

AA-M186B-TC

RA80 Maintenance Guide

Digital Equipment Corporation
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CONTENTS

	Page
1 INTRODUCTION	
1.1 SCOPE OF BOOK	1
1.2 RELATED DOCUMENTATION	1
2 REMOVAL AND REPLACEMENT	
2.1 INTRODUCTION	3
2.2 LOCATION OF MAJOR REPLACEABLE UNITS	3
3 ADJUSTMENTS	
3.1 INTRODUCTION	7
3.2 BELT TENSION ADJUSTMENT	7
3.3 SERVO ADJUSTMENTS	10
4 DRIVE-RESIDENT DIAGNOSTICS	
4.1 INTRODUCTION	19
4.2 DIAGNOSTIC CONTROLS AND INDICATORS	19
4.2.1 Rotary Switches	19
4.2.2 ENTER/RESET Switch	20
4.2.2.1 The ENTER Position	21
4.2.2.2 The RESET Position	21

CONTENTS

4	DRIVE-RESIDENT DIAGNOSTICS (cont.)	Page
4.2.3	LED Display	21
4.3	TEST-SELECT CODES	22
4.4	PROMPT AND STEADY STATE CODES	25
4.5	RA80 UTILITY AND DIAGNOSTIC PROCEDURES	28
5	FAULT ISOLATION	
5.1	INTRODUCTION	73
5.2	HDA FORMATTING PROCEDURE	73
5.3	SUBSYSTEM ERROR MESSAGE INFORMATION	73
5.4	LED ERROR CODES TROUBLE-SHOOTING CHARTS	79
5.5	POWER SUPPLY FAULT ISOLATION	95
5.6	TROUBLESHOOTING TIPS	98
5.6.1	Check Firmware Revision and ROM Set Numbers	98
5.6.2	Testing the Write-Protect Function	99
5.6.3	Spindle Motor Thermal Timeouts	100
	APPENDIX A	
	CONVERSION CHARTS	103
	FIGURES	
2-1	RA80 Logic Chassis Area	4
2-2	RA80 Lower Base Plate Area	5
2-3	RA80 Power Supply	6

CONTENTS

	FIGURES (cont.)	Page
3-1	Belt Tension Adjustment Screw	8
3-2	Reference Marker	9
3-3	RA80 Maintenance Controls	11
3-4	Servo Velocity Adjustment	14
3-5	Servo Velocity LED Pattern	16
4-1	General Fault Indicators	20
4-2	Ground Jumper for Formatter	60
4-3	Servo Velocity LED Pattern	65
4-4	Personality Board Loop Back Plugs	68
5-1	Status Message Interpretation	75
5-2	Response to Get Status Command	76
5-3	Fault Identification Codes	78
5-4	Voltage Test Points	97
5-5	Last Eight Bytes of a ROM	99

TABLES

4-1	Test-Select Codes	22
4-2	Prompt and Steady State Codes	26
4-3	RA80 Utility and Diagnostic Procedures	28
5-1	Hex Representation of Front Panel Fault Codes	79

CONTENTS

	TABLES (cont.)	Page
5-2	LED Error Codes and Possible Cause(s)	80
5-3	FRU/Service Reference Table	89
5-4	Power Supply Failure Indications	95
5-5	DC Voltage Tolerances	98
5-6	Last Byte Address of Each ROM	99
A-1	Binary to Hexadecimal Conversion	103

1 INTRODUCTION

1.1 SCOPE OF BOOK

This maintenance guide provides the diagnostic and troubleshooting information needed to implement the RA80 disk drive corrective maintenance procedures. Chapter 2 illustrates the location of the major Field Replaceable Units (FRUs). Chapter 3 describes how to perform the field adjustments. Chapter 4 explains how to use the drive-resident diagnostics. Chapter 5 contains the fault isolation procedures that Field Service engineers use to troubleshoot the disk drive. Appendix A contains some hexadecimal conversion charts to convert to binary or decimal.

1.2 RELATED DOCUMENTATION

The following documentation may be ordered from Printing and Circulation Services, 444 Whitney St., Northboro, Massachusetts 01532.

- *RA80 Disk Drive User Guide* (EK-ORA80-UG)
- *RA80 Disk Drive Service Manual* (EK-ORA80-SV)
- *RA80 Disk Drive Illustrated Parts Breakdown* (EK-ORA80-IP)

2 INTRODUCTION

The following documentation may be ordered from the Software Distribution Center, Order Administration/Processing, 20 Forbes Rd., (NR4), Northboro, Massachusetts 01532.

- *RA80 Field Maintenance Print Set* (MP-01286)
- *UDA50 Maintenance Documentation Kit* (QP904-GZ) – This kit consists of the maintenance guides for the UDA50 and disk drives in a looseleaf binder.
- Additional small looseleaf maintenance guide binder (AV-L980A-TK).

2 REMOVAL AND REPLACEMENT

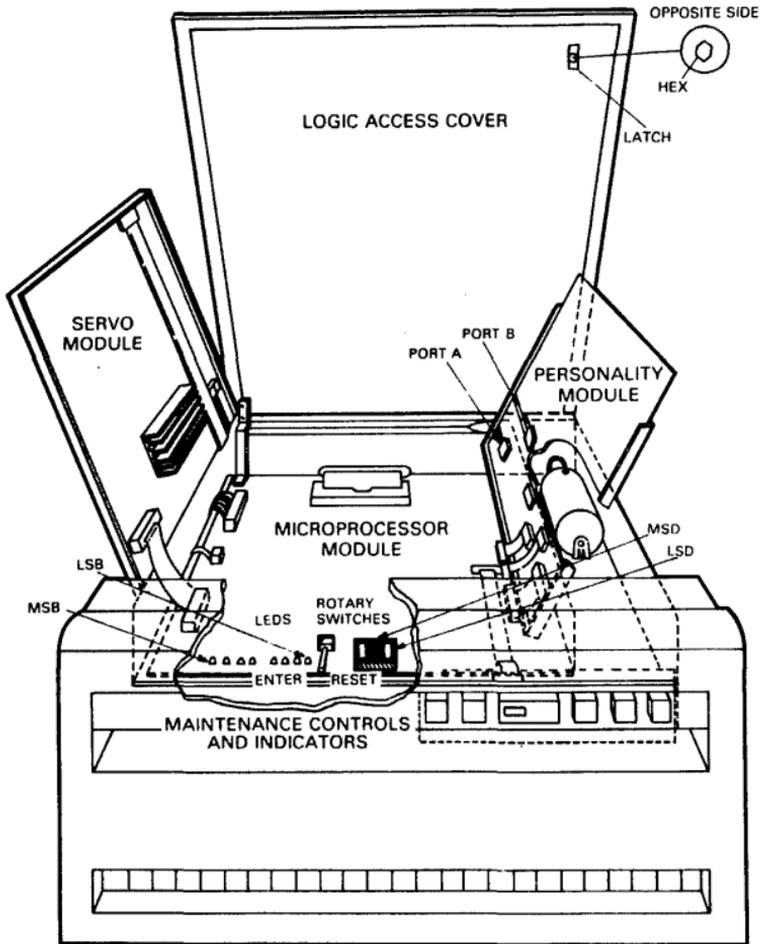
2.1 INTRODUCTION

This chapter shows the location of the major RA80 field replaceable units. It is a very abbreviated form of the removal and replacement information that appears in the RA80 Disk Drive Service Manual. Refer to the *RA80 Disk Drive Service Manual* for detailed removal and replacement instructions.

2.2 LOCATION OF MAJOR REPLACEABLE UNITS

The RA80 disk drive is separated into three illustrations to show the locations of its major field replaceable units. The first illustration, Figure 2-1, shows all the logic modules in the logic chassis area. The second illustration, Figure 2-2, shows the major assemblies located in the RA80 lower base plate area. The third illustration, Figure 2-3, shows the rear view of the RA80 with the power supply removed.

4 REMOVAL AND REPLACEMENT



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Figure 2-1 RA80 Logic Chassis Area

REMOVAL AND REPLACEMENT 5

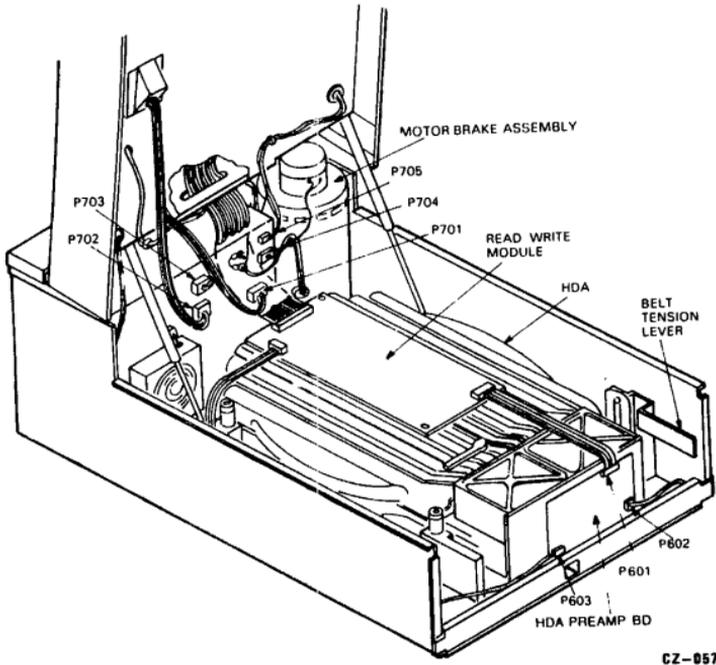
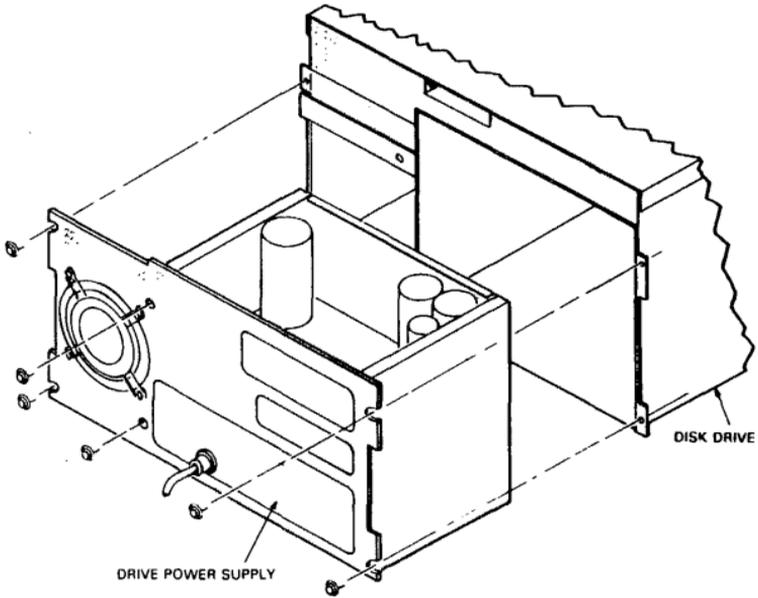


Figure 2-2 RA80 Lower Base Plate Area

6 REMOVAL AND REPLACEMENT



CZ-0087

Figure 2-3 RA80 Power Supply

3 ADJUSTMENTS

3.1 INTRODUCTION

This chapter describes the adjustment procedures for the RA80 disk drive. The two adjustments that can be made are the belt tension adjustment and a servo adjustment.

