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Shugart 300/350
Flexible Disk
Storage Drive

Shugart

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Flexible Disk
Storage Drive

Preliminary OEM Manual

For
3.5-inch Microfloppy
Applications

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ABBREVIATIONS / MNEMONICS

bpi	Bits Per Inch
fci	Flux Changes Per Inch
FM	Frequency Modulation
ID	Identification
I/O	Input/Output
LED	Light Emitting Diode
MFM	Modified FM
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NRZI	Non Return to Zero
PCB	Printed Circuit Board
PM	Preventive Maintenance
TP	Test Point
tpi	Tracks Per Inch
V_{in}	Voltage In
V_{out}	Voltage Out
2F	Double Frequency

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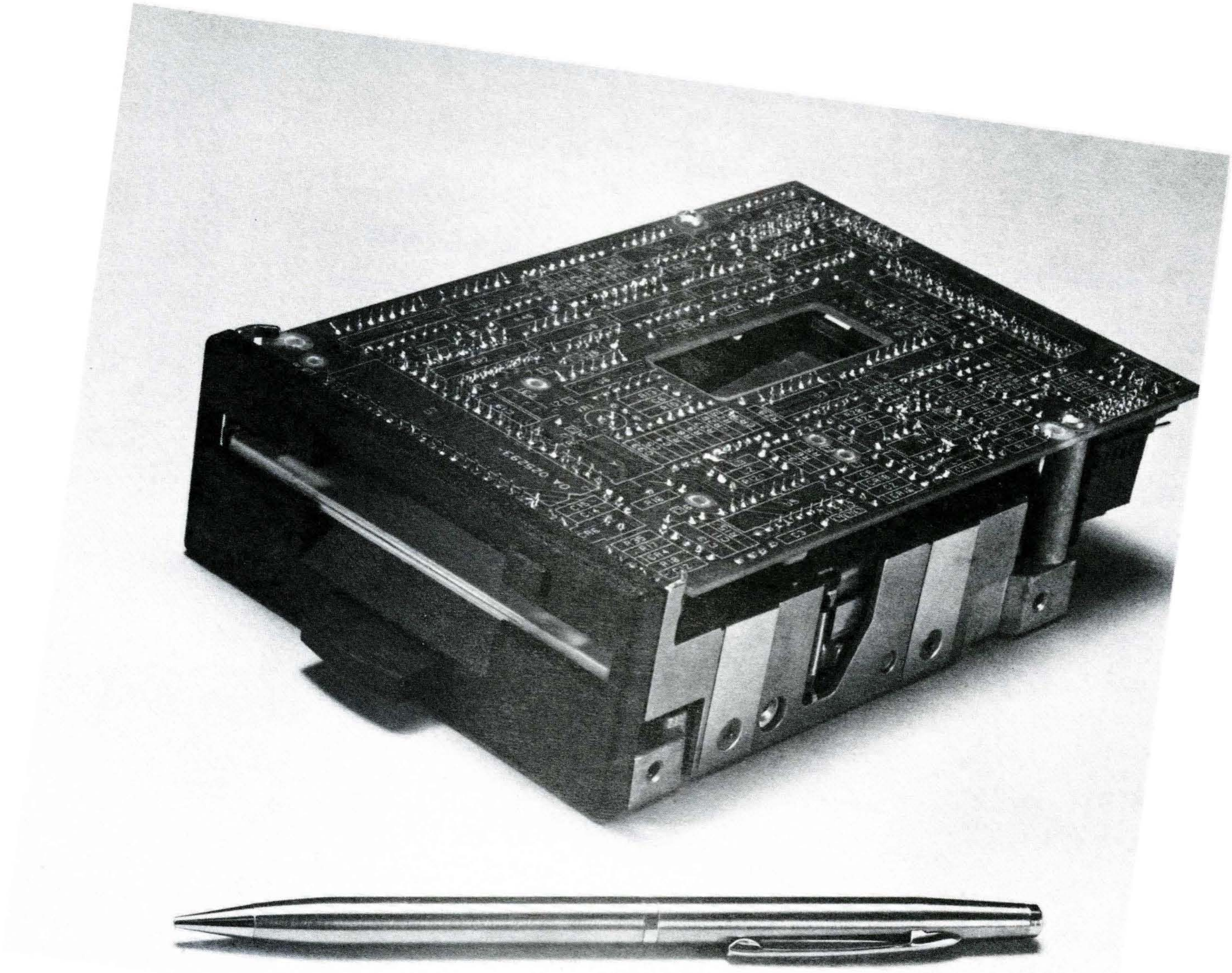


FIGURE 1-1. SHUGART 300/350 SINGLE AND DOUBLE-SIDED MICROFLOPPY DRIVE

39407-01

SECTION I
INTRODUCTION

1.1 PURPOSE

This document for the Shugart 300/350 is intended to satisfy the information needs of OEM engineers and system integrators. This manual provides all the information usually required to integrate the Shugart 300/350 disk drives into a computer system.

1.2 GENERAL DESCRIPTION

The Shugart 300/350. 3.5-inch microfloppy disk drives are designed for the new generations of desktop and portable computers. They offer the same performance as many Minifloppy™ disk drives but in a much smaller package.

Only one-fourth the volume of standard 5.25-inch drives. the 300/350 feature 500 k/Mbytes of unformatted storage capacity. a fast six msec track-to-track access time. microprocessor-controlled electronics. and internal write-protect circuitry. In addition. the 300/350 are interface compatible with Minifloppy disk drives. greatly simplifying system changes and protecting the substantial software investment of existing 5.25-inch floppy-based systems.

The 300/350 also use the proposed industry standard 3.5-inch media. engineered specifically for consumer oriented applications. At 3.5 inches. the new media also fits conveniently into a shirt pocket. Typical applications for the 300/350 include personal and portable computers. intelligent typewriters. terminals. word processors. and computerized office equipment.

Key Features

- 135 tracks per inch
- Microprocessor-controlled electronics
- Cartridge load/true ready
- One-touch cartridge load and eject
- Automatic cartridge shutter
- Compact size — one-fourth the volume of standard Minifloppy
- Fast six msec track-to-track access time
- Direct drive brushless dc motor
- Internal write-protect circuitry
- Removable faceplate
- Buffered Seek
- Self Test

1.3 SPECIFICATIONS SUMMARY

1.3.1 Performance Specifications

	Single Density (FM) Single-Sided	Single Density (FM) Double-Sided	Double Density (MFM) Single-Sided	Double Density (MFM) Double-Sided
Capacity				
Unformatted				
Per Disk	250 k bytes	500 k bytes	500 k bytes	1000 k bytes
Per Surface	250 k bytes	250 k bytes	500 k bytes	500 k bytes
Per Track	3.125 k bytes	3.125 k bytes	6.25 k bytes	6.25 k bytes
Formatted (10 Sectors/Track)				
Per Disk	204.8 k bytes	204.8 k bytes	409.6 k bytes	819.2 k bytes
Per Surface	204.8 k bytes	204.8 k bytes	409.6 k bytes	409.6 k bytes
Per Track	2.56 k bytes	2.56 k bytes	5.12 k bytes	5.12 k bytes
Transfer Rate	125 k bits/sec	125 k bits/sec	250 k bits/sec	250 k bits/sec
Latency (average)	100 msec	100 msec	100 msec	100 msec
Access Time				
Track-to-Track (without settling)	6 msec	6 msec	6 msec	6 msec
Average (excludes settling)	158 msec	158 msec	158 msec	158 msec
Settling Time	15 msec	15 msec	15 msec	15 msec
Motor Start Time	500 msec	500 msec	500 msec	500 msec

1.3.2 Functional Specifications

	Single-Sided	Double-Sided	Single-Sided	Double-Sided
Rotational Speed	300 rpm	300 rpm	300 rpm	300 rpm
Recording Density (inside track)	4093 bpi	4359 bpi	8187 bpi	8717 bpi
Flux Density	8187 fci	8717 fci	8187 fci	8717 fci
Track Density	135 tpi	135 tpi	135 tpi	135 tpi
Tracks	80	160	80	160
Index	1	1	1	1
Encoding Method	FM	FM	MFM	MFM
Media Requirements				
Microfloppy Cartridge Soft-sectored	Shugart 130 Microfloppy Cartridge (for single-sided)		Shugart 135 Microfloppy Cartridge (for double-sided)	

1.3.3 Physical Specifications

Environmental Limits	Operating	Shipping	Storage
Ambient Temperature	50° to 122°F (10.0° to 50°C)	-40° to 144°F (-40° to 62.2°C)	-8° to 117°F -22.2° to 47.2°C)
Relative Humidity	20 to 80%	1 to 95%	1 to 95%
Maximum Wet Bulb	85°F (29.4°C)	no condensation	no condensation

DC Voltage Requirements
+12 V ± 5% @ 0.2 A operating, 1.3 A max
+5 V ± 5% @ 0.5 A operating, 0.7 A max

Mechanical Dimensions
Width = 4.0 in. (101.6 mm)
Height = 1.625 in. (41.275 mm)
Depth = 6.0 in. max (152.4 mm)
Weight = 1.3 lbs (0.59 kg)

Power Dissipation =
5.9 watts (20.0 BTU/hr) Operating
3.0 watts (10.1 BTU/hr) Standby

Shock
Operating 3 g's with duration of 10—20 milliseconds
Non-Operating 30's with duration of 10—20 milliseconds

	Frequency Hz	Peak-to-Peak Displacement in Inches	Acceleration in g's
Operating	5—68	.012	—
	60—500	—	2.0
Non-Operating	5—30	.080	—
	30—500	—	4.0

Altitude
500 feet (152.4 meters) below sea level to 14,000 feet (4267.2 meters) above sea level.

1.3.4 Reliability Specifications

MTBF: 10,000 power on hours 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:
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: 3.0×10^6
Insertions: 30,000+

1.4 FUNCTIONAL CHARACTERISTICS

The 300/350 drives consist of:

a. Read/Write and Control Electronics

b. Drive Mechanism

c. Precision Track Positioning Mechanism

d. Read/Write Head(s)

The interface signals and their relationship to the internal functions are shown in figure 1-2.

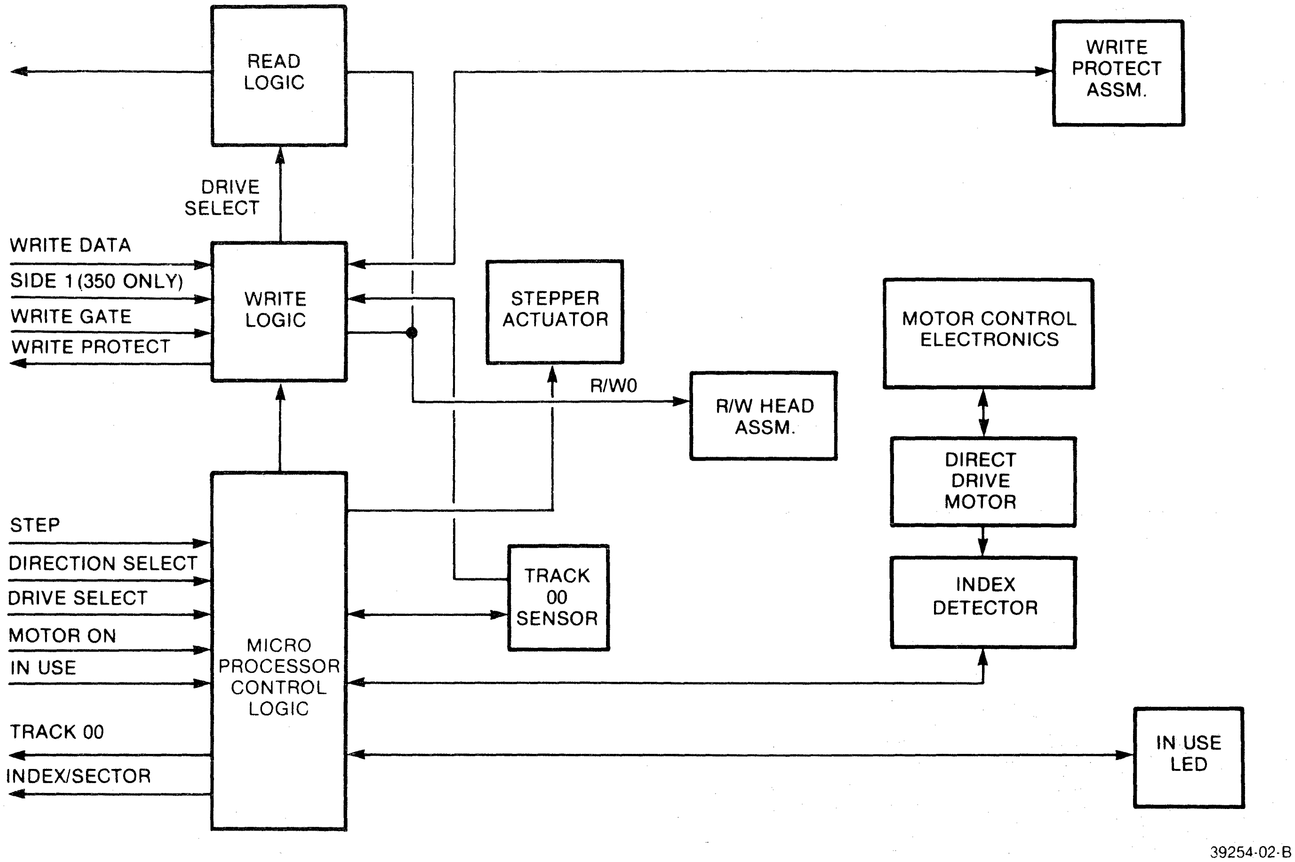


FIGURE 1-2. 300/350 FUNCTIONAL DIAGRAM

1.4.1 Read/Write and Control Electronics

The electronics are packaged on one PCB which contains:

a. Index Detector Circuits

b. Head Position Actuator Driver

c. Read/Write Amplifier and Transition Detector

d. Write Protect Circuit

e. Drive Select Circuits

f. Spindle Motor Start/Stop

g. Microprocessor Control Logic

h. Side Select Circuitry (350 only)

The Head Positioning Actuator moves the read/write head(s) to the desired track on the diskette. The media cartridge is loaded onto the read/write head(s) by an elevator mechanism when the cartridge is inserted.

1.4.2 Drive Mechanism

The dc drive motor under servo speed control (using an intergral tachometer) rotates the spindle at 300 rpm through a direct-drive system. A magnetic chucking device in conjunction with a metallic hub on the media provides precision media positioning to ensure data interchange. A mechanical interlock ensures proper media insertion, thus eliminating media damage. The motor control electronics are contained as part of the spindle motor assembly.

1.4.3 Precision Track Positioning Mechanism

The read/write head(s) assembly is accurately positioned through the use of a precision lead screw with rack 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.

1.4.4 Read/Write Head(s)

The glass bonded ceramic and ferrite read/write head(s) contain 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 diskette interchangeability is ensured.

The read/write head(s) are mounted on a carriage which is located on a precision carriage way. The diskette is held in a plane perpendicular to the read/write head(s) by pins located on the base casting. This precise registration assures perfect compliance with the read/write head(s). The read/write head(s) are 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.

1.4.5 Recording Formats

The format of the data recorded on the diskette is totally a function of the host system. This format can be designed around the user's 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 VI.

1.5 FUNCTIONAL OPERATIONS

1.5.1 Power Sequencing

Applying dc power to the 300/350 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 500-msec delay should be introduced before any operation is performed. After powering on, initial position of the read/write head(s) is at track 00. Because of this, a recalibrate operation should not be required.

1.5.2 Drive Selection

Drive selection occurs when the 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.

1.5.3 Side Select (350 Only)

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 μsec delay is required before any read or write operation can be initiated.

1.5.4 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 MOTOR ON line. A 500 msec 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-seconds (ten revolutions of diskette) after completing the execution of a command. This ensures maximum motor and media life. An option is available to activate MOTOR ON with DRIVE SELECT. Refer to paragraph 2.2.3.

