

RA81 Disk Drive Service Manual

RA81 Disk Drive Service Manual

Prepared by Educational Services
of
Digital Equipment Corporation

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PREFACE

This service manual provides the information needed to implement RA81 disk drive corrective maintenance procedures. This book was written for the needs of the repair technician servicing the RA81. The contents of this manual include the following items:

- The maintenance features of the drive and the related reference documentation for the RA81 subsystem.
- Removal and replacement procedures.
- Spindle drive belt tension adjustment.
- Field service diagnostic terminal installation.
- Drive-resident diagnostic usage.
- Fault isolation procedures.

Installation procedures are not included in this manual, but may be found in the *RA81 User Guide*, Chapter 2.

CHAPTER 1

GENERAL INFORMATION

1.1 INTRODUCTION

This chapter describes the RA81, its maintenance philosophy and features, and lists the related documentation for the drive.

1.2 RA81 DISK DRIVE DESCRIPTION

The RA81 is a random-accessed, moving-head disk drive. It can store up to 456 megabytes of data on a non-removable head/disk assembly. The basic design of the RA81 is similar to the RM80 and RA80 disk drives.

The RA81 connects to a controller by way of the Standard Disk Interconnect (SDI) bus. The drive can be connected in a dual-port arrangement to two controllers. Each controller in turn communicates to the host CPU using Mass Storage Control Protocol (MSCP).

The RA81 has a power supply, cooling system, and drive logic contained within the drive chassis. The drive logic contains extensive self-diagnosis capabilities. Two microprocessors share the control of the diagnostic as well as the operating modes of the drive.

Drive-resident diagnostics are executed by use of an external terminal. This terminal can be any 300 baud, EIA-compatible terminal with an ASCII interface. A portable, hand-held field service terminal is provided with every controlled distribution (CD) kit. Operating instructions are provided in this manual (Appendix I).

The HDA contains four platters and 14 read/write heads. An additional read-only head is positioned over a surface that contains servo information. This servo information is for coarse positioning of the read/write heads. Fine positioning is accomplished by servo information embedded in the data areas.

The HDA contains seven surfaces for reading/recording data. Each surface in turn, has two read/write heads.

1.3 RA81 MAINTENANCE FEATURES

The RA81 has been designed for ease of service and has the following maintenance features.

- Easy access to all field replaceable parts
- Fault reporting by the operator control panel
- FRU callout in the error report
- Drive resident diagnostic and utility routines

- Read/write diagnostic tracks
- No head alignments
- No electrical adjustments
- No preventive maintenance procedures

1.4 RA81 MAINTENANCE PHILOSOPHY

The repair strategy for the RA81 is module replacement. Diagnostics are contained in the drive microcode. The field service engineer uses the results of the diagnostics to isolate fault conditions to the field replaceable unit (FRU) level. In addition to the drive-resident diagnostics, system-resident diagnostics are available to support and verify corrective maintenance decisions.

1.5 RA81 RELATED DOCUMENTATION

The RA81 related documentation is separated into two groups. The following documentation is available from Printing and Circulation Services.

- *RA81 Disk Drive User Guide* (EK-0RA81-UG)
- *RA81 Disk Drive Illustrated Parts Breakdown* (EK-0RA81-IP)

The following documentation is available from the Software Distribution Center.

- *RA81 Field Maintenance Print Set* (MP-01359)
- *RA81 Disk Drive Maintenance Guide* (AA-M879A-TC)
- *Maintenance Guide Binder* (AV-L980A-TK)
- *UDA50 Maintenance Documentation Kit* (QP904-GZ)—This kit includes a binder, the *UDA50 Maintenance Guide* and the available drive maintenance guides that operate on the UDA50.

Non-DIGITAL customers must order manuals through the Accessories and Supplies Group (A & SG). The address for A & SG is:

DIGITAL EQUIPMENT CORPORATION
 Attn: Circulation Department, RQ/W8
 460 Amherst Street
 Nashua, NH 03063.

CHAPTER 2

REMOVAL AND REPLACEMENT PROCEDURES

2.1 INTRODUCTION

This chapter describes the RA81 parts removal and replacement procedures. The following sequence describes the proper removal procedure for RA81 parts.

1. Find the part to be removed on the sequential flow diagram (Figure 2-1).
2. Follow the path to the top of the diagram.
3. Start by removing the first item in the path that the flow line passes through.
4. Continue down the flow line removing parts until the wanted part is reached.

Paragraph numbers help in the location of each removal procedure. Parts that can be removed directly are not shown on the diagram. Unless otherwise indicated, parts replacement is the reverse of the removal procedure.

WARNING

Hazardous voltages are present inside this equipment. Installation and servicing should be performed by a qualified and trained service representative. Bodily injury or equipment damage may result from improper servicing.

2.2 REMOVING POWER FROM THE DISK DRIVE

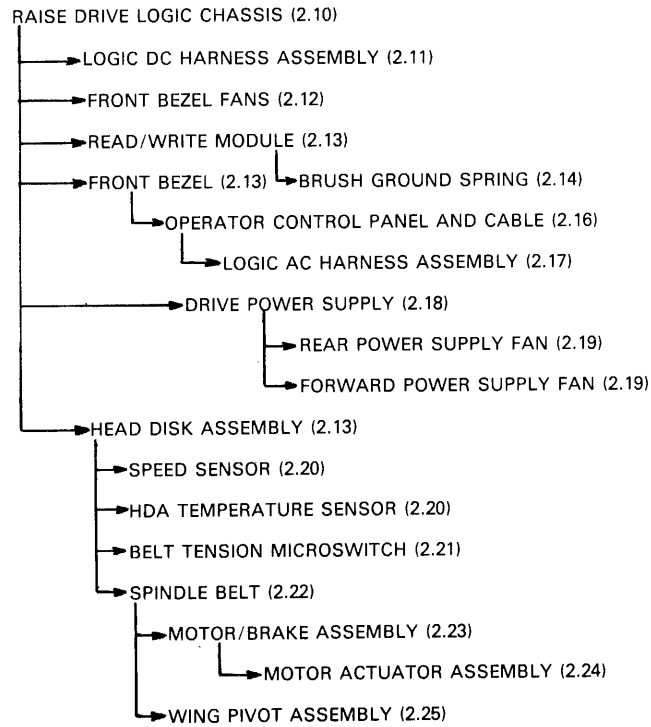
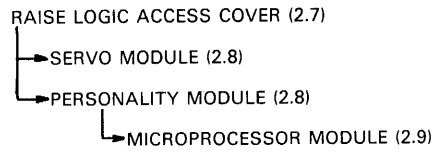
Before replacing assemblies in the RA81, the disk should be stopped and the ac line power removed. Figure 2-2 shows the power controls for the RA81 and power controller (H874).

2.2.1 Removing Power from the Drive Internal Assemblies

To remove power from everything but the power supply, switch off CB1 at the back of the RA81.

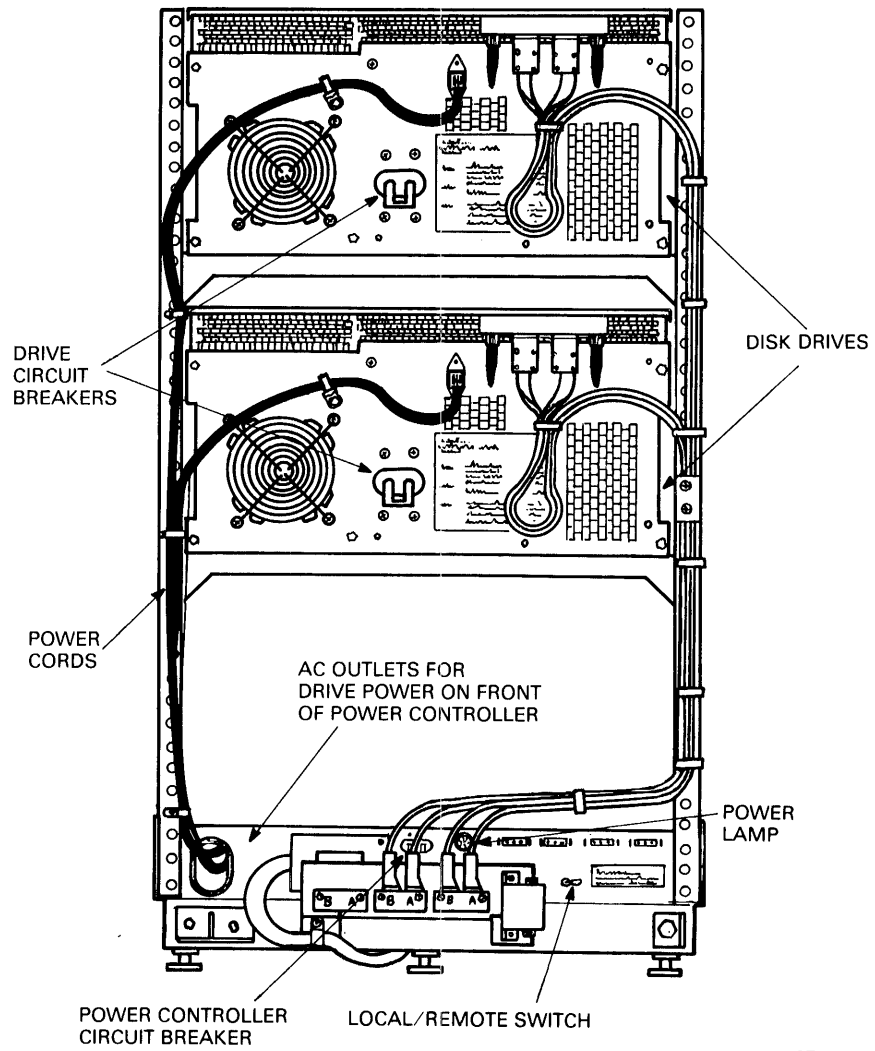
2.2.2 Removing Power from the H7660A or B Power Supply

To remove power from the H7660A or B power supply, unplug the ac cord from the receptacle on the power control unit at the bottom of the RA81 cabinet.



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Figure 2-1 Parts Removal and Replacement Diagram



CZ-0766

Figure 2-2 Location of Power Controls

2.3 REMOVING THE BACK CABINET DOOR AND END PANELS

Refer to Figures 2-3 and 2-4 while performing this procedure.

1. Unlock the back door with a 5/32" hex key wrench.
2. Disconnect the green/yellow striped ground wire using a phillips screwdriver.
3. Unlatch the back door and lift off the frame assembly.
4. Remove the two end panel locks by loosening the screws and then lifting the locks off the panels.
5. Lift the end panels up and away from the cabinet.
6. Remove the green/yellow ground wire from the cabinet and set the end panel aside.

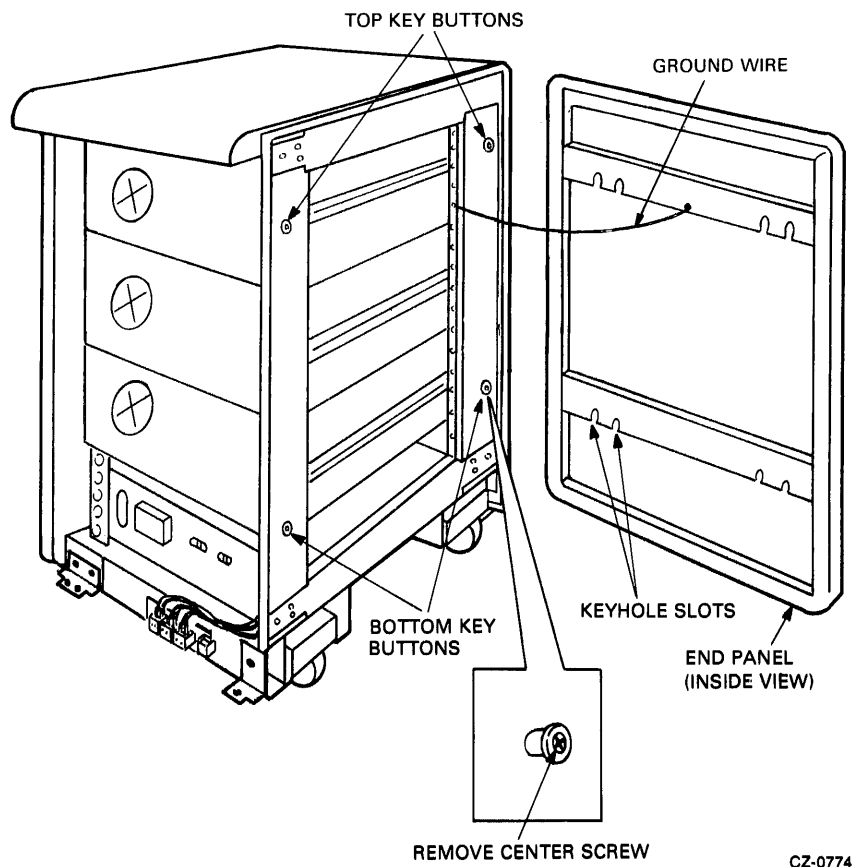
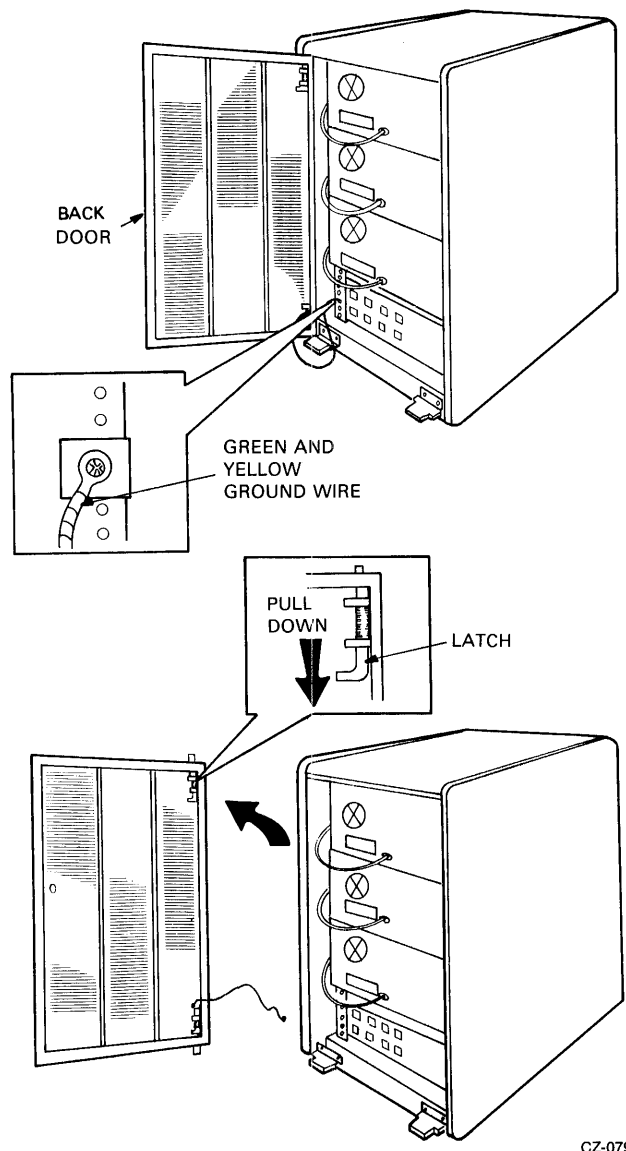


Figure 2-3 End Panel Removal



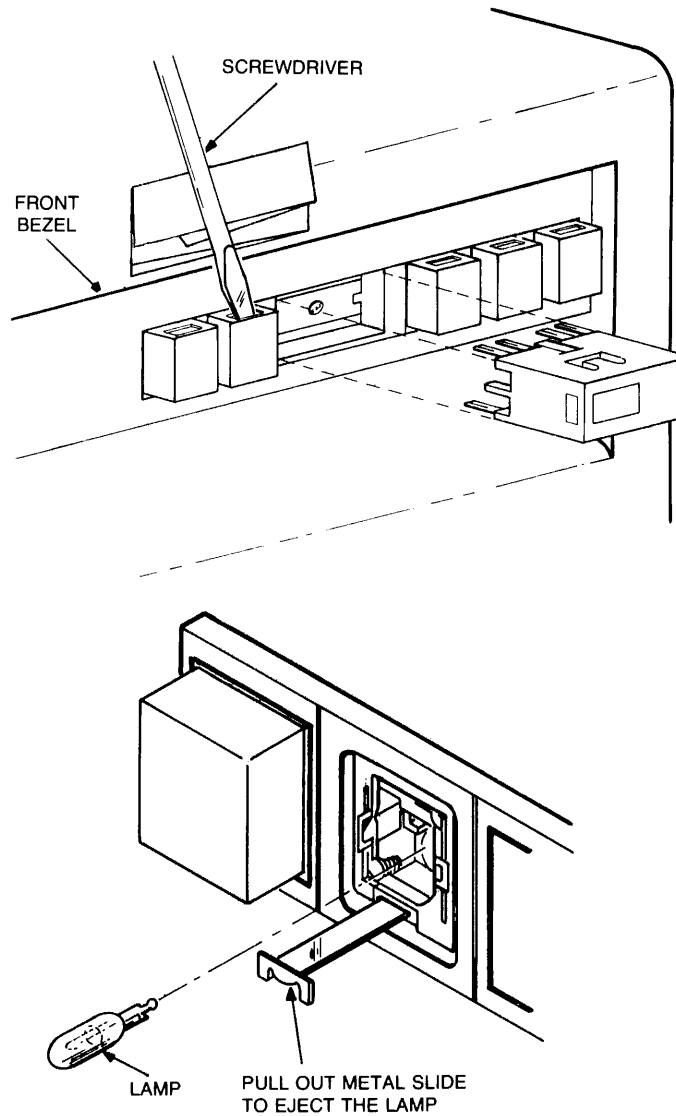
CZ-0792

Figure 2-4 Back Door Removal

1. Remove the switch covers by prying against the recessed side of the cover with a screwdriver.

NOTE

Place paper or other material between the bezel and the screwdriver to prevent chipping the paint on the drive cabinet.



CZ-0636

Figure 2-5 Control Panel Light and Switch Cover Removal

2. Reach into the switch opening and pull on the metal slide to remove each light. The light will pull out with the slide.
3. With the flat section of the new bulb in a horizontal position, push the bulb into the socket as far as it will go.
4. Replace the cover by pushing it into the switch opening as far as it will go. Use only a small amount of pressure to position the cover into place.

2.5 REPLACING THE AIR FILTER

Refer to Figure 2-6 while performing this procedure.

1. Push up on the door latch of the front bezel and lower the door to a horizontal position.
2. Remove the foam air filter by pulling down on the top half of the filter and then lifting it out of the drive.

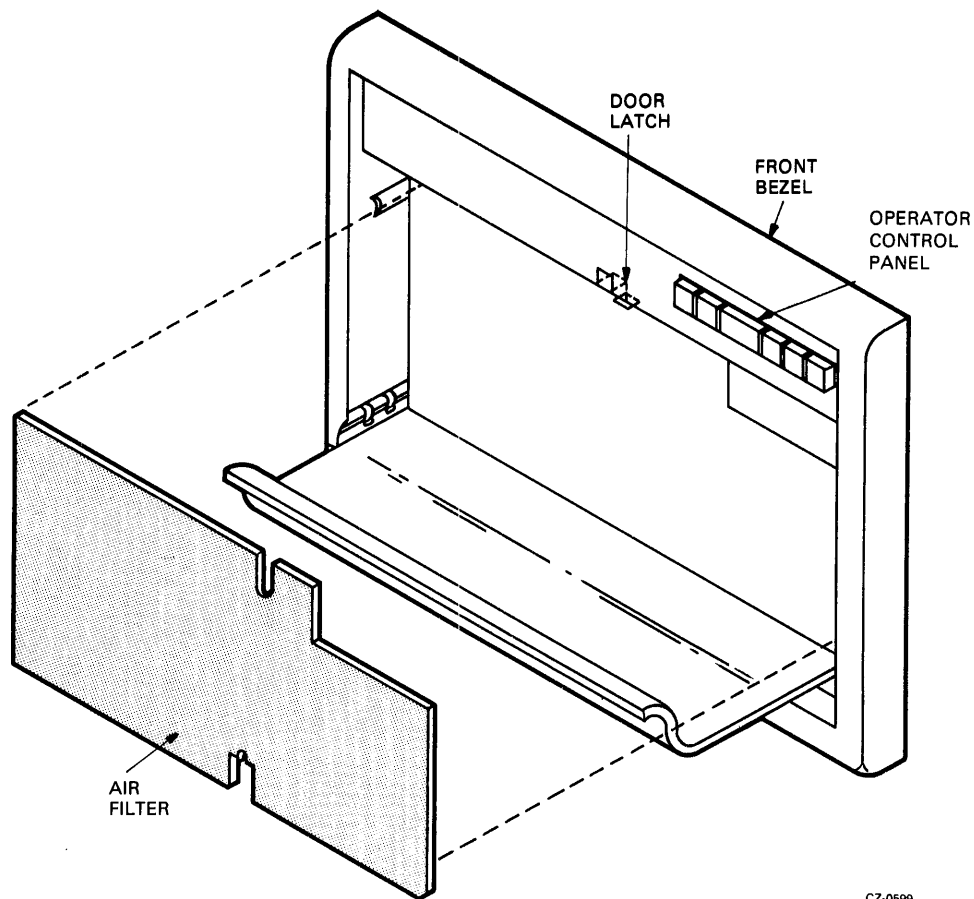


Figure 2-6 Air Filter Removal

2.6 EXTENDING AND RETRACTING THE DRIVE ON SLIDES

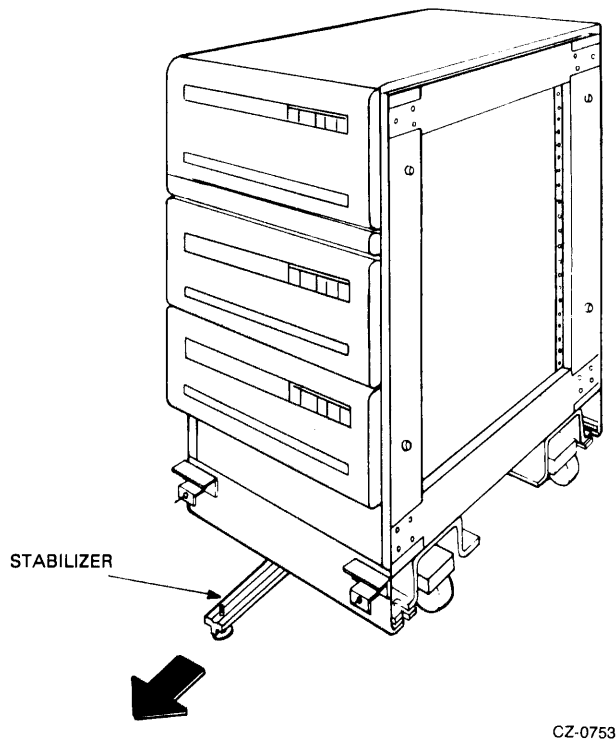
To replace FRUs on drives mounted on slides, follow the procedures in the next two paragraphs.

2.6.1 Extending the Drive on its Slides

1. Pull out the cabinet stabilizer. Refer to Figure 2-7.

CAUTION

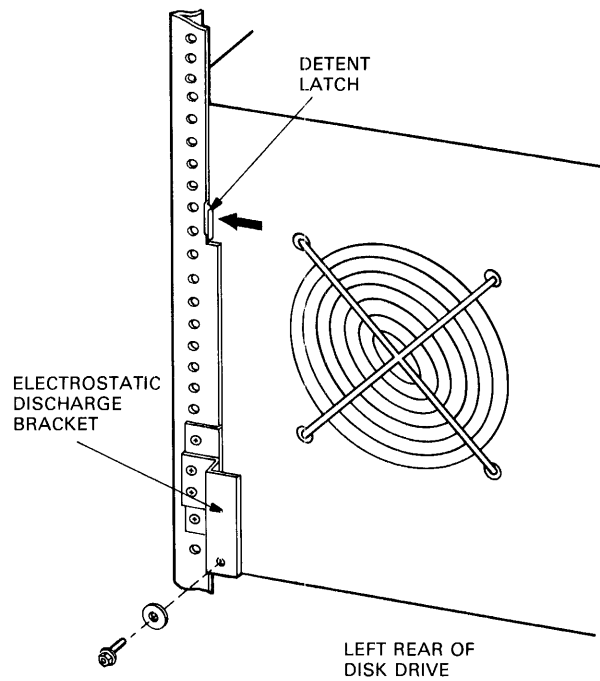
Never slide a drive out of the cabinet without first extending the cabinet stabilizer.



CZ-0753

Figure 2-7 Cabinet Stabilizer

2. Open the back door of the cabinet.
3. Remove the screw that holds the back of the disk drive to the electrostatic discharge bracket. Refer to Figure 2-8.
4. Push the detent latch to the left and push the drive out of the cabinet.
5. Pull the drive out on its slides until it locks in place. Refer to Figure 2-9.
6. Push up on slide lock arm A to extend the drive to the limits of the slides.

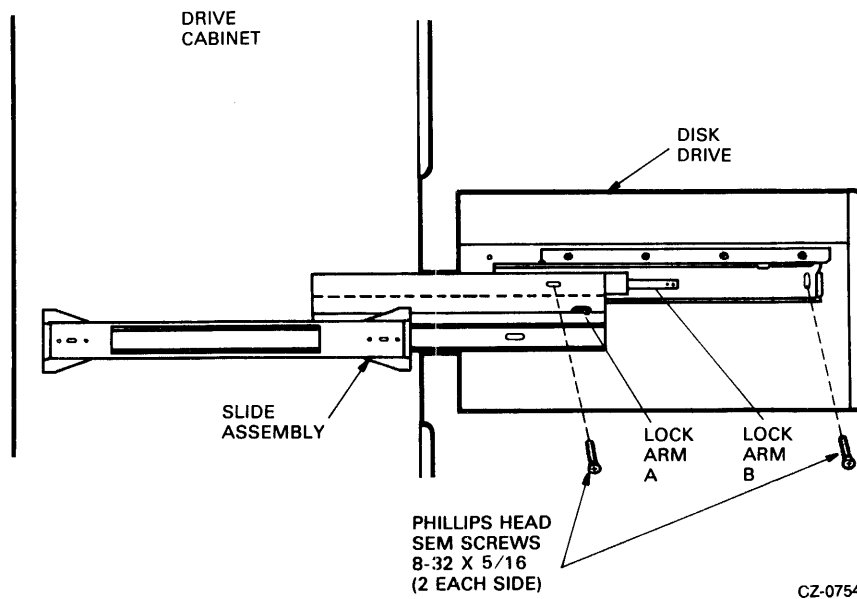


NOTE

1. REMOVE POWER SUPPLY SCREW TO SLIDE DRIVE FORWARD. REPLACE SCREW THROUGH BRACKET EACH TIME THE DRIVE IS SLID BACK INTO CABINET.

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Figure 2-8 Electrostatic Discharge Bracket



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Figure 2-9 Extending the Chassis Slides

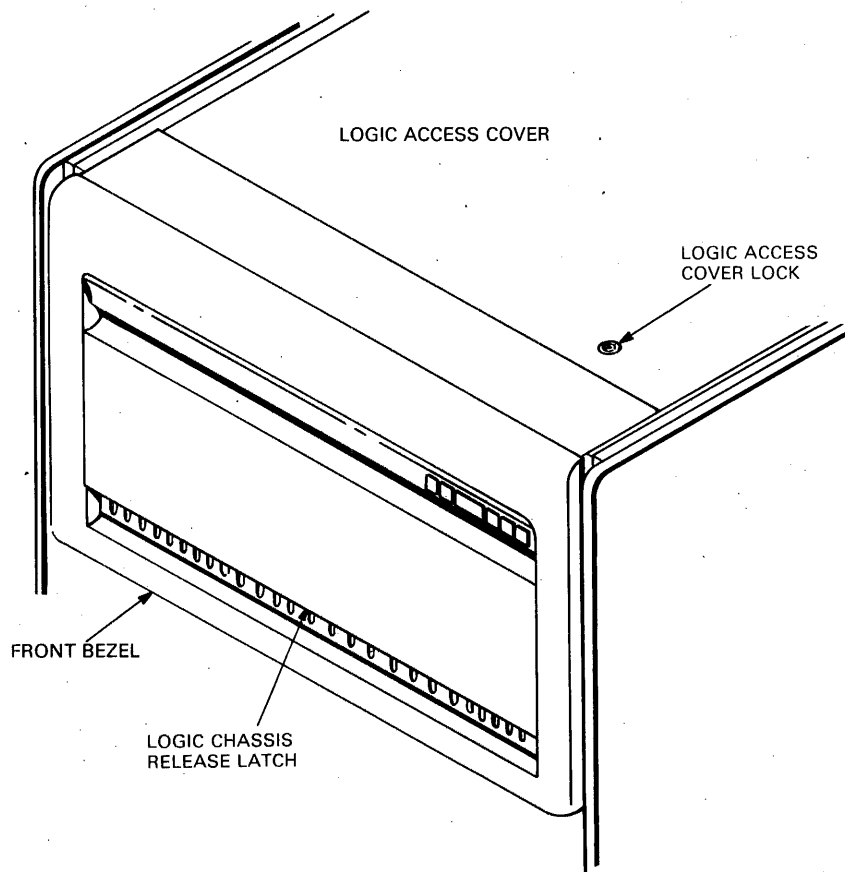
2.6.2 Sliding the Drive Back into the Cabinet

1. Push in on slide lock arm B and slide the drive into the cabinet.
2. Check that the detent latch at the back of the cabinet has locked the drive into place.
3. Replace the screw on the power supply through the electrostatic discharge bracket.
4. Close the back door of the cabinet.

2.7 RAISING THE LOGIC ACCESS COVER

Refer to Figure 2-10 while performing this procedure.

1. Turn the logic access cover lock 90 degrees counterclockwise while placing pressure on the cover. Cover will pop up slightly, once the cover latch is released.
2. Raise the logic access cover.



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Figure 2-10 Access to the Inside of the Drive

2.8 REMOVING THE SERVO AND PERSONALITY MODULES

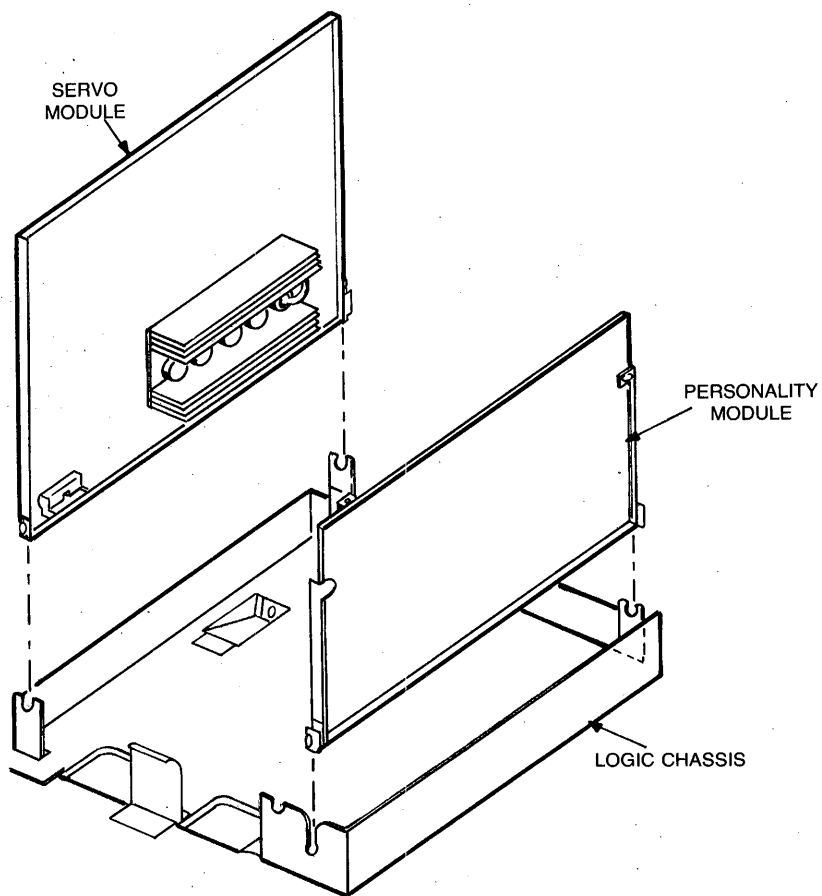
Refer to Figure 2-11 while performing this procedure.

1. Raise the logic access cover (Paragraph 2.7).
2. Unplug all module cables.

NOTE

Do not cut the tie wraps on the SDI cables. Instead, remove the nylon nut and unplug the connector with the tie wrap attached.

3. Lift module(s) out of the chassis.



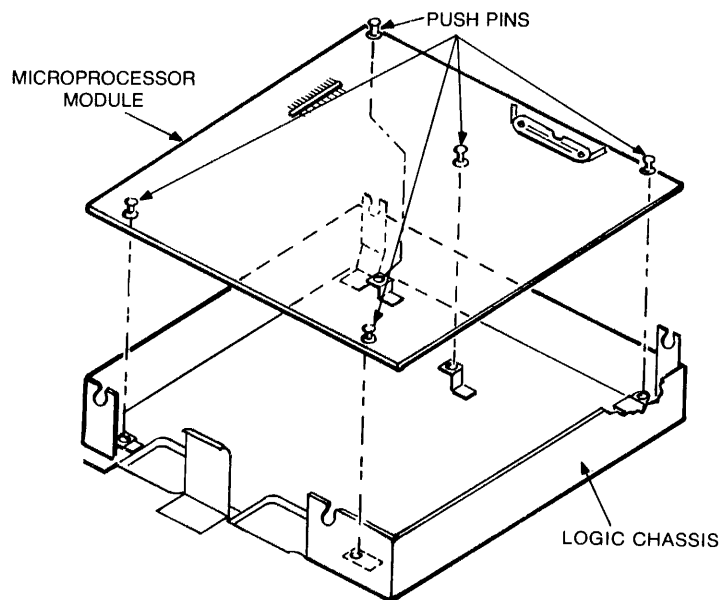
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Figure 2-11 Servo and Personality Module Removal

2.9 REMOVING THE MICROPROCESSOR MODULE

Refer to Figure 2-12 while performing this procedure.

1. Raise the logic access cover (Paragraph 2.7).
2. Pivot the servo and personality modules up to gain access to the microprocessor module.
3. Remove servo and personality modules (Paragraph 2.8).
4. Unplug all cables to the microprocessor module.
5. Pull up on the five push pins holding the module to the chassis.
6. Lift the microprocessor module out of the logic chassis.



