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Section 1

Operation

1. DIAGNOSTIC OPERATION

The Micro Technology, Inc. (MTI) RLO2 diagnostic (RLO2DG) is a stand alone memory resident program, which can be bootstrapped or run from any device supported by Digital Equipment Corporation (DEC*) RT-11 version 4 operating system.

1.1. PROTECTING DISTRIBUTED DIAGNOSTIC

RLO2DG diagnostic is supplied on either the Winchester drive, unit zero, or the RX02 compatible Floppy Diskette. The medium provided is dependent upon system options purchased. Either source will have the diagnostic program recorded with DEC's RT-11 file structure.

Backup can be accomplished using the COPY Command of RT-11. A bootable version can be generated on any storage device supported by RT-11 version 4.

Example commands to build device bootable backup:

1. COPY/SYS DD:RLO2DG:SYS YY:FILENAME
2. COPY/SYS SY:YY.SYS YY:
3. COPY/BOOT YY:FILENAME YY:

where DD = Source device (DY or DL)

YY = Target device

SY = System device

Only step one (1) is required for archival backup or where the RT11 RUN command is used for program activation (See Section 1.2).

*DEC is a registered trademark of Digital Equipment Corporation.

1.2. STARTING THE DIAGNOSTIC

The distributed RLO2DG program is bootable from the media provided. The RT-11 RUN or GET command can be used if device containing the diagnostic program isn't bootable. When using this method the program start/restart address is at location 6100.

If the diagnostic was provided only on the Winchester then it is imperative that the program be copied from the unit (Drive 0) to non volatile media (See Section 1.1).

CAUTION

Running the RLO2DG diagnostic program may cause loss of recorded Winchester stored program.

1.3. INITIALIZATION

Starting the RLO2DG program by bootstrap or via RT-11 RUN/GET commands yields the following program identification:

Micro Technology Incorporated
1620 Miraloma Avenue
Placentia, California 92670
MLV11/MLV11M Utility and
Confidence Diagnostic Version 04

For list of options type 'HE (CR)'

The program begins a dialogue requiring operator responses. Queries requiring numeric input are expected to be in octal; exceptions are noted. Affirmative or negative responses are indicated by default prompts Y for yes and N for no.

Input is terminated by carriage return (CR). Typing only a carriage return signals the program that the default value is to be used. Note the default response is displayed adjacent to the prompt. The following queries are presented as a part of the program startup and initialization.

Unibus device? N

Special processing is required for UNIBUS type controllers.

of controllers? 1

Enter the number of MLV11/MLV11M controllers present. A maximum of two (2) controllers are supported. The next set of questions are duplicated for each controller present.

First controller address? 174400

Enter the address to which the controller is configured. All device register accesses are made relative to this address.

Vector address? 160

Address to which the controller has been strapped for interrupt.

Priority? 5

Priority level at which the controller will interrupt. Do not confuse this with interrupt service level.

of units? 4

Enter the total number of RLO2's emulated by the Winchester drive(s) attached to the controller in question.

Type of controller - MLV11 (8")? N

Respond affirmatively if the controller type is MLV11; else type a carriage return. The operator will be prompted for the next type until a yes response is entered.

Controller 174400
Unit #0 present? N

The unit present query is alternately presented with the use unit query, that follows, until the number of units input via a previous prompt is selected. The program is intolerant of errors. Should an error be detected it is suggested that the operator type Control C (^C). This control action will return the keyboard to a listening mode. The Hardware directive HW can be used to reconfigure the system (See Section 1.4).

Use unit #0 ? N

This query is presented for each affirmative response to the Unit Present query above.

At this point the system configuration has been completely described. An attempt is made to read the Defective Map File. The following dialogue will appear only if the Winchester drive(s) described above is not formatted (See Section 4).

Map file doesn't exist,
Drive hasn't been formatted,
Original index time? 2048

Original index time is entered as a decimal integer. The number represents 1/100 of a millisecond.

Write pattern ? 4

Enter pattern number to be used by test program (See Section 2.0 and Appendix A.).

Type 'Y' to select a test,
Type '^C' to exit to keyboard monitor,
Type anything else to perform tests 1-13.

At this point the operator must decide whether or not to run all tests, selected test, or perform utility functions. It is important to note tests 14 and 15 can only be activated by entering 'Y' to this query.

