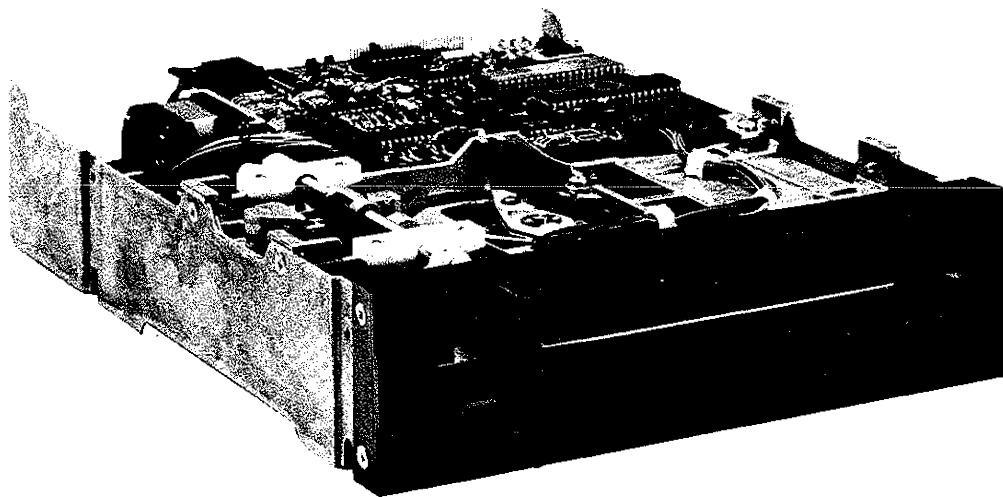


OEM
OPERATING AND SERVICE MANUAL
TM848-1E AND TM848-2E
THINLINE™ FLEXIBLE DISK DRIVES
48 TRACKS PER INCH



Tandon CORPORATION
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SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

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

Tandon Corporation's Model Numbers TM848-1E and TM848-2E, eight-inch flexible drives are full-feature, microprocessor-controlled drives. They may be installed in one-half the space normally required for an eight-inch drive. They are compact data storage devices that use an IBM-formatted, industry standard, eight-inch diskette. Both drives are 48 tracks per inch recording devices.

The Model TM848 series of drives are capable of reading and writing in single-density format on a diskette, using a proprietary read/write head patented by Tandon. In addition, both drives have a double density capability when Modified Frequency Modulation (MFM) or other appropriate recording techniques are used. The encoding and decoding of the data is done by the user's controller. The Model TM848-1E drive uses one side of the diskette for data storage. The Model TM848-2E drive doubles data storage capabilities by using both sides of the diskette.

1.1 SCOPE OF THE DOCUMENT

This document contains a description of the major features, physical and functional specifications, mounting and power requirements, the interface, and typical timing characteristics of the TM848-1E and TM848-2E 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 TM848-1E and TM848-2E 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

MICROPROCESSOR CONTROL

The TM848-1E and TM848-2E drives feature an onboard microprocessor providing six major features:

1. Buffered seek capabilities.
2. Improved head positioning accuracy with reduced hysteresis.
3. Write current switching for optimal data recording quality.
4. True Ready signal.
5. Internal diagnostics (strappable).
6. Power on self-tests.

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.

ACTIVITY INDICATOR

An activity indicator, located on the front panel, is automatically illuminated when the drive is selected. This front panel L.E.D. is also used as an indicator in the diagnostic mode.

DIRECT DRIVE, BRUSHLESS D. C. MOTOR

The spindle motor is a crystal controlled, direct drive, brushless D. C. motor for improved motor start time, and speed accuracy.

COMPACT SIZE

The reduced size of the drive occupies only one-half the mounting space required for a conventional drive.

DISKETTE LEVER LOCK SOLENOID (OPTIONAL)

The diskette lever lock solenoid is controlled by the host system.

1.4 FUNCTIONAL DESCRIPTION

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

The TM848-1E is a single-sided drive. The TM848-2E is a double-sided drive. The only difference between the two drives is the number of heads. The circuit board is identical for both models.

When the diskette lever is opened, access is provided for the insertion of a diskette. The diskette's jacket is accurately positioned by plastic guide rails. Its location is ensured by the back stop and disk ejector.

Closing the diskette lever activates the cone/clamp system, resulting in accurate centering and clamping of the diskette to the drive hub. The drive hub is driven at a constant speed of 360 RPM by a crystal-controlled, direct drive, brushless D. C. motor. The head is loaded into contact with the recording medium whenever the diskette lever is latched.

The heads are positioned over the desired track by means of a stepper motor/band assembly and its associated electronics. This positioner uses a 3.6 degree rotation to cause a one track linear movement.

When a write-protected diskette is inserted into the drive, the Write Protect sensor disables the write electronics of the drive, and a Write Protect status output signal is available to the interface. When performing a write operation, a 0.013-inch wide, nominal, data track is recorded. Then, this track is tunnel erased to 0.012-inch, nominal.

Data recovery electronics include a low-level read amplifier, filter, differentiator, zero crossover detector, and digitizing circuits. No data-clock separation is provided.

In addition, the drive is supplied with the following sensor systems:

1. A Track 0 sensor detects when the Head/Carriage Assembly is positioned over Track 0.
2. The TM848-2E has two index sensors, each consisting of an infrared L.E.D. light source and a phototransistor, positioned to generate a signal when an index hole on the diskette is detected. The drive can determine if a single-sided or double-sided diskette is installed. This output signal is present at the interface.
3. A Write Protect sensor disables the write electronics when a write-enable tab is removed from the diskette.

SELF-TESTS

The drive conducts a power on self-test as part of the normal power on sequence. The two power on tests do not require a diskette to be inserted. These tests are: the head carriage stepping in (away from Track 0), and the head carriage stepping out (toward Track 0). Failure of either of these tests is indicated on the front panel L.E.D. by the following flashing sequence:

- 3 flashes, then 2: Fails to step in from Track 0 or Track 0 sensor is always equal to zero.
- 3 flashes, then 3: Fails to step out to Track 0 or Track 0 sensor is always equal to one.

A third test monitors the index sensors whenever the diskette lever is closed. A diskette must be inserted into the drive for this test. If the diskette lever is closed without a diskette in place, or the spindle motor fails to operate, an error message flashes on the front panel L.E.D. in the following sequence:

3 flashes, then 4: No index pulse with lever closed.

Opening and closing the diskette lever is required to repeat a test that has failed. The diskette lever must be left open for one complete error message cycle.

1.5 PHYSICAL DESCRIPTION

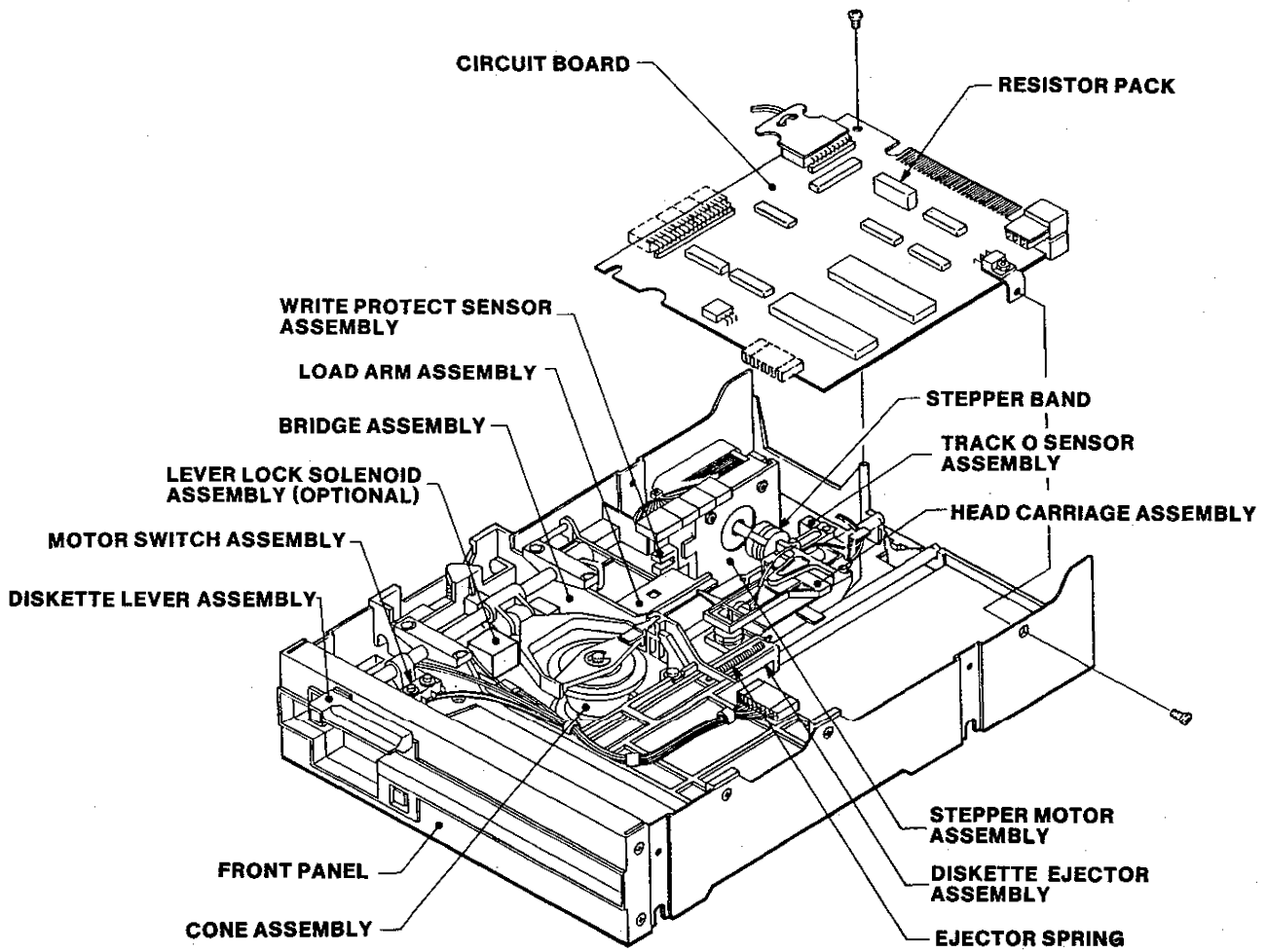
A representative drive is shown in Figure 1-1. The drive can be mounted in a vertical or horizontal plane. However, the logic circuit board must be on the uppermost side when the drive is mounted horizontally.

The spindle is rotated by a direct drive, brushless D. C. motor with an integral tachometer. The crystal-controlled servo circuit and tachometer control the speed of the spindle.

Operator access for diskette loading is provided via a horizontal slot located at the front of the drive.

The read/write double-head assembly is positioned by a split band positioner mounted to a microprocessor-controlled stepper motor. The read/write heads are glass-bonded, ferrite/ceramic structures with a life expectancy of 15,000 operating hours.

The control electronics of the drive are mounted on a printed circuit board located above the chassis. Power and interface signals are routed through connectors plugging directly into the logic circuit board. A second circuit board, mounted under the drive, operates the brushless D. C. spindle motor.



**FIGURE 1-1
DISK DRIVE**

SECTION 2

PRODUCT SPECIFICATIONS

INTRODUCTION

This section contains the mechanical, electrical, reliability, and environmental specifications for the TM848-1E and TM848-2E drives.

2.1 MECHANICAL SPECIFICATIONS

Figure 2-1 contains the physical dimensions of the drive.

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

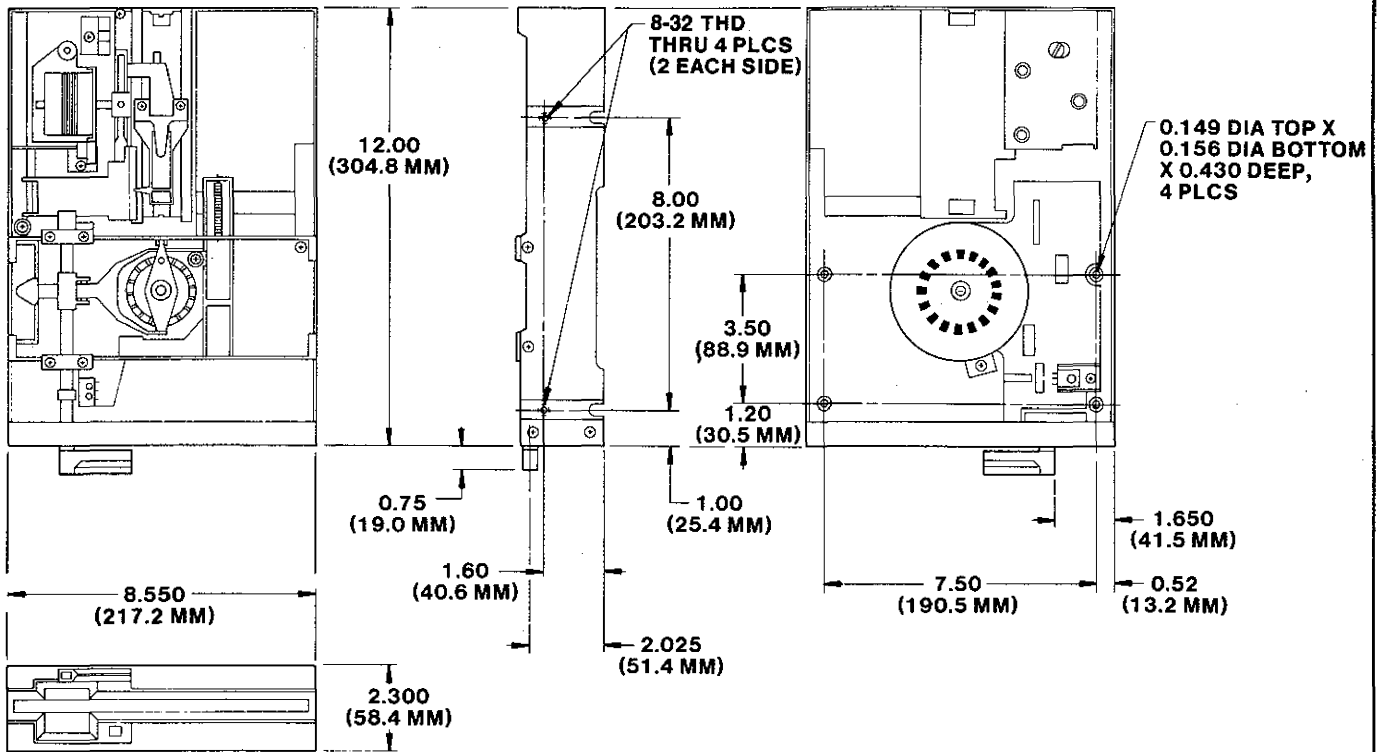
The environmental specifications are located in Table 2-3.

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- NOTES: 1. DIMENSIONS ARE GIVEN IN INCHES. METRIC EQUIVALENTS ARE IN PARENTHESES.
 2. TOLERANCE ON ALL DIMENSIONS IS $\pm .020$ INCH ($\pm .508$ MM).
 3. WEIGHT IS APPROXIMATELY 5.7 POUNDS.

FIGURE 2-1
 DISK DRIVE OUTLINE DRAWING

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

Media	203.20 millimeter, 8-inch, IBM industry- standard diskette
Media Life (for reference only)	3×10^6 passes per track
Tracks Per Inch	48 TPI, both drives
Tracks Per Drive	
TM848-1E	77 tracks per drive
TM848-2E	154 tracks per drive, 77 per side
Track Spacing	0.529 millimeter, 20.8 milinches
Inside Track Radius	
Both Drives, Side 0	51.50 millimeters, 2.03 inches
TM848-2E, Side 1	49.42 millimeters, 1.95 inches
Outside Track Radius	
Both Drives	91.75 millimeters, 3.61 inches
TM848-2E, Side 1	89.64 millimeters, 3.53 inches
Head Life	15,000 media contact hours
Disk Rotational Speed, microprocessor controlled	360 RPM \pm 1.5 percent
Instantaneous Speed Variation (ISV)	\pm 1 percent
Motor Start Time	150 milliseconds, maximum
Seek Time, track to track	3 milliseconds, minimum
Head Settling Time	15 milliseconds
Average Track Access Time, including head settling time	91 milliseconds
Data Transfer Rate	500,000 bits per second

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

<p>Flux Reversals Per Inch (FRPI), inside track</p> <p>Both Drives, Side 0</p> <p>TM848-2E, Side 1</p> <p>Unformatted Recording Capacity</p> <p>TM848-1E</p> <p>TM848-2E</p> <p>D. C. Voltage and Current Requirements</p> <p>+ 24 volts D. C. Power</p> <p>+ 5 volts D. C. Power</p> <p>Typical Current Requirements For + 24 volts D. C.</p> <p>Spindle Motor</p> <p>Stepper Motor</p> <p>Electronics</p> <p>Power Dissipation</p> <p>Shipment</p>	<p>6,536 FRPI</p> <p>6,816 FRPI</p> <p>0.8 megabyte per disk</p> <p>1.6 megabytes per disk</p> <p>+ 24 volts, ± 10 percent at 700 milliamperes, typical. For surge current requirements, see Figures 2-2 and 2-3.</p> <p>+ 5 volts, ± 5 percent at 450 milliamperes, typical</p> <p>170 milliamperes</p> <p>400 milliamperes</p> <p>130 milliamperes</p> <p>20 watts, typical</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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Configured for stepper motor enabled during motor start, 2.25 amps typical surge.

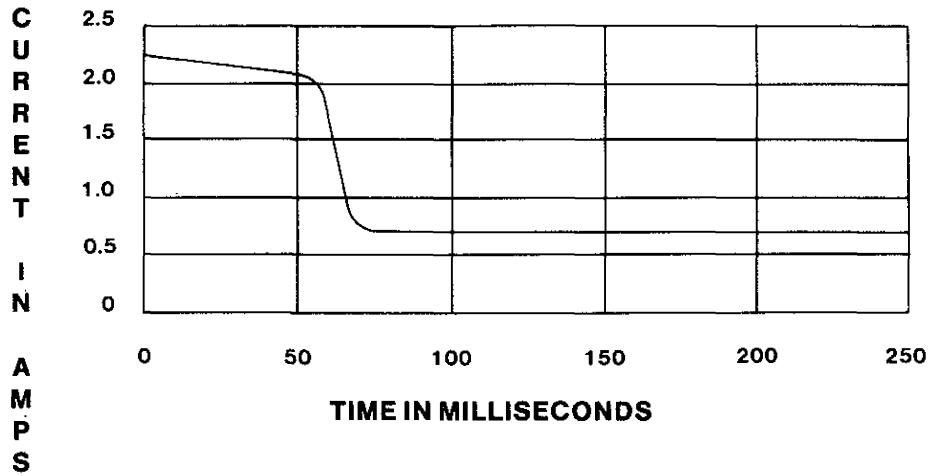


FIGURE 2-2
+24 VOLT D. C. CURRENT, CONFIGURATION 1

Configured for stepper motor disabled until motor comes up to speed, 1.8 amps typical surge.

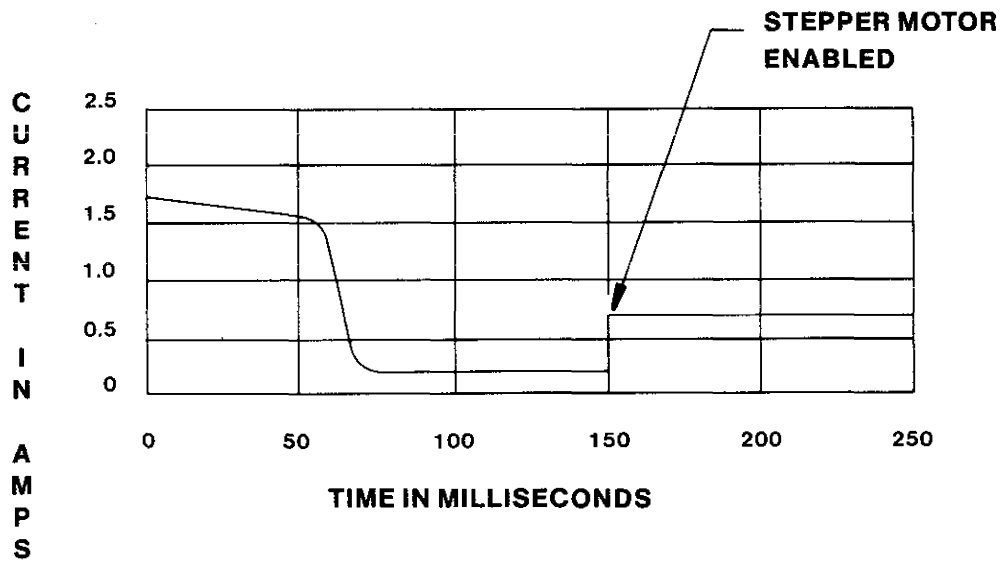


FIGURE 2-3
+24 VOLT D.C. CURRENT, CONFIGURATION 2

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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 10^9 bits</p> <p>One in 10^{12} bits</p> <p>One in 10^6 seeks</p> <p>10,000 power-on hours</p> <p>30 minutes</p>
--	--

**TABLE 2-3
ENVIRONMENTAL SPECIFICATIONS**

<p>Temperature</p> <p>Operating, media dependent</p> <p>Nonoperating</p> <p>Relative Humidity</p> <p>Operating, noncondensing, media dependent</p> <p>Nonoperating, noncondensing</p>	<p>4.4°C to 46°C, 40°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>
---	---

SECTION 3

OPERATION

INTRODUCTION

This section contains information on how to unpack, check out, install, and operate the TM848-1E and TM848-2E 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 that the diskette lever opens and closes.
2. When the lever is moved to an open position, the head arm raises.

3. Remove the cardboard shipping insert, and retain for future shipment.
4. Ensure that the front panel is secure.
5. Ensure that the circuit board is secure.
6. Ensure that the connectors are firmly seated.

3.3 MOUNTING THE DRIVE

The drive has been designed so it may be mounted in any plane, i.e.: upright, horizontal, or vertical. When mounted horizontally, the Logic circuit board side of the chassis must be the top side.

Eight holes are provided for mounting: two on each side and four on the bottom of the housing (see Figure 2-1). The two mounting holes on each side are tapped for 8-32 screws. The four mounting holes on the bottom require 8-32 thread forming screws. When installed in either plane, horizontal or vertical, only two mounting screws are required to securely hold the drive in place.

Optional straps are available to permit two drives to be attached together for installation in standard width drive openings.

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 20 watts, 68 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 boards, 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 TM848-1E and TM848-2E are made via a user-supplied, fifty-pin, flat ribbon connector, 3M Scotchflex, Part Number 3415, or its equivalent. This connector mates directly with the circuit board 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, Section 3.5 of this manual.

The signal wire harness should be of the flat ribbon or twisted pair type, have a maximum length of ten feet, and have a 26-to-28 gauge conductor compatible with the connector to be used. It is recommended that the interface cable have a characteristic impedance of 100 ohms.

All interface signals are TTL compatible. Logic true (low) is +0.4 volt maximum. Logic false (high) is +2.4 volts minimum.

INPUT CONTROL LINES

These input lines are individually terminated through a 150 ohm resistor pack installed in the dip socket located at RP1. In a single-drive system, this resistor pack should be installed to provide the proper terminations. In a multiple-drive system, only the last drive on the interface is to be terminated. All other drives on the interface must have the resistor pack removed.

The drive can terminate the following input lines:

1. Direction
2. Step
3. Write Data
4. Write Gate
5. In Use
6. Side Select (TM848-2E only)
7. Write Current Switch
8. Head Load

MOTOR ON CONTROL

The Motor On Control lines are used to control the spindle motor. With the MOL jumper in (factory installed), the Motor On Control lines are low true. With the MOH jumper installed (optional), the Motor On Control lines are high true (see Table 3-3 located in Section 3.6).

DRIVE SELECT LINES

The Drive Select lines provide a means of selecting and deselecting a drive. These four lines, DS1 through DS4, allow independent selection of up to 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 to Read/

**TABLE 3-1
DRIVE INTERFACE LINES AND PIN ASSIGNMENTS**

Ground	Pin	Signal
1	2	Write Current Switch
3	4	Motor On Control 1
5	6	Motor On Control 2
7	8	True Ready (Motor On Control 3, Optional)
9	10	Two Sided (Strappable) (TM848-2E only)
11	12	Disk Change (Strappable)
13	14	Side Select (TM848-2E only)
15	16	In Use Indicator (Strappable)
17	18	Head Load Line/Motor Control
19	20	Index
21	22	Ready
23	24	Motor On Control 4
25	26	Drive Select 1 (Side Select Option, TM848-2E only)
27	28	Drive Select 2 (Side Select Option, TM848-2E only)
29	30	Drive Select 3 (Side Select Option, TM848-2E only)
31	32	Drive Select 4 (Side Select Option, TM848-2E only)
33	34	Direction Select (Side Select Option, TM848-2E only)
35	36	Step
37	38	Write Data
39	40	Write Gate
41	42	Track 0
43	44	Write Protect
45	46	Read Data
47	48	Alternate I/O
49	50	Alternate I/O

Write commands. When the signal logic level is false (high), the input control lines and the output status lines are disabled.

The Drive Select address is determined by a select shunt on the circuit board. Drive Select lines 1 through 4 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 might result 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. A Drive Select line must remain stable in the true (low) state until any operation in progress (Step, Read/Write) is completed.

Using Side Select options 1B through 4B, Drive Select lines may be used as Side Select lines for the TM848-2E (see Section 3.6).

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 one microsecond, 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 1 microsecond prior to the corresponding rising edge of the step pulse, and remain stable 100 nanoseconds after it.

