# 651 Flexible Disc File

## Maintenance Manual

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MEMOREX

Disc Storage Products

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# PREFACE

This manual contains information necessary for an OEM user to maintain the 651 Flexible Disc Drive when connected in a host system. The manual contains a brief functional description with a listing of operating capabilities and characteristics, a listing of special tools and test equipment required during maintenance, operating instructions, and detailed maintenance procedures. The manual is designed to be used with the *651 Logic Diagrams Manual,* P/N 204166, which together constitute a complete maintenance package to support the 651.

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# SECTION 1
# GENERAL INFORMATION

## 1.1 INTRODUCTION

The Memorex 651 Flexible Disc File (Figure 1-1) is a compact, direct access, removable disc unit which simplifies the distribution, processing, and storage of digital information. Typical applications for the 651 are control store loading, auxiliary storage, data logging, key-entry recording, programmable calculator storage, point-of-sale recording, and accounting machine storage. The 651 is composed of a drive mechanism, a read/write head, a head position actuator, and associated electronics. Connections are made to the host system by signal and power cables with addressing, function requests, data formatting, and power supplied by the user. The 651 can write and read discs interchangeable from unit to unit.

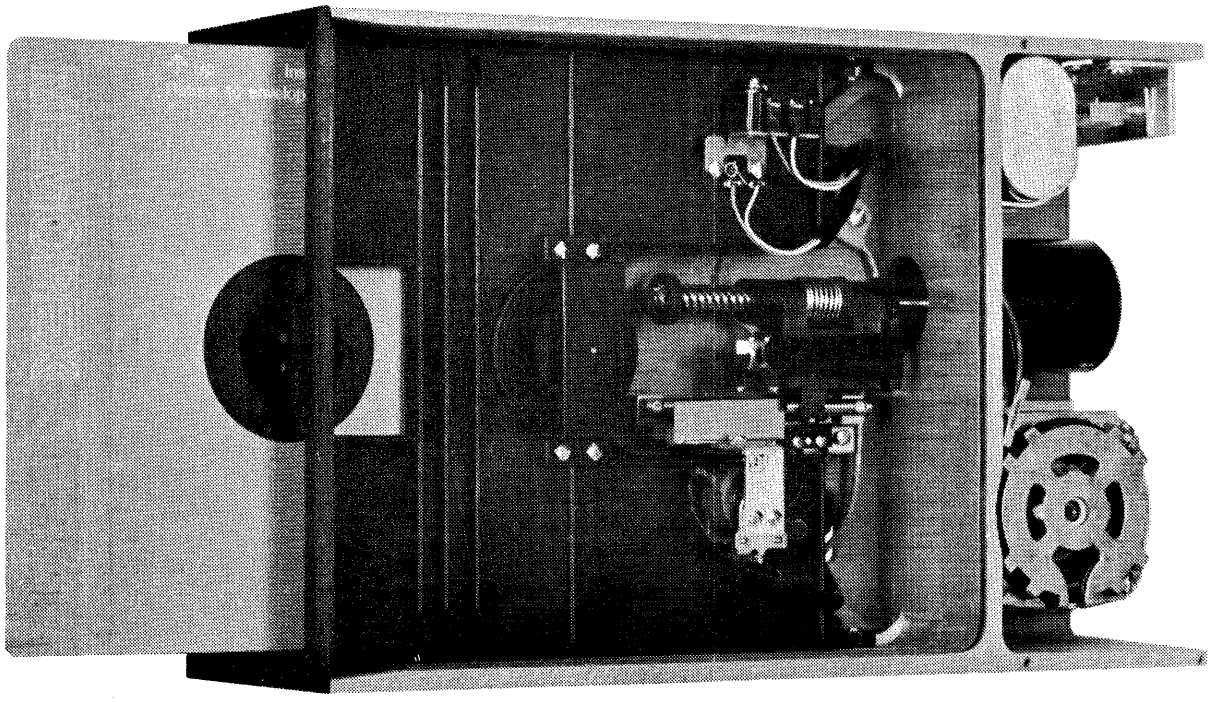


Figure 1-1. 651 Flexible Disc Drive

The FD/IV Flexible Disc Cartridge used in the 651 is a flat disc composed of Mylar® substrate coated with a brown magnetic iron oxide material. For protection during handling, operation, storage, and mailing, the coated disc is encased in a flexible vinyl envelope, eight inches square by one-sixteenth inch thick, which is sealed around the edges of the disc and lined with a self-cleaning wiper. An oval slot in the envelope permits the read/write head to access the disc for recording.

Writing on the disc can be inhibited by sliding a fitted one inch by three-fourths inch adhesive-backed write protect tab into the keying notch of the vinyl envelope containing the disc (Figure 1-2). When this removable plastic tab is in position and the disc is inserted in the 651, the raised portion of the tab pushes the actuator which closes the write protect switch. Once the switch is off (closed), the 651 cannot write. The full read/write operation can be restored by physically removing the write protect tab from the disc.

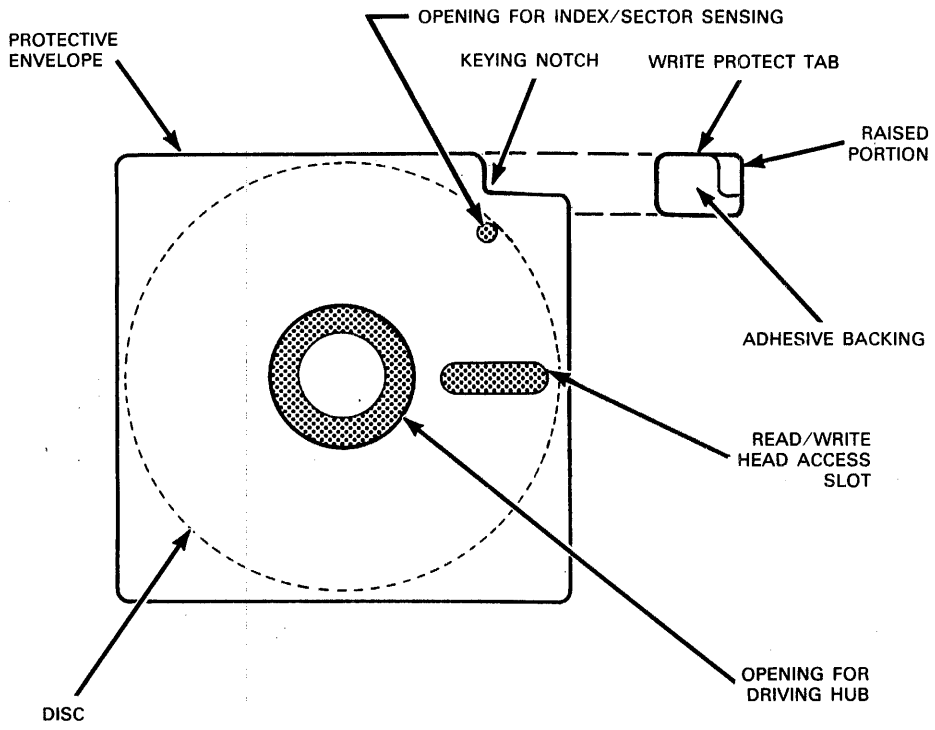



Figure 1-2. Write Protect Tab Insertion

## 1.2 MACHINE CHARACTERISTICS

Machine characteristics include data retrieval times, disc characteristics, and the data recording format. These items are as follows:

**DATA RETRIEVAL TIMES**

| | |
|---|---|
| ● Rotational Speed | 375 rpm |
| ● Track-to-Track Access Time | 10 msec |
| ● Head Settle Time at Last Track | 10 msec |
| ● Data Transfer Rate | 250 kilobits/second |

**DISC CHARACTERISTICS**

| | |
|---|---|
| ● Number of Tracks | 64 |
| ● Recording Density | 3100 bits per inch (inside track) |
| ● Record Length, Sectorized (32 per track) | 1056 bits |
| ● Record Length, Indexed (1 per track) | 38.5 kilobits |
| ● Disc Capacity, Sectorized | 2.2 megabits |
| ● Disc Capacity, Indexed | 2.5 megabits |

**DATA RECORDING FORMAT**

| | |
|---|---|
| ● Recording Mode | Frequency modulation |
| ● Sectors per Track | 32 |
| ● Index per Track | 1 |

## 1.3 ENVIRONMENTAL REQUIREMENTS

Temperature, humidity, and BTU output of the 651 are listed below:

| | |
|---|---|
| ● Temperature | 60° to 100° F (operating)<br>-40° to 140° F (non-operating) |
| ● Relative Humidity | 20% to 80% (operating)<br>90% max (non-operating) |
| ● Wet Bulb Temperature (max) | 78° F |
| ● Heat Generated (max) | 346 BTU per hour |

## 1.4 POWER REQUIREMENTS

Power required to operate the 651 is listed below. All power is supplied by the using system.

**AC Power**

100 to 132 VAC
50/60 Hz ± 1 Hz, single phase
1.0 ampere

207 to 253 VAC
50/60 Hz ± 1 Hz, single phase
1.0 ampere

**DC Power**

+5 ± 0.2 volts @ 0.85 amp (nominal), 50 mv ripple max p-p
-11 to -16 volts @ 0.09 amp (nominal), 100 mv ripple max p-p
+24 ± 1.5 volts @ 1.3 amps (nominal), 100 mv ripple max p-p

## 1.5 OPERATING CAPABILITIES

Operation of the 651 is fully automated requiring no operator intervention during normal operation. All maintenance and diagnostic procedures are predicated on the proper application of power from the using system.

All 651 drives are capable of being operated with 50 or 60 Hz power. For 60 Hz, the disc drive motor pulley is mounted on the shaft with the large end toward the motor. The belt is driven by the small diameter pulley. For 50 Hz, the pulley is reversed on the shaft and the belt is driven by the large diameter pulley.

## 1.6 FUNCTIONAL PRINCIPLES

### 1.6.1 GENERAL OPERATION

The 651 consists of electronic, mechanical, and transducer elements that perform the following functions:

- Receive and generate control signals
- Generate status signals
- Access the appropriate track
- Write or read data upon request

These functions are implemented by the assemblies shown in the block diagram of Figure 1-3.

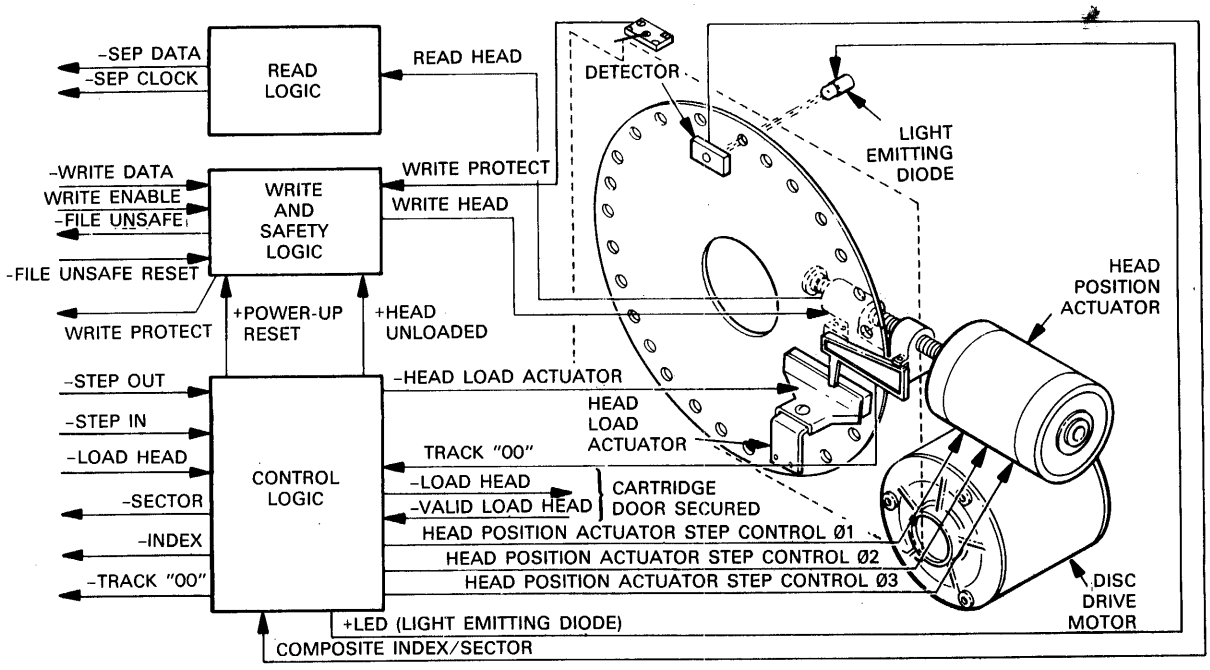



Figure 1-3. 651 Block Diagram

The Control, Read, and Write and Safety Logic constitute the interface electronics between the user system and the 651. These electronics are packaged on one printed circuit (PC) board, along with other circuits. The PC board contains:

1. Sector/index detector circuits
2. Track Position Actuator driver
3. Head Load Actuator driver
4. Read/write amplifier and transition driver
5. Data/clock separation circuits
6. Safety sensing circuits
7. Write protect circuits

The Head Position Actuator consists of a stepping motor which, in conjunction with a lead screw, positions the read/write head. The stepping motor rotates the lead screw clockwise or counterclockwise in 15-degree increments, causing the head to move one track position. The using system increments the head to the desired track.

The Disc Drive Motor rotates the spindle at 375 rpm through a belt-drive system. Either 50 or 60 Hz power is accommodated by means of a stepped pulley. A registration hub, centered on the face of the spindle, positions the disc. The disc is fixed to the registration hub by a clamp that moves in conjunction with the door.

The 651 employs the contact method of recording, wherein the read/write head is in direct contact with the disc. The head is mounted on a carriage which is moved by the lead screw. The write portion of the head is wider than the read portion. This allows a normal deviation of the head from the center of the track without affecting the signal-to-noise ratio, or affecting disc interchangeability from unit to unit.

The Head Load Actuator loads the head by lightly pressing the flexible disc against the rigidly-mounted head. This is achieved by energizing a solenoid, which releases the bail from the spring-loaded carriage load arm, causing the load arm pad to press the disc against the head (Figure 1-4). Deenergizing the solenoid causes the retracting bail to lift the load pad from the disc, thereby unloading the disc.

The disc, 7.5 inches in diameter, has 32 holes spaced around the periphery for sector definition, and one additional hole for indexing (Figure 1-5).The disc rotates inside the plastic envelope during normal operation.

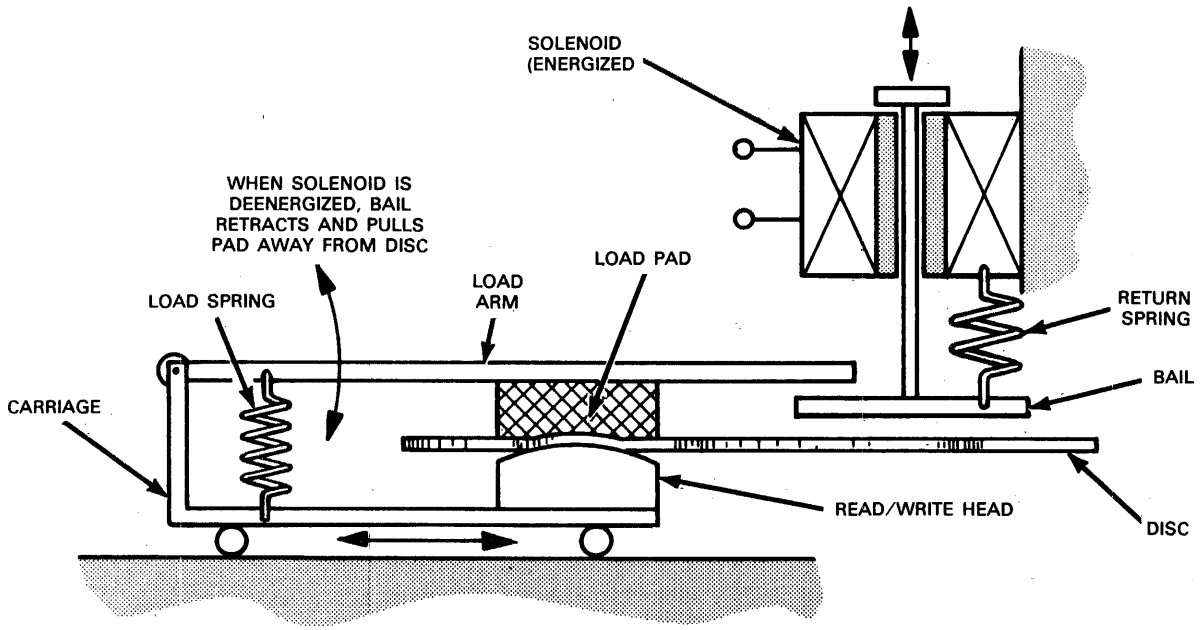



Figure 1-4. Head Loading Mechanical Assembly

The disc cartridge, composed of a disc within the plastic jacket, has openings in it in order for the drive to interface with the disc (Figure 1-5). A cartridge corner is notched which prevents a cartridge from being installed in a drive in an improper attitude. A write protect tab is fastened to the cartridge in the notch area when it is desired to prevent further recording on the disc.

The Light Emitting Diode (LED) and Detector generate disc index and sector pulses used by the host system to format and orient data written on the disc. As shown in Figure 1-5, 32 holes (0.10 inch diameter) divide the disc into equal sectors. The thirty-third hole (same diameter) spaced midway between two sector holes indicates one disc revolution. The LED and Detector (photo transistor) are placed on opposite sides of the disc. As the disc revolves, the holes pass between the LED and Detector illuminating the Detector and turning it on. The Detector output is shaped by a threshold detector and an output pulse is obtained. The output is normally at +5 volts with a transition to 0 volt for the pulse. Internally within the Control Logic, the index and sector pulses are separated and transmitted to the user.

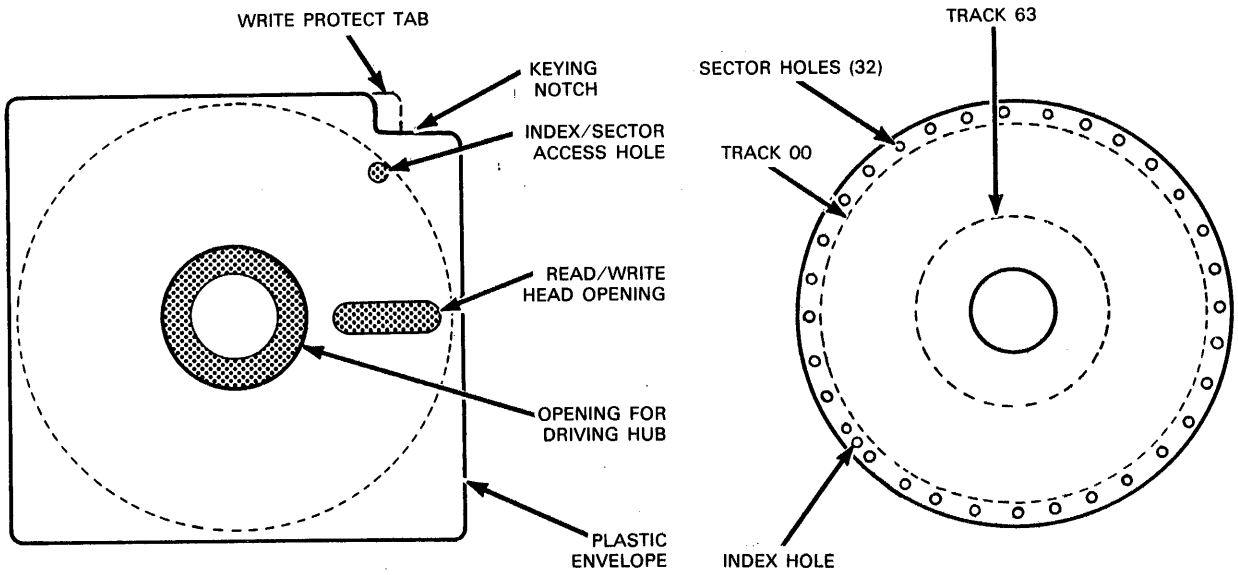



Figure 1-5. Disc Cartridge and Disc Configuration

### 1.6.2 LOGIC AND ANALOG FUNCTIONAL DESCRIPTIONS

These paragraphs discuss each functional logic block, and signal name. The descriptions are divided into three categories associated with the functional blocks: Control, Write and Safety, and Read. All input interface signals are generated by the user. All output interface signals are generated by the 651. Refer to Figure 1-3 for relationships between functional blocks and signal names.

