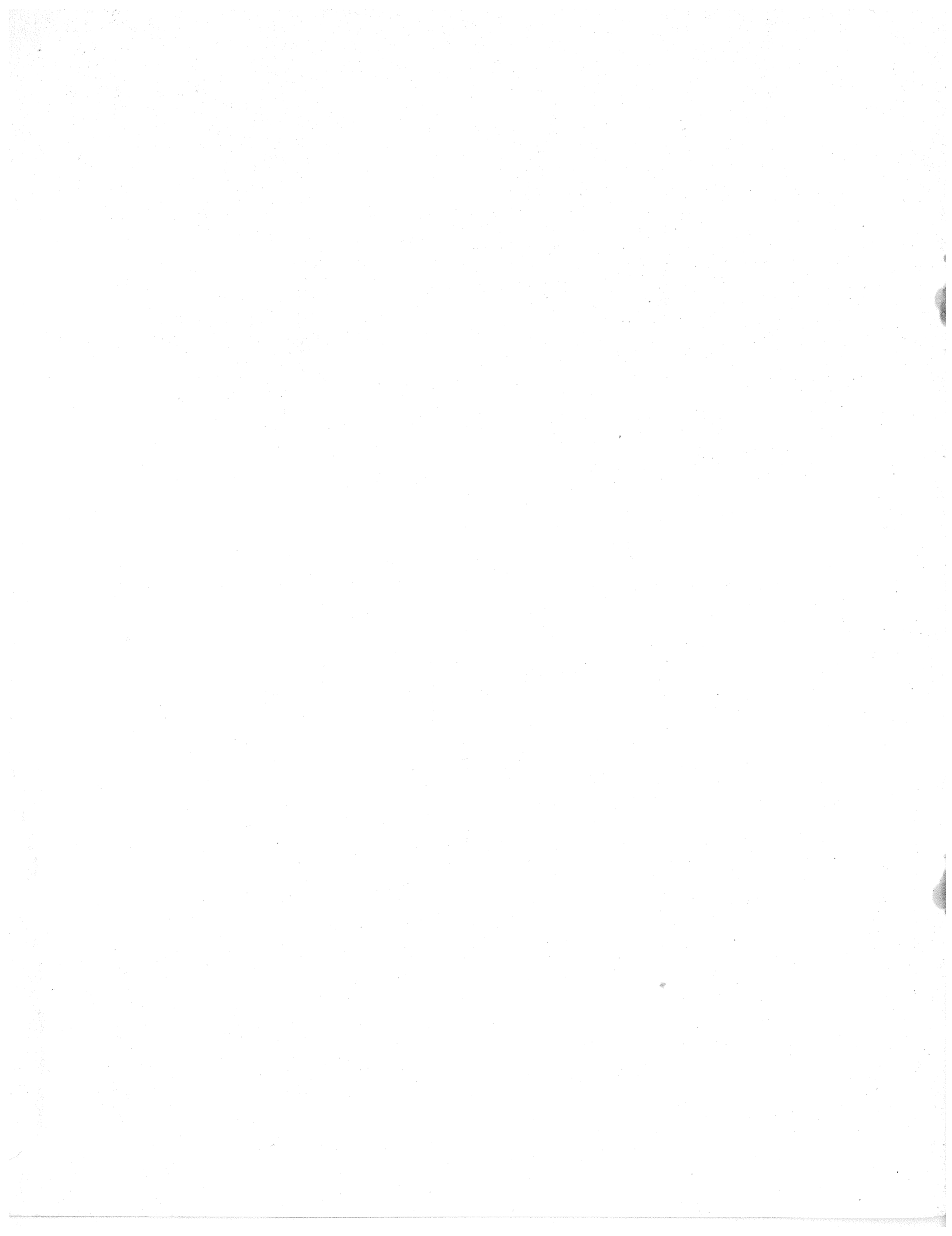


EY-1670E-WB-0001

RA60 Laboratory Project Workbook

Student Guide

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EY-1670E-WB-0001
J-6913-A

RA60 Laboratory Project Workbook

Supplement to RA60
Maintenance Course
EY-1173E-V0-VU01

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Prepared by Educational Services
Digital Equipment Corporation

