FLOPPY DISK DIAGNOSTIC/FORMATTER PROGRAM

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REVISION HISTORY

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SECTION 1. INTRODUCTION

The Floppy Disk Diagnostic/Formatter program consists of a diagnostic utility, a diskette formatter utility, and a series of tech tests. The Diagnostic tests the Floppy Disk Controller, Floppy Disk Drive Cables, and the associated disk drives. It also verifies the integrity of the diskette media in the Floppy Disk Subsystem environment. The Formatter allows the formatting of diskettes in standard IBM formats. The Tech Tests exercise controller functions repeatedly to allow monitoring with an oscilloscope.

Different versions of this program run on any LSI-2 Series or NAKED MINI® 4 Family computer. The program is available in either paper tape or diskette form.

SECTION 2. ENVIRONMENT

Execution of the Floppy Disk Diagnostic/Formatter program requires the hardware and software listed below.

2.1 HARDWARE REQUIREMENTS

The following hardware is required to run the Diagnostic/Formatter:

- LSI-2 or NAKED MINI® 4 processor with programmer's console
- Minimum of 16K words of read/write memory
- ASR-33 or equivalent teletypewriter (TTY) or CRT terminal
- Floppy Disk Controller (Marketing Model No. 53818-00)
- One to four Floppy Disk Drives (Marketing Model No. 22566-xx)
- One to two Floppy Disk Drive Cables (Marketing Model No. 15566-00)
- A paper tape reader or floppy disk system for loading the Diagnostic/Formatter

A line printer also may be used for hard copy output.

2.2 SOFTWARE REQUIREMENTS

The following software is required if the Diagnostic/Formatter is delivered in paper tape form:

- A binary program loader (including the AutoLoad hardware facility) for the LSI-2 or NAKED MINI® 4 processor
- Floppy Disk Diagnostic/Formatter program paper tape for the LSI-2 (Engineering Reference No. 96096-40) or the NAKED MINI® 4 processor (Engineering Reference No. 96096-43).

The following software is required if the Diagnostic/Formatter is delivered in diskette form and is to be run on an LSI-2:

- Floppy Disk Diagnostic/Formatter program diskette (Engineering Reference No. 96096-02)

The following software is required if the Diagnostic/Formatter is delivered in diskette form and is to be run on a NAKED MINI® 4 processor:

- Floppy Disk Diagnostic/Formatter program diskette (Engineering Reference No. 96096-04)

SECTION 3. REFERENCE DOCUMENTATION

The following documents provide supplementary information for the Diagnostic/Formatter user:

	Engineering Reference Number	Marketing Model Number
• Floppy Disk Subsystem User's Manual (LSI-2)	91-53566-00	53566-91
• Floppy Disk Subsystem User's Manual (NAKED MINI® 4)	91-53696-00	53696-91

SECTION 4. GENERAL DESCRIPTION

This program consists of two utilities. The Diskette Formatter utility allows formatting of new diskettes in standard IBM formats. It is described in detail in Section 7.

The Floppy Disk Diagnostic utility is comprised of 17 standard tests (16 for the LSI-2) and 4 tech tests. The purpose of each test is summarized below. A more complete description of each diagnostic test is given in Section 6.

Test	Purpose
A	Tests the operation of basic controller and DMA functions.
B	Tests the operation of DMA and seek functions.
C	Tests the operation of the head seek function.
D	Performs a check for cross-track interference problems on the diskette.
E	Tests the proper functioning of partial sector I/O.
F	Verifies the ability of the controller to handle multiple sector I/O.
G	Tests the proper functioning of the Write Non-Deleted Data, Read Verify, and Read Non-Deleted Data functions.
H	Tests the proper functioning of the Write Deleted Data and Read Deleted Data functions.
I	Tests the proper functioning of data selection in the controller.
J	Forces error conditions to check status word bits.
K	Checks for interchangeability between two or more drives.
L	Performs a variety of simple data transfer operations.
M	Tests the proper execution of the interrupt features.
N	Verifies the proper formatting of a diskette.
O	Verifies the proper operation of the Read Regardless function.

Test	Purpose
P	Verifies the proper operation of the highest read/write locations.
Q	Tests interrupt level (NAKED MINI® 4 only).
T	Performs tech tests. These tests exercise controller functions repeatedly, and are monitored by an oscilloscope. Refer to Section 8 for more information.

SECTION 5. PROGRAM OPERATION

Whether the user desires to run the Diagnostic, the Formatter, or the Tech Tests, he must follow the loading procedures described below and answer the appropriate set of queries listed in the subsequent subsections.

5.1 LOADING AND START UP

The loading procedures for the Diagnostic/Formatter vary depending on whether it is delivered in paper tape or diskette form, and whether it will be executed on an LSI-2 or NAKED MINI® 4 processor.

5.1.1 Using the LSI-2 or NAKED MINI® 4 Paper Tape

When the Diagnostic/Formatter is delivered in paper tape form, it first must be loaded via the hardware AutoLoad facility or another binary loader. If the user desires to use a line printer for output or to accumulate pass and error counts, he must enter the demand mode of the program by taking the steps listed in Subsection 5.2. If the user takes no steps to execute the program in demand mode, the program will begin displaying queries.

5.1.2 Using the LSI-2 Diskette

When the Diagnostic/Formatter is delivered in diskette form and is to be executed on an LSI-2 processor, it must be loaded using DLD, which resides as a file on the product diskette. After DLD is loaded and has announced itself, the user should issue a DLD command to load and execute the Diagnostic/Formatter, as described in the Directoried Load/Dump (DLD) User's Manual (Engineering Reference No. 90-93012-00, Marketing Model No. 93012-90). The Diagnostic/Formatter may be accessed via the file name B09640. The program is loaded automatically at location :100, and the TTY begins to display queries.

If the user desires either to use a line printer for output or to accumulate pass and error counts, he must load the program via DLD and enter the demand mode by taking the steps listed in Subsection 5.2.

5.1.3 Using the NAKED MINI® 4 Diskette

When the Diagnostic/Formatter is delivered in diskette form and is to be executed on a NAKED MINI® 4 processor, it must be loaded using the OMEGA4 PLUS Disk Utility Program, which resides as a file on the product diskette. Auto-Loading the Disk Utility Program generates a TTY display of the form

```
OMEGA4 DISK UTILITY (C0):5DA0-:7DFE
```

The user should issue an E command to load and execute the Diagnostic/Formatter via its file name, FPYDISKDIAG.BIN. The E command should take a form similar to the following:

```
?E,DF.FPYDISKDIAG,BIN,0,5000
```

Because this version of the Diagnostic/Formatter must be executed at location :0, the user must specify both the load address for the Diagnostic/Formatter (0), and the load address for the Diagnostic/Formatter's bootstrap program (e.g., 5000). Keeping in mind the extents of the Disk Utility Program and the size of the Diagnostic/Formatter, the user should specify a load address for the bootstrap which falls between them. The size of the Diagnostic/Formatter is indicated in the diskette's view listing; the program's bootstrap occupies approximately :300 words of memory. Note that the Disk Utility Program is loaded automatically into the high end of memory.

If the user desires either to use a line printer for output or to accumulate pass and error counts, he must now enter the demand mode of the program by taking the steps listed in Subsection 5.2. Otherwise program control branches to the start of the Diagnostic/Formatter, and queries are displayed.

Complete information on the use of the Disk Utility Program E command is presented in Appendix B. The Disk Utility Program additionally provides commands which allow disk creation and maintenance; the uses of these commands are described in Appendix B.

NOTE

The OS4 /AUTOLOAD command may be used alternately to load the Diagnotic/Formatter.

5.2 MAKING A DEMAND MODE ENTRY

If the user desires either to use a line printer for output or to accumulate pass and error counts, he must enter the demand mode of the Diagnostic/Formatter program.

The Diagnostic/Formatter should be loaded according to instructions presented in the preceding subsection; :101 should be entered into the P register. To exercise run options, bits must be set in the Console Data Register. This is accomplished when the user enters the sum of the following desired run options in the Console Data Register:

- Counter Option

  :0 Reset pass and error counts on each pass
  :1 Accumulate pass and error counts

  Line Printer Option

  :0 Use TTY for output
  :2 Use line printer for output

After these steps are taken, the display of queries will begin.

When a line printer is specified for output, the program outputs queries to both the Teletype (or CRT) and the line printer. The operator responds using the keyboard entry device, tnd his Teletype responses are echoed to the line printer. When the actual tests are being run, however, all output is printed by the line printer and suppressed on the Teletype.

Output may be transferred to only the Teletype at any time during program queries by typing

:T

into the keyboard entry device as a response. This procedure overrides any other response to a diagnostic query. An entry of

:L

resets the output to the line printer.

To change run options when execution has begun, the program must be reloaded and the new value entered as before.

