RSX-11M/M-PLUS User Mode Diagnostics Reference Manual

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RSX-11M/M-PLUS
User Mode Diagnostics
Reference Manual

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Typical Diagnostic Initiation

Underlined text indicates expected or required user input.

Install "scratch" medium on device, if applicable.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

>ALLOCATE DK0: (mnemonic and unit number)

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

>MOUNT DK0:/FOR

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

>RUN $RK05 (test name=dev. model no.)

START RK05 DIAGNOSTIC - TIME OF DAY = ...

DEVICE? DK0
  WARNING DK0: RESIDENT DATA WILL ...
CONTINUE? Y (N or RETURN alone aborts)

Cartridge and pack disks also ask FORMAT DISK ONLY? Y response formats resident cartridge or pack and exits. N initiates customer mode.

TU16/TU45 diagnostic also asks TEST IN 1600 BPI MODE? N response selects 800 BPI.

All magnetic tape diagnostics (not DECtape) also ask QUICK TOTAL TAPE CHECK? Y response tests entire tape's data reliability and exits; N initiates customer mode.

Terminal diagnostic also asks HARD COPY TERMINAL? N response tests terminal as video display.

Terminal diagnostic can be used to exercise a line printer by LP device selection and Y response to 132 COLUMN TEST? The default is 72 columns.

Diagnostic runs to completion. To exit sooner, type

CTRL/C
MCR>ABORT

Device Model No.'s and Mnemonics

Cartridge Disks:

RK05	DKn
RK06	DMn

Pack Disks:

RP02	DPn
RPR02	DPn
RP03	DPn
RP04	DBN
RP05	DBn
RP06	DBn

Fixed-head Disks:

RF11	DF0
RS03	DSn
RS04	DSn

Magnetic Tape Units:

TS03	MTn
TU10	MTn
TU16	MMn
TU45	MMn

DECtape Unit:

All Terminals:

TERM	TTn

All Line Printers:

TERM	LPn

NOTE

TERM is the diagnostic test name for terminals and line printers; output to a line printer is not spooled and can interfere with another user's output.

PREFACE

MANUAL OBJECTIVES

The RSX-11M/M-PLUS User Mode Diagnostics Reference Manual is a usage and a reference document for optional software provided with RSX-11M and RSX-11M-PLUS systems. The manual describes the initiation procedures for online diagnostic tasks, the reports generated by the tasks, the tests performed by each diagnostic task, the error messages associated with the tests, the procedures for intervening in tests, and the options for the tests. The manual does not describe the hardware itself or attempt to interpret possible results of tests nor does it indicate how testing might be managed on a system. The manual is strictly for usage and reference.

INTENDED AUDIENCE

This document is intended for customer personnel responsible for system maintenance and for DIGITAL Field Service representatives responsible for servicing customer installations. The document assumes that the reader knows system concepts; understands peripheral device terminology and operation; and is following locally-defined procedures regarding what tests to run and when to run them.

STRUCTURE OF THIS DOCUMENT

This document is structured as follows.

- Chapter 1, Introduction, describes the features and benefits of User Mode Diagnostic software.
- Chapter 2, HELP! The Customer Mode User, presents helpful information for the beginning customer-mode user and for the more experienced user seeking assistance.
- Chapters 3 through 12 are device specific, stand-alone information modules. They show how to initiate the applicable diagnostic task in customer mode or service mode; describe how device functions are tested; and explain the significance of error messages.
- Chapter 13, Disk Drive Compatibility Diagnostic, tells how to gauge the ability of disk drives to write data that can be read by other drives and to completely overwrite data written by other drives.

- Appendix A, HELP! The Service Mode User, presents helpful information for the service-mode user.

- Appendix B, Bit Maps for Device-Controller Registers, summarizes the mnemonics for the hardware registers of devices capable of being tested by user mode diagnostic software.

In addition, the document contains a quick look-up reference sheet after the title page for the customer-mode user and one inside the rear cover for the service-mode user.

ASSOCIATED DOCUMENTS

The procedures to incorporate the user mode diagnostic software on a system are presented in both the RSX-11M System Generation and Management Guide and the RSX-11M-PLUS System Generation and Management Guide. Associated with the user mode diagnostic software is the error logging software. Error logging and related subjects are described in the RSX-11M/M-PLUS Error Logging Reference Manual. For the description of these manuals and other system documentation, refer to either the RSX-11M/RSX-11S Documentation Directory or the RSX-11M-PLUS Documentation Directory.

CONVENTIONS USED IN THIS DOCUMENT

Throughout this book, symbols and other notation conventions are used to represent keyboard characters, to convey textual information, and to otherwise ease the presentation of material. The symbols and conventions used are explained below.

Convention	Meaning
(RET)	Indicates typing the RETURN key; the system performs a carriage return operation. Almost all commands are terminated by typing the RETURN key.
CTRL/x	Represents the combination of the CTRL key and another key to generate a control character. That is, you simultaneously press the CTRL key and another key. For example, the CTRL/C combination causes MCR to prompt for command input with the explicit prompt MCR>.
"print" and "type"	As these words are used in the text, the system prints and the user types.
MCR>	The Monitor Console Routine is one of the command language interfaces used on RSX-11M and RSX-11M-PLUS systems and is the one used in this book.
>	A greater-than sign is the system command interface (MCR) prompting character. Whenever control is returned to the user task terminal and you can type input, MCR prints the prompt.
_____	Underlined material in sample terminal dialogue indicates information you type.

Convention	Meaning
lower case	Indicates a variable item whose actual value is determined either when you enter a command (or a response) or when a message is issued.
UPPER CASE	Information shown in examples in UPPER CASE characters represents either the exact data printed by the program or the exact data the program expects you to supply.

SUMMARY OF TECHNICAL CHANGES

This revision of the RSX-11M/M-PLUS User Mode Diagnostics Reference Manual contains changes and additions to reflect features of two operating systems and to correct technical errors. The following paragraphs describe the technical information added to the manual.

TECHNICAL CHANGES COMMON TO RSX-11M AND RSX-11M-PLUS SYSTEMS

Two new diagnostic programs have been added to the systems.

- RK07 Cartridge Disk diagnostic
- Disk Drive Compatibility diagnostic

TECHNICAL CHANGES FOR RSX-11M-PLUS SYSTEMS

The procedures to run most diagnostic tasks on RSX-11M-PLUS systems includes a new step. The Executive requires that you must logically mount the volume as foreign.

CHAPTER 1

INTRODUCTION

Intelligent application of User Mode Diagnostics with Error Logging[1] can be effective in reducing system down-time. These important system services, however, can be made a part of the system only at system generation. Planners of minimum systems may not wish to make or be able to make the necessary trade-offs to accommodate these services. Planners of larger systems are urged to consider the benefits of having these services available relative to their minimal storage needs. Tell the person doing your system generation to respond YES when the generation software asks:

DO YOU WANT USER MODE DIAGNOSTICS?

DO YOU WANT ERROR LOGGING?

DO YOU WANT GET SENSE SWITCHES DIRECTIVE?[2]

User Mode Diagnostics (UMD's) exercise all programmable functions diagnostics of DIGITAL peripherals in worst-case conditions. Unlike "stand-alones," User Mode Diagnostics can be selectively initiated to test one or more devices (or format disk packs and cartridges) concurrent with normal system operation. You remove a device from service, not the entire system. The diagnostics are device-specific and support the following:

- Pack, Cartridge, and Fixed-Head Disks,
- Magnetic Tape Units,
- DECtape Units,
- Hard-Copy Terminals,
- Video-Display Terminals, and
- Line Printers.

Foremost of the UMD benefits is the ease with which facility personnel can initiate testing in CUSTOMER MODE. The simple procedure requires little more than the naming of the device to be tested and its associated diagnostic. The following is the initiation for the RK06 Cartridge Disk (underlined text indicates expected or required user input).

---

[1] Refer to the RSX-11M/M-PLUS Error Logging Reference Manual for information on error logging.

[2] This option applies only for systems equipped with a CPU console switch register.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DM0:                (Multiuser Protection System Only[1])
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DM0:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK06

START RK06 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DM0
  **WARNING** DM0:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y                   (N or RETURN alone aborts the test)
```

Once initiated, the diagnostic runs to completion without further interaction. The diagnostic reports all errors as detected and produces a "test summary" report on the initiating terminal before exiting. The double entry of the device identification, the WARNING message, and the CONTINUE pause are checks for protection against inadvertent device selection and possible loss of data.

Typical customer mode uses are: a regularly scheduled preventative maintenance program; possible confirmation that the device is at fault and not the medium; and the test of a device reported by Error Logging as having a high error rate.

The complement of customer mode is SERVICE MODE. This mode is intended primarily for use by DIGITAL Field Service Engineers, although system knowledgeable personnel can make use of it, if required. The service-mode user employs the same User Mode Diagnostics with the ability to select sophisticated options and to modify the test sequence as is appropriate for localizing the reported fault condition.

---

[1] The ALLOCATE command is implemented only for multiuser protection systems.

CHAPTER 2

HELP! THE CUSTOMER MODE USER

2.1 PURPOSE OF CHAPTER

This chapter is for the beginning user and for the experienced user who seeks assistance. Its contents include:

- Document assumptions
- Explanation of the diagnostic chapter content
- Diagnostic initiation
- Error messages
- Multidevice testing
- Conversion of physical addresses to logical block numbers.

2.2 ASSUMPTIONS

The diagnostic chapters assume:

THAT YOU UNDERSTAND RSX-11M/M-PLUS SYSTEM CONCEPTS

In particular, what a task is and how the system processes it; MCR use and terminal-user actions in a nonprotected or protected multiuser system environment; privileged versus nonprivileged use of the system; public versus private devices; and mapped versus unmapped systems.[1]

THAT THE APPLICABLE DIAGNOSTIC EXISTS

As a nonprivileged checkpointable task-image file on the system device under UIC [1,m] where "m" equals 54 for a mapped system or 50 for an unmapped system.[2]

---

1 Refer to the RSX-11M/M-PLUS MCR Operations Manual for information on system commands.

2 Refer to either the RSX-11M System Generation and Management Guide or the RSX-11M-PLUS System Generation and Management Guide for details on where the diagnostics reside.

THAT YOU UNDERSTAND THAT

Any command input or data input to MCR or a diagnostic must be terminated by RETURN.

THAT YOU ARE NONPRIVILEGED

With regard to initiating the diagnostic.[1]

THAT YOU ARE FAMILIAR WITH PERIPHERAL DEVICE OPERATION

For the devices implemented; in particular, that you know how to install the applicable medium and make appropriate use of the available controls.[2]

THAT THE DATA BUFFER SIZE WAS NOT CHANGED

At system generation from the default value of 1024 bytes. This buffer controls the size of data transfers for most write and read operations initiated by the diagnostic.[3]

2.3 CONTENT OF THE DIAGNOSTIC CHAPTERS

Each diagnostic chapter includes the following sections.

Customer-mode initiation

Test summary report

Device characteristics

Diagnostic description

Error messages (not applicable for terminal/line printer diagnostic)

Service-mode initiation

Console switch for intervention

Test-parameter selection

Service-mode intervention/restart/termination

Interactive tests

The service-mode user is expected to be familiar with the entire chapter, particularly, where some testing might be accomplished in customer mode for convenience.

---

[1] Refer to the RSX-11M/M-PLUS MCR Operations Manual.

[2] Refer to the equipment document for the peripheral device.

[3] Refer to either the RSX-11M System Generation and Management Guide or the RSX-11M-PLUS System Generation and Management Guide for information on the default data buffer size.

As a customer-mode user, you need only refer to the simple initiation procedure (found at the diagnostic chapter's beginning) and possibly, the test summary report, which identifies the diagnostic's run time, the number of errors detected, the number of functions issued, and the amount of data transferred. Any error messages reported should be saved and made available to the DIGITAL Field Service Engineer for analysis. Should you wish to have an understanding of the diagnostic's performance and the significance of the error messages, refer to the sections: Device Characteristics, Diagnostic Description, and Error Messages.

NOTE

You are urged not to attempt initiation of a diagnostic in service mode because of the complexity of the procedures and the detailed knowledge required.

2.4 DIAGNOSTIC INITIATION

2.4.1 Recording Error Reports

Error Logging is automatically inhibited from accepting error indications made by a device under test. To capture the error messages and the test summary report, you should initiate a diagnostic at a hard-copy terminal.

2.4.2 Medium Requirements

The medium, if applicable, for a device to be tested should neither be "mounted" nor "initialized". It should not contain data that you wish to preserve. The diagnostics, in the course of testing, overwrite all data-recording surfaces. (The exception is the software-protected last track of an RK06 Disk Cartridge, which contains the factory-recorded "marked-bad-sector" file.)

2.4.3 Multiuser Protection Systems

1. Testing Nonpublic Devices:

   A nonpublic device must be "allocated" to your private use as the first step of the initiation procedure. On RSX-11M-PLUS systems, the volume must be mounted as foreign after the device is allocated. Upon completion of diagnostic testing, the device must be explicitly "deallocated" if you intend to remain logged-in.

2. Testing Public Devices:

   A public device cannot be "allocated" and thus tested until it is "set" by a privileged user to be nonpublic.

3. Device Selection:

   To help protect against selection of the wrong device and possible loss of data, the initiation procedure requires that you enter the same device indentification (mnemonic and unit number) twice. A WARNING message and the CONTINUE? pause are additional opportunities for you to verify that the device selected is the device you want tested.

2.4.4 Systems Without Multiuser Protection

The "allocate/deallocate" functions and the considerations of public versus private devices are supported only by multiuser protection systems. Because you enter the device identification only once in initiating a diagnostic, you should observe additional caution. Once a diagnostic is initiated, the selected device is protected against access by other users for the duration of the test period.

2.5 ERROR MESSAGES

The following list describes messages that might be reported by MCR or by a diagnostic during initiation. To learn the significance of other messages, refer to the RSX-11M/M-PLUS MCR Operations Manual and the RSX-11M/M-PLUS Executive Reference Manual.

MCR Command Error Messages:

XXX -- SYNTAX ERROR

Format of entry to MCR is incorrect. Re-enter.

ALL -- DEVICE ALLOCATED TO OTHER USER[1]

Selected device is under control of another user. It cannot be allocated until that user deallocates it or logs out, or a privileged user deallocates it.

ALL -- DEVICE NOT IN SYSTEM[1]

Selected device was not specified during system generation. It cannot be tested by a User Mode Diagnostic.

ALL -- FEATURE NOT SUPPORTED

Indicates ALLOCATE command is not implemented for your system. Ignore message and proceed with initiation.

---

[1] The related command and thus this error message are valid only for multiuser protection systems.

ALL -- PUBLIC DEVICE[1]

Selected device has been declared a public device. It cannot be allocated by any user until it is declared to be a nonpublic device.

HEL -- INVALID ACCOUNT[1]

The name or UIC specified is not present in the account file, or the password given is incorrect.

HEL -- OTHER USER LOGGED ON[1]

Another user left this terminal in logged-in state. It cannot be used until it is logged out by the BYE command.

HEL -- TERMINAL ALLOCATED TO OTHER USER[1]

This terminal has been allocated to another user. It cannot be used until that user deallocates it or logs out, or a privileged user deallocates it.

INS -- FILE NOT FOUND

The specified diagnostic was not built and made part of the system at system generation, or the UMD task-image files are not present on SY: at [1,m] where m is 50 for an unmapped system or 54 for a mapped system.

MCR -- NOT LOGGED IN[1]

multiuser protection system requires that you log-in at the terminal with the HELLO command before issuing any command other than HELP.

DIAGNOSTIC ERROR MESSAGES

The following error messages might be reported after control has been passed from MCR to the selected diagnostic.

* DEVICE OFFLINE *

Selected device is not physically or logically available.

* DEVICE MOUNTED OR ALLOCATED TO OTHER USER *

Indicates that volume on selected device is mounted (must be dismounted for diagnostic testing), or that the device has been allocated to another user (this case can happen if you did not issue the ALLOCATE command for a multiuser protection system).

---

1 The related command and thus this error message are valid only for multiuser protection systems.

* ILLEGAL FUNCTION (MAY BE WRONG DIAGNOSTIC) *

Indicates that the wrong diagnostic was initiated, or that the requested function is not in the selected diagnostic.

* DEVICE OR DRIVER NOT AVAILABLE FOR DIAGNOSTICS *

Selected device or its associated driver with diagnostic capabilities is not in the system.

* INVALID DEVICE OR UNIT *

Device identification (mnemonic and/or unit number) is not correct.

2.6 MULTIDEVICE TESTING

Should you wish to initiate concurrent execution of several diagnostics from the same terminal, each RUN command must include an explicit task name. The following sequence illustrates initiation of an RK06 disk and a TU56 DECtape unit.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DM1:
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DM1:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK06/TASK=DM1
  .
  .
  .
CONTINUE? Y
```

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DT0:
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DT0:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU56/TASK=DT0
  .
  .
  .
CONTINUE? Y
```

You can continue to initiate other diagnostics as you require.

Error messages and summary reports may be interspersed at the terminal, but they will be explicitly identified by device and unit number.

To terminate a diagnostic before its normal completion, you must specify the task name, for example:

```
CTRL/C
MCR> ABORT DM1
```

2.7 LOGICAL BLOCK NUMBERS FROM PHYSICAL ADDRESSES

A disk sector is identified by its physical address (sector-track-cylinder numbers) in diagnostic error messages. Should you wish to register the sector as being bad via the BAD option of the MCR INITVOLUME command[1], you must convert the physical address to a logical block number (LBN), as follows.

```
LBN=(((cyl.  no.*trk's/cyl)+trk no.)sec's/trk)+sec no.
```

where all values are decimal.

For example, an RP06 sector (see Section 3.2 for RP06 data-capacity parameters) with the address of

```
Cylinder = 000536(octal), 350 (decimal)

Track    = 000016(octal), 14 (decimal)

Sector   = 000013(octal), 11 (decimal)
```

is logical block number 146619, computed as follows.

```
LBN = (((350*19)+14)*22)+11
    = (6650)+14)*22+11
    = 146608+11

    = 146619
```

---

1 Refer to the RSX-11M/M-PLUS MCR Operations Manual.

CHAPTER 3

RP04, RP05, OR RP06 PACK DISK DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" disk pack on disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DBn:      (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DBn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RP04                (or RP05 or RP06)

START RP04 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DBn
  **WARNING** DBn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y             (N or RETURN alone aborts the diagnostic)
FORMAT DISK ONLY?       (N initiates customer-mode sequence)
                        (Y formats disk and exits
```

Diagnostic runs to completion in 2 hours for RP04 OR RP05, and 2 hours and 45 minutes for RP06 on a lightly loaded system. Formatting requires approximately 1 hour and 30 minutes for RP04 or RP05, and 3 hours for RP06. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

3.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
RP04 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF RP04 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

3.2 DISK DRIVE CHARACTERISTICS

The following are data-capacity parameters for the RP04, RP05, and RP06 Disk Pack Drives.

	RP04 & RP05	RP06
Cylinders	411	815
Tracks/cylinder	19	19
Sectors/Track	22	22
Words/Sector	256	256

3.3 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the selected disk drive to address correctly all cylinders, tracks, and sectors of the resident disk pack, and to write data on, and to read data from, the pack under selected conditions. A pack formatting routine is also included. Neither ECC correction nor "bad sector (block)" processing are implemented.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 3.4 and Table 3-1 for their significance.

3.3.1 Addressing Exercises

3.3.1.1 **Heads-Positioning Exercise** - This exercise determines that the heads position correctly at all cylinders of the resident disk pack. The exercise is conducted in two parts: incremental seek and cross seek.

For incremental seek, a read-header command (implied seek) alternately addresses cylinder 0 and cylinder "n," where "n" increments by one for cylinder address. After each seek of cylinder 0 or cylinder "n," the exercise verifies that the specified cylinder address was achieved.

For cross seek, a read-header command alternately addresses cylinder "a," where "a" is initially 0, and cylinder "b," where "b" is initially the valid, upper-limit cylinder address. After each seek, "a" is incremented by one and "b" is decremented by one. This part of the exercise continues until "b" equals 0. Cylinder positioning is verified by examination after each seek.

(Related Error Numbers are: 2, 3, 4, 5)

3.3.1.2 **Sector-Addressing Exercise** - This exercise determines that sectors 0 through 21 of the resident disk pack are addressable. Each sector on track 0 of cylinder 0 is written with a data pattern equal to its respective sector number. Then each sector is read and verified that it contains the correct data pattern. All error conditions are reported.

(Related Error Numbers are: 6, 7, 8)

3.3.1.3 **Track-Addressing and Crossover Exercise** - This exercise determines that all tracks are addressable, and that a 2-sector data transfer starting at the last sector of any track except the last track of the last cylinder results in a crossover to the first sector of the successive track. The exercise, first, issues a 512-word write command starting at sector 21 of track 0 and each successive track through track 18 on cylinder 0. The data pattern written is the respective track number. The exercise then reads the first two words from sector 0 of track 1 and each successive track through track 18 on cylinder 0, and sector 0 of track 0 on cylinder 1. If crossover occurred, the data pattern read should be the number of the preceding track (for example, 0 in sector 0, track 1, cylinder 0; 3 in sector 0, track 4, cylinder 0; and 18 in sector 0, track 0, cylinder 1). All error conditions are reported.

(Related Error Numbers are: 9, 10, 11)

3.3.1.4 **Cylinder-Addressing and Crossover Exercise** - This exercise determines that all cylinders are addressable, and that a 2-sector data transfer starting at the last sector of any cylinder except the last results in a crossover to the first sector of the successive cylinder. The exercise, first, issues a 512-word write command starting at sector 21 of track 18 on cylinder 0 and each successive cylinder to the valid upper limit. The data pattern written is the respective cylinder number. The exercise then reads the first two words from sector 0, track 0 on cylinder 1 and each successive cylinder through the valid upper limit. If crossover occurred, the data pattern read should be the number of the preceding cylinder (e.g., 0 in sector 0, track 0, cylinder 1; and 3 in sector 0, track 0, cylinder 4). All error conditions are reported.

(Related Error Numbers are: 12, 13, 14)

3.3.1.5 **Partial-Write Exercise** - This exercise determines that a write on a sector of less than 256 words results in the remainder of the sector being zero-filled. First, the exercise writes sector 0 on track 0 of cylinder 0 with an all-1's pattern. Then, the exercise issues a 2-word write command, all-1's data, to the same sector address. Finally, the exercise reads the sector's contents and verifies that all but the initial two words are zero-filled. All error conditions are reported.

(Related Error Numbers are: 15, 16, 17, 18)

3.3.2 Data-Reliability Exercise

This exercise determines the reliability of the disk drive to write and read data of various patterns at all valid disk addresses. The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)
4. Floating 1's (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (from "1", add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete sequence.

Each pattern is written at all disk addresses, and then read back eight times for verification and to expose possible read-reduction problems. Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 19, 20)

3.3.3 Random Exercise

This exercise determines that the drive can address randomly selected disk-pack addresses and execute random-length transfers of random-patterned data to and from those pack areas. The exercise sequence, which is repeated 512 times, is:

1. Develop a valid, random cylinder-, track-, and sector-address combination.
2. Initiate a write transfer of a random-length, random-data pattern, beginning at the random disk address. The number of words is two or more, and not greater than 512.
3. Upon completion of the write transfer, issue a seek to another random address.
4. Initiate eight read transfers of the previously written random data with intervening seeks to random addresses (the purpose of this command sequence is to expose read-reduction problems or parity errors caused by a vibrating head).
5. Verify the data returned.

Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 21, 22, 23, 24)

3.3.4 Formatting Routine

The formatting routine prepares disk packs for use with the PDP-11. In sequence, the routine:

- Writes the complete header for each sector,
- Verifies the address content of each sector header, and
- Exits.

Formatting, when selected, always runs to completion and exits.

The sector headers are written one at a time. Sectors that cannot be formatted or verified are identified by the cylinder-track-sector addresses that follow the messages

UNABLE TO FORMAT SECTOR AT ADDRESS

HEADER VERIFY ERROR AT ADDRESS

Satisfactory completion of the format process is signaled by the message

FORMATTING COMPLETE

The message

FORMATTING FAILED

indicates that one or more sectors could not be formatted and/or verified.

(Related Error Numbers are: 25, 26, 27, 28)

3.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 14 of the Drive Status Register (RPDS). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer actions. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 3-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

RP04, RP05, OR RP06 PACK DISK DIAGNOSTIC

Equipment error-message format:

```
RP04        UNIT NO. m
ERROR NO. n
RPCS1  =  Control and Status 1 Register contents
RPBA   =  Bus Address Register contents
RPCS2  =  Control and Status 2 Register contents
RPER1  =  Error Register 1 contents
RPLA   =  Look Ahead Register contents
RPMR   =  Maintenance Register contents
RPSN   =  Serial Number Register contents
RPDC   =  Desired Cylinder Register contents
RPER2  =  Error Register 2 contents
RPEC1  =  ECC Position Register contents
RPWC   =  Word Count Register contents
RPDA   =  Desired Sector/Track Address Register
          contents
RPDS   =  Drive Status Register contents
RPAS   =  Attention Summary Register contents
RPDB   =  Data Buffer Register contents
RPDT   =  Drive Type Register contents
RPOF   =  Offset Register contents
RPCC   =  Current Cylinder Register contents
RPER3  =  Error Register 3 contents
RPEC2  =  ECC Pattern Register contents
```

Data-compare error-message format:

```
RP04          UNIT NO. m
ERROR NO. n
EXPECTED  =  Data expected
RECEIVED  =  Data received
```

Disk-address error-message format:

```
RP04          UNIT NO. m
ERROR NO. n
DISK ADDRESS DID NOT UPDATE CORRECTLY
CYLINDER
EXPECTED  =  Cylinder expected
RECEIVED  =  Cylinder received
TRACK
EXPECTED  =  Track expected
RECEIVED  =  Track received
SECTOR
EXPECTED  =  Sector expected
RECEIVED  =  Sector received
```

Other error messages:

```
CONTENTS OF RPCC INCORRECT

HEADER VERIFY ERROR AT ADDRESS

UNABLE TO FORMAT SECTOR AT ADDRESS

REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO. x RECOVERED AFTER y RETRIES
```

Table 3-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Recalibration:	
1	Error bit was set during a home-seek function.
Heads Positioning:	
2	Error bit was set after a read-header command was issued to cylinder 0.
3	Error bit was set after a read-header command was issued to a cylinder in the range 1 through the valid upper limit.
4	Error bit was set after a read-header command was issued to the cylinder address being incremented from 0 through the valid upper limit.
5	Error bit was set after a read-header command was issued to the cylinder address being decremented from the valid upper limit.
Sector Addressing:	
6	Error bit was set while exercise was writing a sector with a data pattern equal to its respective sector number.
7	Error bit was set while exercise was reading a sector with a data pattern equal to its respective sector number.
8	Data-compare error. Data pattern read from a sector (0 through 21) on track 0 of cylinder 0 does not contain the respective sector number.
Track-Addressing and Crossover:	
9	Error bit was set while exercise was writing a 512-word data transfer starting at the last sector on a track of cylinder 0. The data pattern is the respective track number.

(continued on next page)

Table 3-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Track-Addressing and Crossover: (Cont.)	
10	Error bit was set while exercise was reading the first two words of the first sector on a track. The data pattern is the preceding track number.
11	Data-compare error. Data pattern read from the first two words of the first sector of a track does not contain the number of the preceding track.
Cylinder-Addressing and Crossover:	
12	Error bit was set while exercise was writing a 512-word data transfer starting at the last sector on the last track of a cylinder. The data pattern is the respective cylinder number.
13	Error bit was set while exercise was reading the first sector on the first track of a cylinder. The data pattern is the preceding cylinder number.
14	Data-compare error. Data pattern read from the first sector on the first track of a cylinder does not contain the number of the preceding cylinder.
Partial Write:	
15	Error bit was set while exercise was writing sector 0 on track 0 of cylinder 0 with all-1's data.
16	Error bit was set while exercise was writing a 2-word transfer of all-1's data in sector 0 on track 0 of cylinder 0.
17	Error bit was set while exercise was reading the contents of sector 0 on track 0 of cylinder 0.
18	Data-compare error. Data pattern read does not contain 1's in the initial two words and 0's in the remainder of the sector.

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Table 3-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Data-Reliability or Interactive-Data Test:	
19	Error bit was set while exercise was writing the disk pack with a test pattern.
20	Error bit was set while exercise was reading a test pattern from the disk pack. Condition may also occur as a data-compare error. Data read from the pack does not contain the test pattern.
Random:	
21	Error bit was set while exercise was writing a random-data pattern at a randomly selected address.
22	Error bit was set after exercise issued a seek command with a random address.
23	Error bit was set while exercise was reading random data from a previously written random address.
24	Data-compare error. Data pattern read does not contain the random data.
Formatting:	
25	Error bit was set while routine was writing sector-header patterns to format a track.
26	Error bit was set while routine was reading a sector header pattern from a formatted track.
27	Word 1 of the header for the indicated sector does not agree with the expected data.
28	Word 2 of the header for the indicated sector does not agree with the expected data.

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Table 3-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Interactive-Address Test:	
29	Error bit was set after a read-header command was issued to the "first" cylinder selected.
30	Error bit was set after a read-header command was issued to the "second" cylinder selected.

3.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 3.6), test-parameter selection (see Section 3.7), interactive testing (see Sections 3.9 and 3.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Install "scratch" disk pack on disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DBn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DBn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RP04              (or RP05 or RP06)

START RP04 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DBn
  **WARNING** DBn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences after you type RETURN you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

3.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

3.7 TEST-PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 3-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 3-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No

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Table 3-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE-ADDRESS TEST (Bits 10 & 0): Allows the service-mode user to oscillate head motion between two specified cylinders (see Section 3.9 for details).	2001	No
INTERACTIVE-DATA TEST (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data-reliability testing of the drive (see Section 3.10 for details).	2002	No
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTION (Bits 0-4): A) Select addressing exercise (see Section 3.3.1). B) Select data-reliability exercise (see section 3.3.2).	 1 2	 Yes Yes

(continued on next page)

Table 3-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
TEST SEQUENCE SELECTION (Bits 0-4): (cont.)		
C) Select random exercise (see Section 3.3.3).	4	Yes
D) Select random exercise with inter-read seeks inhibited to reduce run time (see Section 3.3.3).	24	No
E) Select formatting routine without other exercises; routine always runs to completion and exits (see Section 3.3.4).	10	Selectable

3.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

Type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

3.9 INTERACTIVE-ADDRESS TEST

This test oscillates the disk drive head (that is, continuous in-and-out motion) between the two cylinders you specify. After test-parameter selection, the test is initialized by your typing of valid cylinder numbers in the range 0 through 814. for an RP06 drive or 0 through 410. for an RP04 or RP05 drive in response to the inquiries.