NOTE

All motors in a daisy chain configuration are activated by MOTOR ON (refer to paragraphs 2.2.3 and 2.2.4).

1.5.5 Track Accessing

Seeking the read/write head(s) from one track to another is accomplished by:

a. Activating the DRIVE SELECT line.

b. Selecting the desired direction using the 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 head(s) 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. See figure 1-3.

1.5.6 Step Out

The STEP line causes the read/write heads to move in the direction defined by the DIRECTION SELECT line. Any change in the DIRECTION SELECT line must occur at least one μsec before the leading edge of the step pulse.

With the DIRECTION SELECT line at a plus logic level (2.5 to 5.25 V), a pulse on the STEP line will cause the read/write head(s) 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 1-3.

With the DIRECTION SELECT line at a minus logic level (0 to 0.4 V), a pulse on the STEP line will cause the read/write head(s) 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 1-3.

Stepping can be performed in either a normal or buffered mode.

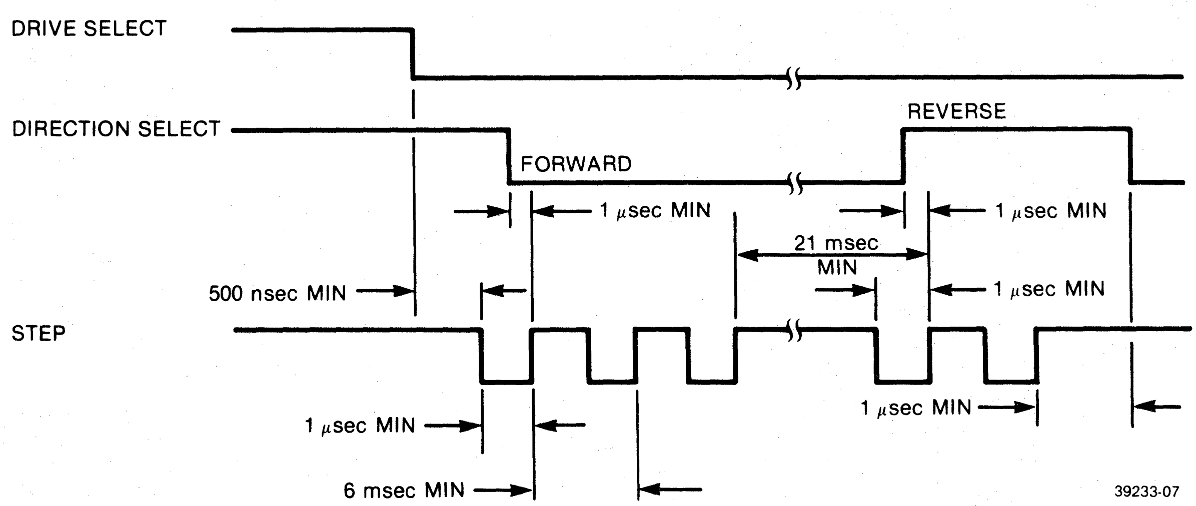


FIGURE 1-3. TRACK ACCESS TIMING

1.5.7 Normal Step Mode

In normal step mode, the read/write head(s) will move at the rate of the incoming step pulses. Motion is initiated at each true to false transition. The minimum time between successive steps is six msec, with a minimum pulse width of one μsec. See figure 1-4.

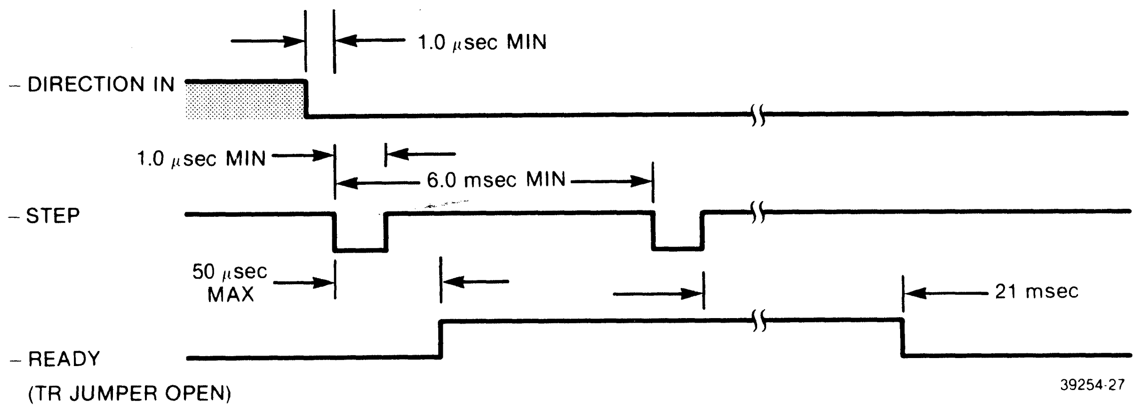


FIGURE 1-4. NORMAL STEP MODE

1.5.8 Buffered Step Mode

In buffered step mode, the step pulses are received at a high rate and buffered into a counter. After the first step pulse, the read/write head(s) begin stepping the desired number of cylinders. READY goes true after the read/write head(s) settle on the cylinder if the TR jumper is open. The buffered mode of operation is automatically selected when the time between step pulses is less than six msec. See figure 1-5 for timing requirements.

DRIVE SELECT may be dropped and a different drive selected one μsec after the last step pulse has been sent to the drive.

The maximum time between steps in buffered mode is 5.9 msec with a minimum pulse width of 1.0 μsec (see figure 1-5). Step pulses with periods less than 50 μsec are not permitted. Seek accuracy is not guaranteed if this timing requirement is violated.

READY may not go false until 50 μsec after the true to false transition of STEP. The TR jumper must be open for READY to go false in response to step pulses.

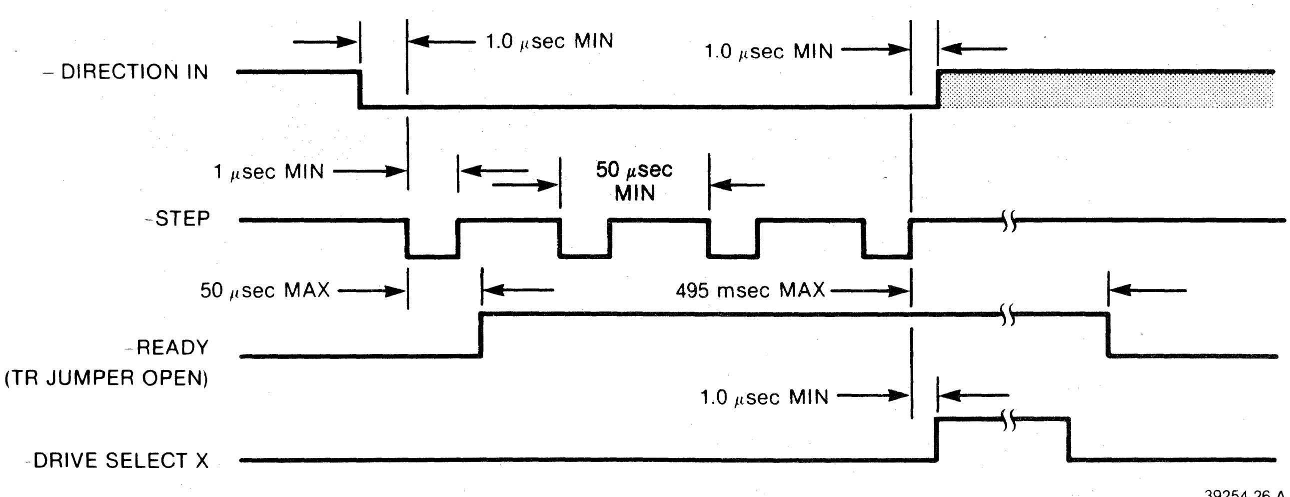


FIGURE 1-5. BUFFERED STEP MODE

1.5.9 Read Operation

Reading data from the 300/350 is accomplished by:

a. Activating DRIVE SELECT line.

b. WRITE GATE being inactive.

The timing relationships required to initiate a read sequence are shown in figure 1-6. These timing specifications are required in order to guarantee that the read/write head(s) position has stabilized prior to reading.

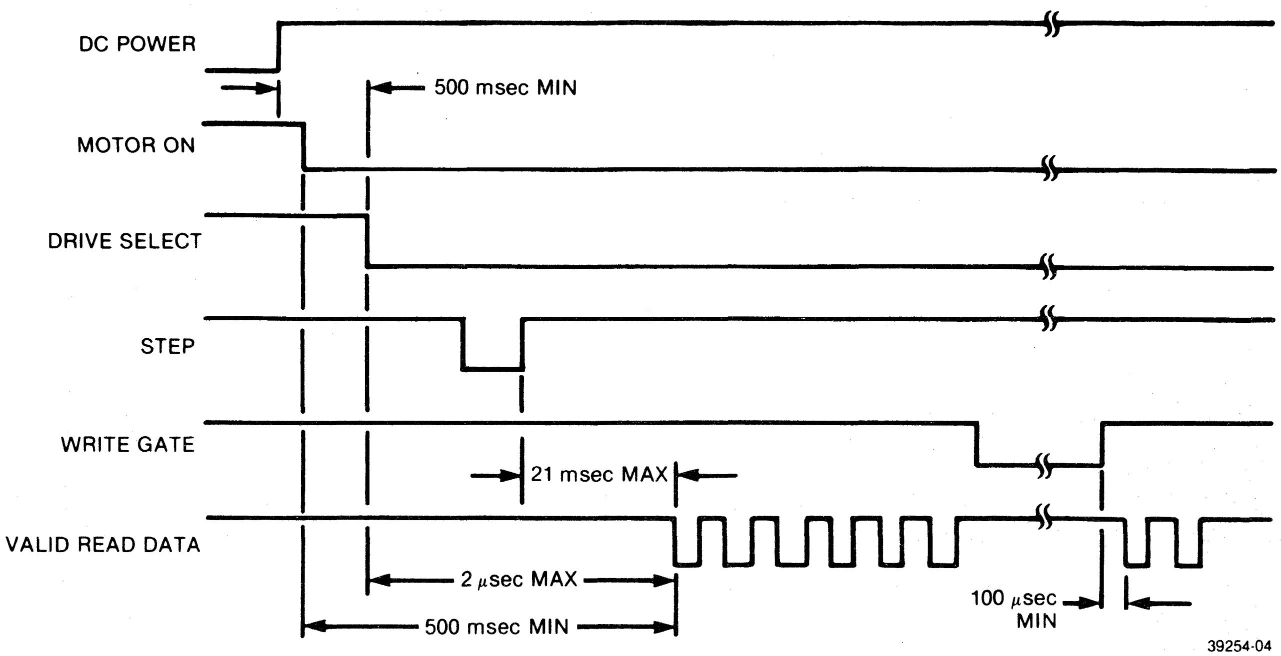


FIGURE 1-6. READ INITIATE TIMING

The timing of read data (FM) is shown in figure 1-7.

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 (see figure 1-7). MFM encoding rules allow clock bits to be omitted from some bit cells if the preceding bit cell or the current bit cell contains a data or clock bit. See figure 1-8.

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

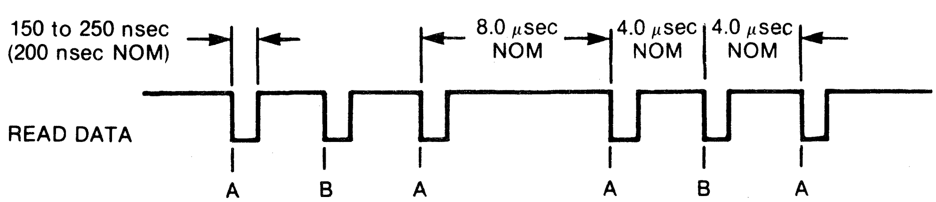


FIGURE 1-7. READ DATA TIMING (FM)

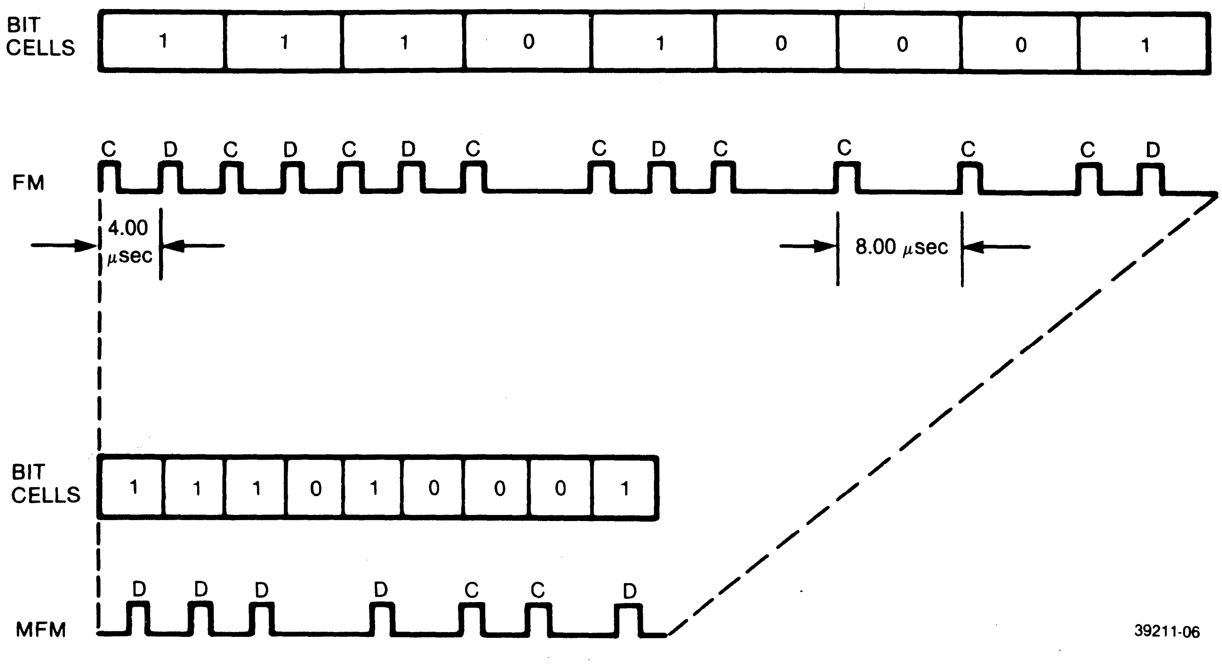


FIGURE 1-8. FM AND MFM CODE COMPARISONS

1.5.10 Write Operation

Writing data to the 300/350 is accomplished by:

a. Activating the DRIVE SELECT line.

b. Activating Side 1 Select Line (350 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 1-9. These timing specifications are required in order to guarantee that the position of the read/write head(s) has stabilized prior to writing. The timing specifications for the write data pulses are shown in figure 1-10.

