure 32 illustrates the circuitry.

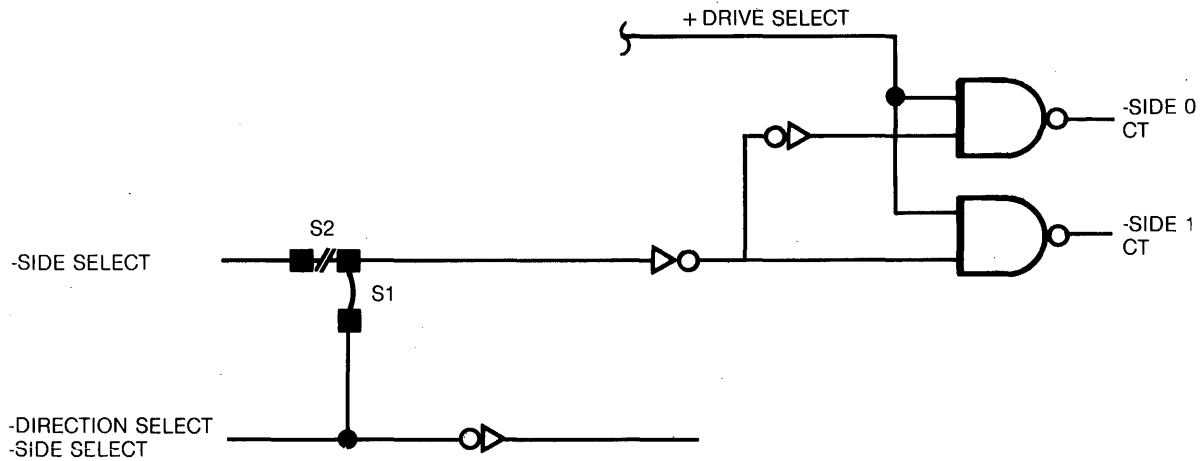


FIGURE 32. SIDE SELECTION, USING DIRECTION SELECT

7.10 SIDE SELECTION USING DRIVE SELECT

In systems containing no more than two SA850/851 drives per controller, each read/write head can be assigned a separate drive address. In such cases, the four Drive Select line can be used to select the four read/write heads. To implement this option, move jumper S2 to S3 and add a jumper to nB ($n = 1, 2, 3$ or 4). For example, the first drive may have jumpers installed at DS1 and 2B while the second drive has jumpers at DS3 and 4B. With this jumper configuration installed, the four Drive Select lines have the following side selection functions.

1. Drive Select 1 selects side 0 of first drive.
2. Drive Select 2 selects side 1 of first drive.
3. Drive Select 3 selects side 0 of second drive.
4. Drive Select 4 selects side 1 of second drive.

Figure 33 illustrates the circuitry.

