Preliminary
Service Manual
November 1983
P/N 39259-0

Shugart 300
Flexible Disk
Storage Drive

Shugart

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Flexible Disk
Storage Drive

Preliminary Service Manual

For
Single-Sided
3.5 Inch
Microfloppy
Applications

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ABBREVIATIONS/MNEMONICS

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

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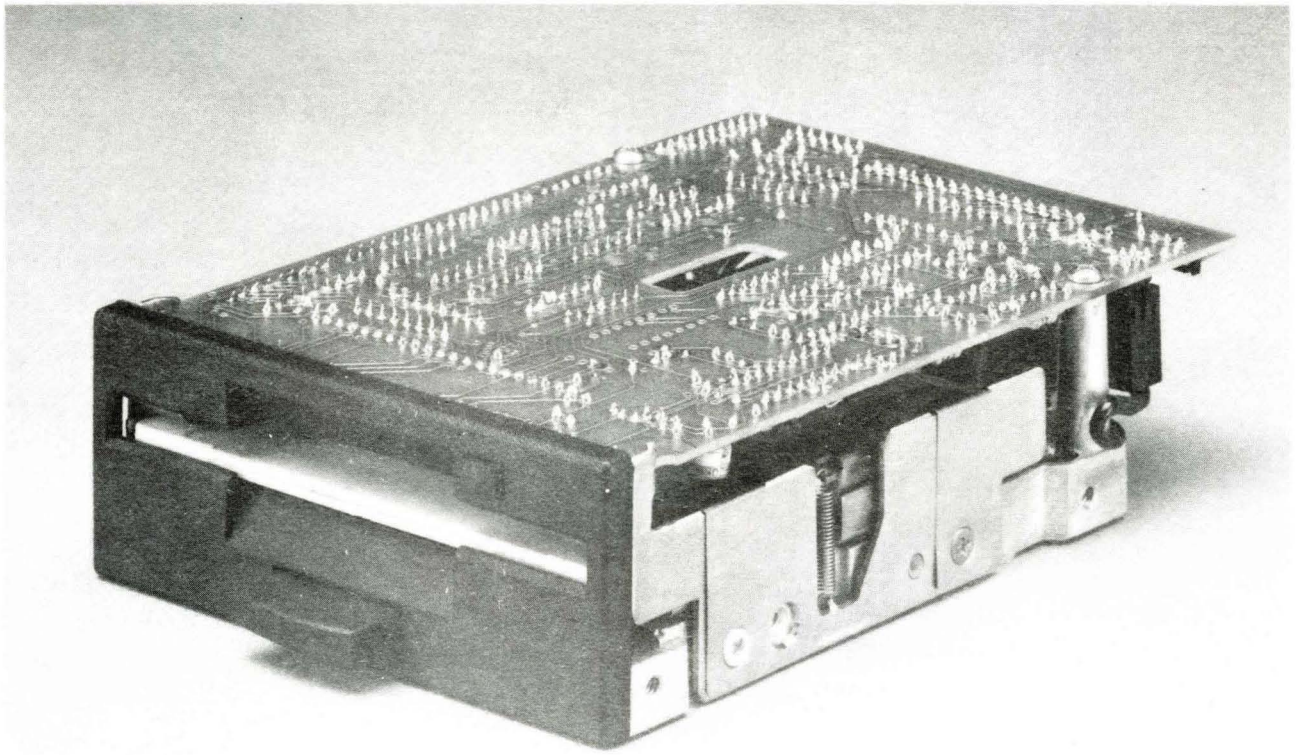


FIGURE 1-1. SA300 SINGLE-SIDED 3.5-INCH MICROFLOPPY DISK DRIVE

SECTION I
INTRODUCTION

1.1 PURPOSE

This document is intended to satisfy the information needs of field Engineers, maintenance and test technicians. A separate OEM manual (P/N 39254-2) is available which describes the installation, power requirements and related information for the applications of this product.

1.1.1 General Description

The single-sided SA300 3.5-inch microfloppy disk drive is designed for new generations of desktop and portable systems. It offers the same performance as any Minifloppy disk drive but in a much smaller package.

The SA300 features 500 k bytes of unformatted storage capacity, a fast six msec track-to-track access time, microprocessor-controlled electronics, and internal write-protect circuitry. In addition, the SA300 is interface compatible with Minifloppy disk drives.

The SA300 also uses 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 SA300 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

1.2 SPECIFICATIONS SUMMARY

1.2.1 Performance Specifications

	Single Density (FM)	**Double Density** (MFM)
Capacity		
Unformatted		
Per Disk	250 k bytes	500 k bytes
Per Surface	250 k bytes	500 k bytes
Per Track	3.125 k bytes	6.25 k bytes
Formatted (10 Sectors/Track)		
Per Disk	204.8 k bytes	409.6 k bytes
Per Surface	204.8 k bytes	409.6 k bytes
Per Track	2.56 k bytes	5.12 k bytes
Transfer Rate	125 k bits/sec	250 k bits/sec
Latency (average)	100 msec	100 msec

	Single Density (FM)	Double Density (MFM)
Access Time		
Track-to-Track (without settling)	6 msec	6 msec
Average (with settling)	158 msec	158 msec
Settling Time	15 msec	15 msec
Motor Start Time	500 msec	500 msec

1.2.2 Functional Specifications

Rotational Speed	300 rpm	300 rpm
Recording Density (inside track)	4093 bpi	8187 bpi
Flux Density	8187 fci	8187 fci
Track Density	135 tpi	135 tpi
Tracks	80	80
Index	1	1
Encoding Method	FM	MFM

Media Requirements
- SA130 Microfloppy Cartridge
- Soft Sectored

1.2.3 Physical Specifications

Environmental Limits	Operating	Shipping	Storage
Ambient Temperature	50° to 115° F (10.0° to 46.1°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% @ 0.4 A operating, 1.5 A max
- + 5 V ± 5% @ 0.6 A operating, 0.7 A max

Mechanical Dimensions (exclusive of front panel)
- 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
- 8 Watts (27 BTU/hr) Operating
- 4 Watts (13.5 BTU/hr) Standby

1.2.4 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+

1.3 FUNCTIONAL CHARACTERISTICS

The SA300 drive consists of:

a. Read/Write and Control Electronics

b. Drive Mechanism

c. Precision Track Positioning Mechanism

d. Read/Write Head

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

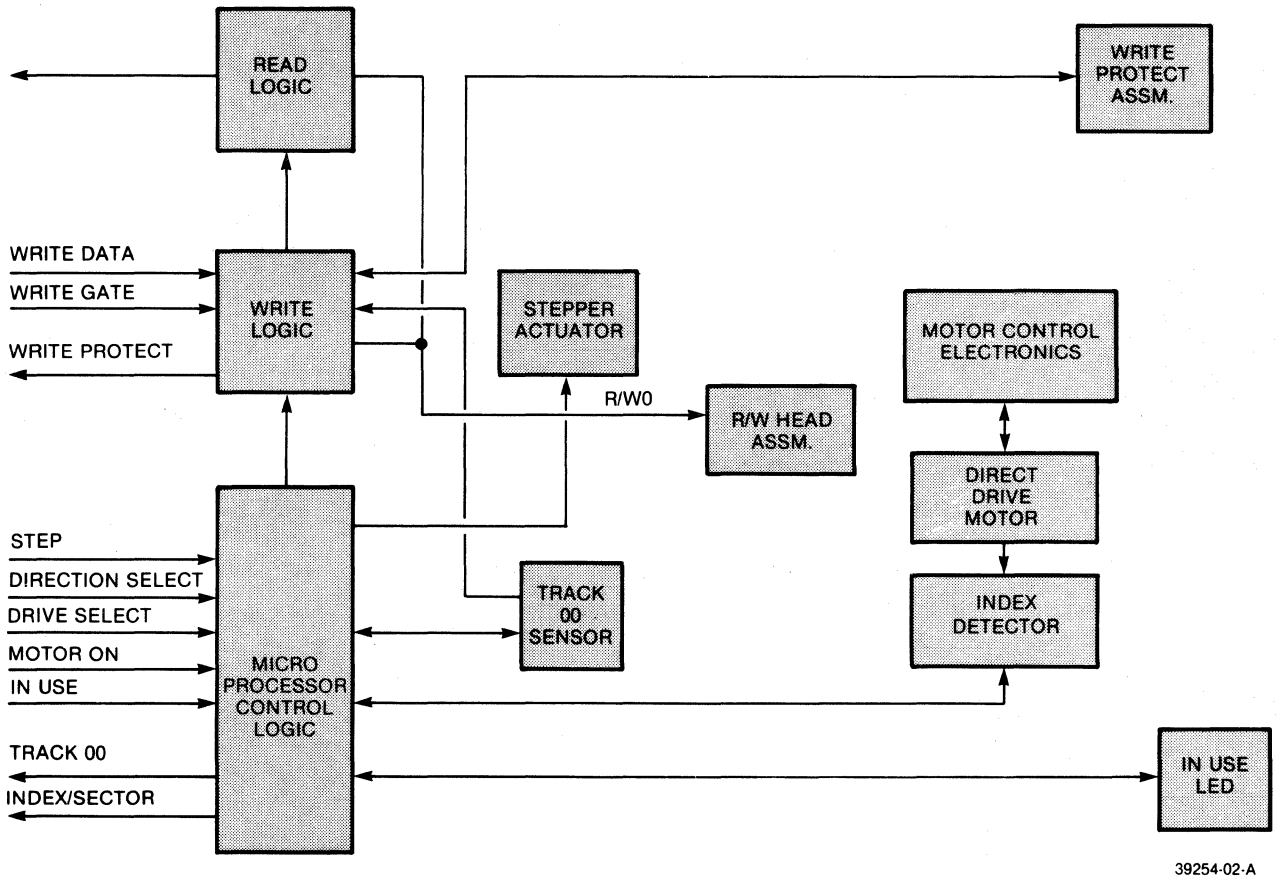


FIGURE 1-2. FUNCTIONAL DIAGRAM

1.3.1 Read/Write and Control Electronics

The electronics are packaged on a 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 Control

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

1.3.2 Drive Mechanism

The dc drive motor under servo speed control (using an integral tachometer) rotates the spindle at 300 rpm through a direct-drive system. 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.

1.3.3 Precision Track Positioning Mechanism

The read/write head 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.

1.3.4 Read/Write Head

The glass bonded ceramic and ferrite read/write head contains 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 is mounted on a carriage assembly which is located on a precision carriage way. The diskette is held in a plane perpendicular to the read/write head by a pin located on the base casting. This precise registration assures perfect compliance with the read/write head. The read/write head is in direct contact with the diskette. The head surfaces have been designed to obtain maximum signal transfer to and from the magnetic surface of the diskette with minimum head/diskette wear.

1.3.5 Recording Format

The format of the data recorded on the diskette is totally a function of the host system. This format can be designed according to the user's needs to take maximum advantage of the total available bits that can be written on any one track.

1.4 RECOMMENDED RECEIVING INSPECTION

All Shugart drives are 100 percent adjusted and tested before leaving the factory. Therefore, it is necessary to inspect only for shipping damage on receipt of drives.

1.4.1 Unpacking the Drive

All drives are shipped in sturdy boxes and are secured properly with protective materials. We recommend the following procedure for unpacking the drive.

a. Place the container on a clean and dry surface in the proper position.

b. Open the top portion of the container.

c. Remove the drive from the inner container.

d. Make sure that all the items match the packing slip.

NOTE

If anything is found damaged, notify the carrier immediately indicating the nature of damage. If anything is missing (that is included in the packing slip), contact the office where you placed the order.

1.4.2 Physical Checkout

a. Ensure that the front latch opens and closes without any difficulty.

b. Ensure that the drive hub rotates freely.

c. Check to see that the PCB is secured properly and no pins are bent.

d. Make sure that there is no contamination at all between the arm and the head.

1.5 FUNCTIONAL OPERATIONS

1.5.1 Power Sequencing

Applying dc power to the SA300 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 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 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).

1.5.4 Track Accessing

Seeking the read/write head 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 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.

1.5.5 Step Line

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 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 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:

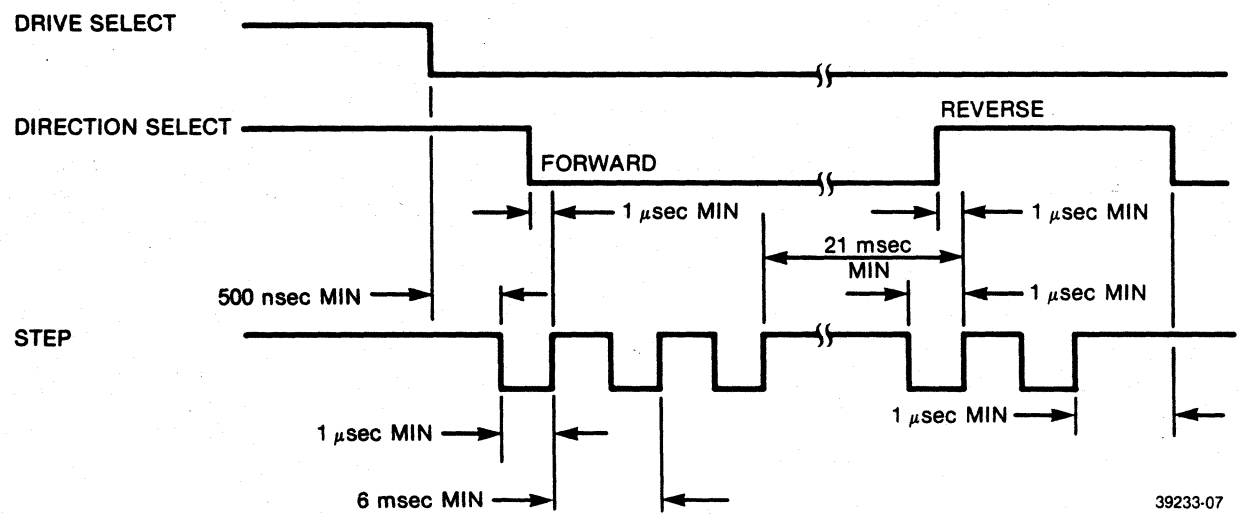


FIGURE 1-3. TRACK ACCESS TIMING

1.5.6 Normal Step Mode

In normal step mode, the read/write heads 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.

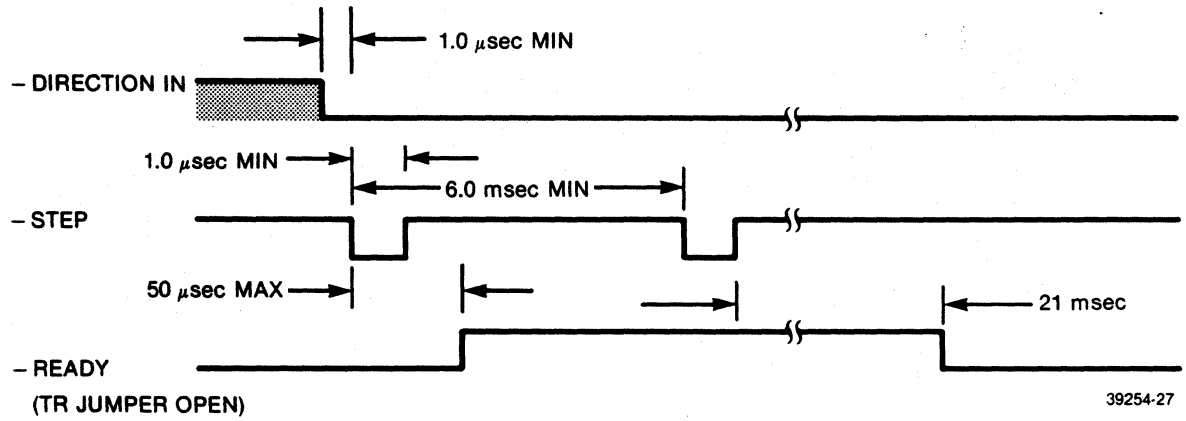


FIGURE 1-4. NORMAL STEP MODE

1.5.7 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 heads begin stepping the desired number of cylinders. READY goes true after the read/write heads 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 SELECT may be performed one μsec after the last step pulse has been sent to the drive.

The maximum time between steps in buffered mode is 5.9 μsec 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.

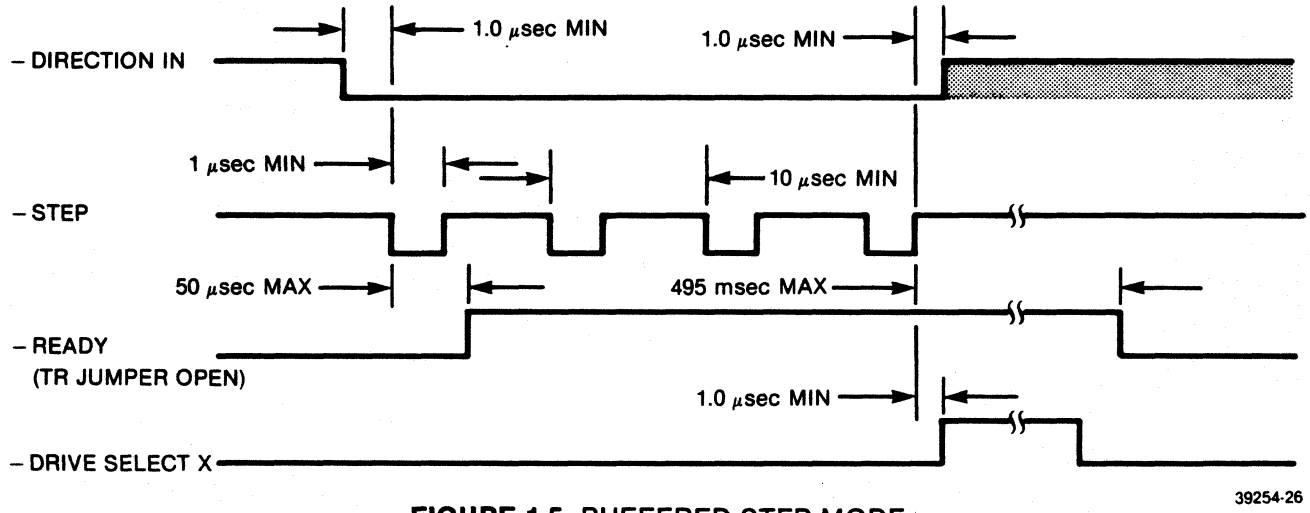


FIGURE 1-5. BUFFERED STEP MODE

1.5.8 Read Operation

Reading data from the SA300 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 position has stabilized prior to reading.

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.

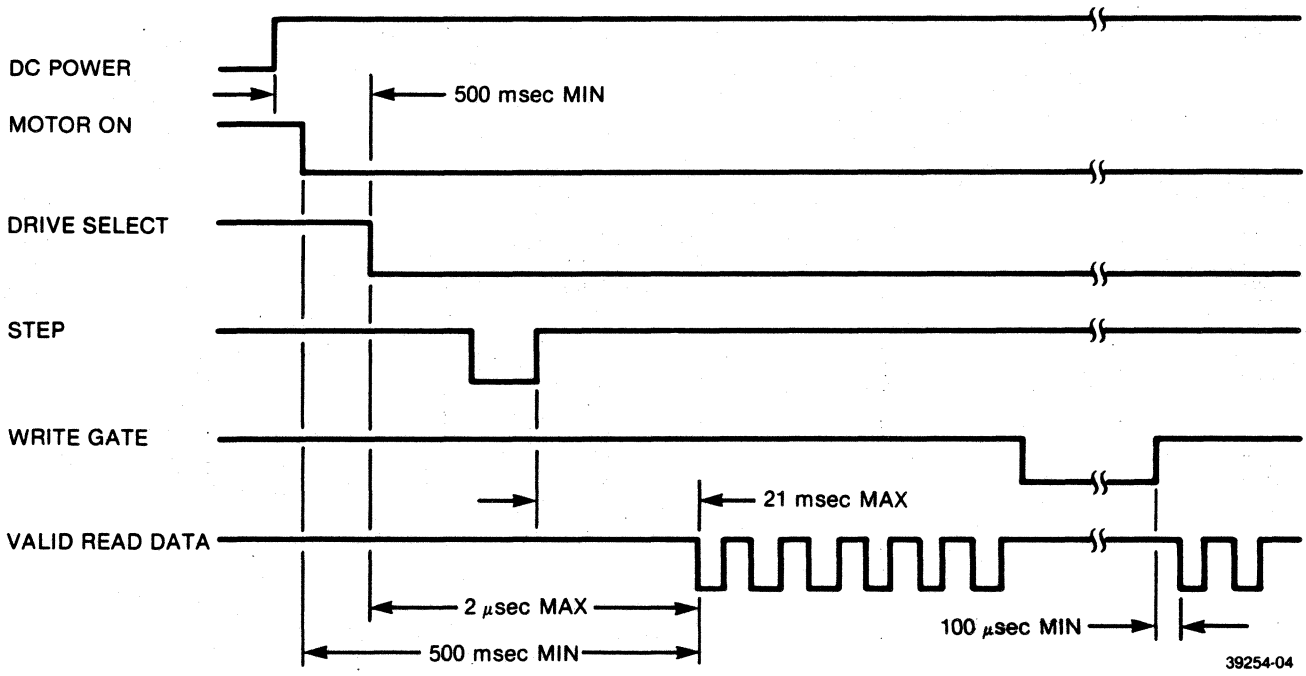


FIGURE 1-6. READ INITIATE TIMING

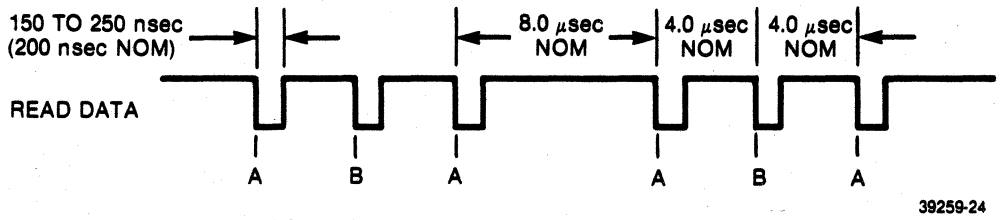


FIGURE 1-7. READ DATA TIMING (FM)

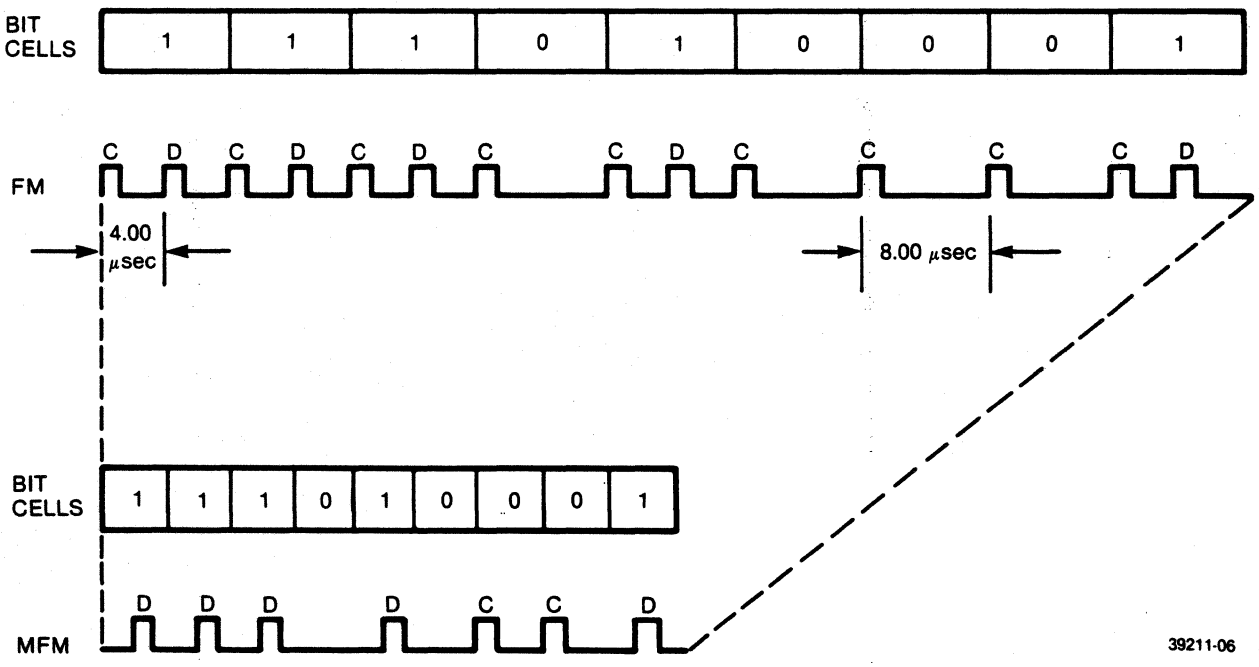


FIGURE 1-8. FM AND MFM CODE COMPARISONS

1.5.9 Write Operation

Writing data to the SA300 is accomplished by:

a. Activating the DRIVE SELECT line.

b. Activating the WRITE GATE line.

c. 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 has stabilized prior to writing. The timing specifications for the write data pulses are shown in figure 1-10.