NOTE

TM848-1E and TM848-2E drives include a microprocessor-controlled buffered seek capability. The controller may issue step pulses of one microsecond minimum width, and fifteen microseconds minimum spacing between trailing edges. Internal drive electronics issue step commands at a rate of three milliseconds.

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

1. The Write Gate is true (low).
2. The Direction Select is false (high), and the head is positioned at Track 0.
3. The drive is not selected.
4. When trying to seek beyond Track 76.
5. When the diskette lever is opened.

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, 250 kilohertz ± 0.1 percent. The repetition of the high-to-low transitions while writing all ones should be equal to the maximum data rate, 500 kilohertz ± 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 125 nanoseconds for systems using MFM double density recording format.

WRITE GATE

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 Gate 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 Gate or Side Select lines. With the NP jumper installed, a diskette cannot be write protected.

NOTE

Changes of state of the Write Gate line should occur before the first Write Data pulse.

IN USE

This strappable feature controls the lever lock solenoid when the DL option is installed.

WRITE CURRENT SWITCH

Normally, Write Current switching is accomplished by the host controller. A true (low) level on this line reduces the Write Current. Using option IC, the drive automatically reduces Write Current at Track 43.

SIDE SELECT

The Side Select interface line, available only on Tandon's TM848-2E, defines which side of a two-sided diskette is used for reading or writing. An open circuit, false (high) level

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. When switching from one head to the other, a 100 microsecond delay is required before any Read or Write operation can be initiated.

HEAD LOAD LINE/MOTOR CONTROL

This line may be used to control the spindle motor and/or the lever lock solenoid (see Section 3.6).

OUTPUT CONTROL LINES

There are eight output lines, five of which are standard and three of which are strappable features. The standard output signals are: Index/Sector, Track 0, Write Protect, Read Data, and Ready. The strappable output signals are Disk Change, Two-Sided, and True Ready.

INDEX

The Index signal represents the output of the Index sensor. An Index pulse is provided once every revolution, 166.67 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 line remains in the true (low) state for the duration of the Index pulse, which is nominally four milliseconds.

TRACK 0

When the drive is selected, the Track 0 interface signal indicates to the controller that the Read/Write head is positioned on Track 0, the outermost track. This signal remains true (low) until the Read/Write head is moved away from Track 0. This signal is false (high) when the selected drive's Read/Write head is not on Track 0.

WRITE PROTECT

The Write Protect signal is provided to indicate to the user that a write protected diskette is installed. This signal is true (low) when the diskette's Write Protect notch is uncovered. When the Write Protect signal is false (high), the write electronics are enabled, and write operations can be performed.

READ DATA

The Read Data line transmits data to the controller when the drive is selected and not writing. It provides a pulse for each flux transition recorded and detected on the diskette by the drive electronics. Normally, this signal is false (high). It becomes true (low) for the active state. The Read Data output line goes true (low) for a duration of 200 nanoseconds, ± 50 nanoseconds, for each change recorded on the diskette.

READY

The Ready interface signal indicates a diskette has been inserted into the drive. Ready will not return to the false state until the lever is opened, and is not affected by Spindle Motor Control.

When a single-sided diskette is installed, Ready is active (low) if side zero is selected. Ready is false (high) if side one is selected on the TM848-1E. When a two-sided diskette is installed, Ready is active when either side of the diskette is selected on the TM848-2E.

TRUE READY

The True Ready interface signal indicates the diskette is rotating at 360 RPM, and a seek operation is complete, i.e., the head has settled. This may be used to indicate seek complete when using the buffered seek operation.

NOTE

This is a strappable feature with the Motor Control 3 input signal line.

DISK CHANGE

This strappable feature provides a true (low) signal to the interface when Drive Select is activated if the drive has gone from a Ready to a Not Ready condition while deselected. This line is reset on the true-to-false transition of Drive Select if the drive has gone to a Ready condition.

TWO-SIDED

This option is available only on Model TM848-2E. True (low) indicates that a two-sided diskette is installed.

TYPICAL INTERFACE CHARACTERISTICS

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

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

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

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

3.5 D. C. POWER

D. C. power is supplied to the drive through a six-pin AMP connector, J2, mounted on the circuit board. The mating connector, not supplied, is AMP Part Number 1-480270-0, using AMP contact Part Number 606191-1. Pin assignments are found in Table 3-2.

The chassis should be connected to earth ground to ensure proper operation.

Pin	Supply Voltage
1	+24 volts D. C.
2	24 volts Return
3	5 volts Return
5	+5 volts D. C.
6	Return

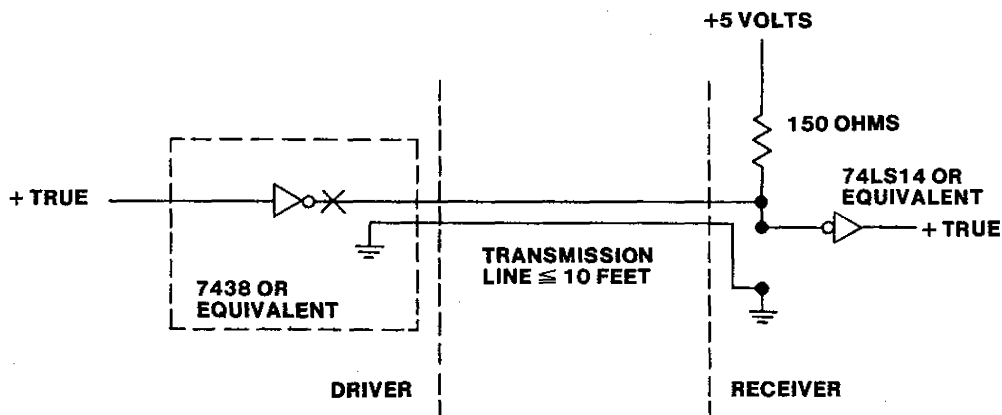
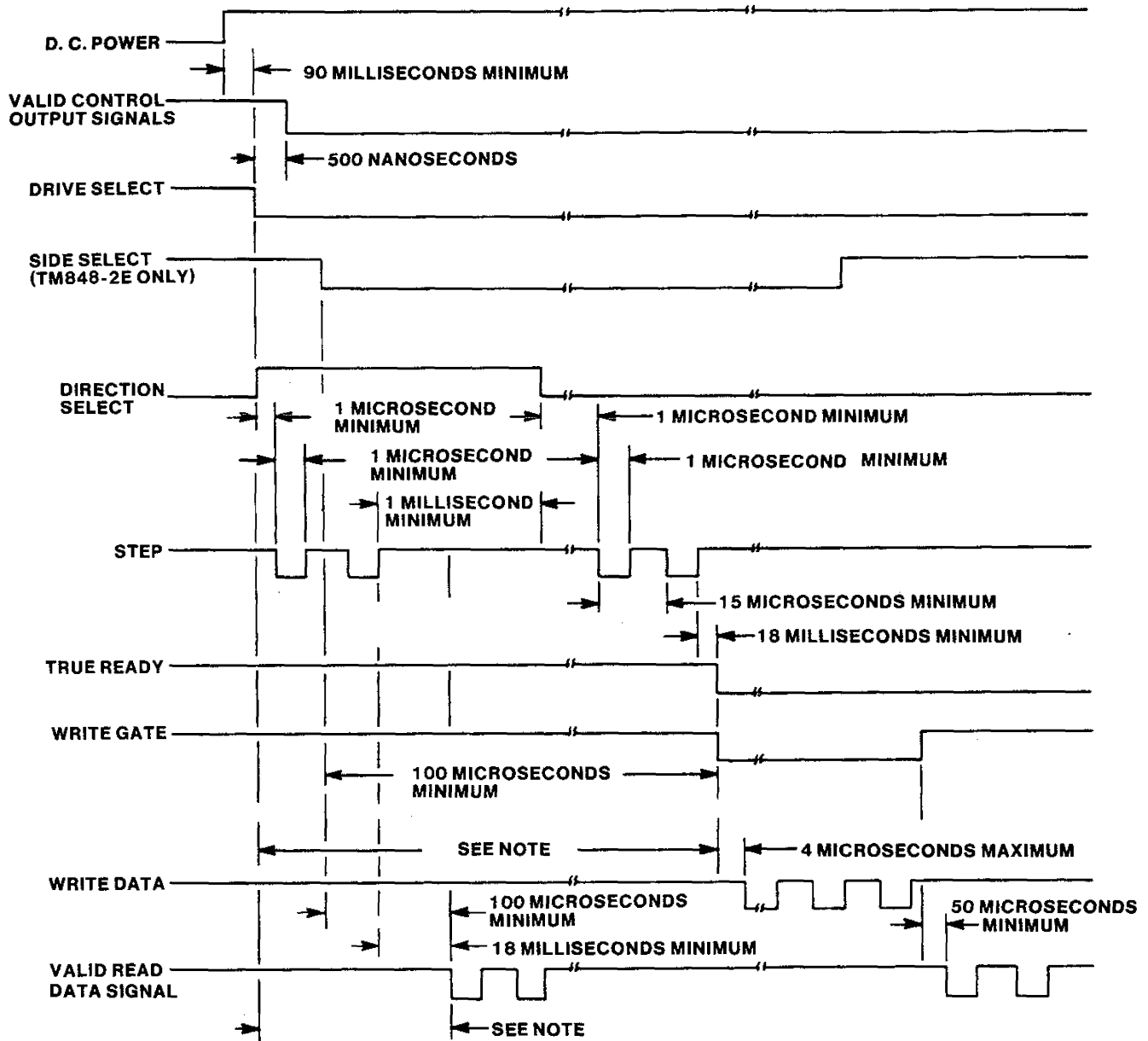


FIGURE 3-1
ELECTRICAL INTERFACE CHARACTERISTICS



NOTE: 150 MILLISECONDS, MINIMUM, DELAY MUST BE INTRODUCED AFTER DRIVE SELECT TO ALLOW TIME FOR THE D.C. MOTOR TO REACH 360 RPM OR THE OPTIONAL TRUE READY LINE MUST BE MONITORED.

FIGURE 3-2
CONTROL AND DATA TIMING REQUIREMENTS

3.6 DRIVE ADDRESS AND OPTION STRAPPING

The drive address and option strapping is determined by the different jumper configurations required for specific system applications. If jumper configurations are changed, power should be cycled off and on so the microprocessor can recognize the new configuration.

The description of user-selectable options should be used in conjunction with Table 3-3.

Throughout Section 3.6, an X denotes jumper installation, and a dash denotes jumper removed.

DRIVE SELECT (DS1—DS4)

This option allows the user to daisy chain up to four drives, and to enable one drive at a time. Drive Select is implemented by shorting one of the four connections, using a shorting plug. The drive comes equipped from the factory with DS1 installed. All outputs are gated with drive select, as set-up at the factory.

NOTE

The terminator resistor pack RPI, 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 resistor packs removed.

HEAD SELECT USING DIRECTION SELECT

During a Read or Write operation, the state of the Direction Select line is undefined. Hence, it may be used to select the desired head. A high enables Head 0. A low enables Head 1. To incorporate this option, etch cut S2 and install S1.

S1	S2	S3	1B	2B	3B	4B	HEAD SELECT
—	X	—	—	—	—	—	Head Select via J1-14.
—	—	X	X	—	—	—	Head Select via J1-26.
—	—	X	—	X	—	—	Head Select via J1-28.
—	—	X	—	—	X	—	Head Select via J1-30.
—	—	X	—	—	—	X	Head Select via J1-32.
X	—	—	—	—	—	—	Head Select via J1-34.

DS1 DS2 DS3 DS4 DRIVE SELECT

X	—	—	—	Selects Drive 0 via J1-26.
—	X	—	—	Selects Drive 1 via J1-28.
—	—	X	—	Selects Drive 2 via J1-30.
—	—	—	X	Selects Drive 3 via J1-32.

HEAD SELECT OPTIONS (S1—S3 and 1B—4B)

The Side Select options allow the user to select the heads by various means. They are implemented by removing the shorting plug from the DS1—DS4 option pads.

HEAD SELECT USING DRIVE SELECT

To use the Drive Select lines to select the heads, etch cut S2 and install S3 along with one of the 1B—4B jumpers. The 1B—4B control signal selected may not be the same control line used for Drive Select, or an undefined condition results. When the control line that corresponds to the Drive Select jumper is driven low (true), the drive is enabled, and the lower head, Head 0, is selected. When the control line that corresponds to the 1B—4B jumper is driven low (true), the drive is enabled, and the upper head, Head 1, is selected.

**TABLE 3-3
OPTION PATCHING**

Option	Trace Designator	As Shipped	
		Installed	Not Installed
Drive Select	DS1—DS4	DS1	DS2—DS4
Head Select	S1—S3	S2	S1, S3
Head Select Using Drive Select	1B—4B		X
Power Save	PS	X	
Stepper Power From Head Load Line	HL		X
Spindle Motor Control	M1, M3, M4	M1, M3	M4
Motor Control Signal, Low True	MOL	X	
Motor Control Signal, High True	MOH		X
Motor Control Select	MC1—MC4		X
Ready	R	X	
True Ready	TR		X
Lever Lock Solenoid	DL		X
In Use, Lever Lock Option	D		X
In Use, Latched	LL		X
In Use, Not Latched	NL	X	
Disk Change	DC	X	
Two-Sided Diskette Installed	2S	X	
Inhibit Write When Write Protected	WP	X	
Allow Write When Write Protected	NP		X
External Write Current Switch	XC	X	
Internal Write Current Switch	IC		X
Diagnostic Mode	DM		X

**STEPPER MOTOR POWER
(PS, PS*, DS, HL)**

When the PS jumper is installed, stepper motor power is controlled by the Drive Select line, DS, or the Head Load line, HL. When either line is true (low), the stepper motor is driven with full power, and is ready for a Seek, Read, or Write operation. When either line is false (high), +5 volt stand-by current is supplied to the stepper motor to hold the head carriage assembly in position. When the PS* option is in, the stepper motor continuously receives full power. PS* is diametrically opposite PS (see Figure 3-3).

PS	PS*	DS	HL	STEPPER POWER
-	X	-	-	Stepper power continuously on.
X	-	X	-	Stepper power on with Drive Select.
X	-	-	X	Stepper power on with Head Load line J1-18.

**SPINDLE MOTOR CONTROL OPTIONS
(M1, M3, M4, MOL, MOH, MC1-MC4)**

M1 is used to enable the motor off delay timer. When this jumper is installed, a five second

turn off delay of the spindle motor is activated on the trailing edge of the Motor Control signal.

With Motor Control using Drive Select or Head Load, the M3 and M4 jumpers determine which method of Motor Control is enabled. If option M3 or M4 jumpers are installed, the Motor On Control, MC1-MC4, options operate in a logical OR manner with the control signal(s) selected by the M3 and M4 jumpers.

NOTE

If the Motor Delay Timer option (M1) is installed, the five second turn off delay is in effect regardless of which M3/M4 configuration is implemented.

M1	M3	M4	MOTOR CONTROL
X	-	-	Enables five-second motor off delay timer.
-	-	-	Motor Control only with MC1-M4 options.
-	X	-	Motor Control using Drive Select.
-	-	X	Motor Control using Head Load.
-	X	X	Motor Control using Drive Select and Head Load, logical AND.

MOL	MOH	MC1	MC2	MC3	MC4	MOTOR CONTROL
X	-	-	-	-	-	Motor Control signals are low (true) active.
-	X	-	-	-	-	Motor Control signals are high (true) active.
X	-	X	-	-	-	Motor Control selected via J1-4.
X	-	-	X	-	-	Motor Control selected via J1-6.
X	-	-	-	X	-	Motor Control selected via J1-8.
X	-	-	-	-	X	Motor Control selected via J1-24.

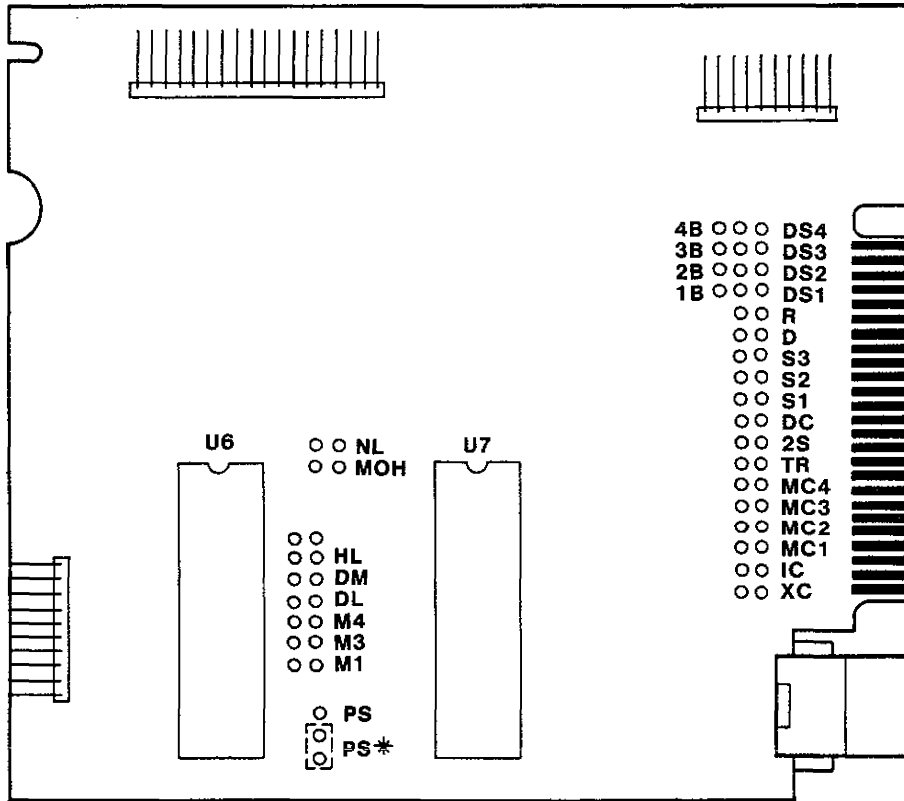


FIGURE 3-3
LSI CIRCUIT BOARD ASSEMBLY

READY AND TRUE READY (R AND TR)

When the R jumper is installed, the Ready signal is available at the interface. When the TR jumper is installed, the True Ready signal is available at the interface.

The R jumper is standard, while the TR jumper is optional. These two lines are independent functions, and may be used separately or together.

R	TR	READY OR TRUE READY
X	—	Ready signal via J1-22.
—	X	True Ready signal via J1-8.

NOTE

When using the True Ready option, Motor Control 3 may not be used.

LEVER LOCK OPTIONS (D, DL, LL, NL)

The lever lock solenoid, an optional feature, can be controlled by the In Use interface line J1-16.

D	DL	LL	NL	LEVER LOCK SOLENOID
—	—	—	—	Latched with Drive Select.
X	X	—	X	Latched by In Use via J1-16, true (low). Active energizes solenoid.
X	X	X	—	Latched by In Use via J1-16. Active low, in conjunction with Drive Select, latches the solenoid. The solenoid remains latched until In Use is false (high) on the leading edge of Drive Select.

DISK CHANGE (DC)

This output is used to indicate to the controller that a disk change has been made. The internal signal is gated with Drive Select. When the lever is opened, the Disk Change line goes low (true), and remains low until the trailing edge of the next Drive Select.

DC	DISK CHANGE
—	Disk Change signal not available.
X	Disk Change signal available via J1-12.

TWO-SIDED DISKETTE INSTALLED (2S)

When a two-sided diskette is installed, internal circuitry gates this signal with Drive Select. It sends a low (true) signal to the controller, indicating that a double-sided diskette is installed (index hole two is present). This option is factory installed.

2S	TWO-SIDED DISKETTE
—	Two-sided diskette signal not available.
X	Two-sided diskette signal available via J1-10.

WRITE PROTECT (WP AND NP)

This WP option is used to lock out the Write Gate when a write protected diskette is installed. It is factory installed.

The NP option allows the controller to write on any diskette, whether or not it is write protected. It does not stop the Write Protect signal from being sent on the interface line. This option is implemented by removing WP, and installing NP.

WP	NP	WRITE PROTECT
X	—	Disables Write Protect, for write protected diskette.
—	X	Allows writing on any diskette.

WRITE CURRENT SWITCH (XC AND IC)

The XC option allows the host controller to switch the Write Current independently of the drive's onboard microprocessor. It is factory installed.

To implement the IC option, remove the XC jumper, then install a jumper at IC.

XC	IC	WRITE CURRENT SWITCHING
X	-	External Write Current switch.
-	X	Microprocessor automatically switches Write Current at Track 43.

DIAGNOSTIC MODE OF OPERATION (DM, DL, M1, M3, M4)

The test programs allow the user to test some aspects of drive operation without the use of special test equipment. The programs allow the user to isolate the problems of the drive. The diagnostic mode provides 16 tests (see Table 3-4).

To enter the diagnostic mode:

1. Make a note of which jumpers are installed for normal operating conditions (see Table 3-3).
2. Remove the DL, M1, M3, and M4 jumpers.
3. Install the DM jumper, and supply power to the drive.
4. Using the DL, M1, M3, and M4 jumpers, select the diagnostic test desired by inserting the jumper according to Table 3-4.

To exit the diagnostic mode:

1. Remove power from the drive.
2. Remove the DM, DL, M1, M3, and M4 jumpers.

3. Reinstall the jumpers in their original configuration.
4. Power on the drive.

3.7 DISKETTES

The TM848-1E and TM848-2E drives use an IBM-compatible, eight-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 3-5 illustrates the diskette used with the drive. This recording media is a flexible diskette enclosed in a protective jacket. The 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, with its head aperture forward, into the front slot of the drive. Access to the diskette loading slot is obtained by opening the front lever.

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 Sensor Assembly. This sensor operates in conjunction with the diskette, which has a slot cut in the protective jacket.

**TABLE 3-4
DIAGNOSTIC MODE OF OPERATION**

DL	M4	M3	M1	Test	Description of Test
-	-	-	-	0	Seek to Track 0, and turn on spindle motor. This test seeks the carriage to Track 0, and turns on the spindle motor. It may be used to check the Track 0 status.
-	-	-	X	1	Seek to Track 1, and turn on spindle motor. This test seeks the carriage to Track 1, and turns on the spindle motor. It may be used for index-to-data burst testing with an alignment diskette.
-	-	X	-	2	Seek to Track 38, and turn on spindle motor. This test seeks the carriage to Track 38. It may be used for radial alignment adjustment with an alignment diskette.
-	-	X	X	3	Alternate seek between Track 0 and Track 76 with spindle motor on. This test continuously moves the carriage between Tracks 0 and 76. This test is used to exercise the positioner system.
-	X	-	-	4	Toggle front panel L.E.D. with each revolution of the disk. This test toggles the front panel L.E.D. at the leading edge of each side zero index pulse. A single-sided disk should be used for this test.
-	X	-	X	5	Toggle front panel L.E.D. with each revolution of the disk. This test toggles the front panel L.E.D. at the leading edge of each side one index pulse. A double-sided disk should be used for this test.
-	X	X	-	6	Seek to Track 76, and turn on spindle motor. This test seeks the carriage to Track 76, and turns on the spindle motor. This test may be used to check index-to-data burst and azimuth.
X	-	-	X	9	Seek to Track 2, and monitor the Track 0 sensor. This test moves the carriage to Track 2, and displays, using the front panel L.E.D., the state of the Track 0 sensor. The Track 0 sensor should change state at Track 2. The L.E.D. is on at Track 0.

**TABLE 3-4 (CONTINUED)
DIAGNOSTIC MODE OF OPERATION**

DL	M4	M3	M1	Test	Description of Test
X	—	X	—	10/A	Monitor the write protect sensor. This test checks the write protect sensor. The front panel L.E.D. should turn on and off by moving a disk, which has the write protect notch covered, in and out of the drive. The L.E.D. is on when write protect is true.
X	X	—	—	12/C	Monitor the status of the lever position switch. This test is used to check the lever position switch. The front panel L.E.D. flashes on and off with the opening and closing of the diskette lever position switch. The L.E.D. is on when the lever is closed.
X	X	X	X	15/F	Flash version number. This test outputs the firmware version number to the front panel L.E.D.

Notes: X = Jumper In
— = Open

When the slot is covered with an optically opaque, self-adhesive tab, the diskette is write enabled. When the tab is removed, the diskette is write protected.

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 heads.

Figure 3-4 contains an illustration of the physical configuration of the diskette. The 7.88-inch diskette is oxide-coated, flexible mylar. It is enclosed in an eight-inch square protective jacket. In addition, openings for the drive hub and diskette index hole are provided.

Figure 3-5 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 procedure 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 approximately three inches from a typical source, e.g., motors, generators, or transformers.

3. To avoid warping the diskette, do not store it 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.

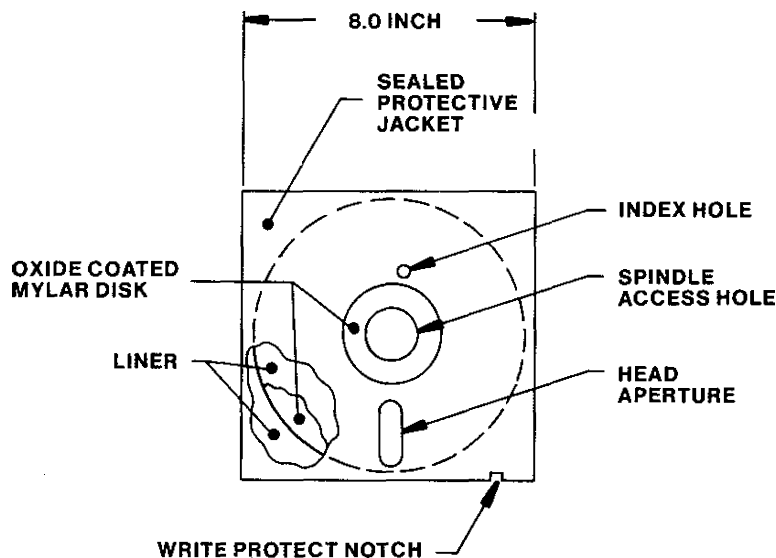
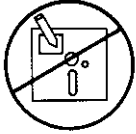
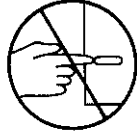


FIGURE 3-4
RECORDING MEDIA



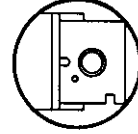
DO NOT WRITE ON THE DISKETTE WITH PEN OR PENCIL. USE A FELT TIPPED PEN.