#### 1.6.2.1 Control Logic

The basic functions of the Control Logic are to place the read/write head on the proper track, hold the disc against the head for write or read operations, and indicate disc rotational position. User interface signals are as follows:

| | |
|---|---|
| STEP OUT | Increments the Track Position Actuator. Each pulse moves the head outward one track away from the center of the disc. |
| STEP IN | Increments the Track Position Actuator. Each pulse moves the head one track inward toward the center of the disc. |
| LOAD HEAD | Loads or unloads the disc from the read/write head. |
| SECTOR and INDEX | Provides disc sector and index position information. Each signal is a separate output. These pulses are generated from holes located around the periphery of the disc and are used for the formatting and orientation of data on the disc. |
| TRACK 00 | Indicates when the read/write head is located at Track 00. |

Transducer signals between the 651 Control Logic and electromechanical assemblies are as follows:

| | |
|---|---|
| HEAD LOAD | Energizes the solenoid as shown in Figure 1-4. It is a function of LOAD HEAD (user-supplied). |
| TRACK 00 | Switch closure indicating that the read/write head is located at Track 00. |
| VALID LOAD HEAD | Switch closure interlock indicating that the cartridge door is secured. If this condition is not satisfied, the read/write head cannot be loaded. |
| LED | Provides power to the Light Emitting Diode (LED). |
| COMPOSITE INDEX/SECTOR | Detector signal input to the Control Logic providing disc index and sector information. Internally within the Control Logic, the INDEX and SECTOR signals are separated and are transmitted via separate interface lines to the user. |
| WRITE PROTECT | Switch closure indicates the disc cartridge has been write protected by means of an add-on tab to the cartridge. |

### 1.6.2.2 Write and Safety Logic

The basic function of the Write and Safety Logic is to record the digital data received from the user system on the disc, and to insure that the file is in proper condition before recording begins. User interface functions are as follows:

WRITE DATA — A user-generated composite signal consisting of alternating data and clock.

WRITE ENABLE — A gating function activated during the write operation. This signal is used to control the recording of data on the proper track and sector.

FILE UNSAFE — Any one of the underlisted electronic conditions within the 651 can produce this signal and disable the write driver circuits:

1. Write enable and head not loaded.
2. Write enable and no write data after 15 microseconds.
3. Write enable, write data, and write protect.

FILE UNSAFE RESET — Resets a latch in the Write and Safety Logic block when conditions have been corrected which produced the FILE UNSAFE signal. Initially, when power comes on, the latch is reset automatically within the 651. Manual intervention is recommended for this function.

WRITE PROTECT — Indicates that the disc has been write protected and no write operation can occur.

Transducer signal communication between the 651 Write Logic and the write head is as follows:

WRITE HEAD — Supplies current to the write head. The direction of this current reverses each time a WRITE DATA pulse is received.

### 1.6.2.3 Read Logic

The basic function of the Read Logic is to receive analog signals from the disc and convert this composite signal into separate clock and data pulses. Data and clock come from the Read Logic block when the disc is loaded onto the head. User interface functions are as follows:

SEP DATA — Digital data bits read from the disc.

SEP CLOCK — Digital clock bits read from the disc.

Transducer signal communication between the 651 Read Logic and the read head is as follows:

READ HEAD — An analog representation of the recorded information described previously for WRITE DATA and WRITE HEAD. This signal is amplified, differentiated, limited, and then shaped. The shaped data is input to a data separator circuit which separates the data bits from the clock bits.

### 1.6.3 FUNCTIONAL OPERATION

The 651 functional sequences are divided into the following three phases of operation: Initialization, Track Access, and Write or Read. The Initialization phase is used when the power is turned on. During normal operation, the desired track is located with Track Access, and either Write or Read is performed.

#### 1.6.3.1 Initial Mode

The user applies ac and dc power to the 651. After a two-second delay (user-provided) from Power On, STEP OUT is applied until the read/write head is positioned at Track 00. This operation is performed to insure that the head is properly oriented before a read or write operation begins. When the head is positioned at Track 00, the TRACK 00 signal becomes true. It changes to false when the head leaves that track.

The LOAD HEAD signal can be applied any time after the power has been turned on. When the LOAD HEAD line is false, the read/write head is unloaded from the disc. The disc must be loaded on the head before a write or read operation can begin. At the user's option, this signal can be made true at the same time as power is applied to the 651 and will remain on until power is removed, or it can be applied when the head has been positioned at Track 00. If a read, write, or head positioning command is not executed within four revolutions of the disc, the head should be unloaded. The LOAD HEAD signal must be applied 40 msec (minimum) before a write or read operation can begin.

#### 1.6.3.2 Track Access Mode

The STEP OUT and STEP IN functions are used for positioning the read/write head to the desired track. The only restriction placed on these signals is that each pulse must be spaced by at least 10 msec. An additional 10 msec head settle time must be allowed for at the addressed track before a write or read operation can begin. The STEP IN pulse width is the same as the pulse width for STEP OUT.

#### 1.6.3.3 Write or Read Mode

The write and read sequences are basically the same. They are discussed separately for clarity. As stated previously, the read/write head must be loaded with LOAD HEAD a minimum of 40 msec before a write or read operation can begin.

**Write**

WRITE ENABLE can be made true 20 msec after the leading edge of the last desired STEP IN or STEP OUT pulse has occurred. WRITE DATA may begin when WRITE ENABLE is true.

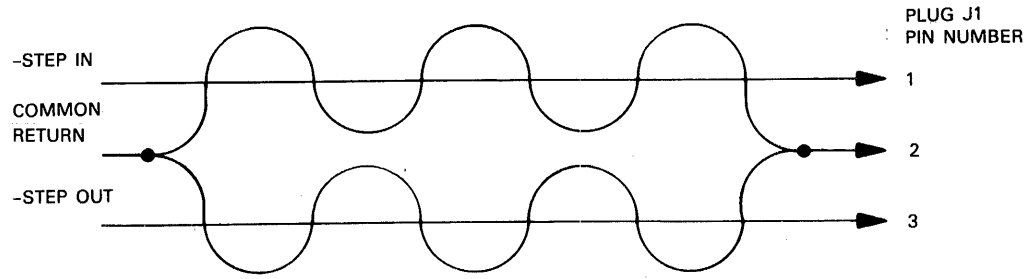
The using system generates separate clock and data. These functions are combined into the composite WRITE DATA input to the 651. Clock and data should have logic gates to control their respective functions for proper formatting on the disc.

**Read**

For read operations, the output functions SEP DATA and SEP CLOCK are the reverse of composite WRITE DATA and are separated into separate clock and data lines. Even though data is outputted immediately when the disc is loaded on the read/write head, reading should not start until the STEP IN or STEP OUT accessing has been completed. The user could accomplish this gating with a Read Enable function which would be used the same as for WRITE ENABLE. As suggested previously for Write, the user should use the SECTOR or INDEX pulses for gating output data from the 651. One of these functions would be connected to Read Enable (user-provided) for proper synchronization.

## 1.7 INTERFACE DESCRIPTION

The interface requirements can be divided into three categories: control, data, and power. The following paragraphs describe the requirements with relationship to connector, polarity, logic level, and pulse width. An interface wiring diagram of the 651 with signal names, pin numbers, and connectors is shown in Figure 1-6. The 651 requires only two cables, power and control-data. The twisted-pair lines consist physically of four wires and are wired as illustrated in the example below.




### 1.7.1 CONTROL

The control signals are divided into two types: input and output. The input signals (listed in Table 1-1) are provided by the host system and output signals (listed in Table 1-2) are from the 651.

### 1.7.2 DATA

The data input and output signals are listed in Table 1-3.

### 1.7.3 POWER

Table 1-4 lists the power requirements of the 651. All power is supplied by the user system. The user must ensure that common practices of powering down a system are followed, such as removing the logic supply voltages last.

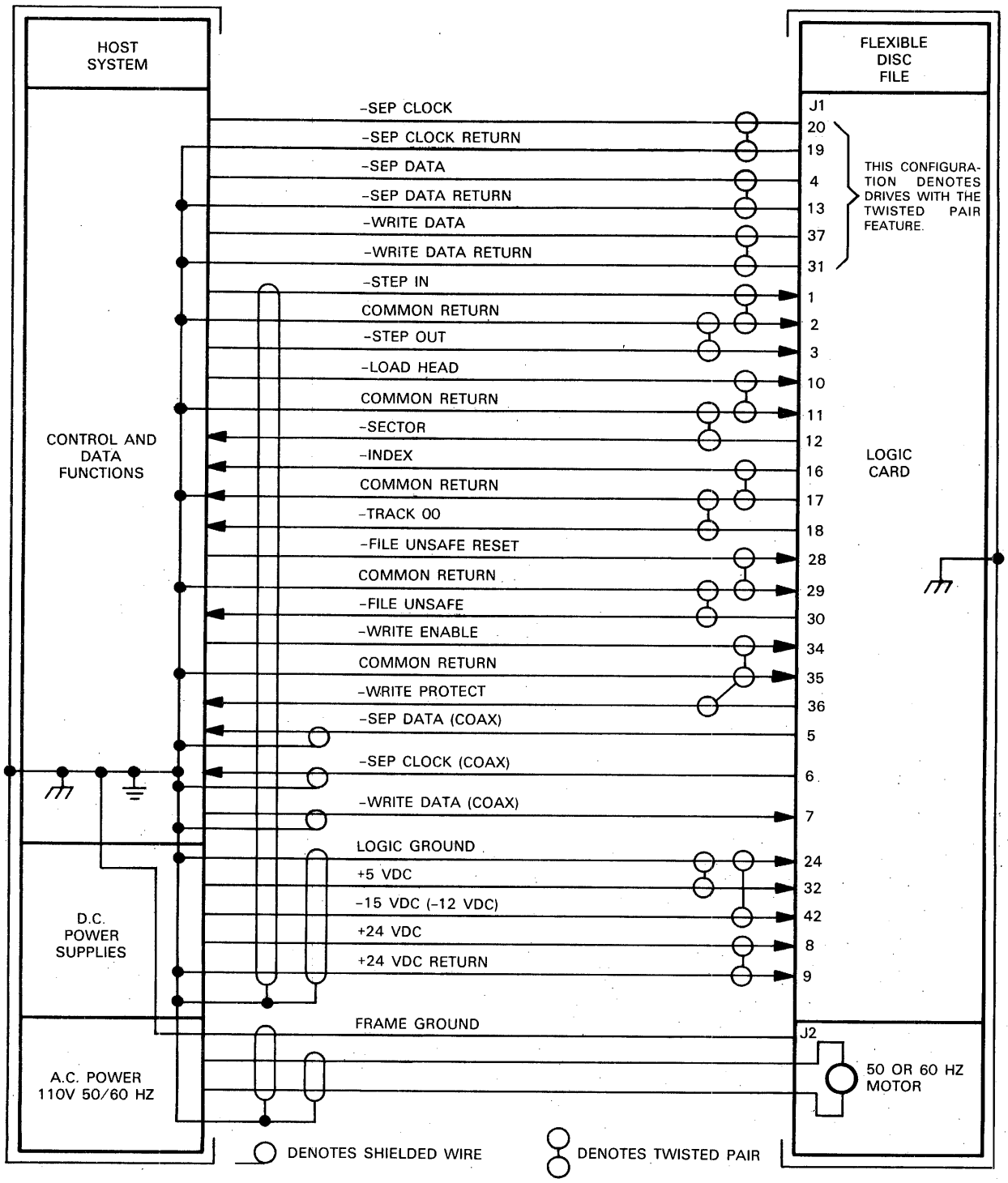



Figure 1-6. 651 Interface Wiring Diagram

TABLE 1-1. INPUT CONTROL SIGNALS

| INPUT SIGNAL DESIGNATION | CONNECTOR AND PIN | ACTIVATION POLARITY | PULSE WIDTH | COMMENTS |
|---|---|---|---|---|
| -STEP IN | J1-1 | Negative | 10 $\mu$s | Track positioning |
| COMMON RETURN | J1-2 | Negative Return | — | |
| -STEP OUT | J1-3 | Negative | 10 $\mu$s | |
| -LOAD HEAD | J1-10 | Negative | Level | Enables head load solenoid |
| COMMON RETURN | J1-11 | Negative Return | — | |
| -FILE UNSAFE RESET | J1-28 | Negative | Level | Reset for 651 control logic |
| COMMON RETURN | J1-29 | Negative Return | — | |
| -WRITE ENABLE | J1-34 | Negative | Level | Enabling function for writing data |
| COMMON RETURN | J1-35 | Negative Return | — | |

TABLE 1-2. OUTPUT CONTROL SIGNALS

| OUTPUT SIGNAL DESIGNATION | CONNECTOR AND PIN | ACTIVATION POLARITY | PULSE WIDTH (TYPICAL) | COMMENTS |
|---|---|---|---|---|
| -SECTOR | J1-12 | Negative | 1 ms | Indicates location on disc |
| COMMON RETURN | J1-11 | Negative Return | | |
| -INDEX | J1-16 | Negative | 1 ms | Indicates location on disc |
| COMMON RETURN | J1-17 | Negative Return | | |
| -TRACK 00 | J1-18 | Negative | Level | Indicates when head is positioned on Track 00 |
| COMMON RETURN | J1-17 | Negative Return | | |
| -FILE UNSAFE | J1-30 | Negative | Level | Safety sensing signal indicating file malfunction |
| COMMON RETURN | J1-29 | Negative Return | | |
| -WRITE PROTECT | J1-36 | Negative | Level | Indicates disc is write protected |

TABLE 1-3. DATA SIGNALS

| DATA SIGNAL DESIGNATION | CONNECTOR AND PIN | ACTIVATION POLARITY | PULSE WIDTH (TYPICAL) | COMMENTS |
|---|---|---|---|---|
| -SEP DATA | J1-5 | Negative | 0.2 $\mu$s | Output data from disc |
| -SEP CLOCK | J1-6 | Negative | 0.2 $\mu$s | Output clock from disc |
| -WRITE DATA | J1-7 | Negative | 0.2 $\mu$s | Input data and clock signal to file |

TABLE 1-4. POWER SIGNALS

| POWER SIGNAL DESIGNATION | CONNECTOR AND PIN | POLARITY | DRIVE CHARACTER-ISTIC | PULSE WIDTH | COMMENTS |
|---|---|---|---|---|---|
| LOGIC GROUND | J1-24 | Logic ground | Logic ground | Logic ground | DC power supply ground |
| +5 VDC | J1-32 | Positive | +5.0 ± 0.2 VDC @0.85 A (nominal) @1.00 A (maximum) 50 mv ripple (maximum p-p) | Power level | Logic Power supply |
| -15 VDC | J1-42 | Negative | -11.0 to -16.0 VDC @0.09 A (nominal) @0.10 A (maximum) 100 mv ripple (maximum p-p) | Power level | DC power supply for read/write amplifiers |
| (-12 VDC)* | | | | | |
| +24 VDC | J1-8 | Positive | +24.0 ± 1.5 VDC @1.3 A (nominal)** @1.5 A (maximum) 100 mv ripple (maximum p-p) | Power level | DC power supply for head positioning motor, head load solenoid, and write current |
| +24 VDC RETURN | J1-9 | DC power ground | DC power ground | DC power ground | +24 VDC power ground |
| 110 VAC 50/60 Hz | J2 Three terminal socket | Line AC | 100 to 132 VAC @1.0 A 50/60 Hz ± 1.0 Hz | Line AC | Must be provided from a branch circuit protected at no more than 20 amperes |
| FRAME GROUND | J2 Center socket | Frame ground | Frame ground | Frame ground | Center socket of 3-wire AC socket |

* May be used in lieu of -15 Volts with no modifications to the file or cables.

** Drops to "0" very rapidly and returns to a steady current condition within 10 msec after a step operation is performed.

# SECTION 2
# SPECIAL TOOLS AND TEST EQUIPMENT

## 2.1 SPECIAL TOOLS

In addition to standard, commonly available tools, a number of special tools are required to maintain the 651 Flexible Disc Drive. These special tools are listed below:

1. Field Service Alignment Cartridge, P/N 307007
2. Read/Write Alignment Adapter, P/N 204296
3. Head Cleaning Kit, P/N 307006
4. Extractor Tool Kit, P/N 30702I, consisting of:
   a. Pin Extractor, P/N 150691
   b. Pin Extractor, P/N 301711
   c. Pin Extractor, P/N 158762
   d. Snap Ring Pliers, P/N 203148
5. Pull-type Gram Gauge, 0 - 20 gram range (commercially available)

## 2.2 TEST EQUIPMENT

The only piece of test equipment necessary to maintain the 651 is an oscilloscope, Tektronix 422 or equivalent.

# SECTION 3
# SPECIAL PRECAUTIONS

The 651 can be damaged by improper servicing, handling, or operating techniques. The following procedures should be observed to properly operate and maintain the 651.

## 3.1 CARTRIDGE LOADING AND HANDLING

The cartridge consists of the flexible disc encased in a plastic jacket. Wipe cushions are bonded to the inside of the jacket. The disc is housed and rotates between these cushions during normal operation. Figure 3-1 shows how the cartridge is inserted in the cartridge guide. This is accomplished by opening the door, inserting the cartridge fully into the cartridge guide, and closing the door. If desired to write-protect the disc, affix the write protect tab to the disc cartridge keying notch, as shown in Figure 3-1.

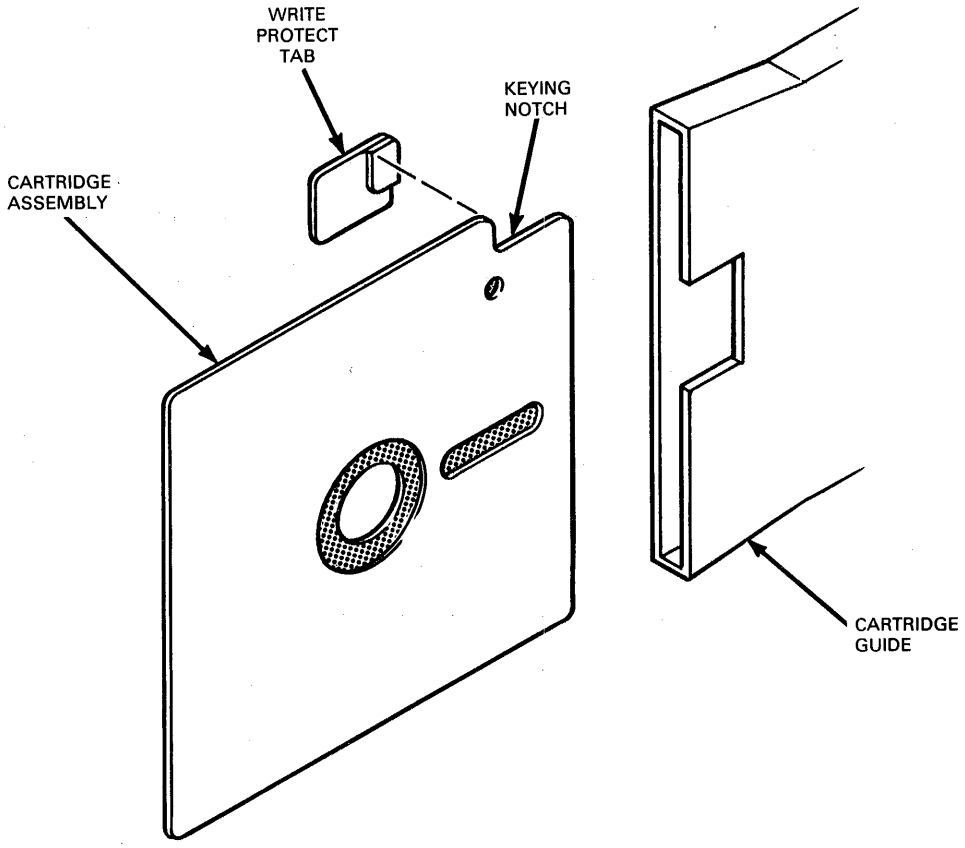



Figure 3-1. Insertion of Disc Cartridge in Cartridge Guide

### 3.1.1 DISC INTERCHANGEABILITY

To ensure interchangeability, discs should be stored in a location that is within ± 5° F of the using system ambient temperature and within ±10% of the using system humidity. Discs stored outside the recommended ranges must be placed in the using system environment at least 20 minutes prior to use.

### 3.1.2 PHYSICAL DAMAGE

When removed from the 651, the disc cartridge is stored in a plastic-coated paper envelope. To protect the cartridge, the same care and handling procedures specified for computer magnetic tapes apply. Additional precautionary procedures are as follows:

1. Return the cartridge to its storage envelope whenever it is removed from file.

2. Store cartridges vertically.

3. Keep cartridges away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields greater than 50 oersteds can distort recorded data on the disc.

4. Replace storage envelopes when they become worn, cracked, or distorted. Envelopes are designed to protect the disc.

5. Do not write on the plastic cartridge. Writing pressure may damage the disc.

6. Do not smoke while handling cartridges. Heat and contamination from a carelessly dropped ash can damage the disc.

7. Do not expose cartridges to heat or sunlight. The read/write head on the 651 cannot properly track a warped disc.

8. Do not touch or attempt to clean the disc surface. Abrasions may cause loss of stored data.

## 3.2 SAFETY

AC and DC power are controlled by the using system. Prior to working on the file, verify that all power is removed from the 651.

