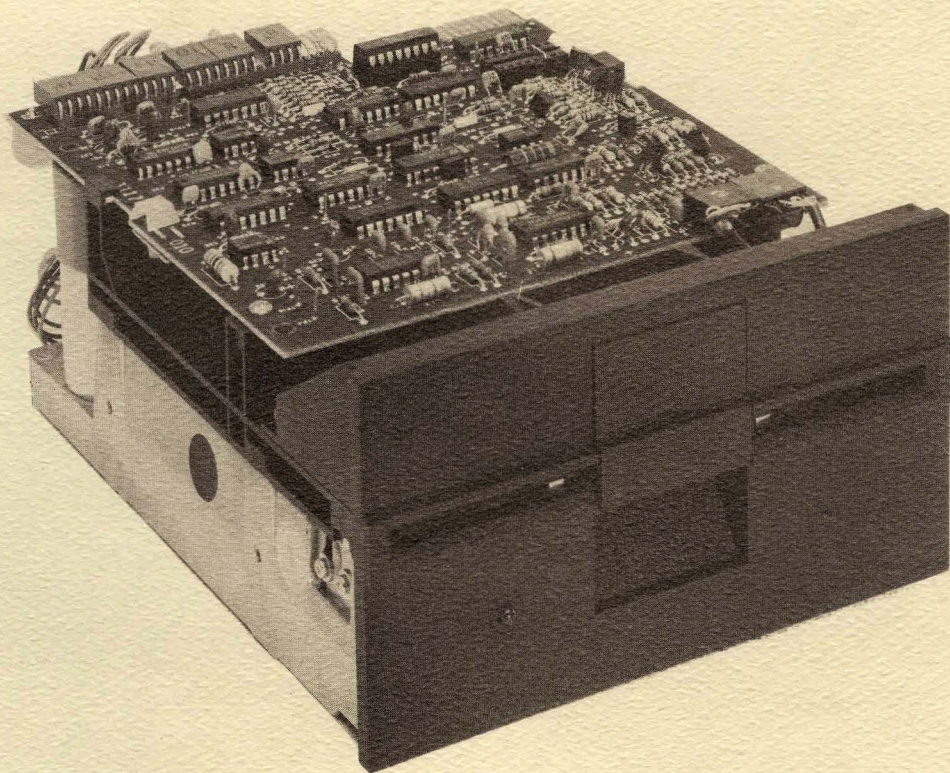


**OEM**  
**OPERATING AND SERVICE MANUAL**  
**TM100-1, TM100-2 DISK DRIVES**  
**48 TRACKS PER INCH**



**Tandon** CORPORATION  
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CHATSWORTH, CALIFORNIA 91311

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# SECTION 1

## GENERAL DESCRIPTION

### INTRODUCTION

This document provides required information in order to evaluate and incorporate Tandon's disk drive into a system.

Tandon Corporation's Model Number TM100-1 and TM100-2 are full-feature, 5-1/4-inch, flexible disk drives. They are compact data storage devices that use an ANSI-compatible, industry standard, 5-1/4-inch diskette.

Model Number TM100-1 and TM100-2 drives each have forty-eight (48) tracks per inch. The TM100-1 is a single-sided recording device. The TM100-2 is a double-sided recording device.

Both drives are capable of reading and writing in single-density format on a diskette, using a proprietary read/write head patented by Tandon. The drives have a double density capability when Modified Frequency Modulation (MFM) or other appropriate recording technique is used. Encoding and decoding of the data is done by the user's controller.

#### 1.1 SCOPE OF THE DOCUMENT

This document contains the major features, physical and functional specifications, mounting and power requirements, the interface, and typical timing characteristics of the TM100-1 and TM100-2 drives. In addition, there is a theory of operation, checks and adjustment procedures, troubleshooting guide, replacement procedures, assembly drawings, and schematics.

#### 1.2 PURPOSE OF THE DRIVE

The TM100-1 and TM100-2 drives are rotating disk memories designed for random access data

entry, storage, and retrieval applications. Typical applications include intelligent terminal controllers, microcomputers, word processing systems, data communication systems, error logging, program loading, and point-of-sale terminals.

### 1.3 MAJOR FEATURES

#### WRITE PROTECT

When a write protected diskette is inserted into the drive, the write electronics are disabled.

#### DAISY CHAIN CAPABILITY

The drive provides the address selection and gating functions necessary to daisy chain a maximum of four units at the user's option. The last drive on the daisy chain terminates the interface. The terminations are accomplished by a resistor array plugged into a DIP socket.

#### INTERNAL TRIM ERASE

The drive provides the control signals necessary for proper trim erasure of data.

#### INDUSTRY STANDARD INTERFACE COMPATIBILITY

The drive is compatible with controllers that use an industry standard interface.

## **TRACK 0 SWITCH**

The Track 0 switch is provided to generate a logic level at the drive interface, indicating the read/write head is positioned at the outermost track.

## **INDEX SENSOR**

An index sensor is provided to generate electrical pulses at the drive interface coincident with sensing Index/Sector holes on the diskette.

## **ACTIVITY INDICATOR**

An activity indicator, located on the front panel, is automatically illuminated when the drive is selected.

## **1.4 FUNCTIONAL DESCRIPTION**

The drives are fully self-contained, and require no operator intervention during normal operation. Each drive consists of electronics to generate and interpret control signals, a head positioning system, a read/write system, and a spindle drive system.

When the front latch is opened, access is provided for insertion of a diskette. The diskette is held in place by plastic guide rails. Its location is ensured when the diskette is inserted until a back stop is encountered.

Closing the front latch activates the cone clamping mechanism, resulting in accurate centering and clamping of the diskette. The drive hub is held at a constant speed of 300 RPM by a servo-controlled D. C. motor. The heads remain in contact with the recording media until the front latch is opened.

The heads are positioned over the desired track by means of a four-phase stepper motor/band

assembly and its associated electronics. This positioner uses a one-step rotation to cause a one track linear movement.

Data recovery electronics include a low-level read amplifier, differentiator, zero crossover detector, and digitizing circuits. No data decoding capabilities are provided.

The drive has the following sensors:

1. A Track 0 switch detects when the head/carriage assembly is positioned at Track 0.
2. An index/sensor is positioned to generate a digital signal when an index/sensor hole on the diskette is detected.
3. A write protect switch disables the write electronics when a write protect tab is applied to the diskette.

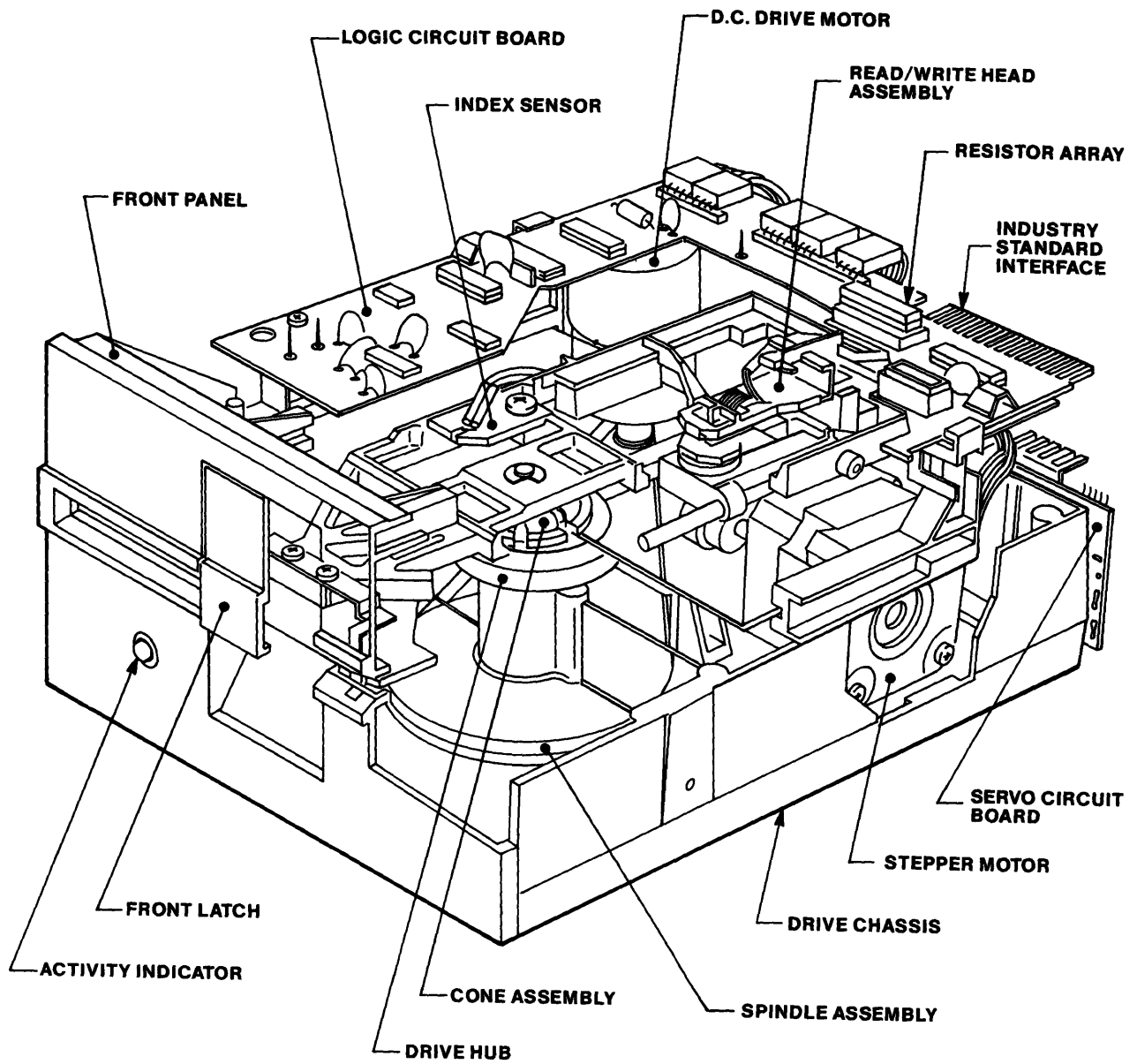
## **1.5 PHYSICAL DESCRIPTION**

A representative drive is shown in Figure 1-1. The drive can be mounted in a vertical or horizontal plane. However, the logic circuit board must be on the uppermost side when the drive is mounted horizontally.

The spindle is belt driven by a D. C. motor with an integral tachometer. The servo control circuit and tachometer control the speed of the spindle.

The read/write head assembly is positioned by a split band positioner mounted to a stepper motor. The read/write head(s) is a glass-bonded, ferrite/ceramic structure with a life expectancy of 20,000 operating hours.

The electronic components of the drive are mounted on two printed circuit boards. The logic circuit board is mounted above the chassis. The spindle motor control circuit board is mounted at the rear of the chassis. Power and interface signals are routed through connectors plugged directly into the logic circuit board.



**FIGURE 1-1  
DISK DRIVE**



# **SECTION 2**

## **PRODUCT SPECIFICATIONS**

### **INTRODUCTION**

This section contains the mechanical, electrical reliability, and environmental specifications for the TM100-1 and TM100-2 drives.

#### **2.1 MECHANICAL SPECIFICATIONS**

The physical dimensions of the drive are located in Figure 2-1.

#### **2.2 ELECTRICAL AND OPERATIONAL SPECIFICATIONS**

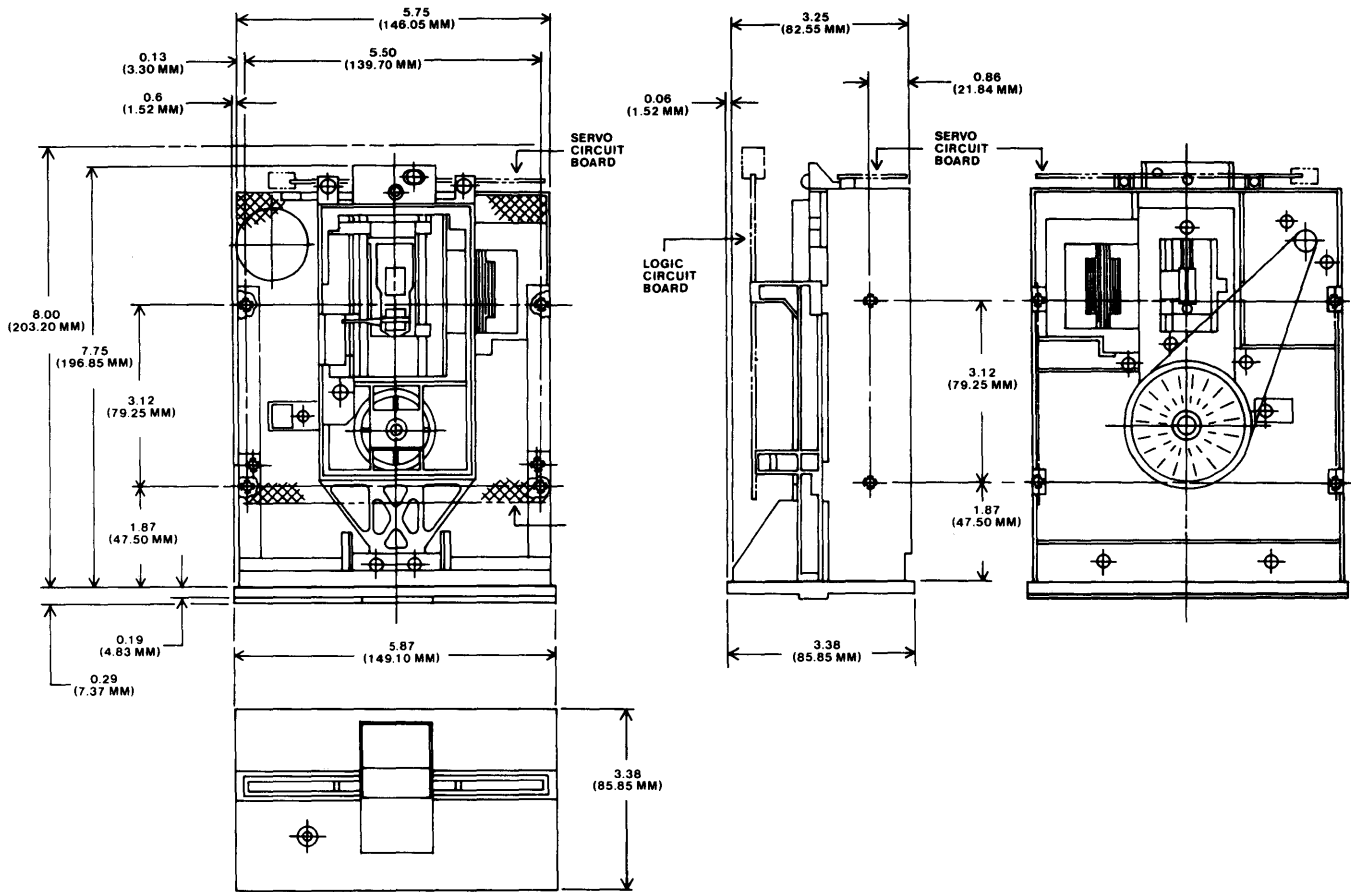
The electrical and operational specifications are located in Table 2-1.

#### **2.3 RELIABILITY SPECIFICATIONS**

The reliability specifications are located in Table 2-2.

#### **2.4 ENVIRONMENTAL SPECIFICATIONS**

The environmental specifications are located in Table 2-3.



- NOTES:**
1. DIMENSIONS ARE GIVEN IN INCHES. METRIC EQUIVALENTS ARE IN PARENTHESES.
  2. TOLERANCE ON ALL DIMENSIONS  $\pm 0.020$  INCH, UNLESS OTHERWISE SPECIFIED.
  3. WEIGHT IS APPROXIMATELY 3 POUNDS (1.35 KILOGRAMS).

**FIGURE 2-1  
DISK DRIVE OUTLINE DRAWING**

**TABLE 2-1  
ELECTRICAL AND OPERATIONAL SPECIFICATIONS**

Media	ANSI-compatible, 5-1/4-inch diskette
Media Life (for reference only)	4 x 10 <sup>6</sup> passes per track
Tracks Per Inch	48 TPI, both drives
Tracks Per Drive	
TM100-1	40 tracks
TM100-2	80 tracks
Track Spacing	0.529 millimeters, 20.8 milinches
Head Life	20,000 media contact hours
Disk Rotational Speed	300 RPM ± 1.5 percent
Average Rotational Latency	100 milliseconds
Instantaneous Speed Variation (ISV)	± 3 percent
Motor Start Time	250 milliseconds, maximum
Motor Stop Time	150 milliseconds, maximum
Seek Time, track-to-track	5 milliseconds
Head Settling Time	15 milliseconds
Average Track Access Time, including head settling time	75 milliseconds
Typical Recording Modes	FM, MFM, MMFM
Data Transfer Rate	250,000 bits per second, double density
Flux Reversals Per Inch (FRPI), inside track	
Both Models, Side 0	5,535 FRPI
TM100-2, Side 1	5,877 FRPI

**TABLE 2-1 (CONTINUED)  
ELECTRICAL AND OPERATIONAL SPECIFICATIONS**

<p>Unformatted Recording Capacity</p> <p>    TM100-1</p> <p>    TM100-2</p> <p>D. C. Voltage and Current Requirements</p> <p>    + 12 volts D. C. Power</p> <p>    + 5 volts D. C. Power</p> <p>Shipment</p>	<p>250 kilobytes per disk</p> <p>500 kilobytes per disk</p> <p>+ 12 volts <math>\pm</math> 0.6 volt, 900 milliamperes, average, 100 millivolts peak-to-peak ripple.</p> <p>+ 5 volts <math>\pm</math> 0.25 volt, 600 milliamperes, average, with less than 100 millivolts peak-to-peak ripple.</p> <p>When prepared for shipment by Tandon, the drive meets the requirements of NSTA preshipment test procedure Project 1A.</p>
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**TABLE 2-2  
RELIABILITY SPECIFICATIONS**

<p>Error Rates, maximum, exclusive of external sources, e.g.: electronics, defective and contaminated diskettes</p> <p>    Soft Errors (Recoverable)</p> <p>    Hard Errors (Nonrecoverable)</p> <p>    Seek Errors</p> <p>Mean Time Between Failures</p> <p>Mean Time To Repair</p>	<p>One in <math>10^9</math> bits</p> <p>One in <math>10^{12}</math> bits</p> <p>One in <math>10^6</math> seeks</p> <p>8,000 hours, 25 percent duty cycle</p> <p>30 minutes</p>
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**TABLE 2-3  
ENVIRONMENTAL SPECIFICATIONS**

<p><b>Temperature</b></p> <p style="padding-left: 40px;">Operating, media dependent</p> <p style="padding-left: 40px;">Nonoperating</p> <p><b>Relative Humidity</b></p> <p style="padding-left: 40px;">Operating, noncondensing, media dependent</p> <p style="padding-left: 40px;">Nonoperating, noncondensing</p> <p><b>Altitude</b></p> <p style="padding-left: 40px;">Operating or nonoperating</p>	<p>10°C to 46°C, 50°F to 115°F</p> <p>–40°C to 71°C, –40°F to 160°F</p> <p>20-to-80 percent</p> <p>5-to-95 percent</p> <p>152.4 meters, 500 feet, below sea level, to 15,240 meters, 50,000 feet, above sea level</p>
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# SECTION 3

## OPERATION

### INTRODUCTION

This section contains information on how to unpack, check out, install, and operate the TM100-1 and TM100-2 drives.

#### 3.1 UNPACKING THE DRIVE

The drives are packaged in protective containers to minimize the possibility of damage during shipment. The following list is the recommended procedure for unpacking the drive.

1. Place the container on a flat work surface.
2. Remove the upper half of the container.
3. Remove the drive from the lower half of the container.
4. Check the contents of the container against the packing slip.
5. Investigate the contents of the container for possible damage.
6. Notify the carrier immediately if any damage is found.

#### 3.2 PREINSTALLATION CHECKOUT

Before applying power to the drive, the following inspection should be conducted:

1. Check to ensure the front latch opens and closes.
2. When the latch is moved to an open position, the head arm raises.

3. Remove the cardboard shipping insert, and retain for future shipment.
4. Ensure the front panel is secure.
5. Ensure the drive belt is in place.
6. Manually rotate the drive hub. It should rotate freely.
7. Ensure both circuit boards are secure.
8. Ensure the connectors are firmly seated.

#### 3.3 MOUNTING THE DRIVE

The drive has been designed to be mounted horizontally or vertically. When mounted horizontally, the logic circuit board side of the drive must be the top side.

Four 6-32 tapped mounting holes are provided on the bottom of the drive, and two 6-32 tapped mounting holes on each side, for attachment to user-supplied mounting brackets. When installed in either plane, horizontal or vertical, only two mounting screws are required to securely hold the drive in place.

Any mounting scheme in which the drive is part of the structural integrity of the enclosure is not permitted. Mounting schemes should allow for adjustable brackets or incorporate resilient members to accommodate tolerances. In addition, it is recommended that mounting schemes include no more than two mounting surfaces.

The drive is manufactured and tested with some critical internal alignments that must be maintained. Hence, it is important that the mounting hardware not introduce significant stress on the chassis.

## DUST COVER

The design of an enclosure should incorporate a means to prevent contamination from loose items, e.g., dust, lint, and paper chad, since the drive does not have a dust cover.

## COOLING

Heat dissipation from a single drive is normally 15 watts, 51 BTU per hour, under high load conditions. When the drive is mounted so the components have access to a free flow of air, normal convection cooling allows operation within the specified temperature range.

When the drive is mounted in a confined environment, air flow must be provided to maintain specified air temperatures in the vicinity of the motors, printed circuit board, and diskettes.

When forced air is used, air flow must be directed outward from the drive. Do not intake air through the drive or heads and diskettes.

## 3.4 INTERFACE CONNECTIONS

Interface connections for the TM100-1 and TM100-2 are made via a user-supplied, thirty-four pin, flat ribbon connector, 3M Part Number 3463-0001 or Amp Part Number 583717-5, using contact Part Number 1-583616-1 for twisted pair or its equivalent. This connector mates directly with the circuit board connector at the rear of the drive. The D. C. power connector is a four-pin connector at the rear of the drive. The interface description of the connectors, and the location of each one, is contained in this section. Interface lines are located in Table 3-1. D. C. power connector pin assignments are located in Table 3-2.

The signal wire harness should be of the flat ribbon or twisted pair type, 26-to-28 gauge conductor, compatible with the connector to be used. The recommended cable length is ten feet maximum.

<b>TABLE 3-1 DRIVE INTERFACE LINES AND PIN ASSIGNMENTS</b>			
<b>Input Control Lines: Controller-To-Disk Drive</b>			
Ground	Pin	Signal	
	1	2	Connector Clamp
	3	4	Spare
	5	6	Drive Select 3
	9	10	Drive Select 0
	11	12	Drive Select 1
	13	14	Drive Select 2
	15	16	Motor On
	17	18	Direction Select
	19	20	Step
	21	22	Composite Write Data
	23	24	Write Enable
	31	32	Side Select
<b>Output Control Lines: Disk Drive-To-Controller</b>			
Ground	Pin	Signal	
	7	8	Index/Sector
	25	26	Track 0
	27	28	Write Protect
	29	30	Composite Read Data
	33	34	Spare

## INPUT CONTROL LINES

### DRIVE SELECT LINES

The Drive Select lines provide a means of selecting and deselecting a drive. These four lines select one of the four drives attached to the controller.

When the signal logic level is true (low), the drive electronics are activated, and the drive is conditioned to respond to Step or Read/Write commands. A Drive Select line must remain stable in the true (low) state until a Step or

Read/Write command is completed. When the signal line logic level is false (high), the input control lines and output status lines are disabled.

The drive address is determined by a jumper select on the logic circuit board. Drive Select lines 0 through 3 provide a means of daisy chaining a maximum of four drives to a controller. Only one can be true (low) at a time. An undefined operation results if two or more drives are assigned the same address or if two or more Drive Select lines are in the true (low) state simultaneously.

## **MOTOR ON**

When this signal is true (low), the drive motor accelerates to its nominal speed of 300 RPM, and stabilizes at this speed in less than 250 milliseconds. When the signal line logic level goes false (high), the drive decelerates to a stop. This signal is not gated with Drive Select.

The motor activates momentarily when the front latch is closed. This motor start function remains active for approximately five seconds, unless Motor On is in the true (low) condition.

## **DIRECTION SELECT AND STEP LINES (TWO LINES)**

When the drive is selected, a true (low) pulse on the Step line, with a time duration greater than 200 nanoseconds, initiates the access motion. The direction of motion is determined by the logic state of the Direction Select line when a step pulse is issued. The motion is toward the center of the disk if the Direction Select line is in the true (low) state. The direction of motion is away from the center of the disk if the Direction Select line is in the false (high) state.

To ensure proper positioning, the Direction Select line should be stable at least 100 nanoseconds prior to issuing a corresponding step pulse, and remain true (low) 100 nanoseconds after it.

The access motion is initiated on the trailing edge of the step pulse. The time period between consecutive trailing edges of step pulses should be not less than five milliseconds.

The drive electronics ignore step pulses when one of three conditions exists:

1. The write enable is true (low).
2. The direction select is false (high), and the head is positioned at Track 0.
3. The drive is not selected.

## **COMPOSITE WRITE DATA**

When the drive is selected, this interface line provides the bit serial composite write data pulses that control the switching of the write current in the selected head. The write electronics must be conditioned for writing by the Write Enable line.

For each high-to-low transition on the Composite Write Data line, a flux change is produced at the write head gap. This causes a flux change to be recorded on the media.

When a single-density (FM) type encoding technique is used in which data and clock form the combined Write Data signal, it is recommended that the repetition of the high-to-low transitions, while writing all zeros, be equal to one-half the maximum data rate, 125 kilohertz  $\pm 0.1$  percent, and the repetition of the high-to-low transitions, when writing all ones, be equal to the maximum data rate, 250 kilohertz  $\pm 0.1$  percent.

Host controllers may implement write precompensation circuits that recognize worst case patterns and adjust the write data waveform. Although a value cannot be specified for write precompensation, Tandon suggests a value of 250 nanoseconds for systems using MFM double density recording format.

## **WRITE ENABLE**

When this signal is true (low), the write electronics are prepared for writing data and the read electronics are disabled. This signal turns on write current in the selected read/write head. Data is written under the control of the Composite Write Data and Side Select input lines. When the Write Enable line is false (high), all write electronics are disabled.

When a write protected diskette is installed in a drive, the write electronics are disabled, irrespective of the state of the Write Enable or Side Select lines.

## **SIDE SELECT, TM100-2**

The Side Select interface line defines which side of a two-sided diskette is used for data transfer.

A false (high) level on this line selects the read/write head on side zero, the lower head, of the drive. A true (low) level on this line selects the read/write head on side one, the upper head of the drive.

## **OUTPUT CONTROL LINES**

### **INDEX/SECTOR**

The index/sector signal is a composite of the index pulse and sector signals.

An index pulse is provided once every revolution, 200 milliseconds nominal, to indicate the beginning of a track to the controller. The leading edge of this signal must always be used to ensure timing accuracy. The index/sector line remains in the true (low) state for the duration of the index pulse, which is nominally four milliseconds.

The sector signal portion appears only when using hard sectored diskettes.

### **TRACK 0**

When the drive is selected, the Track 0 interface signal, when true (low), indicates to the controller that the read/write head(s) are positioned at Track 0. This signal remains true (low) until the heads are moved from Track 0.

## **WRITE PROTECT**

When the Write Protect line goes true (low), the diskette is write protected and the write electronics are disabled. It is recommended the controller not issue a Write command when the Write Protect signal is true (low).

When the Write Protect line is false (high), the write electronics can be enabled.

## **COMPOSITE READ DATA**

This interface line transmits the readback data to the controller when the drive is selected. It provides a pulse for each flux transition detected from the diskette. The Composite Read Data output line goes true (low) for a duration of  $1 \pm 0.25$  microseconds for each flux change detected from the diskette.

The leading edge of the Composite Read Data output pulse represents the true position of the flux transitions on the diskette's surface.

## **TYPICAL INTERFACE CHARACTERISTICS**

Lines between the controller and the drive have the following characteristics:

$$\begin{aligned} V_{\text{out}} \text{ True} &= +0.4 \text{ volt maximum at } I_{\text{out}} \\ &= 48 \text{ milliamperes, maximum} \end{aligned}$$

$$\begin{aligned} V_{\text{out}} \text{ False} &= +2.4 \text{ volts minimum open} \\ &\text{collector at } I_{\text{out}} = 250 \\ &\text{microamperes, maximum} \end{aligned}$$

Figure 3-1 contains the characteristics of the electrical interface. Figure 3-2 contains the control and data timing requirements.

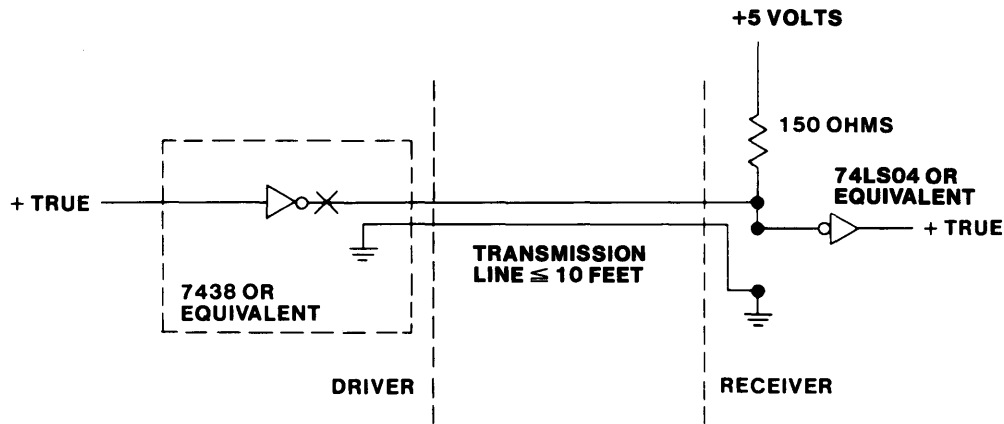


FIGURE 3-1  
ELECTRICAL INTERFACE CHARACTERISTICS

### 3.5 D. C. POWER

D. C. power is supplied to the drive via a four-pin AMP connector, J2, mounted on the circuit board. The mating connector, not supplied, is AMP Part Number 1-480424-0, using AMP contact Part Number 606191-1. Pin assignments are found in Table 3-2. The conductor should be 16-to-18 AWG, minimum.

TABLE 3-2 D. C. POWER CONNECTOR PIN ASSIGNMENTS	
Pin	Supply Voltage
1	+ 12 volts D. C.
2	12 volts return
3	5 volts return
4	+ 5 volts D. C.
Pin	Signal
Ground lug 3/16-inch quick disconnect	Chassis ground from controller

The chassis should be connected to earth ground to ensure proper operation. The conductor should be 16-to-18 AWG, minimum.

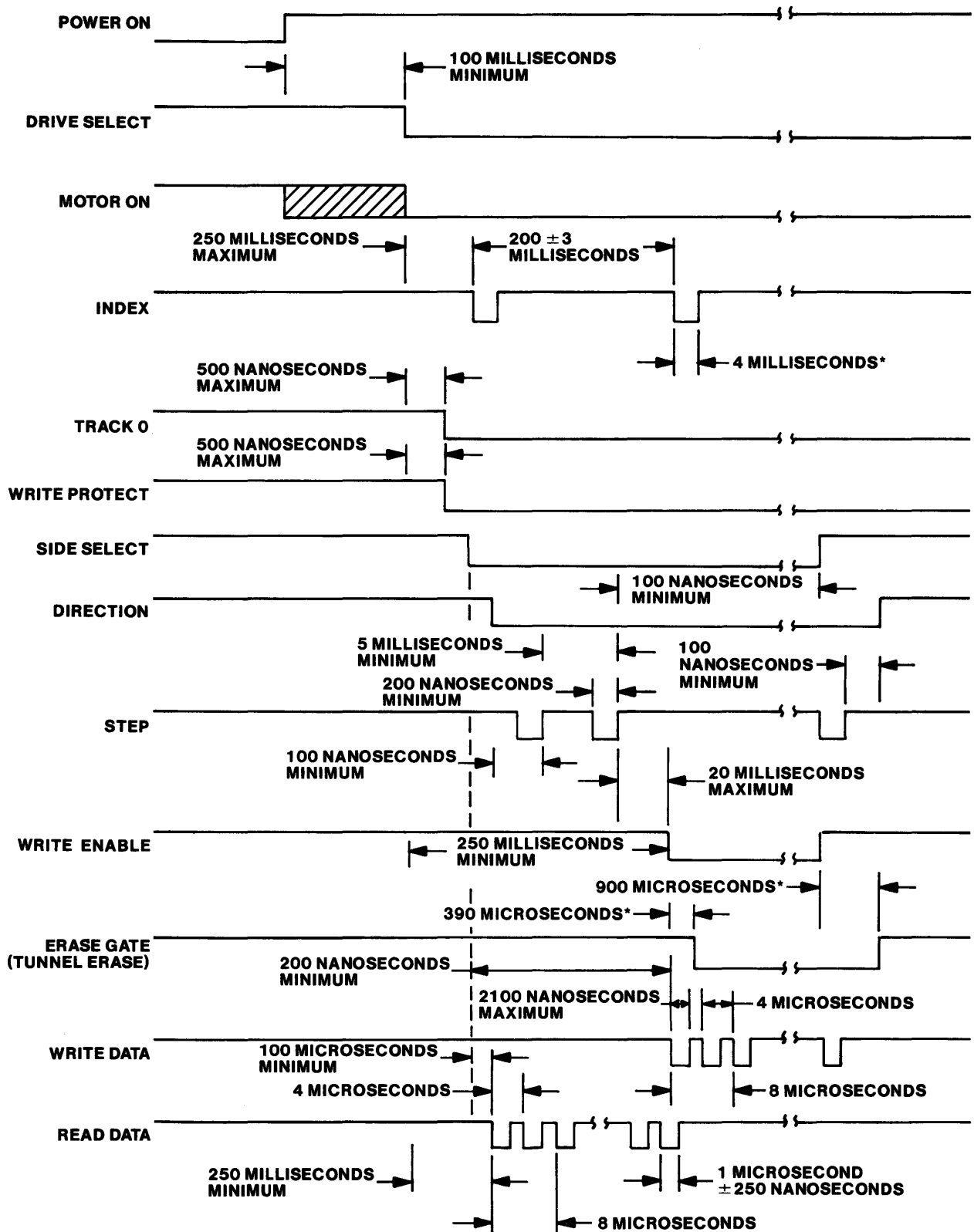
### 3.6 DRIVE ADDRESS AND OPTION PATCHING

The drive address and option patching is determined by the programmable shunt located at 1E on the logic circuit board. The DS0 through DS3 jumpers determine the drive address. The MX jumper is used only in single drive systems. See Figure 3-3.