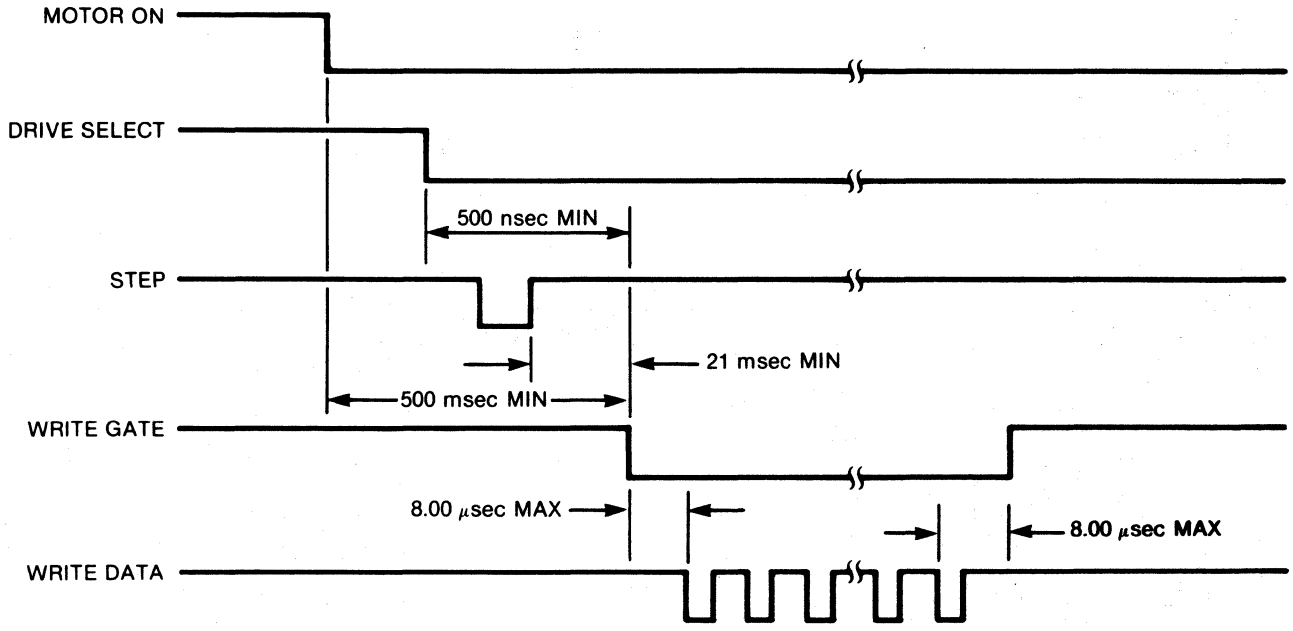


FIGURE 1-9. WRITE INITIATE TIMING

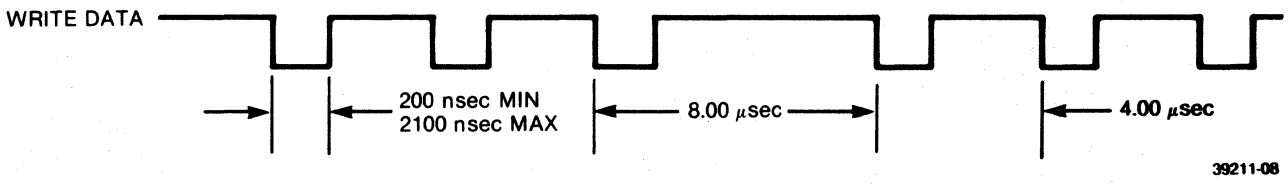


FIGURE 1-10. WRITE DATA TIMING (FM)

Write data encoding can be FM or MFM. The write data should be precompensated 125 to 175 nsec starting at tracks 40-43 to counter the effects of predicable 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 50.

1.5.10 Sequence of Events

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

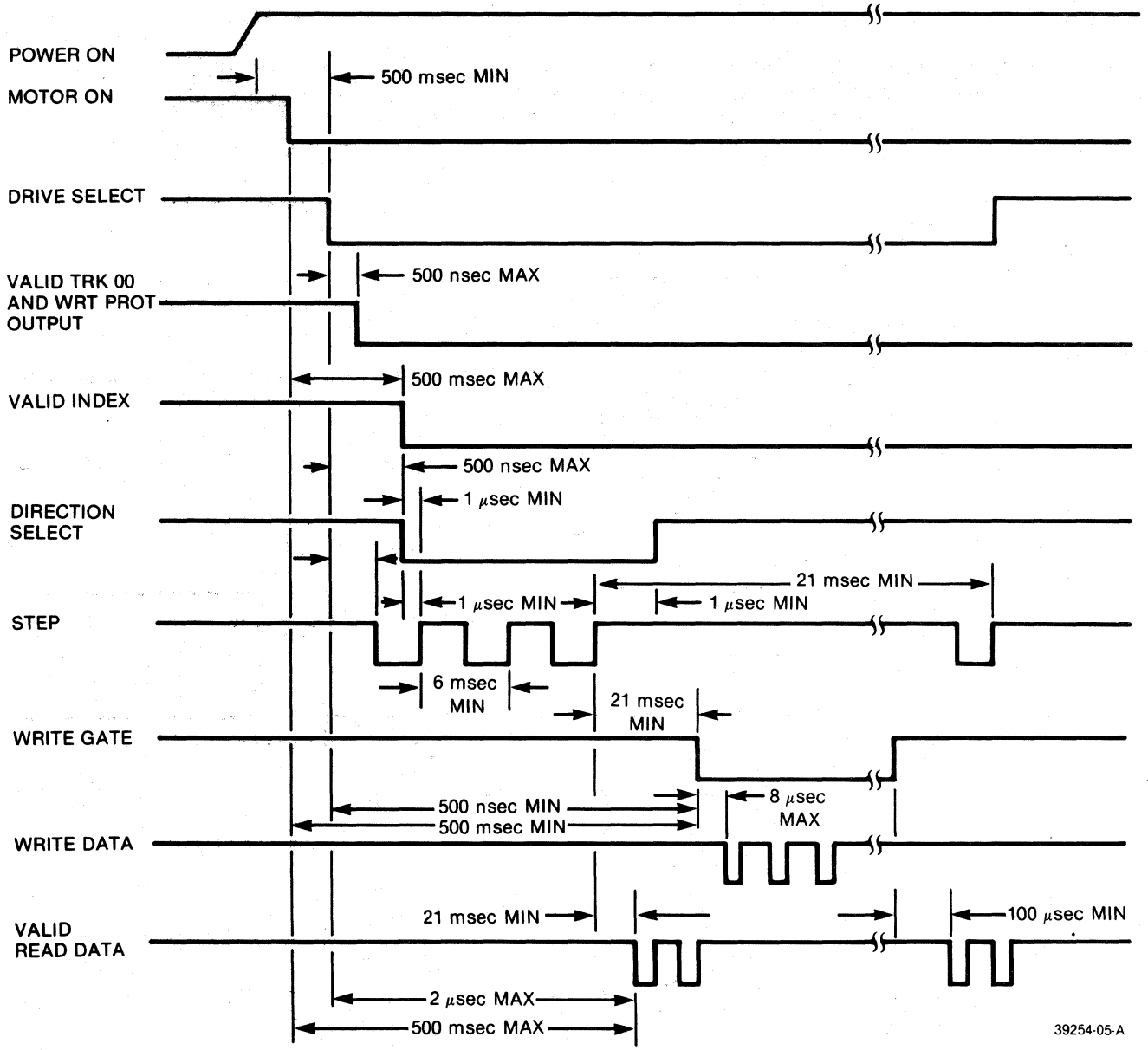


FIGURE 1-11. GENERAL CONTROL AND DATA TIMING REQUIREMENTS

1.5.11 Microcartridge Handling

To protect the cartridge, the same care and handling procedures specified for computer magnetic tapes 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 I.D. 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.

g. Do not touch exposed portion of disk with your fingers.

1.5.12 Microcartridge Loading

To load the microcartridge, insert the cartridge, auto shutter first, with the label facing up. Push in the cartridge. A mechanical interlock ensures proper media insertion. See figure 1-12. Figure 1-12 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.

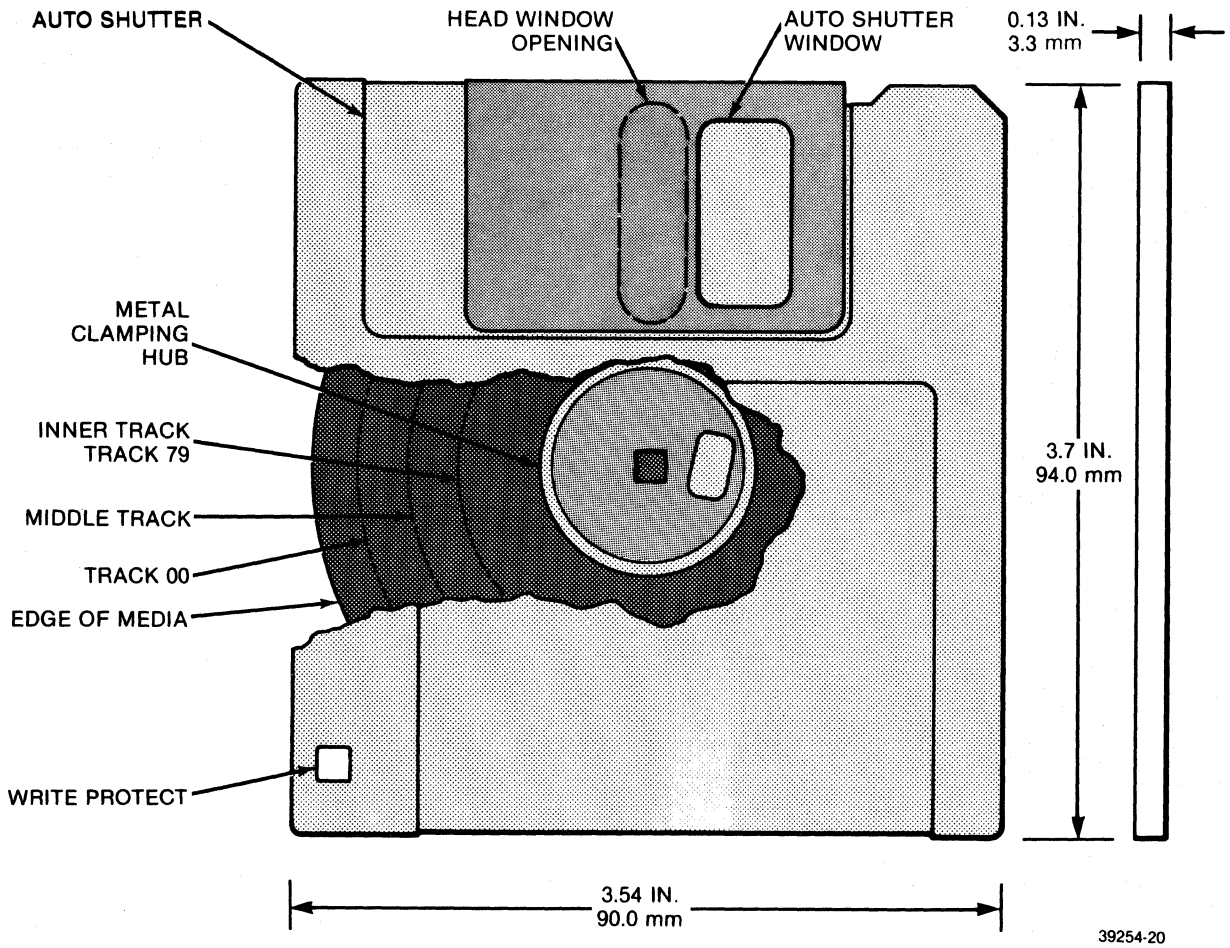


FIGURE 1-12. SA130 MICROCARTRIDGE NOMENCLATURE

1.6 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 1-13):

1. Top Loading — mounted upright.

2. Front Loading — mounted vertical with door opening left or right.
   — mounted horizontal with PCB up.

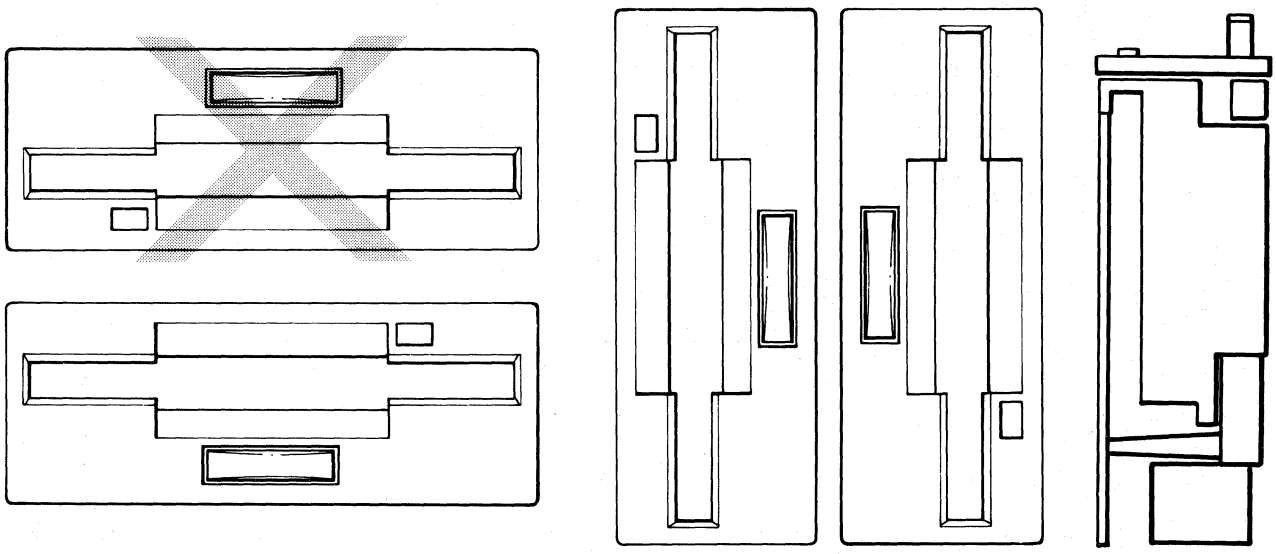


FIGURE 1-13. RECOMMENDED MOUNTING POSITIONS 39254-14

SECTION II
ELECTRICAL INTERFACE

2.1 INTRODUCTION

The interface of the SA300 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 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

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.

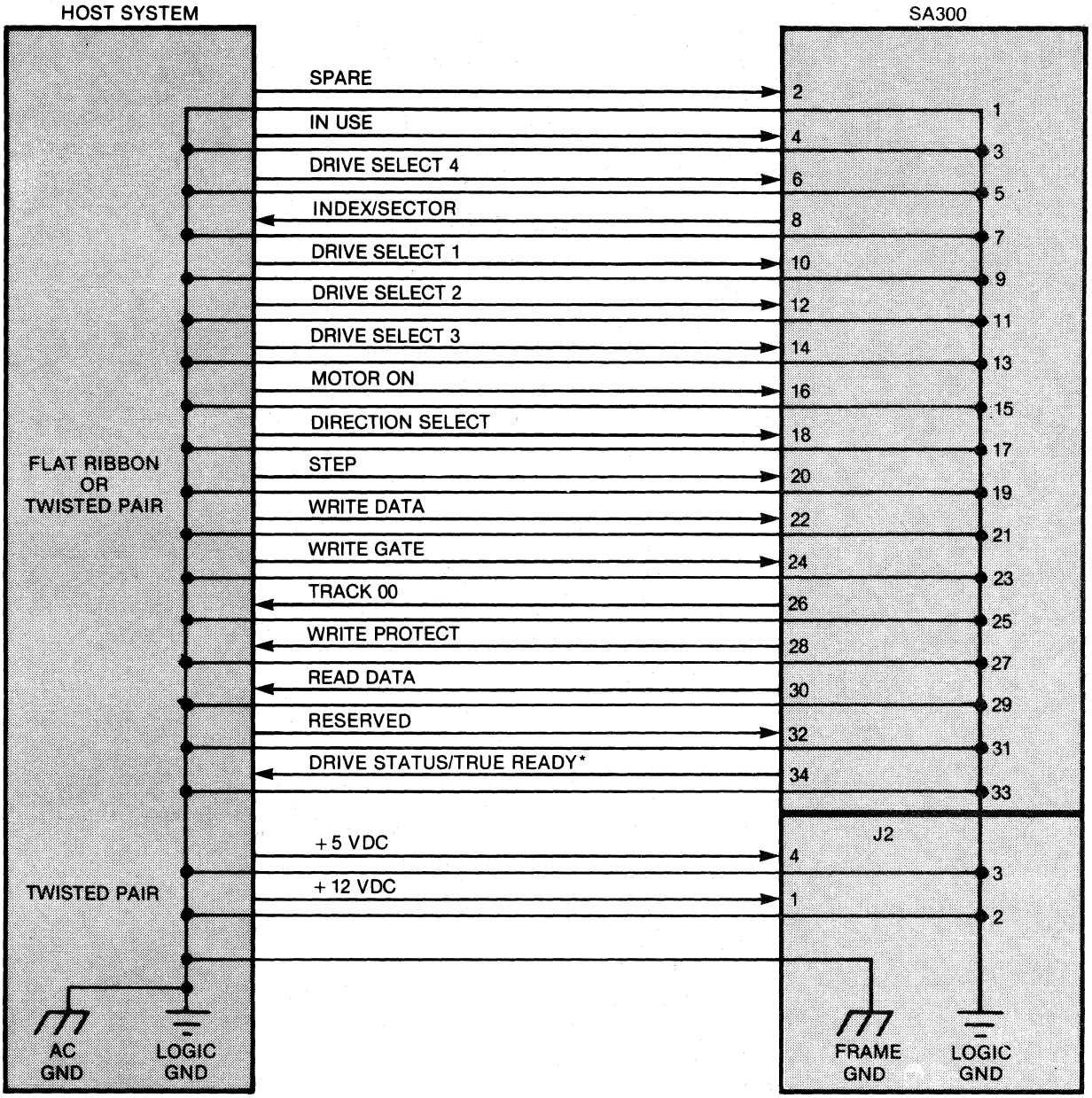


FIGURE 2-1. INTERFACE CONNECTIONS

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

True = Logical 0 = V_{IN} + 0.0 to + 0.4 V @ 40 mA (max)
False = Logical 1 = V_{IN} + 2.5 to + 5.25 V @ 250 μA (open)
Input impedence = 150 ohms

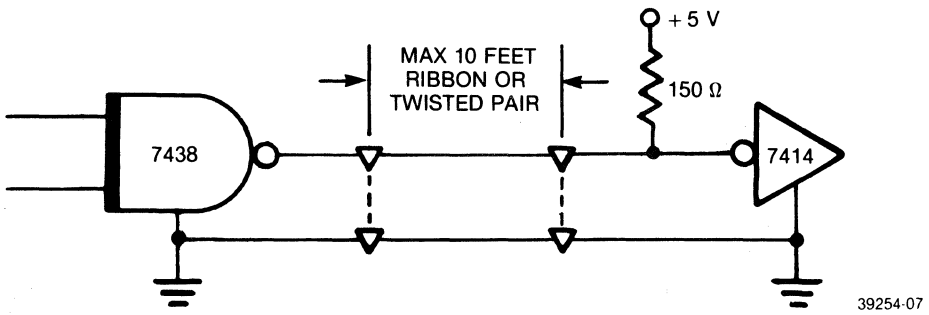


FIGURE 2-2. INTERFACE SIGNAL DRIVER/RECEIVER

2.2.2 Input Line Terminations

The SA300 has been provided with the capability of terminating the following seven input lines:

a. MOTOR ON

b. DIRECTION SELECT

c. STEP

d. WRITE DATA

e. WRITE GATE

f. DOOR LOCK

g. IN USE

These lines are terminated through a 150 ohm resistor pack installed in a DIP socket. In a single drive system, this resistor pack should be kept in place to provide 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, but the user must provide the terminations beyond the last drive and each of the seven lines must be terminated to + 5 Vdc through a 150 ohm, 1/4-watt resistor.

2.2.3 Drive Select 1–4

The SA300 is configured to operate with up to four drives in a multiplexed multiple drive system.

SINGLE DRIVE SYSTEM (MX shorting plug installed)

With the MS shorting plug installed, DRIVE SELECT, when activated to a logical 0 level, will turn the motor on. With MX shorted, the I/O lines are always enabled.

MULTIPLE DRIVE SYSTEM (MS shorting plug not installed)

Four separate input lines (DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3, and DRIVE SELECT 4) are provided so that up to four drives in a multiplexed system may have separate input pins. Only the drive with its unique DRIVE SELECT line active will turn on its motor, allow the drive to respond to multiplexed input lines, and enable the outputs to drive their respective signal lines. A logical 0 on the interface selects a unique drive select line for a drive.

2.2.4 Motor-On

This input, when activated to a logical 0 level, will turn on the drive motor to allow reading or writing on the drive. After activating this line, a 0.5 second delay 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 nominal (ten revolutions of the media) after completion of a previous command. Depending on the application, this time may be varied by the host system to maximize system through-put and motor life.

2.2.5 Direction Select

This interface line defines the direction of motion the read/write heads will take when the STEP line is pulsed. An open circuit, or logical 1, 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 0 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.

2.2.6 Step

This interface line is a control signal which causes the read/write heads to move in the direction of motion defined by the DIRECTION SELECT line. This signal must be a logical 0 pulse with a minimum pulse width of one μsec and a logical 1 for 5.9 msec minimum between adjacent pulses. Each subsequent pulse must be delayed by six msec minimum from the preceding pulse.

The access motion is initiated on each logical 0 to logical 1 transition, or 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 STEP pulse.

2.2.7 Write Gate

The active state of this signal, or logical 0, enables WRITE DATA to be written on the diskette. The inactive state or logical 1, enables the READ DATA logic and stepper logic. Refer to figure 1-7 for timings.

2.2.8 Write Data

This interface line provides the data to be written on the diskette. Each transition from a logical 1 level to a logical 0 level will cause the current through the read/write heads to be reversed, thereby writing a data bit. This line is enabled by WRITE GATE being active. WRITE GATE must be inactive during a read operation. See figure 1-7 for timings.

2.2.9 IN USE Input

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

2.2.10 Output Lines

The output control lines have the following electrical specifications:

True = Logical 0 = V_{OUT} + 0.0 to + 0.04 V @ 40 mA (max)
False = Logical 1 = V_{OUT} + 5.25 V (open collector @ 250 μA max)

See figure 2-2 for the recommended circuit.

2.2.11 Track 00

The active or logical 0 state of this interface signal indicates when the read/write head of the drive are positioned at track 00 (the outermost track) and the stepper is locked on track. This signal is at a logical 1 level or inactive state, when the read/write heads of the drive are not at track 00. When the heads are at track 00 and an additional step out pulse is issued to the drive, a mechanical stop will keep the read/write heads at track 00. See figures 2-3 and 2-4 for track 00 circuit and timing.

2.2.12 Index Signal

This interface signal is provided by the drive on each revolution of the drive motor or every 200 msec. The media has no physical hole, so the pulse is generated by a detector which picks up an output from a magnetic device on the motor hub. This pulse is required to generate READY and indicates the physical beginning of a track.

When using the INDEX signal, look for an edge or transition rather than a level for determining its status. With no diskette inserted, this signal remains active or at a logical 0 level which is an erroneous status.

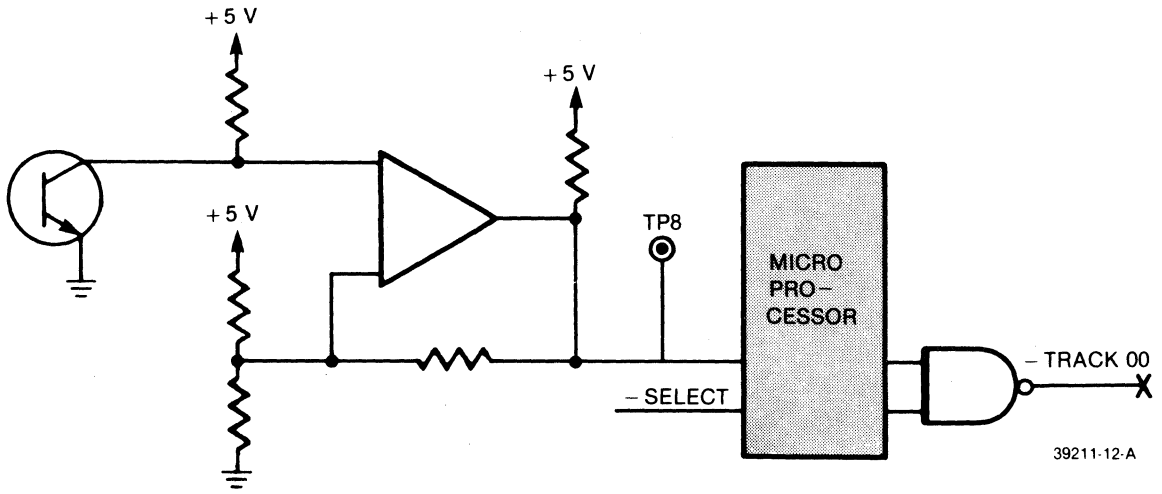


FIGURE 2-3. TRACK ZERO CIRCUIT

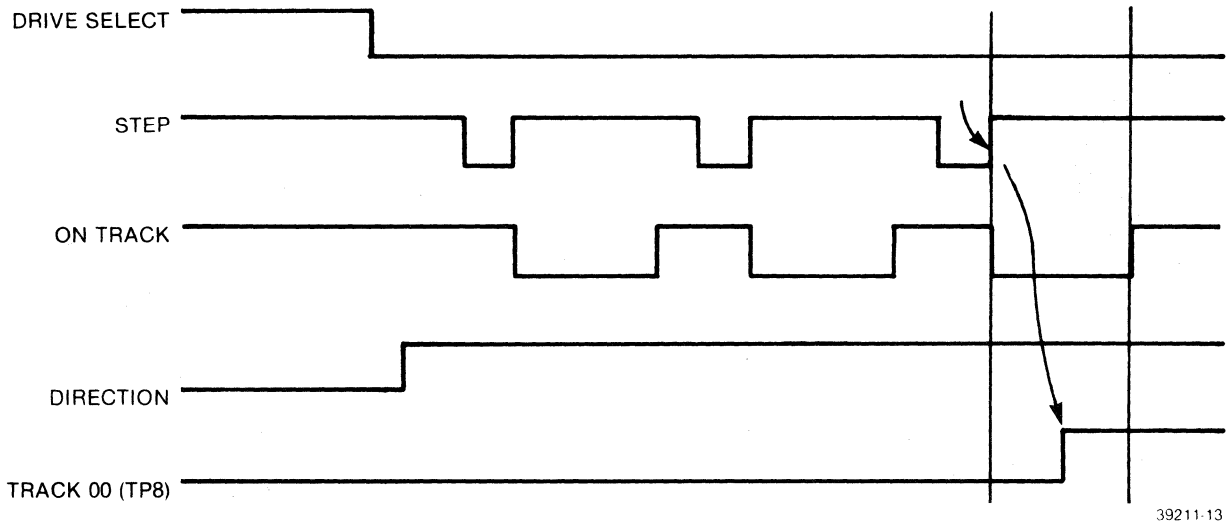


FIGURE 2-4. TRACK ZERO TIMING

2.2.13 Sector

Drive has no provisions for sector pulses.

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 1 level and becomes a logical 0 level for the active state.