3.2 BELT TENSION ADJUSTMENT

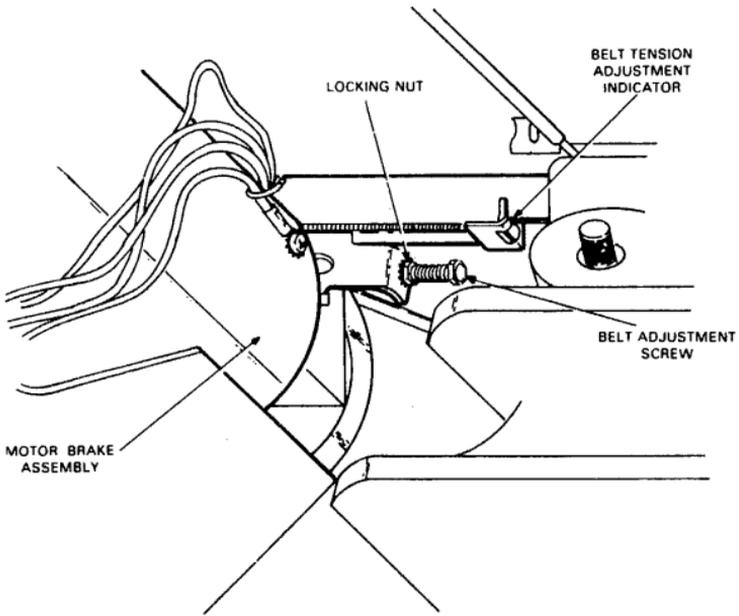
The belt tension should be checked whenever the motor, drive belt or HDA is replaced. Since the belt may stretch slightly with use, belt tension should also be examined anytime a corrective action call is made. To check or adjust belt tension, use the following procedure (refer to Figure 3-1 and 3-2) with the HDA in place.

1. Spin down the HDA by depressing the RUN/STOP switch on the operator control panel.
2. Raise the drive logic chassis and determine if the brass-colored slider is flush with the outside edge of the metal reference marker.

NOTE

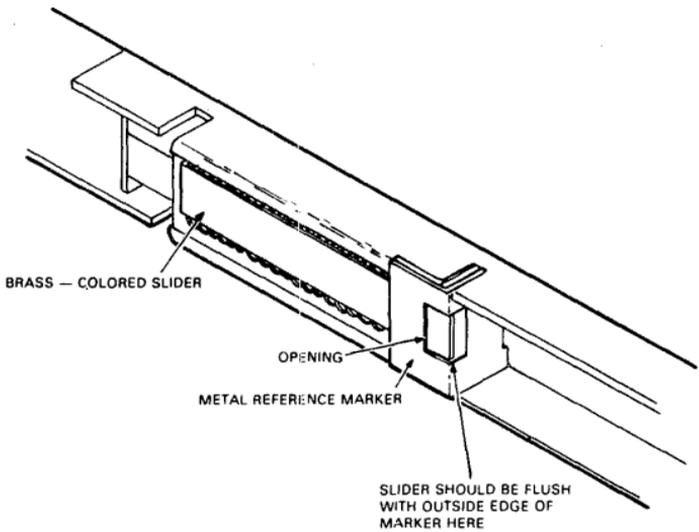
If the brass-colored slider needs adjustment, turn off the ac power at the power controller.

8 ADJUSTMENTS



CZ-0402

Figure 3-1 Belt Tension Adjustment Screw



CZ-0361

Figure 3-2 Reference Marker

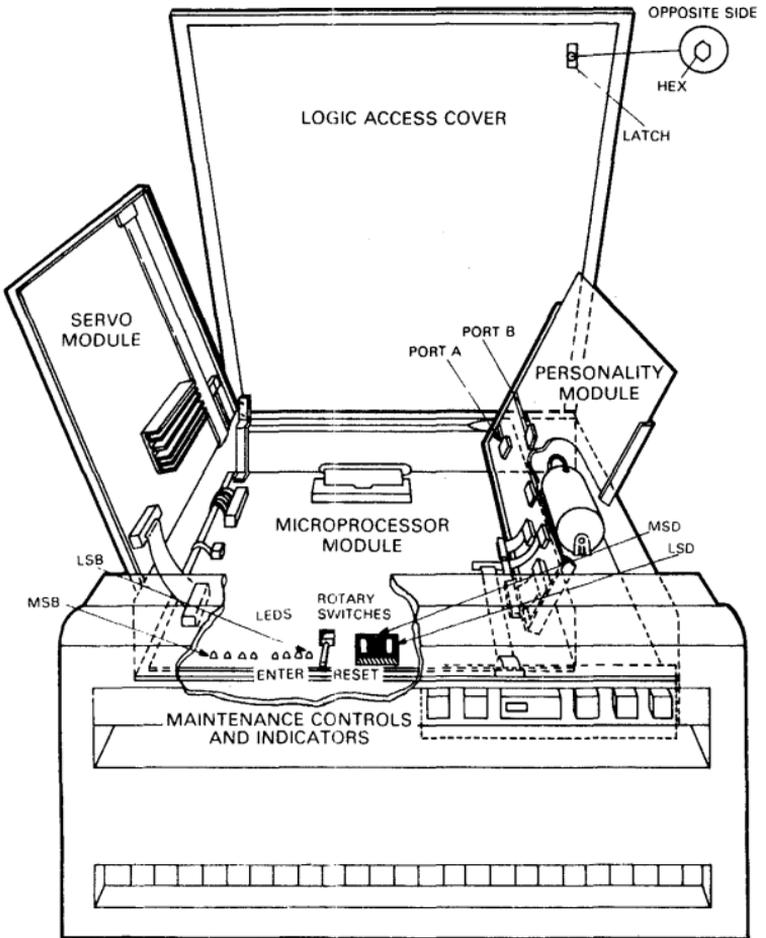
10 ADJUSTMENTS

3. Loosen the locking nut and adjust the belt tension screw until the brass-colored slider is flush with the reference marker shown. Turn the screw clockwise to move the slider forward.
4. Tighten the locking nut after the adjustment is made.
5. Restore the ac power to the drive and spin-up the HDA by depressing the RUN/STOP switch.

3.3 SERVO ADJUSTMENTS

The servo adjustments must be performed after replacing a servo module or HDA. Refer to Figure 3-3 for the locations of the maintenance controls. Use the following procedures to make these adjustments.

1. Switch on the circuit breaker at the rear of the H766 power supply.
2. Enter the diagnostic mode using the following procedure.
 - a. Turn the rotary switches to FF.
 - b. Push the ENTER switch. The LEDs will blink FF.
 - c. Push the ENTER switch again and the LEDs will display a steady state FF.
 - d. Turn the rotary switches to 00.
 - e. Push the ENTER switch. The LEDs will display a steady state 00.



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Figure 3-3 RA80 Maintenance Controls

12 ADJUSTMENTS

- f. Push the ENTER switch again and the LEDs will display the blinking EC prompt.
 3. Call the static servo test using the following procedure.
 - a. Turn the rotary switches to 27.
 - b. Push the ENTER switch. The LEDs will momentarily display 27 and then AA when the test completes successfully. If an error code occurs, replace the servo module and repeat the adjustments from Step 1. If the test ended with an AA, then proceed to Step c.
 - c. Push the ENTER switch again and the LEDs will display the blinking EC prompt.
 4. Spin-up the disk using the following procedure.
 - a. Turn the rotary switches to 1E.
 - b. Push the ENTER switch. The LEDs will momentarily display 1E and then a steady state E7.
 - c. Push the RUN/STOP switch on the operator control panel. The drive will spin-up and the LEDs will display an AA when the spin-up is complete.

NOTE

The READY indicator will not be lit when the disks are spinning in diagnostic mode.

- d. Push the ENTER switch and the LEDs will display the blinking EC prompt.
5. Call the servo velocity adjustment utility using the following procedure.
 - a. Turn the rotary switches to 26.
 - b. Push the ENTER switch. The LEDs will momentarily display 26, then E7, and then one or two LEDs will remain lit. If the LEDs display an error code of 7C, 7D or 7E, proceed to Step c. Otherwise proceed to Step d.
 - c. Look up the LED error code in the following procedure and do what it says.

●Error code 7C – Positioner access time is too slow and requires that the R281 potentiometer be turned counter-clockwise two revolutions. (Refer to Figure 3-4). Then push the ENTER switch to return to the blinking EC prompt and repeat Step 5.

●Error code 7D – This error code indicates that there are too many seek errors. The servo module or the HDA may be defective.

●Error code 7E – Positioner access time is too fast and requires that the R281 potentiometer be turned clockwise two revolutions. Then push the ENTER switch to return to the blinking EC prompt and repeat Step 5.