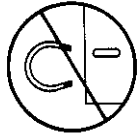
DO NOT TOUCH PRECISION SURFACE WITH YOUR FINGERS.



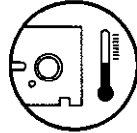
TO AVOID DAMAGE TO THE DISKETTE AND DRIVE, INSERT DISKETTE CAREFULLY UNTIL THE BACKSTOP IS ENCOUNTERED.



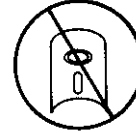
RETURN THE DISKETTE TO ITS JACKET WHEN NOT IN USE.



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 3-5
DISKETTE CARE AND HANDLING**



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 frequency modulation (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.

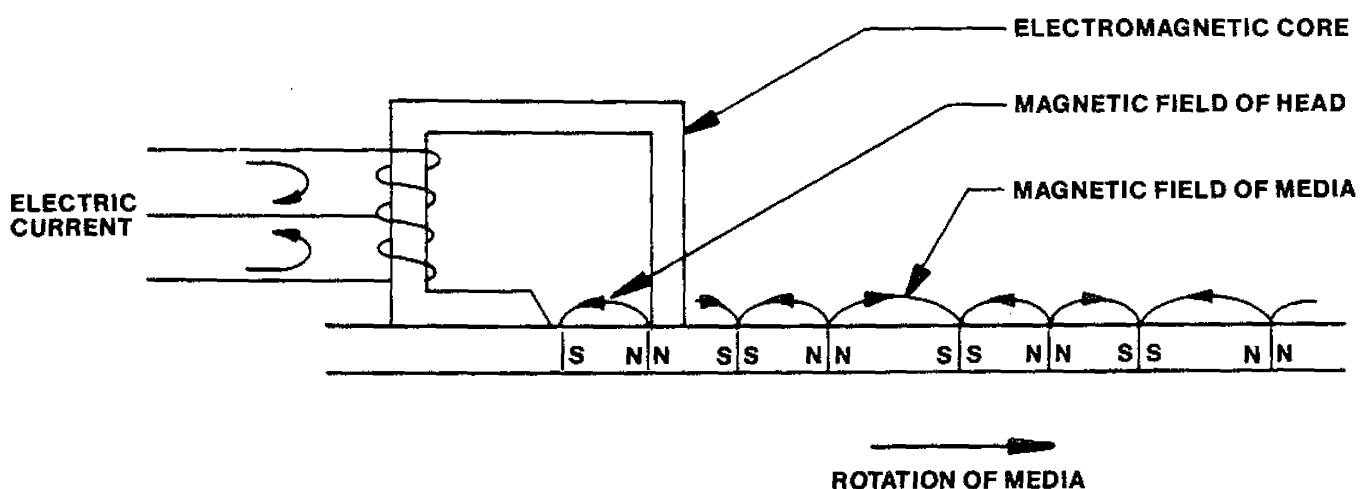
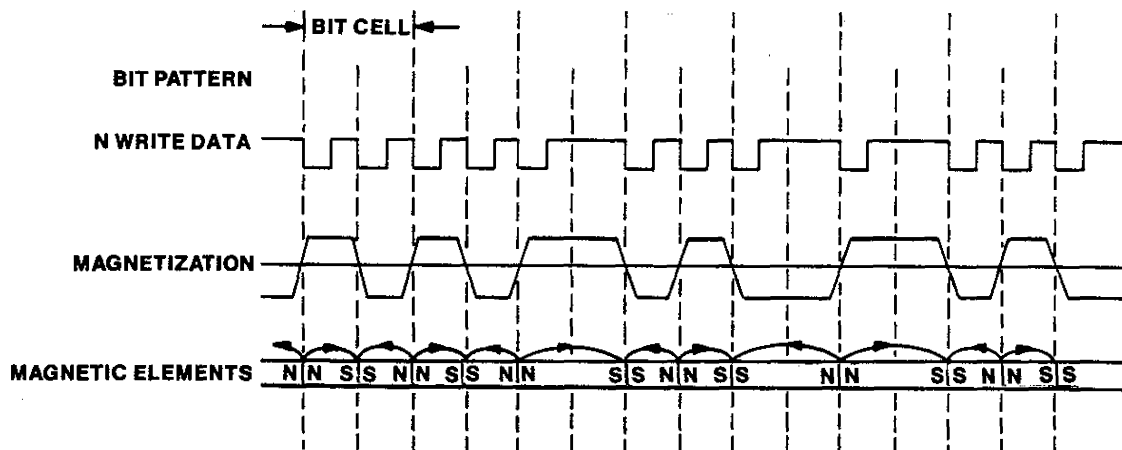


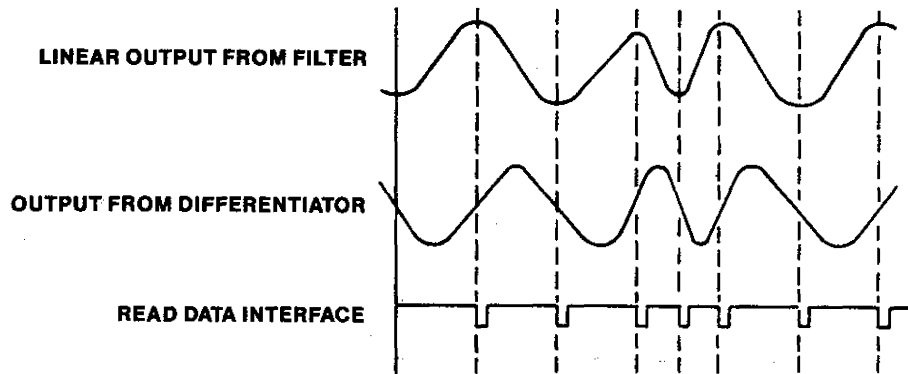
FIGURE 4-1
ELECTROMAGNETIC CORE



**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).



**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 and status 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 multi-pin connectors (Figure 4-4). This allows the individual assemblies to be removed.

All major functions, other than the read data circuits, and part of the write data circuits, are monitored by the LSI chip and the microprocessor. The microprocessor generates the required output status signals and controls the functions of the drive.

4.3 GENERATE AND INTERPRET CONTROL AND STATUS SIGNALS

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

1. Index Sensor(s)
2. Write Protect Sensor
3. Track 0 Switch
4. Lever Closed Switch
5. Lever Lock Solenoid

INDEX SENSOR(S)

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 Test Point 1, for index number two sensor, and Test Point 2 for index number one sensor.

This signal is supplied to the microprocessor for timing. It is also gated internally in the LSI chip with drive select for an output control signal at the interface (Figure 4-5).

WRITE PROTECT SENSOR

When a write protected diskette is installed, light from the write protect L.E.D. is detected by the write protect sensor transistor, causing the output of the sensor to be high at Test Point 5. The signal, gated internally in the LSI chip with DR SEL +, generates the Write Protect signal. If a write protected diskette is inserted, write gate is disabled.

TRACK 0 SENSOR

The Track 0 sensor signal is derived from an optical sensor internal to the drive. As the head carriage moves back toward Track 0, the sensor is deactivated between Tracks 1 and 2 (Figure 4-6).

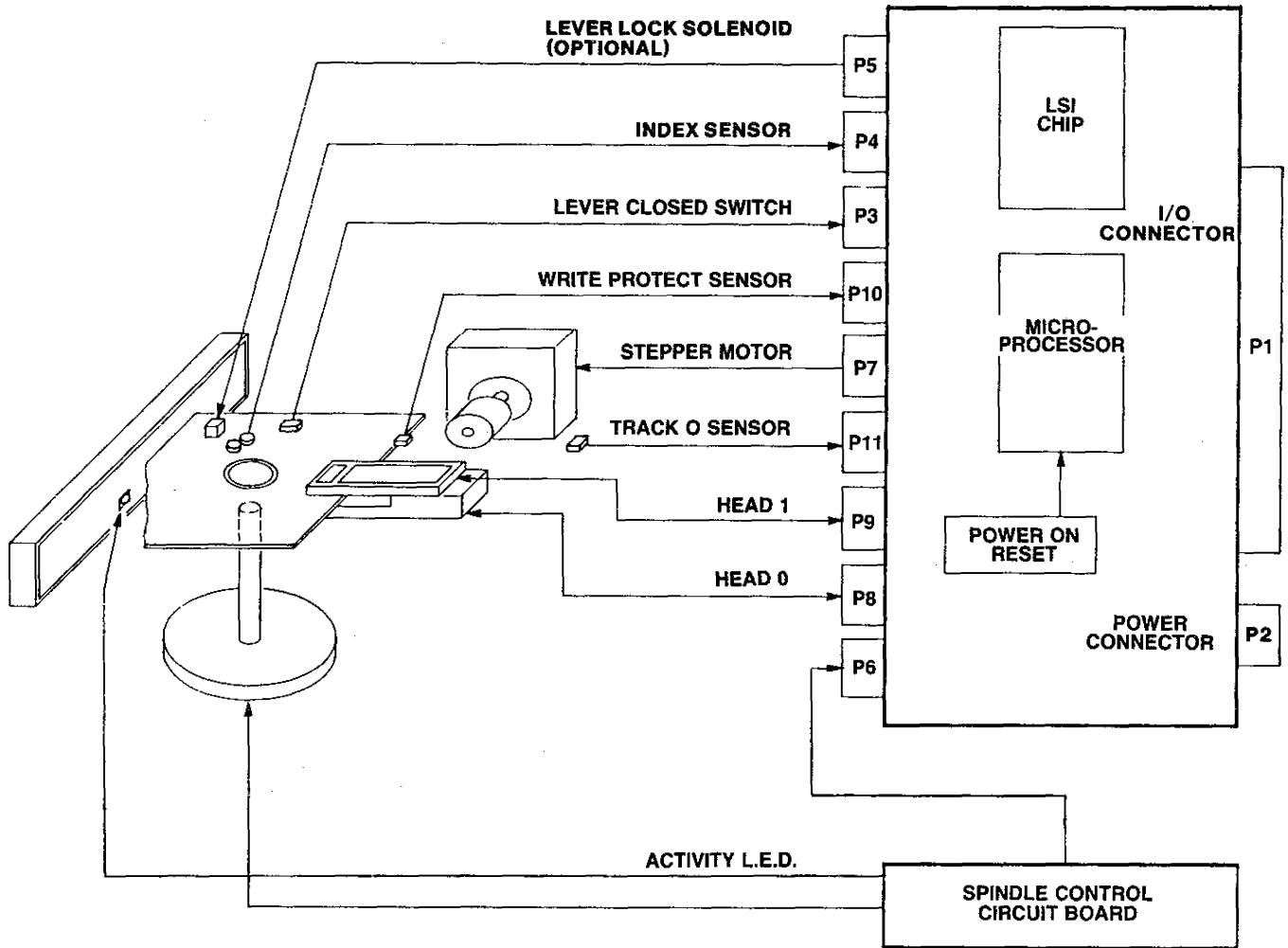
This signal produces a low output on Test Point 3, which is supplied to the LSI chip. The combination of the Track 0 sensor being deactivated and the proper step motor phase (Phase Zero) produces the proper Track 0 signal, gated internally with Drive Select, to the interface connector, PI Pin 42.

LEVER CLOSED SWITCH

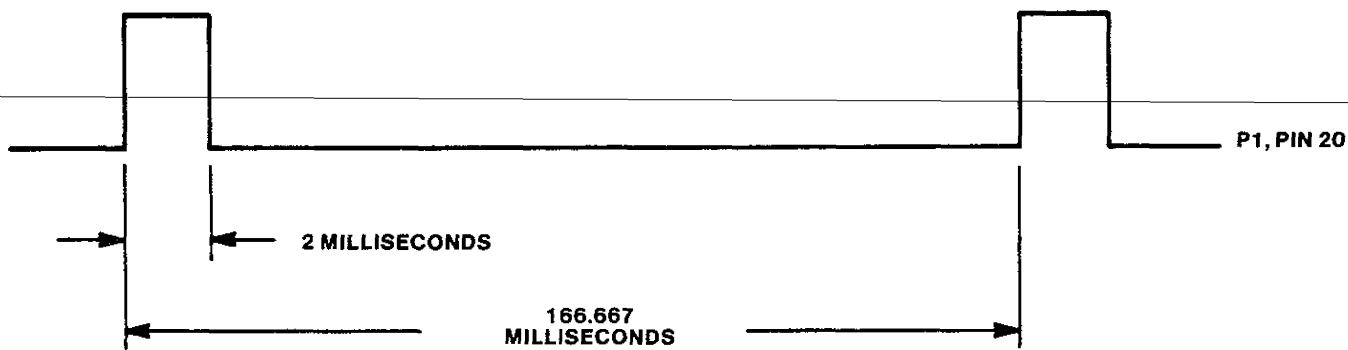
The Lever Closed Switch signal is derived from a mechanical switch mounted internally in the drive. When the lever is closed, a high (true) signal is produced on P3, Pin 12, and supplied to the LSI chip.

DRIVE SELECT

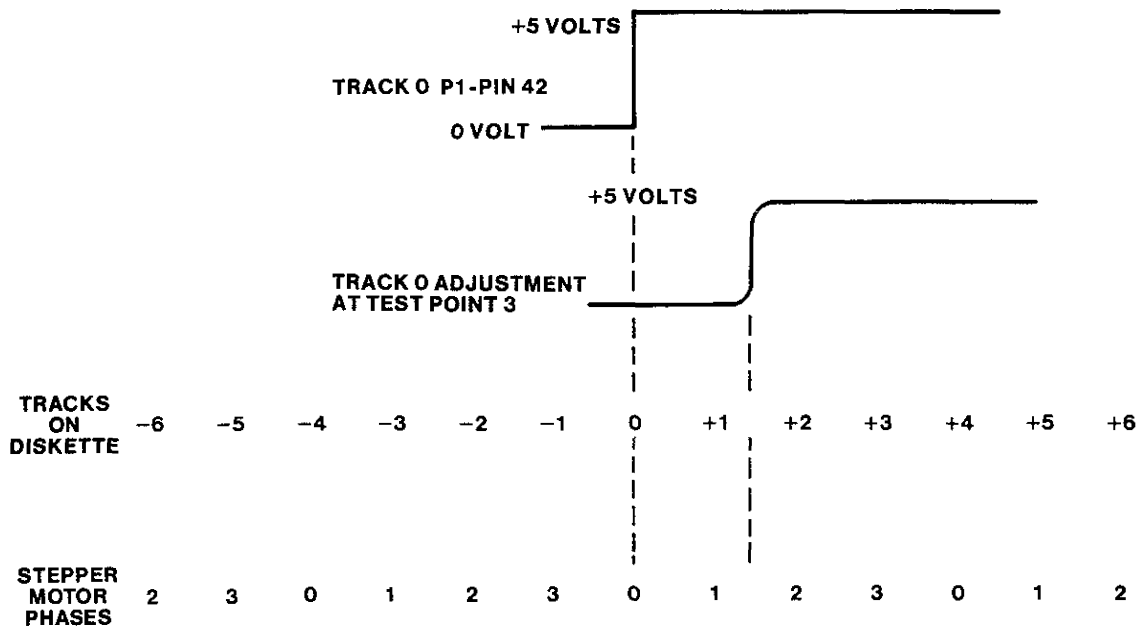
The drive select signal is sent from the host controller to the interface connector.



**FIGURE 4-4
INTERCONNECT BLOCK DIAGRAM**



**FIGURE 4-5
INDEX PULSE**



**FIGURE 4-6
TRACK 0 TIMING**

A low, active signal is supplied to the LSI chip, which supplies an active signal to the microprocessor and enables the input and output signals internally.

LEVER LOCK SOLENOID

When the lever lock solenoid option jumpers are installed and the drive is selected, there is a high output on Pin 16 of the microprocessor. This signal is inverted and energizes the lever lock solenoid.

4.4 READ/WRITE HEAD POSITIONER

The components of the drive required to position the read/write heads 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 P1, Pin 36, and P1, Pin 34, respectively.

The Step and Direction signal is supplied to the LSI chip and gated internally with drive select. If the drive is not selected, or the drive is trying to write data, step pulses are disabled.

The Step and Direction signals are then supplied to the microprocessor.

STEPPER MOTOR CONTROL

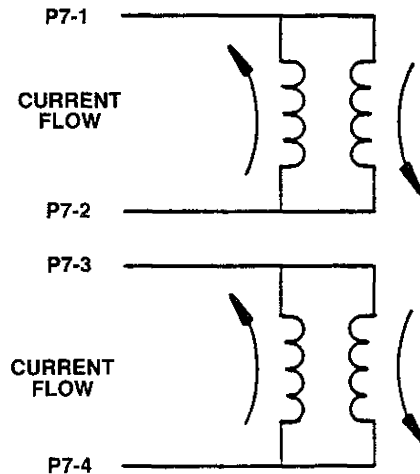
The microprocessor generates the four phases of the step sequence based on information from the step and direction inputs. These four phases are fed to the stepper motor drivers, which produce the current through the motor's coils (Figure 4-7).

STEPPER MOTOR

The stepper motor is a bipolar, four-phase motor, which rotates 1.8 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
P7-1	0	1	1	0	0	P7-1	0	0	1	1	0
P7-2	1	0	0	1	1	P7-2	1	1	0	0	1
P7-3	0	0	1	1	0	P7-3	0	1	1	0	0
P7-4	1	1	0	0	1	P7-4	1	0	0	1	1



**FIGURE 4-7
STEPPER MOTOR CURRENT**

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 P1, Pin

14. 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 low potential is applied to the selected head diode matrix. The write mode increases the voltage applied to the selected head diode matrix to +12 VDC from the beginning of Write Gate until the end of the trim erase time.

WRITE/ERASE CIRCUITS

The write electronics consist of a write current source, Q2, a write waveform generator, an erase current source, the trim erase control, and the side select logic, U3.

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

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

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

When the drive is selected and write protect is false, Write Gate initiates the write logic. Seven events occur as follows:

1. The pre-erase delay one shot is started at 190 microseconds.
2. The post-erase delay one shot is started at 550 microseconds.
3. The Inhibit (INH) signal is used to disable the read data output circuit.
4. The write current source is enabled only when the +5 volts D.C. supplied to the drive is at the correct value.
5. Input diodes to the read amplifier are reverse biased to protect the read amplifier during the write operation.

6. The write data input is used to clock the waveform generator which selects a write driver, providing a ground to forward bias a diode allowing current to flow through the coil.

When the pre-erase delay of 190-microseconds time out, the erase current source is turned on.

The clocking of the waveform generator during the 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.

The Inhibit signal is active until the end of the post-erase delay. It 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 Gate to the false going edge of Trim Erase. This is indicated by the Inhibit waveform (Figure 4-8).

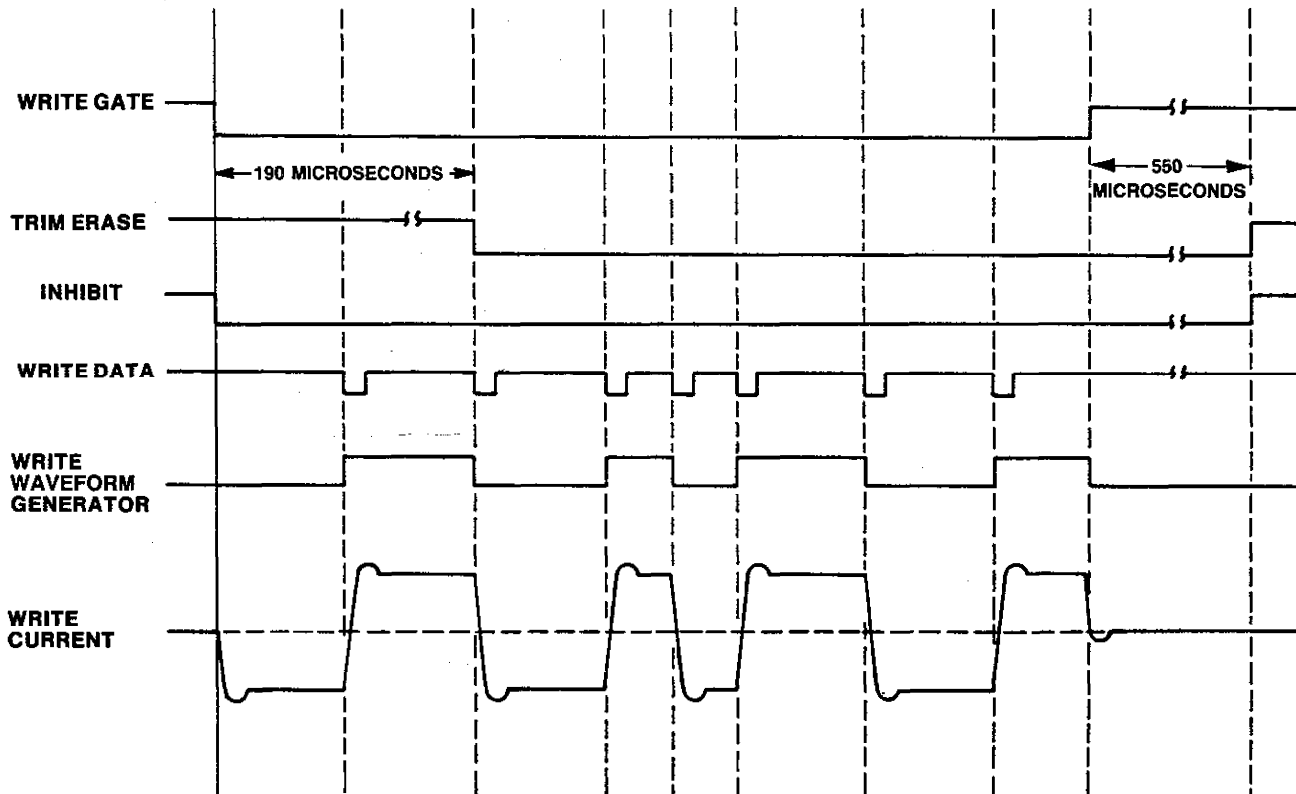


FIGURE 4-8
WRITE OPERATION TIMING DIAGRAM

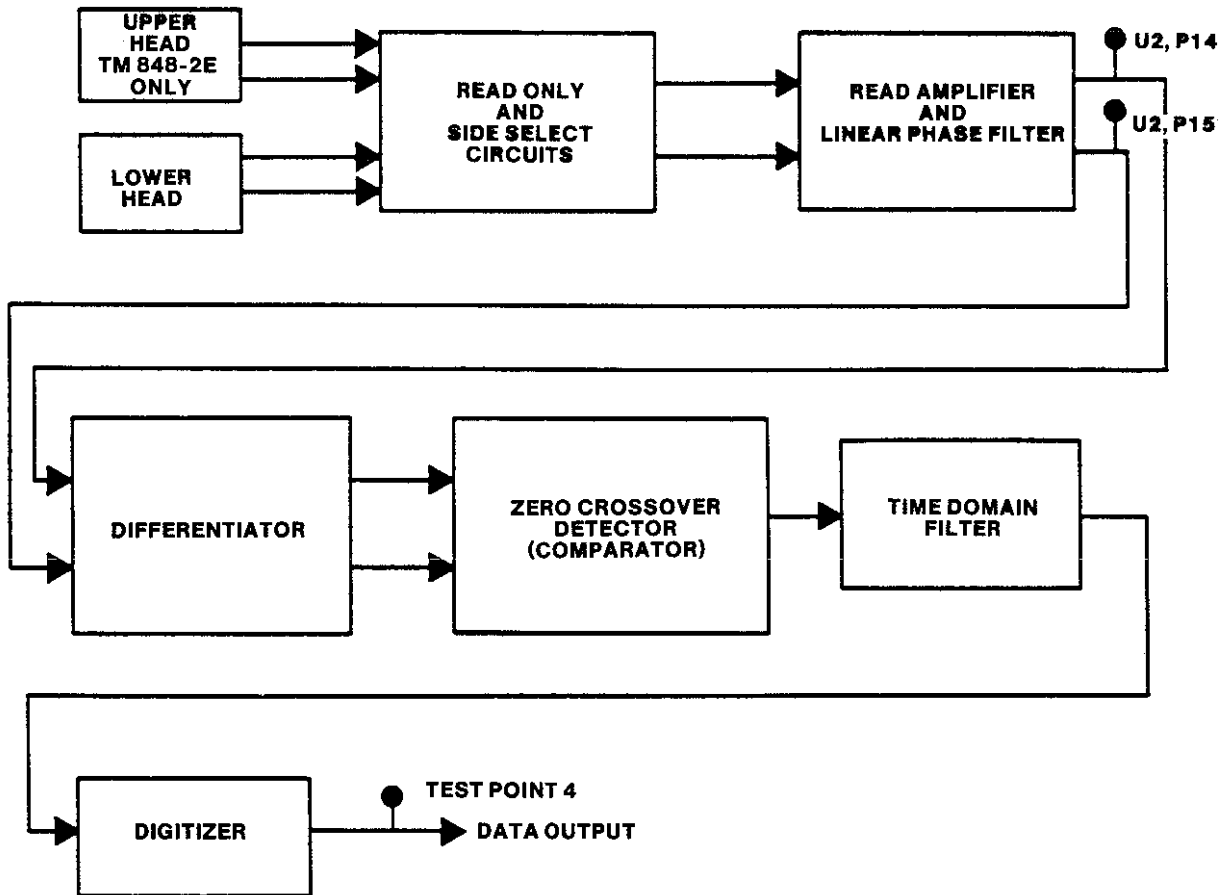
READ DATA CIRCUITS

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 heads.