Enter test number or request MENU (M)

A yes response to the previous query initiates the above. There is no default for this query and the input is either numeric or 'M' is the response:

1. REGISTER ADDRESSABILITY
2. CHECK BUS & DISK ADDRESS REGISTERS
3. CONTROL & STATUS REGISTER
4. INTERRUPT TEST
5. HEAD POSITIONING TEST
6. ILLEGAL TRACK AND SECTOR TEST
7. RANDOM SEEK AND READ HEADER
10. RANDOM SEEK, READ AND WRITE CHECK
11. RANDOM SEEK, READ HEADER AND READ W/O HEADER CHECK
12. RANDOM SECTOR WRITE WITH PREDEFINED PATTERNS
13. RANDOM SECTOR WRITE WITH RANDOM PATTERNS
14. PERFORMANCE EXERCISE
15. CHECK ALL SECTORS FOR READ ERRORS

Enter test number or request MENU (M)

1.4. OPERATOR DIRECTIVES

Control C is valid operator input at any point within the RLO2DG program. Entering ^C terminates whatever operation is being performed. The program then enters a keyboard listening mode. This mode is indicated by the keyboard monitor asterisk (*); the following operator directives are valid input when it appears:

<u>INPUT</u>	<u>DESCRIPTION</u>
AT	SELECT ALL TESTS Initializes the diagnostic jump table to include all test addresses. This command is normally used to reset selected tests following the ST command.
BM	SELECT DEFECTIVE BYTE MAPPING A subset of the Operator Directives is enabled. These commands allow the operator to correct, define, display, format, locate and initialize the defective byte table and/or locations on the selected unit. (See Section 4.0).
CD	INITIALIZE DISK WITH PATTERN Allows the operator to write selectable units with selectable pattern.
FM	FORMAT DISK All units or selectable surfaces can be formatted.
HE	PRINT THIS LIST List all the operator directives.

HW DEFINE HARDWARE ADDRESS
 Causes the initial dialogue to be entered
 (See Section 1.3).

IP INITIALIZE PROGRAM
 Resets system options and restarts diagnostic
 program.

KB DUMP TO TERMINAL
 Causes all output to be sent only to the
 terminal.

LP DUMP TO LINE PRINTER
 Causes all output to be duplicated to the
 line printer.

NT EXECUTE NEXT TEST
 Starts the next schedule test. Normally used
 following a ^C exit from a test program.

PE n PRINT PREVIOUS ERRORS
 Logs on output device(s) the previous
 errors for all functions, optionally for
 selected function.

PT PRINT LIST OF PATTERNS
 Logs the number and description of patterns
 available.

RP REPORT ERROR LOG
 Causes the Error Log to be printed on output
 device(s)

RT RETRY TEST
 Causes an interrupted test program to be
 restarted.

SO n,n,... SET OPTION WORK
 Option word is a Boolean item and is set to
 default value 100000. The number n
 represents the bit position to be set.
 The options are:

OPTIONS: 0 = Stop test on error.
 1 = Inhibit error printout
 2 = Loop on error.
 3 = Save last errors
 4 = Ring bell on error
 5 = Log test numbers.
 6 = Don't drop unit because of
 excessive errors.

SP START TEST PROGRAM
 Starts the first test program in jump table.

ST n,n,n,... SEQUENCE TEST
 This directive allows an operator to schedule the order and number of tests to be included in diagnostic jump table.

TM TYPE TEST MENU
 List number and brief description of the tests that make up the diagnostic program.

TP SELECT TEST WRITE PATTERN
 Allows operator to select the pattern to be used by test programs. (See Section 2.10 Test 12).

1.5. EXAMPLES OF DIRECTIVE RESPONSE

In the examples that follow, operator input is indicated by underscore. Directive commands consist of two (2) character mnemonics followed optionally by a space and numeric data separated by commas. All input must be terminated with a carriage return. Spaces are not permitted except for the initial space separating command from optional data.

Two (2) prompts are used by the program to indicate that the keyboard monitor is awaiting input. The first prompt, an asterisk (*), is used by the Executive monitor. Optional input to the asterisk prompt must be in octal. The second prompt BM>, is presented by the Defect Mapping monitor. Optional command inputs are expected to be decimal integer values.

```
*OP
INV CMD!
For list of options type 'HE cr'
```

An invalid command causes this response. The keyboard monitors are unforgiving. Should the operator mistype a command, pressing a delete key will not correct the error.

1.5.1. *AT

There is no response, except the keyboard monitor returns with an asterisk. A prompt is returned at the completion of all directive commands. The test program jump table is initialized with addresses of Tests 1-13 (See Section 2).

1.5.2. *BM

This command switches the operator responses to the Defect Mapping utility.

Is event clock disabled? N Y

This dialogue is conditional. It only appears if an event clock is present and was enabled at program startup. Note that no prompt is present. The prompt is not presented until the directive function is complete.

Attempting to compute index time

The above dialogue is presented to inform the operator of the delay. The program is determining the current index time (See Section 4).

Current index time? 2049 2048

Current index time calculated by the program is displayed for operator approval. Although the example shows operator input the normal response should be a carriage return.

Original index time? 2048 2044

The default value displayed is read from the defect map file, which is generated via the formatting process (See Section 4). As in the previous example the normal response is a carriage return.

For list of instruction type 'HE cr'

BM>HE

Enter CB n0,n1,n2,n3 cr to correct defective table.