2.2.15 Write Protect

This interface signal is provided by the drive to give the user an indication when a write protected diskette is installed. The logical signal at 0 inhibts writing when the diskette is write protected. The logic disables the write electronics and supplies the status signal to the interface.

2.3 POWER INTERFACE

The SA300 requires only dc power for operation. DC power to the drive is provided via P2/J2 located on the component side the PCB near the spindle drive motor.

2.4 FRAME GROUND

CAUTION

It is important that the drive be frame grounded to the host system ac or frame ground. Failure to do so may result in drive noise susceptibility. Refer to paragraph 3.3 for grounding procedures.

SECTION III
PHYSICAL INTERFACE

3.1 INTRODUCTION

The electrical interface between the SA300 and the host system is via two connectors J1 and J2.

a. J1 provides the signal interface.

b. J2 provides the dc power.

This section describes the location of connectors used on the drive and the recommended connectors to be used with them. See figure 3-1 for connector locations.

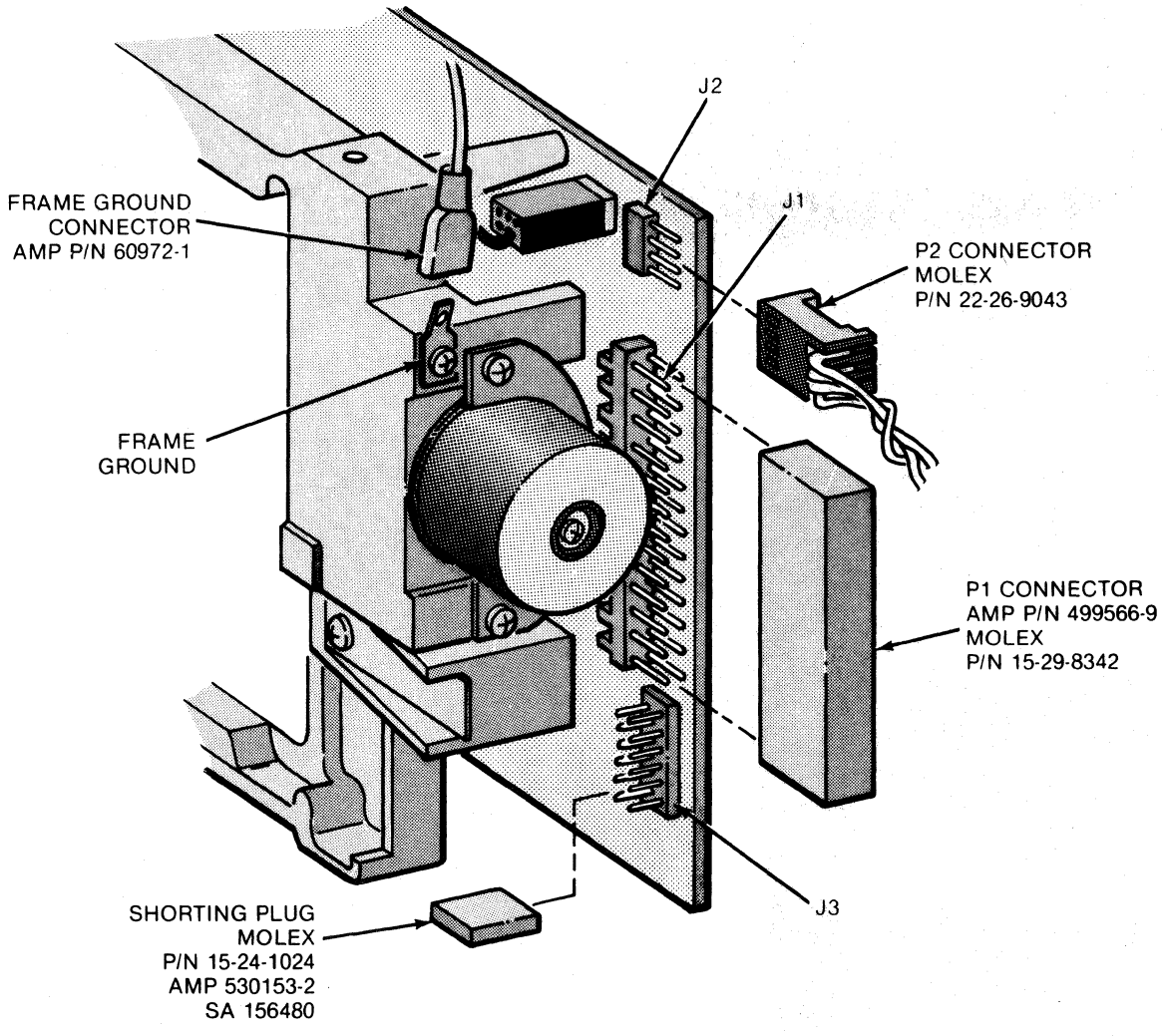


FIGURE 3-1. INTERFACE CONNECTORS — PHYSICAL LOCATIONS

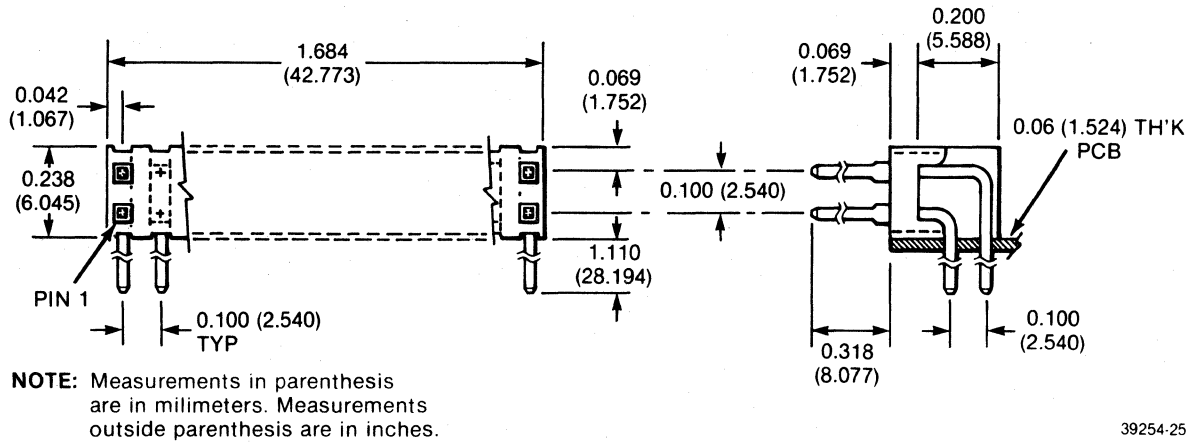
3.2 J1/P1 CONNECTOR

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 connectors for P1 are 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

39259-24



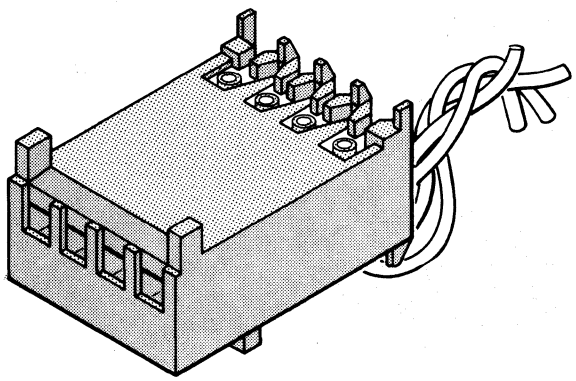
NOTE: Measurements in parenthesis are in milimeters. Measurements outside parenthesis are in inches.

39254-25

FIGURE 3-2. J1 CONNECTOR DIMENSIONS

3.2.1 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 OD/-013003-0. The recommended mating connector (P2) is AMP 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

3.3 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.

SECTION IV
THEORY OF OPERATION

4.1 INTRODUCTION

This section describes the basic principles of operation of SA300. The drive has all the necessary components to perform different functions. A dc power of + 12 volts and + 5 volts is required to operate this drive.

The drive electronics are packaged on one PCB which contains:

a. Read/Write Amplifier and Transition Detector

b. Spindle Motor Control

c. Drive Select Circuits

d. Index Detector Circuits

e. Track Zero Circuits

f. Track Accessing Circuits

g. Power On Reset Control

h. Write Protect Circuits

i. Drive Status Circuits (optional)

j. Microprocessor Control Electronics

The head positioning actuator moves the read/write head(s) to the desired track on the diskette. The head(s) is loaded onto the diskette when the door is closed.

4.2 MICROPROCESSOR LOGIC

Much of the logic for the SA300 is implemented with an internal microprocessor. The microprocessor has its own internal firmware ROM, RAM memory and I/O ports. This approach provides many advanced features in a physically small package. The microprocessor monitors the interface lines for commands from the host system and monitors the drive's internal status information to the host system via the DRIVE STATUS, TRACK 00, and WRITE PROTECT interface lines. The stepper motor positioner, activity LED, spindle motor on/off state, and write enable functions are all controlled by the microprocessor. By appropriate software, the microprocessor makes available buffered step, True Ready and Disk Change status options, and Self-Test with no additional hardware.

4.3 READ/WRITE OPERATIONS

a. The SA300 uses double frequency non return to zero (NRZI) recording method.

b. The read/write head, in general, is a ring with a gap and a coil wound at some point on the ring.

c. During a write operation, a bit is recorded when the flux direction in the ring is reversed by rapidly reversing the current in the coil.

d. During a read operation, a bit is read when the flux direction in the ring is reversed as a result of a flux reversal on the diskette surface.

SA300 drives use the double-frequency (2F) longitudinal (NRZI) method of recording. Double frequency is the term given to the recording system that inserts a clock bit at the beginning of each bit cell thereby doubling the frequency of recorded bits. This clock bit, as well as the data bit, is provided by the using system. See figure 4-1.

The read/write head is a ring with a gap and a coil wound at some point on the ring. When current flows through the coil, the flux induced in the ring fringes at the gap. As the diskette recording surface passes by the gap, the fringe flux magnetizes the surface in a longitudinal direction. See figure 4-2.

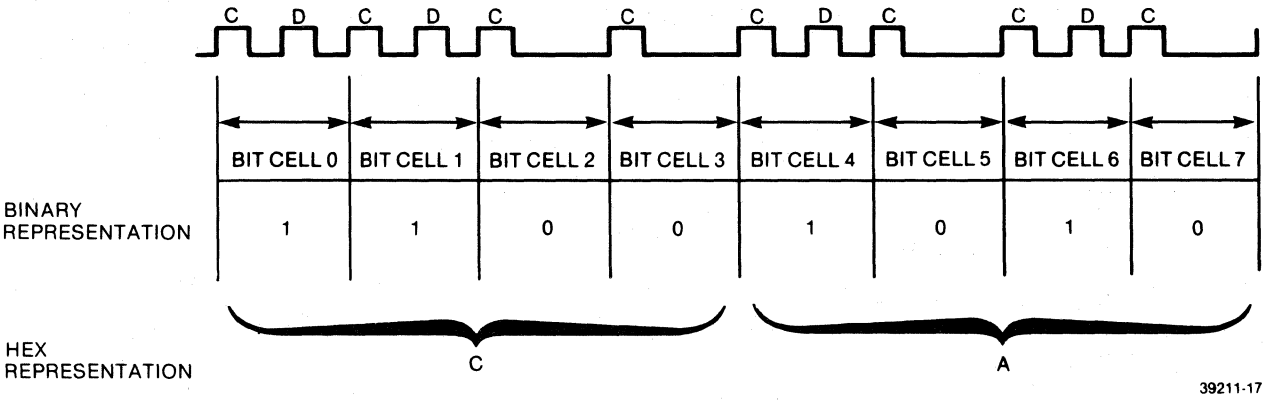


FIGURE 4-1. BYTE

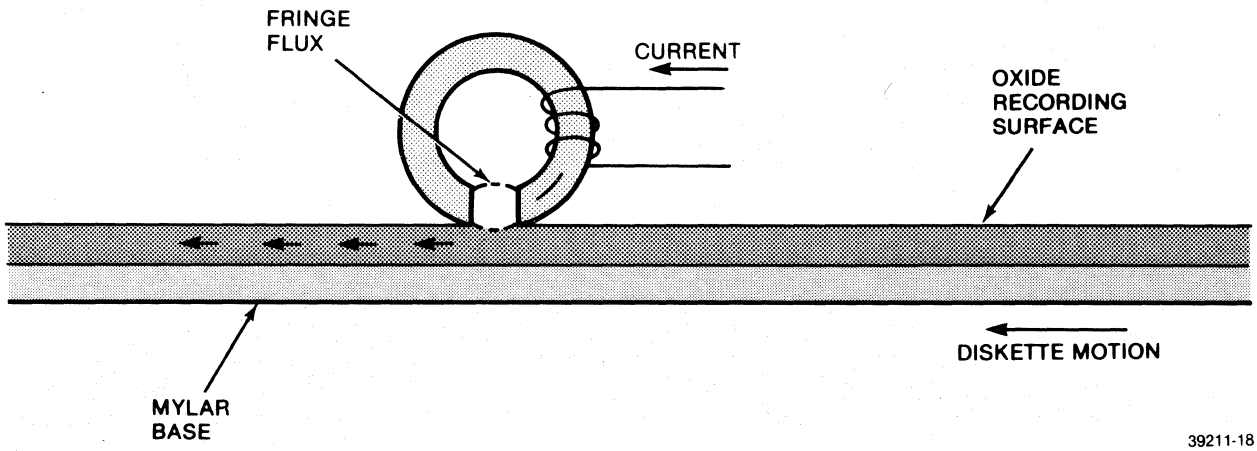


FIGURE 4-2. BASIC READ/WRITE HEAD

The drive writes two frequencies: 1F 62.5 k Hz and 2F 125 k Hz. During a write operation, a bit is recorded when the flux direction in the ring is reversed by rapidly reversing the current in the coil. The fringe flux is reversed in the gap and hence the portion of the flux flowing through the oxide recording surface is reversed. If the flux reversal is instantaneous as compared to the diskette motion, the diskette surface is magnetized. The diskette surface that just passed under the gap is magnetized in one direction. The portion still under the gap is magnetized in opposite direction. The flux reversal represents a recorded bit. See figure 4-3.

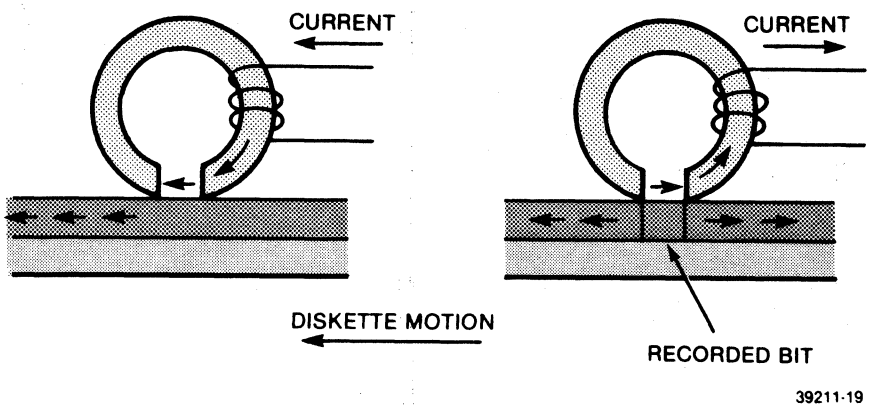


FIGURE 4-3. RECORDING A BIT

During a read operation, a bit is read when the flux direction in the ring is reversed as a result of a flux reversal on the diskette surface. The gap first passes over an area that is magnetized in one direction, and a constant flux flows through the ring and coil. The coil registers no output voltage at this point. When a recorded bit passes under the gap, the flux flowing through the ring and coil make a 180° reversal. This means that the flux reversal in the coil causes a voltage output pulse. See figure 4-4.

These flux reversals produce an FM waveform which transmits data to and from the diskette. See figure 4-5.

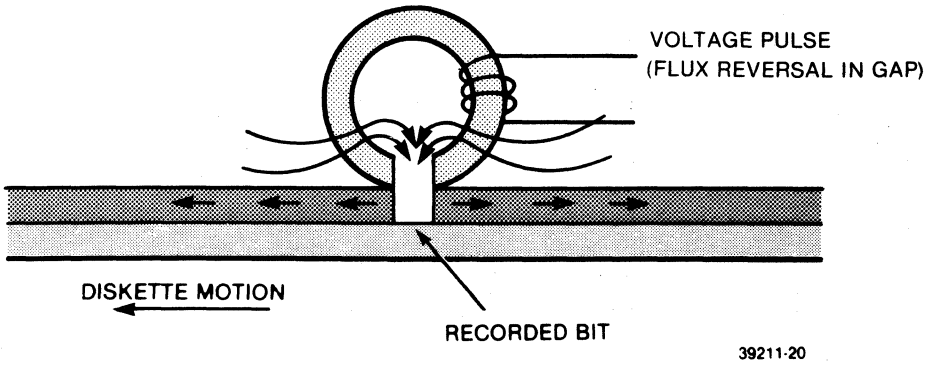


FIGURE 4-4. READING A BIT

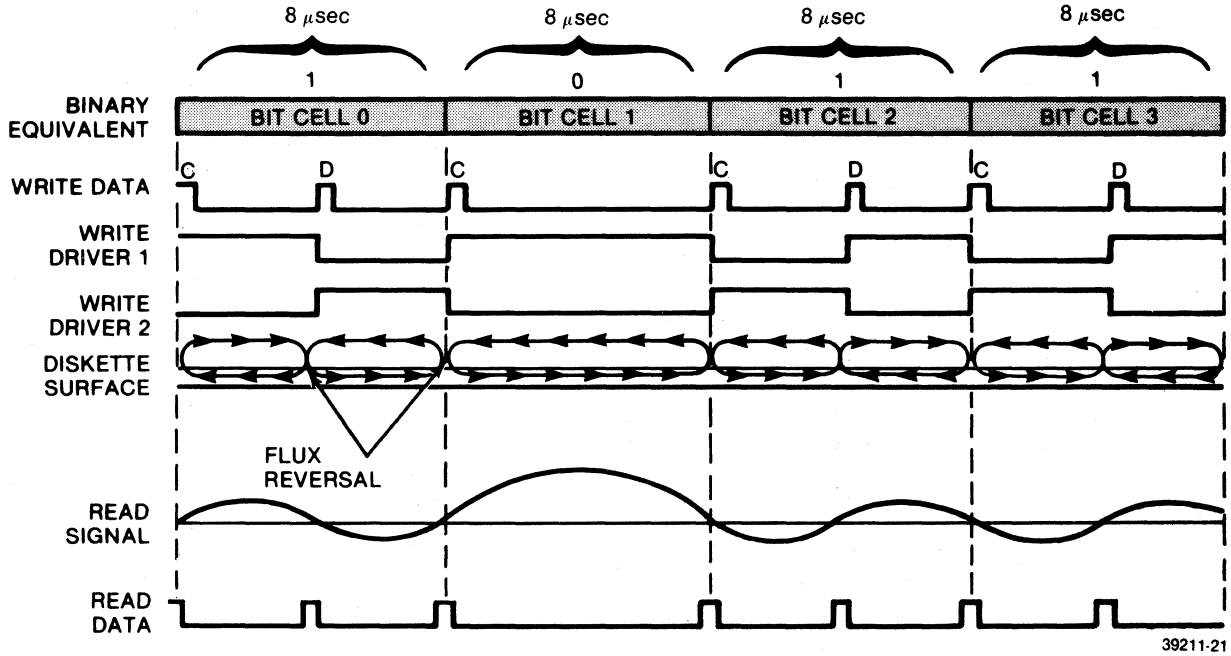


FIGURE 4-5. 1F AND 2F RECORDING FLUX AND PULSE RELATIONSHIP

4.4 READ/WRITE HEAD

a. The ceramic read/write head contains three coils.

b. When writing, the head erases the outer edges of the track to ensure that the data recorded will not exceed the .0045 inch track width.

The read/write head contains three coils. Two read/write coils are wound on a single core, center tapped and, one erase coil is wound on a yoke that spans the track being written. The read/write and erase coils are connected as shown in figure 4-6.

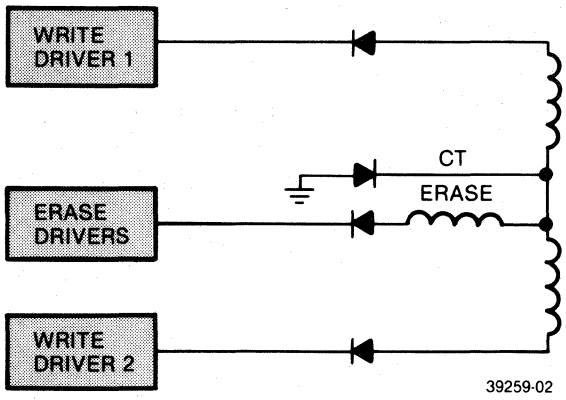


FIGURE 4-6. READ/WRITE HEADS

During a write operation, the erase coil is energized. This causes the outer edges of the track to be trim erased so that the track being recorded will not exceed the .0045 inch track width. Trim erasing allows for minor deviations in read/write head current so that when one track is recorded, it will not "splash over" to adjacent tracks.

Each bit written will be directed to alternate read/write coils, thus causing a change in the direction of current flow through the read/write head. This will cause a change in the flux pattern for each bit. The current through either of the read/write coils will cause the old data to be erased as new data is recorded.

During a read operation, the direction of flux changes on the diskette surface as it passes under the gap and current is induced into one of the windings of the read/write head. This results in a voltage output pulse. When the next data bit passes under the gap, another flux change takes place in the recording surface. This causes current to be induced in the other coil, producing another voltage output pulse of the opposite polarity.

4.5 WRITE CIRCUIT OPERATION

a. The WRITE DATA trigger flips with each pulse on the WRITE DATA line.

b. The WRITE DATA trigger alternately drives one or the other of the WRITE DRIVERS.

c. WRITE GATE allows WRITE CURRENT to flow to the WRITE DRIVER circuits if a diskette is not write protected.

d. WRITE CURRENT sensor allows ERASE COIL CURRENT.

e. Heads are selected by grounding the appropriate center tap.

WRITE DATA pulses (clock and data bits) are supplied by the using system. The WRITE TRIGGER "flips" with each pulse. The outputs are fed to alternate WRITE DRIVERS.

WRITE GATE and NOT WRITE PROTECT are ANDed together and will cause WRITE CURRENT to flow to the WRITE DRIVER circuits, which in turn causes the center tap switch to close and ERASE CURRENT to flow after the turn on delay of 400 μsec.

The output of one of the WRITE DRIVERS allows WRITE CURRENT to flow through one half of the read/write coil. When the WRITE TRIGGER "flips," the other WRITE DRIVER provides WRITE CURRENT to the other half of the read/write coil.

The removal of WRITE GATE causes the turn off delay circuit to time out for 1.1 milliseconds. At the end of the delay, the center tap switch opens and the ERASE CURRENT source is turned off. See figure 4-7.

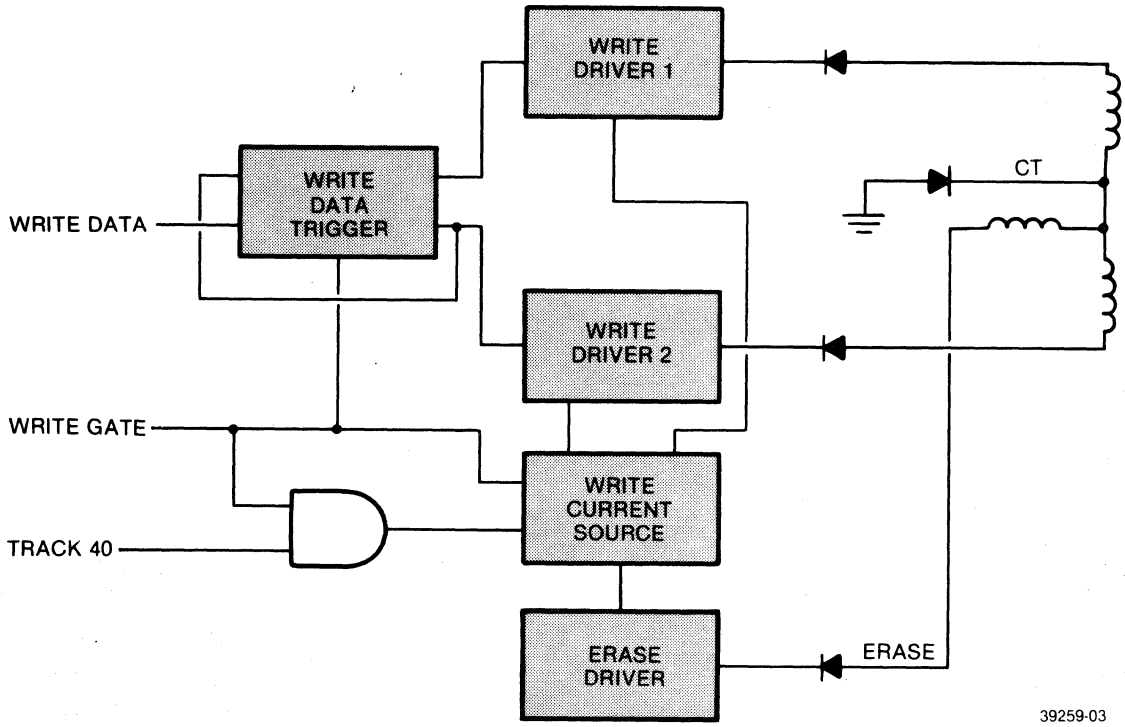


FIGURE 4-7. WRITE CIRCUIT FUNCTIONAL DIAGRAM

4.6 READ CIRCUIT OPERATION

a. Duration of all read operations is under control of the using system.

b. As long as the drive is selected and WRITE GATE is not active, the READ signal is amplified and shaped, and the square wave signals are sent to the interface as READ DATA.

When the using system requires data from the diskette drive, the using system must select the head and DISABLE WRITE GATE. The READ signal is then fed to the amplifier section of the read circuit. After amplification, the READ signal is fed to a filter where the out-of-band noise is removed. The READ signal is then fed to the differentiator amplifier.

Since a clock pulse occurs at least once every eight μsec, and data bits are present once every four μsec, the frequency of the READ DATA varies (FM encoding only). The READ signal amplitude decreases as the frequency increases. Note the signals in figure 4-8. The differential amplifier will amplify, differentiate, limit, and digitize the READ signals (sine waves).