14 ADJUSTMENTS

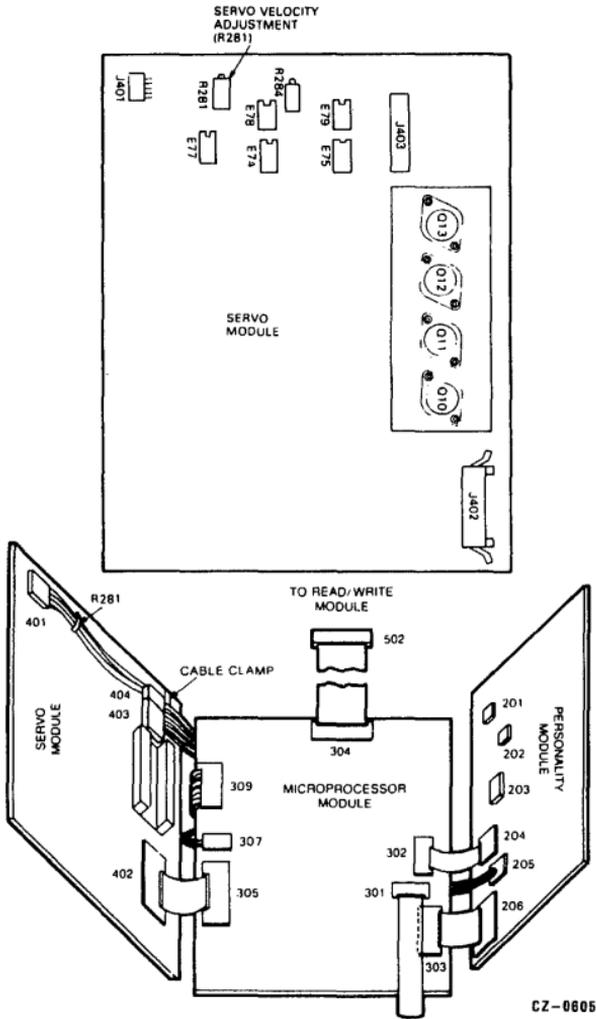


Figure 3-4 Servo Velocity Adjustment

CZ-0605

- d. Read the LED display. If any LEDs other than the center two LEDs are on or flashing (refer to figure 3-5), adjust the R281 potentiometer on the servo module (refer to Figure 3-4). The goal is to adjust the potentiometer until only the center two LEDs are flashing. Rotate R281 clockwise to move the LED pattern towards the ENTER switch, and counterclockwise to move the LED pattern away from the ENTER switch.

NOTE

Rotate the servo velocity adjustment potentiometer (R281) slowly since there is a time delay before the LED patterns react to the adjustment.

- e. Run the servo velocity test for 20 minutes until the positioner motor temperature stabilizes.
- f. Read the LED display. Re-adjust the R281 potentiometer until only the center two LEDs of the display are on or flashing.
- g. Turn the rotary switches to DD.
- h. Push the ENTER switch. The LEDs will display AA or blink EC depending on how long the ENTER switch is pushed.
- i. Push the ENTER switch again if the LEDs display an AA. The LEDs should then display the blinking EC prompt.

16 ADJUSTMENTS

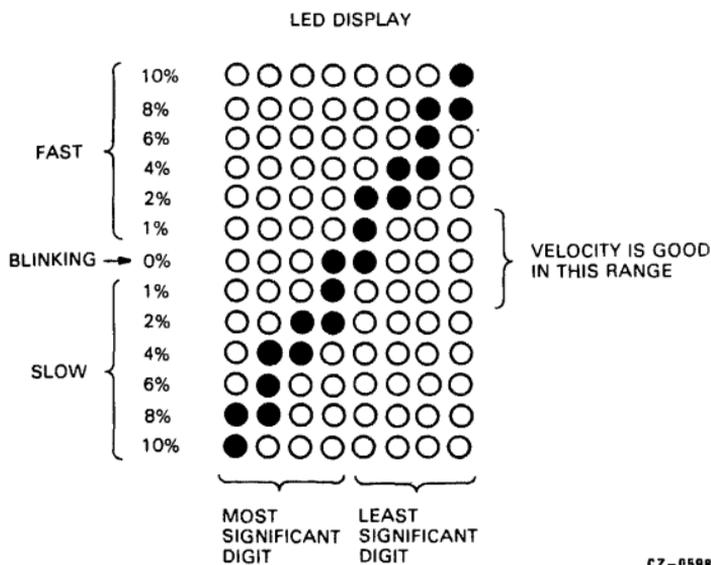


Figure 3-5 Servo Velocity LED Pattern

6. Call the entire unit test using the following procedure.
 - a. Turn the rotary switches to 25.
 - b. Push the ENTER switch. The LEDs will momentarily display 25 and then E7. Wait until all the tests are run and the LEDs display AA.
 - c. Push the ENTER switch and the LEDs will display the blinking EC prompt.

7. Return on-line using the following procedure.
 - a. Turn the rotary switches to 1D.
 - b. Push the ENTER switch. The LEDs will momentarily display 1D and then E7.
 - c. Turn the rotary switches to 00.
 - d. Push the ENTER switch. The LEDs will display 00 and the drive will be on-line. A test for determining if the drive is on-line is to push the WRITE PROTECT switch. If the WRITE PROTECT indicator is lit, then the drive is back in the on-line mode.

4 DRIVE-RESIDENT DIAGNOSTICS

4.1 INTRODUCTION

This chapter describes how to use the RA80 drive-resident diagnostic capabilities. The drive-resident diagnostic gives two kinds of fault indications. It reports general fault codes through the operator control panel on the front of the drive. These general fault codes are illustrated in Figure 4-1. It also reports specific error codes through the internal maintenance LEDs on the micro-processor module.

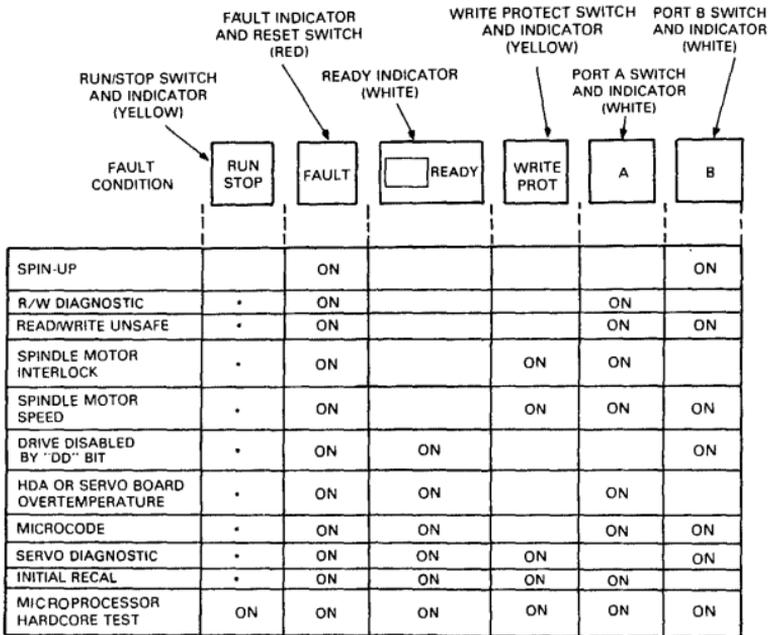
4.2 DIAGNOSTIC CONTROLS AND INDICATORS

The RA80 internal maintenance controls and LEDs are located in the front left-hand corner of the micro-processor module. Refer to Figure 2-1. These maintenance controls and LEDs are divided into three functional areas: rotary switches, an ENTER/RESET switch, and an eight bit LED display.

4.2.1 Rotary Switches

There are two hexadecimal rotary switches (S2 and S3) next to each other. The switch on the right is the least significant hexadecimal digit. The switch on the left is the most significant hexadecimal digit. The rotary position of each switch is shown by a hexadecimal digit on the top surface of the switch. The test-select codes and input parameters to run the utility routines and diagnostics are entered through the rotary switches.

20 DRIVE-RESIDENT DIAGNOSTICS



CZ-0428

Figure 4-1 General Fault Indicators

4.2.2 ENTER/RESET Switch

The ENTER/RESET switch (S1) is a dual-throw, center-off-position switch. When the toggle switch is pushed to the right, it is in the RESET position, which is marked by an R on the circuit module. When the toggle switch is pushed to the left, it is in the ENTER position, which is marked by an E on the circuit module.

4.2.2.1 The ENTER Position – The ENTER position is periodically polled by the firmware to determine if a new action is required. The ENTER switch provides the Field Service engineer with a means of communicating with the firmware. To initiate a diagnostic test, place a test-select code in the rotary switches and push the ENTER/RESET switch to the ENTER position.

4.2.2.2 The RESET Position – The RESET position is connected to interrupt line RST 5.5 on the micro-processor chip. RST 5.5 is a maskable interrupt that is disabled by the firmware during seek operations. Pushing the RESET switch while the drive is in functional mode forces the firmware to reinitialize the drive logic. If the drive halts on a hardcore fault during power up, pushing the RESET switch places the drive in functional mode. While in diagnostic mode, pushing the RESET switch terminates the test.

4.2.3 LED Display

The LED display consists of a row of eight LEDs. The least significant LED is to the right. The codes displayed in the LEDs are read as two hexadecimal digits (four LEDs to each digit). Several kinds of codes appear in the LEDs. They display error codes, prompt codes, test-complete codes and test-select codes for entry verification.

2.2 DRIVE-RESIDENT DIAGNOSTICS

4.3 TEST-SELECT CODES

Each utility routine and diagnostic test has a unique test-select code. The test-select codes are listed in Table 4-1. To call a routine or test, insert the test-select code into the rotary switches and push the ENTER/RESET switch to the ENTER position. The firmware reads the contents of the rotary switches when it detects that the switch is in the ENTER position. The LEDs momentarily display the test-select code to verify that the firmware has received it.

Table 4-1 Test-Select Codes

Test-Select Codes	Tests
01	Examine diagnostic extended status area utility
02	Examine previous error utility
03	Examine drive state utility
04	Examine operational counters utility
05	Memory examine-up utility
06	Memory examine-down utility
07	Three module bus test
08	Microprocessor module bus test
09	Microprocessor and personality module bus test

Table 4-1 Test-Select Codes (Cont)

Test-Select Codes	Tests
0A	Microprocessor and servo module bus test
0B	Personality module microsequencer test
0C	Sector/byte counter test
0D	Control panel, serial #, and drive # test
0E	Head select multiplexer test
0F	General purpose counter test
11	Track counter test
12	Read/write fault force test
13	Servo position loop test
14	Servo velocity loop test
15	Servo functional test
16	Random seek test
17	Seek - seek test with input parameters
18	Seek - seek test with fixed parameters
19	Incremental seek test with input parameters
1A	Incremental seek test with fixed parameters
1B	Read-only test
1C	Write/read test
1D	Go on-line

24 DRIVE-RESIDENT DIAGNOSTICS

Table 4-1 Test-Select Codes (Cont)

Test-Select Codes	Tests
1E	Spindle control utility
1F	Head-select and seek utility
20	Maintenance controls and indicators test
21	Read-only cylinder formatter utility
22	Logic tests
23	Servo tests
24	Read/write tests
25	Entire unit test
26	Servo velocity adjustment utility
27	Static servo test
28	Personality board test
CF	Loop mode set utility
FF	(Go off-line)

A test termination code of DD provides the user with a way of halting diagnostic drive tests. Most tests complete so quickly that they cannot be terminated in this way. However, seek-seek and incremental seek tests are of sufficient duration that they may be terminated prematurely in this manner. Also, tests with the loop mode set can be run for long periods of time. To stop all tests safely, use the DD test termination code.