Where n0=entry #, n1-n3 same as DB below.

CS n0,n1,n2,n3 cr to correct defective table.

Where n0=entry #, n1-n3 same as DB below.

DB n1,n2,n3 cr to input defective locations.

Where n1=cyl., n2=head and n3=byte.

DE entry # cr to remove defective entry number.

DS n1,n2,n3 cr to input defective locations.

Where n1=cyl., n2=head and n3=sector.

DT cr to display defective byte/sector table.

EN cr to terminate.

FT cr to format defective tracks.

HE cr to print this text file.

continued . . .

LB n1,n2,...nn cr to print physical locations and the number of errors received after reading each sector 40 times.
 Where n1-nn are logical block numbers.
 LT n1,n2,n3 cr same as LB above.
 Where n1=cyl., n2=surface (0 or 1) and n3=sector.
 RD cr to read defective map from disk.
 ZE cr to initialize defective byte table.
 ^C same as EN above.

BM>

The new prompt BM is displayed, indicating that input is now being directed to the Defect Mapping utility. Only commands listed in the above help file are acceptable. Optional input is expected to be decimal integers. See Section 4 for complete description of formatting and defect mapping.

BM> DB 235,0,8745

Permanent defects are entered into the Defect Map File. Entries aren't made permanent until the track has been formatted and the defect map is updated on the drive.

BM> DS 234,1,34

User defined location is entered into the defect map.

BM> DT

Entry	Cylinder	Head	Byte/Sector
1	235	0	8745 0
2	234	1	0 34

DT allows the operator to view the current entries within the Defect Map File. Entries that have been previously mapped are delineated with an asterisk adjacent to the entry number. Entries flagged with an asterisk can not be edited.

BM> CS 2,235,0,4

BM> DT

Entry	Cylinder	Head	Byte/Sector
1	235	0	8745 0
2	235	0	0 4

BM> CB 1,250,0,8823

BM>DT

Entry	Cylinder	Head	Byte/Sector
1	250	0	8823 0
2	235	0	0 4

Edit directives CB and CS are used to correct input errors without altering the table's order. Again only unmapped entries can be altered (those without an asterisk).

BM>DE 1

BM> DT

Entry	Cylinder	Head	Byte/Sector
1	235	0	0 4

Directives DE n, ZE or RD are used to delete one or all preformatted entries. There are currently no differences between directives ZE and RD in Version 4 RLO2DG. In both cases the permanent disk file is read to replace current memory copy.

BM>LB 20300

Unit #? 0
No errors detected.

BM>LT 235,0,23

Unit ? 0
No errors detected.

The directives LB and LT prove to very important tools for the operator. DEC's RT-11 provides bad block locations when using the DIRECTORY/BAD command. The locations provided by RT-11 can be used with the LB directive to locate the defective sector. RLO2DG calculates the logical sector pair that make up the logical block. Forty (40) reads of 128 words are performed on each sector. If any errors are detected, the physical location and errors detected are displayed. This information can be used via the DS command to defect map the failing sector. Directive LT provides the information for logical track and sector input, the location format provided by the RLO2DG Diagnostic program.

BM>FT

The format track directive initiates the defect mapping process. Each entry of the defect map is examined for mapping candidates (those entries without an asterisk). The physical location is calculated and defect mapped; this is repeated for each unmapped entry. An updated defect map is written to each unit (See Section 4).

BM>EN

Control C or EN forces exit from the Defect Mapping utility; keyboard control is returned to the Executive keyboard monitor.

1.5.3. *CD

Write all units N Y

Pattern No.? 0 4

Writing disk. . .

Clean Disk directive allows the operator to optionally initialize all or selected units to a known pattern (See Appendix A).

1.5.4. *FM

Is event clock disabled? N Y

Attempting to compute index time.

Total format? N Y

Serial No. can be eight digits.

Most significant four digits? 0 2345

Least significant four digits? 1 1234

To perform formatting ECC must be disabled.

Total and partial formatting are initiated with the directive FM. The initial dialogue is the same as BM; that is, if the clock wasn't disabled at startup the first query will appear, etc. This example is for total formatting. Since total formatting destroys the Bad Sector File a serial number input is requested. In this example formatting was not accomplished because the ECC jumper wasn't disabled (See Section 4).

1234
4321

*FM

Is event clock disabled? N Y

Attempting to compute index time.

Total format? N

Unit No.? 0

Bottom surface? (Y/N) N

Format unit No. 0 top surface? (Y/N) N

*

This is an example of partial formatting. Default response will result in no formatting.

