RA68 Laboratory Project Workbook

Supplement to RA68 Maintenance Course
EY-1173E-V0-V081

FOR INTERNAL USE ONLY

Prepared by Educational Services
Digital Equipment Corporation
INTRODUCTION

As a Field Service engineer, you will be required to perform corrective maintenance on a RA60 Disk Drive. This module gives you the opportunity to gain proficiency in troubleshooting the RA60 to the field replaceable unit (FRU) level of repair.

The course administrator will give you at least two problems to troubleshoot on the RA60 Disk Drive. When you are ready, ask the course administrator to insert a fault into the RA60 drive. You will only be required to isolate the problem to the failing FRU, and then inform the administrator what FRU is bad. He will remove the fault and insert another one for you to troubleshoot.

OBJECTIVES

Upon completing this module, you will be able to troubleshoot the RA60 Disk Drive to locate the failing FRU.

Fault Insertion

Equipment:
- VAX or PDP-11 system
- UDA50 controller
- Input/output terminal
- Operational RA60 Disk Drive
- Diagnostic disk pack
- RA60 scratch disk pack

Reference:
- RA60 Disk Drive Service Manual, Chapter 5, Tables 5-1 and 5-2.
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SUBSYSTEM DIAGNOSTICS

Subsystem Diagnostic Checklist

There are five subsystem diagnostic tests to complete. Use the following checklist to ensure that you complete the subsystem diagnostic projects.

<table>
<thead>
<tr>
<th>DIAGNOSTIC TEST</th>
<th>DATE COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>******</td>
</tr>
<tr>
<td>Test 2</td>
<td>******</td>
</tr>
<tr>
<td>Test 3</td>
<td>******</td>
</tr>
<tr>
<td>Test 4</td>
<td>******</td>
</tr>
<tr>
<td>Test 5</td>
<td>******</td>
</tr>
</tbody>
</table>

The following information will aid in running the subsystem diagnostics.

Equipment:
- VAX or PDP-11 system
- UDA50 controller
- Input/Output terminal
- Operational RA60 Disk Drive
- Diagnostic disk pack
- RA60 scratch disk pack

Reference:
- RA60 Disk Drive Maintenance
- Course Workbook III, Section 2.
INTRODUCTION

To run the subsystem diagnostics, the RA68 must be running under control of a UDA58 controller. The subsystem diagnostics come on an RA68 disk pack and are run under control of the diagnostic supervisor program.

The VAX EVLRA and the PDP-11 CZU8C are the subsystem diagnostics depending on whether you are using a VAX or a PDP-11 system. These diagnostics consist of the following five tests.

- Test 1: UNIBUS Interrupt/Address Test (checks out UDA58 functionality).
- Test 2: Disk Resident Diagnostic Test (runs the drive resident diagnostics).
- Test 3: Disk Function Test (performs drive seek tests).
- Test 4: Disk Exerciser Test (performs a limited read and write test only in the diagnostic cylinder area).
- Test 5: Manual Intervention Test (allows test 4 to be run with new input parameters that could include the customer data area, if desired).

OBJECTIVES

Upon completing this module, you will be able to run the RA68 subsystem diagnostics.
INTRODUCTION
The RA60 Laboratory Project Workbook is designed to be a supplement to the RA60 Disk Drive Maintenance Course. It also allows you to gain experience servicing the RA60 Disk Drive. If you have never taken a self-paced course, the pamphlet, How to Take a Self-Paced Course (KY-DX37-ID-001), should be available from the course administrator.

COURSE DESCRIPTION
The RA60 Laboratory Project Workbook is a source of reference material. The workbook does not contain detailed information, but refers to the proper chapter and paragraph in the RA60 Service Manual where the detailed information is found. This workbook accomplishes two goals:

1. Gives you experience in servicing the RA60 Disk Drive.
2. Teaches you how to use the RA60 Disk Drive Service Manual.

The workbook includes power precautions that should be observed before replacing field replaceable units (FRUs). It lists required special tools and their part numbers and shows the location of the major FRUs for the RA60 Disk Drive.
STUDENT GUIDE

PREREQUISITES
The prerequisite is the RA60 Disk Drive Maintenance Course. If you have not taken this, contact the course administrator.