The read electronics consist of:

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

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 a comparator, time domain filter, and digitizer circuitry. Subsequently, the signal is supplied to the LSI chip, then to the interface.



**FIGURE 4-9
READ BLOCK DIAGRAM**

4.6 SPINDLE CONTROL

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

1. Spindle Motor Enable circuit
2. Spindle Motor Control circuit

SPINDLE MOTOR ENABLE CIRCUIT

The Motor On signal is derived from the host controller to the interface connector. This

signal is supplied to the LSI chip, which uses it to enable the motor current circuit of the spindle motor control.

SPINDLE MOTOR CONTROL CIRCUIT

The Motor On/Off signal turns the spindle motor current on or off. This current is controlled by a crystal phase-locked loop control circuit when the spindle motor is enabled.

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. Then, one may 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 conducted.

The values and tolerances stated in the checks and adjustments are typical values for working drives. If the values measured are within tolerance 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 locations are contained in Figure 5-1.

5.1 VISUAL INSPECTION

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

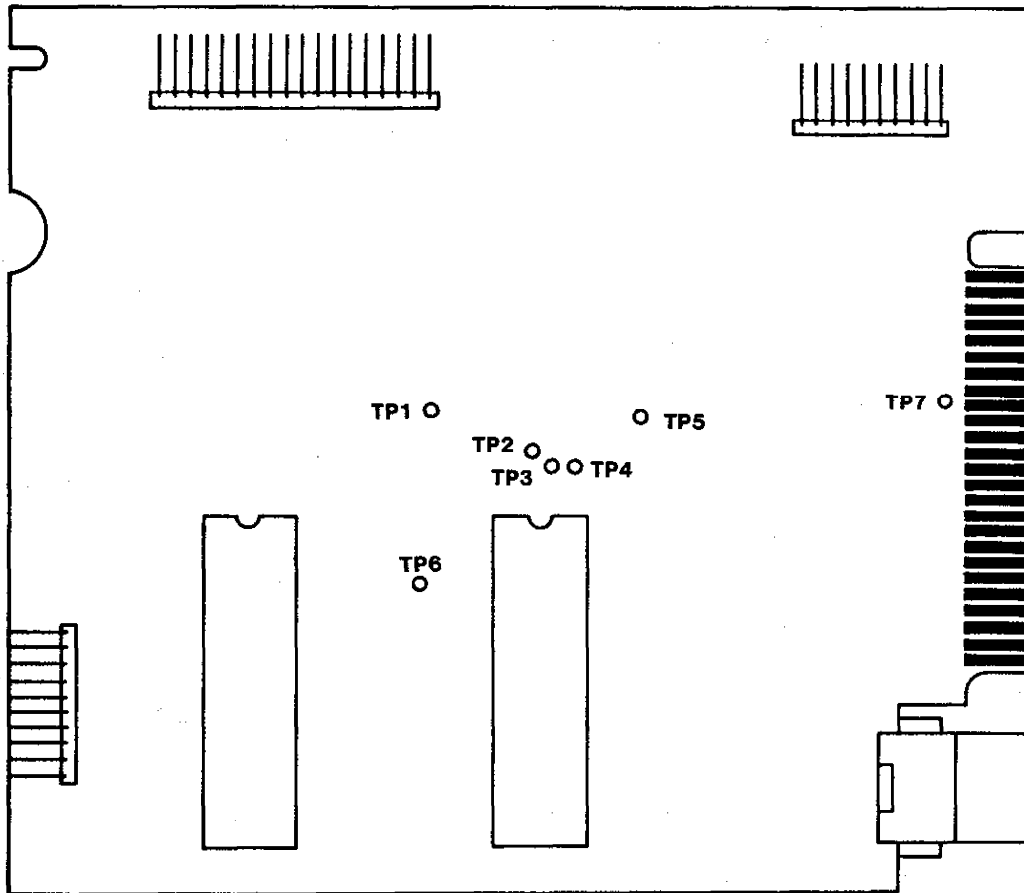
1. Check for loose or missing hardware.
2. Ensure the front lever opens and closes. The head arm raises when the door is opened.

3. Ensure the front panel is secure.
4. Manually rotate the drive motor. 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 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 360/2A or equivalent.
5. A certified output diskette, nonwrite protected, Dysan Model Number 3740/2D with tab or equivalent.
6. A certified output diskette, write protected, Dysan Model Number 3740/2D 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. A set of Allen wrenches.
11. A flat blade screwdriver.
12. A chip clip.

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 the 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 SENSOR CHECK

The write protect sensor check establishes the correct operation of the write protect sensor, i.e., the write electronics are disabled when a write protected diskette is used. If the sensor is faulty, refer to the troubleshooting guide.

1. Connect the drive to an exerciser or computer with a direct monitor of the write protect output (P1, Pin 44).
2. With a nonwrite protected diskette inserted, verify there is a nonwrite protected output to the exerciser, i.e., a high at P1, Pin 44.
3. With a write protected diskette inserted, verify there is a write protect true output to the controller or exerciser, i.e., a low at P1, Pin 44.

NOTE

A defective circuit board can be responsible for a write protect problem. Test Point 5 should be high for a write protected diskette, low for a nonwrite protected diskette.

5.5 DRIVE MOTOR SPEED CHECK

The drive motor's speed check ensures the speed is within the specified tolerance. The motor speed is 360 RPM \pm 1.5 percent. If the motor speed is out of tolerance, refer to the troubleshooting guide.

1. Apply power to the drive.
2. Insert a work diskette.
3. Activate the drive motor.
4. Observe the timing disk on the drive motor under ambient fluorescent lighting (Figure 5-2).
5. Verify the 60 Hertz ring is stationary.

5.6 RADIAL TRACK ALIGNMENT CHECK AND ADJUSTMENT

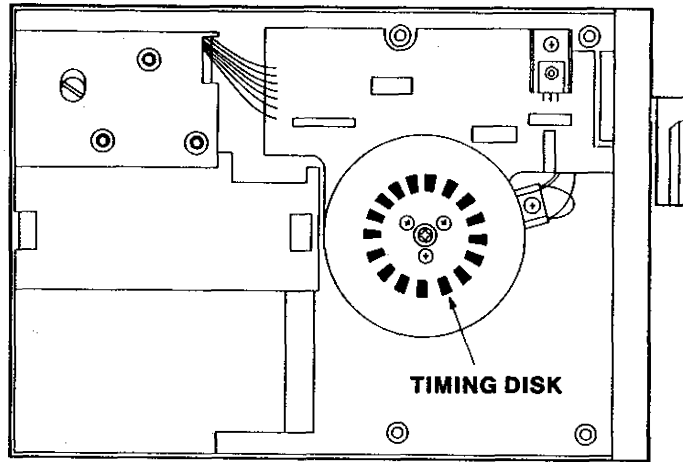
The Radial Track alignment procedure locates the read/write head at the proper radial distance on the hub center line, ensuring the track location is accurate (Figure 5-3). Adjustment is necessary only after servicing or if diskette interchange problems are suspected. If the cats eye pattern cannot be verified or cannot be adjusted, refer to the troubleshooting guide.

NOTE

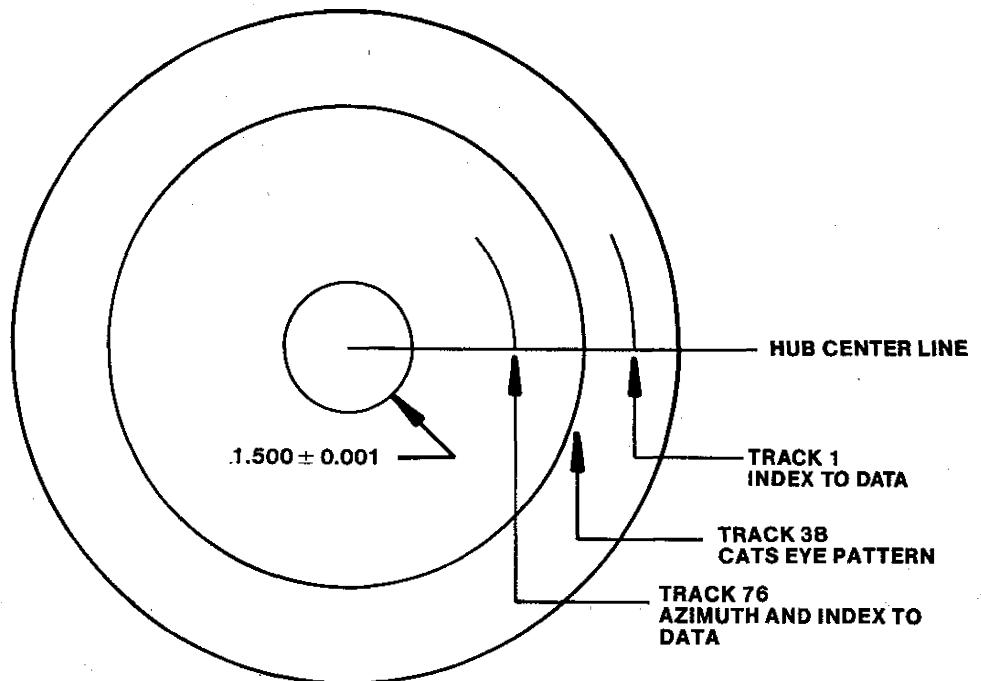
Alignment diskette and drive must be allowed to stabilize at room temperature for one hour before checks and adjustments are made.

RADIAL TRACK ALIGNMENT CHECK

1. Set up the oscilloscope to read:
 - Channel A: U2, Pin 14
 - Channel B: U2, Pin 15
 - Ground: Test Point 8
 - Read Differentially: A plus B, B inverted
 - Time Base: 20 milliseconds per division
 - External Trigger: Test Point 10, positive edge
2. Adjust the amplitude for at least four divisions on the oscilloscope.
3. Apply power to the drive.



**FIGURE 5-2
TIMING DISK**



**FIGURE 5-3
HUB CENTER LINE AND TRACK LOCATION**

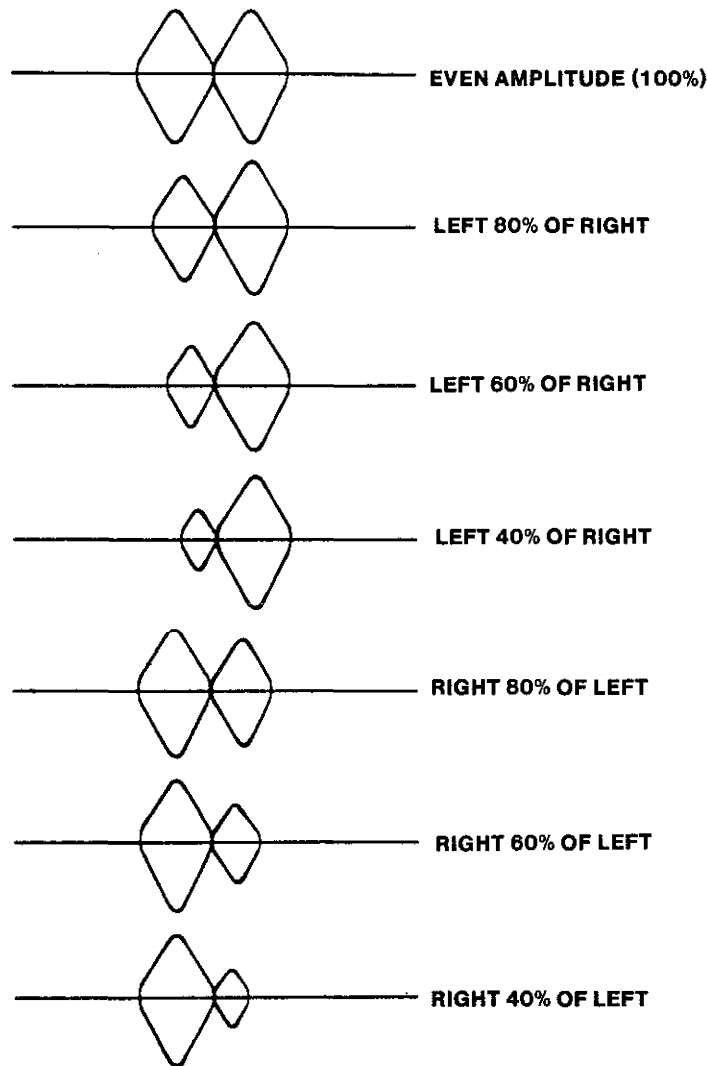
NOTE

The Track 38 radius is $2.8207 \pm .0020$ inches from the center of the hub. Other track locations are computed based upon 48 TPI.

4. Select the drive.
5. Insert a Radial Track alignment diskette, Dysan Number 360/2A, into the drive.
6. Select Head 0, the lower head.
7. Read Track 38 for Radial Track alignment of the lower head.
8. Adjust the oscilloscope to observe a Cats Eye pattern (Figure 5-4).
9. 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.



**FIGURE 5-4
CATS EYE PATTERNS**

10. Step the drive to Track 0, then step it back to Track 38.
11. Verify the Cats Eye pattern.
12. Step the drive to Track 42 or higher; then, step it back to Track 38.
13. Verify the Cats Eye pattern.
14. Switch to Head 1, the upper head.
15. Read Track 38 to verify the alignment of the upper head, if applicable.
16. Verify the Cats Eye pattern.
17. Step the drive to Track 0; then, step it back to Track 38.
18. Verify the Cats Eye pattern.
19. Step the drive to Track 42 or higher; then, step it back to Track 38.
20. Verify the Cats Eye pattern.

21. If all the checks verify, the Radial Track alignment is acceptable.
22. If any check does not verify, the head carriage must be adjusted.

RADIAL TRACK ALIGNMENT ADJUSTMENT

1. Loosen the three head carriage retaining screws one-half turn with an Allen wrench (Figure 5-5).
2. Turn the cam screw counterclockwise.
3. Observe the Cats Eye pattern of the head farthest out of alignment.
4. Turn the cam screw until the Cats Eye patterns are equal in amplitude (Figure 5-4).
5. Tighten the carriage retaining screws with an Allen wrench.
6. Recheck the Radial Track alignment.

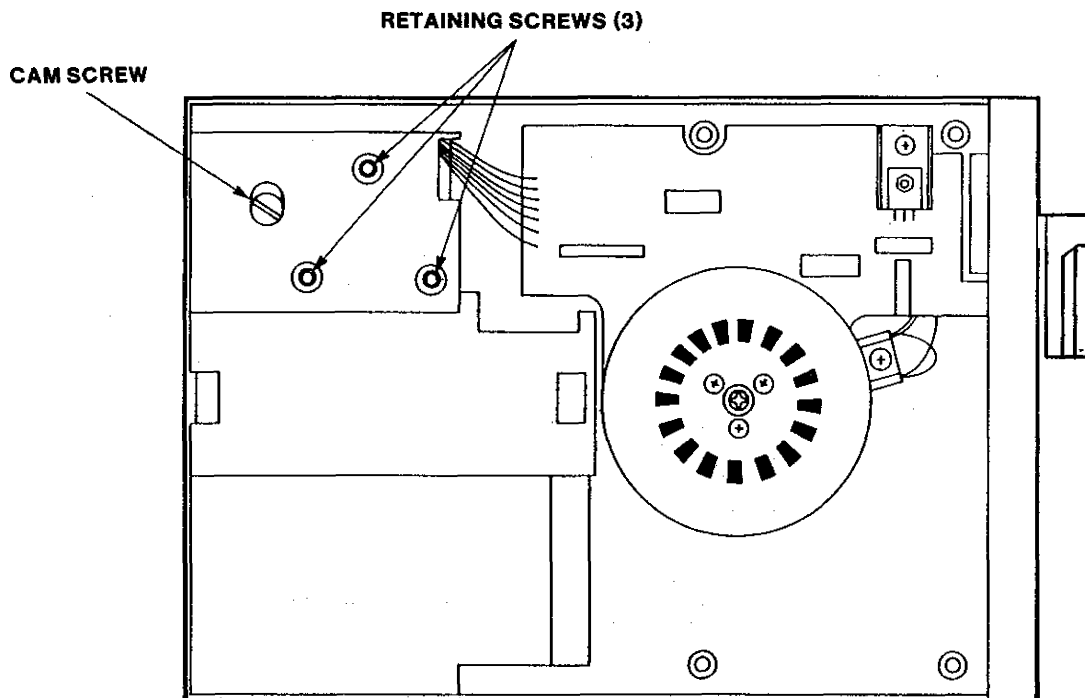


FIGURE 5-5
HEAD CARRIAGE RETAINING AND CAM SCREWS

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 BURST CHECK

1. Set up the oscilloscope to read:

Channel A: U2, Pin 14

Channel B: U2, Pin 15

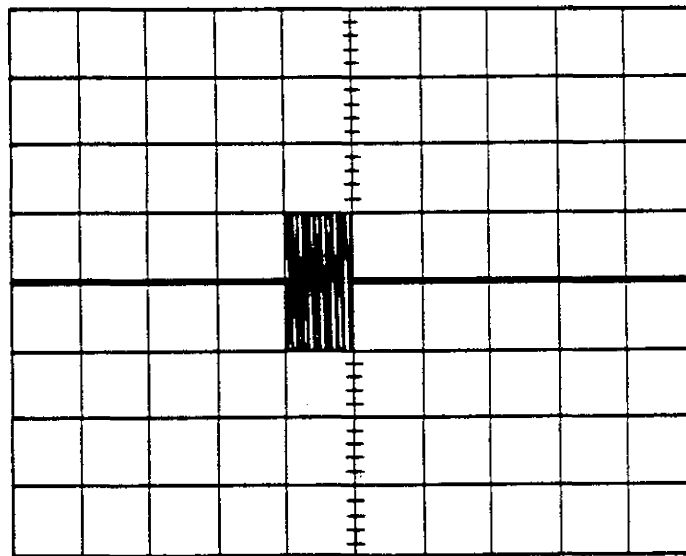
Ground: Test Point 8

Read Differentially: A plus B, B inverted

Time Base: 50 microseconds per division

External Trigger: Test Point 10, positive edge

2. Adjust the amplitude for at least two divisions on the oscilloscope.
3. Apply power to the drive.
4. Select the drive.
5. Check the motor speed of the drive.
6. Insert an alignment diskette.
7. Seek to Track 1.
8. Select Head 0, the lower head.
9. Ensure the index-to-data burst occurs at 200 ± 100 microseconds from the leading edge of the index pulse (Figure 5-6).
10. For double-sided drives, select Head 1, and repeat the steps above.



TIME SCALE: 50 MICROSECONDS PER DIVISION

FIGURE 5-6
INDEX-TO-DATA BURST

NOTE

Head 1 should meet the same tolerance.

11. If either Head 0 or Head 1 does not meet the tolerance, adjust the index sensor.
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-to-data burst on Track 76.
13. On a double-sided drive, check Heads 1 and 0, the upper and lower heads.

NOTE

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

Index Sensor Adjustment

1. Loosen the index sensor's retaining screw located on the underside of the chassis (Figure 5-7).

2. Adjust the index sensor with a flat blade screwdriver until the index-to-data burst occurs 200 ± 100 microseconds from the leading edge of the index pulse.
3. Tighten the index sensor's retaining screw.
4. Recheck the index-to-data bursts.

5.8 AZIMUTH CHECK

Azimuth checks the read/write head(s) relative angle to the center line of the diskette. The Dysan 360/2A alignment diskette has three azimuth bursts, with the first burst having acceptable limits of 12 minutes, the second one of 15 minutes, and the third one of 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.

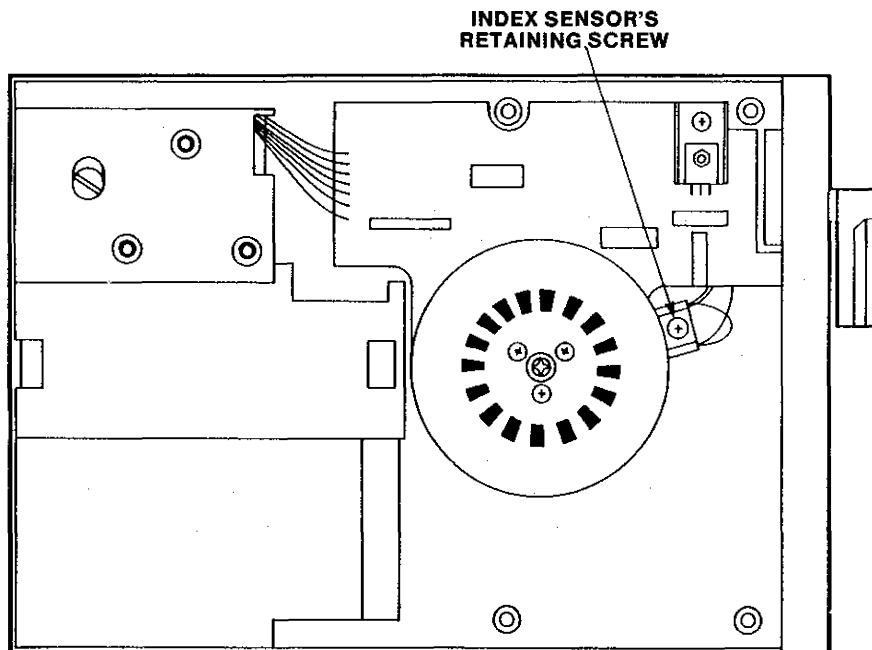


FIGURE 5-7
INDEX SENSOR'S RETAINING SCREW

1. Set up the oscilloscope to read:

Channel A: U2, Pin 14

Channel B: U2, Pin 15

Ground: Test Point 8

Read Differentially: A plus B, B inverted

Time Base: 0.5 millisecond per division

External Trigger: Test Point 10, positive edge

2. Adjust the amplitude for at least four divisions on the oscilloscope.
3. Seek to Track 76.
4. Select Head 0, and observe the third pulse burst on the oscilloscope.
5. Verify the head azimuth is no greater than ± 18 minutes by comparing the third set of pulse bursts to those in Figures 5-8, 5-9, and 5-10.
6. Select Head 1, and verify the head azimuth.

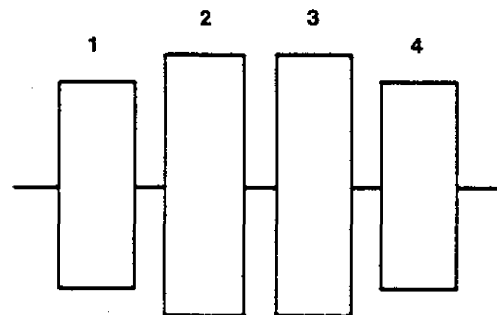
Figure 5-8 depicts an azimuth of exactly zero minutes. This is the optimum head azimuth alignment.

Figure 5-9 depicts an azimuth of exactly minus 18 minutes. This is the lower limit of allowable azimuth error.

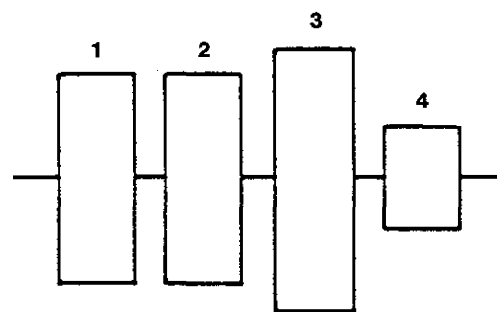
Figure 5-10 depicts an alignment of exactly plus 18 minutes. This is the upper limit of allowable azimuth error.

5.9 TRACK 0 SENSOR CHECK AND ADJUSTMENT

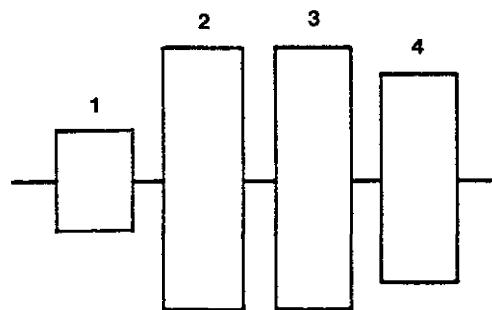
The Track 0 sensor provides a signal identifying Track 0 to the LSI chip. The electronics disable the step-out function when Track 0 is reached. In addition, a Track 0 signal is sent to the controller on Pin 42 of the interface. If the Track 0 sensor cannot be adjusted, refer to the troubleshooting guide.



**FIGURE 5-8
OPTIMUM HEAD AZIMUTH ALIGNMENT**



**FIGURE 5-9
HEAD AZIMUTH ALIGNMENT
OF ACCEPTABLE LOWER LIMITS**



**FIGURE 5-10
HEAD AZIMUTH ALIGNMENT
OF ACCEPTABLE UPPER LIMITS**

TRACK 0 SENSOR CHECK

1. Set up the oscilloscope to read:
Channel A: U2, Pin 14
Channel B: U2, Pin 15
Ground: Test Point 8
Read Differentially: A plus B, B inverted
Time Base: 20 milliseconds per division
External Trigger: Test Point 10, positive edge
Vertical Display: 0.1 volt per division
2. Apply power to the drive.
3. Insert an alignment diskette into the drive.
4. Close the front lever.
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 signal at Test Point 3.
8. Step the carriage to Track 1.
9. Ensure the signal at Track 1 is less than 0.5 volts.
10. Step the carriage out to the radial alignment track.
11. Step the carriage back to Track 2.