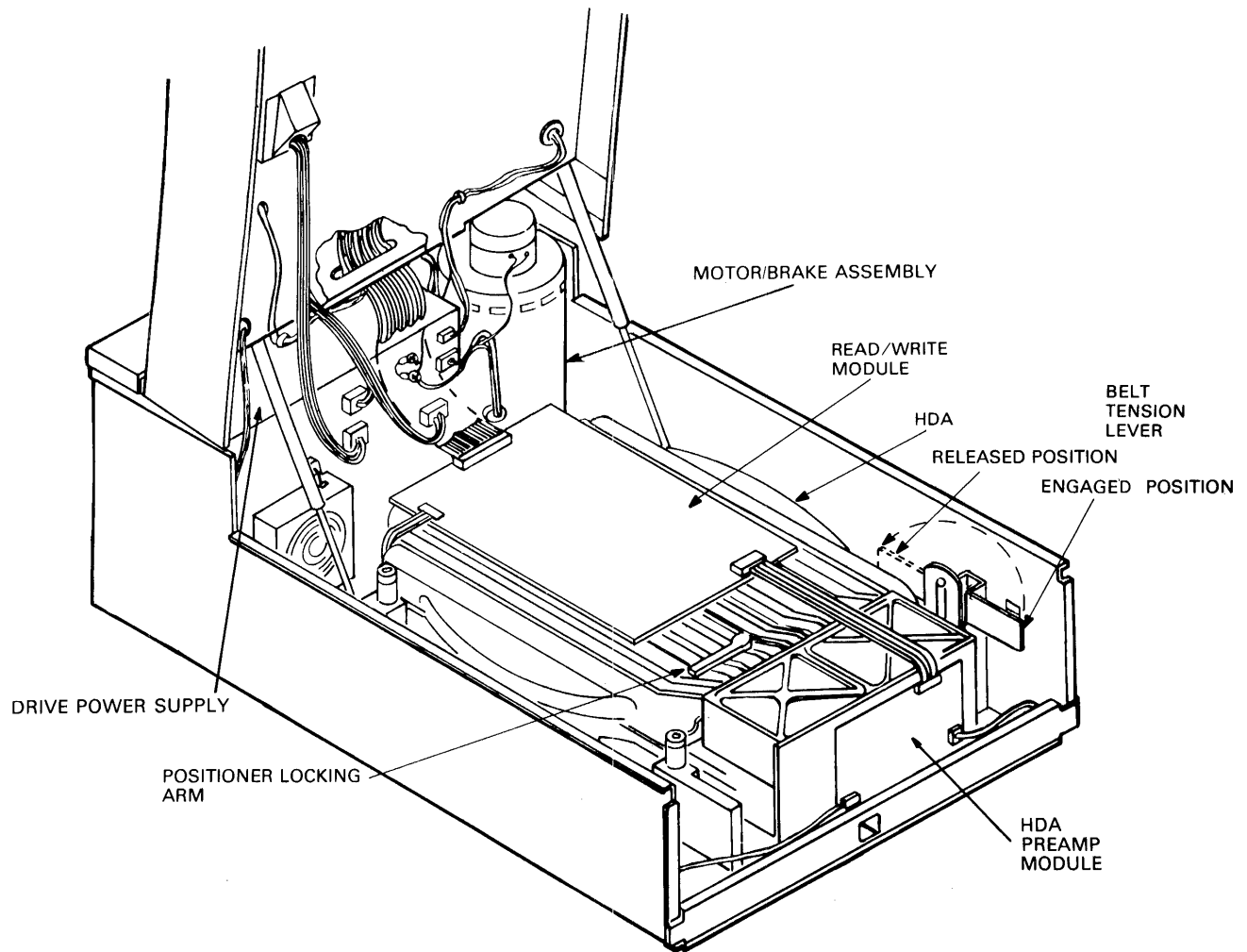
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Figure 2-12 Microprocessor Module Removal

2.10 RAISING THE DRIVE LOGIC CHASSIS

Refer to Figures 2-10 and 2-13 while performing this procedure.

1. Push the logic chassis release latch with a screwdriver.
2. Lift the drive logic chassis to a completely raised position (Figure 2-13).



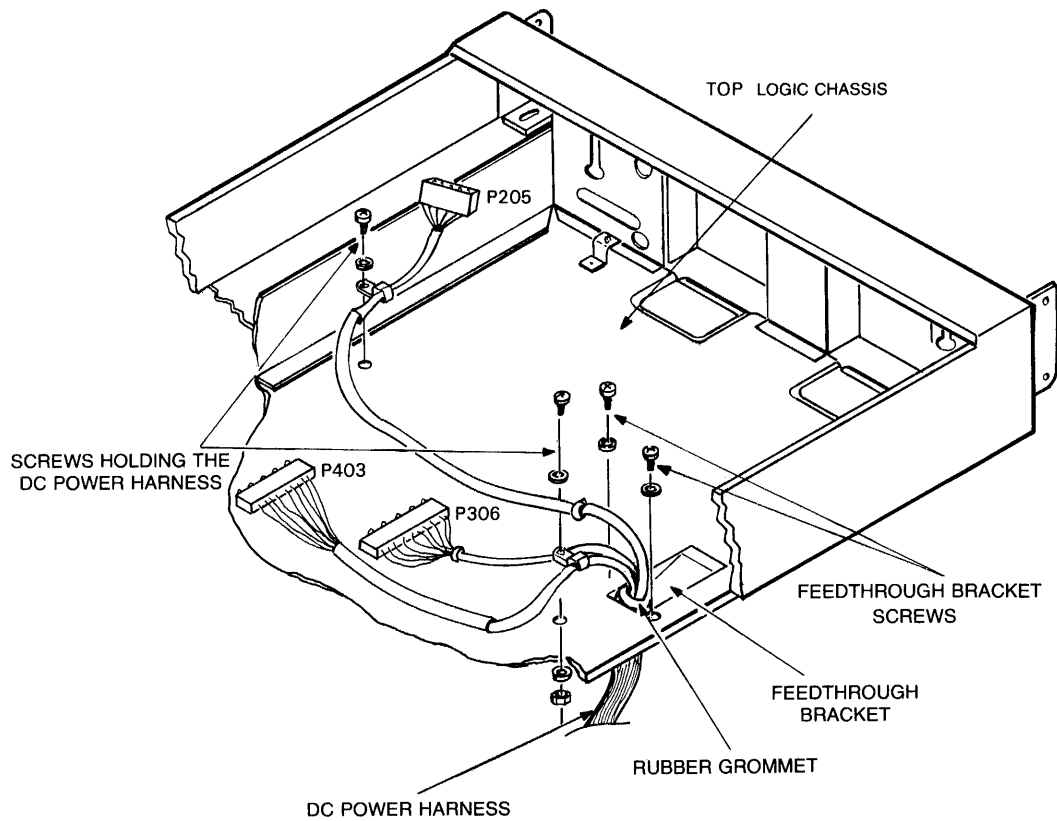
CZ-0793

Figure 2-13 Lower Chassis Part Locations

2.11 REMOVING THE DC POWER HARNESS ASSEMBLY

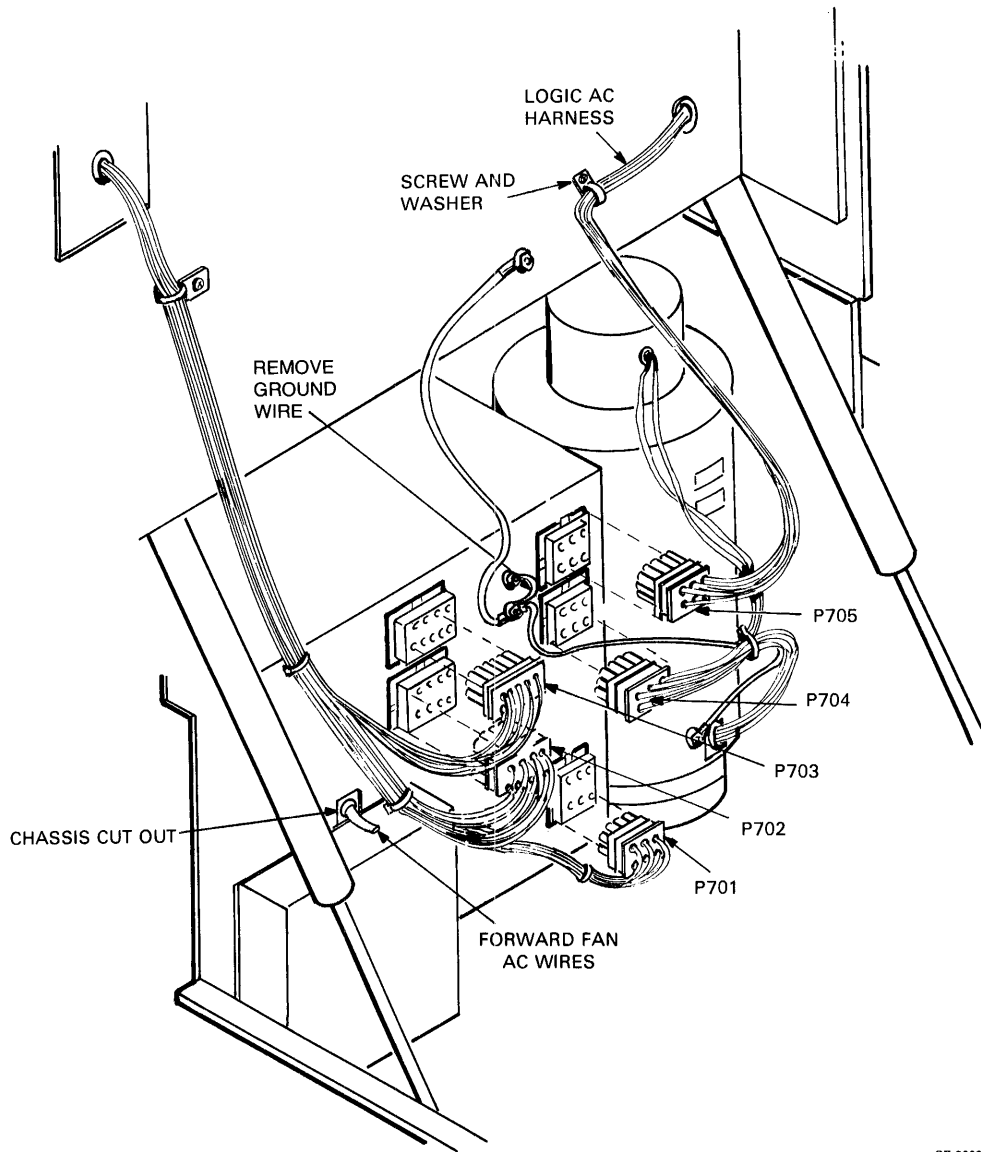
Refer to Figures 2-14 and 2-15 while performing this procedure.

1. Raise the logic access cover (Paragraph 2.7).
2. Remove the servo, personality and microprocessor modules (Paragraphs 2.8 and 2.9).
3. Remove the feedthrough bracket screws.
4. Remove the two screws holding the DC power harness.
5. Raise the drive logic chassis (Paragraph 2.10).
6. Unplug P701, P702 and P703 connectors.
7. Remove the DC power harness.



CZ-0163

Figure 2-14 DC Power Harness Removal



CZ-0628

Figure 2-15 Power Supply Connectors

2.12 REMOVING THE FRONT BEZEL FANS

Refer to Figure 2-16 while performing this procedure.

1. Raise the drive logic chassis (Paragraph 2.11).
2. Remove the two screws holding the fan that is to be removed.
3. Slide the fan out of the chassis and remove the quick-connectors.
4. Remove the four screws and nuts that hold the fan on its bracket.

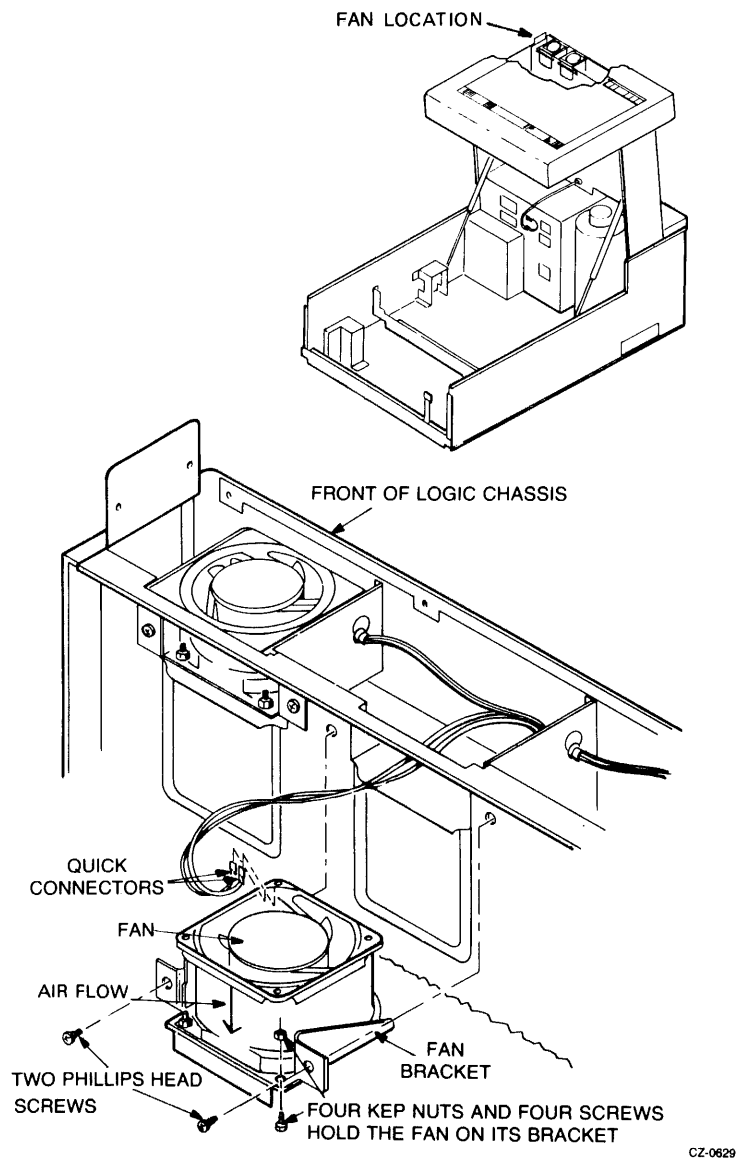


Figure 2-16 Front Bezel Fan Removal

2.13 REPLACING THE HDA AND THE READ/WRITE MODULE

Refer to Figures 2-17 and 2-18 while performing the following removal and replacement procedures.

2.13.1 HDA Removal

1. Raise the drive logic chassis (Paragraph 2.10).
2. Unplug connector P502 from the read/write module.

NOTE

If only the read/write module is being replaced, go to step 9.

3. Unplug connectors P602 and P603 from the HDA preamplifier module.
4. Place the belt tension lever into the release position.
5. Remove the four HDA retaining nuts.
6. Place the positioner lock into the LOCK position (Figure 2-18). The lever must be lifted slightly to clear the surface of the R/W module.

CAUTION

If the above step is not performed, the HDA may be damaged.

7. Remove the HDA from the drive by lifting it from diagonally opposite corners. The HDA weighs approximately 35 pounds.
8. Place the HDA on a level surface in the vertical position only. Feet are provided on the front cover of the HDA for this purpose.

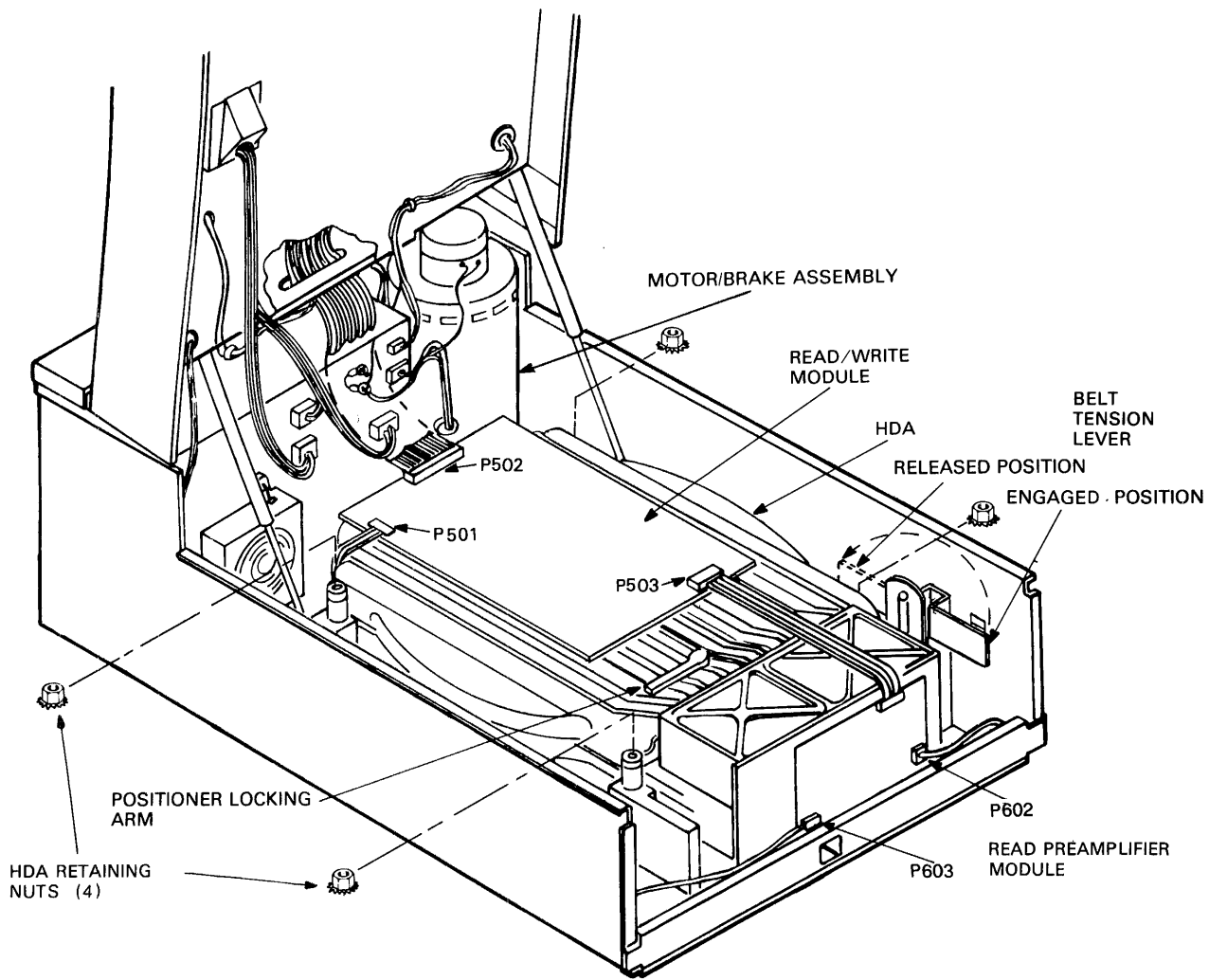
CAUTION

Do not place the HDA in a horizontal position (on its pulley). The speed and temperature transducers mounted on the bottom of the HDA could be damaged.

9. If the read/write module is to be removed:
 1. Unplug connectors P501 and P503 from the read/write module.
 2. Remove the four screws holding the read/write module to the HDA.

NOTE

If an HDA is being replaced, follow the procedures outlined in paragraphs 5.3.5 through 5.3.8. This ensures proper checkout of the new HDA and shipping of the old.



CZ-0797

Figure 2-17 HDA and Read/Write Module Removal

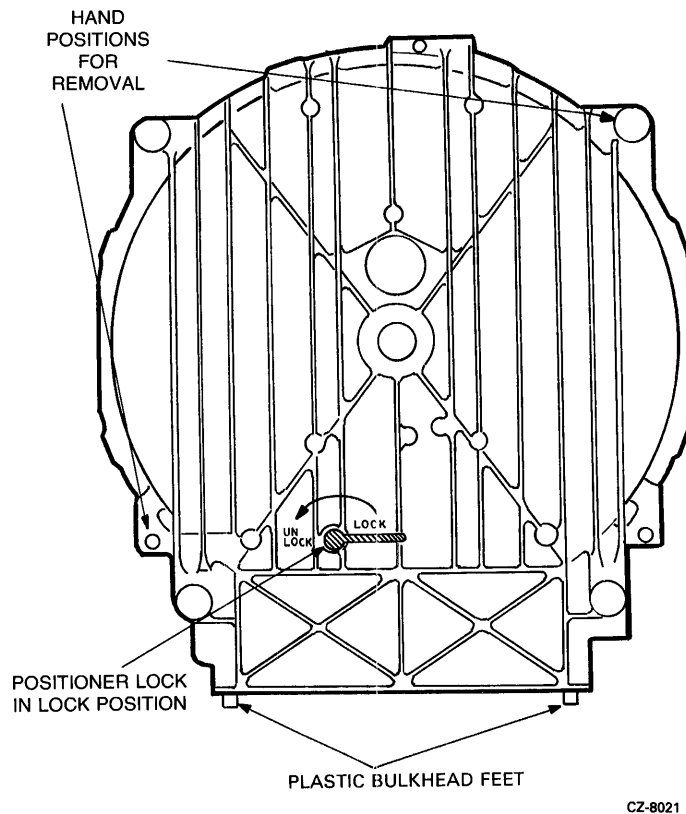


Figure 2-18 HDA Positioner Lock

2.13.2 Replacement Procedures

1. Check that the drive belt is centered on the motor pulley. The other end of the belt should be even with the top of the nylon rollers on the wing pivot assembly (see Figure 2-19).

CAUTION

If the drive belt is not aligned correctly, damage to the HDA, drive belt or nylon roller may result.

2. Lift the HDA by grasping diagonally opposite corners and lower it over the four mounting bolts.
3. Replace the four nuts and washers on the HDA.
4. Connect P602 and P603 to the read preamplifier module on the front of the HDA.
5. Install the read/write module on top of the HDA if it was removed, or if this is a new HDA.
6. Connect P501, P502 and P503 to the read/write module.
7. Connect P601 to the HDA read preamplifier module if it was removed.

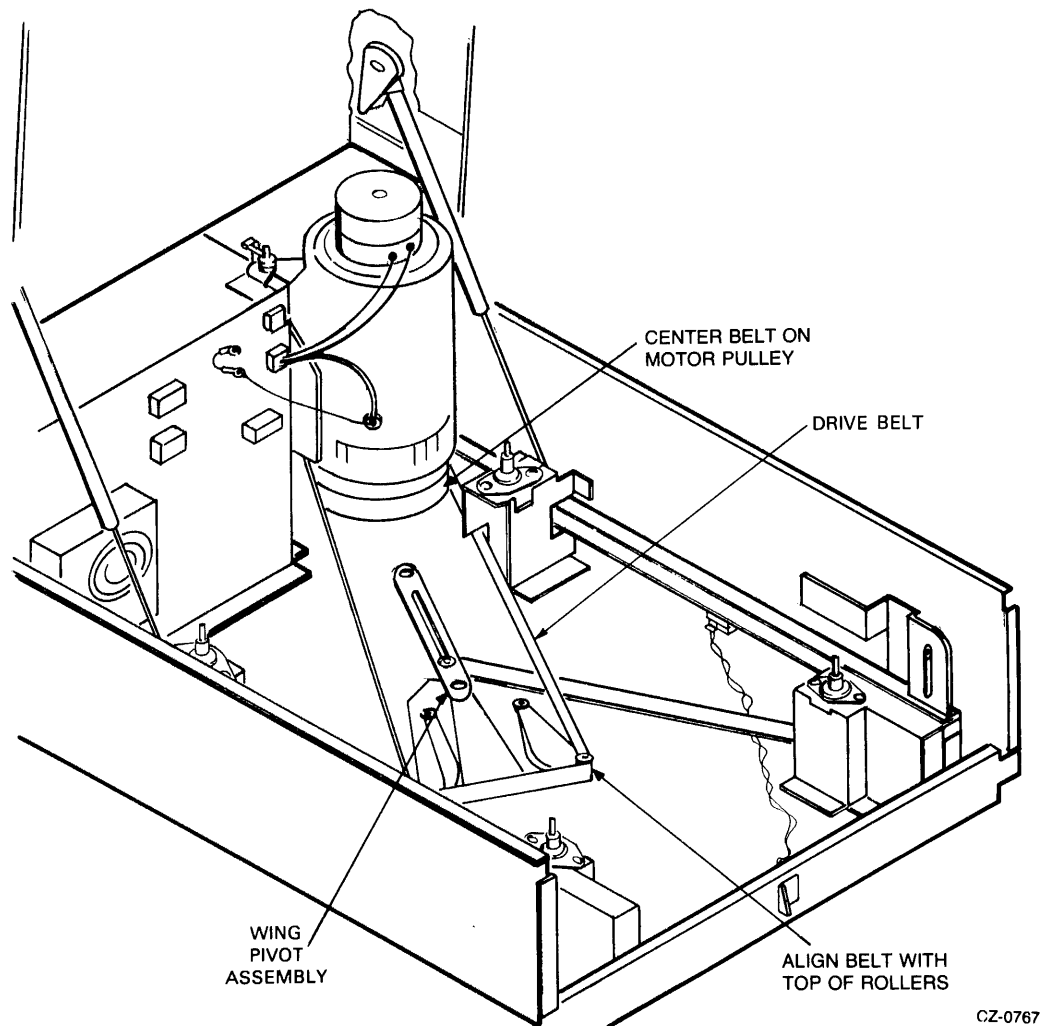


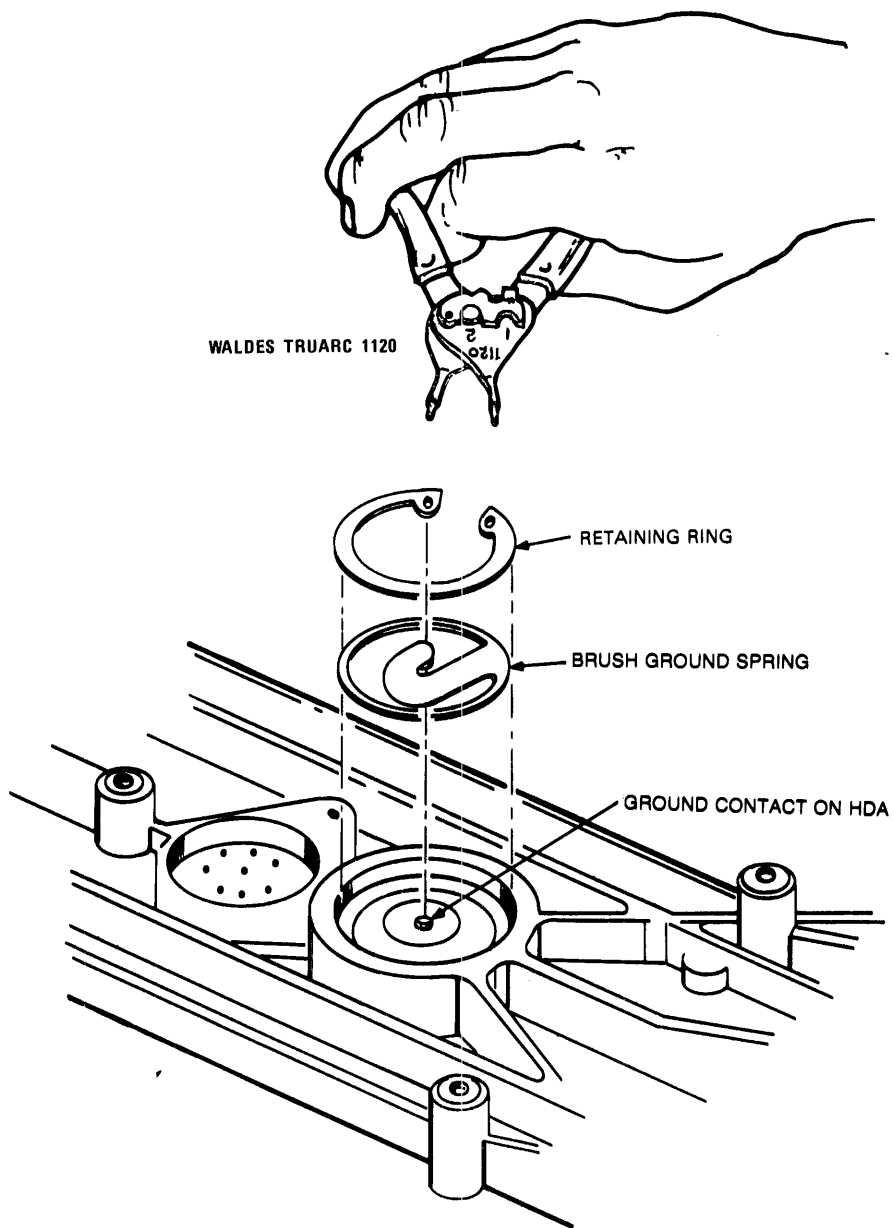
Figure 2-19 Wing Pivot Assembly

8. Place the belt tension lever in the full forward (engaged) position (Figure 2-17).
9. Turn the HDA positioner lock counterclockwise to the unlocked position. The lever must be lifted to clear the surface of the read/write module.

2.14 REMOVING THE BRUSH GROUND SPRING

Refer to Figure 2-20 while performing this procedure.

1. Raise drive logic chassis (Paragraph 2.10).
2. Remove the read/write module (Figure 2-17).
3. Remove brush ground spring retaining ring using retaining ring pliers. A suggested tool is a WALDES TRUARC 1120 (Figure 2-20).
4. Remove brush ground spring from top of spindle.



CZ-0804

Figure 2-20 Brush Ground Spring Removal

2.15 REMOVING THE FRONT BEZEL

Refer to Figure 2-21 while performing this procedure.

1. Raise the drive logic chassis (Paragraph 2.10).
2. Remove the eight screws that hold the front bezel to the drive logic chassis.

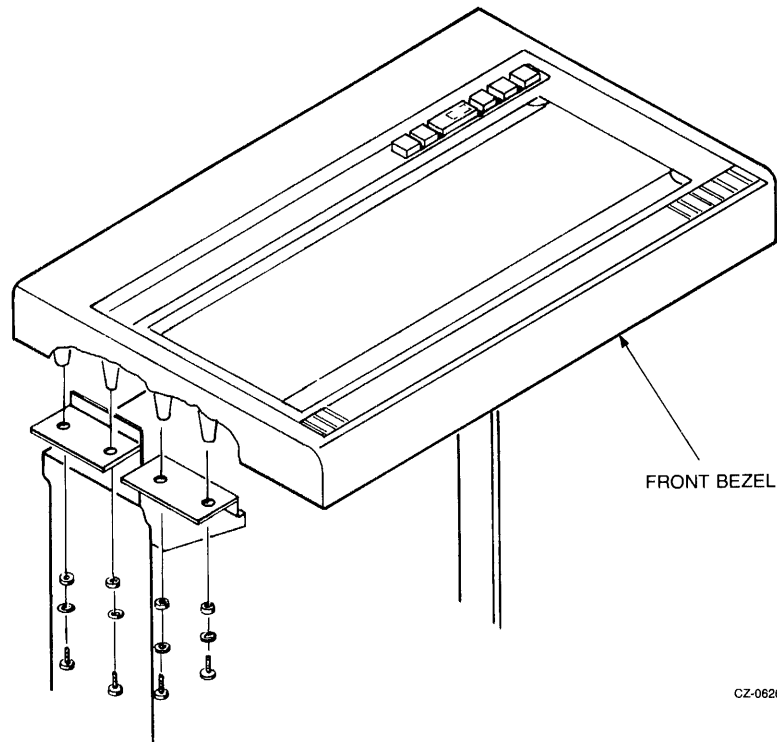
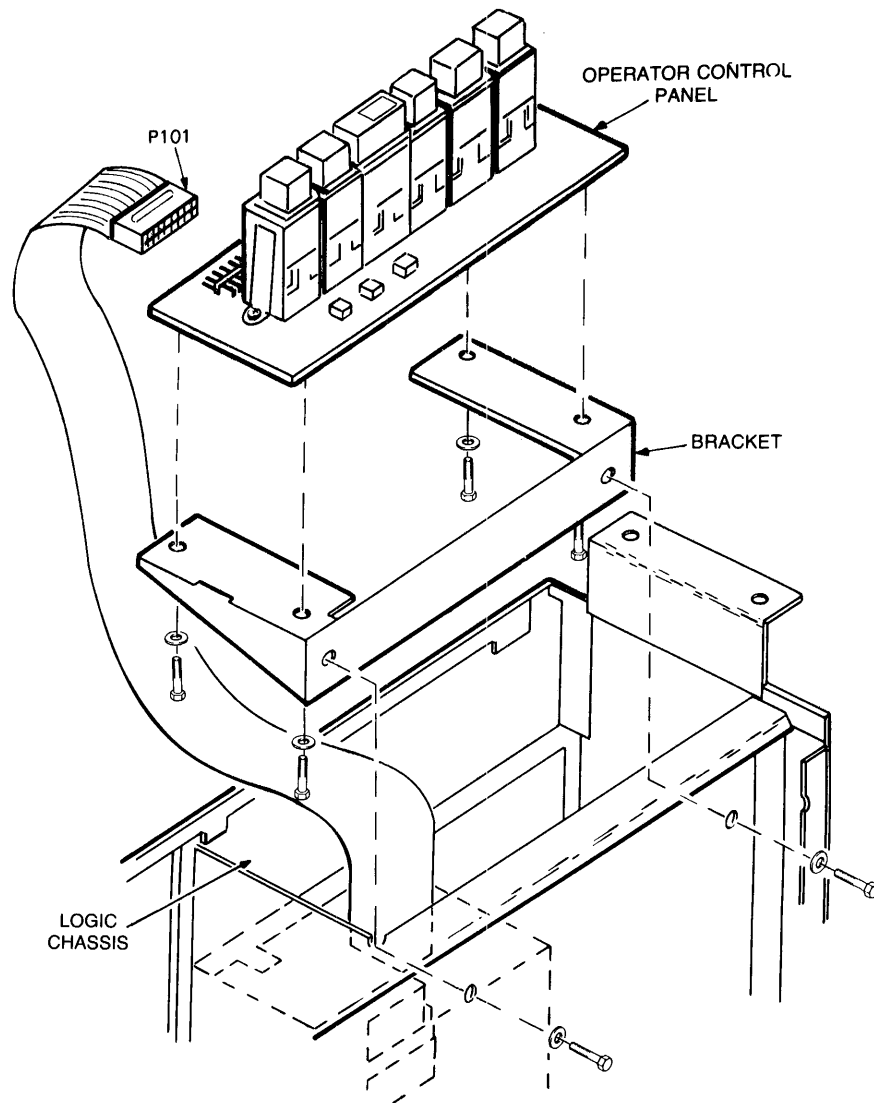


Figure 2-21 Front Bezel Removal

2.16 REMOVING THE OPERATOR CONTROL PANEL AND CABLE

Refer to Figures 2-22 and 2-23 while performing this procedure.

1. Raise drive logic chassis (Paragraph 2.10).
2. Remove front bezel (Paragraph 2.15).
3. Remove the two screws that hold the operator control panel bracket to the chassis. These screws are under the logic chassis.
4. Unplug connector P101 from the operator control panel.

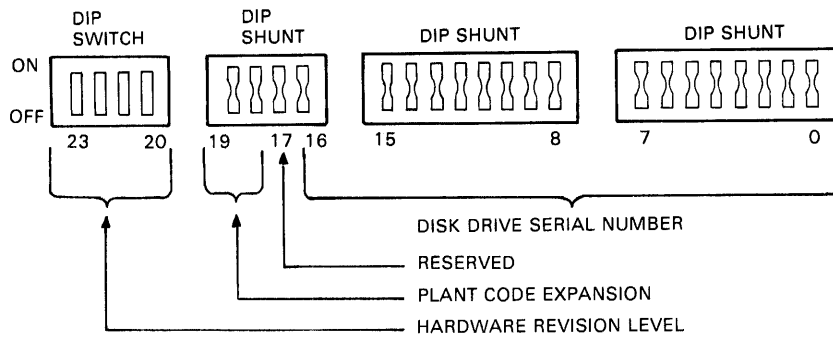


C2-0627

Figure 2-22 Operator Control Panel Removal

NOTE

When installing a new operator control panel, the shunts on the module that indicate the drive serial number must be cut. Also, a DIP switch that determines the revision level of the drive to the software must be configured. Figure 2-23 shows the shunt and switch configuration.



NOTES

1. WHEN REPLACING THE OPERATOR CONTROL PANEL, THE SHUNTS SHOULD BE SET ON THE NEW PANEL TO RESEMBLE THE OLD PANEL. BREAK EACH SHUNT BY PUSHING DOWN ON IT WITH A SMALL SCREWDRIVER. EACH SHUNT LEFT INTACT REPRESENTS A LOGICAL 0. A BROKEN SHUNT REPRESENTS A LOGICAL 1.