If the drive is in loop mode, it will continue in this mode when the tests are halted with a DD code.

4.4 PROMPT AND STEADY STATE CODES

The firmware uses several blinking prompt codes and steady state codes to notify the user when it is waiting for information, is active, or has completed a test. These codes are listed in Table 4-2.

26 DRIVE-RESIDENT DIAGNOSTICS

Table 4-2 Prompt and Steady State Codes

Code	Significance
Blinking EC (●●●○●●○○)	This indicates that firmware is waiting for a test-select code.
Blinking 01 (○○○○○○●), 02 (○○○○○○●○), 03 (○○○○○○●●), or 04 (○○○○○○●○)	This indicates the number of current input parameter required by the diagnostic utility or test.
Blinking EE (●●●○●●○○)	This indicates an invalid test-select code has been entered. It requires entry of a valid test-select code.
Steady State AA (●○○○●○○)	This indicates test completion. Operator should return to the EC prompt before running another test.

Table 4-2 Prompt and Steady State Codes (Cont)

Code	Significance
Steady State E7 (●●●○○●●)	This indicates that the firmware is actively executing a test.
Steady State Error Codes	This indicates why a test or utility has failed. Refer to LED error code list in Chapter 5. Push the ENTER switch to recover from an error code.

NOTE: ● = LED ON ○ = LED OFF

4.5 RA80 UTILITY AND DIAGNOSTIC PROCEDURES

The procedures for running the drive utilities and diagnostics are described in Table 4-3. If a fault occurs during these tests, look up the error code in Table 5-2.

Table 4-3 RA80 Utility and Diagnostic Procedures

Test-Select Code	Operating Procedures
01	<p>Examine Diagnostic Extended Status Area Utility</p> <p>Purpose: To examine the 16 bytes of status information of the diagnostic test just run.</p> <ol style="list-style-type: none"> a. Set rotary switch to 01 and push ENTER switch. LEDs momentarily display 01 (000000●). LEDs then display the first status byte. b. Push the ENTER switch 15 times to display each remaining status byte in the LEDs.

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
02	<ul style="list-style-type: none"> • Byte 1 = test select code • Byte 2 through 7 = input parameters • Byte 8 = test result (AA or error code) • Byte 9 through 16 = diagnostic dependent test data <p>c. Push ENTER switch. LEDs display steady AA (●●●●●●).</p> <p>d. Push ENTER switch again. LEDs display blink EC (●●●●●●).</p> <p>Examine Previous Error Utility</p> <p>Purpose: To examine the 16 latest LED error codes stored in the drive.</p>

30 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
03	<p>Examine Drive State Utility</p> <p>Purpose: To examine the twenty software state words maintained by the functional firmware.</p> <ol style="list-style-type: none"> a. Set rotary switch to 02 and push ENTER switch. LEDs momentarily display 02 (000000●●). LEDs display the most recent error code. b. Push the ENTER switch until all 16 error codes are examined. c. Push the ENTER switch again after examining all 16 error codes. LEDs display steady AA (●●●●●●●●). d. Push the ENTER switch again. LEDs display blinks EC (●●●●●●●●).

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
04	<p>Examine Operational Counters Utility</p> <p>Purpose: To examine the contents of the seek/read error counter, the seek counter and the read and no enable counter.</p> <ol style="list-style-type: none"> a. Set rotary switch to 03 and push ENTER switch. LEDs momentarily display 03 (000000●●). LEDs display contents of first state word. b. Push ENTER switch 19 times until all state words are examined. c. Push ENTER switch. LEDs display steady AA (●000000). d. Push ENTER switch. LEDs display blinks EC (●●●00000).

32 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<p>a. Set rotary switch to 04 and push ENTER switch. LEDs momentarily display 04 (00000●00). LEDs display the first byte of the following list.</p> <ul style="list-style-type: none">● Seek/recalibration error counter contents <p>Byte 1 – overflow indicator</p> <p>Byte 2 – low byte</p> <p>Byte 3 – high byte</p> <ul style="list-style-type: none">● Seek counter contents <p>Byte 4 – overflow indicator</p> <p>Byte 5 – low byte</p> <p>Byte 6 – middle byte</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<p>Byte 7 – high byte</p> <ul style="list-style-type: none"> • Read and no enable counter contents <p>Byte 8 – overflow indicator</p> <p>Byte 9 – low byte</p> <p>Byte 10 – high byte</p> <p>b. Push the ENTER switch 9 or more times to examine the remaining 9 bytes.</p> <p>c. Push the ENTER switch again. LEDs display steady AA (●●●●●●●●).</p> <p>d. Push the ENTER switch again. LEDs display blinks EC (●●●●●●●●).</p>

34 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
05	<p style="text-align: center;">NOTE</p> <p>These counters are reset during drive power up or whenever the RESET switch is pushed while the drive is on-line in a functional mode. When a counter overflows, its indicator byte will contain an FF.</p> <p>Memory Examine-Up Utility</p> <p>Purpose: To examine the contents of any memory location by incrementing through the address locations.</p> <p>a. Set rotary switch to 05 and push ENTER switch. LEDs momentarily display 05 (00000●●). LEDs blink 01 (000000●).</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<p>b. Set rotary switch to low byte of memory address and push ENTER switch. LEDs momentarily display contents of rotary switch. LEDs blink 02 (000000●0).</p> <p>c. Set rotary switch to high byte of memory address and push ENTER switch. LEDs momentarily display contents of rotary switch. LEDs display the 8 bits of data stored at that address.</p> <p>d. Push the ENTER switch each time you wish to increment the address.</p> <p>e. Exit this utility by setting the rotary switch to DD. Push the ENTER switch. LEDs will display either a steady AA (●00000●0) or a blinking EC (●●●00000).</p>

36 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
06	<p>f. Push the ENTER switch again if a steady AA is displayed and return to the EC prompt.</p> <p>Memory Examine-Down Utility</p> <p>Purpose: To examine the contents of any memory location by decrementing through the address locations.</p> <p>This utility operates similarly to the memory examine-up utility described above. The only difference is that the address pointer is decremented each time the ENTER switch is pushed, instead of being incremented. Use a test-select code of 06 to call this utility.</p>
07	<p>Three Module Bus Test</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
08	<p>Microprocessor Module Bus Test</p> <p>Purpose: This test checks the microprocessor data bus with the servo and personality modules disconnected. This test assumes that the three module bus test is run first and indicates a microprocessor bus error. If the error is no longer present, then the servo or personality module is the cause of the error.</p> <p>Purpose: This test checks the microprocessor data bus, the servo bus and the personality bus. All cables must be connected to serve this test.</p> <ol style="list-style-type: none"> a. Set rotary switch to 07 and push ENTER switch. LEDs momentarily display 07 (00000●●●). LEDs display steady AA (●000●000). b. Push ENTER switch. LEDs blink EC (●●00●000).

38 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
09	<p>a. Set rotary switch to 08 and push ENTER switch. LEDs momentarily display 08 (0000●000). LEDs display steady AA (●0●0●0●0).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●0●●00).</p> <p>Microprocessor and Personality Module Bus Test</p> <p>Purpose: This test checks the data bus between the personality and microprocessor modules. The test is run with the servo module disconnected. The microprocessor module bus test should be successfully completed before running this test.</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
0A	<p>Microprocessor and Servo Module Bus Test</p> <p>Purpose: This test checks the data bus between the servo and the microprocessor modules. This test is run with the personality module disconnected. The microprocessor module bus test should be successfully completed before running this test.</p> <ol style="list-style-type: none"> a. Set rotary switch to 09 and push ENTER switch. LEDs momentarily display 09 (0000●00●). LEDs display steady AA (●0●0●00●). b. Push ENTER switch. LEDs blink EC (●●●0●●00).

40 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
0B	<p>Personality Module Microsequencer Test</p> <p>Purpose: This test checks out the ECHO bit path on the personality module and then calls the microprocessor and personaliy bus test.</p> <ol style="list-style-type: none"> a. Set rotary switch to 0B and push ENTER switch. LEDs momentarily display 0B (0000●●●●). LEDs display steady AA (●●●●●●●●). b. Push ENTER switch. LEDs blink EC (●●●●●●●●).

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
0C	<p>Sector/Byte Counter Test</p> <p>Purpose: To test the sector/byte counter by means of diagnostic controls.</p> <ol style="list-style-type: none"> a. Set rotary switch to 0C and push ENTER switch. LEDs momentarily display 0C (0000●●00). LEDs display steady AA (●0●0●00). b. Push ENTER switch. LEDs blink EC (●●●0●●00).
0D	<p>Control Panel, Serial # and Drive # Test</p> <p>Purpose: This test checks out the operator control panel indicators, the drive serial number and the drive unit plug number.</p>

42 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<ul style="list-style-type: none">a. Set the rotary switch to 0D and push ENTER switch. LEDs momentarily display 0D (0000●●●●). The LEDs display the control panel switch settings.b. Push front panel RUN switch. LEDs display 01 (0000000●).c. Push front panel WRITE PROTECT switch. LEDs display steady 02 (000000●0).d. Push front panel Port A switch. LEDs display steady 04 (00000●00).e. Push front panel Port B switch. LEDs display steady 08 (0000●000). <p style="text-align: center;">NOTE The front panel indicators should light as each switch is pushed.</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<ul style="list-style-type: none"> <li>f. Push the FAULT switch. The FAULT indicator should light. <li>g. Remove the unit address plug. READY indicator should go out. <li>h. Replace the unit address plug. READY indicator should be lit. <li>i. Push ENTER switch. LEDs display LSB of drive serial numbers. <li>j. Push ENTER switch. LEDs display second byte of drive serial number. <li>k. Push ENTER switch. LEDs display third byte of drive serial number. <li>l. Push ENTER switch. LEDs display drive unit plug number.