The drive has no data separator, only a pulse standardizer for the READ DATA signal.

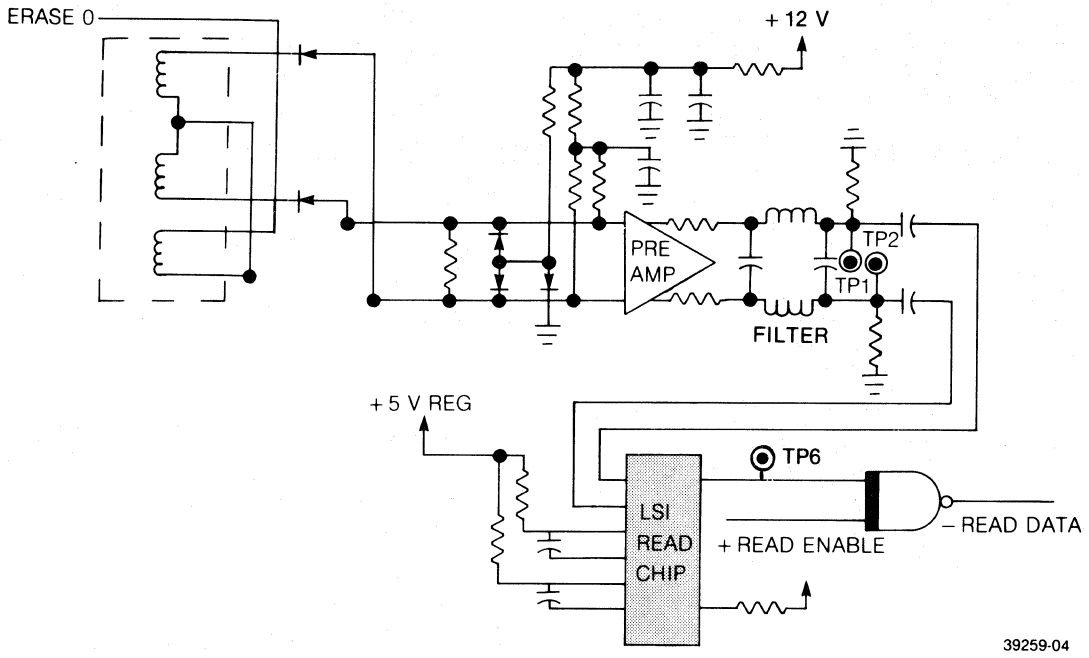


FIGURE 4-8. READ CIRCUIT

4.7 DRIVE MOTOR CONTROL

a. Speed Control

b. Speed Adjust

c. Index Adjust

The spindle motor on the SA300 is a direct drive brushless, dc type with associated control electronics.

When the host system commands the motor on through the interface, the internal drive microprocessor applies power to the spindle motor control electronics. The control electronics start the motor, apply current to the proper motor windings in sequence and regulate the motor speed using an integral tachometer signal. Motor speed adjustment is accomplished through a potentiometer on the motor/electronics module.

4.8 INDEX DETECTOR

Each time a magnetic output device located on the motor hub is moved past the index sensor, a pulse is formed. This pulse is present on the interface as index pin eight. Without a diskette in the drive, the interface line will be high and the using system must look for a transition to be a valid signal. The detector output is fed into a schmidt trigger with a level trigger latch-back to maintain pulse stability while shaping the pulse. With output enable true, this pulse will be on the interface as a negative going pulse.

4.9 TRACK ZERO INDICATION

Track 00 signal (pin 26) is provided to the using system to indicate when the read/write head is positioned on track 00. Figures 2-3 and 2-4 show the logic and timing for track 00 indication. The track 00 indication is provided when the flag attached to the head carriage passes between the photo transistor and the photo detector. On track, DRIVE SELECT is ANDed with the photo detector output. These conditions will cause a track 00 indication to the interface.

4.10 TRACK ACCESSING

a. Stepper Motor (Four Phase)

b. Stepper Control Logic

c. Reverse Seek

d. Forward Seek

Seeking the read/write head from one track to another is accomplished by selecting the desired direction utilizing the DIRECTION IN interface line and pulsing the STEP line. Multiple track movement is accomplished by repeated pulsing of the STEP line.

The four phase stepper motor turns the actuator leadscrew in two step increments per track. Two increments will move the head one track via a follower which is attached to the carriage assembly. The follower rides in the helical grove in the leadscrew.

The stepper motor has four windings; two windings are energized for each phase. Phases A and C occur when the head is on track. Phases B and D are transient states.

The microprocessor provides control of the stepper motor, sequencing the phases with the proper time delays to perform the seek specified on the interface. The microprocessor additionally controls two current modes for the stepper motor. When stepping and settling, the high current mode is used. The low current mode is used while the head is stable on track. Within 21 msec after the last step pulse is issued, stepper motor current is reduced.

At power on reset time, the drive microprocessor automatically recalls the head to track 00. If the track 0 sensor is inactive at power on reset, the head is stepped until the track 0 sensor and phase A are both active. If the track 0 sensor is already active at power on reset, the head is first stepped in to make sure it clears the rear stop and then is stepped back out. Figure 4-9 illustrates the Stepper Logic. See figure 4-10 for Power On Reset and figure 4-11 for Stepper Timing.

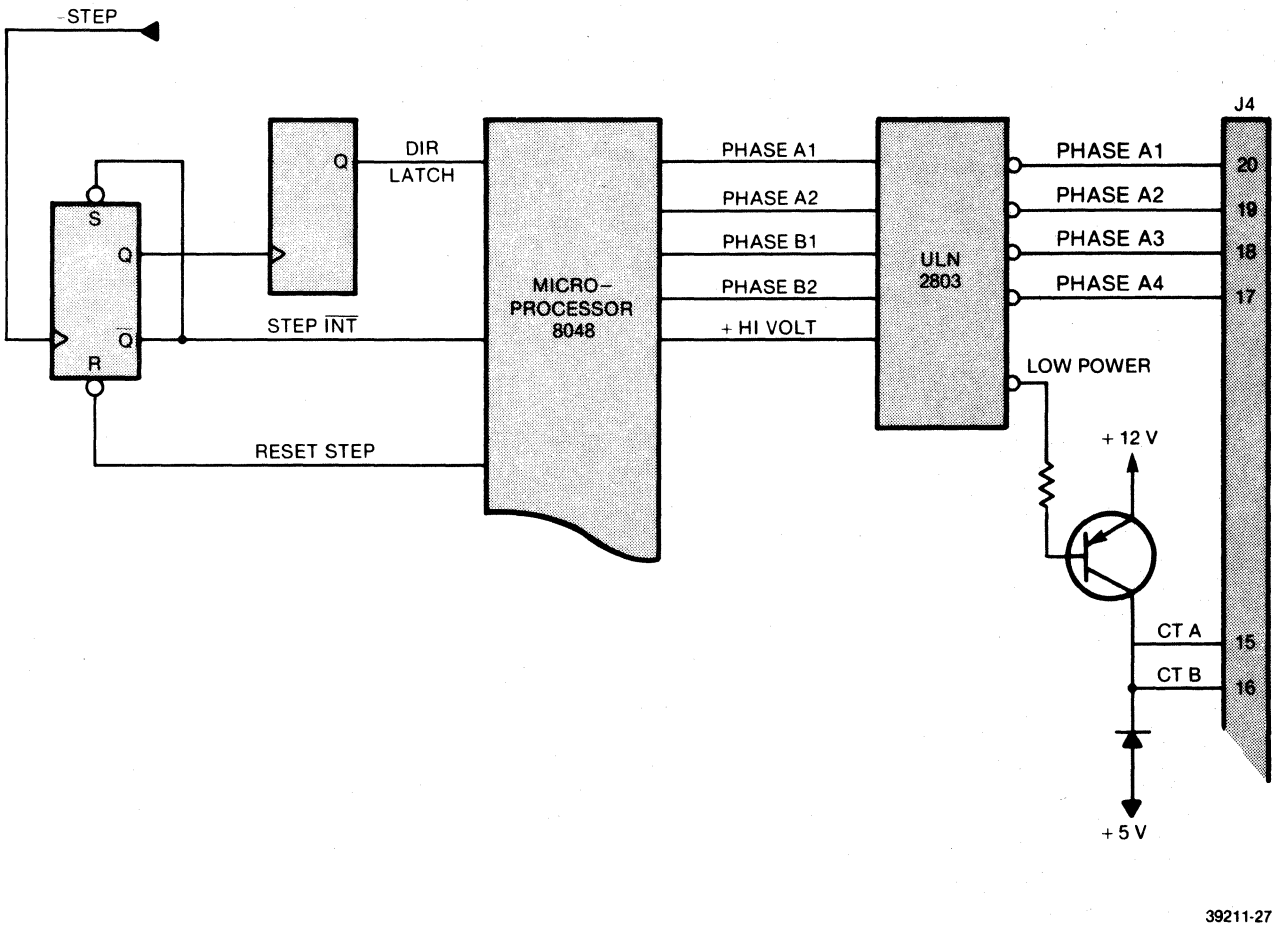


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FIGURE 4-9. STEPPER LOGIC

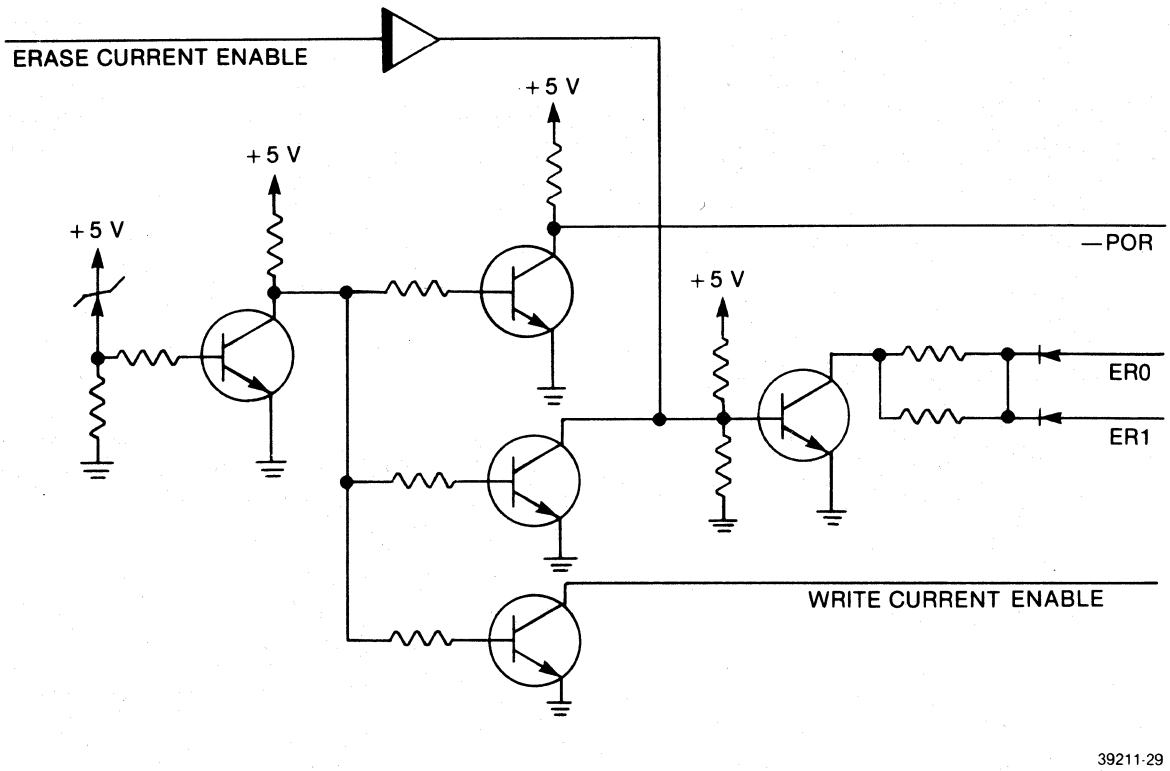

FIGURE 4-10. POWER ON RESET

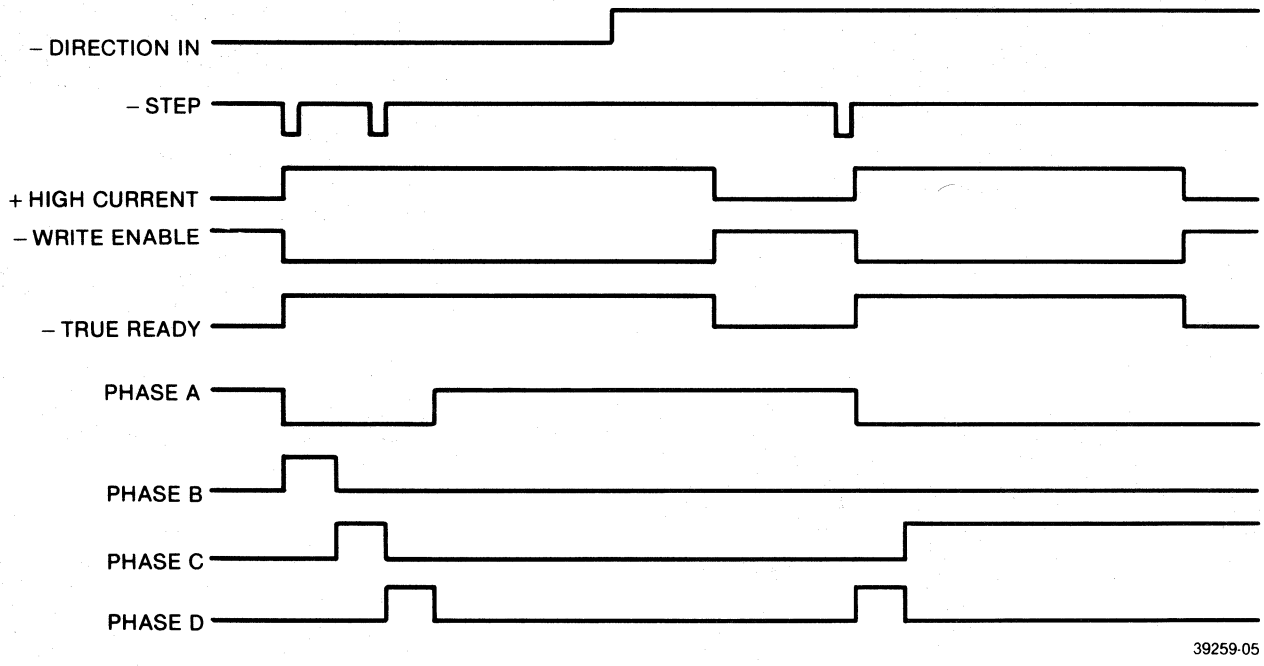

FIGURE 4-11. STEPPER TIMING

4.11 DRIVE SELECT

The SA300 is configured to operate alone in a single drive system. It can be easily modified to operate with other drives in a daisy chained multiplexed drive system. This is done by selecting the specific drive address and jumpering the appropriate DRIVE SELECT line. See figure 4-12.

The MX option is used for single drive systems. By shorting MX, the I/O lines are always enabled. The MS option allows the motor to be enabled from DRIVE SELECT.

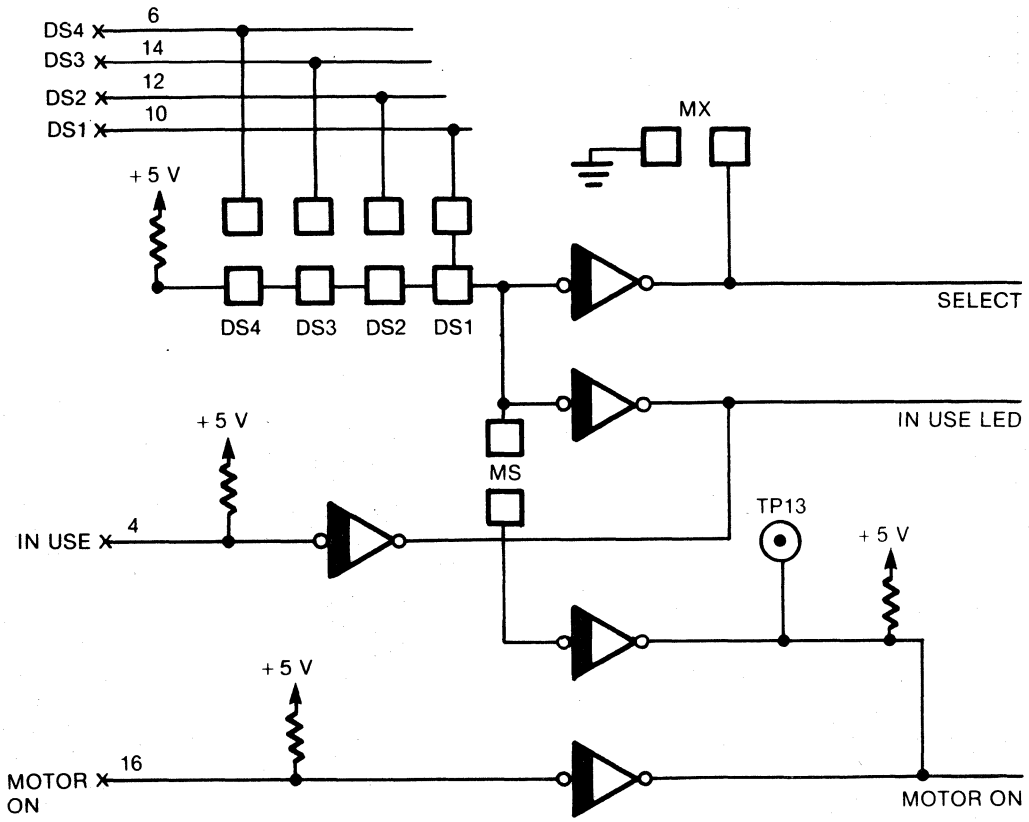

FIGURE 4-12. DRIVE SELECT, MOTOR ON AND IN USE

4.12 WRITE PROTECT

This interface signal is provided by the drive to indicate to the user when a write protected diskette is installed. The signal is logic 0 level when it is protected. Under normal operation, the drive will inhibit writing with a protected diskette installed in addition to notifying the interface.

4.13 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 TP11 is shorted to TP10 (gnd).

TR Shorted, TP11 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, TP11 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, TP11 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.

4.14 AUTO SHUTTER OPENING/CARTRIDGE EJECT MECHANISM

The auto shutter opening/cartridge eject mechanism is a dual function device. It opens the shutter as well as provides spring force to eject the cartridge. The shutter open/eject arm makes contact with the notch in the auto shutter. As the cartridge is pushed further, the arm rotates inward opening the shutter. When the shutter is completely open, the arm is locked by the latch. The elevator is unlatched and is lowered.

When the cartridge Eject Button is depressed, the media is removed from the head. The eject arm is unlatched and the media comes out with the help of a pre-load spring. See figure 4-13 for an operational diagram. If the media is inserted backwards or reverse, the shutter open/eject arm will not pivot. In this case, the cartridge cannot be lowered, causing damage to the head or load arm.

4.15 ELEVATOR OPERATION

The elevator function is to lower the disk cartridge until the media hub engages the spindle. At the same time the load arm is lowered onto the media causing the media to contact the R/W head. The elevator is now latched in the down position.

When the eject button is depressed, the elevator is raised, the media is removed from the drive and the shutter closes before the cartridge is ejected.

4.16 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.

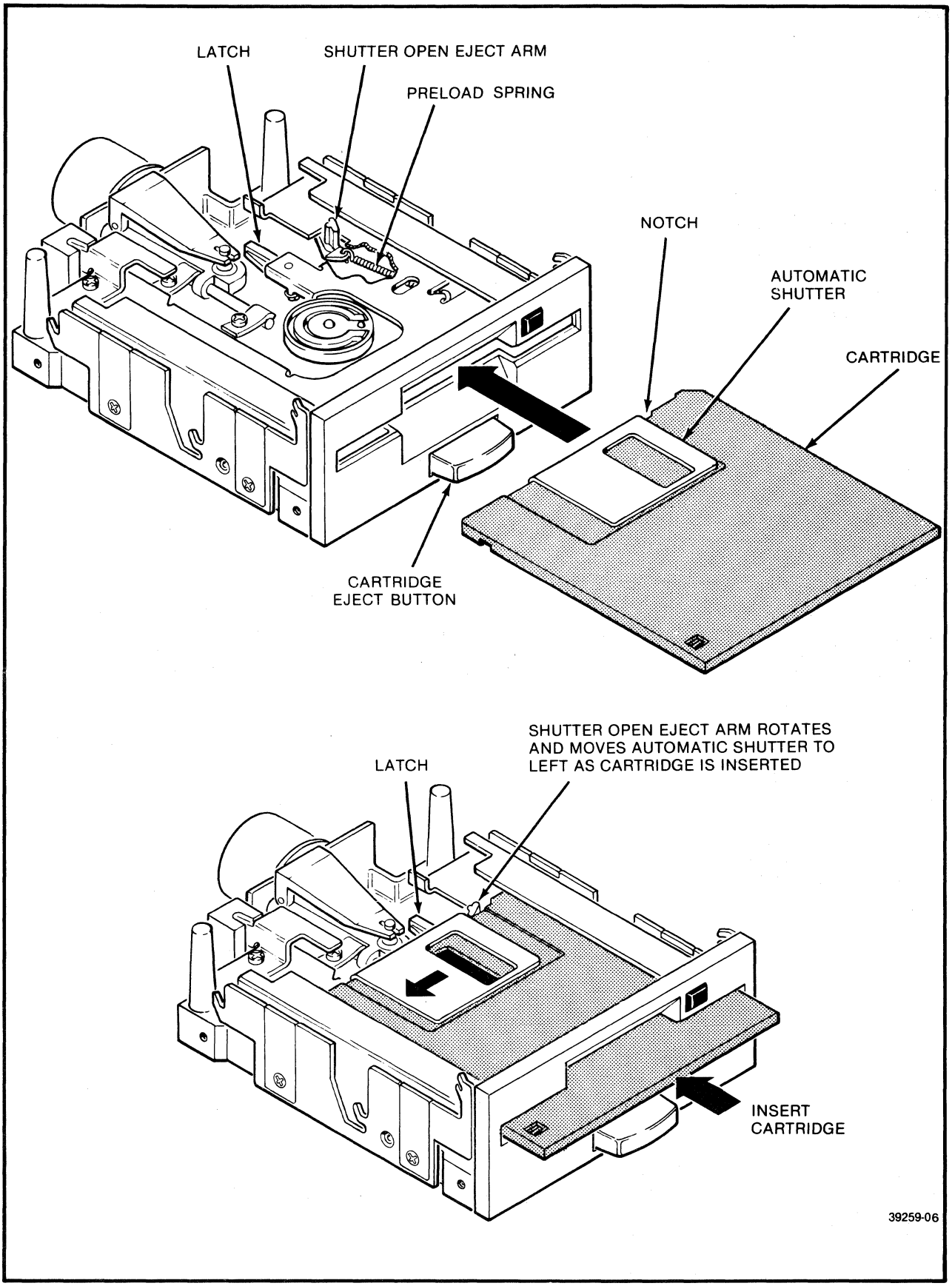

FIGURE 4-13. CARTRIDGE SHUTTER OPENING/CARTRIDGE EJECT MECHANISM

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 4-14 shows the equivalent logic of this function.

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 in 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.

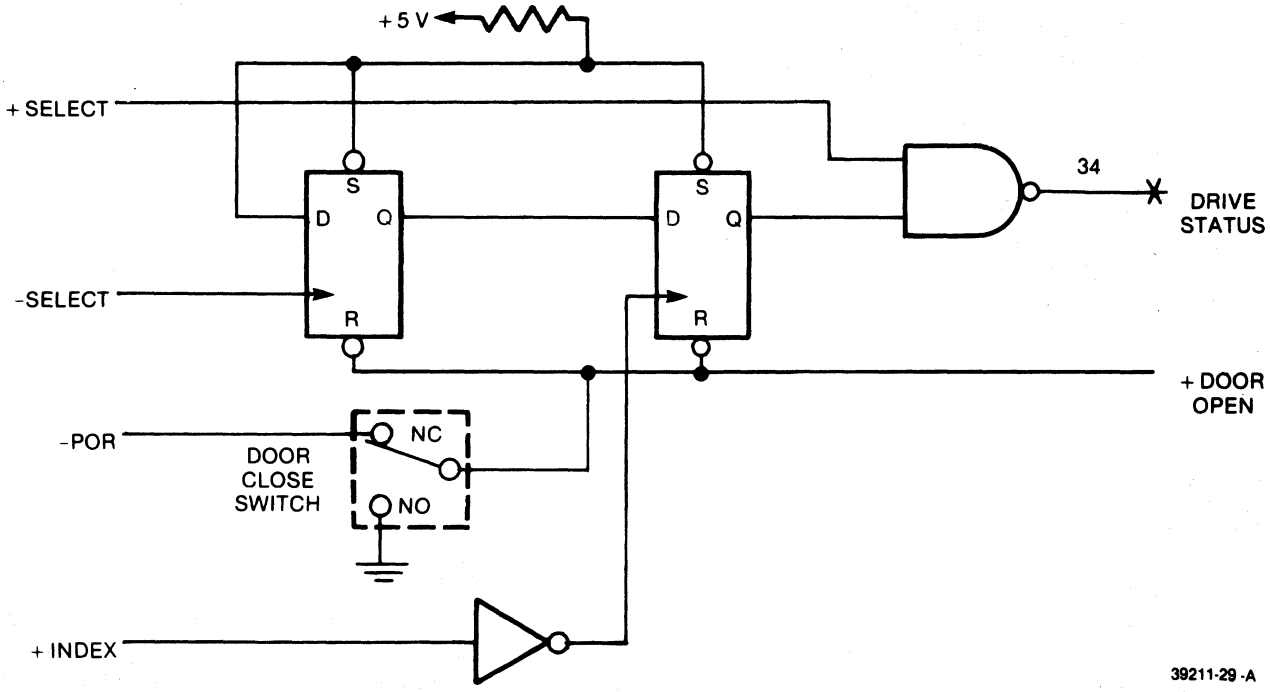

FIGURE 4-14. DRIVE STATUS

SECTION V
MAINTENANCE

5.1 MAINTENANCE EQUIPMENT

5.1.1 Alignment Diskette

The alignment diskette is used for verifying and adjusting the SA300. The SA300 only requires written information on one surface and will utilize the SA138 Microfloppy Alignment Cartridge. The following adjustments and checks can be made using the SA138.

a. Track 00 is recorded with a 125 k Hz signal. This track is used to determine if the head is positioned over track 00 when the track 00 indication is active at the interface.

b. Track 02 is recorded with a special data pattern to determine index detector alignment.

c. Track 40 is recorded with a special data pattern to determine read/write head positioning.

d. Track 40 is recorded with a special data burst pattern to determine azimuth angle.

e. Track 79 is recorded with a 125 k Hz signal.