5.3 PROGRAM RE-ENTRY

The program may be re-entered in either the default or demand mode. To restart the program in the default mode, the Diagnostic/Formatter's starting location may be entered into the P register. A console interrupt also causes the program to re-enter the default mode, unless the interrupt switch was preset.

To restart the program in the demand mode, :101 is entered in the P register. The run options required for initially entering this mode must also be reset.

In the event of power failure, the program restarts in the default mode after power-up. To re-exercise run options allowed in the demand mode, the console data bits must be reset accordingly.

5.4 QUERIES AND RESPONSES

When the program is loaded and execution has begun, queries requiring user responses are printed by the output device.

Each response is terminated with a carriage return, except for request to modify display or output.

Certain characters may be used to simplify answering the queries. These responses are invalid during the running of tests I, J, and L.

- The up-arrow (↑) as the last character typed prior to a carriage return in a response repeats the previous query. The first query is repeated if ↑ is entered in response to the first query.

- When the back-arrow (←) is the last character typed prior to the carriage return in a response, the query is repeated.

- The carriage return as the sole response sets that particular query to the default value.

- The number symbol (#) as a response sets the present and all subsequent queries to their default values. When # is entered, the program skips all subsequent queries and goes directly to the SNS REG message.

SECTION 6. THE DIAGNOSTIC TEST

Procedures for running the Diagnostic utility are outlined in this subsection, along with descriptions of the various Diagnostic tests and methods of Diagnostic error handling.

6.1 DIAGNOSTIC TEST OPERATION

The following queries must be answered appropriately to run the diagnostic. The default value listed in parentheses may be selected by hitting a carriage return only.

Query	Response
FORMATTER OR DIAGNOSTIC(D)?	Enter D (or a carriage return) to run the diagnostic.
TSTS=	This query asks the user to specify tests to be run. Enter up to 17 letters (16 for the LSI-2) separated by commas; the order entered corresponds to the order the tests are run. Repeating a test letter causes a test to be repeated. If a default is selected, the program consecutively runs tests A, E, and F. If test T is specified, program control is immediately transferred to the Tech Tests. (Section 8 provides detailed information on the Tech Tests.)
UNITS(0)?	This query finds out which disk drive units will be tested. Enter one to four numbers in the range 0-3, separated by commas; the order entered corresponds to the order tested.
CYLS(0,76)	Enter the range of tracks to be tested. For example, a response of 0,9 causes tracks 0 through 9 to be tested. A response of 4 causes only track 4 to be tested. The default is to test tracks 0 through 76. Two groups of tracks may be tested sequentially by entering the following type of response: 1,20(space)25,35 Tracks 1 through 20 are tested for a unit, followed by tracks 25 through 35. After running a test and checking results, the user may wish to modify the track range specified in the initial queries. When the program is restarted and queries are redisplayed, he may enter a response similar to the following: 3,18(space) <CR>

Query	Response
	If his response during the previous set of queries was 1,20(space)25,35; this new response causes track 3 through 18 to be substituted for his initial test range of 1 through 20. This is a shorthand way of saying tracks 3 through 18, followed by tracks 25 through 35, are to be tested. Entering a response such as (space)30,40 during second or subsequent sets of queries, causes the first set of tracks specified in the previous set of queries to be retested, followed by tracks 30 through 40. If 1,20(space)25,35 had been the response in the previous set of queries, tracks 1 through 20, then 30 through 40, would be tested.
OPR(N)?	Enter Y if tests requiring operator intervention are run; otherwise, enter N. Tests J and K require operator intervention.
INTS(Y)?	Enter Y to execute the program under interrupt control. Enter N to execute the program with interrupts disabled.
PATN(=:DB24)=:	This query allows the user to specify a one-word data pattern for use in certain tests. Enter one to four hexadecimal digits.
DEV AD(:11)=:	Enter the hexadecimal floppy disk device address. The standard device address is :11.
SET SENSE REGISTER	Set the sense switch on the programmer's console to suppress output of pass number unit number, and test titles, if desired. This switch setting may be altered at any time during program operation. Obtain the hexadecimal sum of the following control feature factors desired, or enter a carriage return to specify a default value of :2.

Printing of I/O Block Contents

:0 Do not print I/O Block contents.
:1 Print I/O Block contents prior to each floppy disk operation.

Suppression of Error Reports

:0 Print error reports.
:2 Suppress error reports (Section 6.4).

Printing of Error Tallies

:0 Suppress error tallies.
:4 Print error tallies at the end of each test (Section 6.4).

Continuous Execution

:0 Halt at the end of each test pass.
:8 Run continuously.

Add :2 to this sum, and enter this hexadecimal number into the sense register of the console, if the machine is an LSI-2. On a NAKED MINI® 4 machine, the sense register is set by entering this value into the keyboard entry device.

For example, to run the tests continuously and to print error tallies, enter (:4+:8) +:2 =:E. To run without any of the four "factor" options, enter :2.

To allow the program to display zero errors in its error tally, enter a :1 after the above sum, using the following form:

(sum),1

Check to see that all switches are properly set; be sure all requested units are powered-up, ready, and not write-protected. Enter a carriage return to begin diagnostic execution.

When each diagnostic test run is completed, the message IOT is displayed on the TTY or CRT. The program halts and again displays the FORM/DIAG query when all tests specified in the TSTS query are run.

NOTE

Tests may be aborted and the program restarted at any time by entering a console interrupt.

6.2 DIAGNOSTIC TEST DESCRIPTIONS

The following paragraphs describe in detail the tests that can be performed as part of the Diagnostic.

As errors occur during test runs, error messages are output to the TTY or line printer. Information on test-specific errors is included in the following test descriptions. For general information on error report format, refer to Section 6.4.

After each test is run, the current pass count and test letter are printed. One or more function mnemonics describing the hardware commands executed during the test run are printed also.

These mnemonics are defined as follows:

NO	No-op
FMAT	Format
WR ND	Write Non-Deleted Data
WR DE	Write Deleted Data
RD ND	Read Non-Deleted Data
RDRG	Read Regardless
READ	Read All Data
VER	Verify
SEEK	Seek
INIT	Initialize
RSTOR ER	Restore

Setting the sense switch suppresses the printing of pass counts, test identification, and function mnemonics.

6.2.1 Test A

Test A checks the proper operation of basic controller and DMA functions. To begin, 77 words are read from sector 20 of the first requested track. Upon completion of the read operation, the "words processed" word of the IOB (word 5) should be set to 77. The same operation is then performed on sector 26 of this track. Expected transfer is 64 words, since the end-of-track is reached at the end of sector 26.

6.2.2 Test B

Test B checks the operation of DMA and seek functions. The head is held static by a continuous relative seek count of zero. All tracks (0-76) are then requested. This should result in one match and 76 ID Miscompare errors. If more than one match is found, the number of matches is output.

6.2.3 Test C

Test C checks for the proper operation of the head Seek function, performing seeks of all lengths and in all directions. Two counters are used to determine the track number--counter A starts at zero; counter B starts at 76. Counter A increments to track 76 and counter B decrements to track 0. When the Seek is completed, a Read Regardless function is performed for one word to verify the correct positioning of the head.

This series of seeks results in a damped oscillation across the disk, the head settling on Track 38. The oscillation then reverses and increases until counter A reaches 76 and counter B reaches 0.

6.2.4 Test D

Test D checks for cross-track interference problems on the diskette. Alternate tracks of 0 and 1 are written to the diskette, beginning with 0 on the first requested track. When all requested tracks are filled, a Read Verify operation is performed to detect any interference.

6.2.5 Test E

Test E checks the proper operation of the partial sector I/O function. To begin, a 33-word record is written to sector 0 of the first requested track using the incrementing data pattern :0-:20. A Read All Data operation is then performed to bring the sector into memory, and the data pattern is checked for correctness. All remaining tracks are tested similarly.

6.2.6 Test F

Test F verifies the ability of the controller to handle multiple sector I/O. This test causes data to be written to all specified tracks, then it performs Read Verify and Read Regardless operations from the tracks.

Three passes are required to perform this test. Pass 1 writes, verifies, and reads 65-word records (one sector and one word). Pass 2 uses 128-word records (two sectors), and pass 3 uses 129-word records.

6.2.7 Test G

Test G verifies the proper functioning of the Write Non-Deleted Data, and Read Non-Deleted Data operations. Each of the above operations is performed on the first requested track using a data length of one sector. After each operation is completed, its proper termination is checked, and correct data transfer is verified.

6.2.8 Test H

Test H is similar to Test G except that it checks the proper functioning of the "deleted data" form of operations listed above (i.e., Write Deleted Data), rather than the non-deleted data operations.