# SECTION 4
# PREVENTIVE MAINTENANCE

The 651 Flexible Disc Drive does not required preventive (scheduled) maintenance. The basis for no corrective maintenance is predicated on the following criteria:

1. Proper handling and storage of discs and spare parts.

2. Alignments and adjustments are made within specification ranges.

3 The user properly installs the 651 both electrically and mechanically.

# SECTION 5
# MAINTENANCE PROCEDURES

## 5.1 GENERAL

Maintenance information is presented throughout the remaining pages in this manual. This information comprises step-by-step procedures for component alignment/adjustment, removal/replacement, and diagnostic testing. These procedures are presented with (in the same pages as) descriptions of the component theory of operation. This presentation scheme allows coverage, within individual component descriptions, of both maintenance information and the theory of operation, and is intended to facilitate manual usability by maintenance personnel.

In most cases, the maintenance procedures have been arranged so that the photograph or line drawing illustrating the parts of an assembly requiring maintenance are located on the same or facing page containing the procedures. Some circuits and assemblies lend themselves to troubleshooting by means of diagnostic flow charts. These charts are located with the corresponding procedures. Where required, special tools are identified in a procedure. A detailed list of all assemblies covered by the procedures is found in the Table of Contents for Section 5.

## 5.2 CHASSIS COVER

### 5.2.1 REMOVAL

1. Remove two screws from left side faceplate cover, and remove faceplate cover (Figure 5-1).

2. Slide clear plastic front cover to left, and remove from baseplate grooves.

### 5.2.2 REPLACEMENT

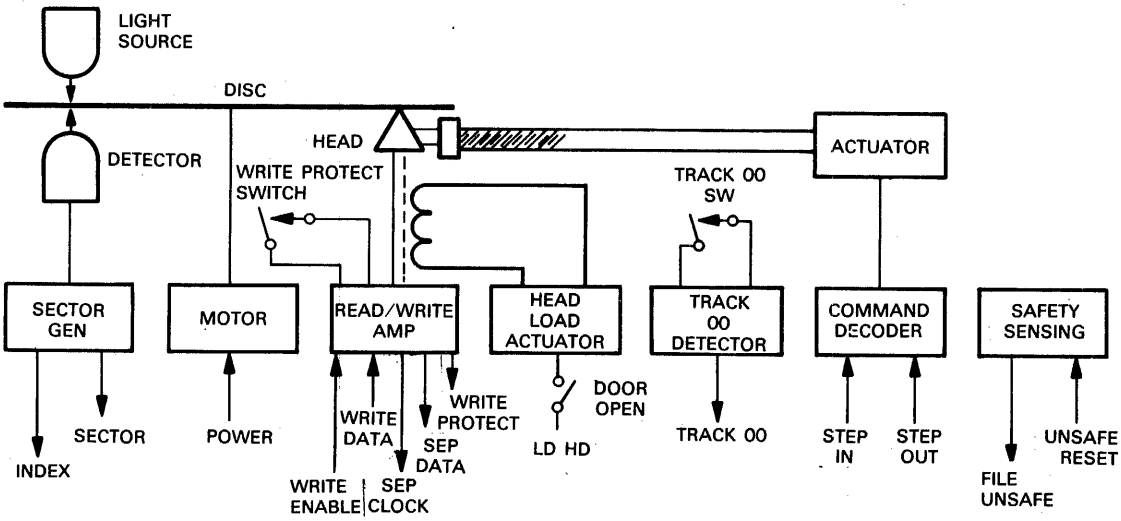
1. Insert clear plastic front cover so that grooved side faces inward into baseplate grooves, and slide into position.

2. Position left side faceplate cover, and install two retaining screws.

## 5.3 PRINTED CIRCUIT BOARD

### 5.3.1 DESCRIPTION

The electrical and electronic circuitry consists of control and status circuits composed primarily of solid-state integrated circuit components mounted on a single printed circuit board (PCB). The block diagram shown below shows the primary motor, actuators, switches, circuit components and circuit groups, and the associated control and status signals. The circuitry involved in the generation and transfer of the control and status signals is shown on the schematic and logic diagrams in the Logic Manual.




The PCB is mounted at the rear of the 651 enclosure. It is secured to the baseplate by four screws, one in each corner. A connector plug on one side mates with connector PC1. The PCB drawing shows the component side of the board, and indicates the locations of the test points. Refer to the Logic Manual, pages FD300 through FD320, for test point circuit locations and normal waveforms and test values.

### 5.3.2 REMOVAL

1. Remove belt from pulleys (Figure 5-1).
2. Disconnect head cable connector.
3. Remove four corner retaining screws.
4. Remove PCB, and disconnect connector PC1.

### 5.3.3 REPLACEMENT

1. Connect connector PC1 to PCB (Figure 5-1).
2. Position PCB, and install four corner screws.
3. Connect head cable connector. (Pin arrangement inside connector is symmetrical so connector can be plugged in either way.)
4. Install belt on pulleys.

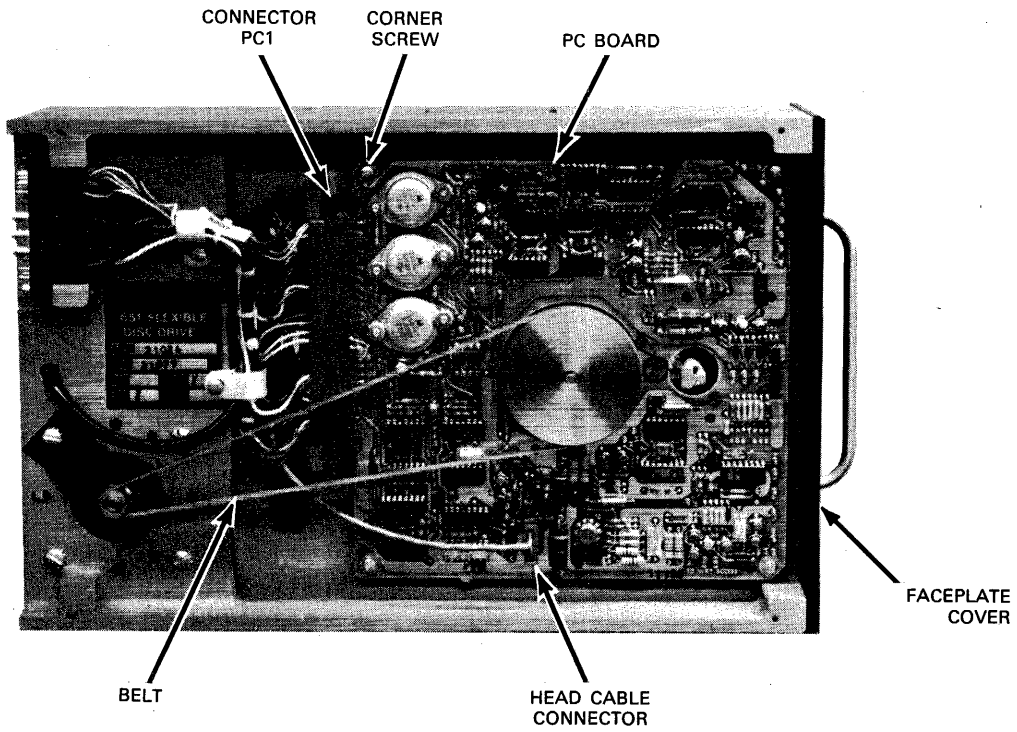



Figure 5-1. Chassis and PC Board Removal and Replacement

## 5.4 HARNESS ASSEMBLY

### 5.4.1 DESCRIPTION

The Harness Assembly comprises connector block J1, PC board connector housing PC1, and the interconnecting cable consisting of the primary 651 input/output leads.

### 5.4.2 REMOVAL

1. Disconnect PC1 from PCB.

2. Disconnect all actuator and transducer leads which are not part of harness assembly (Figure 5-2). Disconnect cable clamps as required.

3. Disconnect and remove three coaxial cables from connector PC1 and connector block J1. Coaxial cables are not part of harness assembly. (Note: Step 3 is not applicable for drives with the twisted pair feature.)

4. Remove four screws holding connector J1 to baseplate. Remove connector J1 and harness assembly.

### 5.4.3 REPLACEMENT

1. Position connector J1 on baseplate and secure with four retaining screws (Figure 5-2).

2. Connect coaxial cables to connector PC1 and connector block J1. Refer to Logic Manual pages FD100, FD310, and FD320. (Note: Step 2 is not applicable for drives with the twisted pair feature.)

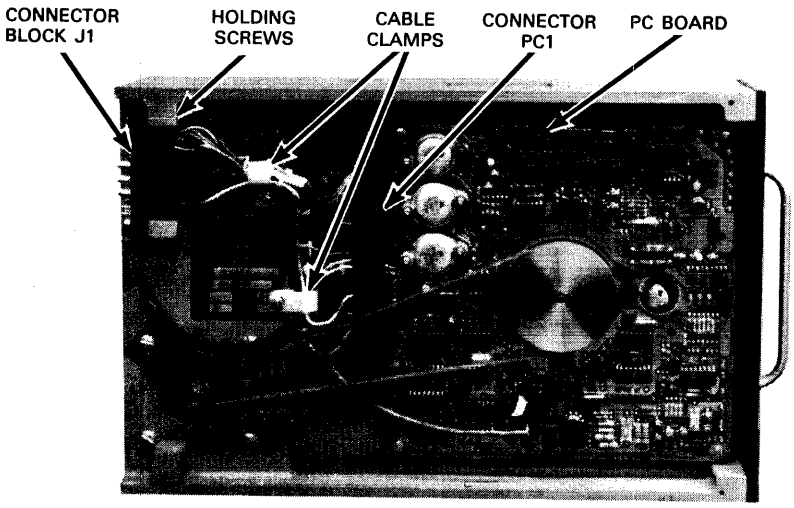



Figure 5-2. Harness Assembly Removal and Replacement

3. Connect actuator and transducer leads to connector PC1 (Logic Manual pages FD400 and FD200)

**CAUTION**

When reinstalling the harness assembly, be sure that connecting wires do not contact the drive belt.

## 5.5 TIMING SEQUENCES

### 5.5.1 POWER-ON SEQUENCE

Whenever the host system control units applies power to the 651, a power-on sequence controlled by the host system occurs automatically to prepare the disc file for operation. The events and timing for this sequence are shown in Figure 5-3.

**NOTE**

As used in this manual, the term "min" is to be interpreted as in the following examples from Figure 5-3:

1. 2.0 sec min means the first stepping pulse should not be furnished until at least 2.0 sec have elapsed from AC/DC power up.
2. 10.0 msec means that no pulse should be furnished sooner than 10.0 msec elapsed time since the last one was furnished.
3. 40 msec means that the read/write enable signal should not be brought up until 40 msec after the load head signal has been brought up.

In all cases, these events may take place at any time after the prescribed minimum interval.

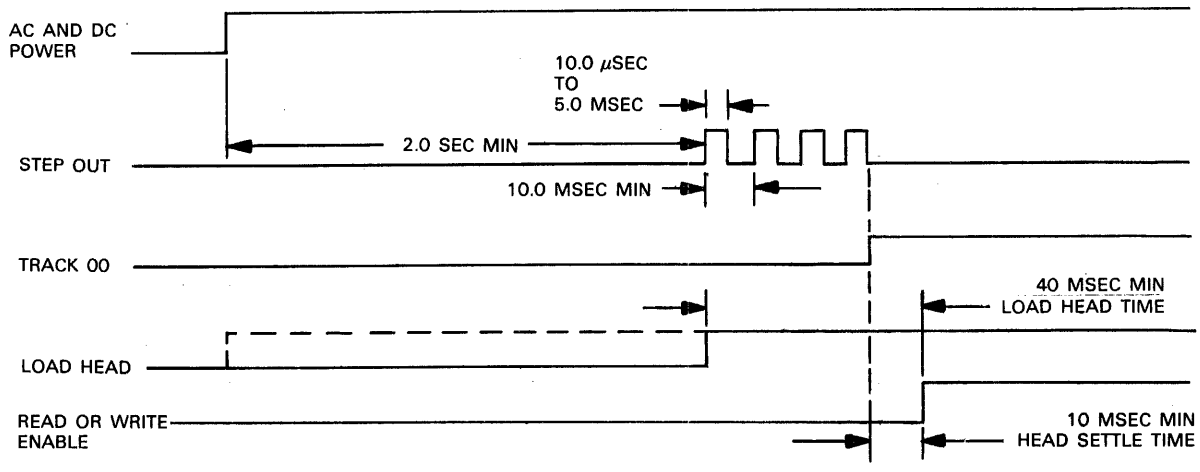



Figure 5-3. Power-On Sequence Timing

## 5.5.2 READ CIRCUITRY

### 5.5.2.1 Description

The Read logic is shown in the Logic Manual on page FD310. The Read head reads the combined clock and data pulses recorded on the disc. The read logic amplifies these signals and separates them into two outputs: separated clock signals (SEP CLOCK) and separated data signals (SEP DATA). The timing is shown in Figure 5-4.

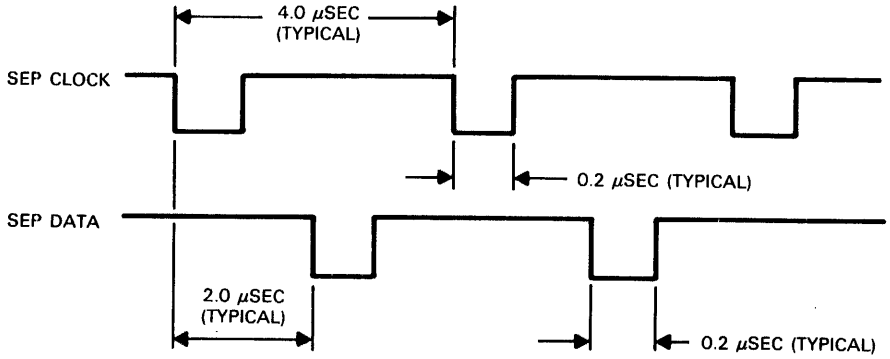



Figure 5-4. Read Data Waveforms

### 5.5.2.2 Read Operation Sequence

A read operation comprises a track and index/sector address seek timing sequence and a read data sequence. Timing is shown in Figures 5-5 and 5-6.

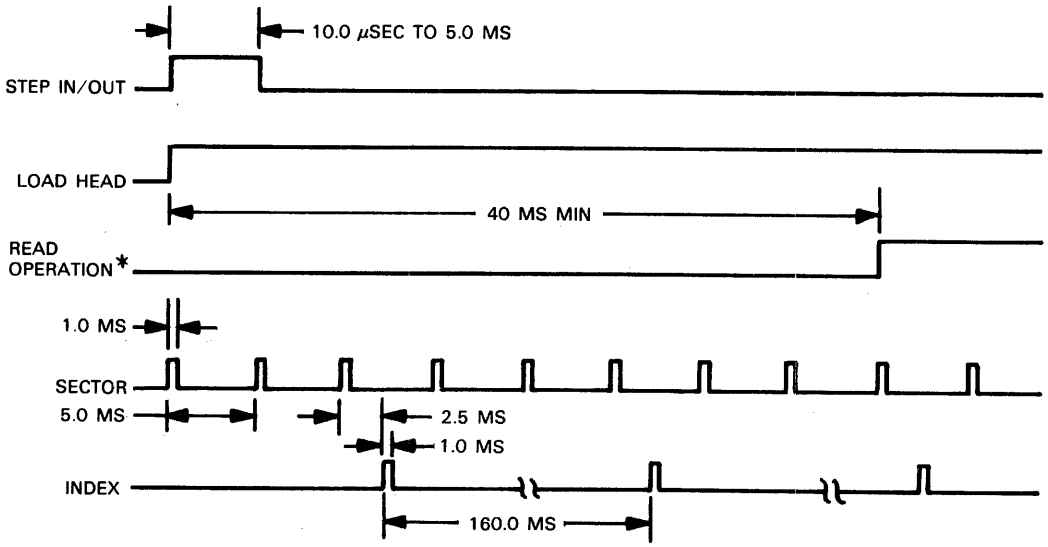



Figure 5-5. Read Operation Sequence Timing

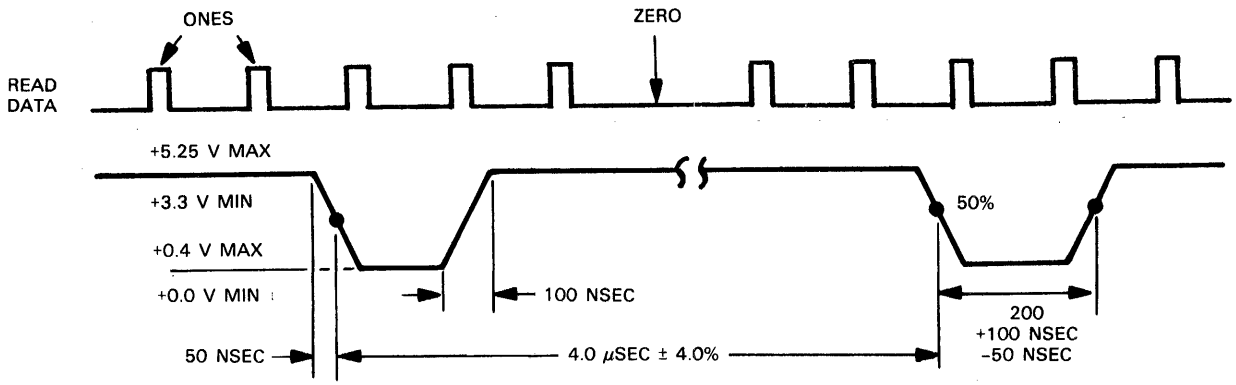



Figure 5-6. Read Data Sequence Timing

### 5.5.2.3 Read Error Detection

Read errors are classified as either soft (data recoverable) or hard (data nonrecoverable). Soft errors may be caused by:

1. Airborne contaminants on disc, normally removed by cartridge wiper.
2. Random electrical noise.
3. Minor, undetected write errors on disc.
4. Disc speed variations.
5. Poor head-to-disc compliance.

### 5.5.2.4 Read Error Recovery Procedure

The following program controlled steps (provided by the host system) occur when a read error is detected.

1. Reread track a maximum of 10 times.
2. If data not recovered in step 1, access next track in direction last moved, and then reaccess error track.
3. If data is not recovered, hard error exists.

### 5.5.2.5 Read Circuit Diagnostic Flow Diagram

The troubleshooting procedure to be used to isolate a malfunction in the read circuitry is shown in Figure 5-7.