CAUTION

Do not destroy pre-recorded alignment tracks. The write protect tab should always be enabled to prevent accidental writing on the alignment diskette. If the write protect option is utilized, disable the write protect tab.

5.1.2 Exerciser PCB

The exerciser PCB can be used in a stand alone mode, built into a test station, or used in a test for field service.

The exerciser will enable the user to make all adjustments and check outs required on the SA300 microfloppy drive. It has no intelligent data handling capabilities but can write a 2F, 125 k Hz signal which is the recording frequency used for amplitude checks in the SA300 drive. The exerciser can start and stop the drive motor and enable read in the SA300 to allow checking for proper read back signals.

5.1.3 Special Tools

The following special tools are available for performing maintenance on the SA300:

Description	Part Number
SA138 Microfloppy Alignment Cartridge	SA138 P/N 52124
Exerciser	54157
Screw Drivers	Medium and Small Phillips
Oscilloscope	Textronix 465 or equivalent

5.2 DIAGNOSTIC TECHNIQUES

5.2.1 Basic Diagnosis Techniques

Incorrect operating procedures, faulty programming, damaged diskettes, "soft errors" created by airborne contaminants, random electrical noise, and other external causes can produce errors falsely attributed to drive failure or misadjustment. Unless visual inspection of the drive discloses an obvious misalignment or broken part, attempt to repeat the fault with the original diskette, then attempt to duplicate the fault on the second diskette.

5.2.2 "Soft Error" Detection and Correction

Soft errors are usually caused by:

a. Airborne contaminants that pass between the read/write head and the disk. Usually, these contaminants can be removed by the the self-cleaning wiper of the cartridge.

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

c. Small defects in the written data and/or track not detected during the write operation may cause soft errors during read.

d. Improper grounding of the power supply, drive, and/or host system. Refer to paragraph 2.4 for proper grounding requirements.

e. Improper motor speed.

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

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

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

c. Repeat step "a".

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

5.2.3 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 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 to determine if the media or the drive is failing. If the error still persists, the diskette should be replaced and the above procedure repeated. If the failure still exists, consider the drive defective. If the failure disappears, consider the original diskette defective and discard it.

5.2.4 Read Error

Most errors that occur will be "soft errors." In these cases, performing an error recovery procedure will recover the data.

5.2.5 Seek Error

a. Stepper malfunction.

b. Carriage binds.

c. To recover from a seek error, recalibrate to track 00 and perform another seek to the original track or do a read ID to find what track head is on and compensate accordingly.

5.2.6 Trouble-Shooting

Figures 5-1 through 5-5 provide trouble-shooting procedures for the SA300.

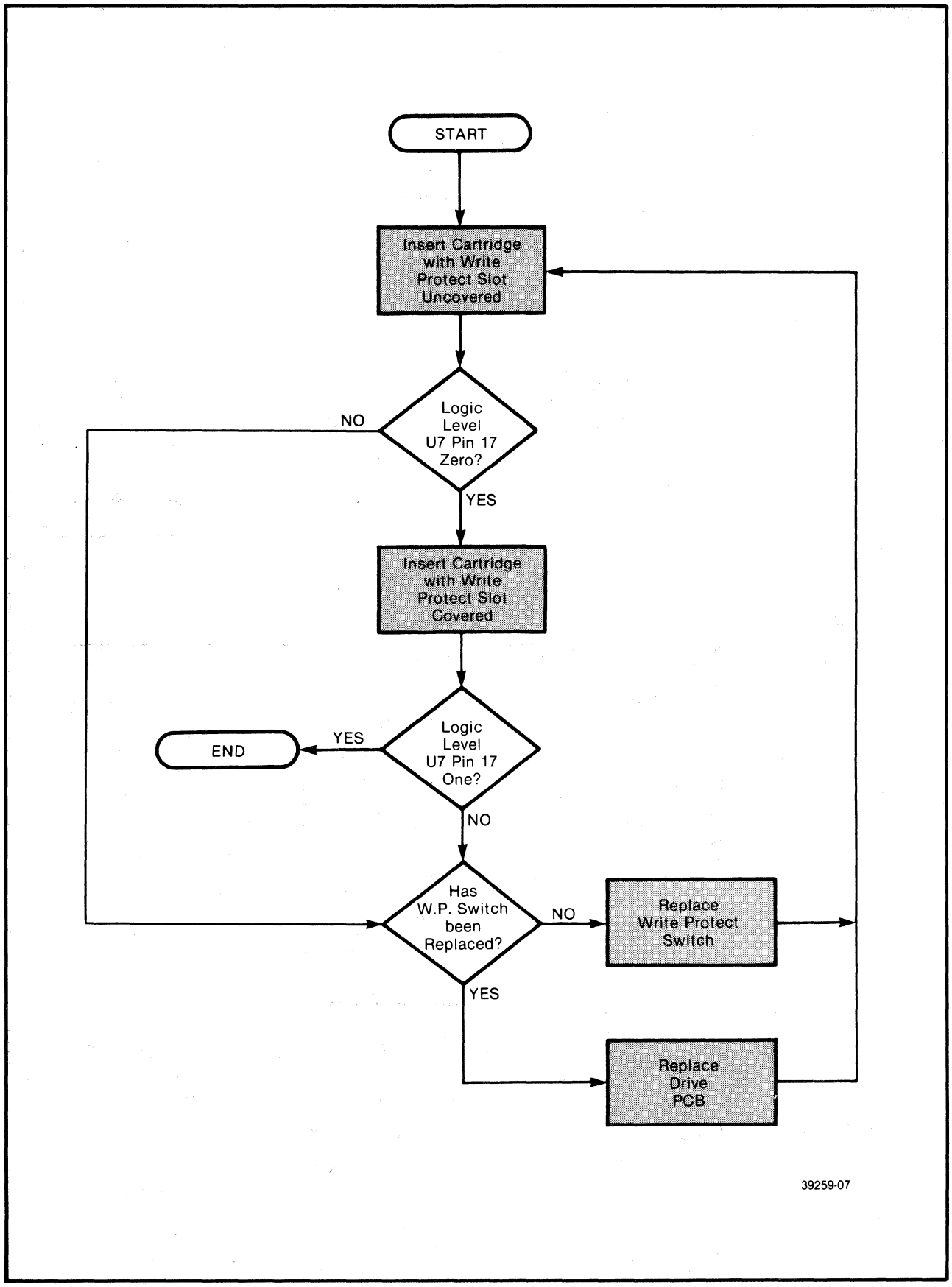

FIGURE 5-1. WRITE PROTECT INOPERATIVE

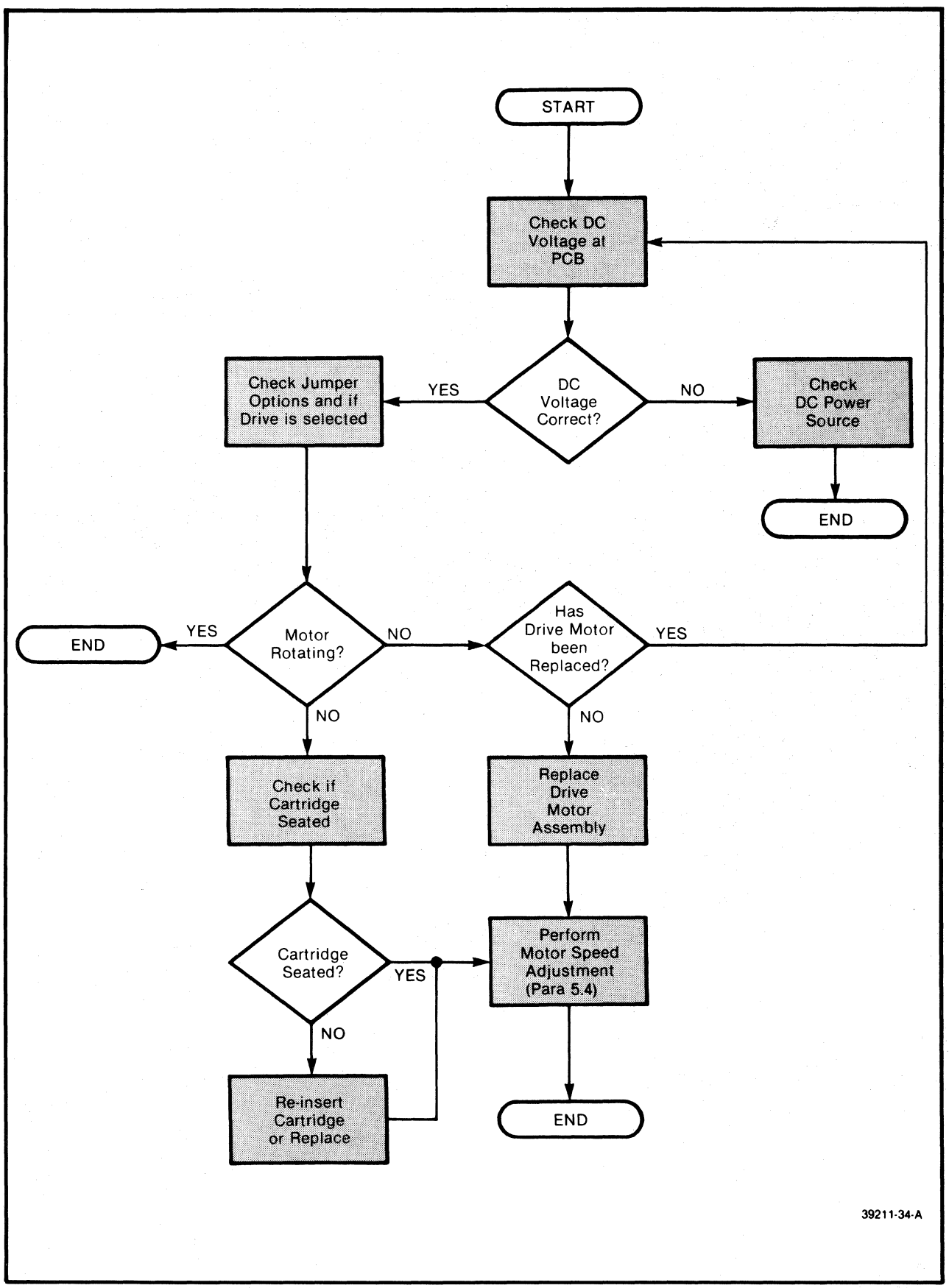

FIGURE 5-2. DISKETTE NOT ROTATING

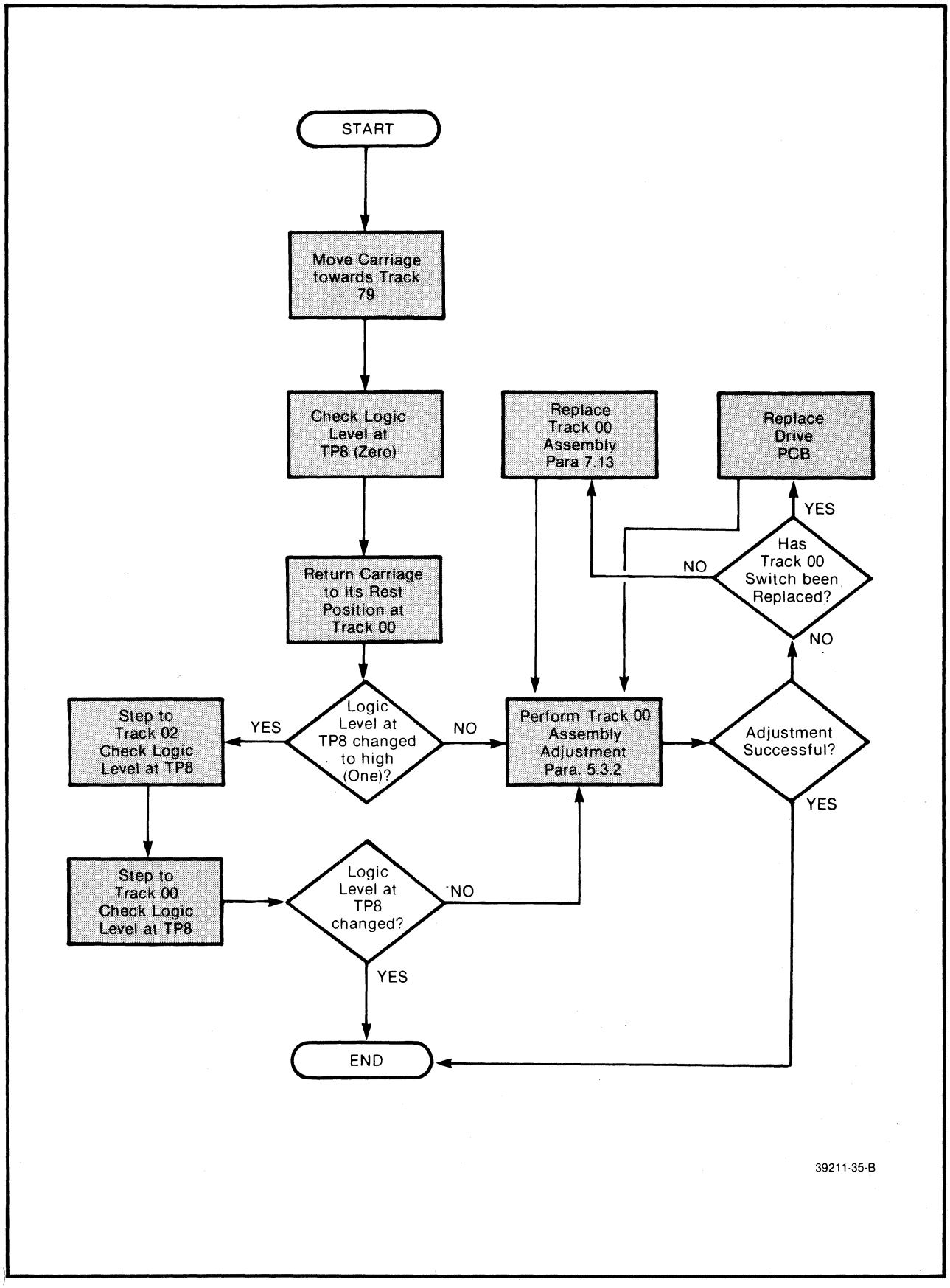

FIGURE 5-3. TRACK 00 INDICATOR INOPERATIVE

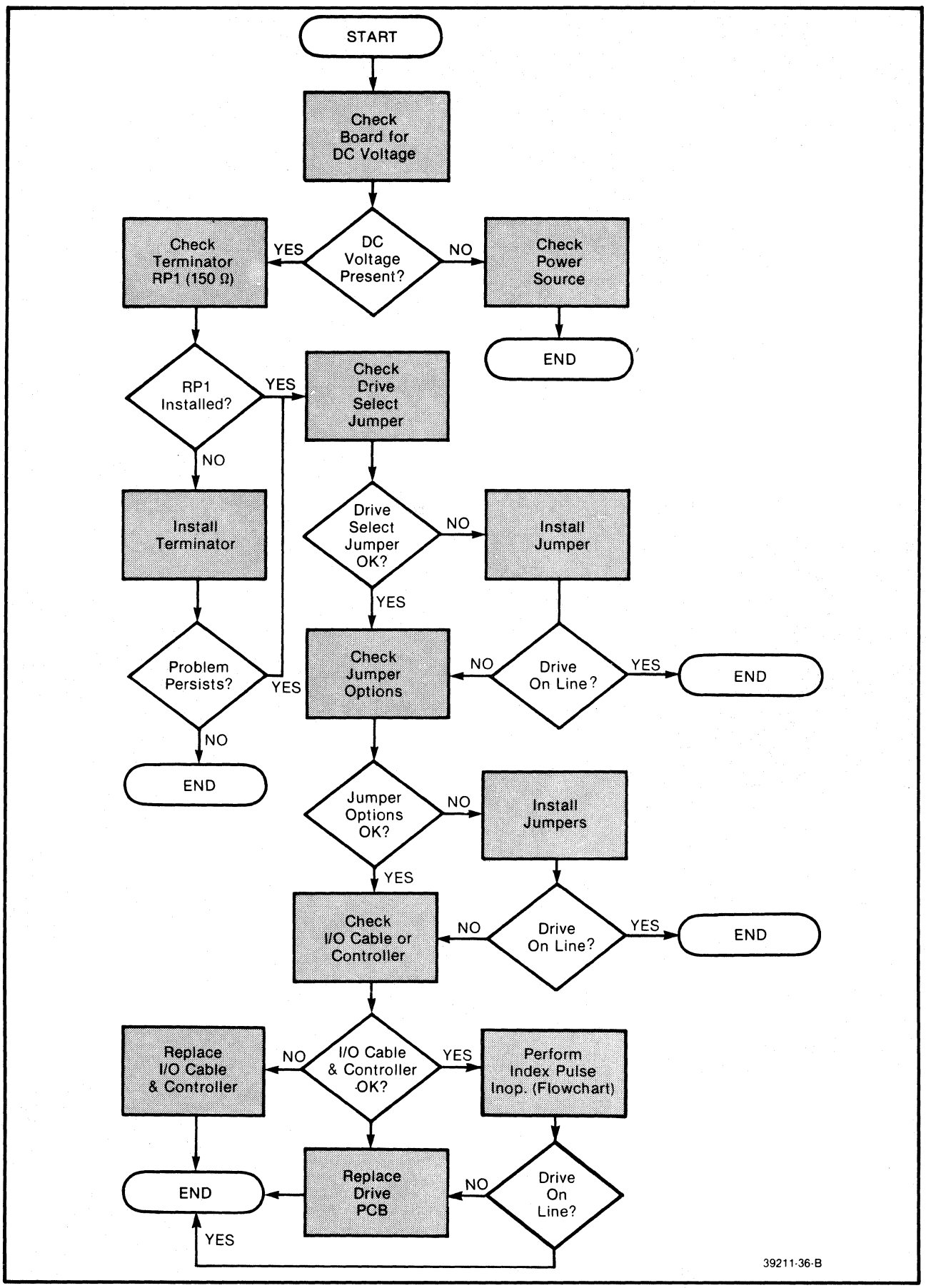

FIGURE 5-4. DRIVE NOT COMING ON LINE

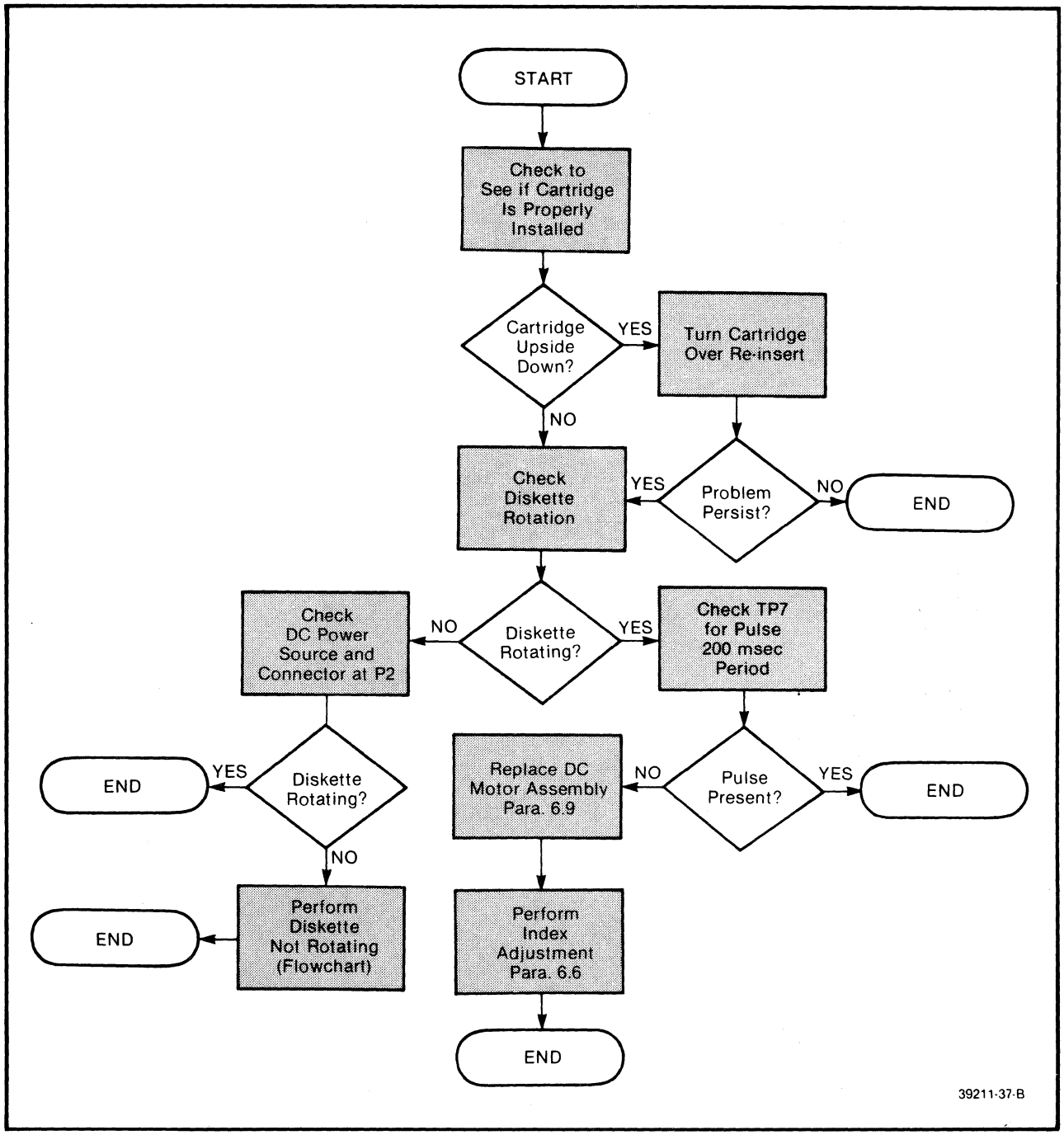

FIGURE 5-5. INDEX PULSE INOPERATIVE

5.2.7 Self-Test

If TP9 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 fails the self-test, the LED will remain on 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.

TP9 needs only be grounded for one second after power is applied to initiate the self-test. If TP9 is shorted to ground (TP10) the self-test will be executed each time 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 internal microprocessor and associated circuitry, stepper motor, track 0 sensor, spindle motor, index sensor, and activity LED of the drive.

5.2.8 Test Point Usage

The microfloppy PCB is mounted with the slder (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 5-6 for test point locations and probe positioning.

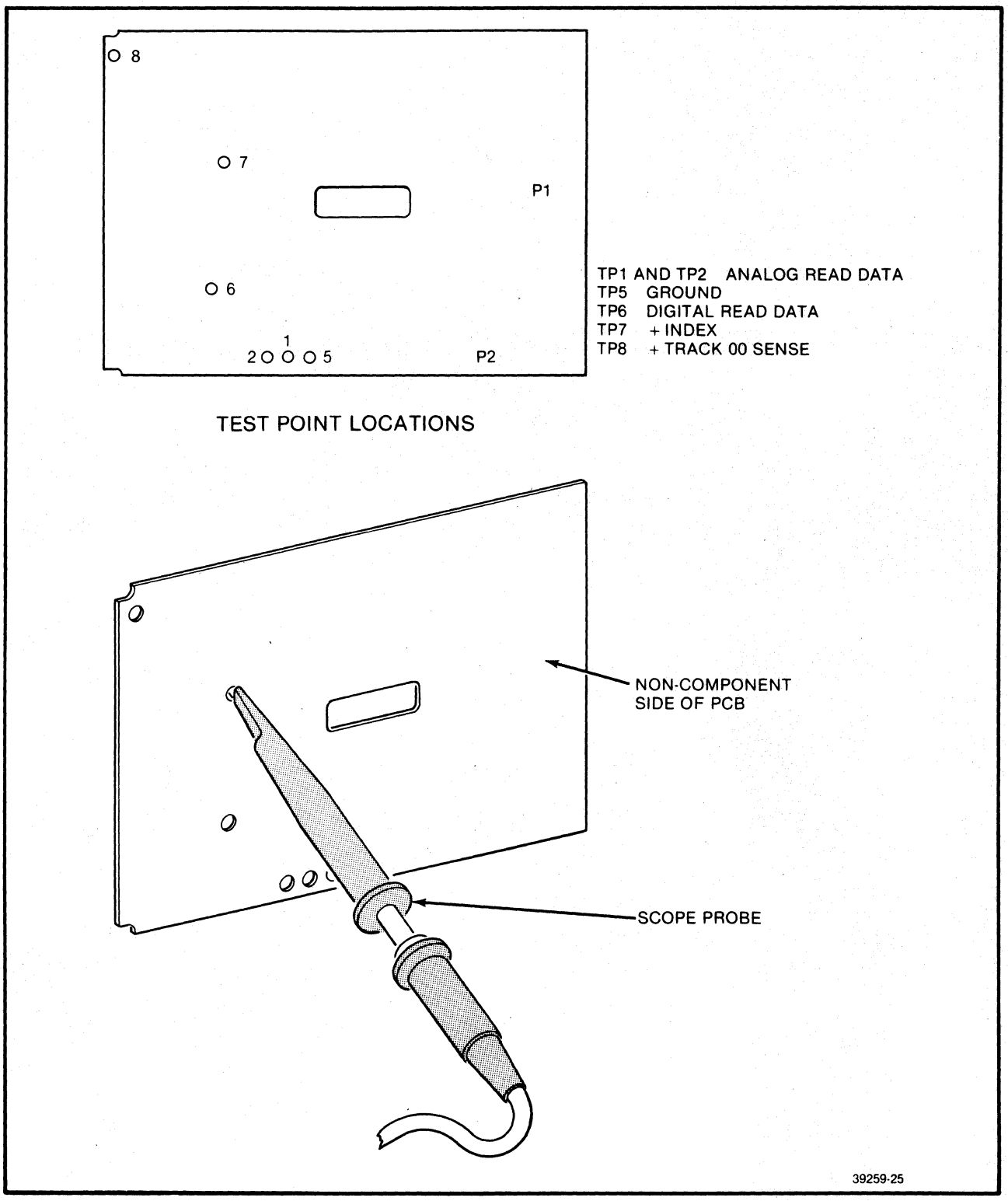

FIGURE 5-6. TEST POINT LOCATIONS AND PROBE POSITIONING

5.3 ADJUSTMENTS

5.3.1 Head Radial Alignment

This alignment method locates the read/write head at the proper radial distance from the hub center line. It also ensures that the track location is accurate. This alignment is needed only if diskette interchange problems still exist after the drive has been serviced. Following steps must be followed during head radial alignment. See figure 5-6 and 5-7.

a. Apply power to the drive.

b. Insert alignment diskette.

c. Step to track 40.

d. Sync the oscilloscope on TP7, external source, positive slope. Set the time base to 20 msec per division; this will display one revolution.

e. Connect one channel to TP1 and the other to TP2, grounding both to PCB. Set the vertical deflection to 100 mV per division, set inputs to ADD and invert one channel.

f. Loosen the stepper motor mounting screws on the back wall of the casting.

g. Tighten the mounting screws when the lobes are of equal amplitude. See figure 5-8.

h. Check track 00 direction adjustment after head radial alignment has been adjusted.