44 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
0E	<p>m. Push ENTER switch. LEDs display steady AA (●●●●●●).</p> <p>n. Push ENTER switch. LEDs blink EC (●●●●●●).</p> <p>Head-Select Multiplexer Test</p> <p>Purpose: This test checks the head select multiplexer on the microprocessor module.</p> <p>a. Set rotary switch to 0E and push ENTER switch. LEDs momentarily display 0E (○○○○●●●). LEDs display steady AA (●●●●●●).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●●●●).</p>
0F	<p>General Purpose Counter Test</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
11	<p>Purpose: This test checks the operation of the two RAM chip general purpose counters.</p> <ol style="list-style-type: none"> a. Set rotary switch to 0F and push ENTER switch. LEDs momentarily display 0F (0000●●●●). LEDs display steady AA (●●●●●●●●). b. Push ENTER switch. LEDs blink EC (●●●●●●●●). <p>Track Counter Test</p> <p>Purpose: This test checks the operation of the track difference counter.</p> <ol style="list-style-type: none"> a. Set rotary switch to 11 and push ENTER switch. LEDs momentarily display 11 (000●0000●). LEDs display steady AA (●●●●●●●●).

46 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
12	<p>b. Push ENTER switch. LEDs blink EC (●●●●●●●●).</p> <p>Read/Write Fault Force Test</p> <p>Purpose: This test checks the read/write safety sense circuits. The spindle must be spinning for this test.</p> <p>a. Set rotary switch to 12 and push ENTER switch. LEDs momentarily display 12 (○○○●○○●○). LEDs display steady AA (●○○●○○●○).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●●●●●●).</p>
13	<p>Servo Position Loop Test</p> <p>Purpose: This test checks the servo position loop circuitry in a static mode.</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
14	<p>Servo Velocity Loop Test</p> <p>Purpose: This test checks the servo velocity loop with a sawtooth waveform that forces the acceleration thresholds.</p> <ul style="list-style-type: none"> a. Set rotary switch to 13 and push ENTER switch. LEDs momentarily display 13 (000●00●●). LEDs display steady AA (●0●0●0●0). b. Push ENTER switch. LEDs blink EC (●●0●00). <p>Servo Velocity Loop Test</p> <p>Purpose: This test checks the servo velocity loop with a sawtooth waveform that forces the acceleration thresholds.</p> <ul style="list-style-type: none"> a. Set rotary switch to 14 and push ENTER switch. LEDs momentarily display 14 (000●0●00). LEDs display steady AA (●0●0●0●0). b. Push ENTER switch. LEDs blink EC (●●0●00).

48 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
15	<p>Servo Functional Test</p> <p>Purpose: This test checks the operation of the servo system by performing seeks and recalibrations.</p> <ol style="list-style-type: none">a. Set rotary switch to 15 and push ENTER switch. LEDs momentarily display 15 (000●000●). LEDs display steady AA (●000●000).b. Push ENTER switch. LEDs blink EC (●●●0●●00).
16	<p>Random Seek Test</p> <p>Purpose: This test does 32 repetitions of a random sequence of 32 seeks.</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
17	<p>Seek-Seek Test with Input Parameters</p> <p>Purpose: This test does 32 repetitive seeks between cylinders that are entered at the beginning of the test.</p> <ol style="list-style-type: none"> a. Set rotary switch to 17 and push ENTER switch. LEDs momentarily display 17 (000●0●●●). LEDs display steady E7 (●●●00●●●). LEDs display steady AA (●0000●00). b. Push ENTER switch. LEDs blink EC (●●●00●00).

50 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<ul style="list-style-type: none">b. Set rotary switch to the low byte of the starting cylinder and push ENTER switch. LEDs blink 02 (000000●0).c. Set rotary switch to the high byte of the starting cylinder and push ENTER switch. LEDs blink 03 (000000●●).d. Set rotary switch to the low byte of the ending cylinder and push ENTER switch. LEDs blink 04 (000000●00).e. Set rotary switch to the high byte of the ending cylinder and push ENTER switch. LEDs display steady E7 (●●●00●●●). LEDs display steady AA (●00●0000).f. Push ENTER switch. LEDs blink EC (●●●0●●00).

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
18	<p>Seek-Seek Test with Fixed Parameters</p> <p>Purpose: This test does 32 repetitive seeks between cylinders 0 and 560.</p> <ol style="list-style-type: none"> a. Set rotary switch to 18 and push ENTER switch. LEDs momentarily display 18 (000●●000). LEDs display steady E7 (●●●00●●●). LEDs display steady AA (●●●00●●0). b. Push ENTER switch. LEDs blink EC (●●●00●●0).
19	<p>Incremental Seek Test with Input Parameters</p> <p>Purpose: This test does an incremental seek between cylinders entered at the beginning of the test.</p>

52 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<ul style="list-style-type: none">a. Set rotary switch to 19 and push ENTER switch. LEDs momentarily display 19 (000●●00●).b. Set rotary switch to the low byte of the starting cylinder and push ENTER switch. LEDs blink 02 (000000●0).c. Set rotary switch to the high byte of the starting cylinder and push ENTER switch. LEDs blink 03 (000000●●).d. Set rotary switch to the low byte of the ending cylinder and push ENTER switch. LEDs blink 04 (000000●00).e. Set rotary switch to the high byte of the ending cylinder and push ENTER switch. LEDs display steady E7 (●●●00●●●). LEDs display steady AA (●0000●00).

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
1A	<p>f. Push ENTER switch. LEDs blink EC (●●●○●●○).</p> <p>Incremental Seek with Fixed Parameters</p> <p>Purpose: This test does an incrementing seek between cylinder 0 and 560.</p> <p>a. Set rotary switch to 1A and push ENTER switch. LEDs momentarily display 1A (○○○●●○○). LEDs display steady E7 (●●●○○●●). LEDs display steady AA (●○○○○○○).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●○●●○).</p>
1B	<p>Read-Only Test</p> <p>Purpose: This test reads with each read/write head using the prerecorded read-only cylinder.</p>

54 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
1C	<p>Write/Read Test</p> <p>Purpose: This test does a write followed by a read with each read/write head on the two write/read cylinders in the guard band.</p> <ol style="list-style-type: none"> a. Set rotary switch to 1C and push ENTER switch. LEDs momentarily display 1C (000●●●00). LEDs display steady AA (●000●000). b. Push ENTER switch. LEDs blink EC (●●00●●00).

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
1D	<p>Go On-Line</p> <p>Purpose: To return the drive to functional on-line mode.</p> <ol style="list-style-type: none"> a. Set rotary switch to 1D and push ENTER switch. LEDs momentarily display 1D (000●●●●●). b. Set rotary switch to 00 (00000000). LEDs display steady 00 (00000000). DRIVE IS BACK ON-LINE WHEN READY LIGHT COMES ON.
1E	<p>Spindle Control Utility</p> <p>Purpose: This utility allows the spindle to be spun up or down from the drive diagnostic mode.</p>

56 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
1F	<p>a. Set rotary switch to 1E and push ENTER switch. LEDs momentarily display 1E (000●●●●●). LEDs display steady E7 (●●●00●●●).</p> <p>b. Push the front panel RUN switch. The spindle will spin up. LEDs display steady AA (●0●0●0●0).</p> <p>To spin down from the diagnostic mode, call the spindle control utility again with the 1E test-select code and release the RUN switch.</p> <p>c. Push ENTER switch. LEDs blink EC (●●0●●00).</p> <p>Head-Select and Seek Utility</p> <p>Purpose: This utility enables the field engineer to seek to a specific head and cylinder address.</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<ul style="list-style-type: none"> a. Set rotary switch to 1F and push ENTER switch. LEDs momentarily display 1F (000●●●●●). LEDs blink 01 (0000000●). b. Set rotary switch to the head number and push ENTER switch. LEDs blink 02 (000000●0). c. Set rotary switch to the cylinder low byte and push ENTER switch. LEDs blink 03 (000000●●). d. Set rotary switch to the cylinder high byte and push ENTER switch. LEDs display E7 (●●●000●●). e. Set rotary switch to DD and push ENTER switch to terminate this test. LEDs blink EC (●●●00000).

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
20	<p>Maintenance Controls and Indicators Test</p> <p>Purpose: This test checks the ability of the firmware to read the rotary switches and control LEDs.</p> <ol style="list-style-type: none"> a. Set rotary switch to 20 and push ENTER switch. LEDs momentarily display 20 (00●00000). LEDs blink FF (●●●●●●●●). b. Set rotary switch to FF and push ENTER switch. LEDs display steady FF (●●●●●●●●). c. Set rotary switch to 00 and push ENTER switch. LEDs display steady 00 (00000000). d. Push ENTER switch. LEDs display steady AA (●●0000●●).

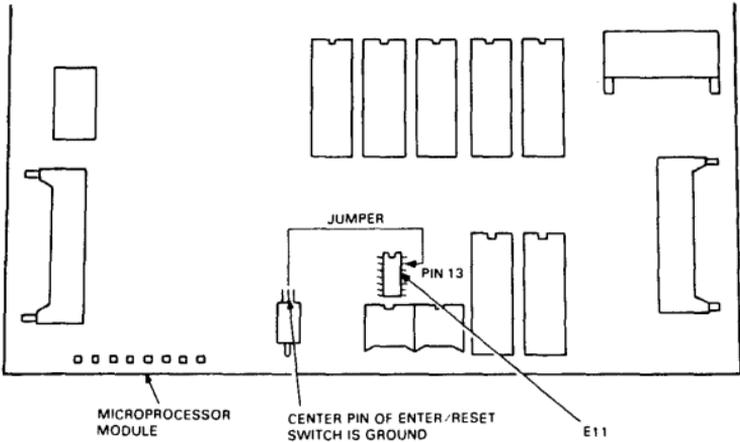
Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
21	<p>c. Push ENTER switch. LEDs blink EC (●●●○●●○○).</p> <p>Read-only Cylinder Formatter Utility</p> <p>Purpose: This utility enables the field service engineer to reformat the prerecorded read-only cylinder in the guard band. As a safety precaution, pin 13 of E11 on the microprocessor or module must first be grounded to the center pin of the E/R switch. Figure 4-2 shows the location of E11.</p> <p>a. Set rotary switch to 21 and push ENTER switch. LEDs momentarily display 21 (○○●○○○○●). LEDs display steady AA (●○○○●○○).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●○●●○○).</p>

60 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
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CZ-0358

Figure 4-2 Ground Jumper for Formatter

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
22	<p>Logic Test</p> <p>Purpose: This test runs the logic tests called by the following test-select codes:</p> <p>07 = Personality module microsequencer test</p> <p>0C = Sector/byte counter test</p> <p>0E = Head-select multiplexer test</p> <p>0F = General purpose counter test</p> <p>a. Set rotary switch to 22 and push ENTER switch. LEDs momentarily display 22 (00●000●0). LEDs display steady AA (●000●00).</p> <p>b. Push ENTER switch. LEDs blink EC (●●00●00).</p>