6.2.9 Test I

Test I checks the proper functioning of data selection in the controller. To do this, it writes interspersed "deleted"-type and "non-deleted"-type records to be written to requested sectors. The deleted and non-deleted records, all with one-word data lengths, are written in patterns that allow the diagnostic to check for transfer of paper type data (i.e., non-deleted type).

A Read Non-Deleted Data operation is then performed and correct data transfer is checked. A Read Deleted Data operation subsequently is performed, and the data transfer is checked. This entire process is repeated on each of the remaining tracks.

6.2.10 Test J

Test J attempts to force the following error conditions in order to test the correct setting of corresponding bits in the status word:

1. The selected unit is not ready (bit 0).
2. The end-of-track is reached and word count is not equal to 0 (bit 2).
3. An attempt was made to write to a write-protected unit (bit 3).
4. A "No ID Compare" error was made (bit 4).
5. A DMA rate error or an attempt to access non-existent memory was made (bit 1).
6. The selected unit is write-protected (bit 15).

Errors 1, 3, and 6 require operator assistance. These errors are tested only if the "OPR?" parameter is set to "Y" (operator intervention desired) during initial queries. The operator should hit a carriage return after completing the intervention.

To test for error 1, the program asks the operator to open the drive door; then it examines the status word. The program's expected response is "Drive Not Ready."

The program checks error 2 by initializing a read operation of 70 words from sector 26 of the first requested track Expected response by the program is "End of Track and Word Count Not Equal To Zero."

To test for errors 3 and 6, the program asks the operator to write-protect the unit; then it issues a one-word write to sector 0 of the first requested track. The program's expected response is "Attempt to Write on Write Protected Unit" or "Selected Unit Write Protected."

The program checks error 4 by issuing a Read All Data command to track 1, sector 4, with the flat (soft write-protect) bits set. Expected status is "No ID Compare."

To check error 5, a read operation is performed from one sector of non-existent memory located at cylinder 9, sector 1. The expected response is "DMA Rate Error."

6.2.11 Test K

Test K checks for interchangeability between two or more disk drive units. All requested diskette tracks are written to; then the diskette is read to ensure correct data transfer. After that, the operator is requested to remove the diskette and reinsert it into another unit. After readying the new unit, the operator enters the unit number into the input device, followed by a carriage return. Read and Verify functions are then performed on the diskette to ensure correctness of the data and interchangeability between drives.

This test is run only if the "OPR" option initially was set to "Y" (operator intervention desired).

6.2.12 Test L

Test L performs a variety of simple tests on the controller. If one word is written to a sector, the entire sector should be filled with that word and CRC should be computed properly. This is tested by writing one word of hexadecimal 'E5E5' to sectors of the first requested track. Unused unit bits in the unit control word are set to 1's and the write is performed. After a Read Regardless function brings the data into memory, the CRC is verified, and 16-bit word count computation is tested. A test to prove that the Read Verify function does not transfer any data is performed. The final test writes each sector of the first specified cylinder with its sector number. The writes are issued to sectors 26 then 25, etc. The verification that no sector overwriting occurred concludes this test.

6.2.13 Test M

Test M checks the proper execution of the interrupt features. First, a 0 is output as the interrupt address in the IOB; this address should disable interrupts. A check then is made that an interrupt indeed did not occur at location 0.

Then a two-sector write operation is performed to sector 3 of the first requested track. A check is made that the interrupt occurred to the normal interrupt return location, and the status word is examined to verify normal interrupt termination.

A two-sector write to the last sector of the first requested track is now performed to force an "End-of-Track and Word Count Not Zero" condition. A check is then performed to ensure that the interrupt occurred to the error return location, and status word is examined to verify the error.

6.2.14 Test N

Test N verifies the proper formatting of a diskette. If a diskette was formatted using the Formatter program, then all tracks may be tested prior to writing to the diskette. In preformatted diskettes, however, tracks 1 through 76 should be tested, as track 0 is a special-cased index track. Test N reads an entire track into memory and checks each sector ID for proper track number. Next, a sum of all the sector numbers is computed--if all 26 sector numbers appear once per track, this sum should equal the sum of integers 1 to 26, which is 351. The data fields are next examined for the hexadecimal "E5E5" initialized value. Finally, the data CRC are checked to see that they all equal hexadecimal "5D30."

6.2.15 Test O

Test O verifies the proper operation of the Read Regardless function. First, all data words in a sector are written with the track/sector word of the sector in which they exist. This procedure is performed for all sectors, then the Read Regardless operation is performed. Finally, all data, track/sector IDs, and data CRCs are examined for correctness.

6.2.16 Test P

Test P verifies the proper operation of the highest read/write locations. To accomplish this, the program first finds the highest read/write location. Then an incrementing pattern is written to one sector and read into an output buffer to verify that what was read is indeed what was written. The test is run under the three following conditions.

- IOB at the end of memory; data buffer in low memory
- IOB in low memory; data buffer at end of memory
- IOB and data buffer at end of memory

6.2.17 Test Q (NAKED MINI® 4 only)

Test Q checks the interrupt levels. Test I/O operations with interrupt vectors are performed for each combination of status bits 12 and 13. Interrupts should be suppressed when bit 12 is on; they should be enabled when bit 12 is off. The setting of bit 13 should not alter the effect of bit 12 in the test.

6.2.18 Test T

Test T (the Tech Tests) is designed to exercise controller functions repeatedly--the intensity of these functions may be verified using an oscilloscope. This test is run separately from the other diagnostic tests. After the user enters a T in response to the TSTS query, the Tech Tests issue their own set of queries. Section 8 contains detailed information on running the Tech Tests.

6.3 I/O CONTROL BLOCK DUMPS

The I/O Control Block (IOB) contents are printed before each floppy disk operation if the proper control factor was entered in the sense register during the queries. The message "IOB" and the contents of words 0-7 are printed on the same line.

The IOB dump contains the following information:

Word 0-Op Code — Bits 0-3 of this word define the operation to be performed, as follows:

Bit Configuration	Operation
0000	No-Op
0001	Format
0010	Write Non-Deleted Data
0011	Write Deleted Data
0100	Read Non-Deleted Data
0101	Read Deleted Data
0110	Read Regardless
0111	Read All Data
1000	Read Verify
1001	Seek Only

Word 1--Unit Number — The floppy disk drive unit number on which the selected operation is to be performed is specified by bits 0 and 1 of the control word 1.

Bit Configuration	Unit Number
00	0
01	1
10	2
11	3

Word 2--Track Address

Bits 0-6 of this word contain the track number on which the operation is to be performed. Bit 7 can be used as a flag bit in non-IBM compatible code.

Word 3--Relative Seek Count

Bits 0-7 of this word define the relative seek count, the number of consecutive cylinders over which the head must traverse in a seek operation to arrive at a desired track. A positive count implies head movement toward the cneter of the disk, while a negative count implies movement toward the outer edge.

Word 4--Sector Number

Bits 0-4 of this word define the sector number where the operation is to begin. Bits 5-7 may be used as flag bits in non-IBM compatible mode; they must be set to 0 to be IBM compatible.

Word 5-- Word Count

Bits 0-14 of this word contain the number of words to be transferred during the operation.

Word 6--Memory Address

Bits 0-15 of this word contain the memory address of the location where data transfer will begin.

Word 7--Interrupt Enable and Address

Bits 0-15 of this word are used to enable interrupts and specify an interrupt address. A value of 0 disables interrupts, while a value of other than 0 enables interrupts and specifies the address to which the program will return if no errors occur. If an error occurs, the interrupt occurs at the specified address +2.

The Floppy Disk Subsystem User's Manual (53566-91, 53696-91) contains detailed descriptions of the I/O Control Block.

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6.4 ERROR HANDLING

The Diagnostic may output error reports and tallies when it detects error conditions.

To assist the user in correcting error conditions, the three versions of the NAKED MINI® 4 Debugging Monitor (DEBUG4, XDBUG4, and MDBUG4) reside as files on the NAKED MINI® 4 Diagnostic/Formatter diskette under the file names DEBUGS.BIN, DEBUGX.BIN, and DEBUGM.BIN, respectively. Control may be transferred to the Debugging Monitor via the Disk Utility Program E command, described in Appendix B. For information on the use of the Debugging Monitor, the user is referred to the NAKED MINI® 4 Debugging Monitor Reference Manual (Engineering Reference No. 90-93015-00, Marketing Model No. 93015-90).

