IAS Diagnostics Reference Manual

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This manual describes the operation of individual diagnostic tasks and their output.

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The postpaid READER'S COMMENTS form on the last page of this document requests the user's critical evaluation to assist in preparing future documentation.

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PREFACE

0.1 MANUAL OBJECTIVES AND READER ASSUMPTIONS

This manual is intended for either a system manager or a DIGITAL field service engineer. It contains information that can be used to monitor and determine the hardware reliability of a system. The reader of this document should be familiar with the hardware as described in the PDP-11 Processor Handbook and the PDP-11 Peripherals Handbook.

0.2 STRUCTURE OF THE DOCUMENT

This manual consists of two introductory chapters and a series of detailed chapters that describe the operation of individual diagnostic tasks and their output.

Chapter 1 introduces the concepts of diagnostic tasks.

Chapter 2 describes the function and operation of diagnostic tasks.

Chapters 3 through 12 detail individual diagnostic tasks.

The first-time user of the diagnostic tasks should read Chapter 2, "Diagnostic Tasks" before attempting to run any of these tasks. When running a diagnostic task, reference should be made to the chapter concerning the device being tested.

0.3 ASSOCIATED DOCUMENTS

For a list of associated IAS or RSX-11D documents and a definition of their readerships, refer to the Documentation Directory for the appropriate system.

CHAPTER 1

INTRODUCTION

IAS and RSX-11D provide the system manager with two complementary methods of monitoring the hardware reliability of the system. The first method, error logging, allows the system manager to compile error statistics for main and cache memory, disks, magnetic tape, and DECtape while the system performs normal operations. When it is desirable, the system manager can obtain printed reports detailing or summarizing hardware errors in memory and on these devices. The logging of errors is continual; the report production can be performed as desired. Error logging is described in the RSX-11D System Manager's Guide, or the IAS System Management Guide.

The second method of monitoring the hardware reliability is by running diagnostic tasks to test a specific device. These tasks execute simultaneously with other system functions and user tasks. If the error logging facility indicates that a device is malfunctioning, the system manager may want to run the diagnostic tasks for that device to further test it.

The data provided by the diagnostic tasks task can be forwarded to the DIGITAL field service engineer to help determine the cause of the error in advance of his arrival at the installation.

Both forms of system monitoring can be performed concurrently with normal day-to-day system operations. Additionally, error logging and diagnostic tasks can run simultaneously. However, error logging information is not accumulated for the device type on which the diagnostics are running.

NOTES

1. The user must be logged onto the system using a privileged UIC to produce error log reports or to run diagnostics.

2. Modules for building diagnostic handlers are to be found on the Object Modules distribution media.

CHAPTER 2

DIAGNOSTIC TASKS

IAS and RSX-11D provide diagnostic tasks that can be run by the user to test the hardware reliability of disks, magnetic tape drives, DECtape drives, and terminals. If the user suspects a hardware malfunction on one of these devices, the appropriate diagnostic task can be installed and run. Results of the testing are printed on the console terminal.

Because the diagnostics are tasks, they can execute concurrently with other system and user tasks. Normal operations need not be disturbed.

Two types of diagnostics are included in the system: diagnostic programs and data reliability tests. Each device for which diagnostics are available has an associated diagnostic program and a data reliability test.

The data reliability tests perform a subset of the functions of the diagnostic programs. They do not provide the capability to select which of the subtests are to be performed as can be done in the diagnostic programs. Additionally, they do not allow selection of conversation mode.

Conversation mode permits dynamic interaction with the diagnostic test. Some diagnostics provide two types of conversation: data and address. The user selects which type of conversation mode is desired when starting the diagnostic. The buffer size for data transfers can be modified, the area to be tested on a disk or tape can be specified, and the test patterns for data tests can be selected. Normally, conversation mode is used only by the DIGITAL field service engineer. Conversation mode is not available with data reliability tests.

Unlike most system tasks which are distributed in task-image form, the diagnostic programs and data reliability tests must be task built (linked) before they can be installed and run. Task building is required to allow specification of variable information such as the specific unit to be tested and the buffer size to be used.

To facilitate the building process, an interactive program named CMD is provided. It asks the questions required to create the input needed by the task builder to produce a task image of the diagnostic. CMD is used to produce build files for all diagnostic programs and data reliability tests. Diagnostics may be built and the task images left on a device and called in to run when needed. They need only be rebuilt if the responses to CMD are to change.

Special device handlers are used in conjunction with the diagnostics. These device handlers pass error information to the diagnostics. The diagnostics intepret the information and print appropriate error messages. These handlers also allow normal user functions to be

performed. The handlers distinguish among diagnostic requests and user requests. However, if error logging also is running, no errors are logged for the diagnostic task or any task using a device of the same type.

2.1 DEVICES SUPPORTED BY DIAGNOSTICS

Table 2-1 lists the devices for which diagnostic programs and data reliability tests are provided and supplies the following additional information:

1. System device mnemonic, which is identical to the device handler name for the device,
2. Diagnostic handler file name,
3. Diagnostic test name,
4. Data reliability test name.

Information in Table 2-1 is referred to throughout this chapter.

NOTE

Throughout this manual, all references to the RKØ5 disk also include the RKØ3. All references to the RSØ4 disk also include the RSØ3 disk.

Table 2-1
Devices Supported by Diagnostic Handlers

DEVICE	SYSTEM DEVICE MNEMONIC (HANDLER NAME)	DIAGNOSTIC HANDLER NAME	DIAGNOSTIC TEST NAME	DATA RELIABILITY TEST NAME
RKØ3	DK	DKD	RKØ3S	RKØ3D
RKØ5	DK	DKD	RKØ5S	RKØ5D
RKØ6	DM	DMD	RKØ6S	RKØ6D
RPØ3	DP	DPD	RPØ3S	RPØ3D
RPØ4	DB	DBD	RPØ4S	RPØ4D
RSØ3 RSØ4	RD (if RPØ4 is also on same RH11 or RH70 controller)	RDBD	RSØ3S RSØ4S	RSØ3D RSØ4D
	DS	DSD	RSØ3S RSØ4S	RSØ3D RSØ4D
TU56	DT	DTD	TU56S	TU56D
TUlØ	MT	TUlØD	TUlØS1 positioning test TUlØS2 data patterns test	TUlØD
TU16	MM	TU16D	TU16S1 positioning test TU16S2 data patterns test	TU16D
RS11	DF	DFD	RS11S	RS11D
terminal		TTYTS		
RPØ2[1]	DP	DPD	RPØ2S	RPØ2D
RPØ2[2] RPRØ2[3]	DP	DPD	RPØ2CS	RPØ2CD

[1] On RP11 Controller.

[2] On RP11C or RP11E Controller.

[3] On RPR11 Controller.

2.2 NAMING CONVENTIONS FOR DIAGNOSTICS

The names of the diagnostic programs and the data reliability tests are listed in the last two columns of Table 2-1.

The conventions described below are used in naming the diagnostics.

Diagnostics have 6-character names in the following format:

xxxxyz

Where:

xxxx — designates the type of unit that the diagnostic is to test, e.g., RPØ3, TU1Ø, RSØ4, and TU16.

y — indicates whether the test is a diagnostic program or a data reliability test by using one of the following letters.

- S — indicates a single unit diagnostic program.
- D — indicates a data reliability test.

z — designates the number of a particular test for that class of diagnostics. If these is only one test in the class the number is omitted. For example, RPØ3S2 the second diagnostic program in the RPØ3S class.

2.3 OPERATIONAL INFORMATION

The following is a summary of the operations that must be performed to build and run the diagnostic task. These are fully described in the following sections. If an appropriate task image already exists, steps 4 onwards only need be performed.

1. Install and run CMD,
2. Respond to the questions printed by CMD,
3. Build the desired diagnostic program or data reliability test,
4. Ensure that no tasks are performing I/O operations using that device and dismount any volumes currently mounted on it,
5. Unload (stop) and remove the handler normally used for the device to be tested after determining that no one is using it.
6. Install and load (run) the diagnostic handler to be used in conjunction with the diagnostic task,
7. Mount a scratch volume on the device to be tested and install the diagnostic task,
8. Run the diagnostic,
9. When finished, terminate the diagnostic and change back

to the normal system handlers.

2.3.1 Installing and Running CMD

CMD is stored under UFD [11,1]. Press CTRL/C to obtain MCR on RSX-11D. On IAS, LOGIN with a system management username (i.e. having UIC of [1,1]). Type the following commands to install and run CMD. All lines are terminated with RETURN unless otherwise noted in the text.

RSX-11D	IAS
MCR>INS [11,1]CMD	PDS> RUN [11,1]CMD
MCR>CMD	

2.3.2 Interacting with CMD

CMD prints the following series of questions on the console. Respond to each question after it is printed. The responses to the questions are used as input to the task builder.

SHORT DIALOGUE? (Y OR N)

Type Y to indicate that the short dialogue is desired. The short dialogue is for users familiar with the operation of CMD. It produces shorter questions with no explanations on the console.

Type N to indicate that the full CMD dialogue, as described below, is desired.

NOTE

Users unfamiliar with CMD are advised to use the full dialogue, i.e., to type N.

TYPE A "/H" IF YOU DO NOT UNDERSTAND THE QUESTION

When any input is requested in the ensuing CMD dialogue, typing /H will provide a further description of the input required.

Figure 2-1 illustrates the information printed on the console when /H is typed in response to the questions.

TYPE OUTPUT/INPUT FILE SPECIFICATION

Because the diagnostic libraries (DIAGU.OLB, DIAGR.OLB, and DIAGD.OLB) and the diagnostic tasks may not be on the (user's) system disk, CMD allows the specification of the UFDs where the diagnostic task is to be stored and/or the diagnostic libraries are to be found.

Two file specifications may be supplied. The output specification determines the device and UFD under which the diagnostic task is to be stored. If the device and UFD are not specified, the system device and the user's UIC are used.

The input specification indicates where the diagnostic libraries are located. If the input specification is omitted, UFD [1,27] of the system device is used.

The specifications have the following format.

```
outdev:[ufd]=indev[ufd]
```

Filenames should not be specified.

```
SPECIFY DRIVE AND UNIT NO.
```

Type the 2-character drive type followed by the unit number. Refer to the column headed "System Device Mnemonic" in Table 2-1 for the drive type.

The drive and unit number typed in response to this question indicate the physical unit to be tested. It also is used as the name of the diagnostic once it has been built; i.e., it is the name used to install the diagnostic.

For example, if the RK05 diagnostic is to run on unit 2, type the following.

```
DK2
```

To test unit 1 of an RS03, type the following.

```
RS1
```

```
CURRENT DATA BUFFER SIZE IS 1000 OCTAL WORDS

DO YOU WISH TO EXPAND IT?  (Y OR N)
```

The buffer size specified at this point determines the size of the data transfers used in the diagnostic programs and reliability test. Refer to individual diagnostic program chapters to determine which tests are affected.

Type Y to indicate that the buffer is to be expanded.

Type N to indicate that a buffer size of 1000 (octal) words is to be used. If N is the response, the next question is not printed.

```
PDS> RUN [11,1]CMD
16:14:09
SHORT DIALOGUE?(Y OR N)
N
TYPE A "/H" IF YOU DO NOT UNDERSTAND ANY OF THE FOLLOWING QUESTIONS
TYPE OUTPUT/INPUT FILE SPECIFICATION
/H
TWO FILE SPECIFICATIONS MAY BE INPUT. THE OUTPUT SPEC DETERMINES
ON WHICH DEVICE AND UNDER WHAT UIC THE DIAGNOSTIC TASK WILL BE
STORED. IF NOT SPECIFIED, THE DEVICE WILL DEFAULT TO THE SYSTEM DEVICE
AND THE UIC WILL DEFAULT TO THE USER'S UIC. THE INPUT SPECIFICATION
DETERMINES WHERE THE DIAGNOSTIC LIBRARIES ARE TO BE FOUND.
IF NOT SPECIFIED, THE DEVICE DEFAULTS TO THE SYSTEM DEVICE
AND THE UIC WILL DEFAULT TO [1,27]. THE FILE SPECIFICATION
IS AS FOLLOWS:
OUTDEV:[XXX,XXX]=INDEV:[XXX,XXX]
TYPE CARRIAGE RETURN IF DEFAULTS ARE REQUIRED
TYPE OUTPUT/INPUT FILE SPECIFICATION

SPECIFY DRIVE TYPE AND UNIT NO.
/H
RESPOND WITH THREE CHARACTERS. THE FIRST TWO CHARACTERS
EQUAL THE SYSTEM MNEMONIC FOR THE DEVICE TYPE. THE MNEMONICS ARE:
DP=RP02/03, DK=RK03/05, DF=RF11, DM=RK06, DB=RP04, DT=DECTAPE,
DS=RS03/04, MT=TU10/TS03, MM=TU16
THE THIRD CHARACTER EQUALS THE UNIT NUMBER.
SPECIFY DRIVE TYPE AND UNIT NO.
DK0
CURRENT DATA BUFFER SIZE IS 1000 OCTAL WORDS
DO YOU WISH TO EXPAND IT? (Y OR N)
/H
THE TASK IS PROVIDED WITH A DATA BUFFER OF 1000(OCTAL)WORDS
THIS BUFFER MAY BE EXTENDED TO A MAXIMUM OF 40000(OCTAL) WORDS OR
16K DECIMAL. A LARGER BUFFER RESULTS IN MORE DATA BEING
TRANSFERRED ON EACH OPERATION. THE SIZE OF THE BUFFER
WILL DEPEND ON THE AMOUNT OF CORE AND USER REQUIREMENTS.
DO YOU WISH TO EXPAND IT? (Y OR N)
Y
WHAT IS THE TOTAL BUFFER SIZE DESIRED IN OCTAL WORDS?
/H
THE TASK IS PROVIDED WITH A DATA BUFFER OF 1000(OCTAL)WORDS
THIS BUFFER MAY BE EXTENDED TO A MAXIMUM OF 40000(OCTAL) WORDS OR
16K DECIMAL. A LARGER BUFFER RESULTS IN MORE DATA BEING
TRANSFERRED ON EACH OPERATION. THE SIZE OF THE BUFFER
WILL DEPEND ON THE AMOUNT OF CORE AND USER REQUIREMENTS.
WHAT IS THE TOTAL BUFFER SIZE DESIRED IN OCTAL WORDS?
1000
WHICH DIAGNOSTIC DO YOU WISH TO RUN?
/H
INPUT THE NAME OF THE DIAGNOSTIC TASK TO BE EXECUTED
WHICH DIAGNOSTIC DO YOU WISH TO RUN?
RK05S
THE FOLLOWING IS A SUMMARY OF COMMANDS NECESSARY TO
GET THE DIAGNOSTIC TASK RUNNING. IF ANY ERRORS
ARE ENCOUNTERED, REFER TO THE DIAGNOSTIC CONTROL CARD.
A) PDS> @DIAG
B) INITIATE THE APPROPRIATE DIAGNOSTIC HANDLER FROM SCI
C) PDS> $MOU/FOR DK0:VOLUME-ID
D) RUN DK0
COMMAND FILE HAS BEEN GENERATED
16:16:14 SIZE: 4K CPU: 0.20
```

Figure 2-1 /H Printouts for CMD running on IAS

WHAT IS THE TOTAL BUFFER SIZE DESIRED IN OCTAL WORDS?

Enter the desired buffer size in octal words. The minimum buffer size is 1000 words (octal) and the maximum buffer size is 40,000 words (octal). The response must be specified in octal.

WHICH DIAGNOSTIC DO YOU WISH TO RUN?

Refer to Table 2-1 for the name of the diagnostic program or data reliability test for the specific device. Enter the name at this point.

For example, RP04S is the name of the diagnostic program for the RP04. TU10D is the data reliability test for the TU10.

At this point, CMD prints a summary of the commands that must be typed by the user before the diagnostic can execute. Provided that a full dialogue has been requested, CMD prints a summary of what must be done to run the diagnostic, then exits.

2.3.3 Building the Diagnostic Program or Data Reliability Test

Once CMD terminates, the diagnostic program or data reliability test can be task built.

For RSX-11D DIAG.CMD is an indirect command file to task builder and for IAS DIAG.CMD is an indirect command file to PDS containing the appropriate LINK statement. It was created by CMD and stored in the users UFD on the default system device:

RSX-11D	IAS
MCR>TKB TKB>@DIAG	PDS>@DIAG

The errors listed in Table 2-2 may occur while the diagnostic program or data reliability test is being built. If no errors occur, the task is ready to be installed. Proceed to the next numbered section.

Table 2-2
TKB Error Messages When Building a Diagnostic

ERROR MESSAGE	MEANING	CORRECTIVE ACTION
TKB FATAL #7	The indirect command file does not exist. Either the command file is not in the default UFD where the task builder expects it, or there was not enough space to place the file on the disk.	If lack of space is the problem, delete files from the default UFD and rerun CMD.
TKB FATAL #24	No disk area is available. Normally, the diagnostic task is placed in the user's UFD on the system device.	Delete files using PIP (for RSX) or DELETE (for IAS) free additional space in the user's UFD and rerun the build.
TKB FATAL #28	Cannot find the diagnostic program to be task built. Probably the diagnostic name was mistyped.	Rerun CMD. See Section 2.3.1.

2.3.4 Changing Handlers

The next step is to ensure that no tasks are performing I/O operations using any device of the type being tested and dismount any volumes currently mounted on those devices. Then terminate the normal device handler and load the diagnostic handler.

For RSX-11D type the following commands to MCR to accomplish this step, for IAS type the following commands to SCI:

RSX-11D	IAS	
MCR>UNL dd	SCI> STOP/HANDLER dd	where dd is the name of the handler to be replaced. Refer to the "System Device Mnemonic" column of Table 2-1 to obtain the appropriate handler name.
MCR>REM dd....	SCI> REMOVE dd....	where dd is the handler name specified in the previous command. For example: DK.... MT.... DB....
MCR>INS [11,27]ddD	SCI> INSTALL [11,27]ddD	where ddD is the diagnostic handler task filename. Refer to the "Diagnostic Handler Name" column of Table 2-1 for the associated diagnostic handler names. For example: DKD or DBD
MCR> LOA dd	SCI>RUN/HANDLER dd	where dd is the handler name. Refer to the "System Device Mnemonic" column of Table 2-1 for the name to be used when loading the diagnostic handler. For example: DK or DB

At this point, the diagnostic handlers are ready to interact with the diagnostic tasks and other user tasks performing I/O on that device type.