62 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
23	<p>Servo Test</p> <p>Purpose: This test runs the servo diagnostics called by the following test-select codes 11 and 13-16.</p> <ol style="list-style-type: none">a. Set rotary switch to 23 and push ENTER switch. LEDs momentarily display 23 (00●000●●). LEDs display steady E7 (●●●000●●). LEDs display steady AA (●000●000).b. Push ENTER switch. LEDs blink EC (●●●00000).
24	<p>Read/Write Test</p> <p>Purpose: This test runs the read-only and the write/head test.</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
25	<p>a. Set rotary switch to 24 and push ENTER switch. LEDs momentarily display 24 (00●00●00). LEDs display steady AA (●0●0●0●0).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●0●●00).</p> <p>Entire Unit Test</p> <p>Purpose: This test runs the diagnostic programs called by the following test-select codes; 07, 0C, 0E, 0F, 11, 12, 13, 14, 15, 16, 1B, 1C.</p> <p>a. Set rotary switch to 25 and push ENTER switch. LEDs momentarily display 25. LEDs display steady E7 (●●●00●●●). LEDs display steady AA (●0●0●0●0).</p>

64 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
26	<p>b. Push ENTER switch. LEDs blink EC (●●●○○○○).</p> <p>Servo Velocity Adjustment Utility</p> <p>Purpose: This utility enables the field service engineer to adjust the servo velocity potentiometer. Before this adjustment, the random seek test should be run for 20 minutes to stabilize the temperature of the servo system. Adjust the servo for a 1% or better servo speed as shown in Figure 4-3.</p> <p>a. Set rotary switch to 26 and push ENTER switch. LEDs momentarily display 26 (○○○○●●●). LEDs display servo speed pattern. ADJUST SERVO SPEED (see adjustments chapter).</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
27	<p>b. Set rotary switch to DD and push ENTER switch. If LEDs display AA (●○○●○○), push ENTER switch. LEDs blink EC (●●●○○○).</p> <p>Static Servo Test</p> <p>Purpose: This test runs the static servo tests called up by test-select codes 11, 13, and 14.</p> <p>a. Set rotary switch to 27 and push ENTER switch. LEDs momentarily display 27 (○○○○●●●). LEDs display steady AA (●○○●○○).</p> <p>b. Push ENTER switch. LEDs blink EC (●●●○○○).</p>
28	<p>Personality Board Test</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
CF	<p>Purpose: This test checks the operation of status registers and the communication path on the personality module. This test cannot be run while the disk is spinning, and the loop back plugs must be inserted as shown in Figure 4-4 before the test is run.</p> <ol style="list-style-type: none"> a. Set rotary switch to 28 and push ENTER switch. LEDs momentarily display 28 (00●0●000). LEDs display steady AA (●0●0●0●0). b. Push ENTER switch. LEDs blink EC (●●0●0●00). <p>Loop Mode Set Utility</p> <p>Purpose: This utility enables the Field Service engineer to set up the diagnostic firmware to do one of the following.</p>

68 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
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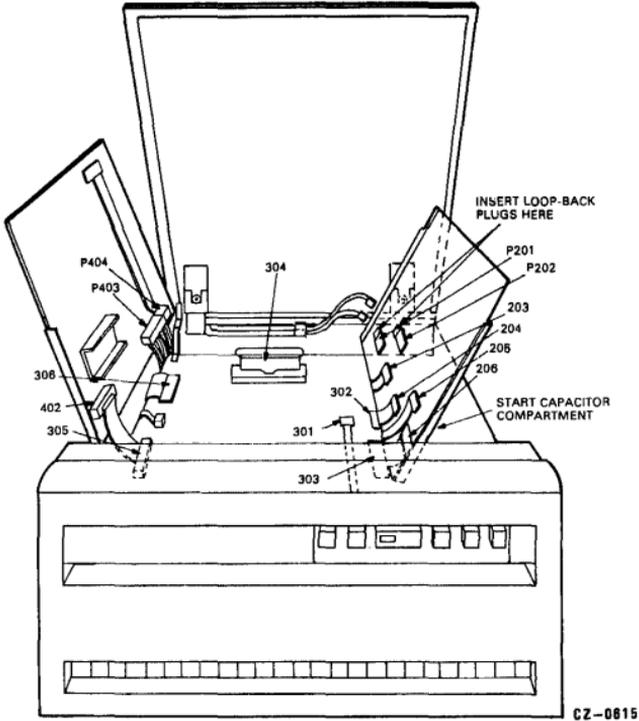


Figure 4-4 Personality Board Loop Back Plugs

CZ-0815

NOTE

1. Loop-back plugs must be inserted in P201 and P202 before running the personality board test 28. The loop-back plugs should be in the motor start capacitor compartment located to the right of the logic chassis.

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<ul style="list-style-type: none"> • Loop forever on the test – 0F • Loop forever but halt on error – 4F • Halt on error or at end of test – FF <p>Once a loop mode is selected, the firmware will remain in this state until the utility is recalled and an alternate mode is selected.</p> <ol style="list-style-type: none"> a. Set rotary switch to CF and push ENTER switch. LEDs momentarily display CF (●●○○●●●●). LEDs blink 01 (○○○○○○●).

70 DRIVE-RESIDENT DIAGNOSTICS

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
FF	<p>b. Set rotary switch to loop mode desired and push ENTER switch. LEDs display steady AA (●●●●●●●●).</p> <p>c. Push ENTER switch. LEDs blink EC.</p> <p>Go Off-Line</p> <p>Purpose: To place drive into diagnostic mode.</p> <p>a. Set rotary switch to FF and push ENTER switch. LEDs blink FF (●●●●●●●●).</p> <p>b. Push ENTER switch. LEDs blink steady FF (●●●●●●●●).</p> <p>c. Set rotary switch to 00 and push ENTER switch. LEDs display steady 00 (00000000).</p>

Table 4-3 RA80 Utility and Diagnostic Procedures (Cont)

Test-Select Code	Operating Procedures
	<p>d. Push ENTER switch. LEDs blink EC (●●●○●●○○).</p> <p style="text-align: center;">NOTE The drive is now in diagnostic mode.</p>

NOTE: ● = LED ON ○ = LED OFF

5 FAULT ISOLATION

5.1 INTRODUCTION

This chapter describes the RA80 fault isolation procedure. It begins with a description of the subsystem error messages. Next, the LED error code troubleshooting charts are presented. Additional troubleshooting tips are given at the end of the chapter.

5.2 HDA FORMATTING PROCEDURE

Replacement HDAs have RM80 formatting and must be reformatted for the RA80 Disk Drive. To reformat the maintenance cylinders, run the RA80 formatter utility (test-select code 21). Refer to Table 4-3. To reformat customer data areas, run the host-resident formatter program.

5.3 SUBSYSTEM ERROR MESSAGE INFORMATION

Subsystem error messages printed out in the error log or the subsystem diagnostics, will contain specific drive error information. The RA80 error messages will show up in bytes 9 to 15 of the status error message. A sample printout of the status message is shown below.

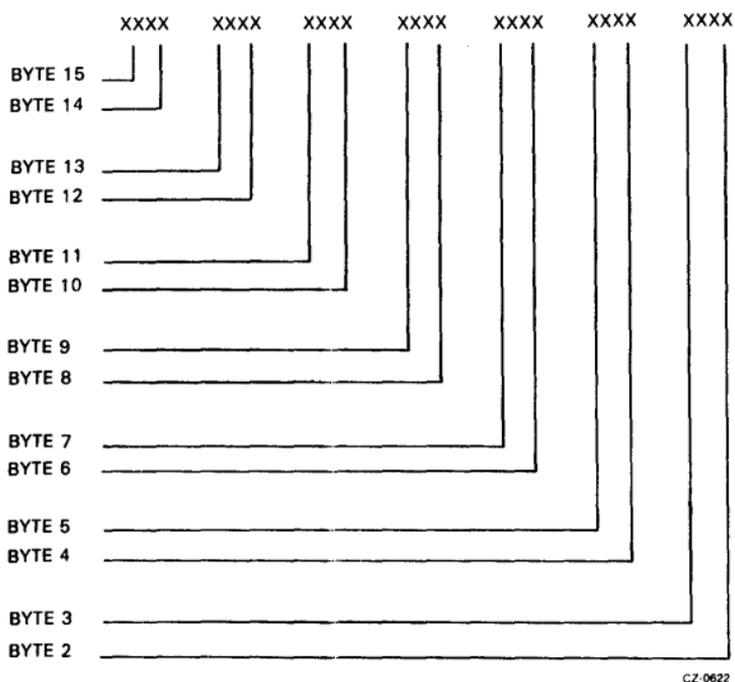
74 FAULT ISOLATION

Error Message Sample Printout:

UDAHRD 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

UDAHRD 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

Refer to Figure 5-1 to locate bytes 9 to 15 of the status message. Refer to Figure 5-2 to see contents of each status byte.