6.4.1 Error Reports

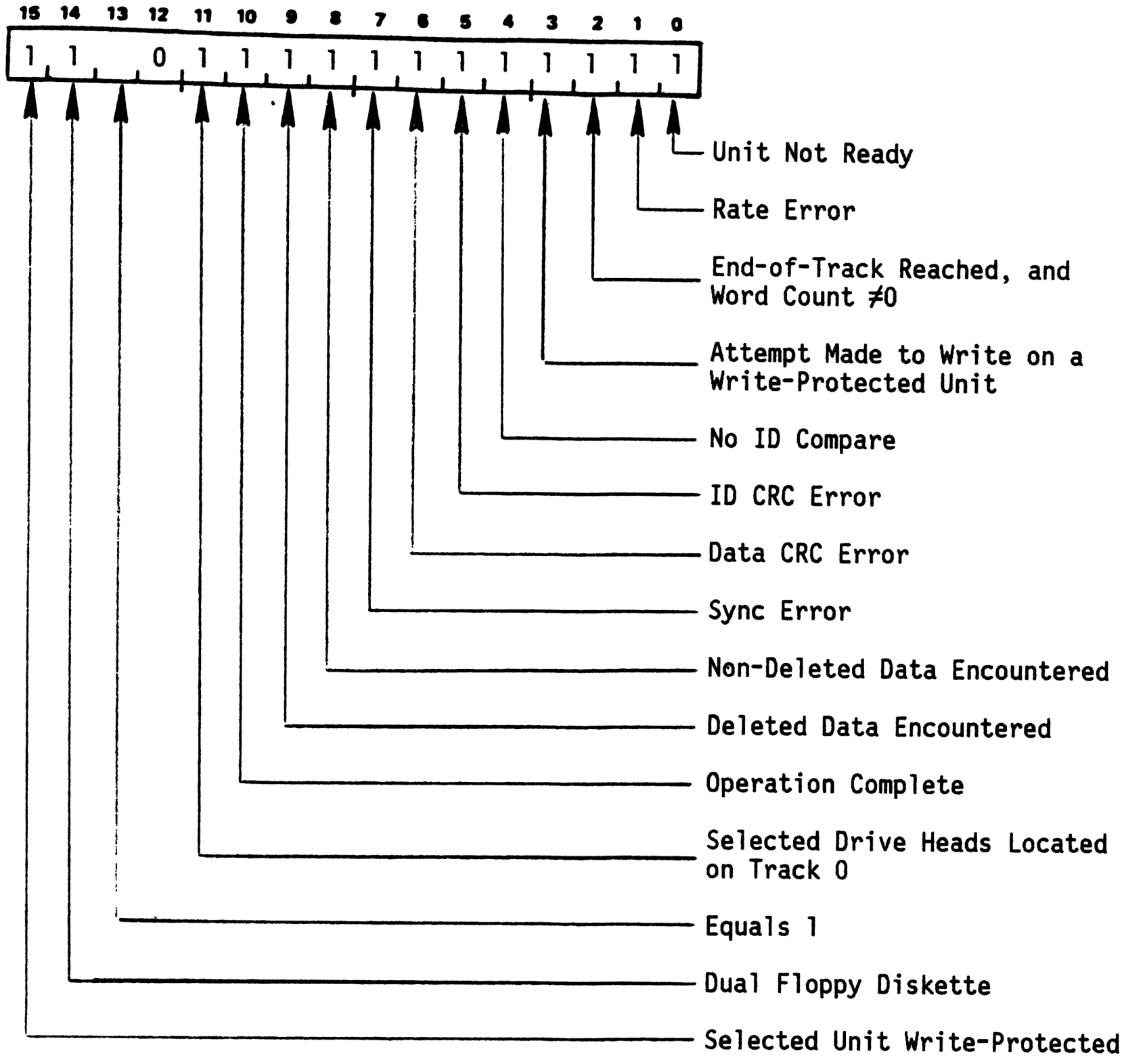
Error reports are printed when the Diagnostic detects an error or abnormal condition during a test run. Following is an example of an error report:

```
ER A 00
ER AD =:0466 PASS UNIT 0
STAT 1000 0101 0000 0000
FUNC = READ C=0 S=13 RL=0
BUF=:151B LEN=128
WDS XFRD 128
EXPECT ACTUAL EXP ADR ACT ADR
:0000 :AAAA :1090 :151D
```

The significance of each error report component is discussed below:

Line 1	ER	Error number. Types of errors are discussed later in this section.
Line 2	ER AD=	Hexadecimal address of the location where the error occurred.
	PASS	Pass number of the test sequence being run when the error occurred.
	UNIT	Number of disk drive unit being tested when error occurred.

Line 3 STAT A 16-bit binary representation of the Floppy Disk Controller status word. Each "1" bit corresponds to the following status:



For a more detailed definition of each status bit, the user is referred to the Floppy Disk Subsystem User's Manual.

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Line 4 FUNC+ A mnemonic corresponding to the function performed when the error occurred:

NO	No-Op
FMAT	Format
WR ND	Write Non-Deleted Data
WR DE	Write Deleted Data
RD ND	Read Non-Deleted Data
RD DD	Read Deleted Data
RDRG	Read Regardless
READ	Read All Data
VER	Verify
SEEK	Seek
INIT	Initialize
RSTOR ER	Restore

C= Track number in decimal

S= Sector number in decimal

RL= Relative seek count in decimal

Line 5 BUF= Starting address of the memory buffer, in hexadecimal

LEN= Data length of the above buffer in decimal

Line 6 WDS XFRD Actual number of words transferred, in decimal

Line 7 and 8 Optional additional information. Some error reports include information on expected data and actual data transferred.

6.4.2 Error Tallies

Error tallies are printed at the end of each test execution, if bit 2 of the sense register is set. A sample error tally follows:

ERRS:	U	HARD	SOFT
	0	00000	00004
	1	00000	00004

Each error tally lists the total number of hard and soft errors for each disk unit number. CRC errors are retried four times. If a CRC error recurs after three out of four retries, the error is considered a hard error. If drive is not ready or not installed this also results in a hard error. Otherwise, the error is a soft error.

6.4.3 Error Descriptions

Two types of errors may be sensed during the running of the Diagnostic tests: general operation errors and specific test-related errors. Detailed descriptions of these errors follow.

General Operation Errors

Number	Description
ER 000	A controller "not busy" status was not sensed after occurrence of an I/O interrupt.
ER 001	A controller "not busy" status was not sensed within approximately six seconds after initiation of an I/O operation.
ER 002	A controller "busy" status was not sensed immediately after an OTA.
ER 003	A controller "busy" status was sensed following an I/O operation.
ER 004	Track number was not sensed at 0 following a restore operation.
ER 005	An "ID Compare Error" status was sensed following an I/O operation.
ER 006	An "ID CRC Error" status was sensed following an I/O operation. (The function will be retried four times).
ER 007	A "Data CRC Error" status was sensed following an I/O operation. (The function will be retried four times).
ER 008	An "End-of-Track" error status was sensed following an I/O operation.
ER 009	A "Rate Error" status was sensed following an I/O operation.
ER 010	A "Unit Not Ready" error status was input following an I/O operation.
ER 011	A "Sync Error" status was input following an I/O operation.
ER 012	An attempt to write on a "Write Protected" unit status was sensed following an I/O operation.

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Number	Description
ER 013	An I/O interrupt did not occur within approximately six seconds after initiation of an I/O operation.
ER 014	An interrupt to location 0 occurred due to a power failure.

Specific Test-Related Errors

The following errors occur during a run of the test indicated by the letter variable in the error number.

Number	Description
ER A 00	The count of words transferred is not equal to expected word count.
ER B 00	"No ID Compare" was sensed.
ER C 00	The track number input in a Read Regardless operation miscompared to the track number addressed. Additional error report data: • Track = ID read from disk • A = Track number in counter A • B = Track number in counter B • # = Actual number of track tested
ER D 00	Unexpected data was encountered during cross track interference test. Additional error report data: • Expected data and its address • Actual data and its address
ER E 00	Unexpected data was encountered during a Read operation. Additional error report data: • Expected data and its address • Actual data and its address
ER F 00	Unexpected data was encountered during a Read Regardless operation. Additional error report data: • Expected data and its address • Actual data and its address
ER G 00	Deleted data was encountered during Non-Deleted Data Only operation.