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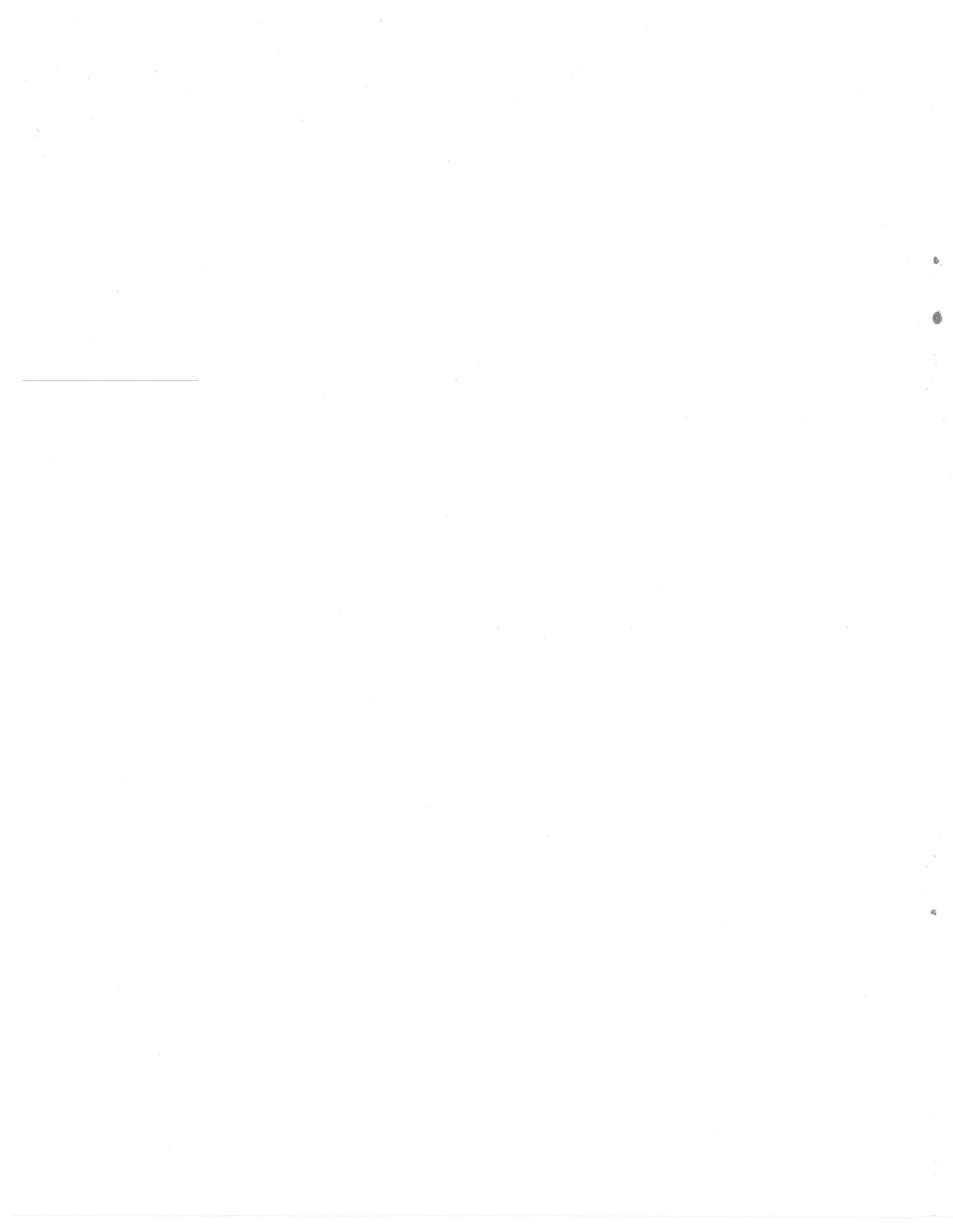
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STUDENT GUIDE



STUDENT GUIDE

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 (EY-DX037-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

STUDENT GUIDE

SPECIAL TOOLS

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

Table 1 Special Tools

Part Number	Description
29-24192-00	Wrench 97, hex adapter, torque
29-24193-00	Wrench, cam-over torque
29-24194-00	Screwdriver, flat 10 inch blade
29-24195-00	Hand-held terminal service kit
29-24672-00	Head insertion tool

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

EK-ORA60-SV

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.