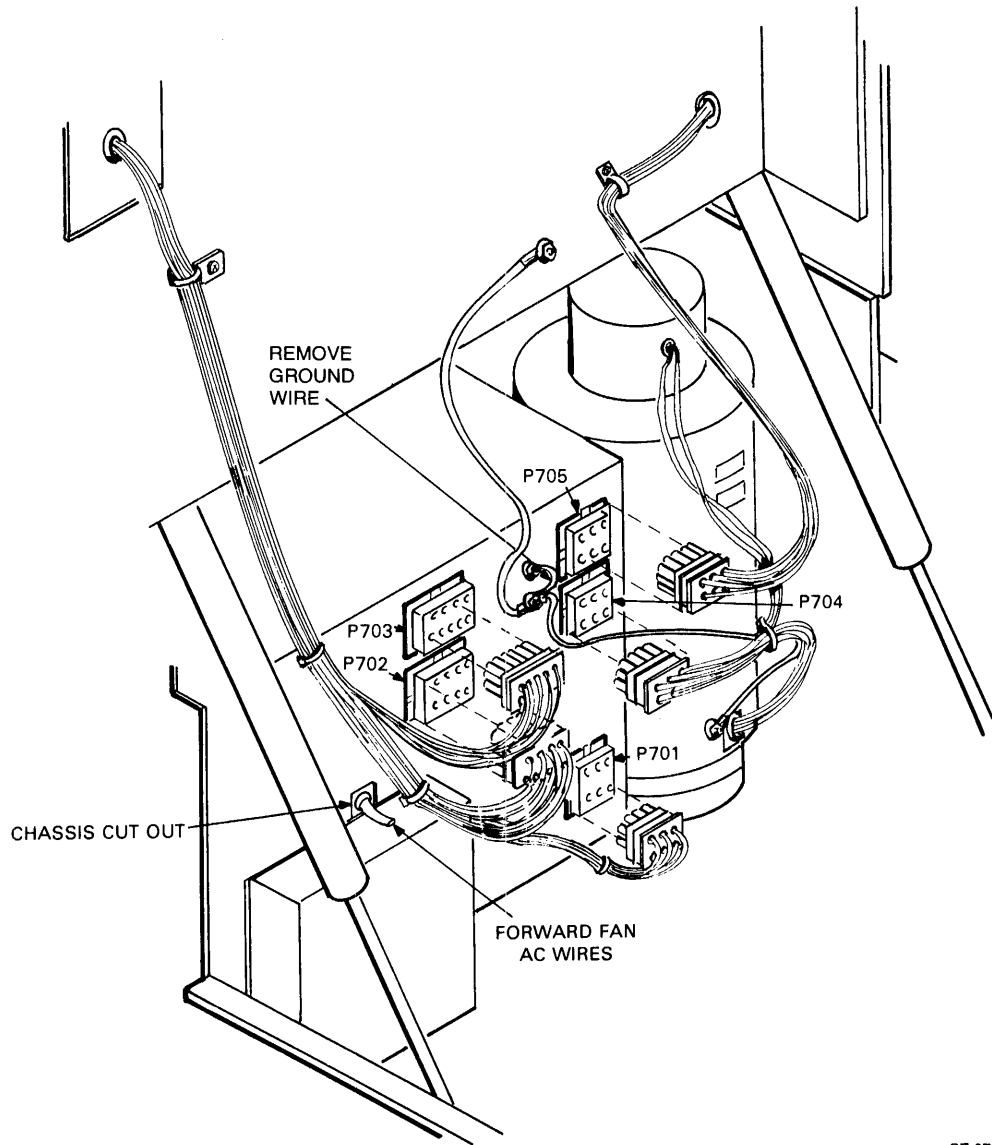
CZ-0641

Figure 2-23 Setting the Drive Serial Number

2.17 REMOVING THE LOGIC AC HARNESS

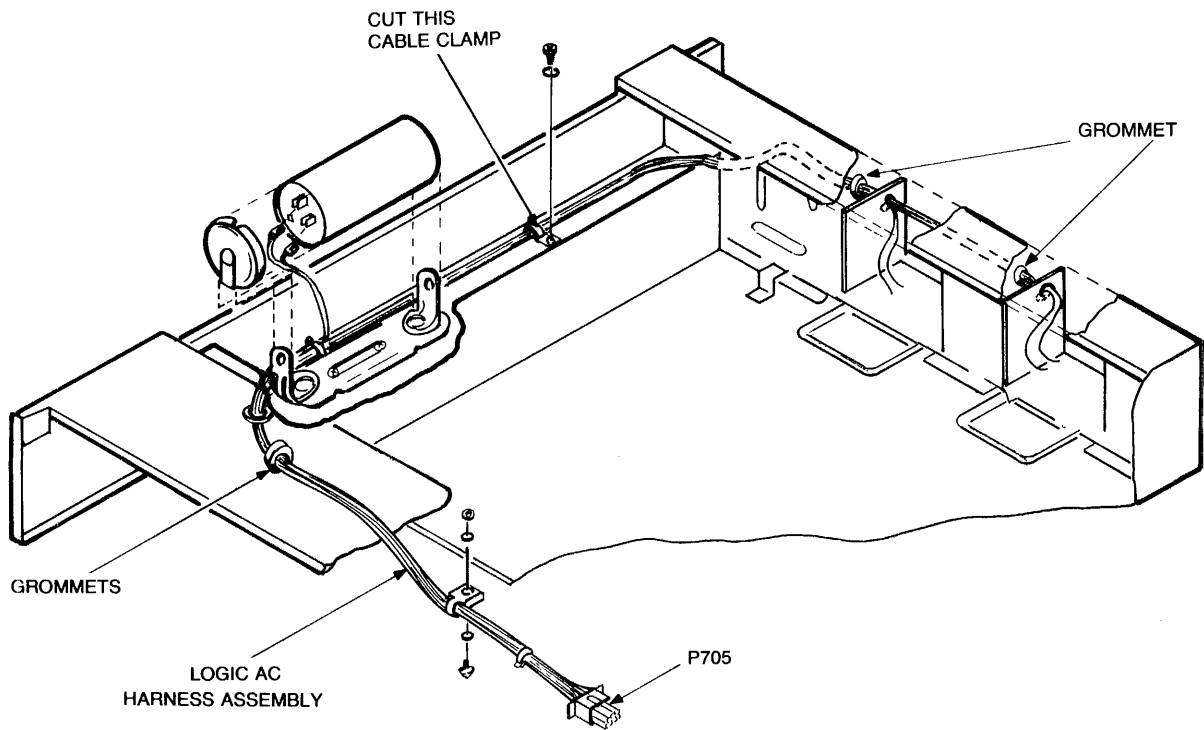
Refer to Figures 2-24 and 2-25 while performing this procedure.

1. Raise the drive logic chassis (Paragraph 2.10).
2. Remove the front bezel (Paragraph 2.15).
3. Remove the operator control panel (Paragraph 2.16).
4. Remove the front bezel fans (Paragraph 2.12).
5. Remove the screw and washer holding the harness to the chassis.
6. Unplug connector P705 from the power supply to the harness.
7. Raise logic access cover (Paragraph 2.7).
8. Remove the wires from the motor start capacitor (found to the right of the personality module).
9. Cut the ac harness cable clamps.
10. Remove the cable clamp screws.
11. Pull the two grommets from their retaining holes.
12. Remove the ac harness from the chassis front.
13. Pull the ac harness down through the hole in the back of the chassis.



CZ-0789

Figure 2-24 Drive Power Supply Connectors



CZ-0174

Figure 2-25 Logic AC Harness Assembly Removal

2.18 REMOVING THE DRIVE POWER SUPPLY

Refer to Figures 2-24 and 2-26 while performing this procedure.

1. Unplug the power supply AC line cord from the power controller at the base of the cabinet.
2. Raise the drive logic chassis (Paragraph 2.10).
3. Unplug connectors P701, P702, P703, P704 and P705 from the drive power supply.
4. Remove the ground wire from the top ground terminal found on the front of the power supply.
5. Remove any cable clamps or cable ties from the ac power cord.
6. Remove the six 1/4" hex-head screws from the back of the power supply.
7. Pull the power supply out of the back of the drive, routing the two fan wires through the chassis cutout.

NOTE

The power supply weighs approximately 35 pounds.

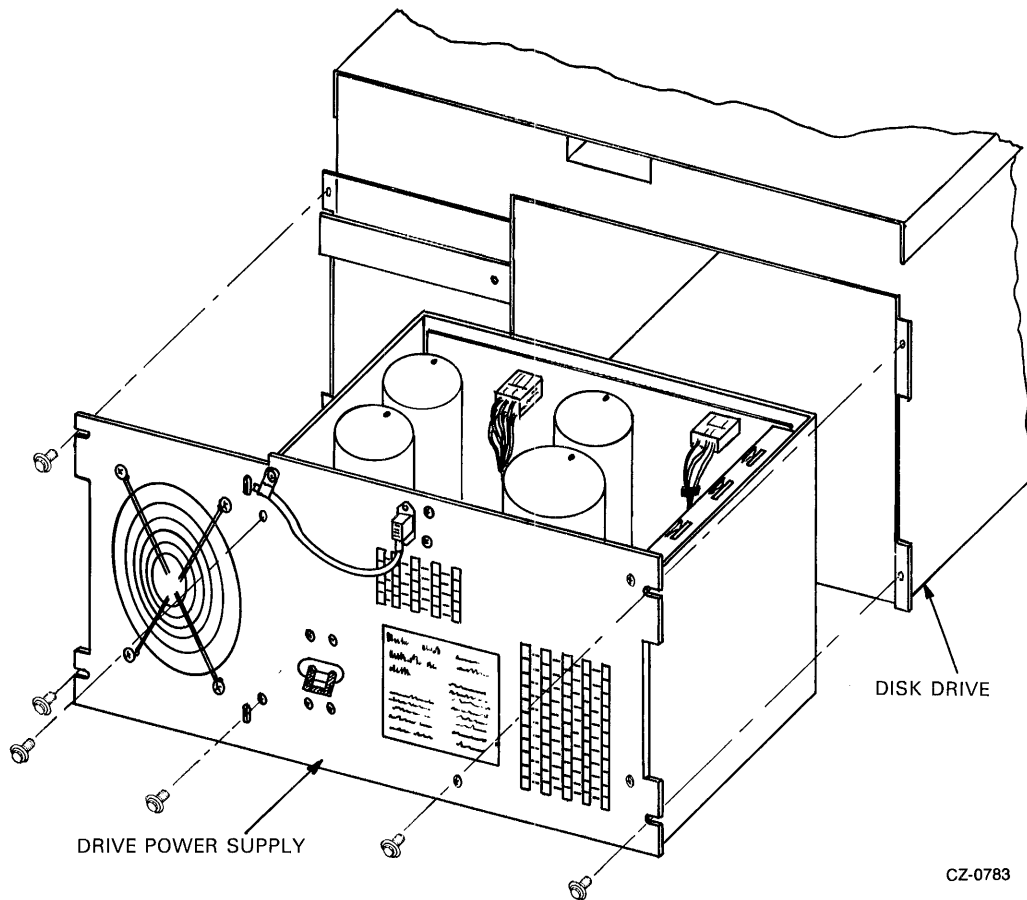


Figure 2-26 Drive Power Supply Removal

2.19 REMOVING THE POWER SUPPLY FANS

Refer to Figure 2-27 while performing this procedure.

1. Remove the drive power supply (Paragraph 2.18).
2. Unplug the black connector from the fan.
3. Remove the four screws that hold the fan in place.
4. Remove the fan guard if the rear fan is to be removed.
5. Remove the four tinnerman nuts from the old fan and mount them on the new.

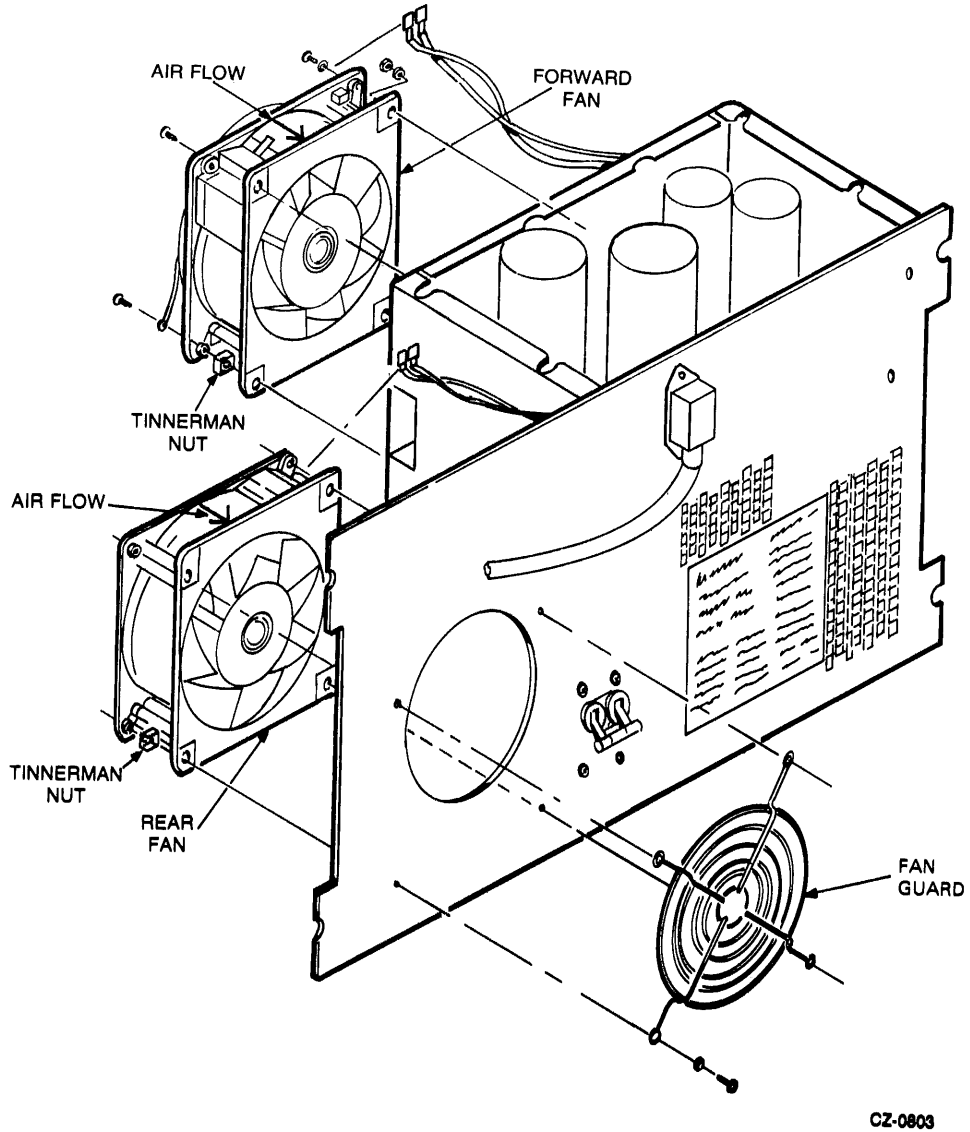


Figure 2-27 Power Supply Fan Removal

2.20 REMOVING THE HDA SPEED AND TEMPERATURE SENSORS

Refer to Figures 2-28 and 2-29 while performing this procedure.

1. Raise the drive logic chassis (Paragraph 2.10).

CAUTION

Place the HDA positioner lock in the locked position before removing the HDA

2. Remove the HDA (Paragraph 2.13).
3. Unplug connector P501 from the read/write module.
4. Remove the quick-connect terminals from the temperature sensor.
5. Remove the temperature sensor by turning it counterclockwise.
6. Remove the two screws that hold the speed transducer on the HDA.
7. Remove the speed transducer assembly.

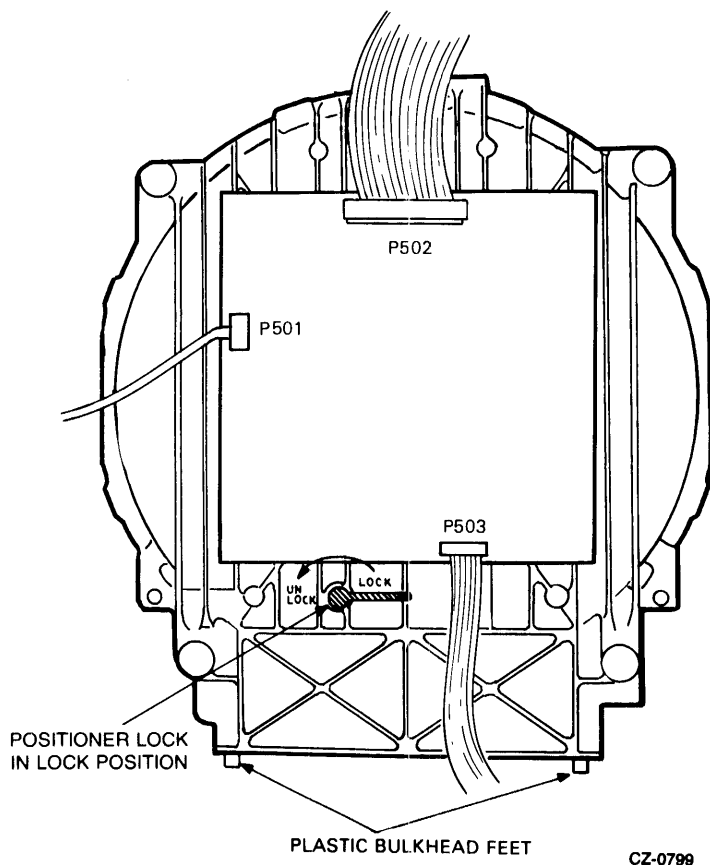


Figure 2-28 HDA and Read/Write Module

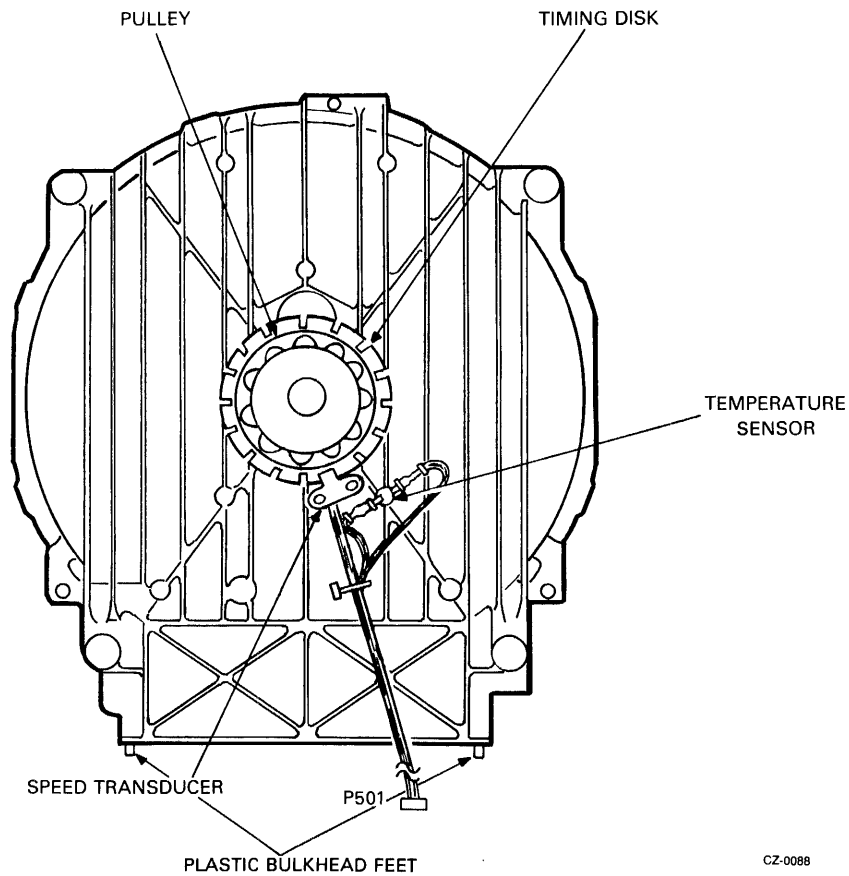
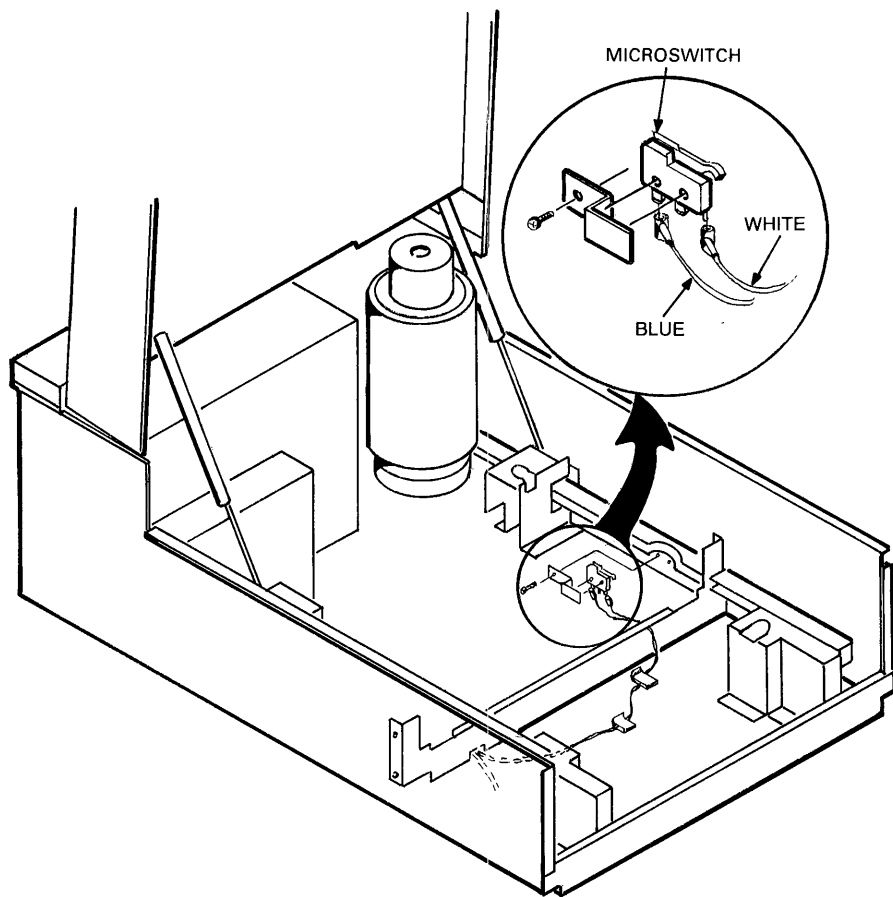


Figure 2-29 HDA Speed and Temperature Sensor

2.21 REMOVING THE BELT TENSION MICROSWITCH

Refer to Figure 2-30 while performing this procedure.

1. Remove the HDA (Paragraph 2.13.1).
2. Remove the screw that holds the belt tension switch to the side of the chassis.
3. Remove the microswitch from its bracket.
4. Unplug the blue and white quick-connect terminals from the microswitch. Replace as shown in Figure 2-30.



CZ-0185

Figure 2-30 Belt Tension Microswitch Removal

2.22 REPLACING THE SPINDLE BELT

Refer to Figure 2-31 while performing the following removal and replacement procedures.

2.22.1 Removal Procedures

1. Remove the HDA (Paragraph 2.13.1)
2. Lift belt off the motor pulley and pull it forward.

2.22.2 Replacement Procedures

1. Slide the new belt under and around the motor pulley making sure that the smooth side of the belt faces in.
2. Center the belt on the motor pulley.
3. Slide the other end of the belt over the two nylon roller bearings found on the wing pivot assembly.

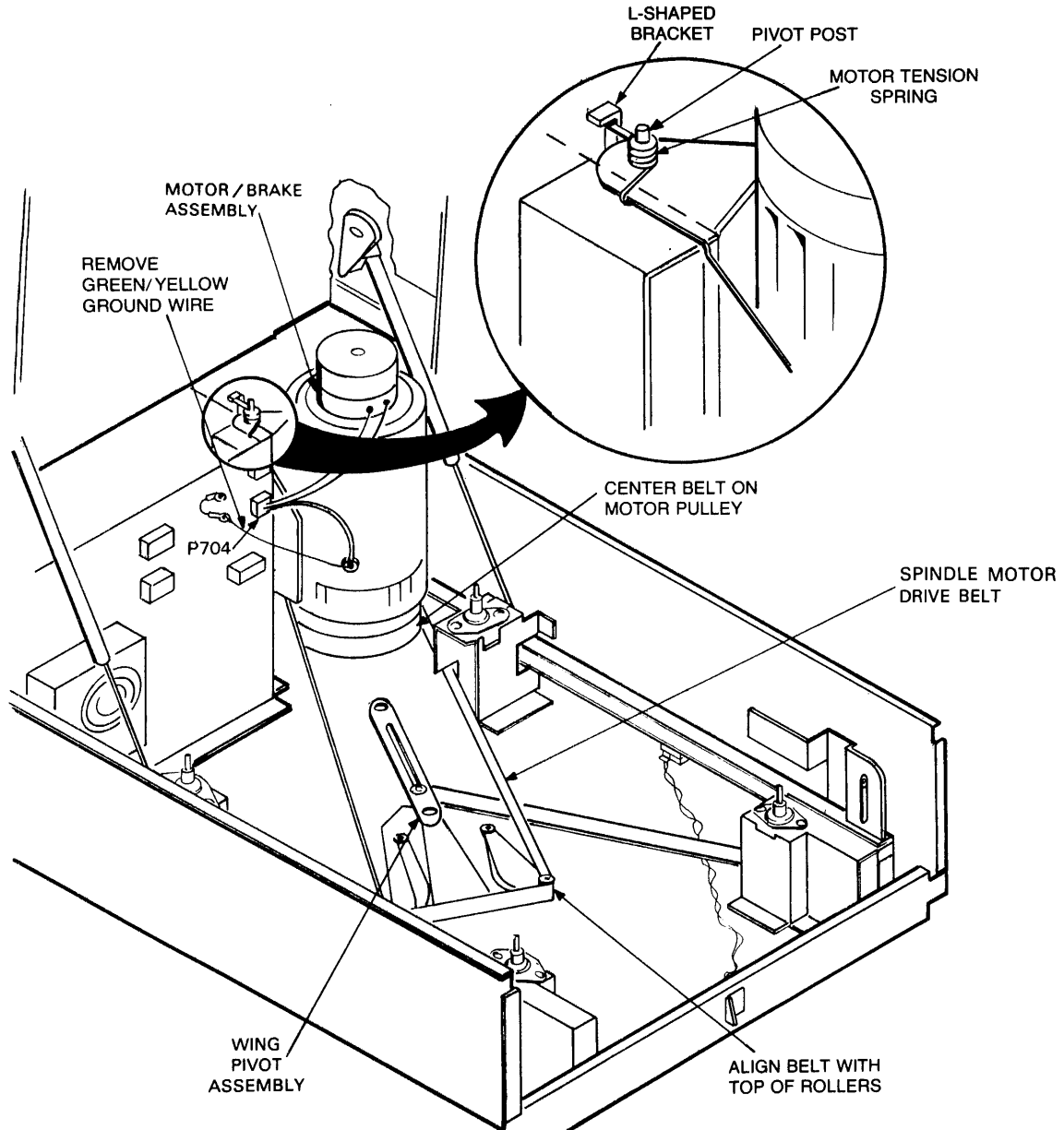
NOTE

The belt should be positioned so that the top of the belt is even with the top of the nylon rollers.

4. Replace the HDA (Pararaph 2.13.2).

2.23 REMOVING THE MOTOR/BRAKE ASSEMBLY

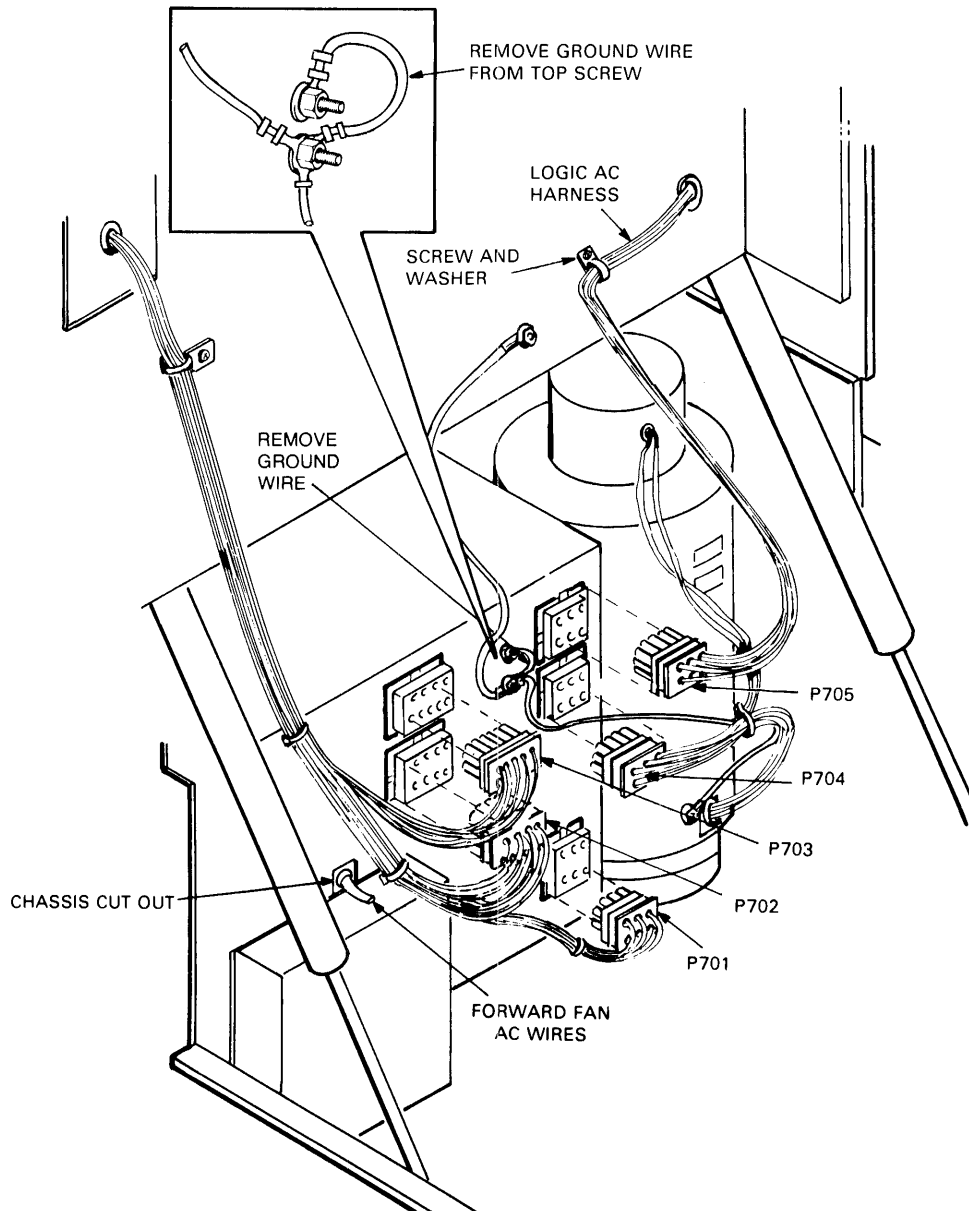
Refer to Figures 2-31 and 2-32 while performing this procedure.



CZ-0791

Figure 2-31 Belt and Motor/Brake Removal

1. Remove the HDA (Paragraph 2.13.1).
2. Remove the two hex nuts on the drive motor ground wire. The ground wire is green/yellow in color and grounds the motor to the power supply chassis.
3. Remove the drive motor ground wire from the grounding bolt.
4. Unplug connector P704 from the power supply chassis.



CZ-0633

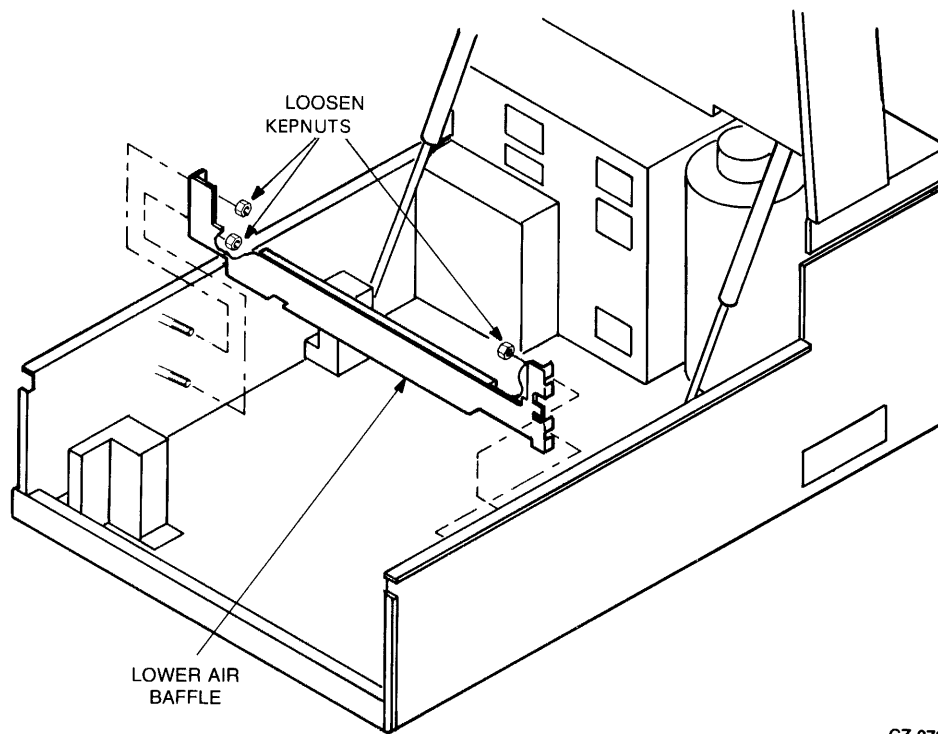
Figure 2-32 Removing the Ground Wire

5. Slide the spindle motor drive belt off the wing pivot assembly and the motor pulley (Figure 2-31).
6. Remove the drive motor tension spring. A pair of long-nosed pliers should be used to remove the spring from under the L-shaped bracket.
7. Lift the motor/brake assembly off the pivot posts.

2.24 REMOVING THE MOTOR ACTUATOR ASSEMBLY

Refer to Figures 2-33 and 2-34 while performing this procedure.

1. Remove the HDA (Paragraph 2.13.1).
2. Remove the motor/brake assembly (Paragraph 2.23).
3. Remove the four kepnuts and washers that hold the lower air baffle in place.
4. Remove the baffle.



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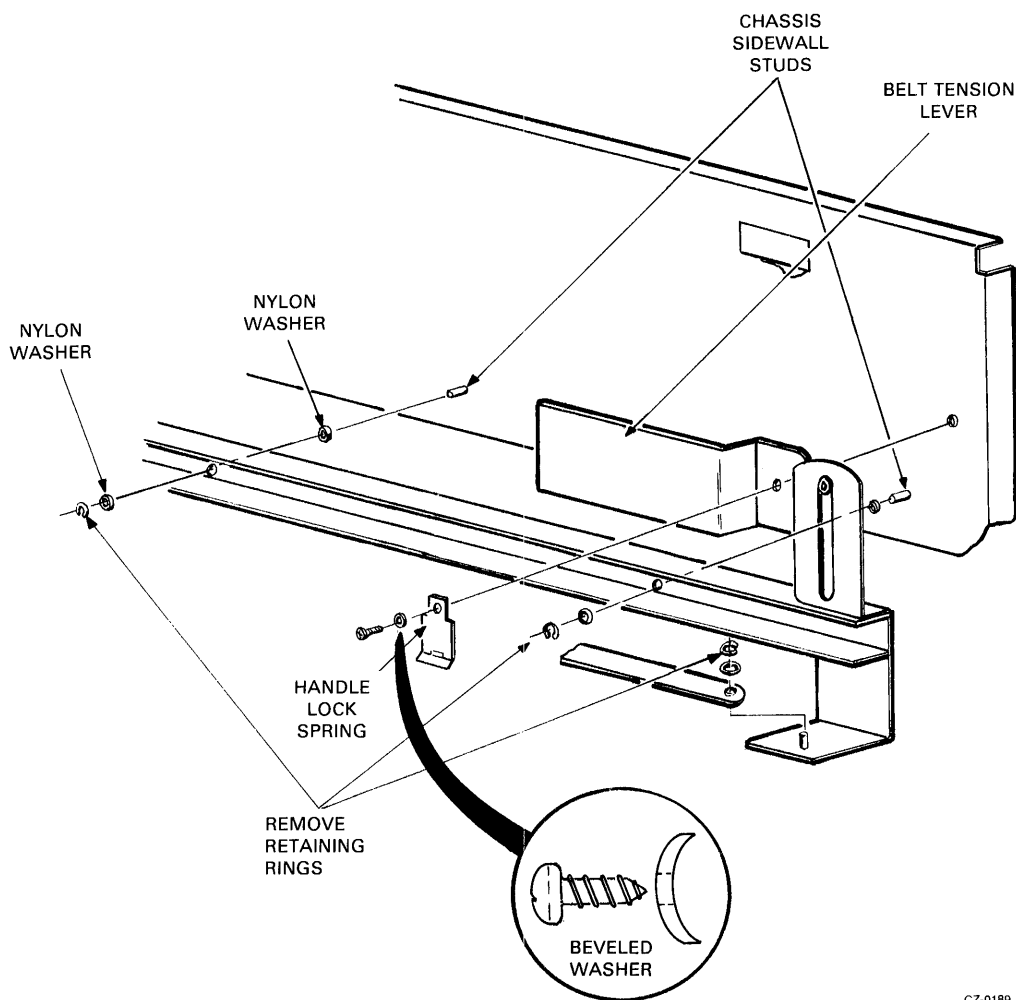
Figure 2-33 Lower Air Baffle Removal

5. Remove the three retaining rings and washers that hold the motor actuator assembly in place.
6. Remove the screw and beveled washer that hold the belt tension lever and lock spring to the chassis.