The program shunt is AMP Part Number 435704-7. The shunt positions can be cut using AMP's tool, Part Number 435705. The shunt is installed in a DIP socket. At the user's option, it can be removed and replaced by a DIP switch.

#### DS0 THROUGH DS3 JUMPERS

When daisy chaining two or more drives to a controller, the Drive Select (DS) jumpers patch the drive select control signal to enable the logic of the proper drive. Normally, all the shunt jumpers would be cut, except for the DS jumper



\*FOR REFERENCE ONLY

**FIGURE 3-2  
CONTROL AND DATA TIMING REQUIREMENTS**



that addresses each individual drive in the daisy chain. The terminator resistor pack, RP1, located on the logic circuit board should be installed in the last drive of the daisy chain. All other drives on the interface must have the resistor pack removed.

## MX JUMPER

The Multiplex (MX) jumper is used only in single drive systems when the user requires the drive logics to be enabled at all times. If the drive is not selected through the DS jumper, and the MX jumper is not cut, the drive logics are enabled but the front panel L.E.D. is not on. The MX jumper must be cut in a multiple drive system.

## HS AND HM JUMPERS

HS and HM jumpers are not used, and must be cut.

## POWER SAVE OPTION

When shipped from the factory, the drive is configured with a jumper at R51, 0 ohm resistor, for the TM100-1 and TM100-2 drives. R51 maintains 200 milliamperes of current to the stepper motor whether or not the drive is selected. Maintaining power to this motor prevents the head carriage from moving when the drive is not selected. The jumper at R51 may be moved to position R50, which removes the power to the stepper motor when the drive is not selected, for a savings of approximately 3.8 watts per drive. When R50 is used, the user must ensure the track location when the drive is reselected.

## SIDE SELECT (W1)

For use in double-sided drives:

<b>W1</b>	<b>SIDE SELECT</b>
—	For use in single-sided drives, TM100-1.
X	For use in double-sided drives, TM100-2.

## WRITE FLIP-FLOP CONTROL (W2, W3)

W2 and W3 control the set and preset lines of the write flip-flop, IC-5C. W2 is installed for the standard configuration, W3 is for special use.

W2	W3	WRITE FLIP-FLOP CONTROL
X	—	Disables set and preset lines on the write flip-flop only during internal N Write.
—	X	Disables set and preset lines on the write flip-flop continuously.

## WRITE PROTECT CONTROL (W4, W5)

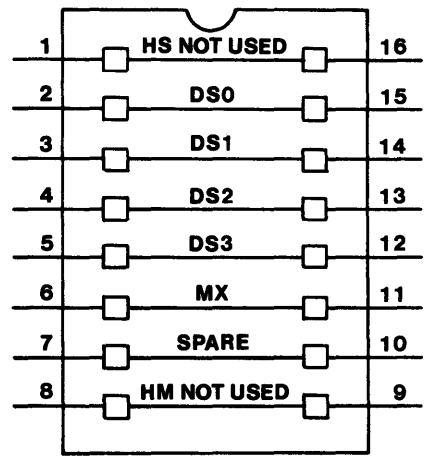
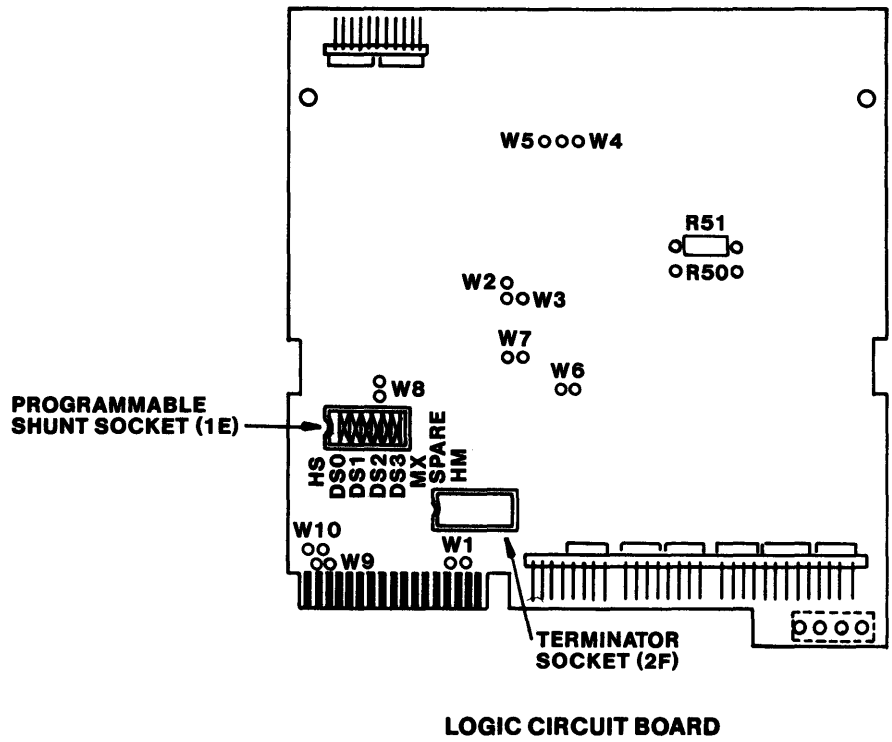
Write Protect Control from the write protect switch is disabled with W5 installed. Standard Write Protect Control is enabled with W4 installed.

W4	W5	WRITE PROTECT CONTROL
X	—	Write Protect Control responds to a write protected diskette.
—	X	Write Protect Control is inhibited.

## ACTIVITY L.E.D. CONTROL (W6, W7, W9)

The Activity L.E.D. may be illuminated by an optional input line, J1-4 (N In Use). Normally, the Activity L.E.D. is controlled with Drive Select, W6 installed.

W6	W7	W9	ACTIVITY L. E. D. CONTROL
X	—	—	Activity L.E.D. is controlled with Drive Select.
—	X	X	Activity L.E.D. is controlled with N In Use, J1-4.



**PROGRAMMABLE SHUNT SOCKET 1E**

**FIGURE 3-3  
LOGIC BOARD WITH PROGRAMMABLE SHUNTS AND OPTION PATCHING LOCATIONS**

## DRIVE SELECT 3 ENABLE (W8)

Removal of this jumper allows interface J1-6 to be used as an alternate input/output line. W8 is normally installed.

<b>W8</b>	<b>DRIVE SELECT 3 ENABLE</b>
X	Allows drive to be selected via J1-6.
—	Disables Drive Select 3 line.

## DOOR LOCK SOLENOID (W10)

This jumper is used in conjunction with an optional door lock solenoid. The W10 jumper is normally not installed.

<b>W10</b>	<b>DOOR LOCK SOLENOID</b>
X	Enables door lock solenoid via J1-2.
—	Disables door lock circuits.

## 3.7 DISKETTES

The TM100-1 and TM100-2 drives use an ANSI-compatible, 5-1/4-inch diskette. Diskettes are available with a single index hole or with multiple (index and sector) holes.

Diskettes with a single hole are used when soft sector format is required. Multiple hole diskettes provide sector information through the use of an index sensor and electronics.

Figure 3-4 illustrates the diskette used with the drive. This recording media is a flexible diskette enclosed in a protective jacket. The protected diskette, free to rotate within the jacket, is continuously cleaned by its soft fabric lining during normal operation.

### LOADING THE DISKETTE

The drive is loaded by inserting the diskette, head aperture forward, into the front slot of the drive. Access to the diskette loading slot is obtained by opening the front latch.

The diskette should be carefully inserted until it is solidly against the back stop.

### CAUTION

*Damage to the center of the diskette may result if the door is closed when the diskette is not properly inserted. This prevents reliable recovery of the recorded data.*

### WRITE PROTECT TAB

The drive is equipped with a write protect switch assembly. This switch operates in conjunction with a diskette that has a slot cut in the protective jacket. Figure 3-5 contains the location of the slot.

When the slot is covered with an optically opaque, self-adhesive tab, the diskette is write protected. The tab must be removed to write on the diskette. Figure 3-5 contains information on how to install a tab to cover the slot.

### DISKETTE HANDLING AND STORAGE

It is important the diskette be handled and stored correctly so the integrity of the recorded data is maintained. A damaged or contaminated diskette can impair or prevent recovery of data, and can result in damage to the read/write head(s).

Figure 3-5 contains an illustration of the physical configuration of the diskette. The 5.125-inch diskette is oxide-coated, flexible mylar. It is enclosed in a 5-1/4-inch square protective jacket. Read/write head access is made through an aperture in the jacket. In addition, openings for the drive hub and diskette index hole are provided.

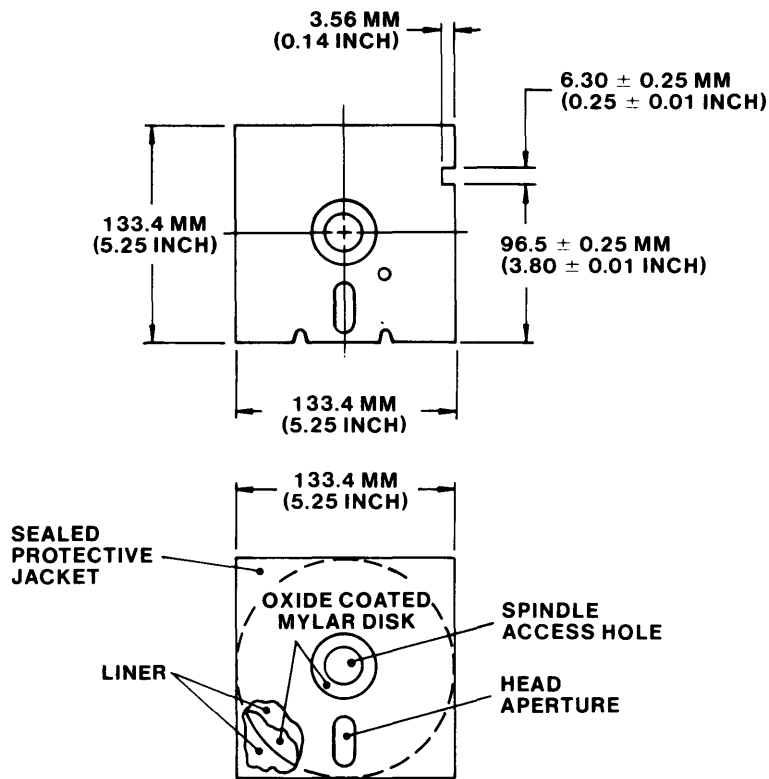
Figure 3-6 provides some helpful hints on the care and handling of the drive and diskettes. In addition, to ensure trouble-free operation and to enhance the service life of the diskette, the following handling procedures should be observed.

1. Return the diskette to the protective jacket when not in use.
2. Avoid exposing the diskette to any magnetizing force in excess of 50 oersted.

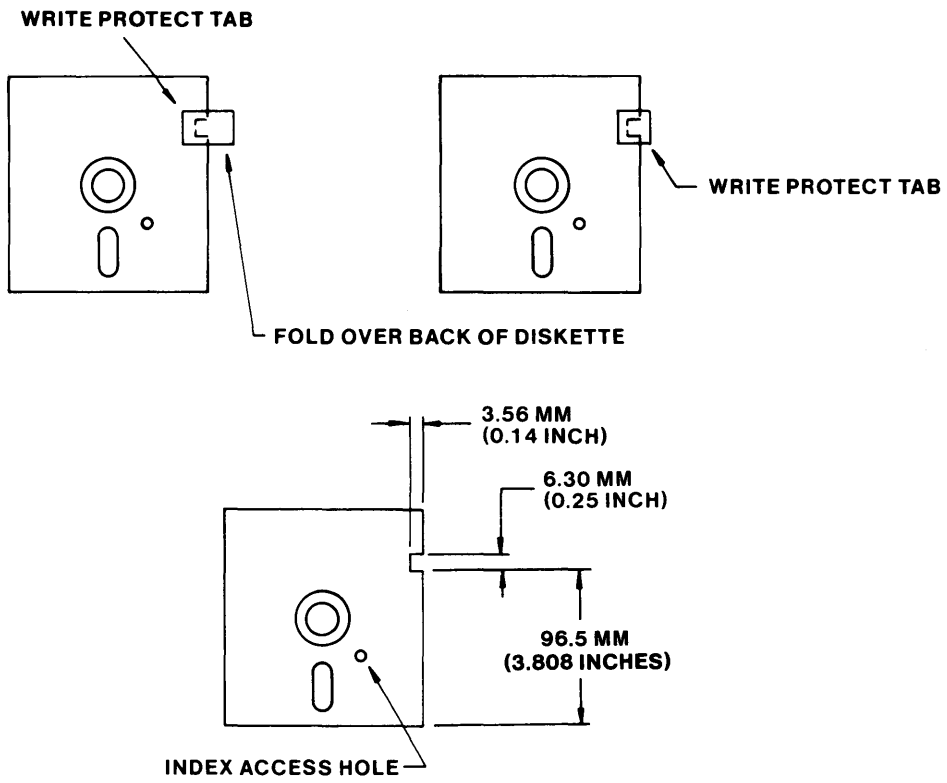
**NOTE**

The 50-oersted level magnetizing force is reached at a distance of approximately three inches from a typical source, e.g., motors, generators, or transformers.

3. To avoid warping, do not store the diskette in direct sunlight.
4. Do not use a lead pencil or a ballpoint pen to write on the label. Use a felt tipped pen, and mark lightly on the label.



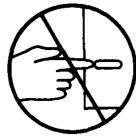
**FIGURE 3-4  
RECORDING MEDIA**



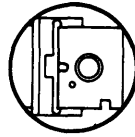
**FIGURE 3-5**  
**WRITE PROTECT TAB**



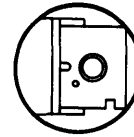
**DO NOT WRITE ON THE JACKET WITH PEN OR PENCIL. USE A FELT TIPPED PEN.**



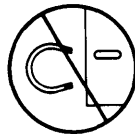
**DO NOT TOUCH PRECISION SURFACE WITH YOUR FINGERS.**



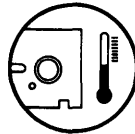
**TO AVOID DAMAGE TO THE DISKETTE AND TO YOUR DRIVE, INSERT DISKETTE CAREFULLY UNTIL THE BACKSTOP IS ENCOUNTERED.**



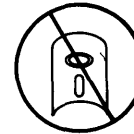
**RETURN THE DISKETTE TO ITS JACKET WHEN NOT IN USE.**



**KEEP THE DISKETTE AWAY FROM MAGNETIC FIELDS.**



**DISKETTES SHOULD BE STORED AT  
10°C to 52°C  
50°F to 125°F**



**HANDLE WITH CARE; BENDING AND FOLDING MAY DAMAGE DISKETTE.**

**FIGURE 3-6  
DISKETTE HANDLING AND STORAGE**

# SECTION 4

## THEORY OF OPERATION

### INTRODUCTION

This section contains a description on the theory of operation of the drive. The discussion begins with a general summary of magnetic data recording, followed by a description of each major function of the drive.

Circuit block diagrams and schematics are located in the appendices. They are useful to show the interconnections between the electronic circuits and the mechanical components.

### 4.1 DATA RECORDING

Digital information is represented by a sequence of bits: either 0 or 1. Small areas of the medium in which such binary information is stored, for example the iron oxide coating of a magnetic disk, must be put in one state or the other to represent the data.

Recording of data on a magnetic medium is based on the principles of electromagnetics. When current flows in a coil of wire it produces a magnetic field. The field is confined in a core of magnetic material around which the wire is wound. A narrow slot, called the air gap, is placed in the core located closest to the media. It is the magnetic field in the vicinity of the air gap that magnetizes the magnetic medium (Figure 4-1). When the current is reversed, the polarity of magnetization is reversed.

Information can be recorded on the diskette by using a double-frequency code. The magnetization profiles in each bit cell for the number sequence shown for FM recording are shown in Figure 4-2.

When data is read, the same head that writes the data is used. The data stored is a digital bit representing a 0 or 1. In each bit cell, the first flux reversal represents a clock bit. A second reversal represents a stored bit 1. The absence of a second reversal represents a bit 0.

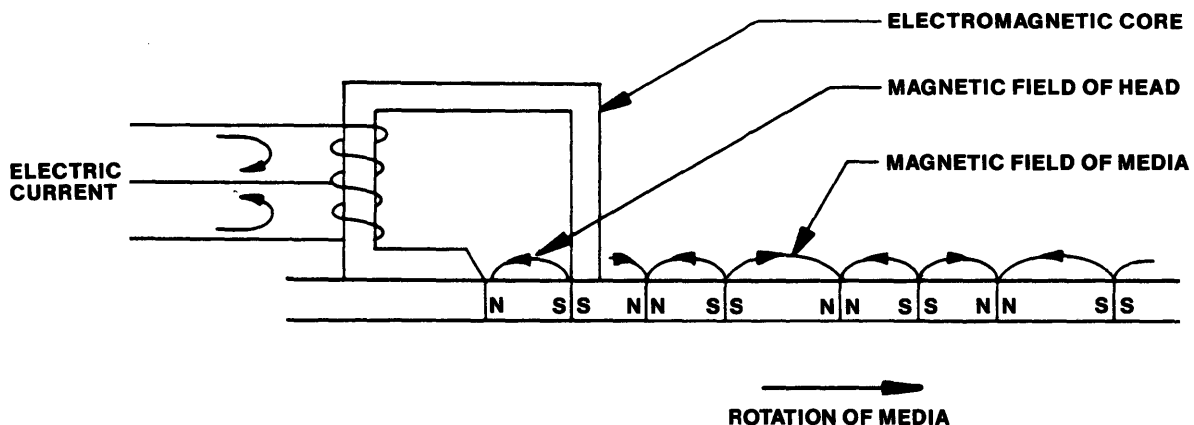
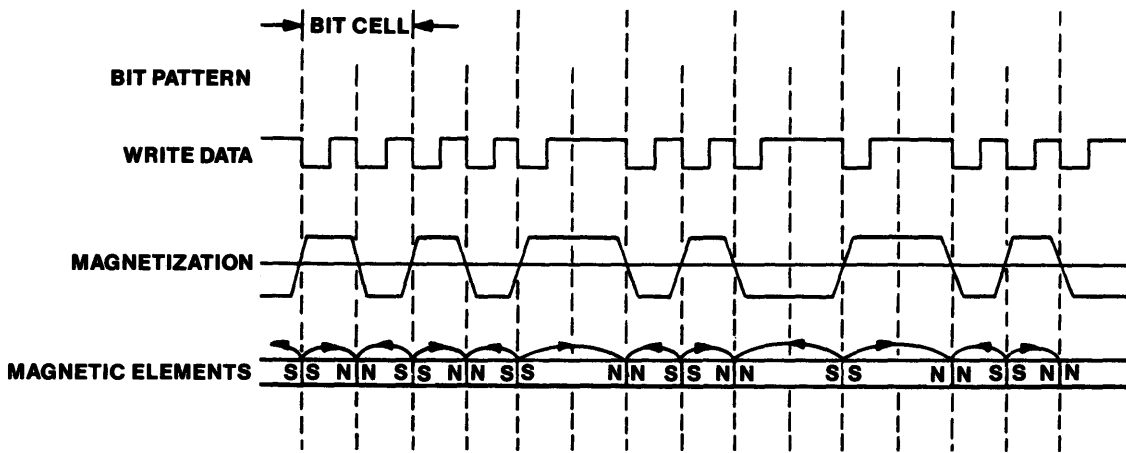


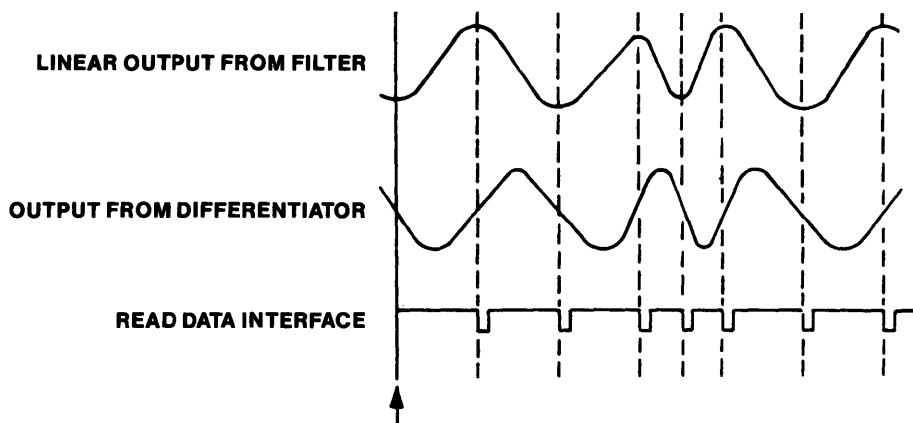
FIGURE 4-1  
ELECTROMAGNETIC CORE



**FIGURE 4-2  
FM RECORDING MAGNETIZATION PROFILES**

As the disk spins, the magnetic fields of the stored data pass successively under the head. The changing fields induce, in the head, an A. C. voltage signal which is then amplified and filtered, differentiated, and digitized (Figure 4-3).

The comparator and the digitizer circuitry generate a one microsecond Read Data pulse, corresponding to each peak of the Read signal. Then, the composite read data signal is sent to the user system via the Read Data interface line.



**FIGURE 4-3  
READ TIMING DIAGRAM**



## 4.2 COMPONENTS OF THE DRIVE

The drive contains the electrical and mechanical components required to perform four major functions:

1. Generate and interpret control signals.
2. Position the read/write head(s) to the desired track.
3. Write and read data.
4. Control the spindle.

The electrical and mechanical components of the drive are connected together via four- and five-pin connectors. This allows the individual assemblies to be removed (Figure 4-4).

## 4.3 GENERATE AND INTERPRET CONTROL SIGNALS

The components of the drive required to generate and interpret the control signals are:

1. Index Sensor
2. Write Protect Switch
3. Track 0 Switch
4. Drive Select

### INDEX SENSOR

The Index signal is derived from an infrared L.E.D. and phototransistor detector. When the index/sector hole in the diskette passes through the index sensor, the light from the L.E.D. is allowed to turn on the index detector, producing a positive pulse on J4, Pin 15 (Figure 4-5).

This signal is shaped by an input buffer, Q8, and supplied to inverter IC 2E. Then, it is gated with Drive Select for an output control signal at the interface J1, Pin 8.

### WRITE PROTECT SWITCH

The Write Protect signal is derived from a mechanical switch integrated into the drive, the switch is deactivated, causing a high signal on J4, Pin 5. Then, it is buffered and inverted to disable the Write Enable signal. It is also gated with drive select, producing an output signal on the interface.

### TRACK 0 SWITCH

The Track 0 sensor signal is derived from a mechanical switch internal to the drive. As the head carriage moves back toward Track 0, the switch is activated between Tracks 0 and 3.

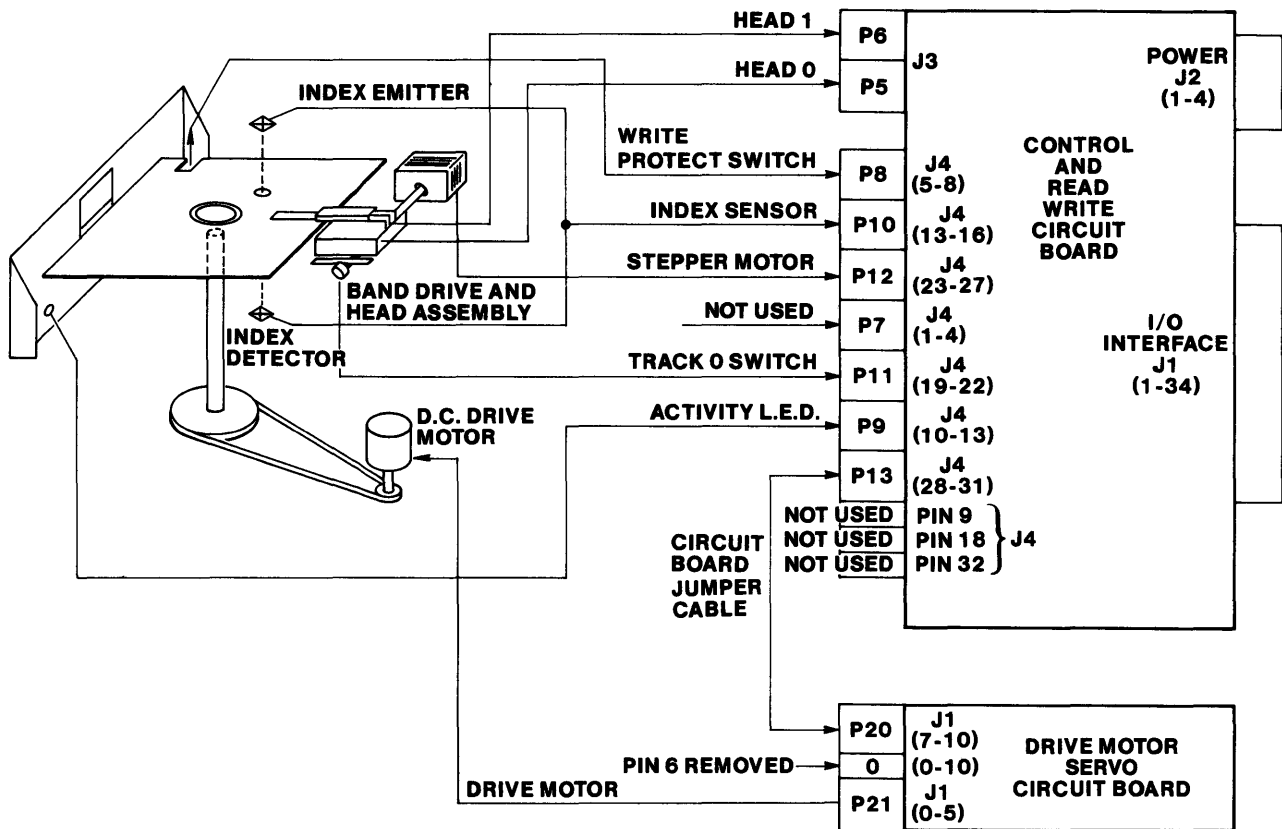
This low active signal comes in via Connector P11, Pin 1, and is supplied to a latch that debounces the switch noise (Figure 4-6). The combination of the Track 0 switch being activated and the proper stepper motor phase (Phase 0) produces all high signals at IC 4B, pins 9, 10, 12, and 13, causing a low output at IC 4B, Pin 8 (Test Point 8). Then, this signal is buffered through IC 3D, Pins 1 and 2, which inhibits stepping to Track 0 minus 1. IC 1F Pins 11, 12, and 13 gate the Track 0 output with Drive Select, to give a Track 0 output to Pin 26 of the interface.

### DRIVE SELECT

The Drive Select signal is derived from the host controller through the interface connector.

R14 holds the output of the appropriate select line high until the line is driven low. This signal is buffered through IC 3E and IC 3D, which enables the drive electronics.

The front panel L.E.D. is driven by the select logic through IC 3E, Pins 3 to 4. If the drive is not selected through the select jumpers, and the MX jumper is not cut, the drive electronics are active but the front panel L.E.D. is not on.



**FIGURE 4-4  
INTERCONNECT BLOCK DIAGRAM**

## 4.4 READ/WRITE HEAD POSITIONER

The components of the drive required to position the read/write head(s) at the desired track are:

1. Step and direction circuits
2. Stepper motor control circuits
3. Stepper motor

### STEP AND DIRECTION

The Step and Direction signals are derived from the host controller via interface connector J1, Pin 20, and J1, Pin 18, respectively.

The direction line sets the proper phase to the exclusive OR gates of IC 5D. This signal is also buffered by IC 3D to gate IC 4F to inhibit stepping outward when the drive is already at Track 0.

The step pulses are buffered by 2E, and gated at IC 4B by the unit select, the N Write signal (false), and by the outward step inhibit of the Track 0 signal. Then, the step pulses go to the clock inputs of the two flip flops at IC 4C. The direction of the step, hence the selection of the flip

flop to be toggled, is accomplished by the two exclusive OR gates of IC 5D. These gates are controlled by the Step direction line and by the state of the two flip flop outputs.

Test Point 8 is low when the carriage is positioned at Track 0 and the stepper motor is at Phase 0. When stepping in or out, Test Point 12 is a high going pulse for each step of the carriage (Table 4-1).

### STEPPER MOTOR CONTROL

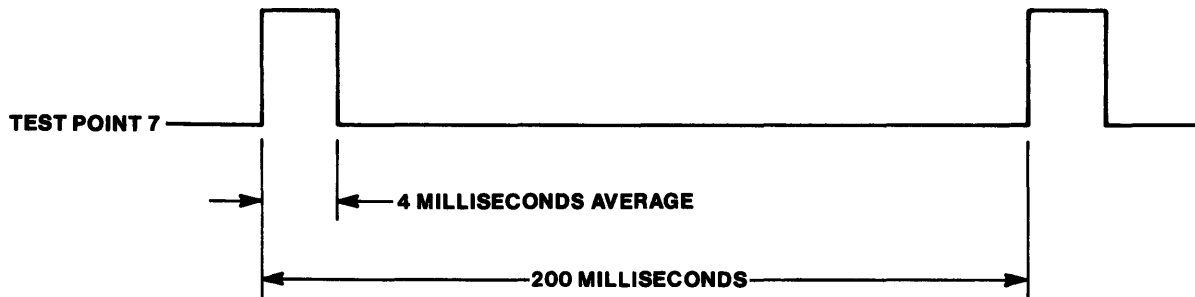
The stepper motor control circuits generate the four phases of the step sequence based on information from the step and direction inputs. These four phases are fed to the stepper motor drivers, which produce the current through the motor's coils.

### STEPPER MOTOR

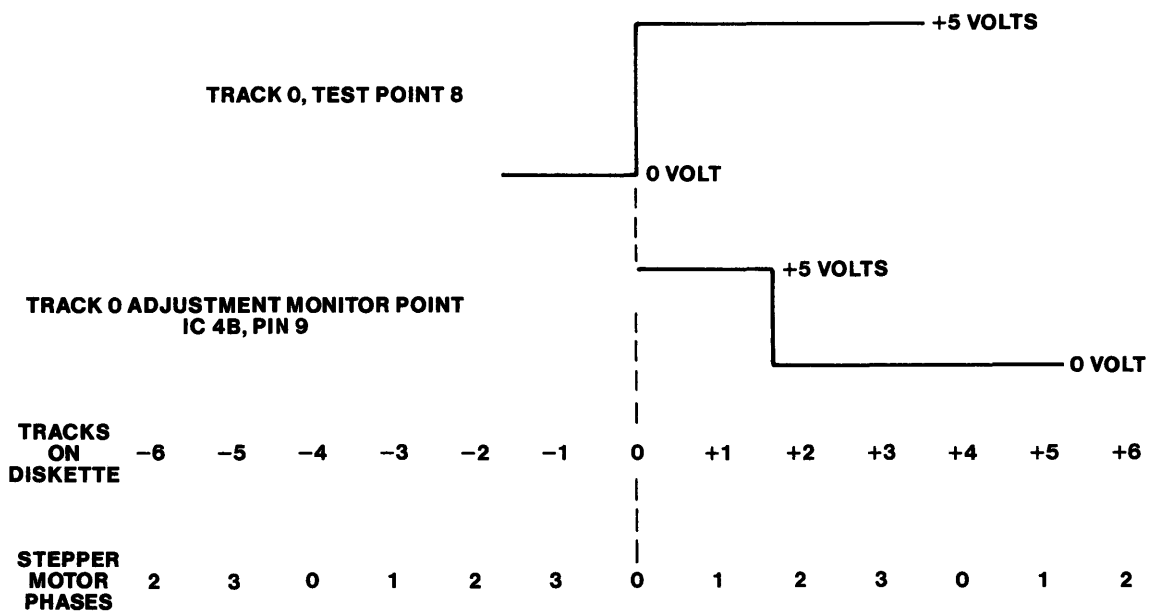
The stepper motor is a unipolar, four-phase motor, which rotates 3.6 degrees for each phase (Table 4-1). The capstan and split band translates this rotation to a one track linear movement of the head carriage assembly.

**TABLE 4-1  
STEPPER LOGIC TRUTH TABLE**

Step Out Toward Track 0						Step In Toward The Inner Tracks					
Pin Number	Phase					Pin Number	Phase				
	0	3	2	1	0		0	1	2	3	0
4C-5	0	1	1	0	0	4C-5	0	0	1	1	0
4C-6	1	0	0	1	1	4C-6	1	1	0	0	1
4C-9	0	0	1	1	0	4C-9	0	1	1	0	0
4C-8	1	1	0	0	1	4C-8	1	0	0	1	1



**FIGURE 4-5  
SOFT-SECTORED INDEX PULSE**



**FIGURE 4-6  
TRACK 0 TIMING**

## 4.5 READ/WRITE DATA

The components of the drive required to read and write data are:

1. Read/Write Head Assembly
2. Side Select circuits
3. Write/Erase circuits
4. Read Data circuits

### READ/WRITE HEAD ASSEMBLY

The read/write head(s) are glass bonded, ferrite cores mounted in a ceramic structure. The lower head structure is mounted in a fixed position to a plastic carriage. The upper head is mounted to a gimbaled flexure to conform to the diskette.

The head carriage assembly is attached to the chassis on guide rails. It is positioned by a split band attached to the stepper motor.

### SIDE SELECT CIRCUITS

The Side Select signal is derived from the host controller via the interface connector J1, Pin 32. This signal is buffered. If the signal is high at the interface, Side 0 is selected by applying a voltage potential on the center tap of Head 0, and allows current to flow in the coils of Head 0. If the signal at the interface is low, Side 1, is selected, by applying a voltage potential on the center tap of Head 1, allowing current to flow in the coils of Head 1.

