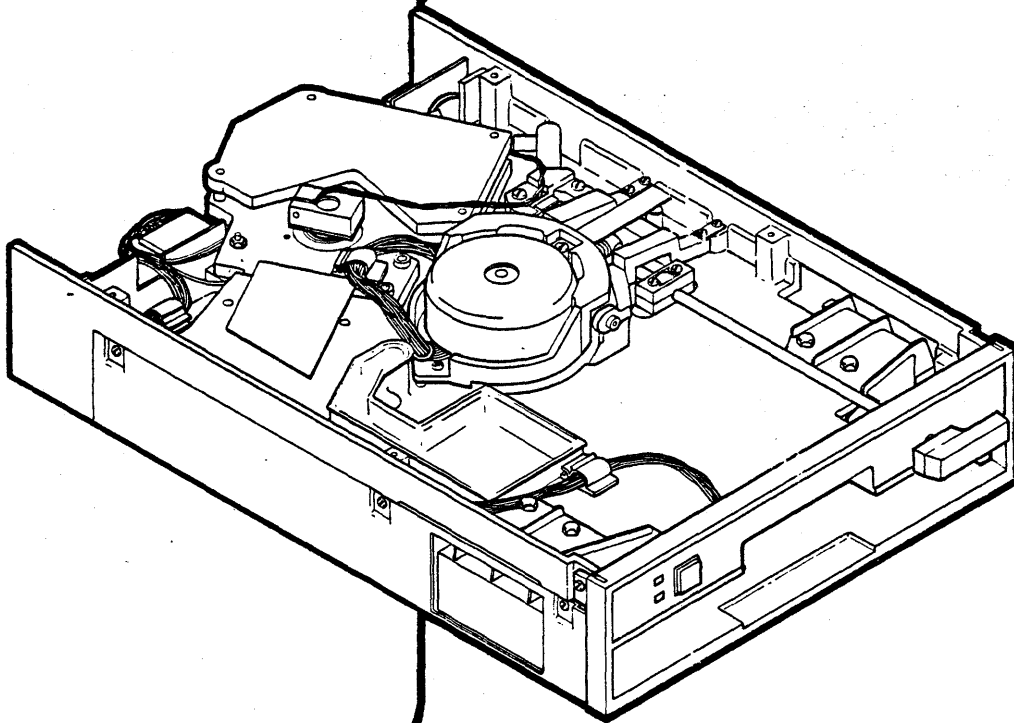




OEM SERVICE MANUAL



OEM DISK DRIVE WITH CONTROLLER

ALPHA-10H/10.5H™ WITH EXTENDED SCSI

IOMEGA Corporation
OCTOBER 1985

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OEM SERVICE MANUAL
FOR THE
ALPHA-10H/10.5H
OEM DISK DRIVE WITH EXTENDED SCSI CONTROLLER

Information for OEMs and Service Trained Personnel
on Repair and Maintenance of the IOMEGA
8 Inch, Half-Height 10/10.5 Megabyte OEM Disk Drive with
Extended SCSI Controller



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PREFACE

This Service Manual provides specific information on the repair and maintenance of the 8 inch, half-height, 10/10.5 megabyte disk drive with controller. Intended for use by service-trained personnel, the manual describes diagnosis, problem identification, and parts removal and replacement procedures. The organization of the manual is as follows:

- SECTION 1. INTRODUCTION provides general servicing information and precautions.
- SECTION 2. THEORY OF OPERATION details the operation theory with block diagrams, description of operations, and hardware information.
- SECTION 3. DIAGNOSTICS AND TROUBLESHOOTING explains the built-in diagnostics of the subsystem and presents service instructions for efficient fault diagnosis and repair.
- SECTION 4. COMPONENT REPLACEMENT PROCEDURES covers removal of defective components, installation of replacements, and any adjustments or alignments that may be necessary after component replacement.
- APPENDIX A. PARTS INFORMATION identifies field replaceable components with manufacturer's part numbers and includes exploded view diagrams of the subsystem.
- APPENDIX B. SCHEMATIC DIAGRAMS contains diagrams for troubleshooting reference.

This manual provides for service only and does not cover integration, operation, or use of the subsystem. The IOMEGA Technical Description Manual (P/N 00701300) is available separately for that purpose.

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1. INTRODUCTION

This manual provides specific information on the repair and maintenance of the half-height 10/10.5 megabyte, 8 inch disk drive, which consists of a single board controller and up to two disk drives, and uses removable 10/10.5 megabyte cartridges (Figure 1-1). Modular replacement is described in this manual to minimize on-site repair time.

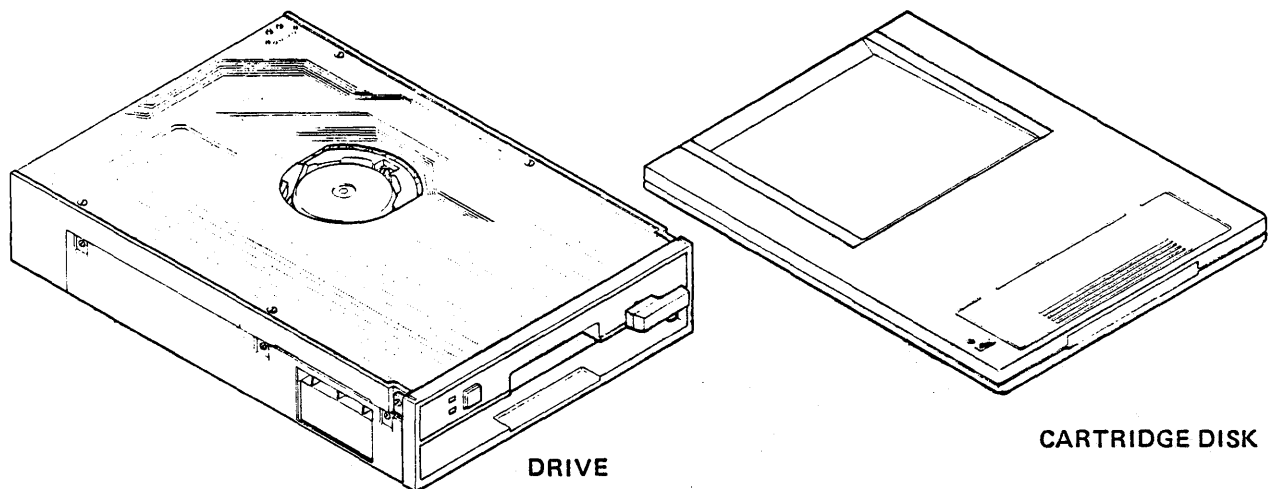


Figure 1-1. Half-Height 10/10.5 Megabyte, 8 Inch Disk Drive

As a field service manual for on-site or in-house repair, this document is designed for service trained personnel and supports diagnosis, problem identification, removal, and replacement.

WARNING

The disk storage drive is a sophisticated, state-of-the-art electromechanical device. Repair by unqualified personnel or without designated equipment is not recommended. Repairs beyond the scope of this manual should not be attempted and would void any warranty coverage.

CAUTION

The disk storage drive runs entirely on direct current (dc) power, with no hazardous voltages. However, in a configured OEM system, hazardous voltages are likely to exist, especially in the power supply. Also, static-sensitive electronic components are used, and service personnel should be familiar with the procedures for handling such equipment.

2. THEORY OF OPERATION

Hardware associated with the subsystem drive and its controller is described in this section, followed by details of the track following, seeking, synchronization, reading, and writing functions.

2.1 HARDWARE DESCRIPTION

The subsystem drive is available in two basic configurations: the more common is a drive with integral controller (Figure 2-1); the other is simply a slave drive without controller. At least one controller must be present in any given application; each controller can support up to two drives (its own and one additional slave).

The host is connected to the controller via one 50-pin Small Computer System Interface (SCSI) bus cable. The controller is connected to each drive via a single daisy-chained 50-pin cable originating at the controller (Figure 2-1). Each drive has drive select jumpers. The drive with controller attached is not necessarily addressed as drive 0.

Each drive has a driver board printed circuit assembly (PCA) (Figure 2-1) to control its own mechanics and provide the interface to the controller via a 50-pin drive interconnect cable. The preamp also resides on this PCB.

The drive mechanism consists of a drive motor, Bernoulli plate, read/write head, head actuator, and associated controls and sensors.

2.2 FUNCTIONAL DESCRIPTION

Each of the major features or operations of the drive are described in this subsection.

2.2.1 Drive Controls

Drive controls and indicators, mechanical controls, and mechanism sensors of the subsystem are described in the following paragraphs.

2.2.1.1 Operator Controls and Indicators

Operator controls and indicators of the drive include:

READY (green) LED -- Circuits on the driver board sense proper motor speed, activate this light emitting diode (LED), and indicate the ready condition to the controller board. During spinup and spindown of the motor, this LED will flash and then glow steadily as proper motor speed is attained. It also will flash if the host has issued a command to lock the cartridge in the drive and then issued a stop command.

ACTIVITY (red) LED -- This indicator serves as an activity light that glows only while the drive is actually being accessed.

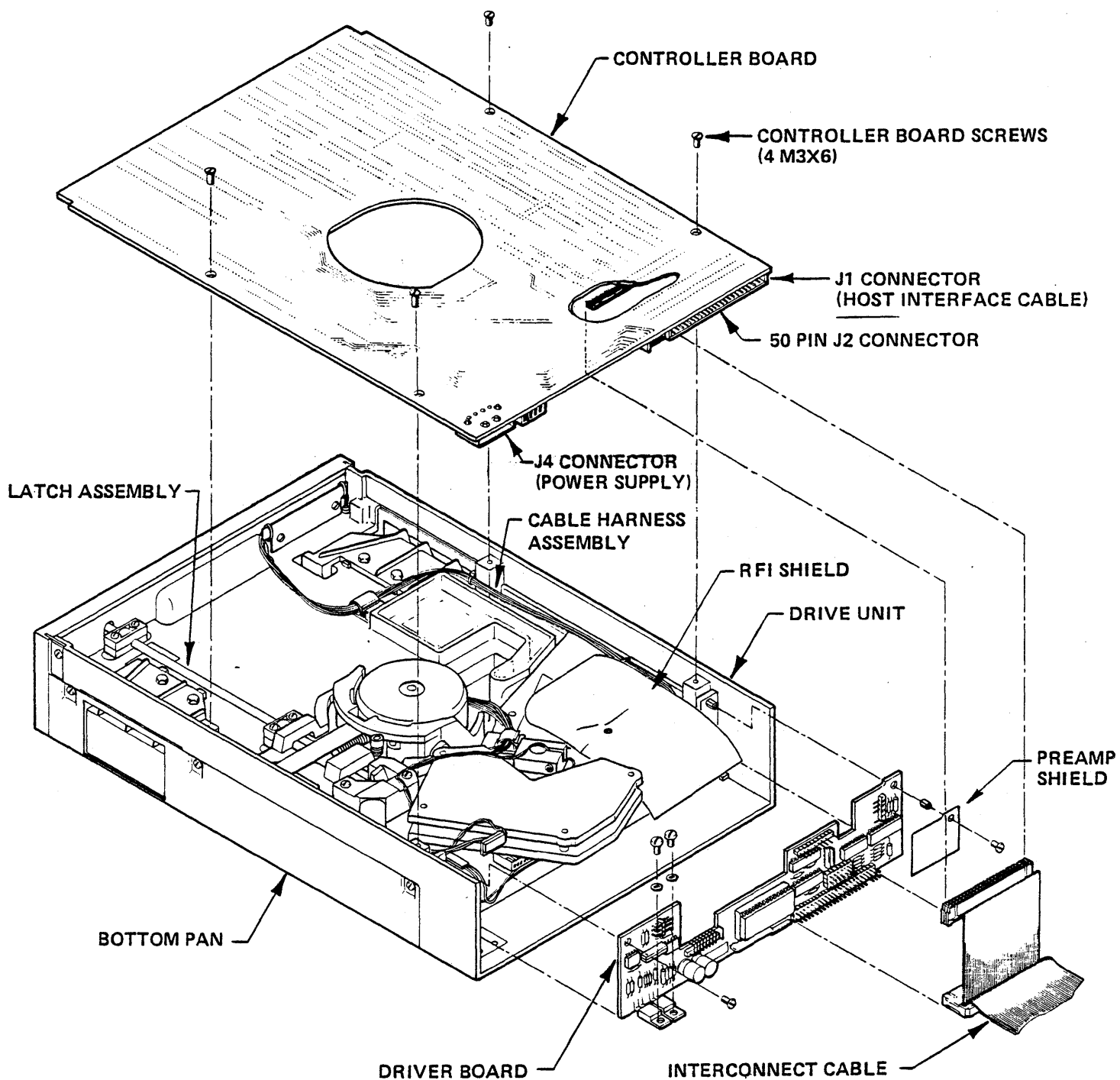


Figure 2-1. Drive Assembly Including Integrated Controller

STOP SWITCH -- This operator control is used to stop the spindle. If the motor is spinning, the switch indicates NOT READY to the controller. When the controller recognizes this signal (after it is finished with operations in progress), the RUN line is deasserted. Then the motor comes to a stop, the cartridge lock solenoid is deactivated, and the motor load lever can be turned counterclockwise to unload the motor and allow removal of the cartridge. The host may issue a command to lock the cartridge in the drive, which, if sent, will cause the drive to ignore the switch.

2.2.1.2 Load Lever

The load lever loads the motor and also prevents cartridge removal while the motor is spinning. As the lever is rotated clockwise, it allows the motor to load. When the motor is completely seated, a switch closes to signal the controller that the motor is loaded. At this time a latch pin engages, preventing the load lever from being turned counterclockwise (and unloading the motor) while the motor is spinning. The lever is constructed to interfere with the cartridge unless the cartridge is fully inserted into the drive, and also to prevent the cartridge from being removed until the motor has been unloaded.

CAUTION

Do not attempt to turn the load lever while the green LED is glowing since physical damage may result.

2.2.1.3 Mechanical Controls

Rotation of the motor is controlled by the controller board, and motor speed is monitored and regulated by the driver board. The controller board supplies a continuous 4 MHz (nominal) clock frequency to the motor controller processor. When the RUN line for the addressed drive is asserted, the phase brushless dc motor with Hall effect sensors. The interface processor samples these sensors and adjusts the driving pulses to compensate for any difference measured from the reference.

The controller must deassert the RUN line to stop the motor. Circuitry on the driver board must sense the "motor stopped" condition and then deactivate the cartridge lock solenoid when the motor has stopped.

2.2.1.4 Mechanism Sensors

The drive includes the following sensors.

MOTOR LOAD SENSOR -- A membrane switch that is activated when the motor is loaded.

WRITE-PROTECT SENSOR -- An infrared LED and photo-transistor that detect the position of the write protect button in the cartridge. The write protect function is enabled when the beam is blocked.

2.2.2 Preamp Section

The preamp section of the driver board is responsible for managing write and read signals traveling to and from the head. During a read function, low level signals from the head are amplified and sent on to the controller board for signal processing.

2.2.3 Track Following

Servo error decoding is done by the controller board, where the read servo information is filtered and amplified. Normal servo fields (used during track following) are prewritten between data tracks by the servowriter at manufacture time. When the signals are read, peaks are compared to determine head position relative to track center. This signal, called the position error, is fed back into the actuator controls to compensate for position error.

Actuator drivers on the driver board respond to servo control signals issued by the controller board. These signals represent the composite of servo correction and seek offsets.

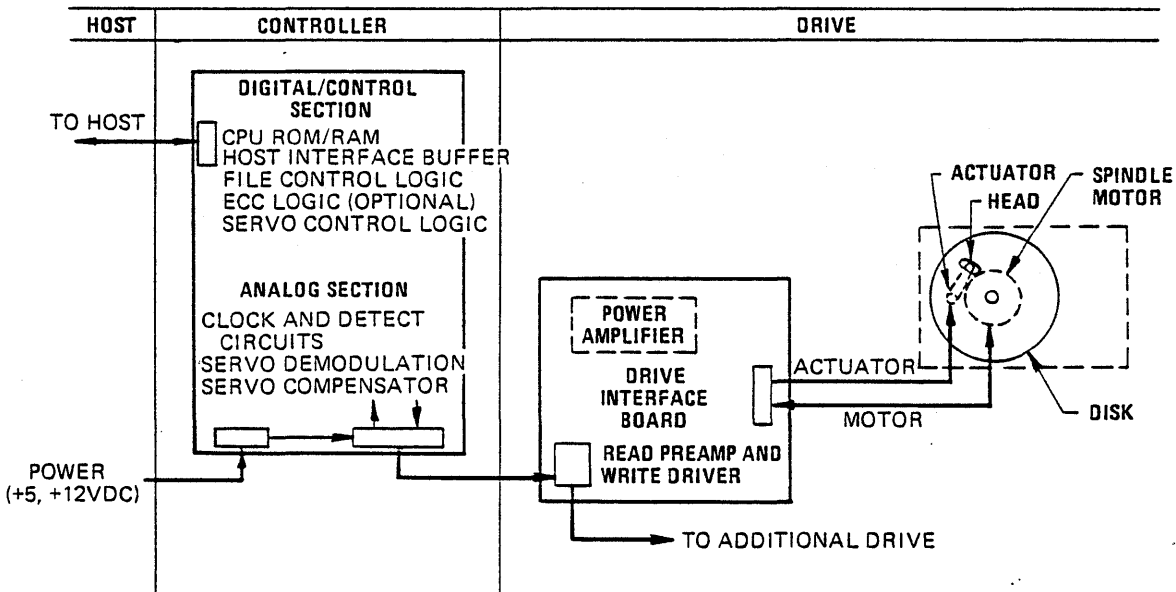


Figure 2-2. Disk Drive/Controller Architecture

2.2.4 Seeking

Seek commands issued by the microprocessor cause additional offsets to be introduced into the actuator servo feedback circuit, forcing the actuator to move the head away from the track it is following. By controlling the duration and amount of the introduced offset, the actuator can move accurately to the desired new track location. As the actuator approaches this location, added offsets are zeroed and the servo loop begins following the new track. Then, address detection circuits verify that the actuator did arrive at the desired track. The microprocessor issues another seek if the target track is missed; or, if retries are disabled, a SEEK ERROR is reported to the host.