NOTE

Before alignment check, the alignment diskette should be at room temperature for at least 24 hours.

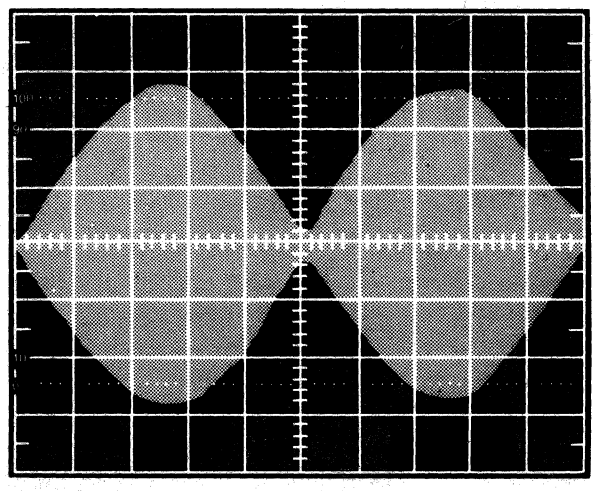

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FIGURE 5-7. HEAD RADIAL ALIGNMENT

FIGURE 5-8. HEAD RADIAL ALIGNMENT

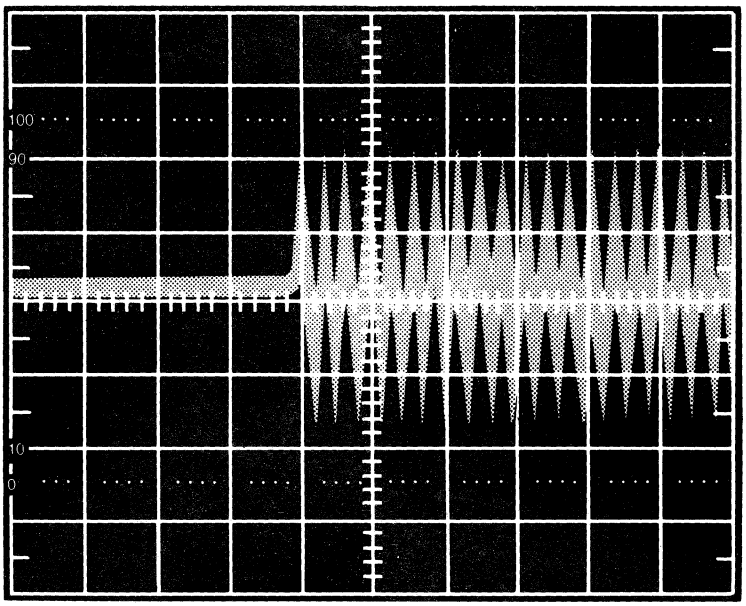

FIGURE 5-9. INDEX BURST TIMING

5.3.2 Track Zero Adjustment

a. Apply power to the drive.

b. Insert alignment diskette.

c. Sync oscilloscope external negative trigger on TP7 (−index) set time base to 20 msec per division. Set inputs to ac, 'ADD', and 'invert' one channel. Set vertical deflection to 50 mV per division. Put input probes on TP1 and TP2. Ground probes to TP5.

d. The 125 KHz track 0 signal should be observed at this time.

e. If the 125 KHz signal is not present, select the drive and step one step at a time until it is observed, step a maximum of five tracks. If signal is observed proceed to step h.

f. If signal is not found yet, loosen the track 00 sensor mounting screws and move detector towards the rear of the drive and tighten the screw.

g. Deselect the drive and turn the dc power off then on. Repeat step "e." until the track 0 signal is found. If you are also doing head alignment at this point loosen the stepper motor mounting screw and rotate the stepper motor until maximum amplitude is obtained. Tighten screw.

h. Once the 125 KHz signal is observed the head is located at track 00. Disconnect probes from TP1, TP2, and TP7. Connect one channel to TP8 and set input to dc. Set vertical deflection to 2 V per division and horizontal deflection to two msec per division. Set for auto trigger.

i. Step to track 1. TP8 should go low. If not, loosen track 0 bracket and move it until it just goes low. This will provide a rough adjustment.

j. Set drive to alternative seek between tracks 00 and 02. Set trigger to selected input channel.

k. Adjust the track 00 bracket until you have as close as possible a 50 percent square wave without observing extra pulses. Do not move sensor to track 2, or it may become the new track 00.

l. Retighten track 00 mounting screw and recheck timing. If timing has changed significantly, repeat steps "i," "j," and "k."

m. Recheck that lobes are on track 40. If not, the track 00 sensor has been set at track 2. Procedure must be repeated if the adjustment is not satisfactory.

5.3.3 Head Amplitude Check

These checks are only valid when writing and reading back as described below. Ensure the diskette used for this check is not "worn" or otherwise shows evidence of damage on either side.

a. Insert good media.

b. Start motor.

c. Select drive and step to track 79.

d. Sync oscilloscope external on TP7 (+Index); connect one probe to TP2 and another to TP1 on drive PCB. Ground probes to PCB, ADD, and invert one input. Set oscilloscope to 50 mV per division and time base to 20 msec per division.

e. Select head 0 and write a 2F pattern on entire track. Average minimum amplitude peak-to-peak should be 140 mV.

f. Select head 1 and write a 2F pattern on entire track. Averge minimum amplitude peak-to-peak should be 140 mV.

g. If either head fails to meet minimum amplitude specifications, continue with procedure.

h. Insert fresh media and recheck.

i. Check motor speed as per paragraph 5.4.

j. With oscilloscope in 'chop' mode, verify that there is output at both TP1 and TP2. If one TP has no output, or significantly less output than other, PCB is faulty and should be replaced.

5.3.4 Index Adjustment

Index adjustment is used to set the time period from the index pulse to the start of the data. Index adjustment should be checked after the drive is aligned or when the motor assembly is replaced. See figure 5-9 for index timing. The following steps should be taken for adjusting index.

a. Trigger on Index (TP7).

b. Read TP1 and TP2 on scope differentially.

c. Set scope time scale to 50 μsec/division.

d. Insert the SA138 alignment disk and step to track 02.

e. Adjust Index pot until the leading edge of Index burst occurs at 200 μsec $\pm$ 175 μsec after Index.

5.4 MOTOR SPEED ADJUSTMENT

5.4.1 Motor Speed Adjustment (Using Fluorescent Lighting)

a. Insert cartridge into the drive and start the motor.

b. Turn the pot on the motor control board until the dark lines on the tach disk remain motionless. For 60 Hz, use outside ring of lines. For 50 Hz, observe the inside lines. See figure 5.9.

NOTE

This adjustment can only be made in an area where there is fluorescent lighting.

5.4.2 Motor Speed Adjustment (Using a Frequency Counter)

a. Install the cartridge.

b. Connect frequency counter to TP7 (+INDEX) on drive PCB.

c. Turn the pot on the motor board assembly for 5 Hz $\pm$ .05 Hz (period = 200 $\pm$ 2 msec).

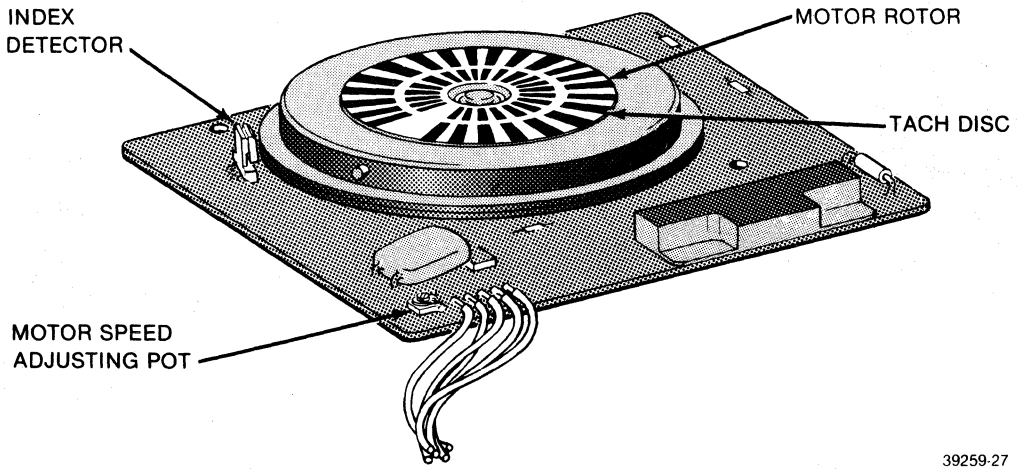

FIGURE 5-10. BRUSHLESS SPINDLE MOTOR ASSEMBLY

SECTION VI
REMOVAL AND REPLACEMENT PROCEDURE

NOTE

Read the entire procedure before attempting a removal or replacement.

6.1 FACE PLATE REMOVAL AND REPLACEMENT

a. Loosen mounting screws located near the motor.

b. Pull face plate forward away from the drive.

c. To reinstall, reverse the above procedure. No adjustment is needed.

6.2 DRIVE PCB REMOVAL AND REPLACEMENT

a. Unplug head connector.

b. Remove two mounting screws and slip PCB out to the rear.

c. Unplug remaining connectors and pull the PCB out of the chasis brackets.

d. To reinstall, replug all the connectors noting the orientation of keys before plugging in the connectors onto the pins.

e. Run self-test diagnosis.

6.3 ELEVATOR REMOVAL AND REPLACEMENT

a. Remove face plate (refer to paragraph 6.1).

b. Remove drive PCB (refer to paragraph 6.2).

c. Remove the R.H. and L.H. vertical elevator hold down springs using a spring hook.

d. Remove the R.H. side wall and roller shields by taking out the side wall mounting screws.

e. Slide the elevator slightly to the right while lifting the front of elevator up about two inches. To clear the head, slide the elevator forward until it is cleared of the drive, while holding tne head load arm up.

f. Lower the head arm down onto the head gently.

g. To reinstall, reverse the above procedure. No adjustments are needed after installing the elevator.

NOTE

Be careful not to lose any of the four elevator rollers.

6.4 WRITE PROTECT SWITCH ASSEMBLY AND DISASSEMBLY

a. Remove elevator by following paragraph 6.3 procedures.

b. Remove W/P switch mounting screw and switch assembly.

c. When reinstalling, press switch assembly block tightly against the step in the casting before tightening screw.

d. Check adjustment per specifications.

e. Reinstall elevator and check that switch transfers when a write enabled cartridge is inserted and doesn't transfer on a write protected diskette.

6.5 CARTRIDGE EJECT PARTS REMOVAL AND REPLACEMENT

a. Remove elevator per instructions in paragraph 6.3.

b. Remove appropriate E-rings and springs and lift parts from underneath the elevator.

c. To reinstall, reverse the above procedure.

d. Check for proper shutter opening and cartridge ejector upon reassembly. No adjustments required upon replacement.

6.6 ACTUATOR PLATE ASSEMBLY

a. Remove elevator per instructions in paragraph 6.3.

b. Remove restore springs, E-rings, and washers.

c. Lift plate assembly from base casting.

d. To reinstall, reverse the above procedure ensuring brass washers are put back in their proper positions. No adjustments required upon reassembly.

6.7 HEAD AND CARRIAGE ASSEMBLY

a. Remove drive PCB.

b. Cut tie wrap so that carriage pigtail is free of casting.

c. Loosen screws on carriage guide rod clamps.

d. Pivot clamps over guide rod until it is free.

e. Remove guide rod from carriage assembly by tilting the carriage slightly up and pulling out from the head end.

f. Push carriage assembly to the left until it is free from the stepper lead screw.

g. To reinstall, reverse the above procedure.

CAUTION

When installing carriage back on the lead screw, be extremely careful not to bend the copper leaf spring that slips beneath the lead screw.

h. Check the following adjustments:

1. Head alignment (refer to paragraph 5.3.1).

2. Track zero adjustment (refer to paragraph 5.3.2).

3. Index adjustment (refer to paragraph 5.3.5).

i. Do a head amplitude check (refer to paragraph 5.3.3).

j. Run self-test.

6.8 STEPPER MOTOR REMOVAL AND REPLACEMENT

a. Remove drive PCB.

b. Remove stepper motor assembly wire harness and connector by cutting tie wraps from P-4 wire harness.

c. Remove stepper motor mounting plate.

d. Pull stepper to the rear until it clears the casting.

e. Push the stepper to the right until it is clear of the carriage assembly and move the stepper to the point until lead screw is clear from casting.

f. To reinstall, reverse the above procedure being extremely careful not to damage the copper tension spring that slips beneath the lead screw.

g. Check the following adjustments:

1. Head alignment (refer to paragraph 5.3.1).

2. Track zero (refer to paragraph 5.3.2).

h. Run self-test.

6.9 DRIVE MOTOR AND SPINDLE ASSEMBLY REMOVAL AND REPLACEMENT

a. Remove connector from PCB and cut tie wraps to remove harness.

b. Remove the four mounting screws and lift motor assembly until spindle is free of casting.

c. To reinstall, reverse the above procedure.

d. Check the following adjustments:

1. Motor speed

2. Index timing

3. Head alignment

4. Track zero

e. Run self-test.

6.10 TRACK ZERO AND ELEVATOR DETECTOR ASSEMBLIES REMOVAL AND REPLACEMENT

a. Remove the connector from the drive PCB.

b. Cut the tie wrap to free cable harness.

c. Remove assembly mounting screw from the casting.

d. Slide assembly back until it is free from casting.

e. To reinstall, reverse the above procedure.

f. Check track zero adjustment.

g. Run self-test.

6.11 LOAD PAD REMOVAL AND REPLACEMENT

a. To remove, hold load arm firmly and pull out load pad in the forward direction.

b. To install, hold firmly the load arm and push the load pad onto the load arm until it fits into the slot in the load arm. See figure 6-1.

c. Adjust load pad for maximum signal amplitude by turning it in 20 degree increments.

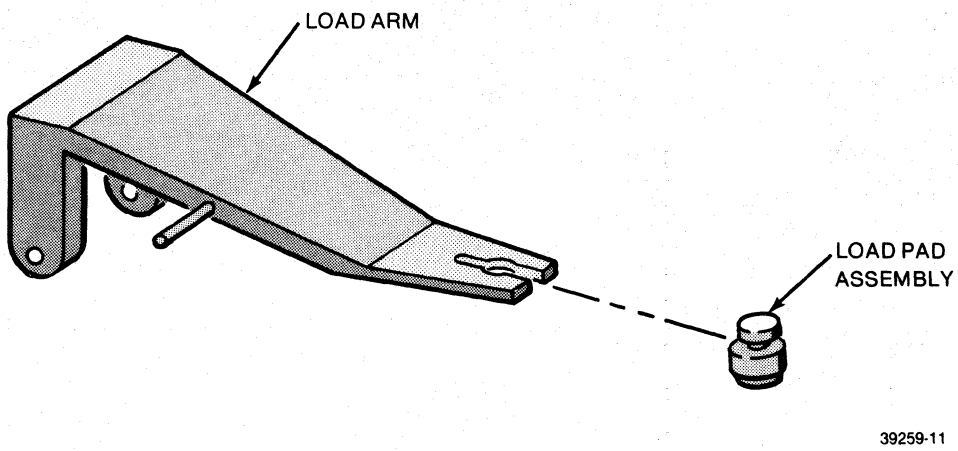

FIGURE 6-1. LOAD PAD ASSEMBLY

SECTION VII
ILLUSTRATED PARTS CATALOG

7.1 DESCRIPTION

The Illustrated Parts Catalog (IPC) is provided for the users. The figures precede the parts listing and appear either directly above the list or on the next page. The first number in the list refers to the figure number. The second number refers to the reference number of the part within the figure. See figures 7-1 through 7-7 for major assemblies.

Part numbers enclosed in parentheses refer to parts of Next Higher Assembly (NHA). These are listed for those customers who have alternate assemblies for their drives. Following the description of these parts, the designation NHA P/N ___ ___ ___ gives the part number of the assembly to which they belong. The quantity per assembly for the alternate parts is the same unless otherwise listed.

7.2 QUANTITIES PER ASSEMBLY

The quantity listed is the quantity used on major assemblies. The drive has several major assemblies which have been described separately.

7.3 RECOMMENDED SPARE PARTS STOCKING GUIDE

The spare parts stocking guide is broken down into three levels. These levels are: Site or Field Support Engineer (level 1), Branch Office (level 2), and Depot or Headquarters (level 3). It is assumed that the Site is replenished by the Branch immediately, and the Branch is replenished by the Depot within 30 days.

The inventories that the three levels should maintain are:

Site	1 to 20 machines
Branch	1 to 100 machines
Depot	
(Only Depot parts)	Unlimited
Branch replenishment	Same as Branch ratio

Table 7-1 shows the spare parts required to support the SA300 microfloppy drive in the field.

NOTE

Some Depot parts are only unique to the depot. Stocking levels to back up Branch stocks are shown. These quantities are only a guide and may exceed or not meet each individual requirement. Requirements can vary due to usage, applications, and repair philosophies. This guide should be modified as required.

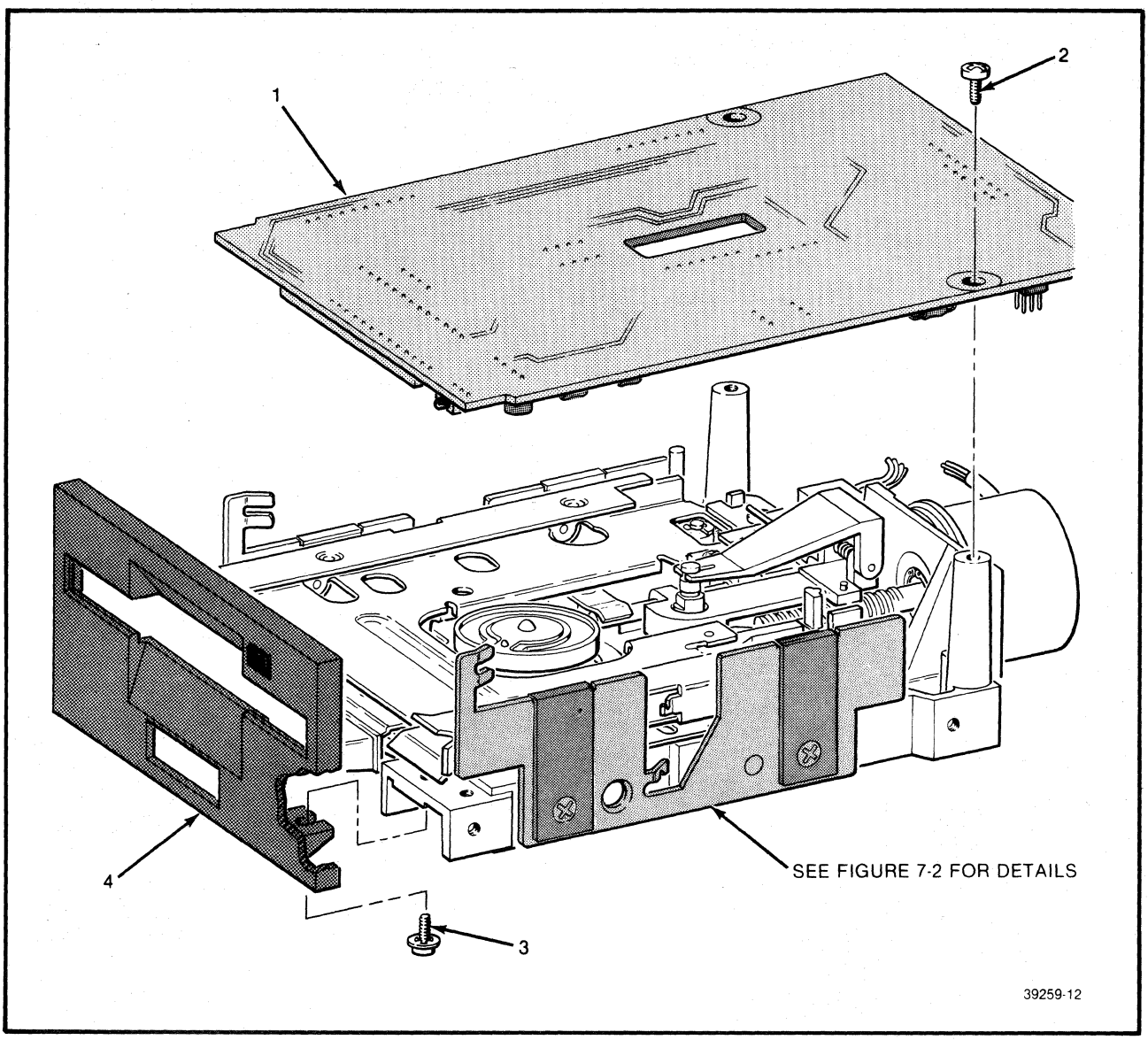

FIGURE 7-1. DRIVE PCB AND FACE PLATE ASSEMBLY

DRIVE PCB AND FACE PLATE ASSEMBLY

REF DES	P/N	DESCRIPTION	QTY
7-1			
1	25281	PCB ASSEMBLY	1
2	71004	SCREW, PANHEAD, PHILLIPS NO. 4-40 x 3/16"	2
3	182001	WASHER AND SCREW PREASSEMBLED, NO. 4-40 x 3/16" INTERNAL	4
4	52084	FRONT PANEL ASSEMBLY	1

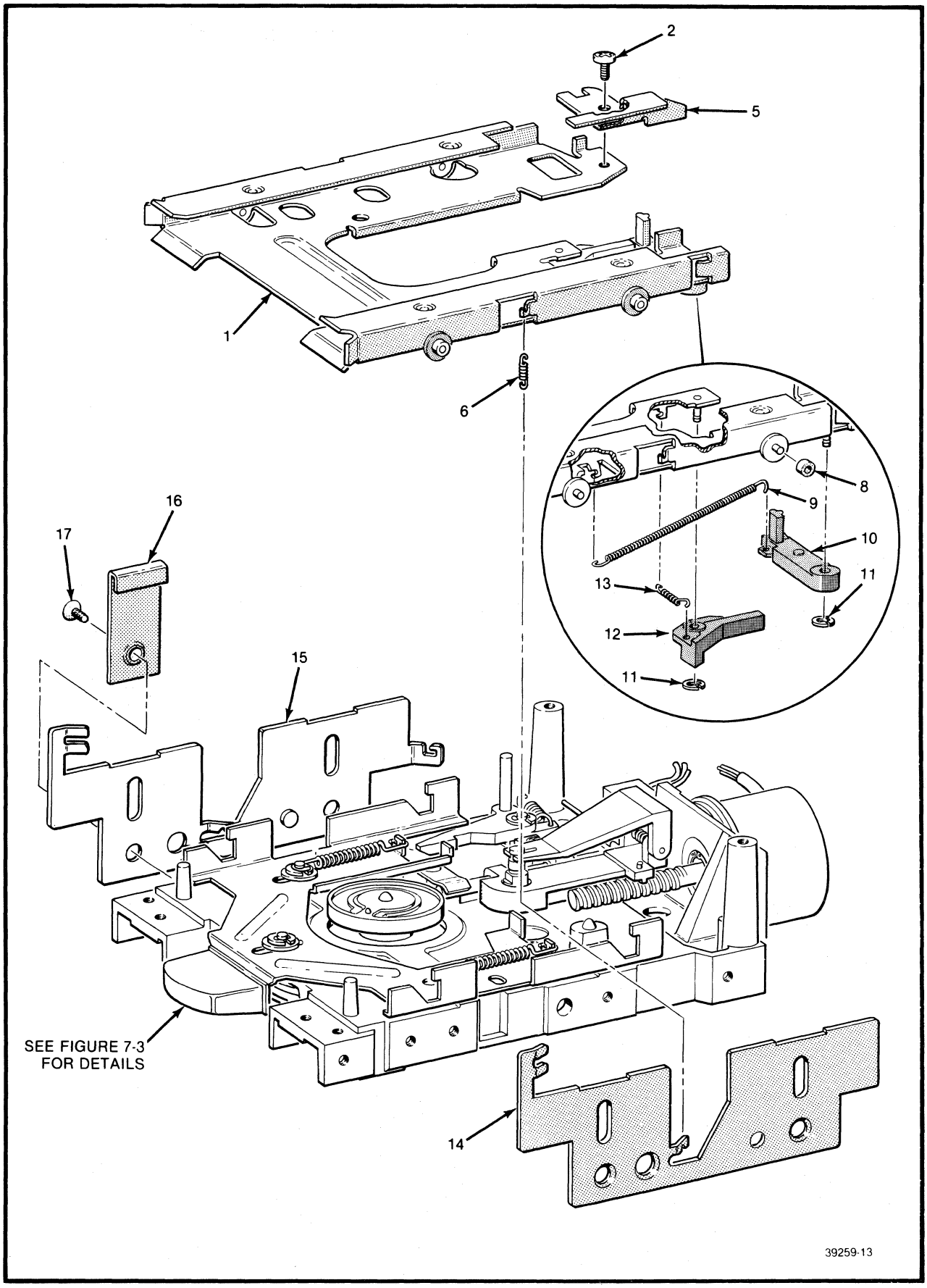

FIGURE 7-2. PLATFORM EJECTOR/ELEVATOR ASSEMBLY

PLATFORM EJECTOR/ELEVATOR ASSEMBLY

REF DES	P/N	DESCRIPTION	QTY
7-2			
1	52080	PLATFORM EJECTOR BASE	
2	171002	SCREW, PANHEAD, PHILLIPS, NO. 4-40 × 3/16″	1
5	52105	FLAG PLATFORM ELEVATOR	1
6	52102	SPRING, PLATFORM HOLD DOWN	1
8	52085	ROLLER ELEVATOR	1
9	52077	SPRING, EJECTOR ARM	4
10	52074	ARM EJECTOR	1
11	52076	RETAINING RING	1
12	52075	LATCH EJECTOR	2
13	52078	SPRING EJECTOR LATCH	1
14	52086	SIDE WALL, R.H.	1
15	52087	SIDE WALL, L.H.	1
16	171003	SCREW, FLATHEAD	1
17		PHILLIPS NO. 4-40 × 1/4″	6