OBJECTIVES
The RA60 Laboratory Project Workbook is designed to be a supplement to the existing RA60 Disk Drive Maintenance Course. Upon completing this workbook, the student will be able to perform the following objectives:

- Remove and replace all the major FRUs.
- Run the internal diagnostics using the hand-held terminal.
- Run the host diagnostics to check-out the operational condition of the disk drive.
- Troubleshoot faults inserted by the administrator.

EQUIPMENT REQUIRED
The following equipment is required for the RA60 Laboratory Project Workbook:

- VAX or PDP-11 system
- UDA50 or HSC50 controller
- Input/output terminal
- Hand-held terminal
- Operational RA60 Disk Drive
- Diagnostic disk pack
- RA60 scratch disk pack
- Standard field service tool kit
SPECIAL TOOLS

Table 1 lists the special tools required to maintain the RA6Ø Disk Drive.

Table 1 Special Tools

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>29-24192-00</td>
<td>Wrench 97, hex adapter, torque</td>
</tr>
<tr>
<td>29-24191-00</td>
<td>Wrench, cam-over torque</td>
</tr>
<tr>
<td>29-24194-00</td>
<td>Screwdriver, flat 10 inch blade</td>
</tr>
<tr>
<td>29-24195-00</td>
<td>Hand-held terminal service kit</td>
</tr>
<tr>
<td>29-24672-00</td>
<td>Head insertion tool</td>
</tr>
</tbody>
</table>

REFERENCE MATERIAL

The following reference material is required to successfully complete this workbook.

RA6Ø Disk Drive Service Manual  EK-ORA60-SV
RA6Ø Disk Drive Maintenance     EY-1173E-WB-0301
Course Workbook III             EY-1173E-WB-0301

COURSE MAP

Figure 1 shows the course map. The course starts at the bottom of the map and should be completed in sequence illustrated. A new module should only be started only after the previous module has been completed.
INTERNAL DIAGNOSTICS

Run the Incremental Seek Command
Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.3

Run the Random Seek Command
Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.4

Run the Seek Command
Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.5

Run the Toggle Seek Command
Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.6
INTERNAL DIAGNOSTICS

Internal Diagnostics Checklist

There are six internal diagnostic projects to be performed. Use the following checklist to ensure completion.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>DATE COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get Status</td>
<td>------</td>
</tr>
<tr>
<td>Recal</td>
<td>------</td>
</tr>
<tr>
<td>Incremental Seek</td>
<td>------</td>
</tr>
<tr>
<td>Random Seek</td>
<td>------</td>
</tr>
<tr>
<td>Seek</td>
<td>------</td>
</tr>
<tr>
<td>Toggle Seek</td>
<td>------</td>
</tr>
</tbody>
</table>

Unless otherwise stated, these internal diagnostics should be run in the order listed below.

Run the Get Status Command

**Equipment:** Operational RA68
hand-held terminal

**Reference:** RA68 Disk Drive Service Manual,
Chapter 3, paragraph 3.15.1

Run the Recal Command

**Equipment:** Operational RA68
hand-held terminal

**Reference:** RA68 Disk Drive Service Manual,
Chapter 3, paragraph 3.15.2
INTERNAL DIAGNOSTICS

Figure 6 Diagnostic Terminal Connections
INTERNAL DIAGNOSTICS

The RS232 interface cable connects to the drive logic module via a connector found at the top of the module. The +5 voltage cable required to power the hand-held terminal is supplied by connector P807 on the power module assembly. Connect the power cable from the hand-held terminal to connector P807. Refer to Figure 6.

Once the cables are connected properly, key in a CTRL C ("C") on the terminal keyboard. The terminal responds to the "C" with the following diagnostic prompt:

$RA60 COMPLETED
RA60 TEST $>

After receiving the diagnostic prompt, testing can be run by keying in any of the internal diagnostic commands.