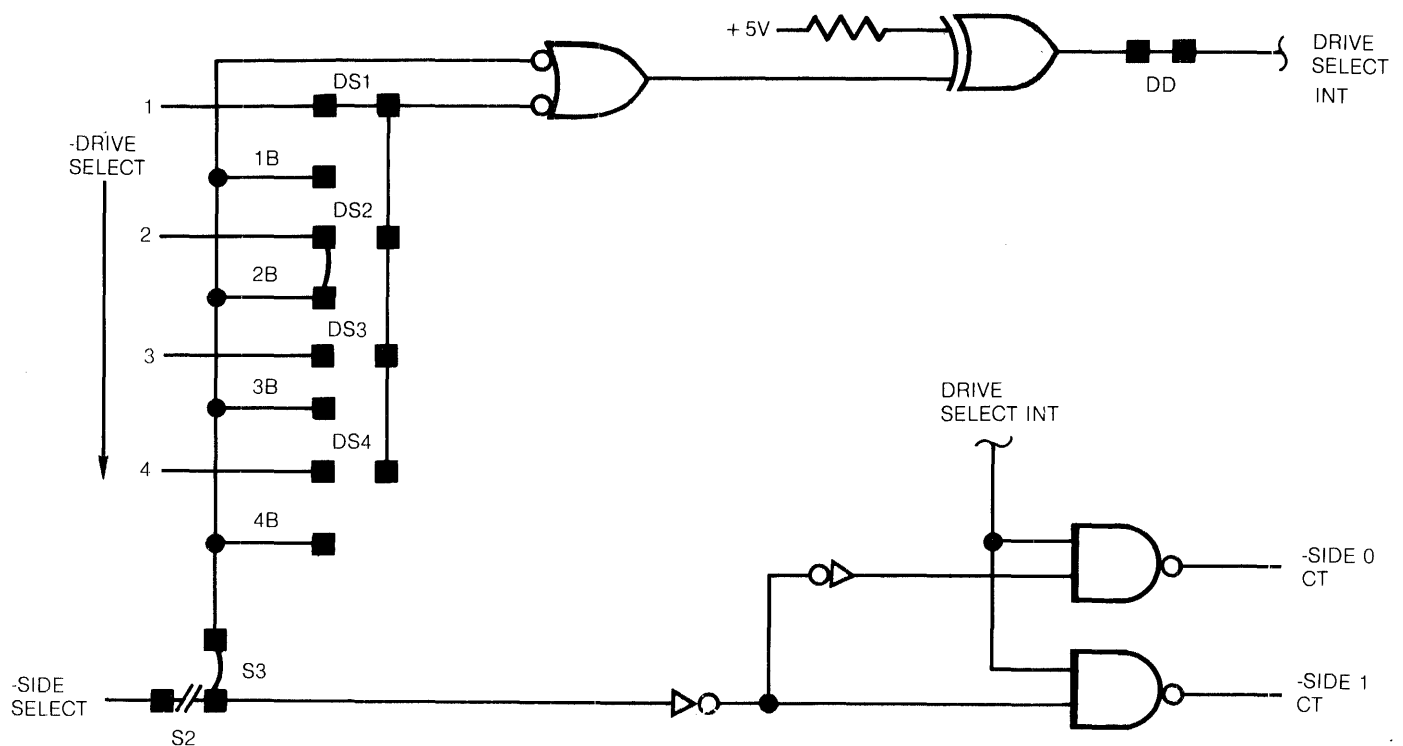


FIGURE 33. SIDE SELECTION, USING DRIVE SELECT

7.11 DOOR LOCK LATCH

The door lock circuit can be latched on under Drive Select control so that the door can remain locked without maintaining the active state of In Use. To implement this option, jumper DL, and then D to HI. Then, if the appropriate Drive Select line is activated while In Use is active, a latch will be set, which holds the