1.5.5. *HE

AT	SELECT ALL TESTS
BM	SELECT DEFECT BYTE MAPPING
CD	INITIALIZE DISK WITH PATTERN
FM	FORMAT DISK
HE	PRINT THIS LIST
HW	DEFINE HARDWARE ADDRESS
IP	INITIALIZE PROGRAM
KB	DUMP TO TERMINAL
LP	DUMP TO LINE PRINTER
NT	EXECUTE NEXT TEST
PE n	PRINT PREVIOUS ERRORS
PT	PRINT LIST OF PATTERNS
RP	REPORT ERROR LOG
RT	RETRY TEST
SO n,n,n,...	SET OPTION WORD
SP	START TEST PROGRAM
ST n,n,...	SEQUENCE TESTS
TM	TYPE TEST MENU
TP	SELECT TEST WRITE PATTERN

Help text containing a brief description of each directive.

1.5.6. *HW

Unibus device? N
No. of controllers? 1 2
First controller address? 174400
Vector address? 160
Priority? 5
Continued . . .

No. of units? 4 1
Type of controller - MLV11 (8") N Y
Second controller address? 174420
Vector address? 150
Priority? 5
No. of units? 4 1
Type of controller - MLV11 (8") N Y
Controller 174400
Unit No. 0 Present? N Y
Use unit No. 0 N
Controller 174420
Unit No. 0 Present? N Y
Use unit No. 0 N Y

System hardware configuration is altered with this directive. When the hardware configuration is altered the data being maintained for the Error Report Log are zeroed.

1.5.7. *IP

MLV11/MLV11M Utility and
Confidence Diagnostic Version 04

For list of options type `HE<CR>`

Unibus device? N
No. of controllers? 2 1
First controller address? 174400
Vector address? 160
Priority? 5
No. of units? 1
Type of controller - MLV11 (8") N Y
Controller 174400
Unit No. 0 Present? N Y
Use unit No. 0 N Y
Map file doesn't exist.
Drive hasn't been formatted.
Original index time? 2048

Write pattern No.? 4 3

Type `Y` to select a test,
Type `^C` to exit to keyboard monitor.
Type anything else to perform tests 1 - 13.

Reinitialization occurs in response to the IP directive. All tests are re-selected (same as AT) the Set Option is reset to default value, and output is directed to the terminal. The example shows that hardware configuration is being requested. This only occurs when hardware hasn't been previously defined. Normal response would result in the first three and last three lines being displayed.

1.5.8. *KB

*LP

Output can be optionally directed to both the line printer and the terminal, or just to the terminal. KB switches output to the terminal only, LP to both. See appendix B for alternate device addresses.

1.5.9. *NT

TEST 01
TEST 02
TEST 03

The next test in currently selected sequence is initiated with the directive NT. This is normally used to skip an interrupted test.

1.5.10. *PE

RLCS	RLBA	RLDA	RLMP	RLMP1	RLMP2
104203	102256	177040	155555	066666	133333
UNIT 0	TRACK 508	SECTOR 32	HEAD 0		

Previous errors, detected by the test programs, are printed. Optionally selected error types can be displayed. Error types are:

- 0 - All
- 1 - Write Check
- 2 - Get Status
- 3 - Seek
- 4 - Read Header
- 5 - Write Data
- 6 - Read Data
- 7 - Read Data Without Header Check

1.5.11. *PT

Pattern	0	All 0's
"	1	-1's TO ALT BITS
"	2	0'S TO ALT BITS
"	3	SHIFTING ALT BITS
"	4	WORST CASE DATA
"	5	ALT 110 BITS
"	6	ALL 1'S
"	7	STRANGE DATA

Brief description of pattern types. See appendix A for actual values.

1.5.12. *RP

```
ERROR LOG FOR CONTROLLER 174400
UNIT NO. 0
SEEKS = 000000000006      SEEK ERRORS = 0000
WORDS READ = 000000003848
WORDS WRITTEN = 000000000000
DPI = 0000      DCRC = 0000      HCRC = 0000
DLT = 0000      HDF = 0000      NXM = 0000
TRK = 0000      CMP = 0000      NOAM = 0000
```

Each unit selected to be tested has an error log maintained by the program. Directive RP displays the recorded log for each unit. Error counts are only recorded during test program operation.

1.5.13. *SP

```
TEST 01
TEST 02
^C
*RT
TEST 02
TEST 03
```

An interrupted test, using Control C, is restarted using the directive RT.

1.5.14. *ST 1,2,3,5

*SP

TEST 01
TEST 02
TEST 03
TEST 05

*S0

*SP

*S0 5

*SP

TEST 01
TEST 02

Directives ST, SP and S0 are demonstrated by this example. The test and order are determined by ST. Starting the test is initiated by SP. The operation of Test 5 is interrupted by a Control C. (Note Control C is not echoed). Set option is used to set all options to false and sequence of test programs is restarted with the SP directive. Since the set option disabled test identification the test being run is not logged. A control C is again used to interrupt the program, a set option enabling test ID, and the test programs restarted.