2.2.5 Disk Synchronization

Sector marks are detected at the beginning of each sector. These sector marks are used by digital circuitry to synchronize various clocks to the revolution of the disk. Synchronization must be maintained at all times and is an essential component of seeking, as well as scheduling, of read and write operations. If synchronization is lost, then all disk operations are suspended until it is regained.

2.2.6 Analog Read

Analog read information is passed through the driver board to the controller board in differential form (Figure 2-3). The information is shaped and conditioned on the controller board. The resultant signal is input to a variable frequency oscillator (VFO), which phase-locks to generate a clock signal synchronous with the data. These transistor-transistor logic (TTL) level data and clock signals then are sent to the digital circuitry for decoding.

2.2.7 Digital Read

Before any read or write operation, the ID from each sector on the current track is compared with that of the target sector. When the IDs match, the microprocessor sets up the hardware for the desired operation (Figure 2-4). During a read operation, serial-clocked information is passed through a deserializer and decoder to decipher the run length limited code (RLLC). A cyclic redundancy check (CRC) pattern is built as the information is deserialized and decoded. The pattern (including CRC bytes appended to the data when written) then is checked for errors. If the pattern indicates an error, the data output in the buffer is not transferred, and the operation is retried or an error is reported.

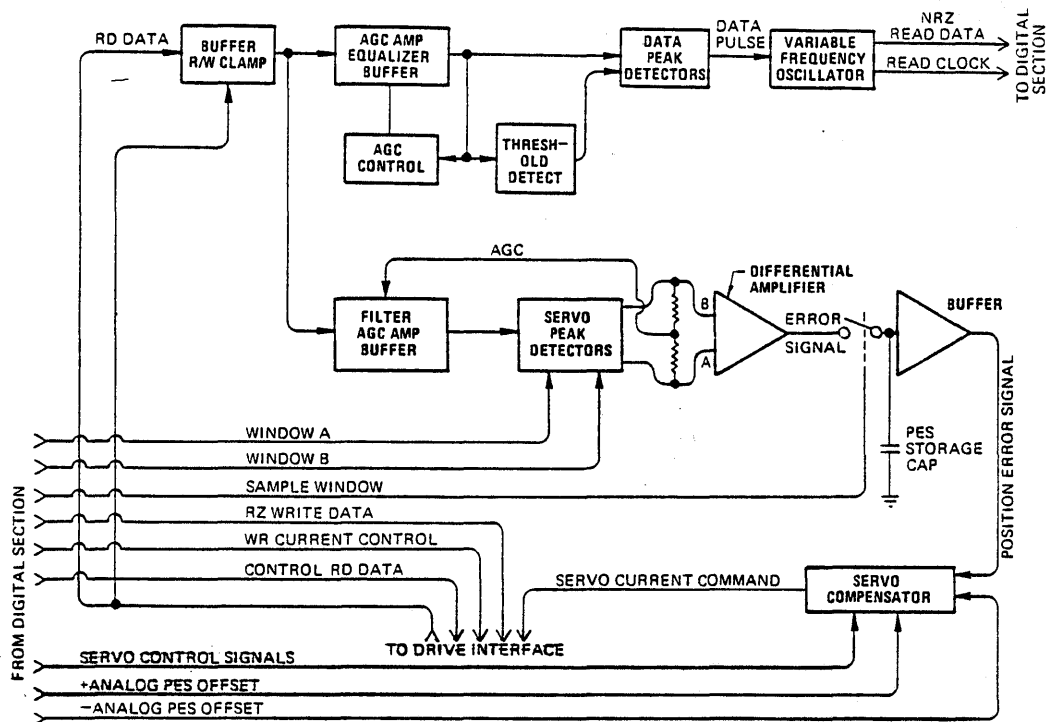


Figure 2-3. Block Diagram of the Subsystem Analog Functions

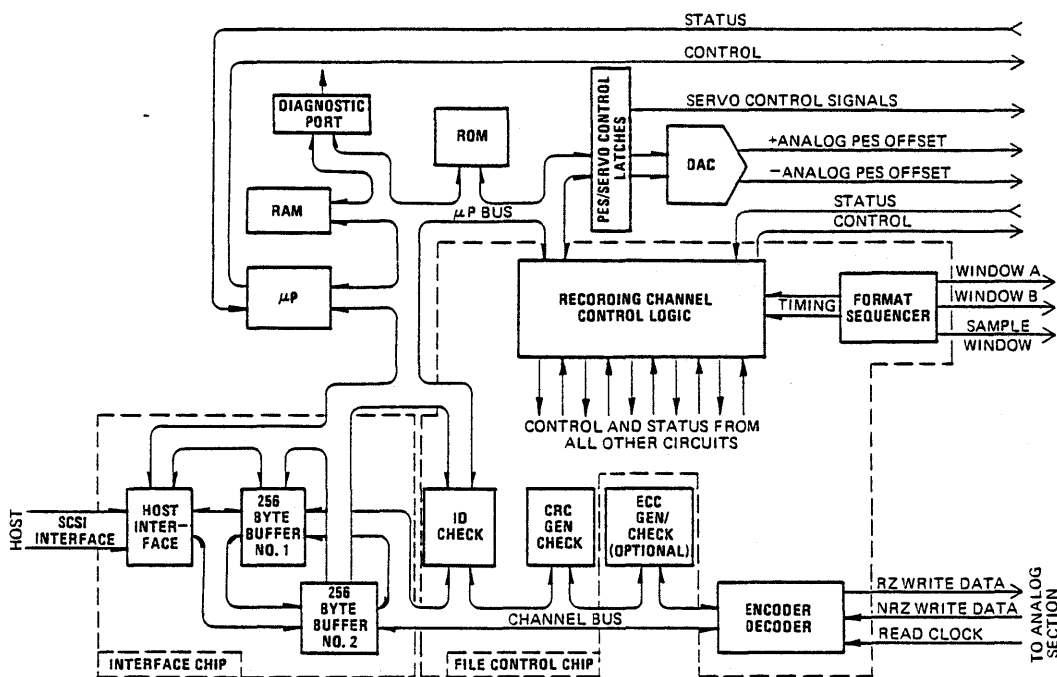


Figure 2-4. Block Diagram of the Subsystem Digital Functions

2.2.8 Digital Write

When information is to be written to the disk, the host loads a data buffer under control of the microprocessor. After the buffer is filled, the microprocessor begins the search for the correct sector ID. When the sector ID is found, the data is routed out of the buffer, through the encoder/serializer, and to the driver board. CRC bytes are appended to the end of the data, to be used for error detection during the read process. The data output to the disk is clocked synchronously with the disk.

2.2.9 Analog Write

The TTL level write information from the digital circuitry is in return to zero (RZ) form. The preamp IC converts it to nonreturn to zero (NRZI) form and sends it to the read/write head (Figure 2-4).

2.2.10 Microprocessor

A Z-80A microprocessor, operating at 4 MHz, controls the synchronization and scheduling of all events on the drive (Figure 2-4). The microprocessor usually does not handle data itself, but controls the hardware that does. Field-replaceable firmware is stored on a programmable read only memory (PROM) or mask-programed read only memory (ROM) and contains the code necessary for diagnostics, command interpretation, seeking, data control, and error reporting.

2.2.11 Interface Channel

The host-to-controller interface consists of several chips centered around a custom metal-oxide semiconductor (MOS) large-scale-integration (LSI) chip that includes two 256 byte first-in, first-out (FIFO) buffers. These buffers are operated in a flip-flop mode so that data can be accepted from/by the host simultaneously with data to/from the disk.

Each byte transferred between the host and the controller is accompanied by a request (REQ) and a corresponding acknowledge (ACK) command. During the data phase of a READ DATA or WRITE DATA command, the handshake is controlled by hardware, allowing high speed transfer through use of a buffer. Any other transfer, such as a command transfer, is controlled by the microprocessor.

At times, such as during an offline seek or drive spinup, the microprocessor is unable to accept a command, and the interface is placed in a "busy" mode. If the host initiates a command while the controller is in this state, the interface chip responds with ending status indicating that the hardware is busy. Do not confuse this condition with the SCSI bus BUSY line.

2.2.12 Z-Track Information

The Z-track is a key component on the cartridge. It includes information read by the controller to determine which interleave value to use and which tracks are flagged.

There are two Z-tracks on each disk. If the primary Z-track cannot be read, the secondary Z-track is used instead. If the secondary track is not readable, the drive spins down and waits for a command.

All commands that alter the Z-tracks update both tracks. The Z-tracks also contain information for internal diagnostics, such as prewritten CRC errors, stress patterns, and others.

3. DIAGNOSTICS AND TROUBLESHOOTING

Internal diagnostics are a feature of the drive. Basic and comprehensive routines are described in this section. Troubleshooting assistance is also provided.

3.1 INTERNAL DIAGNOSTICS

The drive features built-in microprocessor diagnostics. The basic diagnostics provide a confidence test at power-on. Comprehensive diagnostics are invoked by request from the host, or at power-on if enabled by controller option switches.

3.1.1 Basic Diagnostics

The basic diagnostics provide a read only memory (ROM) check, a random access memory (RAM) check, and an interface buffer check. These routines are invoked only at power-on. If a failure occurs, all drive activity halts, and the interface logic does not respond to a selection. An error code on the error readout display, if present, indicates the failure.

The following error codes correspond to errors in the basic diagnostics.

- 01 - ROM Failure -- The EPROM chip IC U33 on the controller board did not match the predetermined CRC. The chip could be defective or misplugged.
- 02 - RAM Failure -- The static RAM chip IC U31 on the controller board appears to be defective.
- 03 - Buffer Failure -- The custom LSI interface chip IC U46 on the controller board appears to be defective, or the read clock is not running.

3.1.2 Comprehensive Diagnostics

The comprehensive diagnostics check most of the functional components and consist of a set of 12 hardware checks monitored by the controller microprocessor. These diagnostics cannot be performed if the subsystem fails the basic diagnostics. Comprehensive diagnostics are invoked upon initial power-on if bit 3 is on and bit 4 is off on switch SW1 of the controller board. Comprehensive diagnostics require about 10 seconds. If bits 3 and 4 of SW1 are both on, these comprehensive diagnostics repeat indefinitely. The SCSI command set also provides a command to invoke these diagnostics from the host computer.

Errors detected during the procedure are displayed on the diagnostic error port and a check status is set for the next host command. A REQUEST SENSE command enables the host to discover the error. These diagnostics do not lock up the interface channel if an error occurs.

The following routines constitute the comprehensive diagnostics.

1. Completes 20 random seeks.
2. Detects incorrect CRC patterns that are prerecorded in protected areas of the Z-track.
3. Attempts to read with the buffers not empty.
4. Attempts to write selected sectors on the Z-track without full buffers.
5. Detects absent sync mark in data field records 1 and 2, which are prerecorded in protected areas of the Z-track.
6. Detects absence of ID sync mark. This pattern also is prerecorded in protected areas of the Z-track.
7. Reads a prerecorded all 1s pattern and compares with expected data.
8. Reads prerecorded stress patterns and compares with expected data.
9. Reads prerecorded incrementing patterns and compares with expected data.
10. Writes, then reads, an all 1s pattern on selected sectors on the Z-track and compares with expected data.
11. Writes, then reads, comparing with expected data, stress patterns on selected sectors on the Z-track.
12. Writes, then reads, an incrementing pattern on selected sectors of the Z-track and compares with expected data.

Note that the comprehensive diagnostics are nondestructive; no user data areas are written. Write operations are performed only on a Z-track.

3.2 TROUBLESHOOTING

Instructions for efficient problem identification are provided in this subsection. Available equipment should include a known-good drive with a controller, a known-good cartridge, an error readout assembly, a voltmeter, a logic probe, scope or other logic sensing device, and a suitable power supply. A host computer for exercising the drive in the problem area also would be useful. Spare components to test or replace defective parts are essential.

WARNING

Always disconnect power before servicing. Do not exchange, connect, or disconnect any component with the power on.

3.2.1 Possible Symptoms

Among the symptoms described below, locate the symptom that most clearly matches your experience with the suspect drive. Read the appropriate instructions and follow the recommended procedures.

<u>Symptom</u>	<u>Description</u>	<u>Page</u>
A	Solenoid engages with the motor not loaded.	3-4
B	Drive will not spin up after the motor is loaded.	3-5
C	Drive spins up when the motor is not loaded.	3-5
D	Drive spins up without a cartridge installed.	3-6
E	Drive spins up with solenoid not engaged.	3-6
F	Drive spins up and then spins down by itself.	3-6
G	Drive is spinning but cannot be accessed from the host.	3-7
H	Drive can read data but will not write.	3-8
I	Drive will not spin down when the stop switch is depressed.	3-8
J	Drive spins down when requested but the solenoid doesn't disengage.	3-8
K	Cosmetic or mechanical problems.	3-9

3.2.2 Probable Causes and Corrective Actions

Probable causes of identified problems and the recommended solutions to those problems are described in this subsection.

Before attempting large-scale debug, check the following areas.

1. Jumpers (see manufacturer's Technical Description Manual, 00701300).
2. Switches (see manufacturer's Technical Description Manual).
3. Connectors (Figure 2-1).
4. Contamination of the read/write head. (A cleaning kit is available from the manufacturer.)

A diagnostic error readout tool (Figure 3-1) is available from the manufacturer to display two-digit diagnostic error hex codes described in the manufacturer's Technical Description Manual (00701300).

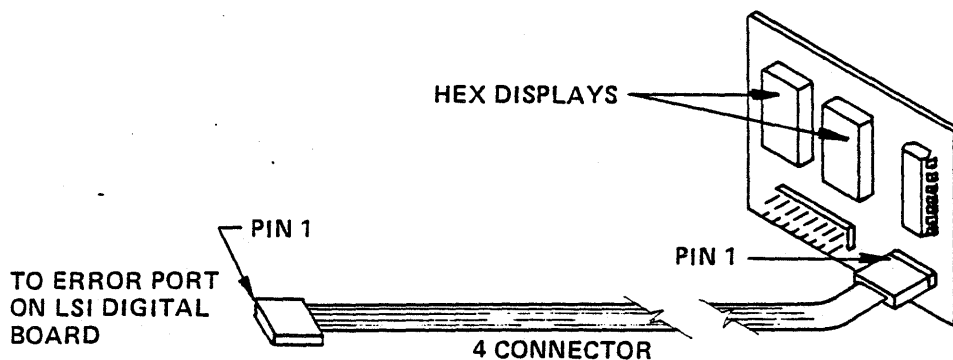


Figure 3-1. Error Readout Tool

Symptoms and Corrective Actions

Symptom A: Solenoid engages with the motor not loaded.

The problem is probably the driver board. Substitute another board and retest. Another possibility is that the driver is receiving 12 volts but not 5 volts. Check the power supply and all cables.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.5).

Symptom B: Drive will not spin up after the motor is loaded.

If the solenoid does not engage, the defective component is probably the motor down sensor, the solenoid, or the driver board. The motor down sensor operation can be verified by using an ohmmeter to test continuity while actuating the motor load lever. Replace the sensor if defective. Next, use the ohmmeter to check continuity of the solenoid. Replace the solenoid if defective; otherwise, replace the driver board.

If the motor load lever latches, but an '86' error does not appear on the error readout (or a corresponding error at the host), the host could be responsible. Unplug the host cable (SCSI Bus) and retest. If the test is successful, the host probably asserted -RESET or -SELECT on the SCSI Bus. Either case indicates a problem with the host or the controller. Substitute the controller for a known-good unit. If the problem is still present, substitute a replacement drive interface cable. Another possibility is that the driver recognized the latched motor load lever but did not report it to the controller. If the above procedures fail, substitute a driver board and retest.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

If the motor load lever latches and an '86' error appears on the error readout, then the controller recognized the motor load lever was latched and timed out waiting for the motor to stabilize at the correct speed. The driver receives a signal from the controller that is used to run the motor. Substitute a replacement driver board and retest.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

If this does not solve the problem, try a substitute controller board (because this is easier to test than the motor). Finally, if the problem still persists, replace the drive motor and retest.

NOTE: For replacement of the drive motor, the drive must be returned to the service center.

Symptom C: Drive spins up when the motor is not loaded.

The most likely cause for this problem would be a short in the motor down sensor. However, if the solenoid does not engage, this is probably not the problem. If the solenoid engages, unplug the motor down sensor and retest. Use a jumper or a switch to retest. If the drive then spins up only when the motor load lever is latched, replace the motor down sensor. If the problem persists, replace the driver board and retest.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Symptom D: Drive spins up without a cartridge installed.

If the motor load lever is latched, this is normal operation. Unlike the full-height predecessor, there is no "cartridge in place" sensor in the drive. If the motor load lever is latched, the controller will assume there is a cartridge installed, and spin it up. After several seconds, the drive should spin down, since synchronization will not take place.

If the motor load lever is unlatched, however, the motor down switch is probably defective. Simulate with a jumper or switch, and replace the motor down switch if replacement is indicated. If the problem persists, replace the driver board.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Symptom E: Drive spins up with solenoid not engaged.

This problem is isolated to either the solenoid itself or the driver board. An easy test is to plug in a substitute solenoid and retest. If the substitute engages, replace the drive solenoid. If it does not engage, replace the driver board.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Symptom F: Drive spins up and then spins down by itself.

If no cartridge is loaded, this is normal operation. This drive contains no "cartridge in place" sensor. If the motor load lever is latched, the drive will assume a cartridge is loaded, spin up, and attempt to read data from the disk. If the attempt is unsuccessful, the drive will shut down.

Symptom F: (Cont)

If an '86' error is reported, it indicates that the controller timed out waiting for the motor to stabilize at the correct speed. This could indicate that the motor is not spinning, that it will not stabilize, or that it did not reach the correct speed soon enough.

Any of these cases indicate a defective motor or driver board. The motor is the most likely culprit, but it is also the most difficult to test. Instead, substitute a known-good driver board and retest.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

If the new board does not correct the problem, verify that the drive interface cable is okay. The controller could also be the cause. Substitute and retest. If the problem still is present, replace the drive motor and retest.