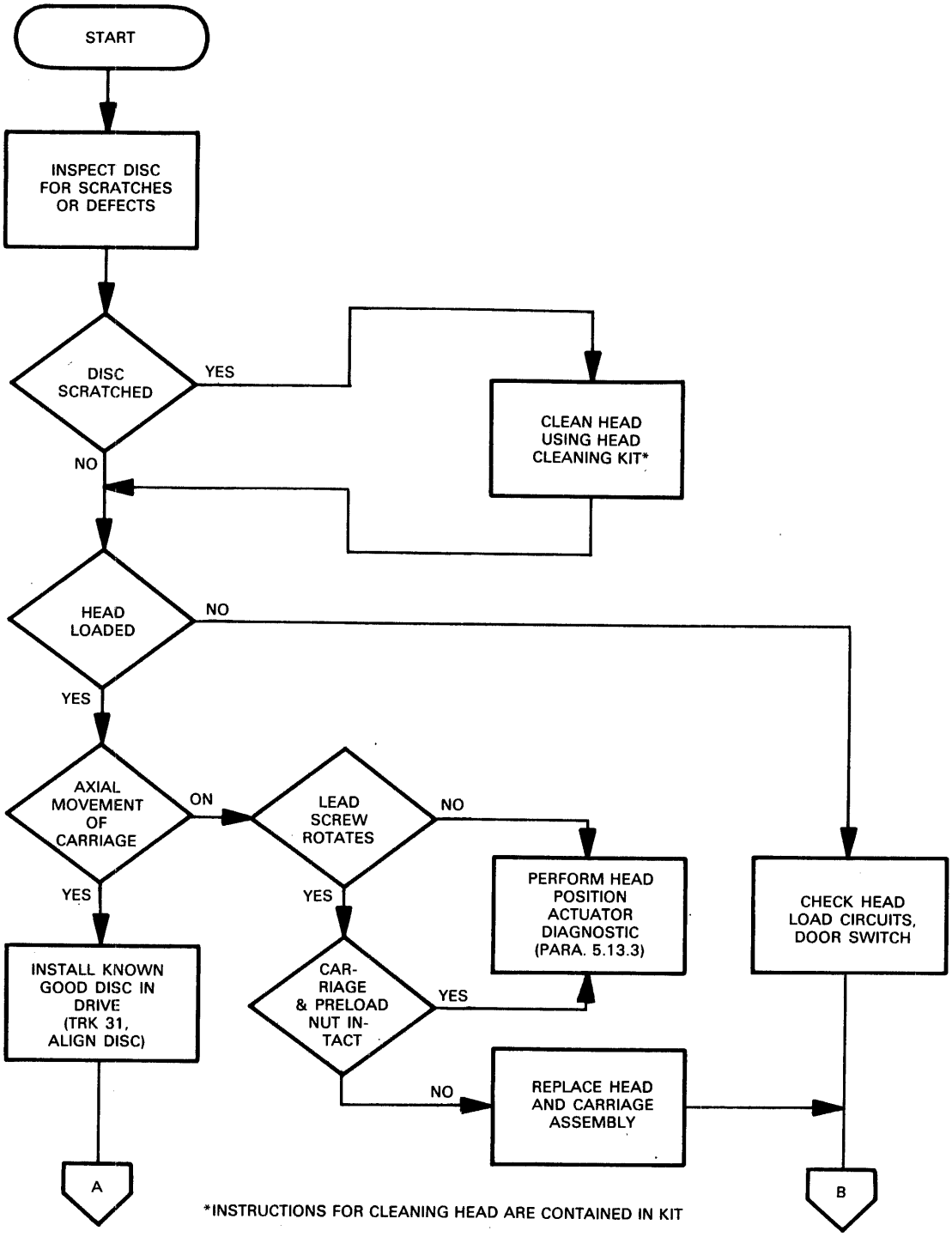



Figure 5-7. Read Circuit Diagnostic Flow Diagram (1 of 2)

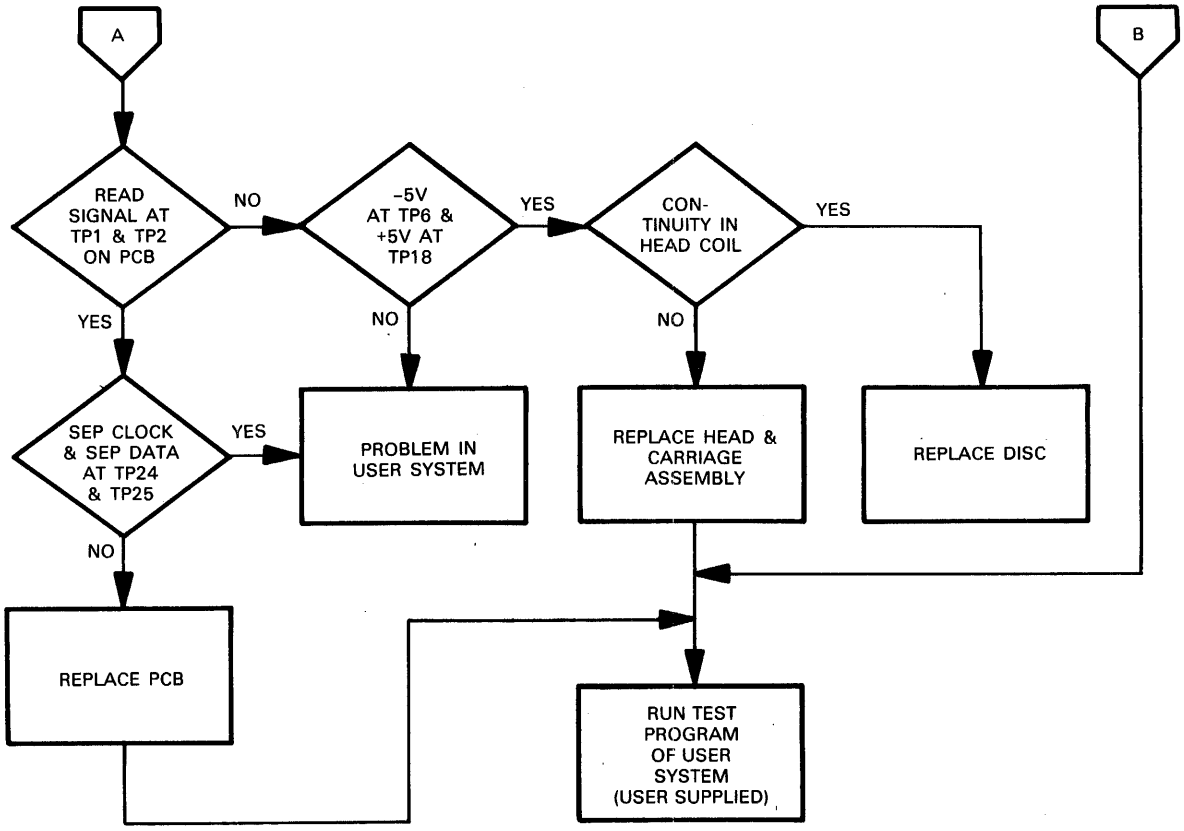



Figure 5-7. Read Circuit Diagnostic Flow Diagram (2 of 2)

## 5.5.3 WRITE CIRCUITRY

### 5.5.3.1 Write Operation Sequence

A write operation comprises a track and index/sector address seek-timing sequence and a write data sequence. Timing is shown in Figures 5-8 and 5-9.

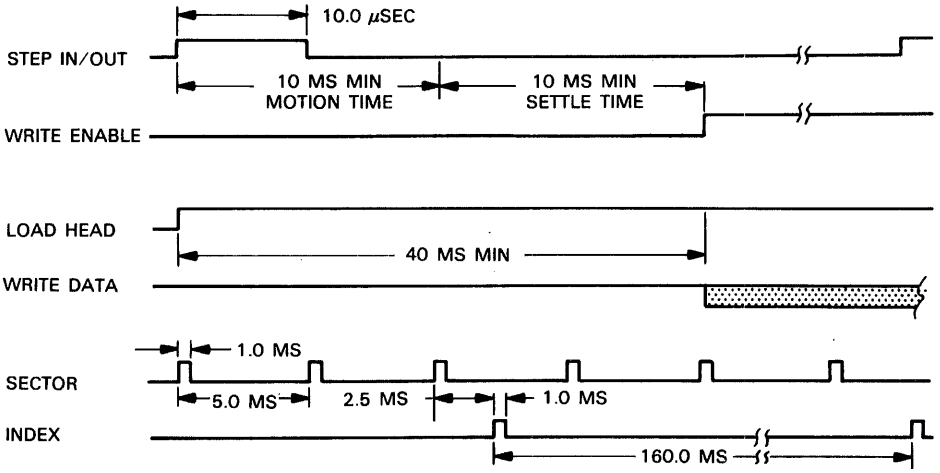



Figure 5-8. Write Operation Sequence Timing

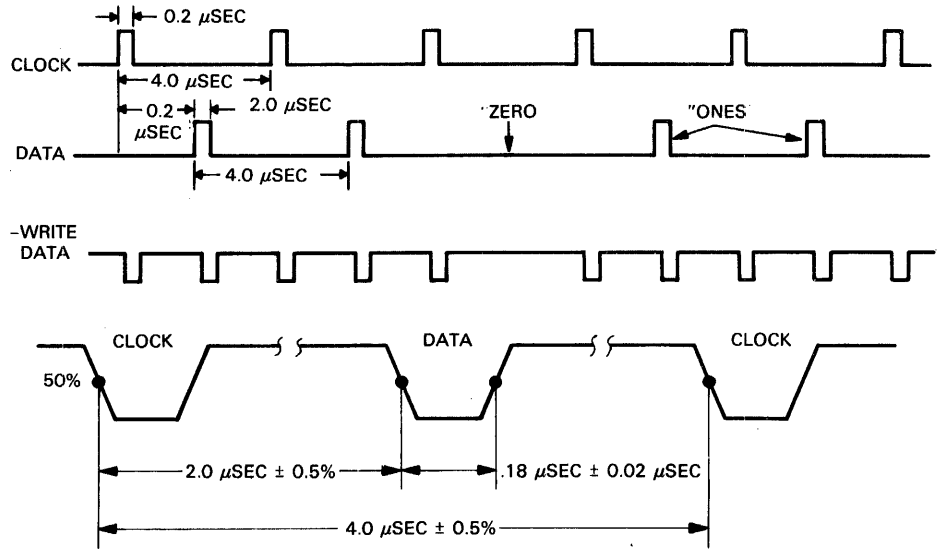



Figure 5-9. Write Data Sequence Timing

### 5.5.3.2 Data Format

Depending on user system requirements, data may be organized in multiple records per track (sector) or single record per track (index) format. Typical requirements for each format are shown in Figure 5-10.

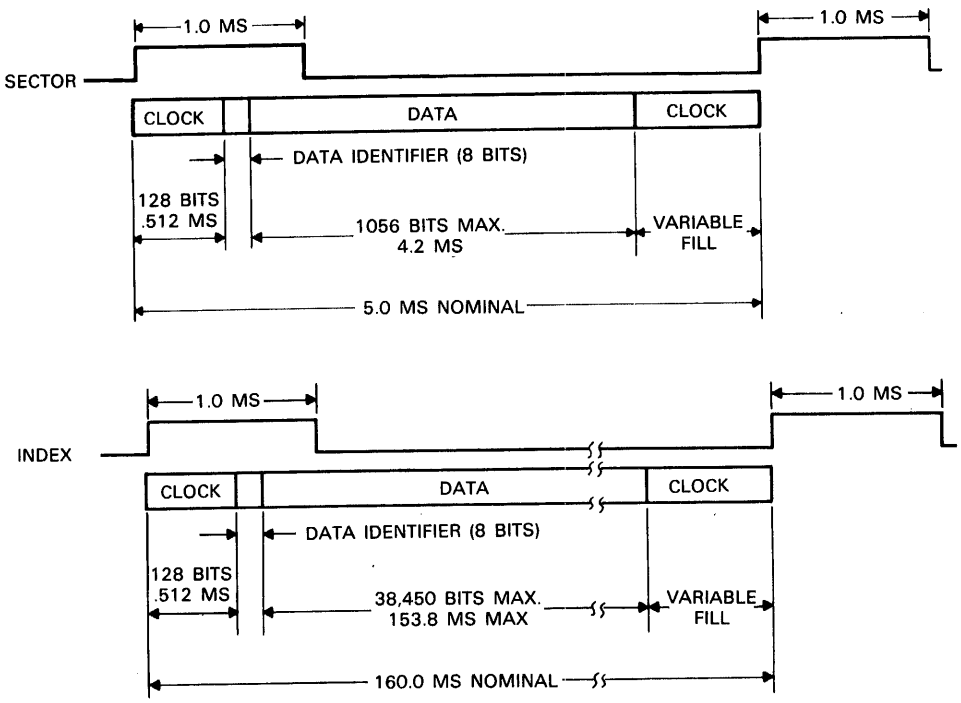



Figure 5-10. Sector And Index Formats

### 5.5.3.3 Write Error Detection

Write errors are detected by a write check consisting of a read operation performed on the ensuing revolution. Make error correction by repeating write and write check operations. After 10 unsuccessful attempts, perform operation on a different track. If error persists, replace disc.

### 5.5.3.4 Write Circuit Diagnostic Flow Diagram

The troubleshooting procedure to be used to isolate a malfunction in the write circuitry is shown in Figure 5-11.

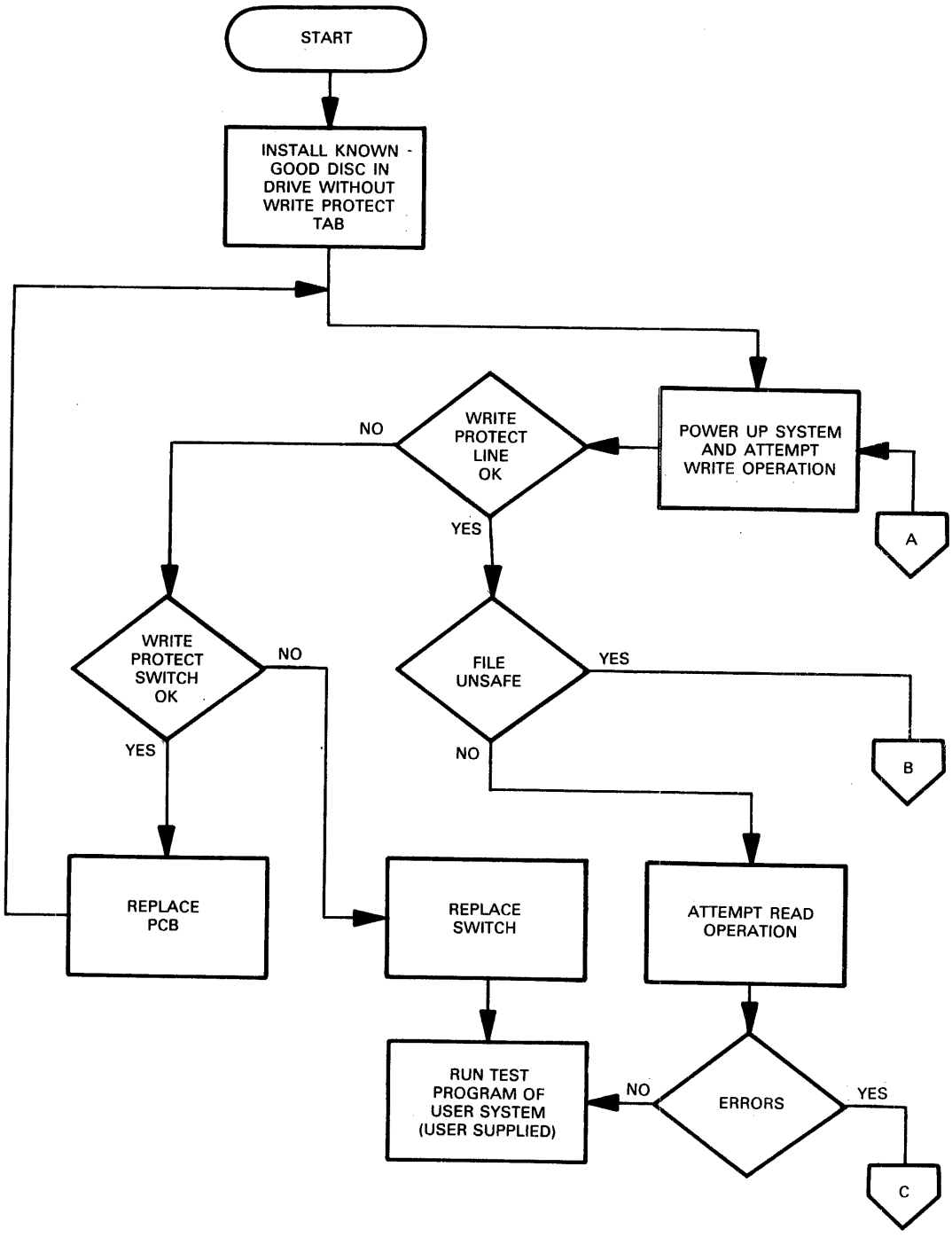



Figure 5-11. Write Circuit Diagnostic Flow Diagram (1 of 2)

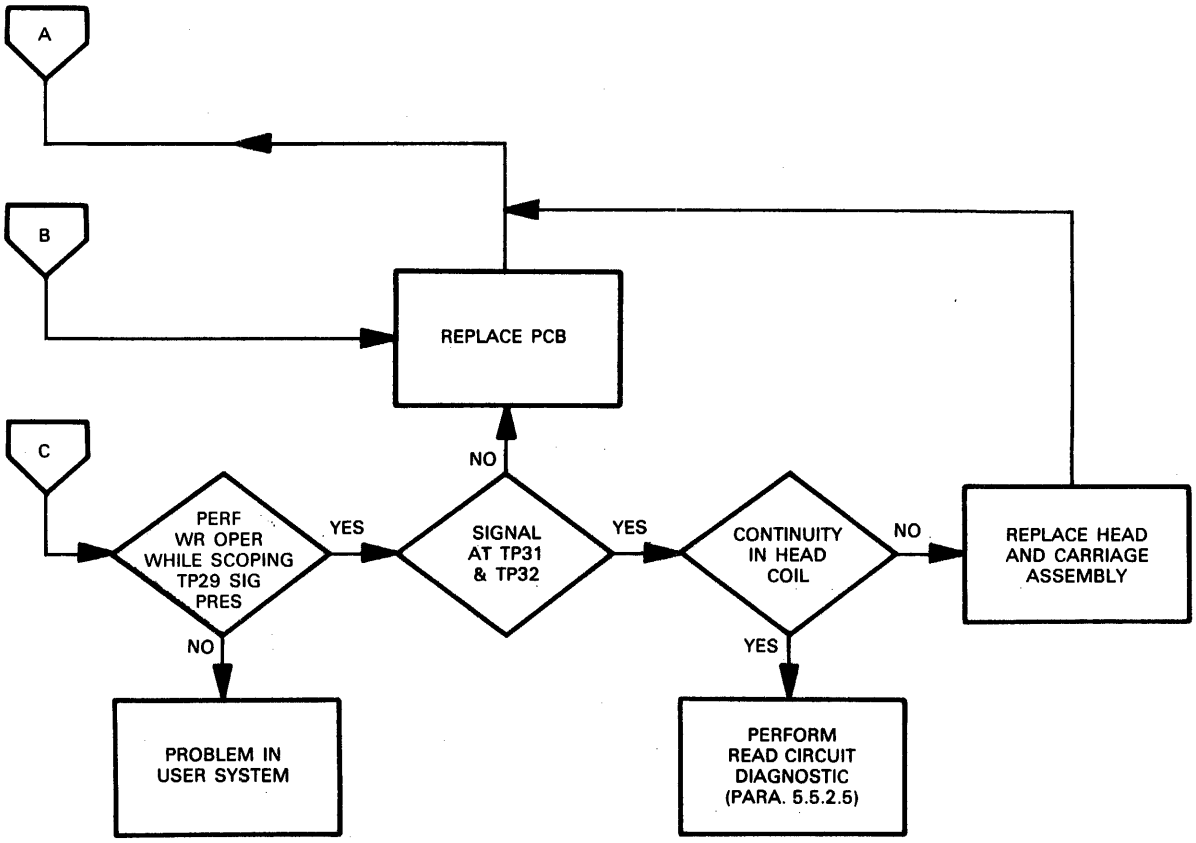



Figure 5-11. Write Circuit Diagnostic Flow Diagram (2 of 2)

## 5.6 CARTRIDGE GUIDE ASSEMBLY

### 5.6.1 DESCRIPTION

The Cartridge Guide Assembly, along with the Clamp, Hub and Spindle, and Head Load Actuator Assemblies, make up the file accessing group of the 651. The purpose of this electromechanical assembly group is to properly position the cartridge and disc for accurate track addressing, place the disc in contact with the head, and rotate the disc.

The Cartridge Guide Assembly is the repository for the cartridge and disc during 651 operation. A cartridge inserted in the cartridge guide correctly positions the disc between the clamp assembly and the hub for proper rotation and track accessing when the drive motor is operating. The cartridge guide is mounted on pivots that permit it to be swung outward to provide access to other assemblies. An extension spring retains the cartridge guide in its normal position.

### 5.6.2 SPECIAL TOOLS

Snap Ring Pliers, Memorex No. 203148.

### 5.6.3 REMOVAL

1. Remove Light Emitting Diode Assembly (Figure 5-12).
2. Disconnect and remove extension spring.

**CAUTION**

Top and bottom pivot pin retaining rings are different. When removing rings, identify for correct reinstallation. Bottom two rings are wavy in shape.

3. Remove Head Load Actuator Assembly.
4. Remove top two pivot pin retaining rings.
5. Remove bottom two pivot pin retaining rings.
6. Remove top and bottom pivot pins.
7. Pull cartridge guide straight out from 651 front.

### 5.6.4 REPLACEMENT

1. Place cartridge guide in position (Figure 5-12).
2. Insert cartridge guide pivot pins.
3. Install top pivot pin retaining rings, making certain to use correct rings.