NOTE

When being replaced, the hollow side of the beveled washer should face the locking spring.

7. Slide the motor actuator assembly off the chassis sidewall studs.
8. Remove the motor actuator assembly through the front of the drive.



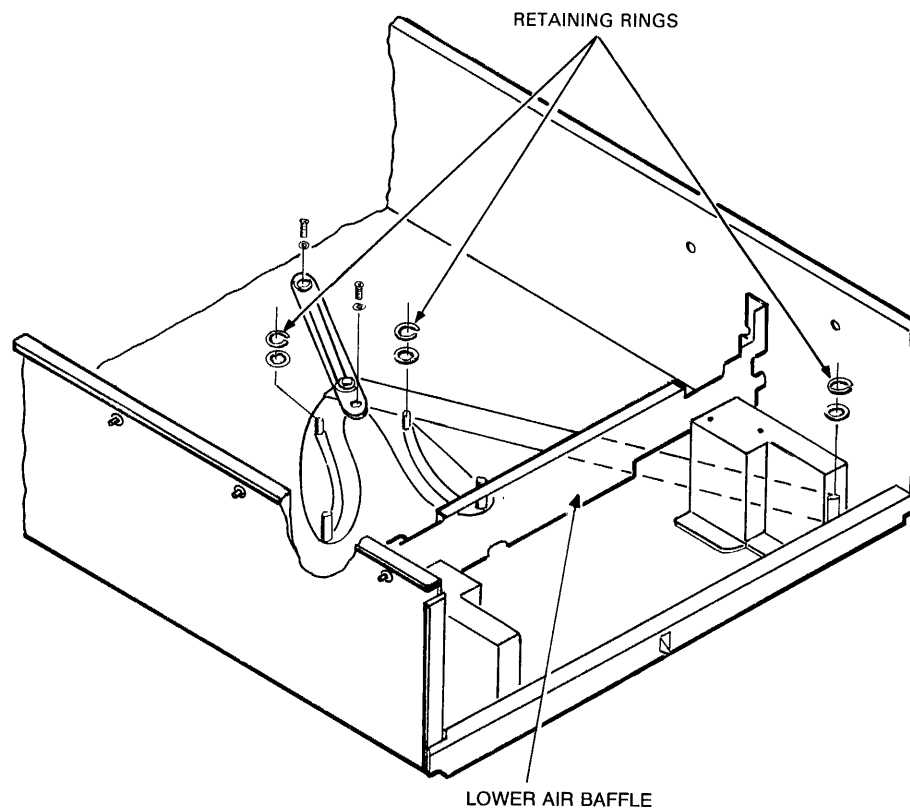
CZ-0189

Figure 2-34 Motor Actuator Assembly Removal

2.25 REMOVING THE WING PIVOT ASSEMBLY

Refer to Figure 2-35 while performing this procedure.

1. Remove the HDA (Paragraph 2.13.1).
2. Lift the belt off the wing pivot assembly.
3. Remove the two screws, three retaining rings and washers that hold the wing pivot assembly in place.
4. Lift the wing pivot assembly off the locating studs and slide it under the lower air baffle.



CZ-0190

Figure 2-35 Wing Pivot Assembly Removal

CHAPTER 3 ADJUSTMENTS

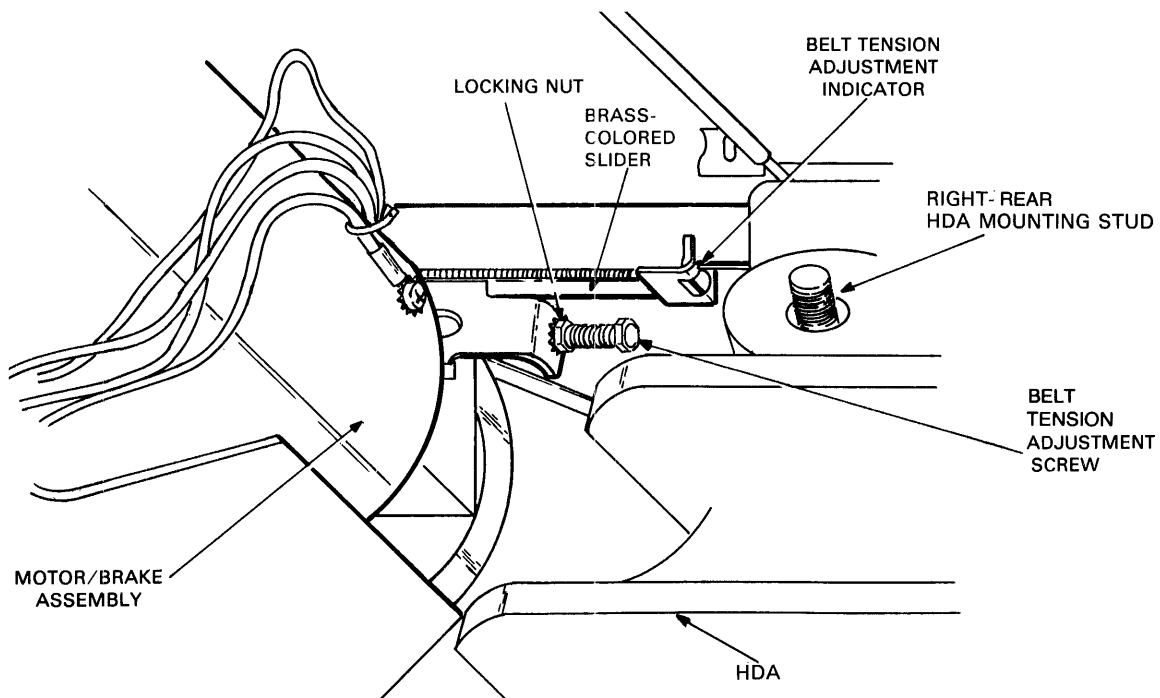
3.1 INTRODUCTION

This chapter describes the drive belt tension adjustment procedure for the RA81. This is the only field adjustment that can be performed on this drive.

3.2 BELT TENSION ADJUSTMENT

The tension on the spindle drive belt should be checked when replacing the motor, motor pulley, drive belt or HDA. Belt tension should also be checked during every service call because the drive belt stretches slightly with use. To check or adjust belt tension, perform the following procedures.

1. Place the RUN switch on the operator control panel in the OUT position to stop the spindle drive motor.
2. Raise the drive logic chassis.
3. Find the belt tension adjustment screw and brass-colored slider shown in Figure 3-1.



CZ-0790

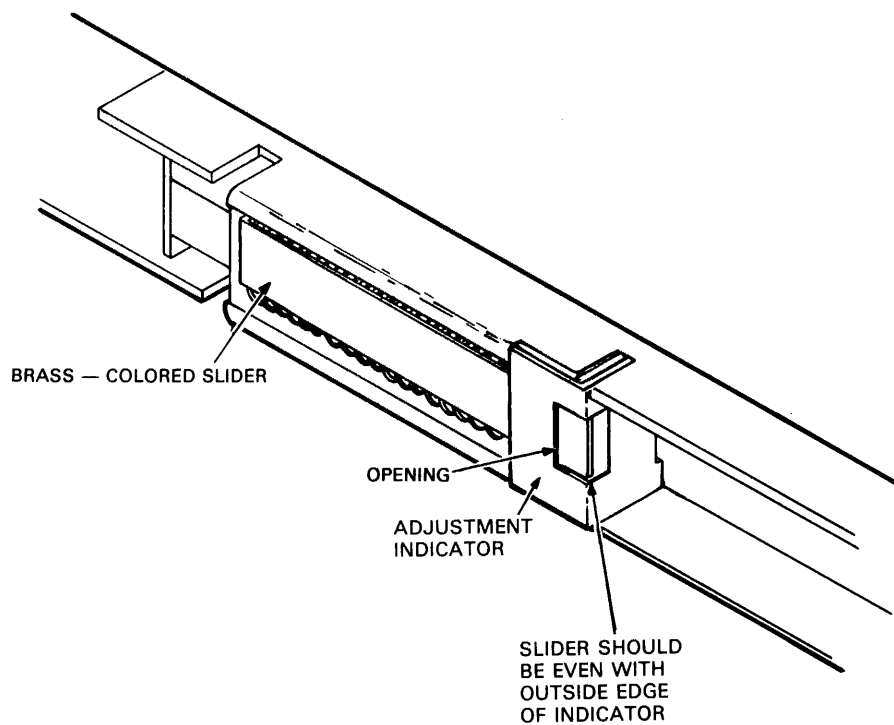
Figure 3-1 Belt Tension Adjustment Screw

4. The brass-colored slider should be even with the belt tension adjustment indicator (Figure 3-2). If not, an adjustment is necessary.

NOTE

Before performing the adjustment, make sure that the power is turned off at the ac power controller

5. Locate the belt tension adjustment locking nut using Figure 3-1.
6. Loosen the locking nut and adjust the belt tension screw until the brass-colored slider is even with the adjustment indicator. Turn the screw clockwise to move the slider forward.
7. Tighten the locking nut after the adjustment is made.
8. Restore ac power to the drive and apply power to the spindle drive motor by pushing the RUN switch to the IN position.



CZ-0782

CHAPTER 4

DRIVE-RESIDENT DIAGNOSTICS

4.1 INTRODUCTION

This chapter describes RA81 drive-resident diagnostic capabilities. Installation of the field service diagnostic terminal is described along with the various diagnostic commands. Diagnostic test descriptions are in Appendix D.

4.2 FUNCTIONAL AND DIAGNOSTIC FIRMWARE

Functional firmware and diagnostic firmware are two distinct software modules in the RA81. The functional firmware controls the spin-up cycle, seek and recalibrate commands. The functional firmware also performs fault monitoring and interface handshaking operations.

The drive is operating in an on-line mode when the functional firmware is controlling the drive operations. The drive is operating in diagnostic monitor mode when it is operating under control of the diagnostic firmware. The diagnostic firmware controls all drive-resident tests and utility programs. Paragraph 4.3.3 describes how to enter diagnostic monitor mode.

4.3 THE DIAGNOSTIC TERMINAL

A field service diagnostic terminal (Figure 4-1) is stocked with every spares kit. It utilizes a standard ASCII keyboard and an RS232 interface. Any EIA-compatible terminal set at 300 baud can be used to communicate with the drive (the drive logic defaults to 300 baud). A variety of drive diagnostic tests can be run using the terminal (paragraphs 4.4 and 4.5). The following paragraphs describe the installation of the terminal.

4.3.1 Powering Up the Drive

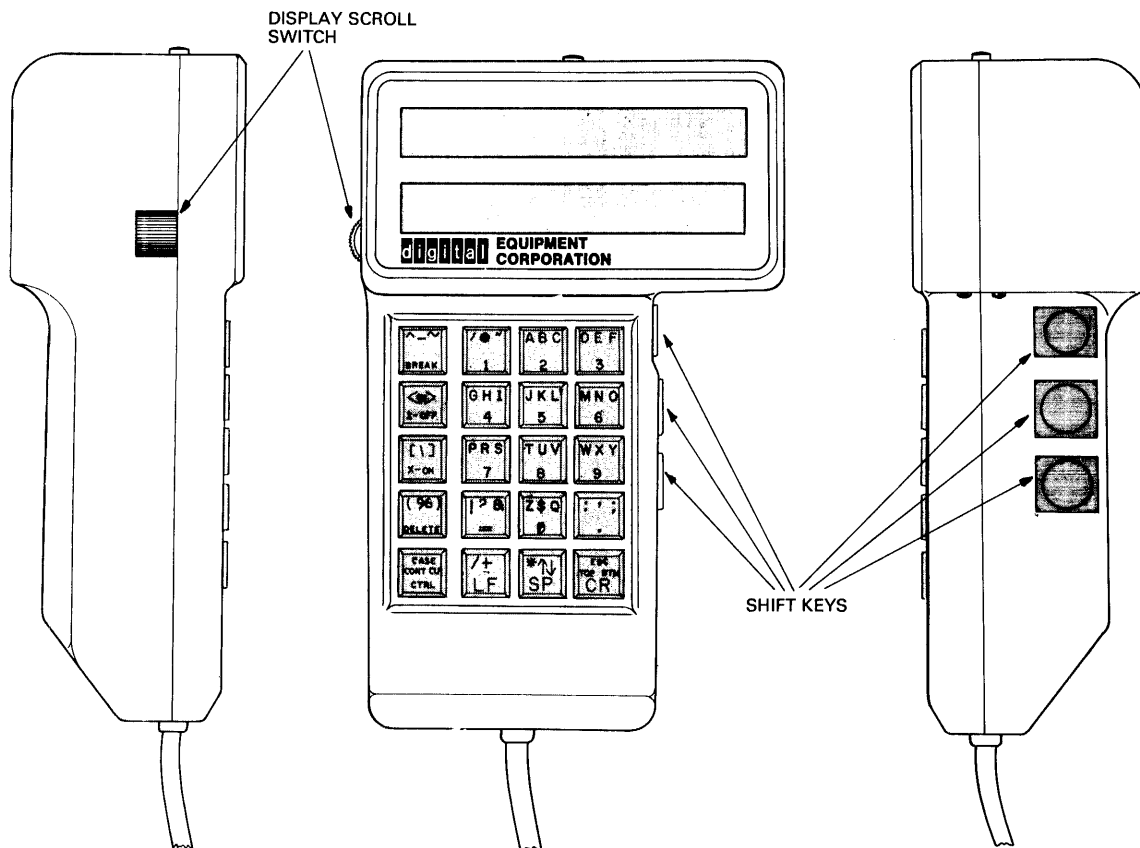
Ensure the RUN/STOP switch and both port select switches are in the OUT position. Apply power to the drive. At this time the drive runs a power-up test sequence. The sequence consists of various hardcore tests with static master logic and servo tests. Appendix B lists the various drive test sequences. The front panel lights turn on when the hardcore tests are being executed. Successful completion of the power-up sequence is indicated by the front panel lights going off in about 3-4 seconds. If any are left on, all or part of the sequence failed. Appendix F of this manual contains the front panel troubleshooting information.

4.3.2 Idle Loop Test

The drive logic proceeds to execute another test sequence called the idle loop test sequence. This test sequence is started approximately 30 seconds following the successful completion of the hardcore test sequence (provided the port select switches are in the OUT position). The idle loop test takes about 30 seconds to run. The microprocessor LEDs display a hexadecimal E7 during the execution of the idle loop test sequence. Errors are reported through the front panel indicators. (See Appendix F for troubleshooting.) The idle loop test sequence repeats as long as the drive switches are not changed or diagnostic mode is not entered. The idle loop test sequence may halt if a front-panel switch is pushed.

The following paragraphs describe the action of the idle loop testing when a switch is pushed.

- Write Protect - The drive logic stops testing and lights the write protect light. The drive then becomes READY. After a 10 to 20 second delay, the READY light goes out and the idle loop testing is resumed.
- Fault - This switch is ignored during idle loop testing.
- Port Select Switches - If either or both of these switches are pushed, idle loop testing stops and the drive logic exits monitor mode.
- Run (Spun Down) - If the drive is spun down when this button is pushed, the current idle loop test completes. Following completion, the HDA is spun up. Idle loop testing resumes following the spin-up test sequence.
- Run (Spun Up) - If the drive is spun up when this button is pushed, the current idle loop test completes. Following completion, the HDA is spun down. Idle loop testing resumes following a delay of 10 to 20 seconds.



CZ-0768

Figure 4-1 Field Service Diagnostic Terminal

4.3.3 Installing the Terminal on an RA81 Disk Drive

To use the diagnostic terminal, diagnostic monitor mode must be entered. The drive does not respond to the keyboard until both port select switches on the drive are in the OUT position. If either switch is IN, the drive is in the available state awaiting a command from the controller.

An interface cable connects to the microprocessor module via a connector located in the center of the module. The connector is keyed so that the cable may be inserted in only one direction (Figure 4-2). The interface cable is routed to a connector bulkhead located on the motor start capacitor compartment. The bulkhead contains a D-subminiature connector used to cable the terminal to the drive. Alongside the connector is a power connector for the field service terminal.

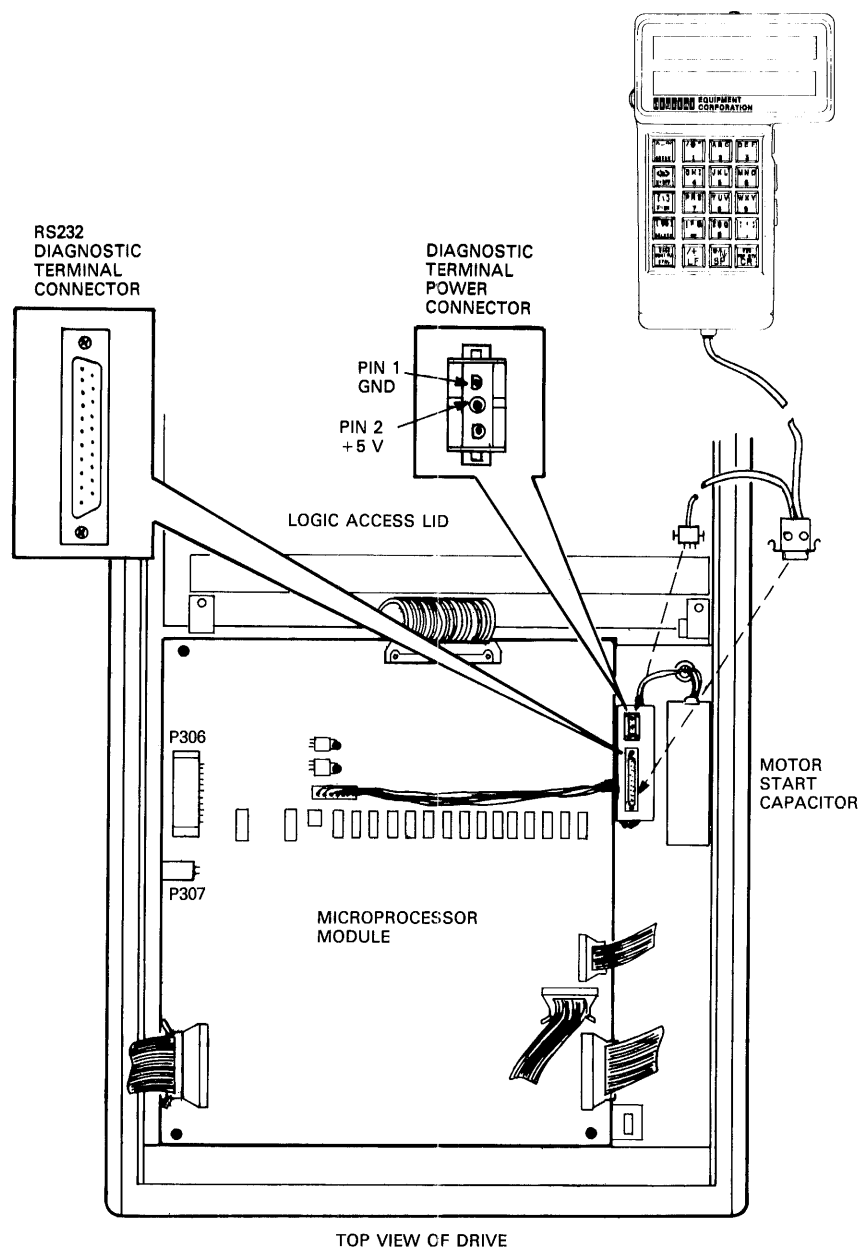


Figure 4-2 Diagnostic Terminal Connections

Once the cable is connected, key in a CTRL C (⌘C) on the terminal keyboard. The terminal responds to the ⌘C with the diagnostic prompt RA81>.

NOTE

If the field service diagnostic terminal is cabled to the drive during the execution of the drive idle loop tests, the prompt is not displayed until the testing is completed. During the execution of the idle loop test sequence, the terminal displays the following:

%RA81-COMPLETED TEST: SUBTEST:xx

Next, key in a continue (CONT) on the terminal keyboard. This disables the automatic X-On, X-Off feature allowing the testing to be continuous.

Upon display of the diagnostic prompt, user diagnostic testing may be run by keying in one of ten diagnostic commands. These commands are described in the following paragraphs.

4.4 DIAGNOSTIC COMMAND SELECTION

Table 4-1 lists the diagnostic commands and their abbreviations. The utility commands that are recognized by the drive are described in Paragraph 4.5.

Table 4-1 Diagnostic Commands

Command Name	Abbreviation
Run Diagnostics	RUN DIAG
Run Seek	RUN SEEK
Run Recalibrate	RUN RECA
Run Read/Write	RUN READ
Run Servo	RUN SERV
Run Interface	RUN INTE
Run Alternate	RUN ALTE
Run Random	RUN RAND
Run Incremental	RUN INCR
Run Diagnostic Test=xx	RUN DIAG TEST=xx

Note that each of the commands may be abbreviated to the first four letters with the exception of RUN DIAGNOSTIC TEST. In this command the word TEST=xx must be present in order to request that a particular test be run. See Appendix C for the test selection list.

When any command is miskeyed, spelled wrong, or if the word RUN is not input first, the terminal responds with an audible tone and displays the following:

COMMAND NOT FOUND

4.4.1 Run Diag

This command may be used on two different occasions:

1. When the drive has power applied but does not have the run switch pushed.
2. When the drive has power applied but the run switch is pushed.

4.4.1.1 Spun Down – In this mode the terminal causes the drive logic to perform an entire drive checkout sequence. The drive determines the test selection when in this mode. In this case the drive is spun down and will run the appropriate series of subtests. Appendix B lists the tests run in this sequence and Appendix D lists the test display fault codes.

As the drive test sequence progresses, the following responses are displayed by the terminal.

```
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
-      -      -      -
-      -      -      -
-      -      -      -
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
RA81>
```

The above response shows that no errors were encountered in any of the subtests executed. At the completion of the drive sequence test, the prompt returns and other tests may be requested. Error reporting is covered in paragraph 4.6.

4.4.1.2 Spun Up – This mode causes a new sequence of tests to be run to check out areas of logic that were not previously accessible. As the drive sequence progresses, the terminal displays a series of messages identical to that of the spun-down sequence. The return of the prompt RA81> signifies the successful completion of the sequence (in about 7 minutes). Other tests may be requested or the monitor mode may be exited. Appendix B lists the tests run in this sequence, and Appendix D lists the test fault codes.

4.4.2 Run Reca

This command may be executed following a spinup cycle. The test causes the drive to position and keep the read/write heads over track 0. At the completion of the recalibration, the terminal displays the following:

```
%RA81-COMPLETED TEST:RECA SUBTEST:xx
RA81>
```

Any errors in the execution of the command are reported in the manner described in paragraph 4.6.

4.4.3 Run Seek

This command may be executed following a spinup cycle. The test causes a single seek to be performed to a user-specified cylinder. Respond to the following prompts with a decimal cylinder address and a group (R/W head) address. The maximum values are 1257 and 13, respectively.

```
ENDING CYLINDER?
```

```
GROUP?
```

At the completion of the seek, the terminal displays the following:

```
COMPLETED  
RA81>
```

Errors in the execution of the seek are reported in the manner described in paragraph 4.6.

4.4.4 Run Read

This command may be executed following a spinup cycle. The test causes the drive to execute the entire read/write test sequence. Appendix B lists the tests run in this sequence, and Appendix E lists the fault display codes. At the completion of the sequence (about one and one-half minutes), the terminal returns with the diagnostic prompt. Any errors in the execution of the sequence are reported in the manner described in paragraph 4.6. While the drive is running these tests, the terminal displays the following messages.

```
%RA81-COMPLETED TEST:READ SUBTEST:xx  
- - - -  
- - - -  
- - - -  
- - - -  
%RA81-COMPLETED TEST:READ SUBTEST:xx  
RA81>
```

4.4.5 Run Serv

This command may be executed following a spinup cycle. The test causes the drive to execute the entire servo test sequence. Appendix B lists the tests run in this sequence and Appendix E lists the test fault display codes. At the completion of the sequence (about four and one-half minutes), the terminal returns with the diagnostic prompt. Any errors in the execution of the sequence are reported in the manner described in paragraph 4.6. While the drive is executing these tests, the terminal displays the following messages.

```
%RA81-COMPLETED TEST:SERV SUBTEST:xx  
- - - -  
- - - -  
- - - -  
%RA81-COMPLETED TEST:SERV SUBTEST:xx  
RA81>
```


4.4.6 Run Inte

This command causes the drive to execute the disk interface test. The drive must be spun down for this sequence to be executed. At the completion of the test the terminal returns with the diagnostic prompt. Any errors in the execution of the sequence are reported in the manner described in paragraph 4.6. While the tests are being executed, the terminal displays the following message.

```
%RA81-COMPLETED TEST:INTE SUBTEST:xx  
RA81>
```

4.4.7 Run Alte

This command may be executed following a spinup cycle. The test causes the drive to perform alternating seeks. The terminal requests the user to key in the starting and ending cylinder addresses in decimal (0-1257).

```
STARTING CYLINDER?  
ENDING CYLINDER?
```

At the completion of the alternating seek test, the terminal displays the following:

```
%RA81-COMPLETED TEST:ALTE SUBTEST:xx  
RA81>
```

Any errors in the execution of the seeks are reported in the manner described in paragraph 4.6.

4.4.8 Run Rand

This command may be executed following a spinup cycle. The test causes the drive to execute the random seek test. The user does not specify the starting and ending cylinders. A random number table is used to calculate the cylinder addresses used by the test. At the completion of the seeks, the terminal displays the following:

```
%RA81-COMPLETED TEST:RAND SUBTEST:xx  
RA81>
```

Any errors in the execution of the seeks are reported in the manner described in paragraph 4.6.

4.4.9 Run Incr

This command may be executed following a spinup cycle. The test causes the drive to execute an incremental seek test. The terminal requests the user to specify the lower and upper cylinder addresses (0-1257 decimal). The drive then seeks between the lower address and the upper, incrementing the lower cylinder address by one until the upper cylinder address is reached. Recalibrates are performed between each of the seeks.

```
STARTING CYLINDER?  
ENDING CYLINDER?
```

At the completion of the incremental seeks, the terminal displays the following:

```
%RA81-COMPLETED TEST:INCR SUBTEST:XX  
RA81>
```

4.4.10 Run Diag Test=xx

This command enables the user to run the test specified by xx. Appendix D describes the tests that may be requested with this command. If the test selection entered under the RUN DIAG/TEST=xx is not available or not defined on the RA81 drive, the terminal responds with the following display.

```
%RA81-TEST:DIAG SUBTEST:xx ERROR:EE UNIT:xx  
%RA81-FRU-TEST NOT AVAILABLE
```

After executing the selected test, the terminal displays the following:

```
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
```

NOTE

A portion of the drive-resident tests may be run under control of the subsystem diagnostics. Appendix C, Table C-1, lists the tests and test select codes that may be requested with the host-resident diagnostics.

4.5 DIAGNOSTIC MONITOR UTILITY COMMANDS

Table 4-2 lists the utility commands for the diagnostic monitor. The paragraphs that follow describe each of these commands.

Table 4-2 Diagnostic Monitor Utility Commands

Command Name	Abbreviation
Help	HELP
Set Diagnostic Loop xxxx	SET DIAG LOOP xxxx
Set Terminal Speed=xxxx	SET TERM SPEED=XXXX
Show Radix	SHOW RADI
Show Version	SHOW VERS
Show Device	SHOW DEVI
Show Terminal Speed	SHOW TERM SPEED
Show Diagnostic Loop	SHOW DIAG LOOP
Show Diagnostic Faults	SHOW DIAG FAUL
Show Diagnostic Status xxxx	SHOW DIAG STAT xxxx
Show Diagnostic Memory xxxx=aaaa	SHOW DIAG MEMO xxxx=aaaa
Exit	EXIT

4.5.1 Help

This command causes the terminal to display a list of all the possible diagnostic and utility commands.

4.5.2 Set Diag Loop xxxx

This command causes the drive to run the desired test (input with the RUN DIAG TEST=xx command) in one of three loop modes available. The user specifies the type of diagnostic loop by inputting one of the following in the xxxx field.

4.5.2.1 On – Typing this word in the xxxx field causes the diagnostic subtest to loop until a CTRL C (⌘C) is input.

4.5.2.2 Off – Typing this word in the xxxx field causes the drive to run the diagnostic once and then stop.

NOTE

Off is the default if no other loop mode is set. If a loop mode is set, it stays in that mode for every test executed until one of the following actions take place:

- 1. The user specifies a new loop mode**
- 2. The user exits the diagnostic monitor and re-enters it**
- 3. The user spins down the drive and then spins it back up**

4.5.2.3 Halt – Typing this word in the xxxx field causes the test to be run until an error is encountered. At this point the testing stops, the error is reported, and the terminal display returns with the diagnostic prompt.

4.5.3 Set Term Speed=xxxx

This command instructs the drive to change the baud rate to that specified by xxxx in the input sequence. The terminal displays the following message if the rate asked for is not available.

```
SELECT 300 OR 1200 BAUD ONLY
```

The default baud rate for the drive logic is 300. The RA81 drive logic can also handle the 1200 baud rate. The field service diagnostic terminal can only handle 300 baud. If 1200 baud is requested by the 300-baud terminal, communications will be discontinued until the drive is powered down and then back up.

4.5.4 Show Radi

This command causes the diagnostic terminal to display the base of all numeric displays. The terminal displays the following when this command is executed.

```
TEST SELECT CODES, MEMORY ADDRESS ENTRIES  
AND MEMORY DUMPS ARE HEX.  
ALL REV NUMBERS, UNIT , SER AND CYLINDER  
NUMBER ENTRIES ARE DECIMAL
```

4.5.5 Show Vers

This command causes the diagnostic terminal to display the microcode, hardware, and SDI versions of the drive. The terminal displays the following when this command is executed.

```
MICROCODE REVISION:xxxx  
HARDWARE REVISION:xxx  
SDI REVISION:xxx
```

4.5.6 Show Devi

This command displays the drive serial and unit numbers. The terminal displays the following when this command is executed.

```
DRIVE SERIAL :xxxxxxx  
UNIT :xxx
```

4.5.7 Show Term Speed

This command causes the diagnostic terminal to display the baud rate the drive is presently using to communicate with the monitor.

4.5.8 Show Diag Loop

This command causes the diagnostic terminal to display the diagnostic loop mode the drive is presently in. The terminal displays the following when this command is executed.

LOOP MODE IS (HALT ON ERROR or DN or OFF)

4.5.9 Show Diag Faul

This command causes the diagnostic terminal to display the last 16 HEX error codes stored in memory.

4.5.10 Show Diag Stat xxxx

This command causes the diagnostic terminal to display up to 32 bytes of diagnostic status. The xxxx field of the command specifies if the master (MAST) or slave (SLAV) processor RAMs will be displayed. Figure 4-3 shows the status results of the MAST RAM while Figure 4-4 shows the results of the SLAV RAM.

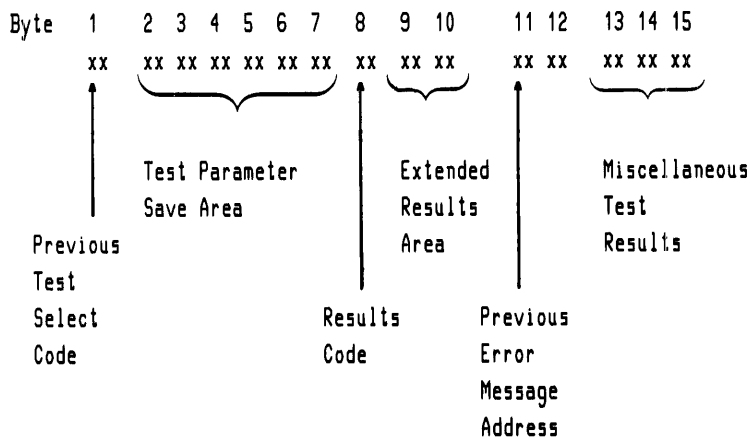


Figure 4-3 Master RAM Status

NOTE
Bits 16 through 32 are not used.

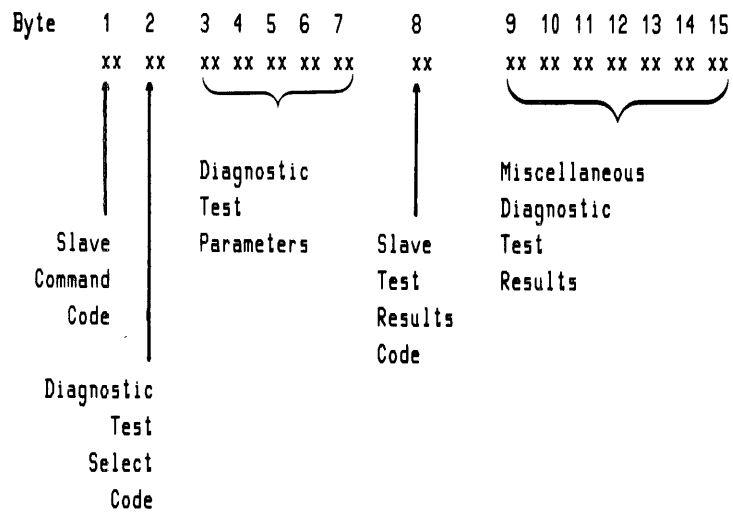


Figure 4-4 Slave RAM Status

NOTE

Bytes 16 through 32 are not used.

NOTE

The display from a show command that reads from the 8080/8085 microprocessor memory is in hexadecimal format. When requesting a specific memory address the address must also be hexadecimal.

4.5.11 Show Diag Memo xxxx=aaaa

This command causes the diagnostic terminal to display 32 bytes of memory. The xxxx field of the command specifies the master (MAST) or slave (SLAVE) processor memory to be displayed. The aaaa field of the command specifies the starting memory address to be displayed.

4.5.12 Exit

This command causes the drive to leave diagnostic monitor mode and enter into the drive off-line mode. The drive then executes the drive idle loop sequence. Errors are reported through the front panel indicators. The diagnostic prompt is not displayed while in this mode. The following will be shown on the terminal:

```

RAB1> EXIT
EXITING THE MONITOR

```

4.6 DIAGNOSTIC ERROR REPORTS

If one of the tests fail, the terminal displays the following.

```
%RA81-TEST:aaaa SUBTEST:xx ERROR:xx UNIT:xxx
%RA81-FRU- (an FRU callout list is printed here)
OR
%RA81-FRU- (instructions to fix the specific fault)
```

Depending on the loop mode that is set, the drive either continues running the sequence or halts on the error. Paragraph 4.5.2 describes the loop mode settings. If the sequence is finished, or halts on an error, or is taken out of loop mode, the diagnostic prompt is then displayed.

4.7 EXITING DIAGNOSTIC MONITOR MODE

The following three methods may be used to exit diagnostic monitor mode and make the drive available to a controller:

1. The command EXIT (described in paragraph 4.5.12) may be typed on terminal.
2. A control Z (↑Z) may be input. The terminal then displays the following message:
3. The port select switches may be pushed. By pushing one or both of them, the diagnostic monitor mode is automatically terminated. The following message is displayed when exiting:

```
FRONT PANEL FUNCTION IN PROGRESS
RA81> EXITING THE MONITOR
```

CHAPTER 5 FAULT ISOLATION

5.1 INTRODUCTION

This chapter describes RA81 fault isolation procedures. It contains a description of the subsystem drive error messages, troubleshooting tips and drive checkout procedures. Error code troubleshooting charts are found in the appendices.

5.2 SUBSYSTEM ERROR MESSAGE INFORMATION

Subsystem error messages that are printed out in either the system error log or by the diagnostics contain controller error as well as specific drive error information. Figure 5-1 shows a sample error printout.

```
CZUDC HRD ERR 00044 ON UNIT 00 TST 004 SUB 000 PC:021044
DISK EXERCISER DM PC:5110 UDA AT 172150 DRIVE 032 RUNTIME 0:00:23
ENTIRE RCT AREA SEARCHED, COULD NOT FIND RBN TO REPLACE
LBN WITH HEADER COMPARE ERROR
SEARCHING FOR LBN: 900
CZUDC SFT ERR 00006 ON UNIT 00 TST 004 SUB 000 PC: 021044
DISK EXERCISER DM PC: 5324 UDA AT 172150 DRIVE 032 RUNTIME 0:00:37
TIMEOUT OF DRIVE DURING WRITE ATTEMPT
WRITE ATTEMPT RETRIES: 0
L/DBN NUMBER 5252
ACTUAL L/R/DBN 0
TRK 1 CRP 0 CYL 6
ORIGIN OF LAST SEEK WAS CYL 5 GROUP 1
REAL TIME DRIVE STATE 8001
STATUS: 0001 1100 0000 0A00 0000 0613 1020
```

Figure 5-1 Subsystem Error Message Sample

5.2.1 Error Message Status Line Interpretation

The status line found in the error message (Figure 5-1) is the result of a get status command. The diagnostic performs get status commands in the reporting of certain error messages. Fourteen of a possible fifteen status bytes are printed out by the error message routine as shown by the sample printout.