FIRST CYLINDER =

SECOND CYLINDER =

Should you inadvertently type a number greater than the appropriate upper limit, the inquiry repeats.

Once initiated, the head oscillation continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

The function of the test is to issue seek commands alternately to the two specified cylinders. An equipment error message is displayed if the seek function fails.

(Related Error Numbers are: 29, 30)

3.10 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the disk-drive's data reliability. After test-parameter selection, the test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

WORD COUNT=

Type a value to indicate the desired upper limit of the data buffer to be used in write/read data-transfer functions (the value cannot exceed 512. and must be 2 or more).

If you type a value greater than 512. or less than 2, the inquiry repeats.

DO YOU WISH TO SPECIFY SECTOR ADDRESS?

Type Y if a specified sector address is to be tested.

Type N if all data surfaces of the disk pack are to be written on and/or read from. The inquiries, which follow, for cylinder, track, and sector numbers are inhibited.

CYLINDER=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired cylinder number in the range 0 through 814. for an RP06 or 0 through 410. for a RP04 or RP05 drive. If you type a number greater than the appropriate upper limit, the inquiry repeats.

TRACK=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired track number in the range 0 through 18 (decimal). If you type a number greater than 18., the inquiry repeats.

SECTOR=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired sector number in the range 0 through 21 (decimal). If you type a number greater than 21., the inquiry repeats.

PATTERN NO.=

Type the appropriate number, as indicated below, to select a specific stored data pattern or the combination of all stored patterns for use in exercising the disk drive.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify your own pattern to be used in place of the stored patterns by typing a full-word (6-digit) octal value in response to the above inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions.

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries will be repeated.

With selection of the read-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 19, 20)

CHAPTER 4

RF11 FIXED-HEAD DISK DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DF0:
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DF0:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RF11

START RF11 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE?  DF0
  **WARNING** DF0:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE?  Y            (N or RETURN alone aborts the diagnostic)
```

Diagnostic testing of all valid drives runs to completion in 35 minutes per drive for a lightly loaded system. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

4.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
RF11 UNIT NO.  0
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF RF11 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only.)

4.2 DISK CHARACTERISTICS

An RF11 disk subsystem consists of the RF11 controller and up to eight RS11 fixed-head disk drives, each with parameters as follows:

Tracks	128
Sectors/Track	8
Words/Sector	256

The entire subsystem is identified externally as DF0 because, unlike other disks, the RF11 automatically implements upward data transfer crossovers between available drives without requiring external reference. In this regard, the RF11 drives appear to be a continuous disk surface containing unit multiples of the storage parameters. Drive selection (0-7) is, nevertheless, an explicit and integral element of track addressing to define the starting track and sector addresses for a data transfer to or from this disk.

4.3 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the RF11 to address correctly all tracks and sectors of the disk, and to write data on, and to read data from, the disk under selected conditions. Neither ECC correction nor "bad sector (block)" processing are implemented.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 4.4 and Table 4-1 for their significance.

4.3.1 Addressing Exercises

4.3.1.1 **Sequential-Addressing Exercise** - This exercise determines that the 128 tracks and the eight 256-word sectors per track for each drive are addressable in sequence. The exercise first writes each sector with a data pattern consisting of the following information in each word:

Bits 8-15	Respective track number, right justified.
Bits 6,7	Unused.
Bits 3-5	Respective drive number
Bits 0-2	Respective sector number

The exercise then reads each sector and verifies its contents for agreement with the written pattern. All error conditions are reported.

(Related Error Numbers are: 2, 3, 4)

4.3.1.2 **Random-Addressing Exercise** - This exercise determines that the disk responds correctly to random addressing. The exercise issues a 2-word read with a randomly selected track-sector address to access the data written by the previous exercise. The data read is compared to the expected pattern (the respective track number, sector number, and drive number) and reported if in disagreement. The reading continues until 512 random addresses have been checked. All error conditions are reported.

(Related Error Numbers are: 5, 6)

4.3.2 Data-Reliability Exercise

This exercise determines the reliability of the disk to write and read data of various patterns at all disk addresses. The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)
4. Floating 1's (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (from "1", add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete test sequence.

Each pattern is written at all disk addresses, and then read back eight times for verification and to expose possible read-reduction problems. Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 7, 8)

4.3.3 Random Exercise

This exercise determines that the drive can address randomly selected disk addresses and execute random-length transfers of random-patterned data to and from those areas. The exercise sequence, which is repeated 1024 times, is:

1. Develop a valid, random track- and sector-address combination.

2. Initiate a write transfer of a random length, random data pattern, beginning at the random disk address. The number of words is two or more, and not greater than 512.

3. Initiate eight read transfers of the previously written random data.

4. Verify the data returned.

Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 9, 10, 11)

4.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 15 of the Control and Status Register (RFCS). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer actions. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 4-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
RF11          UNIT NO.  0
ERROR NO.  m
RFCS       =  Control and Status Register contents
RFWC       =  Word Count Register contents
RFBA       =  Bus Address Register contents
RFDA       =  Disk Address Register contents
RFER       =  Error Register contents
DRIVE NO.  =  n
```

Data-compare error-message format:

```
RF11          UNIT NO.  0
ERROR NO.  m
EXPECTED   =  Data expected
RECEIVED   =  Data received
```

Disk-address error-message format:

```
RF11          UNIT NO.  0
ERROR NO.  m
DISK ADDRESS DID NOT UPDATE CORRECTLY
DRIVE
EXPECTED   =  Drive expected
RECEIVED   =  Drive indicated
TRACK
EXPECTED   =  Track expected
RECEIVED   =  Track indicated
SECTOR
EXPECTED   =  Sector expected
RECEIVED   =  Sector indicated
```

Other error messages:

```
REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO.  x RECOVERED AFTER y RETRIES
```

Table 4-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Initialization:	
1	Nonexistent disk error. Error bit was set while exercise was reading the first sector of each drive to determine the number of RF11 drives available at the time of RSX-11M system generation.
Sequential Addressing:	
2	Error bit was set while exercise was writing a 256-word sector with the sector's address (drive, track, and sector numbers).
3	Error bit was set while exercise was reading a sector. The pattern expected is the sector's address (drive, track, and sector numbers).
4	Data-compare error. Data-pattern read from a sector does not contain the sector's address (drive, track, and sector numbers).

(continued on next page)

Table 4-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Random Addressing:	
5	Error bit was set while exercise was reading the initial two words of a sector.
6	Data-compare error. The content of the initial two words read from a sector does not contain the sector's address (track and sector numbers).
Data-Reliability or Interactive-Data Test:	
7	Error bit was set while exercise was writing the disk with a test pattern.
8	Error bit was set while exercise was reading a test pattern from the disk. Condition may also occur as a data-compare error. Data read from the disk does not contain the expected data.
Random:	
9	Error bit was set while exercise was writing a random-data pattern at a randomly selected address.
10	Error bit was set while exercise was reading random data from a previously written random address.
11	Data-compare error. The content of the data pattern read from a sector does not contain the random data previously written.

4.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 4.6), test-parameter selection (see Section 4.7), interactive testing (see Sections 4.9 and 4.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DF0:
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DF0:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RF11

START RF11 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DF0
  **WARNING** DF0:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL) = n
TEST ALL DRIVES?        (Y tests all valid drives)
                        (N initiates WHICH DRIVE? inquiry)
WHICH DRIVE?            Type value (0-7) to test one drive.
                        Inquiry repeats if entry exceeds maximum
                        valid drive number (set during system
                        generation).
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

4.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

4.7 TEST-PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 4-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 4-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE-DATA TEST (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data reliability testing of a drive or the entire disk (see Section 4.9 for details).	2002	No

(continued on next page)

Table 4-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTION (Bits 0-3): A) Select addressing exercises (see Section 4.3.1). B) Select data-reliability exercise (see Section 4.3.2). C) Select random exercise (see Section 4.3.3).	 1 2 4	 Yes Yes Yes

4.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

(CTRL/C)
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

4.9 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the data reliability of the entire disk or a particular drive. After test-parameter selection, the test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

WORD COUNT=

Type a value to indicate the desired upper limit of the data buffer to be used in write/read data transfer functions (the value cannot exceed 512. and must be 2 or more).

If you type a value greater than 512. or less than 2, the inquiry repeats.

DO YOU WISH TO SPECIFY THE SECTOR ADDRESS?

Type Y if a specified sector address is to be tested.

Type N if all data surfaces of the disk are to be written on and/or read from. The inquiries, which follow, for track and sector numbers are inhibited.

TRACK=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired track number in the range 0 through 127 (decimal). If you type a number greater than 127., the inquiry repeats.

SECTOR=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired sector number in the range 0 through 7. If you type a number greater than 7, the inquiry repeats.

PATTERN NO.=

Type the appropriate number, as indicated below, to select a specific stored data pattern or the combination of all stored patterns for use in exercising the disk drive.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify your own pattern to be used in place of the stored patterns by typing a full-word (6-digit) octal value in response to the above inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions.

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries will be repeated.

With selection of the read-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 7, 8)

CHAPTER 5

RK05 CARTRIDGE DISK AND RK05F FIXED DISK DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" disk cartridge in RK05 disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DKn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DKn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK05

START RK05 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DKn
  **WARNING** DKn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y             (N or RETURN alone aborts the diagnostic)
FORMAT DISK ONLY?       (N initiates customer-mode sequence)
                        (Y formats disk and exits)
```

Diagnostic runs to completion in 25 minutes for a lightly loaded system. Formatting requires approximately 20 minutes. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

5.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
RK05 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF RK05 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

5.2 DISK DRIVE CHARACTERISTICS

The following are data-capacity parameters for the RK05 Cartridge Disk. The RK05F Fixed Disk is equivalent to two independently selected RK05 units.

Cylinders	200+3
Tracks/Cylinder	2
Sectors/Track	12
Words/Sector	256

The "spare" cylinders (210-203) cannot be addressed.

5.3 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the selected disk drive to address correctly all cylinders, tracks, and sectors of the resident disk cartridge, and to write data on, and to read data from, the cartridge under selected conditions. A formatting routine is also included. Neither ECC correction nor "bad sector (block)" processing are implemented.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 5.4 and Table 5-1 for their significance.

5.3.1 Addressing Exercises

5.3.1.1 **Heads-Positioning Exercise** - This exercise determines that the heads position correctly at all cylinders of the resident disk cartridge. The exercise is conducted in two parts: incremental seek and cross seek.

For incremental seek, a read-header command (implied seek) alternately addresses cylinder 0 and cylinder "n," where "n" increments by one for each seek to it for the range of 1 through 199. After each seek of cylinder 0 or cylinder "n," the exercise verifies that the specified cylinder address was achieved.

For cross seek, a read-header command alternately addresses cylinder "a," where "a" is initially 0, and cylinder "b," where "b" is initially 199. After each seek, "a" is incremented by one and "b" is decremented by one. This part of the exercise continues until "b" equals 0. Cylinder positioning is verified after each seek.

(Related Error Numbers are: 1, 2, 3, 4, 5)

5.3.1.2 **Sector-Addressing Exercise** - This exercise determines that sectors 0 through 11 of the resident disk cartridge are addressable. Each sector on track 0 of cylinder 0 is written with a data pattern

equal to the sector number. Then each sector is read and verified that it contains the correct data pattern. All error conditions are reported.

(Related Error Numbers are: 6, 7, 8)

5.3.1.3 **Track-Addressing Exercise** - This exercise determines that tracks 0 and 1 are addressable. Sector 0 on each track is written with a data pattern consisting of the respective track number. Then, each sector is read and verified that it contains the correct data pattern. All error conditions are reported.

(Related Error Numbers are: 9, 10, 11)

5.3.1.4 **Cylinder-Addressing Exercise** - This exercise determines that all cylinders are addressable. Sector 0 of each cylinder, 0 through 199, is written with a data pattern consisting of the respective cylinder number. Then, each sector 0 is read and verified that it contains the correct data pattern. All error conditions are reported.

(Related Error Numbers are: 12, 13, 14)

5.3.1.5 **Track-Crossover Exercise** - This exercise determines that a 2-sector data transfer starting at the last sector of a track results in a crossover to the first sector of the successive track. The exercise first issues a 512-word write command starting at sector 11 of track 0 on cylinder 0; the data pattern written is all 1's. The exercise then reads sector 0 on track 1 of cylinder 0 and verifies that the data pattern is all 1's. All error conditions are reported.

(Related Error Numbers are: 15, 16, 17)

5.3.1.6 **Cylinder-Crossover Exercise** - This exercise determines that a 2-sector data transfer starting at the last sector of a cylinder results in a crossover to the first sector on the first track of the successive cylinder. The exercise first issues a 512-word write command starting at sector 11 on track 1 of cylinder 0; the data pattern written is all 1's. The exercise then reads sector 0 on track 0 of cylinder 1 and verifies that the data pattern is all 1's. All error conditions are reported.

(Related Error Numbers are: 18, 19, 20)

5.3.2 Data-Reliability Exercise

This exercise determines the reliability of the disk drive to write and read data of various patterns at all valid disk addresses. The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)

4. Floating 1's (sequenced bit-position advancement through each word)

5. Random data

6. Count pattern (from "1," add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete test sequence.

Each pattern is written at all disk addresses, and then read back eight times for verification and to expose possible read-reduction problems. Detection of any errors while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 21, 22)

5.3.3 Random Exercise

This exercise determines that the drive can address randomly selected disk addresses and execute random-length transfers of random-patterned data to and from those areas. The exercise sequence, which is repeated 512 times, is:

1. Develop a valid, random cylinder-, track-, and sector-address combination.

2. Initiate a write transfer of a random-length, random-data pattern, beginning at the random disk address. The number of words is 2 or more, and not greater than 512.

3. Upon completion of the write transfer, issue a seek to another random address.

4. Initiate eight read transfers of the previously written random data with intervening seeks to random addresses (the purpose of this command sequence is to expose read-reduction problems or parity errors caused by a vibrating head).

5. Verify the data returned.

Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 23, 24, 25, 26)

5.3.4 Formatting Routine

The formatting routine prepares disks for use with the PDP-11. In sequence, the routine:

- Writes the complete header for each sector,
- Verifies the address content of each sector header, and
- Exits.

Formatting, when selected, always runs to completion and exits.

The sector headers are written one at a time. Sectors that cannot be formatted or verified are identified by the cylinder-track-sector addresses that follow the messages

UNABLE TO FORMAT SECTOR AT ADDRESS

HEADER VERIFY ERROR AT ADDRESS

Satisfactory completion of the format process is signaled by the message

FORMATTING COMPLETE

The message

FORMATTING FAILED

indicates that one or more sectors could not be formatted and/or verified.

(Related Error Numbers are: 27, 28, 29)

5.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 15 of the Control and Status Register (RKCS). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer actions. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 5-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
RK05          UNIT NO.  m
ERROR NO.  n
RKDS       =  Drive Status Register contents
RKER       =  Error Register contents
RKCS       =  Control and Status Register contents
RKWC       =  Word Count Register contents
RKBA       =  Bus Address Register contents
RKDA       =  Desired Address Register contents
```

Data-compare error-message format:

```
RK05          UNIT NO.  m
ERROR NO.  n
EXPECTED   =  Data expected
RECEIVED   =  Data received
```

Sector error-message format:

```
RK05          UNIT NO.  m
ERROR NO.  n
EXPECTED   =  Data expected
RECEIVED   =  Data received
CYLINDER   =  Number (in octal and decimal)
TRACK      =  Number (in octal and decimal)
SECTOR     =  Number (in octal and decimal)
WORD NO. IN SECTOR = Number (in octal and decimal)
```

Other error messages:

CONTENTS OF RKDA INCORRECT

HEADER VERIFY ERROR AT ADDRESS a

UNABLE TO FORMAT SECTOR AT ADDRESS b

REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO. x RECOVERED AFTER y RETRIES

Table 5-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Heads Positioning:	
1	Error bit was set after a read-header command was issued to cylinder 0.
2	Cylinder address acquired by a read-header command does not agree with the specified address.
3	Error bit was set after a read-header command was issued to a cylinder in the range 1 through 199.
4	Error bit was set after a read-header command was issued to the cylinder address being incremented from 0 through 199.
5	Error bit was set after a read-header command was issued to the cylinder address being decremented from 199 through 0.

(continued on next page)

Table 5-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Sector Addressing:	
6	Error bit was set while exercise was writing a sector with a data pattern equal to its sector number.
7	Error bit was set while exercise was reading a sector with a data pattern equal to its sector number.
8	Data-compare error. Data pattern read from a sector on track 0 of cylinder 0 does not contain the respective sector number.
Track Addressing:	
9	Error bit was set while exercise was writing a data pattern equal to the respective track number in sector 0 on a track of cylinder 0.
10	Error bit was set while exercise was reading sector 0 on a track of cylinder 0. The data pattern is the respective track number.
11	Data-compare error. Data pattern read from sector 0 on tracks 0 and 1 of cylinder 0 does not contain the respective track number.
Cylinder Addressing:	
12	Error bit was set while exercise was writing a data pattern equal to the respective cylinder number in sector 0 of a cylinder.
13	Error bit was set while exercise was reading sector 0 of a cylinder. The data pattern expected is the respective cylinder number.
14	Data-compare error. Data pattern read from sector 0 of a cylinder does not contain the respective cylinder number.
Track Crossover:	
15	Error bit was set while exercise was writing a 2-sector data transfer starting at sector 11 on track 0 of cylinder 0. The transfer should cross over into sector 0 of track 1. The data pattern is all 1's.

(continued on next page)

Table 5-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Track Crossover: (Cont.)	
16	Error bit was set while exercise was reading the initial two words of sector 0 on track 1 of cylinder 0. The data pattern is all 1's.
17	Data-compare error. Data pattern read from sector 0 on track 1 of cylinder 0 does not contain the expected data of all 1's.
Cylinder Crossover:	
18	Error bit was set while exercise was writing a 2-sector data transfer starting at sector 11 on track 1 of each cylinder. Each transfer should cross over into sector 0 on track 0 of the successive cylinder. The data pattern is all 1's.
19	Error bit was set while exercise was reading the initial two words of sector 0 on track 0 of a cylinder. The data pattern is all 1's.
20	Data-compare error. Data pattern read from sector 0 on track 0 of a cylinder does not contain the expected data of all 1's.
Data-reliability or Interactive-Data Test:	
21	Error bit was set while exercise was writing the disk with a test pattern.
22	Error bit was set while exercise was reading a test pattern from the disk. Condition may also occur as a data-compare error. Data read from the disk does not contain the expected test pattern.
Random:	
23	Error bit was set while exercise was writing a random-data pattern at a randomly selected disk address.
24	Error bit was set after the issuing of a seek command with a random disk address.

(continued on next page)

Table 5-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Random: (Cont.)	
25	Error bit was set while exercise was reading random data from a previously written random disk address.
26	Data-compare error. Data pattern read does not contain the expected random data.
Formatting:	
27	Error bit was set while routine was writing a sector header to format one sector at a time.
28	Error bit was set while routine was reading a sector header.
29	The header for the indicated sector does not contain the correct format.
Interactive-Address Test:	
30	Error bit was set after a seek command was issued to the "first" cylinder selected.
31	Error bit was set after a seek command was issued to the "second" cylinder selected.

5.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 5.6), test-parameter selection (see Section 5.7), interactive testing (see Sections 5.9 and 5.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Install "scratch" cartridge in disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DKn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DKn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK05

START RK05 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DKn
  **WARNING** DKn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

5.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

5.7 TEST PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 5-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 5-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE-ADDRESS TEST (Bits 10 & 0): Allows the service-mode user to oscillate head motion between two specified cylinders (see Section 5.9 for details).	2001	No

(continued on next page)

Table 5-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
INTERACTIVE-DATA TEST (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data-reliability testing of the drive (see Section 5.10 for details).	2002	No
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTION (Bits 0-4):		
A) Select addressing exercises (see Section 5.3.1).	1	Yes
B) Select data-reliability exercise (see Section 5.3.2).	2	Yes
C) Select random exercise (see Section 5.3.3).	4	Yes
D) Select random exercise with inter-read seeks inhibited to reduce run time (see Section 5.3.3).	24	No
E) Select formatting routine without other exercises; routine always runs to completion and exits (see Section 5.3.4).	10	Selectable

5.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test-sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

5.9 INTERACTIVE-ADDRESS TEST

This test oscillates the disk drive head (that is, continuous in-and-out motion) between the two cylinders you specify. After test-parameter selection, the test is initialized by your typing of valid cylinder numbers in the range 0 through 199. in response to the inquiries.

FIRST CYLINDER =

SECOND CYLINDER =

Should you inadvertently type a number greater than 199., the inquiry repeats.

Once initiated, the head oscillation continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

The function of the test is to issue seek commands alternately to the two specified cylinders. An equipment error message is displayed if the seek function fails.

(Related Error Numbers are: 30, 31)

5.10 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the disk-drive's data reliability. After test-parameter selection, the test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

WORD COUNT=

Type a value to indicate the desired upper limit of the data buffer to be used in write/read transfer functions (the value cannot exceed 512. and must be 2 or more).

If you type a value greater than 512. or less than 2, the inquiry repeats.

DO YOU WISH TO SPECIFY THE SECTOR ADDRESS?

Type Y if a specified sector address is to be tested.

Type N if all data surfaces of the disk are to be written on and/or read from. The inquiries, which follow, for cylinder, track, and sector numbers are inhibited.

CYLINDER=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired cylinder number in the range 0 through 199 (decimal). If you type a number greater than 199., the inquiry repeats.

TRACK=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired track number, 0 or 1. If you type a number greater than 1, the inquiry repeats.

SECTOR=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired sector number in the range 0 through 11 (decimal). If you type a number greater than 11., the inquiry repeats.

PATTERN NO.=

Type the appropriate number, as indicated below, to select a specific stored data pattern or the combination of all stored patterns for use in exercising the disk drive.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify your own pattern to be used in place of the stored patterns by typing a full-word (6-digit) octal value in response to the above inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions.

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries will be repeated.

With selection of the read-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 21, 22)

CHAPTER 6

RK06 AND RK07 CARTRIDGE DISK DIAGNOSTICS

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" disk cartridge in disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DMn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DMn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK06              (or RUN $RK07)

START RK06 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DMn
  **WARNING** DMn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y             (N or RETURN alone aborts the diagnostic)
FORMAT DISK ONLY?       (N initiates customer-mode sequence)
                        (Y formats disk and exits)
```

Diagnostic runs to completion in 24 minutes (RK06) or 48 minutes (RK07) for a lightly loaded system. Formatting requires approximately 6 minutes (RK06) or 12 minutes (RK07). To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

6.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
RK06 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF RK06 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

6.2 DISK-DRIVE CHARACTERISTICS

The following is general information for the RK06 and RK07 Cartridge Disk Drives.

	RK06	RK07
Cylinders	411	815
Tracks/Cylinder	3	3
Sectors/Track	22	22
Words/Sector	256	256

The highest track (track 2 of cylinder 410 (RK06) or cylinder 814 (RK07)) is reserved for use as a "marked bad sector" file. It is software-protected against accidental overwriting. Sectors 0 through 9 record the addresses of those sectors, if any, that were detected as being unreliable by Digital Manufacturing. Manufacturing-detected bad sectors are flagged in their headers, both initially and by any subsequent reformatting, as being "bad". All other sectors, regardless of their current status, are flagged as being "good" when the cartridge is reformatted.

NOTE

This action does not preclude use of the BAD utility program to register on the cartridge those sectors it finds to be "bad" for reference by the INITVOLUME command. (Refer to the RSX-11 Utilities Manual and the RSX-11M/M-PLUS MCR Operations Manual, respectively).

6.3 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the selected disk drive to address correctly all cylinders, tracks, and sectors of the resident cartridge, and to write data on, and to read data from, the cartridge under selected conditions. A formatting routine is included. ECC correction and "bad sector (block)" processing are implemented.

During exercise execution, the address of a sector flagged as "bad" is, first, saved in a "marked-bad-sector" table for later validation, and then skipped for that phase of the exercise. Subsequent phases, such as write-check or read may address the same "bad" sector; thus the table may contain several entries of the "bad" sector address. Any condition that occurs as a result of a "bad" sector is not reported as an error. At the end of testing in each occurrence of the Addressing Exercises, the Data-Reliability Exercise, and the Random Exercise, the marked-bad-sector handler compares the table-resident sector addresses with the contents of the "manufacturing marked bad sector" file on the cartridge and reports any addresses not matched by the file.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 6.4 and Table 6-1 for their significance.

6.3.1 Addressing Exercises

6.3.1.1 **Heads-Positioning Exercise** - This exercise determines that the heads position correctly at all cylinders. The exercise is conducted in two parts: incremental seek and cross seek.

For incremental seek, a read-header command (implied seek) alternately addresses cylinder 0 or cylinder "n," where "n" increments by one for each seek to it for the range of one through 410 (RK06) and one through 814 (RK07). After each seek of cylinder 0 or cylinder "n," the exercise compares the contents of the Desired Cylinder register (RKDC) with the cylinder address sought to verify that the specified cylinder address was achieved.

For cross seek, a read-header command alternately addresses cylinder "a," where "a" is initially 0, and cylinder "b," where "b" is initially 410 (RK06) and 814 (RK07). After each seek, "a" is incremented by one and "b" is decremented by one. This part of the exercise continues until "b" equals 0. Cylinder positioning is verified by comparison of the RKDC register contents with the cylinder address sought.

(Related Error Numbers are: 2, 3, 4, 5, 6, 7)

6.3.1.2 **Sector-Addressing Exercise** - This exercise determines that sectors 0 through 21 of the resident disk cartridge are addressable. Each "good" sector on track 0 of cylinder 0 is completely written with a repeating 2-word data pattern equal to its respective sector number followed by its complement. Then each sector is read and verified that it contains the correct data pattern. All error conditions are reported.

(Related Error Numbers are: 8, 9, 10, 11)

6.3.1.3 **Track-Addressing Exercise** - This exercise determines that all tracks are addressable. The exercise first issues a sector-write command (256 words) to sector 0 of each track (0-2) on cylinder 0; the repeating 2-word data pattern written is the respective track number followed by its complement. The exercise then reads sector 0 on tracks 0 through 2 of cylinder 0 and verifies that the data pattern equals the respective track number. After each read verification, each sector is rewritten with the track-number pattern to detect if more than one head is bieng energized at a time. All error conditions are reported.

(Related Error Numbers are: 12, 13, 14, 15, 16)

6.3.1.4 **Cylinder-Addressing and Crossover Exercise** - This exercise determines that all cylinders are addressable, and that a 2-sector data transfer starting at the last sector of a cylinder results in a crossover to the first sector on the first track of the successive cylinder. The exercise first issues a 512-word write command starting at sector 21 on track 2 of cylinder 0 through 409 (RK06) and 0 through 813 (RK07); the repeating 2-word data pattern written is the respective cylinder number followed by its complement. The exercise then reads sector 0 on track 0 of cylinder 1 and each successive

cylinder through cylinder 410 (RK06) and cylinder 814 (RK07). If crossover occurred, the data pattern read should be the number of the preceding cylinder (e.g., 0 in sector 0, track 0, cylinder 1; and 3 in sector 0, track 0, cylinder 4). All error conditions are reported.

(Related Error Numbers are: 17, 18, 19, 20)

6.3.1.5 **Partial-Sector-Write Exercise** - This exercise determines that a write on a sector of less than 256 words results in the remainder of the sector being zero-filled. First, the exercise writes sector 0 (on track 0 of cylinder 0) or the first "good" sector found on cylinder 0 with an all-1's pattern. Then, the exercise issues a 2-word write command, all -1's data, to the same sector address. Finally, the exercise reads the sector's contents and verifies that all but the initial two words are zero-filled. All error conditions are reported.

(Related Error Numbers are: 21, 22, 23, 24, 25)

6.3.2 Data-Reliability Exercise

This exercise determines the reliability of the disk drive to write and read data of various patterns at all "good" sector addresses other than track 2 on cylinder 410 (RK06) and cylinder 814 (RK07). The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)
4. Floating 1's (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (from "1," add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete test sequence.

After each read, ECC correction is implemented, if called for by the disk controller, to compensate for recoverable data-transfer errors. If ECC correction is not successful, the exercise reports the failing address and attempts up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 26, 27, 28, 29)

6.3.3 Random Exercise

This exercise determines that the drive can address randomly selected disk addresses (other than track 2 on cylinder 410 (RK06) and on cylinder 814 (RK07)) and execute random-length transfers of random-patterned data to and from those areas. The exercise sequence, which is repeated 512 times, is:

1. Develop a valid, random cylinder-, track-, and sector-address combination.
2. Initiate a write transfer of a random-length, random-data pattern, beginning at the random disk address. The number of words is two or more, and not greater than 512.
3. Upon completion of the write transfer, issue a seek to another random address.
4. Initiate eight read transfers of the previously written random data with intervening seeks to random addresses (the purpose of this command sequence is to expose read-reduction problems or parity errors caused by a vibrating head).
5. Verify the data returned.

Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 30, 31, 32, 33)

6.3.4 Formatting Routine

The formatting routine prepares non-PDP-11 formatted RK06 and RK07 cartridges for use with the PDP-11 or cartridges that require reformatting. In sequence, the routine:

- Writes the complete header for each sector, including a "good" or a "bad" sector flag, where appropriate, as determined by the contents of the manufacturing bad sector portion of the marked-bad-sector file, and
- Exits.

Formatting, when selected, always runs to completion and exits.

The sector headers are written one track at a time. Sectors that cannot be formatted are identified by the cylinder-track addresses that follows the message

UNABLE TO FORMAT ONE OR MORE SECTORS AT ADDRESS

Satisfactory completion of the format process is signaled by the message

FORMATTING COMPLETE

The message

FORMATTING FAILED

indicates that one or more sectors could not be formatted.

(Related Error Numbers are: 34, 35, 36)

6.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 15 of the Control and Status 1 Register (RKCS1). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer actions. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 6-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
RK06        UNIT NO. m
ERROR NO. n

RKCS1    =  Control and Status 1 Register contents
RKWC     =  Word Count Register contents
RKBA     =  Bus Address Register contents
RKDA     =  Disk Address Register contents
RKCS2    =  Control and Status 2 Register contents
RKDS     =  Drive Status Register contents
RKER     =  Error Register contents
RKAS/OF  =  Attention Summary and Offset Register contents
RKDC     =  Desired Cylinder Register contents
RKDB     =  Data Buffer Register contents
RKMR1    =  Maintenance Register 1 contents
RKECPS   =  ECC Position Register contents
RKECPT   =  ECC Pattern Register contents
RKMR2-0  =  Maintenance Register 2 - Message 0
RKMR3-0  =  Maintenance Register 3 - Message 0
RKMR2-1  =  Maintenance Register 2 - Message 1
RKMR3-1  =  Maintenance Register 3 - Message 1
RKMR2-2  =  Maintenance Register 2 - Message 2
RKMR3-2  =  Maintenance Register 3 - Message 2
RKMR2-3  =  Maintenance Register 2 - Message 3
RKMR3-3  =  Maintenance Register 3 - Message 3
```

Data-compare error-message format:

```
RK06         UNIT NO.  m
ERROR NO.  n
EXPECTED  =  Data received
```

Other error messages:

UNABLE TO FORMAT ONE OR MORE SECTORS AT ADDRESS n

CONTENTS OF RKDC REGISTER INCORRECT

FORMATTING FAILED

FORMATTING COMPLETE

FOUND 128. BAD CYLINDERS WHICH EXCEEDS MEMORY SPACE

EVERY SECTOR ON CYLINDER 0 IS MARKED AS BAD

UNABLE TO LOCATE THE BAD SECTOR BLOCK ON THE BAD SECTOR FILE TRACK

FOUND BAD SECTOR NOT IN BAD SECTOR BLOCK FILE AT ADDRESS n

REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO. x RECOVERED AFTER y RETRIES

Table 6-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Initialization:	
1	Error bit was set during a home-seek (re-calibration) function.
Heads Positioning:	
2	Error bit was set after a read-header command was issued to cylinder 0.
3	Error bit was set after a read-header command was issued to a cylinder in the range 1 through 410 (RK06) and 1 through 814 (RK07).
4	Error bit was set after a read-header command was issued to the cylinder number being incremented from 0 through 410 (RK06) and 0 through 814 (RK07).
5	Data-compare error. The cylinder number obtained via the read-header command does not agree with the cylinder number sought (number incrementing from 0 through 410 (RK06) and 0 through 814 (RK07).