4. Install bottom pivot pin retaining rings.

5. Install extension spring.

6. Close door, and verify that cartridge guide actuates Door Open Switch.

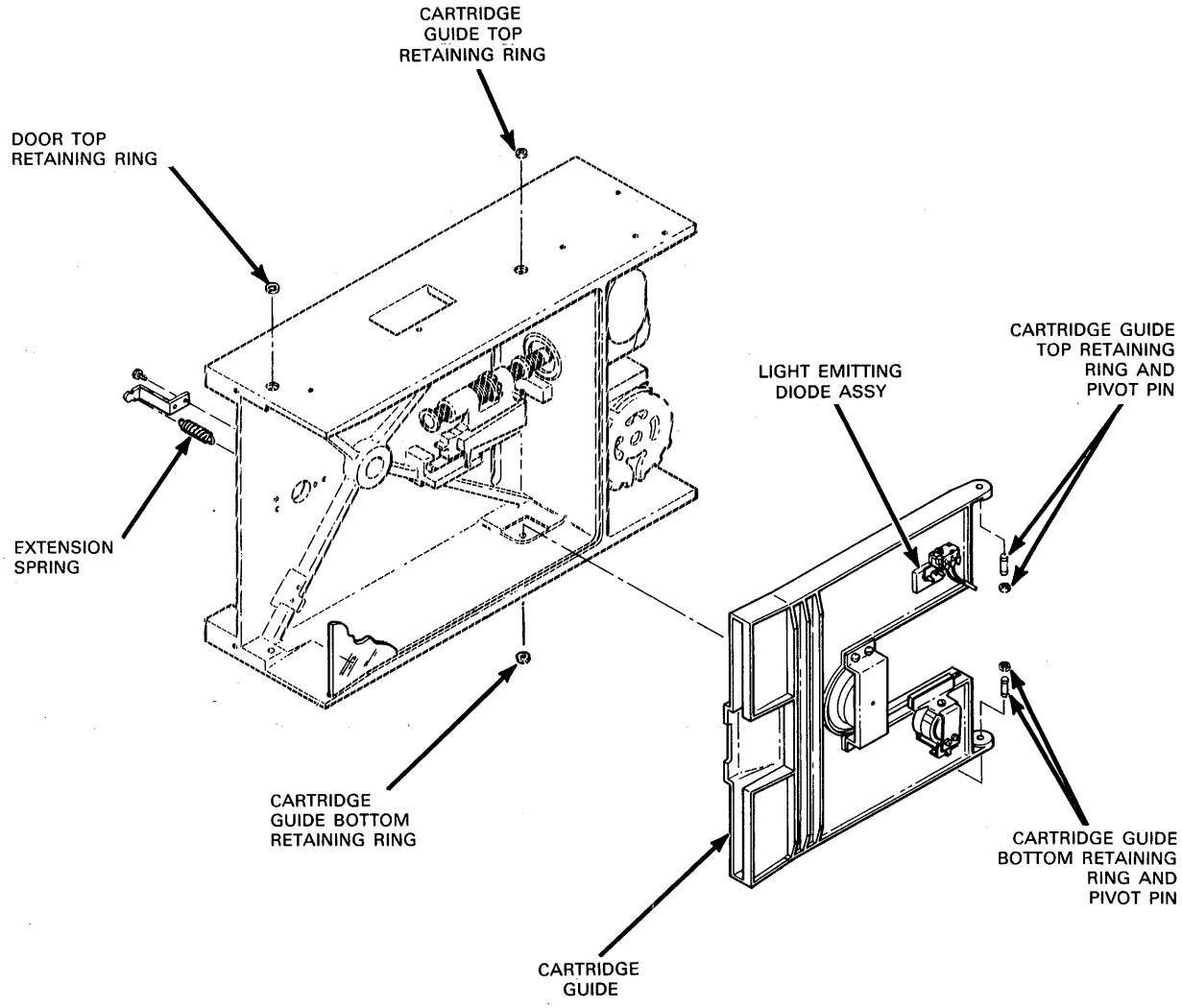



Figure 5-12. Cartridge Guide Assembly Removal and Replacement

## 5.7 CLAMP ASSEMBLY

### 5.7.1 DESCRIPTION

The Clamp Assembly consists of a ball bearing mounted rotary clamp that is spring loaded to press the disc against the drive hub. The resulting friction causes disc and clamp rotation in response to hub rotation. The clamp must be aligned symetrically with the hub to avoid eccentricity during rotation.

### 5.7.2 ALIGNMENT

1. At interfacing equipment, apply 651 ac power.
2. Verify that door is closed and no cartridge is installed.
3. Slightly loosen four screws in clamp support bracket (Figure 5-13) sufficiently to withdraw clamp from contact with hub.
4. Press clamp support bracket against cartridge guide, and check clamp rotation for wobble. If clamp rotation is true, hold clamp support bracket against cartridge guide to maintain clamp-to-hub contact, and tighten four screws; if not, repeat steps 3 and 4.
5. Recheck clamp rotation for eccentricity.

### 5.7.3 REMOVAL

1. Open door.
2. Remove four Clamp Assembly mounting screws from clamp support bracket (Figure 5-13).
3. Remove Clamp Assembly.

### 5.7.4 REPLACEMENT

1. Open door.
2. Position Clamp Assembly in cartridge guide (Figure 5-13).
3. Install four Clamp Assembly mounting screws.
4. Perform Clamp Assembly alignment (paragraph 5.7.2).

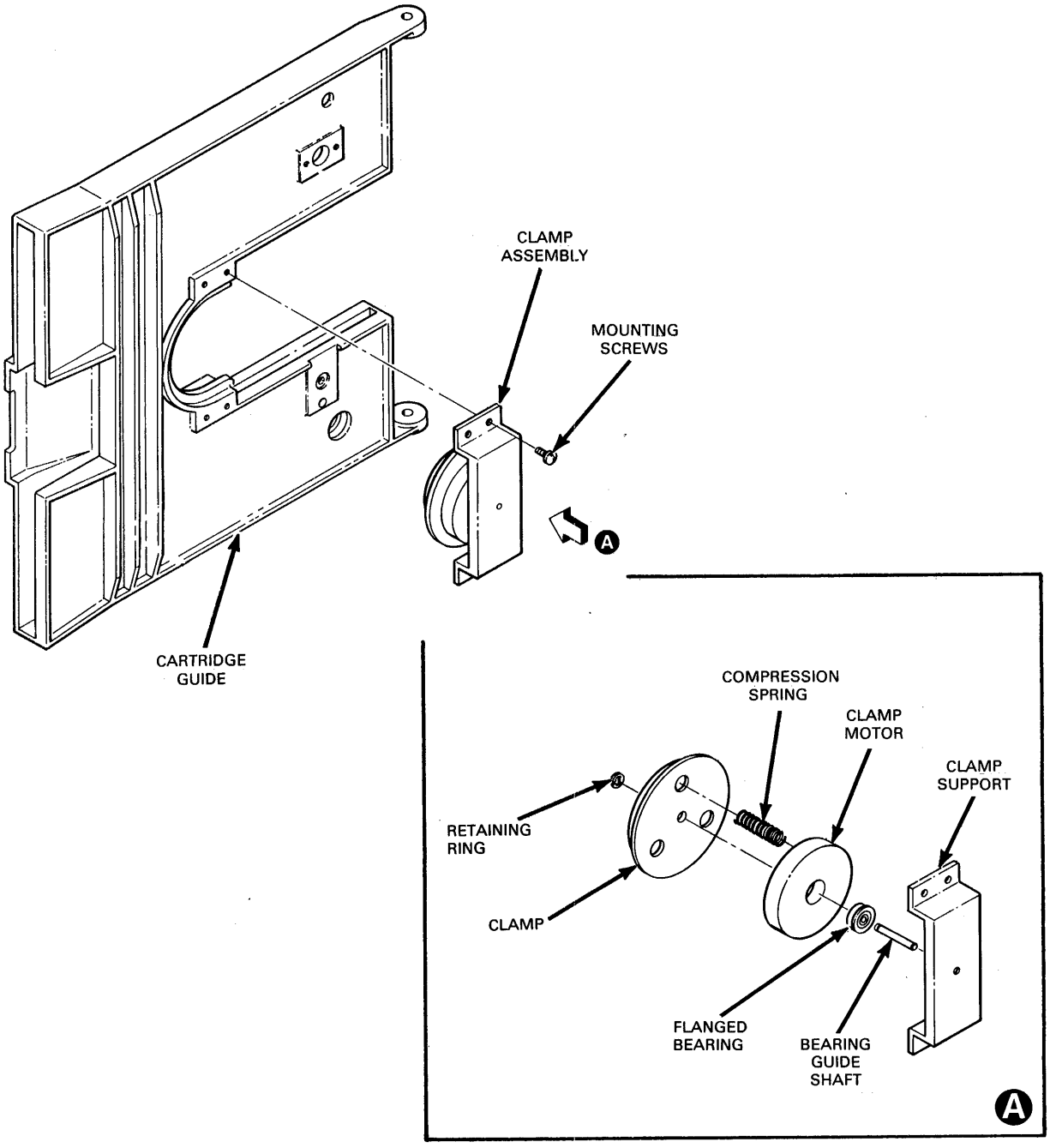



Figure 5-13. Clamp Assembly Removal and Replacement

## 5.8 HUB AND SPINDLE ASSEMBLY

### 5.8.1 DESCRIPTION

The Hub and Spindle Assembly consists of a hub and spindle that mounts in ball bearings in the baseplate access hole. A spindle pulley is installed on the spindle outside the baseplate. The assembly is driven by the drive motor and belt to provide disc rotation within the Cartridge Guide Assembly.

### 5.8.2 REMOVAL

1. Remove belt from pulleys (Figure 5-14).
2. Disconnect and remove extension spring.
3. Swing cartridge guide out on pivots.
4. Loosen spindle pulley set screw, and remove pulley.
5. Remove hub and spindle.
6. Remove both ball bearings from baseplate hole.

### 5.8.3 REPLACEMENT

1. Swing cartridge guide out on pivots (Figure 5-14).
2. Install ball bearings in baseplate spindle hole.
3. Install hub spindle in ball bearings.
4. Slide spindle pulley onto spindle.
5. Press pulley against bearing to eliminate axial play, and tighten pulley set screw.
6. Position cartridge guide, and connect extension spring.
7. Install belt.

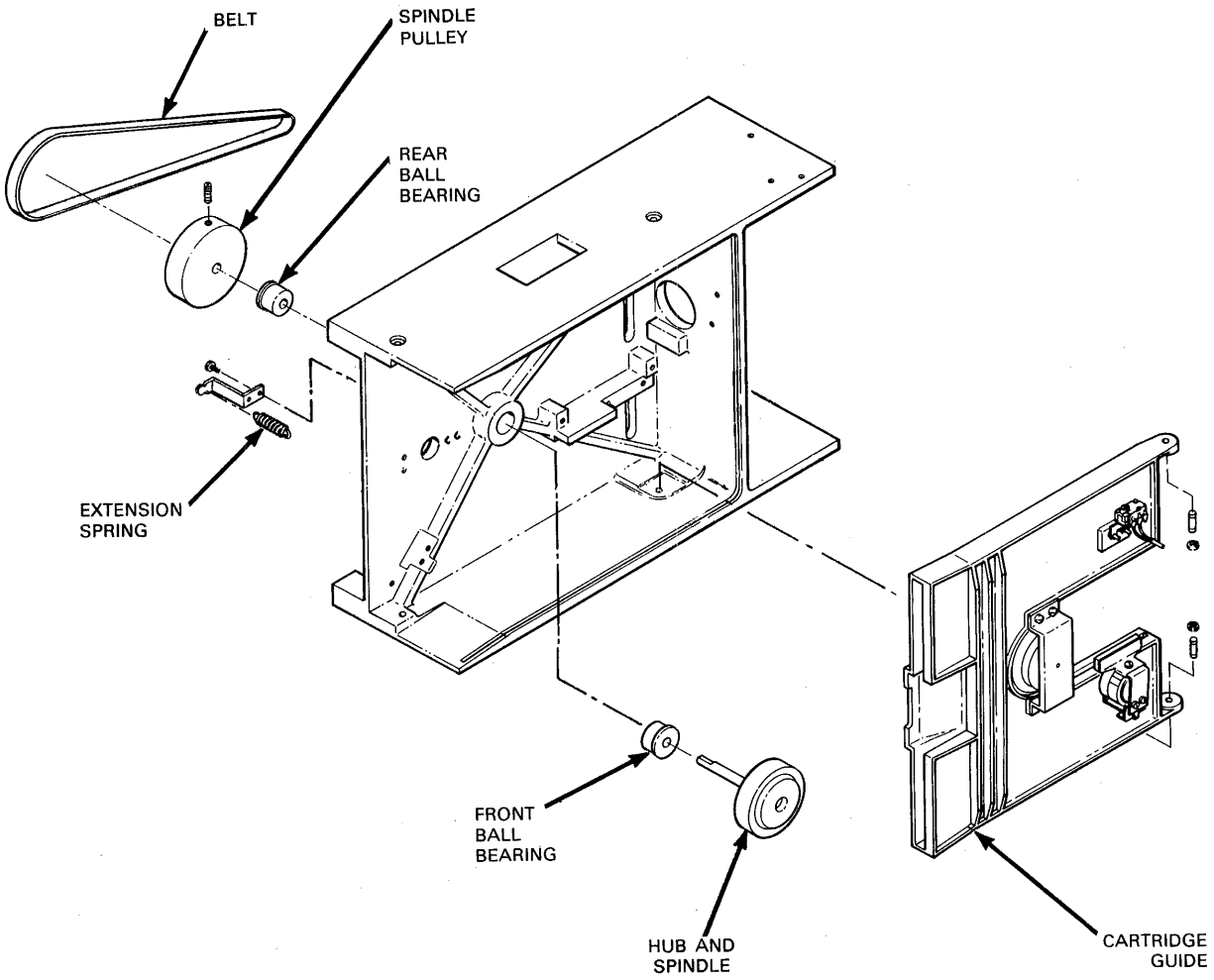



Figure 5-14. Hub and Spindle Assembly Removal and Replacement

## 5.9 DOOR ASSEMBLY

### 5.9.1 DESCRIPTION

The Door Assembly is mounted to the baseplate on pivots, and provides access to the cartridge guide. Closing the door seats the cartridge guide to actuate the Door Open Switch. The door must be closed for 651 file operation.

### 5.9.2 REMOVAL

1. Disconnect and remove extension spring (Figure 5-15).
2. Swing cartridge guide out on pivots.
3. Remove top and bottom door pivot pin retaining rings.
4. Remove top and bottom door pivot pins.
5. Remove door.

### 5.9.3 REPLACEMENT

1. Swing cartridge guide out on pivots (Figure 5-15).
2. Position door and align pivots with pivot pin holes.
3. Insert top and bottom door pivot pins.
4. Install retaining rings on pivot pins.

## 5.10 HEAD LOAD ACTUATOR ASSEMBLY

### 5.10.1 DESCRIPTION

The Head Load Actuator Assembly consists of a solenoid assembly with an armature extension that operates a bail and wiper pad. The purpose of the assembly is to control the action of the load arm, which is spring-loaded to press the disc in the cartridge guide against the head mounted on the carriage assembly. When the solenoid is deactuated, armature spring action moves the bail away from the disc. The bail contacts the load arm tab, and bail travel moves the load arm pressure pad out of contact with the disc. The solenoid is energized by the -LOAD HEAD signal. When the solenoid is actuated, the armature moves the bail toward the disc, which places the wiper pad lightly in contact with the cartridge, and disengages the bail from the load arm tab. The load arm spring moves the released load arm toward the disc, and the load arm pressure pad presses the disc against the head. The position of the bail on the armature extension is adjustable, and must be adjusted so that the bail is out of contact with the load arm tab when the solenoid is actuated, but accomplishes the required amount of load arm travel when the solenoid is deactuated. The load arm spring must be capable of supplying a pressure of 10 to 18 grams between the load arm pressure pad and the head.

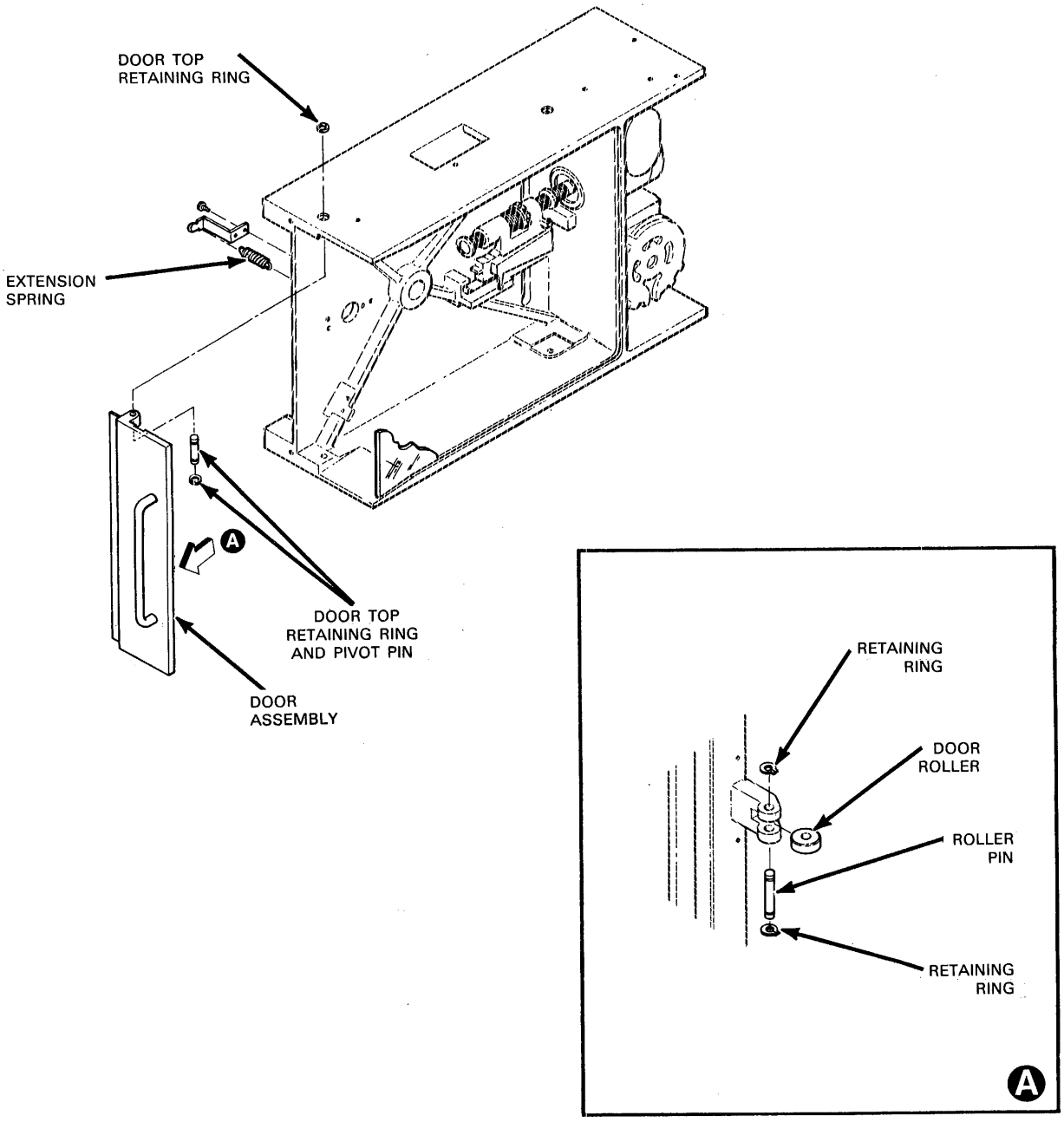



Figure 5-15. Door Assembly Removal and Replacement

### 5.10.2 SPECIAL TOOLS

Connector Pin Extractor, Memorex No. 301711

Pull-type Gram Gauge - 20 gram range.

### 5.10.3 LOAD ARM SPRING FORCE CHECK

1. At interfacing equipment, load head (initiate -LOAD HEAD signal) so that actuator solenoid is energized (or ground TP28 on PCB).

2. Connect gram gage to load arm tab (Figure 5-16).

3. Pull gage until load arm pressure pad breaks contact with head. Gage must indicate 10 to 18 grams; if not, replace carriage assembly.

### 5.10.4 ACTUATOR BAIL ALIGNMENT CHECK

1. Load head.

2. Access track 00.

**NOTE**

Track accessing may be accomplished normally by interfacing equipment procedures, or manually at the 651. To manually step the carriage to access a track, a jumper must be connected to chassis ground. Touching the jumper free end to PCB test point TP26 steps the carriage in, touching it to TP27 steps the carriage out. Insure that a single, definite contact of the jumper is made; contact bounce will cause multiple stepping.

3. Verify that clearance between bail and load arm tab (Figure 5-16) is .015 ± .005 in. at both ends of bail.

4. Unload head, and verify that bail moves load arm so that pressure pad will not contact the disc cartridge during cartridge interchange.

5. Load head, and access track 31.

6. Repeat steps 3 and 4.

7. Load head, and access track 63.

8. Repeat steps 3 and 4.

9. If requirements of steps 3 and 4 are not met at all three accessed tracks, perform actuator adjustment procedure (paragraph 5.10.5).

### 5.10.5 ACTUATOR BAIL ADJUSTMENT PROCEDURE

1. Unload head.

2. Referring to Figure 5-16, measure gap between head load solenoid pole and clapper arm when the solenoid is in the de-energized state. Gap should be .030 ± .005 in. If gap is not within tolerance, carefully bend bottom of clapper arm with a screwdriver until gap is within tolerance.

3. Load head.

4. Loosen actuator bail adjustment screw (Figure 5-16).

5. Adjust bail position to correct alignment check discrepancy. Gap should be .015 ± .005 in. at both ends of bail.

6. Tighten bail adjustment screw.

7. Repeat steps 1 and 2, and 3 through 6 as often as necessary until both gaps are within tolerance.

8. Repeat alignment check.

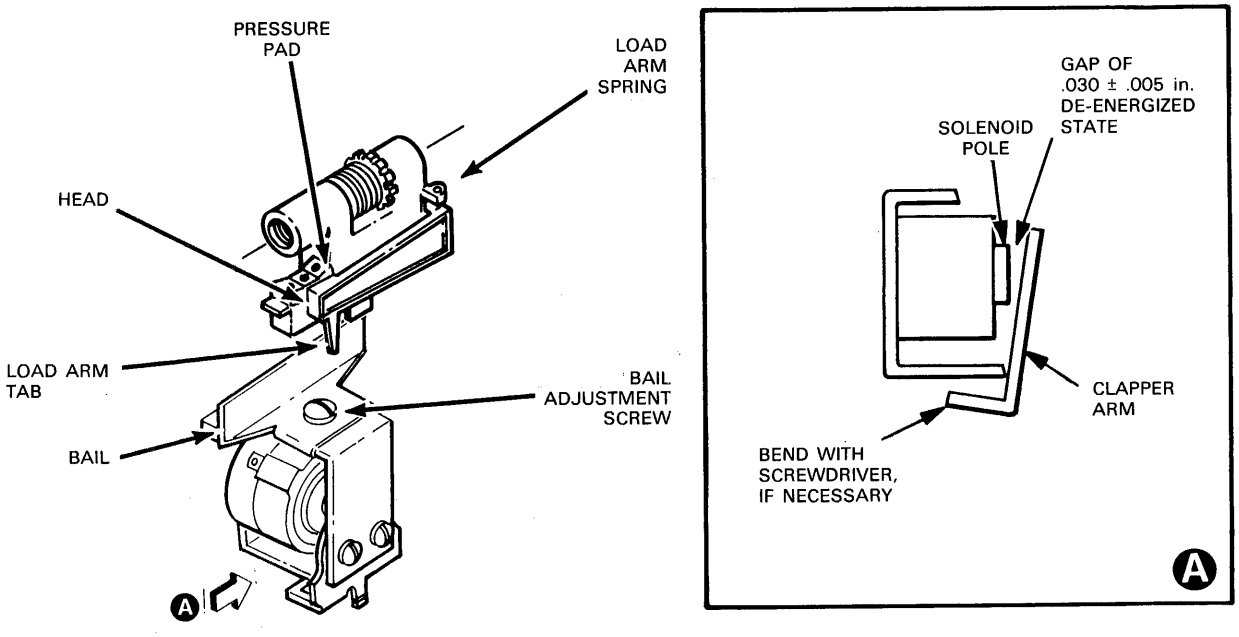



Figure 5-16. Head Load Actuator Components

**CAUTION**

When performing the following removal and replacement procedures, use care to prevent bail or fingers from contacting head.