Figure 5-2 locates the RA81 drive-specific status bytes of the error message. Bytes 2 through 8 are controller specific error/status information. Refer to the appropriate controller manual for a description of these bytes. Note in Figure 5-2 that the first byte is not printed out. The first byte is a response code to the get status command and is therefore not needed in the error report. The RA81 drive-specific status bytes are 9 through 15. Table 5-1 describes the contents of each RA81 status byte.

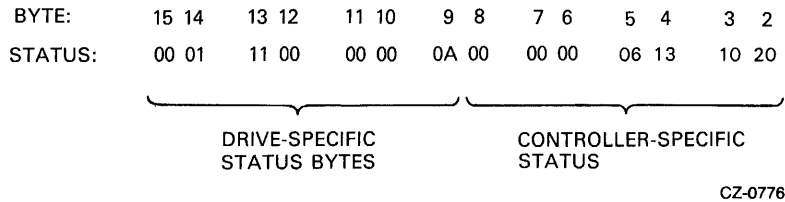
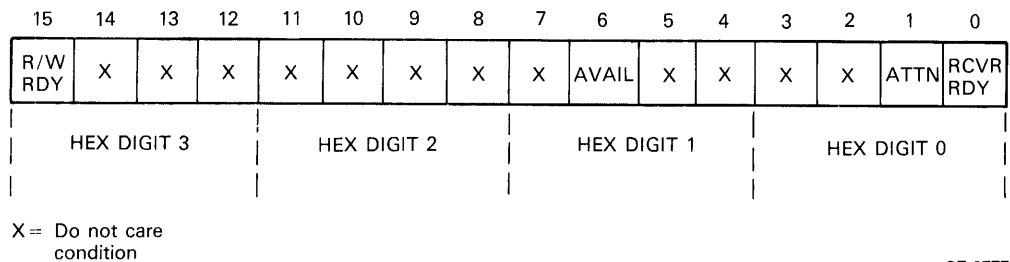


Figure 5-2 Drive-Specific Status Location

5.2.2 Real-Time Drive State Message Interpretation

The real-time drive state (RTDS) is represented by the line preceding the status in the error message. The RTDS consists of four hexadecimal digits. In the sample printout found in Figure 5-1, the code is 8001. Only four state bits within the four hexadecimal digits are of value to the field service engineer. The rest of the bits are transitory and are therefore masked out before the RTDS message is printed. The location of these four state bits within the hexadecimal code is shown in Figure 5-3. Paragraphs 5.2.2.1 through 5.2.2.4 describe the four RTDS state bits.



5.2.2.1 Read/write ready (R/W RDY) – The R/W RDY bit indicates that the drive is capable of performing a data transfer to or from the disk surface. Any seek operation negates this signal.

5.2.2.2 Drive available (AVAIL) – The interpretation of the AVAIL bit requires an understanding of what is meant by the terms drive on-line, drive off-line, and drive unavailable. Definitions of the drive available states follow.

- Drive off-line - The drive is not operational and may not communicate with either controller via the drive control protocol.
- Drive on-line - The drive is dedicated to the exclusive use of one of the controllers in a dual-controller subsystem. The drive is not available to the controller on the other port.
- Drive unavailable - The drive is in a drive on-line state to the controller on the other port. A drive in this state may at times communicate with, but may not be fully utilized by, the controller on this port.

- Drive available - The drive is not currently in a drive on-line state to either of the controllers in a dual controller configuration. A drive in this state is capable of executing an on-line command to either controller.

Table 5-1 RA81 Status Bytes

Byte	Description
9	This byte contains the controller command function code last executed.
10	<p>This byte contains SDI error status bits 3, 4, 5, 7.</p> <ul style="list-style-type: none"> • Bit 3 (overflow error) - This bit sets when either a read or a write command extends past the sector or index pulse that the operations started from. • Bit 4 (parity error found) - This bit sets when a parity error is discovered during the transmission of a real-time command on the real-time controller state line. The real-time controller state line of the SDI bus carries the following four commands to the selected drive: <ol style="list-style-type: none"> 1. Init 2. Read gate 3. Write gate 4. Receiver ready • Bit 5 (control pulse error) - This bit sets during the transmission of a real-time command if two or more pulses of the same polarity are detected on the real-time controller state line. • Bit 7 (data pulse error) - This bit sets during the transmission of a real-time command if two or more pulses of the same polarity are detected on the write command data line.
11	This byte contains the low order bits of the cylinder address of the last seek operation.
12	This byte contains the high order bits of the cylinder address of the last seek operation.
13	This byte contains the present RA81 group address. An RA81 group is defined as one of the 14 addressable read/write heads (0-13 decimal).
14	This byte contains the hexadecimal error codes that are displayed by the diagnostic terminal or microprocessor LEDs during the execution of drive-resident diagnostics. Refer to Appendix E.
15	This byte contains the hexadecimal codes representing the front panel fault indicators. Refer to Appendix F.

5.2.2.3 Attention (ATTN) – A drive in the drive on-line state asserts this signal whenever any of the generic status bits change state. The generic status bits are found in bytes four, five, and six of the get status command response.

5.2.2.4 Receiver ready (RCVR RDY) – The RCVR RDY bit indicates that the drive is ready to receive a command on the write/command data line of the SDI bus. RCVR RDY drops while the drive is processing a command.

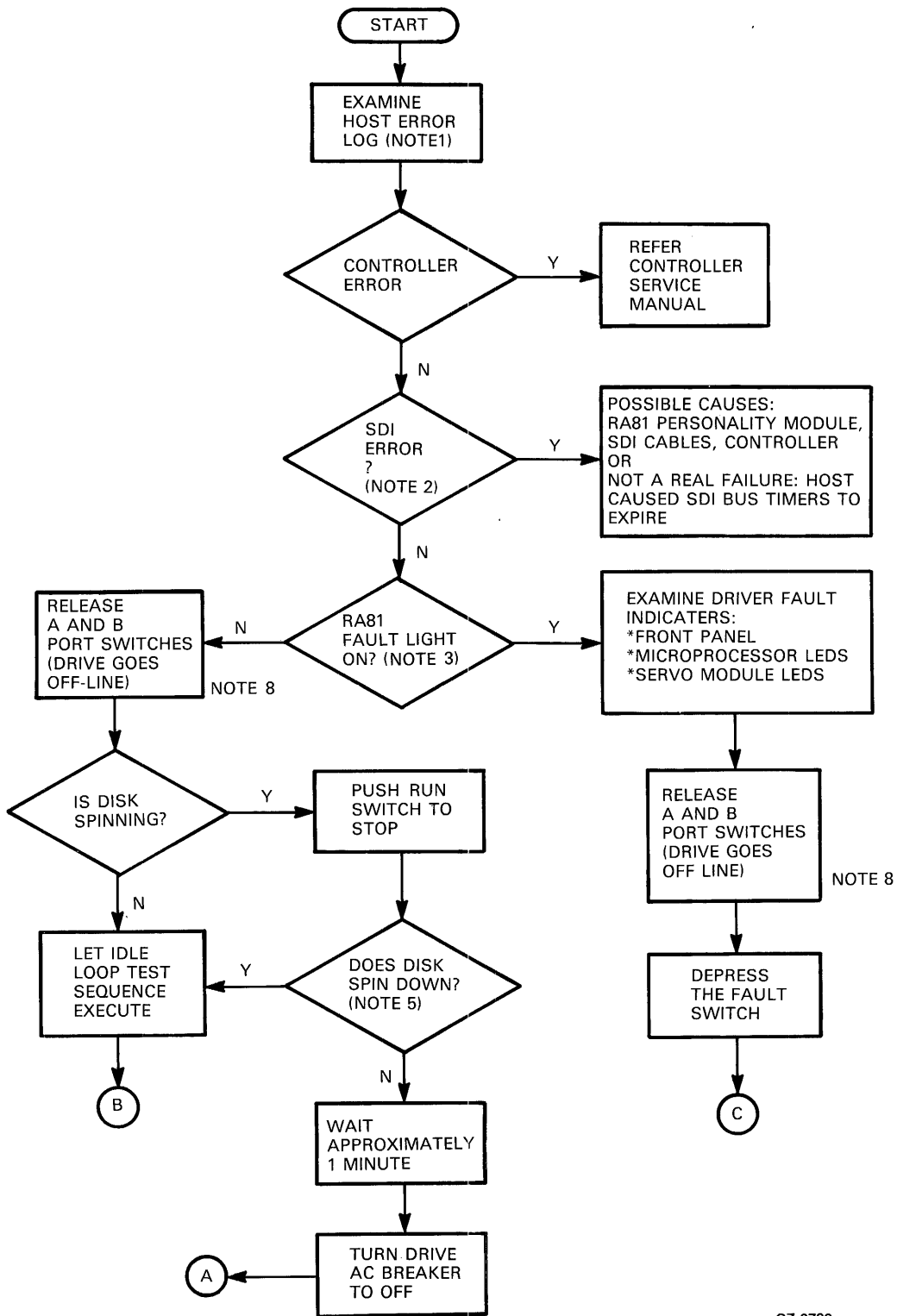
5.3 TROUBLESHOOTING PROCEDURES AND TIPS

The following paragraphs describe general troubleshooting tips that may be useful when performing RA81 drive fault isolation.

- When the host-resident diagnostics are used, the resultant error message contains a drive error code. Byte 14 of the error message status line (paragraph 5.2.1) contains the error code. Look up the error code in Appendix G to define the failing FRU. Appendix E may then be used to look up the name of the error, if needed.
- When the error code is displayed by the front panel lights, use Appendix F, Table F-1, to encode the displayed light pattern into a drive error name. Errors from the front panel should be translated into a specific error code by observing the microprocessor LEDs. Once a specific error code is obtained, refer to Appendix G for a suggested FRU replacement.
- When the field service diagnostic terminal is used, it displays instructions for FRU replacement.

NOTE

No matter which procedure is used, the drive may have to be cycled down with the use of CB1 if the servo module is bad.



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Figure 5-4 RA81 Drive Troubleshooting (Sheet 1 of 7)

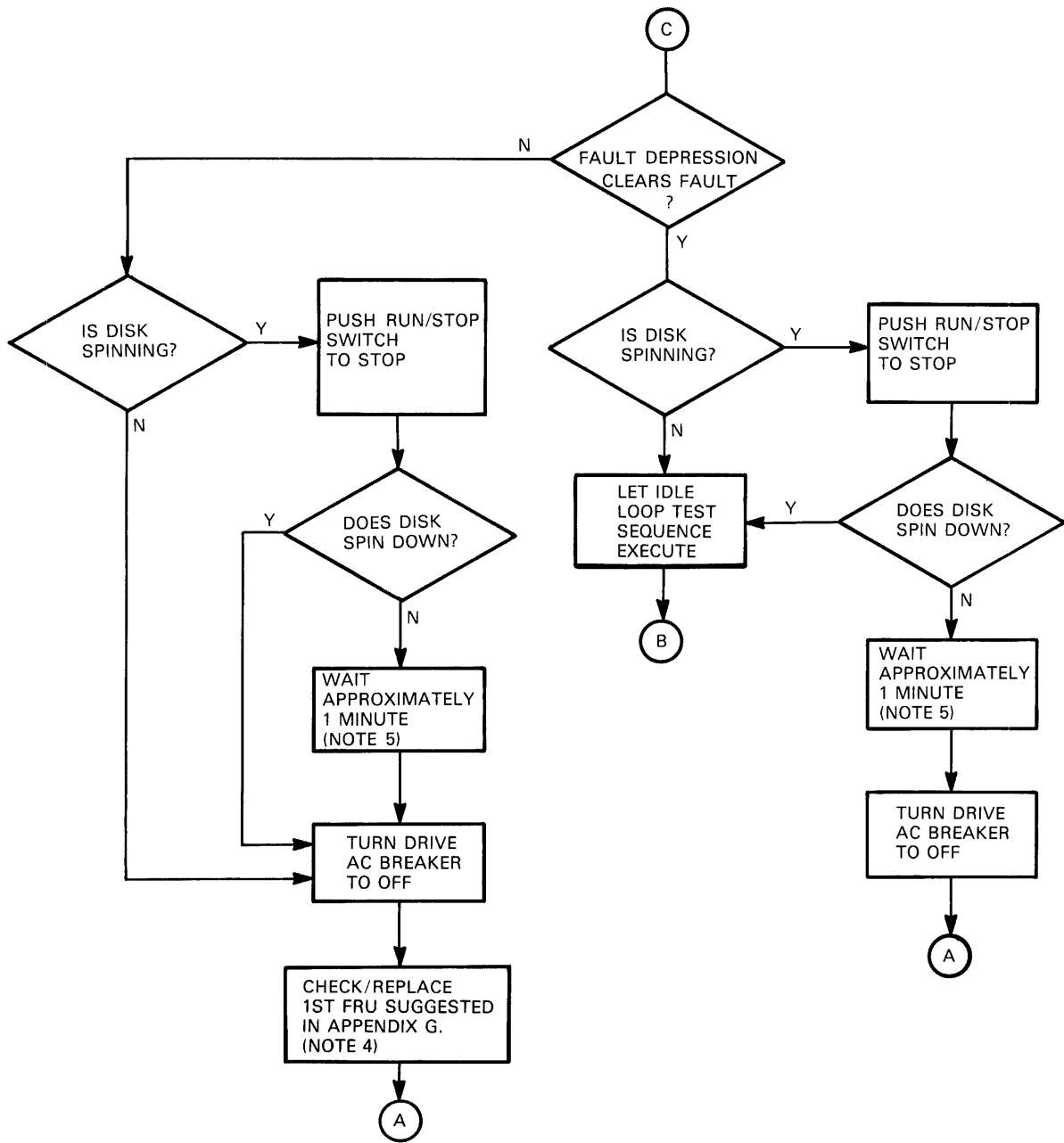


Figure 5-4 RA81 Drive Troubleshooting (Sheet 2 of 7)

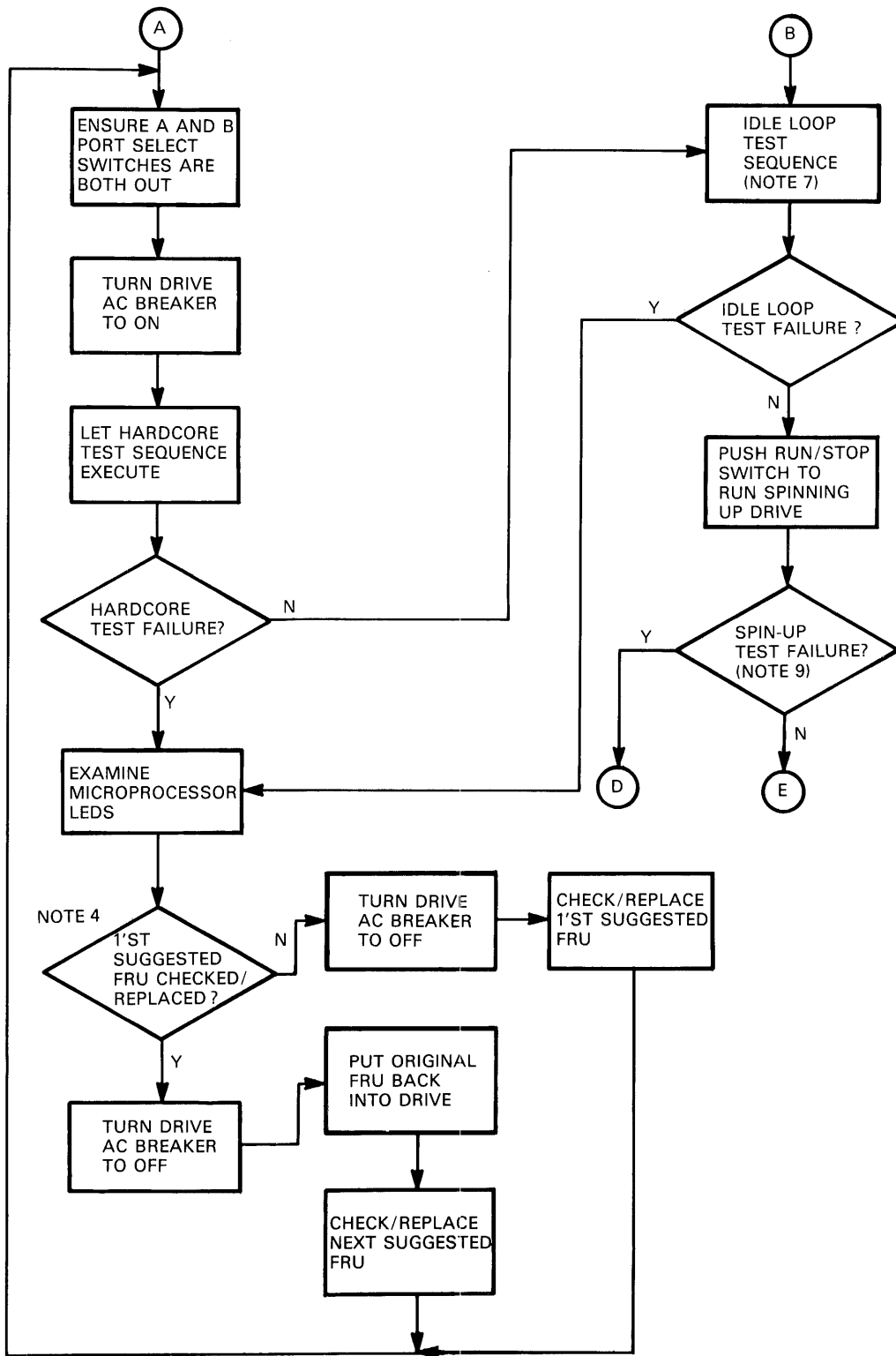


Figure 5-4 RA81 Drive Troubleshooting (Sheet 3 of 7)

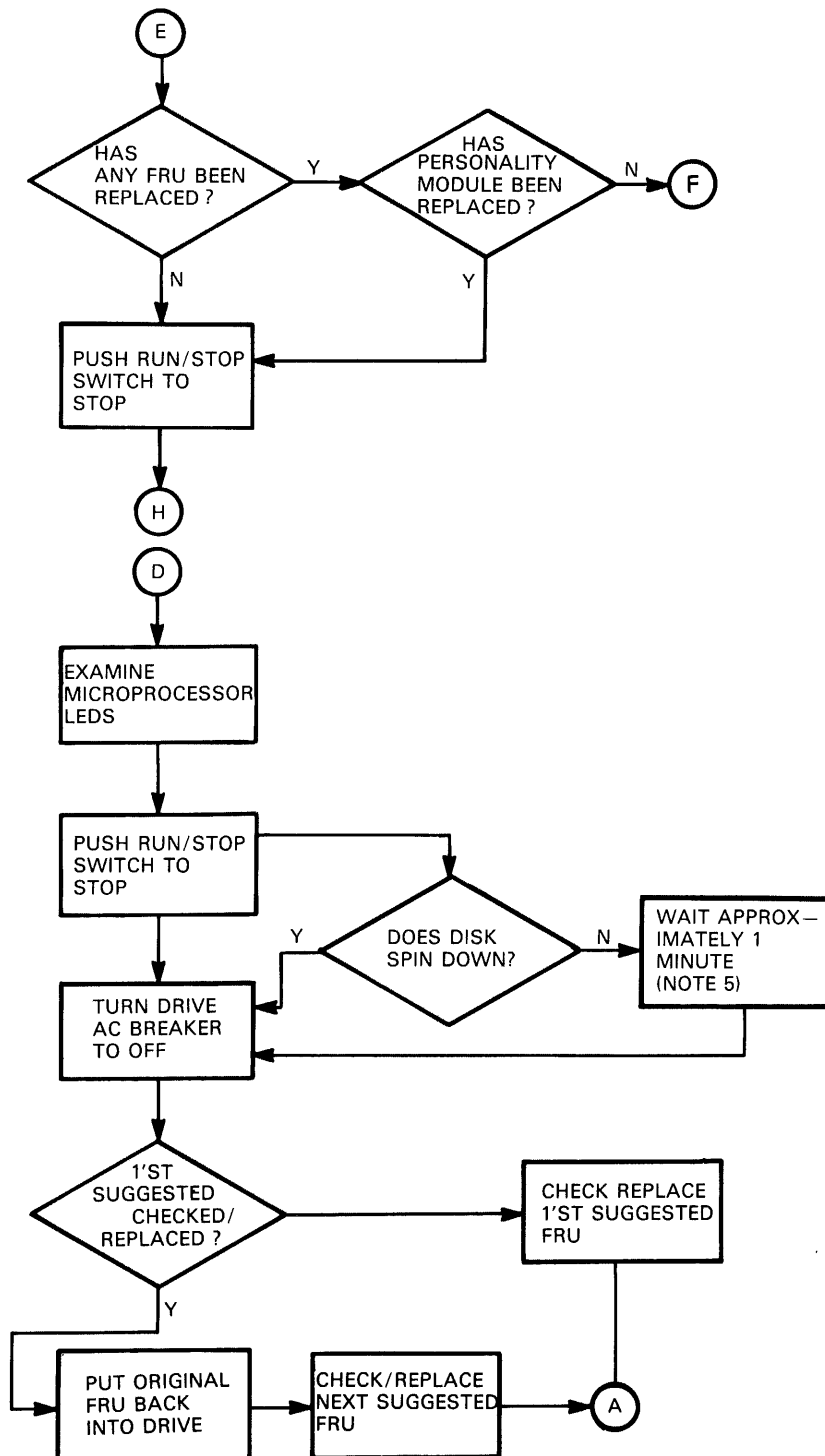


Figure 5-4 RA81 Drive Troubleshooting (Sheet 4 of 7)

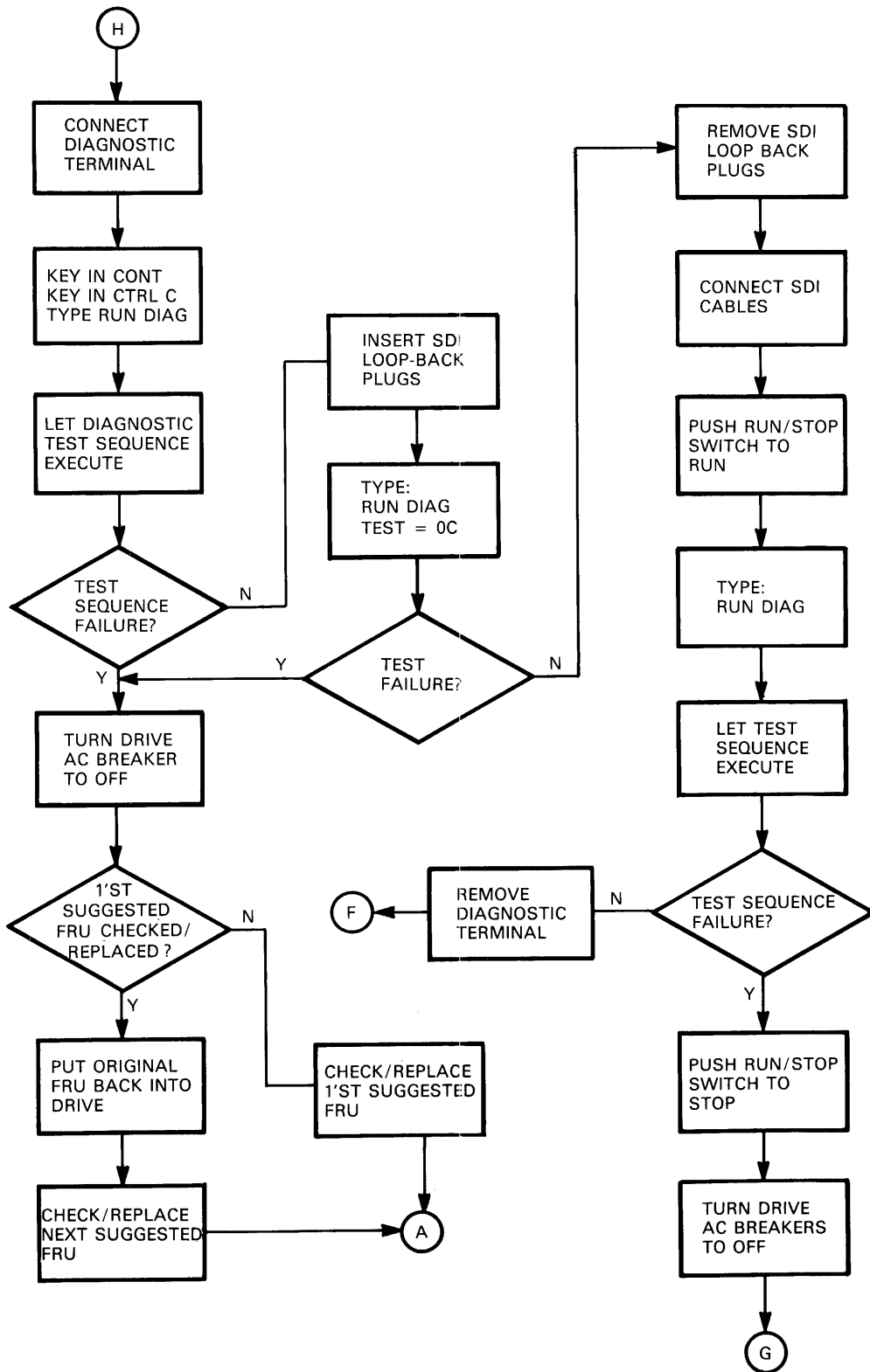


Figure 5-4 RA81 Drive Troubleshooting (Sheet 5 of 7)

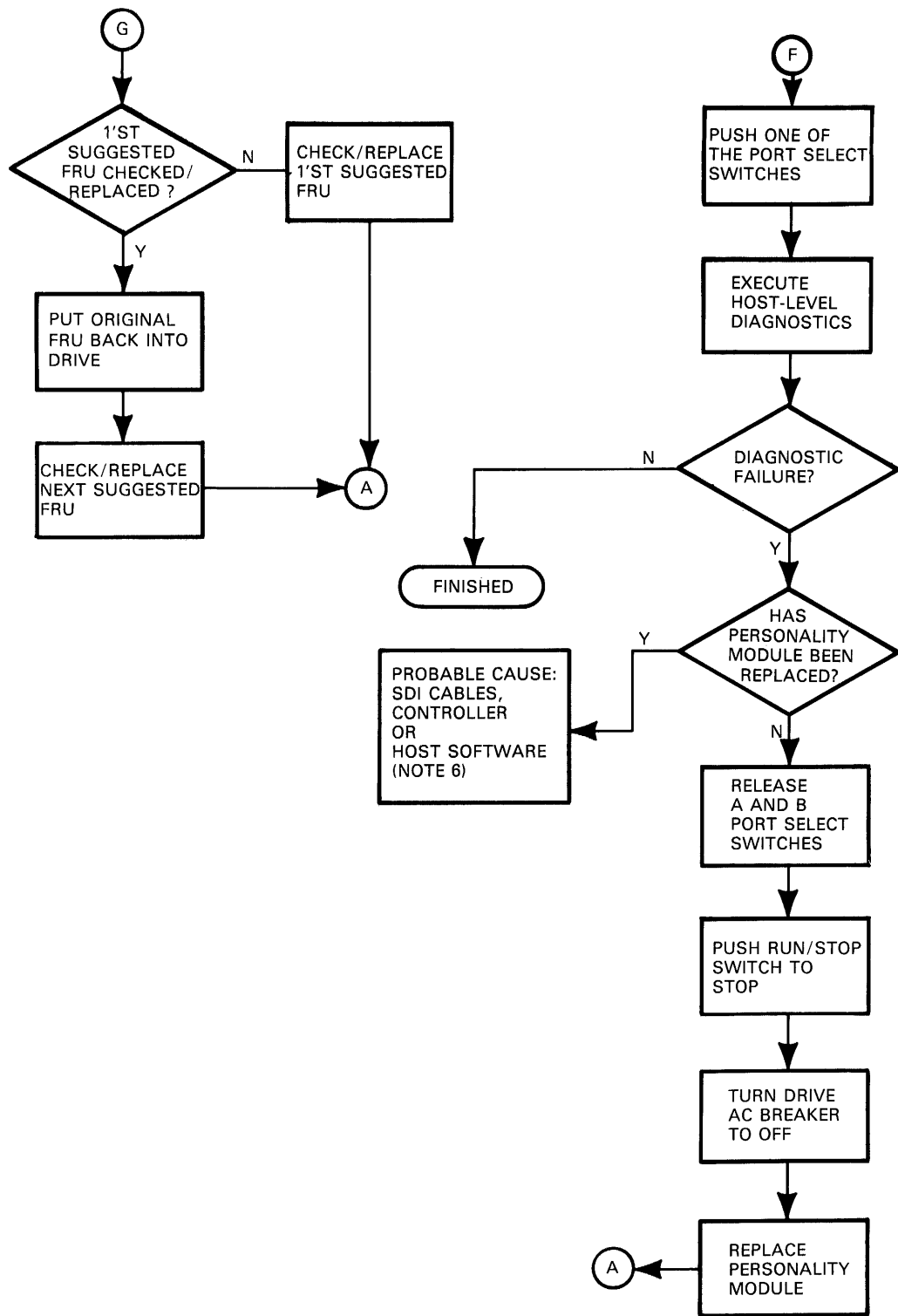


Figure 5-4 RA81 Drive Troubleshooting (Sheet 6 of 7)

FLOW CHART NOTES

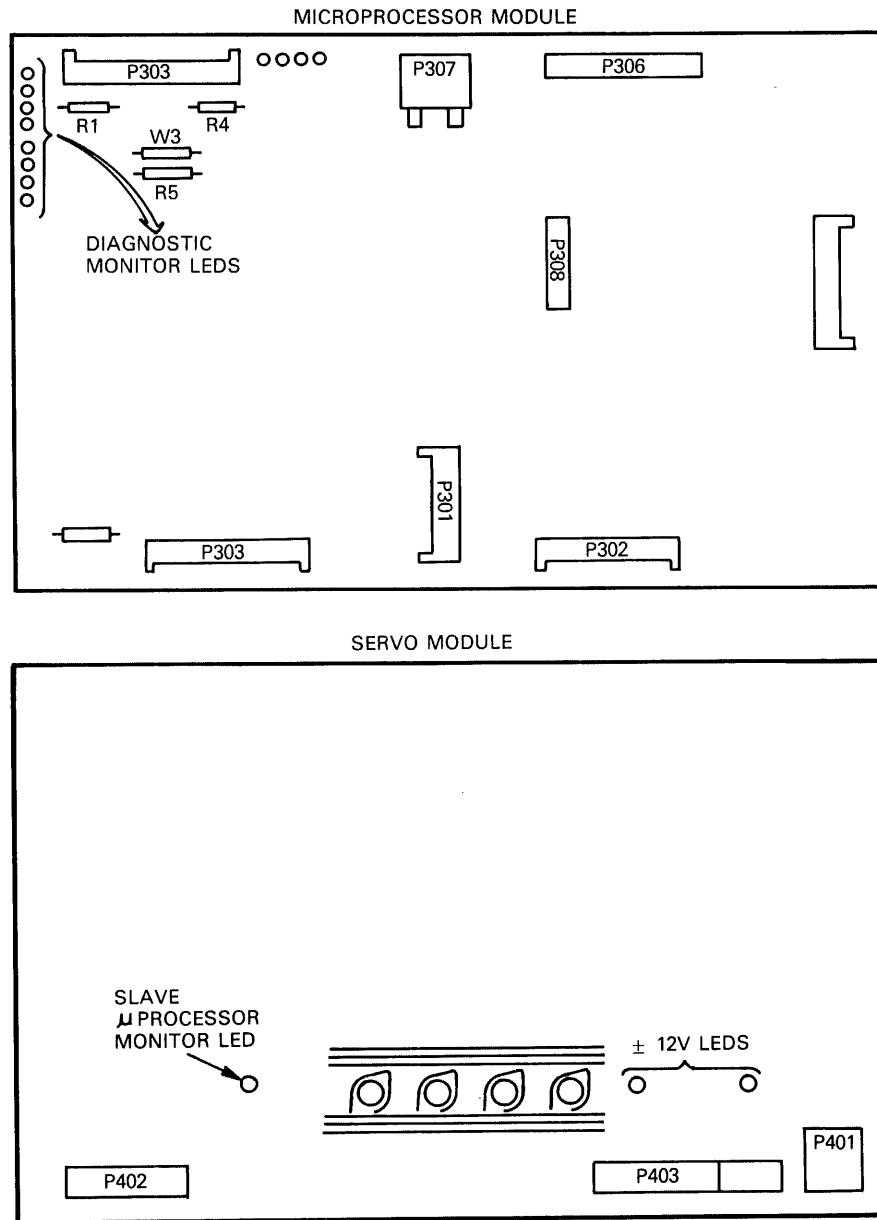
1. The host error log is used to isolate problems to the drive or controller and to log intermittent failures.
2. SDI errors may be controller or drive detected. The RA81 Fault light may be on.
3. The drive Fault light may have been cleared by the subsystem or by the pushing of the Fault switch.
4. Suggested FRU replacement sequence is found in Appendix G. Microprocessor LED's form a hexadecimal error code which is translated into FRU replacements.
5. If the drive idle loop test sequence has already started, the drive will not spin down until completion (about one minute). A drive failure may also cause the drive not to spin down. During on-line modes of operation, the controller governs the timing of the spin-down cycle even though the operator may have pushed the RUN/STOP switch to stop.
6. The RA81 stores up to 16 fault codes provided the drive is not powered off. This information is useful for troubleshooting intermittent drive faults. Intermittent drive faults are not logged by the host system software. Use the SHOW DIAG FAUL utility command with the diagnostic terminal to obtain these error codes. Paragraph 4.5.9 in the RA81 Service Manual describes this command.
7. Idle loop diagnostics execute for about 30 seconds every 10 to 20 seconds provided the port select switches are in the OUT position. The drive may be either spun up or down.
8. Normal operating states of the RA81 drive:
 - A and B port select switches out with neither light on = OFF-LINE.
 - A or B port select switches in but neither light on = AVAILABLE.
 - A or B port select switches in or out with either light on = ON-LINE.
9. An entire spin-up test sequence is executed each time the drive is spun up in the AVAILABLE or OFF-LINE states. When the controller spins up the drive (drive ON-LINE), the spin-up tests are run with the exception of the read/write diagnostics.

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Figure 5-4 RA81 Drive Troubleshooting (Sheet 7 of 7)

5.3.2 Module LED Indicators

There are several groups of LEDs that perform special functions in the drive. One group displays the status of the execution of drive-resident diagnostics. Two other sets of LEDs override the other fault indications in the drive. These fault indications take on the form of front panel error displays, or diagnostic terminal error callouts, or microprocessor LED error callouts. These special LED indicators are located in the drive as shown in Figures 5-5 and 5-6.