STUDENT GUIDE

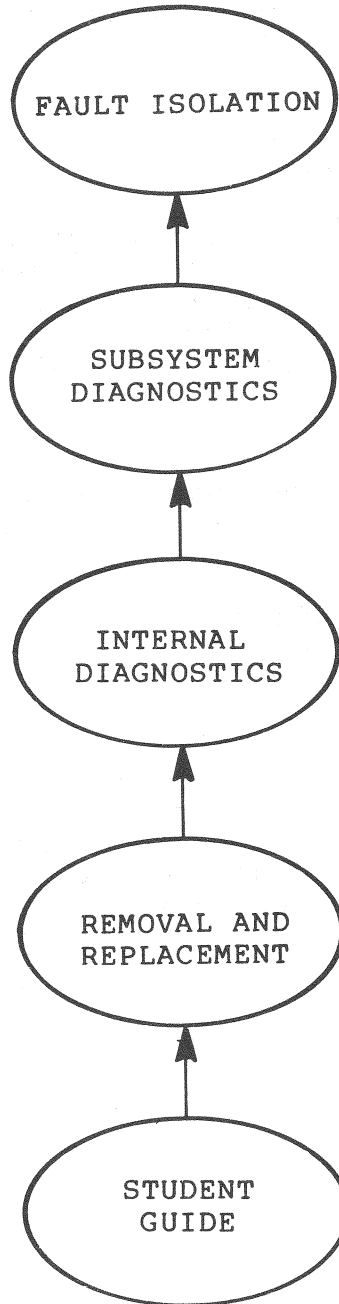


Figure 1 Course Map

REMOVAL AND REPLACEMENT

1950

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

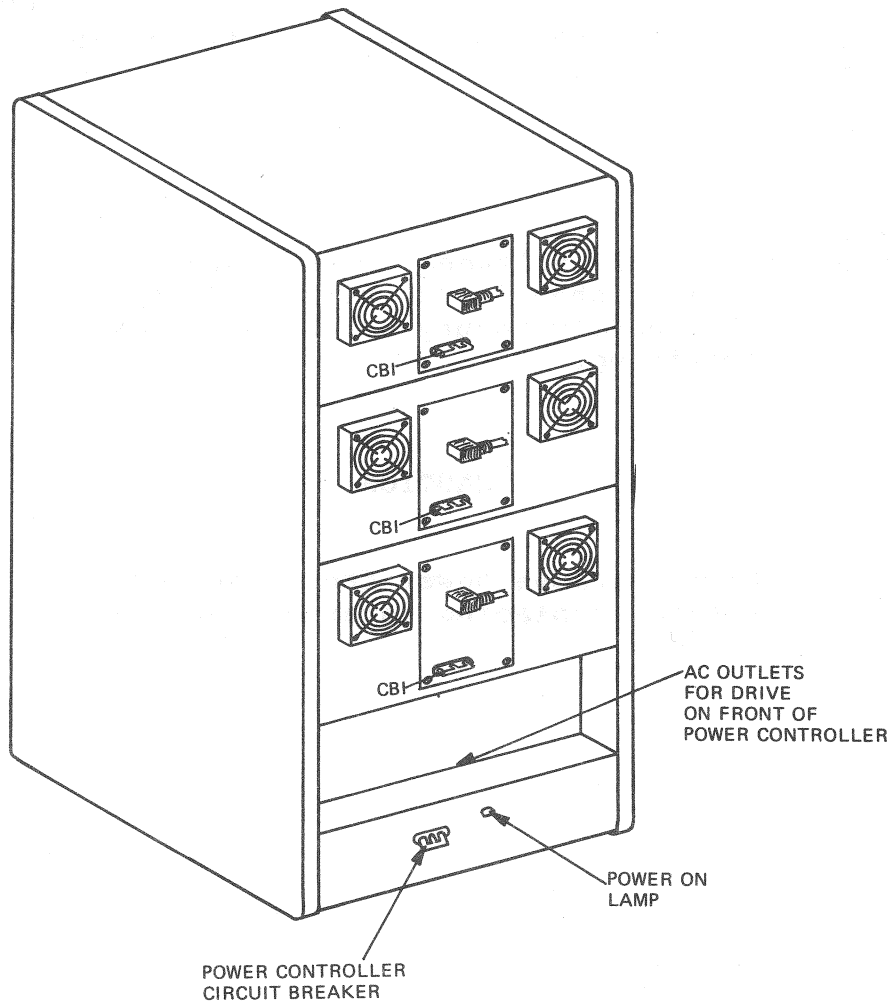
Remove Power From the Disk Drive

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 CBI 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.