If some other error is reported, it indicates that the motor reached correct operating speed, but that the controller could not work with the data from the disk. Several possibilities exist for this problem.

1. The media may be worn or defective.
2. The head may need cleaning.
3. The actuator may be stuck or not working.
4. The controller may be defective.
5. The drive interface cable or driver board may be defective.
6. The drive may be exposed to excessive EMI (electromagnetic interference).

Follow up with whichever symptom seems most probable. Remember to exchange the head current resistor on the driver board. Make sure the head has been cleaned, use a known-good cartridge, and verify the actuator can move freely. If you are using a new configuration (as opposed to a purchased configuration), then EMI may be the source of the trouble. Try to isolate the unit from potential noise sources and retest. After this is done, substitute for suspect components in the following order until the source of the problem is found: controller, drive interface cable, driver board, motor, drive assembly.

If the spindown is several minutes after spinup or last access, the dwell timer may be responsible. This timer causes the motors in any drives not used for a period of time to rotate at half speed to preserve media life. This is normal operation and should not affect the host.

Symptoms and Corrective Actions

Symptom G: Drive is spinning but cannot be accessed from the host.

If an '82' error is reported, the controller must be working with the host but believes the specified drive is not ready. The most common cause for this error is that the drive logical unit number (LUN) requested does not match the setting of the drive select jumpers on the driver board. Verify that the addressed drive is spinning. If the problem persists, the controller must be faulty and should be replaced.

If the host detects an SCSI fault, such as a timeout, the controller SCSI channel number could be incorrect. Verify that the channel addressed matches the setting of the jumper on the controller board. If this is not the problem, replace either the host interface cable or the controller board and retest.

Symptom H: Drive can read data but will not write.

If an '80' error (write protected) is issued, first verify the cartridge is not actually write protected. The button in one corner of the cartridge sets write protect. If the cartridge is write protected, this is the obvious problem. Write-enable the cartridge and retest. If the problem persists, the next most likely suspect is the write-protect sensor or its infrared emitter. However, this component is also the most difficult to diagnose, so save it for last.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Next, try a known-good controller unit. Lastly, try a substitute drive interface cable in case some lines in it are damaged.

If the problem is still not identified, the write protect sensor or its emitter must be at fault. Replace the cable harness and retest.

If an error other than '80' (write protected) or no error is reported, there are three possibilities. Either the controller has a problem, the correct head current resistor is not on the driver board, or too much EMI is influencing the drive. The latter case is not likely in a commonly configured (purchased) system. Exchange the controller for a known-good unit and retest. If the problem persists, try any of the following: driver board and resistor, drive interface cable, or replacement of the mechanical drive assembly.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Symptom I: Drive will not spin down when the stop switch is depressed.

The controller must issue a stop command to the driver when the button is pressed. Several things may cause this symptom to occur. First unplug the host and reset the controller. If this relieves the symptom, the host must have been asserting activity on the -RESET or -SELECT lines on the SCSI Bus, preventing the controller from polling the drive status. The bus must be inactive for the controller to poll drives.

The next suspect would be the controller. Substitute a known-good controller and retest. If the symptom is corrected, replace the controller. If the controller does not correct the problem, replace the driver board and retest.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Symptom J: Drive spins down when requested but the solenoid doesn't disengage.

First, ensure that nothing is physically obstructing the solenoid plunger. See that the knob shaft is not applying pressure against the solenoid plunger. Also verify that the solenoid releases when no power is applied. (Just unplug the solenoid if you wish.)

If the motor load lever has been latched by the host computer, this is normal operation. In this case, the motor will stop spinning but the green LED will keep flashing. Certain software packages may request the motor load lever to remain latched while files are open, or for other reasons. Disconnect the host and reset the controller. If the motor load lever now unlatches, a software request was causing the problem.

The motor down switch may have failed, or the switch may not be receiving proper pressure from the rotation stop. Be sure the solenoid bracket is adjusted so it doesn't interfere with the rotation stop in the closed position. Ensure that the load shaft assembly rotates freely and is not bound by misaligned load shaft bearings. Connect an ohmmeter to the motor down switch and check for electrical continuity, ensuring the switch is being properly depressed. Replace the switch if necessary.

The driver could be defective, keeping the solenoid engaged. Substitute for the driver board and retest.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

Symptoms and Corrective Actions

Symptom J: (Cont)

The controller could be locking the cartridge even though no command came from the host. Substitute the controller and retest. If this does not solve the problem, check the drive interface cable and replace if it is suspect.

Symptom K: Cosmetic or mechanical problems.

Refer to Section 4 for component replacement procedures for the components involved.

4. COMPONENT REPLACEMENT PROCEDURES

CAUTION

Turn off the power before starting any component replacement.

Attempted component removal with power applied could result in disaster.

WARNING

Avoid touching the Bernoulli plate while servicing the drive. Fingerprints or contamination may cause media wear. The only recommended cleaning agent is Freon TF, which is available from the manufacturer. USE OF COMMERCIALY AVAILABLE MAGNETIC TAPE HEAD CLEANERS WILL CAUSE IRREVERSABLE DRIVE DAMAGE OR MEDIA FAILURE.

Work on a clean, neat surface where small parts will not be misplaced and the drive will not get dirty while it is being serviced.

The yoke and drive motor are not field replaceable at this time. If either must be replaced, the drive should be returned to the factory.

4.1 CONTROLLER FIRMWARE

The controller board is designed to be upgraded easily by replacement of firmware. Chip U33 shown in Figure 4-1 contains the instructions for the Z-80A microprocessor. This chip is located near the edge of the controller board in socket U33 (see Figure 4-1). Carefully pull the chip from the socket.

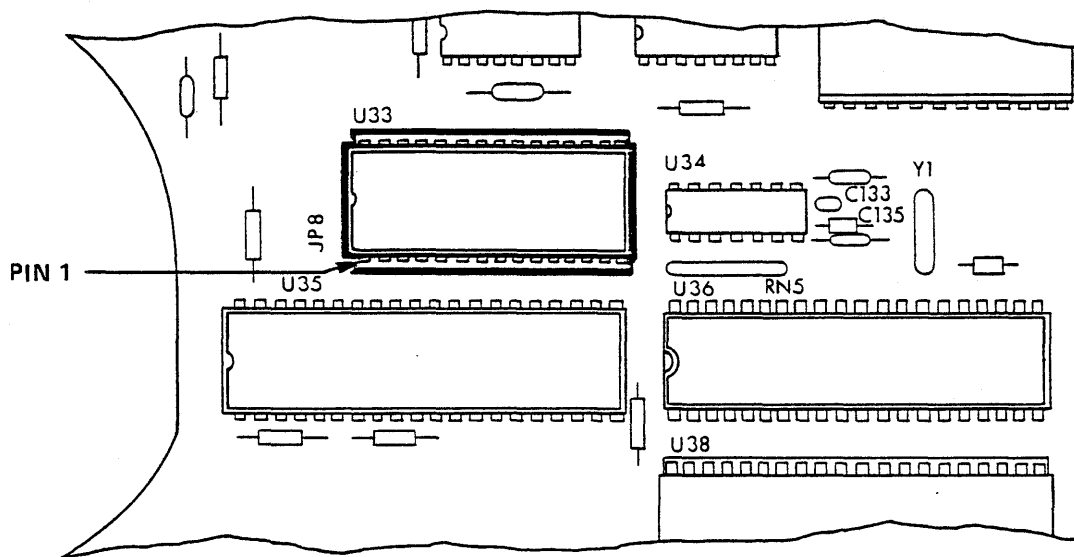


Figure 4-1. Firmware Installation

Replacement firmware comes in one 27128 EPROM. Carefully plug in the replacement firmware, noting orientation of pin 1.

4.2 CONTROLLER BOARD

Removal of the controller board provides access to the major mechanical components of the drive, which includes cable harness assembly, loading shaft, latch assembly, and motor down sensor. Remove the controller board (Figure 4-2) as follows:

1. Disconnect the power supply plug from connector J4.
2. Remove the host interface cable at the rear of the board (connector J1).
3. Remove the four M3x6 flathead screws securing the board to the drive unit casting.
4. Rotate the front end of the board up and over toward the rear of the drive. Lay the board on a padded surface, component side up. Note that the 50-conductor drive interconnect cable acts as a hinge for the board. Carefully remove the 50-pin connector at J2.
5. To reassemble the board to the drive, reverse the above procedure.

4.3 BOTTOM PAN

Removal of the bottom pan provides access to the Bernoulli plate and the read/write head. The bottom pan (Figure 4-3) must be removed before you replace the front panel.

1. Remove the three M2.5x5 flat head screws along the front bottom edge of the pan.
2. Remove the six M3x6 slotted-head screws (three on each side of the bottom pan) that screw into the sides of the main casting.
3. Slide the base pan over the left and right guide brackets. Be careful not to slice the insulation on the two wires which run down the edge of the left guide bracket (from front of drive). These two wires go to the cartridge write protect sensor mounted to the bottom edge of the front panel.
4. To replace the pan, reverse the preceding procedure. Push the top of the pan up against the drive unit before torquing the pan screws. The pans can vary up to 1 mm in height (see subsection 4.5, step 7).

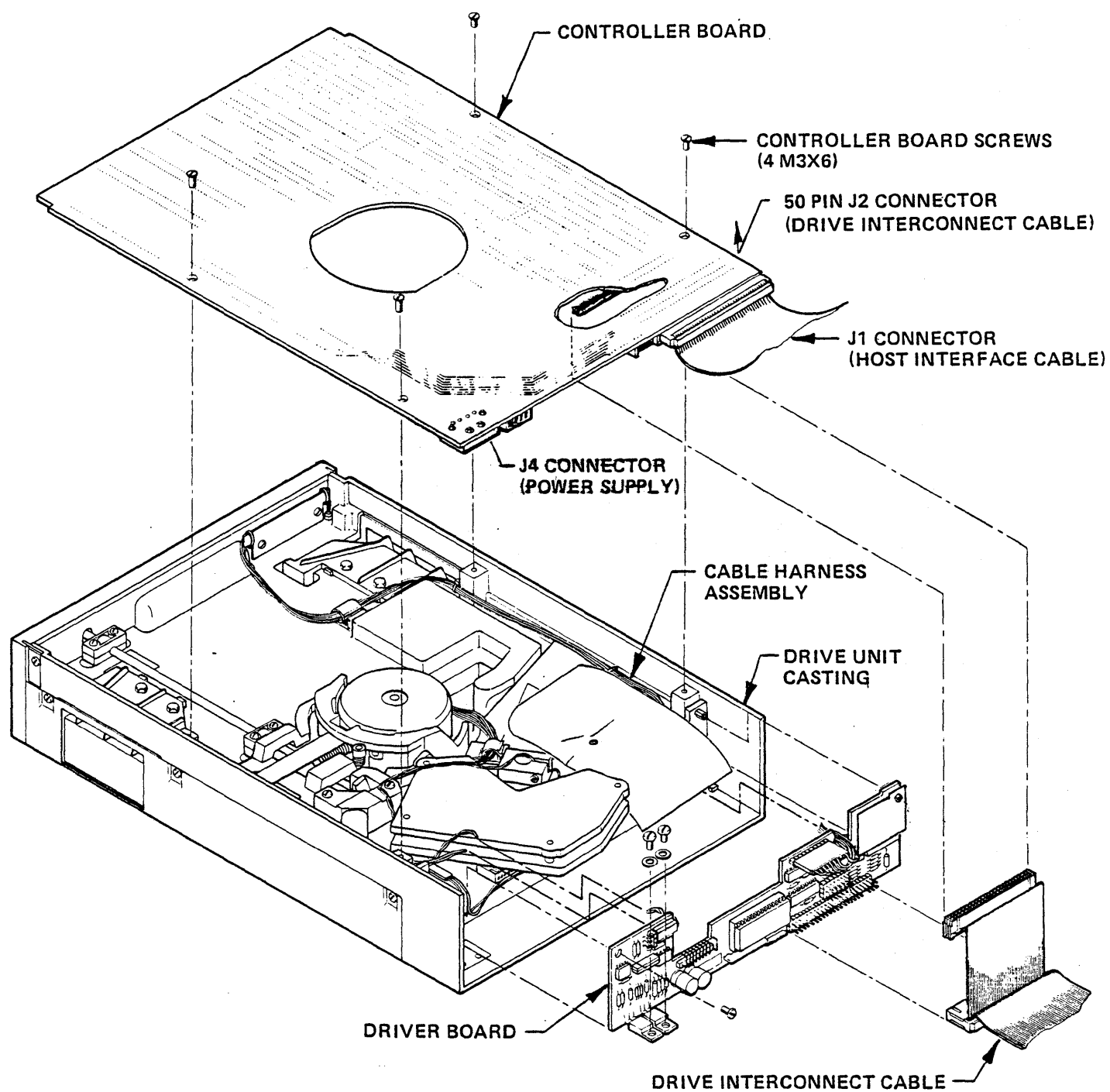


Figure 4-2. Drive and Controller Assembly

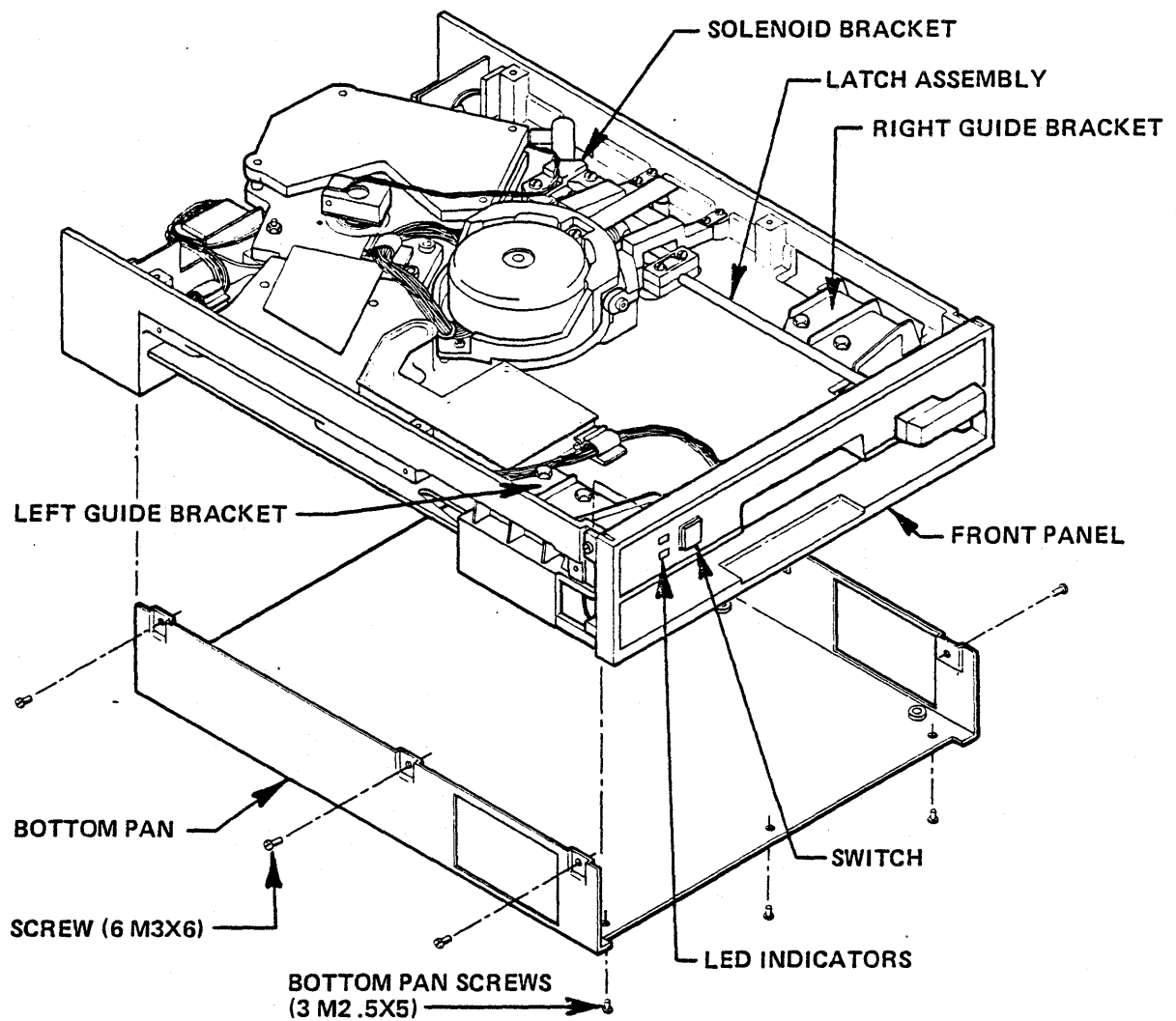


Figure 4-3. Removal of Bottom Pan

4.4 CABLE HARNESS ASSEMBLY

The cable harness assembly (Figure 4-4) includes the front panel switch and red and green LED indicators (Figure 4-3), mounted to a small switch circuit board attached to the front panel. The cable harness also interconnects the motor-down sensor (Figure 4-8) and cartridge write-protect sensors (Figure 4-4) with the driver board at the rear of the drive through connector J5. To remove the cable harness assembly, proceed as follows:

1. Remove the controller from the top of the drive as detailed in subsection 4.2.
2. Remove the RFI shield from the drive (optional).
3. Remove the bottom pan from the drive as detailed in subsection 4.3.
4. Remove the two M3x6 screws that secure the switch circuit board to the rear of the front panel.
5. Carefully remove the cartridge write-protect photo emitter located on the main casting near the power switch. The photo emitter is retained by a plastic panel mount adapter in a hole in the casting. Hint: to remove the photo emitter, use a padded device, such as the insulated handle of a pair of needle nose pliers, to push on the lens side of the photo emitter. The photo emitter should snap out of the panel mount adapter.
6. Turn the drive over and carefully remove the photo transistor. The photo transistor is attached to the bottom of the front panel (see Figure 4-3) by a sensor cover with adhesive on one side. The photo transistor should remain attached to the adhesive side of the sensor cover. Note the routing of the two wires that go down the outside edge of the left guide bracket (as viewed from the front).
7. Unlatch the two plastic cable retainers attached to the surface of the main casting (Figure 4-4).
8. Unplug the connector attached to driver board connector J5. Note that this connector is keyed so that it can be inserted only one way.
9. Unplug the two-pin connector attached to the motor down sensor (Figure 4-8) coming from the other side of the back end of the drive. These wires run behind the driver board. This connector can be plugged in either way.
10. To replace the cable harness assembly, reverse the above procedure.