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Figure 5-5 Module LED Locations

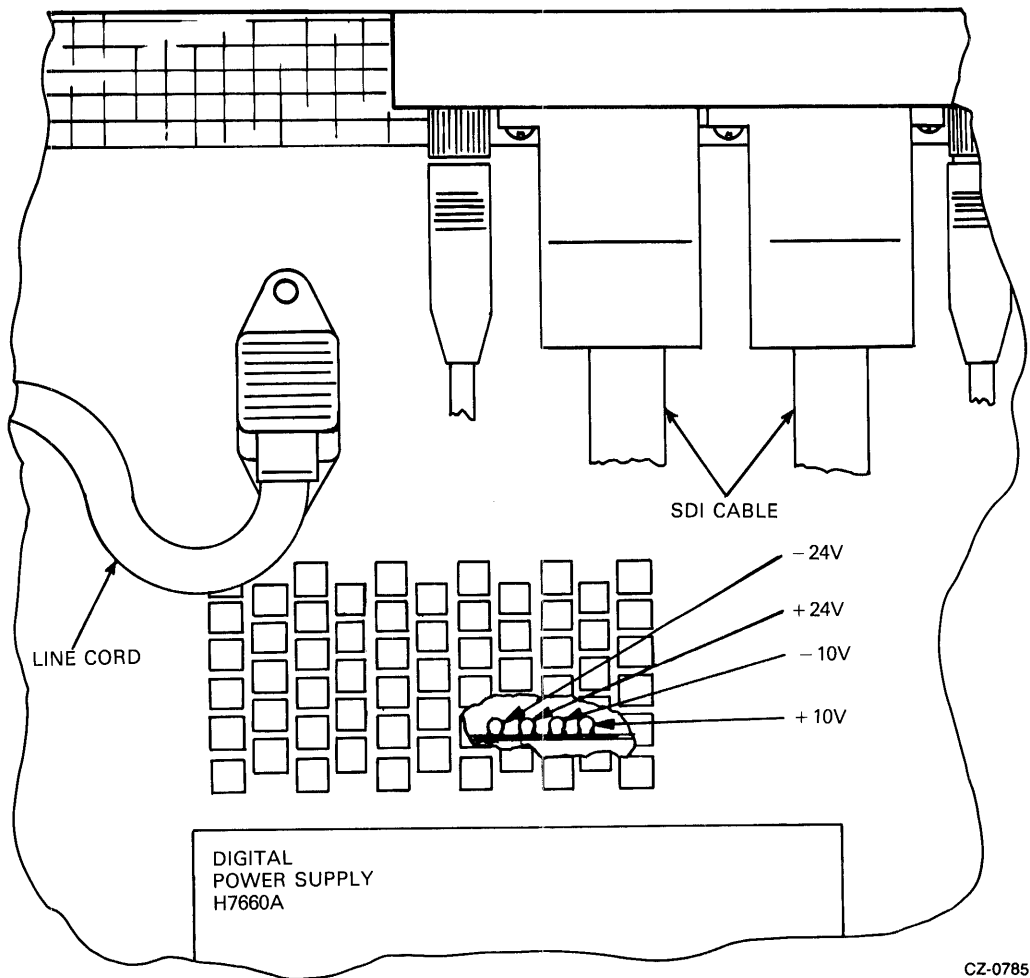


Figure 5-6 Power Supply LEDs

- Two groups of four LEDs in the front left-hand side of the microprocessor module. These LEDs monitor the drive diagnostics. Any time the drive-resident diagnostics are running, these LEDs display the hex code of E7. Failures that occur in the execution of these diagnostics are reflected in the LEDs as discrete error codes (see Appendix G).
- One group of four LEDs on the left-hand side of the microprocessor module. The first three LEDs are normally off and the last LED is normally on. If it is observed that these LEDs are lighted in any other configuration, the microprocessor module should be replaced. These LEDs represent the integrity of the master microprocessor. Ignore all other error codes and replace the microprocessor module.
- A single LED in the lower left-hand side of the servo module. This LED represents the integrity of the slave microprocessor located on the servo module. If this LED should ever go out, the servo module should be replaced immediately. All other error codes should be ignored.
- Two LEDs on the right-hand side of the servo module. These LEDs represent the status of the plus and minus 12 volt supply. These LEDs are normally on. If either LED goes out, it represents a failure in the power supply. See Table 5-2.

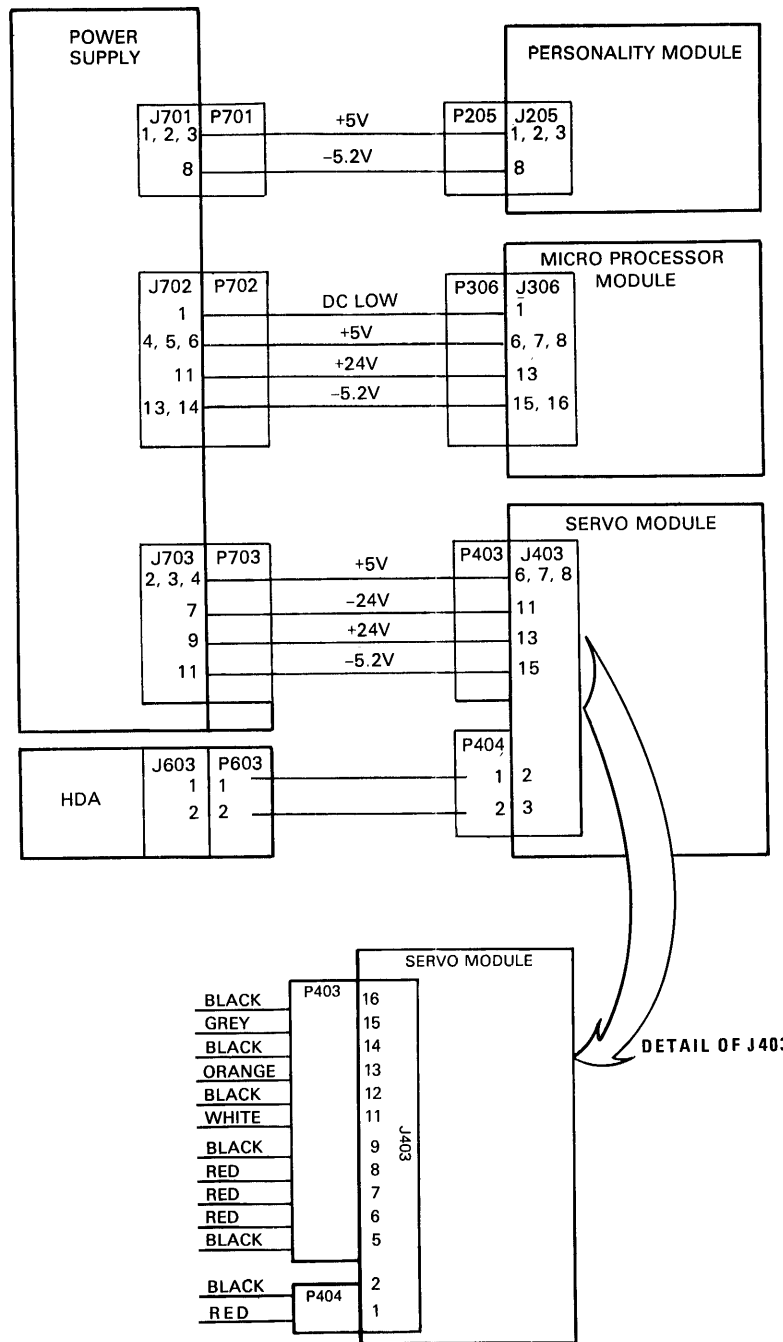
- Four LEDs in the power supply (Figure 5-6). These LEDs may be observed through the back-center grillwork on the power supply. The LEDs monitor the presence of $\pm 24V$ dc and $\pm 10V$ dc. If one goes out, it represents a failure in the power supply. See Table 5-2.

Table 5-2 Power Supply Checks

Check	Action
+ 5 volt	Check that the operator control panel indicators flash on momentarily when power is applied to the drive. The flash indicates that + 5 volts is present. If the drive cannot be powered down, check that + 5 volts is present at the WRITE PROT switch. The WRITE PROTECT switch lamp should light when pushed if + 5 volts is present and the drive is on-line. If the front panel lights fail to come on, then check the front panel light bulbs. This can be accomplished either visually or with a ohmmeter. If the + 5 volts is missing, the power supply should be replaced.
± 12 volt	Check that the two green 12-volt LEDs on the servo module (to the right of the heatsink) are on. When lit, they indicate that both +12 and -12 volts are present. If either or both are off, the regulator for the voltages is bad, and the servo module should be replaced.
± 10 volt ± 24 volt	These voltages are monitored by leds located in the power supply (Figure 5-5). If any of the leds are not lit, replace the power supply.
FAULT indicator off, all other operator control panel indicators on	This condition occurs only when the DC LOW signal is asserted. Possible causes are the power supply, microprocessor or servo module

5.3.3 Power Supply Troubleshooting

Table 5-2 contains power supply troubleshooting procedures. If a problem is suspected in the power supply, use the table to find what checks are available. All power supply voltage measurements are taken on the circuit modules at the connector pins indicated in Figure 5-7. The tolerances for these measurements are given in Table 5-3.



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Figure 5-7 Voltage Test Points

Table 5-3 DC Voltage Testpoints and Tolerances

Voltage	Test Points
+5 ±0.2	Pins 1,2,3 of J205
-5.2 ±0.2	Pins 15,16 of J306
+24 +3,-1	Pin 13 of J403
-24 +1,-3	Pin 11 of J403
DC low	Pin 1 of J306

5.3.4 HDA Formatting Procedure

Replacement HDAs (part number 70-18491-01) do not have to be formatted before use in the RA81. Each HDA is formatted at point of manufacture.

5.3.5 HDA Identification

RA81 HDAs may be identified by labels found on the front plastic cover. RA81s to be used for 16-bit applications have the following label: R81 16BIT (black lettering on a red background). RM80 and RA80 HDAs either have no label or the following label: R80 (black lettering on a white background).

5.3.6 HDA Fault Isolation

If it appears that an HDA is defective, check the voltages applied to the HDA before replacing it. These connectors are found on the read/write preamplifier module.

1. J601, pins 7,8 contain -4v.
2. J601, pins 9,10 contain +6v.
3. J602, pin 2 contains -8.2v.

If the -4 or the +6 voltages are missing or incorrect, the HDA is not at fault. Check the voltage regulators on the read/write module.

If the -8.2v is missing or incorrect, the HDA is not at fault. The servo module or cables are faulty.

5.3.7 HDA Substitution Procedure

The following procedure is designed to ensure the field service engineer has done everything possible to verify that the suspected HDA is defective.

This procedure should be followed only after the probable FRU replacements from the troubleshooting tables have not corrected the problem. At this point, all original FRUs are back in the drive and the next step is to verify that the HDA is defective.

1. Advise the customer to backup the data from the HDA to another media (if possible).

2. Attempt to reformat the suspect HDA and run the host level diagnostics.
3. If diagnostics fail, record the error data.
4. Replace the HDA with a spare using the procedure found in Paragraph 2.14.
5. Run the same diagnostics that failed previously.
6. If the diagnostics fail with the same errors:
 - Put the original HDA back in the drive.
 - Call for support. The HDA is probably not the failing FRU.
7. If a new or different error occurs running the diagnostics, the possibility exists that the fault is in multiple areas or that the spare HDA is defective.
8. If all of the host-level diagnostics run without error, the drive should be turned over to the customer after reformatting.

5.3.8 Shipment of HDAs

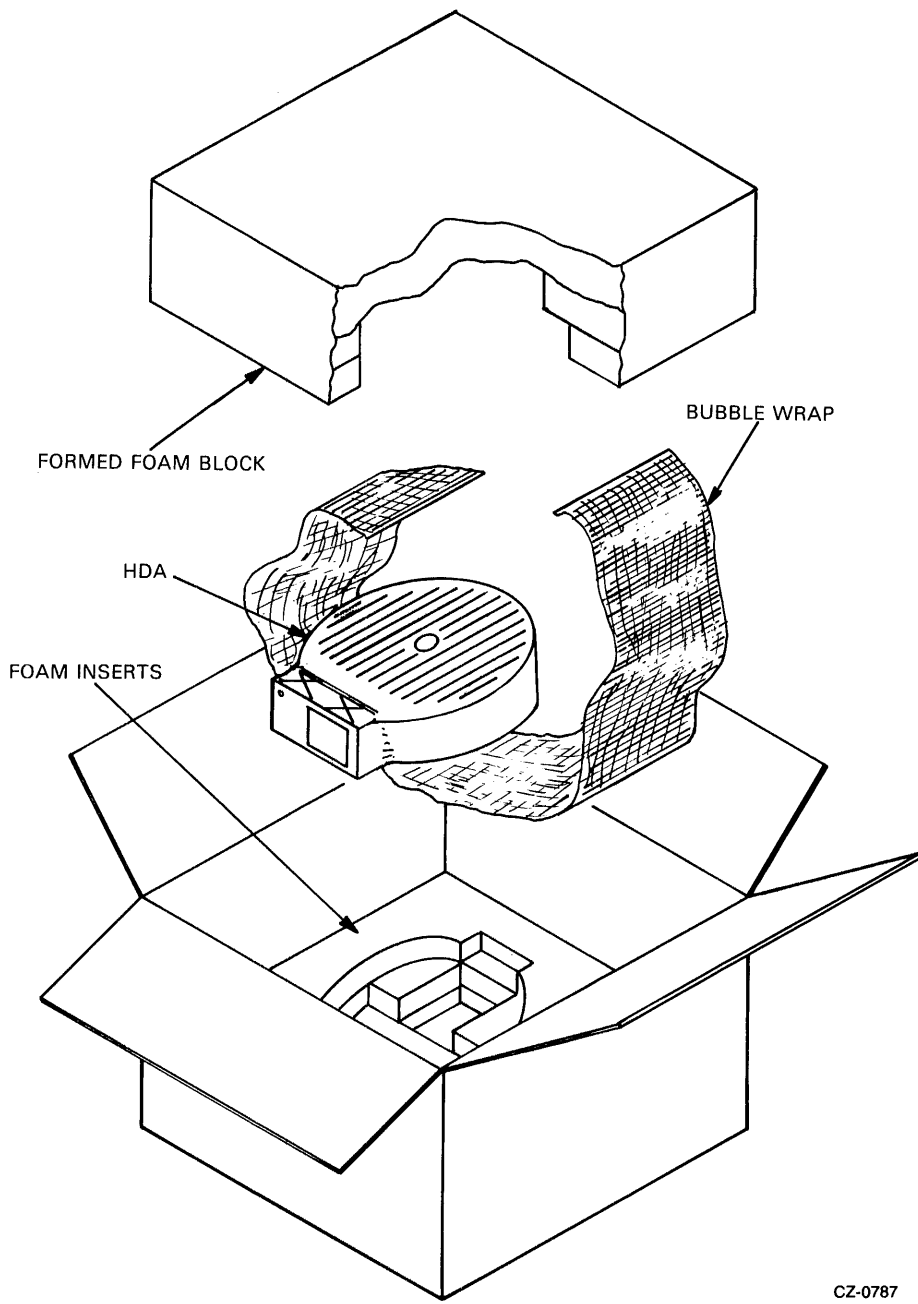
The following is a list of steps to be followed when shipping an HDA.

1. The positioner lock should be in the LOCK position.
2. The spindle pulley should be taped to the HDA housing with a good nylon-reinforced packing tape. Masking tape should never be used as it is not strong enough.
3. The HDA should be packed in the proper shipping carton (see Figure 5-8).
4. A repair tag should be filled out correctly.
5. Error data at the time of failure should be shipped with the HDA. Examples are the diagnostic printouts and/or the system error log.
6. The HDA Support/Removal Form should be filled out and packed with the HDA and the repair tag.

NOTE

If these forms are not available, refer to Figure 5-9 for a sample. Answer all questions and send one copy of the form with the HDA and another to:

7. The packed HDA should be shipped to Field Service Logistics Returns Stockrooms.



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Figure 5-8 HDA Shipping Container



DEFECTIVE HDA DATA SHEET

MUST be filled out for all HDAs replaced/returned

Customer Name: _____

System Type _____ Serial # _____

Drive Type: _____ Serial # _____

Remote Diagnosis Session Number (if applicable): _____

Bad HDA Serial #: _____ Date: _____

New HDA Serial # being installed: _____

Name of person changing HDA: _____

Badge #: _____ Cost Center _____

Phone #: _____

SYMPTOM

List all error Symptoms from Diagnostic/Errorlog

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

Did the Error log (syserr) indicate failure?

Y N N/A

Microdiagnostics indicate failure?

Y N N/A

Did maintenance documentation assist in HDA isolation?

Y N N/A

Is problem sensitive to specific HDA area?

Reading Writing Seeking Spinning

Cylinder(s) _____

Head(s) _____

Sector(s) _____

LBN (if applicable) _____

How often did the symptoms occur (solid occurrence or in hours)

HDA solve problem?

Y N

MICRODIAGNOSTIC FAILURE SYMPTOMS

<u>Routine</u>	<u>Micro Error Code</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

TIME METER READING (if applicable) _____

COMMENTS: (Problems or specific observations) _____

Other drive assemblies replaced during troubleshooting

1. _____ 5. _____

2. _____ 6. _____

3. _____ 7. _____

4. _____ 8. _____

Figure 5-9 HDA Support/Removal Form

5.3.9 Write Protect Function Test

The write protect function in the RA81 may be tested while the drive is operating in the functional mode using the following procedure.

1. Spin down the disk by releasing the RUN/STOP switch.
2. Push the WRITE PROTECT switch.
3. Spin-up the disk by pushing in the RUN/STOP switch. If the write protect function is working properly, the FAULT indicator will light.
4. Push in the FAULT indicator to enter the fault display mode. The operator control panel will display a R/W diagnostic fault code (Appendix F). Both the FAULT and PORT A indicators should be on.
5. Push the FAULT indicator again to clear the fault condition and display mode.
6. Release the WRITE PROTECT switch.

5.3.10 Power Failure

The drive responds to a power failure by spinning down. The drive spins up automatically upon resumption of power as long as the RUN/STOP switch remains IN. Multiple drives spin up in a sequence determined by the power sequencing each cable. Each drive spins up as the previous drive reaches proper speed.

5.3.11 Spindle Motor Thermal Timeouts

The RA81 engineering specification states that a three-minute delay should occur between successive start-up cycles of the spindle drive motor. This delay prevents the spindle drive motor from overheating. If the motor does overheat, an internal thermal circuit breaker in the drive motor trips. The thermal breaker trips if either of the following conditions exists.

- Frequent spindle motor start-up
- Loss of cooling due to a fan failure

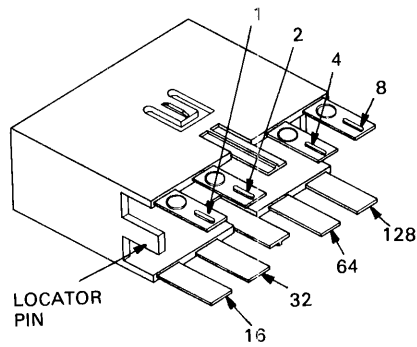
If the spindle motor thermal breaker trips, the front panel fault display shows a spinup error (see Appendix F). To recover from a motor thermal breaker trip, check the fans for operation. If the fans are operating, let the motor cool for 10 to 15 minutes with power applied to the drive. The air flow from the operating fans cool the drive motor.

5.3.12 Changing a Drive Unit Number

Drive unit numbers between 0 and 251 (decimal) may be programmed into the READY switch. A new switch cover is set up as unit 0. For any other number, cut off the tabs (Figure 5-10) that add up to the required number. For example, if unit number 7 is required, tabs 1, 2, and 4 are cut. If unit number 113 is required, tabs 64, 32, 16, and 1 are cut. All tabs left intact represent 0. Unit numbers 252 through 256 are illegal.

5.3.13 RA81 Block Diagram

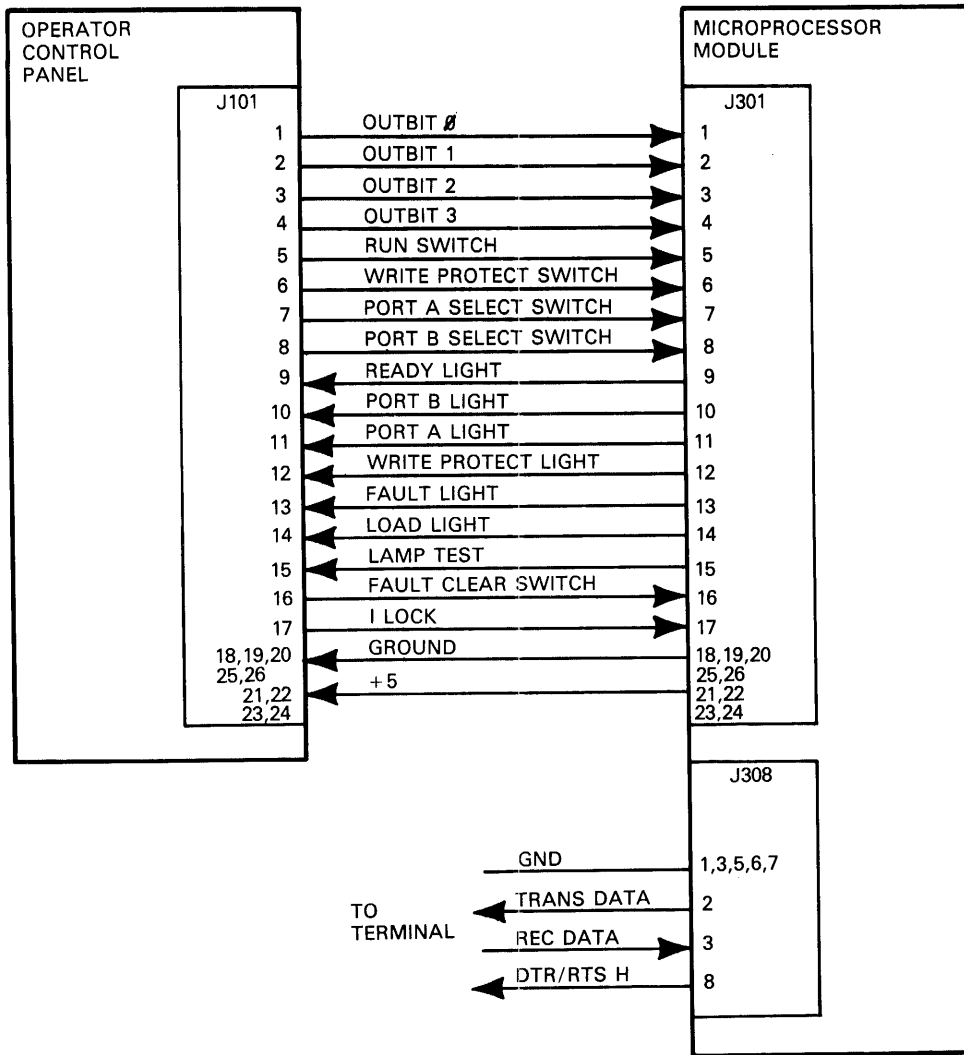
Figure 5-11 is provided as a cabling reference. All signals and all cables between modules are represented in this diagram.



REAR PIN CONFIGURATION

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Figure 5-10 Drive Unit Address Plugs



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Figure 5-11 RA81 Signal Diagram (Sheet 1 of 7)

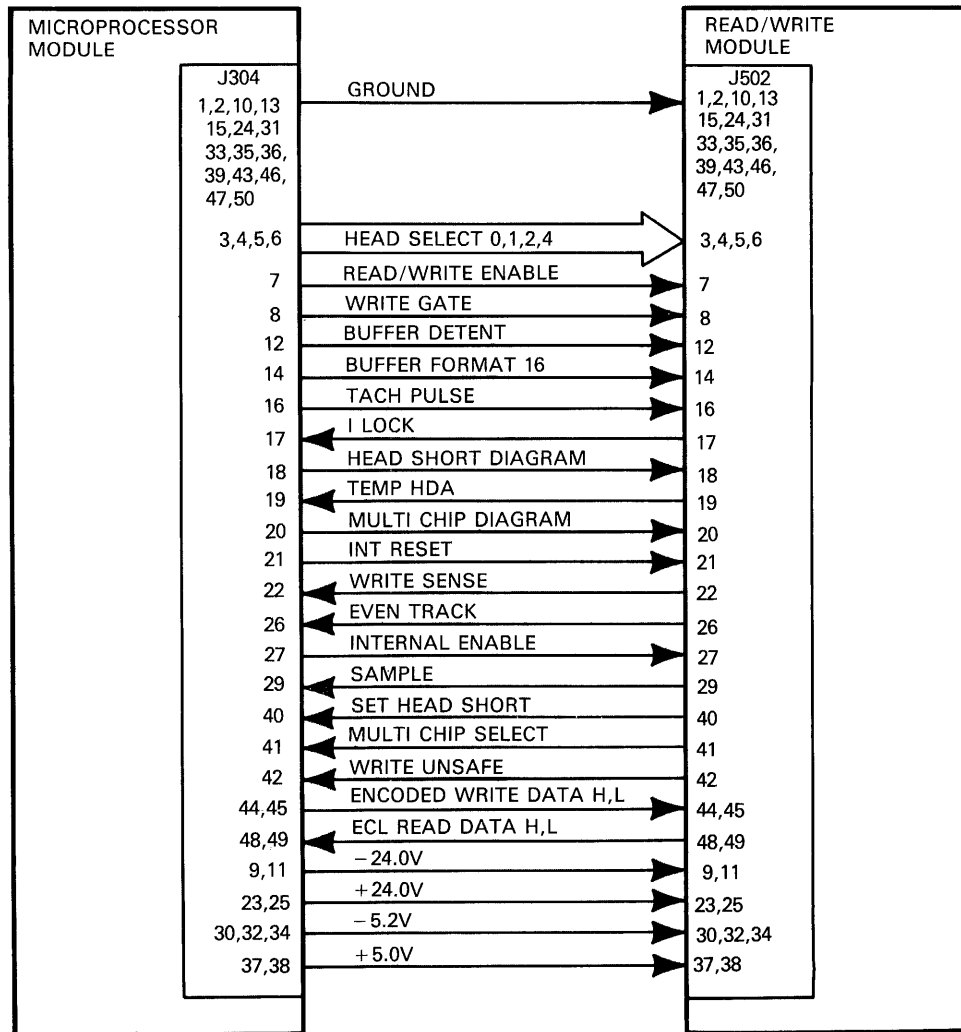


Figure 5-11 RA81 Signal Diagram (Sheet 2 of 7)

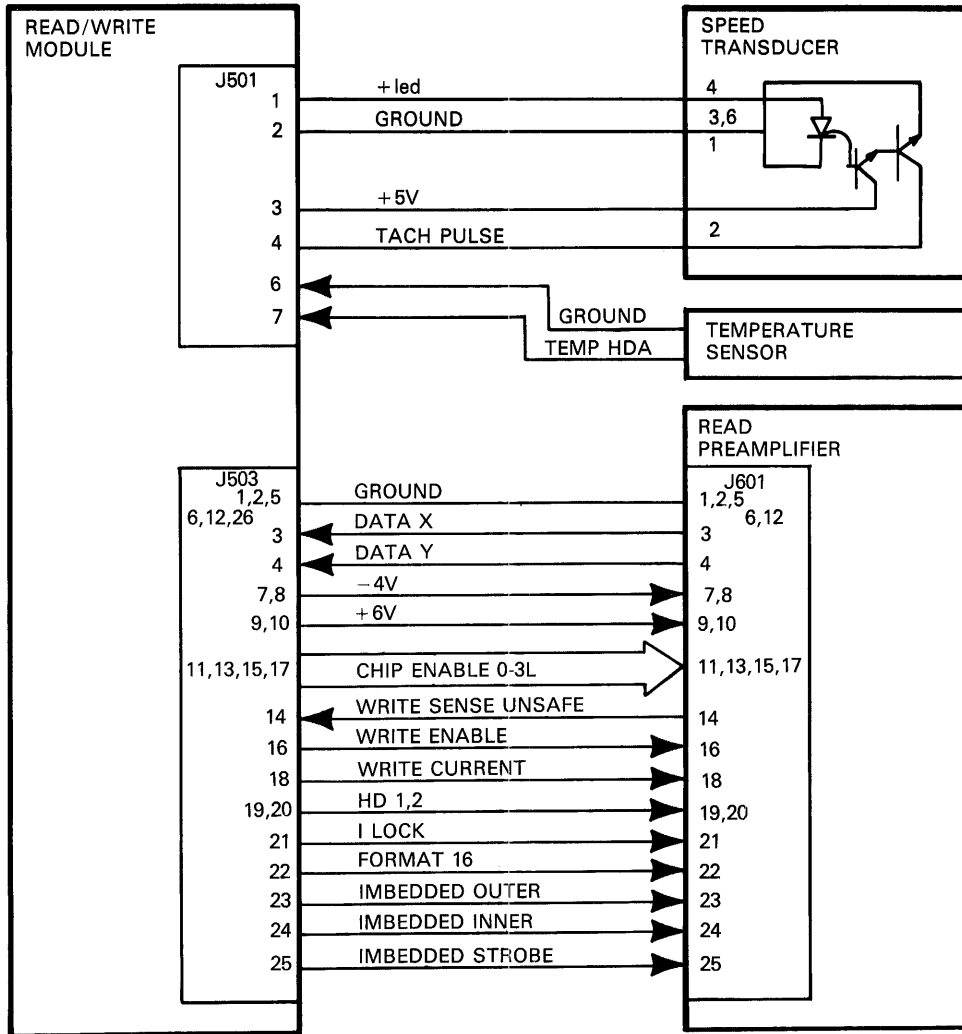


Figure 5-11 RA81 Signal Diagram (Sheet 3 of 7)

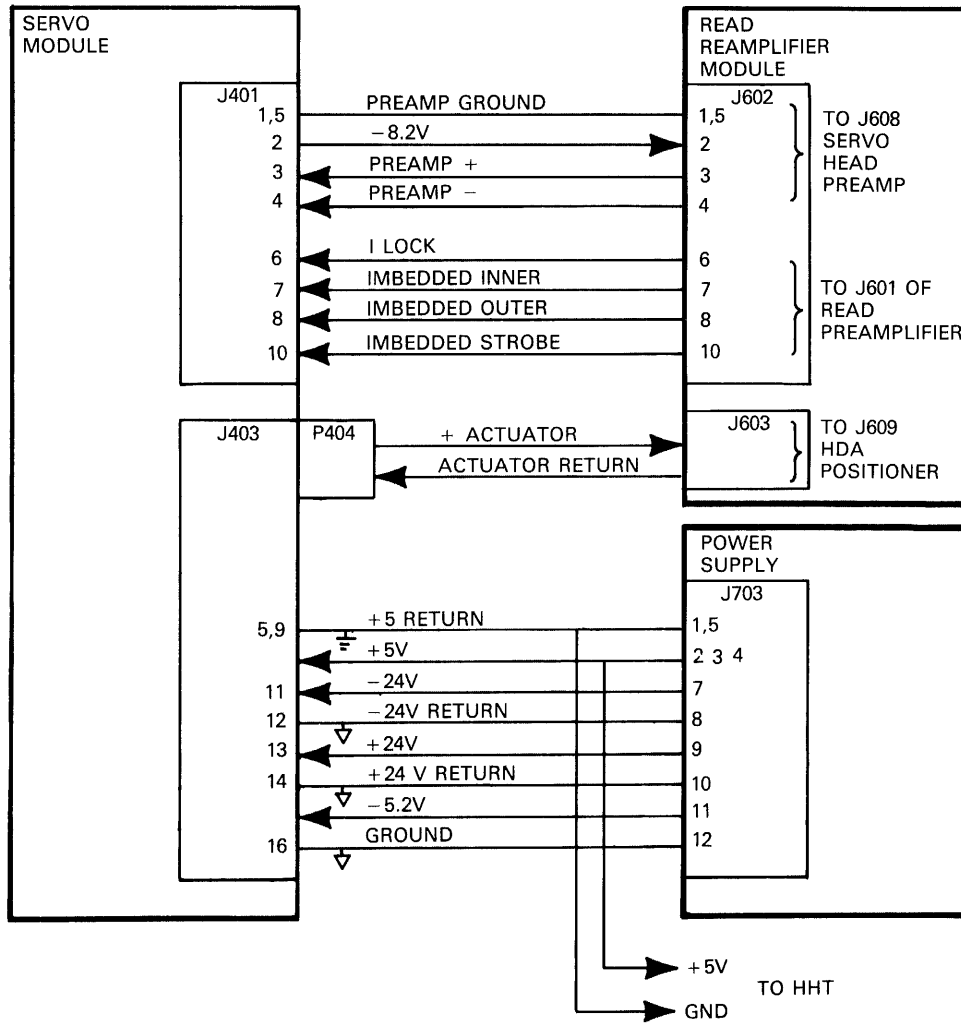


Figure 5-11 RA81 Signal Diagram (Sheet 4 of 7)

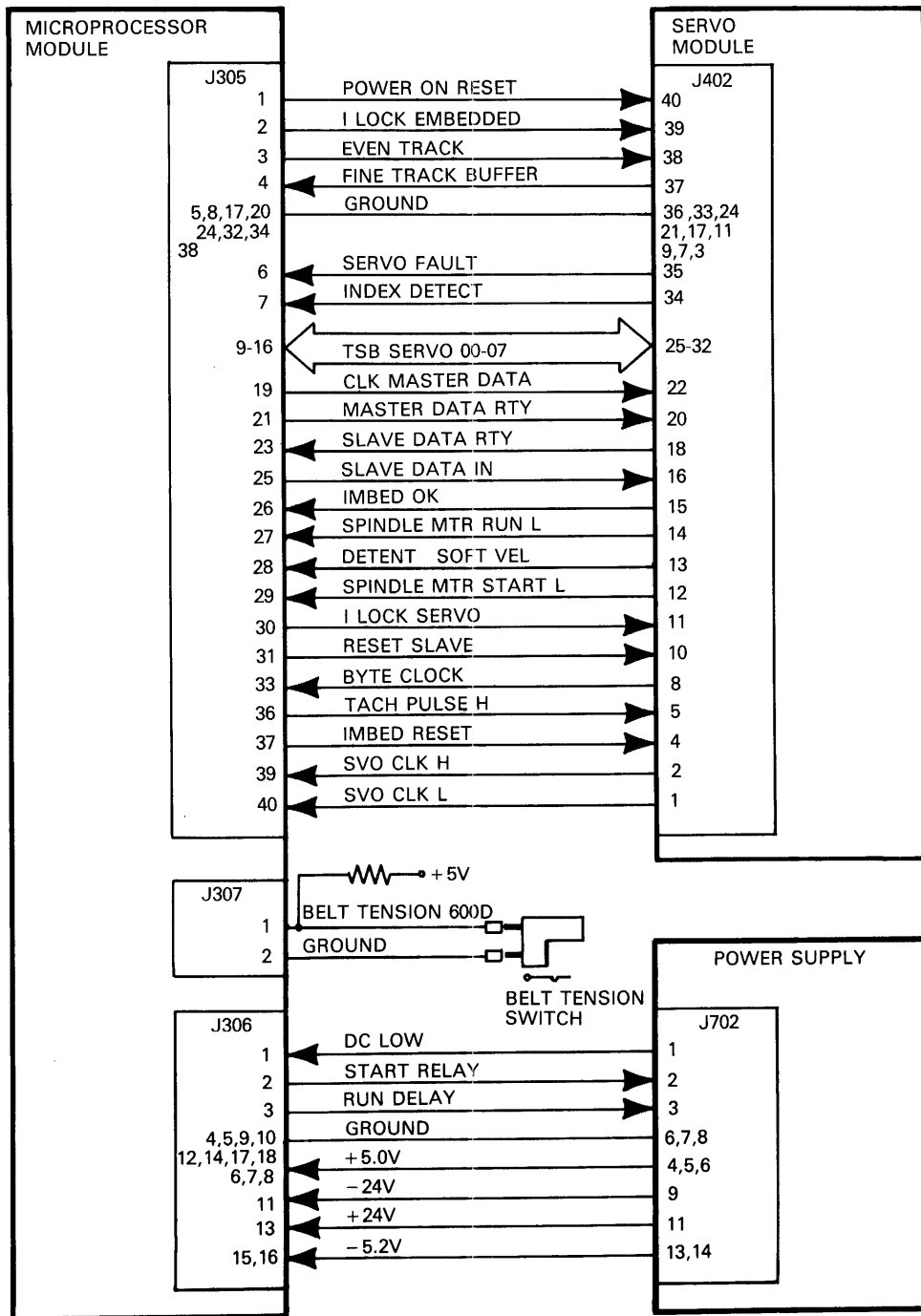


Figure 5-11 RA81 Signal Diagram (Sheet 5 of 7)