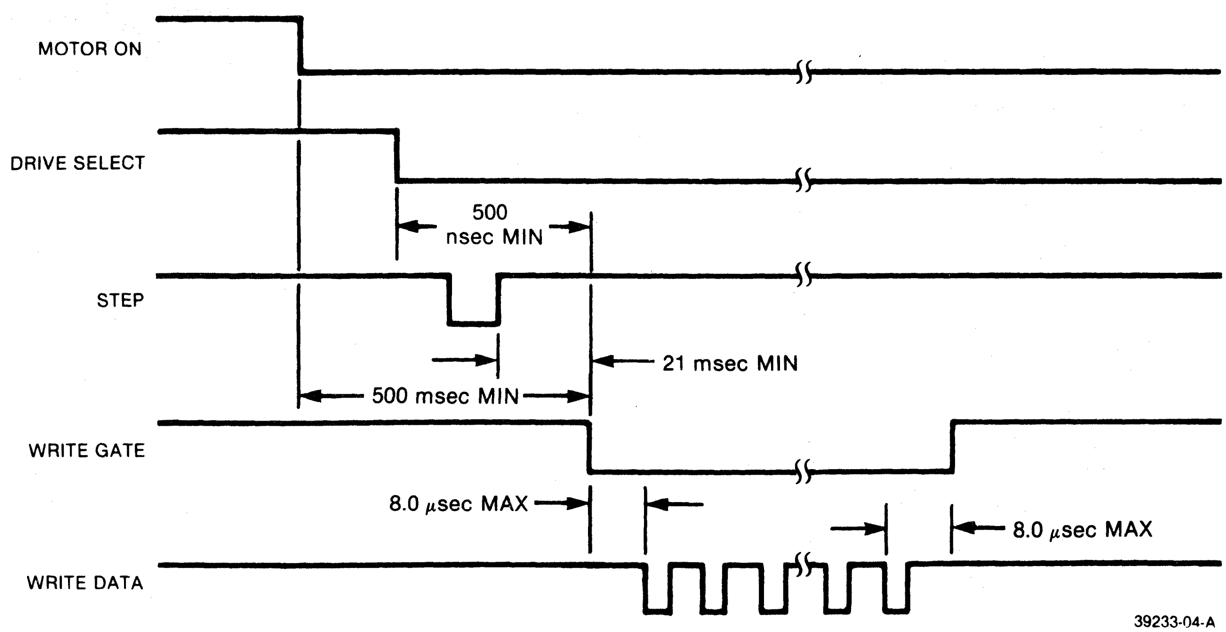


FIGURE 1-9. WRITE INITIATE TIMING

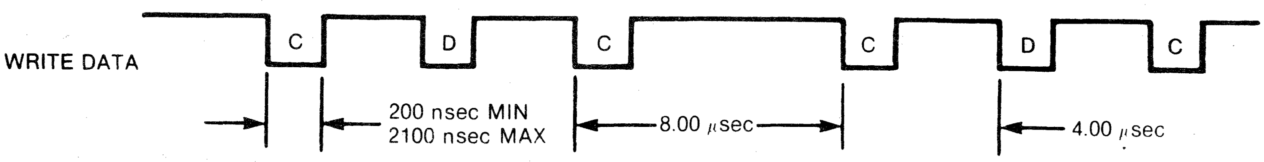
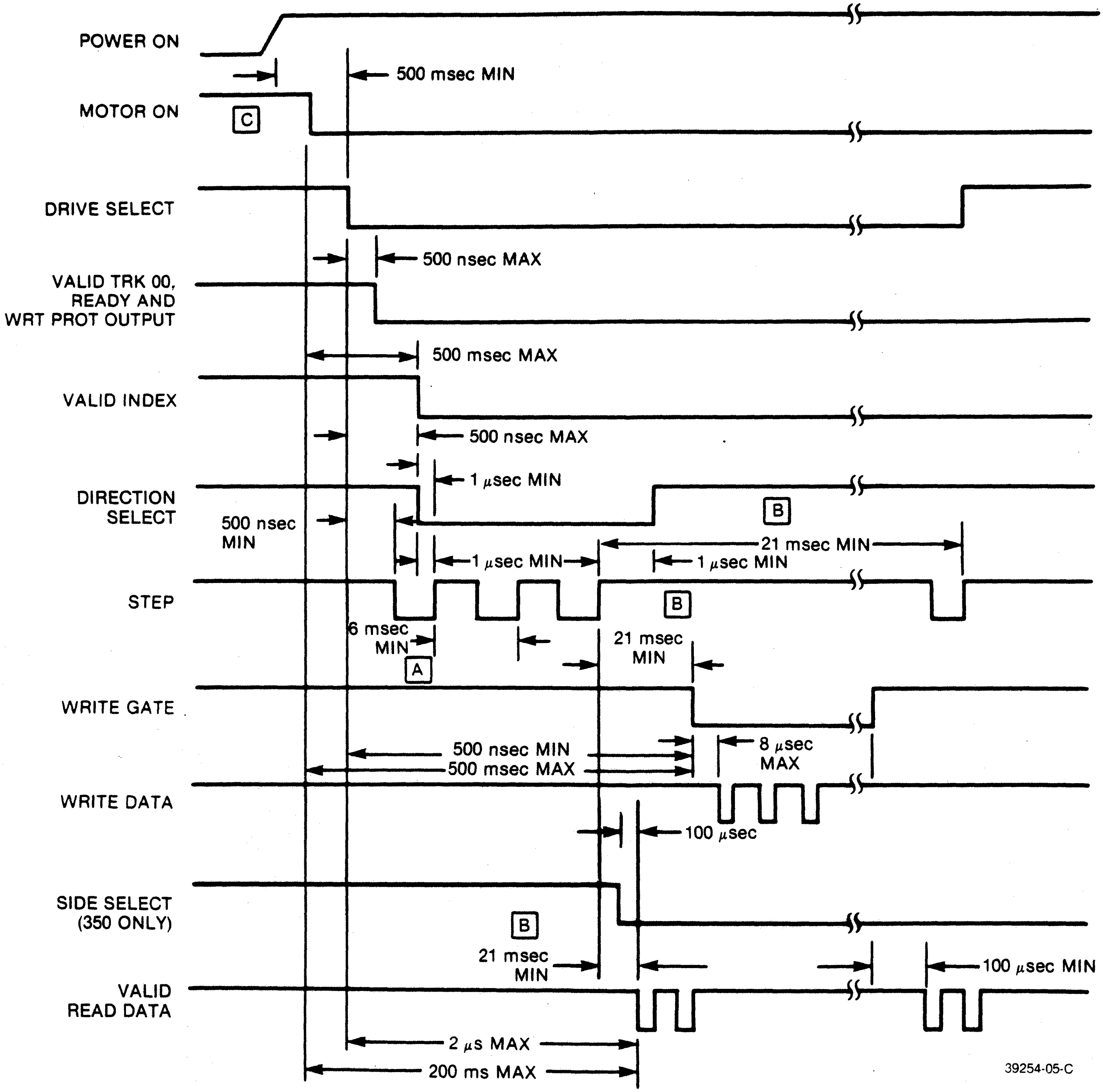


FIGURE 1-10. WRITE DATA TIMING (FM)

Write data encoding can be FM or MFM. The write data should be precompensated 100 nsec starting at tracks 40 to 43 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. Write current is automatically switched at track 40.

1.5.11 Sequence of Events

The timing diagram shown in figure 1-11 shows the necessary sequence of events with associated timing requirements for proper operation.



A — STEP TO STEP TIME IS
6 msec MINIMUM IN NORMAL MODE OR,
50 μsec MINIMUM IN BUFFERED MODE.

B — THE DELAY FROM THE LAST STEP TO READ, WRITE OR DIRECTION CHANGE IS
21 msec MINIMUM IN NORMAL MODE OR,
15 msec + 6 msec TIMES THE NUMBER OF STEPS TO EXECUTE IN BUFFERED STEP MODE.

C — MOTOR ON SIGNAL CAN BE ASSERTED 25 msec MINIMUM AFTER POWER ON.

FIGURE 1-11. GENERAL CONTROL AND DATA TIMING REQUIREMENTS

SECTION II
ELECTRICAL INTERFACE

2.1 INTRODUCTION

The interface of the 300/350 can be divided into two categories:

a. Signal Lines

b. Power Lines

The following paragraphs provide the electrical definition for each line. See figure 2-1 for all 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 provide signals to the drive (input) or to the host (output) via interface connector P1/J1.

2.2.1 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 (350 only)

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

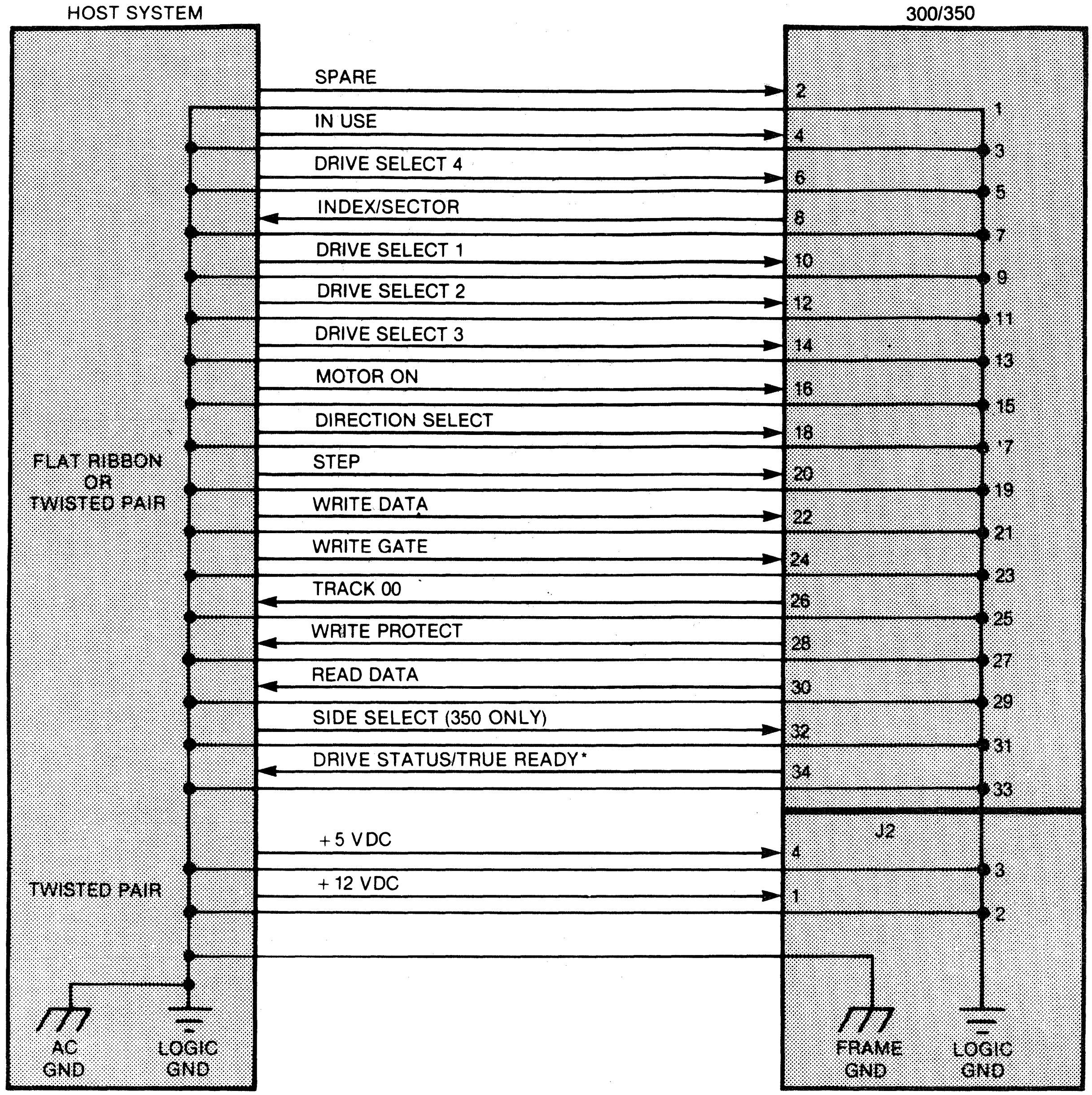
a. DRIVE SELECT 1

b. DRIVE SELECT 2

c. DRIVE SELECT 3

d. DRIVE SELECT 4

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



*TRUE READY IS A
CUSTOMER JUMPER OPTION

39254-06-A

FIGURE 2-1. INTERFACE CONNECTIONS

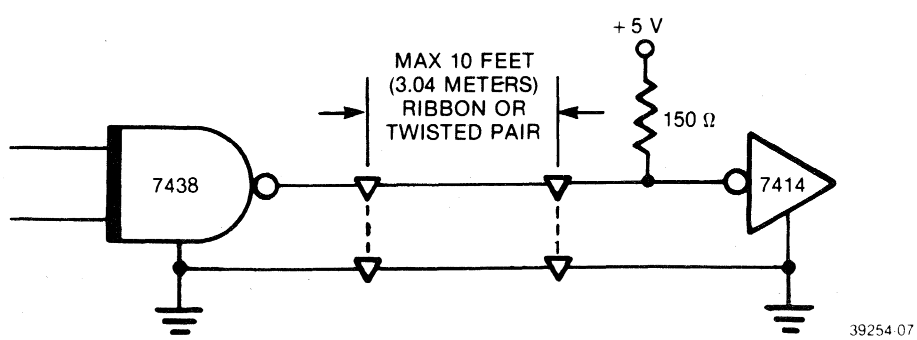


FIGURE 2-2. INTERFACE SIGNAL DRIVER/RECEIVER

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

True = Logical zero = Vin +0.0 to +0.04 V @ 40 mA (max)

False = Logical one = Vin +2.5 to +5.25 V @ 250 μA (open)

Input impedance = 150 ohms

2.2.2 Input Line Terminations

The 300/350 have been provided with the capability of terminating the six input lines listed below:

a. MOTOR ON

b. DIRECTION SELECT

c. STEP

d. WRITE DATA

e. WRITE GATE

f. IN USE

g. SIDE SELECT (350 only)

These lines are terminated through a 150-ohm resistor pack installed in a SIP 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. However, the user must provide the terminations beyond the last drive and each of the six lines must be terminated to +5 Vdc through a 222/330 ohm, 1/4-watt resistor, or a 150-ohm, 1/4-watt resistor.

2.2.3 Drive Select 1 – 4

The 300/350 are configured to operate with up to four drives in a multiplexed multiple drive system.

SINGLE DRIVE SYSTEM (MX shorting plug installed)

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 through 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 allow the drive to respond to multiplexed input lines, and enable the outputs to drive their respective signal lines. A logical zero on the interface selects a unique drive select line for a drive. With the MS shorting plug installed, DRIVE SELECT (when activated to a logical zero level) will turn the motor on.

2.2.4 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 0.5-second delay after activating this line must be allowed before reading or writing. For maximum motor life, this line should be deactivated if no commands have been issued to the drive within two seconds (ten 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 the application.

As discussed in paragraph 2.2.3, when MS is shorted, the motor will turn on if either the DRIVE SELECT line or the MOTOR ON line is activated. A user selectable option is available that allows the motor to turn on only when the MOTOR ON line is activated.

2.2.5 Direction Select

This interface line defines the direction of motion the read/write head(s) 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 head(s) 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 head(s) will move towards the center of the disk.

2.2.6 Side Select (350 only)

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(s) 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 μsec delay is required before any read or write operation can be initiated.

2.2.7 Step

This interface line is a control signal which causes the read/write head(s) to move in the direction of motion defined by the DIRECTION SELECT line. This signal must be a logical zero going pulse with a minimum pulse width of one μsec and a logical one for 5.5 msec minimum between adjacent pulses. Each subsequent pulse must be delayed by six msec minimum from the preceeding pulse for normal mode or 50 μsec in buffered step mode. Refer to paragraph 1.5.8 for buffered seek operation.

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 one μsec before the trailing edge of the step pulse, the DIRECTION SELECT logic level must be maintained one μsec after the trailing edge of the step pulse. See figure 2-3 for these timings.