door lock circuit active. To unlock the door, Drive Select is again activated while In Use is inactive.

Figure 34 illustrates the circuitry for this option.

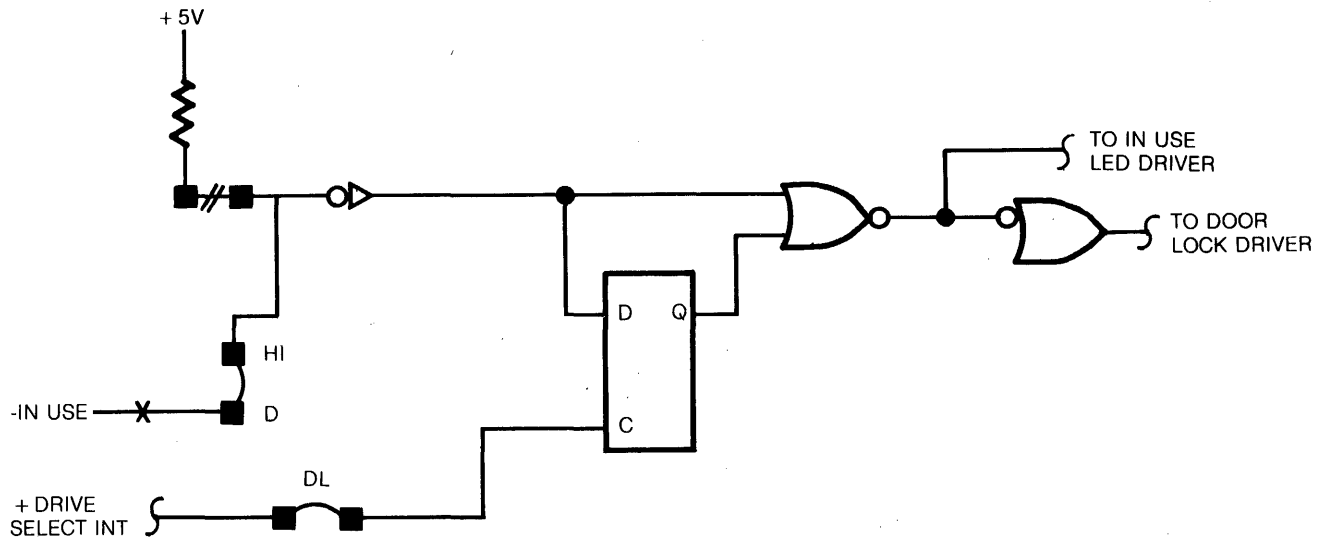


FIGURE 34. DOOR LOCK LATCH CONTROL

7.12 TWO-SIDED (OPTIONAL OUTPUT)

This signal indicates whether a Two-Sided (True Output) or a Single-Sided (False Output) Diskette is installed. To implement this option, install a jumper at 2S.