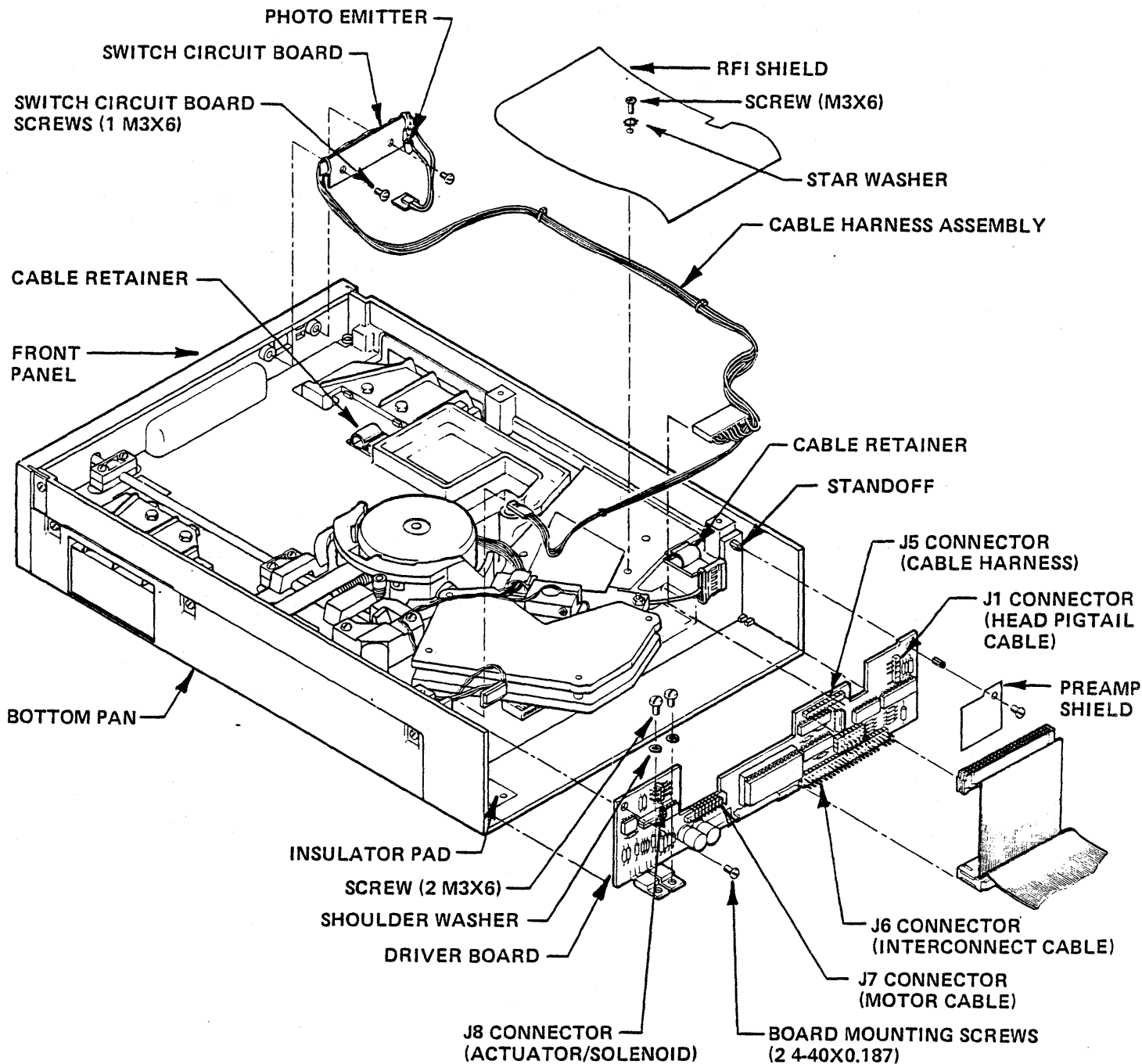


Figure 4-4. Removal of Cable Harness

4.5 FRONT PANEL

The front panel (Figure 4-5) is a molded plastic assembly and should not need replacement unless it is cracked or suffers other cosmetic damage. To remove, proceed as follows:

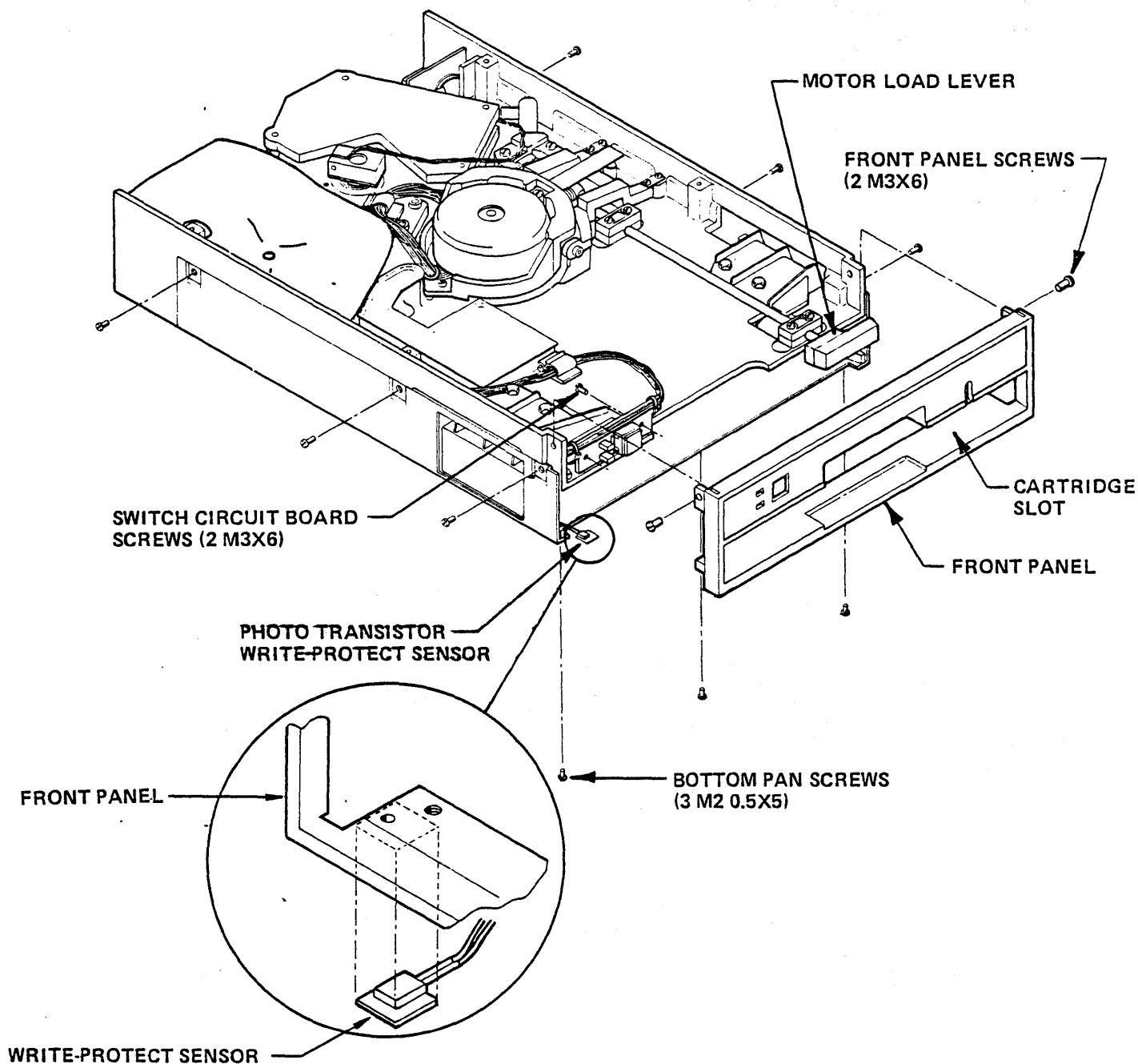


Figure 4-5. Removal of Front Panel

1. Remove the controller board as detailed in subsection 4.2.
2. Remove the bottom pan as detailed in subsection 4.3.
3. Remove the two M3x6 slotted head screws which secure the switch circuit board to the back of the front panel.
4. Remove the two M3x6 slotted head screws on the top at both sides of the front panel.
5. Carefully remove the photo transistor from the bottom of the front panel by removing the sensor cover.

6. Before removing the panel, the motor load lever must be turned to a horizontal position. To remove the panel, raise the panel upward so that the lever handle slips through the cartridge slot in the panel.
7. Reverse the procedure to install the new front panel. Install the two M3x6 screws that attach the panel to the frame, but do not tighten until the pan screws are tight. (If the front panel is more than 0.010 inch from the top of the frame, reposition the bottom pan.) (See subsection 4.3, step 4.)

4.6 DRIVER BOARD

The driver board contains the electronics that interface the drive to the controller. The driver board (1) runs and controls the speed of the drive motor; (2) positions the read/write head; (3) controls write current switching to the head; (4) amplifies the read signal from the head; and (5) monitors the motor, front panel pushbutton, and the control lines from the controller. To remove the driver board, proceed as follows (Figure 4-6):

A factory select resistor on the driver board (Figure A-4) sets the write current through the head. This resistor is labeled R17 on the board and is located directly above the drive select jumper connector. The resistor is socketed so it can be removed. The resistor must be transferred to the new driver board to maintain the correct write current for the head in the drive. Always make sure the resistor is in this location before operating the drive.

WARNING

The head current resistor (R17) on the driver board must be moved to the new board (see subsection 4.6).

1. Remove the controller board as detailed in subsection 4.2.
2. Remove the RFI shield (optional).
3. Remove the interconnect (drive interface) cable from connector J6. Gently rock the cable connector off so as not to bend the header pins.
4. Remove the cable harness assembly from connector J5.
5. Remove the head pigtail cable connector from connector J1. Be very careful not to damage the insulation around this cable.
6. Remove the actuator (white and orange) cable from connector J8. Note the double row of pins; the actuator cable plugs onto the outside two pins. Also, take careful note of the position of the wire leads to pin 1 of the actuator cable.
7. Remove the solenoid cable connector from the three pins of the J8 connector.

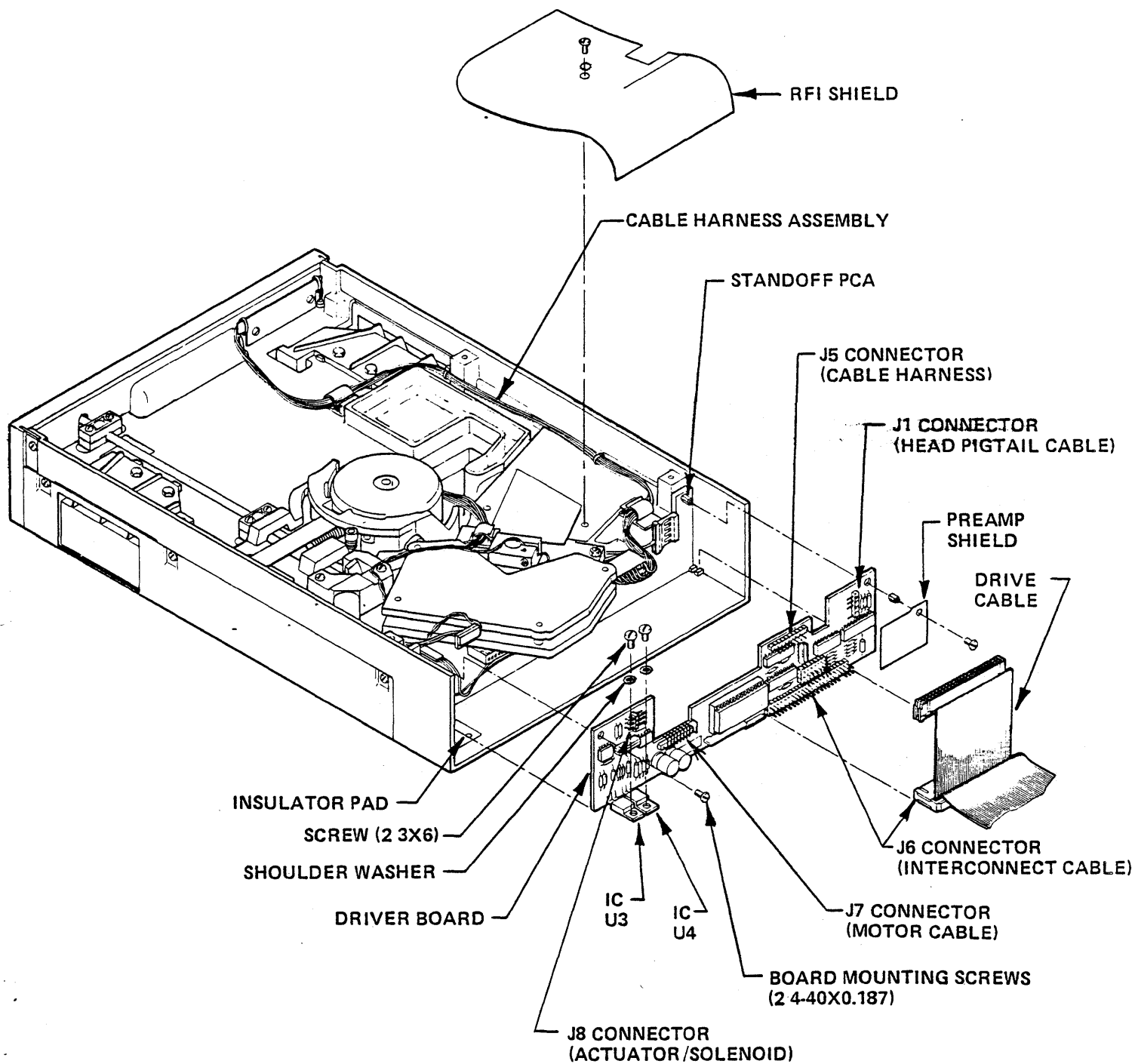


Figure 4-6. Removal of Driver Board

8. Remove the two M3x4 slotted head screws from the two motor driver ICs U3 and U4. Note the insulator shoulder washers under the heads of these screws. Make sure these shoulder washers are in place when these two screws are reinstalled.
9. Remove the two 4-40x0.187 (nonmetric) board mounting screws at the top corners of the driver board and the 4-40 standoff between the preamp shield and the driver board. Do not attempt to re-use the shield; install a new shield with the new board.
10. Pull the driver board away from the back of the main casting. Unplug the motor cable from connector J7 on the driver board.
11. To install the driver board, follow the above procedure in reverse order. The bottom of the board should fit into the slot in the casting.

NOTE: When installing the board, make sure insulating washers are used to tie ICs U3 and U4 to the main casting. Also, make sure the insulator pad is in place on the main casting surface and that it is not damaged. DO NOT use silicon grease under these transistors when remounting them. The silicon grease could migrate to the media, causing media or head damage.

4.7 SOLENOID BRACKET/MOTOR DOWN SENSOR

The solenoid bracket holds the solenoid and the end bearing/sensor assembly in position (Figure 4-7). The solenoid prevents rotation of the load shaft lever when the motor is still spinning. The motor down sensor, mounted on the load lever end bearing, tells the microprocessor on the driver board that the motor is loaded and ready to spin up.

The end bearing retains the load shaft and also sets the end play between the back of the cartridge and the loading lever, which in turn positions the disk in the cartridge to the motor hub (Figure 4-7).

NOTE: Do not loosen any screws on the shaft or motor assembly unless instructed to do so.

1. Disconnect the two-pin cable coming off the solenoid.
2. Raise the motor to the unloaded position (motor up).
3. Remove the one M3x6 slotted head screw that holds the cantilever spring to the motor flange.

NOTE: Mark the top side of the spring so that it may be reassembled with the same side up.

4. Using a spring hook, remove the motor bias spring (Figure 4-8) that goes between the motor flange and bearing sleeve on the loading shaft.
5. Carefully lower the motor to its loaded position (motor down).