NOTE

Extreme caution must be exercised when attempting to change the handlers for the system device. The system must be totally inactive when this is done. It

is advisable to change system disk handlers immediately after loading the system. The following is an example of the sequence to be followed when changing the handlers for an RK system based disk.

MCR>INS [11,27]DKD/TASK=xxx	xxx can be any user-assigned task name
MCR>FIX xxx	
MCR>RUN xxx 20S	
MCR>UNL DK	Depress ALTMODE. This command must be typed within 20 seconds of the RETURN key that terminates the RUN command.

DO NOT TOUCH THE CONSOLE FOR THE NEXT 20 SECONDS. This interval gives the system time to unload the nondiagnostic handler and start the diagnostic handler.

2.3.5 Mounting the Volume and Installing the Task

Type the following commands to mount a scratch volume that has been placed in the unit and to install the diagnostic task.

RSX-11D	IAS	
MCR>MOU dvn:/CHA=[FOR,ATCH]	PDS> MOUNT/FOR dvn:volume-id	dvn is the device and unit number to be tested. Volume-id is the volume label of the scratch volume.
MCR>INS dvn		dvn is the name of the diagnostic program or data reliability test created via DIAG.CMD in step 2.3.3 above. It also is identical to the device and unit information specified in the MOU command.
MCR>RUN dvn	PDS>RUN dvn	dvn is the name of the diagnostic program or data reliability test task to be executed.

NOTE

The volume must be physically online and write enabled.

At this point, the diagnostic task is running.

2.3.6 Running the Diagnostic Task

After the command to run the diagnostic program or data reliability test is issued, the program or test responds by printing the following on the console.

```
xx DIAGNOSTIC          xx indicates the device to be tested

WARNING ALL DATA ON DEVICE dvn WILL BE DESTROYED

TYPE Y <CR> TO CONTINUE
```

PRESS RETURN to continue with the diagnostic. Any other response causes the diagnostic to be aborted. If RETURN is pressed, the diagnostic types the following request for test parameters.

```
TEST PARAMETERS=
```

Test parameters are bits that can be set to specify operational variables for the diagnostic. Bits 9 through 15 have the same meaning for all diagnostic programs and data reliability tests. The remaining bits have different meanings for different diagnostics or are not used. Table 2-3 lists the bits that have a common meaning for all diagnostics. Tables 2-4, 2-5, and 2-6 list bits that are diagnostic specific.

Table 2-3
Common TEST PARAMETER Bit Setting

BIT	SETTING	MEANING
15	1	Stall on error. The task waits for up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop can be aborted only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and repeats the specified testing sequence.
10	1	Enter conversation mode (not applicable for data reliability tests, TU10S1, and TU16S1).
9	1	Restart the program. The program aborts the present sequence and restarts at the newly selected test.

Table 2-4
Additional TEST PARAMETERS for Disks and DECtape

BIT	SETTING	MEANING
5	1	Print only the first data compare error found within a specified data transfer.
	Ø	Print up to 3 data compare errors within a specified data transfer.
4	1	Inhibit seek operations between successive reads during the random test. This bit applies only to RKØ5, RPØ3, and RPØ4 tests (S and D versions).
3	1	Run the formatter (RKØ5S, RPØ3S, and RPØ4S only).
2	1	Run the random test (S versions only).
1	1	Run the data test (S versions only).
Ø	1	Run the address test (S versions only).

Table 2-5
Additional TEST PARAMETERS for Magnetic Tape (All Versions)

BIT	SETTING	MEANING
7	1	Perform an infinite number of retries for data error recovery.
	Ø	Perform a maximum of 64 retries for data error recovery.
6		This bit applies only to the TU16 tests.
	1	Perform data reliability or conversation mode for 9-track transports at 800 bpi NRZ.
	Ø	Perform data reliability or conversation mode for 9-track transports of 1600 bpi PE.
5	1	Print only the first data compare error for each data transfer.
	Ø	Print up to 3 data compare errors per data transfer.
4	1	Print all errors during error recovery.
	Ø	Print only the first error during error recovery. At completion of error recovery, print the error recovery type retry number.
2	1	Perform the read portion of write/read amp slice adjustment. (TU1ØS2 and TU16S2 only).
1	1	Perform the data reliability test (TU1ØS2 and TU16S2 only).
Ø	1	Perform the pattern test (TU1ØS2 and TU16S2 only).

Table 2-6
Additional TEST PARAMETERS for Terminals

BIT	SETTING	MEANING
7	1	LA30
6	1	VT05
5	1	ASR35
4	1	ASR33
3	1	Run all tests
2,1,0	000	Carriage return test
	001	Space test
	010	Tab test
	011	Line feed test
	100	Character test
	101	ASR33 worst case test
	110	ASR35 worst case test
	111	User-selected pattern test

2.3.6.1 Specifying the Test Parameters - In order to enter the test parameters in response to the TEST PARAMETERS= question, the 16 test parameter bits must be converted into 6 octal digits. For example, if bits 11, 5, and 1 are set to 1 and all other bits are zero, the following conversion is performed.

Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0
Results	0		0			4			0			4			2	

Following the example above, the number 4042 is entered in response to TEST PARAMETERS=. Leading zeros can be omitted.

Any combination of bits can be set. If more than one test is selected, the test that has the lowest bit position is run first. For example, if bits 0 and 1 are both set for the RK05s diagnostic, the address test runs before the data test; refer to Table 2-4. The only exception is the formatter; when it is selected, no other test is run. When the formatter finishes, the diagnostic exits.

2.3.6.2 Specifying NEW PARAMETERS Switch - After the test parameters are entered, the program prints the following question on the console.

WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION?

The switch specified in response to this is used while the diagnostics are running to specify new test parameters and to abort the stall-on-error sequence. When the switch is toggled, the program reprints the TEST PARAMETERS= request.

NOTE

If the test currently running is to be aborted to allow a new test to run, bit 9 also must be set in the new parameter word. If it is not set, the test currently running completes before execution of the next test starts.

To specify the switch number, enter the octal value that results on the console when that switch is set and all others are cleared. For example, octal 1 indicates switch 0, octal 2 represents switch 1, octal 4 represents switch 2, octal 10 represents switch 3, and octal 20 indicates switch 4.

Once the switch is specified, the diagnostic or data reliability test enters its testing routines.

2.4 TERMINATING THE DIAGNOSTIC

Any of the following methods can be used to terminate a diagnostic program or data reliability test.

1. Press CTRL/C and type the following command.

RSX-11D	IAS	
MCR>ABO dvn	PDS>ABORT dvn	where dvn is the diagnostic task name, e.g., DK1, RP2.

2. Lift the switch specified in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION? In response to the question TEST PARAMETERS=, press CTRL/Z.

3. Press CTRL/Z in response to any question printed by the diagnostic.

Once the diagnostic is terminated, the task should be removed. The diagnostic handler should then be removed and the normal handler should be loaded. Use the following series of instructions.

RSX-11D	IAS	
MCR>REM dvn		Remove the diagnostic task (RSX-11D only) where dvn is the diagnostic task name. For example: DK1 RP2
MCR>DMO dvn	PDS> DISMOUNT dvn:volume-id	
MCR>UNL dd	SCI>STOP/HANDLER dd	where dd is the name of the diagnostic handler to be replaced. Refer to the "System Device Mnemonic" column of Table 2-1 to determine the name of the diagnostic handler to unload.
MCR>REM dd....	SCI> REMOVE dd....	where dd is the handler name specified in the previous command. For example: DK.... DM.... DT...
MCR>INS [11,1]dd	PDS> INSTALL [11,1]dd	where dd is the handler task filename. Refer to the "System Device Mnemonic" column of Table 2-1 for the appropriate handler name.
MCR>LOA dd	PDS> RUN/HANDLER dd	where dd is the handler name. Refer to the "System Device Mnemonic"

column of Table 2-1 for the appropriate handler name.

NOTE

Extreme caution must be exercised when attempting to change the handlers for the system device. The system must be totally inactive when this is done. It is advisable to change system disk handlers immediately after loading the system. The following is an example of the sequence to be followed when changing the handlers for an RK system-based disk.

```
MCR>INS [11,1]DK

MCR>FIX DK....

MCR>RUN DK.... 20S

MCR>UNL xxx     Depress ALTMODE. xxx is the user assigned name of the diagnostic handler. This command must be typed within 20 seconds of the RETURN key that terminates the RUN command.
```

DO NOT TOUCH THE CONSOLE FOR THE NEXT 20 SECONDS. This interval gives the system time to unload the diagnostic handler and start the nondiagnostic handler.

CHAPTER 3

RKØ5S AND RK05D DIAGNOSTIC PROGRAMS

The RKØ5S diagnostic program and the RK05D data reliability proram are the two hardware tests for the RKØ5 and RKØ3 disks. The RK05D data reliability test is a subset of the RKØ5S diagnostic program.

The RKØ5S diagnostic program provides four disk tests:

1. Address test,
2. Data test,
3. Random test,
4. Formatter.

The RK05D data reliability test provides two disk tests:

1. Data test,
2. Random test.

NOTE

Throughout this manual, all references to the RKØ5 disk also include the RKØ3.

3.1 ADDRESS TEST (RKØ5S ONLY)

The address test consists of seven parts. Additionally, another testing routine is run in conjunction with the address test for the RKØ5S. After a read header command is issued, this routine verifies the content of the data buffer with the cylinder address. If the data received is incorrect, the heads did not position correctly. Error number 1Ø0 is issued when the heads do not position correctly. Error numbers and meanings are detailed in Table 3-2.

3.1.1 Part 1 of Address Test

Part 1 of the address test issues read header commands to allow the program to verify the true position of the heads without causing a header verify error in the hardware. The seek commands in this test are implied seeks that result from the read header command.

In part 1, the program seeks from cylinder 0 to cylinder n and back to 0 again. The value of n starts at 1 and is increased to 199. After each seek, the program checks for errors and reads the header on that cylinder to determine whether the head is positioned correctly.

3.1.2 Part 2 of Address Test

Part 2 of the address test issues read header commands to allow the program to verify the true position of the heads without causing a header verify error in the hardware. The seek commands in this test are implied seeks that result from the read header command.

This part differs from part 1 in that a seek command is issued from cylinder 0 through cylinder 199. The first cylinder number is increased by 1 and the second is decreased by 1. Then the test seeks to cylinder 1 and back to 198. This process is repeated until the number being decreased goes back to zero.

3.1.3 Part 3 of Address Test

Part 3 of the address test verifies that each sector from 0 through 11 is uniquely addressable. Each sector on track 0 of cylinder 0 is written with its address. Then each sector is read and the data is verified. Any errors are reported to the operator.

3.1.4 Part 4 of Address Test

Part 4 of the address test ensures that each track on cylinder 0 is uniquely addressable. Sector 0 on each track is written with the track address. Then the data is read and verified. Any errors are reported to the operator.

3.1.5 Part 5 of Address Test

Part 5 of the address test ensure that each cylinder is uniquely addressable. Sector 0 of each cylinder is written with the cylinder address. Then each cylinder is read and the data is verified. Any errors are reported to the operator.

3.1.6 Part 6 of Address Test

Part 6 of the address test verifies that a transfer initiated on sector 11 of track 0 crosses over to sector 0 of track 1. 512 words of data containing a pattern of 177777 are written on the disk starting at sector 11 of track 0. Two words are read from sector 0 of track 1 and checked to ensure that they contain 177777.

3.1.7 Part 7 of Address Test

Part 7 of the address test verifies that the RK is able to cross cylinders when a 512-word transfer is initiated on sector 11 of track 1 of any cylinder. The data pattern written is 177777. Sector Ø of cylinders 1 through 199 are read to verify that the data transferred did cross cylinder boundaries.

3.2 DATA TEST

During execution of the data test, write and read operations are performed on the drive. The data is written on the entire pack and then read back. The data is verified and any errors are reported.

If an error is detected during the read operation, four retries are attempted, and then the head is homed. Four more attempts are made to recover the data.

The entire surface is tested with the following six patterns:

1. Zeroes,
2. Ones (177777),
3. Checkerboard (alternating 1's and Ø's)
4. Floating ones,
5. Random data,
6. Count pattern (sequential binary, full-word, up to size of the buffer).

The size of the transfer is determined by the buffer size selected during the execution of CMD.

3.3 RANDOM TEST

The random test selects a disk surface address randomly and writes random data on it. After each write operation, the program issues a random seek to cause the heads to seek back to the cylinder just prior to reading. The size of the transfer depends on the buffer size selected during execution of CMD.

Prior to each read operation, the data buffer is cleared. Then, the random data is read and verified. This sequence is repeated 1ØØØ (octal) times. The read operation is repeated eight times with intervening seeks to detect any read reduction problems. If an error is detected, the read number is typed to show which read was being performed when the error occurred. If the error is unrecoverable, the read operation is terminated. If an error is detected during the read operation, four attempts are made to read the data. If the data still cannot be read, the heads are homed and four more attempts are made to read the data.

If the heads have a tendency to vibrate, this condition should appear as parity errors.

3.4 FORMATTER TEST (RK05S ONLY)

The formatter test formats the entire RK pack and then verifies it. The sectors are formatted one at a time. Any errors are reported to the operator. After formatting, the entire pack is verified 12 sectors at a time to ensure that the headers were written correctly.

3.5 OPERATIONAL INFORMATION

The operational information for the RK05S and RK05D tests consists of TEST PARAMETER bit settings and conversation mode use. Conversation mode can be used only for RK05S.

3.5.1 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 3-1 lists the switches and provides their meanings. Bits 10, 3, 2, 1, and 0 apply to the RK05S only.

Table 3-1
RK05S and RK05D TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop is abortable only by specifying new test parameters with bit 14 equal to zero.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the testing sequence.
10	1	Enter conversation mode. See Section 3.5.2 for a description of conversation mode (RK05S only).
9	1	Restart the program. The program aborts the present test sequence and restarts at the newly selected test.
5	1	Print only the first data compare error found within a specified data transfer.
	0	Print up to 3 data compare errors within a specified data transfer.
4	1	Inhibit seek operation between successive reads during the random test.
3	1	Formatter (RK05S only).
2	1	Random test (RK05S only).
1	1	Data test (RK05S only).
1	1	Data test (RK05S only).
0	1	Address test (RK05S only).

3.5.2 Conversation Mode (RK05S only)

When conversation mode is requested by setting bit 10 in response to TEST PARAMETERS, a series of questions is printed on the console.

Two versions of conversation mode are provided with the RKØ5S diagnostic program. One specifies information for the address test and the other specifies information for the data test.

3.5.2.1 Address Test Conversation Mode - Conversation mode for the address test allows the operator to specify two cylinder addresses in octal. The program then issues seek commands between the specified cylinders. Any errors encountered are reported to the operator. Once started, this program loops until it is aborted by the operator.

The program requests the two cylinder addresses as follows.

"A" CYLINDER?

Enter a valid cylinder address in octal.

"B" CYLINDER?

Enter a valid cylinder address in octal.

3.5.2.2 Data Test Conversation Mode - In conversation mode for the data test, the operator can specify the data transfer size, the disk surface address, the pattern desired, and the function to be performed.

The following questions are asked.

WORD COUNT 2 TO x

Enter an octal value to indicate the data buffer size for the data test. The maximum value that x can attain is the number specified during execution of CMD.

DO YOU WISH TO SPECIFY THE DISK ADDR? (Y OR N)

Type Y to indicate that a particulat surface address is to be specified for testing; otherwise, type N. If N is typed, the entire surface is read and/or written and the next question asked is PATTERN NO.?.

CYLINDER?

Type the desired cylinder in octal.

TRACK

Type the desired track number in octal.

SECTOR

Type the desired sector number in octal.

PATTERN NO.?

Select one of the diagnostic program's patterns or enter the desired pattern. To select one of the prestored patterns type the number that precedes the desired pattern in the following list.

Ø = zeros

1 = ones (177777)

2 = checkerboard

3 = floating ones

4 = random data

5 = count pattern (full word, binary, sequential for size of buffer)

6 = run all patterns

If a user-supplied pattern is to be specified, enter 6 octal characters and press the RETURN key.

WRITE? (Y OR N)

Type Y to perform all write operations in the test or type N to inhibit write operations.

READ? (Y OR N)

Type Y to perform all read operations in the test or type N to inhibit read operations.

3.6 ERROR MESSAGES

The following three error message formats are issued by the RKØ5S diagnostic program. The first two are issued by the RKØ5D data reliability test.

RK ERROR NO.=	ERR followed by an error number. Refer to Table 3-2.
RKDS=	Contents of the Drive Status Register
RKER=	Contents of the Error Register
RKCS=	Content of the Control Status Register

RKBA=	Contents of the Current Bus Address Register
RKDA=	Content of the Disk Address Register
RK ERROR NO.=	ERR followed by an error number. Refer to Table 3-2.
EXPECTED=	Data expected
RECEIVED=	Data received
CYLINDER=	Cylinder address of error
TRACK=	Track address of error
SECTOR=	Sector address of error
DISTANCE INTO SECTOR=	Distance into sector before a verify error occurred. Count starts at 0.
RETRY NO.=	Which retry attempt has failed
READ NO.=	Which of the 8 successive read attempts failed during random test

CONTENTS OF RKDA INCORRECT

EXPECTED=	RKDA contents expected
RECEIVED=	RKDA contents received

Table 3-2
RKØ5S and RKØ5D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Conversation mode for address test	Error detected when performing an implied seek to cylinder "A".
2	Conversation mode for address test	Error detected when performing an implied seek to cylinder "B".
3	Address (part 1)	A hardware error occurred after issuing a read header command to cause an implied seek to cylinder Ø.
4	Address (part 1)	A hardware error occurred after issuing a read header command to cause an implied seek to cylinder n.
5	Address (part 2)	A hardware error occurred after issuing a read header command to cause an implied seek to the cylinder address being increased.
6	Address (part 2)	A hardware error occurred after issuing a read header command to cause an implied seek to the cylinder address that is being decreased.
7	Address (part 3)	A hardware error occurred after a 2-word write command has been issued to put the sector address pattern in the selected sector on track Ø of cylinder Ø.
1Ø	Address (part 3)	A hardware error occurred after issuing a 2-word read command to a sector on track Ø, cylinder Ø.
11	Address (part 3)	The data read does not match the sector address selected.
12	Address (part 4)	A hardware error occurred after issuing a 2-word write command to sector Ø of the selected track. The data pattern written is the track address.
13	Address (part 4)	A hardware error occurred after issuing a 2-word read command.
14	Address (part 4)	The data does not match the track address selected.
15	Address (part 5)	A hardware error occurred after issuing a 2-word write command to track Ø sector Ø of the selected cylinder. The data written is the cylinder address.