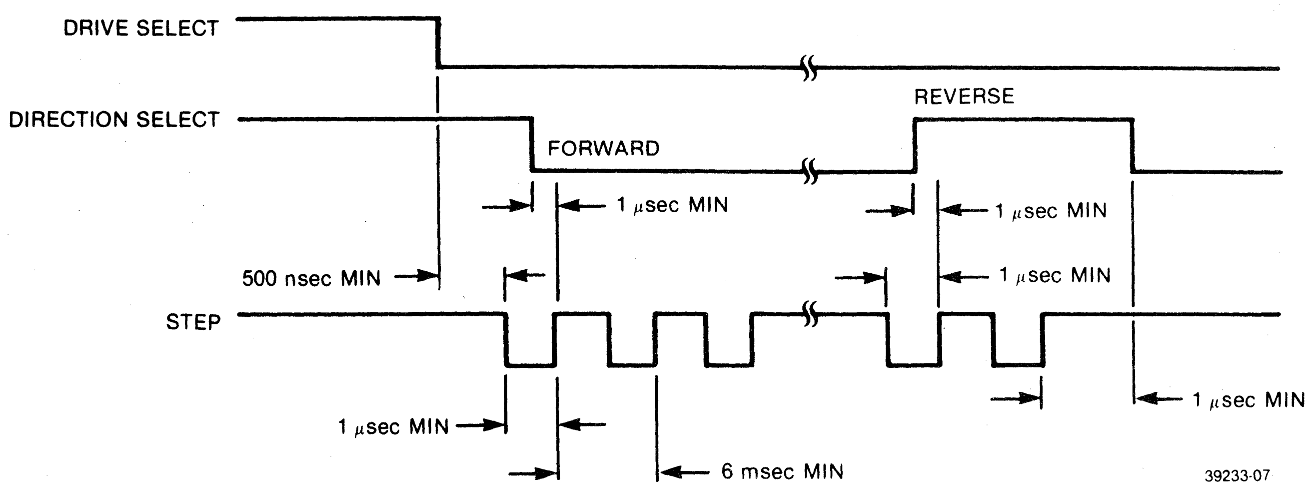


FIGURE 2-3. STEP TIMING

2.2.8 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. See figure 1-7 for timings.

2.2.9 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(s) 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. See figure 1-10 for timings.

2.2.10 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 drives in a daisy chain or separately in a radial configuration.

2.2.11 Output Lines

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

True = Logical zero = Vout +0.0 to +0.4 V @ 40 mA (max)

False = Logical one = Vout +2.5 to +5.25 V (open collector) @ I = 250 μA (max)

2.2.12 Track 00

The active or logical zero state of this interface signal indicates when the read/write head(s) of the drive(s) 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 read/write head(s) are not at track 00. When the read/write head(s) are at track 00 and an additional step out pulse is issued to the drive, microprocessor logic will keep the read/write head(s) positioned at track 00.

2.2.13 Index

This interface signal is provided by the drive with each motor revolution. Normally, this signal is at a logical one level and makes the transition to the logical zero level with each revolution of the spindle motor.

There is one pulse on this interface signal per revolution of the diskette (200 msec). This pulse indicates the physical beginning of a track. See figure 2-4 for timings.

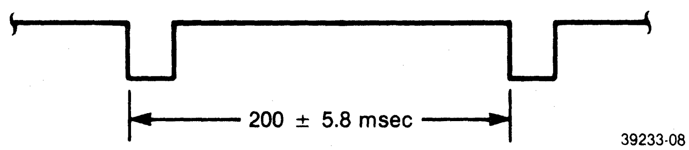


FIGURE 2-4. INDEX TIMING (SHUGART 130 SOFT-SECTORED MEDIA)

When using the INDEX signal, look for an edge or transition rather than a level for determining the status.

2.2.14 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. See figure 1-7 for the timing and bit shift tolerance within normal media variations.

2.2.15 Write Protect

This interface signal is provided by the drive to indicate to the user that a write protected cartridge is installed. The signal is logical zero level when it is protected. The drive will inhibit writing with a protected diskette installed and, additionally, notifying the interface.

2.2.16 Drive Status

This interface line provides information on the status of the drive. The information relayed is determined by whether the TR jumper is open or shorted and whether or not TP 11 is shorted to TP 10 (gnd).

TR Shorted, TP 11 Open (Disk In), Normal Configuration as Shipped

The DRIVE STATUS line goes to the active (logical zero) level when a cartridge is inserted in the drive.

TR Open, TP 11 Open (TRUE READY)

The line goes to the active (logical zero) level when *all* of the following conditions are met:

a. The cartridge is inserted in the drive.

b. The spindle motor is on and up to speed.

c. The head is settled on the specified data track.

TR Open, TP 11 Grounded (Disk Change)

The line goes to the active (logical zero) level when *all* the following conditions are met:

a. The cartridge is in the drive.

b. The cartridge has not been removed since the drive was last deselected.

c. An index pulse has been sensed after conditions "a" and "b" 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 cartridge had previously been removed but is now inserted, DRIVE STATUS will activate upon sensing an index pulse.

This option cannot be used (i.e., DRIVE STATUS will never become active) when the MX jumper is shorted, because condition "b" will never be met.

Figure 2-5 shows the equivalent logic of this function.

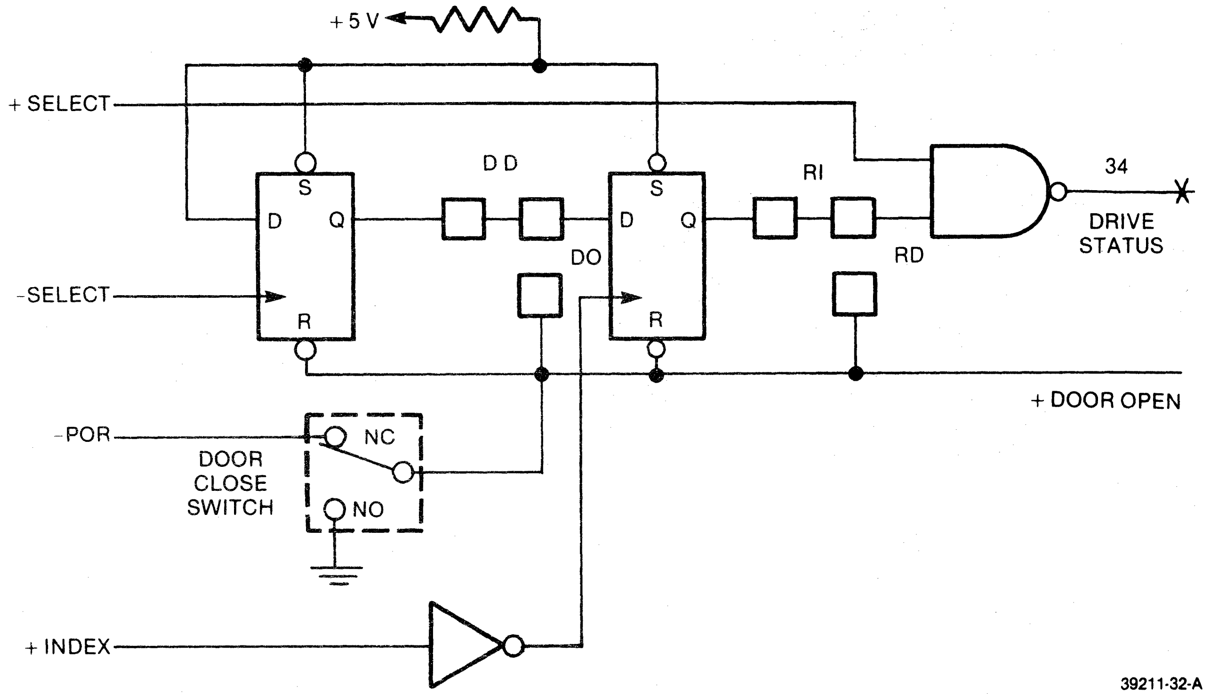


FIGURE 2-5. DISK CHANGE DRIVE STATUS LOGIC

TR Open, TP 11 Grounded (TRUE READY and Disk Change)

The line goes to the active (logical zero) level when *all* the conditions for TRUE READY and *all* the conditions for Disk Change are met as follows:

a. The cartridge is in the drive.

b. The spindle motor is on and up to speed.

c. The head is settled on the specified data track.

d. The cartridge has not been removed since the drive was last deselected.

e. An index pulse has been sensed since conditions "a", "b", "c" and "d" 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 cartridge had previously been removed but is now inserted, DRIVE STATUS will activate upon sensing an index pulse after the spindle motor is up to speed.

This option cannot be used (i.e., DRIVE STATUS will never become active) when the MX jumper is shorted, because condition "d" will never be met.

2.2.17 Self Test

If TP 9 is grounded when power is first applied to the drive, a self test will be performed before the drive responds to the interface. If the drive is functioning properly, the activity LED will flash for approximately eight seconds following a two-second initial delay when it will be OFF. If the drive should fail the self test, the LED will remain at a steady level (On or Off) for 12 seconds. Following the completion of the self test sequence and display, the drive will begin to service the interface normally.

TP 9 need only be grounded for one second after power is applied to initiate the self test: if TP 9 is shorted to ground (TP 10), the self test will be executed each time the power is applied. A cartridge need not be in the drive and no interface signals are required to perform the self test.

The self test sequence verifies the drive's internal microprocessor and associated circuitry, stepper motor, track 0 sensor, spindle motor, index sensor, and activity LED.

2.3 POWER INTERFACE

The 300/350 requires only dc power for operation. DC power to the drives is provided via P2/J2 located on the component side of the PCB near the spindle drive motor. The two dc voltages (+5 V and +12 V), their specifications and their J2/P2 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. **Figure 2-6 illustrates the 300/350 dc power profile.**

2.4 FRAME GROUND

CAUTION

It is important that the drive be frame grounded to the ac ground or frame ground of the host system. Failure to do so may result in drive noise susceptibility. Refer to paragraph 3.4 for the procedure.

TABLE 2-1. DC POWER REQUIREMENTS

P2 PIN	DC VOLTAGE	TOLERANCE	CURRENT	MAX RIPPLE (p to p)
1	+ 12 VDC	± 0.6 VDC	1.3 MAX 0.25 TYP	100 mV MAX ALLOWABLE
2	+ 12 RETURN			
3	+ 5 RETURN			
4	+ 5 VDC	± 0.25 VDC	0.60 MAX 0.45 TYP	100 mV MAX ALLOWABLE

39254-09

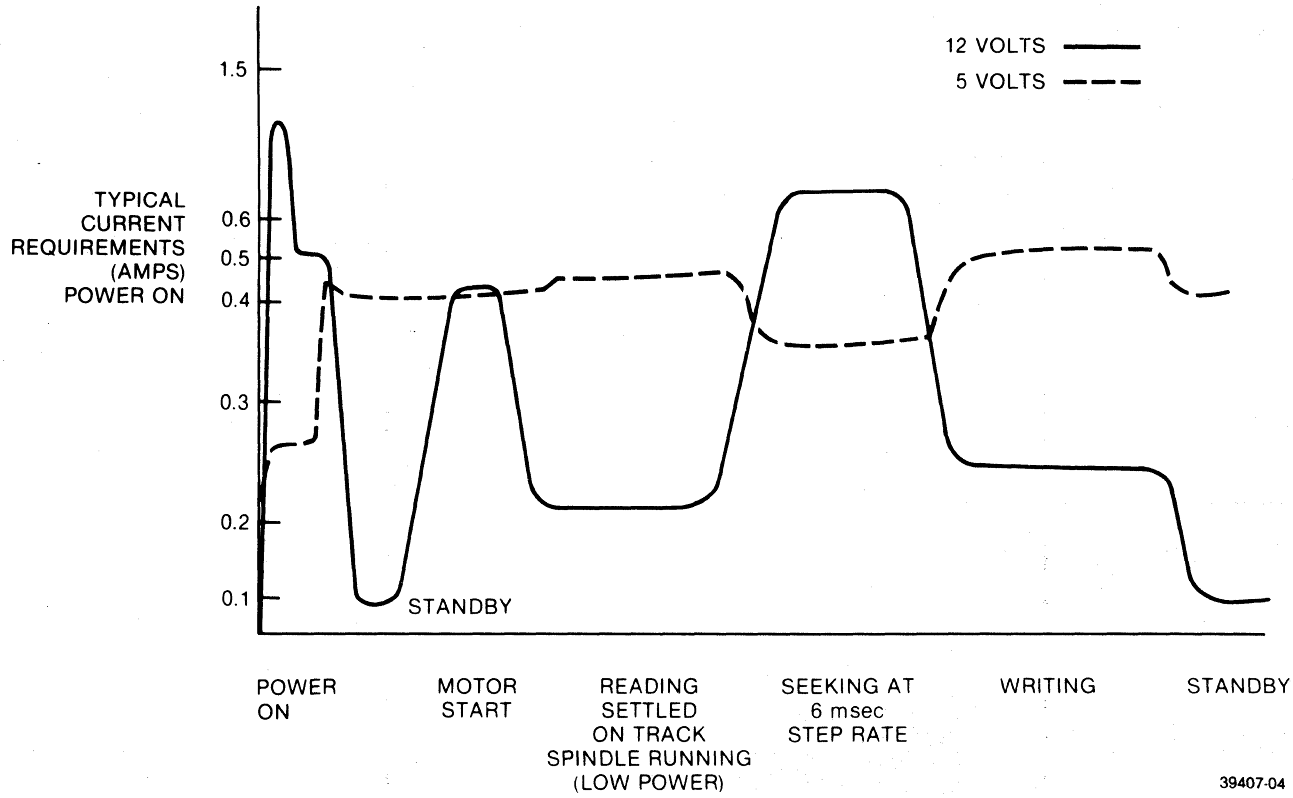


FIGURE 2-6. DC POWER PROFILE

SECTION III
PHYSICAL INTERFACE

3.1 INTRODUCTION

The electrical interface between the 300/350 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 locations of the connectors on the drive and the recommended connectors to be used with them. See figure 3-1 for connector locations.