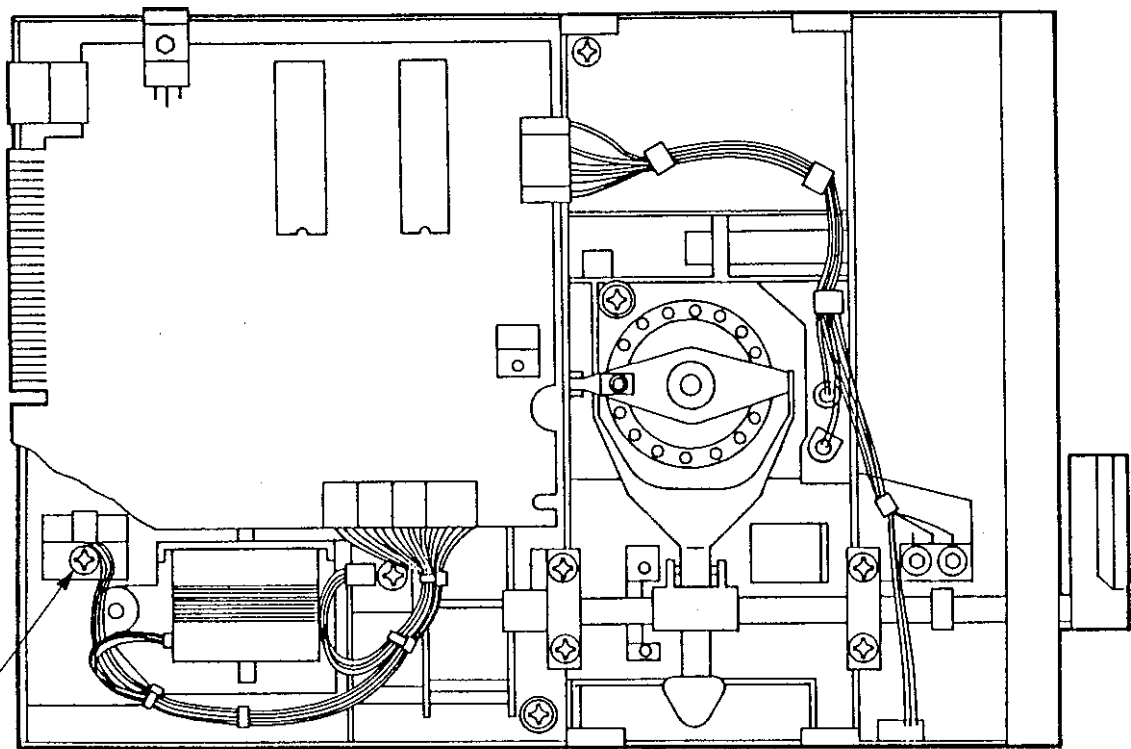
12. Verify the logic level at Test Point 3 is at least 2.5 volts.
13. If all of these checks are satisfactory, no adjustment is required.
14. If any of these checks is unsatisfactory, adjust the Track 0 switch.

TRACK 0 SENSOR ADJUSTMENT

1. Loosen the retaining screw on the base of the Track 0 bracket (Figure 5-11).
2. Retighten the screw slightly to provide some friction on the bracket.
3. Slide the Track 0 Sensor toward the rear of the chassis 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. Slide the Track 0 Sensor forward very slowly until the signal at Test Point 3 is less than 0.5 volts at Track 1 and greater than 2.5 volts at Track 2.
6. Retighten the retaining screw.
7. Repeat the Track 0 Sensor check to ensure the correct setting has been attained.

5.10 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.



TRACK 0 RETAINING SCREW

FIGURE 5-11
TRACK 0 RETAINING SCREW

Head amplitude can be verified by establishing a nominal value of amplitude for the diskette on a known working drive. In all cases, amplitudes above 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 to read:
 - Channel A: U2, Pin 14
 - Channel B: U2, Pin 15
 - Vertical Amplitude: 50 millivolts per division

Ground: Test Point 8

Read Differentially: A plus B, B inverted

Time Base: 20 milliseconds per division

External Trigger: Test Point 10, positive edge

3. Seek to Track 0.
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.

5.11 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 should be made whenever the cone lever assembly has been removed or replaced. If cone centering cannot be achieved, verify the measurement with a second diskette. Otherwise refer to the troubleshooting guide.

1. Set up the oscilloscope to read:

Channel A: U2, Pin 14

Channel B: U2, Pin 15

Vertical Amplitude: 50 millivolts per
division

Ground: Test Point 8

Read Differentially: A and B, B
inverted

Time Base: 10 microseconds per
division

External Trigger: Test Point 10,
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 lever, and remove the diskette.
8. Reinsert the diskette, and close the front lever.
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.

SECTION 6

TROUBLESHOOTING GUIDE AND REPLACEMENT PROCEDURES

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. Usually, quality media is sufficient to clean the heads. When contamination of the heads 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 heads by hand since damage to the heads 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**

Condition	Possible Cause	Recommended Action
<p>No index.</p>	<p>Diskette not inserted.</p> <p>Lever 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 lever.</p> <p>Verify unit select and jumper configuration.</p> <p>Check P4.</p> <p>Replace index sensor.</p> <p>See: Spindle Not Turning.</p> <p>Replace logic circuit board.</p>
<p>Spindle speed out of tolerance or spindle not turning.</p>	<p>Drive Motor not turning.</p> <p>Connector loose or disconnected.</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>Verify Motor Control option jumpers.</p> <p>Check connector P6.</p> <p>Replace Drive Motor Assembly.</p> <p>Replace Logic circuit board.</p> <p>Replace Drive Motor Assembly.</p>
<p>Will not seek or restore.</p>	<p>Interface not enabled.</p> <p>Connector loose or disconnected.</p> <p>Defective step logic.</p> <p>Defective stepper motor.</p>	<p>Verify interface direction, step, and select signals.</p> <p>Check Connector P7.</p> <p>Replace Logic circuit board.</p> <p>Replace Stepper Motor Assembly.</p>

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

Condition	Possible Cause	Recommended Action
Will not write.	<p>Diskette is write protected.</p> <p>Interface not enabled.</p> <p>Head(s) or write protect sensor not connected.</p> <p>Write protect sensor faulty.</p> <p>Defective write logic.</p> <p>Defective head(s).</p>	<p>Install write tab on diskette.</p> <p>Verify write enable, select, and write data interface lines.</p> <p>Check Connectors P8, P9, and P10.</p> <p>Check write protect sensor operation.</p> <p>Replace Logic circuit board.</p> <p>Replace Head Carriage Assembly.</p>
Will not read.	<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 Radial Track alignment index pulse, and Track 0 sensor adjustment.</p> <p>Replace Logic circuit board.</p> <p>Replace Head Carriage Assembly.</p>
No Track 0 indication.	<p>Defective seek.</p> <p>Track 0 sensor not loose or disconnected.</p> <p>Track 0 sensor not adjusted.</p> <p>Defective logic.</p> <p>Defective Track 0 sensor.</p>	<p>See: Will not seek or restore.</p> <p>Check P11.</p> <p>Adjust Track 0 sensor.</p> <p>Replace Logic circuit board.</p> <p>Replace Track 0 Sensor Assembly.</p>

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

Condition	Possible Cause	Recommended Action
Fails drive select check.	Power not applied to the 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 sensor check.	Defective write protect sensor. Faulty Logic circuit board.	Replace write protect sensor. Replace Logic circuit board.
Fails drive motor speed check.	--	See: Spindle speed out of tolerance or not turning.
Fails Radial Track 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
TROUBLESHOOTING GUIDE (CONTINUED)**

Condition	Possible Cause	Recommended Action
Fails Index checks and adjustment.	<p align="center">— —</p> <p>Diskette not centering.</p> <p>Alignment diskette defective.</p>	<p>See: No index.</p> <p>See: Fails centering check.</p> <p>Verify alignment diskette and replace if necessary.</p>
Fails Track 0 sensor check and adjustment.	<p align="center">— —</p>	<p>See: No Track 0 indication.</p>
Fails head output check.	<p>Defective media.</p> <p>Cannot read.</p>	<p>Replace media.</p> <p>See: Will not read.</p>
Fails cone centering check.	<p>Defective diskette.</p> <p>Defective Cone Assembly.</p> <p>Defective Bridge Assembly.</p> <p>Defective drive motor.</p>	<p>Replace diskette.</p> <p>Replace Cone Assembly.</p> <p>Replace Bridge Assembly.</p> <p>Replace drive motor.</p>

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. Checks and adjustment procedures are in Section 5.

**TABLE 6-2
CHECKS AND ADJUSTMENT GUIDE**

PARTS OR ASSEMBLIES REPLACED	RECOMMENDED CHECKS AND ADJUSTMENTS									
	POWER/DRIVE SELECT CHECK	WRITE PROTECT SENSOR	DRIVE MOTOR SPEED	RADIAL TRACK ALIGNMENT	INDEX	AZIMUTH	TRACK 0 SENSOR	HEAD OUTPUT	CONE CENTERING	
Logic Circuit Board	X		X					X		
Cone Assembly					X				X	
Diskette Lever Assembly										
Front Panel	X									
Bridge Assembly					X				X	
Drive Motor Assembly	X		X						X	
Load Arm Assembly								X		
Track 0 Sensor							X			
Write Protect Sensor		X								
Motor Switch Assembly	X		X							
Index Sensor Assembly					X					
Diskette Ejector Assembly									X	
Ejector Spring									X	
Stepper Band				X	X	X	X			
Stepper Motor Assembly				X	X	X	X			
Head Carriage Assembly				X	X	X	X	X		

LOGIC CIRCUIT BOARD

REPLACEMENT

REMOVAL

1. Remove all connectors from the circuit board (Figure 6-1). Note their location.
2. Remove the two circuit board mounting screws.
3. Slide the circuit board toward the back of the drive about one-half inch.
4. Remove it from the drive.

1. Place the new circuit board on the drive.
2. Install the two mounting screws attaching the circuit board to the rails.
3. Plug in all connectors, ensuring they are in the proper slots.
4. Perform all checks indicated in Table 6-2.

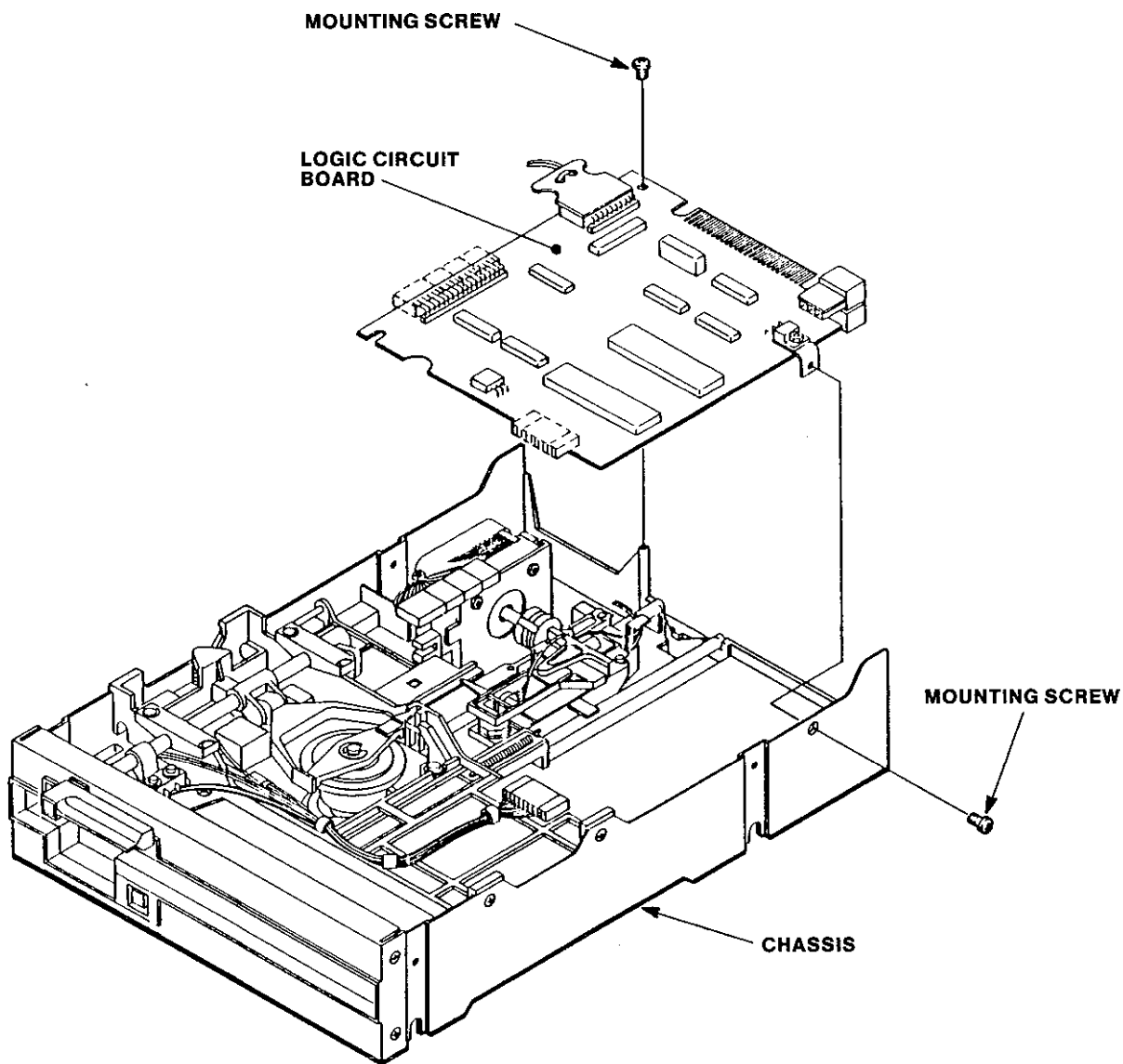


FIGURE 6-1
LOGIC CIRCUIT BOARD CONNECTORS AND MOUNTING SCREWS

CONE ASSEMBLY

REMOVAL

1. Remove the screw that attaches the cone bracket to the cone alignment arm (Figure 6-2).
2. Unlatch the diskette lever.
3. Swing the Cone Assembly up 90 degrees so that it points toward the side of the drive.
4. Carefully remove the E-Ring, flat washer, and washer that holds on the cone shaft.
5. Gently lift out the Cone Assembly.

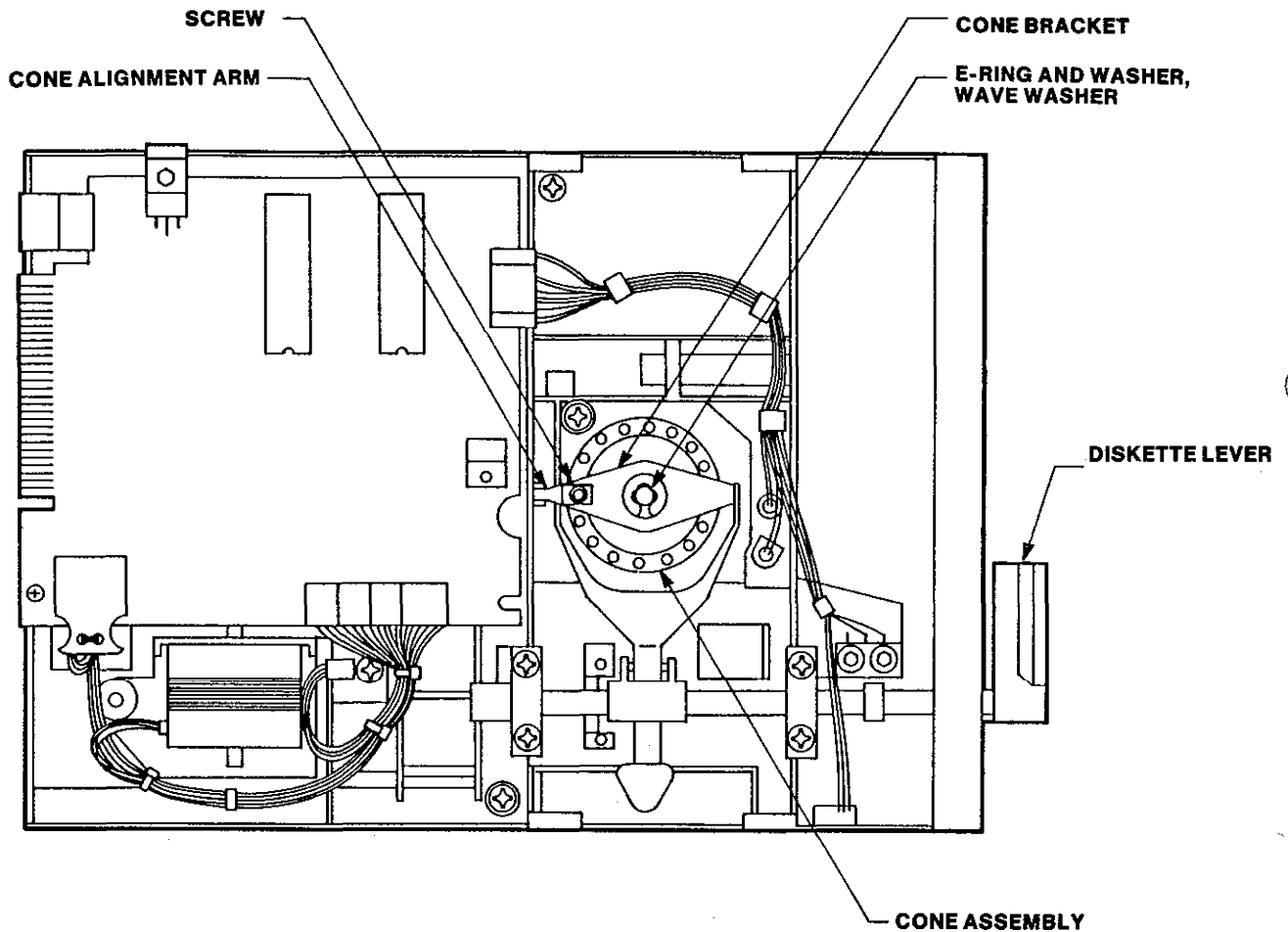
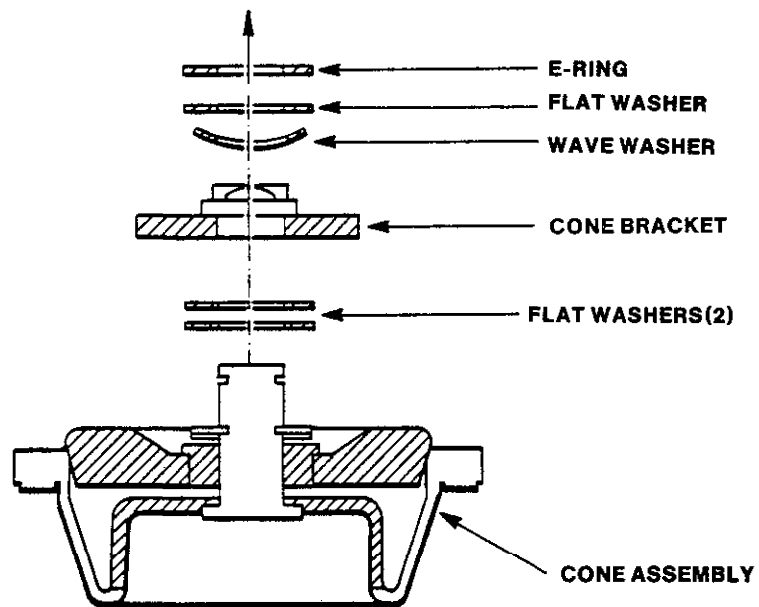


FIGURE 6-2
CONE BRACKET

INSTALLATION

1. Gently insert the Cone Assembly.
2. Carefully insert the E-Ring, flat washer, and wave washer that holds on the cone shaft (see Figure 6-3).
3. Swing the Cone Assembly down 90 degrees so that it points toward the bottom of the unit.
4. Latch the diskette lever.
5. Insert the screw that attaches the cone bracket to the cone alignment arm (Figure 6-2).
6. Ensure the Cone Assembly turns freely.
7. If not, reverify that the Cone Assembly has been installed correctly.
8. Insert a diskette.
9. Ensure the diskette is clamped properly by the cone.
10. Perform the checks and adjustments indicated in Table 6-2.



**FIGURE 6-3
CONE ASSEMBLY**

DISKETTE LEVER

REMOVAL

1. Pry off the cover that hides the diskette lever's retaining screw (Figure 6-4).
2. Remove the diskette lever's retaining screw.
3. Carefully remove the diskette lever.

INSTALLATION

1. Put the diskette lever on the shaft.

2. Put a drop of Loctite Number 234 on the threads of the diskette lever's screw.
3. Install and tighten the diskette lever's screw.
4. Put the cover back on the diskette lever.
5. Ensure the diskette lever is perpendicular to the drive when the diskette is clamped.
6. Ensure the diskette lever is parallel to the drive when the diskette is unclamped.

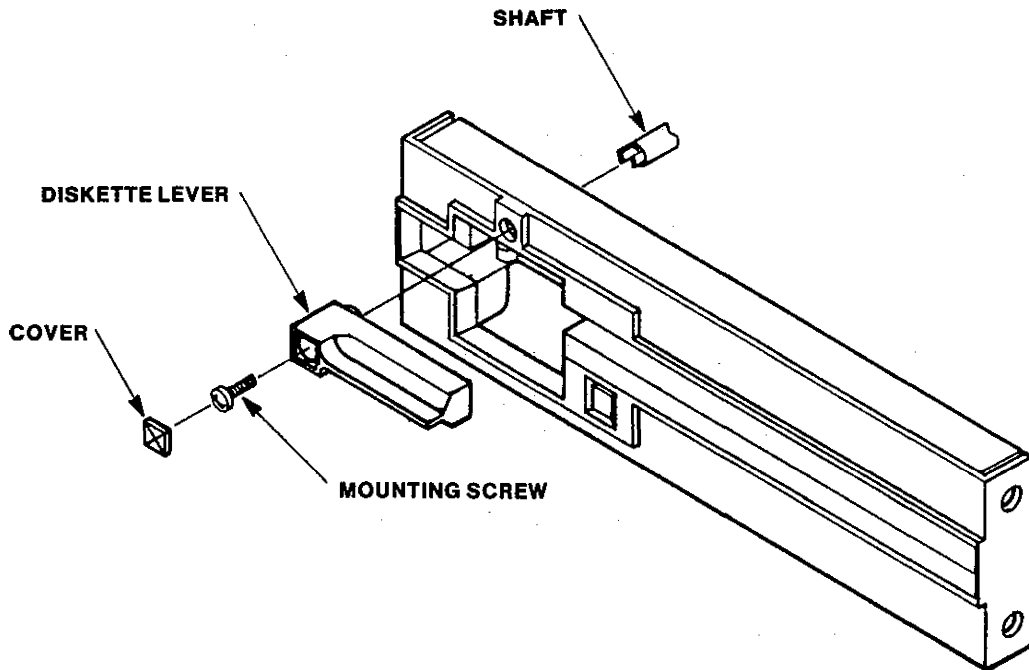


FIGURE 6-4
DISKETTE LEVER

FRONT PANEL

REMOVAL

1. Remove the diskette lever.
2. Remove the four mounting screws, two on each side, that attach the front panel to the chassis (Figure 6-5).
3. Lift off the front panel, being careful that the Activity L.E.D. comes out of its mounting with no binding.

INSTALLATION

1. Put the front panel on the drive, ensuring the Activity L.E.D. goes into its holder.
2. Install the four mounting screws attaching the front panel to the chassis.
3. Reinstall the diskette lever.
4. Ensure the diskette lever clamps the cone and loads the heads.
5. Perform the checks indicated in Table 6-2.

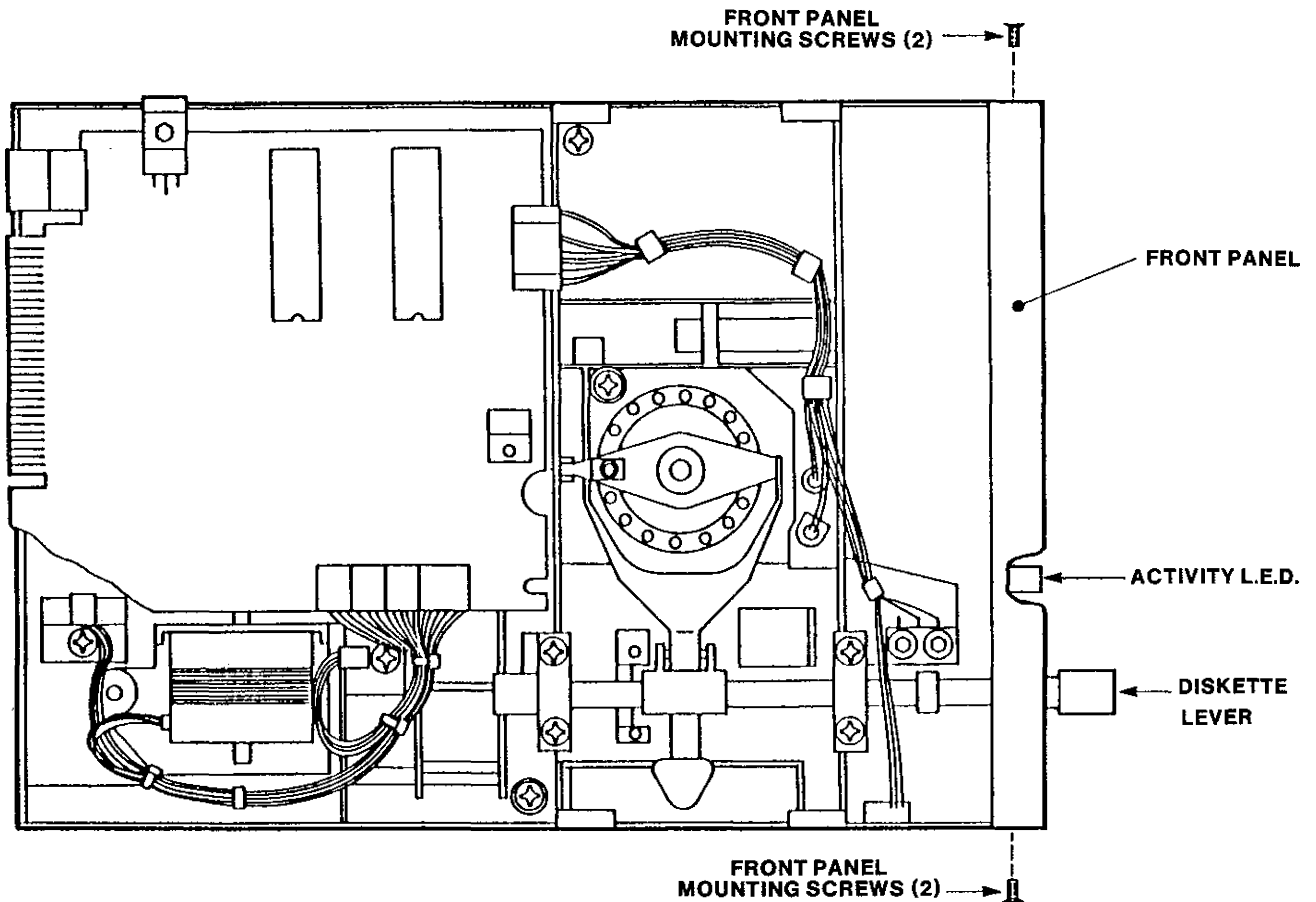


FIGURE 6-5
FRONT PANEL

BRIDGE ASSEMBLY

NOTE

REMOVAL

1. Remove the Logic circuit board.
2. Remove the diskette lever.
3. Remove the four bridge mounting screws attaching the Bridge Assembly to the chassis (Figure 6-6).
4. Carefully pull out the two index L.E.D.'s from the Bridge Assembly.
5. Carefully lift out the Bridge Assembly toward the back of the drive. The shaft must clear the front panel (Figure 6-7).