(continued on next page)

Table 6-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Heads Positioning:	(Cont.)
6	Error bit was set after a read-header command was issued to the cylinder number being decremented from 410 (RK06) and 814 (RK07) through 0.
7	Data-compare error. The cylinder number obtained via the read-header command does not agree with the cylinder number sought (number decrementing from 410 (RK06) and 814 (RK07) through 0).
Sector Addressing:	
8	Error bit was set while exercise was writing a sector with a 2-word data pattern equal to its respective sector number followed by its complement.
9	Error bit was set while exercise was write-checking a sector written with a 2-word data pattern equal to its respective sector number followed by its complement.
10	Error bit was set while exercise was reading a sector with a 2-word data pattern equal to its respective sector number followed by its complement.
11	Data-compare error. Data pattern read from a sector on track 0 of cylinder 0 does not contain the respective sector number followed by its complement.
Track Addressing:	
12	Error bit was set while exercise was writing sector 0 on each track of cylinder 0 with a repeating 2-word data pattern equal to the respective track number followed by its complement.
13	Error bit was set while exercise was write-checking a sector written with a repeating 2-word data pattern equal to the respective track number followed by its complement.

(continued on next page)

Table 6-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Track Addressing:	(Cont.)
14	Error bit was set while exercise was reading sector 0 on tracks 0 through 2 of cylinder 0. The repeating 2-word data pattern is the respective track number followed by its complement.
15	Data-compare error. Data pattern read from a sector 0 on tracks 0 through 2 of cylinder 0 does not contain the number of the respective track followed by its complement.
16	Error bit was set while exercise was rewriting a sector with a repeating 2-word data pattern equal to the respective track number followed by its complement. Detects erroneous turn-on of more than one head at a time.
Cylinder-Addressing and Crossover:	
17	Error bit was set while exercise was writing a 512-word data transfer starting at the last sector on the last track of a cylinder. The repeating 2-word data pattern is the respective cylinder number followed by its complement.
18	Error bit was set while exercise was write-checking a 512-word data transfer written starting at the last sector on the last track of a cylinder. The repeating 2-word data pattern is the respective cylinder number followed by its complement.
19	Error bit was set while exercise was reading the first sector on the first track of a cylinder. The repeating 2-word data pattern is the preceding cylinder number followed by its complement.
20	Data-compare error. Data pattern read from the first sector on the first track of a cylinder does not contain the number of the preceding cylinder followed by its complement.

(continued on next page)

Table 6-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Partial Write:	
21	Error bit was set while exercise was writing sector 0 on track 0 of cylinder 0, or the first "good" sector found on cylinder 0, with all-1's data.
22	All sectors of cylinder 0 are marked as being "bad" sectors.
23	Error bit was set while exercise was writing a 2-word transfer of all-1's data in sector 0 on track 0 of cylinder 0, or in the first "good" sector found on cylinder 0.
24	Error bit was set while exercise was reading the contents of the first "good" sector found.
25	Data-compare error. Data pattern read from the first "good" sector found does not contain all 1's.
Data-Reliability or Interactive-Data Test:	
26	Error bit was set while exercise was writing a test pattern.
27	Error bit was set while exercise was write-checking a previously written test pattern.
28	Error bit was set while exercise was reading a test pattern.
29	Data-compare error. Data read does not contain the expected test pattern.
Random:	
30	Error bit was set while exercise was writing a random-data pattern at a randomly selected address.
31	Error bit was set after the issuing of a seek command with a random address.
32	Error bit was set while exercise was reading random data from a previously written random address.

(continued on next page)

Table 6-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Random: (Cont.)	
33	Data-compare error. Data read from the random address does not contain the previously written random data.
Formatting:	
34	Error bit was set after routine issued a command to read the "manufacturing bad sector" portion of the "marked bad sector" file.
35	The "manufacturing bad sector" information cannot be located. Formatting is aborted.
36	Error bit was set while routine was writing sector-header patterns to format a track.
Marked Bad Sector Handling:	
37	The core-resident "marked bad sector" table is full (i.e., detected bad sectors exceed 128). Subsequent bad-sector addresses cannot be retained for validation.
38	Error bit was set after routine issued a command to read the "manufacturing bad sector" portion of the "marked bad sector" file.
39	The "manufacturing bad sector" information cannot be located. The diagnostic is aborted.
Interactive-Address Test:	
40	Error bit was set after a seek command was issued to the "first" cylinder selected.
41	Error bit was set after a seek command was issued to the "second" cylinder selected.

6.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 6.6), test-parameter selection (see Section 6.7), interactive testing (see Sections 6.9 and 6.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Install "scratch" cartridge in disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DMn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DMn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK06              (or RUN $RK07)

START RK06 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DMn
  **WARNING** DMn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

6.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

6.7 TEST PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 6-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option

descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 6-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE-ADDRESS TEST (Bits 10 & 0): Allows the service-mode user to oscillate head motion between two specified cylinders (see Section 6.9 for details).	2001	No

(continued on next page)

Table 6-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
INTERACTIVE-DATA TEST (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data reliability testing of the drive (see Section 6.10 for details).	2002	No
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTION (Bits 0-4):		
A) Select addressing exercises Section 6.3.1).	1	Yes
B) Select data-reliability exercise (see Section 6.3.2).	2	Yes
C) Select random exercise (see Section 6.3.3).	4	Yes
D) Select random exercise with inter-read seeks inhibited to reduce run time (see Section 6.3.3).	24	No
E) Select formatter routine without other exercises; formatter always runs to completion and exits (see Section 6.3.4).	10	Selectable

6.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)=	Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART?	Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

6.9 INTERACTIVE-ADDRESS TEST

This test oscillates the disk drive head (that is, continuous in-and-out motion) between the two cylinders you specify. After test-parameter selection, the test is initialized by your typing of valid cylinder numbers in the range 0 through 410. (RK06) and 0 through 814. (RK07) in response to the inquiries.

FIRST CYLINDER =

SECOND CYLINDER =

Should you inadvertently type a number greater than 410. (RK06) and 814. (RK07), the inquiry repeats.

Once initiated, the head oscillation continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

The function of the test is to issue seek commands alternately to the two specified cylinders. An equipment error message is displayed if the seek function fails.

(Related Error Numbers are: 40, 41)

6.10 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the disk-drive's data reliability. After test-parameter selection, the test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

NOTE

Track 2 of cylinder 410 (RK06) and 814 (RK07), the "marked-bad-sector" file, cannot be addressed. Violation of this restriction results in rejection of your responses and the repeat of all inquiries from "WORD COUNT=."

WORD COUNT=

Type a decimal value to indicate the desired upper limit of the data buffer to be used in write/read data transfer functions (the value cannot exceed 512. and must be 2 or more).

If you type a value less than 2 or more than 512., the inquiry repeats.

DO YOU WISH TO SPECIFY THE SECTOR ADDRESS?

Type Y if a specified sector address is to be tested.

Type N if all data surfaces of the cartridge other than track 2 of cylinder 410 (RK06) and 814 (RK07) are to be written on and/or read from. The inquiries, which follow, for cylinder, track, and sector numbers are inhibited.

CYLINDER=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired cylinder number in the range 0 through 410 (decimal) for the RK06 and 814 (decimal) for the RK07. If you type a number greater than 410. (RK06) and 814. RK07), the inquiry repeats.

TRACK=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired track number in the range 0 through 2. If you type a number greater than 2, the inquiry repeats.

SECTOR=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired sector number in the range 0 through 21 (decimal). If you type a number greater than 21., the inquiry repeats.

PATTERN NO.=

Type the appropriate number, as indicated below, to select a specific stored data pattern or the combination of all stored patterns for use in exercising the disk drive.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify your own pattern to be used in place of the stored patterns by typing a full-word (6-digit) octal value in response to the above inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions.

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries will be repeated.

With selection of the read-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 26, 27, 28, 29)

CHAPTER 7

RP02, RPR02, OR RP03 DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" disk pack on disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DPn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DPn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RP03              (or RP02 or RPR02

START RP03 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DPn
  **WARNING** DPn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y             (N or RETURN alone aborts the diagnostic)
FORMAT DISK ONLY?       (N initiates customer-mode sequence)
                        (Y formats disk pack and exits)
```

Diagnostic runs to completion in 2 hours for RP03, and 1 hour and 5 minutes for RP02 or RPR02 on a lightly loaded system. Formatting requires approximately 30 minutes for RP03, and 18 minutes for RP02 or RPR02. RP02 or RPR02 packs must be formatted one at a time. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

7.1 TEST SUMMARY REPORT

Upon completion of each diagnostic-test sequence, the following report is displayed.

```
RP03 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF RP03 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

7.2 DISK DRIVE CHARACTERISTICS

The following are data-capacity parameters for the RP02, RPR02, and RP03 Disk Pack Drives.

	RP02 & RPR02	RP03
Cylinders	200+3	400+6
Tracks/Cylinder	20	20
Sectors/Track	10	10
Words/Sector	256	256

The "spare" cylinders (201-203 for RP02 and RPR02, and 401-406 for RP03) cannot be addressed.

7.3 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the selected disk drive to address correctly all cylinders, tracks, and sectors of the resident disk pack, and to write data on, and to read data from, the pack under selected conditions. A pack formatting routine is also included. Neither ECC correction nor "bad sector (block)" processing are implemented.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 7.4 and Table 7-1 for their significance.

7.3.1 Addressing Exercises

7.3.1.1 **Heads-Positioning Exercise** - This exercise determines that the heads position correctly at all cylinders of the resident disk pack. The exercise is conducted in two parts: incremental seek and cross seek.

For incremental seek, a read-header command (implied seek) alternately addresses cylinder 0 and cylinder "n," where "n" increments by one for each seek to it for the range of 1 through the valid, upper-limit cylinder address. After each seek of cylinder 0 or cylinder "n," the exercise compares the contents of the SUCA register (selected unit cylinder address) with the current header data to verify that the specified cylinder address was achieved.

For cross seek, a read-header command alternately addresses cylinder "a," where "a" is initially 0, and cylinder "b," where "b" is initially the valid, upper-limit cylinder address. After each seek, "a" is incremented by one and "b" initially the valid, upper-limit cylinder address. After each seek, is decremented by one. This part

of the exercise continues until "b" equals 0. Cylinder positioning is verified after each seek.

(Related Error Numbers are: 2, 3, 4, 5)

7.3.1.2 **Sector-Addressing Exercise** - This exercise determines that sectors 0 through 9 of the resident disk pack are addressable. Each sector on track 0 of cylinder 0 is written with a data pattern equal to its respective sector number. Then each sector is read and verified that it contains the correct data pattern. All error conditions are reported.

(Related Error Numbers are: 6, 7, 8)

7.3.1.3 **Track-Addressing and Crossover Exercise** - This exercise determines that all tracks are addressable, and that a 2-sector data transfer starting at the last sector of any track except the last track of the last cylinder results in a crossover to the first sector of the successive track. The exercise, first, issues a 512-word write command starting at sector 9 of track 0 and each successive track through track 19 on cylinder 0. The data pattern written is the respective track number. The exercise then reads the first two words from sector 0 of track 1 and each successive track through track 19 on cylinder 0, and sector 0 of track 0 on cylinder 1. If crossover occurred, the data pattern read should be the number of the preceding track (e.g., 0 in sector 0, track 1, cylinder 0; 3 in sector 0, track 4, cylinder 0; and 19 in sector 0, track 0, cylinder 1). All error conditions are reported.

(Related Error Numbers are: 9, 10, 11)

7.3.1.4 **Cylinder-Addressing and Crossover Exercise** - This exercise determines that all cylinders are addressable, and that a 2-sector data transfer starting at the last sector of any cylinder except the last results in a crossover to the first sector of the successive cylinder. The exercise, first, issues a 512-word write command starting at sector 9 of track 19 on cylinder 0 and each successive cylinder through the cylinder that precedes the valid upper limit. The data pattern written is the respective cylinder number. The exercise then reads the first two words from sector 0, track 0, on cylinder 1 and each successive cylinder to the valid upper limit. If crossover occurred, the data pattern read should be the number of the preceding cylinder (e.g., 0 in sector 0, track 0, cylinder 1; and 3 in sector 0, track 0, cylinder 4). All error conditions are reported.

(Related Error Numbers are: 12, 13, 14)

7.3.1.5 **Partial-Write Exercise** - This exercise determines that a write on a sector of less than 256 words results in the remainder of the sector being zero-filled. First, the exercise writes sector 0 on track 0 of cylinder 0 with an all-1's pattern. Then, the exercise issues a 2-word write command, all-1's data, to the same sector address. Finally, the exercise reads the sector's contents and verifies that all but the initial two words are zero-filled. All error conditions are reported.

(Related Error Numbers are: 15, 16, 17, 18)

7.3.2 Data-Reliability Exercise

This exercise determines the reliability of the disk drive to write and read data of various patterns at all valid disk addresses. The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)
4. Floating 1's (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (from "1," add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete test sequence.

Each pattern is written at all disk addresses, and then read back eight times for verification and to expose possible read-reduction problems. Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 19, 20)

7.3.3 Random Exercise

This exercise determines that the drive can address randomly selected disk-pack addresses and execute random-length transfers of random-patterned data to and from those pack areas. The exercise sequence, which is repeated 512 times, is:

1. Develop a valid, random cylinder-, track-, and sector-address combination.
2. Initiate a write transfer of a random-length, random-data pattern, beginning at the random disk address. The number of words is two or more, and not greater than 512.
3. Upon completion of the write transfer, issue a seek to another random address.
4. Initiate eight read transfers of the previously written random data with intervening seeks to random addresses (the purpose of this command sequence is to expose read-reduction problems or parity errors caused by a vibrating head).
5. Verify the data returned.

Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If a retry is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates recovery and advances to the next disk address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 21, 22, 23, 24)

7.3.4 Formatting Routine

The formatting routine prepares disk packs for use with the PDP-11. In sequence, the routine:

- Writes the complete header for each sector,
- Verifies the address content of each sector header, and
- Exits.

Formatting, when selected, always runs to completion and exits.

The sector headers are normally written ten at a time. If the routine detects an error, it shifts to error recovery and attempts to write complete sector headers one at a time. Sectors that cannot be formatted or verified are identified by the cylinder-track-sector addresses that follow the messages

UNABLE TO FORMAT SECTOR AT ADDRESS

HEADER VERIFY ERROR AT ADDRESS

Satisfactory completion of the formatting process is signaled by the message

FORMATTING COMPLETE

The message

FORMATTING FAILED

indicates that one or more sectors could not be formatted and/or verified.

NOTE

RP02 and RPR02 packs must be formatted one at a time (that is, not concurrently on multiple drives that are interfaced to the same controller).

(Related Error Numbers are: 25, 26, 27, 28, 29, 30)

7.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 15 of the Control and Status Register (RPCS). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer operations. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 7-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
RP03          UNIT NO.  m
ERROR NO. n
RPDS      =   Drive Status Register contents
RPER      =   Error Register contents
RPCS      =   Control and Status Register contents
RPWC      =   Word Count Register contents
RPBA      =   Bus Address Register contents
RPCA      =   Cylinder Address Register contents
RPDA      =   Disk Address Register contents
SUCA      =   Selected Unit Cylinder Address Register contents
```

Data-compare error-message format:

```
RP03          UNIT NO.  m
ERROR NO. n
EXPECTED  =   Data expected
RECEIVED  =   Data received
CYLINDER  =   Number (in octal and decimal)
TRACK     =   Number (in octal and decimal)
SECTOR    =   Number (in octal and decimal)
WORD NO. IN SECTOR = Number (in octal and decimal)
```

Disk-address error-message format:

```
RP03          UNIT NO.  m
ERROR NO. n
DISK ADDRESS DID NOT UPDATE CORRECTLY
CYLINDER
EXPECTED  =   Cylinder expected
RECEIVED  =   Cylinder received
TRACK
EXPECTED  =   Track expected
RECEIVED  =   Track received
SECTOR
EXPECTED  =   Sector expected
RECEIVED  =   Sector received
```

Other error messages:

REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO. x RECOVERED AFTER y RETRIES

CONTENTS OF SUCA INCORRECT

CYLINDER ADDRESS WITHIN HEADER INCORRECT

HEADER VERIFY ERROR AT ADDRESS a

UNABLE TO FORMAT SECTOR AT ADDRESS b

Table 7-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Initialization:	
1	Error bit was set during a home-seek (recalibration) function.
Heads Positioning:	
2	Error bit was set after a read-header command was issued to cylinder 0.
3	Error bit was set after a read-header command was issued to a cylinder in the range 1 through the valid upper limit.
4	Error bit was set after a read-header command was issued to the cylinder address being incremented from 0 through the valid upper limit.
5	Error bit was set after a read-header command was issued to the cylinder address being decremented from the valid upper limit.
Sector Addressing:	
6	Error bit was set while exercise was writing a sector with a data pattern equal to its respective sector number.
7	Error bit was set while exercise was reading a sector with a data pattern equal to its respective sector number.
8	Data-compare error. Data pattern read from a sector (0 through 9) on track 0 of cylinder 0 does not contain the respective sector number.

(continued on next page)

Table 7-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Track Addressing and Crossover:	
9	Error bit was set while exercise was writing a 512-word data transfer starting at the last sector on a track of cylinder 0. The data pattern is the respective track number.
10	Error bit was set while exercise was reading the first two words of the first sector on a track. The data pattern is the preceding track number.
11	Data-compare error. Data pattern read from the first sector on a track of cylinder 0 does not contain the number of the preceding track.
Cylinder Addressing and Crossover:	
12	Error bit was set while exercise was writing a 512-word data transfer starting at the last sector on the last track of a cylinder. The data pattern is the cylinder number.
13	Error bit was set while exercise was reading the first sector on the first track of a cylinder. The data pattern is the preceding cylinder number.
14	Data-compare error. Data pattern read from the first sector on the first track of a cylinder does not contain the number of the preceding cylinder.
Partial Write:	
15	Error bit was set while exercise was writing sector 0 on track 0 of cylinder 0 with all 1's data.
16	Error bit was set while exercise was writing a 2-word transfer of all-1's data in sector 0 on track 0 of cylinder 0.
17	Error bit was set while exercise was reading the contents of sector 0 on track 0 of cylinder 0.
18	Data-compare error. Data pattern read does not contain 1's in the initial two words and 0's in the remainder of the sector.

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Table 7-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Data-Reliability or Interactive-Data Test:	
19	Error bit was set while exercise was writing the disk pack with a test pattern.
20	Error bit was set while exercise was reading a test pattern from the disk pack. Condition may also occur as a data-compare error. Data read from the pack does not contain the test pattern.
Random:	
21	Error bit was set while exercise was writing a random data pattern at a randomly selected address.
22	Error bit was set after the exercise issued a seek command with a random address.
23	Error bit was set while exercise was reading random data from a previously written random address.
24	Data-compare error. Data pattern read does not contain the random data.
Formatting:	
25	Error bit was set while routine was writing sector-header patterns to format a track (ten sectors at a time; or one sector at a time in error recovery).
26	Error bit was set while routine was reading sector-header patterns from a formatted track.
27	Word 1 of the formatted header for the indicated sector does not contain all 0's.
28	Word 2 of the formatted header for the indicated sector does not contain the correct cylinder number (bits 6-14) or the correct track number (bits 1-5).
29	Word 3 of the formatted header for the indicated sector does not contain the correct sector address.

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Table 7-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Formatting: (Cont.)	
30	Error bit was set while routine was attempting to write one sector-header pattern at a time in error recovery.
Interactive-Address Test:	
31	Error bit was set after a read-header command was issued to the "first" cylinder selected.
32	Error bit was set after a read-header command was issued to the "second" cylinder selected.

7.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 7.6), test-parameter selection (see Section 7.7), interactive testing (see Sections 7.9 and 7.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Mount "scratch" disk pack on disk drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DPn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DPn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN  $RP03             (or RP02 or RPR02)

START RP03 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE?  DPn
  **WARNING** DPn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE?  SERVICE      (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

7.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

7.7 TEST-PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 7-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 7-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No

(continued on next page)

Table 7-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE-ADDRESS TEST (Bits 10 & 0): Allows the service-mode user to oscillate head motion between two specified cylinders (see Section 7.9 for details).	2001	No
INTERACTIVE-DATA TEST (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data reliability testing of the drive (see Section 7.10 for details).	2002	No
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes

(continued on next page)

Table 7-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
TEST SEQUENCE SELECTION (Bits 0-4):		
A) Select addressing exercises (see Section 7.3.1).	1	Yes
B) Select data-reliability exercise (see Section 7.3.2).	2	Yes
C) Select random exercise (see Section 7.3.3).	4	Yes
D) Select random exercise with inter-read seeks inhibited to reduce run time (see Section 7.3.3).	24	No
E) Select formatting routine without other exercises; routine always runs to completion and exits (see Section 7.3.4).	10	Selectable

7.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test-sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

7.9 INTERACTIVE-ADDRESS TEST

This test oscillates the disk drive head (that is, continuous in-and-out motion) between the two cylinders you specify. After test-parameter selection, the test is initialized by your typing of valid decimal cylinder numbers in the range 0 through 399. for an RP03 drive or 0 through 199. for an RP02 or RPR02 drive in response to the inquiries.

FIRST CYLINDER=

SECOND CYLINDER=

Should you inadvertently type a number greater than the above range, the inquiry repeats.

Once initiated, the head oscillation continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

The function of the test is to issue seek commands alternately to the two specified cylinders. An equipment error message is displayed if the seek function fails.

(Related Error Numbers are: 31, 32)

7.10 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the disk-drive's data reliability. After test-parameter selection, the test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

WORD COUNT=

Type a value to indicate the desired upper limit of the data buffer to be used in write/read data-transfer functions (the value cannot exceed 512. and must be 2 or more).

If you type a value greater than 512., the inquiry repeats.

DO YOU WISH TO SPECIFY SECTOR ADDRESS?

Type Y if a specified sector address is to be tested.

Type N if all data surfaces of the disk pack are to be written on and/or read from. The inquiries, which follow, for cylinder, track, and sector numbers are inhibited.

CYLINDER=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired cylinder number in the range 0 though 399. for an RP03 drive or 0 through 199. for an RP02 or RPR02 drive. If you type a number greater than the appropriate upper limit, the inquiry repeats.

TRACK=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired track number in the range 0 through 19 (decimal). If you type a number greater than 19., the inquiry repeats.

SECTOR=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired sector number in the range 0 through 9 (decimal). If you type a number greater than 9., the inquiry repeats.

PATTERN NO.=

Type the appropriate number, as indicated below, to select a specific stored data pattern or the combination of all stored patterns for use in exercising the disk drive.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify your own pattern to be used in place of the stored patterns by typing a full-word (6-digit) octal value in response to the above inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions.

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries will be repeated.

With selection of the read-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 19, 20)

CHAPTER 8

RS03 OR RS04 FIXED-HEAD DISK

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DSn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DSn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RS03              (or RS04)

START RS03 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DSn
  **WARNING** DSn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y             (N or RETURN alone aborts the diagnostic)
```

Diagnostic runs to completion in 3 minutes for RS03 and 7 minutes for RS04 on a lightly loaded system. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

8.1 TEST SUMMARY REPORT

Upon completion of each diagnostic-test sequence, the following report is displayed.

```
RS03 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF RS03 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

8.2 DISK-DRIVE CHARACTERISTICS

The following are data-capacity parameters for the RS03 and RS04 fixed-head disks.

	RS03	RS04
Tracks	64	64
Sectors/Track	64	64
Words/Sector	64	128

This diagnostic executes data transfers in logical blocks of 256 words each except for the 2-word reads of the Random-Addressing Exercise. Initial sector addressing, therefore, is in multiples of four for the RS03 and in multiples of two for the RS04.

8.3 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the selected disk drive to address correctly all tracks and sectors of the disk, and to write data on, and to read data from, the disk under selected conditions. Neither ECC correction nor "bad sector (block)" processing are implemented.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 8.4 and Table 8-1 for their significance.

8.3.1 Addressing Exercises

8.3.1.1 **Sequential Addressing Exercise** - This exercise determines that all tracks and sectors of the selected disk are addressable in sequence. The exercise first writes the entire surface in blocks of 256 words each (four RS03 disk sectors or two RS04 disk sectors). The data pattern written in each word is:

High-order byte--respective track number, right justified

Low-order byte--respective disk-sector number, right justified

where the disk sector numbers increment from 0 by four for the RS03 and by two for the RS04. The exercise then reads each block and verifies its content for agreement with the written pattern. All error conditions are reported.

(Related Error Numbers are: 2, 3, 4)

8.3.1.2 **Random-Addressing Exercise** - This exercise determines that the disk responds correctly to random addressing. The exercise issues a 2-word read with a randomly selected track-sector address to access the data written previously by the Sequential-Addressing Exercise. The data read is compared with the expected pattern and reported if not in agreement. The expected pattern consists of the respective track number in the high-order byte and the initial sector number of

the respective block in the low-order byte. Reading continues until 512 random addresses have been checked. All error conditions are reported.

(Related Error Numbers are: 5, 6)

8.3.2 Data-Reliability Exercise

This exercise determines the reliability of the disk drive to write and read data of various patterns in 256-word blocks (four RS03 sectors or two RS04 sectors). The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)
4. Floating 1's (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (from "1," add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete test sequence.

Each pattern is written at all addresses, and then read back eight times for verification and to expose possible read-reduction problems. Detection of any error while reading causes the exercise to report the failing address and then to attempt up to eight retries to read the data. If the read is successful, the exercise reports the error recovered after "n" retries and advances to the next sector address. If the read remains unsuccessful after eight retries, the exercise terminates the recovery attempt and advances reading to the next sector address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 7, 8)

8.3.3 Random Exercise

This exercise determines that the drive can address randomly selected disk addresses and execute random-length transfers of random-patterned data to and from those areas. The exercise sequence, which is repeated 1024 times, is:

1. Develop a valid, random track- and sector-address combination.
2. Initiate a write transfer of a random-length, random-data pattern, beginning at the random disk address. The number of words is two or more, and not more than 512.

3. Initiate eight read transfers of the previously written random data (the purpose of this command sequence is to expose read-reduction problems).

4. Verify the data returned.

Detection of any error while reading causes the exercise to report the failing address and to attempt up to eight retries to read the data. If the read is successful, the exercise reports the error recovered after "n" retries and advances to the next disk address. If the read remains unsuccessful after eight retries, the exercise terminates the recovery attempt and advances reading to the next sector address. The absence of a "recovered" report signifies an unsuccessful recovery.

(Related Error Numbers are: 9, 10, 11)

8.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 14 of the Drive Status Register (RSDS). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer operations. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 8-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
RS03          UNIT NO.  m
ERROR NO. n
RSCS1     =   Control and Status 1 Register contents
RSWC      =   Word Count Register contents
RSBA      =   Bus Address Register contents
RSDA      =   Desired Address Register contents
RSCS2     =   Control and Status 2 Register contents
RSDS      =   Drive Status Register contents
RSER      =   Error Register contents
RSAS      =   Attention Summary Register contents
```

Data-compare error-message format:

```
RS03          UNIT NO.  m
ERROR NO. n
EXPECTED  =   Data expected
RECEIVED  =   Data received
```

Disk-address error-message format:

```
RS03          UNIT NO.  m
ERROR NO. n
DISK ADDRESS DID NOT UPDATE CORRECTLY
TRACK
EXPECTED  =   Track expected
RECEIVED  =   Track received
SECTOR
EXPECTED  =   Sector expected
RECEIVED  =   Sector received
```

Sector error-message format:

```
RS03          UNIT NO.  m
ERROR NO. n
EXPECTED  =  Data expected
RECEIVED  =  Data received
TRACK     =  Number (in octal and decimal)
SECTOR    =  Number (in octal and decimal)
WORD NO. IN SECTOR=Number (in octal and decimal)
```

Other error messages:

```
REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO. x RECOVERED AFTER m RETRIES
```

Table 8-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Initialization:	
1	Error bit was set while exercise was reading the disk type to determine whether the disk selected (by mnemonic and unit number) is an RS03 or RS04.
Sequential Addressing:	
2	Error bit was set while exercise was writing a 256-word block in four RS03 sectors or two RS04 sectors; the data pattern is the respective track number in the high-order byte and the respective sector number in the low-order byte.
3	Error bit was set while exercise was reading a 256-word block from four RS03 sectors or two RS04 sectors; the data pattern is the respective track number in the high-order byte and the respective sector number in the low-order byte.
4	Data-compare error. The data pattern read from a 256-word block does not contain the respective track number in the high-order byte and the respective sector number in the low-order byte.
Random Addressing:	
5	Error bit was set while exercise was reading the initial two words of a 256-word block (four RS03 sectors or two RS04 sectors).