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Table 3-2 (Cont.)
RK05S and RK05D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
16	Address (part 5)	A hardware error occurred after issuing a 2-word read command.
17	Address (part 5)	The data read does not match the cylinder address selected.
20	Address (part 6)	A hardware error occurred while writing 512 words of data consisting of 177777 starting at sector 11 of track 0.
21	Address (part 6)	A hardware error occurred while reading 2 words from sector 0 of track 1.
22	Address (part 6)	The data pattern read was not 177777. Therefore, it is probable that the hardware logic did not cross over to sector 0 of track 1.
23	Address (part 7)	A hardware error occurred while writing a data pattern of 177777's to sector 11 of track 1.
24	Address (part 7)	A hardware error occurred while reading 2 words from sector 0. The cylinder address is in the range 1 through 199.
25	Data test and conversation mode	A hardware error occurred while writing the selected data pattern.
26	Data test and conversation mode for data test	A hardware error occurred while reading the data or the data is incorrect.
27	Random test	A hardware error occurred while writing random data to a random surface address.
30	Formatter	A hardware error occurred while executing a write header command.
31	Formatter	A hardware error occurred while executing a read header command.
32	Formatter	Header data is incorrect.
33	Random test	A hardware error occurred while executing a random seek command prior to reading the data.
34	Random test	The data read is incorrect.

(continued on next page)

Table 3-2 (Cont.)
RK05S and RK05D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
36	Random test	A hardware error occurred when executing a head reset command during an error recovery sequence.
75	Address (part 7)	Data read did not consist of a pattern of 177777. Therefore, it is probable that the data transferred did not cross cylinder boundaries.
100	Routine run in conjunction with address test and conversation mode.	

CHAPTER 4

RP03S, RP02S, RP02CS, RP03D, RP02D, AND RP02CD, DIAGNOSTIC PROGRAMS

The RP03S, RP02S, and RP02CS diagnostic programs and the RP03D, RP02D, and RP02CD data reliability programs are the hardware tests for the RP02 and RP03 disk. The data reliability tests are a subset of the diagnostic programs.

The RP03S, RP02S, and RP02CS diagnostic programs provide four disk tests:

1. Address test,
2. Data test,
3. Random test,
4. Formatter.

The RP03D, RP02D, and RP02CD data reliability tests provide two disk tests:

1. Data test,
2. Random test.

4.1 ADDRESS TEST (RP03S, RP02S AND RP02CS ONLY)

The address test consists of six parts.

4.1.1 Part 1 of Address Test

Part 1 of the address test issues read header commands to allow the program to verify the true position of the heads without causing a header verify error in the hardware. The seek commands in this test are implied seeks that result from the read header command.

In part 1, the program seeks from cylinder 0 to cylinder n and then back to 0 again. The value of n starts at 1 and is increased to 625 for the RP03; it is increased to 312 for the RP02. After each seek, the contents of SUCA (selected unit cylinder address register) are verified to ensure that the heads are positioned at the correct cylinder.

4.1.2 Part 2 of Address Test

Part 2 of the address test issues a read header command to allow the program to verify the true position of the heads without causing a header verify error in the hardware. The seek commands in this test are implied seeks that result from the read header command.

This part differs from part 1 in that a seek command is issued from cylinder 0 through 625. The first cylinder number is increased by 1 and the second is decreased by 1. Then the test seeks to cylinder 1 and back to 624. This process is repeated until the number being decreased goes back to zero. After each seek command, the test checks for errors and verifies the contents of SUCA (selected unit cylinder address register).

4.1.3 Part 3 of Address Test

Part 3 of the address test verifies that each sector from 0 through 9 is addressable. Each sector on cylinder 0 and track 0 is written with a data pattern equal to its address. Then each of the sectors is read and verified. Any errors are reported to the operator.

4.1.4 Part 4 of Address Test

Part 4 of the address test ensures that each track on cylinder 0 is addressable and that 2-sector transfers initiated on sector 9 cross over to the next track. A 2-sector write is issued to sector 9 of each track on cylinder 0. The pattern written is the track number. Two words of sector 0 of tracks 1 through 19 of cylinder 0 are read and verified.

4.1.5 Part of Address Test

Part 5 of the address test ensures that each cylinder is addressable and that the device updates to the next cylinder if a transfer crosses cylinder boundaries. A 2-sector write is issued for each cylinder at sector 9 of track 19. The pattern written is the cylinder number. Starting at cylinder 1, sector 0 of track 0, the sector is read and the data verified. This process is repeated for subsequent cylinders.

4.1.6 Part 6 of Address Test

Part 6 of the address test ensures that the drive can erase the remainder of a sector on a partial write. Sector 0 of track 0 of cylinder 0 is written with a pattern of all ones (177777). Then, a partial write of two words of ones is issued to the same disk address. The sector is read and checked to determine whether all of the sector except the first two words has been erased.

4.2 DATA TEST

In the data test, write and read operations are performed on the drive. The data is first written on the entire pack and then read.

Prior to each read, the data buffer always is cleared. The data is verified and any errors are reported to the operator.

If an error is detected while reading, four retries are attempted; then the head is homed and four more attempts are made to read the data.

The entire surface is tested with six distinct patterns:

1. Zeroes,
2. Ones (177777),
3. Checkboard,
4. Floating ones,
5. Random data,
6. Count pattern (full-word, binary, sequential, for the size of the buffer).

The size of the transfer is the buffer size specified during execution of CMD. The minimum transfer is 512 words.

4.3 RANDOM TEST

The random test randomly selects a disk surface address and writes random data to it. The size of the transfer is the buffer size specified during execution of CMD.

Prior to each read, the data buffer always is cleared. The random data then is read and verified. The sequence is repeated 1000 (octal) times. After each write operation, a random seek is issued. The purpose of this is to have the heads seek back to the cylinder just before reading. The read operation is repeated 10 (octal) times with intervening seeks. The purpose of these operations is to expose any read reduction problems.

If the heads have a tendency to vibrate, this difficulty should appear as parity errors.

If an error is detected, the read number is typed to show which read was being performed. If the error is unrecoverable, the read operation is terminated. If an error is detected during the read operation four attempts are made to read the data. If the attempts are unsuccessful, the heads are homed and four more attempts are made to read the data.

4.4 FORMATTER (RP03S, RP02S, AND RP02CS ONLY)

The formatter allows the operator to format an RP03 or RP02 disk pack on line. The entire pack is formatted 10 sectors at a time. If an error occurs, the program retires by formatting only one sector at a time. After formatting, the entire pack is verified 10 sectors at a time. The operator is informed of any sectors that cannot be formatted correctly.

The following header format is used.

Word 1 = 0

Word 2 bits 6 through 14 = cylinder address

Word 2 bits 1 through 5 = track address

Word 3 = sector address

4.5 OPERATIONAL INFORMATION

The operational information for the RP03 and RP02 tests consists of TEST PARAMETER bit settings and conversation mode use. Conversation mode applies only to the RP03S, RP02S, and RP02CS diagnostic programs.

4.5.1 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 5-1 lists the bits and providees their meanings. Bits 10, 3, 2, 1, and 0 apply only to the RP03S diagnostic program.

4.5.2 Conversation Mode (RP03S, RP02S, and RP02CS Only)

When conversation mode is requested by setting bit 10 in response to TEST PARAMETERS, a series of questions is printed on the console.

Two versions of conversation mode are provided with the RP03S diagnostic program. One specifies information for the address test and the other specifies information for the data test.

4.5.2.1 Address Test Conversation Mode - Conversation mode for the address test allows the operator to specify two cylinder addresses in octal. The program then issues seek commands between the specified cylinder. Any errors encountered are reported to the operator. Once started, this program loops until it is aborted by the operator.

The program requests the two cylinder addresses as follows.

"A" CYLINDER?

Enter a valid cylinder address in octal.

"B" CYLINDER?

Enter a valid cylinder address in octal.

4.5.2.2 Data Test Conversation Mode - In conversation mode for the data test, the operator can specify the data transfer size, the disk surface address, the pattern desired, and the function to be performed.

The following questions are asked.

Table 4-1
RP03S and RP03D TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop is abortable only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the testing sequence.
10	1	Enter conversation mode. See Section 4.5.2 for a description of conversation mode (S versions only).
9	1	Restart the program. The program aborts the present test sequence and restarts at the newly selected test.
5	1	Print only the first data compare error found within a specified data transfer.
	0	Prints up to 3 data compare errors within a specified data transfer.
4	1	Inhibit seek operation between successive reads during the random test.
3	1	Formatter (S versions only).
2	1	Random test (S versions only).
1	1	Data test (S versions only).
0	1	Address test (S versions only).

WORD COUNT 2 TO x

Enter an octal value to indicate the data buffer size for the data test. The maximum value that x can attain is the number specified during execution of CMD.

DO YOU WISH TO SPECIFY THE DISK ADDR? (Y OR N)

Type Y to indicate that a particular surface address is to be specified for testing; otherwise, type N. If N is typed the entire surface is read and/or written and the next question asked is PATTERN NO.?.

CYLINDER

Type the desired cylinder number in octal.

TRACK

Type the desired track number in octal.

SECTOR

Type the desired sector number in octal.

PATTERN NO.?

Select one of the diagnostic program's patterns or enter the desired pattern. To select one of the prestored patterns type the number that precedes the desired pattern in the following list.

0 = zeros

1 = ones (177777)

2 = checkerboard

3 = floating ones

4 = random data

5 = count pattern (full word, binary, sequential for size of buffer)

6 = run all patterns

If a user-selected pattern is to be specified, enter 6 octal characters and press RETURN.

WRITE? (Y OR N)

Type Y to perform all write operations in the test or type N to inhibit write operations.

READ? (Y OR N)

Type Y to perform all read operations in the test or type N to inhibit read operations.

4.6 ERROR MESSAGE FORMAT

The following four message formats are issued by the RP03S diagnostic program and the RP03D data reliability test.

RP ERROR NO.=	ERR followed by an error number. Refer to Table 4-2.
RPDS=	Contents of Device Status Register
RPER=	Contents of Error Register
RPCS=	Contents of Control Status Register
RPBA=	Contents of Bus Address Register
CYLINDER=	Cylinder number of the error
TRACK=	Track number of the error
SECTOR=	Sector number of the error

DATA VERIFY ERROR

RP ERROR NO.=	ERR followed by the number of the error. Refer to Table 4-2.
EXPECTED=	Data expected
RECEIVED=	Data received
CYLINDER=	Cylinder address or error
TRACK=	Track address of error
SECTOR=	Sector address of error
DISTANCE INTO SECTOR=	Distance into sector in which the verify error was encountered. The count starts at 0.
RETRY NO.=	Indicates which read attempt is in progress.
READ NO.=	Printed during random test to indicate which of the 8 successive read attempts failed

DISK ADDRESS DID NOT UPDATE PROPERLY

EXPECTED=	Address expected
RECEIVED=	Address received

CONTENTS OF SUCA INCORRECT

EXPECTED=	SUCA expected
RECEIVED=	SUCA received

Table 4-2
RP03S, RP02S, RP02CS, RP03D, RP02D, and RP02CD Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Address test portion of conversation mode	A hardware error occurred after the test issued a read header command. This command caused an implied seek to cylinder A.
2	Address test portion of conversation mode	A hardware error occurred after the test issued a read header command. This command caused an implied seek to cylinder B.
3	Address (part 1)	A hardware error occurred after issuing a read header command. This command causes an implied seek to cylinder 0.
4	Address (part 1)	A hardware error occurred after issuing a read header command. This command causes an implied seek to cylinder n.
5	Address (part 2)	A hardware error occurred after issuing a read header command to the cylinder address being increased. It causes an implied seek to the selected cylinder.
6	Address (part 2)	A hardware error occurred after issuing a read header command to the cylinder address that is decreasing. It causes an implied seek to the selected cylinder.
7	Address (part 3)	A hardware error occurred when issuing a 2-word write to the selected sector. The data pattern written is equal to the sector address.
10	Address (part 3)	A hardware error occurred after issuing a 2-word read command.
11	Address (part 3)	The data is incorrect.
12	Address (part 4)	A hardware error occurred after issuing a 512-word write command to sector 9 of a track on cylinder 0. Each write should overflow into sector 0 of the next track. The data pattern written is the address of the selected track.
13	Address (part 4)	A hardware error occurred after issuing a 2-word read command

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Table 4-2 (Cont.)
RP03S, RP02S, RP02CS, RP03D, RP02D, and RP02CD Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
		to sector 0. The track address varies from 1 through 19. The data read should be equal to the track address selected minus 1 because the data written overflowed from the previous track.
14	Address (part 4)	The data is incorrect. The data should equal the track address selected minus 1.
15	Address (part 5)	A hardware error occurred after issuing a 512-word write command to sector 9 of track 19 on a cylinder. The data pattern written is the address of the selected cylinder.
16	Address (part 5)	A hardware error occurred after issuing a 2-word read command to sector 0 of track 0 on a cylinder. The data read from sector 0 should be equal to the cylinder address minus 1. The reason is that the data written overflowed from the previous cylinder.
17	Address (part 5)	The data is incorrect. It should be equal to the cylinder address minus 1.
20	Address (part 6)	A hardware error occurred after issuing a 256-word write command to sector 0, track 0, cylinder 0. The data pattern to be written is 177777.
21	Address (part 6)	A hardware error occurred after issuing a 2-word write to sector 0, track 0, cylinder 0.
22	Address (part 6)	A hardware error occurred when reading 256 words from sector 0, track 0, cylinder 0.
23	Address (part 6)	The data is incorrect.
25	Data test and data test portion of conversation mode	A hardware error occurred while writing the selected pattern.

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Table 4-2 (Cont.)
RPØ3S, RPØ2S, RPØ2CS, RPØ3D, RPØ2D, and RPØ2CD Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
27	Data test or data test portion of conversation mode	A hardware error occurred while reading the data or the data is incorrect.
5Ø	Formatter	A hardware error occurred while issuing a write header command to format 1Ø sectors at a time.
51	Formatter	A hardware error occurred when issuing a read header command to read 1Ø sectors at a time.
52	Formatter	The first word in the header is not Ø.
53	Formatter	The second word in the header does not contain the cylinder and track address.
54	Formatter	The third word of the header does not contain the sector address.
55	Formatter	A hardware error occurred while issuing a write header command to format 1 sector at a time. This error message should be preceded by ERR 5Ø.
56	Random test	A hardware error occurred after writing random data to a random surface address.
57	Random test	A hardware error occurred while reading the random data or the data is incorrect.
6Ø	Random test	A hardware error occurred after issuing a seek command to a random address.
61	Random test	A hardware error occurred after issuing a home seek. This is part of the error recovery sequence.

CHAPTER 5

RP04S AND RP04D DIAGNOSTIC PROGRAMS

The RP04S diagnostic program and the RP04D data reliability program are the two hardware tests for the RP04 disk. The RP04D data reliability test is a subset of the RP04S diagnostic program.

The RP04S diagnostic program provides four disk tests:

1. Address test,
2. Data test,
3. Random test,
4. Formatter,

The RP04S data reliability test provides two disk tests:

1. Data test,
2. Random test

5.1 ADDRESS TEST (RP04S ONLY)

The address test consists of six parts.

5.1.1 Part 1 of Address Test

Part 1 of the address test issues read header commands to allow the program to verify the true position of the heads without causing a header verify error in the hardware. The seek commands in this test are implied seeks that result from the read header command.

In part 1, the program seeks from cylinder 0 to cylinder n and then back to 0 again. The value of n starts at 1 and increases to 633. After each seek, the contents of current cylinder register (RHCC) are verified to ensure that the heads are positioned at the correct cylinder.

5.1.2 Part 2 of Address Test

Part 2 of address test issues a read header command to allow the program to verify the true position of the heads without causing a header verify error in the hardware. The seek commands in this test

are implied seeks that result from the read header command.

This part differs from part 1 in that a seek command is issued from cylinder 0 through cylinder 633. The first cylinder number is increased by 1 and the second is decreased by 1. Then the test seeks to cylinder 1 and back to cylinder 633. This process is repeated until the number being decreased goes back to zero. After each seek command, the test checks for errors and verifies the contents of RHCC (current cylinder address). The header data are compared to! ensure that the heads are positioned at the correct cylinder.

5.1.3 Part 3 of Address Test

Part 3 of the address test verifies that each sector from 0 through 25 is addressable. The test issues a 2-word write to each sector on cylinder 0 and track 0. The pattern written is the sector address. Each of the sectors is read and verified. Any errors are reported to the operator.

5.1.4 Part 4 of Address Test

Part 4 of the address test ensures that each track on cylinder 0 is addressable and that 2-sector transfers initiated on sector 25 cross over to the next track. A 2-sector write is issued to sector 25 of each track on cylinder 0. The pattern written is the track number. Two words of sector 0 of tracks 1 through 21 of cylinder 0 are read and verified.

5.1.5 Part 5 of Address Test

Part 5 of the address test ensures that each cylinder is addressable and that the device updates to the next cylinder if a transfer crosses cylinder boundaries. A 2-sector write is issued for each cylinder at sector 25 of track 1. The pattern written is the cylinder number. Starting at cylinder 1, sector 0 of track 0, 2 words of the sector are read and the data is verified. This process is repeated for subsequent cylinders.

5.1.6 Part 6 of Address Test

Part 6 of the address test ensures that the drive can erase the remainder of a sector on a partial write. Sector 0 of track 0 of cylinder 0 is written with a pattern of all ones (177777). Then, a partial write of two words of ones is issued to the disk address. The sector is read and checked to determine whether all of the sector except the first two words have been erased.

5.2 DATA TEST

During execution of the data test, write and read operations are performed on the drive. The data is written on the entire pack and then read back. The data buffer is cleared before each read. The data is verified and any errors are reported.

If an error is detected during the read operation, four retries are attempted, and then the head is homed. Four more attempts are made to recover the data.

The entire surface is tested with the following six patterns:

1. Zeroes,
2. Ones (177777),
3. Checkerboard,
4. Floating ones,
5. Random data,
6. Count pattern (sequential, binary, full-word, up to size of the buffer).

The size of the transfer is determined by the buffer size selected during the execution of CMD.