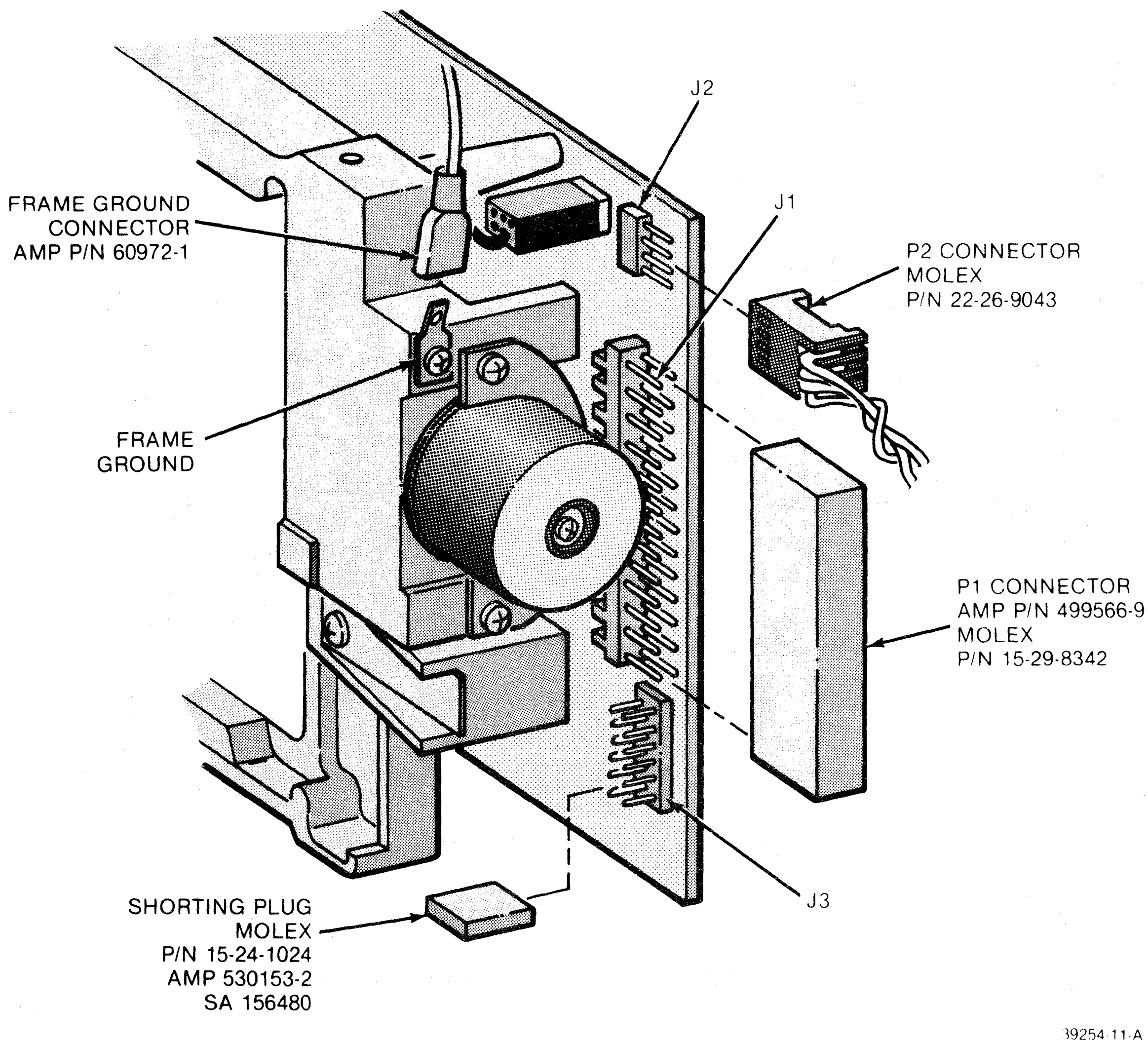


FIGURE 3-1. INTERFACE CONNECTORS — PHYSICAL LOCATIONS

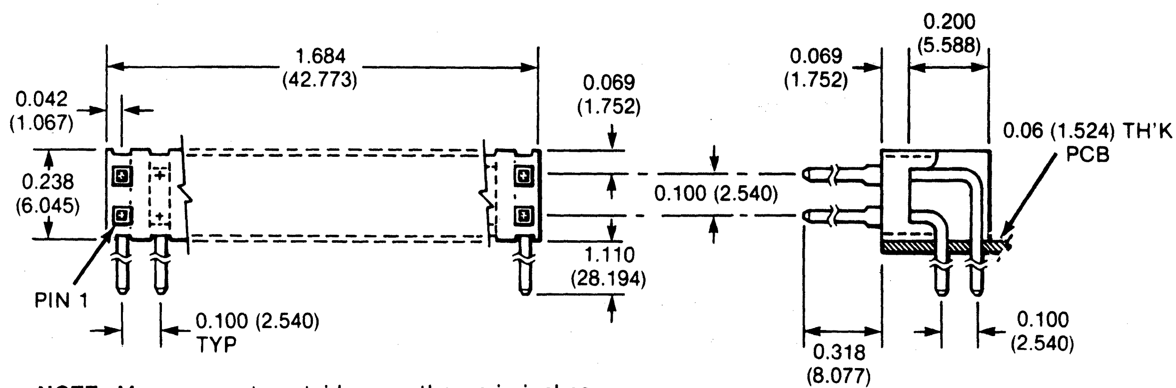
3.2 J1/P1 CONNECTOR

Connection to J1 is through a PCB pin type connector. The dimensions and location of pin 1 for the connector are shown in figure 3-2. Pins are numbered 1 through 34 with the even numbered pins on the top row. Pins 1, 2, and 34 are numbered on the PCB. Keying is not available with this connector. The recommended connector for P1 is shown in table 3-1.

TABLE 3-1. RECOMMENDED J1 CONNECTORS

TYPE OF CABLE	MANUFACTURER	CONNECTOR P/N
FLAT CABLE	3M "SCOTCHFLEX"	AMP 499566-9

39254-24-A



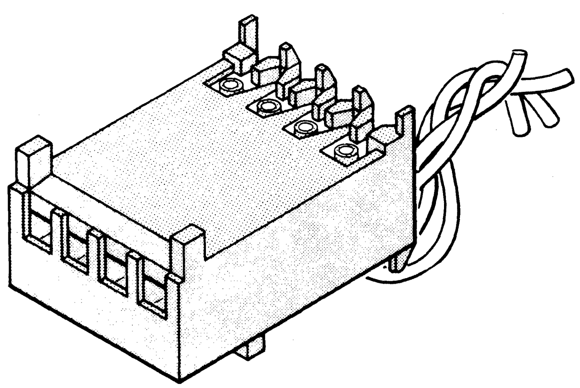
NOTE: Measurements outside parentheses in inches.
Measurements in parentheses in millimeters.

39254-25

FIGURE 3-2. J1 CONNECTOR DIMENSIONS

3.3 J2/P2 CONNECTOR

The dc power connector, J2, is mounted on the component side of the PCB and is located near the stepper motor. J2 is a 4 pin AMP data connector P/N 87232-4. The recommended mating connector and pins (P2) is Molex P/N 22-26-9043. J2, pin 1, is labeled on the component side of the PCB. Figure 3-3 illustrates the J2 connector.



P2 CONNECTOR PIN

1	+12 V DC
2	+12 RETURN
3	+5 RETURN
4	+5 V DC

39254-13-A

FIGURE 3-3. J2/P2 CONNECTOR

3.4 FRAME GROUNDING

The drive 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 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.

APPENDIX A
ORDERING INFORMATION

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

TABLE A-1. 300/350 PSI

AB	C	D	E	F

AB	PRODUCT TYPE
31	300

C	OPTION
0	NONE

D	MODEL
1	300
2	350
3	AUTO EJECT

E	OPTION
0	NONE
1	1 μsec READ DATA PULSE

F	OPTION
0	NONE

39407-11

SECTION IV
DRIVE PHYSICAL SPECIFICATIONS

4.1 GENERAL

This section contains the mechanical dimensions and mounting recommendations for the 300/350.

4.2 MOUNTING

NOTE

Do not mount the drive in horizontal position with PCB down.

As shipped from the factory, the drive is capable of being mounted in either of the following positions (see figure 4-1):

1. Top Loading — mounted upright.
2. Front Loading — mounted vertical with the PCB either on the left or right.
   — mounted horizontal with PCB up.

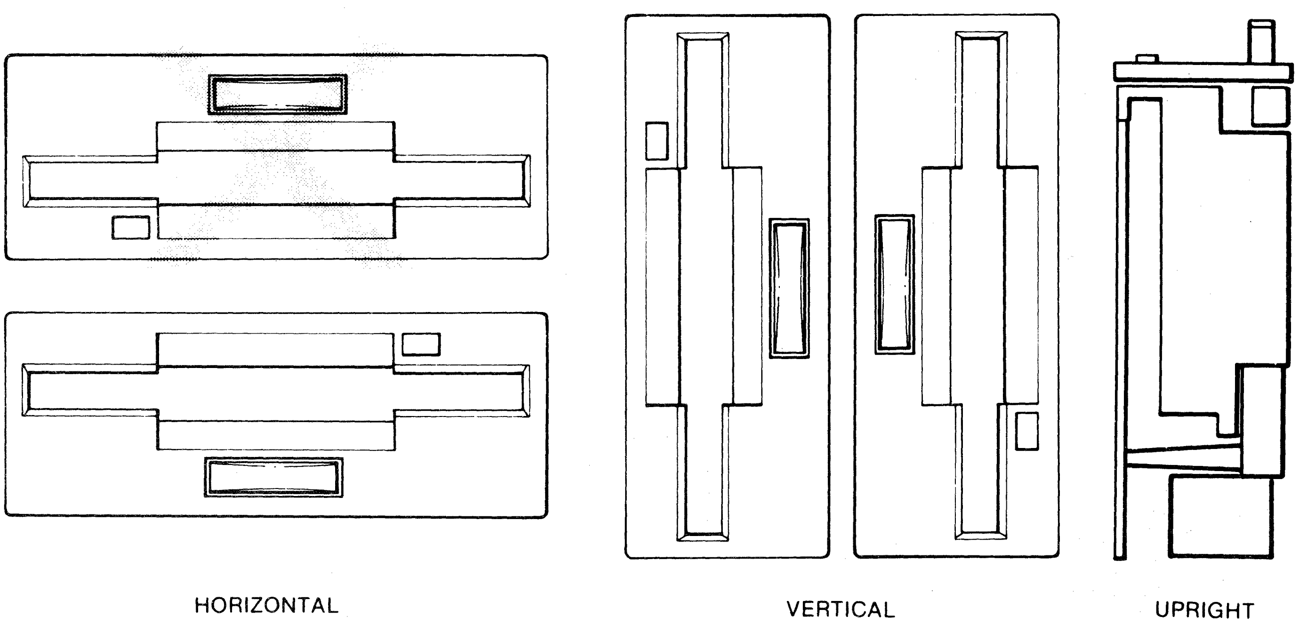


FIGURE 4-1. RECOMMENDED MOUNTING POSITIONS

39254-14

4.3 MECHANICAL DIMENSIONS

See figure 4-2 for dimensions of the 300/350.

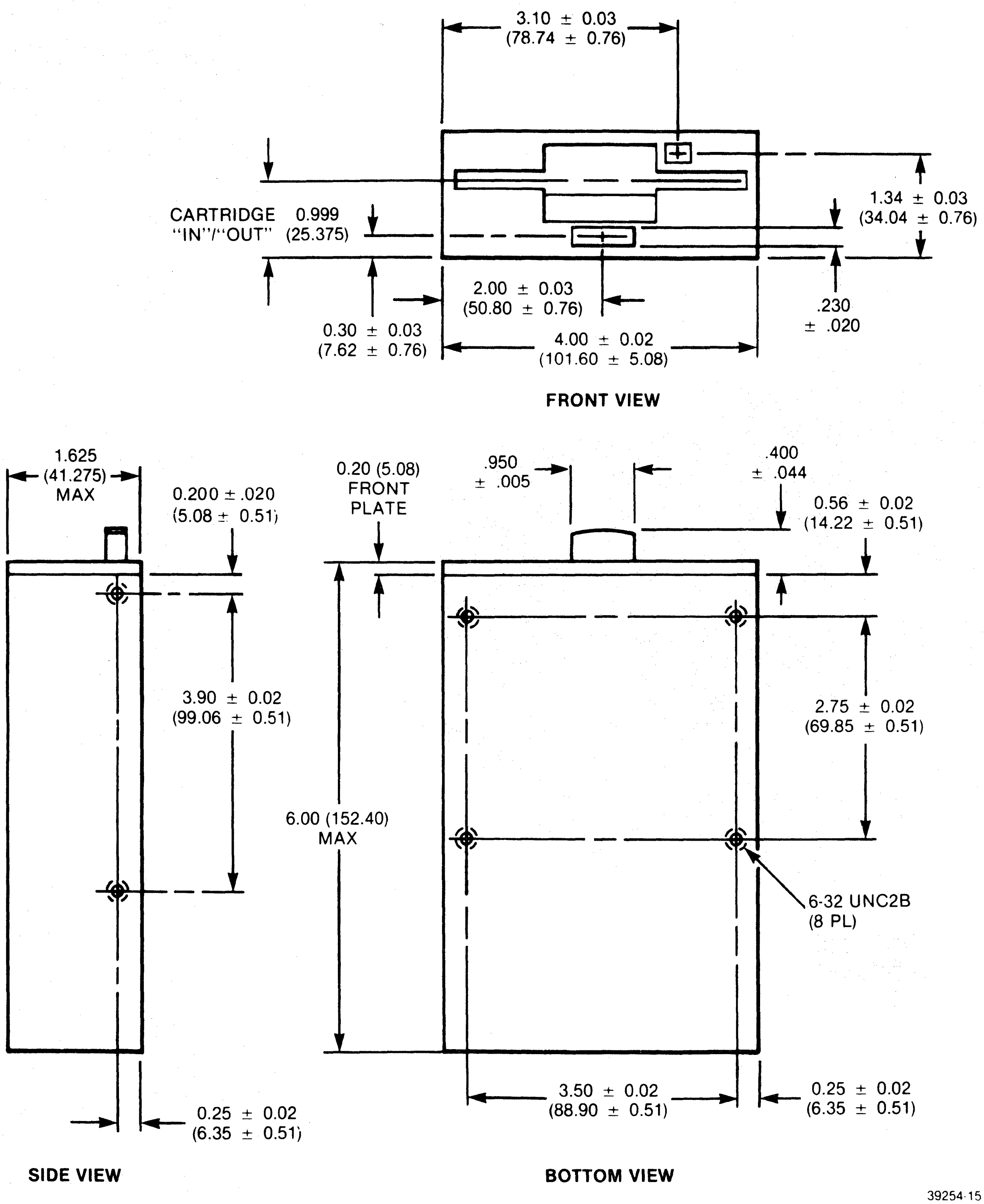


FIGURE 4-2. 300/350 PHYSICAL DIMENSIONS

NOTE: Measurements outside parentheses in inches.
Measurements inside parentheses in millimeters.

SECTION V
ERROR RECOVERY

5.1 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 attempts have been made, a read operation should be attempted on another track. This is done to determine if the media or the drive is failing. If the error still persists, the disk should be considered defective and discarded.

5.2 READ ERROR

Most errors that occur will be "soft" errors. Soft errors are usually caused by the following:

a. Airborne contaminants passing between the read/write head and the disk. The contaminants will generally be removed by the cartridge self-cleaning wiper.

b. Random electrical noise which usually lasts for a few microseconds.

c. 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 procedure is recommended to recover from errors:

a. Reread the track ten times or until such time as the data is recovered.

b. If data is not recovered after using step "a," access the head to the adjacent track in the same direction it was moved previously. Return to the desired track.

c. Repeat step "a."

d. If data is not recovered, the error is not recoverable.

5.3 SEEK ERROR

Seek errors are detected by reading the ID field after the seek is completed. The ID field contains the track address. If a seek error is detected, the host system should issue a recalibrate operation (step out until the TRACK 00 line goes active) and seek back to the original track.

SECTION VI
RECORDING FORMAT

6.1 GENERAL

The format of the data recorded on the diskette is totally a function of the host system. As discussed in paragraph 1.5.10, 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.

Byte

A byte, when referring to serial data (being written onto or read from the disk drive), is defined as eight 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 6-1 illustrates the relationship of the bits within a byte and figure 6-2 illustrates the relationship of the bytes for read and write data.