### 5.10.6 ACTUATOR ASSEMBLY REMOVAL

1. Remove PCB (paragraph 5.3.2).
2. Using extractor tool, remove actuator leads from connector PC1.
3. Disconnect and remove extension spring (Figure 5-17).
4. Swing cartridge guide out on pivots.
5. Remove actuator mounting screw from back of cartridge guide.

**CAUTION**

Remove assembly with care to avoid damage to load arm and head. Hold arm during bail assembly removal to prevent arm from swinging into head.

6. Remove actuator assembly, carefully guiding leads through baseplate access hole to avoid damaging crimp pins.

### 5.10.7 ACTUATOR ASSEMBLY REPLACEMENT

1. Swing cartridge guide out on pivots (Figure 5-17).
2. Insert actuator leads through baseplate access hole.
3. Position actuator assembly on cartridge guide, making certain that actuator bail is between load arm tab and cartridge position.
4. Install mounting screw through cartridge guide.
5. Connect actuator leads to connector PC1 (Logic Manual page FD200).
6. Perform actuator bail alignment check (paragraph 5.10.4) before placing 651 in service.

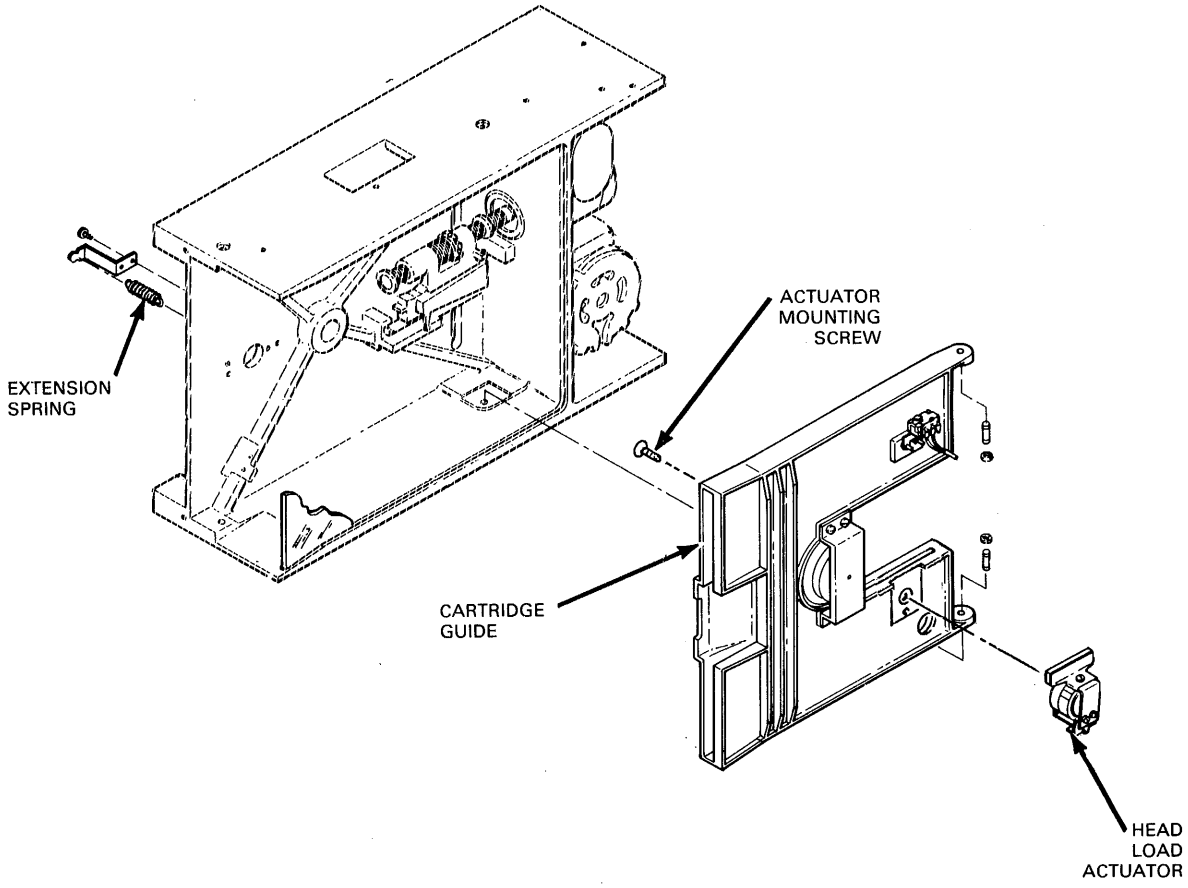



Figure 5-17. Head Load Actuator Removal and Replacement

## 5.11 DOOR OPEN SWITCH

### 5.11.1 DESCRIPTION

The Door Open Switch is a two-position button actuator switch, which is spring-loaded to the contacts-open position (door open). When the door is closed, the extension spring seats the cartridge guide so that the switch is actuated. When the door is open, the cartridge guide is released, and the switch is deactuated. The switch contacts enable the head load actuator solenoid control circuit; therefore, the head cannot be loaded when the door is open.

### 5.11.2 SPECIAL TOOLS

Connector Pin Extractor, Memorex No. 301711.

### 5.11.3 REMOVAL

1. Remove PCB.
2. Using extractor tool, remove switch leads from PC1.
3. Disconnect and remove extension spring (Figure 5-18).
4. Swing cartridge guide out on pivots.
5. Remove switch retaining screws.
6. Remove switch, carefully guiding leads through baseplate access hole.

### 5.11.4 REPLACEMENT

1. Insert switch leads through baseplate access hole, and position switch on baseplate (Figure 5-18).
2. Install switch retaining screws.
3. Connect leads to PC1 (Logic Manual page FD200).
4. Before placing 651 in service, verify that cartridge guide actuates switch when properly seated.

## 5.12 WRITE PROTECT SWITCH

### 5.12.1 DESCRIPTION

The Write Protect Switch is a spring-loaded, lever-actuated switch with contacts normally open (no write protected disc installed in drive). With a write protected disc installed, the switch is activated to its closed position. This prevents WRITE ENABLE from being initiated and provides a write protect status to the using system.

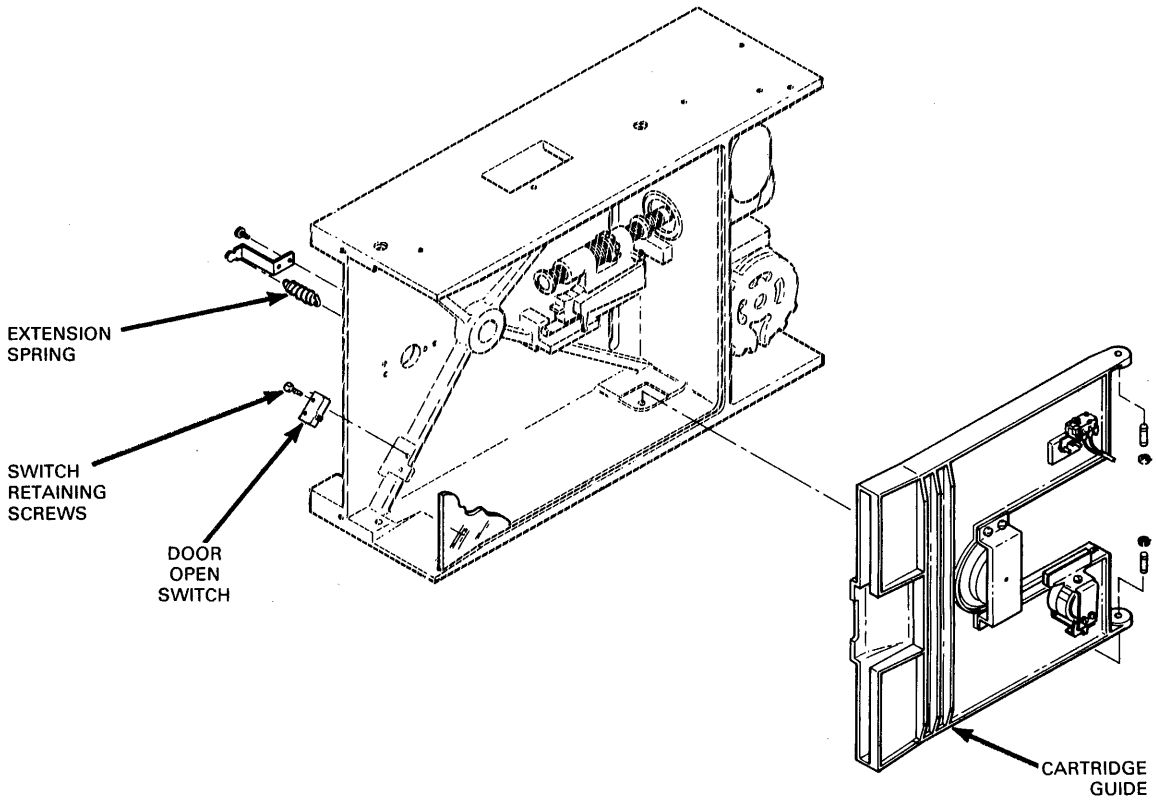



Figure 5-18. Door Open Switch Removal and Replacement

### 5.12.2 SPECIAL TOOLS

Connector Pin Extractor, Memorex No. 301711.

**NOTE**

Avoid disturbing the LED, located below the write protect switch, when performing the following procedures. If the LED is disturbed, it will be necessary to perform the sector alignment procedure (paragraph 5.16.5).

### 5.12.3 ADJUSTMENT

1. Adjust switch such that the actuator just touches the left side of the cartridge guide hole (Figure 5-19). This may be accomplished by loosening the switch-bracket to cartridge-guide retaining screws and moving the switch. If this movement does not provide sufficient adjustment latitude, bend the wire switch actuator to provide for proper adjustment.

2. Check that the switch is in the open condition without a disc cartridge installed in the 651, and that the switch actuates to the closed condition when a write protected disc is installed. The switch should actuate 1/32-inch (minimum) before the cartridge is fully inserted into the cartridge guide, and deactuate at or before the cartridge is extracted 1/8-inch.

### 5.12.4 REMOVAL

1. Loosen screws retaining switch bracket and LED to cartridge guide just enough to remove switch bracket.

2. Using extractor tool, remove switch leads from PC1.

3. Remove switch.

### 5.12.5 REPLACEMENT

1. Reverse Removal procedure above.

2. Perform Write protect switch adjustment procedure (paragraph 5.12.1).

## 5.13 HEAD CARRIAGE AND HEAD POSITION ACTUATOR ASSEMBLIES

### 5.13.1 DESCRIPTION

The Head Carriage assembly, along with the Track Position Actuator, and Track 00 Switch Assemblies make up the track accessing group of the 651. The purpose of this assembly group is to provide file access by track address.

The recording head is mounted on a carriage that travels parallel to a horizontal radius of the vertically mounted disc. The carriage is driven toward or away from the disc center by a rotating screw on which the carriage is mounted. The screw is rotated in either direction by the head position actuator. This actuator is a stepping motor that rotates the screw in 15 degree increments. The linear head travel resulting from one rotation increment is equal to the center-to-center distance between two adjacent tracks on the disc (approximately .020 inch). Track accessing depends upon the initial alignment of the carriage on the screw so that the head is radially positioned over a track centerline. Carriage stops are mounted on either end of the screw to prevent inadvertent carriage overtravel. The stops must be correctly positioned after the head radial alignment is complete.

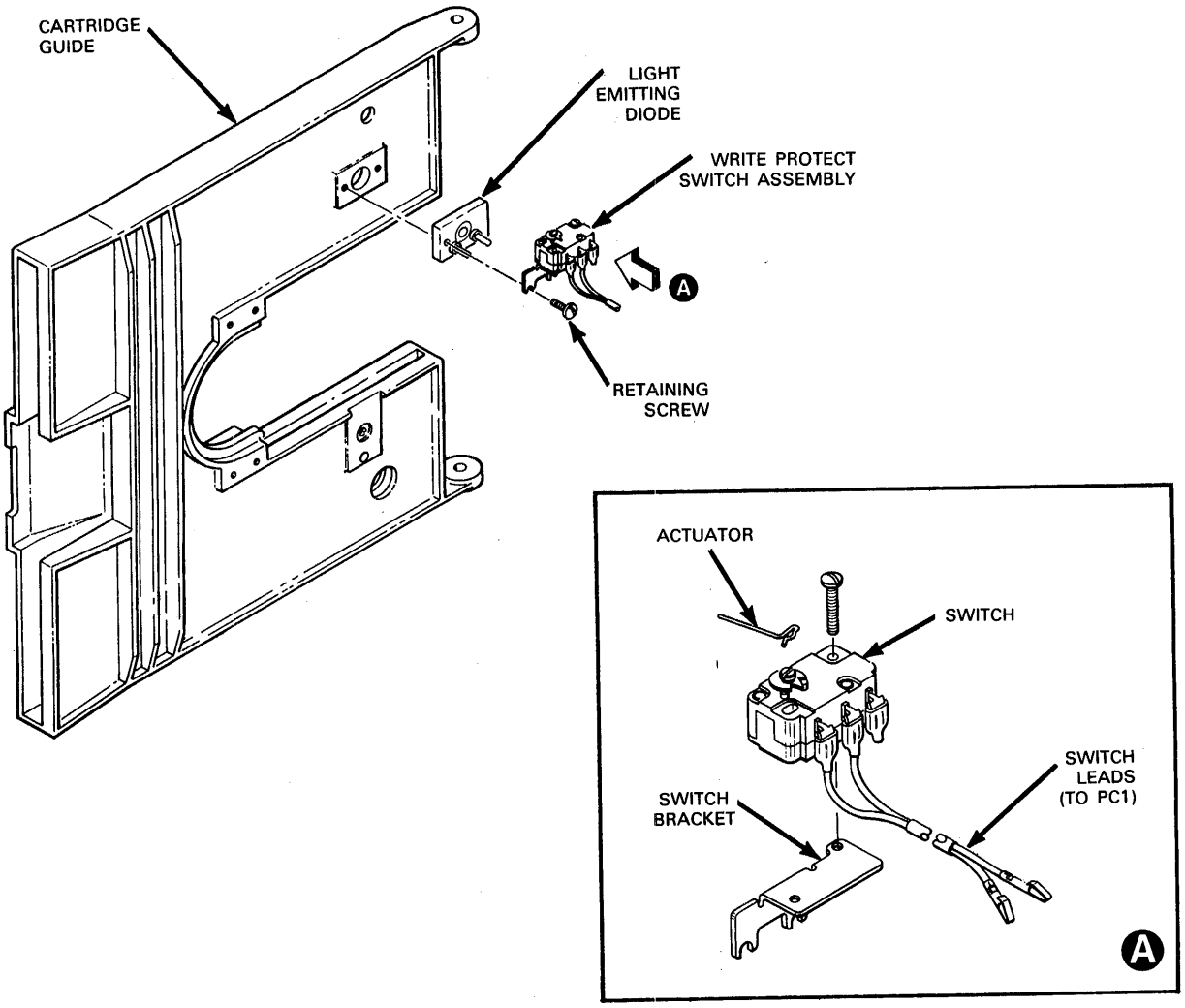



Figure 5-19. Write Protect Switch Removal and Replacement

### 5.13.2 SPECIAL TOOLS

Connector Pin Extractor,Memorex PN 301711.

Field Service Alignment Cartridge, Memorex PN 307007.

Oscilloscope, Textronix Model 422, or equivalent.

### 5.13.3 HEAD POSITION ACTUATOR DIAGNOSTIC FLOW DIAGRAM

The troubleshooting procedure to isolate a malfunction in the track accessing components is shown in Figure 5-20.

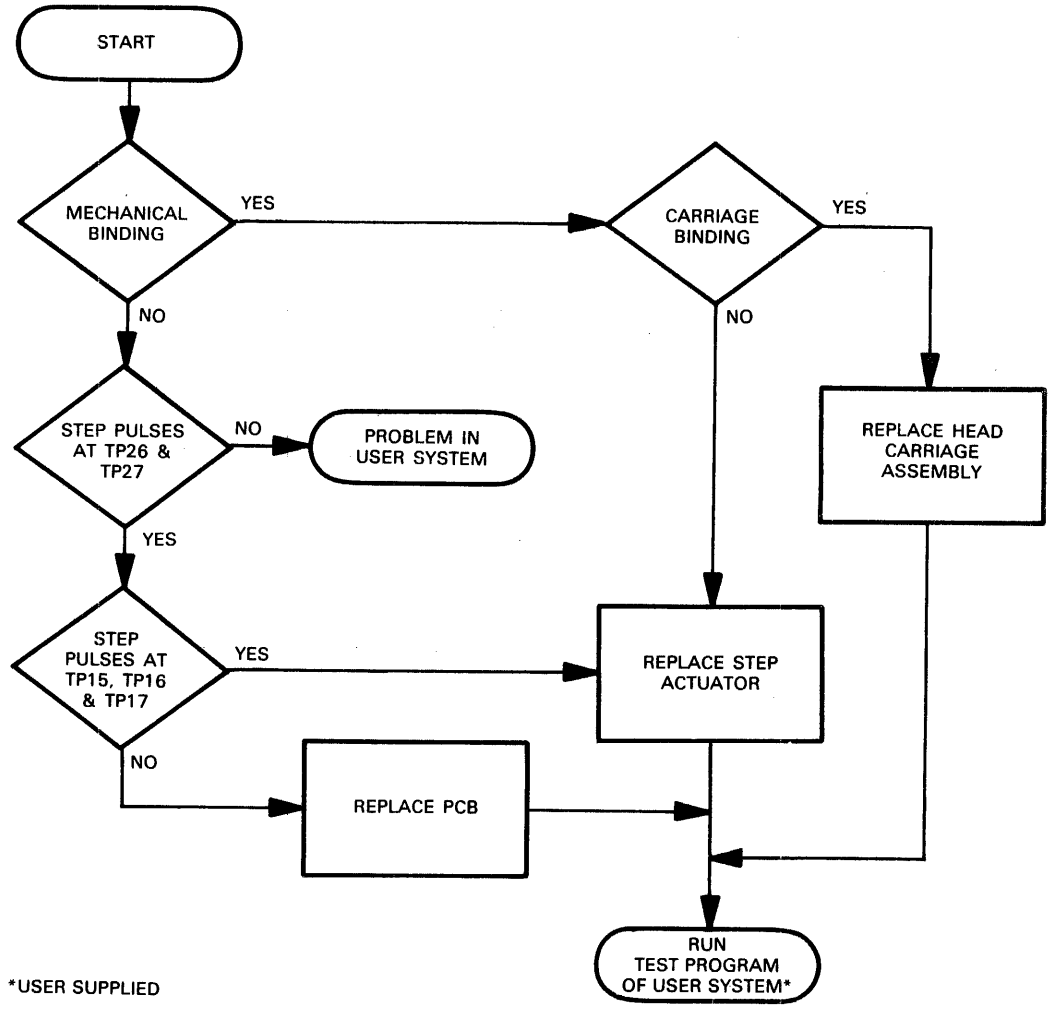



Figure 5-20. Head Position Actuator Diagnostic Flow Diagram

### 5.13.4 HEAD READ/WRITE CHECK

1. Access track 63.
2. Write all one's on entire track.
3. Connect oscilloscope across read head output (TP1 and TP2). Synchronize on sector output pulse (TP10) and set controls to add differentially.
4. Read data written on track 63. Amplitude of read signal should be 170 mv minimum. If signal is below minimum, check for proper amplifier gain and/or poor head-to-disc compliance.