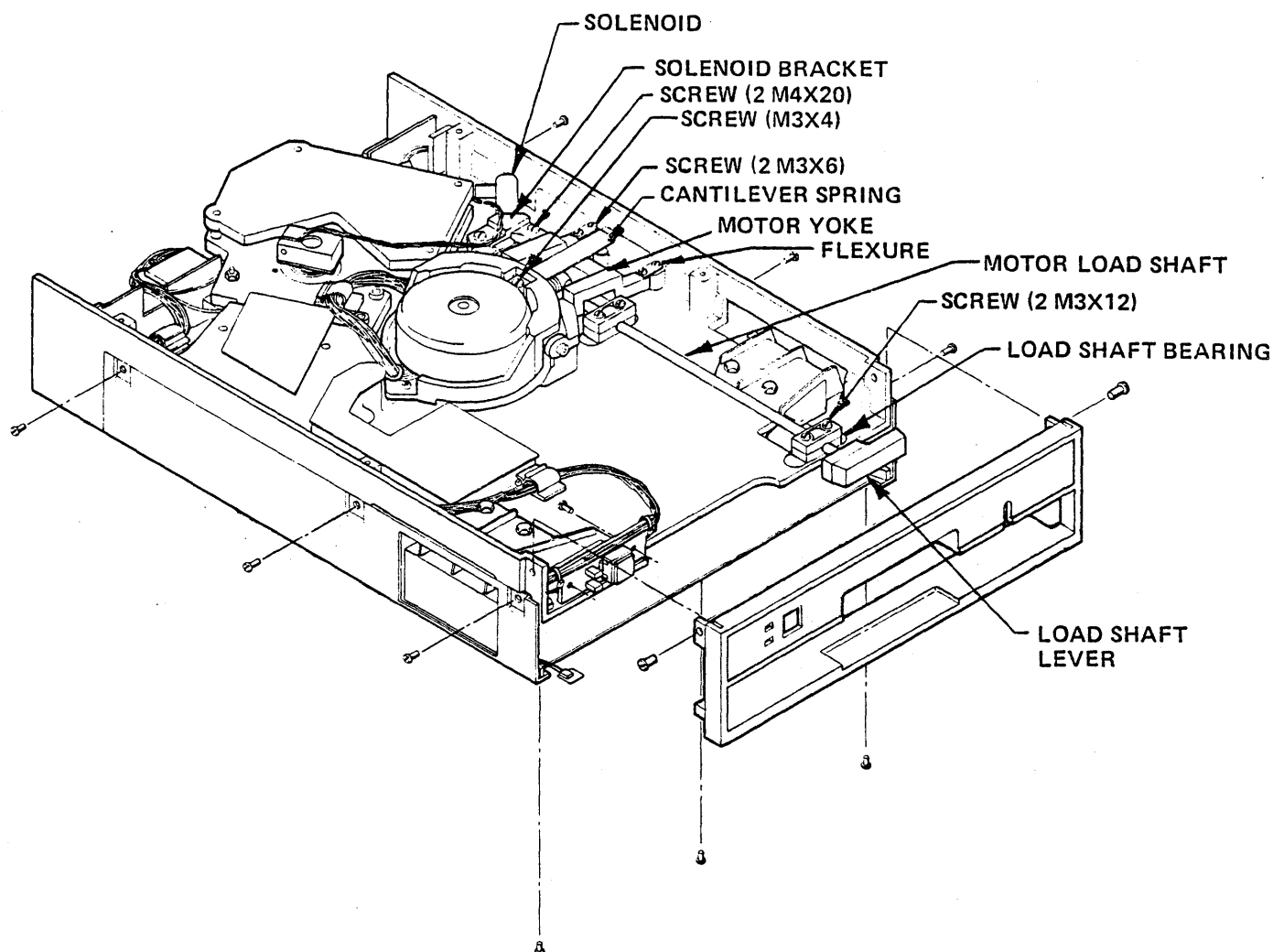


Figure 4-7. Removal of Solenoid Bracket/Motor Down Sensor and Shaft Assembly

6. Remove the two M4x20 slotted head screws securing the solenoid bracket to the main casting. (If you are replacing the solenoid, the coil wires glued to the bracket must be removed without breaking them.) Remove the solenoid bracket.
7. If only replacing the solenoid bracket, skip to Step 10 for reassembly instructions.
8. Unplug and remove the motor down sensor from the shaft end bearing. The sensor has a self-stick backing that secures it to the surface of the bearing bracket. Note the location of the alignment mark and match it up with the replacement sensor.

9. Clean the adhesive from the end bearing surface before laying down the new sensor. Check the new sensor, using an ohmmeter, to make sure the sensor is positioned correctly and is operating (open with motor up, closed with motor down).
10. Insert the shaft adjustment tool (tool that sets position of loading shaft lever) into the drive. This is IOMEGA tool number TOL 43400.
11. Turn load lever to the "loaded" position (motor down).
12. Position the solenoid bracket on the shaft end bearing over the motor sensor. Insert the two M4x20 slotted head screws into the solenoid bracket. Do not tighten screws yet.
13. Slide the loading shaft lever toward the rear of the drive until the lever touches the machined surface of the tool (TOL 43400). Hold the loading shaft in this position and at the same time slide the solenoid bracket assembly toward the front of the drive. The solenoid bracket should come to rest so the outline of the solenoid bracket coincides with the outline of the shaft rotation stop. Again check to make sure the motor load lever is against the machined surface of the tool (TOL 43400).
14. Tighten the two M4x20 slotted head screws on the solenoid bracket.
15. Turn the motor load shaft lever to the "unloaded" position (motor up).
16. With the spring hook, install the motor bias spring back on the load shaft sleeve. Make sure the end of the bias spring wraps around the shaft sleeve from "top to bottom."
17. Remove adjustment tool (TOL 43400) from drive.
18. Check the motor down sensor with an ohmmeter to make sure it is functional (open with motor in up position, closed with motor in down position).
19. Install the cantilever spring (with the previously marked side up) (Figure 4-7) using one M3x4 slotted head screw. Put motor down for this operation.
20. Check to make sure the solenoid plunger will prevent the load shaft from moving to the "unload" (motor up) position when the plunger is in the activated position, and the solenoid bracket allows the rotation stop to close the motor down sensor.
21. Plug the solenoid cable back on the solenoid connector. The cable may be plugged in either way.
22. Check lead dress on all cables in the drive.
23. Reinstall the controller board on the drive, reversing the process in subsection 4.2.

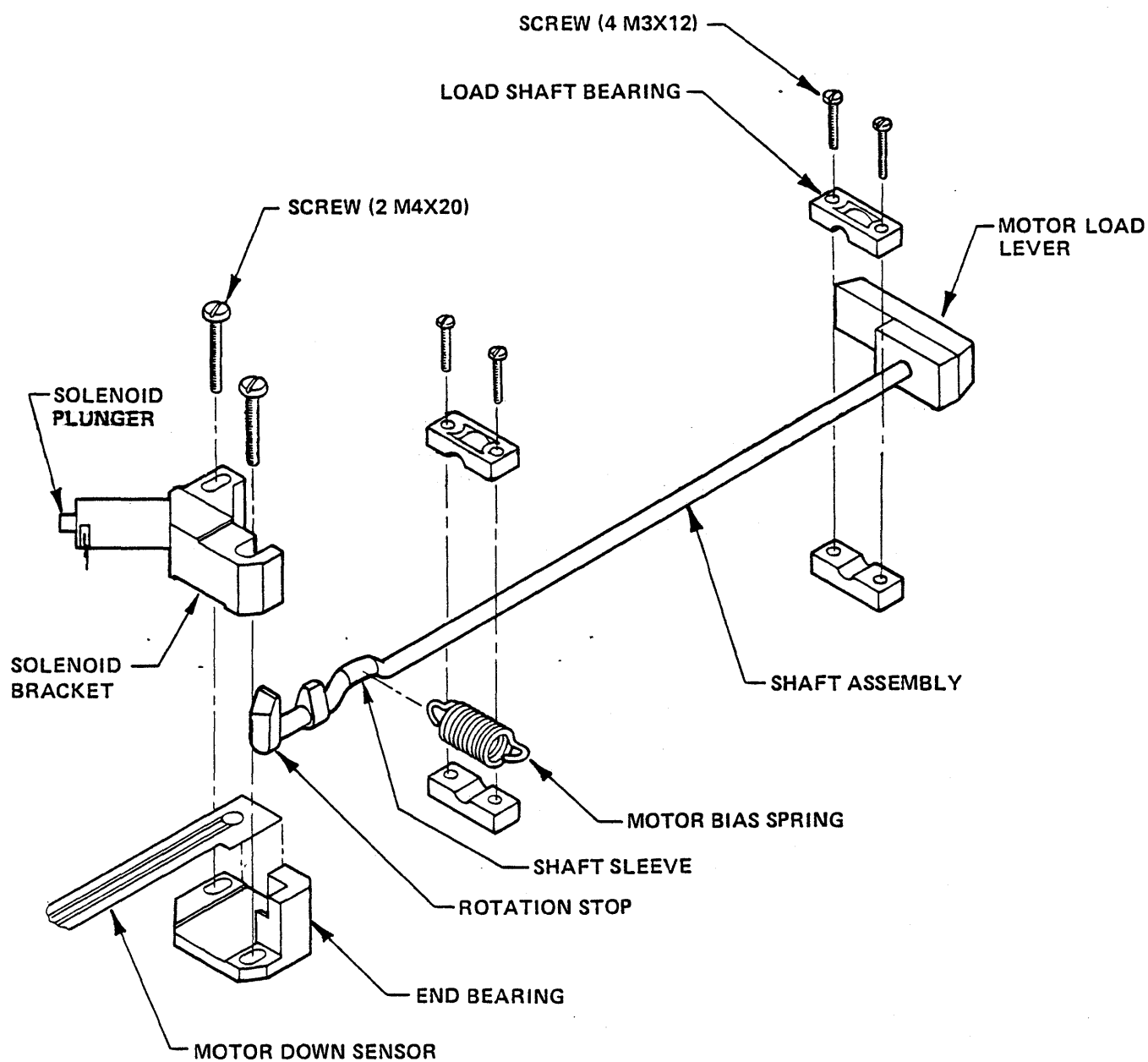


Figure 4-8. Shaft Assembly

4.8 SHAFT ASSEMBLY

The shaft assembly includes the load shaft lever and the load shaft (Figure 4-8). Turning the load lever loads the motor and also prevents cartridge removal while the motor is spinning. To replace the shaft assembly, proceed as follows.

1. Remove the controller board as described in subsection 4.2.
2. Turn the drive upside down and remove the three M2.5x5 flat head screws along the front bottom edge of the bottom pan. These screws attach the front panel to the pan. Turn the drive back right side up.
3. Turn the motor load latch clockwise to lower the motor.
4. Disconnect the two-pin cable coming off the solenoid.
5. Remove the M3x4 slotted head screw that holds the cantilever spring to the motor flange.

<p>NOTE: Mark the top side of the spring so that it may be reassembled with the same side up.</p>
--

6. Turn the motor load latch counterclockwise to raise the motor to the unloaded position.
7. Using a spring hook, remove the motor bias spring (Figure 4-8) between the motor flange and the bearing sleeve on the loading shaft.
8. Carefully lower the motor to its loaded position (motor down).
9. Remove the two M4x20 slotted head screws securing the solenoid bracket to the main casting. Remove the solenoid bracket. The coil wires do not need to be removed from the bracket.
10. Remove the shoulder screw securing the loading spring (Figure A-8), using a 2.5 mm Allen wrench. Remove the loading spring and the two spacers located at the top and bottom of the spring.
11. Remove the two M3x6 screws securing the motor yoke flexures to the frame and swing the yoke over the motor and clear of the load lever shaft. As you do so, note any shims and their numbers and locations before removing them.
12. Remove the two M3x12 screws in each of the load shaft bearings and lift off the bearings.
13. Remove the M3x6 screw holding the end of the front panel nearest the load lever (right end when facing the drive). If any shims are present between the panel and bottom pan surfaces, take careful note of their locations and retain them for re-use.

14. Unplug the motor down sensor from the connector to the driver board (brown and black wire).
15. Lift up on the load lever shaft, at the same time pushing the shaft at the lever end back out of the slot in the front panel. Hold panel away from bottom pan just enough to slide load lever out from behind panel. The front panel can be flexed slightly. If more space is needed, remove the other mounting screw.

NOTE: Because the self-stick backing is destroyed when the motor down sensor is removed, a new sensor is required when the shaft assembly is replaced. Do not attempt to reapply the sensor that was removed; a new sensor must be used.

16. You are now ready to install the new shaft assembly. First check the new assembly to be sure it is complete and undamaged. Reverse the procedure followed in removing the damaged shaft assembly.
17. Check and make sure the end bearing surface of the shaft is clean before laying down the new sensor. Check the new sensor with an ohmmeter to make sure the sensor is positioned correctly and is operating (open with motor up, closed with motor down).
18. Slide the new shaft assembly into place.
19. Replace the M3x6 screw that attaches the front panel to the frame, but do not tighten the screw completely. Install the shims if any were used.
20. Install the load shaft bearings, insert the two M3x12 screws in each bearing, and tighten.
21. Insert the shaft adjustment tool (for setting the position of the loading shaft) into the drive. The shaft adjustment tool (IOMEGA tool number TOL 43400) is a calibrated disk cartridge that is inserted into the drive.
22. Turn the load lever to the loaded position (motor down).
23. Position the solenoid bracket on the shaft end bearing over the motor sensor. Insert the two M4x20 slotted head screws into the solenoid bracket, but do not yet tighten the screws.
24. Slide the loading shaft lever toward the rear of the drive until the lever touches the machined surface of the tool (TOL 43400). Hold the loading shaft in this position and at the same time slide the solenoid bracket assembly toward the front of the drive. Position the bracket so that the outline coincides with the outline of the shaft rotation stop (Figure 4-8). Again, check to make sure the motor load lever is against the machined surface of the tool.

25. Tighten the two M4x20 slotted head screws on the solenoid bracket.
26. Lower the motor yoke into place. Put back any shims that were present and insert the M3x6 screws linking the yoke flexures to the frame.
27. Install the loading spring. Be sure to put back both spacers on the top and bottom of the spring.
28. Turn the motor load shaft lever to the unloaded (motor up) position.
29. Using the spring hook, install the motor bias spring back on the load shaft sleeve bearing. Make sure the end of the bias spring is fully wrapped around the bearing sleeve.
30. Remove the adjustment tool from the drive.
31. Check the motor down sensor with an ohmmeter to make sure the sensor is functional (open with the motor in the up position, closed with the motor in the down position).
32. Turn the motor to the loaded position (motor down) and install the cantilever spring (with the previously marked side up), using one M3x4 slotted head screw.
33. Plug the solenoid cable back on the solenoid connector and reconnect the motor down sensor. Both cables may be plugged in either way.
34. Be sure the solenoid plunger will prevent load shaft movement to the unload (motor up) position when the plunger is in the activated position. Also be sure there is sufficient clearance between the solenoid bracket and rotation stop that the stop can close the sensor.
35. Check the lead dress on all cables in the drive. Make sure the cables do not interfere with the action of the coil card.
36. Turn the drive over and install the three M2.5x5 screws in the bottom pan.
37. Tighten the front panel screw on the right side of the drive.
38. Reinstall the controller board on the drive, reversing the process in subsection 4.2.

4.9 FILTER

Under normal operating conditions, the filter should not need to be changed. However, in extremely dirty environments, the filter may restrict the flow of air entering the cartridge chamber and therefore could affect the performance of the drive. If the drive shows signs of being operated in a contaminated environment (dust, dirt, etc.) or if the drive has been in service for a number of years, it is a good idea to change the filter.

1. Remove the controller board as outlined in subsection 4.2.
2. Remove the plastic filter cover by pulling it free of the casting (Figure 4-9).

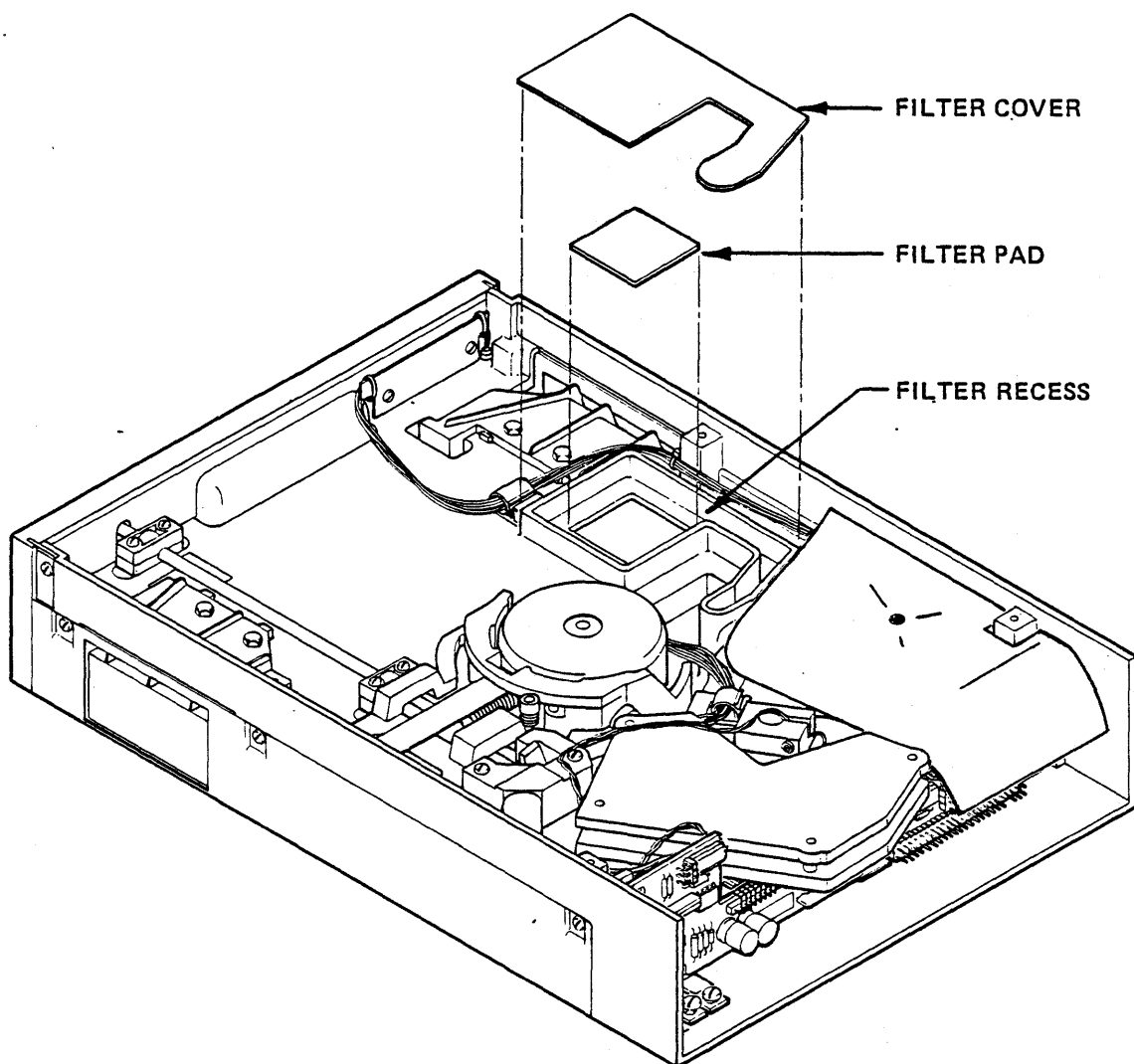


Figure 4-9. Filter Replacement

3. Remove the filter pad from the recess in the main casting. Be sure to remove all traces of filter fibers and adhesive from the main casting. Clean out any dirt or other foreign objects which may have fallen off the filter pad and down onto the back side of the Bernoulli plate. (Turning the drive over to remove the filter minimizes the dirt problem.)
4. Press the new filter pad (adhesive side down) into the recess in the casting. Make sure the filter seals around the edges.
5. Install a new filter cover over the casting opening. Be sure the cover is sealed all the way around the edges.
6. Reinstall the controller.