1.5.15. *TM

- 1 REGISTER ADDRESSABILITY
- 2 CHECK BUS & DISK ADDRESS REGISTERS
- 3 CONTROL & STATUS REGISTER
- 4 INTERRUPT TEST
- 5 HEAD POSITIONING TEST
- 6 ILLEGAL TRACK AND SECTOR TEST
- 7 RANDOM SEEK AND READ HEADER
- 10 RANDOM SEEK, READ AND WRITE CHECK
- 11 RANDOM SEEK, READ HEADER AND READ W/O HEADER CHECK
- 12 RANDOM SECTOR WRITE WITH PREDEFINED PATTERNS
- 13 RANDOM SECTOR WRITE WITH RANDOM PATTERNS
- 14 PERFORMANCE EXERCISER
- 15 CHECK ALL SECTORS FOR READ ERRORS

A list of the test numbers and titles are output.

1.5.16. *TP

Write pattern No.? 3 4

*

The test pattern to be used by Test 13 is altered to worst case pattern number four (4).

Section 2

Test Description

2. GENERAL

Test programs are identified by octal numbers within the various directives and displays. The numbers and tests they represent are:

- 1 REGISTER ADDRESSABILITY
- 2 CHECK BUS & DISK ADDRESS REGISTERS
- 3 CONTROL & STATUS REGISTER
- 4 INTERRUPT TEST
- 5 HEAD POSITIONING TEST
- 6 ILLEGAL TRACK AND SECTOR TEST
- 7 RANDOM SEEK AND READ HEADER
- 10 RANDOM SEEK, READ AND WRITE CHECK
- 11 RANDOM SEEK, READ HEADER AND READ W/O HEADER CHECK
- 12 RANDOM SECTOR WRITE WITH PREDEFINED PATTERNS
- 13 RANDOM SECTOR WRITE WITH RANDOM PATTERNS
- 14 PERFORMANCE EXERCISER
- 15 CHECK ALL SECTORS FOR READ ERRORS

Tests are run via a jump table. There are twelve (12) entries, one for each possible test. The table is initialized at startup and following the execution of operator directives HW, AT, ST and IP (See Sections 1.4 and 1.5).

2.1. TEST 1

Verifies that the MLV11/MLV11M responds to register access. The Control and Status, Bus, Disk and Multipurpose registers are addressed. Program traps are fielded to determine failing registers.

2.2. TEST 2

A varying pattern is loaded and set into the Bus and Disk Address registers. After each set and load the registers are read and compared with the current pattern. Failing register and the values expected and received are displayed.

2.3. TEST 3

Tests the ability to set, load and read the Control and Status register. Every combination of drive, interrupt and function is used. The register is checked following each load and set operation to verify it remains unchanged. The Bus and Disk registers are also loaded and read to insure their values remain unchanged.

2.4. TEST 4

Tests the ability of the controller to effect an interrupt following an operation complete. Functions are initiated at device priority to verify its ability to interrupt at that level.

2.5. TEST 5

Tests that every cylinder can be addressed. The heads are stepped in contracting and growing pattern around the center cylinder. Four passes through the disk are made.

2.6. TEST 6

Tests the controller response to invalid sector addresses. Attempts are made to write sector 40 and beyond. Unexpected responses are reported.

2.7. TEST 7

Tests the ability to seek to a given track. Similar to Test 5; however, this test uses random seeks on random units followed by read header to verify positioning.

2.8. TEST 10

Tests the ability to read disk data. Random units, tracks, sector, and number of words to read are calculated. The data are read and compared using the write check function.

CAUTION

The following tests perform write functions; recorded data on selected units will be destroyed.

2.9. TEST 11

Tests the recovery of data without header check. A random unit and location are selected. Read header is executed until preceding sector is reached; read without header check is used to capture data. The data read are compared with the pattern written.

2.10. TEST 12

Tests the write function. Random units and locations are written with the preselected data pattern (selected at startup or with TP directive). Data verification is performed by comparing the data read and written.

2.11. TEST 13

Same as Test 12 except for data pattern and method of comparison. Prior to each write a randomly selected pattern is written to the output buffer. Following the write function, the written data are read and compared to the data pattern written.

2.12. TEST 14

Randomly selects Test 7 through 13 to be executed. Selected test performed for one iteration. In effect, the tests are operated as subroutines.

2.13. TEST 15

Tests each sector of the designated unit (selected at the start of the test) to check for sector read errors.

Section 3

Error Messages

3. GENERAL

Error printouts are composed of four lines. Line one contains the error description, line two the data headers, line three the data and line four the disk address.

Example:

```
STATUS   ERROR

   PC      EXPCTD   RCVD
 ddddddd ddddddd ddddddd
UNIT d TRACK ddd SECTOR dd HEAD d
```

where PC = program counter

EXPCTD = expected

RCVD = received

dddddd = the recorded data

The majority of error processing is performed within the common test interrupt handler; therefore, all errors can't be associated with a unique test. Where possible these associations have been shown.