In the read mode, a potential of +5 volts D. C. is applied to the selected head diode matrix. The write mode increases the voltage applied to the selected head diode matrix to +12 volts D. C. from the beginning of Write Enable until the end of Internal Write Busy.

## WRITE/ERASE CIRCUITS

The write electronics consist of a write current source, a write waveform generator, an erase current source, the trim erase control logic, and the side select logic (Figure 4-7).

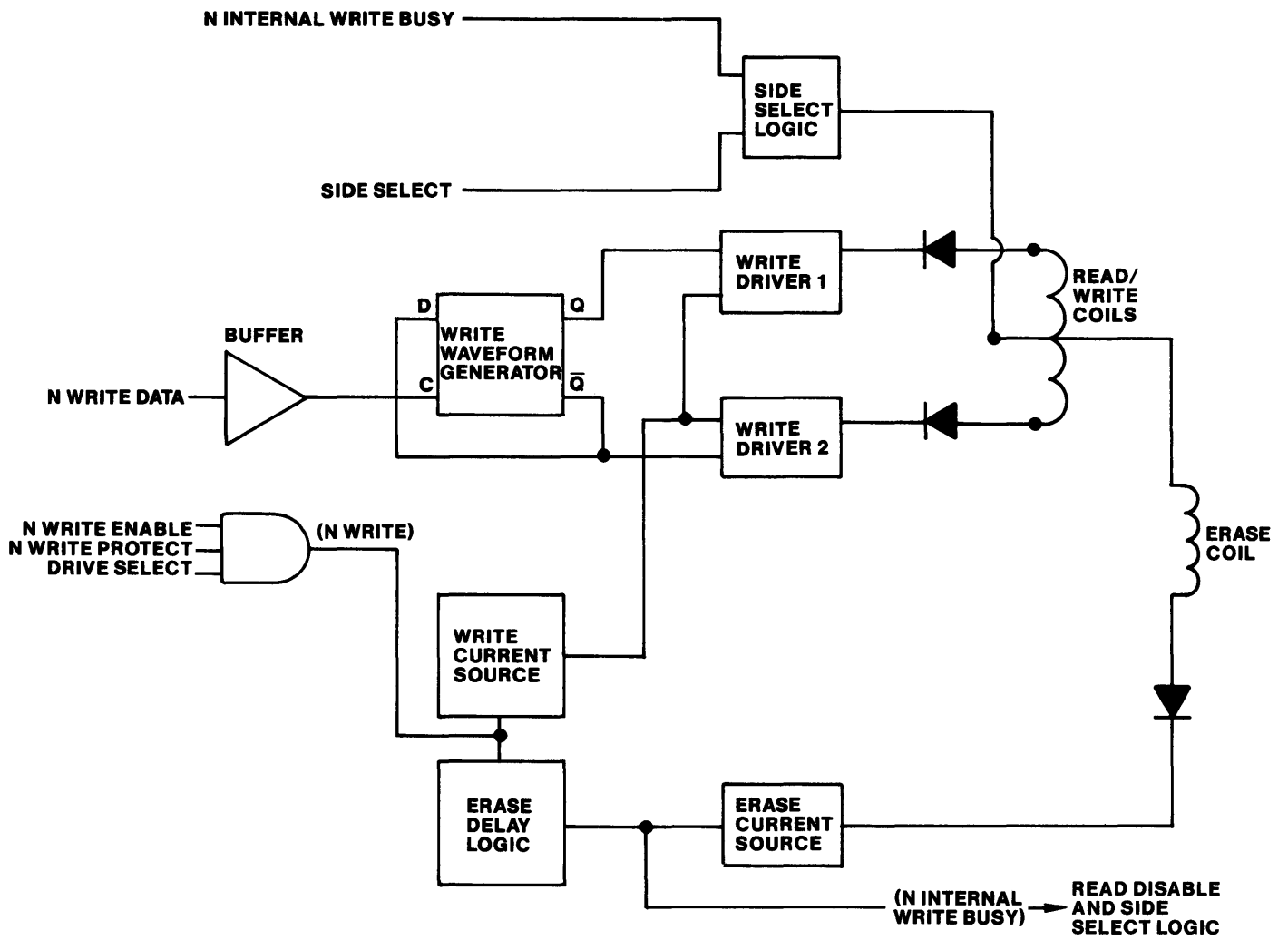
The signals required to control the data electronics provided by the host controller are:

1. Drive Select
2. Write Enable
3. Write Data
4. Side Select

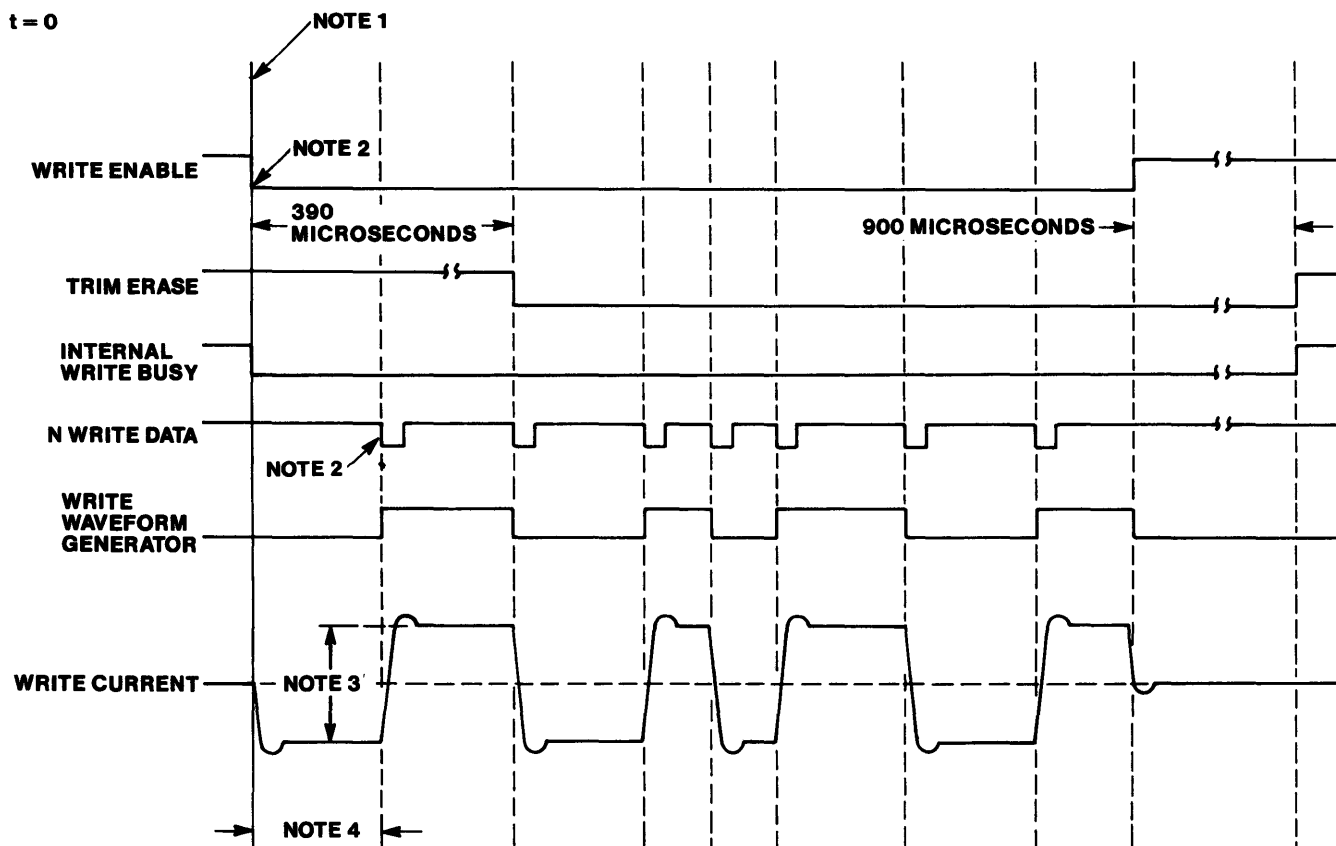
The winding on the head is center tapped. During a write operation, current from the write current source flows in alternate halves of the winding, under control of the write waveform generator.

When the drive is selected and write protect is false, N Write Enable initiates the write logic. Seven events that occur are (Figures 4-7 and 4-8):

1. The pre-erase delay one shot is started, 390 microseconds.
2. The post-erase delay one shot is started, 900 microseconds.
3. The post-erase delay one shot outputs a signal: N Internal Write Busy. It is used to disable the Read Data output circuit, and to increase the read/write diode matrix voltage from 5 volts D. C. to 12 volts D. C. via the side select logic during a write operation.
4. The write current source is enabled only when the +5 volts D. C. supplied to the drive is at the correct value.
5. The write waveform generator has its preset and clear inputs set to +5 volts D. C. instead of ground.



**FIGURE 4-7**  
**WRITE DATA CIRCUIT BLOCK DIAGRAM**



- NOTES:**
1.  $t = 0 = 250$  MILLISECONDS AFTER DRIVE MOTOR STARTS OR 20 MILLISECONDS AFTER LAST STEP PULSE, WHICHEVER IS THE LATEST TIME.
  2. UNSYNCHRONIZED
  3. 8.5 MILLIAMPERAGE PEAK TO PEAK
  4. 4 MICROSECONDS MINIMUM, 8 MICROSECONDS MAXIMUM

**FIGURE 4-8**  
**WRITE OPERATION TIMING DIAGRAM**

6. Input diodes to the read amplifier are reverse biased by N Write to protect the read amplifier during the write operation.
7. The write data input is inverted and used to clock the waveform generator which selects a write driver, thus providing a ground to forward bias a diode, allowing current to flow through the coil.

When there is a pre-erase delay 390-microsecond time out, the erase current source is turned on.

The clocking of the waveform generator during write operation provides a trigger to the post-erase delay one shot, and does not allow it to time out until all data is written.

N Internal Write Busy is active until the end of the post-erase delay, and keeps +12 volts D. C. on the read/write diode matrix during the erase time.

The duration of a write operation is from the true going edge of Write Enable to the false going edge of Trim Erase. This is indicated by the Internal Write Busy waveform (Figure 4-8).

## READ DATA CIRCUITS

The read electronics consist of:

1. Read Only and Side Select circuits
2. Read Amplifier and Linear Phase Filter
3. Differentiator
4. Comparator, Time Domain Filter, and Digitizer

The Read Only circuits are used to isolate the read amplifier from the voltage excursion across the head during a write operation. The side select is used to enable one of the read/write head(s).

The drive must be in a ready condition before reading can begin. This ready condition must be established by the user system. In addition to the requirements established in this section, a 100 microsecond delay must exist from the trailing edge of the Trim Erase signal to allow the read amplifier to settle after the transient caused by the Read Only circuit returning to the Read mode.

The output signal from the read/write head is amplified by a read amplifier, and filtered by a linear phase filter to remove noise. The linear output from the filter is passed to the differentiator, which generates a waveform whose zero crossovers correspond to the peaks of the Read signal, then, this signal is fed to the comparator, time domain filter, and digitizer circuitry (Figure 4-9).

## 4.6 SPINDLE CONTROL

The components of the drive required to control the spindle are:

1. Spindle Motor and Spindle Assembly
2. Spindle Motor Enable circuit
3. Spindle Motor Control circuit

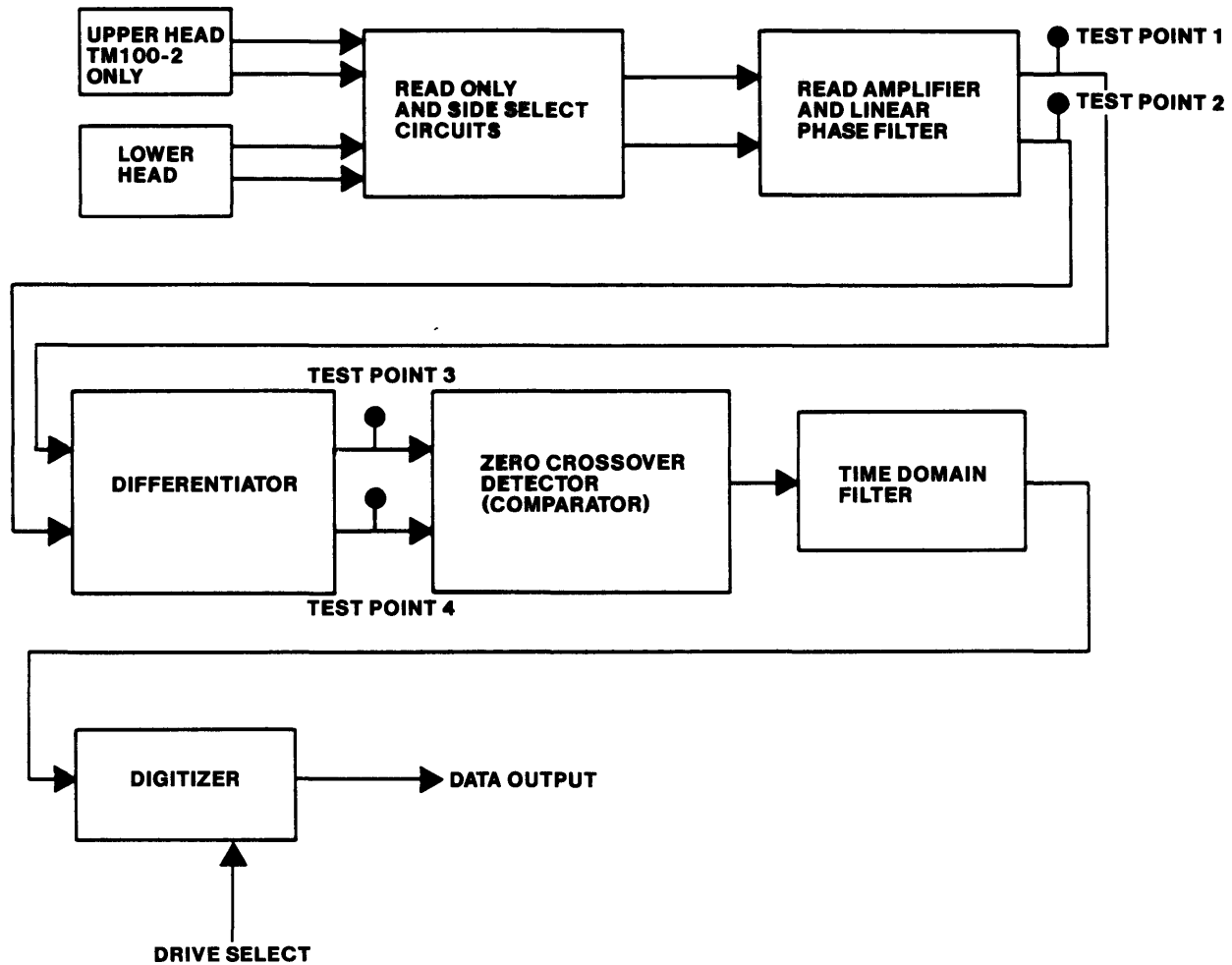
### SPINDLE MOTOR AND SPINDLE ASSEMBLY

The Spindle Assembly is driven by a belt attached between two pulleys. The drive motor pulley is turned by a D. C. motor with a built in integral tachometer. The spindle pulley connects to a hub that rotates a clamped diskette.

### SPINDLE MOTOR ENABLE CIRCUIT

The Motor On signal is derived from the host controller to the interface connector via J1, Pin 16. This signal is buffered and supplied to the servo circuit board, which uses it to enable the motor current circuit of the spindle motor control.



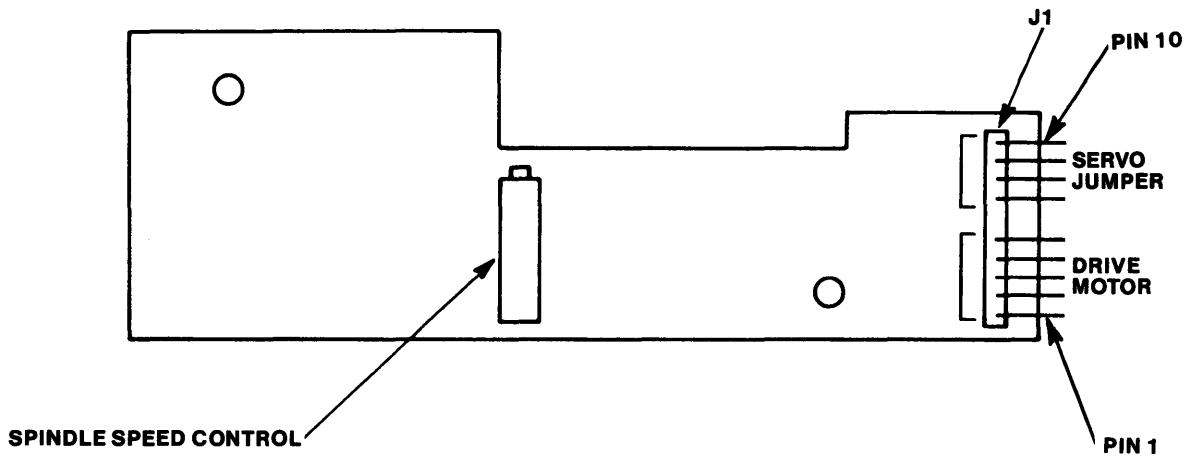


**FIGURE 4-9  
READ CIRCUIT BLOCK DIAGRAM**

## SPINDLE MOTOR CONTROL CIRCUIT

The Spindle Motor Enable signal is input via Pin 7 of the servo circuit board to gate the spindle motor current (Figure 4-10). This current is controlled by an integrated regulator circuit when

the spindle motor is enabled. The potentiator provides an adjustable D. C. voltage reference to the regulator circuit for spindle speed adjustment. The tachometer signal provides feedback from the motor via Pins 1 and 2 of the servo circuit board to maintain a constant speed of 300 RPM. This signal is 12 volts A. C.



**FIGURE 4-10**  
**SERVO CIRCUIT BOARD**

# SECTION 5

## MAINTENANCE CHECKS AND ADJUSTMENTS

### INTRODUCTION

This section is for the use of the OEM Repair and Service Departments. It contains the maintenance checks and adjustments used during the normal life of the drive. The purpose of this section is to outline the steps necessary to verify the operation of the drive during troubleshooting, or after replacing a part or assembly.

If a fault is suspected with a drive, following the checks and adjustments in the order presented will help to isolate the problem area, and refer to the proper section of the troubleshooting guide. However, if a specific check and adjustment is required, the preceding checks do not necessarily need to be performed.

The values and tolerances stated in the checks and adjustments are typical values for working drives. If the values measured are within tolerances or close to the limits, the suspected fault is normally caused by some other problem. Completing other checks and adjustments may disclose the actual problem.

Refer to the schematics and assembly drawings in the appendices and the theory of operation in Section 4 for circuit descriptions. Test point location is illustrated in Figure 5-1.

### 5.1 VISUAL INSPECTION

Before applying power to the drive, or doing any checks or adjustments, visually inspect the drive:

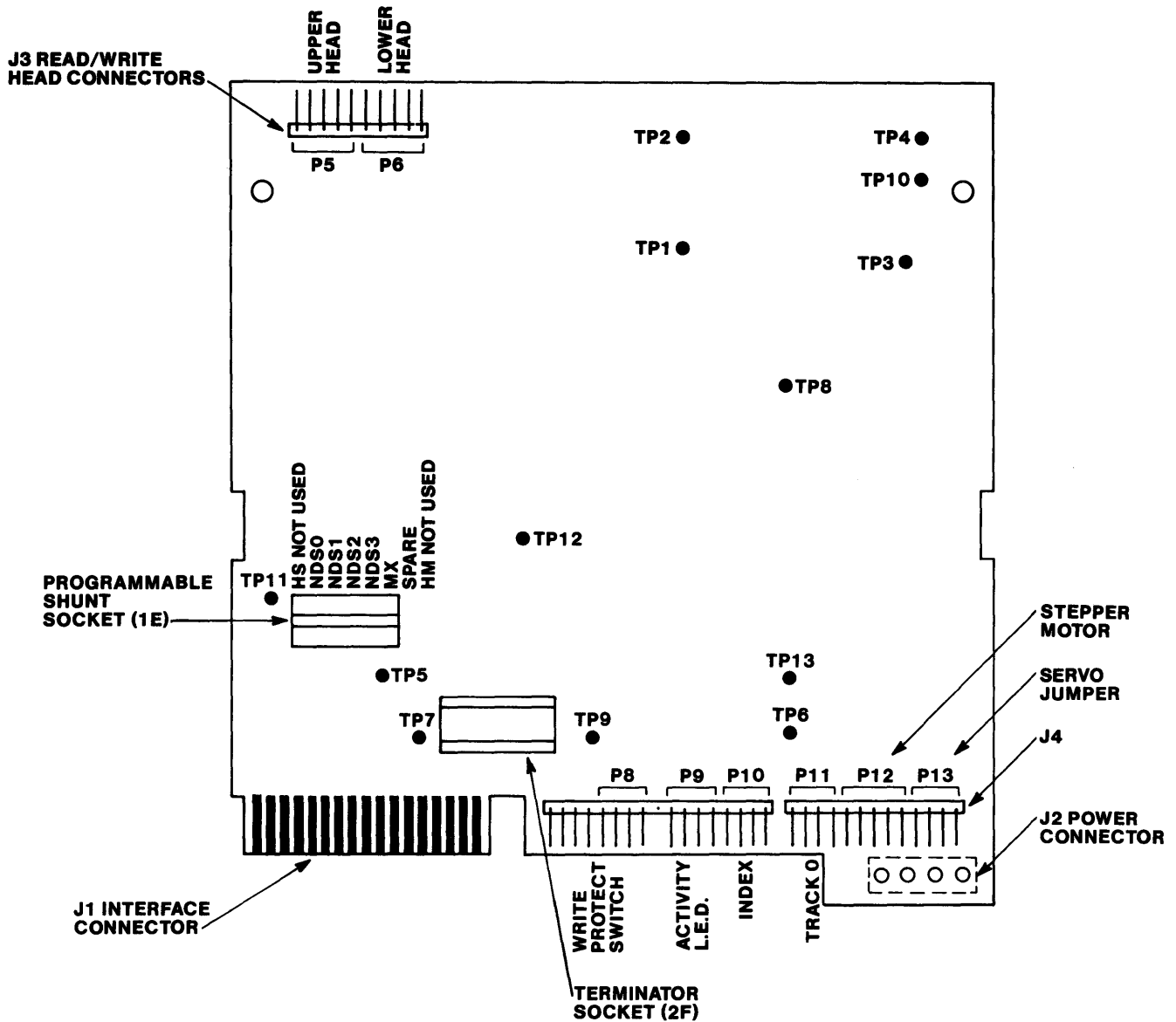
1. Check for loose or missing hardware.
2. Ensure the front latch opens and closes. The head arm raises when the door is opened.

3. Ensure the front panel is secure.
4. Manually rotate the drive hub. It should rotate freely.
5. Ensure the circuit boards are secure.
6. Ensure the connectors are firmly seated, and installed correctly.
7. Check for damaged or missing components on the circuit boards.
8. Ensure that a diskette can be inserted and removed easily.

### 5.2 EQUIPMENT REQUIRED

The following equipment is required for checks and adjustments.

1. A dual-channel, wideband oscilloscope, Hewlett Packard Model 1740A or equivalent.
2. An exerciser, AVA Model 103C or equivalent, or a software routine capable of stepping the drive to any track, selecting the upper or lower head, and writing a 1F, all zeros in FM, or 2F, all ones in FM, pattern.
3. A power supply.
4. A certified alignment diskette, Dysan Model 224/2A or equivalent.
5. A certified output diskette, write protected, Dysan Model 104/2D with tab or equivalent.
6. A certified output diskette, nonwrite protected, Dysan Model 104/2D or equivalent.



**FIGURE 5-1  
LOGIC CIRCUIT BOARD WITH TEST POINTS**

7. Associated power and interface cables.
8. A number 1 Phillips screwdriver.
9. A number 2 Phillips screwdriver.
10. An 0.050-inch Allen wrench.
11. A flat blade screwdriver.
12. A 5/64-inch Allen wrench.
13. A 7/64-inch Allen wrench.

Test equipment must be in calibration. This may be verified by observing the calibration due date on the calibration sticker affixed to the equipment.

### **5.3 POWER/DRIVE SELECT CHECK**

The drive select check verifies the activity L.E.D. can be illuminated, and power is supplied

to the drive. If the check fails, measure the power supply voltages to ensure they are correct, or refer to the troubleshooting guide.

1. Turn off power to the drive.
2. Connect the interface cable that goes from the exerciser to the drive.
3. Apply power to the drive.
4. Verify power supply voltages are within tolerances.
5. Ensure a drive select jumper is in place.
6. Select the drive.
7. Verify the front panel L.E.D. is illuminated.
8. Deselect the drive.
9. Ensure the front panel L.E.D. extinguishes.

## **5.4 WRITE PROTECT SWITCH CHECK AND ADJUSTMENT**

The write protect switch check and adjustment establishes the correct operation of the write protect switch, i.e., the write electronics are disabled when a write protected diskette is used. If the switch is faulty or cannot be adjusted, refer to the troubleshooting guide.

### **WRITE PROTECT SWITCH CHECK**

1. Connect the drive to an exerciser or computer with a direct monitor of the write protect output (J1, Pin 28) or, with no power to the drive, disconnect Plug 8, and check the continuity with an ohmmeter.
2. With a nonwrite protected diskette inserted, verify there is continuity between the two wires of Plug 8 or there is a nonwrite protected output to the exerciser, i.e., a high at J1, Pin 28.

3. With a write protected diskette inserted, verify there is no continuity between the two wires of Plug 8 or that there is a write protect true output to the controller or exerciser, i.e., a low at J1, Pin 28.

### **NOTE**

A defective circuit board can be responsible for a write protect problem. Test Point 9 should be high for a write protected diskette, low for a nonwrite protected diskette.

### **WRITE PROTECT SWITCH ADJUSTMENT**

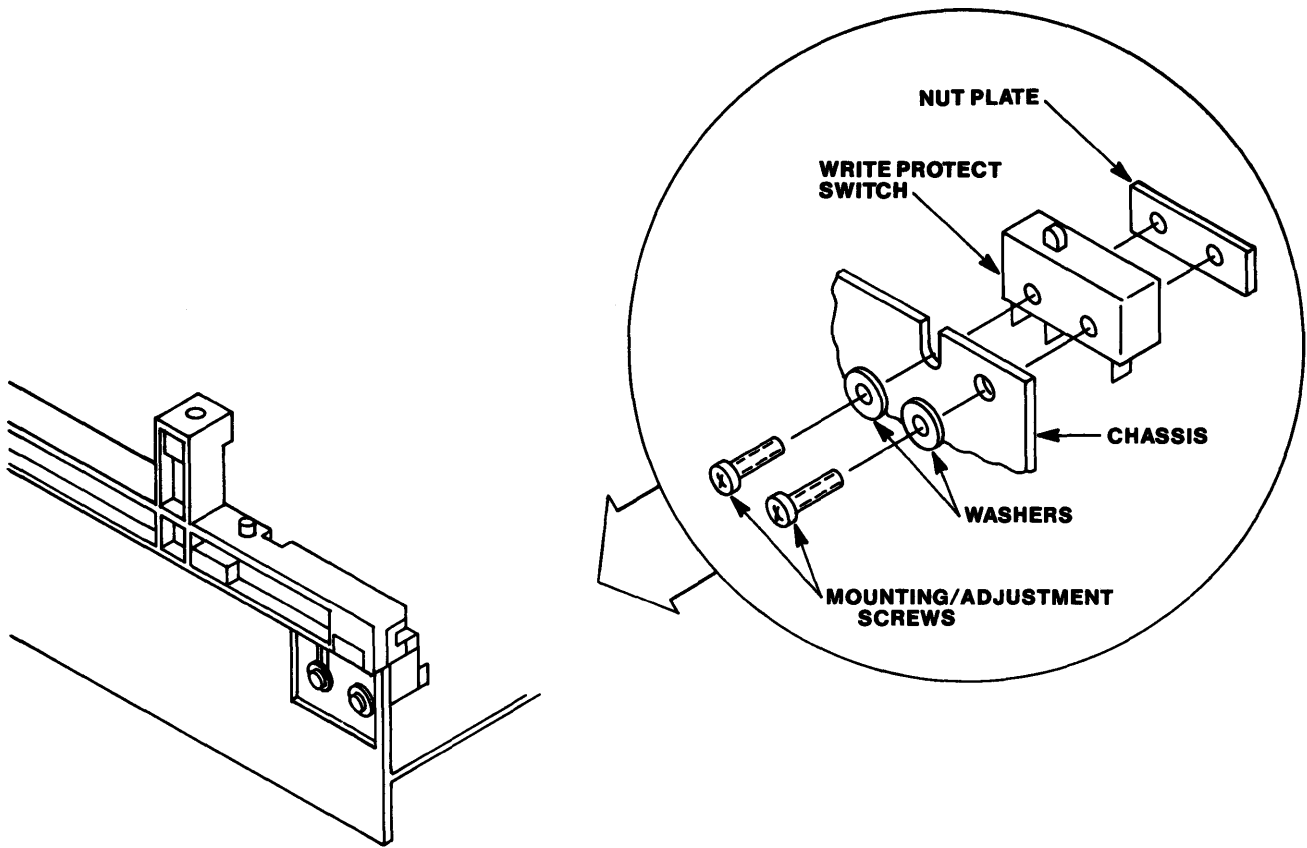
1. Loosen the screws holding it to the bracket on the side nearest to the front of the drive (Figure 5-2).
2. Move the switch up or down, as required, and recheck it.

## **5.5 DRIVE MOTOR SPEED CHECK AND ADJUSTMENT**

The long-term drive motor's speed adjustment ensures the speed is within the specified tolerance. The motor speed tolerance is 300 R.P.M.  $\pm 1.5$  percent. If the motor speed cannot be adjusted, refer to the troubleshooting guide.

### **DRIVE MOTOR CHECK**

1. Verify power: +12 volts D. C.  $\pm 0.6$  volt  
+5 volts D. C.  $\pm 0.25$  volt
2. Apply power to the drive.
3. Activate the drive motor.
4. Insert a work diskette.



**FIGURE 5-2  
WRITE PROTECT SWITCH ADJUSTMENT**

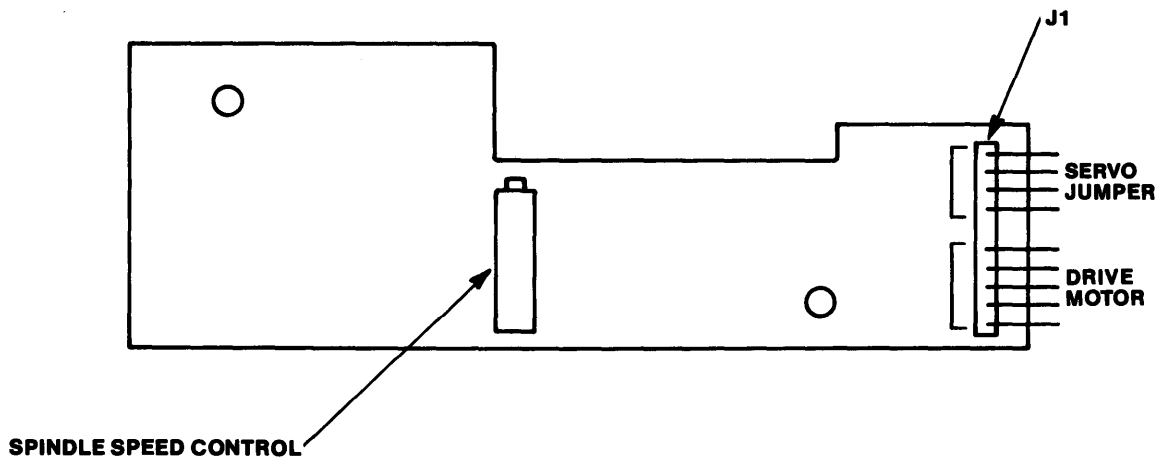
5. Observe the speed disk on the spindle pulley under ambient fluorescent lighting.
6. Verify the 60 Hertz outer ring is stationary.

**DRIVE MOTOR ADJUSTMENT**

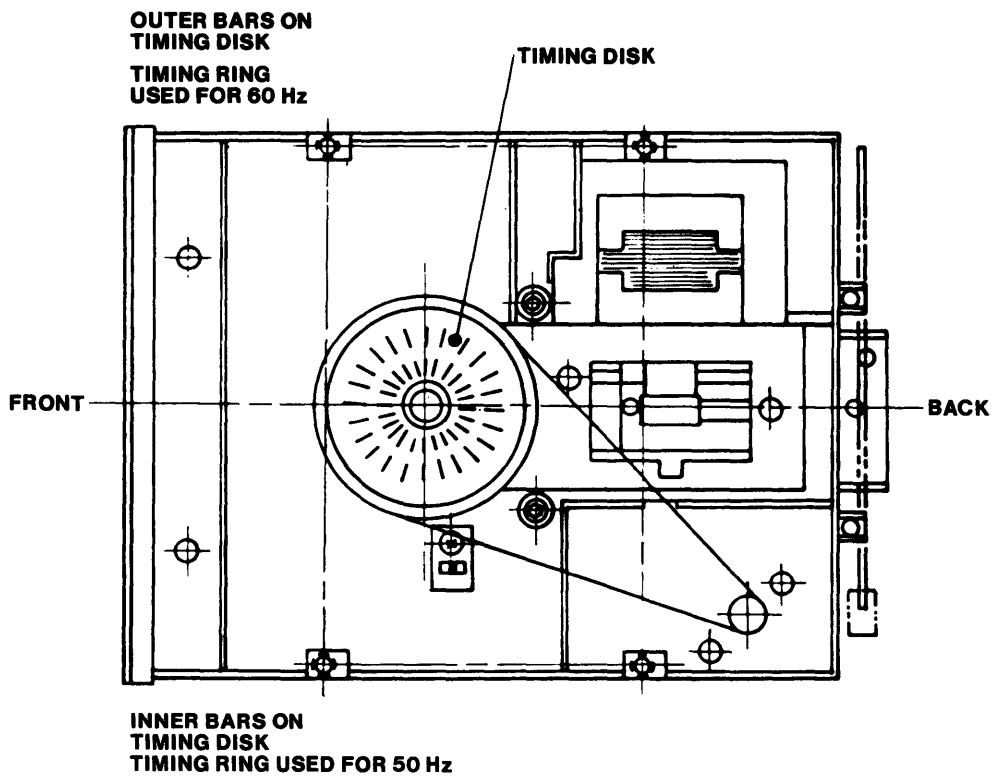
1. Adjust R4, located on the Servo circuit board, until the speed disk is stationary (Figures 5-3 and 5-4).