4.10 COIL CARD ASSEMBLY

The coil card assembly is located beneath the upper return path at the rear of the drive (Figure 4-10). To replace this assembly, proceed as follows:

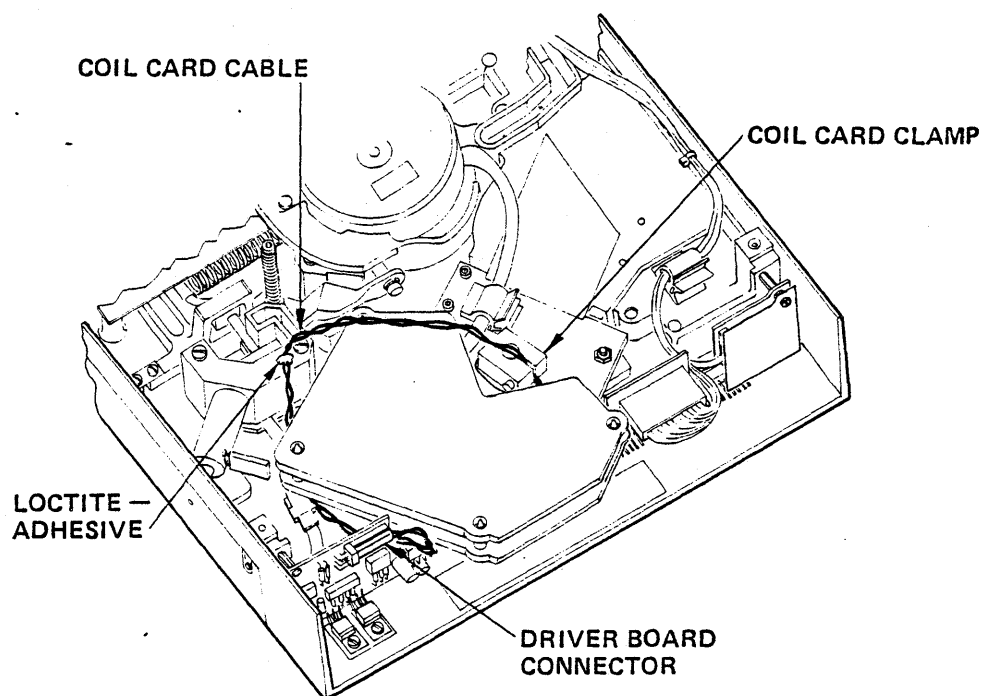


Figure 4-10. Replacement of Coil Card Assembly

1. Remove the controller board as described in subsection 4.2.
2. The upper return path is held in place over the coil card by two magnets. To remove the return path, hold the coil card to the left and insert a wedge tool between the upper and lower return paths, between the rearmost posts. Be careful not to pinch the coil card. Pry upward until the upper return path can be lifted and the magnet force is released. Lift it free of the posts.

WARNING

Extreme care must be taken both in removing and replacing the upper return path. The magnets can draw it down quickly and violently onto the coil card and magnets. If proper care is not taken, you can injure your fingers, damage the coil card, or break the magnets. Screwdrivers or other tools also can damage the coil card or magnets.

3. Disconnect the coil card cable from the driver board. Lift the cable free of the Loctite adhesive securing the cable to the solenoid bracket.
4. Loosen the inset hex screw in the coil card clamp. Lift the assembly off the spindle shaft. Save the hex screw for attaching the new assembly to the spindle shaft (Figure 4-11).
5. Set the replacement coil card assembly with the clamp up in place on the spindle shaft. Slightly tighten the hex inset screw. Before tightening the hex screw completely, center the coil card by rotating the spindle until it hits one of the stops. Note the distance from the edge of the card to the edge of the magnet. Then rotate the spindle in the opposite direction until it hits the other stop. Adjust the card on the spindle shaft until the two coil card edges are the same distance from the edge of the two magnets. The top of the spindle shaft and the top of the coil card clamp should be flush with each other. The most important point is that the coil card not touch the magnets or the upper return path.
6. Tighten the hex head screw.
7. Attach the cable to the solenoid bracket with Loctite adhesive after cleaning the Loctite from the bracket surface. Avoid getting any particles of Loctite in the drive. Make sure the cable clears the return path posts and goes around the return path.
8. Attach the cable connector to the driver board with the white cable uppermost on the connector.
9. Hold the upper return path vertically against the front posts and carefully lower the back part into place over the back posts. Place the wedge between the upper and lower return path into place.

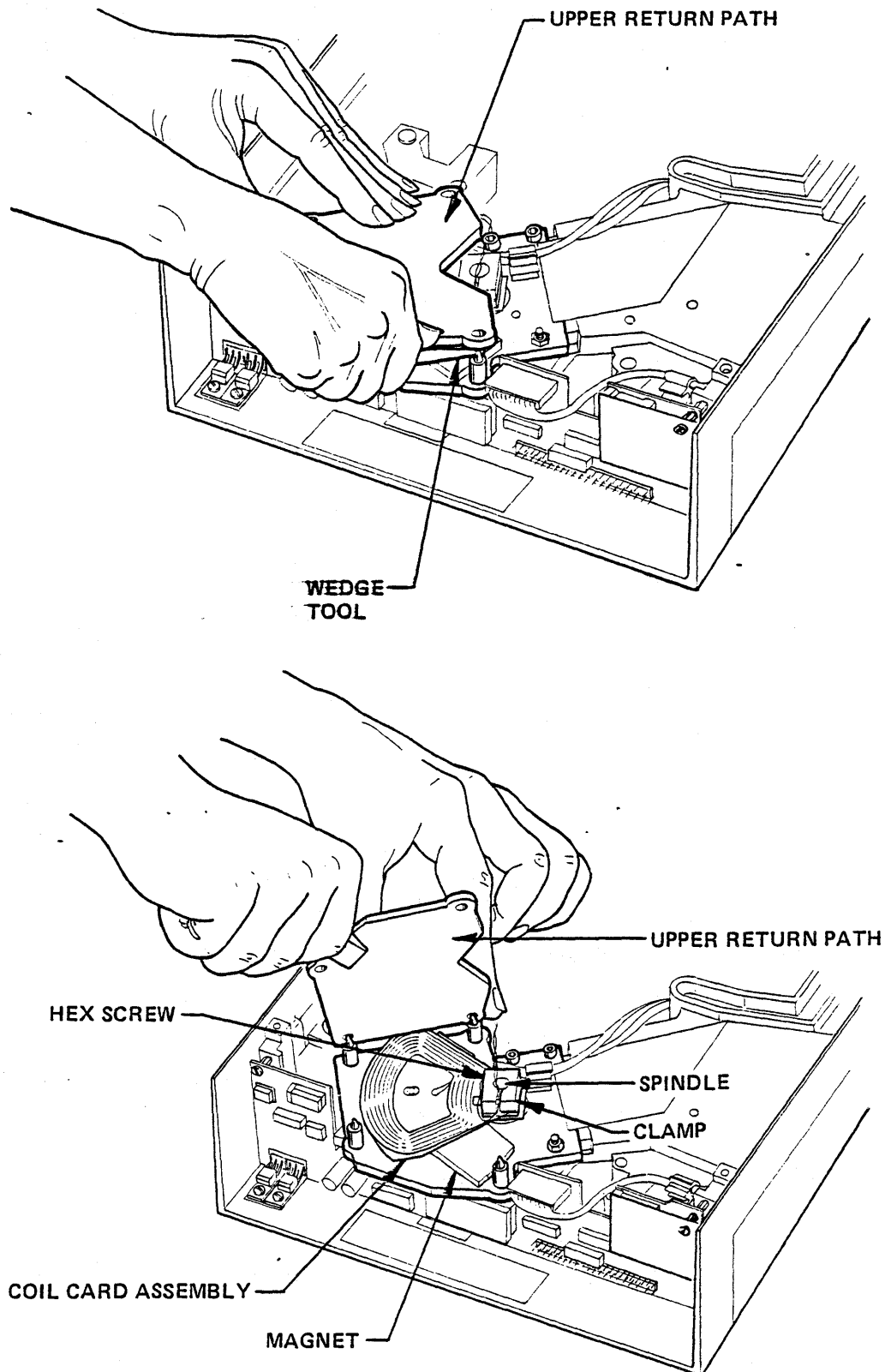


Figure 4-11. Removal of Upper Return Path

4.11 GUIDE BRACKET

Plastic guide brackets are located on each side of the cartridge opening (Figure 4-12). If a bracket is damaged, replace it in the following manner by removing the two M5x6 screws and taking out the bracket.

1. Remove the controller as detailed in subsection 4.2.
2. Remove the bottom pan as described in subsection 4.3.
3. Remove the two M5x6 screws in the bracket and lift off the bracket.
4. To remove the right bracket, rotate the bracket through the casting opening and pivot around the shaft.
5. Be sure the replacement bracket is the correct bracket for that side of the drive. Each bracket carries a separate part number.
6. Install the new bracket(s), being sure the bracket touches all three edge bosses, and reassemble the bottom pan to the drive.
7. Install the controller board per subsection 4.2.

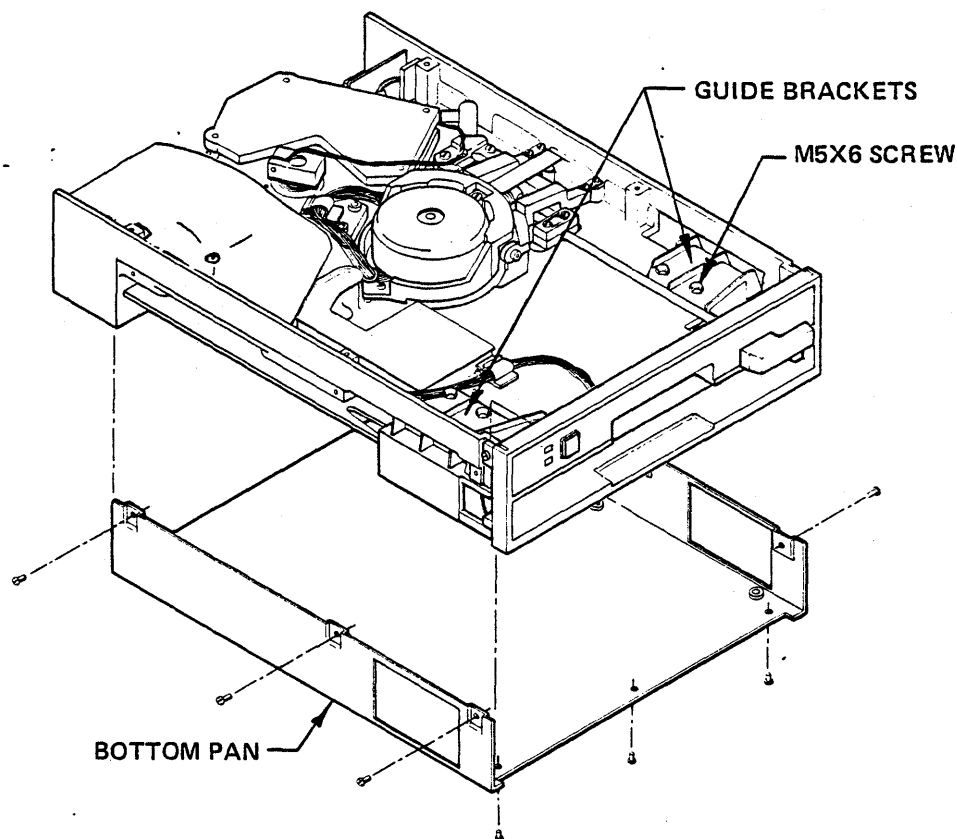


Figure 4-12. Guide Bracket Replacement

APPENDIX A

PARTS INFORMATION

Field Replaceable Components

Exploded View Illustrations

FIELD REPLACEABLE COMPONENTS

The following components can be replaced in the field. See reference numbers on the exploded view figures in this section for identification and location of the part or assembly.

<u>Reference No.</u>	<u>Part No.</u>	<u>Quantity</u>	<u>Description</u>
Disk Drive Unit			
1	00701101	1	Drive Unit
2	00711003	1	PCA, Controller Board
3	50000818	4	Screw, M3x0.5-6SX6LG
4	00741000	1	Front Panel
5	00713100	1	Coil Card Assembly
6	00745500	1	Filter Pad
7	00745600	1	Filter Cover
8	00740600	1	Latch Assembly
9	00710600	1	Motor Down Sensor
10	50000575	2	Screw, SLPH, M4x0.7-6SX20
11	00741100	1	Shaft Assembly
12	00740500	4	Load Shaft Bearing
13	50000573	4	Screw, M3x0.5-6SX12
14	00740100	1	Bias Spring
15	00751300	1	Loading Spring
16	00740300	2	Loading Spring Spacer
17	50000574	1	Shoulder Screw
18	00745200	1	Cantilever Spring
19	50000746	3	Screw, M3x0.5-6SX4
20	A1101201	1	Guide Bracket, Left
21	00742100	1	Guide Bracket, Right
22	00500005	4	Screw, M5x6
23	00710200	3	Standoff PCA
24	00710501	1	Cable Harness Assembly
25	00747500	1	Insulator
26	50000817	2	Shoulder Washer, Fiber
27	00747800	1	Pigtail Assembly, Solenoid
28	00500009	12	Screw, M3x0.5-6SX6LG
29	00715300	1	Interconnect Cable
30	00720400	1	RFI Shield
31	00711200	1	PCA, Driver Board
32	00714501	1	IC, EPROM (U33)
33	50000728	1	IC, EPROM (U6)
34	00719203	1	Jumper (J2, 3)
35	00747400	1	Shield, Top
36	50001166	2	Screw, 4-40x0.187
37	00722200	1	Preamp Shield