5.3 RANDOM TEST

The random test selects a disk surface address randomly and writes random data on it. After each write operation, the program issues a random seek to cause the heads to seek back to the cylinder just prior to reading. The size of the transfer depends on the buffer size selected during execution of CMD.

Prior to each read operation, the data buffer is cleared. Then, the random data is read and verified. This sequence is repeated 1000 (octal) times. The read operation is repeated eight times with intervening seeks to detect any read reduction problems. If an error is detected, the read number is typed to show which read was being performed when the error occurred. If the error is unrecoverable, the read operation is terminated. If an error is detected during the read operation, four attempts are made to read the data. If the data still cannot be read, thee heads are homed and four more attempts are made to read the data.

If the heads have a tendency to vibrate, this condition should appear as parity errors.

5.4 FORMATTER TEST (RP04S ONLY)

The formatter test formats the entire RP04 pack and then verifies it. The entire pack is formatted one sector at a time. Any errors are reported to the operator. After formatting, the entire pack is verified one sector at a time to ensure that the headers were written correctly.

5.5 OPERATIONAL INFORMATION

The operational information for the RP04S and RP04D diagnostic program consists of TEST PARAMETER bit settings and conversation mode use. Conversation can be used only for RP04S.

5.5.1 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 5-1 lists the switches and provides their meanings. Bits 10, 3, 2, 1, and 0 apply to the RP04S only.

Table 5-1
RP04S and RP04D TEST PARAMETERS Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop is abortable only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the testing sequence.
10	1	Enter conversation mode. See Section 5.5.2 for a description of conversation mode (RP04 only).
9	1	Restart the program. The program aborts the present test sequence and restarts at the newly selected test.
5	1	Print only the first data compare error found within a specified data transfer.
	0	Print up to 3 data compare errors within a specified data transfer.
4	1	Inhibit seek operation between successive reads during the random test.
3	1	Formatter (RP04S only).
2	1	Random test (RP04S only).
1	1	Data test (RP04S only).
0	1	Address test (RP04S only).

5.5.2 Conversation Mode

When conversation mode is requested by setting bit 10 in response to TEST PARAMETERS, a series of questions is printed on the console.

Two versions of conversation mode are provided with the RP04S diagnostic program. One specifies information for the address test and the other specifies information for the data test.

5.5.2.1 Address Test Conversation Mode - Conversation mode for the address test allows the operator to specify two cylinder addresses in octal. The program then issues seek commands between the specified cylinders. Any errors eencountered are reported to the operator. Once started, this program loops until it is aborted by the operator.

The program requests the two cylinder addresses as follows.

"A" CYLINDER?

Enter a valid cylinder address in octal.

"B" CYLINDER?

Enter a valid cylinder address in octal.

5.5.2.2 Data Test Conversation Mode - In conversation mode for the data test, the operator can specify the data transfer size, the disk surface address, the patten desired, and the function to be performed.

The following questions are asked.

WORD COUNT 2 TO x

Enter an octal value to indicate the data buffer size for the data test. The maximum value that x can attain is thee number specified during execution of CMD.

DO YOU WISH TO SPECIFY THE DISK ADDR? (Y OR N)

Type Y to indicate that a particular surface address is to be specified for testing; otherwise, type N. If N is typed the entire surface is read and/or written and the next question asked is PATTERN NO.?

CYLINDER

Type the desired cylinder number in octal. The maximum cylinder address is 632.

TRACK

Type the desired track number in octal.

SECTOR

Type the desired seector number in octal.

PATTERN NO.?

Select one of the diagnostic program's patterns or enter the desired pattern. To select one of the prestored patterns type the number that precedes the desired pattern in the following list.

0 = zeros

1 = ones (177777)

2 = checkerboard

3 = floating ones

4 = random data 5 = count pattern (full word, binary sequential for size of buffer)

6 = run all patterns

If a user-supplied pattern is to be specified, enter 6 octal characters and press the RETURN key.

WRITE? (Y OR N)

Type Y to perform all write operations in the test or type N to inhibit write operations.

READ? (Y OR N)

Type Y to perform all read operations in the test or type N to inhibit read operations.

5.6 ERROR MESSAGES

The following three error message formats are issued by the RP04S diagnostic program. The first two are issued by the RP04D data reliability test.

RP ERROR NO.=	ERR followed by an error number. Refer to Table 5-2.
RHCS1=	contents of the Control and Status 1 register
RHBA=	content of the Unibus Address Register
RHDA=	contents of the desired Addres Register
RHCS2=	contents of the Control and Status 2 register
RHDS1=	contents of the Status Register
RHER1=	contents of Error Register 1
RHCA=	contents of desired Cylinder Address Register
RHER2=	contents of Error Register 2
RHER3=	contents of Error Register 3

CYLINDER=	cylinder address of the error
TRACK=	track address of the error
SECTOR=	sector address of the error

RP ERROR NO.=	ERR followed by an error number. Refer to Table 5-2.
EXPECTED=	data expected
RECEIVED=	data received
CYLINDER=	cylinder address of the error
TRACK=	track address of the error
SECTOR=	sector address of the error
DISTANCE	distance into sector before a verify
INTO SECTOR=	error occurred. Count starts at 0.
RETRY NO.=	indicates which reread attempt recovered the data
READ NO.=	indicates which of the 8 successive read attempts failed during the random test

DISK ADDRESS DID NOT UPDATE PROPERLY

EXPECTED=	address expected
RECEIVED=	address received

Table 5-2
RP04S and RP04D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Conversation mode for address test	Error detected when performing an implied seek to cylinder "A".
2	Conversation mode for address test	Error detected when performing an implied seek to cylinder "B".
3	Address (part 1)	A hardware error occurred after issuing a read header command to cause an implied seek to cylinder 0.
4	Address (part 1)	A hardware error occurred after issuing a read header command to cause an implied seek to cylinder n.
5	Address (part 2)	A hardware error occurred after issuing a read header command to cause an implied seek to the cylinder address being increased.
6	Address (part 2)	A hardware error occurred after issuing a read header command to cause an implied seek to the cylinder address being decreased.
7	Address (part 3)	A hardware error occurred after a 2-word write command has been issued to put the sector address pattern in the selected sector of track 0, cylinder 0.
10	Address (part 3)	A hardware error occurred after issuing a 2-word read command to a sector on track 0, cylinder 0.
11	Address (part 3)	The data read does not match the sector address selected.
12	Address (part 4)	A hardware error occurred after issuing a 512-word write command to sector 25 on tracks 0 through 20 of cylinder 0. Each write should overflow onto sector 0 of the next track. The data pattern written is the track address.

(continued on next page)

Table 5-2 (Cont.)
RP04S and RP04D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
13	Address (part 4)	A hardware error occurred after issuing a 2-word read command to sector 0 of tracks 1 through 21 on cylinder 0. The data read from sector 0 should be the track address selected minus 1. The reason is that the data pattern overflowed from the previous track.
14	Address (part 4	The data is incorrect. It should be the track address selected minus 1.
15	Address (part 5)	A hardware error occurred after issuing a 512-word write command to sector 25 of track 21 on a cylinder. The data pettern written is the cylinder address selected.
16	Address (part 5)	A hardware error occurred after issuing a 2-word read command from sector 0, track 0 on a cylinder.
17	Address (part 5)	The data is incorrect. It should be the cylinder selected minus 1. The reason is that the data pattern written should have overflowed from the previous cylinder.
20	Address (part 6)	A hardware error occurred after issuing a 256-word write command to sector 0 of track 0, cylinder 0. The data written is 177777.
21	Address (part 6)	A hardware error occurred after issuing a 2-word write command to sector 0 of track 0, cylinder 0. The data written is 177777. A partial write command should result in the rest of the sector being erased.
22	Address (part 6)	A hardware error occurred after issuing a 256-word read command to sector 0 of track 0, cylinder 0.

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Table 5-2 (Cont.)
RP04S and RP04D Error Messages

ERROR NUMBER	ASSOCIATED TESTS	MEANING
23	Address (part 6)	The data is incorrect, the first 2 words should be 177777 and the rest of the sector should be zeros.
25	Data test and data test portion of conversation mode	A hardware error occurred while writing the selected pattern.
27	Data test and data test portion of conversation mode	A hardware error occurred while reading the data pattern or the data is incorrect.
50	Formatter	A hardware error occurred after issuing a write header command to the selected address.
51	Formatter	A hardware error occurred after issuing a read header command to the selected address.
52	Formatter	The first word of the header is incorrect. It should contain the cylinder address and bit 12 should be set.
53	Formatter	The second word of the header is incorrect. It should contain the sector and track address.
56	Random test	A hardware error occurred while writing random data to a random surface address.
57	Random test	A hardware error occurred while reading the random data or the data is incorrect.
60	Random test	A hardware error occurred after issuing a seek command to a random address.

CHAPTER 6

RS04S, RS03S, RS04D, RS03D DIAGNOSTIC PROGRAMS

The RS04S and RS03S diagnostic program and the RS04D and RS03D data reliability program are the two hardware tests for the RS04/RS03 disks. The RS04D data reliability program is a subset of the RS04S diagnostic program.

The RS04S and RS03S diagnostic programs provides three disk tests:

1. Address test,
2. Data test,
3. Random test.

The RS04D and RS03D data reliability tests provides two disk tests:

1. Data test,
2. Random test.

The following information is important to an understanding of both the RS04/RS03 S and D programs.

1. In IAS and RSX-11D, all surface addressing to an RS03/RS04 is done on a 256-word boundary.

   Since a sector on the RS04 contains 128 words, all addressing must be performed to an even-numbered sector.

   Since a sector on the RS03 contains 64 words, all addressing must be done in multiples of four. For example, the sector address in octal always must end in a 0 or 4.

2. In order to determine whether the device is an RS03 or an RS04, a 2-word read operation is issued to sector 0 of track 0 to obtain the contents of the device registers. Error number 100, described in Table 6-2, is associated with this initialization program.

NOTE

All reference to the RS04 disks also include the RS03 disks.

6.1 ADDRESS TEST (RS04S ONLY)

The address test for the RS04S consists of two parts.

6.1.1 Part 1 of Address Test

Part 1 of the address test ensures that each sector of the RS03/RS04 surface is uniquely addressable by performing the following steps.

1. Writing a pattern on the entire surface. The pattern contains the current track and sector address. 256 words are written at a time.

2. Reading and verifying the content of each sector after it is written.

The pattern written and verified by the test consists of 256 words of current address information. Each word has the following format.

Byte 1 contains the track address right jusvified.

Byte 0 contains the sector addres right justified.

6.1.2 Part 2 of Address Test

Part 2 of the address test selectes a random disk address and issues a read operation. The data on the disk was written by part 1 of the address test. It should contain the sector and track address of the read. The random read is repeated 1000 (octal) times.

If an error occurs, the error message printed by the program can be used to determine whether the wrong disk address was selected.

6.2 DATA TEST

The data test performs read and write operations on the drive. The data is written on the entire pack and then read back. Prior to each read operation, the input data buffer is cleared. The data is verified and any errors are reported to the operator.

The entire surface is tested with six distinct patterns:

1. Zeros,

2. Ones (177777)

3. Checkerboard,

4. Floating ones,

5. Random data

6. Count pattern (full-word, binary, sequential for the size of the buffer).

If an error is detected while reading, eight retries are attempted.

The size of the transfer is determined by the buffer size specified during execution of CMD.

6.3 RANDOM TEST

The data test randomly selects a disk surface address and writes random data on it. The data is read back and verified. Before each read operation, the input buffer is cleared. This sequence is repeated 2000 (octal) times. After the data is written, it is read eight times to expose any read reduction problems.

The size of the transfer is determined by the data buffer size specified during execution of CMD.

If an error is detected, eight attempts are made to read the data correctly. With each read error, the read number is also typed to show on which read the error occurred. The read number should not be confused with the retry number. Once an unrecoverable error is encountered, the program does not attempt any additional read operations on the same data.

6.4 OPERATIONAL INFORMATION

Operational information for the RS04S diagnostic program consists of TEST PARAMETER bit settings and conversation mode. For the RS04D data reliability program, it consists of TEST PARAMETER bits only.

6.4.1 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 6-1 lists the bits and provides their meanings. Bits 10, 2, 1, and 0 apply only to the RS04S diagnostic program.

Table 6-1
RS04S and RS04D TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task start-up in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop is abortable only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the testing sequence.
10	1	Enter conversation mode. See Section 6.4.2 for a description of conversation mode (RS04S only).
9	1	Restart the program. The program aborts the present test sequence and restarts at the newly selected test.
5	1	Print only the first data compare error found within a specified data transfer.
	0	Print up to 3 data compare errors within a specified data transfer.
2	1	Random test (RS04S only).
1	1	Data test (RS04S only).
0	1	Address test (RS04S only).

6.4.2 Conversation Mode (RSØ4S ONLY)

When conversation mode is requested by setting bit 1Ø in response to TEST PARAMETERS, a series of questions is printed on the console. The following is a list of the questions and a descriptions of responses to them.

WORD COUNT 2 TO X

Enter an octal value to indicate the data buffer size for the data test. The maximum value that x can attain is the number specified during execution of CMD.

DO YOU WISH TO SPECIFY THE DISK ADDR? (Y OR N)

Type Y to indicate that a particular surface address is to be specified for testing; otherwise, type N. If N is typed the entire surface is read and/or written and the next question asked is PATTERN NO.?

TRACK

Type the desired track number in octal.

SECTOR

Type the desired sector number in octal.

PATTERN NO.?

Select one of the diagnostic program's patterns or enter the desired pattern. To select one of the prestored patterns type the number that precedes the desired pattern in the following list.

Ø = zeros

1 = ones (177777)

2 = checkerboard

3 = floating ones

4 = random data

5 = count pattern (full word, binary, sequential for size of buffer)

6 = run all patterns

If a user-selected pattern is to be specified, enter 6 octal characters and press RETURN.

WRITE? (Y OR N)

Type Y to perform all write operations in the test or type N to inhibit write operations.

READ? (Y OR N)

Type Y to perform all read operations in the test or type N to inhibit read operations.

6.5 ERROR MESSAGE FORMATS

The following three error message formats are issued by the RS04S diagnostic program. The first two also are issued by the RS04D data reliability test.

RS ERROR NO.=	ERR followed by an error number. Refer to Table 6-2.
RSCS1=	Contents of Control and Status 1 Registers
RSWC=	Contents of Word Count Register
RSBA=	Contents of Unibus Address Register
RSDA=	Contents of desired Disk address Register
RSCS2=	Contents of Control and Status 2 Register
RSDS=	Contents of Drive Status Register
RSER=	Contents of Error Register
RSAS=	Contents of Attention Summary Register

RS ERROR NO.=	ERR followed by an error number. Refer to Table 6-2.
EXPECTED=	Data expected
TRACK=	Track address of the error
SECTOR=	Sector address of error
DISTANCE INTO SECTOR=	Distance into sector before a verify error was encountered. The count starts at 0.
RETRY NO.=	Indicates which read retry attempt has failed.
READ NO.=	Printed during random test to indicate which of the 8 successive read attempts failed.

DISK ADDRESS IS INCORRECT

TRACK

EXPECTED=	Track address expected
RECEIVED=	Track address received

SECTOR

EXPECTED=	sector address expected
RECEIVED=	sector address received

Table 6-2
RS04S and RS04D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Address (part 1)	A hardware error occurred while writing 256 words to the selected sector. The pattern written contains the sector address.
2	Address (part 1)	A hardware error occurred while reading 256 words to the selected sector address.
3	Address (part 1)	The data is incorrect.
4	Address (part 2)	A hardware error occurred while reading 2 words from a random sector.
5	Address (part 2)	The data is incorrect. It should be the track and sector address.
25	Data test and conversation mode	A hardware error occurred while writing the selected pattern.
26	Data test and conversation mode	A hardware error occurred while reading the data or the data is incorrect.
27	Random test	A hardware error occurred while writing the random data to a random surface address.
34	Random test	A hardware error occurred while reading random data or the data is incorrect. Each read is repeated eight times.
100	Program initialization	A hardware error occurred when issuing a 2-word read to sector 0 of track 0.

CHAPTER 7

RS11S AND DIAGNOSTIC PROGRAMS

The RS11S diagnostic program and the RS11D data reliability program are the two hardware tests for the RS11 disk. The RSX-11D data reliability test is a subset of the RS11S diagnostic program.

The RS11S diagnostic program provides three disk tests:

1. Address test,
2. Data test,
3. Random test,

The RS11D data reliability test provides two disk tests:

1. Data test,
2. Random test.

The following information is important to an understanding of the diagnostics.

1. Under IAS and RSX-11D, each disk surface is divided into 256-word blocks. Each track is divided into eight sectors of 256 words. The sectors are numbered 0 through 7.
2. IAS and RSX-11D treat all units on an RF controller as one continuous surface. To determine whether a specific drive is to be exercised or whether all drives are to be exercised, the series of questions described in Section 7.4.1 are printed on the console for operator response.
3. In order to determine the number of surfaces that exist on an RS, an initializer task issues a read to the first sector of each unit until the nonexistent drive condition sets. When nonexistent drive sets, the initializer ensure that the error bit sets also.

7.1 ADDRESS TEST (RS11S ONLY)

The address test comprises two parts.

7.1.1 Part 1 of Address Test

The first part of the address test ensures unique addresses on the

disk surface by performing the following steps.

1. Writing a pattern on the entire surface. The pattern written contains the current unit, track, and sector address as described below. 256 words are written at a time.

2. Reading and verifying each sector after it is written. Any errors are reported to the operator.

The patterm written and verified by the test consists of 256 words of current address information. Each word of the pattern has the following format.

Byte 1 contains the track address right justified.

Byte 0 contains thee sector address in bits 0 through 2 and the unit address in bits 3 through 5.

7.1.2 Part 2 of Address Test

The second part of the address test performs the following steps:

1. Randomly selects a disk address and reads 2 words of the pattern written by the first part of the test. The 2 words should contain the sector, track, and unit address of the current read operation.

2. Compares the sector, track, and unit address of the read operation with those contained in the 2 words and issues an error message if they do not match.

3. Repeats steps 1 and 2 1000 (octal) times.

7.2 DATA TEST

The data test uses read and write operations to verify data written on a drive. The data is written on the entire pack and then read. Prior to each read operation, the input data buffer is cleared. The data is verified and any errors are reported to the operator.

If an error is detected during the read operation, eight retries are attempted.

The entire surface is tested with the following six distinct patterns.