3.1. BUS ADDR REG. ERROR

Test 2 displays this error when the value in the Bus Address register changes without a control function being initiated. The values expected and received are displayed.

BUS ADDR REG. ERROR

```
PC      EXPCTD   RCVD
 ddddddd ddddddd ddddddd
```

3.2. CANNOT ADDRESS XXXX

Test 1 displays this error when unable to address the register in question, where xxxx is the register mnemonic RLCS, RLBA, RLDA or RLMP. Lines 2, 3 and 4 are not displayed.

3.3. CONTROLLER ERROR

Test 4 initiated a controller function with interrupt enabled. The interrupt wasn't accompanied by controller ready. The value of the Control and Status register is displayed.

CONTROLLER ERROR

```
PC      Status
dddddd dddddd
```

3.4. DATA COMPARISON ERROR

Tests 10, 11 and 13 cause this error to be displayed. The common routine used by the tests discovered a mismatch between the input/output buffer and the pattern used to create it. Expected and received values are displayed.

DATA COMPARISON ERROR

```
PC      EXPCTD  RCVD
dddddd dddddd dddddd
```

3.5. DATA CRC

Tests 10, 11 and 13 display this error which indicates that while reading a data field from the disk, an error was detected. The device registers are displayed.

DATA CRC

```
PC      RLCS    RLBA    RLDA    RLMP    RLMP1  RLMP2
dddddd dddddd dddddd dddddd dddddd dddddd dddddd
```

3.6. DATA LATE

Test 11 displays this error indicating that the FIFO RAM was more than half full and the controller was unable to read the next sector.

DATA LATE

```
PC      RLCS    RLBA    RLDA    RLMP    RLMP1  RLMP2
dddddd dddddd dddddd dddddd dddddd dddddd dddddd
```

3.7. DISK ADDR REG. ERROR

Test 2 loaded or set a value into the RLDA which changed without a controller function being initiated. Expected and received values are displayed.

DISK ADDR REG. ERROR

PC	EXPCTD	RCVD
dddddd	dddddd	dddddd

3.8. ERROR ON INTERRUPTS RECEIVED

Test 4 received more or less than the number of interrupts required. Expected and received values are displayed.

ERROR ON INTERRUPTS RECEIVED

PC	EXPCTD	RCVD
dddddd	dddddd	dddddd

3.9. HEADER CRC

Tests 5, 7-15 display this error, indicating the controller was unable to read a header from disk (the header CRC was invalid). Device registers are displayed.

HEADER CRC

PC	RLCS	RLBA	RLDA	RLMP	RLMP1	RLMP2
dddddd						

3.10. HEADER NOT FOUND

Tests 10, 12 and 13 produce this error indicating that OPI timeout occurred while the controller was in search of a correct sector to read or write. A header compare did not occur. Device registers are displayed.

HEADER NOT FOUND

PC	RLCS	RLBA	RLDA	RLMP	RLMP1	RLMP2
dddddd						

3.11. NON-EXISTENT MEMORY

Tests 10-13 generate this error indicating that the memory location addressed did not respond within the bus timeout period. The device registers are displayed.

NON-EXISTENT MEMORY

PC	RLCS	RLBA	RLDA	RLMP	RLMP1	RLMP2
dddddd						

3.12. OPI ERROR

Tests 5-13 display this error when a controller operation does not complete within the OPI timeout period. Controller registers are displayed.

OPI ERROR

PC	RLCS	RLBS	RLDA	RLMP	RLMP1	RLMP2
dddddd						

3.13. RLBA REG. CHANGED

Test 3 displays this error. The value loaded into the RLBA changed without an operation being initiated. Expected and received values are displayed.

RLBA REG. CHANGED

PC	EXPCTD	RCVD
dddddd	dddddd	dddddd

3.14. RLCS SETTING ERROR

Test 3 displays this error when the value of the Control and Status register changes from the value set. Expected and received value of RLCS are displayed.

RLCS SETTING ERROR

PC	EXPCTD	RCVD
dddddd	dddddd	dddddd

3.15. RLDA REG. CHANGED

Test 3 presents this error when the Disk Address register fails to maintain the value loaded. Values expected and received are displayed.

RLDA REG. CHANGED

PC	EXPCTD	RCVD
dddddd	dddddd	dddddd

3.16. STATUS ERROR

Test 6 displays this error. An attempt to write to an invalid address did not result in the controller error expected. The Control and Status register value expected and received are displayed.

STATUS ERROR

PC	EXPCTD	RCVD
dddddd	dddddd	dddddd

3.17. AM NOT FOUND

Tests 7-15 display this error when the address mark on the sector data is not found. Device registers are displayed.