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Table 8-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Random Addressing:	(Cont.)
6	Data-compare error. The contents of the initial two words read from a 256-word block does not reflect the desired address.
Data-Reliability or Interactive-Data Test:	
7	Error bit was set while exercise was writing the disk with a test pattern.
8	Error bit was set while exercise was reading a test pattern from the disk. Condition may also occur as a data-compare error. Data read from the disk does not contain the expected test pattern.
Random:	
9	Error bit was set while exercise was writing a random-data pattern at a randomly selected address.
10	Error bit was set while exercise was reading random data from a previously written random address.
11	Data-compare error. Data pattern read does not contain the expected random data.

8.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 8.6), test-parameter selection (see Section 8.7), interactive testing (see Section 8.9), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DSn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DSn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RS03                    (or RS04)

START RS03 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DSn
  **WARNING** DSn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE        (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)=nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)=n
```

The selectd test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

8.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

8.7 TEST-PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 8-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 8-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE-DATA TEST (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data reliability testing of the drive (see Section 8.9 for details).	2002	No

(continued on next page)

Table 8-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTION (Bits 0-2):		
A) Select addressing exercises (see Section 8.3.1).	1	Yes
B) Select data-reliability exercise (see Section 8.3.2).	2	Yes
C) Select random exercise (see Section 8.3.3).	4	Yes

8.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test-sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

(CTRL/C)
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

8.9 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the disk-drive's data reliability. After test-parameter selection, the test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

WORD COUNT=

Type either 256. or 512. to indicate the desired upper limit of the data buffer to be used in write/read data-transfer functions.

If you type a value greater than 512., the inquiry repeats.

DO YOU WISH TO SPECIFY SECTOR ADDRESS?

Type Y if a specified sector address is to be tested.

Type N if all data surfaces of the disk are to be written on and/or read from. The inquiries, which follow, for track and sector numbers are inhibited.

TRACK=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired track number in the range 0 through 63 (decimal). If you type a number greater than 63., the inquiry repeats.

SECTOR=

This inquiry appears only if you have requested the sector-addressing feature. Type the desired sector number in the range 0 through 63. (for RS03, the sector number must be a multiple of four; for RS04 it must be even). If you type a number greater than 63., the inquiry repeats. The message

RS03 SECTOR ADDRESS MUST BE A MULTIPLE OF FOUR

or

RS04 SECTOR ADDRESS MUST BE EVEN

alerts you to an invalid entry.

PATTERN NO.=

Type the appropriate number, as indicated below, to select a specific stored data pattern or the combination of all stored patterns for use in exercising the disk drive.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify your own pattern to be used in place of the stored patterns by typing a full-word (6-digit) octal value (followed by RETURN) in response to the above inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions.

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries will be repeated.

With selection of the read-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 7, 8)

CHAPTER 9

TU56 DECTAPE DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" DECtape on drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DTn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DTn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU56

START TU56 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE?  DTn
**WARNING** DTn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE?  Y            (N or RETURN alone aborts the diagnostic)
```

Diagnostic runs to completion in 15 minutes for a lightly loaded system. To exit sooner, type:

```
(CTRL/C)
MCR>ABORT
```

9.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
TU56 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF TU56 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

9.2 DEVICE CHARACTERISTICS

The following are data-capacity parameters for DECtape.

Blocks/Reel	578
Words/Block	256

9.3 DIAGNOSTIC DESCRIPTION

The TU56 diagnostic tests the ability of the selected DECtape drive to position its resident DECtape correctly, and to write and read data correctly under selected conditions.

The exercises described hereafter are executed in a one pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 9.4 and Table 9-1 for their significance.

9.3.1 DECtape Positioning and Data Compare Exercises

9.3.1.1 **Rewind Exercise** - This exercise determines that the drive, as result of a read-block-0-reverse command, rewinds its DECtape to the end-zone and indicates this by setting the status register's end zone bit and the command register's error bit.

(Related Error Number is: 1)

9.3.1.2 **Block Write-Read Exercise** - This exercise determines that the drive can write and read blocks 0 and 1 in both directions. The sequence is:

1. Write block 0 forward with all 0's. Read block in reverse, then forward.
2. Write blocks 0 and 1 forward with all 1's. Read blocks in reverse and then forward.
3. Write blocks 1 and 0 in reverse with all 1's. Read blocks in reverse and then forward.

(Related Error Numbers are: 2, 3, 4, 5, 6, 7, 8, 9, 10)

9.3.1.3 **Odd-Even Block Exercise** - This exercise determines that the drive can address each block uniquely, and write and retrieve data correctly. First, all odd-numbered blocks are written forward and all even-numbered blocks are written in reverse. The data pattern for each block is its block number. Then, all odd-numbered blocks are read in reverse, and all even-numbered blocks are read forward. The data read from each block is compared to the expected-block number pattern.

(Related Error Numbers are: 11, 12, 13, 14)

9.3.1.4 **Random Read Exercise** - This exercise determines that the drive can address and read 20 randomly selected blocks. The data read from each block is compared to the expected-block number pattern written by the odd-even block exercise (see previous exercise description).

(Related Error Number is: 15)

9.3.2 Stop-Start Exercise

This exercise determines that the drive stops and starts its DECtape motion within the prescribed limits in both directions. DECtape should halt within approximately two blocks when the controller issues a stop command to the drive, and reach normal speed within approximately two blocks when a read block number command is issued. The exercise also determines that the DECtape moves in the required direction. The sequence is:

1. Rewind DECtape to end zone (by a read-block-0-reverse command).
2. Read a block number forward (drive shuts down after each successful read).
3. Read another block number forward.
4. Determine that the second block number is greater than the first block number, indicating forward motion, and, secondly, that the second block number is within five blocks of the first block number.
5. Read a block number in reverse.
6. Read another block number in reverse.
7. Determine that the second block number is less than the first block number, indicating reverse motion, and, secondly, that the second block number is within five blocks of the first block number.

(Related Error Numbers are: 16, 17, 18, 19, 20, 21, 22, 23)

9.3.3 Data-Reliability Exercise

This exercise determines the reliability of the drive to write and read data of various patterns in blocks 64 through 192 in forward and reverse directions. The data patterns used are:

1. All 0's
2. All 1's
3. Checkerboard (alternate 1's and 0's)
4. Floating 1's (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (from "1," add 1 for each word written)

NOTE

In customer mode, only the floating-1's pattern is implemented to reduce the run time for the complete test sequence.

For each pattern, the DECtape is first written and read forward, and then read in reverse. Detection of an error while reading results in the exercise attempting up to eight retries to read the data.

(Related Error Numbers are: 24, 25)

9.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 15 of the Command Register (TCCM). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer operations. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 9-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
TU56                    UNIT NO.  m
ERROR NO.  n
TCST=                   Control and Status Register contents
TCCM=                   Command Register contents
TCWC=                   Word Count Register contents
TCBA=                   Bus Address Register contents
FORWARD (OR REVERSE) DIRECTION
```

Data-compare error-message format:

```
TU56                    UNIT NO.  m
ERROR NO.  n
EXPECTED=               Data expected
RECEIVED=               Data received
BLOCK ADDRESS=          Number (in octal and decimal)
WORD NO.  IN BLOCK=     Error position in block
```

Other error messages:

SELECT OR WRITE ENABLE ERROR

TAPE MOVED FORWARD INSTEAD OF REVERSE

TAPE MOVED REVERSE INSTEAD OF FORWARD

ERROR BIT IN TCCM FAILED TO SET WHEN END ZONE DETECTED

END ZONE FOUND EARLY WHILE DOING READ BLOCK NO. z

ERROR NO. x RECOVERED AFTER y RETRIES.

Table 9-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Rewind:	
1	End zone not detected and/or error bit in TCCM did not set.
Block Read-Write:	
2	Write of block 0 forward failed; expected data is all 0's written forward.
3	Read of block 0 in reverse failed; expected data is all 0's written forward.
4	Read of block 0 forward failed; expected data is all 0's written forward.
5	Write of blocks 0 and 1 forward failed; expected data is all 1's written forward.
6	Read of blocks 0 and 1 in reverse failed; expected data is all 1's written forward.
7	Read of blocks 0 and 1 forward failed; expected data is all 1's written forward.
8	Write of blocks 0 and 1 in reverse failed; expected data is all 1's written in reverse.
9	Read of blocks 0 and 1 in reverse failed; expected data is all 1's written in reverse.
10	Read of blocks 0 and 1 forward failed; expected data is all 1's written in reverse.
Odd-Even Block:	
11	Write of odd-numbered block forward failed; expected data pattern is its block number written forward.
12	Write of even-numbered block in reverse failed; expected data pattern is its block number written in reverse.
13	Read of odd-numbered block in reverse failed; expected data pattern is its block number written forward.
14	Read of even-numbered block forward failed; expected data pattern is its block number written in reverse.

(continued on next page)

Table 9-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Random Read:	
15	Read of randomly addressed block failed; data pattern expected is its block number, written forward for odd block numbers and in reverse for even numbers.
Stop-Start:	
16	Read of a block number forward failed.
17	A block number read forward after the start of DECtape motion was not within five blocks of the block number read prior to drive shutdown.
18	DECtape did not move forward from "stop" in response to a read-block-number-forward command.
19	End zone detected before it was expected.
20	Read of a block number in reverse failed.
21	A block number read in reverse after the start of DECtape motion was not within five blocks of the block number read prior to drive shutdown.
22	DECtape did not move in reverse from "stop" in response to a read-block-number-reverse command.
23	End zone detected before it was expected.
Data-Reliability or Interactive-Data Test:	
24	Write of various data patterns in blocks 64 through 192 or user-selected block failed.
25	Read of various data patterns in blocks 64 through 192 or user-selected block failed.
Interactive-Address Test:	
26	Write of user-selected "first" block failed; command specified a 4-byte write of data.
27	Write of user-selected "second" block failed; command specified a 4-byte write of data.

9.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 9.6), test-parameter selection (see Section 9.7), interactive testing (see Sections 9.9 and 9.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Install "scratch" DECtape on drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DTn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DTn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU56

START TU56 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? DTn
  **WARNING** DTn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

9.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

9.7 TEST-PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 9-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit octal value (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 9-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before exiting. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No

(continued on next page)

Table 9-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
INTERACTIVE-ADDRESS TEST (Bits 10 & 0): Allows the service-mode user to "rock" the DECtape between specified blocks (see Section 9.9 for details).	2001	No
INTERACTIVE-DATA TESTING (Bits 10 & 1): Allows the service-mode user to specify explicit conditions for data-reliability testing of the drive (see Section 9.10 for details).	2002	No
LIMIT DATA COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display error messages for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTIONS (Bits 0, 1, and 2):		
A) Select DECtape-positioning and data-compare exercises (see Section 9.3.1).	1	Yes
B) Select data-reliability exercise (see Section 9.3.3).	2	Yes
C) Select stop-start exercise (see Section 9.3.2).	4	Yes

9.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test-sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

9.9 INTERACTIVE-ADDRESS TEST

This test "rocks" the DECtape (that is, continuous forward-and-reverse motion) between any two blocks you specify. After test-parameter selection, the test is initialized by your typing of two valid block numbers in the range 0 through 577. in response to the inquiries.

FIRST BLOCK =

SECOND BLOCK =

Should you inadvertently enter a number greater than 577., the inquiry repeats.

Once initiated, the DECtape rock continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

The function of this test is to issue write commands to the specified blocks with byte counts of 4 and an all-0's pattern. An equipment error message is displayed if the write function fails at any time.

(Related Error Numbers are: 26, 27)

9.10 INTERACTIVE-DATA TEST

This test allows you to specify the conditions for determining the drive's data reliability. After test-parameter selection, this test is initialized by your typing of valid and appropriate responses to the test's inquiries as noted hereafter.

WORD COUNT=

Type a value (no greater than 512.) to indicate the desired size of the data buffer to be used in write/read functions.

DO YOU WISH TO SPECIFY THE BLOCK ADDRESS?

Type Y if a specific block is to be exercised.

Type N if the single block-addressing feature is not needed. Your selected test will therefore operate on blocks 64 through 192 (decimal).

BLOCK ADDRESS=

This inquiry appears only if you have requested the block-addressing feature. Type the desired block number in the range 0 through 577 (decimal).

PATTERN NO=

Type the appropriate number, as indicated below, to select a specific, stored data pattern or the combination of all stored patterns.

Stored Patterns	No.
All 0's	0
All 1's	1
Checkerboard	2
Floating 1's	3
Random 1's and 0's	4
Count pattern (full-word, binary, sequential)	5
Run above patterns in sequence	6

You can specify a pattern to be used in place of the stored patterns by typing a 6-digit octal value in response to the inquiry.

WRITE?

Type Y to permit performance of write functions during the test.

Type N to inhibit write functions

READ?

Type Y to permit performance of read functions during the test.

Type N to inhibit read functions.

NOTE

An N response to both inquiries is invalid. The inquiries are repeated.

FORWARD DIRECTION?

Type Y to restrict the test to the forward direction only.

Type N to restrict the test to the reverse direction only.

With selection of the direction-condition established, the test commences and continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

(Related Error Numbers are: 24, 25)

CHAPTER 10

TU16 OR TU45 MAGNETIC TAPE DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" tape, with write-enable ring installed, on tape drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE MMn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT MMn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU16              (or TU45)

START TU16 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE?  MMn
  **WARNING** MMn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE?  Y            (N or RETURN alone aborts the diagnostic)
TEST IN 1600 BPI MODE?  (N initiates 800 BPI mode)
QUICK TOTAL TAPE CHECK? (Y tests tape's reliability and exits)
                        (N initiates customer-mode test sequence)
```

Diagnostic runs to completion in 20 minutes for a lightly loaded system. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

10.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
TU16 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF TU16 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

10.2 TAPE DRIVE CHARACTERISTICS

	TU16	TU45
Channels (tracks)	9	9
Recording density, bits per inch (BPI)	800 or 1600	800 or 1600
Tape speed, inches per second	45 normal 150 rewind	75 normal 225 rewind
Recording	NRZI for 800 BPI, phase encoded for 1600 BPI	NRZI for 800 BPI, phase encoded for 1600 BPI
Interrecord Gap (IRG)	0.5 in. minimum 0.60 in. nominal	0.5 in. minimum 0.60 in. nominal
Extended IRG	3.0 in. minimum	3.0 in. minimum
End-of-File (EOF) Character	23 (octal)	23 (octal)

Figures 11-1 and 11-2 in Chapter 11 illustrate the relationship between tape characters and memory bytes, and the 9-channel tape format. The correlation between PDP-11 memory bits and 9-channel tape is as follows:

Bit Positions (high-order byte)	15	14	13	12	11	10	9	8
Bit Positions (low-order byte)	7	6	5	4	3	2	1	0
Channel Numbers	7	6	5	3	9	1	8	2

Tape Channel No. 4 is parity.

10.3 DIAGNOSTIC DESCRIPTION

The TU16/TU45 diagnostic tests the ability of the selected tape drive to:

1. Position its resident tape correctly,
2. Write and read data correctly, and
3. Check for parity errors.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 10.4 and Table 10-1 for their significance.

10.3.1 Beginning-of-Tape (BOT) Exercise

First, this exercise determines that the tape positions at BOT after a rewind command, and then that the tape remains at BOT although a backspace (space-reverse) command is issued.

(Related Error Numbers are: 1, 2)

10.3.2 Interrecord-Gap (IRG) Exercise

This exercise determines that IRG's produced by the drive are of adequate length for tape motion to decrease from normal speed to stop (shutdown in an IRG) and increase to normal speed, in either direction, before an IRG-boundary reaches the write-read heads. The sequence is:

1. Rewind the tape.
2. Write ten 16-byte records, all 1's, and rewind tape.
3. Read each record and verify its character count, waiting after each read for tape motion to stop before issuing the next read-one-record command.

(Related Error Numbers are: 3, 4)

10.3.3 Variable-Length Record Positioning Exercise

This exercise determines that the drive properly responds to commands specifying the writing and reading of records of varying lengths. The sequence is:

1. Rewind the tape.
2. From BOT, write 63 all-1's records decreasing in length by 16-byte decrements from 1024 bytes, initially, to 16 bytes; then write 63 all-1's records increasing in length by 16-byte increments from 16 bytes to 1024 bytes.
3. Rewind the tape.
4. Read the records by read-one-record commands, allowing tape motion to stop before issuing the next read. Determine that record lengths agree with those written as specified above.

(Related Error Numbers are: 5, 6)

10.3.4 Record-Length Exercise

This exercise determines that the drive writes a 512-byte all-1's record, and then properly responds to read commands that specify a byte count larger (1024) or smaller (511) than the written record. The data pattern is not checked for correct content.

(Related Error Numbers are: 7, 8, 9, 10)

10.3.5 Lateral-Parity Exercise

This exercise determines that the drive responds properly to apparent lateral parity errors, which are forced by writing one 512-byte all-1's record with odd parity and then reading it as even parity. The reverse condition is checked by writing the record as even parity and reading it as odd parity. The data pattern is not checked for correct content.

(Related Error Numbers are: 11, 12, 13, 14, 15)

10.3.6 Longitudinal-Parity-Check-Character (LPCC) Exercise

This exercise determines that the drive's LPCC facility functions properly. The exercise writes one 1024-byte record with a data pattern (an all-0's byte followed by 1023 all-1's bytes) that has a predicted LPCC; it then checks for the presence of the predicted LPCC.

(Related Error Numbers are: 16, 17)

10.3.7 Cyclic-Redundancy-Check-Character (CRCC) Exercise

This exercise determines that the drive develops correct CRCC's by, first writing ten records with data patterns that are designed to sequentially set each of the CRCC nine bits and, then, comparing the CRCC's read to the expected CRCC's.

(Related Error Numbers are: 18, 19, 20)

10.3.8 Record Creep Exercise

First, this exercise determines that the drive can write and read a data pattern of all 1's, and then all 0's in a 1024-byte record. The sequence is:

1. From BOT, write one 1024-byte record of all 1's, rewind the tape, and read the record.
2. Rewind the tape and, from BOT, write one 1024-byte record of all 0's.
3. Rewind the tape, read the record, and rewind the tape.

The exercise then determines that the issuing of a backspace command followed by a write command does not result in an erroneous data entry (creep) either into the interrecord gap (IRG) or beyond the IRG into the record that precedes the record sought. The sequence is:

1. From BOT, write two 1024-byte records: the first with all 1's, the second with all 0's.
2. Repetitively, backspace the tape one record and write the second record with an all-0's pattern 64 times.
3. Rewind the tape and read the first record to determine if the record content (all 1's) and byte count remain intact.

4. From stop in the IRG, read the second record to determine if the byte count equals 1024. A lesser count indicates a probable loss of data due to the second record creeping into and shortening the IRG.

(Related Error Numbers are: 21, 22, 23, 24, 25, 26, 27)

10.3.9 Skew Exercise

This exercise determines whether the drive has actual or potential tape-skew problems by writing and reading two "worst case" data patterns that are designed to accentuate data retrieval errors. Errors may be caused by factors such as electrical-skew, bad-head, or magnetized-head conditions. The patterns consist of ten 1024-byte records. Data in both cases is read and checked ten times to expose possible read-reduction problems.

(Related Error Numbers are: 28, 29, 30)

10.3.10 End-of-File (EOF) Exercise

This exercise determines that the drive properly writes and detects the presence of an EOF character (octal 23). The sequence is:

1. Rewind the tape.
2. From BOT, write an EOF character and check that the drive's EOF bit in the status register sets as required.
3. Write two records, each containing 1023 EOF characters followed by an all-1's character; then write an EOF.
4. Rewind the tape.
5. Read two records, each 1024 bytes long. Determine that the EOF status register bit does set for the legitimate EOF characters, but not for the EOF characters written in the records as data.

(Related Error Numbers are: 31, 32, 33, 34, 35, 36)

10.3.11 Single-Record Positioning Exercise

This exercise determines that the drive properly positions tape in response to forwardspace and backspace commands. The sequence is:

1. Rewind the tape.
2. From BOT, write an EOF character and check that the drive's EOF bit in the status register sets as required.
3. Write 63 records, each with 16 all-1's bytes.
4. Until EOF character is detected, backspace tape two records, and then forwardspace one record.

5. Report tape position by record count if EOF-character detection occurs before or after the 63rd backspace command.

(Related Error Numbers are: 37, 38, 39, 40)

10.3.12 Multiple-Record Positioning Exercise

This exercise determines that the drive properly positions the tape in response to backspace and forwardspace commands that specify various multiple-record skips. The exercise uses the tape data formatted by the Single-Record Positioning Exercise. The sequence is:

1. Rewind the tape.
2. Read for EOF character.
3. Alternately, forwardspace and backspace "n" records, where "n" is initialized at 63 and decremented by one for each space command until "n" equals 0.
4. Backspace tape from point halted in step 3 until EOF is detected. Report tape position by record count if EOF occurs before or after its anticipated position (after 32 records if step 3 does not fail).

(Related Error Numbers are: 41, 42, 43, 44)

10.3.13 Crosstalk Exercise

This exercise determines whether the drive has a crosstalk problem by writing and reading two data patterns that are designed to accentuate potential crosstalk. The first pattern consists of ten 1024-byte records in which each 1 bit has contiguous 0 bits. The second pattern, also of ten 1024-byte records, complements the first by having reversed bit states (i.e., 0 bits with contiguous 1 bits). Each pattern is read and checked ten times to expose possible read-reduction problems.

(Related Error Numbers are: 45, 46, 47)

10.3.14 Data-Reliability Exercise

This exercise determines the drive's data reliability by writing selected data patterns in 64 files (or in files from BOT to EOT in service-mode), and then reading the files ten times each to expose possible read-reduction problems. Each file consists of three random-length records in the range of 16 to 1024 bytes, and an EOF record.

The least significant digit of the octal record number appearing in a data-compare error message indicates the data pattern expected, as follows.

Pattern Indicator	Pattern Expected
1	Floating 1's
2	Random number
3	Count pattern

The sequence is:

1. Write three variable-data records and an EOF record (EOF mark plus LPC character).

2. Repeatedly, backspace and read the file ten times (ignore the EOF record on successive re-reads).

3. Continue until 64 files (or in service mode, the multiple files from BOT to EOT) have been written and read.

(Related Error Numbers are: 48, 49, 50, 51, 52)

10.3.15 Quick Total-Tape-Check Exercise

The customer-mode user initiates this independent exercise for a fast determination of a tape's data-reliability from BOT to EOT. The exercise differs from service-mode execution of the data-reliability exercise only in that one read of each file is made rather than the ten reads designed to expose possible read-reduction problems. Once initiated, the "check" exercise runs to completion and terminates diagnostic control. All errors are reported as detected.

(Related Error Numbers are: 48, 49, 50)

10.3.16 1600-BPI Identification Burst (IDB) Exercise

This exercise determines that the drive writes and reads the IDB correctly for 1600 BPI, phase-encoded (PE) data. The sequence is:

1. Rewind the tape and issue a command calling for data recording in the PE mode.

2. From BOT, write one 1024-byte record of all 1's. The IDB Bit, Bit 3 of the Drive Status Register (MTDS), should be set, indicating that the 1600-BPI identification burst was written, as required.

3. Rewind the tape and, from BOT, write one 1024-byte record of all 1's in NRZI. The IDB bit should not be set, indicating that the IDB was erased.

4. Rewind the tape and, from BOT, read the previously written 800-bpi record as a 1600-BPI record. The IDB bit should not be set.

(Related Error Numbers are: 53, 54, 55)

10.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 14 of the Drive Status Register (MTDS). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer operations. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 10-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
TU16                        UNIT NO.  m
ERROR NO.  n
RECORD NO.          =  Number (in octal and decimal)
BYTE COUNT          =  Number (in octal and decimal)
MTCS1               =  Control and Status 1 Register contents
MTWC                =  Word Count Register contents
MTBA                =  Bus Address Register contents
MTFC                =  Frame Count Register contents
MTCS2               =  Control and Status 2 Register contents
MTDS                =  Drive Status Register contents
MTER                =  Error Register contents
MTAS                =  Attention Summary Register contents
MTCK                =  Character Check Register contents
MTDB                =  Data Buffer Register contents
MTMR                =  Maintenance Register contents
MTDT                =  Drive Type Register contents
MTSN                =  Serial Number Register contents
MTTC                =  Tape Control Register contents
```

Data-compare error-message format:

```
TU16                        UNIT NO.  m
ERROR NO.  n
EXPECTED            =  Data expected
RECEIVED            =  Data received
BYTE NO.  IN RECORD =  Number (in octal and decimal)
RECORD NO.          =  Number (in octal and decimal)
BYTE COUNT          =  Number (in octal and decimal)
```

Other error messages:

```
EOF NOT DETECTED AFTER WRITE EOF

EOF NOT DETECTED AFTER READ EOF

n RECORDS SKIPPED OVER

m RECORDS NOT BACKSPACED OVER

LPCC ERROR

CRCC ERROR

REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO.  x RECOVERED AFTER y RETRIES

ERROR NO.  a RECORD NO.  b RECOVERED AFTER c RETRIES
```

Table 10-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
BOT:	
1	BOT not detected after tape rewind.
2	BOT not detected after backspace was issued while tape was at BOT.
IRG:	
3	Illegal-command bit was set during write function. May be caused by drive going offline.
4	Record-length error bit was set during read of ten short (16-byte) records with stall between read commands.
Variable-Length Record:	
5	Error bit was set by a condition other than parity error while exercise was writing variable-length records.
6	Error bit was set by a condition other than parity error while exercise was reading records with stall between read commands.
Record-Length:	
7	Error bit was set by a condition other than parity error while exercise was writing a 512-byte record.
8	Byte-count register did not contain a value of -512 (177000 octal) after the 512-byte record was read with the byte-count register initialized to 1024.
9	Error bit did not set when 512-byte record was read with byte-count register initialized to 510.
10	Error bit was set by a condition other than parity error when 512-byte record was read with byte-count register initialized to 510.

(continued on next page)

Table 10-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Lateral Parity:	
11	Parity error expected by even-parity read of odd-parity record did not set parity-error bit.
12	Error bit was set by a condition other than forced parity error caused by even-parity read of odd-parity record.
13	Error bit was set while exercise was writing a 512-byte record with even parity.
14	Parity error expected by odd-parity read of even-parity record did not set parity-error bit.
15	Error bit was set by a condition other than forced parity error caused by odd-parity read of even-parity record.
LPCC:	
16	Error bit was set while exercise was writing the LPCC-test record (an all-0's byte followed by 1023 all-1's bytes).
17	Error bit was set by a condition other than parity error during read of the LPCC-test record (1024 bytes, an all-0's byte followed by 1023 all-1's bytes). LPCC received after read of the LPCC-test record did not agree with the expected LPCC.
CRCC:	
18	Error bit was set while exercise was writing a CRCC-test record.
19	Error bit was set by a condition other than a CRCC parity error while exercise was reading a CRCC-test record.
20	CRCC received after read of a CRCC-test record did not agree with the expected CRCC content.

(continued on next page)

Table 10-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Record Creep:	
21	Error bit was set while exercise was reading a 1024-byte record of all 1's from BOT.
22	Data-compare error. The 1024-byte record did not contain all 1's.
23	Error bit was set while exercise was reading a 1024-byte record of all 0's from BOT.
24	Data-compare error. The 1024-byte record did not contain all 0's.
25	Error bit was set while exercise was backspacing one record and rewriting the second 1024-byte record with all 0's.
26	Data-compare error. The 1024-byte record from BOT did not contain all 1's; indicates probable entry into the record while exercise was writing the second record of all 0's.
27	Read of second record did not transfer 1024 bytes before end-of-record.
Skew:	
28	Error bit was set while exercise was writing a skew-test record.
29	Error bit was set while exercise was reading a skew-test record.
30	Data-received while exercise was reading a skew-test record does not agree with the expected test pattern.
EOF:	
31	Error bit was set by a condition other than "no EOF detected: while exercise was writing an EOF after BOT.
32	Error bit was set while exercise was writing an EOF-test record (1023 EOF-pattern bytes followed by an octal 77 byte).
33	First EOF, written previously after BOT, was not detected by a read from rewind.

(continued on next page)

Table 10-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
EOF: (Cont.)	
34	False EOF indication occurred while exercise was reading EOF test record of EOF-pattern bytes.
35	Error bit was set by condition other than false EOF indication while exercise was reading the EOF test record of EOF-pattern bytes.
36	EOF, written previously after EOF test file, was not detected by a forwardspace-one-file command from rewind.
Single-Record Positioning:	
37	Error bit was set while exercise was writing an EOF and 63 16-byte records of all 1's.
38	Illegal-command bit was set during a command sequence of backspace two records, and then forwardspace one record. Condition may be caused by drive going offline.
39	EOF, written previously after BOT, was detected before it was expected. EOF should have occurred on backspace after the 63rd command sequence: backspace two records, and then forwardspace one record (net backspace equals one record for each sequence). The message "...n RECORDS SKIPPED OVER" indicates the number of records that were erroneously skipped over during the backspace sequence.
40	EOF, written previously after BOT, was detected after it was expected. EOF should have occurred on backspace after the 63rd command sequence: backspace two records, and then forwardspace one record (net backspace equals one record for each sequence). The message "...n" RECORDS NOT BACKSPACED OVER" indicates the number of records that remained to be backspaced over after the backspace sequence ended.

(continued on next page)

Table 10-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Multiple-Record Positioning:	
41	EOF, written previously after BOT, was not detected after rewind.
42	Illegal-command bit was set during a sequence of record-space commands. Conditions may be caused by drive going offline.
43	EOF, written previously after BOT, was detected before it was expected. EOF should have occurred on the 32nd backspace-one-record command; this premise assumes that an earlier command sequence positioned the tape properly at the midpoint of the test-record sequence (an EOF record followed by 63 16-byte records). The message "...n RECORDS SKIPPED OVER" indicates the number of records that were erroneously skipped over during the backspace sequence.
44	EOF, written previously after BOT, was detected after it was expected. EOF should have occurred on the 32nd backspace-one-record command; this premise assumes that an earlier command sequence positioned the tape properly at the midpoint of the test-record sequence (an EOF record followed by 63 16-byte records). The message "...n RECORDS NOT BACKSPACED OVER" indicates the number of records that remained to be backspaced over after the backspace sequence ended.
Crosstalk:	
45	Error bit was set while exercise was writing the crosstalk-test records (ten records of 1024 bytes each).
46	Error bit was set while exercise was reading the crosstalk-test records. A "REREAD SAME DATA..." message with a reread count greater than 0 may indicate a read-reduction condition. Check for dirty, worn, or magnetized heads.

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Table 10-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Crosstalk: (Cont.)	
47	Data received while exercise was reading the crosstalk-test records did not agree with the expected test pattern.
Reliability:	
48	Error bit was set while exercise was writing a reliability-test file.
49	Error bit was set while exercise was reading a reliability-test file forward.
50	Data received while exercise was reading a reliability-test file forward does not agree with the data expected.
51	Error bit was set while exercise was reading a reliability-test file in reverse.
52	Data received from reading a reliability-test file in reverse does not agree with the data expected.
1600-BPI IDB:	
53	IDB bit was not set while exercise was writing a record from BOT in the 1600-BPI mode.
54	IDB bit was set incorrectly while exercise was writing a record from BOT in the 800-BPI mode.
55	IDB bit was set incorrectly while exercise was reading an 800-BPI record from BOT in the 1600-BPI mode.

10.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 10.6), test-parameter selection (see Section 10.7), interactive testing (see Sections 10.9 and 10.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Install "scratch" tape, write-enable ring installed, on tape drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE MMn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT MMn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU16              (or TU45)

START TU16 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? MMn
  **WARNING** MMn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

10.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

10.7 TEST PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 10-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 10-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE DRIVE-COMPATIBILITY TEST (Bits 10 & 2): Allows the service-mode user to determine the compatibility of system tape drives (see Section 10.9 for details). The requirement that Bit 2 not be set inhibits selection of this option with the write-read slice adjustment test.	2000	No

(continued on next page)

Table 10-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
INTERACTIVE WRITE-READ SLICE ADJUSTMENT (Bits 10 & 2): Allows the service-mode user to select a write- or a read-repetitive function for adjustment of the write or read slice levels (see Section 10.10 for details).	2004	NO
DATA-COMPARE ERROR RECOVERY (Bit 7): Test attempts infinite data-transfer retries to recover from a data-compare error. The default is: attempt up to eight data-transfer retries to recover from a data-compare error.	200	Default
1600-BPI, PHASE-ENCODED MODE (Bit 6): Enables the writing of 1600-BPI phase encoded data records. The default is 800 BPI, NRZ mode.	100	Selectable
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes

(continued on next page)

Table 10-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
TEST SEQUENCE SELECTION (Bits 1 & 0): A) Execute the following exercises in the order shown: BOT IRG Variable-length record positioning Record Length EOF Single-record positioning Multiple-record positioning Lateral parity LPCC Record Creep CRCC Skew Crosstalk (See Section 10.3 for exercise descriptions.)	1	Yes
B) Execute the data-reliability exercise for the entire tape (from BOT to EOT) (see Section 10.3.14).	2	No

10.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