INSTALLATION

1. Insert the shaft into the front panel, and lay the Bridge Assembly in place.

Ensure the upper head lift arm is on top of the load arm assembly.

2. Install and tighten the four bridge mounting screws attaching the Bridge Assembly to the chassis.
3. Install the two index L.E.D.'s into the Bridge Assembly.
4. Install the diskette lever.
5. Install the circuit board.
6. Ensure the diskette lever clamps the cone and loads the head(s).
7. Perform the checks and adjustments in Table 6-2.

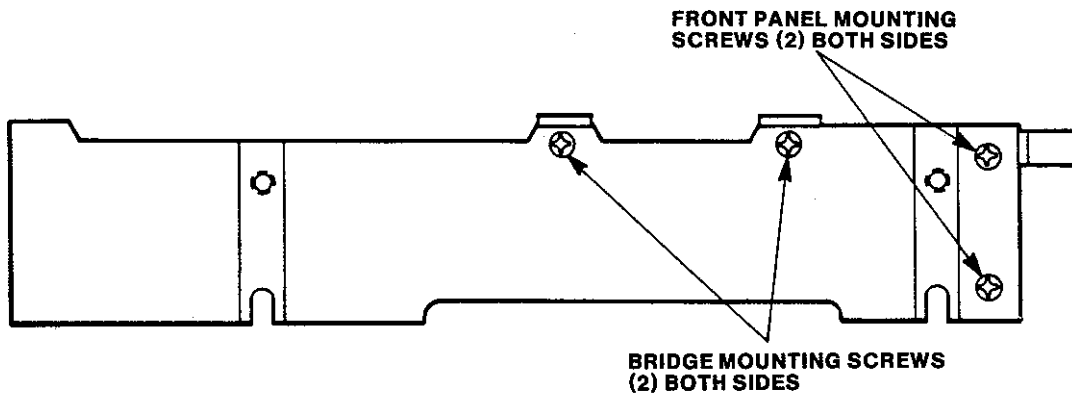
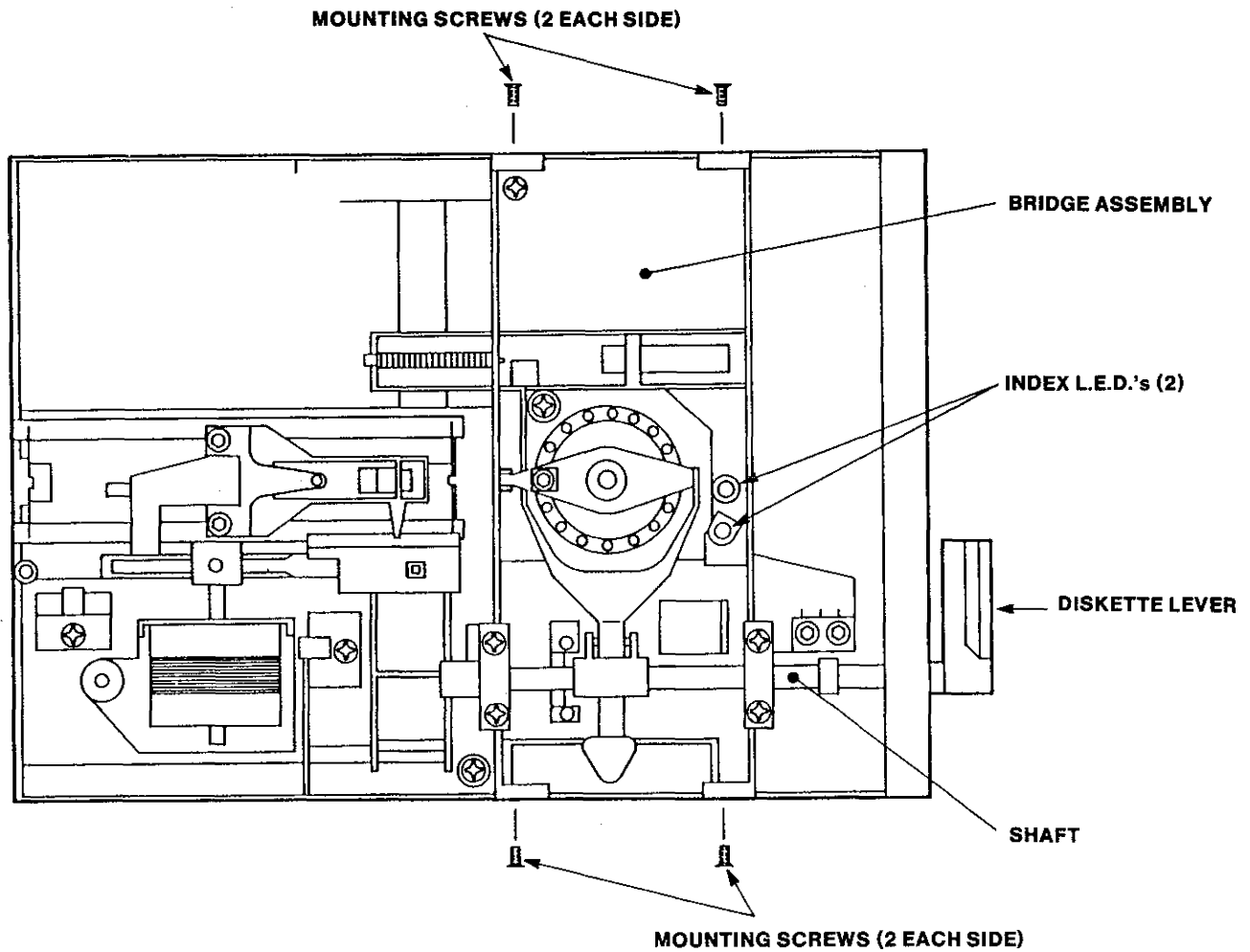


FIGURE 6-6
BRIDGE ASSEMBLY MOUNTING SCREWS



**FIGURE 6-7
BRIDGE ASSEMBLY**

DRIVE MOTOR

REMOVAL

1. Remove the Logic circuit board.
2. Remove the diskette lever.
3. Remove the front panel.
4. Remove the Bridge Assembly.
5. Cut the tie wraps attaching the drive motor connector to the cable harness (Figure 6-8).
6. Remove the mounting screw attaching the heat sink to the chassis. The heat sink is located on the drive motor servo board (Figure 6-9).
7. Remove the three drive motor mounting screws.
8. Lift the drive motor from the bottom of the drive, pulling the cable through the slot in the chassis.

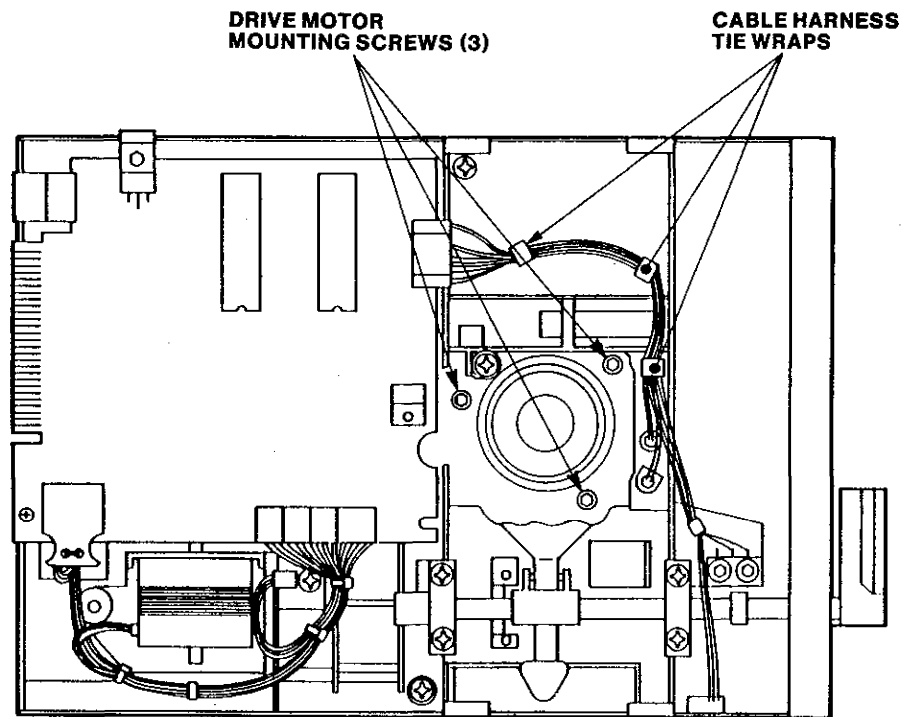
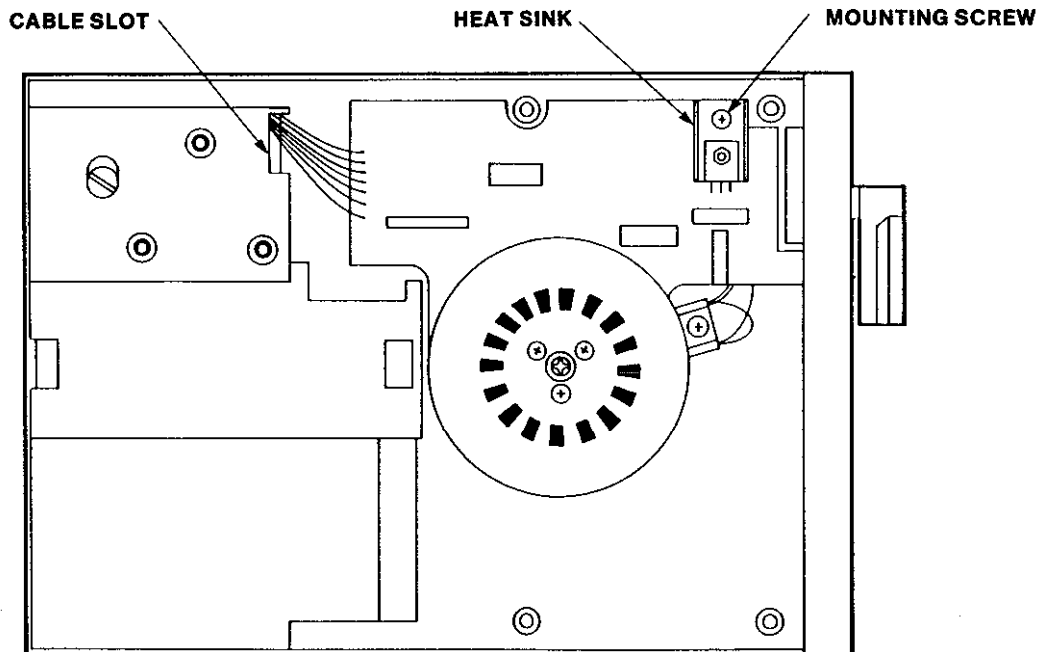


FIGURE 6-8
DRIVE MOTOR MOUNTING SCREWS

INSTALLATION

1. Install the new drive motor assembly, aligning the mounting hole on the top side of the chassis.
2. Install and tighten the three mounting screws (Figure 6-8).
3. Install and tighten the heat sink mounting screw.
4. Route the connector through the cable slot (Figure 6-9).
5. Bundle the cable harness with two tie wraps.
6. Install the bridge assembly.
7. Install the front panel.
8. Install the diskette lever.
9. Install the logic circuit board.
10. Perform the checks in Table 6-2.



**FIGURE 6-9
HEAT SINK AND CABLE SLOT**

LOAD ARM ASSEMBLY

REMOVAL

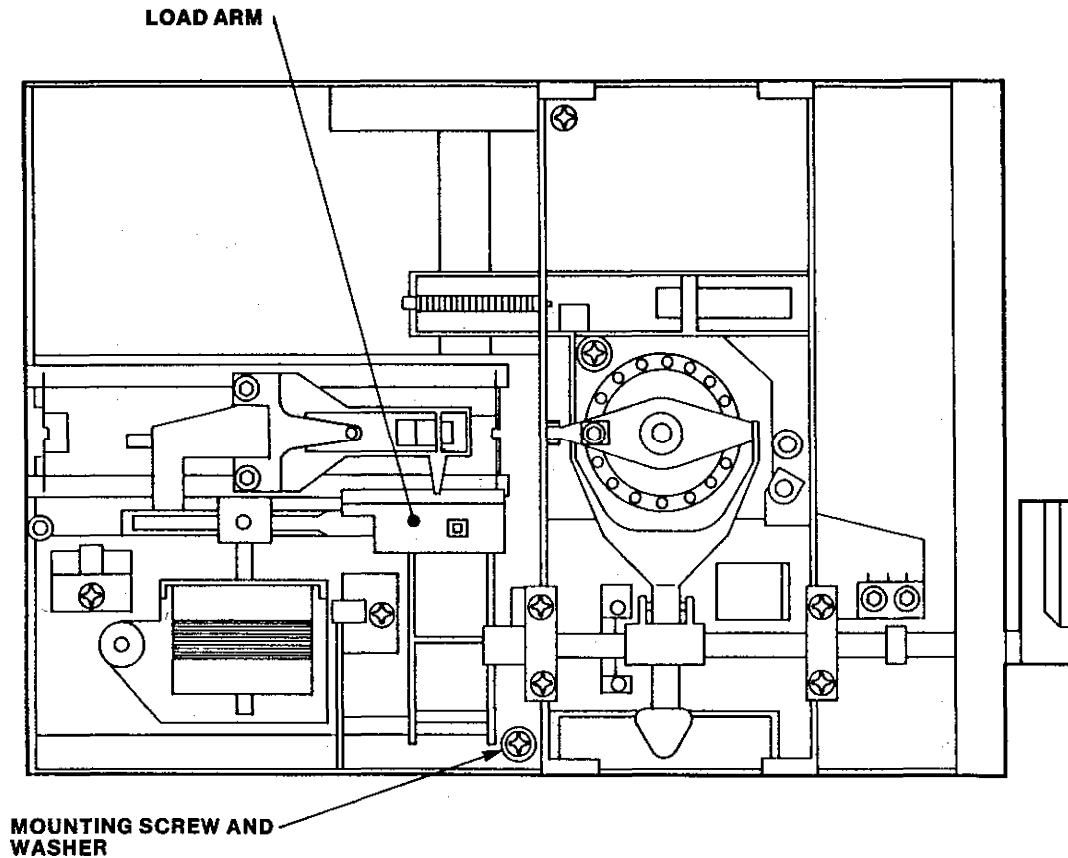
1. Remove the Logic circuit board.
2. Remove the mounting screw and washer that are used to attach the Load Arm Assembly to the Bridge Assembly (Figure 6-10).
3. Carefully slide out the Load Arm Assembly toward the rear of the chassis.

INSTALLATION

1. Slide the Load Arm Assembly into position from the rear of the chassis,

ensuring the load arm pin is sitting under the front of the mounting screws and washer.

2. Install and tighten the mounting screw attaching the Load Arm Assembly to the chassis, ensuring the washer is under the screw and the head lift arm is over the Load Arm Assembly.
3. Install the Logic circuit board.
4. Insert a diskette into the drive.
5. Ensure the head is loaded when the diskette lever is activated and adequate clearance is attained for diskette insertion and ejection.
6. Perform the checks indicated in Table 6-2.



**FIGURE 6-10
LOAD ARM ASSEMBLY**

TRACK 0 SENSOR ASSEMBLY

REMOVAL

1. Remove P11 from the Logic circuit board.
2. Cut the tie wraps that hold the cable harness, and remove the P11 wires (Figure 6-11).
3. Remove the P11 wires from the chassis.
4. Remove the mounting screw holding down the Track 0 Sensor Assembly bracket.
5. Remove the bracket.
6. Lift off the Track 0 Sensor Assembly.

INSTALLATION

1. Install the Track 0 Sensor Assembly.
2. Install the Track 0 sensor mounting bracket with the mounting screw.
3. Loop the P11 wires from the Track 0 Sensor Assembly through the bracket attached to the chassis.
4. Using tie wraps, cable harness the P11 wires and the other wires together.
5. Plug P11 into the circuit board.
6. Perform the checks and adjustments in Table 6-2.

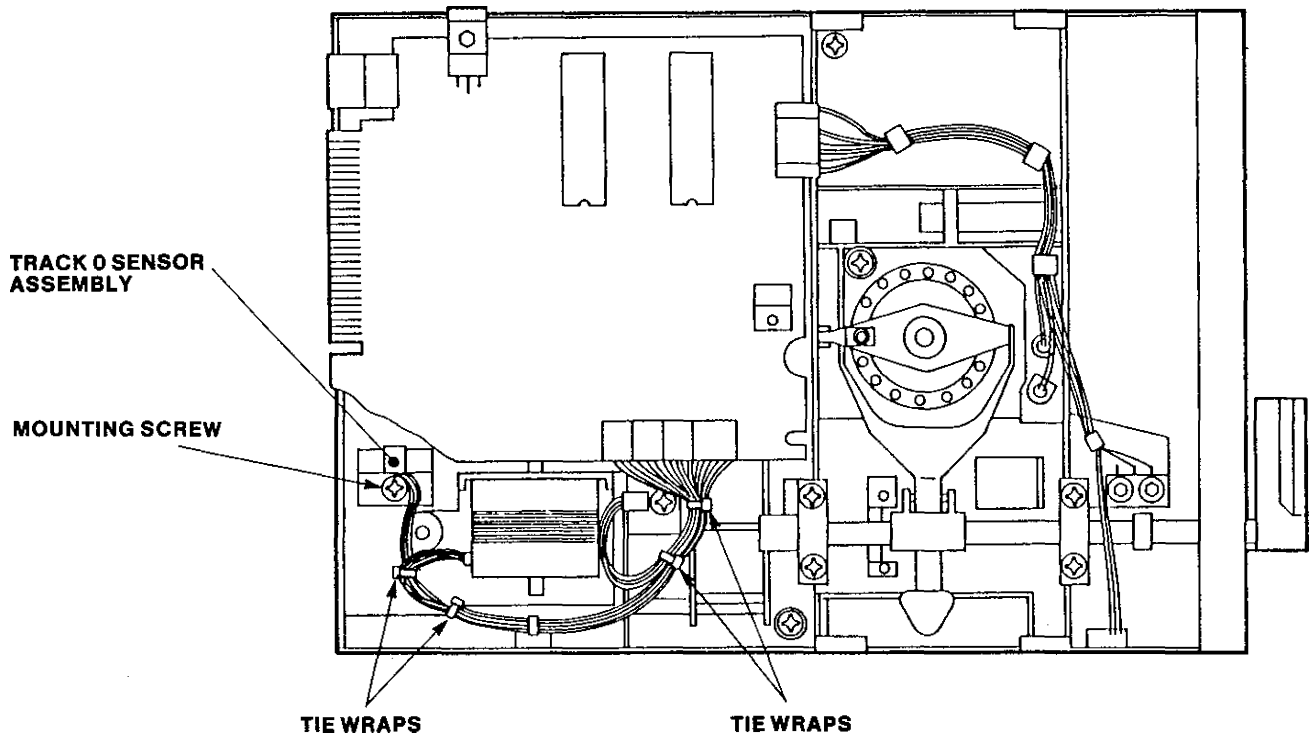


FIGURE 6-11
TRACK 0 SENSOR ASSEMBLY

WRITE PROTECT SENSOR ASSEMBLY

INSTALLATION

REMOVAL

1. Remove P10 from the circuit board.
2. Remove the mounting screws attaching the Write Protect Sensor Assembly to the chassis (see Figure 6-12).
3. Cut the tie wraps that hold the wires to the cable harness, and lift out the Write Protect Sensor Assembly.

1. Using the original mounting bracket, attach the Write Protect Sensor Assembly to the chassis.
2. Plug P10 into the circuit board.
3. Tie wrap the Write Protect wires to the cable harness.
4. Perform the checks and adjustments in Table 6-2.

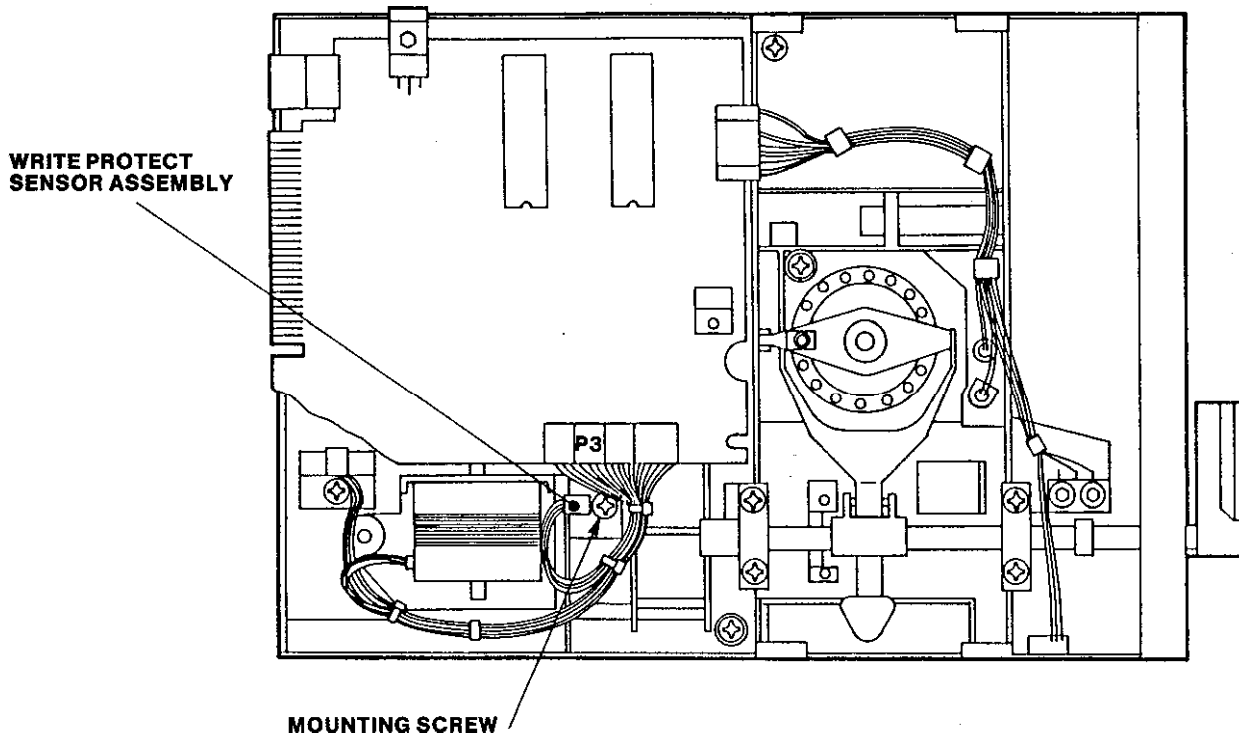


FIGURE 6-12
WRITE PROTECT SENSOR ASSEMBLY

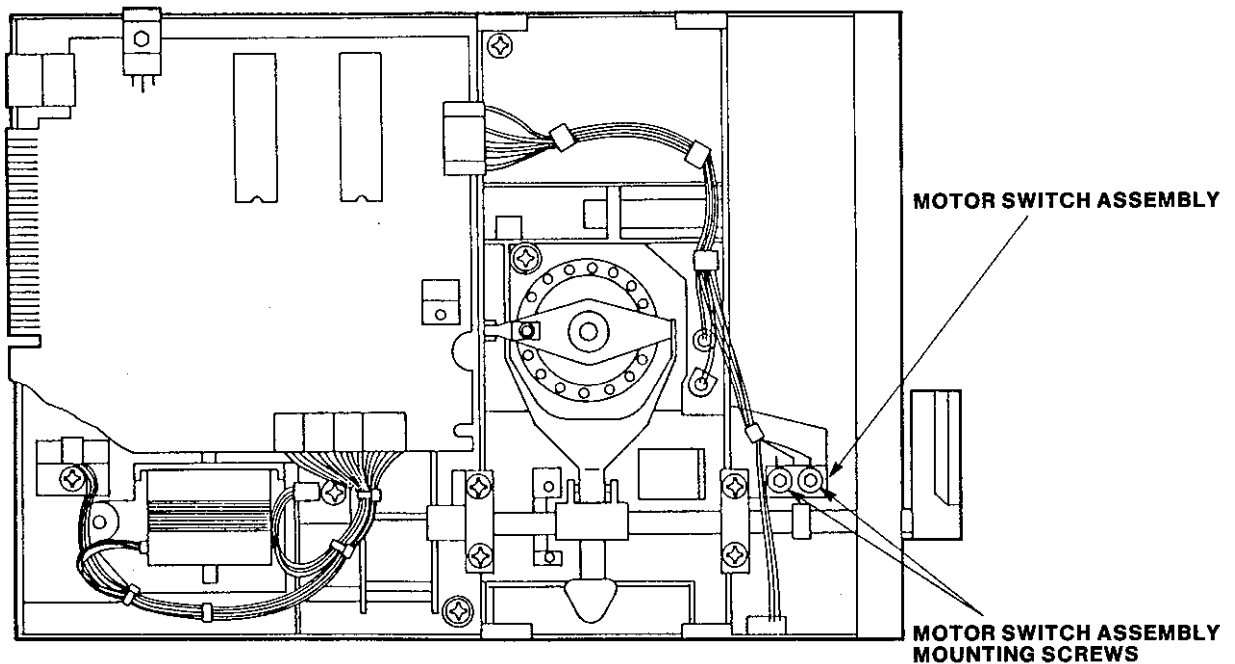
MOTOR SWITCH ASSEMBLY

INSTALLATION

REMOVAL

1. Remove P3 from the circuit board.
2. Remove the mounting screws from the motor switch (Figure 6-13).
3. Remove the cable harness tie wraps leading to P3.
4. Lift out the Motor Switch Assembly.