**5.6 RADIAL TRACK ALIGNMENT CHECK AND ADJUSTMENT**

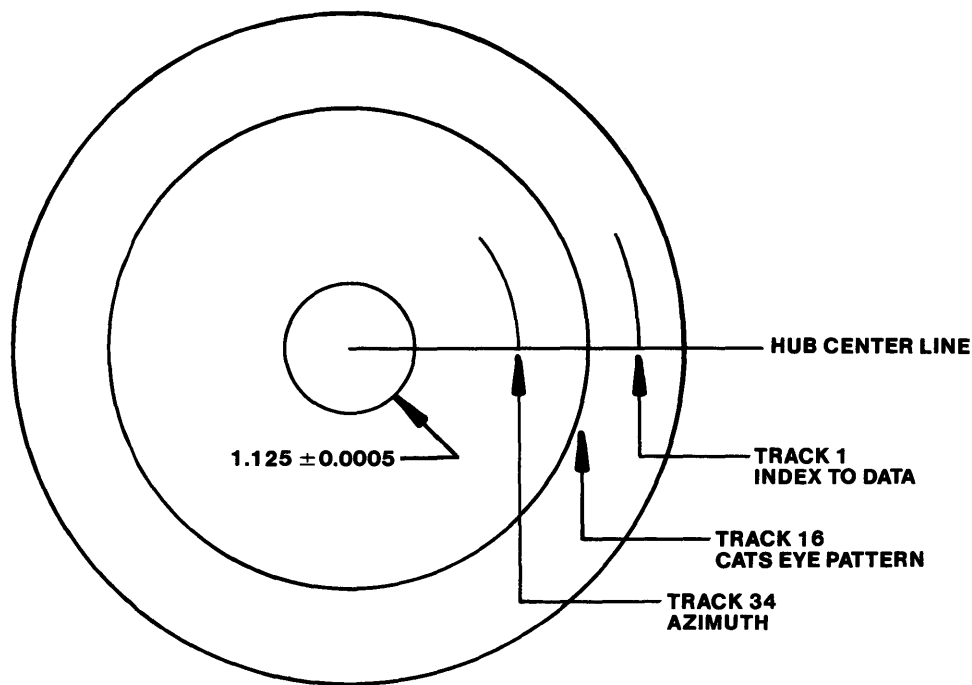
The Radial Track alignment procedure locates the read/write head at the proper radial distance on the hub center line, ensuring the track location is accurate (Figure 5-5). Adjustment is necessary only after servicing or if diskette interchange problems are suspected. If the Cats Eye pattern cannot be verified or cannot be adjusted, refer to the troubleshooting guide.



**FIGURE 5-3  
LOCATION OF R4 SPEED CONTROL POTENTIOMETER**



**FIGURE 5-4  
BOTTOM VIEW OF DRIVE**



**FIGURE 5-5  
HUB CENTER LINE AND TRACK LOCATION**

**NOTE**

The alignment diskette and drive must be allowed to stabilize at room temperature for one hour before checks and adjustments are performed.

**RADIAL TRACK ALIGNMENT CHECK**

1. Set up the oscilloscope:
  - Channel A: Test Point 1
  - Channel B: Test Point 2
  - Ground: Test Point 10
  - Read Differentially: A plus B, B inverted
  - Time Base: 20 milliseconds per division
  - External Trigger: Test Point 7, positive edge

Adjust amplitude for at least four divisions on the oscilloscope, A. C. coupled.

2. Apply power to the drive.

**NOTE**

The Track 16 radius is 1.9167 inches from the center of the hub. Other track locations are computed based upon 48 TPI.

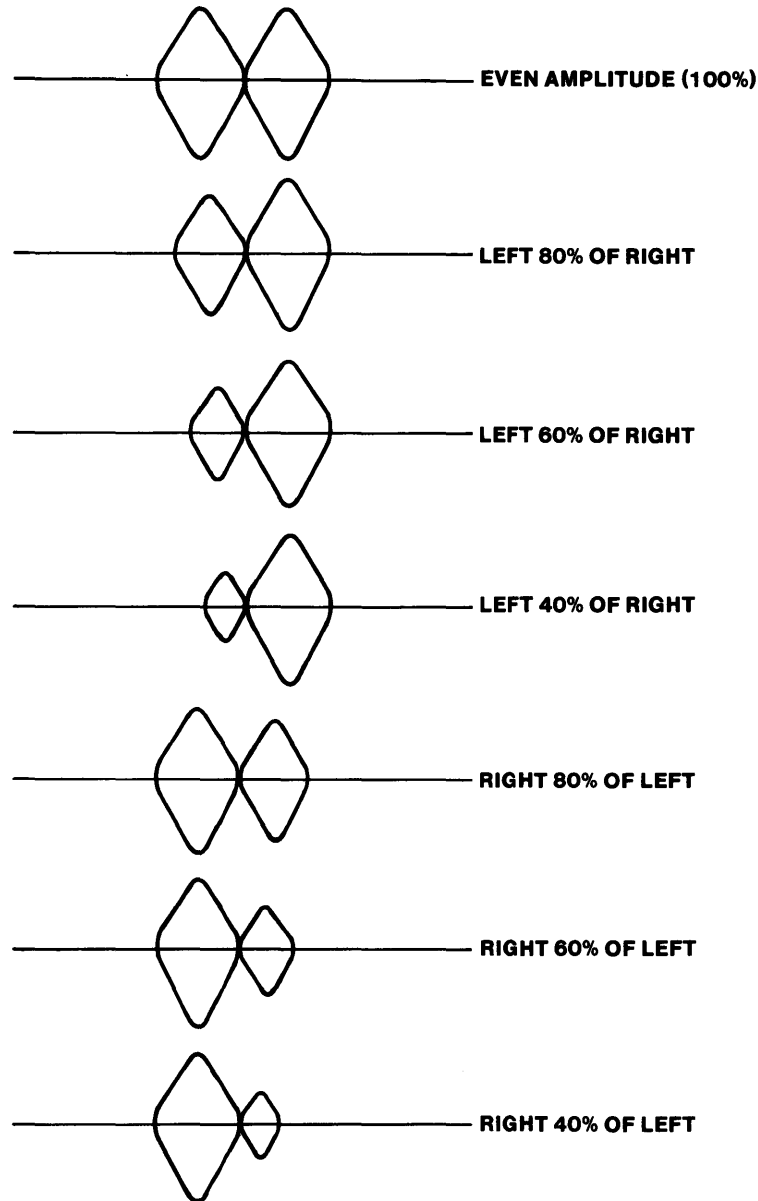
3. Select the drive.
4. Insert a certified alignment diskette, Dysan Number 224/2A, into the drive.
5. Select Head 0, the lower head.
6. Read Track 16 for Radial Track alignment of the lower head.
7. Adjust the oscilloscope to observe a Cats Eye pattern (Figure 5-6).
8. Verify the smaller of the two Cats Eye patterns is not less than 75 percent in amplitude of the other one.



**NOTE**

The 75 percent figure is for use with an alignment diskette verified against a standard alignment diskette.

9. Step the drive to Track 0; then, step it back to Track 16.
10. Verify the Cats Eye pattern.
11. Step the drive to Track 26 or higher; then, step it back to Track 16.
12. Verify the Cats Eye pattern.
13. Switch to Head 1, the upper head.
14. Read Track 16 to verify the alignment of the upper head, if applicable.
15. Verify the Cats Eye pattern.

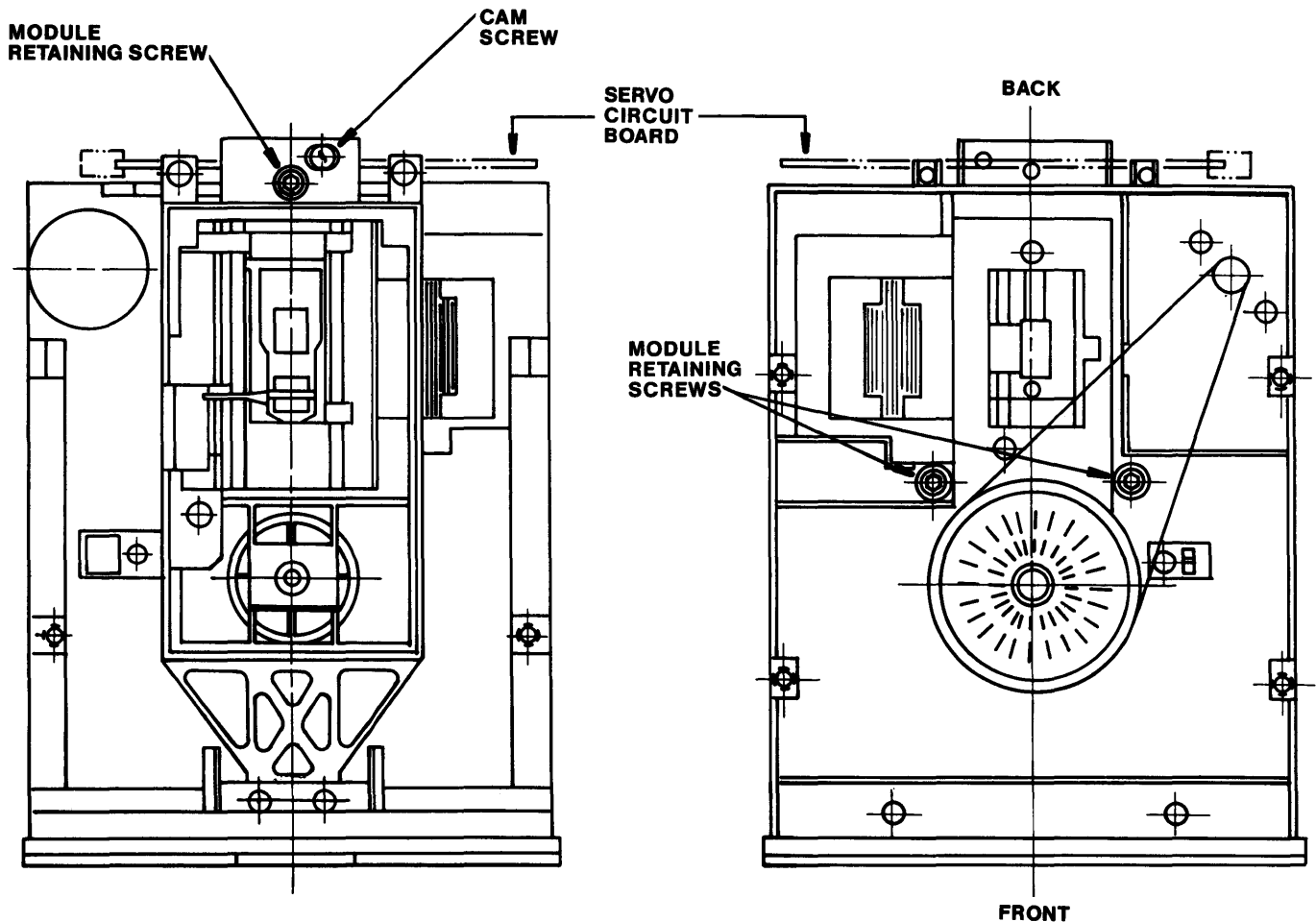


**FIGURE 5-6  
CATS EYE PATTERNS**

16. Step the drive to Track 0; then, step it back to Track 16.
17. Verify the Cats Eye pattern.
18. Step the drive to Track 26 or higher; then, step it back to Track 16.
19. Verify the Cats Eye pattern.
20. If all the checks verify, the Radial Track alignment is acceptable.
21. If any check does not verify, the module must be adjusted.

## RADIAL TRACK ALIGNMENT ADJUSTMENT

1. Loosen the three module retaining screws 1/2-turn with a 7/64-inch Allen wrench. Two of the screws are located underneath the module, and one is located at the rear of the module (Figure 5-7).
2. Turn the cam screw counterclockwise.
3. Observe the Cats Eye pattern of the head farthest out of alignment.



**FIGURE 5-7  
HEAD MODULE RETAINING AND CAM SCREWS**

4. Turn the cam screw until the Cats Eye patterns are equal in amplitude (Figure 5-6).
5. Tighten the module retaining screws with a 7/64-inch Allen wrench.
6. Recheck the Radial Track alignment

7. Select Head 0.
8. Read the trigger point to the start of the first data pulse width (Figure 5-8).
9. For double-sided drives, if Head 0, the lower head, meets the tolerance, check the upper head.

## 5.7 INDEX CHECKS AND ADJUSTMENT

The index adjustment changes the time period from the index pulse to the start of the data in hard sectored diskettes. The adjustment should be checked after the drive has been aligned or when diskette interchange errors are suspected. If the index checks and adjustments fail, refer to the troubleshooting guide.

### INDEX-TO-DATA PULSE CHECKS

1. Set up the oscilloscope:

Channel A: Test Point 1

Channel B: Test Point 2

Ground: Test Point 6

Read Differentially: A plus B, B inverted

Time Base: 50 microseconds per division

External Trigger: Test Point 7, negative edge

Adjust amplitude for at least two divisions on the oscilloscope.

2. Apply power to the drive.
3. Select the drive with the control logic.
4. Check the speed of the drive's motor.
5. Insert an alignment diskette.
6. Seek the carriage to Track 1.

#### NOTE

Head 1 should meet the same tolerance.

10. If either head does not meet the tolerance, adjust the index sensor.
11. Recheck both indexes after they are adjusted.
12. When both index measurements on a double-sided drive or the one index measurement on a single-sided drive meet the tolerance, check the index on Track 34.
13. For double-sided drives, check Heads 0 and 1.

#### NOTE

If any index measurement does not meet the tolerance, the index sensor must be adjusted.

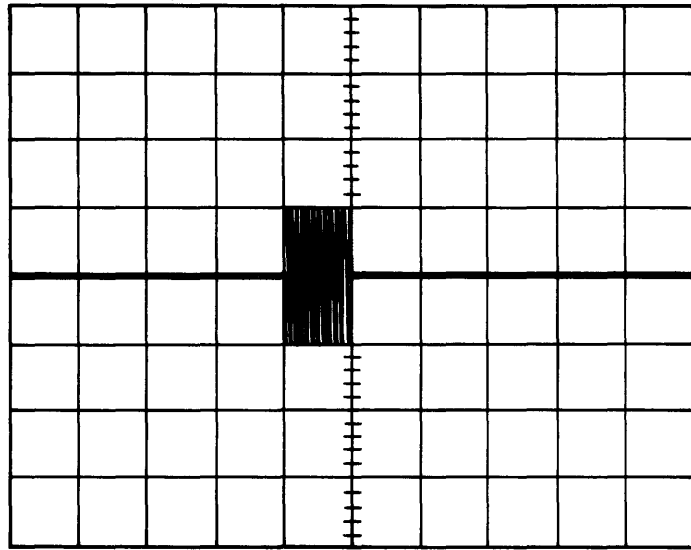
14. Recheck all indexes after each adjustment.

### INDEX SENSOR ADJUSTMENT

1. From the bottom of the chassis, loosen the index sensor's retaining screw counterclockwise one-quarter turn (Figure 5-9).
2. Adjust the index sensor with a flat blade screwdriver until the data pulse begins 200 microseconds  $\pm$  100 microseconds from the trigger point.
3. Tighten the index sensor's retaining screw.
4. Recheck the index-to-data pulse.

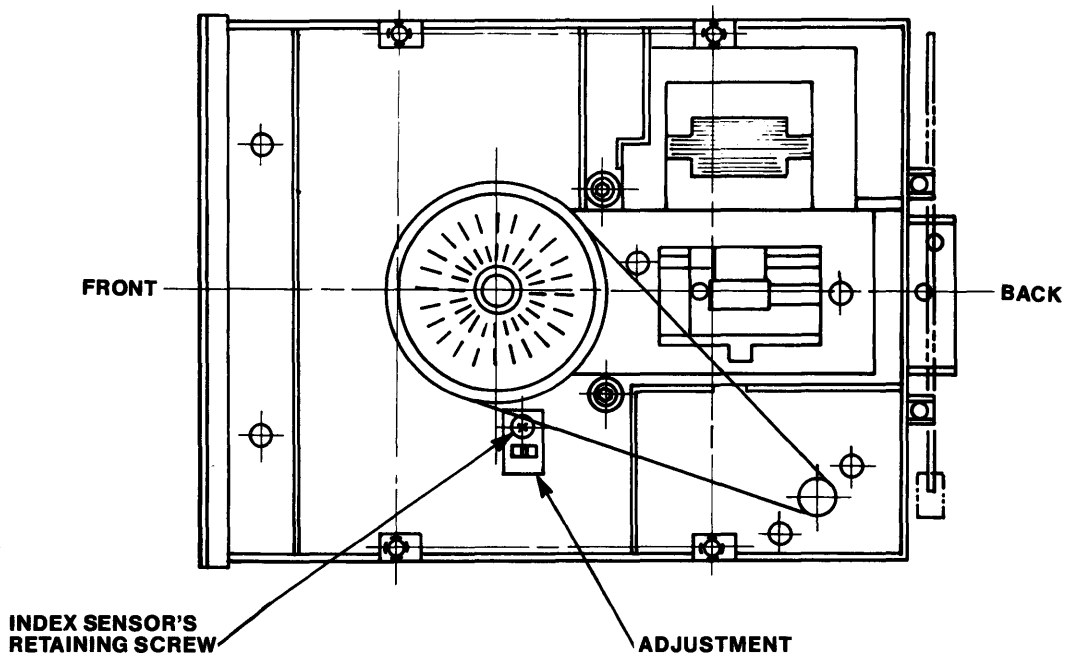
**NOTE**

The tolerance is  $200 \pm 100$  microseconds.



**TIME SCALE: 50 MICROSECONDS PER DIVISION**

**FIGURE 5-8  
INDEX-TO-DATA PULSE**



**FIGURE 5-9  
INDEX SENSOR'S RETAINING SCREW AND ADJUSTMENT**

## 5.8 AZIMUTH CHECK

Azimuth checks the read/write head's relative angle to the center line of the diskette. The Dysan 224/2D alignment diskette has three azimuth bursts, the first one having acceptable limits of 12 minutes; the second one, 15 minutes; and the third one, 18 minutes. The third burst of 18 minutes should be used for the check.

The head's azimuth is not adjustable. If the head's fail the azimuth check, replace the Module Assembly.

1. Set up the oscilloscope:

Channel A: Test Point 1

Channel B: Test Point 2

Ground: Test Point 10

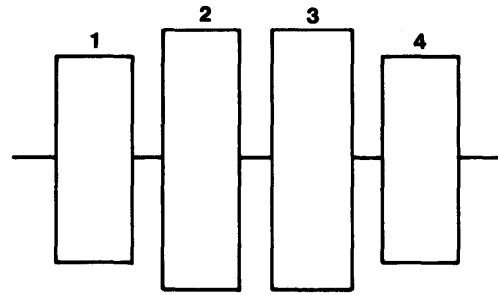
Read Differentially: A plus B, B inverted

Time Base: 0.5 millisecond per division

External Trigger: Test Point 7, positive edge

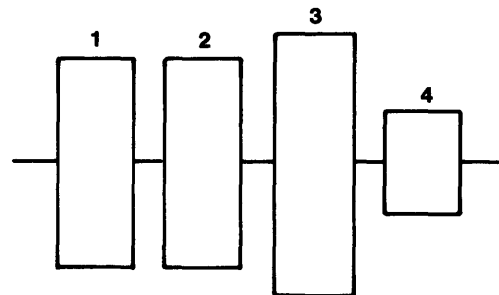
Adjust amplitude for at least four divisions on the oscilloscope.

2. Seek to Track 34.
3. Select Head 0, and observe the third pulse burst on the oscilloscope.
4. Verify the head azimuth is no greater than  $\pm 18$  minutes by comparing the third set of pulse burst to those in Figures 5-10, 5-11, and 5-12.
5. Select Head 1, and verify the head azimuth. Figure 5-10 depicts an azimuth of exactly zero minutes. This is the optimum head azimuth alignment.



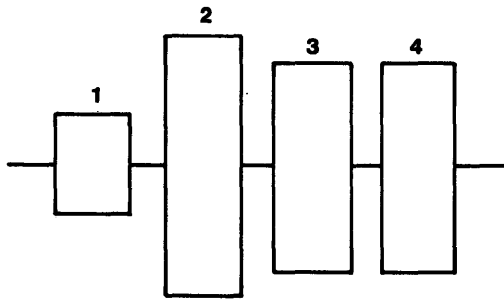
**FIGURE 5-10**  
**OPTIMUM HEAD AZIMUTH ALIGNMENT**

Figure 5-11 depicts an azimuth of exactly minus 18 minutes. This is the lower limit of allowable azimuth error.



**FIGURE 5-11**  
**HEAD AZIMUTH ALIGNMENT**  
**OF ACCEPTABLE LOWER LIMITS**

Figure 5-12 depicts an alignment of exactly plus 18 minutes. This is the upper limit of allowable azimuth error.



**FIGURE 5-12  
HEAD AZIMUTH ALIGNMENT  
OF ACCEPTABLE UPPER LIMITS**

## 5.9 TRACK 0 SWITCH CHECK AND ADJUSTMENT

The Track 0 switch circuitry provides a signal identifying Track 0 to the logic electronics. The electronics disable the step-out function when Track 0 is reached. In addition, a Track 0 signal is sent to the controller on Pin 26 of the interface. If the Track 0 switch cannot be adjusted, refer to the troubleshooting guide.

### TRACK 0 SWITCH CHECK

1. Set up the oscilloscope:

Channel A: Test Point 1

Channel B: Test Point 2

Ground: Test Point 10

Read Differentially: A plus B, B inverted

Time Base: 20 milliseconds per division

External Trigger: Test Point 7, positive edge

Vertical Display: 0.1 volt per division

2. Apply power to the drive.
3. Insert a Cats Eye alignment diskette into the drive.
4. Close the front latch.

5. Step the carriage to the radial alignment track.
6. Confirm the position by observing the Cats Eye pattern.
7. Set up the oscilloscope to monitor the TTL signal at IC 4B, Pin 9, or at P11, Pin 2.
8. Step the carriage back to Track 1.
9. Ensure the signal at Track 1 is at least 2.5 volts.
10. Step the carriage out to the radial alignment track.
11. Step the carriage back to Track 2.
12. Verify the logic level at IC 4B, Pin 9, is less than 0.8 volt.
13. If all of these checks are satisfactory, no adjustment is required.
14. If any of these checks is unsatisfactory, adjust the Track 0 switch.

### TRACK 0 SWITCH ADJUSTMENT

1. Loosen the retaining screw on the base of the Track 0 bracket.
2. Retighten the screw slightly to provide some friction on the bracket.
3. Rotate the Track 0 adjustment screw, at the rear of the chassis, counterclockwise as far as it will go without forcing it.
4. Step the carriage back from the radial alignment track to Track 1, but do not restore it to Track 0.
5. Rotate the Track 0 adjustment screw clockwise, very slowly, until the signal at IC 4B, Pin 9, is at least 2.5 volts at Track 1 and less than 0.8 volt at Track 2.
6. Retighten the retaining screw.
7. Repeat the Track 0 Switch check to ensure the correct setting has been attained.

## 5.10 TRACK 0 STOP ADJUSTMENT

The Track 0 stop screw should be adjusted after the Cats Eye pattern has been adjusted, or when the carriage seeks to a track lower than Track 0.

1. Set up the oscilloscope:

Channel A: Test Point 1

Channel B: Test Point 2

Ground: Test Point 10

Read Differentially: A plus B, B inverted

Time Base: 20 milliseconds per division

External Trigger: Test Point 7

2. Apply power to the drive.
3. Select the drive.
4. Insert an alignment diskette.

5. Turn the Track 0 stop screw counterclockwise two turns with a 0.050-inch Allen wrench or a number one Phillips screwdriver (Figure 5-13).
6. Step the carriage to Track 0, and observe the waveform.
7. Slowly turn the screw clockwise until the output amplitude begins to decrease on the oscilloscope.
8. Turn it counterclockwise until the amplitude stops increasing.
9. Turn it counterclockwise an additional 1/8 turn.

## 5.11 HEAD OUTPUT CHECK

The head output check measures the head's output amplitude relative to the diskette being used. When using certified, quality media, typical values will be 200 millivolts peak-to-peak or greater. However, values may be significantly less, 100 millivolts peak-to-peak typical, if inferior or defective media is used, and does not indicate a faulty head.

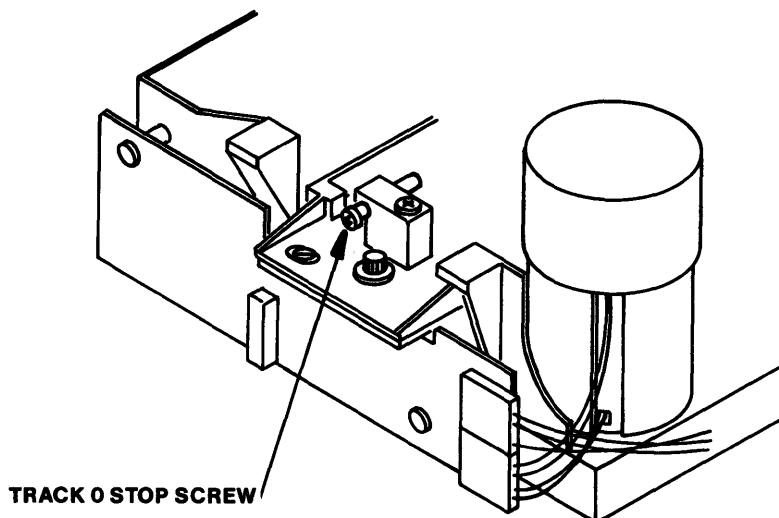


FIGURE 5-13  
TRACK 0 STOP

Head amplitude can be verified by establishing a nominal value of amplitude for the diskette on a known working drive. In all cases, amplitudes greater than 200 millivolts peak-to-peak are acceptable. If head amplitude is suspected as being faulty, refer to the troubleshooting guide.

1. Remove the alignment diskette, and insert a nonwrite protected diskette into the drive.
2. Set up the oscilloscope:  
  
Channel A: Test Point 1  
  
Channel B: Test Point 2  
  
Vertical Amplitude: 50 millivolts per division  
  
Ground: Test Point 10  
  
Read Differentially: A plus B, B inverted  
  
Time Base: 20 milliseconds per division  
  
External Trigger: Test Point 7
3. Seek to Track 39.
4. Write a 2F, all ones, pattern on Head 0.
5. Verify the amplitude is 200 millivolts or greater, peak-to-peak.
6. Write a 2F, all ones, pattern on Head 1.
7. Verify the amplitude is 200 millivolts or greater, peak-to-peak.

## 5.12 CONE CENTERING CHECK

Cone centering is the ability of the cone clamping mechanism to center the diskette on the hub, causing it to rotate concentrically. This check and adjustment should be made whenever the cone lever assembly has been removed or replaced. If the cone centering cannot be adjusted, verify the measurement with a second diskette, otherwise refer to the troubleshooting guide.

1. Set up the oscilloscope:

Channel A: Test Point 1

Channel B: Test Point 2

Vertical Amplitude: 100 millivolts per division

Ground: Test Point 10

Read Differentially: A plus B, B inverted

Time Base: 20 milliseconds per division

External Trigger: Test Point 7, positive edge

2. Apply power to the drive.
3. Select the drive.
4. Seek to Track 0.
5. Write a 2F pattern on Head 0.
6. Measure the amplitude of the signal by positioning the deepest dip in the signal on the center vertical graticule.
7. Release the front latch, and remove the diskette.
8. Reinsert the diskette, and close the front latch.
9. Repeat Steps 7 and 8 until the deepest dip in the waveform is produced.
10. Measure the amplitude of the deepest dip.
11. Divide this measurement by the measurement in Step 6, and multiply it by 100. This result should be above 85 percent.
12. The signal amplitude should not decrease below 85 percent of the average amplitude at any point on the track.



## 5.13 COMPLIANCE CHECK AND ADJUSTMENT (SINGLE-SIDED DRIVES)

Compliance is the maximized output of the head when the pressure of the felt pad is centered over the read/write gap. For double-sided drives, a compliance check and adjustment must be made at the factory. If the compliance check and adjustment fails, refer to the troubleshooting guide.

### COMPLIANCE CHECK

1. Remove the screws attaching the logic circuit board to the guide rails.
2. Lift out the logic circuit board, and lay it on the drive.

#### NOTE

This allows one to reach the drive to move the head.

3. Set up the oscilloscope:

Channel A: Test Point 1

Channel B: Test Point 2

Vertical Amplitude: 100 millivolts per division

Ground: Test Point 10

Read Differentially: A plus B, B inverted

Time Base: 10 microseconds per division

External Trigger: Test Point 7, positive edge

4. Apply power to the drive.

5. Select the drive.
6. Insert a nonwrite protected diskette.
7. Write a 1F pattern on Track 34.
8. Observe the output waveform voltage.
9. With a gram gauge, carefully apply fifteen grams pressure to the upper arm.

#### NOTE

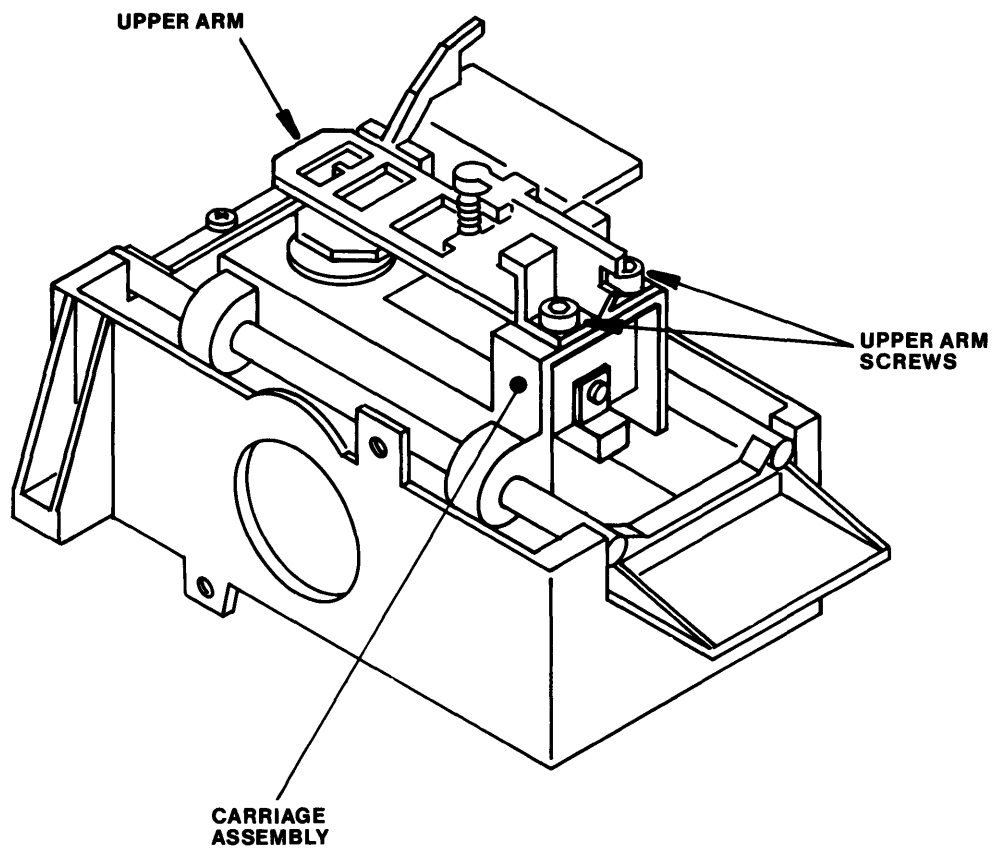
Fifteen grams is about the weight of a quarter.

10. If the output shown on the oscilloscope increases by more than ten percent, adjust the compliance.

### COMPLIANCE ADJUSTMENT

Compliance is adjusted by using the same procedure used in the compliance check.

1. Loosen the two screws attaching the upper arm to the carriage assembly (Figure 5-14) counterclockwise one-quarter turn with an Allen wrench.
2. While monitoring the output, move the upper arm around the axis of the head until the output amplitude is highest.
3. Tighten the two screws, attaching the upper arm to the carriage assembly, clockwise with an Allen wrench, while holding the arm in the highest position.
4. Reverify the compliance.
5. If it cannot be adjusted, replace the upper arm.



**FIGURE 5-14**  
**UPPER ARM AND SCREWS**

# SECTION 6

## TROUBLESHOOTING GUIDE AND REPLACEMENT PROCEDURE

### INTRODUCTION

This section is designed to help locate and correct failures related to the drive. Table 6-1 is a troubleshooting guide outlining the problem, its possible cause, and the recommended action. This section also contains parts removal and replacement procedures.

The recommended spare parts list and assembly drawings in Appendix A are useful when replacing assemblies. In addition, the checks and adjustment procedures in Section 5 must be used to verify proper installation and ensure the drive's performance.

### 6.1 SYMPTOM DIAGNOSTIC TECHNIQUES

When trying to diagnose a fault attributed to drive failure, a visual inspection of the drive may reveal an obvious misalignment or broken part on the drive. Always check the power supply voltages before proceeding with the troubleshooting guide.

In some cases, errors attributed to the drive actually may be caused by incorrect operating procedures, faulty system programming, incorrect drive option patching, and damaged or incorrect certified diskettes. Review Section 3 to ensure correct configuration of the drive.

### 6.2 SOFT ERRORS

Soft errors can be caused by airborne contaminants, random electrical noise, excessive temperature, and other external causes. To correct soft errors:

1. Ensure proper grounding between power supply, drive, and host system.

2. Verify there is no random electrical noise to the drive.
3. Verify there is no radiated noise to the drive.
4. Ensure temperature in the vicinity of the drive is within specification.
5. Try to verify and duplicate the fault on a second diskette.
6. Using quality media is usually sufficient to clean the head(s). When contamination of the head(s) is extreme due to poor quality media or airborne contaminants, cleaning diskettes may be used in accordance with the manufacturer's instructions.