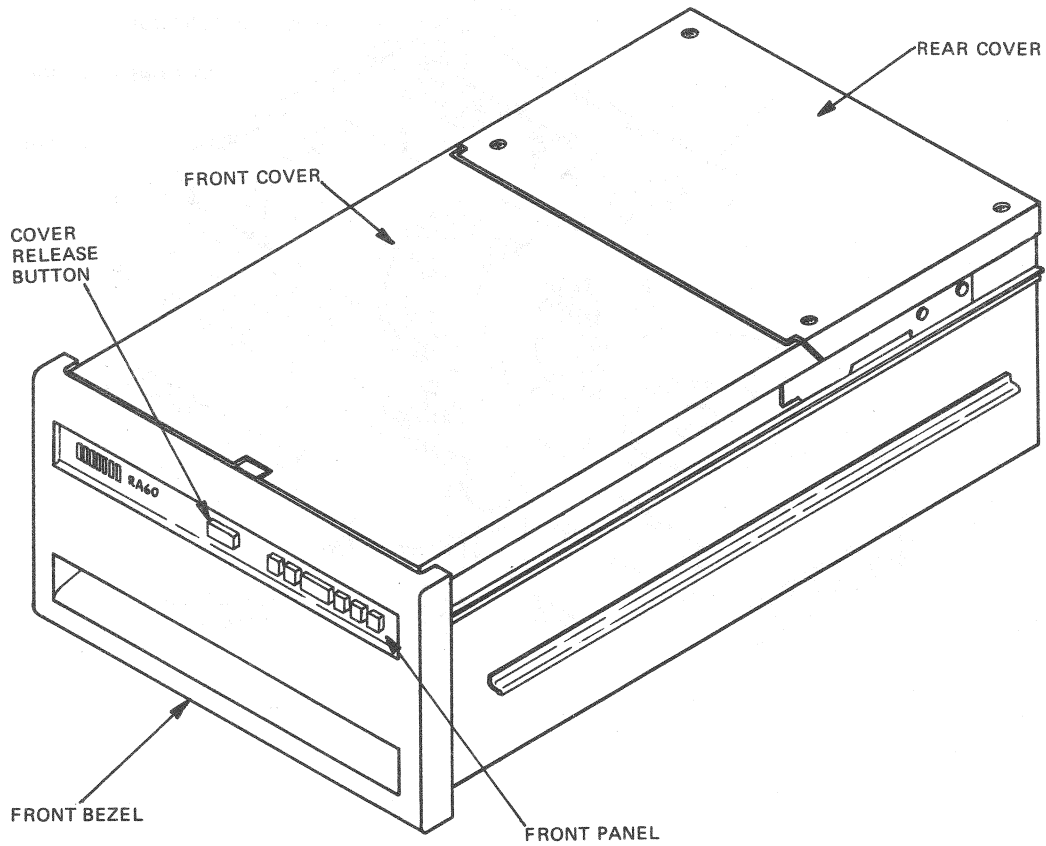
CZ-0830

Figure 2 RA60 Power Controls

REMOVAL AND REPLACEMENT

RA60 FRU Location

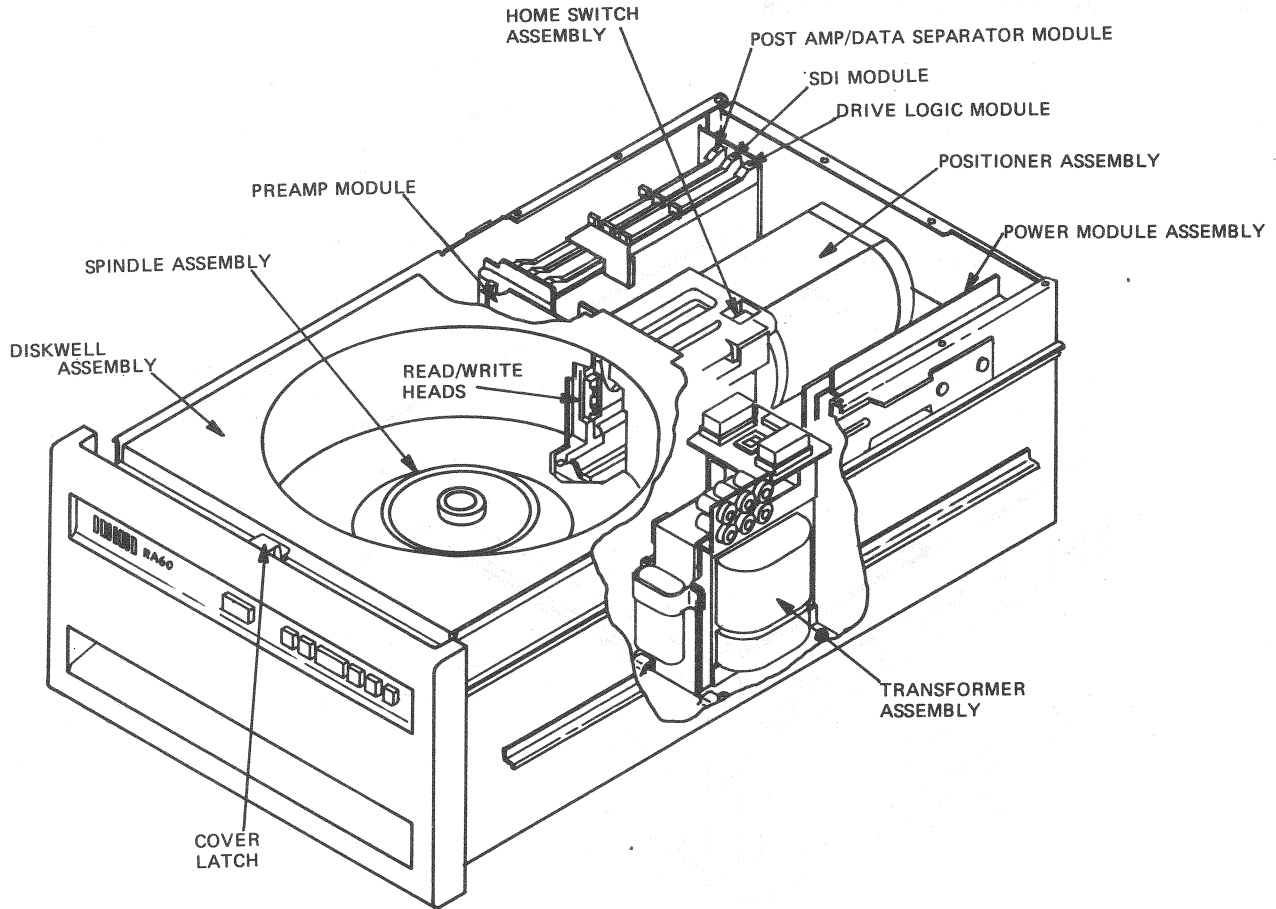
Figures 3 and 4 show the location of the main FRUs contained within the RA60 Disk Drive.



CZ-0831

Figure 3 RA60 External FRU Location

REMOVAL AND REPLACEMENT



CZ-0832

Figure 4 RA60 Internal FRU Location

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	Completed
Rear cover	-----
Rear shield	-----
Front Cover	-----
Post/amp data separator module	-----
SDI module	-----
Drive logic module	-----
Preamp module	-----
Power module assembly	-----
Transformer assembly	-----
Read/write head	-----
Bezel	-----
Front panel	-----
Air filter assembly	-----
Diskwell assembly	-----
Spindle assembly	-----
Positioner assembly	-----
Switch plate assembly	-----
Rear fan	-----

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

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.12

Remove the SDI Module

Tools Required: None

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.13

Remove the Drive Logic Module

Tools Required: None

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.14

Remove the Preamp Module

Tools Required: Flat-blade screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.16

Remove the Power Module Assembly

Tools Required: Flat-blade 10 inch screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.17

REMOVAL AND REPLACEMENT

Remove the Transformer Assembly

Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.18

Remove the Bezel

Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.22

Remove the Front Panel

Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.23

Remove the Air Filter Assembly

Tools Required: None

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.24

Remove the Diskwell Assembly

Tools Required: Phillips head screwdriver

Reference Material: RA60 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: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.26

Remove Read/write Head 0

Tools Required: Wrench 97, hex adapter, torque
Wrench, cam-over torque
Head insertion tool

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.20

NOTE

Replace read/write head 0 before continuing on with any other removal. This will prevent any damage to the read/write head.

Replace Read/write Head 0

Tools Required: Wrench 97, hex adapter, torque
Wrench, cam-over torque
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