AM NOT FOUND

PC	RLCS	RLBA	RLDA	RLMP	RLMP1	RLMP2
dddddd						

Section 4

Formatting

4. GENERAL

The purpose of formatting is to section the disk tracks into smaller addressable units called sectors. The Winchester drives used with the MLV11/MLV11M controllers are soft sectored type, meaning that the beginning of each sector is defined by a pre-written identification (ID) field which contains the sector address plus cylinder and head information. The ID field is then followed by a user data field.

The formatting scheme used by the MLV11/MLV11M controller permits the recovery of areas containing manufacturing defects.

The MLV11/MLV11M controller provides full formatting capability, which writes both sector headers and data fields across all tracks of a selected surface. In addition a media defect mapping algorithm is available to correct for media defects on a track-by-track basis.

.NOTE

If formatting or defect mapping is requested during testing, the HW function should be invoked before testing is resumed. Failure to do this may result in tracking errors during testing.

When a track is formatted a "blind" spare section is written following the last sector on the track. Mapping a defect causes the specified track to be formatted. All sectors prior to the sector containing the defect are written as normal. Next the sector area containing the defect is written as a gap. Following this gap and beginning with the sector skipped, the sectors are written as normal, absorbing the "blind" spare sector at the end of the track. The advantage of this method is that it does not affect drive performance as with alternate track schemes provided by other controllers, in particular, the sector replacement technique. This technique is supported by the RLO2DG Diagnostic; however, no tools are provided for updating DEC's Bad Sector Map Files.

The RLO2DG Diagnostic program does maintain a Defect Map File. This file is created when a unit is formatted initially. The program will attempt to read this file at startup. If the Defect Map File does not exist on any of the units within a drive then the drive is considered unformatted.

Information contained within the Defect Map File is:

- Word 0 - Table identification
- 1 - Original (factory) index time.
- 2 - File Status.
- 3 - Number of entries
- 4 - Cylinder number
- 5 - Head number (surface).
- 6 - Sector number.
- 7 - Byte number.
- n - Checksum word.

Defect information is provided by the drive manufacturer, notably:

Original Index Time Rotation time at which prerecorded data were initialized for each defect detected.

Cylinder The cylinder address that contains the defect.

Head - surface The physical surface number

Byte Address Offset from index point.

Two type of entries are maintained in the Defect Map File, permanent and non permanent. Permanent entries are those defects entered with byte offset (manufacturer supplied locations). Non permanent entries are those locations entered relative to disk format (location identified by sector).

The Winchester drive supplied by Micro Technology, Inc. has been completely formatted. DEC's Bad Block Replacement Table is initialized with the drive serial number and zero bad sectors. MTI's Defect Map File has been initialized with the locations provided by the disk manufacturer and the disk has been defect mapped.

MTI's Defect Map File is maintained in duplicate at sectors 19 and 39, cylinder 511, bottom surface, of each unit within a disk drive.

NOTE

Prior to attempting a format, the jumper disabling ECC must be inserted (See Controller Manual). If the system configuration consists of two (2) drives per controller, the physical drive to be formatted or defect mapped must be specified in response to a query.

The FM directive will initiate dialogue with the formatting program. Prompts will guide the operation for the necessary responses. When an operator reformats a unit the Defect Map File is used. Permanent entries referencing the unit and surface being reformatted are defect mapped. Non-permanent entries referencing the selected surface will be deleted. When formatting/reformatting is complete the Defect Map File is updated on all units of the drive. Defect mapping is automatically performed following any format operation.

4.1. FORMATTING UTILITY

The formatting utility is capable of effecting both surface and defect formatting. The two directives used to initiate formatting are FM for surface, and BM for defect mapping.

In the following paragraphs are detailed examples of total device, unit, surface formatting and defect mapping. The drive type used in the example contains three (3) logical units.

4.2. TOTAL FORMATTING

Before starting any formatting operation the steps noted in Section 4.0 must be performed and the ECC disabled.

NOTE

If a total format is requested only those units specified as present and in use will be formatted.

In this and subsequent examples, operator input is indicated by underscore and terminated by carriage return (not shown).

*FM

Is event clock disabled? N Y
Total format? N Y
Serial no. can be eight digits.
Most significant four digits? 0 16
Least significant four digits? 1 7258
Bad sector file is being created.

After serial number is entered, the formatting process is performed on both surfaces of the first logical unit. The Bad Sector Map Files required by DEC are created, containing the serial number entered and zero bad sector entries. The serial number is incremented and the process repeated until all units have been formatted. Nonpermanent entries of the Defect Map File are removed.

Remapping defective locations . . .

The program maps each of the remaining locations contained in the Defect Map File and then rewrites it to each unit. This completes the total format process.

NOTE

Do not forget to enable the ECC controller function; damage to recorded data could be experienced if formatting remains enabled.