#### CAUTION

*Do not use cotton swabs, solvents, or otherwise clean the head(s) by hand. Damage to the head(s) may result.*

### 6.3 TROUBLESHOOTING GUIDE

The troubleshooting guide is presented in the form of a table. The table includes:

1. A statement representing the condition.
2. A list of possible causes.
3. The recommended action to be taken.

#### NOTE

Check the power supply voltages to ensure they are within specification before proceeding with the troubleshooting guide.

**TABLE 6-1  
TROUBLESHOOTING GUIDE**

<b>Condition</b>	<b>Possible Cause</b>	<b>Recommended Action</b>
<p><b>No index.</b></p>	<p>Diskette not inserted.</p> <p>Door not closed.</p> <p>Unit not selected.</p> <p>Index sensor not connected.</p> <p>Index sensor defective.</p> <p>Spindle not turning.</p> <p>Defective Logic circuit board.</p>	<p>Insert Diskette.</p> <p>Close door.</p> <p>Verify unit select and jumper configuration.</p> <p>Check P10.</p> <p>Replace index sensor.</p> <p>See Spindle not turning.</p> <p>Replace Logic circuit board.</p>
<p><b>Spindle speed out of tolerance or not turning.</b></p>	<p>Drive Motor not turning.</p> <p>Connectors loose or missing.</p> <p>Drive belt loose or missing.</p> <p>Defective Servo circuit board.</p> <p>Defective Logic circuit board.</p> <p>Defective drive motor.</p>	<p>Verify interface Motor On signal.</p> <p>Check Connectors P13, P20, and P21.</p> <p>Replace drive belt.</p> <p>Replace Servo circuit board.</p> <p>Replace Logic circuit board.</p> <p>Replace Drive Motor Assembly.</p>
<p><b>Will not seek or restore.</b></p>	<p>Interface not enabled.</p> <p>Stepper motor disconnected.</p> <p>Defective step logic.</p> <p>Defective stepper motor.</p>	<p>Verify interface direction, step, and select signals.</p> <p>Check Connector P12.</p> <p>Replace Logic circuit board.</p> <p>Replace Module Assembly.</p>

**TABLE 6-1 (CONTINUED)  
TROUBLESHOOTING GUIDE**

<b>Condition</b>	<b>Possible Cause</b>	<b>Recommended Action</b>
<p><b>Will not write.</b></p>	<p>Diskette is write protected.</p> <p>Interface not enabled.</p> <p>Alignment is off.</p> <p>Head(s) or write protect switch not connected.</p> <p>Write protect switch misadjusted.</p> <p>Defective write logic.</p> <p>Defective head(s).</p>	<p>Remove write protect tab from diskette.</p> <p>Verify write enable, select, and write data interface lines.</p> <p>Verify alignment.</p> <p>Check Connectors P5, P6, and P8.</p> <p>Check write protect switch operation.</p> <p>Replace Logic circuit board.</p> <p>Replace Module Assembly.</p>
<p><b>Will not read.</b></p>	<p>Interface incorrect.</p> <p>Alignment off.</p> <p>Defective read electronics.</p> <p>Defective head(s).</p>	<p>Verify select is true and write enable is false.</p> <p>Verify Cats Eye lobes, index burst, and Track 0 switch adjustment.</p> <p>Replace Logic circuit board.</p> <p>Replace Module Assembly.</p>
<p><b>Front panel L.E.D. inoperative</b></p>	<p>Interface not enabled.</p> <p>L.E.D. not connected.</p> <p>L.E.D. defective.</p> <p>L.E.D. driver defective.</p>	<p>Verify interface select and jumper configuration.</p> <p>Check P9.</p> <p>Replace front panel L.E.D. Assembly.</p> <p>Replace Logic circuit board.</p>

**TABLE 6-1 (CONTINUED)  
TROUBLESHOOTING GUIDE**

Condition	Possible Cause	Recommended Action
No Track 0 indication.	Defective seek. Track 0 switch not connected. Track 0 switch not adjusted. Defective logic. Defective Track 0 switch.	See Will Not Seek or Restore. Check P11. Adjust Track 0 switch. Replace Logic circuit board. Replace Track 0 Switch Assembly.
Fails drive select check.	Power not applied to drive. Drive not selected. Faulty Activity L.E.D. Faulty Logic circuit board.	Verify power supply voltages. Verify proper jumper configuration. See Section 3. Replace Activity L.E.D. Replace Logic circuit board.
Fails Write Protect switch check and adjustment.	Defective Write Protect switch. Broken Write Protect lever. Write Protect switch out of adjustment.	Replace Write Protect switch. Replace left rail. Adjust Write Protect switch.
Fails drive motor speed check and adjustment.		See Spindle Speed Out of Tolerance or Not Turning.
Fails Cats Eye alignment check and adjustment.	Cannot read. Cannot step. Track 0 sensor misadjusted. Alignment diskette defective.	See Will Not Read. See Will Not Seek or Restore. Perform Track 0 switch adjustment procedure. Verify alignment diskette, and replace if necessary.

**TABLE 6-1 (CONTINUED)  
TROUBLESHOOTING GUIDE**

Condition	Possible Cause	Recommended Action
Fails index checks and adjustment.	Diskette not centering.  Alignment diskette defective.	See No Index.  See Fails Centering Check.  Verify alignment diskette and replace if necessary.
Fails Track 0 switch check and adjustment.		See No Track 0.
Fails head output check.	Defective media.  Cannot read.  Compliance misadjusted.	Replace media.  See Will Not Read.  Perform compliance check and adjustment.
Fails cone centering check.	Defective diskette.  Cone Lever Assembly misadjusted.  Cone faulty.	Replace diskette.  See Cone Lever Assembly replacement procedure.  Replace Cone Assembly.
Fails compliance check and adjustment.	Defective diskette  Head load pad damaged or worn.	Replace diskette.  Replace Upper Arm Assembly.

## 6.4 REPLACEMENT PROCEDURES

This section contains the replacement procedures for the major parts and assemblies. After replacing a part or assembly, perform the appropriate check and adjustment recommended in Table 6-2.

**TABLE 6-2  
GUIDE TO CHECKS AND ADJUSTMENTS**

PART OR ASSEMBLY REPLACED	RECOMMENDED CHECKS AND ADJUSTMENTS									
	POWER/DRIVE SELECT	WRITE PROTECT SWITCH	DRIVE MOTOR SPEED	RADIAL TRACK ALIGNMENT	INDEX	AZIMUTH	TRACK 0 SWITCH	HEAD OUTPUT	CONE CENTERING	COMPLIANCE
Drive Belt			X							
Logic Circuit Board	X	X						X		
Servo Circuit Board			X							
Cone Lever Assembly					X				X	
Cone Assembly					X				X	
Activity L.E.D.	X									
Front Panel	X								X	
Guide Rail		X							X	
Index Assembly					X					
Drive Motor Assembly			X							
Track 0 Switch Assembly				X			X			
Write Protect Switch		X								
Upper Arm Assembly								X		X
Head Module Assembly				X	X	X	X	X	X	*
Latch Plate Assembly									X	

\* Single-sided drives only.



## TOOL REQUIREMENTS

In addition to the tools listed in Section 5, the following tools are required for replacement of assemblies:

1. 0.010 to 0.025-inch feeler gauge
2. Tie wraps
3. Needle nose pliers

## DRIVE BELT

### REMOVAL

1. Turn the drive over, spindle facing up.
2. Remove the drive belt.

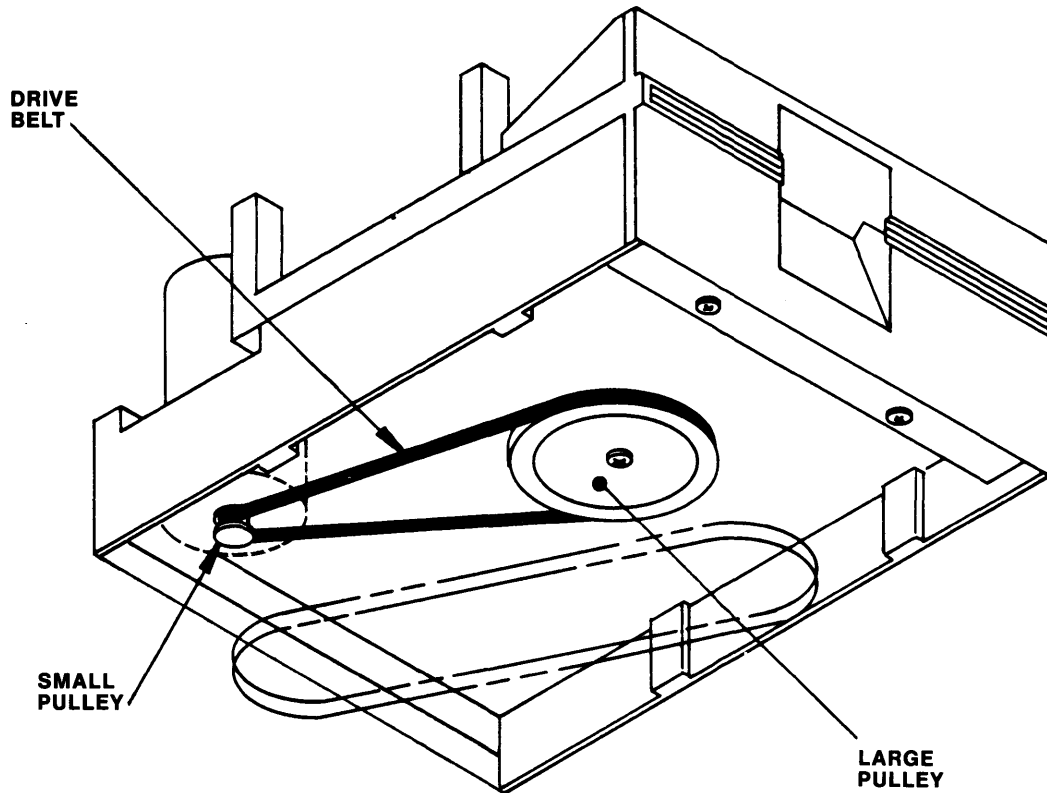
## REPLACEMENT

1. With the shiny side inward, loop the new drive belt onto the small, flanged motor pulley.
2. While turning the spindle, put the belt on the large spindle motor pulley (Figure 6-1).

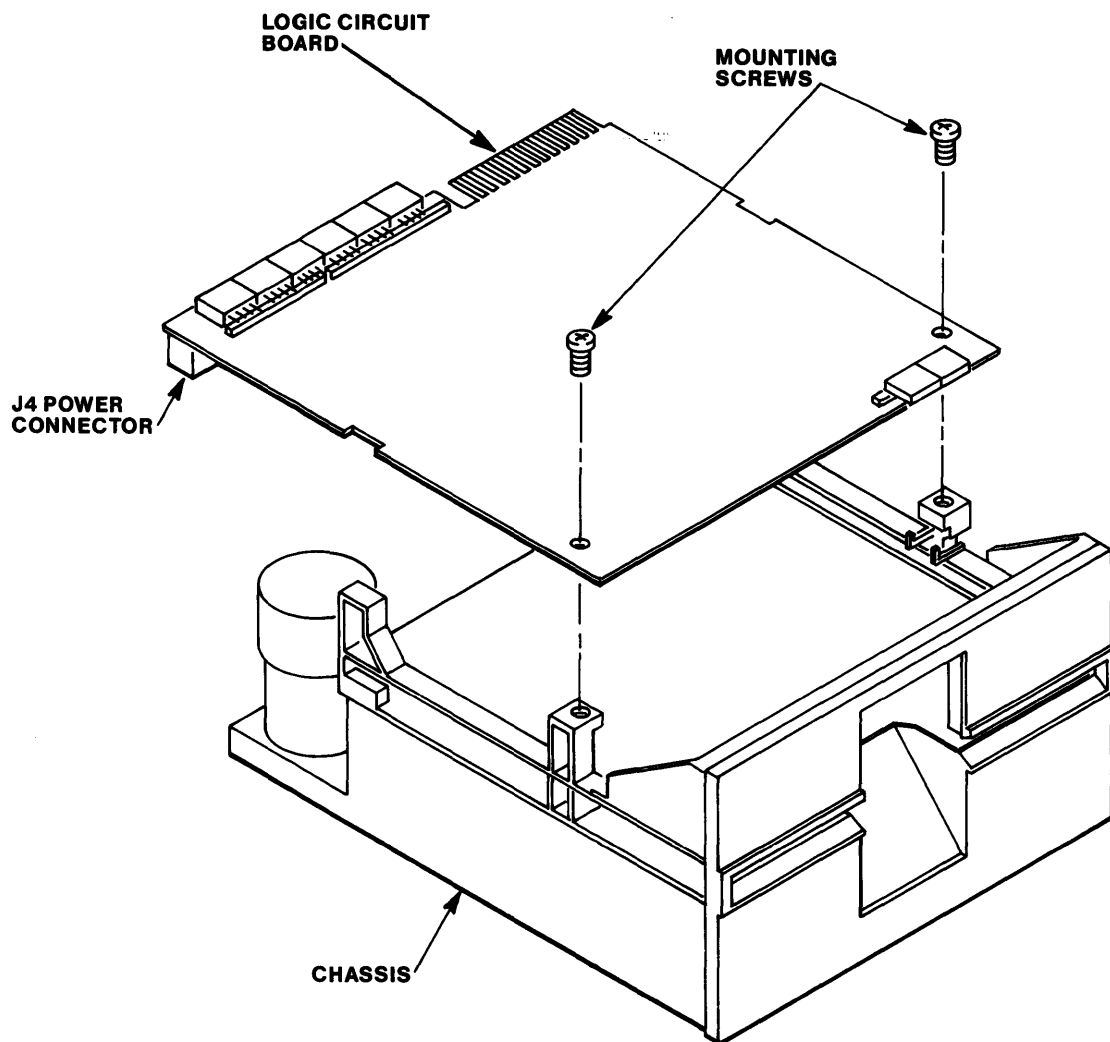
## LOGIC CIRCUIT BOARD

### REMOVAL

1. Remove all connectors from the circuit board (Figure 6-2). Note their location.
2. Remove the two circuit board mounting screws.



**FIGURE 6-1**  
**DRIVE BELT AND PULLEYS**



**FIGURE 6-2**  
**LOGIC CIRCUIT BOARD MOUNTING**

- Slide the circuit board toward the back of the drive about one-half inch.
- Remove it from the drive.

### REPLACEMENT

- Verify option configuration of the new circuit board.
- Place the circuit board on the drive.
- Install the two mounting screws attaching the circuit board to the rails.
- Plug in all the connectors, ensuring they are in the proper slots.

## SERVO CIRCUIT BOARD

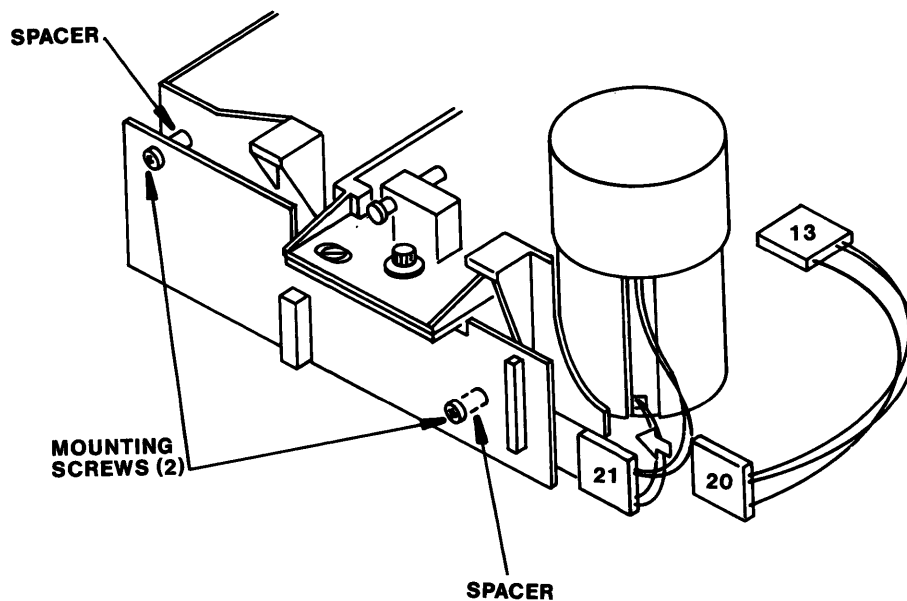
### REMOVAL

- Detach connectors P20 and P21 from the circuit board (Figure 6-3).
- Remove the mounting screws and spacers attaching the circuit board to the chassis.

### NOTE

Save all spacers and mounting screws.

- Remove the circuit board from the chassis.



**FIGURE 6-3**  
**SERVO CIRCUIT BOARD MOUNTING**

## REPLACEMENT

1. Stand the drive on its front panel.

### CAUTION

*Do not scratch the front panel.*

2. Place the two spacers on top of the mounting holes in the chassis.
3. Place the new circuit board on top of the spacers, aligning the holes.
4. Attach the circuit board to the chassis with mounting screws.

### NOTE

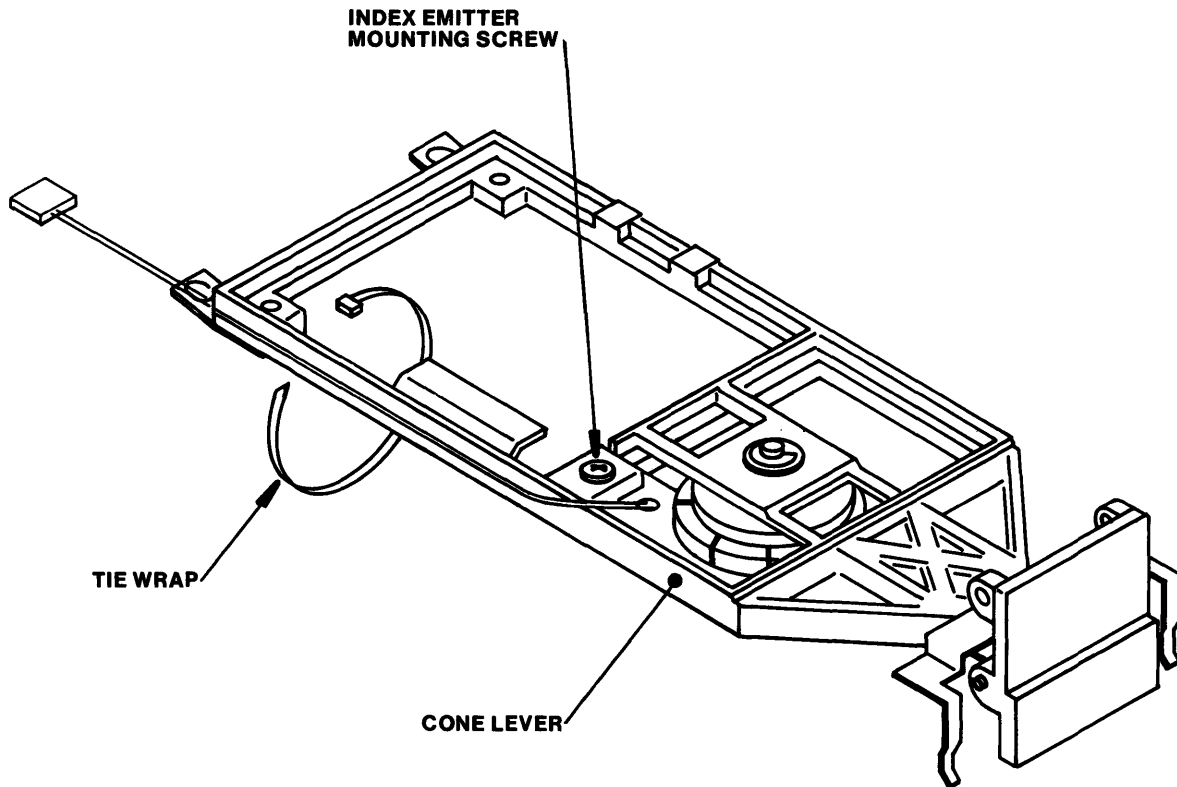
If using a nylon screw, ensure it is installed at the bottommost location, from which it was removed.

5. Plug Connectors P21 into the bottom right-hand corner of the circuit board; plug in P20 above it.
6. Check the drive motor's speed.

## CONE LEVER ASSEMBLY

### REMOVAL

1. Remove the Logic circuit board.
2. Open the front latch.
3. Cut the tie wrap attaching the top index cables to the assembly (Figure 6-4).
4. Remove the mounting screw attaching the index emitter holder to the assembly.
5. Unloop the head cable(s) from the right rail.



**FIGURE 6-4**  
**CONE LEVER CABLE HARNESSING**

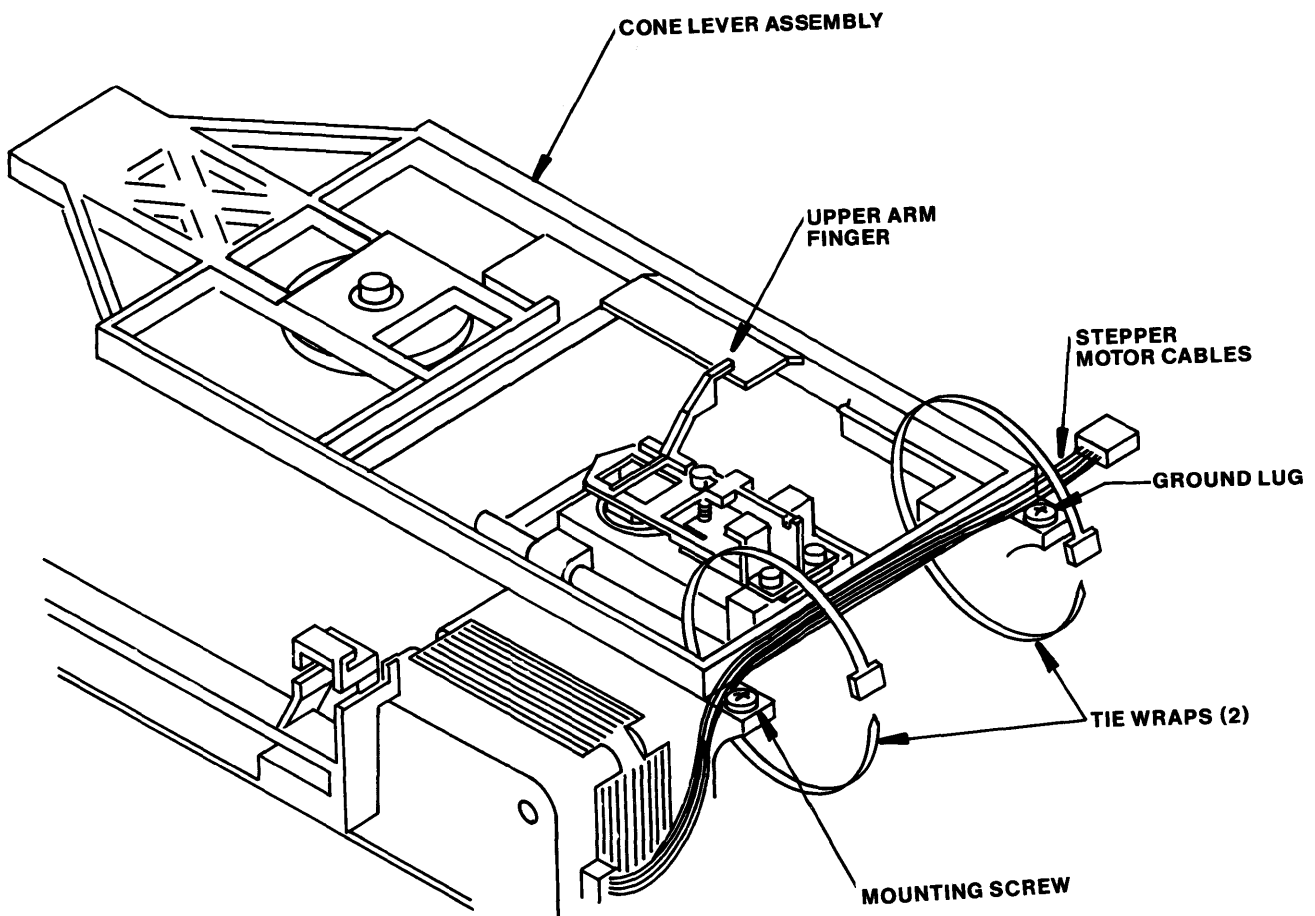
6. Cut the tie wraps holding the stepper motor cables at the rear of the assembly (Figure 6-5).
7. Remove the two mounting screws and ground lug attaching the assembly to the rear of the chassis.
8. Gently slide the head carriage toward the rear of the drive.
9. Slide the assembly toward the rear of the drive.
10. Lift up the assembly and slide it toward the rear of the drive, and slide the front latch out of its tracks.

11. Slide the assembly toward the rear of the drive, tilting it until the upper arm finger is free.

12. Remove the assembly from the drive.

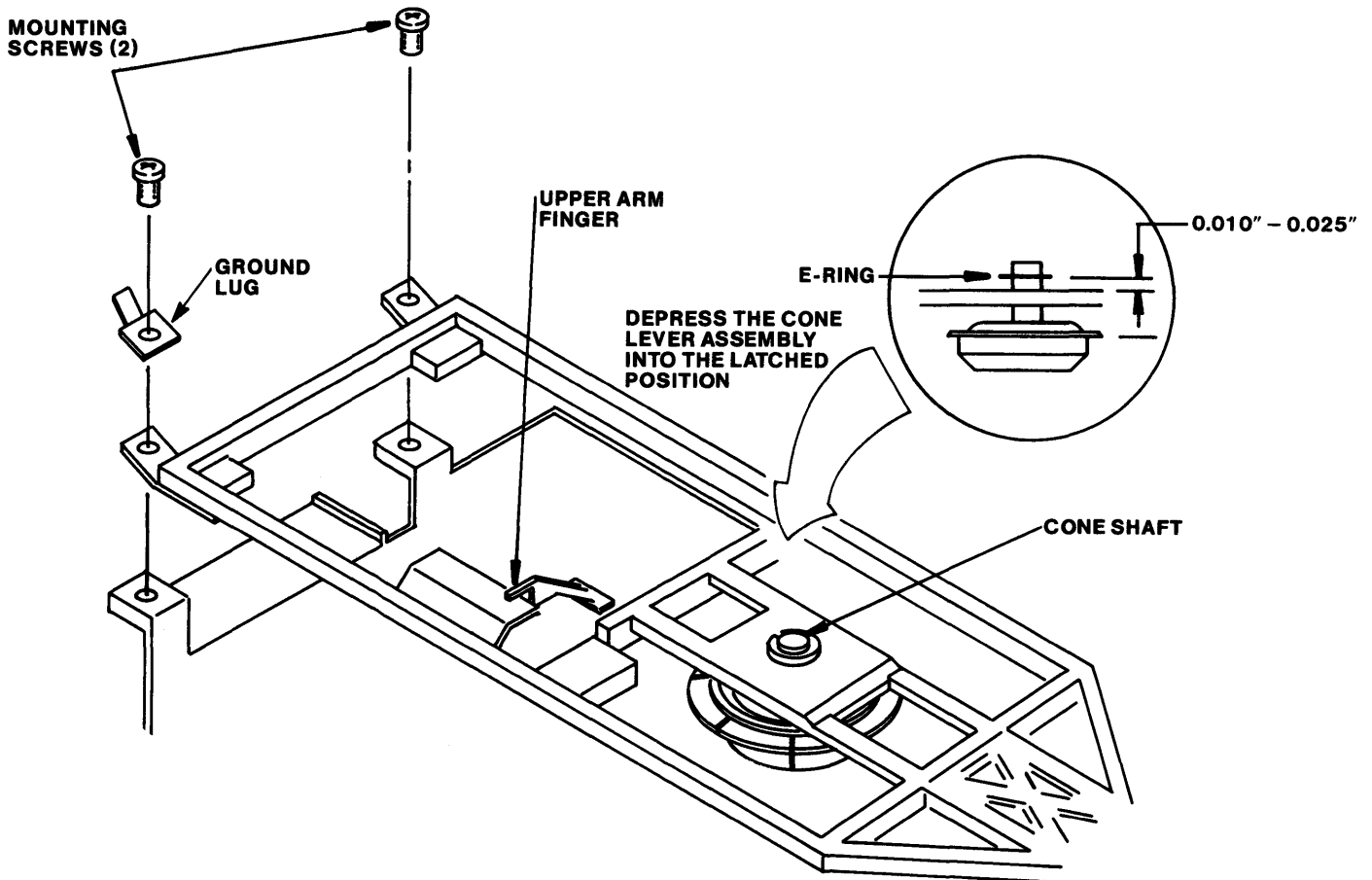
#### REPLACEMENT

1. Route the head cable up through the large open area of the Cone Lever assembly.
2. Position the assembly to ensure the upper arm finger is in place. Place the front door latch in its tracks, and slide it to the front of the drive.



**FIGURE 6-5  
CONE LEVER ASSEMBLY AND CABLE HARNESSING**

3. Install but do not tighten the two mounting screws and ground lug attaching the assembly to the rear of the chassis.
4. Reloop the head cable(s) on the right rail in two places.
5. Install the mounting screw attaching the index emitter holder to the assembly.
6. Attach the top index emitter cable harness to the assembly (Figure 6-4).
7. Attach the stepper motor cable harness at the rear of the assembly (Figure 6-5).
8. Close the front latch of the drive to engage cone and hub.
9. Ensure the cone is centered in the shaft hole (Figure 6-6).
10. Tighten the two mounting screws attaching the assembly to the chassis.
11. Ensure there is clearance between the E-ring and the cone lever. The cone shaft E-ring should be between 0.010 and 0.025-inch above the cone level when the assembly is in the latched position.
12. If necessary, adjust the clearance by adding or deleting a washer located under the E-ring.
13. Reinstall the Logic circuit board.



**FIGURE 6-6**  
**CONE SHAFT AND E-RING**

## **CONE ASSEMBLY**

### **REMOVAL**

1. Remove the Logic circuit board.
2. Remove the Cone Lever Assembly.
3. Remove the E-ring that holds on the cone shaft (Figure 6-7).

#### **NOTE**

The cone's parts are now loose from the cone lever.

### **REPLACEMENT**

1. Put the cone shaft through the cone.
2. Slip on the cone release spring, expander, bearing, step washer, cone spring, and shoulder washer.

#### **NOTE**

Ensure that the bearing is fully seated in the expander.

3. Compress the assembly, and put the cone shaft through the hole in the Cone Lever Assembly.
4. Install the E-ring and the three washers, as required, so there is the proper clearance (Figure 6-6).
5. Reinstall the Cone Lever Assembly.
6. Reinstall the Logic circuit board.

## **ACTIVITY L.E.D.**

### **REMOVAL**

1. Remove the Logic circuit board.

2. Cut the tie wraps attaching the Activity L.E.D. and the Write Protect Switch Assembly to the chassis (Figure 6-8).

3. Remove the retaining collar holding the Activity L.E.D. to the grommet, using needle nose pliers, gently pulling the retaining collar away from the front panel (Figure 6-9).

4. Push out the Activity L.E.D. toward the rear of the drive.

5. Remove the Activity L.E.D. from the drive.

### **REPLACEMENT**

1. Slip the retaining collar onto the new assembly.

2. Push the new Activity L.E.D. into the front panel's grommet.

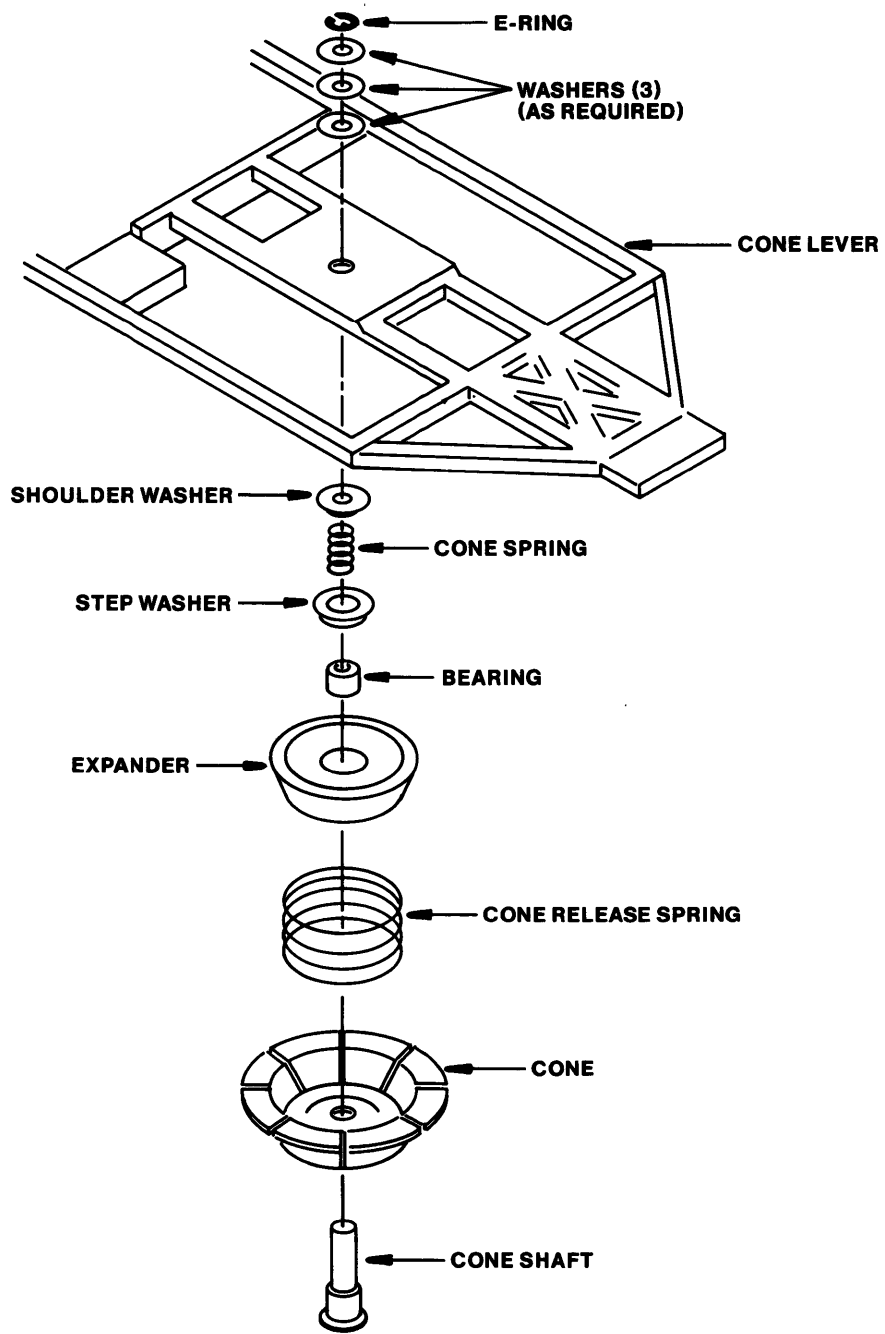
3. Push the retaining collar over the L.E.D. grommet.