INTRODUCTION

This module allows you to gain experience on servicing the RA60 Disk Drive. It also includes power precautions that should be observed before removing and replacing field replaceable units (FRUs).

OBJECTIVES

Upon completion of this module, you will be able to remove and replace eighteen of the major FRUs within the RA60 Disk Drive.

Power Precautions
Because hazardous voltages are present inside this equipment, servicing should be performed only by qualified service personnel. Bodily injury or equipment damage may result from incorrect servicing.

CAUTION

Always remove power from the unit before replacing internal parts or cables.
REMOVAL AND REPLACEMENT

Remove Power From the Disk Drive

Before replacing assemblies in the RA60 Disk Drive, the disk should be spun-down and the ac line power removed using the following instructions.

1. Switch off CB1 at the back of the RA60 to remove power to the drive internal assemblies.
2. Unplug the ac cord from the back of the drive to remove power to the RA60 power supply.

Power Supply Location and Controls

The power controls for the RA60 and power controller (874) are shown in Figure 2.

Figure 2 RA60 Power Controls

INTERNAL DIAGNOSTICS

Installing The Terminal

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

Figure 5 Field Service Diagnostic Terminal
INTERNAL DIAGNOSTICS

Powering Up The Drive

Apply power to the drive so that it can run a power-up test sequence. The sequence consists of various hardcore tests with static master logic. 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. The run light will remain on until the drive has verified that the spindle has stopped. The cover will remain locked until the run light goes off. If the fault light is on, all or part of the power-up sequence has failed. Chapter 5 of the RA68 Disk Drive Service Manual contains the troubleshooting procedures enabling you to repair the RA68 Disk Drive.

The Diagnostic Terminal

A field service diagnostic terminal used to communicate with the RA68 drive is stocked with every spares kit. Refer to Figure 5. The terminal contains a two-level LED display and a keyboard. The display holds a maximum of 32 characters at one time 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.

REMOVAL AND REPLACEMENT

RA68 FRU Location

Figures 3 and 4 show the location of the main FRUs contained within the RA68 Disk Drive.

Figure 3 RA68 External FRU Location
INTRODUCTION

The RA60 internal diagnostics includes diagnostic command selection, powering up the disk drive, how to install the hand-held terminal, and how to call in and run the internal diagnostics using the hand-held terminal.

OBJECTIVES

Upon completing this module, you will be able to run the RA60 internal diagnostics using the hand-held terminal.

Internal Diagnostic Command Selection

The RA60 has six internal diagnostics that will check out the status, recalibration, and seeking capability of the drive. Table 2 lists the codes and names of the diagnostic tests.

<table>
<thead>
<tr>
<th>Test Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Get Status</td>
</tr>
<tr>
<td>02</td>
<td>Recal</td>
</tr>
<tr>
<td>03</td>
<td>Incremental Seek</td>
</tr>
<tr>
<td>04</td>
<td>Random Seek</td>
</tr>
<tr>
<td>05</td>
<td>Seek</td>
</tr>
<tr>
<td>06</td>
<td>Toggle Seek</td>
</tr>
</tbody>
</table>
REMOVAL AND REPLACEMENT

Removal And Replacement Checklist

There are eighteen removal and replacement procedures to be performed. Unless otherwise stated, reverse the removal procedure to replace any of the FRUs. Use this checklist to ensure that you complete each procedure.

Units

<table>
<thead>
<tr>
<th>Units</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear cover</td>
<td>---------</td>
</tr>
<tr>
<td>Rear shield</td>
<td>---------</td>
</tr>
<tr>
<td>Front Cover</td>
<td>---------</td>
</tr>
<tr>
<td>Post/amp data separator module</td>
<td>---------</td>
</tr>
<tr>
<td>SDI module</td>
<td>---------</td>
</tr>
<tr>
<td>Drive logic module</td>
<td>---------</td>
</tr>
<tr>
<td>Preamp module</td>
<td>---------</td>
</tr>
<tr>
<td>Power module assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Transformer assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Read/write head</td>
<td>---------</td>
</tr>
<tr>
<td>Bezel</td>
<td>---------</td>
</tr>
<tr>
<td>Front panel</td>
<td>---------</td>
</tr>
<tr>
<td>Air filter assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Diskwell assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Spindle assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Positioner assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Switch plate assembly</td>
<td>---------</td>
</tr>
<tr>
<td>Rear fan</td>
<td>---------</td>
</tr>
</tbody>
</table>

The removals should be done before any replacements.