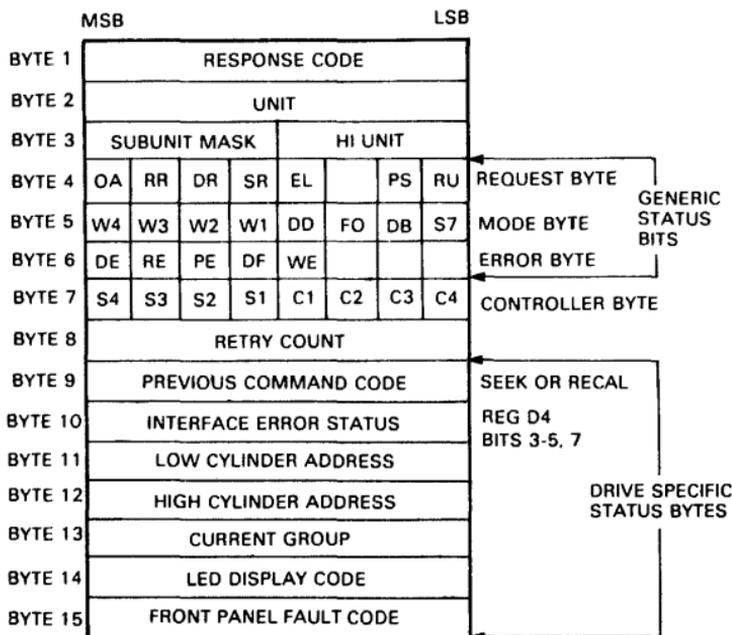
CZ.0622

Figure 5-1 Status Message Interpretation

NOTE

1. The content of these status bytes is shown in Figure 5-2.

76 FAULT ISOLATION



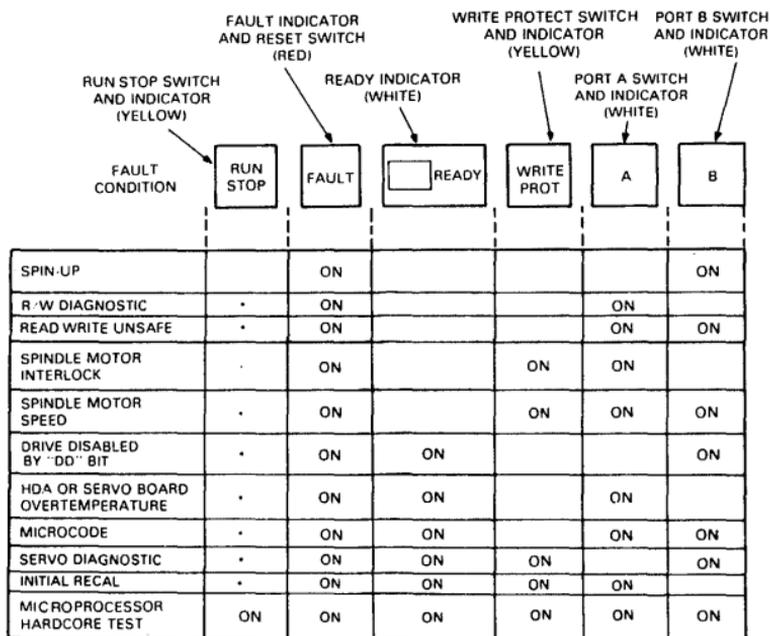
CZ 0613

Figure 5-2 Response to Get Status Command

- Byte 9 of the status message contains the following examples:
 - Seek CMD = hex code 0A
 - Recal CMD = hex code 8E
- Byte 10 contains bits 3 to 5 and 7 of the drive register D4.

- **Bit 3 (Overrun Error)** – This bit is set when either a read or a write extends past the sector or index pulse following that sector that the operation is taking place on.
 - **Bit 4 (Parity Error Found)** – This bit is set when a parity error is discovered on the real-time controller status line during a real-time command.
 - **Bit 5 (Control Pulse Error)** – This bit is set during a real-time command if two or more pulses of the same polarity are detected on the real-time controller status line of the SDI.
 - **Bit 7 (Data Pulse Error)** – This bit is set during a real-time command if two or more pulses of the same polarity are detected on the write command data line of the SDI.
-
- Bytes 11 and 12 contain the head location information of the previous group cylinder.
 - Byte 13 contains present head location information. (A group is a logical point that is accessible from the present head location in less time than one disk rotation.)
 - Byte 14 contains the hexadecimal LED error codes displayed in the RA80 disk drive. Refer to paragraph 5.4.
 - Byte 15 contains the hexadecimal code for the front panel fault indicators. (Refer to Figure 5-3). Their hexadecimal codes are listed in Table 5-1.

78 FAULT ISOLATION



CZ-0428

Figure 5-3 Fault Identification Codes

NOTE

1. The indicator state will be the same as it was before the fault switch was pushed.

Table 5-1 Hex Representation of Front Panel Fault Codes

Front Panel Faults	Hex Codes
Spin-up	11
R/W diagnostic	12
Read write unsafe	13
Spindle motor interlock	16
Spindle motor speed	17
Drive disabled by DD bit	19
HDA or servo Bd overtemp	1A
Microcode	1B
Servo diagnostic	1D
Initial recalibration	1E
Microprocessor hardcore test	3F

5.4 LED ERROR CODES TROUBLESHOOTING CHARTS

Table 5-2 provides a list of the LED error codes for the drive and the errors they represent. The numbers in the right-hand column correspond to reference numbers in Table 5-3 and denote the most, to least, likely causes of the error.

80 FAULT ISOLATION

Table 5-2 LED Error Codes and Possible Cause(s)

Error Code	Possible Cause(s)*
01	7, 16, 21, 20, 35, 3, 1, 25, 28
02	5, 25, 7, 16, 21, 23
03	5, 25, 7, 16, 21, 23
04	5, 25, 7, 16, 21, 23
05	†
07	†
08	†
09	†
0A	†
0B	†
0C	†
0D	†
0E	†
0F	†
11‡	38, 21, 32, 23
12	38, 21, 32, 30, 23, 1
13	38, 21, 32, 23, 1
14‡	38, 21, 32, 23, 1

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
15‡	56, 38, 21, 32, 39, 23, 1
16‡	38, 21, 32, 23, 1
17‡	38, 21, 32, 23, 1
1A	21, 31, 46, 47
1F	†
20	†
21	†
22	†
23	57, 21, 15, 39
24	38, 21, 32, 30, 23, 1
25‡	38, 21, 32, 23, 1
26	5, 58
27	5, 59, 60, 17, 20, 35, 21
28	6, 59, 38, 32, 21
29	†
2A	†
2B	†

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

82 FAULT ISOLATION

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
2C	†
2D	†
2E	†
2F	†
30	20, 21, 35, 23
31	21, 33, 46, 47
32	21, 43, 20, 32, 35, 34, 23
33	21, 20, 43, 35, 33
34	21, 43, 31
35	20, 35, 34, 21, 23
36	20, 35, 34, 21, 23
37	20, 35, 34, 21, 43, 33, 46, 47, 23
38	20, 35, 34, 21, 23
39‡	37, 21, 31, 29, 23
3A	21, 41, 35
40	†
41	†

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
42	†
43	†
44	†
45	†
46	†
47	†
48	†
49	†
4A	†
51	21, 37, 31
53	43, 21, 30
54	21, 43, 20, 32, 34
57	21
58	21
60	21, 20, 32, 34, 33, 22
61	43, 21, 30
62	20, 21, 32, 34, 33, 22

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

84 FAULT ISOLATION

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
63	20, 33, 22, 34, 21, 32
64	37, 21, 31, 22
65	37, 21, 31, 43, 32
66	53, 37, 22
67	61
6A	20, 21, 43, 32, 34, 33, 22
6B	33, 20, 34, 42, 32
70	21, 43, 30
71	21
72	77, 43, 21, 31
73	77, 43, 21, 31
74	77, 43, 21, 31
75	77, 43, 21, 31
76	77, 43, 21, 31
77	77, 43, 21, 31
78	77, 43, 21, 31
79	77, 43, 21, 31

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
7A	77, 43, 21, 31
7B	78
7C	62
7D	37, 42, 31, 22, 1
7E	63
7F	64
80	21
81	77, 43, 21, 31
82	77, 43, 21, 31
83	77, 43, 21, 31
84	77, 43, 21, 31
85	21
86	21
87	21
8A	65
8B	21
8F	21
90	77, 43, 21, 31

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

86 FAULT ISOLATION

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
91	77, 43, 21, 31
92	77, 43, 21, 31
93	77, 43, 21, 31
94	77, 43, 21, 31
95	77, 43, 21, 31
96	77, 43, 21, 31
97	21
9F	21
A0	21, 43, 20, 31, 33, 35, 23
A3	21, 43, 34, 31
A4	21, 43, 31
A5	21, 43, 31
A6	21
A7	21
A9‡	38, 43, 20, 21, 32
AB‡	38, 21, 32, 23, 1
AF	21
B0	21

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
B1	43, 21, 31
B2	38, 21, 32
B3	21
B4	43, 21, 31
B5	38, 21, 31
C2	38, 21, 31
C3	38, 21, 31
C4	38, 21, 31
C5	38, 21, 31
C6	38, 21, 31
C7	38, 21, 31
CB	38, 21, 32
CD	38, 31
CE‡	38, 21, 32, 23, 1
CF‡	38, 21, 32, 23, 1
D0‡	38, 21, 32, 23, 1
D1‡	38, 21, 32, 23, 1
D2‡	38, 21, 32, 23, 1

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

88 FAULT ISOLATION

Table 5-2 LED Error Codes and Possible Cause(s) (Cont)

Error Code	Possible Cause(s)*
D3‡	38, 21, 32, 23, 1
D4‡	38, 21, 32, 23, 1
D5‡	38, 21, 32, 23, 1
D6‡	38, 21, 32, 23, 1
D7‡	38, 21, 32, 23, 1
D8‡	38, 21, 32, 23, 1
D9‡	38, 21, 32, 23, 1
E0‡	38, 21, 31, 22, 1
E1	66, 67
EA	68
EE	69, 70
EF	71
FE	21

*See Table 5-3

†This error may not indicate a hardware problem. Retry the test again. If failure persists, further troubleshooting may indicate a controller or drive personality module problem.

‡Perform the servo adjustments before replacing the modules.

NOTE

The part numbers listed for the FRUs in Table 5-3 are accurate up to the time of this manual edition. When ordering FRUs, always refer to the latest RA80 Series Illustrated Parts Break-down Manual for the most up to date part numbers.

Table 5-3 FRU/Service Reference Table

Ref. No.	Description
1	Power supply, 115 V, 60 Hz (H766-C)
2	Power supply, 220 V, 50 Hz (H766-D)
3	Motor start cap., 115 V, 60 Hz (10-16924-00)
4	Motor start cap., 220 V, 50 Hz (10-17217-00)
5	Fan, and bracket assembly (70-16745-00)
6	Front bezel fan (12-10719-03)
7	Belt, 60 Hz (12-12635-03)
8	Belt, 50 Hz (12-12635-04)
9	RUN/STOP switch cap (12-12714-00)
10	WRITE PROTECT switch cap (12-12714-01)
11	FAULT switch cap (12-12714-02)
12	A port switch cap (12-12714-03)

*SV = RA80 Service Guide

†UG = RA80 User's Guide

90 FAULT ISOLATION

Table 5-3 FRU/Service Reference Table (Cont.)

Ref. No.	Description
13	B port switch cap (12-12714-04)
14	Wedge lamp, 6.3 V (12-12716-00)
15	Belt tension microswitch (12-14011-00)
16	HDA speed sensor optical switch (12-16817-00)
17	HDA thermal switch (12-16870-00)
18	Gas spring assembly (12-17072-00)
19	Encoder switch cap (12-18199-00)
20	Read/write module (54-13596-00)
21	Microprocessor and ROM assembly (54-15284-01)
22	Brush ground assembly (70-16215-00)
23	Head disk assembly (70-16225-00)
24	Wing pivot assembly (70-16230-00)
25	Motor/brake assembly, 115 V, 60 Hz (70-16723-00)
26	Motor/brake assembly, 220 V, 50 Hz (70-16723-01)
27	Motor actuator assembly (70-16724-00)
28	Logic dc power cable assembly (70-16732-00)

*SV = RA80 Service Guide

†UG = RA80 User's Guide

Table 5-3 FRU/Service Reference Table (Cont.)