4. Attach the Activity L.E.D. and the Write Protect Switch Assembly cable harness to the chassis using the two holes in the bottom of the chassis.

5. Bundle the wires behind the drive motor, and attach a tie wrap to the cable harness (Figure 6-8).

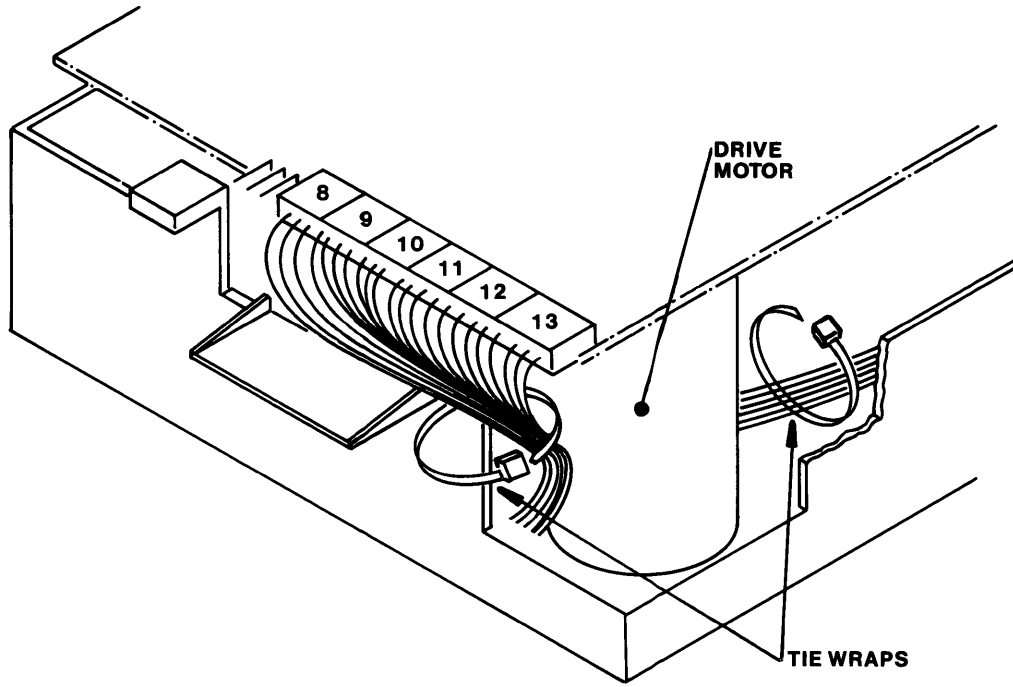
6. Reinstall the Logic circuit board.

7. Using a computer or exerciser, verify the Activity L.E.D. operates.

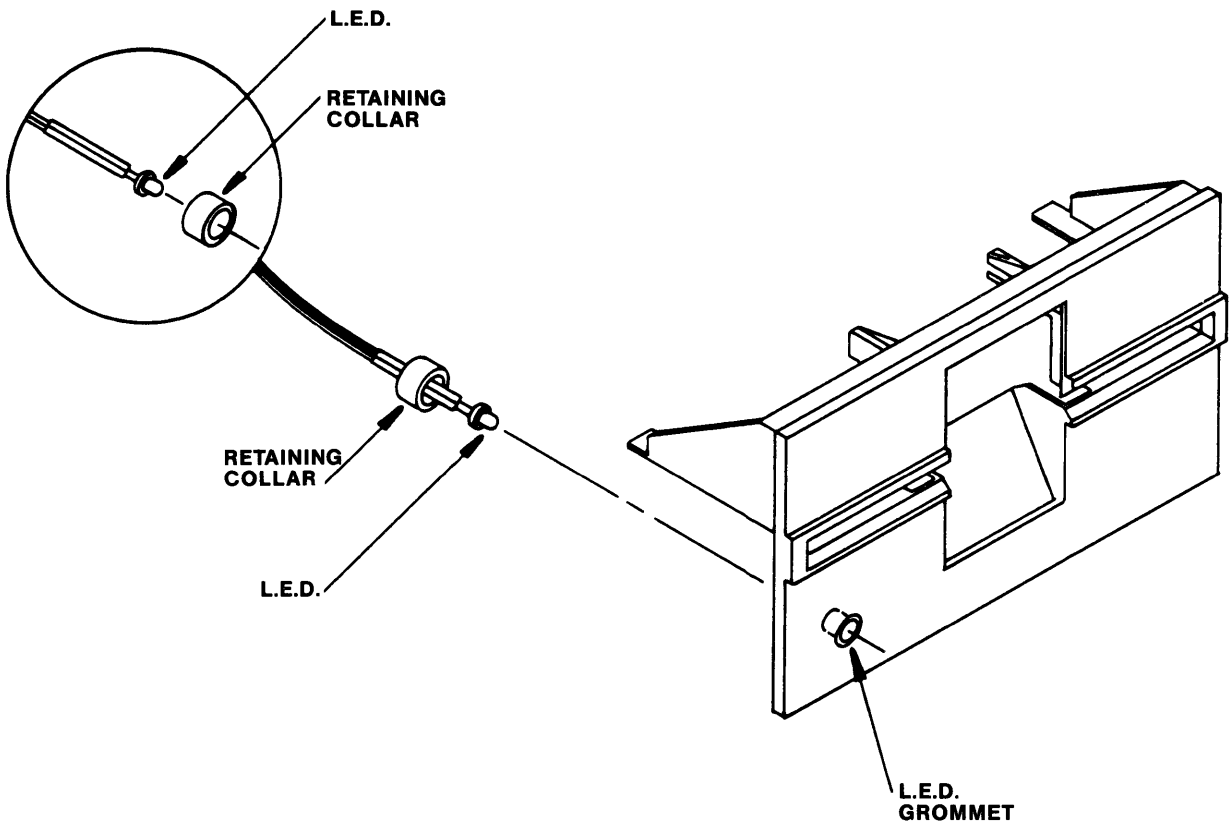


**FIGURE 6-7**  
**CONE'S COMPONENT PARTS**





**FIGURE 6-8  
ACTIVITY L.E.D. CABLE HARNESSING**



**FIGURE 6-9  
ACTIVITY L.E.D. ASSEMBLY RETAINING COLLAR AND GROMMET**

## FRONT PANEL

### REMOVAL

1. Remove the Logic circuit board.
2. Remove the two bushings located on the right- and left-hand sides of the front panel (Figure 6-10). Bushings are glued on. Be careful not to break the locating tabs.
3. Remove the Activity L.E.D.
4. Remove the two mounting screws located underneath the front of the drive (Figure 6-11).
5. Remove the front panel from the chassis.

### REPLACEMENT

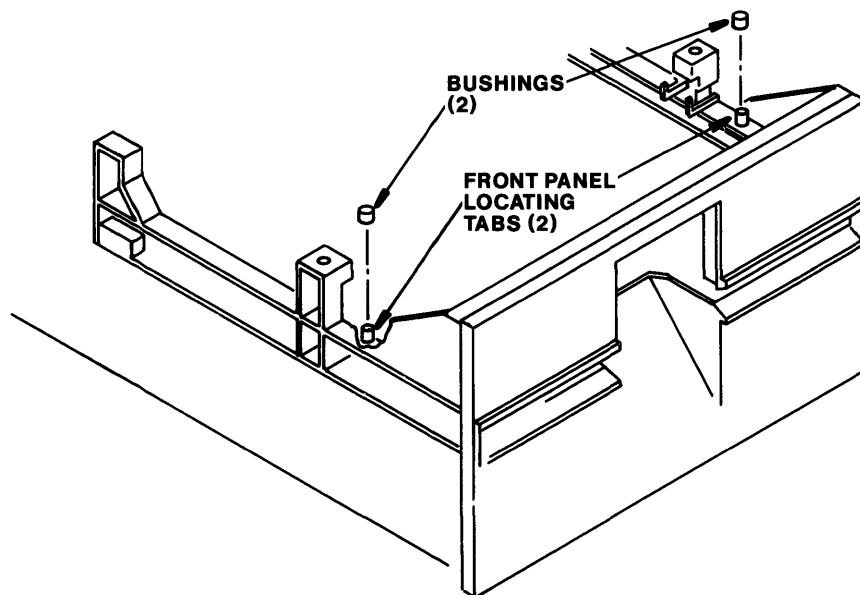
1. Place the front latch in its tracks on the front panel, and place the new front panel on the locating tabs.

2. Reinstall the two mounting screws attaching the front panel to the chassis.
3. Reinstall the Activity L.E.D.
4. Install new bushings on both right and left sides of the front panel over the locating tabs.
5. Put a small drop of glue, e.g., Permabond or Superglue on top of each bushing.
6. Reinstall the Logic circuit board.

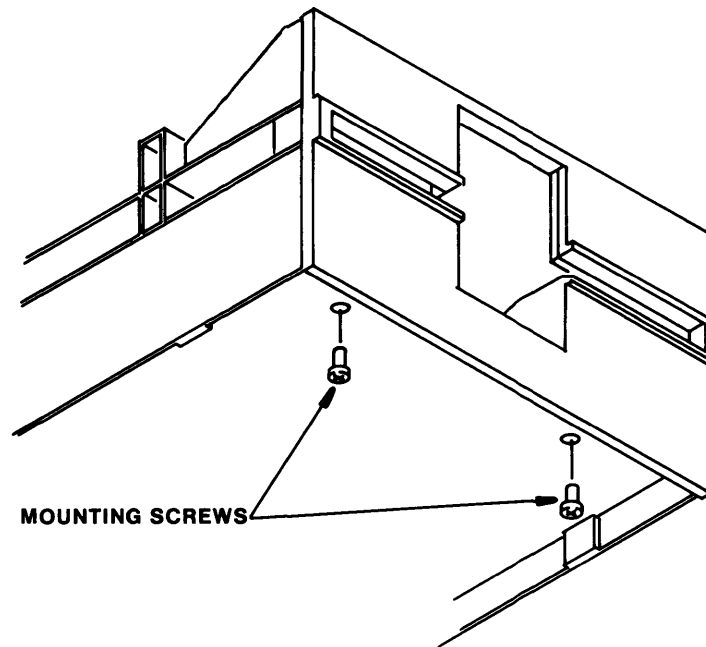
## GUIDE RAIL

### REMOVAL

1. Remove the Logic circuit board.
2. Remove the front panel.
3. If the right guide rail is to be replaced, detach the head cable(s) from it.



**FIGURE 6-10**  
**FRONT PANEL LOCATING TABS AND BUSHINGS**



**FIGURE 6-11**  
**FRONT PANEL MOUNTING SCREWS**

4. With a screwdriver inserted between the guide rail and the chassis, pry up, from both ends, the guide rail that is to be replaced, and remove it.
5. If one of the chassis locating tabs underneath the removed guide rail has broken off inside the chassis, clean out the hole completely, using a 1/8-inch drill or a soldering iron to melt the plastic, and remove the debris.
3. If the right guide rail has been replaced, reloop the head cable(s) over the two guide rail posts (Figure 6-12).
4. If the left guide rail has been replaced, verify the Write Protect Switch and its adjustment.
5. Reinstall the Logic circuit board.

**CAUTION**

*Do not enlarge the hole in the chassis.*

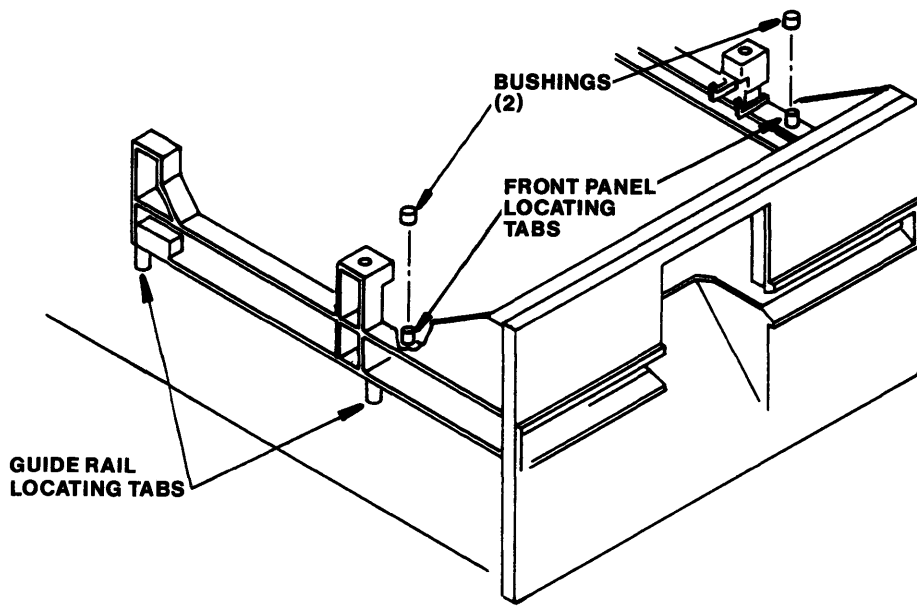
**REPLACEMENT**

1. Evenly press the new guide rail into the chassis locating tab holes (Figure 6-12).
2. Replace the front panel.

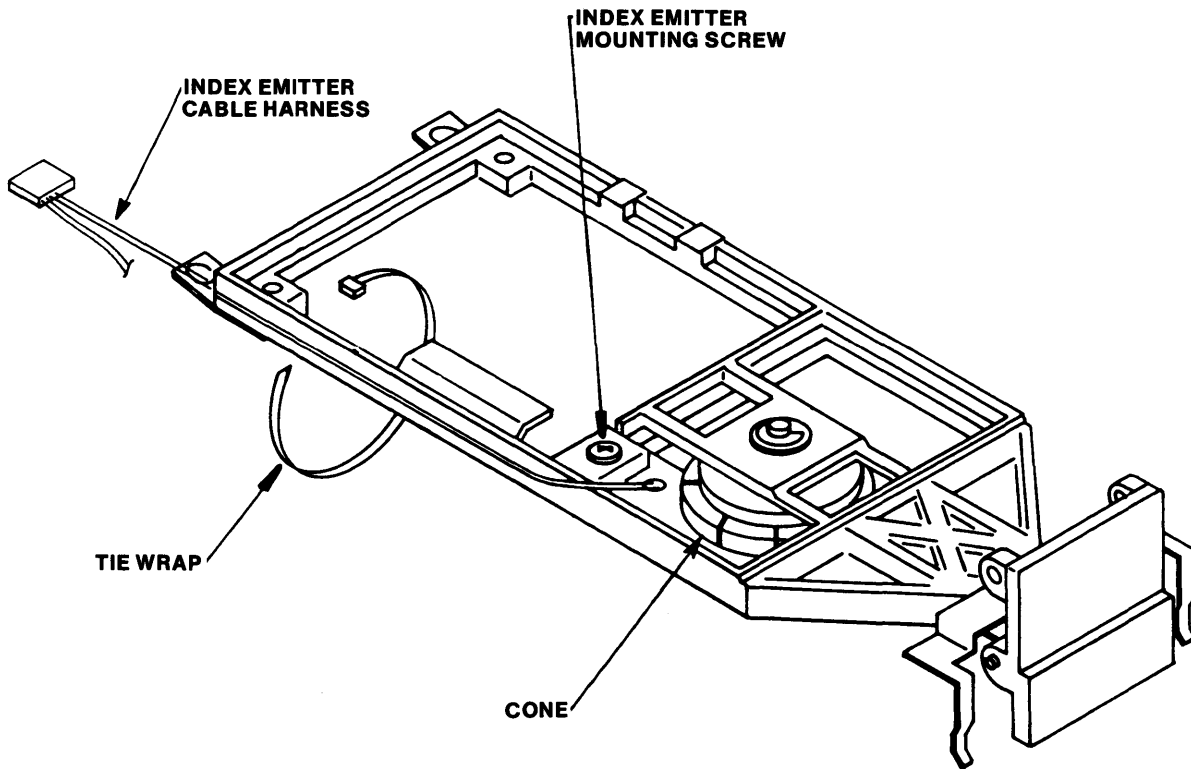
**INDEX ASSEMBLY**

**REMOVAL**

1. Remove the Logic circuit board.
2. Remove the mounting screw attaching the index emitter sensor to the Cone Lever Assembly (Figure 6-13).
3. Remove the index emitter sensor cable harness from the Cone Lever Assembly.



**FIGURE 6-12  
GUIDE RAIL LOCATING TABS AND BUSHINGS**



**FIGURE 6-13  
INDEX EMITTER SENSOR'S MOUNTING AND CABLE HARNESSING**

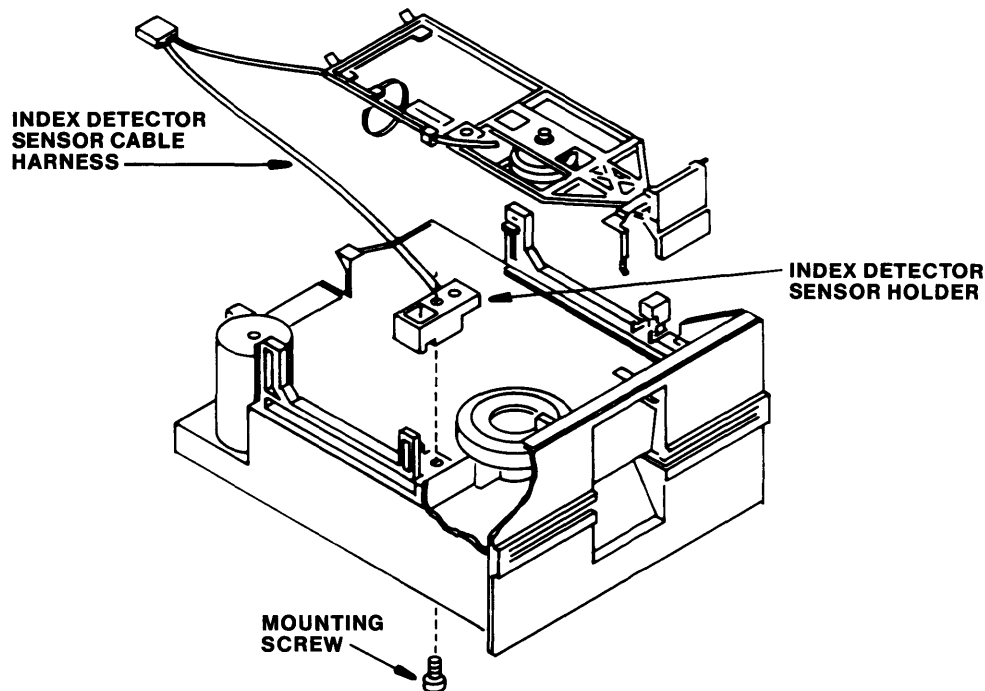
4. Remove the mounting screw from the bottom of the drive, attaching the index detector sensor holder to the chassis (Figure 6-14).
5. Cut the tie wrap attaching the index detector sensor cable harness to the chassis.
6. Lift out the Index Sensor Assembly from the drive.

3. Smooth out the cable harness.
4. Attach the index emitter cable harness to the Cone Lever Assembly.
5. Attach the index detector cable harness to the chassis.
6. Bundle the wires behind the drive motor, and attach a tie wrap to the cable harness (Figure 6-15).

## REPLACEMENT

1. Install the new index emitter sensor holder onto the Cone Lever Assembly using the mounting screw.
2. Install the new index detector sensor holder in the top of the chassis, and while holding the drive upside down, install the mounting screw.

7. Insert a diskette into the drive.
8. Ensure the sensor cables do not touch the diskette, Cone Lever Assembly, and Carriage Assembly.
9. Reinstall the Logic circuit board.
10. Adjust the index-to-data timing.



**FIGURE 6-14**  
**INDEX DETECTOR SENSOR'S MOUNTING SCREW AND CABLE**

## DRIVE MOTOR ASSEMBLY

### REMOVAL

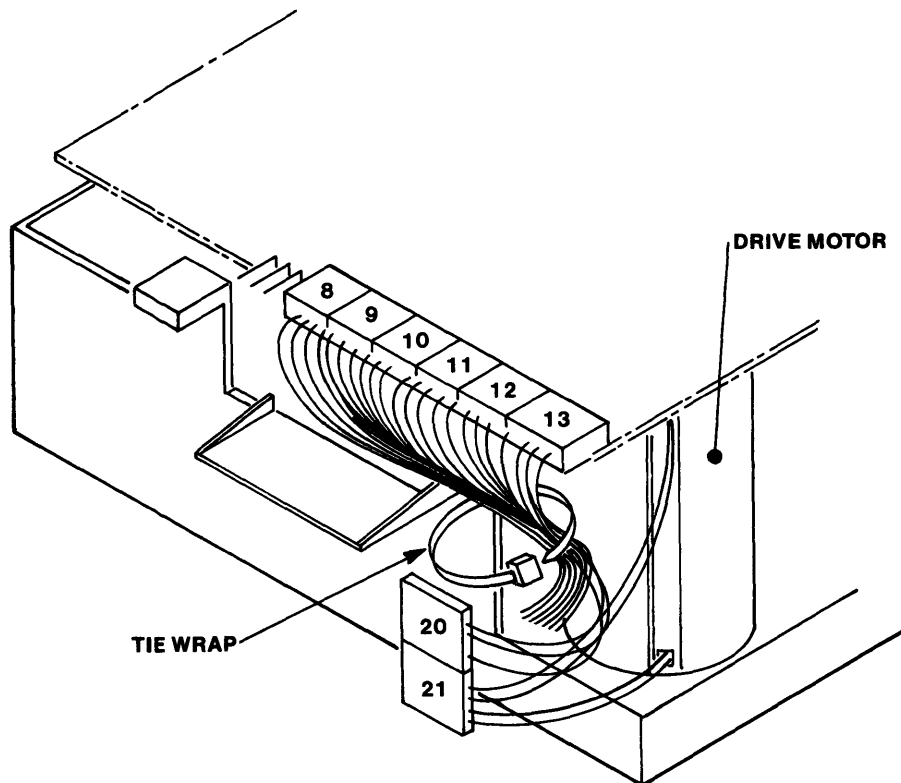
1. Remove the Logic circuit board.
2. Cut the cable harness tie wrap Connector P21 (Figure 6-15).
3. Detach Connector P21 from the Servo circuit board.

4. Remove the drive belt.
5. Remove the mounting screws and shoulder washers attaching the Drive Motor Assembly to the chassis (Figure 6-16).

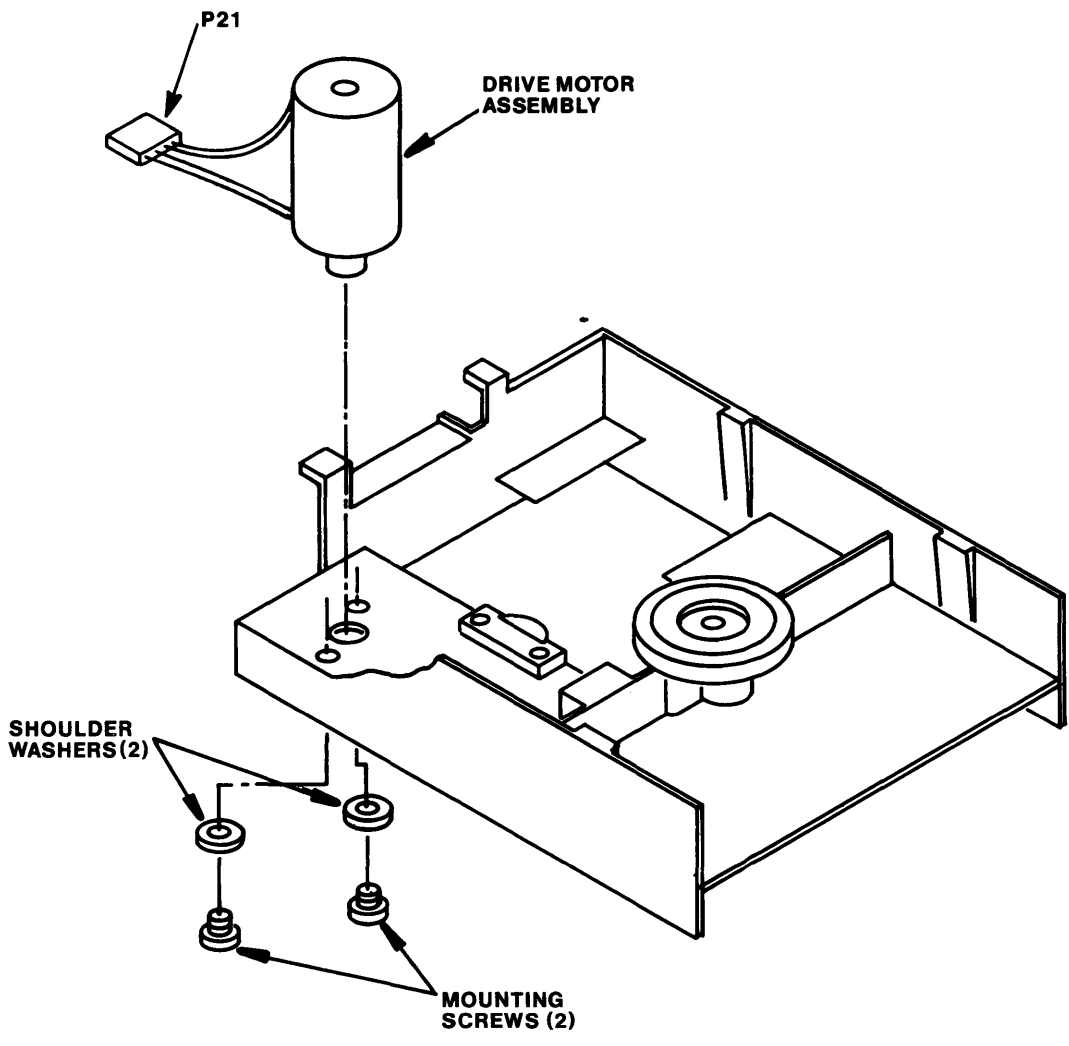
### NOTE

Save the mounting screws and shoulder washers.

6. Remove the assembly.



**FIGURE 6-15  
CABLE HARNESS**



**FIGURE 6-16**  
**DRIVE MOTOR HARNESSING AND MOUNTING**

## REPLACEMENT

1. Insert the pulley end of the new assembly through the bottom of the chassis (Figure 6-17).
2. Rotate the assembly until its two tapped holes are aligned with the holes in the chassis.

### NOTE

Ensure Connector P21's cables face the back rather than the front of the drive.

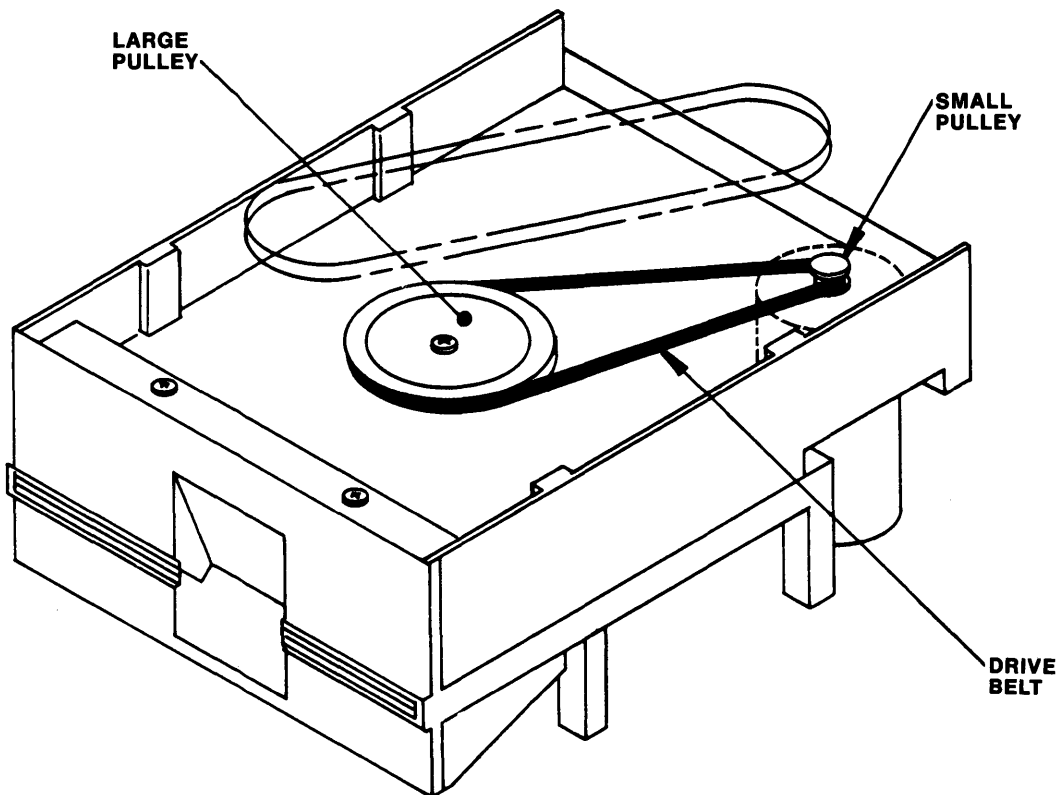
3. Install the shoulder washers and mounting screws.
4. Reinstall the drive belt (Figure 6-1).
5. Plug Connector P21 into the Servo circuit board.

6. Attach a tie wrap to the bundle of wires located behind the drive motor.
7. Reinstall the Logic circuit board.
8. Adjust the drive motor's speed.

## TRACK 0 SWITCH ASSEMBLY

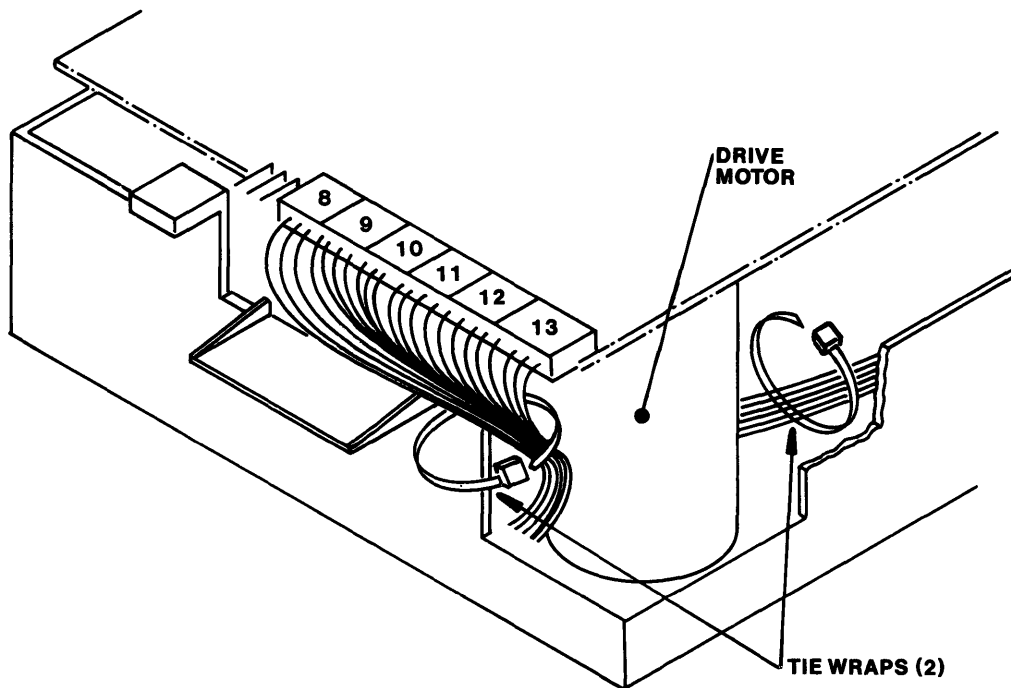
### REMOVAL

1. Remove the Logic circuit board.
2. Cut the tie wraps holding the bundle of cables at the back of the drive motor and attach the cables to the bottom of the chassis (Figure 6-18).
3. Move the head carriage toward the front of the drive.