### 5.13.5 HEAD RADIAL ALIGNMENT CHECK

1. Perform steps 1, 2, and 3 of head radial alignment procedure (paragraph 5.13.6).
2. Compare amplitudes of two adjacent oscilloscope-displayed lobes (Figure 5-21). They must be equal within 25 percent.
3. Access track 30, and then reaccess track 31.
4. Repeat step 2.
5. If amplitudes are not as specified in step 2, perform head radial alignment procedure (paragraph 5.13.6).

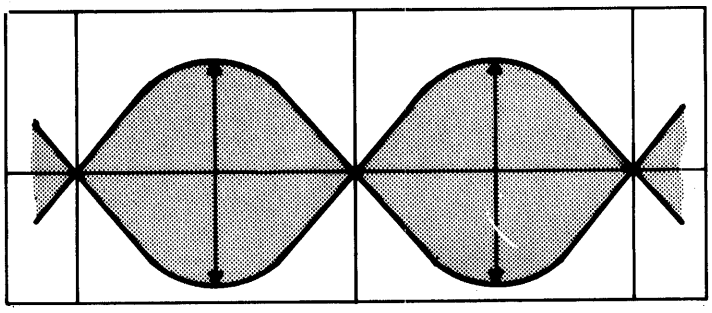


Figure 5-21. Head Radial Alignment Waveform

### 5.13.6 HEAD RADIAL ALIGNMENT PROCEDURE

**NOTE**

Both 651 and Field Service Alignment disc must be exposed to ambient room temperature for at least 20 minutes prior to performing alignment procedure.

1. Insert Field Service Alignment cartridge into cartridge guide.

2. At interfacing equipment, apply ac and dc power, load head (initiate -LOAD HEAD signal to actuate head load actuator), and access track 31.

**NOTE**

Track accessing may be accomplished normally, by interfacing equipment procedures, or manually at the 651. To manually step the carriage to access a track, a jumper must be connected to chassis ground. Touching the jumper free end to PCB test point TP26 steps the carriage in, touching it to TP27 steps the carriage out. Insure that a single, definite contact of the jumper is made; contact bounce will cause multiple stepping.

3. Connect oscilloscope direct probes to differentially monitor PCB test points TP1 and TP2 (head signals). Set oscilloscope to sync on PCB test point 10 (identified on logic page FD300). Set time base to 20 milliseconds per division; set amplitude to 0.2 volt/cm.

**NOTE**

An alignment pattern is recorded on Field Service Alignment disc track 31. The oscilloscope should now display a signal envelope.

4. Assure that phase Ø2 of the stepping motor is energized at track position 31 (+0.2 volt at TP17).

**WARNING**

The housing may be quite warm if the drive has been operating for some time prior to performing the following steps. If so, avoid possible burn by wrapping a handkerchief or other protective material around housing.

5. Loosen three screws in head position actuator housing-to-baseplate clamps sufficiently to permit housing rotation (Figure 5-22).

6. Rotate actuator housing until oscilloscope displays distinct lobe patterns, and then adjust housing radial position until two adjacent lobes are equal in amplitude. See Figure 5-21.

7. Retighten clamp screws without disturbing alignment.

8. Access track 30, and then reaccess track 31.

9. Compare amplitudes of two adjacent lobes. They must equal within 15 percent; if not, repeat steps 5, 6, and 7. (Note: The 15 percent tolerance in this step is deliberately tighter than the 25 percent tolerance specified in step 2 of paragraph 5.13.5. The 25 percent tolerance makes allowance for the alignment having been set with a different Field Service Alignment cartridge.)

10. Access track 32, and then reaccess track 31.

11. Repeat step 9.

12. Disconnect and remove test equipment.

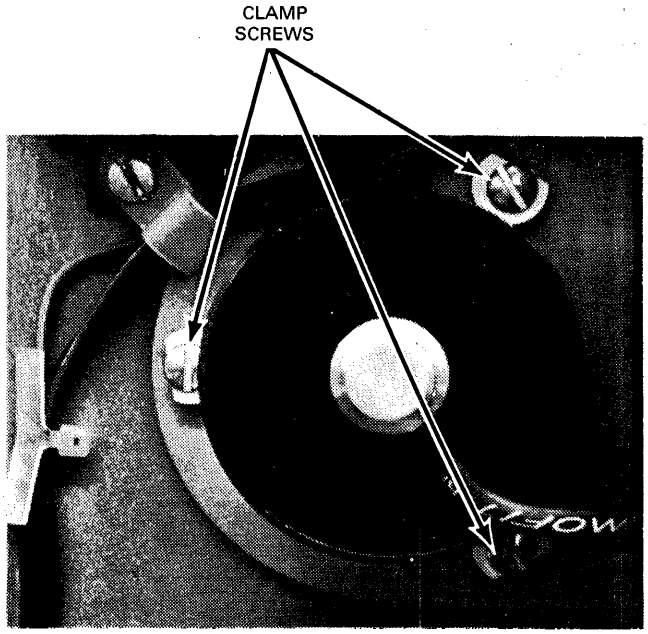



Figure 5-22. Head Position Actuator Clamp Screws (on rear of 651)

### 5.13.7 CARRIAGE STOP ADJUSTMENT PROCEDURE

1. Perform head radial alignment check (paragraph 5.13.5).
2. At interfacing equipment, apply 651 ac and dc power, load head, and access track 00.
3. Loosen rear carriage stop set screw (Figure 5-23).
4. Insert a 0.007-inch gage (one data processing card) between rear carriage stop and carriage.
5. Press rear carriage stop firmly against gage, tighten set screw, and remove gage.
6. Access track 63.
7. Repeat steps 3 through 5 for front carriage stop.

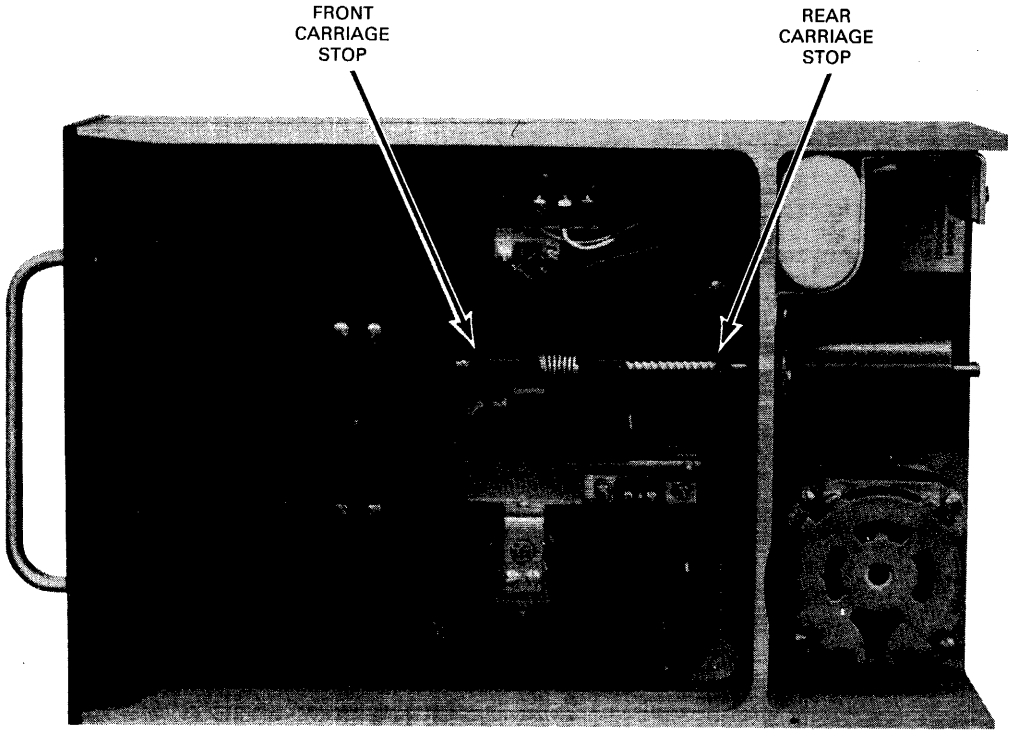



Figure 5-23. Carriage Stop Adjustment

### 5.13.8 CARRIAGE REMOVAL

1. Loosen front carriage stop set screw (Figure 5-24) and remove stop.

**CAUTION**

The head lead can be damaged by stress, crimping, or excessive flexing. To avoid damage, it must be handled with care. When removing the carriage and lead, the cable clamp location and lead routing should be noted to assure correct reinstallation.

2. Note routing of head cable and loop size between head and cable clamp. Remove head cable clamp.

3. Loosen three clamp screws and release actuator from clamps holding actuator to baseplate.

4. Rotate actuator lead screw to disengage it from carriage. Carefully guide actuator leads through baseplate access hole so as not to damage crimp pins, and remove actuator and screw.

5. Remove carriage from way, and carefully guide head lead and connector through access hole, avoiding tension on lead.

### 5.13.9 CARRIAGE REPLACEMENT

1. Insert head lead and connector through baseplate access hole, and install carriage on way (Figure 5-24).

2. Insert actuator screw through baseplate access hole into unthreaded opening in carriage.

3. Insert spring and preload nut into carriage opening, and thread preload nut onto actuator screw.

4. Press carriage toward actuator to compress spring, and rotate actuator screw to thread screw into threaded opening in carriage.

**NOTE**

Pressure exerted in step 4 establishes carriage assembly preload force. Preload force is correct when gap is less than a $\frac{1}{16}$ of an inch (the width of a nickel) but clearance still exists between the nut and carriage.

5. Position actuator on baseplate, and install clamps and retaining screws.

6. Install front carriage stop on actuator screw, and tighten set screw.

7. Connect actuator leads to connector PC1 (Logic Manual page FD400).

8. Install head lead in cable clamp as it was previously installed, allowing 4 inches of lead between clamp and head. Carefully route lead and connector through baseplate access hole.

9. Perform head radial alignment (paragraph 5.13.6) carriage (paragraph 5.13.7), and index and sector alignment check (paragraph 5.16.4) prior to placing 651 in service.

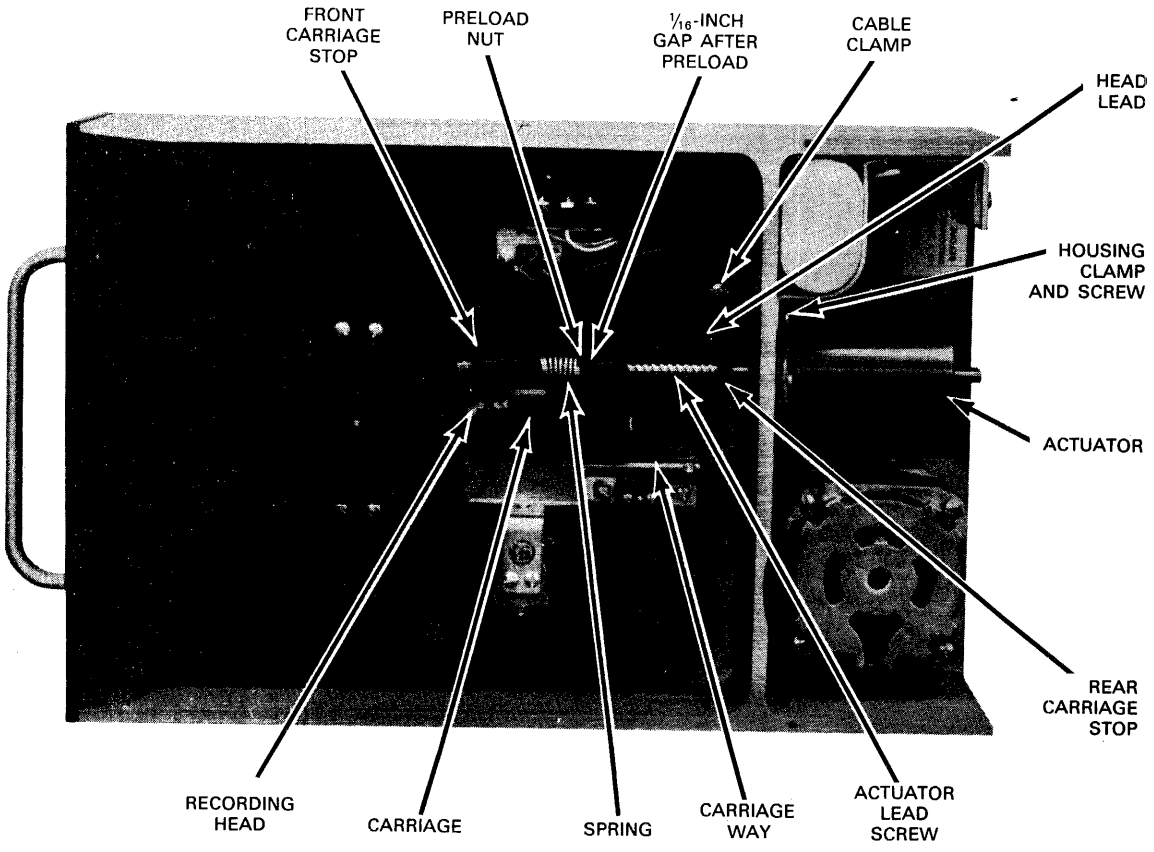



Figure 5-24. Head Carriage and Head Position Actuator Removal and Replacement

## 5.14 TRACK 00 SWITCH ASSEMBLY

### 5.14.1 DESCRIPTION

The Track 00 Switch is a two-position actuator button switch that generates the TRACK 00 head position status signal. The switch is actuated by a cam surface on the carriage assembly when the carriage is in the track 00 position. Following the head radial position alignment, this switch must be positioned so that it is actuated when the head is positioned at track 01, and is deactuated when the head is stepped to track 02.

**NOTE**

The switch circuit is ANDed with the pulses required to stop the actuator motor to track 00 to indicate a true Track 00. In this manner, switch hysteresis and adjustment tolerance are not critical. Switch closure must be measured at the switch, not the Track 00 line.

### 5.14.2 SPECIAL TOOLS

Connector Pin Extractor, Memorex No. 301711.

### 5.14.3 ADJUSTMENT CHECK

1. At interfacing equipment, apply 651 ac and dc power, load head, and access track 01.
2. Verify that Track 00 Switch is actuated.
3. Access track 02.
4. Verify that Track 00 Switch is deactuated.
5. If condition specified in steps 2 and 4 are not met, perform Track 00 Switch adjustment procedure (paragraph 5.14.4).

### 5.14.4 ADJUSTMENT PROCEDURE

1. Perform head radial alignment check (paragraph 5.13.5).
2. At interfacing equipment, load head and access track 01.
3. Loosen two retaining screws in bracket (Figure 5-25).
4. Slide bracket to right so that switch is deactuated.
5. Gently slide bracket to left until switch actuator button touches carriage cam; then exert pressure until hearing switch actuating click.

6. Tighten bracket retaining screws while holding switch in actuated position.

7. Access track 02, and verify that switch becomes deactuated. If not, slightly loosen left-hand bracket screw, and gently nudge bracket downward until switch is deactuated.

8. Perform Track 00 Switch adjustment check (paragraph 5.14.3).

### 5.14.5 REMOVAL

1. Remove PCB.

2. Using extractor tool, remove switch leads from connector PC1.

3. Remove retaining screws at either end of bracket (Figure 5-25).

4. Remove bracket and switch assembly, carefully guiding leads through baseplate access hole.

### 5.14.6 REPLACEMENT

1. Insert switch leads through baseplate access hole, and position bracket and switch on baseplate (Figure 5-25).

2. Install retaining screws in bracket.

3. Install switch leads in connector PC1 (Logic Diagram page FD200).

4. Perform Track 00 Switch adjustment procedure (paragraph 5.14.4).

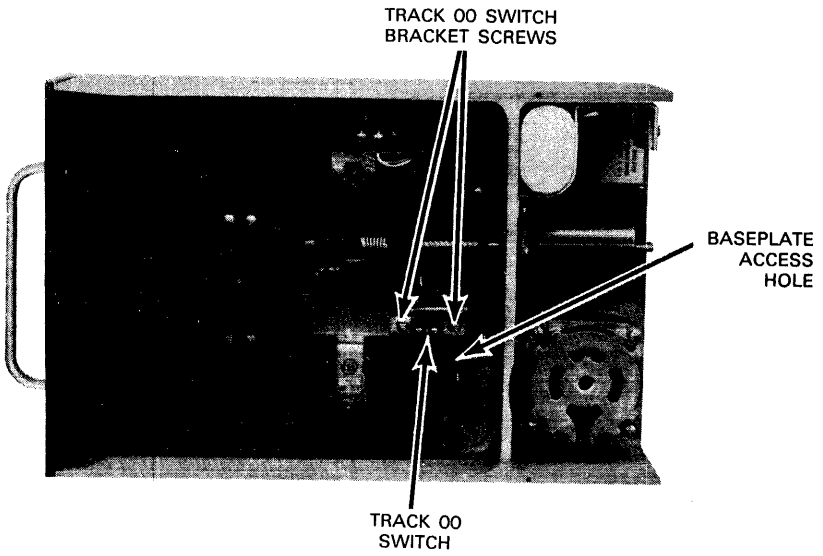



Figure 5-25. Track 00 Switch Removal and Replacement

## 5.15 DRIVE MOTOR ASSEMBLY

### 5.15.1 DESCRIPTION

The Drive Motor assembly, in conjunction with the index and sector sensing components, make up the index and sector accessing group of the 651. The first assembly group consists of the drive motor and motor pulley. The latter are the Light Emitting Diode Assembly and the Photo Transistor Assembly. These components provide disc rotation and relative degree of rotation status signals.

### 5.15.2 DRIVE MOTOR

#### 5.15.2.1 Description

The drive motor is a constant speed ac motor used to drive the disc. The motor is furnished in either 110 volt ac or 220 volt ac configurations. The ac power to drive the motor is supplied by the host system. The drive motor operates whenever the required voltage appears across the J2 ac terminals.

#### 5.15.2.2 Removal

1. At interfacing equipment, turn off 651 ac power.
2. Remove belt from pulleys (Figure 5-26).
3. Remove two screws from connector bracket to free bracket and connector. Do not disassemble connector from bracket.
4. Remove two capacitor strap screws and strap to free capacitor.
5. Remove belt guard and assembly wiring cable clamps.
6. Remove four motor-to-baseplate screws to free motor, and remove entire assembly, leaving wires and motor pulley connected.

#### 5.15.2.3 Replacement

1. Insert motor shaft and attached motor pulley through baseplate access hole, and position motor on baseplate (Figure 5-26).
2. Install four motor-to-baseplate screws.
3. Install belt guard.
4. Position capacitor and strap, and install strap screws.
5. Position connector bracket with attached connector, and install two bracket screws.
6. Install belt on pulleys.

### 5.15.3 MOTOR PULLEY

#### 5.15.3.1 Description

The drive motor may be operated by either 50-Hz or 60-Hz ac power. This is accomplished by use of a dual-radius motor pulley, which can be mounted on the motor shaft so that either the smaller radius pulley or the larger radius pulley faces away from the motor. The belt is installed on the pulley facing away from the motor. The motor pulley must be installed with the smaller radius pulley facing away from the motor for 60 Hz operation, and the larger radius pulley facing away from the motor for 50 Hz operation.

#### 5.15.3.2 Removal

1. Loosen set screw in pulley (Figure 5-26).

2. Slide pulley off end of shaft.

#### 5.15.3.3 Replacement and Adjustment

1. Determine frequency of drive motor power.

2. Engage pulley on end of motor shaft, directionally oriented according to preceding motor pulley description (Figure 5-26).

3. Align motor pulley with spindle pulley so that planes of rotation are aligned within $\frac{1}{32}$ of an inch.

4. Tighten set screw in motor pulley.

## 5.16 INDEX AND SECTOR SENSING COMPONENTS

### 5.16.1 DESCRIPTION

These components consist of the Light Emitting Diode Assembly, mounted on the front of the cartridge guide, and the Photo Transistor Assembly, mounted behind the cartridge guide. The line of sight connecting these two components is perpendicular to the plane of the disc, and intersects the disc at the circle formed by the thirty-two sector holes and the index hole. When the disc is rotating, invisible infrared light emission from the light emitting diode actuates the photo transistor, which generates a 5-volt pulse, each time one of the 0.10-diameter holes in the disc exposes the photo transistor to the light emitting diode. An adjusting screw on the Photo Transistor Assembly permits positioning the photo transistor along the arc of the disc holes so that the leading edge of the index/sector pulse occurs simultaneously with coincidence of the recording head and the geometric index or sector radius on the disc. This will assure that the leading edge of the sector pulse will occur simultaneously with the beginning of the physical sector. This alignment is accomplished with the aid of the Field Service Alignment disc. Bursts of 16 transitions each are recorded on tracks 07 and 56 of this disc. The initial transition peak of the burst occurs 100 $\mu$sec after the leading edge of the SECTOR pulse.