```
(CTRL/C)
MCR>ABORT
```

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

10.9 INTERACTIVE DRIVE-COMPATIBILITY TEST

This test determines the data-transfer compatibility of the system's magnetic tape drives by use of a test-pattern tape. After test-parameter selection, the test is initialized in the test-tape-preparation or read-check mode by your response to the inquiry

```
WHICH COMPATIBILITY MODE?(W=TEST TAPE PREP;  R=READ CHECK)
```

Type W to initiate preparation of the "scratch" tape on the selected drive as the test-pattern tape.

Type R to initiate read-testing of the selected magnetic tape drive with the test tape mounted.

In the test-tape-preparation mode, the "scratch" tape is first written with the test pattern. Completion of the writing phase is indicated by the message

```
COMPATIBILITY TAPE WRITTEN-VERIFYING TAPE
```

The message

```
WRITE COMPATIBILITY TAPE FAILED
```

indicates that the test could not successfully complete preparation of the test tape. Error conditions are reported during the write-phase by the message

```
TEST TAPE WRITE FAILED
```

followed by the current contents of the controller registers.

The tape is then read for agreement with the test pattern. Successful completion of the reading phase is indicated by the message

```
COMPATIBILITY TAPE VERIFIED
```

The message

```
READ COMPATIBILITY TAPE FAILED
```

indicates that the test could not successfully verify the contents of the test tape. Error conditions are reported during the read-phase by the message

```
TEST TAPE READ FAILED
```

followed by the current contents of the controller registers.

In read-check mode, the test compares the data read with the expected data. Differences are noted as data-compare errors. Completion of the test is indicated by the message

COMPATIBILITY TAPE VERIFIED

10.10 INTERACTIVE WRITE-READ SLICE ADJUSTMENT

This test provides either a write-repetitive or a read-repetitive function for adjustment or checking of the drive's write or read slice levels. After test-parameter selection, the test is initialized by your response to the inquiry

SLICE ADJUSTMENT?(W=WRITE;R=READ)

Type W to initiate the write function.

Type R to initiate the read function.

The write function repetitively writes from BOT three 1024-byte records with all 1's until you intervene with the selected console switch or abort the diagnostic by MCR command.

The read function first writes from BOT three 1024-byte records with all 1's, and then repetitively reads these records until you intervene with the selected console switch or abort the diagnostic by MCR command.

CHAPTER 11

TU10 OR TS03 MAGNETIC TAPE DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

Install "scratch" tape, with write-enable ring installed, on tape drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE MTn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT MTn:/FOR
```

On both RSX-11M and RSX-11-PLUS systems, proceed as follows.

```
>RUN $TU10              (or TS03)

START TU10 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? MTn
  **WARNING** MTn:  RESIDENT DATA WILL BE DESTROYED **WARNING**
CONTINUE? Y           (N or RETURN alone aborts the diagnostic)
QUICK TOTAL TAPE CHECK? (Y tests tape's reliability and exits)
                      (N initiates customer-mode test sequence)
```

Diagnostic runs to completion in 20 minutes for a lightly loaded system. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

11.1 TEST SUMMARY REPORT

Upon completion of each diagnostic test sequence, the following report is displayed.

```
TU10 UNIT NO.  n        (n=unit number)
PASS COUNT=
TOTAL ERRORS ENCOUNTERED=
TOTAL FUNCTIONS ISSUED=
TOTAL WORDS TRANSFERRED=
END OF TU10 DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

"Pass count" and "totals" are cumulative for multipass testing (initiated in service mode only).

11.2 TAPE DRIVE CHARACTERISTICS

	TU10	TS03
Channels (tracks)	7 or 9	9
Recording density, bits per inch (BPI)	200, 556, or 800 for 7-channel; 800 for 9-channel.	800
Tape speed, inches per second	45 normal 150 rewind	15 normal 120 rewind
Recording	NRZI	NRZI
Interrecord Gap (IRG)	0.5 in. minimum 0.65 in. nominal	0.5 in. minimum 0.65 in. nominal
End-of-File (EOF) Character	17 (octal) for 7-channel; 23 (octal) for 9-channel	23 (octal)

Figures 11-1, 11-2, and 11-3 illustrate the relationship between tape characters and memory bytes, the 9-channel tape format, and the 7-channel tape format.

The correlation between PDP-11 memory bits and tape channels is as follows:

7-Channel Tape		9-Channel Tape	
Bit	Channel	Bit	Channel
15	0	15	7
14	0	14	6
13	B	13	5
12	A	12	3
11	8	11	9
10	4	10	1
9	2	9	8
8	1	8	2
7	0	7	7
6	0	6	6
5	B	5	5
4	A	4	3
3	8	3	9
2	4	2	1
1	2	1	8
0	1	0	2

Channel C is parity Channel 4 is parity

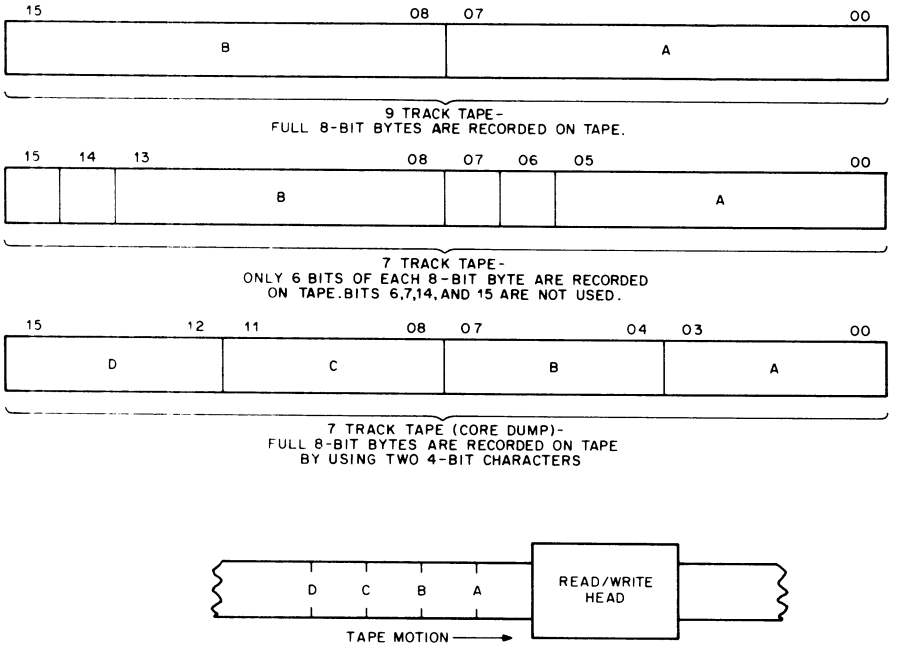

Figure 11-1 Relationship Between Tape Characters and Memory Bytes

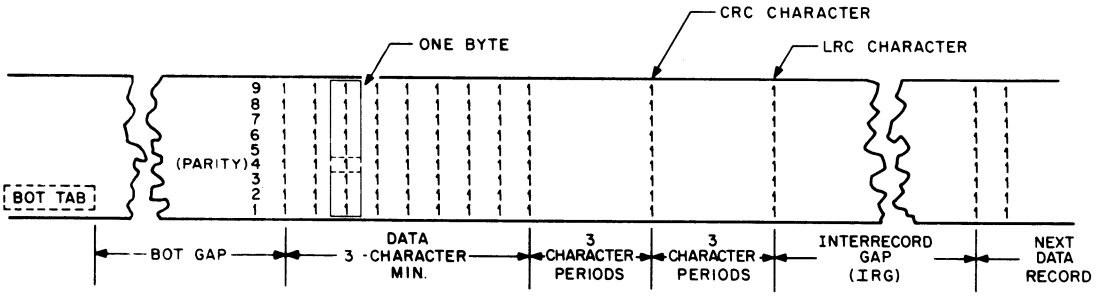

Figure 11-2 9-Channel Tape Format

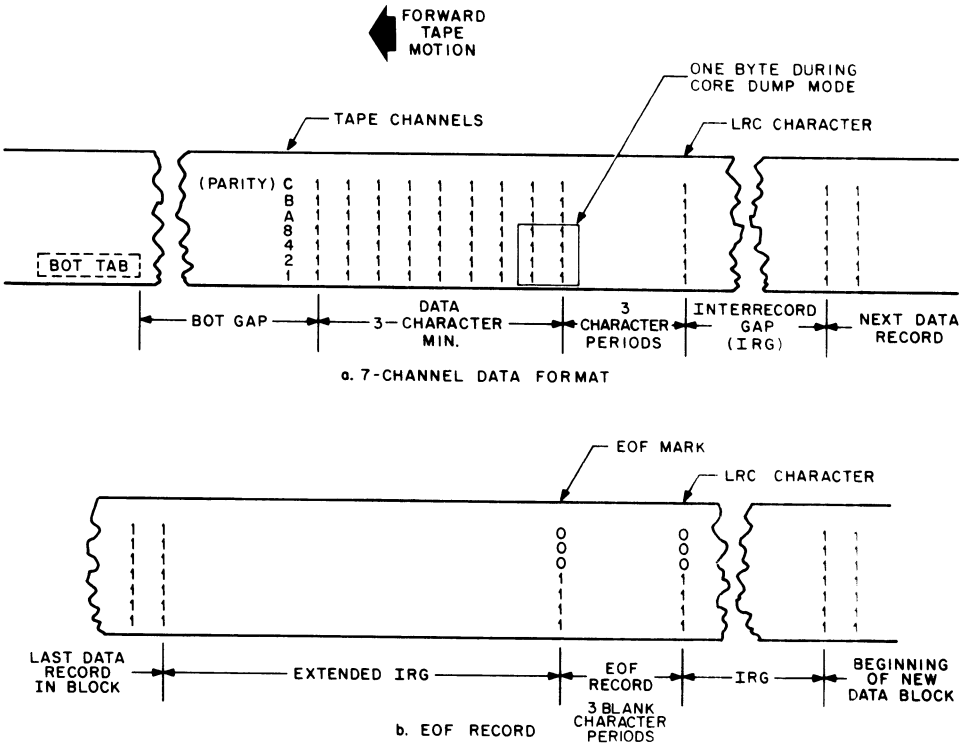

Figure 11-3 7-Channel Tape Format

11.3 DIAGNOSTIC DESCRIPTION

The TU10/TS03 diagnostic tests the ability of the selected tape drive to:

1. Position its resident tape correctly,
2. Write and read data correctly, and
3. Check for parity errors.

The exercises described hereafter are executed in a one-pass uninterrupted sequence for customer mode. The "Related Error Numbers" following each description appear in error messages for detected fault conditions; refer to Section 11.4 and Table 11-1 for their significance.

11.3.1 Beginning-of-Tape (BOT) Exercise

First, this exercise determines that the tape positions at BOT after a rewind command, and then that the tape remains at BOT although a backspace (space-reverse) command is issued.

(Related Error Numbers are: 1, 2)

11.3.2 Interrecord-Gap (IRG) Exercise

This exercise determines that IRG's produced by the drive are of adequate length for tape motion to decrease from normal speed to stop (shutdown in an IRG) and to increase to normal speed, in either direction, before an IRG-boundary reaches the write-read heads. The sequence is:

1. Rewind the tape.
2. Write ten 16-byte records, all 1's, and rewind tape.
3. Read each record and verify its character count, waiting after each read for tape motion to stop before issuing the next read-one-record command.

(Related Error Numbers are: 3, 4)

11.3.3 Variable-Length Record-Positioning Exercise

This exercise determines that the drive properly responds to commands specifying the writing and reading of records of varying lengths. The sequence is:

1. Rewind the tape.
2. From BOT, write 63 all-1's records decreasing in length by 16-byte decrements from 1024 bytes, initially, to 16 bytes; then write 63 all-1's records increasing in length by 16-byte increments from 16 bytes to 1024 bytes.
3. Rewind the tape.
4. Read the records by read-one-record commands, allowing tape motion to stop before issuing the next read. Determine that record lengths agree with those written as specified above.

(Related Error Numbers are: 5, 6)

11.3.4 Record-Length Exercise

This exercise determines that the drive writes a 512-byte all-1's record, and then properly responds to read commands that specify a byte count larger (1024) or smaller (511) than the written record. The data pattern is not checked for correct content.

(Related Error Numbers are: 7, 8, 9, 10)

11.3.5 Lateral-Parity Exercise

This exercise determines that the drive responds properly to apparent lateral-parity errors, which are forced by writing one 512-byte all-1's record with odd parity and then reading it as even parity. The reverse condition is checked by writing the record as even parity and reading it as odd parity. The data pattern is not checked for correct content.

(Related Error Numbers are: 11, 12, 13, 14, 15)

11.3.6 Longitudinal-Parity-Check-Character (LPCC) Exercise

This exercise determines that the drive's LPCC facility functions properly. The exercise writes one 1024-byte record with a data pattern (an all-0's byte followed by 1023 all-1's bytes) that has a predicted LPCC. It then checks for the presence of the predicted LPCC.

(Related Error Numbers are: 16, 17)

11.3.7 Cyclic-Redundancy-Check-Character (CRCC) Exercise

This exercise checks 9-track (channel) tape only. Detection of a 7-track tape on the selected drive causes the exercise to be skipped.

The exercise determines that the drive develops correct CRCC's by, first, writing ten records with data patterns that are designed to sequentially set each of the CRCC nine bits and, then, comparing the CRCC's read to the expected CRCC's.

(Related Error Numbers are: 18, 19, 20)

11.3.8 Record Creep Exercise

First, this exercise determines that the drive can write and read a data pattern of all 1's, and then all 0's in a 1024-byte record. The sequence is:

1. From BOT, write one 1024-byte record of all 1's, rewind the tape, and read the record.
2. Rewind the tape and, from BOT, write one 1024-byte record of all 0's.
3. Rewind the tape, read the record, and rewind the tape.

The exercise then determines that the issuing of a backspace command followed by a write command does not result in a erroneous data entry (creep) either into the interrecord gap (IRG) or beyond the IRG into the record that precedes the record sought. The sequence is:

1. From BOT, write two 1024-byte records: the first with all 1's, the second with all 0's.
2. Repetitively backspace the tape one record and write the second record with all-0's pattern, 64 times.
3. Rewind the tape and read the first record to determine if the record content (all 1's) and byte count remain intact.
4. From stop in the IRG, read the second record to determine if the byte count equals 1024. A lesser count indicates probable loss of data due to the second record creeping into and shortening the IRG.

(Related Error Numbers are: 21, 22, 23, 24, 25, 26, 27)

11.3.9 Skew Exercise

This exercise determines whether the drive has actual or potential tape-skew problems by writing and reading two "worst case" data patterns that are designed to accentuate data retrieval errors. Errors may be caused by factors such as electrical-skew, bad-head, or magnetized-head conditions. The patterns consist of ten 1024-byte records. Data in both cases is read and checked ten times to expose possible read-reduction problems.

(Related Error Numbers are: 28, 29, 30)

11.3.10 End-of-File (EOF) Exercise

This exercise determines that the drive properly writes and detects the presence of an EOF character (octal 17 for 7-track, octal 23 for 9-track). The sequence is:

1. Rewind the tape.
2. From BOT, write an EOF character and check that the drive's EOF bit in the status register sets as required.
3. Write two records, each containing 1023 EOF characters followed by an all-1's character; then write an EOF.
4. Rewind the tape.
5. Read two records, each 1024 bytes long. Determine that the EOF status register bit does set for the legitimate EOF characters, but not for the EOF characters written in the records as data.

(Related Error Numbers are: 31, 32, 33, 34, 35, 36)

11.3.11 Single-Record Positioning Exercise

This exercise determines that the drive properly positions tape in response to forwardspace and backspace commands. The sequence is:

1. Rewind the tape.
2. From BOT, write an EOF character and check that the drive's EOF bit in the status register sets as required.
3. Write 63 records, each with 16 all-1's bytes.
4. Until EOF character is detected, backspace tape two records, and then forwardspace one record.
5. Report tape position by record count if EOF-character detection occurs before or after the 63rd backspace command.

(Related Error Numbers are: 37, 38, 39, 40)

11.3.12 Multiple-Record Positioning Exercise

This exercise determines that the drive properly positions the tape in response to backspace and forwardspace commands that specify various multiple-record skips. The exercise uses the tape data formatted by the Single-Record Positioning Exercise. The sequence is:

1. Rewind the tape.
2. Read for EOF character.
3. Alternately, forwardspace and backspace "n" records, where "n" is initialized at 63 and decremented by one for each space command until "n" equals 0.
4. Backspace tape from point halted in step 3 until EOF is detected. Report tape position by record count if EOF occurs before or after its anticipated position (after 32 records if step 3 does not fail).

(Related Error Numbers are: 41, 42, 43, 44)

11.3.13 Crosstalk Exercise

This exercise determines whether the drive has a crosstalk problem by writing and reading two data patterns that are designed to accentuate potential crosstalk. The first pattern consists of ten 1024-byte records in which each 1 bit has contiguous 0 bits. The second pattern, also of ten 1024-byte records, complements the first by having reversed bit states (i.e., 0 bits with contiguous 1 bits). Each pattern is read and checked ten times to expose possible read-reduction problems.

(Related Error Numbers are: 45, 46, 47)

11.3.14 Data-Reliability Exercise

This exercise determines the drive's data reliability by writing selected data patterns in 64 files (or in files from BOT to EOT in service-mode), and then reading the files ten times each to expose possible read-reduction problems. Each file consists of three random-length records in the range of 16 or 1024 bytes, and an EOF record.

The least significant digit of the octal record number appearing in a data-compare error message indicates the data pattern expected, as follows.

Pattern Indicator	Pattern Expected
1	Floating 1's
2	Random number
3	Count pattern

The sequence is:

1. Write three varible-data records and an EOF record (EOF mark plus LPC character).

2. Repeatedly, backspace and read the file ten times (ignore the EOF record on successive re-reads).

3. Continue until 64 files (or in service mode, the multiple files from BOT to EOT) have been written and read.

For seven-track tape, the exercise implements "core dump" mode (i.e., each memory byte is written or read as two consecutive 4-bit tape characters).

(Related Error Numbers are: 48, 49, 50)

11.3.15 Quick Total-Tape-Check Exercise

The customer-mode user initiates this independent exercise for a fast determination of a tape's data reliability from BOT to EOT. The exercise differs from service-mode execution of the data-reliability exercise only in that one read of each file is made rather than the ten reads designed to expose possible read-reduction problems. Once initiated, the "check" exercise runs to completion and terminates diagnostic control. All errors are reported as detected.

(Related Error Numbers are: 48, 49, 50)

11.4 ERROR MESSAGES

Fault conditions detected during the test sequence are reported at the initiating terminal; they are classified as equipment errors or data-compare errors. Equipment errors are those conditions that result in the setting of the "error" bit, Bit 15 of the Command Register (MTC). Data-compare errors occur when the diagnostic finds data other than the data expected in data-transfer operations. Some conditions may cause both an equipment error and a data-compare error.

The following representations illustrate the context of the various error messages. Table 11-1 lists the error numbers and their related fault conditions. Appendix B defines the register contents displayed in the error messages.

Equipment error-message format:

```
TU10              UNIT NO.  m
ERROR NO.  n
RECORD NO.     = Number (in octal and decimal)
BYTE COUNT     = Number (in octal and decimal)
MTS            = Status Register contents
MTC            = Command Register contents
MTBRC          = Byte Record Count Register contents
MTCMA          = Current Memory Address Register contents
MTD            = Data Buffer Register contents
MTRD           = Read Lines Register contents
```

Data-compare error-message format:

```
TU10      UNIT NO.  m
ERROR NO. n
EXPECTED  =  Data expected
RECEIVED  =  Data received
BYTE NO.  IN RECORD  =  Number (in octal and decimal)
RECORD NO.  =  Number (in octal and decimal)
BYTE COUNT  =  Number (in octal and decimal)
```

Other error messages:

EOF NOT DETECTED AFTER WRITE EOF

EOF NOT DETECTED AFTER READ EOF

n RECORDS SKIPPED OVER

m RECORDS NOT BACKSPACED OVER

LPCC ERROR

CRCC ERROR

REREAD SAME DATA n TIMES BEFORE ERROR

ERROR NO. x RECOVERED AFTER y RETRIES

ERROR NO. a RECORD NO. b RECOVERED AFTER c RETRIES

Table 11-1
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
BOT:	
1	BOT not detected after tape rewind.
2	BOT not detected after backspace was issued while tape was at BOT.
IRG:	
3	Illegal-command bit was set during write function. May be caused by drive going offline.
4	Record-length error bit was set during read of ten short (16-byte) records with stall between read commands.

(continued on next page)

Table 11-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Variable-Length Record:	
5	Error bit was set by a condition other than parity error while exercise was writing variable-length records.
6	Error bit was set by a condition other than parity error while exercise was reading records with stall between read commands.
Record-Length:	
7	Error bit was set by a condition other than parity error while exercise was writing a 512-byte record.
8	Byte-count register did not contain a value of -512 (177000 octal) after the 512-byte record was read with the byte-count register initialized to 1024.
9	Record-length error bit (MTS bit 9) did not set when 512-byte record was read with byte-count register initialized to 510.
10	Error bit was set by a condition other than parity error or expected record-length error when 512-byte record was read with byte-count register initialized to 510.
Lateral Parity:	
11	Parity error expected by even-parity read of odd-parity record did not set parity-error and error bits.
12	Error bit was set by a condition other than forced parity error caused by even-parity read of odd-parity record.
13	Error bit was set while exercise was writing a 512-byte record with even parity.
14	Parity error expected by odd-parity read of even-parity record did not set parity-error and error bits.

(continued on next page)

Table 11-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Lateral Parity: (Cont.)	
15	Error bit was set by a condition other than forced parity error caused by odd-parity read of even-parity record.
LPCC:	
16	Error bit was set while exercise was writing the LPCC-test record (an all-0's byte followed by 1023 all-1's bytes).
17	Error bit was set by a condition other than parity error during read of the LPCC-test record (1024 bytes, an all-0's byte followed by 1023 all-1's bytes). LPCC received after read of the LPCC-test record did not agree with the expected LPCC.
CRCC:	
18	Error bit was set while exercise was writing a CRCC-test record.
19	Error bit was set by a condition other than a CRCC parity error while exercise was reading a CRCC-test record.
20	CRCC received after read of a CRCC-test record did not agree with the expected CRCC content.
Record Creep:	
21	Error bit was set while exercise was reading a 1024-byte record of all 1's from BOT.
22	Data-compare error. The 1024-byte record did not contain all 1's.
23	Error bit was set while exercise was reading a 1024-byte record of all 0's from BOT.

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Table 11-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Record Creep: (Cont.)	
24	Data-compare error. The 1024-byte record did not contain all 0's.
25	Error bit was set while exercise was backspacing one record and rewriting the second 1024-byte record with all 0's.
26	Data-compare error. The 1024-byte record from BOT did not contain all 1's; indicates probable entry into the record while exercise was writing the second record of all 0's.
27	Read of second record did not transfer 1024 bytes before end-of-record.
Skew:	
28	Error bit was set while exercise was writing a skew test record.
29	Error bit was set while exercise was reading a skew test record.
30	Data received while exercise was reading a skew-test record does not agree with the expected test pattern.
EOF:	
31	Error bit was set by a condition other than "no EOF detected" while exercise was writing an EOF after BOT.
32	Error bit was set while exercise was writing an EOF-test record (1023 EOF-pattern bytes followed by an octal 77 byte).
33	First EOF, written previously after BOT, was not detected by a read from rewind.
34	False EOF indication occurred while exercise was reading EOF test record of EOF-pattern bytes.
35	Error bit was set by condition other than false EOF indication while exercise was reading the EOF-test record of EOF-pattern bytes.

(continued on next page)

Table 11-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
EOF: (Cont.)	
36	EOF, written previously after EOF test file, was not detected by a forwardspace-one-file command from rewind.
Single-Record Positioning:	
37	Error bit was set while exercise was writing an EOF and 63 16-byte records of all 1's.
38	Illegal-command bit was set during a command sequence of backspace two records, and then forwardspace one record. Condition may be caused by drive going offline.
39	EOF, written previously after BOT, was detected before it was expected. EOF should have occurred on backspace after the 63rd command sequence: backspace two records, and then forwardspace one record (net backspace equals one record for each sequence). The message "...n RECORDS SKIPPED OVER" indicates the number of records that were erroneously skipped over during the backspace sequence.
40	EOF, written previously after BOT, was detected after it was expected. EOF should have occurred on backspace after the 63rd command sequence: backspace two records, and then forwardspace one record (net backspace equals one record for each sequence). The message "...n RECORDS NOT BACKSPACED OVER" indicates the number of records that remained to be backspaced over after the backspace sequence ended.
Multiple-Record Positioning:	
41	EOF, written previously after BOT, was not detected after rewind.

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Table 11-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Multiple-Record Positioning: (Cont.)	
42	Illegal-command bit was set during a sequence of record-space commands. Condition may be caused by drive going offline.
43	EOF, written previously after BOT, was detected before it was expected. EOF should have occurred on the 32nd backspace-one-record command; this premise assumes that an earlier command sequence positioned the tape properly at the midpoint of the test-record sequence (an EOF record followed by 63 16-byte records). The message "...n RECORDS SKIPPED OVER" indicates the number of records that were erroneously skipped over during the backspace sequence.
44	EOF, written previously after BOT, was detected after it was expected. EOF should have occurred on the 32nd backspace-one-record command; this premise assumes that an earlier command sequence positioned the tape properly at the midpoint of the test-record sequence (an EOF record followed by 63 16-byte records). The message "...n RECORDS NOT BACKSPACED OVER" indicates the number of records that remained to be backspaced over after the backspace sequence ended.
Crosstalk:	
45	Error bit was set while exercise was writing the crosstalk-test records (ten records of 1024 bytes each).
46	Error bit was set while exercise was reading the crosstalk-test records. A "REREAD SAME DATA..." message with a reread count greater than 0 may indicate a read-reduction condition. Check for dirty, worn, or magnetized heads.

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Table 11-1 (Cont.)
Error Conditions

Error Number and Associated Test Exercise	Fault Condition
Crosstalk: (Cont.)	
47	Data received while exercise was reading the crosstalk-test records did not agree with the expected test pattern.
Reliability:	
48	Error bit was set while exercise was writing a reliability-test file.
49	Error bit was set while exercise was reading a reliability-test file.
50	Data received while exercise was reading a reliability-test file does not agree with the data expected.

11.5 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console-switch selection (see Section 11.6), test-parameter selection (see Section 11.7), interactive testing (see Sections 11.9 and 11.10), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

Install "scratch" tape, with write-enable ring installed, on tape drive to be tested.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE MTn:          (n=unit number)
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT MTn:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU10              (or TS03)

START TU10 DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE? MTn
  **WARNING** MTn:  RESIDENT DATA WILL BE DESTROYED **WARNING**

CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

11.6 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

11.7 TEST PARAMETERS SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 11-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-digit number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 11-2
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
STOP ON ERROR (Bit 15): Test sequence waits up to 30 minutes before terminating. User may abort stop by setting console switch selected for intervention.	100000	No

(continued on next page)

Table 11-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
LOOP ON ERROR (Bit 14): Test sequence loops on the failing instruction sequence. User should intervene and select new test parameters that exclude this option.	40000	No
INHIBIT ERROR MESSAGE PRINTOUT (Bit 13): Prevents appearance of all diagnostic error messages except the test summary report that appears at the end of each sequence pass.	20000	No
BELL (Bit 12): The terminal bell rings for each error detected.	10000	No
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes. The updated test summary report is displayed at the end of each pass.	4000	No
INTERACTIVE DRIVE-COMPATIBILITY TEST (Bits 10 & 2): Allows the service-mode user to determine the compatibility of system tape drives (see Section 11.9 for details). The requirement that Bit 2 not be set inhibits selection of this option with the write-read slice adjustment test.	2000	No
INTERACTIVE WRITE-READ SLICE ADJUSTMENT (Bits 10 & 2): Allows the service-mode user to select a write- or a read-repetitive function for adjustment of the write or read slice levels (see Section 11.10 for details).	2004	No

(continued on next page)

Table 11-2 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
DATA-COMPARE ERROR RECOVERY (Bit 7): Test attempts infinite data-transfer retries to recover from a data-compare error. The default is: attempt up to eight data-transfer retries to recover from a data-compare error.	200	Default
LIMIT DATA-COMPARE ERROR MESSAGES (Bit 5): Display an error message only for the first data-compare error condition detected during a specified data transfer. The default is: display an error message for up to three data-compare error conditions detected during retries of a specified data transfer.	40	Yes
TEST SEQUENCE SELECTION (Bits 1 & 0): A) Execute the following exercises in the order shown: BOT IRG Variable-length record positioning Record Length EOF Single-record positioning Multiple-record positioning Lateral parity LPCC Record Creep CRCC (9-track tape only) Skew Crosstalk (See Section 11.3 for exercise descriptions.) B) Execute the data-reliability exercise for the entire tape (from BOT to EOT) (see Section 11.3.14).	1 2	Yes Yes

11.8 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention), or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

11.9 INTERACTIVE DRIVE-COMPATIBILITY TEST

This test determines the data-transfer compatibility of the system's magnetic tape drives by use of a test-pattern tape. After test-parameter selection, the test is initialized in the test-tape-preparation or read-check mode by your response to the inquiry

WHICH COMPATIBILITY MODE?(W=TEST TAPE PREP; R=READ CHECK)

Type W to initiate preparation of the "scratch" tape on the selected drive as the test-pattern tape.

Type R to initiate read-testing of the selected magnetic tape drive with the test tape mounted.

In the test-tape-preparation mode, the "scratch" tape is first written with the test pattern. Completion of the writing phase is indicated by the message

COMPATIBILITY TAPE WRITTEN-VERIFYING TAPE

The message

WRITE COMPATIBILITY TAPE FAILED

indicates that the test could not successfully complete preparation of the test tape. Error conditions are reported during the write-phase by the message

TEST TAPE WRITE FAILED

followed by the current contents of the controller registers.

The tape is then read for agreement with the test pattern. Successful completion of the reading phase is indicated by the message

COMPATIBILITY TAPE VERIFIED

The message

READ COMPATIBILITY TAPE FAILED

indicates that the test could not successfully verify the contents of the test tape. Error conditions are reported during the read-phase by the message

TEST TAPE READ FAILED

followed by the current contents of the controller registers.

In read-check mode, the test compares the data read with the data expected. Differences are noted as data-compare errors. Completion of the test is indicated by the message

COMPATIBILITY TAPE VERIFIED

For 7-track tape, the test implements core-dump mode (that is, each memory byte is written or read as two consecutive 4-bit tape characters).

11.10 INTERACTIVE WRITE-READ SLICE ADJUSTMENT

This test provides either a write-repetitive or a read-repetitive function for adjustment or checking of the drive's write or read slice levels. After test-parameter selection, the test is initialized by your response to the inquiry

SLICE ADJUSTMENT?(W=WRITE;R=READ)

Type W to initiate the write function.

Type R to initiate the read function.

The write function repetitively writes from BOT three 1024-byte records with all 1's until you intervene with the selected console switch or abort the diagnostic by MCR command.

The read function first writes from BOT three 1024-byte records with all 1's, and then repetitively reads these records until you intervene with the selected console switch or abort the diagnostic by MCR command.

CHAPTER 12

TERMINAL OR LINE PRINTER DIAGNOSTIC

CUSTOMER-MODE INITIATION

(Underlined text indicates required or expected user input; see Chapter 2 for additional information.)