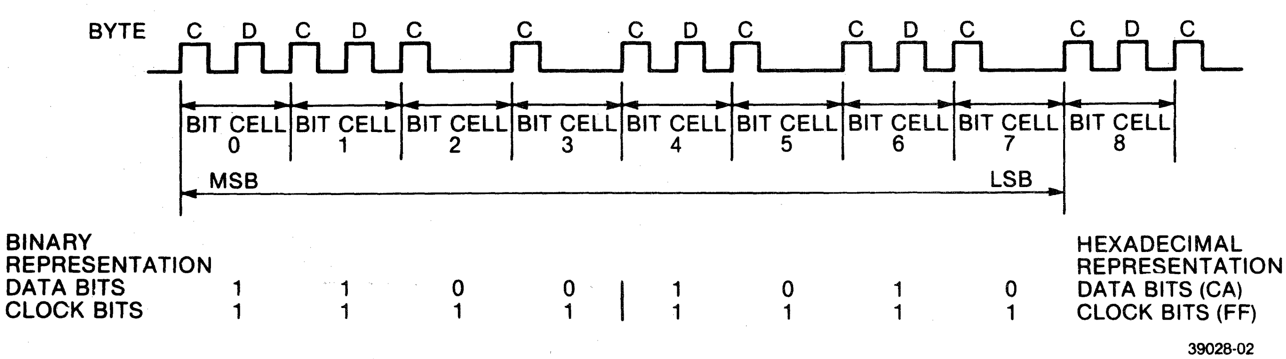


FIGURE 6-1. BYTE (FM ENCODING)

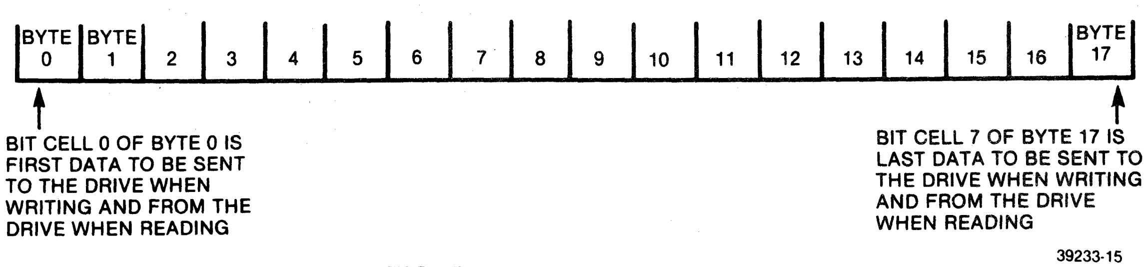
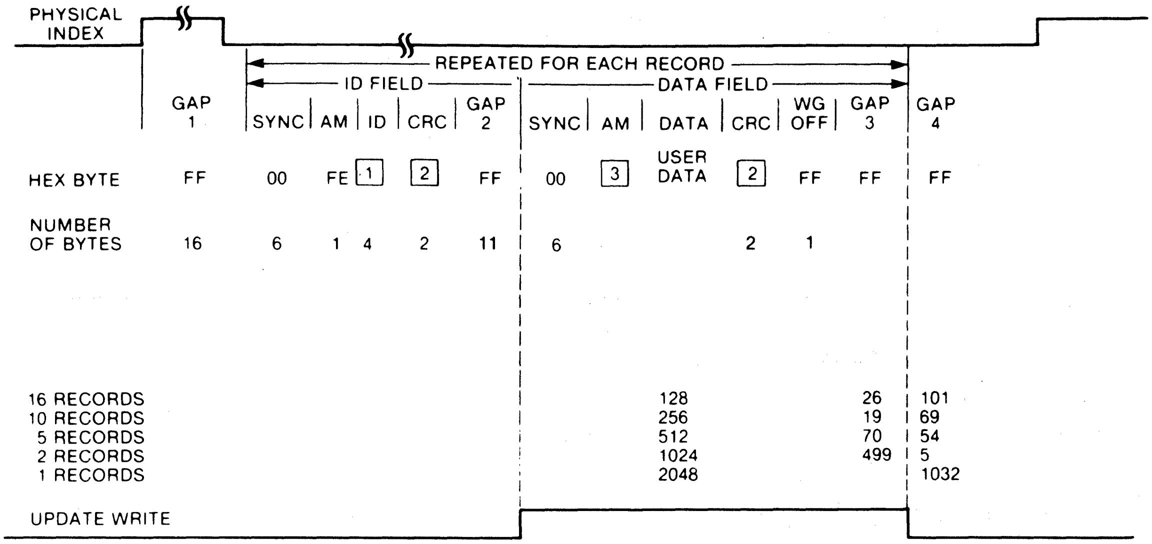


FIGURE 6-2. DATA BYTES

6.2 300/350 SOFT-SECTORED RECORDING FORMAT

In this format, the using system may record one long record or several smaller records. Each track is started by a physical index pulse and then each record is preceded by a unique recorded identifier. This type of recording is called soft-sectoring. Figure 6-3 illustrates the recommended single density (FM) formats. Figures 6-4 through 6-7 show the recommended different IBM type (MFM) double density recording formats.



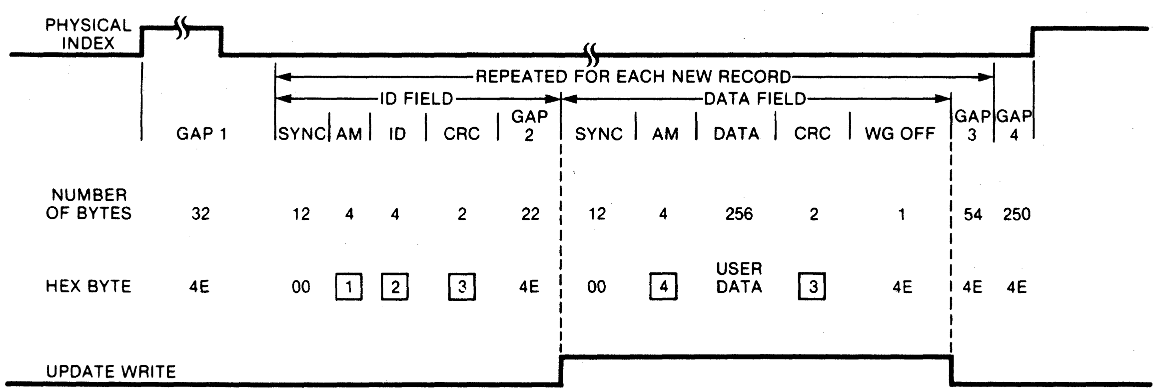
NOTES: 1 Track Number, Head Number, Sector Number, Sector Length.

2 IBM or Equivalent CRC Generator.

3 FB for Data or F8 for Deleted Data.

39028-04-A

FIGURE 6-3. RECOMMENDED FM SOFT SECTOR SINGLE DENSITY FORMAT (EVEN BOUNDARIES)



NOTES: 1 FIRST THREE BYTES ARE HEX A1 WITH MISSING CLOCK TRANSITIONS BETWEEN BITS 4 AND 5. LAST BYTE IS HEX FE.

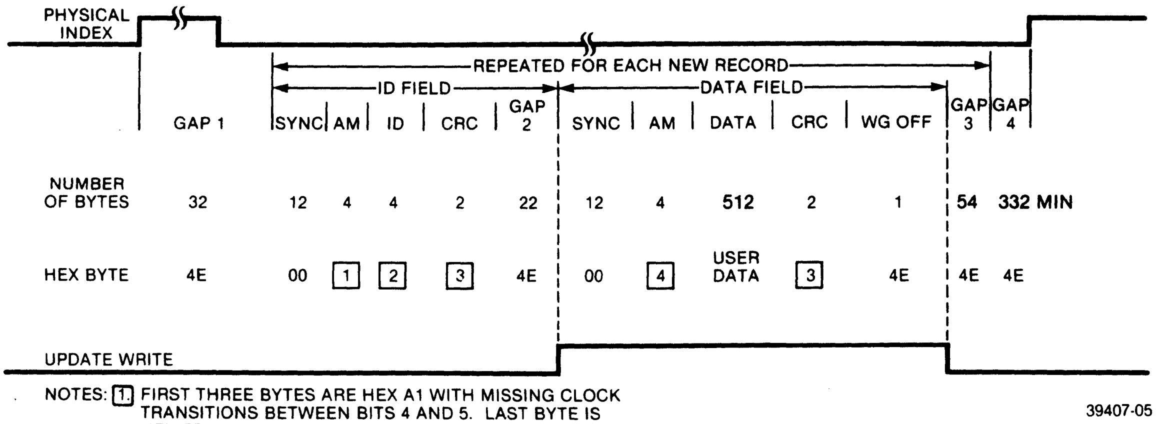
2 TRACK NUMBER, HEAD NUMBER, SECTOR NUMBER, SECTOR LENGTH (HEX 01).

3 IBM OR EQUIVALENT CRC GENERATOR.

4 SAME AS NOTE 1, EXCEPT LAST BYTE = HEX FB.

39028-25

FIGURE 6-4. MFM RECOMMENDED IBM TYPE FORMAT, 256 BYTES/16 RECORDS PER TRACK



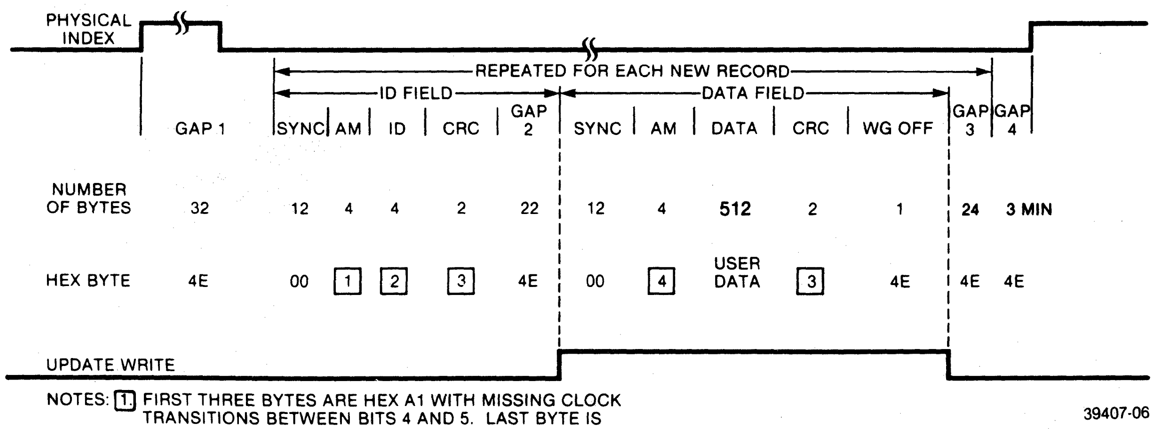
NOTES: 1. FIRST THREE BYTES ARE HEX A1 WITH MISSING CLOCK TRANSITIONS BETWEEN BITS 4 AND 5. LAST BYTE IS HEX FE.

2. TRACK NUMBER, HEAD NUMBER, SECTOR NUMBER, SECTOR LENGTH (HEX 01).

3. IBM OR EQUIVALENT CRC GENERATOR.

4. SAME AS NOTE 1, EXCEPT LAST BYTE = HEX FB.

FIGURE 6-5. MFM RECOMMENDED IBM TYPE FORMAT, 512 BYTES/9 RECORDS PER TRACK



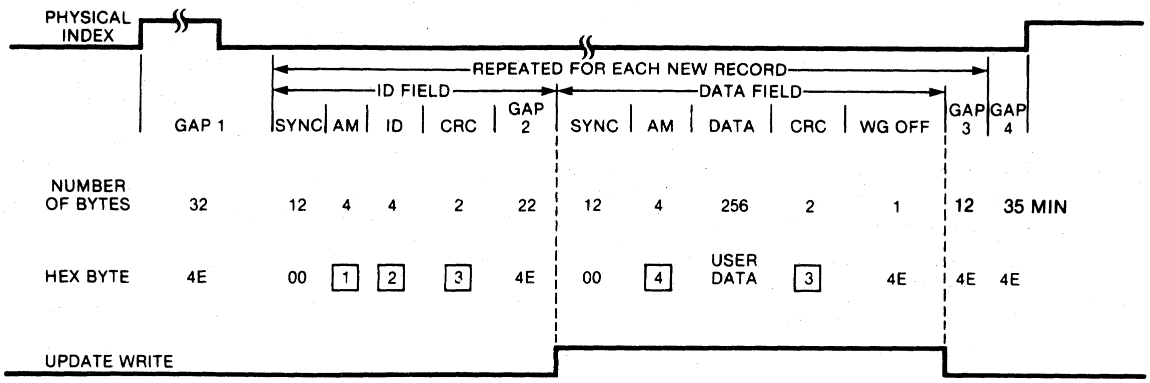
NOTES: 1. FIRST THREE BYTES ARE HEX A1 WITH MISSING CLOCK TRANSITIONS BETWEEN BITS 4 AND 5. LAST BYTE IS HEX FE.

2. TRACK NUMBER, HEAD NUMBER, SECTOR NUMBER, SECTOR LENGTH (HEX 01).

3. IBM OR EQUIVALENT CRC GENERATOR.

4. SAME AS NOTE 1, EXCEPT LAST BYTE = HEX FB.

FIGURE 6-6. MFM RECOMMENDED IBM TYPE FORMAT, 512 BYTES/10 RECORDS PER TRACK



NOTES: 1. FIRST THREE BYTES ARE HEX A1 WITH MISSING CLOCK TRANSITIONS BETWEEN BITS 4 AND 5. LAST BYTE IS HEX FE.

2. TRACK NUMBER, HEAD NUMBER, SECTOR NUMBER, SECTOR LENGTH (HEX 01).

3. IBM OR EQUIVALENT CRC GENERATOR.

4. SAME AS NOTE 1, EXCEPT LAST BYTE = HEX FB.

39407-07

FIGURE 6-7. MFM RECOMMENDED IBM TYPE FORMAT, 256 BYTES/18 RECORDS PER TRACK

6.3 TRACK LAYOUT

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

Gap 1 — Gap 1 is from the physical index mark to the ID field address mark sync. Gap 1 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. Sync includes a minimum of two bytes plus worst case separator sync up requirements.

ID Pre Address Mark (MFM) is 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 is not written per encode rules.

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

ID is 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 2 is from ID CRC to data AM sync. Gap 2 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. Sync includes a minimum of two bytes plus worst case separator sync up requirements.

Pre Data Address Mark (MFM) is three bytes of A1 with unique clock bits not written per encode rules.

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

Data Address Mark (MFM) is one byte of FB or F8 and is written per 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 3 is from WG OFF to next ID AM sync. Gap 3 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 — Gap 4 is the last gap prior to physical index. Gap 4 allows for speed and write oscillator variation during a format write and physical index variation.

SECTION VII
CUSTOMER INSTALLABLE OPTIONS

7.1 GENERAL

The 300/350 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 or a solder jumper (see table 7-1). This section discusses the following modifications and how to install them:

a. Drive Select

b. Drive Status

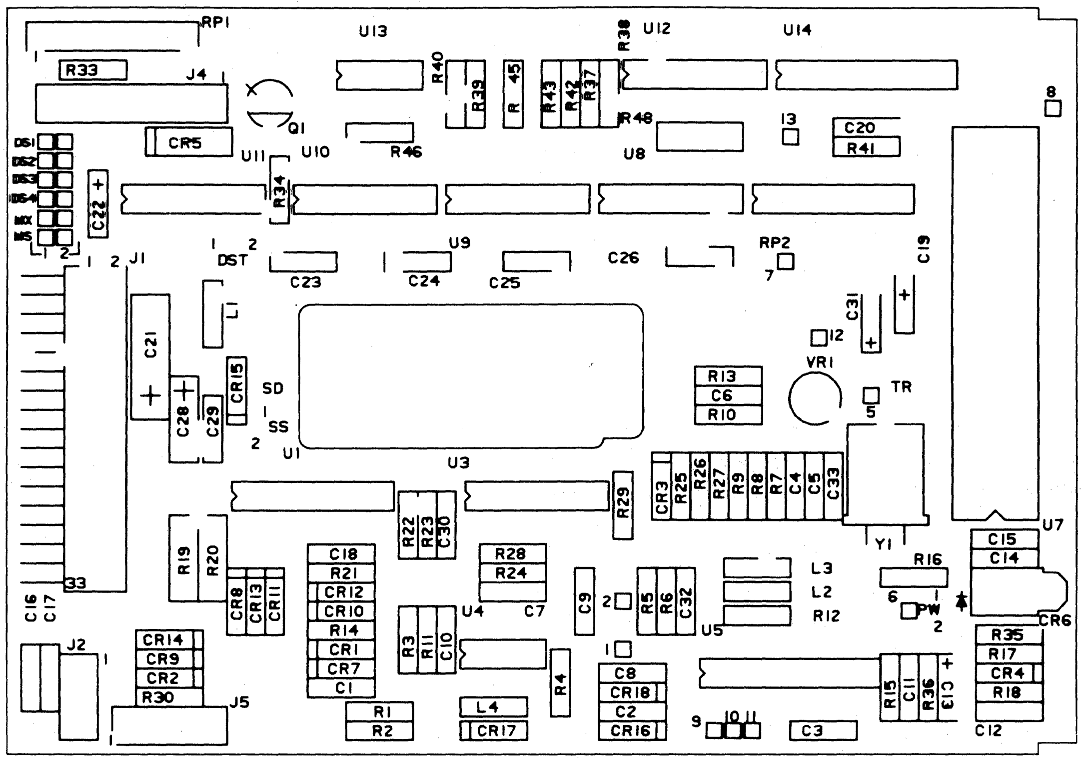
c. Self Test

TABLE 7-1. CUSTOMER CUT/ADD TRACE OPTIONS

TRACE DESIGNATOR	DESCRIPTION	SHIPPED FROM FACTORY	
		OPEN	SHORT
RP1	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		PLUGGED
TR	"TRUE READY" DRIVE STATUS		X
TP 11	"DISK CHANGE" DRIVE STATUS	X	
TP 9	SELF TEST Function	X	
PW	Cutting makes the READ DATA PULSE 1 μsec.		SHORT

39407-08

For component locations, see figure 7-1.