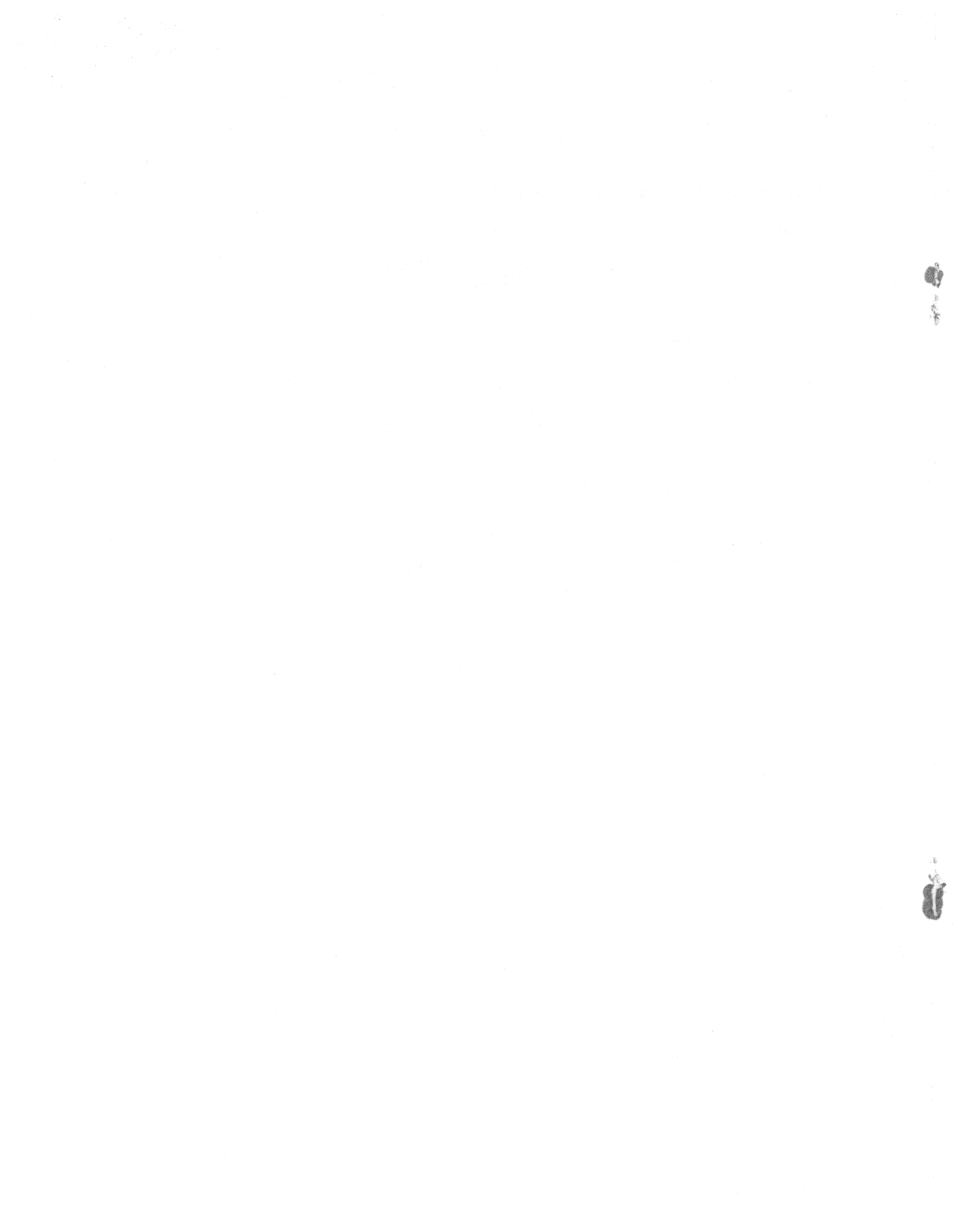
Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.29

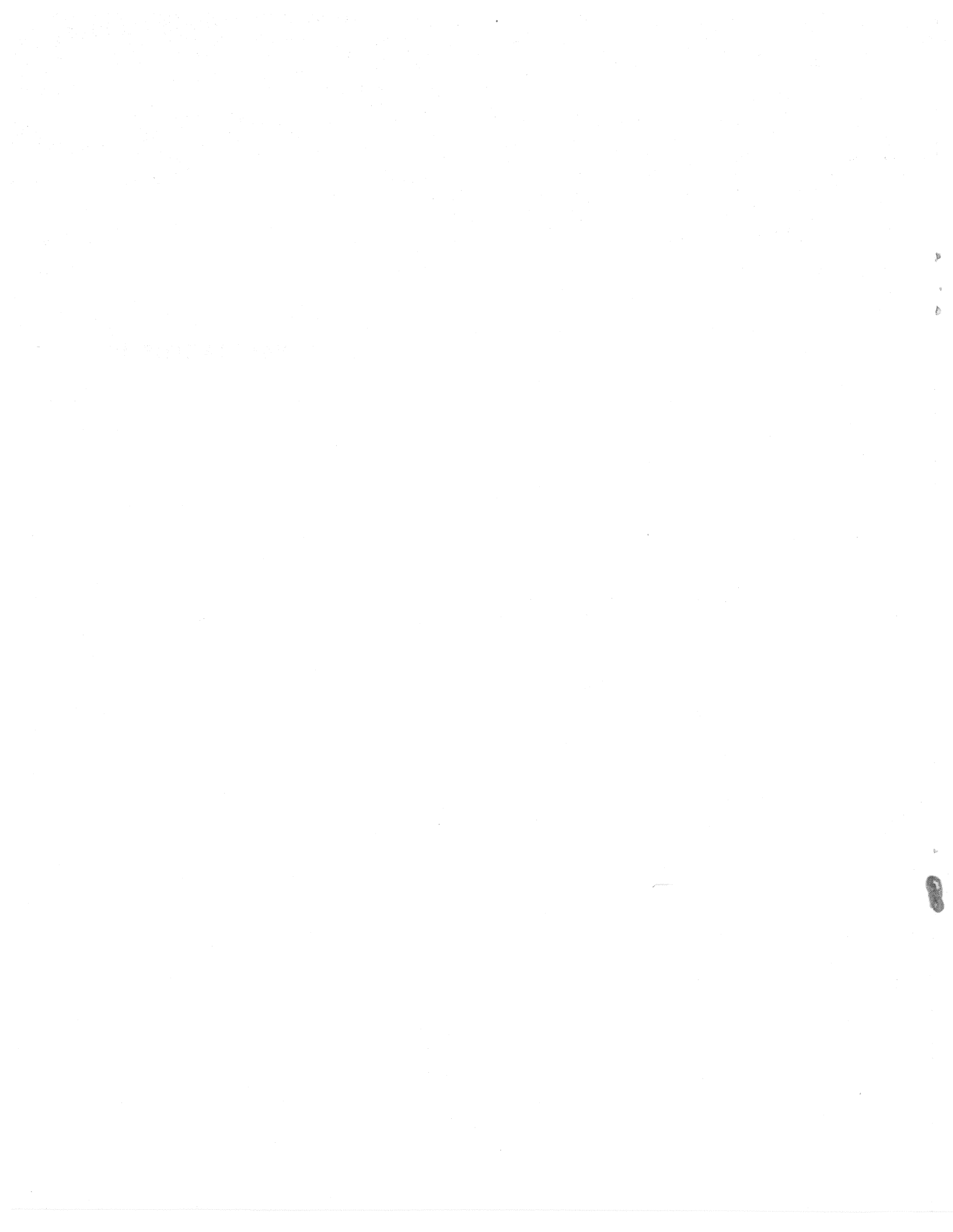
Remove the Switch Plate Assembly

Tools Required: Phillips head screwdriver

Reference Material: RA60 Disk Drive Service Manual,
Chapter 2, paragraph 2.30



INTERNAL DIAGNOSTICS



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 2 RA60 Diagnostic Codes

Test Code	Name
01	Get Status
02	Recal
03	Incremental Seek
04	Random Seek
05	Seek
06	Toggle Seek