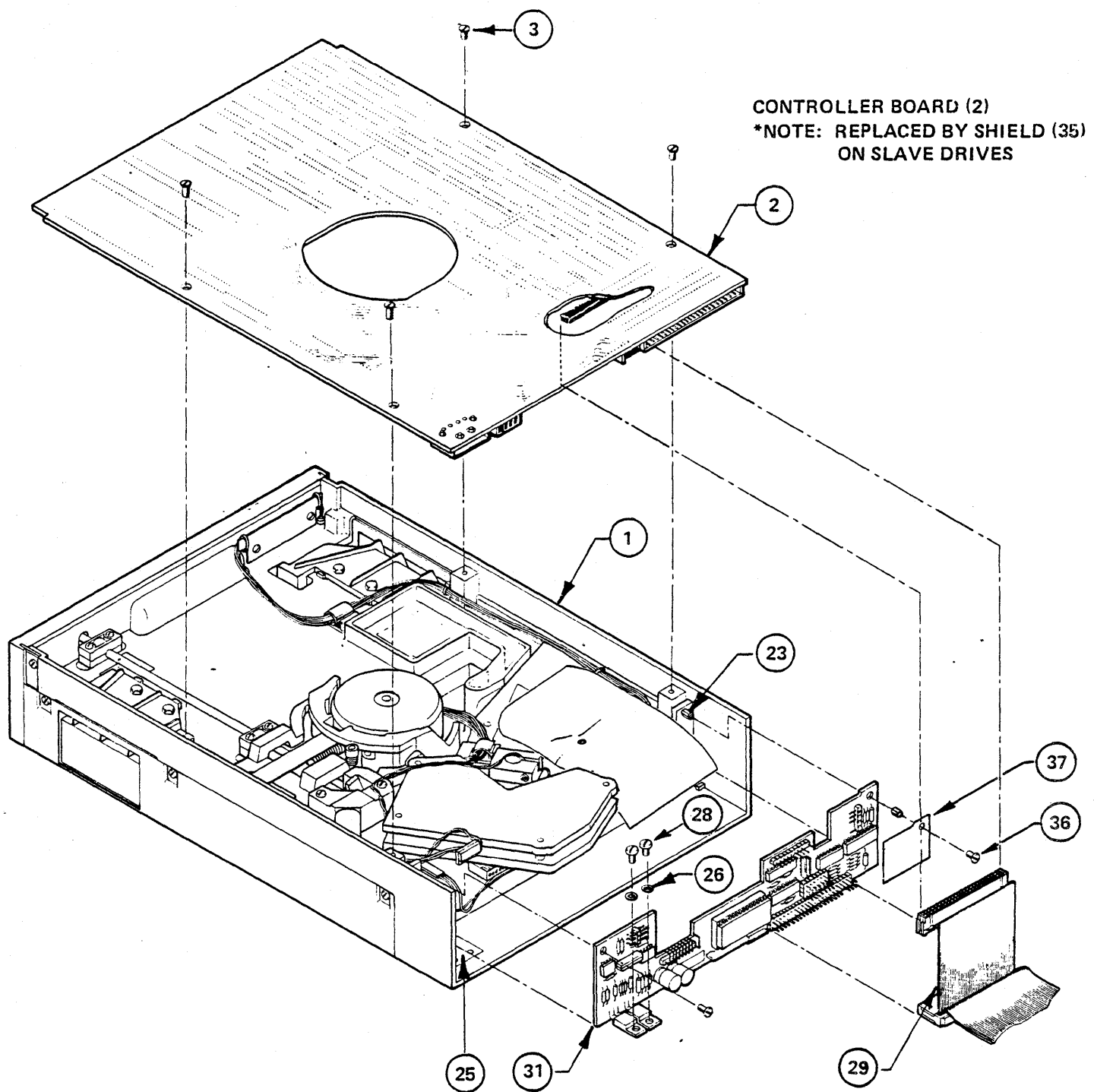


Figure A-1. Drive, Controller, and Driver Board Assembly

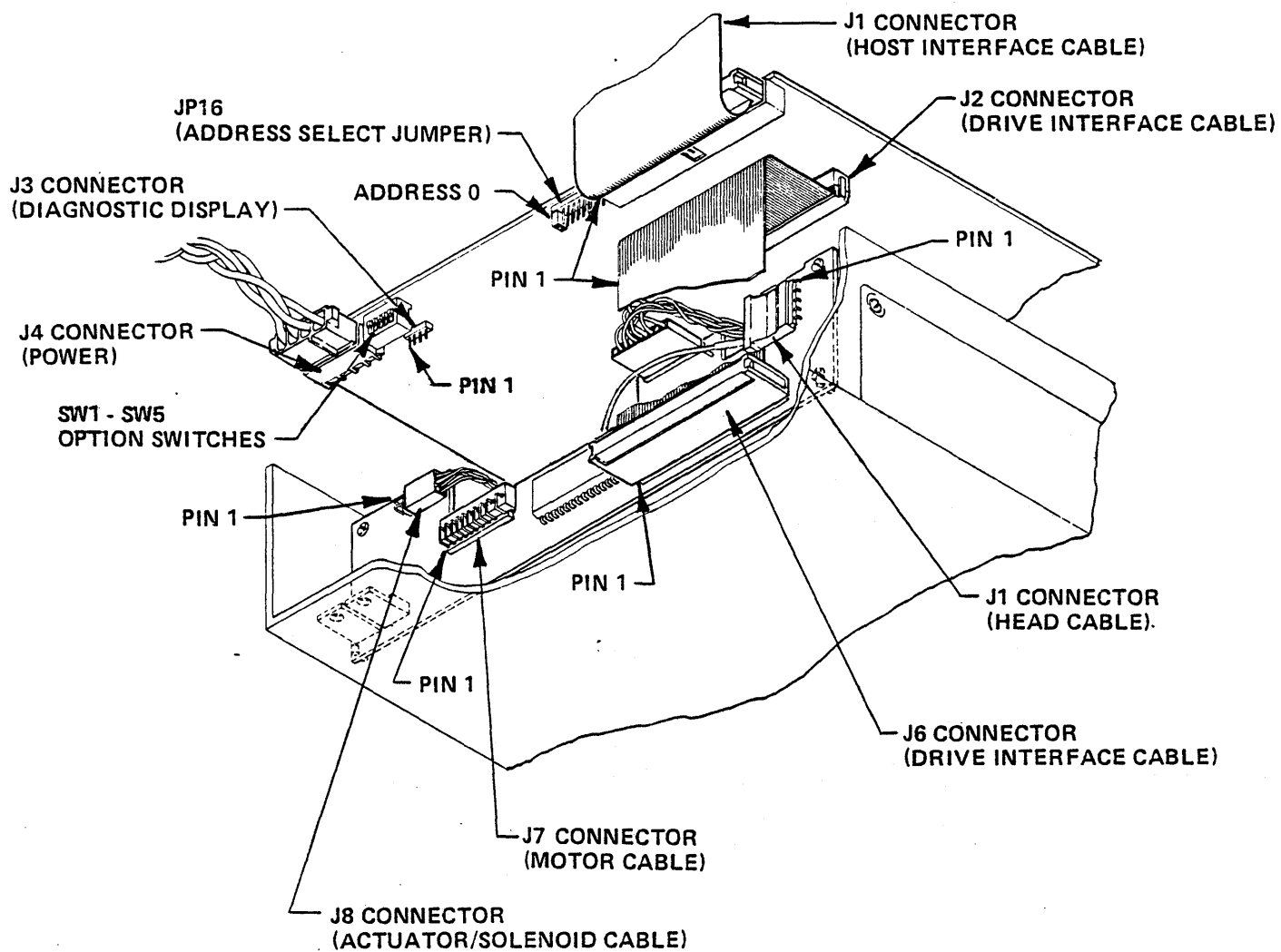
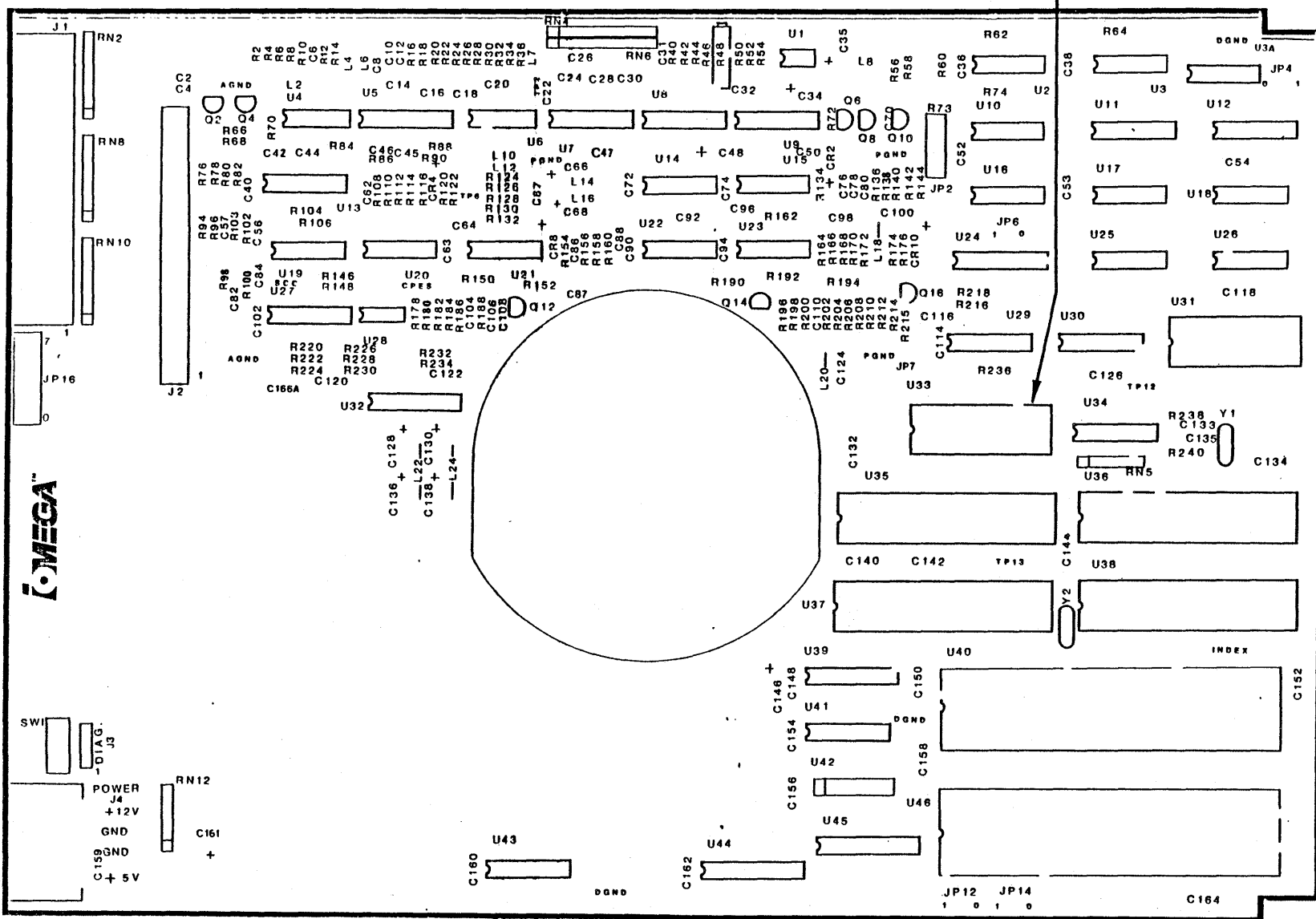


Figure A-2. Printed Circuit Board and Main Cable Locations

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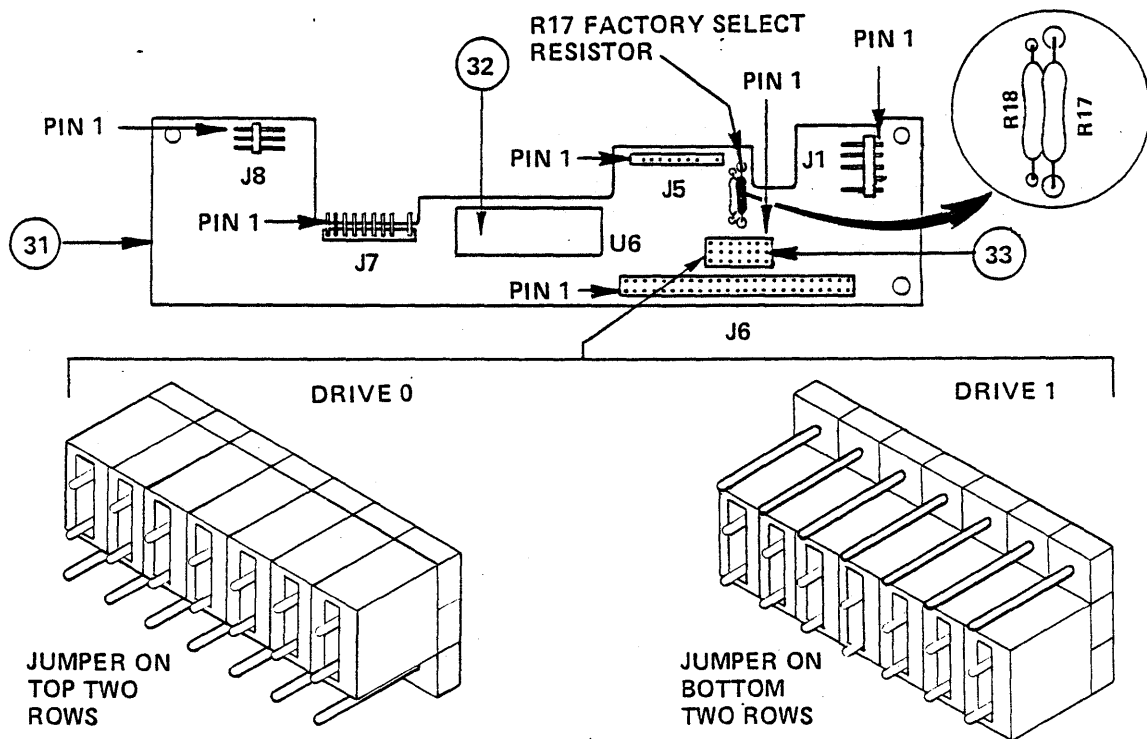
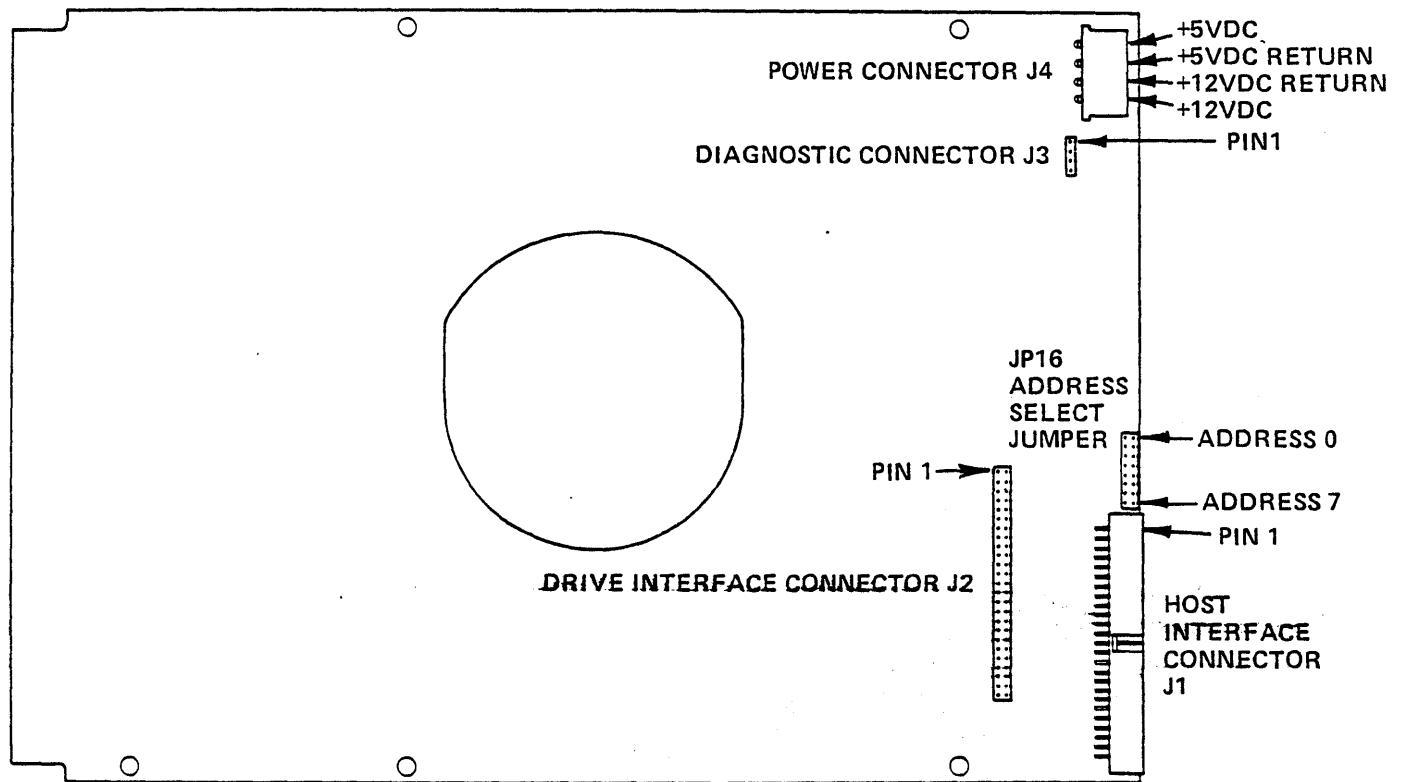