39407-09

FIGURE 7-1. PCB COMPONENT LOCATIONS (P/N 25293-0)

7.2 DRIVE SELECT

The Drive Select jumper (DS1,2,3,4), as the drives are shipped, are in position DS1 (see figure 7-2). The 300/350 is configured to operate alone in a single drive system. The 300/350 can be easily modified to operate with other drives in a daisy chained, multiplexed multiple drive system. This is done by selecting a specific drive address and jumpering the appropriate DRIVE SELECT line.

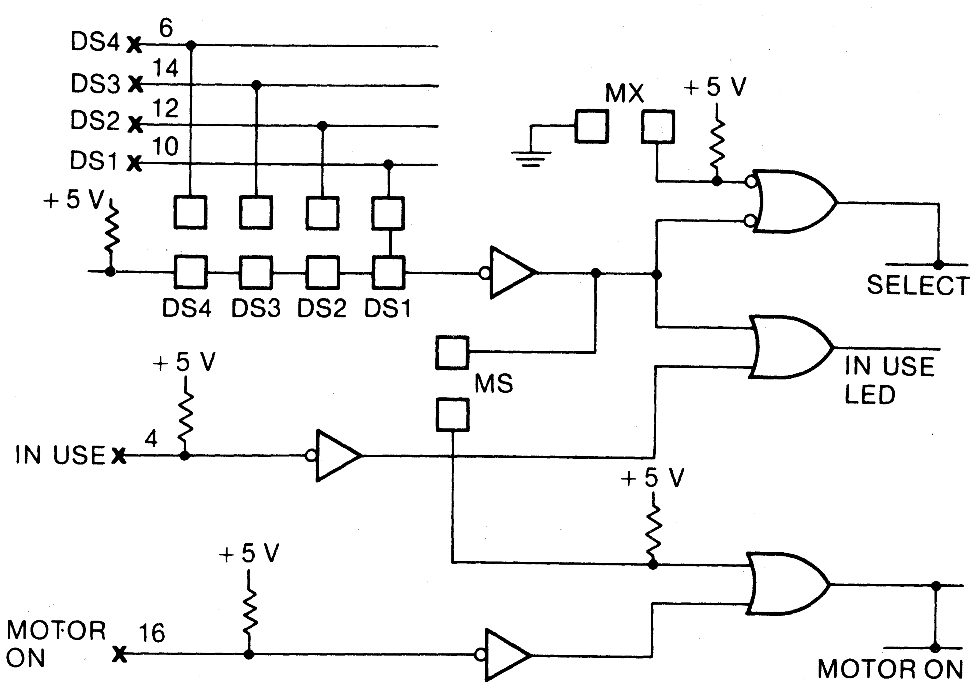


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FIGURE 7-2. DRIVE SELECT LOGIC

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.

7.3 DRIVE STATUS

As described in paragraph 2.2.16, the DRIVE STATUS interface pin 34 is determined by the TR jumper and TP 11. The available modes are:

TR Jumper	TP 11	DRIVE STATUS Mode
Shorted	Open	Disk In
Open	Open	TRUE READY
Shorted	Shorted	Disk Change
Open	Shorted	TRUE READY and Disk Change

7.4 SELF TEST

As described in paragraph 2.2.17, the drive will perform a self test if TP 9 is held at ground when power is first applied to the drive.

SECTION VIII
OPERATION PROCEDURES

8.1 INTRODUCTION

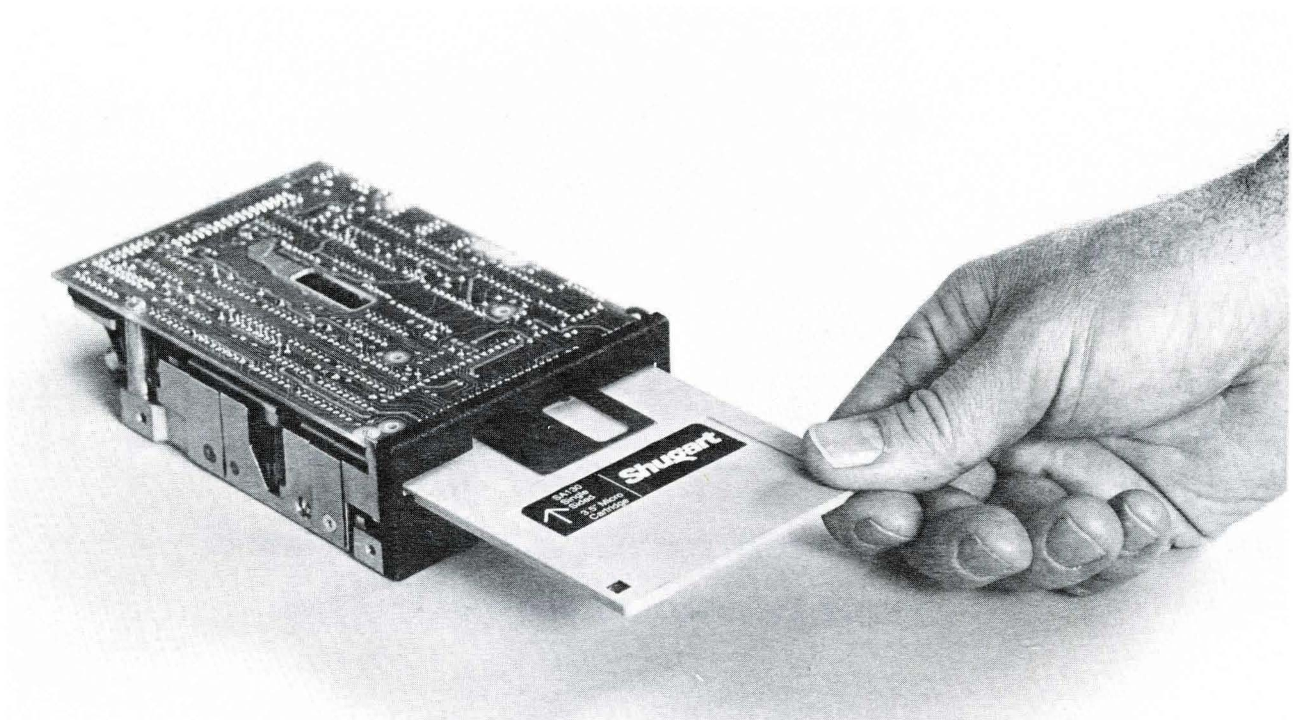
The 300/350 are designed for ease of operator use to facilitate a wide range of operator-oriented applications. The following paragraphs are a guide for the handling procedures on the microcartridge and microfloppy drive.

8.2 MICROCARTRIDGE LOADING

To load the microcartridge, insert the cartridge auto shutter first, with the label facing up or opposite the eject button in vertical mounting applications. Push in the cartridge. A mechanical interlock ensures proper media insertion. See figure 8-1 for insertion illustration. Figure 8-2 provides nomenclature description.

If the cartridge fails to load, press the eject button, then reinsert cartridge.

To remove the cartridge, push the eject button. The cartridge will automatically eject.



39254-19

FIGURE 8-1. MICROCARTRIDGE LOADING

8.3 MICROCARTRIDGE HANDLING

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

a. Cartridges not intended for immediate use should be stored in the box.

b. Keep cartridges away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can distort recorded data on disk.

c. Place ID labels in correct location, never use in layers.

d. Do not use erasers.

e. Heat and contamination from carelessly dropped ash could damage disk.

f. Do not expose cartridge to heat or sunlight.

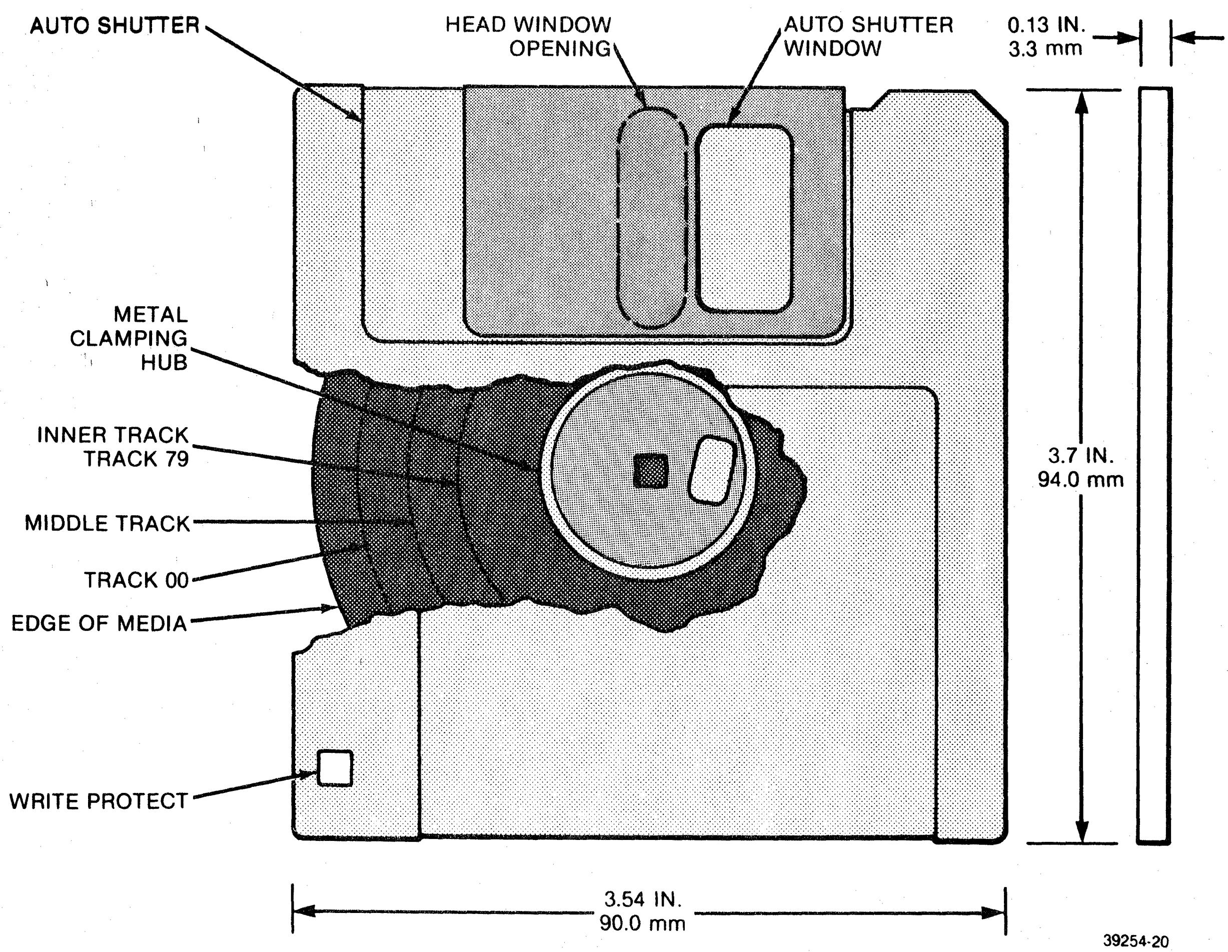


FIGURE 8-2. MICROCATRIDGE NOMENCLATURE

8.4 WRITE PROTECT FEATURE

The microcartridge comes with a mechanical write protect tab. To write protect the cartridge, turn the mechanical tab as shown in figure 8-3 to uncover the write protect hole.

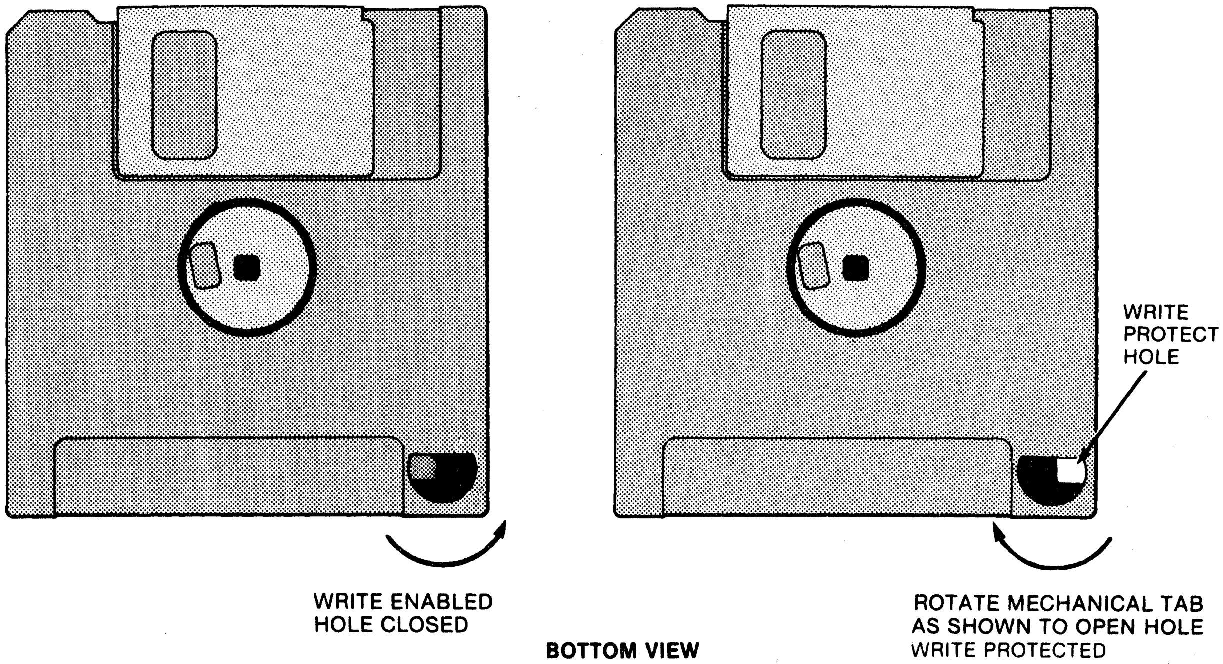
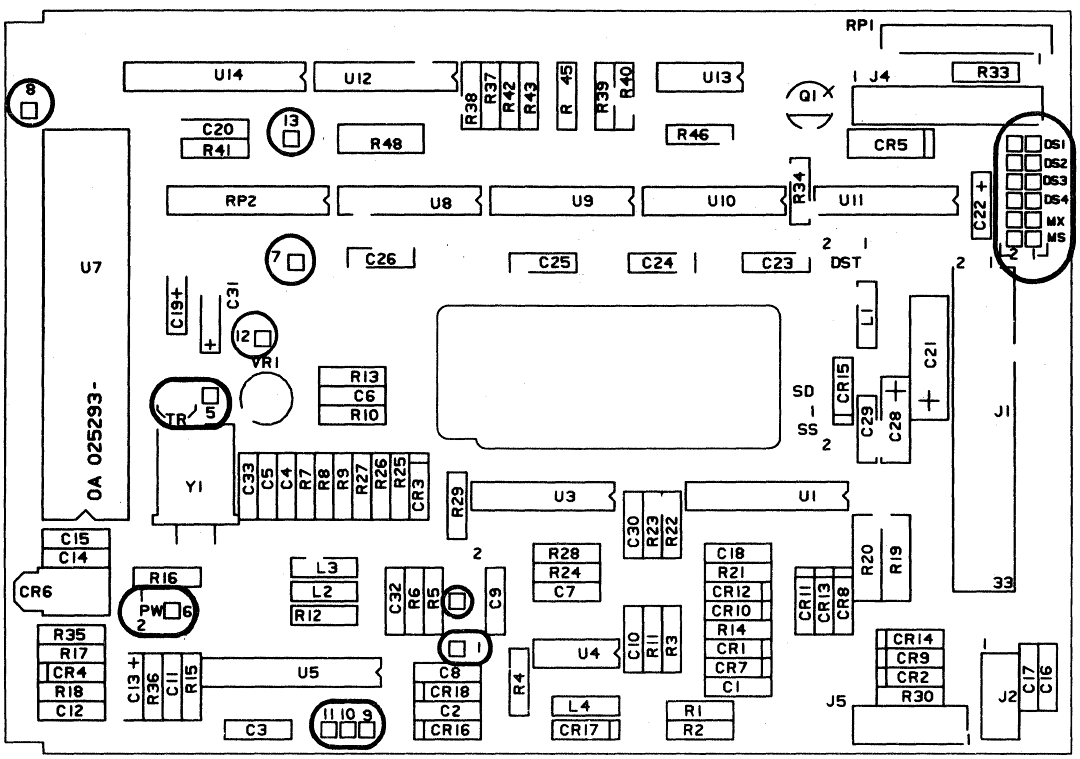


FIGURE 8-3. 300/350 WRITE PROTECT OPERATION

8.5 TEST POINT USAGE

The microfloppy PCB is mounted with the solder (non-component) side out. The test points required for drive testing can be accessed without removing the PCB. Holes are provided in the board which have traces connected to them on the component side. To reach the test point, insert and attach a hook-type scope probe to the side of the test point hole.