INTERNAL DIAGNOSTICS

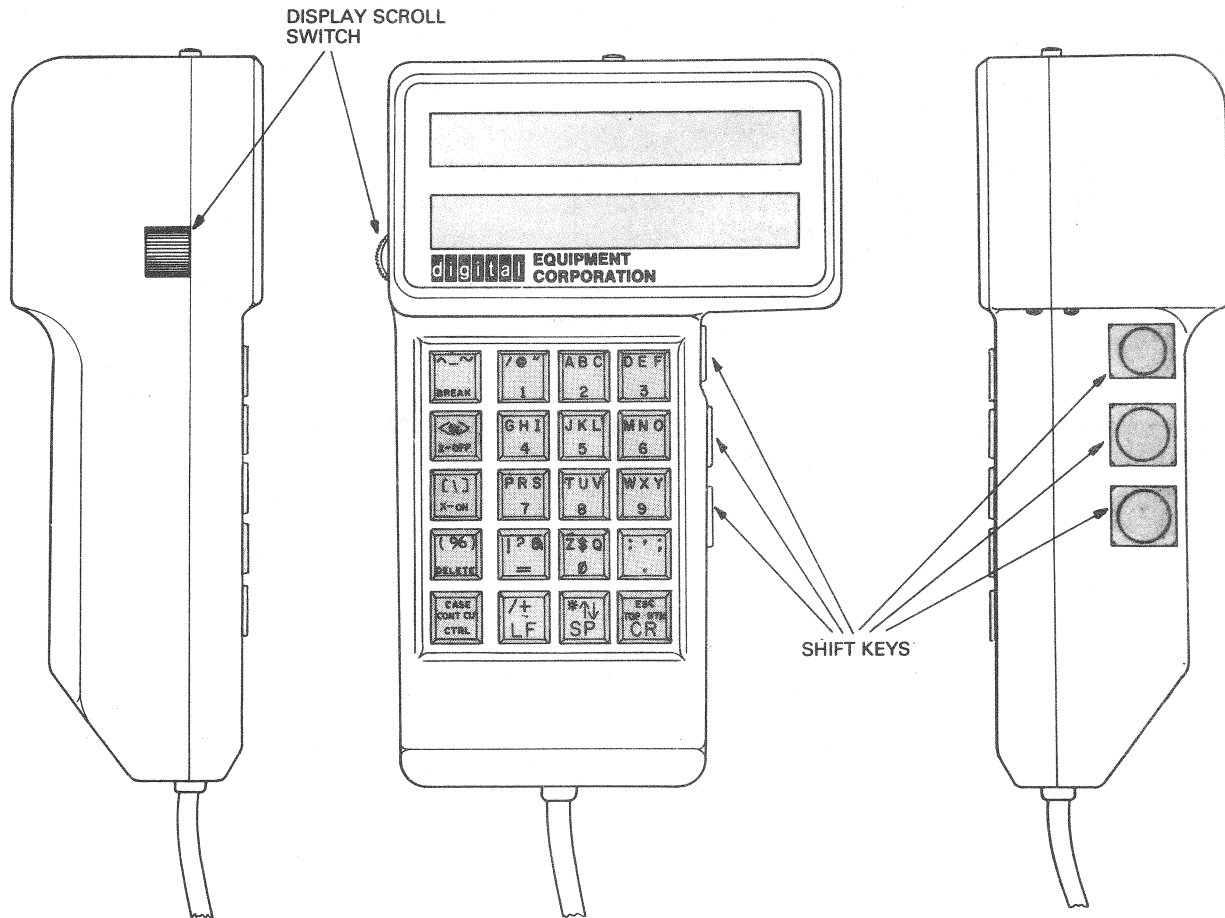
Powering Up The Drive

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 RA60 Disk Drive Service Manual contains the troubleshooting procedures enabling you to repair the RA60 Disk Drive.

The Diagnostic Terminal

A field service diagnostic terminal used to communicate with the RA60 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.

INTERNAL DIAGNOSTICS



CZ-0768

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.