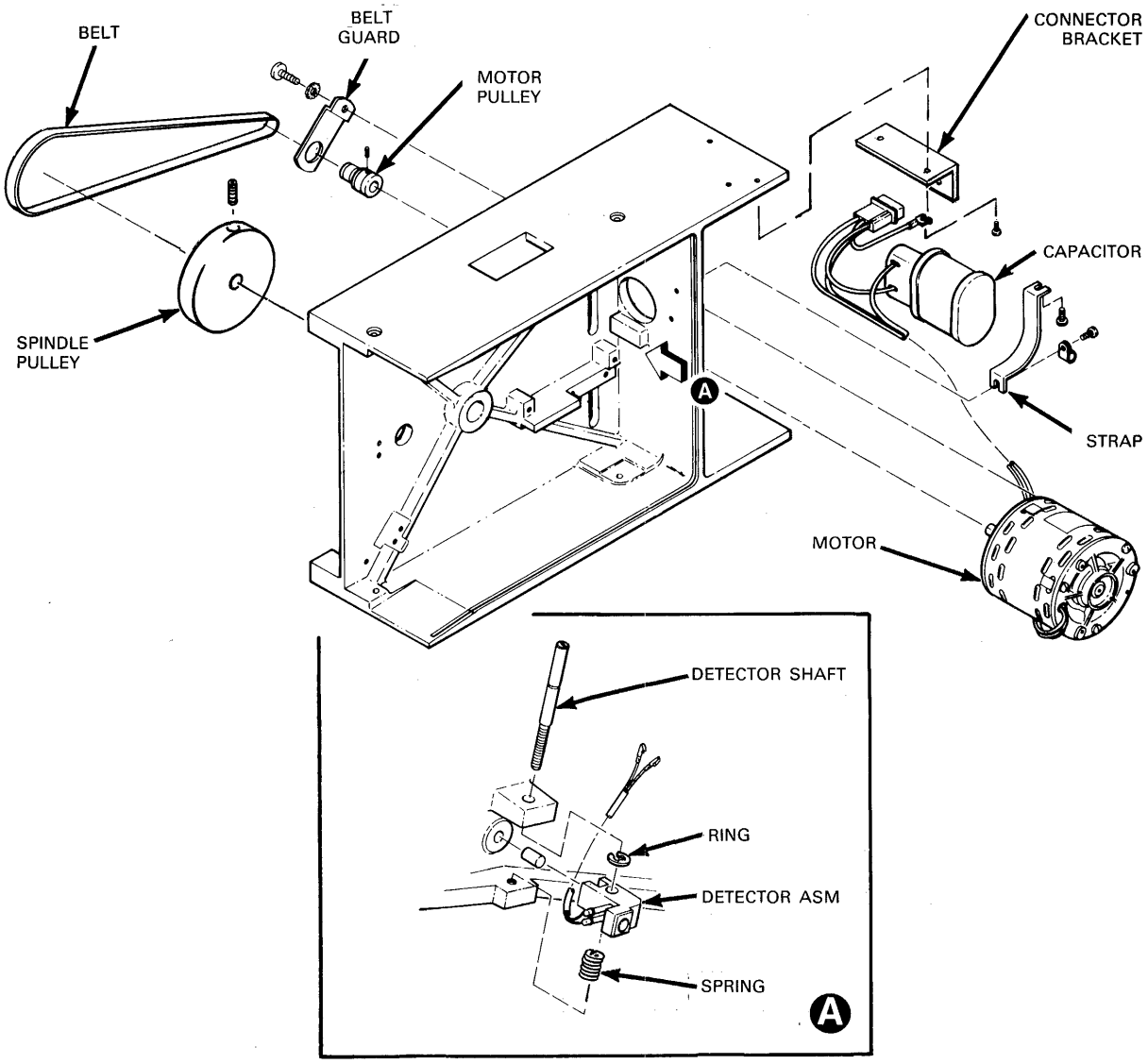



Figure 5-26. Drive Motor Assembly Removal and Replacement

### 5.16.2 SPECIAL TOOLS

Field Service Alignment Cartridge, Memorex No. 307007.

Oscilloscope, Tektronix Model 422, or equivalent.

Read/Write Adapter Plug, Memorex No. 204296

### 5.16.3 INDEX AND SECTOR SENSING DIAGNOSTIC FLOW DIAGRAMS

The troubleshooting procedure to isolate malfunctions in the index and sector sensing components is shown in Figures 5-27 and 5-28. Figure 5-27 is used when no index/sector pulses are present. Figure 5-28 is used when a timing problem exists.

### 5.16.4 ALIGNMENT CHECK

1. Perform steps 2, 3, (4 if applicable), 5, and 9 of index and sector alignment procedure (paragraph 5.16.5).
2. Verify that first peak of burst occurs 100 ± 40 $\mu$sec after start of oscilloscope sweep. Record time.
3. Access track 56.
4. Repeat step 2.
5. If tolerances specified in steps 2 and 4 are not met, perform index and sector timing alignment procedure (paragraph 5.16.5).
6. Disconnect and remove test equipment.

### 5.16.5 ALIGNMENT PROCEDURES

1. Perform head radial alignment check (paragraph 5.13.5).
2. Insert Field Service Alignment cartridge in cartridge guide.

**NOTE**

The Alignment disc contains only one sector hole, versus 32 for a regular disc. It therefore cannot be used for Index/Sector diagnostics, only for alignment.

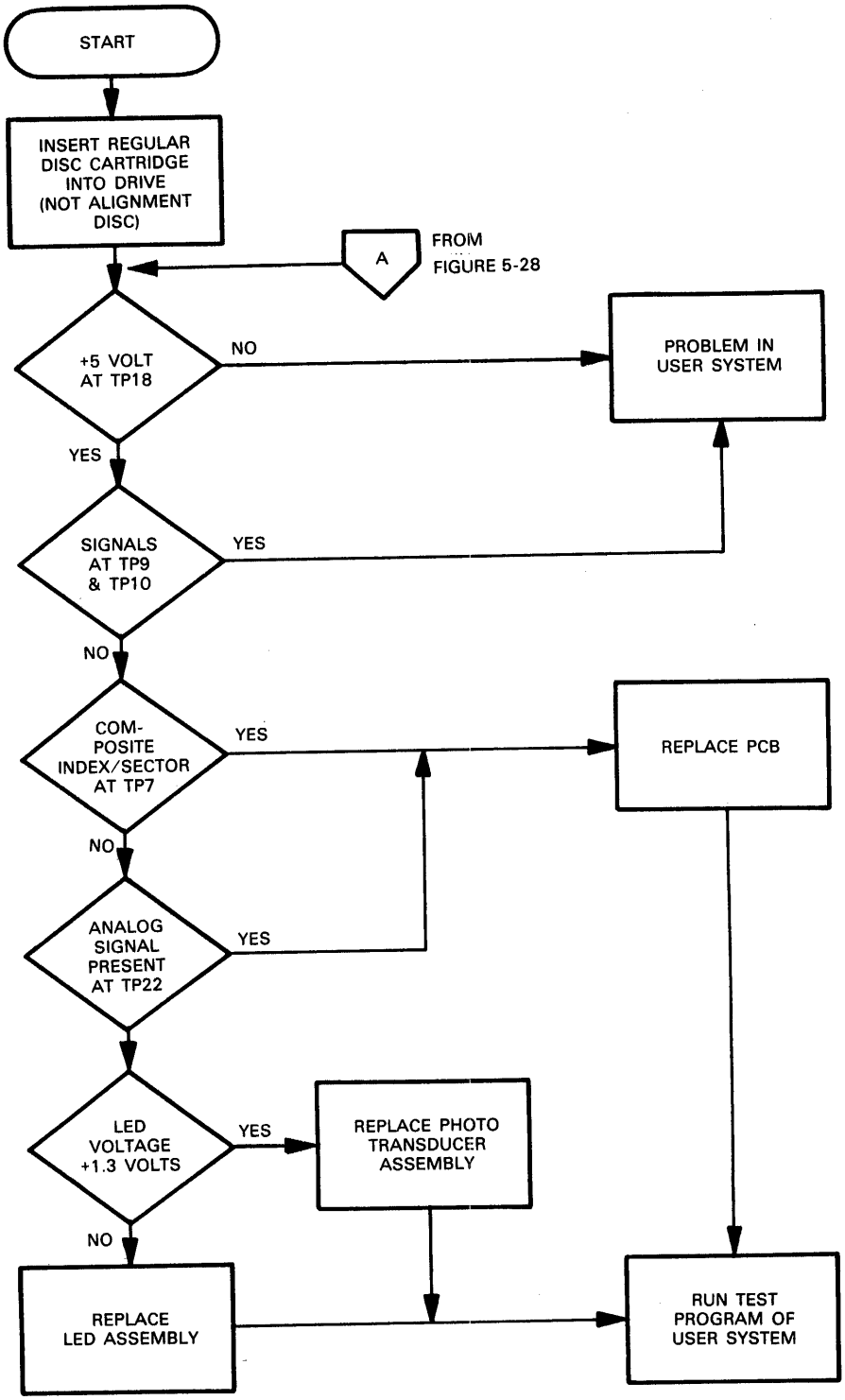



Figure 5-27. Diagnostic Flow Diagram, Index/Sector Pulses Absent

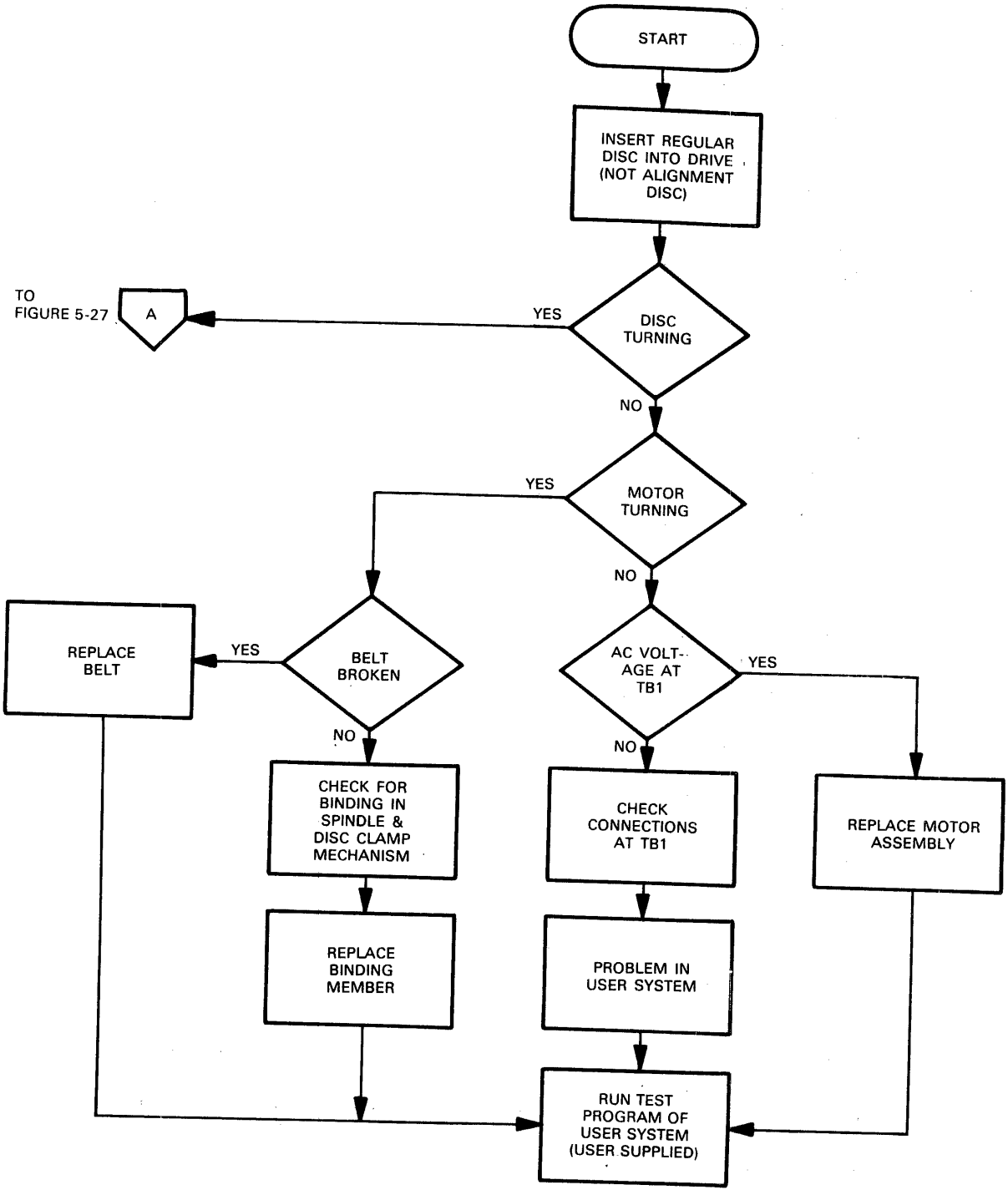



Figure 5-28. Diagnostic Flow Diagram, Index/Sector Timing Problem

3. Connect oscilloscope direct probes to differentially monitor PCB test points TP1 and TP2 (head signal). Set oscilloscope to sync positively on leading edge of SECTOR pulse (TP10). Set time base to 10 ms/cm.

4. Disconnect head cable connector from PCB, and insert R/W adapter plug in its place. Connect head cable connector to adapter plug.

5. At interfacing equipment, apply ac and dc power to 651, load head, and access track 07.

6. Insert screwdriver through baseplate top access hole, and rotate detector shaft as required to position burst within first 20 ms of oscilloscope sweep.

7. Expand oscilloscope time base to 100 μsec/cm.

8. Rotate detector shaft to adjust burst so that first peak occurs 100 μsec after start of sweep.

9. Expand oscilloscope time base to 20 μsec/cm (Figure 5-29).

10. Repeat step 8.

11. Access track 56. First peak of track 56 burst must occur 100 ±40 μsec after start of sweep. If not, repeat step 8 and compensate this adjustment in the direction required to permit track 56 to be within tolerance. Do not exceed 100 ± 40 μsec setting at either track.

12. Reaccess track 07 and repeat steps 6 through 11 until required tolerance is met on both tracks. Failure to meet tolerance specified may be caused by poor optical coupling between LED and photo transistor, misaligned track position actuator, broken carriage, or damaged Field Service Alignment disc.

13. Disconnect and remove test equipment.

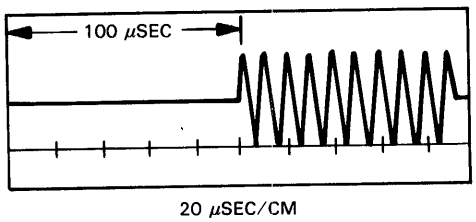



Figure 5-29. Index and Sector Sensing Alignment Waveform

## 5.17 LIGHT EMITTING DIODE ASSEMBLY

### 5.17.1 DESCRIPTION

The Light Emitting Diode Assembly is mounted over a hole on the front of the cartridge guide. The diode is installed in a mounting block, and emits invisible infrared light whenever dc power is applied to the 651.

### 5.17.2 SPECIAL TOOLS

Connector Pin Extractor, Memorex No. 301711.

### 5.17.3 REMOVAL

1. Remove PCB.
2. Using the extractor tool, remove diode leads from connector PC1.
3. Remove two mounting screws (Figure 5-30).
4. Remove assembly, carefully guiding leads through baseplate access hole.

### 5.17.4 REPLACEMENT

1. Insert diode leads through baseplate access hole (Figure 5-30).
2. Position assembly and install two mounting screws.

**CAUTION**

Diode leads must be connected exactly as shown in Logic Manual to ensure correct polarity.

3. Install diode leads in connector PC1. (Logic Manual page FD200.)
4. Perform sector alignment check (paragraph 5.16.4).

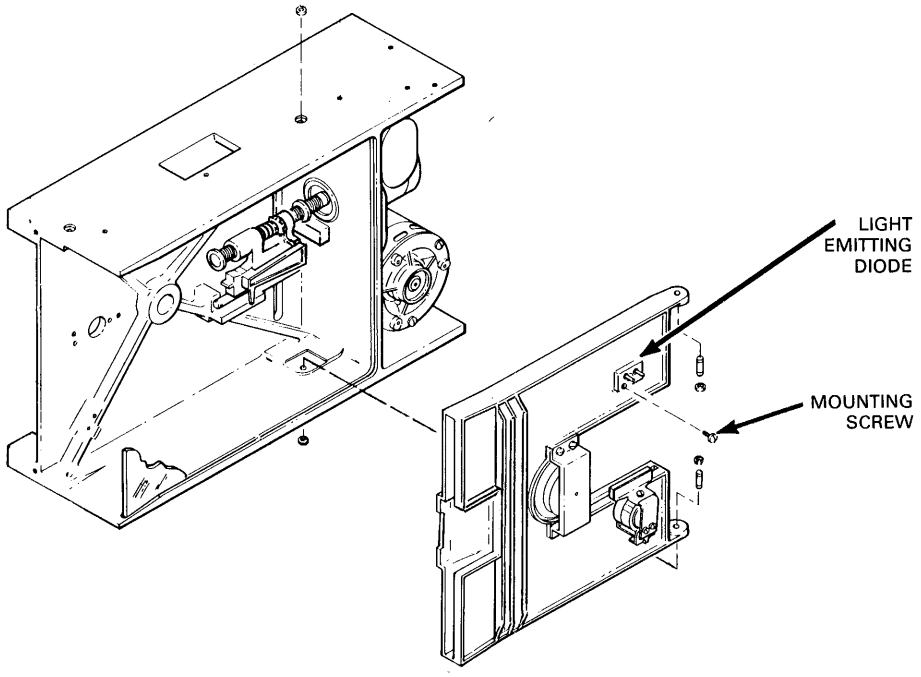



Figure 5-30. Light Emitting Diode Removal and Replacement

## 5.18 PHOTO TRANSISTOR ASSEMBLY

### 5.18.1 DESCRIPTION

The major components of the Photo Transistor Assembly are the detector assembly, detector shaft, retaining ring, and detector spring. The detector shaft is threaded, and screws into the detector assembly. The relative position of the detector assembly on the shaft determines the timing alignment. Light from the light emitting diode, applied to the photo transistor when a disc index or sector hole passes between the two, turns on the transistor,and a threshold detector circuit generates the timing pulse. Discrimination between INDEX and SECTOR pulses is accomplished by circuitry on the PCB.

### 5.18.2 SPECIAL TOOLS

Connector Pin Extractor, Memorex No. 301711.

### 5.18.3 REMOVAL

1. Remove PCB.
2. Using extractor tool, remove transistor leads from connector PC1.
3. Disconnect and remove extension spring.
4. Swing cartridge guide out on pivots.
5. Remove retaining ring from detector shaft (Figure 5-31).
6. Grasp spring and detector assembly, and unscrew and remove detector shaft through baseplate access hole.
7. Withdraw spring and detector assembly, carefully guiding leads through baseplate access hole.

### 5.18.4 REPLACEMENT

1. Insert leads through baseplate access hole, and insert spring and detector assembly into position (Figure 5-31).
2. Insert detector shaft through access hole, and screw shaft into detector assembly.
3. Install retaining ring on shaft.
4. Install photo transistor leads in connector PC1. (Refer to Logic Manual page FD200).
5. Perform index and sector timing alignment procedure (paragraph 5.16.5) before placing 651 in service.

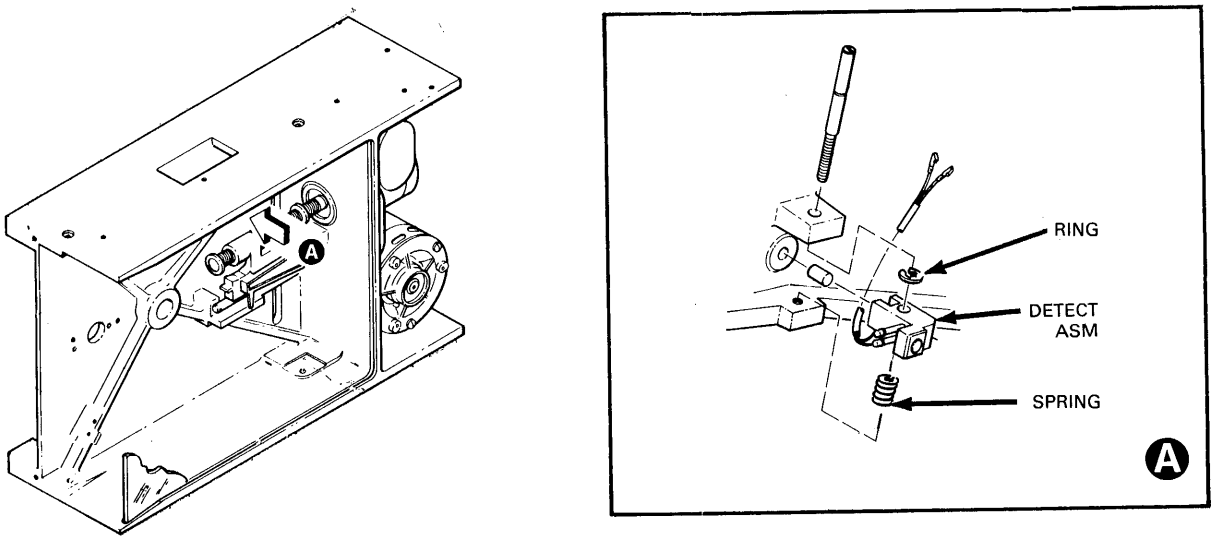



Figure 5-31. Photo Transistor Removal and Replacement

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