Ref. No.	Description
29	Logic ac power harness assembly (70-16733-00)
30	Servo preamp cable assembly (70-16735-00)
31	Personality data cable, 40 cond. (70-16737-00)
32	Servo data cable, 40 cond. (70-16737-01)
33	Personality data cable, 20 cond. (70-16738-00)
34	Read/write data cable, 20 cond. (70-16738-01)
35	Read/write cable, 50 cond. (70-16739-00)
36	Operator control panel cable assembly (70-16740-00)
37	Shock mount assembly (70-16742-00)
38	Servo module/stiffener (70-16976-00)
39	Belt tension switch harness assembly (70-16980-00)
40	Line cord assembly, 115 V, 60 Hz (70-18345-00)

*SV = RA80 Service Guide

†UG = RA80 User's Guide

92 DRIVE-RESIDENT DIAGNOSTICS

Table 5-3 FRU/Service Reference Table (Cont.)

Ref. No.	Description
41	Line cord assembly, 220 V, 50 Hz (70-18345-01)
42	Control panel assembly (70-18324-00)
43	Personality module/stiffener (70-18327-00)
44	Cabinet I/O bulkhead assembly (70-18340-01)
45	Sequence terminator (70-09490-00)
46	Variable lengths of external SI I/O cable (BC26V-XX)
47	Internal SI I/O cable (70-18487-6B)
48	Motor tension spring (74-22440-00)
49	Front bezel foam air filter (74-22816-00)
50	UDA50 microprocessor board (M-7161)
51	UDA50 SI interface (M-7162)
52	Belt tension adjustment (*SV Chap 3)
53	Servo adjustments (*SV Chap 3)
54	Drive I/O cables not connected properly (†UG Chap 2)
55	Drive sequence cable not connected properly or defective (†UG Chap 2)

*SV = RA80 Service Guide

†UG = RA80 User's Guide

Table 5-3 FRU/Service Reference Table (Cont.)

Ref. No.	Description
56	HDA positioner lock in wrong position (*SV Chap 2)
57	Belt tension lever in wrong position (*SV Chap 2)
58	Spindle motor overheated (*SV Chap 5)
59	Ambient room temperature too high (Decrease temp.)
60	Speed transducer cable not connected (*SV Chap 2)
61	Read-only test failed (*SV Chap 5)
62	Positioner motor going to slow (*SV Chap 4)
63	Positioner motor going too fast (*SV Chap 4)
64	Spindle not spinning (*SV Chap 5)
65	Cables not connected properly (†UG Chap 2)
66	Drive-unsafe condition (*SV Chap 4)
67	Recalibration failure (*SV Chap 5)
68	Test inhibited by drive error (*SV Chap 4)

*SV = RA80 Service Guide

†UG = RA80 User's Guide

Table 5-3 FRU/Service Reference Table (Cont.)

Ref. No.	Description
69	Starting and ending address same as for seek test (enter correct address)
70	Jumper for read-only cylinder formatter utility missing (*SV Chap 4)
71	Cylinder address greater than 560 has been entered (enter correct address)
72	Wrong procedure used or wrong value entered (*SV Chap 4)
73	Software problem (Check prog.)
74	Cable problems (†UG Chap 2)
75	Operator error (*SV Chap 4)
76	Low ac power input (†UG Chap 1)
77	Loop back plugs need to be in (*SV Chap 4)
78	Spin motor down (*SV Chap 4) 20 in. drive sequence cable (70-18328-00) 6 ft. internal drive sequence cable (70-18457-06) 8 ft. drive sequence cable (70-18458-08) Variable lengths of external drive sequence cable (70-18458-XX)

*SV = RA80 Service Guide

†UG = RA80 User's Guide

5.5 POWER SUPPLY FAULT ISOLATION

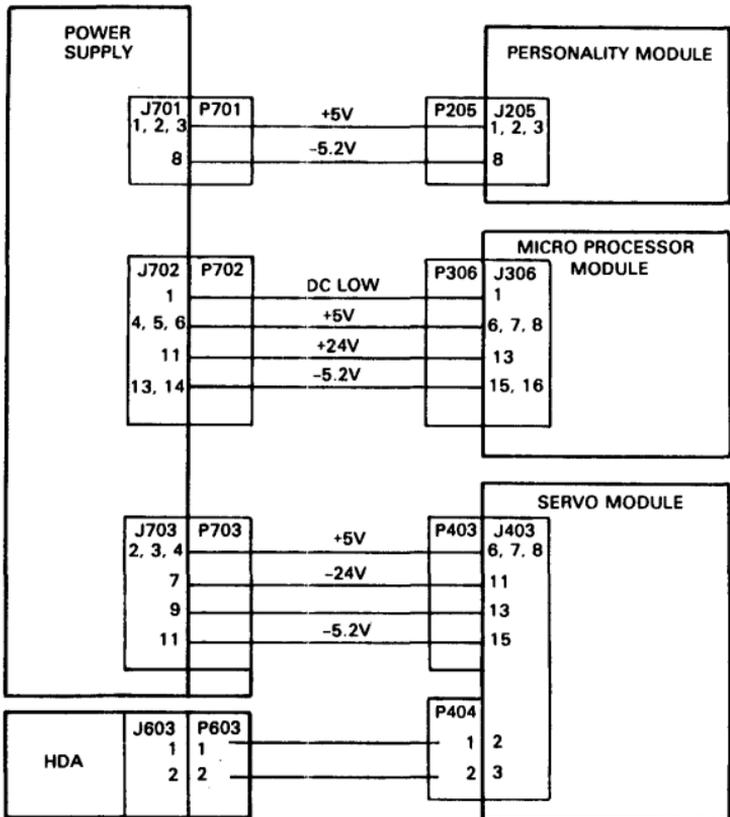
Power supply failure symptoms are listed in Table 5-4. Power supply voltages can be measured on the circuit modules at the connector pins indicated in Figure 5-4, and the tolerances for these measurements are given in Table 5-5.

Table 5-4 Power Supply Failure Indications

Symptom Check	Action
Fans	Check that all four fans are spinning.
+ 5 volt indicators	Check that the operator control panel indicators and the internal LED display flash on momentarily when power is applied to the drive. The flash will indicate that + 5 volts is present.
WRITE PROTECT switch	Check that + 5 volts is present at the operator control panel WRITE PROTECT switch. The WRITE PROTECT switch should light when pushed if + 5 volts is present and the drive is on-line.

Table 5-4 Power Supply Failure Indications (Cont)

Symptom Check	Action
± 12 volt LEDs	Check that the two 12 volt LEDs on the servo module next to the heat sink are on. When lit, they indicate that both +12 and -12 volts are present.
FAULT indicator off. All other operator control panel indicators are on	Check if only the FAULT indicator on the operator control panel is not lit. This condition occurs only when the DC LOW signal is asserted. Possible causes could be the power supply, micro-processor module, or servo module.



CZ-0614

Figure 5-4 Voltage Test Points

98 FAULT ISOLATION

Table 5-5 DC Voltage Tolerances

DC Voltages	Test Points (See Figure 5-4)
+5; ± 0.2 volts J205	Pins 1, 2, or 3 of
-5.2; ± 0.2 volts	Pins 15 or 16 of J306
+24; +3, -1 volts	Pin 13 of J403
-24; +1, -3 volts	Pin 11 of J403
DC Low	Pin 1 of J306

5.6 TROUBLESHOOTING TIPS

The following text describes some general troubleshooting tips that may be useful when performing RA80 drive fault isolation.

5.6.1 Check Firmware Revision and ROM Set Numbers

The firmware revision and ROM set numbers are in the last few bytes of each ROM. The easiest way to examine these numbers is by using the memory examine-down utility, test-select code "06". Enter the address of the last byte of the ROM to be examined. Then push the ENTER switch to examine each byte location starting with the last byte in the ROM. Refer to Table 5-6 for the last address of each ROM. Figure 5-5 shows what is contained in the last eight bytes of each ROM.

Table 5-6 Last Byte Address of Each ROM

ROM	Address of Last Byte
0	07FF
1	0FFF
2	17FF
3	1FFF
4	27FF
5	2FFF

REV HIGH BYTE	REV LOW BYTE	ROM SET HIGH BYTE	ROM SET LOW BYTE	ZEROS (UNUSED)	ONES COLUMN CHECK	ZEROS COLUMN CHECK	CHECK SUM
XXX8	XXX9	XXXA	XXXB	XXXC	XXXD	XXXE	XXXF

CZ 0366

Figure 5-5 Last Eight Bytes of a ROM

5.6.2 Testing the Write-Protect Function

The write-protect function in the RA80 Disk Drive may be tested while the drive is in the functional mode with the following procedure.

1. Spin-down the disks by releasing the RUN/STOP switch.
2. Push in the WRITE PROTECT switch.

100 FAULT ISOLATION

3. Spin-up the disk by pushing in the RUN/STOP switch. If the write-protect function is working, the FAULT indicator is lit. The internal LEDs on the microprocessor module will display an error code of "6A".
4. Push the FAULT switch to enter the fault display mode. The operator control panel will display a R/W diagnostic fault code. Both the FAULT and Port A indicators should be on.
5. Push the FAULT switch again to clear this fault condition.
6. Release the WRITE PROTECT switch.

5.6.3 Spindle Motor Thermal Timeouts

The RA80 Engineering Specification calls for a three minute wait period between successive start-up cycles of the spindle motor. This wait period is required to prevent the spindle motor from overheating and setting an internal thermal switch in the motor. A spindle motor thermal timeout may be caused by one of the following.

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

If the spindle motor thermal switch was set, it would result in the following symptoms.

- LED error codes of 01, 02, 03, 04, or 26
- Spin-up fault on the operator control panel

To recover from a spindle motor thermal timeout, check the fans first. If the fans are operating, let the motor cool off for 10 to 15 minutes while power is applied to the drive.

APPENDIX A

BINARY TO HEXADECIMAL CONVERSION

The LED display on the microprocessor module consists of eight LEDs in a row which are read as two hexadecimal digits. Use Table A-1 to convert the binary LED code into hexadecimal.

Table A-1 Binary To Hexadecimal Conversion

Binary	Hexa- decimal
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F