```
>ALLOCATE TTn:          (or LPn, n=unit number)
>RUN $TERM

START TERMINAL DIAGNOSTIC - TIME OF DAY=hour:minute:second

DEVICE?  TTn
CONTINUE?  Y            (N or RETURN alone aborts the diagnostic)
HARD COPY TERMINAL?     (N tests device as video display)
132 COLUMN TEST?        (N sets 72 columns)
```

Diagnostic runs to completion in 3 minutes. To exit sooner, type:

```
CTRL/C
MCR>ABORT
```

12.1 END-OF-TEST INDICATION

Upon completion of the diagnostic test sequence, the following is displayed.

```
END OF TERMINAL DIAGNOSTIC - TIME OF DAY=hour:minute:second
```

12.2 DIAGNOSTIC DESCRIPTION

The diagnostic tests the ability of the selected terminal device to print (display) the alphanumeric and special-character sets and to perform all positioning functions properly. The following describes some special situations.

NOTE

If an LA30S or VT05B terminal has not been identified to the system by the MCR command SET/LA30S=TTn: or SET/VT05=TTn:, respectively, test output at the terminal may be garbled.

80-Column Terminals:

The capability to exercise the full 80 columns is an option in Service Mode. Customer Mode exercises all functions with the exception of positioning to and from the last 8 columns.

Line Printers:

A line printer is exercised as if it were a video-display terminal. Page-formatting functions are not exercised. Note that the test output is not spooled.

Special-Purpose Terminals:

Special-purpose terminals, such as a badge reader, for the most part, should not be exercised by the diagnostic. If required, the Interactive-Pattern Test option of Service Mode can be used to accept data and display it.

Test the Initiating Terminal:

The diagnostic can be used to test the initiating terminal. Unsolicited input during testing is directed to MCR.

Special-Character Sets:

This diagnostic exercises the alphanumeric characters and special-character set illustrated in Section 12.2.7. If a terminal has an equivalent character, the equivalent is displayed. Non-equivalent characters are not exercised.

Upper-Case Terminals:

An upper-case only terminal forces upper case when the diagnostic attempts to exercise a lower-case character (see Section 12.2.7).

Tabbing Exercise:

The tabbing exercise (see Section 12.2.5) is valid only for those terminals that are equipped with the ability to tab by hardware. The results displayed on a non-tabbing terminal have no meaning and should be ignored. The exercise assumes that the transparent terminal read-write support option (IO.RAL and IO.WAL) was implemented at system generation.

Remote Terminals:

A remote terminal is exercised by the terminal diagnostic in the same manner as a local terminal. No special provisions are implemented.

12.2.1 Carriage-Return Exercise, Hard-Copy Terminal

This exercise determines that the terminal's print-position returns correctly to position 0 from all other line positions. The sequence is:

1. Print a backslash character (\) at position 0 and space the print-position to the end of the line.
2. Issue return command.
3. Print a slash character (/) and space the print-position to the position that precedes the end of the line.
4. Issue return command.
5. Continue the exercise until the print-position has been spaced to every in-line position and has been returned from there to print a slash character each time.

Upon exercise completion, position 0 should display a multistruck X.

12.2.2 Carriage-Return Exercise, Video-Display Terminal

This exercise determines that the terminal's print-position returns correctly to position 0 from all other line positions. The sequence is:

1. Display a line of 72 asterisks (*) (or 132, if selected) and issue a return, line-feed command combination.
2. Continue the exercise by displaying lines of asterisks, where the quantity for each line is one less than that of the preceding line, until the quantity is zero.

A partial representation of the pattern follows.

CARRIAGE RETURN TEST

```
********** etc.
*********
********
*******
******
*****
****
***
**
*
```

12.2.3 Spacing Exercise, Hard-Copy Terminal

This exercise determines that the terminal spaces the print-position correctly. The sequence is:

1. Print backslashes(\) in alternate positions, starting at position 0.
2. Return to position 0 and print slashes(/) in the alternate blank positions.

Upon exercise completion, the printed line should resemble a "sawtooth" pattern as follows:

/\/\/\/\/\/\/\/\ etc.

12.2.4 Spacing Exercise, Video-Display Terminal

This exercise determines that the terminal spaces the character-display position correctly. The exercise consists of displaying six lines of asterisks (*) in alternate positions, with the asterisks in lines 2, 4, and 6 offset by one character position from those of lines 1, 3, and 5.

At exercise completion, the terminal screen should display the following pattern.

SPACE TEST

```
* * * * * * * * * * * *
 * * * * * * * * * * * *
* * * * * * * * * * * *
 * * * * * * * * * * * *
* * * * * * * * * * * *
 * * * * * * * * * * * *
```

12.2.5 Tabbing Exercise

This exercise determines that the terminal, if equipped for tabbing, tabs correctly from one tab-stop to the next tab-stop or from an inter-tab position to the next tab-stop. The sequence is:

1. Print a slash (/) at position 0, tab to successive tab-stops, which are eight spaces apart, and print a slash at each tab-stop.

2. For seven lines thereafter, print a slash at position 0, space a number of positions equal to the line number less one before tabbing to each tab-stop, and print a slash at each tab-stop.

Upon completion of the exercise, the following pattern should be displayed.

TAB SET

```
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
/       /       /       /       /       /       /       /       /
```

12.2.6 Line-Feed Exercise

This exercise determines that the terminal performs unit line-feeds (advances) correctly. The sequence is:

1. Print a backslash (\) at position 0.
2. Issue a line-feed command (without return) and print a backslash.
3. Continue line-feeding and printing backslashes 70 times (or 78 times for an 80-column device selected in Service Mode).

Upon completion of the exercise, a diagonal line should be displayed from position 0, line 0, to the right-most position of line 71 (or line 79).

NOTE

A line printer, other than a keyboardless terminal, displays a sequence of backslash characters in column 0.

12.2.7 Character-Set Exercise

This exercise determines that the terminal can display its entire upper-case and lower-case, if available) character set, alphanumeric and special (see below). The terminal displays the alphanumeric characters, in groups of three characters at a time to fill out the line, beginning with ABC and ending with 789. Then, the terminal displays the special characters in groups of three characters, as follows:

```
!"#
$%&
'()
*+,
-./
:;<
=>?
@[\
]^
```

Upon completion of the exercise, the above character set should be displayed.

12.3 SERVICE-MODE INITIATION

Initiation of this mode demands a knowledge of console switch selection (see Section 12.4), test parameter selection (see Section 12.5), service-mode intervention (see Section 12.6), interactive testing (see Section 12.7), and the content of Appendix A. Underlined text in this procedure indicates required or expected user input.

```
>ALLOCATE TTn:          (or LPn, n=unit number)
>RUN $TERM

START TERMINAL DIAGNOSTIC -  TIME OF DAY=hour:minute:second

DEVICE? TTn
CONTINUE? SERVICE       (N or RETURN alone aborts the diagnostic)
TEST PARAMETERS (OCTAL)= nnnnnn
CONSOLE SWITCH FOR INTERVENTION (DECIMAL)= n
```

The selected test sequence commences upon RETURN after you have responded to all inquiries, if any, that occur as a result of test-parameters selection.

12.4 CONSOLE SWITCH FOR INTERVENTION

Service-mode initialization requires that you select a CPU console switch (0-15) for intervention in the test sequence when, for example, you desire to change test parameters. The facility to select more than one switch is useful only if more than one device is to be tested concurrently; that is, you can assign a unique switch to each diagnostic.

For those systems without a CPU switch console or without the GET SENSE SWITCHES directive, respond to the message "CONSOLE SWITCH..." with 0.

12.5 TEST PARAMETER SELECTION

Customer mode allows only a fixed sequence of the diagnostic's tests. Service mode, however, permits customization of the test content through the test-parameters facility. Table 12-2 describes the various options available to you as a service-mode user. You select options by logically ORing their related octal codes to form a 6-character number (leading zeros need not be expressed) for entry in response to TEST PARAMETERS (OCTAL)=.

NOTE

A response of 0 implies that no tests are to be performed. The diagnostic issues the test summary report and then terminates.

The table also indicates those options that are automatically selected for customer-mode execution. The "bit" references in the option descriptions refer to the bit positions of a test-parameters status word that is monitored by the diagnostic.

Table 12-1
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
MULTIPASS EXECUTION (Bit 11): Test sequence repeats until user intervenes.	4000	No
TERMINAL TYPE (Bit 7): A) Test selected terminal as a hard-copy device. B) Test selected terminal (or line printer) as a video-display device.	 200 0	 Selectable Selectable
132 COLUMN TEST (Bit 6): Implements 132-column print-out. Overrides LINE LENGTH selection.	100	Selectable
LINE LENGTH (Bit 5): A) Implement line length of 80 print positions. B) Implement line length of 72 print positions.	 40 0	 No Yes
INTERACTIVE-PATTERN TEST (Bits 0-2): Allows the service-mode user to specify a character pattern for repetitive exercising of the selected terminal (see Section 12.7) A line printer cannot be exercised by this test.	7	No
TEST SEQUENCE ELECTION (Bits 0-3): NOTE You have the option of executing either one exercise or the entire sequence. You cannot combine several individual exercises to create different test sequences.		

(continued on next page)

Table 12-1 (Cont.)
Test-Parameter Options

Option Description	Selection Code (Octal)	In Customer Mode
TEST SEQUENCE ELECTION (bits 0-3): (Cont.)		
A) Execute the carriage-return exercise (see Section 12.2.1 or 12.2.2).	1	No
B) Execute the spacing exercise (see Section 12.3.3 or 12.3.4).	2	No
C) Execute the tabbing exercise (see Section 12.2.5).	3	No
D) Execute the line-feed exercise (see Section 12.2.6).	4	No
E) Execute the character-set exercise (see Section 12.2.7).	5	No
F) Execute all of the above exercises (see Section 12.2).	10	Yes

12.6 SERVICE-MODE INTERVENTION/RESTART/TERMINATION

You can intervene in (stop) the test-sequence pass at any time by changing from its current setting (0 to 1 or 1 to 0) the previously selected CPU console switch. Such action causes the diagnostic to suspend testing and await response to the following message sequence.

TEST PARAMETERS (OCTAL)= Type an octal value (other than 0) to select new test parameters (or re-enter the old parameters, which are not saved at intervention, or

type 0 to terminate the diagnostic.

If new (or the old) parameters are entered, the following message is displayed.

RESTART? Type Y to abort the suspended test sequence and initiate the new sequence at the beginning, or

type N to allow the suspended test sequence to run to completion before the new sequence commences.

For those systems not equipped with a CPU switch console or not implemented with the GET SENSE SWITCHES directive, the user wishing to alter test parameters must first terminate the diagnostic by typing:

CTRL/C
MCR>ABORT

and then reinitiate the diagnostic with new parameters. The intervention and restart provisions are not accessible.

12.7 INTERACTIVE-PATTERN TEST

This test allows you to specify a character-pattern for repetitive line display by the selected terminal (not a line printer or a keyboardless terminal). After test-parameter selection, the test is initialized by your typing up to 132 characters in response to the following inquiry.

```
KEYBOARD TEST
TYPE UP TO 132 CHARACTERS - TERMINATE WITH RETURN
```

Once initiated, the line repetition continues until you intervene with the selected console switch or abort the diagnostic by MCR command.

CHAPTER 13

DISK DRIVE COMPATIBILITY DIAGNOSTIC

The disk drive compatibility diagnostic program verifies the compatibility of up to eight disk drives running under RSX-11M-PLUS or RSX-11M. The program can be run so that compatibility operations can be performed online rather than shutting the operating system down to run the stand-alone diagnostic.

Compatibility is defined here as the ability of a drive to write data that can be read by all other drives and, in addition, the ability of a drive to completely overwrite data written by all other drives.

The program is designed to detect the following conditions that most commonly cause incompatibility between drives:

1. Head Alignment
2. Positioner lateral misalignment
3. Improper levels of write current
4. Incorrect addressing of read/write heads

13.1 HARDWARE AND SOFTWARE ENVIRONMENT

The program runs on the minimum hardware configuration for an RSX-11M system (unmapped 16K RK05 or RL01/2 or 24K for any other disk). At least two additional disk drives other than the system disk are required. The following disks are supported: RK05, RL01/2, RP02/3, RP04/5/6, RK06/7, and RM02/3.

The program runs under either the RSX-11M-PLUS or RSX-11M operating system.

13.2 EXTERNAL INTERACTIONS - USER INTERFACE FOR INITIATION

This section describes the terminal dialogue through which the program directs the operator in the selection of drives and the movement of the test cartridge.

On both RSX-11M and RSX-11M-PLUS systems, allocate the devices to be compared.

```
>ALLOCATE DB2:
>ALLOCATE DB5:
>ALLOCATE DB3:
>ALLOCATE DB7:
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
RUN $COMP
```

The program first identifies itself as follows:

```
START DISK DRIVE COMPATIBILITY DIAGNOSTIC - TIME OF DAY = hh:mm:ss
```

The program then asks for the device mnemonic to test:

```
ENTER DEVICE MNEMONIC ?
```

If a carriage return is typed, the following help information is printed:

```
THE FOLLOWING IS A LIST OF SUPPORTED DEVICES:

DK - RK05,      DP - RP02/3,    DB - RP04/5/6,
DL - RL01/2,    DM - RK06/7,    DR - RM02/3

ENTER DEVICE MNEMONIC ? DB
```

Then, the program asks for the drives to be tested as follows:

```
ENTER LOGICAL UNIT NUMBERS ?
```

If the escape or altmode key is pressed, the program requests the device mnemonic again. If carriage return is typed, then the following help information is printed:

```
ENTER UP TO 8.  UNIT NUMBERS IN OCTAL (I.E., 0,1,2).

ENTER LOGICAL UNIT NUMBERS ? 2,5,3,7
```

13.2.1 Pass 1 Dialogue

After the selection of unit numbers, the program indicates the start of Pass 1 as follows:

```
** STARTING PASS 1 **
```

Next, the program selects the first drive to be tested and instructs the operator to mount the test cartridge or pack and load the heads on that drive, as in the following example:

```
LOAD PACK IN DRIVE 2 AND START THE DRIVE.
WHEN THE DRIVE IS READY TYPE :
```

On RSX-11M-PLUS systems, COMP displays two commands to logically mount the volume as foreign and to resume the task.

```
MOUNT DB2:/FOR<CR>
RESUME TT24   <CR>
```

On RSX-11M systems, COMP displays only the command to resume the task.

On both RSX-11M and RSX-11M-PLUS systems, COMP continues with the following message:

```
THE DIAGNOSTIC WILL NOW SUSPEND:
```

The task then suspends itself. On both RSX-11M and RSX-11M-PLUS systems, load the pack or cartridge in the drive and ready the unit. When the drive-ready light is on, proceed to type the command(s) that COMP displayed.

On RSX-11M-PLUS systems only, type the command to mount the volume as foreign.

```
MOUNT DB2:/FOR (RET)
>
```

On both RSX-11M and RSX-11M-PLUS systems, type the command to resume the task.

```
>RESUME TT24 (RET)
>
```

The task then resumes execution.

If the disk cartridge or pack has a home block (refer to step 3 of Section 13.5.1, "Description of Pass 1 Tests"), the following message is printed:

```
**WARNING** DB2:  HAS A FILE STRUCTURED VOLUME **WARNING**

CONTINUE ?
```

If the answer is Y, the program performs Pass 1 functions on this drive (described in Section 13.5.1, "Description of Pass 1 Tests"). Any other response causes the program to exit. The program then instructs the operator to unload the drive and move the pack to the next drive, as follows:

```
UNLOAD DRIVE 2 AND REMOVE THE PACK.

LOAD PACK IN DRIVE 5 AND START THE DRIVE.
WHEN THE DRIVE IS READY TYPE :
```

On RSX-11M-PLUS systems, COMP displays two commands to logically mount the volume as foreign and to resume the task.

```
MOUNT DB5:/FOR<CR>
RESUME TT24   <CR>
```

On RSX-11M systems, COMP displays only the command to resume the task.

On both RSX-11M and RSX-11M-PLUS systems, COMP continues with the following message:

```
THE DIAGNOSTIC WILL NOW SUSPEND:
```

The task then suspends itself. On both RSX-11M and RSX-11M-PLUS systems, load the pack or cartridge in the drive and ready the unit. When the drive-ready light is on, proceed to type the command(s) that COMP displayed.

ON RSX-11M-PLUS systems only, type the command to mount the volume as foreign.

```
MOUNT DB5:/FOR (RET)
>
```

On both RSX-11M and RSX-11M-PLUS systems, type the command to resume the task.

```
>RESUME TT24 (RET)
>
```

The task then resumes execution.

The operator performs these functions and, in the same manner, the program instructs the operator in the movement of the pack throughout the rest of the drives. When all drives have been completed, the program starts Pass 2.

13.2.2 Pass 2 Dialogue

The Pass 2 dialogue is the same as the Pass 1 dialogue except that the drives are tested in the reverse order. For example, if drives 2, 5, 3, and 7 were tested in that order during Pass 1, Pass 2 requests the drive numbers 3, 5, and 2. Drive 7 would not be requested since all tests were completed on that drive at the end of Pass 1. This is in accordance with the testing algorithm designed for a minimal number of cartridge changes. The program indicates the start of Pass 2 by printing the following message:

```
** STARTING PASS 2 **

LOAD PACK IN DRIVE 3 AND START THE DRIVE.
WHEN THE DRIVE IS READY TYPE :
```

On RSX-11M-PLUS systems, COMP displays two commands to logically mount the volume as foreign and to resume the task.

```
MOUNT DB3:/FOR<CR>
RESUME TT24   <CR>
```

On RSX-11M systems, COMP displays only the command to resume the task.

On both RSX-11M and RSX-11M-PLUS systems, COMP, continues with the following message:

```
THE DIAGNOSTIC WILL NOW SUSPEND:
```

The task then suspends itself. On both RSX-11M and RSX-11M-PLUS systems, load the pack or cartridge in the drive and ready the unit. When the drive-ready light is on, proceed to type the command(s) that COMP displayed.

On RSX-11M-PLUS systems only, type the command to mount the volume as foreign.

```
MOUNT DB3:/FOR (RET)
>
```

On both RSX-11M and RSX-11M-PLUS systems, type the command to resume the task.

```
>RESUME TT24 (RET)
>
```

The task then resumes execution.

The program then performs Pass 2 functions on this drive (described in Section 13.5.2, "Description of Pass 2 Tests"). The program then instructs the operator to unload the drive and move the pack to the next drive.

```
UNLOAD DRIVE 3 AND REMOVE THE PACK.

LOAD THE PACK IN DRIVE 5 AND START THE DRIVE.
WHEN THE DRIVE IS READY TYPE :
```

On RSX-11M-PLUS systems, COMP displays two commands to logically mount the volume as foreign and to resume the task.

```
MOUNT DB5:/FOR<CR>
RESUME TT24   <CR>
```

On RSX-11M systems, COMP displays only the command to resume the task.

On both RSX-11M and RSX-11M-PLUS systems, COMP continues with the following messages:

```
THE DIAGNOSTIC WILL NOW SUSPEND:
```

The task then suspends itself. On both RSX-11M and RSX-11M-PLUS systems, load the pack or cartridge in the drive and ready the unit. When the drive-ready light is on, proceed to type the command(s) that COMP displayed.

On RSX-11M-PLUS systems only, type the command to mount the volume as foreign.

```
MOUNT DB5:/FOR (RET)
>
```

On both RSX-11M and RSX-11M-PLUS systems, type the command to resume the task.

```
>RESUME TT24 (RET)
>
```

The task then resumes execution.

The operator performs these functions and, in the same manner, the program instructs the operator in the movement of the pack throughout the remaining drives. At the end of Pass 2, if all drives are compatible, the following message is printed:

```
** ALL DRIVES ARE COMPATIBLE **
```

Drives found to be incompatible will have appropriate error messages printed when the error is encountered (refer to Section 13.3, "Error Messages").

13.3 ERROR MESSAGES

Section 13.3.1 and 13.3.2 describe possible error conditions and recovery procedures.

13.3.1 Dialogue Errors

Any errors occurring because of an answer input by the operator are trapped by the program and the dialogue resumes at the question just asked after the operator is notified of the error condition. Help information is available for each question, where applicable, by typing carriage return.

13.3.2 Program Errors

Error messages give all pertinent information including good data, bad data, logical block number, cylinder, track, sector, and the operation being performed. All numbers are printed in decimal. The following is the format for error messages:

```
ERROR NO.= n
EXPECTED =
RECEIVED =

FUNCTION =          ERROR CODE = (or WORD)   LBN =
CYLINDER =          TRACK =                  SECTOR =
```

NOTE

On I/O errors, the ERROR CODE is printed. On compare errors, the ERROR WORD on which the compare failed is printed.

The ERROR NO.=n message is the test number being performed at the time of the error. The error number, n, can be any of the following test numbers:

TEST 1 - Writing the overwrite and compatibility groups

TEST 2 - Overwrite test

TEST 3 - Compatibility test

Refer to the operational description for an explanation of each of the above tests. The following is a list of the error messages:

DIAGNOSTIC DOES NOT SUPPORT OPERATING SYSTEM

The diagnostic only runs on the RSX-11M or RSX-11M-PLUS operating systems. This error occurs when the diagnostic is run on the RSTS/E, VAX/VMS, RSX-11D, or IAS operating systems.

DEVICE HANDLER NOT LOADED

The device driver does not reside in memory. The diagnostic aborts so that the driver can be loaded.

DEVICE MOUNTED OR ALLOCATED TO OTHER USER

Another user is using the device under test. On RSX-11M-PLUS, this error also occurs when the device is not mounted foreign. The diagnostic aborts so that the device can be allocated and/or mounted foreign.

LOGICAL UNIT NUMBER n DOES NOT EXIST

One of the unit numbers specified (n) does not exist. The program requests new unit numbers after the message is printed.

DEVICE XXn: HAS THE WRONG MAXIMUM LOGICAL BLOCK NUMBER

The maximum logical block number passed back by the Get LUN Directive (GLUN$) is not the number expected by the diagnostic. XX is the device mnemonic, and n is the logical unit number.

DRIVES n AND y ARE NOT THE SAME DEVICE TYPE

The unit numbers specified include two different device types (for example, RP04/5s and RP06s): n is the unit number of the first drive specified, and y is the unit number of the drive that is a different type.

MAKE DRIVE READY, TYPE <CR> WHEN READY TO CONTINUE

The drive is not ready (that is, the heads are not loaded). The program waits for the operator to make the drive ready and type carriage return to continue.

WRITE-ENABLE DRIVE, TYPE <CR> WHEN READY TO CONTINUE

The program attempted to write to a unit that is write protected. The program waits for the operator to write enable the drive and type carriage return to continue.

WARNING DBn: HAS A FILE STRUCTURED VOLUME **WARNING**

The disk cartridge being used is either a FILES-11 or DOS (XXDP) formatted disk. This message is used to warn the operator against accidentally writing on a file-structured disk. After the message is typed, the operator is asked whether to continue.

THE DISK PACK IN DRIVE n IS NOT THE PACK BEING USED FOR TESTING. REPLACE IT WITH THE TEST PACK, TYPE <CR> WHEN READY TO CONTINUE

This message is printed when a drive other than the first drive being tested is found to have a home block on it. Because the home block is destroyed during testing on the first drive, no home block should be found on any other drive being tested. The program will not continue until the test pack is loaded in drive n.

THE OVERWRITE GROUP COULD NOT BE WRITTEN.
or
THE COMPATIBILITY GROUP COULD NOT BE WRITTEN

This error occurs if either the overwrite or compatibility groups cannot be written after three retries. Because all bad blocks should have been found on the first drive tested by the worst case data pattern, the program assumes that there must be a hardware problem. The program exits so that the appropriate user mode diagnostic can be run.

COULD NOT FIND n CONTIGUOUS GROUPS OF GOOD CYLINDERS

Too many bad cylinders were discovered within a write-current zone. This message occurs during the Bad Block Check, performed on the first drive, when the overwrite and compatibility groups overlap. In the message, n is the number of contiguous cylinders that were needed. This value corresponds to the number of units under test. The error indicates that the disk cartridge cannot be used. The diagnostic exits when this error occurs.

DATA WRITTEN BY DRIVE y COULD NOT BE OVERWRITTEN BY DRIVE n

The drive under test has improper levels of write current. The unit number under test is n, and the number of the unit that initially wrote the data is y.

DATA WRITTEN BY DRIVE y WAS RECOVERED USING OFFSET o BY DRIVE n

During the compatibility test, offsets were needed to recover the data. The data was recovered within specifications (refer to Section 13.7.3, Retry Algorithm). The unit number under test, is n, the drive that wrote the data is y, and the offset that was used to recover the data is o. This message informs the operator that a problem may be developing. The operator should record this information, so that it can be compared against future runs of the diagnostic.

INCOMPATIBILITY FOUND:
DATA WRITTEN BY DRIVE y COULD NOT BE READ BY DRIVE n

The drive under test is not compatible with one of the other drives. The data could not be recovered within specifications (refer to Section 13.7.3, "Retry Algorithm"). The unit number under test is n, and the number of the unit that wrote the data is y.

13.4 FUNCTIONAL DESCRIPTION

The disk pack is segmented into seven zones, called write-current zones. The term "write-current" comes from the fact that within each zone, different amounts of write-current can be used to write on that area of the disk. Each write-current zone is divided into two groups called the overwrite group and the compatibility group. The first eight cylinders of each write-current zone are the cylinders used during the overwrite test. The last eight cylinders of each write-current zone (except for the innermost zone) are the cylinders used for the compatibility test.

Each logical drive writes and/or reads one cylinder in each group, one and the maximum number of sectors per track (test dependent), two groups in a write-current zone, and seven write-current zones on a pack. The entire test consists of two passes (Pass 1 and Pass 2) through the units selected for testing. Section 13.5 describes the operations of each pass in detail.

13.5 OPERATION DESCRIPTION

The main functional blocks of code in the program are assigned test numbers for the purpose of identification in error printouts. The following sections describe the Pass 1 and Pass 2 tests in test number order.

13.5.1 Description of Pass 1 Tests

1. Starting the diagnostic - The program requests the operator to enter up to eight unit numbers in octal. The program then checks to ensure that the units specified exist and are the same device type.

2. Mounting the test cartridge for Pass 1 - The operator mounts the pack on the drive specified by the program, and loads the heads. The operator performs the task and types the command(s) to continue (refer to Section 13.2.1, "Pass 1 Dialogue").

3. HOME-BLOCK CHECK - This test is performed on every drive before testing begins to check the volume for a home block (either a FILES-11 or DOS (XXDP) formatted disk). If a home block is found on the first drive, a warning message is printed and the operator is asked whether to continue. If a home block is found on any drive other than the first drive, this indicates that the test cartridge is not loaded. A warning message is printed and the operator is requested to mount the test cartridge.

4. BAD-BLOCK CHECK - This test is performed on the first drive tested. It writes and verifies the worst-case data pattern (refer to Section 13.6.3 for a description of the patterns) in each of the group of cylinders specified in Section 13.6.4. If a bad block is detected, the starting cylinder for the group is adjusted to point to another group of cylinders (refer to Section 13.7.2 "Bad Block Algorithm"). The operations are then repeated until either a good group of cylinders is found, or the overwrite and compatibility groups overlap. If the groups overlap, an error message is printed indicating the disk pack cannot be used.

5. TEST 1 - Writing the Overwrite and Compatibility Groups - The program writes and verifies all cylinders for this drive within the cylinder groups shown in Section 13.6.4 using a single pattern in Section 13.6.5. One cylinder in each overwrite and compatibility group is written by the current drive. There are 7 overwrite and 6 compatibility groups on a pack. In all, 13 cylinders are written by each drive. The cylinders written correspond to the logical drive number (drive 0 writes the first cylinder of each group, drive 1 writes the second cylinder of each group, and so forth). The cylinders written by each drive are shown in Section 13.6.7.

6. TEST 2 - Overwrite Test - The Overwrite Test checks that the drive under test is capable of successfully overwriting data previously written by any other drive. The program overwrites and verifies one sector in each cylinder of each overwrite group written by previous drives. The sector overwritten corresponds to the logical drive number under test. If this is the first drive, the overwrite test is not performed because the same drive would be overwriting. The

basic cylinder layout for each overwrite cylinder is shown in Section 13.6.6.

For example, if drives 2, 5, 3, and 7 are being checked for compatibility, and the drive currently under test is drive 3, then drive 3 will overwrite sector 2 of cylinders written by drives 2 and 5. The cylinders written by drive 7 would not be overwritten because they have not been written yet.

7. TEST 3 - Compatibility Test - The Compatibility Test checks that the drive under test is capable of successfully reading data previously written by any other drive. The program reads the cylinders in each compatibility group written by the previous drives and verifies the data. The read operation is performed after a seek from both the minimum and maximum cylinders to uncover any carriage problems. If this is the first drive, the compatibility test is not performed because the same drive would be reading.

   For example, if drives 2, 5, 3, and 7 are being checked for compatibility, and the current drive under test is 3, then drive 3 will read all sectors on cylinders written by drives 2 and 5.

8. Dismounting the test cartridge in Pass 1 - The operator unloads the drive and dismounts the pack, as directed by the program, to proceed with the steps on the next drive. If this is the last drive, the program starts Pass 2.

13.5.2 Description of Pass 2 Tests

In Pass 2, the drives are tested in the reverse order. The last drive that was tested in Pass 1, will not be requested in Pass 2 because all tests were completed on that drive at the end of Pass 1.

9. Mounting the test cartridge in Pass 2 - The operator mounts the pack in the drive specified by the program, and loads the heads. The operator performs the task and types the command(s) to continue (refer to Section 13.2.2, "Pass 2 Dialogue").

10. HOME-BLOCK CHECK - The volume is checked for a home block (either a FILES-11 or DOS (XXDP) formatted disk). If a home block is found, this indicates that the test cartridge is not loaded. A warning message is printed and the operator is requested to load the test pack.

11. TEST 2 - Overwrite Test - The program overwrites and verifies one sector in each cylinder of each overwrite group written by drives tested after the current drive in Pass 1.

    For example, if drives 2, 5, 3, and 7 were tested in Pass 1, and the current drive under test is drive 5, then drive 5 will overwrite sector 1 of cylinders written by drives 3 and 7. The cylinders written by drive 2 would not be overwritten because they were overwritten in Pass 1.

12. TEST 3 - Compatibility Test - The program reads the cylinders of each compatibility group written by drives tested after the current drive in Pass 1. The read operation is performed after a seek from both the minimum and maximum cylinders to uncover any carriage problems.

For example, if drives 2, 5, 3, and 7 were tested in Pass 1, and the current drive under test is drive 5, then drive 5 will read cylinders written by drives 3 and 7.

13. Dismounting the test cartridge in Pass 2 - The operator unloads the drive and dismounts the pack, as directed by the program, to proceed with the above steps on the next drive. If this is the last drive, going in the reverse order, then testing is complete.

13.5.3 Restrictions

The program is restricted to testing a maximum of eight disk drives at a time. The drives can be on the same or different controllers.

13.6 DESCRIPTION OF MAJOR MODULES

There are two modules for the disk drive compatibility diagnostic: a common disk function handler module and the main module that contains all other routines. The following sections explain each module in more detail.

13.6.1 Common Disk Function Handler

The common module contains the routines to convert a disk address to a logical block number (LBN), to check the LBN to ensure that it does not exceed the maximum LBN, and then to issue the function.

13.6.2 Main Module

The main module contains all other routines, other than the function handler, used by the diagnostic. The following list explains each routine and the operations it performs:

1. Input Routine - This routine requests the operator to enter the unit numbers of the drives to test and checks the number input to ensure that it is a valid number. If the number is invalid, help information is printed to assist the operator.

2. Device Check - This routine ensures that the unit numbers specified exist. If they do not, those numbers of the units that do not exist are printed at the terminal and the user is requested to input new unit numbers.

3. Table Search Routine - This routine searches a device table to determine whether the disk is supported and what the device type is. It then sets up the maximum parameters (LBN, cylinders, tracks, and sectors). It also ensures that all the units selected are the same device type. This is done by comparing the maximum LBN of each drive with the first drive specified. If the units are different (that is, RP04 and RP06), a message is printed indicating this and the operator is requested to enter new unit numbers.

4. Load and Unload Routines - These routines direct the operator in the loading and unloading of the disk cartridge to the appropriate drives.

5. Home-Block Routine - This routine is performed on every drive before testing begins. It checks for a home block (either a FILES-11 or DOS (XXDP) formatted disk). If a home block is found on the first drive tested in Pass 1, a warning message is printed and the operator asked whether to continue. If the drive is not the first drive being tested, a warning message is printed indicating that the test pack is not loaded. In this case, the operator is requested to load the test pack.

6. Bad Block Checking Routine - This routine is performed on the first drive tested during Pass 1. It writes and verifies the worst-case data pattern in each group of cylinders (refer to Table 13-2), to ensure that there are no bad blocks. If a bad block is encountered, the write-current zone is adjusted to point to another group of cylinders and the operation repeated (refer to Section 13.7.2, "Bad-Block Algorithm"). If there are too many bad cylinders within a write-current zone, a message is printed indicating that the disk pack cannot be used.

13.6.3 Worst-Case Data Pattern

Table 13-1 lists the pattern used for basic read/write test and bad-block checking routine. It occurs in the RP04/5/6 multidrive diagnostic and is the same pattern used by the BAD utility program. A repetition of the pattern is written and verified in each sector.

Table 13-1
Worst Case Data Pattern

Word No.	Data (octal)
0	165555
1	133333

13.6.4 Write-Current Zones Tables

Table 13-2 shows the cylinder breakdown of the disk for the write-current zones and the breakdown of each write-current zone for the overwrite and compatibility groups for the RP04/5. All values are in octal.

Table 13-2
Cylinder Group Assignment for a Given Surface

Disk	Write-Current Zone and Range (in octal)	Overwrite Cylinder Group Range (in octal)	Compatibility Cylinder Group Range (in octal)
RK05, RPR02	1 - 0-37	0 - 7	30 - 37
	2 - 40-77	40 - 47	70 - 77
	3 - 100-137	100-107	130-137
	4 - 140-177	140-147	170-177
	5 - 200-237	200-207	230-237
	6 - 240-277	240-247	270-277
	7 - 300-307	300-307	-
RK06, RP03, RP04/5	1 - 0-77	0 - 7	70 - 77
	2 - 100-177	100-107	170-177
	3 - 200-277	200-207	270-277
	4 - 300-377	300-307	370-377
	5 - 400-477	400-407	470-477
	6 - 500-577	500-507	570-577
	7 - 600-632	600-607	-
RK07, RM02/3, RP06	1 - 0-177	0-7	170-177
	2 - 200-377	200-207	370-377
	3 - 400-577	400-407	570-577
	4 - 600-777	600-607	770-777
	5 - 1000-1177	1000-1007	1170-1177
	6 - 1200-1377	1200-1207	1370-1377
	7 - 1400-1456	1400-1407	-

13.6.5 Random Data Pattern Table

Each word of Table 13-3 corresponds to the logical drive number (word 0 is used for the first drive, word 1 is used for the second drive, and so forth.) The following patterns also occur in the RM03 compatibility diagnostic.

Table 13-3
Random Data Pattern

Word Number	Data (Octal)
0	040135
1	177070
2	070414
3	064531
4	174473
5	062422
6	114352
7	036620

13.6.6 Basic Overwrite Cylinder Group Layout

This section shows the sectors of the first cylinder of an overwrite group written by the first logical drive under test. It then shows the sectors after each drive (assuming eight drives are being tested) has performed the overwrite test. If less than 8 drives are being tested, then additional sectors are simply not used.

The contents of the first cylinder in each overwrite group for the first drive include word 0 of the random data table.

SECTOR NUMBER	0	1	2	3	4	5	6	7
DATA PATTERN	0	0	0	0	0	0	0	0

Every other drive writes one sector within the cylinders written by the first drive. The sector overwritten by every other drive corresponds to the logical drive number under test (that is, logical drive 1 overwrites sector 1 and logical drive 2 overwrites sector 2). The pattern written by every other drive corresponds to a pattern from Table 13-3. After all drives have completed the overwrite test, the sectors look as follows:

SECTOR NUMBER	0	1	2	3	4	5	6	7
DATA PATTERN	0	1	2	3	4	5	6	7

This same operation is also performed on cylinders written by every other drive. This ensures that each drive can overwrite data written by every other drive.

13.6.7 Cylinders Table

Table 13-4 shows the cylinders written by each drive, assuming no bad blocks were found, in the overwrite and compatibility groups on each track.

Table 13-4
Cylinders Written (RK06, RP03, and RP04/5)

Drive No.	Overwrite Cylinders	Compatibility Cylinders
0	0,100,200,300,400,500,600	70,170,270,370,470,570
1	1,101,201,301,401,501,601	71,171,271,371,471,571
2	2,102,202,302,402,502,602	72,172,272,372,472,572
3	3,103,203,303,403,503,603	73,173,273,373,473,573
4	4,104,204,304,404,504,604	74,174,274,374,474,574
5	5,105,205,305,405,505,605	75,175,275,375,475,575
6	6,106,206,306,406,506,606	76,176,276,376,476,576
7	7,107,207,307,407,507,607	77,177,277,377,477,577

Refer to Table 13-2 to determine the cylinders that are written for all other disks.

13.7 KEY ALGORITHMS

The following algorithms are used throughout the disk drive compatibility diagnostic.

13.7.1 Determining Sectors Used by Each Drive

There is a counter that corresponds to the logical drive number under test (that is, 0 = first logical drive, 1 = second logical drive). The counter is added to the starting cylinder in each overwrite and compatibility group to determine the cylinder to read and/or write on each track. When the overwrite test is performed, the counter also determines the sector to overwrite on each cylinder in each overwrite group.

13.7.2 Bad-Block Algorithm

When the diagnostic checks for bad blocks, normal retries performed by the driver are inhibited. The write-current zones table is adjusted when any of the following errors occur:

1. WRITE-CHECK ERROR (IE.WCK) ; Only if enabled by MCR.
2. BAD BLOCK ERROR (IE.BBE)
3. PARITY OR SOFT ERROR (IE.VER)

This adjustment should ensure that all areas of the disk being used by the diagnostic are error free.

If a bad block is encountered in an overwrite group, the current cylinder+1 becomes the new starting cylinder for that group.

If a bad block is encountered in a compatibility group, the current cylinder (the number of units under test) becomes the new starting cylinder for that group.

13.7.3 Retry Algorithm

Normal retries performed by the driver are inhibited during any data transfer. If a read operation fails, the program performs three retries at centerline. If retries fail at centerline, then retries are performed with offsets. Table 13-5 lists the disks that support offset recovery, the maximum plus and minus offset to be used, and the offset increment.

Table 13-5
Maximum and Minimum Offsets

Device	Maximum Offset	Offset Increment
RK06	600	25.0
RK07	300	12.5
RM03	200	200.0
RP04/5	600	25.0
RP06	300	25.0

Two retries at each offset position are performed.

If the data is recoverable within the specified offsets, then a warning message is printed indicating that offsets were used and at which offset position the data was recovered. If the data is not recovered, then a message is printed indicating the drives that are incompatible.

APPENDIX A

HELP! THE SERVICE-MODE USER

A.1 GENERAL INFORMATION

As a service-mode user, you are expected to understand system concepts or to have the assistance of a systems programmer.

Each diagnostic chapter includes the following sections.

Customer-mode initiation

Test summary report

Device characteristics

Diagnostic description

Error messages (not applicable for terminal/line printer diagnostic)

Service-mode initiation

Console switch for intervention

Test-parameter selection

Service mode intervention/restart/termination

Interactive tests

You should be familiar with the entire applicable chapter and the performance of the diagnostic before initiating device testing.

Test-parameter selection is a major section as it details the various options available to you for the customization of the test sequence. Test-parameter selection is also the initiating facility for interactive testing, such as "rocking" a DECtape between two user-specified blocks or exercising a user-specified disk sector with a specific data pattern.

The reference sheet located at the rear of this manual is a quick-access information source for the knowledgeable service-mode user.

A.2 DIAGNOSTIC INITIATION

ERROR LOGGING SHUTOFF

Error information for any device under test is not accumulated by Error Logging during diagnostic execution; thus, you should always initiate a diagnostic at a hard-copy terminal to capture error reports and the test summary report.

INPUT LINE TERMINATION

Termination of any command or data-line input is indicated by RETURN.

WRONG DEVICE SELECTION

To protect against the selection of the wrong device and possible loss of data, you must enter the same device identification (device mnemonic and unit number) twice. The WARNING message and CONTINUE? pause are additional checks for you to verify that the device selected is the device you want tested.

NUMERICAL ENTRIES

Unless an inquiry specifies otherwise, any numerical entry can be expressed in decimal or octal radix. Decimal entries must be identified as such by a decimal point after the last digit.

MULTIPLE EXERCISE SELECTION

Multiple exercises selected from the test-parameter options are executed in the order of their selection codes; the exercise with the lowest octal code is executed first.

DIAGNOSTIC RESIDENCE

The initiation procedure assumes that the applicable diagnostic exists as a non-privileged, checkpointable task-image file on the system device (SY0:) under UIC [1,m] where "m" is 54 for a mapped system or 50 for an unmapped system. If the diagnostics were filed elsewhere, appropriate identification must be included in the RUN command.

DATA BUFFER SIZE

The diagnostic descriptions assume that the data buffer size was not changed at system generation from the default of 1024 bytes. This buffer controls the size of data transfers for most write and read operations initiated by the diagnostic.

A.3 ERROR MESSAGES

The following list describes messages that might be reported by MCR or by a diagnostic during initiation. To learn the significance of other messages, refer to the RSX-11M/M-PLUS MCR Operations Manual and the RSX-11M/M-PLUS Executive Reference Manual.

MCR Command Error Messages:

XXX -- SYNTAX ERROR

Format of entry to MCR is incorrect. Re-enter.

ALL -- DEVICE ALLOCATED TO OTHER USER[1]

Selected device is under control of another user. It cannot be allocated until that user deallocates it or logs out, or a privileged user deallocates it.

ALL -- DEVICE NOT IN SYSTEM[1]

Selected device was not specified during system generation. It cannot be tested by a User Mode Diagnostic.

ALL -- FEATURE NOT SUPPORTED

Indicates ALLOCATE command is not implemented for your system. Ignore message and proceed with initiation.

ALL -- PUBLIC DEVICE[1]

Selected device has been declared a public device. It cannot be allocated by any user until it is declared to be a nonpublic device.

HEL -- INVALID ACCOUNT[1]

The name or UIC specified is not present in the account file, or the password given is incorrect.

HEL -- OTHER USER LOGGED ON[1]

Another user left this terminal in logged-in state. It cannot be used until it is logged out by the BYE command.

HEL -- TERMINAL ALLOCATED TO OTHER USER[1]

This terminal has been allocated to another user. It cannot be used until that user deallocates it or logs out, or a privileged user deallocates it.

---

[1] The related command thus this error message are valid only for multiuser protection systems.

INS -- FILE NOT FOUND

The specified diagnostic was not build and made part of the system at system generation, or the UMD task-image files are not present on SY: at [1,m] where m is 50 for an unmapped system or 54 for a mapped system.

MCR -- NOT LOGGED IN[1]

Multiuser protection system requires that you log-in at the terminal with the HELLO command before issuing any command other than HELP.

DIAGNOSTIC ERROR MESSAGES

The following error messages might be reported after control has been passed from MCR to the selected diagnostic.

* DEVICE OFFLINE *

Selected device is not physically or logically available.

* DEVICE MOUNTED OR ALLOCATED TO OTHER USER *

Indicates that volume on selected device is mounted (must be dismounted for diagnostic testing), or that device has been allocated to another user (this case assumes that you did not issue the ALLOCATE command, multiuser protection system only).

* ILLEGAL FUNCTION (MAY BE WRONG DIAGNOSTIC) *

Indicates that the wrong diagnostic was initiated.

* DEVICE OR DRIVER NOT AVAILABLE FOR DIAGNOSTICS *

Selected device or its associated driver with diagnostic capabilities is not in the system.

* INVALID DEVICE OR UNIT *

Device identification (mnemonic and/or unit number) is not correct.

* ONLY SWITCHES 0-15 ALLOWED *

Indicates that you entered a switch number greater than 15 (decimal) in response to the inquiry "CONSOLE SWITCH FOR...".

---

[1] The related command and thus this error message are valid only for multiuser protection systems.

A.4 MULTIDEVICE TESTING

Should you wish to initiate concurrent execution of multiple diagnostics from the same terminal, each RUN command must include an explicit task name, and a unique console switch must be assigned to each diagnostic for intervention. The following sequence illustrates initiation for concurrent testing of a TU10 tape transport and a RK05 disk.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE MT2:
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT MT2:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $TU10/TASK=MT2

START TU10 DIAGNOSTIC...

DEVICE?  MT2
  **WARNING**...
CONTINUE?  SERVICE
TEST PARAMETERS (OCTAL)=4001
CONSOLE SWITCH FOR INTERVENTION(DECIMAL)=15
```

The tape diagnostic executes the full-tape data reliability exercise until you intervene by setting switch 15.

On both RSX-11M and RSX-11M-PLUS systems, allocate the device.

```
>ALLOCATE DK0:
```

On RSX-11M-PLUS systems only, logically mount the volume as foreign.

```
>MOUNT DK0:/FOR
```

On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.

```
>RUN $RK05/TASK=DK0

START RK05 DIAGNOSTIC...

DEVICE?  DK0
  *WARNING**...
CONTINUE?  SERVICE
TEST PARAMETERS (OCTAL)=2002
CONSOLE SWITCH FOR INTERVENTION(DECIMAL)=0
WORD COUNT=256.
DO YOU WISH TO SPECIFY THE SECTOR ADDRESS?  Y
CYLINDER=11.
TRACK=0
SECTOR=4
PATTERN NO.=4
WRITE?  Y
READ?  Y
```

The disk diagnostic exercises the specified sector with a random-data pattern until you intervene with switch 0.

Error messages and summary reports from the diagnostics may be interspersed at the terminal, but they will be explicitly identified by device and unit number.

A.5 DIAGNOSTIC TERMINATION

The test sequence selected from the test parameter options runs to completion and exits. If multi-pass or interactive testing were selected, the test continues until you intervene with the console switch and/or terminate the test. The following describes the various termination methods available to the service-mode user.

One termination method is to intervene with the console switch and respond with 0 to TEST PARAMETERS (OCTAL)=. The test summary report for the current pass will be produced before the diagnostic exits.

You may also use the MCR ABORT command at any time (be sure to include the task name if one was assigned during initiation).

(CTRL/C)
MCR>ABORT or ABORT DK0

The current-pass test summary report will not be produced.

Another termination method is to respond with CTRL/Z to any inquiry. The current-pass test summary report will not be produced.

A.6 LOGICAL BLOCK NUMBERS FROM PHYSICAL ADDRESSES

A disk sector is identified by its physical address (sector-track-cylinder numbers) in diagnostic error messages. Should you wish to register the sector as being bad via the BAD option of the INITVOLUME command[1], you must convert the physical address to a logical block number (LBN), as follows.

LBN = (((cyl no.*trk's/cyl)+trk no.)sec's/trk)+sec no.

where all values are decimal.

For example, an RP06 sector (see Section 3.2 for RP06 data-capacity parameters) with the address of

Cylinder = 000536(octal), 350 (decimal)

Track = 000016(octal), 14 (decimal)

Sector = 000013(octal), 11 (decimal)

is logical block number 146619, computed as follows.

```
LBN = (((350*19)+14)*22)+11
    = (6650+14)*22+11
    = 146608+11

    = 146619
```

[1] Refer to the RSX-11M/M-PLUS MCR Operations Manual for descriptions of commands.

APPENDIX B

BIT MAPS FOR DEVICE-CONTROLLER REGISTERS

This appendix helps you decipher the significance of the register contents displayed in the error messages. Tables B-1 through B-9 define the meaning of the bit positions for the applicable registers. They are device specific, as follows.

Device	Table Reference
Cartridge Disks:	
RK05(RK05F)	B-1
RK06	B-2
Pack Disks:	
RP02,RPR02,RP03	B-3
RP04,RP05,RP06	B-4
Fixed-Head Disks:	
RF11	B-5
RS03,RS04	B-6
Magnetic Tape Units:	
TS03,TU10	B-7
TU16,TU45	B-8
DECtape Unit:	
TU56	B-9

These tables have an indexing format for ease of access to a specific bit mnemonic. The following is an example. Assume that the RK05 diagnostic has produced an error message in which the contents of the Error Register (RKER) are displayed as octal 100400. To determine the meaning of the "set" bits, use the Octal Index in Table B-1 to establish the horizontal positions for the octal values 100000 and 400, and then search across to the bit-map for RKER (registers are in alphabetic order by mnemonics) to find that 100000 indicates DRE (drive error) and 400 indicates TE (timing error).

BIT MAPS FOR DEVICE-CONTROLLER REGISTERS

NOTE

The 6-digit octal index values in the tables each have a space inserted for ease of visual recognition. The spaces have no significance.

Table B-10 defines the meaning of the various mnemonics appearing in the register bit-maps.

Table B-1
RK05(RK05F) Controller Registers

Octal Index	RKBA	RKCS	RKDA	RKDS	RKER	RKWC	Bit
100 000	BA15	ERR	US02	ID02	DRE	WC15	15
040 000	BA14	HE	US01	ID01	OVR	WC14	14
020 000	BA13	SCP	US00	ID00	WLO	WC13	13
010 000	BA12	0	CA07	DPL	SKE	WC12	12
004 000	BA11	BAI	CA06	RK05	PGE	WC11	11
002 000	BA10	FMT	CA05	DRU	NEM	WC10	10
001 000	BA09	0	CA04	SIN	DLT	WC09	9
000 400	BA08	SSE	CA03	SOK	TE	WC08	8
000 200	BA07	RDY	CA02	DRY	NED	WC07	7
000 100	BA06	IDE	CA01	ARDY	NEC	WC06	6
000 040	BA05	MEX01	CA00	WPS	NES	WC05	5
000 020	BA04	MEX00	SUR	SC=SA	0	WC04	4
000 010	BA03	F02	SA03	SC03	0	WC03	3
000 004	BA02	F01	SA02	SC02	0	WC02	2
000 002	BA01	F00	SA01	SC01	CSE	WC01	1
000 001	BA00	GO	SA00	SC00	WCE	WC00	0

Table B-2
RK06 Controller Registers

Octal Index	RKAS/OF	RKBA	RKCS1	RKCS2	Bit
100 000	ATN07	BA15	ERR	DLT	15
040 000	ATN06	BA14	DI	WCE	14
020 000	ATN05	BA13	DCPAR	UPE	13
010 000	ATN04	BA12	CFMT	NED	12
004 000	ATN03	BA11	CTO	NEM	11
002 000	ATN02	BA10	CDT	PGE	10
001 000	ATN01	BA09	BA17	MDS	9
000 400	ATN00	BA08	BA16	UFE	8
000 200	0	BA07	RDY	OR	7
000 100	OFS06	BA06	IE	IR	6
000 040	OFS05	BA05	0	SCLR	5
000 020	OFS04	BA04	F03	BAI	4
000 010	OFS03	BA03	F02	RLS	3
000 004	OFS02	BA02	F01	US02	2
000 002	OFS01	BA01	F00	US01	1
000 001	OFS00	BA00	GO	US00	0

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Table B-2 (Cont.)
RK06 Controller Registers

Octal Index	RKDA	RKDB	RKDC	RKDS	Bit
100 000	0	DB15	0	SVAL	15
040 000	0	DB14	0	CDA	14
020 000	0	DB13	0	PIP	13
010 000	0	DB12	0	0	12
004 000	0	DB11	0	WRL	11
002 000	TA02	DB10	0	0	10
001 000	TA01	DB09	DC09	0	9
000 400	TA00	DB08	DC08	DDT	8
000 200	0	DB07	DC07	DRDY	7
000 100	0	DB06	DC06	VV	6
000 040	0	DB05	DC05	DROT	5
000 020	SA04	DB04	DC04	SPLS	4
000 010	SA03	DB03	DC03	ACLO	3
000 004	SA02	DB02	DC02	OFST	2
000 002	SA01	DB01	DC01	0	1
000 001	SA00	DB00	DC00	DRA	0

Octal Index	RKECPS	RKECPT	RKER	RKMR1	Bit
100 000	0	0	DCK	RDGATE	15
040 000	0	0	UNS	WRGATE	14
020 000	0	0	OPI	ECCW	13
010 000	EPO12	0	DTE	PCD	12
004 000	EPO11	0	WLE	PCA	11
002 000	EPO10	EPA10	IDAE	MEWD	10
001 000	EPO09	EPA09	COE	MERD	9
000 400	EPO08	EPA08	HVRC	MCLK	8
000 200	EPO07	EPA07	BSE	MIND	7
000 100	EPO06	EPA06	ECH	MSP	6
000 040	EPO05	EPA05	DTYE	DMD	5
000 020	EPO04	EPA04	FMTE	PAT	4
000 010	EPO03	EPA03	DRPAR	MS03	3
000 004	EPO02	EPA02	NXF	MS02	2
000 002	EPO01	EPA01	SKI	MS01	1
000 001	EPO00	EPA00	ILF	MS00	0

Octal Index	RKMR2-0	RKMR2-1	RKMR2-2	RKMR2-3	Bit
100 000	PAR	PAR	PAR	PAR	15
040 000	DSC	UNLD HDS	0	DSN3	14
020 000	PIP	RTZ	0	DSN3	13
010 000	SPON	LD HDS	OFS08	DSN3	12
004 000	WRLK	REV	OFS07	DSN3	11
002 000	OFFON	FWD	OFS06	DSN2	10
001 000	FMT	SPDOK	OFS05	DSN2	9
000 400	DTYE	CRTP	OFS04	DSN2	8
000 200	DRDY	DRLCH	OFS03	DSN2	7
000 100	VV	BHME	OFS02	DSN1	6

(continued on next page)

Table B-2 (Cont.)
RK06 Controller Registers

Octal Index	RKMR2-0	RKMR2-1	RKMR2-2	RKMR2-3	Bit
000 040	DRA	HDHME	OFS01	DSN1	5
000 020	0	TKFOK	OFS00	DSN1	4
000 010	0	0	0	DSN1	3
000 004	US02	US02	US02	US02	2
000 002	US01	US01	US01	US01	1
000 001	US00	US00	US00	US00	0

Octal Index	RKMR3-0	RKMR3-1	RKMR3-2	RKMR3-3	RKWC	Bit
100 000	PAR	PAR	PAR	PAR	WC15	15
040 000	UNS	SERVO BRAKE	0	0	WC14	14
020 000	DROT	SK LIMIT	0	0	WC13	13
010 000	SPLS	SK NO MO	CA08	0	WC12	12
004 000	WLE	PLO ERR	CA07	DECODED	WC11	11
002 000	SKI	TRIBIT ERR	CA06	HEAD	WC10	10
001 000	CDPAR	INDEX ERR	CA05	ADDRESS	WC09	9
000 400	ILF	MLT HD SEL	CA04	SC04	WC08	8
000 200	FLT	HD FLT	CA03	SC03	WC07	7
000 100	ACLO	WRGT NXFR	CA02	SC02	WC06	6
000 040	IVDA	WRCUR NWRGT	CA01	SC01	WC05	5
000 020	0	SECT ERR	CA00	SC00	WC04	4
000 010	0	0	0	0	WC03	3
000 004	0	0	0	0	WC02	2
000 002	0	0	1	1	WC01	1
000 001	0	1	0	1	WC00	0

Table B-3
RP02-RPR02-RP03 Controller Registers

Octal Index	SUCA	RPBA	RPCA	RPCS	Bit
100 000	0	BA15	0	ERR	15
040 000	0	BA14	0	HE	14
020 000	0	BA13	0	AIE	13
010 000	0	BA12	0	MODE	12
004 000	0	BA11	0	HDR	11
002 000	0	BA10	0	US02	10
001 000	0	BA09	0	US01	9
000 400	CA08	BA08	CA08	US00	8
000 200	CA07	BA07	CA07	RDY	7
000 100	CA06	BA06	CA06	IDE	6
000 040	CA05	BA05	CA05	MEX01	5
000 020	CA04	BA04	CA04	MEX00	4
000 010	CA03	BA03	CA03	F02	3
000 004	CA02	BA02	CA02	F01	2
000 002	CA01	BA01	CA01	F00	1
000 001	CA00	BA00	CA00	GO	0

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Table B-3 (Cont.)
RP02-RPR02-RP03 Controller Registers

Octal Index	RPDA	RPDS	RPER	RPWC	Bit
100 000	0	DRDY	WPV	WC15	15
040 000	0	OL	FUV	WC14	14
020 000	0	RP03	NEC	WC13	13
010 000	TA04	HNF	NET	WC12	12
004 000	TA03	SKI	NES	WC11	11
002 000	TA02	SKU	PGE	WC10	10
001 000	TA01	DUNS	FMTE	WC09	9
000 400	TA00	WLO	MDER	WC08	8
000 200	SOT03	ATN07	LPE	WC07	7
000 100	SOT02	ATN06	WPE	WC06	6
000 040	SOT01	ATN05	CSE	WC05	5
000 020	SOT00	ATN04	TE	WC04	4
000 010	SA03	ATN03	WCE	WC03	3
000 004	SA02	ATN02	NEM	WC02	2
000 002	SA01	ATN01	EOP	WC01	1
000 001	SA00	ATN00	DERR	WC00	0

Table B-4
RP04-RP05-RP06 Controller Registers

*=indicates mnemonic or bit condition unique to the RP06.

Octal Index	RPAS	RPBA	RPCC	RPCS1	Bit
100 000	0	BA15	0	SC	15
040 000	0	BA14	0	TRE	14
020 000	0	BA13	0	MCPE	13
010 000	0	BA12	0	0	12
004 000	0	BA11	0	DRA	11
002 000	0	BA10	0	PSEL	10
001 000	0	BA09	0(CC09*)	BA17	9
000 400	0	BA08	CC08	BA16	8
000 200	ATA07	BA07	CC07	RDY	7
000 100	ATA06	BA06	CC06	IE	6
000 040	ATA05	BA05	CC05	F04	5
000 020	ATA04	BA04	CC04	F03	4
000 010	ATA03	BA03	CC03	F02	3
000 004	ATA02	BA02	CC02	F01	2
000 002	ATA01	BA01	CC01	F00	1
000 001	ATA00	BA00	CC00	GO	0

Octal Index	RPCS2	RPDA	RPDB	RPDC	Bit
100 000	DLT	0	DB15	0	15
040 000	WCE	0	DB14	0	14
020 000	PE	0	DB13	0	13

(continued on next page)

Table B-4 (Cont.)
RP04-RP05-RP06 Controller Registers

*=indicates mnemonic or bit condition unique to the RP06.