7.13 HEAD CURRENT SWITCH/ACTIVE READ COMPENSATION

This interface signal is used for two different functions depending on whether the drive is in a write or read mode.

7.13.1 HEAD CURRENT SWITCH

When the interface signal is activated to a logical zero level, the lower value of the write current is selected for writing on tracks 43 through 76.

To enable head current switching, short trace "IW" (to connect to the interface).

To disable head current switching and select only the lower value of the write current, move the shorting plug at trace "IW" to the ground position and short trace "M".

Trace "M" is used to increase the values of both the lower and higher write currents available when current switching.

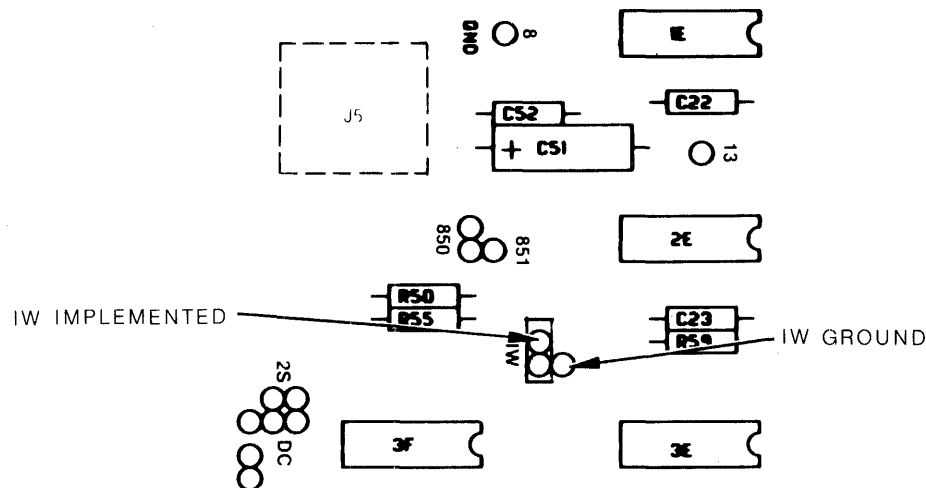


FIGURE 35. IW JUMPER OPTION

7.13.2 ACTIVE READ FILTER

When the interface signal is activated to a logical zero level, the read signal is passed through an active filter network for reading tracks 60 through 76. Performance will improve when reading a diskette that has been recorded without write precompensation.

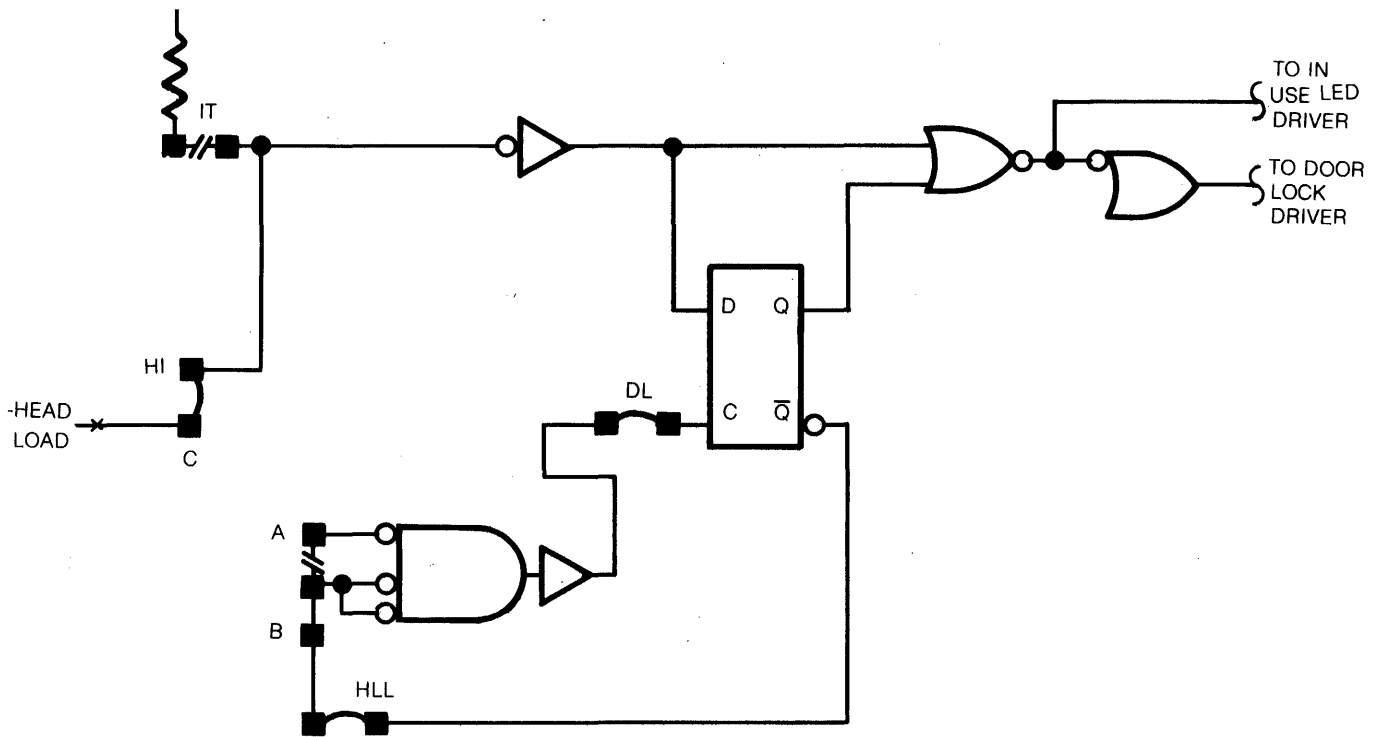
To control the active read filter from the interface, short trace "IW" (to connect to the interface), remove jumpers AF and NF. When the interface is activated to a logical zero level, read compensation is selected as if AF were added. When the interface is activated to a +5V level, read compensation is selected as if NF were added.