1. Zeros

2. Ones (177777)

3. Checkerboard

4. Floating ones

5. Random data

6. Count pattern (full word, binary sequential for size of the buffer)

The size of the transfer is determined during CMD execution. The

minimum size of the transfer is 512 words (2 sectors). The maximum size is 16,000 words.

7.3 RANDOM TEST

The random test selects a disk surface address and writes data on it. Both the disk address selected and the data written are random. The data is read back and verified. This sequence is repeated 2000 (octal) times. After the data is written, the test reads it eight times to determine read reduction problems.

If an error is detected during the read operation, eight attempts are made to read the data correctly. The read number is printed as part of the error message to the operator to indicate on which read the error occurred. The read number should not be confused with the retry count which indicates the number of attempts to recover from an error. Once an unrecoverable error is encountered, the program does not attempt any additional reads on the same data.

The size of the transfer is determined during CMD execution.

7.4 OPERATIONAL INFORMATION

7.4.1 Determing the Number of Drives to Exercise

Once the diagnostic program is started, it prints the following questions on the console.

7.4.2 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 7-1 lists the switches to set and provides their meanings. Bits 10, 2, 1, and 0 apply only to the RS11S diagnostic program.

Table 7-1
RS11S and RS11D TEST PARAMETERS Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop is abortable only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and repeats the specified test sequence.
10	1	Enter conversation mode. See Section 7.4.3 for a description of conversation mode (RS11S only).
9	1	Restart the program. The program aborts the present test sequence and restarts at the newly selected test.
5	1	Print only the first data compare error found within a specified data transfer.
	0	Print up to 3 data compare errors within a specified data transfer.
2	1	Random test (RS11S only).
1	1	Data test (RS11S only).
0	1	Address test (RS11S only).

7.4.3 Conversation Mode (RS11S Only)

When conversation mode is requested by setting bit 10 in response to TEST PARAMETERS, a series of questions is printed on the console. The following is a list of the questions and a description of responses to them.

WORD COUNT 2 TO X

Enter an octal value to indicate the data buffer size for the data

test. The maximum value that x can attain is the number specified during execution of CMD.

DO YOU WISH TO SPECIFY THE DISK ADDR? (Y OR N)

Type Y to indicate that a particular surface address is to be specified for testing; otherwise, type N. If N is typed the entire surface is read and/or written and the next question asked is PATTERN NO.?.

TRACK

Type the desisred track number in octal.

TEST ALL DRIVES? (Y OR N)

Type Y to indicate yes or N to indicate no.

If the answer is yes (Y), the task determines how many drives are present and tests all of them.

If the answer is no (N), the following question is asked.

WHICH DRIVE?

Type the number of the drive to be tested. Drive numbers range from 0 through 7.

SECTOR

Type the desired sector number in octal.

PATTERN NO.?

Select one of the diagnostic program's prestored patterns or enter the desired pattern. To select one of the prestored patterns type the number that precedes the desired pattern in the following list.

0 = zeros

1 = ones (177777)

2 = checkerboard

3 = floating ones

4 = random data

5 = count pattern (full word, binary, sequential for size of buffer)

6 = run all patterns

If a user-specified pattern is to be specified, enter 6 octal characters and press the RETURN key.

WRITE? (Y OR N)

Type Y to perform all write operations in the test or type N to inhibit write operations.

READ? (Y OR N)

Type Y to perform all read operations in the test or type N to inhibit read operations.

7.5 ERROR MESSAGES

The following three error message formats are issued by the RS11S diagnostic program and the RS11D data reliability test.

RF ERROR NO.=	ERR followed by an error number. Refer to Table 7-2.
RFCS=	Contents of Disk Control Status Register
RFWC=	Contents of Word Count Register
RFBA=	Contents of Current Memory Address Register
RFDA=	Contents of Disk Address Register
RFER=	Contents of Disk Address Extension Error Register
UNIT NO.=	Number of the unit on which the error occurred
RF ERROR NO.=	ERR followed by an error number. Refer to Table 7-2.
EXPECTED=	Data expected
RECEIVED=	Data received
TRACK=	Track address of error
SECTOR=	Sector address of error
UNIT NO.=	Number of unit on which error occurred
DISTANCE INTO SECTOR=	Distance into sector before a verify error occurred. Count starts at 0.
RETRY NO.=	Which retry attempt has failed.
READ NO.=	Which of the 8 successive read attempts failed during random test

DISK ADDRESS IS INCORRECT

UNIT	
EXPECTED=	Unit number expected
RECEIVED=	Unit number received
TRACK	
EXPECTED=	Track address expected
RECEIVED=	Track address received
SECTOR	
EXPECTED=	Sector address expected
RECEIVED=	Sector address received

Table 7-2
RS11S and RS11D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Address (part 1)	A hardware error occurred while trying to write 256 words. The pattern written is equal to the surface address.
2	Address (part 1)	A hardware error occurred while trying to read 256 words.
3	Address (part 1)	Data is incorrect. The data read should equal the surface address.
4	Address (part 2)	A hardware error occurred while trying to read 2 words from a random address.
5	Address (part 2)	Data is incorrect. The data should equal the surface address.
6	Initializer or conversation mode	An error occurred when trying to read the first sector of the selected unit.
25	Data test or conversation mode	A hardware error occurred while writing the test pattern.
26	Data test or conversation mode	A hardware error occurred while reading the test pattern or the data is incorrect.
27	Random test	A hardware error occurred while writing random data to a random surface address.
34	Random test	A hardware error occurred while reading random data or the data is incorrect.

CHAPTER 8

TU56S AND TU56D DIAGNOSTIC PROGRAMS

The TU56S diagnostic program and the TU56D data reliability program are the two hardware tests for the TU56 (DECtape) controller. The TU56D data reliability test is a subset of the TU56S diagnostic program.

The TU56S diagnostic program povides three tests:

1. Address test,
2. Start/stop test (forward and reverse),
3. Data test.

The TU56D data reliability test provides the data test.

8.1 ADDRESS TEST (TU56S ONLY)

Address test consist of four parts.

8.1.1 Part 1 of Address Test

Part 1 of the address test issued a rewind command and verified that the unit rewinds by testing the end zone bit. It also tests to ensure that the error bit sets as a result of encountering the end zone.

8.1.2 Part 2 of Address Test

Part 2 of the address test determines that the drive can write and read data. The following steps are performed:

1. In a forward direction, write zeros on block 0 and read the pattern in both directions,
2. In a forward direction, write ones on blocks 0 and 1 and read the pattern in both directions,
3. In a reverse direction, write ones on block 1 and 0 and read the pattern in both directions.

8.1.3 Part 3 of Address Test

Part 3 of the address test verifies that each block on the tape can be addressed uniquely. First, the odd numbered blocks are written in the forward direction and the even numbered blocks are written in the reverse direction. The pattern written is the block number.

Secondly, all the odd numbered blocks are read in the reverse direction and the even numbered blocks are read in the forward direction. After each read, the data is verified.

8.1.4 Part 4 of Address Test

Part 4 of the address test randomly selects a block address and issues a read command. The pattern should be the block address. This sequence is repeated 128 times.

8.2 START/STOP TEST (TU56S ONLY)

The start/stop test verifies that the stop and start times are within the standard specification for the forward direction. After the tape is rewound, a command is issued to read a block number. The block number must be within five blocks of the previously read block number. Then a stop command is issued.

For example, assume that block number 5 was just read and a stop command is issued.. It takes approximately two blocks for the tape to stop. Then another command to read a block is issued. It requires approximately two more blocks for the tape to get up to speed. The number of the block just read should be within five blocks of the number of the block previously read. In this example, the number of the block just read should be no greater than 12 (octal). Another check is made to ensure that the block number is not less than or equal to the number of the previously read block (5 in this case).

A smaller number indicates that the tape moved in the wrong direction.

The reverse start/stop test is the same as the forward start/stop test except that the blocks are read in the reverse direction rather than the forward direction.

8.3 DATA TEST

The data test verifies the data reliability of the DECtape drive. All data in this test is transferred between block 100 (octal) and 300 (octal). The following six patterns are used:

1. Zeroes,
2. Ones (177777),
3. Checkerboard,
4. Floating ones,
5. Random data,

6. Count pattern (full-word, binary sequential for the size of the buffer).

For each pattern, the tape is written in the forward direction and read in the forward direction. Then, the tape is written in the reverse direction and read in the reverse direction.

If an error is detected while reading, five attempts are made to recover the data.

The size of the data transferred is determines during execution of CMD.

8.4 OPERATIONAL INFORMATION

The operational information for the TU56S diagnostic program consists of TEST PARAMETER bit settings and conversation mode use. Operational information for the TU56D data reliability test consists of TEST PARAMETER bit settings.

8.4.1 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 8-1 lists the switches and provides their meanings. Bits 10, 2, 1, and 0 apply to the TU56S diagnostic program only.

Table 8-1
TU56S and TU56D TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop is abortable only by specifying new test parameters with bit 4 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the specified testing sequence.
10	1	Enter conversation mode. See Section 8.4.2 for a description of conversation mode (TU56S ONLY).
9	1	Restart the program. The program aborts the present test sequence and restarts at the newly selected test:
5	1	Print only the first data compare error found within a specified data transfer.
	0	Print up to 3 data compare errors within a specified data transfer.
2	1	Run data test (TU56S only)
1	1	Run start/stop test (TU56S only)
0	1	Run address test (TU56S only)

8.4.2 Conversation Mode

When conversation mode is requested by setting bit 10 in response to TEST PARAMETERS, a series of questions is printed on the console. Two versions of conversation mode are provided with the TU56S diagnostic program. One specifies information for the address test and the other specified information for the data test. Setting bit 0 equal to 1 implies that the conversation mode of the address test is to execute; whereas, setting bit 2 equal to 1 implies that the conversation mode of the data test is to execute.

8.4.2.1 Address Test Conversation Mode - Conversation mode for the address test allows the operator to specify two block numbers in octal. The program issues a 2-word write to the first block and then to the second.

The program requests the two block addresses as follows.

```
BLOCK "A"

                        Enter a valid block address in octal.

BLOCK "B"

                        Enter a valid block address in octal.
```

8.4.2.2 Data Test Conversation Mode - The following questions are printed on the console in conversation mode for the data test.

```
WORD COUNT 2 TO x
```

Enter an octal value to indicate the data buffer size for the data test. The maximum value that x can attain is the number specified during execution of CMD.

```
DO YOU WISH TO SPECIFY THE BLOCK ADDR?  (Y OR N)
```

Type Y if a particular block address is to be specified for testing; otherwise, type N. If N is typed, data is written and/or read in block 100 (octal) through 300 (octal) and the next question asked is PATTERN NO.?.

```
RESPOND WITH THE DESIRED BLOCK ADDRESS IN OCTAL
```

Type the desired block address in octal.

```
PATTERN NO.?
```

Select one of the diagnostic program's prestored patterns or enter the desired pattern. To select one of the prestored patterns type the number that precedes the desired pattern in the following list.

0 = zeros

1 = ones (177777)

2 = checkerboard

3 = floating ones

4 = random data

5 = count pattern (full word, binary, sequential for size of buffer)

6 = run all patterns

If a user-specified pattern is to be specified, enter 6 octal characters and press the RETURN key.

WRITE? (Y OR N)

Type Y to perform all write operations in the test or type N to inhibit write operations.

WRITE AND/OR READ IN THE FORWARD DIRECTION? (Y OR N)

Type Y to indicate that read and write operations are to be performed in a forward direction. Type N to indicate a reverse direction.

8.5 ERROR MESSAGES

The following three error message formats are issued by the TU56S diagnostic program. The first two are issued by the TU56D data reliability test.

DT ERROR NO.=	ERR followed by an error number. Refer to Table 8-2.
TCST=	Contents of Control and Status Register
TCCM=	Contents of Command Register
TCWC=	Contents of the Word Count Register
TCBA=	Contents of the Bus Address Register

{FORWARD / REVERSE} DIRECTION

DT ERROR NO.=	ERR followed by an error number. Refer to Table 8-2.
EXPECTED=	Data expected
RECEIVED=	Data received
DISTANCE INTO BLOCK	Distance into block before a verify error was encountered. Count starts at 0.
RETRY NO.=	Which retry attempt has failed

STOP/START TIMING ERROR

The function of the stop/start test is to check the mechanical movement of the tape. If hardware errors are detected, the start/stop test is aborted. Synchronisation is lost because of the errors and further testing would be meaningless.

Table 8-2
TU56S and TU56D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
2	Start/stop test	A hardware error occurred while reading the block number in the forward direction.
3	Start/stop test	A block number read was not within 5 blocks of the number of the previously read block.
4	Start/stop test	End of zone was reached prematurely.
5	Start/stop test (reverse)	A hardware error occurred while reading the block number in the reverse direction.
6	Start/stop test (reverse)	The block number read was not within 5 blocks of the number of the previously read block.
7	Start/stop test (reverse)	End of zone was reached prematurely.
11	Address (part 1)	Rewind failed to detect end zone or did not set the error bit.
12	Address (part 2)	A hardware error occurred while writing a pattern of zeros on block 0 in the forward direction.
13	Address (part 2)	A hardware error occurred while reading block 0 in the reverse direction or the data was not all zeros.
14	Address (part 2)	A hardware error occurred while reading block 0 in the forward direction or the data was not all zeros.
15	Address (part 2)	A hardware error occurred while writing blocks 0 and 1 in the forward direction with a pattern of 177777.
16	Address (part 2)	A hardware error occurred while reading blocks 1 and 0 in the reverse direction or the data pattern was not 177777.
17	Address (part 2)	A hardware error occurred while reading blocks 0 and 1 in the forward direction or the data pattern was not 177777.

(continued on next page)

Table 8-2 (Cont.)
TU56S and TU56D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
20	Address (part 2)	A hardware error occurred while writing blocks 1 and 0 in the reverse direction with a pattern of 177777.
21	Address (part 2)	A hardware error occurred while reading blocks 1 and 0 in the reverse direction or the data pattern was not 177777.
22	Address (part 2)	A hardware error occurred while reading blocks 0 and 1 in the forward direction or the data was not a pattern of 177777.
23	Address (part 3)	A hardware error occurred while writing an odd numbered block in the forward direction. The pattern written is the block number.
24	Address (part 3)	A hardware error occurred while writing an even numbered block in the reverse direction. The pattern written is the block number.
25	Address (part 3)	A hardware error occurred while reading an odd numbered block in the reverse direction or the data pattern read was not the block number.
26	Address (part 3)	A hardware error occurred while reading an even numbered block in the forward direction or the data pattern read was not the block number.
27	Address (part 4)	A hardware error occurred while reading a random block or the data pattern was not the block number.
30	Data test and data test portion of conversation mode	A hardware error occurred while writing the selected pattern on tape.
31	Data test and data test portion of conversation mode	A hardware error occurred while reading the data pattern or the data is incorrect.
50	Stop/start test	The tape did not move forward when a read was issued to a forward block number.

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Table 8-2 (Cont.)
TU56S and TU56D Eror Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
51	Stop/start test (reverse)	The tape did not move reverse when a read was issued to a block number in the reverse direction.
52	Conversation mode for address test	A hardware error occurred when a command was issued to block "A".
53	Conversation mode for address test	A hardware error occurred when a write command was issued to block "B".

CHAPTER 9

TU10S1 AND TU16S1 DIAGNOSTIC PROGRAMS

The TU10S1 and the TU16S1 diagnostic programs test the positioning capabilities of the TU10 and TU16 tape drives, respectively. Each diagnostic program consists of a series of tests that are described below. The tests for each program are identical.

9.1 REWIND AND BACKSPACE TEST

The rewind and backspace test ensures that the rewind command leaves the tape positioned at BOT and that a backspace from BOT also leaves the tape positioned at BOT.

9.2 WRITE AND READ RECORD TEST

The write and read record test tests the capability of the transport to write and read a record of either all ones or all zeros. The first portion of the test is accomplished using the following steps:

1. From BOT, write a record with a data pattern of 177777,
2. Rewind the tape,
3. Read the record,
4. Rewind the tape and write a data pattern of 000000,
5. Rewind the tape, read the record, and rewind the tape.

At this point, the second portion of the test executes. The second portion ensures that a backspace command does not creep into the previous record. This test uses the following steps:

1. Write two records with a data pattern of 177777,
2. Rewrite the second record 100 (octal) times,
3. Test to determine whether the first record is complete.

9.3 END OF RECORD TEST

The end of record test writes 12 (octal) short record, rewinds the tape, and then reads the records. A short record is 20 (octal) words. After each read, total shut down of the transport is required. This

process ensures that the gaps are long enough for shutdown and startup. The data pattern written is 177777. It is not checked for data or parity errors.

9.4 EXTENDED RECORD GAP TEST

The extended record gap test performs the following steps:

1. Write two record with extended record gaps,
2. Rewind the tape and skip the first record,
3. Write two records inside the extended gap,
4. Rewind the tape,
5. Read four records and check for lost information.

The data pattern written is 177777. It is not checked for data or parity errors.

9.5 END OF FILE TEST

The end of file test ensures that the transport can write and read an EOF mark. It also checks that EOF is detected only as a single byte record by writing and reading records containing only EOF marks.

9.6 SINGLE-RECORD POSITIONING TEST

The single-record positioning test writes an EOF and then 63 data records. The test repeatedly backspace two records and forward spaces one record. It eventually reaches the point where the next backspace should detect an EOF.

9.7 MULTIPLE-FILE POSITIONING TEST

The multiple-file positioning test uses the tape prepared in the previous test. This test positions back and forth across the tape starting with the first and ending with the last record. It decreases the difference between the starting and ending records until the difference is 0.

The test then backspaces until the tape is positioned before the EOF mark. The next backspace should detect an EOF mark. An EOF mark detected before or after it is expected is reported as are the number of files detected before or after the EOF was expected.

9.8 VARIABLE-LENGTH RECORD POSITIONING TEST

The variable-length record positioning test performs the following steps:

1. From BOT, writes records of the maximum length specified during execution of CMD decreasing to 20 bytes in length and from 20 bytes increasing to the maximum length in 20 byte increments.
2. Checks records for completeness (i.e., no lost data),
3. Stops the transport before each read.

The data pattern written is 177777. It is not checked for parity or data errors.

9.9 TEST PARAMETER BIT SETTINGS

In response to the question TEST PARAMETERS, certain bits can be set. Table 9-1 lists the bits and provides their meanings.

Table 9-1
TU10S1 and TU16S1 TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop can be aborted only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the specified testing sequence.
9	1	Restart the program. The program aborts the present sequence and restarts at the newly selected test.
7	1	Perform an infinite number of retries for data error recovery.
	0	Perform a maximum of 64 retries for data error recovery.
5	1	Print only the first data compare error for each data transfer.
	0	Print up to 3 data compare errors per data transfer.