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Number	Description
ER G 01	Unexpected data was encountered during a Read operation. Additional error report data: • Expected data and its address • Actual data and its address
ER H 00	Non-deleted data was encountered during Deleted Data Only operation.
ER H 01	Unexpected data was encoutered during a Read operation. Additional error report data: • Expected data and its address • Actual data and its address
ER I 00	Unexpected data was encountered during a Read operation. Additional error report data: • Expected data and its address • Actual data and its address
ER J 00	A "drive not ready" status was not sensed after manually disabling drive.
ER J 01	A write-protected bit was not set after unit was manually write-protected.
ER J 02	An error was not sensed following an attempt to write to a write-protected unit.
ER J 03	An end-of-track word count was not sensed after a 70-word Read was issued to sector 26.
ER J 04	A DMA rate error was not sensed after a read operation was attempted into non-existent memory.
ER J 05	A "No ID Compare" status was not sensed after a read operation was attempted to a non-existent track.
ER J 06	Words were transferred during No-Op.
ER K 00	Data read after interchange between drives was not equal to expected data. Additional error report data: • Expected data and its address • Actual data and its address

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Number	Description
ER L 00	A sector was overwritten. Additional error report data: • Expected data and its address • Actual data and its address
ER L 01	The memory buffer was modified during a Read Verify CRC operation. Additional error report data: • Expected data and its address • Actual data and its address
ER L 02	Incorrect computation of 16-bit word count was noted.
ER L 03	CRC read from the disk was not correct (i.e., was not :5D30).
ER M 00	Interrupt instructions at location 0 are in error.
ER M 01	Interrupt to erroneous location on normal interrupt return was noted.
ER M 02	End-of-track word count is not equal to 0. An error return was not taken during a two-sector Write to sector 26.
ER M 03	An end-of-track error was not returned after a two-sector Write to sector 26.
ER M 04	An I/O interrupt did not occur after initiation of an I/O operation.
ER N 00	The returned data CRC was not equal to the computed CRC. Additional error report data: • Expected data and its address • Actual data and its address
ER N 01	The track read was not equal to the track expected. Additional error report data: • Expected data and its address • Actual data and its address
ER N 02	The data read was not equal to the expected data. Additional error report data: • Expected data and its address • Actual data and its address

Number	Description
ER N 03	An error in sector numbering was noted.
ER O 00	A data CRC error was noted. Additional error report data: • Expected data and its address • Actual data and its address
ER O 01	The data read was not equal to the expected data. Additional error report data: • Expected data and its address • Actual data and its address
ER P 00	The data read was not equal to the expected data. (The data buffer is in low memory; the IOB is in high memory.) Additional error report data: • Expected data and its address • Actual data and its address
ER P 01	Data read was not equal to the expected data. (The data buffer is in high memory; the IOB is in low memory.) Additional error report data: • Expected data and its address • Actual data and its address
ER P 02	Data read was not equal to the expected data. (The data buffer is in high memory; the IOB is in high memory.) Additional error report data: • Expected data and its address • Actual data and its address
ER P 03	Sufficient memory does not exist to perform the high memory test, and the test was skipped.
ER Q 00	Suppression of interrupts did not occur. (Bit 12 of the status word is on.)
ER Q 01	No interrupt occurred. (Bit 12 of the status word is off.)

SECTION 7. THE FORMATTER UTILITY

The Formatter utility may be run if the user wishes to format his diskette in the desired IBM format. Procedures for running the Formatter are outlined below.

7.1 FORMATTER UTILITY OPERATION

When the program is loaded and the query listed in Section 5 is answered appropriately, program control is transferred to the Formatter utility. The user must then respond to the queries listed below; he may select the default response in parentheses by hitting a carriage return only.

Query	Response
UNIT(0)=	Enter one to four disk drive unit numbers (in the range 0-3), separated by commas. Disk drive units are formatted in the order of input.
CYLS(42,43)	Enter the range of tracks to be formatted. For example, a response of 0,9 causes tracks 0 through 9 to be formatted; a response of 4 causes only track 4 to be formatted. The default is to format tracks 42 and 43.
INTS(Y)?	Enter Y to execute the program under interrupt control. If interrupts are requested, the Real-Time Clock (if present) is also enabled. Enter N to execute the program with interrupts disabled.
DEV AD(:11)=:	Enter the hexadecimal floppy disk device address.
SNS REG(:2)=:	Enter a carriage return to specify the default, since run options are disabled during Formatter execution. This response begins Formatter execution, causing the message FORMAT UTILITY PROGRAM to be displayed.
FORMAT SEQUENCE NUMBER(01)=	Enter the desired IBM format sequence number as illustrated in Figure 7-1. The format sequence number specifies a particular ordering of sectors on the diskette. In certain applications an improvement in data transfer can occur by reordering the sectors.

Sequence Number																										
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
2	1	3	5	7	9	11	13	15	17	19	21	23	25	2	4	6	8	10	12	14	16	18	20	22	24	26
3	1	4	7	10	13	16	19	22	25	2	5	8	11	14	17	20	23	26	3	6	9	12	15	18	21	24
4	1	5	9	13	17	21	25	2	6	10	14	18	22	26	3	7	11	15	19	23	4	8	12	16	20	24
5	1	6	11	16	21	26	2	7	12	17	22	3	8	13	18	23	4	9	14	19	24	5	10	15	20	25
6	1	7	13	19	25	2	8	14	20	26	3	9	15	21	4	10	16	22	5	11	17	23	6	12	18	24
7	1	8	15	22	2	9	16	23	3	10	17	24	4	11	18	25	5	12	19	26	6	13	20	7	14	21
8	1	9	17	25	2	10	18	26	3	11	19	4	12	20	5	13	21	6	14	22	7	15	23	8	16	24
9	1	10	19	2	11	20	3	12	21	4	13	22	5	14	23	6	15	24	7	16	25	8	17	26	9	18
10	1	11	21	2	12	22	3	13	23	4	14	24	5	15	25	6	16	26	7	17	8	18	9	19	10	20
11	1	12	23	2	13	24	3	14	25	4	15	26	5	16	6	17	7	18	8	19	9	20	10	21	11	22
12	1	13	25	2	14	26	3	15	4	16	5	17	6	18	7	19	8	20	9	21	10	22	11	23	12	24
13	1	14	2	15	3	16	4	17	5	18	6	19	7	20	8	21	9	22	10	23	11	24	12	25	13	26
14	1	15	2	16	3	17	4	18	5	19	6	20	7	21	8	22	9	23	10	24	11	25	12	26	13	14
15	1	16	2	17	3	18	4	19	5	20	6	21	7	22	8	23	9	24	10	25	11	26	12	13	14	15
16	1	17	2	18	3	19	4	20	5	21	6	22	7	23	8	24	9	25	10	26	11	12	13	14	15	16
17	1	18	2	19	3	20	4	21	5	22	6	23	7	24	8	25	9	26	10	11	12	13	14	15	16	17
18	1	19	2	20	3	21	4	22	5	23	6	24	7	25	8	26	9	10	11	12	13	14	15	16	17	18
19	1	20	2	21	3	22	4	23	5	24	6	25	7	26	8	9	10	11	12	13	14	15	16	17	18	19
20	1	21	2	22	3	23	4	24	5	25	6	26	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	1	22	2	23	3	24	4	25	5	26	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
22	1	23	2	24	3	25	4	26	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	1	24	2	25	3	26	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	1	25	2	26	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
25	1	26	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

Figure 7-1. Standard IBM Sector-Ordering Sequences for Floppy Disks

Query	Response
SECTOR FLAG FIELD(0)=	Enter a number between 0 and 7 which is entered into bits 5-7 of the sector ID field. This sector flag field is treated as part of the sector number by the hardware. The sector number (including the flag field) requested must match the sector ID on the diskette. Bits 5-7 are used as a means of soft write-protecting certain tracks.

Formatting begins after these queries are answered. After all requested tracks on a unit are formatted, a Read Verify operation is performed on those tracks, and the next requested unit is formatted. The message FORMAT COMPLETE is printed when all formatting is completed. The program then halts.

The RUN button may be pressed to reexecute the Formatter, and the program will restart with the UNITS= query. After running the Formatter once and making demand entries to queries, subsequent runs require that all queries be answered with default entries.

SECTION 8. TECH TESTS DESCRIPTION

When T is entered in response to the TSTS query of the Diagnostic, program control is transferred to the Tech tests. The Tech tests then print a series of queries. After the required response is entered, a space should be entered to terminate it.

Query	Response
T=	Enter the address of the starting track.
S=	Enter the starting sector address.
W=	Enter the word count to be used for the Read or Write operation.
N=	Enter the number of tracks to be cycled.
P=	Enter the hexadecimal pattern to be written.

The message RUNNING... is displayed after all required queries are answered. The Tech Test runs continuously until the user restarts it by setting the sense switch, or terminates it by pressing the interrupt switch on the programmer's console. Test T restarts with the U= query.

APPENDIX A. OPERATION SUMMARY

A.1 RUNNING THE DIAGNOSTIC

1. Load and execute the Floppy Disk Diagnostic/Formatter program using the required binary loader.

   Make a demand program entry if a line printer will be used for output or if accumulation of pass and error counts is desired. To do so, enter :101 into the P register and set Console Data Register bits.

2. Use the Teletype or CRT keyboard to respond to all queries. (Use the programmer's console to answer the SENSE REGISTER? query if the machine is of the LSI-2.

   Make sure D is entered in response to the FORMATTER or DIAGNOSTIC? query. Enter control information in the sense register in response to the SENSE REGISTER? query. Set the sense switch to suppress test identification data, if desired.