INTERNAL DIAGNOSTICS

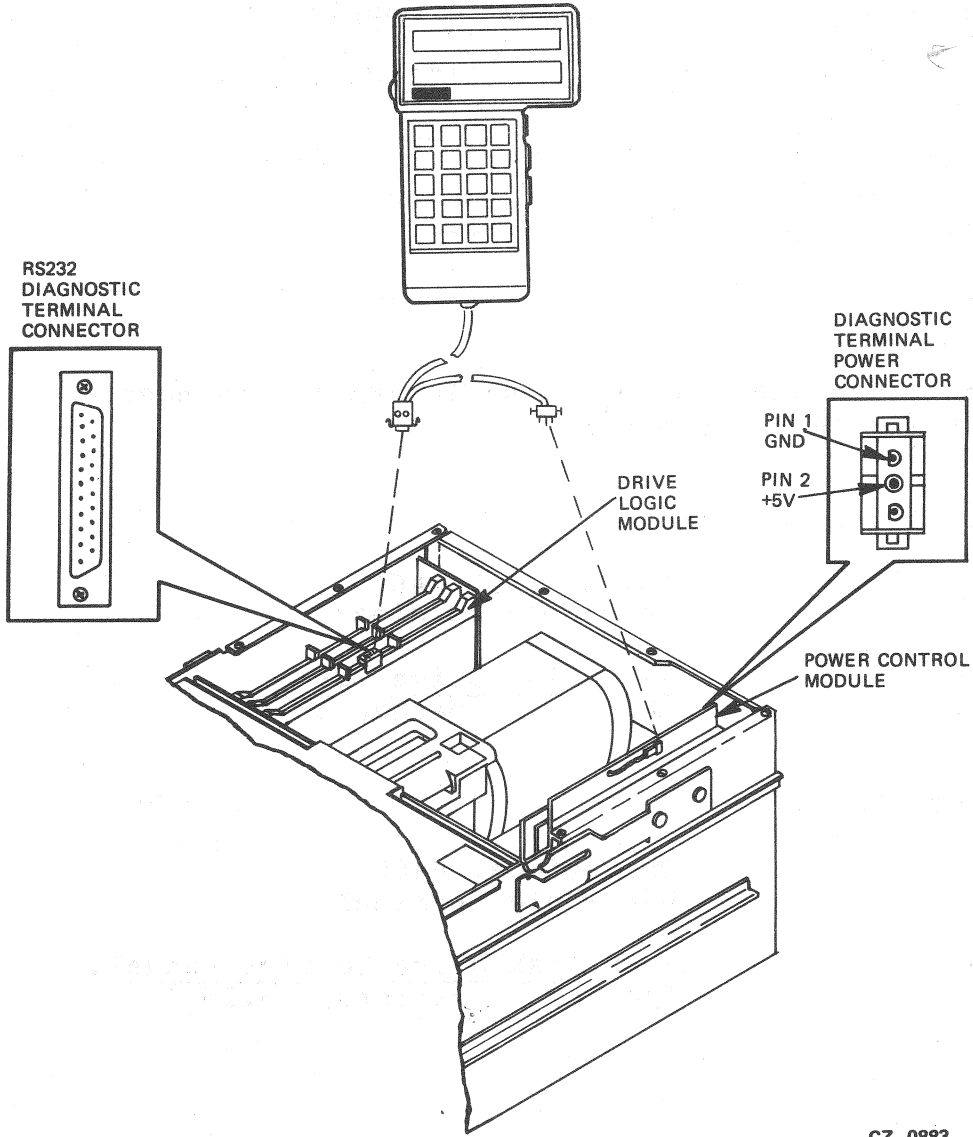
The RS232 interface cable connects to the drive logic module via a connector found at the top of the module. The +5 voltage cable required to power the hand-held terminal is supplied by connector P807 on the power module assembly. Connect the power cable from the hand-held terminal to connector P807.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

INTERNAL DIAGNOSTICS



CZ-0883

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.

COMMAND	DATE COMPLETED
Get Status	-----
Recal	-----
Incremental Seek	-----
Random Seek	-----
Seek	-----
Toggle Seek	-----

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

Run the Get Status Command

Equipment: Operational RA60
hand-held terminal

Reference: RA60 Disk Drive Service Manual,
Chapter 3, paragraph 3.15.1

Run the Recal Command

Equipment: Operational RA60
hand-held terminal

Reference: RA60 Disk Drive Service Manual,
Chapter 3, paragraph 3.15.2

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

11

STATE OF TEXAS

COUNTY OF DALLAS

Know all men that I, the undersigned, do hereby certify that the following is a true and correct copy of the original as the same appears in the records of the County Clerk of the County of Dallas, State of Texas:

WITNESSETH my hand and seal of office this 1st day of January, 1901.

JOHN W. BROWN, County Clerk

My Comm. Expires 1st day of January, 1902.

WITNESSETH my hand and seal of office this 1st day of January, 1901.

JOHN W. BROWN, County Clerk

My Comm. Expires 1st day of January, 1902.

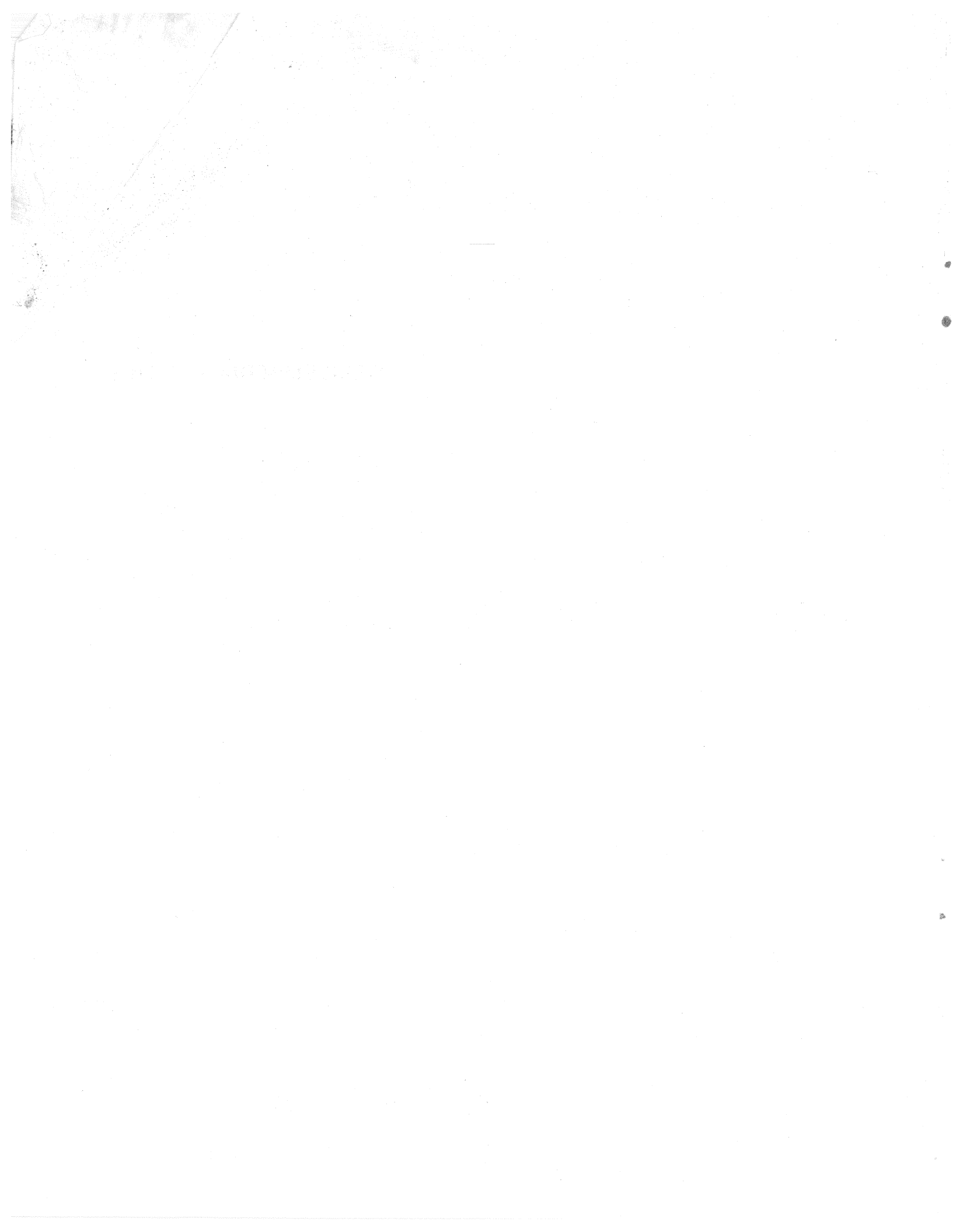
WITNESSETH my hand and seal of office this 1st day of January, 1901.