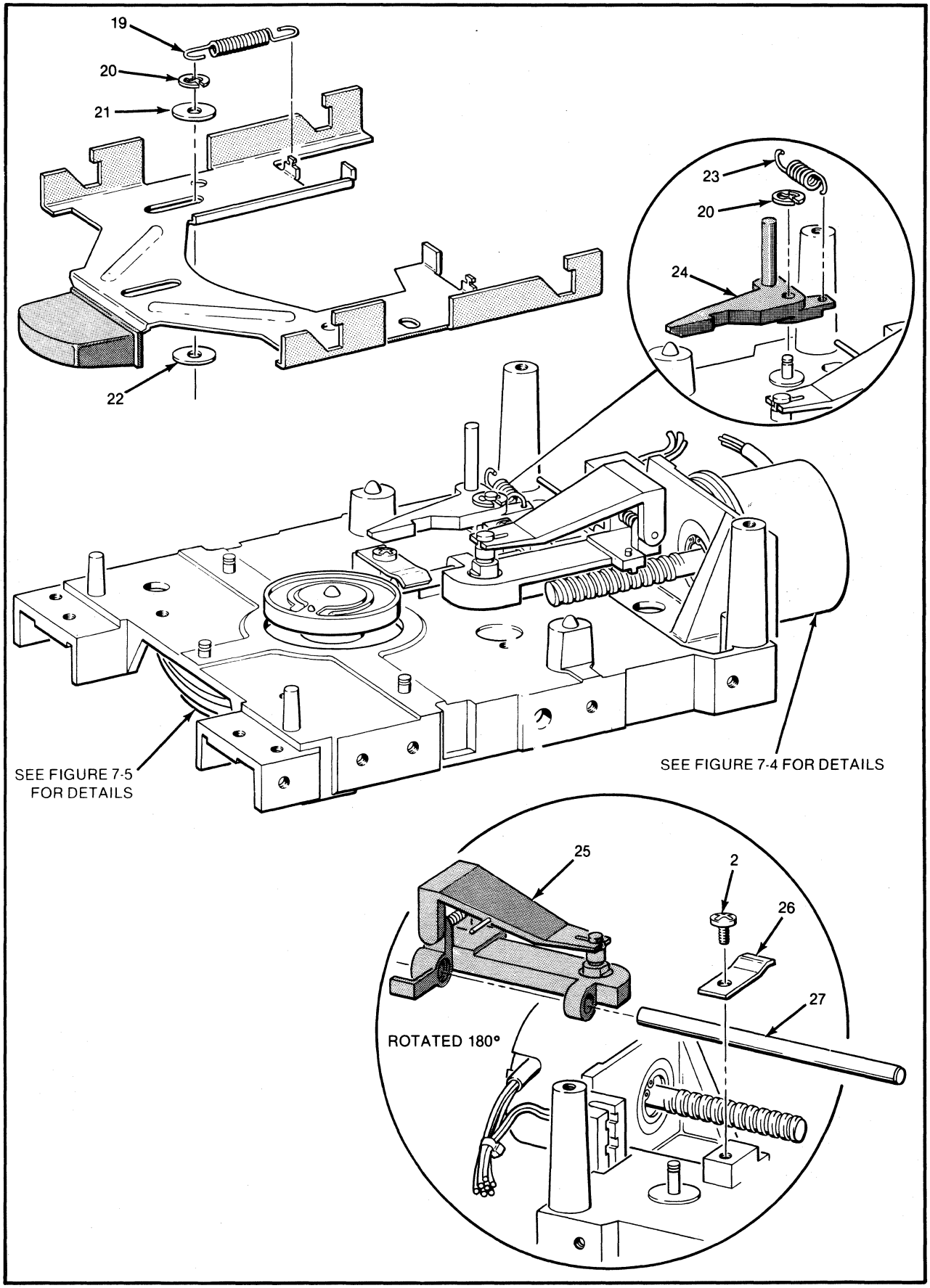

FIGURE 7-3. EJECTOR HEAD AND CARRIAGE ASSEMBLY

EJECTOR HEAD AND CARRAIGE ASSEMBLY

REF DES	P/N	DESCRIPTION	QTY
7-3			
2	171004	SCREW, PANHEAD, PHILLIPS NO. 4-40 × 1/4″	6
19	52101	SPRING, ACTUATOR EXTENSION	2
20	52099	RETAINING RING	2
21	52091	WASHER, ACTUATOR	2
22	52196	WASHER, ACTUATOR	2
23	52103	SPRING, LATCH EXTENSION	1
24	52089	LATCH	1
25	52038	CARRIAGE ARM ASSEMBLY	1
26	52053	CLAMP, GUIDE ROD	2
27	52052	GUIDE ROD	1

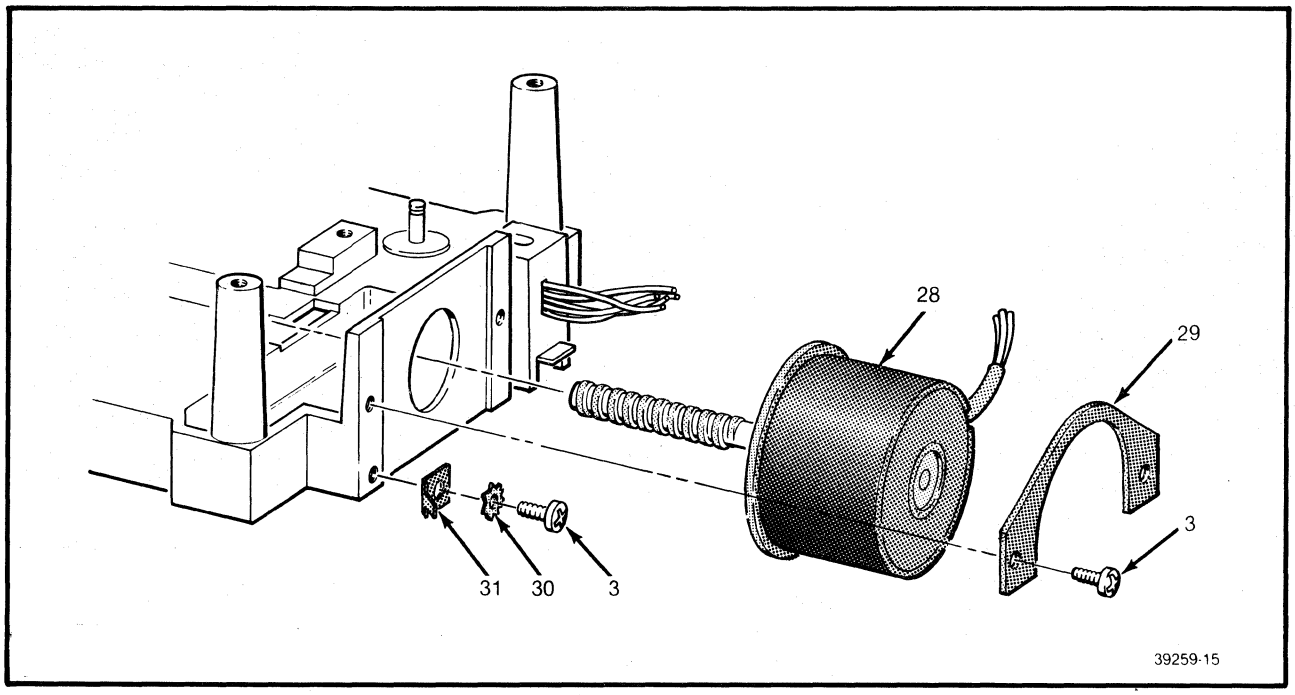

FIGURE 7-4. STEPPER MOTOR ASSEMBLY

STEPPER MOTOR ASSEMBLY

REF DES	P/N	DESCRIPTION	QTY
7-4			
3	171002	SCREW, PANHEAD, PHILLIPS NO. 4-40 × 3/16″	3
28	52041	STEPPER MOTOR ASSEMBLY	1
29	52054	CLAMP, STEPPER MOTOR	1
30	181002	WASHER, START NO. 4, EXTERNAL	1
31	52104	FASTON TAB	1

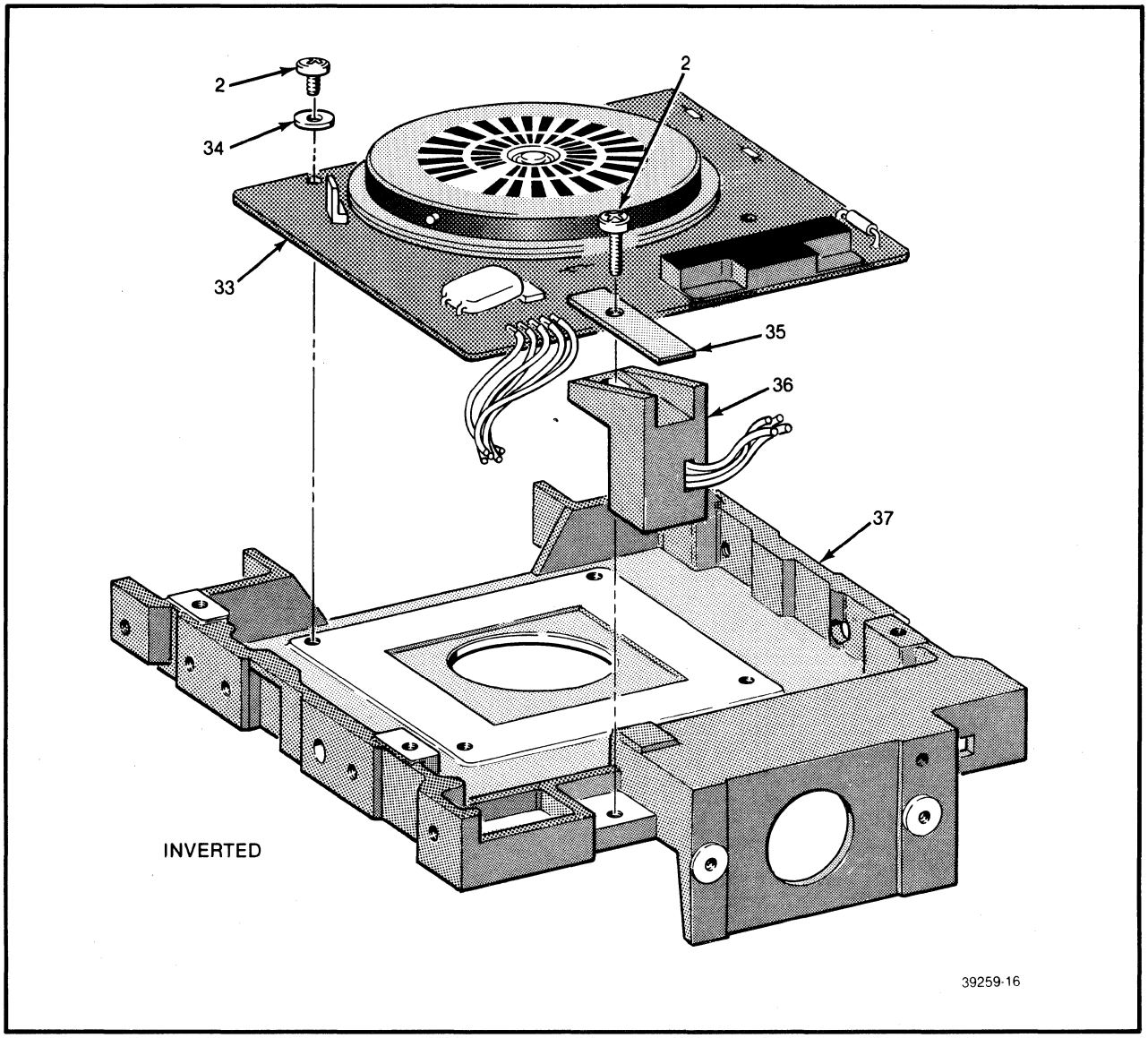

FIGURE 7-5. BRUSHLESS SPINDLE MOTOR, TK 0 AND ELEVATOR DETECTOR ASSEMBLY

BRUSHLESS SPINDLE MOTOR, TK 0 AND ELEVATOR DETECTOR ASSEMBLY

REF DES	P/N	DESCRIPTION	QTY
7-5			
2	171002	SCREW, PANHEAD, PHILLIPS NO. 4-40 × 3/16″	5
33	52064	BRUSHLESS MOTOR ASSEMBLY	1
34	52108	WASHER, FLAT, NO. 4 NYLON	4
35	52122	TRACK 0 CLAMP	1
36	52128	SWITCH/CONNECTOR ASSEMBLY	1
37	52065	BASE MACHINED ASSEMBLY	1

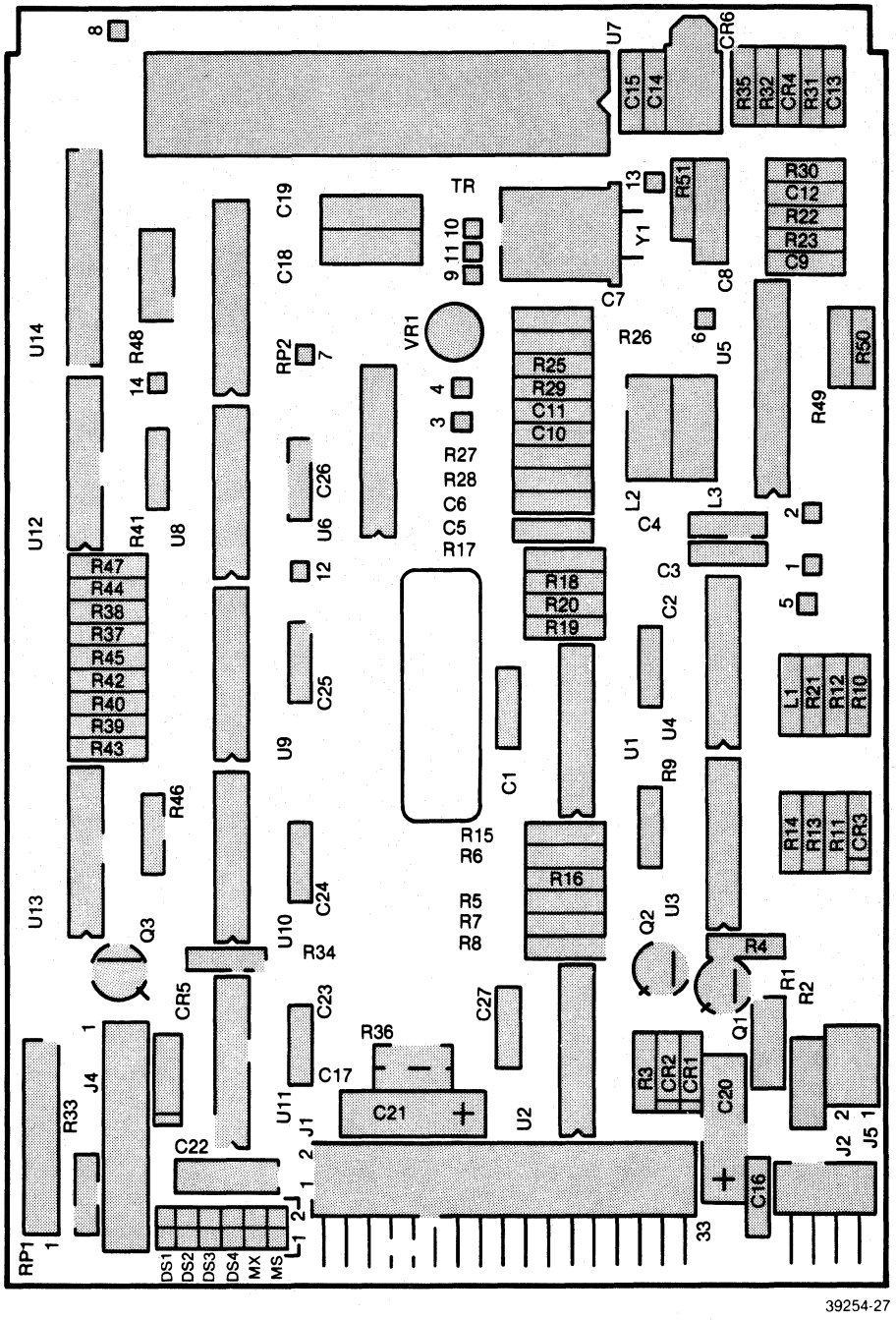

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FIGURE 7-6. DRIVE PCB COMPONENT LOCATIONS, P/N 25281-03 (COMPONENT SIDE)

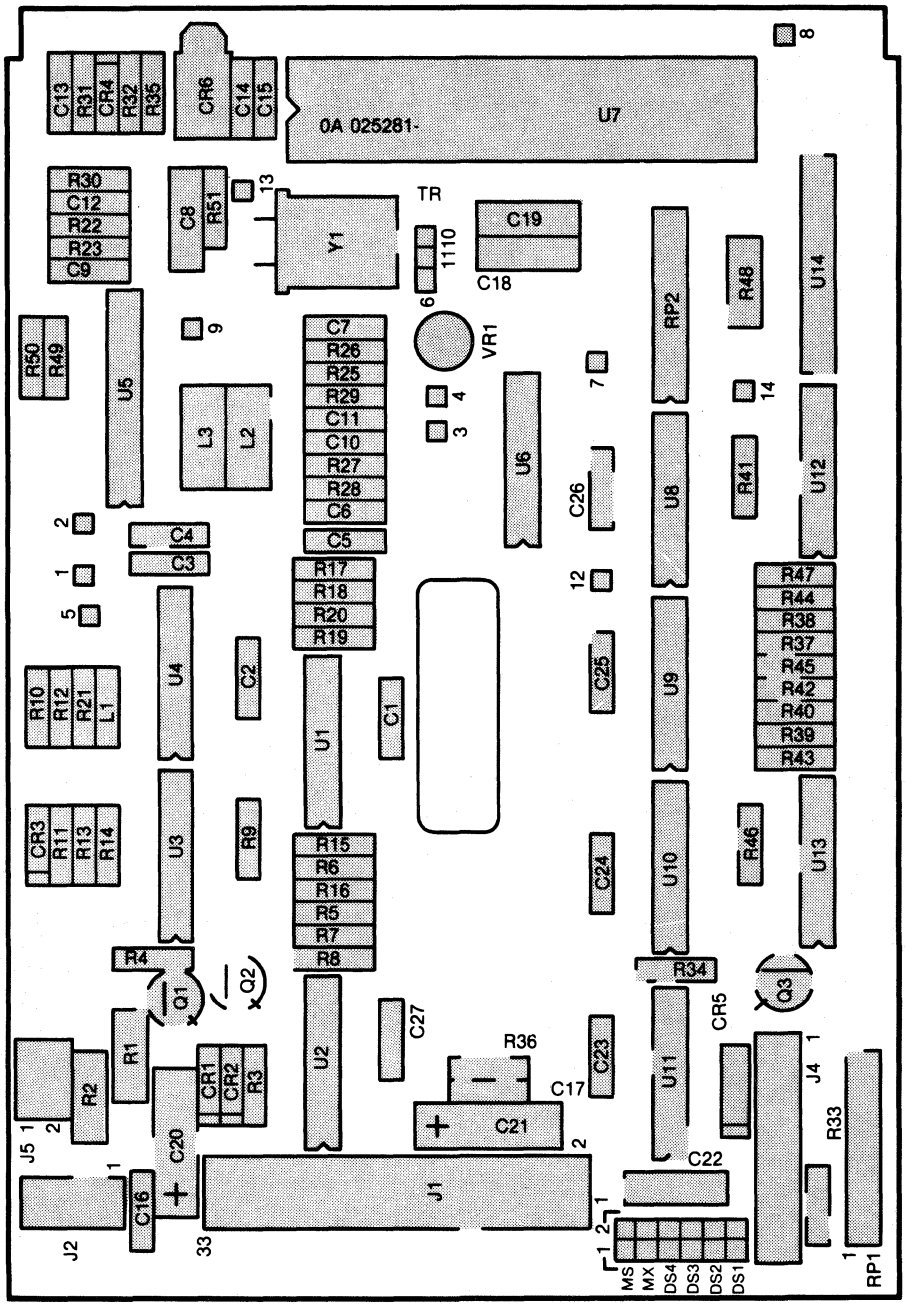


FIGURE 7-7. DRIVE PCB COMPONENT LOCATIONS, P/N 25281-03 (SOLDER SIDE)

DRIVE PCB COMPONENT LOCATIONS (COMPONENT SIDE)

REF DES	PART NUMBER	DESCRIPTION	QTY
7-6	25280	CONTROL, PCB, FAB	1
C1-7,16,17,23-27	15080	CAP, CER, 0.1 μF, +80-20%, 50 V	14
C9	15064	CAP, CER, 680 pF, ±5%, 50 V	1
C10,13	15096	CAP, CER, 150 pF, ±5%, 50 V	2
C11	15067	CAP, CER, 1000 pF, ±5%, 50 V	1
C12	15059	CAP, CER, 270 pF, ±5%, 50 V	1
C8,18,19,22	15150	CAP, CER, 1.0 μF, ±20%, 50 V	4
C14,15	15148	CAP, CER, 20 pF, ±5%, 50 V	2
C20,21	15125	CAP, ALUM ELECTROLYTIC, 4.7 μF, ±20%, 50 V	2
U8	12681	IC, 74LS08	1
U9	16265	IC, 74LS14	1
U6,12	16276	IC, 74LS74	2
U13	16227	IC, LM339	1
U4	16244	IC, NE592N	1
U14	12666	IC, ULN2803	1
U3	12678	IC, CA3046, TRANS ARRAY	1
U5	16278	IC, READ, LSI	1
U1	12693	IC, CD4066	1
U7 [1]	15530	IC, 8748	1
U10,11	16207	IC, 7438	2
U2	12672	IC, UHP408	1
[1]	54756	SA300 SOFTWARE	1
CR1,2	10062	DIODE, 1N4148, 75 V	2
CR3	15924	DIODE, ZENER, 1N5226B, ±5%, 3.3 V	1
CR4	15902	DIODE, ZENER, 1N5231B, ±5%, 5.1 V	1
CR5	15900	DIODE, PWR, 1N4003	1
CR6	15936	DIODE, LED, RT. ANG. RED	1
Y1	15703	CRYSTAL, 6 MHz	1
L1	16326	INDUCTOR, SHIELDED, 33 μH, ±10%	1
L2,3	16327	INDUCTOR, SHIELDED, 220 μH, ±10%	2
Q1,2	17627	TRANSISTOR, PNP-PN2907	2
Q3	17637	TRANSISTOR, MPS4355	1
R3,4,17,18	16759	RES., 5.6 K, ±5%, 1/4 W	4
R9,13,14,16,30	10113	RES., 10 K, ±5%, 1/4 W	5
R11,25,22,23	10102	RES., 100 Ω, 5%, 1/4 W	4
R12,29,49,50	10108	RES., 1 K, ±5%, 1/4 W	4
R15	16780	RES., 3.6 K, ±5%, 1/4 W	1
R19,20	16859	RES., 2.7 K, ±5%, 1/4 W	2
R21	16826	RES., 68 Ω, ±5%, 1/4 W	1
R26	16757	RES., 3.9 K, ±5%, 1/4 W	1
R27,28	16824	RES., 470 Ω, ±5%, 1/4 W	2
R31	10118	RES., 2.2 K, ±5%, 1/4 W	1
R32,51	16749	RES., 390 Ω, ±5%, 1/4 W	2
R34,35	16777	RES., 150 Ω, ±5%, 1/4 W	2
R37-41	16779	RES., 3.3 K, ±5%, 1/4 W	5
R42-44	16738	RES., 47 K, ±5%, 1/4 W	3
R45-47	16923	RES., 220 K, ±5%, 1/4 W	3
R10,33	10101	RES., 82 Ω, ±5%, 1/4 W	2
R5	16701	RES., 4.99 K, ±1%, 1/8 W	1
R6	16866	RES., 7.5 K, ±1%, 1/8 W	1
R8	16705	RES., 909 Ω, ±1%, 1/8 W	1
R7	17115	RES., 17.8 K, ±1%, 1/8 W	1
R48	16727	RES., FIXED, 360 Ω, ±5%, 1/2 W	1
R1,2	16871	RES., FIXED, 470 Ω, ±5%, 1/2 W	2
VR1	17107	POTENTIOMETER, TRIMMING, 20 K	1

DRIVE PCB COMPONENT LOCATIONS (COMPONENT SIDE) (CONT.)