4.3. DEFECT MAPPING

The following information was supplied by the disk manufacturer for the drive used in our examples:

Cylinder	Head	Byte Offset
245	1	7894
304	2	3478
304	3	3478
400	5	2932
29	6	1968
206	6	4973
478	6	6789

Serial number 167258
Index Time 20.48 Milliseconds

To defect our formatted drive proceed as follows:

*BM>

Attempting to compute index time. Is event clock disabled? N Y

Current index time? 2043

Original index time? 2043 2048

For list of instruction type "HE cr".

BM>

At this point the Defect Mapping Utility is in control.

DB 245,1,7894

BM>DB 304,2,3478

BM>DB 304,3,3418

BM>DB 400,5,2932

BM>DB 29,5,2932

BM>DB 29,6,1968

BM>DB 206,6,4973

BM>DB 478,6,6789

BM>DT

Entry	Cylinder	Head	Byte/Sector
1	245	1	7894 0
2	304	2	3478 0
3	304	3	3418 0
4	400	5	2932 0
5	29	5	2932 0
6	29	6	1968 0
7	206	6	4973 0
8	478	6	6789 0

The following commands correct the entry errors.

BM>CB 3,304,3,3478

BM>DE 5

BM>DT

Entry	Cylinder	Head	Byte/Sector	
1	245	1	7894	0
2	304	2	3478	0
3	304	3	3478	0
4	400	5	2932	0
5	29	6	1968	0
6	206	6	4973	0
7	478	6	6789	0

BM> FT

The command FT initiates the actual mapping process. The physical location of each Defect Map File entry is calculated and the sectors containing the defects are mapped out.

4.4. UNIT FORMATTING

Unit formatting is accomplished by initiating the directive FM for each surface of the logical unit.

*FM

Is event clock disabled? N Y
Total format? N
Unit no.? 0 2
Bottom surface? (Y/N) N Y
Format unit no. 2 bottom surface? (Y/N) N Y

Formatting . . .

Bad sector file is being created.

Serial no. can be eight digits.
Most significant four digits? 0 16
Least significant four digits? 1 7260
Remapping defective location

*FM

Is event clock disabled? N Y
Total format? N
Unit No.? 2
Bottom surface (Y/N) N
Format unit no. 2 top surface? (Y/N) Y

Formatting . . .

Remapping defective locations . . .

After a surface is formatted the Bad Sector File is optionally created. Optionally because the file exists only on the bottom logical surface. The Defect Map File is updated, nonpermanent entries associated with surface and unit selected are removed, permanent entries are defect mapped, and the updated file is rewritten to each unit of the drive.

4.5. MAPPING A BAD SECTOR

Bad sectors detected by the diagnostic, an operating system or user programs can be defect mapped. The defect mapping function provides two methods of locating potentially bad disk areas. Directives for initiating these functions are LB for locating defective sectors within a logical block and LT for the logical track and sector.

*BM

Attempting to compute index time.

Current index time? 2048

Original index time? 2048

For list of instruction type "HE cr".

BM>LB 142

Unit No.?	Cylinder	Head	Sector	Errors
0	233	1	28	40

BM>LT 256,1,30

Unit No.?	Cylinder	Head	Sector	Errors
0	233	1	28	40

The program begins a dialogue requiring operator responses. Queries requiring numeric input are expected to be in octal, exceptions are noted. Affirmative or negative responses are indicated by default prompts Y for yes and N for no.

BM>DS 233,1,28

BM>DS 2,1,16

BM>DT

Entry	Cylinder	Head	Byte/Sector	
1*	245	1	7894	0
2*	304	2	3478	0
3*	304	3	3478	0
4*	400	5	2932	0
5*	29	6	4973	0
6*	206	6	4973	0
7*	478	6	6789	0
8	233	1	0	28
9	2	1	0	16

BM>FT

BM>DT

Entry	Cylinder	Head	Byte/Sector	
1*	245	1	7894	0
2*	304	2	3478	0
3*	304	3	3478	0
4*	400	5	2932	0
5*	29	6	4973	0
6*	206	6	4973	0
7*	478	6	6789	0
8*	233	1	0	28
9*	2	1	0	16

BM>

Defective locations were found using the LT and LB commands; these locations were entered into the Defect Map File. The defects are mapped when FT command is issued. Only the entries without an asterisk are mapped. The updated file is written to all units.

Performing a total format at this point would produce the following:

*FM

Is event clock disabled? N Y
Total format? N Y
Serial No. can be eight digits.
Most significant four digits? 0 16
Least significant four digits 1 7258
Bad sector file is being created.

*BM

Attempting to compute index time.

Current index time? 2048

Original index time? 2048

For list of instruction type `HE<cr>'.

BM>DT

Entry	Cylinder	Head	Byte/Sector
1*	245	1	7894 0
2*	304	2	3478 0
3*	304	3	3478 0
4*	400	5	2932 0
5*	29	6	4973 0
6*	206	6	4973 0
7*	478	6	6789 0