Octal Index	RPAS	RPBA	PRCC	RPCS1	Bit
010 000	NED	TA04	DB12	0	12
004 000	NEM	TA03	DB11	0	11
002 000	PGE	TA02	DB10	0	10
001 000	MXF	TA01	DB09	0(DC09*)	9
000 400	MDPE	TA00	DB08	DC08	8
000 200	OR	0	DB07	DC07	7
000 100	IR	0	DB06	DC06	6
000 040	CLR	0	DB05	DC05	5
000 020	PAT	SA04	DB04	DC04	4
000 010	BAI	SA03	DB03	DC03	3
000 004	US02	SA02	DB02	DC02	2
000 002	US01	SA01	DB01	DC01	1
000 001	US00	SA00	DB00	DC00	0

Octal Index	RPDS	RPDT	RPEC1	RPEC2	Bit
100 000	ATA	0	0	0	15
040 000	ERR	0	0	0	14
020 000	PIP	MOH	0	0	13
010 000	MOL	0	EP012	0	12
004 000	WRL	DRQ	EP011	EPA11	11
002 000	LST	0	EP010	EPA10	10
001 000	PGM	0	EP009	EPA09	9
000 400	DPR	DT08	EP008	EPA08	8
000 200	DRY	DT07	EP007	EPA07	7
000 100	VV(0*)	DT06	EP006	EPA06	6
000 040	DE1(0*)	DT05	EP005	EPA05	5
000 020	DL64(0*)	DT04	EP004	EPA04	4
000 010	GRV(0*)	DT03	EP003	EPA03	3
000 004	DIGB(0*)	DT02	EP002	EPA02	2
000 002	DF20(0*)	DT01	EP001	EPA01	1
000 001	DF5(0*)	DT00	EP000	EPA00	0

Octal Index	RPER1	RPER2	RPER3	RPLA	Bit
100 000	DCK	ACU(0*)	OCYL	0	15
040 000	UNS	0	SKI	0	14
020 000	OPI	PLU	0(OPE*)	0	13
010 000	DTE	3OVU(0*)	0	0	12
004 000	WLE	IXE	0	0	11
002 000	IAE	NHS	0	SC04	10
001 000	AOE	MHS	0	SC03	9
000 400	HCRC	WRU	0	SC02	8
000 200	HCE	FEN(ABS*)	0	SC01	7
000 100	ECH	TUF	ACL	SC00	6

(continued on next page)

Table B-4 (Cont.)
RP04-RP05-RP06 Controller Registers

*=indicates mnemonic or bit condition unique to the RP06.

Octal Index	RPER1	RPER2	RPER3	RPLA	Bit
000 040	WCF	TDF	DCL	EXT1(EXT05*)	5
000 020	FER	MSE(RAW*)	0(35F*)	EXT0(EXT04*)	4
000 010	PAR	CSU	UWR(0*)	0(EXT03*)	3
000 004	RMR	WSU	0	0(EXT02*)	2
000 002	ILR	CSF	VUF(WAO*)	0(EXT01*)	1
000 001	ILF	WCU	PSU(DCU*)	0(EXT00*)	0

Octal Index	RPMR	RPOF	RPSN	RPWC	Bit
100 000	0	SCG	DSN4	WC15	15
040 000	0	0	DSN4	WC14	14
020 000	0	0	DSN4	WC13	13
010 000	0	FMT22	DSN4	WC12	12
004 000	0	ECI	DSN3	WC11	11
002 000	0(HCD*)	HCI	DSN3	WC10	10
001 000	SBD	0	DSN3	WC09	9
000 400	DFE	0	DSN3	WC08	8
000 200	DEN	OFS07	DSN2	WC07	7
000 100	ECCE	OFS06	DSN2	WC06	6
000 040	MWR	OFS05	DSN2	WC05	5
000 020	MRD	OFS04	DSN2	WC04	4
000 010	MSCLK	OFS03	DSN1	WC03	3
000 004	MIND	OFS02	DSN1	WC02	2
000 002	MCLK	OFS01	DSN1	WC01	1
000 001	DMD	OFS00	DSN1	WC00	0

Table B-5
RF11 Controller Registers

Octal Index	RFBA	RFCS	RFDA	RFER	RFWC	Bit
100 000	CA15	ERR	TA04	APE	WC15	15
040 000	CA14	FRZ	TA03	ATER	WC14	14
020 000	CA13	WCE	TA02	BTER	WC13	13
010 000	CA12	DPE	TA01	CTER	WC12	12
004 000	CA11	NED	TA00	0	WC11	11
002 000	CA10	WLO	WA10	NEM	WC10	10
001 000	CA09	MXF	WA09	0	WC09	9
000 400	CA08	DCLR	WA08	CMA-INH	WC08	8
000 200	CA07	RDY	WA07	DRL	WC07	7
000 100	CA06	INT-EN	WA06	0	WC06	6
000 040	CA05	XM1	WA05	DA03	WC05	5
000 020	CA04	XM0	WA04	DA02	WC04	4
000 010	CA03	MA	WA03	DA01	WC03	3
000 004	CA02	F01	WA02	DA00	WC02	2
000 002	CA01	F00	WA01	TA06	WC01	1
000 001	CA00	GO	WA00	TA05	WC00	0

Table B-6
RS03-RS04 Controller Registers

Octal Index	RSAS	RSBA	RSCS1	RSCS2	Bit
100 000	0	BA15	SC	DLT	15
040 000	0	BA14	TRE	WCE	14
020 000	0	BA13	MCPE	UPE	13
010 000	0	BA12	0	NED	12
004 000	0	BA11	DVA	NEM	11
002 000	0	BA10	PSEL	PGE	10
001 000	0	BA09	A17	MXF	9
000 400	0	BA08	A16	MDPE	8
000 200	ATA07	BA07	RDY	OR	7
000 100	ATA06	BA06	IE	IR	6
000 040	ATA05	BA05	F04	CLR	5
000 020	ATA04	BA04	F03	PAT	4
000 010	ATA03	BA03	F02	BAI	3
000 004	ATA02	BA02	F01	US02	2
000 002	ATA01	BA01	F00	US01	1
000 001	ATA00	BA00	GO	US00	0

Octal Index	RSDA	RSDS	RSER	RSWC	Bit
100 000	SP03	ATA	DCK	WC15	15
040 000	SP02	ERR	UNS	WC14	14
020 000	SP01	PIP	OPI	WC13	13
010 000	SP00	MOL	DTE	WC12	12
004 000	TA05	WRL	WLE	WC11	11
002 000	TA04	LBT	IAE	WC10	10
001 000	TA03	0	AO	WC09	9
000 400	TA02	DPR	0	WC08	8
000 200	TA01	DRY	0	WC07	7
000 100	TA00	0	0	WC06	6
000 040	SA05	0	0	WC05	5
000 020	SA04	0	0	WC04	4
000 010	SA03	0	PAR	WC03	3
000 004	SA02	0	RMR	WC02	2
000 002	SA01	0	ILR	WC01	1
000 001	SA00	0	ILF	WC00	0

Table B-7
TU10-TS03 Control Registers

Octal Index	MTBRC	MTC	MTCMA	Bit
100 000	BRC15	ERR	CMA15	15
040 000	BRC14	DEN8	CMA14	14
020 000	BRC13	DEN5	CMA13	13
010 000	BRC12	PWRCLR	CMA12	12
004 000	BRC11	PEVN	CMA11	11

(continued on next page)

Table B-7 (Cont.)
TU10-TS03 Control Registers

Octal Index	MTBRC	MTC	MTCMA	Bit
002 000	BRC10	US02	CMA10	10
001 000	BRC09	US01	CMA09	9
000 400	BRC08	US00	CMA08	8
000 200	BRC07	CUR	CMA07	7
000 100	BRC06	IE	CMA06	6
000 040	BRC05	0	CMA05	5
000 020	BRC04	0	CMA04	4
000 010	BRC03	F02	CMA03	3
000 004	BRC02	F01	CMA02	2
000 002	BRC01	F00	CMA01	1
000 001	BRC00	GO	CMA00	0

Octal Index	MTD	MTRD	MTS	Bit
100 000	RDB07	TIMER	ILC	15
040 000	RDB06	CHAR.SEL.	EOF	14
020 000	RDB05	BTE GEN	CRE	13
010 000	RDB04	GAP SHUTDN	PAE	12
004 000	RDB03	0	BGL	11
002 000	RDB02	0	EOT	10
001 000	RDB01	0	RLE	9
000 400	PARITY	PARITY	BTE	8
000 200	DB07	DATA07	NEM	7
000 100	DB06	DATA06	SELR	6
000 040	DB05	DATA05	BOT	5
000 020	DB04	DATA04	7CH	4
000 010	DB03	DATA03	SDWN	3
000 004	DB02	DATA02	WRL	2
000 002	DB01	DATA01	RWS	1
000 001	DB00	DATA00	TUR	0

Table B-8
TU16-TU45 Control Registers

Octal Index	MTAS	MTBA	MTCK (NRZI)	MTCK (PE)	MTCS1	Bit
100 000	0	BA15	0	0	SC	15
040 000	0	BA14	0	0	TRE	14
020 000	0	BA13	0	0	MCPE	13
010 000	0	BA12	0	0	0	12
004 000	0	BA11	0	0	DVA	11
002 000	0	BA10	0	0	PSEL	10
001 000	0	BA09	0	0	0	9
000 400	0	BA08	CRCP	DTKP	0	8
000 200	ATA07	BA07	CRC07	DTK07	RDY	7
000 100	ATA06	BA06	CRC06	DTK06	IE	6

(continued on next page)

Table B-8 (Cont.)
TU16-TU45 Control Registers

Octal Index	MTAS	MTBA	MTCK (NRZI)	MTCK (PE)	MTCS1	Bit
000 040	ATA05	BA05	CRC05	DTK05	F04	5
000 020	ATA04	BA04	CRC04	DTK04	F03	4
000 010	ATA03	BA03	CRC03	DTK03	F02	3
000 004	ATA02	BA02	CRC02	DTK02	F01	2
000 002	ATA01	BA01	CRC01	DTK01	F00	1
000 001	ATA00	BA00	CRC00	DTK00	GO	0

Octal Index	MTCS2	MTDB	MTDS	MTDT	MTER	Bit
100 000	DLT	DB15	ATA	1	COR/CRC	15
040 000	WCE	DB14	ERR	1	UNS	14
020 000	UPE	DB13	PIP	0	OPI	13
010 000	NED	DB12	MOL	0	DTE	12
004 000	NEM	DB11	WRL	0	NXF	11
002 000	PGE	DB10	EOT	SPR	CS/ITM	10
001 000	MXF	DB09	0	0	FCE	9
000 400	MDPE	DB08	DPR	DT08	NSG	8
000 200	OR	DB07	DRY	DT07	PEF/LRC	7
000 100	IR	DB06	SSC	DT06	INC/VPE	6
000 040	CLR	DB05	PES	DT05	DPAR	5
000 020	PAT	DB04	SDWN	DT04	FMT	4
000 010	BAI	DB03	IDB	DT03	CPAR	3
000 004	US02	DB02	TM	DT02	RMR	2
000 002	US01	DB01	BOT	DT01	ILR	1
000 001	DS00	DB00	SLA	DT00	ILF	0

Octal Index	MTFC	MTMR	MTSN	MTTC	MTWC	Bit
100 000	FC15	MDF08	DSN3	ACCL	WC15	15
040 000	FC14	MDF07	DSN3	FCS	WC14	14
020 000	FC13	MDF06	DSN3	TCW	WC13	13
010 000	FC12	MDF05	DSN3	EAODTE	WC12	12
004 000	FC11	MDF04	DSN2	0	WC11	11
002 000	FC10	MDF03	DSN2	DEN02	WC10	10
001 000	FC09	MDF02	DSN2	DEN01	WC09	9
000 400	FC08	MDF01	DSN2	DEN00	WC08	8
000 200	FC07	MDF00	DSN1	FMTSEL03	WC07	7
000 100	FC06	200BPI	DSN1	FMTSEL02	WC06	6
000 040	FC05	MC	DSN1	FMTSEL01	WC05	5
000 020	FC04	MOP03	DSN1	FMTSEL00	WC04	4
000 010	FC03	MOP02	DSN0	EVPAR	WC03	3
000 004	FC02	MOP01	DSN0	SS02	WC02	2
000 002	FC01	MOP00	DSN0	SS01	WC01	1
000 001	FC00	MM	DSN0	SS00	WC00	0

Table B-9
TU56 Controller Registers

Octal Index	TCBA	TCCM	TCST	TCWC	Bit
100 000	BA15	ERR	ENDZ	WC15	15
040 000	BA14	0	PAR	WC14	14
020 000	BA13	MAINT	MTE	WC13	13
010 000	BA12	DINHB	ILO	WC12	12
004 000	BA11	REV	SELE	WC11	11
002 000	BA10	US02	BLKM	WC10	10
001 000	BA09	US01	DATM	WC09	9
000 400	BA08	US00	NEM	WC08	8
000 200	BA07	DRY	UPS	WC07	7
000 100	BA06	IE	CLK	WC06	6
000 040	BA05	BA17	MMT	WC05	5
000 020	BA04	BA16	DT0	WC04	4
000 010	BA03	F02	DT1	WC03	3
000 004	BA02	F01	DT2	WC02	2
000 002	BA01	F00	XD17	WC01	1
000 001	BA00	GO	XD16	WC00	0

Table B-10
Glossary of Register Mnemonics

ABS	Abnormal stop
ACCL	Acceleration
ACL	AC low or interrupted
ACLO	AC low or interrupted
ACU	AC unsafe
AIE	Attention interrupt enable
AOE	Address overflow error
APE	Address parity error
ARDY	Access ready
ATA	Attention active
ATER	A-track timing error
ATN	Attention
BA	Bus address
BAI	Bus-address increment inhibit
BGL	Bus gate late

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

BHME	Brushes home
BLKM	Block missed
BOT	Beginning of tape
BRCn	Byte record count
BSE	Bad-sector error
BTE	Bad-tape error
BTE GEN	BTE error generation
BTER	B-track timing error
CA	Cylinder address
CC	Character check
CDA	Current drive attention
CDPAR	Controller-to-drive parity
CDT	Controller drive type
CFMT	Controller format
CLK	Maintenance clock
CLR	Controller clear
CMA	Current memory address
CMA-INH	Current memory address, inhibit incrementing
COE	Cylinder overflow error
COR/CRC	Correctable data error, or CRC error
CPAR	Control-bus parity error
CRC	Cyclic redundancy check
CRCP	CRC parity
CRE	Cyclic redundancy error
CRTP	Cartridge present
CS/ITM	Correctable skew, or illegal tape mark
CSE	Checksum error
CSF	Current sink failure

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

CSU	Current sink unsafe
CTER	C-track timing error
CTO	Controller timeout error
CUR	Control unit ready
DATM	Data missed
DB	Data bus
DC	Desired cylinder
DCK	Data check error
DCL	DC low or interrupted
DCLD	Disk clear
DCPAR	Drive-to-controller parity
DDT	Disk drive type
DENn	Density select
DERR	Disk error. OR of header not found and seek incomplete
DEl	Difference equals 1
DFE	Data field envelope
DF5	Drive forward at 5 inches/second
DF20	Drive forward at 20 inches/second
DI	Drive interrupt
DIGB	Drive to inner guard band
DINHB	Delay inhibit
DL64	Difference less than 64
DLT	Data late error
DMD	Diagnostic mode
DPAR	Data bus parity error
DPE	Data parity error
DPL	Drive power low
DPR	Drive present

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

DRA	Drive available
DRE	Drive error
DRL	Data request late
DRLCH	Door latched
DROT	Drive off track
DRPAR	Drive parity error
DRQ	Drive request required
DRU	Drive unsafe
DRDY	Device ready
DRY	Device ready
DSC	Drive status change
DSNn	Device serial number (BCD)
DTn	Drive type
DTE	Drive timing error
DTKn	Dead track
DTKP	Dead track parity
DTYE	Drive type error
DUNS	Drive unit unsafe
EAODTE	Enable abort on data transfer error
ECCW	ECC word
ECH	Error correction hard
ECI	Error correction inhibit
ENDZ	End zone detected
EOF	End of file
EOP	End of pack
EOT	End of tape
EPA	ECC pattern data
EPO	ECC position data

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

ERR	OR of subsystem errors
EVPAR	Even parity
EXTn	Encoded extension field
Fn	Function select
FCn	Frame count
FCE	Frame count error
FCS	Frame count status
FEN	Failsafe enabled
FER	Format error
FLT	Fault
FMT	Format select
FMTE	Format error
FMTSEL	Format select
FMT22	Format select
FRZ	Freeze
FUV	File unsafe violation
FWD	Forward direction
GO	New function issued
GRV	Go reverse
HCE	Header compare error
HCI	Header compare inhibit
HCRC	Header CRC error
HD FLT	Head fault
HDHME	Heads home
HDR	Header
HE	Hard error
HNF	Header not found
HVRC	Header VRC error

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

IAE	Invalid address error
IDn	Drive identification
IDAE	Invalid disk address error
IDB	Identification burst
IDE	Interrupt on done (or error) enabled
IE	Interrupt enabled
ILC	Illegal command
ILF	Illegal function
ILO	Illegal operation
ILR	Illegal register addressed
INC/VPE	Noncorrectable data, or vertical parity error
IR	Input ready
IVDA	Invalid address
IXE	Index (pulse) error
LBT	Last block transferred
LD HDS	Loading heads
LPE	Longitudinal parity error
LST	Last sector transferred
MAINT	Maintenance
MC	Maintenance clock
MCLK	Maintenance clock
MCPE	Mass-bus control, parity error
MDER	Mode error
MDFn	Maintenance data field
MDPE	Mass-bus data, parity error
MDS	Multiple drive select
MERD	Maintenance encoded read data
MEXn	Memory address extension

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

MEWD	Maintenance encoded write data
MHS	Multiple heads selected
MIND	Maintenance index
MLT HD SEL	Multiple heads selected
MM	Maintenance mode
MMT	Maintenance mark track
MODE	Pack format mode
MOH	Moving head device
MOL	Medium online
MOPn	Maintenance operation code
MSE	Motor sequence error
MSP	Maintenance sector pulse
MSn	Message select
MTE	Mark track error
MXF	Missed data transfer
NEC	Nonexistent cylinder
NED	Nonexistent disk
NEM	Nonexistent memory
NES	Nonexistent sector
NET	Nonexistent track
NHS	No head selection
NSG	Nonstandard gap
NXF	Nonexecutable function
OCYL	Off cylinder condition
OFFON	Offset on
OFS	Offset
OFST	Offset
OL	Online

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

OPE	Operator plug error
OPI	Operation incomplete
OR	Output ready
OVR	Overrun
PAE	Parity error, lateral or LPC
PAR	Parity error
PAT	Parity test
PCA	Precompensation advance
PCD	Precompensation delay
PE	Parity error
PEF/LRC	PE-format error, or LRC error
PES	Phase encoded (PE) status
PEVN	Lateral parity, even
PGE	Program error
PGM	Programmable
PIP	Positioning in program
PLO ERR	Servo signal error
PLU	Phase-locked oscillator unsafe
PSEL	Port select
PSU	Pack speed unsafe
PWRCLR	Power clear
RAW	Read and write
RDBn	Repeat of data bus
RDGATE	Read gate
RDY	Device ready
REV	Reverse direction
RK05	Device is RK05
RLE	Record length error

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

RLS	Release unit
RMR	Register modification refused
RP03	Selected device is an RP03
RTZ	Returning to zero
RWS	Rewind status
SA	Sector address desired
SBD	Sync byte detected
SC	Sector counter
SC=SA	Sector counter equals sector address
SCG	Sign change
SCLR	Subsystem clear
SCO	Sector address, lookahead
SCP	Search complete
SDWN	Tape settle down
SECT ERR	Sector error
SELE	Selection error
SELR	Select remote
SK LIMIT	Seek limit
SK NO MO	Seek and no motion
SKE	Seek error
SKI	Seek incomplete
SKU	Seek underway
SLA	Slave attention
SOK	Sector counter OK
SOT	Current sector address
SPn	Spare bits
SPDOK	Speed OK
SPLS	Drive speed loss
SPON	Spindle on

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

SPR	Slave present
SSC	Slave status change
SSE	Stop on soft error
SSn	Slave select
SUCA	Selected unit cylinder address
SUR	Surface
SVAL	Status valid
TA	Track address
TCW	Tape control write
TDF	Write-transitions detector failed
TE	Timing error
TKFOK	Servo signal present
TM	Tape mark
TRE	Transfer error
TUF	Write transitions unsafe
TUR	Tape unit ready
UFE	Unit field unsafe
UNLD HDS	Unloading heads
UNS	Drive unsafe
UPE	UNIBUS parity error
UPS	Tape is up to speed
USn	Unit select
UWR	Any unsafe condition except read/write
VUF	Velocity unsafe
VV	Valid volume
WA	Word address
WAO	Write and offset

(continued on next page)

Table B-10 (Cont.)
Glossary of Register Mnemonics

WC	Word count
WCE	Write check error
WCF	Write check failed
WCU	Write current unsafe
WLE	Write lock error
WLO	Write lockout error
WPE	Word parity error
WPS	Write protect status
WPV	Write protect violation
WRCUR NWRGT	Write current and no write gate
WRGT NXFR	Write gate and no transitions
WRGATE	Write gate
WRLK	Write lock
WRL	Write lock
WRU	Write ready unsafe
WSU	Write select unsafe
XDn	Extended data
7CH	7- or 9-channel tape
30VU	30-volt DC unsafe
200BPI	200 BPI maintenance clock

SERVICE-MODE KNOWLEDGEABLE USER REFERENCE

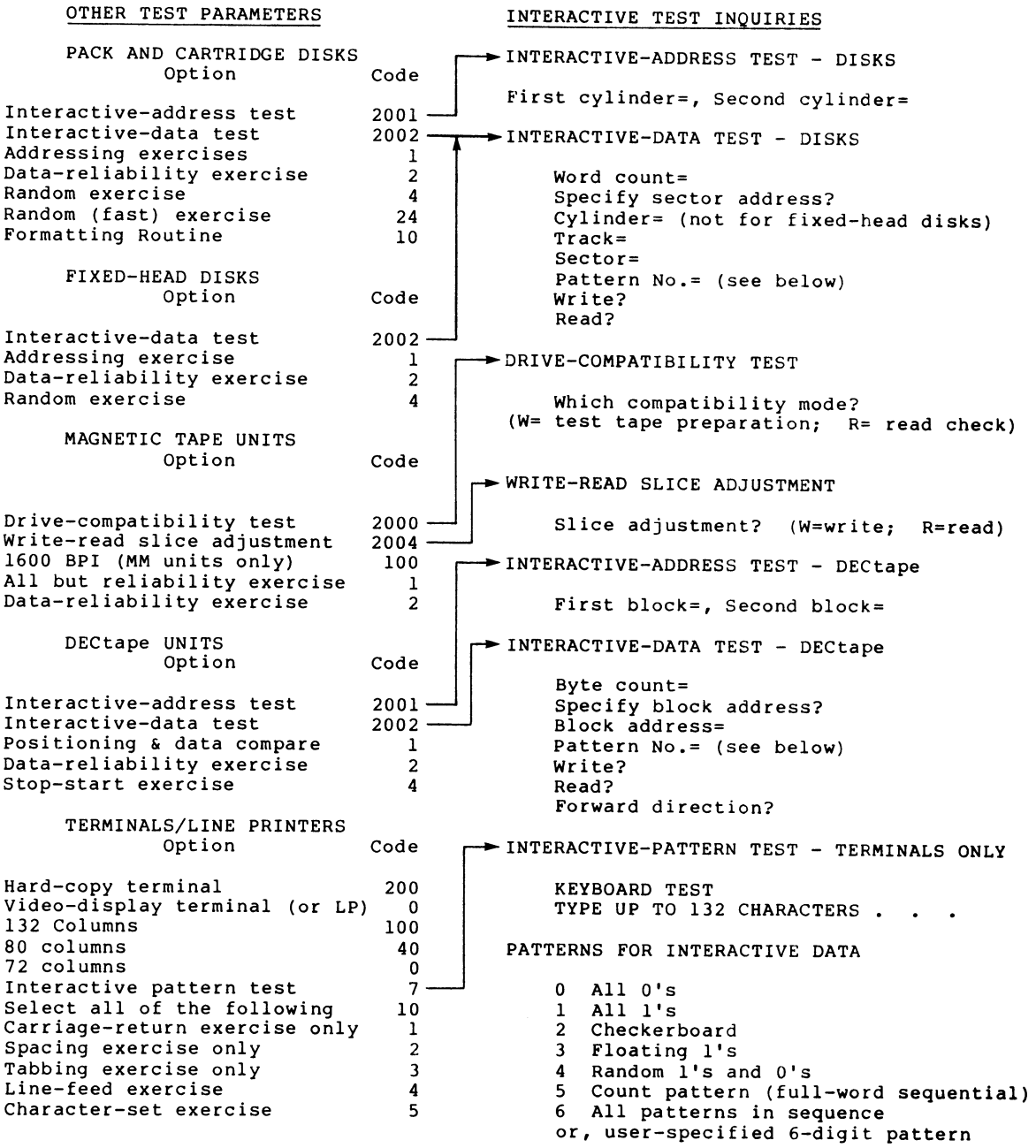
Typical Diagnostic Initiation

Device Model No.'s and Mnemonics		Underlined text indicates expected or required user input. Install "scratch" medium, if applicable
Cartridge Disks:		
On both RSX-11M and RSX-11M-PLUS systems, allocate the device.		
RK05	DKn	>ALLOCATE DB1:
On RSX-11M-PLUS systems only, logically mount the volume as foreign.		
		>MOUNT DB1:/FOR
On both RSX-11M and RSX-11M-PLUS systems, proceed as follows.		
RK06	DMn	>RUN $RP04
Pack Disks:		START RP04 DIAGNOSTIC - TIME OF DAY. . .
RP02	DPn	DEVICE? DB1
RPR02	DPn	**WARNING** DB1: RESIDENT DATA. . .
RP03	DPn	CONTINUE? SERVICE
		TEST PARAMETERS (OCTAL)=
RP04	DBn	CONSOLE SWITCH FOR INTERVENTION (DECIMAL)=
RP05	DBn	
RP06	DBn	THE RF11 (DF0) also asks
Fixed-head Disks:		TEST ALL DRIVES? (Y tests all drives) (N initiates WHICH inquiry)
RF11	DF0	WHICH DRIVE? (Respond with valid drive number)
RS03	DSn	
RS04	DSn	
Magnetic Tape Units:		All diagnostics (except for TERM which includes multipass only) can implement the following general test parameter options. Refer to the reverse of this reference sheet for device-specific options and for interactive test inquiries.
TS03	MTn	
TU10	MTn	
TU16	MMn	
TU45	MMn	
DECtape Unit:		
TU56	DTn	
All terminals:		
TERM	TTn	
All Line Printers:		
TERM	LPn	

GENERAL TEST PARAMETERS OPTIONS

Option	Selection Code
Stop on error	100000
Loop on error	40000
Inhibit error message printout	20000
Bell on error	10000
Multipass execution	4000
Limit data-compare messages to first error only (default is: messages for up to three errors during error recovery)	40

NOTE - TERM is the diagnostic test name for terminals and line printers; output to line printers is not spooled and can interfere with another user's output.


OTHER TEST PARAMETERS
PACK AND CARTRIDGE DISKS
Option Code
Interactive-address test 2001
Interactive-data test 2002
Addressing exercises 1
Data-reliability exercise 2
Random exercise 4
Random (fast) exercise 24
Formatting Routine 10
FIXED-HEAD DISKS
Option Code
Interactive-data test 2002
Addressing exercise 1
Data-reliability exercise 2
Random exercise 4
MAGNETIC TAPE UNITS
Option Code
Drive-compatibility test 2000
Write-read slice adjustment 2004
1600 BPI (MM units only) 100
All but reliability exercise 1
Data-reliability exercise 2
DECtape UNITS
Option Code
Interactive-address test 2001
Interactive-data test 2002
Positioning & data compare 1
Data-reliability exercise 2
Stop-start exercise 4
TERMINALS/LINE PRINTERS
Option Code
Hard-copy terminal 200
Video-display terminal (or LP) 0
132 Columns 100
80 columns 40
72 columns 0
Interactive pattern test 7
Select all of the following 10
Carriage-return exercise only 1
Spacing exercise only 2
Tabbing exercise only 3
Line-feed exercise 4
Character-set exercise 5
INTERACTIVE TEST INQUIRIES
INTERACTIVE-ADDRESS TEST - DISKS
First cylinder=, Second cylinder=
INTERACTIVE-DATA TEST - DISKS
Word count=
Specify sector address?
Cylinder= (not for fixed-head disks)
Track=
Sector=
Pattern No.= (see below)
Write?
Read?
DRIVE-COMPATIBILITY TEST
Which compatibility mode?
(W= test tape preparation; R= read check)
WRITE-READ SLICE ADJUSTMENT
Slice adjustment? (W=write; R=read)
INTERACTIVE-ADDRESS TEST - DECtape
First block=, Second block=
INTERACTIVE-DATA TEST - DECtape
Byte count=
Specify block address?
Block address=
Pattern No.= (see below)
Write?
Read?
Forward direction?
INTERACTIVE-PATTERN TEST - TERMINALS ONLY
KEYBOARD TEST
TYPE UP TO 132 CHARACTERS . . .
PATTERNS FOR INTERACTIVE DATA
0 All 0's
1 All 1's
2 Checkerboard
3 Floating 1's
4 Random 1's and 0's
5 Count pattern (full-word sequential)
6 All patterns in sequence
or, user-specified 6-digit pattern

READER'S COMMENTS

NOTE: This form is for document comments only. DIGITAL will use comments submitted on this form at the company's discretion. If you require a written reply and are eligible to receive one under Software Performance Report (SPR) service, submit your comments on an SPR form.

Did you find this manual understandable, usable, and well-organized? Please make suggestions for improvement.

Did you find errors in this manual? If so, specify the error and the page number.

Please indicate the type of reader that you most nearly represent.

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- ☐ Higher-level language programmer
- ☐ Occasional programmer (experienced)
- ☐ User with little programming experience
- ☐ Student programmer
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