REF DES	PART NUMBER	DESCRIPTION	QTY
RP1	17109	NETWORK, RES., 150 Ω, SIP	1
RP2	17108	NETWORK, RES., 3.3 K, SIP	1
X-RP1	19193	SOCKET, 8 PIN SIP	1
P1	19195	CONN., HDR., 34 POS.	1
P2	13002	CONN., HDR., 4 POS.	1
P4-2-11,13-15, 17-20, P5-1-4,6, DS1-1,2, DS2-1,2, DS3-1,2, DS4-1,2, MX-1,2;MS-1,2	17756	TERM POST (.025 SQ.)	34
DS1 MS	15648	CONN, SHORTING PLUG, 2 POS	2

TABLE 7-1. SA300 SPARE PARTS STOCKING GUIDE

PART NUMBER	DESCRIPTION	QUANTITY PER LEVEL		
		SITE	BRANCH	DEPOT
25281	PCB ASSMY	1	4	4
52018	LOAD PAD	5	10	20
52038	HEAD CARRIAGE ASSEMBLY		2	4
52041	STEPPER MOTOR		1	3
52052	GUIDE ROD			1
52054	CLAMP, STEPPER MOTOR			1
52064	SPINDLE MOTOR ASSEMBLY		2	3
52070	ACTUATOR PLATE ASSEMBLY			1
52073	PLATFORM ELEVATOR			1
52084	FRONT PANEL ASSEMBLY		1	2
52085	ROLLER ELEVATOR	4	4	8
52086	SIDE WALL R.H.			1
52087	SIDE WALL L.H.			1
52088	ROLLER SHIELD			2
52089	LATCH			1
52090	TK 00 AND ELEVATOR SWITCH ASSEMBLY	1	2	2
52196	WASHER, ACTUATOR	4	4	8
52099	RETAINER RING	4	4	8
52101	SPRING, ACTUATOR EXTENSION	2	4	8
52102	SPRING, PLATFORM HOLD DOWN	2	4	8
52103	SPRING, PLATEN EXTENSION	1	2	4
52104	TAB, FASTON		1	2
52105	FLAG, HEAD UNLOAD		1	2
52108	WASHER, FLAT NO. 4 NYLON	2	4	8
52109	SCREW, PANHEAD PHILLIPS NO. 4-40 x 3/16	3	6	8
171001	SCREW, PANHEAD PHILLIPS NO. 4-40 x 5/32	2	4	4
171004	SCREW, FLATHEAD PHILLIPS NO. 4-40 x 1/4	3	6	8
182001	WASHER & SCREW NO. 4-40 x 3/16	2	4	8
52114	TIE WRAP	2	4	8
181002	WASHER, STAR NO. 4	2	4	6
52122	CLAMP, TK 00		1	2

SECTION VIII
SPARE PARTS ORDERING INFORMATION

8.1 ROUTINE ORDER ENTRY

Shugart Corporation is committed to provide quality service to its customers. A dedicated and professional Spare Parts/Logistic Support group is available to Support the OEM customers as well as the end users.

Routine orders (domestic open accounts) in the U.S. may be placed with Shugart Corporation by phone, facsimile, TWX or by mail. All verbal orders will be booked as received but will require confirmation of purchase documents before the order is processed for shipment.

PHONE: (408) 733-0100 (Ask operator for Spares)

TWX: (910) 339-9355

FACSIMILE: (408) 735-7486

MAIL: Shugart Corporation
475 Oakmead Parkway
Sunnyvale, CA 94086 (U.S.A.)
ATTN: Spare Parts Dept.

8.2 EMERGENCY ORDER ENTRY

Request for parts required on an emergency basis should be communicated to Shugart Corporation by either TWX or phone. Be particularly careful to ensure that all applicable information is communicated.

SECTION IX
PACKAGING INFORMATION

(Packaging information will be supplied at a later date.)

SECTION X
SCHEMATIC DIAGRAMS

The following schematic diagrams (figures 10-1 through 10-5) are furnished as an aid to malfunction analysis.

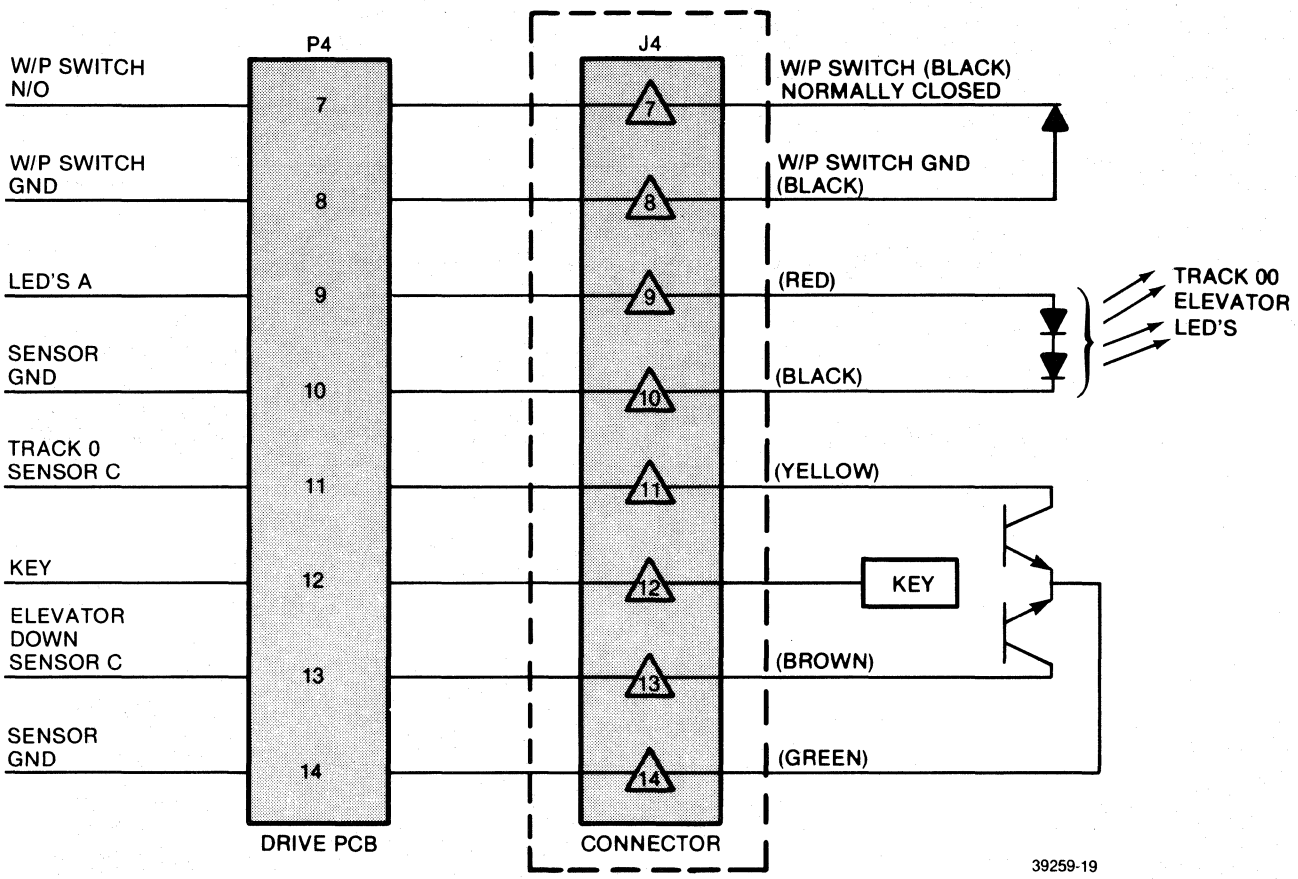


FIGURE 10-1. WRITE PROTECT — TRACK 00 — ELEVATOR DOWN SENSOR CONNECTIONS

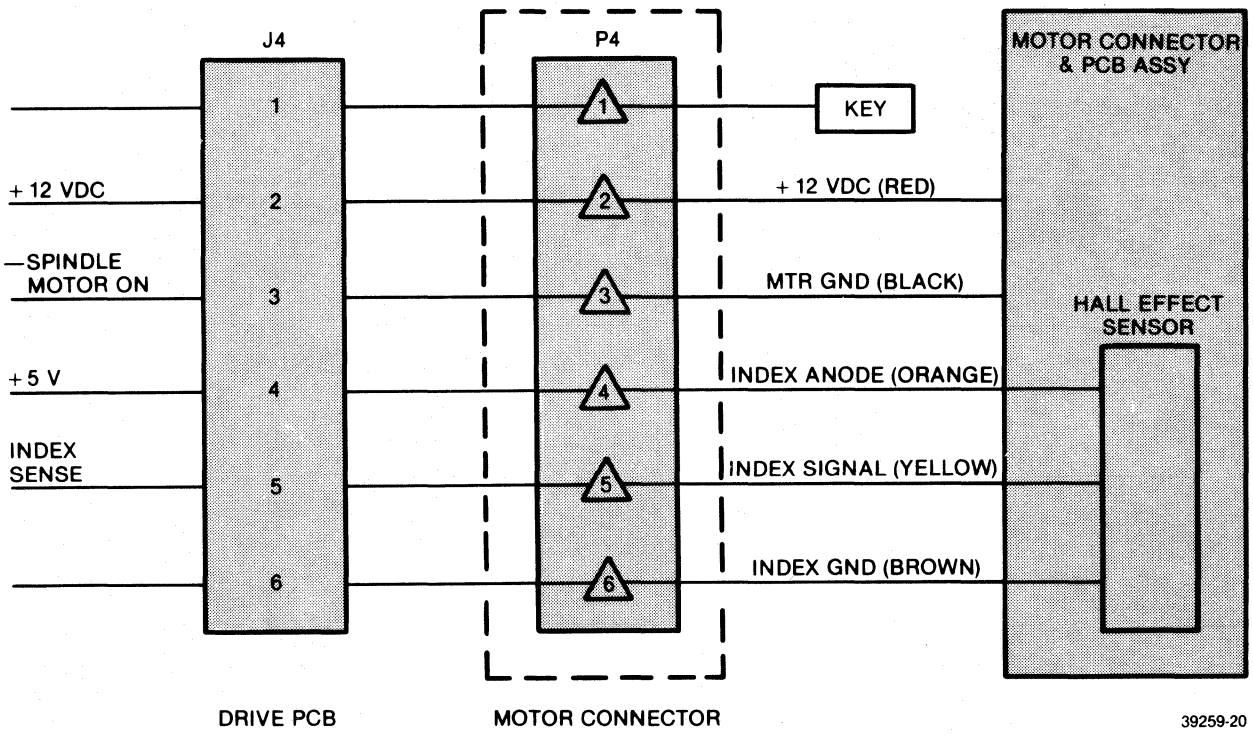


FIGURE 10-2. SPINDLE MOTOR HARNESS CONNECTIONS

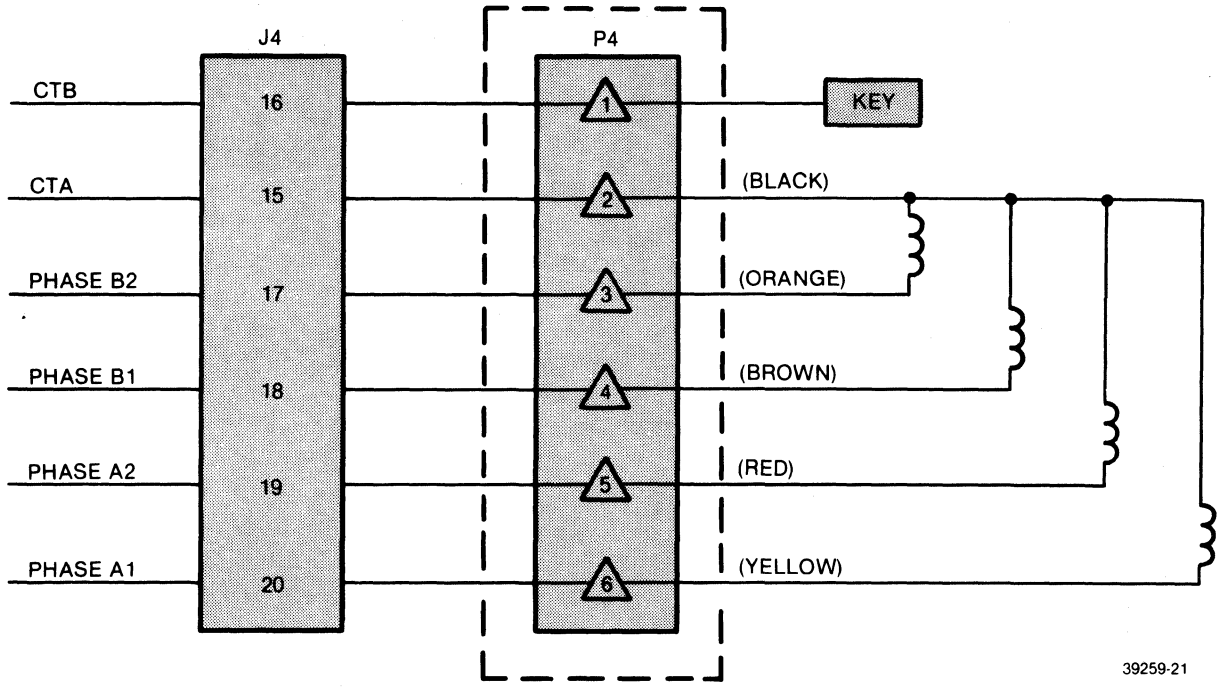


FIGURE 10-3. STEPPER MOTOR HARNESS CONNECTIONS

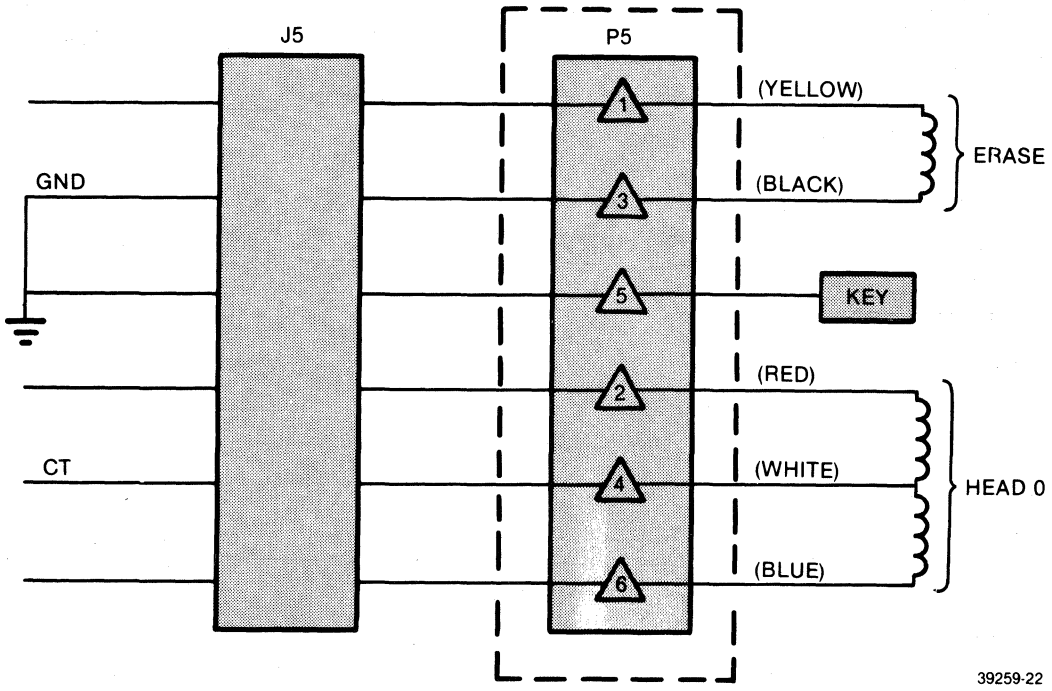
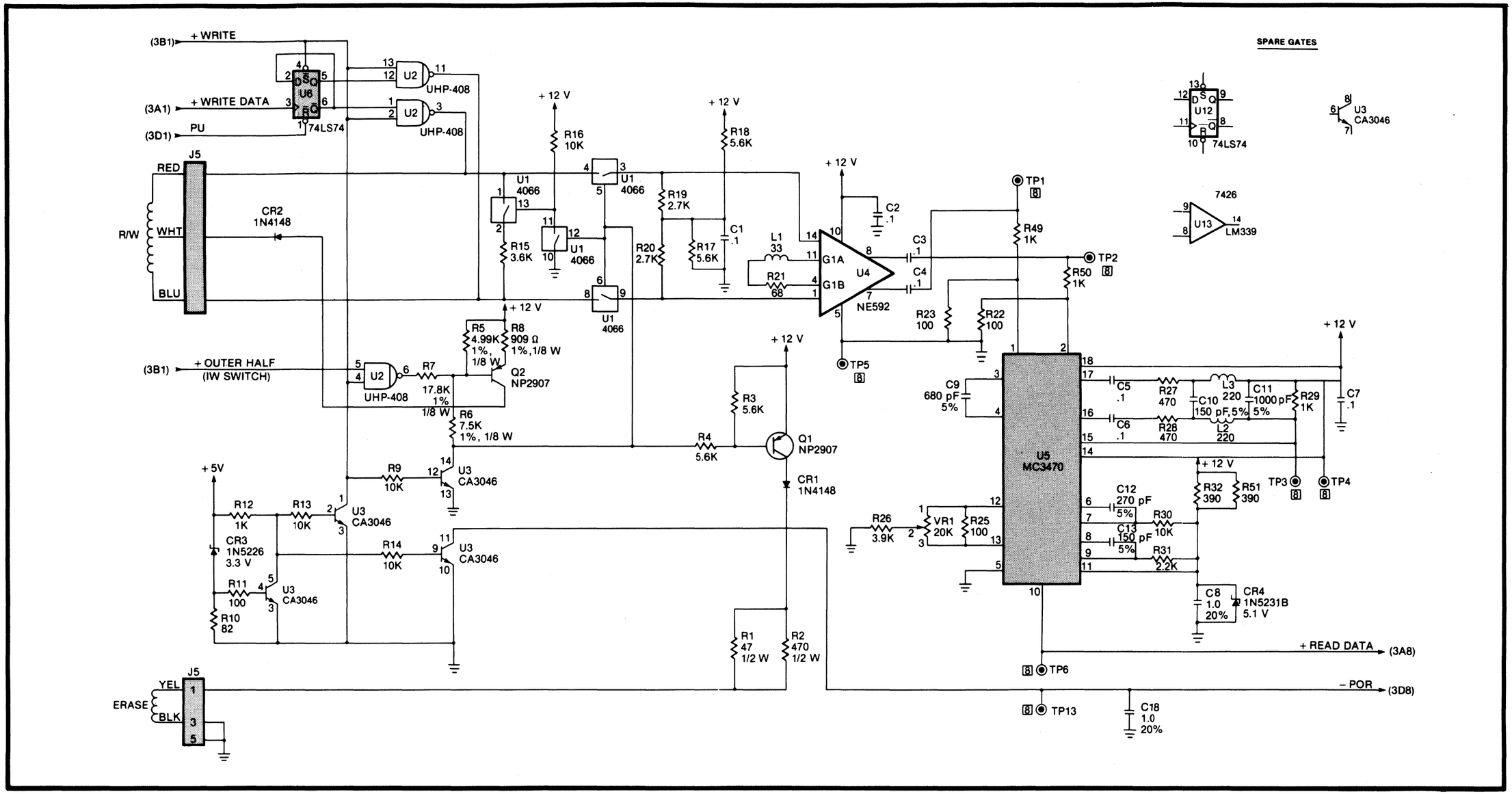


FIGURE 10-4. READ/WRITE HEAD CONNECTION



39259-23

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL CAPACITOR VALUES ARE IN MICROFARADS, 50 V ± 10%.
2. ALL DIODES ARE 1N4148.
3. ALL INDUCTOR VALUES ARE IN MICROHENRYS, ± 10%.
4. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ±5%.
5. ALL TRANSISTOR ARE _____.
6. — — — INDICATES CUT-TRACE OPTION.
7. — — — INDICATES JUMPER OPTION.
8. THESE COMPONENTS ARE NOT INSTALLED: R36, TP1 THRU 14.

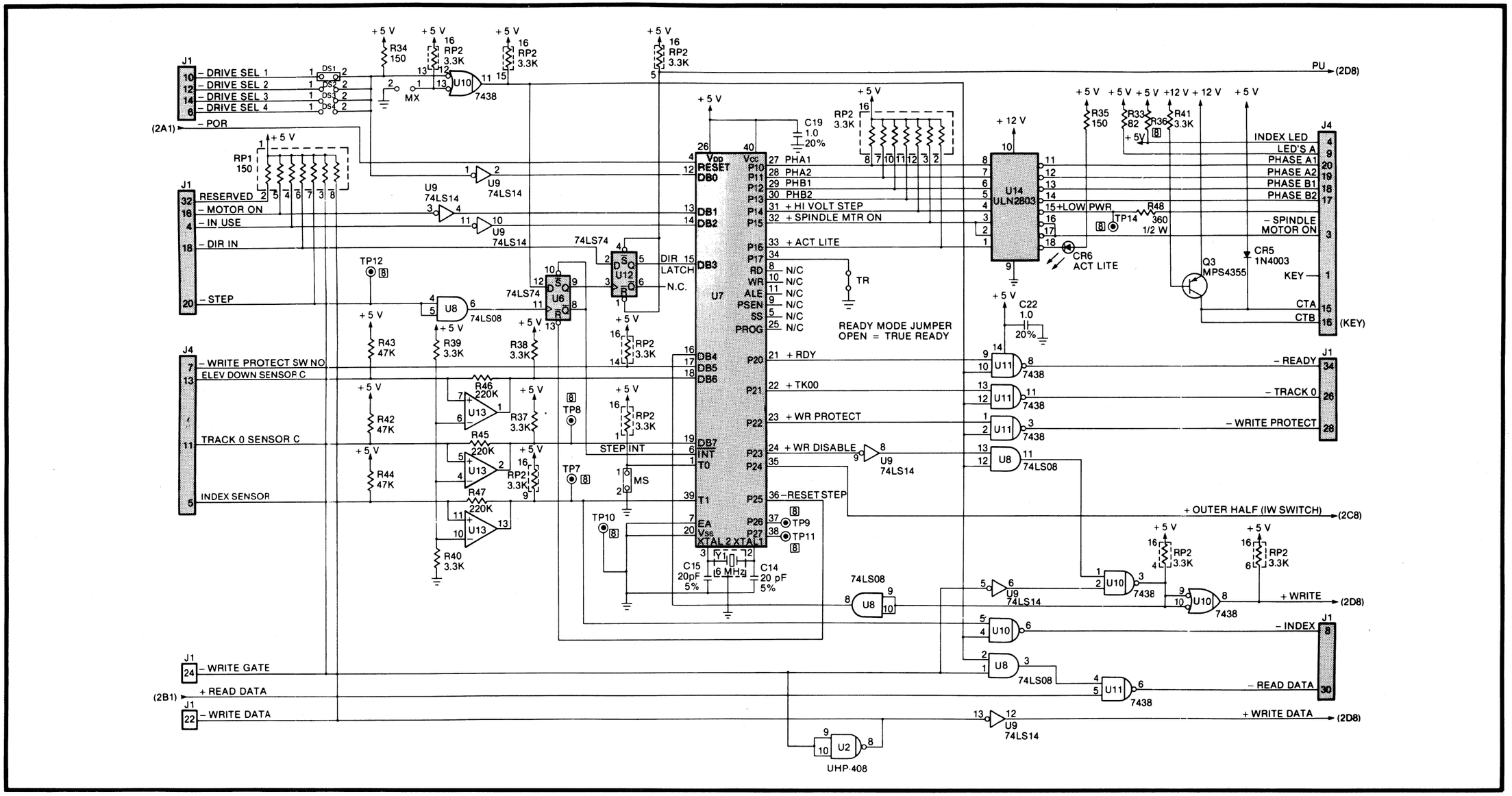
TYPE	REF. DES.	IND.	+5 V	+12 V
SIP, 150	RP1	—	1	—
DIP, 3.3 I	RP2	—	16	O
CA3045	U3	3,10,13	—	—
CD4066	U1	7,10	—	14
LM399	U13	12	3	—
NE592	U4	5	—	10
MC3470	U5	5	—	18
ULN2803	U14	9	—	10
74LS08	U8	7	14	—
74LS14	U9	7	14	—
UHP-408	U2	7	14	—
7438	U10,U11	7	14	—
74LS74	U6,U12	7	14	—
8348	U7	7,20	26,40	—

TEST POINTS	
5,10	GND
1,2	READ ANALOG DATA
3,4	FILTERED READ ANALOG DATA
6	DIGITAL READ DATA
13	– RESET MPU
8	+ TRACK 00 SENSE
9,11	SOFTWARE MODE
7	+ INDEX
14	LOW/HIGH STEPPER VOLTAGE
12	– STEP

REFERENCE DESIGNATION	
LAST USED	NOT USED
VR1,CR6	
R51,C27,Q3	
U14,RP2,L3	R24

USED ON ASSEMBLY
P/N 025281-3
DOCUMENT CODE SC
REVISION/EC 3548

FIGURE 10-5. CONTROL PCB SCHEMATIC (SHEET 1 OF 2)



39259-24

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL CAPACITOR VALUES ARE IN MICROFARADS, 50 V ± 10%.
2. ALL DIODES ARE 1N4148.
3. ALL INDUCTOR VALUES ARE IN MICROHENRYS, ± 10%.
4. ALL RESISTOR VALUES ARE IN OHMS, 1/4 W ±5%.
5. ALL TRANSISTOR ARE _____.
6. — — — INDICATES CUT-TRACE OPTION.
7. — — — INDICATES JUMPER OPTION.
8. THESE COMPONENTS ARE NOT INSTALLED: R36, TP1 THRU 14.

TYPE	REF. DES.	IND.	+5 V	+12 V
SIP, 150	RP1	—	1	—
DIP, 3.3 I	RP2	—	16	O
CA3045	U3	3,10,13	—	—
CD4066	U1	7,10	—	14
LM399	U13	12	3	—
NE592	U4	5	—	10
MC3470	U5	5	—	18
ULN2803	U14	9	—	10
74LS08	U8	7	14	—
74LS14	U9	7	14	—
UHP-408	U2	7	14	—
7438	U10,U11	7	14	—
74LS74	U6,U12	7	14	—
8348	U7	7,20	26,40	—

TEST POINTS	
5,10	GND
1,2	READ ANALOG DATA
3,4	FILTERED READ ANALOG DATA
6	DIGITAL READ DATA
13	– RESET MPU
8	+ TRACK 00 SENSE
9,11	SOFTWARE MODE
7	+ INDEX
14	LOW/HIGH STEPPER VOLTAGE
12	– STEP

REFERENCE DESIGNATION	
LAST USED	NOT USED
VR1,CR6	
R51,C27,Q3	
U14,RP2,L3	R24

USED ON ASSEMBLY
P/N 025281-3
DOCUMENT CODE SC
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FIGURE 10-5. CONTROL PCB SCHEMATIC (SHEET 2 OF 2)

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