Remove the Rear Cover, Rear Shield, Front Cover

Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.11
REMOVAL AND REPLACEMENT

Remove the Post/amp Data Separator Module

Tools Required: None

Remove the SDI Module

Tools Required: None
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.13

Remove the Drive Logic Module

Tools Required: None
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.14

Remove the Preamp Module

Tools Required: Flat-blade screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.16

Remove the Power Module Assembly

Tools Required: Flat-blade 10 inch screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.17
REMOVAL AND REPLACEMENT

Remove the Transformer Assembly
Tools Required: Phillips head screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.18

Remove the Bezel
Tools Required: Phillips head screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.22

Remove the Front Panel
Tools Required: Phillips head screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.23

Remove the Air Filter Assembly
Tools Required: None
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.24

Remove the Diskwell Assembly
Tools Required: Phillips head screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.25
REMOVAL AND REPLACEMENT

Remove the Spindle Assembly

Tools Required: Hex wrench 1/4 inch
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.26

Remove Read/write Head Ø

Tools Required: Wrench 97, hex adapter, torque wrench, cam-over torque wrench, head insertion tool
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.28

NOTE
Replace read/write head Ø before continuing on with any other removal. This will prevent any damage to the read/write head.

Replace Read/write Head Ø

Tools Required: Wrench 97, hex adapter, torque wrench, cam-over torque wrench, head insertion tool
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.21

REMOVAL AND REPLACEMENT

Remove the Positioner Assembly

Tools Required: Hex driver 3/16 inch
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.27

Remove the Rear Fan

Tools Required: Phillips head screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.29

Remove the Switch Plate Assembly

Tools Required: Phillips head screwdriver
Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.30
REMOVAL AND REPLACEMENT

Remove the Spindle Assembly
Tools Required: Hex wrench 1/4 inch
Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.26

Remove Read/write Head Ø
Tools Required: Wrench 97, hex adapter, torque wrench, cam-over torque wrench, head insertion tool
Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.28

NOTE
Replace read/write head Ø before continuing on with any other removal. This will prevent any damage to the read/write head.

Replace Read/write Head Ø
Tools Required: Wrench 97, hex adapter, torque wrench, cam-over torque wrench, head insertion tool
Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.21

REMOVAL AND REPLACEMENT

Remove the Positioner Assembly
Tools Required: Hex driver 3/16 inch
Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.27

Remove the Rear Fan
Tools Required: Phillips head screwdriver
Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.29

Remove the Switch Plate Assembly
Tools Required: Phillips head screwdriver
Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.30
REMOVAL AND REPLACEMENT

Remove the Transformer Assembly

Tools Required: Phillips head screwdriver

Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.18

Remove the Bezel

Tools Required: Phillips head screwdriver

Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.22

Remove the Front Panel

Tools Required: Phillips head screwdriver

Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.23

Remove the Air Filter Assembly

Tools Required: None

Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.24

Remove the Diskwell Assembly

Tools Required: Phillips head screwdriver

Reference Material: RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.25
## REMOVAL AND REPLACEMENT

### Remove the Post/amp Data Separator Module

**Tools Required:** None  
**Reference Material:** RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.12

### Remove the SDI Module

**Tools Required:** None  
**Reference Material:** RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.13

### Remove the Drive Logic Module

**Tools Required:** None  
**Reference Material:** RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.14

### Remove the Preamp Module

**Tools Required:** Flat-blade screwdriver  
**Reference Material:** RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.15

### Remove the Power Module Assembly

**Tools Required:** Flat-blade 10 inch screwdriver  
**Reference Material:** RA68 Disk Drive Service Manual, Chapter 2, paragraph 2.17

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**INTERNAL DIAGNOSTICS**
REMOVAL AND REPLACEMENT

Removal And Replacement Checklist

There are eighteen removal and replacement procedures to be performed. Unless otherwise stated, reverse the removal procedure to replace any of the FRUs. Use this checklist to ensure that you complete each procedure.