1. Mount the Motor Switch Assembly to the bridge, using the original mounting screws and nut plate.
2. Route the motor switch cables using the cable harness tie wraps.
3. Plug P3 into the circuit board.
4. Perform the checks and adjustments in Table 6-2.



**FIGURE 6-13
MOTOR SWITCH ASSEMBLY**

INDEX SENSOR ASSEMBLY

REMOVAL

1. Remove the Logic circuit board.
2. Remove the diskette lever.
3. Remove the front panel.
4. Remove the Bridge Assembly, and upper index sensors (Figure 6-14).
5. Remove the drive motor.
6. Remove the left guide rail by pushing in on the center tab of the rail, and push the rail out (Figure 6-15).
7. Remove the lower index sensor mounting screw.
8. Slide the index cable and connector through the slot in the chassis. Remove the index sensor.

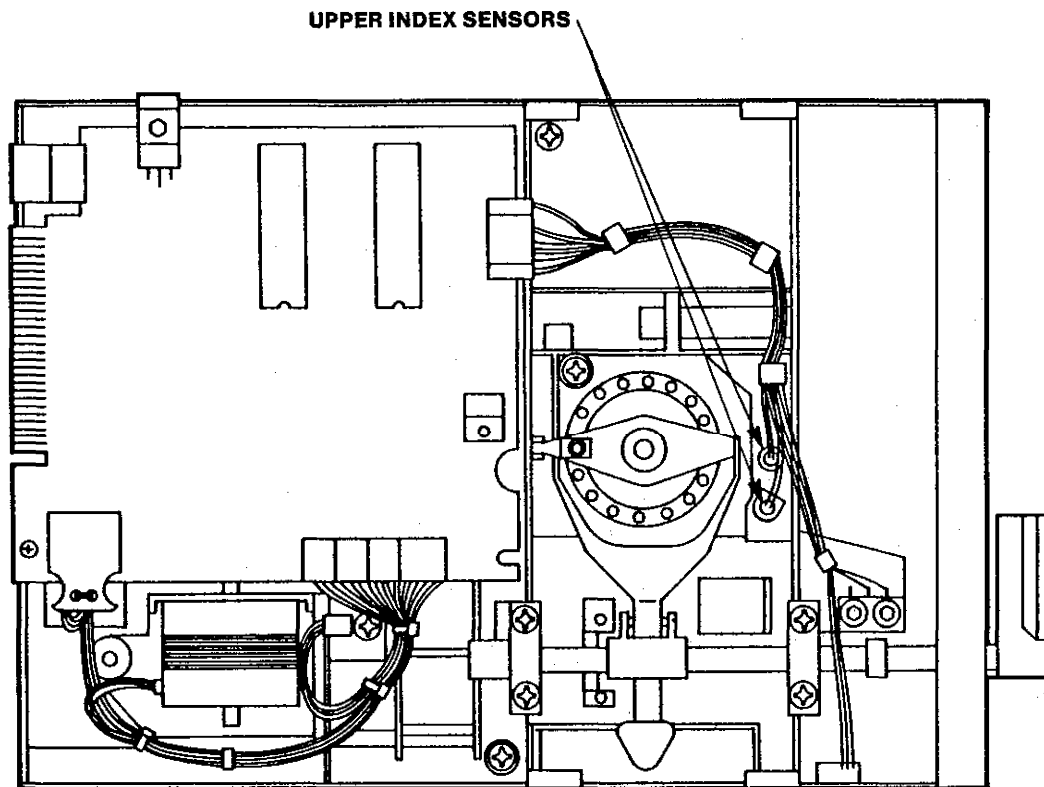


FIGURE 6-14
INDEX SENSOR ASSEMBLY, TOP VIEW

INSTALLATION

1. Mount the lower index sensor to the chassis.
2. Slide the upper index sensor cable and connector through the slot in the chassis.
3. Install the left rail by pressing it into its mounting slots in the chassis.

NOTE

Ensure the index sensor cables are between the chassis and rail.

4. Install the drive motor
5. Install the Bridge Assembly, and upper index sensor.
6. Install the front panel.
7. Install the diskette lever.
8. Install the Logic circuit board.
9. Perform the checks and adjustment in Table 6-2.

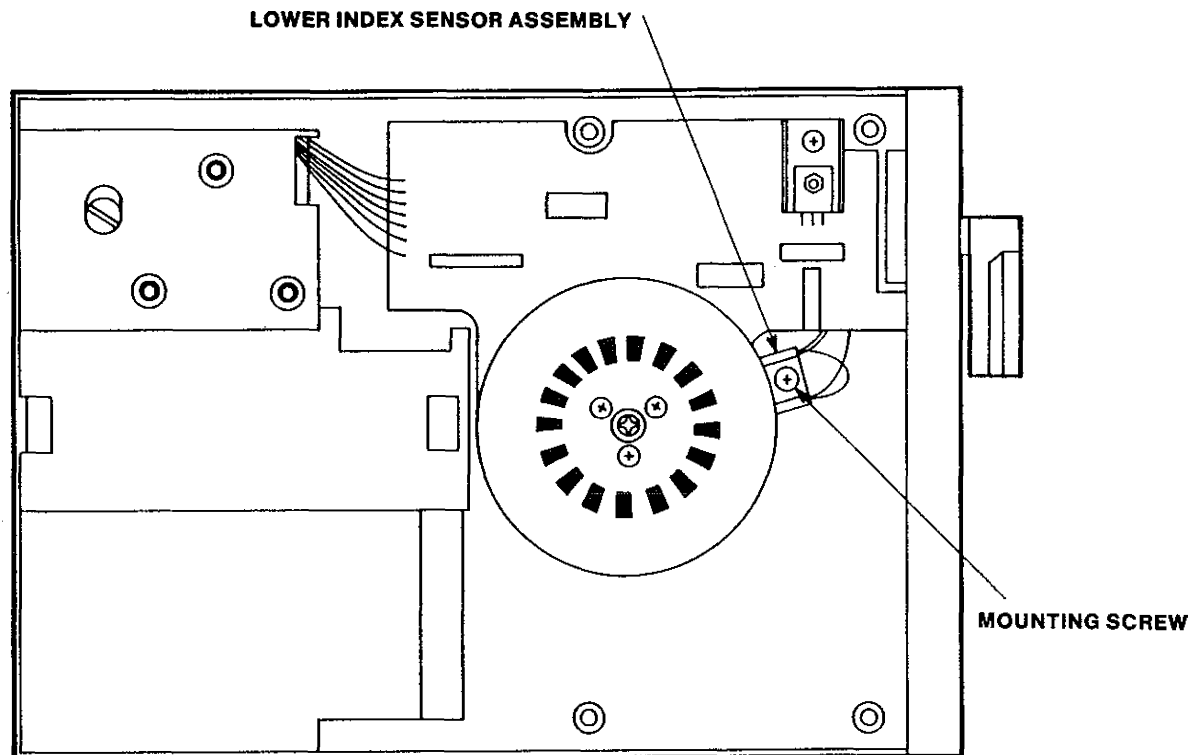


FIGURE 6-15
INDEX SENSOR ASSEMBLY, BOTTOM VIEW

DISKETTE EJECTOR ASSEMBLY

REMOVAL

1. Remove the Logic circuit board.
2. Remove the diskette lever.
3. Remove the Bridge Assembly.
4. Remove the Trigger Assembly (Figure 6-16).
5. Release the spring attached to the rear of the ejector.
6. Remove the ejector by sliding it out.

INSTALLATION

1. Ensure the ejector spring is hooked to the bridge.

2. Insert the ejector.
3. Pull the spring back, attaching it to the rear of the ejector.
4. Install the Trigger Assembly.
5. Reinstall the Bridge Assembly.
6. Install the diskette lever.
7. Reinstall the Logic circuit board.
8. Insert a work diskette into the drive.
9. Ensure the diskette stays in prior to being closed.
10. Close and open the diskette lever.
11. The diskette should eject.

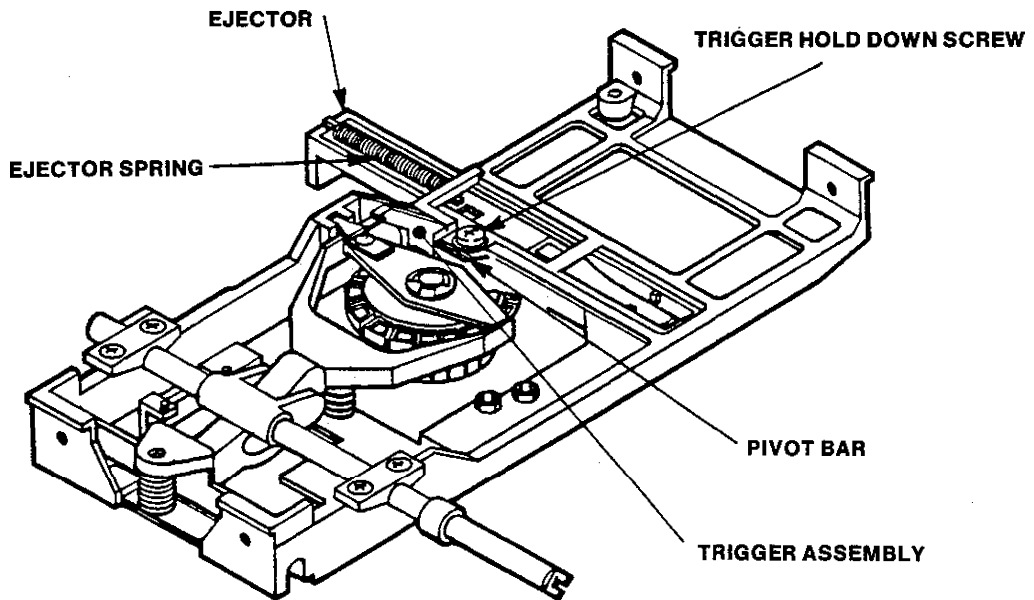


FIGURE 6-16
DISKETTE EJECTOR ASSEMBLY

STEPPER BAND

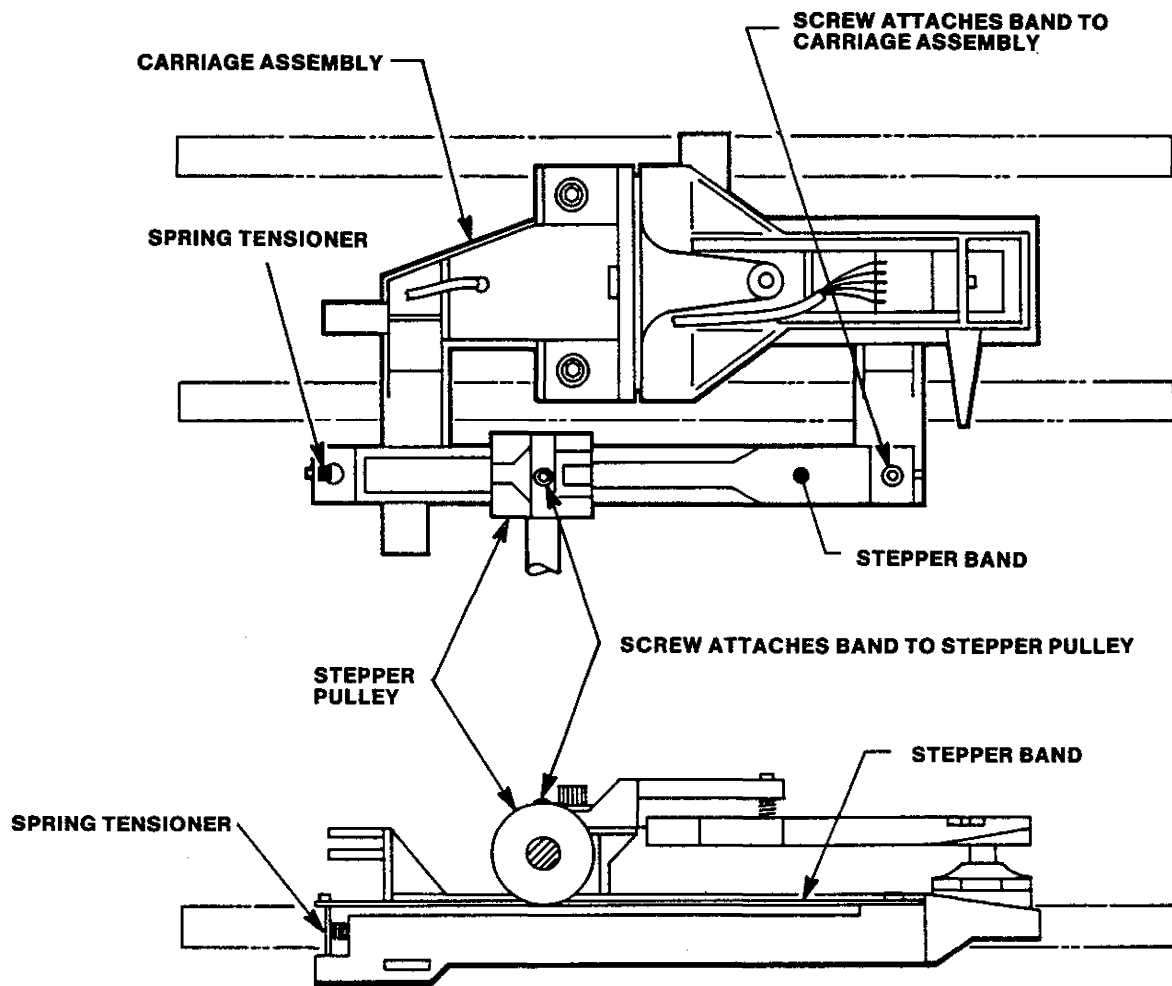
REMOVAL

1. Remove the circuit board.
2. Lift off the stepper band from the spring tensioner (Figure 6-17).
3. Lift off the stepper band where it attaches to the front of the Head Carriage Assembly.
4. Remove the mounting screw attaching the stepper band to the stepper pulley.
5. Lift out the stepper band.

INSTALLATION

1. Loop the front of the stepper band into the Head Carriage Assembly (Figure 6-17).

2. Loop the stepper band around the stepper pulley.
3. Attach the rear of the band to the spring tensioner.
4. Attach the stepper band to the stepper pulley loosely with the mounting screw.
5. Move the Head Carriage Assembly back and forth at least five times.
6. Visually inspect the stepper band to ensure it is centered on the stepper pulley.
7. Tighten the mounting screw attaching the stepper band to the stepper pulley.
8. Reinstall the Logic circuit board.
9. Perform the checks and adjustments in Table 6-2.



**FIGURE 6-17
STEPPER BAND**

STEPPER MOTOR ASSEMBLY

REMOVAL

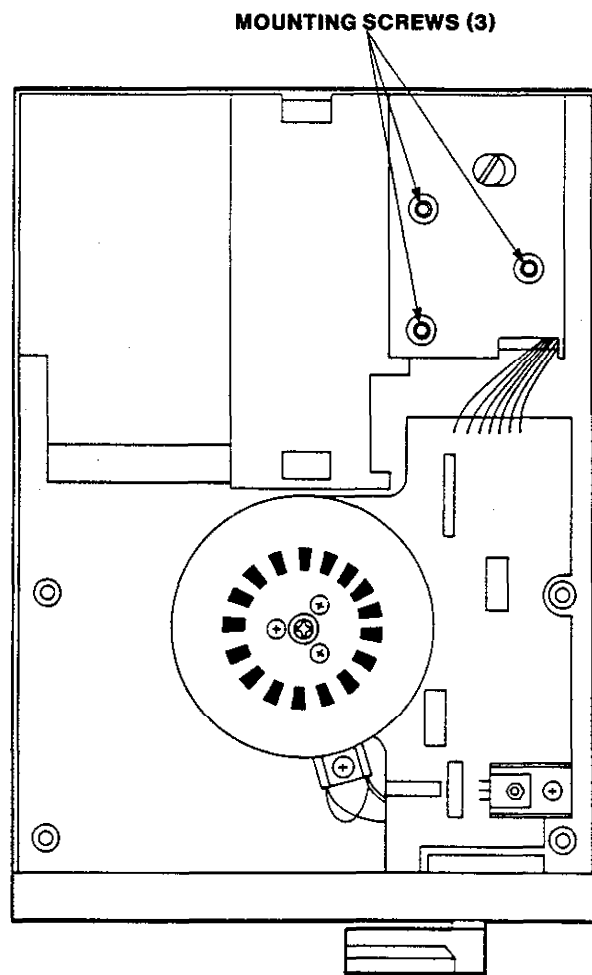
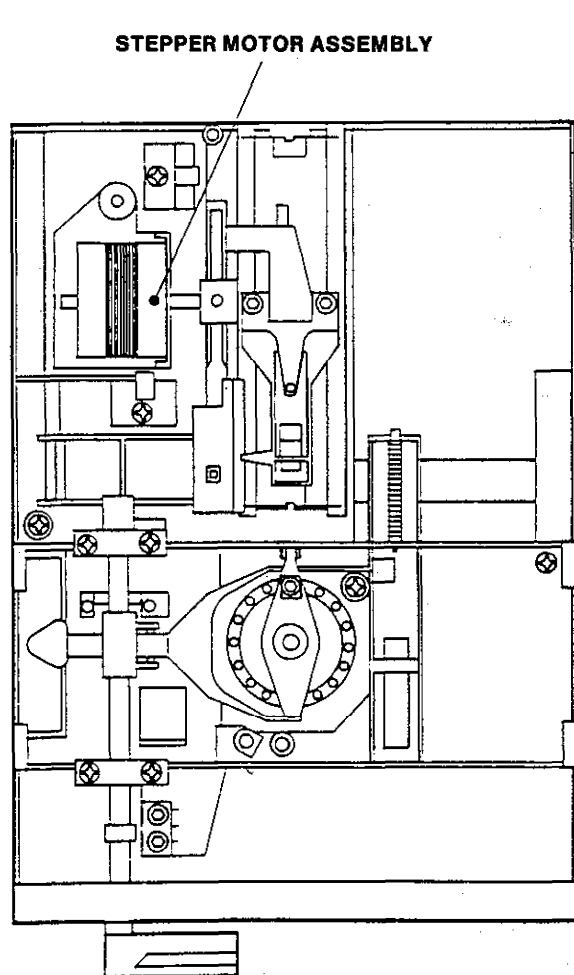
1. Remove the Logic circuit board.
2. Remove the stepper band.
3. Remove the three mounting screws attaching the Stepper Motor Assembly to the chassis (Figure 6-18).
4. Cut the tie wraps connecting the stepper motor wires to the cable harness.
5. Lift out the Stepper Motor Assembly.

NOTE

Be careful not to damage the stepper band.

INSTALLATION

1. Place the Stepper Motor Assembly into the drive's chassis.
2. Using the original three mounting screws, attach the Stepper Motor Assembly to the chassis.
3. Install the stepper band.
4. Replace the Logic circuit board.
5. Rebundle the cable harness and connect it with two tie wraps.
6. Perform the checks and adjustments in Table 6-2.



**FIGURE 6-18
STEPPER MOTOR**

HEAD CARRIAGE ASSEMBLY

REMOVAL

1. Remove the Logic circuit board.
2. Remove the stepper band.
3. Remove the two clips that hold the carriage guide rails to the chassis (Figure 6-19).
4. Carefully lift out the Head Carriage Assembly.
5. Remove the carriage guide rails from the Head Carriage Assembly.

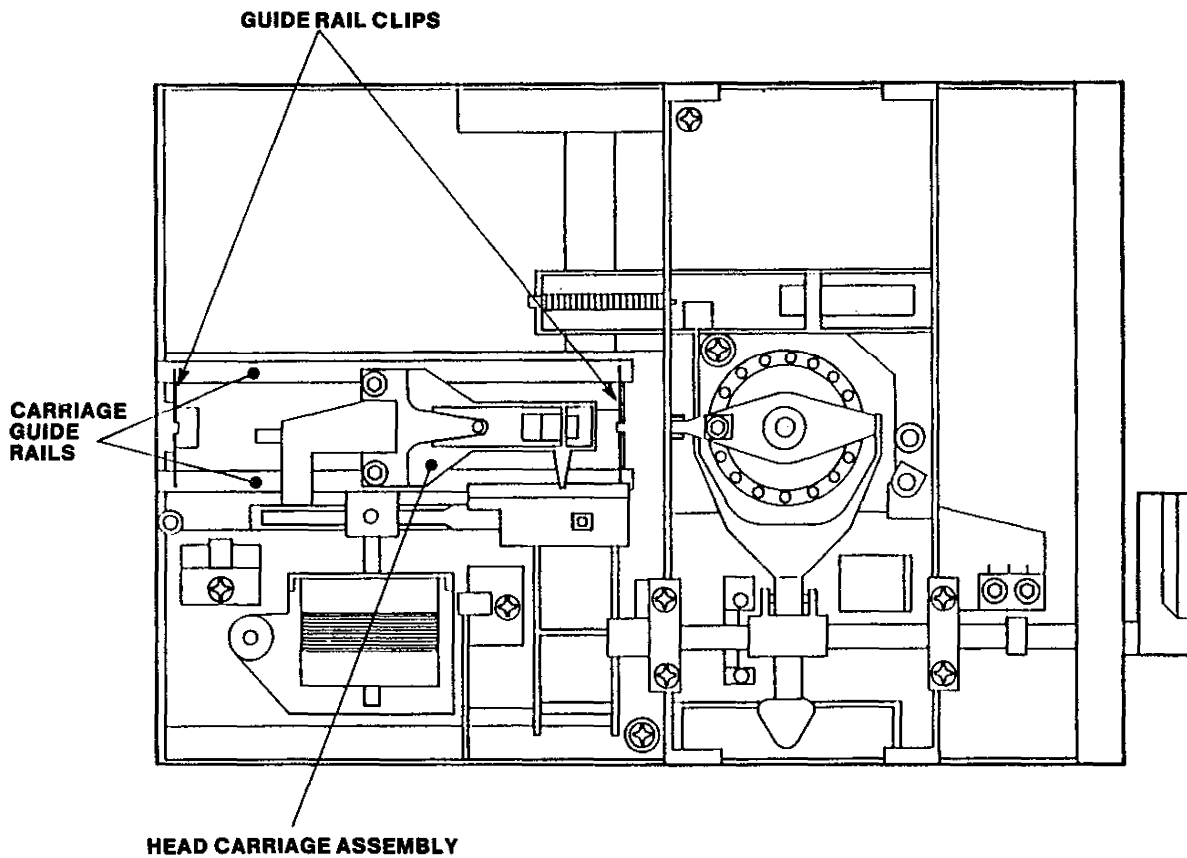
INSTALLATION

1. Install the carriage guide rails into the carriage.
2. Using the two clips, attach the carriage guide rails to the chassis.
3. Install the stepper band.

NOTE

Take care not to damage the stepper band.