3. The message EOT is printed when the test run is completed. To restart the program, enter :100 (default mode entry) or :101 (demand mode entry) into the P register. The console interrupt switch may also be pressed at any time to restart the program.

A.2 RUNNING THE FORMATTER

1. Load and execute the Floppy Disk Diagnostic/Formatter program using the required binary loader.

   Make a demand program entry if a line printer will be used for output or if accumulation of pass and error counts is desired. To do so, enter :101 into the P register and set Console Data Register bits.

2. Use the Teletype or CRT keyboard to respond to all queries.

   Make sure F is entered in response to the FORMATTER or DIAGNOSTIC? query. Enter a carriage return in response to the SENSE REGISTER? query.

3. The program halts when formatting is completed. Press RUN to restart the formatter.

4. To restart the program, enter :100 (default mode entry) or :101 (demand mode entry) into the P register. Reload the program first if the diagnostic is to be run after the formatter.

A.3 RUNNING THE TECH TESTS

1. Load the Floppy Disk Diagnostic/Formatter program using the required binary loader.

   Make a demand program entry if a line printer will be used for output. To do so, enter :101 into the P register and set Console Data Register bits.

2. Use the Teletype or CRT keyboard to respond to all queries and terminate each response with a space. Enter D in response to the FORMATTER or DIAGNOSTIC? query. Enter T in response to the TSTS= query.

3. Set the sense switch to terminate the current tech test run.

4. To restart the program, enter :100 (default mode entry) or :101 (demand mode entry) into the P register. The console interrupt switch may also be pressed at any time to restart the program.

APPENDIX B. OMEGA4 PLUS DISK UTILITY PROGRAM

B.1 INTRODUCTION

The Disk Utility Program is included as a file on the Floppy Disk Diagnostic/Formatter diskette, allowing the user to create floppy disks in Standard File Manager (SFM) format, and to maintain such disks. The Disk Utility Program provides commands to perform the functions listed below:

- Copy a disk file or an entire disk to another file or device
- Delete a file from a disk
- Format a disk to prepare for labeling it
- Label a disk to be used with either OS4 or OMEGA4 PLUS
- Display the current contents of the disk directory on the current list output device
- Dump (in hexadecimal notation) the contents of a disk
- Rename a file
- Load and execute a program module
- Transfer control to another address or a program
- Designate the list output device

Disks generated by OS4 or the OMEGA4 PLUS Disk Utility Program may be used under both OMEGA4 PLUS and the Real-Time Executive (RTX)-based operating system OS4. OS4-labeled disks, however, may not be used to hold programs to be executed via the OMEGA4 PLUS E command. This exception is due to the fact that the bootstrap code, which is written to a disk during the labeling operation, does not operate in the same way or provide the same facilities under OS4 as under OMEGA4. Programs to be executed via the OMEGA4 PLUS E command, therefore, either must be loaded using an OMEGA4-labeled disk or copied to one before execution is attempted. In all other respects, an OS4-labeled disk is identical to an OMEGA4-labeled disk.

B.2 PHYSICAL DEVICE USE

The OMEGA4 PLUS Disk Utility Program reads input from and writes output to several physical devices. To associate an input or an output operation with a particular device, the user normally identifies the physical device in a command line by specifying its device name. Because the device specified is determined by the device's function within the system as well as by the actual name of the device, the mnemonic value of the device name is lost in many cases. For example, CR may be used to identify a TTY paper tape punch for output, but this is not clear from the name "CR."

Device names, descriptions, and device addresses are given below. It is recommended that the device specifications included in command lines be consistent with the required device addresses, and vice versa.

TY refers to the interactive terminal used to enter commands. List output goes to the printer or screen portion of the terminal and all other output goes to the paper tape (or cassette) portion of the terminal. All input (except command input) is read without echoing from the paper tape (or cassette) input portion of the terminal. The device address used is :F8.

TX refers to the paper tape or cassette input and output portions of the TTY. All input is read (without echoing) from the reader and all output is directed to the punch. The device address used is :F8.

TV refers to the TTY or CRT. All input is read from the keyboard; all output is written to the printer or screen. All input is echoed, but no line-feeds are appended to returns; these must be explicitly entered. The device address used is :F8.

PT refers to the high-speed paper tape reader for input and the high-speed paper tape punch for output. Either or both of these devices may be replaced with RS-232 or interactive terminals emulating the reader and punch if no high-speed paper tape reader or punch is included in the system. The device addresses used are :FA for the reader and :FC for the punch. The card reader may be reassigned to the paper tape reader input address, but assignment to PT is not the same as assignment to the changed CR.

PR is used identically to PT except that the device address of :FA is used for both the reader and the punch.

PP is used identically to PT except that the device address of :FC is used for both the reader and the punch.

LP refers to either a line printer or an RS-232-compatible interactive device that emulates line printer operations. If an RS-232-compatible device is used, it must not perform automatic line feeds. If LP is specified as an input device, input is taken from a high-speed paper tape reader or TTY paper tape reader. The device address used is :FE.

CR refers to a card reader for input and to a TTY paper tape punch or TTY printer for output. The data read is in the form of 80-column records in standard ASCII-Hollerith form. The input is processed as standard Hollerith punched card codes, with all EBCDIC codes permutated to one 8-bit ASCII code. The device address normally used with the CR device name is :F0. When an LSI 4/10 processor is used, a different device address derived from patching is used. See Subsection 2.7.

DFnn refers to a floppy disk mounted in drive unit nn. The unit number may be any value from 0-3, with or without a leading zero. If the value is zero, the unit number may be omitted altogether. The device address used with the floppy disk controller is :88 (or :11 if a five-bit device address).

DFnn.filename.extension

refers to a file named filename on a floppy disk mounted in drive unit nn. The unit number may be any value from 0-3, with or without a leading zero. If the value is zero, the unit number may be omitted altogether. The file name is a string of one to 11 alphanumeric characters, the first of which is always alphabetic.

A file name extension is a four-character string (a period followed by three letters) appended to the file name to reflect the type of information the file contains. The file name extensions are:

.ASM - Assembly language source text file
.MAC - Assembly language Definition File
.FTN - FORTRAN source text file
.BAK - Source backup file
.TXT - Text file
.LST - Listing file
.OBJ - Object file
.BIN - LINK output file
.LIB - Library file
.JCL - Job file
.DAT - Data file
.HLP - Documentation file
.Sxx - (where "x" denotes a letter) System file

The programmer can assign the file name and extension when he creates the file. While it is not mandatory that he assign file name extensions according to the conventions listed above, it is recommended that he do so. It is also recommended that the programmer avoid assigning file names which conflict with names having a defined meaning in OS4: command words, logical unit names, and the like.

File name extensions allow related files to share a common file name. For example, the programmer might create the following set of files:

PROG.ASM	(containing an assembly language source program)
PROG.BAK	(containing an assembly language source backup of PROG.ASM)
PROG.OBJ	(containing the object code produced by assemblying PROG.ASM and PROG.MAC)
PROG.LST	(containing the assembly listing produced by the assembly)
PROG.BIN	(containing PROG.OBJ linked with other object modules)

OMEGA4 accepts one additional device name in special situations; its use is treated in more detail later in this appendix.

DU refers to a simulated dummy file. When read from it always returns an end-of-file (EOF) condition, and when written to it always accepts data and returns a no-error condition.

B.3 DISK UTILITY PROGRAM COMMANDS

The programmer can issue any of the following commands in response to the Disk Utility Program's command prompt, a question mark (?). These commands are summarized at the end of this appendix. If the Disk Utility Program detects an error in a user command, it generates one of the error messages described at the end of this appendix.

B.3.1 Designating the List Output Device: the P Command

Format: P{[Wwidth][Llength],device | C[Wwidth][Llength][,device] | D[Wwidth][Llength][,device]}

The Disk Utility Program provides commands which generate list output, such as the commands to generate view listings and dumps. Before entering one of these commands, the programmer can issue a P command to specify which device is to receive the listing.

Entering the P command with the device parameter included serves to direct list output generated by the Disk Utility Program to "device." The device parameter is one of the physical device names listed in Subsection B.2, including a floppy disk file.

When a line printer is specified as the device, the C or D option may be included in the command line. Including the C option in the P command line causes only a carriage return to be generated before a new line is printed. The C option typically is included when a Centronics line printer is used, or when any printer that generates an internal line feed in response to a carriage return is used. Including the D option causes both a carriage return and a line feed to be generated before each new line is printed. The D option typically is included when a Dataproducts line printer or any other printer requiring an explicit line feed is used. When neither option is included and the line printer is specified as a device, the system defaults to generating only a carriage return before printing a line.