**FIGURE 6-17**  
**DRIVE MOTOR PULLEYS**





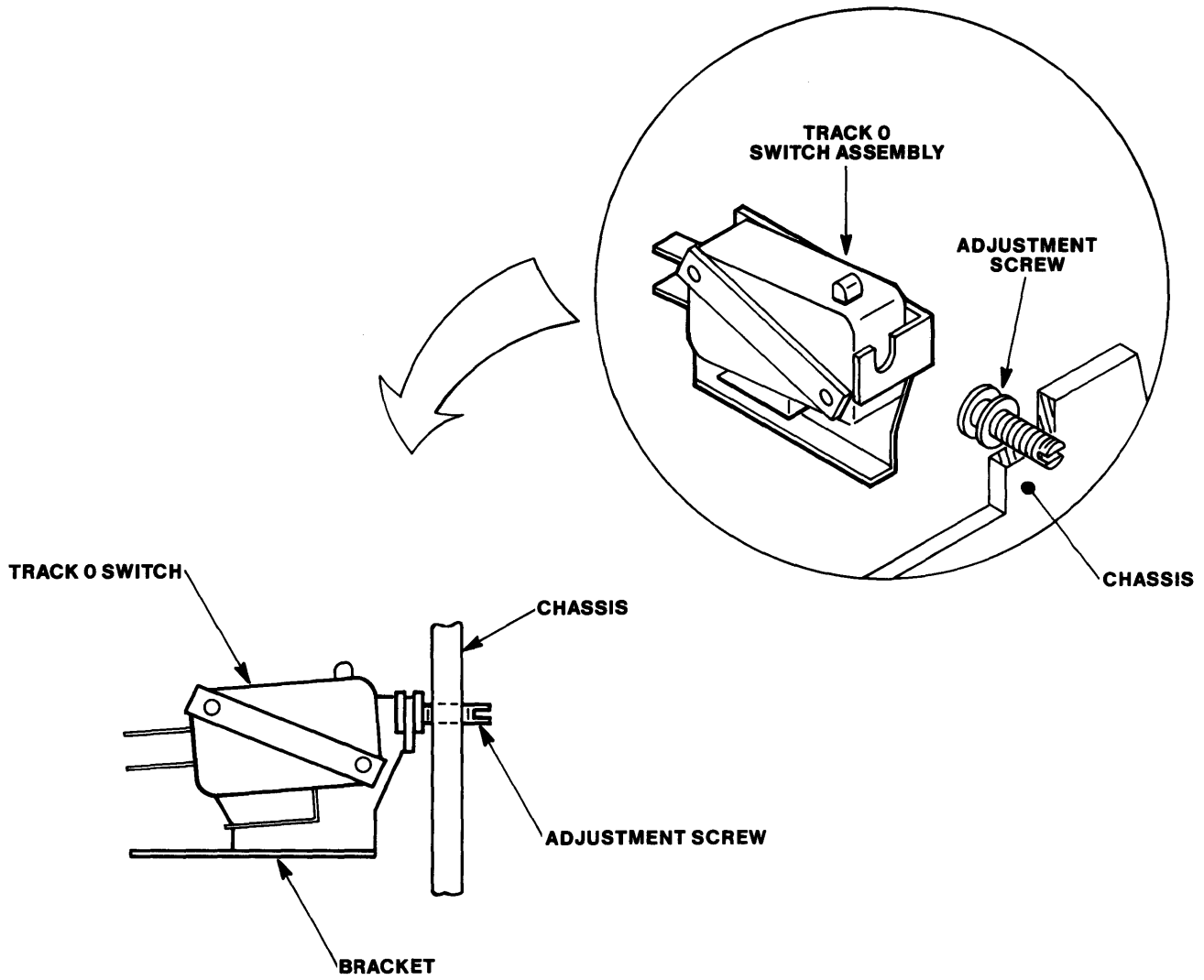
**FIGURE 6-18  
TRACK 0 CABLE HARNESSING**

4. Remove the mounting screw attaching the assembly to the chassis (Figure 6-20).
5. Remove the assembly, pulling it toward the front of the drive, and slipping it out from the adjustment screw (Figure 6-19).

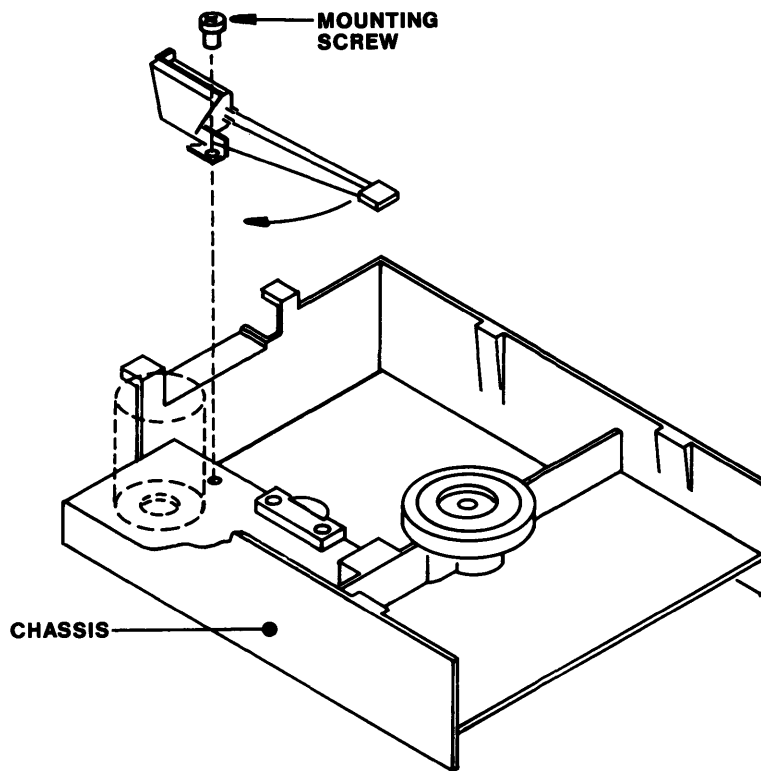
#### **REPLACEMENT**

1. Put the new assembly into the drive.
2. Push this assembly toward the rear of the drive, and slip the bracket into the adjustment screw (Figure 6-19).

3. Ensure there are no cables underneath the assembly.
4. Install the mounting screw (Figure 6-20) attaching the assembly to the bottom of the chassis.
5. Attach a tie wrap to the cable harness at the bottom of the chassis.
6. Tie wrap the bundle of cables located at the back of the drive motor.
7. Reinstall the Logic circuit board.
8. Adjust the Track 0 Switch Assembly.



**FIGURE 6-19**  
**TRACK 0 ADJUSTMENT SCREW**



**FIGURE 6-20  
TRACK 0 MOUNTING SCREW**

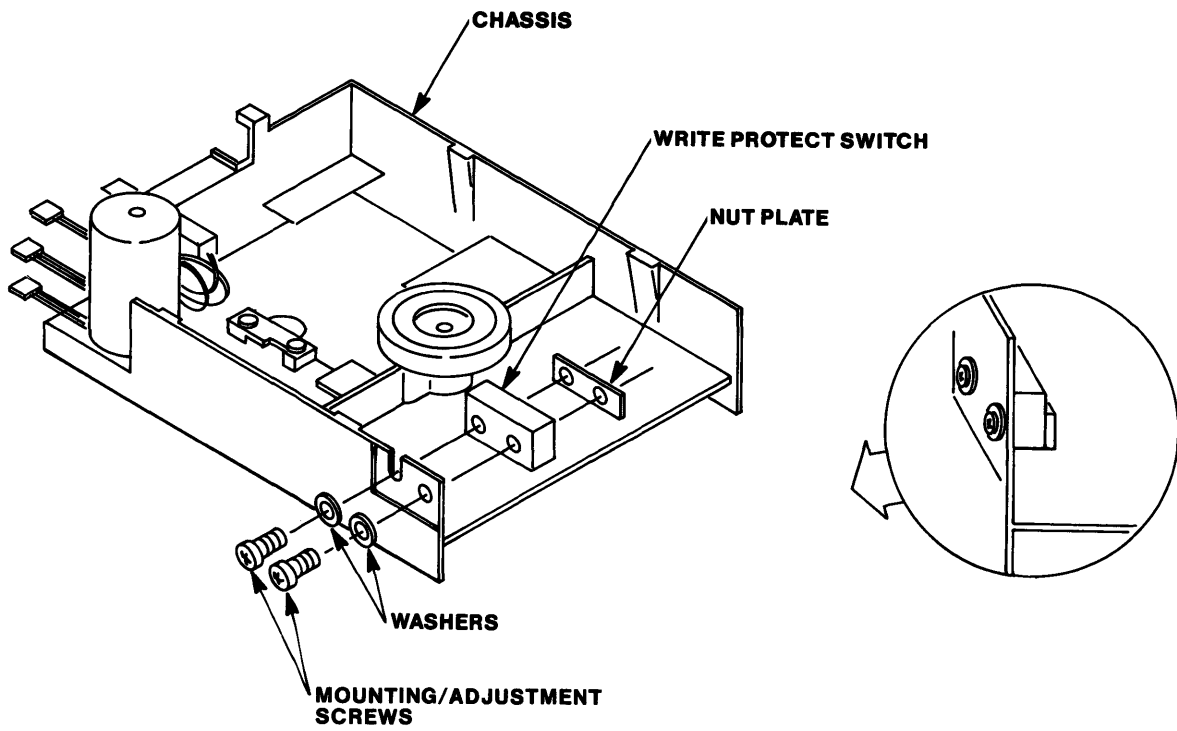
## **WRITE PROTECT SWITCH ASSEMBLY**

### **REMOVAL**

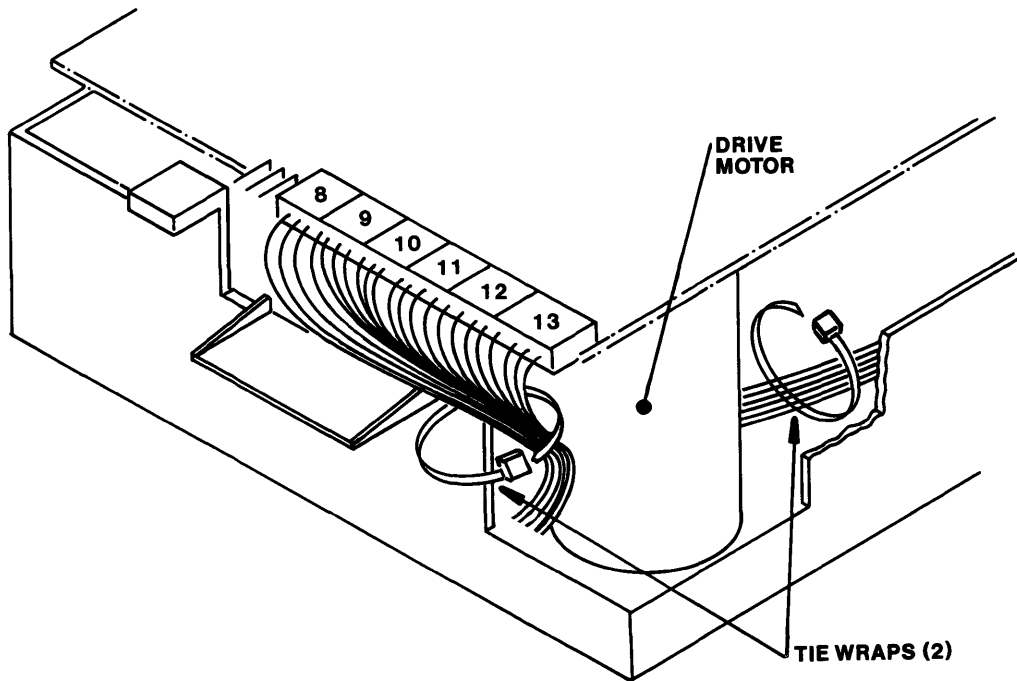
1. Remove the Logic circuit board.
2. Remove the mounting/adjustment screws attaching the assembly to the side of the chassis (Figure 6-21).
3. Cut the tie wrap attaching the cable harness to the bottom of the chassis.
4. Cut the tie wrap attaching the assembly's cables to the bundle of wires at the back of the drive motor (Figure 6-22).
5. Remove the assembly.

### **REPLACEMENT**

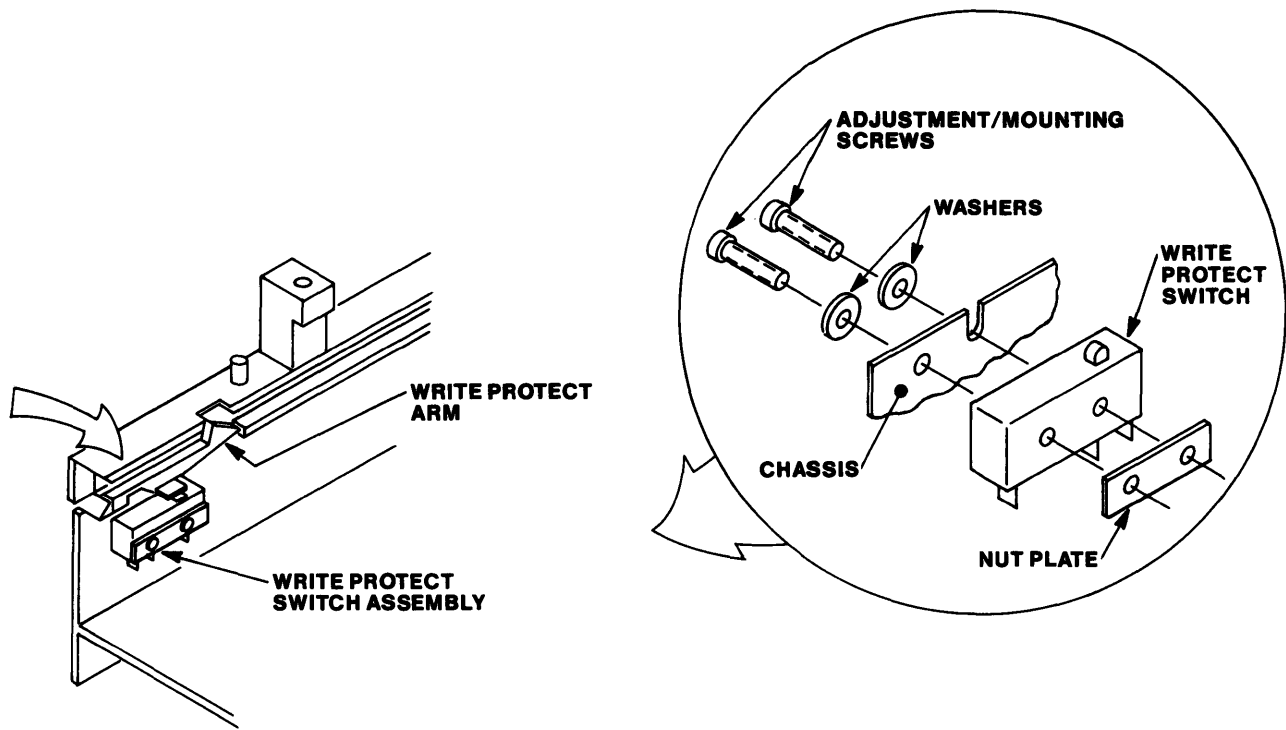
1. Install the new assembly, using its mounting/adjustment screws.
2. Tie wrap the bundle of wires at the back of the drive motor.
3. Attach the write protect cable harness to the chassis.
4. Ensure the write protect arm causes the switch to make a clicking noise when the arm is pushed down (Figure 6-23).
5. Reinstall the Logic circuit board.
6. Recheck the Write Protect Switch adjustment.



**FIGURE 6-21**  
**WRITE PROTECT MOUNTING/ADJUSTMENT SCREWS**



**FIGURE 6-22**  
**WRITE-PROTECT CABLE HARNESSING**



**FIGURE 6-23**  
**WRITE PROTECT ARM AND ADJUSTMENT SCREWS**

## UPPER ARM ASSEMBLY (SINGLE-SIDED DRIVES ONLY)

### REMOVAL

1. Remove the Logic circuit board.
2. Close the front door.
3. Using a 5/64-inch Allen wrench, remove the two screws attaching the upper arm and spring retainer to the Carriage Assembly (Figure 6-24).
4. Carefully lift off the spring retainer and spring (Figure 6-25).
5. Remove the Upper Arm Assembly.

### REPLACEMENT

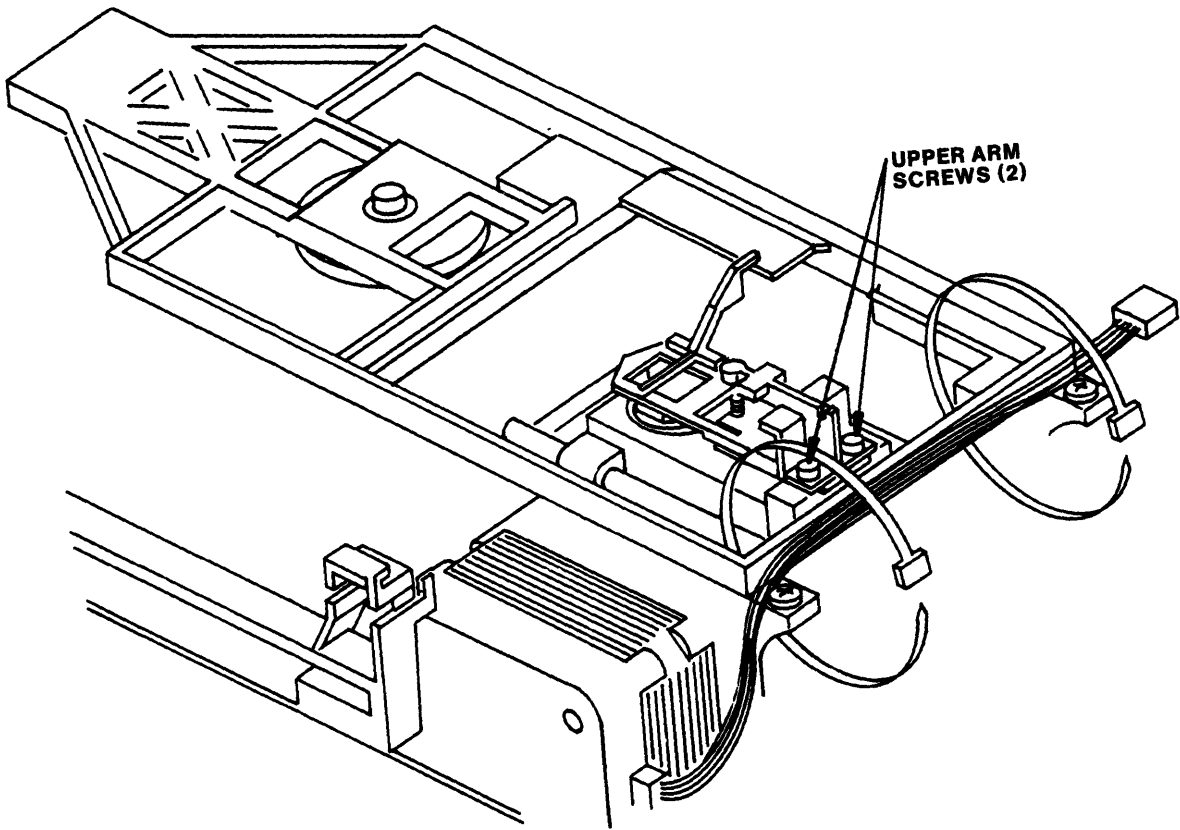
1. Place the new assembly on the head carriage, aligning the screw holes.
2. Carefully replace the spring and spring retainer, ensuring the spring is seated on both ends, and align the screw holes.

3. Reinstall but do not completely tighten the screws.
4. Visually align the felt pad with the head (Figure 6-26).
5. Tighten the two screws.
6. After inserting a diskette into the drive, visually check to ensure the felt pad clears the disk when the front door is opened.
7. Reinstall the Logic circuit board.
8. Check the compliance.

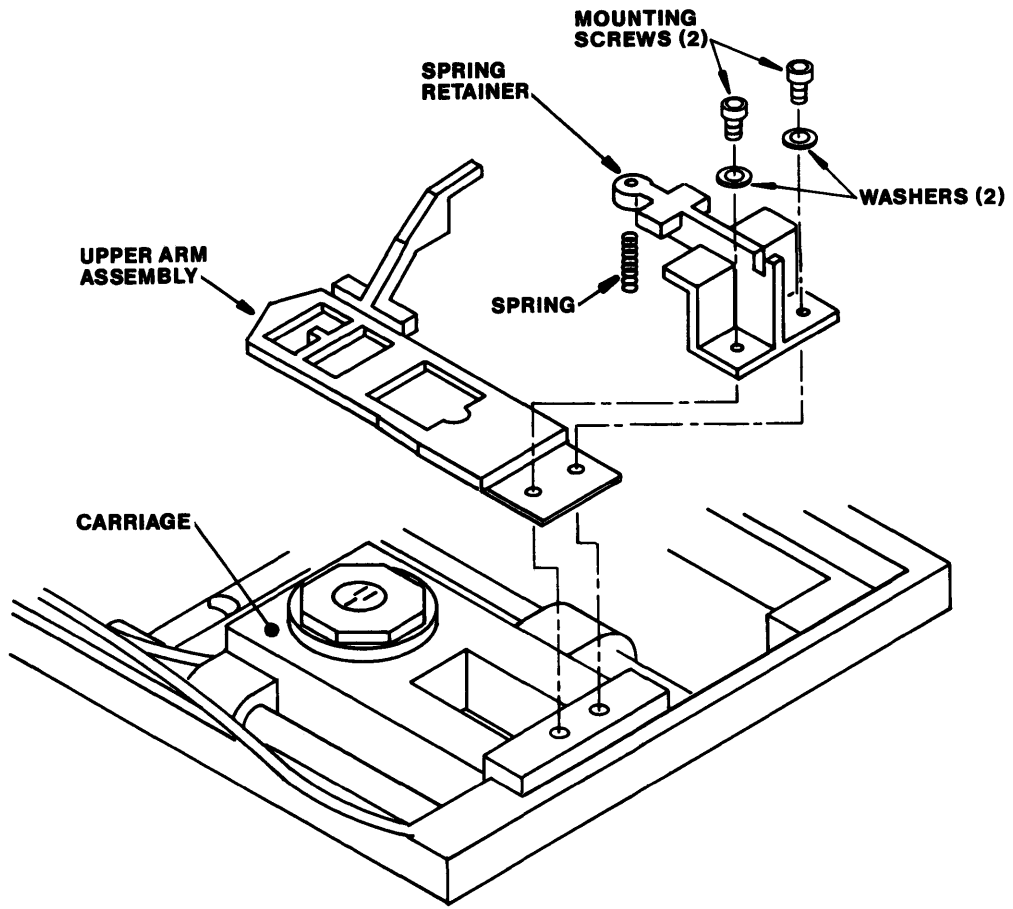
## HEAD MODULE ASSEMBLY

### REMOVAL

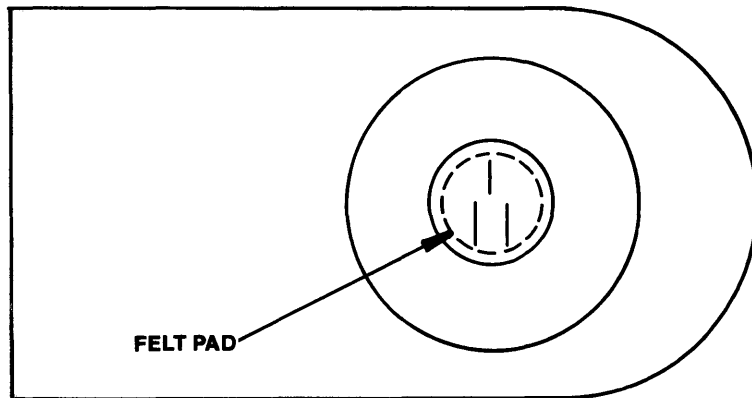
1. Remove the Logic circuit board.
2. Remove the head cable(s) from the right rail.
3. Remove the Cone Lever Assembly.



**FIGURE 6-24**  
**UPPER ARM SCREWS**



**FIGURE 6-25  
UPPER ARM PARTS**



**FIGURE 6-26  
FELT PAD ON UPPER ARM**

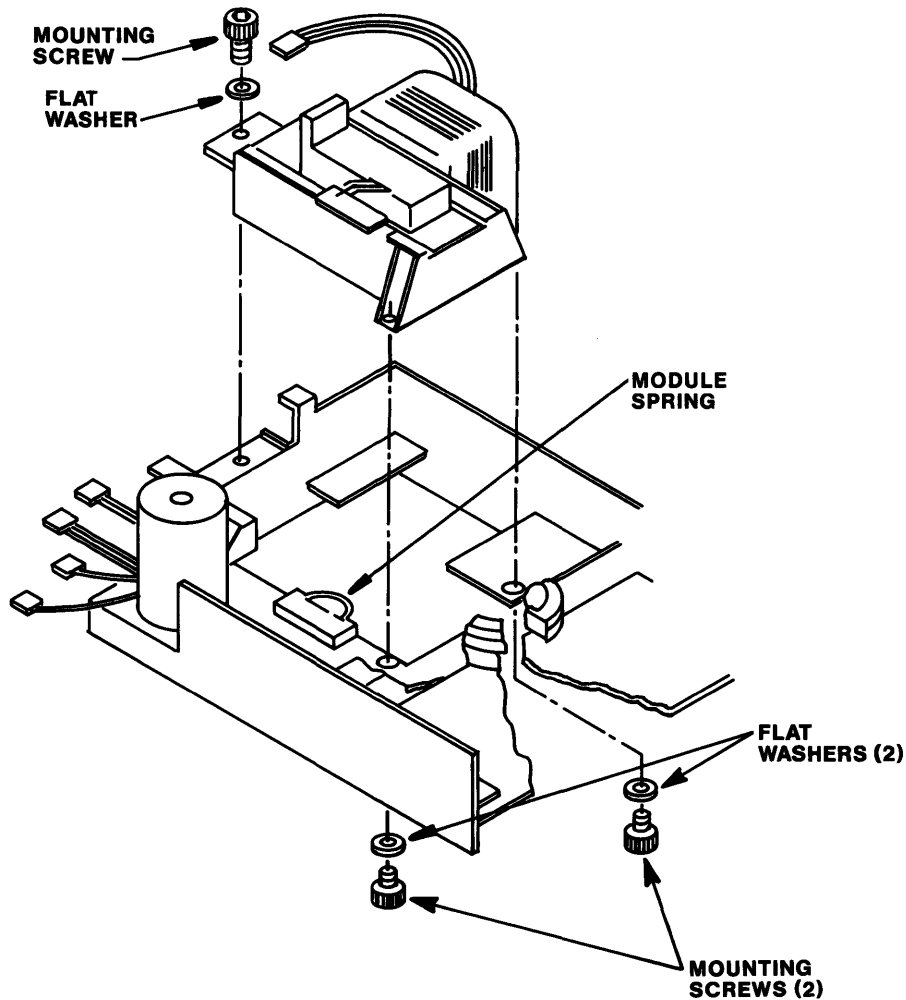
4. Remove the stepper motor cable from the cable harness.
5. Remove the mounting screws and flat washers attaching the Head Module Assembly to the chassis (Figure 6-27).
6. Remove the Head Module Assembly from the chassis.

**CAUTION**

*Be extremely careful of the upper head and head carriage when handling the assembly. Hold the assembly by the stepper motor or the module casting, not the heads.*

**REPLACEMENT**

1. Install the new assembly by placing its left side against the module spring, and compressing the module spring to seat the other side of the assembly. Ensure the module is seated around the adjustment cam screw.
2. With a 7/64-inch Allen wrench, reinstall the flat washers and mounting screws.
3. Install the Cone Lever Assembly.
4. Attach the head cable(s) to the right rail.
5. Attach the stepper motor cables to the cable harness.



**FIGURE 6-27  
HEAD MODULE ASSEMBLY**



6. Install the Logic circuit board.
7. Complete the checks and adjustments in Section 5.

## LATCH PLATE ASSEMBLY

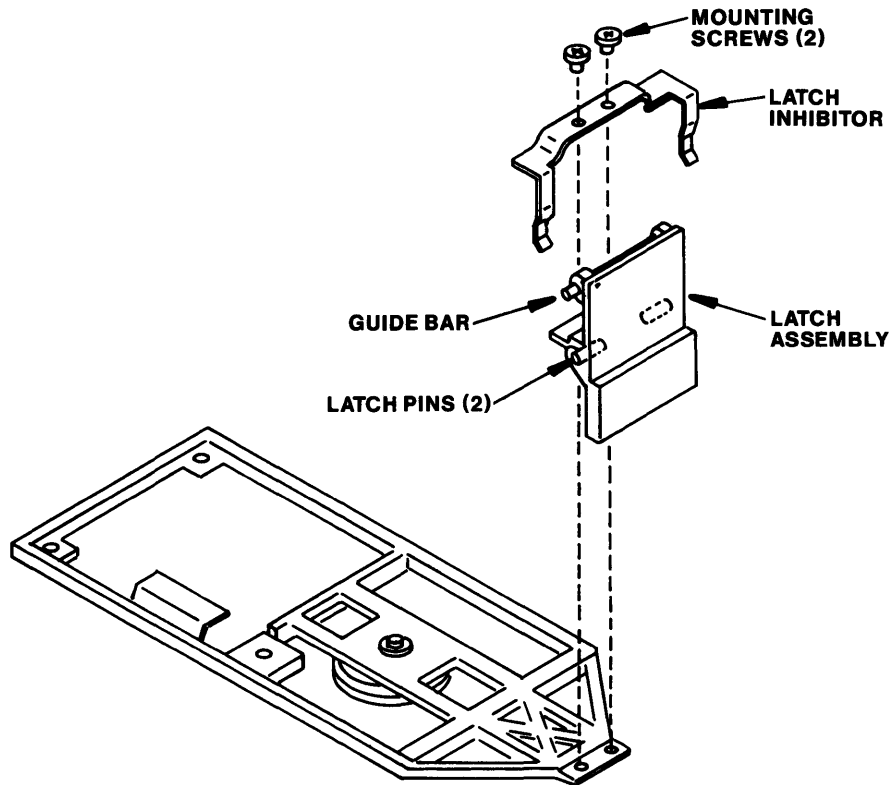
### REMOVAL

1. Remove the Logic circuit board.
2. Remove the mounting screws attaching the Latch Plate Assembly to the Cone Lever Assembly (Figure 6-28).
3. Remove the latch inhibitor and the assembly.

### REPLACEMENT

1. Holding the Cone Lever Assembly down, insert the new assembly into its tracks.

2. Close the front latch.
3. Still holding the Cone Lever Assembly down, place the latch inhibitor on top of the assembly.
4. Install but do not tighten the mounting screws attaching the latch inhibitor and the Latch Plate Assembly to the Cone Lever Assembly.
5. Open the front latch.
6. Insert a diskette into the drive.
7. Close the front latch.
8. Align the latch inhibitor so it just touches the diskette as the front door is closed.
9. While holding the latch inhibitor in place, tighten the mounting screws.
10. Reinstall the Logic circuit board.



**FIGURE 6-28**  
**LATCH PLATE MOUNTING**

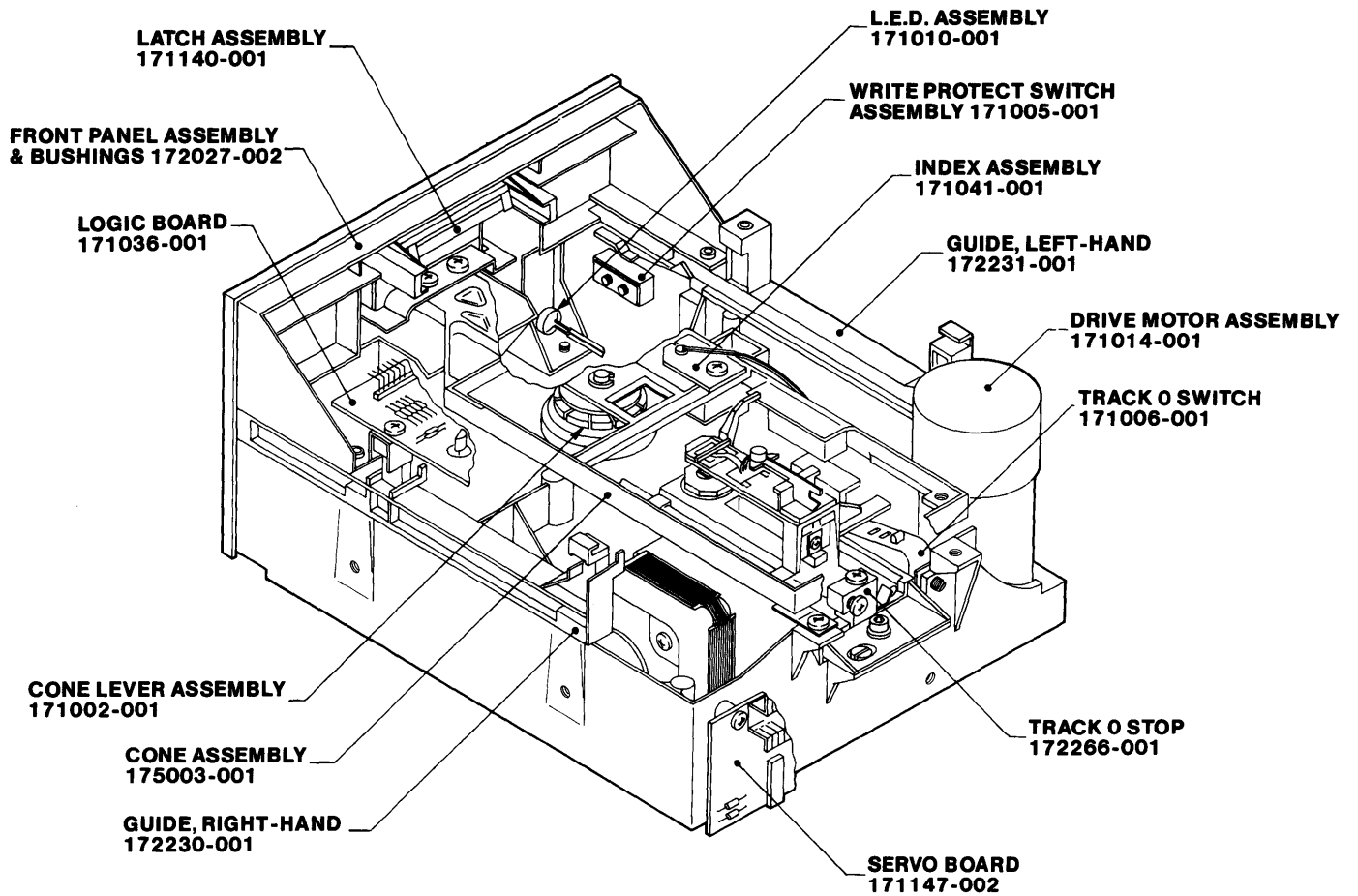


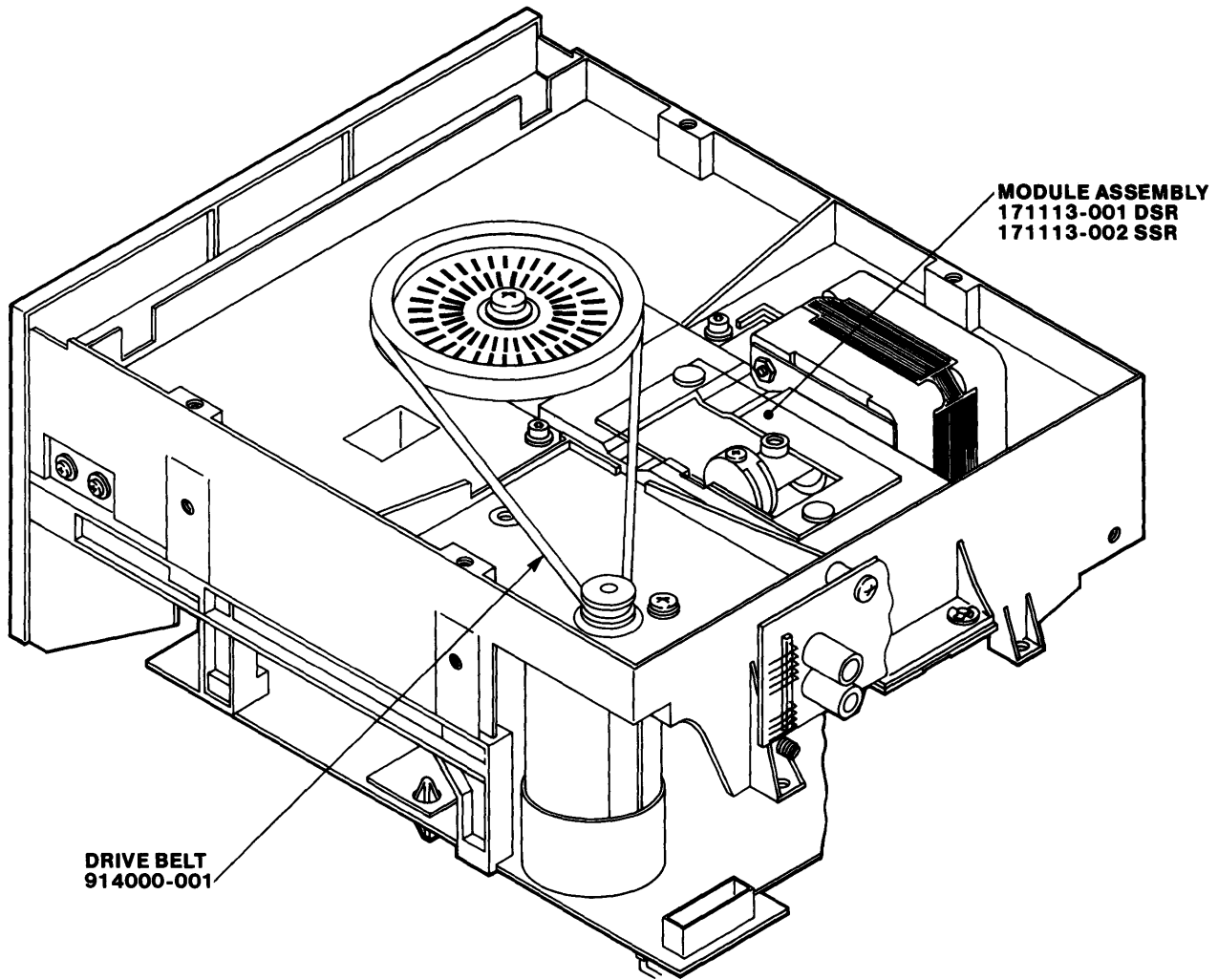
# APPENDIX A

## RECOMMENDED SPARES AND MAJOR ASSEMBLIES

This appendix contains the recommended spare parts list and the major assembly drawings for the drive. Part numbers on this list should be used for ordering spare parts. A spare parts list with prices for parts and services is available from Tandon Corporation.