For optimum performance for FM or MFM encoding, jumper trace AF, for M²FM encoding jumper trace NF.

7.14 READY STANDARD/READY MODIFIED

As shipped the "RS" jumper is plugged and the drive's Ready Circuit will function as in the past. With the shorting plug in the "RM" position, the Ready Circuit is modified so that the drive will stay ready. This option is useful for those customers using the Direction Select line as Slide Select, so that when using single sided media the drive will stay ready when side 1 is selected.

This option enables the heads to remain loaded when the drive is deselected. To enable this option, jumper traces “DL” and “HLL”. The head load can then be latched by either of two interface lines - Head Load (pin 18) or In Use (pin 16). If Head Load is to be used jumper pin “C” to pin “H1” and remove the “IT” jumper (refer to figure 36). If In Use is to be used jumper pin “D” to pin “H1” (refer to figure 37). In both cases, trace “A” on shunt 4F must be cut. To load and latch the heads the user must activate either the Head Load or In Use lines and select the drive. When the drive is deselected, the heads will stay loaded and the door locked. To unload the heads, the Head Load or In Use line must be inactive when the drive is selected.



43

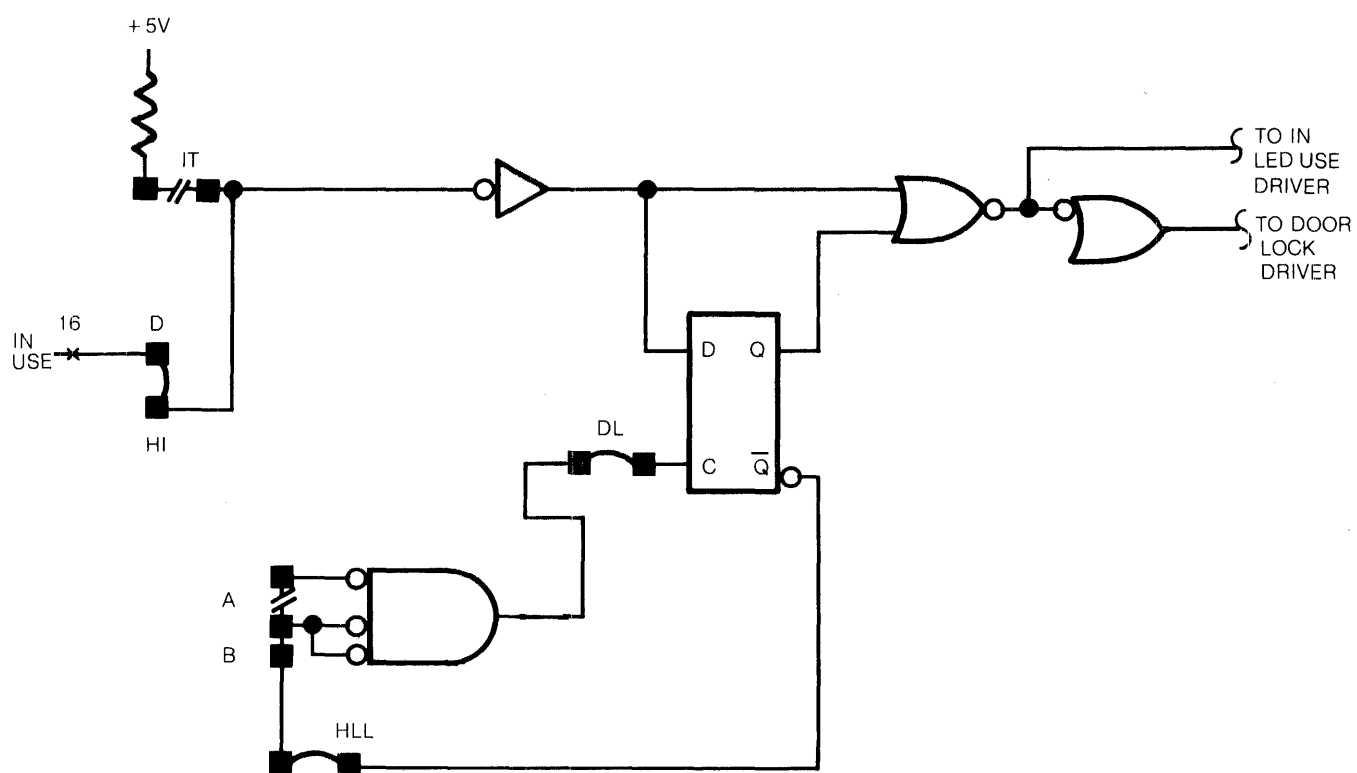


FIGURE 37. HEAD LOAD LATCH USING IN USE

8.0 OPERATION PROCEDURES

The SA850/851 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 and error recovery procedures on the diskette and diskette drive.

8.1 DISKETTE LOADING AND HANDLING

The diskette is a flexible disk enclosed in a plastic jacket. The interior of the jacket is lined with a wiping material to clean the disk of foreign material. Figure 38 shows the proper method of loading a diskette in the SA850/851 Diskette Storage Drive. To load the diskette, depress latch, insert the diskette with the label facing out. Move the latch handle to the left to lock diskette on drive spindle. The diskette can be loaded or unloaded with all power on and drive spindle rotating.

When removed from the drive, the diskette is stored in an envelope. 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. Keep diskettes away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can destroy recorded data on the disk.
3. Replace storage envelopes when they become worn, cracked or distorted. Envelopes are designed to protect the disk.
4. Do not write on the plastic jacket with a lead pencil or ball-point pen. Use a felt tip pen.
5. Heat and contamination from a carelessly dropped ash can damage the disk.
6. Do not expose diskette to heat or sunlight.
7. Do not touch or attempt to clean the disk surface. Abrasions may cause loss of stored data.