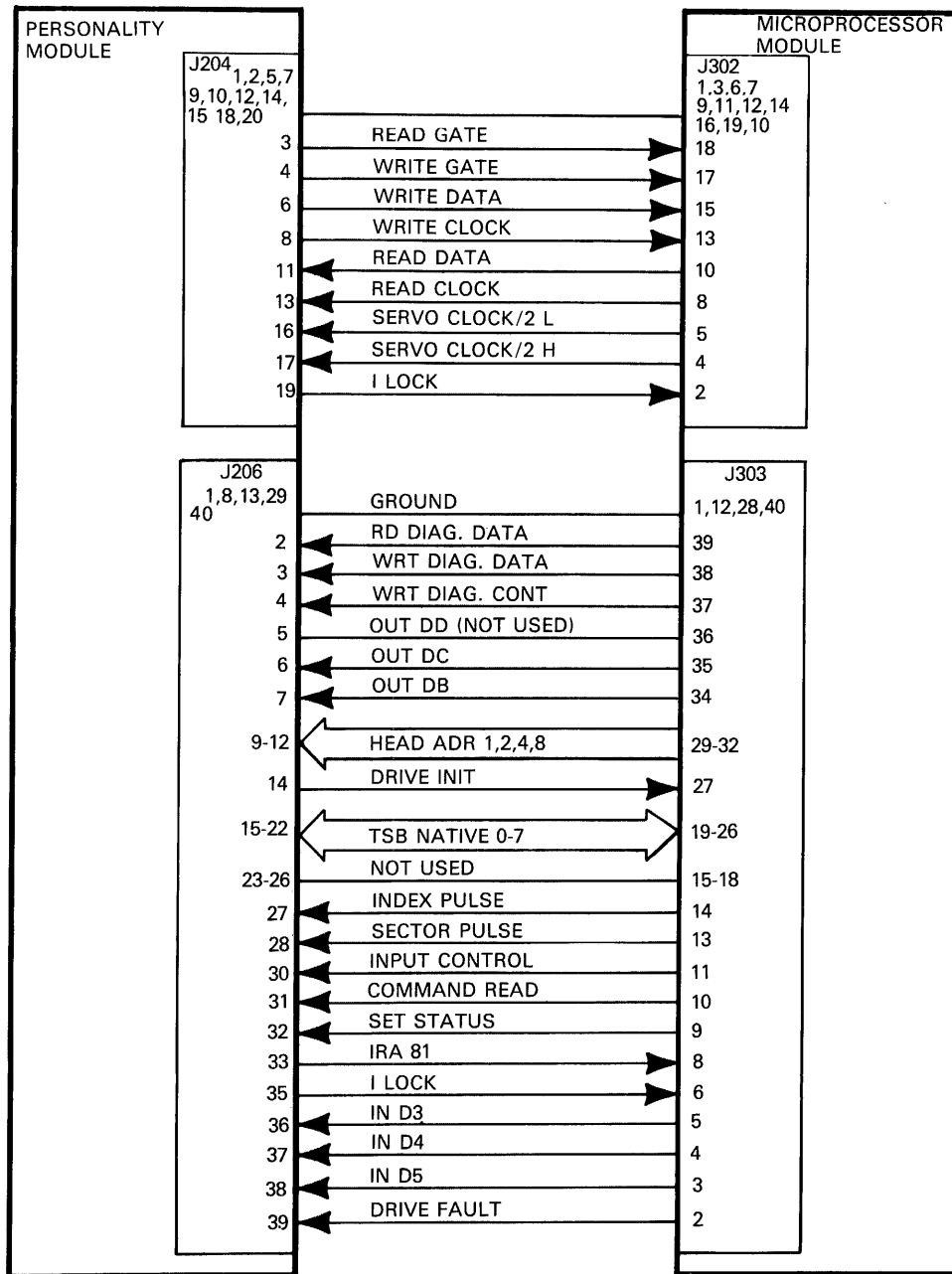
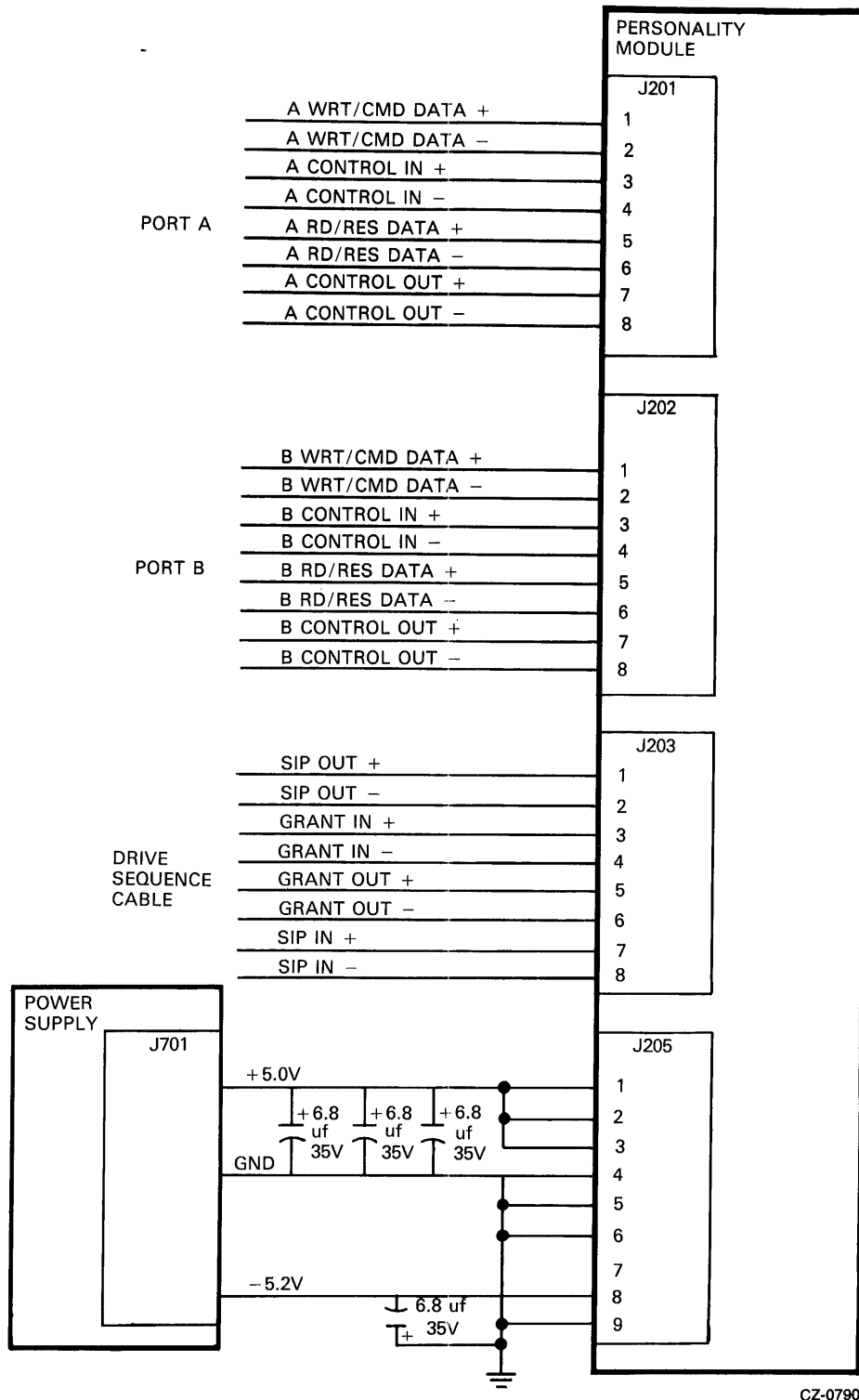


Figure 5-11 RA81 Signal Diagram (Sheet 6 of 7)



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Figure 5-11 RA81 Signal Diagram (Sheet 7 of 7)

5.4 RA81 DRIVE CHECKOUT

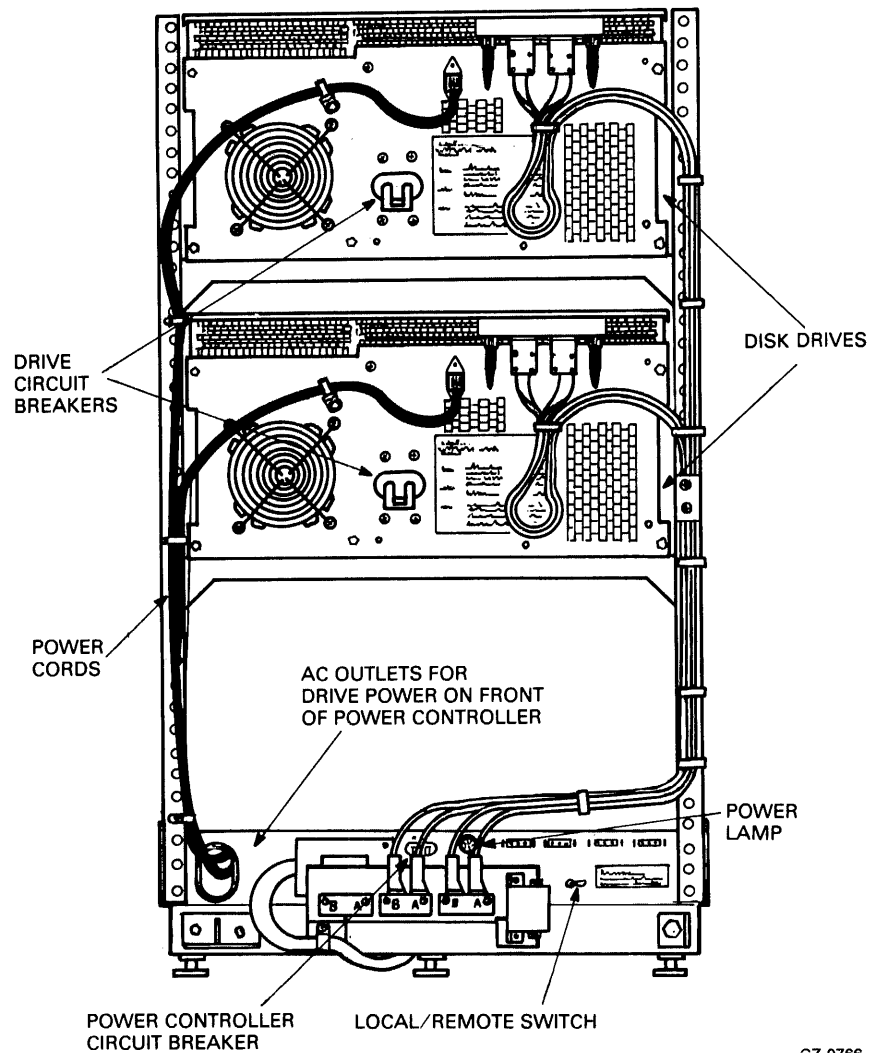
Use the following procedure to verify RA81 drive operation after installation.

NOTE

This checkout procedure should be used only by trained maintenance personnel.

5.4.1 Applying Power

1. Verify that the ac circuit breakers on the power control unit and each disk drive are in the OFF position (Figure 5-12).



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2. If this is an add-on drive, plug the ac power cord from the drive into the ac power receptacle on the power control unit at the bottom of the cabinet.
3. Ensure that the LOCAL/REMOTE switch on the power controller is in the LOCAL position. This switch must always be in the local position for the drives to operate as no power sequencing cable is used.
4. Plug the ac power cord from the power control unit into an external ac receptacle.
5. Place the ac circuit breaker on the power control unit in the ON position.

5.4.2 Checkout

1. Ensure the drive is in the off-line state by placing both port select switches (A and B) in the OUT position.
2. Place the RUN/STOP switch in the OUT position.
3. Open the logic access cover and raise the servo and personality modules.
4. Ensure that all logic module cables are connected properly.
5. Place the ac circuit breaker on the back of the drive in the ON position. Internal drive diagnostics (hardcore test sequence) run automatically when the drive circuit breaker is turned on. All front panel lights turn on while the drive runs this diagnostic. If the drive successfully passes the hardcore test sequence, the front panel indicators go off (in about 3-4 seconds). If an error code is displayed on the front-panel indicators, refer to Appendix F for fault isolation procedures.

NOTE

Do not have the diagnostic terminal connected to the drive at this time. Some terminals cause the hardcore tests to fail with an error code of B6.

6. The drive idle loop tests are run next. These tests start automatically about 30 seconds following the end of the hardcore test sequence. Allow about 30 seconds for the execution of the drive idle loop test. Observe the microprocessor LEDs for a display of a hexadecimal E7 during the execution of the test. The lights go out after a successful completion. Errors are reported through the front panel lights. Refer to Appendix F for fault isolation.
7. Connect the diagnostic terminal to the RS232 port connector in the drive. Refer to Figure 5-13. This connector is located in the center of the microprocessor module. The connector is keyed so that the cable may be inserted only one way.

NOTE

The diagnostics may be run with any terminal that is set for 300 baud and is EIA compatible.

8. Input a CTRL C (⌘C) on the terminal keyboard to place the drive in diagnostic monitor mode. A diagnostic prompt (RA81>) is then displayed by the terminal.

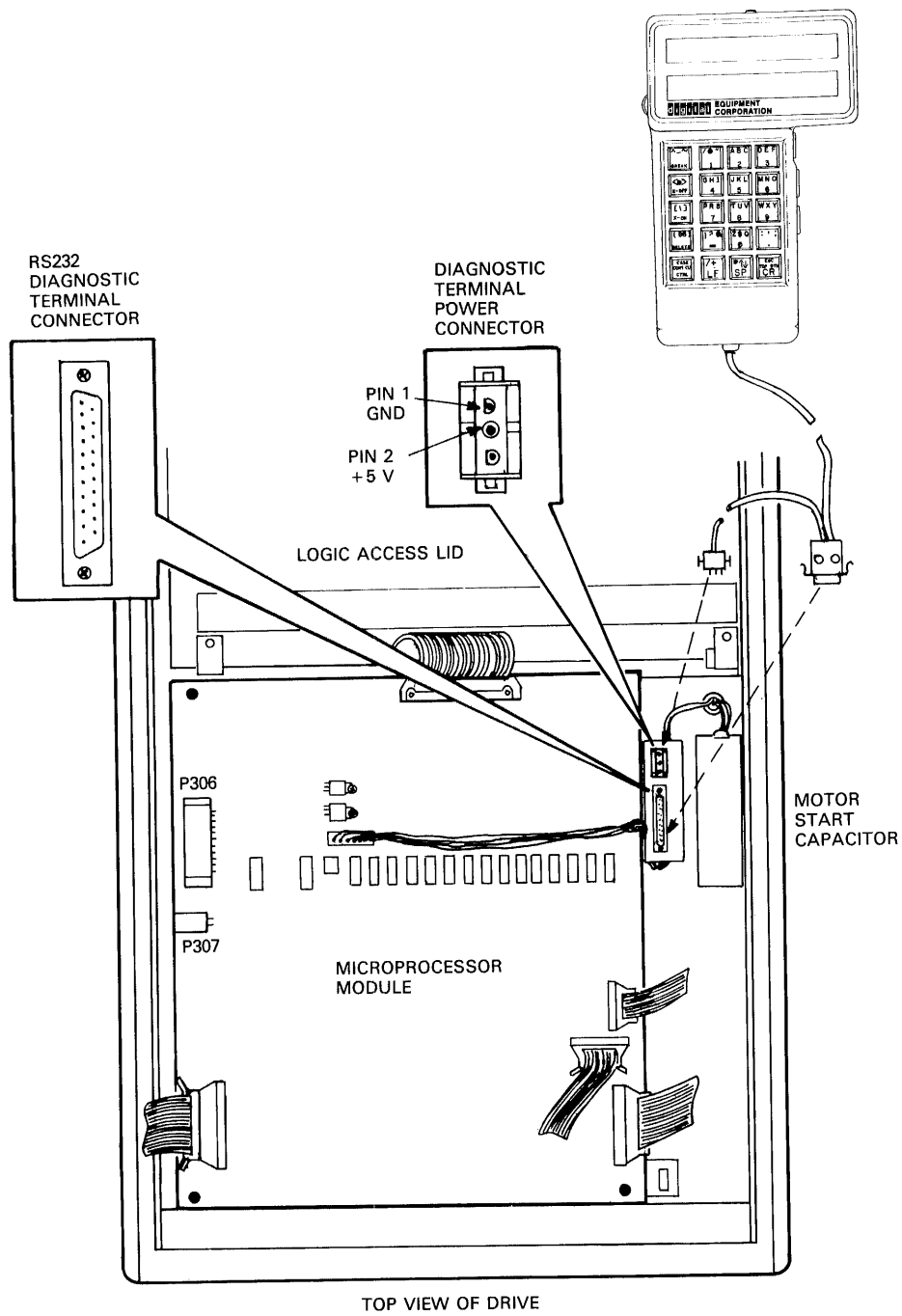


Figure 5-13 Diagnostic Terminal Connections

NOTE

The drive idle loop test sequence repeats continuously as long as no front panel switch is pushed. Once a switch is pushed the drive logic executes that switch function. The prompt is not displayed until the sequence is completed.

9. Input a continue (CONT) on the terminal keyboard. This disables the automatic X-On, X-Off feature of the terminal allowing the testing to be continuous.
10. Run the entire drive test sequence with the drive spun down by typing RUN DIAG on the terminal. As the sequence is executed, the following messages are displayed by the terminal:

```
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
- - -
- - -
- - -
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
RA81>
```

The microprocessor LEDs increment and then settle on a hexadecimal E7 while the sequence is being executed. The display of the prompt indicates successful completion of the test sequence.

The following terminal display means that one of the tests has failed. When a test fails, refer to the fault isolation procedures.

```
%RA81-TEST:DIAG SUBTEST:xx ERROR:xx UNITxxx
%RA81-FRU-xxxx,xxxx,xxxx
```

11. After the above test has been passed, spin up the drive by pushing the RUN/STOP switch to the IN position. The drive responds with the following message:

```
FRONT PANEL FUNCTION IN PROGRESS
```

During drive spin-up, a spin-up diagnostic sequence is automatically executed. The microprocessor LEDs remain off while the drive spins up. When the drive is up to speed, the LEDs display the E7 code and the terminal displays the following:

```
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
      -      -      -
      -      -      -
      -      -      -
%RA81-COMPLETED TEST:DIAG SUBTEST:xx
RA81>
```

If an error condition is noted during the above sequence, the terminal displays the most likely FRU to replace. The diagnostic takes about 45 seconds to complete. Do not proceed to the next step until the prompt is displayed.

12. Type RUN DIAG initiating the entire drive sequence test with the drive spun up. The terminal should display messages similar to those displayed when the drive was spun down. If an error is indicated during this test, the terminal displays the most likely FRU to replace. The microprocessor LEDs increment and then settle on a hexadecimal E7 while the sequence is being executed (about 7 minutes).
13. When the RA81> prompt is displayed, respond by typing in SET DIAG LOOP=HALT placing the drive in a continuous loop, halting only on an error.
14. As soon as the drive returns with the RA81> prompt, respond by typing RUN DIAG. This initiates the entire drive sequence diagnostic once again. Run this test sequence for 25 minutes. If any errors occur during this time, the terminal displays the most likely failing FRU.
15. After the above test has run for 25 minutes without an error, key in CTRL C (↑C) terminating the loop mode and the test.
16. As soon as the drive returns an RA81> prompt, exit the diagnostic monitor mode (paragraph 4.7).
17. Push in the desired port select button to place the drive in an available state.
18. Run the main system diagnostics.
19. Upon completion of all tests on each drive, disconnect the diagnostic terminal, fold the servo and personality modules back into their proper positions, and close and secure the logic access cover on the drive.

APPENDIX A HEXADECIMAL NUMBER CONVERSIONS

The maintenance terminal used to execute the internal diagnostics displays error codes in hexadecimal format. Table A-1 may be used to convert the hexadecimal numbers to binary, decimal or octal.

Table A-1 Hexadecimal Number Conversions

HEXADECIMAL	BINARY	DECIMAL	OCTAL
0	00000	0	0
1	00001	1	1
2	00010	2	2
3	00011	3	3
4	00100	4	4
5	00101	5	5
6	00110	6	6
7	00111	7	7
8	01000	8	10
9	01001	9	11
A	01010	10	12
B	01011	11	13
C	01100	12	14
D	01101	13	15
E	01110	14	16
F	01111	15	17
10	10000	16	20
11	10001	17	21
12	10010	18	22
13	10011	19	23
14	10100	20	24
15	10101	21	25
16	10110	22	26
17	10111	23	27
18	11000	24	30
19	11001	25	31
20	11010	26	32

APPENDIX B DIAGNOSTIC SEQUENCE LISTS

Test sequences make up many of the diagnostics that are executed using the terminal. There are also several automatically run tests that are sequences. This appendix lists the various test sequences with the sub-test names and hexadecimal codes.

NOTE

The last 4 tests in the spin-up sequence are not executed if the drive is in an on-line state when the RUN/STOP switch is pushed. The last four tests comprise the read/write sequence (test 13).

Table B-1 Diagnostic Sequence Lists

Test Code	Name
Hardcore Sequence (run on power-up)	
	Master RAM Test
01	Master ROM Check
0B	Master RAM Timer Test
03	3-Board Bus Test
	UART Test
	Slave RAM Test
19	Slave ROM Check Test

Table B-1 Diagnostic Sequence Lists (Cont)

Test Code	Name
------------------	-------------

Drive Idle Loop Sequence (same as test 18)

01	Master ROM Check
07	Head Select MUX Test
08	Sector Byte Counter Test
0B	Master RAM Timer Test
03	3-Board Bus Test
19	Slave ROM Check
1B	PLO Test
1A	Slave Communication Bus Test
1C	Servo Sanity Timer Test
1D	ADC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test

Spinup Sequence

1B	PLO Test
1C	Servo Sanity Timer Test
1D	ADC/DAC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test
0A	Stream Test
0F	Read Check Test
10	Write Check Test
0E	Read/Write Force Fault Test

Entire Drive Checkout, Spun Down (same as test 17)

02	Master LED Check
01	Master ROM Check
07	Head Select MUX Test
08	Sector Byte Counter Test
0B	Master RAM Timer Test
0D	PCB Wrap Test
19	Slave ROM Check
1B	Servo PLO Check
1C	Servo Sanity Timer Test
1D	ADC/DAC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test

Table B-1 Diagnostic Sequence Lists (Cont)

Test Code	Name
------------------	-------------

Entire Drive Checkout, Spun Up (same as test 16)

02	Master LED Check
01	Master ROM Check
07	Head Select MUX Test
08	Sector Byte Counter Test
0B	Master RAM Timer Test
03	Three-Board Bus Test
19	Slave ROM Check Test
1B	PLO Test
1C	Servo Sanity Timer Test
1D	ADC/DAC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test
21	Servo Slow Seek Test
22	Guard Band Detect Test
25	Random Seek Test
26	Seek-Seek Test (Default Mode)
27	Incremental Seek Test (Default Mode)
0A	Stream Test
0F	Read Check Test
10	Write Check Test
0E	Read/Write Force Fault Test
2A	Servo Recalibration

Hardcore Sequence (same as test 12)

02	LED Check
01	Master ROM Check
07	Head Select MUX Test
0B	Master RAM Timer Test
03	Three-Board Bus Test

Read/Write Sequence (same as test 13)

0A	Stream Test
0F	Read Check Test
10	Write Check Test
0E	Read/Write Fault Force Test

Table B-1 Diagnostic Sequence Lists (Cont)

Test Code	Name
------------------	-------------

Servo Spinup Sequence (same as test 14)

1B	PLO Test
1C	Servo Sanity Timer Test
1D	ADC/DAC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test

Entire Servo Sequence (same as test 15)

19	Slave ROM Check
1A	Slave Communication Bus Test
1B	PLO Test
1C	Servo Sanity Timer Test
1D	ADC/DAC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test
21	Servo Slow Seek Test
22	Guard Band Detect Test
25	Random Seek Test
26	Seek-Seek Test (Default Mode)
27	Incremental Seek Test (Default Mode)
2A	Servo Recalibration

APPENDIX C SUBSYSTEM RUN DIAGNOSTICS

Table C-1 contains a list of the drive-resident tests that can be initiated by the present subsystem diagnostics through the SDI controller.

Table C-1 Subsystem Run Diagnostics

Test Code	Name
01	Master ROM Check
02	Master LED Check
03	Three-Board Bus Test
04	Microprocessor-Only Bus Test
06	Servo/Microprocessor Bus Test
07	Head Select MUX Test
08	Sector/Byte Counter Test
0B	Master RAM Timer Test
14	Servo Spinup Test Sequence
15	Entire Servo Test Sequence
18	Drive Idle Test Sequence
19	Slave ROM Check Test
1A	Slave Communication Bus Test
1B	PLO Test
1C	Servo Sanity Timer Test
1D	ADC/DAC Test
1E	Positioner Loop Test
1F	Velocity Loop Test
20	Track Counter Test
21	Servo Slow Seek Test
22	Guard Band Detect Test
25	Random Seek Test
26	Seek-Seek Test (Default Mode)
27	Incremental Seek Test (Default Mode)
28	Servo Outer Guard Band Seek Test
29	Servo Inner Guard Band Verify Test
2A	Servo Recalibration Test

Any of the above-listed tests may be run under control of the host-resident diagnostics. These drive tests may be called in using the drive-resident diagnostic for the subsystem. This diagnostic consists of four parts. For a UDA50 subsystem, the host-resident diagnostic is CZUDCxx, part two. To call in one of the tests listed in Table C-1, use the following instructions

1. Answer Y to the question CHANGE SW (L)? N
2. Answer Y to the question ENTER MANUAL INTERVENTION MODE FOR SPECIAL DIAGNOSIS (L)?
3. The diagnostic allows the drive to begin the drive idle loop test sequence. Refer to the appropriate VAX or 11-family diagnostic listing for specific directions. At the completion of the sequence, the following message is printed:

```
TEST 2 MANUAL INTERVENTION ON UNIT x UDA AT 172150 DRIVE x
TO WRITE AND READ MEMORY:
    W DATA REGION OFFSET
    R REGION OFFSET
TO RUN A DIAGNOSTIC:
    D REGION
TO EXIT QUESTIONING:
    E
DATA, REGION AND OFFSET ARE HEX VALUES.
(A) ? (Type in the D followed by the specific test number
       found in Table C-1)
(A) ? (Type in another test number or an E to exit the
       questioning)
```

A diagnostic error message is printed and the drive faults if an invalid test number is requested. Byte 14 of the status line (see paragraph 5.2.1) contains the error code of 2B (invalid region specified). The diagnostic then requests a new test to be run. This causes the diagnostic to print another error message and the drive to execute another drive idle loop test sequence. At the completion of the test sequence, the test number question is once again asked and legitimate testing can be continued.

NOTE

Do not depress the FAULT light to obtain a specific fault code during this time. The only way to clear the fault if the FAULT light has been depressed is to ↑C the diagnostic.

Depressing a ↑C exits testing from the system level and cuts off communications between the drive and the controller. Testing continues until the current test sequence is complete. This can result in an unwanted error code of 41 (response timed out). This is also accompanied by a front panel display of an SDI error. Both of these faults may be ignored (under these circumstances only).

APPENDIX D

RA81 DIAGNOSTIC TEST DESCRIPTION

The following paragraphs describe the RA81 diagnostic tests that can be initiated by the user keying in the command RUN DIAG/TEST=xx. There are a total of 44 tests that can be requested. All test numbers shown are hexadecimal and all test results are displayed on the terminal as well as on the LEDs of the microprocessor module. A code of AA is displayed by the LEDs for all successful completions. Appendix E lists the test fault codes.

D.1 TEST 0 (ENTIRE DRIVE SEQUENCE)

The microcode executes a particular sequence of tests depending upon whether the drive is spun up or not. All errors reported correspond to the individual tests. See Appendix B for a list of the tests run in this sequence.

D.2 TEST 1 (MASTER ROM TEST)

This test checks the master ROM set for consistency and checksum.

Errors associated with this test are: 80, 87, 8F, 97, 9F, A7, AF.

D.3 TEST 2 (LED TEST)

This test checks for proper operation of the LEDs. The test starts by lighting the least significant LED and rotates through the LEDs to the most significant. All the LEDs are then turned on. By observing successful completion of the test, the following assumptions can be made:

1. No LED is broken
2. No two LEDs are shorted together
3. The LEDs are operating correctly
4. The LED decode hardware is operating correctly
5. The microprocessor/LED bus is operating correctly.

The time to execute this test is about 4 seconds.

D.4 TEST 3 (THREE-BOARD BUS TEST)

This test checks the module interlocks and communications buses on all 3 modules provided the test is run under control of the diagnostic terminal. This test does not check the personality module bus under the following conditions:

1. The drive is connected to an SDI controller subsystem and this test is run as part of the hardcore test sequence.

2. The drive is connected to an SDI controller subsystem and this test is run as part of remote diagnosis.

Errors associated with this test are: 3B, 3C, 3D, 3E, 3F, B3, B4, 50, F0 to Fe.

D.5 TEST 4 (MICROPROCESSOR-ONLY BUS TEST)

This test checks the bus on the microprocessor board. The SHOW DIAG STAT xxxx command may be used to view the test results. The extended status area byte 9 contains the actual data received in performing this test. Byte 10 contains the expected data received in performing this test.

The error associated with this test is: B3

D.6 TEST 5 (PERSONALITY/MICROPROCESSOR BUS TEST)

This test checks the communication bus between the microprocessor and the personality modules. It also checks the communication bus on the personality module.

The error associated with this test is: B4

D.7 TEST 6 (SERVO/MICROPROCESSOR BUS TEST)

This test checks the communication bus between the microprocessor and the servo modules.

Errors associated with this test are: 50, F0 to FE.

D.8 TEST 7 (HEAD SELECT MUX TEST)

This test checks the capability of the drive to select the r/w heads properly.

Errors associated with this test are: 52, 53, 54.

D.9 TEST 8 (SECTOR/BYTE COUNTER TEST)

This test checks the sector and byte counter clocks on the microprocessor module to see if they count properly.

The error associated with this test is: 51.

D.10 TEST 9 (F.E. FRONT PANEL TEST)

This test checks the ability of the drive to read the front panel switches while checking for any bulbs that are burned out. After the test is called in, the terminal displays the following:

```
THIS IS THE OPERATOR CONTROL PANEL TEST
```

```
ENTER A ^C TO EXIT- (ENTER ^C TWICE IF IN LOOP MODE)
```

The front panel lights may then be checked by the operator. Open the logic access cover on the drive and observe the microprocessor LEDs. As each front panel light is pushed, a corresponding LED lights. As the front panel lights are turned off, the corresponding LED goes off. This test checks the switch decode logic for proper operation. If diagnostic loop mode had been previously set by the operator, ↑C must be input twice to exit the test and obtain the following display:

%RA81-COMPLETED TEST:DIAG SUBTEST:09
RA81>

D.11 TEST A (STREAM TEST)

This test checks for the presence of r/w signals when generated. It also checks for the assertion of these signals by the r/w detection circuitry on the microprocessor module.

Errors associated with this test are: 50, D0, D6, DA, 65, B8, B9, BA, BB, BC, BD, BE, 25, 30 to 3A and F0 to FE.

D.12 TEST B (MASTER RAM TIMER TEST)

This test checks the ability of the RAM timers on the microprocessor module to count correctly.

The error associated with this test is: 57.

D.13 TEST C (PERSONALITY MODULE LOGIC TEST)

This test checks the personality module logic. To successfully execute this test, loop-back plugs are required in the SDI connectors of the module (Figure D-1).

NOTE

Loop-back plugs left in the drive after running this test cause multiple false error indications.

Errors associated with this test are: 7B, 73, 74, 75, 76, 77, 78, 79, 7A, 90, 91, 92, 93, 94, 95, 96, 81, 82, 83, 84.

D.14 TEST D (PERSONALITY MODULE WRAP TEST)

This test performs the same testing as Test C with the exception that the loop-back function is not checked. This test is also identical to the RUN INTE command. This test does not require the loop-back plugs to run.

Errors associated with this test are: 7B, 70, 71, 72, 7C, 7D, 81.

D.15 TEST E (R/W FAULT FORCE TEST)

This test checks the ability of the drive to detect certain read/write faults.

Errors associated with this test are: 50, D0, D6, DA, A0, A3, A4, A5, A6, A9, 25, 30 to 3A, and F0 to FE.

D.16 TEST F (READ ONLY TEST)

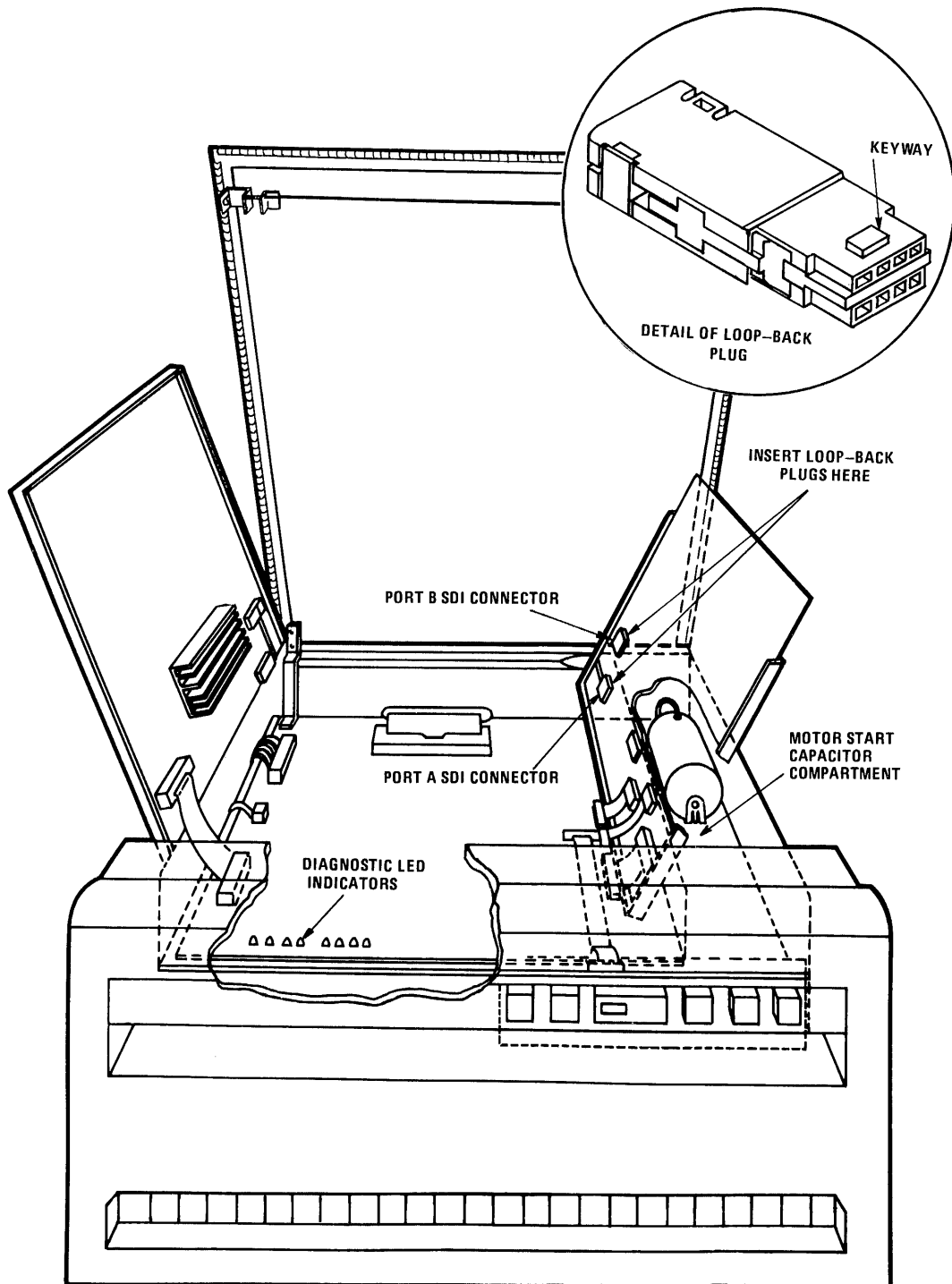
This test checks the ability of the drive to read data from the disk correctly. This test uses the dedicated diagnostic read-only cylinder. This cylinder has a specific data pattern already written on it. If the data is destroyed, then Test 11 may be run to reformat the read-only cylinder.

Errors associated with this test are: 50, D0, D6, DA, 54, 61, 62, 63, 65, 66, 25, 30 to 3A, and F0 to FE.

D.17 TEST 10 (WRITE AND READ TEST)

This test checks the ability of the drive to write data on the disk and then read it back correctly. All read/write heads are used in the execution of this test. The test uses the dedicated read/write cylinder of the HDA. Test F must be run and successfully passed before this test can be executed properly.

Errors associated with this test are: 50, D0, D6, DA, 61, 62, 63, 65, 66, 67, 25, 30 to 3A, and F0 to FE.