Part Number	Description
171140-001	Latch Assembly
171010-001	L.E.D. Assembly
172027-002	Front Panel with Bushings
171041-001	Index Assembly
171036-001	Logic Circuit Board, Standard
175003-001	Cone Assembly (1 Piece)
172231-001	Left-Hand Guide Rail (Aluminum Chassis)
171002-001	Cone Lever Assembly
171014-001	Drive Motor
171103-001	Upper Arm
171113-001	Module DSR (Aluminum Chassis)
171113-002	Module SSR (Aluminum Chassis)
973530-151	Resistor Pack
171147-002	Servo Circuit Board, Standard
172230-001	Right-Hand Guide Rail (Aluminum Chassis)
914000-001	Drive Belt
172266-001	Track 0 Stop
171006-001	Track 0 Switch Assembly
171005-001	Write Protect Switch Assembly







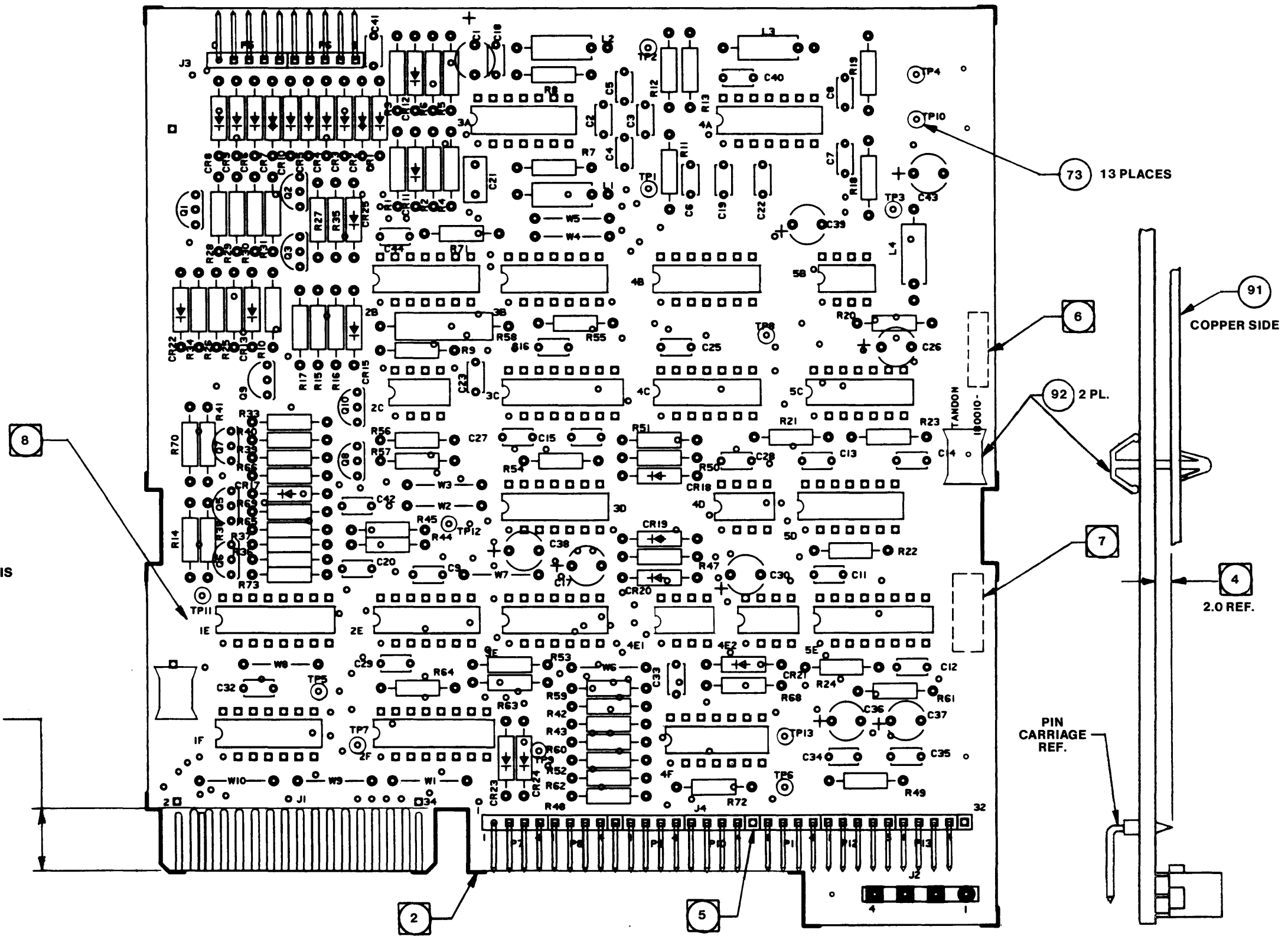
# APPENDIX B

## CIRCUIT BOARD SCHEMATICS AND DRAWINGS

This appendix contains the current circuit board schematics and circuit board drawings for the TM100-1 and TM100-2 drives.

Drawing Number	Title	Page Number
180010, REV K	Logic Circuit Board Assembly Drawing	B-2, B-3
180011, REV F	Logic Circuit Board Schematic	B-4, B-5, B-6
180000, REV G	Servo Circuit Board Assembly Drawing	B-7
180001, REV F	Servo Circuit Board Schematic	B-8

PARTS LIST REFERENCE		
PART LIST NUMBER	REV	REMARKS
180010-001	F	
180010-002		
180010-003		
180010-004	G	
180010-005	F	
180010-006	E	9
180010-007		
180010-008		
180010-009		
180010-010	F	8



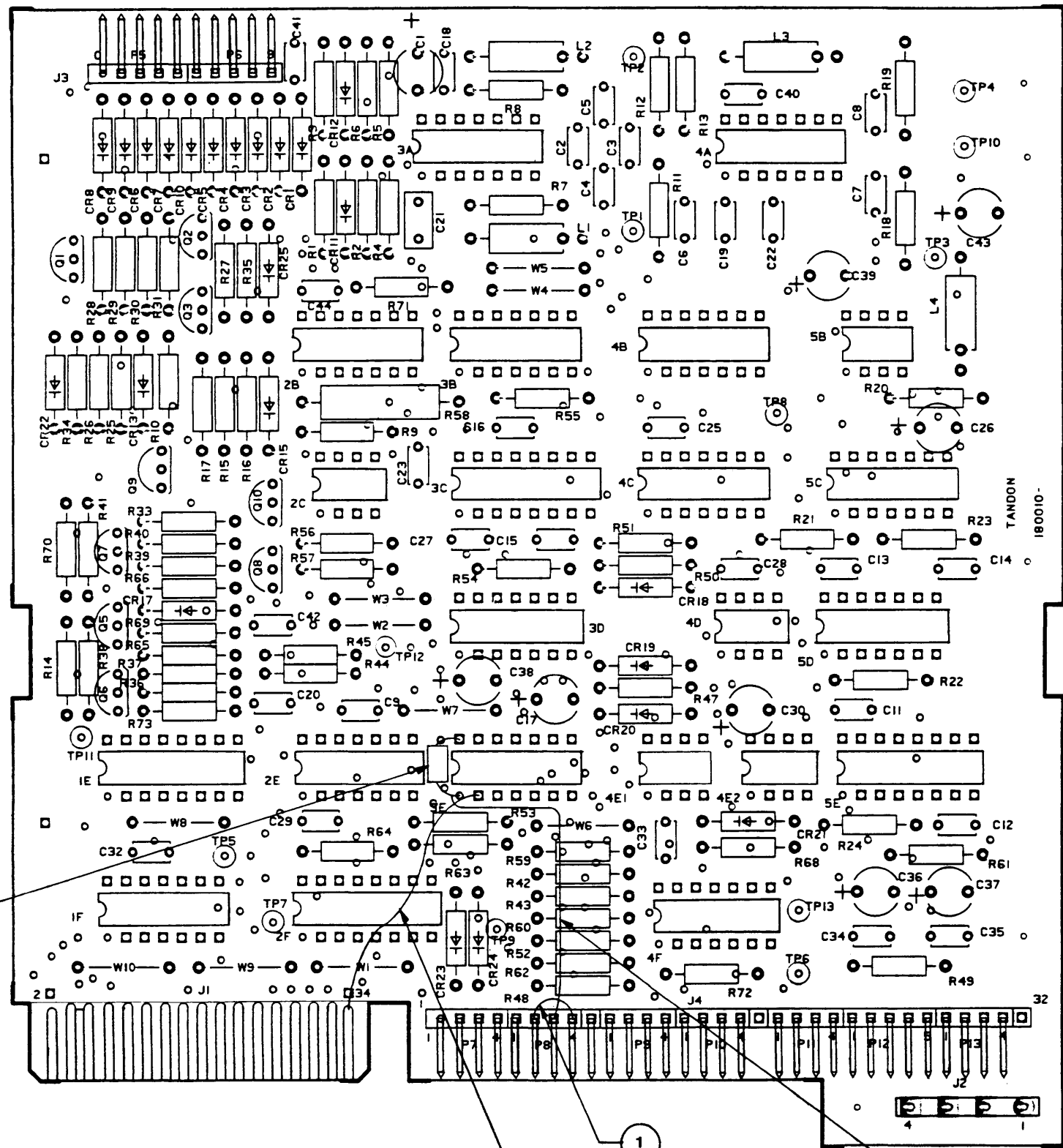
NOTE: SOLDER COATING ON GOLD FINGERS ALLOWED UP TO THIS REFERENCE LINE, ON BOTH SIDES OF PCB.

NO SOLDER COATING ON FINGERS IN THIS AREA

- 9 -006 ASSEMBLY: INSTALL MODIFICATIONS DESCRIBED ON SHEET 2.
- 8 -010 ASSEMBLY: INSTALL 172181-001 ACROSS PINS 3 & 14 (3E).
- 7 VENDOR TO MARK BOARDS PERMANENTLY WITH VENDOR IDENTIFIER IN AREA SHOWN.
- 6 MARK VERSION NUMBER (DASH NUMBER), REVISION LETTER, AND DATE CODE IN AREA SHOWN.
- 5 CUT DESIGNATED PIN, TANGENT TO PIN CARRIAGE.
- 4 MAX PENETRATION OF COMPONENT LEADS, BELOW BOARD AFTER ASSEMBLY AND TRIMMING SHALL NOT EXCEED 2.0 MAX.
- 3. COMPONENT HEIGHT, EXCEPT RESISTOR PACKAGE 2F (WHEN INSTALLED), SHALL NOT EXCEED 8.89 ABOVE P.C. BOARD. RESISTOR PACKAGE (2F) TO BE 9.65 MAX.
- 2 THIS ASSEMBLY SHALL BE MADE FROM PCB 180012-001 REV E.
- 1. ASSEMBLE PER STANDARD MANUFACTURING METHODS.

Tandon CORPORATION  
 LOGIC CIRCUIT BOARD  
 ASSEMBLY DRAWING  
 180010 - REV K  
 SHEET 1 OF 2  
 B-2





9

REWORK INSTRUCTIONS FOR - 006

REWORK NUMBER	REWORK DESCRIPTION
1	ADD JUMPER BET. J4-6 AND J4-8 (W12)
2	ADD JUMPER BET. J4-7 AND 3E-1 (W11)
3	ADD JUMPER BET. J1-34 TO 3E-2 (W13)
4	INSTALL R74 BET. 3E-1 AND 3E-14

COMPONENT SIDE

**Tandon CORPORATION**  
**LOGIC CIRCUIT BOARD**  
**ASSEMBLY DRAWING**  
**180010 - REV K**  
**SHEET 2 OF 2**  
**B-3**

TABLE I 5

VERSION NUMBER	2F (RP1)	4E1	CR24	IE	R6
-001	150 973530-151	OMIT	OMIT	948000-002	OMIT
-002	—	—	—	—	—
-003	150 973530-151	OMIT	OMIT	948000-002	OMIT
-004	330 973530-331	75463 977015-463	IN4003 975020-001	948000-002	OMIT
-005	330 973530-331	OMIT	OMIT	948000-002	OMIT
-006	150 973530-151	OMIT	OMIT	948000-002	OMIT
-007	—	—	—	—	—
-008	—	—	—	—	—
-009	—	—	—	—	—
-010	150 973530-151	OMIT	OMIT	172181-001	OMIT

TABLE II 6

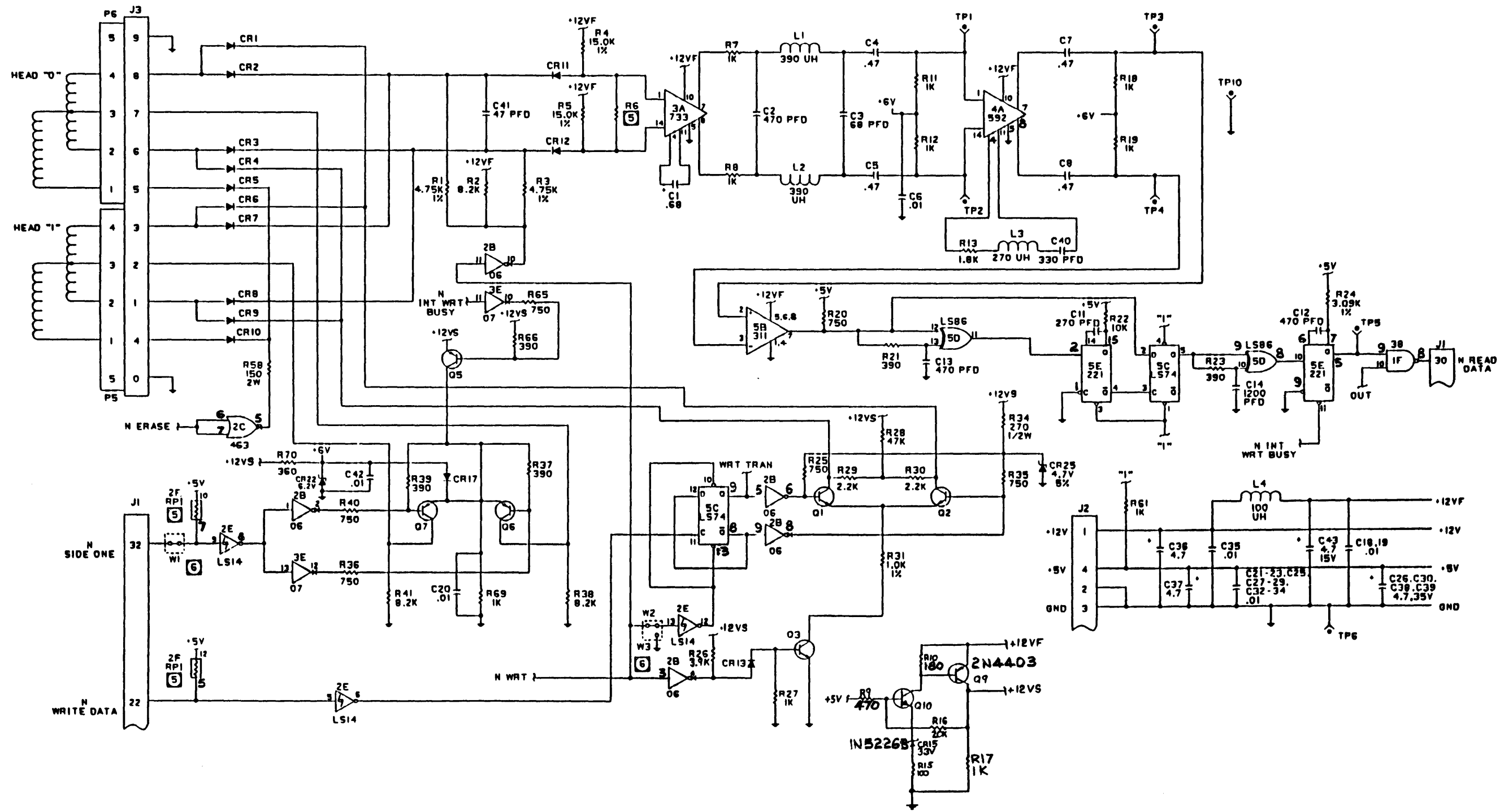
VERSION NUMBER	I/O SIDE SELECT ENABLE	WRITE F/F PRESET CONTROL		WRITE PROTECT DISABLE		ACTIVITY LED CONTROL		I/O DS 3 ENABLE	I/O IN USE ENABLE	I/O DOOR LOCK SOLENOID	DOOR CLOSED SWITCH
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	R74, W11, W12, W13
-001	USE	USE	OMIT	USE	OMIT	USE	OMIT	USE	OMIT	OMIT	OMIT
-002	—	—	—	—	—	—	—	—	—	—	—
-003	USE	USE	OMIT	OMIT	USE	USE	OMIT	USE	OMIT	OMIT	OMIT
-004	USE	USE	OMIT	USE	OMIT	OMIT	USE	USE	USE	USE	OMIT
-005	OMIT	OMIT	USE	USE	OMIT	USE	OMIT	OMIT	OMIT	OMIT	OMIT
-006	USE	USE	OMIT	USE	OMIT	USE	OMIT	USE	OMIT	OMIT	USE
-007	—	—	—	—	—	—	—	—	—	—	—
-008	—	—	—	—	—	—	—	—	—	—	—
-009	—	—	—	—	—	—	—	—	—	—	—
-010	USE	USE	OMIT	USE	OMIT	USE	OMIT	USE	OMIT	OMIT	OMIT

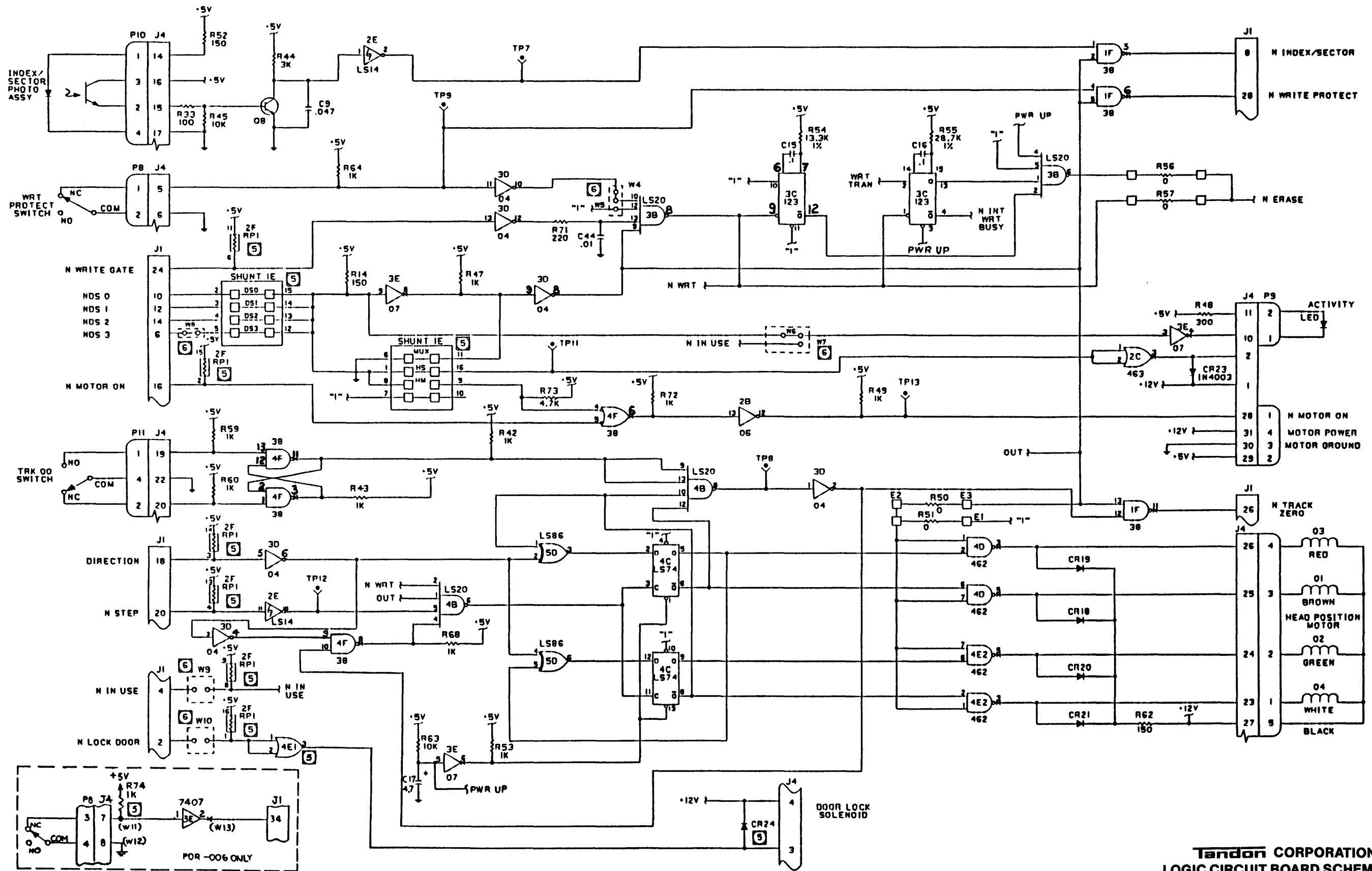
6 FOR OPTION JUMPER CONFIGURATION, REFER TO TABLE II.

5 FOR VALUE, PART NUMBER AND USAGE OF COMPONENTS AFFECTED BY VERSION NUMBER SEE TABLE 1.

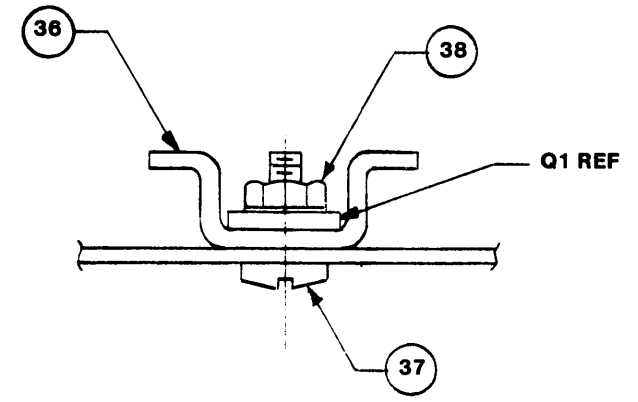
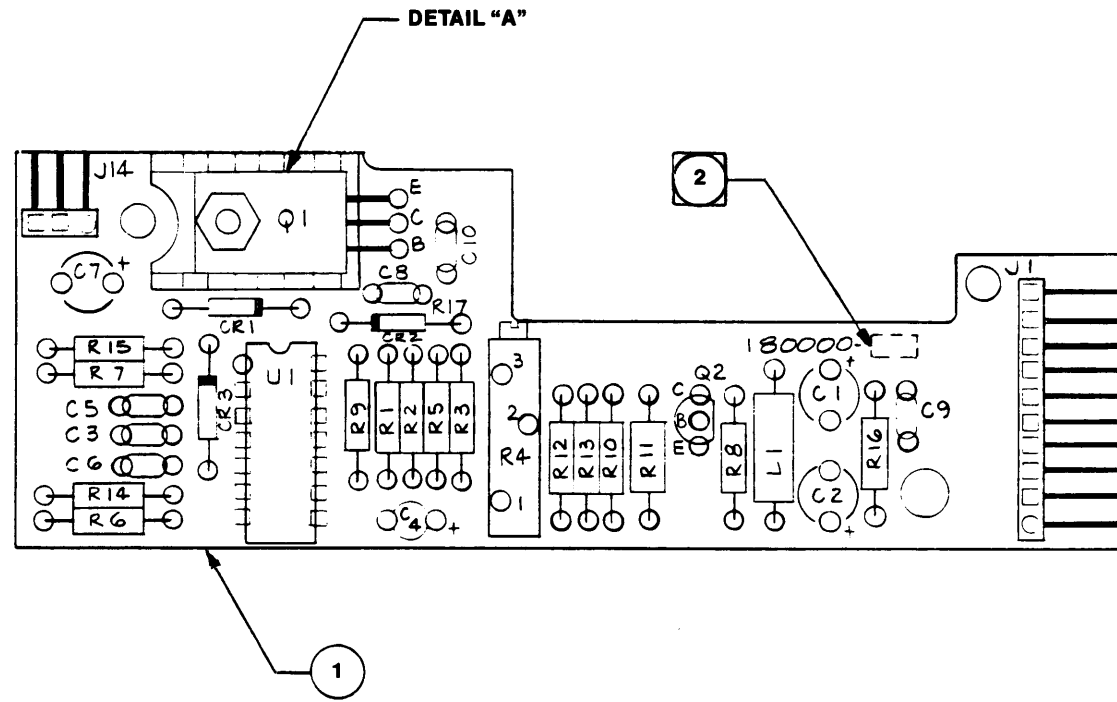
4. ALL TRANSISTORS NPN ARE 2N4124 & PNP ARE 2N4125.
3. ALL DIODES ARE IN4446.
2. ALL CAPS ARE IN  $\mu$ FD.
1. ALL RESISTORS ARE IN OHMS, 1/4W,5%.

REF DESIGNATION LAST USED	REF DESIGNATION NOT USED
L4	C10
R74	C24
W13	C31
C44	Q4
Q10	
CR25	R46
Y13	R67
	R32
	CR16
	CR14





Tandon CORPORATION  
 LOGIC CIRCUIT BOARD SCHEMATIC  
 180011 REV F  
 SHEET 3 OF 3  
 B-6



**3** **DETAIL "A"**  
SCALE: NONE

PART NUMBER	VERSION CHARACTERISTICS
180000-001	MOTOR START OPTION
180000-002	STANDARD
180000-003	MOTOR START OPTION PLUS ISOLATED GND
180000-004	GND

- 4. VENDOR TO MARK BOARD PERMANENTLY WITH VENDOR IDENTIFIER.
- 3** TRANSISTOR MOUNTING. TORQUE TO 4.7 INCH - LBS. ± 10%.
- 2** MARK VERSION NUMBER, REVISION LETTER AND DATE CODE IN AREA SHOWN ON COMPONENT SIDE.
- 1. ASSEMBLE PER STANDARD MANUFACTURING METHODS.

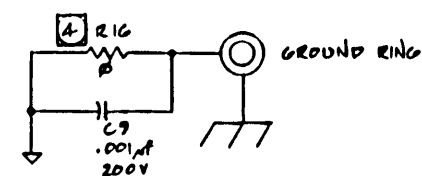
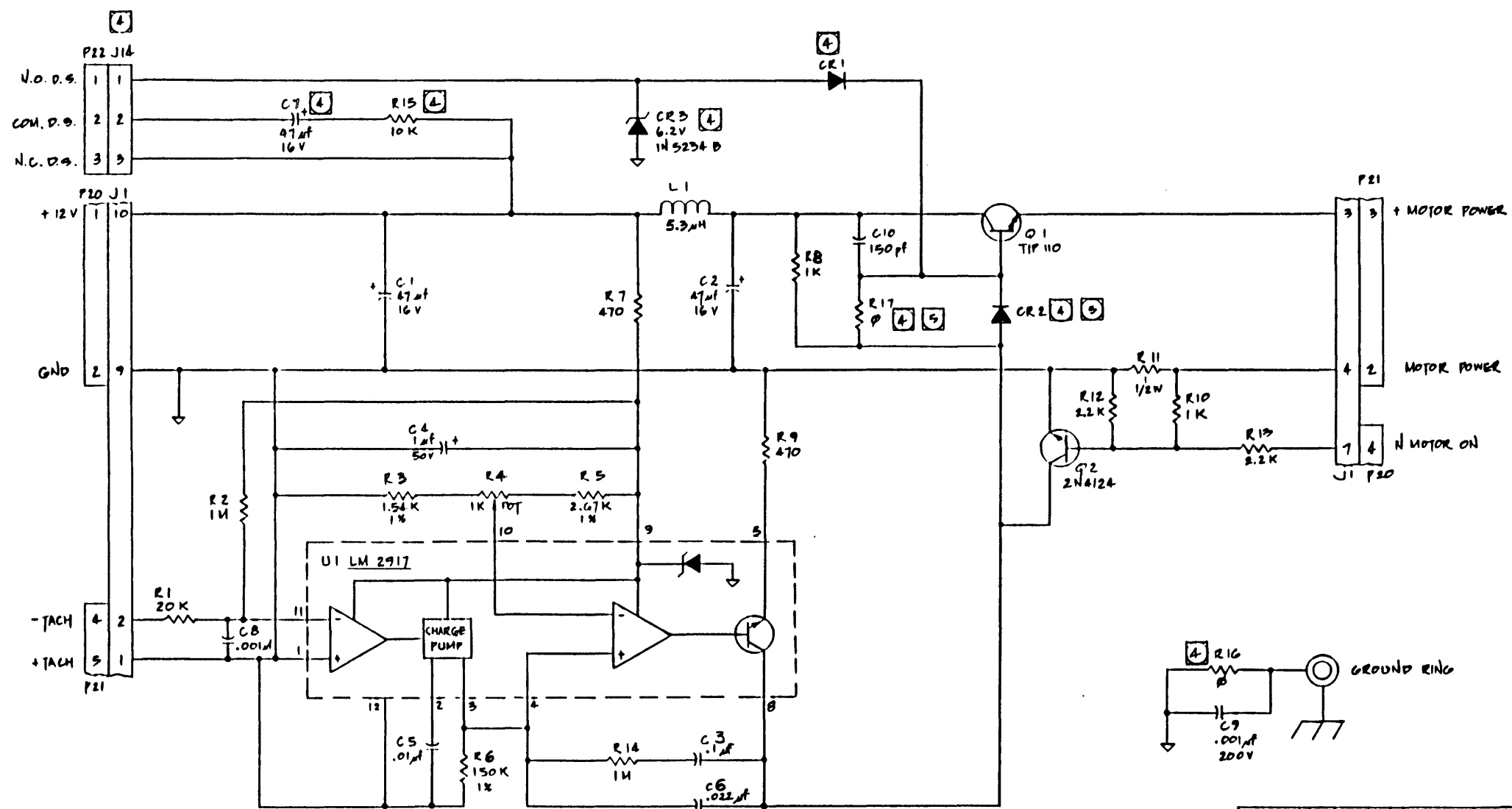


TABLE I 4

PART NR	VERSION CHARACTERISTIC	J 14	CR 1	CR 2	R 15	R 17	C 7	R 16	CR 3
180000-001	MOTOR START OPTION	USE	USE	USE	USE	OMIT	USE	USE	USE
180000-002	STANDARD	OMIT	OMIT	OMIT	OMIT	USE	OMIT	USE	OMIT
180000-003	MOTOR START OPTION PLUS ISOLATED GND	USE	USE	USE	USE	OMIT	USE	OMIT	USE
180000-004	GND ISOLATION	OMIT	OMIT	OMIT	OMIT	USE	OMIT	OMIT	OMIT

5 CR 2 & R17 SHARE THE SAME MOUNTING HOLES, THUS, THEY CANNOT BE USED SIMULTANEOUSLY. REFER TO TABLE I FOR USAGE.

4 FOR PART NO. & USAGE OF COMPONENTS AFFECTED BY VERSION NR, SEE TABLE I.

3. DIODES ARE IN 4446.
2. 1% RESISTORS ARE 1/8 W.
1. RESISTOR VALUES ARE IN OHMS, 5%. 1/4 W.

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PRINTED IN U.S.A.

P/N 179022-001B (T5012B 7-83)