9.10 ERROR MESSAGES

The following error message formats are issued by the TU10S1 and TU16S1 diagnostic programs. Error numbers are used in the message formats presented in Table 9-2.

TU10 POSITIONING TEST

ERROR NO.=	ERR followed by the error number
RECORD #	number of the record in which the error occurred
BYTECOUNT=	number of bytes in the record
MTS=	contents of the Status Register
MTC=	contents of the Command Register
MTBRC=	contents of the Byte Record Counter
MTCMA=	contents of the Current Memory Address Register
MTD=	contents of the data buffer
MTRD=	TU10 read lines

TU16 POSITIONING TEST

ERROR NO.=	ERR followed by the error number
RECORD #	number of the record in which the error occurred
BYTECOUNT=	number of bytes in the record
MTSC1=	contents of the Control and Status 1 Register
MTWC=	contents of Word Count Register
MTBA=	contents of the Unibus Address Register
MTFC=	contents of the Frame Count Register
MTCS2=	contents of Control and Status 2 Register
MTDS=	contents of the Drive Status Register
MTER=	contents of the Error Register
MTAS=	contents of the Attention Summary Register

MTCH=	contents of the Tape Character Check
MTMR=	contents of the Maintenance Register
MTDT=	contents of the Drive Type Register
MTSN=	contents of the Serial Number Register
MTTC=	contents of the Tape Control Register

TU10 POSITIONING TEST

TU16 POSITIONING TEST

ERROR NO.=	ERR followed by the error number
EXPECTED=	Data expected
RECEIVED=	Data received
DISTANCE INTO RECORD IN WORDS=	distance into record when a verify error was encountered. Count starts at 0.
BYTECOUNT=	number of bytes in the record

TU10 POSITIONING TEST

RETRY #=	number of times the record was read to obtain good data

TU10 POSITIONING TEST

ERROR NO.=	ERR followed by the error number
RECORD #=	record in which the error occurred
BYTECOUNT=	number of bytes in the record
CREEP LOSS OF DATA (IN BYTES)=	number of bytes lost due to transport creeping
MTS=	contents of Status Register
MTC=	contents of Command Register
MTBRC=	contents of the Byte Record Counter
MTCMA=	contents of the Current Memory

	Addrress Register
MTD=	contents of data buffer
MTRD=	contents of TU10 read lines

TU16 POSITIONING TEST

ERROR NO.=	ERR followed by the error number
RECORD #=	record in which the error occurred
BYTECOUNT=	number of bytes in the record
CREEP LOSS OF DATA (IN BYTES)=	
	number of bytes lost due ti transport creeping
MTCS1=	contents of control and Status Register
MTWC=	contents of the Word Count Register
MTBA=	contents of Unibus Address Register
MTFC=	contents of Frame Count Register
MTCS2=	contents of RH11 Control and Status Register
MTDS=	contents of Drive Status Register
MTER=	contents of Error Register
MTAS=	contents of Attention Summary Register
MTCH=	contents of Tape Character Check
MTMR=	contents of Maintenance Register
MTDT=	contents of Drive Type Register
MTSN=	contents of Serial Number Register
MTTC=	contents of Tape Control Register

TU10 POSITIONING TEST

TU16 POSITIONING TEST

ERROR NO.=	ERR followed by the error number
END OF FILE MARK EARLY BY n RECORDS=	
	n indicates the number of records

EOF MISSING

TU10 POSITIONING TEST

ERROR NO.=50

END OF FILE MARK NOT DETECTED AFTER WRITE END OF FILE.

MTS=	contents of Status Register
MTC=	contents of Command Register
MTBRC=	contents of Byte Record Counter
MTCMA=	contents of Current Memory Address
MTD=	contents of the data buffer
MTRD=	contents of TU10 Read Lines

EOF MISSING

TU16 POSITIONING TEST

ERROR NO.=50

END OF FILE MARK NOT DETECTED AFTER WRITE END OF FILE.

MTCS1=	contents of Control and Status 1 Register
MTWC=	contents of Word Count Register
MTBA=	contents of Unibus Address Register
MTFC=	contents of Frame Count Register
MTCS2=	contents of Control and Status 2 Register
MRDS=	contents of Drive Status Register
MTER=	contents of the Error Register
MTAS=	contents of the Attention Summary Register
MTCH=	contents of the Tape Character Check
MTMR=	contents of the Maintenance Register
MTDT=	contents of the Drive Type Register
MTSN=	contents of the Serial Number Register
MTTC=	contents of the Tape Control Register

END OF PASS

TU16 POSITIONING TEST

TU10 POSITIONING TEST

PASS COUNT= number of this pass

ERROR ENCOUNTERED THIS UNIT=

number of cumulative errors across multiple passes

NUMBER OF FUNCTIONS ISSUED THIS UNIT=

number of cumulative functions performed across multiple passes

NUMBER OF WORDS TRANSFERRED THIS UNIT=

number of cumulative words transferred across multiple passes

END OF TEST

TASK ABORTED

FROM VIRTUAL PC= PC contents

Table 9-2
TU10S1 and TU16S1 Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Rewind and backspace	BOT was not detected at completion of the rewind.
2	Rewind and backspace	BOT was not detected after issuing a backspace command from BOT.
3	Write and read record (part 1)	A hardware error occurred after a record from BOT. The data pattern is 177777.
4	Write and read record (part 1)	A hardware error occurred after reading a record from BOT or the data is incorrect. The data pattern is 177777.
5	Write and read record (part 1)	A hardware error occurred after writing a record from BOT. The data pattern is 000000.
6	Write and read record (part 1)	A hardware error occurred after reading a record from BOT. The data pattern is 000000.
7	Write and read record (part 2)	A hardware error occurred after writing a record from BOT. The data pattern is 177777.

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Table 9-2 (Cont.)
TU10S1 and TU16S1 Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
10	Write and read record (part 2)	A hardware error occurred after writing the second record. The data pattern for the second record is 000000.
11	Write and read record (part 2)	A hardware error occurred while writing the creeping record. This error loops to writing the creeping record.
12	Write and read record (part 2)	Data lost due to negative creep. Printout indicates the number of bytes lost in the first record. This error loops to writing the creeping record.
13	Write and read record (part 2)	The second record crept in reverse causing the record gap to be too short resulting in loss of data in the second record at start time. This error loops to writing the creeping record.
14	End of record	An illegal command was detected during a write operation. It is probably due to the device going off line.
15	End of record	Read of 8-word records with stall between records failed due to record length error.
16	Extended record gap	A hardware error occurred while writing a record with an extended record gap.
17	Extended record gap	A hardware error occurred while writing a record without an extended record gap.

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Table 9-2 (Cont)
TU10S1 and TU16S1 Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
20	Extended record gap	A hardware error occurred while reading 4 records. The 2 middle records were written inside an extended gap and did not fit because the gap was too short. Loop on error causes the program to loop to the write of records with extended record gaps.
21	End of file	A hardware error other than lack of EOF occurred while writing end of file from BOT. The EOF bit was cleared in the applicable register by the diagnostic program.
22	End of file	A hardware error occurred while writing records with a data pattern of end of file marks.
23	End of file	EOF was not detected from BOT when doing a read EOF from BOT. The first record is EOF.
24	End of file	EOF was detected at the result of reading a record with EOF marks as data.
25	End of file	A hardware error other than EOF occurred while reading a record of EOF data. The EOF bit was cleared by the diagnostic program.
26	End of file	EOF was not detected when skipping over an EOF mark after reading records of EOF data.
27	Single-record position	A hardware error other than EOF occurred after writing EOF from BOT.

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Table 9-2 (Cont.)
TU10S1 and TU16S1 Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
30 [1]	Single-record position	A hardware error occurred writing short records (20(9) words).
31 [1]	Single-record position	An illegal command bit was set during a backspace 2 and forward space 1 operation. It is probably due to the unit going off line.
32 [1]	Single-record position	End of file was not detected soon enough. Backspace 2 and forward space 1 did not move the tape backwards one record. The number of records needed to return to EOF is reported. The total effective backspace was 63 records. No registers are dumped.
33 [1]	Single-record position	End of file mark at BOT was detected too early. Backspacing 2 records and forward spacing 1 moved the tape more than 1 record back. The number of record too early is printed. No registers are dumped.
34 [2]	Multiple-file positioning	EOF was not detected when doing a read EOF from BOT.
35 [2]	Multiple-file positioning	The illegal command bit was set. The transport probably went off line during multiple record space commands.
36 [2]	Multiple-file positioning	End of file was detected too soon when doing large number skips forward and backward. The number of records too soon is reported. No registers are dumped.

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[1] Loop on error causes the test to restart at the point described for ERR 30 because the tape position has been lost.

[2] Loop on error causes the test sequence to begin at the point described for ERR 34 because the tape position has been lost.

Table 9-2 (Cont.)
TU10S1 and TU16S1 Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
37[1]	Multiple-file positioning	End of file occurred too late after multiple space commands. The number of records missing is reported. No registers are dumped.
40	Variable record length positioning	A hardware error occurred while writing variable-length records. Loop on error causes the entire tape to be rewritten from BOT.
41	Variable record length positioning	An error occurred while reading variable-length record with a total stop in the gap. Parity errors may be an indication that the tape is flying away from the head at start time. Loop on error causes the tape to be reread from BOT.
50	End of file and single record position	A write EOF operation did not cause detection of EOF.
202	End of file	A hardware error other than no EOF occurred after writing EOF after records containing a data pattern of EOF marks. The EOF bit is cleared in the applicable register by the diagnostic program.

[1] Loop on error causes the test sequence to begin at the point described for ERR 34 because the tape position has been lost.

CHAPTER 10

TU10S2, TU10D, TU16S2 AND TU16D DIAGNOSTIC PROGRAMS

The TU10S2, TU10D, TU16S2, and TU16D diagnostic programs are data pattern tests for the TU10 and TU16 tape drives. Each diagnostic program consists of a series of tests that are described below. The TU10D and TU16D data reliability tests are subsets of the TU10S2 and TU16S2 diagnostic programs.

The TU10S2 and TU16S2 diagnostic programs provide the following data tests:

1. Record length test,
2. Lateral parity test,
3. Longitudinal parity test,
4. CRC test,
5. Skew test,
6. Crosstalk test,
7. TU16 burst test,

} Data pattern tests

8. Data reliability test

10.1 RECORD LENGTH TEST (TU10S2 AND TU16S2 ONLY)

The record length test checks the ability of the transport to sense when a record is too long or too short. The data pattern written is 177777. It is not checked for correctness.

10.2 LATERAL PARITY TEST (TU10S2 AND TU16S2)

The lateral parity tests check the parity logic by writing a record with odd parity and reading it as even parity. Then it writes a record with even parity and reads it as odd parity. The data pattern used is 177777. It is not checked for correctness.

10.3 LONGITUDINAL PARITY TEST (TU10S2 AND TU16S2 ONLY)

The longitudinal parity test ensures that the longitudinal parity register works properly by writing a record that sets all bits in LPCC.

10.4 CRC TEST (TU10S2 AND TU16S2 ONLY)

The CRC test checks the ability of the unit to calculate the proper CRC character. Each CRC bit is checked individually.

10.5 SKEW TEST (TU10S2 AND TU16S2 ONLY)

The skew test writes data pattern designed to detect data errors caused by tape skew. Two patterns are written. The first is a sine wave and the second is a bursting pattern. The data is read and checked 10 times to expose read reduction problems.

10.6 CROSSTALK TEST (TU10S2 AND TU16S2 ONLY)

The crosstalk test detects errors caused by having a 1 bit completely surrounded by zeros and a 0 bit completely surrounded by ones.

10.7 TU16 BURST TEST (TU16 ONLY)

The TU16 burst test checks the phase encoded burst logic test. This test ensures that a burst is written when it is appropriate and that the burst is properly detectable both when it is desired and when it is not desired.

10.8 DATA RELIABILITY TEST (ALL PROGRAMS)

The data reliability test writes the whole tape in core dump mode if the drive is 7 track using four patterns. The test writes three records and an EOF mark. It then backspaces and reads each record, including the EOF mark, 10 times.

On TU16 transports, the test writes three record and an EOF mark and then reads each record, including the EOF mark, 10 times in the reverse direction instead of backspacing.

The process of reading records continues until EOT is detected. The data at EOT is checked 10 times. The tape is rewound and the end-of-pass routine is entered. This routine prints the statistics.

Standard error recovery, as determined by TEST PARAMETERS bit 7, is used. The records written are random length. When errors are detected, the following information prints on the console:

1. Read number, if reading,
2. Byte count,
3. Record number.

The units digit in the record number indicates what the record should have contained, as follows:

1. 1 and 5 indicate a floating ones and zeros pattern,
2. 2 and 6 indicate random numbers that are negated in alternate locations,
3. 3 and 7 indicate a count pattern that is negated in alternate location.

10.9 OPERATIONAL INFORMATION

Operational information for the TU10S2 and TU16S2 diagnostic programs consists of TEST PARAMETER bit settings and conversation mode usage. Operational information for the TU10D and TU16D data reliability tests consist only of TEST PARAMETER bit settings.

10.9.1 TEST PARAMETER Bit Settings

In response to the question TEST PARAMETERS, certain bits can be set. Table 11-1 lists the bits and provides their meanings. The only TEST PARAMETER bits that apply to the TU10D and TU16D data reliability tests are 15 through 11 and 9.

Table 10-1
TU10S2, TU16S2, TU10D, and TU16D TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits for up to 30 minutes before exiting. The stall can e aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop can be aborted only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the specified sequence.
10	1	Enter conversation mode. (TU10S2 and TU16S2 only.)
9	1	Restart the program. The program aborts the present sequence and restarts at the newly selected test.
		NOTE From this point, bit settings apply only to S2 diagnostic programs.
7	1	Perform an infinite number of retries for data error recovery.
	0	Perform a maximum of 64 retries for data error recovery.
6		This bit applies only to the TU16 data patterns test (TU16S2).
	1	Perform data reliability or conversation mode for 9-track transports at 800 bpi NRZ.
	0	Perform data reliability or conversation mode for 9-track transports of 1600 bpi PE.
5	1	Print only the first data compare error for each data transfer.
	0	Print up to 3 data compare errors per data transfer.
4	1	Print all errors during error recovery.

(continued on next page)

Table 10-1 (Cont.)
TU10S2, TU16S2, TU10D, and TU16D TEST PARAMETER Bits

BIT	SETTING	MEANING
	0	Print only the first error during error recovery. At completion of error recovery, print the error recovery type retry number.
2	1	Perform the read portion of write/read amp slice adjustment.
1	1	Perform the data reliability test.
0	1	Perform the pattern test.

10.9.2 Conversation Mode (TU10S2 and TU16S2 Only)

Conversation mode is requested by setting TEST PARAMETER bit 10. Conversation mode provides two tests that are not related to the data pattern or reliability tests. The two tests are the compability test and the write/read amplifier slice amplifier adjustment test.

10.9.2.1 Compatibility Test - The compatibility test allows the operator to write a tape to be read on other transportd or to read a tape written on another transport. The following questions are printed on the console.

WANT COMPATIBILITY TEST? (Y OR <CR>)

Type Y to request the compatibility test. Press RETURN to request the slice adjustment test, described below.

WHICH COMPATIBILITY TEST (0 = WRITE & READ; 1 = READ ONLY)

Type 0 to write the magnetic tape and then read it. The program rpints the following message when the tape is written.

Type 1 to read the compatibility tape mounted on the selected device.

COMPATIBILITY TAPE WRITTEN - VERIFYING TAPE

During the read portion of the test, all data and hardware errors are reported. When the tape has been completely read, the test types the following message.

COMPATIBILITY TAPE VERIFIED

10.9.2.2 Write/Read Amplifier Slice Adjustment Test - The following questions are printed on the console for the write/read amplifier adjustment test.

WANT COMPATIBILITY TEST? (Y OR <CR>)

Press RETURN to obtain the questions for the slice adjustment test. Typing Y causes the Compatibility test to run.

WANT SLIDE ADJUSTMENT? (Y OR <CR>)

Type Y. Pressing RETURN causes the question WANT COMPATIBILITY TEST? to be repeated.

10.10 ERROR MESSAGES

The following message formats are issued by the TU10S2 and TU16S2 diagnostic programs. The TU10D and TU16D data reliability test issues a subset of this list. Error numbers are listed in Table 10-2.