4. Install the Logic circuit board.
5. Perform the checks and adjustments in Table 6-2.



**FIGURE 6-19
HEAD CARRIAGE**

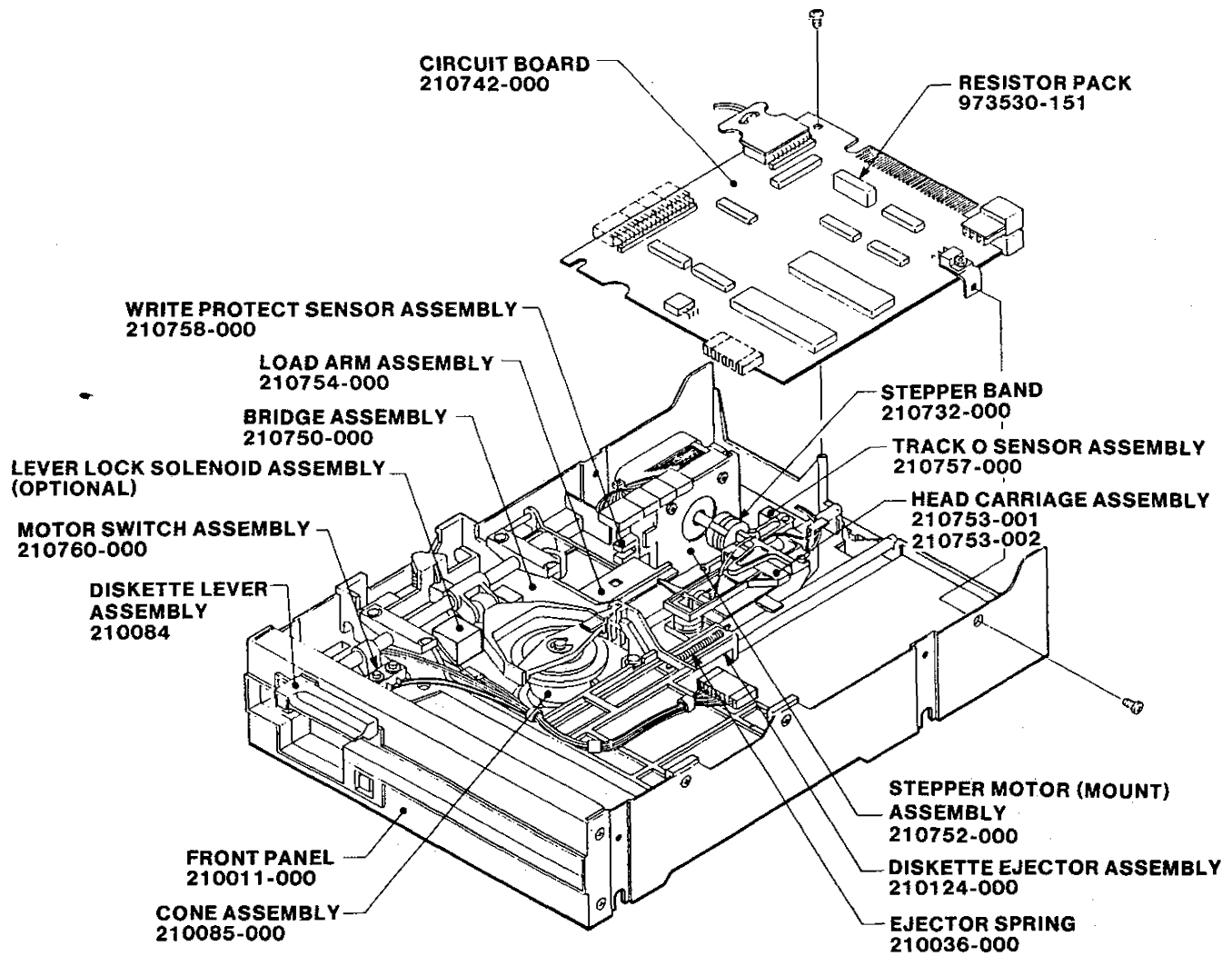


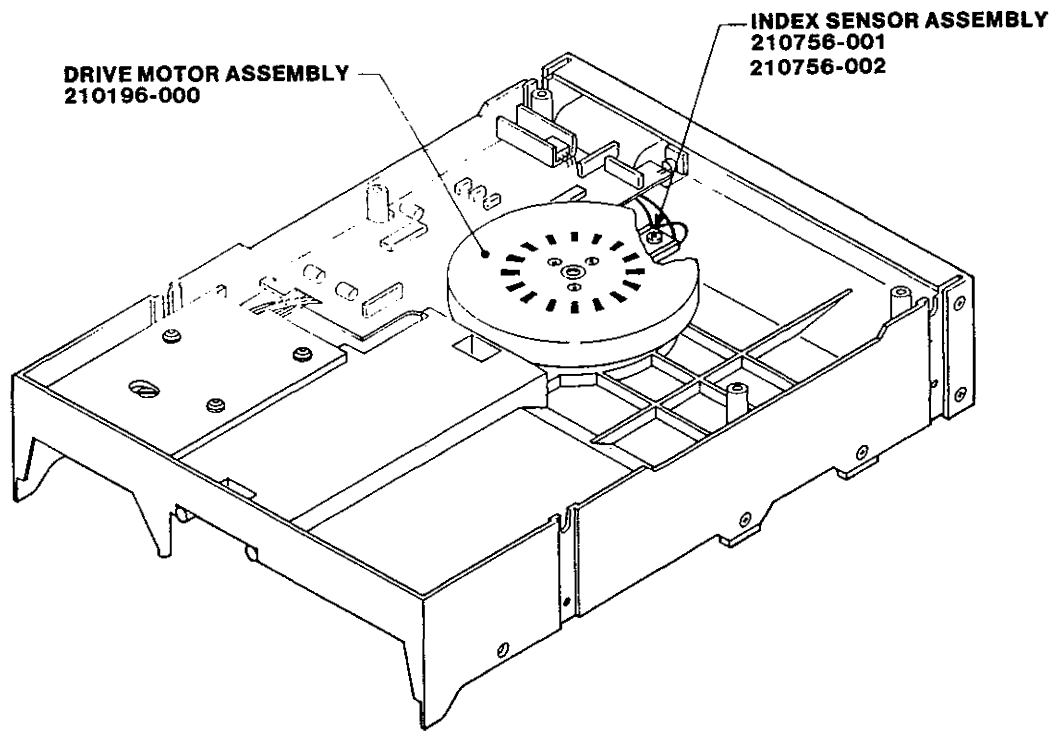
APPENDIX A

RECOMMENDED SPARE PARTS AND MAJOR ASSEMBLIES

This appendix contains the recommended spare parts 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
210742-000	Circuit Board
210085-000	Cone Assembly
210084-000	Diskette Lever Assembly
210011-000	Front Panel
210750-000	Bridge Assembly
210196-000	Drive Motor
210754-000	Load Arm Assembly
210757-000	Track 0 Sensor Assembly
210758-000	Write Protect Sensor Assembly
210760-000	Motor Switch Assembly
210756-001	Index Sensor Assembly, Single-Sided
210756-002	Index Sensor Assembly, Double-Sided
210124-000	Diskette Ejector Assembly
210036-000	Ejector Spring
210732-000	Stepper Band
210752-000	Motor Mount Assembly
210753-001	Head Carriage Assembly, Single-Sided
210753-002	Head Carriage Assembly, Double-Sided
973530-151	Resistor Pack
210140-000	Filler Panel Kit (Not Shown)
210132-000	Mounting Strap Kit (Not Shown)
210106-000	Shipping Insert (Not Shown)





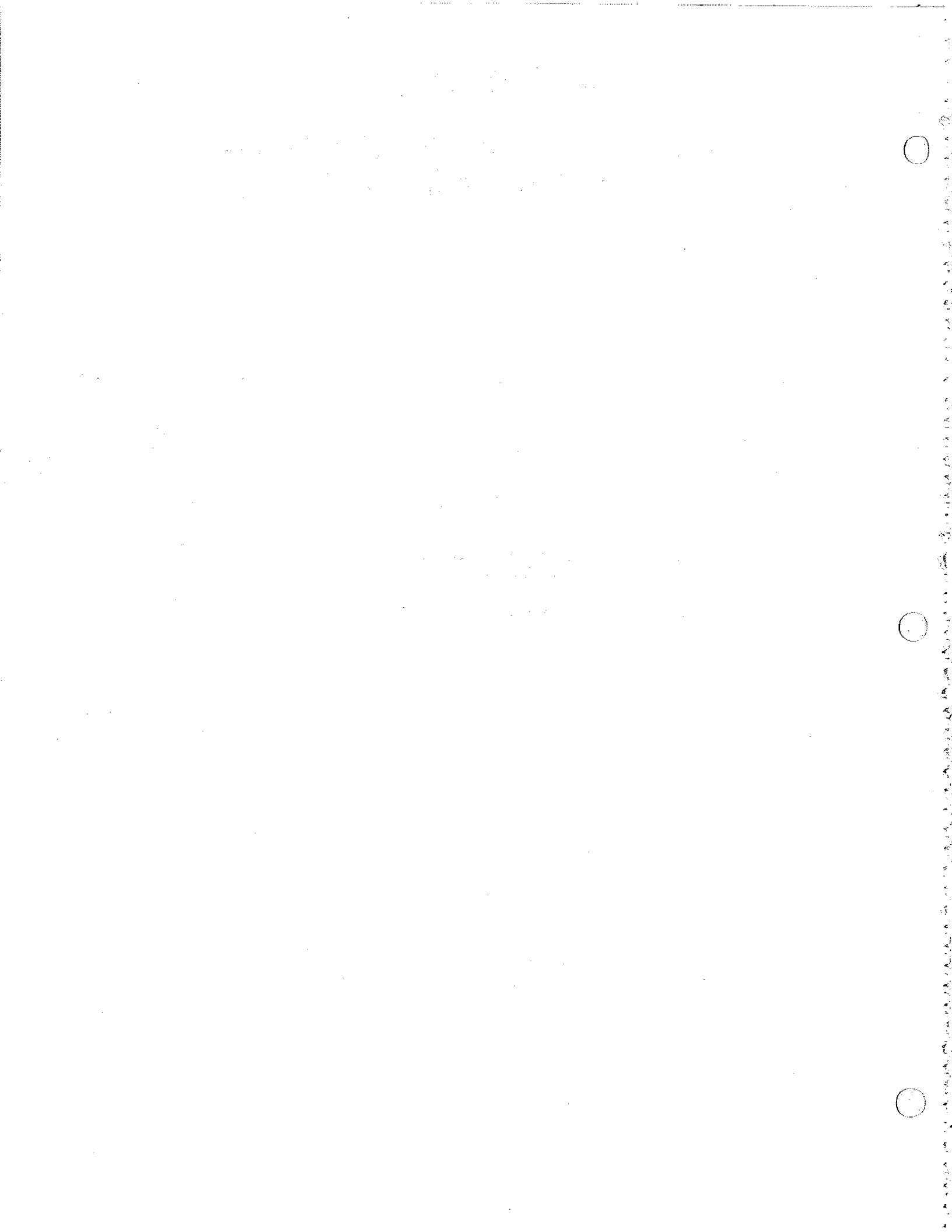


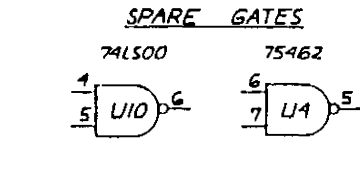
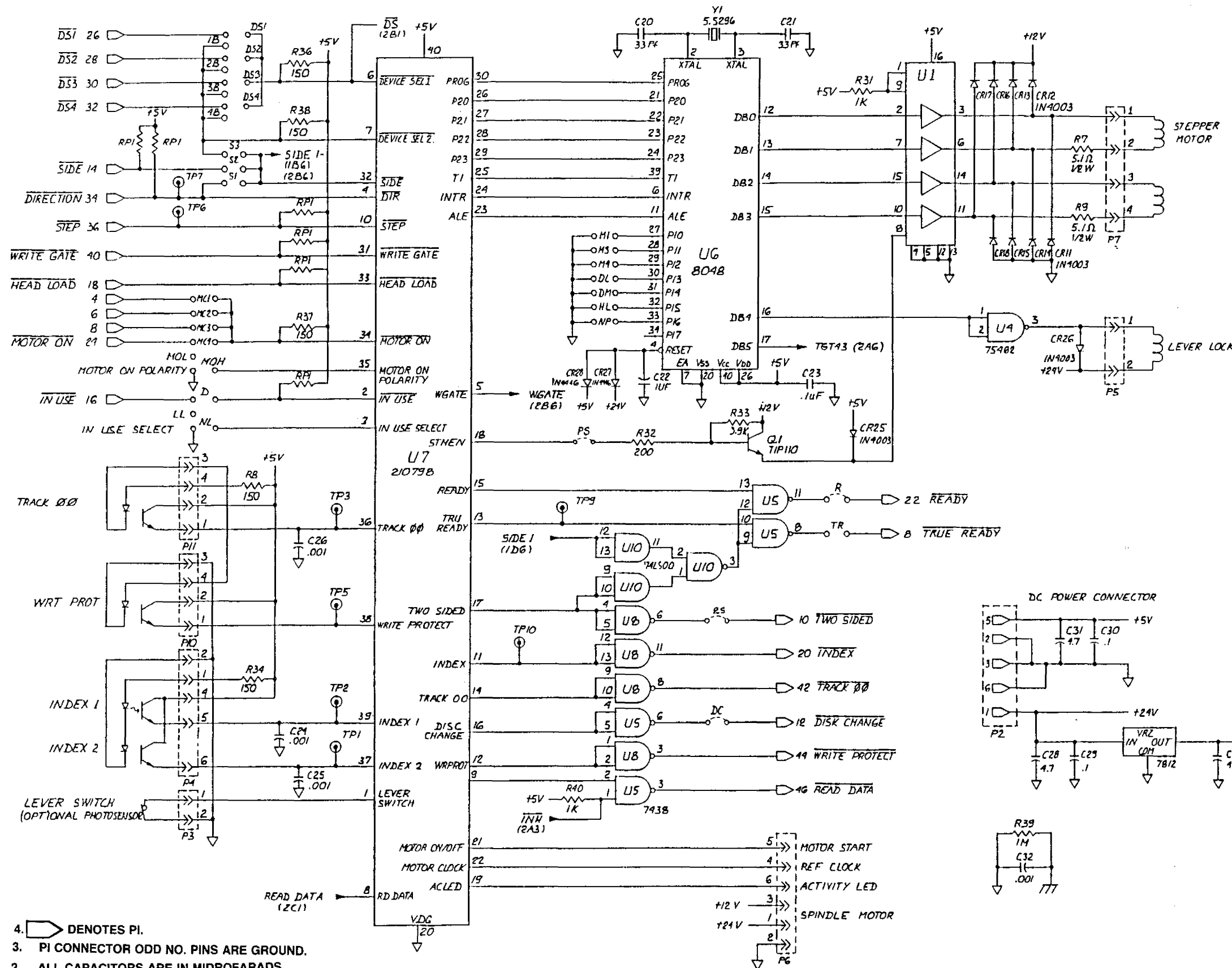
APPENDIX B

CIRCUIT BOARD SCHEMATICS AND DRAWINGS

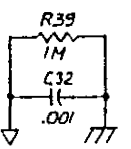
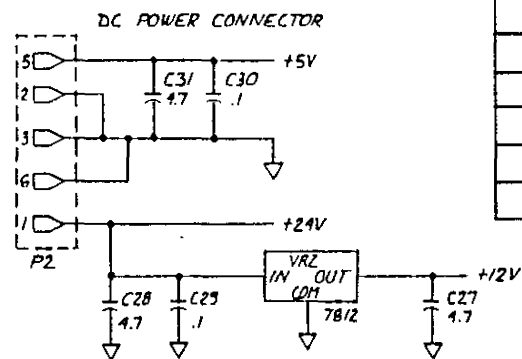
This appendix contains the current circuit board schematics and circuit board drawings for the TM848-1E and TM848-2E.

Drawing Number	Title	Page Number
210772 Revision E	Logic Circuit Board Assembly Drawing	B-2
210771 Revision C	Logic Circuit Board Schematics	B-3 – B-4
210196 Revision C	Direct Drive Motor Schematic	B-5

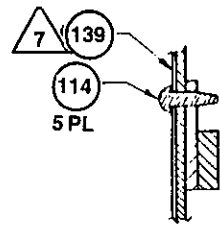




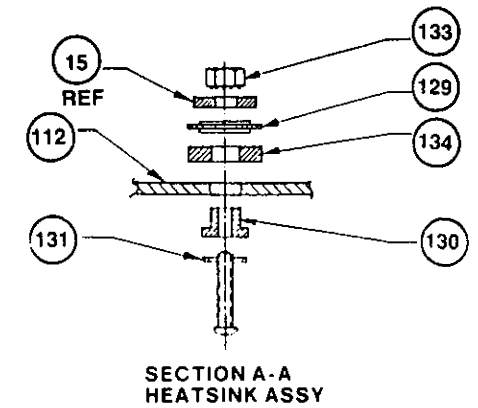
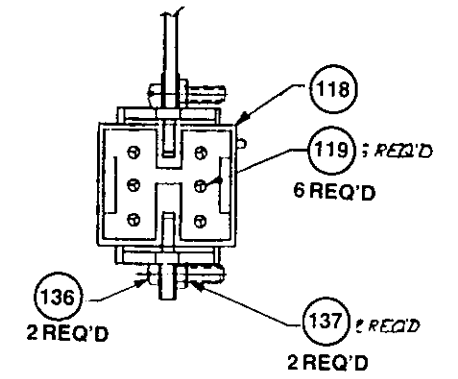
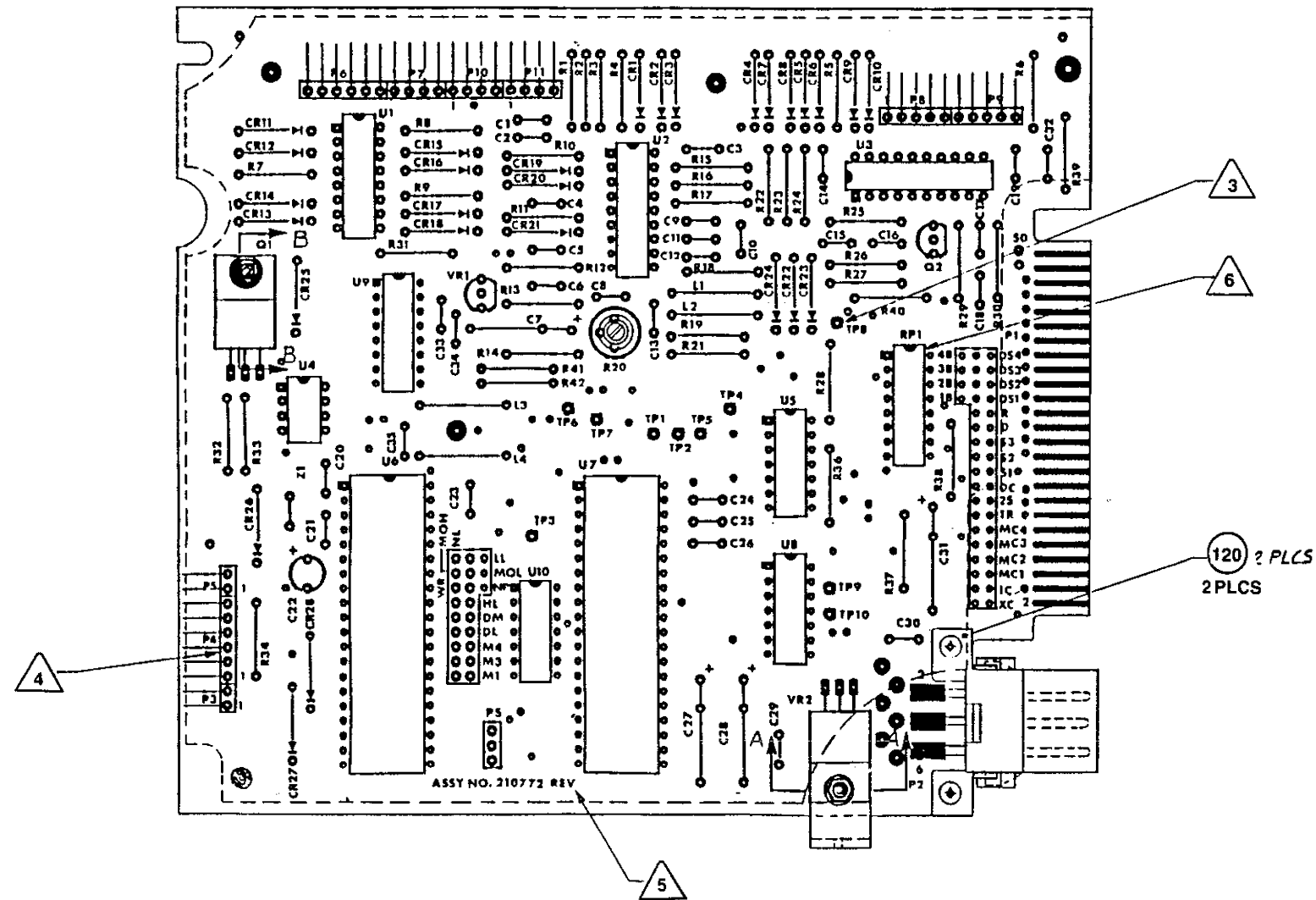
REF. DES. TABLE	
USED	NOT USED
U-U10	
R1-R34,36-42	R35
CR1-CR2B	
RP1	
VR1-2	
L1-4	
DS1,M1,M3	
TP1-10	
P1-P11	



- 4. DENOTES PI.
- 3. PI CONNECTOR ODD NO. PINS ARE GROUND.
- 2. ALL CAPACITORS ARE IN MIDROFARADS.
- 1. ALL RESISTORS ARE IN OHMS.

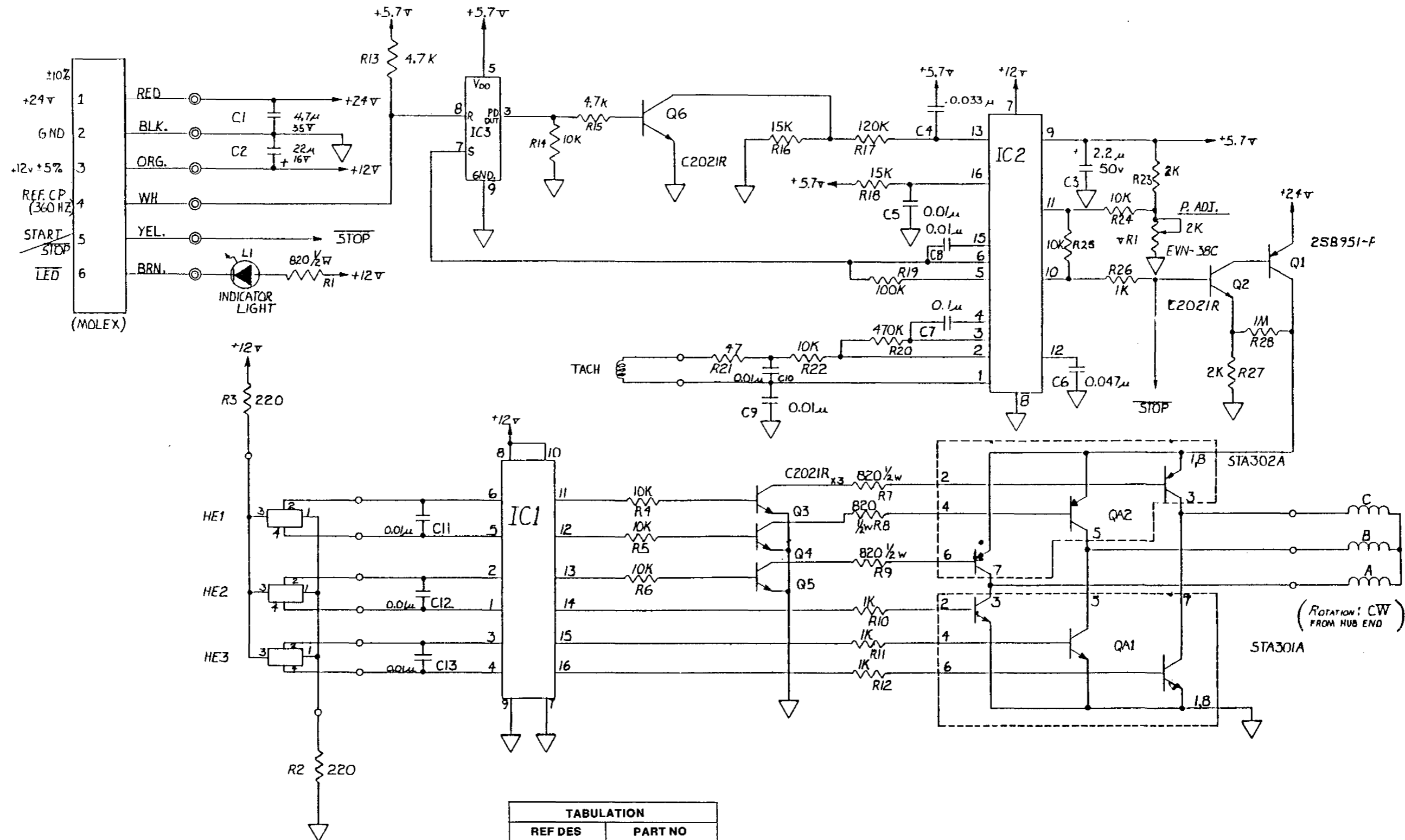


SECTION B-B
INSERT PLASTIC RIVET
INTO Q1 & SHIELD
5 PLACES AS SHOWN



- ⑦ ITEM 139 (SHIELD) TO BE MOUNTED ON CIRCUIT SIDE OF BOARD.
- ⑥ RPI IS INSTALLED AT FINAL ASSY.
- ⑤ MARK REV. LETTER IN AREA INDICATED.
- ④ REMOVE OR CUT FLUSH CONNECTOR P4 PIN 3 AS SHOWN.
- ③ TEST POINTS DENOTED BY □ SYMBOL.
- ② REF: SCHEMATIC DRAWING 210771.
- ① REF: FABRICATION DRAWING 210773.

Tandon CORPORATION
LOGIC CIRCUIT BOARD
ASSEMBLY DRAWING
210772 - REV E
SHEET 1 OF 1
B-2



TABULATION	
REF DES	PART NO
IC1	µPC1246C
IC2	µPC1043C
IC3	TC5081P

4. REFERENCE: NIDEC DIRECT DRIVE MOTOR ASSEMBLY 88PTDN8003.

5. "IDENTIFY CONNECTOR BY MARKING "P6" ON SOLID PLASTIC SURFACE."

Tandon CORPORATION
 DIRECT DRIVE MOTOR
 SCHEMATIC
 210196 - REV C
 SHEET 1 OF 1
 B-5

Tandon

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