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Figure D-1 Loop-Back Plug Insertion

D.18 TEST 11 (READ-ONLY CYLINDER FORMATTER)

This is a utility program used to reformat the dedicated read-only cylinder of the HDA. The program requires a jumper to be inserted from the top of R5 to a ground point such as either lead on connector P307. Figure D-2 shows the location of R5 and connector P307.

Errors associated with this test are: 50, D0, D6, DA, 61, 62, 63, 65, 66, 68, 25, 30 to 3A, and F0 to FE.

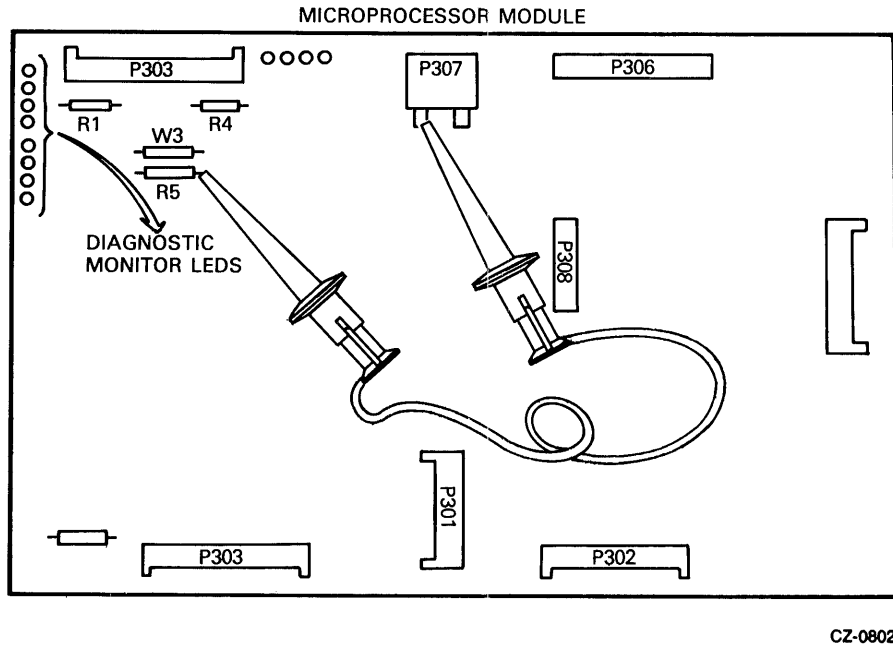


Figure D-2 Ground Jumper For Formatter

D.19 TEST 12 (MASTER HARDCORE SEQUENCE TESTS)

A list of the tests run in this sequence may be found in Appendix B. Note that this sequence is not the same as the hardcore sequence run when power is first applied.

D.20 TEST 13 (MASTER READ/WRITE SEQUENCE TESTS)

This sequence is executed each time the drive is spun up. A list of the tests run in this sequence may be found in Appendix B.

D.21 TEST 14 (SERVO SEQUENCE TESTS)

This sequence tests the servo logic of the drive. A list of the tests run in this sequence may be found in Appendix B. These tests and four others are executed automatically as soon as the drive is spun up or down. See spinup sequence in Appendix B.

D.22 TEST 15 (ENTIRE SERVO SEQUENCE TESTS)

A list of the tests run in this sequence may be found in Appendix B. The drive must be spun up in order to run this sequence.

D.23 TEST 16 (ENTIRE DRIVE SEQUENCE, SPUN UP)

This sequence is run when the user keys in the diagnostic command RUN DIAG when the HDA is spun up and the heads are loaded. A list of the tests run in this sequence may be found in Appendix B. The time to execute this sequence is about 6 minutes, 30 seconds.

D.24 TEST 17 (ENTIRE DRIVE SEQUENCE, SPUN DOWN)

This sequence is run when the user keys in the diagnostic command RUN DIAG with the drive power on and the RUN/STOP switch not depressed. A list of the tests run in this sequence may be found in Appendix B. The time to execute this sequence is about 25 seconds.

D.25 TEST 18 (DRIVE IDLE SEQUENCE TESTS)

This sequence is run automatically when the drive is in the drive off-line mode (both port select buttons are out; i.e., not pushed). A list of the tests run in this sequence may be found in Appendix B. The time to execute this sequence is about 20 seconds with the drive spun down. With the drive spun up, the time is about 30 seconds.

D.26 TEST 19 (SLAVE ROM TEST)

This test checks the slave ROM set for consistency and checksum.

Errors associated with this test are: E2 to E6, 50, F0 to FE

D.27 TEST 1A (SLAVE MICROPROCESSOR BUS TEST)

This test checks the communication bus between the microprocessor and the servo modules.

Errors associated with this test are: 50, F0 to FE.

D.28 TEST 1B (SERVO PLO TEST)

This test checks the servo module PLO circuitry.

Errors associated with this test are: 50, 7B, C6, F0 to FE.

D.29 TEST 1C (SERVO SANITY TIMER TEST)

This test checks the ability of the servo module to generate a trap interrupt from the sanity timer.

Errors associated with this test are: 50, CE, F0 to FE.

D.30 TEST 1D (SERVO DAC TEST)

This test checks the DAC and the ODAC on the servo module.

Errors associated with this test are: 50, C8, C9, CA, F0 to FE.

D.31 TEST 1E (SERVO POSITIONER LOOP TEST)

This test checks the ability of the servo to reach fine track status within the given time limit.

Errors associated with this test are: 50, C0, C2, C3, C4, C5, F0 to FE.

D.32 TEST 1F (SERVO VELOCITY LOOP TEST)

This test checks the ability of the servo to maintain the proper read/write head velocity during any seek.

Errors associated with this test are: 50, CB, F0 to FE.

D.33 TEST 20 (SERVO TRACK COUNTER TEST)

This test checks the ability of the track counters on the servo module to count properly.

Errors associated with this test are: 50, CC, CD, F0 to FE.

D.34 TEST 21 (SERVO SLOW SEEK TEST)

This test checks the ability of the drive to perform a slow seek to the last data track and back to track 0. The drive is then requested to perform normal 1-, 2-, and 4-track seeks.

Errors associated with this test are: 50, C6, D0, D6, DA, DB, DE, F0 to FE.

D.35 TEST 22 (GUARD BAND DETECT TEST)

This test checks the ability of the drive to seek into both the inner and outer guard bands. The test also verifies that the heads can be loaded while in either guard band.

Errors associated with this test are: 50, D0 to DB, F0 to FE.

D.36 Test 23 (INCREMENTAL SEEK, F.E. MODE)

This test causes the drive to perform incremental seeks. The user specifies the starting and ending cylinder addresses. The drive then seeks from the starting address to the ending address performing recalibrates in between each seek. At the completion of each seek, the starting address is incremented by one.

Errors associated with this test are: 50, D0, D6, DA, DB, DC, F0 through FE .

D.37 TEST 24 (SEEK-SEEK, F.E. MODE)

This test causes the drive to perform seeks to addresses specified by the user.

Errors associated with this test are: 50, D0, D6, DA, DB, DC, F0 through FE.

D.38 TEST 25 (RANDOM SEEK TEST)

This test causes the drive to perform random seeks using the random seek table to specify the cylinder addresses.

Errors associated with this test are: 50, D0, D6, DA, DB, DD, F0 through FE.

D.39 TEST 26 (SEEK-SEEK, DEFAULT MODE)

This test causes the drive to perform seeks between the first and last data cylinders.

Errors associated with this test are: 50, D0, D6, DA, DB, F0 through FE.

D.40 TEST 27 (INCREMENTAL SEEK, DEFAULT MODE)

This test causes the drive to perform an incremental seek between the first and last data cylinders.

Errors associated with this test are: 50, D0, D6, DA, DB, F0 through FE.

D.41 TEST 28 (SERVO OUTER GUARD BAND SEEK)

This test checks the ability of the drive to seek into and detect the outer guard band.

Errors associated with this test are: 50, D0, D4, D6, DA, DB, DD, F0 through FE.

D.42 TEST 29 (SERVO INNER GUARD BAND VERIFY)

This test checks the spindle status and the ability of the drive to load the heads.

Errors associated with this test are: 50, D0, D6, DA, F0 through FE.

D.43 TEST 2A (SERVO RECALIBRATION)

This test causes the drive to perform a recalibration, detenting the heads on cylinder 0.

Errors associated with this test are: 50, D0, D6, DA, DB, DD, F0 through FE.

**APPENDIX E
SYSTEM FAULT CODES**

Table E-1 lists the RA81 drive errors and fault display codes.

NOTE
Loop-back plugs left in the drive following execution of Diagnostic Test C cause multiple false error codes to be displayed.

Table E-1 Drive Error Display Codes

Error Code	Name
01	Spindle motor speed transducer timeout
02	Spindle speed of 1000 r/min not reached in 6 seconds during spinup
03	Spindle not accelerating during spinup
04	Spindle speed of 3420 r/min not reached in 40 seconds during spinup
05	Startup being inhibited by power sequencing grant not present or start in progress (SIP) present (this could be legitimate status)
06	Microcode fault
07	Level two message frame sequencing error
08	Level two message checksum error
09	SDI message framing error
0A	Invalid operation code parity for a level 1 or 2 message
0B	Invalid operation code for a level 1 or 2 message
0C	Invalid command length for a level 2 message

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
0D	Status error byte non-zero while attempting to execute a command
0E	Group select code non-zero while attempting to execute a command
0F	Write protect switch is in the PROTECT position while attempting to write enable the drive
10	Invalid error code sent by slave
13	Fine track not reached during detent mode
15	Too much time taken to execute a seek or recal command
16	Guard band detected while performing a seek command
17	Seek logic difference counter decremented past 0 before expected cylinder was reached
1A	Seek command contains an invalid cylinder address
1B	Velocity calibration detected too many bad seeks
1C	Unsuccessful recalibrate command detected during a velocity calibration
1D	Drive seeks are more than 10% too fast
1E	Drive seeks are more than 15% too slow
1F	A sector pulse is detected during the execution of a read or write of a sector
20	A parity is error detected on the controller real-time state line
21	Two or more pulses of the same polarity are detected on the controller real-time state line (control pulse error)
22	Two or more pulses of the same polarity are detected on the controller write command data line (data pulse error)
23	Spindle motor interlock broken (belt tension lever is released)
25	Servo error (SVOCHK) detected (off track during detent mode)
26	Spindle speed is detected as being less than 3420 r/min (3600-5%)
27	HDA temperature too high

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
28	Servo module temperature too high
29	Invalid error recovery level specified
2A	Invalid subunit specified
2B	Invalid region specified in a diagnose command
2C	Seek or recal command attempted while the spindle is not spinning
2D	Invalid command timeout value given
2E	Controller flags are detected prohibiting drive spinup
2F	RUN/STOP switch is in the stop position while attempting a run command
30	Write current is turned on without write gate being asserted
31	A read command is attempted with write gate asserted
32	A read or write command is attempted while the drive is faulted
33	A burst error is detected while writing
34	Read data separator/encoder error
35	Write unsafe error detected while attempting a write command
36	Short circuit detected in head winding
37	No write current detected with write gate asserted
38	A read command is attempted with multiple heads selected
39	A write command is attempted while the positioner is off track (not detented)
3A	A write command is attempted while the drive is write protected
3B	Servo/HDA interlock broken
3C	Servo interlock broken
3D	Read/Write interlock broken

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
3E	Control panel interlock broken
3F	Personality module interlock broken
40	Invalid R/W region specified
41	SDI controller response timed out
42	Drive not in an on-line state while attempting a seek command
43	R/W READY not set while attempting a real-time command
44	Format enable not set while attempting a format command
45	Real-time command contains an invalid head (track) address
46	R/W safety interrupt occurred with no cause bits set
47	Disconnect command contains an incorrect TT bit
48	Invalid write memory offset or byte count
49	Invalid command found while in topology mode
4A	Drive is disabled by DD bit
4B	Index pulse error
4D	Bad embedded servo data found during a write command
50	Slave diagnostic timeout
NOTE This error could be the result of the positioner lock lever in the lock position.	
51	The sector/byte failed to count properly
52	Group 0 cannot be selected
53	Group 1 cannot be selected

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
54	R/W head select error while executing the head select multiplexer test
57	Master RAM timer faulty
60	R/W head select error while executing read/write test
61	R/W data setup error (diagnostic write data register not equal to diagnostic read data reg.)
62	The data from 3 or more heads is bad while executing the read only test
63	The data from 1 or 2 heads is bad while executing the read only test
65	Read/Write test sector could not be found within two revolutions of the disk.
66	Read failure caused by servo being off-track
67	Write test cannot be executed because Test F was not run or failed
68	Read-only cylinder cannot be reformatted without jumper
69	Read/Write diagnostic comparison circuitry never detects an error
6F	Diagnostic write attempted while write protected
70	Command available timeout error during execution of PCB wrap test
71	SDI INIT always asserted
72	No control clock or framing error occurred during execution of PCB wrap test
73	Microprocessor and PCB board data bus communication error
74	Initial personality board status incorrect for offline condition
75	Failure in control clock error detect circuit
76	Failure in data clock error detect circuit
77	Port A select latch failed
78	Port A data transmitter/receiver error
79	Port A control line transmitter/receiver error
7A	Port B select latch failure

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
7B	Spindle motor spinning while attempting PCB test
7C	Received error in frame code during PCB wrap test
7D	Received error in data byte during PCB wrap test
80	Consistency fault detected in master ROM
81	Command available did not reset after reading data
82	Frame code did not reset after reading data
83	Cannot receive SDI INIT from Port B
84	INIT bit not clear following INIT
85	Master RAM 0 failed RAM test
86	Master RAM 1 failed RAM test
87	Checksum error detected in master ROM 0
8F	Checksum error detected in master ROM 1
90	Port B data transmitter/receiver error
91	Port B control line transmitter/receiver error
92	Port A wraparound error
93	Response serializer error
94	Loop-around frame not received properly
95	Loop-around frame was not decoded properly
96	Loop-around frame data byte was not received properly
97	Checksum error detected in master ROM 2
9F	Checksum error detected in master ROM 3
A0	Unable to clear faults at R/W safety register
A1	Unable to force head short error while writing

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
A2	Unable to force multiple head select error while reading
A3	Unable to force read gate and write gate active at the same time
A4	Unable to force write current without write gate
A5	Unable to force write gate without write current
A6	Unable to force a miscompare of the data from the write compensation logic and the read encoder logic
A7	Checksum error detected in master ROM 4
A9	Servo fault caused a R/W forced fault
AA	Diagnostic firmware OK prompt code
AF	Checksum error detected in master ROM 5
B0	Test will not run due to a drive fault
B3	Bus test error in microprocessor module
B4	Bus test error in personality module
B6	UART transmitter/receiver error
B8	Stream test write clock not active
B9	Stream read clock not active
BA	Stream buffered servo clock not active
BB	Stream ECL write data not present
BC	Stream encoded write data not present
BD	Stream decoded read data not present
BE	Stream ECL read data not present
BF	Unable to reset stream bit
C0	Fine track timer error

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
C1	Fine track status not true
C2	Fine track status not false
C3	Fine track over-range error
C4	Fine track under-range error
C5	Wrong fine track channel detected
C6	PLO error
C8	ADC/DAC reference voltage not within range
C9	ADC/DAC bit error
CA	ADC/ODAC bit error
CB	Servo velocity test acceleration status error
CC	Seek difference counter did not load correctly
CD	Seek difference counter error or the old Gray code bits are wrong
CE	Servo sanity tests timer error
D0	Load attempt failed
D1	Outer guard band detected following a head load operation
D2	Inner guard band detected following a head load operation
D3	Seek into the outer guard band failed
D4	Outer guard band not detected following a seek into the outer guard band
D5	Load from outer guard band failed
D6	Spindle not up to speed
D7	Seek into inner guard band failed
D8	Inner guard band not detected following a seek into the inner guard band

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
D9	Load from inner guard band failed
DA	Spindle not spinning
DB	Diagnostic seek failed
DC	Incorrect parameters entered during execution of drive-resident diagnostics
DD	Recalibrate error
DE	Low velocity seek error
DF	Spinup failed
E0	Random seek error
E1	Integrator error
E2	Slave ROM consistency error
E3	Checksum error on slave ROM 0
E4	Checksum error on slave ROM 1
E5	Checksum error on slave ROM 2
E6	Checksum error on slave ROM 3
E7	Test execution code
E8	Error in slave RAM 0
E9	Error in slave RAM 1
EE	Incorrect test parameter entered
F0	Slave uncommanded spindown
F1	Slave load timeout
F2	Slave sent an unexpected message
F3	Slave received a bad command packet

Table E-1 Drive Error Display Codes (Cont)

Error Code	Name
F4	Slave operation code parity error
F5	Slave received an invalid operation code
F6	Master received a bad status packet from slave
F7	Slave recalibrate timeout

NOTE

This error could be the result of the positioner lock lever in the lock position.

F8	Slave seek timeout
F9	Slave offset timeout
FA	Slave spinup timeout
FB	Slave spindown timeout
FC	Slave send status timeout
FD	Slave initialization timeout
FE	Slave speed check timeout

APPENDIX F FRONT PANEL FAULT IDENTIFICATION

This appendix is used to identify faults called out by the front panel indicator lights. Table F-1 shows the status of the front panel lights for each type of error reported.

Table F-1 Drive Front-Panel Fault Identification Codes

Fault Condition	RUN/ STOP	FAULT	RDY	WRITE PROT	A	B	Status Byte 15 Hex Code
Index error	on	on					11
Master/slave error		on		on			12
Servo diagnostic test error	on	on		on			13
Microprocessor fault		on			on		14
Drive disabled by DD bit	on	on			on		15
Servo coarse positioning error		on		on	on		16
Diagnostic idle loop test error	on	on		on	on		17
Spin error		on				on	18
Write and bad embedded data	on	on				on	19
Servo fine positioning error		on		on		on	1A

Table F-1 Drive Front-Panel Fault Identification Codes (Cont)

Fault Condition	RUN/ STOP	FAULT	RDY	WRITE PROT	A	B	Status Byte 15 Hex Code
R/W diagnostic test error	on	on		on		on	1B
SDI error		on			on	on	1C
Write enable and write protect asserted error	on	on			on	on	1D
Spindle motor interlock error		on		on	on	on	1E
Servo or HDA overtemp error		on	on				30
Servo/microprocessor interlock error		on	on	on			32
R/W command error		on	on		on		34
Control panel/microprocessor interlock error		on	on	on	on		36
R/W unsafe error		on	on			on	38
Read/write microprocessor interlock error		on	on	on		on	3A
Servo/HDA interlock error		on	on		on	on	3C
Personality/microprocessor interlock error		on	on	on	on	on	3E
Microprocessor hardcore test error	on	on	on	on	on	on	3F
DC low	on		on	on	on	on	*

NOTE

The DC Low condition locks up the drive logic and therefore cannot have a hexadecimal code represented by the host system diagnostics.

APPENDIX G

ERROR CODE TROUBLESHOOTING TABLE

Table G-1 correlates the error codes that are displayed by the subsystem diagnostics or the field service diagnostic terminal to an FRU reference code. Appendix H provides names and part numbers for FRUs. Note that more than one error code can result in the same FRU reference.

Table G-1 Drive Error Code/FRU Reference List

Error Code	FRU Probable Cause
01 02 03 04	Mtr/Brk assembly, belt, servo module, power supply, speed transducer
05	The power sequencing signals are inhibiting the startup of the drive. Probably caused by the preceding drive not being up to speed. Check to see if the drive can spin up with the power sequencing jumper moved to this drive. If drive spins up then problem is with the preceding drive. Replace personality module, microprocessor module, and the cables between the two drives. If the drive did not spin up, then the problem is with the drive that displayed the error. Check modules and cables as outlined above.
06	Microprocessor module, servo module
07 08 09 0A 0B 0C	Personality module, SDI cables, controller
0D 0E 0F	SDI cables, controller
10	Servo module, microprocessor module
13	Servo module, R/W module, HDA

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
15 16 17	Servo module, HDA
18	Servo module, microprocessor module
1A	SDI cables, controller
1B 1C	Servo module, R/W module, HDA
1D 1E	Servo module, HDA
1F	Microprocessor module, SDI cables, controller
20 21 22	Personality module, SDI cables, controller
23	Check cables or motor/belt interlock
25	Servo module, microprocessor module, motor/brake assembly, belt, power supply, HDA
26	Motor/Brake assembly, belt, servo module, power supply, speed transducer
27	Check fans, ambient room temperature and temperature sensor for proper operation. Check proper seating of cable from R/W to microprocessor module. If OK, then replace the R/W module, microprocessor module, cables, HDA.
28	Check fans and ambient room temperature. If OK, then replace servo module, microprocessor module, cables between microprocessor and servo module.
29 2A 2B 2C 2D 2E 2F	SDI cables, controller
30	Microprocessor module, R/W module, personality module, HDA

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
31	Microprocessor module, personality module, SDI cables, controller
32	
33	
34	Microprocessor module, R/W module, personality module, HDA
35	R/W module, microprocessor module, HDA
36	
37	
38	
39	Servo module, R/W module, HDA
3A	Microprocessor module, SDI cables, controller
3B	Check servo/HDA cable, read-write/HDA cable
3C	Check servo/microprocessor cable
3D	Check read-write/microprocessor cable
3E	Check control panel/microprocessor cable
3F	Check personality/microprocessor cable
40	SDI cables, controller
41	
42	SDI cables, controller
43	
44	
45	
46	Microprocessor module, power supply
47	SDI cables, controller
48	
49	
4A	
4B	Servo module, microprocessor module, motor/brake assembly, belt, power supply, HDA
4D	R/W module, servo module, HDA, microprocessor module

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
50	Ensure that positioner motor lock is in the unlock position. If OK, then replace servo module, microprocessor module
51	Microprocessor module
52	
53	
54	
57	
60	
61	Personality module, microprocessor module
62	R/W module, microprocessor module, personality module, HDA
63	R/W module, microprocessor module, HDA
65	Microprocessor module, servo module
66	Servo module, R/W module, HDA
67	Test 10 (write and read test) was attempted before a successful completion of test 0F.
68	Install the jumper to run test 11 successfully.
69	Microprocessor module, R/W module, reformat the read-only cylinders using Test 11.
6F	Remove write protect status from drive. If OK, then replace microprocessor module, control panel module.
70	Personality module, microprocessor module
71	
72	
73	
74	
75	
76	
77	
78	Insert SDI loop-back plugs, personality module
79	Personality module, microprocessor module
7A	
7B	Spin down the disk

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
7C 7D	Personality module, microprocessor module
80	Microprocessor module
81 82 83 84	Personality module, microprocessor module
85 86 87	Microprocessor module
8B	Microprocessor module, personality module, SD controller
8F	Microprocessor module
90	Insert SDI loop-back plugs, personality module
91 92 93 94 95 96	Personality module, microprocessor module
97 9F A0	Microprocessor module
A1 A2	Microprocessor module, R/W module
A3	Microprocessor module
A4	Microprocessor module, R/W module
A5 A6 A7	Microprocessor module
A9	Servo module, R/W module, HDA
AF	Microprocessor module

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
AB	Servo module, HDA
B0	A drive fault is inhibiting the running of a test. Check microprocessor LEDs for a specific drive fault.
B3	Microprocessor module
B4	Personality module, microprocessor module
B6	Ensure the diagnostic terminal cable is not connected. Check the 24 volt supply to the microprocessor module. If 24 volts is missing then check cable to module then replace power supply. If OK, then replace the microprocessor module
B7	R/W module, microprocessor module, personality module, HDA
B8	Personality module, microprocessor module
B9	Microprocessor module, servo module
BA	Servo module, microprocessor module
BB	Microprocessor module
BC	
BD	R/W module, microprocessor module, HDA
BE	
BF	Microprocessor module
C0	Servo module
C1	
C2	
C3	
C4	
C5	
C6	
C8	
C9	
CA	
CB	
CC	
CD	
CE	

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
D0 D1 D2	Servo module, R/W module, HDA
D3	Servo module, HDA
D4	Servo module, R/W module, HDA
D5	Servo module, HDA
D6	Motor/Brake assembly, belt, servo module, power supply, speed transducer
D7	Servo module, R/W module, HDA
D8	Servo module, HDA
D9	Servo module, R/W module, HDA
DA	Spin up disk
DB	Servo module, R/W module, HDA
DC	Reenter parameters
DD DE	Servo module, R/W module, HDA
DF	Motor/Brake assembly, belt, servo module, power supply, speed transducer
E0	Servo module, R/W module, HDA
E1 E2 E3 E4 E5 E6	Servo module
E8 E9	Servo module
EE	Illegal test parameter

Table G-1 Drive Error Code/FRU Reference List (Cont)

Error Code	FRU Probable Cause
F0	Motor/Brake assembly, belt, servo module, power supply, speed transducer
F1	Servo module, R/W module, HDA
F2	Servo module, microprocessor module
F3	Microprocessor module, servo module
F4	
F5	
F6	Servo module, microprocessor module
F7	Servo module, R/W module, HDA
F8	
F9	Servo module, microprocessor module
FA	
FB	
FC	
FD	
FE	

APPENDIX H FRU PART NUMBER LIST

Tables H-1 and H-2 contain a list of the FRUs and their part numbers. Part numbers may change after publication of this manual edition. When ordering FRUs, refer to the latest *RA81 Illustrated Parts Breakdown Manual* for part number information.

Table H-1 FRU Part Number List (60 Hz - RA81-AA)

Part Number	Description
12-12635-03	Belt (60 Hz) *
70-16980-00	Belt tension assembly
70-18340-02	Cabinet I/O bulkhead assembly
70-19666-01	Cable (ASCII port interface) *
70-16735-00	Cable (servo preamp)
70-16737-00	Cable (40 conductor for personality module)
70-16737-01	Cable (40 conductor for servo module)
70-16738-00	Cable (20 conductor for personality module)
70-19060-01	Cable (26 conductor between R/W module and HDA)
70-16739-00	Cable (50 conductor for R/W module)
70-16740-00	Cable (control panel)
70-19691-10	Cable (internal drive sequencing, 20 inch)
70-19690-06	Cable (drive sequencing, 6 foot)
70-19690-08	Cable (drive sequencing, 8 foot)
70-19690-12	Cable (drive sequencing, 12 foot)
70-19690-25	Cable (drive sequencing, 25 foot)
70-19690-50	Cable (drive sequencing, 50 foot)
70-19690-80	Cable (drive sequencing, 80 foot)
BC26V-12	Cable (SDI, 12 foot)
BC26V-25	Cable (SDI, 25 foot)
BC26V-50	Cable (SDI, 50 foot)
BC26V-80	Cable (SDI, 80 foot)
10-16924-00	Cap, motor start (115v/60 Hz)
29-23187-00	Case (spares carrying) *
12-10719-03	Fan (25-35 CFM)

Table H-1

Part Number	Description
12-17719-03	Fan (115 CFM)
74-22816-00	Filter (air) *
12-17072-00	Gas spring
(TBS)	Hand-Held terminal *
70-16732-00	Harness assembly (logic dc power)
70-16733-00	Harness assembly (logic ac power)
70-18491-01	HDA (16 bit)
70-20016-01	I/O block (sequence cables)
12-14011-00	Microswitch (1 PSA) *
12-12716-00	Lamp wedge
70-18324-00	Module (control panel) *
54-15247-00	Module (microprocessor) *
70-19046-01	Module (personality with stiffener) *
54-15253-00	Module (read/write) *
70-19045-01	Module (servo with stiffener) *
70-16723-00	Motor/brake assembly (115v/60 Hz) *
H7660-A	Power supply (120v/60 Hz) *
17-00083-23	Power cord assembly (60 Hz)
12-16817-00	Sensor (speed) *
12-16870-00	Sensor (temperature)
70-16742-00	Shock mount assembly
70-19689-01	SI internal assembly
70-19074-00	SDI loop-back plug *
70-16215-00	Spring (brush ground) *
74-22440-00	Spring (motor tension) *
12-12714-00	Switch cap (Run/Stop)
12-12714-01	Switch cap (Write Prot)
12-12714-02	Switch cap (Fault)
12-12714-03	Switch cap (Port A)
12-12714-04	Switch cap (Port B)
12-18199-00	Switch cap (Unit Select 0-255/Ready) *
70-19692-01	Terminator (sequence)
70-16230-00	Wing pivot assembly

NOTE

The * denotes branch spares found in the CD kit (AS-W0512-10).

Table H-2 FRU Part Number List (50 Hz - RA81-AD)

Same as RA81-AA with the following exceptions:

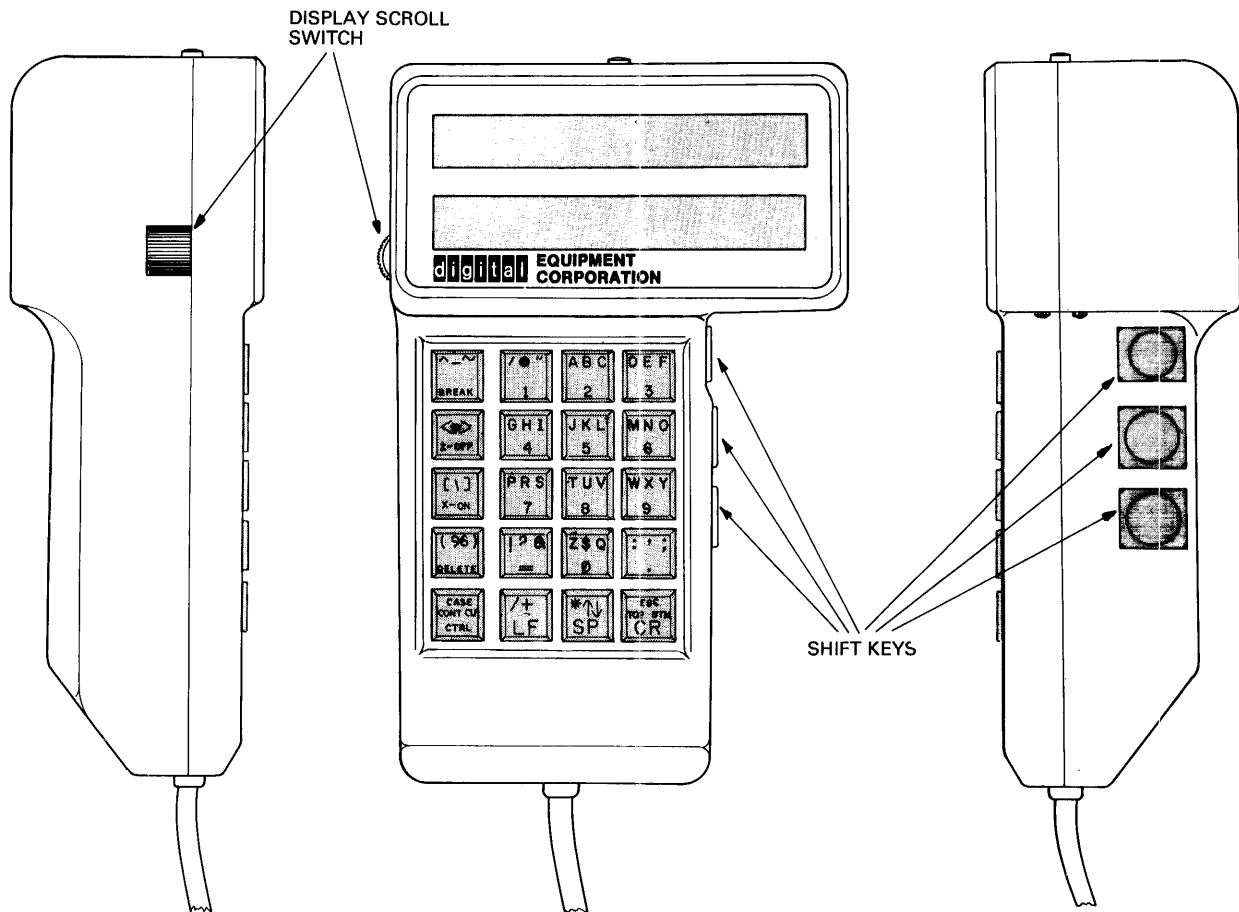
Part Number	Description
H7660-B	Power supply (220v/50 Hz)
10-17217-00	Cap (motor start, 220v/50 Hz)
12-12635-04	Belt (50 Hz)
70-00083-24	Power cord assembly (50 Hz)
70-16723-01	Motor/Brake assembly (240v/50 Hz)

APPENDIX I DIAGNOSTIC TERMINAL INSTRUCTIONS

This appendix provides instructions on how to use the field service diagnostic terminal.

I.1 INTRODUCTION

Refer to Figure I-1. The terminal contains a two-level LED display and a keyboard. The display holds a maximum of 32 characters while an internal buffer stores 2K characters for the display. The keyboard contains a standard ASCII set of alphanumeric characters. The larger character on each keybutton is the default character displayed when the button is pushed.



CZ-0768

Figure I-1 Diagnostic Terminal Keypad

I.2 SHIFT KEYS

To obtain one of the other three possible characters shown on any key, one of the three shift keys on the right side of the terminal must be used. When the upper shift key on the terminal is pushed and held while depressing a keyboard button, the left-most character is displayed.

As an example, hold the middle shift key and push the number 5 key. The letter K is displayed. Pushing the lower shift key and the 0 key, results in the letter Q being displayed.

I.3 CONTROL CHARACTERS

A control character (e.g., ↑C) is obtained by using the CTRL key, the shift keys, and the appropriate letter key. Push the CTRL key. Push one of the shift keys simultaneously with the appropriate letter key.

Example: A ↑Z is desired. The following steps should be used.

1. Push CTRL key
2. Push the upper shift key on the right-hand side of the drive
3. Simultaneously with step 2, push the number 0 key.

I.4 CONTINUE (CONT) AND CLEAR (CLR) KEYS

These two keys control the automatic transmit-on and transmit-off feature of the terminal. The CONT key disables the feature while the CLR key re-enables the feature.

The transmit-on/transmit-off feature is automatically enabled when power is applied to the terminal. Keeping this feature in automatic allows the transmit-on (X-On) signal to fill the display buffer. After the buffer is full, the transmit-off (X-Off) signal stops all transmission to the display buffer. No more data is sent to the terminal until the buffer is unloaded. At this time, the terminal re-enables data transmission by sending the signal transmit-on (X-On).

I.5 X-ON, X-OFF KEYS

These keys manually control the display buffer of the terminal. If the buffer is full, an automatic X-Off signal stops all transmission to the buffer. Pushing X-On key will reload the buffer with new information even though the buffer has not been read (unloaded).

Pushing X-Off key will stop the loading of the buffer even though the it not full. For example, the automatic X-On, X-Off feature is disabled by the CONT key while test messages are being input to the terminal. These messages are received at a faster rate than can be read by the human eye. Pushing the X-Off key stops the diagnostic testing (and the messages). This enables the user to read the display and manually scroll through the buffer.

I.6 DELETE KEY

The delete key is used to correct mistakes in keyboard entries. Once a mistake is discovered, the delete may be pushed causing a backslash (\) to be displayed with the last character input. The new character may now be keyed in. For example, if RUN DIAF was keyed in, the delete key could be used as follows.

```
RUN DIAF\F\G
```

The command RUN DIAG is now input correctly.

I.7 DISPLAY SCROLL SWITCH

The display scroll switch is located on the left side of the terminal. Its function is to back up or advance the display within the 2K buffer. The display scroll switch is moved in the upward direction to scroll the display forward. The display scroll switch is moved downward to scroll the display backward.

I.8 BREAK KEY

The break key transmits a break character when pushed. Its function is the same as a VT100 break key and is not used in RA81 diagnostic operation.

I.9 CR KEY (CARRIAGE RETURN)

This key is pushed after typing a command string. Its effect is that of an enter key on other computers.

I.10 ESCAPE KEY

This key transmits an escape character when pushed. Its function is the same as a VT100 escape key and is not used in RA81 diagnostic operation.

I.11 LINE FEED KEY (LF)

This key causes the display to advance 16 characters in the display buffer (one line of text).

I.12 SPACE KEY (SP)

This key causes a space to be input between characters in a string.

I.13 UP AND DOWN ARROW KEYS

These keys cause the cursor to be positioned at either the last or next carriage return character.

I.14 TOP AND BOTTON KEYS (TOP/BTM)

These keys position the display to either the top or the bottom of the display buffer.

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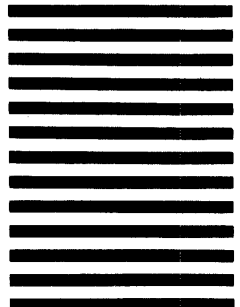
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