If a paper tape or disk file is specified as the device, list output may be copied to a printer at a later time via the OMEGA4 PLUS Disk Utility Program's C command, discussed in Topic B.3.2.

The width is used to specify page width in characters per line; the default is 80. The length is used to specify page length in lines per page; the default is 46.

The device parameter may be omitted in the D command line and only the C or D option included, if the user previously designated the line printer as the list output device during Disk Utility Program execution. A P command formatted in this manner is used to override the prevailing printer control option.

The P specification remains in effect until:

1) it is overridden by a subsequent P command, or

2) the programmer exits the current module.

If the programmer does not issue a P command and if no list output specification currently is in effect, list output is generated to the command output device by default.

Example:
```
?PD,LP
  .
  .
  .
?P,TY
  .
  .
  .
?P,LP
```

In this sequence, the programmer first directs list output to the line printer and specifies that LP refers to a Dataproducts line printer. Later, he changes the list output device to the TY device. At a later point in the session he issues another P command to direct list output to the LP device. Since he has not overridden his earlier specification concerning the line printer type, LP still refers to a Dataproducts line printer.

B.3.2 Copying a File or an Entire Disk: the C Command

Format: C,[type][format],device1,device2

The C command is used to copy the contents of the device or file (either binary or source) named "device1" to another device or file named "device2," where the device specifications made are from Subsection B.2. Various types of copy operations may be specified, represented by the type parameter. The format of the text being copied also may be specified as the format parameter.

The format parameter must be one of the following:

S Specifies that data within the file is to be treated as source text, and will result in all parity bits being set to zero.

B Specifies that data within the file is to be treated as binary object text.

L Specifies that the data is in the form of lines of text preceded by either an ASCII control character or a FORTRAN control character.

A Specifies that all files on a disk will be copied, but otherwise acts as if no format specifier were entered. When the A format is included, the device parameters must represent disks.

When the user includes the S, B, or L parameter, the system is free to reblock the input, to standardize its parity, or to modify the input in other ways during the copy operation. In any case, appropriate validity checks are made on the input and check sums are output.

When the format parameter is omitted, or when A is the parameter, the system generates to device2 a byte-for-byte unformatted copy of device1. The unformatted copy is an exact image of the source code, except for differences in extent boundaries and other physical variations. Neither software CRC validity checks nor special end-of-file checks are performed when the format parameter is omitted.

The type parameters and corresponding functions are as follows:

U Copies an entire disk in the unformatted manner described above; notes error but does not attempt error recovery. The format parameter cannot be used with the U type parameter. Device parameters used must represent floppy disk devices.

F Copies device1 to device2. If a file with the same name as "device1" already exists on device2, the contents of that file are replaced by those of device1.

C Copies device1 to device2. If a file with the same name as "device1" already exists on device2, no copying takes place.

R Replaces the contents of a file named "device1" that resides on device2, with the contents of device1. If a file named "device1" does not exist on device2, no copying takes place.

If the type parameter is omitted from the command line, an F-type copy operation is performed by default. If both type and format parameters are omitted, an unformatted F-type copy operation is performed.

Example: ?C,,DF1.ANYFILE,DF.YZXX3
?

In this example, the programmer instructs the system to copy the contents of a file named ANYFILE from the floppy disk in unit 1 to a file named YZXX3 on the floppy disk in unit 0. Since the format specifier is omitted here (two commas are entered consecutively instead) the copy will be an exact image of ANYFILE on DF0. No error checking, parity standardization, or reformatting will be done.

If a paper tape or disk file was indicated to receive list output in a previously-executed module's P command, the C command later may be used to copy that file to the line printer.

Example: ?C,L,DF.PGMG,LP
?

In this example, the file PGMG, previously written to the floppy disk in unit DF, is reproduced on the line printer. Care should be taken not to use "S" as a format specifier, nor to omit the specifier entirely, as an "S" defeats page formatting, and omitting the specifier entirely results in no carriage returns being issued.

B.3.3 Deleting a File: the D Command

Format: D,file

The D command provides the user with a means of removing the file named "file" from a floppy disk. The name "file" first is removed from the floppy disk's directory; then, the space allocated to the file "target" is made available.

The parameter "file" must be an acceptable disk file name, as described in Subsection B.2. If a non-file device such as a keyboard/printer or paper tape device is specified as "file," the command is completely ignored. Likewise, use of the device parameter DU causes the command to be ignored.

B.3.4 Formatting a Disk: the F Command

Format: F,disk[,k]

The F command provides a means of reformatting a floppy disk to prepare it for labeling, without using the Floppy Disk Diagnostic/Formatter. Entry of the F command causes a floppy disk, identified using the specification in Subsection B.2, to be formatted. The optional parameter "k" may be specified to identify the sector-ordering sequence to be used.

Floppy disks are formatted using the standard IBM sector-ordering sequences presented in Figure B-1. If the k parameter is not specified, the disk is formatted in sequence number 1.

Sequence Number																										
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
2	1	3	5	7	9	11	13	15	17	19	21	23	25	2	4	6	8	10	12	14	16	18	20	22	24	26
3	1	4	7	10	13	16	19	22	25	2	5	8	11	14	17	20	23	26	3	6	9	12	15	18	21	24
4	1	5	9	13	17	21	25	2	6	10	14	18	22	26	3	7	11	15	19	23	4	8	12	16	20	24
5	1	6	11	16	21	26	2	7	12	27	22	3	8	13	18	23	4	9	14	19	24	5	10	15	20	25
6	1	7	13	19	25	2	8	14	20	26	3	9	15	21	4	10	16	22	5	11	17	23	6	12	18	24
7	1	8	15	22	2	9	16	23	3	10	17	24	4	11	18	25	5	12	19	26	6	13	20	7	14	21
8	1	9	17	25	2	10	18	26	3	11	19	4	12	20	5	13	21	6	14	22	7	15	23	8	16	24
9	1	10	19	2	11	20	3	12	21	4	13	22	5	14	23	6	15	24	7	16	25	8	17	26	9	18
10	1	11	21	2	12	22	3	13	23	4	14	24	5	15	25	6	16	26	7	17	8	18	9	19	10	20
11	1	12	23	2	13	24	3	14	25	4	15	26	5	16	6	17	7	18	8	19	9	20	10	21	11	22
12	1	13	25	2	14	26	3	15	4	16	5	17	6	18	7	19	8	20	9	21	10	22	11	23	12	24
13	1	14	2	15	3	16	4	17	5	18	6	19	7	20	8	21	9	22	10	23	1	24	12	25	13	26
14	1	15	2	16	3	17	4	18	5	19	6	20	7	21	8	22	9	23	10	24	11	25	12	26	13	14
15	1	16	2	17	3	18	4	19	5	20	6	21	7	22	8	23	9	24	10	25	11	26	12	13	14	15
16	1	17	2	18	3	19	4	20	5	21	6	22	7	23	8	24	9	25	10	26	11	12	13	14	15	16
17	1	18	2	19	3	20	4	21	5	22	6	23	7	24	8	25	9	26	10	11	12	13	14	15	16	17
18	1	19	2	20	3	21	4	22	5	23	6	24	7	25	8	26	9	10	11	12	13	14	15	16	17	18
19	1	20	2	21	3	22	4	23	5	24	6	25	7	26	8	9	10	11	12	13	14	15	16	17	18	19
20	1	21	2	22	3	23	4	24	5	25	6	26	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	1	22	2	23	3	24	4	25	5	26	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
22	1	23	2	24	3	25	4	26	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	1	24	2	25	3	26	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
24	1	25	2	26	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
25	1	26	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

Figure B-1. Standard IBM Sector-Ordering Sequences for Floppy Disks

B.3.5 Labeling a Disk: the L Command

Format: L,disk[(count)],label

The Standard File Manager (SFM) requires that all file-type devices it accesses be labeled in SFM format. The L command can be used by the OMEGA4 PLUS programmer to label his disks.

When the L command is entered, the system performs a quick surface analysis of the disk (identified using the appropriate device specification in Subsection B.2, searching for bad sectors. Using this information, the SFM is able to avoid accessing faulty sectors later.

The system then writes the designated "label" to the floppy disk. It also places an F-list on the floppy disk with space for the number of files specified in the optional decimal "count" or for 32 files if count is not specified. A directory, tables of usable and bad sectors, and the bootstrap code are also written to the floppy disk.

The label entered in the command is a character string of up to 14 characters. If the programmer enters less than 14 characters, the program pads the string with blanks to produce the 14-character string. The label must begin with a letter and may contain only alphanumeric characters, embedded colons, and trailing blanks, if the disk is to be fully compatible with OS4.

Example: L,DF3(20),OTHER:COPY

In the example presented above, the programmer instructs the system to perform a surface analysis of the standard floppy disk located in drive unit 3, and to label it "OTHER:COPY." The command also specifies that space be allocated for 32 (hexadecimal 20) files in the F-list.