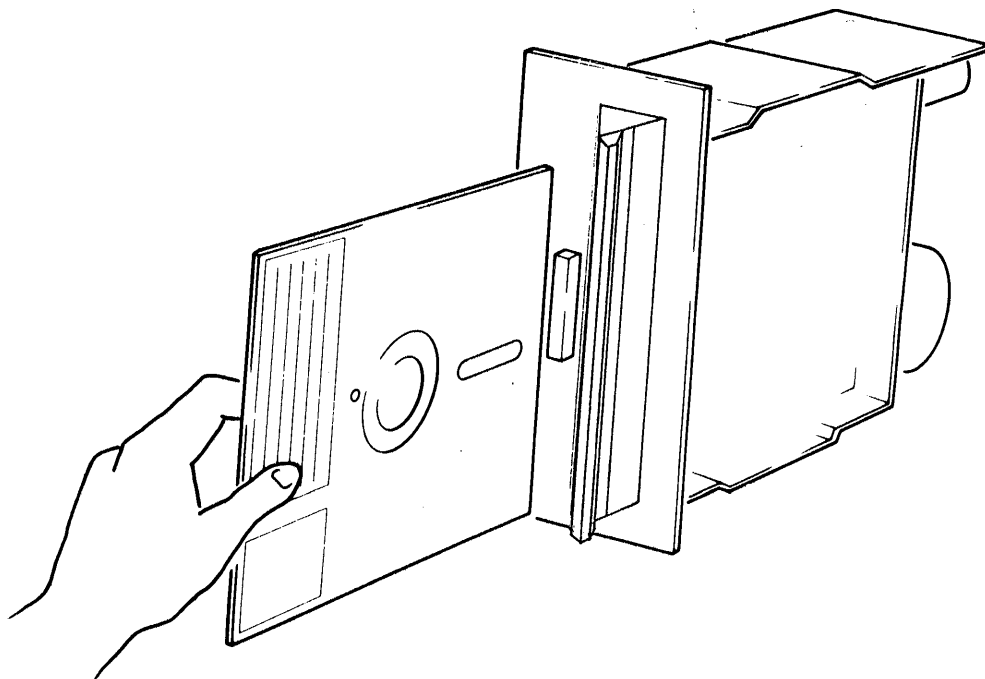


FIGURE 38. LOADING SA850/851

8.2 WRITE PROTECT — SA150/151 DISKETTES

The SA150/151 diskettes have the capability of being write protected. The write protect feature is selected by the slot in the SA150/151. When the slot is open it is protected; when covered, writing is allowed. The slot is closed by placing a tab over the front of the slot, and the tab folded over covering the rear of the slot. The Diskette can then be write protected by removing the tab. See Figure 39.

8.3 WRITE PROTECT, IBM DISKETTES

IBM Diskettes are not manufactured with a write protect slot punched out as are the Shugart Diskettes. To Write Protect one of these diskettes, a slot must be punched out as specified in Figure 40. The operation of the write protect is that which is outlined in paragraph 8.2

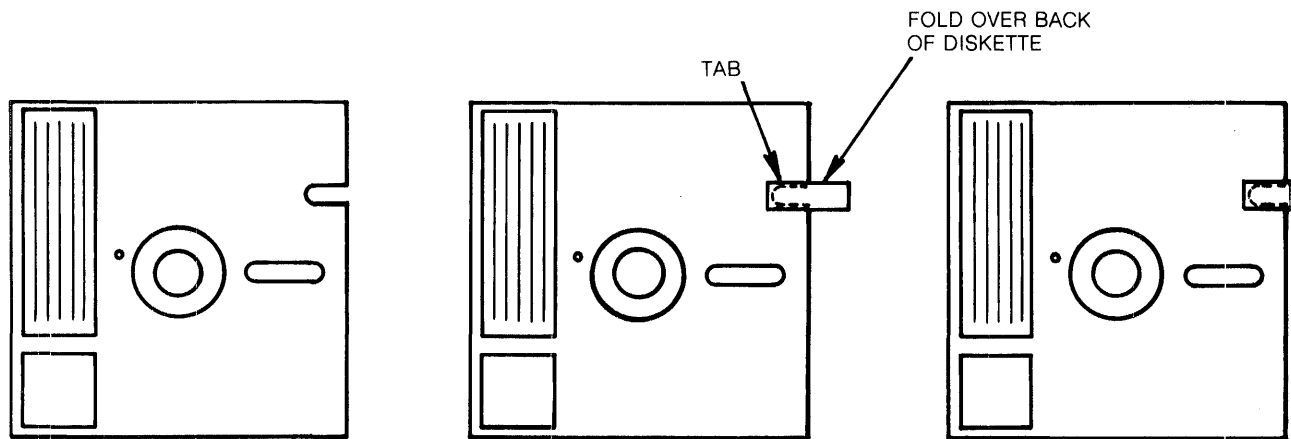


FIGURE 39. DISKETTE WRITE PROTECTED

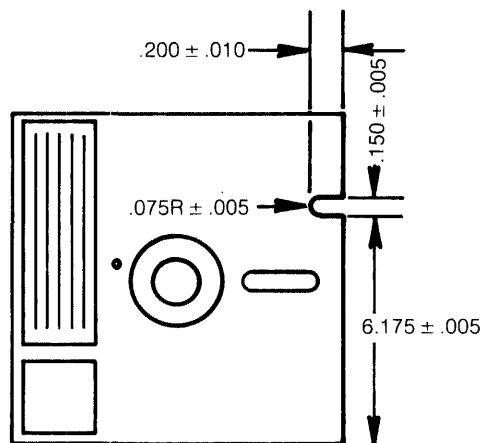


FIGURE 40. WRITE INHIBIT NOTCH SPECIFICATIONS

9.0 ERROR DETECTION AND CORRECTION

9.1 WRITE ERROR

If an error occurs during a write operation, it will be detected on the next revolution by doing a read operation, commonly called a "write check". To correct the error, another write and write check operation must be done. If the write operation is not successful after ten (10) attempts have been made, a read operation should be attempted on another track to determine if the media or the drive is failing. If the error still persists, the disk should be considered defective and discarded.