JOHN W. BROWN, County Clerk

My Comm. Expires 1st day of January, 1902.

WITNESSETH my hand and seal of office this 1st day of January, 1901.

SUBSYSTEM DIAGNOSTICS



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.

DIAGNOSTIC TEST	DATE COMPLETED
Test 1	-----
Test 2	-----
Test 3	-----
Test 4	-----
Test 5	-----

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.

FAULT ISOLATION

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

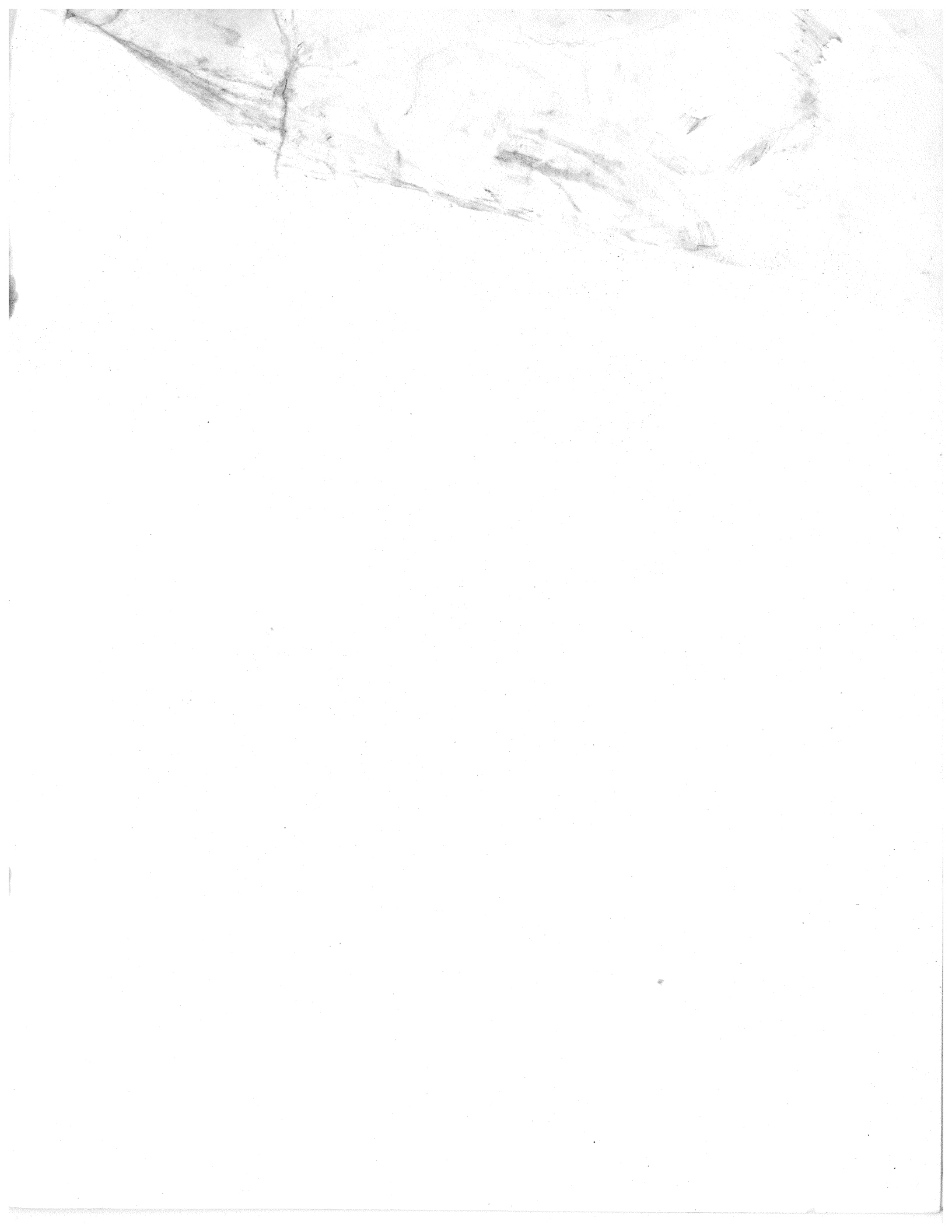
Equipment:

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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