B.3.6 Displaying a Disk's Files: the V Command

Format: V[N],disk

The V command generates to the list output device a listing of all files in the directory of a disk. Each file's F-number and other pertinent F-list information also is included in the listing.

The device parameter included must be a device identifier for a floppy disk, as described in Subsection B.2. When the optional N parameter is not included in the command line, the current page of list output is ejected, and the file listing begins at the top of the next page. Entering the N parameter causes the listing to be printed directly under other list output, with no page ejected.

Example: ?V,DF
?

This command requests a listing of the files contained on the DF device. Since the N option is not included, the listing is output after a page is ejected.

B.3.7 Dumping the Absolute AUs of a Disk: the X Command

Format: X[L/W],device,au1[,au2]

The X command generates to the current list output device a listing of the contents of a specified allocation unit (AU) or a range of AUs. An AU is a unit of data equivalent to 510 bytes or 4 sectors on a floppy disk.

The device parameter included must be a device identifier for a floppy disk, as described in Subsection B.2. The au1 parameter, when entered without the au2 parameter, specifies the number of the AU to be dumped. When the au2 parameter also is entered, the range of AUs from au1 through au2 is dumped. The L parameter is entered when an AU listing 8 columns wide is desired. The W parameter is entered when wide line printer paper is being used; it causes the contents of 16 words of storage to be output per line instead of eight. Use of the W parameter requires the printer page to be 87 columns wide and the contents of word 6 of memory to be greater than :57. When neither parameter is included, an 8-column wide listing is produced by default.

The data in the listing is ordered so that bytes within a sector follow one another, that sectors on one surface of a disk follow one another, and that the other surfaces of the disk accessible without head movements, follow. Two AUs are printed on each page, identified by AU number. The contents of each AU are identified by a relative word number on the left (in hexadecimal), and are printed in 8 or 16 columns of 4 hexadecimal digits each. Figure B-2 illustrates a dump listing 8 columns wide.

Example:
```
?P,LP
?X,DF1,26,28
?
```

This command sequence assigns list output to the line printer device, then it requests a dump of AUs 26 through 28 from the DF1 unit.

```
AU = :0000
0000   9E3D 0004 0000 0000 0000 0009 0200 0000
0008   0000 0000 0000 1000 0200 9E0B 0940 3000
0010   827C 86F8 2900 8080 AA76 31BD AE75 A66F
0018   2901 0988 030A 2200 030A 0600 9E7D 826A
0020   18FF 1141 0E0D A263 9C81 0000 9EF8 9EBB
0028   9EF4 0192 00B5 0129 0000 0000 0040 001A
0030   0001 004D 0004 0004 0088 0000 0007 0000
0038   0000 0000 0002 0100 0100 0000 0000 0000
0040   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0048   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0050   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0058   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0060   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0068   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0070   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0078   5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A 5A5A
0080   4F53 3420 2020 0080 001A 0001 004D 00C1
0088   0004 00FA 0000 4F53 3739 3031 3234 3036
0090   3039 3039 4F53 3739 3031 3234 3036 3039
0098   3039 2020 3739 3031 3234 3036 3039 3039
00A0   0000 0000 0000 0000 0000 0000 0000 0000
00A8   0000 0000 0000 0000 0000 0000 0000 0000
00B0   0000 0000 0000 0000 0000 0000 0000 0000
00B8   000B 4F4D 4547 4134 3A50 4C55 5320 2020
00C0   2020 2020 2020 2020 2020 2020 2020 2020
00C8   2020 2020 2020 2020 2020 2020 2020 2020
00D0   2020 2020 2020 2020 2020 2020 2020 2020
00D8   2020 2020 2020 2020 2020 2020 2020 2020
00E0   2020 2020 2020 2020 2020 2020 2020 2020
00E8   2020 2020 2020 2020 2020 2020 2020 2020
00F0   2020 2020 2020 2020 2020 2020 2020 2020
00F8   2020 2020 2020 2020 2020 2020 2020 2020
```

Figure B-2. 8-Column Dump Listing

B.3.8 Renaming a File: the R Command

Format: R,file1,file2

The R command is used to change the name of file1 to file2, where file1 is a valid floppy disk file identifier, as described in Subsection B.2. The parameter file2 must be a valid file name, i.e., a file identifier minus the disk device specification. If a file already exists with the name "file2" on that floppy disk, the operation aborts and no renaming is done. If file1 does exist and the renaming does not generate any file name conflicts, that fact is noted in a RENAMED message from the Disk Utility Program.

```
Example:  ?R,DF1.OLDNAME,NEWNAME
           RENAMED
          ?
```

Entering this command changes the name of the file OLDNAME on the DF1 device to NEWNAME.

B.3.9 Transferring Control to Another Address or Program: the J Command

Format: J,address

The J command is used to transfer program control to a specified hexadecimal address, generally the starting address of or any other program resident in memory. When control is transferred to the Diagnostic/Formatter or another program in memory, user program or other memory address, the system begins to execute that program.

B.3.10 Invoking Another Program Module: the E Command

Format: E,file[,address1[,address2]]

The E command is used to terminate an executing program, then to load and execute an another program. Entering the E command causes the floppy disk program "file" (identified using the specification in Subsection B.2 to be loaded and executed. Before attempting to execute this command, OMEGA4 PLUS closes all open devices other than command input and command output files, thereby ensuring the availability of buffers and control blocks for the transfer of control.

The optional address1 parameter is entered when the user wants the module to be loaded at a particular address. Otherwise, the system loads the module as high in memory as possible.

The user enters the optional address2 parameter when he wants to specify that the module's bootstrap program be loaded at address2 and that the module itself be loaded at address1. Entry of this parameter is essential if the module to be loaded will occupy any part of memory currently occupied by the resident module's bootstrap program. For example, this parameter should be used when a diagnostic program with a required execution address of :0 is being loaded. The bootstrap program occupies approximately :300 words of memory; therefore, to execute the module in low memory it is recommended that the bootstrap program be loaded in high memory.

After the E command is entered with the Diagnostic/Formatter as the specified file, the Diagnostic/Formatter identifies itself and generates a command prompt.

Example:
```
?E,DF.FPYDISKDIAG.BIN,0,5000
?
```

In the above sequence, the programmer instructs the system to load the Diagnostic/Formatter's bootstrap program at location :5000, to load the Diagnostic/Formatter at location :0, and to execute it.

B.4 OMEGA4 PLUS DISK UTILITY PROGRAM COMMAND SUMMARY

The commands listed below may be entered under OMEGA4 PLUS Disk Utility Program control.

C,[type][format],device1,device2

Copies source or binary code from device1 to device2 with the following allowable type options enabled:

U - Performs the copy operation on an entire disk without regard to format.

F - Performs the copy operation, replacing a file on device2 named "device1" with the contents of device1.

C - Performs the copy operation, but does not replace any existing file on device2 named "device1."

R - Performs the copy operation but requires that a file named "device1" exist on device2 to be replaced.

D,file — Removes name of file from disk directory; physically removes file contents.

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E,file [,address1[,address2]]

Loads and executes a specified file at address1, optionally loading the file's bootstrap program at address2.

F,disk[,k] Formats a disk with an optional sector-ordering sequence k.

J,address Transfers control to the specified address.

L,disk[(count)],label

Performs a quick analysis of a disk and labels it with the specified label.

P {[Wwidth][Llength],device / C[Wwidth][Llength][,device] / D[Wwidth][Llength][,device]}

Designates the list output divice.

R,file1,file2 Changes the name of a file in a disk directory.

V[N],disk Displays a listing of files in a disk directory.

X[W/L],disk,au1[,au2] Displays a listing of files in a disk directory.

B.5 OMEGA4 PLUS DISK UTILITY PROGRAM MESSAGE SUMMARY

Various messages are generated by the OMEGA4 PLUS Disk Utility Program as a result of both normal processing and error detection. Those messages resulting from normal processing require operator intervention, as indicated beside the appropriate messages below. The meanings of those messages generated in response to error conditions are listed below also.

Message	Meaning
:nnnn BAD SECTORS	nnnn (in hexadecimal) floppy disk sectors generated CRC errors when tested for usability during a label operation (L command). A list of the bad sectors will be displayed with the message on the CO device.
DELETED	The file specified was deleted.
** DE 13	An invalid logical unit was specified (system error).

Message	Meaning
** DE 14	All FCBs are in use (system error).
** DE 15	Insufficient buffer space is available for requested operation. (System error)
** PE 01	An error occurred in reading a disk during an unformatted a disk during an unformatted copy operation (C command).
** PE 02	An error occurred in writing to a disk during an unformatted copy operation (C command).
** PE 03	A label operation failed for lack of sufficient good AUs on the disk to store the system control block.

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