Figure A-4. Connector Locations and Pin Orientations

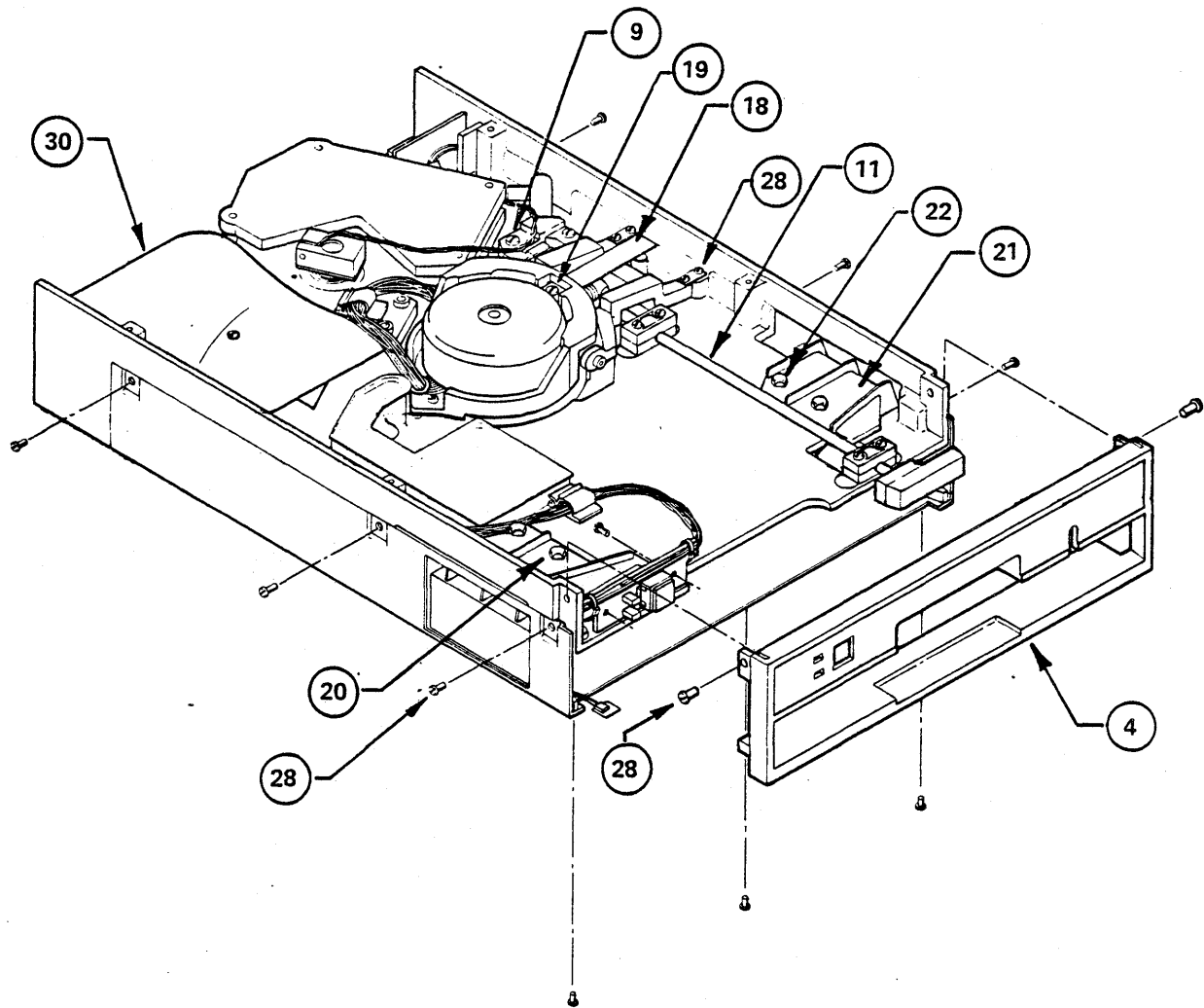


Figure A-5. Front Panel, Shaft, and Guide Bracket Assemblies

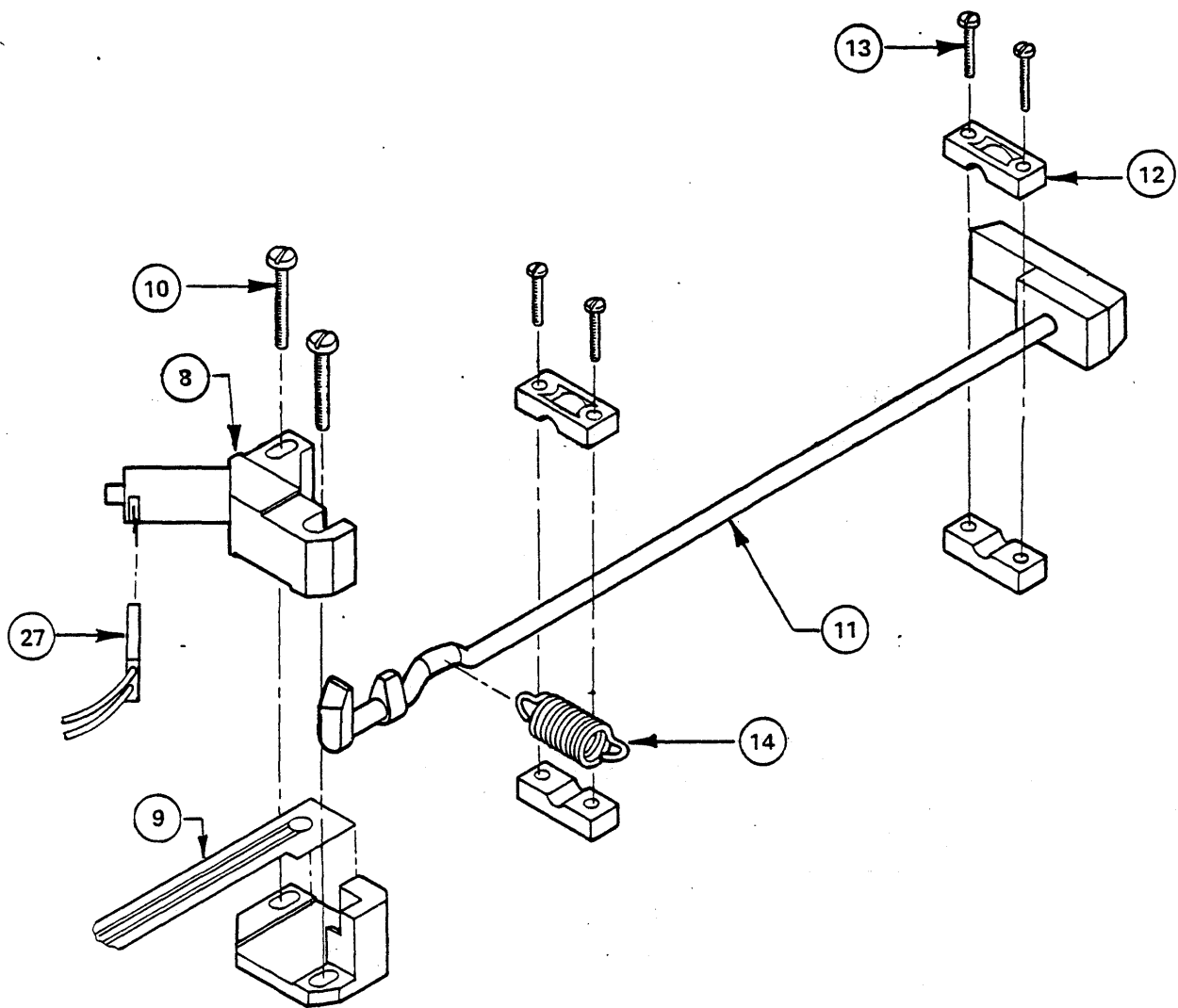


Figure A-6. Shaft Assembly

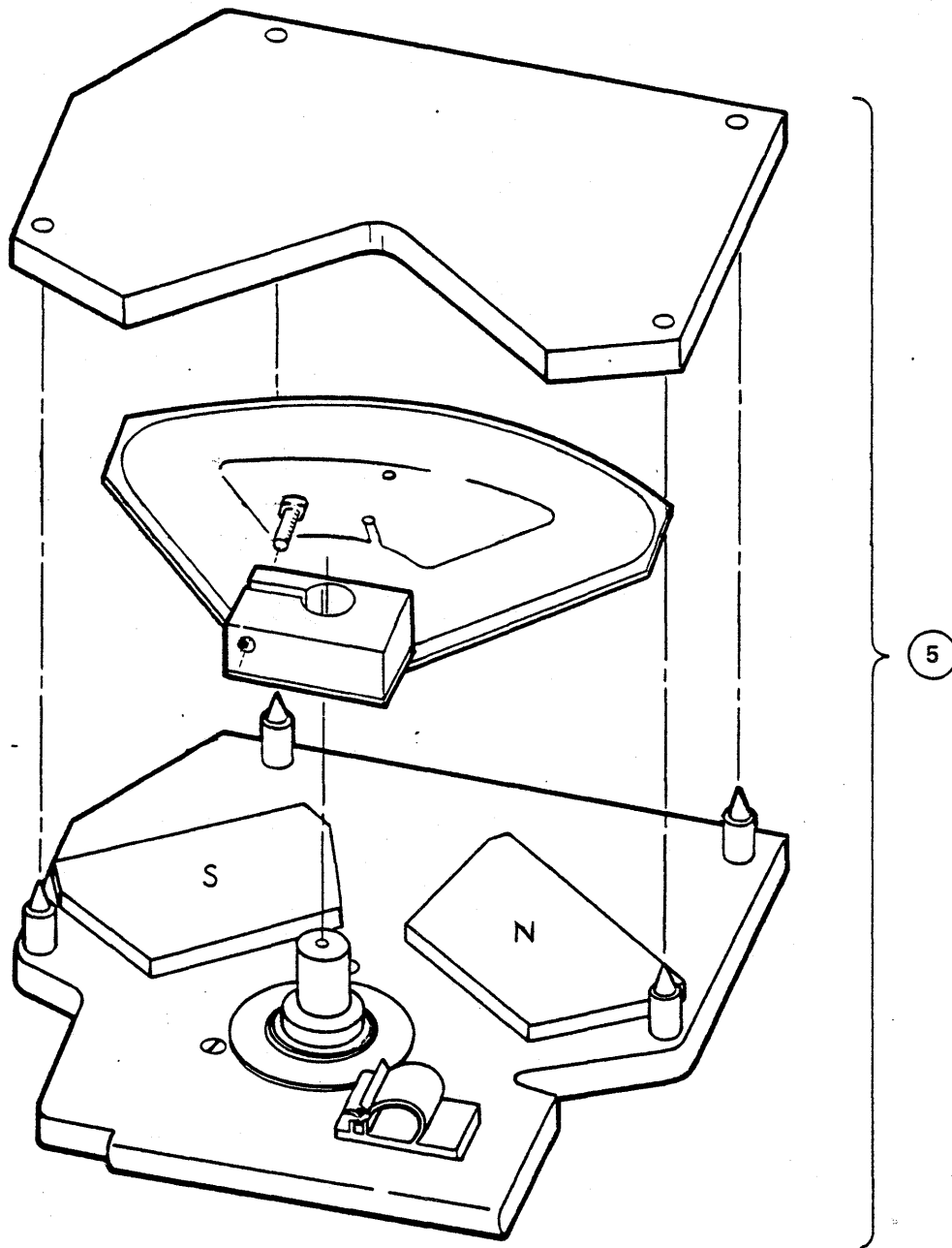


Figure A-7. Coil Card Assembly

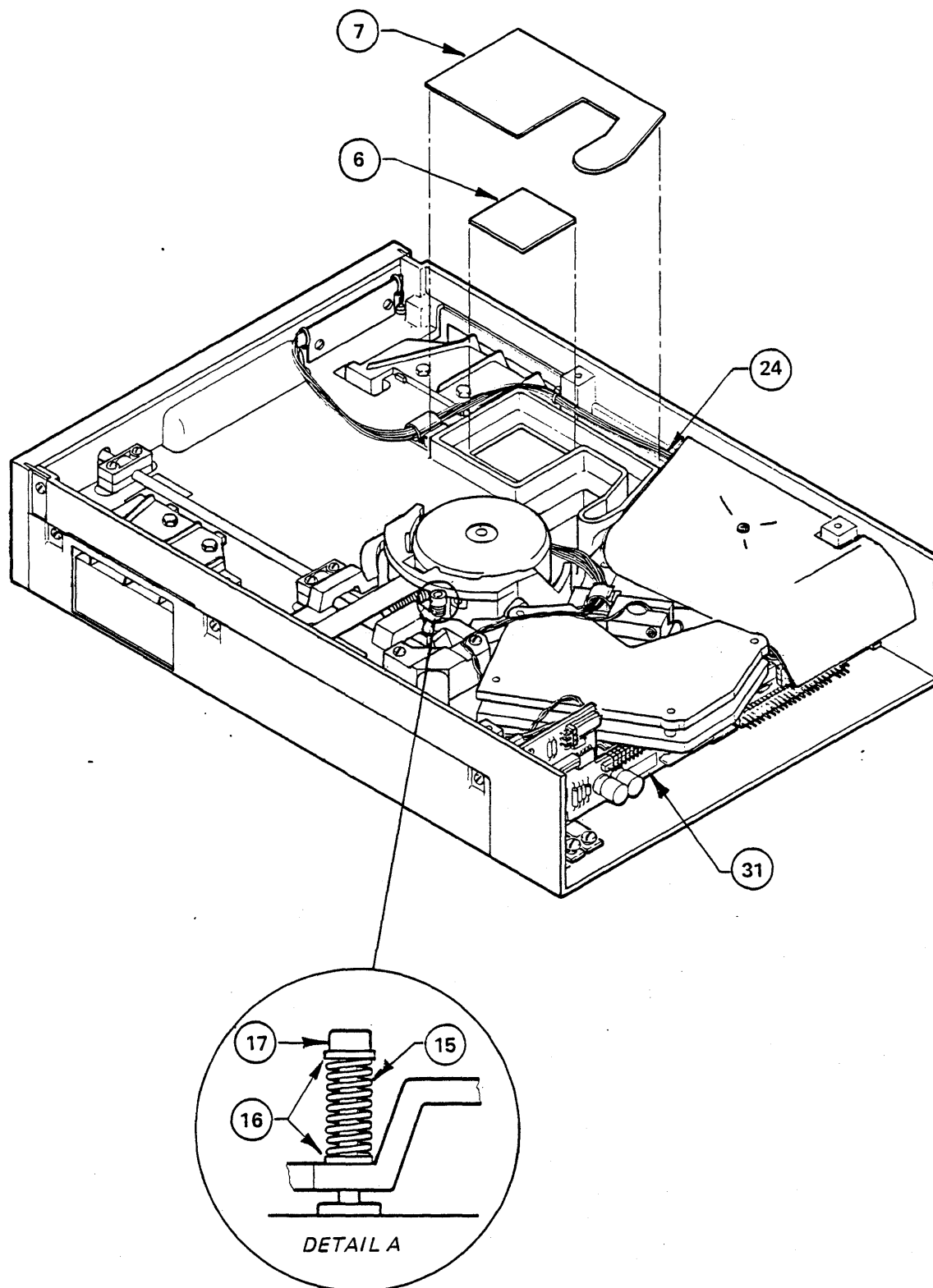


Figure A-8. Filter and Loading Spring Assemblies

APPENDIX B SCHEMATIC DIAGRAMS

Figure B-1 Driver Board Schematic Diagram

Figure B-2 Driver Board Component Locator

DRIVER BOARD

Figure B-1 depicts the complete schematic diagram for the driver board. A component placement chart is provided in Figure B-2.

The only supported means of service for the subsystem is through board-level assembly removal and replacement. Electrical component service is not recommended. The only board schematic diagram provided here is for the driver board, which contains the power amplifiers for the servo controls, including fuses, and drivers for the solenoid and sensor circuits. Provision of this schematic diagram is not to indicate support for electrical component service. It is provided for reference only. Its usefulness to OEMs will be the basis for determining the need for additional schematic diagrams in the future.

The controller board is too complex to anticipate field component level service at this time. Service of this board would require extensive training and sophisticated test equipment. That level of service is beyond the scope of this manual.

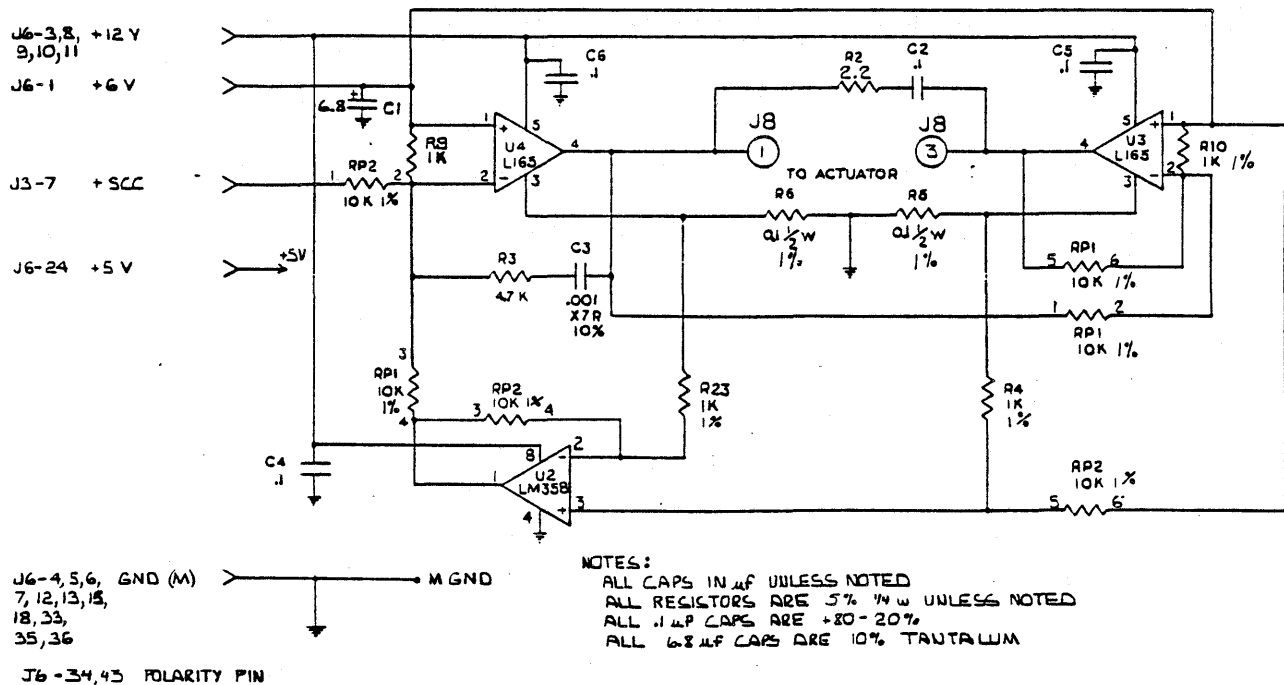
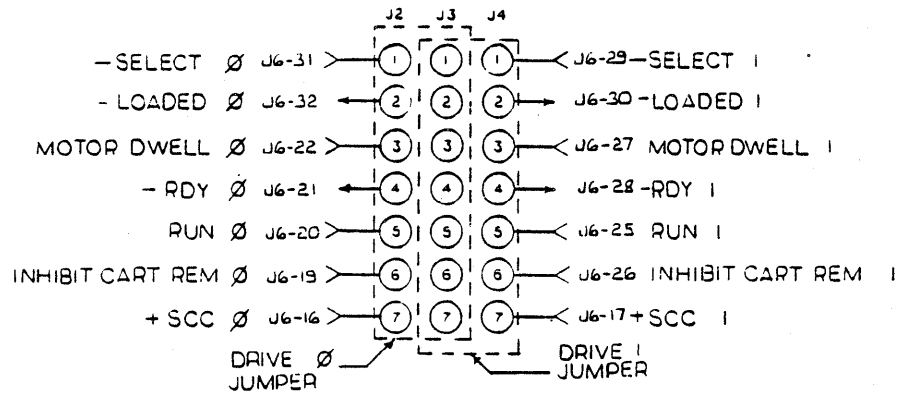


Figure B-1. Driver Board Schematic Diagram (Actuator Drivers)



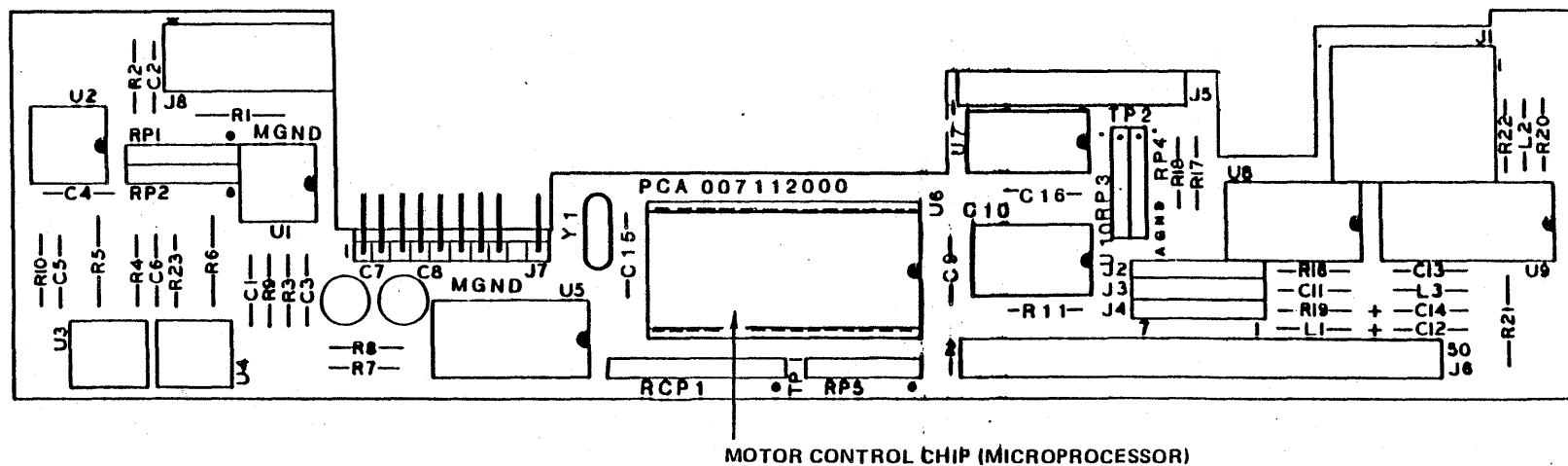


Figure B-3. Driver Board Component Locator