<table>
<thead>
<tr>
<th>Units</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear cover</td>
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<tr>
<td>Rear shield</td>
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<td>Bezel</td>
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<td>Front panel</td>
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</tr>
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<td>Air filter assembly</td>
<td></td>
</tr>
<tr>
<td>Diskwell assembly</td>
<td></td>
</tr>
<tr>
<td>Spindle assembly</td>
<td></td>
</tr>
<tr>
<td>Positioner assembly</td>
<td></td>
</tr>
<tr>
<td>Switch plate assembly</td>
<td></td>
</tr>
<tr>
<td>Rear fan</td>
<td></td>
</tr>
</tbody>
</table>

The removals should be done before any replacements.

Remove the Rear Cover, Rear Shield, Front Cover

Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual, Chapter 2, paragraph 2.11
INTRODUCTION

The RA68 internal diagnostics includes diagnostic command selection, powering up the disk drive, how to install the hand-held terminal, and how to call in and run the internal diagnostics using the hand-held terminal.

OBJECTIVES

Upon completing this module, you will be able to run the RA68 internal diagnostics using the hand-held terminal.

Internal Diagnostic Command Selection

The RA68 has six internal diagnostics that will check out the status, recalibration, and seeking capability of the drive. Table 2 lists the codes and names of the diagnostic tests.

Table 2 RA68 Diagnostic Codes

<table>
<thead>
<tr>
<th>Test Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Get Status</td>
</tr>
<tr>
<td>02</td>
<td>Recal</td>
</tr>
<tr>
<td>03</td>
<td>Incremental Seek</td>
</tr>
<tr>
<td>04</td>
<td>Random Seek</td>
</tr>
<tr>
<td>05</td>
<td>Seek</td>
</tr>
<tr>
<td>06</td>
<td>Toggle Seek</td>
</tr>
</tbody>
</table>
INTERNAL DIAGNOSTICS

Powering Up The Drive

Apply power to the drive so that it can run a power-up test sequence. The sequence consists of various hardcore tests with static master logic. 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. The run light will remain on until the drive has verified that the spindle has stopped. The cover will remain locked until the run light goes off. If the fault light is on, all or part of the power-up sequence has failed. Chapter 5 of the RA68 Disk Drive Service Manual contains the troubleshooting procedures enabling you to repair the RA68 Disk Drive.

The Diagnostic Terminal

A field service diagnostic terminal used to communicate with the RA68 drive is stocked with every spares kit. Refer to Figure 5. The terminal contains a two-level LED display and a keyboard. The display holds a maximum of 32 characters at one time 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.

REMOVAL AND REPLACEMENT

RA68 FRU Location

Figures 3 and 4 show the location of the main FRUs contained within the RA68 Disk Drive.

Figure 3 RA68 External FRU Location
REMOVAL AND REPLACEMENT

Remove Power From the Disk Drive
Before replacing assemblies in the RA60 Disk Drive, the disk should be spun-down and the ac line power removed using the following instructions.

1. Switch off CB1 at the back of the RA60 to remove power to the drive internal assemblies.
2. Unplug the ac cord from the back of the drive to remove power to the RA60 power supply.

Power Supply Location and Controls
The power controls for the RA60 and power controller (874) are shown in Figure 2.

INTERNAL DIAGNOSTICS

Figure 5 Field Service Diagnostic Terminal

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

Figure 2 RA60 Power Controls
INTERNAL DIAGNOSTICS

The RS232 interface cable connects to the drive logic module via a connector found at the top of the module. The +5 voltage cable required to power the hand-held terminal is supplied by connector P807 on the power module assembly. Connect the power cable from the hand-held terminal to connector P807. Refer to Figure 6.

Once the cables are connected properly, key in a CTRL C ("C") on the terminal keyboard. The terminal responds to the "C" with the following diagnostic prompt.