TU10 DATA PATTERN TEST

ERROR NO.=	ERR followed by the error number
RECORD #	number of the record in which the error occurred
BYTE COUNT=	number of bytes in the record
MTS=	contents of Status Register
MTC=	contents of Command Register
MTBRC=	contents of Byte Record Counter
MTCMA=	contents of the Current Memory Address Register
MTD=	contents of the Data Buffer
MTRD=	contents of TU10 Read Lines
READ NUMBER=	number of times the record has been read

TU16 DATA PATTERN TEST

ERROR NO.=	ERR followed by the error number
RECORD #	number of the record in which the error occurred
BYTECOUNT=	number of bytes in the record
MTSC1=	contents of the control and status 1 register
MTWC=	contents of Word Count Register
MTBA=	contents of the Unibus Address Register
MTFC=	contents of the Frame Count Register

MTCS2=	contents of RH11 Control and Status 2 Register
MTDS=	contents of the Drive Status Register
MTER=	contents of the Error Register
MTAS=	contents of the Attention Summary Register
MTCH=	contents of the Tape Character Check
MTMR=	contents of the Maintenance Register
MTDR=	contents of the Drive Type Register
MTSN=	contents of the Serial Number Register
MTTC=	contents of the Tape Control Register

TU16 DATA RELIABILITY TEST

TU10 DATA RELIABILITY TEST

TU16 DATA PATTERN TEST

TU10 DATA PATTERN TEST

UNIT #	number of the unit on which the error occurred (Reliability test only)
ERROR NO.=	ERR followed by the error number
EXPECTED=	data expected
RECEIVED=	data received
DISTANCE INTO RECORD IN WORDS=	distance into record before a verify error was encountered. Count starts at 0.
RECORD #	Record in which the error occurred
READ NUMBER=	number of times the record has been read
BYTE COUNT=	number of bytes in the record

TU10 DATA PATTERN TEST

TU10 DATA RELIABILITY TEST

UNIT #	number of unit on which the error occurred (Reliability test only)

ERROR NO. = 50

EOF NOT DETECTED AFTER WRITE EOF

RECORD #	number of the record in which the error occurred
BYTE COUNT=	number of bytes in the record
MTS=	contents of status register
MTC=	contents of the Command Register
MTBRC=	contents of the Byte Record Counter
MTMCA=	contents of the Current Memory Address Register
MTD=	contents of the Data Buffer
MTRD=	contents of the TU10 Read Lines
READ NUMBER =	number of times the record has been read

TU16 DATA RELIABILITY TEST

TU16 DATA PATTERN TEST

UNIT #	number of the unit on which the error occurred (Reliability test only)

ERROR NO. = 50

EOF NOT DETECTED AFTER WRITE EOF

RECORD #	number of the record in which the error occurred
MTSC1=	contents of the Control and Status 1 Register
MTWC=	contents of Word Count Register
MTBA=	contents of the Unibus Address Register
MTFC=	contents of the Frame Count Register
MTCS2=	contents of Control and Status 2 Register
MTDS=	contents of the Drive Status Register
MTER=	contents of the Error Register
MTAS=	contents of the Attention Summary Register
MTCH=	contents of the Tape Character Check
MTMR=	contents of the Maintenance Register
MTDT=	contents of the Drive Type Register
MTSN=	contents of the Serial Number Register
MTTC=	contents of the Tape Control Register

TU10 DATA PATTERN TEST

TU10 DATA RELIABILITY TEST

UNIT # number of unit on which the error occurred
(Reliability test only)

ERROR NO.=51

EOF NOT DETECTED AFTER READ

RECORD # number of the record in which the error occurred

BYTE COUNT= number of bytes in the record

MTS= contents of status register

MTC= contents of the Command Register

MTBRC= contents of the Byte Record Counter

MTCMA= contents of the Current Memory Address Register

MTD= contents of the Data Buffer

MTRD= contents of the TU10 Read Lines

READ NUMBER= number of times the record has been read

TU16 DATA RELIABILITY TEST

TU16 DATA PATTERN TEST

UNIT # number of the unit on which the error occurred
(Reliability test only)

ERROR NO.=51

EOF NOT DETECTED AFTER READ EOF

RECORD # number of the record in which the error occurred

MTSC1= contents of the Control and Status 1 Register

MTWC= contents of Word Count Register

MTBA= contents of the Unibus Address Register

MTFC= contents of the Frame Count Register

MTCS2= contents of Control and Status 2 Register

MTDS= contents of the Drive Status Register

MTER= contents of the Error Register

MTAS= contents of the Attention Summary Register

MTCH= contents of the Tape Character Check

MTMR= contents of the Maintenancee Register

MTDT= contents of the Drive Type Register

MTSN= contents of the Serial Number Register

MTTC= contents of the Tape Control Register

TU10 DATA RELIABILITY TEST

TU10 DATA PATTERN TEST

UNIT # number of the unit on which the error occurred
(Reliability test only)

ERROR NO.= ERR followed by the error number

RECORD # number of the record in which the error occurred

BYTE COUNT= number of bytes in the record

MTS= contents of status register

MTC= contents of the command register

MTBRC= contents of the byte record counter

MTCMA= contents of the current memory address register

MTD= contents of the data buffer

MTRD= contents of the TU10 read lines

TU16 DATA RELIABILITY

TU16 DATA PATTERN TEST

UNIT # number of the unit on which the error occurred
(Reliability test only)

ERROR NO.= ERR followed by the error number

RECORD # number of the record in which the error occurred

BYTECOUNT= number of bytes in the record

MTSC1= contents of the Control and Status 1 Register

MTWC= contents of Word Count Register

MTBA= contents of the Unibus Address Register

MTFC= contents of the Frame Count Register

MTCS2= contents of Control and Status 2 Register

MTDS= contents of the Drive Status Register

MTER= contents of the Error Register

MTAS= contents of the Attention Summary Register

MTCH= contents of the Tape Character Check

MTMR= contents of the Maintenance Register

MTDT= contents of the Drive Type Register

MTSN= contents of the Serial Number Register

MTTC= contents of the Tape Control Register

TU10 DATA PATTERN TEST

TU16 DATA PATTERN TEST

ERROR NO.= ERR followed by the error number

CRC ERROR

EXPECTED= CRC expected

RECEIVED= CRC received

TU10 DATA PATTERN TEST

TU16 DATA PATTERN TEST

ERROR NO.= ERR followed by the error number

LPCC ERROR

EXPECTED= LPCC expected

RECEIVED= LPCC received

Table 10-2
TU10S2, TU16S2, TU10D, and TU16D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Record length	A hardware error occurred while writing a 1000-byte record with a data pattern of 177777.
2	Record length	A record is too short; the requested record was 2000 bytes. However, if the byte count or word count registers indicate a proper negative number (-1000 for TU10 or -400 for TU16), the error is other than receiving too-short record. Check the applicable error register bits.
3	Record length	A record length error was not detected when the byte count went to zero and 1 byte remained to be read. This message applies only to TU10 transports.
4	Record length	The record length error was set when it should have been, but other hardware-detected errors occurred. This message applies only to the TU10 transport.
5[1]	Lateral parity	A hardware error occurred while writing odd parity from BOT.
6[1]	Lateral parity	Reading an odd parity record with even parity did not force a parity error.
7[1]	Lateral parity	The parity error bit was set after reading an odd parity record as even, but other hardware errors were detected. The parity error bits are cleared by the program.
10[1]	Lateral parity	A hardware error occurred when writing an even parity record from BOT.
11[1]		Reading an even parity record as odd parity failed to generate a hardware parity error.

(continued on next page)

[1]TU16 is running at 800 BPI NRZ.

Table 10-2 (Cont.)
TU10S2, TU16S2, TU10D, and TU16D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
12[1]	Lateral parity	The parity error bit was set after reading an even parity record as odd, but other hardware errors were detected. The parity error bits are cleared by the program.
13[1]	Longitudinal parity	A hardware error occurred while writing an odd number of bytes.
14[1]	Longitudinal parity	When reading a record with an odd number of bytes, a hardware error other than a parity error occurred.
15[1]	Longitudinal parity	LPCC is not correct. The expected LPCC and that received are printed on the console.
16[1]	CRC	A hardware error occurred while writing the CRC test. The pattern written is 20 (octal) bytes long and contains all zeros except for word 2.
17[1]	CRC	A hardware error other than CRC error occurred while reading the CRC record. The CRC error bit is cleared by the program.
20[1]	CRC	The CRC is incorrect. The CRC expected and that received are printed on the console.
21[1]	Skew	A hardware error occurred while writing the skew record.
22[1]	Skew	A hardware error occurred while reading skew records. Check the electrical skew of the drive. Note the reread counter for possible read reduction caused by a bad head or a magnetized head partially erasing data during the read.

(continued on next page)

[1] TU16 is running at 800 BPI NRZ.

Table 10-2 (Cont.)
TU10S2, TU16S2, TU10D, and TU16D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
23[1]	Crosstalk	A hardware error occurred while writing the crosstalk pattern tape.
24[1]	Crosstalk	A hardware error occurred while reading the crosstalk pattern. Check for head wear or data reduction caused by the partial erasure of the tape during the read operation.
25[1]	TU16 burst test	The ID burst was not detected after a write from BOT. Loop on error causes the test to begin with this function.
26	TU16 burst test	A write at 800 BPI from BOT detected an ID burst. The ID burst should be cleared during a write from BOT NRZ recording. Loop on error causes the test to begin with the function described in error 25.
27	TU16 burst test	Reading an NRZ tape as a PE tape causes an ID burst to be detected. This error probably is caused by a write function not erasing the ID during an NRZ write from BOT. Loop on error causes the test to begin with the function described in error 25.
40	Data reliability	A hardware error occurred during the data reliability test. Check the record number for the pattern type and the console printout for record size.
41	Data reliability	A hardware error occurred while reading reliability test tape or the data is incorrect. Check the record number for the data pattern. Check the read number for data reduction on successive reads.

(continued on next page)

[1] TU16 is running at 800 BPI NRZ.

Table 10-2 (Cont.)
TU10S2, TU16S2, TU10D, and TU16D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
42	TU16 data reliability	A hardware error occurred when reading the reliability record in the reverse direction or the data is incorrect. Check the record number for data pattern. Check the read number for read reduction.
50	Data reliability and conversation mode	A write EOF operation did not detect an EOF mark. This error is not looped on even if loop on error is set.
51	Data reliability and conversation mode	A skip over EOF operation did not detect an EOF mark. Write EOF should set the EOF bit in the applicable register. The bit is not set. This error is not looped on even if loop on error is set.
101	Conversation mode	A hardware error occurred while writing 16 records. Each record contains 32 words of floating 1's pattern.
102	Conversation mode	A hardware error occurred while writing 64 records. Each record contains 64 words of all ones data pattern.
103	Conversation mode	A hardware error occurred while writing 64 records. Each record contains 64 words of all zeros data pattern.
104	Conversation mode	A hardware error occurred while writing 128 records. Each record contains 256 words of random data.
105	Conversation mode	A hardware error occurred while writing 64 records. Each record contains 512 words of random data.
106	Conversation mode	A hardware error occurred while writing 64 records. Each record contains 1024 words of random data.

(continued on next page)

Table 10-2 (Cont.)
TU10S2, TU16S2, TU10D, and TU16D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
107	Conversation mode	A hardware error occurred while writing 32 records. Each record contains 1536 words of random data.
110	Conversation mode	A hardware error occurred while writing 32 records. Each record contains 2048 words of random data.
111	Conversation mode	A hardware error occurred while reading 16 records that are 32 words in length and contain a data pattern of floating 1's.
112	Conversation mode	A hardware error occurred while reading 64 records that are 64 words in length and contain all zeros.
113	Conversation mode	A hardware error occurred while reading 64 records that are 64 words in length and contain all zeros.
114	Conversation mode	A hardware error occurred while reading 128 records that are 256 words in length and contain random data.
115	Conversation mode	A hardware error occurred while reading 64 records that are 512 words in length and contain random data.
116	Conversation mode	A hardware error occurred while reading 64 records that are 1024 words in length and contain random data.
117	Conversation mode	A hardware error occurred while reading 32 records that are 1536 words in length and contain random data.
120	Conversation	A hardware error occurred while reading 32 records that are 2048 words in length and contain random data.

CHAPTER 11

TTYTS DIAGNOSTIC PROGRAM

The TTYTS diagnostic program tests the ASR33, ASR35, LA30 and VT05 terminals. The program performs the following tests:

1. Carriage return test,
2. Space test,
3. Tab test,
4. Line feed test,
5. Character test,
6. Worst case test pattern for ASR33 and ASR35
7. User-selected test pattern.

11.1 CARRIAGE RETURN TEST

The carriage return test checks the ASR33, ASR35, and LA30 terminals as one group and checks the VT05 with a separate test.

11.1.1 ASR33, ASR35, and LA30 Carriage Return Test

The carriage return for the ASR33, ASR35, and LA30 checks the ability of the carriage to return correctly to print position zero from every other print position. The program first prints a backslash (\) and then spaces to the other end of the carriage. A carriage return command is issued and then the program prints a slash (/) in print position zero. It then prints a \ to form an X and spaces to one position short of the end of the carriage. This sequence is continued from every print position. When the test is completed, an X should be present in print position zero.

11.1.2 VT05 Carriage Return Test

The VT05 carriage return test checks the ability of the display to return correctly to print position zero from every other print position. The program displays a line of 72 asterisks (*) and then issued a carriage return and line feed command. This sequence is repeated with the number of asterisk diminished by one for each line displayed until the count reached zero. See Figure 11-1 for an image

of the asterisk pattern displayed.

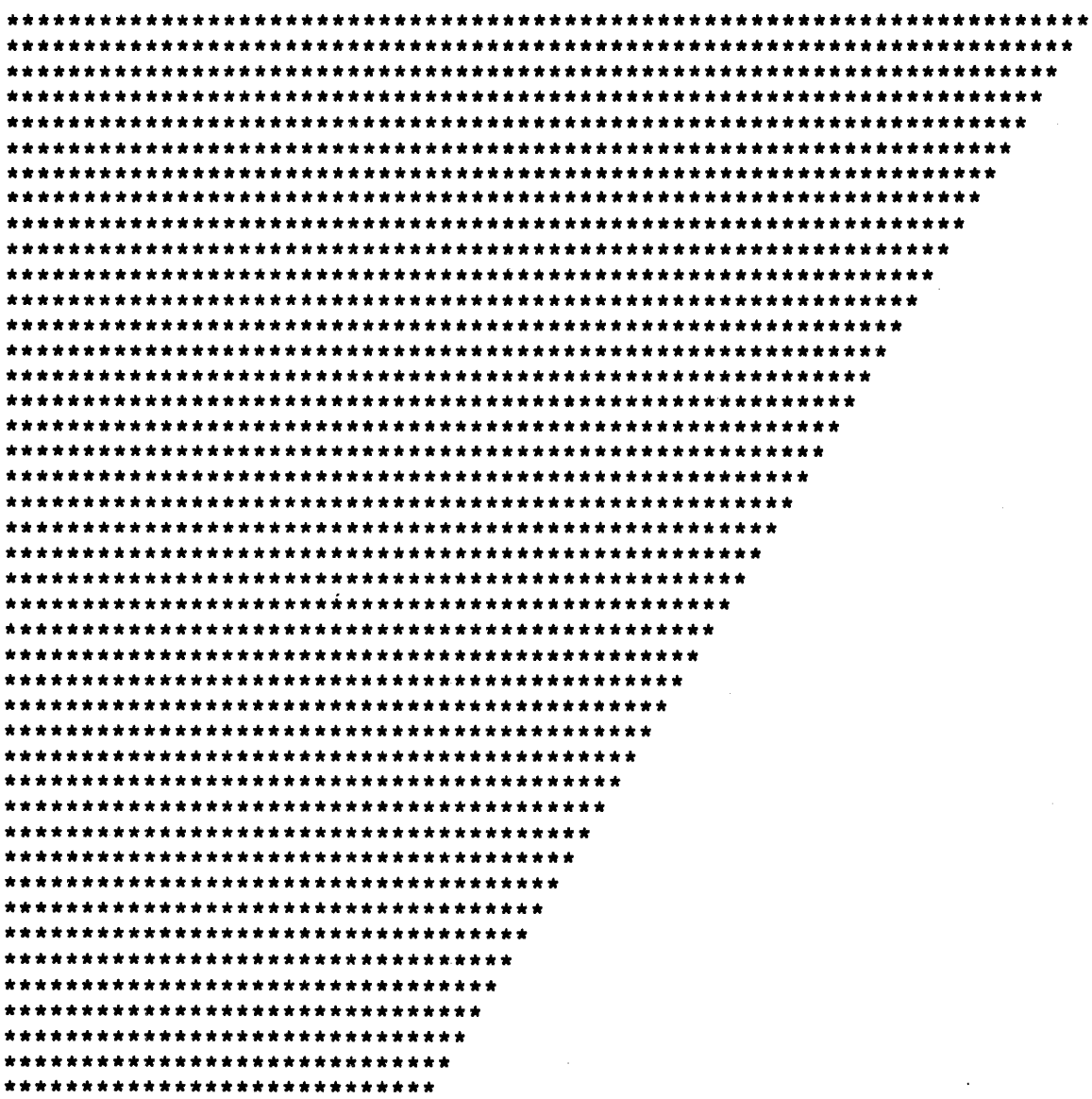

Figure 11-1
VT05 Carriage Return Test Display
(Partial Display)

11.2 SPACE TEST

The space test treats the ASR33, ASR35, and LA30 as one group and provides a separate test for the VT05.

11.2.1 ASR33, ASR35, and LA30 Space Test

The space test for the ASR33, ASR35, and LA30 checks the ability of the printer to space correctly. The test first prints backslashes (\) in alternate print positions starting at print position zero. It then spaces to position zero and prints slashes in the blank positions-2. See Figure 11-2.

```
\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/\/
\/\/\/\/\/\/\/\/\/\/\/
```

Figure 11-2
ASR33, ASR35, and LA30 Space Test

11.2.2 VT05 Space Test

The VT05 space test verifies that the VT05 can space correctly. The pattern displayed if the terminal spaces properly is shown in Figure 11-3.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

Figure 11-3
VT05 Space Test

11.3 TAB TEST

The tab test checks the ability of the ASR33, ASR35, and LA 30 printers and the VT05 display to tab to a tab position that is from one through seven character positions away from the current head position.

The first line printed marks the tab positions. The second line printeed tabs from one tab stop to the next. After that, each line has an additional character printed after the slash (/). The last line has six spaces printed after the slash. Figure 11-4 illustrates the output from this test.

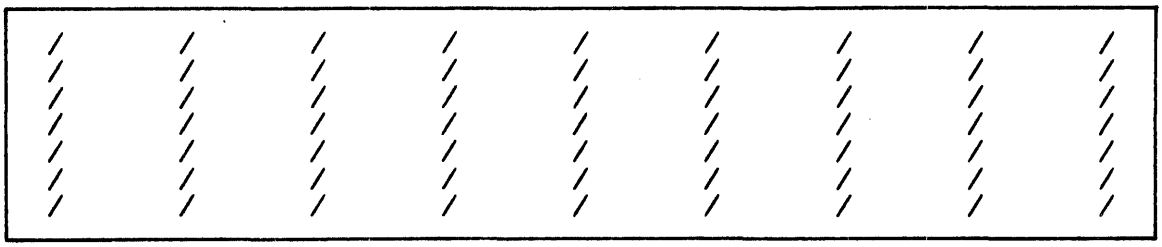

Figure 11-4
Tab Test Output

11.4 LINE FEED TEST

The line feed test checks the ability of an ASR33, ASR35, LA30, or VT05 to perform a line feed. A correctly performed test appears as a diagonal line printed (displayed) between print position 0 and print position 72.

11.5 CHARACTER TEST

The character test prints (displays) a line containing a repetition of three character. The first line consists of the characters ABC; the second line consists of DEF, and so on until a line of the characters 789 is printed. Then, the special characters are printed with three characters on each line as follows.

```
!"#
$%&
'()
*+,
-./
:;<
=>?
@[\
]
```

11.6 ASR33 WORST CASE PATTERN TEST

The ASR33 worst case pattern test prints 10 lines of the ASR33 worst case pattern. The pattern is shown below.

```
' W/W
```

11.7 ASR35 WORST CASE PATTERN TEST

The ASR35 worst case pattern test prints 10 line of the ASR35 worst case pattern. The pattern is shown below.

```
"[?C?[
```

11.8 USER-SELECTED PATTERN TEST

The user-selected pattern test is an aid in making teleprinter adjustments. The program permists the user to type in five test characters. It then prints successive lines containing the five selected characters. The characters used for this test must be printable characters. When specifying the characters to be printed, terminate the line by pressing RETURN.