See figure 8-4 for test point and jumper locations and probe positioning.



TP1 and TP2 Analog Read Data
TP0 Ground
TP6 Digital Read Data
TP7 + Index
TP8 + Track 00 Sense
Circled Areas Indicate Locations

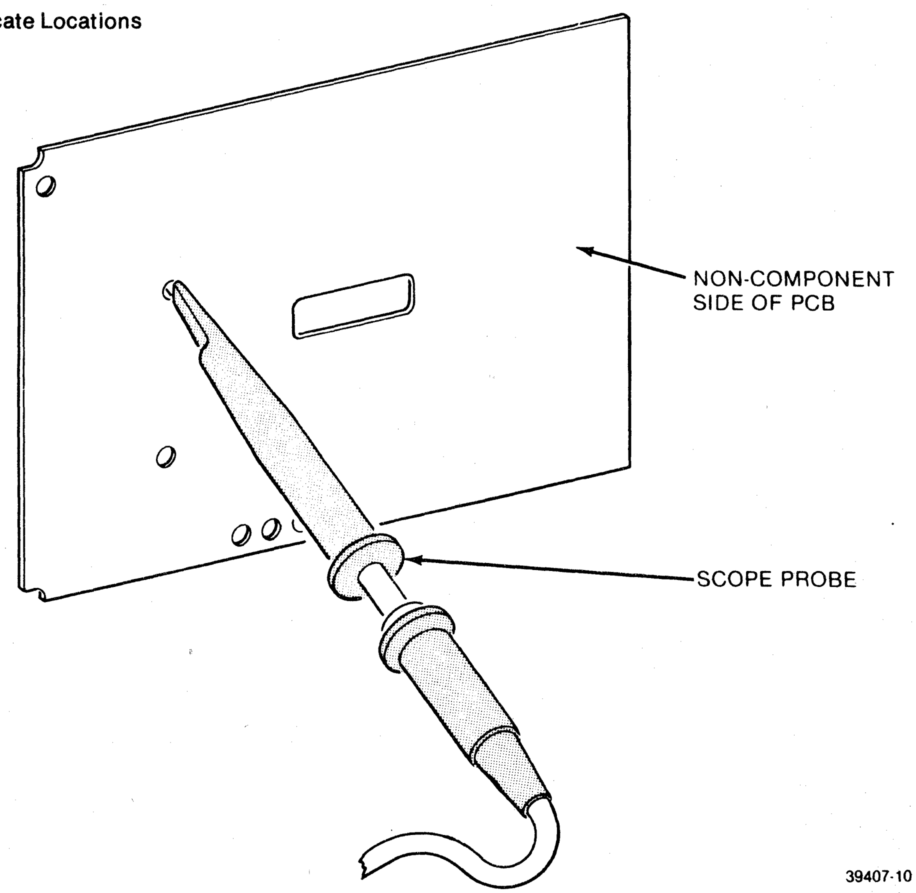


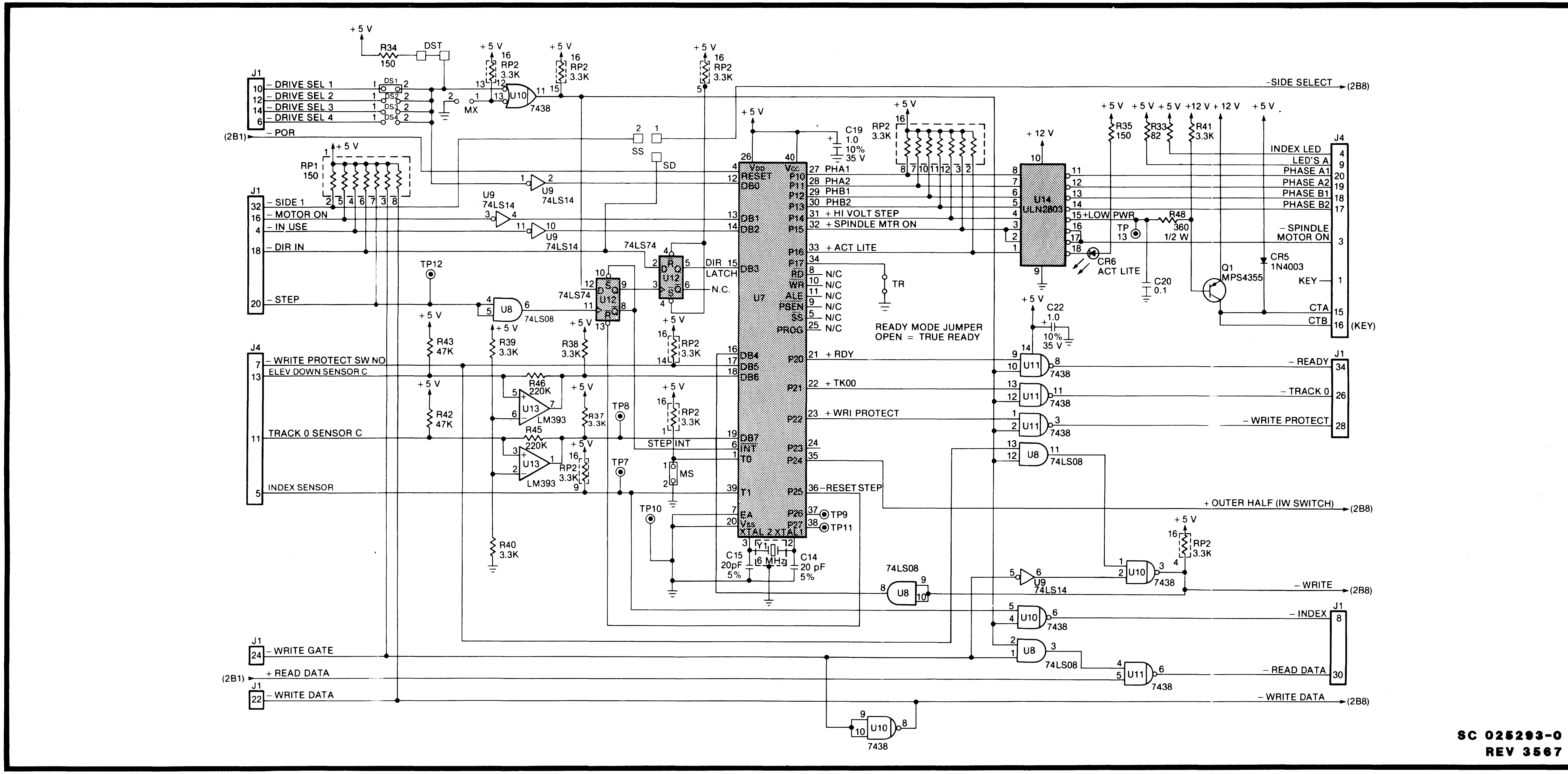
FIGURE 8-4. TEST POINT, JUMPER LOCATIONS AND PROBE POSITIONING

SECTION IX
PACKAGING

Packaging information will be supplied at a later date.

APPENDIX B
SCHEMATIC DIAGRAM

The following schematic diagrams are furnished to aid in malfunction analysis.



NOTES: UNLESS OTHERWISE SPECIFIED:

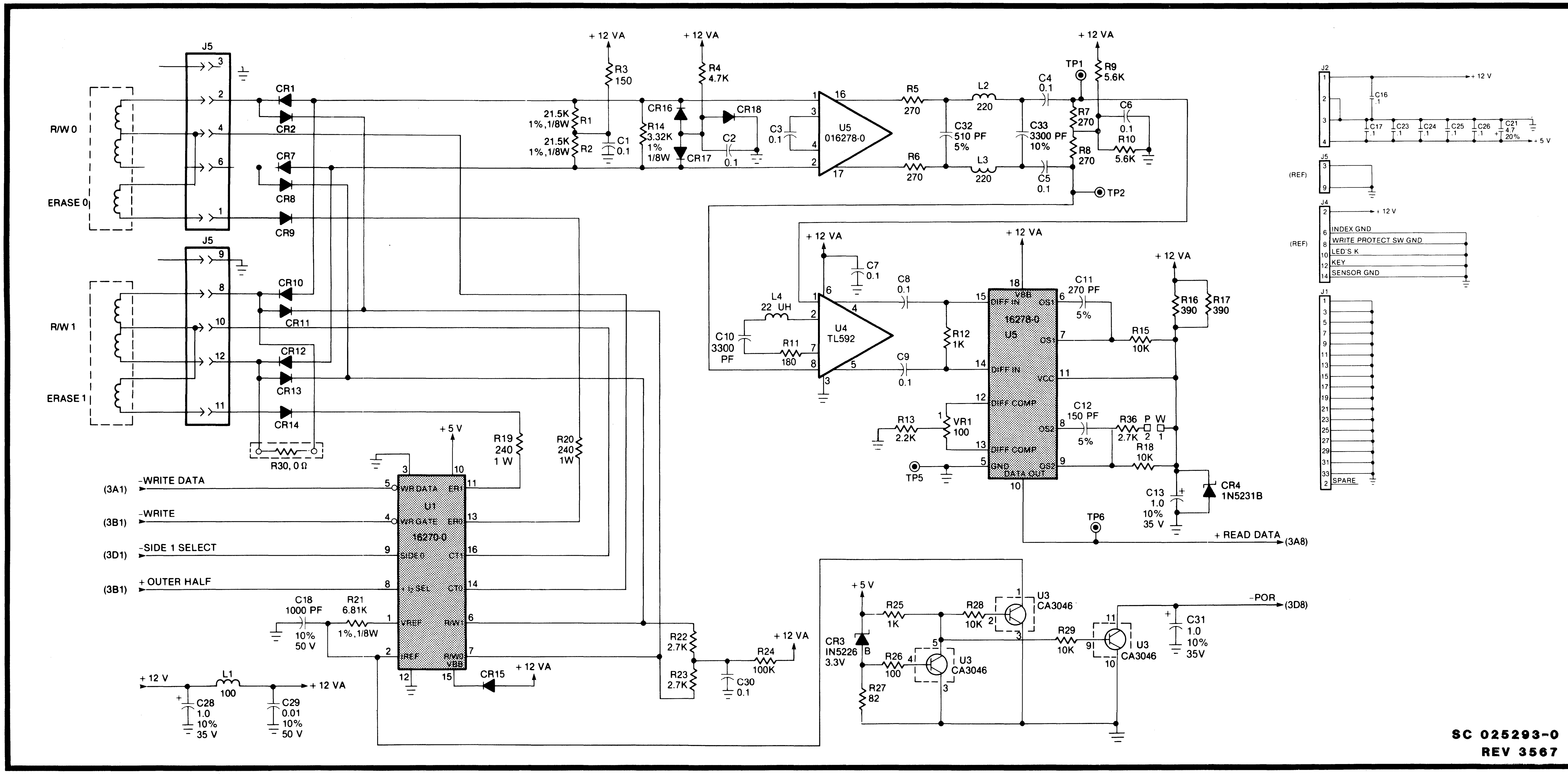
1. ALL CAPACITORS VALUES ARE IN MICROFARARDS, 50V+80-20%.
2. ALL DIODES ARE 1N4148.
3. ALL INDUCTORS ARE IN MICROHENRYS, ±10%.
4. ALL RESISTORS VALUES ARE IN OHMS, 1/4W, 5%.
5. -□-□- INDICATES CUT TRACE OPTION.
6. -□ □- INDICATES JUMPER OPTION.

LAST USED	NOT USED
C33	C27
CR18	
L4	
J5	J3
Q1	
R48	R31,32,44,47
U14	U2,6
Y1	
VR1	
RP2	

TEST POINTS	
5,10	GND
1,2	READ ANALOG DATA
	FILTERED READ ANALOG DATA
6	DIGITAL READ DATA
	-RESET MPU
8	+TRACK 00 SENSE
9,11	SOFTWARE MODE
7	+INDEX
13	LOW/HIGH STEPPER VOLTAGE
12	-STEP

REFERENCE DESIGNATIONS					
TYPE	GND	+5	+12	REF DES	SP.GATES
74LS08	7	14		U8	
74LS14	7	14		U9	U9-8,12
7438	7	14		U10,11	
74LS74	7	14		U12	
LM393	4	8		U13	
TL592	3		6	U4	
ULN2803	9		10	U14	
CA3046	7,13,10	14		U3	
READ,LSI	5		18	U5	
WRITE,LSI	3	10		U1	
8048	7	40		U7	
R.PACK,150		1		RP1	
R.PACK,3.3K		16		RP2	RP2-6

FIGURE B-1. CONTROL PCB SCHEMATIC (SHEET 1 OF 2)



NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL CAPACITORS VALUES ARE IN MICROFARARDS, 50V+80-20%.
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3. ALL INDUCTORS ARE IN MICROHENRYS, ±10%.
4. ALL RESISTORS VALUES ARE IN OHMS, 1/4W, 5%.
5. -□-□- INDICATES CUT TRACE OPTION.
6. -□ □- INDICATES JUMPER OPTION.

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CR18	
L4	
J5	J3
Q1	
R48	R31,32,44,47
U14	U2,6
Y1	
VR1	
RP2	

TEST POINTS	
5,10	GND
1,2	READ ANALOG DATA
	FILTERED READ ANALOG DATA
6	DIGITAL READ DATA
	-RESET MPU
8	+TRACK 00 SENSE
9,11	SOFTWARE MODE
7	+INDEX
13	LOW/HIGH STEPPER VOLTAGE
12	-STEP

REFERENCE DESIGNATIONS					
TYPE	GND	+5	+12	REF DES	SP.GATES
74LS08	7	14		U8	
74LS14	7	14		U9	U9-8,12
7438	7	14		U10,11	
74LS74	7	14		U12	
LM393	4	8		U13	
TL592	3		6	U4	
ULN2803	9		10	U14	
CA3046	7,13,10	14		U3	
READ,LSI	5		18	U5	
WRITE,LSI	3	10		U1	
8048	7	40		U7	
R.PACK,150		1		RP1	
R.PACK,3.3K		16		RP2	RP2-6

FIGURE B-2. CONTROL PCB SCHEMATIC (SHEET 2 OF 2)

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