$RA60 COMPLETED
RA60 TEST $>

After receiving the diagnostic prompt, testing can be run by keying in any of the internal diagnostic commands.

INTRODUCTION

This module allows you to gain experience on servicing the RA60 Disk Drive. It also includes power precautions that should be observed before removing and replacing field replaceable units (FRUs).

OBJECTIVES

Upon completion of this module, you will be able to remove and replace eighteen of the major FRUs within the RA60 Disk Drive.

Power Precautions
Because hazardous voltages are present inside this equipment, servicing should be performed only by qualified service personnel. Bodily injury or equipment damage may result from incorrect servicing.

CAUTION

Always remove power from the unit before replacing internal parts or cables.
Figure 6 Diagnostic Terminal Connections
INTERNAL DIAGNOSTICS

Internal Diagnostics Checklist

There are six internal diagnostic projects to be performed. Use the following checklist to ensure completion.

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>DATE COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get Status</td>
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<td>Recal</td>
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<tr>
<td>Incremental Seek</td>
<td>------</td>
</tr>
<tr>
<td>Random Seek</td>
<td>------</td>
</tr>
<tr>
<td>Seek</td>
<td>------</td>
</tr>
<tr>
<td>Toggle Seek</td>
<td>------</td>
</tr>
</tbody>
</table>

Unless otherwise stated, these internal diagnostics should be run in the order listed below.

Run the Get Status Command

Equipment: Operational RA68
hand-held terminal

Reference: RA68 Disk Drive Service Manual,
Chapter 3, paragraph 3.15.1

Run the Recal Command

Equipment: Operational RA68
hand-held terminal

Reference: RA68 Disk Drive Service Manual,
Chapter 3, paragraph 3.15.2
STUDENT GUIDE

INTERNAL DIAGNOSTICS

Run the Incremental Seek Command

Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.3

Run the Random Seek Command

Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.4

Run the Seek Command

Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.5

Run the Toggle Seek Command

Equipment: Operational RA60 hand-held terminal
Reference: RA60 Disk Drive Service Manual, Chapter 3, paragraph 3.15.6

Figure 1 Course Map
STUDENT GUIDE

SPECIAL TOOLS
Table 1 lists the special tools required to maintain the RA60 Disk Drive.

Table 1 Special Tools

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>29-24192-00</td>
<td>Wrench 97, hex adapter, torque</td>
</tr>
<tr>
<td>29-24191-00</td>
<td>Wrench, cam-overs torque</td>
</tr>
<tr>
<td>29-24194-00</td>
<td>Screwdriver, flat 10 inch blade</td>
</tr>
<tr>
<td>29-24195-00</td>
<td>Hand-held terminal service kit</td>
</tr>
<tr>
<td>29-24672-00</td>
<td>Head insertion tool</td>
</tr>
</tbody>
</table>

REFERENCE MATERIAL
The following reference material is required to successfully complete this workbook.

RA60 Disk Drive Service Manual
RA60 Disk Drive Maintenance
Course Workbook III

COURSE MAP
Figure 1 shows the course map. The course starts at the bottom of the map and should be completed in sequence illustrated. A new module should only be started only after the previous module has been completed.
STUDENT GUIDE

PREREQUISITES
The prerequisite is the RA6Ø Disk Drive Maintenance Course.
If you have not taken this, contact the course administrator.

OBJECTIVES
The RA6Ø Laboratory Project Workbook is designed to be a supplement to the existing RA6Ø Disk Drive Maintenance Course. Upon completing this workbook, the student will be able to perform the following objectives:

- Remove and replace all the major FRUs.
- Run the internal diagnostics using the hand-held terminal.
- Run the host diagnostics to check-out the operational condition of the disk drive.
- Troubleshoot faults inserted by the administrator.

EQUIPMENT REQUIRED
The following equipment is required for the RA6Ø Laboratory Project Workbook.