9.2 READ ERROR

Most errors that occur will be "soft" errors; that is, by performing an error recovery procedure the data will be recovered.

Soft errors are caused by:

1. Airborne contaminants that pass between the read/write head and the disk. These contaminants will generally be removed by the cartridge self-cleaning wiper.
2. Random electrical noise which usually lasts for a few microseconds.
3. Small defects in the written data and/or track not detected during the write operation which may cause a soft error during a read.

The following procedures are recommended to recover from the above mentioned soft errors:

1. Reread the track ten (10) times or until such time as the data is recovered.
2. If data is not recovered after using step 1, access the head to the adjacent track in the same direction previously moved, then return to the desired track.
3. Repeat step 1.
4. If data is not recovered, the error is not recoverable.

10.0 RESHIPMENT PRECAUTION

Be sure to insert the shipping disk that was shipped with the unit, close the door, and install the latch stop when reshipping the drive.

The packaging material must be clean and dry as determined by visual inspection. Figure 41 shows how to repackage the disk drive using the original shipping containers. Figure 42 shows the pallet pattern and the minimum/maximum pallet size to use if reshipped in large enough quantities.

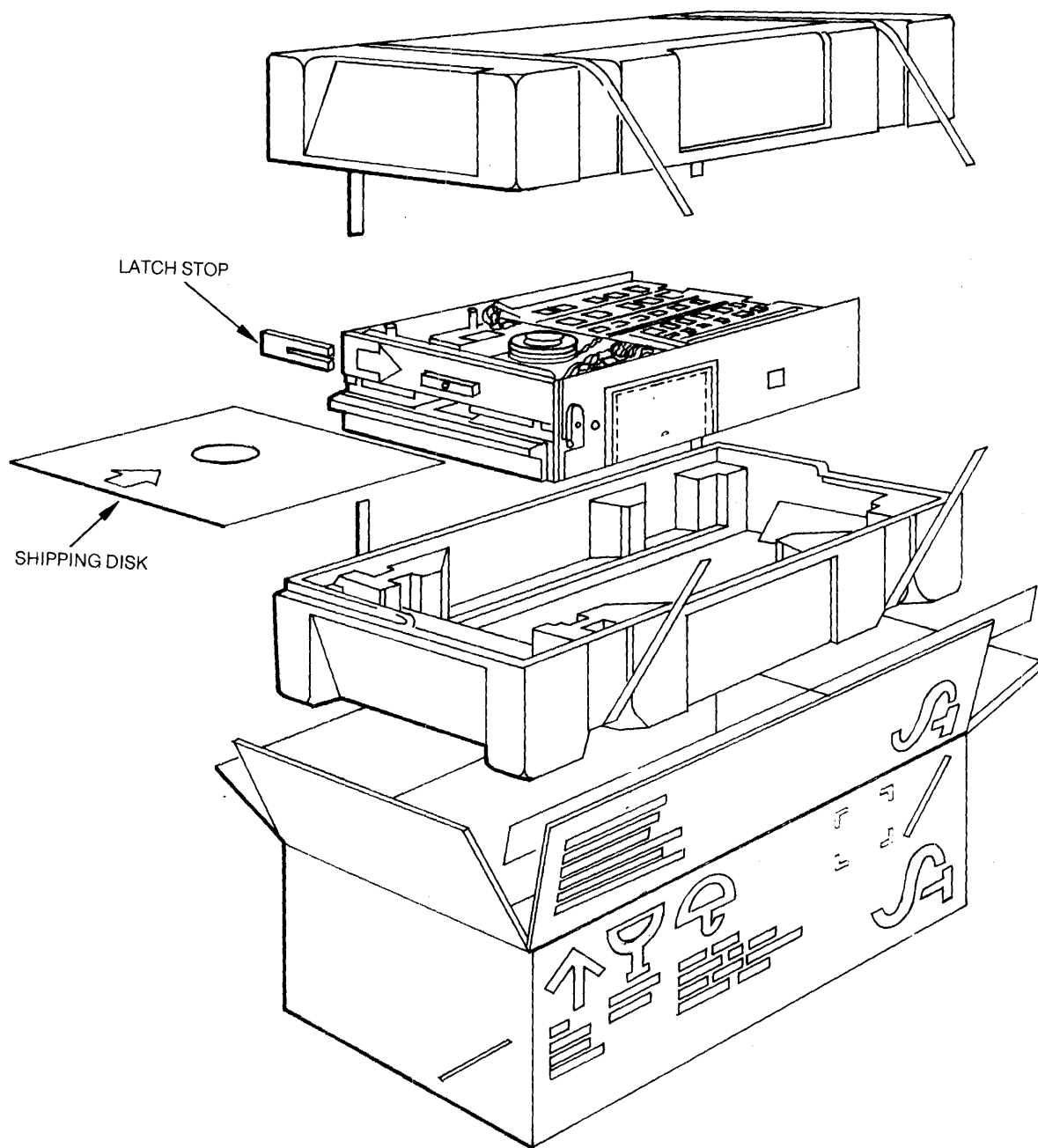
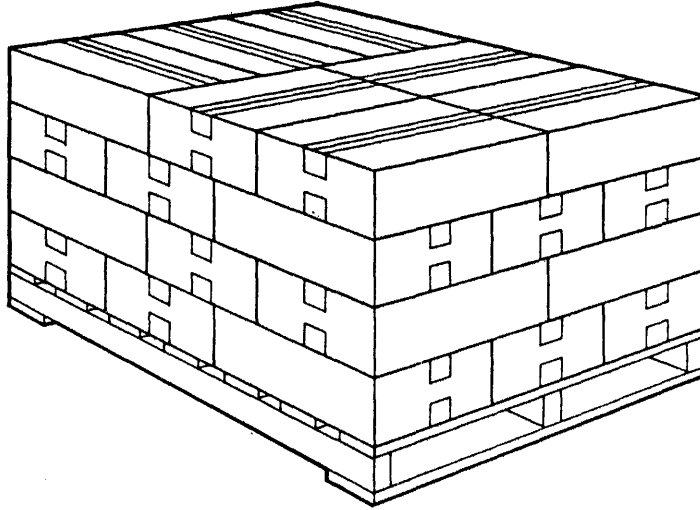
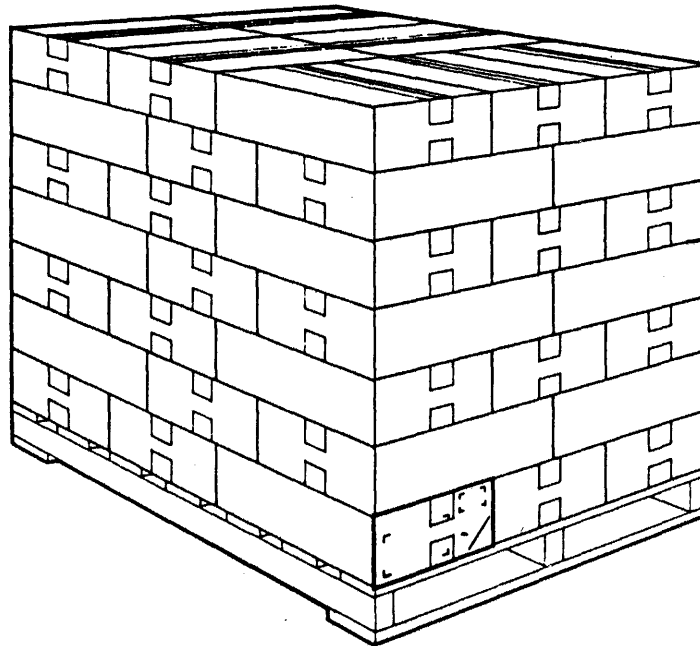


FIGURE 41. PACKAGE ASSEMBLY



MINIMUM LOAD



MAXIMUM LOAD

FIGURE 42. PALLET LOADING

APPENDIX A - ORDERING INFORMATION

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

A B C D E F

AB	MODEL
850 BC	75

C	VOLTAGE FREQUENCY	
	60	50
115	1	3
230	2	4

D	MODEL
850	1
851	2
850-4	3

E	FEATURE
STD.	1
RACK	2

F	OPTIONS
NONE	0

DECORATIVE FACE PLATES

Size	Color	Part Numbers
4-5/8 × 10-1/2	Tan	50264
4-5/8 × 10-1/2	White	50263
5-1/4 × 10	Tan	50261
5-1/4 × 10	White	50260
5-1/4 × 11	Tan	50258
5-1/4 × 11	White	50257
Rack Mount 4-5/8 × 8-11/16	Tan	50675

Primary Voltage and Frequency	Part Numbers		
	Motor ASM*	Motor Pulley	Belt
115 VAC, 60 Hz	50747	50358	50356
115 VAC, 50 Hz	50747	50357	50355
230 VAC, 60 Hz	50748	50358	50356
230 VAC, 50 Hz	50748	50357	50355

*Motor assemblies include - motor, capacitor, and connector



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