11.9 TEST PARAMETER BIT SETTINGS

Certain bits can be set in response to the question TEST PARAMETERS. Table 11-1 lists the bits and provides their meaning.

Table 11-1
TTYTS TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The task waits for up to 30 minutes before exiting. The stall can be aborted by toggling the console switch defined at task startup in response to the question WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION.
14	1	Loop on error. The task loops on the failing instruction sequence. The loop can be aborted only by specifying new test parameters with bit 14 equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the specified sequence.
9	1	Restart the program. The program aborts the present sequence and restarts at the newly selected test.
7	1	LA30
6	1	VT05
5	1	ASR35
4	1	ASR33
3	1	Run all tests.
2,1,0	000	Carriage return test
	001	Space test
	010	Tab test
	011	Line feed test
	100	Character test
	101	ASR33 worst case test
	110	ASR35 worst case test
	111	User-selected pattern test

CHAPTER 12

RK06S AND RK06D USER MODE DIAGNOSTIC PROGRAMS

The RK06S diagnostic program and the RK06D data reliability program are the two hardware tests for the RK06 disk cartridge. The RK06D data reliability test is a subset of the RK06S diagnostic program.

The RK06S diagnostic program provides four disk tests:

1. Address test
2. Data test
3. Random test
4. Formatter test

The RK06D data reliability test provides a data test only.

12.1 ADDRESS TEST (RK06S ONLY)

The address test consists of six parts:

- cylinder test 1,
- cylinder test 2,
- sector addressing test,
- track/head addressing test,
- write/read cylinder spirraling test,
- partial sector write test.

Descriptions of these tests follow in this section.

12.1.1 Cylinder Test 1

This is an incremental seek test, in which a read-header command (implied seek) alternately addresses cylinder 0 and cylinder "N": the value of "N" starts with 1 and is incremented by 1 for each seek, through the range 0-410. After each seek, the diagnostic program compares the contents of the RKDC register with the current header data to verify that the specified cylinder address was found.

12.1.2 Cylinder Test 2

This is a cross-seek test, in which a read-header command (implied seek) alternately addresses cylinder "A", which is initially 0, and cylinder "B", which is initially 410. After each seek, "A" is incremented by 1 and "B" is decremented by 1. This continues until "B" equals 0. Cyclinder positioning is verified by comparison of the RCDC register contents with the current header data after each seek.

12.1.3 Sector Addressing Test

This routine verifies that each sector from 0 to 21 is addressable. The test issues a full 256-word write (made up of the 2-word address pattern: sector number and its complement) into each sector on track 0 of cylinder 0, followed immediately by a write-check function. If a marked bad sector is encountered, its address is saved in the bad sector table for later validation. If an error is encountered, it is reported to the operator.

Once the entire track has been accedded, each sector is read and the full 256 words of data are compared, if necessary, in an attempt to match the expected 2-word address pattern.

12.1.4 Track/Head Addressing Test

This test verifies that each track from 0 to 2 is addressable. The routine issues full 256-word writes (made up of the 2-word address pattern: track number and its complement) into sector 0 on track 0, 1, and 2 of cylinder 0, followed immediately by a write-check function. If an error is encountered, it is reported to the operator immediately.

If sector 0 on any of the tracks happens to be marked bad sector, its address is saved in a core resident bad sector table for later validation.

Once all the tracks on the cylinder have been accessed, sector 0 of each track is read and the full 256 words of data are compared, if necessary, in an attempt to match the expected 2-word track address pattern. The sector is then rewritten with its address pattern and the next track is accessed.

12.1.5 Write/Read Cylinder Spiraling Test

This test ensures that each cylinder is addressable and that the device will update to the next cylinder if a transfer crosses cylinder boundaries. The test starts by issuing a 2-sector write to the last sector on the last track of each cylinder. The pattern used is the 2-word cylinder address pattern: cylinder number and its complement number. Then, starting with sector 0 on track 0 of cylinder 1, the sector is read and the address pattern is verified. This is done for each subsequent cylinder.

The procedure verifies that the crossover logic is functioning properly for write/read operations.

12.1.6 Partial Sector Write Test

This test ensures that the RK611 can zero fill the remainder of a sector on a partial sector write. Sector Ø on track Ø of cylinder Ø (or the first good sector on the cylinder) is written with a pattern of all ones (177777). Then a partial write of two words of ones is issued to the same disk address. The sector is then read and its contents are checked to detemine if all of the sector except the first two words has been filled with zeroes.

12.2 DATA TEST

During execution of the data test, write, write-check, and read operations are performed. The data is written on the entire cartridge disk and then read back. The data buffer is cleared before each read. The data is verified and any errors are reported.

If an error is detected during a read operation, an attempt is made to correct it with an ECC correction algorithm. If this is unsuccessful, four retries are attempted. If the data still cannot be read, the heads are homed and four more retries are attempted.

The disk surface is tested with the following patterns:

1. All zeroes
2. All ones
3. Checkerboard (alternate ones and zeroes)
4. Floating ones (sequenced bit-position advancement through each word)
5. Random data
6. Count pattern (sequential, binary, full-word count, up to size of buffer)

In data test conversation mode, described in 12.5.2.2, one of the above patterns may be selected for test use, or a user-supplied pattern may be specified.

The size of the transfer is 512 (decimal) words.

12.3 RANDOM TEST

The random test consists of the writing and reading of randomly generated data patterns to randomly selected disk addresses. The size of the data transfers are generated randomly; however, they will not exceed 512 words. This write/read sequence is repeated 512 times. The program ensures that no data is written on the bad sector block (sectors Ø-21 on cylinder 41Ø, track 2).

Each write operation is followed immediately by a verification pass, which consists of an explicit seek operation to another randomly selected disk address, followed by reading and checking of the data. This seek/read sequence is repeated eight times in an attempt to detect read reduction problems or parity errors causes by a vibrating head.

If an error is detected, the read number is typed to show which read was being performed when the error occurred. Four more attempts are then made to read the data.

12.4 FORMATTER (RK06 ONLY)

This routine formats the RK06 cartridge disk by writing the header format for every (non-reserved) sector on the disk.

Prior to formatting, the routine reads the manufacturing bad sector block to obtain the addresses of any sectors that were found to be unreliable during the manufacturing process. The disk area reserved for this block extends from sector 0 through sector 9 on the last track of the last cylinder (track 2 of cylinder 410). The formatter routine marks each disk sector "good" or "bad" in accordance with any addresses contained on the manufacturing bad sector block. Sectors marked as "bad" in this manner do not interfere with disk operations and do not produce errors during formatting.

Sector headers are written one track at a time. If a sector cannot be formatted, the routine will output the message:

UNABLE TO FORMAT ONE OR MORE SECTORS ON THE FOLLOWING TRACK

(Track address)

(Cylinder address)

Normally, the inability to format one, or several, sectors on a track will not affect the operating capability of the cartridge disk.

When formatting is complete, the routine will output the message:

FORMATTING COMPLETE

12.5 OPERATIONAL INFORMATION

Operational information for the RK06S and RK06D diagnostic and data reliability program is entered through Test Parameter bit settings and through conversation-mode responses. Conversation mode is handled by the RK06S routines.

12.5.1 TEST PARAMETER Bit Settings

In response to the TEST PARAMETERS prompting, the user can set certain parameter bits. The associated switches, bit settings, and meanings are listed in Table 12-2.

Bits 10, 3, 2, 1, and 0 relate only to the RK06S routines:

Bit

10 enter conversation mode (RK06S only)

3 formatter test (RK06S only)

2 random test (RKØ6S only)

1 (bit 1 and bit 1Ø set) data test/conversation mode (RKØ6S only)

Ø (bit Ø and bit 1Ø set) address test/conversation mode (RKØ6S only)

12.5.2 Conversation Mode

When conversation mode is requested by setting bit 1Ø in response to the TEST PARAMETERS prompting, a series of questions is printed at the console.

Two versions of conversation mode are provided with the RKØ6 diagnostic program. One specifies information for the address test and one specifies information for the data test.

12.5.2.1 Address Test Conversation Mode - Conversation mode for the address test allows the operator to specify two cylinder addresses. The program then issues seek commands between the specified cylinders. Any errors encountered are reported to the operator.

Once started, this program continues until it is aborted by the operator.

Table 12-1
RKØ6S and RKØ6D TEST PARAMETER Bits

BIT	SETTING	MEANING
15	1	Stall on error. The diagnostic task waits up to 30 minutes before exiting. The user can abort the stall by setting the console switch selected for intervention. This is the console switch defined by the answer to the question (WHICH CONSOLE SWITCH APPLIES FOR OPERATOR INTERVENTION?) that is typed at task startup.
14	1	Loop on error. The diagnostic test routine loops on the failing instruction sequence. To abort the loop, the user must intervene, then specify new test parameters in which bit 14 is equal to 0.
13	1	Inhibit printouts except for forced printing.
12	1	Ring bell on error. The console bell rings every time an error is detected in a test sequence.
11	1	Run continuously. The program prints the end of pass number at completion and then repeats the testing sequence.
10	1	Enter conversation mode. Refer to Section 12.5.2 for a description of conversation mode. (RK06S only)
9	1	Restart the program. The program aborts the present test sequence and starts at the newly selected test.
5	1	Print only the first data-compare error found within a specified data transfer.
	0	Print up to 3 data-compare errors within a specified data transfer.
4	1	Inhibit seek operation between successive reads during the random test.
3	1	Formatter (RK06S only)
2	1	Random test (RK06S only)
1	1	Data Test/Conversation Mode (RK06S)
0	1	Address Test/Conversation Mode (RK06S)

The program requests the two cylinder addresses as follows:

"A" CYLINDER?

Enter a valid cylinder address in octal.

"B" CYLINDER?

Enter a valid cylinder address in octal.

12.5.2.2 Data Test Conversation Mode - In conversation mode for the data test, the operator can specify the data transfer size, the disk surface address, the pattern desired, and the function to be performed; writes, reads, or writes and reads.

The following prompts/questions are printed by the program:

WORD COUNT 2 TO X

Enter an octal value to indicate the data buffer size for the data test. The maximum value that can be entered for X is the number specified during the execution of CMD.

DO YOU WISH TO SPECIFY A DISK SURFACE ADDRESS (Y OR N)?

Type Y to indicate that a particular surface address is to be specified for testing; otherwise, type N.

If N is typed, the entire disk surface, with the exception of the bad sector block, will be read and/or written; the program will request the pattern to be used by immediately typing:

DATA PATTERN NO.=

CYLINDER

Type the desired cylinder address in octal. The maximum cylinder address is 631 (octal).

TRACK

Type the desired track number in octal.

SECTOR

Type the desired sector number in octal.

DATA PATTERN NO.=

Select one of the diagnostic program's patterns or enter a user-supplied pattern.

To select one of the prestored patterns, type the number that precedes the desired pattern in the following list:

Ø all zeroes

1 all ones

2 checkerboard (alternate ones and zeroes)

3 floating ones (sequenced bit-position advancement through each word)

4. random data

5 count pattern (a sequential, binary, full-word count up to size of buffer)

6 run all prestored patterns

If a user-supplied pattern is to be specified, enter 6 octal characters for the pattern, then press the RETURN key.

```
WRITE (Y OR N)?
```

Type Y to perform all write operations in the test or type N to inhibit write operations.

```
READ (Y OR N)?
```

Type Y to perform all read operations in the test or type N to inhibit read operations.

NOTE

The operator must answer Y (Yes) to at least one of the READ/WRITE? questions.

12.6 ERROR MESSAGES

Error messages are output in one of three formats, as shown below. The name of the diagnostic routine (RKØ6S or RKØ6D) that outputs the error message will appear on the first line in each format. Refer to Table 12-2 for error-message numbers and descriptions.

Format 1

ERROR NO.=	ERR followed by the error number
RKCS1=	contents of the Control and Status 1 register
RKWC=	contents of the Word Count register
RKBA=	contents of the Unibus Address register
RKDA=	contents of the Track and Sector Address register
RKCS2=	contents of the Control and Status 2 register
RKDS=	contents of the Status register
RKER=	contents of the Error register
RKAS/OF=	contents of the Attention Summary and OFFset register
RKDC=	contents of desired cylinder Address register
RKDB=	contents of the Data Buffer register
RKMR1=	contents of Maintenance Register 1
RKMR2=	contents of Maintenance Register 2
RKMR3=	contents of Maintenance Register 3
RKECPS=	contents of ECC Position register
RKECPT=	contents of ECC Pattern register
SECTOR=	sector address of the error
TRACK=	track address of the error
CYLINDER=	cylinder address of the error

Format 2

ERROR NO.=	ERR followed by the error number
EXPECTED=	data expected
RECEIVED=	data received
SECTOR=	sector address of the error

TRACK=	track address of the error
CYLINDER=	cylinder address of the error
DISTANCE IN-TO SECTOR=	distance into sector before a verify error occurred. Count starts at Ø.
RETRY NO.=	indicates which reread attempt recovered the data
READ NO.=	indicates which of the 8 successive read attempts failed during the random test.

Format 3

DISK ADDRESS DID NOT UPDATE PROPERLY

EXPECTED=	address expected
RECEIVED=	address received

Table 12-2
RKØ6S and RKØ6D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
1	Cylinder test - conversation mode	Error was detected during an explicit seek to Cylinder A in an address test.
2	Cylinder test - conversation mode	Error was detected during an explicit seek to Cylinder B in an address test.
3	Cylinder test 1	A hardware error occurred after a read header command was issued to cause an implied seek to Cylinder 0.
4	Cylinder test 1	A hardware error occurred after a read header command was issued to cause an implied seek to Cylinder N.
5	Cylinder test 2	A hardware error occurred after a read header command was issued to cause an implied seek to the cylinder number being incremented.
6	Cylinder test 2	A hardware error occurred after a read header command was issued to cause an implied seek to the cylinder number being decremented.
7	Cylinder test 2	The cylinder number contained in the sector's header does not match the requested cylinder number.
10	Sector addressing test	A hardware error occurred after a write command was issued to put the sector address pattern into a sector with a number equal to the pattern.
11	Sector addressing test	An error occurred when a write operation to a sector on track 0 of Cylinder 0 was followed by a write-check command.
12	Sector addressing test	A hardware error occurred after a read command was issued to read the sector address pattern in the selected sector on track 0 of Cylinder 0.

(continued on next page)

Table 12-2 (Cont.)
RK06S and RK06D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
13	Track/head addressing test	An error occurred after a 256-word write was issued to sector 0 on track 0, 1, or 2 of Cylinder 0. (The data that was written was made up of the 2-word track address pattern: track address number and its complement.)
14	Track/head addressing test	An error occurred when a write operation to sector 0 on track 0, 1, or 2 was followed by a write-check command.
15	Track/head addressing test	An error occurred after a read data command was issued to read the track address pattern in sector 0 of track 0, 1, or 2 of Cylinder 0.
16	Track/head addressing test	An error occurred while rewriting sector 0 on track 0, 1, or 2 of Cylinder 0 with the 2-word track address pattern.
17	Write/read cylinder spiraling test	An error occurred while attempting a 2-sector write, using the 2-word cylinder address pattern, to the last sector of a cylinder.
20	Write/read cylinder spiraling test	An error occurred when a 2-sector write to the last sector on the last track of a cylinder was followed by a write-check command.
21	Write/read cylinder spiraling test	An error occurred while attempting a read data command to sector 0 on track 0 of a cylinder. The data read should be the value of the cylinder number minus 1.
22	Sector addressing test, Track/head addressing test, Write/read cylinder spiraling test	The entire contents of the sectors were searched in an attempt to match the expected 2-word address pattern, and no match was found.
23	Partial sector write test	An error occurred while a pattern of all ones was being written into sector 0 on track 0 of Cylinder 0 (or the first good sector on the cylinder).

(continued on next page)

Table 12-2 (Cont.)
RK06S and RK06D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
24	Partial sector write test	The entire Cylinder 0 was found to be marked bad. The cartridge disk will probably need to be reformatted.
25	Partial sector write test	An error occurred during a 2-word write data operation to sector 0 on track 0 of Cylinder 0 (or the first good sector on the cylinder). The data written is all ones (177777). A partial write command should result in the remainder of the sector being zero filled.
26	Partial sector write test	An error occurred while a full sector read command to sector 0 on track 0 of Cylinder 0 (or the first good sector on the cylinder) was being executed.
27	Partial sector write test	A data compare error occurred when a previously written test pattern was write-checked. The first two data words in the sector should be ones (177777), and the remainder of the sector should contain all zeroes.
30	Random test	An error occurred while attempting a random length write of random data to a randomly selected disk address.
31	Random test	An error occurred while attempting an explicit seek operation to a randomly selected address. The error occurred between write and read operations.
32	Random test	An error occurred while reading the random data pattern from the randomly selected disk address.
33	Random test	Data compare error; data read did not match the expected random data pattern.
34	Random test	An error occurred during a recalibration operation attempt, after four unsuccessful attempts to read random data.

(continued on next page)

Table 12-2 (Cont.)

RK06S and RK06D Error Messages

ERROR NUMBER	ASSOCIATED TEST	MEANING
35	Data test, and data test portion of conversation mode	An error occurred during execution of a write data command.
36	Data test, and data test portion of conversation mode	An error occurred when a write-check command, following a write data command, was executed.
37	Data test, and data test portion of conversation mode	An error occurred while reading data.
40	Data test, and data test portion of conversation mode	Data compare error; data read did not match the expected data pattern.
41	Data test, and data test portion of conversation mode	An error occurred during a recalibration operation attempt, after four unsuccessful attempts to read data.
42	Validate marked bad address routine/Read bad block routine	An error occurred while the manufacturing bad sector block on the maximum track of the maximum cylinder was being read.
43	Formatting routine/ Read bad block routine	An error occurred while the manufacturing bad sector block on the maximum track of the maximum cylinder was being read.
44	Formatting routine	An error occurred after a write/ read command was issued to a selected track.
45	Bad sector handling routine	The core-resident table, used to store the addresses of marked bad sectors encountered, is full.
46	Read bad block from bad sector file track routine	The routine was unable to locate the bad sector block on the bad sector file track.

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