- VAX or PDP-11 system
- UDA5Ø or HSC5Ø controller
- Input/output terminal
- Hand-held terminal
- Operational RA6Ø Disk Drive
- Diagnostic disk pack
- RA6Ø scratch disk pack
- Standard field service tool kit

SUBSYSTEM DIAGNOSTICS
INTRODUCTION

The RA68 Laboratory Project Workbook is designed to be a supplement to the RA68 Disk Drive Maintenance Course. It also allows you to gain experience servicing the RA68 Disk Drive. If you have never taken a self-paced course, the pamphlet, How to Take a Self-Paced Course (EY-6X037-ID-901), should be available from the course administrator.

COURSE DESCRIPTION

The RA68 Laboratory Project Workbook is a source of reference material. The workbook does not contain detailed information, but refers to the proper chapter and paragraph in the RA68 Service Manual where the detailed information is found. This workbook accomplishes two goals:

1. Gives you experience in servicing the RA68 Disk Drive.
2. Teaches you how to use the RA68 Disk Drive Service Manual.

The workbook includes power precautions that should be observed before replacing field replaceable units (FRUs). It lists required special tools and their part numbers and shows the location of the major FRUs for the RA68 Disk Drive.
INTRODUCTION

To run the subsystem diagnostics, the RA60 must be running under control of a UDA50 controller. The subsystem diagnostics come on an RA60 disk pack and are run under control of the diagnostic supervisor program.

The VAX EVLRA and the PDP-11 CZUDC are the subsystem diagnostics depending on whether you are using a VAX or a PDP-11 system. These diagnostics consist of the following five tests.

- Test 1: UNIBUS Interrupt/Address Test (checks out UDA50 functionality).
- Test 2: Disk Resident Diagnostic Test (runs the drive resident diagnostics).
- Test 3: Disk Function Test (performs drive seek tests).
- Test 4: Disk Exerciser Test (performs a limited read and write test only in the diagnostic cylinder area).
- Test 5: Manual Intervention Test (allows test 4 to be run with new input parameters that could include the customer data area, if desired).

OBJECTIVES

Upon completing this module, you will be able to run the RA60 subsystem diagnostics.
SUBSYSTEM DIAGNOSTICS

Subsystem Diagnostic Checklist

There are five subsystem diagnostic tests to complete. Use the following checklist to ensure that you complete the subsystem diagnostic projects.

<table>
<thead>
<tr>
<th>DIAGNOSTIC TEST</th>
<th>DATE COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>-----</td>
</tr>
<tr>
<td>Test 2</td>
<td>-----</td>
</tr>
<tr>
<td>Test 3</td>
<td>-----</td>
</tr>
<tr>
<td>Test 4</td>
<td>-----</td>
</tr>
<tr>
<td>Test 5</td>
<td>-----</td>
</tr>
</tbody>
</table>

The following information will aid in running the subsystem diagnostics.

Equipment:
- VAX or PDP-11 system
- UDA50 controller
- Input/Output terminal
- Operational RA60 Disk Drive
- Diagnostic disk pack
- RA60 scratch disk pack

Reference:
- RA60 Disk Drive Maintenance
- Course Workbook III, Section 2.
SUBSYSTEM DIAGNOSTICS

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INTRODUCTION

As a Field Service engineer, you will be required to perform corrective maintenance on a RA60 Disk Drive. This module gives you the opportunity to gain proficiency in troubleshooting the RA60 to the field replaceable unit (FRU) level of repair.

The course administrator will give you at least two problems to troubleshoot on the RA60 Disk Drive. When you are ready, ask the course administrator to insert a fault into the RA60 drive. You will only be required to isolate the problem to the failing FRU, and then inform the administrator what FRU is bad. He will remove the fault and insert another one for you to troubleshoot.

OBJECTIVES

Upon completing this module, you will be able to troubleshoot the RA60 Disk Drive to locate the failing FRU.

Fault Insertion

Equipment:
- VAX or PDP-11 system
- UDA50 controller
- Input/output terminal
- Operational RA60 Disk Drive
- Diagnostic disk pack
- RA60 scratch disk pack

Reference:
- RA60 Disk Drive Service Manual, Chapter 5, Tables 5-1 and 5-2.
RA68 Laboratory Project Workbook

Supplement to RA68
Maintenance Course

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